

EMBRAER 190

AIRPLANE OPERATIONS MANUAL
VOLUME 1

EMPRESA BRASILEIRA DE AERONÁUTICA S.A.

TACA

This manual is applicable to the EMBRAER 190 airplanes AR model equipped with CF34-10E6 engines and operating under FAA certification.

THIS PUBLICATION IS INCOMPLETE WITHOUT AIRPLANE OPERATIONS MANUAL AOM-1502 VOLUME 2.

AOM-1502-017
MARCH 25, 2008
REVISION 4 - APRIL 30, 2010

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Airplane Operations Manual
AOM-1502-017

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HIGHLIGHTS OF CHANGE

REVISION 4 – APRIL 30, 2010

Editorial revisions (for example, spelling corrections) may have revision bars with no associated highlight.

Block	Change Description
1-20	Update of abbreviations and acronyms list.
1-25	Update of Units Conversion table.
1-35	Update of Service Bulletin Table.
1-40	Deletion of CDL item.
2-05	Replacement of Weight and Balance Manual reference by Airplane Operations Manual sections reference.
2-10	Update of Wind Limitations for operation with tailwind up to 15 kt.
2-36	Deletion of Russian and Ukrainian fuels.
2-40	Update of thrust assurance check information and thrust reverser limitation (Pre-Mod. SB 170-73-0003 or Pre-Mod. SB 190-73-0010).
2-57	Update of information for CAT II operation.
2-64	Update of Navigation Limitation.
2-68	Inclusion of block title.
3-01	Update of Cockpit Safety Inspection procedure title and Power Up procedure.
3-03	Update of block title.
3-09	Update of Before Start procedure.
3-11	Update of Engine Start procedure.
3-13	Update of After Start Procedure.
3-15	Update of recommendation to turn off nose taxi lights.
3-16	Inclusion of Takeoff with tailwind above 10 kt procedure.
3-23	Update of recommendation to keep nose taxi lights turned off.

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Block	Change Description
3-70	Update of Engine Battery Start Procedure.
3-75	Update of Icing Conditions, Cold Weather and Cold Soak Operations.
3-75	Deletion of Windshear information included in SOPM.
3-75	Update of turbulent air penetration procedure.
3-80	Inclusion of QFE operation.
3-95	Update of Flight Patterns pictures.
4-01-01	SMOKE, FIRE, FUMES - Organizes the list of relevant inoperative items in alphabetical order.
4-02-01	Inclusion of Unreliable Airspeed procedure.
4-02-01	ABNORMAL LANDING GEAR EXTENSION - Includes note regarding completely pulling the alternate extension lever.
4-02-01	LOSS OF HYDRAULIC SYSTEM 1 - Organizes the list of relevant inoperative items in alphabetical order.
4-02-01	LOSS OF HYDRAULIC SYSTEM 2 - Organizes the list of relevant inoperative items in alphabetical order.
4-02-01	LOSS OF HYDRAULIC SYSTEM 1 AND 2 - Organizes the list of relevant inoperative items in alphabetical order.
4-02-01	LOSS OF HYDRAULIC SYSTEM 1 AND 3 - Organizes the list of relevant inoperative items in alphabetical order, and includes Outboard Aileron actuators in the list.
4-02-01	LOSS OF HYDRAULIC SYSTEM 2 AND 3 - Organizes the list of relevant inoperative items in alphabetical order.
4-02-01	JAMMED CONTROL WHEEL ROLL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-03	BRK LH (RH) FAIL - Corrects landing distance factor for EMBRAER 190 TCCA.
4-03-05	AC BUS 1 OFF - Organizes the list of relevant inoperative items in alphabetical order.
4-03-05	AC BUS 2 OFF - Organizes the list of relevant inoperative items in alphabetical order.

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Block	Change Description
4-03-05	DC BUS 1 OFF - Organizes the list of relevant inoperative items in alphabetical order.
4-03-05	DC BUS 2 OFF - Organizes the list of relevant inoperative items in alphabetical order and includes autobrake in the list.
4-03-05	DC ESS BUS 1 OFF - Organizes the list of relevant inoperative items in alphabetical order.
4-03-05	DC ESS BUS 2 OFF - Organizes the list of relevant inoperative items in alphabetical order.
4-03-05	DC ESS BUS 3 OFF - Organizes the list of relevant inoperative items in alphabetical order.
4-03-05	ELEC EMERGENCY - Organizes the list of relevant inoperative items in alphabetical order.
4-03-06	ENGINE 1 (2) REV DEPLOYED – Includes the instruction to set the transponder to TA only. Includes APU bleed button action according to OB170-001/09.
4-03-06	ENGINE 1 (2) CONTROL FAULT – Includes the instruction to move associated Thrust Lever to IDLE and set the transponder to TA only, if engine thrust is stable at IDLE.
4-03-06	ENGINE 1 (2) FAIL – Includes the instruction to set the transponder to TA only, if engine is not restarted. Includes APU bleed button action according to OB170-001/09.
4-03-06	ENGINE 1 (2) TLA FAIL – Includes the instruction to set the transponder to TA only, if thrust is at IDLE. Also includes scenario where engine thrust control is not lost.
4-03-07	ENGINE 1 (2) FIRE – Includes the instruction to set the transponder to TA only. Includes APU bleed button action according to OB170-001/09.
4-03-08	RUDDER FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-08	SPOILER FAULT - Allows the use of the spoilers after the Flight Controls Mode reset.
4-03-08	FLAP FAIL - Includes one additional unloking attempt.
4-03-08	SLAT FAIL - Includes one additional unloking attempt.

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Block	Change Description
4-03-08	RUDDER NML MODE FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-08	SPOILER NML MODE FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-09	AVNX MAU 1A FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-09	AVNX MAU 1B FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-09	AVNX MAU 2A FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-09	AVNX MAU 2B FAIL - Organizes the list of relevant inoperative items in alphabetical order, and corrects which autopilot channel is failed.
4-03-09	AVNX MAU 3A FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-09	AVNX MAU 3B FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-09	DISPLAY CTRL FAIL - Organizes the list of relevant inoperative items in alphabetical order.
4-03-12	A-I ENG LEAK - Removes the message for EMBRAER 190/195 (Message is applicable only to EMBRAER 170/175).
5-10	Update of Geometric Height to Pressure Height example.
5-20	Update of flexible temperature determination flowchart.
5-35	Inclusion of Unfactored Landing Distance tables for contaminated runway.
6-15	Update of Economic Cruise Speed introduction.
6-35	Inclusion of a guideline when flying over mountainous area.
8-10	Update of overwing door clearances.
11-15	Update of Fire Extinguisher operation.
11-30	Text improved.
13-11	Update of Towbarless Towing procedure.

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13-25	Inclusion of recommendations for refueling with APU running.
13-40	Language review.
13-60	Improvement of FUEL 1 (2) FEED FAULT procedure. Inclusion of QRH 1(2) TIME OUT message.
14-01-05	Update of Airplane Antennas picture with TDR1 and TDR2 correction position.
14-01-10	Deletion of emergency equipment information from cockpit partition. For emergency equipment information refer to section 11.
14-01-10	Inclusion of Observer seat fold procedure.
14-01-22	Inclusion of Interphone Handset/Cradle Assembly description.
14-01-25	Update of CMF2 information.
14-01-37	Inclusion of description of red indication of LED at the outlet.
14-01-45	Inclusion of maximum wind limitation for operating doors.
14-02-05	Update of cabin altitude, cabin rate of change and differential pressure indications.
14-02-10	Update of table "Bleed Source Prioritization Logic".
14-02-15	Text improvement. Change from TDS to T/O Dataset.
14-02-20	Text improvement to describe OFV logic.
14-03-05	Update of FD button note according to Load 23.1 and Autothrottle Indications on FMA.
14-03-05	Deletion of FLARE label on Vertical Mode Indications on FMA.
14-03-10	Inclusion of AFCS logic regarding maximum bank angles while in LOC mode. Update of Preview Feature description according to Load 23.1. Update of Altitude Select note.
14-03-20	Update of CRZ mode description according to Load 23.1.
14-04-10	Update of APU START procedure.
14-05-05	Update of DC BUS tie toggle switch description.
14-05-10	Update of Ram Air Turbine description.

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14-05-35	Update of DC ESS BUS 1 and 2 lists including brake control module 1 and 2.
14-06-05	Improvement of amber indication of oil level on MFD.
14-06-20	Inclusion of comment about igniters life reduction when OVRD position is continued used.
14-06-20	Update of Ground Start description to include no light off logic.
14-06-35	Update of ENG 1 (2) OIL SW FAIL meaning.
14-07-25	Inclusion of details about lavatory smoke sensor.
14-08-05	Inclusion note about SLAT/FLAP readout according to Load 23.1. Update Speedbrake Indication description.
14-08-15	Update of Tail Strike avoidance function description.
14-08-30	Update of Slat/Flap system interlocks description.
14-08-45	Update of EICAS MESSAGES table according to Load 23.1.
14-09-05	Update of VNAV altitude constraint annunciation.
14-09-15	Update of CMF information. Delete CMF2 information.
14-09-25	Language review.
14-09-35	Inclusion of XPDR 1 (2) IN STBY EICAS message according to Load 23.1.
14-10-10	Change the maximum fuel tank capacity to maximum fuel indicated to flight crew.
14-12-15	Update of block title on footer.
14-13-25	Inclusion of Handwheel Steering Mode for Airplanes equipped with NWSCM-04.
14-14-15	Update of portable oxygen cylinder components description.
14-15-10	Inclusion of inhibition phases for RAAS messages.
14-15-10	Inclusion of TAIL STRIKE AVOID FAIL and XPDR 1 (2) IN STBY EICAS messages according to Load 23.1. Update of inhibition phase to ENG REF ECS DISAG EICAS message according to Load 23.1. Update of CAUTION definition on EICAS messages categorization.

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LIST OF EFFECTIVE PAGES

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4-03-08 (add)	* 24	Rev. 4	4-03-11 (rev)	* 6	Rev. 4
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4-03-09-TOC (rev)	* 3	Rev. 4	4-03-12 (rev)	* 1	Rev. 4
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4-03-09 (rev)	* 2	Rev. 4	4-03-12 (rev)	* 4	Rev. 4
4-03-09 (rev)	* 3	Rev. 4	4-03-12 (rev)	* 5	Rev. 4
4-03-09 (rev)	* 4	Rev. 4	4-03-12 (rev)	* 6	Rev. 4
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4-03-09 (rev)	* 18	Rev. 4	4-03-13 (rev)	* 8	Rev. 4
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SECTION 1

GENERAL INFORMATION AND DEFINITION OF TERMS

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GENERAL

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

Any difference found between the data in the Airplane Operations Manual and the approved manuals is attributable to airplane modifications and scheduling of amendments to publications. In the event of such a difference, the data contained in the approved manuals must prevail.

REVISIONS

Embraer may periodically revise this manual as required to update information or to provide information not available at the time of last issue. Revised data may result from either airplane modifications or improved techniques gained through operational experience.

Changes to the content are indicated by a vertical line in the outside page margin, at the direction of revised text, graphic or table. A deleted text, graph or table is marked by a vertical line in the outside margin, at the direction of immediate previous line. A deleted table row is marked by a vertical line in the outside margin, at the direction of immediate next row.

For relocated or rearranged contents, the vertical line marker is drawn adjacent to the page number.

The basic issue date of this Manual is presented on the title page. Subsequent revisions are sequentially numbered (Revision 1, Revision 2, and so forth). The last Revision number is presented on the title page and on the footer of every page affected, replacing the former number.

The status of each page is presented in the List of Effective Pages (LEP).

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TEMPORARY REVISIONS

Temporary revisions may be issued when the need arises.

The temporary revision pages will be clearly identified and they are to be inserted adjacent to the affected page.

Temporary revisions description are presented at the Log of Temporary Revisions. Temporary revision pages status is not included in the List of Effective Pages.

Temporary revision pages shall be removed when the changed content is either incorporated or canceled by a Revision.

LIST OF EFFECTIVE PAGES

A List of Effective Pages (LEP) for all the sections is located at the beginning of this Manual. The LEP presents the list of revision numbers with the corresponding revision date, as well as the roll of pages with the current revision number.

The LEP is updated at every revision, and it is the reference to verify each Manual page for its proper updating status.

EFFECTIVITY

►*Effectivity range to which this information is applicable*

Texts, tables and graphics applicable to a specific airplane range are identified by: a preceding start tag and text (presented in a different font type) and an end tag at the final of the marked element. This paragraph constitutes an example of effectivity text.

SUB-EFFECTIVITY

►►*Sub-effectivity range to which this information is applicable*

When the information is applicable to a specific range within a marked range, they are identified by: a double start tag and text and a double end tag at the final of the marked element. This paragraph constitutes an example of sub-effectivity text.

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OPERATIONAL REQUIREMENTS AND THE AIRPLANE OPERATIONS MANUAL

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

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

Some Operation Requirements just define the main subjects that must be presented in an Airplane Operations Manual. However, even detailing the AOM at that level, all the requirements let the operators free to use different Airplane Operations Manual structures, depending on the manuals that have been already issued.

Therefore, EMBRAER has developed this AOM in an attempt to cover, in the best possible manner, the most currently used requirements. By doing so, it is possible for an operator to use the EMBRAER AOM by just adding some missing information that is specific to that operator. Below is a suggested Airplane Operations Manual structure to comply with most of the Operation Requirements:

PART A

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

PART B

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

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PART C

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

PART D

Presents training information.

EMBRAER AIRPLANE OPERATIONS MANUAL

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

AIRPLANE OPERATIONS MANUAL STRUCTURE

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

Volume 1:

– 1 General
– 2 Limitations
– 3 Normal Procedures
– 4 Emergency and Abnormal Procedures
– 5 Performance
– 6 Flight Planning
– 7 Weight and Balance
– 8 Loading
– 9 Configuration Deviation List
– 10 Minimum Equipment List
– 11 Emergency Information
– 12 Emergency Evacuation
– 13 Ground Servicing

Volume 2:

– 14-01 Airplane Description
– 14-02 Air Management System
– 14-03 Automatic Flight

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– 14-04 Auxiliary Power Unit
– 14-05 Electrical
– 14-06 Engine
– 14-07 Fire Protection
– 14-08 Flight Controls
– 14-09 Flight Instruments, Communication, Navigation and Flight Management System
– 14-10 Fuel
– 14-11 Hydraulic
– 14-12 Ice and Rain Protection
– 14-13 Landing Gear and Brakes
– 14-14 Oxygen
– 14-15 Warning System

Each of the above sections may be divided into smaller parts, called blocks. The number of the section followed by a two-digit number identifies such blocks.

For example:

Section 14-03 can be divided as follows:

– 14-03-01 General Description
– 14-03-05 Controls and Indications
– 14-03-10 Flight Guidance Control System
– 14-03-20 Thrust Management
– 14-03-30 EICAS Messages

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DEFINITION OF TERMS

The following definitions apply to the terms below:

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

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

NOTE: Operating procedures, techniques and other related information, which are considered essential to emphasize the safety of flight.

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ABBREVIATIONS AND ACRONYMS

ABBREVIATION	DESCRIPTION
°	Degree
°C	Degree Celsius
°F	Degree Fahrenheit
ℓ	Liter
A	Ampere
A/C	Aircraft
A/I	Anti-Ice
ABM	Auto Brake Control Module
ABV	Auxiliary Power-Unit Bleed-Valve
AC	Advisory Circular
ACARS	Aircraft Communication Addressing and Reporting System
ACE	Actuator Control Electronics
ACMP	Alternating-Current Motor-Driven Pump
ACN	Aircraft Classification Number
ACP	Audio Control Panel
ACT	Altitude Compensated Tilt
ADA	Air Data Application
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADS	Air Data System
ADSP	Air Data Smart Probe
AFCS	Automatic-Flight Control System
AFE	Above Field Elevation
AFM	Airplane Flight Manual
AFU	Artificial Feel Unit
AGL	Above Ground Level
AICC	Auxiliary Integrated Control-Center
AIOP	Actuator Input-Output Processor
AIP	Aeronautical Information Publication
ALT	Altitude

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ABBREVIATION	DESCRIPTION
AMM	Aircraft Maintenance Manual
AMS	Air Management System
ANAC	Agência Nacional de Aviação Civil
ANR	Automatic Navigation Realignment
AOA	Angle of Attack
AOC	Airline Operational Communications
AOM	Airplane Operations Manual
AP	Automatic Pilot
APM	Aircraft Personality Module
APP	Autopilot Panel
APPR	Approach
APR	Approach
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio Incorporated
ASCB	Avionics Standard-Communication Bus
ASEL	Altitude Preselect
ASTM	American Society of Testing Material
AT	Autothrottle
ATA	Air Transport Association of America
ATC	Air Traffic Control
ATIS	Automatic-Terminal-Information Service
ATS	Air Turbine Starter
ATTCS	Automatic Takeoff-Thrust Control-System
ATTND	Attendant
AUTO	Automatic
AVAIL	Available
AVOD	Audio and Video on Demand
AWS	Aural Warning System
AZFW	Actual Zero Fuel Weight
BARO	Barometric Setting
BATT	Battery
BC	Back Course
BCM	Brake Control Module
BEW	Basic Empty Weight

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ABBREVIATION	DESCRIPTION
BFO	Beat Frequency Oscillator
BIT	Built-in Test
BITE	Built-in Test Equipment
BOD	Bottom of Descent
BRG	Bearing
BRT	Bright
BTC	Bus Tie Contactor
CAB	Cabin
CAFM	Computerized Airplane Flight Manual
CAGE	Commercial and Government Entity
CAS	Calibrated Airspeed
CAT I	Category I Operation
CAT II	Category II Operation
CB	Circuit Breaker
CCD	Cursor Control Device
CDL	Configuration Deviation List
CFR	Code of Federal Regulations
CG	Center of Gravity
CGD	Corrected Ground Distance
CH	Channel
CLR	Clear
cm	Centimeter
CMC	Central Maintenance Computer
CMF	Communications Management Function
CMS	Configuration Management System
COMM	Communications
CON	Continuous
CPC	Cabin Pressure Controller
CPCS	Cabin Pressure Control-System
CRS	Course
CRZ	Cruise
CTRL	Control
CVR	Cockpit Voice Recorder
DB	Database

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ABBREVIATION	DESCRIPTION
DC	Direct Current
DDPM	Dispatch-Deviation Procedures Manual
DET	Detector
DGRAD	Degraded
DH	Decision Height
DIM	Dimmer
DLK	Datalink
DME	Distance Measuring Equipment
DMU	Data-Loader Management Unit
DN	Down
DO	RTCA Document
DOW	Dry Operating Weight
DR	Dead Reckoning
DU	Display Unit
DVDR	Digital Voice-Data Recorder
E-BAY	Electronic Bay
EADI	Electronic Attitude Director Indicator
EBV	Engine Bleed Valve
ECAFM	Electronic Computerized AFM
ECEF	Earth-Centered Earth-Fixed
ECL	Electronic Checklist
ECS	Environmental Control System
EDP	Engine Driven Pump
EDS	Electronic Display System
EDU	Electronic Display Unit
EFB	Electronic Flight Bag
EGPWM	Enhanced Ground-Proximity Warning-Module
EGPWS	Enhanced Ground-Proximity Warning-System
EGT	Exhaust Gas Temperature
EHSI	Electronic Horizontal Situation-Indicator
EICAS	Engine Indicating and Crew Alerting System
EICC	Emergency Integrated Control-Center
ELPU	Emergency Lights Power Unit
ELT	Emergency Locator Transmitter

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ABBREVIATION	DESCRIPTION
EMERG	Emergency
ENG	Engine
EPNL	Effective Perceived Noise Level
EPU	Estimated Position Uncertainty
ESS	Essential
ETA	Estimated Time of Arrival
ETC	Elevator Thrust Compensation
ETE	Estimated Time Enroute
ETP	Equal Time Point
FAA	Federal Aviation Authority
FADEC	Full-Authority Digital Electronic-Control
FAF	Final Approach Fix
FAP	Flight Attendant Panel
FAR	Federal Aviation Regulations
FAWP	Final Approach Waypoint
FBW	Fly-by-wire
FCM	Flight Control Module
FCOC	Fuel Cooled Oil Cooler
FCP	Flight Control Panel
FCU	Fuel Conditioning Unit
FCV	Flow Control Valve
FD	Flight Director
FDR	Flight Data Recorder
FGCS	Flight Guidance Control System
FIM	Fault Isolation Manual
FIREX	Fire Extinguisher
FLCH	Flight Level Change
FLEX	Flexible
FMA	Flight Mode Annunciator
FMS	Flight Management System
FMU	Fuel Metering Unit
FOM	Figure of Merit
FPA	Flight Path Angle
FPL	Flight Plan

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ABBREVIATION	DESCRIPTION
FPR	Flight Path Reference
FSTN	Fasten
ft	Foot
ft/min	Foot per Minute
ft^3	Cubic Foot
FWD	Forward
g	Gravity Acceleration
G/A	Go-Around
GA	Go Around
GB	Gigabyte
GCU	Generator Control Unit
GD	Ground Distance
GEN	Generator
GMAP	Ground Map
GMT	Greenwich Mean Time
GND	Ground
GNSS	Global Navigation Satellite System
GP	Guidance Panel
GPS	Global Positioning System
GPU	Ground Power Unit
GPWS	Ground-Proximity Warning System
GS	Glide Slope
h	Hour
HDG	Heading
HDOP	Horizontal Dilution of Precision
HDPH	Headphone
HF	High Frequency
HGS	Head-up Guidance System
HI	High
HP	High Pressure
hPa	Hectopascal
HPC	High Pressure Compressor
HPT	High Pressure Turbine
HPU	High Pressure Unit

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ABBREVIATION	DESCRIPTION
HS-ACE	Horizontal-Stabilizer Actuator-Control Electronics
HSA	Horizontal Stabilizer Actuator
HSI	Horizontal Situation Indicator
HYD	Hydraulic
Hz	Hertz
I/O	Input/Output
IAS	Indicated Air Speed
IATA	International Air Transport Association
IBIT	Inflight Built In Test
ICAO	International Civil Aviation Organization
ICC	Integrated Control-Center
ID	Identification
IDG	Integrated Drive Generator
IESS	Integrated Electronic Standby System
IFE	In Flight Entertainment
IFR	Instrument Flight Reference
IGN	Ignition
ILS	Instrument Landing System
in	Inch
in^3	Cubic Inch
INBD	Inboard
inHg	Inch of Mercury
INHIB	Inhibition
INOP	Inoperative
INPH	Interphone
INT	Initialization
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ITT	Interstage Turbine Temperature
IU	Index Unit
IU/kg	Index Unit per Kilogram
KCAS	Calibrated Airspeed in Knots

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ABBREVIATION	DESCRIPTION
kg	Kilogram
kg/ℓ	Kilogram per Liter
kg/m^2	Kilogram per Square Meter
kg.m	Kilogram Meter
KIAS	Indicated Airspeed in Knots
km	Kilometer
km/h	Kilometer per Hour
kPa	Kilopascal
KPH	Kilograms per Hour
kt	Knot
kVA	Kilovolt-Ampere
LAT	Latitude
LAV	Lavatory
lb	Pound
lb/ft^2	Pound per Square Foot
lbf	Pound Force
LCD	Liquid-Crystal Display
LDA	Localizer Directional Aid
LDG	Landing Gear
LED	Light-Emitting Diode
LEMAC	Leading Hedge Aerodynamic Chord
LFE	Landing Field Elevation
LG	Landing Gear
LH	Left-Hand
LICC	Left Integrated Control-Center
LIM	Limited Thrust
LNAV	Lateral Navigation
LO	Low
LOC	Localizer
LOC-BC	Localizer-Back Course
LON	Longitude
LP	Low Pressure
LRC	Long Range Cruise
LRM	Line Replaceable Module

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ABBREVIATION	DESCRIPTION
LRU	Line Replaceable Unit
LSK	Line Select Key
LSS	Lightning Sensor System
LT	Light
LX	Lightning Detection
m	Meter
m^3	Cubic Meter
MAC	Mean Aerodynamic Chord
MAP	Multiple Alarm Panel
MAU	Modular Avionics Unit
MAX	Maximum
MaxAT	Maximum Assumed Temperature
mbar	Milibar
MCDU	Multifunction Control Display Unit
MDA	Minimum Descent Altitude
MEA	Minimum Enroute Altitude
MEL	Minimum Equipment List
MEW	Manufacture Empty Weight
MFD	Multi-Function Display
MHz	Megahertz
MIC	Microphone
MID	Middle
min	Minute
MLG	Main Landing Gear
MLS	Microwave Landing System
MLW	Maximum Landing Weight
mm	Millimeter
MMEL	Master Minimum Equipment List
M_{MO}	Maximum Mach Operation
MOW	Maximum Design Operating Weight
MPEG	Moving Picture Experts Group
mph	Mile per Hour
MRC	Modular Radio Cabinet
MRW	Maximum Ramp Weight

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ABBREVIATION	DESCRIPTION
MSA	Minimum Safety Altitude
MSL	Mean Sea Level
MTOW	Maximum Takeoff Weight
MTP	Maintenance Test Panel
MZFW	Maximum Zero Fuel Weight
N1	Fan Rotor Speed
N2	Core Rotor Speed
NAD-83	North American Datum 1983
NAS	National Airspace System
NAV	Navigation
NAVCOM	Navigation & Communication
NBPT	No-Break Power Transfer
NDB	Non-Directional Beacon
NIC	Network Interface Controller
NLG	Nose Landing Gear
NM	Nautical Miles
NOTAM	Notice to Airmen
NPRV	Negative Pressure Relief Valve
OAT	Outside Air Temperature
OBV	Operability Bleed Valve
ODS	Overheat Detection System
OEI	One Engine Inoperative
OEW	Operational Empty Weight
OFV	Outflow Valve
OUTBD	Outboard
OVHT	Overheat
OVRD	Override
OVSP	Overspeed
OWE	Overwing Emergency Exit
OXY	Oxygen
P-ACE	Primary Actuator Control Electronics
P-RNAV	Precision Required Navigation
PA	Passenger Address
PAX	Passenger

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ABBREVIATION	DESCRIPTION
PBE	Protective Breathing Equipment
PBIT	Power Up Built in Test
PC	Personal Computer
PCN	Pavement Classification Number
PCU	Power Control Unit
PDU	Power Drive Unit
PED	Portable Electronic Device
Perf	Performance
PF	Pilot Flying
PFD	Primary Flight Display
PIT	Pitch
PMA	Permanent Magnet Alternator
PPH	Pounds per Hour
PPOS	Present Position
PRA	Prerecorded Announcement
PREV	Previous
PRN	Pseudo-Random Noise
PSEM	Proximity Sensor Electronic Module
psi	Pounds per Square Inch
psid	Pound per Square Inch Differential
psig	Pound per Square Inch Gauge
PSU	Passenger Service Unit
PTT	Press To Transmit
PTU	Power Transfer Unit
PWR	Power
QFE	Question Field Elevation
QNH	Local Altimeter Setting
QRH	Quick Reference Handbook
RA	Resolution Advisory
RAD	Radio
RAIM	Receiver Autonomous Integrity Monitor
RALT	Radio Altitude
RAMP	Reliability Analysis and Motoring Program
RAT	Ram Air Turbine

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ABBREVIATION	DESCRIPTION
RCT	Rain Echo Attenuation
REACT	Rain Echo Attenuation Compensation Technique
RECIRC	Recirculation
REF.	Reference
RETD	Retard
REV	Reverse
RH	Right-Hand
RICC	Right Integrated Control-Center
RNAV	Area Navigation System
RNP	Required Navigation Performance
rpm	Revolutions per Minute
RSV	Reserve
RTA	Receiver/Transmitter Antenna
RTO	Rejected Takeoff
RVSM	Reduced Vertical Separation Minimum
RWY	Runway
s	Second
S-ACE	Spoiler Actuator-Control Electronics
SAD	Still Air Distance
SAI	Slat Anti-Ice
SAT	Static Air Temperature
SCV	Starter Control Valve
SDF	Simplified Directional Facility
SECT	Sector
SEL	Selector
SELCAL	Selective Call
SF-ACE	Slat/Flap Actuator Control Electronics
SID	Standard Instrument Departures
SL	Sea Level
SMKG	Smoking
SOV	Shutoff Valve
SPD	Speed
SPDA	Secondary Power Distribution Assembly

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ABBREVIATION	DESCRIPTION
SPKR	Speaker
SPS	Stall Protection System
SSPC	Solid State Power Controller
SSR	Secondary Surveillance Radar
STAB	Stabilizer
STAR	Standard Instrument Arrivals
STBY	Standby
STD	Standard
SVC	Service
SW	Switch
SYS	System
T/O	Takeoff
T2	Fan Inlet Temperature
TA	Traffic Advisory
TA/RA	Traffic Advisory/ Resolution Advisory
TAS	True Airspeed
TAT	Total Air Temperature
TCAS	Traffic Alert and Collision Avoidance System
TCS	Touch Control Steering
TDS	Takeoff Data Set
TEMP	Temperature
TERM	Terminal
TGL	Temporary Guidance Leaflet
TGT	Target
TLA	Thrust Lever Angle
TMS	Thrust Management System
TO	Takeoff
TOC	Top of Climb
TOD	Top of Descent
TOGA	Takeoff/Go Around
TOW	Takeoff Weight
TRS	Thrust Rating Selector
TRU	Transformer Rectifier Unit
TWIP	Terminal Weather Information for Pilots

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ABBREVIATION	DESCRIPTION
US gal	Gallon
USB	Universal Serial Bus
UTC	Universal Time Coordinated
V	Volt
V_1	Takeoff Decision Speed
V_2	Takeoff Safety Speed
V_A	Design Maneuvering Speed
V_{AC}	Approach Climb Speed
VALT	Vertical Altitude
V_{APP}	Approach Speed
VAR	Variable
VARM	Vertical ARM
VASEL	Vertical Altitude Select
VDC	Volt Direct Current
VDOP	Vertical Dilution of Precision
VDR	VHF Data Radio
V_{EF}	Critical Engine Failure Speed
V_{FE}	Maximum Flaps Extended Speed
VFLCH	Vertical Flight Level Change
VFR	Visual Flight Reference
V_{FS}	Final Segment Speed
VGP	VNAV Glide Path
VHF	Very High Frequency
V_{LE}	Maximum Landing Gear Extended Speed
V_{LO}	Maximum Landing Gear Operating Speed
V_{MCA}	Air Minimum Control Speed
V_{MCG}	Ground Minimum Control Speed
V_{MCL}	Minimum Control Speed During Landing
V_{MO}	Maximum Operating Speed
VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VOR/LOC	VOR Localizer
VPATH	Vertical Path
V_R	Rotation Speed

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ABBREVIATION	DESCRIPTION
Vref	Reference Speed
V_{REFXX}	Landing Reference Speed associated to the flap setting XX
VS	Vertical Speed
VSI	Vertical Speed Indicator
VTA	Vertical Track Alert
WGS-84	World Geodetic System 1984
WML	Windmilling
WOW	Weight-on-Wheels
WRN	Warning
WSHR	Windshear
WX	Weather Radar
XBLEED	Cross Bleed
XCHECK	Cross Check
XFEED	Cross Feed
XPDR	Transponder
YD	Yaw Damper

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UNITS CONVERSION

TO CONVERT	INTO	MULTIPLY BY	AND ADD
Degree Celsius (°C)	Degree Fahrenheit (°F)	1.8000	+32
Degree Fahrenheit (°F)	Degree Celsius (°C)	0.5556	-17.7778
Feet (ft)	Meter (m)	0.3048	–
Inches (in)	Millimeter (mm)	25.4000	–
Inches of Mercury (inHg)	Millibar (mbar)	33.8636	–
Kilogram (kg)	Pounds (lb)	2.2046	–
Kilogram force per Square meter (kg/m^2)	Pound per Square Inch (psi)	0.0014	–
Kilometer (km)	Nautical Mile (NM)	0.5399	–
Kilometer per hour (km/h)	Knot (kt)	0.5399	–
Knot (kt)	Kilometer per hour (km/h)	1.852	–
Pounds (lb)	Kilogram (kg)	0.4536	–
Meter (m)	Feet (ft)	3.2808	–
Millibar (mbar)	Inches of Mercury (inHg)	0.0295	–
Millimeter (mm)	Inches (in)	0.0394	–
Nautical Mile (NM)	Kilometer (km)	1.852	–
Pound per Square Inch (psi)	Kilogram force per Square meter (kg/m^2)	703.0740	–

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SERVICE BULLETIN TABLE

EMBRAER 190/195 models

SB	SUBJECT
SB 190-00-0002	Installation of placard indicating the Maximum Takeoff Weight (MTOW) of 50000 kg.
SB 190-00-0008	Installation of placard indicating the Maximum Takeoff Weight (MTOW) of 46000 kg.
SB 190-00-0009	Installation of placard indicating the Maximum Takeoff Weight (MTOW) of 51800 kg.
SB 190-00-0012	Installation of placard indicating the Maximum Takeoff Weight (MTOW) of 47790 kg.
SB 190-00-0013	Installation of placard indicating the Maximum Takeoff Weight (MTOW) of 50300 kg.
SB 190-23-0009	Installation of Dual active HF (High Frequency).
SB 190-31-0007	Update of Load 4.3 to Load 4.5 version of the PRIMUS EPIC field-loadable software system into the Primus Epic Integrated Avionics System.
SB 190-31-0009	Update of Load 4.5 to Load 19.3 version of the PRIMUS EPIC field-loadable software system into the Primus Epic Integrated Avionics System.
SB 190-31-0015	Update of current Load to Load 21.2 version of the PRIMUS EPIC field-loadable software system into the Primus Epic Integrated Avionics System.

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SB	SUBJECT
SB 190-32-0022	Installation of Nose Wheel Steering Control Module new version.
SB 190-34-0010	Upgrade of HGS software version to 811.
SB 190-34-0015	Installation of HGS software 811 version with CAT IIIa functionalities.
SB 190-49-0001	Upgrade of APU FADEC software version to FADEC 02.00.
SB 190-52-0013	Slide Mechanism Modification.
SB 190-73-0004	Installation of placard in the cockpit with new time limit for maximum TO thrust.
SB 190-73-0010	Upgrade of engine FADEC software version to 5.32.

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EMBRAER 170/175 X 190/195

EMBRAER 170/175 and EMBRAER 190/195 models are classified as common type rating, thus have a high level commonality and may use almost the same AOM. The differences are customized in the manual according to each airplane model and configuration. The following table is presented to help identifying and finding the relevant differences between models EMBRAER 170/175 and EMBRAER 190/195.

Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
LIMITATIONS	2-05 Weight and CG	MRW, MTOW, MLW and MZFW		–	–
LIMITATIONS	2-05 Weight and CG	Center of Gravity envelopes		–	–
LIMITATIONS	2-36 Fuel	Maximum Usable Fuel per Tank/Unusable Fuel per Tank		–	–
LIMITATIONS	2-40 Powerplant	Engine Parameter limits		ENGINE	–
LIMITATIONS	2-40 Powerplant	Noise Levels		NOISE LEVELS	–
NORMAL PROCEDURES	3-11 Engine Start	Ground Start ITT limitation		–	–
NORMAL PROCEDURES	3-16 Takeoff	Pitch Trim table for FD inoperative		–	–
EMERGENCY AND ABNORMAL PROCEDURES/ SMOKE	4-01-01 Smoke	Abnormal landing factors for ELECTRICAL SYSTEM FIRE OR SMOKE procedure		ELECTRICAL SYSTEM FIRE OR SMOKE	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for DUAL ENGINE FAILURE procedure		DUAL ENGINE FAILURE	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for JAMMED CONTROL COLUMN - PITCH procedure		JAMMED CONTROL COLUMN - PITCH	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for JAMMED CONTROL WHEEL - ROLL procedure		JAMMED CONTROL WHEEL - ROLL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Engine Airstart envelope		ENGINE AIRSTART ENVELOPE	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for LOSS OF HYDRAULIC SYSTEM 1 procedure		LOSS OF HYDRAULIC SYSTEM 1	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for LOSS OF HYDRAULIC SYSTEM 2 procedure		LOSS OF HYDRAULIC SYSTEM 2	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for LOSS OF HYDRAULIC SYSTEM 1 AND 3 procedure		LOSS OF HYDRAULIC SYSTEM 1 AND 3	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-02-01 Non Annunciated	Abnormal Landing factors for LOSS OF HYDRAULIC SYSTEM 2 AND 3 procedure		LOSS OF HYDRAULIC SYSTEM 2 AND 3	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-03 Autoflight	Abnormal Landing factors for STALL PROT FAIL procedure		STALL PROT FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Abnormal Landing factors and Relevant Inoperative Items list for ELEC EMERGENCY procedure		ELEC EMERGENCY	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Relevant Inoperative Items list for AC BUS 1 OFF procedure		AC BUS 1 OFF	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Relevant Inoperative Items list for AC ESS BUS OFF procedure		AC ESS BUS OFF	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Abnormal Landing factors for DC BUS 1 OFF procedure		DC BUS 1 OFF	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Abnormal Landing factors for DC BUS 2 OFF procedure		DC BUS 2 OFF	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Abnormal Landing factors for DC ESS BUS 1 OFF procedure		DC ESS BUS 1 OFF	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Abnormal Landing factors and Relevant Inoperative Items list for DC ESS BUS 2 OFF procedure		DC ESS BUS 2 OFF	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-05 Electrical	Relevant Inoperative Items list for DC ESS BUS 3 OFF procedure		DC ESS BUS 3 OFF	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-08 Flight Controls	Abnormal Landing factors for GROUND SPOILERS FAIL procedure		GROUND SPOILERS FAIL	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-08 Flight Controls	Abnormal Landing factors for SPOILERS NML MODE FAIL procedure		SPOILERS NML MODE FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-08 Flight Controls	Abnormal Landing factors for ELEVATOR RH (LH) FAIL procedure		ELEVATOR RH (LH) FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-08 Flight Controls	FLAP (SLAT) FAIL performance table		FLAP (SLAT) FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-08 Flight Controls	Abnormal Landing factors for PITCH TRIM FAIL procedure		PITCH TRIM FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-08 Flight Controls	Abnormal Landing factors for SPOILER FAULT procedure		SPOILER FAULT	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-09 FMS/Nav/ Com & Flight Instruments	Abnormal Landing factors for AVNX MAU 1A FAIL procedure		AVNX MAU 1A FAIL	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-09 FMS/Nav/ Com & Flight Instruments	Abnormal Landing factors for AVNX MAU 1B FAIL procedure		AVNX MAU 1B FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ NON ANNUNCIATED	4-03-09 FMS/Nav/ Com & Flight Instruments	Abnormal Landing factors and Relevant Inoperative Items list for AVNX MAU 2B FAIL procedure		AVNX MAU 2B FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ ANNUNCIATED	4-03-09 FMS/Nav/ Com & Flight Instruments	Abnormal Landing factors for AVNX MAU 3A FAIL procedure		AVNX MAU 3A FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ ANNUNCIATED	4-03-09 FMS/Nav/ Com & Flight Instruments	Abnormal Landing factors for AVNX MAU 3B FAIL procedure		AVNX MAU 3B FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ ANNUNCIATED	4-03-12 Ice and Rain Protection	Abnormal Landing factors for A-I WING FAIL procedure		A-I WING FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ ANNUNCIATED	4-03-13 Landing Gear and Brakes	Abnormal Landing factors for BRAKE LH (RH) FAIL procedure		BRAKE LH (RH) FAIL	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
EMERGENCY AND ABNORMAL PROCEDURES/ ANNUNCIATED	4-03-13 Landing Gear and Brakes	Abnormal Landing factors for LG WOW SYS FAIL procedure		LG WOW SYS FAIL	–
EMERGENCY AND ABNORMAL PROCEDURES/ ANNUNCIATED	4-03-13 Landing Gear and Brakes	Abnormal Landing factors for BRAKE LH (RH) FAULT procedure		BRAKE LH (RH) FAULT	–
PERFORMANCE	5	Performance data		–	–
FLIGHT PLANNING	6	Flight Planning data		–	–
WEIGHT AND BALANCE	7	Weight and Balance data		–	–
LOADING	8-10 External Dimensions	External dimensions of the airplane		–	–
LOADING	8-10 External Dimensions	Ground clearances		GROUND CLEARANCES GRAPHIC	–
LOADING	8-10 External Dimensions	Ground clearances		VERTICAL GROUND CLEARANCES TABLE	–
LOADING	8-10 External Dimensions	Passenger, service and cargo compartment door clearances		DOOR CLEARANCES	–
LOADING	8-30 Interior Arrangement	Interior arrangement of flight deck and passenger cabin		–	–
LOADING	8-30 Interior Arrangement	Passenger balance arm and furnishings and equipment balance arms		–	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
LOADING	8-50 Cargo Compartment Door	Cargo doors dimensions		–	–
LOADING	8-60 Cargo Compartment	Cargo compartments dimensions		DIMENSIONS AND LIMITS	–
LOADING	8-60 Cargo Compartment	Cargo compartments balance arms and volumes		DIMENSIONS AND LIMITS	–
LOADING	8-60 Cargo Compartment	Package size dimensions table		PACKAGE SIZE TABLES	–
LOADING	8-70 Cargo Nets	Cargo nets limitation and positions		–	–
EMERGENCY INFORMATION	11-05 Emergency Equipment	Emergency equipment location		–	–
EMERGENCY EVACUATION	12-40 Doors and Exits	Emergency evacuation exits for EMBRAER 190/195		–	–
GROUND SERVICING	13-25 Fuel	Fuel quantity according to magnetic level indication		FUEL MAGNETIC LEVER	–
GROUND SERVICING	13-30 Engine Oil	Engine Oil Level Check		ENGINE OIL SERVICING	ENGINE OIL LEVEL CHECK - ENGINE
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-05 Airplane Basic Data	Maximum seat capacity for EMBRAER 190/195 airplane models		–	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-05 Airplane Basic Data	External dimensions of the airplane		EXTERNAL DIMENSIONS	–
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-05 Airplane Basic Data	Antennas positioning along the airplane		AIRPLANE ANTENNAS	–
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-05 Airplane Basic Data	Main service points location		MAIN SERVICE POINTS	–
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-25 Electronic Display System (EDS)	OWE door pictorial status page on MFD, for EMBRAER 190/195		MULTI FUNCTION DISPLAY (MFD)	STATUS PAGE
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-30 Controls and Indications	OWE door pictorial status page on MFD, for EMBRAER 190/195		SYNOPTIC PAGE ON MFD	–
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-40 Lighting	Overwing emergency lights		EXTERNAL LIGHTING	WING INSPECTION, LOGOTYPE AND OVERWING EMERGENCY LIGHTS
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-40 Lighting	Photoluminescent strips for EMBRAER 190/195		EMERGENCY LIGHTING	PHOTOLUMI-NESCENT STRIPS
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-40 Lighting	Cargo compartment lights quantity and location		CARGO COMPARTMENT LIGHTS	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-45 Doors	Overwing emergency exits for EMBRAER 190/195		EMERGENCY EXITS	–
SYSTEMS DESCRIPTION/ AIRPLANE GENERAL	14-01-80 EICAS Messages	EICAS messages applicable only for EMBRAER 190/195		–	–
SYSTEMS DESCRIPTION/ AIR MANAGEMENT SYSTEM	14-02-10 Bleed Air System	Engine bleed stage supply and precooler		ENGINE BLEED SYSTEM	–
SYSTEMS DESCRIPTION/ AUTOMATIC FLIGHT	14-03-10 Flight Guidance Control System	Airplane pitch angle guidance for flaps 2		FGCS	TAKEOFF (TO)
SYSTEMS DESCRIPTION/ AUTOMATIC FLIGHT	14-03-10 Mach Trim	Description of mach trim function		–	–
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	Reading lights MID Right/Left		AC/DC BUSSES LOAD DISTRIBUTION	DC BUS 2
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	Pitch Trim 1 Control		AC/DC BUSSES LOAD DISTRIBUTION	DC ESS BUS 1
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	Right Smoke Detector A3/F4 Cargo Bay		AC/DC BUSSES LOAD DISTRIBUTION	DC ESS BUS 1

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	Pitch Trim 2 Control		AC/DC BUSSES LOAD DISTRIBUTION	DC ESS BUS 3
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	AFT Lavatory Lights		AC/DC BUSSES LOAD DISTRIBUTION	DC GND SVC
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	Pitch Trim 1 AC power		AC/DC BUSSES LOAD DISTRIBUTION	AC BUS 1
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	FAN AFT Avionics bay		AC/DC BUSSES LOAD DISTRIBUTION	AC BUS 2
SYSTEMS DESCRIPTION/ ELECTRICAL	14-05-35 Electrical Loads Distribution	Pitch Trim 2 AC power		AC/DC BUSSES LOAD DISTRIBUTION	AC ESS BUS
SYSTEMS DESCRIPTION/ ENGINE	14-06-01 General Description	Engine model, graphic and schematic for EMBRAER 190/195		–	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-10 Engine Fuel System	Fuel system characteristics		ENGINE FUEL SYSTEM	GENERAL
SYSTEMS DESCRIPTION/ ENGINE	14-06-10 Engine Fuel System	Description of fuel flow into the fuel pump		FUEL PUMP	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-10 Engine Fuel System	Variable Geometric Actuator	Variable Stator Vanes	VARIABLE STATOR VANES	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-10 Engine Fuel System	Fuel schematic		FUEL SCHEMATIC	–

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		Embraer 170/175	Embraer 190/195		
SYSTEMS DESCRIPTION/ ENGINE	14-06-15 Lubrication System	Lubrication schematic		LUBRICATION SCHEMATIC	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-20 Start and Ignition System	Starter Control Valve (SCV)	Starter Air Valve (SAV)	–	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-20 Start and Ignition System	N2 speeds for ignition and fuel flow during ground start		GROUND START	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-20 Start and Ignition System	N2 speeds for ignition and fuel flow during IN FLIGHT START		IN FLIGHT START	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-30 Engine Control System	Starter Control Valve	Starter Air Valve	FULL AUTHORITY DIGITAL ELECTRONIC CONTROL (FADEC)	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-30 Engine Control System	Flexible takeoff reduction limitation		FLEXIBLE TAKEOFF	–
SYSTEMS DESCRIPTION/ ENGINE	14-06-30 Engine Control System	Thrust ratings table for CF34-10E engines		ENGINE THRUST RATINGS	THRUST RATINGS TABLE
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SYSTEMS DESCRIPTION/ FLIGHT CONTROLS	14-08-05 Controls and Indications	SLAT/FLAP deflection		SLAT/FLAP SELECTOR LEVER	–
SYSTEMS DESCRIPTION/ FLIGHT CONTROLS	14-08-05 Controls and Indications	Tic marks along pitch trim scale		EICAS INDICATIONS	ROLL/ PITCH/ YAW TRIM INDICATION ON EICAS
SYSTEMS DESCRIPTION/ FLIGHT CONTROLS	14-08-10 FCS Description	Mach Trim Function and Configuration Trim Compensation for EMBRAER 190/195 only		MODES OF OPERATION	–
SYSTEMS DESCRIPTION/ FLIGHT CONTROLS	14-08-15 Pitch Control	Mach Trim for EMBRAER 190/195 only		STABILIZER TRIM	MACH TRIM
SYSTEMS DESCRIPTION/ FUEL	14-10-10 Fuel System Description	2 water drains quantity		FUEL TANKS	–
SYSTEMS DESCRIPTION/ FUEL	14-10-10 Fuel System Description	Fuel Quantity		FUEL TANKS	–
SYSTEMS DESCRIPTION/ FUEL	14-10-10 Fuel System Description	Fuel LO LEVEL trigger value		FUEL LOW LEVEL WARNING	–
SYSTEMS DESCRIPTION/ FUEL	14-10-15 EICAS Messages	Unusable fuel increase due to fuel feed fault condition		–	–

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Section/ Subsection	Reference Block	Difference		Topic	Sub-Topic
		Embraer 170/175	Embraer 190/195		
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SYSTEMS DESCRIPTION/ ICE AND RAIN PROTECTION	14-12-10 System Description	Engine Anti Ice System Bleeds Air from the 10th High Stage Valve	Engine Anti Ice System Bleeds Air from the 5th Low Stage Valve	ICE PROTECTION SYSTEM	ENGINE ANTI ICE SYSTEM
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SYSTEMS DESCRIPTION/ LANDING GEAR AND BRAKES	14-13-05 Controls and Indication	Landing Gear Warning Inhibition reactivation TLA values		–	–
SYSTEMS DESCRIPTION/ LANDING GEAR AND BRAKES	14-13-25 Nosewheel Steering System	Turning Radii		–	–

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SECTION 2

LIMITATIONS

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INTRODUCTION

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

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

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

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

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

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WEIGHT

The maximum structural weights are shown in the table below for the models:

EMBRAER 190 AR

Max. Ramp Weight (MRW) (kg)	Max. Takeoff Weight (MTOW) (kg)	Max. Landing Weight (MLW) (kg)	Max. Zero Fuel Weight (MZFW) (kg)
51960	51800	44000	40900

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

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

– Maximum takeoff weight as calculated using the approved software, and as limited by field length, climb and brake energy.

– Maximum takeoff weight, as limited by enroute, and landing operating requirements.

The landing weight is the lowest among MLW and the following weights calculated using the approved software:

– Maximum landing weight as limited by runway.

– Maximum approach and landing weight as limited by altitude, temperature and climb gradient.

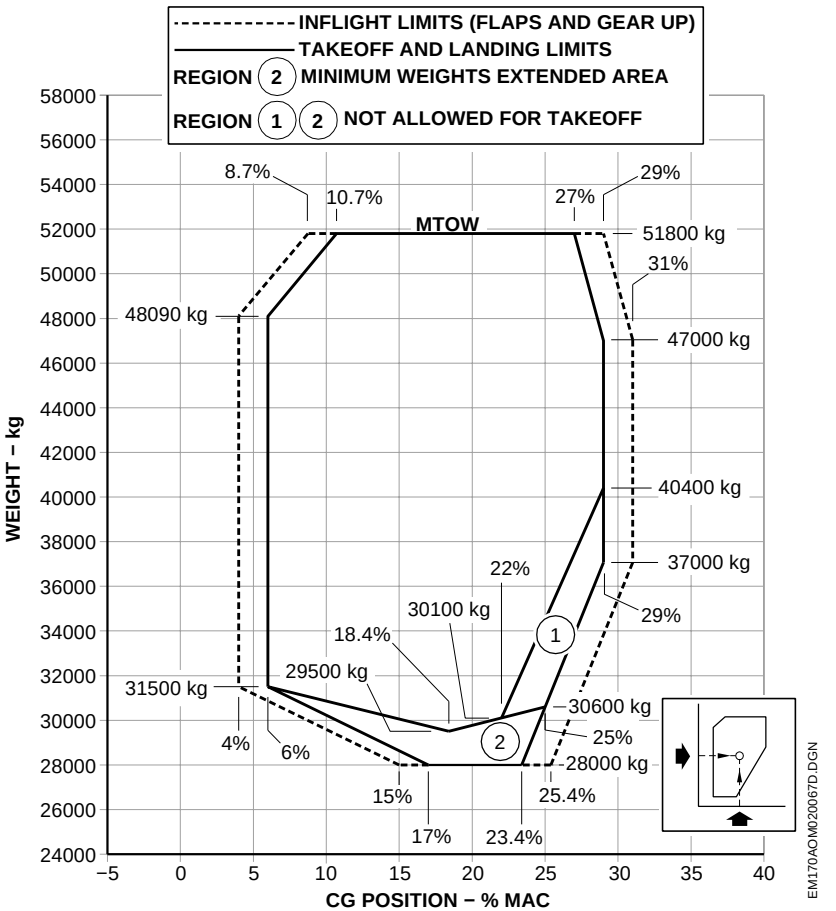
LOADING

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

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CENTER OF GRAVITY ENVELOPE

The Weight and CG envelope is shown in the graphics below for the models:



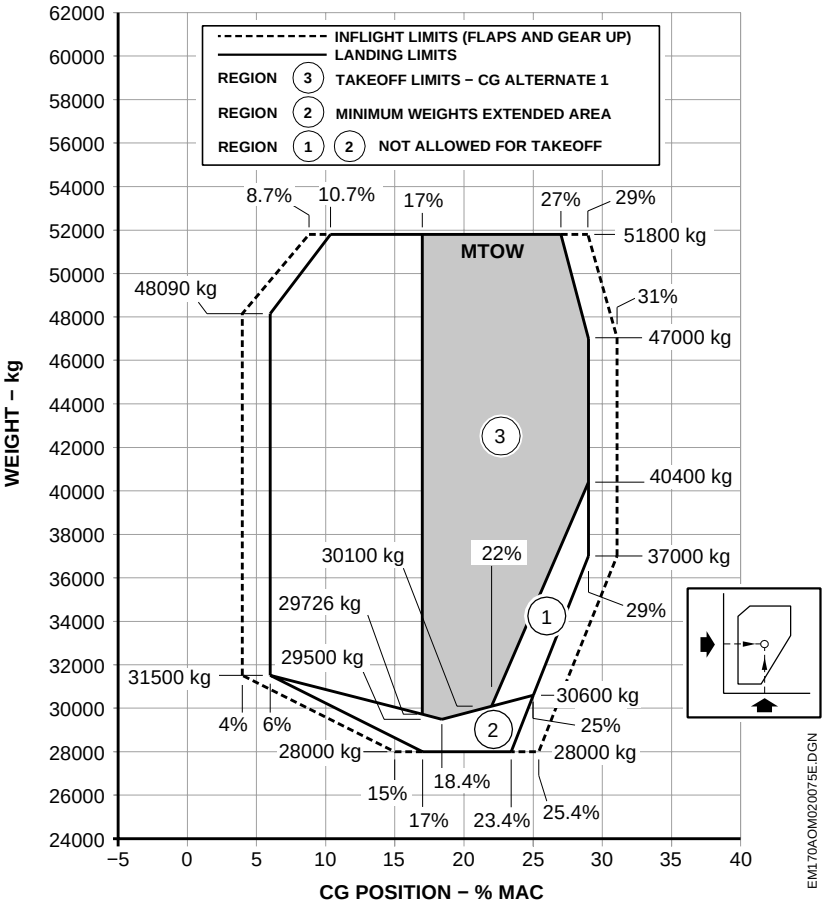
CG ENVELOPE - EMBRAER 190 AR

▶*190 AR, CG envelope with alternative 17%, units in kg AND Except airplanes S/N 19000147, 19000150, 19000241, 19000242, 19000249 and 19000257*

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CG ENVELOPE - EMBRAER 190 AR (ALTERNATE 1 - CENTER OF GRAVITY - 17%)

NOTE: The CAFM CG Envelope option must be set to Alternate 1 for takeoff.

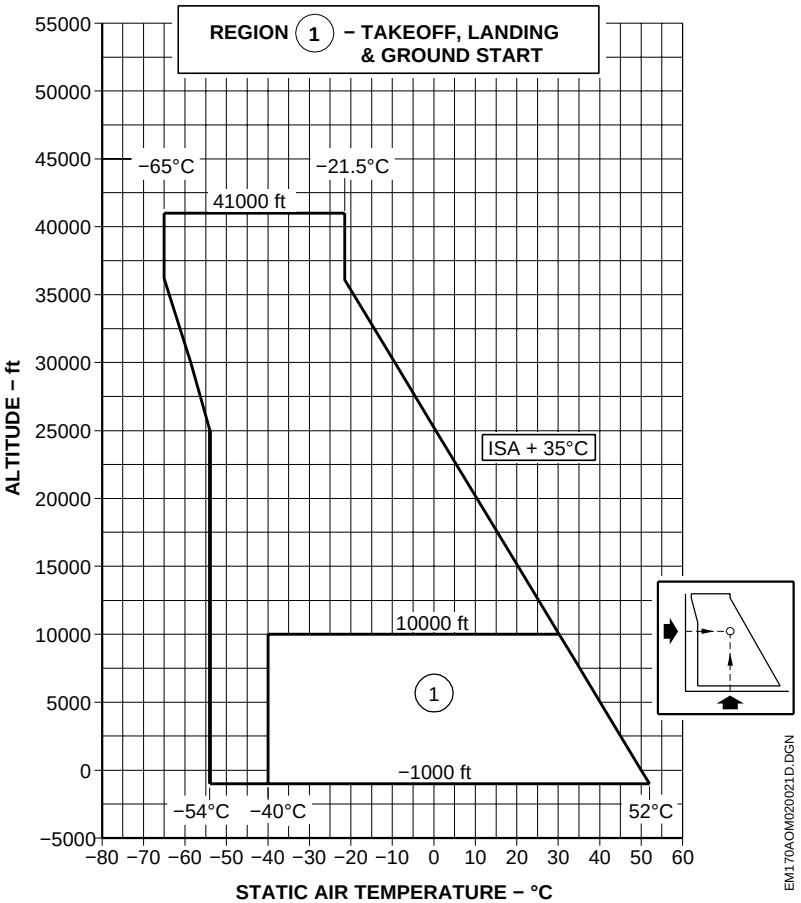
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OPERATIONAL ENVELOPE



OPERATIONAL ENVELOPE

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

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MAXIMUM ALTITUDE FOR FLAP EXTENSION

Maximum Altitude For Flap Extension..... 20000 ft

AIRSPEEDS

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

V_{LO} for retraction..... 235 KIAS
V_{LO} for extension..... 265 KIAS
V_{LE}..... 265 KIAS

NOTE: – V_{LO} is the maximum speed at which the landing gear can be safely extended and retracted.
– V_{LE} is the maximum speed at which the airplane can be safely flown with the landing gear extended and locked.

MAXIMUM SPEED TO OPEN THE DIRECT VISION WINDOW

Maximum Speed to Open the Direct Vision Window..... 160 KIAS

MINIMUM CONTROL SPEED

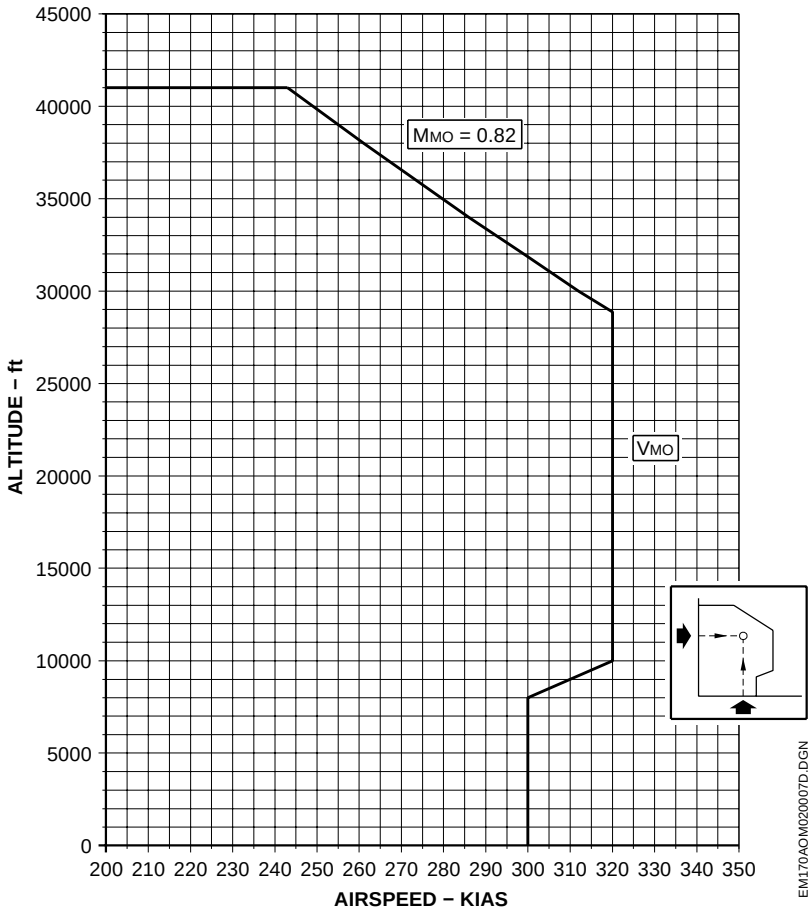
Refer to Section 5 – Performance.

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MAXIMUM OPERATING SPEED



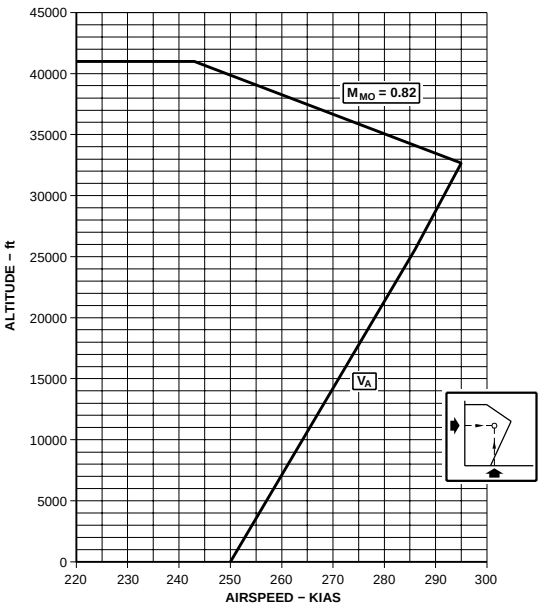
NOTE: V_{MO}/M_{MO} may not be deliberated exceeded in any regime of flight (climb, cruise, or descent).

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MANEUVERING SPEED (V_A)



EM170AOM020023D.DGN

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

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

MAXIMUM FLAP EXTENDED SPEED (V_{FE})

Flaps 1..... 230 KIAS
Flaps 2..... 215 KIAS
Flaps 3..... 200 KIAS

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Flaps 4..... 180 KIAS
Flaps 5..... 180 KIAS
Flaps Full..... 165 KIAS

MAXIMUM TIRE GROUND SPEED

Maximum Tire Ground Speed..... 225 mph (195 kt)

WIND LIMITATIONS

Maximum Takeoff and Landing Tailwind Component..... 15 kt

The capability of this airplane has been satisfactorily demonstrated for takeoff and landing with tailwinds up to 15 kt. This finding does not constitute operational approval to conduct takeoffs or landings with tailwind components greater than 10 kt.

MAXIMUM RECOMMENDED CROSSWIND

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

Dry Runway..... 38 kt
Wet Runway..... 31 kt
Runway with Compacted Snow..... 20 kt
Runway with Standing Water/Slush..... 18 kt
Runway with Wet Ice (no melting)..... 12 kt

NOTE: Due to engine compressor stall possibility, static takeoff is not recommended with crosswind component greater than 25 kt.

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KINDS OF OPERATION

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

– Visual (VFR);

– Instrument (IFR);

– Icing conditions;

– Category I and II;

– Extended Over-water Operation;

– RVSM;

– RNP.

MINIMUM CREW

Minimum Flight Crew..... PILOT AND COPILOT

MANEUVERING FLIGHT LOAD FACTORS

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

LOAD FACTOR LIMIT	FLAPS UP	FLAPS DOWN (1, 2, 3, 4, 5 AND FULL)
Positive	2.5 g	2.00 g
Negative	-1.00 g	0 g

RUNWAY

Runway Slope..... -2% TO +2%
Runway Surface Type..... PAVED

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TOWING

Towbarless towing is prohibited, unless it is conducted in accordance with the procedure presented in the AMM chapter 9.

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ELECTRONIC CHECKLIST

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

Operational approval is required in order to load database into the airplane and use the electronic checklist.

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WARNING

ENHANCED GROUND PROXIMITY WARNING

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

– Navigation is not to be predicated on the use of the Terrain Awareness System.

– The use of predictive EGPWS functions should be manually inhibited when landing to an airport that is not in the airport database to avoid unwanted alerts.

– Pilots are authorized to deviate from their current Air Traffic Control (ATC) clearance to the extent necessary to comply with an EGPWS warning.

– The Terrain Display is intended to be used as a situational tool only and may not provide the accuracy and/or fidelity on which to solely base terrain avoidance maneuvering.

– The use of predictive EGPWS functions should be manually inhibited during QFE operations if GPS data is unavailable or inoperative.

TRAFFIC ALERT AND COLLISION AVOIDANCE

The following limitations are applicable to the Traffic Alert and Collision Avoidance System (TCAS):

– Deviation from the ATC assigned altitude is authorized only to extent necessary to comply with a TCAS Resolution Advisory (RA);

– Maneuvers must not be based solely on information presented in the traffic display.

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FUEL

AIRPLANE MODEL	EMBRAER 190/195 ALL MODELS
Maximum usable quantity per wing tank	8076.3 ℓ (6550 kg) [1]
Unusable quantity per wing tank	56.7 ℓ (46 kg) [1]

1. The weights above have been determined for an adopted fuel density of 0.811 kg/ℓ. Different fuel densities may be used provided the volumetric limits are not exceeded.

NOTE: Maximum fuel capacity is 16266 ℓ (13192 kg).

Maximum permitted imbalance between wing tanks..... 360 kg

FUEL SPECIFICATION

Brazilian Specification..... QAV1

ASTM Specification..... D1655-JET A AND JET A-1

American Specification..... MIL-T-83133A-JP8

FUEL ADDITIVES

For approved additives refer to the GE Specification D50TF2 Manual, latest revision.

FUEL TANK TEMPERATURE

Minimum..... -40°C

CROSSFEED OPERATION

Crossfeed Selector Knob must be set OFF during takeoff and landing.

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APU SUNDSTRAND APS 2300

OPERATIONAL LIMITS

PARAMETER	MIN	MAX
START:	-	-
TEMPERATURE	-54°C	[1]
ALTITUDE	-	30000 ft
OPERATION:	-	-
TEMPERATURE	[1]	[1]
ALTITUDE:	-	33000 ft
ELECTRICAL GEN	-	33000 ft
BLEED	-	15000 ft
TO ASSIST ENGINE START	-	21000 ft
ROTOR SPEED	-	108 %
EGT:	-	[2] [3]
START	-	1032°C
CONTINUOUS	-	717°C

1. APU temperature matches the Airplane Operational Envelope temperature.
2. In flight, there is no automatic shutdown if EGT exceeds the limits.
3. There is no time limitation for operating the APU on ground or in flight in the amber range between 662°C and 717°C.

APU STARTER LIMITS

Cooling period after each starting attempt:

First and Second Attempts..... 60 s OFF
Third Attempt..... 5 min OFF

APU APPROVED OILS

For APU Oil Types/Brands/Servicing refer to the APU Model Specification Manual (Hamilton Sundstrand, APU Model APS 2300) - ESR 1235, latest revision.

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ENGINE

Two General Electric CF34-10E6

OPERATIONAL LIMITS

►*CF34-10E6 engines with takeoff thrust time limited to 10 minutes OR POST-MOD SB 190-73-0004*

PARAMETER	MIN	MAX
N1	–	100%
N2	59.27%	100%
ITT:	–	–
Ground Start	–	740°C
Inflight Start		875°C
Normal Takeoff and Go Around	–	947°C [1] [2]
Maximum Takeoff and Go Around	–	983°C [1] [3] [4] [2]
Maximum Continuous	–	960°C
OIL PRESSURE	25 psi [5]	–
OIL TEMPERATURE:	–	–
Continuous	–	155°C

1. Time limited to 5 min.
2. ITT transients above the nominal ITT limits are allowed to Normal and Maximum takeoff, up to 5.5°C for 2 s, 4.4°C for 5 s, 3.6°C for 15 s and 2.4°C for 30 s.
3. The takeoff time limit is extended to 10 min with one engine inoperative for airplanes Post-Mod. SB 190-73-0004 or equivalent factory incorporated modification.
4. Automatically engaged mode in one engine inoperative or windshear conditions, when the thrust lever is in the TOGA position.
5. During starts with oil temperature below -22°C the minimum oil pressure is 5 psi, time limited to 2 min.

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STARTER

DRY MOTORING DUTY CYCLE LIMITS

Motoring Number	Maximum Time	Cool-Down Time
1	90 Seconds	5 Minutes
2 through to 5 [1]	30 Seconds	5 Minutes

1. After five sequential motorings, cycle may be repeated following a 15-minute cool-down period.

STARTING DUTY CYCLE LIMITS

Motoring Number	Maximum Time	Cool-Down Time
1 and 2	90 Seconds (On ground) 120 seconds (In-flight)	10 Seconds
3 through to 5	90 Seconds (On ground) 120 seconds (In-flight)	5 Minutes

NOTE:– For ground starts, the maximum cumulative starter run time per start attempt is 90 seconds (motoring plus start time).
– For in-flight starts, the maximum cumulative starter run time per start attempt is 120 seconds (motoring plus start time).

ENGINE APPROVED OILS

For Engines Oil Types/Brands/Servicing refer to the GE Specification D50TF2 Manual, latest revision.

ENGINE THRUST

Powerback is prohibited.

Operation at reduced takeoff thrust based on the assumed temperature higher than the actual ambient temperature is permissible if the airplane meets all applicable performance requirements at the planned takeoff weight and reduced thrust setting. The total thrust reduction must not exceed 25% of the full takeoff thrust. As a condition to the use of the reduced thrust procedures, operators must establish a means to ensure that the engines are capable of producing full takeoff thrust without exceeding any engine operating limits. Use of reduced takeoff thrust procedures is not allowed on runways contaminated with standing water,

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slush, snow, or ice, and are not allowed on wet runways unless suitable performance accountability is made for the increased stopping distance on the wet surface. Application of reduced takeoff thrust is always at the pilot discretion. When conducting a takeoff using reduced takeoff thrust, normal takeoff thrust may be selected at any time during the takeoff operation.

NOISE LEVELS

The following Effective Perceived Noise Levels (EPNL's) comply with, FAA Part 36, Appendix C, Stage 3 noise limits and were obtained by analysis of approved data from noise tests conducted under the provisions of ICAO Annex 16, Volume 1 - Chapter 3 and FAA Part 36.

For the airplanes equipped with both right and left hand side engines with the following reference:

– EBUCF34-10E6G07

The noise levels are presented in the following table:

NOISE LEVEL IN EPNdB

►*190 AR, CF34-10E6 engines, ANAC/TCCA/FAA certification*

CONDITION		
Flyover	**Lateral**	**Approach**
86.3	91.8	92.4

◄

Otherwise, the noise levels are:

NOISE LEVEL IN EPNdB

►*190 AR, CF34-10E6 engines, ANAC/TCCA/FAA certification*

CONDITION		
Flyover	**Lateral**	**Approach**
86.9	91.9	92.8

◄

The noise levels for EMBRAER 190 equipped with APU Hamilton Sundstrand APS 2300 and two GE CF34-10E6, were established as described below:

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– Flyover: at maximum takeoff weight, flap setting 1 and thrust power cutback;

– Lateral: at maximum takeoff weight, flap setting 1 and with all engines at maximum takeoff power setting;

– Approach: at maximum landing weight, 3° glide slope, Vref +10 KIAS and flap setting FULL.

No determination has been made by the Airworthiness Authority that the noise levels in this manual are or should be acceptable or unacceptable for operation at, into, or out of any airport.

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PRESSURIZATION

Maximum differential pressure:

– Up to 37000 ft..... 7.8 psi
– Above 37000 ft..... 8.34 psi
Maximum differential overpressure..... 8.77 psi
Maximum differential negative pressure..... -0.5 psi
Maximum differential pressure for Takeoff and Landing..... 0.2 psi

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ICE AND RAIN PROTECTION

OPERATION IN ICING CONDITIONS

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

On ground:

– The TO DATASET MENU on the MCDU must be set to ENG in the following cases when OAT is between 5°C and 10°C and:
  – if there is any possibility of encountering visible moisture up to 1700 ft AFE.
  – when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on engines, nacelles, or engine sensor probes.

– The TO DATASET MENU on the MCDU must be set to ALL in the following cases when OAT is below 5°C and:
  – if there is any possibility of encountering visible moisture up to 1700 ft.
  – when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on engines, nacelles, or engine sensor probes.

In flight:

– The engine and wing anti-ice systems operate automatically, in case of ice encounter when the ice protection mode selector is in the AUTO position. If both ice detectors are failed, the crew must set the mode selector to ON when icing conditions exist or are anticipated below 10°C TAT with visible moisture.

NOTE: – Icing conditions may exist whenever the Outside Air Temperature (OAT) on the ground or for takeoff, or Total Air Temperature (TAT) in flight, is 10°C or below and visible moisture in any form is present (such as clouds, fog with visibility of one mile or less, rain, snow, sleet, and ice crystals).

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– Icing conditions may also exist when the OAT on the ground and for takeoff is 10°C or below when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on engines, nacelles, or engine sensor probes.

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

WINDSHIELD WIPER OPERATION

Maximum Airspeed for Windshield Wiper Operation..... 253 KIAS

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NAVIGATION, COMMUNICATION AND AUTOPILOT

AUTOPILOT

Minimum Engagement Height..... 400 ft

Minimum Use Height..... 50 ft

NAVIGATION EQUIPMENT

– TAS, TAT and SAT information are only valid above 60 KIAS.

– While transmitting in VHF1 the standby magnetic compass indication is not valid.

– Baro altimeter minimums must be used for all Cat I approaches.

– Back course approaches using IESS are prohibited.

– The ACARS is limited to the transmission and receipt of messages that will not create an unsafe condition if the message is improperly received, unless they are verified per approved operational procedures.

INERTIAL REFERENCE SYSTEM

– The airplanes may be operated within the North and South magnetic polar cut-out regions specified in the table below, but IRS magnetic heading and track angle magnetic data will not be available.

MAGNETIC CUT-OUT REGIONS	LATITUDE	LONGITUDE
North	Between 73.125°N and 82°N	Between 80°W and 130°W
	North of 82°N	Between 0° and 180°W/E
South	Between 60°S and 82°S	Between 120°E and 160°E
	South of 82°S	Between 0° and 180°W/E

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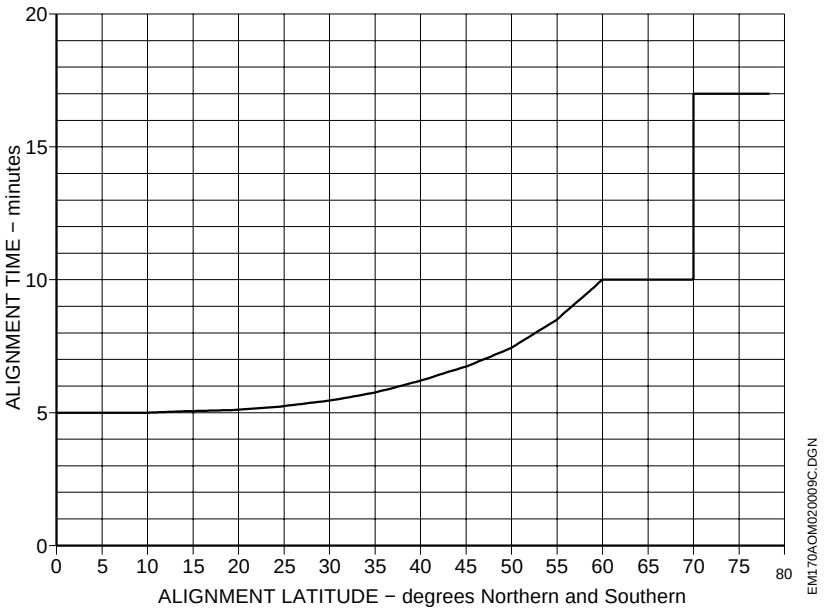
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NOTE: Whenever operating within North or South magnetic polar cut-out regions, current airplane heading must be referenced to true heading, if not already selected. Otherwise, the Heading Failure Indication flag will be displayed.

Maximum latitude for stationary alignment:..... 78.25° Northern and Southern

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

– Time to stationary alignment completion:



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CAT II LIMITATIONS

MINIMUM EQUIPMENT REQUIRED

The performance of CAT II approaches has been demonstrated to meet the airworthiness requirements of FAA AC 120-29A – Appendix 3 and CS AWO Subpart 2 requirement, when the following equipments are installed and operative:

– 2 Inertial Reference Systems;

– 2 Flight Director Systems;

– 2 Primary Flight Displays (PFD);

– Windshield Wipers;

– 2 VOR/ILS NAV System;

– 1 VHF/COMM System;

– 1 Radio Altimeter;

– 1 Ground Proximity Warning System (EGPWS);

– 2 Air Data System (ADS);

For CAT II operation with one engine inoperative, the following also applies:

– 1 Autopilot System Channel;

– Manual FD Category II ILS approaches are prohibited.

FLIGHT CONTROLS

CAT II is prohibited with the SPOILER FAULT EICAS message displayed.

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AUTOPILOT SYSTEM

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

NOTE: Coupled go-around height loss may be 50 ft.

APPROACH AND LANDING FLAPS

CAT II approach and landing must be performed with flaps 5.

MAXIMUM WIND COMPONENTS

This limitation applies to manual FD (Flight Director) approaches only.

Headwind..... 10 kt
Tailwind..... 5 kt

DEMONSTRATED WIND COMPONENTS

For manual FD (Flight Director) approaches:

Crooswind..... 16 kt

For coupled approaches:

Headwind..... 37 kt
Tailwind..... 15 kt
Crosswind..... 16 kt

These demonstrated values are not considered to be limiting.

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OZONE CONCENTRATION

The tables below show the airplane altitude limitations due to ozone concentration in atmosphere for airplanes not equipped with the Ozone Converters.

NOTE:
- These tables are based on FAA ADVISORY CIRCULAR 120.38.
- The tables show altitude limitations calculated for constant ozone concentration and cabin stabilized at 8000 ft.
- For conditions other than those specified in item 2 above, an optimized flight plan must be approved by regulatory agencies.
- For longitudes, the following apply:
  - W = Western
  - E = Eastern
  - Reference = 100° W longitude

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NORTH AMERICA - MAXIMUM OZONE CRITERIA

FLIGHT LEVEL	JAN		FEB		MAR		APR		MAY		JUN	
LATITUDE	W	E	W	E	W	E	W	E	W	E	W	E
80°N	-	323	-	323	-	314	-	313	-	307	-	326
75°N	-	327	-	323	-	321	-	314	-	314	-	327
70°N	-	341	-	323	-	326	-	321	-	314	-	334
65°N	356	346	333	326	328	327	328	321	326	321	338	336
60°N	376	356	347	336	338	334	327	326	327	326	341	336
55°N	394	362	376	346	347	341	327	334	327	327	347	356
50°N	407	376	409	362	366	346	327	336	334	336	356	366
45°N	-	396	-	376	376	366	346	346	346	362	376	396
40°N	406	-	366	386	376	396	382	366	402	396	-	-
35°N	-	-	-	-	-	-	-	-	-	-	-	-

FLIGHT LEVEL	JUL		AUG		SEP		OCT		NOV		DEC	
LATITUDE	W	E	W	E	W	E	W	E	W	E	W	E
80°N	-	336	-	382	-	394	-	382	-	346	-	346
75°N	-	346	-	396	-	386	-	382	-	362	-	356
70°N	-	346	-	406	-	396	-	382	-	382	-	356
65°N	346	356	396	406	406	406	382	394	406	386	376	366
60°N	347	366	402	-	-	-	396	401	407	394	386	382
55°N	356	382	406	-	-	-	-	-	407	401	401	396
50°N	366	406	-	-	-	-	-	-	-	406	-	-
45°N	-	-	-	-	-	-	-	-	-	-	-	-
40°N	-	-	-	-	-	-	-	-	-	-	-	-
35°N	-	-	-	-	-	-	-	-	-	-	-	-

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NORTH AMERICA - TWA OZONE CRITERIA

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

FLIGHT LEVEL	JAN		FEB		MAR		APR		MAY		JUN	
LATITUDE	W	E	W	E	W	E	W	E	W	E	W	E
80°N	-	274	-	270	-	270	-	270	-	270	-	270
75°N	-	278	-	274	-	270	-	270	-	270	-	270
70°N	-	292	-	274	-	270	-	270	-	270	-	274
65°N	312	294	298	270	301	273	292	270	270	270	303	274
60°N	321	298	311	278	303	291	274	270	270	270	311	274
55°N	332	298	321	292	311	291	270	274	270	270	311	292
50°N	338	312	354	298	315	298	270	274	274	274	311	312
45°N	338	314	338	312	315	311	274	294	294	294	318	318
40°N	332	334	312	318	312	317	312	311	318	318	334	334
35°N	374	354	374	354	338	353	354	334	374	334	392	374

FLIGHT LEVEL	JUL		AUG		SEP		OCT		NOV		DEC	
LATITUDE	W	E	W	E	W	E	W	E	W	E	W	E
80°N	-	270	-	298	-	298	-	298	-	292	-	298
75°N	-	274	-	314	-	312	-	298	-	294	-	298
70°N	-	274	-	321	-	314	-	312	-	298	-	298
65°N	294	294	332	332	334	318	321	314	334	298	318	301
60°N	298	312	332	334	338	334	323	318	334	298	321	312
55°N	301	312	332	334	354	334	334	334	338	314	334	318
50°N	312	318	332	334	374	334	354	354	338	334	354	334
45°N	321	334	354	354	-	374	374	354	353	334	354	334
40°N	294	354	-	398	-	-	-	374	394	354	354	334
35°N	-	394	-	-	-	-	-	-	-	398	-	374

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FLIGHT MANAGEMENT SYSTEM

NAVIGATION OPERATIONAL APPROVALS

Honeywell Primus Epic FMS installation has been demonstrated to be capable of and has been shown to meet the requirements for the following operations:

– **Required Navigation Performance (RNP) Operations** – The FMS has been demonstrated compliant with the requirements of RTCA DO–283, Minimum Operational Performance Specification for Required Navigation Performance. The FMS has been demonstrated to provide a minimum RNP level of RNP 0.3, when operated according to the limitations and procedures described in FMS AFM supplement.
The airplane capability does not constitute RNP operation approval. The operators must be granted local approval to conduct RNP operations.

– **Navigation using GPS** – The FMS has been demonstrated compliant with the requirements of FAA AC90-94, regarding the use of GPS for IFR navigation in en-route, terminal, and non-precision approach operations.

– **Navigation using IRS** – The FMS has been demonstrated compliant with the requirements of AC25-4, AC121-13, and FAR 121, Appendix G, regarding the use of IRS as a long range navigation system. Pilot qualification is required to comply with operation under AC121-13.

– **Remote/Oceanic Operation** – The FMS has been demonstrated compliant with the requirements of AC20-130A, regarding multi-sensor system operation in remote/oceanic flight, when operated as a dual system, with dual installed FMS, GPS, and IRS operational prior to the start of flight.
The FMS has been demonstrated compliant with the requirements of AC121-13 and FAR121, Appendix G, regarding use of IRS as a primary means of navigation in remote/oceanic flight, with dual installed FMS and IRS operational prior to the start of flight.
The FMS has been demonstrated compliant with the requirements of FAA Notice 8110.60, regarding use of GPS as a primary means of navigation in remote/oceanic flight, with dual installed FMS and GPS operational prior to the start of flight. Compliance with Notice 8110.60 also requires the operator to use the Honeywell Sure Flight Off Line

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RAIM and FDE prediction program prior to flight.

– **North Atlantic Minimum Navigation Performance Specification (NAT-MNPS) Airspace** – The FMS has been demonstrated compliant with the requirements of AC120-33 when operated as a dual system, with dual installed FMS, GPS , and IRS operational prior to the start of flight.

– **RNP-10 Airspace** – FMS has been demonstrated compliant with the requirements of FAA Order 8400.12A when operated as a dual system, with dual installed FMS, GPS, and IRS operational prior to the start of flight.

– **Enroute and Terminal Operation** – The FMS has been demonstrated compliant with the requirements of AC20-130A and AC25-15, regarding multi-sensor system IFR operation in en-route/terminal flight, with at least a single PFD, MFD, FMS, VOR, DME, and IRS in NAV mode operational prior to the start of flight.

– **Approach Operation** – The FMS has been demonstrated compliant with the requirements of AC20-130A and AC25-15, regarding multi-sensor system instrument non-precision approach operation. The FMS has been demonstrated compliant with AC90-94, regarding the use of GPS for non-precision approaches. The FMS must be operated as at least a single system, with a minimum of one PFD, MFD, and FMS operational prior to commencing the approach. The signal source(s) used to define the approach and on-board equipment must be verified operational prior to commencing the approach, as explained in the General Limitations of this AOM block.
The FMS supports the following non-precision approach types:

  – GPS only (type III FAA overlay definition);

  – RNAV (including type II or type III FAA overlay definition);

  – VOR;

  – VOR-DME;

  – NDB;

  – NDB-DME.

NOTE: VOR and NDB based approaches include FAA type II GPS overlays. AC90-94 deals with the use of GPS in the US National Airspace System (NAS). The general approval to use GPS to fly overlay instrument approaches as described in the AC, is initially

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limited to the NAS. Refer to General Limitations of this block, for use of GPS for non-precision approaches outside the US NAS.

– **Barometric Vertical Navigation** – For airplanes with VNAV enabled, the FMS has been demonstrated compliant with the requirements of AC20-129, regarding the barometric vertical navigation in en-route, terminal, and non-precision approach operations, when used in accordance with the limitations and operational procedures contained in the AFM FMS Supplement.

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

The FMS has been demonstrated compliant with the requirements of AC90-97, regarding the use of barometric vertical navigation for instrument approach operations using decision altitude, when used in accordance with the limitations and operational procedures contained in the AFM FMS Supplement.

◄

GENERAL LIMITATIONS

FMS PILOT'S OPERATING MANUAL

– Pilot's Operating Manual P/N A28-1146-179 or other approved manual must be available to the flight crew.

– The Pilot's Manual must match the FMS software version installed in the airplane.

FMS DATABASE/SOFTWARE VERSION

– Honeywell Primus Epic FMS software version installed must be that found on Limitations chapter of airplanes AFM.

– The Honeywell Primus Epic FMS Airplane Database configuration must be that found on Limitations chapter of airplanes AFM.

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NAVIGATION LIMITATIONS

– For operations using RNP 1 to RNP less than 2, the use of Flight Director is required.

NOTE: This applies to operations where RNP-1 is mandatory, including P-RNAV.

– For operations using RNP 0.3 to less than 1, the use of GPS and Flight Director is required.

NOTE: This applies to operations where RNP-0.3 is mandatory. Approach charts that contain the note “RNP-0.3 or GPS” do not constitute mandatory RNP operation.

– Operations requiring RNP less than 0.3 are not approved.

– For operations requiring RNP AR, Embraer General Publication GP-3801 must be used.

– The use of FMS speed guidance is prohibited when the FD vertical mode is standby.

– The use of speed mode in FMS is prohibited for one engine operative condition.

– The use of VNAV guidance is prohibited when the FD vertical mode is standby.

– The use of the VNAV guidance when the FD mode is other than VNAV is prohibited unless pilots set the ALT SEL to each waypoint altitude constraint required by the FMS entered procedure.

– The use of GPS is limited to areas where GPS is approved. Deselection of GPS should be performed in other non-approved areas.

– Prior to flight using the FMS for IFR navigation, a minimum of one VOR, DME, and IRS must be verified to be installed and operational. Also, any appropriate ground facilities (VOR, DME) that are utilized by the procedures to be flown must be verified as operational using an approved method (NOTAM, etc.).

– If GPS RAIM is annunciated as not available during terminal, enroute,

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or remote/oceanic operation, the pilot must monitor FMS guidance data and crosscheck against raw data from an alternate source (i.e. VOR, DME, or IRS).

– Due to priority use of GPS by the FMS, IFR Navigation using the FMS is limited to use with procedures that are referenced to the WGS-84 or NAD-83 datum, unless other appropriate authorized procedures are used.

– IFR Navigation using the FMS is prohibited unless the pilot verifies the currency of the selected navigation database cycle on the NAV IDENT page.

– IFR Navigation using the FMS is limited to geographic regions contained within the navigation database that is installed in the airplane.

– Operation above 72° 30.0' north latitude and below 59° 30.0' south latitude is prohibited due to unreliable magnetic heading, unless at least one Inertial Reference System (IRS) is verified operational as a sensor to the FMS.

– FMS performance management calculations have not been certified by the Airworthiness Authority. FMS performance management information is advisory information only, and may not be used as a basis for fuel load planning or airplane range predictions.

– Selection of FMS Position Update is prohibited during RNP operations, including RNP-10 operations.

– The use of the Step Climb function is prohibited.

– The selection of course interception to a conditional waypoint (waypoints created automatically by FMS that is not part of nav database, i.e. TOC) is prohibited.

– FMS LNAV may command bank angles above the local regulations limits (i.e. There is no automatic protection for engine out situation).

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APPROACH LIMITATIONS

– ILS, LOC, LOC-BC, LDA, SDF, GLS, MLS, Visual, and Radar approaches, using the FMS as the navigation source for guidance, are prohibited.

– FMS instrument approaches must be accomplished in accordance with approved instrument approach procedures that are retrievable from the FMS navigation database (as displayed on the APPROACH page on the MCDU). The pilot must review the complete procedure, comparing the waypoints, speeds, and altitudes displayed on the FMS with those on the published procedure charts. If any doubt exists about the integrity of the coded procedure, the procedure should not be used.

– Prior to commencing and during the final approach, the APPR annunciator must be visible on the PFD. If the APPR annunciator is not visible, and the appropriate runway visibility indications are not observed, the pilot should request a missed approach.

– When using FMS guidance to conduct an instrument approach procedure that does not include GPS in the title of the published procedure, the flight crew must verify that the procedure specified navaids(s) and associated avionics are operational (i.e. VOR, DME, ADF). If GPS RAIM is annunciated as not available during the approach, the pilot must monitor FMS guidance data and crosscheck against raw data from the alternate source(s).

– When a GPS Only Approach is planned (GPS only in title or GPS required by operational rules), prior to dispatch, the crew is required to verify that the predictive RAIM at the destination ETA is within the approach criteria. This information (RAIM AVAILABLE), is displayed on the PREDICTIVE RAIM page on the MCDU.

– When the reported station temperature exceeds the limits published in the approach chart, the use of VNAV barometric procedures are prohibited unless the pilot uses the VNAV temperature compensation function.

– The pilot must rely on the altimeter as the primary vertical reference during the final approach segment, including step down fixes. VNAV path guidance is supplementary guidance information.

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– Use of VNAV guidance below the published approach minimums is prohibited.

►*Airplanes Pre-mod MAU load 21.4*

– When using VGP, use of Temperature Compensation is prohibited. ◄

►*Airplanes Post-mod MAU load 21.2 and Pre-mod MAU load 21.4*

– VGP approaches are prohibited. ◄

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ELECTRONIC FLIGHT BAG (EFB)

This supplement contains additional information about the use and operational approval of the EFB applications.

SOFTWARE APPLICATIONS

Operators will be responsible to select, install and manage the applications and functionalities used in the EFB platform.

Operators are solely responsible for:

- Selection of applications to be used;
- Installation of applications and functionalities and;
- Management of the update process for each application.

APPROVAL OF THE APPLICATIONS AND PROCEDURES TO MANAGE THEM

It is the operators responsibility to obtain approval from the local authority for use of the EFB including:

- Installation process;
- Software application functionalities and;
- Update process.

The selection of applications and their operational approvals process shall be based on applicable regulations such as the TGL-36 and AC120-76A, referring to this platform as a Class II EFB System.

INFORMATION INTEGRITY

The information provided by the Class II EFB platform shall be considered advisory only and should not be used in place of any primary flight display.

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HARD COPY QRH

The QRH with the latest revision incorporated must be on board in hard copy format.

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RVSM OPERATION

MINIMUM EQUIPMENT REQUIRED

During RVSM operation it is necessary that the following equipment and instruments be in proper operating condition:

– 2 RVSM Compliant Air Data Systems;

– 1 Autopilot with Altitude Hold Mode operative;

– 1 Altitude Alerter;

– 1 Transponder.

NOTE:
- The ADS 1, ADS 2 and ADS 3 are compliant with RVSM operation.
- The ADS 3 is not considered RVSM compliant in case of loss of sideslip compensation, i.e., with the EICAS message ADS 3 SLIPCOMP FAIL displayed.
- The IESS must not be used for RVSM operation.
- Should any of the required equipment fail prior to the airplane entering RVSM airspace, the pilot should request a new clearance to avoid entering this airspace.
- An operating transponder may not be required for entry into all designated RVSM airspace. The operator should determine the requirement for an operational transponder in each RVSM area where operations are intended. The operator should also determine the transponder requirements for transition areas next to RVSM airspace.

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SECTION 3

NORMAL PROCEDURES

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INTRODUCTION

NORMAL PROCEDURES

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

In case any discrepancy between a procedure contained in this section and the approved Airplane Flight Manual (AFM) occurs, the AFM procedures must be followed. In the event that any of the procedures is missing or unusable, operations may be continued provided the approved AFM is available for use.

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

NORMAL CHECKLIST

The normal checklist is just a memory aid to assist the pilots so they do not forget actions which, if not carried out, can result in some type of risk to the airplane, to any of its systems, to its occupants, to the operational environment or can affect passengers comfort. Specific regulations also ask for items to be included in the checklist.

The normal checklist is named and divided according to each specific phase of flight.

The normal checklist further assumes that the pilots previously accomplished the normal procedures.

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INTERNAL SAFETY INSPECTION

Maintenance Status..... CHECKED
Cockpit Emer Equip..... CHECKED
ELECTRIC Panel..... SET
FUEL Panel..... CHECKED
Windshield Wiper..... OFF
HYDRAULIC Panel..... CHECKED
AIR COND/PNEUMATIC Panel..... CHECKED
PASSENGER OXYGEN Panel..... CHECKED
ELT..... ARMED
Landing Gear Lever..... DOWN
START/STOP Selectors..... STOP
Speed Brake Lever..... CLOSED
RAT Manual Deploy..... STOWED
SLAT/FLAP Lever..... VERIFY POS
Circuit Breakers..... CHECKED

POWER UP

CAUTION: ENSURE THE AIRPLANE IS NOT MOVED BEFORE THE IESS IS INITIALIZED.

Battery 1..... ON

Battery 2..... AUTO

CAUTION: VERIFY THAT ONLY DISPLAYS 2 AND 3 ARE AVAILABLE. IF MORE THAN DISPLAYS 2 AND 3 ARE AVAILABLE, THE AIRPLANE MUST NOT BE DISPATCHED.

Battery Voltage..... CHECKED

GPU Button (if applicable)..... PUSHED IN

FIRE EXTINGUISHER Panel..... CHECKED

APU..... AS REQUIRED

NAV Light..... ON

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HYDRAULIC Panel..... AS REQUIRED
Electronic CBs..... CHECKED
Electronic Checklist (if applicable)..... CHECKED
DVDR Panel..... CHECKED
Cockpit Reinforced Door Panel (if applicable)..... CHECKED
Photoluminescent Strips..... CHECKED

BEFORE START

PASSENGER SIGNS Panel..... SET
PRESSURIZATION Panel..... SET
Oxygen Masks..... CHECKED
Flight Instruments..... X-CHECKED
Thrust Levers..... IDLE

.....

Fuel Quantity..... CHECKED
MCDU..... SET
TRIM Panel..... _SET/ZERO/ZERO

Doors & Windows..... CLOSED
Red Beacon..... ON
Emergency/Parking Brake..... AS REQUIRED

AFTER START

Ground Equipment..... REMOVED
SLAT/FLAP..... _SET
Flight Controls..... CHECKED

BEFORE TAKEOFF

Brakes Temperature..... CHECKED
EICAS..... CHECKED
Transponder..... TA/RA

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Takeoff Configuration..... CHECKED

AFTER TAKEOFF

Landing Gear..... UP
SLAT/FLAP..... 0

APPROACH

PASSENGER SIGNS Panel..... SET
Altimeters..... SET/X-CHECKED

BEFORE LANDING

Landing Gear..... DOWN
SLAT/FLAP..... _SET

SHUTDOWN

Emergency/Parking Brake..... SET
START/STOP Selectors..... STOP
Hydraulic Pump 3A..... OFF

LEAVING THE AIRPLANE

PASSENGER SIGNS Panel..... OFF
GPU/APU..... OFF
Batteries 1 and 2..... OFF

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INTERNAL SAFETY INSPECTION

The Internal Safety Inspection procedures must be performed before the Power Up on a particular airplane.

Maintenance Status..... CHECK

Cockpit Emergency Equipment..... CHECK

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

- Protective Breathing Equipment (PBE).
- Fire Extinguishers.
- Crash Axe.
- Life Vests.
- Escape Ropes.
- Flashlights.

ELECTRIC Panel..... SET

IDG 1 Selector..... AUTO

IDG 2 Selector..... AUTO

AC BUS TIES Selector..... AUTO

GPU Button..... PUSHED OUT

APU GEN Button..... PUSHED IN

TRU 1..... AUTO

TRU ESS..... AUTO

TRU 2..... AUTO

DC BUS TIES..... AUTO

Battery 1 Selector..... OFF

Battery 2 Selector..... OFF

►*190 Models Commercial Airplanes Non-ETOPS Configured - partially compliant or not at all compliant with FAA CMP-2925 or ANAC CMP-2356*

FUEL Panel..... CHECK

Verify all fuel pumps knobs in AUTO position and XFEED in the desired position.

◄

WINDSHIELD WIPER Selector..... OFF

HYDRAULIC Panel..... CHECK

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Verify:

SYS 1 ENG PUMP SHUTOFF Button..... PUSHED OUT

PTU Selector..... AUTO

SYS 2 ENG PUMP SHUTOFF Button..... PUSHED OUT

SYS 1 and 2 ELEC PUMP Selectors..... AUTO

SYS 3 ELEC PUMP A..... OFF

SYS 3 ELEC PUMP B..... AUTO

AIR COND/PNEUMATIC Panel..... CHECK

Verify all buttons pushed in and no striped bars illuminated.

PASSENGER OXYGEN Panel..... CHECK

Verify Masks Deploy Selector Knob in Auto.

ELT..... ARM

Landing Gear Lever..... DOWN

START/STOP Selectors..... STOP

Speed Brake Lever..... CLOSED

RAT Manual Deploy..... STOWED

SLAT/FLAP Lever..... VERIFY POSITION

Verify and make sure that the actual SLAT/FLAP Lever position agrees with the surface position.

Circuit Breakers..... CHECK

Verify both sidewall panels to ensure agreement with maintenance status.

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POWER UP

CAUTION: ENSURE THE AIRPLANE IS NOT MOVED BEFORE THE IESS IS INITIALIZED.

Battery 1..... ON

Battery 2..... AUTO

CAUTION:
- VERIFY THAT ONLY DISPLAYS 2 AND 3 ARE AVAILABLE.
- IF MORE THAN DISPLAYS 2 AND 3 ARE AVAILABLE, THE AIRPLANE MUST NOT BE DISPATCHED.

Batteries Voltage..... CHECK

CAUTION: EACH BATTERY VOLTAGE MUST BE AT LEAST 22.5 VOLTS.

IF BATTERIES VOLTAGE IS BETWEEN 21 VOLTS AND 22.5 VOLTS, RECHARGE THE BATTERIES PRIOR TO TAKEOFF, THROUGH ANY AC SOURCE (INCLUDING ENGINES DURING TAXI) FOR:
- 30 MINUTES IF BATTERIES TEMPERATURE IS AT OR ABOVE 0°C OR;
- 35 MINUTES IF BATTERIES TEMPERATURE IS AT OR ABOVE -5°C AND BELOW 0°C OR;
- 40 MINUTES IF BATTERIES TEMPERATURE IS AT OR ABOVE -10°C AND BELOW -5°C OR;
- 50 MINUTES IF BATTERIES TEMPERATURE IS BELOW -10°C.

IF BATTERIES VOLTAGE IS BELOW 21 VOLTS REPORT TO MAINTENANCE.

NOTE: – Minimize the time the airplane is left with batteries as the unique power source, to avoid discharging.

GPU Button (if applicable)..... PUSHED IN

Verify AVAIL light illuminated before pushing in. When GPU is not available, or is not necessary, maintain GPU Button pushed out.

NOTE: – The Electrical PBIT is automatically performed after the airplane is powered by any AC source and takes 3 minutes to complete. The Electrical PBIT will be interrupted if any electric hydraulic pump is running or if the FLIGHT

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CONTROL MODE Panel switches are cycled or if AC power is interrupted while the test is running.

– A FLT CTRL TEST IN PROG Status message is displayed to inform the pilot that the Electrical PBIT is in progress.
– If the displays 2 and/or 4 are configured as PFD, set the respective reversionary panel selector knob to MFD then to AUTO. After 8 seconds, the affected display configuration will return to MFD.

FIRE EXTINGUISHER Panel (Overhead)..... CHECK

Verify there are no fire protection fail messages displayed on the EICAS after Power Up.

Press and hold the TEST button and observe the following EICAS messages, lights and warnings:

– Aural warning.
– Fire handles illuminated.
– CARGO SMOKE FWD/AFT Buttons illuminated.
– APU Button illuminated.
– Upper half of the APU EMER STOP Button illuminated.
– WARNING lights flashing.
– ″CARGO AFT SMOKE″ EICAS message.
– ″CARGO FWD SMOKE″ EICAS message.
– ″APU FIRE″ EICAS message.
– ″ENG 1 FIRE″ EICAS message.
– ″ENG 2 FIRE″ EICAS message.
– ″FIRE″ warning annunciation displayed inside ITT indicators.

APU Selector Knob..... AS REQUIRED

Verify EMER STOP Button is pushed out and not illuminated.

NOTE: If AC source is lost due to unintentional GPU or APU generator disconnection, power down the airplane and perform the power up procedure.

Navigation Light..... ON

HYDRAULIC Panel..... AS REQUIRED

Only after the electrical PBIT is completed and if the FLT CTRL BIT EXPIRED EICAS message is displayed perform the hydraulic panel checks.

– Do not move any flight control surface;
– Turn the Electrical Hydraulic Pumps 1, 2 and 3A to ON;
– Wait 1 minute. At this point the FLT CTRL BIT EXPIRED EICAS message should extinguish;
– Turn Electrical Hydraulic Pumps 1 and 2 to AUTO and 3A to OFF.

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The FLT CTRL TEST IN PROG Status message is displayed while hydraulic PBIT is in progress.

If the FLT CTRL BIT EXPIRED EICAS message is still displayed, power down the airplane and perform a power up procedure.

Electronic CBs..... CHECK

- Select CB OUT/LOCK page on the MCDU and check the CBs status to ensure agreement with maintenance status.
- Press the NEW TRIP prompt on the MCDU to check the electronic CBs status.

Electronic Checklist (if applicable)..... CHECK

Verify that this ECL database corresponds to the paper QRH revision present in the cockpit.

DVDR CONTROL Panel..... CHECK

Press the test button and verify no fail messages displayed on EICAS.

Electronic Flight Bag..... ON

Cockpit Reinforced Door Panel..... CHECK

- Close the cockpit door;
- Press the TEST Button on the COCKPIT DOOR Panel;
- Check the aural and UNLOCKED indication on;
- Push in the LOCK Button and check the electromechanical latch normal operation;
- Press the EMERG CALL Button on the door control panel in the passenger cabin and check normal operation;
- Push out the LOCK Button.

Photoluminescent Strips..... CHECK

Be sure that at least 15 min of ceiling and entrance lighting exposure in bright or daylight to charge the photoluminescent strips.

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EXTERNAL INSPECTION

While conducting the external inspection, be aware of moving vehicles around the airplane and surroundings.

In case of suspicious object is identified, inform immediately the security staff.

Prior to starting the external inspection:

External Lights..... AS REQUIRED

If the external lights check was not performed by the maintenance, turn the external lights ON and check them. Turn the lights OFF immediately after checking them.

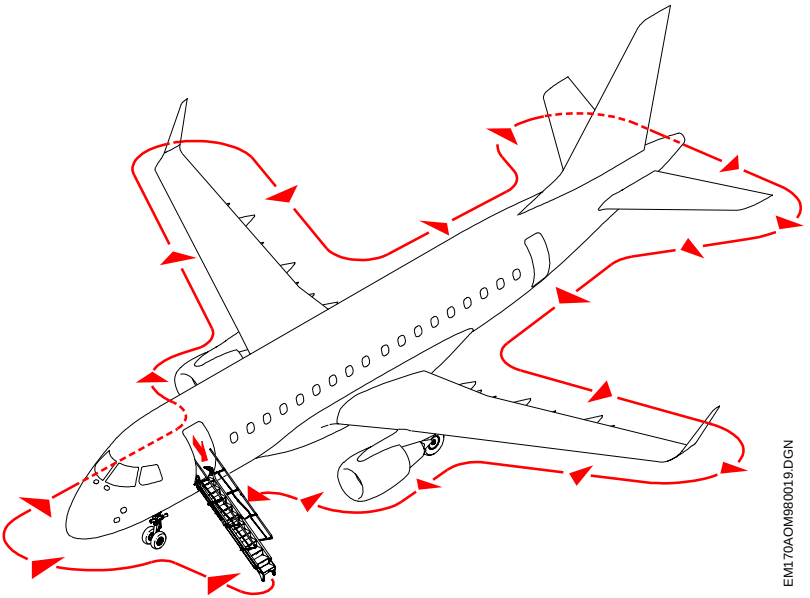
Emergency/Parking Brake..... ON

Check if there is sufficient hydraulic pressure to activate the Emergency/Parking Brake to check the Brake Wear Indicators.

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Recommended walk-around sequence

LEFT FWD FUSELAGE

FWD Pax Door..... CHECK

External Power Receptacle..... SECURED

Left Smart Probes/TAT Sensor/Ice Detector..... CHECK

Verify condition with no obstructions, covers or damage.

NOSE SECTION

Windshield Wipers..... CHECK

Radome..... CHECK

Forward Avionics Compartment..... SECURED

If not in use, visibly secured.

Lower FWD Antenna..... CONDITION

Undamaged.

Nose Gear..... CHECK

Wheels and Tires..... CONDITION

Nose Gear Up Lock Hook..... UNLOCKED

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Nose Gear Strut/Wheel Well/Doors..... CONDITION, NO LEAKS

Ground Locking Pin..... REMOVED

Landing and Taxi Lights..... CONDITION

Clean and undamaged.

RIGHT FWD FUSELAGE

Right Smart Probes/TAT Sensor/Ice Detector..... CHECK

Verify condition with no obstructions, covers or damage.

RAT Safety Lock Pin..... REMOVED

FWD Service Door..... CHECK

If not in use, visibly secured.

Oxygen Discharge Indicator..... GREEN DISC

Lower FWD Antennas/FWD Drain Mast..... CONDITION

Undamaged.

FWD Cargo Door..... CHECK

If not in use, visibly secured.

Wing Inspection Landing and Taxi Lights..... CONDITION

Clean and undamaged.

Right Ram Air Inlet/Air Inlets and Outlets..... NO OBSTRUCTION

No obstruction or damage.

Lower Red Beacon Light..... CONDITION

Clean and undamaged.

Collector Tank Water Drain Valve Door..... SECURED

If not in use, visibly secured.

Wing Tank Water Drain Valve..... CONDITION, NO LEAKS

RIGHT WING

Wing Leading Edges..... CONDITION

Pylon..... CONDITION

Thrust Reverser Cowl..... FLUSHED WITH NACELLE

RH 1 and RH 2 Magnetic Level Indicators..... PUSHED IN, NO LEAKS

Engine..... CHECK

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Check engine for leaks, damage, FO's in the air inlets and exhaust and check access panels secured.

RH 3 Magnetic Level Indicators..... PUSHED IN, NO LEAKS

Refueling Compartment Door..... SECURED

Access Doors and Panels..... SECURED

Pressure Relief Valve..... CHECK

Wing Vents..... NO OBSTRUCTION

Navigation and Strobe Lights..... CONDITION

Clean and undamaged.

Static Dischargers..... NUMBER AND CONDITION

Verify 3 static dischargers on the aileron and 6 static dischargers on the winglet. Refer to the CDL for dispatch with missing items.

Flight Control Surfaces and Fairings..... CONDITION

Surfaces clear and unobstructed.

RIGHT MAIN GEAR

Wheels and Tires..... CONDITION

Main Gear Up Lock Hook..... UNLOCKED

Strut/Wheel Wells..... CONDITION, NO LEAKS

Ground Locking Pin..... REMOVED

Brakes Wear Indicators..... CHECK

RIGHT AFT FUSELAGE

Access Doors and Panels..... SECURED

If not in use, visibly secured.

Drain Mast..... CONDITION

No obstruction or damage.

AFT Cargo Door..... CHECK

If not in use, visibly secured.

AFT Service Door..... CHECK

If not in use, visibly secured.

Lower AFT Antennas/AFT Drain Mast..... CONDITION

Undamaged.

Battery Air Outlet..... NO OBSTRUCTION

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No obstruction or damage.

TAIL SECTION

Flight Control Surfaces..... CONDITION

Surfaces Clear and Unobstructed.

Empennages Leading Edges..... CONDITION

Static Dischargers..... NUMBER AND CONDITION

Verify 4 Static Dischargers on the rudder, 3 on each elevator, 3 on each horizontal stabilizer and 1 on vertical stabilizer. Refer to the CDL for dispatch with missing items.

APU..... CONDITION

LEFT AFT FUSELAGE

APU External Power Receptacle..... CHECK

If not in use, visibly secured.

Overboard Vent..... NO OBSTRUCTION

No obstruction or damage.

Pressurization Static Port..... NO OBSTRUCTION

No obstruction or damage.

Potable Water Service Panel..... SECURED

If not in use, visibly secured.

AFT Pax Door..... CHECK

If not in use, visibly secured.

Lower AFT Antennas..... CONDITION

Undamaged.

Access Doors and Panels..... SECURED

If not in use, visibly secured.

LEFT MAIN GEAR

Wheels and Tires..... CONDITION

Main Gear Up Lock Hook..... UNLOCKED

Strut/Wheel Wells..... CONDITION, NO LEAKS

Ground Locking Pin..... REMOVED

Brakes Wear Indicators..... CHECK

LEFT WING

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Flight Control Surfaces and Fairings..... CONDITION

Surfaces clear and unobstructed.

Static Dischargers..... NUMBER AND CONDITION

Verify 3 static dischargers on the aileron and 6 static dischargers on the winglet. Refer to the CDL for dispatch with missing items.

Navigation, Strobe Lights and Upper Beacon Lights..... CONDITION

Clean and undamaged.

Upper Antennas..... CONDITION

Undamaged.

Wing Vents..... NO OBSTRUCTION

Pressure Relief Valve..... CHECK

Access Doors and Panels..... SECURED

Wing Leading Edges..... CONDITION

LH 3 Magnetic Level Indicators..... PUSHED IN, NO LEAKS

Engine..... CHECK

Check engine for leaks, damage, FO's in the air inlets and exhaust and check access panels secured.

LH 2 and LH 1 Magnetic Level Indicator..... PUSHED IN, NO LEAKS

Thrust Reverser Cowl..... FLUSHED WITH NACELLE

Pylon..... CONDITION

LEFT FWD FUSELAGE

Landing, Taxi and Wing Inspection Light..... CONDITION

Clean and undamaged.

Left Ram Air Inlet/Air Inlets and Outlets..... NO OBSTRUCTION

No obstruction or damage.

Wing Tank Water Drain Valve..... CONDITION, NO LEAKS

Clean and undamaged.

Collector Tank Water Drain Valve Door..... SECURED

If not in use, visibly secured.

Air Conditioning Connection Access Door..... CHECK

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No obstruction or damage.

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BEFORE START

Airplane Manuals & Documents..... ON BOARD

Check all the required documents including:
- Technical Log.
- AOM.
- QRH.
- Airworthiness Certificate.
- Weight and Balance.
- Radio Station Certificate.
- Navigation Kit.

Jump Seat Oxy Masks, Regulators and Audio Panel..... CHECK

Carry out the test as follows:
- Set the regulator control knob to ″100%″.
- Press and hold the ″TEST/RESET″ Button.
- Verify a short illumination or ″blink″ of the flow indicator.
- Verify audible oxygen flow in the headset or loudspeakers.
- Once the mask fully pressurizes the indicator must go out, showing that the system is leak free.
- Release the ″TEST/RESET″ Button.

ELECTRIC Panel..... SET
- IDG 1 and IDG 2 Selectors AUTO.
- AC BUS TIES Selector AUTO.
- GPU push button AS REQUIRED.
- APU GEN button PUSHED IN.
- TRU 1 AUTO.
- TRU ESS AUTO.
- TRU 2 AUTO.
- DC BUS TIES AUTO.
- Battery 1 Selector ON.
- Battery 2 Selector AUTO.

COCKPIT LIGHTS Panel..... AS REQUIRED
- Adjust Main Panel, Overhead Panel and Pedestal lights.
- Push ANNUNCIATORS TEST button and verify all associated lights.
- Set DOME light as required.

Engine 1 Fire Handle..... STOWED

FUEL Panel..... SET
- FUEL XFEED Selector knob on the desired position.

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– DC PUMP Selector knob on AUTO position.
– AC PUMP 1 and AC PUMP 2 Selectors AUTO.

PASSENGER SIGNS Panel..... SET
– Set Emergency Lights selector ON and verify the EMER LT ON and EMER LT NOT ARMED messages displayed on the EICAS.
– Emergency lights selector ARMED.
– NO SMKG and FSTN BELTS ON.
– STERILE light as required.

FIRE EXTINGUISHER Panel (Overhead)..... CHECK
– Cargo Smoke FWD/AFT buttons pushed out and not illuminated.
– APU Fire Extinguishing button pushed out and not illuminated.

APU CONTROL Panel..... AS REQUIRED

EMER STOP Button pushed out and not illuminated.

EXTERNAL LIGHTS Panel..... AS REQUIRED

Engine 2 Fire Handle..... STOWED

HYDRAULIC Panel..... CHECK/SET
– Verify ENG PUMP SHUTOFF 1 and 2 shutoff buttons with no lights and guarded.
– Verify PTU Selector to AUTO.
– Verify the HYDRAULIC SYS 1 and HYDRAULIC SYS 2 ELEC PUMPs to AUTO.
– Verify the HYDRAULIC SYS 3 ELEC PUMP A to OFF.
– Verify the HYDRAULIC SYS 3 ELEC PUMP B to AUTO.

PRESSURIZATION Panel..... SET
– CABIN ALT Selector STOP.
– MODE Selector AUTO.
– LFE Selector STOP.
– DUMP Button, no lights and guarded.

WINDSHIELD HEATING Button..... PUSHED IN

ICE PROTECTION Panel..... SET
– WINDSHIELD/ENGINE buttons pushed in.
– MODE selector AUTO.
– WING Button pushed in.
– TEST selector OFF.

AIR COND/PNEUMATIC Panel..... SET
– Cockpit and passenger cabin temperature control as required.
– RECIRC, PACK 1, PACK 2, XBLEED, APU BLEED, BLEED 1 and BLEED 2 Buttons pushed in.

PASSENGER OXYGEN Panel..... SET
– Mask Deploy Selector Knob AUTO.
– MASK DEPLOYED indicator no light.

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Oxygen Masks & Regulators..... CHECK/100 %

Check masks for oxygen supply and for microphone functionality. Verify also the observer's mask.

The MFD Status page must be checked and the available oxygen supply and pressure must be adequate for use.

Carry out the test as follows:
- Set the regulator controller to "100%".
- Press and hold the "TEST/RESET" button.
- Verify a short illumination or "blink" of the indicator.
- Verify audible pressurization in the headset.
- Once the mask fully pressurizes the indicator must go out, showing that the system is leak free.
- Release the "TEST/RESET" Button.

Glareshield Lights Control Panel..... AS REQUIRED

DISPLAY CONTROLLER Panel..... SET
- Set BARO SET knob to actual pressure.
- Push HSI button for Full Compass, ARC or MAP.
- Select the FMS or V/L as the primary NAV source.
- BRG circle (O) to OFF, VOR1, ADF1, FMS1, as required.
- BRG diamond (◊) to OFF,VOR2, ADF2, FMS2, as required.

REVERSIONARY Panel..... SET
- Displays selectors in AUTO.
- Sensors selectors (ADS/IRS) as required.

Flight Instruments..... SET/XCHECK

Verify:
- AIRSPEED TAPES not showing speed.
- EADIs leveled and flag-free.
- Initial assigned altitude on the ALT SEL.
- Altitude tape indications within limits.
- Both VSIs showing zero.
- EHSIs with the courses selected according to the intended departure procedure and NAV source selected.
- EHSIs and magnetic compass flag free and showing the same magnetic heading.
- HDG bug set according to the proposed departure procedure.
- Check IESS and adjust the altimeter setting.
- Weather set on PFD and/or MFDs MAP page as required.
- It is recommended that PNF sets the Terrain on MFD up to MSA.
- Set the MFDs MAP page menu as required.
- TCAS should be always displayed on both MFDs.

STATUS Page..... CHECK

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Verify on the status page ENG OIL LEVEL and BRAKES EMER ACCU pressure.

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

Autobrake..... RTO

◄

GND PROX TERR INHIB Button..... CHECK

Verify button pushed out and no striped white bar illuminated.

EICAS..... CHECK

Check EICAS messages to ensure agreement with airplane status.

Clock ..... SET

Select GPS on the GPS/INT/SET selector. If the clock displays dashes (-- -- --), adjust the clock INT position.

GND PROX G/S INHIB Button..... CHECK

Verify no striped white bar illuminated.

LG WRN INHIB Button..... CHECK

Verify no striped white bar illuminated.

FLIGHT CONTROLS MODE Panel ..... CHECK

Verify ELEVATORS, RUDDER and SPOILER Buttons guarded and no striped white bar illuminated.

SHAKER 1 and 2 CUTOUT Buttons..... CHECK

Verify the SHAKER 1 CUTOUT and SHAKER 2 CUTOUT buttons pushed out and no striped white bar illuminated.

IGNITION Selector Knobs..... AUTO

EICAS FULL..... CHECK

Verify the EICAS Full button in the desired position.

Speedbrake Lever..... CLOSED

Thrust Levers..... IDLE

GND PROX FLAP OVRD..... CHECK

Verify button pushed out, guarded and no striped white bar illuminated.

AUDIO CONTROL Panel..... AS REQUIRED

Select the microphone and audio reception buttons as required and adjust the volume levels. To avoid background noise do not set the SPKR volume higher than 55.

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TRIM Panel..... CHECK

Verify that ROLL, YAW and PITCH (Captain, First Officer and Backup) trims are operating properly both ways and check that Position Indication on EICAS changes accordingly. Verify system's 3 second protection working properly. Adjust YAW and ROLL trims to the neutral position and PITCH trim to the green band.

NOTE: The PITCH TRIM Backup Switch may be checked once a day only, by flight crew or maintenance personnel, at the operator's discretion.

Flight Controls DISCONNECT Handles..... CHECK

Alternate Gear Extension Compartment..... CHECK

Verify the alternate gear extension lever is fully down and the electrical override switch is in the "NORMAL" position.

MCDU..... SET

Insert route in the FMS according to the flight plan.

.....SHORTLY BEFORE STARTUP.....

Fuel Quantity..... CHECK

MCDU..... SET

– Complete and crosscheck FMS data.
– Select TAKEOFF DATASET MENU page on the MCDU and set the data below:
- Thrust Rate Mode (TO-1, TO-2 or, when applicable,TO-3).
- TO TEMP (__ºC).
- ATTCS (ON or OFF).
- REF ECS (ON or OFF).
- REF A/I (OFF, ENG or ALL).
- FLEX T/O (ON or OFF).
- FLEX TEMP (__ºC).
- Press ENTER Prompt to confirm the settings.

– Set the Performance initialization data on PERF INIT page. If it is already available enter the zero fuel weight, the total fuel on board, and press CONFIRM INIT prompt on page 3/3.
– Select TAKEOFF page 3/3 on the MCDU. Set or verify airplane configuration, performance data and takeoff speeds.
– Select the LANDING page on the MCDU and set landing speeds for the takeoff weight.
– Select RADIO page 1/2 and insert assigned transponder code.

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►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

SPEED Selector Knob..... SET

At pilot's discretion set the SPEED Selector knob to FMS or MANUAL.

In case of Noise Abatement procedure set V_2+10.

◄

TOGA Button..... PRESS

TRIM Panel..... SET/ZERO/ZERO

Set the PITCH trim according to load sheet and verify YAW and ROLL trims to the neutral position.

Doors and Windows..... CLOSED

Verify that the cockpit windows are closed and check all airplane doors closed indications on MFD status page. It is recommended to assure that escape slides are armed.

Check the cockpit door securely closed.

Takeoff Briefing..... COMPLETED

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

Red beacon..... ON

Electric Hydraulic Pump 3A..... ON

Ground Equipment..... AS REQUIRED

If performing a push back assure that the ground equipment not used for this procedure is removed.

Emergency/Parking Brake..... AS REQUIRED

Verify if the Emergency/Parking Brake is set in accordance with the engine start procedures.

Steering Disengage Switch..... PRESS

Verify the STEER OFF message displayed on the EICAS.

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ENGINE START

BASIC STATEMENT

NOTE: – Engine start can be done simultaneously with push back, requiring the parking brake released and disengagement of the steering (verify EICAS message STEER OFF). In case of a static engine start be sure that the parking brake is set.
– Check if the jet way and stairs are removed and the doors are closed.
– Obtain ATC and ground clearance.
– Confirm nose gear green towing light prior to start pushback with the ground personnel.

ENGINE WARMUP

In order to allow thermal stabilization of the engines, operate them at or near IDLE for at least 2 minutes before selecting high trust settings. Taxi time at or near IDLE can be included in the warm up period.

NO BREAK POWER TRANSFER (NBPT)

To avoid power interruptions it is recommended to wait 30 s after the %N2 stabilizes before shutting the APU down or GPU disconnection, or to use the Electrical Synoptic Page to follow the power transfer.

ENGINE VIBRATION

During the first minute after engine start, the vibration level amber band will start at 5.0 instead of 4.0 units, as long as the thrust levers are kept at IDLE.

ABNORMAL ENGINE START INDICATIONS

Although FADEC provides automatic over-temperature protection and will automatically abort the start in the event of a hot start or hung start, the engine start must be manually aborted when:

– No positive oil pressure indication by the time N2 has increased to idle.

– No ITT indication within 5 s (on ground) or 30 s (in flight) after fuel is applied.

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– ITT rapidly increasing or exceeding start limit (740°C - Hot start).

– If oil pressure stabilizes below the engine limits.

– N1 and/or N2 failing to accelerate to stable idle speed (hung start).

– An intermittent electrical pneumatic or starter malfunction occurs before the starter disengagement.

NOTE: In case an automatic abort occurs or engine start is manually aborted due to abnormal engine indications, its cause must be investigated and corrected before further attempts to start the engines.

ENGINE START PROCEDURE

Associated START/STOP Selector..... START, then RUN

Hold the selector knob at START position for at least 2 s.

During ground starts only, the transition of the cockpit START/STOP switch from STOP to START must be less than 30 s or the FADEC will prevent an engine start until the switch is cycled through STOP.

Engine Parameters..... MONITOR

Repeat the sequence for the other engine.

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AFTER START

Ground Equipment..... REMOVED

Be sure that the emergency/parking brake is set and nose gear/RAT pins and ground equipment have been removed.

APU..... AS REQUIRED

Set APU ON or OFF according to the electrical and pressurization systems. The APU usage shall be defined for a specific operation in order to minimize the overall costs.

APU shutting down can only be performed after confirmation of the power transfer through the Electrical Synoptic page or wait 30 s after %N2 stabilizes.

N1 Target..... CHECK

The N1 target indication on the EICAS must be equivalent to the N1 target indication available via performance calculation.

Transponder..... AS REQUIRED

Select the transponder to TA/RA or in accordance with local requirements.

SLAT/FLAP..... SET__

Adjust SLAT/FLAP to a setting consistent with the intended takeoff configuration and performance.

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

If the SLAT/FLAP lever setting is different from the input made on TAKEOFF page 2/3 of the FMS the aural message “NO TAKEOFF FLAP” will sound during the takeoff configuration check.

◄

Flight Controls..... CHECK

Press the STEERING DISENGAGE SWITCH, check the control column and rudder pedals.

Flight controls should be checked for freedom of movement in a smooth and continuous manner.

A full green box indication on the synoptic page is not a requirement for a successful check.

– The flight controls check must be performed with the flight controls synoptic page displayed;
– Elevator - full up, neutral, full down and neutral;
– Aileron - full left, neutral, full right and neutral;
– Rudder - full left, neutral, full right and neutral;

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– Press the steering handle to engage the STEERING and select MAP on the MFD prior to start the taxi.

NOTE: – The Hydraulic PBIT starts when all the three hydraulic systems are pressurized and takes about one minute to complete. Performing the flight controls check while the Hydraulic PBIT is running may interrupt the PBIT.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

– FLT CTRL TEST IN PROG Status message is displayed while hydraulic PBIT is in progress.

◄

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BEFORE TAKEOFF

The Before Takeoff Procedures and checklist must be performed when cleared to line up on the runway. Use all available information such as heading and FMS course indication (PFD), lateral profile (MFD) and departure runway (MCDU) to ensure the airplane is at the assigned runway for takeoff.

Cabin Crew..... ADVISE

After receiving “Cabin OK” from the Purser, notify, via PA, the cabin crew: “Cabin Crew prepare for take-off”.

Lights..... ON

Turn on the landing and strobe lights. Whenever possible, turn off the nose taxi lights before proceeding to takeoff.

Brake Temperature..... CHECK

Brake temperature indication must be in the green range for takeoff.

EICAS..... CHECK

Check:
- No Warning and Caution EICAS messages displayed.
- Thrust Rate Mode: TO-1, TO-2 or, when applicable, TO-3.
- ATTCS ON or OFF.
- FLEX TEMP (__°C).

Transponder..... TA/RA

Takeoff Configuration..... CHECK

Press the T/O button and “TAKEOFF OK” synthetic message shall be heard.

NOTE: Arm the AT when the airplane is lined up and ready for takeoff.

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TAKEOFF

For tailwind value greater than 10 kt, Takeoff with tailwind above 10 kt procedure must be followed.

Thrust Levers..... TO/GA

Engine Parameters..... MONITOR

NOTE: During takeoff roll, after checking thrust levers to TO/GA, check N1 equal to N1 target and green ATTCS indication presented on EICAS if ATTCS ON is selected in MCDU.

At V_R rotate the airplane following the Flight Director guidance.

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

In case of Flight Director inoperative, rotate the airplane according to the takeoff pitch angle displayed on TAKEOFF page 3/3 on the MCDU.

◄

With Positive Rate:

Landing Gear..... UP

Minimum Airspeed..... V_2 + 10

TAKEOFF WITH TAILWIND ABOVE 10 KT

Autothrottle..... OFF

Brakes..... APPLY

Thrust Levers..... 60% N1

When engines stabilize at 60% N1:

Brakes..... RELEASE

Autothrottle..... AS REQUIRED

Thrust Levers..... TO/GA

Slowly advance the thrust levers to the TO/GA position or allow the autothrottle to do it.

Engine Parameters..... MONITOR

NOTE: During takeoff roll, after checking thrust levers to TOGA, check N1 equal to N1 target and green ATTCS indication presented on EICAS if ATTCS ON is selected in MCDU.

At V_R rotate the airplane following the flight director guidance.

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With positive rate of climb:

Landing Gear..... UP

Minimum Airspeed..... V_2 + 10

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AFTER TAKEOFF

This checklist should be initiated as soon as possible after FLAPS are retracted.

Landing Gear..... UP

Confirm the three white UP indications on the EICAS.

SLAT/FLAP..... 0

Select SLAT/FLAP to zero following F-Bug reference.

CLIMB

This procedure can be initiated as soon as the After Takeoff Checklist is completed.

APU..... AS REQUIRED

Set the APU ON or OFF according to the electrical and pressurization systems. The APU usage shall be defined for a specific operation in order to minimize the overall costs.

Air Conditioning & Press..... CHECK

Check for the proper air conditioning and pressurization settings and parameters.

.....At Transition Altitude.....

Altimeters..... SET & XCHECK

Set the altimeters to standard (as required by local regulations). The IESS altimeter must be set also.

.....Above 10000 ft AFE.....

FSTN BELTS..... AS REQUIRED

NO SMKG..... AS REQUIRED

Verify in accordance with local regulations.

External lights..... OFF

Upon passing 10000 ft AFE switch off the external lights according to the operating policies.

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DESCENT

Approach Briefing..... COMPLETE

- It is recommended to perform the approach briefing before the start of descent.
- The items to be covered are: inoperative airplane components, weather at destination/alternate airports, fuel status/delays, runway conditions, low visibility procedures, terrain/MSA, descent profile and missed approach procedures.
- If the destination airport runway is reported to be slippery or contaminated, it is necessary to discuss the outcome on the landing distance during the approach briefing. The same discussion is applicable if the crew has planned to use additional speed for the approach due to wind/gust conditions.
- If any failure that affects the required landing distance occurs in the final approach, consider a missed approach in order to better evaluate the situation and an appropriate runway length. Failures that affect the landing distance are commonly associated to brakes, ground spoilers and/or thrust reversers.
- A thorough understanding by the pilots of all the applicable approach charts and NOTAMs is essential, including taxi-in procedures.
- Both pilots should set RA/BARO minimums, pre-select radios and courses for the approach.
- With VNAV engaged, select the ALT SEL only to altitudes cleared by ATC.

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

AUTOBRAKE..... SET

Set the AUTOBRAKE OFF, LOW, MED or HI in accordance with the runway analysis calculations for landing. ◄

Landing Data..... SET

- Verify on the LANDING page 1/2 the expected landing weight. Select the LANDING page 2/2 and insert all data according to the type of approach and runway conditions and set V_{RF}, V_{AP}, V_{AC} and V_{FS}.

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APPROACH

PASSENGER SIGNS Panel..... SET

SPEED Selector Knob..... MAN

Altimeters..... SET & XCHECK

If flight is being conducted in ICAO airspace, set the altimeters to QNH when passing the Transition Level. Otherwise, set as required by local regulations.

Approach Aids..... SET & XCHECK

Verify that the frequencies and courses that were selected and pre-selected are correct for the intended approach.

If using preview mode to set the courses for final approach, assure that the course selected is the one desired (on-side or cross-side).

Pressing the preview button once displays the on-side course on PFD; pressing twice shows the cross-side course and a third time deactivates the preview mode.

Ensure that both PFDs are displaying appropriate information.

Also verify that the approach minimums and the FMS are properly selected for the type of approach in use.

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BEFORE LANDING

Lights..... AS REQUIRED

Whenever possible, keep the nose taxi lights off until landing.

Landing Gear..... DOWN

Slat/Flap..... SET

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GO AROUND

TOGA button..... PRESS
Thrust Levers..... TO/GA

Rotate or verify that autopilot rotates the airplane following the flight director guidance.

NOTE: In case of flight director is inoperative, rotate the airplane to 8° nose up.

Select flaps according to the table below:

Landing SLAT/FLAP	Go Around SLAT/FLAP
FULL	4
5	2

With positive climb:

Landing Gear..... UP

Minimum Airspeed..... V_{REF} + 20

At the acceleration altitude proceed as in a normal takeoff.

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AFTER LANDING

NOTE: Upon landing, thrust reversers should be set to MIN REV at 60 KIAS and be closed at 30 KIAS. During RTO the thrust reversers can be used until the airplane comes to a complete stop.

APU..... AS REQUIRED

Turns the APU On when it is required.

External Lights..... AS REQUIRED

Turn off the unnecessary lights.

Transponder..... AS REQUIRED

Select the transponder to STBY or in accordance with local requirements.

SLAT/FLAP..... 0

Select the SLAT/FLAP control lever to zero.

PITCH Trim..... SET

Set Pitch Trim to 2 UP.

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SHUTDOWN

Thrust Levers..... IDLE

It is recommended to keep the engine running at idle during 2 min to permit engine thermal stabilization prior to shutdown the engine. Time of operation at or near idle, such as taxiing, is included in this 2 min minutes period.

Emergency/Parking Brake..... SET

- Pull the Emergency/Parking Brake to the set position after airplane has stopped. Make sure that the airplane is static before doing so.
- Verify brakes temperature and if they are close to the cautionary range, release the Emergency/Parking Brake as soon as the chocks are on.

Electrical..... ON GPU/APU

- If APU GEN is not available, an AC GPU should be plugged in.
- Check the AVAIL light illuminated before pushing in the GPU button.
- To avoid power interruptions it is recommended to wait 5 s after GPU switch is pushed in or the APU is available to shut the remaining engine down, so as to allow No Brake Power Transfer completion.

START/STOP Selectors..... STOP

- The engines will not shut down with START/STOP Selectors unless Thrust Levers are first moved to IDLE. If STOP is selected before Thrust Lever is retarded to IDLE, momentarily cycle START/STOP Selector do RUN and back to STOP.

Electric Hydraulic Pump System 3A..... OFF

Red Beacon..... OFF

FSTN Belts..... OFF

Make sure that the scape slides are disarmed before turning OFF the fasten belts signs.

Turn FSTN BELTS switch to OFF after complete engine stop.

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LEAVING THE AIRPLANE

NOTE: This procedure applies when a power down is required.

PASSENGER SIGNS Panel..... OFF

Set all switches to OFF.

Electrical..... OFF GPU/APU

– If APU is available turn OFF the APU by selecting the APU selector knob to OFF. Wait until the APU shuts down and the label OFF is displayed before turning off the GPU and both batteries.
– If GPU is available push out the GPU button.

Batteries 1 & 2..... OFF

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MANUAL PRESSURIZATION OPERATION

Pressurization Mode Selector..... MAN

Cabin Altitude Controller..... AS REQUIRED

The airplane/cabin altitude conversion table must be consulted to determine the cabin altitude according to airplane altitude. Refer to the Quick Reference Handbook.

Check on the EICAS the proper cabin altitude, cabin rate and differential pressure values.

Selection to UP momentarily position causes an increase of cabin rate.

Selection to DOWN momentarily position causes a decrease in cabin rate.

At the traffic pattern altitude, slowly position the knob to full UP. The maximum differential pressure at takeoff and landing is 0.2 psi.

During descent the thrust levers should be moved as slowly as possible to prevent bumps.

ECS OFF TAKEOFF

The Engines or the APU can supply bleed air for the air conditioning packs during takeoff. To have an additional engine thrust during takeoff, the FADEC may send an ECS OFF signal to the AMS controller requesting that no air is extracted from the Engines and the bleed air for packs operation can be provided by the APU.

ECS OFF TAKEOFF PROCEDURE

On the MCDU Takeoff Data Set Menu the ECS ON or OFF option is displayed. Selecting ECS ON commands the ENG BLEED to remain ON and selecting ECS OFF commands the ENG BLEED to OFF until the first 500 ft AGL.

In order to maintain the airplane pressurized during the initial 500 ft when ECS is selected to OFF the use of APU BLEED is recommended.

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Following the procedure below, the ENG BLEED valves will remain closed and the APU BLEED valve will supply bleed air for PACKS operation during takeoff until 500 ft AGL. If APU BLEED is unavailable the PACKS will remain OFF until 500 ft AGL.

NOTE: The APU bleed cannot be used for the anti-ice system operation. If the REF A/I is set to ENG or ALL for takeoff or ice is detected during takeoff with APU BLEED, the APU BLEED VALVE will close and the PACKS will switch OFF.

Before Start:

On the MCDU Takeoff Data Set:

REF ECS..... OFF

After Start:

APU..... ON

After Takeoff

APU..... OFF

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ENGINE CROSSBLEED START

ENGINE START PROCEDURE

BEFORE START

Operating Engine Thrust Lever..... ADVANCE AS REQUIRED

The minimum recommended bleed duct pressure prior to start is 40 minus 0.5 psi for every 1000 ft above sea level.

Smoothly advance operating engine thrust lever to obtain the recommended duct pressure required. Check on STATUS synoptic page the bleed pressure before start.

Engine Start..... ACCOMPLISH

A bleed pressure drop is expected, but no thrust levers adjustment is necessary.

AFTER START

Thrust Levers..... AS REQUIRED

ENGINE GROUND PNEUMATIC START

Engine starts using pneumatic carts usually presents higher ITT values. Consider performing a crossbleed start on the second engine.

BASIC STATEMENTS

AIR CONDITIONING PACKS

Before connecting the ground pneumatic cart, the packs must be pushed out in order to avoid any cabin air contamination.

BLEED PRESSURE

The minimum recommended bleed duct pressure prior to start is 40 minus 0.5 psi for every 1000 ft above sea level. Check on STATUS synoptic page the bleed pressure before starting the engines.

ENGINE START PROCEDURE

BEFORE START

PACKS..... PUSHED OUT

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Ground Cart..... CONNECTED

Minimum duct pressure..... CHECK

Engine Start..... ACCOMPLISH

Ground Cart..... DISCONNECTED

AFTER START

PACKS..... PUSHED IN

ENGINE BATTERY START

This procedure allows engine starts with batteries as the only electrical power and a pneumatic source (i.e. HPU or APU bleed air).

Engine starts using pneumatic carts usually presents higher ITT value. Consider performing a crossbleed start on the second engine.

After completing the procedures herein described perform all applicable normal checklists.

Considerations about the logistic regarding passengers boarding and ground personal clearance must be taken into account prior to the engine start, according to local authority allowances.

BASIC STATEMENTS

AIR CONDITIONING PACKS

Before connecting the ground pneumatic cart, the packs must be pushed out in order to avoid any cabin air contamination.

BLEED PRESSURE

The minimum recommended bleed duct pressure is 40 minus 0.5 psi for every 1000 ft above sea level. Check on STATUS synoptic page the bleed pressure before starting the engines.

HYDRAULIC PUMPS

No hydraulic pump may be turned on for at least 3 minutes after AC power is established or, for airplanes Post-Mod. SB 190-31-0007 (Primus Epic Load 4.5) or an equivalent modification factory incorporated, the FLT CTRL TEST IN PROG Status message is no longer presented. Otherwise the electrical PBIT will not run.

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EICAS MESSAGES

Expect EICAS messages related to hydraulic system not being pressurized and PACKs being shutoff. Wait until the procedure is complete before acknowledging any EICAS message not related to an abnormal engine start.

ENGINE START PROCEDURE

BEFORE START

Perform the cabin inspection normally.

Battery 1..... ON

Battery 2..... AUTO

Batteries Voltage..... CHECK

FIRE EXTINGUISHER Panel..... CHECK

Hydraulic ENG PUMP SHUTOFF 1 and 2..... PUSH IN

Electric Hydraulic Pumps..... OFF

PACKS..... PUSH OUT

Pneumatic Source..... AVAILABLE

Minimum Duct Pressure..... CHECK

Ignition Selector Knob..... AUTO

Red Beacon..... ON

Engine Start..... ACCOMPLISH

Ground Cart (if applicable)..... DISCONNECTED

AFTER START

Ignition Selector Knob..... AUTO

.....Wait 2 Minutes.....

PACKS..... PUSH IN

After electrical PBIT is completed:

ENG PUMP SHUTOFF 1 and 2..... PUSHED OUT

Electric Hydraulic Pumps 1, 2 and 3B..... AUTO

Electric Hydraulic Pump 3A..... ON

Perform an engine crossbleed start on the second engine.

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MANUAL STARTER VALVE OPERATION

ENGINE START

Accomplish an engine start with the following differences:

Prior to turning the START/STOP selector to START coordinate with the ground personnel to open the Starter Control Valve (SCV) .

When N2 reaches 50% ask the ground personnel to close the SCV.

SINGLE ENGINE TAXI

To improve fuel savings a single engine taxi can be used, delaying the start of the second engine prior to takeoff and/or shutting one engine just after landing when taxiing in.

Single engine taxi should be avoided when operating under icing conditions because the engine nacelle anti-ice of the inoperative engine will be unavailable.

BASIC STATEMENT

When performing a single engine taxi with engine 2 running, the Electric Hydraulic Pump 1 Selector knob must be set to ON to ensure that the hydraulic system 1 is pressurized.

Additional considerations should be taken into account to evaluate the viability of this procedure.

TAXI OUT

When taxiing out, check if the following statements permit the single engine taxi.

- Ramp gradient: positive ramp gradients demand more power.
- Ramp weight: heavier aircrafts demand more power.
- Taxi time to active runway.
- Engines warm up.

If performing the Flight Controls check during Single Engine Taxi, check one surface at a time (aileron, rudder or elevator) to avoid spurious FLT CTRL NO DISPATCH message display.

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SECOND ENGINE START

The engine start should be preferably performed with the airplane static to avoid heads down condition during taxi.

Prior to takeoff, the second engine warm up cycle must be performed:

- Keep the engine running at or near IDLE for at least 2 minutes before selecting high trust settings.

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TAXI IN

When taxiing in, engines cool down cycle must be performed:

– Keep engines running for at least 2 minutes after IDLE thrust has been set before engine shutdown to allow engine thermal stabilization.

ENGINE 2 SHUTDOWN

The APU start cycle must be performed as follows:

– The APU start must be accomplished with the engine 2 running or after the engine 2 shutdown cycle has been completed.

This procedure is necessary to ensure that battery 2 is available to the airplane's electrical network as a back-up and not isolated for APU start only.

ENGINE 1 SHUTDOWN

In order to maintain hydraulic pressure on both brake systems the Electric Hydraulic Pump 1 must be kept ON throughout the taxi.

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SINGLE ENGINE TAXI PROCEDURE

TAXI OUT

After one engine start up:

Before starting taxi out with engine 2 running:

Electric Hydraulic Pump 1 Selector knob..... ON

At approximately 2 minutes from take off:

Second engine start..... ACCOMPLISH

Electric Hydraulic Pump 1 Selector knob..... AUTO

After start procedure..... ACCOMPLISH

TAXI IN

APU..... AS REQUIRED

Electric Hydraulic Pump 1 or 2 Selector knob..... ON

START/STOP Selector..... STOP

►*MAU load 4.5 and on*

TAXI IN

APU..... AS REQUIRED

Before shutting down engine 1 during taxi in:

Electric Hydraulic Pump 1 Selector knob..... ON

After engines shutdown:

Electric Hydraulic Pump 1 Selector knob..... AUTO

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BOUNCED LANDING RECOVERY

The key factor for a successful landing is a stabilized approach and proper thrust/flare coordination. Do not extend the flare at idle thrust as it will significantly increase landing distance. Reducing to idle before the flare will also require an increase in pitch. Flaring high and quickly reducing thrust to idle can cause the plane to settle abruptly. Do not apply stabilizer trim during the flare.

When a light bounce occurs, maintain or re-establish a normal landing attitude. Increasing pitch can lead to a tail strike. Beware of the increased landing distance and use power as required to soften the second touchdown. When a more severe bounce occurs, initiate a go around – do not attempt to land. Press the go-around button and advance thrust levers to TOGA. Hold the flare attitude until the engines spool up and reset stabilizer trim, then follow normal go-around procedures.

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HOT WEATHER OPERATION

The following procedures will improve cockpit and cabin cooling during ground operations:

Recirculation Fan Button..... PUSHED IN

Cockpit/Passenger Temperature Controllers..... MAX COLD

- When possible apply cool air from the air conditioning cart when engine is shutdown.
- All doors and windows must be kept closed as much as possible.
- Open all passenger cabin gasper and cockpit outlets.
- Close all window shades on the sun-exposed side of the cabin.

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ICING CONDITIONS, COLD WEATHER AND COLD SOAK OPERATIONS

This Section contains amplified procedures to operate in icing, cold weather and cold soak conditions and supplements those procedures published in the AFM. In case of differences, the AFM shall govern. Strict reference to AFM procedures throughout the flight is necessary.

The procedure begins with information on several systems and then continues with the procedures and checklists to perform before, during and after flight.

BASIC STATEMENTS

BATTERIES

Certain temperatures require batteries removal to prevent cold soaking. Verify that batteries have been re-installed.

Minimum battery temperature..... -20°C (-4°F)

Minimum battery 2 voltage..... 22.5 V

EXTERNAL POWER

Minimum temperature:

Using external electrical power..... -54°C (-65°F)

FUEL TEMPERATURE

Minimum fuel temperature for APU start:

Using Jet A fuel..... -40°C (-40°F)

Using Jet A1 fuel..... -45°C (-49°F)

APU

Check the APU air inlet, cooling air inlet and APU outlet to ensure that it is clear of ice or snow.

If APU cannot be started, apply heat from a ground cart directly into the APU compartment.

CAUTION: DO NOT ALLOW THE HOT AIR FROM THE GROUND CART TO EXCEED 100°C (212°F), IN ORDER TO PREVENT ANY DAMAGE TO THE COMPONENTS INSIDE THE COMPARTMENT.

HYDRAULIC

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The Hydraulic Systems Warm-Up must be accomplished before starting the engines, in case of reservoir temperatures below -18°C:

EXTERNAL INSPECTION

Operating regulations clearly state that no takeoff is allowed when snow, ice or frost is adhering to the airplane.

The captain has the final responsibility for ensuring that the airplane is clear of ice, frost or snow. The primary method for the flight crew to ensure a clean airplane is through close visual and physical inspection of the critical surfaces prior to takeoff.

Even at intermediate stops, an external walk around is necessary due to the possibility of ice forming after landing from either cold soaking frost, conventional frost or precipitation freezing on the airplane.

Make sure nose wheel chocks are in place. If required, chock main wheels as well.

Remove covers from engine air inlet/outlet, APU air outlet, APU oil cooler air inlet, smart probes, TAT probes and wheels. If required, leave engine covers installed until engine start.

Visually check the wing, control surfaces, engines and fuselage prior to takeoff. In addition, as no frozen contamination is allowed on the wing upper surface, when in doubt of the severity of the contamination, the pilot may carry out or request a physical (hands-on) inspection to ensure that there is no contamination.

Do not touch the surfaces with bare hands, as the skin may stick to a freezing surface.

Check that the fuselage, wing upper and lower surfaces, tail and control surfaces are free of frost, ice or snow. Inspect control surfaces, gaps and hinges for signs of residual fluid or gel.

A 3 mm (1/8 in) frost layer is permitted on the underwing surfaces. Frost is not permitted on the lower or upper surface of the horizontal stabilizer or the upper surface of the wing.

A thin layer of hoarfrost is permitted on the fuselage provided the layer is thin enough to distinguish surface features underneath, such as painting and markings.

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No contamination is permitted on the lower/upper surface of the horizontal stabilizer or the upper surface of the wing. If any degree of contamination is found, de-icing and/or anti-icing has to be requested by the pilot in command. All snow and ice must also be cleared from nose radome and fuselage nose forward of windshield, as it is likely to blow back into windshields during taxi or takeoff.

Check that the engine inlet is clear of ice or snow, and that the fan is free to rotate. Ensure that all ice deposits are removed prior to engine starting.

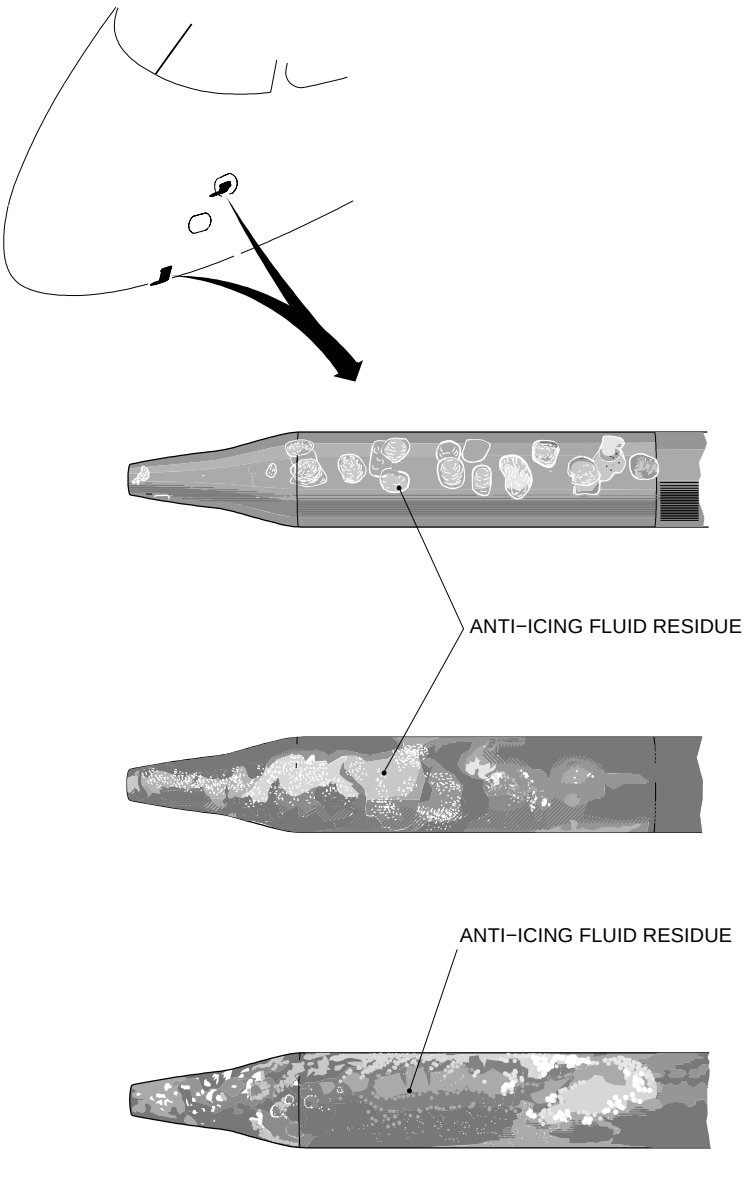
During the pre-flight walk-around check that the Air Data Smart Probes (ADSPs) are free from residual deicing and anti-icing fluid and that there is no residual hardened residue on any part of the ADSPs, especially if Type II or IV fluid were used recently. If any contamination is found on Smart Probes, call maintenance.

Check TAT probes, pressurization static port, all inlets, outlets and vents are clear of ice and unobstructed.

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SAMPLE OF SMART PROBE ANTI-ICE FLUID CONTAMINATION

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If the airplane has become cold soaked as a result of flight at very cold temperatures, fuel might be at a subfreezing temperature. This can cause ice accumulation if the airplane is subjected to high humidity, fog, drizzle or rain even when the outside air temperature is substantially above freezing.

At the completion of the walk-around, if ice, snow or frost is discovered, de-icing, and possibly anti-icing will be required. The check for ice accumulation should be done in a well-lit area.

Recommended practice is to use holdover times in conjunction with a pre-takeoff check to ascertain that frozen deposits have not started to accumulate on treated surfaces. This check is normally accomplished from inside the cabin. It will require a crewmember to visually inspect the wing/leading edges and the engines by looking throught an appropriate cabin window.

A pre-takeoff contamination check is normally accomplished from outside the airplane when the airplane cannot be effectively inspected by a pre-takeoff check or when the holdover times has been exceeded. It must be completed within 5 min prior to beginning takeoff. The assistance of ground personnel trained and qualified to inspect the wing, empennage and fuselage is required.

When contamination is in evidence, the de-icing/anti-icing operation must be repeated. It is the pilot's responsibility to decide whether or not to accept the airplane for flight. If contamination is suspected, the airplane should return for additional deicing or anti-icing.

Holdover time should not be considered an exact figure. It is just an average time, which can be reduced by many factors affecting the fluid effectiveness. In the case of ice build up after deicing/anti-icing fluid application, do not assume that ice will be blown off during takeoff roll.

DOORS

All doors and windows must be closed to prevent snow and humidity from entering into the airplane.

Whenever possible, to maintain cabin warmth, keep the passenger, cargo and service doors closed at intermediate stops.

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Check that doors, gear locks and mechanisms are unobstructed and clear of ice and snow and ensure no leaks exist.

NOTE: In case the cargo door vent panel is stuck due to cold soak, heat should be applied for at least 5 min to the door latch mechanism at the bottom edge of the door, around the inspection windows. Use a heat gun or heater equipment with maximum hot air temperature of 80°.

ICE PROTECTION

Ensure that the TO DATASET MENU page on the MCDU and Ice Protection Mode Selector are set according to the table OAT/visible moisture table.

ON GROUND			
Static Air Temperature	**Visible Moisture**	**MCDU (TAKEOFF DATASET MENU)**	**Ice Protection Mode Selector**
Higher than 10°C	YES	OFF	AUTO
Higher than 5°C and lower than 10°C	YES	ENG	
Lower than 5°C	YES	ALL	
Any	NO	OFF	

If moisture presence is in question, visible moisture should be assumed.

ENGINE START

Do not start the engine until it has been checked that all ice deposits have been removed from the air inlet.

Fuel and oil temperature limits for engine start are the same as those prescribed for APU start.

Perform normal engine start. If the engine does not start, maintenance procedures may be required or ground heating may be necessary to warm the nacelle, Air Turbine Starter (ATS) and Starting Control Valve (SCV).

During start with low oil temperatures, the oil pressure may drop below the minimum oil pressure levels temporarily after start. If the oil pressure

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remains below minimum levels for more than 2 min, the engine must be shut down and the oil heated. During the subsequent start after heating the oil, if the oil pressure does not recover, the engine must be shut down and the cause investigated.

NOTE: – In order to improve the chances of a successful engine start, the oil temperature should be raised to at least -20°C.
– In ambient temperatures lower than -2°C, dual ignition and increased starting fuel flow schedule take place to provide greater torque during engine on ground starts.

CAUTION:
- TO PREVENT DAMAGE TO NACELLE COMPONENTS, DO NOT ALLOW THE HOT AIR FROM THE GROUND CART TO EXCEED 100°C (212°F).
- DURING COLD WEATHER OPERATIONS, OIL PRESSURE PEAKS TO FULL SCALE MAY OCCUR DUE TO HIGH OIL VISCOSITY. OIL PRESSURE SHOULD DECREASE AS THE OIL TEMPERATURE INCREASES. IF THE OIL PRESSURE REMAINS ABOVE NORMAL OPERATING RANGE, THE ENGINE SHOULD BE SHUTDOWN AND THE CAUSE INVESTIGATED.

TAXI

Use minimum thrust for breakaway and taxiing, to avoid blowing snow or slush on personnel or airplanes nearby. Maintain ground speed below 10 kt when taxiing in snow covered or icy runways. Lower speeds will also avoid throwing slush on the wheel and brake assembly.

Use firm brake pressure on taxi stops whenever pavement conditions permit in order to warm up the brakes and dry moisture buildup within the disk stack. Anti-skid protection is not provided below this speed, so apply brakes accordingly.

During taxi, “cold set” (the condition where the tire retains the flat shape it had while parked) may induce vibration in the airplane. Vibration should disappear as the tires recover their elasticity during taxi. Do not initiate your takeoff run before the “cold set” disappears.

Turns should be performed at the largest turning radius, preferably at a speed which do not required braking during the turn.

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Maintain a greater than normal distance behind other airplanes while taxiing in snow or slush-covered runways, to avoid contamination by snow blown by jet blasts.

During ground operations of more than 30 min (including taxi in and taxi out) in icing conditions or if increased fan vibration due to fan ice accumulation is present, it is recommended that the engine thrust level be increased at 30 min intervals to approximately 54 % N1 and held at that thrust level for 30 s or until fan vibe level returns to normal. If airport surface conditions and the concentration of airplane do not permit the engine thrust level to be increased to 54 %, then set a thrust level and time at that thrust level as high as practical.

Do not apply reverse thrust during taxi, unless absolutely necessary.

GENERAL REMARKS WHEN FLYING IN ICING CONDITIONS

- Continuously monitor engine parameters, airplane pitch attitude and airspeed. In use of green dot guidance on icing condition is recommended fly green dot + 10 kt when the EICAS message STALL PROT ICE SPEED is displayed;
- Be careful for any mistrimmed condition that may be masked by the autopilot - keep the airplane trimmed at all the times. Consider turning autopilot off if you suspect you are flying in severe icing conditions;
- Monitor anti-ice systems for proper operation. Apply the associated AFM abnormal procedure in case of system failure. If the failure persists, exit and avoid icing conditions. Make the air traffic controller know you are requesting a change due to icing conditions and keep him informed about it;
- Strictly follow AFM Operation In Icing Condition normal procedures;
- Avoid landing in an airport where icing conditions exist or are anticipated if anti-ice system, brakes, thrust reverser, ground spoilers, nosewheel steering or flight controls have failed;
- Do not hesitate to leave icing conditions when icing cannot be handled, even with anti-ice system operating properly.
- Typically as ice is shed asymmetrically from the fan, a fan unbalance will occur resulting in higher than normal vibration indications. When the ice shedding is complete the vibration levels will typically return to normal indication levels for the

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particular engine. This reduction in vibration indication is a sign to the flight crew that the ice shed was successful and it may take several minutes or more for this to occur. Likewise, an increase in vibration level would be a sign that fan ice was possibly accumulating.

NOTE: Engine and Wing Ice Protection Systems operation is automatic and based on the primary ice detection system. However the crew remains responsible for monitoring icing conditions and for manual activation of the ice protection system if icing conditions are present and the ice detection system is not activating the ice protection system.

LANDING ON WET OR SLIPPERY RUNWAYS

Conduct a positive landing to ensure initial wheel spin-up and initiate firm ground contact upon touchdown, achieving wheel load as quickly as possible. Such technique avoids hydroplaning on wet runways and reduces the strength of any ice bond that might have been eventually formed on brake and wheel assemblies during flight.

The factors that influence the occurrence of hydroplaning are high speed, standing water and poor runway macrotexture. When hydroplaning occurs, it causes a substantial loss of tire friction and wheel spin-up may not occur.

Icy runways can be very slippery at all speeds depending on temperature.

Stopping the airplane with the least landing run must be emphasized when landing on wet or slippery runways.

- Anticipate the approach procedures and speeds: a well-planned and executed approach, flare and touchdown minimize the landing distance;
- Immediately after touchdown, check the ground spoiler automatic deployment when thrust levers are reduced to IDLE;
- Lower nose wheel immediately to the runway. It will decrease lift and will increase main gear loading;
- Apply thrust reversers cautiously and observe how the airplane responds before full reverse is used. Normal procedure is to move the thrust levers out of reverse when ground speed is reduced to 60 kt. In a emergency, reverse thrust may be used to bring the airplane to a full stop;

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– Do not use asymmetric reverse thrust on slippery and icy runways;

– Apply brakes with moderate-to-firm pressure, smoothly and symmetrically, and let the anti-skid do its job;

– If no braking action is felt, hydroplaning is probably occurring. Do not apply Emergency/Parking Brake, as it will remove anti-skid protection. Maintain runway centerline and keep braking until airplane is decelerated.

FREEZING RAIN AND FREEZING DRIZZLE

Atmospheric conditions involving freezing rain or freezing drizzle associated to supercooled large droplets (SLD), may present a condition that is beyond those for which the airplane was certified.

Both freezing rain and freezing drizzle can exist down to ground level and cause ice to form quite rapidly on all surfaces even during short exposures and on areas not normally known to be subjected to ice accretion. This means that the airplane is not designed to fly under freezing rain/drizzle (SLD) conditions.

If the crew notices abnormal ice formation on areas not usually affected by this phenomenon, or ice formation on the previously treated upper surface of the wings, they must consider to be flying under severe icing conditions. In this case, the anti-ice system is failing to reduce or control ice formation. The crew must then exit freezing rain/drizzle conditions as soon as possible since continuous flight under such conditions is, indeed, quite hazardous.

SAFETY INSPECTION

Wheel Chocks	IN PLACE
All Protective Covers	REMOVE
APU Area	CLEAR OF ICE OR SNOW
Air Conditioning Inlets and Outlets	CLEAR OF ICE
Batteries	INSTALLED

POWER UP

Accomplish a normal power up.

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After the electric PBIT is done and the message FLT CTRL TEST IN PROG disapears:

Hydraulic Systems Warm-Up..... PERFORM

The procedures below must be accomplished before starting the engines in case of reservoir temperatures below -18°C:

Electric Hydraulic Pumps Sys 1 and 3A..... ON

PTU..... ON

.....After 30 seconds.....

PTU..... AUTO

Electric Hydraulic Pump Sys 2..... ON

SLAT/FLAP..... CHECKED

Leave the flaps and slats up if application of anti-icing/deicing fluids is expected. Ensure they are free from ice or snow. Extend and retract them.

EXTERNAL INSPECTION

Fuselage, Wing, Tail and Control Surfaces..... FREE OF FROST, ICE OR SNOW

Smart Probe/TAT..... CLEAR OF ICE AND ANTI-ICING RESIDUE CONTAMINATION

Engine..... CLEAR OF ICE OR SNOW

Landing Gear..... CLEAR OF ICE, UNOBSTRUCTED

Fuel Tank Vents..... CLEAR OF ICE OR SNOW

Pressurization Static Port..... CLEAR OF ICE

CABIN WARM-UP

Air Conditioning/Pneumatic Panel..... SET

Keep all pushbuttons pushed in, while bleeding air from the APU, or use a ground cart to warm up the interior of the airplane. Set Cockpit and Cabin rotating knobs to full hot for rapid cabin warm up in low ambient temperature. The warm-up should be accomplished with all doors closed and the toilets doors open, if possible.

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CAUTION: DO NOT LEAVE THE AIRPLANE UNATTENDED.

BEFORE START

Ensure that the TO DATASET MENU page on the MCDU and Ice Protection Mode Selector are set according to the table OAT/visible moisture table.

ADS Probe Heaters..... AS REQUIRED

If probes are contaminated, push in and verify light illuminates.

NOTE: Do not turn on the heaters while the airplane is energized by batteries, to avoid battery discharge.

ENGINE START

Accomplish normal Engine start.

AFTER START

Engine Instruments..... MONITOR

Continue to monitor engine instruments, mainly oil pressure and temperature. Apply associated abnormal procedure if any failure arises.

Main Panel..... CHECKED

Check proper operation of all instruments and systems. Confirm engine anti-ice system is operating normally.

Steering..... ENGAGED

NOTE: If steering had been disengaged for push-back, reengage it and keep it engaged while the electric hydraulic pumps are running.

After reservoir temperatures are higher than 0° for systems 1, 2 and 3:

Electric Hydraulic Pumps SYS 1 & 2..... AUTO

NOTE:
- When attempting a single engine taxi with engine 2, select the Electric Hydraulic Pump 1 knob to ON.
- After starting engine 1, select Electric Hydraulic Pump 1 knob to AUTO.

ADS Probes Heater..... PUSHED OUT

AIRPLANE ANTI-ICING/DEICING FLUID APPLICATION WITH ENGINES/APU RUNNING

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CAUTION: APU OPERATION IS NOT RECOMMENDED DURING THE AIRPLANE DEICING/ANTI-ICING PROCEDURE. IF APU OPERATION IS ABSOLUTELY NECESSARY, MAKE SURE DEICING/ANTI-ICING FLUID IS NOT APPLIED DIRECTLY TO OR NEAR THE APU AIR INLET. THAT THE APU BLEED AIR VALVE IS CLOSED, AND THAT PACKS ARE SET TO OFF.

Parking Brake..... ON

Doors..... CLOSED

Thrust Levers..... IDLE

SLAT/FLAP..... UP

Pitch Trim..... FULL NOSE DOWN

Engine Bleed Buttons..... PUSHED OUT

APU Bleed Button..... PUSHED OUT

Packs Buttons..... PUSHED OUT

Packs should be off to avoid contamination of cabin air with fumes generated from ingestion of fluids in engine/APU.

After Deicing/Anti-icing Procedure is complete:

.....Wait at least 1 minute.....

APU Bleed Button..... PUSHED IN

Engine Bleed Buttons..... PUSHED IN

Wait at least 1 minute to push in bleed buttons.

.....Wait at least 3 minutes.....

Packs Buttons..... PUSHED IN

Wait at least three minutes to push in the air conditioning packs pushbuttons, thereby avoiding contaminating the airframe air conditioning system with deicing/anti-icing fluid gases.

TAXI

Engine Run-Up..... AS REQUIRED

SLAT/FLAP..... AS REQUIRED

When taxiing through slush or standing water, slat/flap should be retracted to avoid snow and slush contamination from the main gear wheels.

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WARNING: IF FLAPS/SLATS WERE LEFT UP DURING TAXI, COMPLETE AFTER START CHECKLIST BEFORE TAKING OFF.

CAUTION: TAXI AT REDUCED SPEED IN ICE-COVERED RUNWAYS TO AVOID SKIDDING THE AIRPLANE. REDUCE SPEED FOR ALL TURNS AND USE CAUTION WHEN TAXING WITH HIGH CROSSWINDS.

BEFORE TAKEOFF

Takeoff Briefing..... COMPLETE

Flight Controls..... CHECK

Check freedom of movement and full travel of all flight controls (including trims).

Pitch Trim..... SET

Set the PITCH trim according to load sheet and verify YAW and ROLL trims to the neutral position.

SLAT/FLAP..... SET

Set SLAT/FLAP to takeoff setting (if flaps were left up after starting the engines).

Takeoff Configuration..... CHECK

Ice Accumulation..... CHECK

TAKEOFF

Engine Run-Up..... AS REQUIRED

For takeoff in icing conditions, it is recommended that takeoff power be set to approximately 54 % N1 and held at that thrust level for 30 s or until fan vibe level returns to normal just before or in conjunction with the final takeoff power setting.

CLIMB/CRUISE

Operation in moderate to severe icing conditions may allow ice to build up on the fan spinner and/or blades.

If allowed to accumulate, asymmetrical ice shedding may result in high fan vibration.

For operations in moderate to severe icing conditions, reduce one thrust lever at a time towards idle, then advance to a minimum of 70 % N1 for 10 - 30 s, then return thrust lever to position required for flight conditions.

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Accomplish the periodic engine run up every 15 min if fan ice build up is suspected (high indicated or perceived vibration).

Operation of the ignition system is not required for this procedure provided the FADEC automatic relight system is operating normally.

NOTE: Engine vibration indication may peek to the maximum value prior to ice shedding, however, this will not affect the engine.

HOLDING

Landing Gear..... UP

SLAT/FLAP..... UP

Minimum Airspeed..... 210 KIAS

CAUTION: EVEN SMALL ACCUMULATIONS OF ICE ON THE WING LEADING EDGE MAY CHANGE THE STALL CHARACTERISTICS OR THE STALL PROTECTION SYSTEM WARNING MARGIN.

DESCENT

If engine vibration increases reduce the thrust to idle, advance thrust levers to obtain 70% N1 and then return to the desired setting.

When using the autopilot, monitor pitch attitude and speed continuously.

CAUTION: EVEN SMALL ACCUMULATIONS OF ICE ON THE WING LEADING EDGE MAY CHANGE THE STALL CHARACTERISTICS OR THE STALL PROTECTION SYSTEM WARNING MARGIN.

APPROACH AND LANDING

Observe normal approach and landing procedures.

TAXI-IN AND PARKING

Engine and Wing Ice Protection..... AS REQUIRED

After landing, set the Engine and Wing Ice Protection systems using the overhead panel Ice Protection Mode Switches according to weather conditions.

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SLAT/FLAP..... AS REQUIRED

NOTE: – Make sure the slat/flap are free from snow, ice or slush before retracting them.
– If any difference is felt while taxiing, verify if tires present any flat spot which may indicate that the brake was blocked at touchdown.

CAUTION: TAXI AT REDUCED SPEED IN ICE-COVERED RUNWAYS TO AVOID SKIDDING THE AIRPLANE AND THROWING SLUSH ON WHEEL AND BRAKE ASSEMBLIES.

THROUGH-FLIGHTS

Doors and Windows..... CLOSED

Whenever possible, to maintain cabin warmth, keep the passenger, cargo and service doors closed at intermediate stops.

APU..... ON

APU should be on to provide bleed air to the air conditioning packs in order to maintain cabin heat.

Walk around the airplane and check the following items:

Wing, Tail and Control Surfaces..... FREE OF FROST, ICE OR SNOW

Air Data Smart and TAT Probes..... CLEAR OF ICE

Engine/APU Air Inlet..... CLEAR OF ICE OR SNOW

Landing Gear ..... CLEAR OF ICE, UNOBSTRUCTED

Air Conditioning Inlets and Outlets..... CLEAR OF ICE

Fuel Tank Vents..... CLEAR OF ICE OR SNOW

Pressurization Static Port..... CLEAR OF ICE

In case of deice/anti-ice fluid application is necessary, perform “Airplane anti-icing/de-icing fluid application with engines/APU running”.

LEAVING THE AIRPLANE - SECURING FOR COLD SOAK OR AN EXTENDED PERIOD

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Anti-icing fluid can be applied to the airplane surfaces at the time of arrival, on short turn arounds during freezing precipitation, and on overnight stops. This will minimize ice accumulation before departure and usually makes subsequent deicing easier.

The procedures below should be performed in the event of extended airplane exposure to low temperatures. At non-maintenance stations, the crew should ensure that the following actions have been accomplished.

SLAT/FLAP..... UP

Pitch Trim..... FULL DOWN

Wheel Chocks..... IN PLACE

Emergency/Parking Brakes..... AS REQUIRED

For an icy ramp, leave Emergency/Parking Brakes applied. Otherwise, Emergency/Parking Brakes must not be applied to avoid brakes freezing. Wheel and tires may melt snow or ice by the heat retained in the brakes. Parking main tires on a layer of sand or on a mat may prevent tires from freezing on pavement surfaces.

Protective Covers..... INSTALLED

Install protective covers at engines and APU inlets/outlets, APU oil cooler air inlet, smart probes, TAT probes, and wheels.

Water and Waste System..... DRAINED

Drain water and waste from all water tanks if cold soak temperature is expected to be lower than 0°C (32°F).

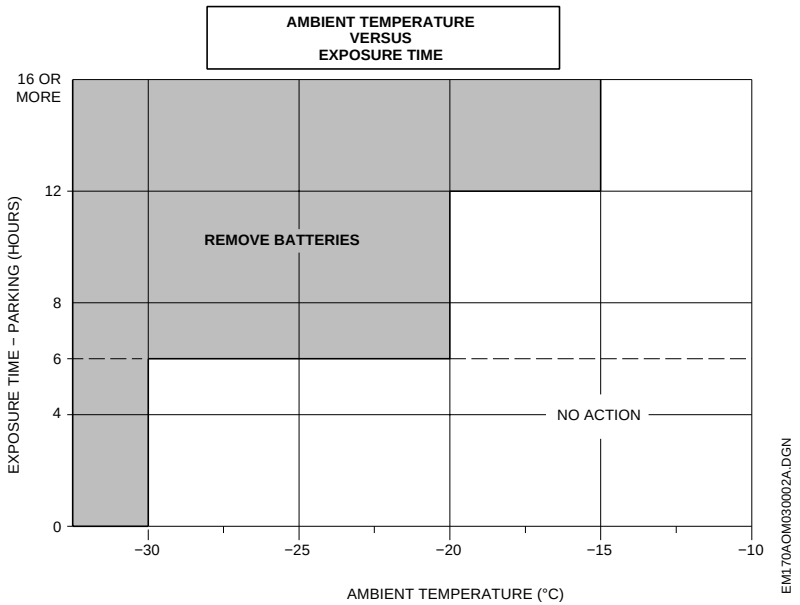
Batteries..... REMOVED

Remove the batteries according to the following graphic:

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NOTE: – The time count starts when the airplane is powered down.
– The temperature used to enter the graphic must be the lowest one that the airplane has been exposed during the parking time.
– If the airplane is heated (external pneumatic heat source) during the parking, there is no need to remove the batteries, regardless of time and temperature.

Doors and Windows..... CLOSED

All doors and windows must be closed to prevent snow and humidity from entering into the airplane.

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LIGHTNING STRIKE

Even though the airplane is adequately protected against lightning strike effects, operating procedures should be established in an attempt to avoid such phenomenon.

In-flight lightning avoidance is closely associated with thunderstorm avoidance. Therefore, avoid penetration of thunderstorms. Maintain visual contact with thunderstorms during the daytime and lightning at night. Check the radar for precipitation, review all available types of weather information, examine other pilot reports and follow ATC instructions. Even with a good weather report received and understood, pay close attention to storms that develop rapidly along the route in a given area which cannot be predicted. While enroute, continuously update weather briefings through the use of radio contact and airborne equipment for actual storm avoidance.

Remember that radar detects only liquid droplets, not the cloud itself. Only rain suspended in the cloud will produce a radar echo, which may lead to occasional encounters with hail and lightning.

If possible, circumnavigate the detected thundercloud or area by 25 miles or more when traffic conditions permit.

Be aware that lightning can strike an airplane miles away from the extreme side of a developed thunderstorm. Reports of airplane receiving strikes in clear air at 25 NM or more from the nearest storm are common.

The following paragraphs summarize the conditions in which strikes are most common:

Meteorological conditions: incident reports show that an airplane must be within or beneath a cloud to receive a strike, or in or near regions of precipitation. Incident reports show that in over 80% of the strikes, the airplane was within a cloud and experiencing some precipitation and turbulence. But other strikes may occur in a cloud where there is no precipitation nearby, in clear air reasonably distant from a thundercloud, during snowstorms and in clouds over erupting volcanoes. Flight through or in the vicinity of a cold front, warm front, stationary front, unstable air or squall lines increases the probability of lightning strikes. Incident reports also show that lightning strikes occur most commonly under light or heavy turbulence conditions.

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– Flight regime: Takeoff, climb, level flight, descent or approach.

– Altitude: strikes are more common between 5000 ft and 20000 ft, but may occur at virtually all flight altitudes. Lightning strike incidents at lower altitudes are far more frequent since at higher altitudes airplanes can divert around thunderclouds with greater ease.

– Outside air temperature: most strike incidents have occurred when the airplane is flying in temperatures near or at freezing level. Strikes may also occur at temperatures as high as 25°C, or as low as - 45°C.

Metal airplanes produce a phenomenon called Faraday Cage effect, which distributes electrical charges along the airframe in such a manner that occupants and internal components will not receive the high current that causes injury and damage. Internal components and systems have also special protections against side effects of the lightning strike.

Direct effects which result from a lightning strike may be:

– Pit marks often seen along the fuselage or holes in the trailing edge of wing and tail tips.

– Melting of rivets.

– Puncturing of nonmetallic structures.

– Puncturing and de-lamination of composites.

– Slight deformation of metal skins and structure.

– Welding or roughening of moveable hinges and bearings.

– Damage to other parts that may conduct lightning current other than the airframe, such as bonding or diverted straps and pitot tubes.

Effects caused by the flash-induced electromagnetic field and the increase of the voltage due to the current at the airplane structure are defined as indirect effects and may be:

– Interruption of instruments and navigation equipment.

– Damage to electronic and electrical equipment.

– Popping of circuit breakers.

– Loss of electrical power.

– Engine flame-out.

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IN FLIGHT OPERATIONS

IF A LIGHTNING STRIKE IS LIKELY TO OCCUR

An imminent lightning strike event may be indicated to flight crews by the buildup of static discharge which causes interference on ADF indicators or noise in communication receivers. Another indication is St. Elmo's Fire, which is visible at night as small electrical discharges running across the windshields and sparking on the wings.

If possible, circumnavigate the detected thundercloud or area by 25 miles or more when traffic conditions permit.

All Cockpit Lights..... ON/FULL BRIGHTNESS

Consider wearing sunglasses to protect your eyes from the flash or have one pilot keep eyes downward.

IF THE AIRPLANE HAS BEEN HIT BY LIGHTNING

If the situation is under control after a lightning strike, apply the following procedure to ascertain whether the flight may proceed safely.

Altitude..... MAINTAIN

If not required by performance, obstacle clearance or operational contingencies, stop climbing during airplane check.

Circuit Breakers..... CHECK

Navigation Systems..... CHECK

Check magnetic compass and heading system for normal indications.

Engine Indication..... CHECK

Check engine for normal indications. In case of engine shutdown, the flight crew shall analyze the circumstances of the event and consider an engine airstart.

Pressurization..... CHECK

Check for no evidences of pressurization leaks.

Flight Controls..... CHECK

Check all flight controls for freedom of movement. Verify that slats/flaps and speed brakes are working properly.

Fuel System..... CHECK

Check fuel system for normal operation. Monitor fuel remaining and fuel consumption to ascertain that no fuel leak exists.

Communication Systems..... CHECK

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All Other Airplane Systems..... CHECK

Check for EICAS messages and airplane instruments following a panel scan sequence to ascertain that safety of flight prevails.

Apply the associated emergency/abnormal procedure if any failure arises after a lightning strike. Consider discontinuing the flight and land at the nearest suitable airport if any unsafe condition is revealed after checking systems operation.

ON GROUND OPERATIONS

ON THE GROUND

Approach and landing during a thunderstorm is strongly discouraged. If you are in the cockpit, do not attempt to communicate through a wire handset, and stay inside the airplane until the storm has passed.

IF THE AIRPLANE HAS BEEN HIT BY LIGHTNING

External safety inspection

Check for holes, punctures, discoloration and de-lamination throughout the whole airframe.

Verify that there are no loose, melted or missing rivets.

Check that all static dischargers are in place or in accordance with the CDL.

Verify the integrity of the lights installed on tail, wing, fuselage and landing gear.

Verify all antennas, ice detectors, smart probes, TAT probes and pressurization static ports for condition.

Report the lightning strike to maintenance personnel, by filling out the LIGHTNING STRIKE INCIDENT REPORT form.

Make sure that maintenance proceed is in accordance with AMM MPP 05-50-01/ 601 before flying the airplane again.

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EMB –190 LIGHTNING STRIKE INCIDENT REPORT

Part I (to be completed by flight crew)

Conditions at time of strike:

- Operator: _____ Date of incident: _____
- ACFT S/N: _____ Flight no.: _____
- Route: From _____ To: _____
- Altitude: _____ ft Airspeed: _____ kt
- Flight phase: Approach ☐ Climb ☐ Level Flight ☐

  Other: _____
- Weather: Cloud type % Cover Ceiling (ft) Top at (ft) OAT (°C)

  _____ _____ _____ _____ _____

  Rain ☐ Sleet ☐ Hail ☐ Snow ☐ None ☐
- Was St. Elmo's fire visible before strike? Yes ☐ No ☐
- Any effects on:

Electrical power system: _____

Flight controls: _____

Engine: _____

Avionics: _____

Other (describe): _____

- Any effects on personnel, such as: Flash blindness: _____

  Electrical shock: _____

Part I completed by: _____

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EMB-190 LIGHTNING STRIKE INCIDENT REPORT

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TURBULENT AIR PENETRATION

Flight through severe turbulence must be avoided, if possible.

If not possible, reduce altitude to increase buffet margin.

The recommended procedures for turbulent air penetration are:

MAXIMUM RECOMMENDED TURBULENT AIR PENETRATION SPEED

Below 10000 ft	250 KIAS
At or above 10000 ft	270 KIAS/0.76 M, WHICHEVER IS LOWER

Severe turbulence will cause large and often rapid variations in indicated airspeed. Do not chase the airspeed.

ATTITUDE

Maintain wings level and pitch attitude. Use attitude indicator as the primary instrument. Do not use sudden large control inputs.

PITCH TRIM

Maintain control of the airplane with the elevators. After establishing the trim setting for penetration speed, do not change pitch trim.

ALTITUDE

Large altitude variations are possible in severe turbulence, do not chase altitude. Allow altitude and airspeed to vary and maintain attitude.

THRUST SETTING

If severe turbulence cannot be avoided disconnect autothrottle and make an initial thrust setting for the target airspeed. Change thrust setting only in case of unacceptable airspeed variation.

NOTE: Do not extend flaps except for approach and landing.

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VOLCANIC ASH

Flight in areas of known volcanic activity must be avoided. This is particularly crucial while flying at night or in daytime with instrument meteorological conditions when volcanic dust may not be visible. When a flight is planned into an area with a known potential for volcanic activity, it is recommended that all NOTAMs and air traffic control directives be reviewed for current status of volcanic activity. If volcanic activity is reported, the planned flight should remain well clear of the area and, if possible, stay on the upwind side of the volcanic dust.

The airplane's weather radar is not capable of detecting volcanic ash/dust clouds and is therefore not reliable under these circumstances. The presence of volcanic ash/dust may be indicated by:

- Smoke of dust appearing inside the airplane;
- Odor similar to electrical smoke;
- Engine malfunctions such as power loss, engine stalls, increasing ITT, fluctuating engine rpm, etc;
- At night, Saint Elmo's fire/static discharges may be observed around the windshield or windows;
- Orange glow from engine inlets.

Flight into volcanic ash/dust clouds can result in the degradation of airplane and engine performance. The adverse effects cause by volcanic ash/dust encounters may be:

- Rapid erosion and damage to the internal engine components;
- Ash/dust build-up and blockage of the guide vanes and cooling holes, which may cause surge, loss of thrust and/or high ITT;
- Ash/dust blockage of the pitot system, resulting in unreliable airspeed indications;
- The abrasive properties of volcanic material may cause serious damage to the engines, wing and tail leading edge surfaces, windshields, landing lights, etc;
- Windshield and windows may become opaque, reducing visibility.

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ON GROUND OPERATIONS

The following recommendations apply to starting and operating engines on airports where volcanic ash has fallen and ground contamination is present:

- When the airplane is parked install engine covers or reposition the aircraft to limit blowing ash accumulation from wind and jet blasts from other airplane;
- During preflight, check that the engine inlet and exhaust areas have been cleared of volcanic ash;
- Check that all volcanic ash has been cleaned away from the area within 14 ft of the engine inlets;
- Use APU for engine starting only, not for air conditioning.
- Prior to starting, dry motor the engine for 90 s in order to blow out any ash that may have entered the engine bypass duct area;
- Borescope inspect the HPC and HPT at the 6:00 o'clock position to look for foreign material. If loose material is observed, dry motor the engine again for 90 s and re-inspect.
- Change engine oil filters.
- Drain oil system and refill with fresh oil.
- Use minimum required thrust for breakaway and taxi;
- Limit exposure to contaminated surfaces by selecting alternate cleaner taxi routes if available;
- Avoid static engine operation above idle;
- Be aware of loose ash being blown by the exhaust wake of other aircraft. Maintain adequate ground separation;
- Use a rolling takeoff technique. Avoid setting high thrust at low airspeeds;
- After landing at an airport contaminated with volcanic ash, minimize the use of reverse thrust to prevent any recirculation ingestion.

IN FLIGHT OPERATIONS

Flight operations in volcanic ash are extremely hazardous and must be avoided. However, volcanic ash/dust clouds may sometimes extend for

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hundreds of miles, reaching altitudes above 60000 ft and an encounter may be unavoidable.

In case of an inadvertent encounter, proceed as follows:

APU (if available)..... START
Ignition Selectors..... OVRD
Autothrottle..... Disconnect

The autothrottle must be kept disconnected to prevent thrust increase due to smart probes contamination.

Thrust Lever (If altitude permits)..... IDLE
Ice Protection Mode Selector..... ON

This action will increase bleed air extraction from the engines and further improve the engine stall margin.

Recirculation Button..... PUSH OUT
ITT..... MONITOR

NOTE: If the ITT is still increasing even with the thrust levers in idle:
Affected Engine..... Shutdown

If engine is shutdown or flames-out, restart the engine (refer to Quick Reference Handbook) once it has cooled down. If engine fails to start, repeated attempts should be made immediately.

NOTE: A successful start may not be possible until the airplane is clear of the volcanic ash/dust, and the airspeed and altitude is within the airstart envelope. The engines may accelerate slowly to idle at high altitudes and this could be interpreted as a failure to start or as an engine malfunction.

After exiting the area of volcanic ash/dust cloud and with the engine(s) restarted, restore systems to normal operation. Inform ATC of the encounter.

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ALTIMETERS MISCOMPARE TOLERANCES

The Air Data System (ADS) relies on total of four Air Data Smart Probes (ADSPs) and two Total Air Temperature probes (TATs) to determine air total pressure, static pressure and total temperature. Three Air Data Applications (ADAs) compute these informations to provide air data to PFDs and other airplane systems. IESS (Integrated Electronic Standby System) performs both the functions of computing air information and presenting air data to flight crew.

There are four ADS, which interact with flight crew. In normal operation, ADS 1 provides information to captain's PFD, ADS 2 provides information to co-pilot's PFD and ADS 3 is the backup source for both PFDs whereas ADS 4 is the IESS.

Differences between pilot and co-pilot altitude readings may occur due to a number of reasons. Altitude, airspeed, airplane configuration and the ADSPs locations influence the altitude reading miscompare. As long as the miscompare is within a certain tolerance, it is acceptable.

To verify if altimeter difference is within tolerance, the flight crew should proceed as follows:

Altitude..... STABILIZE
Maintain variation within ± 50 ft.

Air Speed..... STABILIZE
Maintain variation within ± 5 kt.

Wait a minimum of 15 s in straight and leveled flight, preferably with Autopilot engaged, to compare the difference between altitudes using the following table:

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AIRPLANE ALTITUDE	MAXIMUM DIFFERENCE BETWEEN ALTITUDES [1]
	ADS 1 to ADS 2
	ADS 1 to ADS 3/IESS [2]
	ADS 2 to ADS 3/IESS [3]
-2000 ft up to 10000 ft	50 ft
10000 ft up to 20000 ft	120 ft
20000 ft up to 41000 ft	180 ft

1. These are comparative, not absolute values.
2. Message ADS 3 (4) SLIPCOMP FAIL must not be displayed.
3. ADS 3 and IESS use the same pressure sensors. Comparison between them is not applicable.

If a difference above the tolerance is noticed, report to the maintenance personnel.

COMMUNICATION MANAGEMENT FUNCTION OPERATION

Specific operational procedures are required for the ACARS function use in accordance with CFR 14, Part 25, Subpart G - Operating Limitations and Information, § 25.1529,§ 25.1581, § 25.1583 and § 25.1585.

DO-296 - Safety Requirements for Aeronautical Operational Control (AOC) Datalink Messages provides a guideline for hazard identification and risk reduction strategies related to ACARS operation.

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PRNAV OPERATIONS

The material contained herein is a guidance material prepared based on TGL-10.

The P-RNAV operations satisfies a required track keeping accuracy of ±1 NM for at least 95% of the flight time, and the automatic selection, verification and, where appropriate, de-selection of navaids.

P-RNAV operations determine airplane position on the horizontal plane using inputs from the following types of positioning sensors:

- Distance Measurement Equipment (DME) giving measurements from two or more ground station (DME/DME).
- VHF Omni-directional Range (VOR) with a co-located DME (VOR/DME), where it is identified as meeting the requirements of the procedures.
- Global Navigation Satellite System (GNSS) GPS or GALILEO.
- Inertial Reference System (IRS), with automatic updating from suitable radio based navigation equipment.

P-RNAV is used for departures, arrivals and approaches down to (FAWP). The final APPR segment down to the RWY threshold and the associated missed approach are not covered by P-RNAV procedures.

NOTE: The FMS VNAV and the FMS SPEED are not required for P-RNAV.

LIMITATIONS

MINIMUM EQUIPMENT LIST

- 1 FMS.

  FMS 1 (2) FAIL displayed on the EICAS.

- 1 FD.

  FD FAULT displayed on the EICAS.

- 1 DME.
- 1 VOR.
- 1 GPS.

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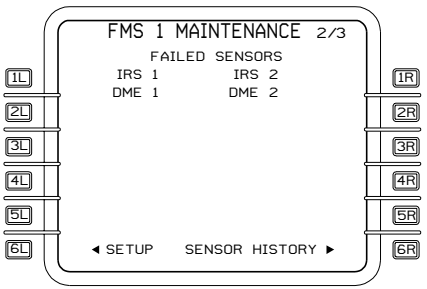
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– 1 MCDU.

NOTE: For procedures specified in the Aeronautical Information Publication (AIP) as requiring dual P-RNAV, both FMS must be operative at dispatch. If an FMS in-flight failure occurs, the procedure must be discontinued.

The sensors status can be checked in FMS MAINTENANCE PAGE 2/3.



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GENERAL LIMITATIONS

– If GPS RAIM is annunciated as not available during any phase of flight, the pilot must monitor FMS guidance data and crosscheck with raw data from an alternate source (i.e. VOR, DME, or IRS).

– Although the magnetic heading and track angle provided by the IRS are available up to 73° latitude north and 60° latitude south, the FMS uses the IRS as sensor in the range 72° 30.0' latitude north and 59° 30.0' latitude south. The P-RNAV operation is prohibited outside of the IRS FMS usable range.

– The RNP-RNAV airworthiness approval has not accounted for database accuracy or compatibility as defined per FAA AC 20-153.

– P-RNAV requires the use of the Flight Director.

– Prior to flight using FMS for IFR navigation any appropriate ground facilities that are utilized by the procedures to be flown must be verified as operational using an approved method.

– The Approved FMS Pilot's Operating Manual or other approved manual must be available to the flight crew. The Pilot's Manual must match the FMS software version installed in the airplane.

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- The creation of new waypoints by manual entry into the RNAV system by the flight crew is not permitted as it would invalidate the affected P-RNAV procedure. Route modifications in the terminal area may take the form of radar headings or 'direct to' clearances and the flight crew must be capable of reacting in a timely fashion. This may include the insertion in the flight plan of waypoints loaded from the database.
- The FMS software version NZ7.01 or later approved version must be installed.
- P-RNAV operations with FMS software v7.0, v7.01 or v7.02 are prohibited after December 31, 2013.
- When a GPS Only Approach is planned (GPS only in title or GPS required by operational rules), prior to dispatch, the crew is required to verify that the predictive RAIM at the destination ETA is within the approach criteria. This information (RAIM AVAILABLE), is displayed on the PREDICTIVE RAIM page on the MCDU.
- The FMS Disable selection on MCDU Radio Tune NAV page is prohibited.
- The pilot must ensure that the displayed guidance data from non-usable stations is not used for navigation purposes by the flight crew. The NOTAM function in the FMS does not always inhibit tuning of a NOTAM selected station by the FMS when in AUTO tune mode. Note that the FMS will not use NOTAM selected station data for FMS position determination.

NORMAL PROCEDURES

PRIOR TO FLIGHT

Verify NOTAM for the availability of the intended P-RNAV procedure. Verify also if any navaid identified in the AIP as critical for the intended P-RNAV procedure is unavailable.

FMS Identification..... VERIFY NAV DB

FMS Position..... INITIALIZE

Flight Plan..... ACTIVATE

At system initialization, the flight crew must confirm that the navigation database is current and verify that the aircraft position has been entered correctly. The active flight plan should be checked by comparing the charts, SID or other applicable documents, with the MFD MAP display and the MCDU. This includes confirmation of

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the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over. If required by a procedure, a check will need to be made to confirm that updating will use a specific navigation aid(s), or to confirm exclusion of a specific navigation aid. A procedure shall not be used if doubt exists as to the validity of the procedure in the navigation database.

FMS AUTOTUNE..... VERIFY ENABLE

Select Radio page and press the LSK 4L twice to reach the NAV 1 page and select or verify that the FMS AUTOTUNE is ENABLE.

FMS Tune..... AUTO

FMS Autotuning is selected by using the DEL key for each NAV radio frequency on the MCDU PROGRESS page.

PFD NAVSource on PF Side..... SELECT FMS

Contigency Procedure..... REVIEW

AFTER TAKEOFF

LNAV..... SELECT

The LNAV mode can command bank angles up to 30°, which is above the maximum allowable bank angle for OEI conditions below the level OFF. Do not engage the LNAV mode until the airplane is above the level off if the departure procedure may cause the airplane to bank over the 15° limit.

ARRIVAL

Verify NOTAM for the availability of the intended P-RNAV procedure. Verify also if any navaid identified in the AIP as critical for the intended P-RNAV procedure is unavailable.

Flight Plan..... LOAD

At the desired flight plan loading, the flight crew must confirm that the navigation database is current and verify that the aircraft position has been entered correctly. The loaded procedure must be checked by comparing the charts or other applicable documents with the MFD MAP display and the MCDU. This includes confirmation of the waypoint sequence, reasonableness of track angles and distances, any altitude or speed constraints, and, where possible, which waypoints are fly-by and which are fly-over. If required by a procedure, a check will need to be made to confirm that updating will use a specific navigation aid(s), or to confirm exclusion of a specific navigation aid. A procedure shall not be used if doubt exists as to the validity of the procedure in the navigation database.

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PFD NAV Source on PF Side..... SELECT FMS

Contigency Procedure..... REVIEW

NOTE: During the procedure and where feasible, flight progress should be monitored for navigational reasonableness, by cross-checks, with conventional navigation aids using the primary displays in conjunction with the MCDU.

EMERGENCY AND ABNORMAL PROCEDURES

NAVIGATION DEGRADATION

The navigation degradation is annunciated by:

– The DGRAD annunciator on the PFD.

– The DEAD REACKONING scratchpad message.

– The UNABLE RNP scratchpad message.

Non Affected FMS..... SELECT

In case the procedure requires dual P-RNAV capability, single FMS installations failures or dual FMS failures in dual FMS configuration, accomplish the contingency procedure.

FMS 1 (2) FAIL

Non Affected FMS..... SELECT

In case the procedure requires dual P-RNAV capability, single FMS installations failures or dual FMS failures in dual FMS configuration, accomplish the contingency procedure.

FD FAULT

Non Affected Side..... SELEC AS NAVIGATION SOURCE

In case of FD FAIL occurs, apply the P-RNAV contingency procedure.

NOTE: A single channel FD loss is annunciated through the FD FAULT EICAS message. In the affected side, the FD cue comes out of view.

FMS USAGE IN AREAS NOT COVERED BY WGS-84 OR NAD-83 DATUM

BASIC STATEMENTS

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This procedure is to be used in cases when operating in areas not covered by coordinates method WGS – 84 or NAD-83 datum and the use of the FMS is desired.

When applying this procedure by deselecting the GPS 1 and 2 on both MCDUs the FMS may be used normally as long as no DEGRADED message appears, meaning that the EPU (estimate position uncertainty) is meeting the required navigation performance for the flight phase.

When the GPS is deselected an inscription DESEL is displayed confirming that the GPS is disabled.

POSITION INITIALIZATION

The inertial component requires system initialization (entry of latitude and longitude). Initialization may take place either from a FMS from input that the crew manually enters via the MCDU, or automatically from the GPS. A pilot-entered position has priority over a position from a GPS.

FLIGHTS ORIGINATING ON AREAS NOT COVERED

AFTER AIRPLANE POWER UP

POS INIT page (from the NAV INDEX)..... SELECT

If the airplane is at the same position it was on the last power down.

LAST POS..... LOAD

For other cases, set the proper position coordinate using the airport or the gate position.

REF WPT..... SET and LOAD
POS SENSORS page..... SELECT

On MCDU 1:

GPS 1 (LSK 4L)..... DISABLE

- Press DELETE key
- LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... DISABLE

- Press DELETE key
- LINE SELECT on GPS 2

On MCDU 2:

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GPS 1 (LSK 4L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 2

DURING THRU FLIGHTS

POS SENSORS page..... SELECT

On MCDU 1:

GPS 1 (LSK 4L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 2

On MCDU 2:

GPS 1 (LSK 4L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 2

AFTER TAKEOFF

AFTER TRANSITION ALTITUDE

POS SENSORS page..... SELECT

On MCDU 1:

GPS 1 (LSK 4L)..... ENABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... ENABLE

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– Press DELETE key

– LINE SELECT on GPS 2

On MCDU 2:

GPS 1 (LSK 4L)..... ENABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... ENABLE

– Press DELETE key

– LINE SELECT on GPS 2

FLIGHTS APPROACHING TO AREAS NOT COVERED

DESCENT PHASE

AFTER TRANSITION LEVEL

POS SENSORS page..... SELECT

On MCDU 1:

GPS 1 (LSK 4L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 2

On MCDU 2:

GPS 1 (LSK 4L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 1

GPS 2 (LSK 5L)..... DISABLE

– Press DELETE key

– LINE SELECT on GPS 2

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QFE OPERATION

This procedure is accomplished when ATC altitude assignments are referenced to QFE altimeter settings.

NOTE: Do not use VNAV below transition altitude/level. Altitudes in the navigation database are not referenced to QFE. Use only raw data for navigation.

Altimeters..... SET

Set altimeters to QFE when below transition altitude/level.

Prior to descent:

Pressurization Mode Selector..... LFE CTRL
LFE Selector..... SET ZERO

Perform a normal descent approach and landing procedures.

After engines shutdown:

Pressurization Mode Selector..... AUTO

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GENERAL

The RVSM operation reduces the airplane minimum vertical separation from 2000 ft to 1000 ft between FL 290 and FL 410.

Airworthiness approval alone, does not authorize the flight into the airspace for which a RVSM operational approval is required by an ICAO Regional Navigation Agreement.

NORMAL PROCEDURES

EXTERNAL SAFETY INSPECTION

NOSE SECTION

Air Data Smart Probes..... NO DAMAGE OR OBSTRUCTION

Particular attention should be paid to the condition of the pressure ports and to the marked area on the fuselage skin near each Air Data Smart Probe.

BEFORE TAKEOFF

Altimeters..... SET TO THE AIRFIELD QNH

Altitude Indications..... CHECK

NOTE: – An alternative procedure using QFE may also be used;
– The maximum difference between altimeters indication should not exceed 23 m (75 ft).

CRUISE

Be sure that all required equipment are in proper operating condition.

Ensure that the airplane is flown at the cleared flight level and that ATC clearances are fully understood and followed. Do not depart from cleared flight level without a positive clearance from ATC except for a contingency or emergency situation.

While changing flight levels, do not overshoot or undershoot the cleared flight level by more than 45 m (150 ft).

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The autopilot should be operative and engaged during level cruise, except for circumstances such as the need to re-trim the airplane or when it must be disengaged due to turbulence.

When altitude difference between PFD 1 and PFD 2 exceeds 100 ft, select ADS 3 on the PFD that does not agree with IESS.

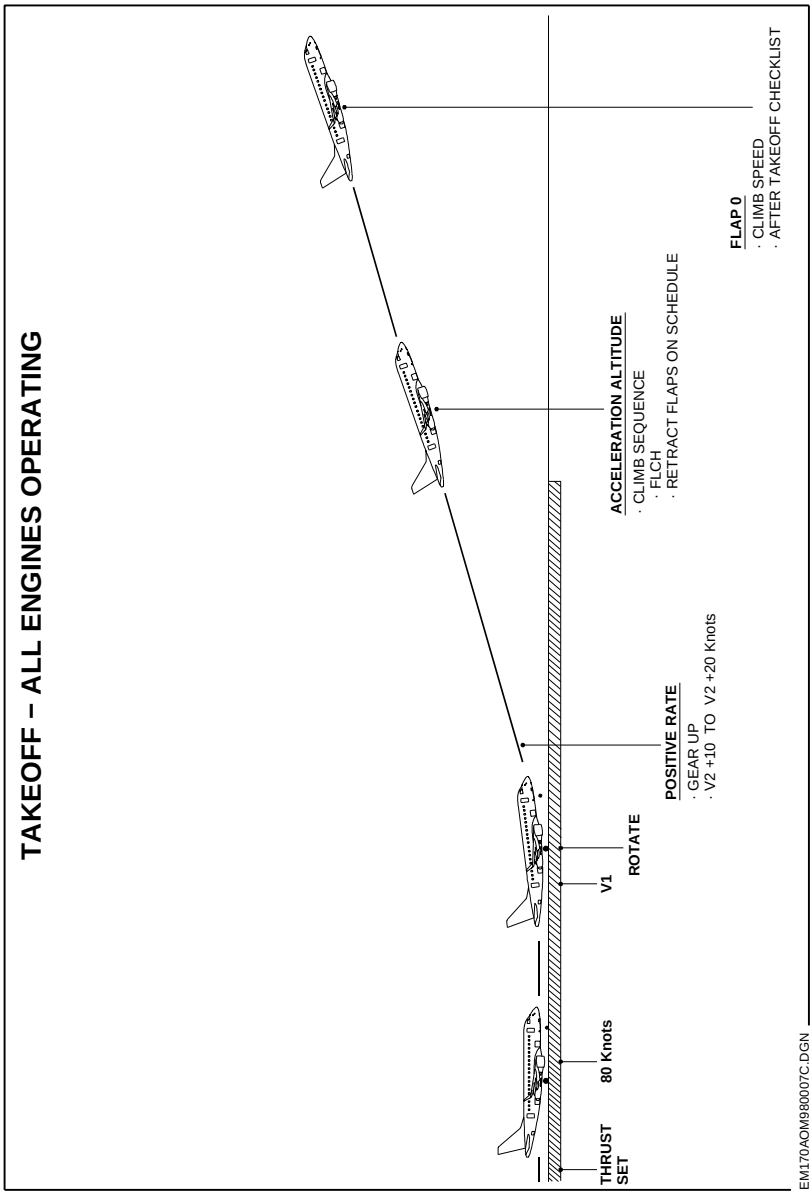
AFTER LANDING

In case of failure or malfunction, the following information should be recorded when appropriate:

- ADS 1, ADS 2, ADS 3 altimeter readings;
- Altitude selector setting;
- Baro Set value and Baro Set unit (INHG/HPA);
- Flight Director used with the Autopilot to control the airplane and any differences when the other Flight Director was coupled;
- Use of air data system reversion for fault diagnosis procedure;
- The transponder selected to provide altitude information to ATC and any difference noted when an alternative transponder was selected.

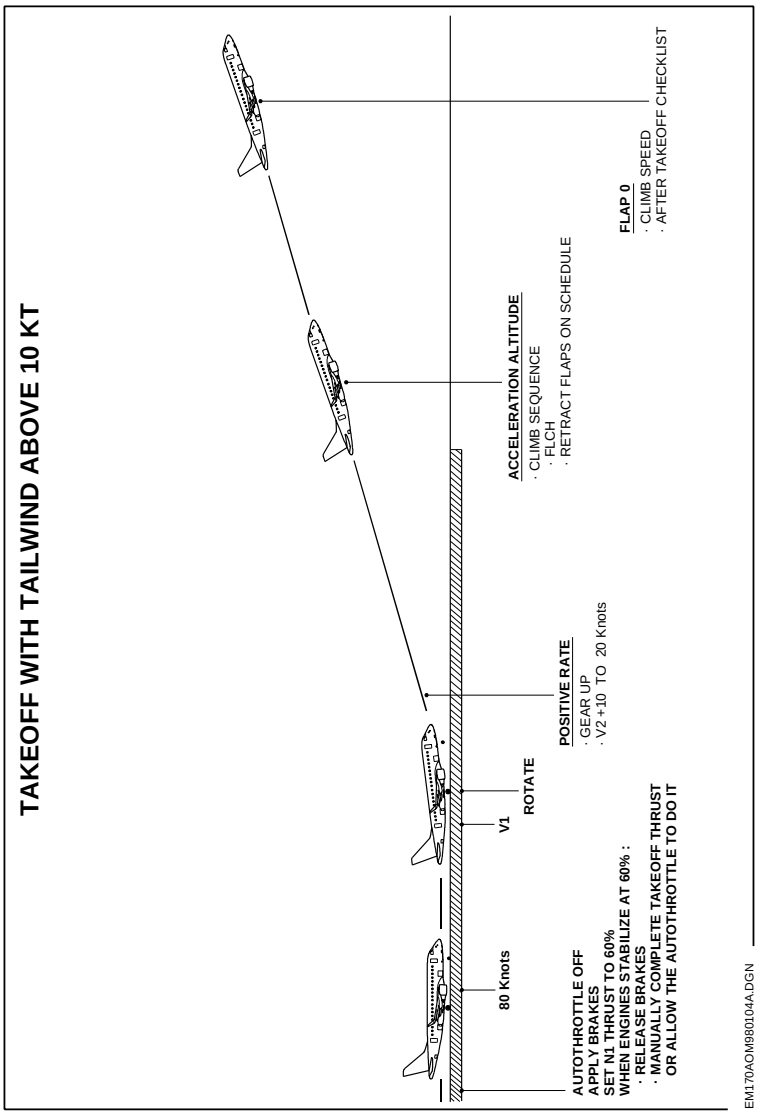
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FLIGHT PATTERNS



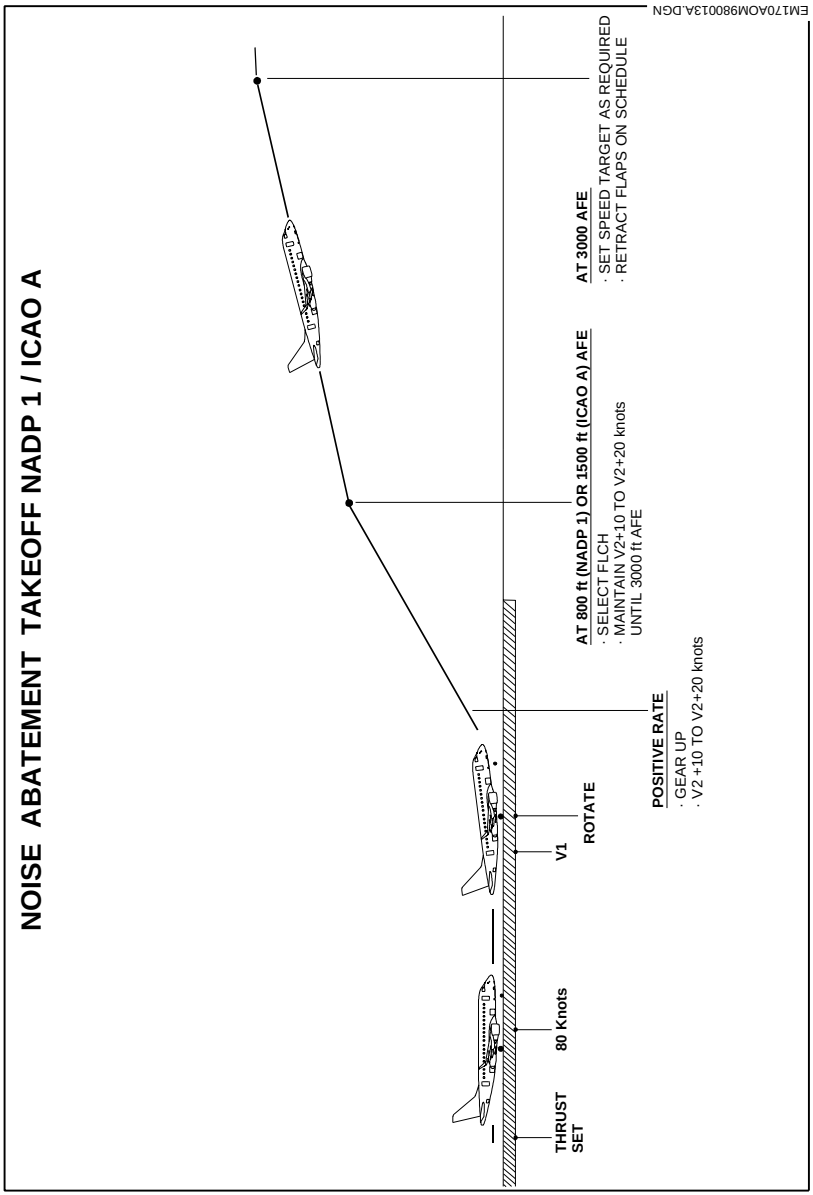
TAKEOFF

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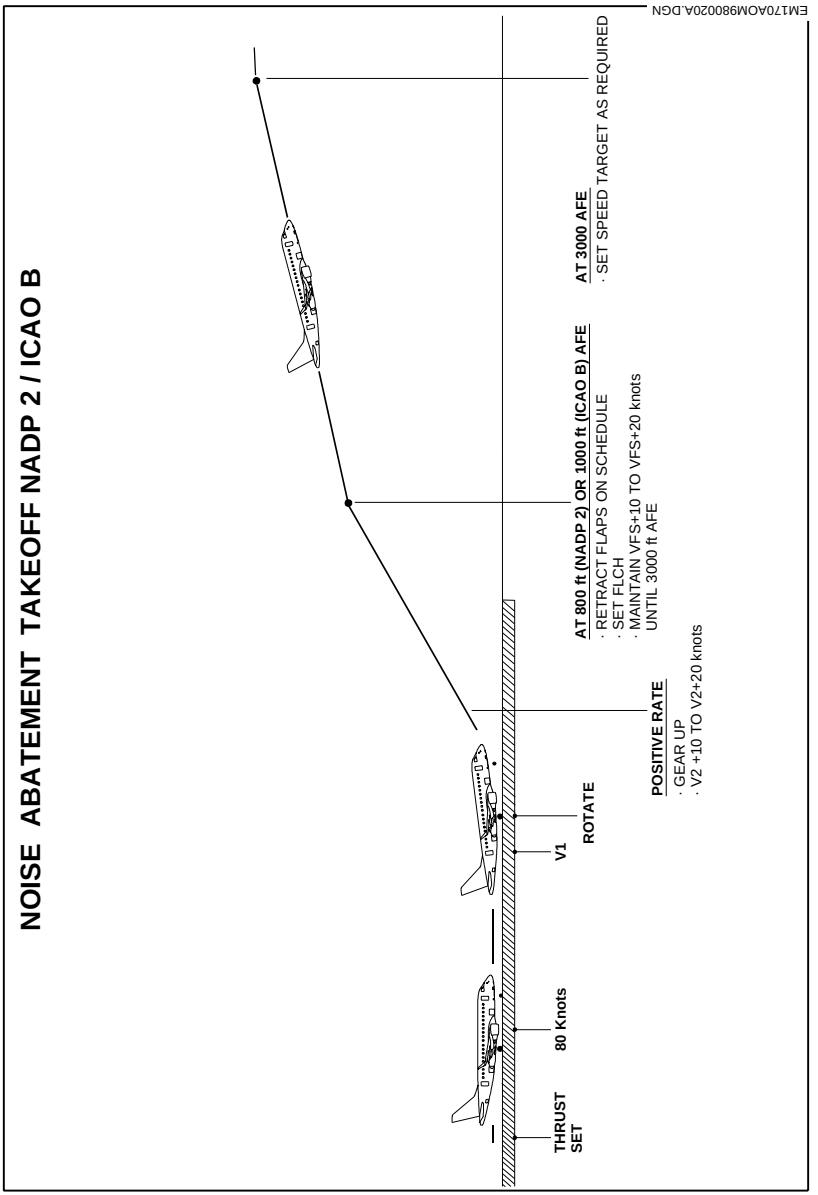
TAKEOFF WITH TAILWIND ABOVE 10 kt

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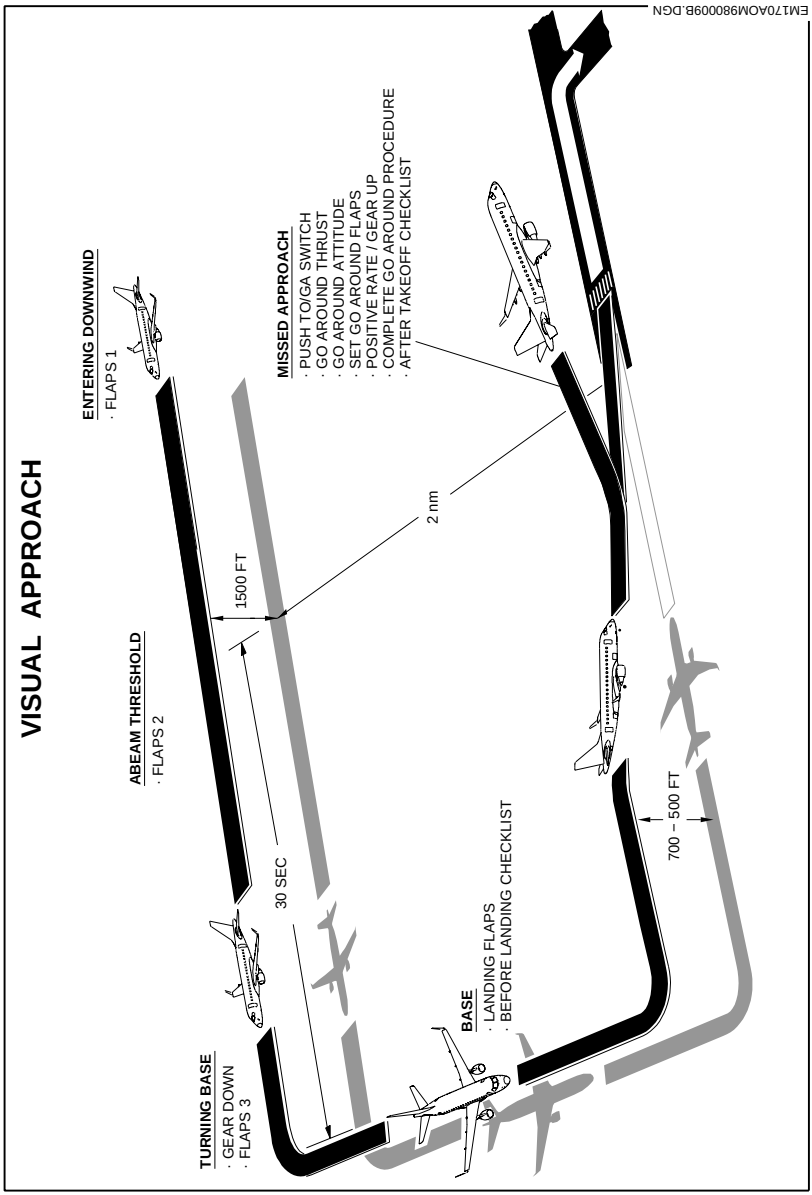
NOISE ABATEMENT TAKEOFF A

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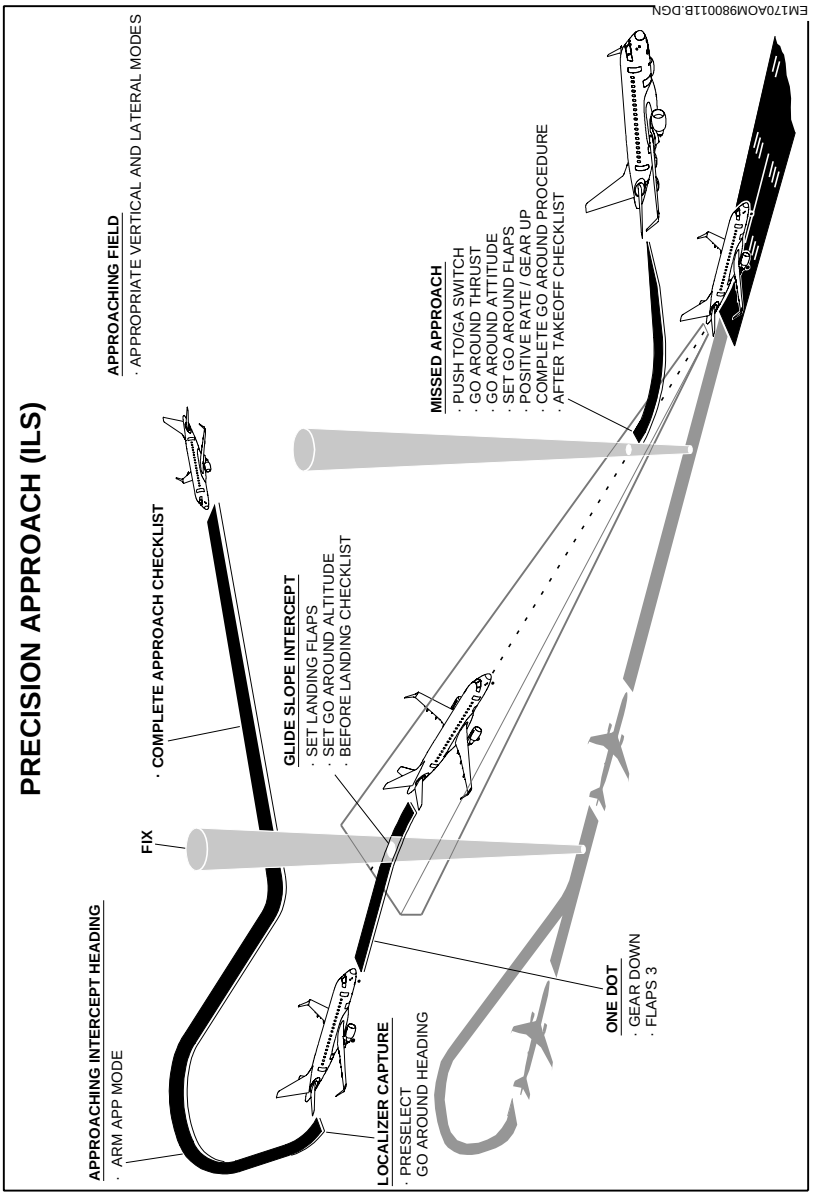
NOISE ABATEMENT TAKEOFF B

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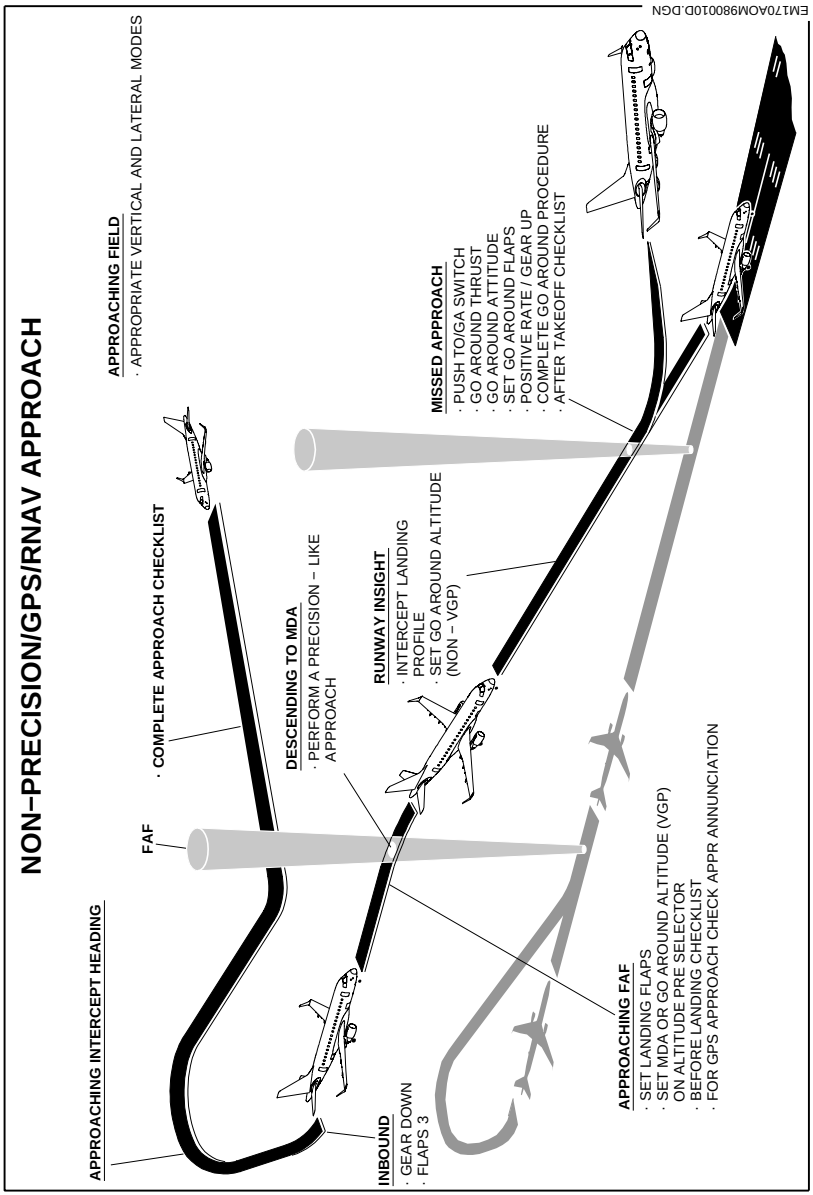
VISUAL APPROACH

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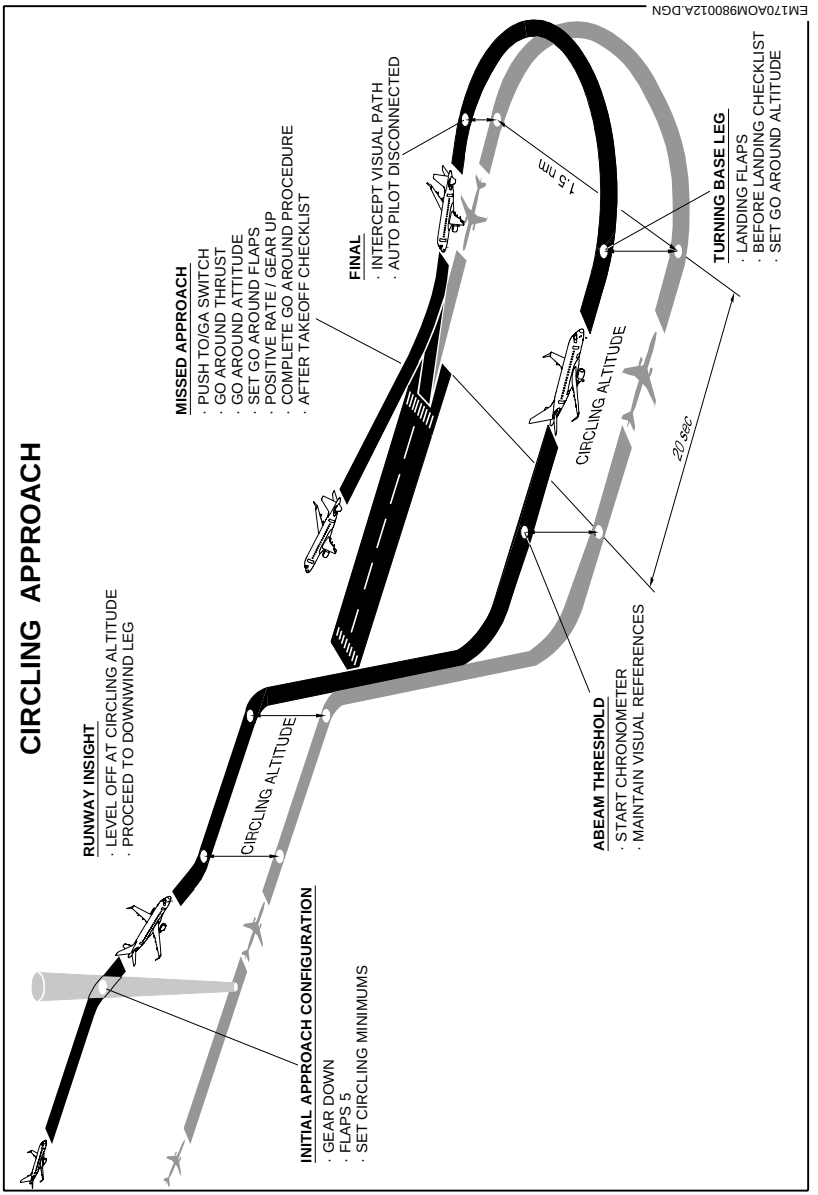
PRECISION APPROACH (ILS)

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NON–PRECISION APPROACH

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CIRCLING APPROACH

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CAT II ENGAGEMENT LOGIC

The Primus-Epic integrated Avionics has a CAT II logic which is automatically activated whenever the RA/BARO Minimums Selector knob is set to RA position. A green APPR 2 annunciator indicates the correct setting and a white or amber APPR 1 ONLY annunciator indicates an incorrect setting. The green APPR 2 annunciator is displayed in the Autopilot Approach Status Annunciator above each FMA.

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

CAT II CONDITIONS OF OPERATION

CAT II operation is allowed only with the green APPR 2 annunciator enabled.

To obtain a green APPR 2 annunciator the following conditions must be met:

- Radio altitude below 1500 ft.
- SLAT/FLAP 5.
- NAV 1 on pilot's side and NAV 2 on copilot's side, both NAVs tuned to the same LOC frequency.
- An active approach GS/LOC mode selected. Both courses set to same value.
- Both Flight Directors operational.
- Attitude and Heading valid on both PFDs.
- Glide slope and Localizer deviation valid on both PFDs.
- No reversions (IRS and ADC) modes selected on both PFDs.
- Valid Airspeed and Baro Altitude on both PFDs.
- No comparison monitors are tripped (FPA, Attitude, Heading, Airspeed, Baro Altitude, Localizer, Glide slope and Radio altitude) on both PFDs.
- No back course selected.
- The EICAS message APPR 2 NOT AVAIL not presented.

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– Both Display Control Panels set to the same CAT II Decision Height. (RA to OFF or an altitude greater than 80 ft)

– RA/BARO Minimums Selector knob set to RA.

– No TCS Button pressed.
►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

NOTE: – If the CAT II Instrument Approach Landing chart does not authorize the use of RA, set the RA to OFF. In this case there is no EGPWS call outs “APPROACHING MINIMUMS” and “MINIMUMS”.

– When the green APPR 2 annunciator is enabled, the localizer lateral deviation scale is expanded with the external limits representing the excessive deviation points.

◄

If one of these conditions is not met, the green APPR 2 annunciator will not appear.

If the green APPR 2 annunciation is displayed and one of the following conditions is achieved, the amber APPR 1 ONLY annunciation will flash active characters inverse video for 5 s then steady in conjunction with the RA Minimum Selected Digital Readout:

– No valid Radio Altitude displayed.

– Airplane no longer APPR 2 capable.

– Crew selects flaps position other than 5 below 800 ft.

– EICAS message SLAT/FLAP LEVER DISAG displayed.

– Either Minimums Selected Readouts change from RA to BARO.

– LOC frequency or inbound course mismatch.

CAT II WARNINGS

LOCALIZER, GLIDE SLOPE AND RADIO ALTITUDE COMPARATORS WARNINGS

A comparison between the localizer, glide slope and radio altitude deviation indications are performed when the following conditions are met:

– On-side radio altitude valid and below 1500 ft.

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– APR mode selected on Flight Guidance Panel.

– SLAT/FLAP 5.

– CAT II Decision Height setting on both Display Control Panels.

– On-side VOR/LOC active course valid.

– Cross-side data valid.

– Go-around not selected on either side.

– No back course selected.

For localizer, the following additional condition is required:

– Both LOC signals tuned and valid for at least 15 seconds.

If LOC indications differ by values above approximately 1/2 dot, an amber LOC annunciator will appear flashing (for 10 seconds) then steady on the left side of the PFDs between EADI and EHSI.

For glide slope, the following additional condition is required:

– Both glide slope signals valid and both LOC signals tuned and valid for at least 15 seconds.

If GS indications differ by values above approximately 2/3 dot, an amber GS annunciator will appear flashing (for 10 seconds) then steady on the left side of the PFDs between EADI and EHSI.

For radio altitude, the following additional condition is required:

– Both radio altimeters signals valid and on scale.

If radio altimeters indications differ more than 10 ft approximately, an amber RA annunciator will appear flashing (for 10 seconds) then steady in the ADI.

EXCESSIVE LOCALIZER AND GLIDE SLOPE DEVIATIONS WARNINGS

The on-side localizer and glide slope excessive deviations are compared to the CAT II limits and displayed when the following conditions are met:

– APR mode selected on Guidance Panel.

– SLAT/FLAP 5.

– CAT II Decision Height setting on Guidance Panel.

– VOR/LOC is the active course is valid.

– On-side radio altitude between 500 and 80 ft.

– On-side localizer tuned and valid.

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– On-side glide slope valid.

– No back course selected.

– Go-around not selected on either side.

Localizer excessive deviation:

If a localizer deviation greater than approximately 1/3 dot is detected, the HSI lateral deviation bar on the PFDs HSI will change from green to amber, the lateral deviation scale will change from white to amber, and flash.

NOTE: The on-side excessive deviation warning is also displayed when the cross-side system has detected an excessive deviation.

Glide slope excessive deviation:

If a glide slope deviation greater than approximately one dot is detected, the GS pointer on the PFDs ADI will change from green to amber, the GS scale will change from white to amber, and flash.

NOTE: The on-side excessive deviation warning is also displayed when the cross-side system has detected an excessive deviation.

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NORMAL PROCEDURES

CAT II APPROACH

BEFORE INTERCEPTING LOCALIZER COURSE

- Set the RA/BARO Minimums Selector knob to RA.
- Perform the Descent/Approach/Before Landing checklists, as appropriate.
- Set the CAT II Decision Height on both Display Control Panels.
- Test Radio Altimeter if only one is available.
- Select the same ILS frequency on MCDU.

NOTE: – If Radio Altimeter is checked not functioning properly the CAT ll approach must be discontinued.
– A minimum distance of 4 NM to the Outer Marker is recommended for interception and stabilization along the approach course.

BEFORE INTERCEPTING THE GLIDE SLOPE

- Monitor radio altimeter information.
- Lower landing gear (one dot below GS interception) and set flaps to 5.
- Set the Landing Reference Speed ($V_{REF\ 5}$) on AP bug (cyan bug).
- Stabilize and maintain the Landing Reference Speed ($V_{REF\ 5}$).
- Set approach climb speed on FS reference speed bug (green bug).
- Be sure that Marker Beacon audio is on.

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AFTER PASSING FAF

– The pilot flying should maintain the Landing Reference Speed ($V_{REF\ 5}$).

– At 80 ft above the decision height setting the EGPWS will call out ″APPROACHING MINIMUMS″.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

NOTE: If CAT II Instrument Approach Landing chart does not authorize the use of RA, set the RA to OFF. In this case there is no EGPWS call outs ″APPROACHING MINIMUMS″ and “MINIMUMS”.

◄

– If visual contact is not made upon reaching the decision height or if any malfunction could not be promptly identified during approach, a missed approach must be immediately initiated.

MISSED APPROACH

GO-AROUND Procedure..... APPLY

LANDING

Reaching the Decision Height with runway in sight:

Autopilot..... DISENGAGE

Landing..... PERFORM

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SECTION 4

EMERGENCY AND ABNORMAL PROCEDURES

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INTRODUCTION

This section provides the emergency and abnormal procedures to be performed in case of a system malfunction or failure, in order to protect passengers and/or crew from serious harm and to maintain the airworthiness of the airplane.

In case any discrepancy between a procedure contained in this section and the approved Airplane Flight Manual (AFM) occurs, the AFM procedures must be followed. In the event that any of the procedures are missing or unusable, operations may be continued provided the approved AFM is available for use.

The Emergency/Abnormal Procedures, in this section, are ordered in alphabetical sequence and divided into four blocks:

– Smoke Procedures: contain all annunciated and non-annunciated smoke related procedures.

– Non Annunciated Procedures: procedures, which are not related to an EICAS message but rather to a condition presented in the airplane.

– Annunciated Procedures: procedures related to an EICAS message. These procedures are grouped by system and titled with the correspondent EICAS message wording.

– Supplementary Procedures: procedures related to a special operation, like CAT II or HGS or Steep Approach which have specific procedures. These procedures are divided in Non-annunciated and Annunciated procedures, both in alphabetical order.

CHECKLIST OPERATION

The emergency/abnormal procedures have priority over the normal checklist, except when the crew judges that this is not the safest course of action.

Flying the airplane is always the priority in any emergency/abnormal situation. Checklists should only be called by the PF after the flight path is under control, critical phases of flight (takeoff and landing) have ended and all recall items have been accomplished.

Some EICAS messages do not have an associated QRH procedure. In those cases, “Crew Awareness” identifies the EICAS message as noted in the Index Table. If a Crew Awareness message is displayed on the EICAS, takeoff is prohibited, unless at least one of the following conditions is met:

– - The message is an expected result of an intentional operation;

– - Flight crew action is taken to clear the message;

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– - Maintenance personnel take action to clear the message;

– - The airplane is dispatched in accordance with all approved company MEL provisions.

The procedures contained herein assume that:

– Airplane systems were operating normally prior to the failure.

– All emergency/abnormal actions are performed in the order they are presented in the procedure.

– Normal procedures have been properly accomplished.

– System controls were in normal condition prior to initiation of the associated procedure.

– Aural warnings are silenced as applicable. Master Warning/Caution lights are reset as soon as the failure is recognized.

– In case of depressurization and presence of smoke, full-face oxygen masks have been donned and communication has been established.

– Circuit breakers must not be reset.

All tasks foreseen in the procedures have the indication END stating that the specific task for that condition is over. No task is over until END has been reached.

Upon completion of the procedure the pilot reading it should state: "_____Procedure Complete".

CHECKLIST STRUCTURE

Some procedures bring a characterization below the title in case any relevant emergency/abnormal condition is present, such as aural warnings, lights, EICAS indications, flight instrument flags and the airplane condition itself.

The actions contained in the bold square boxes are recall items. They must be performed expeditiously, from memory.

Some procedures require landing at the nearest suitable airport. This statement may be presented below the associated emergency/abnormal characterization or at the beginning of a task that requires so. When the crew determines that significant threat to safety is present, they should always accomplish the earliest possible descent and landing regardless of having this statement present in the procedure.

Some procedures contain "Lists of Relevant Inoperative Items" for that particular condition. Those lists presents only the most relevant items and for the full list, the AOM should be consulted. As SMOKE events are

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very time critical, on those procedures the lists contain only items that significantly affect airplane performance and/or controllability. For the entire list of relevant inoperative items on those conditions, the pilot can refer to the procedures associated with the electrical busses off.

Procedures for failures affecting the landing distance presents an ″abnormal landing correction factor″. This factor must be multiplied by the applicable unfactored landing distance. The factor presented in the procedure is applicable to dry runways. Additional factors for other conditions are presented in the performance section of this manual.

Throughout this manual, a text followed by () means that either condition apply. A text followed by “-” means that both conditions apply simultaneously.

Whenever a question is necessary in the checklist it will be in a Yes/No format and presented inside a box, with arrows pointing where the checklist will continue depending on the answer, being that the “Yes” will always be directly below the question box. In some cases the arrows may be presented as a dashed line, to avoid confusion when there are two arrows close to each other.

NOTE: Circuit Breakers reset may be performed when following the limitations and procedures specified in the GROUND RESETS.

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SMOKE

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CRG FWD (AFT) SMOKE

Light: Associated Cargo Fire-Extinguishing Button illuminates.

Associated Cargo Fire Extinguishing Button..... PUSH

LAND AT THE NEAREST SUITABLE AIRPORT.

ON GROUND? **No**

Yes

After CRG AFT (FWD) FIREX HI ARM message is displayed and the associated Cargo Fire Extinguishing Button is illuminated:

Associated Cargo Fire Extinguishing Button..... PUSH AGAIN

END

LAV SMOKE

Establish contact with the cabin crew.

If necessary:

Diversion..... CONSIDER

SMOKE EVACUATION Procedure..... ACCOMPLISH

END

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SMOKE EVACUATION

Crew Oxygen Masks..... DON, 100%
Crew Communication..... ESTABLISH
Pressurization Dump Button..... PUSH IN

LAND AT THE NEAREST SUITABLE AIRPORT.

Cockpit Door..... CLOSE
Cabin Rate..... VERIFY

CABIN RATE IS LESS THAN 1000 FT/MIN?

No

Yes

Pressurization Mode Selector..... MAN
Pack 1 Button..... PUSH OUT
Pack 2 Button..... PUSH OUT
Recirc Fan Button..... PUSH OUT

Fstn Belts Signs..... ON
Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER
Thrust Lever..... IDLE
Speedbrake..... FULL OPEN
Airspeed..... MAX APPROPRIATE
Transponder..... 7700
ATC..... NOTIFY

END

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SMOKE / FIRE / FUMES

CONDITION: Smoke fire or fumes have been spotted by the crew without an EICAS warning.

Crew Oxygen Masks	DON, 100%
Crew Communication	ESTABLISH

LAND AT THE NEAREST SUITABLE AIRPORT.

Recirc Fan Button ..... PUSH OUT

NOTE: Any time the smoke becomes dense, perform the SMOKE EVACUATION Procedure.

SMOKE ORIGIN IS OBVIOUS AND CAN BE REMOVED? **No**

Yes

Affected source ..... REMOVE

SMOKE STOPS OR DECREASES? **No**

Yes

SMOKE EVACUATION Procedure ..... AS REQUIRED

END

Fstn Belts Signs ..... ON

Altitude ..... 10000 ft OR MEA, WHICHEVER IS HIGHER

Thrust Levers ..... IDLE

Speedbrake ..... FULL OPEN

CONTINUED...

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...CONTINUED

Airspeed..... MAX APPROPRIATE
Transponder..... 7700
ATC..... NOTIFY
Pressurization DUMP Button..... PUSH

NOTE: Smoke will initially decrease due to pressurization dumping, even if the correct source has not yet been removed.

Bleed 1 Button..... PUSH OUT
Bleed 2 Button..... PUSH OUT
Emergency Lights..... OFF
RAT Manual Deploy Lever..... PULL
Airspeed..... MIN 130 KIAS
IDG 1 Selector..... OFF
IDG 2 Selector..... OFF
APU Gen Button..... PUSH OUT

NOTE: Do not accomplish THE ELEC EMERGENCY Procedure.

BATT DISCHARGING MESSAGE PRESENTED? **No**

Yes

IDG 1 or 2 Selector..... AUTO

SMOKE STOPS OR DECREASES? **No**

Yes

Relevant Inoperative Items

All Engine Reversers	All Multi Function Spoilers
All Ground Spoilers	Nosewheel Steering

Icing Conditions..... EXIT/AVOID

Landing Configuration:

Emergency Lights..... ARMED
Gnd Prox Flap Ovrd Button..... PUSH IN
Slat/Flap..... 3

CONTINUED...

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...CONTINUED

Set Vref = Vref $_{FULL}$ + 20 KIAS or 130 KIAS (whichever is higher).

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.21.

NOTE: On ground, steer the airplane using differential braking and rudder.

If a go around is required:

Slat/Flap..... 3

Airspeed..... Vref $_{FULL}$+ 20 or 130 KIAS WHICHEVER IS HIGHER

END

SUITABLE AIRPORT IS DISTANT? **No**

Yes

IDG 1 Selector..... AUTO
IDG 2 Selector..... AUTO
DC BUS TIES Switch..... OFF
TRU 1 Switch..... OFF
Battery 1..... OFF

DC ESS BUS 1 AND DC BUS 1 ARE DEENERGIZED.

SMOKE STOPS OR DECREASES? **No**

Yes

Relevant Inoperative Items

Engine 1 Reverser	Outboard Brakes
Multi function spoilers L5 and R5	

Icing Conditions..... EXIT/AVOID

Landing Configuration:

CONTINUED...

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...CONTINUED

Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Slat/Flap 3

Set Vref = Vref $_{FULL}$ + 20 KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.37.

If necessary, on Ground:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

END

Battery 1..... ON
TRU 1 Switch..... AUTO
TRU 2 Switch..... OFF
Battery 2..... OFF

DC ESS BUS 2 AND DC BUS 2 ARE DEENERGIZED.

SMOKE STOPS OR DECREASES? **No**

Yes

Relevant Inoperative Items

All Engine Reversers	Nosewheel Steering
Inboard Brakes	Speedbrakes
Multi Function Spoilers L3, R3, L4 and R4	

Icing Conditions..... EXIT/AVOID

Landing Configuration:

CONTINUED...

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Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Slat/Flap 3

Set Vref = Vref $_{FULL}$ + 20 KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.55.

If necessary, on Ground:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

NOTE: On ground, steer the airplane using differential braking and rudder.

END

Battery 2..... AUTO
TRU 2 Switch..... AUTO
TRU ESS Switch..... OFF

DC ESS BUS 3 ARE DEENERGIZED.

SMOKE STOPS OR DECREASES? **No**

Yes

Landing Configuration:

Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Slat/Flap 3

Set Vref = Vref $_{FULL}$ + 20 KIAS.

CONTINUED...

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.35.

END

WARNING: CONSIDER AN IMMEDIATE LANDING.

TRU ESS Switch..... AUTO
DC BUS TIES Switch..... AUTO

Landing Configuration:

Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Slat/Flap 3

Set Vref = Vref $_{FULL}$ + 20 KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.35.

END

Relevant Inoperative Items

All Engine Reversers	All Multi Function Spoilers
All Ground Spoilers	Nosewheel Steering

Icing Conditions..... EXIT / AVOID

Landing Configuration:

Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Slat/Flap..... 3

Set Vref = Vref $_{FULL}$ + 20 KIAS or 130 KIAS (whichever is higher).

CONTINUED...

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.21.

NOTE: On ground, steer the airplane using differential braking and rudder.

If a go around is required:

Slat/Flap..... 3

Airspeed..... $V_{REF\ FULL}$ + 20 or 130 KIAS WHICHEVER IS HIGHER

END

IFE RACK SMOKE

LAND AT THE NEAREST SUITABLE AIRPORT.

IFE Button..... PUSH OUT

If necessary:

SMOKE EVACUATION Procedure..... ACCOMPLISH

END

RECIRC SMOKE

LAND AT THE NEAREST SUITABLE AIRPORT.

Recirc Fan Button..... PUSH OUT

END

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NON ANNUNCIATED

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CARGO COMPARTMENT FIRE

LAND AT THE NEAREST SUITABLE AIRPORT.

Associated Cargo Fire Extinguishing Button..... PUSH

After CRG AFT (FWD) FIREX HI ARM message is displayed and the associated Cargo Fire Extinguishing Button is illuminated:

Associated Cargo Fire Extinguishing Button..... PUSH AGAIN

END

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DITCHING

Descent:

Cabin Crew..... NOTIFY

ATC..... NOTIFY

Transponder..... 7700

Aural Warning CBs (C7; C31)..... PULL

No Smkg/Fstn Belts Signs..... ON

ELT..... ON

Landing Data..... SET

At 10000 ft AGL:

Pressurization Dump Button..... PUSH IN

When differential pressure reaches 0.2 psid or below:

Airspeed..... MAX 160 KIAS

If necessary extend Flap/Slat as required to mantain airspeed below 160 KIAS.

Direct Vision Window..... OPEN

Approach:

Altimeters..... SET

At 5000 ft AGL:

Pressurization Mode Selector..... MAN

Cabin Alt Controller..... HOLD DOWN FOR 50 s

Ditching Configuration:

Terrain Inhibit Button..... IN

Landing Gear..... UP

Slat/Flap..... MAXIMUM AVAILABLE

APU Emergency Stop Button..... PUSH IN

NOTE: If engines are not running maintain minimum speed of 130 KIAS.

CONTINUED...

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Just Before Water Contact:

Cabin..... ANNOUNCE IMPACT

After Ditching:

Thrust Levers..... IDLE

Start/Stop Selectors..... STOP

Fire Extinguishing Handles..... PULL AND ROTATE

Emergency Evacuation..... ANNOUNCE

Batteries..... OFF

END

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DUAL ENGINE FAILURE

EICAS Indication: FAIL icon inside both N1 indicators.

EICAS Indication: Both oil pressure indications in red.

Airspeed	265 KIAS MIN
RAT Manual Deploy Lever	PULL

LAND AT THE NEAREST SUITABLE AIRPORT.

APU..... START
Emergency Lights..... OFF
Thrust Levers..... IDLE

BOTH ENGINES SUCCESSFUL AUTORELIGHT? **No**

Yes

Flight Controls Mode Buttons (Spoilers, Elevators, Rudder)..... PUSH IN, then OUT

Landing Configuration:

Emergency Lights..... ARMED
Gnd Prox Flap Ovrd Button..... PUSH IN
Slat/Flap..... 3
Set $V_{REF} = V_{REF\ FULL} + 20$ KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.35.

END

Airstart Envelope..... CHECK
Fuel Xfeed Selector..... LOW 1

Inoperative Engine(s):

Start/Stop Selector(s)..... STOP

CONTINUED...

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Ignition(s)..... OVRD

Start/Stop Selector(s)..... START, then RUN

DUAL ENGINE FAILURE CONDITION PERSISTS? **No**

Yes

Landing Configuration:

Emergency Lights..... ARMED

Slat/Flap..... 3

Set V_{REF} = $V_{REF\ FULL}$ + 20 KIAS or V_{REF} = 130 KIAS (whichever is higher).

FORCED LANDING or DITCHING Procedure..... ACCOMPLISH

END

Flight Controls Mode Buttons (Spoilers, Elevators, Rudder)..... PUSH IN, then OUT

After engine(s) stabilized at idle:

Ignition(s)..... AUTO

Fuel..... BALANCE

Descent:

Landing Data..... SET

Approach Aids..... SET

Altimeters..... SET/CHECK

Landing Configuration:

Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Landing Gear..... DOWN

Slat/Flap..... 3

Set V_{REF} = $V_{REF\ FULL}$ + 20 KIAS.

CONTINUED...

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CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.35.

If a go around is required:

Slat/Flap..... 3

Airspeed..... $V_{REF\ FULL}$ + 20 KIAS

END

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EMERGENCY DESCENT

Fstn Belts Signs	ON
Altitude	10000 ft OR MEA, WHICHEVER IS HIGHER
Thrust Levers	IDLE
Speedbrake	FULL OPEN
Airspeed	MAX APPROPRIATE
Transponder	7700
ATC	NOTIFY

END

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EMERGENCY EVACUATION

Emergency/Parking Brake	ON
Slat/Flap Lever	5
Thrust Levers	IDLE
Start/Stop Selectors	STOP
Fire Extinguishing Handles	PULL AND ROTATE (1-L and 2-R)
APU Emergency Stop Button	PUSH IN
APU Fire Extinguishing Button	PUSH
Pressurization Dump Button	PUSH IN
ATC	NOTIFY
Emergency Evacuation	ANNOUNCE
Batteries	OFF

END

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ENGINE ABNORMAL START

Affected engine:
Start/Stop Selector..... STOP

ENGINE AIRSTART ENVELOPE..... CHECK

ENGINE DRY MOTORING CONSIDERED? **No**

Yes

Affected engine:
Ignition..... OFF
Start/Stop Selector..... START, then RUN

.....After appropriate parameters are attained.....
Start/Stop Selector..... STOP
Ignition..... AUTO

If applicable:
Transponder..... TA ONLY
ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

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ENGINE FIRE, SEVERE DAMAGE OR SEPARATION

Autothrottle..... DISENGAGE

Affected engine:

Thrust Lever..... IDLE

Start/Stop Selector..... STOP

Fire Extinguishing Handle..... PULL

LAND AT THE NEAREST SUITABLE AIRPORT.

Fire Extinguishing Handle..... ROTATE
(L or R)

.....Wait 30 seconds.....

FIRE PERSISTS? **No**

Yes

Fire Extinguishing Handle (remaining bottle)..... ROTATE

HIGH VIBRATION? **No**

Yes

Airspeed..... REDUCE

Airspeeds around 200 KIAS are recommended to reduce vibration.

Transponder..... TA ONLY

EICAS ASSOCIATED FUEL INDICATION LOST? **No**

Yes

CONTINUED...

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FUEL LEAK Procedure..... ACCOMPLISH

Assume that fuel is leaking from tank associated to engine failed side.

END

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT ◄

APU..... START
Fuel..... BALANCE
Autothrottle..... AS REQUIRED

When appropriate:

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

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FORCED LANDING

Descent:

Cabin Crew..... NOTIFY

ATC..... NOTIFY

Transponder..... 7700

Aural Warning CBs (C7; C31)..... PULL

No Smkg/Fstn Belts Signs..... ON

ELT..... ON

Landing Data..... SET

At 10000 ft:

Pressurization Dump Button..... PUSH IN

Approach:

Altimeters..... SET

Landing Configuration:

Terrain Inhibit Button..... IN

Landing Gear..... DOWN

Slat/Flap..... MAXIMUM AVAILABLE

APU Emergency Stop Button..... PUSH IN

NOTE: If engines are not running maintain minimum speed of 130 KIAS and alternate gear extension may be required.

Just Before Touchdown:

Cabin..... ANNOUNCE IMPACT

CONTINUED...

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After Landing:

Thrust Levers..... IDLE

Start/Stop Selectors..... STOP

Fire Extinguishing Handles..... PULL AND ROTATE

Emergency Evacuation..... ANNOUNCE

Batteries..... OFF

END

FUEL LEAK

LAND AT THE NEAREST SUITABLE AIRPORT.

NOTE: An unexpected difference between the total fuel quantity indicated on EICAS and the total fuel quantity indicated on the FMS Fuel Management page may indicate a fuel leak condition.

Fuel Xfeed Selector..... OFF

Affected Fuel Tank..... IDENTIFY

Identify the affected fuel tank using the fuel flow, fuel quantity or visually.

Asymmetric Thrust..... AS REQUIRED

Use asymmetric thrust to improve or maintain wing fuel balance to counteract the effect of the suspected wing fuel leak.

LEAK ON THE RH TANK? **No**

Yes

APU..... OFF

Right tank supplies fuel to the APU.

If fuel leakage continues and is severe:

The pilot may consider to shutdown the engine at the same side as the apparent fuel leakage. In that case, perform the engine shutdown procedure and pull the fire handle at the same side.

END

CONTINUED...

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...CONTINUED

►*O.B Nº 170-001/09 - ENGINE STALL DUE TO BACKPRESSURE FROM APU BLEED*

NOTE: If APU use is intended, push OUT the APU Bleed button prior to APU start.

◄

APU..... AS REQUIRED

If fuel leakage continues and is severe:

The pilot may consider to shutdown the engine at the same side as the apparent fuel leakage. In that case, perform the engine shutdown procedure and pull the fire handle at the same side.

END

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JAMMED CONTROL COLUMN (PITCH)

Elev Disc Handle	PULL

Unrestricted Control Column	IDENTIFY
Maximum Airspeed	CURRENT OR 175 KIAS, WHICHEVER IS HIGHER

NOTE: Expect lower pitch rates and authority.

Relevant Inoperative Items:

AOA Limit
Autopilot

Avoid sideslipping the airplane.

NOTE: The stick shaker remains operative.

Landing configuration:

Slat/Flap..... 5

Set $V_{REF} = V_{REF\ FULL} + 15$ KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.29.

If a go around is required:

Slat/Flap	4
Airspeed	$V_{REF\ FULL}$ + 15 KIAS (limited to 175 KIAS)

END

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JAMMED CONTROL WHEEL (ROLL)

Aileron Disc Handle..... PULL

Unrestricted Control Wheel..... IDENTIFY
Maximum Airspeed..... CURRENT OR 175 KIAS, WHICHEVER IS HIGHER

NOTE: – Expect lower roll rates.
– Avoid abrupt and large aileron inputs.
– Maintain bank angle below 25°.
– Rudder may be used to help controlling the airplane.
– Do not accomplish the Spoiler Fault procedure.

Relevant Inoperative Items:

Affected side aileron	Multi Function Spoiler L3 and R3
Autopilot	Another Multi Function Spoiler pair depending on the affected side

Landing configuration:

Slat/Flap..... 5

Set $V_{REF} = V_{REF\ FULL} + 15$ KIAS.

CAUTION:
- DURING LANDING, A CROSSWIND COMPONENT GREATER THAN 10 KT MUST BE AVOIDED.
- MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.29.

If a go around is required:

Slat/Flap..... 4

Airspeed..... $V_{REF\ FULL}$ + 15 KIAS (limited to 175 KIAS)

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END

JAMMED RUDDER PEDALS

Maximum Airspeed..... CURRENT OR 175 KIAS, WHICHEVER IS HIGHER

Relevant Inoperative Items:

Yaw trim

NOTE: Use asymmetric thrust for directional control.

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: DURING LANDING, A CROSSWIND COMPONENT GREATER THAN 10 KT MUST BE AVOIDED.

Before Landing:

Steer Disc Switch (Pilot non flying)..... PRESS and HOLD

Asymmetric Thrust..... MAINTAIN UNTIL NOSEWHEEL TOUCHDOWN

After nosewheel touchdown:

Nosewheel Steering Handle..... PRESS and HOLD

Steer Disc Switch..... RELEASE

Thrust Levers..... IDLE

Asymmetric Braking..... AS REQUIRED

CAUTION: DO NOT RELEASE THE NOSEWHEEL STEERING HANDLE UNTIL THE AIRPLANE IS COMPLETELY STOPPED.

CONTINUED...

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If a go around is required, proceed as a normal go around limiting the airspeed to 175 KIAS.

NOTE: As asymmetric thrust may be required to help controlling the airplane, maximum thrust on both engines may not be possible.

END

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PITCH TRIM RUNAWAY

A/P Disc Button	PRESS AND HOLD
Pitch Trim Systems 1 and 2 Cutout Button	PUSH IN

A/P Disc Button..... RELEASE

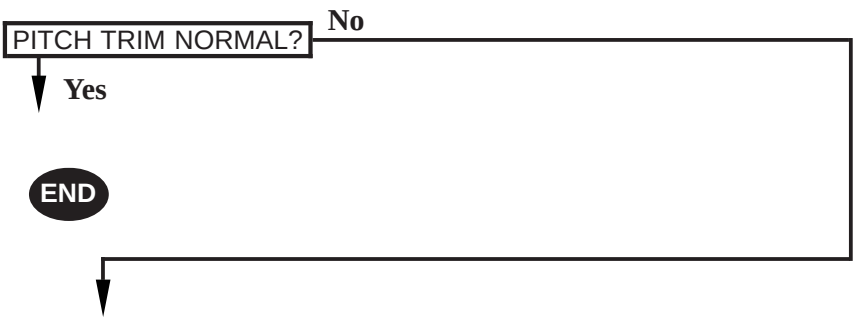
WARNING: DO NOT OPEN THE SPEEDBRAKE.

NOTE: Continuous turns helps to alleviate excessive pitch up tendencies.

Prepare to overcome unwanted pitch change:

Pitch Trim System 1 Cutout Button..... PUSH OUT

Pitch Trim Switch..... ACTUATE



Pitch Trim System 1 Cutout Button..... PUSH IN

Pitch Trim System 2 Cutout Button..... PUSH OUT

END

REJECTED TAKEOFF

Thrust Levers..... IDLE

Reverse Thrust..... AS REQUIRED

CONTINUED...

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Brake Pedals (If Autobrake is not armed)..... MAXIMUM APPLY

NOTE: During RTO the thrust reversers can be used until the airplane comes to a complete stop.

When airplane has stopped:

Emerg/Parking Brake..... ON

If applicable:

EMERGENCY EVACUATION Procedure..... ACCOMPLISH

END

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ROLL (YAW) TRIM RUNAWAY

A/P Disc Button..... PRESS AND HOLD

Do not engage the autopilot.

Prepare to overcome unexpected roll (yaw):

A/P Disc Button..... RELEASE

ROLL (YAW) TRIM NORMAL? **No**

Yes

END

A/P Disc Button..... PRESS AND HOLD

Roll (Yaw) Trim Electronic CB..... OUTROLL (YAW) TRIM RUNAWAY

Select on the MCDU: CB → CB MENU → CB BY SYSTEM → NEXT → FLT CTRL → ROLL TRIM PWR or YAW TRIM PWR.

A/P Disc Button..... RELEASE

END

STEERING RUNAWAY

Steer Disc Switch..... PRESS

Use differential braking and rudder to steer the airplane.

END

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TAKEOFF WITH ENGINE FAILURE AT OR ABOVE V1

At V_R rotate the airplane following the flight director guidance.

In case of flight director is inoperative, rotate the airplane according to the following schedule:

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

Rotate the airplane according to the takeoff pitch angle displayed on TAKEOFF page 3/3 on the MCDU.

◄

With positive climb:

Landing Gear..... UP

Airspeed..... MIN V_2

Maintain V_2 minimum up to the acceleration altitude. At the acceleration altitude, select flaps up according to the flap retraction speed reference indication.

Accelerate the airplane to the final segment speed (V_{FS}) and set the engine thrust rate to continuous.

NOTE: If the airplane is at low weight and the selected altitude is low, TO/GA vertical mode may be reverted to ASEL.

After retracting flaps, accomplish the ENG 1 (2) FAIL Procedure.

END

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ABNORMAL LANDING GEAR EXTENSION

Landing Gear Lever..... DOWN
Electrical Override Switch..... GEAR DOWN

LG INDICATIONS DOWN? **No**

Yes

END

PTU..... ON

.....Wait 30 Seconds.....

PTU..... AUTO

LG INDICATIONS DOWN? **No**

Yes

END

Alternate Gear Extension Lever..... PULL

NOTE: Ensure the Alternate Gear Extension Lever is completely actuated and locked.

Landing Gear Indications..... CHECK

LG INDICATIONS DOWN? **No**

Yes Relevant Inoperative Items

Nosewheel Steering

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END

PARTIAL OR GEAR UP LANDING Procedure..... ACCOMPLISH

END

BLANK DISPLAY UNIT WITHOUT AUTOMATIC REVERSION

Select the affected side reversionary panel display selector to PFD or EICAS, as required.

END

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EICAS MESSAGE MISCOMPARISON

INDICATION: CAS MGS flag on PFD.

CAS SOURCE SELECTION..... ALTERNATE BETWEEN CAS 1 AND CAS 2 AND COMPARE

Select on the MCDU: MENU→MISC (LSK 1L)→SETUP (LSK 2L)→CAS SOURCE SELECTION (LSK 2R)→CAS 1→CAS 2.

Compare the messages of the two CAS sources displayed on the EICAS to check which is the discrepant message. Analyze the situation to check whether the discrepant message is spurious or not, and take the appropriate corrective action.

END

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ENGINE ABNORMAL VIBRATION

EICAS Indication: Engine vibration indication displayed in amber.

Autothrottle..... DISENGAGE

ENG VIBRATION DUE TO ICE ACCUMULATION? **No**

Yes

Associated Thrust Lever..... REDUCE TO IDLE, THEN ADVANCE TO MIN 70% N1

.....Wait 30 seconds.....

Associated Thrust Lever..... AS REQUIRED

END

Associated Thrust Lever..... REDUCE

Reduce thrust to keep vibration within normal range.

Transponder..... TA ONLY

If other engine parameters become abnormal or exceed operating limits:

ENGINE SHUTDOWN Procedure..... ACCOMPLISH

END

ENGINE AIRSTART

NOTE: – After an engine airstart, if flight conditions permit operate the engine at idle for 2 minutes prior to apply engine thrust.

CONTINUED...

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– Engine Starts at altitudes between 20000 and 21000 ft are more reliable with ITT above 50°C.

Autothrottle..... DISENGAGE
Airstart Envelope..... CHECK

ENGINE AIRSTART ASSISTED? **No**

Yes

N2 (Operative Engine)..... MIN 80%

Inoperative engine:

Ignition..... OVRD
Start/Stop Selector..... START, THEN RUN

ENGINE NORMAL START? **No**

Yes

After engine stabilizes at idle:

Ignition..... AUTO
Autothrottle..... AS REQUIRED
Transponder..... TA/RA

END

Start/Stop Selector..... STOP
Ignition..... AUTO
Fuel..... BALANCE
Transponder..... TA ONLY
ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

CONTINUED...

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...CONTINUED

Xbleed Button..... PUSH OUT
APU Bleed Button (if engine 1 affected)..... PUSH OUT

Inoperative engine:

N2..... MIN 7.2%

Ignition..... OVRD

Start/Stop Selector..... START, THEN RUN

ENGINE NORMAL START? **No**

Yes

After engine stabilizes at idle:

Xbleed Button..... PUSH IN

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

NOTE: If the APU is ON, mantain the APU Bleed Button pushed OUT.

◄

APU Bleed Button..... PUSH IN

Ignition..... AUTO

Autothrottle..... AS REQUIRED

Transponder..... TA/RA

END

CONTINUED...

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Xbleed Button..... PUSH IN

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

NOTE: If the APU is ON, mantain the APU Bleed Button pushed OUT.

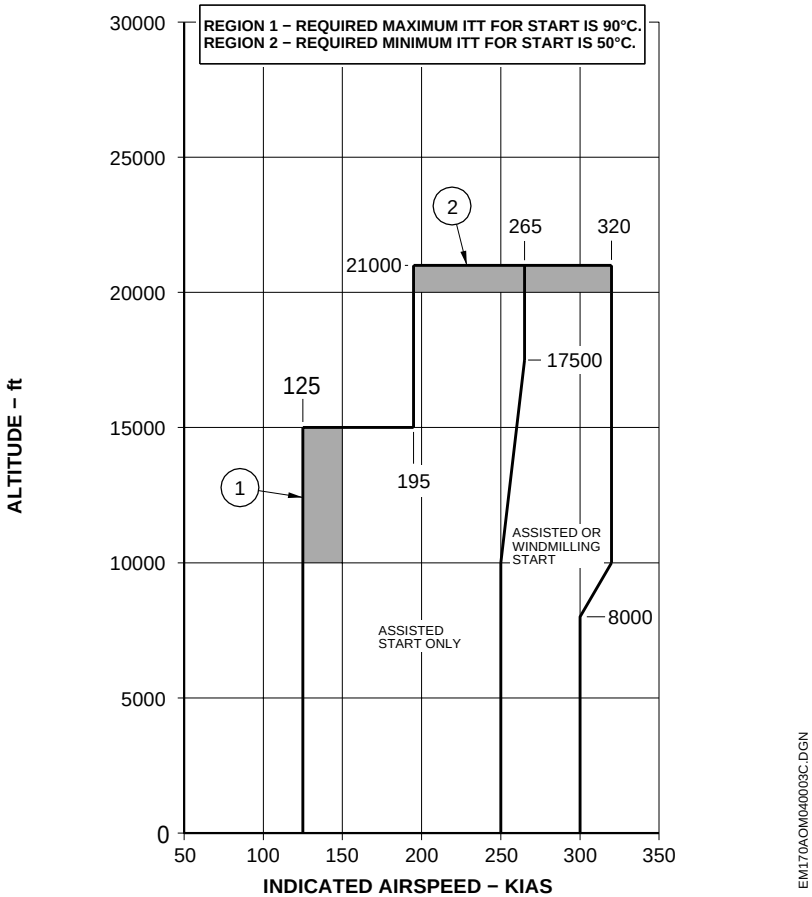
◄

APU Bleed Button..... PUSH IN
Start/Stop Selector..... STOP
Ignition..... AUTO
Transponder..... TA ONLY
ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

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ENGINE AIRSTART ENVELOPE



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ENGINE ITT OVERTEMPERATURE

CONDITION: ITT pointer and digits flashing red.

Autothrottle..... DISENGAGE
Associated Thrust Lever..... REDUCE

Reduce thrust to keep ITT within limits.

Transponder..... TA ONLY

END

ENGINE OIL OVERTEMPERATURE

Autothrottle..... DISENGAGE
Associated Thrust Lever..... ADJUST TO KEEP TEMPERATURE WITHIN LIMITS

NOTE: If oil temperature rise follows thrust reduction, advancing the thrust lever may reduce oil temperature.

Transponder..... TA ONLY

OVERTEMPERATURE REMAINS? **No**

Yes

If other engine parameters become abnormal or exceed operating limits:

ENGINE SHUTDOWN Procedure..... ACCOMPLISH

END

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ENGINE SHUTDOWN

LAND AT THE NEAREST SUITABLE AIRPORT.

Autothrottle..... DISENGAGE

Affected Engine:

Thrust Lever..... IDLE

Start/Stop Selector..... STOP

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT

◄

APU..... START

Associated Fuel Pump..... AUTO

Fuel..... BALANCE

Transponder..... TA ONLY

When appropriate:

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

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ENGINE TAILPIPE FIRE

CONDITION: Tailpipe fire was detected visually by crew or ground personnel. No EICAS message displayed.

Affected Engine:

Thrust Lever..... IDLE

Start/Stop Selector..... STOP

Ignition..... OFF

Fuel Pump..... OFF

Start/Stop Selector..... START, then RUN

ITT..... MONITOR

ATC..... NOTIFY

.....Wait 90 Seconds.....

Associated Start/Stop Selector..... OFF

NOTE: If fire is not extinguished while the engine is motored, it must be extinguished using ground equipment, and maintenance procedures applied.

END

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GEAR LEVER CAN NOT BE MOVED UP

Landing Gear Lever..... DOWN

LG WOW SYS FAIL Procedure..... ACCOMPLISH

NOTE: The DN LOCK REL button may be pressed to move the landing gear lever up if climb performance is required to clear obstacles.

If a go around is required:

Landing Gear..... DOWN

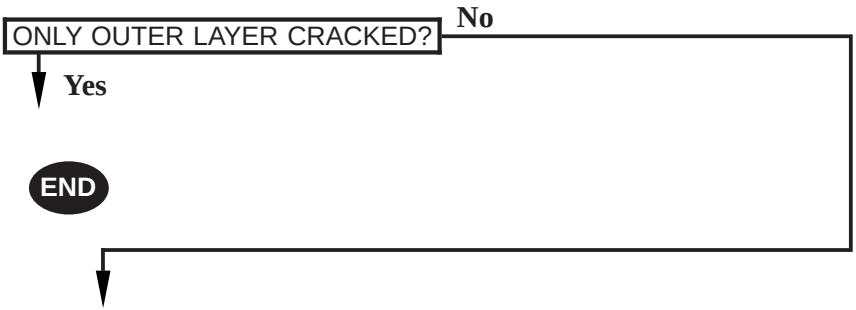
END

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IMPAIRED OR CRACKED WINDSHIELD

Affected Windshield Heating Button..... PUSH OUT
Cockpit Door ..... CLOSE

NOTE: There is a windshield heating wire between the middle and outer layers that can be used as a reference to determine which layer is cracked. If the wire can be seen without a gap the crack is in the outer layer, and if there is a wire discontinuity, the crack may be located in the middle and/or inner layers.



CAUTION: ACCOMPLISH THE DESCENT IN A MAXIMUM OF 15 MINUTES.

Airspeed..... MAX 220 KIAS

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

During Descent:

Pressurization Mode Selector..... MAN

Cabin Altitude..... INCREASE

NOTE: Maintain cabin altitude at 10000 ft while descending the airplane.

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At or below 10000 ft:

Pack 1 Button..... PUSH OUT

Pack 2 Button..... PUSH OUT

ONLY ONE SIDE IMPAIRED **No**

Yes

Pilot flying must be on the non-impaired side.

END

Airspeed..... MAX 140 KIAS

Direct Vision Window..... OPEN

END

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LOSS OF APU INDICATIONS

CONDITION: APU RPM or APU EGT indication on EICAS is displayed in amber dashes.

APU ESSENTIAL FOR THE FLIGHT?

No

Yes

Monitor the APU for the remainder of the flight. If any APU fault message is displayed on EICAS:

APU Emergency Stop Button..... PUSH IN
APU Master Selector..... OFF

Do not restart the APU.

END

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LOSS OF HYDRAULIC SYSTEM 1

Autopilot..... DISENGAGE

NOTE: – Expect lower roll rates and lower speedbrake efficiency.
– Do not accomplish the SPOILER FAULT procedure.
– Do not command the engine 1 reverser.

Relevant Inoperative Items:

Autopilot	Multi Function Spoilers L3, R3, L4 and R4
Engine 1 Reverser	Outboard Brakes
Ground Spoiler L2 and R2	

Plan a long final approach.

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.76.

END

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LOSS OF HYDRAULIC SYSTEM 2

NOTE: – Expect lower roll rates and lower speedbrake efficiency.
– Do not accomplish the SPOILER FAULT procedure.
– Do not command the engine 2 reverser.

Relevant Inoperative Items:

Engine 2 Reverser	Landing Gear Retraction and Normal Extension
Ground Spoilers L1 and R1	Multi Function Spoilers L5 and R5
Inboard Brakes	Nosewheel Steering

Plan a long final approach.

Landing configuration:

Landing Gear Lever..... DOWN

Alternate Gear Extension Lever..... PULL

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.66.

If a go around is required:

Landing Gear..... DOWN

END

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LOSS OF HYDRAULIC SYSTEM 3

Relevant Inoperative Items:

Outboard Aileron Actuators.

END

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LOSS OF HYDRAULIC SYSTEM 1 AND 2

LAND AT THE NEAREST SUITABLE AIRPORT.

NOTE:
- Expect lower roll and pitch rates.
- Do not accomplish the ELEVATOR FAULT and the SPOILER FAULT procedures.
- Apply the Emergency/Parking Brake to stop the airplane monitoring the Emergency/Parking Brake light.
- When the Emergency/Parking Brake light is on, maintain steady pressure since the Anti-Skid protection is not available.

Relevant Inoperative Items:

Autopilot	Multi Function Spoilers L3, R3, L4, R4, L5 and R5
Engine 1 and Engine 2 Reversers	Nosewheel Steering
Ground Spoilers L1, R1, L2 and R2	Outboard and Inboard Brakes
Landing Gear Retraction and Normal Extension	Speedbrake
L.H. Elevator	

Plan a long final approach.

Landing configuration:

Landing Gear Lever..... DOWN

Alternate Gear Extension Lever..... PULL

Slat/Flap..... 5

Airspeed..... $V_{REF\ FULL}$ + 10 KIAS

CAUTION:
- AVOID LANDING WITH CROSSWIND COMPONENTS ABOVE 10 KT.
- MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.46.

If a go around is required:

Landing Gear Lever..... DOWN

CONTINUED...

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Slat/Flap..... 5

Airspeed..... $V_{REF\ FULL}$ +
10 KIAS

END

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LOSS OF HYDRAULIC SYSTEM 1 AND 3

LAND AT THE NEAREST SUITABLE AIRPORT.

Autopilot..... DISENGAGE

NOTE: – Expect lower roll rates and lower speedbrake efficiency.
– Do not accomplish the SPOILER FAULT procedure.
– Do not command the engine 1 reverser.

Relevant Inoperative Items:

Autopilot	Outboard aileron actuators.
Engine 1 Reverser	Outboard Brakes
Ground Spoilers L2 and R2	Rudder
Multi Function Spoilers L3, R3, L4 and R4	

Landing configuration:

Slat/Flap..... 5

Airspeed..... $V_{REF\ FULL}$ + 10 KIAS

CAUTION:
- AVOID LANDING WITH CROSSWIND COMPONENTS ABOVE 10 KT.
- MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.11.

END

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LOSS OF HYDRAULIC SYSTEM 2 AND 3

LAND AT THE NEAREST SUITABLE AIRPORT.

NOTE: – Expect lower roll and pitch rates and lower speedbrake efficiency.
– Do not accomplish the ELEVATOR FAULT and the SPOILER FAULT procedures.
– Do not command the engine 2 reverser.

Relevant Inoperative Items:

Ailerons	Landing Gear Retraction and Normal Extension
Autopilot	Multi Function Spoilers L5 and R5
Engine 2 Reverser	NoseWheel Steering
Ground Spoilers L1 and R1	R.H. Elevator
Inboard Brakes	

Plan a long final approach.

Landing configuration:

Landing Gear Lever..... DOWN

Alternate Gear Extension Lever..... PULL

Slat/Flap..... 5

Airspeed..... $V_{REF\ FULL}$ + 10 KIAS

CAUTION:
- AVOID LANDING WITH CROSSWIND COMPONENTS ABOVE 10 KT.
- MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.96.

If a go around is required:

Landing Gear Lever..... DOWN

Slat/Flap..... 5

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Airspeed..... $V_{REF\ FULL}$ + 10 KIAS

END

LOSS OF PRESSURIZATION INDICATION

CONDITION: Cabin altitude or cabin ΔP is not being presented, or during use of the pressurization manual control.

NOTE: This table must be used to control the cabin altitude/ΔP, when operating in manual mode only.

AIRPLANE/CABIN ALTITUDE CONVERSION TABLE

AIRPLANE ALTITUDE (ft)	CABIN ALTITUDE (ft)	DIFFERENTIAL PRESSURE (psid)
10000	900	4.2
11000	1000	4.5
12000	1200	4.8
13000	1300	5.1
14000	1500	5.3
15000	1700	5.6
16000	1900	5.8
17000	2100	6.0
18000	2300	6.2
19000	2600	6.4
20000	2800	6.6
21000	3000	6.7
22000	3300	6.9
23000	3600	7.0
24000	3900	7.1
25000	4200	7.2
26000	4500	7.3
27000	4800	7.4
28000	5100	7.5

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AIRPLANE ALTITUDE (ft)	CABIN ALTITUDE (ft)	DIFFERENTIAL PRESSURE (psid)
29000	5400	7.5
30000	5700	7.6
31000	6000	7.7
32000	6300	7.7
33000	6700	7.7
34000	7000	7.8
35000	7300	7.8
36000	7600	7.8
37000	8000	7.8
38000	8000	8.0
39000	8000	8.1
40000	8000	8.3
41000	8000	8.4

END

ONE ENGINE INOPERATIVE APPROACH AND LANDING

Descent:

Landing Data ..... SET

Approach Aids..... SET

Altimeters ..... SET/CHECK

Landing Configuration:

Landing Gear..... DOWN

Slat/Flap..... 5

Set $V_{REF} = V_{REF\ FULL} + 20$ KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.37.

If a go around is required:

TOGA Button..... PRESS

CONTINUED...

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Thrust Levers..... TO/GA

Rotate the airplane following the flight director guidance.

NOTE: – In case of flight director guidance is inoperative, rotate the airplane to 8° nose up.

Slat/Flap..... 2

With positive climb:

Landing Gear..... UP

Airspeed..... Approach Climb Speed

END

OXYGEN LEAKAGE

CONDITION: Evidence of oxygen leakage through the crew masks, mask hose, flow indicator (blinker), or oxygen lines.

No Smoking..... ON
Oxygen Test/Reset Button..... ACTUATE
Altitude..... AS REQUIRED

END

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PARTIAL OR GEAR UP LANDING

NOTE: – Plan to land on available gear.
– Burn off fuel to reduce touchdown speed.

Prior to approach:

Cabin Crew..... NOTIFY
Aural Warning CBs (C7; C31)..... PULL
APU..... OFF
Pressurization Dump Button ..... PUSH IN
Landing Gear Lever..... DOWN
Slat/Flap..... FULL

Just Before Touchdown:

Cabin..... ANNOUNCE

After Landing:

Thrust Levers..... IDLE
Start/Stop Selectors..... STOP
Fire Extinguishing Handles..... PULL and ROTATE
Emergency Evacuation..... ANNOUNCE
Batteries..... OFF

If a go around is required:

Landing Gear Lever..... DOWN

END

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STRUCTURAL DAMAGE

LAND AT THE NEAREST SUITABLE AIRPORT.

Airspeed..... MAX 200 KIAS

Avoid high maneuvering loads.

FUSELAGE IS DAMAGED? **No**

Yes

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

When reaching 10000 ft:

Pressurization Dump Button..... PUSH IN

Establish landing configuration early.

END

UNRELIABLE AIRSPEED

Autothrottle..... DISENGAGE

Avoid quick Thrust Lever movements.

Autopilot..... DISENGAGE

Flight Director..... OFF

Yaw Damper..... OFF

CAUTION: AVOID USING THE SPEEDBRAKE.

Attitude/Thrust..... ADJUST

Maintain airplane control. Refer to Unreliable Airspeed tables. Altitude and/or Vertical Speed indications may also be unreliable.

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Ground speed indication is available on the PFD for reference.

GPS altitude may also be used as a reference if PFD indication is unreliable.

UNRELIABLE AIRSPEED TABLES

CLIMB, Flaps UP, CLB-1 Thrust Rating Mode

PRESSURE ALTITUDE (FT)		WEIGHT (KG)					
		30000	36000	42000	48000	51000	54000
0 (250 KIAS)	Pitch ATT V/S (ft/min)	14 6300	13 5100	11 4300	11 3600	10 3300	10 3000
10000 (250 KIAS)	Pitch ATT V/S (ft/min)	7 3300	6 2700	6 2200	6 1800	6 1700	7 1500
20000 (290 KIAS)	Pitch ATT V/S (ft/min)	5 3500	4 2700	4 2200	4 1800	4 1600	4 1500
30000 (0.75 Mach)	Pitch ATT V/S (ft/min)	3 2600	3 2000	3 1500	3 1100	3 900	3 700
40000 (0.75 Mach)	Pitch ATT V/S (ft/min)	3 1200	4 600	-	-	-	-

CRUISE, Flaps UP, %N1 for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (KG)					
		30000	36000	42000	48000	51000	54000
10000 (250 KIAS)	Pitch ATT %N1	0 63.3	1 64.5	2 66.2	3 67.8	3 68.7	4 69.6
15000 (270 KIAS)	Pitch ATT %N1	0 69.8	1 70.8	1 72.0	2 73.4	2 74.3	3 75.1
20000 (270 KIAS)	Pitch ATT %N1	0 73.2	1 74.4	1 75.8	2 77.3	2 77.9	3 78.6
25000 (270 KIAS)	Pitch ATT %N1	0 76.9	1 78.2	1 79.4	2 81.0	2 81.8	3 82.8

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30000 (0.70 Mach)	Pitch ATT %N1	0 79.7	1 80.9	2 82.5	3 84.2	3 85.0	3 86.0
35000 (0.70 Mach)	Pitch ATT %N1	1 79.8	2 81.8	3 83.8	4 87.6	5 89.2	-
40000 (0.70 Mach)	Pitch ATT %N1	3 82.2	4 86.0	-	-	-	-

DESCENT, Flaps UP, IDLE Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (KG) 30000	36000	42000	48000	51000	54000
0 (250 KIAS)	Pitch ATT V/S (ft/min)	-4 -1800	-3 -1600	-2 -1500	-1 -1500	0 -1400	0 -1400
10000 (250 KIAS)	Pitch ATT V/S (ft/min)	-2 -1400	-1 -1200	0 -1100	1 -1100	1 -1100	1 -1100
20000 (290 KIAS)	Pitch ATT V/S (ft/min)	-5 -3000	-4 -2900	-3 -2600	-2 -2500	-2 -2400	-1 -2300
30000 (0.75 Mach)	Pitch ATT V/S (ft/min)	-4 -3000	-3 -3000	-3 -3000	-2 -3000	-2 -3000	-1 -3000
40000 (0.75 Mach)	Pitch ATT V/S (ft/min)	-2 -2800	-1 -2700	1 -2600	2 -2600	2 -2600	3 -2700

HOLDING, %N1 for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (KG) 30000	36000	42000	48000	51000	54000
5000	Pitch ATT	2	3	4	5	6	5
	%N1	54.0	56.2	58.7	61.6	63.0	64.6
	KIAS	210	210	210	210	210	220
10000	Pitch ATT	2	3	4	5	6	6
	%N1	57.6	59.9	62.5	65.3	66.7	68.2
	KIAS	210	210	210	210	210	220

CONTINUED...

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TERMINAL AREA (5000FT), Gear UP, %N1 for Level Flight

SLAT/FLAP POSITION ($V_{REF\ FULL}$ + INCREMENT)		WEIGHT (KG)			
		30000	36000	42000	48000
SLAT/FLAP 0 ($V_{REF\ FULL}$ + 60)	Pitch ATT %N1	5 63.4	6 68.4	7 72.8	7 76.8
SLAT/FLAP 1 ($V_{REF\ FULL}$ + 35)	Pitch ATT %N1	6 67.6	7 73.0	7 77.6	8 81.7
SLAT/FLAP 2 ($V_{REF\ FULL}$ + 25	Pitch ATT %N1	7 68.5	8 74.1	8 78.7	9 82.9
SLAT/FLAP 3 ($V_{REF\ FULL}$ + 20)	Pitch ATT %N1	5 71.6	6 77.0	6 81.5	6 85.7
SLAT/FLAP 4 ($V_{REF\ FULL}$ + 10)	Pitch ATT %N1	8 72.8	8 78.4	9 83.0	9 87.2

FINAL APPROACH (1500FT), Flaps Down, %N1 for 3° GLIDESLOPE

SLAT/FLAP POSITION ($V_{REF\ FULL}$ + INCREMENT)		WEIGHT (KG)			
		30000	36000	42000	48000
SLAT/FLAP 5 ($V_{REF\ FULL}$ + 10)	Pitch ATT %N1	5 59.5	6 64.5	6 68.8	6 72.7
SLAT/FLAP FULL ($V_{REF\ FULL}$ + 10)	Pitch ATT %N1	1 65.8	2 70.6	2 74.9	2 78.8

END

VOLCANIC ASH

LAND AT THE NEAREST SUITABLE AIRPORT.

Volcanic Ash Area..... EXIT/AVOID

CONTINUED...

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...CONTINUED

Ignition Selectors..... OVRD
Autothrottle..... DISENGAGE
Ice Protection Mode Selector..... ON

If altitude permits:

Thrust Lever..... IDLE

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT

◄

APU..... ON
Recirculation Button..... PUSH OUT
ITT..... MONITOR

ANY ENGINE FLAMEOUT? **No**

Yes

Ice Protection Mode Selector..... AUTO

ENG 1 (2) FAIL or DUAL ENGINE FAILURE Procedure..... ACCOMPLISH

END

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AIRPLANE GENERAL (CARGO COMPARTMENT/DOORS/LIGHTING)

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DOOR HYD OPEN 4-03-01 4
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ADVISORY

DOOR FUELING OPEN ..... Crew Awareness
EMER LT BATT FAULT ..... Crew Awareness

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DOOR CRG FWD (AFT) OPEN

NORMAL PRESSURIZATION?

No

Yes

END

LAND AT THE NEAREST SUITABLE AIRPORT.

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

At 10000 ft :

Pressurization Dump Button..... PUSH IN

END

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DOOR EMER LH (RH) OPEN

Fstn Belts Signs..... ON

NORMAL PRESSURIZATION?

No

Yes

Check the affected door lock indicators.

MINIMUM OF 1 INDICATOR IN GREEN?

No

Yes

END

LAND AT THE NEAREST SUITABLE AIRPORT.

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

At 10000 ft:

Pressurization Dump Button..... PUSH IN

END

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DOOR PAX (SERV) FWD (AFT) OPEN

Fstn Belts Signs..... ON

NORMAL PRESSURIZATION?

No

Yes

Check the affected door lock and latch indicators.

MINIMUM OF 2 INDICATORS IN GREEN?

No

Yes

END

LAND AT THE NEAREST SUITABLE AIRPORT.

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

At 10000 ft:

Pressurization Dump Button..... PUSH IN

END

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DOOR CENTER (FWD) EBAY OPEN

NORMAL PRESSURIZATION? — No

Yes

END

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

END

DOOR HYD OPEN

Airspeed..... MAX 250 KIAS

END

EMER LT NOT ARMED

Emergency Lights..... ARMED

END

EMER LT ON

Emergency Lights..... OFF, then ARMED

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END

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DOOR FUELING OPEN

Crew Awareness.

END

EMER LT BATT FAULT

Crew Awareness.

END

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AMS - PNEUMATIC/AIR CONDITIONING/PRESSURIZATION

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XBLEED SW OFF	Crew Awareness	

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CABIN ALTITUDE HI

EICAS Indication: Cabin Altitude indication in red.

Aural Warning: CABIN

Crew Oxygen Masks	DON, 100%
Crew Communication	ESTABLISH
Altitude	10000 ft or MEA, WHICHEVER IS HIGHER
Thrust Levers	IDLE
Speed Brake	FULL OPEN
Airspeed	MAX/ APPROPRIATE
Transponder	7700
ATC	NOTIFY

Pressurization DUMP Button..... PUSH

Cabin Altitude..... MONITOR

CABIN ALTITUDE REACHES 14500 ft?

No

Yes

Passenger Oxygen Selector..... OVRD

END

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AMS CTRL FAIL

CONDITION: Cabin Pressurization and temperature control is lost.

Icing Conditions..... EXIT/AVOID
Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

NOTE: Monitor Cabin Altitude and increase rate of descent accordingly. An emergency descent may be required.

At 10000 ft:

Pressurization Dump Button..... PUSH IN

NOTE: – Assisted crossbleed start is not available.
– Pneumatic assisted engine start with APU is not available.

END

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BLEED 1 (2) FAIL

Affected Bleed Button..... PUSH OUT

.....Wait 1 minute.....

BLEED 1 (2) FAIL MESSAGE EXTINGUISHES? **No**

Yes

Affected Bleed Button..... PUSH IN

END

BOTH BLEEDS AFFECTED? **No**

Yes

Icing Conditions..... EXIT/AVOID

APU..... START

Altitude..... MAX 15000 ft

END

Altitude..... MAX 31000 ft

END

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BLEED 1 (2) LEAK

Light: Amber stripped bar illuminates inside the affected bleed button

Affected Bleed Button..... PUSH OUT
APU Bleed Button (if applicable)..... PUSH OUT
XBleed Button..... PUSH OUT
Icing Conditions..... EXIT/AVOID
Altitude..... MAX 31000 ft

.....Wait 3 minutes.....

BLEED 1 (2) LEAK MESSAGE EXTINGUISHES? **No**

Yes

END

NOTE: Consider the possibility of leaking occuring in the oposite side.

Opposite Side Bleed Button..... PUSH OUT
APU Bleed Button..... OFF
Altitude..... 10000 FT OR MEA WHICHEVER IS HIGHER

At 10000 ft

Pressurization Dump Button..... PUSH IN

END

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BLEED 1 (2) OVERPRESS

Affected Bleed Button..... PUSH OUT
then IN

BLEED 1 (2) OVERPRESS MESSAGE EXTINGUISHES?

No

Yes

END

Affected Bleed Button..... PUSH OUT
APU Bleed Button (if applicable)..... PUSH OUT
XBleed Button..... PUSH OUT
Icing Conditions..... EXIT/AVOID
Altitude..... MAX 31000 ft

BLEED 1 (2) OVERPRESS MESSAGE EXTINGUISHES?

No

Yes

END

Associated Thrust Lever..... IDLE
Transponder..... TA ONLY

When applicable:

ONE ENGINE INOPERATIVE APPROACH AND

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LANDING Procedure..... ACCOMPLISH

END

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BLEED APU LEAK

APU Bleed Button..... PUSH OUT

.....Wait 3 minutes.....

BLEED APU LEAK MESSAGE EXTINGUISHES?

No

Yes

END

APU Emergency Stop Button..... PUSH IN

APU..... OFF

BLEED APU LEAK MESSAGE EXTINGUISHES?

No

Yes

END

Bleed 1 Button..... PUSH OUT

XBleed Button..... PUSH OUT

Verify BLEED 1 OFF and XBLEED SW OFF messages displayed on EICAS.

Icing Conditions..... EXIT/AVOID

Altitude..... MAX 31000 ft

END

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CABIN DIFF PRESS FAIL

EICAS Indication: Abnormal cabin altitude indication may be presented.

If Cabin Differential Pressure red limit is reached:

CABIN DIFFERENTIAL PRESSURE POSITIVE? **No**

Yes

Pack 1 Button..... PUSH OUT

Pack 2 Button..... PUSH OUT

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

END

Airplane Descent Rate..... REDUCE

END

CENTER EBAY FANS FAIL

LAND AT THE NEAREST SUITABLE AIRPORT.

END

CRG FWD VENT FAIL

LAND AT THE NEAREST SUITABLE AIRPORT.

END

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FWD EBAY FANS FAIL

TRU 1 (2) FAIL MESSAGE DISPLAYED?

No

Yes

LAND AT THE NEAREST SUITABLE AIRPORT.

END

PACK 1 (2) FAIL

Associated Temperature Controller..... 12 O'CLOCK
Affected Pack Button..... PUSH OUT

.....Wait 1 minute.....

Affected Pack Button..... PUSH IN

PACK 1 (2) FAIL MESSAGE EXTINGUISHES?

No

Yes

After 1 minute:

Associated Temperature Controller..... OPERATE NORMALLY

END

Affected Pack Button..... PUSH OUT
Altitude..... MAX 31000 ft

END

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PACK 2 LEAK

Pack 2 Button..... PUSH OUT
Altitude..... MAX 31000 ft

.....Wait 3 minutes.....

PACK 2 LEAK MESSAGE EXTINGUISHES? **No**

Yes

END

Icing Conditions..... EXIT/AVOID
Bleed 2 Button..... PUSH OUT
XBleed Button..... PUSH OUT

END

PRESN AUTO FAIL

EICAS Indication: Landing Field Elevation indications showing amber dashes.

Pressurization Mode Selector..... MAN, THEN AUTO

PRESN AUTO FAIL MESSAGE EXTINGUISHES? **No**

Yes

END

CONTINUED...

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...CONTINUED

Pressurization Mode Selector..... MAN
Cabin Alt Controller..... AS REQUIRED

Operate the cabin altitude control knob to set pressurization according to the PRESSURIZATION CONVERSION TABLE.

At 5000 ft AGL:

Cabin Alt Controller..... HOLD UP FOR 50 s

END

PRESN MAN FAIL

Altitude ..... 10000 ft OR MEA, WHICHEVER IS HIGHER

At 25000 ft:

Pack 1 Button..... PUSH OUT

At 10000 ft:

Pack 2 Button..... PUSH OUT

END

PRESSURIZATION CONVERSION TABLE

NOTE: This table must be used to control the cabin altitude/ ΔP when operating in manual mode only.

CONTINUED...

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...CONTINUED

AIRPLANE/CABIN ALTITUDE CONVERSION TABLE

AIRPLANE ALTITUDE (ft)	CABIN ALTITUDE (ft)	DIFFERENTIAL PRESSURE (psid)
10000	900	4.2
11000	1000	4.5
12000	1200	4.8
13000	1300	5.1
14000	1500	5.3
15000	1700	5.6
16000	1900	5.8
17000	2100	6.0
18000	2300	6.2
19000	2600	6.4
20000	2800	6.6
21000	3000	6.7
22000	3300	6.9
23000	3600	7.0
24000	3900	7.1
25000	4200	7.2
26000	4500	7.3
27000	4800	7.4
28000	5100	7.5
29000	5400	7.5
30000	5700	7.6
31000	6000	7.7
32000	6300	7.7
33000	6700	7.7
34000	7000	7.8
35000	7300	7.8
36000	7600	7.8
37000	8000	7.8
38000	8000	8.0
39000	8000	8.1
40000	8000	8.3

CONTINUED...

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...CONTINUED

AIRPLANE ALTITUDE (ft)	CABIN ALTITUDE (ft)	DIFFERENTIAL PRESSURE (psid)
41000	8000	8.4

END

RECIRC SMK DET FAIL

Recirc Fan Button..... PUSH OUT

END

AMS CTRL FAULT

Crew Awareness.

END

BLEED 1 (2) OFF

Altitude..... MAX 31000 ft

END

PACK 1 (2) OFF

Altitude..... MAX 31000 ft

END

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PRESN AUTO FAULT

Crew Awareness.

END

RAM AIR FAULT

Crew Awareness.

END

XBLEED FAIL

Crew Awareness.

END

XBLEED SW OFF

Crew Awareness.

END

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AUTOFLIGHT

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AT FAULT	Crew Awareness	
FD FAIL	Crew Awareness	
FD FAULT	Crew Awareness	
SHAKER 1 (2) FAIL	Crew Awareness	
STALL PROT FAULT	Crew Awareness	
YD FAIL	Crew Awareness	
YD FAULT	Crew Awareness	
YD OFF	Crew Awareness	

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AP FAIL

Fly the airplane manually.

RVSM capability is lost.

END

AP PITCH MISTRIM

Control Wheel..... HOLD FIRMLY
A/P Disc Button ..... PRESS
Pitch Trim..... AS REQUIRED
Autopilot..... AS REQUIRED

END

AP PITCH TRIM FAIL

Control Wheel..... HOLD FIRMLY
A/P Disc Button..... PRESS
Pitch Trim..... AS REQUIRED
Autopilot..... AS REQUIRED

END

AP ROLL MISTRIM

Roll Trim..... AS REQUIRED

END

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AT FAIL

Operate thrust levers manually.

END

AT NOT IN HOLD

Disengage the autothrottle.

END

FD LATERAL MODE OFF

Select a flight director lateral mode.

END

FD VERT MODE OFF

Select a flight director vertical mode.

END

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SHAKER ANTICIPATED

Avoid side slipping the airplane.

Airspeed..... MAX 0.5 M

FLAP FAIL MESSAGE PRESENTED? — No

Yes

FLAP FAIL Procedure..... ACCOMPLISH

END

SLAT FAIL MESSAGE PRESENTED? — No

Yes

SLAT FAIL Procedure..... ACCOMPLISH

END

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

END

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STALL PROT FAIL

Condition: Stick Shaker and AOA Limiting are inoperative.

Avoid side slipping the airplane.

Landing Configuration:

For flaps 5, set $V_{REF} = V_{REF\ FULL} + 15$ KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.29.

For flaps FULL, set $V_{REF} = V_{REF\ FULL} + 10$ KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.15.

END

AFCS FAULT

Crew Awareness

END

AFCS PANEL FAIL

Crew Awareness.

END

AFCS PANEL FAULT

Crew Awareness.

END

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AP FAULT

Crew Awareness.

END

AP PITCH TRIM FAULT

Crew Awareness.

END

AT FAULT

Crew Awareness.

END

FD FAIL

Crew Awareness.

END

FD FAULT

Crew Awareness.

END

SHAKER 1 (2) FAIL

Crew Awareness.

END

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STALL PROT FAULT

Crew Awareness.

END

YD FAIL

Crew Awareness.

END

YD FAULT

Crew Awareness.

END

YD OFF

Crew Awareness.

END

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AUXILIARY POWER UNIT

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APU OIL LO PRESS	4-03-04	3

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►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

APU ALTITUDE EXCEED

APU IS ESSENTIAL FOR FLIGHT?

No

Yes

Descend until the message is no longer displayed.

END

APU..... OFF

END

◄

APU FAIL

APU FAILED DURING START?

No

Yes

APU can be restarted according to the APU starter limitations.

END

APU..... OFF

Do not restart the APU.

END

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APU FAULT

EICAS Indication: Abnormal APU EGT indication may be presented.

ABNORMAL INDICATION?

No

Yes

APU Bleed Button..... PUSH OUT

.....Wait 1 minute.....

ABNORMAL INDICATION REMAINS?

No

Yes

APU Emergency Stop Button..... PUSH IN
APU..... OFF

END

NOTE: If the APU is not essential for the flight, turn off the APU.

END

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APU OIL HI TEMP

APU FAULT Procedure..... ACCOMPLISH

END

APU OIL LO PRESS

APU FAULT Procedure..... ACCOMPLISH

END

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ELECTRICAL

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ADVISORY

REMOTE CB TRIP..... Crew Awareness
SPDA FAIL ..... 4-03-05..... 17

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BATT 1 (2) OVERTEMP

Associated Battery..... OFF

NOTE: Do not start the APU.

END

BATT 1-2 OFF

LAND AT THE NEAREST SUITABLE AIRPORT.

NOTE: APU start is not available.

END

BATT DISCHARGING

LAND AT THE NEAREST SUITABLE AIRPORT.

END

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ELEC EMERGENCY

LAND AT THE NEAREST SUITABLE AIRPORT.

Airspeed..... MIN 150 KIAS

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT

◄

APU..... START

IDG 1 Selector..... OFF, THEN AUTO

IDG 2 Selector..... OFF, THEN AUTO

Emergency Lights..... OFF

CAUTION: ONLY TWO APU START ATTEMPTS ARE ALLOWED.

ELEC EMERGENCY MESSAGE PERSISTS? **No**

Yes

BATT DISCHARGING MESSAGE PRESENTED? **No**

Yes

RAT Manual Deploy Lever..... PULL

TRU 1 Switch ..... OFF

TRU 2 Switch ..... OFF

Icing Conditions..... EXIT/AVOID

Altitude..... 10000 ft OR MEA, WHICHEVER IS HIGHER

CONTINUED...

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...CONTINUED

Relevant Inoperative Items:

ADS 1 and 2	IRS 2
Anti-Ice System	MCDU 1
AOA Limit	Multi Function Spoilers L3, R3, L4, R4, L5 and R5
Autopilot	NAVCOM 2
Autothrottle	Nosewheel Steering
CCD 2	Pack 1 and 2
Display Unit 1, 4 and 5	Pax Masks Auto Deploy
Engine 1 and Engine 2 Reversers	Radio Altimeters 1 and 2
FMS 1	Speedbrake
Flight Director 1 and 2	TAT 1 and 2
Fuel AC Pump 1	TCAS
GPS 1	Yaw Damper
Ground Spoilers L1, R1, L2 and R2	Weather Radar
Hyd Sys 1 Elec Pump	Windshear Detection
Hyd Sys 2 Elec Pump	Windshield Heater 1 and 2
Hyd Sys 3 Elec Pump B	Windshield Wiper 1 and 2
Ice Detectors 1 and 2	

NOTE: – Avoid side slipping the airplane.
– On ground, use differential braking and rudder to steer the airplane.
– The slats and flaps will operate at low rate.

Landing configuration:

Emergency Lights..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

LG WRN INHIB Button..... PUSH IN

Slat/Flap..... 3

Set $V_{REF} = V_{REF\ FULL}$ + 20 KIAS or 130 KIAS (whichever is higher).

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 2.21.

If a go around is required:

CONTINUED...

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...CONTINUED

Slat/Flap..... 3

Airspeed..... $V_{REF\ FULL}$ + 20 KIAS or 130 KIAS (whichever is higher)

END

Flight Controls Mode Buttons (Spoilers, Elevators and Rudder)..... PUSH IN, THEN OUT

Landing configuration:

Emergency Lights ..... ARMED

Gnd Prox Flap Ovrd Button..... PUSH IN

Slat/Flap..... 3

Set V_{REF} = $V_{REF\ FULL}$ +20 KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.35.

If a go around is required:

Slat/Flap..... 3

Airspeed..... $V_{REF\ FULL}$ + 20 KIAS

END

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AC BUS 1 OFF

Relevant Inoperative Items:

Fuel AC Pump 1	Pitch Trim Indication
Hyd Sys 2 Elec Pump	Windshield Wiper 2
Ice Detector 1	Windshield Heater 2

NOTE: – The slats will operate at low rate mode.
– Fuel Crossfeed Low 2 is not available.

When flying in icing conditions:

Ice Protection Mode Selector..... ON

Two minutes after exiting icing conditions:

Ice Protection Mode Selector..... AUTO

END

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AC BUS 2 OFF

Relevant Inoperative Items:

Hyd Sys 1 Elec Pump	Windshield Wiper 1
Hyd Sys 3 Elec Pump B	Windshield Heater 1
Ice Detector 2	

NOTE: The flaps will operate at low rate.

When flying in icing conditions:

Ice Protection Mode Selector..... ON

Two minutes after exiting icing conditions:

Ice Protection Mode Selector..... AUTO

END

AC ESS BUS OFF

TRU ESS Switch..... OFF

Relevant Inoperative Items:

AC Fuel Pump 2
Hyd Sys 3 Elec Pump A
Pitch Trim Indication

NOTE: – The flaps and slats will extend at low rate mode.
– Fuel Crossfeed Low 1 is not available.

END

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AC STBY BUS OFF

Monitor the electrical system.

Relevant Inoperative Items:

Ignition 1A
Ignition 2A

NOTE: Engine Start, with batteries only, is not available.

END

APU GEN OFF BUS

APU Gen Button..... PUSH OUT, THEN IN

APU GEN OFF BUS MESSAGE EXTINGUISHES?

No

Yes

END

APU Gen Button..... PUSH OUT

END

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BATT 1 (2) DISCHARGING

Associated TRU Switch..... OFF, THEN AUTO

BATT 1 (2) DISCHARGING MESSAGE EXTINGUISHES?

No

Yes

END

Associated TRU Switch..... OFF

END

BATT 1 (2) TEMP SENS FAULT

Crew Awareness.

END

BATT 1 OFF

Battery 1..... VERIFY ON

NOTE: If battery 1 selector is off, APU start is not available.

END

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BATT 2 OFF

Battery 2..... VERIFY AUTO

END

DC BUS 1 OFF

Autothrottle..... DISENGAGE
Emergency Lights..... OFF
Altitude..... MAX 31000 ft

Relevant Inoperative Items:

ADS 1	Nosewheel Steering
Autopilot	Pax Oxy Masks Auto Deploy
Autothrottle 1	Pack 1
CCD 2	Pitch Trim Indication
Display Unit 1	PTU
Display Unit 4	Radio Altimeter 1
Engine 1 Reverser	Weather Radar
Hyd Sys 2 Elec Pump	Windshield Heater 2
MCDU 1	Windshield Wiper 2
Multi Function Spoiler L5 and R5	

NOTE: The slats will operate at low rate.

Landing Configuration:

Emergency Lights..... ARMED

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.07.

CONTINUED...

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...CONTINUED

On ground:

Use differential braking and rudder to steer the airplane.

END

DC BUS 2 OFF

Autothrottle..... DISENGAGE
Altitude..... MAX 31000 ft

Relevant Inoperative Items:

ADS 2	Nosewheel Steering
Autobrakes	Pack 2
Autothrottle 2	Pax Oxy Masks Auto Deploy
Display Unit 5	Pedal Adjustment Switch
Engine 2 Reverser	Pitch Trim indication
Engines Vibration Indications	Radio Altimeter 2
FMS 1	Roll Trim
HF Transceiver	Speedbrake
Hyd Sys 1 Elec Pump	TCAS
Hyd Sys 1 Elec Pump	Transponder 2
Hyd Sys 3 Elec Pump B	Windshield Heater 1
Multi Function Spoilers L3, R3, L4 and R4	Windshield Wiper 1
NAVCOM 2	

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.10.

CONTINUED...

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...CONTINUED

On ground:

Use differential braking and rudder to steer the airplane.

END

DC ESS BUS 1 OFF

LAND AT THE NEAREST SUITABLE AIRPORT.

Icing Conditions..... EXIT/AVOID
Battery 1..... OFF

Relevant Inoperative Items:

ADS 1	Ignition 1A
APU	Master Warning/Caution 1
Autopilot	MCDU 1 (except circuit breakers page)
Digital Audio Panel 1	Multi Function Spoilers L5 and R5
Display Unit 3	NAVCOM 1
Engine 1 Start Valve	Oil Pressure Indicator 1
Fuel Quantity 1 Indication	Outboard Brakes
Fwd LAV Smoke Detection	RAT Automatic Deployment
Hyd Sys 2 Depressurization Valve	Transponder 1
Hyd Sys 3 Elec Pump A	Weather Radar

NOTE:
- Compass internal light will be lost.
- FADEC will set flight idle on ground.
- The flaps will operate at low rate.
- Engine 2 windmill start is not available.
- Thrust Reversers, Wing Anti-Ice and Ground Idle may not be available.
- Expect lower roll rates and lower speedbrake efficiency.
- Do not accomplish the SPOILER FAULT procedure.

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CONTINUED...

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.58.

On Ground:

Brakes..... APPLY NORMALLY

Use differential braking and rudder to steer the airplane.

If necessary:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

END

DC ESS BUS 2 OFF

LAND AT THE NEAREST SUITABLE AIRPORT.

Icing Conditions ..... EXIT/AVOID
Battery 2..... OFF

Relevant Inoperative Items:

AC Fuel Pump 1.	Engine 2 Oil pressure indication
ADS 3	Fuel Quantity 2 Indication
Aft Lavatory Smoke Detection	Fuel x-feed LOW 2 Operation
APU Fire Extinguishing	Hydraulic System 1 Depressurization Valve
APU Fuel Shutoff Valve	IESS
Aural Warning 2	Ignition 2A
CCD 1	Inboard Brakes
DC Fuel Pump	Master Warning/Caution 2

CONTINUED...

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...CONTINUED

Digital Audio Panel 2	MCDU 2
Display Unit 2	Multi Function Spoilers L3, R3, L4 and R4
Engine 1 and Engine 2 Reversers	Pitch Trim Indication

NOTE: – The slats will operate at low rate.
– FADEC will set flight idle on ground.
– Engine 1 windmill start is not available.
– Thrust Reversers, Wing Anti-Ice and Ground Idle may not be available.
– Expect lower roll rates and lower speedbrake efficiency.
– Do not accomplish the SPOILER FAULT procedure.

APU..... OFF

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.66.

On Ground:

Brakes..... APPLY NORMALLY

Use differential braking and rudder to steer the airplane.

If necessary:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

END

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DC ESS BUS 3 OFF

TRU ESS Switch..... OFF

DC ESS BUS 3 OFF MESSAGE EXTINGUISHES? **No**

Yes

END

Relevant Inoperative Items:

ADS 2	Landing Gear Override Switch
AFT LAV Smoke Detector	PAX Address
Cargo Compartment Fire Bottles	Pitch Trim Indication
Fuel Crossfeed Valve	Rudder Trim
Internal Light of all Switches	

NOTE: The flaps will operate at low rate.

END

GPU CONNECTED

Before Taxi:

GPU..... DISCONNECT

END

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IDG 1 (2) OFF BUS

Affected IDG Selector..... OFF, THEN AUTO

IDG 1 (2) OFF BUS MESSAGE EXTINGUISHES?

No

Yes

END

Affected IDG Selector ..... OFF

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

NOTE: If APU use is intended, push OUT the APU Bleed button prior to APU start.

◄

APU..... AS REQUIRED

END

IDG 1 (2) OIL

Light: Affected IDG light becomes amber.

Affected IDG Selector..... DISC

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

NOTE: If APU use is intended, push OUT the APU Bleed button prior to APU start.

◄

APU..... AS REQUIRED

END

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INVERTER FAIL

Crew Awareness.

END

RAT FAIL

Crew Awareness.

END

TRU 1 (2) FAIL

Affected TRU Switch..... OFF, THEN AUTO

TRU 1 (2) FAIL MESSAGE EXTINGUISHES?

No

Yes

END

Affected TRU Switch..... OFF

END

TRU ESS FAIL

TRU ESS Switch..... OFF

END

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LOAD SHED

Crew Awareness.

END

REMOTE CB TRIP

Crew Awareness.

END

SPDA FAIL

Both thrust reversers may be inoperative.

END

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ENGINE

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ENG 1 (2) OIL LO PRESS

EICAS Indication: Oil pressure indication in amber may be presented.

OIL PRESSURE INDICATION ABNORMAL? **No**

Yes

ENGINE SHUTDOWN Procedure..... ACCOMPLISH

END

ENG 1 (2) REV DEPLOYED

EICAS Indication: REV icon above the associated ITT indication.

LAND AT THE NEAREST SUITABLE AIRPORT.

Autothrottle..... DISENGAGE
Associated Thrust Lever..... IDLE

ANY BUFFETING NOTICED? **No**

Yes

Start/Stop Selector (affected engine)..... STOP

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT

◄

APU ..... START

Fuel ..... BALANCE

CONTINUED...

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...CONTINUED

Autothrottle..... AS REQUIRED

Transponder..... TA ONLY

When appropriate:

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

ENG 1 (2) CONTROL FAULT

Autothrottle..... DISENGAGE

CAUTION: AVOID QUICK THRUST LEVER MOVEMENT, HIGH ENGINE THRUST AND THRUST REVERSER OPERATION ON THE AFFECTED ENGINE.

ABLE TO CONTROL AFFECTED ENGINE THRUST? **No**

Yes

END

AFFECTED ENGINE THRUST STABLE AT IDLE? **No**

Yes

Associated Thrust Lever..... IDLE

Transponder..... TA ONLY

Continue the flight monitoring engine parameters.

END

CONTINUED...

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...CONTINUED

ENGINE SHUTDOWN Procedure..... ACCOMPLISH

END

ENG 1 (2) FADEC OVERTEMP

ENGINE PARAMETERS ABNORMAL? **No**

Yes

ENGINE SHUTDOWN Procedure..... ACCOMPLISH

CAUTION: IF THE ENGINE DOES NOT SHUTDOWN, PULL (DO NOT ROTATE) THE ASSOCIATED FIRE-EXTINGUISHING HANDLE.

END

ENG 1 (2) FAIL

EICAS Indication: FAIL icon on N1 indication.

EICAS Indication: Oil press indication in red.

LAND AT THE NEAREST SUITABLE AIRPORT.

Associated Thrust Lever..... IDLE

CONTINUED...

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...CONTINUED

ENGINE AUTO RELIGHTS? **No**

Yes

NOTE: If flight conditions permit, operate the engine at idle for 2 min prior to apply engine thrust.

END

Associated Start/Stop Selector..... STOP

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT ◄

APU..... START

Transponder..... TA ONLY

FUEL LEAK SUSPECTED? **No**

Yes

FUEL LEAK Procedure..... ACCOMPLISH

END

RESTART CONSIDERED? **No**

Yes

ENGINE AIRSTART Procedure..... ACCOMPLISH

END

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...CONTINUED

Fuel..... BALANCE

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

ENG 1 (2) FUEL IMP BYPASS

CAUTION: IF BOTH ENGINES ARE AFFECTED, LAND AT THE NEAREST SUITABLE AIRPORT.

END

ENG 1 (2) FUEL LO PRESS

Fuel Xfeed Selector..... OFF
Autothrottle..... DISENGAGE
Engine Parameters..... MONITOR

FUEL LEAK SUSPECTED? **No**

Yes

FUEL LEAK Procedure..... ACCOMPLISH

END

DESIRED THRUST MAINTAINED? **No**

Yes

CONTINUED...

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...CONTINUED

ENGINE PARAMETERS FLUCTUATE? **No**

Yes

Altitude..... DESCEND AS REQUIRED

END

END

Altitude..... DESCEND AS REQUIRED

END

ENG 1 (2) NO DISPATCH

Crew Awareness.

END

ENG 1 (2) OIL LO LEVEL

Crew Awareness.

END

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ENG 1 (2) REV FAIL

Crew Awareness.

END

ENG 1 (2) REV PROT FAULT

Crew Awareness.

END

ENG 1 (2) REV TLA FAIL

Do not move thrust levers below idle in flight.

END

ENG 1 (2) START VLV OPEN

XBleed Button..... PUSH OUT
Associated Bleed Button..... PUSH OUT

ON GROUND? **No**

Yes

ENGINE 1 AFFECTED? **No**

Yes

APU Bleed Button..... PUSH OUT

CONTINUED...

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...CONTINUED

Engine 1:

Thrust Lever..... IDLE

Start/Stop Selector..... STOP

END

Engine Start Ground Cart..... REMOVE

Engine 2:

Thrust Lever..... IDLE

Start/Stop Selector..... STOP

END

APU Bleed Button..... PUSH OUT

Icing Conditions ..... EXIT/AVOID

Altitude..... MAX 31000 ft

CAUTION: IN FLIGHT ASSISTED STARTS ARE NOT POSSIBLE FOR THE AFFECTED ENGINE.

END

ENG 1 (2) TLA FAIL

CONDITION: Associated engine thrust control may be lost.

ABLE TO CONTROL AFFECTED ENGINE THRUST?

No

Yes

CONTINUED...

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...CONTINUED

END

NOTE: The engine thrust will be set to idle automatically.

Associated Thrust Lever..... IDLE
Transponder..... TA ONLY

When appropriate:

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

ENG EXCEEDANCE

Crew Awareness.

END

ENG NO TAKEOFF DATA

Engine Takeoff Data..... ENTER

END

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ENG REF A-I DISAG

Configure the airplane according to takeoff data or re-enter the takeoff data according to the airplane configuration.

END

ENG REF ECS DISAG

Configure the airplane according to takeoff data or re-enter the takeoff data according to the airplane configuration.

NOTE: The EICAS message ENG REF ECS DISAG will be always displayed when the following conditions apply simultaneously: The REF ECS is set to ON, the APU is running and the engine thrust levers are set to idle.

END

ENG THR RATING DISAG

Crew Awareness.

END

ENG TLA NOT TOGA

Move the thrust levers to TOGA position.

END

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ENG 1 (2) FADEC FAULT

Crew Awareness.

END

ENG 1 (2) FUEL SW FAIL

Crew Awareness.

END

ENG 1 (2) OIL IMP BYPASS

Crew Awareness.

END

ENG 1 (2) OIL SW FAIL

Crew Awareness.

END

ENG 1 (2) SHORT DISPATCH

Crew Awareness.

END

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FIRE PROTECTION

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APU FIRE

Light: APU Emergency Stop Button upper half illuminates in red.

APU Emergency Stop Button..... PUSH IN

APU..... OFF

APU FIRE MESSAGE EXTINGUISHES? **No**

Yes

END

APU Fire Extinguishing Button..... PUSH

END

ENG 1 (2) FIRE

EICAS Indication: FIRE icon on the associated ITT indicator

Light: Associated fire handle illuminates.

Autothrottle..... DISENGAGE

Affected engine:

Thrust Lever..... IDLE

Start/Stop Selector..... STOP

Fire Extinguishing Handle..... PULL

LAND AT THE NEAREST SUITABLE AIRPORT.

Fire Extinguishing Handle..... ROTATE (L or R)

CONTINUED...

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...CONTINUED

.....Wait 30 seconds.....

FIRE PERSISTS? **No**

Yes

Fire Extinguishing Handle (remaining bottle)..... ROTATE

HIGH VIBRATION? **No**

Yes

Airspeed..... REDUCE

Airspeeds around 200 KIAS are recommended to reduce vibration.

Transponder..... TA ONLY

EICAS ASSOCIATED FUEL INDICATION LOST? **No**

Yes

FUEL LEAK Procedure..... ACCOMPLISH

Assume that fuel is leaking from tank associated to engine failed side.

END

►*O.B. N° 170-001/09 - ENGINE 2 STALL DUE TO BACKPRESSURE FROM APU BLEED*

APU Bleed Button..... PUSH OUT

◄

CONTINUED...

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...CONTINUED

APU..... START
Fuel..... BALANCE
Autothrottle..... AS REQUIRED

When appropriate:

ONE ENGINE INOPERATIVE APPROACH AND LANDING Procedure..... ACCOMPLISH

END

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APU FIRE DET FAIL

APU..... OFF

END

APU FIREX FAIL

APU..... OFF

END

CRG AFT (FWD) FIRE SYS FAIL

AFFECTED CARGO COMPARTMENT IS EMPTY?

No

Yes

END

LAND AT THE NEAREST SUITABLE AIRPORT.

END

ENG 1 (2) FIRE DET FAIL

If fire is suspected in the affected engine:

ENGINE FIRE, SEVERE DAMAGE OR SEPARATION Procedure..... ACCOMPLISH

END

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LAV SMOKE DET FAIL

Crew Awareness.

END

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APU FIREXBTL DISCH

Crew Awareness.

END

CRG AFT FIREX HI (LO) ARM

Crew Awareness.

END

CRG FIRE PROT FAULT

Crew Awareness.

END

CRG FWD FIREX HI (LO) ARM

Crew Awareness.

END

ENG 1 (2) FIREXBTL A (B) FAIL

Crew Awareness.

END

ENG FIREXBTL A (B) DISCH

Crew Awareness.

END

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FLIGHT CONTROLS

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ELEV NML MODE FAIL

Flight Controls Mode Elevators Button..... PUSH IN

NOTE: Do not accomplish the ELEVATOR FAULT Procedure.

Relevant Inoperative Items:

AOA Limit	Autopilot
Auto Configuration Trim	Elevator Thrust Compensation

Avoid side slipping the airplane.

END

GROUND SPOILERS FAIL

CONDITION: One or more ground spoiler panels have extended inadvertently, have failed to extend when commanded or are unavailable to extend.

In flight:

Speedbrake..... CLOSE

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.10.

END

RUDDER NML MODE FAIL

Flight Controls Mode Rudder Button..... PUSH IN

NOTE: Do not accomplish the RUDDER FAULT Procedure.

CONTINUED...

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...CONTINUED

Relevant Inoperative Items:

Turn Coordination	Yaw Damper

END

SPOILER NML MODE FAIL

Speedbrake..... CLOSE
Flight Controls Mode Spoilers Button..... PUSH IN

NOTE: Do not accomplish the SPOILER FAULT Procedure.

Relevant Inoperative Items:

Ground Spoilers	SpeedBrake

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.30.

END

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AOA LIMIT FAIL

Avoid side slipping the airplane.

NOTE: The stick shaker remains operative.

END

ELEV THR COMP FAIL

Compensate manually any pitch tendency following thrust variations.

END

ELEVATOR FAULT

NOTE: If the SPOILER FAULT message is also displayed, accomplish the Spoiler Fault procedure prior to this procedure.

Flight Controls Mode Elevators Button..... PUSH IN, THEN OUT

ELEVATOR FAULT MESSAGE EXTINGUISHES?

No

Yes

END

Relevant Inoperative Items:

AOA Limit	Autopilot
Auto Configuration Trim	Elevator Thrust Compensation

CONTINUED...

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...CONTINUED

Avoid side slipping the airplane.

END

ELEVATOR LH (RH) FAIL

Maximum Airspeed..... CURRENT OR 175 KIAS, WHICHEVER IS HIGHER

NOTE: Expect less elevator control authority and slower response, especially during landing flare.

Landing configuration:

Slat/Flap..... 5

Set $V_{REF} = V_{REF\ FULL} + 15$ KIAS.

Apply brakes only after nose landing gear touches down.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.29.

If a go around is required:

Slat/Flap..... 5

Airspeed..... $V_{REF\ FULL}$ + 15 KIAS

END

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FLAP FAIL

Slat/Flap Lever..... RETURN TO THE PREVIOUS POSITION

.....Wait 10 seconds.....

MESSAGE EXTINGUISHES? **No**

Yes

Slat/Flap Lever..... RESELECT DESIRED POSITION

MESSAGE REMAINS EXTINGUISHED? **No**

Yes

END

Slat/Flap Lever..... RETURN TO THE PREVIOUS POSITION

.....Wait 10 seconds.....

Slat/Flap Lever..... RESELECT DESIRED POSITION

MESSAGE EXTINGUISHES? **No**

Yes

CONTINUED...

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...CONTINUED

END

Landing Configuration:

Select the desired slat position and use the landing data according to the FLAP/SLAT FAIL LANDING CONFIGURATION TABLE, or FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE.

NOTE: – If amber dashes are displayed on the EICAS, use the most conservative position to enter the table (e.g. for a failure between 1 and 2, consider 1).
– Flaps external marks can be used to determine flap position.

Autothrottle..... DISENGAGE

Bank Angle..... 20° MAXIMUM

Gnd Prox Flap Ovrd Button..... PUSH IN

If a go-around is required:

Slat/Flap..... MAINTAIN

Maintain the Vref presented in the respective Landing Configuration Table.

FLAP/SLAT FAIL LANDING CONFIGURATION TABLE

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+50	$V_{REF\ FULL}$+50
LDG Coef		1.90	1.77	1.81

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	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35
LDG Coef		1.52	1.56	1.58
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+25	$V_{REF\ FULL}$+25
LDG Coef		1.44	1.39	1.41
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+10
LDG Coef			1.35	1.22
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.08	1.00

FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60
LDG Coef		1.90	1.95	1.99
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40
LDG Coef		1.60	1.63	1.66
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30
LDG Coef		1.44	1.47	1.49
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+15
LDG Coef			1.35	1.29
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.08	1.00

END

FLT CTRL BIT EXPIRED

Crew Awareness.

END

AOM-1502-017

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FLT CTRL NO DISPATCH

Crew Awareness.

END

FLT CTRL TEST FAILED

Crew Awareness.

END

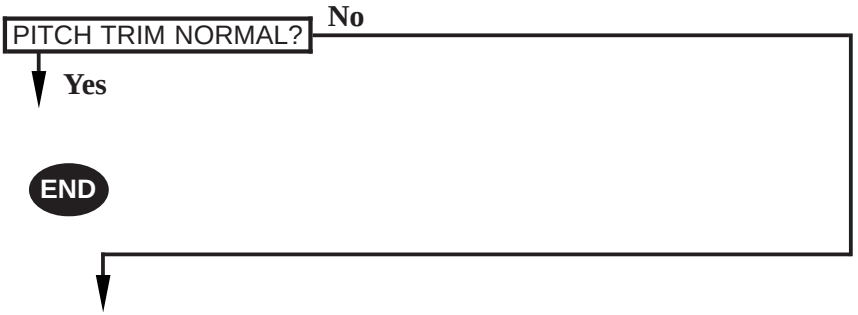
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PITCH TRIM FAIL

Maximum Airspeed..... CURRENT OR 175 KIAS, WHICHEVER IS HIGHER

Pitch Trim System 1 and 2 Cutout Buttons..... PUSH IN, THEN OUT

Pitch Trim Switches..... ACTUATE



Pitch Trim System 1 and 2 Cutout Buttons..... PUSH IN

NOTE: – No more pitch trim is available.
– Continuous turns helps to alleviate excessive pitch up tendencies.

Landing configuration:

Slat/Flap..... 5

Airspeed..... $V_{REF\ FULL}$ + 15 KIAS (limited to 175 KIAS)

Establish landing configuration early.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.29.

If a go around is required:

Slat/Flap..... 5

CONTINUED...

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Airspeed..... $V_{REF\ FULL}$ + 15 KIAS (limited to 175 KIAS)

END

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RUDDER FAIL

LAND AT THE NEAREST SUITABLE AIRPORT.

Maximum Airspeed..... CURRENT OR 175 KIAS, WHICHEVER IS HIGHER

Relevant Inoperative Items:

Turn Coordination	Yaw Trim
Yaw Damper	

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: AVOID LANDING WITH CROSSWIND COMPONENTS ABOVE 10 KT.

If a go around is required, proceed as a normal go around limiting the airspeed to 175 KIAS.

NOTE: As assymetric thrust may be required to help controlling the airplane, maximum thrust on both engines may not be possible.

END

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RUDDER FAULT

NOTE: If the SPOILER FAULT message is also displayed, accomplish the SPOILER FAULT procedure prior to this procedure.

Flight Controls Mode Rudder Button..... PUSH IN, THEN OUT

RUDDER FAULT MESSAGE EXTINGUISHES?

No

Yes

END

RUDDER LIMITER FAIL MESSAGE DISPLAYED?

No

Yes

Flight Controls Mode Rudder Button..... PUSH IN, THEN OUT

RUDDER FAULT MESSAGE EXTINGUISHES?

No

Yes

END

CONTINUED...

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...CONTINUED

Relevant Inoperative Items:

Yaw Damper
Turn Coordination

END

RUDDER LIMITER FAIL

CONDITION: Rudder position limiter is inoperative and rudder authority in flight is 30°.

WARNING:
- **DO NOT APPLY ABRUPT PEDAL COMMANDS.**
- **DO NOT APPLY FULL RUDDER DEFLECTION.**

END

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SLAT FAIL

Slat/Flap Lever..... RETURN TO THE PREVIOUS POSITION

.....Wait 10 seconds.....

MESSAGE EXTINGUISHES? **No**

Yes

Slat/Flap Lever..... RESELECT DESIRED POSITION

MESSAGE REMAINS EXTINGUISHED? **No**

Yes

END

Slat/Flap Lever..... RETURN TO THE PREVIOUS POSITION

.....Wait 10 seconds.....

Slat/Flap Lever..... RESELECT DESIRED POSITION

MESSAGE EXTINGUISHES? **No**

Yes

CONTINUED...

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END

Landing Configuration:

Select the desired flap position and use the landing data according to the FLAP/SLAT FAIL LANDING CONFIGURATION TABLE, or FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE.

NOTE: – If amber dashes are displayed on the EICAS, use the most conservative position to enter the table (e.g. for a failure between 1 and 2, consider 1).
– Slats external marks can be used to determine slat position.

Autothrottle..... DISENGAGE

Bank Angle..... 20° MAXIMUM

Gnd Prox Flap Ovrd Button..... PUSH IN

If a go-around is required:

Slat/Flap..... MAINTAIN

Maintain the Vref presented in the respective Landing Configuration Table.

FLAP/SLAT FAIL LANDING CONFIGURATION TABLE

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+50	$V_{REF\ FULL}$+50
LDG Coef		1.90	1.77	1.81

CONTINUED...

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	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35
LDG Coef		1.52	1.56	1.58
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+25	$V_{REF\ FULL}$+25
LDG Coef		1.44	1.39	1.41
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+10
LDG Coef			1.35	1.22
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.08	1.00

FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60
LDG Coef		1.90	1.95	1.99
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40
LDG Coef		1.60	1.63	1.66
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30
LDG Coef		1.44	1.47	1.49
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+15
LDG Coef			1.35	1.29
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.08	1.00

END

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SLAT-FLAP LEVER DISAG

Return the slat/flap lever to previous position and then use it as required.

END

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SPOILER FAULT

CONDITION: One or more Multifunction Spoilers Panels have reverted to Direct Mode, have extended inadvertently or have failed to extend.

Autopilot..... DISENGAGE

Speedbrake..... CLOSE

Flight Controls Mode Spoilers Button..... PUSH IN, THEN OUT

SPOILER FAULT MESSAGE EXTINGUISHES? **No**

Yes

Speedbrake..... AS REQUIRED

END

Relevant Inoperative Items:

Ground Spoilers (partially or fully lost)
SpeedBrake (partially or fully lost)

NOTE: In case of Speedbrake partially lost, the remaining panels may be used. In this case the advisory message SPDBRK LEVER DISAG may be displayed.

ALL SPOILER PANELS POSITION DETERMINED? **No**

Yes

ALL SPOILER PANELS FAILED CLOSED? **No**

Yes

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CONTINUED...

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.30.

END

Landing configuration:

Slat/Flap..... 5

Set V_{REF} = $V_{REF\ FULL}$ + 15 KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.63.

END

STAB LOCK FAULT

CONDITION: The Horizontal Stabilizer may have a drift rate up to 0.5 deg/min nose up or nose down.

LAND AT THE NEAREST SUITABLE AIRPORT.

Pitch Trim..... AS REQUIRED

CAUTION: DO NOT PRESS ANY PITCH TRIM SYSTEM CUTOUT BUTTON.

END

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AILERON LH (RH) FAIL

On ground, do not takeoff.

In flight:

Avoid abrupt and large aileron inputs and limit bank angle to 25°.

Establish landing configuration early.

Landing configuration:

Slat/Flap..... 5

Set $V_{REF\ FULL}$+10 KIAS.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.21.

END

AUTO CONFIG TRIM FAIL

Crew Awareness.

END

FLAP (SLAT) LO RATE

During approach:

Slat/Flap Actuation..... ANTICIPATE

END

FLT CTRL FAULT

Crew Awareness.

END

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PITCH CONTROL DISC

Crew Awareness.

END

PITCH TRIM BKUP FAIL

Crew Awareness.

END

PITCH TRIM LO RATE

Crew awareness.

END

PITCH TRIM SW 1 (2) FAIL

Crew Awareness.

END

ROLL CONTROL DISC

Crew Awareness.

END

SPDBRK LEVER DISAG

Crew Awareness.

END

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STALL PROT ICE SPEED

Set landing reference speeds for ice accretion.

LANDING IN ICING CONDITIONS OR WITH ICE ACCRETION?

No

Yes

Use landing performance data for ice accretion.

END

Landing Configuration:

For flap 5:

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.35.

For flap FULL:

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.10.

END

TAILSTRIKE AVOID FAIL

During landing:

Pitch Angle..... MAX 10°

END

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TAILSTRIKE PROT FAIL

During landing:

Pitch Angle..... MAX 10°

END

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FMS/NAV/COMM/FLIGHT INSTRUMENTS

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ADVISORY

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NO TAKEOFF CONFIG

Configure the airplane for takeoff.

END

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ADS 1 (2) FAIL

Confirm the affected ADS automatic reversion.

If necessary:

Associated Reversionary Panel ADS Button..... PUSH

END

ADS 3 FAIL

Reversion..... AS REQUIRED

END

ADS 1 (2) (3) HTR FAIL

Revert the affected ADS.

END

ADS 4 HTR FAIL

Disregard IESS altitude and airspeed indication.

END

APM FAIL

Crew Awareness.

END

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APM MISCOMP

Crew Awareness.

END

AURAL WRN SYS FAIL

Monitor visual indications.

NOTE: Aural warnings, including EGPWS callouts, are lost. TCAS aural will be operative.

END

AVNX ASCB FAULT

Crew Awareness.

END

AVNX MAU 1A FAIL

Icing Conditions..... EXIT/AVOID

Relevant Inoperative Items:

ACARS	Multi Function Spoilers L5 and R5
ADS 1	Nosewheel Steering
Autopilot 1	Outboard Brakes
Left Aileron Indication	Pitch Trim Indication
MCDU1 (except circuit breakers page)	Weather Radar

Landing Configuration:

Slat/Flap..... FULL

CONTINUED...

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Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.58.

On ground:

Brakes..... APPLY NORMALLY

Steer the airplane using differential braking and rudder.

If necessary:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

END

AVNX MAU 1B FAIL

Relevant Inoperative Items:

GPS 1	Pitch Trim Indication
Multi Function Spoilers L5 and R5	

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.07.

END

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AVNX MAU 2A FAIL

Relevant Inoperative Items:

Autobrake	Nosewheel Steering.
FMS 1.	

On ground:

Steer the airplane using rudder and differential braking.

END

AVNX MAU 2B FAIL

Relevant Inoperative Items:

ADS 2	Inboard Brakes
Autopilot 2	Mach Trim
EGPWS	MCDU 2 (except circuit breakers page)
IESS Localizer and Glide Slope Indication	Right Side Weather Radar Control

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.51.

On ground:

Brakes..... APPLY NORMALLY

If necessary:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.

CONTINUED...

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...CONTINUED

- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

END

AVNX MAU 3A FAIL

Icing Conditions..... EXIT/AVOID

Relevant Inoperative Items:

ADS 3 Multi Function Spoiler L3, R3, L4 and R4	GPS 2
APU	Right Aileron Indication
Autopilot 2	Speedbrake
FMS 2	

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.30.

END

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AVNX MAU 3B FAIL

Relevant Inoperative Items:

Engine Vibration Indication	Pitch Trim Indication
Multi Function Spoilers L3, R3, L4 and R4	

Landing Configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.10.

END

AVNX MAU 1A (1B) OVHT

Associated CB..... PULL

NOTE: – For MAU 1A OVHT, pull the B6 and B7 CB.
– For MAU 1B OVHT, pull the B15 CB.

Associated AVNX MAU 1A FAIL or AVNX MAU 1B FAIL Procedure..... ACCOMPLISH

END

AVNX MAU 2A (2B) OVHT

Associated CB..... PULL

NOTE: – For MAU 2A OVHT, pull the B25 CB.
– For MAU 2B OVHT, pull the B26 and B35 CB.

Associated AVNX MAU 2A FAIL or AVNX MAU 2B FAIL Procedure..... ACCOMPLISH

END

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AVNX MAU 3A (3B) OVHT

Associated CB..... PULL

NOTE: – For MAU 3A OVHT, pull the B34 CB.
– For MAU 3B OVHT, pull the B27 CB.

Associated AVNX MAU 3A FAIL or AVNX MAU 3B FAIL Procedure..... ACCOMPLISH

END

AVNX MAU 1 (2) (3) FAN FAIL

Crew Awareness.

END

CMS FAIL

Crew Awareness.

END

CREW WRN SYS FAULT

Crew Awareness.

END

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DISPLAY CTRL FAIL

NOTE: – PFD selections of VOR, FMS, RA/BARO, Minimums and Baro setting will be locked at the last setting position prior to the failure.
– Disregard altitude callouts from aural system.
– Use IESS for barometric setting and ILS approach.

Relevant Inoperative Items:

Bearing “<>” Pushbutton	PREV Pushbutton
Bearing “O” Pushbutton	RAD/BARO Minimums Knob
FMS Pushbutton	STD Pushbutton
FPR Pushbutton	V/L Pushbutton
HSI Pushbutton	WX Pushbutton
IN/Hpa baro setting knob	

NOTE: The items above are inoperative on both pilot and copilot display controllers.

END

DISPLAY CTRL FAULT

Crew Awareness.

END

EICAS FAULT

Crosscheck EICAS information and revert if necessary.

END

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EICAS OVHT

B11 CB..... PULL
Reversionary Panel Selector..... EICAS

END

FMS POS DISAG

Do not use FMS as navigation source.

END

FMS1 (2) - GPS POS DISAG

DUAL FMS INSTALLED?

No

Yes

Select another FMS source.

END

Select another navigation source.

END

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GND PROX FAIL

Increase awareness in relation to ground proximity.

END

IRS EXCESSIVE MOTION

Airplane..... STOP

The IRS will restart the alignment after the motion is stopped.

END

IRS 1 (2) FAIL

Reversionary Panel IRS Button..... PUSH

END

MCDU 1 (2) OVHT

Associated CB..... PULL

NOTE: – For MCDU 1 OVHT, pull the B16 CB.
– For MCDU 2 OVHT, pull the B31 CB.

NOTE: The associated FMS will be lost.

END

MFD 1 (2) FAULT

Crosscheck the affected MFD display information (System Synoptics, MAP, TAS, TAT, SAT, TCAS info, WX radar and Terrain Data) with the opposite side MFD display information and revert if necessary. Disregard any non reliable information from the affected

CONTINUED...

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MFD.

END

MFD 1 (2) OVHT

Associated CB..... PULL
Reversion..... AS REQUIRED

NOTE: – For MFD 1 OVHT, pull the B29 CB.
– For MFD 2 OVHT, pull the B20 CB.

END

NAVCOM 1 (2) FAIL

Select and use the remaining NAVCOM (VHF, VOR, DME and Transponder).

END

NAVCOM 1 (2) OVHT

Associated MRC CB..... PULL

NOTE: – For NAVCOM 1 OVHT, pull the C10 CB.
– For NAVCOM 2 OVHT, pull the MRC 2 Electronic CB.

NAVCOM 1 (2) FAIL Procedure..... ACCOMPLISH

END

PFD 1 (2) FAULT

Crosscheck the affected PFD display information (Attitude, Airspeed, Altitude, FMA, FPA, Minimums, Baro setting, NAVCOM radio frequencies, HDG and CRS) with the opposite side PFD display information and revert if necessary. Disregard any non-reliable

CONTINUED...

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...CONTINUED

information from the affected PFD.

END

PFD 1 (2) OVHT

Associated CB..... PULL
Reversionary Panel Selector..... AS REQUIRED

NOTE: – For PFD 1 OVHT, pull the B19 CB
– For PFD 2 OVHT, pull the B21 CB.

END

SYS CONFIG FAIL

Crew Awareness.

END

TERRAIN FAIL

Increase awareness in relation to terrain proximity.

END

VALIDATE CONFIG

Crew Awareness.

END

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VHF 1 (2) (3) OVHT

Associated CB..... PULL

NOTE: – For VHF 1 OVHT, pull the C11 CB.
– For VHF 2 OVHT, pull the VHF 2 Electronic CB.
– For VHF 3 OVHT, pull the VHF 3 Electronic CB.

END

VHF 3 FAIL

Select another VHF source.

END

WINDSHEAR FAIL

Increase awareness in relation to weather, wind and speed variations.

END

ADS PROBE 1 (2) (3) (4) FAIL

Crew Awareness.

END

ADS 1 (2) HTR FAULT

Crew Awareness.

END

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ADS 3 SLIPCOMP FAIL

Crew Awareness.

END

ADS 4 SLIPCOMP FAIL

Crew Awareness.

END

APM FAULT

Crew Awareness.

END

AURAL WRN SYS FAULT

Crew Awareness.

END

AVNX DB MODULE FAIL

Crew Awareness.

END

AVNX MAU 1A (1B) FAULT

Crew Awareness.

END

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AVNX MAU 2A (2B) FAULT

Crew Awareness.

END

AVNX MAU 3A (3B) FAULT

Crew Awareness.

END

CCD 1 (2) FAUL

Crew Awareness.

END

CMC FAIL

Crew Awareness.

END

CMF 1 (2) FAIL

Crew Awareness.

END

CMS FAULT

Crew Awareness.

END

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CVR AFT (FWD) FAIL

Crew Awareness.

END

FDR AFT (FWD) FAIL

Crew Awareness.

END

FLT CTRL ADS FAIL

Crew Awareness.

END

FMS 1 (2) FAIL

ANOTHER FMS AVAILABLE?

No

Yes

Select another FMS source.

END

Select another navigation source.

END

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IRS 1 (2) NAV MODE FAIL

Associated Reversionary Panel IRS Button..... PUSH

END

IRS ALIGNING

Crew Awareness.

END

IRS PRES POS INVALID

FMS Present Position..... ENTER OR
REENTER

END

RALT 1 (2) FAIL

ANOTHER RADIO ALTIMETER AVAILABLE? **No**

Yes

During approach:

Increase awareness in relation to autothrottle operation.

END

CONTINUED...

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During approach:

Autothrottle..... DISENGAGE

END

TAT 1 (2) FAIL

TAT 1 FAILED? **No**

Yes

TAS data from ADS 1and 3 is not reliable anymore.

Do not couple AP and AT source to a PFD using ADS 1 or 3.

END

TAS data from ADS 2 is not reliable anymore.

Do not couple AP and AT source to a PFD using ADS 2.

END

TCAS FAIL

Crew Awareness.

END

TERRAIN NOT AVAILABLE

Crew Awareness.

END

AOM-1502-017

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XPDR 1 (2) FAIL

Crew Awareness.

END

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FUEL

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FUEL 1 (2) LO LEVEL

EICAS Indication: Associated fuel quantity indication in red.

LAND AT THE NEAREST SUITABLE AIRPORT.

CAUTION: AVOID ATTITUDES IN EXCESS OF 15° NOSE UP OR DOWN, UNCOORDINATED MANEUVERS AND NEGATIVE G'S.

Associated Fuel AC Pump..... ON

FUEL LEAK SUSPECTED? — No

Yes

FUEL LEAK Procedure..... ACCOMPLISH

END

Fuel Xfeed Selector..... AS REQUIRED

END

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APU FUEL SOV FAIL

Do not restart the APU.

END

ENG 1 (2) FUEL SOV FAIL

AFTER PULLING FIRE HANDLE?

No

Yes

Associated Fuel AC Pump..... OFF

Fuel Xfeed Selector..... OFF

END

FUEL DC PUMP FAIL

Fuel DC Pump Selector ..... OFF

END

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FUEL IMBALANCE

CONDITION: Imbalance between wing tanks greater than the limit.

FUEL LEAK SUSPECTED? **No**

Yes

FUEL LEAK Procedure..... ACCOMPLISH

END

Attitude..... WING LEVEL

Compare total fuel quantity indication on EICAS with fuel remaining information indicated on FMS Fuel Management page. If FMS fuel remaining quantity is lower than EICAS total fuel indication, disregard FMS fuel remaining information and monitor fuel quantities.

RH WING LOWER LEVEL? **No**

Yes

Fuel Xfeed Selector..... LOW 2

When the desired balance is achieved:

Fuel Xfeed Selector..... OFF

Monitor total fuel indication in EICAS with FMS fuel remaining information.

END

Fuel Xfeed Selector..... LOW 1

When the desired balance is achieved:

Fuel Xfeed Selector..... OFF

Monitor total fuel indication in EICAS with FMS fuel remaining

CONTINUED...

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...CONTINUED

information.

END

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

FUEL TANK LO TEMP

Airspeed..... ACCELERATE AS MUCH AS POSSIBLE UP TO V_{MO}/M_{MO}

.....Wait 3 minutes.....

FUEL TANK LO TEMP MESSAGE PERSISTS? **No**

Yes

Altitude ..... DESCEND AS REQUIRED

END

◄

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FUEL XFEED FAIL

FUEL XFEED SELECTOR OFF?

No

Yes

END

FUEL IS BEING EQUALIZED?

No

Yes

When appropriate:

Fuel Xfeed Selector..... OFF

END

Fuel Xfeed Selector..... OFF
Asymmetric Thrust..... AS REQUIRED

END

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DEFUEL SOV OPEN

Crew Awareness.

END

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

FUEL AC PUMP 1 (2) FAIL

Fuel Xfeed Selector..... OFF

END

◄

FUEL EQUAL-XFEED OPEN

Crew Awareness.

END

FUEL FEED 1 (2) FAULT

IN FLIGHT? **No**

Yes

Continue the flight monitoring the systems.

END

Emergency/Parking Brake..... SET

Associated FUEL AC PUMP..... AUTO

CONTINUED...

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...CONTINUED

Associated Thrust Lever..... ADVANCE to 65% N2

Associated FUEL AC PUMP..... ON

.....Wait 5 seconds.....

Associated FUEL AC PUMP..... AUTO

FUEL FEED 1 (2) FAULT MESSAGE PERSISTS? **No**

Yes

Do not takeoff.

Associated Thrust Lever..... IDLE

END

FUEL KG-LB MISMATCH

Crew Awareness.

END

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HYD 1 (2) OVERHEAT

Associated Electric Hydraulic Pump Selector ..... OFF
Associated Engine Pump Shutoff Button..... PUSH IN

HYD 1 (2) SOV FAIL MESSAGE PRESENTED?

No

Yes

LAND AT THE NEAREST SUITABLE AIRPORT.

ENGINE SHUTDOWN Procedure ..... ACCOMPLISH

Appropriate LOSS OF HYDRAULIC SYSTEM 1 or
LOSS OF HYDRAULIC SYSTEM 2 Procedure.... ACCOMPLISH

END

HYD 3 OVERHEAT

Electric HYD SYS 3 Pump A Selector ..... OFF
Electric HYD SYS 3 Pump B Selector ..... OFF

Relevant Inoperative Items:

Outboard Aileron Actuators.

END

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HYD PTU FAIL

PTU Selector..... ON

HYD PTU FAIL MESSAGE PERSISTS? — No

Yes

PTU Selector Knob..... OFF

END

NOTE: During cruise flight, the PTU Selector Knob may be turned to AUTO.

END

HYD 1 (2) EDP NOT D-PRESS

An engine windmill restart will not be available.

END

HYD 1 (2) HI TEMP

Associated Electric Hydraulic Pump Selector ..... OFF

END

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HYD 3 HI TEMP

Electric Hydraulic Pump A Selector..... OFF

END

HYD 1 (2) LO PRESS

Associated Electric Hydraulic Pump Selector ..... ON

HYD 1 (2) LO PRESS MESSAGE PERSISTS?

No

Yes

Associated Electric Hydraulic Pump Selector..... OFF

Appropriate LOSS OF HYDRAULIC SYSTEM 1 or LOSS OF HYDRAULIC SYSTEM 2..... ACCOMPLISH

END

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HYD 3 LO PRESS

Electric Hydraulic Pump B Selector ..... ON
Electric Hydraulic Pump A Selector..... OFF

HYD 3 LO PRESS MESSAGE PERSISTS?

No

Yes

Electric Hydraulic Pump B Selector..... OFF

Relevant Inoperative Items:

Outboard Aileron Actuators.

END

HYD 3 VLV FAIL

Airspeed..... MIN 130 KIAS

END

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HYD PTU NOT AUTO

Crew Awareness.

END

HYD PUMP NOT AUTO

Crew Awareness.

END

HYD TEMP SENS FAIL

Crew Awareness.

END

HYD 1 (2) EDP FAIL

Crew Awareness.

END

HYD 1 (2) ELEC PUMP FAIL

Associated Electric Hydraulic Pump Selector ..... OFF

END

HYD 3 ELEC PUMP A FAIL

Electric Hydraulic Pump A Selector..... OFF

END

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HYD 3 ELEC PUMP B FAIL

Electric Hydraulic Pump B Selector..... OFF

END

HYD 1 (2) (3) LO QTY

Crew Awareness.

END

HYD 1 (2) SOV FAIL

Crew Awareness.

END

HYD 3 PUMP A NOT ON

Crew Awareness.

END

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ICE AND RAIN PROTECTION

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ICE CONDITION	Crew Awareness	

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A-I WING 1 (2) LEAK

Ice Protection Wing Button..... PUSH OUT
Icing Conditions ..... EXIT/AVOID

A-I WING 1 (2) LEAK MESSAGE PERSISTS? **No**

Yes

Affected Bleed Button..... PUSH OUT
XBleed Button..... PUSH OUT
Altitude..... MAX 31000 ft

AFFECTED BLEED 1? **No**

Yes

APU Bleed Button..... PUSH OUT

During Landing:

ICE CONDITIONS OR ICE ACCRETION? **No**

Yes

Landing Configuration:

Slat/Flap..... 5

Set $V_{REF\ FLAP\ 5\ ICE}$.

CONTINUED...

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.25.

NOTE: Do not perform the A-I WING FAIL procedure.

END

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A-I ENG 1 (2) FAIL

Affected Ice Protection Engine Button..... PUSH OUT, THEN IN

A-I ENG 1 (2) FAIL MESSAGE EXTINGUISHES? **No**

Yes

END

Ice Protection Mode Selector..... ON

A-I ENG 1 (2) FAIL MESSAGE PERSISTS? **No**

Yes

Icing Conditions..... EXIT/AVOID

HIGH ENGINE VIBRATION? **No**

Yes

ENGINE ABNORMAL VIBRATION Procedure..... ACCOMPLISH

CONTINUED...

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...CONTINUED

Five minutes after exiting icing conditions:

Ice Protection Mode Selector..... AUTO

END

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A-I LO CAPACITY

Thrust Levers..... ADVANCE

A-I LO CAPACITY MESSAGE PERSISTS?

No

Yes

Icing Conditions..... EXIT/AVOID

END

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A-I WING FAIL

Ice Protection Wing Button..... PUSH OUT,
THEN IN

A-I WING FAIL MESSAGE EXTINGUISHES? **No**

Yes

END

Ice Protection Mode Selector..... ON

A-I WING FAIL MESSAGE PERSISTS? **No**

Yes

Ice Protection Mode Selector..... AUTO

Ice Protection Wing Button..... PUSH OUT

Icing Conditions ..... EXIT/AVOID

LANDING IN ICING CONDITION OR WITH ICE ACCRETION? **No**

Yes

Landing Configuration:

Slat/Flap..... 5

Set $V_{REF\ FLAP\ 5\ ICE}$.

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.25.

NOTE: Limit bank angle to 20°.

END

Five minutes after exiting icing conditions:

Ice Protection Mode Selector..... AUTO

END

A-I WING NO DISPATCH

Do not perform an assisted engine start.

END

ICE DETECTOR 1 (2) FAIL

When flying in icing conditions:

Ice Protection Mode Selector..... ON

Two minutes after exiting icing conditions:

Ice Protection Mode Selector..... AUTO

END

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WINDSHIELD 1 (2) HTR FAIL

Affected Windshield Heating Button..... PUSH OUT, THEN IN

WINDSHIELD 1 (2) HTR FAIL MSG EXTINGUISHES?

No

Yes

END

Affected Windshield Heating Button..... PUSH OUT

END

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A-I ENG 1 (2) FAULT

Crew Awareness.

END

A-I MODE NOT AUTO

Crew Awareness.

END

A-I SWITCH OFF

Crew Awareness.

END

ICE CONDITION

Crew Awareness.

END

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LANDING GEAR AND BRAKES

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STEER FAULT	Crew Awareness	

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LG LEVER DISAG

EICAS Indication: One or more landing gear indications disagree with the landing gear lever.

Landing Gear Lever..... CYCLE

LG LEVER DISAG MESSAGE PERSISTS? **No**

Yes

DURING EXTENSION? **No**

Yes

ABNORMAL LANDING GEAR EXTENSION
Procedure..... ACCOMPLISH

END

Landing Gear..... DOWN

Icing Conditions ..... EXIT/AVOID

END

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

AUTOBRAKE FAIL

Apply brakes normally.

END

◄

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BRK LH (RH) FAIL

NOTE: During landing run, Thrust Reverser and/or the Emergency/Parking Brake may be used to stop the airplane.

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.51.

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

END

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BRK OVERHEAT

ON GROUND? **No**

Yes

Airplane..... STOP

Chocks..... ON

Emergency/Parking Brake..... OFF

END

Landing Gear..... DOWN

BRK OVERHEAT MESSAGE PERSISTS? **No**

Yes

After the BRK OVERHEAT message disappears:

.....Wait 5 minutes.....

Landing Gear..... UP

END

EMER BRK FAIL

CONDITION: Emergency/Parking Brake is inoperative.

When parking the airplane, use wheel chocks.

END

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LG NO DISPATCH

Crew Awareness.

END

LG NOSE DOOR OPEN

Airspeed..... MAX 250 KIAS

GEAR LEVER DOWN? **No**

Yes

CAUTION: DO NOT MOVE THE LANDING GEAR LEVER UP, EXCEPT FOR CLIMB PERFORMANCE TO CLEAR OBSTACLES.

END

LG WOW SYS FAIL

LAND AT THE NEAREST SUITABLE AIRPORT.

Icing Conditions ..... EXIT/AVOID

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.30.

NOTE: – Thrust Reversers, Steering, Ground Spoilers, Wing Anti-Ice and Ground Idle may not be available.

CONTINUED...

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– If the Weather Radar is inoperative, the Forced Standby option may be available to allow its use.

END

PRKG BRK NOT RELEASED

Crew awareness.

END

STEER FAIL

Steer the airplane using differential braking and rudder.

END

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BRK CONTROL FAULT

Brakes..... APPLY NORMALLY

Landing configuration:

Slat/Flap..... FULL

Set $V_{REF\ FULL}$.

END

BRK LH (RH) FAULT

NOTE: During landing run, expect a slight directional tendency.

Landing Configuration:

Slat/Flap..... FULL

Set Vref $_{FULL}$.

Brakes..... APPLY NORMALLY

If necessary:

Emergency/Parking Brake..... PULL

CAUTION:
- APPLY THE EMERGENCY/PARKING BRAKE MONITORING THE EMERGENCY/PARKING BRAKE LIGHT.
- WHEN THE EMERGENCY/PARKING BRAKE LIGHT IS ON, MAINTAIN STEADY PRESSURE SINCE THE ANTI-SKID PROTECTION IS NOT AVAILABLE.

BOTH SIDES AFFECTED? **No**

Yes

CONTINUED...

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...CONTINUED

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.51.

END

CAUTION: MULTIPLY THE FULL FLAPS UNFACTORED LANDING DISTANCE BY 1.19.

END

BRK PEDL LH (RH) SEAT FAIL

Crew Awareness.

END

EMER BRK FAULT

Crew Awareness.

END

LG TEMP EXCEEDANCE

Crew Awareness.

END

STEER FAULT

Crew Awareness.

END

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OXYGEN

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CREW OXY LO PRESS

Altitude..... 10000 ft or MEA, WHICHEVER IS HIGHER

END

PAX OXY NOT DEPLOYED

If required:

Passenger Oxygen Selector..... OVRD

END

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OBSERVER OXY LO PRESS

OBSERVER SEAT OCCUPIED?

No

Yes

Altitude ..... 10000 ft or MEA, WHICHEVER IS HIGHER

END

PAX OXY SW NOT AUTO

Crew Awareness.

END

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CATEGORY II OPERATION

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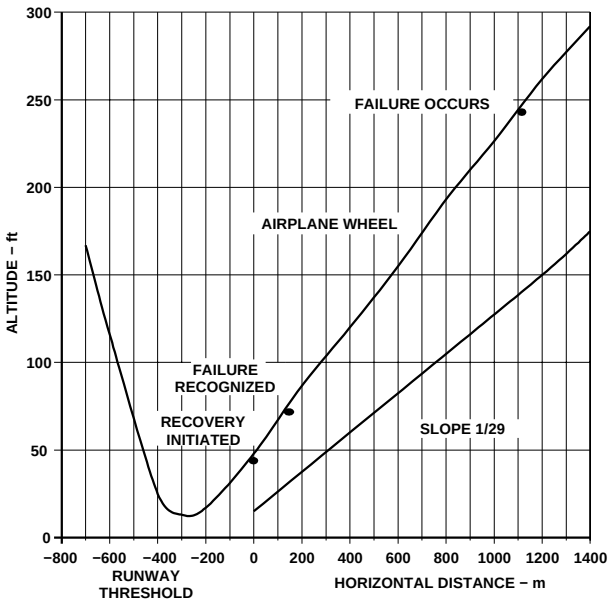
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ALTITUDE LOSS

The demonstrated altitude loss due to a pitch down hardover during flight test is presented in the graph below.

– Recovery initiated 1 second after failure recognition:



HARDOVER ALTITUDE LOSS

NOTE: The maximum demonstrated altitude loss due to autopilot malfunction is 20 ft.

END

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HARDOVER

If any unusual acceleration or motion is noticed on the airplane flight path the approach must be discontinued, and:

Autopilot..... DISENGAGE

MISSED APPROACH Procedure..... PERFORM AS REQUIRED

Perform a normal MISSED APPROACH Procedure, unless the approach is continued under visual conditions and the airplane position and attitude assure a safe landing.

END

SLOWOVER

The Slowover consists in a smooth and slow airplane attitude change due to an autopilot system malfunction. It may be recognized if one of the following symptoms occurs during approach:

– Unusual glide slope small deviation.

– Change in the rate of descent (small or large).

– Excessive glide slope deviation and the GS indications becoming amber.

– Autopilot self disconnection.

If a Slowover tendency is confirmed:

Autopilot..... DISENGAGE

MISSED APPROACH Procedure..... PERFORM AS REQUIRED

NOTE: Consider the possibility of continuing and performing the landing if under visual conditions and the airplane position and attitude assure a safe landing.

END

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ENGINE FAILURE ON FINAL APPROACH OR DURING GO-AROUND

Go-Around..... PERFORM

END

AUTOPILOT MALFUNCTION

BEFORE REACHING FAF

If the autopilot disengages or has to be disengaged, try to reengage it.

If the autopilot disengages again:

MISSED APPROACH Procedure..... PERFORM AS REQUIRED

NOTE: Consider the possibility of continuing and performing the landing if under visual conditions and the airplane position and attitude assure a safe landing.

AFTER REACHING FAF

If the autopilot disengages or has to be disengaged, do not reengage the autopilot.

MISSED APPROACH Procedure..... PERFORM AS REQUIRED

NOTE: Consider the possibility of continuing and performing the landing if under visual conditions and the airplane position and attitude assure a safe landing.

DISPLAY WARNINGS DURING FINAL APPROACH

Discontinue the approach if any of the following warnings occur:

– APPR 1 ONLY displayed on Autopilot Approach Status Annunciator,

– EICAS message APPR 2 NOT AVAIL presented,

– RALT FAIL (cyan),

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– RA (amber),
– GS (amber),
– LOC (amber),
– PIT (amber),
– HDG (amber),
– CAS (amber),
– FPA (amber).

Perform a normal MISSED APPROACH Procedure, unless the approach is continued under visual conditions and the airplane position and attitude assure a safe landing.

EXCESSIVE DEVIATION WARNING

If warning occurs above 200 ft Radio Altitude:

Monitor the ILS deviation to ensure that the airplane returns to the center beam.

If not recovered up to 200 ft radio altitude:

Discontinue the approach.

If warning occurs below 200 ft Radio Altitude:

Discontinue the approach.

In both cases, perform a normal MISSED APPROACH Procedure, unless the airplane position and attitude assure a safe landing.

END

ABNORMALITIES

The following abnormalities are deviation from CAT II ILS tracking normal range and must be called out:

– Excessive LOC or GS deviations.
– Airspeed 10 kt higher or 5 kt lower than the Landing Reference Speed ($V_{REF\ 5}$).
– Roll angle in excess of 25°.

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– Pitch angle below -5° or above 5°.

– Rate of descent in excess of 1200 ft/min.

END

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ELECTRONIC FLIGHT BAG (EFB)

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ELECTRONIC FLIGHT BAG (EFB)

ABNORMAL OPERATION

Information about abnormal operation is presented in the table below:

FAILURE	ACTION
POWER UP - The unit fails to power up.	Check that the power connections are secure. Verify that the circuit breakers (Pilot and Copilot) are closed. Check that the EDU is connected properly to the I/O connector.
BRIGHTNESS - The display is too dark or too light.	To lighten or darken the display, use the top right Brightness buttons of the EDU.
HARDWARE - USB device not working.	Unplug the USB device, wait 10 seconds and then reconnect it.
WINDOWS - Shutdown not functioning.	Press the reset button at the top of the EDU.
WIRELESS COMMUNICATION - Inoperative.	Enable wireless functionality and enter parameters via Windows Control Panel (Start/Control Panel/Network Connection).
MASTER MENU - Changed Master Menu setting via the Setup application and changes are not active.	Prior to exiting Setup, ensure to select Save and Exit. The PilotView™ EFB will need to be restarted to make the changes active.
PASSWORD - Invalid when trying to exit Master Menu.	Password is case sensitive. Make sure that Caps Lock is not activated.

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RVSM OPERATION

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ABNORMAL

EMERGENCY AND ABNORMAL PROCEDURES ... 4-04-57..... 1

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EMERGENCY AND ABNORMAL PROCEDURES

– In case of either emergency, abnormal situation or contingencies (equipment failures, weather, etc.), which affect the ability to maintain the cleared flight level, notify ATC and co-ordinate an action plan that is appropriate to the airspace concerned;

– Notify ATC when encountering greater than moderate turbulence;

– If unable to notify ATC and obtain an ATC clearance prior to deviating from the cleared flight level, follow any established contingency procedures and obtain ATC clearance as soon as possible.

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SECTION 5

PERFORMANCE

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AIRSPEED DEFINITIONS

INDICATED AIRSPEED – KIAS

It is the reading on the airspeed indicator (knots), as installed in the airplane, uncorrected for static source position error. Zero instrument error is assumed.

CALIBRATED AIRSPEED – KCAS

It is the indicated airspeed (knots), corrected for static source position error.

TRUE AIRSPEED – TAS

It is the equivalent airspeed corrected for atmospheric density effects.

CRITICAL ENGINE FAILURE SPEED – V_{EF}

It is the speed at which, if one engine fails, the failure is recognized at V_1.

1-G STALL SPEED – V_{S1G}

Is the minimum speed at which the lift provided by the wing is capable of supporting the weight of the airplane.

REFERENCE STALL SPEED – V_{SR}

It is stall speed used as the reference in determining the various airplane speeds. V_{SR} may not be less than V_{S1G}.

TAKEOFF DECISION SPEED – V_1

It is the speed at which, following a failure of one engine at V_{EF}, the decision to continue the takeoff results in:

- A takeoff distance to a height of 35 ft at V_2 speed, that will not exceed the available takeoff distance;
- A distance to bring the airplane to a full stop that will not exceed the accelerate-stop distance available.

V_1 must not be greater than the rotation speed (V_R).

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ROTATION SPEED – V_R

It is the speed at which rotation is initiated during the takeoff, to attain the takeoff safety speed at or before a height of 35 ft above runway surface.

TAKEOFF SAFETY SPEED – V_2

The target speed to be attained at a height of 35 ft during a takeoff with an engine failure.

AIR MINIMUM CONTROL SPEED – V_{MCA}

The minimum flight speed at which the airplane is controllable with a maximum 5° bank, when one engine suddenly becomes inoperative with the remaining engine operating at takeoff power. The value presented represents the most critical combination of power, weight, and center of gravity.

GROUND MINIMUM CONTROL SPEED – V_{MCG}

The minimum speed on the ground at which the takeoff can be continued, utilizing aerodynamic controls alone, when one engine suddenly becomes inoperative and the remaining engine is operating at takeoff power. The value presented represents the most critical combination of power, weight, and center of gravity.

LANDING REFERENCE SPEED – V_{REFXX}

The speed at a height of 50 ft in a normal landing. This speed is equal to 1.23 V_{S1G} in the landing configuration (gear down and specific landing flaps XX).

MANEUVERING SPEED – V_A

The maximum speed at which application of full available aileron or rudder will not overstress the airplane.

Maneuver involving pitching control must not exceed the limit load factor defined in Section 2 – Limitations.

MINIMUM CONTROL SPEEDS DURING LANDING AND APPROACH – V_{MCL}

V_{MCL} is the minimum control speed during landing and approach with all engines operating, when the critical engine is suddenly made inoperative.

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FINAL TAKEOFF SEGMENT SPEED – V_{FS}

It is the speed to be achieved during final segment, with landing gear up and flaps retracted.

METEOROLOGICAL DEFINITIONS

INTERNATIONAL STANDARD ATMOSPHERE – ISA

As accepted by the International Civil Aviation Organization.

STATIC AIR TEMPERATURE – SAT

Outside air temperature as indicated on the MFD.

TRUE OUTSIDE AIR TEMPERATURE

The free air static (ambient) temperature.

WIND VELOCITY

The actual wind velocity at a height of 10 m (32.8 ft), reported from the tower and corrected by the wind component chart to a headwind or tailwind component parallel to the flight path.

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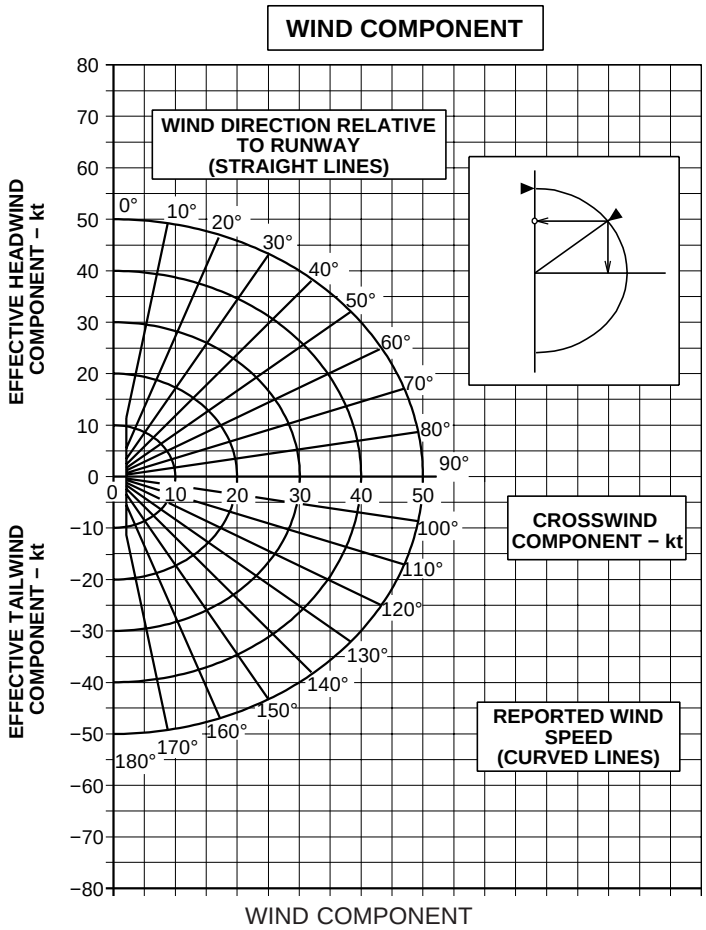
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DEMONSTRATED CROSSWIND

The maximum demonstrated crosswind component for landing is 28 kt. This maximum demonstrated value is not considered to be limiting.

WIND AND ALTITUDE CONVERSION



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USE

Enter the chart with the reported wind velocity and the relative angle to the runway, to read the wind component parallel to the runway and the crosswind.

EXAMPLE

Given:

Wind velocity..... 20 kt
Wind direction..... 60°

Determine:

Wind component parallel to the runway..... 10 kt
Crosswind..... 17.5 kt

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ALTIMETER SETTING TO STATION PRESSURE

QNH TO PRESSURE ALTITUDE

QNH		CORRECTION TO ELEVATION FOR PRES. ALT. (ft)
inHg	hPa	
28.81 to 28.91	976 to 979	1000
28.92 to 29.02	980 to 983	900
29.03 to 29.12	984 to 986	800
29.13 to 29.23	987 to 990	700
29.24 to 29.34	991 to 994	600
29.35 to 29.44	995 to 997	500
29.45 to 29.55	998 to 1001	400
29.56 to 29.66	1002 to 1004	300
29.67 to 29.76	1005 to 1008	200
29.77 to 29.87	1009 to 1012	100
29.88 to 29.97	1013 to 1015	0
29.98 to 30.08	1016 to 1019	-100
30.09 to 30.19	1020 to 1022	-200
30.20 to 30.30	1023 to 1026	-300
30.31 to 30.41	1027 to 1030	-400
30.42 to 30.52	1031 to 1034	-500
30.53 to 30.63	1035 to 1037	-600
30.64 to 30.74	1038 to 1041	-700
30.75 to 30.85	1042 to 1045	-800
30.86 to 30.96	1046 to 1048	-900
30.97 to 31.07	1049 to 1052	-1000

Example: Elevation = 2000 ft
QNH = 29.60 in.Hg
Correction = 300 ft
Pressure Altitude = 2300 ft

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QFE TO STATION PRESSURE

QFE		PRESSURE		QFE		PRESSURE
inHg	hPa	ALTITUDE (ft)		inHg	hPa	ALTITUDE (ft)
31.01	1050	-989		25.55	865	4313
30.86	1045	-856		25.40	860	4468
30.71	1040	-723		25.25	855	4625
30.57	1035	-589		25.10	850	4781
30.42	1030	-454		24.96	845	4939
30.27	1025	-319		24.81	840	5097
30.12	1020	-184		24.66	835	5257
29.98	1015	-48		24.51	830	5417
29.83	1010	89		24.36	825	5579
29.68	1005	227		24.21	820	5740
29.53	1000	364		24.07	815	5903
29.38	995	503		23.92	810	6065
29.23	990	641		23.77	805	6230
29.09	985	781		23.62	800	6394
28.94	980	921		23.48	795	6561
28.79	975	1062		23.33	790	6727
28.64	970	1202		23.18	785	6895
28.50	965	1344		23.03	780	7063
28.35	960	1486		22.89	775	7233
28.20	955	1630		22.74	770	7402
28.05	950	1773		22.59	765	7574
27.91	945	1918		22.44	760	7745
27.76	940	2062		22.30	755	7920
27.61	935	2208		22.15	750	8095
27.46	930	2353		22.00	745	8269
27.32	925	2500		21.85	740	8442
27.17	920	2647		21.71	735	8619
27.02	915	2796		21.56	730	8796
26.87	910	2944		21.41	725	8975
26.73	905	3094		21.26	720	9154
26.58	900	3243		21.12	715	9335

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QFE		PRESSURE ALTITUDE (ft)		QFE		PRESSURE ALTITUDE (ft)
inHg	hPa			inHg	hPa	
26.43	895	3394		20.97	710	9516
26.28	890	3545		20.82	705	9699
26.14	885	3698		20.67	700	9882
25.99	880	3850		20.53	695	10068
25.84	875	4004		20.38	690	10253
25.69	870	4157		20.19	685	10439

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GEOMETRIC HEIGHT TO PRESSURE HEIGHT

Pressure altimeters are calibrated to indicate true altitude under International Standard Atmosphere (ISA) conditions. Any deviation from ISA will therefore result in an erroneous reading on the altimeter. When the temperature is higher than ISA, the true altitude will be higher than the figure indicated by the altimeter. When the temperature is lower than ISA, the true altitude will be lower than the figure indicated by the altimeter. The altimeter error may be significant under conditions of extremely cold temperature (ICAO PANS-OPS Vol I 3.1.4.5.2).

AERODROME TEMP. (°C)	HEIGHT ABOVE THE ELEVATION OF THE ALTIMETER SETTING SOURCE (ft)						
	200	300	400	500	600	700	800
0	20	20	30	30	40	40	50
-10	20	30	40	50	60	70	80
-20	30	50	60	70	90	100	120
-30	40	60	80	100	120	140	150
-40	50	80	100	120	150	170	190
-50	60	90	120	150	180	210	240

AERODROME TEMP. (°C)	HEIGHT ABOVE THE ELEVATION OF THE ALTIMETER SETTING SOURCE (ft)						
	900	1000	1500	2000	3000	4000	5000
0	50	60	90	120	170	230	280
-10	90	100	150	200	290	390	490
-20	130	140	210	280	420	570	710
-30	170	190	280	380	570	760	950
-40	220	240	360	480	720	970	1210
-50	270	300	450	590	890	1190	1500

The tables above are based on an aerodrome at sea level. However, they can be used operationally at any aerodrome elevation.

Example:

Airport Elevation..... 1500 ft

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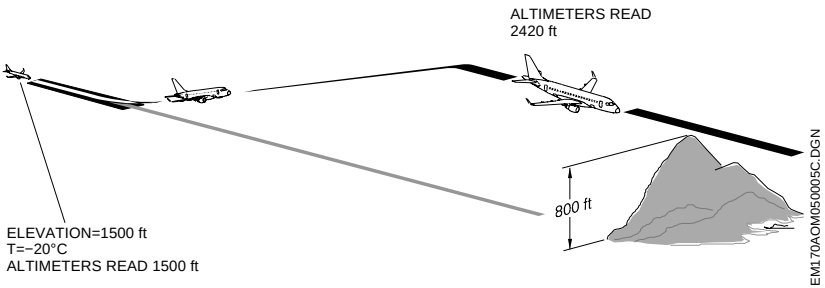
Airport Temperature..... -20°C

Obstacle Height above airport elevation..... 800 ft

Altimeter adjusted to airport QNH (on ground altimeter reads 1500 ft).

Refer to table at 800 ft and -20°C and read 120 ft.

Therefore, when the airplane reaches the obstacle geometric height, the altimeter will read 1500 + 800 + 120 = 2420 ft.



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THRUST SETTING TABLES

Thrust settings tables are presented for various pressure altitudes and static air temperatures, with engine bleed closed or open, and anti-ice on or off.

The following tables present Takeoff N1 regarding T/O-1 and T/O-2 mode and Go-around N1 for CF34-10E6 engines.

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N1 FOR T/O-1 MODE
ECS ON — ANTI-ICE OFF

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-40	-35	-30	-25	-20	-15	-10	-5	0	5
-1000	78.4	79.2	80.0	80.8	81.6	82.3	83.1	83.9	84.6	85.4
0	79.3	80.2	81.0	81.8	82.6	83.4	84.1	84.9	85.7	86.4
1000	79.8	80.6	81.4	82.2	83.0	83.8	84.6	85.4	86.1	86.9
2000	80.2	81.1	81.9	82.7	83.5	84.3	85.1	85.8	86.6	87.4
3000	80.7	81.6	82.4	83.2	84.0	84.8	85.6	86.3	87.1	87.9
4000	81.2	82.1	82.9	83.7	84.5	85.3	86.0	86.8	87.6	88.3
5000	81.7	82.6	83.3	84.1	84.9	85.7	86.5	87.3	88.1	88.8
6000	82.0	82.9	83.7	84.5	85.3	86.1	86.9	87.6	88.4	89.2
7000	82.5	83.3	84.1	84.9	85.7	86.5	87.3	88.1	88.8	89.6
8000	82.9	83.7	84.6	85.3	86.1	86.9	87.7	88.5	89.3	90.0
9000	83.3	84.2	85.0	85.8	86.5	87.3	88.1	88.9	89.7	90.5
10000	83.8	84.7	85.5	86.3	87.0	87.8	88.6	89.4	90.2	91.0

Pressure Altitude	Static Air Temperature — °C								
(ft)	10	15	20	25	30	35	40	45	50
-1000	86.1	86.8	87.6	88.3	89.0	89.8	89.5	88.8	88.2
0	87.2	87.9	88.7	89.4	90.1	90.9	90.0	89.4	88.8
1000	87.6	88.4	89.1	89.9	90.6	90.7	90.0	89.4	88.7
2000	88.1	88.9	89.6	90.4	91.1	90.7	90.1	89.5	88.6
3000	88.6	89.4	90.1	90.9	91.3	90.7	90.1	89.4	88.6
4000	89.1	89.8	90.6	91.3	91.3	90.7	90.1	89.4	88.6
5000	89.6	90.3	91.1	91.8	91.3	90.7	90.2	89.3	88.7
6000	90.0	90.7	91.5	91.7	91.1	90.6	89.9	89.1	88.6
7000	90.4	91.1	91.9	91.5	91.0	90.4	89.6	89.0	88.4
8000	90.8	91.6	92.1	91.3	90.8	90.2	89.4	88.8	---
9000	91.2	92.0	91.8	91.2	90.6	89.9	89.2	88.7	---
10000	91.7	92.5	91.6	91.1	90.5	89.7	89.1	88.6	---

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N1 FOR T/O-1 MODE
ECS ON — WING AND ENGINE ANTI-ICE ON

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-35	-30	-25	-20	-15	-10	-5	0	5	10
-1000	79.2	80.0	80.8	81.6	82.3	83.1	83.9	84.6	85.4	86.1
0	80.2	81.0	81.8	82.6	83.4	84.1	84.9	85.7	86.4	87.2
1000	80.6	81.4	82.3	83.0	83.8	84.6	85.4	86.1	86.9	87.7
2000	81.1	81.9	82.7	83.5	84.3	85.1	85.8	86.6	87.4	88.1
3000	81.6	82.4	83.2	84.0	84.8	85.5	86.3	87.1	87.8	88.6
4000	82.0	82.9	83.7	84.5	85.2	86.0	86.8	87.6	88.3	89.1
5000	82.6	83.3	84.1	84.9	85.7	86.5	87.3	88.1	88.8	89.6
6000	82.9	83.7	84.5	85.3	86.1	86.9	87.6	88.4	89.2	90.0
7000	83.3	84.1	84.9	85.7	86.5	87.3	88.1	88.8	89.6	90.4
8000	83.7	84.6	85.3	86.1	86.9	87.7	88.5	89.3	90.0	90.8
9000	84.1	85.0	85.8	86.6	87.4	88.1	88.9	89.7	90.5	90.8
10000	84.7	85.5	86.3	87.0	87.8	88.6	89.4	90.2	91.0	90.6

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N1 FOR T/O-1 MODE
ECS OFF — ANTI-ICE OFF

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-40	-35	-30	-25	-20	-15	-10	-5	0	5
-1000	79.0	79.9	80.7	81.5	82.3	83.0	83.8	84.6	85.4	86.1
0	80.0	80.9	81.7	82.5	83.3	84.1	84.9	85.7	86.5	87.2
1000	80.5	81.4	82.2	83.0	83.8	84.6	85.4	86.2	86.9	87.7
2000	81.0	81.8	82.7	83.5	84.3	85.1	85.9	86.7	87.5	88.2
3000	81.5	82.3	83.2	84.0	84.8	85.6	86.4	87.2	88.0	88.7
4000	82.0	82.9	83.7	84.5	85.3	86.1	86.9	87.7	88.5	89.3
5000	82.5	83.4	84.2	85.0	85.8	86.6	87.4	88.3	89.0	89.8
6000	83.0	83.8	84.6	85.4	86.2	87.1	87.9	88.7	89.4	90.2
7000	83.4	84.3	85.1	85.9	86.7	87.5	88.4	89.1	89.9	90.7
8000	83.9	84.7	85.6	86.4	87.2	88.0	88.8	89.6	90.4	91.2
9000	84.3	85.2	86.0	86.8	87.6	88.4	89.3	90.1	90.9	91.7
10000	84.9	85.8	86.6	87.4	88.2	89.0	89.8	90.6	91.4	92.2

Pressure Altitude	Static Air Temperature — °C								
(ft)	10	15	20	25	30	35	40	45	50
-1000	86.9	87.6	88.4	89.1	89.9	90.6	90.4	89.6	89.1
0	88.0	88.7	89.5	90.2	91.0	91.8	90.9	90.3	89.7
1000	88.5	89.2	90.0	90.7	91.5	91.7	90.9	90.4	89.7
2000	89.0	89.7	90.5	91.3	92.0	91.7	91.0	90.4	89.6
3000	89.5	90.3	91.0	91.8	92.3	91.7	91.1	90.5	89.7
4000	90.0	90.8	91.6	92.3	92.3	91.7	91.2	90.4	89.7
5000	90.6	91.3	92.1	92.8	92.3	91.8	91.2	90.4	89.8
6000	91.0	91.8	92.5	92.8	92.2	91.7	91.0	90.3	89.7
7000	91.5	92.3	93.0	92.7	92.1	91.6	90.8	90.2	89.6
8000	92.0	92.7	93.3	92.5	92.0	91.4	90.6	90.1	---
9000	92.4	93.2	93.1	92.4	91.9	91.2	90.5	90.0	---
10000	93.0	93.8	92.9	92.3	91.8	91.0	90.5	89.9	---

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N1 FOR T/O-1 MODE
ECS OFF — WING AND ENGINE ANTI-ICE ON

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-35	-30	-25	-20	-15	-10	-5	0	5	10
-1000	79.8	80.7	81.5	82.3	83.1	83.8	84.6	85.4	86.2	86.9
0	80.9	81.7	82.5	83.3	84.1	84.9	85.7	86.5	87.2	88.0
1000	81.4	82.2	83.0	83.8	84.6	85.4	86.2	86.9	87.7	88.5
2000	81.8	82.7	83.5	84.3	85.1	85.9	86.7	87.5	88.2	89.0
3000	82.3	83.2	84.0	84.8	85.6	86.4	87.2	88.0	88.8	89.5
4000	82.8	83.7	84.5	85.3	86.1	86.9	87.7	88.5	89.3	90.0
5000	83.4	84.2	85.0	85.8	86.6	87.4	88.3	89.0	89.8	90.6
6000	83.8	84.6	85.4	86.2	87.1	87.9	88.7	89.5	90.2	91.0
7000	84.3	85.1	85.9	86.7	87.5	88.4	89.1	89.9	90.7	91.5
8000	84.7	85.6	86.4	87.2	88.0	88.8	89.6	90.4	91.2	92.0
9000	85.2	86.0	86.9	87.7	88.5	89.3	90.1	90.9	91.7	91.9
10000	85.8	86.6	87.4	88.2	89.0	89.8	90.6	91.4	92.2	91.8

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N1 FOR T/O-2 MODE
ECS ON — ANTI-ICE OFF

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-40	-35	-30	-25	-20	-15	-10	-5	0	5
-1000	75.5	76.3	77.1	77.8	78.6	79.3	80.1	80.8	81.5	82.2
0	76.4	77.2	78.0	78.8	79.6	80.3	81.1	81.8	82.6	83.3
1000	76.8	77.7	78.5	79.2	80.0	80.7	81.5	82.3	83.0	83.7
2000	77.3	78.1	78.9	79.7	80.4	81.2	81.9	82.7	83.5	84.2
3000	77.7	78.5	79.3	80.1	80.8	81.6	82.4	83.1	83.9	84.6
4000	78.1	78.9	79.7	80.5	81.3	82.0	82.8	83.6	84.3	85.0
5000	78.5	79.3	80.1	80.9	81.7	82.4	83.2	84.0	84.7	85.5
6000	78.9	79.7	80.5	81.3	82.1	82.9	83.6	84.4	85.1	85.9
7000	79.3	80.1	80.9	81.7	82.5	83.3	84.0	84.8	85.6	86.3
8000	79.7	80.5	81.3	82.1	82.9	83.6	84.4	85.2	86.0	86.7
9000	80.1	80.9	81.7	82.5	83.2	84.0	84.8	85.6	86.4	87.1
10000	80.5	81.3	82.1	82.9	83.6	84.4	85.2	86.0	86.8	87.5

Pressure Altitude	Static Air Temperature — °C								
(ft)	10	15	20	25	30	35	40	45	50
-1000	82.9	83.6	84.3	85.1	85.8	85.6	84.9	84.3	83.7
0	84.0	84.7	85.4	86.1	86.8	86.2	85.5	84.8	84.3
1000	84.5	85.2	85.9	86.6	86.8	86.1	85.5	84.8	84.1
2000	84.9	85.6	86.3	87.1	86.7	86.0	85.4	84.7	83.9
3000	85.3	86.1	86.8	87.2	86.6	86.0	85.3	84.6	83.8
4000	85.8	86.5	87.2	87.2	86.5	85.9	85.3	84.5	83.8
5000	86.2	86.9	87.7	87.1	86.4	85.8	85.2	84.3	83.8
6000	86.7	87.4	87.6	87.0	86.4	85.8	85.0	84.3	84.2
7000	87.1	87.8	87.5	86.9	86.3	85.7	84.8	84.3	84.7
8000	87.5	88.0	87.4	86.8	86.2	85.6	84.8	84.5	---
9000	87.9	87.9	87.3	86.7	86.1	85.4	84.8	85.0	---
10000	88.3	87.7	87.2	86.6	86.1	85.2	84.9	85.5	---

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N1 FOR T/O-2 MODE
ECS ON — WING AND ENGINE ANTI-ICE ON

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-35	-30	-25	-20	-15	-10	-5	0	5	10
-1000	76.3	77.0	77.8	78.6	79.3	80.0	80.8	81.5	82.3	83.0
0	77.3	78.0	78.8	79.6	80.3	81.1	81.8	82.6	83.3	84.0
1000	77.7	78.5	79.2	80.0	80.7	81.5	82.3	83.0	83.7	84.5
2000	78.1	78.9	79.7	80.4	81.2	81.9	82.7	83.5	84.2	84.9
3000	78.5	79.3	80.1	80.9	81.6	82.4	83.1	83.8	84.6	85.3
4000	78.9	79.7	80.5	81.3	82.0	82.8	83.5	84.3	85.0	85.8
5000	79.3	80.1	80.9	81.7	82.4	83.2	84.0	84.7	85.5	86.2
6000	79.7	80.5	81.3	82.1	82.9	83.6	84.4	85.1	85.9	86.6
7000	80.1	80.9	81.7	82.5	83.3	84.0	84.8	85.6	86.3	86.5
8000	80.5	81.3	82.1	82.9	83.6	84.4	85.2	86.0	86.7	86.4
9000	80.9	81.7	82.5	83.3	84.1	84.8	85.6	86.4	86.8	86.3
10000	81.3	82.1	82.9	83.6	84.4	85.2	86.0	86.8	86.7	86.1

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N1 FOR T/O-2 MODE
ECS OFF — ANTI-ICE OFF

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-40	-35	-30	-25	-20	-15	-10	-5	0	5
-1000	76.1	76.9	77.7	78.5	79.2	80.0	80.8	81.5	82.3	83.0
0	77.1	77.9	78.7	79.5	80.3	81.0	81.8	82.6	83.3	84.0
1000	77.5	78.4	79.2	80.0	80.7	81.5	82.3	83.0	83.8	84.6
2000	78.0	78.8	79.6	80.4	81.2	82.0	82.7	83.5	84.3	85.0
3000	78.4	79.3	80.1	80.9	81.6	82.4	83.2	84.0	84.8	85.5
4000	78.9	79.7	80.5	81.3	82.1	82.9	83.7	84.5	85.2	86.0
5000	79.3	80.2	81.0	81.7	82.5	83.3	84.1	84.9	85.7	86.4
6000	79.8	80.6	81.4	82.2	83.0	83.8	84.6	85.4	86.1	86.9
7000	80.2	81.0	81.8	82.6	83.4	84.2	85.0	85.8	86.6	87.3
8000	80.6	81.4	82.3	83.1	83.9	84.7	85.4	86.2	87.0	87.8
9000	81.0	81.9	82.7	83.5	84.3	85.1	85.9	86.7	87.5	88.3
10000	81.5	82.3	83.2	84.0	84.8	85.6	86.4	87.2	88.0	88.7

Pressure Altitude	Static Air Temperature — °C								
(ft)	10	15	20	25	30	35	40	45	50
-1000	83.7	84.4	85.1	85.9	86.6	86.5	85.8	85.1	84.6
0	84.8	85.5	86.2	87.0	87.7	87.0	86.4	85.7	85.2
1000	85.3	86.0	86.7	87.5	87.7	87.0	86.4	85.8	85.1
2000	85.8	86.5	87.2	88.0	87.6	87.0	86.4	85.7	84.9
3000	86.2	87.0	87.7	88.2	87.6	87.0	86.3	85.7	84.9
4000	86.7	87.4	88.2	88.1	87.5	86.9	86.3	85.6	84.9
5000	87.2	87.9	88.7	88.1	87.5	86.9	86.3	85.4	84.9
6000	87.6	88.4	88.6	88.1	87.5	86.9	86.2	85.4	84.9
7000	88.1	88.9	88.6	88.0	87.4	86.9	86.0	85.4	84.9
8000	88.6	89.1	88.5	88.0	87.4	86.8	86.0	85.4	---
9000	89.0	89.1	88.5	88.0	87.4	86.7	86.0	85.5	---
10000	89.5	89.0	88.5	87.9	87.4	86.5	86.0	85.5	---

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N1 FOR T/O-2 MODE
ECS OFF — WING AND ENGINE ANTI-ICE ON

AIRSPEED: 0 KCAS

CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-35	-30	-25	-20	-15	-10	-5	0	5	10
-1000	76.9	77.7	78.5	79.3	80.0	80.8	81.5	82.3	83.0	83.7
0	77.9	78.7	79.5	80.3	81.0	81.8	82.6	83.3	84.1	84.8
1000	78.4	79.2	80.0	80.7	81.5	82.3	83.0	83.8	84.6	85.3
2000	78.8	79.6	80.4	81.2	82.0	82.7	83.5	84.3	85.0	85.8
3000	79.3	80.1	80.9	81.6	82.4	83.2	84.0	84.8	85.5	86.2
4000	79.7	80.5	81.3	82.1	82.9	83.6	84.4	85.2	85.9	86.7
5000	80.2	81.0	81.7	82.5	83.3	84.1	84.9	85.7	86.4	87.2
6000	80.6	81.4	82.2	83.0	83.8	84.6	85.4	86.1	86.9	87.5
7000	81.0	81.8	82.6	83.4	84.2	85.0	85.8	86.6	87.4	87.5
8000	81.4	82.3	83.1	83.9	84.7	85.4	86.2	87.0	87.8	87.4
9000	81.9	82.7	83.5	84.3	85.1	85.9	86.7	87.5	87.9	87.4
10000	82.3	83.2	84.0	84.8	85.6	86.4	87.2	88.0	87.9	87.4

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N1 FOR GO-AROUND MODE
ECS OFF — ANTI-ICE OFF

ANAC/FAA CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-40	-35	-30	-25	-20	-15	-10	-5	0	5
-1000	81.3	82.2	83.0	83.8	84.6	85.4	86.2	87.0	87.8	88.5
0	82.3	83.1	83.9	84.8	85.6	86.4	87.2	88.0	88.8	89.5
1000	82.9	83.7	84.6	85.4	86.2	87.0	87.8	88.6	89.4	90.2
2000	83.5	84.3	85.2	86.0	86.8	87.6	88.4	89.2	90.0	90.8
3000	84.1	85.0	85.8	86.6	87.4	88.3	89.1	89.9	90.7	91.4
4000	84.7	85.6	86.4	87.3	88.1	88.9	89.7	90.5	91.3	92.1
5000	85.4	86.3	87.1	87.9	88.7	89.5	90.3	91.2	91.9	92.7
6000	85.9	86.7	87.5	88.4	89.2	90.0	90.8	91.6	92.4	93.2
7000	86.3	87.2	88.0	88.8	89.6	90.4	91.2	92.0	92.8	93.6
8000	86.8	87.7	88.5	89.3	90.1	90.9	91.7	92.5	93.3	94.1
9000	87.3	88.1	89.0	89.8	90.6	91.4	92.2	93.0	93.8	94.5
10000	86.3	87.1	87.9	88.7	89.4	90.2	91.0	91.8	92.5	93.2

Pressure Altitude	Static Air Temperature — °C								
(ft)	10	15	20	25	30	35	40	45	50
-1000	89.3	90.1	90.8	91.6	92.3	93.1	93.2	92.7	92.1
0	90.3	91.1	91.8	92.6	93.4	94.1	93.8	93.2	92.6
1000	90.9	91.7	92.5	93.2	94.0	94.3	93.8	93.3	---
2000	91.6	92.3	93.1	93.9	94.6	94.4	93.8	93.2	---
3000	92.2	93.0	93.7	94.5	95.0	94.4	93.8	---	---
4000	92.8	93.6	94.4	95.2	95.1	94.4	93.8	---	---
5000	93.5	94.3	95.0	95.8	95.1	94.4	93.9	---	---
6000	94.0	94.7	95.5	95.7	95.0	94.4	---	---	---
7000	94.4	95.2	95.9	95.6	95.0	94.3	---	---	---
8000	94.9	95.6	96.2	95.6	94.9	---	---	---	---
9000	95.3	96.1	96.1	95.5	94.8	---	---	---	---
10000	94.0	94.7	94.2	93.5	92.8	---	---	---	---

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N1 FOR GO-AROUND MODE
ECS OFF — WING AND ENGINE ANTI-ICE ON

ANAC/FAA CF34-10E6 ENGINE

Pressure Altitude	Static Air Temperature — °C									
(ft)	-35	-30	-25	-20	-15	-10	-5	0	5	10
-1000	85.3	86.2	87.0	87.8	88.6	89.4	90.2	91.0	91.8	92.5
0	86.6	87.4	88.2	89.0	89.9	90.7	91.5	92.3	93.0	93.8
1000	87.2	88.0	88.8	89.6	90.4	91.2	92.0	92.8	93.6	94.4
2000	87.7	88.6	89.4	90.2	91.0	91.8	92.6	93.4	94.1	94.9
3000	88.4	89.2	90.0	90.8	91.6	92.4	93.2	94.0	94.8	95.5
4000	89.0	89.8	90.6	91.4	92.2	93.0	93.8	94.6	95.4	95.7
5000	89.1	89.9	90.7	91.5	92.3	93.1	93.9	94.6	95.4	95.4
6000	89.1	89.9	90.7	91.5	92.3	93.1	93.9	94.6	95.4	95.4
7000	89.1	89.9	90.7	91.5	92.3	93.0	93.8	94.6	95.3	95.3
8000	89.0	89.9	90.7	91.5	92.3	93.0	93.8	94.6	95.4	95.1
9000	89.0	89.8	90.6	91.4	92.2	93.0	93.8	94.6	95.3	95.1
10000	87.1	87.9	88.7	89.4	90.2	91.0	91.8	92.5	92.5	91.9

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TAKEOFF ANALYSIS DESCRIPTION AND USE

Using Embraer Runway Analysis Software, airlines can produce takeoff analysis tables. Using these tables the crew is able to get the following information for a certain ambient conditions and airplane configuration:

– Maximum takeoff weight and the performance limitation code;

– Takeoff speeds;

– Takeoff N1.

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PART A

NOTE: FOR REFERENCE ONLY

TAKEOFF ANALYSIS − EMBRAER 190

EMBRAER 190 − TAKEOFF ANALYSIS, CF34−10E6 Engines, FAA Certification

Airport: BERGSTROM INTL KAUS/AUS	Runway #: 17L	Elevation: 492 ft
Length: 9000 ft	Align Allow TODA: 0.0 ft	Align Allow ASDA: 0 ft
Clearway: 0 ft	Stopway: 0 ft	Slope: −0.20 %
Runway Surface: Normal		
Runway Condition: Dry		
T/O Mode: T/O−1	Anti Ice: Off	Flaps: 2
Air Conditioning: Off	ATTCS: On	App Flaps: 2
Brakes: ABSC 90002340PR	Auto Brakes: Off	
CG: Standard	Reverse: No reverse thrust credit	

Flight Path: 2nd seg. obst. clearance preferred
V2/Vs Ratio: Fixed 1.21
Pitch Angle: 9.8
V1/Vr Ratio: Optimum V1
Stop Margin: No Stop Margin
MTOW User Defined: 51800 kg

Obstacle Data (measured from BTORA)

Obs Nbr	1	2	3	4	5	6	7	8	9	10
Height	15	6	−8	−2	−11	18	8	10	16	27
Dist	9498	9617	9708	9805	10073	10251	10258	10584	10754	11026
Obs Nbr	11	12	13	14						
Height	33	42	103	110						
Dist	11597	11756	15244	15728						

REMARKS:

Output Description(Weights in kg, Speeds in KIAS):
MTOW−LIM
V1/Vr/V2

Temp(C)	N1	−10	−5	0	5	10	15	20
3	87.2	51279−1 152/152/156	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
6	87.6	51019−1 151/152/156	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
9	88.1	50742−1 151/152/155	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
12	88.5	50488−1 150/151/155	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
15	89.0	50218−1 150/151/155	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
18	89.4	49964−1 149/150/154	51695−1 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
21	89.9	49701−1 148/150/154	51426−1 152/153/156	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
24	90.3	49460−1 148/149/153	51159−1 152/152/156	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157	51800−S 153/153/157
27	90.8	49208−1 147/149/153	50907−1 151/152/156	51800−S 154/154/157	51800−S 154/154/157	51800−S 154/154/157	51800−S 154/154/157	51800−S 154/154/157
30	91.3	48967−1 147/148/153	50647−1 151/151/155	51800−S 154/154/157	51800−S 154/154/157	51800−S 154/154/157	51800−S 154/154/157	51800−S 154/154/157
A/ICE Correction, valid up to 10C:								
Sub:		156	0	0	0	0	0	0

21 89.9

PART B

51800−S 153/153/157

Codes: RA=Field Length AEO RO=Field Length OEI A=Approach Climb OEI P=Tire Speed
FS=Climb 1 Seg. W=Climb 2 Seg. AS=Climb Acc. Seg. SF=Climb Final Seg.

1,2,3...=Obstacle # S=MTOW Max Str TOW B=Brake Energy U=Undefined
− Minimum V1 check must be done

RW−017−E v1.1.0 alfa1 Date (day−month−year): 11−06−2008
SCAP Module Version: 170−29723−260 Database: 191−05677−251.DAT;191−05679−251.DAT

Minimum Gross Level Off Height: 816 ft Maximum Gross Level off Height: 950 ft
Minimum Gross Level Off Altitude : 1308 ft Maximum Gross Level off Altitude: 1442 ft

EM170AOM050067A.DGN

AUS

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DESCRIPTION OF THE OUTPUTS OF THE CHART

Part A: Head Lines with the following information:

– Airplane Configuration (engine, thrust, flap, brakes, etc);

– Runway Characteristics (elevation, length, obstacles, clearway, stopway, slope, etc).

Part B: Performance Information:

– OAT: Outside Air Temperature (if a letter A follow the temperature it means that the weight can be used only for assumed temperature calculation);

– Takeoff N1;

– Maximum Takeoff Weight;

– V_1: Takeoff decision speed;

– V_R: Rotation speed;

– V_2: Safety speed;

– Limitation code.

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ASSUMED TEMPERATURE REDUCED THRUST

In many situations, the airplane takes off at weights lower than the maximum permissible takeoff weight. In consequence, it is possible to continue complying with performance limitations using a decreased engine thrust adapted to the actual weight. This is called assumed temperature reduced thrust method.

Certification authorities permit the use of up to 25% of takeoff thrust reduction for operation with assumed temperature reduced thrust.

UTILIZATION OF ASSUMED TEMPERATURE REDUCED THRUST

Assumed temperature reduced thrust method can be only used when a takeoff analysis data generated for a fixed V2/VS ratio is available, and the actual weight is lower than the maximum permissible takeoff weight for the actual temperature.

AIRWORTHINESS REQUIREMENTS

- Maximum Assumed Temperature (MaxAT) (25% reduction). See Maximum Assumed Temperature Table.
- Assumed temperature reduced thrust is not allowed when runway is contaminated with water, ice, slush or snow.
- The operator shall at regular intervals check the maximum thrust in order to detect any possible engine deterioration, unless the operators has an adequate engine performance monitoring program.

RECOMMENDATION

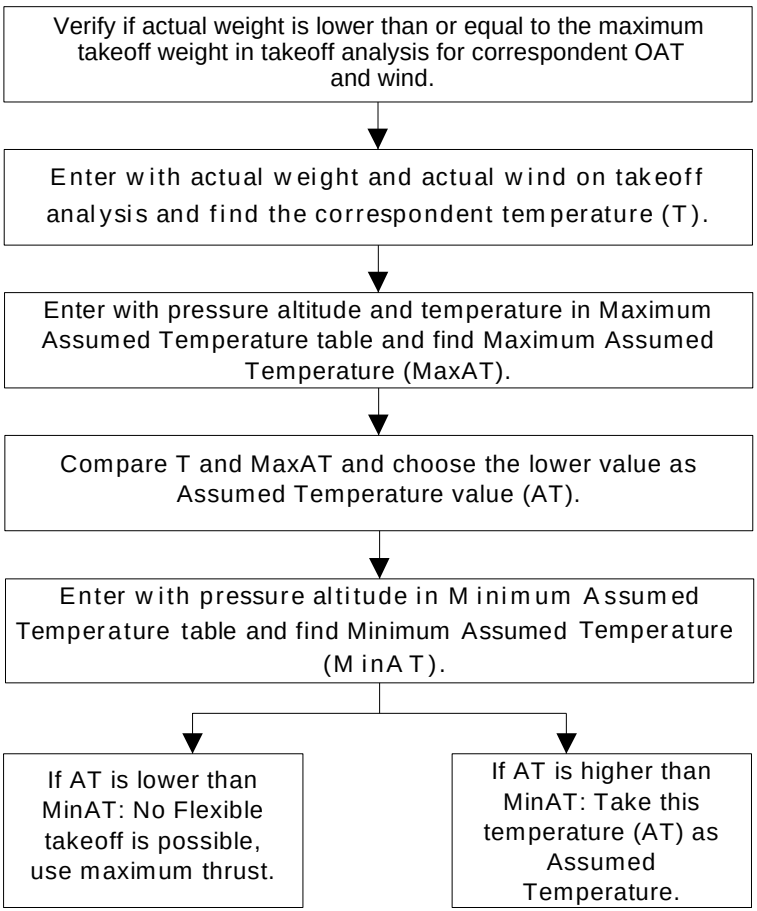
Assumed temperature reduced thrust should be used whenever possible in order to save engine life.

Always use the flaps configuration, that provides the greatest maximum takeoff weight in order to maximize thrust reduction.

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FLEXIBLE TEMPERATURE DETERMINATION

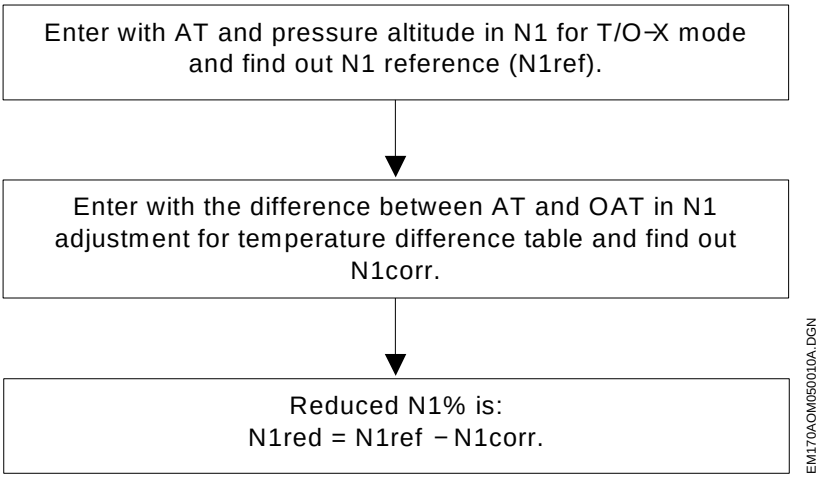
The following flowcharts are only applicable to takeoff analysis generated with fixed V2/VS ratio and ANTI-ICE OFF.



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N1 % FOR FLEXIBLE TAKEOFF

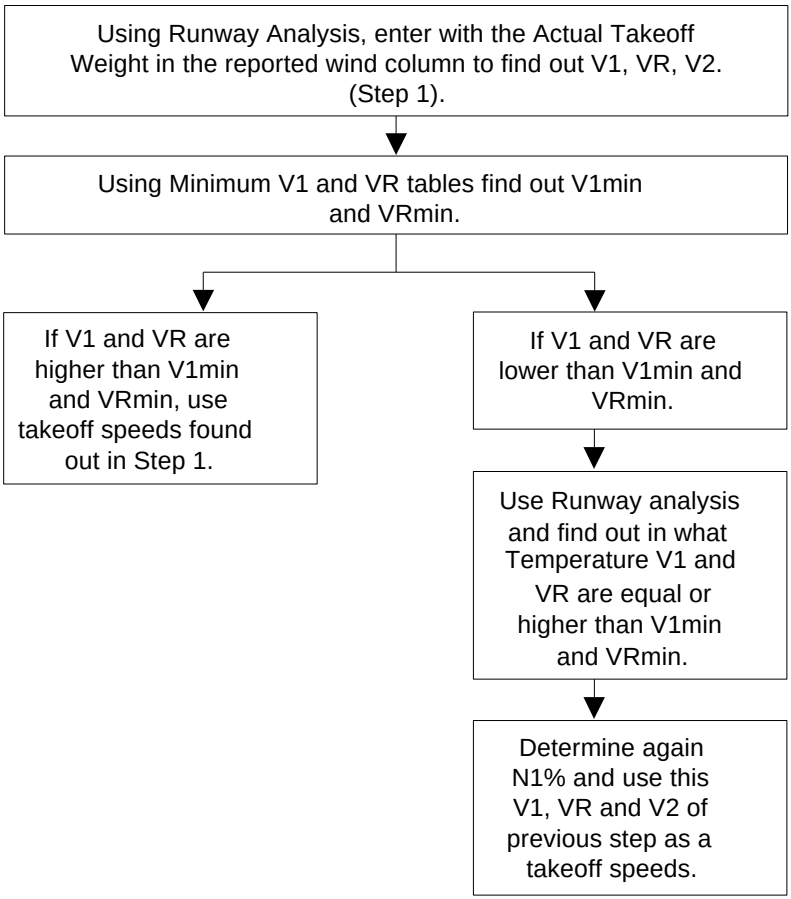
The following flowcharts are only applicable to takeoff analysis generated with fixed V2/VS ratio and ANTI-ICE OFF.



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TAKEOFF SPEEDS

The following flowcharts are only applicable to takeoff analysis generated with fixed V2/VS ratio and ANTI-ICE OFF.



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FLEXIBLE TEMPERATURE DETERMINATION TABLES

MAXIMUM ASSUMED TEMPERATURE TABLE

Engine: CF34-10E6 — T/O-1 ECS ON – ANTI-ICE OFF

OAT (°C)	PRESSURE ALTITUDE (x 1000 ft)											
	-1	0	1	2	3	4	5	6	7	8	9	10
52	66	---	---	---	---	---	---	---	---	---	---	---
50	66	64	---	---	---	---	---	---	---	---	---	---
45	64	64	62	61	---	---	---	---	---	---	---	---
40	59	60	59	59	59	57	55	---	---	---	---	---
35	56	54	54	54	54	54	54	53	51	---	---	---
30	54	54	52	50	49	49	49	49	49	48	47	45
25	51	50	50	50	48	47	45	45	45	44	44	44
20	51	49	48	46	45	45	45	44	42	41	41	40
15	51	49	48	46	44	42	40	40	39	38	37	37
10	51	49	47	45	44	42	40	38	35	33	32	32
5	51	49	47	45	44	42	40	38	35	32	30	27
0 and below	50	49	47	45	43	42	40	37	35	32	29	27
RMK: FOR ECS OFF ADD 2°C ON MAXIMUM ASSUMED TEMPERATURE												

MINIMUM ASSUMED TEMPERATURE

Engine: CF34-10E6 — T/O-1 ANTI-ICE OFF

	PRESSURE ALTITUDE (x 1000 ft)											
	-1	0	1	2	3	4	5	6	7	8	9	10
MinAt	37	35	33	31	29	27	25	23	21	19	17	15

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N1% ADJUSTMENT FOR TEMPERATURE DIFFERENCE

Engine: CF34-10E6 — T/O-1 ANTI-ICE OFF

AT MINUS OAT (°C)	OUTSIDE AIR TEMPERATURE (OAT) – (°C)													
	-40	-20	0	5	10	15	20	25	30	35	40	45	50	52
5	---	---	---	---	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7
10	---	---	---	1.6	1.6	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.3	1.3
20	---	---	3.2	3.1	3.1	3.0	2.9	2.9	2.8	2.7	2.7	2.6	---	---
30	---	---	4.6	4.5	4.4	4.3	4.2	4.1	4.0	3.9	---	---	---	---
40	---	6.5	6.0	5.8	5.7	5.5	5.4	5.3	---	---	---	---	---	---
50	---	7.9	7.2	7.0	6.8	6.7	---	---	---	---	---	---	---	---
60	10.0	9.1	8.3	8.1	---	---	---	---	---	---	---	---	---	---
70	11.2	10.2	---	---	---	---	---	---	---	---	---	---	---	---

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MAXIMUM ASSUMED TEMPERATURE TABLE

Engine: CF34-10E6 — T/O-2 ECS ON – ANTI-ICE OFF

OAT (°C)	PRESSURE ALTITUDE (x 1000 ft)											
	-1	0	1	2	3	4	5	6	7	8	9	10
52	62	---	---	---	---	---	---	---	---	---	---	---
50	59	60	---	---	---	---	---	---	---	---	---	---
45	54	54	54	54	---	---	---	---	---	---	---	---
40	49	49	49	49	48	48	48	---	---	---	---	---
35	44	44	44	44	44	44	43	43	43	---	---	---
30	39	39	39	39	39	39	39	39	38	38	38	38
25	36	34	34	34	34	34	34	33	33	33	33	33
20	35	34	32	29	28	28	28	28	28	28	28	27
15	35	33	31	29	27	25	23	23	22	22	22	22
10	35	33	31	29	27	25	23	21	18	17	16	16
5	35	33	31	29	27	25	23	20	18	16	13	11
0 and below	34	33	31	29	27	24	22	20	18	16	13	11
RMK: FOR ECS OFF ADD 2°C ON MAXIMUM ASSUMED TEMPERATURE												

MINIMUM ASSUMED TEMPERATURE

Engine: CF34-10E6 — T/O-2 ANTI-ICE OFF

	PRESSURE ALTITUDE (x 1000 ft)											
	-1	0	1	2	3	4	5	6	7	8	9	10
MinAt	32	30	28	26	24	22	20	18	16	14	12	10

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N1% ADJUSTMENT FOR TEMPERATURE DIFFERENCE

Engine: CF34-10E6 — T/O-2 ANTI-ICE OFF

AT MINUS OAT (°C)	OUTSIDE AIR TEMPERATURE (OAT) – (°C)													
	-40	-20	0	5	10	15	20	25	30	35	40	45	50	52
5	---	---	---	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6
10	---	---	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3	---
20	---	---	3.0	3.0	2.9	2.8	2.8	2.7	2.7	2.6	2.6	---	---	---
30	---	4.8	4.4	4.3	4.2	4.1	4.0	4.0	3.9	---	---	---	---	---
40	---	6.2	5.6	5.6	5.4	5.3	5.2	---	---	---	---	---	---	---
50	8.2	7.5	6.8	6.7	6.5	---	---	---	---	---	---	---	---	---
60	9.5	8.6	7.9	---	---	---	---	---	---	---	---	---	---	---
70	10.7	9.7	---	---	---	---	---	---	---	---	---	---	---	---

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MINIMUM V1

Engine: CF34-10E6 — T/O-1 EMBRAER 190

Altitude: Sea Level and Below

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	103	102	101	101	100	99	99	98
15	103	102	101	101	100	99	98	98
20	103	102	101	100	100	99	98	98
25	103	102	101	100	100	99	98	98
30	103	102	101	100	99	99	98	98
35	103	102	101	100	99	99	98	97
40	101	100	99	98	97	97	96	96
45	98	98	97	96	95	95	94	94
50	96	95	95	94	93	93	92	92

Altitude: 2000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	101	100	99	98	98	97	96	96
15	101	100	99	98	98	97	96	96
20	101	100	99	98	97	97	96	96
25	100	100	99	98	97	97	96	95
30	100	100	99	98	97	97	96	95
35	99	98	97	96	96	95	94	94
40	97	96	95	94	94	93	93	92
45	95	94	93	92	92	91	91	90

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MINIMUM V1

Engine: CF34-10E6 — T/O-1 EMBRAER 190

Altitude: 4000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	98	98	97	96	95	95	94	94
15	98	97	97	96	95	95	94	93
20	98	97	97	96	95	95	94	93
25	98	97	97	96	95	94	94	93
30	97	96	95	95	94	93	93	92
35	95	94	94	93	92	92	91	90
40	93	92	91	91	90	90	89	89

Altitude: 6000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	96	95	94	93	93	92	92	91
15	96	95	94	93	93	92	92	91
20	96	95	94	93	93	92	91	91
25	95	94	93	93	92	91	91	90
30	93	92	92	91	90	90	89	89
35	91	90	90	89	89	88	87	87

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MINIMUM V1

Engine: CF34-10E6 — T/O-1 EMBRAER 190

Altitude: 8000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	93	92	91	91	90	89	89	88
15	93	92	91	91	90	89	89	88
20	92	92	91	90	90	89	89	88
25	91	90	89	89	88	88	87	87
30	89	88	88	87	87	86	86	85

Altitude: 10000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	90	89	89	88	87	87	86	86
15	90	89	89	88	87	87	86	86
20	89	88	87	87	86	85	85	85
25	87	86	86	85	85	84	83	83
30	85	85	84	84	83	82	82	82

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MINIMUM V1

Engine: CF34-10E6 — T/O-2 EMBRAER 190

Altitude: Sea Level and Below

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	98	97	97	96	95	94	94	93
15	98	97	96	96	95	94	94	93
20	98	97	96	96	95	94	94	93
25	98	97	96	95	95	94	93	93
30	98	97	96	95	95	94	93	93
35	96	95	94	93	93	92	91	91
40	93	93	92	91	91	90	89	89
45	91	91	90	89	89	88	87	87
50	89	88	88	87	86	86	85	85

Altitude: 2000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	96	95	94	94	93	92	92	91
15	96	95	94	93	93	92	91	91
20	96	95	94	93	93	92	91	91
25	95	95	94	93	93	92	91	91
30	94	93	92	92	91	90	90	89
35	92	91	90	90	89	88	88	87
40	90	89	88	88	87	86	86	85
45	88	87	86	86	85	85	84	84

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MINIMUM V1

Engine: CF34-10E6 — T/O-2 EMBRAER 190

Altitude: 4000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	94	93	92	91	91	90	89	89
15	93	93	92	91	91	90	89	89
20	93	93	92	91	90	90	89	89
25	92	91	91	90	89	89	88	88
30	90	89	89	88	87	87	86	86
35	88	87	87	86	86	85	84	84
40	86	85	85	84	84	83	83	82

Altitude: 6000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	91	90	90	89	88	88	87	87
15	91	90	90	89	88	88	87	87
20	90	90	89	88	88	87	87	86
25	88	88	87	86	86	85	85	84
30	86	86	85	85	84	83	83	82
35	85	84	83	83	82	82	81	81

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MINIMUM V1

Engine: CF34-10E6 — T/O-2 EMBRAER 190

Altitude: 8000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	89	88	87	87	86	86	85	85
15	88	88	87	86	86	85	85	84
20	87	86	85	85	84	84	83	83
25	85	84	83	83	82	82	81	81
30	83	82	82	81	81	80	80	79

Altitude: 10000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	86	86	85	85	84	83	83	82
15	85	84	84	83	82	82	81	81
20	83	82	82	81	81	80	80	79
25	81	81	80	80	79	78	78	78
30	80	79	78	78	77	77	76	76

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MINIMUM VR

Engine: CF34-10E6 — T/O-1 EMBRAER 190

Altitude: Sea Level and Below

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	106	103	101	101	100	99	99	98
15	106	103	101	101	100	99	98	98
20	106	103	101	100	100	99	98	98
25	106	103	101	100	100	99	98	98
30	106	103	101	100	99	99	98	98
35	106	103	101	100	99	99	98	97
40	102	100	99	98	97	97	96	96
45	99	98	97	96	95	95	94	94
50	96	95	95	94	93	93	92	92

Altitude: 2000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	103	100	99	98	98	97	96	96
15	103	100	99	98	98	97	96	96
20	103	100	99	98	97	97	96	96
25	102	100	99	98	97	97	96	95
30	102	100	99	98	97	97	96	95
35	100	98	97	96	96	95	94	94
40	97	96	95	94	94	93	93	92
45	95	94	93	92	92	91	91	90

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MINIMUM VR

Engine: CF34-10E6 — T/O-1 EMBRAER 190

Altitude: 4000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	99	98	97	96	95	95	94	94
15	99	97	97	96	95	95	94	93
20	99	97	97	96	95	95	94	93
25	99	97	97	96	95	94	94	93
30	97	96	95	95	94	93	93	92
35	95	94	94	93	92	92	91	90
40	93	92	91	91	90	90	89	89

Altitude: 6000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	96	95	94	93	93	92	92	91
15	96	95	94	93	93	92	92	91
20	96	95	94	93	93	92	91	91
25	95	94	93	93	92	91	91	90
30	93	92	92	91	90	90	89	89
35	91	90	90	89	89	88	87	87

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MINIMUM VR

Engine: CF34-10E6 — T/O-1 EMBRAER 190

Altitude: 8000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	93	92	91	91	90	89	89	88
15	93	92	91	91	90	89	89	88
20	92	92	91	90	90	89	89	88
25	91	90	89	89	88	88	87	87
30	89	88	88	87	87	86	86	85

Altitude: 10000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	90	89	89	88	87	87	86	86
15	90	89	89	88	87	87	86	86
20	89	88	87	87	86	85	85	85
25	87	86	86	85	85	84	83	83
30	85	85	84	84	83	82	82	82

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MINIMUM VR

Engine: CF34-10E6 — T/O-2 EMBRAER 190

Altitude: Sea Level and Below

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	98	97	97	96	95	94	94	93
15	98	97	96	96	95	94	94	93
20	98	97	96	96	95	94	94	93
25	98	97	96	95	95	94	93	93
30	98	97	96	95	95	94	93	93
35	96	95	94	93	93	92	91	91
40	93	93	92	91	91	90	89	89
45	91	91	90	89	89	88	87	87
50	89	88	88	87	86	86	85	85

Altitude: 2000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	96	95	94	94	93	92	92	91
15	96	95	94	93	93	92	91	91
20	96	95	94	93	93	92	91	91
25	95	95	94	93	93	92	91	91
30	94	93	92	92	91	90	90	89
35	92	91	90	90	89	88	88	87
40	90	89	88	88	87	86	86	85
45	88	87	86	86	85	85	84	84

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MINIMUM VR

Engine: CF34-10E6 — T/O-2 EMBRAER 190

Altitude: 4000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	94	93	92	91	91	90	89	89
15	93	93	92	91	91	90	89	89
20	93	93	92	91	90	90	89	89
25	92	91	91	90	89	89	88	88
30	90	89	89	88	87	87	86	86
35	88	87	87	86	86	85	84	84
40	86	85	85	84	84	83	83	82

Altitude: 6000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	91	90	90	89	88	88	87	87
15	91	90	90	89	88	88	87	87
20	90	90	89	88	88	87	87	86
25	88	88	87	86	86	85	85	84
30	86	86	85	85	84	83	83	82
35	85	84	83	83	82	82	81	81

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MINIMUM VR

Engine: CF34-10E6 — T/O-2 EMBRAER 190

Altitude: 8000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	89	88	87	87	86	86	85	85
15	88	88	87	86	86	85	85	84
20	87	86	85	85	84	84	83	83
25	85	84	83	83	82	82	81	81
30	83	82	82	81	81	80	80	79

Altitude: 10000ft

OAT (°C)	WEIGHT (kg)							
	31000	34000	37000	40000	43000	46000	49000	52000
10	86	86	85	85	84	83	83	82
15	85	84	84	83	82	82	81	81
20	83	82	82	81	81	80	80	79
25	81	81	80	80	79	78	78	78
30	80	79	78	78	77	77	76	76

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

Simplified Takeoff Analysis tables are presented for a set of pressure altitudes, temperatures and runway lengths for the conditions below:

– Dry runway;

– Zero wind;

– Zero slope;

– No clearway;

– No stopway;

– Obstacles are not considered;

– Anti ice-off;

– Balanced V_1.

Following limitation factors were considered in the calculation of these tables:

– Field length;

– Climb;

– Brake energy;

– Tire speed.

Limitation codes:

– R – Runway Length;

– W – WAT (Climb);

– B – Brake;

– S – Structural;

– A – Approach Climb.

– SF – Final Segment.

NOTE: The Maximum Structural Takeoff Weight defined in the AFM must be checked.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: Sea Level

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	46111 R	48235 R	50315 R	51800 S	51800 S	51800 S	51800 S
	137/139/143	141/143/146	145/147/150	148/149/152	148/149/152	148/149/152	148/149/152
-15	45691 R	47793 R	49845 R	51800 S	51800 S	51800 S	51800 S
	136/138/142	140/142/146	144/146/149	148/149/152	148/149/152	148/149/152	148/149/152
-10	45288 R	47360 R	49385 R	51343 R	51800 S	51800 S	51800 S
	135/138/142	140/141/145	144/145/148	147/149/151	148/149/152	148/149/152	148/149/152
-5	44896 R	46944 R	48939 R	50878 R	51800 S	51800 S	51800 S
	134/137/141	139/141/144	143/144/147	146/148/150	148/149/152	148/149/152	148/149/152
0	44493 R	46523 R	48480 R	50403 R	51800 S	51800 S	51800 S
	133/136/141	138/140/144	142/144/147	145/147/150	148/149/152	148/149/152	148/149/152
5	44108 R	46118 R	48046 R	49945 R	51771 R	51800 S	51800 S
	132/135/140	137/139/143	141/143/146	145/146/149	148/149/152	148/149/152	148/149/152
10	43703 R	45688 R	47600 R	49466 R	51283 R	51800 S	51800 S
	131/135/139	136/138/142	140/142/145	144/145/148	147/149/151	148/149/152	148/149/152
15	43314 R	45277 R	47169 R	49006 R	50802 R	51800 S	51800 S
	131/134/139	135/138/142	139/141/145	143/145/148	146/148/150	148/149/152	148/149/152
20	42933 R	44881 R	46744 R	48559 R	50336 R	51800 S	51800 S
	130/133/138	134/137/141	138/141/144	142/144/147	145/147/150	148/149/152	148/149/152
25	42557 R	44484 R	46333 R	48122 R	49876 R	51560 R	51800 S
	129/133/137	133/136/141	137/140/143	141/143/146	145/146/149	148/149/151	148/150/152
30	42193 R	44102 R	45934 R	47698 R	49434 R	51105 R	51800 S
	128/132/137	133/136/140	137/139/143	140/142/146	144/145/148	147/148/151	148/150/152
35	41834 R	43712 R	45527 R	47267 R	48970 R	50623 R	51800 S
	127/131/136	132/135/139	136/138/142	139/142/145	143/145/148	146/148/150	148/150/152
40	40459 R	42279 R	44026 R	45716 R	47342 R	48935 R	50459 R
	126/129/134	130/133/137	134/136/140	137/139/143	141/142/145	144/145/147	147/148/150
45	39228 R	40998 R	42700 R	44332 R	45917 R	47444 R	48152 A
	124/127/132	128/131/135	132/134/138	136/137/140	139/140/143	142/143/145	143/144/146
50	38046 R	39771 R	41429 R	43021 R	44564 R	46047 R	46218 A
	123/126/130	127/129/133	131/132/136	134/136/138	137/139/141	140/141/143	141/142/143

For A/Ice ON, decrease weight by 150 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	45455 R	47551 R	49591 R	51566 R	51800 S	51800 S	51800 S
	136/138/142	140/142/145	144/146/148	148/149/151	148/149/152	148/149/152	148/149/152
-15	45052 R	47112 R	49125 R	51081 R	51800 S	51800 S	51800 S
	135/137/142	139/141/145	143/145/148	147/148/151	148/149/152	148/149/152	148/149/152
-10	44655 R	46690 R	48671 R	50603 R	51800 S	51800 S	51800 S
	134/137/141	138/140/144	142/144/147	146/147/150	148/149/152	148/149/152	148/149/152
-5	44259 R	46278 R	48223 R	50139 R	51800 S	51800 S	51800 S
	133/136/140	138/140/143	142/143/146	145/147/149	148/149/152	148/149/152	148/149/152
0	43861 R	45864 R	47783 R	49674 R	51495 R	51800 S	51800 S
	132/135/140	137/139/143	141/142/146	144/146/149	148/149/151	148/150/152	148/150/152
5	43474 R	45455 R	47359 R	49215 R	51020 R	51800 S	51800 S
	131/134/139	136/138/142	140/142/145	143/145/148	147/148/151	148/150/152	148/150/152
10	43083 R	45038 R	46923 R	48750 R	50541 R	51800 S	51800 S
	130/134/138	135/137/141	139/141/144	143/144/147	146/147/150	148/150/152	148/150/152
15	42701 R	44642 R	46498 R	48298 R	50069 R	51761 R	51800 S
	130/133/138	134/137/141	138/140/144	142/144/147	145/147/149	148/150/152	148/150/152
20	42323 R	44243 R	46085 R	47868 R	49607 R	51290 R	51800 S
	129/132/137	133/136/140	137/139/143	141/143/146	144/146/149	147/149/151	148/150/152
25	41960 R	43862 R	45683 R	47451 R	49164 R	50832 R	51800 S
	128/132/137	132/135/140	136/139/142	140/142/145	143/145/148	147/148/150	148/150/152
30	41605 R	43481 R	45291 R	47030 R	48729 R	50380 R	51800 S
	127/131/136	131/135/139	135/138/142	139/141/145	143/144/147	146/147/150	148/150/152
35	41066 R	42910 R	44696 R	46404 R	48060 R	49693 R	51217 R
	126/130/135	130/134/138	134/137/141	138/140/144	142/143/146	145/146/149	147/149/151
40	39740 R	41528 R	43247 R	44908 R	46504 R	48053 R	49506 A
	124/128/133	129/132/136	133/135/139	136/138/141	139/141/144	143/144/146	145/147/148
45	38539 R	40275 R	41948 R	43562 R	45110 R	46607 R	47329 A
	123/126/131	127/130/134	131/133/137	134/136/139	138/139/142	141/142/144	142/143/145
50 A	37327 R	39016 R	40649 R	42207 R	43722 R	45174 R	45303 A
	122/124/129	126/128/132	129/131/134	133/134/137	136/137/139	139/140/142	139/140/142

For A/Ice ON, decrease weight by 200 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 1000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	44809 R	46875 R	48870 R	50821 R	51800 S	51800 S	51800 S
	135/137/141	139/141/144	143/145/147	147/148/150	149/150/152	149/150/152	149/150/152
-15	44406 R	46441 R	48410 R	50343 R	51800 S	51800 S	51800 S
	134/136/140	138/140/144	142/144/147	146/147/150	149/150/152	149/150/152	149/150/152
-10	44013 R	46029 R	47966 R	49867 R	51703 R	51800 S	51800 S
	133/136/140	137/139/143	141/143/146	145/146/149	148/149/152	149/150/152	149/150/152
-5	43620 R	45616 R	47533 R	49405 R	51225 R	51800 S	51800 S
	132/135/139	136/139/142	140/142/145	144/146/148	147/149/151	149/150/152	149/150/152
0	43230 R	45206 R	47103 R	48947 R	50740 R	51800 S	51800 S
	131/134/139	136/138/142	140/141/145	143/145/148	147/148/150	149/150/152	149/150/152
5	42847 R	44795 R	46679 R	48487 R	50271 R	51800 S	51800 S
	130/133/138	135/137/141	139/141/144	142/144/147	146/147/150	149/150/152	149/150/152
10	42465 R	44392 R	46251 R	48037 R	49799 R	51487 R	51800 S
	129/133/137	134/136/140	138/140/143	141/143/146	145/146/149	148/149/151	149/150/152
15	42092 R	44002 R	45833 R	47604 R	49340 R	51020 R	51800 S
	129/132/137	133/136/140	137/139/143	141/142/145	144/146/148	147/148/151	148/150/152
20	41723 R	43614 R	45430 R	47184 R	48890 R	50553 R	51800 S
	128/131/136	132/135/139	136/138/142	140/142/145	143/145/147	146/148/150	148/150/152
25	41367 R	43233 R	45036 R	46768 R	48453 R	50104 R	51640 R
	127/131/136	131/134/139	135/138/141	139/141/144	142/144/147	145/147/149	148/150/152
30	41020 R	42868 R	44655 R	46367 R	48025 R	49656 R	51187 R
	126/130/135	130/134/138	134/137/141	138/140/144	141/143/146	145/146/149	147/149/151
35	40301 R	42112 R	43862 R	45544 R	47171 R	48755 R	50268 R
	125/129/134	129/132/137	133/136/140	137/139/142	140/142/145	143/145/147	146/148/150
40	39024 R	40783 R	42475 R	44102 R	45674 R	47191 R	48541 A
	123/127/132	128/130/135	131/134/137	135/137/140	138/140/142	141/143/145	144/145/147
45	37855 R	39561 R	41210 R	42785 R	44312 R	45783 R	46507 A
	122/125/130	126/129/133	130/132/135	133/135/138	137/138/140	139/141/143	141/142/144
50 A	36611 R	38269 R	39865 R	41398 R	42881 R	44307 R	44386 A
	120/123/128	124/127/130	128/130/133	132/133/136	135/136/138	138/139/140	138/139/140

For A/Ice ON, decrease weight by 150 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 1500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	44195 R	46221 R	48179 R	50098 R	51800 S	51800 S	51800 S
	134/136/140	138/140/143	142/143/146	146/147/149	149/150/152	149/150/152	149/150/152
-15	43797 R	45804 R	47733 R	49619 R	51447 R	51800 S	51800 S
	133/135/140	137/139/143	141/143/146	145/146/149	148/149/151	149/150/152	149/150/152
-10	43409 R	45394 R	47301 R	49159 R	50968 R	51800 S	51800 S
	132/135/139	136/138/142	140/142/145	144/145/148	147/148/151	149/150/152	149/150/152
-5	43017 R	44982 R	46866 R	48702 R	50490 R	51800 S	51800 S
	131/134/138	135/138/141	139/141/144	143/144/147	146/148/150	149/150/152	149/150/152
0	42630 R	44580 R	46439 R	48245 R	50015 R	51714 R	51800 S
	130/133/138	134/137/141	138/140/144	142/144/146	145/147/149	149/150/152	149/150/152
5	42254 R	44177 R	46022 R	47798 R	49546 R	51238 R	51800 S
	129/132/137	134/136/140	138/140/143	141/143/146	145/146/148	148/149/151	149/150/152
10	41880 R	43779 R	45604 R	47367 R	49092 R	50758 R	51800 S
	128/132/136	133/135/140	137/139/142	140/142/145	144/145/148	147/148/150	149/150/152
15	41510 R	43392 R	45199 R	46944 R	48633 R	50295 R	51800 S
	127/131/136	132/135/139	136/138/142	139/141/144	143/144/147	146/147/150	149/150/152
20	41154 R	43016 R	44806 R	46532 R	48195 R	49840 R	51375 R
	127/130/135	131/134/138	135/137/141	139/141/144	142/144/146	145/147/149	148/149/151
25	40803 R	42646 R	44423 R	46123 R	47772 R	49396 R	50919 R
	126/130/135	130/133/138	134/137/141	138/140/143	141/143/146	144/146/148	147/149/151
30	40468 R	42288 R	44045 R	45735 R	47370 R	48962 R	50479 R
	125/129/134	129/133/137	133/136/140	137/139/143	140/142/145	144/145/148	146/148/150
35	39569 R	41347 R	43069 R	44714 R	46310 R	47850 R	49345 R
	124/128/133	128/131/136	132/135/138	136/138/141	139/141/144	142/144/146	145/146/148
40	38326 R	40056 R	41716 R	43319 R	44864 R	46353 R	47690 A
	122/126/130	126/129/133	130/133/136	134/136/139	137/139/141	140/141/144	143/144/146
45	37151 R	38827 R	40444 R	41994 R	43493 R	44936 R	45659 A
	121/124/128	125/127/131	129/131/134	132/134/137	135/137/139	138/139/141	140/141/142
50 A	35898 R	37525 R	39094 R	40600 R	42049 R	43448 R	43515 A
	119/122/126	123/125/129	127/129/132	130/132/134	133/135/137	136/137/139	137/137/139

For A/Ice ON, decrease weight by 150 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 2000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	43589 R	45580 R	47506 R	49382 R	51194 R	51800 S	51800 S
	133/135/139	137/139/142	141/142/145	145/146/148	148/149/151	149/150/152	149/150/152
-15	43192 R	45168 R	47068 R	48911 R	50709 R	51800 S	51800 S
	132/134/139	136/138/142	140/142/145	144/145/148	147/148/150	149/150/152	149/150/152
-10	42811 R	44765 R	46638 R	48457 R	50239 R	51800 S	51800 S
	131/134/138	135/137/141	139/141/144	143/144/147	146/147/150	149/150/152	149/150/152
-5	42418 R	44353 R	46207 R	48005 R	49757 R	51450 R	51800 S
	130/133/137	134/137/140	138/140/143	142/143/146	145/146/149	148/149/151	149/150/152
0	42037 R	43951 R	45790 R	47557 R	49290 R	50968 R	51778 A
	129/132/137	133/136/140	137/139/143	141/143/145	144/146/148	147/149/151	149/150/152
5	41665 R	43551 R	45374 R	47123 R	48830 R	50494 R	51679 A
	128/131/136	132/135/139	136/139/142	140/142/145	143/145/147	147/148/150	149/150/152
10	41300 R	43168 R	44967 R	46703 R	48383 R	50028 R	51577 R
	127/131/135	132/134/139	136/138/141	139/141/144	143/144/147	146/147/149	148/150/151
15	40938 R	42791 R	44573 R	46292 R	47943 R	49577 R	51108 R
	126/130/135	131/134/138	135/137/141	138/140/143	142/143/146	145/146/149	148/149/151
20	40588 R	42417 R	44184 R	45880 R	47523 R	49127 R	50650 R
	126/129/134	130/133/137	134/136/140	138/140/143	141/143/145	144/146/148	147/148/150
25	40245 R	42058 R	43808 R	45484 R	47113 R	48688 R	50206 R
	125/129/134	129/132/137	133/136/140	137/139/142	140/142/145	143/145/147	146/147/149
30	39921 R	41712 R	43440 R	45109 R	46720 R	48275 R	49778 R
	124/128/133	128/132/136	132/135/139	136/138/142	139/141/144	142/144/147	145/147/149
35	38842 R	40586 R	42270 R	43889 R	45455 R	46965 R	48423 R
	123/126/131	127/130/134	131/133/137	134/136/140	138/139/142	141/142/145	144/145/147
40	37633 R	39331 R	40964 R	42540 R	44055 R	45523 R	46842 A
	121/125/129	125/128/132	129/131/135	133/134/138	136/137/140	139/140/142	141/143/144
45	36452 R	38096 R	39682 R	41210 R	42681 R	44098 R	44811 A
	120/123/127	124/126/130	127/130/133	131/133/135	134/135/138	137/138/140	138/140/141
50 A	35188 R	36787 R	38325 R	39805 R	41224 R	42595 R	42639 A
	118/121/125	122/124/128	126/127/131	129/131/133	132/133/135	135/136/138	135/136/138

For A/Ice ON, decrease weight by 300 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 2500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	42994 R	44961 R	46858 R	48692 R	50483 R	51498 A	51498 A
	132/134/138	136/138/141	140/141/144	143/145/147	147/148/150	149/150/151	149/150/151
-15	42606 R	44550 R	46427 R	48229 R	50003 R	51449 A	51449 A
	131/133/138	135/137/141	139/141/144	143/144/146	146/147/149	149/150/151	149/150/151
-10	42223 R	44150 R	45999 R	47785 R	49534 R	51213 R	51396 A
	130/133/137	134/136/140	138/140/143	142/143/146	145/146/148	148/149/151	148/149/151
-5	41839 R	43746 R	45578 R	47339 R	49056 R	50726 R	51302 A
	129/132/136	133/136/139	137/139/142	141/142/145	144/145/148	147/148/150	148/149/151
0	41461 R	43341 R	45156 R	46901 R	48593 R	50250 R	51204 A
	128/131/136	132/135/139	136/138/142	140/142/144	143/145/147	146/148/150	148/149/151
5	41093 R	42960 R	44744 R	46474 R	48145 R	49779 R	51106 A
	127/130/135	131/134/138	135/138/141	139/141/144	142/144/146	145/147/149	148/149/151
10	40730 R	42577 R	44348 R	46060 R	47705 R	49323 R	50856 R
	126/130/135	131/133/138	134/137/140	138/140/143	141/143/146	145/146/148	147/149/150
15	40379 R	42208 R	43965 R	45657 R	47287 R	48876 R	50396 R
	125/129/134	130/133/137	134/136/140	137/139/143	141/142/145	144/145/147	147/148/150
20	40033 R	41835 R	43582 R	45251 R	46868 R	48437 R	49946 R
	125/128/133	129/132/136	133/135/139	136/139/142	140/142/144	143/144/147	146/147/149
25	39696 R	41480 R	43204 R	44861 R	46467 R	48008 R	49509 R
	124/128/133	128/131/136	132/135/139	136/138/141	139/141/144	142/144/146	145/146/148
30	39292 R	41055 R	42755 R	44396 R	45975 R	47506 R	48986 R
	123/127/132	127/131/135	131/134/138	135/137/141	138/140/143	141/143/145	144/146/148
35	38140 R	39853 R	41507 R	43100 R	44633 R	46118 R	47545 R
	121/125/130	126/129/133	130/132/136	133/135/138	136/138/141	139/141/143	142/144/145
40	36950 R	38618 R	40220 R	41768 R	43256 R	44695 R	46021 A
	120/123/128	124/127/131	128/130/134	131/133/136	135/136/139	138/139/141	140/141/143
45	35768 R	37384 R	38940 R	40438 R	41882 R	43274 R	43978 A
	119/122/126	123/125/129	126/128/132	130/131/134	133/134/136	136/137/139	137/138/140
50 A	34536 R	36102 R	37614 R	39066 R	40461 R	41809 R	41856 A
	117/120/124	121/123/127	125/126/129	128/129/132	131/132/134	134/135/136	134/135/136

For A/Ice ON, decrease weight by 300 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 3000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	42408 R	44347 R	46216 R	48010 R	49775 R	50939 A	50939 A
	131/133/137	135/137/140	139/140/143	142/144/146	146/147/149	148/149/151	148/149/151
-15	42025 R	43944 R	45783 R	47563 R	49304 R	50887 A	50887 A
	130/132/137	134/136/140	138/140/143	141/143/145	145/146/148	148/149/151	148/149/151
-10	41647 R	43548 R	45366 R	47126 R	48830 R	50493 R	50826 A
	129/132/136	133/135/139	137/139/142	141/142/145	144/145/147	147/148/150	148/149/150
-5	41261 R	43134 R	44942 R	46679 R	48360 R	50011 R	50729 A
	128/131/135	132/135/139	136/138/141	140/141/144	143/144/147	146/147/149	147/148/150
0	40890 R	42743 R	44531 R	46248 R	47907 R	49537 R	50631 A
	127/130/135	131/134/138	135/137/141	139/141/143	142/144/146	145/146/148	147/148/150
5	40526 R	42360 R	44125 R	45828 R	47475 R	49073 R	50534 A
	126/129/134	130/133/137	134/137/140	138/140/143	141/143/145	144/146/148	147/148/150
10	40167 R	41988 R	43734 R	45421 R	47048 R	48627 R	50148 R
	125/129/134	130/132/137	133/136/139	137/139/142	140/142/145	144/145/147	146/148/149
15	39822 R	41617 R	43351 R	45018 R	46627 R	48186 R	49692 R
	124/128/133	129/132/136	133/135/139	136/138/142	140/141/144	143/144/146	146/147/149
20	39481 R	41260 R	42975 R	44625 R	46219 R	47755 R	49249 R
	124/127/132	128/131/135	132/134/138	135/138/141	139/141/143	142/143/146	145/146/148
25	39152 R	40908 R	42608 R	44243 R	45821 R	47342 R	48815 R
	123/127/132	127/130/135	131/134/138	135/137/140	138/140/143	141/143/145	144/145/147
30	38666 R	40400 R	42075 R	43687 R	45243 R	46747 R	48193 R
	122/126/131	126/130/134	130/133/137	134/136/139	137/139/142	140/142/144	143/144/146
35	37443 R	39124 R	40749 R	42308 R	43818 R	45277 R	46679 R
	120/124/129	125/128/132	128/131/135	132/134/137	135/137/140	138/140/142	141/142/144
40	36272 R	37915 R	39487 R	41001 R	42461 R	43875 R	45197 A
	119/122/127	123/126/130	127/129/133	130/132/135	133/135/137	136/138/140	139/140/142
45 A	35088 R	36674 R	38199 R	39672 R	41089 R	42454 R	43144 A
	118/121/125	121/124/128	125/127/130	128/130/133	132/133/135	134/136/137	136/137/139
50 A	33889 R	35427 R	36910 R	38332 R	39703 R	41029 R	41073 A
	116/119/123	120/122/125	123/125/128	127/128/131	130/131/133	133/134/135	133/134/135

For A/Ice ON, decrease weight by 300 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 3500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	41815 R	43720 R	45563 R	47332 R	49058 R	50349 A	50349 A
	129/132/136	134/136/139	138/139/142	141/143/145	145/146/148	147/148/150	147/148/150
-15	41426 R	43322 R	45135 R	46889 R	48587 R	50237 R	50294 A
	129/131/136	133/135/139	137/139/142	140/142/144	144/145/147	147/148/150	147/148/150
-10	41056 R	42933 R	44724 R	46458 R	48128 R	49763 R	50234 A
	128/131/135	132/134/138	136/138/141	139/141/144	143/144/146	146/147/149	147/148/150
-5	40689 R	42534 R	44315 R	46025 R	47678 R	49300 R	50156 A
	127/130/135	131/134/138	135/137/140	139/140/143	142/143/146	145/146/148	147/148/149
0	40323 R	42150 R	43910 R	45605 R	47240 R	48832 R	50063 A
	126/129/134	130/133/137	134/136/140	138/140/142	141/143/145	144/145/147	146/148/149
5	39959 R	41777 R	43510 R	45190 R	46803 R	48374 R	49895 R
	125/129/133	129/132/136	133/136/139	137/139/142	140/142/144	143/145/147	146/147/149
10	39609 R	41401 R	43124 R	44785 R	46385 R	47931 R	49437 R
	124/128/133	129/131/136	132/135/139	136/138/141	139/141/144	142/144/146	145/147/148
15	39269 R	41037 R	42748 R	44387 R	45973 R	47506 R	48988 R
	123/127/132	128/131/135	132/134/138	135/137/141	138/140/143	142/143/145	144/146/148
20	38934 R	40684 R	42369 R	44000 R	45571 R	47089 R	48552 R
	123/127/132	127/130/135	131/133/137	134/137/140	138/140/142	141/142/145	144/145/147
25	38606 R	40342 R	42010 R	43622 R	45178 R	46679 R	48125 R
	122/126/131	126/129/134	130/133/137	134/136/139	137/139/142	140/142/144	143/144/146
30	37956 R	39658 R	41299 R	42885 R	44408 R	45886 R	47314 R
	121/125/130	125/128/133	129/132/136	132/135/138	136/138/141	139/140/143	142/143/145
35	36761 R	38411 R	40007 R	41538 R	43021 R	44446 R	45828 R
	119/123/128	123/126/131	127/130/133	131/133/136	134/136/138	137/138/141	140/141/143
40	35596 R	37204 R	38749 R	40239 R	41674 R	43062 R	44379 A
	118/121/126	122/125/129	126/128/131	129/131/134	132/134/136	135/136/138	138/139/141
45 A	34417 R	35974 R	37471 R	38917 R	40308 R	41647 R	42313 A
	116/119/124	120/123/126	124/126/129	127/129/132	130/132/134	133/134/136	135/136/137
50 A	33269 R	34777 R	36232 R	37630 R	38981 R	40280 R	40338 A
	115/118/122	119/121/124	122/124/127	126/127/129	129/130/132	131/132/134	132/132/134

For A/Ice ON, decrease weight by 300 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 2 - V2/VS = 1.17
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 4000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	41217 R	43104 R	44908 R	46655 R	48342 R	49760 A	49760 A
	128/131/135	133/135/139	137/138/141	140/142/144	144/145/147	146/147/149	146/147/149
-15	40837 R	42707 R	44491 R	46219 R	47882 R	49505 R	49700 A
	128/130/135	132/134/138	136/138/141	139/141/143	143/144/146	146/147/148	146/147/149
-10	40473 R	42317 R	44087 R	45790 R	47438 R	49044 R	49641 A
	127/130/134	131/133/137	135/137/140	138/140/143	142/143/145	145/146/148	146/147/149
-5	40119 R	41938 R	43693 R	45380 R	47009 R	48593 R	49582 A
	126/129/134	130/133/137	134/136/139	138/139/142	141/142/145	144/145/147	146/147/149
0	39762 R	41562 R	43295 R	44966 R	46580 R	48131 R	49494 A
	125/128/133	129/132/136	133/135/139	137/138/141	140/141/144	143/144/146	146/147/148
5	39402 R	41186 R	42905 R	44554 R	46149 R	47690 R	49188 R
	124/128/132	128/131/135	132/135/138	136/138/141	139/141/143	142/144/146	145/146/148
10	39055 R	40820 R	42517 R	44153 R	45730 R	47255 R	48729 R
	123/127/132	127/130/135	131/134/138	135/137/140	138/140/143	141/143/145	144/145/147
15	38717 R	40460 R	42141 R	43760 R	45323 R	46829 R	48289 R
	122/126/131	127/130/134	131/133/137	134/136/140	137/139/142	140/142/144	143/145/147
20	38388 R	40112 R	41774 R	43379 R	44923 R	46419 R	47865 R
	122/126/131	126/129/134	130/132/136	133/136/139	137/139/141	140/141/144	143/144/146
25	38062 R	39773 R	41417 R	43008 R	44537 R	46022 R	47451 R
	121/125/130	125/128/133	129/132/136	132/135/138	136/138/141	139/141/143	142/143/145
30	37249 R	38920 R	40533 R	42088 R	43581 R	45030 R	46431 R
	120/124/129	124/127/132	128/130/134	131/133/137	134/136/139	137/139/142	140/142/144
35	36080 R	37703 R	39268 R	40776 R	42229 R	43629 R	44986 R
	118/122/127	122/125/129	126/129/132	129/132/135	133/134/137	136/137/139	138/140/142
40	34924 R	36503 R	38018 R	39482 R	40890 R	42253 R	43557 A
	117/120/125	121/123/127	124/127/130	128/130/133	131/132/135	134/135/137	137/138/139
45 A	33749 R	35276 R	36746 R	38161 R	39528 R	40844 R	41481 A
	115/118/122	119/122/125	123/125/128	126/128/130	129/130/133	132/133/135	133/134/136
50 A	32652 R	34133 R	35562 R	36934 R	38259 R	39539 R	39603 A
	114/116/120	118/120/123	121/123/126	124/126/128	127/128/130	130/131/133	130/131/133

For A/Ice ON, decrease weight by 300 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: Sea Level

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	48977 R	48977 R	48977 R	48977 R	48977 R	48977 R	48977 R
	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133
-15	48964 R	48964 R	48964 R	48964 R	48964 R	48964 R	48964 R
	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133
-10	48941 R	48941 R	48941 R	48941 R	48941 R	48941 R	48941 R
	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133
-5	48928 R	48928 R	48928 R	48928 R	48928 R	48928 R	48928 R
	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133	128/128/133
0	48868 R	48868 R	48868 R	48868 R	48868 R	48868 R	48868 R
	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132
5	48641 R	48817 R	48817 R	48817 R	48817 R	48817 R	48817 R
	127/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132
10	48289 R	48706 R	48706 R	48706 R	48706 R	48706 R	48706 R
	127/127/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132
15	47955 R	48603 R	48603 R	48603 R	48603 R	48603 R	48603 R
	126/127/131	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132
20	47643 R	48490 R	48490 R	48490 R	48490 R	48490 R	48490 R
	125/126/131	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132	128/128/132
25	47335 R	48386 R	48386 R	48386 R	48386 R	48386 R	48386 R
	124/126/130	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
30	46978 R	48271 R	48271 R	48271 R	48271 R	48271 R	48271 R
	123/125/130	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
35	46549 R	48095 R	48253 R	48253 R	48253 R	48253 R	48253 R
	122/124/129	127/127/131	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
40	45043 R	46241 R	46241 R	46241 R	46241 R	46241 R	46241 R
	121/123/127	125/125/129	125/125/129	125/125/129	125/125/129	125/125/129	125/125/129
45	43543 R	44262 R	44262 R	44262 R	44262 R	44262 R	44262 R
	119/121/125	122/122/126	122/122/126	122/122/126	122/122/126	122/122/126	122/122/126
50	42028 R	42307 R	42307 R	42307 R	42307 R	42307 R	42307 R
	118/119/123	119/119/123	119/119/123	119/119/123	119/119/123	119/119/123	119/119/123

For A/Ice ON, decrease weight by 450 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	48345 R	48345 R	48345 R	48345 R	48345 R	48345 R	48345 R
	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
-15	48331 R	48331 R	48331 R	48331 R	48331 R	48331 R	48331 R
	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
-10	48309 R	48309 R	48309 R	48309 R	48309 R	48309 R	48309 R
	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
-5	48285 R	48285 R	48285 R	48285 R	48285 R	48285 R	48285 R
	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
0	48224 R	48224 R	48224 R	48224 R	48224 R	48224 R	48224 R
	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132	127/127/132
5	47946 R	48154 R	48154 R	48154 R	48154 R	48154 R	48154 R
	126/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131
10	47634 R	48070 R	48070 R	48070 R	48070 R	48070 R	48070 R
	125/126/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131
15	47326 R	47986 R	47986 R	47986 R	47986 R	47986 R	47986 R
	125/126/130	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131
20	47020 R	47906 R	47906 R	47906 R	47906 R	47906 R	47906 R
	124/125/130	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131
25	46721 R	47819 R	47819 R	47819 R	47819 R	47819 R	47819 R
	123/125/129	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131
30	46310 R	47738 R	47738 R	47738 R	47738 R	47738 R	47738 R
	122/124/129	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131	127/127/131
35	45691 R	47212 R	47345 R	47345 R	47345 R	47345 R	47345 R
	121/123/128	126/126/130	126/126/130	126/126/130	126/126/130	126/126/130	126/126/130
40	44243 R	45395 R	45395 R	45395 R	45395 R	45395 R	45395 R
	120/121/126	123/123/128	123/123/128	123/123/128	123/123/128	123/123/128	123/123/128
45	42783 R	43497 R	43497 R	43497 R	43497 R	43497 R	43497 R
	118/120/124	121/121/125	121/121/125	121/121/125	121/121/125	121/121/125	121/121/125
50 A	41227 R	41480 R	41480 R	41480 R	41480 R	41480 R	41480 R
	117/118/122	118/118/122	118/118/122	118/118/122	118/118/122	118/118/122	118/118/122

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 1000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	47781 R 127/127/131	47781 R 127/127/131	47781 R 127/127/131	47781 R 127/127/131	47781 R 127/127/131	47781 R 127/127/131	47781 R 127/127/131
-15	47761 R 127/127/131	47761 R 127/127/131	47761 R 127/127/131	47761 R 127/127/131	47761 R 127/127/131	47761 R 127/127/131	47761 R 127/127/131
-10	47749 R 127/127/131	47749 R 127/127/131	47749 R 127/127/131	47749 R 127/127/131	47749 R 127/127/131	47749 R 127/127/131	47749 R 127/127/131
-5	47711 R 127/127/131	47711 R 127/127/131	47711 R 127/127/131	47711 R 127/127/131	47711 R 127/127/131	47711 R 127/127/131	47711 R 127/127/131
0	47597 R 126/126/131	47651 R 126/126/131	47651 R 126/126/131	47651 R 126/126/131	47651 R 126/126/131	47651 R 126/126/131	47651 R 126/126/131
5	47297 R 125/126/130	47584 R 126/126/131	47584 R 126/126/131	47584 R 126/126/131	47584 R 126/126/131	47584 R 126/126/131	47584 R 126/126/131
10	46997 R 124/125/130	47523 R 126/126/131	47523 R 126/126/131	47523 R 126/126/131	47523 R 126/126/131	47523 R 126/126/131	47523 R 126/126/131
15	46698 R 124/125/129	47449 R 126/126/131	47449 R 126/126/131	47449 R 126/126/131	47449 R 126/126/131	47449 R 126/126/131	47449 R 126/126/131
20	46401 R 123/125/129	47376 R 126/126/130	47376 R 126/126/130	47376 R 126/126/130	47376 R 126/126/130	47376 R 126/126/130	47376 R 126/126/130
25	46056 R 122/124/129	47296 R 126/126/130	47296 R 126/126/130	47296 R 126/126/130	47296 R 126/126/130	47296 R 126/126/130	47296 R 126/126/130
30	45643 R 121/123/128	47130 R 126/126/130	47222 R 126/126/130	47222 R 126/126/130	47222 R 126/126/130	47222 R 126/126/130	47222 R 126/126/130
35	44838 R 120/122/127	46333 R 124/125/129	46460 R 125/125/129	46460 R 125/125/129	46460 R 125/125/129	46460 R 125/125/129	46460 R 125/125/129
40	43449 R 118/120/125	44549 R 122/122/126	44549 R 122/122/126	44549 R 122/122/126	44549 R 122/122/126	44549 R 122/122/126	44549 R 122/122/126
45	42026 R 117/119/123	42733 R 120/120/124	42733 R 120/120/124	42733 R 120/120/124	42733 R 120/120/124	42733 R 120/120/124	42733 R 120/120/124
50 A	40424 R 116/116/120	40651 R 117/117/121	40651 R 117/117/121	40651 R 117/117/121	40651 R 117/117/121	40651 R 117/117/121	40651 R 117/117/121

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 1500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	47342 R 126/126/130	47342 R 126/126/130	47342 R 126/126/130	47342 R 126/126/130	47342 R 126/126/130	47342 R 126/126/130	47342 R 126/126/130
-15	47323 R 126/126/130	47323 R 126/126/130	47323 R 126/126/130	47323 R 126/126/130	47323 R 126/126/130	47323 R 126/126/130	47323 R 126/126/130
-10	47311 R 126/126/130	47311 R 126/126/130	47311 R 126/126/130	47311 R 126/126/130	47311 R 126/126/130	47311 R 126/126/130	47311 R 126/126/130
-5	47265 R 126/126/130	47265 R 126/126/130	47265 R 126/126/130	47265 R 126/126/130	47265 R 126/126/130	47265 R 126/126/130	47265 R 126/126/130
0	47017 R 125/126/130	47208 R 126/126/130	47208 R 126/126/130	47208 R 126/126/130	47208 R 126/126/130	47208 R 126/126/130	47208 R 126/126/130
5	46719 R 124/125/130	47150 R 126/126/130	47150 R 126/126/130	47150 R 126/126/130	47150 R 126/126/130	47150 R 126/126/130	47150 R 126/126/130
10	46422 R 123/125/129	47084 R 126/126/130	47084 R 126/126/130	47084 R 126/126/130	47084 R 126/126/130	47084 R 126/126/130	47084 R 126/126/130
15	46128 R 123/124/129	47021 R 126/126/130	47021 R 126/126/130	47021 R 126/126/130	47021 R 126/126/130	47021 R 126/126/130	47021 R 126/126/130
20	45821 R 122/124/128	46944 R 126/126/130	46944 R 126/126/130	46944 R 126/126/130	46944 R 126/126/130	46944 R 126/126/130	46944 R 126/126/130
25	45414 R 121/123/128	46856 R 125/125/130	46872 R 126/126/130	46872 R 126/126/130	46872 R 126/126/130	46872 R 126/126/130	46872 R 126/126/130
30	45013 R 120/122/127	46569 R 125/125/129	46807 R 125/125/130	46807 R 125/125/130	46807 R 125/125/130	46807 R 125/125/130	46807 R 125/125/130
35	44020 R 119/121/126	45510 R 123/124/128	45660 R 124/124/128	45660 R 124/124/128	45660 R 124/124/128	45660 R 124/124/128	45660 R 124/124/128
40	42674 R 117/119/124	43738 R 121/121/125	43738 R 121/121/125	43738 R 121/121/125	43738 R 121/121/125	43738 R 121/121/125	43738 R 121/121/125
45	41221 R 116/117/122	41866 R 119/119/123	41866 R 119/119/123	41866 R 119/119/123	41866 R 119/119/123	41866 R 119/119/123	41866 R 119/119/123
50 A	39611 R 115/115/119	39787 R 116/116/119	39787 R 116/116/119	39787 R 116/116/119	39787 R 116/116/119	39787 R 116/116/119	39787 R 116/116/119

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 2000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	46903 R 125/125/130	46903 R 125/125/130	46903 R 125/125/130	46903 R 125/125/130	46903 R 125/125/130	46903 R 125/125/130	46903 R 125/125/130
-15	46891 R 125/125/130	46891 R 125/125/130	46891 R 125/125/130	46891 R 125/125/130	46891 R 125/125/130	46891 R 125/125/130	46891 R 125/125/130
-10	46872 R 125/125/130	46872 R 125/125/130	46872 R 125/125/130	46872 R 125/125/130	46872 R 125/125/130	46872 R 125/125/130	46872 R 125/125/130
-5	46734 R 125/125/130	46826 R 125/125/130	46826 R 125/125/130	46826 R 125/125/130	46826 R 125/125/130	46826 R 125/125/130	46826 R 125/125/130
0	46437 R 124/125/129	46762 R 125/125/130	46762 R 125/125/130	46762 R 125/125/130	46762 R 125/125/130	46762 R 125/125/130	46762 R 125/125/130
5	46146 R 123/124/129	46708 R 125/125/130	46708 R 125/125/130	46708 R 125/125/130	46708 R 125/125/130	46708 R 125/125/130	46708 R 125/125/130
10	45848 R 122/124/128	46645 R 125/125/129	46645 R 125/125/129	46645 R 125/125/129	46645 R 125/125/129	46645 R 125/125/129	46645 R 125/125/129
15	45561 R 121/123/128	46585 R 125/125/129	46585 R 125/125/129	46585 R 125/125/129	46585 R 125/125/129	46585 R 125/125/129	46585 R 125/125/129
20	45178 R 121/123/127	46508 R 125/125/129	46508 R 125/125/129	46508 R 125/125/129	46508 R 125/125/129	46508 R 125/125/129	46508 R 125/125/129
25	44770 R 120/122/127	46278 R 124/125/129	46439 R 125/125/129	46439 R 125/125/129	46439 R 125/125/129	46439 R 125/125/129	46439 R 125/125/129
30	44388 R 119/121/126	46009 R 124/124/129	46392 R 125/125/129	46392 R 125/125/129	46392 R 125/125/129	46392 R 125/125/129	46392 R 125/125/129
35	43208 R 118/120/125	44684 R 122/122/127	44857 R 123/123/127	44857 R 123/123/127	44857 R 123/123/127	44857 R 123/123/127	44857 R 123/123/127
40	41907 R 116/118/123	42926 R 120/120/124	42926 R 120/120/124	42926 R 120/120/124	42926 R 120/120/124	42926 R 120/120/124	42926 R 120/120/124
45	40420 R 115/116/120	41003 R 117/117/121	41003 R 117/117/121	41003 R 117/117/121	41003 R 117/117/121	41003 R 117/117/121	41003 R 117/117/121
50 A	38800 R 114/114/118	38922 R 114/114/118	38922 R 114/114/118	38922 R 114/114/118	38922 R 114/114/118	38922 R 114/114/118	38922 R 114/114/118

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 2500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	46446 R 125/125/129	46446 R 125/125/129	46446 R 125/125/129	46446 R 125/125/129	46446 R 125/125/129	46446 R 125/125/129	46446 R 125/125/129
-15	46434 R 125/125/129	46434 R 125/125/129	46434 R 125/125/129	46434 R 125/125/129	46434 R 125/125/129	46434 R 125/125/129	46434 R 125/125/129
-10	46412 R 125/125/129	46412 R 125/125/129	46412 R 125/125/129	46412 R 125/125/129	46412 R 125/125/129	46412 R 125/125/129	46412 R 125/125/129
-5	46156 R 124/124/129	46361 R 125/125/129	46361 R 125/125/129	46361 R 125/125/129	46361 R 125/125/129	46361 R 125/125/129	46361 R 125/125/129
0	45858 R 123/124/128	46306 R 125/125/129	46306 R 125/125/129	46306 R 125/125/129	46306 R 125/125/129	46306 R 125/125/129	46306 R 125/125/129
5	45564 R 122/124/128	46243 R 125/125/129	46243 R 125/125/129	46243 R 125/125/129	46243 R 125/125/129	46243 R 125/125/129	46243 R 125/125/129
10	45276 R 121/123/128	46188 R 125/125/129	46188 R 125/125/129	46188 R 125/125/129	46188 R 125/125/129	46188 R 125/125/129	46188 R 125/125/129
15	44956 R 121/123/127	46122 R 125/125/129	46122 R 125/125/129	46122 R 125/125/129	46122 R 125/125/129	46122 R 125/125/129	46122 R 125/125/129
20	44542 R 120/122/126	45995 R 124/124/129	46057 R 124/124/129	46057 R 124/124/129	46057 R 124/124/129	46057 R 124/124/129	46057 R 124/124/129
25	44147 R 119/121/126	45703 R 123/124/128	45983 R 124/124/129	45983 R 124/124/129	45983 R 124/124/129	45983 R 124/124/129	45983 R 124/124/129
30	43681 R 118/120/125	45316 R 122/123/128	45775 R 124/124/128	45775 R 124/124/128	45775 R 124/124/128	45775 R 124/124/128	45775 R 124/124/128
35	42427 R 117/119/123	43883 R 121/121/126	44052 R 122/122/126	44052 R 122/122/126	44052 R 122/122/126	44052 R 122/122/126	44052 R 122/122/126
40	41146 R 115/117/122	42133 R 119/119/123	42133 R 119/119/123	42133 R 119/119/123	42133 R 119/119/123	42133 R 119/119/123	42133 R 119/119/123
45	39651 R 114/115/119	40200 R 116/116/120	40200 R 116/116/120	40200 R 116/116/120	40200 R 116/116/120	40200 R 116/116/120	40200 R 116/116/120
50 A	38073 R 113/113/117	38182 R 113/113/117	38182 R 113/113/117	38182 R 113/113/117	38182 R 113/113/117	38182 R 113/113/117	38182 R 113/113/117

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 3000 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	45995 R	45995 R	45995 R	45995 R	45995 R	45995 R	45995 R
	124/124/129	124/124/129	124/124/129	124/124/129	124/124/129	124/124/129	124/124/129
-15	45976 R	45976 R	45976 R	45976 R	45976 R	45976 R	45976 R
	124/124/129	124/124/129	124/124/129	124/124/129	124/124/129	124/124/129	124/124/129
-10	45875 R	45958 R	45958 R	45958 R	45958 R	45958 R	45958 R
	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
-5	45577 R	45896 R	45896 R	45896 R	45896 R	45896 R	45896 R
	123/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
0	45282 R	45841 R	45841 R	45841 R	45841 R	45841 R	45841 R
	122/123/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
5	44991 R	45778 R	45778 R	45778 R	45778 R	45778 R	45778 R
	121/123/127	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
10	44707 R	45723 R	45723 R	45723 R	45723 R	45723 R	45723 R
	120/122/127	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
15	44322 R	45658 R	45658 R	45658 R	45658 R	45658 R	45658 R
	120/122/126	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
20	43918 R	45412 R	45597 R	45597 R	45597 R	45597 R	45597 R
	119/121/126	123/124/128	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
25	43534 R	45129 R	45525 R	45525 R	45525 R	45525 R	45525 R
	118/120/125	122/123/127	124/124/128	124/124/128	124/124/128	124/124/128	124/124/128
30	42979 R	44626 R	45151 R	45151 R	45151 R	45151 R	45151 R
	117/119/124	121/122/127	123/123/127	123/123/127	123/123/127	123/123/127	123/123/127
35	41650 R	43071 R	43244 R	43244 R	43244 R	43244 R	43244 R
	116/118/122	120/120/124	121/121/125	121/121/125	121/121/125	121/121/125	121/121/125
40	40391 R	41338 R	41338 R	41338 R	41338 R	41338 R	41338 R
	114/116/120	118/118/122	118/118/122	118/118/122	118/118/122	118/118/122	118/118/122
45 A	38882 R	39395 R	39395 R	39395 R	39395 R	39395 R	39395 R
	113/114/118	115/115/119	115/115/119	115/115/119	115/115/119	115/115/119	115/115/119
50 A	37349 R	37440 R	37440 R	37440 R	37440 R	37440 R	37440 R
	112/112/116	112/112/116	112/112/116	112/112/116	112/112/116	112/112/116	112/112/116

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 3500 ft

TEMP (°C)	RUNWAY LENGTH (ft)						
	TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	45500 R 124/124/128	45500 R 124/124/128	45500 R 124/124/128	45500 R 124/124/128	45500 R 124/124/128	45500 R 124/124/128	45500 R 124/124/128
-15	45484 R 124/124/128	45484 R 124/124/128	45484 R 124/124/128	45484 R 124/124/128	45484 R 124/124/128	45484 R 124/124/128	45484 R 124/124/128
-10	45283 R 123/123/128	45469 R 124/124/128	45469 R 124/124/128	45469 R 124/124/128	45469 R 124/124/128	45469 R 124/124/128	45469 R 124/124/128
-5	44999 R 122/123/127	45435 R 124/124/128	45435 R 124/124/128	45435 R 124/124/128	45435 R 124/124/128	45435 R 124/124/128	45435 R 124/124/128
0	44711 R 121/122/127	45380 R 124/124/128	45380 R 124/124/128	45380 R 124/124/128	45380 R 124/124/128	45380 R 124/124/128	45380 R 124/124/128
5	44422 R 120/122/126	45323 R 123/123/128	45323 R 123/123/128	45323 R 123/123/128	45323 R 123/123/128	45323 R 123/123/128	45323 R 123/123/128
10	44102 R 119/121/126	45260 R 123/123/128	45260 R 123/123/128	45260 R 123/123/128	45260 R 123/123/128	45260 R 123/123/128	45260 R 123/123/128
15	43689 R 119/121/125	45118 R 123/123/127	45202 R 123/123/127	45202 R 123/123/127	45202 R 123/123/127	45202 R 123/123/127	45202 R 123/123/127
20	43296 R 118/120/125	44836 R 122/123/127	45136 R 123/123/127	45136 R 123/123/127	45136 R 123/123/127	45136 R 123/123/127	45136 R 123/123/127
25	42914 R 117/119/124	44555 R 121/122/127	45074 R 123/123/127	45074 R 123/123/127	45074 R 123/123/127	45074 R 123/123/127	45074 R 123/123/127
30	42188 R 116/118/123	43812 R 120/121/125	44337 R 122/122/126	44337 R 122/122/126	44337 R 122/122/126	44337 R 122/122/126	44337 R 122/122/126
35	40892 R 115/117/121	42280 R 119/119/123	42440 R 119/119/123	42440 R 119/119/123	42440 R 119/119/123	42440 R 119/119/123	42440 R 119/119/123
40	39627 R 113/115/119	40528 R 117/117/121	40528 R 117/117/121	40528 R 117/117/121	40528 R 117/117/121	40528 R 117/117/121	40528 R 117/117/121
45 A	38124 R 112/113/117	38604 R 114/114/118	38604 R 114/114/118	38604 R 114/114/118	38604 R 114/114/118	38604 R 114/114/118	38604 R 114/114/118
50 A	36664 R 111/111/115	36755 R 111/111/115	36755 R 111/111/115	36755 R 111/111/115	36755 R 111/111/115	36755 R 111/111/115	36755 R 111/111/115

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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SIMPLIFIED TAKEOFF ANALYSIS TABLES

EMBRAER 190 - CF34-10E6 - T/O-1 MODE - ATTCS ON
ANAC/FAA CERTIFICATION - FLAPS 4 - V2/VS = 1.19
AUTOBRAKES OFF - DRY RUNWAY - ANTI ICE OFF - ECS ON

Airport Pressure Altitude: 4000 ft

TEMP (°C)	RUNWAY LENGTH (ft) TAKEOFF WEIGHT(kg) – LIMITATION CODE V1/VR/V2 (KIAS)						
	5500	6000	6500	7000	7500	8000	8500
-20	45007 R 123/123/127	45007 R 123/123/127	45007 R 123/123/127	45007 R 123/123/127	45007 R 123/123/127	45007 R 123/123/127	45007 R 123/123/127
-15	44961 R 123/123/127	44999 R 123/123/127	44999 R 123/123/127	44999 R 123/123/127	44999 R 123/123/127	44999 R 123/123/127	44999 R 123/123/127
-10	44693 R 122/122/127	44980 R 123/123/127	44980 R 123/123/127	44980 R 123/123/127	44980 R 123/123/127	44980 R 123/123/127	44980 R 123/123/127
-5	44424 R 121/122/126	44965 R 123/123/127	44965 R 123/123/127	44965 R 123/123/127	44965 R 123/123/127	44965 R 123/123/127	44965 R 123/123/127
0	44143 R 120/122/126	44918 R 123/123/127	44918 R 123/123/127	44918 R 123/123/127	44918 R 123/123/127	44918 R 123/123/127	44918 R 123/123/127
5	43858 R 119/121/126	44860 R 123/123/127	44860 R 123/123/127	44860 R 123/123/127	44860 R 123/123/127	44860 R 123/123/127	44860 R 123/123/127
10	43468 R 118/120/125	44797 R 123/123/127	44797 R 123/123/127	44797 R 123/123/127	44797 R 123/123/127	44797 R 123/123/127	44797 R 123/123/127
15	43065 R 118/120/124	44541 R 122/122/127	44739 R 123/123/127	44739 R 123/123/127	44739 R 123/123/127	44739 R 123/123/127	44739 R 123/123/127
20	42680 R 117/119/124	44261 R 121/122/126	44674 R 123/123/127	44674 R 123/123/127	44674 R 123/123/127	44674 R 123/123/127	44674 R 123/123/127
25	42302 R 116/118/123	43985 R 120/121/126	44614 R 123/123/127	44614 R 123/123/127	44614 R 123/123/127	44614 R 123/123/127	44614 R 123/123/127
30	41403 R 115/117/122	43000 R 119/120/124	43524 R 121/121/125	43524 R 121/121/125	43524 R 121/121/125	43524 R 121/121/125	43524 R 121/121/125
35	40144 R 114/116/120	41491 R 118/118/122	41637 R 118/118/122	41637 R 118/118/122	41637 R 118/118/122	41637 R 118/118/122	41637 R 118/118/122
40	38865 R 112/114/118	39722 R 116/116/119	39722 R 116/116/119	39722 R 116/116/119	39722 R 116/116/119	39722 R 116/116/119	39722 R 116/116/119
45 A	37372 R 111/112/116	37810 R 113/113/117	37810 R 113/113/117	37810 R 113/113/117	37810 R 113/113/117	37810 R 113/113/117	37810 R 113/113/117
50 A	35981 R 110/110/114	36068 R 110/110/114	36068 R 110/110/114	36068 R 110/110/114	36068 R 110/110/114	36068 R 110/110/114	36068 R 110/110/114

For A/Ice ON, decrease weight by 400 kg. The certified MTOW of the airplane has to be respected.

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TAKEOFF SPEEDS

The following tables present V1, VR and V2 for balanced runway and fixed V2/VS ratio.

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V1/VR/V2 SPEEDS

T/O-1 MODE - ATTCS ON - FLAPS 1

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.18 - DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)																	
-1000 →	-40	to	40	41	to	47	48	to	52									
SL →	-40	to	37	38	to	44	45	to	50									
1000 →	-40	to	33	34	to	40	41	to	48									
2000 →				-40	to	35	36	to	44	45	to	46						
3000 →				-40	to	30	31	to	39	40	to	44						
4000 →				-40	to	22	23	to	35	36	to	42						
5000 →							-40	to	31	32	to	40						
6000 →							-40	to	26	27	to	36	37	to	38			
7000 →							-40	to	21	22	to	31	32	to	36			
8000 →							-40	to	14	15	to	26	27	to	34			
9000 →										-40	to	21	22	to	32			
10000 →										-40	to	15	16	to	30			
	↓			↓			↓			↓			↓					
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2			
28000	102	108	117	100	107	115	99	108	115	100	108	115	103	110	115			
29000	102	108	117	100	109	117	100	110	117	103	111	117	106	112	117			
30000	102	110	119	101	111	119	103	112	119	106	113	119	109	114	119			
31000	102	113	121	104	113	121	106	115	121	109	115	121	112	117	121			
32000	105	115	123	107	116	123	109	117	123	112	118	123	115	119	123			
33000	108	117	125	110	118	125	112	119	125	114	120	125	117	121	125			
34000	111	120	127	112	120	127	115	121	127	117	122	127	120	123	127			
35000	113	122	128	115	122	129	117	123	129	119	124	129	122	125	129			
36000	116	124	130	118	124	130	120	125	130	122	126	130	125	127	131			
37000	119	126	132	120	127	132	122	128	132	124	128	132	128	129	132			
38000	121	128	134	122	129	134	125	130	134	127	130	134	130	131	134			
39000	123	130	136	125	131	136	127	132	136	129	132	136	132	133	136			
40000	126	132	137	127	133	137	130	134	137	132	134	138	134	135	138			
41000	128	134	139	129	134	139	132	135	139	134	136	139	136	137	139			
42000	130	136	141	132	136	141	134	137	141	137	138	141	138	139	141			
43000	133	138	142	134	138	142	137	139	143	139	140	143	---	---	---			
44000	135	140	144	137	140	144	139	141	144	141	142	144	---	---	---			
45000	137	141	146	139	142	146	141	143	146	143	143	146	---	---	---			
46000	140	143	147	141	144	147	143	145	147	144	145	147	---	---	---			
47000	142	145	149	144	146	149	145	146	149	---	---	---	---	---	---			
48000	144	147	150	146	147	151	147	148	151	---	---	---	---	---	---			
49000	147	149	152	148	149	152	148	150	152	---	---	---	---	---	---			
50000	149	150	154	150	151	154	150	151	154	---	---	---	---	---	---			
51000	151	152	155	151	152	155	---	---	---	---	---	---	---	---	---			
52000	152	154	157	153	154	157	---	---	---	---	---	---	---	---	---			

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V1/VR/V2 SPEEDS

T/O-1 MODE - ATTCS ON - FLAPS 2

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.17- DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)																	
-1000 →	-40	to	40	41	to	44	45	to	52									
SL →	-40	to	37	38	to	41	42	to	50									
1000 →	-40	to	28	29	to	37	38	to	46	47	to	48						
2000 →				-40	to	32	33	to	41	42	to	46						
3000 →							-40	to	37	38	to	44						
4000 →							-40	to	33	34	to	42						
5000 →							-40	to	28	29	to	39	40	to	40			
6000 →							-40	to	23	24	to	34	35	to	38			
7000 →							-40	to	16	17	to	29	30	to	36			
8000 →										-40	to	25	26	to	34			
9000 →										-40	to	19	20	to	32			
10000 →										-40	to	11	12	to	30			
	↓			↓			↓			↓			↓					
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2			
28000	100	107	119	98	105	116	96	103	113	97	104	112	100	106	112			
29000	99	106	117	98	105	115	98	105	114	100	106	114	103	108	114			
30000	99	106	116	98	106	116	100	108	116	103	109	116	106	111	116			
31000	99	108	118	100	109	118	103	110	118	106	112	118	110	113	118			
32000	102	111	120	103	111	120	106	113	120	109	114	120	112	116	120			
33000	105	113	122	106	114	122	109	115	122	112	116	122	115	118	122			
34000	108	115	123	109	116	123	111	117	123	114	118	123	118	120	124			
35000	111	117	125	112	118	125	114	119	125	117	121	125	120	122	125			
36000	113	120	127	114	120	127	117	121	127	120	123	127	123	124	127			
37000	116	122	129	117	122	129	119	124	129	122	125	129	125	127	129			
38000	118	124	130	120	124	130	122	126	130	124	127	131	127	128	131			
39000	121	126	132	122	127	132	124	128	132	127	129	132	129	130	132			
40000	124	128	134	125	129	134	127	130	134	129	131	134	131	132	134			
41000	126	130	135	127	131	135	129	132	136	131	133	136	133	134	136			
42000	129	132	137	130	133	137	131	134	137	133	135	137	135	136	137			
43000	131	134	139	132	135	139	134	136	139	135	137	139	137	138	139			
44000	133	136	140	134	137	140	136	138	140	137	139	140	---	---	---			
45000	135	138	142	136	138	142	138	140	142	139	140	142	---	---	---			
46000	138	140	143	138	140	143	140	141	144	141	142	144	---	---	---			
47000	140	142	145	140	142	145	142	143	145	143	144	145	---	---	---			
48000	142	144	147	142	144	147	143	145	147	---	---	---	---	---	---			
49000	144	145	148	144	146	148	145	146	148	---	---	---	---	---	---			
50000	146	147	150	146	148	150	147	148	150	---	---	---	---	---	---			
51000	147	149	151	148	149	151	148	150	151	---	---	---	---	---	---			
52000	149	151	153	149	151	153	---	---	---	---	---	---	---	---	---			

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V1/VR/V2 SPEEDS

T/O-1 MODE - ATTCS ON - FLAPS 3

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.17 - DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)																	
-1000 →	-40	to	41	42	to	47	48	to	52									
SL →	-40	to	38	39	to	44	45	to	50									
1000 →	-40	to	34	35	to	40	41	to	47	48	to	48						
2000 →				-40	to	35	36	to	42	43	to	46						
3000 →				-40	to	31	32	to	38	39	to	44						
4000 →				-40	to	22	23	to	33	34	to	42						
5000 →							-40	to	28	29	to	40						
6000 →							-40	to	23	24	to	38						
7000 →										-40	to	33	34	to	36			
8000 →										-40	to	28	29	to	34			
9000 →										-40	to	23	24	to	32			
10000 →										-40	to	18	19	to	30			
	↓			↓			↓			↓			↓					
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2			
28000	101	107	120	99	104	116	96	100	111	92	97	107	95	99	106			
29000	101	106	119	98	103	114	96	99	110	94	99	108	98	101	108			
30000	100	105	117	98	102	113	95	100	110	97	102	110	101	104	110			
31000	100	104	115	97	102	112	97	103	112	100	104	112	105	106	112			
32000	100	104	114	98	104	113	100	105	113	103	107	113	108	109	113			
33000	99	105	115	100	106	115	103	107	115	106	109	115	110	111	115			
34000	101	107	117	103	108	117	106	109	117	109	111	117	113	113	117			
35000	104	110	119	106	110	119	108	112	119	112	113	119	115	115	119			
36000	107	112	120	109	113	120	111	114	120	114	115	120	117	117	120			
37000	110	114	122	112	115	122	114	116	122	117	117	122	119	119	122			
38000	112	116	123	114	117	124	116	118	124	119	119	124	121	121	124			
39000	115	118	125	117	119	125	119	120	125	121	121	125	123	123	125			
40000	118	120	127	119	121	127	121	122	127	123	123	127	125	125	127			
41000	120	122	128	122	123	128	123	124	128	125	125	128	---	---	---			
42000	122	124	130	124	125	130	125	126	130	127	127	130	---	---	---			
43000	125	126	131	126	127	131	128	128	131	129	129	131	---	---	---			
44000	127	128	133	128	129	133	129	129	133	130	130	133	---	---	---			
45000	129	130	134	130	130	134	131	131	134	132	132	135	---	---	---			
46000	131	131	136	132	132	136	133	133	136	---	---	---	---	---	---			
47000	133	133	137	134	134	137	135	135	137	---	---	---	---	---	---			
48000	135	135	139	136	136	139	136	136	139	---	---	---	---	---	---			
49000	137	137	140	137	137	140	---	---	---	---	---	---	---	---	---			
50000	138	138	142	139	139	142	---	---	---	---	---	---	---	---	---			
51000	140	140	143	---	---	---	---	---	---	---	---	---	---	---	---			
52000	141	141	144	---	---	---	---	---	---	---	---	---	---	---	---			

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V1/VR/V2 SPEEDS

T/O-1 MODE - ATTCS ON - FLAPS 4

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.19 - DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)																	
-1000 →	-40	to	40	41	to	45	46	to	52									
SL →	-40	to	38	39	to	43	44	to	50									
1000 →	-40	to	33	34	to	38	39	to	46	47	to	48						
2000 →				-40	to	34	35	to	41	42	to	46						
3000 →				-40	to	29	30	to	36	37	to	44						
4000 →							-40	to	32	33	to	39	40	to	42			
5000 →							-40	to	27	28	to	35	36	to	40			
6000 →										-40	to	30	31	to	38			
7000 →										-40	to	24	25	to	36			
8000 →										-40	to	14	15	to	34			
9000 →													-40	to	32			
10000 →													-40	to	30			
	↓			↓			↓			↓			↓					
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2			
28000	98	107	120	96	104	116	94	101	112	90	96	106	90	93	102			
29000	98	106	118	96	103	115	93	100	110	90	96	105	92	95	103			
30000	98	105	117	96	102	113	93	99	108	91	96	105	94	98	104			
31000	98	104	115	96	101	112	93	98	108	94	98	106	97	100	106			
32000	97	103	114	95	101	110	96	100	109	97	101	108	100	102	108			
33000	97	102	112	97	101	110	98	102	110	99	103	110	102	104	109			
34000	98	103	112	99	103	112	100	104	111	102	105	111	105	106	111			
35000	100	105	114	101	105	113	102	106	113	104	107	113	107	108	113			
36000	102	107	115	103	107	115	104	108	114	106	108	114	109	110	114			
37000	104	108	116	105	109	116	107	109	116	108	110	116	111	112	116			
38000	107	110	118	107	111	117	109	111	117	110	112	117	112	113	117			
39000	109	112	119	109	112	119	111	113	119	112	114	119	114	115	119			
40000	110	114	120	111	114	120	113	115	120	115	116	120	117	117	120			
41000	113	115	122	113	116	122	115	117	122	117	118	122	118	118	122			
42000	115	117	123	115	118	123	117	119	123	119	120	123	---	---	---			
43000	116	119	125	117	120	125	119	120	125	121	121	125	---	---	---			
44000	118	121	126	119	121	126	121	122	126	---	---	---	---	---	---			
45000	120	122	128	122	123	128	124	124	128	---	---	---	---	---	---			
46000	122	124	129	124	125	129	125	125	129	---	---	---	---	---	---			
47000	125	126	130	126	126	130	---	---	---	---	---	---	---	---	---			
48000	127	128	132	128	128	132	---	---	---	---	---	---	---	---	---			
49000	129	129	133	---	---	---	---	---	---	---	---	---	---	---	---			
50000	131	131	134	---	---	---	---	---	---	---	---	---	---	---	---			
51000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
52000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			

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V1/VR/V2 SPEEDS

T/O-2 MODE - ATTCS ON - FLAPS 1

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.18 - DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)														
-1000 →	-40	to	39	40	to	50	51	to	52						
SL →	-40	to	37	38	to	48	49	to	50						
1000 →	-40	to	33	34	to	44	45	to	48						
2000 →	-40	to	28	29	to	40	41	to	46						
3000 →	-40	to	24	25	to	35	36	to	44						
4000 →	-40	to	22	23	to	31	32	to	42						
5000 →				-40	to	26	27	to	40						
6000 →				-40	to	22	23	to	36	37	to	38			
7000 →				-40	to	17	18	to	31	32	to	36			
8000 →				-40	to	14	15	to	26	27	to	34			
9000 →							-40	to	22	23	to	32			
10000 →							-40	to	17	18	to	28	29	to	30
	↓			↓			↓			↓			↓		
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2
28000	99	108	115	101	109	115	104	110	115	107	111	115	109	112	115
29000	101	110	117	104	111	117	107	112	117	110	114	117	112	114	117
30000	104	112	119	107	113	119	110	115	119	113	116	119	115	116	119
31000	107	115	121	110	116	121	113	117	121	116	118	121	118	119	121
32000	110	117	123	113	118	123	116	119	123	119	120	123	121	121	123
33000	113	119	125	115	120	125	119	121	125	122	123	125	123	123	125
34000	116	121	127	118	122	127	121	124	127	124	125	127	125	125	127
35000	118	124	129	121	125	129	124	126	129	126	127	129	---	---	---
36000	121	126	130	123	127	130	126	128	130	129	129	131	---	---	---
37000	123	128	132	126	129	132	129	130	132	131	131	132	---	---	---
38000	126	130	134	128	131	134	131	132	134	---	---	---	---	---	---
39000	128	132	136	131	133	136	133	134	136	---	---	---	---	---	---
40000	130	134	137	133	135	137	135	135	137	---	---	---	---	---	---
41000	133	136	139	135	137	139	137	137	139	---	---	---	---	---	---
42000	135	138	141	138	138	141	139	139	141	---	---	---	---	---	---
43000	138	139	142	140	140	143	---	---	---	---	---	---	---	---	---
44000	140	141	144	142	142	144	---	---	---	---	---	---	---	---	---
45000	142	143	146	143	144	146	---	---	---	---	---	---	---	---	---
46000	144	145	147	145	145	147	---	---	---	---	---	---	---	---	---
47000	146	147	149	147	147	149	---	---	---	---	---	---	---	---	---
48000	148	148	150	---	---	---	---	---	---	---	---	---	---	---	---
49000	150	150	152	---	---	---	---	---	---	---	---	---	---	---	---
50000	151	151	154	---	---	---	---	---	---	---	---	---	---	---	---
51000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
52000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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V1/VR/V2 SPEEDS

T/O-2 MODE - ATTCS ON - FLAPS 2

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.17- DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)																	
-1000 →	-40	to	39	40	to	48	49	to	52									
SL →	-40	to	36	37	to	46	47	to	50									
1000 →	-40	to	32	33	to	41	42	to	48									
2000 →	-40	to	28	29	to	37	38	to	46									
3000 →	-40	to	24	25	to	33	34	to	44									
4000 →				-40	to	28	29	to	40	41	to	42						
5000 →				-40	to	24	25	to	36	37	to	40						
6000 →				-40	to	19	20	to	31	32	to	38						
7000 →				-40	to	16	17	to	27	28	to	36						
8000 →				-40	to	14	15	to	22	23	to	34						
9000 →							-40	to	17	18	to	32						
10000 →							-40	to	13	14	to	28	29	to	30			
		↓			↓			↓			↓			↓				
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2			
28000	96	103	112	98	105	112	101	106	112	105	108	112	107	109	112			
29000	98	106	114	101	107	114	104	108	114	108	110	114	110	111	114			
30000	101	108	116	104	110	116	107	111	116	111	113	116	113	114	116			
31000	104	111	118	108	112	118	110	113	118	114	115	118	115	116	118			
32000	107	113	120	111	115	120	113	116	120	116	118	120	118	119	120			
33000	110	115	122	113	117	122	116	118	122	119	120	122	120	121	122			
34000	113	118	123	116	119	123	118	120	123	121	122	124	---	---	---			
35000	116	120	125	119	121	125	121	122	125	123	124	125	---	---	---			
36000	118	122	127	121	123	127	123	125	127	125	126	127	---	---	---			
37000	121	124	129	124	126	129	126	127	129	127	128	129	---	---	---			
38000	124	126	130	126	128	130	128	129	131	129	130	131	---	---	---			
39000	126	128	132	128	130	132	130	131	132	---	---	---	---	---	---			
40000	128	130	134	130	132	134	132	133	134	---	---	---	---	---	---			
41000	130	132	135	133	134	136	134	134	136	---	---	---	---	---	---			
42000	133	134	137	134	135	137	136	136	137	---	---	---	---	---	---			
43000	135	136	139	136	137	139	137	138	139	---	---	---	---	---	---			
44000	137	138	140	138	139	140	---	---	---	---	---	---	---	---	---			
45000	139	140	142	140	141	142	---	---	---	---	---	---	---	---	---			
46000	141	142	144	142	142	144	---	---	---	---	---	---	---	---	---			
47000	143	144	145	---	---	---	---	---	---	---	---	---	---	---	---			
48000	145	145	147	---	---	---	---	---	---	---	---	---	---	---	---			
49000	146	147	148	---	---	---	---	---	---	---	---	---	---	---	---			
50000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
51000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			
52000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---			

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V1/VR/V2 SPEEDS

T/O-2 MODE - ATTCS ON - FLAPS 3

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.17 - DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)														
-1000 →	-40	to	34	35	to	38	39	to	46	47	to	52			
SL →	-40	to	32	33	to	36	37	to	44	45	to	50			
1000 →	-40	to	28	29	to	31	32	to	40	41	to	48			
2000 →				-40	to	27	28	to	35	36	to	46			
3000 →				-40	to	26	27	to	31	32	to	43	44	to	44
4000 →				-40	to	22	23	to	26	27	to	39	40	to	42
5000 →							-40	to	22	23	to	34	35	to	40
6000 →							-40	to	18	19	to	30	31	to	38
7000 →										-40	to	25	26	to	36
8000 →										-40	to	20	21	to	34
9000 →										-40	to	16	17	to	32
10000 →										-40	to	11	12	to	30
	↓			↓			↓			↓			↓		
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2
28000	96	100	111	94	98	108	93	98	106	95	99	106	100	101	106
29000	96	99	109	94	99	108	95	100	108	98	101	108	102	103	108
30000	96	100	110	96	101	110	97	102	110	101	103	110	105	106	110
31000	97	103	112	99	104	112	101	104	112	104	106	112	108	108	112
32000	100	105	113	102	106	113	104	107	113	107	108	113	110	110	113
33000	103	107	115	105	108	115	107	109	115	110	111	115	112	112	115
34000	106	110	117	108	110	117	110	111	117	112	113	117	114	114	117
35000	109	112	119	111	113	119	112	113	119	115	115	119	116	116	119
36000	112	114	120	113	115	120	115	115	120	117	117	120	118	118	120
37000	114	116	122	116	117	122	117	117	122	119	119	122	120	120	122
38000	117	118	123	118	119	124	119	119	124	121	121	124	---	---	---
39000	120	120	125	121	121	125	121	121	125	123	123	125	---	---	---
40000	122	122	127	123	123	127	123	123	127	124	124	127	---	---	---
41000	124	124	128	125	125	128	125	125	128	126	126	128	---	---	---
42000	126	126	130	127	127	130	127	127	130	---	---	---	---	---	---
43000	128	128	131	128	128	131	129	129	131	---	---	---	---	---	---
44000	130	130	133	130	130	133	130	130	133	---	---	---	---	---	---
45000	131	131	134	132	132	134	---	---	---	---	---	---	---	---	---
46000	133	133	136	133	133	136	---	---	---	---	---	---	---	---	---
47000	135	135	137	---	---	---	---	---	---	---	---	---	---	---	---
48000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
49000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
50000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
51000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
52000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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V1/VR/V2 SPEEDS

T/O-2 MODE - ATTCS ON - FLAPS 4

EMBRAER 190 - ANAC/FAA CERTIFICATION - CF34-10E6 ENGINES

BALANCED V1 - V2/VS = 1.19 - DRY RUNWAY – ANTI-ICE ON/OFF – ECS ON/OFF

PRESSURE ALTITUDE (ft)	STATIC AIR TEMPERATURE (°C)														
-1000 →	-40	to	34	35	to	39	40	to	52						
SL →	-40	to	32	33	to	36	37	to	50						
1000 →	-40	to	28	29	to	32	33	to	48						
2000 →				-40	to	27	28	to	46						
3000 →							-40	to	42	43	to	44			
4000 →							-40	to	37	38	to	42			
5000 →							-40	to	33	34	to	40			
6000 →							-40	to	28	29	to	38			
7000 →							-40	to	23	24	to	36			
8000 →							-40	to	18	19	to	34			
9000 →							-40	to	13	14	to	32			
10000 →							-40	to	10	11	to	28	29	to	30
	↓			↓			↓			↓			↓		
WEIGHT (kg)	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2	V_1	V_R	V_2
28000	93	100	110	92	97	107	90	94	103	93	95	101	95	97	101
29000	93	99	109	92	96	106	92	95	103	96	98	102	98	99	103
30000	93	98	107	92	96	105	94	97	104	99	100	104	101	101	104
31000	93	97	106	94	98	106	97	100	106	101	102	106	103	103	106
32000	96	100	108	97	101	108	100	102	108	103	104	108	---	---	---
33000	99	102	110	100	103	110	102	104	109	105	106	109	---	---	---
34000	101	104	111	102	104	111	104	106	111	107	108	111	---	---	---
35000	103	106	113	104	106	113	107	108	113	109	109	113	---	---	---
36000	105	108	114	106	108	114	109	110	114	111	111	114	---	---	---
37000	107	110	116	108	110	116	111	112	116	---	---	---	---	---	---
38000	109	112	117	110	112	117	112	113	117	---	---	---	---	---	---
39000	111	113	119	112	114	119	114	115	119	---	---	---	---	---	---
40000	113	115	120	114	116	120	116	117	120	---	---	---	---	---	---
41000	115	117	122	117	118	122	118	118	122	---	---	---	---	---	---
42000	118	119	123	119	119	123	120	120	123	---	---	---	---	---	---
43000	121	121	125	121	121	125	---	---	---	---	---	---	---	---	---
44000	122	122	126	123	123	126	---	---	---	---	---	---	---	---	---
45000	124	124	128	---	---	---	---	---	---	---	---	---	---	---	---
46000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
47000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
48000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
49000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
50000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
51000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
52000	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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FLAP RETRACTION SPEED SCHEDULE

During flap retraction, the next flap setting should be selected when the F-Bug is reached.

The F-Bug calculation algorithm is designed so as to meet minimum safe margins to V_{FE} and Shaker speed. A minimum margin of 20% above the stall speed is set for the next flap.

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FINAL SEGMENT SPEED

EMBRAER 190

WEIGHT (kg)	VFS (KIAS)
28000	156
29000	159
30000	161
31000	164
32000	167
33000	169
34000	172
35000	174
36000	177
37000	179
38000	182
39000	184
40000	186
41000	189
42000	191
43000	193
44000	196
45000	198
46000	200
47000	202
48000	204
49000	206
50000	209
51000	211
52000	213

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STAB TRIM SETTING FOR TAKEOFF

EMBRAER 190

FLAPS 1													
TOW (kg)	CG POSITION (% MAC)												
	5	7	9	11	13	15	17	19	21	23	25	27	29
52000	4 UP	4 UP	4 UP	3.8 UP	3.5 UP	3.1 UP	2.8 UP	2.4 UP	2.2 UP	1.8 UP	1.5 UP	1.2 UP	0.8 UP
50000	4 UP	4 UP	3.9 UP	3.6 UP	3.3 UP	2.9 UP	2.6 UP	2.2 UP	2 UP	1.6 UP	1.3 UP	1 UP	0.6 UP
48000	4 UP	4 UP	3.8 UP	3.4 UP	3.1 UP	2.8 UP	2.5 UP	2.1 UP	1.8 UP	1.5 UP	1.2 UP	0.8 UP	0.5 UP
46000	4 UP	3.9 UP	3.6 UP	3.3 UP	3 UP	2.7 UP	2.3 UP	2 UP	1.7 UP	1.4 UP	1 UP	0.7 UP	0.4 UP
44000	3.9 UP	3.8 UP	3.4 UP	3.1 UP	2.8 UP	2.5 UP	2.1 UP	1.8 UP	1.5 UP	1.2 UP	0.8 UP	0.6 UP	0.3 UP
42000	3.9 UP	3.6 UP	3.3 UP	2.9 UP	2.6 UP	2.3 UP	2 UP	1.7 UP	1.4 UP	1.1 UP	0.7 UP	0.4 UP	0.2 UP
40000	3.7 UP	3.4 UP	3.1 UP	2.7 UP	2.4 UP	2.1 UP	1.8 UP	1.5 UP	1.2 UP	0.9 UP	0.6 UP	0.2 UP	0.1 UP
38000	3.5 UP	3.1 UP	2.8 UP	2.4 UP	2.2 UP	1.9 UP	1.5 UP	1.3 UP	1 UP	0.7 UP	0.4 UP	0.1 UP	0
36000	3.3 UP	2.9 UP	2.5 UP	2.2 UP	2 UP	1.7 UP	1.3 UP	1.1 UP	0.8 UP	0.5 UP	0.2 UP	0	0
34000	3 UP	2.7 UP	2.3 UP	2 UP	1.8 UP	1.5 UP	1.1 UP	0.9 UP	0.6 UP	0.3 UP	0.1 UP	0	0
32000	2.7 UP	2.4 UP	2.1 UP	1.8 UP	1.5 UP	1.2 UP	0.8 UP	0.6 UP	0.3 UP	0.1 UP	0	0	0
30000	2.5 UP	2.2 UP	1.9 UP	1.6 UP	1.3 UP	1 UP	0.7 UP	0.4 UP	0.1 UP	0	0	0	0

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EMBRAER 190

FLAPS 2													
TOW (kg)	CG POSITION (% MAC)												
	5	7	9	11	13	15	17	19	21	23	25	27	29
52000	3.5 UP	3.5 UP	3.5 UP	3.4 UP	3 UP	2.7 UP	2.4 UP	2.1 UP	1.7 UP	1.4 UP	1 UP	0.6 UP	0.2 UP
50000	3.5 UP	3.5 UP	3.5 UP	3.2 UP	2.8 UP	2.5 UP	2.2 UP	1.9 UP	1.5 UP	1.2 UP	0.8 UP	0.4 UP	0
48000	3.5 UP	3.5 UP	3.5 UP	3.1 UP	2.7 UP	2.4 UP	2.1 UP	1.7 UP	1.4 UP	1 UP	0.7 UP	0.3 UP	0.1 DN
46000	3.5 UP	3.5 UP	3.3 UP	3 UP	2.6 UP	2.3 UP	1.9 UP	1.6 UP	1.3 UP	0.9 UP	0.6 UP	0.2 UP	0.2 DN
44000	3.5 UP	3.4 UP	3.1 UP	2.8 UP	2.4 UP	2.1 UP	1.7 UP	1.4 UP	1.1 UP	0.7 UP	0.4 UP	0	0.4 DN
42000	3.4 UP	3.3 UP	2.9 UP	2.6 UP	2.2 UP	1.9 UP	1.6 UP	1.3 UP	1 UP	0.6 UP	0.2 UP	0.2 DN	0.4 DN
40000	3.3 UP	3 UP	2.7 UP	2.4 UP	2 UP	1.7 UP	1.4 UP	1.1 UP	0.8 UP	0.4 UP	0	0.3 DN	0.5 DN
38000	3.1 UP	2.8 UP	2.4 UP	2.1 UP	1.7 UP	1.5 UP	1.2 UP	0.9 UP	0.5 UP	0.2 UP	0.2 DN	0.4 DN	0.5 DN
36000	2.9 UP	2.6 UP	2.2 UP	1.9 UP	1.5 UP	1.3 UP	1 UP	0.7 UP	0.3 UP	0	0.4 DN	0.5 DN	0.5 DN
34000	2.7 UP	2.3 UP	2 UP	1.6 UP	1.3 UP	1.1 UP	0.8 UP	0.5 UP	0.1 UP	0.2 DN	0.4 DN	0.5 DN	0.5 DN
32000	2.5 UP	2 UP	1.7 UP	1.3 UP	1.1 UP	0.8 UP	0.5 UP	0.2 UP	0.1 DN	0.5 DN	0.5 DN	0.5 DN	0.5 DN
30000	2.2 UP	1.8 UP	1.5 UP	1.1 UP	0.8 UP	0.6 UP	0.3 UP	0	0.3 DN	0.5 DN	0.5 DN	0.5 DN	0.5 DN

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EMBRAER 190

FLAPS 3													
TOW (kg)	CG POSITION (% MAC)												
	5	7	9	11	13	15	17	19	21	23	25	27	29
52000	3 UP	3 UP	3 UP	2.7 UP	2.3 UP	1.9 UP	1.5 UP	1.2 UP	0.8 UP	0.4 UP	0	0.4 DN	0.8 DN
50000	3 UP	3 UP	2.9 UP	2.5 UP	2.1 UP	1.7 UP	1.4 UP	1 UP	0.6 UP	0.2 UP	0.2 DN	0.6 DN	1 DN
48000	3 UP	3 UP	2.8 UP	2.4 UP	2 UP	1.6 UP	1.3 UP	0.9 UP	0.5 UP	0.1 UP	0.3 DN	0.7 DN	1.1 DN
46000	3 UP	2.9 UP	2.6 UP	2.2 UP	1.9 UP	1.5 UP	1.1 UP	0.7 UP	0.4 UP	0	0.4 DN	0.8 DN	1.2 DN
44000	2.9 UP	2.8 UP	2.4 UP	2 UP	1.7 UP	1.3 UP	0.9 UP	0.5 UP	0.2 UP	0.2 DN	0.6 DN	1 DN	1.3 DN
42000	2.8 UP	2.6 UP	2.2 UP	1.9 UP	1.5 UP	1.1 UP	0.7 UP	0.4 UP	0	0.4 DN	0.7 DN	1.1 DN	1.4 DN
40000	2.6 UP	2.4 UP	2 UP	1.7 UP	1.3 UP	0.9 UP	0.5 UP	0.2 UP	0.2 DN	0.6 DN	0.9 DN	1.3 DN	1.5 DN
38000	2.4 UP	2.1 UP	1.7 UP	1.4 UP	1 UP	0.6 UP	0.3 UP	0.1 DN	0.5 DN	0.8 DN	1.1 DN	1.4 DN	1.5 DN
36000	2.2 UP	1.8 UP	1.5 UP	1.1 UP	0.8 UP	0.4 UP	0.1 UP	0.3 DN	0.7 DN	1 DN	1.3 DN	1.5 DN	1.5 DN
34000	2 UP	1.6 UP	1.2 UP	0.8 UP	0.5 UP	0.1 UP	0.2 DN	0.6 DN	0.9 DN	1.2 DN	1.4 DN	1.5 DN	1.5 DN
32000	1.7 UP	1.3 UP	0.9 UP	0.5 UP	0.2 UP	0.2 DN	0.6 DN	0.9 DN	1.2 DN	1.5 DN	1.5 DN	1.5 DN	1.5 DN
30000	1.5 UP	1 UP	0.7 UP	0.3 UP	0	0.4 DN	0.8 DN	1.1 DN	1.4 DN	1.5 DN	1.5 DN	1.5 DN	1.5 DN

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EMBRAER 190

FLAPS 4													
TOW (kg)	CG POSITION (% MAC)												
	5	7	9	11	13	15	17	19	21	23	25	27	29
52000	4 UP	4 UP	3.9 UP	3.5 UP	3 UP	2.6 UP	2.2 UP	1.8 UP	1.3 UP	0.9 UP	0.5 UP	0	0.5 DN
50000	4 UP	4 UP	3.7 UP	3.3 UP	2.8 UP	2.4 UP	2 UP	1.6 UP	1.1 UP	0.7 UP	0.3 UP	0.2 DN	0.6 DN
48000	4 UP	4 UP	3.6 UP	3.1 UP	2.7 UP	2.3 UP	1.9 UP	1.4 UP	1 UP	0.6 UP	0.1 UP	0.3 DN	0.7 DN
46000	4 UP	3.8 UP	3.4 UP	3 UP	2.5 UP	2.2 UP	1.7 UP	1.2 UP	0.8 UP	0.4 UP	0	0.4 DN	0.8 DN
44000	3.9 UP	3.6 UP	3.2 UP	2.8 UP	2.3 UP	2 UP	1.5 UP	1 UP	0.6 UP	0.2 UP	0.2 DN	0.6 DN	1 DN
42000	3.8 UP	3.4 UP	3 UP	2.6 UP	2.1 UP	1.8 UP	1.3 UP	0.9 UP	0.4 UP	0	0.4 DN	0.8 DN	1 DN
40000	3.6 UP	3.1 UP	2.7 UP	2.3 UP	1.9 UP	1.5 UP	1.1 UP	0.7 UP	0.2 UP	0.2 DN	0.6 DN	0.9 DN	1 DN
38000	3.2 UP	2.8 UP	2.4 UP	2 UP	1.6 UP	1.2 UP	0.8 UP	0.3 UP	0.1 DN	0.5 DN	0.8 DN	1 DN	1 DN
36000	2.9 UP	2.5 UP	2.1 UP	1.7 UP	1.3 UP	0.9 UP	0.5 UP	0	0.3 DN	0.7 DN	1 DN	1 DN	1 DN
34000	2.6 UP	2.2 UP	1.8 UP	1.4 UP	1 UP	0.6 UP	0.2 UP	0.3 DN	0.6 DN	0.8 DN	1 DN	1 DN	1 DN
32000	2.2 UP	1.8 UP	1.4 UP	1 UP	0.6 UP	0.2 UP	0.2 DN	0.6 DN	1 DN	1 DN	1 DN	1 DN	1 DN
30000	1.9 UP	1.6 UP	1.2 UP	0.8 UP	0.4 UP	0.1 DN	0.4 DN	0.8 DN	1 DN	1 DN	1 DN	1 DN	1 DN

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CLIMB GRADIENT - ALL ENGINES OPERATING

The climb gradient tables show the climb gradients in percentage and in ft/NM for several weights, temperatures and pressure altitudes. These tables are published in the following configurations:

GRADIENTS FOR TAKEOFF THRUST

The gradients were obtained for:

– A speed equal to V_2 + 10 KIAS;

– FLAP 2;

– V_2/V_S ratio equal to the minimum of the range;

– Anti-Ice OFF;

– ECS ON;

– Landing Gear Up;

– Wings Leveled;

– Temperatures in Celsius Degrees.

Corrections in the climb gradient for Anti-Ice ON and Flaps 4 are also provided in the footer of each table.

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GRADIENTS FOR CLIMB THRUST

The gradients were obtained for:

– A speed equal to V_{FS} KIAS and 250 KIAS;

– FLAP UP;

– CLB-1 Thrust Rating;

– Anti-Ice OFF;

– ECS ON;

– Landing Gear Up;

– Wings Leveled;

– Temperatures in ISA Deviation.

Corrections in the climb gradient for Anti-Ice ON and CLB-2 thrust rating are also provided in the footer of each table.

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CLIMB GRADIENT – ALL ENGINES OPERATING
TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-1 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 0FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
30 and below	31.7 (1923)	28.8 (1747)	26.2 (1594)	24.0 (1460)	22.1 (1341)	20.3 (1235)	18.8 (1140)	17.4 (1055)	16.1 (978)	15.0 (911)	14.0 (851)
35	31.4 (1904)	28.5 (1729)	26.0 (1578)	23.8 (1445)	21.9 (1328)	20.2 (1224)	18.6 (1131)	17.2 (1046)	16.0 (970)	14.9 (904)	13.9 (844)
40	28.9 (1758)	26.3 (1596)	24.0 (1455)	21.9 (1331)	20.1 (1222)	18.5 (1125)	17.1 (1038)	15.8 (959)	14.6 (887)	13.6 (826)	12.7 (771)
45	27.1 (1644)	24.5 (1491)	22.4 (1358)	20.4 (1241)	18.7 (1138)	17.2 (1046)	15.9 (963)	14.6 (888)	13.5 (821)	12.6 (763)	11.7 (710)
50	25.4 (1545)	23.0 (1399)	20.9 (1272)	19.1 (1160)	17.5 (1061)	16.0 (973)	14.7 (893)	13.5 (821)	12.4 (756)	11.5 (700)	10.7 (650)
A-ICE CORRECTION SUBTRACT: 0.0 % OR 0. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.2 % OR 72. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-1 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 2000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
25 and below	29.5 (1793)	26.8 (1629)	24.5 (1486)	22.4 (1360)	20.6 (1249)	18.9 (1150)	17.5 (1061)	16.1 (980)	14.9 (908)	13.9 (845)	13.0 (789)
30	29.4 (1789)	26.7 (1624)	24.4 (1482)	22.3 (1356)	20.5 (1245)	18.9 (1146)	17.4 (1058)	16.1 (978)	14.9 (905)	13.9 (843)	13.0 (787)
35	27.7 (1684)	25.2 (1528)	22.9 (1393)	21.0 (1274)	19.2 (1168)	17.7 (1074)	16.3 (989)	15.0 (913)	13.9 (844)	12.9 (785)	12.0 (731)
40	25.9 (1570)	23.4 (1424)	21.3 (1296)	19.5 (1183)	17.8 (1084)	16.4 (994)	15.1 (914)	13.9 (842)	12.8 (776)	11.9 (720)	11.0 (670)
45	24.1 (1463)	21.8 (1325)	19.8 (1204)	18.1 (1097)	16.5 (1003)	15.1 (918)	13.9 (842)	12.7 (774)	11.7 (711)	10.8 (658)	10.1 (610)
50	22.2 (1351)	20.1 (1220)	18.2 (1107)	16.6 (1006)	15.1 (917)	13.8 (837)	12.6 (765)	11.5 (701)	10.6 (642)	9.7 (592)	9.0 (547)
A-ICE CORRECTION SUBTRACT: 0.0 % OR 0. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.2 % OR 71. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-1 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 4000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
20 and below	27.7 (1683)	25.1 (1527)	22.9 (1392)	21.0 (1273)	19.2 (1167)	17.7 (1073)	16.3 (989)	15.0 (913)	13.9 (844)	12.9 (785)	12.0 (732)
25	27.6 (1678)	25.1 (1522)	22.8 (1387)	20.9 (1269)	19.2 (1164)	17.6 (1070)	16.2 (986)	15.0 (910)	13.8 (841)	12.9 (782)	12.0 (729)
30	26.5 (1609)	24.0 (1459)	21.9 (1329)	20.0 (1214)	18.3 (1112)	16.8 (1021)	15.5 (940)	14.3 (866)	13.2 (799)	12.2 (742)	11.4 (691)
35	24.7 (1499)	22.4 (1358)	20.3 (1235)	18.5 (1126)	17.0 (1030)	15.6 (944)	14.3 (867)	13.1 (797)	12.1 (734)	11.2 (680)	10.4 (631)
40	22.9 (1393)	20.8 (1260)	18.8 (1144)	17.2 (1042)	15.7 (951)	14.3 (870)	13.1 (797)	12.0 (731)	11.1 (671)	10.2 (620)	9.5 (574)
45	21.2 (1287)	19.1 (1162)	17.3 (1052)	15.7 (956)	14.3 (870)	13.1 (794)	11.9 (724)	10.9 (662)	10.0 (605)	9.2 (558)	8.5 (514)
50	19.6 (1191)	17.7 (1073)	16.0 (970)	14.5 (878)	13.1 (797)	11.9 (724)	10.8 (658)	9.9 (599)	9.0 (545)	8.2 (500)	7.6 (459)
A-ICE CORRECTION SUBTRACT: 0.0 % OR 2. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.2 % OR 72. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-1 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 6000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
15 and below	25.8 (1569)	23.4 (1422)	21.3 (1295)	19.5 (1183)	17.8 (1083)	16.4 (995)	15.1 (915)	13.9 (843)	12.8 (778)	11.9 (722)	11.1 (672)
20	25.8 (1564)	23.4 (1418)	21.3 (1291)	19.4 (1179)	17.8 (1080)	16.3 (992)	15.0 (912)	13.8 (840)	12.8 (775)	11.8 (719)	11.0 (669)
25	25.0 (1520)	22.7 (1377)	20.6 (1253)	18.8 (1143)	17.2 (1046)	15.8 (960)	14.5 (882)	13.4 (812)	12.3 (748)	11.4 (694)	10.6 (644)
30	23.3 (1414)	21.1 (1279)	19.1 (1162)	17.4 (1059)	15.9 (967)	14.6 (884)	13.3 (810)	12.2 (744)	11.2 (683)	10.4 (632)	9.6 (585)
35	21.7 (1316)	19.6 (1190)	17.8 (1078)	16.1 (981)	14.7 (893)	13.4 (815)	12.3 (745)	11.2 (681)	10.3 (624)	9.5 (575)	8.8 (532)
40	20.0 (1216)	18.1 (1097)	16.3 (992)	14.8 (900)	13.5 (818)	12.3 (745)	11.2 (679)	10.2 (619)	9.3 (565)	8.6 (519)	7.9 (478)
45	18.4 (1119)	16.6 (1007)	15.0 (909)	13.5 (822)	12.3 (745)	11.1 (676)	10.1 (613)	9.2 (557)	8.3 (506)	7.6 (463)	7.0 (424)
50	17.1 (1041)	15.4 (935)	13.9 (841)	12.5 (759)	11.3 (686)	10.2 (620)	9.2 (561)	8.4 (507)	7.5 (458)	6.9 (417)	6.3 (381)
A-ICE CORRECTION SUBTRACT: 0.1 % OR 7. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.2 % OR 76. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-1 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 8000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
10 and below	23.8 (1449)	21.6 (1312)	19.6 (1193)	17.9 (1088)	16.4 (995)	15.0 (912)	13.8 (837)	12.7 (769)	11.7 (708)	10.8 (656)	10.0 (609)
15	23.8 (1445)	21.5 (1308)	19.6 (1189)	17.9 (1085)	16.3 (992)	15.0 (909)	13.7 (834)	12.6 (767)	11.6 (706)	10.8 (654)	10.0 (607)
20	23.4 (1423)	21.2 (1288)	19.3 (1170)	17.6 (1067)	16.1 (975)	14.7 (893)	13.5 (819)	12.4 (753)	11.4 (692)	10.6 (641)	9.8 (594)
25	21.7 (1317)	19.6 (1190)	17.8 (1079)	16.2 (981)	14.7 (894)	13.4 (817)	12.3 (747)	11.3 (683)	10.3 (626)	9.5 (578)	8.8 (534)
30	20.1 (1223)	18.2 (1103)	16.4 (998)	14.9 (905)	13.6 (823)	12.3 (749)	11.2 (683)	10.3 (623)	9.4 (568)	8.6 (522)	7.9 (481)
35	18.7 (1133)	16.8 (1020)	15.2 (921)	13.7 (833)	12.4 (755)	11.3 (685)	10.2 (622)	9.3 (565)	8.5 (513)	7.7 (470)	7.1 (432)
40	17.1 (1038)	15.3 (932)	13.8 (839)	12.5 (757)	11.3 (684)	10.2 (618)	9.2 (559)	8.3 (506)	7.5 (457)	6.9 (417)	6.3 (380)
45	15.8 (962)	14.2 (862)	12.7 (774)	11.5 (696)	10.3 (626)	9.3 (564)	8.4 (508)	7.5 (457)	6.8 (411)	6.1 (373)	5.6 (338)
A-ICE CORRECTION SUBTRACT: 0.2 % OR 11. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 77. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-1 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 10000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
10 and below	21.9 (1329)	19.8 (1202)	18.0 (1091)	16.4 (993)	14.9 (906)	13.6 (828)	12.5 (758)	11.4 (695)	10.5 (638)	9.7 (589)	9.0 (545)
15	21.8 (1326)	19.7 (1199)	17.9 (1088)	16.3 (990)	14.9 (903)	13.6 (826)	12.4 (756)	11.4 (693)	10.5 (635)	9.7 (587)	8.9 (543)
20	20.2 (1228)	18.3 (1108)	16.5 (1004)	15.0 (911)	13.7 (829)	12.4 (755)	11.3 (689)	10.4 (629)	9.5 (575)	8.7 (529)	8.0 (488)
25	18.7 (1138)	16.9 (1024)	15.2 (925)	13.8 (837)	12.5 (759)	11.3 (689)	10.3 (626)	9.4 (569)	8.5 (517)	7.8 (474)	7.2 (435)
30	17.4 (1054)	15.6 (947)	14.0 (853)	12.7 (769)	11.5 (695)	10.4 (629)	9.4 (569)	8.5 (515)	7.7 (466)	7.0 (425)	6.4 (388)
35	15.8 (961)	14.2 (861)	12.7 (773)	11.4 (695)	10.3 (625)	9.3 (563)	8.4 (507)	7.5 (456)	6.8 (410)	6.1 (372)	5.6 (338)
40	14.7 (890)	13.1 (795)	11.7 (711)	10.5 (637)	9.4 (571)	8.4 (512)	7.6 (459)	6.8 (411)	6.0 (367)	5.4 (331)	4.9 (298)
45	13.5 (820)	12.0 (730)	10.7 (651)	9.6 (581)	8.5 (518)	7.6 (462)	6.8 (411)	6.0 (366)	5.3 (324)	4.8 (290)	4.3 (259)
A-ICE CORRECTION SUBTRACT: 1.1 % OR 69. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 79. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-2 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 0FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
30 and below	26.8 (1626)	24.3 (1474)	22.1 (1343)	20.2 (1227)	18.5 (1125)	17.0 (1033)	15.7 (951)	14.4 (877)	13.3 (809)	12.4 (752)	11.5 (700)
35	24.9 (1515)	22.6 (1373)	20.6 (1249)	18.8 (1139)	17.2 (1043)	15.7 (956)	14.5 (878)	13.3 (808)	12.2 (744)	11.4 (689)	10.5 (640)
40	23.2 (1411)	21.0 (1277)	19.1 (1160)	17.4 (1057)	15.9 (965)	14.5 (883)	13.3 (809)	12.2 (743)	11.2 (682)	10.4 (631)	9.6 (585)
45	21.6 (1312)	19.5 (1186)	17.7 (1075)	16.1 (977)	14.7 (891)	13.4 (813)	12.2 (743)	11.2 (680)	10.3 (623)	9.5 (574)	8.7 (530)
50	20.0 (1214)	18.0 (1095)	16.3 (991)	14.8 (899)	13.5 (817)	12.2 (743)	11.2 (677)	10.2 (618)	9.3 (563)	8.5 (518)	7.8 (476)
A-ICE CORRECTION SUBTRACT: 0.0 % OR 0. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.2 % OR 75. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-2 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 2000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
25 and below	25.0 (1518)	22.6 (1375)	20.6 (1251)	18.8 (1142)	17.2 (1045)	15.8 (958)	14.5 (881)	13.3 (810)	12.3 (746)	11.4 (692)	10.6 (643)
30	23.6 (1436)	21.4 (1300)	19.4 (1181)	17.7 (1077)	16.2 (984)	14.8 (901)	13.6 (826)	12.5 (758)	11.5 (697)	10.6 (645)	9.8 (598)
35	22.0 (1335)	19.9 (1207)	18.0 (1095)	16.4 (996)	15.0 (908)	13.7 (829)	12.5 (758)	11.4 (694)	10.5 (636)	9.7 (587)	8.9 (542)
40	20.5 (1243)	18.5 (1121)	16.7 (1015)	15.2 (921)	13.8 (838)	12.6 (763)	11.5 (696)	10.5 (636)	9.6 (581)	8.8 (534)	8.1 (492)
45	19.0 (1152)	17.1 (1038)	15.4 (937)	14.0 (848)	12.7 (770)	11.5 (699)	10.5 (636)	9.5 (578)	8.7 (526)	7.9 (482)	7.3 (442)
50	17.4 (1057)	15.6 (949)	14.1 (855)	12.7 (771)	11.5 (697)	10.4 (631)	9.4 (571)	8.5 (517)	7.7 (467)	7.0 (426)	6.4 (389)
A-ICE CORRECTION SUBTRACT: 0.0 % OR 0. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 77. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-2 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 4000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
20 and below	23.3 (1412)	21.0 (1278)	19.1 (1161)	17.4 (1058)	15.9 (966)	14.6 (884)	13.3 (811)	12.3 (744)	11.3 (684)	10.4 (632)	9.7 (586)
25	22.3 (1355)	20.2 (1225)	18.3 (1112)	16.7 (1012)	15.2 (923)	13.9 (844)	12.7 (772)	11.7 (708)	10.7 (649)	9.9 (599)	9.1 (554)
30	20.8 (1261)	18.7 (1139)	17.0 (1031)	15.4 (936)	14.0 (852)	12.8 (777)	11.7 (709)	10.7 (647)	9.7 (591)	9.0 (544)	8.3 (502)
35	19.3 (1171)	17.4 (1055)	15.7 (954)	14.2 (864)	12.9 (785)	11.7 (713)	10.7 (649)	9.7 (591)	8.9 (538)	8.1 (493)	7.5 (453)
40	17.9 (1087)	16.1 (977)	14.5 (881)	13.1 (796)	11.9 (721)	10.8 (653)	9.8 (592)	8.8 (537)	8.0 (487)	7.3 (445)	6.7 (407)
45	16.4 (998)	14.7 (895)	13.3 (805)	11.9 (724)	10.8 (653)	9.7 (589)	8.8 (532)	7.9 (480)	7.1 (432)	6.5 (393)	5.9 (357)
50	15.1 (915)	13.5 (818)	12.1 (733)	10.8 (657)	9.7 (590)	8.7 (530)	7.8 (476)	7.0 (426)	6.3 (382)	5.7 (345)	5.1 (311)
A-ICE CORRECTION SUBTRACT: 0.0 % OR 2. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 78. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-2 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 6000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
15 and below	21.6 (1312)	19.5 (1185)	17.7 (1075)	16.1 (977)	14.7 (890)	13.4 (813)	12.2 (743)	11.2 (680)	10.3 (622)	9.5 (574)	8.7 (530)
20	21.0 (1276)	19.0 (1152)	17.2 (1044)	15.6 (948)	14.2 (863)	13.0 (787)	11.8 (719)	10.8 (657)	9.9 (601)	9.1 (554)	8.4 (511)
25	19.6 (1188)	17.6 (1071)	15.9 (968)	14.4 (877)	13.1 (797)	11.9 (725)	10.9 (660)	9.9 (601)	9.0 (548)	8.3 (503)	7.6 (463)
30	18.1 (1102)	16.3 (991)	14.7 (894)	13.3 (808)	12.0 (732)	10.9 (663)	9.9 (602)	9.0 (546)	8.2 (495)	7.5 (453)	6.8 (414)
35	16.8 (1020)	15.1 (916)	13.6 (824)	12.2 (742)	11.0 (670)	10.0 (605)	9.0 (546)	8.1 (493)	7.3 (445)	6.7 (405)	6.1 (369)
40	15.5 (939)	13.8 (840)	12.4 (753)	11.1 (677)	10.0 (608)	9.0 (547)	8.1 (492)	7.3 (441)	6.5 (396)	5.9 (358)	5.3 (324)
45	14.1 (859)	12.6 (766)	11.3 (684)	10.1 (612)	9.0 (547)	8.1 (489)	7.2 (437)	6.4 (390)	5.7 (347)	5.1 (312)	4.6 (280)
50	13.4 (815)	11.9 (725)	10.6 (646)	9.5 (576)	8.5 (514)	7.5 (458)	6.7 (408)	6.0 (362)	5.3 (321)	4.7 (287)	4.2 (256)
A-ICE CORRECTION SUBTRACT: 0.1 % OR 7. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 80. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-2 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 8000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
10 and below	20.0 (1213)	18.0 (1094)	16.3 (989)	14.8 (897)	13.4 (816)	12.2 (742)	11.1 (677)	10.2 (617)	9.3 (563)	8.5 (517)	7.8 (476)
15	19.7 (1196)	17.7 (1078)	16.0 (975)	14.6 (884)	13.2 (803)	12.0 (730)	11.0 (665)	10.0 (606)	9.1 (552)	8.4 (507)	7.7 (467)
20	18.3 (1112)	16.5 (1000)	14.9 (902)	13.4 (816)	12.2 (739)	11.0 (670)	10.0 (608)	9.1 (552)	8.3 (501)	7.6 (459)	6.9 (421)
25	17.0 (1032)	15.3 (926)	13.7 (834)	12.4 (752)	11.2 (679)	10.1 (614)	9.1 (555)	8.3 (501)	7.5 (453)	6.8 (412)	6.2 (376)
30	15.7 (955)	14.1 (855)	12.6 (767)	11.4 (689)	10.2 (620)	9.2 (558)	8.3 (502)	7.4 (451)	6.7 (405)	6.0 (367)	5.5 (333)
35	14.5 (880)	12.9 (786)	11.6 (702)	10.4 (629)	9.3 (563)	8.3 (504)	7.4 (451)	6.6 (403)	5.9 (360)	5.3 (324)	4.8 (291)
40	13.2 (802)	11.7 (713)	10.5 (635)	9.3 (565)	8.3 (504)	7.4 (448)	6.6 (398)	5.8 (353)	5.1 (312)	4.6 (278)	4.1 (248)
45	12.4 (751)	11.0 (665)	9.7 (591)	8.6 (524)	7.7 (465)	6.8 (412)	6.0 (364)	5.3 (321)	4.6 (281)	4.1 (249)	3.6 (220)
A-ICE CORRECTION SUBTRACT: 1.2 % OR 71. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 80. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING TAKEOFF THRUST

EMBRAER 190 – CF34-10E6 – T/O-2 MODE – FLAPS 2
V2/VS = 1.17

ALTITUDE: 10000FT

Grad % (ft/NM)	WEIGHT (kg)										
SAT (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
10 and below	18.3 (1112)	16.5 (1001)	14.9 (903)	13.5 (817)	12.2 (740)	11.1 (671)	10.0 (609)	9.1 (553)	8.3 (502)	7.6 (460)	7.0 (422)
15	17.1 (1036)	15.3 (930)	13.8 (837)	12.4 (755)	11.2 (682)	10.2 (617)	9.2 (557)	8.3 (504)	7.5 (455)	6.8 (414)	6.2 (379)
20	15.8 (961)	14.2 (861)	12.7 (773)	11.4 (695)	10.3 (625)	9.3 (563)	8.4 (507)	7.5 (456)	6.8 (410)	6.1 (372)	5.6 (338)
25	14.7 (891)	13.1 (796)	11.7 (712)	10.5 (638)	9.4 (571)	8.4 (512)	7.6 (459)	6.8 (410)	6.0 (366)	5.4 (330)	4.9 (298)
30	13.5 (821)	12.0 (731)	10.7 (651)	9.6 (581)	8.5 (518)	7.6 (461)	6.8 (410)	6.0 (365)	5.3 (323)	4.8 (288)	4.3 (258)
35	12.2 (744)	10.9 (659)	9.6 (584)	8.5 (518)	7.6 (459)	6.7 (406)	5.9 (359)	5.2 (316)	4.6 (276)	4.0 (244)	3.6 (216)
40	11.4 (690)	10.0 (610)	8.9 (538)	7.8 (475)	6.9 (419)	6.1 (369)	5.3 (323)	4.6 (282)	4.0 (244)	3.5 (214)	3.1 (187)
45	11.2 (682)	9.9 (602)	8.7 (531)	7.7 (468)	6.8 (412)	6.0 (362)	5.2 (317)	4.6 (276)	3.9 (239)	3.4 (209)	3.0 (182)
A-ICE CORRECTION SUBTRACT: 2.1 % OR 126. ft/NM											
FLAP 4 CORRECTION SUBTRACT: 1.3 % OR 81. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – VFS

ALTITUDE: 0FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	30.3 (1842)	27.6 (1675)	25.2 (1533)	23.2 (1410)	21.5 (1303)	19.9 (1209)	18.5 (1121)	17.2 (1045)	16.1 (976)	15.1 (915)	14.1 (858)
-20	30.3 (1838)	27.5 (1672)	25.2 (1530)	23.2 (1407)	21.4 (1301)	19.9 (1206)	18.4 (1119)	17.2 (1043)	16.0 (974)	15.0 (913)	14.1 (856)
-10	30.2 (1832)	27.4 (1666)	25.1 (1525)	23.1 (1403)	21.3 (1296)	19.8 (1202)	18.4 (1115)	17.1 (1039)	16.0 (970)	15.0 (910)	14.0 (853)
0	30.0 (1822)	27.3 (1657)	25.0 (1516)	23.0 (1394)	21.2 (1288)	19.7 (1195)	18.2 (1108)	17.0 (1033)	15.9 (964)	14.9 (904)	13.9 (847)
10	29.8 (1811)	27.1 (1647)	24.8 (1507)	22.8 (1386)	21.1 (1281)	19.5 (1187)	18.1 (1101)	16.9 (1026)	15.8 (958)	14.8 (898)	13.9 (841)
20	26.0 (1580)	23.6 (1435)	21.6 (1312)	19.8 (1205)	18.3 (1111)	16.9 (1028)	15.6 (950)	14.5 (883)	13.5 (822)	12.6 (768)	11.8 (717)
30	22.6 (1374)	20.5 (1247)	18.7 (1139)	17.2 (1044)	15.8 (962)	14.6 (887)	13.5 (817)	12.5 (756)	11.6 (701)	10.8 (653)	10.0 (606)
A-ICE CORRECTION: SUBTRACT 2.4 % OR 143. ft/NM											
CLB-2 CORRECTION: SUBTRACT 5.3 % OR 319. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – VFS

ALTITUDE: 2000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	28.3 (1722)	25.8 (1568)	23.6 (1436)	21.8 (1323)	20.1 (1218)	18.6 (1128)	17.3 (1048)	16.1 (978)	15.0 (912)	14.0 (852)	13.1 (798)
-20	28.3 (1718)	25.8 (1565)	23.6 (1433)	21.7 (1320)	20.0 (1216)	18.5 (1126)	17.2 (1046)	16.1 (976)	15.0 (911)	14.0 (850)	13.1 (796)
-10	28.2 (1713)	25.7 (1560)	23.5 (1429)	21.7 (1316)	20.0 (1212)	18.5 (1123)	17.2 (1043)	16.0 (973)	14.9 (908)	14.0 (848)	13.1 (793)
0	28.1 (1704)	25.5 (1552)	23.4 (1421)	21.5 (1309)	19.8 (1205)	18.4 (1116)	17.1 (1037)	15.9 (967)	14.9 (902)	13.9 (842)	13.0 (789)
10	27.9 (1695)	25.4 (1544)	23.3 (1414)	21.4 (1302)	19.7 (1199)	18.3 (1110)	17.0 (1031)	15.8 (962)	14.8 (897)	13.8 (837)	12.9 (784)
20	24.4 (1480)	22.2 (1347)	20.3 (1232)	18.7 (1133)	17.1 (1041)	15.8 (961)	14.7 (890)	13.6 (828)	12.7 (769)	11.8 (716)	11.0 (667)
30	21.2 (1287)	19.3 (1170)	17.6 (1069)	16.2 (981)	14.8 (898)	13.6 (827)	12.6 (763)	11.6 (707)	10.8 (654)	10.0 (605)	9.3 (562)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 139. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.9 % OR 299. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – VFS

ALTITUDE: 4000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	26.6 (1613)	24.2 (1471)	22.2 (1348)	20.4 (1236)	18.8 (1140)	17.4 (1057)	16.2 (982)	15.0 (912)	14.0 (849)	13.1 (793)	12.2 (742)
-20	26.5 (1610)	24.2 (1468)	22.1 (1345)	20.3 (1234)	18.7 (1138)	17.4 (1055)	16.1 (980)	15.0 (910)	13.9 (847)	13.0 (791)	12.2 (741)
-10	26.4 (1606)	24.1 (1464)	22.1 (1342)	20.3 (1230)	18.7 (1134)	17.3 (1052)	16.1 (977)	14.9 (908)	13.9 (845)	13.0 (789)	12.2 (739)
0	26.3 (1598)	24.0 (1457)	22.0 (1335)	20.2 (1224)	18.6 (1129)	17.2 (1047)	16.0 (972)	14.9 (903)	13.8 (840)	12.9 (785)	12.1 (735)
10	26.2 (1590)	23.9 (1450)	21.9 (1328)	20.1 (1218)	18.5 (1123)	17.1 (1041)	15.9 (967)	14.8 (898)	13.8 (836)	12.9 (780)	12.0 (731)
20	22.8 (1386)	20.8 (1263)	19.0 (1155)	17.4 (1057)	16.0 (972)	14.8 (899)	13.7 (833)	12.7 (771)	11.8 (715)	11.0 (666)	10.2 (621)
30	19.8 (1203)	18.0 (1094)	16.4 (998)	15.0 (911)	13.8 (835)	12.7 (770)	11.7 (711)	10.8 (655)	10.0 (605)	9.2 (560)	8.6 (520)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 141. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.6 % OR 281. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – VFS

ALTITUDE: 6000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	24.9 (1510)	22.7 (1376)	20.7 (1257)	19.0 (1155)	17.5 (1066)	16.2 (986)	15.0 (912)	14.0 (848)	13.0 (789)	12.1 (736)	11.3 (685)
-20	24.8 (1507)	22.6 (1373)	20.7 (1255)	19.0 (1152)	17.5 (1063)	16.2 (984)	15.0 (910)	13.9 (846)	13.0 (788)	12.1 (734)	11.3 (684)
-10	24.7 (1503)	22.5 (1369)	20.6 (1251)	18.9 (1150)	17.5 (1061)	16.2 (981)	15.0 (908)	13.9 (844)	12.9 (786)	12.1 (732)	11.2 (682)
0	24.6 (1496)	22.4 (1363)	20.5 (1246)	18.8 (1144)	17.4 (1056)	16.1 (977)	14.9 (904)	13.8 (840)	12.9 (782)	12.0 (729)	11.2 (679)
10	24.5 (1490)	22.3 (1357)	20.4 (1240)	18.8 (1139)	17.3 (1051)	16.0 (972)	14.8 (899)	13.8 (836)	12.8 (778)	11.9 (725)	11.1 (675)
20	21.3 (1296)	19.4 (1178)	17.7 (1075)	16.2 (986)	15.0 (908)	13.8 (838)	12.7 (773)	11.8 (716)	10.9 (665)	10.2 (617)	9.4 (572)
30	18.5 (1125)	16.8 (1020)	15.3 (927)	14.0 (848)	12.8 (778)	11.8 (715)	10.8 (657)	10.0 (606)	9.2 (560)	8.5 (517)	7.8 (476)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 139. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.3 % OR 259. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – VFS

ALTITUDE: 8000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	23.3 (1417)	21.2 (1289)	19.4 (1179)	17.8 (1084)	16.4 (995)	15.1 (919)	14.0 (851)	13.0 (790)	12.0 (732)	11.2 (680)	10.4 (633)
-20	23.3 (1415)	21.2 (1287)	19.4 (1177)	17.8 (1082)	16.4 (994)	15.1 (918)	14.0 (849)	13.0 (788)	12.0 (730)	11.2 (679)	10.4 (632)
-10	23.2 (1411)	21.1 (1284)	19.3 (1174)	17.8 (1079)	16.3 (991)	15.1 (916)	14.0 (847)	13.0 (787)	12.0 (728)	11.1 (677)	10.4 (630)
0	23.1 (1406)	21.1 (1279)	19.3 (1170)	17.7 (1075)	16.3 (988)	15.0 (912)	13.9 (844)	12.9 (783)	11.9 (725)	11.1 (674)	10.3 (627)
10	23.1 (1401)	21.0 (1274)	19.2 (1165)	17.6 (1071)	16.2 (984)	15.0 (908)	13.8 (841)	12.8 (780)	11.9 (722)	11.1 (671)	10.3 (624)
20	19.9 (1207)	18.0 (1096)	16.5 (1002)	15.1 (919)	13.9 (843)	12.8 (776)	11.8 (717)	10.9 (663)	10.1 (612)	9.3 (567)	8.7 (525)
30	17.2 (1046)	15.6 (947)	14.2 (863)	13.0 (789)	11.9 (720)	10.9 (660)	10.0 (607)	9.2 (559)	8.4 (512)	7.8 (472)	7.2 (434)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 141. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.1 % OR 249. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – VFS

ALTITUDE: 10000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	21.6 (1314)	19.7 (1197)	18.0 (1094)	16.5 (1002)	15.2 (921)	14.0 (851)	12.9 (784)	12.0 (726)	11.1 (673)	10.3 (624)	9.6 (581)
-20	21.6 (1312)	19.7 (1195)	18.0 (1092)	16.5 (999)	15.1 (919)	14.0 (849)	12.9 (782)	11.9 (724)	11.1 (671)	10.3 (623)	9.5 (579)
-10	21.5 (1308)	19.6 (1192)	17.9 (1089)	16.4 (997)	15.1 (917)	13.9 (847)	12.9 (781)	11.9 (723)	11.0 (669)	10.2 (621)	9.5 (578)
0	21.5 (1304)	19.6 (1188)	17.9 (1086)	16.4 (993)	15.0 (913)	13.9 (844)	12.8 (777)	11.9 (720)	11.0 (666)	10.2 (618)	9.5 (575)
10	21.4 (1300)	19.5 (1184)	17.8 (1082)	16.3 (990)	15.0 (910)	13.8 (841)	12.8 (774)	11.8 (717)	10.9 (664)	10.1 (616)	9.4 (572)
20	18.5 (1123)	16.8 (1021)	15.3 (931)	14.0 (851)	12.8 (780)	11.8 (719)	10.9 (660)	10.0 (609)	9.2 (561)	8.5 (518)	7.9 (479)
30	16.0 (970)	14.5 (880)	13.2 (799)	12.0 (727)	10.9 (664)	10.0 (609)	9.2 (556)	8.4 (510)	7.7 (467)	7.0 (428)	6.5 (393)
A-ICE CORRECTION: SUBTRACT 2.2 % OR 134. ft/NM											
CLB-2 CORRECTION: SUBTRACT 3.7 % OR 226. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – 250 KIAS

ALTITUDE: 0FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	23.9 (1452)	22.2 (1351)	20.8 (1263)	19.5 (1184)	18.3 (1113)	17.3 (1048)	16.3 (988)	15.4 (933)	14.5 (882)	13.8 (836)	13.1 (793)
-20	23.9 (1449)	22.2 (1348)	20.7 (1259)	19.4 (1181)	18.3 (1110)	17.2 (1045)	16.2 (985)	15.3 (930)	14.5 (880)	13.7 (834)	13.0 (790)
-10	23.8 (1443)	22.1 (1343)	20.7 (1255)	19.4 (1176)	18.2 (1106)	17.1 (1041)	16.2 (981)	15.3 (927)	14.4 (877)	13.7 (831)	13.0 (787)
0	23.6 (1433)	22.0 (1334)	20.5 (1246)	19.2 (1168)	18.1 (1099)	17.0 (1034)	16.0 (975)	15.2 (920)	14.3 (871)	13.6 (825)	12.9 (782)
10	23.4 (1424)	21.8 (1325)	20.4 (1238)	19.1 (1161)	18.0 (1091)	16.9 (1027)	15.9 (968)	15.1 (914)	14.2 (865)	13.5 (820)	12.8 (776)
20	20.0 (1216)	18.6 (1131)	17.4 (1056)	16.3 (990)	15.3 (930)	14.4 (874)	13.5 (822)	12.8 (775)	12.1 (732)	11.4 (693)	10.8 (655)
30	17.1 (1036)	15.9 (963)	14.8 (898)	13.8 (841)	13.0 (789)	12.2 (740)	11.4 (695)	10.8 (654)	10.1 (616)	9.6 (582)	9.0 (548)
A-ICE CORRECTION: SUBTRACT 2.4 % OR 143. ft/NM											
CLB-2 CORRECTION: SUBTRACT 5.3 % OR 319. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – 250 KIAS

ALTITUDE: 2000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	22.2 (1350)	20.7 (1257)	19.3 (1175)	18.1 (1102)	17.0 (1034)	16.0 (973)	15.1 (917)	14.3 (866)	13.5 (819)	12.7 (774)	12.1 (733)
-20	22.2 (1347)	20.7 (1254)	19.3 (1173)	18.1 (1100)	17.0 (1032)	16.0 (971)	15.1 (915)	14.2 (865)	13.5 (817)	12.7 (773)	12.0 (731)
-10	22.1 (1342)	20.6 (1250)	19.2 (1169)	18.1 (1096)	16.9 (1028)	15.9 (967)	15.0 (912)	14.2 (862)	13.4 (815)	12.7 (770)	12.0 (729)
0	22.0 (1334)	20.5 (1242)	19.1 (1162)	17.9 (1090)	16.8 (1022)	15.8 (961)	14.9 (906)	14.1 (856)	13.3 (809)	12.6 (765)	11.9 (724)
10	21.8 (1326)	20.3 (1235)	19.0 (1154)	17.8 (1083)	16.7 (1016)	15.7 (955)	14.8 (901)	14.0 (851)	13.2 (804)	12.5 (760)	11.8 (719)
20	18.6 (1132)	17.4 (1054)	16.2 (985)	15.2 (923)	14.2 (864)	13.4 (812)	12.6 (764)	11.9 (721)	11.2 (680)	10.6 (641)	10.0 (605)
30	15.9 (963)	14.7 (895)	13.8 (836)	12.9 (782)	12.0 (731)	11.3 (685)	10.6 (644)	10.0 (606)	9.4 (570)	8.8 (536)	8.3 (504)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 139. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.9 % OR 299. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – 250 KIAS

ALTITUDE: 4000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	20.7 (1255)	19.3 (1169)	18.0 (1093)	16.8 (1023)	15.8 (960)	14.9 (903)	14.0 (852)	13.2 (802)	12.5 (757)	11.8 (716)	11.2 (678)
-20	20.6 (1252)	19.2 (1167)	18.0 (1090)	16.8 (1020)	15.8 (958)	14.8 (901)	14.0 (850)	13.2 (801)	12.4 (756)	11.8 (715)	11.1 (677)
-10	20.5 (1248)	19.1 (1163)	17.9 (1087)	16.7 (1017)	15.7 (955)	14.8 (898)	14.0 (847)	13.1 (798)	12.4 (753)	11.7 (712)	11.1 (674)
0	20.4 (1241)	19.0 (1157)	17.8 (1081)	16.7 (1012)	15.6 (949)	14.7 (893)	13.9 (843)	13.1 (794)	12.3 (749)	11.7 (708)	11.0 (671)
10	20.3 (1234)	18.9 (1150)	17.7 (1075)	16.6 (1006)	15.5 (944)	14.6 (888)	13.8 (838)	13.0 (789)	12.3 (745)	11.6 (704)	11.0 (666)
20	17.4 (1054)	16.2 (982)	15.1 (916)	14.1 (856)	13.2 (803)	12.4 (754)	11.7 (710)	11.0 (667)	10.3 (628)	9.8 (592)	9.2 (560)
30	14.7 (892)	13.7 (830)	12.7 (774)	11.9 (722)	11.1 (675)	10.4 (633)	9.8 (595)	9.2 (557)	8.6 (523)	8.1 (492)	7.6 (463)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 141. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.6 % OR 281. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – 250 KIAS

ALTITUDE: 6000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	19.2 (1167)	17.9 (1087)	16.7 (1014)	15.6 (950)	14.7 (892)	13.8 (838)	13.0 (788)	12.2 (743)	11.6 (702)	10.9 (662)	10.3 (625)
-20	19.2 (1165)	17.9 (1085)	16.7 (1012)	15.6 (948)	14.7 (890)	13.8 (837)	13.0 (787)	12.2 (742)	11.5 (700)	10.9 (661)	10.3 (624)
-10	19.1 (1162)	17.8 (1082)	16.6 (1010)	15.6 (945)	14.6 (888)	13.7 (834)	12.9 (785)	12.2 (740)	11.5 (698)	10.9 (659)	10.3 (622)
0	19.0 (1157)	17.7 (1077)	16.5 (1005)	15.5 (941)	14.6 (884)	13.7 (830)	12.9 (781)	12.1 (736)	11.4 (695)	10.8 (656)	10.2 (619)
10	19.0 (1151)	17.6 (1072)	16.5 (1000)	15.4 (936)	14.5 (879)	13.6 (826)	12.8 (777)	12.1 (732)	11.4 (691)	10.7 (653)	10.1 (616)
20	16.2 (982)	15.0 (913)	14.0 (851)	13.1 (796)	12.3 (746)	11.5 (700)	10.8 (657)	10.2 (618)	9.6 (582)	9.0 (548)	8.5 (515)
30	13.6 (828)	12.7 (768)	11.8 (715)	11.0 (667)	10.3 (625)	9.6 (584)	9.0 (547)	8.4 (512)	7.9 (481)	7.4 (451)	7.0 (423)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 139. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.3 % OR 259. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – 250 KIAS

ALTITUDE: 8000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	17.8 (1083)	16.6 (1008)	15.5 (941)	14.5 (881)	13.6 (825)	12.8 (775)	12.0 (730)	11.3 (687)	10.7 (647)	10.1 (610)	9.5 (577)
-20	17.8 (1080)	16.5 (1005)	15.5 (938)	14.5 (879)	13.6 (823)	12.7 (773)	12.0 (728)	11.3 (685)	10.6 (645)	10.0 (609)	9.5 (575)
-10	17.7 (1077)	16.5 (1002)	15.4 (936)	14.4 (877)	13.5 (821)	12.7 (771)	12.0 (726)	11.3 (683)	10.6 (644)	10.0 (607)	9.4 (573)
0	17.7 (1073)	16.4 (998)	15.3 (932)	14.4 (873)	13.5 (817)	12.6 (768)	11.9 (722)	11.2 (680)	10.6 (641)	10.0 (604)	9.4 (571)
10	17.6 (1068)	16.4 (993)	15.3 (928)	14.3 (869)	13.4 (814)	12.6 (764)	11.8 (719)	11.2 (677)	10.5 (638)	9.9 (601)	9.4 (568)
20	15.0 (910)	13.9 (846)	13.0 (789)	12.1 (737)	11.4 (689)	10.6 (646)	10.0 (607)	9.4 (570)	8.8 (535)	8.3 (503)	7.8 (473)
30	12.6 (764)	11.7 (709)	10.9 (660)	10.1 (616)	9.5 (574)	8.8 (536)	8.3 (502)	7.7 (470)	7.2 (439)	6.8 (411)	6.4 (385)
A-ICE CORRECTION: SUBTRACT 2.3 % OR 141. ft/NM											
CLB-2 CORRECTION: SUBTRACT 4.1 % OR 249. ft/NM											

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CLIMB GRADIENT – ALL ENGINES OPERATING
CLIMB THRUST

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
CLB-1 MODE – 250 KIAS

ALTITUDE: 10000FT

Grad % (ft/NM)	WEIGHT (kg)										
ISA (°C)	32000	34000	36000	38000	40000	42000	44000	46000	48000	50000	52000
-30	16.6 (1006)	15.4 (936)	14.4 (873)	13.4 (816)	12.6 (765)	11.8 (719)	11.1 (675)	10.5 (635)	9.8 (598)	9.3 (563)	8.8 (531)
-20	16.5 (1003)	15.4 (934)	14.3 (871)	13.4 (814)	12.6 (763)	11.8 (717)	11.1 (673)	10.4 (633)	9.8 (596)	9.3 (562)	8.7 (530)
-10	16.5 (1000)	15.3 (931)	14.3 (869)	13.4 (812)	12.5 (761)	11.8 (715)	11.0 (671)	10.4 (631)	9.8 (595)	9.2 (560)	8.7 (528)
0	16.4 (996)	15.3 (927)	14.2 (865)	13.3 (808)	12.5 (757)	11.7 (711)	11.0 (668)	10.3 (628)	9.7 (592)	9.2 (557)	8.7 (526)
10	16.3 (991)	15.2 (923)	14.2 (861)	13.2 (805)	12.4 (754)	11.7 (708)	10.9 (665)	10.3 (625)	9.7 (589)	9.1 (555)	8.6 (523)
20	13.8 (840)	12.9 (781)	12.0 (727)	11.2 (679)	10.5 (635)	9.8 (595)	9.2 (557)	8.6 (522)	8.1 (490)	7.6 (460)	7.1 (432)
30	11.6 (702)	10.7 (652)	10.0 (606)	9.3 (564)	8.7 (526)	8.1 (491)	7.5 (458)	7.0 (428)	6.6 (400)	6.2 (374)	5.8 (349)
A-ICE CORRECTION: SUBTRACT 2.2 % OR 134. ft/NM											
CLB-2 CORRECTION: SUBTRACT 3.7 % OR 226. ft/NM											

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SUPPLEMENTARY TAKEOFF INFORMATION

TURN ANALYSIS

The method below presents the criteria for transforming a takeoff flight path with turns into an equivalent straight flight path. This allows the use of runway analysis software to determine obstacle clearance.

The method to be used herein converts an actual flight path with turns and wind effects into an equivalent straight flight path with still air.

This straight flight path will be determined in terms of increments on the height of the existing obstacle, and is taken into account to ensure obstacle clearance. The performance calculation must be made with the equivalent straight flight path, as per the AFM.

OPERATIONAL LIMITATIONS

Maximum bank angle:
- Both Engines Operative: 25° at V_2 + 10
- One Engine Inoperative: 15° at V_2
- One Engine Inoperative: 20° at V_2 + 5 (*)
- One Engine Inoperative: 25° at V_2 + 10 (*)

(*) According to FAR 121.189(f), the maximum bank angle with one engine inoperative is 15°.

According to JAR OPS 1.495 (c), for bank angles greater than 15°, the airplane's net path must clear all obstacles after the banked turn by 50 ft instead of 35 ft.

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EQUIVALENT STRAIGHT FLIGHT PATH DETERMINATION

The equivalent straight flight path (zero wind) to be used in the performance calculation should be determined as follows:

1 - OBSTACLE INCREMENT IN A STEADY TURN

During a steady turn, the climb gradient deteriorates. To compensate for this, an increment of the actual obstacle height must be obtained as a function of the gradient loss due to a steady turn and the turning distance flown to the obstacle:

$$\Delta H = D_T \times G_L$$

where:

ΔH = height increment.
D_T = distance flown along the turning flight.
G_L = gradient loss (obtained from the gradient loss due to a steady turn chart).

The equivalent obstacle height to be used in an obstacle clearance calculation is:

$$H_E = H_A + \Delta H_1 + \Delta H_2 + ...+ \Delta H_n$$

where:

H_E = equivalent obstacle height.
H_A = actual obstacle height.
$\Delta H_{1,2,n}$ = height increments for each distance portion flown in the turn to the obstacle.

2 - WIND EFFECT ON THE FLIGHT PATH

2.1 - STRAIGHT FLIGHT PORTIONS

Considering the drift compensation, the straight portions of the flight path may be corrected to a still air equivalent distance as follows:

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$$SAD = \frac{GD \times TAS}{GS}$$

where:

SAD = still air equivalent distance.
GD = actual ground distance.
TAS = airplane true airspeed (obtained from the radius of turns and speed conversion chart).
GS = airplane ground speed.

For straight flight:

$$GS = TAS + (V_w \times \cos\alpha)$$

where:

V_w = wind speed.
α = angle between flight direction and wind direction.
Remarks:
$V_w \times \cos\alpha$ is negative for a head wind component.
$V_w \times \cos\alpha$ is positive for a tailwind component.

2.2 - TURNING FLIGHT PORTIONS

Two effects must be taken into account:

2.2.1 - Distance Flown Compensation:

The wind takes the same effect as mentioned in item 2.1.

$$SAD = \frac{GD \times TAS}{GS}$$

For turning flight:

$$GS = \frac{Dm}{\Delta t}$$

where:

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Dm = distance flown along the actual trajectory.

Δt = elapsed time in turning flight.

2.2.2 - Trajectory Displacement:

The trajectory is displaced in the wind component direction proportionally to time.

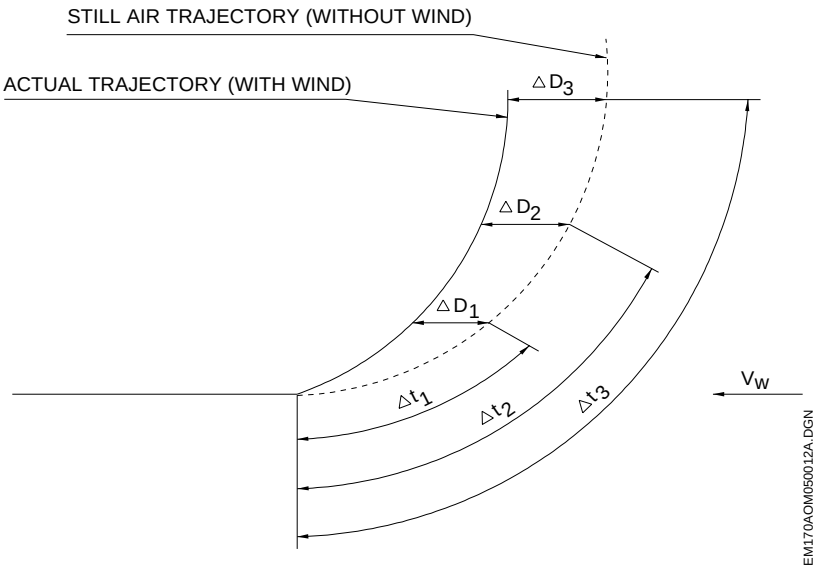
The displacement may be calculated by:

$\Delta D = \Delta t \times V_W$.

ΔD = trajectory displacement in the wind component direction.

Δt = elapsed time in turning flight (obtained from the Horizontal Distance and Time to Complete chart).

V_W = wind speed.



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PERFORMANCE CHARTS PRESENTATION

All necessary information is provided in the ECAFM.

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AIRCRAFT CLASSIFICATION NUMBER - ACN

The Pavement Classification Number (PCN) reported shall indicate that an airplane with ACN equal to or less than the reported PCN can operate on that pavement.

PCN - PAVEMENT CLASSIFICATION NUMBER

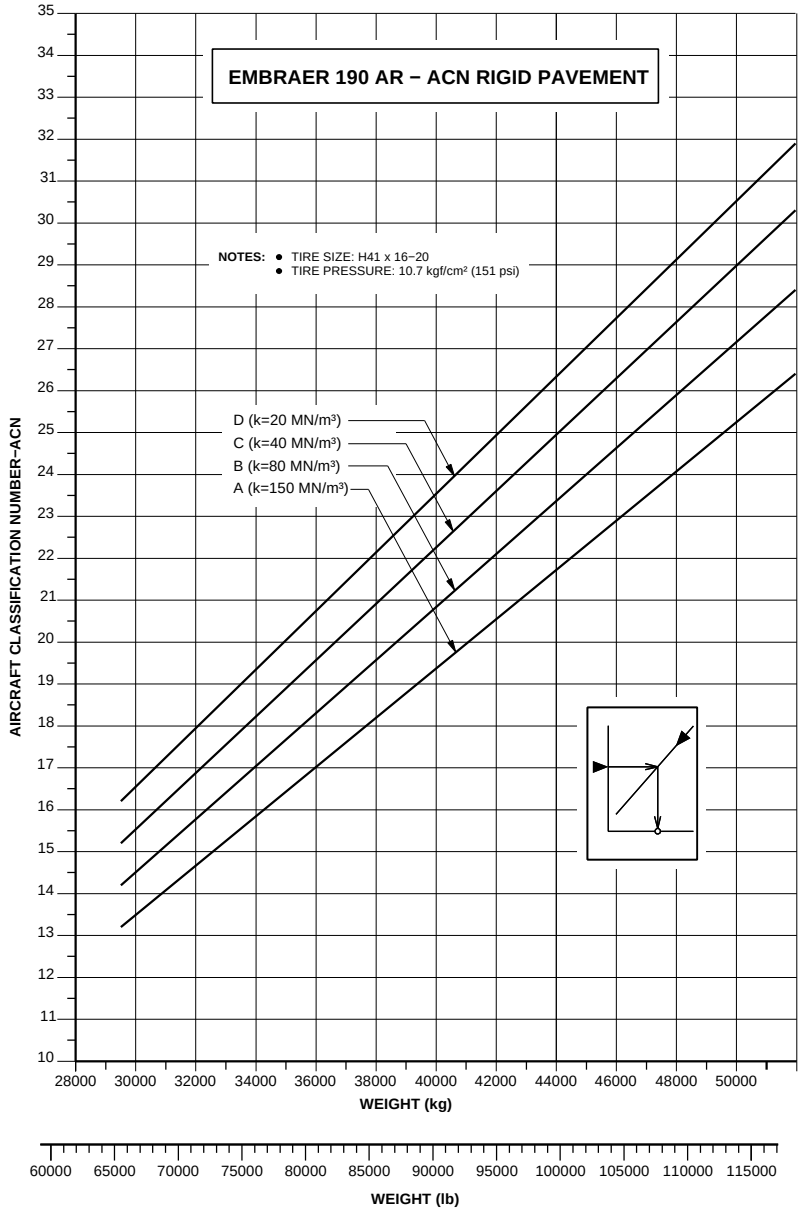
Example: PCN 50 / F / A / X / T
1 2 3 4

1) Type of pavement:
   R = Rigid (concrete);
   F = Flexible (asphalt);
2) Pavement sub-grade strength category:
   A = High,
   B = Medium,
   C = Low,
   D = Ultra-low.
3) Maximum tire pressure authorized for the pavement:
   W = High, no limit;
   X = Medium (up to 217 psi);
   Y = Low (up to 145 psi);
   Z = Very low (up to 73 psi).
4) Pavement evaluation method:
   T = Technical evaluation;
   U = By experience of airplane actually using the pavement.

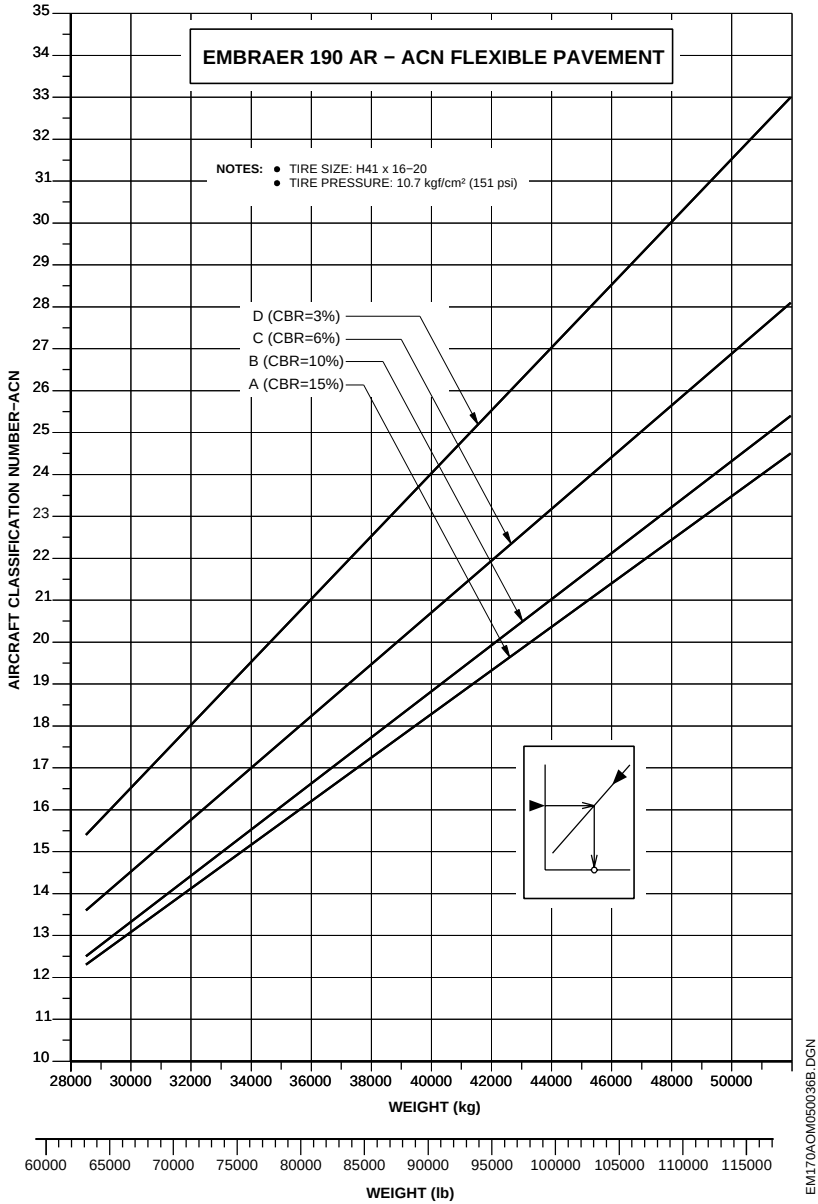
OVERLOAD OPERATIONS

Individual airport authorities are free to decide on their own criteria for permitting overload operations as long as pavements remain safe for use by airplane. However, a 10% difference in ACN over PCN for flexible pavement and 5% for rigid pavements is generally accepted, provided that overload operations do not exceed 5% of the annual departures and are spread throughout the year.

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APPROACH

APPROACH CLIMB SPEEDS

EMBRAER 190 – ANAC/FAA CERTIFICATION
CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

With or Without Ice Accretion

WEIGHT (kg)	FLAP 2 (KIAS)	FLAP 4 (KIAS)
28000	130	115
29000	132	117
30000	134	119
31000	137	121
32000	139	123
33000	141	125
34000	143	127
35000	145	128
36000	147	130
37000	149	132
38000	151	134
39000	153	136
40000	155	137
41000	157	139
42000	159	141
43000	161	142
44000	163	144
45000	165	146
46000	166	147
47000	168	149
48000	170	151
49000	172	152
50000	174	154
51000	175	155
52000	177	157

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LANDING CLIMB AND REFERENCE SPEEDS

EMBRAER 190 – ANAC/FAA CERTIFICATION
CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

No Ice Accretion

WEIGHT (kg)	FLAP 5 (KIAS)	FLAP FULL (KIAS)
28000	106	103
29000	108	103
30000	110	103
31000	111	105
32000	113	106
33000	115	108
34000	117	110
35000	118	111
36000	120	113
37000	122	114
38000	123	116
39000	125	117
40000	127	119
41000	128	120
42000	130	122
43000	131	123
44000	133	125
45000	134	126
46000	136	127
47000	137	129
48000	139	130
49000	140	132
50000	142	133
51000	143	134
52000	144	136

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LANDING CLIMB AND REFERENCE SPEEDS

EMBRAER 190 – ANAC/FAA CERTIFICATION
CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

With Ice Accretion

WEIGHT (kg)	FLAP 5 (KIAS)	FLAP FULL (KIAS)
28000	114	105
29000	116	107
30000	118	109
31000	120	111
32000	122	112
33000	124	114
34000	126	116
35000	127	118
36000	129	119
37000	131	121
38000	133	123
39000	135	124
40000	136	126
41000	138	127
42000	140	129
43000	141	130
44000	143	132
45000	145	134
46000	146	135
47000	148	136
48000	150	138
49000	151	139
50000	153	141
51000	154	142
52000	156	144

NOTE: The approach climb, landing climb and reference speeds for CAT II operation are equal to the speeds presented for Flaps 5 with ice accretion.

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FLAPS MANEUVERING SPEEDS

FLAP	SPEED (KIAS)
UP	210
1	180
2	160
3	150
4	140
5	140
FULL	130

These speeds allow an inadvertent 15 degrees overshoot beyond the normal 25 degrees bank and provide 1.3 g margin over stick shaker speed. They are valid for all weights up to the Maximum Structural Landing Weight.

The speeds above may be used as reference for flaps extension and maneuvering. For flaps retraction refer to the scheduled related on section 5-20 (Takeoff).

For weights above the Maximum Structural Landing Weight, the speeds above are maintained.

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APPROACH CLIMB GRADIENT TABLES

The Approach Climb Gradient tables show the gradients as function of temperature (°C) and weight (kg).

The associated conditions are:

– Approach Flaps: 2 or 4;

– Gear UP;

– Anti-Ice OFF, and Engine and Wing anti-ice ON;

– ECS OFF;

– One Engine Inoperative.

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS 5 - APPROACH CLIMB FLAPS 2 - ANAC/FAA CERTIFICATION

ALTITUDE: SL EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	16.35	14.40	12.58	11.16	9.92	8.82	7.83	6.95	6.16	5.44	4.79
2	16.34	14.39	12.56	11.15	9.90	8.80	7.82	6.94	6.15	5.43	4.78
4	16.32	14.37	12.55	11.13	9.89	8.79	7.81	6.93	6.14	5.42	4.77
6	16.30	14.35	12.53	11.12	9.88	8.78	7.80	6.92	6.13	5.41	4.76
8	16.27	14.33	12.51	11.10	9.86	8.76	7.78	6.90	6.11	5.39	4.74
10	16.25	14.31	12.49	11.08	9.84	8.74	7.76	6.88	6.09	5.38	4.73
12	16.22	14.28	12.47	11.06	9.82	8.72	7.74	6.87	6.08	5.36	4.71
14	16.20	14.26	12.45	11.04	9.80	8.70	7.73	6.85	6.06	5.35	4.70
16	16.17	14.24	12.42	11.02	9.78	8.68	7.71	6.83	6.05	5.33	4.69
18	16.15	14.21	12.40	11.00	9.76	8.67	7.69	6.82	6.03	5.32	4.67
20	16.12	14.19	12.38	10.98	9.74	8.65	7.67	6.80	6.02	5.31	4.66
22	16.10	14.17	12.36	10.96	9.72	8.63	7.66	6.78	6.00	5.29	4.64
24	16.07	14.14	12.34	10.94	9.70	8.61	7.64	6.77	5.98	5.28	4.63
26	16.05	14.12	12.32	10.92	9.68	8.59	7.62	6.75	5.97	5.26	4.62
28	16.02	14.10	12.30	10.90	9.66	8.57	7.60	6.74	5.95	5.25	4.60
30	16.00	14.08	12.28	10.88	9.64	8.55	7.59	6.72	5.94	5.23	4.59
32	15.93	14.01	12.22	10.83	9.61	8.52	7.56	6.69	5.91	5.21	4.57
34	15.86	13.95	12.16	10.78	9.56	8.48	7.52	6.66	5.88	5.18	4.54
36	15.55	13.67	11.90	10.54	9.34	8.28	7.33	6.48	5.71	5.02	4.39
38	15.00	13.16	11.44	10.11	8.94	7.91	6.98	6.16	5.41	4.74	4.12
40	14.46	12.66	10.98	9.68	8.54	7.54	6.64	5.83	5.11	4.45	3.85
42	14.02	12.27	10.61	9.34	8.22	7.24	6.36	5.57	4.86	4.21	3.62
44	13.60	11.87	10.24	9.00	7.90	6.94	6.08	5.30	4.60	3.97	3.39
46	13.19	11.50	9.90	8.67	7.60	6.65	5.80	5.04	4.35	3.73	3.16
48	12.82	11.15	9.57	8.36	7.30	6.36	5.53	4.78	4.10	3.49	2.93
50	12.44	10.80	9.24	8.05	7.01	6.08	5.26	4.52	3.85	3.25	2.70

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	16.29	14.35	12.52	11.11	9.87	8.77	7.79	6.91	6.12	5.40	4.75
-6	16.28	14.33	12.51	11.10	9.86	8.76	7.78	6.90	6.11	5.39	4.74
-4	16.26	14.32	12.50	11.09	9.85	8.75	7.77	6.89	6.10	5.39	4.73
-2	16.25	14.30	12.49	11.08	9.84	8.74	7.76	6.88	6.09	5.38	4.73
0	16.23	14.29	12.47	11.06	9.83	8.73	7.75	6.87	6.08	5.37	4.72
2	16.22	14.28	12.46	11.05	9.82	8.72	7.74	6.86	6.07	5.36	4.71
4	16.20	14.26	12.45	11.04	9.80	8.71	7.73	6.85	6.07	5.35	4.70
6	16.18	14.24	12.43	11.02	9.79	8.69	7.72	6.84	6.05	5.34	4.69
8	16.16	14.22	12.41	11.00	9.77	8.67	7.70	6.82	6.04	5.32	4.67
10	16.13	14.19	12.38	10.98	9.74	8.65	7.68	6.80	6.02	5.31	4.66

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS 5 - APPROACH CLIMB FLAPS 2 - ANAC/FAA CERTIFICATION

ALTITUDE: 1000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	15.67	13.79	12.02	10.64	9.44	8.37	7.43	6.58	5.81	5.12	4.49
2	15.66	13.77	12.00	10.63	9.42	8.36	7.42	6.57	5.81	5.11	4.48
4	15.64	13.75	11.99	10.62	9.41	8.34	7.40	6.56	5.79	5.10	4.47
6	15.62	13.73	11.97	10.60	9.39	8.33	7.39	6.54	5.78	5.09	4.46
8	15.59	13.71	11.95	10.58	9.38	8.32	7.37	6.53	5.77	5.07	4.44
10	15.57	13.69	11.93	10.56	9.36	8.30	7.36	6.51	5.75	5.06	4.43
12	15.54	13.67	11.91	10.55	9.35	8.29	7.35	6.50	5.74	5.05	4.42
14	15.52	13.64	11.89	10.53	9.33	8.27	7.33	6.49	5.72	5.03	4.41
16	15.50	13.62	11.87	10.51	9.32	8.26	7.32	6.47	5.71	5.02	4.39
18	15.47	13.60	11.85	10.49	9.30	8.24	7.30	6.46	5.70	5.01	4.38
20	15.45	13.58	11.83	10.47	9.28	8.23	7.29	6.44	5.68	4.99	4.37
22	15.42	13.56	11.81	10.45	9.26	8.21	7.27	6.43	5.67	4.98	4.36
24	15.40	13.54	11.79	10.43	9.25	8.19	7.25	6.41	5.65	4.97	4.34
26	15.38	13.51	11.77	10.41	9.23	8.18	7.24	6.40	5.64	4.95	4.33
28	15.35	13.49	11.74	10.40	9.21	8.16	7.22	6.38	5.63	4.94	4.32
30	15.33	13.47	11.72	10.38	9.19	8.14	7.21	6.37	5.61	4.93	4.30
32	15.31	13.45	11.70	10.36	9.17	8.13	7.19	6.35	5.60	4.91	4.29
34	15.04	13.20	11.48	10.15	8.98	7.94	7.02	6.19	5.44	4.77	4.15
36	14.51	12.72	11.03	9.73	8.59	7.58	6.68	5.87	5.14	4.48	3.87
38	13.99	12.24	10.59	9.32	8.21	7.22	6.34	5.55	4.84	4.19	3.61
40	13.56	11.84	10.22	8.98	7.89	6.92	6.06	5.29	4.59	3.96	3.38
42	13.13	11.45	9.86	8.64	7.57	6.62	5.78	5.03	4.34	3.72	3.15
44	12.73	11.08	9.51	8.31	7.26	6.33	5.51	4.77	4.09	3.48	2.93
46	12.35	10.72	9.18	8.00	6.97	6.05	5.24	4.51	3.85	3.25	2.70
48	11.97	10.37	8.85	7.69	6.67	5.77	4.97	4.25	3.60	3.01	2.48

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	15.62	13.73	11.97	10.60	9.40	8.34	7.39	6.55	5.78	5.09	4.46
-6	15.60	13.72	11.95	10.59	9.39	8.33	7.39	6.54	5.78	5.08	4.45
-4	15.59	13.71	11.94	10.58	9.38	8.32	7.38	6.53	5.77	5.07	4.44
-2	15.57	13.69	11.93	10.57	9.37	8.31	7.37	6.52	5.76	5.06	4.43
0	15.56	13.68	11.92	10.56	9.36	8.30	7.36	6.51	5.75	5.05	4.43
2	15.55	13.67	11.91	10.55	9.35	8.29	7.34	6.50	5.74	5.05	4.42
4	15.53	13.65	11.89	10.53	9.33	8.27	7.33	6.49	5.72	5.03	4.41
6	15.50	13.63	11.87	10.51	9.31	8.26	7.31	6.47	5.71	5.02	4.39
8	15.47	13.60	11.85	10.49	9.29	8.24	7.30	6.45	5.69	5.00	4.38
10	15.45	13.58	11.82	10.47	9.28	8.22	7.28	6.44	5.68	4.99	4.36

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS 5 - APPROACH CLIMB FLAPS 2 - ANAC/FAA CERTIFICATION

ALTITUDE: 2000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	15.05	13.22	11.50	10.16	8.98	7.94	7.02	6.19	5.45	4.77	4.16
2	15.03	13.20	11.48	10.15	8.97	7.93	7.01	6.18	5.44	4.76	4.15
4	15.01	13.18	11.47	10.13	8.96	7.92	7.00	6.17	5.43	4.75	4.14
6	14.99	13.17	11.45	10.12	8.94	7.90	6.98	6.16	5.42	4.74	4.13
8	14.98	13.15	11.43	10.10	8.93	7.89	6.97	6.15	5.41	4.73	4.12
10	14.96	13.13	11.41	10.08	8.91	7.88	6.96	6.14	5.39	4.72	4.11
12	14.94	13.11	11.40	10.07	8.90	7.87	6.95	6.13	5.38	4.71	4.10
14	14.92	13.09	11.38	10.05	8.88	7.85	6.94	6.11	5.37	4.70	4.09
16	14.90	13.07	11.36	10.04	8.87	7.84	6.92	6.10	5.36	4.69	4.08
18	14.88	13.05	11.34	10.02	8.86	7.83	6.91	6.09	5.35	4.68	4.07
20	14.86	13.04	11.32	10.00	8.84	7.81	6.90	6.08	5.34	4.67	4.06
22	14.84	13.02	11.31	9.99	8.83	7.80	6.88	6.06	5.33	4.66	4.05
24	14.81	13.00	11.29	9.97	8.81	7.78	6.87	6.05	5.31	4.65	4.04
26	14.79	12.98	11.27	9.95	8.80	7.77	6.86	6.04	5.30	4.63	4.03
28	14.77	12.96	11.25	9.94	8.78	7.76	6.84	6.03	5.29	4.62	4.02
30	14.76	12.95	11.24	9.93	8.77	7.75	6.84	6.02	5.28	4.62	4.01
32	14.52	12.72	11.04	9.74	8.59	7.58	6.68	5.87	5.14	4.48	3.88
34	14.02	12.27	10.62	9.34	8.22	7.23	6.35	5.56	4.85	4.21	3.62
36	13.52	11.81	10.19	8.95	7.86	6.89	6.03	5.26	4.56	3.93	3.36
38	13.11	11.43	9.84	8.62	7.55	6.60	5.75	5.00	4.32	3.70	3.14
40	12.70	11.05	9.48	8.29	7.24	6.31	5.48	4.74	4.07	3.47	2.92
42	12.28	10.67	9.13	7.96	6.93	6.02	5.21	4.48	3.82	3.23	2.70
44	11.87	10.29	8.78	7.63	6.62	5.73	4.93	4.22	3.58	3.00	2.47
46	11.46	9.91	8.42	7.30	6.31	5.44	4.66	3.96	3.33	2.76	2.24

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	15.01	13.18	11.46	10.13	8.96	7.92	7.00	6.17	5.43	4.75	4.14
-6	14.99	13.16	11.44	10.11	8.94	7.91	6.99	6.16	5.42	4.74	4.13
-4	14.98	13.15	11.42	10.09	8.93	7.89	6.97	6.15	5.40	4.73	4.12
-2	14.97	13.13	11.41	10.08	8.91	7.88	6.96	6.14	5.39	4.72	4.11
0	14.95	13.12	11.39	10.06	8.90	7.86	6.95	6.12	5.38	4.71	4.10
2	14.94	13.10	11.37	10.05	8.88	7.85	6.93	6.11	5.37	4.70	4.09
4	14.91	13.08	11.36	10.03	8.87	7.84	6.92	6.10	5.36	4.69	4.08
6	14.89	13.06	11.34	10.02	8.85	7.82	6.91	6.09	5.35	4.68	4.07
8	14.87	13.04	11.32	10.00	8.84	7.81	6.90	6.07	5.34	4.67	4.06
10	14.85	13.02	11.31	9.99	8.82	7.80	6.88	6.06	5.32	4.65	4.05

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS 5 - APPROACH CLIMB FLAPS 2 - ANAC/FAA CERTIFICATION

ALTITUDE: 3000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	14.51	12.71	11.03	9.73	8.59	7.58	6.68	5.87	5.14	4.49	3.89
2	14.49	12.70	11.01	9.71	8.57	7.56	6.66	5.86	5.13	4.48	3.88
4	14.47	12.68	11.00	9.70	8.56	7.55	6.65	5.85	5.12	4.47	3.87
6	14.45	12.66	10.98	9.69	8.55	7.54	6.64	5.83	5.11	4.46	3.86
8	14.43	12.65	10.96	9.67	8.53	7.53	6.63	5.82	5.10	4.45	3.85
10	14.42	12.63	10.95	9.66	8.52	7.51	6.62	5.81	5.09	4.44	3.84
12	14.40	12.61	10.93	9.64	8.51	7.50	6.60	5.80	5.08	4.42	3.83
14	14.38	12.60	10.92	9.63	8.49	7.49	6.59	5.79	5.07	4.41	3.82
16	14.36	12.58	10.90	9.61	8.48	7.47	6.58	5.78	5.06	4.40	3.81
18	14.34	12.56	10.88	9.60	8.46	7.46	6.57	5.77	5.04	4.39	3.80
20	14.32	12.54	10.87	9.58	8.45	7.45	6.55	5.75	5.03	4.38	3.79
22	14.30	12.53	10.85	9.56	8.43	7.43	6.54	5.74	5.02	4.37	3.78
24	14.28	12.51	10.83	9.55	8.42	7.42	6.53	5.73	5.01	4.36	3.77
26	14.26	12.49	10.82	9.53	8.41	7.41	6.52	5.72	5.00	4.35	3.76
28	14.25	12.47	10.80	9.52	8.39	7.39	6.51	5.71	4.99	4.34	3.74
30	14.02	12.27	10.61	9.34	8.22	7.24	6.36	5.57	4.86	4.21	3.63
32	13.55	11.84	10.21	8.97	7.88	6.91	6.05	5.27	4.58	3.95	3.37
34	13.08	11.41	9.82	8.60	7.53	6.58	5.74	4.98	4.30	3.68	3.12
36	12.67	11.02	9.46	8.27	7.22	6.29	5.47	4.73	4.06	3.45	2.90
38	12.26	10.65	9.11	7.94	6.92	6.01	5.20	4.47	3.82	3.22	2.68
40	11.85	10.27	8.76	7.62	6.61	5.72	4.93	4.21	3.57	2.99	2.46
42	11.44	9.89	8.41	7.29	6.31	5.43	4.66	3.96	3.33	2.76	2.25
44	11.03	9.51	8.06	6.96	6.00	5.15	4.39	3.70	3.09	2.53	2.03

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	14.48	12.69	11.00	9.70	8.56	7.55	6.65	5.85	5.12	4.47	3.87
-6	14.46	12.67	10.98	9.69	8.55	7.54	6.64	5.84	5.11	4.45	3.86
-4	14.44	12.65	10.96	9.67	8.53	7.52	6.63	5.82	5.10	4.44	3.85
-2	14.42	12.63	10.95	9.65	8.52	7.51	6.61	5.81	5.09	4.43	3.83
0	14.40	12.61	10.93	9.64	8.50	7.50	6.60	5.80	5.08	4.42	3.82
2	14.38	12.60	10.92	9.62	8.49	7.48	6.59	5.79	5.06	4.41	3.81
4	14.36	12.58	10.90	9.61	8.47	7.47	6.58	5.77	5.05	4.40	3.80
6	14.34	12.56	10.88	9.59	8.46	7.46	6.56	5.76	5.04	4.39	3.79
8	14.32	12.54	10.87	9.58	8.44	7.44	6.55	5.75	5.03	4.38	3.78
10	14.30	12.53	10.85	9.56	8.43	7.43	6.54	5.74	5.02	4.36	3.77

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS 5 - APPROACH CLIMB FLAPS 2 - ANAC/FAA CERTIFICATION

ALTITUDE: 4000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	13.98	12.23	10.57	9.31	8.20	7.21	6.34	5.55	4.84	4.20	3.62
2	13.96	12.21	10.56	9.29	8.18	7.20	6.32	5.54	4.83	4.19	3.61
4	13.94	12.19	10.54	9.28	8.17	7.18	6.31	5.52	4.82	4.18	3.59
6	13.92	12.17	10.52	9.26	8.15	7.17	6.30	5.51	4.81	4.17	3.58
8	13.90	12.15	10.51	9.25	8.14	7.16	6.28	5.50	4.79	4.15	3.57
10	13.88	12.13	10.49	9.23	8.12	7.14	6.27	5.49	4.78	4.14	3.56
12	13.86	12.12	10.47	9.21	8.11	7.13	6.26	5.47	4.77	4.13	3.55
14	13.84	12.10	10.46	9.20	8.09	7.11	6.24	5.46	4.76	4.12	3.54
16	13.82	12.08	10.44	9.18	8.08	7.10	6.23	5.45	4.75	4.11	3.53
18	13.80	12.06	10.42	9.17	8.06	7.09	6.22	5.44	4.74	4.10	3.52
20	13.78	12.04	10.41	9.15	8.05	7.07	6.20	5.43	4.72	4.09	3.51
22	13.76	12.03	10.39	9.14	8.03	7.06	6.19	5.41	4.71	4.08	3.50
24	13.74	12.01	10.37	9.12	8.02	7.05	6.18	5.40	4.70	4.07	3.49
26	13.72	11.99	10.36	9.11	8.01	7.03	6.17	5.39	4.69	4.05	3.48
28	13.52	11.80	10.18	8.94	7.85	6.89	6.03	5.26	4.56	3.93	3.36
30	13.08	11.40	9.81	8.59	7.52	6.58	5.74	4.98	4.30	3.69	3.13
32	12.64	10.99	9.43	8.24	7.20	6.27	5.45	4.71	4.04	3.44	2.89
34	12.23	10.62	9.08	7.92	6.90	5.99	5.18	4.46	3.80	3.21	2.67
36	11.82	10.24	8.74	7.60	6.59	5.71	4.91	4.20	3.56	2.98	2.45
38	11.41	9.87	8.39	7.27	6.29	5.42	4.65	3.95	3.33	2.76	2.24
40	11.01	9.49	8.04	6.95	5.99	5.14	4.38	3.70	3.09	2.53	2.03
42	10.60	9.12	7.70	6.63	5.69	4.86	4.12	3.45	2.85	2.31	1.82

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	13.93	12.18	10.53	9.27	8.16	7.18	6.30	5.52	4.81	4.17	3.59
-6	13.91	12.16	10.52	9.26	8.15	7.17	6.29	5.51	4.80	4.16	3.58
-4	13.89	12.15	10.50	9.24	8.13	7.15	6.28	5.49	4.79	4.15	3.57
-2	13.87	12.13	10.48	9.22	8.12	7.14	6.27	5.48	4.78	4.14	3.56
0	13.85	12.11	10.47	9.21	8.10	7.13	6.25	5.47	4.77	4.13	3.55
2	13.83	12.09	10.45	9.19	8.09	7.11	6.24	5.46	4.75	4.12	3.54
4	13.82	12.08	10.44	9.18	8.08	7.10	6.23	5.45	4.74	4.11	3.53
6	13.80	12.06	10.42	9.16	8.06	7.09	6.22	5.44	4.73	4.09	3.51
8	13.78	12.04	10.40	9.15	8.05	7.07	6.20	5.42	4.72	4.08	3.50
10	13.76	12.03	10.39	9.13	8.03	7.06	6.19	5.41	4.71	4.07	3.49

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS 5 - APPROACH CLIMB FLAPS 2 - ANAC/FAA CERTIFICATION

ALTITUDE: 5000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	13.41	11.71	10.10	8.87	7.79	6.83	5.98	5.21	4.53	3.90	3.33
2	13.39	11.69	10.08	8.85	7.77	6.82	5.97	5.20	4.51	3.89	3.32
4	13.38	11.68	10.07	8.84	7.76	6.80	5.95	5.19	4.50	3.88	3.31
6	13.36	11.66	10.05	8.82	7.75	6.79	5.94	5.18	4.49	3.87	3.30
8	13.34	11.64	10.03	8.81	7.73	6.78	5.93	5.17	4.48	3.86	3.29
10	13.32	11.63	10.02	8.79	7.72	6.77	5.92	5.15	4.47	3.85	3.28
12	13.30	11.61	10.00	8.78	7.70	6.75	5.90	5.14	4.46	3.84	3.27
14	13.29	11.59	9.99	8.76	7.69	6.74	5.89	5.13	4.45	3.82	3.26
16	13.27	11.57	9.97	8.75	7.68	6.73	5.88	5.12	4.43	3.81	3.25
18	13.25	11.56	9.96	8.74	7.66	6.71	5.87	5.11	4.42	3.80	3.24
20	13.23	11.54	9.94	8.72	7.65	6.70	5.85	5.09	4.41	3.79	3.23
22	13.21	11.52	9.92	8.71	7.64	6.69	5.84	5.08	4.40	3.78	3.22
24	13.20	11.51	9.91	8.69	7.62	6.67	5.83	5.07	4.39	3.77	3.21
26	13.01	11.33	9.75	8.54	7.48	6.54	5.70	4.95	4.27	3.66	3.10
28	12.60	10.96	9.40	8.22	7.17	6.25	5.43	4.69	4.03	3.43	2.88
30	12.20	10.59	9.06	7.90	6.87	5.96	5.16	4.44	3.79	3.20	2.66
32	11.79	10.22	8.72	7.57	6.57	5.68	4.89	4.18	3.54	2.97	2.44
34	11.39	9.85	8.37	7.25	6.27	5.39	4.62	3.93	3.30	2.74	2.22
36	10.99	9.48	8.03	6.93	5.97	5.12	4.36	3.68	3.07	2.51	2.01
38	10.59	9.11	7.69	6.62	5.68	4.84	4.11	3.44	2.84	2.30	1.81
40	10.19	8.74	7.35	6.30	5.39	4.57	3.85	3.20	2.62	2.09	1.61

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	13.37	11.67	10.06	8.83	7.75	6.80	5.95	5.18	4.50	3.88	3.32
-6	13.35	11.65	10.05	8.82	7.74	6.79	5.94	5.17	4.49	3.87	3.31
-4	13.33	11.64	10.03	8.80	7.73	6.77	5.92	5.16	4.48	3.86	3.30
-2	13.32	11.62	10.02	8.79	7.71	6.76	5.91	5.15	4.47	3.85	3.29
0	13.30	11.60	10.00	8.78	7.70	6.75	5.90	5.14	4.46	3.84	3.28
2	13.28	11.59	9.99	8.76	7.69	6.73	5.89	5.13	4.44	3.83	3.27
4	13.26	11.57	9.97	8.75	7.67	6.72	5.88	5.11	4.43	3.82	3.25
6	13.25	11.56	9.96	8.73	7.66	6.71	5.86	5.10	4.42	3.80	3.24
8	13.23	11.54	9.94	8.72	7.65	6.70	5.85	5.09	4.41	3.79	3.23
10	13.21	11.53	9.93	8.71	7.63	6.68	5.84	5.08	4.40	3.78	3.22

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS FULL - APPROACH CLIMB FLAPS 5 - ANAC/FAA CERTIFICATION

ALTITUDE: SL EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	15.36	13.38	11.50	10.07	8.82	7.70	6.70	5.81	5.00	4.27	3.60
2	15.34	13.36	11.49	10.06	8.80	7.69	6.69	5.80	4.99	4.26	3.59
4	15.33	13.35	11.47	10.05	8.79	7.68	6.68	5.79	4.98	4.25	3.58
6	15.31	13.33	11.45	10.03	8.78	7.66	6.67	5.77	4.97	4.24	3.57
8	15.28	13.30	11.43	10.01	8.76	7.64	6.65	5.76	4.95	4.22	3.56
10	15.25	13.28	11.41	9.99	8.74	7.63	6.63	5.74	4.94	4.21	3.54
12	15.23	13.25	11.39	9.97	8.72	7.61	6.62	5.73	4.92	4.19	3.53
14	15.20	13.23	11.36	9.95	8.70	7.59	6.60	5.71	4.91	4.18	3.51
16	15.17	13.20	11.34	9.93	8.68	7.57	6.58	5.70	4.89	4.16	3.50
18	15.14	13.18	11.32	9.91	8.66	7.56	6.57	5.68	4.88	4.15	3.48
20	15.12	13.15	11.30	9.89	8.65	7.54	6.55	5.66	4.86	4.13	3.47
22	15.09	13.13	11.27	9.87	8.63	7.52	6.54	5.65	4.85	4.12	3.46
24	15.06	13.10	11.25	9.84	8.61	7.50	6.52	5.63	4.83	4.10	3.44
26	15.04	13.08	11.23	9.82	8.59	7.49	6.50	5.62	4.82	4.09	3.43
28	15.01	13.05	11.21	9.80	8.57	7.47	6.49	5.60	4.80	4.07	3.41
30	14.98	13.03	11.18	9.78	8.55	7.45	6.47	5.59	4.79	4.06	3.40
32	14.94	12.99	11.14	9.73	8.50	7.40	6.42	5.55	4.75	4.03	3.37
34	14.88	12.93	11.08	9.68	8.45	7.35	6.38	5.50	4.71	3.99	3.34
36	14.57	12.65	10.82	9.43	8.21	7.14	6.17	5.31	4.53	3.82	3.18
38	14.01	12.14	10.35	8.99	7.80	6.75	5.81	4.97	4.21	3.52	2.89
40	13.46	11.63	9.87	8.55	7.39	6.37	5.45	4.63	3.89	3.21	2.60
42	13.02	11.22	9.50	8.21	7.07	6.06	5.16	4.35	3.63	2.97	2.36
44	12.58	10.82	9.13	7.86	6.74	5.76	4.87	4.08	3.37	2.72	2.13
46	12.17	10.44	8.78	7.53	6.44	5.47	4.60	3.82	3.12	2.48	1.90
48	11.78	10.08	8.45	7.23	6.15	5.20	4.34	3.58	2.88	2.25	1.68
50	11.40	9.73	8.12	6.92	5.87	4.93	4.09	3.33	2.65	2.03	1.46

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	15.30	13.32	11.45	10.02	8.77	7.66	6.66	5.77	4.96	4.23	3.56
-6	15.29	13.31	11.44	10.01	8.76	7.65	6.65	5.76	4.95	4.22	3.56
-4	15.27	13.30	11.42	10.00	8.75	7.64	6.64	5.75	4.94	4.21	3.55
-2	15.26	13.28	11.41	9.99	8.74	7.62	6.63	5.74	4.94	4.21	3.54
0	15.24	13.27	11.40	9.98	8.73	7.61	6.62	5.73	4.93	4.20	3.53
2	15.23	13.25	11.38	9.96	8.71	7.60	6.61	5.72	4.92	4.19	3.52
4	15.21	13.24	11.37	9.95	8.70	7.59	6.60	5.71	4.91	4.18	3.52
6	15.19	13.22	11.35	9.94	8.69	7.58	6.59	5.70	4.90	4.17	3.50
8	15.16	13.20	11.33	9.91	8.67	7.56	6.57	5.68	4.88	4.15	3.49
10	15.14	13.17	11.31	9.89	8.65	7.54	6.55	5.66	4.86	4.14	3.47

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS FULL - APPROACH CLIMB FLAPS 5 - ANAC/FAA CERTIFICATION

ALTITUDE: 1000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	14.68	12.75	10.92	9.53	8.31	7.23	6.27	5.40	4.61	3.90	3.25
2	14.67	12.74	10.91	9.52	8.30	7.22	6.26	5.39	4.60	3.89	3.24
4	14.65	12.72	10.89	9.50	8.28	7.21	6.24	5.38	4.59	3.88	3.23
6	14.62	12.70	10.87	9.48	8.27	7.19	6.23	5.36	4.58	3.87	3.22
8	14.60	12.68	10.85	9.47	8.25	7.17	6.21	5.35	4.57	3.86	3.21
10	14.58	12.65	10.83	9.45	8.23	7.16	6.20	5.33	4.55	3.85	3.20
12	14.55	12.63	10.81	9.43	8.21	7.14	6.18	5.32	4.54	3.83	3.19
14	14.53	12.61	10.79	9.41	8.19	7.12	6.16	5.30	4.53	3.82	3.18
16	14.51	12.59	10.77	9.39	8.18	7.11	6.15	5.29	4.51	3.81	3.17
18	14.48	12.57	10.75	9.37	8.16	7.09	6.13	5.27	4.50	3.80	3.16
20	14.46	12.55	10.73	9.35	8.14	7.07	6.12	5.26	4.49	3.78	3.14
22	14.44	12.52	10.71	9.33	8.12	7.06	6.10	5.24	4.47	3.77	3.13
24	14.41	12.50	10.69	9.31	8.11	7.04	6.09	5.23	4.46	3.76	3.12
26	14.39	12.48	10.67	9.30	8.09	7.02	6.07	5.22	4.44	3.74	3.10
28	14.37	12.46	10.65	9.28	8.07	7.01	6.05	5.20	4.43	3.73	3.09
30	14.34	12.44	10.63	9.26	8.05	6.99	6.04	5.19	4.41	3.71	3.08
32	14.32	12.42	10.61	9.24	8.03	6.97	6.02	5.17	4.40	3.70	3.06
34	14.05	12.17	10.38	9.02	7.83	6.78	5.84	5.00	4.24	3.55	2.92
36	13.52	11.68	9.92	8.60	7.44	6.41	5.50	4.67	3.93	3.25	2.64
38	12.99	11.19	9.47	8.18	7.04	6.04	5.15	4.34	3.62	2.96	2.35
40	12.55	10.79	9.10	7.83	6.72	5.74	4.86	4.07	3.36	2.71	2.12
42	12.11	10.39	8.73	7.49	6.40	5.43	4.57	3.80	3.10	2.46	1.89
44	11.70	10.01	8.38	7.16	6.09	5.14	4.30	3.54	2.85	2.23	1.66
46	11.31	9.65	8.05	6.85	5.80	4.87	4.04	3.29	2.61	2.00	1.44
48	10.92	9.29	7.72	6.55	5.52	4.60	3.77	3.04	2.37	1.77	1.22

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	14.62	12.70	10.87	9.48	8.26	7.19	6.23	5.36	4.58	3.87	3.23
-6	14.61	12.69	10.86	9.47	8.25	7.18	6.22	5.35	4.57	3.86	3.22
-4	14.60	12.67	10.85	9.46	8.24	7.17	6.21	5.34	4.56	3.86	3.21
-2	14.58	12.66	10.83	9.45	8.23	7.16	6.20	5.34	4.56	3.85	3.20
0	14.57	12.65	10.82	9.44	8.22	7.15	6.19	5.33	4.55	3.84	3.20
2	14.56	12.64	10.81	9.43	8.21	7.14	6.18	5.32	4.54	3.83	3.19
4	14.54	12.62	10.79	9.41	8.20	7.12	6.17	5.31	4.53	3.82	3.18
6	14.51	12.59	10.77	9.39	8.18	7.11	6.15	5.29	4.51	3.81	3.16
8	14.48	12.57	10.75	9.37	8.16	7.09	6.13	5.27	4.50	3.79	3.15
10	14.46	12.55	10.73	9.35	8.14	7.07	6.12	5.26	4.48	3.78	3.14

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS FULL - APPROACH CLIMB FLAPS 5 - ANAC/FAA CERTIFICATION

ALTITUDE: 2000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	14.05	12.17	10.38	9.03	7.84	6.79	5.86	5.02	4.25	3.56	2.92
2	14.03	12.15	10.36	9.02	7.83	6.78	5.85	5.01	4.24	3.54	2.91
4	14.01	12.13	10.35	9.00	7.81	6.77	5.84	4.99	4.23	3.53	2.90
6	13.99	12.12	10.33	8.99	7.80	6.76	5.82	4.98	4.22	3.52	2.89
8	13.97	12.10	10.32	8.97	7.79	6.74	5.81	4.97	4.20	3.51	2.88
10	13.96	12.08	10.30	8.96	7.77	6.73	5.80	4.96	4.19	3.50	2.87
12	13.94	12.07	10.29	8.94	7.76	6.72	5.78	4.94	4.18	3.49	2.86
14	13.92	12.05	10.27	8.93	7.75	6.70	5.77	4.93	4.17	3.48	2.85
16	13.90	12.03	10.25	8.91	7.73	6.69	5.75	4.92	4.16	3.47	2.84
18	13.88	12.01	10.23	8.89	7.71	6.67	5.74	4.90	4.15	3.46	2.83
20	13.86	11.99	10.22	8.88	7.70	6.66	5.73	4.89	4.13	3.45	2.82
22	13.83	11.97	10.20	8.86	7.68	6.64	5.71	4.88	4.12	3.44	2.81
24	13.81	11.95	10.18	8.84	7.67	6.63	5.70	4.86	4.11	3.42	2.80
26	13.79	11.94	10.16	8.83	7.65	6.61	5.69	4.85	4.10	3.41	2.79
28	13.77	11.92	10.15	8.81	7.64	6.60	5.67	4.84	4.08	3.40	2.78
30	13.76	11.90	10.13	8.80	7.63	6.59	5.66	4.83	4.08	3.39	2.77
32	13.51	11.68	9.92	8.60	7.44	6.42	5.50	4.68	3.93	3.26	2.64
34	13.01	11.21	9.50	8.20	7.07	6.07	5.17	4.36	3.63	2.97	2.37
36	12.51	10.75	9.07	7.81	6.70	5.71	4.84	4.05	3.34	2.69	2.10
38	12.09	10.37	8.71	7.47	6.38	5.42	4.56	3.78	3.08	2.45	1.87
40	11.67	9.98	8.35	7.14	6.07	5.12	4.28	3.52	2.83	2.21	1.64
42	11.25	9.60	8.00	6.81	5.76	4.83	4.00	3.26	2.58	1.97	1.41
44	10.84	9.21	7.64	6.47	5.45	4.53	3.72	2.99	2.33	1.73	1.19
46	10.42	8.83	7.28	6.14	5.13	4.24	3.44	2.73	2.08	1.49	0.96

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	14.01	12.13	10.35	9.00	7.81	6.76	5.83	4.99	4.22	3.53	2.90
-6	14.00	12.12	10.34	8.99	7.80	6.75	5.82	4.97	4.21	3.52	2.89
-4	13.98	12.11	10.32	8.98	7.79	6.74	5.80	4.96	4.20	3.51	2.88
-2	13.96	12.09	10.31	8.97	7.78	6.73	5.79	4.95	4.19	3.50	2.87
0	13.95	12.08	10.30	8.95	7.77	6.72	5.78	4.94	4.18	3.49	2.86
2	13.93	12.07	10.29	8.94	7.76	6.71	5.77	4.92	4.17	3.48	2.85
4	13.91	12.05	10.27	8.92	7.74	6.69	5.75	4.91	4.15	3.47	2.84
6	13.89	12.03	10.25	8.91	7.73	6.68	5.74	4.90	4.14	3.46	2.83
8	13.87	12.01	10.23	8.89	7.71	6.66	5.73	4.89	4.13	3.44	2.82
10	13.85	11.99	10.21	8.87	7.69	6.65	5.71	4.88	4.12	3.43	2.81

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS FULL - APPROACH CLIMB FLAPS 5 - ANAC/FAA CERTIFICATION

ALTITUDE: 3000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	13.50	11.67	9.92	8.60	7.44	6.41	5.49	4.67	3.93	3.25	2.64
2	13.48	11.65	9.90	8.58	7.42	6.40	5.48	4.66	3.92	3.24	2.63
4	13.46	11.63	9.88	8.57	7.41	6.39	5.47	4.65	3.91	3.23	2.62
6	13.44	11.62	9.87	8.55	7.40	6.37	5.46	4.64	3.90	3.22	2.61
8	13.43	11.60	9.85	8.54	7.38	6.36	5.45	4.63	3.88	3.21	2.60
10	13.41	11.58	9.84	8.53	7.37	6.35	5.43	4.61	3.87	3.20	2.59
12	13.39	11.57	9.82	8.51	7.36	6.34	5.42	4.60	3.86	3.19	2.58
14	13.37	11.55	9.81	8.50	7.34	6.32	5.41	4.59	3.85	3.18	2.57
16	13.35	11.53	9.79	8.48	7.33	6.31	5.40	4.58	3.84	3.17	2.56
18	13.33	11.51	9.77	8.46	7.31	6.29	5.38	4.57	3.83	3.16	2.55
20	13.31	11.49	9.76	8.45	7.30	6.28	5.37	4.55	3.82	3.15	2.54
22	13.29	11.47	9.74	8.43	7.29	6.27	5.36	4.54	3.80	3.14	2.53
24	13.27	11.45	9.72	8.42	7.27	6.25	5.34	4.53	3.79	3.13	2.52
26	13.25	11.44	9.70	8.40	7.26	6.24	5.33	4.52	3.78	3.12	2.51
28	13.24	11.42	9.69	8.39	7.24	6.23	5.32	4.51	3.77	3.10	2.50
30	13.01	11.21	9.50	8.21	7.07	6.07	5.17	4.36	3.64	2.98	2.37
32	12.53	10.78	9.09	7.83	6.72	5.74	4.86	4.07	3.35	2.71	2.12
34	12.06	10.34	8.69	7.45	6.37	5.40	4.54	3.77	3.07	2.44	1.86
36	11.64	9.95	8.33	7.12	6.05	5.11	4.27	3.51	2.82	2.20	1.64
38	11.22	9.57	7.97	6.78	5.74	4.81	3.99	3.24	2.57	1.96	1.41
40	10.81	9.19	7.62	6.45	5.43	4.52	3.71	2.98	2.32	1.73	1.18
42	10.39	8.80	7.26	6.12	5.12	4.23	3.43	2.72	2.08	1.49	0.96
44	9.98	8.42	6.91	5.79	4.81	3.93	3.16	2.46	1.83	1.25	0.73

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	13.47	11.64	9.89	8.57	7.41	6.39	5.47	4.65	3.91	3.23	2.62
-6	13.45	11.62	9.87	8.56	7.40	6.37	5.46	4.64	3.89	3.22	2.61
-4	13.43	11.60	9.86	8.54	7.39	6.36	5.45	4.62	3.88	3.21	2.60
-2	13.42	11.58	9.84	8.53	7.37	6.35	5.43	4.61	3.87	3.20	2.59
0	13.40	11.57	9.82	8.51	7.36	6.33	5.42	4.60	3.86	3.19	2.58
2	13.38	11.55	9.81	8.50	7.34	6.32	5.41	4.59	3.85	3.18	2.57
4	13.36	11.53	9.79	8.48	7.33	6.31	5.39	4.58	3.84	3.17	2.56
6	13.34	11.51	9.77	8.46	7.31	6.29	5.38	4.56	3.82	3.15	2.54
8	13.32	11.49	9.76	8.45	7.30	6.28	5.37	4.55	3.81	3.14	2.53
10	13.30	11.48	9.74	8.43	7.28	6.27	5.36	4.54	3.80	3.13	2.52

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS FULL - APPROACH CLIMB FLAPS 5 - ANAC/FAA CERTIFICATION

ALTITUDE: 4000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	12.96	11.17	9.46	8.17	7.04	6.04	5.14	4.34	3.61	2.96	2.36
2	12.94	11.15	9.44	8.16	7.02	6.02	5.13	4.33	3.60	2.94	2.35
4	12.92	11.13	9.42	8.14	7.01	6.01	5.12	4.31	3.59	2.93	2.33
6	12.90	11.11	9.41	8.12	6.99	6.00	5.10	4.30	3.58	2.92	2.32
8	12.88	11.09	9.39	8.11	6.98	5.98	5.09	4.29	3.57	2.91	2.31
10	12.86	11.08	9.37	8.09	6.97	5.97	5.08	4.28	3.55	2.90	2.30
12	12.84	11.06	9.35	8.08	6.95	5.95	5.06	4.26	3.54	2.89	2.29
14	12.82	11.04	9.34	8.06	6.94	5.94	5.05	4.25	3.53	2.88	2.28
16	12.80	11.02	9.32	8.04	6.92	5.93	5.04	4.24	3.52	2.87	2.27
18	12.78	11.00	9.30	8.03	6.91	5.91	5.02	4.23	3.51	2.85	2.26
20	12.76	10.98	9.29	8.01	6.89	5.90	5.01	4.21	3.50	2.84	2.25
22	12.74	10.97	9.27	8.00	6.88	5.88	5.00	4.20	3.48	2.83	2.24
24	12.72	10.95	9.25	7.98	6.86	5.87	4.99	4.19	3.47	2.82	2.23
26	12.70	10.93	9.24	7.97	6.85	5.86	4.97	4.18	3.46	2.81	2.22
28	12.49	10.74	9.06	7.80	6.69	5.71	4.83	4.05	3.34	2.69	2.10
30	12.05	10.33	8.68	7.45	6.36	5.40	4.54	3.77	3.07	2.44	1.86
32	11.60	9.92	8.30	7.09	6.03	5.09	4.25	3.49	2.81	2.19	1.62
34	11.19	9.54	7.94	6.76	5.72	4.80	3.97	3.23	2.56	1.95	1.40
36	10.78	9.16	7.59	6.43	5.41	4.50	3.70	2.97	2.31	1.72	1.18
38	10.36	8.78	7.24	6.10	5.10	4.21	3.42	2.71	2.07	1.48	0.95
40	9.95	8.40	6.89	5.77	4.79	3.92	3.15	2.45	1.82	1.25	0.73
42	9.54	8.02	6.53	5.44	4.48	3.63	2.87	2.19	1.58	1.02	0.51

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	12.92	11.13	9.42	8.13	7.00	6.00	5.11	4.31	3.58	2.93	2.33
-6	12.90	11.11	9.40	8.12	6.99	5.99	5.10	4.29	3.57	2.92	2.32
-4	12.88	11.09	9.38	8.10	6.97	5.98	5.08	4.28	3.56	2.91	2.31
-2	12.87	11.08	9.37	8.09	6.96	5.96	5.07	4.27	3.55	2.89	2.30
0	12.85	11.06	9.35	8.07	6.95	5.95	5.06	4.26	3.54	2.88	2.29
2	12.83	11.04	9.34	8.06	6.93	5.94	5.05	4.25	3.53	2.87	2.28
4	12.81	11.03	9.32	8.04	6.92	5.92	5.03	4.23	3.52	2.86	2.27
6	12.79	11.01	9.31	8.03	6.91	5.91	5.02	4.22	3.50	2.85	2.26
8	12.77	10.99	9.29	8.01	6.89	5.90	5.01	4.21	3.49	2.84	2.25
10	12.75	10.98	9.28	8.00	6.88	5.88	5.00	4.20	3.48	2.83	2.24

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APPROACH CLIMB GRADIENT (%)

LANDING FLAPS FULL - APPROACH CLIMB FLAPS 5 - ANAC/FAA CERTIFICATION

ALTITUDE: 5000 ft EMBRAER 190 – CF34-10E6 & CF34-10E6A1 ENGINES

ANTI-ICE OFF

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
0	12.38	10.64	8.97	7.72	6.62	5.64	4.77	3.99	3.28	2.64	2.06
2	12.37	10.62	8.95	7.70	6.60	5.63	4.76	3.98	3.27	2.63	2.05
4	12.35	10.61	8.94	7.69	6.59	5.62	4.75	3.96	3.26	2.62	2.04
6	12.33	10.59	8.92	7.68	6.58	5.60	4.73	3.95	3.25	2.61	2.03
8	12.31	10.57	8.91	7.66	6.56	5.59	4.72	3.94	3.24	2.60	2.02
10	12.29	10.56	8.89	7.65	6.55	5.58	4.71	3.93	3.23	2.59	2.01
12	12.27	10.54	8.88	7.63	6.54	5.56	4.70	3.92	3.22	2.58	2.00
14	12.26	10.52	8.86	7.62	6.52	5.55	4.68	3.91	3.21	2.57	1.99
16	12.24	10.51	8.85	7.60	6.51	5.54	4.67	3.89	3.19	2.56	1.98
18	12.22	10.49	8.83	7.59	6.50	5.53	4.66	3.88	3.18	2.55	1.97
20	12.20	10.47	8.81	7.57	6.48	5.51	4.65	3.87	3.17	2.54	1.96
22	12.18	10.46	8.80	7.56	6.47	5.50	4.64	3.86	3.16	2.53	1.95
24	12.17	10.45	8.79	7.55	6.46	5.49	4.62	3.85	3.15	2.52	1.94
26	11.98	10.27	8.62	7.39	6.31	5.35	4.50	3.73	3.04	2.41	1.83
28	11.56	9.89	8.27	7.07	6.00	5.06	4.23	3.47	2.79	2.17	1.61
30	11.15	9.51	7.92	6.74	5.70	4.78	3.95	3.21	2.54	1.94	1.38
32	10.74	9.13	7.56	6.41	5.39	4.49	3.68	2.96	2.30	1.70	1.16
34	10.33	8.75	7.21	6.08	5.09	4.20	3.41	2.70	2.05	1.47	0.93
36	9.92	8.37	6.86	5.76	4.78	3.91	3.14	2.44	1.81	1.24	0.72
38	9.51	7.99	6.51	5.43	4.47	3.63	2.87	2.19	1.57	1.01	0.50
40	9.11	7.61	6.16	5.10	4.17	3.34	2.60	1.93	1.33	0.78	0.29

ENGINE & WING A/I ON

SAT	WEIGHT (kg)										
(°C)	28000	30000	32000	34000	36000	38000	40000	42000	44000	46000	48000
-8	12.34	10.60	8.93	7.68	6.58	5.61	4.74	3.96	3.25	2.62	2.03
-6	12.32	10.59	8.92	7.67	6.57	5.60	4.73	3.95	3.24	2.61	2.02
-4	12.31	10.57	8.90	7.66	6.56	5.58	4.72	3.94	3.23	2.60	2.02
-2	12.29	10.56	8.89	7.64	6.54	5.57	4.70	3.93	3.22	2.59	2.01
0	12.27	10.54	8.88	7.63	6.53	5.56	4.69	3.91	3.21	2.58	2.00
2	12.26	10.53	8.86	7.62	6.52	5.55	4.68	3.90	3.20	2.57	1.99
4	12.24	10.51	8.85	7.60	6.51	5.54	4.67	3.89	3.19	2.56	1.98
6	12.22	10.49	8.83	7.59	6.49	5.52	4.66	3.88	3.18	2.55	1.97
8	12.21	10.48	8.82	7.57	6.48	5.51	4.65	3.87	3.17	2.54	1.96
10	12.19	10.46	8.80	7.56	6.47	5.50	4.64	3.86	3.16	2.53	1.95

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UNFACTORED LANDING DISTANCE

Unfactored landing distance is the actual distance to land the airplane on a zero slope, ISA temperature, dry runway, from a point 50 ft above runway threshold at V_{ref}, using only the brakes and spoilers as deceleration devices (i.e., no engine reverse thrust is used).

NORMAL OPERATION

The required landing distance for dispatch is the unfactored landing distance increased by 66.7% for dry runway, or 91.7% for wet runway.

For obtaining the DRY runway factored distance, multiply unfactored landing distance by 1.667.

For obtaining the WET runway factored distance, multiply unfactored landing distance by 1.917.

EMERGENCY/ABNORMAL OPERATION

For each Emergency/Abnormal or Flaps/Slat Fail Condition, the Actual Landing Distance is the Unfactored Landing Distance for flaps FULL multiplied by the associated landing distance correction factor for DRY or WET runways.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS 5 – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – NO ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2691	2262	2126	1994	2741	2309	2172	2039
34000	2853	2413	2274	2139	2907	2464	2323	2187
37000	3014	2564	2421	2282	3072	2618	2474	2334
40000	3169	2709	2563	2421	3231	2767	2620	2476
43000	3325	2855	2706	2561	3391	2917	2766	2619
46000	3481	3002	2849	2701	3551	3067	2913	2763
49000	3634	3146	2990	2838	3707	3214	3057	2904
52000	3785	3286	3127	2972	3872	3358	3198	3041

Weight (kg)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2793	2357	2219	2085	2848	2408	2269	2133
34000	2963	2516	2374	2237	3022	2571	2428	2289
37000	3132	2674	2529	2387	3195	2733	2586	2443
40000	3295	2827	2678	2533	3361	2889	2739	2593
43000	3458	2980	2828	2680	3529	3046	2893	2743
46000	3622	3134	2979	2827	3697	3204	3047	2894
49000	3782	3285	3126	2971	3861	3359	3198	3042
52000	3962	3432	3270	3112	4057	3510	3346	3187

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS 5 – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – NO ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2904	2461	2320	2183	2963	2515	2373	2235
34000	3083	2628	2483	2343	3145	2686	2540	2398
37000	3259	2793	2645	2501	3326	2856	2706	2560
40000	3430	2953	2802	2654	3501	3020	2867	2717
43000	3602	3115	2960	2808	3677	3185	3029	2876
46000	3774	3276	3118	2963	3853	3351	3191	3034
49000	3942	3435	3273	3115	4037	3514	3350	3190
52000	4156	3590	3425	3263	4259	3672	3506	3343

Weight (kg)	ALTITUDE							
	6000 ft				7000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3023	2571	2428	2288	3085	2629	2484	2343
34000	3210	2746	2599	2456	3277	2808	2660	2515
37000	3395	2920	2769	2622	3467	2987	2834	2686
40000	3575	3089	2934	2783	3651	3160	3004	2851
43000	3755	3258	3100	2945	3836	3334	3174	3018
46000	3936	3428	3266	3108	4021	3508	3345	3185
49000	4136	3595	3430	3268	4239	3679	3512	3349
52000	4367	3762	3589	3425	4479	3862	3676	3509

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS 5 – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – NO ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	8000 ft				9000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3149	2689	2543	2400	3215	2750	2603	2459
34000	3346	2873	2723	2576	3416	2939	2788	2640
37000	3540	3056	2902	2751	3616	3127	2971	2819
40000	3729	3233	3075	2921	3809	3309	3149	2993
43000	3918	3412	3250	3092	4004	3492	3328	3169
46000	4108	3590	3425	3264	4205	3675	3508	3345
49000	4346	3766	3597	3432	4457	3855	3685	3518
52000	4595	3966	3772	3597	4717	4075	3877	3687

Weight (kg)	ALTITUDE			
	10000 ft			
	WIND			
	-10 kt	0 kt	10 kt	20 kt
31000	3283	2814	2665	2519
34000	3489	3008	2854	2705
37000	3694	3200	3043	2889
40000	3893	3387	3226	3068
43000	4092	3575	3410	3248
46000	4312	3763	3594	3429
49000	4573	3954	3776	3607
52000	4844	4189	3986	3791

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS FULL – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – NO ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2491	2075	1944	1817	2531	2113	1981	1853
34000	2621	2198	2064	1934	2665	2239	2104	1973
37000	2748	2317	2180	2048	2795	2361	2223	2090
40000	2875	2437	2298	2163	2926	2484	2344	2208
43000	3001	2555	2413	2276	3054	2605	2462	2324
46000	3124	2671	2527	2387	3181	2724	2579	2437
49000	3251	2790	2643	2500	3310	2846	2698	2554
52000	3383	2914	2765	2620	3456	2982	2831	2684

Weight (kg)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2573	2152	2019	1890	2617	2194	2060	1930
34000	2710	2281	2145	2013	2758	2325	2189	2056
37000	2843	2406	2268	2133	2894	2454	2314	2179
40000	2977	2532	2391	2254	3032	2583	2441	2303
43000	3109	2656	2513	2373	3167	2711	2566	2425
46000	3239	2778	2632	2490	3300	2836	2688	2545
49000	3381	2912	2763	2617	3455	2981	2830	2683
52000	3530	3052	2899	2751	3608	3124	2971	2820

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS FULL – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – NO ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2663	2236	2101	1970	2710	2280	2144	2012
34000	2807	2371	2234	2100	2857	2419	2280	2145
37000	2947	2503	2362	2226	3001	2554	2412	2274
40000	3088	2636	2492	2353	3145	2690	2545	2405
43000	3227	2766	2620	2478	3288	2824	2677	2533
46000	3370	2902	2753	2607	3445	2971	2821	2674
49000	3531	3052	2900	2751	3610	3126	2972	2822
52000	3688	3200	3044	2892	3778	3278	3120	2967

Weight (kg)	ALTITUDE							
	6000 ft				7000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2758	2325	2188	2055	2808	2372	2234	2100
34000	2910	2468	2328	2192	2964	2518	2377	2240
37000	3057	2606	2463	2324	3115	2661	2517	2376
40000	3205	2746	2600	2458	3268	2804	2657	2514
43000	3357	2889	2740	2595	3433	2959	2809	2662
46000	3522	3044	2891	2743	3603	3119	2965	2814
49000	3692	3203	3047	2895	3777	3282	3125	2971
52000	3875	3358	3199	3044	3977	3442	3281	3124

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS FULL – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – NO ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	8000 ft				9000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2860	2421	2282	2146	2914	2471	2331	2194
34000	3020	2571	2429	2290	3077	2625	2481	2342
37000	3175	2717	2572	2430	3237	2775	2628	2486
40000	3333	2866	2717	2573	3409	2937	2786	2640
43000	3511	3032	2880	2732	3591	3108	2954	2804
46000	3685	3196	3040	2888	3770	3276	3118	2965
49000	3864	3364	3205	3049	3961	3449	3287	3130
52000	4082	3528	3366	3207	4192	3618	3453	3292

Weight (kg)	ALTITUDE			
	10000 ft			
	WIND			
	-10 kt	0 kt	10 kt	20 kt
31000	2969	2522	2381	2243
34000	3137	2681	2536	2395
37000	3301	2835	2687	2543
40000	3487	3010	2858	2710
43000	3675	3186	3030	2878
46000	3859	3359	3199	3044
49000	4066	3536	3373	3214
52000	4308	3713	3544	3381

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS 5 – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2948	2502	2361	2223	3004	2554	2412	2273
34000	3129	2672	2526	2385	3190	2728	2582	2439
37000	3306	2837	2689	2544	3371	2898	2748	2602
40000	3484	3005	2852	2704	3553	3070	2916	2766
43000	3657	3167	3011	2859	3730	3236	3079	2925
46000	3830	3330	3171	3015	3907	3403	3242	3085
49000	4011	3490	3328	3169	4104	3567	3403	3242
52000	4234	3650	3485	3322	4335	3736	3564	3400

Weight (kg)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3062	2609	2465	2325	3123	2666	2521	2379
34000	3252	2787	2639	2495	3318	2848	2699	2554
37000	3437	2961	2809	2661	3508	3026	2873	2724
40000	3624	3136	2981	2830	3699	3206	3050	2897
43000	3806	3307	3148	2993	3885	3381	3221	3064
46000	3987	3478	3316	3157	4071	3557	3393	3232
49000	4200	3646	3481	3318	4302	3729	3562	3398
52000	4440	3830	3646	3480	4551	3929	3737	3564

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS 5 – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3186	2724	2578	2435	3251	2785	2637	2493
34000	3385	2911	2761	2614	3455	2977	2825	2676
37000	3580	3094	2940	2789	3654	3164	3008	2856
40000	3776	3279	3120	2966	3855	3353	3193	3037
43000	3966	3458	3296	3137	4050	3537	3373	3213
46000	4163	3638	3472	3310	4264	3722	3554	3390
49000	4408	3815	3645	3480	4519	3907	3732	3565
52000	4667	4033	3837	3650	4788	4141	3941	3748

Weight (kg)	ALTITUDE							
	6000 ft				7000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3318	2848	2698	2553	3388	2913	2762	2615
34000	3527	3044	2891	2741	3602	3114	2959	2808
37000	3732	3236	3079	2925	3811	3311	3152	2996
40000	3938	3431	3269	3111	4023	3510	3347	3187
43000	4137	3619	3453	3292	4228	3704	3536	3373
46000	4369	3808	3639	3473	4479	3898	3727	3559
49000	4634	4010	3822	3652	4754	4118	3921	3743
52000	4914	4253	4049	3853	5046	4371	4163	3962

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS 5 – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	8000 ft				9000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3459	2980	2827	2678	3533	3048	2894	2744
34000	3679	3186	3029	2876	3758	3260	3102	2947
37000	3893	3388	3227	3070	3978	3468	3305	3146
40000	4110	3593	3428	3266	4200	3677	3511	3347
43000	4320	3791	3622	3456	4426	3881	3710	3543
46000	4593	3990	3817	3648	4712	4087	3911	3739
49000	4879	4230	4029	3836	5009	4347	4142	3944
52000	5183	4493	4280	4075	5327	4621	4404	4194

Weight (kg)	ALTITUDE			
	10000 ft			
	WIND			
	-10 kt	0 kt	10 kt	20 kt
31000	3608	3119	2964	2812
34000	3840	3337	3177	3021
37000	4065	3550	3386	3225
40000	4293	3765	3596	3431
43000	4538	3974	3801	3632
46000	4836	4199	4007	3834
49000	5146	4469	4260	4058
52000	5477	4755	4533	4318

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS FULL – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2642	2218	2083	1953	2686	2259	2124	1993
34000	2784	2351	2215	2081	2832	2396	2258	2124
37000	2923	2482	2342	2207	2974	2530	2389	2252
40000	3061	2612	2469	2330	3115	2663	2519	2380
43000	3199	2742	2597	2455	3258	2797	2650	2508
46000	3342	2876	2728	2584	3413	2942	2793	2647
49000	3496	3021	2869	2722	3571	3091	2938	2789
52000	3654	3169	3014	2863	3738	3243	3086	2934

Weight (kg)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2731	2301	2165	2033	2780	2346	2210	2076
34000	2881	2442	2303	2168	2933	2491	2351	2214
37000	3027	2580	2438	2300	3083	2632	2489	2349
40000	3172	2716	2571	2430	3231	2771	2626	2483
43000	3321	2856	2708	2565	3393	2924	2774	2629
46000	3486	3011	2860	2713	3563	3083	2930	2781
49000	3648	3163	3009	2858	3729	3239	3083	2930
52000	3830	3319	3161	3007	3926	3399	3239	3084

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS FULL – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2829	2393	2255	2120	2880	2440	2301	2166
34000	2986	2541	2400	2262	3041	2592	2450	2312
37000	3140	2685	2541	2401	3199	2741	2595	2454
40000	3292	2829	2682	2538	3364	2895	2747	2602
43000	3468	2993	2843	2695	3545	3066	2913	2764
46000	3642	3157	3002	2852	3724	3233	3077	2925
49000	3813	3317	3159	3005	3902	3398	3239	3083
52000	4027	3482	3320	3163	4132	3567	3404	3245

Weight (kg)	ALTITUDE							
	6000 ft				7000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	2933	2490	2350	2213	2988	2541	2400	2262
34000	3098	2646	2502	2363	3158	2701	2556	2415
37000	3260	2798	2652	2509	3327	2860	2712	2568
40000	3439	2966	2815	2669	3516	3038	2886	2738
43000	3625	3140	2986	2836	3708	3218	3062	2910
46000	3808	3313	3155	3001	3896	3395	3235	3079
49000	4003	3482	3321	3163	4108	3569	3406	3246
52000	4242	3656	3491	3329	4356	3758	3581	3417

NOTE: Landing distance in ft.

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UNFACTORED LANDING DISTANCE TABLE

FLAPS FULL – ISA CONDITIONS – ANAC/FAA CERTIFICATION
EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES
ANTI-ICE OFF – ICE ACCRETION – AUTO BRAKES OFF

Weight (kg)	ALTITUDE							
	8000 ft				9000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
31000	3044	2594	2452	2313	3102	2649	2505	2365
34000	3219	2759	2613	2470	3282	2818	2670	2527
37000	3402	2931	2781	2635	3479	3003	2852	2704
40000	3597	3113	2960	2810	3679	3191	3035	2884
43000	3793	3298	3140	2986	3881	3380	3221	3065
46000	3986	3480	3318	3161	4081	3568	3404	3245
49000	4217	3659	3494	3332	4331	3752	3585	3421
52000	4475	3865	3676	3508	4600	3977	3784	3602

Weight (kg)	ALTITUDE			
	10000 ft			
	WIND			
	-10 kt	0 kt	10 kt	20 kt
31000	3163	2705	2560	2419
34000	3352	2883	2735	2589
37000	3559	3078	2925	2775
40000	3765	3271	3114	2960
43000	3972	3466	3305	3147
46000	4190	3659	3493	3332
49000	4450	3849	3679	3513
52000	4731	4093	3896	3706

NOTE: Landing distance in ft.

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LANDING DISTANCE CORRECTION FACTOR

The Actual Landing Distance is equal to the Unfactored Landing Distance for flaps FULL multiplied by the associated landing distance factor for DRY or WET runways.

The DRY + OVSP corresponds to the factor associated to a 10 kt overspeed (above the non-normal V_{REF}) on a dry runway and the WET + OVSP corresponds to a 10 kt overspeed on a wet runway.

Emerg/Abnormal Procedure	Flaps – Speed	Factor			
		DRY	WET	DRY + OVSP	WET + OVSP
Dual Engine Failure	Slat/Flap 3 – $V_{REF\ FULL}$ + 20 or 130 KIAS	1.35	1.56	1.51	1.73
Jammed Control Column (pitch)	Slat/Flap 5 – $V_{REF\ FULL}$ + 15	1.29	1.48	1.45	1.67
Jammed Control Wheel	Slat/Flap 5 – $V_{REF\ FULL}$ + 15	1.29	1.48	1.45	1.67
Loss of Hydraulic System 1	Slat/Flap Full – $V_{REF\ FULL}$	1.76	2.02	2.01	2.31
Loss of Hydraulic System 2	Slat/Flap Full – $V_{REF\ FULL}$	1.66	1.91	1.87	2.16
Loss of Hydraulic System 1 and 2	Slat/Flap 5 – $V_{REF\ FULL}$ + 10	2.46	2.83	2.97	3.42
Loss of Hydraulic System 1 and 3	Slat/Flap 5 – $V_{REF\ FULL}$ + 10	2.11	2.43	2.43	2.79
Loss of Hydraulic System 2 and 3	Slat/Flap 5 – $V_{REF\ FULL}$ + 10	1.96	2.25	2.20	2.54
One Engine Inoperative Approach and Landing	Slat/Flap 5 – $V_{REF\ FULL}$ + 20	1.37	1.57	1.53	1.76
Stall Protection Failure	Slat/Flap 5 – $V_{REF\ FULL}$ + 15	1.29	1.48	1.45	1.67
	Slat/Flap Full – $V_{REF\ FULL}$ + 10	1.15	1.32	1.28	1.48

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Emerg/Abnormal Procedure	Flaps – Speed	Factor			
		DRY	WET	DRY + OVSP	WET + OVSP
Electrical Emergency	Slat/Flap 3 – $V_{REF\ FULL}$ + 20 or 130 KIAS	2.21	2.54	2.21	2.54
DC BUS 1 OFF	Slat/Flap Full – $V_{REF\ FULL}$	1.07	1.22	1.20	1.38
DC BUS 2 OFF	Slat/Flap Full – $V_{REF\ FULL}$	1.10	1.26	1.25	1.44
DC Essential BUS 1 OFF	Slat/Flap Full – $V_{REF\ FULL}$	1.58	1.81	1.77	2.03
DC Essential BUS 2 OFF	Slat/Flap Full – $V_{REF\ FULL}$	1.66	1.91	1.87	2.16
Ground Spoilers Failure	Slat/Flap Full – $V_{REF\ FULL}$	1.10	1.26	1.26	1.45
Spoilers Normal Mode Failure	Slat/Flap Full – $V_{REF\ FULL}$	1.30	1.50	1.58	1.81
Elevator LH (RH) Failure	Slat/Flap 5 – $V_{REF\ FULL}$ + 15	1.29	1.48	1.45	1.67
Pitch Trim Failure	Slat/Flap 5 – $V_{REF\ FULL}$ + 15	1.29	1.48	1.45	1.67
Spoiler Fault	Slat/Flap 5 – $V_{REF\ FULL}$ + 15	1.63	1.88	1.96	2.26
	Slat/Flap Full – $V_{REF\ FULL}$	1.30	1.50	1.58	1.81
Aileron LH (RH) Failure	Slat/Flap 5 – $V_{REF\ FULL}$ + 10	1.21	1.40	1.37	1.57
Avionics MAU 1A Failure	Slat/Flap Full – $V_{REF\ FULL}$	1.58	1.81	1.77	2.03
Avionics MAU 1B Failure	Slat/Flap Full – $V_{REF\ FULL}$	1.07	1.22	1.20	1.38
Avionics MAU 2B Failure	Slat/Flap Full – $V_{REF\ FULL}$	1.51	1.73	1.68	1.93
Avionics MAU 3A Failure	Slat/Flap Full – $V_{REF\ FULL}$	1.30	1.50	1.58	1.81

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Emerg/Abnormal Procedure		Flaps – Speed	Factor			
			DRY	WET	DRY + OVSP	WET + OVSP
Avionics MAU 3B Failure		Slat/Flap Full – $V_{REF\ FULL}$	1.10	1.26	1.26	1.45
Anti-Ice Wing Failure		Slat/Flap 5 – $V_{REF\ FULL}$ 5 after ice encounter	1.25	1.44	1.40	1.61
Brake LH (RH) Failure		Slat/Flap Full – $V_{REF\ FULL}$	1.51	1.73	1.68	1.93
Landing Gear WOW System Failure		Slat/Flap Full – $V_{REF\ FULL}$	1.30	1.50	1.58	1.81
Brake LH (RH) Fault		—	1.19	1.37	1.34	1.54
Smoke/ Fire/ Fumes	DC BUS 1 OFF and DC Essential BUS OFF	Slat/Flap 3 – $V_{REF\ FULL}$ + 20 or 130 KIAS	2.37	2.73	2.37	2.73
	DC Essential BUS 2 and DC BUS 2 OFF	Slat/Flap 3 – $V_{REF\ FULL}$ + 20 or 130 KIAS	2.55	2.93	2.55	2.93
	DC Essential BUS 3 OFF	Slat/Flap 3 – $V_{REF\ FULL}$ + 20 or 130 KIAS	2.21	2.54	2.21	2.54
	TRU ESS and TRU BUS AUTO	Slat/Flap 3 – $V_{REF\ FULL}$ + 20 or 130 KIAS	1.35	1.56	1.51	1.73

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FLAP (SLAT) FAIL

Refer to the following tables for reference speed and coefficient to be applied to the unfactored landing distance, for a flap/slat fail or a flap/slat fail with shaker anticipated:

FLAP/SLAT FAIL LANDING CONFIGURATION TABLE - DRY RUNWAY

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+50	$V_{REF\ FULL}$+50
LDG Coef		1.90	1.77	1.81
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35
LDG Coef		1.52	1.56	1.58
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+25	$V_{REF\ FULL}$+25
LDG Coef		1.44	1.39	1.41
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+10
LDG Coef			1.35	1.22
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.08	1.00

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FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE - DRY RUNWAY

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60
LDG Coef		1.90	1.95	1.99
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40
LDG Coef		1.60	1.63	1.66
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30
LDG Coef		1.44	1.47	1.49
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+15
LDG Coef			1.35	1.29
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.08	1.00

FLAP/SLAT FAIL LANDING CONFIGURATION TABLE - WET RUNWAY

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+50	$V_{REF\ FULL}$+50
LDG Coef		2.18	2.04	2.08
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35
LDG Coef		1.75	1.79	1.82
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+25	$V_{REF\ FULL}$+25
LDG Coef		1.66	1.60	1.63
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+10
LDG Coef			1.56	1.40
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.25	1.15

FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE - WET RUNWAY

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60
LDG Coef		2.18	2.24	2.28

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	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40
LDG Coef		1.83	1.88	1.91
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30
LDG Coef		1.66	1.69	1.71
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+15
LDG Coef			1.56	1.49
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.25	1.15

FLAP/SLAT FAIL LANDING CONFIGURATION TABLE - DRY RUNWAY + 10 KT OVERSPEED

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+50	$V_{REF\ FULL}$+50
LDG Coef		2.08	1.95	1.99
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35
LDG Coef		1.67	1.71	1.74
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+25	$V_{REF\ FULL}$+25
LDG Coef		1.58	1.54	1.57
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+10
LDG Coef			1.51	1.37
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.20	1.11

FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE - DRY RUNWAY + 10 KT OVERSPEED

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60
LDG Coef		2.08	2.14	2.18
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40
LDG Coef		1.74	1.79	1.82

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	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30
LDG Coef		1.58	1.62	1.64
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+15
LDG Coef			1.51	1.45
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.20	1.11

FLAP/SLAT FAIL LANDING CONFIGURATION TABLE - WET RUNWAY + 10 KT OVERSPEED

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+50	$V_{REF\ FULL}$+50
LDG Coef		2.39	2.24	2.28
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35	$V_{REF\ FULL}$+35
LDG Coef		1.92	1.97	2.00
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+25	$V_{REF\ FULL}$+25
LDG Coef		1.82	1.77	1.80
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+10
LDG Coef			1.73	1.58
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.38	1.28

FLAP/SLAT FAIL WITH SHAKER ANTICIPATED LANDING CONFIGURATION TABLE - WET RUNWAY + 10 KT OVERSPEED

	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	0	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60	$V_{REF\ FULL}$+60
LDG Coef		2.39	2.46	2.51
V_{REF} (KIAS)	1	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40	$V_{REF\ FULL}$+40
LDG Coef		2.00	2.05	2.09
V_{REF} (KIAS)	2	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30	$V_{REF\ FULL}$+30
LDG Coef		1.82	1.86	1.89

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	FLAP	SLAT		
		0	1 (2) (3)	4 (5) (FULL)
V_{REF} (KIAS)	3 (4) (5)	NOT SELECT-ABLE	$V_{REF\ FULL}$+20	$V_{REF\ FULL}$+15
LDG Coef			1.73	1.67
V_{REF} (KIAS)	FULL		$V_{REF\ FULL}$+5	$V_{REF\ FULL}$
LDG Coef			1.38	1.28

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UNFACTORED LANDING DISTANCE - CONTAMINATED RUNWAY

NOTE: The contaminated runways results are for guidance information only.

A runway is considered to be contaminated when more than 25% of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by the following:

– surface water more than 3 mm (0.125 in) deep, or by slush, or loose snow, equivalent to more than 3 mm (0.125 in) of water;

– snow which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (compacted snow); or

– ice, including wet ice.

The contaminated unfactored landing distance is the actual distance to land the airplane after a stabilized approach, crossing a point at 50 ft above the threshold at V_{REF}, on a zero slope runway, ISA temperature, using maximum manual braking effort.

The following tables present guidance information for obtaining the airplane unfactored landing distance on contaminated runways.

This distance does not consider the 1.15 factor from EU-OPS 1.515 and 1.520 or SAFO 06012. It is the operator's responsibility to evaluate the application of the factor above.

The factors to multiply the full flaps unfactored landing distance from the emergency/abnormal procedures were not analyzed for contaminated runways.

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

In order to find the contaminated landing distance, enter the table with the current contaminant, flaps and autobrakes configuration, ice condition, and current landing weight and obtain a reference contaminated unfactored landing distance ($CULD_{REF}$).

◄

Apply corrections to the reference contaminated unfactored landing

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distance according to the formula below:

Final altitude correction (%) = Altitude correction from the table x (Current Altitude in ft/1000 ft)

Final tailwind correction (%) = Wind correction from the table x (Current tailwind component in kt/5 kt)

Final overspeed correction (%) = Overspeed correction from the table x (Current overspeed in kt/5 kt)

Final reverse correction (%) = Reverse correction from the table.

The unfactored landing distance on contaminated runways (CULD) becomes:

Additional Distance = $CULD_{REF}$ x (Final Altitude Correction + Final Tailwind Correction + Final overspeed Correction + Final reverse correction)

CULD = $CULD_{REF}$ + Additional distance

Suppose that, for the following condition:

– Airport pressure altitude: 4000 ft

– Wind: 10 kt headwind

– Overspeed: V_{REF} + 5 kt

– Reverses: All reverses operating

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

For a certain contaminant, weight, flaps and autobrakes configuration and ice condition, the results from the table are:

◄

– $CULD_{REF}$: 1000 m

– Altitude correction: 3%

– Wind correction: 8%

– Overspeed correction: 7%

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– Reverse correction: -3%

Calculations:

– Final Altitude Correction = 3% x (4000 ft/1000 ft) = 12%
– Final Tailwind Correction = 8% x (0 kt/5 kt) = 0%
– Final Overspeed Correction = 7% x (5 kt/5 kt) = 7%
– Final reverse correction = -3%

Unfactored landing distance on contaminated runway:

– Additional Distance = 2000 ft x (12% + 0%+ 7% - 3%) = 2000 ft x 16% = 320 ft
  CULD = 2000 ft + 320 ft = 2320 ft

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UNFACTORED LANDING DISTANCE - CONTAMINATED RUNWAY

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

STANDING WATER 1/8 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	5670	6285	4731	5114
	HI	5995	6641	5106	5525
	MED	5995	6641	5106	5525
	LO	6490	7306	5745	6301
37000	MAN	6125	6782	5091	5515
	HI	6442	7146	5494	5942
	MED	6442	7146	5494	5942
	LO	6941	7813	6147	6751
40000	MAN	6587	7296	5475	5924
	HI	6909	7667	5877	6365
	MED	6909	7667	5877	6365
	LO	7382	8332	6555	7199
43000	MAN	7043	7818	5851	6330
	HI	7371	8172	6265	6785
	MED	7371	8172	6265	6785
	LO	7836	8843	6960	7654
46000	MAN	7536	8356	6231	6760
	HI	7844	8712	6656	7209
	MED	7844	8712	6656	7209
	LO	8300	9371	7359	8104
49000	MAN	8013	8878	6626	7177
	HI	8321	9235	7061	7635
	MED	8321	9235	7061	7635
	LO	8765	9894	7771	8549
52000	MAN	8495	9436	7023	7608
	HI	8802	9768	7468	8075
	MED	8802	9768	7468	8075
	LO	9229	10425	8175	9006

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 5%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 14%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-4%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

STANDING WATER 1/2 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	4950	5437	4268	4577
	HI	5376	5891	4711	5056
	MED	5376	5891	4722	5071
	LO	6419	7236	5699	6255
37000	MAN	5328	5861	4574	4919
	HI	5751	6318	5041	5412
	MED	5751	6318	5044	5418
	LO	6872	7744	6101	6705
40000	MAN	5714	6305	4899	5270
	HI	6140	6762	5371	5776
	MED	6140	6762	5372	5776
	LO	7312	8261	6510	7154
43000	MAN	6105	6760	5222	5625
	HI	6531	7202	5705	6142
	MED	6531	7202	5705	6142
	LO	7757	8765	6915	7609
46000	MAN	6526	7237	5550	6000
	HI	6936	7672	6043	6513
	MED	6936	7672	6043	6513
	LO	8207	9273	7314	8059
49000	MAN	6944	7712	5894	6371
	HI	7349	8138	6394	6889
	MED	7349	8138	6394	6889
	LO	8649	9775	7725	8503
52000	MAN	7371	8219	6243	6759
	HI	7767	8619	6748	7281
	MED	7767	8619	6748	7281
	LO	9081	10279	8129	8960

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 12%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-3%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

SLUSH 1/8 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	5587	6187	4653	5042
	HI	5895	6545	5064	5466
	MED	5895	6545	5064	5466
	LO	6495	7311	5749	6304
37000	MAN	6015	6668	5021	5434
	HI	6350	7035	5409	5862
	MED	6350	7035	5409	5862
	LO	6946	7819	6150	6754
40000	MAN	6462	7166	5384	5833
	HI	6787	7541	5787	6276
	MED	6787	7541	5787	6276
	LO	7386	8335	6558	7202
43000	MAN	6925	7669	5751	6229
	HI	7236	8031	6166	6685
	MED	7236	8031	6166	6685
	LO	7831	8838	6963	7657
46000	MAN	7380	8189	6121	6645
	HI	7694	8553	6547	7098
	MED	7694	8553	6547	7098
	LO	8280	9348	7362	8108
49000	MAN	7841	8693	6522	7050
	HI	8157	9060	6942	7513
	MED	8157	9060	6942	7513
	LO	8728	9856	7774	8552
52000	MAN	8306	9233	6890	7468
	HI	8622	9576	7337	7941
	MED	8622	9576	7337	7941
	LO	9175	10372	8178	9009

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 5%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 14%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-4%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

SLUSH 1/2 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	4983	5458	4280	4598
	HI	5394	5916	4737	5079
	MED	5396	5919	4755	5109
	LO	6429	7246	5706	6262
37000	MAN	5342	5865	4594	4934
	HI	5777	6331	5047	5427
	MED	5777	6331	5062	5445
	LO	6881	7754	6108	6712
40000	MAN	5715	6288	4907	5276
	HI	6147	6760	5377	5784
	MED	6147	6760	5384	5792
	LO	7321	8271	6517	7160
43000	MAN	6103	6720	5222	5620
	HI	6527	7181	5707	6142
	MED	6527	7181	5709	6144
	LO	7767	8774	6921	7616
46000	MAN	6492	7170	5542	5981
	HI	6917	7629	6038	6503
	MED	6917	7629	6038	6503
	LO	8216	9283	7321	8066
49000	MAN	6888	7618	5885	6336
	HI	7312	8072	6380	6866
	MED	7312	8072	6380	6866
	LO	8658	9785	7732	8510
52000	MAN	7291	8096	6209	6707
	HI	7712	8528	6723	7243
	MED	7712	8528	6723	7243
	LO	9091	10289	8136	8967

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 12%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-2%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

WET SNOW 1/4 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	5383	5877	4607	4927
	HI	5788	6323	5044	5398
	MED	5788	6323	5044	5398
	LO	6490	7306	5745	6302
37000	MAN	5735	6261	4907	5253
	HI	6154	6721	5362	5742
	MED	6154	6721	5362	5742
	LO	6941	7813	6147	6751
40000	MAN	6081	6650	5212	5578
	HI	6511	7123	5683	6085
	MED	6511	7123	5683	6085
	LO	7381	8330	6555	7199
43000	MAN	6430	7082	5515	5907
	HI	6871	7515	6001	6430
	MED	6871	7515	6001	6431
	LO	7826	8833	6960	7654
46000	MAN	6782	7523	5814	6233
	HI	7232	7924	6314	6771
	MED	7232	7924	6314	6773
	LO	8275	9342	7360	8105
49000	MAN	7176	7979	6120	6555
	HI	7588	8387	6634	7107
	MED	7588	8387	6634	7110
	LO	8718	9844	7771	8549
52000	MAN	7583	8428	6422	6942
	HI	7937	8841	6948	7449
	MED	7937	8841	6948	7454
	LO	9151	10349	8175	9006

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 12%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-3%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

WET SNOW 1 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	4730	5119	4153	4418
	HI	5209	5647	4636	4937
	MED	5251	5760	4678	5027
	LO	6414	7230	5695	6251
37000	MAN	5035	5448	4420	4705
	HI	5533	5995	4923	5246
	MED	5583	6124	4973	5351
	LO	6866	7739	6098	6701
40000	MAN	5333	5779	4689	4991
	HI	5847	6344	5212	5552
	MED	5906	6491	5271	5672
	LO	7307	8256	6506	7150
43000	MAN	5633	6127	4956	5279
	HI	6163	6685	5496	5859
	MED	6230	6849	5566	5996
	LO	7753	8760	6911	7605
46000	MAN	5935	6480	5220	5563
	HI	6479	7033	5777	6162
	MED	6556	7208	5855	6315
	LO	8202	9269	7311	8056
49000	MAN	6254	6838	5488	5844
	HI	6789	7405	6062	6460
	MED	6876	7562	6151	6629
	LO	8644	9771	7722	8500
52000	MAN	6577	7194	5752	6161
	HI	7093	7772	6341	6762
	MED	7189	7917	6442	6950
	LO	9077	10275	8126	8957

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 11%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-1%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

DRY SNOW 1 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	5199	5662	4482	4787
	HI	5627	6133	4933	5272
	MED	5627	6134	4933	5279
	LO	6465	7282	5730	6286
37000	MAN	5539	6031	4775	5104
	HI	5981	6517	5244	5607
	MED	5981	6520	5244	5617
	LO	6917	7789	6132	6736
40000	MAN	5873	6405	5071	5419
	HI	6327	6905	5556	5941
	MED	6327	6911	5557	5954
	LO	7357	8306	6540	7184
43000	MAN	6209	6772	5364	5737
	HI	6676	7285	5866	6276
	MED	6676	7292	5867	6293
	LO	7802	8810	6945	7639
46000	MAN	6549	7142	5655	6053
	HI	7026	7666	6171	6608
	MED	7026	7675	6172	6629
	LO	8252	9319	7345	8090
49000	MAN	6884	7507	5952	6365
	HI	7370	8042	6483	6935
	MED	7370	8053	6485	6960
	LO	8694	9821	7756	8534
52000	MAN	7213	7874	6244	6683
	HI	7708	8418	6788	7267
	MED	7708	8432	6791	7297
	LO	9127	10325	8160	8991

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 12%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-2%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

DRY SNOW 2 in

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	4805	5205	4207	4478
	HI	5276	5724	4685	4992
	MED	5303	5811	4714	5063
	LO	6421	7238	5700	6256
37000	MAN	5117	5542	4479	4772
	HI	5606	6080	4977	5306
	MED	5639	6179	5013	5390
	LO	6874	7746	6103	6706
40000	MAN	5424	5884	4755	5065
	HI	5929	6439	5272	5619
	MED	5966	6551	5314	5715
	LO	7314	8263	6512	7156
43000	MAN	5733	6218	5029	5360
	HI	6252	6789	5563	5933
	MED	6296	6915	5612	6042
	LO	7760	8768	6917	7611
46000	MAN	6044	6555	5299	5652
	HI	6577	7140	5849	6243
	MED	6627	7279	5906	6365
	LO	8210	9277	7316	8062
49000	MAN	6351	6888	5575	5941
	HI	6896	7487	6141	6549
	MED	6952	7639	6206	6684
	LO	8652	9779	7728	8506
52000	MAN	6653	7222	5847	6236
	HI	7209	7833	6428	6859
	MED	7272	7999	6501	7009
	LO	9086	10284	8132	8963

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+ 11%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 8%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-1%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

COMPACTED SNOW

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	4008	4431	3473	3747
	HI	4476	4934	3957	4261
	MED	4527	5036	4045	4395
	LO	6262	7078	5569	6125
37000	MAN	4273	4722	3700	3995
	HI	4757	5242	4203	4529
	MED	4817	5359	4304	4682
	LO	6718	7591	5975	6578
40000	MAN	4531	5017	3929	4242
	HI	5029	5553	4451	4795
	MED	5099	5685	4566	4967
	LO	7162	8111	6386	7030
43000	MAN	4791	5305	4156	4491
	HI	5303	5854	4694	5062
	MED	5382	6001	4823	5253
	LO	7610	8618	6793	7487
46000	MAN	5053	5595	4379	4736
	HI	5577	6156	4933	5325
	MED	5666	6319	5076	5536
	LO	8062	9128	7193	7939
49000	MAN	5310	5880	4608	4979
	HI	5846	6454	5178	5583
	MED	5944	6631	5335	5813
	LO	8505	9632	7606	8383
52000	MAN	5562	6167	4832	5227
	HI	6108	6751	5416	5846
	MED	6216	6944	5589	6097
	LO	8939	10137	8010	8841

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+11%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 9%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-2%	for ALL REV OP

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CONTAMINATED RUNWAY – UNFACTORED LANDING DISTANCE

EMBRAER 190 – CF34-10E5/10E5A1/10E6/10E6A1 ENGINES – ANAC/FAA

ICE

WEIGHT (kg)	AUTO BRAKE	FLAP 5		FLAP FULL	
		NO ICE ACC	ICE ACC	NO ICE ACC	ICE ACC
34000	MAN	8921	9584	7310	7725
	HI	9184	9895	7660	8110
	MED	9184	9895	7660	8110
	LO	9205	10020	7748	8303
37000	MAN	9414	10124	7731	8180
	HI	9684	10439	8092	8578
	MED	9684	10439	8092	8578
	LO	9716	10587	8200	8803
40000	MAN	9914	10684	8167	8644
	HI	10188	11005	8540	9056
	MED	10188	11005	8540	9056
	LO	10228	11177	8669	9313
43000	MAN	10431	11246	8607	9119
	HI	10708	11571	8991	9542
	MED	10708	11571	8991	9542
	LO	10758	11765	9139	9834
46000	MAN	10960	11822	9048	9596
	HI	11238	12147	9441	10030
	MED	11238	12147	9441	10030
	LO	11299	12365	9609	10355
49000	MAN	11491	12399	9504	10074
	HI	11767	12724	9905	10516
	MED	11767	12724	9905	10516
	LO	11839	12965	10096	10874
52000	MAN	12020	12986	9956	10563
	HI	12294	13309	10365	11013
	MED	12294	13309	10365	11013
	LO	12375	13573	10578	11408

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CORRECTIONS			
ALTITUDE	LANDING DISTANCE	+ 4%	per 1000 ft above SEA LEVEL
WIND	LANDING DISTANCE	+16%	per 5kt tailwind
OVERSPEED	LANDING DISTANCE	+ 6%	per 5kt above VREF
REVERSER	LANDING DISTANCE	-5%	for ALL REV OP

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QUICK TURN AROUND WEIGHT

For normal operation, the brake temperature can be monitored through the brake temperature indication in the MFD.

The Quick Turn Around Weight Table must be used only when the brake temperature indication is not working properly (according to the MMEL). In this case, if the landing weight exceeds the Quick Turn Around Weight, a subsequent takeoff must not be performed before 22 minutes after chocks on. At the end of this time interval, check that the wheel thermal plugs have not melted.

NOTE: If the tires are not flat after 22 minutes, this is a positive indication that the wheel thermal plugs have not melted.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS 5 – NO ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51800	51800	51800	51800	51800	51800	51800	51800
-15	51800	51800	51800	51800	51800	51800	51800	51800
-10	51800	51800	51800	51800	51520	51800	51800	51800
-5	51800	51800	51800	51800	51061	51800	51800	51800
0	51480	51800	51800	51800	50606	51800	51800	51800
5	51031	51800	51800	51800	50162	51800	51800	51800
10	50591	51800	51800	51800	49729	51800	51800	51800
15	50163	51800	51800	51800	49306	51800	51800	51800
20	49744	51800	51800	51800	48899	51800	51800	51800
25	49335	51800	51800	51800	48518	51800	51800	51800
30	48939	51800	51800	51800	48124	51800	51800	51800
35	48569	51800	51800	51800	47738	51800	51800	51800
40	48192	51800	51800	51800	47361	51800	51800	51800
45	47818	51800	51800	51800	46992	51425	51800	51800
50	47452	51800	51800	51800	46651	51021	51800	51800

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS 5 – NO ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51578	51800	51800	51800	50699	51800	51800	51800
-15	51108	51800	51800	51800	50225	51800	51800	51800
-10	50645	51800	51800	51800	49762	51800	51800	51800
-5	50187	51800	51800	51800	49308	51800	51800	51800
0	49739	51800	51800	51800	48872	51800	51800	51800
5	49300	51800	51800	51800	48461	51800	51800	51800
10	48880	51800	51800	51800	48038	51800	51800	51800
15	48484	51800	51800	51800	47625	51800	51800	51800
20	48077	51800	51800	51800	47223	51683	51800	51800
25	47678	51800	51800	51800	46839	51242	51800	51800
30	47288	51757	51800	51800	46474	50811	51800	51800
35	46913	51329	51800	51800	46098	50389	51800	51800
40	46561	50912	51800	51800	45745	49977	51473	51800
45	46200	50503	51800	51800	---	---	---	---

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS 5 – NO ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	49813	51800	51800	51800	48930	51800	51800	51800
-15	49342	51800	51800	51800	48490	51800	51800	51800
-10	48888	51800	51800	51800	48035	51800	51800	51800
-5	48461	51800	51800	51800	47592	51800	51800	51800
0	48024	51800	51800	51800	47159	51613	51800	51800
5	47596	51800	51800	51800	46752	51139	51800	51800
10	47179	51635	51800	51800	46355	50678	51800	51800
15	46784	51178	51800	51800	45955	50228	51734	51800
20	46403	50732	51800	51800	45585	49788	51278	51800
25	46015	50297	51800	51800	45206	49359	50832	51800
30	45655	49872	51365	51800	44841	48943	50398	51800
35	45293	49456	50933	51800	44494	48557	49973	51445
40	44934	49050	50511	51800	44136	48160	49557	51014

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS 5 – ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	50183	51800	51800	51800	49356	51800	51800	51800
-15	49748	51800	51800	51800	48919	51800	51800	51800
-10	49307	51800	51800	51800	48461	51800	51800	51800
-5	48870	51800	51800	51800	48032	51800	51800	51800
0	48422	51800	51800	51800	47609	51800	51800	51800
5	48003	51800	51800	51800	47195	51614	51800	51800
10	47595	51800	51800	51800	46792	51156	51800	51800
15	47195	51615	51800	51800	46397	50714	51800	51800
20	46805	51172	51800	51800	46013	50271	51761	51800
25	46424	50746	51800	51800	45637	49836	51311	51800
30	46052	50319	51800	51800	45269	49424	50885	51800
35	45688	49894	51372	51800	44910	49023	50466	51800
40	45332	49497	50959	51800	44558	48609	50035	51490
45	44983	49107	50555	51800	44214	48219	49635	51078
50	44643	48711	50141	51600	43884	47844	49246	50675

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS 5 – ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	48516	51800	51800	51800	47698	51800	51800	51800
-15	48078	51800	51800	51800	47256	51686	51800	51800
-10	47646	51800	51800	51800	46824	51190	51800	51800
-5	47219	51641	51800	51800	46401	50716	51800	51800
0	46801	51165	51800	51800	45988	50240	51729	51800
5	46393	50708	51800	51800	45584	49775	51248	51800
10	45995	50248	51737	51800	45191	49336	50792	51800
15	45606	49799	51272	51800	44807	48901	50337	51800
20	45226	49375	50831	51800	44431	48460	49884	51336
25	44855	48957	50395	51800	44065	48050	49460	50897
30	44492	48528	49953	51408	43721	47650	49045	50465
35	44137	48131	49543	50982	43382	47260	48619	50020
40	43801	47744	49142	50566	43039	46878	48217	49610
45	43477	47365	48734	50140	---	---	---	---

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS 5 – ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	46871	51246	51800	51800	46045	50308	51800	51800
-15	46432	50753	51800	51800	45612	49808	51281	51800
-10	46004	50259	51749	51800	45188	49334	50790	51800
-5	45586	49777	51249	51800	44776	48865	50300	51765
0	45177	49321	50776	51800	44372	48395	49817	51267
5	44780	48869	50304	51769	43981	47956	49362	50796
10	44391	48415	49837	51288	43616	47528	48914	50327
15	44012	47991	49399	50833	43248	47111	48458	49861
20	43659	47578	48969	50383	42882	46703	48036	49424
25	43305	47174	48526	49928	42525	46305	47624	48996
30	42952	46780	48116	49505	42192	45916	47222	48554
35	42606	46395	47717	49092	41861	45537	46828	48144
40	42279	46018	47327	48669	41527	45165	46443	47746

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS FULL – NO ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51800	51800	51800	51800	51800	51800	51800	51800
-15	51800	51800	51800	51800	51800	51800	51800	51800
-10	51800	51800	51800	51800	51800	51800	51800	51800
-5	51800	51800	51800	51800	51800	51800	51800	51800
0	51800	51800	51800	51800	51800	51800	51800	51800
5	51800	51800	51800	51800	51800	51800	51800	51800
10	51800	51800	51800	51800	51800	51800	51800	51800
15	51800	51800	51800	51800	51800	51800	51800	51800
20	51800	51800	51800	51800	51800	51800	51800	51800
25	51800	51800	51800	51800	51800	51800	51800	51800
30	51800	51800	51800	51800	51800	51800	51800	51800
35	51800	51800	51800	51800	51517	51800	51800	51800
40	51800	51800	51800	51800	51120	51800	51800	51800
45	51601	51800	51800	51800	50715	51800	51800	51800
50	51218	51800	51800	51800	50324	51800	51800	51800

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS FULL – NO ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51800	51800	51800	51800	51800	51800	51800	51800
-15	51800	51800	51800	51800	51800	51800	51800	51800
-10	51800	51800	51800	51800	51800	51800	51800	51800
-5	51800	51800	51800	51800	51800	51800	51800	51800
0	51800	51800	51800	51800	51800	51800	51800	51800
5	51800	51800	51800	51800	51800	51800	51800	51800
10	51800	51800	51800	51800	51800	51800	51800	51800
15	51800	51800	51800	51800	51395	51800	51800	51800
20	51800	51800	51800	51800	50972	51800	51800	51800
25	51451	51800	51800	51800	50531	51800	51800	51800
30	51043	51800	51800	51800	50126	51800	51800	51800
35	50621	51800	51800	51800	49732	51800	51800	51800
40	50222	51800	51800	51800	49336	51800	51800	51800
45	49840	51800	51800	51800	---	---	---	---

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS FULL – NO ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51800	51800	51800	51800	51800	51800	51800	51800
-15	51800	51800	51800	51800	51800	51800	51800	51800
-10	51800	51800	51800	51800	51800	51800	51800	51800
-5	51800	51800	51800	51800	51359	51800	51800	51800
0	51800	51800	51800	51800	50899	51800	51800	51800
5	51364	51800	51800	51800	50432	51800	51800	51800
10	50922	51800	51800	51800	50000	51800	51800	51800
15	50469	51800	51800	51800	49578	51800	51800	51800
20	50052	51800	51800	51800	49145	51800	51800	51800
25	49644	51800	51800	51800	48734	51800	51800	51800
30	49230	51800	51800	51800	48341	51800	51800	51800
35	48826	51800	51800	51800	47957	51800	51800	51800
40	48445	51800	51800	51800	47581	51800	51800	51800

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS FULL – ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	0 ft				1000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51800	51800	51800	51800	51800	51800	51800	51800
-15	51800	51800	51800	51800	51800	51800	51800	51800
-10	51800	51800	51800	51800	51800	51800	51800	51800
-5	51800	51800	51800	51800	51800	51800	51800	51800
0	51800	51800	51800	51800	51800	51800	51800	51800
5	51800	51800	51800	51800	51666	51800	51800	51800
10	51800	51800	51800	51800	51216	51800	51800	51800
15	51668	51800	51800	51800	50778	51800	51800	51800
20	51234	51800	51800	51800	50349	51800	51800	51800
25	50810	51800	51800	51800	49931	51800	51800	51800
30	50395	51800	51800	51800	49521	51800	51800	51800
35	49989	51800	51800	51800	49143	51800	51800	51800
40	49593	51800	51800	51800	48760	51800	51800	51800
45	49222	51800	51800	51800	48377	51800	51800	51800
50	48856	51800	51800	51800	48003	51800	51800	51800

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS FULL – ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	2000 ft				3000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51800	51800	51800	51800	51800	51800	51800	51800
-15	51800	51800	51800	51800	51729	51800	51800	51800
-10	51800	51800	51800	51800	51250	51800	51800	51800
-5	51690	51800	51800	51800	50778	51800	51800	51800
0	51225	51800	51800	51800	50318	51800	51800	51800
5	50771	51800	51800	51800	49869	51800	51800	51800
10	50327	51800	51800	51800	49435	51800	51800	51800
15	49894	51800	51800	51800	49031	51800	51800	51800
20	49473	51800	51800	51800	48615	51800	51800	51800
25	49083	51800	51800	51800	48207	51800	51800	51800
30	48684	51800	51800	51800	47809	51800	51800	51800
35	48289	51800	51800	51800	47419	51782	51800	51800
40	47903	51800	51800	51800	47037	51355	51800	51800
45	47525	51800	51800	51800	---	---	---	---

NOTE: Quick Turn Around Weight in kg.

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QUICK TURN AROUND WEIGHT TABLE

EMBRAER 190 – ALL ENGINE TYPES – ANAC/FAA
FLAPS FULL – ICE ACCRETION – AUTOBRAKES OFF

Temp (°C)	ALTITUDE							
	4000 ft				5000 ft			
	WIND							
	-10 kt	0 kt	10 kt	20 kt	-10 kt	0 kt	10 kt	20 kt
-20	51301	51800	51800	51800	50381	51800	51800	51800
-15	50813	51800	51800	51800	49899	51800	51800	51800
-10	50336	51800	51800	51800	49431	51800	51800	51800
-5	49870	51800	51800	51800	48997	51800	51800	51800
0	49420	51800	51800	51800	48549	51800	51800	51800
5	49002	51800	51800	51800	48111	51800	51800	51800
10	48569	51800	51800	51800	47684	51800	51800	51800
15	48148	51800	51800	51800	47268	51614	51800	51800
20	47735	51800	51800	51800	46869	51159	51800	51800
25	47333	51686	51800	51800	46493	50714	51800	51800
30	46943	51246	51800	51800	46105	50279	51746	51800
35	46579	50815	51800	51800	45725	49855	51305	51800
40	46207	50394	51800	51800	45362	49443	50875	51800

NOTE: Quick Turn Around Weight in kg.

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CAT II OPERATION

The performance data required for Category II operations are presented by basic CAFM output tables and must be calculated previously.

	ENGINES	TLA	FLAPS	GEAR	AIRSPEED
APPROACH CLIMB	1	TO/GA	2	UP	APPROACH CLMB SPEED
LANDING CLIMB	2	TO/GA	5	DOWN	V_{REF5} [1]
LANDING	2	IDLE	5	DOWN	V_{REF5} [1]

1. The Landing Reference Speed (VREF5) for Category II operations is the appropriate speed obtained from the CAFM and differs from the VREF5 used for Category I operations.

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SECTION 6

FLIGHT PLANNING

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SIMPLIFIED FLIGHT PLANNING

Simplified flight planning charts allow quick determination of estimated trip fuel and time from brake release to landing. The following phases are included: takeoff, climb, cruise, descent, approach and landing.

Charts are provided for Long Range Cruise (LRC) and Mach 0.78.

Alternate fuel, holding, reserve fuel and other allowances (APU usage and taxi) should be added to the trip fuel in order to obtain the total fuel required.

To determine trip fuel enter trip ground distance, correct for wind condition and estimated landing weight, move as far as the line indicating cruise pressure altitude, and read the trip fuel.

To determine trip time, enter trip ground distance, correct for wind condition, move as far as the referring cruise pressure altitude, and read the trip time.

For winds greater than those shown, enter in the chart, directly, corrected ground distance, ignore wind correction reference line, to obtain the corrected ground distance, apply the following equation.

$$CGD = GD \times \frac{(TAS)}{(TAS + WIND)}$$

Where:

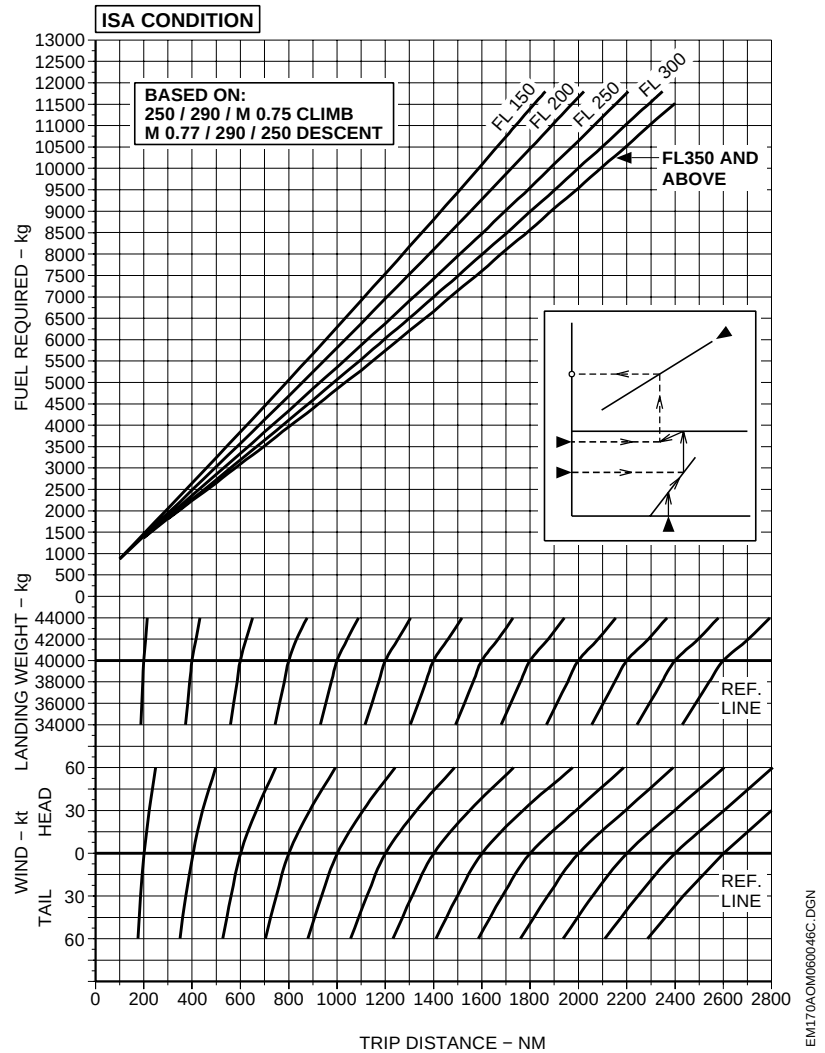
CGD: Corrected ground distance;
GD: Ground distance;
Head wind is negative;
Tail wind is positive.

The alternate fuel is determined by entering the LRC Simplified Flight Planning chart with the alternate distance and wind.

The holding fuel is determined from the holding table in this section. Depending upon national regulations, the holding fuel is normally calculated so that the aircraft can hold for 30 min, at 1500 ft above the alternate airport.

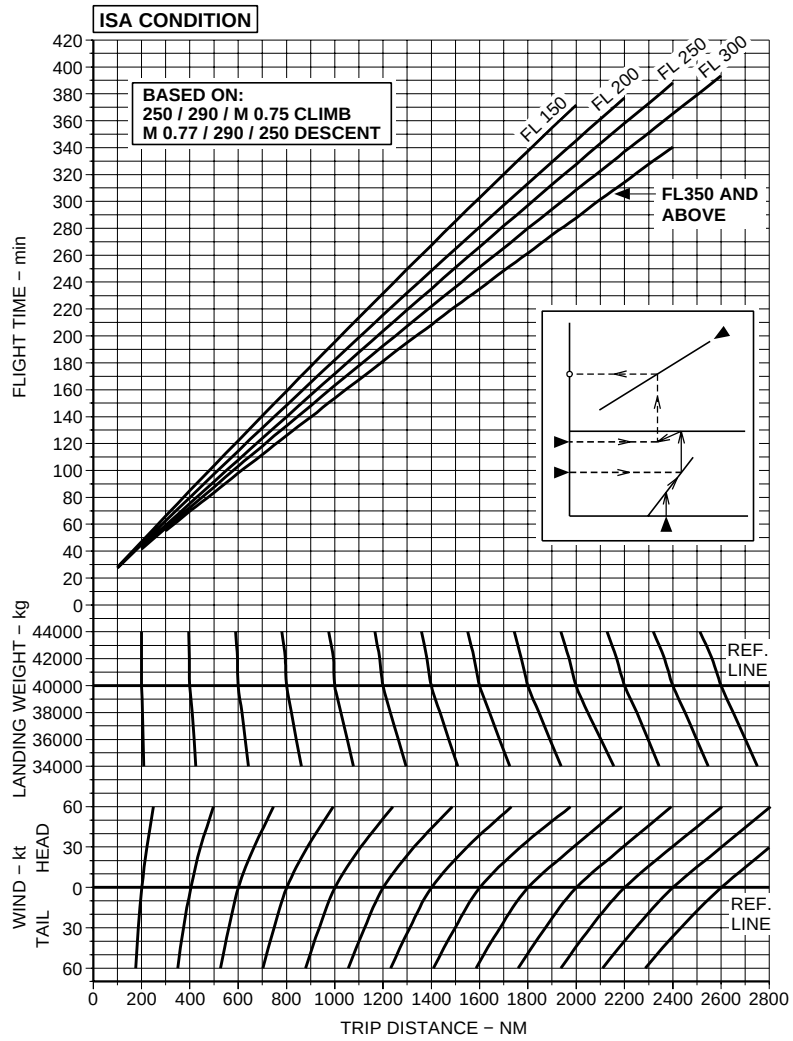
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EMBRAER 190 SIMPLIFIED FLIGHT PLANNING
TRIP FUEL
ALL ENGINE TYPES
LONG RANGE CRUISE



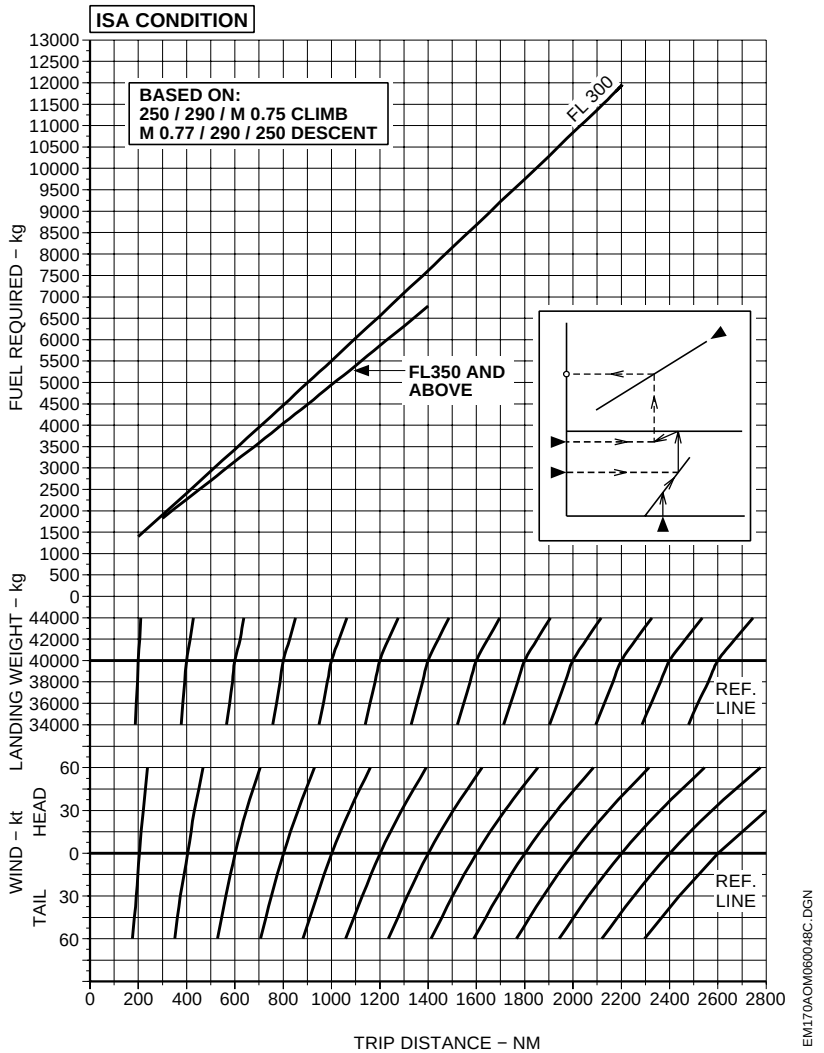
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EMBRAER 190 SIMPLIFIED FLIGHT PLANNING
TRIP TIME
ALL ENGINE TYPES
LONG RANGE CRUISE



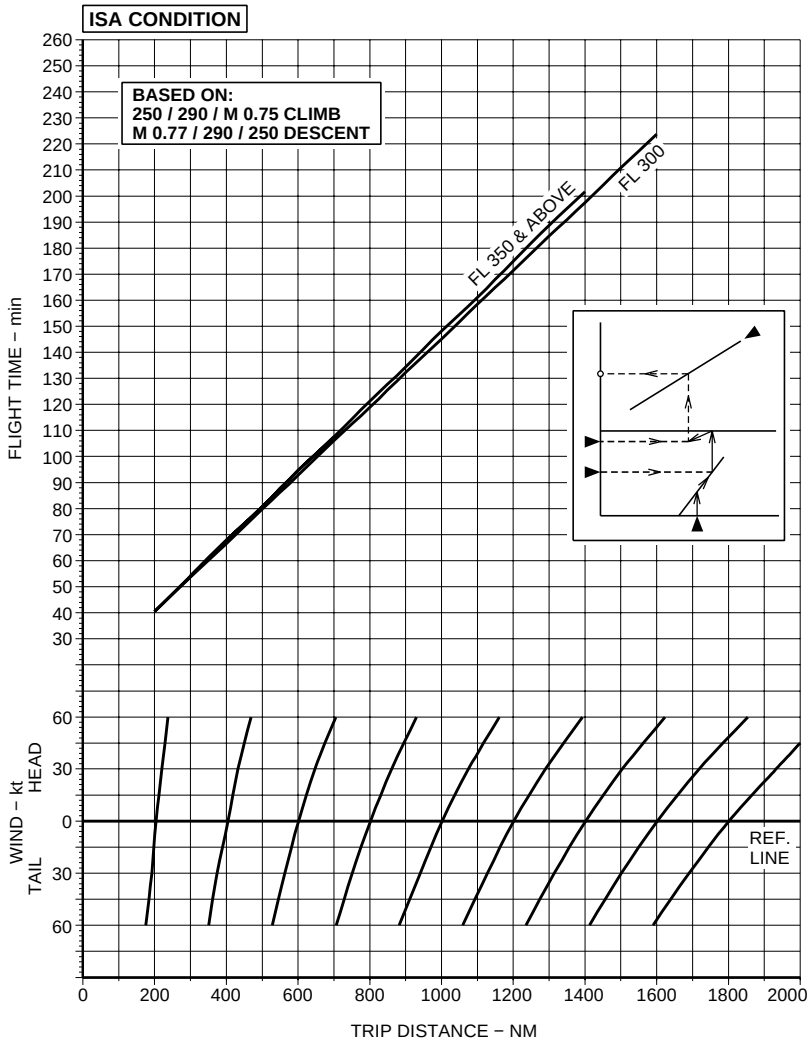
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EMBRAER 190 SIMPLIFIED FLIGHT PLANNING
TRIP FUEL
ALL ENGINE TYPES
MACH 0.78 CRUISE



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EMBRAER SIMPLIFIED FLIGHT PLANNING
TRIP TIME
ALL ENGINE TYPES
MACH 0.78 CRUISE



PERFORMANCE FOR FLIGHT WITHOUT CABIN PRESSURIZATION

The following tables provide performance at Flight Level 100 in case of flight without pressurization. The following assumptions apply:

– All engine types;

– Anti-ice OFF;

– ECS ON;

– No ice accretion;

– FADEC 5.20;

– ISA condition;

– Climb: 240/290/M0.70;

– Cruise at Flight Level 100;

– Long range cruise;

– Descent: M0.77/290/250;

1 - Enter in the following table with ground distance and wind to obtain the air distance.

AIR DISTANCE (NM) HEADWIND COMPONENTS (KT)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENTS (KT)				
-100	-80	-60	-40	-20		20	40	60	80	100
319	285	257	235	216	200	187	177	167	158	151
638	570	515	470	432	400	375	354	334	317	302
957	855	773	705	648	600	563	531	502	476	452
1276	1140	1031	940	864	800	751	708	669	635	603
1596	1426	1288	1175	1080	1000	939	885	836	793	754
1915	1711	1546	1410	1296	1200	1126	1062	1004	953	906
2234	1996	1804	1645	1513	1400	1314	1239	1172	1111	1057
2554	2281	2062	1881	1729	1600	1499	1411	1332	1262	1199
2873	2567	2320	2116	1945	1800	1687	1587	1499	1420	1349
3192	2852	2577	2351	2161	2000	1869	1755	1654	1564	1483

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2 - Enter the air distance in the table below to find the correspondent reference fuel and time required.

AIR DISTANCE (NM)	FL 100	
	REFERENCE FUEL (KG)	TIME (MIN)
200	1207	43
400	2397	86
600	3605	128
800	4831	169
1000	6074	209
1200	7334	249
1400	8613	289
1600	9911	328
1800	11228	366
2000	12560	404

3 - Correct the reference fuel found previously using the next table.

REFERENCE FUEL (KG)	FUEL CORRECTION (KG)					
	LANDING WEIGHT (KG)					
	29000	31000	35000	38000	41000	44000
2000	-80	-55	0	91	178	267
4000	-252	-173	0	180	358	529
6000	-436	-300	0	226	447	663
8000	-532	-362	0	319	628	936
10000	-724	-489	0	364	720	-
12000	-821	-554	0	457	812	-

The holding fuel is determined from the holding table of AOM section 6-25.

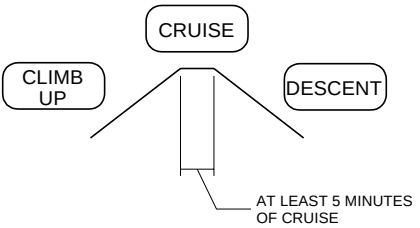
CRUISE - FLIGHT LEVEL TABLE

The following tables permit quick determination of the cruise flight level for minimum fuel consumption, based on the trip distance and takeoff weight.

The flight level was calculated based on a combination of minimum fuel

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consumption and at least 5 minutes in cruise.



EM170AOM060008B.DGN

The table data are presented for ISA condition, all engines operating, Long Range Cruise and Mach 0.78 schedules. A minimum remaining rate of climb equal to 300 ft/min is considered.

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FLIGHT LEVEL - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1

LONG RANGE CRUISE AND ISA CONDITIONS

TOW (kg)	TRIP DISTANCE (NM)											
	200	300	400	500	600	700	800	900	1000	1100	1200	1500 and above
51500 [1]	-	-	-	-	-	-	-	-	-	-	-	350
50000 [1]	-	-	-	-	-	-	-	-	-	-	350	350
48500 [1]	-	-	-	-	-	-	-	360	360	360	360	360
47000 [1]	-	-	-	-	-	370	370	370	370	370	370	370
45500 [1]	-	-	340	350	350	370	370	370	370	370	370	370
44000	260	350	350	350	350	380	380	380	380	380	380	380
42500	270	360	360	360	360	390	390	390	390	390	390	390
41000	270	360	360	370	370	390	390	390	390	390	390	390
39500	280	370	370	370	380	400	400	400	400	400	400	400
38000 [2]	300	380	380	380	380	410	410	410	410	410	410	-
36500 [2]	300	390	390	390	390	400	400	400	400	400	400	-
35000 [2]	310	400	400	400	400	400	400	-	-	-	-	-
33500 [2]	320	400	400	-	-	-	-	-	-	-	-	-

1. Owing to reduce fuel consumption in this trip, the blank spaces are caused by the landing weight going beyond the Maximum Landing Weight.

2. The blank spaces are caused by the TOW that does not allow a sufficient fuel quantity to accomplish the specified trip distance.

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FLIGHT LEVEL - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1
MACH 0.78 AND ISA CONDITIONS

TOW (kg)	TRIP DISTANCE (NM)											
	200	300	400	500	600	700	800	900	1000	1100	1200	1500 and above
51500 [1]	-	-	-	-	-	-	-	-	-	-	-	350
50000 [1]	-	-	-	-	-	-	-	-	-	-	360	360
48500 [1]	-	-	-	-	-	-	-	360	360	360	360	360
47000 [1]	-	-	-	-	370	370	370	370	370	370	370	370
45500 [1]	-	-	380	380	380	380	380	380	380	380	380	380
44000	320	380	380	380	380	380	380	380	380	380	380	380
42500	320	390	390	390	390	390	390	390	390	390	390	390
41000	330	400	400	400	400	400	400	400	400	400	400	400
39500	340	400	400	400	400	400	400	400	400	400	400	400
38000	350	410	410	410	410	410	410	410	410	410	410	410
36500 [2]	350	410	410	410	410	410	410	410	410	410	410	-
35000 [2]	360	410	410	410	410	410	410	-	-	-	-	-
33500 [2]	370	410	410	-	-	-	-	-	-	-	-	-

1. Owing to reduce fuel consumption in this trip, the blank spaces are caused by the landing weight going beyond the Maximum Landing Weight.

2. The blank spaces are caused by the TOW that does not allow a sufficient fuel quantity to accomplish the specified trip distance.

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CRUISE - ALTITUDE CAPABILITY TABLE

The tables below permit quick determination of the altitude capability, based on the initial cruise weight. Two tables are presented, one considering a Long Range Cruise Schedule and the other Mach 0.78, for various ISA conditions and all engines operating.

The established associated conditions are:

Flaps..... UP
Gears..... UP
Bleeds..... OPEN
Center of gravity..... 22%
Minimum Remaining Rate of Climb..... 300 ft/min

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CRUISE ALTITUDE CAPABILITY - ALL ENGINES OPERATING

LONG RANGE CRUISE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

Weight	ISA + ºC									
(kg)	-10	-5	0	5	10	15	20	25	30	35
52000	340	340	340	340	340	330	320	310	290	270
51000	340	340	340	340	340	330	320	310	300	280
50000	340	350	350	350	350	340	330	320	310	280
49000	340	350	350	350	350	340	330	320	310	290
48000	340	360	360	360	360	350	340	330	320	300
47000	340	360	360	360	360	350	340	340	330	300
46000	340	370	370	370	370	360	350	340	330	310
45000	340	370	370	370	370	360	350	340	340	320
44000	340	370	370	370	370	360	350	350	340	330
43000	340	380	380	380	380	370	360	350	350	340
42000	340	380	380	380	380	370	370	350	350	350
41000	340	390	390	390	390	380	370	360	360	350
40000	340	390	390	390	390	380	370	370	360	360
39000	340	400	400	400	400	390	380	370	370	360
38000	340	400	400	400	400	390	380	380	370	370
37000	340	410	410	410	410	390	390	390	380	370
36000	340	410	410	410	410	400	390	390	380	380
35000	340	410	410	410	410	400	400	400	390	380
34000	340	410	410	410	410	410	400	400	400	390
33000	340	410	410	410	410	410	410	410	400	390
32000	340	410	410	410	410	410	410	410	410	400
31000	340	410	410	410	410	410	410	410	410	400
30000	340	410	410	410	410	410	410	410	410	410
29000	340	410	410	410	410	410	410	410	410	410
28000	340	410	410	410	410	410	410	410	410	410

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CRUISE ALTITUDE CAPABILITY - ALL ENGINES OPERATING

MACH 0.78

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

Weight	ISA + ºC									
(kg)	-10	-5	0	5	10	15	20	25	30	35
52000	340	340	340	340	340	310	-	-	-	-
51000	340	350	350	350	350	320	-	-	-	-
50000	340	350	350	350	350	340	-	-	-	-
49000	340	350	350	350	350	340	-	-	-	-
48000	340	360	360	360	360	350	-	-	-	-
47000	340	360	360	360	360	360	330	-	-	-
46000	340	370	370	370	370	360	340	-	-	-
45000	340	370	370	370	370	360	350	-	-	-
44000	340	380	380	380	380	370	350	-	-	-
43000	340	380	380	380	380	370	360	-	-	-
42000	340	390	390	390	390	380	360	-	-	-
41000	340	390	390	390	390	380	370	350	-	-
40000	340	390	390	390	390	380	370	360	-	-
39000	340	400	400	400	400	390	380	360	-	-
38000	340	400	400	400	400	390	380	370	-	-
37000	340	410	410	410	410	400	390	370	-	-
36000	340	410	410	410	410	400	390	370	-	-
35000	340	410	410	410	410	410	390	380	-	-
34000	340	410	410	410	410	410	400	380	360	-
33000	340	410	410	410	410	410	400	390	360	-
32000	340	410	410	410	410	410	410	390	370	-
31000	340	410	410	410	410	410	410	390	370	-
30000	340	410	410	410	410	410	410	400	380	-
29000	340	410	410	410	410	410	410	400	380	-
28000	340	410	410	410	410	410	410	410	380	360

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CRUISE - WIND ALTITUDE TRADE

The following tables allow the determination of the break-even wind in order to maintain the same ground specific range at another altitude than the one planned initially. Long Range Cruise or Mach 0.78 tables are provided.

These tables are based on the comparison between ground specific range at the new and actual altitudes. They do not consider climb/descent time, fuel and distances. The tables may be used in-flight, where the wind information is available and more accurate.

Evaluation Method

1 - Check the wind factors for actual and new altitudes.

2 - Calculate the difference between new and actual wind factors. This number may be negative or positive.

3 - The BREAK-EVEN WIND at the new altitude is the wind component at actual altitude plus the difference calculated on step (2).

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CRUISE – WIND ALTITUDE TRADE TABLES

LONG RANGE CRUISE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES										
Pressure Altitude (ft)	**Weight (kg)**									
	32000	**34000**	**36000**	**38000**	**40000**	**42000**	**44000**	**46000**	**48000**	**50000**
41000	0	5	0	-	-	-	-	-	-	-
40000	6	0	4	0	-	-	-	-	-	-
39000	12	4	1	7	0	-	-	-	-	-
38000	17	10	2	3	7	0	-	-	-	-
37000	21	15	8	3	4	7	0	0	-	-
36000	25	20	13	8	1	4	6	5	0	-
35000	28	24	19	15	9	2	4	13	7	0
34000	33	27	23	21	15	9	3	10	13	7
33000	40	33	27	25	21	16	10	9	10	13
32000	48	38	32	29	25	22	16	16	10	9
31000	55	43	37	33	29	26	22	22	17	11
30000	63	51	41	38	33	30	27	28	23	17
29000	72	60	49	43	39	35	31	33	29	24
28000	79	68	57	50	44	40	35	36	34	29
27000	86	76	66	59	50	45	41	41	38	34

Example: 40000 kg of actual cruise weight, LRC:

Actual Flight Level: FL 280, -10 kt (headwind)

New Flight Level: FL 350, -20 kt (headwind)

1 - Wind factor FL280 = 44, Wind factor FL350 = 9

2 - Difference = 9 (new FL) - 44 (actual FL) = -35

3 - Break Even Wind = -10 (wind actual FL) + (-35) (difference) = -45 kt

Wind on FL350 (20 kt headwind) is more favorable than Break-Even Wind (45 kt headwind). Therefore, climb to FL350.

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MACH 0.78

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES										
Pressure Altitude (ft)	**Weight (kg)**									
	32000	**34000**	**36000**	**38000**	**40000**	**42000**	**44000**	**46000**	**48000**	**50000**
41000	0	0	0	-	-	-	-	-	-	-
40000	11	3	6	0	-	-	-	-	-	-
39000	24	13	10	9	0	0	-	-	-	-
38000	37	26	19	12	8	6	0	-	-	-
37000	51	39	32	20	12	14	6	0	-	-
36000	66	53	45	32	18	18	14	6	0	-
35000	83	69	61	47	33	26	19	16	7	0
34000	101	87	78	63	47	39	27	20	15	8
33000	118	103	94	78	62	54	41	29	20	16
32000	136	120	111	95	78	69	55	42	29	21
31000	158	139	129	112	95	86	71	57	44	32
30000	180	161	148	130	113	103	87	73	59	45
29000	204	183	169	149	131	121	104	89	74	61
28000	229	207	192	171	150	140	123	107	91	76
27000	254	230	215	192	170	158	140	124	108	92

Example: 40000 kg of actual cruise weight, Mach 0.78:

Actual Flight Level: FL 360, -10 kt (headwind)
New Flight Level: FL 310, 15 kt (tailwind)
1 - Wind factor FL360 = 18, Wind factor FL310 = 95
2 - Difference = 95 (new FL) - 18 (actual FL) = 77
3 - Break-Even Wind = -10 (wind actual FL) + 77 (difference) = 67 kt

Wind on FL310 (15 kt tailwind) is less favorable than Break-Even Wind (67 kt tailwind). Therefore, maintain FL360.

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FLIGHT PLANNING - FUEL TANKERING

Fuel price variations at different airports may require carrying more fuel than the minimum required on a flight leg. The procedure of loading this extra amount of fuel (or surplus fuel) in order to minimize fuel costs is known as Fuel Tankering.

Since the surplus fuel tankered results in additional fuel burnoff (due to the weight increase) it is important to analyze the costs of the extra fuel transportation operation.

The following tables are designed to determine the break-even fuel price on departure airport and it may be used whenever there is difference on fuel price comparing to destination. Tables are provided for LRC and M 0.78 cruise schedule.

Enter the trip distance on the table and read the fuel surplus ratio according to cruise altitude. The break-even fuel price is the price at departure multiplied by the fuel surplus ratio. If break-even fuel price is lower than destination price, it is economically feasible to execute fuel tankering.

The additional maintenance costs involved with increased weight operations (additional brakes and tires wearing) are not considered. It is important to remind that whenever fuel tankering is considered, the estimated landing weight at destination should be lower than the Maximum Landing Weight.

Example

Analyze the possibility to proceed with fuel tankering between two airports distant 600 NM from each other, using LRC speed schedule cruising on FL350. Consider the following fuel prices:

Departure Airport: 1.80 US$/Gal.

Destination Airport: 2.00 US$/Gal.

- Enter the LONG RANGE CRUISE table for 600 NM trip distance and FL350, the FUEL SURPLUS RATIO is 1.05.
- The BREAK-EVEN PRICE is 1.80 (price at departure) multiplied by 1.05 = 1.89 US$/Gal.

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Since fuel price on destination airport (2.00 US$/Gal) is greater than break-even fuel price (1.89 US$/Gal), it is economically feasible the fuel tankering operation between these two airports.

FUEL TANKERING		
EMBRAER 190 / CF34-10E5/10E5A1/10E6/10E6A1 ENGINES		
LONG RANGE CRUISE		
TRIP DISTANCE (NM)	FUEL SURPLUS RATIO	
	31000 ft and below	32000 ft above
200	1.01	1.02
400	1.03	1.03
600	1.04	1.05
800	1.05	1.06
1000	1.07	1.08
1200	1.08	1.10
1400	1.10	1.12
1600	1.11	1.13
1800	1.13	1.15
2000	1.14	1.18
2200	1.16	1.20
2400	1.17	1.21

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FUEL TANKERING		
EMBRAER 190 / CF34-10E5/10E5A1/10E6/10E6A1 ENGINES		
MACH 0.78		
TRIP DISTANCE (NM)	FUEL SURPLUS RATIO	
	31000 ft and below	32000 ft above
200	1.01	1.01
400	1.02	1.02
600	1.02	1.03
800	1.03	1.04
1000	1.04	1.05
1200	1.05	1.06
1400	1.06	1.07
1600	1.06	1.08
1800	1.07	1.09
2000	1.08	1.10
2200	1.09	1.11
2400	1.10	1.12

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ENGINE FUEL CONSUMPTION

The following values established for taxi, take-off, approach and go around fuel consumption should be considered when calculating detailed flight plans.

FUEL CONSUMPTION

ENGINE	PHASE OF FLIGHT	FUEL CONSUMPTION kg/min
ALL ENGINE TYPES	TAXI	9
	TAKE-OFF	95
	APPROACH AND LANDING	26
	GO AROUND	89

A typical average value to be used during the flight planning calculation should be considered:

TAKE-OFF = 142 kg (1.5 minutes used);

APPROACH AND LANDING = 79 kg (3 minutes used);

GO AROUND = 71 kg (0.8 minutes used).

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APU FUEL CONSUMPTION

The table below shows the APU fuel consumption on the ground and during level flight at 5000 ft, 15000 ft, and 33000 ft altitudes. The data is calculated for different airspeeds, APU air bleeds and electrical loads.

ALTITUDE (ft)	AIRSPEED (KIAS)	APU AIR BLEED	APU GEN. LOAD (kVA)	APU FUEL FLOW (kg/min)
0	0	0	0	1.5
			40	1.7
		Max.	0	2.1
			40	2.4
5000	170	0	0	1.3
			40	1.5
		Max.	0	1.8
			40	2.0
	300	0	0	1.3
			40	1.5
		Max.	0	1.8
			40	2.0
15000	170	0	0	1.0
			40	1.2
		Max.	0	1.4
			40	1.7
	320	0	0	1.0
			40	1.2
		Max.	0	1.4
			40	1.7
33000	170	0	0	0.7
			40	1.0
	300	0	0	0.6
			40	0.9

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CLIMB SPEEDS

MAXIMUM ANGLE SPEED

This speed is recommended for obstacle clearance in order to reach an altitude on minimum ground distance. The recommended maximum angle speed is related to flaps up, all engines operating and is approximately VFS for all gross weights and altitudes.

MAXIMUM RATE OF CLIMB SPEED

This speed is recommended when maximum rate of climb is desired in order to reach an altitude on minimum climb time. The recommended maximum rate of climb speed is related to flaps up, all engines operating and is function of gross weights and altitudes as shown in the tables below:

Altitude (ft)	Weight (kg)							
	38000	40000	42000	44000	46000	48000	50000	52000
5000	255	256	259	262	264	265	267	269
10000	249	250	250	251	253	254	255	257
15000	238	241	243	244	246	247	249	252
20000	228	232	235	239	243	244	247	249
25000	225	226	230	234	237	242	245	249

Maintain the speeds above until intercepting Mach 0.60. Then fly with this Mach number until level off.

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CLIMB TABLES

The climb planning tables show fuel consumption, distance, and time elapsed from the Sea Level to the top of climb. Data are shown for various weights, ISA deviations and cruise altitudes.

The takeoff fuel consumption is not considered in the following tables.

Tables present the scheduled climb speed according to the autopilot climb mode, i.e.:

– 250 KIAS for altitudes up to 10000 ft, increasing linearly to 290 KIAS at 12000 ft, maintaining 290 KIAS up to 28900 ft and 0.75 Mach above 28900 ft.

The associated conditions are:

Thrust Mode..... CLB1
Flaps..... UP
Gear..... UP
Bleeds..... OPEN
Anti-Ice..... OFF
CG..... 22%
Minimum Remaining Rate of Climb..... 300 ft/min

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EXAMPLE:

Given:
Departure Airport Elevation..... 3500 ft
Takeoff weight..... 46000 kg
ISA Condition Cruise Altitude..... 33000 ft

RESULTS:

Data for 5000 ft (3500 ft + 1500 ft above departure airport) obtained from the climb table:

Fuel: 121 kg

Distance: 6 NM

Time: 1 min

Data provided from the Sea Level to 33000 ft (Top of Climb) table:

Fuel: 1061 kg

Distance: 109 NM

Time: 17 min

The fuel, distance and time spent during the climb phase (from 5000 ft to 33000 ft) are:

Fuel: 1061 – 121 = 940 kg

Distance: 109 – 6 = 103 NM

Time: 17 – 1 = 16 min

The fuel consumption related to the takeoff phase is provided on the Section 1-06-07.

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 5000 AND 6000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			5000 FT ISA + °C					6000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	130	136	143	149	167	157	164	171	179	200
52000	Distance	NM	6	7	7	7	9	8	8	9	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	127	133	139	145	162	152	159	167	175	195
51000	Distance	NM	6	7	7	7	9	8	8	8	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	124	129	135	141	157	148	155	162	170	189
50000	Distance	NM	6	6	7	7	8	7	8	8	8	10
	Time	min	1	2	2	2	2	2	2	2	2	2
	Fuel	kg	120	126	132	138	153	144	151	158	165	184
49000	Distance	NM	6	6	6	7	8	7	8	8	8	10
	Time	min	1	1	2	2	2	2	2	2	2	2
	Fuel	kg	117	122	128	134	149	140	147	154	161	178
48000	Distance	NM	6	6	6	7	8	7	7	8	8	10
	Time	min	1	1	1	2	2	2	2	2	2	2
	Fuel	kg	114	119	124	130	144	137	143	149	156	173
47000	Distance	NM	6	6	6	6	8	7	7	7	8	10
	Time	min	1	1	1	1	2	2	2	2	2	2
	Fuel	kg	111	116	121	127	140	133	139	145	152	168
46000	Distance	NM	5	6	6	6	8	7	7	7	8	9
	Time	min	1	1	1	1	2	2	2	2	2	2
	Fuel	kg	108	113	118	123	136	129	135	141	148	163
45000	Distance	NM	5	6	6	6	7	6	7	7	7	9
	Time	min	1	1	1	1	2	2	2	2	2	2
	Fuel	kg	105	109	114	120	132	125	131	137	144	159
44000	Distance	NM	5	5	6	6	7	6	7	7	7	9
	Time	min	1	1	1	1	2	2	2	2	2	2
For Anti-	Fuel	(%)	6	6	3	0	0	6	6	4	0	0
ice ON,	Distance	(%)	10	11	6	0	0	11	11	7	0	0
increase	Time	(%)	10	11	6	0	0	10	11	7	0	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 5000 AND 6000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			5000 FT ISA + °C					6000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	102	106	111	116	128	122	128	133	140	154
43000	Distance	NM	5	5	5	6	7	6	6	7	7	8
	Time	min	1	1	1	1	2	1	2	2	2	2
	Fuel	kg	99	103	108	113	124	118	124	130	136	149
42000	Distance	NM	5	5	5	6	7	6	6	6	7	8
	Time	min	1	1	1	1	2	1	1	2	2	2
	Fuel	kg	96	100	105	110	121	115	120	126	132	145
41000	Distance	NM	5	5	5	5	6	6	6	6	7	8
	Time	min	1	1	1	1	1	1	1	1	1	2
	Fuel	kg	93	97	102	106	117	112	117	122	128	141
40000	Distance	NM	5	5	5	5	6	6	6	6	6	8
	Time	min	1	1	1	1	1	1	1	1	1	2
	Fuel	kg	90	94	99	103	113	108	113	118	124	136
39000	Distance	NM	4	5	5	5	6	5	6	6	6	7
	Time	min	1	1	1	1	1	1	1	1	1	2
	Fuel	kg	87	92	96	100	110	105	110	115	120	132
38000	Distance	NM	4	4	5	5	6	5	5	6	6	7
	Time	min	1	1	1	1	1	1	1	1	1	2
	Fuel	kg	85	89	93	97	106	102	106	111	116	128
37000	Distance	NM	4	4	5	5	6	5	5	6	6	7
	Time	min	1	1	1	1	1	1	1	1	1	2
	Fuel	kg	82	86	90	94	103	99	103	108	113	124
36000	Distance	NM	4	4	4	5	6	5	5	5	6	7
	Time	min	1	1	1	1	1	1	1	1	1	2
	Fuel	kg	80	83	87	91	100	95	100	104	109	120
35000	Distance	NM	4	4	4	4	5	5	5	5	5	7
	Time	min	1	1	1	1	1	1	1	1	1	1
For Anti-	Fuel	(%)	6	6	3	0	0	6	6	4	0	0
ice ON,	Distance	(%)	10	10	6	0	0	10	10	7	0	0
increase	Time	(%)	10	10	5	0	0	10	10	6	0	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 5000 AND 6000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			5000 FT ISA + °C					6000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	77	81	84	88	96	92	97	101	106	116
34000	Distance	NM	4	4	4	4	5	5	5	5	5	6
	Time	min	1	1	1	1	1	1	1	1	1	1
	Fuel	kg	74	78	81	85	93	89	93	98	102	112
33000	Distance	NM	4	4	4	4	5	4	5	5	5	6
	Time	min	1	1	1	1	1	1	1	1	1	1
	Fuel	kg	72	75	79	82	90	86	90	94	99	108
32000	Distance	NM	4	4	4	4	5	4	4	5	5	6
	Time	min	1	1	1	1	1	1	1	1	1	1
	Fuel	kg	69	73	76	79	87	83	87	91	95	104
31000	Distance	NM	3	4	4	4	5	4	4	4	5	6
	Time	min	1	1	1	1	1	1	1	1	1	1
	Fuel	kg	67	70	73	77	84	80	84	88	92	100
30000	Distance	NM	3	3	4	4	4	4	4	4	4	5
	Time	min	1	1	1	1	1	1	1	1	1	1
For Anti-	Fuel	(%)	5	5	3	0	0	5	5	3	0	0
ice ON,	Distance	(%)	10	10	5	0	0	10	10	6	0	0
increase	Time	(%)	9	9	5	0	0	9	10	6	0	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 7000 AND 8000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			7000 FT ISA + °C					8000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	183	191	200	210	234	209	219	229	240	268
52000	Distance	NM	9	10	10	11	13	11	11	12	12	15
	Time	min	2	2	2	2	3	3	3	3	3	3
	Fuel	kg	178	186	195	204	227	204	213	223	233	260
51000	Distance	NM	9	10	10	10	13	11	11	12	12	15
	Time	min	2	2	2	2	3	3	3	3	3	3
	Fuel	kg	173	181	190	198	221	198	207	217	227	253
50000	Distance	NM	9	9	10	10	12	10	11	11	12	14
	Time	min	2	2	2	2	3	2	3	3	3	3
	Fuel	kg	168	176	184	193	215	193	202	211	221	246
49000	Distance	NM	9	9	9	10	12	10	11	11	11	14
	Time	min	2	2	2	2	3	2	2	2	3	3
	Fuel	kg	164	171	179	188	208	187	196	205	215	239
48000	Distance	NM	8	9	9	10	12	10	10	11	11	14
	Time	min	2	2	2	2	3	2	2	2	2	3
	Fuel	kg	159	167	174	183	202	182	191	200	209	232
47000	Distance	NM	8	9	9	9	11	10	10	10	11	13
	Time	min	2	2	2	2	3	2	2	2	2	3
	Fuel	kg	155	162	170	177	197	177	185	194	203	225
46000	Distance	NM	8	8	9	9	11	9	10	10	10	13
	Time	min	2	2	2	2	2	2	2	2	2	3
	Fuel	kg	151	158	165	172	191	172	180	189	197	218
45000	Distance	NM	8	8	8	9	11	9	9	10	10	12
	Time	min	2	2	2	2	2	2	2	2	2	3
	Fuel	kg	146	153	160	168	185	167	175	183	192	212
44000	Distance	NM	8	8	8	8	10	9	9	9	10	12
	Time	min	2	2	2	2	2	2	2	2	2	3
For Anti-	Fuel	(%)	6	7	5	0	0	6	7	5	0	0
ice ON,	Distance	(%)	11	11	8	0	0	11	11	8	1	0
increase	Time	(%)	11	11	8	0	0	11	11	8	1	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 7000 AND 8000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			7000 FT ISA + °C					8000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	142	149	156	163	180	163	170	178	186	206
43000	Distance	NM	7	8	8	8	10	8	9	9	10	12
	Time	min	2	2	2	2	2	2	2	2	2	3
	Fuel	kg	138	144	151	158	174	158	165	173	181	199
42000	Distance	NM	7	7	8	8	10	8	9	9	9	11
	Time	min	2	2	2	2	2	2	2	2	2	3
	Fuel	kg	134	140	147	153	169	153	160	168	175	193
41000	Distance	NM	7	7	7	8	9	8	8	9	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	130	136	142	149	164	149	156	163	170	187
40000	Distance	NM	7	7	7	8	9	8	8	8	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	126	132	138	144	159	144	151	158	165	182
39000	Distance	NM	6	7	7	7	9	8	8	8	8	10
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	122	128	134	140	154	140	146	153	160	176
38000	Distance	NM	6	7	7	7	9	7	8	8	8	10
	Time	min	1	2	2	2	2	2	2	2	2	2
	Fuel	kg	119	124	130	136	149	135	142	148	155	170
37000	Distance	NM	6	6	7	7	8	7	7	8	8	10
	Time	min	1	1	2	2	2	2	2	2	2	2
	Fuel	kg	115	120	126	131	144	131	137	144	150	165
36000	Distance	NM	6	6	6	7	8	7	7	7	8	9
	Time	min	1	1	1	2	2	2	2	2	2	2
	Fuel	kg	111	116	122	127	140	127	133	139	145	160
35000	Distance	NM	6	6	6	6	8	7	7	7	7	9
	Time	min	1	1	1	1	2	2	2	2	2	2
For Anti-	Fuel	(%)	6	6	4	0	0	6	6	4	0	0
ice ON,	Distance	(%)	10	10	7	0	0	10	10	8	1	0
increase	Time	(%)	10	10	7	0	0	10	10	8	1	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 7000 AND 8000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			7000 FT ISA + °C					8000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	108	113	118	123	135	123	129	135	141	154
34000	Distance	NM	5	6	6	6	7	6	7	7	7	9
	Time	min	1	1	1	1	2	2	2	2	2	2
	Fuel	kg	104	109	114	119	130	119	124	130	136	149
33000	Distance	NM	5	5	6	6	7	6	6	7	7	8
	Time	min	1	1	1	1	2	1	2	2	2	2
	Fuel	kg	100	105	110	115	126	115	120	126	131	144
32000	Distance	NM	5	5	6	6	7	6	6	6	7	8
	Time	min	1	1	1	1	2	1	1	1	2	2
	Fuel	kg	97	101	106	111	121	111	116	121	127	139
31000	Distance	NM	5	5	5	6	7	6	6	6	6	8
	Time	min	1	1	1	1	2	1	1	1	1	2
	Fuel	kg	94	98	102	107	117	107	112	117	122	134
30000	Distance	NM	5	5	5	5	6	5	6	6	6	8
	Time	min	1	1	1	1	1	1	1	1	1	2
For Anti-	Fuel	(%)	5	5	4	0	0	5	5	4	0	0
ice ON,	Distance	(%)	10	10	7	0	0	10	10	8	1	0
increase	Time	(%)	9	10	7	0	0	9	10	7	1	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 9000 AND 10000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			9000 FT ISA + °C					10000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	236	247	258	270	302	262	275	287	301	337
52000	Distance	NM	13	13	14	14	18	14	15	16	16	20
	Time	min	3	3	3	3	4	3	3	3	4	4
	Fuel	kg	229	240	251	263	294	255	267	280	293	327
51000	Distance	NM	12	13	13	14	17	14	14	15	16	19
	Time	min	3	3	3	3	4	3	3	3	3	4
	Fuel	kg	223	233	244	256	285	248	260	272	285	318
50000	Distance	NM	12	12	13	13	17	14	14	15	15	19
	Time	min	3	3	3	3	4	3	3	3	3	4
	Fuel	kg	217	227	238	249	277	241	253	264	277	308
49000	Distance	NM	12	12	13	13	16	13	14	14	15	18
	Time	min	3	3	3	3	4	3	3	3	3	4
	Fuel	kg	211	221	231	242	269	235	246	257	269	299
48000	Distance	NM	11	12	12	13	16	13	13	14	14	18
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	205	215	225	235	261	228	239	250	261	291
47000	Distance	NM	11	11	12	12	15	12	13	13	14	17
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	199	209	218	228	253	222	232	243	254	282
46000	Distance	NM	11	11	12	12	15	12	13	13	14	17
	Time	min	2	3	3	3	3	3	3	3	3	4
	Fuel	kg	194	203	212	222	246	216	226	236	247	274
45000	Distance	NM	10	11	11	12	14	12	12	13	13	16
	Time	min	2	2	3	3	3	3	3	3	3	4
	Fuel	kg	188	197	206	216	239	209	219	229	240	266
44000	Distance	NM	10	10	11	11	14	11	12	12	13	16
	Time	min	2	2	2	3	3	3	3	3	3	3
For Anti-	Fuel	(%)	6	7	5	1	0	7	7	5	2	0
ice ON,	Distance	(%)	11	11	9	2	0	11	11	9	4	0
increase	Time	(%)	11	11	9	2	0	11	11	9	4	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 9000 AND 10000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			9000 FT ISA + °C					10000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	183	191	200	210	232	203	213	223	233	258
43000	Distance	NM	10	10	11	11	13	11	11	12	12	15
	Time	min	2	2	2	2	3	3	3	3	3	3
	Fuel	kg	178	186	195	203	225	197	207	216	226	250
42000	Distance	NM	9	10	10	11	13	11	11	12	12	15
	Time	min	2	2	2	2	3	3	3	3	3	3
	Fuel	kg	172	180	189	197	218	192	201	210	219	242
41000	Distance	NM	9	10	10	10	13	10	11	11	12	14
	Time	min	2	2	2	2	3	2	2	3	3	3
	Fuel	kg	167	175	183	192	211	186	195	204	213	235
40000	Distance	NM	9	9	10	10	12	10	10	11	11	14
	Time	min	2	2	2	2	3	2	2	2	3	3
	Fuel	kg	162	170	178	186	205	180	189	197	206	227
39000	Distance	NM	9	9	9	10	12	10	10	11	11	13
	Time	min	2	2	2	2	3	2	2	2	2	3
	Fuel	kg	157	165	172	180	198	175	183	191	200	220
38000	Distance	NM	8	9	9	9	11	9	10	10	11	13
	Time	min	2	2	2	2	3	2	2	2	2	3
	Fuel	kg	152	159	167	174	192	169	177	185	194	213
37000	Distance	NM	8	8	9	9	11	9	10	10	10	13
	Time	min	2	2	2	2	2	2	2	2	2	3
	Fuel	kg	148	154	162	169	186	164	172	180	188	206
36000	Distance	NM	8	8	8	9	11	9	9	10	10	12
	Time	min	2	2	2	2	2	2	2	2	2	3
	Fuel	kg	143	149	156	164	180	159	166	174	182	200
35000	Distance	NM	8	8	8	9	10	9	9	9	10	12
	Time	min	2	2	2	2	2	2	2	2	2	3
For Anti-	Fuel	(%)	6	6	5	1	0	6	6	5	2	0
ice ON,	Distance	(%)	10	11	8	2	0	10	11	9	3	0
increase	Time	(%)	10	10	8	2	0	10	10	8	3	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 9000 AND 10000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			9000 FT ISA + °C					10000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	138	145	151	158	174	153	161	168	176	193
34000	Distance	NM	7	8	8	8	10	8	9	9	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	134	140	146	153	168	148	155	162	170	186
33000	Distance	NM	7	7	8	8	10	8	8	9	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	129	135	141	148	162	143	150	157	164	180
32000	Distance	NM	7	7	7	8	9	8	8	8	9	11
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	125	130	136	143	156	138	145	151	158	173
31000	Distance	NM	7	7	7	7	9	7	8	8	8	10
	Time	min	2	2	2	2	2	2	2	2	2	2
	Fuel	kg	120	126	131	137	150	133	140	146	153	167
30000	Distance	NM	6	7	7	7	9	7	7	8	8	10
	Time	min	2	2	2	2	2	2	2	2	2	2
For Anti-	Fuel	(%)	5	5	4	1	0	5	6	4	2	0
ice ON,	Distance	(%)	10	10	8	2	0	10	10	8	3	0
increase	Time	(%)	10	10	8	2	0	10	10	8	3	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 11000 AND 12000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			11000 FT ISA + °C					12000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	304	318	333	349	391	348	365	382	400	451
52000	Distance	NM	17	18	19	19	24	21	21	22	23	29
	Time	min	4	4	4	4	5	5	5	5	5	6
	Fuel	kg	296	310	324	339	380	339	355	372	389	438
51000	Distance	NM	17	17	18	19	23	20	21	22	23	28
	Time	min	4	4	4	4	5	4	5	5	5	6
	Fuel	kg	288	301	315	330	369	330	345	361	378	425
50000	Distance	NM	16	17	18	18	23	19	20	21	22	27
	Time	min	4	4	4	4	5	4	4	5	5	6
	Fuel	kg	280	293	306	321	358	320	336	351	368	413
49000	Distance	NM	16	16	17	18	22	19	20	20	21	26
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	272	285	298	312	348	312	326	342	357	400
48000	Distance	NM	15	16	17	17	21	18	19	20	21	26
	Time	min	3	4	4	4	5	4	4	4	4	5
	Fuel	kg	264	277	290	303	337	303	317	332	347	389
47000	Distance	NM	15	16	16	17	21	18	19	19	20	25
	Time	min	3	3	4	4	4	4	4	4	4	5
	Fuel	kg	257	269	281	294	328	294	308	323	337	377
46000	Distance	NM	14	15	16	16	20	17	18	19	20	24
	Time	min	3	3	3	4	4	4	4	4	4	5
	Fuel	kg	250	261	273	286	318	286	299	313	328	366
45000	Distance	NM	14	15	15	16	20	17	17	18	19	23
	Time	min	3	3	3	3	4	4	4	4	4	5
	Fuel	kg	242	254	266	278	308	278	291	304	318	355
44000	Distance	NM	14	14	15	15	19	16	17	18	18	23
	Time	min	3	3	3	3	4	4	4	4	4	5
For Anti-	Fuel	(%)	7	7	6	3	0	7	7	7	4	0
ice ON,	Distance	(%)	11	12	10	6	0	12	12	11	7	0
increase	Time	(%)	11	12	10	5	0	12	12	11	7	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 11000 AND 12000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			11000 FT ISA + °C					12000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	235	246	258	270	299	270	282	296	309	344
43000	Distance	NM	13	14	14	15	18	16	16	17	18	22
	Time	min	3	3	3	3	4	4	4	4	4	5
	Fuel	kg	228	239	250	262	290	262	274	287	300	334
42000	Distance	NM	13	13	14	15	18	15	16	17	17	21
	Time	min	3	3	3	3	4	3	3	4	4	4
	Fuel	kg	222	232	243	254	281	254	266	278	291	323
41000	Distance	NM	12	13	14	14	17	15	16	16	17	21
	Time	min	3	3	3	3	4	3	3	3	4	4
	Fuel	kg	215	225	236	246	272	246	258	270	282	313
40000	Distance	NM	12	13	13	14	17	14	15	16	16	20
	Time	min	3	3	3	3	4	3	3	3	3	4
	Fuel	kg	209	218	228	239	264	239	250	262	274	304
39000	Distance	NM	12	12	13	13	16	14	15	15	16	19
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	202	212	221	232	255	232	242	254	265	294
38000	Distance	NM	11	12	12	13	16	14	14	15	15	19
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	196	205	215	224	247	224	235	246	257	285
37000	Distance	NM	11	11	12	12	15	13	14	14	15	18
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	190	198	208	217	239	217	227	238	249	275
36000	Distance	NM	11	11	12	12	15	13	13	14	14	18
	Time	min	2	2	3	3	3	3	3	3	3	4
	Fuel	kg	183	192	201	210	231	210	220	230	241	266
35000	Distance	NM	10	11	11	12	14	12	13	13	14	17
	Time	min	2	2	2	3	3	3	3	3	3	4
For Anti-	Fuel	(%)	6	6	5	3	0	6	7	6	4	0
ice ON,	Distance	(%)	11	11	9	5	0	11	12	10	7	0
increase	Time	(%)	10	11	9	5	0	11	11	10	6	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 11000 AND 12000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			11000 FT ISA + °C					12000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	177	186	194	203	224	203	213	223	233	257
34000	Distance	NM	10	10	11	11	14	12	12	13	13	16
	Time	min	2	2	2	2	3	3	3	3	3	3
	Fuel	kg	172	180	188	197	216	197	206	215	225	248
33000	Distance	NM	10	10	10	11	13	11	12	12	13	16
	Time	min	2	2	2	2	3	3	3	3	3	3
	Fuel	kg	166	173	181	190	208	190	199	208	218	240
32000	Distance	NM	9	10	10	10	13	11	12	12	12	15
	Time	min	2	2	2	2	3	2	3	3	3	3
	Fuel	kg	160	167	175	183	201	183	192	201	210	231
31000	Distance	NM	9	9	10	10	12	11	11	12	12	15
	Time	min	2	2	2	2	3	2	2	2	3	3
	Fuel	kg	154	161	169	177	194	177	185	194	202	223
30000	Distance	NM	9	9	9	10	12	10	11	11	12	14
	Time	min	2	2	2	2	3	2	2	2	2	3
For Anti-	Fuel	(%)	6	6	5	2	0	6	6	5	3	0
ice ON,	Distance	(%)	10	11	9	5	0	11	11	10	6	0
increase	Time	(%)	10	10	9	4	0	10	11	9	6	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 13000 AND 14000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			13000 FT ISA + °C					14000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	377	395	414	433	491	407	426	446	467	531
52000	Distance	NM	23	24	25	26	32	25	26	28	29	36
	Time	min	5	5	5	5	7	5	6	6	6	7
	Fuel	kg	367	384	403	421	476	396	414	434	454	516
51000	Distance	NM	22	23	24	25	31	25	26	27	28	35
	Time	min	5	5	5	5	6	5	5	6	6	7
	Fuel	kg	357	374	392	410	462	385	403	422	442	500
50000	Distance	NM	22	23	23	24	31	24	25	26	27	34
	Time	min	5	5	5	5	6	5	5	5	5	7
	Fuel	kg	347	363	381	398	449	374	392	410	429	486
49000	Distance	NM	21	22	23	24	30	23	24	25	26	33
	Time	min	5	5	5	5	6	5	5	5	5	7
	Fuel	kg	337	353	370	387	435	363	381	399	417	471
48000	Distance	NM	20	21	22	23	29	23	24	25	26	32
	Time	min	4	5	5	5	6	5	5	5	5	6
	Fuel	kg	328	343	360	376	423	353	370	388	406	457
47000	Distance	NM	20	21	22	22	28	22	23	24	25	31
	Time	min	4	4	5	5	6	5	5	5	5	6
	Fuel	kg	319	334	349	366	410	343	359	377	394	443
46000	Distance	NM	19	20	21	22	27	21	22	23	24	30
	Time	min	4	4	4	4	5	5	5	5	5	6
	Fuel	kg	309	324	339	355	398	333	349	366	383	430
45000	Distance	NM	19	19	20	21	26	21	22	22	23	29
	Time	min	4	4	4	4	5	4	5	5	5	6
	Fuel	kg	301	315	330	345	386	324	339	355	372	417
44000	Distance	NM	18	19	20	21	25	20	21	22	23	28
	Time	min	4	4	4	4	5	4	4	5	5	6
For Anti-	Fuel	(%)	8	8	7	5	1	8	8	7	5	2
ice ON,	Distance	(%)	12	13	12	8	1	13	13	12	9	4
increase	Time	(%)	12	13	11	8	1	13	13	12	9	3

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 13000 AND 14000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			13000 FT ISA + °C					14000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	292	306	320	335	374	314	329	345	361	404
43000	Distance	NM	18	18	19	20	25	19	20	21	22	27
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	283	297	311	325	363	305	320	335	350	392
42000	Distance	NM	17	18	19	19	24	19	20	21	21	27
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	275	288	301	315	352	296	310	325	340	380
41000	Distance	NM	17	17	18	19	23	18	19	20	21	26
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	267	279	292	306	341	287	301	315	330	368
40000	Distance	NM	16	17	17	18	22	18	19	19	20	25
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	259	271	284	297	330	278	292	305	320	357
39000	Distance	NM	16	16	17	18	22	17	18	19	20	24
	Time	min	3	3	4	4	4	4	4	4	4	5
	Fuel	kg	251	262	275	288	319	270	283	296	310	345
38000	Distance	NM	15	16	16	17	21	17	17	18	19	23
	Time	min	3	3	3	4	4	4	4	4	4	5
	Fuel	kg	243	254	266	279	309	261	274	287	300	334
37000	Distance	NM	15	15	16	17	20	16	17	18	18	23
	Time	min	3	3	3	3	4	3	4	4	4	4
	Fuel	kg	235	246	258	270	299	253	265	278	291	323
36000	Distance	NM	14	15	15	16	20	16	16	17	18	22
	Time	min	3	3	3	3	4	3	3	4	4	4
	Fuel	kg	228	238	249	261	289	245	257	269	281	313
35000	Distance	NM	14	14	15	15	19	15	16	16	17	21
	Time	min	3	3	3	3	4	3	3	3	3	4
For Anti-	Fuel	(%)	7	7	6	4	1	7	7	7	5	2
ice ON,	Distance	(%)	12	12	11	8	1	12	12	11	9	3
increase	Time	(%)	11	12	10	7	1	12	12	11	8	3

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 13000 AND 14000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			13000 FT ISA + °C					14000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	220	230	241	252	280	237	248	260	272	302
34000	Distance	NM	13	14	14	15	18	15	15	16	17	20
	Time	min	3	3	3	3	4	3	3	3	3	4
	Fuel	kg	213	223	233	244	270	229	240	251	263	292
33000	Distance	NM	13	13	14	14	18	14	15	15	16	20
	Time	min	3	3	3	3	4	3	3	3	3	4
	Fuel	kg	205	215	225	236	261	221	232	243	254	282
32000	Distance	NM	12	13	13	14	17	14	14	15	15	19
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	198	208	217	227	251	213	224	234	245	272
31000	Distance	NM	12	12	13	13	16	13	14	14	15	18
	Time	min	3	3	3	3	3	3	3	3	3	4
	Fuel	kg	191	200	210	219	242	206	216	226	236	262
30000	Distance	NM	11	12	12	13	16	13	13	14	14	18
	Time	min	3	3	3	3	3	3	3	3	3	4
For Anti-	Fuel	(%)	6	6	6	4	1	6	7	6	4	1
ice ON,	Distance	(%)	11	11	10	7	1	12	12	11	8	3
increase	Time	(%)	11	11	10	7	1	11	11	10	7	2

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 15000 AND 16000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			15000 FT ISA + °C					16000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	437	458	480	502	573	467	490	513	538	616
52000	Distance	NM	28	29	30	32	40	31	32	33	35	44
	Time	min	6	6	6	6	8	6	6	7	7	8
	Fuel	kg	425	445	466	488	556	454	476	499	523	598
51000	Distance	NM	27	28	30	31	39	30	31	32	34	43
	Time	min	6	6	6	6	8	6	6	6	7	8
	Fuel	kg	413	433	453	475	540	442	463	485	508	580
50000	Distance	NM	26	27	29	30	38	29	30	32	33	42
	Time	min	6	6	6	6	7	6	6	6	6	8
	Fuel	kg	401	420	441	461	523	429	450	471	494	563
49000	Distance	NM	26	27	28	29	37	28	29	31	32	40
	Time	min	5	6	6	6	7	6	6	6	6	8
	Fuel	kg	390	409	428	448	508	417	437	458	480	546
48000	Distance	NM	25	26	27	28	35	27	29	30	31	39
	Time	min	5	5	5	6	7	6	6	6	6	7
	Fuel	kg	379	397	416	436	493	405	425	445	466	529
47000	Distance	NM	24	25	26	27	34	27	28	29	30	38
	Time	min	5	5	5	5	7	5	6	6	6	7
	Fuel	kg	368	386	404	423	478	393	412	432	452	513
46000	Distance	NM	23	24	26	27	33	26	27	28	29	37
	Time	min	5	5	5	5	6	5	5	6	6	7
	Fuel	kg	358	375	393	411	463	382	400	420	439	498
45000	Distance	NM	23	24	25	26	32	25	26	27	28	36
	Time	min	5	5	5	5	6	5	5	5	6	7
	Fuel	kg	347	364	381	399	449	371	389	407	427	482
44000	Distance	NM	22	23	24	25	31	24	25	26	28	35
	Time	min	5	5	5	5	6	5	5	5	5	7
For Anti-	Fuel	(%)	8	8	8	6	3	9	9	8	7	4
ice ON,	Distance	(%)	14	14	13	11	6	14	15	14	12	8
increase	Time	(%)	13	14	13	10	5	14	14	13	11	6

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 15000 AND 16000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			15000 FT ISA + °C					16000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	337	353	370	387	436	360	377	396	414	467
43000	Distance	NM	21	22	23	24	30	24	25	26	27	33
	Time	min	5	5	5	5	6	5	5	5	5	6
	Fuel	kg	327	343	359	376	422	349	366	384	402	453
42000	Distance	NM	21	22	23	24	29	23	24	25	26	32
	Time	min	4	4	5	5	6	5	5	5	5	6
	Fuel	kg	317	332	348	365	409	339	355	372	390	439
41000	Distance	NM	20	21	22	23	28	22	23	24	25	31
	Time	min	4	4	4	5	6	5	5	5	5	6
	Fuel	kg	308	322	338	354	396	329	344	361	378	425
40000	Distance	NM	20	20	21	22	28	21	22	23	24	30
	Time	min	4	4	4	4	5	4	5	5	5	6
	Fuel	kg	298	313	328	343	384	319	334	350	366	411
39000	Distance	NM	19	20	21	22	27	21	22	23	24	29
	Time	min	4	4	4	4	5	4	4	5	5	6
	Fuel	kg	289	303	317	332	372	309	324	339	355	398
38000	Distance	NM	18	19	20	21	26	20	21	22	23	28
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	280	294	308	322	360	299	314	329	344	386
37000	Distance	NM	18	19	19	20	25	19	20	21	22	28
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	271	284	298	312	348	290	304	318	333	373
36000	Distance	NM	17	18	19	20	24	19	20	21	21	27
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	263	275	288	302	336	280	294	308	322	361
35000	Distance	NM	17	17	18	19	23	18	19	20	21	26
	Time	min	4	4	4	4	5	4	4	4	4	5
For Anti-	Fuel	(%)	7	7	7	5	3	8	8	7	6	3
ice ON,	Distance	(%)	13	13	12	10	5	13	14	13	11	7
increase	Time	(%)	12	12	11	9	4	13	13	12	10	6

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 15000 AND 16000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			15000 FT ISA + °C					16000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	254	266	279	292	325	271	284	298	312	348
34000	Distance	NM	16	17	17	18	23	18	18	19	20	25
	Time	min	3	3	4	4	4	4	4	4	4	5
	Fuel	kg	245	257	269	282	314	262	275	288	301	336
33000	Distance	NM	16	16	17	18	22	17	18	19	19	24
	Time	min	3	3	3	4	4	4	4	4	4	5
	Fuel	kg	237	248	260	272	303	253	265	278	291	325
32000	Distance	NM	15	16	16	17	21	16	17	18	19	23
	Time	min	3	3	3	3	4	3	4	4	4	4
	Fuel	kg	229	240	251	263	292	244	256	268	281	313
31000	Distance	NM	14	15	16	16	20	16	17	17	18	22
	Time	min	3	3	3	3	4	3	3	3	4	4
	Fuel	kg	221	231	242	253	281	236	247	259	271	302
30000	Distance	NM	14	15	15	16	19	15	16	17	17	21
	Time	min	3	3	3	3	4	3	3	3	3	4
For Anti-	Fuel	(%)	7	7	6	5	2	7	7	7	5	3
ice ON,	Distance	(%)	12	12	12	9	5	13	13	12	10	6
increase	Time	(%)	11	12	11	8	4	12	12	11	9	5

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 17000 AND 18000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			17000 FT ISA + °C					18000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	499	523	548	574	661	531	557	584	612	707
52000	Distance	NM	34	35	37	38	49	37	38	40	42	54
	Time	min	7	7	7	7	9	7	8	8	8	10
	Fuel	kg	485	508	533	558	641	516	541	567	594	686
51000	Distance	NM	33	34	36	37	47	36	37	39	41	52
	Time	min	7	7	7	7	9	7	7	8	8	10
	Fuel	kg	471	494	518	542	622	501	526	551	577	665
50000	Distance	NM	32	33	35	36	46	35	36	38	39	50
	Time	min	6	7	7	7	9	7	7	7	7	9
	Fuel	kg	458	480	503	527	603	487	511	535	561	645
49000	Distance	NM	31	32	34	35	44	34	35	37	38	49
	Time	min	6	6	7	7	8	7	7	7	7	9
	Fuel	kg	445	466	489	512	585	473	496	520	545	625
48000	Distance	NM	30	31	33	34	43	33	34	36	37	47
	Time	min	6	6	6	7	8	7	7	7	7	9
	Fuel	kg	432	453	475	497	567	460	482	505	529	606
47000	Distance	NM	29	30	32	33	42	32	33	35	36	46
	Time	min	6	6	6	6	8	6	7	7	7	8
	Fuel	kg	419	440	461	483	549	446	468	490	514	587
46000	Distance	NM	28	29	31	32	40	31	32	34	35	44
	Time	min	6	6	6	6	8	6	6	6	7	8
	Fuel	kg	407	427	448	469	533	433	454	476	499	569
45000	Distance	NM	27	29	30	31	39	30	31	33	34	43
	Time	min	6	6	6	6	7	6	6	6	6	8
	Fuel	kg	395	414	434	455	516	420	441	462	484	551
44000	Distance	NM	27	28	29	30	38	29	30	32	33	42
	Time	min	5	6	6	6	7	6	6	6	6	8
For Anti-	Fuel	(%)	9	9	9	7	5	10	10	10	8	6
ice ON,	Distance	(%)	15	15	15	13	9	16	16	16	14	11
increase	Time	(%)	14	15	14	12	8	15	16	15	13	10

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 17000 AND 18000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			17000 FT ISA + °C					18000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	384	402	422	441	500	408	428	448	469	534
43000	Distance	NM	26	27	28	29	37	28	29	31	32	40
	Time	min	5	5	6	6	7	6	6	6	6	7
	Fuel	kg	372	390	409	428	485	396	415	435	455	517
42000	Distance	NM	25	26	27	28	36	27	28	30	31	39
	Time	min	5	5	5	5	7	5	6	6	6	7
	Fuel	kg	361	378	397	415	469	384	402	422	441	501
41000	Distance	NM	24	25	26	27	34	26	28	29	30	38
	Time	min	5	5	5	5	7	5	5	6	6	7
	Fuel	kg	350	367	385	403	454	372	390	409	428	485
40000	Distance	NM	23	24	26	27	33	26	27	28	29	37
	Time	min	5	5	5	5	6	5	5	5	6	7
	Fuel	kg	339	356	373	390	440	360	378	396	415	469
39000	Distance	NM	23	24	25	26	32	25	26	27	28	35
	Time	min	5	5	5	5	6	5	5	5	5	7
	Fuel	kg	329	345	361	378	426	349	366	384	402	454
38000	Distance	NM	22	23	24	25	31	24	25	26	27	34
	Time	min	5	5	5	5	6	5	5	5	5	6
	Fuel	kg	318	334	350	366	412	338	354	372	389	439
37000	Distance	NM	21	22	23	24	30	23	24	25	26	33
	Time	min	4	4	5	5	6	5	5	5	5	6
	Fuel	kg	308	323	339	355	398	327	343	360	377	424
36000	Distance	NM	21	21	22	23	29	22	23	24	25	32
	Time	min	4	4	4	5	6	5	5	5	5	6
	Fuel	kg	298	313	328	343	385	317	332	348	364	410
35000	Distance	NM	20	21	22	23	28	22	23	24	25	31
	Time	min	4	4	4	4	5	4	4	5	5	6
For Anti-	Fuel	(%)	8	8	8	6	4	8	9	8	7	5
ice ON,	Distance	(%)	14	14	14	12	8	14	15	14	13	10
increase	Time	(%)	13	14	13	11	7	14	14	14	11	8

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 17000 AND 18000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			17000 FT ISA + °C					18000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	289	302	317	332	372	306	321	336	352	396
34000	Distance	NM	19	20	21	22	27	21	22	23	24	30
	Time	min	4	4	4	4	5	4	4	4	5	6
	Fuel	kg	279	292	306	321	359	296	310	325	340	383
33000	Distance	NM	19	19	20	21	26	20	21	22	23	29
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	269	282	296	310	347	286	300	314	329	369
32000	Distance	NM	18	19	20	20	25	20	20	21	22	28
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	260	272	285	299	334	276	289	303	317	356
31000	Distance	NM	17	18	19	20	24	19	20	21	21	27
	Time	min	4	4	4	4	5	4	4	4	4	5
	Fuel	kg	251	263	275	288	322	266	279	292	306	343
30000	Distance	NM	17	17	18	19	24	18	19	20	21	26
	Time	min	3	4	4	4	4	4	4	4	4	5
For Anti-	Fuel	(%)	7	8	7	6	4	8	8	7	6	5
ice ON,	Distance	(%)	13	13	13	11	7	14	14	14	12	9
increase	Time	(%)	12	13	12	10	6	13	13	13	11	7

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 19000 AND 20000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			19000 FT ISA + °C					20000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	564	592	621	650	755	599	628	658	690	805
52000	Distance	NM	40	42	44	46	59	44	46	48	50	65
	Time	min	8	8	8	8	11	8	9	9	9	12
	Fuel	kg	548	575	603	632	732	581	610	640	670	780
51000	Distance	NM	39	41	42	44	57	42	44	46	48	62
	Time	min	8	8	8	8	10	8	8	9	9	11
	Fuel	kg	533	559	586	614	709	565	592	621	651	756
50000	Distance	NM	38	39	41	43	55	41	43	45	47	60
	Time	min	7	8	8	8	10	8	8	8	9	11
	Fuel	kg	517	543	569	596	688	549	575	603	632	732
49000	Distance	NM	37	38	40	42	54	40	42	44	45	59
	Time	min	7	7	8	8	10	8	8	8	8	11
	Fuel	kg	502	527	552	579	666	533	559	586	614	709
48000	Distance	NM	36	37	39	40	52	39	40	42	44	57
	Time	min	7	7	7	8	9	8	8	8	8	10
	Fuel	kg	488	512	536	562	646	517	542	569	596	687
47000	Distance	NM	35	36	38	39	50	38	39	41	43	55
	Time	min	7	7	7	7	9	7	8	8	8	10
	Fuel	kg	474	497	521	545	625	502	526	552	578	665
46000	Distance	NM	34	35	37	38	49	36	38	40	41	53
	Time	min	7	7	7	7	9	7	7	7	8	10
	Fuel	kg	460	482	505	529	606	487	511	535	561	644
45000	Distance	NM	32	34	35	37	47	35	37	39	40	51
	Time	min	6	7	7	7	9	7	7	7	7	9
	Fuel	kg	446	468	490	514	587	472	495	519	544	624
44000	Distance	NM	32	33	34	36	46	34	36	37	39	50
	Time	min	6	6	7	7	8	7	7	7	7	9
For Anti-	Fuel	(%)	10	10	10	9	8	10	11	11	9	9
ice ON,	Distance	(%)	17	17	17	15	13	17	18	18	16	15
increase	Time	(%)	16	16	16	14	11	16	17	17	15	13

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 19000 AND 20000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			19000 FT ISA + °C					20000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	433	454	476	498	568	458	481	504	528	604
43000	Distance	NM	31	32	33	35	44	33	35	36	38	48
	Time	min	6	6	6	7	8	6	7	7	7	9
	Fuel	kg	420	440	461	483	550	444	466	488	512	585
42000	Distance	NM	30	31	32	34	43	32	34	35	37	47
	Time	min	6	6	6	6	8	6	6	7	7	8
	Fuel	kg	407	427	447	468	533	431	452	473	496	566
41000	Distance	NM	29	30	31	33	41	31	33	34	35	45
	Time	min	6	6	6	6	8	6	6	6	7	8
	Fuel	kg	394	413	433	454	515	417	438	459	481	547
40000	Distance	NM	28	29	30	32	40	30	31	33	34	43
	Time	min	6	6	6	6	7	6	6	6	6	8
	Fuel	kg	382	401	420	440	499	404	424	444	465	529
39000	Distance	NM	27	28	29	31	39	29	30	32	33	42
	Time	min	5	5	6	6	7	6	6	6	6	8
	Fuel	kg	370	388	407	426	482	391	410	430	451	512
38000	Distance	NM	26	27	28	30	37	28	29	31	32	41
	Time	min	5	5	5	6	7	6	6	6	6	7
	Fuel	kg	358	376	394	412	466	379	397	416	436	495
37000	Distance	NM	25	26	27	29	36	27	29	30	31	39
	Time	min	5	5	5	5	7	5	5	6	6	7
	Fuel	kg	347	363	381	399	451	367	384	403	422	478
36000	Distance	NM	24	25	27	28	35	26	28	29	30	38
	Time	min	5	5	5	5	6	5	5	5	6	7
	Fuel	kg	335	352	369	386	436	354	372	390	408	462
35000	Distance	NM	24	25	26	27	34	26	27	28	29	37
	Time	min	5	5	5	5	6	5	5	5	5	7
For Anti-	Fuel	(%)	9	9	9	8	6	9	9	9	8	7
ice ON,	Distance	(%)	15	16	15	14	11	15	16	16	15	12
increase	Time	(%)	14	15	14	12	9	15	15	15	13	11

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 19000 AND 20000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			19000 FT ISA + °C					20000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	324	340	356	373	421	343	359	377	394	446
34000	Distance	NM	23	24	25	26	32	25	26	27	28	35
	Time	min	5	5	5	5	6	5	5	5	5	6
	Fuel	kg	313	329	344	361	406	331	347	364	381	430
33000	Distance	NM	22	23	24	25	31	24	25	26	27	34
	Time	min	4	4	5	5	6	5	5	5	5	6
	Fuel	kg	303	317	332	348	392	320	335	351	368	415
32000	Distance	NM	21	22	23	24	30	23	24	25	26	33
	Time	min	4	4	4	5	6	5	5	5	5	6
	Fuel	kg	292	306	321	336	378	308	323	339	355	400
31000	Distance	NM	20	21	22	23	29	22	23	24	25	32
	Time	min	4	4	4	4	5	4	4	5	5	6
	Fuel	kg	281	295	309	324	364	297	312	327	342	386
30000	Distance	NM	20	21	21	22	28	21	22	23	24	30
	Time	min	4	4	4	4	5	4	4	4	5	6
For Anti-	Fuel	(%)	8	8	8	7	5	8	8	8	7	6
ice ON,	Distance	(%)	14	15	14	13	10	14	15	15	13	11
increase	Time	(%)	13	14	13	11	8	14	14	14	12	9

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 21000 AND 22000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			21000 FT ISA + °C					22000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	634	665	698	731	856	671	704	738	774	910
52000	Distance	NM	47	50	52	54	71	51	54	56	59	77
	Time	min	9	9	10	10	12	10	10	10	10	13
	Fuel	kg	616	646	678	710	830	651	683	717	751	882
51000	Distance	NM	46	48	50	52	68	50	52	55	57	75
	Time	min	9	9	9	9	12	9	10	10	10	13
	Fuel	kg	598	627	658	689	804	632	663	696	729	854
50000	Distance	NM	45	47	49	51	66	48	51	53	55	72
	Time	min	9	9	9	9	12	9	9	10	10	13
	Fuel	kg	581	609	639	669	778	614	644	676	708	827
49000	Distance	NM	43	45	47	49	64	47	49	51	54	70
	Time	min	8	9	9	9	11	9	9	9	10	12
	Fuel	kg	564	591	620	650	754	596	625	656	687	801
48000	Distance	NM	42	44	46	48	62	46	48	50	52	68
	Time	min	8	8	8	9	11	9	9	9	9	12
	Fuel	kg	547	574	602	631	730	578	607	636	667	775
47000	Distance	NM	41	43	44	46	60	44	46	48	50	65
	Time	min	8	8	8	8	11	8	9	9	9	11
	Fuel	kg	531	557	584	612	707	561	589	617	647	750
46000	Distance	NM	40	41	43	45	58	43	45	47	49	63
	Time	min	8	8	8	8	10	8	8	9	9	11
	Fuel	kg	515	540	567	594	684	544	571	599	627	726
45000	Distance	NM	38	40	42	44	56	42	43	45	47	61
	Time	min	7	8	8	8	10	8	8	8	8	11
	Fuel	kg	500	524	550	576	662	528	554	581	608	703
44000	Distance	NM	37	39	41	42	54	40	42	44	46	59
	Time	min	7	7	8	8	10	8	8	8	8	10
For Anti-	Fuel	(%)	11	11	11	10	10	11	12	11	11	11
ice ON,	Distance	(%)	18	18	18	17	17	18	19	19	18	19
increase	Time	(%)	17	17	17	16	15	17	18	18	16	17

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 21000 AND 22000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			21000 FT ISA + °C					22000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	484	508	533	558	641	512	537	563	590	680
43000	Distance	NM	36	38	39	41	52	39	41	43	44	57
	Time	min	7	7	7	7	9	7	8	8	8	10
	Fuel	kg	470	493	517	541	620	496	520	546	572	658
42000	Distance	NM	35	36	38	40	51	38	39	41	43	55
	Time	min	7	7	7	7	9	7	7	8	8	10
	Fuel	kg	455	477	501	524	600	480	504	529	554	636
41000	Distance	NM	34	35	37	38	49	37	38	40	42	53
	Time	min	7	7	7	7	9	7	7	7	7	9
	Fuel	kg	441	462	485	508	580	465	488	512	536	615
40000	Distance	NM	33	34	36	37	47	35	37	39	40	51
	Time	min	6	6	7	7	8	7	7	7	7	9
	Fuel	kg	427	448	470	492	561	451	473	496	519	594
39000	Distance	NM	32	33	34	36	46	34	36	37	39	50
	Time	min	6	6	6	7	8	7	7	7	7	9
	Fuel	kg	413	434	455	476	542	436	457	480	503	574
38000	Distance	NM	31	32	33	35	44	33	35	36	38	48
	Time	min	6	6	6	6	8	6	6	7	7	8
	Fuel	kg	400	420	440	461	524	422	443	464	486	555
37000	Distance	NM	30	31	32	34	43	32	33	35	36	46
	Time	min	6	6	6	6	8	6	6	6	7	8
	Fuel	kg	387	406	426	446	506	408	428	449	470	536
36000	Distance	NM	29	30	31	33	41	31	32	34	35	45
	Time	min	6	6	6	6	7	6	6	6	6	8
	Fuel	kg	374	392	411	431	489	394	414	434	454	517
35000	Distance	NM	28	29	30	31	40	30	31	33	34	43
	Time	min	5	5	6	6	7	6	6	6	6	8
For Anti-	Fuel	(%)	9	10	9	8	8	9	10	10	9	9
ice ON,	Distance	(%)	16	16	16	15	14	16	17	17	16	16
increase	Time	(%)	15	16	15	14	12	15	16	16	15	14

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 21000 AND 22000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			21000 FT ISA + °C					22000 FT ISA + °C				
			–20	**–10**	**0**	**10**	**20**	**–20**	**–10**	**0**	**10**	**20**
	Fuel	kg	361	379	397	416	472	381	400	419	439	499
34000	Distance	NM	27	28	29	30	38	29	30	31	33	42
	Time	min	5	5	5	6	7	6	6	6	6	7
	Fuel	kg	349	366	384	402	455	368	386	405	424	481
33000	Distance	NM	26	27	28	29	37	28	29	30	32	40
	Time	min	5	5	5	5	7	5	5	6	6	7
	Fuel	kg	337	353	371	388	439	355	372	390	409	464
32000	Distance	NM	25	26	27	28	36	27	28	29	30	39
	Time	min	5	5	5	5	6	5	5	5	6	7
	Fuel	kg	325	341	358	374	423	342	359	376	394	447
31000	Distance	NM	24	25	26	27	34	26	27	28	29	37
	Time	min	5	5	5	5	6	5	5	5	5	7
	Fuel	kg	313	329	345	361	408	330	346	363	380	430
30000	Distance	NM	23	24	25	26	33	25	26	27	28	36
	Time	min	4	5	5	5	6	5	5	5	5	6
For Anti-	Fuel	(%)	8	9	8	7	7	8	9	9	8	7
ice ON,	Distance	(%)	15	15	15	14	12	15	15	15	15	14
increase	Time	(%)	14	14	14	13	11	14	15	14	13	12

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 23000 AND 24000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			23000 FT ISA + °C					24000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	709	744	781	818	968	750	787	826	866	1030
52000	Distance	NM	56	58	61	64	84	61	64	66	69	92
	Time	min	10	11	11	11	14	11	11	12	12	16
	Fuel	kg	688	722	758	794	937	727	763	801	840	996
51000	Distance	NM	54	57	59	62	81	59	62	64	67	89
	Time	min	10	10	11	11	14	11	11	11	12	15
	Fuel	kg	668	701	736	771	907	706	741	777	815	963
50000	Distance	NM	53	55	57	60	79	57	60	62	65	86
	Time	min	10	10	10	11	14	11	11	11	11	15
	Fuel	kg	648	680	714	748	878	685	719	754	790	932
49000	Distance	NM	51	53	56	58	76	55	58	60	63	83
	Time	min	10	10	10	10	13	10	10	11	11	14
	Fuel	kg	629	660	693	726	850	664	697	731	767	901
48000	Distance	NM	50	52	54	56	74	54	56	59	61	80
	Time	min	9	9	10	10	13	10	10	10	11	14
	Fuel	kg	611	641	672	704	822	644	676	709	744	872
47000	Distance	NM	48	50	52	55	71	52	54	57	59	78
	Time	min	9	9	9	10	12	10	10	10	10	13
	Fuel	kg	592	621	652	683	796	625	656	688	721	843
46000	Distance	NM	47	49	51	53	69	50	53	55	57	75
	Time	min	9	9	9	9	12	9	10	10	10	13
	Fuel	kg	574	603	632	663	770	606	636	667	699	816
45000	Distance	NM	45	47	49	51	67	49	51	53	56	73
	Time	min	8	9	9	9	11	9	9	9	10	12
	Fuel	kg	557	584	613	642	745	587	616	647	678	789
44000	Distance	NM	44	46	48	50	64	47	49	52	54	70
	Time	min	8	8	9	9	11	9	9	9	9	12
For Anti-	Fuel	(%)	11	12	12	11	13	12	12	12	12	15
ice ON,	Distance	(%)	18	19	20	19	22	19	20	20	20	25
increase	Time	(%)	18	18	18	17	19	18	19	19	18	22

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 23000 AND 24000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			23000 FT ISA + °C					24000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	540	566	594	623	720	569	597	627	657	763
43000	Distance	NM	42	44	46	48	62	46	48	50	52	68
	Time	min	8	8	8	9	11	8	9	9	9	11
	Fuel	kg	523	549	576	603	697	551	579	607	636	737
42000	Distance	NM	41	43	45	47	60	44	46	48	50	65
	Time	min	8	8	8	8	10	8	8	9	9	11
	Fuel	kg	507	532	558	584	673	534	560	588	616	713
41000	Distance	NM	40	41	43	45	58	43	45	47	49	63
	Time	min	7	8	8	8	10	8	8	8	9	11
	Fuel	kg	491	515	540	566	651	517	542	569	596	688
40000	Distance	NM	38	40	42	44	56	41	43	45	47	61
	Time	min	7	7	8	8	10	8	8	8	8	10
	Fuel	kg	475	498	523	548	629	500	525	551	577	665
39000	Distance	NM	37	39	40	42	54	40	42	44	46	59
	Time	min	7	7	7	7	9	7	8	8	8	10
	Fuel	kg	460	482	506	530	607	484	508	533	558	642
38000	Distance	NM	36	37	39	41	52	39	41	42	44	57
	Time	min	7	7	7	7	9	7	7	8	8	10
	Fuel	kg	444	466	489	513	586	468	491	515	540	620
37000	Distance	NM	35	36	38	39	50	37	39	41	43	55
	Time	min	7	7	7	7	9	7	7	7	7	9
	Fuel	kg	430	451	473	495	566	452	475	498	522	598
36000	Distance	NM	33	35	36	38	49	36	38	39	41	53
	Time	min	6	6	7	7	8	7	7	7	7	9
	Fuel	kg	415	436	457	479	546	437	458	481	504	577
35000	Distance	NM	32	34	35	37	47	35	36	38	40	51
	Time	min	6	6	6	7	8	6	7	7	7	9
For Anti-	Fuel	(%)	10	10	10	9	10	10	10	10	10	12
ice ON,	Distance	(%)	16	17	17	17	18	17	18	18	17	20
increase	Time	(%)	16	16	16	15	16	16	17	17	16	18

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 23000 AND 24000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			23000 FT ISA + °C					24000 FT ISA + °C				
			–20	–10	0	10	20	–20	–10	0	10	20
	Fuel	kg	401	421	441	462	527	422	443	464	486	556
34000	Distance	NM	31	33	34	35	45	34	35	37	38	49
	Time	min	6	6	6	6	8	6	6	7	7	8
	Fuel	kg	387	406	426	446	508	407	427	448	469	536
33000	Distance	NM	30	31	33	34	43	32	34	35	37	47
	Time	min	6	6	6	6	8	6	6	6	6	8
	Fuel	kg	373	392	411	430	489	392	412	432	453	516
32000	Distance	NM	29	30	32	33	42	31	33	34	36	45
	Time	min	5	6	6	6	7	6	6	6	6	8
	Fuel	kg	360	378	396	415	471	378	397	416	436	496
31000	Distance	NM	28	29	30	32	40	30	31	33	34	43
	Time	min	5	5	6	6	7	6	6	6	6	7
	Fuel	kg	347	364	382	400	453	364	382	401	420	478
30000	Distance	NM	27	28	29	31	39	29	30	32	33	42
	Time	min	5	5	5	5	7	5	6	6	6	7
For Anti-	Fuel	(%)	9	9	9	8	8	9	9	9	9	9
ice ON,	Distance	(%)	15	16	16	15	15	15	16	16	16	17
increase	Time	(%)	14	15	15	14	13	15	15	15	14	15

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 25000 AND 26000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			25000 FT ISA + °C					26000 FT ISA + °C				
			–19	–10	0	10	20	–18	–10	0	10	20
	Fuel	kg	795	832	873	916	1097	845	881	924	969	1171
52000	Distance	NM	66	69	72	75	101	73	75	79	82	112
	Time	min	12	12	13	13	17	13	13	14	14	18
	Fuel	kg	771	807	847	888	1060	819	853	895	939	1130
51000	Distance	NM	64	67	70	73	98	70	73	76	80	108
	Time	min	12	12	12	12	16	13	13	13	13	18
	Fuel	kg	747	782	821	861	1024	793	827	868	910	1091
50000	Distance	NM	62	65	68	71	94	68	71	74	77	104
	Time	min	11	12	12	12	16	12	12	13	13	17
	Fuel	kg	725	759	796	835	990	769	801	841	882	1053
49000	Distance	NM	60	63	66	68	91	66	68	71	74	100
	Time	min	11	11	11	12	15	12	12	12	13	16
	Fuel	kg	703	736	772	809	957	745	776	815	854	1017
48000	Distance	NM	58	61	64	66	88	64	66	69	72	96
	Time	min	11	11	11	11	15	11	12	12	12	16
	Fuel	kg	681	713	748	784	925	722	752	790	828	982
47000	Distance	NM	57	59	62	64	85	62	64	67	70	93
	Time	min	10	11	11	11	14	11	11	12	12	15
	Fuel	kg	660	691	725	760	894	699	729	765	802	949
46000	Distance	NM	55	57	60	62	82	60	62	65	68	90
	Time	min	10	10	10	11	14	11	11	11	11	15
	Fuel	kg	640	670	703	737	865	678	706	741	777	916
45000	Distance	NM	53	55	58	60	79	58	60	63	65	86
	Time	min	10	10	10	10	13	10	11	11	11	14
	Fuel	kg	620	649	681	714	836	657	684	718	753	885
44000	Distance	NM	51	54	56	58	76	56	58	61	63	83
	Time	min	9	10	10	10	13	10	10	10	11	14
For Anti-	Fuel	(%)	12	13	13	13	18	13	14	14	13	21
ice ON,	Distance	(%)	20	21	21	21	29	21	22	22	22	34
increase	Time	(%)	19	20	20	19	26	20	21	21	20	30

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 25000 AND 26000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			25000 FT ISA + °C					26000 FT ISA + °C				
			–19	–10	0	10	20	–18	–10	0	10	20
	Fuel	kg	601	629	660	692	808	636	663	695	729	855
43000	Distance	NM	50	52	54	56	74	54	56	59	61	81
	Time	min	9	9	9	10	12	10	10	10	10	13
	Fuel	kg	582	609	639	670	781	616	642	673	706	826
42000	Distance	NM	48	50	52	55	71	52	54	57	59	78
	Time	min	9	9	9	9	12	9	10	10	10	13
	Fuel	kg	564	590	619	649	754	596	621	652	683	798
41000	Distance	NM	47	49	51	53	69	51	53	55	57	75
	Time	min	8	9	9	9	12	9	9	9	10	12
	Fuel	kg	545	571	599	628	728	577	601	631	661	770
40000	Distance	NM	45	47	49	51	66	49	51	53	55	72
	Time	min	8	8	9	9	11	9	9	9	9	12
	Fuel	kg	528	552	580	608	703	558	581	610	639	743
39000	Distance	NM	43	45	47	49	64	47	49	51	53	70
	Time	min	8	8	8	9	11	8	9	9	9	11
	Fuel	kg	510	534	561	588	679	539	562	590	618	717
38000	Distance	NM	42	44	46	48	62	46	47	49	52	67
	Time	min	8	8	8	8	10	8	8	9	9	11
	Fuel	kg	493	517	542	568	655	521	543	570	597	692
37000	Distance	NM	41	42	44	46	59	44	46	48	50	65
	Time	min	7	8	8	8	10	8	8	8	8	11
	Fuel	kg	477	499	524	549	632	504	525	551	577	667
36000	Distance	NM	39	41	43	44	57	42	44	46	48	62
	Time	min	7	7	7	8	10	8	8	8	8	10
	Fuel	kg	460	482	506	530	609	486	507	531	557	643
35000	Distance	NM	38	39	41	43	55	41	43	44	46	60
	Time	min	7	7	7	7	9	7	8	8	8	10
For Anti-	Fuel	(%)	10	11	11	10	13	11	11	11	11	15
ice ON,	Distance	(%)	17	18	19	18	23	18	19	19	19	25
increase	Time	(%)	17	17	17	17	20	17	18	18	17	22

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 25000 AND 26000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			25000 FT ISA + °C					26000 FT ISA + °C				
			–19	**–10**	**0**	**10**	**20**	**–18**	**–10**	**0**	**10**	**20**
	Fuel	kg	444	465	488	512	587	469	489	513	538	619
34000	Distance	NM	36	38	40	41	53	39	41	43	45	58
	Time	min	7	7	7	7	9	7	7	7	8	10
	Fuel	kg	429	449	471	493	565	452	471	495	518	596
33000	Distance	NM	35	37	38	40	51	38	39	41	43	55
	Time	min	6	7	7	7	9	7	7	7	7	9
	Fuel	kg	413	433	454	476	544	436	454	477	500	573
32000	Distance	NM	34	35	37	38	49	37	38	40	41	53
	Time	min	6	6	6	7	8	7	7	7	7	9
	Fuel	kg	398	417	437	458	523	420	437	459	481	551
31000	Distance	NM	32	34	35	37	47	35	37	38	40	51
	Time	min	6	6	6	6	8	6	6	7	7	8
	Fuel	kg	383	401	421	441	503	404	421	442	463	530
30000	Distance	NM	31	33	34	35	45	34	35	37	38	49
	Time	min	6	6	6	6	8	6	6	6	7	8
For Anti-	Fuel	(%)	9	9	9	9	10	9	10	10	9	12
ice ON,	Distance	(%)	16	17	17	16	19	16	17	17	17	21
increase	Time	(%)	15	16	16	15	17	16	16	16	15	18

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 27000 AND 28000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			27000 FT ISA + °C					28000 FT ISA + °C				
			–17	–10	0	10	20	–17	–10	0	10	20
	Fuel	kg	899	933	979	1027	1253	959	990	1040	1091	1345
52000	Distance	NM	80	82	86	90	124	88	90	95	99	138
	Time	min	14	14	15	15	20	15	15	16	16	22
	Fuel	kg	871	903	948	994	1207	928	958	1006	1055	1294
51000	Distance	NM	77	80	83	87	119	85	87	91	95	132
	Time	min	13	14	14	14	19	15	15	15	16	21
	Fuel	kg	843	875	918	963	1164	898	927	973	1021	1245
50000	Distance	NM	75	77	81	84	114	82	84	88	92	127
	Time	min	13	13	14	14	18	14	14	15	15	20
	Fuel	kg	817	847	889	932	1122	869	897	941	988	1199
49000	Distance	NM	72	74	78	81	110	79	81	85	89	122
	Time	min	13	13	13	13	18	14	14	14	15	19
	Fuel	kg	791	820	861	903	1082	840	868	911	956	1155
48000	Distance	NM	70	72	75	79	106	76	79	82	86	117
	Time	min	12	12	13	13	17	13	13	14	14	19
	Fuel	kg	766	794	834	874	1044	813	840	882	925	1113
47000	Distance	NM	67	70	73	76	102	74	76	79	83	113
	Time	min	12	12	12	13	16	13	13	13	14	18
	Fuel	kg	742	769	807	847	1008	787	813	853	895	1073
46000	Distance	NM	65	67	70	73	98	71	73	77	80	108
	Time	min	11	12	12	12	16	12	13	13	13	17
	Fuel	kg	718	745	782	820	973	762	786	825	866	1035
45000	Distance	NM	63	65	68	71	95	69	71	74	77	104
	Time	min	11	11	12	12	15	12	12	12	13	17
	Fuel	kg	695	721	757	794	939	737	761	799	838	998
44000	Distance	NM	61	63	66	69	91	67	69	72	75	100
	Time	min	11	11	11	11	15	12	12	12	12	16
For Anti-	Fuel	(%)	14	15	15	15	24	15	16	16	16	25
ice ON,	Distance	(%)	22	23	24	24	40	24	25	26	26	41
increase	Time	(%)	21	22	22	22	35	23	23	24	24	36

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 27000 AND 28000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			27000 FT ISA + °C					28000 FT ISA + °C				
			–17	–10	0	10	20	–17	–10	0	10	20
	Fuel	kg	673	698	733	768	906	713	736	773	810	962
43000	Distance	NM	59	61	64	66	88	64	66	69	72	96
	Time	min	10	11	11	11	14	11	11	12	12	15
	Fuel	kg	651	676	709	744	875	690	712	747	784	928
42000	Distance	NM	57	59	62	64	85	62	64	67	70	93
	Time	min	10	10	10	11	14	11	11	11	11	15
	Fuel	kg	630	654	686	720	844	667	689	723	758	895
41000	Distance	NM	55	57	59	62	82	60	62	65	67	89
	Time	min	10	10	10	10	13	10	11	11	11	14
	Fuel	kg	610	632	664	696	815	645	666	699	733	863
40000	Distance	NM	53	55	57	60	79	58	60	62	65	86
	Time	min	9	10	10	10	13	10	10	10	11	14
	Fuel	kg	590	611	642	673	786	623	644	676	709	832
39000	Distance	NM	51	53	55	58	76	56	58	60	63	83
	Time	min	9	9	9	10	12	10	10	10	10	13
	Fuel	kg	570	591	620	650	758	602	622	653	685	802
38000	Distance	NM	50	51	54	56	73	54	56	58	61	80
	Time	min	9	9	9	9	12	9	10	10	10	13
	Fuel	kg	551	571	599	628	731	582	601	630	661	772
37000	Distance	NM	48	49	52	54	70	52	54	56	58	77
	Time	min	8	9	9	9	11	9	9	9	10	12
	Fuel	kg	532	551	579	607	704	562	580	609	638	744
36000	Distance	NM	46	48	50	52	68	50	52	54	56	74
	Time	min	8	8	9	9	11	9	9	9	9	12
	Fuel	kg	513	532	559	586	678	542	559	587	616	716
35000	Distance	NM	44	46	48	50	65	48	50	52	54	71
	Time	min	8	8	8	8	11	8	9	9	9	11
For Anti-	Fuel	(%)	11	12	12	12	17	12	13	13	13	20
ice ON,	Distance	(%)	19	20	20	20	29	20	21	21	21	33
increase	Time	(%)	18	19	19	18	26	19	19	20	20	29

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 27000 AND 28000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			27000 FT ISA + °C					28000 FT ISA + °C				
			–17	–10	0	10	20	–17	–10	0	10	20
	Fuel	kg	495	513	539	565	653	523	539	566	594	689
34000	Distance	NM	43	44	46	48	63	47	48	50	52	68
	Time	min	8	8	8	8	10	8	8	8	9	11
	Fuel	kg	477	495	519	545	628	504	520	546	572	663
33000	Distance	NM	41	43	45	46	60	45	46	48	50	65
	Time	min	7	7	8	8	10	8	8	8	8	11
	Fuel	kg	460	477	500	525	604	485	501	525	551	637
32000	Distance	NM	40	41	43	45	58	43	44	46	48	63
	Time	min	7	7	7	8	9	8	8	8	8	10
	Fuel	kg	443	459	482	505	581	467	482	506	530	612
31000	Distance	NM	38	39	41	43	55	41	43	45	46	60
	Time	min	7	7	7	7	9	7	7	8	8	10
	Fuel	kg	426	442	463	486	558	449	463	486	510	587
30000	Distance	NM	37	38	40	41	53	40	41	43	45	58
	Time	min	7	7	7	7	9	7	7	7	7	9
For Anti-	Fuel	(%)	10	10	10	10	13	10	11	11	11	15
ice ON,	Distance	(%)	17	18	18	18	23	18	18	19	19	26
increase	Time	(%)	16	17	17	16	21	17	17	18	17	23

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 29000 AND 30000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			29000 FT ISA + °C					30000 FT ISA + °C				
			–16	–10	0	10	20	–15	–10	0	10	20
	Fuel	kg	1023	1051	1104	1159	1447	1076	1100	1156	1213	1531
52000	Distance	NM	97	99	104	109	154	105	107	112	117	168
	Time	min	16	17	17	17	24	17	18	18	18	26
	Fuel	kg	989	1016	1067	1120	1390	1039	1063	1116	1172	1468
51000	Distance	NM	93	96	100	105	147	101	103	108	112	160
	Time	min	16	16	16	17	23	17	17	17	18	25
	Fuel	kg	956	982	1032	1082	1335	1004	1027	1079	1132	1409
50000	Distance	NM	90	92	97	101	141	97	99	104	108	153
	Time	min	15	15	16	16	22	16	16	17	17	23
	Fuel	kg	924	950	997	1046	1284	970	992	1042	1094	1353
49000	Distance	NM	87	89	93	97	135	94	96	100	104	146
	Time	min	15	15	15	16	21	16	16	16	17	23
	Fuel	kg	894	918	964	1012	1235	937	959	1007	1057	1300
48000	Distance	NM	84	86	90	94	130	90	92	96	101	140
	Time	min	14	14	15	15	20	15	15	16	16	22
	Fuel	kg	864	888	932	978	1188	906	926	973	1021	1249
47000	Distance	NM	81	83	87	91	124	87	89	93	97	134
	Time	min	14	14	14	15	19	15	15	15	15	21
	Fuel	kg	836	859	902	946	1144	875	895	940	987	1201
46000	Distance	NM	78	80	84	88	119	84	86	90	94	129
	Time	min	13	13	14	14	19	14	14	15	15	20
	Fuel	kg	808	830	872	915	1101	846	865	909	954	1156
45000	Distance	NM	75	77	81	84	115	81	83	86	90	124
	Time	min	13	13	13	14	18	14	14	14	14	19
	Fuel	kg	781	803	843	884	1061	818	836	878	922	1112
44000	Distance	NM	73	75	78	82	110	78	80	83	87	118
	Time	min	12	13	13	13	17	13	13	14	14	18
For Anti-	Fuel	(%)	17	17	18	18	27	18	19	19	20	32
ice ON,	Distance	(%)	26	27	29	29	45	29	29	31	32	51
increase	Time	(%)	25	25	26	27	40	27	27	29	29	45

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 29000 AND 30000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			29000 FT ISA + °C					30000 FT ISA + °C				
			–16	**–10**	**0**	**10**	**20**	**–15**	**–10**	**0**	**10**	**20**
	Fuel	kg	755	776	815	855	1022	790	808	849	890	1070
43000	Distance	NM	70	72	75	79	106	75	77	80	84	114
	Time	min	12	12	12	13	17	13	13	13	13	18
	Fuel	kg	730	750	788	826	984	763	781	820	860	1030
42000	Distance	NM	68	70	73	76	102	73	74	78	81	109
	Time	min	12	12	12	12	16	12	12	13	13	17
	Fuel	kg	706	725	761	799	948	737	754	792	831	991
41000	Distance	NM	65	67	70	73	98	70	71	75	78	105
	Time	min	11	11	12	12	15	12	12	12	13	16
	Fuel	kg	682	701	736	772	913	712	728	765	802	954
40000	Distance	NM	63	65	68	71	94	67	69	72	75	101
	Time	min	11	11	11	11	15	11	12	12	12	16
	Fuel	kg	659	677	711	745	880	688	703	738	775	918
39000	Distance	NM	61	62	65	68	90	65	66	69	73	97
	Time	min	10	11	11	11	14	11	11	11	12	15
	Fuel	kg	636	654	686	720	848	664	679	713	748	884
38000	Distance	NM	59	60	63	66	87	63	64	67	70	93
	Time	min	10	10	10	11	14	11	11	11	11	14
	Fuel	kg	614	631	663	695	816	641	655	688	722	851
37000	Distance	NM	57	58	61	63	84	60	62	65	67	89
	Time	min	10	10	10	10	13	10	10	11	11	14
	Fuel	kg	593	609	639	671	786	618	632	664	696	818
36000	Distance	NM	55	56	59	61	80	58	59	62	65	86
	Time	min	9	9	10	10	13	10	10	10	10	13
	Fuel	kg	572	587	617	647	756	596	609	640	671	787
35000	Distance	NM	53	54	56	59	77	56	57	60	62	82
	Time	min	9	9	9	10	12	9	10	10	10	13
For Anti-	Fuel	(%)	13	13	14	14	23	14	14	15	15	26
ice ON,	Distance	(%)	21	22	23	23	39	23	23	24	25	43
increase	Time	(%)	20	21	21	21	34	21	22	22	22	38

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 29000 AND 30000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			29000 FT ISA + °C					30000 FT ISA + °C				
			–16	**–10**	**0**	**10**	**20**	**–15**	**–10**	**0**	**10**	**20**
	Fuel	kg	551	566	594	624	727	574	587	617	647	757
34000	Distance	NM	51	52	54	57	74	54	55	58	60	79
	Time	min	9	9	9	9	12	9	9	9	10	12
	Fuel	kg	531	545	573	601	699	553	565	594	623	727
33000	Distance	NM	49	50	52	54	71	52	53	55	58	76
	Time	min	8	8	9	9	11	9	9	9	9	12
	Fuel	kg	511	525	551	578	671	532	544	571	599	698
32000	Distance	NM	47	48	50	52	68	50	51	53	55	72
	Time	min	8	8	8	9	11	8	9	9	9	11
	Fuel	kg	492	505	530	556	644	512	523	550	576	670
31000	Distance	NM	45	46	48	50	65	48	49	51	53	69
	Time	min	8	8	8	8	10	8	8	8	9	11
	Fuel	kg	473	486	510	535	618	492	503	528	554	643
30000	Distance	NM	43	44	46	48	62	46	47	49	51	66
	Time	min	7	8	8	8	10	8	8	8	8	10
For Anti-	Fuel	(%)	11	11	11	11	17	11	12	12	12	18
ice ON,	Distance	(%)	19	19	20	20	29	19	20	21	21	31
increase	Time	(%)	18	18	18	18	26	18	19	19	19	28

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 31000 AND 32000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			31000 FT ISA + °C					32000 FT ISA + °C				
			–14	–10	0	10	20	–13	–10	0	10	20
	Fuel	kg	1131	1151	1209	1269	1617	1188	1203	1265	1328	1708
52000	Distance	NM	113	115	120	125	182	122	123	129	135	198
	Time	min	19	19	19	20	27	20	20	20	21	30
	Fuel	kg	1091	1111	1167	1225	1548	1145	1160	1219	1280	1631
51000	Distance	NM	109	110	115	121	174	117	118	124	129	188
	Time	min	18	18	18	19	26	19	19	20	20	28
	Fuel	kg	1053	1072	1126	1183	1484	1104	1119	1176	1234	1561
50000	Distance	NM	104	106	111	116	166	112	114	119	124	179
	Time	min	17	17	18	18	25	18	18	19	19	27
	Fuel	kg	1017	1035	1088	1142	1423	1066	1079	1134	1191	1495
49000	Distance	NM	101	102	107	112	158	108	109	114	120	171
	Time	min	17	17	17	18	24	18	18	18	19	26
	Fuel	kg	982	1000	1050	1103	1366	1028	1042	1095	1149	1433
48000	Distance	NM	97	99	103	108	151	104	105	110	115	163
	Time	min	16	16	17	17	23	17	17	18	18	25
	Fuel	kg	949	965	1014	1065	1311	993	1005	1056	1109	1375
47000	Distance	NM	93	95	99	104	145	100	101	106	111	156
	Time	min	15	16	16	16	22	16	16	17	17	23
	Fuel	kg	916	933	980	1028	1260	958	970	1020	1070	1319
46000	Distance	NM	90	91	96	100	139	96	98	102	107	149
	Time	min	15	15	15	16	21	16	16	16	17	22
	Fuel	kg	885	901	946	993	1210	925	937	984	1033	1266
45000	Distance	NM	87	88	92	96	133	93	94	98	103	142
	Time	min	14	14	15	15	20	15	15	16	16	22
	Fuel	kg	855	870	914	959	1164	893	904	950	997	1216
44000	Distance	NM	84	85	89	93	127	89	90	95	99	136
	Time	min	14	14	14	15	19	15	15	15	15	21
For Anti-	Fuel	(%)	20	20	21	22	36	19	19	20	21	34
ice ON,	Distance	(%)	31	32	33	35	57	29	29	31	32	53
increase	Time	(%)	29	29	31	32	51	27	28	29	30	47

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 31000 AND 32000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			31000 FT ISA + °C					32000 FT ISA + °C				
			–14	**–10**	**0**	**10**	**20**	**–13**	**–10**	**0**	**10**	**20**
	Fuel	kg	825	840	882	926	1119	862	873	917	963	1168
43000	Distance	NM	81	82	86	89	122	86	87	91	95	130
	Time	min	13	13	14	14	19	14	14	15	15	20
	Fuel	kg	797	811	852	894	1076	832	842	885	929	1122
42000	Distance	NM	78	79	83	86	117	83	84	88	92	125
	Time	min	13	13	13	14	18	14	14	14	14	19
	Fuel	kg	770	783	823	863	1035	803	813	854	896	1078
41000	Distance	NM	75	76	80	83	112	80	81	84	88	120
	Time	min	12	13	13	13	17	13	13	14	14	18
	Fuel	kg	743	756	794	833	995	774	784	824	865	1036
40000	Distance	NM	72	73	77	80	108	77	78	81	85	115
	Time	min	12	12	12	13	17	13	13	13	13	17
	Fuel	kg	717	730	766	804	957	747	756	795	834	996
39000	Distance	NM	69	71	74	77	103	74	75	78	82	110
	Time	min	12	12	12	12	16	12	12	13	13	17
	Fuel	kg	692	704	740	776	920	720	730	766	804	957
38000	Distance	NM	67	68	71	74	99	71	72	75	79	105
	Time	min	11	11	12	12	15	12	12	12	12	16
	Fuel	kg	667	679	713	749	885	695	703	739	776	920
37000	Distance	NM	64	65	68	71	95	68	69	72	76	101
	Time	min	11	11	11	11	15	11	11	12	12	15
	Fuel	kg	643	655	688	722	851	669	678	712	747	884
36000	Distance	NM	62	63	66	69	91	66	67	70	73	97
	Time	min	10	10	11	11	14	11	11	11	11	15
	Fuel	kg	620	631	663	696	818	645	653	686	720	849
35000	Distance	NM	60	61	63	66	87	63	64	67	70	93
	Time	min	10	10	10	11	14	10	11	11	11	14
For Anti-	Fuel	(%)	15	15	15	15	29	14	14	15	15	28
ice ON,	Distance	(%)	24	24	25	26	48	23	23	24	24	44
increase	Time	(%)	22	23	24	24	42	21	22	22	23	40

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 31000 AND 32000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			31000 FT ISA + °C					32000 FT ISA + °C				
			–14	**–10**	**0**	**10**	**20**	**–13**	**–10**	**0**	**10**	**20**
	Fuel	kg	597	608	639	670	786	621	629	661	693	815
34000	Distance	NM	57	58	61	64	84	61	62	64	67	89
	Time	min	10	10	10	10	13	10	10	10	11	14
	Fuel	kg	575	585	615	645	755	598	605	636	667	783
33000	Distance	NM	55	56	59	61	80	58	59	62	65	85
	Time	min	9	9	10	10	12	10	10	10	10	13
	Fuel	kg	553	563	592	621	725	575	582	612	642	751
32000	Distance	NM	53	54	56	59	77	56	57	59	62	81
	Time	min	9	9	9	9	12	9	9	10	10	13
	Fuel	kg	532	541	569	597	695	553	560	588	617	720
31000	Distance	NM	51	52	54	56	74	54	54	57	60	78
	Time	min	9	9	9	9	11	9	9	9	9	12
	Fuel	kg	511	520	546	573	666	531	538	565	593	690
30000	Distance	NM	49	49	52	54	70	52	52	55	57	74
	Time	min	8	8	8	9	11	9	9	9	9	12
For Anti-	Fuel	(%)	12	12	12	12	20	12	12	12	12	19
ice ON,	Distance	(%)	20	21	21	22	34	19	20	20	21	32
increase	Time	(%)	19	19	20	20	30	18	18	19	19	28

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 33000 AND 34000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			33000 FT ISA + °C					34000 FT ISA + °C				
			–12	–10	0	10	20	–11	–10	0	10	20
	Fuel	kg	1253	1263	1328	1394	1818	1325	1329	1398	1468	-
52000	Distance	NM	132	133	139	145	217	144	144	151	158	-
	Time	min	21	21	22	22	32	23	23	23	24	-
	Fuel	kg	1204	1214	1276	1340	1726	1271	1275	1340	1408	1845
51000	Distance	NM	126	127	133	139	205	137	137	144	150	227
	Time	min	20	20	21	21	30	22	22	22	23	33
	Fuel	kg	1159	1168	1228	1289	1645	1220	1223	1286	1351	1746
50000	Distance	NM	121	122	127	133	194	131	131	137	144	213
	Time	min	19	20	20	21	29	21	21	21	22	31
	Fuel	kg	1116	1125	1182	1242	1571	1172	1175	1236	1298	1658
49000	Distance	NM	116	117	122	128	184	125	125	131	137	200
	Time	min	19	19	19	20	27	20	20	20	21	30
	Fuel	kg	1076	1084	1140	1197	1504	1127	1130	1188	1248	1580
48000	Distance	NM	111	112	118	123	176	120	120	126	131	190
	Time	min	18	18	19	19	26	19	19	20	20	28
	Fuel	kg	1038	1046	1099	1155	1440	1085	1088	1144	1202	1509
47000	Distance	NM	107	108	113	118	167	115	115	121	126	180
	Time	min	17	17	18	18	25	18	18	19	19	27
	Fuel	kg	1001	1009	1061	1114	1381	1046	1049	1103	1158	1444
46000	Distance	NM	103	104	109	114	160	110	111	116	121	172
	Time	min	17	17	17	18	24	18	18	18	19	25
	Fuel	kg	966	973	1023	1074	1324	1008	1011	1063	1116	1384
45000	Distance	NM	99	100	105	109	153	106	106	111	116	164
	Time	min	16	16	17	17	23	17	17	17	18	24
	Fuel	kg	932	939	987	1036	1270	972	975	1025	1076	1326
44000	Distance	NM	95	96	101	105	146	102	102	107	112	156
	Time	min	15	16	16	16	22	16	16	17	17	23
For Anti-	Fuel	(%)	18	18	19	20	32	17	17	18	18	31
ice ON,	Distance	(%)	27	27	28	30	49	25	25	26	27	46
increase	Time	(%)	25	26	27	28	44	24	24	25	25	42

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 33000 AND 34000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			33000 FT ISA + °C					34000 FT ISA + °C				
			–12	–10	0	10	20	–11	–10	0	10	20
	Fuel	kg	899	906	952	1000	1219	937	940	988	1037	1271
43000	Distance	NM	92	92	97	101	139	98	98	103	108	149
	Time	min	15	15	15	16	21	16	16	16	17	22
	Fuel	kg	867	874	918	964	1170	903	906	952	1000	1219
42000	Distance	NM	88	89	93	97	133	94	94	99	103	142
	Time	min	14	14	15	15	20	15	15	16	16	21
	Fuel	kg	836	843	886	930	1123	871	873	918	964	1169
41000	Distance	NM	85	86	90	94	128	91	91	95	99	136
	Time	min	14	14	14	15	19	15	15	15	15	20
	Fuel	kg	806	813	854	897	1079	839	842	885	929	1122
40000	Distance	NM	82	82	86	90	122	87	87	91	96	130
	Time	min	13	13	14	14	18	14	14	14	15	20
	Fuel	kg	778	784	823	864	1036	809	811	853	895	1077
39000	Distance	NM	79	79	83	87	117	84	84	88	92	124
	Time	min	13	13	13	14	18	14	14	14	14	19
	Fuel	kg	749	755	794	833	995	779	781	821	862	1033
38000	Distance	NM	76	76	80	83	112	80	81	84	88	119
	Time	min	12	12	13	13	17	13	13	13	14	18
	Fuel	kg	722	728	765	803	955	751	753	791	831	991
37000	Distance	NM	73	73	77	80	107	77	77	81	85	114
	Time	min	12	12	12	13	16	13	13	13	13	17
	Fuel	kg	696	701	737	773	917	723	725	762	800	951
36000	Distance	NM	70	70	74	77	103	74	74	78	81	109
	Time	min	11	11	12	12	16	12	12	12	13	16
	Fuel	kg	670	675	709	745	880	696	698	733	770	912
35000	Distance	NM	67	68	71	74	98	71	71	75	78	104
	Time	min	11	11	11	12	15	12	12	12	12	16
For Anti-	Fuel	(%)	14	14	14	14	27	13	13	14	14	25
ice ON,	Distance	(%)	21	21	22	23	41	20	20	21	22	39
increase	Time	(%)	20	20	21	21	37	19	19	20	20	35

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 33000 AND 34000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			33000 FT ISA + °C					34000 FT ISA + °C				
			–12	**–10**	**0**	**10**	**20**	**–11**	**–10**	**0**	**10**	**20**
	Fuel	kg	645	650	683	717	845	669	671	705	740	875
34000	Distance	NM	65	65	68	71	94	68	69	72	75	100
	Time	min	11	11	11	11	14	11	11	11	12	15
	Fuel	kg	620	625	657	690	811	644	645	678	712	839
33000	Distance	NM	62	62	65	68	90	66	66	69	72	95
	Time	min	10	10	10	11	14	11	11	11	11	14
	Fuel	kg	597	601	632	663	777	619	620	652	684	804
32000	Distance	NM	59	60	63	66	86	63	63	66	69	91
	Time	min	10	10	10	10	13	10	10	11	11	14
	Fuel	kg	573	578	607	637	745	594	596	626	657	770
31000	Distance	NM	57	57	60	63	82	60	60	63	66	87
	Time	min	9	9	10	10	13	10	10	10	10	13
	Fuel	kg	551	555	583	612	714	570	572	601	631	738
30000	Distance	NM	55	55	58	60	79	58	58	61	63	83
	Time	min	9	9	9	9	12	9	9	10	10	13
For Anti-	Fuel	(%)	11	11	12	12	18	11	11	11	11	17
ice ON,	Distance	(%)	18	18	19	19	30	17	17	18	18	28
increase	Time	(%)	17	18	18	18	27	17	17	17	17	26

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 35000 AND 36000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			35000 FT ISA + °C					36000 FT ISA + °C				
			–10	–10	0	10	20	–9	–5	0	10	20
	Fuel	kg	1405	1405	1475	1550	-	1505	1533	1573	1653	-
52000	Distance	NM	157	157	164	172	-	175	178	182	191	-
	Time	min	25	25	25	26	-	27	27	28	28	-
	Fuel	kg	1344	1344	1411	1483	-	1430	1457	1494	1570	-
51000	Distance	NM	149	149	156	163	-	164	167	171	179	-
	Time	min	23	23	24	25	-	26	26	26	27	-
	Fuel	kg	1288	1288	1352	1420	1869	1364	1389	1425	1498	-
50000	Distance	NM	142	142	149	156	236	155	158	162	170	-
	Time	min	22	22	23	24	34	24	24	25	25	-
	Fuel	kg	1235	1235	1296	1361	1765	1304	1329	1363	1432	-
49000	Distance	NM	135	135	142	148	221	148	150	154	161	-
	Time	min	21	21	22	22	32	23	23	24	24	-
	Fuel	kg	1185	1185	1243	1306	1672	1249	1272	1305	1371	1783
48000	Distance	NM	129	129	135	142	207	140	143	146	153	229
	Time	min	20	20	21	21	30	22	22	22	23	33
	Fuel	kg	1138	1138	1194	1254	1589	1197	1219	1250	1314	1686
47000	Distance	NM	124	124	129	135	195	134	136	139	146	214
	Time	min	20	20	20	21	29	21	21	21	22	31
	Fuel	kg	1094	1094	1148	1206	1514	1148	1169	1199	1260	1598
46000	Distance	NM	118	118	124	129	185	128	130	133	139	201
	Time	min	19	19	19	20	27	20	20	21	21	29
	Fuel	kg	1052	1052	1104	1160	1446	1102	1123	1151	1209	1519
45000	Distance	NM	113	113	119	124	176	122	124	127	133	190
	Time	min	18	18	18	19	26	19	19	20	20	28
	Fuel	kg	1014	1014	1064	1117	1384	1059	1078	1106	1162	1447
44000	Distance	NM	109	109	114	119	167	117	119	121	127	180
	Time	min	17	17	18	18	25	18	19	19	19	26
For Anti-	Fuel	(%)	16	16	17	17	29	15	15	16	16	27
ice ON,	Distance	(%)	23	23	24	25	42	20	21	21	22	38
increase	Time	(%)	22	22	23	23	39	20	20	20	21	35

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 35000 AND 36000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			35000 FT ISA + °C					36000 FT ISA + °C				
			–10	**–10**	**0**	**10**	**20**	**–9**	**–5**	**0**	**10**	**20**
	Fuel	kg	977	977	1025	1076	1325	1018	1037	1063	1117	1382
43000	Distance	NM	104	104	109	114	159	112	114	116	122	171
	Time	min	17	17	17	17	24	18	18	18	18	25
	Fuel	kg	941	941	987	1037	1269	980	998	1023	1075	1322
42000	Distance	NM	100	100	105	110	152	107	109	112	117	162
	Time	min	16	16	16	17	23	17	17	17	18	24
	Fuel	kg	906	906	951	999	1216	943	961	985	1035	1265
41000	Distance	NM	96	96	101	105	145	103	105	107	112	155
	Time	min	15	15	16	16	22	16	16	17	17	23
	Fuel	kg	873	873	916	962	1166	908	925	948	996	1212
40000	Distance	NM	93	93	97	101	139	99	100	103	107	148
	Time	min	15	15	15	16	21	16	16	16	16	22
	Fuel	kg	841	841	882	926	1118	874	890	913	959	1161
39000	Distance	NM	89	89	93	97	132	95	96	99	103	141
	Time	min	14	14	15	15	20	15	15	15	16	21
	Fuel	kg	810	810	849	892	1072	841	857	878	923	1112
38000	Distance	NM	85	85	89	93	126	91	92	95	99	134
	Time	min	14	14	14	14	19	14	15	15	15	20
	Fuel	kg	780	780	818	859	1028	810	824	845	888	1065
37000	Distance	NM	82	82	86	90	121	87	89	91	95	128
	Time	min	13	13	13	14	18	14	14	14	15	19
	Fuel	kg	750	750	787	826	985	779	793	813	854	1021
36000	Distance	NM	79	79	82	86	115	84	85	87	91	122
	Time	min	13	13	13	13	17	13	13	14	14	18
	Fuel	kg	722	722	757	795	945	749	762	782	821	978
35000	Distance	NM	76	76	79	83	110	80	82	83	87	117
	Time	min	12	12	12	13	17	13	13	13	13	17
For Anti-	Fuel	(%)	13	13	13	13	24	12	13	13	13	23
ice ON,	Distance	(%)	19	19	20	20	36	18	18	18	19	33
increase	Time	(%)	18	18	19	19	33	17	18	18	18	31

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 35000 AND 36000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			35000 FT ISA + °C					36000 FT ISA + °C				
			–10	**–10**	**0**	**10**	**20**	**–9**	**–5**	**0**	**10**	**20**
	Fuel	kg	694	694	728	764	905	720	733	751	789	936
34000	Distance	NM	72	72	76	79	105	77	78	80	84	112
	Time	min	12	12	12	12	16	12	12	13	13	17
	Fuel	kg	667	667	700	735	867	691	704	722	758	897
33000	Distance	NM	69	69	73	76	101	74	75	77	80	106
	Time	min	11	11	11	12	15	12	12	12	12	16
	Fuel	kg	641	641	672	706	831	664	676	693	728	858
32000	Distance	NM	67	67	70	73	96	70	72	73	77	102
	Time	min	11	11	11	11	14	11	11	12	12	15
	Fuel	kg	615	615	645	678	795	637	649	665	698	821
31000	Distance	NM	64	64	67	70	92	67	69	70	73	97
	Time	min	10	10	11	11	14	11	11	11	11	15
	Fuel	kg	591	591	619	650	762	611	622	638	670	786
30000	Distance	NM	61	61	64	67	88	65	66	67	70	92
	Time	min	10	10	10	10	13	10	10	11	11	14
For Anti-	Fuel	(%)	11	11	11	17	10	11	10	10	16	16
ice ON,	Distance	(%)	17	17	17	26	16	16	16	16	25	25
increase	Time	(%)	16	16	16	24	15	16	16	16	23	23

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 37000 AND 38000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			37000 FT ISA + °C					38000 FT ISA + °C				
			–8	–5	0	10	20	–8	–5	0	10	20
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
52000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
51000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	1463	1490	1529	1607	-	-	-	-	-	-
50000	Distance	NM	174	177	181	190	-	-	-	-	-	-
	Time	min	27	27	27	28	-	-	-	-	-	-
	Fuel	kg	1389	1414	1450	1524	-	-	-	-	-	-
49000	Distance	NM	163	166	170	178	-	-	-	-	-	-
	Time	min	25	26	26	27	-	-	-	-	-	-
	Fuel	kg	1322	1346	1380	1451	-	-	-	-	-	-
48000	Distance	NM	154	157	161	168	-	-	-	-	-	-
	Time	min	24	24	24	25	-	-	-	-	-	-
	Fuel	kg	1263	1286	1319	1386	-	1348	1372	1407	1479	-
47000	Distance	NM	146	149	152	160	-	163	166	170	178	-
	Time	min	23	23	23	24	-	25	25	26	26	-
	Fuel	kg	1209	1231	1262	1326	1706	1280	1303	1337	1405	-
46000	Distance	NM	139	141	145	152	223	153	156	160	167	-
	Time	min	22	22	22	23	32	24	24	24	25	-
	Fuel	kg	1158	1178	1209	1270	1613	1222	1244	1276	1341	-
45000	Distance	NM	132	135	138	144	209	145	147	151	158	-
	Time	min	21	21	21	22	30	22	23	23	24	-
	Fuel	kg	1110	1130	1158	1217	1530	1168	1189	1219	1281	1636
44000	Distance	NM	126	128	131	137	197	138	140	143	150	219
	Time	min	20	20	20	21	29	21	22	22	22	32
For Anti-	Fuel	(%)	13	14	14	14	25	12	12	12	12	21
ice ON,	Distance	(%)	18	18	18	19	34	15	16	16	16	28
increase	Time	(%)	17	18	18	18	31	15	15	16	16	26

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 37000 AND 38000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			37000 FT ISA + °C					38000 FT ISA + °C				
			–8	–5	0	10	20	–8	–5	0	10	20
	Fuel	kg	1064	1083	1111	1167	1453	1117	1137	1166	1226	1546
43000	Distance	NM	120	122	125	131	185	131	133	136	143	205
	Time	min	19	19	19	20	27	20	21	21	21	30
	Fuel	kg	1021	1040	1066	1120	1384	1070	1089	1117	1173	1464
42000	Distance	NM	115	117	120	125	175	124	126	129	136	192
	Time	min	18	18	18	19	26	19	20	20	20	28
	Fuel	kg	981	999	1024	1076	1321	1025	1043	1070	1124	1390
41000	Distance	NM	110	112	114	120	166	118	120	123	129	181
	Time	min	17	17	18	18	24	18	19	19	19	26
	Fuel	kg	943	960	985	1034	1263	982	1000	1025	1077	1322
40000	Distance	NM	105	107	110	115	158	113	115	118	123	171
	Time	min	17	17	17	17	23	18	18	18	19	25
	Fuel	kg	907	924	947	995	1208	943	960	984	1034	1261
39000	Distance	NM	101	103	105	110	151	108	110	112	118	162
	Time	min	16	16	16	17	22	17	17	17	18	24
	Fuel	kg	873	888	911	957	1156	906	922	945	993	1205
38000	Distance	NM	97	98	101	105	143	103	105	107	112	154
	Time	min	15	15	16	16	21	16	16	17	17	23
	Fuel	kg	839	854	876	920	1107	870	886	908	954	1152
37000	Distance	NM	93	94	96	101	137	99	100	103	108	146
	Time	min	15	15	15	15	20	16	16	16	16	21
	Fuel	kg	807	821	842	884	1059	836	851	872	916	1101
36000	Distance	NM	89	90	92	97	130	95	96	98	103	139
	Time	min	14	14	14	15	19	15	15	15	16	20
	Fuel	kg	775	789	809	850	1014	803	817	838	880	1053
35000	Distance	NM	85	87	89	93	124	90	92	94	99	133
	Time	min	13	14	14	14	18	14	14	15	15	20
For Anti-	Fuel	(%)	12	12	12	12	22	11	11	11	11	20
ice ON,	Distance	(%)	17	17	17	17	30	15	15	16	16	27
increase	Time	(%)	16	17	17	17	28	15	15	15	15	25

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 37000 AND 38000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			37000 FT ISA + °C					38000 FT ISA + °C				
			–8	**–5**	**0**	**10**	**20**	**–8**	**–5**	**0**	**10**	**20**
	Fuel	kg	745	758	777	816	970	771	784	804	845	1007
34000	Distance	NM	81	83	85	89	118	87	88	90	94	126
	Time	min	13	13	13	14	18	14	14	14	14	19
	Fuel	kg	715	728	746	784	928	739	752	772	810	962
33000	Distance	NM	78	79	81	85	113	83	84	86	90	120
	Time	min	12	13	13	13	17	13	13	13	14	18
	Fuel	kg	686	698	716	752	888	709	722	740	777	920
32000	Distance	NM	75	76	78	81	108	79	80	82	86	114
	Time	min	12	12	12	12	16	13	13	13	13	17
	Fuel	kg	658	670	687	721	849	680	692	709	745	879
31000	Distance	NM	71	73	74	78	103	76	77	79	82	109
	Time	min	11	11	12	12	15	12	12	12	13	16
	Fuel	kg	631	642	658	692	812	651	663	680	714	839
30000	Distance	NM	68	69	71	74	98	72	73	75	79	104
	Time	min	11	11	11	11	15	11	12	12	12	15
For Anti-	Fuel	(%)	10	10	10	10	16	10	10	10	10	15
ice ON,	Distance	(%)	15	15	15	15	23	14	14	14	15	22
increase	Time	(%)	15	15	15	15	22	14	14	14	14	20

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 39000 AND 40000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			39000 FT ISA + °C					40000 FT ISA + °C				
			–8	–5	0	10	20	–8	–5	0	10	20
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
52000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
51000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
50000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
49000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
48000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
47000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
46000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	1307	1330	1366	1435	-	-	-	-	-	-
45000	Distance	NM	163	166	170	178	-	-	-	-	-	-
	Time	min	25	25	26	26	-	-	-	-	-	-
	Fuel	kg	1239	1261	1294	1360	-	-	-	-	-	-
44000	Distance	NM	152	155	159	166	-	-	-	-	-	-
	Time	min	23	24	24	25	-	-	-	-	-	-
For Anti-	Fuel	(%)	11	11	11	11	0	0	0	0	0	0
ice ON,	Distance	(%)	14	14	14	14	0	0	0	0	0	0
increase	Time	(%)	14	14	14	14	0	0	0	0	0	0

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 39000 AND 40000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			39000 FT ISA + °C					40000 FT ISA + °C				
			–8	–5	0	10	20	–8	–5	0	10	20
	Fuel	kg	1180	1201	1232	1295	-	-	-	-	1390	-
43000	Distance	NM	144	146	150	157	-	-	-	-	178	-
	Time	min	22	22	23	23	-	-	-	-	26	-
	Fuel	kg	1126	1146	1176	1236	-	1196	1217	1249	1313	-
42000	Distance	NM	136	138	142	149	-	151	154	158	165	-
	Time	min	21	21	22	22	-	23	23	24	24	-
	Fuel	kg	1076	1095	1123	1180	1484	1137	1157	1187	1248	-
41000	Distance	NM	129	131	134	141	202	142	145	148	156	-
	Time	min	20	20	20	21	29	22	22	22	23	-
	Fuel	kg	1029	1047	1074	1128	1402	1083	1102	1131	1189	-
40000	Distance	NM	122	125	128	134	189	134	137	140	147	-
	Time	min	19	19	19	20	27	21	21	21	22	-
	Fuel	kg	984	1001	1027	1079	1328	1033	1051	1079	1134	1423
39000	Distance	NM	116	118	121	127	177	127	129	132	139	200
	Time	min	18	18	19	19	26	20	20	20	21	29
	Fuel	kg	942	959	984	1034	1262	986	1004	1030	1082	1341
38000	Distance	NM	111	113	115	121	167	120	122	125	131	186
	Time	min	17	17	18	18	24	19	19	19	20	27
	Fuel	kg	903	919	943	991	1203	942	959	984	1034	1268
37000	Distance	NM	106	107	110	115	158	114	116	119	125	173
	Time	min	16	17	17	17	23	18	18	18	19	25
	Fuel	kg	867	882	905	951	1148	901	917	941	989	1203
36000	Distance	NM	101	103	105	110	150	108	110	113	118	163
	Time	min	16	16	16	17	22	17	17	17	18	24
	Fuel	kg	832	846	868	912	1096	863	878	901	946	1144
35000	Distance	NM	96	98	101	105	142	103	105	108	113	154
	Time	min	15	15	15	16	21	16	16	16	17	22
For Anti-	Fuel	(%)	10	11	11	11	17	10	10	10	10	15
ice ON,	Distance	(%)	14	14	14	14	23	12	12	13	13	19
increase	Time	(%)	14	14	14	14	22	12	13	13	13	18

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 39000 AND 40000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			39000 FT ISA + °C					40000 FT ISA + °C				
			–8	**–5**	**0**	**10**	**20**	**–8**	**–5**	**0**	**10**	**20**
	Fuel	kg	798	812	833	875	1046	827	841	863	907	1091
34000	Distance	NM	92	94	96	101	135	99	100	103	108	146
	Time	min	14	15	15	15	20	15	15	16	16	21
	Fuel	kg	765	778	798	839	999	792	806	827	869	1040
33000	Distance	NM	88	90	92	96	128	94	96	98	103	138
	Time	min	14	14	14	14	19	15	15	15	15	20
	Fuel	kg	733	746	765	804	954	758	772	792	832	991
32000	Distance	NM	84	86	88	92	122	90	91	93	98	131
	Time	min	13	13	14	14	18	14	14	14	15	19
	Fuel	kg	702	715	733	770	910	726	739	758	796	945
31000	Distance	NM	80	82	84	88	116	85	87	89	93	124
	Time	min	13	13	13	13	17	13	13	14	14	18
	Fuel	kg	673	684	702	737	869	695	707	725	762	901
30000	Distance	NM	77	78	80	84	110	81	83	85	89	118
	Time	min	12	12	12	13	16	13	13	13	13	17
For Anti-	Fuel	(%)	9	9	9	9	14	9	9	9	9	14
ice ON,	Distance	(%)	13	13	13	14	20	12	12	13	13	19
increase	Time	(%)	13	13	13	13	19	12	12	12	12	18

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 41000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN **CF34-10E5/10E5A1/10E6/10E6A1 ENGINES**

WEIGHT (kg)			41000 FT ISA + °C									
			–8	–5	0	10	20					
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
43000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
42000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	-	-	-	-	-	-	-	-	-	-
41000	Distance	NM	-	-	-	-	-	-	-	-	-	-
	Time	min	-	-	-	-	-	-	-	-	-	-
	Fuel	kg	1151	1172	1202	1264	-	-	-	-	-	-
40000	Distance	NM	150	153	156	164	-	-	-	-	-	-
	Time	min	23	23	23	24	-	-	-	-	-	-
	Fuel	kg	1092	1111	1140	1199	-	-	-	-	-	-
39000	Distance	NM	141	143	147	154	-	-	-	-	-	-
	Time	min	22	22	22	23	-	-	-	-	-	-
	Fuel	kg	1038	1057	1084	1140	-	-	-	-	-	-
38000	Distance	NM	132	135	138	145	-	-	-	-	-	-
	Time	min	20	21	21	21	-	-	-	-	-	-
	Fuel	kg	989	1006	1033	1085	-	-	-	-	-	-
37000	Distance	NM	125	127	130	136	-	-	-	-	-	-
	Time	min	19	19	20	20	-	-	-	-	-	-
	Fuel	kg	942	959	984	1034	1278	-	-	-	-	-
36000	Distance	NM	118	120	123	129	182	-	-	-	-	-
	Time	min	18	18	19	19	26	-	-	-	-	-
	Fuel	kg	899	915	938	986	1205	-	-	-	-	-
35000	Distance	NM	112	113	116	122	169	-	-	-	-	-
	Time	min	17	17	18	18	24	-	-	-	-	-
For Anti-	Fuel	(%)	9	9	9	9	13	-	-	-	-	-
ice ON,	Distance	(%)	11	11	12	12	17	-	-	-	-	-
increase	Time	(%)	11	12	12	11	16	-	-	-	-	-

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CLIMB PLANNING - ALL ENGINES OPERATING

ALTITUDE: SEA LEVEL TO 41000 FT

SPEED SCHEDULE 250 KIAS UP TO 10000 FT, INCREASING LINEARLY TO 290 KIAS AT 12000 FT, MAINTAINING 290 KIAS UP TO 28900 FT AND MACH 0.75 ABOVE 28900 FT.

CRUISE CONFIGURATION

BLEED: OPEN

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WEIGHT (kg)			41000 FT ISA + °C									
			–8	–5	0	10	20					
	Fuel	kg	858	874	896	942	1142	-	-	-	-	-
34000	Distance	NM	106	108	110	116	159	-	-	-	-	-
	Time	min	16	17	17	17	23	-	-	-	-	-
	Fuel	kg	821	835	857	901	1085	-	-	-	-	-
33000	Distance	NM	101	102	105	110	150	-	-	-	-	-
	Time	min	16	16	16	16	22	-	-	-	-	-
	Fuel	kg	785	799	820	861	1033	-	-	-	-	-
32000	Distance	NM	96	97	100	105	141	-	-	-	-	-
	Time	min	15	15	15	16	21	-	-	-	-	-
	Fuel	kg	751	764	784	824	983	-	-	-	-	-
31000	Distance	NM	91	93	95	100	134	-	-	-	-	-
	Time	min	14	14	15	15	19	-	-	-	-	-
	Fuel	kg	718	731	750	788	936	-	-	-	-	-
30000	Distance	NM	87	88	90	95	127	-	-	-	-	-
	Time	min	14	14	14	14	18	-	-	-	-	-
For Anti-	Fuel	(%)	9	9	9	9	13	-	-	-	-	-
ice ON,	Distance	(%)	11	11	12	12	17	-	-	-	-	-
increase	Time	(%)	11	12	12	12	16	-	-	-	-	-

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BUFFET ONSET

This chart provides the buffet margin (maneuver capability) and associated bank angles for a variety of cruise altitudes and weights as function of Mach number.

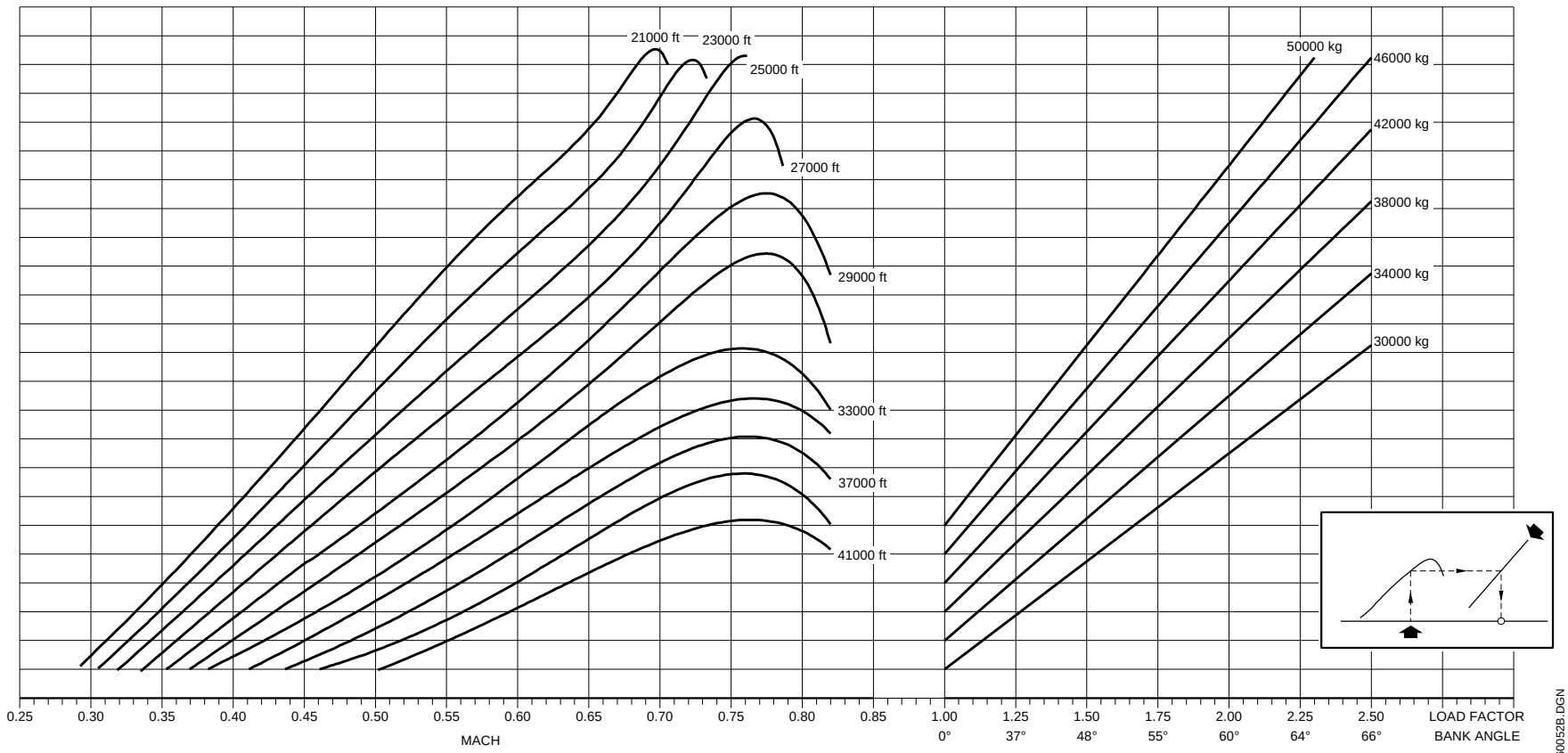
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MANEUVER CAPABILITY

ISA CONDITIONS



EM170AOM060052B.DGN

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LONG RANGE CRUISE

These tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data are presented for various weights and altitudes. Correction for ISA deviation and anti-ice are also presented.

In the long range cruise schedule (LRC), the airplane is flown at a speed corresponding to a specific range equal to 99% of maximum specific range. It is used when range is the main factor.

The associated conditions are:

Flaps..... UP
Gear..... UP
Bleeds..... OPEN
Anti-ice..... OFF
Center of gravity..... 22%
Minimum Remaining Rate of Climb..... 300 ft/min

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	67.7	70.5	71.2	71.9	72.5	73.6	74.5	75.3	76.0
	Fuel Flow	kg/h/Eng	1192	1137	1134	1129	1121	1137	1141	1142	1142
	IAS	kt	289	282	282	282	281	284	285	286	287
52000	TAS	kt	310	325	330	334	338	347	354	360	366
	Ind. MACH		0.48	0.51	0.52	0.53	0.54	0.55	0.56	0.58	0.59
	Buffet Marg	G	2.50	2.29	2.27	2.24	2.21	2.21	2.19	2.16	2.13
	SR	NM/kg	0.130	0.143	0.145	0.148	0.151	0.153	0.155	0.158	0.160
	N1	%	67.2	70.1	70.8	71.4	72.1	73.0	73.9	74.8	75.6
	Fuel Flow	kg/h/Eng	1170	1119	1115	1108	1102	1108	1116	1120	1120
	IAS	kt	286	280	280	279	279	280	282	283	284
51000	TAS	kt	307	323	327	331	336	343	350	357	363
	Ind. MACH		0.47	0.51	0.51	0.52	0.53	0.55	0.56	0.57	0.58
	Buffet Marg	G	2.50	2.32	2.29	2.26	2.23	2.22	2.20	2.18	2.15
	SR	NM/kg	0.131	0.144	0.147	0.150	0.152	0.155	0.157	0.159	0.162
	N1	%	66.8	69.7	70.4	71.0	71.6	72.3	73.3	74.2	75.1
	Fuel Flow	kg/h/Eng	1149	1101	1096	1088	1083	1077	1089	1095	1098
	IAS	kt	284	278	278	277	277	276	279	280	281
50000	TAS	kt	305	321	325	329	333	338	346	353	360
	Ind. MACH		0.47	0.50	0.51	0.52	0.53	0.54	0.55	0.57	0.58
	Buffet Marg	G	2.50	2.34	2.31	2.27	2.24	2.21	2.21	2.19	2.17
	SR	NM/kg	0.133	0.146	0.148	0.151	0.154	0.157	0.159	0.161	0.164
	N1	%	66.3	69.3	70.0	70.5	71.2	71.8	72.7	73.7	74.6
	Fuel Flow	kg/h/Eng	1129	1084	1079	1069	1064	1057	1060	1070	1074
	IAS	kt	281	277	276	275	274	274	275	277	278
49000	TAS	kt	302	319	323	326	331	335	341	349	356
	Ind. MACH		0.46	0.50	0.51	0.51	0.52	0.53	0.54	0.56	0.57
	Buffet Marg	G	2.50	2.37	2.34	2.29	2.26	2.23	2.22	2.21	2.18
	SR	NM/kg	0.134	0.147	0.150	0.153	0.155	0.158	0.161	0.163	0.166
	N1	%	65.8	68.9	69.5	70.1	70.8	71.4	72.0	73.1	74.0
	Fuel Flow	kg/h/Eng	1108	1066	1060	1050	1045	1038	1030	1044	1050
	IAS	kt	279	275	274	273	272	271	271	274	275
48000	TAS	kt	299	317	321	324	328	332	336	345	352
	Ind. MACH		0.46	0.50	0.50	0.51	0.52	0.53	0.54	0.55	0.57
	Buffet Marg	G	2.50	2.40	2.36	2.31	2.28	2.25	2.21	2.22	2.20
	SR	NM/kg	0.135	0.149	0.151	0.154	0.157	0.160	0.163	0.165	0.168

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 4.3%.
- DECREASE SR(%) by 3.3%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	65.3	68.5	69.1	69.6	70.3	70.9	71.6	72.5	73.4
	Fuel Flow	kg/h/Eng	1085	1048	1041	1030	1025	1017	1013	1017	1024
	IAS	kt	276	273	272	270	270	269	269	270	272
47000	TAS	kt	296	315	319	321	325	329	334	341	348
	Ind. MACH		0.45	0.49	0.50	0.51	0.52	0.52	0.53	0.55	0.56
	Buffet Marg	G	2.50	2.42	2.38	2.34	2.30	2.26	2.24	2.22	2.21
	SR	NM/kg	0.136	0.150	0.153	0.156	0.159	0.162	0.165	0.168	0.170
	N1	%	64.7	68.1	68.6	69.2	69.8	70.4	71.1	71.8	72.8
	Fuel Flow	kg/h/Eng	1062	1033	1021	1012	1005	997	994	991	998
	IAS	kt	273	272	270	268	268	266	267	267	268
46000	TAS	kt	292	313	316	319	323	326	331	337	344
	Ind. MACH		0.45	0.49	0.50	0.50	0.51	0.52	0.53	0.54	0.55
	Buffet Marg	G	2.50	2.46	2.41	2.36	2.32	2.28	2.26	2.23	2.22
	SR	NM/kg	0.138	0.152	0.155	0.158	0.160	0.164	0.167	0.170	0.172
	N1	%	64.1	67.5	68.2	68.7	69.3	69.9	70.6	71.3	72.1
	Fuel Flow	kg/h/Eng	1037	1011	1002	993	985	977	975	971	970
	IAS	kt	269	269	268	266	265	264	264	264	265
45000	TAS	kt	289	310	313	317	320	323	328	333	339
	Ind. MACH		0.44	0.49	0.49	0.50	0.51	0.51	0.52	0.53	0.55
	Buffet Marg	G	2.50	2.47	2.43	2.39	2.34	2.30	2.28	2.25	2.22
	SR	NM/kg	0.139	0.153	0.156	0.159	0.162	0.165	0.168	0.172	0.175
	N1	%	63.5	67.2	67.7	68.3	68.9	69.4	70.1	70.8	71.4
	Fuel Flow	kg/h/Eng	1012	996	984	975	967	958	956	951	945
	IAS	kt	266	267	266	264	263	262	262	262	261
44000	TAS	kt	285	308	311	314	317	321	326	330	335
	Ind. MACH		0.44	0.48	0.49	0.50	0.50	0.51	0.52	0.53	0.54
	Buffet Marg	G	2.50	2.50	2.46	2.41	2.37	2.32	2.30	2.27	2.23
	SR	NM/kg	0.141	0.155	0.158	0.161	0.164	0.167	0.170	0.174	0.177
	N1	%	62.9	66.7	67.2	67.8	68.4	69.0	69.6	70.3	71.0
	Fuel Flow	kg/h/Eng	989	977	966	956	949	940	936	930	926
	IAS	kt	263	265	263	262	261	260	259	259	259
43000	TAS	kt	282	306	308	312	315	318	323	327	332
	Ind. MACH		0.43	0.48	0.49	0.49	0.50	0.51	0.52	0.52	0.53
	Buffet Marg	G	2.50	2.50	2.48	2.44	2.40	2.35	2.32	2.28	2.25
	SR	NM/kg	0.142	0.157	0.160	0.163	0.166	0.169	0.172	0.176	0.179

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 5 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 4.7%. • DECREASE SR(%) by 3.5%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	62.4	66.1	66.7	67.3	67.9	68.5	69.2	69.7	70.4
	Fuel Flow	kg/h/Eng	970	953	947	939	932	923	918	910	907
	IAS	kt	261	262	261	260	259	258	257	256	256
42000	TAS	kt	280	302	306	309	313	316	320	324	329
	Ind. MACH		0.43	0.47	0.48	0.49	0.50	0.50	0.51	0.52	0.53
	Buffet Marg	G	2.50	2.50	2.50	2.47	2.43	2.38	2.35	2.30	2.28
	SR	NM/kg	0.144	0.159	0.161	0.165	0.168	0.171	0.174	0.178	0.181
	N1	%	62.0	65.5	66.2	66.8	67.5	68.0	68.6	69.2	69.9
	Fuel Flow	kg/h/Eng	954	933	927	921	914	905	899	892	888
	IAS	kt	259	259	259	258	257	256	255	254	254
41000	TAS	kt	278	299	303	307	311	314	317	321	325
	Ind. MACH		0.43	0.47	0.48	0.48	0.49	0.50	0.51	0.51	0.52
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.46	2.41	2.37	2.33	2.30
	SR	NM/kg	0.146	0.160	0.163	0.167	0.170	0.173	0.177	0.180	0.183
	N1	%	61.7	64.9	65.6	66.4	67.0	67.5	68.1	68.7	69.4
	Fuel Flow	kg/h/Eng	941	911	906	904	896	886	880	872	868
	IAS	kt	258	256	256	256	255	254	253	251	251
40000	TAS	kt	276	295	300	305	308	311	315	318	322
	Ind. MACH		0.43	0.46	0.47	0.48	0.49	0.49	0.50	0.51	0.52
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.49	2.44	2.40	2.35	2.32
	SR	NM/kg	0.147	0.162	0.165	0.168	0.172	0.175	0.179	0.182	0.186
	N1	%	61.4	64.2	65.0	65.8	66.4	67.0	67.6	68.2	68.8
	Fuel Flow	kg/h/Eng	927	887	885	884	876	868	861	853	849
	IAS	kt	256	252	253	254	252	251	250	249	248
39000	TAS	kt	275	291	296	302	305	308	312	315	319
	Ind. MACH		0.42	0.46	0.47	0.48	0.48	0.49	0.50	0.50	0.51
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.47	2.43	2.38	2.34
	SR	NM/kg	0.148	0.164	0.167	0.171	0.174	0.177	0.181	0.184	0.188
	N1	%	61.0	63.5	64.4	65.2	65.8	66.4	67.0	67.7	68.3
	Fuel Flow	kg/h/Eng	912	863	865	863	857	850	843	835	830
	IAS	kt	255	248	250	251	250	249	248	247	246
38000	TAS	kt	273	286	293	298	302	305	309	312	316
	Ind. MACH		0.42	0.45	0.46	0.47	0.48	0.49	0.49	0.50	0.51
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.45	2.41	2.37
	SR	NM/kg	0.150	0.166	0.169	0.173	0.176	0.180	0.183	0.187	0.190

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 7 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 5.2%.
- DECREASE SR(%) by 3.9%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	60.5	62.9	63.7	64.6	65.2	65.9	66.5	67.1	67.7
	Fuel Flow	kg/h/Eng	897	842	843	844	836	832	825	816	810
	IAS	kt	253	245	246	248	247	247	246	244	243
37000	TAS	kt	272	283	289	295	298	302	306	309	313
	Ind. MACH		0.42	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.50
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.49	2.44	2.40
	SR	NM/kg	0.151	0.168	0.171	0.175	0.178	0.182	0.185	0.189	0.193
	N1	%	60.1	62.3	63.1	63.9	64.6	65.3	65.9	66.5	67.1
	Fuel Flow	kg/h/Eng	880	823	824	823	817	813	806	799	791
	IAS	kt	251	242	243	244	244	244	243	242	241
36000	TAS	kt	269	280	285	291	295	299	303	306	310
	Ind. MACH		0.41	0.44	0.45	0.46	0.47	0.48	0.48	0.49	0.50
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.47	2.43
	SR	NM/kg	0.153	0.170	0.173	0.177	0.180	0.184	0.188	0.192	0.196
	N1	%	59.4	61.7	62.5	63.2	64.0	64.7	65.3	66.0	66.5
	Fuel Flow	kg/h/Eng	858	804	804	801	798	793	787	781	773
	IAS	kt	248	240	241	241	241	241	240	240	238
35000	TAS	kt	266	277	282	287	291	296	299	303	306
	Ind. MACH		0.41	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.49
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.46
	SR	NM/kg	0.155	0.173	0.176	0.179	0.183	0.187	0.190	0.194	0.198
	N1	%	58.5	61.2	61.9	62.5	63.3	64.0	64.6	65.4	66.0
	Fuel Flow	kg/h/Eng	831	789	784	779	776	772	766	763	756
	IAS	kt	243	238	238	237	237	238	237	237	236
34000	TAS	kt	261	275	279	283	287	292	296	300	304
	Ind. MACH		0.40	0.43	0.44	0.45	0.45	0.46	0.47	0.48	0.49
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	SR	NM/kg	0.157	0.175	0.178	0.181	0.185	0.189	0.193	0.197	0.201
	N1	%	57.7	60.7	61.2	61.6	62.4	63.2	64.0	64.7	65.4
	Fuel Flow	kg/h/Eng	808	773	763	751	751	750	747	744	738
	IAS	kt	239	236	235	232	233	234	234	235	234
33000	TAS	kt	257	273	275	277	282	287	292	297	301
	Ind. MACH		0.40	0.43	0.43	0.44	0.45	0.46	0.47	0.48	0.48
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	SR	NM/kg	0.159	0.177	0.180	0.184	0.188	0.191	0.195	0.200	0.204

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1(%) BY 0.6% AND FUEL FLOW BY 5.4%. • DECREASE SR(%) by 4.1%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	56.9	60.3	60.7	60.8	61.6	62.5	63.4	64.2	64.7
	Fuel Flow	kg/h/Eng	788	759	746	727	728	729	730	729	720
	IAS	kt	235	235	232	228	229	230	232	233	231
32000	TAS	kt	253	271	273	272	277	283	289	294	297
	Ind. MACH		0.39	0.42	0.43	0.43	0.44	0.45	0.46	0.47	0.48
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	SR	NM/kg	0.160	0.179	0.183	0.187	0.191	0.194	0.198	0.202	0.206
	N1	%	56.2	59.9	60.2	60.2	60.9	61.7	62.7	63.7	64.2
	Fuel Flow	kg/h/Eng	768	746	731	710	707	707	711	714	705
	IAS	kt	232	233	230	226	226	227	229	231	229
31000	TAS	kt	249	270	270	269	274	279	285	292	295
	Ind. MACH		0.38	0.42	0.43	0.42	0.43	0.44	0.46	0.47	0.47
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	SR	NM/kg	0.162	0.181	0.185	0.190	0.194	0.197	0.201	0.204	0.209
	N1	%	55.6	59.6	59.7	59.7	60.3	60.9	62.1	63.2	63.8
	Fuel Flow	kg/h/Eng	751	735	717	696	691	685	693	701	693
	IAS	kt	229	232	229	224	224	223	226	229	228
30000	TAS	kt	246	269	268	267	271	274	282	290	293
	Ind. MACH		0.38	0.42	0.42	0.42	0.43	0.44	0.45	0.46	0.47
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
	SR	NM/kg	0.164	0.183	0.187	0.192	0.196	0.200	0.203	0.207	0.211

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 4% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 8 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 7.0%.
- DECREASE SR(%) by 5.6%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	76.8	77.3	77.8	78.1	78.7	79.5	80.3	81.0	81.8
	Fuel Flow	kg/h/Eng	1139	1127	1113	1093	1086	1091	1091	1095	1099
	IAS	kt	287	285	284	281	279	279	278	278	278
52000	TAS	kt	372	376	380	381	385	391	396	402	408
	Ind. MACH		0.60	0.61	0.62	0.62	0.63	0.64	0.65	0.67	0.68
	Buffet Marg	G	2.09	2.04	1.98	1.92	1.86	1.82	1.79	1.77	1.75
	SR	NM/kg	0.163	0.167	0.171	0.174	0.177	0.179	0.181	0.184	0.186
	N1	%	76.3	76.9	77.5	77.8	78.2	79.1	79.8	80.5	81.4
	Fuel Flow	kg/h/Eng	1118	1107	1097	1078	1062	1068	1071	1070	1076
	IAS	kt	285	283	282	279	277	277	276	276	276
51000	TAS	kt	369	373	378	379	382	388	393	399	405
	Ind. MACH		0.60	0.61	0.61	0.62	0.63	0.64	0.65	0.66	0.68
	Buffet Marg	G	2.11	2.06	2.01	1.94	1.88	1.84	1.80	1.78	1.76
	SR	NM/kg	0.165	0.168	0.172	0.176	0.180	0.181	0.184	0.186	0.188
	N1	%	75.9	76.5	77.1	77.4	77.9	78.6	79.4	80.1	80.9
	Fuel Flow	kg/h/Eng	1097	1089	1078	1061	1047	1046	1050	1049	1051
	IAS	kt	282	281	280	277	275	275	274	274	274
50000	TAS	kt	366	371	375	377	380	385	391	396	402
	Ind. MACH		0.59	0.60	0.61	0.62	0.62	0.63	0.65	0.66	0.67
	Buffet Marg	G	2.13	2.09	2.04	1.97	1.91	1.86	1.82	1.79	1.78
	SR	NM/kg	0.167	0.170	0.174	0.178	0.182	0.184	0.186	0.189	0.191
	N1	%	75.4	76.0	76.7	77.1	77.6	78.1	78.9	79.7	80.2
	Fuel Flow	kg/h/Eng	1075	1068	1060	1045	1033	1023	1027	1027	1019
	IAS	kt	279	279	278	276	274	273	272	272	270
49000	TAS	kt	362	368	372	375	379	382	388	393	397
	Ind. MACH		0.59	0.60	0.61	0.61	0.62	0.63	0.64	0.65	0.66
	Buffet Marg	G	2.15	2.11	2.06	2.00	1.94	1.89	1.84	1.81	1.77
	SR	NM/kg	0.169	0.172	0.176	0.179	0.183	0.187	0.189	0.191	0.195
	N1	%	74.9	75.6	76.2	76.7	77.3	77.8	78.4	79.1	79.7
	Fuel Flow	kg/h/Eng	1053	1048	1039	1029	1019	1007	1004	1001	994
	IAS	kt	277	276	276	274	273	271	270	269	267
48000	TAS	kt	359	364	369	373	377	380	385	389	393
	Ind. MACH		0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.65
	Buffet Marg	G	2.17	2.13	2.09	2.03	1.98	1.92	1.87	1.81	1.77
	SR	NM/kg	0.171	0.174	0.178	0.181	0.185	0.189	0.192	0.194	0.197

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 7 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.1%. • DECREASE SR(%) by 3.4%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	74.3	75.0	75.7	76.4	77.0	77.4	77.9	78.5	79.3
	Fuel Flow	kg/h/Eng	1028	1024	1018	1012	1005	991	980	976	978
	IAS	kt	273	273	273	272	272	270	268	266	266
47000	TAS	kt	355	360	366	371	376	378	382	385	391
	Ind. MACH		0.57	0.58	0.60	0.61	0.62	0.62	0.63	0.64	0.65
	Buffet Marg	G	2.18	2.15	2.11	2.06	2.01	1.95	1.89	1.83	1.80
	SR	NM/kg	0.173	0.176	0.179	0.183	0.187	0.191	0.195	0.197	0.200
	N1	%	73.7	74.5	75.2	75.9	76.6	77.0	77.4	78.0	78.8
	Fuel Flow	kg/h/Eng	1002	1001	997	994	989	973	958	954	954
	IAS	kt	269	270	270	271	270	267	265	264	263
46000	TAS	kt	350	356	362	368	374	376	378	382	387
	Ind. MACH		0.57	0.58	0.59	0.60	0.61	0.62	0.62	0.63	0.65
	Buffet Marg	G	2.19	2.16	2.12	2.09	2.04	1.98	1.91	1.86	1.81
	SR	NM/kg	0.175	0.178	0.182	0.185	0.189	0.193	0.197	0.200	0.203
	N1	%	73.1	73.9	74.7	75.4	76.2	76.6	77.0	77.4	78.2
	Fuel Flow	kg/h/Eng	978	978	976	974	970	955	941	929	930
	IAS	kt	266	267	267	268	268	265	263	261	260
45000	TAS	kt	346	353	358	365	370	373	375	378	384
	Ind. MACH		0.56	0.57	0.58	0.60	0.61	0.61	0.62	0.63	0.64
	Buffet Marg	G	2.21	2.18	2.15	2.11	2.07	2.00	1.94	1.88	1.83
	SR	NM/kg	0.177	0.180	0.184	0.187	0.191	0.195	0.199	0.204	0.206
	N1	%	72.5	73.3	74.2	74.9	75.6	76.1	76.6	77.0	77.7
	Fuel Flow	kg/h/Eng	953	955	954	952	948	937	926	911	908
	IAS	kt	263	264	265	265	265	263	261	259	258
44000	TAS	kt	342	349	355	361	367	370	373	376	381
	Ind. MACH		0.55	0.57	0.58	0.59	0.60	0.61	0.62	0.62	0.63
	Buffet Marg	G	2.23	2.20	2.17	2.13	2.09	2.03	1.97	1.91	1.86
	SR	NM/kg	0.180	0.183	0.186	0.189	0.193	0.197	0.202	0.206	0.210
	N1	%	71.7	72.7	73.6	74.4	75.1	75.7	76.2	76.6	77.1
	Fuel Flow	kg/h/Eng	925	930	931	931	928	919	910	896	885
	IAS	kt	259	261	262	262	262	261	260	257	256
43000	TAS	kt	337	345	351	357	363	367	371	374	377
	Ind. MACH		0.54	0.56	0.57	0.58	0.60	0.60	0.61	0.62	0.63
	Buffet Marg	G	2.23	2.22	2.19	2.16	2.12	2.06	2.01	1.95	1.89
	SR	NM/kg	0.182	0.185	0.188	0.192	0.196	0.200	0.204	0.208	0.213

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 5 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.2%.
- DECREASE SR(%) by 3.4%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	71.1	72.0	73.0	73.8	74.6	75.2	75.8	76.2	76.7
	Fuel Flow	kg/h/Eng	903	904	907	908	906	900	893	880	869
	IAS	kt	256	257	258	259	259	258	258	256	254
42000	TAS	kt	333	340	347	353	359	363	368	371	375
	Ind. MACH		0.54	0.55	0.56	0.58	0.59	0.60	0.61	0.62	0.63
	Buffet Marg	G	2.25	2.23	2.21	2.18	2.14	2.09	2.04	1.98	1.92
	SR	NM/kg	0.185	0.188	0.191	0.194	0.198	0.202	0.206	0.211	0.216
	N1	%	70.6	71.2	72.3	73.2	74.0	74.7	75.3	75.8	76.4
	Fuel Flow	kg/h/Eng	882	875	882	885	884	880	875	865	856
	IAS	kt	253	253	255	256	256	256	255	254	253
41000	TAS	kt	330	334	342	349	355	360	365	369	374
	Ind. MACH		0.53	0.54	0.56	0.57	0.58	0.59	0.60	0.61	0.62
	Buffet Marg	G	2.26	2.23	2.22	2.20	2.16	2.12	2.07	2.02	1.96
	SR	NM/kg	0.187	0.191	0.194	0.197	0.201	0.205	0.209	0.213	0.218
	N1	%	70.0	70.6	71.6	72.5	73.3	74.1	74.8	75.4	76.0
	Fuel Flow	kg/h/Eng	862	852	857	860	861	860	857	849	842
	IAS	kt	250	249	251	252	253	253	253	252	252
40000	TAS	kt	326	330	337	344	350	356	362	367	372
	Ind. MACH		0.53	0.53	0.55	0.56	0.57	0.59	0.60	0.61	0.62
	Buffet Marg	G	2.28	2.24	2.23	2.21	2.18	2.14	2.10	2.05	2.00
	SR	NM/kg	0.189	0.194	0.197	0.200	0.203	0.207	0.211	0.216	0.221
	N1	%	69.4	70.1	70.8	71.8	72.6	73.5	74.3	75.0	75.6
	Fuel Flow	kg/h/Eng	840	835	828	835	837	839	838	833	826
	IAS	kt	247	247	247	249	249	250	251	251	250
39000	TAS	kt	322	327	332	339	345	352	359	364	370
	Ind. MACH		0.52	0.53	0.54	0.55	0.57	0.58	0.59	0.61	0.62
	Buffet Marg	G	2.30	2.27	2.24	2.23	2.20	2.17	2.13	2.09	2.04
	SR	NM/kg	0.192	0.196	0.200	0.203	0.206	0.210	0.214	0.219	0.224
	N1	%	68.9	69.5	70.2	70.9	72.0	72.9	73.7	74.4	75.1
	Fuel Flow	kg/h/Eng	823	815	810	806	814	818	818	814	809
	IAS	kt	245	244	244	244	246	247	248	248	248
38000	TAS	kt	319	323	328	333	341	348	355	361	366
	Ind. MACH		0.52	0.52	0.53	0.54	0.56	0.57	0.59	0.60	0.61
	Buffet Marg	G	2.33	2.29	2.26	2.23	2.22	2.19	2.16	2.12	2.07
	SR	NM/kg	0.194	0.198	0.203	0.207	0.210	0.213	0.217	0.221	0.226

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 5 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.5%. • DECREASE SR(%) by 3.6%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	68.3	69.0	69.6	70.2	71.2	72.2	73.1	73.9	74.5
	Fuel Flow	kg/h/Eng	803	799	790	783	787	795	798	795	790
	IAS	kt	242	242	241	240	242	244	245	245	245
37000	TAS	kt	316	321	325	328	336	344	351	357	362
	Ind. MACH		0.51	0.52	0.53	0.54	0.55	0.57	0.58	0.59	0.60
	Buffet Marg	G	2.35	2.33	2.28	2.24	2.23	2.22	2.19	2.15	2.11
	SR	NM/kg	0.197	0.201	0.205	0.210	0.213	0.216	0.220	0.225	0.230
	N1	%	67.7	68.4	69.0	69.7	70.3	71.4	72.5	73.2	74.0
	Fuel Flow	kg/h/Eng	783	780	770	765	759	767	775	774	771
	IAS	kt	239	240	238	238	237	239	242	242	243
36000	TAS	kt	312	317	321	325	330	338	346	353	359
	Ind. MACH		0.50	0.51	0.52	0.53	0.54	0.56	0.57	0.59	0.60
	Buffet Marg	G	2.38	2.35	2.30	2.27	2.23	2.22	2.21	2.18	2.14
	SR	NM/kg	0.199	0.204	0.208	0.213	0.217	0.220	0.223	0.228	0.233
	N1	%	67.1	67.8	68.3	69.1	69.8	70.6	71.6	72.6	73.4
	Fuel Flow	kg/h/Eng	765	761	749	745	741	741	748	753	751
	IAS	kt	237	237	235	235	235	235	237	239	240
35000	TAS	kt	310	314	316	321	326	332	340	348	355
	Ind. MACH		0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.58	0.59
	Buffet Marg	G	2.41	2.38	2.32	2.29	2.26	2.24	2.22	2.21	2.17
	SR	NM/kg	0.202	0.206	0.211	0.216	0.220	0.224	0.227	0.231	0.236
	N1	%	66.6	67.3	67.9	68.6	69.2	70.0	70.9	71.9	72.6
	Fuel Flow	kg/h/Eng	749	743	736	733	724	725	728	730	725
	IAS	kt	235	235	234	234	232	234	234	236	235
34000	TAS	kt	307	311	315	320	323	330	336	343	348
	Ind. MACH		0.50	0.50	0.51	0.52	0.53	0.54	0.56	0.57	0.58
	Buffet Marg	G	2.45	2.41	2.37	2.34	2.29	2.28	2.26	2.23	2.18
	SR	NM/kg	0.205	0.209	0.214	0.218	0.223	0.227	0.231	0.235	0.240
	N1	%	66.0	66.7	67.5	68.1	68.8	69.5	70.3	71.1	71.9
	Fuel Flow	kg/h/Eng	731	727	723	717	712	710	709	708	707
	IAS	kt	233	233	233	232	231	232	232	232	233
33000	TAS	kt	304	309	313	317	322	327	333	339	345
	Ind. MACH		0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57
	Buffet Marg	G	2.49	2.46	2.43	2.39	2.35	2.32	2.29	2.26	2.22
	SR	NM/kg	0.208	0.212	0.217	0.221	0.226	0.230	0.235	0.239	0.244

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 7 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 5.0%.
- DECREASE SR(%) by 4.8%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	65.4	66.2	67.1	67.7	68.3	69.1	69.9	70.5	71.3
	Fuel Flow	kg/h/Eng	713	712	711	705	700	699	698	690	688
	IAS	kt	230	231	232	231	230	231	231	230	230
32000	TAS	kt	301	306	312	316	320	326	332	336	341
	Ind. MACH		0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57
	Buffet Marg	G	2.50	2.50	2.49	2.45	2.40	2.38	2.35	2.30	2.26
	SR	NM/kg	0.211	0.215	0.220	0.224	0.229	0.233	0.238	0.243	0.248
	N1	%	64.8	65.7	66.6	67.3	68.0	68.8	69.5	70.1	70.7
	Fuel Flow	kg/h/Eng	697	699	699	695	689	689	688	678	673
	IAS	kt	228	230	231	230	229	230	230	229	228
31000	TAS	kt	298	305	311	316	319	325	331	334	339
	Ind. MACH		0.48	0.49	0.51	0.52	0.52	0.54	0.55	0.56	0.56
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.47	2.45	2.42	2.36	2.31
	SR	NM/kg	0.214	0.218	0.222	0.227	0.232	0.236	0.241	0.246	0.252
	N1	%	64.3	65.3	66.4	66.9	67.6	68.4	69.2	69.8	70.3
	Fuel Flow	kg/h/Eng	684	688	692	684	679	679	679	671	660
	IAS	kt	227	228	231	230	229	230	230	229	227
30000	TAS	kt	296	303	311	314	319	325	331	334	337
	Ind. MACH		0.48	0.49	0.51	0.51	0.52	0.53	0.55	0.56	0.56
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.44	2.37
	SR	NM/kg	0.216	0.220	0.225	0.230	0.235	0.239	0.243	0.249	0.255

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 5% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 12 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.6% AND FUEL FLOW BY 7.8%.
- DECREASE SR(%) by 6.4%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	82.6	83.3	83.7	84.2	85.0	86.5	87.3	87.9	-
	Fuel Flow	kg/h/Eng	1107	1110	1103	1094	1107	1158	1160	1144	-
	IAS	kt	279	279	277	274	276	282	280	276	-
52000	TAS	kt	416	422	426	429	438	455	458	460	-
	Ind. MACH		0.70	0.71	0.72	0.73	0.75	0.78	0.79	0.79	-
	Buffet Marg	G	1.74	1.73	1.70	1.66	1.67	1.61	1.53	1.45	-
	SR	NM/kg	0.188	0.190	0.193	0.196	0.198	0.196	0.198	0.201	-
	N1	%	82.2	82.9	83.3	83.8	84.4	85.8	87.0	87.5	-
	Fuel Flow	kg/h/Eng	1084	1089	1081	1075	1073	1118	1141	1125	-
	IAS	kt	277	277	274	273	272	278	279	275	-
51000	TAS	kt	413	420	423	427	433	448	457	458	-
	Ind. MACH		0.69	0.71	0.71	0.72	0.74	0.77	0.79	0.79	-
	Buffet Marg	G	1.75	1.74	1.71	1.68	1.66	1.65	1.56	1.48	-
	SR	NM/kg	0.190	0.193	0.196	0.199	0.202	0.200	0.200	0.204	-
	N1	%	81.6	82.4	82.9	83.5	84.1	85.0	86.4	87.1	87.6
	Fuel Flow	kg/h/Eng	1056	1061	1059	1056	1053	1071	1117	1109	1093
	IAS	kt	273	274	272	271	270	272	277	274	270
50000	TAS	kt	408	415	420	425	430	440	455	457	458
	Ind. MACH		0.68	0.70	0.71	0.72	0.73	0.75	0.78	0.79	0.79
	Buffet Marg	G	1.76	1.74	1.71	1.69	1.67	1.68	1.60	1.52	1.44
	SR	NM/kg	0.193	0.195	0.198	0.201	0.204	0.205	0.204	0.206	0.209
	N1	%	81.1	81.8	82.5	83.2	83.7	84.1	85.7	86.7	87.3
	Fuel Flow	kg/h/Eng	1028	1034	1037	1036	1032	1024	1074	1090	1077
	IAS	kt	270	270	270	270	268	266	273	273	269
49000	TAS	kt	404	410	417	423	427	431	447	455	457
	Ind. MACH		0.68	0.69	0.70	0.72	0.73	0.74	0.77	0.79	0.79
	Buffet Marg	G	1.76	1.74	1.72	1.71	1.68	1.65	1.64	1.55	1.47
	SR	NM/kg	0.196	0.198	0.201	0.204	0.207	0.210	0.208	0.209	0.212
	N1	%	80.5	81.3	82.1	82.7	83.2	83.7	84.8	86.2	86.9
	Fuel Flow	kg/h/Eng	1000	1007	1013	1014	1009	1002	1029	1068	1061
	IAS	kt	267	267	268	268	266	264	267	272	268
48000	TAS	kt	399	406	413	419	423	427	439	453	456
	Ind. MACH		0.67	0.68	0.70	0.71	0.72	0.73	0.76	0.78	0.79
	Buffet Marg	G	1.76	1.74	1.73	1.72	1.69	1.66	1.67	1.59	1.51
	SR	NM/kg	0.199	0.201	0.204	0.207	0.210	0.213	0.213	0.212	0.215

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 8 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.5%.
- DECREASE SR(%) by 3.7%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	79.9	80.7	81.5	82.2	82.8	83.3	83.9	85.5	86.4
	Fuel Flow	kg/h/Eng	973	979	987	990	986	981	982	1032	1041
	IAS	kt	264	264	265	265	263	262	261	268	267
47000	TAS	kt	394	401	408	415	420	424	431	448	453
	Ind. MACH		0.66	0.67	0.69	0.70	0.72	0.73	0.74	0.77	0.79
	Buffet Marg	G	1.76	1.74	1.74	1.72	1.69	1.67	1.66	1.63	1.54
	SR	NM/kg	0.203	0.205	0.207	0.210	0.213	0.216	0.219	0.217	0.218
	N1	%	79.5	80.2	81.0	81.8	82.4	82.9	83.5	84.6	86.0
	Fuel Flow	kg/h/Eng	956	953	962	967	966	960	960	990	1021
	IAS	kt	263	261	262	262	261	259	259	263	266
46000	TAS	kt	393	397	405	412	417	421	427	440	451
	Ind. MACH		0.66	0.67	0.68	0.70	0.71	0.72	0.73	0.76	0.78
	Buffet Marg	G	1.79	1.75	1.74	1.73	1.71	1.68	1.67	1.66	1.58
	SR	NM/kg	0.206	0.208	0.210	0.213	0.216	0.219	0.223	0.222	0.221
	N1	%	79.0	79.7	80.5	81.3	82.0	82.5	83.1	83.7	85.3
	Fuel Flow	kg/h/Eng	932	930	940	946	945	941	942	943	988
	IAS	kt	260	259	260	260	259	258	258	257	263
45000	TAS	kt	389	394	401	409	414	419	425	431	447
	Ind. MACH		0.65	0.66	0.68	0.69	0.71	0.72	0.73	0.74	0.78
	Buffet Marg	G	1.80	1.77	1.76	1.75	1.72	1.70	1.68	1.67	1.62
	SR	NM/kg	0.209	0.212	0.214	0.216	0.219	0.222	0.226	0.229	0.226
	N1	%	78.5	79.2	80.0	80.8	81.5	82.2	82.7	83.2	84.4
	Fuel Flow	kg/h/Eng	912	909	915	920	923	924	922	916	945
	IAS	kt	258	257	257	257	257	257	255	254	257
44000	TAS	kt	387	391	398	404	411	417	422	426	438
	Ind. MACH		0.65	0.66	0.67	0.69	0.70	0.71	0.73	0.74	0.76
	Buffet Marg	G	1.82	1.79	1.77	1.75	1.73	1.72	1.70	1.67	1.66
	SR	NM/kg	0.212	0.215	0.217	0.220	0.222	0.225	0.229	0.233	0.232
	N1	%	78.0	78.7	79.4	80.2	81.0	81.7	82.2	82.7	83.5
	Fuel Flow	kg/h/Eng	891	889	889	893	900	904	900	895	900
	IAS	kt	256	255	254	254	254	255	253	251	252
43000	TAS	kt	384	388	393	399	407	414	418	422	430
	Ind. MACH		0.64	0.65	0.66	0.68	0.69	0.71	0.72	0.73	0.75
	Buffet Marg	G	1.84	1.80	1.78	1.76	1.74	1.73	1.70	1.68	1.67
	SR	NM/kg	0.215	0.218	0.221	0.224	0.226	0.229	0.232	0.236	0.239

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 7 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.8%. • DECREASE SR(%) by 4.0%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	77.5	78.2	78.9	79.6	80.4	81.2	81.8	82.3	82.9
	Fuel Flow	kg/h/Eng	869	868	867	868	875	880	878	873	872
	IAS	kt	254	253	252	251	251	252	250	249	248
42000	TAS	kt	381	385	390	395	402	409	414	418	425
	Ind. MACH		0.64	0.65	0.66	0.67	0.69	0.70	0.71	0.72	0.74
	Buffet Marg	G	1.87	1.82	1.79	1.76	1.75	1.74	1.71	1.68	1.67
	SR	NM/kg	0.219	0.222	0.225	0.228	0.230	0.233	0.236	0.240	0.243
	N1	%	76.8	77.6	78.3	79.0	79.8	80.6	81.2	81.8	82.4
	Fuel Flow	kg/h/Eng	844	846	845	842	850	854	855	852	852
	IAS	kt	251	250	249	248	248	248	248	246	246
41000	TAS	kt	376	382	386	390	398	404	410	415	421
	Ind. MACH		0.63	0.64	0.65	0.66	0.68	0.69	0.70	0.72	0.73
	Buffet Marg	G	1.90	1.85	1.81	1.77	1.76	1.74	1.72	1.70	1.68
	SR	NM/kg	0.223	0.226	0.229	0.232	0.234	0.237	0.240	0.243	0.247
	N1	%	76.4	77.0	77.7	78.3	79.1	79.9	80.7	81.4	82.0
	Fuel Flow	kg/h/Eng	828	822	821	818	822	828	832	833	831
	IAS	kt	249	248	246	245	245	245	245	245	244
40000	TAS	kt	374	378	382	386	392	399	406	412	417
	Ind. MACH		0.63	0.64	0.65	0.66	0.67	0.68	0.70	0.71	0.72
	Buffet Marg	G	1.93	1.88	1.82	1.78	1.76	1.74	1.73	1.72	1.69
	SR	NM/kg	0.226	0.230	0.233	0.236	0.238	0.241	0.244	0.247	0.251
	N1	%	75.9	76.3	77.1	77.8	78.5	79.3	80.2	80.9	81.5
	Fuel Flow	kg/h/Eng	810	796	799	798	796	803	811	815	810
	IAS	kt	247	244	244	243	241	242	243	243	241
39000	TAS	kt	371	372	378	383	387	394	402	410	414
	Ind. MACH		0.62	0.63	0.64	0.65	0.66	0.67	0.69	0.71	0.72
	Buffet Marg	G	1.97	1.90	1.85	1.80	1.77	1.75	1.75	1.74	1.70
	SR	NM/kg	0.229	0.234	0.237	0.240	0.243	0.246	0.248	0.251	0.255
	N1	%	75.4	75.8	76.4	77.2	78.0	78.7	79.6	80.4	81.0
	Fuel Flow	kg/h/Eng	794	781	775	777	778	779	787	792	791
	IAS	kt	245	242	241	240	240	239	240	240	239
38000	TAS	kt	368	370	374	379	385	390	398	405	410
	Ind. MACH		0.62	0.62	0.63	0.64	0.66	0.67	0.68	0.70	0.71
	Buffet Marg	G	2.00	1.93	1.88	1.83	1.79	1.77	1.76	1.75	1.72
	SR	NM/kg	0.232	0.237	0.241	0.244	0.247	0.250	0.253	0.256	0.259

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 5 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.7%.
- DECREASE SR(%) by 4.1%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	74.9	75.4	75.8	76.6	77.4	78.1	79.0	79.8	80.5
	Fuel Flow	kg/h/Eng	777	767	754	755	758	758	764	769	771
	IAS	kt	242	241	238	238	237	237	237	237	237
37000	TAS	kt	364	368	370	376	381	387	394	401	407
	Ind. MACH		0.61	0.62	0.63	0.64	0.65	0.66	0.68	0.69	0.71
	Buffet Marg	G	2.04	1.97	1.91	1.86	1.81	1.79	1.77	1.76	1.74
	SR	NM/kg	0.235	0.240	0.245	0.249	0.252	0.255	0.258	0.261	0.264
	N1	%	74.4	74.9	75.4	75.9	76.8	77.5	78.3	79.1	79.9
	Fuel Flow	kg/h/Eng	759	750	740	733	736	737	739	743	748
	IAS	kt	240	238	237	235	235	234	234	234	234
36000	TAS	kt	361	365	368	372	378	383	389	395	402
	Ind. MACH		0.60	0.61	0.62	0.63	0.64	0.66	0.67	0.68	0.70
	Buffet Marg	G	2.07	2.01	1.95	1.89	1.84	1.81	1.78	1.76	1.75
	SR	NM/kg	0.238	0.243	0.248	0.254	0.256	0.260	0.263	0.266	0.269
	N1	%	73.9	74.4	74.9	75.5	76.2	76.9	77.6	78.4	79.2
	Fuel Flow	kg/h/Eng	741	734	725	718	716	717	715	717	723
	IAS	kt	238	236	235	234	233	232	231	230	231
35000	TAS	kt	358	362	365	369	374	380	384	389	397
	Ind. MACH		0.60	0.61	0.62	0.63	0.64	0.65	0.66	0.67	0.69
	Buffet Marg	G	2.11	2.05	1.99	1.93	1.88	1.83	1.80	1.77	1.76
	SR	NM/kg	0.241	0.246	0.252	0.257	0.261	0.265	0.269	0.272	0.274
	N1	%	73.2	73.9	74.5	75.1	75.6	76.4	77.0	77.6	78.5
	Fuel Flow	kg/h/Eng	722	716	710	704	696	698	696	692	700
	IAS	kt	235	234	233	232	230	230	229	227	228
34000	TAS	kt	353	358	363	367	371	377	381	385	392
	Ind. MACH		0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.66	0.68
	Buffet Marg	G	2.14	2.09	2.03	1.98	1.92	1.86	1.82	1.78	1.77
	SR	NM/kg	0.245	0.250	0.255	0.261	0.267	0.270	0.274	0.278	0.280
	N1	%	72.7	73.3	73.9	74.6	75.2	75.8	76.4	76.9	77.8
	Fuel Flow	kg/h/Eng	705	698	694	690	684	680	676	670	675
	IAS	kt	233	231	231	231	229	229	226	224	224
33000	TAS	kt	350	354	360	365	369	374	377	380	386
	Ind. MACH		0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.66	0.67
	Buffet Marg	G	2.18	2.13	2.08	2.02	1.97	1.91	1.85	1.80	1.78
	SR	NM/kg	0.248	0.254	0.259	0.265	0.270	0.275	0.279	0.283	0.286

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 7.1%.
- DECREASE SR(%) by 6.0%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	72.0	72.8	73.5	74.0	74.7	75.3	75.7	76.2	77.0
	Fuel Flow	kg/h/Eng	686	683	681	673	670	666	656	648	649
	IAS	kt	230	230	230	228	228	227	224	221	220
32000	TAS	kt	346	352	358	361	367	372	373	375	380
	Ind. MACH		0.58	0.59	0.60	0.61	0.63	0.64	0.64	0.65	0.66
	Buffet Marg	G	2.22	2.17	2.13	2.07	2.01	1.96	1.88	1.81	1.79
	SR	NM/kg	0.252	0.257	0.263	0.269	0.274	0.279	0.284	0.289	0.293
	N1	%	71.5	72.3	72.9	73.6	74.3	74.9	75.1	75.7	76.4
	Fuel Flow	kg/h/Eng	672	669	665	660	660	655	640	635	632
	IAS	kt	228	228	227	227	227	226	222	220	219
31000	TAS	kt	344	349	354	359	366	370	371	374	378
	Ind. MACH		0.58	0.59	0.60	0.61	0.62	0.63	0.64	0.65	0.66
	Buffet Marg	G	2.27	2.23	2.18	2.12	2.07	2.01	1.93	1.87	1.82
	SR	NM/kg	0.256	0.261	0.267	0.272	0.277	0.283	0.290	0.295	0.299
	N1	%	71.1	71.9	72.5	73.1	73.8	74.5	74.8	75.2	76.0
	Fuel Flow	kg/h/Eng	659	658	653	648	647	645	630	621	620
	IAS	kt	227	227	226	226	226	225	222	219	218
30000	TAS	kt	343	348	353	357	363	369	370	372	377
	Ind. MACH		0.57	0.59	0.60	0.61	0.62	0.63	0.64	0.64	0.65
	Buffet Marg	G	2.33	2.29	2.24	2.18	2.13	2.07	1.99	1.92	1.88
	SR	NM/kg	0.260	0.265	0.270	0.276	0.281	0.286	0.293	0.300	0.304

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 7 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 7.9%.
- DECREASE SR(%) by 6.7%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
52000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
51000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
50000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
49000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	87.4	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1041	-	-	-	-	-
	IAS	kt	263	-	-	-	-	-
48000	TAS	kt	454	-	-	-	-	-
	Ind. MACH		0.79	-	-	-	-	-
	Buffet Marg	G	1.43	-	-	-	-	-
	SR	NM/kg	0.218	-	-	-	-	-

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	87.0	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1028	-	-	-	-	-
	IAS	kt	263	-	-	-	-	-
47000	TAS	kt	455	-	-	-	-	-
	Ind. MACH		0.79	-	-	-	-	-
	Buffet Marg	G	1.46	-	-	-	-	-
	SR	NM/kg	0.221	-	-	-	-	-
	N1	%	86.5	87.5	-	-	-	-
	Fuel Flow	kg/h/Eng	1008	998	-	-	-	-
	IAS	kt	262	257	-	-	-	-
46000	TAS	kt	453	454	-	-	-	-
	Ind. MACH		0.79	0.79	-	-	-	-
	Buffet Marg	G	1.50	1.43	-	-	-	-
	SR	NM/kg	0.225	0.227	-	-	-	-
	N1	%	86.1	87.1	-	-	-	-
	Fuel Flow	kg/h/Eng	991	988	-	-	-	-
	IAS	kt	261	258	-	-	-	-
45000	TAS	kt	451	456	-	-	-	-
	Ind. MACH		0.79	0.80	-	-	-	-
	Buffet Marg	G	1.54	1.45	-	-	-	-
	SR	NM/kg	0.228	0.231	-	-	-	-
	N1	%	85.7	86.7	-	-	-	-
	Fuel Flow	kg/h/Eng	974	969	-	-	-	-
	IAS	kt	260	257	-	-	-	-
44000	TAS	kt	450	454	-	-	-	-
	Ind. MACH		0.78	0.79	-	-	-	-
	Buffet Marg	G	1.57	1.49	-	-	-	-
	SR	NM/kg	0.231	0.234	-	-	-	-
	N1	%	85.0	86.3	87.2	-	-	-
	Fuel Flow	kg/h/Eng	941	952	946	-	-	-
	IAS	kt	257	255	252	-	-	-
43000	TAS	kt	445	452	456	-	-	-
	Ind. MACH		0.78	0.79	0.80	-	-	-
	Buffet Marg	G	1.61	1.53	1.45	-	-	-
	SR	NM/kg	0.237	0.237	0.241	-	-	-

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.7%.
- DECREASE SR(%) by 4.0%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	84.1	85.8	86.7	-	-	-
	Fuel Flow	kg/h/Eng	902	933	927	-	-	-
	IAS	kt	252	254	251	-	-	-
42000	TAS	kt	438	450	454	-	-	-
	Ind. MACH		0.76	0.79	0.79	-	-	-
	Buffet Marg	G	1.66	1.57	1.49	-	-	-
	SR	NM/kg	0.243	0.241	0.245	-	-	-
	N1	%	83.1	85.0	86.2	87.1	-	-
	Fuel Flow	kg/h/Eng	855	903	909	903	-	-
	IAS	kt	246	252	249	246	-	-
41000	TAS	kt	428	446	452	456	-	-
	Ind. MACH		0.75	0.78	0.79	0.80	-	-
	Buffet Marg	G	1.67	1.61	1.53	1.45	-	-
	SR	NM/kg	0.250	0.247	0.249	0.253	-	-
	N1	%	82.5	84.1	85.7	86.7	-	-
	Fuel Flow	kg/h/Eng	827	859	892	886	-	-
	IAS	kt	242	246	249	245	-	-
40000	TAS	kt	422	436	450	454	-	-
	Ind. MACH		0.74	0.76	0.79	0.79	-	-
	Buffet Marg	G	1.67	1.66	1.57	1.49	-	-
	SR	NM/kg	0.255	0.254	0.253	0.256	-	-
	N1	%	82.0	83.1	84.9	86.2	87.1	-
	Fuel Flow	kg/h/Eng	805	816	858	869	862	-
	IAS	kt	240	240	245	244	241	-
39000	TAS	kt	418	428	445	452	456	-
	Ind. MACH		0.73	0.75	0.78	0.79	0.80	-
	Buffet Marg	G	1.67	1.67	1.62	1.53	1.45	-
	SR	NM/kg	0.260	0.262	0.259	0.260	0.264	-
	N1	%	81.5	82.5	84.0	85.7	86.6	-
	Fuel Flow	kg/h/Eng	788	794	820	849	843	-
	IAS	kt	238	238	241	242	239	-
38000	TAS	kt	415	424	438	450	453	-
	Ind. MACH		0.72	0.74	0.76	0.78	0.79	-
	Buffet Marg	G	1.70	1.69	1.66	1.58	1.50	-
	SR	NM/kg	0.264	0.267	0.267	0.265	0.269	-

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 4.9%.
- DECREASE SR(%) by 4.2%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	81.1	82.0	82.9	84.8	86.1	87.1
	Fuel Flow	kg/h/Eng	771	774	777	816	826	823
	IAS	kt	237	236	235	239	238	235
37000	TAS	kt	413	420	428	444	452	456
	Ind. MACH		0.72	0.73	0.75	0.77	0.79	0.79
	Buffet Marg	G	1.72	1.70	1.68	1.62	1.54	1.46
	SR	NM/kg	0.268	0.271	0.275	0.272	0.273	0.277
	N1	%	80.6	81.5	82.4	83.8	85.5	86.6
	Fuel Flow	kg/h/Eng	750	753	756	774	806	806
	IAS	kt	234	233	232	234	237	233
36000	TAS	kt	409	416	423	435	449	453
	Ind. MACH		0.71	0.73	0.74	0.76	0.78	0.79
	Buffet Marg	G	1.74	1.71	1.69	1.67	1.59	1.51
	SR	NM/kg	0.273	0.276	0.280	0.281	0.279	0.281
	N1	%	79.9	80.9	81.8	82.7	84.5	86.0
	Fuel Flow	kg/h/Eng	727	731	734	734	770	787
	IAS	kt	231	230	229	228	232	232
35000	TAS	kt	404	411	419	425	442	451
	Ind. MACH		0.70	0.72	0.73	0.74	0.77	0.79
	Buffet Marg	G	1.74	1.72	1.70	1.67	1.64	1.55
	SR	NM/kg	0.278	0.281	0.285	0.290	0.287	0.287
	N1	%	79.3	80.3	81.3	82.3	83.3	85.3
	Fuel Flow	kg/h/Eng	704	710	714	719	724	762
	IAS	kt	228	227	227	227	226	230
34000	TAS	kt	399	407	415	423	431	448
	Ind. MACH		0.69	0.71	0.72	0.74	0.75	0.78
	Buffet Marg	G	1.75	1.74	1.72	1.71	1.68	1.60
	SR	NM/kg	0.283	0.287	0.291	0.294	0.297	0.294
	N1	%	78.6	79.7	80.7	81.7	82.4	84.2
	Fuel Flow	kg/h/Eng	680	687	693	698	692	723
	IAS	kt	224	224	224	224	221	225
33000	TAS	kt	393	402	410	419	422	439
	Ind. MACH		0.69	0.70	0.72	0.73	0.74	0.77
	Buffet Marg	G	1.76	1.75	1.74	1.72	1.67	1.66
	SR	NM/kg	0.289	0.292	0.296	0.300	0.305	0.303

INCREASE/DECREASE N1(%) BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 3% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 9 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.4% AND FUEL FLOW BY 6.3%.
- DECREASE SR(%) by 5.5%.

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LONG RANGE CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	77.9	79.0	80.0	81.1	82.0	82.9
	Fuel Flow	kg/h/Eng	655	663	669	675	679	680
	IAS	kt	221	221	221	221	220	219
32000	TAS	kt	388	396	405	413	421	428
	Ind. MACH		0.68	0.69	0.71	0.72	0.73	0.75
	Buffet Marg	G	1.78	1.76	1.74	1.73	1.71	1.69
	SR	NM/kg	0.296	0.299	0.303	0.306	0.310	0.315
	N1	%	77.1	78.4	79.5	80.5	81.4	82.6
	Fuel Flow	kg/h/Eng	631	644	653	655	657	668
	IAS	kt	218	219	220	218	217	219
31000	TAS	kt	382	393	403	409	416	427
	Ind. MACH		0.67	0.69	0.70	0.71	0.73	0.75
	Buffet Marg	G	1.79	1.79	1.78	1.75	1.72	1.73
	SR	NM/kg	0.303	0.305	0.308	0.312	0.317	0.320
	N1	%	76.6	77.8	79.2	80.1	81.0	82.0
	Fuel Flow	kg/h/Eng	618	628	641	642	641	650
	IAS	kt	217	218	220	218	216	216
30000	TAS	kt	382	391	402	408	414	423
	Ind. MACH		0.67	0.68	0.70	0.71	0.72	0.74
	Buffet Marg	G	1.84	1.83	1.83	1.80	1.76	1.76
	SR	NM/kg	0.309	0.311	0.314	0.318	0.323	0.326

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.5% AND FUEL FLOW BY 7.6%.
- DECREASE SR(%) by 6.8%.

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FIXED SPEED CRUISE

These tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data are presented for various weights and altitudes. Correction for ISA deviation and anti-ice are also presented.

The associated conditions are:

Flaps..... UP
Gear..... UP
Bleeds..... OPEN
Anti-ice..... OFF
Center of gravity..... 22%
Minimum Remaining Rate of Climb..... 300 ft/min

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	85.9	85.8	85.9	85.9	86.1	86.6	87.0	87.4	-
	Fuel Flow	kg/h/Eng	1338	1295	1253	1213	1181	1162	1140	1113	-
	IAS	kt	315	309	302	296	289	283	277	271	-
52000	TAS	kt	466	464	462	460	458	456	454	452	-
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	-
	Buffet Marg	G	2.02	1.93	1.85	1.76	1.69	1.61	1.54	1.47	-
	SR	NM/kg	0.174	0.179	0.184	0.190	0.194	0.196	0.199	0.203	-
	N1	%	85.7	85.7	85.7	85.7	85.8	86.2	86.7	87.0	87.7
	Fuel Flow	kg/h/Eng	1329	1286	1245	1204	1168	1145	1128	1100	1083
	IAS	kt	315	309	302	296	289	283	277	271	264
51000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.06	1.97	1.88	1.80	1.72	1.64	1.57	1.49	1.43
	SR	NM/kg	0.175	0.180	0.185	0.191	0.196	0.199	0.201	0.205	0.208
	N1	%	85.6	85.5	85.6	85.6	85.7	85.8	86.4	86.7	87.2
	Fuel Flow	kg/h/Eng	1320	1278	1236	1195	1159	1127	1112	1087	1064
	IAS	kt	315	309	302	296	289	283	277	271	264
50000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.10	2.01	1.92	1.84	1.75	1.67	1.60	1.52	1.45
	SR	NM/kg	0.176	0.181	0.187	0.192	0.197	0.202	0.204	0.208	0.211
	N1	%	85.4	85.4	85.4	85.4	85.5	85.5	86.0	86.4	86.8
	Fuel Flow	kg/h/Eng	1311	1269	1227	1187	1150	1112	1095	1075	1051
	IAS	kt	315	309	302	296	289	283	277	271	264
49000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.14	2.05	1.96	1.87	1.79	1.71	1.63	1.56	1.48
	SR	NM/kg	0.178	0.183	0.188	0.194	0.199	0.205	0.207	0.210	0.214
	N1	%	85.3	85.2	85.2	85.2	85.3	85.3	85.6	86.1	86.5
	Fuel Flow	kg/h/Eng	1303	1261	1218	1178	1141	1102	1077	1061	1039
	IAS	kt	315	309	302	296	289	283	277	271	264
48000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.19	2.09	2.00	1.91	1.83	1.74	1.66	1.59	1.51
	SR	NM/kg	0.179	0.184	0.190	0.195	0.201	0.207	0.211	0.213	0.216

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	85.1	85.1	85.1	85.1	85.1	85.1	85.2	85.7	86.2
	Fuel Flow	kg/h/Eng	1294	1252	1209	1169	1132	1093	1061	1044	1027
	IAS	kt	315	309	302	296	289	283	277	271	264
47000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.23	2.14	2.04	1.95	1.87	1.78	1.70	1.62	1.55
	SR	NM/kg	0.180	0.185	0.191	0.197	0.202	0.208	0.214	0.216	0.219
	N1	%	84.9	84.9	84.9	84.9	84.9	84.9	85.0	85.3	85.9
	Fuel Flow	kg/h/Eng	1285	1244	1200	1161	1123	1084	1051	1027	1014
	IAS	kt	315	309	302	296	289	283	277	271	264
46000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.28	2.18	2.09	2.00	1.91	1.82	1.74	1.66	1.58
	SR	NM/kg	0.181	0.186	0.192	0.198	0.204	0.210	0.216	0.220	0.222
	N1	%	84.8	84.8	84.7	84.7	84.7	84.7	84.8	84.9	85.4
	Fuel Flow	kg/h/Eng	1275	1235	1192	1152	1114	1076	1043	1011	997
	IAS	kt	315	309	302	296	289	283	277	271	264
45000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.33	2.23	2.13	2.04	1.95	1.86	1.78	1.69	1.62
	SR	NM/kg	0.183	0.188	0.194	0.200	0.205	0.212	0.218	0.223	0.226
	N1	%	84.6	84.6	84.6	84.6	84.5	84.5	84.6	84.6	85.0
	Fuel Flow	kg/h/Eng	1266	1226	1183	1143	1105	1067	1034	1000	979
	IAS	kt	315	309	302	296	289	283	277	271	264
44000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.39	2.28	2.18	2.09	1.99	1.90	1.82	1.73	1.65
	SR	NM/kg	0.184	0.189	0.195	0.201	0.207	0.214	0.219	0.226	0.230
	N1	%	84.5	84.5	84.4	84.4	84.4	84.4	84.4	84.4	84.6
	Fuel Flow	kg/h/Eng	1257	1216	1174	1135	1096	1059	1025	991	963
	IAS	kt	315	309	302	296	289	283	277	271	264
43000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.44	2.34	2.23	2.13	2.04	1.95	1.86	1.77	1.69
	SR	NM/kg	0.185	0.191	0.197	0.203	0.209	0.215	0.221	0.228	0.234

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 3.9%.
- DECREASE SR(%) by 3.7%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	84.3	84.3	84.2	84.2	84.2	84.2	84.2	84.2	84.3
	Fuel Flow	kg/h/Eng	1247	1207	1165	1126	1087	1050	1016	982	952
	IAS	kt	315	309	302	296	289	283	277	271	264
42000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.39	2.29	2.19	2.09	1.99	1.90	1.82	1.73
	SR	NM/kg	0.187	0.192	0.198	0.204	0.211	0.217	0.223	0.230	0.236
	N1	%	84.1	84.1	84.1	84.0	84.0	84.0	84.0	84.0	84.1
	Fuel Flow	kg/h/Eng	1238	1197	1156	1118	1078	1042	1008	974	943
	IAS	kt	315	309	302	296	289	283	277	271	264
41000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.45	2.34	2.24	2.14	2.04	1.95	1.86	1.77
	SR	NM/kg	0.188	0.194	0.200	0.206	0.212	0.219	0.225	0.232	0.238
	N1	%	84.0	83.9	83.9	83.9	83.8	83.8	83.8	83.8	83.9
	Fuel Flow	kg/h/Eng	1230	1187	1146	1108	1070	1033	999	966	934
	IAS	kt	315	309	302	296	289	283	277	271	264
40000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.40	2.29	2.19	2.09	2.00	1.91	1.82
	SR	NM/kg	0.189	0.195	0.201	0.207	0.214	0.221	0.227	0.234	0.241
	N1	%	83.8	83.8	83.7	83.7	83.7	83.6	83.6	83.6	83.7
	Fuel Flow	kg/h/Eng	1222	1178	1137	1099	1061	1025	990	958	926
	IAS	kt	315	309	302	296	289	283	277	271	264
39000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.46	2.35	2.25	2.15	2.05	1.95	1.86
	SR	NM/kg	0.191	0.197	0.203	0.209	0.216	0.222	0.229	0.236	0.243
	N1	%	83.7	83.6	83.5	83.5	83.5	83.5	83.4	83.4	83.5
	Fuel Flow	kg/h/Eng	1214	1171	1128	1089	1052	1016	982	949	917
	IAS	kt	315	309	302	296	289	283	277	271	264
38000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.42	2.31	2.20	2.10	2.01	1.91
	SR	NM/kg	0.192	0.198	0.205	0.211	0.218	0.224	0.231	0.238	0.245

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 3.9%.
- DECREASE SR(%) by 3.7%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	83.5	83.5	83.3	83.3	83.3	83.3	83.2	83.2	83.2
	Fuel Flow	kg/h/Eng	1207	1163	1119	1080	1043	1007	973	941	908
	IAS	kt	315	309	302	296	289	283	277	271	264
37000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.48	2.37	2.26	2.16	2.06	1.97
	SR	NM/kg	0.193	0.199	0.206	0.213	0.219	0.226	0.233	0.240	0.248
	N1	%	83.4	83.3	83.2	83.1	83.1	83.1	83.1	83.1	83.0
	Fuel Flow	kg/h/Eng	1199	1156	1111	1070	1033	998	965	933	900
	IAS	kt	315	309	302	296	289	283	277	271	264
36000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.44	2.33	2.22	2.12	2.02
	SR	NM/kg	0.194	0.201	0.208	0.215	0.221	0.228	0.235	0.242	0.250
	N1	%	83.3	83.2	83.0	82.9	82.9	82.9	82.9	82.9	82.8
	Fuel Flow	kg/h/Eng	1191	1148	1104	1062	1024	989	956	925	891
	IAS	kt	315	309	302	296	289	283	277	271	264
35000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.39	2.28	2.18	2.08
	SR	NM/kg	0.195	0.202	0.209	0.216	0.223	0.230	0.237	0.244	0.252
	N1	%	83.1	83.0	82.9	82.8	82.7	82.7	82.6	82.7	82.6
	Fuel Flow	kg/h/Eng	1184	1141	1096	1055	1015	979	947	917	883
	IAS	kt	315	309	302	296	289	283	277	271	264
34000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.46	2.35	2.24	2.14
	SR	NM/kg	0.197	0.203	0.211	0.218	0.226	0.233	0.240	0.246	0.255
	N1	%	83.0	82.9	82.7	82.6	82.5	82.4	82.4	82.4	82.4
	Fuel Flow	kg/h/Eng	1176	1133	1089	1047	1007	970	938	907	874
	IAS	kt	315	309	302	296	289	283	277	271	264
33000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.42	2.31	2.20
	SR	NM/kg	0.198	0.205	0.212	0.220	0.227	0.235	0.242	0.249	0.257

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 3.9%.
- DECREASE SR(%) by 3.8%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	82.8	82.7	82.6	82.5	82.4	82.3	82.2	82.2	82.2
	Fuel Flow	kg/h/Eng	1169	1126	1081	1039	1000	962	929	898	866
	IAS	kt	315	309	302	296	289	283	277	271	264
32000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.38	2.27
	SR	NM/kg	0.199	0.206	0.214	0.221	0.229	0.237	0.244	0.251	0.260
	N1	%	82.7	82.6	82.4	82.3	82.2	82.1	82.0	82.0	81.9
	Fuel Flow	kg/h/Eng	1161	1118	1073	1032	992	954	919	889	856
	IAS	kt	315	309	302	296	289	283	277	271	264
31000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.46	2.35
	SR	NM/kg	0.201	0.207	0.215	0.223	0.231	0.239	0.247	0.254	0.263
	N1	%	82.5	82.4	82.3	82.1	82.0	81.9	81.8	81.8	81.7
	Fuel Flow	kg/h/Eng	1154	1111	1066	1024	985	947	912	880	847
	IAS	kt	315	309	302	296	289	283	277	271	264
30000	TAS	kt	466	464	462	460	458	456	454	452	450
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.42
	SR	NM/kg	0.202	0.209	0.216	0.224	0.232	0.241	0.249	0.257	0.265

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.2% AND FUEL FLOW BY 4.0%.
- DECREASE SR(%) by 3.8%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
52000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
51000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
50000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-
49000	TAS	kt	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-
	N1	%	86.9	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1017	-	-	-	-	-
	IAS	kt	258	-	-	-	-	-
48000	TAS	kt	448	-	-	-	-	-
	Ind. MACH		0.78	-	-	-	-	-
	Buffet Marg	G	1.44	-	-	-	-	-
	SR	NM/kg	0.220	-	-	-	-	-

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	86.5	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1002	-	-	-	-	-
	IAS	kt	258	-	-	-	-	-
47000	TAS	kt	448	-	-	-	-	-
	Ind. MACH		0.78	-	-	-	-	-
	Buffet Marg	G	1.47	-	-	-	-	-
	SR	NM/kg	0.223	-	-	-	-	-
	N1	%	86.2	87.1	-	-	-	-
	Fuel Flow	kg/h/Eng	989	975	-	-	-	-
	IAS	kt	258	252	-	-	-	-
46000	TAS	kt	448	447	-	-	-	-
	Ind. MACH		0.78	0.78	-	-	-	-
	Buffet Marg	G	1.51	1.44	-	-	-	-
	SR	NM/kg	0.226	0.229	-	-	-	-
	N1	%	85.8	86.7	-	-	-	-
	Fuel Flow	kg/h/Eng	977	959	-	-	-	-
	IAS	kt	258	252	-	-	-	-
45000	TAS	kt	448	447	-	-	-	-
	Ind. MACH		0.78	0.78	-	-	-	-
	Buffet Marg	G	1.54	1.47	-	-	-	-
	SR	NM/kg	0.229	0.233	-	-	-	-
	N1	%	85.5	86.3	87.2	-	-	-
	Fuel Flow	kg/h/Eng	965	947	935	-	-	-
	IAS	kt	258	252	247	-	-	-
44000	TAS	kt	448	447	447	-	-	-
	Ind. MACH		0.78	0.78	0.78	-	-	-
	Buffet Marg	G	1.58	1.50	1.43	-	-	-
	SR	NM/kg	0.232	0.236	0.239	-	-	-
	N1	%	85.1	85.9	86.6	-	-	-
	Fuel Flow	kg/h/Eng	948	935	919	-	-	-
	IAS	kt	258	252	247	-	-	-
43000	TAS	kt	448	447	447	-	-	-
	Ind. MACH		0.78	0.78	0.78	-	-	-
	Buffet Marg	G	1.61	1.54	1.46	-	-	-
	SR	NM/kg	0.236	0.239	0.244	-	-	-

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 4.0%.
- DECREASE SR(%) by 3.8%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	84.6	85.6	86.2	87.2	-	-
	Fuel Flow	kg/h/Eng	930	923	906	895	-	-
	IAS	kt	258	252	247	241	-	-
42000	TAS	kt	448	447	447	447	-	-
	Ind. MACH		0.78	0.78	0.78	0.78	-	-
	Buffet Marg	G	1.65	1.57	1.50	1.43	-	-
	SR	NM/kg	0.241	0.242	0.247	0.250	-	-
	N1	%	84.2	85.1	85.9	86.7	-	-
	Fuel Flow	kg/h/Eng	913	906	894	878	-	-
	IAS	kt	258	252	247	241	-	-
41000	TAS	kt	448	447	447	447	-	-
	Ind. MACH		0.78	0.78	0.78	0.78	-	-
	Buffet Marg	G	1.69	1.61	1.54	1.46	-	-
	SR	NM/kg	0.245	0.247	0.250	0.255	-	-
	N1	%	83.9	84.6	85.5	86.3	-	-
	Fuel Flow	kg/h/Eng	902	890	882	866	-	-
	IAS	kt	258	252	247	241	-	-
40000	TAS	kt	448	447	447	447	-	-
	Ind. MACH		0.78	0.78	0.78	0.78	-	-
	Buffet Marg	G	1.73	1.65	1.57	1.50	-	-
	SR	NM/kg	0.248	0.251	0.254	0.258	-	-
	N1	%	83.7	84.2	85.0	85.9	86.6	-
	Fuel Flow	kg/h/Eng	894	873	865	854	839	-
	IAS	kt	258	252	247	241	235	-
39000	TAS	kt	448	447	447	447	447	-
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	-
	Buffet Marg	G	1.78	1.69	1.61	1.54	1.47	-
	SR	NM/kg	0.250	0.256	0.259	0.262	0.267	-
	N1	%	83.5	83.9	84.5	85.5	86.2	-
	Fuel Flow	kg/h/Eng	885	863	847	842	826	-
	IAS	kt	258	252	247	241	235	-
38000	TAS	kt	448	447	447	447	447	-
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	-
	Buffet Marg	G	1.82	1.74	1.66	1.58	1.51	-
	SR	NM/kg	0.253	0.259	0.264	0.266	0.271	-

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 4.1%.
- DECREASE SR(%) by 3.9%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	83.2	83.7	84.0	85.0	85.8	86.6
	Fuel Flow	kg/h/Eng	877	854	830	824	813	801
	IAS	kt	258	252	247	241	235	230
37000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	1.87	1.79	1.70	1.62	1.55	1.47
	SR	NM/kg	0.255	0.262	0.269	0.271	0.275	0.279
	N1	%	83.0	83.4	83.8	84.5	85.4	86.2
	Fuel Flow	kg/h/Eng	868	845	822	807	800	789
	IAS	kt	258	252	247	241	235	230
36000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	1.93	1.84	1.75	1.67	1.59	1.51
	SR	NM/kg	0.258	0.265	0.272	0.277	0.280	0.284
	N1	%	82.8	83.2	83.5	84.0	84.8	85.7
	Fuel Flow	kg/h/Eng	860	836	813	792	783	776
	IAS	kt	258	252	247	241	235	230
35000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	1.98	1.89	1.80	1.71	1.63	1.56
	SR	NM/kg	0.260	0.268	0.275	0.282	0.286	0.288
	N1	%	82.6	83.0	83.3	83.8	84.3	85.2
	Fuel Flow	kg/h/Eng	851	827	805	783	765	761
	IAS	kt	258	252	247	241	235	230
34000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.04	1.94	1.85	1.77	1.68	1.60
	SR	NM/kg	0.263	0.270	0.278	0.286	0.292	0.294
	N1	%	82.4	82.7	83.1	83.5	83.9	84.7
	Fuel Flow	kg/h/Eng	843	819	796	775	753	744
	IAS	kt	258	252	247	241	235	230
33000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.10	2.00	1.91	1.82	1.73	1.65
	SR	NM/kg	0.266	0.273	0.281	0.289	0.297	0.301

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 4.3%. • DECREASE SR(%) by 4.1%.

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MACH 0.78 CRUISE - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE: 36000 FT TO 41000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 36000	37000	38000	39000	40000	41000
	N1	%	82.1	82.5	82.8	83.2	83.6	84.1
	Fuel Flow	kg/h/Eng	834	810	788	766	745	727
	IAS	kt	258	252	247	241	235	230
32000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.17	2.06	1.97	1.88	1.79	1.70
	SR	NM/kg	0.268	0.276	0.284	0.292	0.300	0.308
	N1	%	81.9	82.3	82.6	83.0	83.4	83.8
	Fuel Flow	kg/h/Eng	826	802	779	757	736	718
	IAS	kt	258	252	247	241	235	230
31000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.24	2.13	2.03	1.94	1.85	1.76
	SR	NM/kg	0.271	0.279	0.287	0.296	0.304	0.312
	N1	%	81.7	82.0	82.4	82.7	83.1	83.5
	Fuel Flow	kg/h/Eng	817	794	771	749	728	709
	IAS	kt	258	252	247	241	235	230
30000	TAS	kt	448	447	447	447	447	447
	Ind. MACH		0.78	0.78	0.78	0.78	0.78	0.78
	Buffet Marg	G	2.31	2.20	2.10	2.00	1.91	1.82
	SR	NM/kg	0.274	0.282	0.290	0.299	0.307	0.315

INCREASE/DECREASE N1(%) BY 1% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 2% PER 5°C ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 6 KT PER 5°C ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1(%) BY 0.3% AND FUEL FLOW BY 4.4%.
- DECREASE SR(%) by 4.2%.

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COST INDEX AND ECONOMIC CRUISE SPEED

The cost index represents the ratio between time related costs per fuel related costs and is a way to express the direct operational costs of an operator.

Flying on an economic cruise speed will minimize the direct operational cost of the cruise phase for a given cost index.

There are two types of tables:

– Correction to cost index.

– Corrected cost index.

In order to find the economic speed for a given flight condition and cost index the following procedure should be applied:

1. Enter in the Correction to cost index table.
   Inputs: Route cost index and Wind speed.
   Outputs: Cost index wind correction for the route cost index.
2. Add the cost index wind correction found in (1) to the route cost index. This new value is the corrected cost index.
3. Enter in Corrected cost index table for the current altitude.
   Inputs: Corrected cost index and Airplane current weight.
   Outputs: Mach number for the economic speed.

NOTE: The values were calculated for ISA conditions and all engines operating. The ISA deviations corrections are negligible.

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

WIND CORRECTION **CRUISE MACH NUMBER**

Wind Corrections

Wind (kt)	CORRECTION TO COST INDEX																	
	0	**5**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120 & Above**
-100	0	-5	-7	-8	-9	-10	-11	-12	-13	-14	-15	-17	-19	-20	-22	-24	-26	-27
-80	0	-5	-6	-7	-8	-9	-9	-10	-11	-12	-13	-14	-15	-17	-18	-20	-21	-23
-60	0	-4	-5	-5	-6	-7	-7	-8	-9	-9	-10	-11	-12	-13	-14	-15	-17	-18
-40	0	-3	-3	-4	-4	-5	-5	-6	-6	-6	-7	-8	-8	-9	-10	-11	-11	-12
-20	0	-2	-2	-2	-2	-2	-3	-3	-3	-3	-4	-4	-4	-5	-5	-6	-6	-6
20	1	2	2	2	2	3	3	3	3	4	4	4	5	5	6	6	7	7
40	3	4	4	5	5	6	6	7	7	8	8	9	10	11	12	13	14	15
60	5	6	7	7	8	9	10	10	11	12	13	14	16	17	18	20	21	23
80	7	8	9	10	11	13	14	15	16	17	18	20	22	24	26	28	30	32
100	9	11	12	14	15	17	18	19	21	22	23	26	29	31	34	37	40	42

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE MACH NUMBER

Altitude: 27000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.54	0.56	0.60	0.62	0.64	0.67	0.71	0.73	0.75	0.76	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
32000	0.54	0.57	0.60	0.63	0.65	0.69	0.71	0.73	0.75	0.76	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
34000	0.55	0.58	0.61	0.63	0.65	0.69	0.71	0.73	0.75	0.76	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
36000	0.56	0.59	0.62	0.63	0.66	0.69	0.71	0.73	0.74	0.76	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
38000	0.57	0.60	0.63	0.64	0.66	0.69	0.71	0.73	0.75	0.76	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
40000	0.58	0.61	0.63	0.64	0.67	0.69	0.72	0.73	0.75	0.77	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
42000	0.60	0.62	0.63	0.65	0.68	0.70	0.72	0.73	0.75	0.76	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
44000	0.61	0.63	0.64	0.66	0.69	0.71	0.72	0.74	0.75	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
46000	0.62	0.63	0.65	0.67	0.69	0.71	0.72	0.74	0.75	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
48000	0.63	0.65	0.66	0.69	0.70	0.71	0.73	0.74	0.76	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
50000	0.64	0.66	0.68	0.69	0.71	0.72	0.74	0.75	0.77	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE MACH NUMBER

Altitude: 29000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.56	0.58	0.61	0.64	0.66	0.69	0.73	0.74	0.75	0.78	0.80	0.81	0.81	0.81	0.81	0.82	0.82	0.82
32000	0.56	0.59	0.62	0.65	0.67	0.69	0.73	0.74	0.76	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.82
34000	0.57	0.60	0.62	0.65	0.67	0.71	0.73	0.74	0.76	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81
36000	0.58	0.60	0.63	0.65	0.68	0.71	0.73	0.75	0.76	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81
38000	0.59	0.62	0.64	0.66	0.68	0.71	0.73	0.75	0.76	0.79	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81
40000	0.60	0.63	0.65	0.67	0.69	0.71	0.73	0.75	0.76	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81
42000	0.62	0.64	0.65	0.68	0.70	0.72	0.74	0.75	0.77	0.79	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
44000	0.63	0.65	0.67	0.69	0.71	0.73	0.74	0.75	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
46000	0.65	0.66	0.68	0.70	0.72	0.73	0.75	0.77	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
48000	0.65	0.68	0.69	0.71	0.72	0.74	0.76	0.77	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
50000	0.67	0.69	0.70	0.71	0.73	0.75	0.76	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE MACH NUMBER

Altitude: 31000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.58	0.61	0.63	0.65	0.69	0.71	0.74	0.76	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.82
32000	0.58	0.62	0.63	0.66	0.69	0.71	0.74	0.76	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81
34000	0.59	0.62	0.63	0.66	0.69	0.72	0.74	0.76	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81
36000	0.61	0.63	0.65	0.68	0.70	0.72	0.75	0.76	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
38000	0.62	0.64	0.66	0.69	0.71	0.73	0.74	0.76	0.79	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
40000	0.63	0.65	0.68	0.69	0.71	0.73	0.75	0.77	0.79	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
42000	0.64	0.66	0.69	0.71	0.72	0.74	0.76	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
44000	0.66	0.68	0.69	0.71	0.73	0.75	0.77	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
46000	0.68	0.69	0.70	0.72	0.74	0.76	0.77	0.79	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
48000	0.68	0.70	0.72	0.74	0.75	0.76	0.78	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
50000	0.69	0.71	0.72	0.74	0.75	0.77	0.79	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE MACH NUMBER

Altitude: 33000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.60	0.62	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
32000	0.60	0.63	0.66	0.68	0.71	0.73	0.75	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
34000	0.62	0.64	0.66	0.69	0.71	0.73	0.75	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
36000	0.63	0.65	0.68	0.70	0.72	0.74	0.77	0.79	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82
38000	0.65	0.66	0.69	0.71	0.73	0.75	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
40000	0.66	0.68	0.70	0.72	0.74	0.76	0.78	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
42000	0.67	0.69	0.71	0.73	0.75	0.77	0.79	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
44000	0.69	0.70	0.72	0.74	0.75	0.78	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
46000	0.70	0.71	0.73	0.75	0.77	0.79	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81
48000	0.71	0.73	0.75	0.77	0.78	0.78	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81
50000	0.74	0.75	0.77	0.78	0.78	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE MACH NUMBER

Altitude: 35000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.63	0.64	0.66	0.70	0.72	0.74	0.77	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82
32000	0.63	0.65	0.68	0.71	0.73	0.75	0.77	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82	0.82
34000	0.64	0.66	0.69	0.71	0.74	0.76	0.78	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82
36000	0.65	0.69	0.70	0.72	0.75	0.77	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
38000	0.68	0.69	0.71	0.74	0.75	0.77	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
40000	0.69	0.70	0.72	0.75	0.76	0.79	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
42000	0.69	0.71	0.74	0.75	0.77	0.79	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
44000	0.72	0.74	0.75	0.77	0.78	0.78	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81
46000	0.75	0.76	0.78	0.78	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80
48000	0.76	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80
50000	0.77	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80

Altitude: 37000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.65	0.66	0.69	0.72	0.74	0.77	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82	0.82	0.82
32000	0.66	0.68	0.70	0.73	0.75	0.78	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82
34000	0.67	0.69	0.72	0.74	0.76	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
36000	0.68	0.71	0.73	0.75	0.77	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
38000	0.70	0.72	0.74	0.76	0.79	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
40000	0.72	0.74	0.76	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81
42000	0.75	0.77	0.78	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80
44000	0.76	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80
46000	0.77	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79

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ECONOMIC CRUISE - ALL ENGINES OPERATING

EMBRAER 190

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE MACH NUMBER

Altitude: 39000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.68	0.69	0.72	0.74	0.77	0.79	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.82
32000	0.69	0.70	0.73	0.75	0.77	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
34000	0.69	0.72	0.74	0.76	0.79	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
36000	0.71	0.74	0.76	0.78	0.78	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81
38000	0.75	0.77	0.78	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80
40000	0.77	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
42000	0.76	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78

Altitude: 41000 ft

Weight (KG)	CORRECTED COST INDEX																	
	0	5	10	15	20	25	30	35	40	45	50	60	70	80	90	100	110	120 & Above
30000	0.69	0.72	0.75	0.76	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
32000	0.71	0.73	0.75	0.77	0.80	0.80	0.80	0.80	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81	0.81
34000	0.74	0.76	0.78	0.78	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80
36000	0.76	0.78	0.78	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
38000	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76

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DESCENT

The descent table shows fuel consumption, distance and time from the top of descent to sea level for various cruise altitudes. The data are calculated for flight idle thrust setting, maintaining Mach 0.77 above 30200 ft, 290 KIAS between 30200 ft and 12000 ft, decreasing linearly to 250 KIAS at 10000 ft and maintaining 250 KIAS below 10000 ft.

The approach and landing fuel consumption is not considered in the following tables.

The associated conditions are:

Final Altitude..... Sea Level
Flaps..... UP
Gear..... UP
Bleeds..... OPEN
Anti-Ice..... OFF
CG..... 22%
Thrust Setting..... FLIGHT IDLE

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EXAMPLE:

Given:
Arrival Airport Elevation..... 3500 ft
Top of Descent Weight..... 40000 kg
ISA Condition Cruise Altitude..... 35000 ft

RESULTS

Data provided from 35000 ft (Top of Descent) to Sea Level table:

Fuel: 146 kg

Distance: 89 NM

Time: 16 min

Data for 5000 ft (3500 ft + 1500 ft above arrival airport) obtained from the 5000 ft descent table:

Fuel: 36 kg

Distance: 14 NM

Time: 3 min

The fuel, distance and time spent during the descent phase (from 35000 ft to 5000 ft) are:

Fuel: 146 - 36 = 110 kg

Distance: 89 - 14 = 75 NM

Time: 16 - 3 = 13 min

The fuel consumption related to the approach and landing phase is provided on the Section 1-06-07.

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DESCENT - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED OPEN

FLIGHT IDLE

AIRSPEED: M 0.77 / 290 KIAS / 250 KIAS

ISA CONDITIONS

WEIGHT (kg)			TOP OF DESCENT (ft)							
			5000	10000	15000	20000	25000	30000	35000	41000
	Fuel	kg	40	72	101	120	138	153	164	179
52000	Distance	NM	15	30	47	61	75	90	101	117
	Time	min	3	7	10	12	14	16	18	20
	Fuel	kg	39	72	101	119	137	152	163	178
51000	Distance	NM	15	30	47	60	74	89	101	116
	Time	min	3	7	10	12	14	16	18	20
	Fuel	kg	39	72	100	119	136	151	162	177
50000	Distance	NM	15	29	46	60	74	88	100	116
	Time	min	3	7	10	12	14	16	17	20
	Fuel	kg	39	71	100	118	135	150	161	176
49000	Distance	NM	15	29	46	59	73	88	99	115
	Time	min	3	7	10	12	14	16	17	19
	Fuel	kg	39	71	99	117	134	149	159	174
48000	Distance	NM	15	29	46	59	73	87	98	114
	Time	min	3	7	10	12	14	16	17	19
	Fuel	kg	39	71	98	116	133	147	158	173
47000	Distance	NM	14	29	45	58	72	86	97	113
	Time	min	3	6	9	12	14	16	17	19
	Fuel	kg	38	70	98	115	132	146	157	171
46000	Distance	NM	14	29	45	58	71	85	96	112
	Time	min	3	6	9	11	13	15	17	19
	Fuel	kg	38	70	97	114	130	145	155	170
45000	Distance	NM	14	29	45	57	71	84	95	111
	Time	min	3	6	9	11	13	15	17	19
	Fuel	kg	38	69	96	113	129	143	153	168
44000	Distance	NM	14	28	44	57	70	83	94	110
	Time	min	3	6	9	11	13	15	17	19
	Fuel	kg	38	69	95	112	128	142	152	166
43000	Distance	NM	14	28	44	56	69	82	93	109
	Time	min	3	6	9	11	13	15	16	18

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DESCENT - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED OPEN

FLIGHT IDLE

AIRSPEED: M 0.77 / 290 KIAS / 250 KIAS

ISA CONDITIONS

WEIGHT (kg)			TOP OF DESCENT (ft)							
			5000	10000	15000	20000	25000	30000	35000	41000
	Fuel	kg	37	68	94	111	126	140	150	165
42000	Distance	NM	14	28	43	56	68	81	92	107
	Time	min	3	6	9	11	13	15	16	18
	Fuel	kg	37	67	93	110	125	138	148	163
41000	Distance	NM	14	28	43	55	67	80	91	106
	Time	min	3	6	9	11	13	15	16	18
	Fuel	kg	36	67	92	108	123	137	146	161
40000	Distance	NM	14	27	42	54	66	79	89	105
	Time	min	3	6	9	11	13	14	16	18
	Fuel	kg	36	66	91	107	122	135	144	159
39000	Distance	NM	13	27	42	53	65	78	88	103
	Time	min	3	6	9	11	12	14	16	18
	Fuel	kg	36	65	89	105	120	133	142	156
38000	Distance	NM	13	27	41	53	65	77	87	102
	Time	min	3	6	9	10	12	14	15	17
	Fuel	kg	35	64	88	104	118	131	140	154
37000	Distance	NM	13	26	40	52	63	76	85	100
	Time	min	3	6	8	10	12	14	15	17
	Fuel	kg	35	63	87	102	116	128	137	152
36000	Distance	NM	13	26	40	51	62	74	84	99
	Time	min	3	6	8	10	12	13	15	17
	Fuel	kg	34	62	85	100	114	126	135	149
35000	Distance	NM	13	25	39	50	61	73	82	97
	Time	min	3	6	8	10	12	13	15	17
	Fuel	kg	33	61	84	98	112	124	132	146
34000	Distance	NM	12	25	38	49	60	72	81	95
	Time	min	3	6	8	10	11	13	14	16

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DESCENT - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED OPEN

FLIGHT IDLE

AIRSPEED: M 0.77 / 290 KIAS / 250 KIAS

ISA CONDITIONS

WEIGHT (kg)			TOP OF DESCENT (ft)							
			5000	10000	15000	20000	25000	30000	35000	41000
	Fuel	kg	33	60	82	96	110	121	130	143
33000	Distance	NM	12	25	38	48	59	70	79	94
	Time	min	3	6	8	10	11	13	14	16
	Fuel	kg	32	59	80	94	107	119	127	140
32000	Distance	NM	12	24	37	47	58	69	77	92
	Time	min	3	5	8	9	11	12	14	16
	Fuel	kg	32	58	79	92	105	116	124	137
31000	Distance	NM	12	24	36	46	56	67	76	90
	Time	min	3	5	8	9	11	12	13	15
	Fuel	kg	31	56	77	90	102	113	121	134
30000	Distance	NM	12	23	35	45	55	65	74	88
	Time	min	3	5	7	9	10	12	13	15

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HOLDING

The holding tables show indicated and true airspeed, Mach number, N1, fuel flow for various weights, altitudes, anti-ice on (with and without ice accretion) and off condition. Data are presented in ISA condition for all engines operating configuration.

The associated conditions are:

Flaps	UP
Gear	UP
Bleeds	OPEN
Airspeed A/I OFF	Minimum Fuel Consumption or 1.29 V_S, whichever is higher.
Airspeed A/I ON	Minimum Fuel Consumption or 210 KIAS , whichever is higher.
Anti Ice	OFF; ON and; ON (WITH ICE ACCRETION).
CG	22%
Minimum Remaining Rate of Climb	300 ft/min

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	207	209	208	209	211	220	223	235
	TAS	kt	212	224	241	261	286	322	354	403
52000	MACH		0.322	0.345	0.377	0.417	0.465	0.535	0.600	0.700
	N1	%	59.7	62.1	65.7	70.0	73.9	78.4	82.5	87.8
	Fuel Flow	kg/h/Eng	973	952	930	930	921	944	959	1029
	IAS	kt	206	206	206	207	211	218	221	229
	TAS	kt	211	221	239	258	286	319	351	395
51000	MACH		0.320	0.340	0.374	0.413	0.465	0.530	0.595	0.685
	N1	%	59.2	61.6	65.3	69.4	73.5	77.8	82.0	87.2
	Fuel Flow	kg/h/Eng	956	934	913	907	904	919	940	999
	IAS	kt	203	203	204	205	209	214	219	226
	TAS	kt	208	219	236	256	283	313	348	389
50000	MACH		0.315	0.336	0.370	0.409	0.460	0.520	0.590	0.675
	N1	%	58.6	61.1	64.8	68.7	73.0	77.3	81.6	86.8
	Fuel Flow	kg/h/Eng	938	917	897	883	887	898	920	981
	IAS	kt	201	203	202	203	205	212	217	224
	TAS	kt	205	218	234	253	276	310	345	386
49000	MACH		0.312	0.335	0.366	0.404	0.450	0.515	0.585	0.670
	N1	%	58.1	60.6	64.3	68.0	72.6	76.8	81.1	86.3
	Fuel Flow	kg/h/Eng	920	901	880	859	870	876	901	962
	IAS	kt	200	200	200	201	202	207	215	222
	TAS	kt	204	214	231	251	273	304	342	383
48000	MACH		0.310	0.330	0.363	0.400	0.445	0.505	0.580	0.665
	N1	%	57.5	60.2	63.8	67.2	72.1	76.2	80.6	85.8
	Fuel Flow	kg/h/Eng	901	885	862	835	852	854	881	943
	IAS	kt	197	197	198	198	200	205	213	220
	TAS	kt	201	212	229	248	270	301	339	380
47000	MACH		0.306	0.326	0.359	0.396	0.440	0.500	0.575	0.660
	N1	%	57.0	59.6	63.3	66.7	71.6	75.5	80.0	85.2
	Fuel Flow	kg/h/Eng	885	869	846	820	835	830	861	923
	IAS	kt	195	196	196	196	198	201	209	219
	TAS	kt	199	211	227	245	267	295	333	378
46000	MACH		0.302	0.325	0.355	0.392	0.435	0.490	0.565	0.655
	N1	%	56.6	59.1	62.7	66.3	71.0	74.8	79.5	84.6
	Fuel Flow	kg/h/Eng	870	852	829	805	816	806	840	901
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	193	193	193	194	195	199	207	211
	TAS	kt	197	208	224	243	264	292	330	366
45000	MACH		0.300	0.320	0.351	0.388	0.430	0.485	0.560	0.635
	N1	%	56.1	58.5	62.2	65.8	70.4	74.0	79.0	83.8
	Fuel Flow	kg/h/Eng	855	835	812	790	798	780	818	863
	IAS	kt	191	191	191	192	193	195	205	206
	TAS	kt	195	205	222	240	261	286	327	357
44000	MACH		0.296	0.316	0.347	0.383	0.425	0.475	0.555	0.620
	N1	%	55.5	57.9	61.6	65.2	69.8	73.5	78.4	82.8
	Fuel Flow	kg/h/Eng	839	818	795	774	778	762	796	825
	IAS	kt	188	189	190	190	191	193	201	203
	TAS	kt	192	203	220	237	258	283	321	352
43000	MACH		0.292	0.312	0.345	0.379	0.420	0.470	0.545	0.610
	N1	%	55.0	57.3	61.0	64.7	69.2	73.0	77.8	81.7
	Fuel Flow	kg/h/Eng	823	800	777	759	758	746	773	784
	IAS	kt	186	186	187	187	188	190	198	199
	TAS	kt	190	200	217	235	255	280	315	346
42000	MACH		0.289	0.308	0.340	0.374	0.415	0.465	0.535	0.600
	N1	%	54.5	56.7	60.4	64.2	68.4	72.5	77.1	81.1
	Fuel Flow	kg/h/Eng	806	782	760	743	736	731	750	760
	IAS	kt	184	184	185	185	186	188	196	197
	TAS	kt	188	198	214	232	252	277	312	343
41000	MACH		0.286	0.305	0.335	0.370	0.410	0.460	0.530	0.595
	N1	%	53.9	56.2	59.9	63.6	67.7	71.9	76.4	80.6
	Fuel Flow	kg/h/Eng	789	767	743	726	714	714	727	743
	IAS	kt	182	182	182	183	184	186	192	196
	TAS	kt	186	196	211	229	249	274	307	340
40000	MACH		0.282	0.301	0.331	0.365	0.405	0.455	0.520	0.590
	N1	%	53.2	55.6	59.3	63.0	66.8	71.4	75.7	80.1
	Fuel Flow	kg/h/Eng	771	751	728	710	690	698	706	725
	IAS	kt	179	180	180	181	181	184	190	194
	TAS	kt	183	193	209	226	246	271	304	337
39000	MACH		0.279	0.297	0.327	0.361	0.400	0.450	0.515	0.585
	N1	%	52.6	55.1	58.7	62.4	65.9	70.8	75.0	79.5
	Fuel Flow	kg/h/Eng	753	736	712	693	667	681	685	707
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	177	177	179	178	179	182	188	192
	TAS	kt	181	191	207	223	242	268	301	334
38000	MACH		0.275	0.293	0.325	0.356	0.395	0.445	0.510	0.580
	N1	%	52.0	54.5	58.0	61.7	65.3	70.1	74.2	78.8
	Fuel Flow	kg/h/Eng	736	720	696	677	653	665	663	687
	IAS	kt	175	175	176	176	176	180	182	188
	TAS	kt	179	189	204	220	239	265	292	329
37000	MACH		0.271	0.290	0.320	0.351	0.389	0.440	0.495	0.570
	N1	%	51.5	53.8	57.3	61.1	64.7	69.5	73.4	78.2
	Fuel Flow	kg/h/Eng	722	704	679	661	640	648	641	668
	IAS	kt	172	173	173	173	174	178	178	187
	TAS	kt	176	186	201	217	236	262	286	326
36000	MACH		0.268	0.285	0.315	0.347	0.384	0.435	0.485	0.565
	N1	%	50.9	53.2	56.7	60.4	64.1	68.8	72.5	77.5
	Fuel Flow	kg/h/Eng	708	687	662	645	627	632	619	647
	IAS	kt	170	170	170	171	171	174	175	185
	TAS	kt	174	183	198	214	233	256	280	323
35000	MACH		0.264	0.281	0.310	0.342	0.379	0.425	0.475	0.560
	N1	%	50.4	52.5	55.9	59.7	63.5	68.0	71.8	76.8
	Fuel Flow	kg/h/Eng	693	671	645	629	614	615	603	627
	IAS	kt	167	168	168	170	169	172	173	181
	TAS	kt	171	180	195	213	229	253	277	317
34000	MACH		0.260	0.277	0.305	0.340	0.373	0.420	0.470	0.550
	N1	%	49.8	51.8	55.3	59.0	62.8	67.2	71.2	76.0
	Fuel Flow	kg/h/Eng	678	654	631	613	601	597	589	606
	IAS	kt	165	165	165	167	166	167	169	178
	TAS	kt	169	178	192	210	226	246	271	311
33000	MACH		0.256	0.273	0.301	0.335	0.368	0.409	0.460	0.540
	N1	%	49.1	51.1	54.6	58.3	62.1	66.2	70.6	75.2
	Fuel Flow	kg/h/Eng	664	640	619	601	587	575	574	586
	IAS	kt	164	163	163	165	164	164	167	175
	TAS	kt	168	175	189	207	222	243	268	305
32000	MACH		0.255	0.269	0.296	0.330	0.362	0.403	0.455	0.530
	N1	%	48.5	50.5	53.9	57.6	61.4	65.2	69.9	74.3
	Fuel Flow	kg/h/Eng	650	629	606	587	572	552	558	566
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	161	160	160	161	161	162	163	169
	TAS	kt	164	172	186	202	219	239	262	297
31000	MACH		0.250	0.265	0.291	0.322	0.356	0.397	0.445	0.515
	N1	%	47.8	49.9	53.2	56.9	60.7	64.3	69.2	73.5
	Fuel Flow	kg/h/Eng	637	616	592	572	556	534	542	547
	IAS	kt	158	157	158	158	159	159	161	166
	TAS	kt	161	169	183	198	215	235	259	291
30000	MACH		0.245	0.261	0.287	0.316	0.351	0.390	0.440	0.505
	N1	%	47.1	49.3	52.5	56.1	59.9	63.6	68.5	72.6
	Fuel Flow	kg/h/Eng	623	604	578	557	541	521	526	526
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	211	220	223	-
	TAS	kt	213	226	243	262	286	322	354	-
52000	MACH		0.326	0.347	0.381	0.419	0.465	0.535	0.600	-
	N1	%	59.5	62.3	65.9	70.2	74.1	78.6	82.7	-
	Fuel Flow	kg/h/Eng	1002	986	962	960	950	976	994	-
	IAS	kt	210	210	210	210	210	218	221	-
	TAS	kt	213	226	243	262	284	319	351	-
51000	MACH		0.326	0.347	0.381	0.419	0.462	0.530	0.595	-
	N1	%	59.0	61.8	65.5	69.5	73.6	78.0	82.2	-
	Fuel Flow	kg/h/Eng	985	968	946	937	933	951	974	-
	IAS	kt	210	210	210	210	210	216	219	-
	TAS	kt	213	226	243	262	284	316	348	-
50000	MACH		0.326	0.347	0.381	0.419	0.462	0.525	0.590	-
	N1	%	58.5	61.3	65.0	68.9	73.2	77.5	81.8	-
	Fuel Flow	kg/h/Eng	968	952	930	914	916	929	954	-
	IAS	kt	210	210	210	210	210	212	217	-
	TAS	kt	213	226	243	262	284	310	345	-
49000	MACH		0.326	0.347	0.381	0.419	0.462	0.515	0.585	-
	N1	%	58.0	60.9	64.5	68.2	72.7	76.9	81.3	-
	Fuel Flow	kg/h/Eng	951	937	914	891	899	906	934	-
	IAS	kt	210	210	210	210	210	210	215	-
	TAS	kt	213	226	243	262	284	308	342	-
48000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.580	-
	N1	%	57.5	60.5	64.1	67.6	72.2	76.3	80.8	-
	Fuel Flow	kg/h/Eng	935	922	899	869	883	883	913	-
	IAS	kt	210	210	210	210	210	210	213	-
	TAS	kt	213	226	243	262	284	308	339	-
47000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.575	-
	N1	%	57.1	60.0	63.6	67.2	71.7	75.7	80.3	-
	Fuel Flow	kg/h/Eng	920	908	884	856	866	859	892	-
	IAS	kt	210	210	210	210	210	210	210	219
	TAS	kt	213	226	243	262	284	308	334	378
46000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.655
	N1	%	56.7	59.5	63.2	66.8	71.2	75.0	79.7	84.9
	Fuel Flow	kg/h/Eng	907	893	870	843	850	836	871	939
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	210	210	213
	TAS	kt	213	226	243	262	284	308	334	369
45000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.640
	N1	%	56.3	59.1	62.7	66.3	70.7	74.3	79.1	84.0
	Fuel Flow	kg/h/Eng	894	878	856	830	833	813	849	900
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
44000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	55.9	58.6	62.2	65.9	70.2	73.8	78.5	83.0
	Fuel Flow	kg/h/Eng	881	864	842	818	817	797	828	861
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
43000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	55.5	58.1	61.8	65.5	69.7	73.4	77.9	81.9
	Fuel Flow	kg/h/Eng	867	849	827	806	800	784	807	821
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
42000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	55.0	57.6	61.3	65.1	69.1	72.9	77.3	81.2
	Fuel Flow	kg/h/Eng	854	834	813	793	784	772	786	798
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
41000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	54.6	57.2	60.9	64.6	68.6	72.5	76.7	80.7
	Fuel Flow	kg/h/Eng	841	823	801	781	770	759	765	782
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
40000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	54.2	56.8	60.5	64.2	68.0	72.1	76.1	80.3
	Fuel Flow	kg/h/Eng	828	811	789	769	757	746	748	766
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
39000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	53.7	56.4	60.1	63.7	67.4	71.7	75.6	79.8
	Fuel Flow	kg/h/Eng	815	799	778	757	745	734	731	749
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
38000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	53.3	56.0	59.7	63.3	67.1	71.2	75.0	79.3
	Fuel Flow	kg/h/Eng	803	788	766	746	737	727	714	733
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
37000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	53.0	55.6	59.3	62.9	66.7	70.8	74.5	78.8
	Fuel Flow	kg/h/Eng	793	777	755	738	729	723	707	717
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
36000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	52.6	55.3	58.9	62.5	66.3	70.4	74.0	78.3
	Fuel Flow	kg/h/Eng	784	772	747	734	721	716	700	704
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
35000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	52.3	54.9	58.5	62.2	66.0	69.9	73.5	77.8
	Fuel Flow	kg/h/Eng	776	771	745	732	713	705	689	696
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
34000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	52.0	54.5	58.1	61.7	65.6	69.5	73.2	77.3
	Fuel Flow	kg/h/Eng	770	769	744	725	703	693	679	686
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
33000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	51.7	54.2	57.8	61.4	65.1	69.0	72.8	76.8
	Fuel Flow	kg/h/Eng	769	762	739	715	693	680	669	672
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
32000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	51.4	53.8	57.4	61.0	64.7	68.5	72.4	76.3
	Fuel Flow	kg/h/Eng	769	754	729	705	683	668	659	658
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
31000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	51.1	53.5	57.1	60.6	64.3	68.1	72.1	75.8
	Fuel Flow	kg/h/Eng	765	746	720	695	674	657	650	646
	IAS	kt	210	210	210	210	210	210	210	210
	TAS	kt	213	226	243	262	284	308	334	364
30000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	0.631
	N1	%	50.8	53.2	56.7	60.3	64.0	67.7	71.7	75.4
	Fuel Flow	kg/h/Eng	759	738	711	686	665	649	640	634
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	226	226	227	228	-	-	-	-
	TAS	kt	230	243	263	285	-	-	-	-
52000	MACH		0.351	0.374	0.412	0.454	-	-	-	-
	N1	%	69.8	72.9	76.6	80.7	-	-	-	-
	Fuel Flow	kg/h/Eng	1454	1452	1435	1447	-	-	-	-
	IAS	kt	224	224	225	226	227	-	-	-
	TAS	kt	227	241	260	282	306	-	-	-
51000	MACH		0.347	0.371	0.408	0.450	0.499	-	-	-
	N1	%	69.3	72.3	76.1	80.1	84.2	-	-	-
	Fuel Flow	kg/h/Eng	1426	1423	1407	1413	1433	-	-	-
	IAS	kt	222	222	223	224	225	-	-	-
	TAS	kt	225	238	258	279	303	-	-	-
50000	MACH		0.344	0.367	0.404	0.446	0.494	-	-	-
	N1	%	68.7	71.8	75.6	79.5	83.7	-	-	-
	Fuel Flow	kg/h/Eng	1398	1394	1379	1378	1402	-	-	-
	IAS	kt	219	220	220	221	223	-	-	-
	TAS	kt	223	236	255	276	300	-	-	-
49000	MACH		0.340	0.363	0.400	0.441	0.489	-	-	-
	N1	%	68.1	71.2	75.0	78.9	83.1	-	-	-
	Fuel Flow	kg/h/Eng	1370	1366	1351	1343	1371	-	-	-
	IAS	kt	217	217	218	219	220	-	-	-
	TAS	kt	221	234	252	273	297	-	-	-
48000	MACH		0.337	0.359	0.395	0.437	0.484	-	-	-
	N1	%	67.6	70.7	74.5	78.2	82.6	-	-	-
	Fuel Flow	kg/h/Eng	1341	1339	1323	1308	1339	-	-	-
	IAS	kt	215	215	216	217	218	-	-	-
	TAS	kt	218	231	250	271	294	-	-	-
47000	MACH		0.333	0.356	0.391	0.432	0.479	-	-	-
	N1	%	67.0	70.1	74.0	77.7	82.0	-	-	-
	Fuel Flow	kg/h/Eng	1315	1311	1296	1281	1307	-	-	-
	IAS	kt	212	213	214	214	215	-	-	-
	TAS	kt	216	229	247	268	291	-	-	-
46000	MACH		0.330	0.352	0.387	0.427	0.474	-	-	-
	N1	%	66.5	69.5	73.4	77.1	81.5	-	-	-
	Fuel Flow	kg/h/Eng	1289	1283	1268	1253	1275	-	-	-
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	211	211	212	213	-	-	-
	TAS	kt	214	226	244	265	288	-	-	-
45000	MACH		0.326	0.348	0.383	0.423	0.468	-	-	-
	N1	%	65.9	68.9	72.8	76.6	80.9	-	-	-
	Fuel Flow	kg/h/Eng	1263	1254	1240	1225	1242	-	-	-
	IAS	kt	210	210	210	210	211	212	-	-
	TAS	kt	213	226	243	262	285	310	-	-
44000	MACH		0.326	0.347	0.381	0.419	0.463	0.515	-	-
	N1	%	65.6	68.5	72.4	76.0	80.3	84.2	-	-
	Fuel Flow	kg/h/Eng	1249	1236	1219	1199	1211	1218	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
43000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	65.3	68.2	72.1	75.7	79.8	83.7	-	-
	Fuel Flow	kg/h/Eng	1235	1221	1204	1186	1189	1193	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
42000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	65.0	67.8	71.7	75.4	79.4	83.4	-	-
	Fuel Flow	kg/h/Eng	1222	1206	1189	1173	1172	1180	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
41000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	64.7	67.6	71.4	75.2	79.1	83.1	-	-
	Fuel Flow	kg/h/Eng	1208	1194	1176	1160	1154	1166	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
40000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	64.4	67.3	71.2	74.9	78.7	82.8	-	-
	Fuel Flow	kg/h/Eng	1195	1182	1164	1147	1136	1151	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
39000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	64.1	67.0	70.9	74.6	78.3	82.5	-	-
	Fuel Flow	kg/h/Eng	1182	1171	1152	1134	1120	1136	-	-
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
38000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	63.8	66.8	70.6	74.3	78.0	82.2	-	-
	Fuel Flow	kg/h/Eng	1169	1159	1140	1123	1109	1121	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
37000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	63.6	66.5	70.3	74.0	77.8	81.8	-	-
	Fuel Flow	kg/h/Eng	1159	1147	1127	1111	1097	1107	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
36000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	63.3	66.2	70.0	73.7	77.5	81.5	-	-
	Fuel Flow	kg/h/Eng	1149	1136	1115	1099	1086	1093	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
35000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	63.1	65.9	69.7	73.5	77.2	81.2	-	-
	Fuel Flow	kg/h/Eng	1140	1124	1102	1087	1075	1078	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
34000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	62.9	65.6	69.4	73.2	77.0	80.8	-	-
	Fuel Flow	kg/h/Eng	1130	1112	1092	1076	1063	1064	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
33000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	62.6	65.4	69.2	73.0	76.7	80.5	-	-
	Fuel Flow	kg/h/Eng	1120	1102	1082	1066	1052	1050	-	-
	IAS	kt	210	210	210	210	210	210	210	-
	TAS	kt	213	226	243	262	284	308	334	-
32000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	-
	N1	%	62.4	65.2	68.9	72.7	76.4	80.2	84.2	-
	Fuel Flow	kg/h/Eng	1110	1094	1073	1057	1040	1036	1043	-
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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HOLDING - ALL ENGINES OPERATING

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	210	210	-
	TAS	kt	213	226	243	262	284	308	334	-
31000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	-
	N1	%	62.1	64.9	68.7	72.5	76.2	79.9	83.9	-
	Fuel Flow	kg/h/Eng	1101	1086	1063	1047	1030	1025	1032	-
	IAS	kt	210	210	210	210	210	210	210	-
	TAS	kt	213	226	243	262	284	308	334	-
30000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	0.567	-
	N1	%	61.9	64.7	68.4	72.2	76.0	79.7	83.7	-
	Fuel Flow	kg/h/Eng	1091	1077	1054	1038	1020	1015	1023	-
FOR HOLDING IN A RACETRACK INCREASE FUEL FLOW BY 5%.										

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ONE ENGINE INOPERATIVE - LONG RANGE CRUISE

CRUISE TABLES

The one engine inoperative long range cruise tables show N1, fuel flow, indicated airspeed, true airspeed, indicated Mach number, buffet margin and specific range. Data are presented for various weights and altitudes. Corrections for ISA deviation and Anti-ice are also presented.

The associated conditions are:

Flaps..... UP
Gear..... UP
Bleeds..... OPEN
Anti-ice..... OFF
CG..... 22%
Minimum Remaining Rate of Climb..... 100 ft/min

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	84.6	87.8	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	2263	2225	-	-	-	-	-	-	-
	IAS	kt	279	275	-	-	-	-	-	-	-
52000	TAS	kt	299	317	-	-	-	-	-	-	-
	Ind. MACH		0.461	0.497	-	-	-	-	-	-	-
	Buffet Marg	G	2.38	2.21	-	-	-	-	-	-	-
	SR	NM/kg	0.132	0.143	-	-	-	-	-	-	-
	N1	%	84	87.4	88.1	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	2208	2191	2186	-	-	-	-	-	-
	IAS	kt	276	274	273	-	-	-	-	-	-
51000	TAS	kt	296	316	320	-	-	-	-	-	-
	Ind. MACH		0.455	0.495	0.503	-	-	-	-	-	-
	Buffet Marg	G	2.39	2.25	2.21	-	-	-	-	-	-
	SR	NM/kg	0.134	0.144	0.146	-	-	-	-	-	-
	N1	%	83.5	87	87.6	87.9	-	-	-	-	-
	Fuel Flow	kg/h/Eng	2159	2156	2142	2105	-	-	-	-	-
	IAS	kt	273	273	271	267	-	-	-	-	-
50000	TAS	kt	293	315	317	317	-	-	-	-	-
	Ind. MACH		0.451	0.493	0.499	0.5	-	-	-	-	-
	Buffet Marg	G	2.4	2.28	2.23	2.15	-	-	-	-	-
	SR	NM/kg	0.136	0.146	0.148	0.151	-	-	-	-	-
	N1	%	82.9	86.5	87	87.5	88.3	-	-	-	-
	Fuel Flow	kg/h/Eng	2115	2114	2093	2072	2082	-	-	-	-
	IAS	kt	270	271	268	266	267	-	-	-	-
49000	TAS	kt	290	313	314	316	322	-	-	-	-
	Ind. MACH		0.446	0.49	0.494	0.498	0.51	-	-	-	-
	Buffet Marg	G	2.41	2.3	2.24	2.18	2.17	-	-	-	-
	SR	NM/kg	0.137	0.148	0.15	0.152	0.155	-	-	-	-
	N1	%	82.4	86	86.4	87	87.8	88.5	-	-	-
	Fuel Flow	kg/h/Eng	2070	2066	2046	2029	2036	2038	-	-	-
	IAS	kt	268	268	266	264	264	265	-	-	-
48000	TAS	kt	287	310	311	313	319	324	-	-	-
	Ind. MACH		0.442	0.485	0.489	0.494	0.505	0.515	-	-	-
	Buffet Marg	G	2.42	2.31	2.25	2.2	2.19	2.16	-	-	-
	SR	NM/kg	0.139	0.15	0.152	0.154	0.157	0.159	-	-	-

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
- DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	81.8	85.4	86	86.5	87.2	87.8	88.6	-	-
	Fuel Flow	kg/h/Eng	2021	2019	2007	1996	1991	1974	1982	-	-
	IAS	kt	265	265	264	263	262	260	261	-	-
47000	TAS	kt	284	306	309	312	316	318	324	-	-
	Ind. MACH		0.437	0.48	0.486	0.492	0.5	0.506	0.518	-	-
	Buffet Marg	G	2.43	2.32	2.28	2.23	2.2	2.15	2.14	-	-
	SR	NM/kg	0.141	0.152	0.154	0.156	0.159	0.161	0.164	-	-
	N1	%	81.2	84.9	85.5	86.1	86.7	87.2	88.1	-	-
	Fuel Flow	kg/h/Eng	1973	1979	1968	1961	1946	1929	1946	-	-
	IAS	kt	262	263	262	261	259	257	259	-	-
46000	TAS	kt	281	304	307	311	313	315	322	-	-
	Ind. MACH		0.432	0.476	0.483	0.49	0.496	0.501	0.515	-	-
	Buffet Marg	G	2.44	2.34	2.31	2.27	2.22	2.16	2.17	-	-
	SR	NM/kg	0.142	0.154	0.156	0.158	0.161	0.163	0.166	-	-
	N1	%	80.6	84.4	85	85.6	86.2	86.7	87.6	88.4	88.8
	Fuel Flow	kg/h/Eng	1929	1938	1931	1922	1912	1890	1904	1912	1878
	IAS	kt	259	261	260	260	258	255	257	258	253
45000	TAS	kt	278	301	305	309	311	313	320	326	325
	Ind. MACH		0.428	0.472	0.48	0.487	0.493	0.497	0.51	0.522	0.522
	Buffet Marg	G	2.45	2.37	2.33	2.3	2.25	2.19	2.19	2.17	2.09
	SR	NM/kg	0.144	0.156	0.158	0.161	0.163	0.165	0.168	0.17	0.173
	N1	%	80	83.9	84.5	85.1	85.7	86.2	87	87.6	88.2
	Fuel Flow	kg/h/Eng	1889	1897	1890	1883	1873	1854	1856	1849	1837
	IAS	kt	257	259	258	258	256	254	254	253	252
44000	TAS	kt	276	299	303	306	309	311	316	320	323
	Ind. MACH		0.425	0.468	0.476	0.484	0.49	0.495	0.504	0.512	0.52
	Buffet Marg	G	2.48	2.39	2.35	2.32	2.28	2.22	2.2	2.16	2.12
	SR	NM/kg	0.146	0.158	0.16	0.163	0.165	0.168	0.17	0.173	0.176
	N1	%	79.5	83.3	84	84.6	85.2	85.8	86.4	86.8	87.7
	Fuel Flow	kg/h/Eng	1848	1852	1848	1841	1832	1824	1807	1784	1797
	IAS	kt	255	256	256	255	254	253	251	248	250
43000	TAS	kt	274	296	300	304	307	310	312	313	320
	Ind. MACH		0.422	0.463	0.471	0.479	0.486	0.493	0.498	0.502	0.515
	Buffet Marg	G	2.5	2.41	2.38	2.34	2.3	2.26	2.2	2.14	2.14
	SR	NM/kg	0.148	0.16	0.162	0.165	0.168	0.17	0.173	0.175	0.178

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
- DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	78.9	82.6	83.4	84	84.6	85.3	85.8	86.3	87.3
	Fuel Flow	kg/h/Eng	1806	1802	1802	1799	1791	1784	1764	1749	1766
	IAS	kt	253	253	253	253	252	251	248	246	249
42000	TAS	kt	272	292	296	301	304	308	309	311	319
	Ind. MACH		0.418	0.458	0.466	0.474	0.482	0.489	0.493	0.499	0.513
	Buffet Marg	G	2.5	2.42	2.39	2.36	2.33	2.29	2.22	2.17	2.18
	SR	NM/kg	0.15	0.162	0.164	0.167	0.17	0.172	0.175	0.178	0.181
	N1	%	78.3	81.8	82.7	83.5	84.1	84.7	85.3	85.8	86.7
	Fuel Flow	kg/h/Eng	1764	1745	1754	1758	1752	1744	1728	1715	1722
	IAS	kt	250	249	250	250	250	249	247	245	246
41000	TAS	kt	269	287	293	298	302	305	307	310	315
	Ind. MACH		0.413	0.45	0.461	0.47	0.478	0.486	0.49	0.496	0.507
	Buffet Marg	G	2.5	2.41	2.4	2.39	2.35	2.32	2.26	2.21	2.19
	SR	NM/kg	0.152	0.165	0.167	0.169	0.172	0.175	0.178	0.181	0.183
	N1	%	77.7	81.1	81.9	82.9	83.6	84.2	84.7	85.4	86
	Fuel Flow	kg/h/Eng	1723	1693	1698	1716	1712	1707	1692	1684	1677
	IAS	kt	247	245	246	248	247	247	245	244	243
40000	TAS	kt	266	283	288	295	299	303	305	309	312
	Ind. MACH		0.409	0.443	0.453	0.466	0.473	0.482	0.487	0.494	0.502
	Buffet Marg	G	2.5	2.41	2.4	2.41	2.38	2.35	2.29	2.25	2.21
	SR	NM/kg	0.154	0.167	0.17	0.172	0.175	0.177	0.18	0.183	0.186
	N1	%	77.1	80.5	81.3	82.1	82.9	83.6	84.2	84.8	85.4
	Fuel Flow	kg/h/Eng	1685	1657	1654	1661	1669	1665	1653	1648	1632
	IAS	kt	245	243	243	244	245	245	243	242	240
39000	TAS	kt	263	280	285	290	296	300	303	307	308
	Ind. MACH		0.405	0.439	0.448	0.458	0.468	0.477	0.483	0.491	0.496
	Buffet Marg	G	2.5	2.44	2.42	2.41	2.4	2.37	2.32	2.29	2.23
	SR	NM/kg	0.156	0.169	0.172	0.175	0.177	0.18	0.183	0.186	0.189
	N1	%	76.5	79.8	80.6	81.3	82.1	83	83.6	84.2	84.7
	Fuel Flow	kg/h/Eng	1649	1610	1611	1608	1613	1623	1612	1604	1587
	IAS	kt	243	240	240	240	241	242	241	240	237
38000	TAS	kt	261	277	281	286	291	297	300	303	305
	Ind. MACH		0.401	0.434	0.442	0.451	0.461	0.472	0.478	0.486	0.49
	Buffet Marg	G	2.5	2.45	2.43	2.41	2.4	2.39	2.35	2.31	2.25
	SR	NM/kg	0.158	0.172	0.175	0.178	0.18	0.183	0.186	0.189	0.192

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

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- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	75.9	79.2	79.9	80.6	81.4	82.3	82.9	83.5	84.1
	Fuel Flow	kg/h/Eng	1610	1569	1567	1563	1564	1576	1570	1562	1551
	IAS	kt	240	237	237	237	237	239	238	237	235
37000	TAS	kt	258	274	278	282	287	293	296	300	303
	Ind. MACH		0.397	0.429	0.437	0.444	0.454	0.466	0.473	0.481	0.487
	Buffet Marg	G	2.5	2.48	2.45	2.42	2.41	2.41	2.37	2.33	2.28
	SR	NM/kg	0.16	0.175	0.177	0.18	0.183	0.186	0.189	0.192	0.195
	N1	%	75.2	78.4	79.2	79.9	80.7	81.6	82.3	82.9	83.5
	Fuel Flow	kg/h/Eng	1568	1524	1523	1520	1523	1528	1526	1521	1514
	IAS	kt	237	234	234	234	234	235	235	234	234
36000	TAS	kt	255	271	274	278	283	289	293	297	300
	Ind. MACH		0.392	0.424	0.431	0.439	0.449	0.459	0.467	0.475	0.483
	Buffet Marg	G	2.5	2.5	2.47	2.44	2.43	2.42	2.39	2.36	2.32
	SR	NM/kg	0.163	0.178	0.18	0.183	0.186	0.189	0.192	0.195	0.198
	N1	%	74.4	77.6	78.5	79.2	80	80.7	81.5	82.3	83
	Fuel Flow	kg/h/Eng	1521	1480	1480	1478	1480	1476	1481	1482	1478
	IAS	kt	234	231	231	231	231	231	232	232	232
35000	TAS	kt	251	267	271	275	280	284	289	294	298
	Ind. MACH		0.387	0.419	0.426	0.434	0.443	0.451	0.461	0.471	0.479
	Buffet Marg	G	2.5	2.5	2.49	2.46	2.45	2.42	2.41	2.39	2.35
	SR	NM/kg	0.165	0.181	0.183	0.186	0.189	0.192	0.195	0.198	0.201
	N1	%	73.6	77.1	77.7	78.5	79.3	79.9	80.7	81.6	82.3
	Fuel Flow	kg/h/Eng	1475	1451	1439	1438	1436	1427	1429	1441	1438
	IAS	kt	231	230	229	228	228	227	228	229	229
34000	TAS	kt	248	266	268	272	276	279	284	290	294
	Ind. MACH		0.381	0.416	0.422	0.429	0.437	0.443	0.454	0.465	0.474
	Buffet Marg	G	2.5	2.5	2.5	2.49	2.47	2.42	2.41	2.41	2.38
	SR	NM/kg	0.168	0.183	0.186	0.189	0.192	0.195	0.199	0.202	0.205
	N1	%	72.9	76.5	77	77.7	78.4	79.1	80	80.7	81.6
	Fuel Flow	kg/h/Eng	1434	1411	1400	1393	1390	1385	1388	1390	1393
	IAS	kt	228	227	226	225	225	224	225	225	226
33000	TAS	kt	244	262	265	268	272	275	280	285	290
	Ind. MACH		0.376	0.411	0.417	0.424	0.431	0.438	0.448	0.457	0.467
	Buffet Marg	G	2.5	2.5	2.5	2.5	2.48	2.45	2.44	2.42	2.4
	SR	NM/kg	0.17	0.186	0.19	0.193	0.196	0.199	0.202	0.205	0.208

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
• DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 5000 FT TO 17000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 5000	10000	11000	12000	13000	14000	15000	16000	17000
	N1	%	72.2	75.8	76.4	76.8	77.6	78.3	79.1	79.8	80.7
	Fuel Flow	kg/h/Eng	1397	1376	1363	1347	1344	1342	1342	1338	1345
	IAS	kt	225	225	223	222	221	221	221	221	222
32000	TAS	kt	241	260	262	265	268	272	276	280	286
	Ind. MACH		0.371	0.407	0.412	0.417	0.424	0.432	0.44	0.448	0.46
	Buffet Marg	G	2.5	2.5	2.5	2.5	2.5	2.47	2.45	2.42	2.41
	SR	NM/kg	0.173	0.189	0.192	0.196	0.199	0.202	0.206	0.209	0.212
	N1	%	71.4	75	75.6	76.2	76.8	77.5	78.2	78.9	79.8
	Fuel Flow	kg/h/Eng	1358	1334	1323	1314	1302	1297	1295	1291	1298
	IAS	kt	222	221	220	220	219	218	217	217	218
31000	TAS	kt	238	256	259	262	265	267	271	275	281
	Ind. MACH		0.366	0.401	0.407	0.413	0.419	0.425	0.433	0.441	0.452
	Buffet Marg	G	2.5	2.5	2.5	2.5	2.5	2.49	2.46	2.43	2.43
	SR	NM/kg	0.175	0.192	0.195	0.199	0.203	0.206	0.209	0.213	0.216
	N1	%	70.7	74.2	74.9	75.6	76.1	76.6	77.4	78.2	79
	Fuel Flow	kg/h/Eng	1324	1291	1287	1281	1267	1255	1256	1252	1256
	IAS	kt	219	218	218	217	216	215	214	214	215
30000	TAS	kt	236	252	256	259	261	264	268	271	277
	Ind. MACH		0.362	0.394	0.402	0.409	0.414	0.42	0.427	0.435	0.445
	Buffet Marg	G	2.5	2.5	2.5	2.5	2.5	2.5	2.49	2.46	2.45
	SR	NM/kg	0.178	0.195	0.199	0.202	0.206	0.21	0.213	0.217	0.22

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
47000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
46000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
45000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	89.1	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1847	-	-	-	-	-	-	-	-
	IAS	kt	252	-	-	-	-	-	-	-	-
44000	TAS	kt	328	-	-	-	-	-	-	-	-
	Ind. MACH		0.529	-	-	-	-	-	-	-	-
	Buffet Marg	G	2.09	-	-	-	-	-	-	-	-
	SR	NM/kg	0.177	-	-	-	-	-	-	-	-
	N1	%	88.7	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1816	-	-	-	-	-	-	-	-
	IAS	kt	252	-	-	-	-	-	-	-	-
43000	TAS	kt	328	-	-	-	-	-	-	-	-
	Ind. MACH		0.529	-	-	-	-	-	-	-	-
	Buffet Marg	G	2.14	-	-	-	-	-	-	-	-
	SR	NM/kg	0.18	-	-	-	-	-	-	-	-

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	88.2	88.6	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1779	1746	-	-	-	-	-	-	-
	IAS	kt	250	245	-	-	-	-	-	-	-
42000	TAS	kt	326	324	-	-	-	-	-	-	-
	Ind. MACH		0.527	0.525	-	-	-	-	-	-	-
	Buffet Marg	G	2.17	2.08	-	-	-	-	-	-	-
	SR	NM/kg	0.183	0.185	-	-	-	-	-	-	-
	N1	%	87.4	87.8	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1723	1694	-	-	-	-	-	-	-
	IAS	kt	246	242	-	-	-	-	-	-	-
41000	TAS	kt	321	321	-	-	-	-	-	-	-
	Ind. MACH		0.518	0.52	-	-	-	-	-	-	-
	Buffet Marg	G	2.17	2.1	-	-	-	-	-	-	-
	SR	NM/kg	0.186	0.189	-	-	-	-	-	-	-
	N1	%	86.6	87.3	88.2	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1662	1663	1672	-	-	-	-	-	-
	IAS	kt	241	241	242	-	-	-	-	-	-
40000	TAS	kt	314	320	326	-	-	-	-	-	-
	Ind. MACH		0.507	0.518	0.53	-	-	-	-	-	-
	Buffet Marg	G	2.16	2.14	2.12	-	-	-	-	-	-
	SR	NM/kg	0.189	0.192	0.195	-	-	-	-	-	-
	N1	%	85.8	86.8	87.8	88.3	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1612	1628	1646	1615	-	-	-	-	-
	IAS	kt	237	240	242	236	-	-	-	-	-
39000	TAS	kt	310	317	326	323	-	-	-	-	-
	Ind. MACH		0.5	0.515	0.531	0.528	-	-	-	-	-
	Buffet Marg	G	2.16	2.17	2.18	2.07	-	-	-	-	-
	SR	NM/kg	0.192	0.195	0.198	0.2	-	-	-	-	-
	N1	%	85.2	86.2	87.1	87.4	88.2	-	-	-	-
	Fuel Flow	kg/h/Eng	1572	1587	1600	1562	1559	-	-	-	-
	IAS	kt	235	237	239	233	232	-	-	-	-
38000	TAS	kt	307	314	322	319	322	-	-	-	-
	Ind. MACH		0.496	0.509	0.524	0.522	0.528	-	-	-	-
	Buffet Marg	G	2.19	2.19	2.19	2.09	2.04	-	-	-	-
	SR	NM/kg	0.195	0.198	0.201	0.204	0.206	-	-	-	-

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
- DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	84.7	85.5	86.1	86.8	87.7	88.8	-	-	-
	Fuel Flow	kg/h/Eng	1539	1540	1534	1523	1532	1533	-	-	-
	IAS	kt	234	234	233	232	232	229	-	-	-
37000	TAS	kt	305	310	314	317	323	324	-	-	-
	Ind. MACH		0.493	0.503	0.51	0.518	0.53	0.533	-	-	-
	Buffet Marg	G	2.23	2.21	2.17	2.13	2.11	2.04	-	-	-
	SR	NM/kg	0.198	0.201	0.204	0.208	0.211	0.211	-	-	-
	N1	%	84.2	84.8	85.4	86.3	87.2	87.8	88.6	-	-
	Fuel Flow	kg/h/Eng	1508	1499	1484	1496	1504	1483	1478	-	-
	IAS	kt	233	231	229	231	233	227	224	-	-
36000	TAS	kt	304	307	309	316	323	321	322	-	-
	Ind. MACH		0.491	0.497	0.502	0.517	0.53	0.529	0.533	-	-
	Buffet Marg	G	2.28	2.23	2.17	2.18	2.17	2.07	2	-	-
	SR	NM/kg	0.202	0.205	0.208	0.211	0.215	0.216	0.218	-	-
	N1	%	83.6	84.1	84.6	85.6	86.6	86.9	87.6	89.3	-
	Fuel Flow	kg/h/Eng	1471	1455	1436	1451	1466	1433	1429	1457	-
	IAS	kt	231	228	226	228	230	225	222	222	-
35000	TAS	kt	302	303	304	312	320	318	320	325	-
	Ind. MACH		0.487	0.491	0.495	0.51	0.525	0.523	0.529	0.54	-
	Buffet Marg	G	2.32	2.25	2.19	2.19	2.2	2.09	2.04	2.01	-
	SR	NM/kg	0.205	0.208	0.212	0.215	0.218	0.222	0.224	0.223	-
	N1	%	82.9	83.4	83.9	84.8	85.7	86.2	87.1	88.3	89
	Fuel Flow	kg/h/Eng	1430	1414	1397	1405	1411	1395	1399	1409	1392
	IAS	kt	228	226	223	224	225	223	223	221	216
34000	TAS	kt	298	300	301	307	313	316	320	322	321
	Ind. MACH		0.481	0.486	0.49	0.502	0.514	0.52	0.53	0.536	0.535
	Buffet Marg	G	2.34	2.28	2.22	2.21	2.19	2.13	2.1	2.05	1.96
	SR	NM/kg	0.208	0.212	0.216	0.219	0.222	0.226	0.229	0.229	0.23
	N1	%	82.3	82.8	83.3	84	84.7	85.6	86.5	87.2	87.7
	Fuel Flow	kg/h/Eng	1392	1376	1361	1358	1351	1362	1369	1357	1335
	IAS	kt	226	224	222	221	220	221	223	218	213
33000	TAS	kt	295	297	299	303	306	313	320	319	317
	Ind. MACH		0.476	0.481	0.487	0.495	0.502	0.516	0.53	0.53	0.529
	Buffet Marg	G	2.37	2.32	2.26	2.22	2.18	2.18	2.17	2.07	1.98
	SR	NM/kg	0.212	0.216	0.22	0.223	0.226	0.23	0.234	0.235	0.237

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
• DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 18000 FT TO 26000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 18000	19000	20000	21000	22000	23000	24000	25000	26000
	N1	%	81.6	82.1	82.7	83.3	84	84.9	85.9	86.1	87
	Fuel Flow	kg/h/Eng	1352	1340	1326	1320	1312	1324	1336	1304	1303
	IAS	kt	223	221	220	219	217	219	221	215	213
32000	TAS	kt	292	294	297	300	303	310	318	315	318
	Ind. MACH		0.471	0.477	0.483	0.49	0.497	0.511	0.526	0.523	0.53
	Buffet Marg	G	2.41	2.35	2.3	2.26	2.21	2.21	2.21	2.1	2.05
	SR	NM/kg	0.216	0.219	0.224	0.227	0.231	0.234	0.238	0.242	0.244
	N1	%	80.8	81.4	82	82.7	83.3	84.1	84.6	85.4	86.3
	Fuel Flow	kg/h/Eng	1308	1299	1290	1285	1279	1281	1265	1267	1270
	IAS	kt	220	219	218	217	216	216	213	214	214
31000	TAS	kt	287	290	294	298	301	306	307	313	318
	Ind. MACH		0.464	0.471	0.478	0.486	0.494	0.504	0.508	0.52	0.53
	Buffet Marg	G	2.43	2.38	2.34	2.3	2.26	2.23	2.17	2.14	2.11
	SR	NM/kg	0.22	0.224	0.228	0.232	0.235	0.239	0.243	0.247	0.25
	N1	%	79.8	80.6	81.3	82	82.6	83.3	83.9	84.8	85.7
	Fuel Flow	kg/h/Eng	1257	1256	1253	1249	1242	1235	1226	1234	1243
	IAS	kt	215	215	215	215	214	212	211	212	213
30000	TAS	kt	282	286	291	294	298	301	303	310	318
	Ind. MACH		0.455	0.464	0.473	0.481	0.489	0.496	0.502	0.515	0.53
	Buffet Marg	G	2.43	2.41	2.38	2.34	2.3	2.25	2.19	2.19	2.18
	SR	NM/kg	0.224	0.228	0.232	0.236	0.24	0.244	0.247	0.251	0.255

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
- DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
37000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
36000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
35000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	-	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	-	-
	IAS	kt	-	-	-	-	-	-	-	-	-
34000	TAS	kt	-	-	-	-	-	-	-	-	-
	Ind. MACH		-	-	-	-	-	-	-	-	-
	Buffet Marg	G	-	-	-	-	-	-	-	-	-
	SR	NM/kg	-	-	-	-	-	-	-	-	-
	N1	%	89.5	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1366	-	-	-	-	-	-	-	-
	IAS	kt	214	-	-	-	-	-	-	-	-
33000	TAS	kt	324	-	-	-	-	-	-	-	-
	Ind. MACH		0.542	-	-	-	-	-	-	-	-
	Buffet Marg	G	1.96	-	-	-	-	-	-	-	-
	SR	NM/kg	0.237	-	-	-	-	-	-	-	-

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.
FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON • INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
• DECREASE SR% BY 7%.

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LONG RANGE CRUISE - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

ALTITUDE 27000 FT TO 35000 FT

CRUISE CONFIGURATION

BLEED: OPEN/ISA CONDITION

WEIGHT (kg)			ALTITUDE (ft) 27000	28000	29000	30000	31000	32000	33000	34000	35000
	N1	%	88.4	-	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1317	-	-	-	-	-	-	-	-
	IAS	kt	212	-	-	-	-	-	-	-	-
32000	TAS	kt	321	-	-	-	-	-	-	-	-
	Ind. MACH		0.537	-	-	-	-	-	-	-	-
	Buffet Marg	G	2	-	-	-	-	-	-	-	-
	SR	NM/kg	0.244	-	-	-	-	-	-	-	-
	N1	%	87.2	87.9	-	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1266	1255	-	-	-	-	-	-	-
	IAS	kt	210	205	-	-	-	-	-	-	-
31000	TAS	kt	317	316	-	-	-	-	-	-	-
	Ind. MACH		0.532	0.532	-	-	-	-	-	-	-
	Buffet Marg	G	2.03	1.95	-	-	-	-	-	-	-
	SR	NM/kg	0.251	0.252	-	-	-	-	-	-	-
	N1	%	86.1	86.8	88.7	-	-	-	-	-	-
	Fuel Flow	kg/h/Eng	1217	1208	1235	-	-	-	-	-	-
	IAS	kt	207	204	205	-	-	-	-	-	-
30000	TAS	kt	314	314	320	-	-	-	-	-	-
	Ind. MACH		0.526	0.528	0.541	-	-	-	-	-	-
	Buffet Marg	G	2.07	1.99	1.97	-	-	-	-	-	-
	SR	NM/kg	0.258	0.26	0.259	-	-	-	-	-	-

INCREASE/DECREASE N1% BY 1.1% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE FUEL FLOW BY 1.5% PER 5ºC ABOVE/BELOW ISA CONDITIONS.
INCREASE/DECREASE TAS BY 4 KT PER 5ºC ABOVE/BELOW ISA CONDITIONS.

FOR ALTITUDES BELOW 31000 FT AND ANTI-ICE ON
- INCREASE N1% BY 0.6% AND FUEL FLOW BY 6%.
- DECREASE SR% BY 7%.

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ONE ENGINE INOPERATIVE - DRIFTDOWN

In the event of an engine failure during cruise it will generally be necessary to reduce speed and descent to a lower altitude.

Immediately after engine failure set maximum continuous N1 and allow the airplane to decelerate from the cruise speed to the driftdown speed shown in the driftdown table. When this speed is achieved, start the descend profile.

The airplane should level off at the gross altitude and weight shown in the driftdown table.

NET LEVEL OFF ALTITUDE

Federal regulations require terrain clearance flight planning based on net performance which is the gross (or real) gradient performance degraded by 1.1%.

To estimate the net level off pressure altitude, enter with the gross weight, proceed to the ISA deviation and find the value within bracket. This is the net level off pressure altitude. The net level off pressure altitude must clear all en-route obstacles by at least 1000 ft.

In case the obstacles heights are close to the values published in the tables below, a detailed driftdown analysis must be accomplished.

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DRIFTDOWN TABLES
EMBRAER 190 – ALL ENGINE TYPES
BLEEDS ON/ENGINE & WING ANTI-ICE OFF

WEIGHT (kg)		FIXED DRIFTDOWN SPEED (KIAS)	GROSS LEVEL OFF ALTITUDE - ft (NET LEVEL OFF ALTITUDE - ft)		
START DRIFTDOWN	LEVEL OFF		ISA+10°C & BELOW	ISA +15°C	ISA+20°C
50000	47600	239	18400	17200	15300
			(12800)	(11000)	(8700)
48000	45800	234	19400	18400	17100
			(14300)	(12600)	(10700)
46000	44000	230	20400	19500	18400
			(15800)	(14200)	(12500)
44000	42100	224	22200	20800	19700
			(17900)	(16200)	(14400)
42000	40200	219	23700	22500	20900
			(19000)	(17900)	(16400)
40000	38400	214	25100	24000	22700
			(20200)	(19200)	(18100)
38000	36600	208	26500	25600	24500
			(22100)	(20600)	(19600)
36000	34650	201	28100	27200	26200
			(24000)	(22800)	(21100)

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DRIFTDOWN TABLES
EMBRAER 190 – ALL ENGINE TYPES
BLEEDS ON/ENGINE & WING ANTI-ICE ON

WEIGHT (kg)		FIXED DRIFTDOWN SPEED (KIAS)	GROSS LEVEL OFF ALTITUDE - ft (NET LEVEL OFF ALTITUDE - ft)		
START DRIFTDOWN	LEVEL OFF		ISA-8°C & BELOW	ISA	ISA+10°C
50000	47700	239	18200	17400	14000
			(12500)	(11700)	(7800)
48000	45850	234	19100	18500	15700
			(14100)	(13300)	(9600)
46000	43950	230	20200	19500	17300
			(15500)	(14800)	(11300)
44000	42150	224	21800	20800	18700
			(17400)	(16500)	(13200)
42000	40200	219	23300	22700	19900
			(18700)	(18000)	(15000)
40000	38450	214	24600	24200	21400
			(19900)	(19200)	(16900)
38000	36550	208	26000	25600	23300
			(21600)	(20600)	(18600)
36000	34700	201	27500	27100	25200
			(23400)	(23000)	(20200)

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ONE ENGINE INOPERATIVE - ALTITUDE CAPABILITY

The table below permits quick determination of the altitude capability, based on the initial cruise weight. The table data are presented for various ISA conditions, one engine inoperative and Long Range Cruise schedule.

The established associated conditions are:

Flaps..... UP
Gears..... UP
Bleeds..... OPEN
CG..... 22%
Minimum Remaining Rate of Climb..... 100 ft/min

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CRUISE ALTITUDE CAPABILITY ONE ENGINE INOPERATIVE

LONG RANGE CRUISE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

Weight	ISA + ºC									
(kg)	-10	-5	0	5	10	15	20	25	30	35
52000	100	100	100	100	100	-	-	-	-	-
51000	120	110	110	110	110	-	-	-	-	-
50000	120	120	120	120	120	-	-	-	-	-
49000	130	130	130	130	130	100	-	-	-	-
48000	140	140	140	140	140	110	-	-	-	-
47000	150	150	150	150	150	120	-	-	-	-
46000	150	150	150	150	150	130	110	-	-	-
45000	170	170	170	170	170	140	120	-	-	-
44000	180	180	180	180	170	160	130	100	-	-
43000	180	180	180	180	180	170	140	110	-	-
42000	190	190	190	190	190	170	160	120	100	-
41000	190	190	190	190	190	180	160	130	110	-
40000	200	200	200	200	200	190	180	140	120	100
39000	210	210	210	210	210	190	180	160	130	110
38000	220	220	220	220	220	200	190	180	140	120
37000	230	230	230	230	230	210	200	180	160	130
36000	240	240	240	240	240	220	200	190	170	140
35000	250	250	250	250	250	230	210	200	180	150
34000	260	260	260	260	260	240	220	210	190	170
33000	270	270	270	260	260	250	230	220	200	180
32000	270	270	270	270	270	260	250	220	210	190
31000	280	280	280	280	280	270	250	240	220	200
30000	290	290	290	290	290	280	270	250	230	210
29000	300	300	300	300	300	290	280	260	240	220
28000	310	310	310	310	310	300	280	270	260	240

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ONE ENGINE INOPERATIVE - HOLDING

The holding tables show indicated and true airspeed, Mach number, N1, fuel flow for various weights, altitudes, anti-ice on (with and without ice accretion) and off condition. Data are presented in ISA condition for one engine inoperative configuration.

The associated conditions are:

Flaps	UP
Gear	UP
Bleeds	OPEN
CG	22%
Minimum Remaining Rate of Climb	100 ft/min
Airspeed A/I OFF	Minimum Fuel Consumption or 1.29 V_S, whichever is higher.
Airspeed A/I ON	Minimum Fuel Consumption or 210 KIAS, whichever is higher.
Anti-ice	OFF, ON and ON (WITH ICE ACCRETION).

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	207	209	208	211	-	-	-	-
	TAS	kt	212	224	241	263	-	-	-	-
52000	MACH		0.322	0.345	0.377	0.420	-	-	-	-
	N1	%	77.3	79.8	83.7	88.1	-	-	-	-
	Fuel Flow	kg/h/Eng	1863	1849	1851	1894	-	-	-	-
	IAS	kt	206	206	206	208	-	-	-	-
	TAS	kt	211	221	239	260	-	-	-	-
51000	MACH		0.320	0.340	0.374	0.415	-	-	-	-
	N1	%	76.8	79.3	83.2	87.4	-	-	-	-
	Fuel Flow	kg/h/Eng	1825	1809	1813	1841	-	-	-	-
	IAS	kt	203	203	204	206	-	-	-	-
	TAS	kt	208	219	236	257	-	-	-	-
50000	MACH		0.315	0.336	0.370	0.410	-	-	-	-
	N1	%	76.2	78.7	82.7	86.7	-	-	-	-
	Fuel Flow	kg/h/Eng	1786	1771	1774	1789	-	-	-	-
	IAS	kt	201	203	202	203	-	-	-	-
	TAS	kt	205	218	234	254	-	-	-	-
49000	MACH		0.312	0.335	0.366	0.405	-	-	-	-
	N1	%	75.6	78.2	82.1	85.9	-	-	-	-
	Fuel Flow	kg/h/Eng	1747	1736	1735	1733	-	-	-	-
	IAS	kt	200	200	200	201	-	-	-	-
	TAS	kt	204	214	231	251	-	-	-	-
48000	MACH		0.310	0.330	0.363	0.400	-	-	-	-
	N1	%	75.0	77.7	81.5	85.0	-	-	-	-
	Fuel Flow	kg/h/Eng	1707	1701	1695	1678	-	-	-	-
	IAS	kt	197	197	198	198	-	-	-	-
	TAS	kt	201	212	229	248	-	-	-	-
47000	MACH		0.306	0.326	0.359	0.396	-	-	-	-
	N1	%	74.4	77.1	80.9	84.5	-	-	-	-
	Fuel Flow	kg/h/Eng	1672	1665	1658	1645	-	-	-	-
	IAS	kt	195	196	196	196	202	-	-	-
	TAS	kt	199	211	227	245	273	-	-	-
46000	MACH		0.302	0.325	0.355	0.392	0.445	-	-	-
	N1	%	73.9	76.5	80.4	84.0	89.6	-	-	-
	Fuel Flow	kg/h/Eng	1639	1629	1620	1610	1701	-	-	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	193	193	193	194	200	-	-	-
	TAS	kt	197	208	224	243	270	-	-	-
45000	MACH		0.300	0.320	0.351	0.388	0.440	-	-	-
	N1	%	73.3	75.9	79.7	83.5	88.6	-	-	-
	Fuel Flow	kg/h/Eng	1605	1592	1582	1575	1647	-	-	-
	IAS	kt	191	191	191	192	197	-	-	-
	TAS	kt	195	205	222	240	267	-	-	-
44000	MACH		0.296	0.316	0.347	0.383	0.435	-	-	-
	N1	%	72.7	75.3	79.1	82.9	87.7	-	-	-
	Fuel Flow	kg/h/Eng	1571	1554	1543	1540	1594	-	-	-
	IAS	kt	188	189	190	190	193	-	-	-
	TAS	kt	192	203	220	237	261	-	-	-
43000	MACH		0.292	0.312	0.345	0.379	0.425	-	-	-
	N1	%	72.1	74.6	78.4	82.3	86.9	-	-	-
	Fuel Flow	kg/h/Eng	1536	1516	1503	1504	1545	-	-	-
	IAS	kt	186	186	187	187	188	-	-	-
	TAS	kt	190	200	217	235	255	-	-	-
42000	MACH		0.289	0.308	0.340	0.374	0.415	-	-	-
	N1	%	71.4	73.9	77.7	81.7	86.1	-	-	-
	Fuel Flow	kg/h/Eng	1500	1476	1464	1468	1497	-	-	-
	IAS	kt	184	184	185	185	186	-	-	-
	TAS	kt	188	198	214	232	252	-	-	-
41000	MACH		0.286	0.305	0.335	0.370	0.410	-	-	-
	N1	%	70.7	73.3	77.1	81.1	85.3	-	-	-
	Fuel Flow	kg/h/Eng	1463	1444	1429	1431	1448	-	-	-
	IAS	kt	182	182	182	183	184	192	-	-
	TAS	kt	186	196	211	229	249	282	-	-
40000	MACH		0.282	0.301	0.331	0.365	0.405	0.468	-	-
	N1	%	70.0	72.7	76.5	80.4	84.4	91.7	-	-
	Fuel Flow	kg/h/Eng	1425	1411	1395	1393	1395	1500	-	-
	IAS	kt	179	180	180	181	181	186	-	-
	TAS	kt	183	193	209	226	246	274	-	-
39000	MACH		0.279	0.297	0.327	0.361	0.400	0.455	-	-
	N1	%	69.2	72.0	75.8	79.7	83.4	90.5	-	-
	Fuel Flow	kg/h/Eng	1386	1377	1361	1356	1342	1450	-	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	177	178	179	178	179	184	-	-
	TAS	kt	181	192	207	223	243	271	-	-
38000	MACH		0.275	0.295	0.325	0.356	0.395	0.450	-	-
	N1	%	68.5	71.3	75.1	79.1	82.7	89.2	-	-
	Fuel Flow	kg/h/Eng	1347	1343	1326	1319	1308	1399	-	-
	IAS	kt	175	175	176	176	177	182	-	-
	TAS	kt	179	189	204	220	240	268	-	-
37000	MACH		0.271	0.290	0.320	0.351	0.390	0.445	-	-
	N1	%	67.9	70.6	74.4	78.3	82.1	88.0	-	-
	Fuel Flow	kg/h/Eng	1317	1307	1289	1282	1274	1348	-	-
	IAS	kt	172	173	173	173	174	178	-	-
	TAS	kt	176	186	201	217	236	262	-	-
36000	MACH		0.268	0.285	0.315	0.347	0.385	0.435	-	-
	N1	%	67.2	69.8	73.7	77.6	81.4	86.8	-	-
	Fuel Flow	kg/h/Eng	1285	1271	1252	1244	1240	1297	-	-
	IAS	kt	170	170	171	171	172	176	-	-
	TAS	kt	174	183	198	214	233	259	-	-
35000	MACH		0.264	0.281	0.310	0.342	0.380	0.430	-	-
	N1	%	66.5	69.0	72.9	76.8	80.8	85.7	-	-
	Fuel Flow	kg/h/Eng	1253	1233	1214	1206	1205	1246	-	-
	IAS	kt	167	168	168	168	170	172	-	-
	TAS	kt	171	180	195	211	230	253	-	-
34000	MACH		0.260	0.277	0.305	0.337	0.375	0.420	-	-
	N1	%	65.8	68.2	72.1	75.9	80.0	84.6	-	-
	Fuel Flow	kg/h/Eng	1219	1194	1180	1168	1168	1195	-	-
	IAS	kt	165	165	165	166	166	167	172	-
	TAS	kt	169	178	192	208	226	247	276	-
33000	MACH		0.256	0.273	0.301	0.332	0.368	0.410	0.468	-
	N1	%	65.0	67.4	71.3	75.2	79.3	83.5	91.6	-
	Fuel Flow	kg/h/Eng	1185	1160	1147	1135	1132	1144	1230	-
	IAS	kt	162	163	163	163	164	164	171	-
	TAS	kt	166	175	189	205	222	243	274	-
32000	MACH		0.252	0.269	0.296	0.327	0.362	0.403	0.465	-
	N1	%	64.2	66.6	70.5	74.4	78.4	82.3	90.0	-
	Fuel Flow	kg/h/Eng	1151	1129	1114	1101	1094	1091	1184	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: OFF

SPEED: MINIMUM FUEL CONSUMPTION OR 1.29 V_S

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	160	160	160	161	161	162	167	-
	TAS	kt	163	172	186	202	219	239	268	-
31000	MACH		0.248	0.265	0.291	0.322	0.356	0.397	0.455	-
	N1	%	63.3	65.9	69.7	73.6	77.6	81.4	88.4	-
	Fuel Flow	kg/h/Eng	1115	1098	1080	1066	1059	1050	1136	-
	IAS	kt	158	157	158	158	159	159	163	-
	TAS	kt	161	169	183	198	215	235	262	-
30000	MACH		0.245	0.261	0.287	0.316	0.351	0.390	0.445	-
	N1	%	62.4	65.1	68.8	72.8	76.8	80.7	86.8	-
	Fuel Flow	kg/h/Eng	1079	1067	1046	1032	1024	1019	1088	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	213	-	-	-	-
	TAS	kt	213	226	243	266	-	-	-	-
52000	MACH		0.326	0.347	0.381	0.425	-	-	-	-
	N1	%	77.1	80.1	84.0	88.4	-	-	-	-
	Fuel Flow	kg/h/Eng	1930	1930	1932	1982	-	-	-	-
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
51000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	76.6	79.5	83.5	87.7	-	-	-	-
	Fuel Flow	kg/h/Eng	1893	1890	1895	1927	-	-	-	-
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
50000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	76.1	79.0	83.0	87.0	-	-	-	-
	Fuel Flow	kg/h/Eng	1856	1852	1858	1873	-	-	-	-
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
49000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	75.5	78.5	82.4	86.2	-	-	-	-
	Fuel Flow	kg/h/Eng	1819	1819	1822	1819	-	-	-	-
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
48000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	74.9	78.0	81.9	85.5	-	-	-	-
	Fuel Flow	kg/h/Eng	1782	1786	1785	1767	-	-	-	-
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
47000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	74.5	77.5	81.4	85.0	-	-	-	-
	Fuel Flow	kg/h/Eng	1751	1754	1752	1737	-	-	-	-
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
46000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	74.0	77.0	80.9	84.6	-	-	-	-
	Fuel Flow	kg/h/Eng	1722	1722	1718	1706	-	-	-	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	-	-	-	-
	TAS	kt	213	226	243	262	-	-	-	-
45000	MACH		0.326	0.347	0.381	0.419	-	-	-	-
	N1	%	73.5	76.5	80.4	84.1	-	-	-	-
	Fuel Flow	kg/h/Eng	1693	1689	1684	1675	-	-	-	-
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
44000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	73.0	76.0	79.8	83.6	88.2	-	-	-
	Fuel Flow	kg/h/Eng	1664	1657	1650	1644	1696	-	-	-
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
43000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	72.5	75.5	79.3	83.1	87.5	-	-	-
	Fuel Flow	kg/h/Eng	1636	1625	1615	1614	1650	-	-	-
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
42000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	72.0	74.9	78.7	82.7	86.8	-	-	-
	Fuel Flow	kg/h/Eng	1607	1593	1582	1584	1608	-	-	-
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
41000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	71.5	74.5	78.2	82.2	86.2	-	-	-
	Fuel Flow	kg/h/Eng	1578	1567	1553	1555	1570	-	-	-
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
40000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	71.0	74.0	77.7	81.7	85.5	-	-	-
	Fuel Flow	kg/h/Eng	1549	1542	1527	1526	1530	-	-	-
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
39000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	70.5	73.6	77.3	81.2	84.9	-	-	-
	Fuel Flow	kg/h/Eng	1520	1518	1500	1498	1492	-	-	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	-	-	-
	TAS	kt	213	226	243	262	284	-	-	-
38000	MACH		0.326	0.347	0.381	0.419	0.462	-	-	-
	N1	%	70.0	73.1	76.8	80.8	84.5	-	-	-
	Fuel Flow	kg/h/Eng	1493	1493	1473	1472	1466	-	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
37000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	69.6	72.6	76.3	80.3	84.0	89.8	-	-
	Fuel Flow	kg/h/Eng	1472	1468	1446	1445	1440	1517	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
36000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	69.1	72.1	75.8	79.8	83.6	88.9	-	-
	Fuel Flow	kg/h/Eng	1452	1443	1420	1418	1416	1479	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
35000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	68.7	71.6	75.4	79.3	83.1	88.0	-	-
	Fuel Flow	kg/h/Eng	1431	1418	1394	1391	1391	1441	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
34000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	68.3	71.2	74.9	78.8	82.7	87.2	-	-
	Fuel Flow	kg/h/Eng	1410	1392	1373	1366	1366	1402	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
33000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	67.9	70.7	74.5	78.4	82.2	86.5	-	-
	Fuel Flow	kg/h/Eng	1389	1371	1353	1345	1341	1367	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
32000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	67.5	70.4	74.2	78.0	81.7	85.8	-	-
	Fuel Flow	kg/h/Eng	1369	1353	1334	1323	1317	1332	-	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
31000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	67.1	70.0	73.8	77.5	81.3	85.2	-	-
	Fuel Flow	kg/h/Eng	1348	1335	1314	1302	1296	1303	-	-
	IAS	kt	210	210	210	210	210	210	-	-
	TAS	kt	213	226	243	262	284	308	-	-
30000	MACH		0.326	0.347	0.381	0.419	0.462	0.511	-	-
	N1	%	66.6	69.6	73.4	77.1	80.9	84.8	-	-
	Fuel Flow	kg/h/Eng	1328	1318	1295	1281	1276	1284	-	-

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	-	-	-	-	-	-	-	
	TAS	kt	-	-	-	-	-	-	-	
52000	MACH		-	-	-	-	-	-	-	
	N1	%	-	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	
	IAS	kt	-	-	-	-	-	-	-	
	TAS	kt	-	-	-	-	-	-	-	
51000	MACH		-	-	-	-	-	-	-	
	N1	%	-	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	
	IAS	kt	-	-	-	-	-	-	-	
	TAS	kt	-	-	-	-	-	-	-	
50000	MACH		-	-	-	-	-	-	-	
	N1	%	-	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	-	-	-	-	-	-	-	
	IAS	kt	219	-	-	-	-	-	-	
	TAS	kt	223	-	-	-	-	-	-	
49000	MACH		0.340	-	-	-	-	-	-	
	N1	%	86.9	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2778	-	-	-	-	-	-	
	IAS	kt	217	-	-	-	-	-	-	
	TAS	kt	221	-	-	-	-	-	-	
48000	MACH		0.337	-	-	-	-	-	-	
	N1	%	86.3	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2710	-	-	-	-	-	-	
	IAS	kt	215	-	-	-	-	-	-	
	TAS	kt	218	-	-	-	-	-	-	
47000	MACH		0.333	-	-	-	-	-	-	
	N1	%	85.7	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2648	-	-	-	-	-	-	
	IAS	kt	212	-	-	-	-	-	-	
	TAS	kt	216	-	-	-	-	-	-	
46000	MACH		0.330	-	-	-	-	-	-	
	N1	%	85.1	-	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2588	-	-	-	-	-	-	

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	211	-	-	-	-	-	
	TAS	kt	214	226	-	-	-	-	-	
45000	MACH		0.326	0.348	-	-	-	-	-	
	N1	%	84.5	87.7	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2528	2562	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
44000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	84.1	87.2	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2494	2519	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
43000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	83.8	86.9	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2462	2483	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
42000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	83.5	86.5	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2430	2447	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
41000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	83.1	86.2	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2398	2419	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
40000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	82.7	85.9	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2366	2391	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
39000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	82.4	85.5	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2335	2363	-	-	-	-	-	

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

BLEED: OPEN

ANTI-ICE: ON (WITH ICE ACCRETION)

SPEED: MINIMUM FUEL CONSUMPTION OR 210 KIAS

STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
38000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	82.0	85.2	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2306	2334	-	-	-	-	-	
	IAS	kt	210	210	-	-	-	-	-	
	TAS	kt	213	226	-	-	-	-	-	
37000	MACH		0.326	0.347	-	-	-	-	-	
	N1	%	81.8	84.9	-	-	-	-	-	
	Fuel Flow	kg/h/Eng	2283	2306	-	-	-	-	-	
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
36000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	81.5	84.6	88.6	-	-	-	-	
	Fuel Flow	kg/h/Eng	2261	2278	2306	-	-	-	-	
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
35000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	81.2	84.3	88.2	-	-	-	-	
	Fuel Flow	kg/h/Eng	2238	2250	2277	-	-	-	-	
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
34000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	80.9	83.9	87.9	-	-	-	-	
	Fuel Flow	kg/h/Eng	2216	2222	2252	-	-	-	-	
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
33000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	80.6	83.7	87.7	-	-	-	-	
	Fuel Flow	kg/h/Eng	2194	2199	2230	-	-	-	-	
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
32000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	80.4	83.4	87.4	-	-	-	-	
	Fuel Flow	kg/h/Eng	2172	2179	2207	-	-	-	-	

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HOLDING - ONE ENGINE INOPERATIVE

CF34-10E5/10E5A1/10E6/10E6A1 ENGINES

CRUISE CONFIGURATION

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STANDARD ATMOSPHERE

WEIGHT (kg)			ALTITUDE (ft) 1500	5000	10000	15000	20000	25000	30000	35000
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
31000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	80.1	83.2	87.1	-	-	-	-	
	Fuel Flow	kg/h/Eng	2150	2160	2185	-	-	-	-	
	IAS	kt	210	210	210	-	-	-	-	
	TAS	kt	213	226	243	-	-	-	-	
30000	MACH		0.326	0.347	0.381	-	-	-	-	
	N1	%	79.8	82.9	86.9	-	-	-	-	
	Fuel Flow	kg/h/Eng	2129	2141	2162	-	-	-	-	

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INFLIGHT DIVERSION

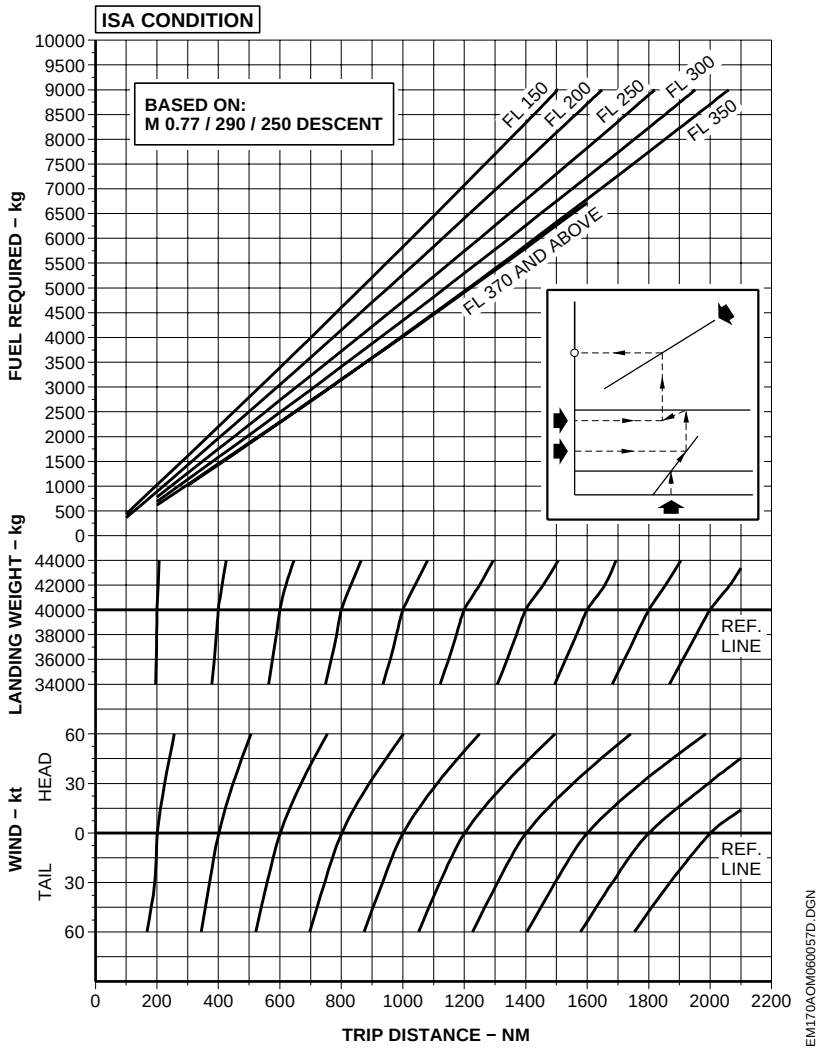
These charts are provided for the pilots to determine if the fuel remaining is enough to complete the trip at Long Range Cruise (LRC) mode from one point in cruise to an alternate airport. The charts also enable rapid determination of fuel and time required to proceed to an alternate airport.

Fuel and time are determined in the same way as the simplified flight planning charts, with distance to destination instead of trip distance, disregarding the climb phase.

The pilots can also use the charts in the opposite direction, i.e., entering with the fuel remaining on board and finding the range at a given flight level at LRC.

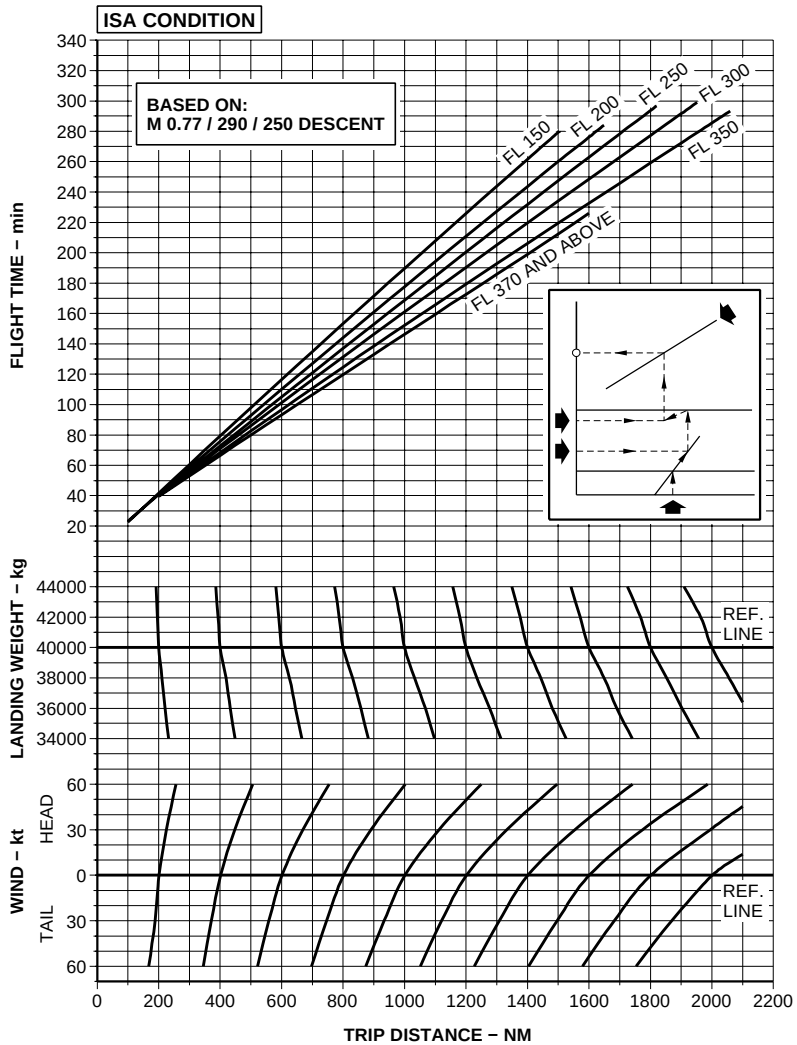
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EMBRAER 190 INFLIGHT DIVERSION
TRIP FUEL
ALL ENGINE TYPES
LONG RANGE CRUISE



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EMBRAER 190 INFLIGHT DIVERSION TRIP TIME ALL ENGINE TYPES LONG RANGE CRUISE



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FLIGHT OVER MOUNTAINOUS AREA

Two situations must be considered when flying over mountainous areas, in order to clear route obstacles:

Engine Failure

For most normal cruise weights and altitudes, an airplane will not be able to maintain its cruise altitude following an engine failure, and will begin to descend (drift down). In order to remain as high as possible, the pilot will use maximum continuous thrust on the remaining engine and slow down to the optimum driftdown speed, which is the speed that results in the lower descent gradient. The airplane will then descend along what is called the optimum driftdown profile. The optimum driftdown profile will keep the airplane as high as possible during the descent.

Regulations require that the actual airplane performance be calculated in the most conservative airplane configuration and then further decreased by a 1.1 percent climb gradient for two-engine airplanes. This reduced gradient path is called the en-route net flight path and is used to ensure en-route obstacle clearance (FAR 25.123).

During a driftdown, the available thrust increases as the aircraft descends. Eventually, at a certain altitude the available thrust will become equal to the airplane drag, and the airplane will level off. This altitude is called the gross level off altitude. The gross level-off altitude, when corrected by the 1.1% gradient margin, is called the net level-off altitude and will depend on the atmospheric temperature and the airplane weight.

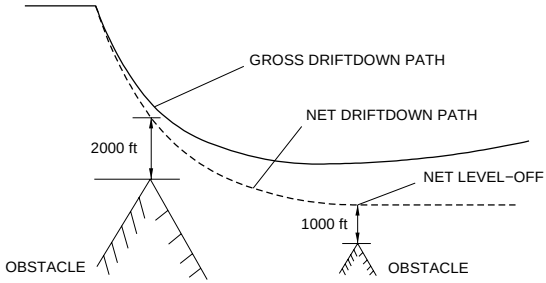
The aircraft actual climb gradient (gross gradient) at the net level-off altitude will be 1.1%. The net gradient is the gross gradient subtracted by 1.1%. Obviously, the net gradient is zero at the net level off altitude, and the gross gradient is zero at the gross level off altitude.

Regulations (FAR 121.191) require that the airplane be able to clear all terrain by a given margin when an engine fails. Two means of compliance for en-route obstacle clearance are allowed:

– The net level-off altitude must clear all en-route obstacles by at least 1000 ft; or

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– The net flight path must clear all en-route obstacles between the point where the engine is assumed to fail and an airport where a landing can be made by at least 2000 ft.



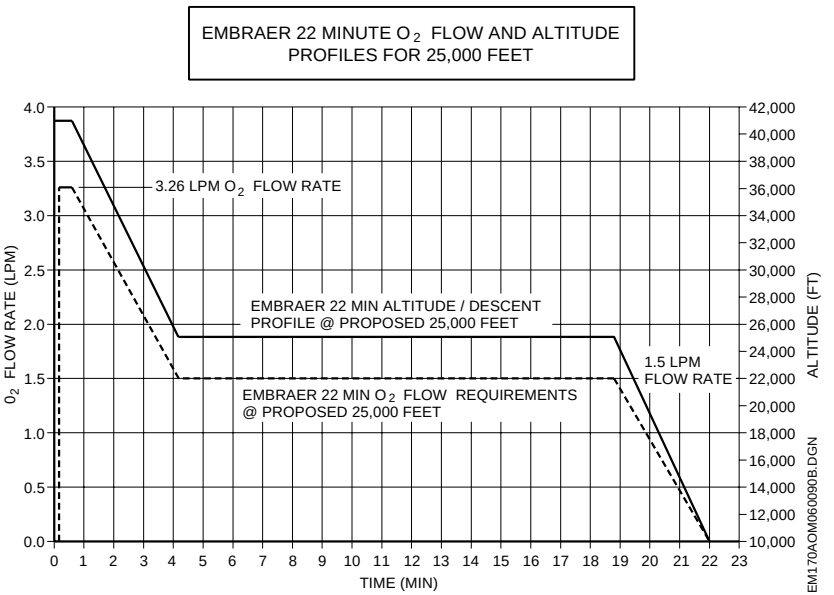
Prior to departure a detailed analysis of the route should be made using contour maps of the high terrain and plotting the highest points within the corridor's width along the route (or, alternatively, using Minimum En-Route Altitude, MEA, or Minimum Off Route Altitude, MORA). The next step is to determine if it is possible to maintain level flight with one engine inoperative 1000 ft above the highest point of the crossing. If this is not possible, or if the associated weight penalties are unacceptable, a driftdown procedure should be worked out, based on engine failure at the most critical point and clearing critical obstacles during the driftdown by at least 2000 ft. The minimum cruise altitude and the point of no return (PNR) are determined by the intersection of the two driftdown paths.

If an engine failure occurs after the PNR, the airplane will drift down on course. If the failure occurs before PNR, the airplane will have to turn back. In either flight direction the net flight path must clear the obstacles by 2000 ft.

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Depressurization

In case of an emergency descent a profile has to be taken into account. The EMBRAER 22 minutes passenger oxygen flow and altitude profile recalculated for 25000 ft level-off are illustrated below:



The emergency descent is presented in the procedure “CABIN ALTITUDE HI”.

This descent profile is valid for the Oxygen Generators P/N 801387-23.

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SECTION 7

WEIGHT AND BALANCE

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INTRODUCTION

This section contains information equivalent to the Weight and Balance manual and is intended to assist the operator in defining the weight and balance system and constrained CG limits.

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STANDARD TERMS AND DEFINITIONS

EQUIPPED EMPTY WEIGHT (EEW) OR MANUFACTURER EMPTY WEIGHT (MEW)

It is the weight of structure, powerplant, instruments, interior furnishings, systems, optional, portable, and emergency equipment and other items of equipment that are an integral part of the airplane configuration. It is essentially a dry weight, including only those fluids contained in closed systems such as oxygen, fire extinguisher agent, landing gear shock absorber fluid, etc.

BASIC EMPTY WEIGHT (BEW)

It is the MEW plus the weight of the following items:

- APU oil;
- Engine oil;
- Hydraulic fluid;
- Unusable fuel.

OPERATIONAL EMPTY WEIGHT (OEW) OR DRY OPERATING WEIGHT (DOW)

It is the BEW plus the weight of the operational items, which are those necessary for airplane operation and not included in the BEW.

The operational items are:

- Crew and crew baggage;
- Navigation kit (manuals, charts, etc.);
- Catering (beverages and foods) and removable service equipment for galley (such as standard units, etc.);
- Lavatory rinse water;
- Lavatory chemical fluid.

ACTUAL ZERO FUEL WEIGHT (AZFW)

This is the OEW plus actual payload.

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PAYLOAD OR TOTAL TRAFFIC LOAD

This is the weight of passengers, baggage and cargo.

MAXIMUM ALLOWABLE PAYLOAD

It is the maximum approved weight that can be loaded into the airplane. Maximum payload is the Maximum Zero Fuel Weight (MZFW) minus Operational Empty Weight (OEW).

MAXIMUM DESIGN ZERO FUEL WEIGHT (MZFW)

This is the maximum authorized weight before usable fuel be loaded. The MZFW is related to airplane structural limitations.

MAXIMUM DESIGN RAMP WEIGHT (MRW)

This is the maximum authorized ramp weight.

MAXIMUM DESIGN TAKEOFF WEIGHT (MTOW)

This is the maximum authorized weight for takeoff.

MAXIMUM DESIGN LANDING WEIGHT (MLW)

This is the maximum authorized weight for landing.

MINIMUM OPERATING WEIGHT (MOW)

This is the minimum authorized weight to operate the airplane.

CENTER OF GRAVITY (CG)

This is the position where the mass of the aircraft is considered concentrated for balance purposes. It is normally referred to in terms of % MAC.

AIRPLANE DATUM

This is a plane perpendicular to the fuselage centerline from where all arm measurements are taken.

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MEAN AERODYNAMIC CHORD (MAC)

This is the chord of an imaginary rectangular airfoil with the same area of the actual wing and which produces the same resulting force vectors of the actual wing. The airplane forward and aft CG limits are referred to in terms of % MAC.

INDEX SYSTEM

This is a convention for presenting airplane or body moments. It is the moment of the body converted to a different measuring system.

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GENERAL DATA

The general data presented in this section is used for specific weight and balance calculations and is equivalent to the information contained in the Weight & Balance Manual.

BALANCE REFERENCE SYSTEM

AIRPLANE DATUM

Airplane datum is a perpendicular plane to the fuselage centerline, located at 14.443 m ahead of the wing stub front spar. For external reference, datum is located at 14.857 m ahead of the wing jack points.

BALANCE ARMS/BODY STATION

Balance arms are the distances in meters from the airplane datum - located at the zero station of the fuselage - of the centers of gravity (CG) regarding airplane and components identified throughout this manual.

WING MEAN AERODYNAMIC CHORD (MAC)

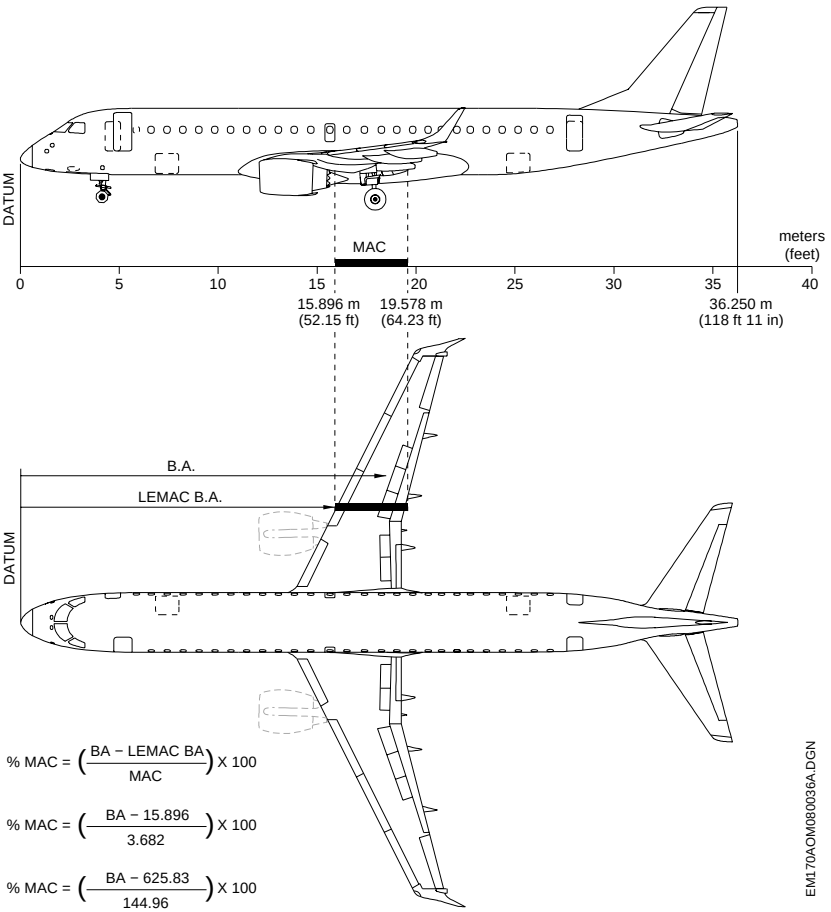
MAC length	=	3.682 m
LEMAC balance arm	=	15.896 m

Percentage of MAC is obtained using the following formula:

$$\%MAC = \frac{(B.A. - 15.896) \times 100}{3.682}$$

Where B.A. = Balance arm of airplane CG measured in meters.

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WING MEAN AERODYNAMIC CHORD (MAC)

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MOMENT/CG CHANGES

DUE TO ANY PASSENGER OR CREW MEMBER INFLIGHT MOVEMENT

A person moving from the front to the rear of the cabin or vice-versa causes the following CG travel:

– For 30000 kg (low weights): CG moves aft or forward in a maximum range of 1.6% of MAC.

– For 41000 kg (intermediate weights): CG moves aft or forward in a maximum range of 1.1% of MAC.

– For 51000 kg (high weights): CG moves aft or forward in a maximum range of 0.9% of MAC.

DUE TO LANDING GEAR CONFIGURATION

When the landing gear is retracted, there is a moment reduction in respect to the airplane datum.

– For 30000 kg: CG moves forward 0.4% of MAC (most critical case).

DUE TO FUEL CONSUMPTION AND DENSITY VARIATION TEMPERATURE

The fuel CG variation in relation to consumption is shown in the Fuel Distribution Table.

The variation of fuel density with temperature has negligible effects in the airplane CG.

AIRPLANE JACKING

Refer to Chapter 7 of the Aircraft Maintenance Manual for airplane jacking procedures.

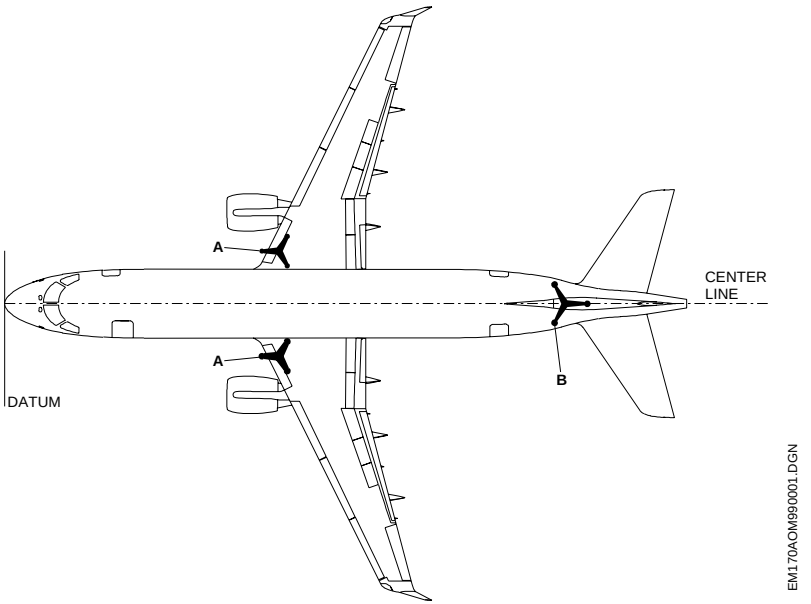
JACK POINTS LOCATION

POINT	BALANCE ARM (meters)	CENTERLINE DISTANCE (meters)
A	14.857	2.326

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POINT	BALANCE ARM (meters)	CENTERLINE DISTANCE (meters)
B	30.480	0

NOTE: The jack points balance arms refer to the Airplane Datum.



JACK POINTS

MISCELANNEOUS FLUIDS

FLUID	WEIGHT (kg)	BALANCE ARM (m)
ENGINE OIL [1]	32	14.002
APU OIL [1]	3.7	34.304

1. Engine oil density used (ref. MIL-L-7808): 0.98 kg/l. Engine oil is the oil from engine, integrated driven generator (IDG), oil lines and starter.

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FLUID	WEIGHT (kg)	BALANCE ARM (m)
HYDRAULIC [1]	54	16.709
WASTE TANK FLUID	8	29.632
POTABLE WATER [2]	110	28.437

1. Hydraulic fluid density used (ref. SAE AS 1241A TYPE IV): 0.99 kg/l.
2. Potable water is kept in a potable water tank. Tank capacity may vary between 35, 70, 90, and 110 liters.

BAGGAGE LOADING

BAGGAGE WEIGHT AND LOCATION

The baggage weight limits, location and the respective balance arm may be obtained from the applicable interior arrangement.

The data shown enclosed are applicable to the airplane's Standard Configuration. For other interior configuration options, the weight limits, location and the respective balance arm are supplied together with the "Airplane Weighing Form", inserted in the "FINAL INSPECTION REPORT".

CARRY-ON BAGGAGE

Carry-on volumes may be stowed in the overhead bins and in the wardrobe closet. There is no specific requirement for underseat carry-on volumes; however a maximum of 9.0 kg/20.0 lb is allowable, provided the volume is properly restrained to avoid sliding.

BAGGAGE COMPARTMENT

Whenever possible, baggage should be distributed between both compartments, taking into account CG position.

The baggage should be evenly distributed in each compartment to avoid load concentration.

Baggage/Cargo must not become a hazard to the airplane structure or systems as a result of shifting under operational loads. Therefore, sharp edge volumes (like wooden or metal containers) and/or dense cargo (objects significantly more dense than typical passenger baggage) must be arranged with adjacent soft volumes or protections thus preventing aircraft damage in case of baggage/cargo shifting due to operational

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loads. Regular baggage/volumes must be evenly distributed to prevent large displacements (length greater than one cargo compartment section) inside the baggage compartments.

The use of vertical cargo nets is not required. In case of total or partial use of vertical nets in the forward or aft cargo compartments, maximum cargo compartment section weights must be observed. These weights must be observed even when the vertical cargo nets are not installed.

BAGGAGE LOADING PROCEDURES

For the EMBRAER 190 airplanes, the aft tipping limit is at 56.0% CG, which corresponds to the CG of the main landing gear wheel axle position measured from airplane datum. From CG positions greater than this, tipping is expected.

In order to maintain a minimum recommended static margin of 5% (difference between the aft tipping limit and the airplane CG), the maximum difference between the load in the aft and the forward cargo compartments must be 900 kg/1984 lb. In other words, the aft cargo compartment must not be 900 kg/1984 lb heavier than the forward compartment - loading and unloading procedures.

Also, the forward cargo compartment should be loaded before the aft cargo compartment, while the aft cargo compartment should be unloaded before the forward cargo compartment.

FUEL DATA

FUEL QUANTITIES

FUEL CATEGORY	VOLUME (liters)	WEIGHT (kg)	CG BALANCE ARM (m)
UNUSABLE UNDRAINABLE	15.4	12.5	16.314
UNUSABLE DRAINABLE	98.0	79.5	16.554
TOTAL UNUSABLE	113.4	92.0	16.521
USABLE	16153	13100	16.378

The values specified above have been determined for an adopted fuel density of 0.811 kg/ℓ.

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PASSENGERS

PASSENGER LOCATION

The passenger location and respective balance arm are shown in the applicable interior arrangement.

PASSENGER WEIGHT

According to AC 120-27E, the standard average passenger weights include 5 pounds (2.3 kg) for summer clothing, 10 pounds (4.5 kg) for winter clothing and a 16 pounds (7.3 kg) allowance for personal and carry-on bags.

Where no genger is given, the standard average passenger weights are based on the assumption that 50 percent of passengers are male and 50 percent of passengers are female.

An operator that chooses to use standard average weights for checked bags should use a standard averageweight of at least 30 pounds (13.6 kg).

	Summer Operation	Winter Operation
Adult Passenger	190 lb (86 kg)	195 lb (88 kg)
Male	200 lb (91 kg)	205 lb (93 kg)
Female	179 lb (81 kg)	184 lb (83 kg)
Children (age 2-12)	82 lb (37 kg)	87 lb (39 kg)

Chindren under age of 2 has been factored into the standard average and segmented adult passenger weights. Children 13 years or older should be treated as adult passengers for purposes of standard average weights.

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FLIGHT CREW ITEMS

FLIGHT CREW ITEMS WEIGHT AND BALANCE ARM

ITEM	WEIGHT (kg)	BALANCE ARM (m)
CAPTAIN [1]	87	2.810
FIRST OFFICER [1]	87	2.810
OBSERVER [1]	87	3.500
FWD ATTENDANT [1]	82	4.940
1st AFT ATTENDANT [1]	82	28.187
2nd AFT ATTENDANT [1]	82	27.639
CREW BAGGAGE (wardrobe)	15	6.147
NAVIGATION KIT	10	3.520

1. Occupant balance arm.

NOTE: – The adopted flight crew items are in accordance with the approved average weight, not including the respective carryon baggage.
– The crew members and attendants weights presented herein refer to male. For female crew members, a weight equal to 73 kg may be adopted.
– Crew baggage location is considered inside the wardrobe.
– 2nd Aft Attendant seat is optional. Check the airplane actual internal configuration.

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INDEX SYSTEM

Moment, per definition, is weight multiplied by the distance to a reference point. If the moment of the airplane and of the items loaded on it is computed in reference to the aircraft datum, very long numeric expressions would result.

As the operational usage of long numeric expressions may result in safety problems (since personnel may get confused with the long numbers), airlines usually adopt an Index System for weight and balance purposes.

The Index System is just a convention for presenting airplane or body moments on a different measuring system. When using the Index System, short numeric expressions result.

The Index System formula is presented below:

$$I = \frac{Wx(Arm-A)}{B} + C$$

where:

- I = Index.
- W = Aircraft or body weight
- Arm = Arm or body center of gravity.
- A = Reference arm. Selected arm around which all index values are calculated. On the balance chart CG envelope, the reference arm CG% line is the only vertical CG% line. [1]
- B = Constant used as a denominator to convert moment values into index values. On the balance chart CG envelope, B controls the CG% lines splay (splay decreases with increasing B). [1]
- C = Constant used as a plus value to avoid negative index figures. It is only used when computing the aircraft operating empty weight Index (OEI), and is not used when computing individual bodies index influence. On the balance chart CG envelope, the reference arm CG% vertical line is at C index units. [1]

1. Values for A, B and C may be chosen at the operator discretion.

Embraer recommended Index System Formulas is:

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$$I = \frac{Wx(Arm-16.7)}{500} + 65$$

INDEX INFLUENCE

Index influence is the variation of index when a body is loaded or unloaded from the airplane. It is usually referred in index units per mass units for variable weight bodies (cargo, catering, etc.), index units per passenger when computing passenger influence or index units for fixed weight bodies (flight attendant, cockpit observer, etc.).

The following tables show the index influence for various items:

INDEX INFLUENCE

Item	Arm (m)	Reference Weight (kg)	Index Influence
Forward cargo	8.912	1	-0.0156 IU/kg
Aft cargo	24.002	1	0.0146 IU/kg
Forward Galley G1	3.960	1	-0.0255 IU/kg
Forward Galley G2	5.600	1	-0.0222 IU/kg
Aft Galley G3	28.640	1	+0.0239 IU/kg
Wardrobe	6.147	1	-0.0211 IU/kg
Fwd Flight Attendant	4.94	82	-1.9286 IU
1st Aft Flight Attendant	28.187	82	1.8552 IU
2nd Aft Flight Attendant	27.679	82	1.7940 IU
Cockpit Observer	3.500	87	-2.2968 IU

NOTE: – The galley, wardrobe and cargo compartment arms are for the standard configuration. Check the airplane actual configuration arms in AOM Loading Section.

– 2nd Aft Flight Attendant seat is an optional item. Check airplane actual configuration arms on AOMLoading Section

Example: Computation of cargo index influence for the EMBRAER 190.
The EMBRAER 190 forward cargo compartment centroid is located 8.912 m from the airplane datum.
The index influence per kg is:

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$$I = \frac{1x\ (8.912 - 16.7)}{500} = -0.0156 \quad IU$$

So, for each kg of cargo loaded in the cargo compartment, the index decreases by 0.0156 index units.

FUEL INDEX VARIATION

EMBRAER 190 ALL MODELS

VOLUME (liters)	WEIGHT (kg)	ARM (meters)	Index (IU)
200	162	16.119	-0.19
400	324	16.023	-0.44
600	487	15.962	-0.72
800	649	15.917	-1.02
1000	811	15.883	-1.33
1200	973	15.855	-1.64
1400	1135	15.834	-1.97
1600	1298	15.820	-2.28
1800	1460	15.808	-2.60
2000	1622	15.800	-2.92
2200	1784	15.795	-3.23
2400	1946	15.790	-3.54
2600	2109	15.787	-3.85
2800	2271	15.785	-4.16
3000	2433	15.784	-4.46
3200	2595	15.784	-4.75
3400	2757	15.783	-5.06
3600	2920	15.784	-5.35
3800	3082	15.785	-5.64
4000	3244	15.786	-5.93
4200	3406	15.788	-6.21
4400	3568	15.789	-6.50
4600	3731	15.791	-6.78
4800	3893	15.793	-7.06
5000	4055	15.796	-7.33

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VOLUME (liters)	WEIGHT (kg)	ARM (meters)	Index (IU)
5200	4217	15.798	-7.61
5400	4379	15.801	-7.87
5600	4542	15.804	-8.14
5800	4704	15.807	-8.40
6000	4866	15.810	-8.66
6200	5028	15.813	-8.92
6400	5190	15.816	-9.18
6600	5353	15.820	-9.42
6800	5515	15.823	-9.67
7000	5677	15.826	-9.92
7200	5839	15.829	-10.17
7400	6001	15.833	-10.41
7600	6164	15.836	-10.65
7800	6326	15.840	-10.88
8000	6488	15.844	-11.11
8200	6650	15.847	-11.35
8400	6812	15.851	-11.57
8600	6975	15.855	-11.79
8800	7137	15.858	-12.02
9000	7299	15.862	-12.23
9200	7461	15.866	-12.45
9400	7623	15.870	-12.65
9600	7786	15.874	-12.86
9800	7948	15.878	-13.07
10000	8110	15.882	-13.27
10200	8272	15.886	-13.47
10400	8434	15.890	-13.66
10600	8597	15.895	-13.84
10800	8759	15.900	-14.01
11000	8921	15.905	-14.18
11200	9083	15.910	-14.35
11400	9245	15.916	-14.50

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VOLUME (liters)	WEIGHT (kg)	ARM (meters)	Index (IU)
11600	9408	15.924	-14.60
11800	9570	15.935	-14.64
12000	9732	15.947	-14.66
12200	9894	15.960	-14.64
12400	10056	15.974	-14.60
12600	10219	15.988	-14.55
12800	10381	16.004	-14.45
13000	10543	16.021	-14.32
13200	10705	16.038	-14.17
13400	10867	16.056	-14.00
13600	11030	16.075	-13.79
13800	11192	16.095	-13.54
14000	11354	16.115	-13.28
14200	11516	16.137	-12.97
14400	11678	16.160	-12.61
14600	11841	16.183	-12.24
14800	12003	16.207	-11.83
15000	12165	16.232	-11.39
15200	12327	16.258	-10.90
15400	12489	16.285	-10.37
15600	12652	16.314	-9.77
15800	12814	16.343	-9.15
16000	12976	16.373	-8.49
16153	13100	16.378	-8.37

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OEW/OEI DETERMINATION

The OEW (Operational Empty Weight) is the BEW plus the weight of the operational items (crew, catering, lavatory fluid, etc.). The OEI (Operational Empty Index) is the index for the OEW.

In order to determine the OEW and OEI, it is necessary to add to the BEW all the weight and moment variations referent to the operational items. The BEW is obtained from the aircraft weighting record.

Example: Computation of OEW/OEI for the EMBRAER 190.

For a BEW equal 26118.10 kg and BEW moment equal 437791.592 kg.m:

Item	Weight (kg)	Arm (m)	Moment (kg.m)
BEW	27452	16.793	461001.436
Captain and First Officer	174.00	2.810	488.940
Fwd flight attendant	82.00	4.940	405.080
1st aft flight attendant	82.00	28.187	2311.334
2nd aft flight attendant	82.00	27.679	2269.678
Waste Tank Fluid	8.00	29.632	237.056
Potable Water	110.00	28.437	3128.070
Flight kit	10.00	3.200	32.000
Crew baggage	15.00	6.147	92.205
Catering galley G1	30.00	3.960	118.800
Catering galley G2	162.00	5.600	907.200
Catering galley G3	280.00	28.640	8019.200
OEW	**28207**	**16.982**	**479001.815**

NOTE: – BEW computation considers APU oil, engine oil, hydraulic fluid and unusable fuel.

– Potable water is stored in a potable water tank. Tank capacity may vary between 35, 70, 90 and 110 liters. The OEW calculated in this example takes into account potable water tank's maximum capacity.

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– Catering weight was considered above, but its weight is not constant. Use the airplane actual internal configuration for galleys location.
– The values above are an example. Use the airplane actual BEW for determining the OEW.

$$\text{Aircraft arm} = 479001.815/28207 = 16.982 \text{ m}$$

$$\text{Aircraft index} = \frac{28207 \cdot (16.982-16.7)}{500} + 65 = 81 \text{ IU}$$

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SECTION 8

LOADING

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INTRODUCTION

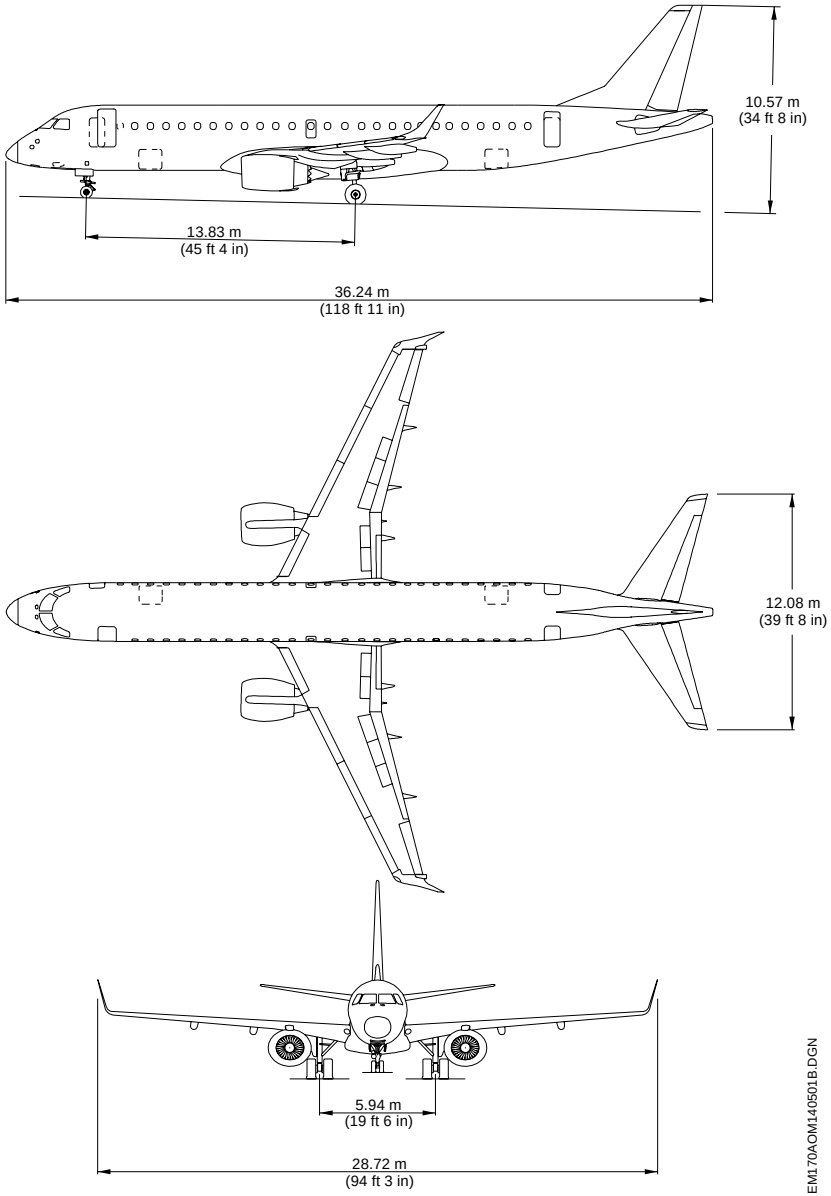
This Section contains airplane dimensions, interior arrangement data for loading purposes and loading capacity information in the passenger cabin and cargo compartment.

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EXTERNAL DIMENSIONS

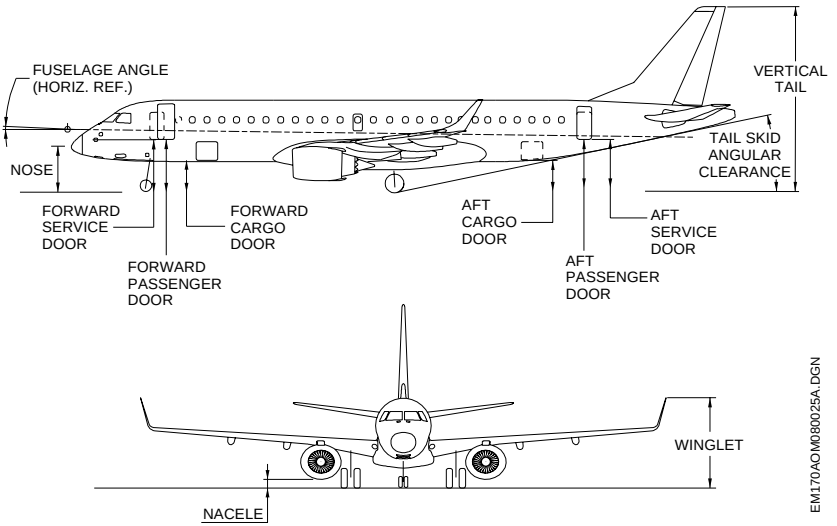


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GROUND CLEARANCES



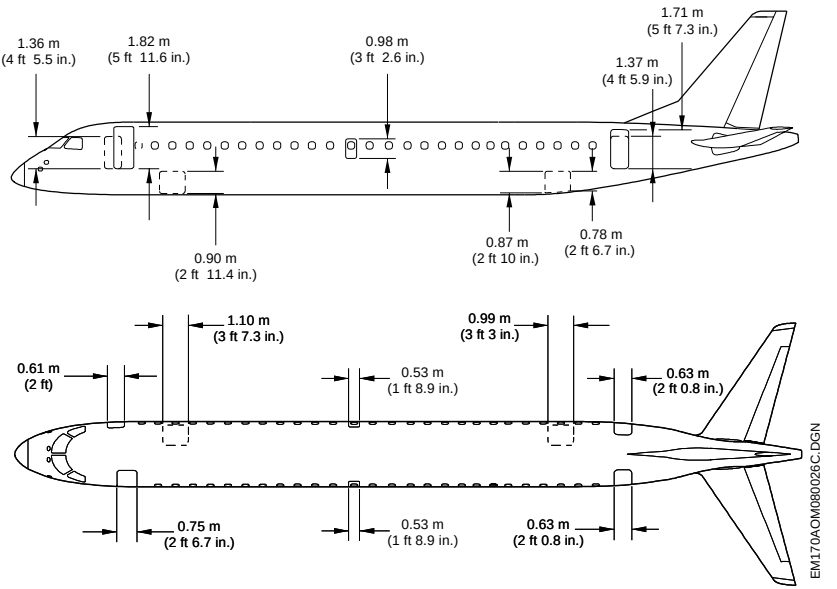
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VERTICAL GROUND CLEARANCES TABLE

VERTICAL CLEARANCE	MINIMUM	MAXIMUM
Aft Cargo Door	1.93 m (6 ft 4.1 in)	2.08 m (6 ft 10 in)
Aft Passenger Door	2.96 m (9 ft 8.7 in)	3.13 m (10 ft 3.3 in)
Aft Service Door	2.96 m (9 ft 8.7 in)	3.13 m (10 ft 3.3 in)
Forward Cargo Door	1.57 m (5 ft 1.8 in)	1.66 m (5 ft 5.4 in)
Forward Passenger Door	2.59 m (8 ft 5.9 in)	2.68 m (8 ft 7 in)
Forward Service Door	2.54 m (8 ft 4 in)	2.64 m (8 ft 9.7 in)
Fuselage Angle	-1.27°	-0.83°
Nacelle	0.48 m (1 ft 6 in)	0.57 m (1 ft 10 in)
Nose	2.05 m (6 ft 8.8 in)	2.16 m (7 ft 1.2 in)
Overwing Exit	3.23 m (10 ft 7.2 in	3.32 m (10 ft 10.7 in
Tailskid Angular Clearance	12.3°	13.2°
Vertical Tail	10.32 m (33 ft 10.4 in)	10.55 m (34 ft 7.2 in)
Winglet	5.05 m (16 ft 6.8 in)	5.18 m (17 ft 0.1 in)

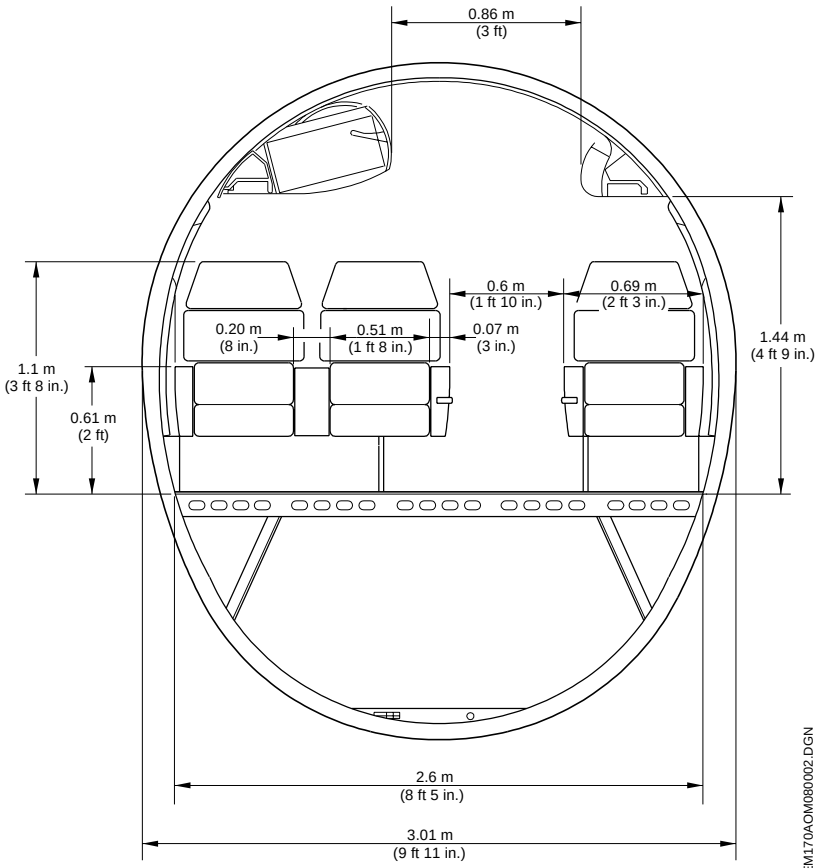
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DOOR CLEARANCES



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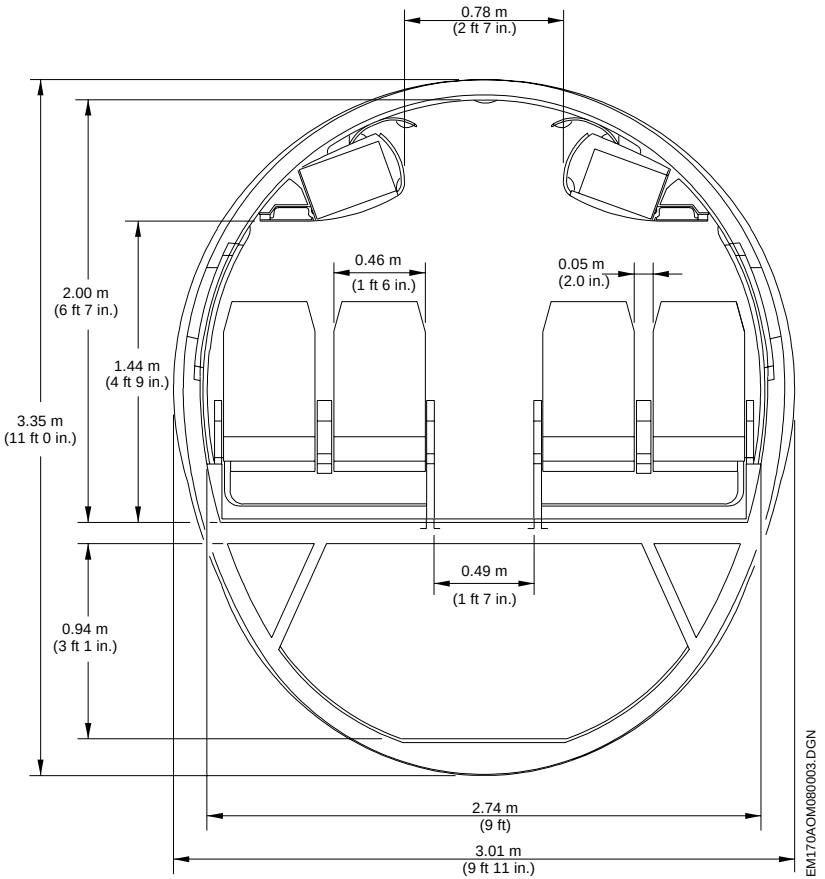
FIRST CLASS CROSS SECTION



FIRST CLASS CROSS SECTION DIMENSIONS

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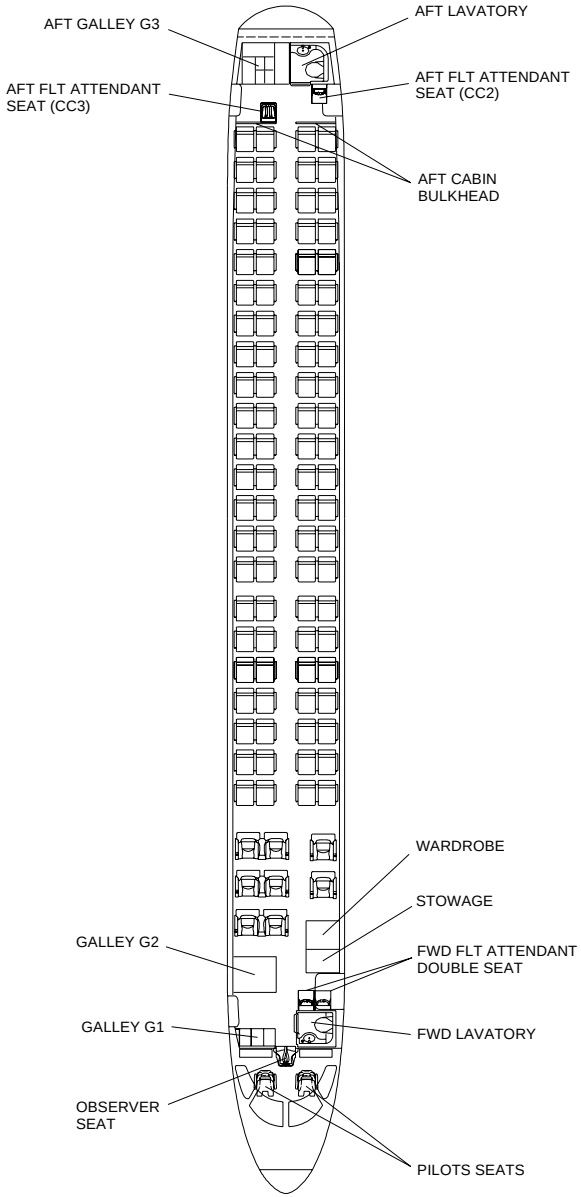
STANDARD CABIN CROSS SECTION



STANDARD CABIN CROSS SECTION DIMENSIONS

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INTERIOR ARRANGEMENTS



96 SEATS

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PASSENGER BALANCE ARM

SEATS ROW	PASSENGER SEATS	PAX BALANCE ARM	
		(m)	(in)
1	A1, D1, F1	6.892	271.3
2	A2, D2, F2	7.857	309.3
3	A3, C3, D3, F3	8.823	347.4
4	A4, C4, D4, F4	10.194	401.3
5	A5, C5, D5, F5	10.982	432.4
6	A6, C6, D6, F6	11.769	463.3
7	A7, C7, D7, F7	12.556	494.3
8	A8, C8, D8, F8	13.344	525.4
9	A9, C9, D9, F9	14.131	556.3
10	A10, C10, D10, F10	14.919	587.4
11	A11, C11, D11, F11	15.922	626.9
12	A12, C12, D12, F12	16.709	657.8
13	A13, C13, D13, F13	17.496	688.8
14	A14, C14, D14, F14	18.284	719.8
15	A15, C15, D15, F15	19.071	750.8
16	A16, C16, D16, F16	19.859	781.9
17	A17, C17, D17, F17	20.646	812.8
18	A18, C18, D18, F18	21.433	843.8
19	A19, C19, D19, F19	22.221	874.8
20	A20, C20, D20, F20	23.008	905.8
21	A21, C21, D21, F21	23.796	936.9
22	A22, C22, D22, F22	24.583	967.8
23	A23, C23, D23, F23	25.370	998.8

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FURNISHINGS AND EQUIPMENT BALANCE ARM

	Balance Arm	
	(m)	(in)
Galley G1	3.970	156.3
Galley G2	5.614	221.0
FWD Lavatory LH	4.220	166.1
FWD FLT Attendant Double Seat	4.940	194.5
Stowage LH	5.957	234.5
Observer Seat	3.500	137.8
Pilot Seat	2.810	110.6
Wardrobe LH	6.621	260.7
FWD Divider LH	9.440	371.7
FWD Divider RH	9.440	371.7
AFT Bulkhead RH	27.422	1079.6
AFT Bulkhead LH	27.422	1079.6
AFT FLT Attendant LH	28.187	1109.7
AFT Lavatory	28.947	1139.6
Galley G3	28.947	1139.6
AFT FLT Attendant RH	27.679	1089.7

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CARRY-ON BAGGAGE

Carry-on volumes may be stowed in the overhead bins and in the wardrobe.

There is no specific requirement for underseat carry-on volumes; however a maximum of 0.04 m^3 (1.4 ft^3) or 9.0 kg (20 lb) is allowable, provided the volume is properly restrained to avoid sliding.

OVERHEAD BINS

In a typical Economy Class, the overhead bins comprise of eight Economy Class Standard overhead bin assemblies, and one Economy Class Long and one Economy Class Short overhead bin assembly, on the both sides of the passenger cabin.

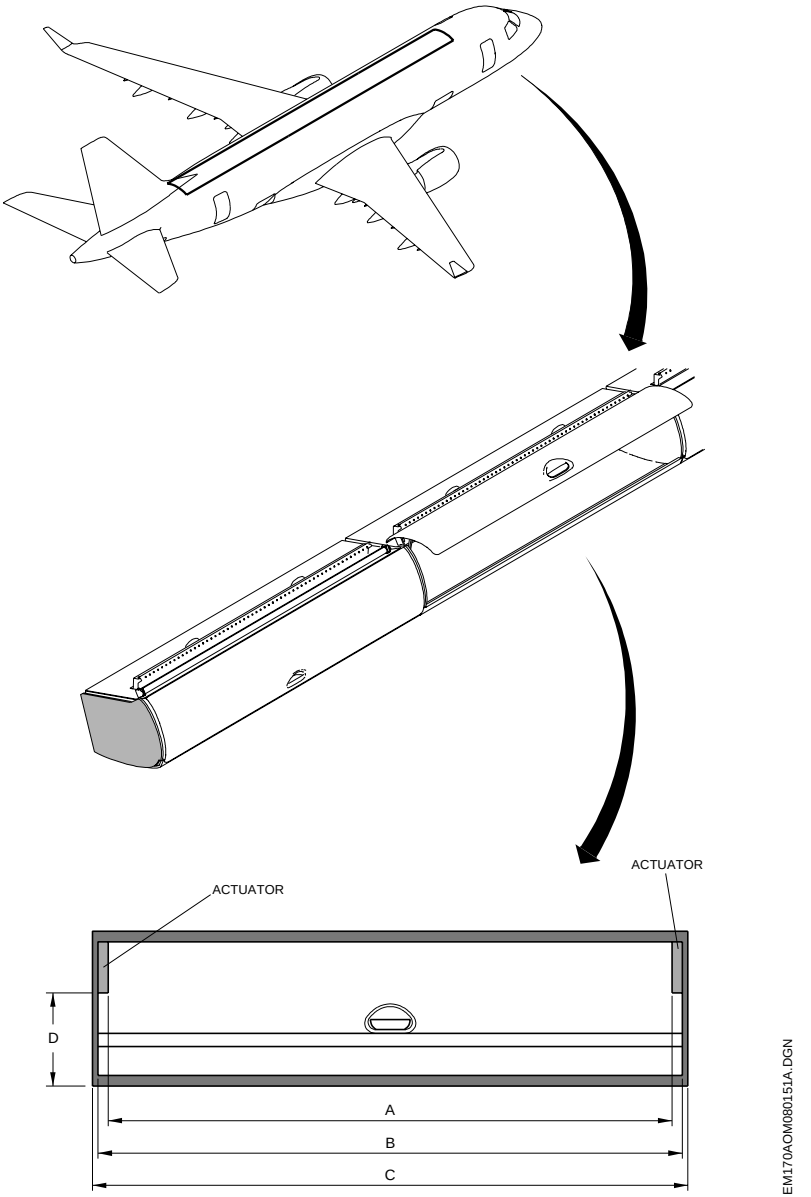
In a typical First Class, on the right side, the overhead bins comprise of one First Class Standard overhead bin assembly (in the middle position) and two Right First Class Short overhead bin assemblies; on the left side, the overhead bins comprise of one First Class Shallow overhead bin assembly (in the middle position) and two Left First Class Short overhead bin assemblies.

Overhead stowage compartments provide carry-on provisions for rollon bags (61 cm x 35.5 cm x 25.4 cm or 24 in x 14 in x 10 in size).

The average volume of overhead bins is 0.06 m^3 (2.12 ft^3) per passenger.

OVERHEAD BINS CAPACITY AND LENGTH

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OVERHEAD BIN SCHEMATIC - FRONT VIEW

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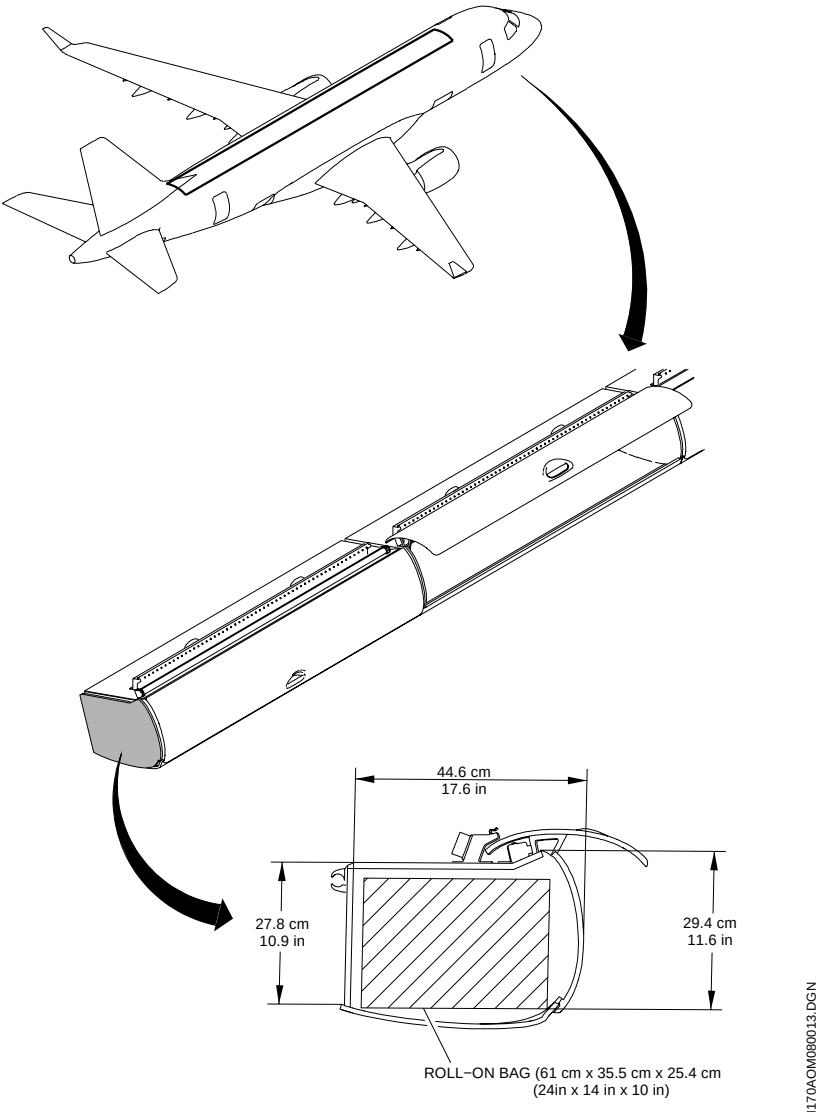
OVERHEAD BINS: STANDARD CABIN

Capacity and Dimensions	Standard Overhead Bin	Long Overhead Bin
A	151.3 cm (60 in)	154.9 cm (61 in)
B	157.0 cm (62 in)	160.4 cm (63 in)
C	160.6 cm (63 in)	164.3 cm (65 in)
D	22.8 cm (9 in)	22.8 cm (9 in)
Capacity	36.3 kg (80 lb)	36.3 kg (80 lb)

OVERHEAD BINS: FIRST CLASS

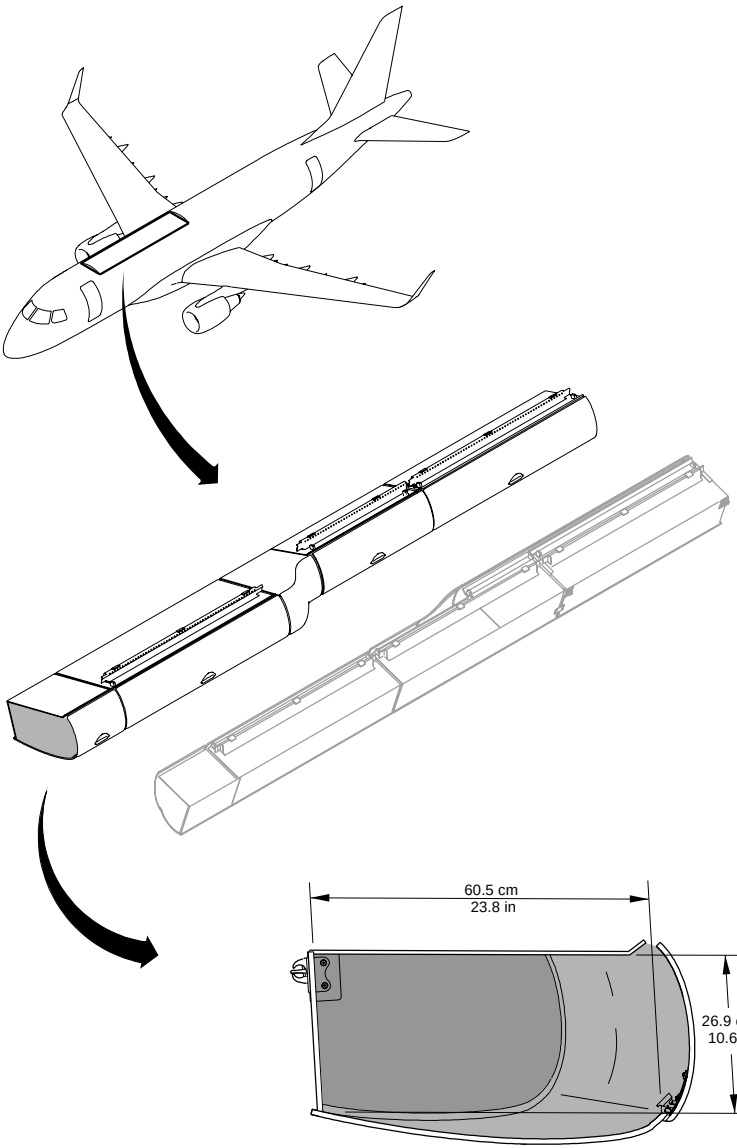
Capacity and Dimensions	Standard Overhead Bin	Shallow Bin
A	151.3 cm (60 in)	151.3 cm (60 in)
B	157.0 cm (62 in)	157.0 cm (62 in)
C	160.6 cm (63 in)	160.6 cm (63 in)
D	22.8 cm (9 in)	22.8 cm (9 in)
Capacity	54.4 kg (120 lb)	18.1 kg (40 lb)

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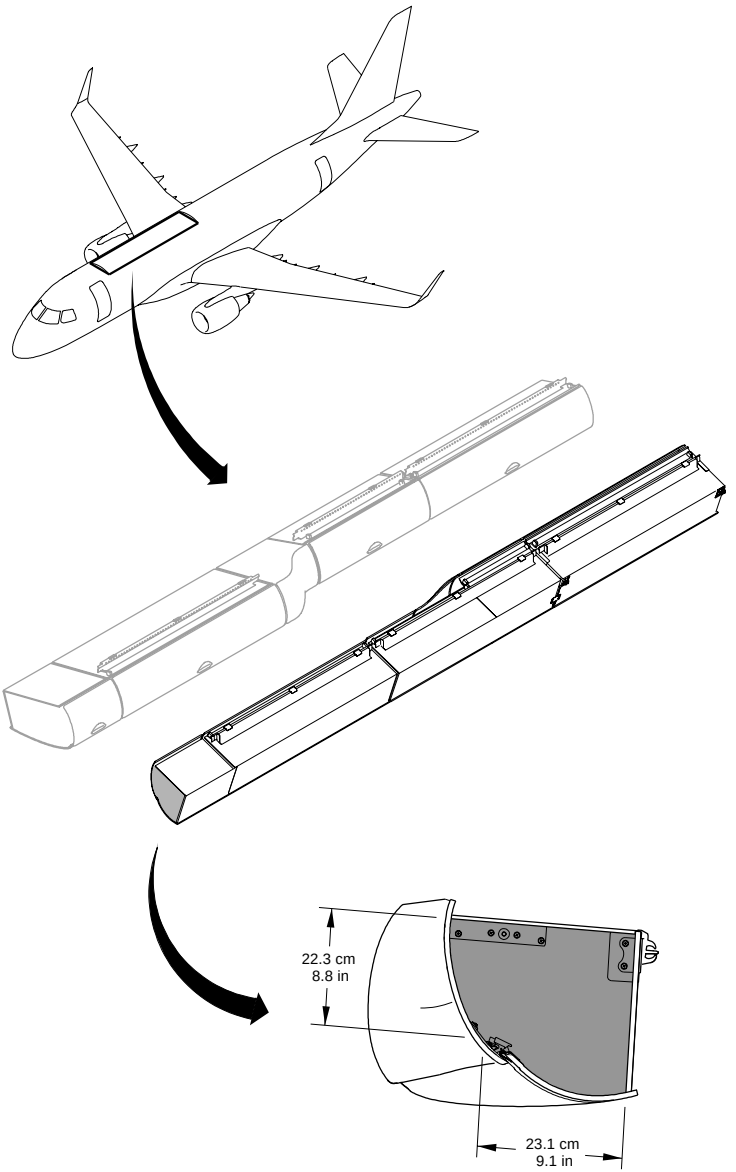
OVERHEAD BINS

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RIGHT FIRST CLASS OVERHEAD BINS

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LEFT FIRST CLASS SHALLOW BINS

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CARGO DOORS

The cargo doors are manually operated from the outside. The initial opening movement (displacement of the door inward) and final closing and latching movement (displacement of the door outward) are achieved by means of a door locking mechanism controlled by an external handle.

Two actuators are installed in each cargo door to give assistance in door opening and closing movements. So, the door operator must support the door weight by using the rod during all opening and closing movements.

The forward cargo door is 1.10 m (3 ft 7.3 in) wide and 0.90 m (2 ft 11.4 in) high.

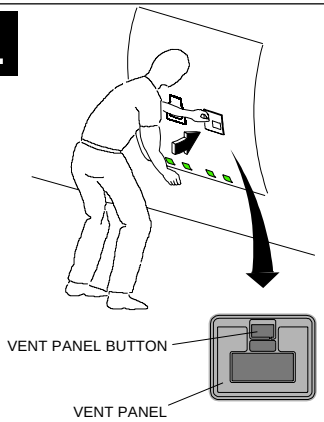
The aft cargo door is a trapezoid 0.99 m (3 ft 3 in) wide and with minor high of 0.78 m (2 ft 6.7 in) and major high of 0.87 m (2 ft 10 in).

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CARGO DOOR OPENING

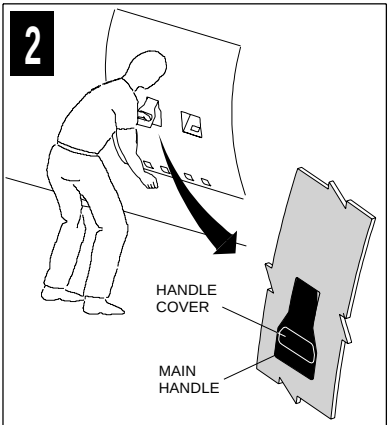
TO OPEN:

1



PUSH DOWN THE VENT PANEL BUTTON.
PUSH IN THE VENT PANEL.

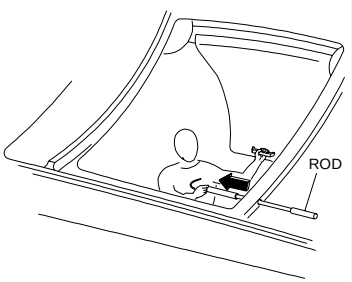
2



PUSH IN THE MAIN DOOR HANDLE COVER.
PULL THE MAIN DOOR HANDLE FULLY UP TO RELEASE THE DOOR.

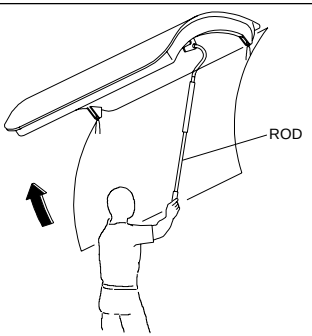
3

VIEWED FROM INSIDE CARGO COMPARTMENT



OPEN AND HOLD THE DOOR.
REMOVE ROD FROM STOWAGE.

4



ENGAGE THE ROD TO DOOR'S ROD ATTACHMENT AND LIFT DOOR TO FULLY OPEN POSITION WITH ASSISTANCE OF ROD.
CHECK IF DOOR IS LOCKED IN FULLY OPEN POSITION.
STOW THE ROD.

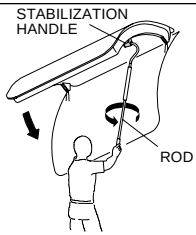
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CARGO DOOR CLOSING

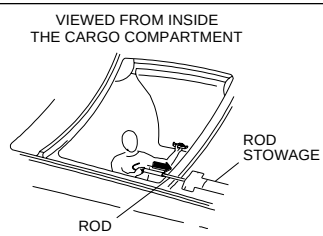
TO CLOSE:

1



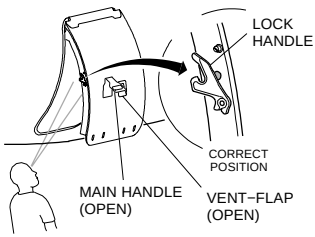
REMOVE THE ROD FROM THE STOWAGE.
ENGAGE THE ROD TO THE DOOR'S ROD ATTACHMENT (HANDLE), AND WHILE PUSHING IT UP, TURN IT CLOCKWISE.

2



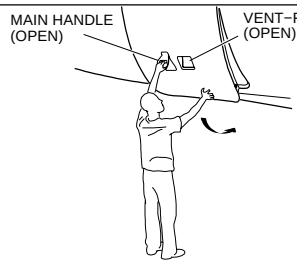
PULL THE DOOR DOWN WITH THE ROD AND GRASP THE INTERNAL HANDLE.
REMOVE THE ROD FROM THE DOOR AND PUT IT INTO THE CARGO COMPARTMENT STOWAGE.

3



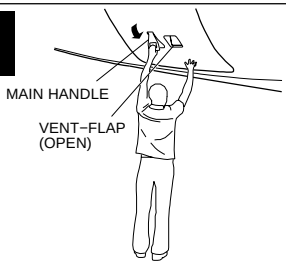
MAKE SURE THAT LOCK HANDLE IS IN THE OPEN POSITION (DOWN) BEFORE CLOSING THE DOOR.

4



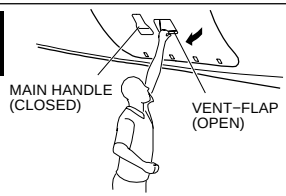
MOVE THE DOOR DOWN AND INTO THE FUSELAGE.

5



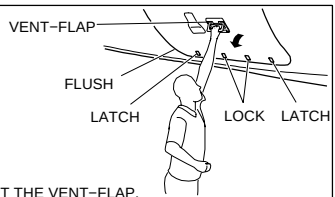
PUSH THE DOOR MAIN HANDLE FULLY DOWN.

6



CHECK IF THE DOOR IS LATCHED.
GRAB THE DOOR BY VENT−FLAP APERTURE AND PULL THE DOOR. IF THE DOOR MOVES, LIFT THE MAIN HANDLE AND LATCH THE DOOR AGAIN (STEP 5).

7



PULL OUT THE VENT−FLAP.
ENSURE THAT MAIN HANDLE AND VENT−FLAP ARE FLUSH WITH THE DOOR.
ENSURE THAT DOOR IS CORRECTLY CLOSED (FLUSH WITH FUSELAGE).
CHECK LOCK AND LATCH GREEN INDICATIONS.

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CARGO COMPARTMENT

Cargo compartments are located in the forward and rear part of the fuselage.

Both cargo compartments are pressurized. They are “class-C” compartments and have the following systems installed:

- Smoke Detection System.
- Fire Extinguishing System.

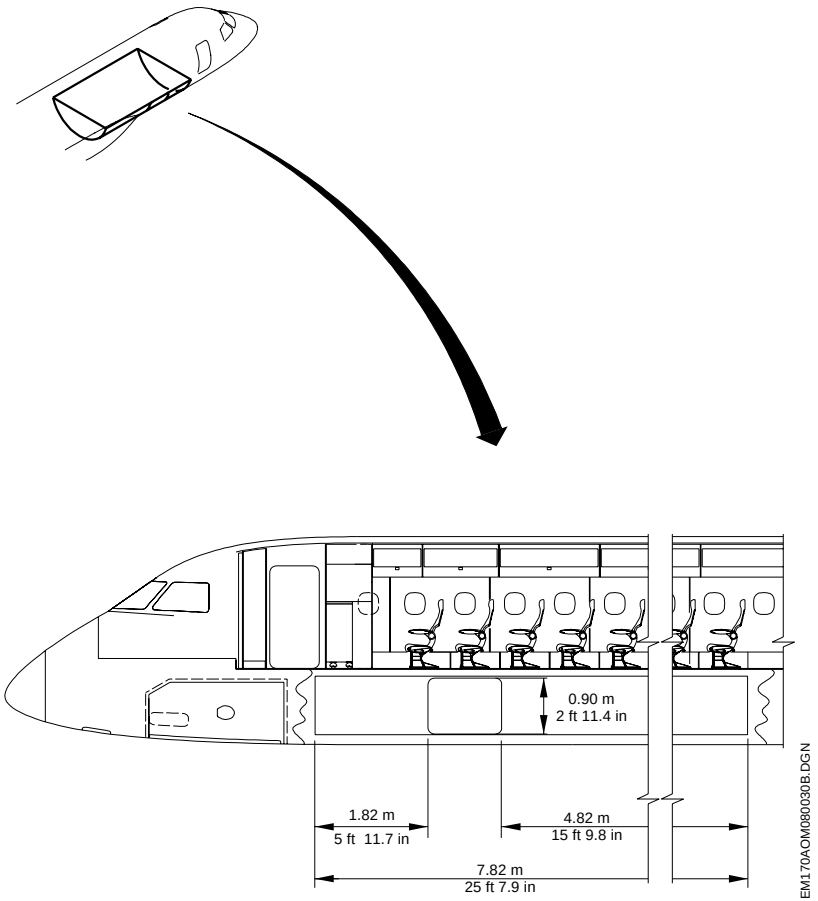
No dedicated temperature control is available for cargo compartments.

The following cargo nets may be installed in the cargo compartment:

- Doors Safety Nets.
- Cargo Barrier Net (vertical net).

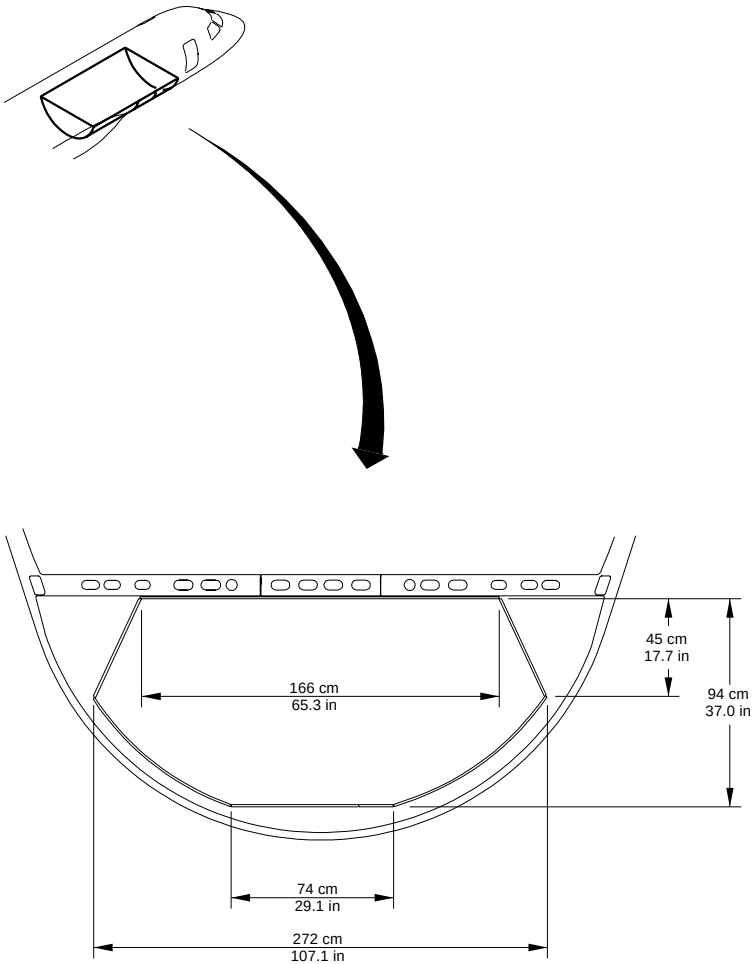
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DIMENSIONS AND LIMITS



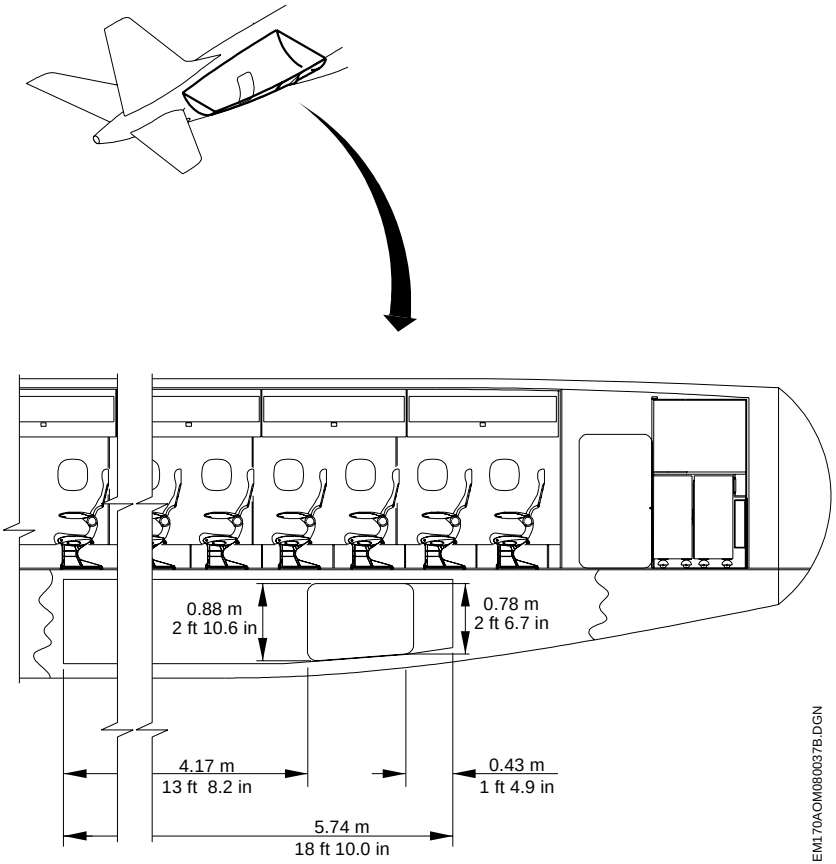
FORWARD CARGO COMPARTMENT

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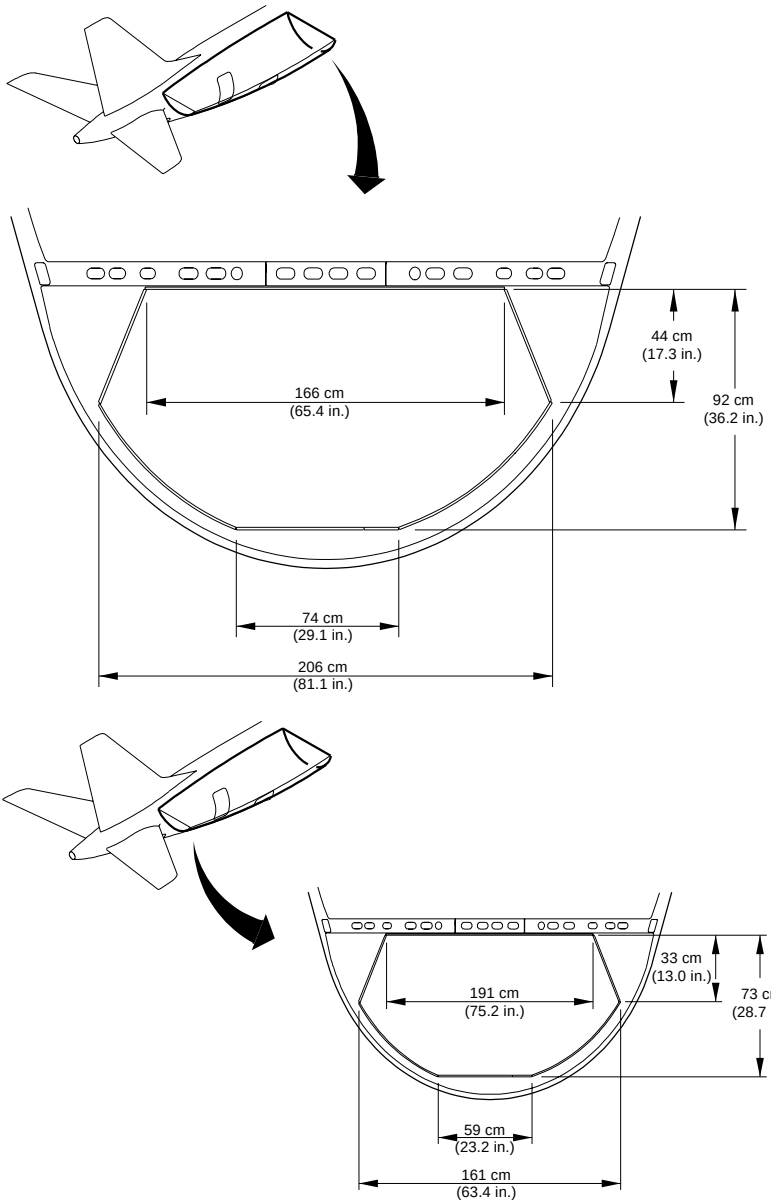
FORWARD CARGO COMPARTMENT CROSS SECTION

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AFT CARGO COMPARTMENT

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AFT CARGO COMPARTMENT CROSS SECTION

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CARGO COMPARTMENT BALANCE ARM

FORWARD	8.912 m (350.87 in)
AFT	22.806 m (897.87 in)

FORWARD CARGO COMPARTMENT LIMITS

Cargo Compartment Available Volume (usable)	10.83 m^3	382.50 ft^3
Maximum Floor Distributed Load	488 kg/m^2	100 lb/ft^2
Total Maximum Capacity	1850 kg	4079 lb

AFT CARGO COMPARTMENT LIMITS

Cargo Compartment Available Volume (usable)	7.64 m^3	269.80 ft^3
Maximum Floor Distributed Load	488 kg/m^2	100 lb/ft^2
Total Maximum Capacity	1440 kg	3175 lb

BAGGAGE AND CARGO LOADING

Baggage and cargo should be evenly distributed over the cargo compartment to avoid load concentration.

Baggage/Cargo must not become a hazard to the airplane structure or systems as a result of shifting under operational loads. Therefore, sharp edge volumes (like wooden or metal containers) and/or dense cargo (objects significantly more dense than typical passenger baggage) must be arranged with adjacent soft volumes or protections thus preventing airplane damage in case of baggage/cargo shifting due to operational loads.

To ensure proper operation of the smoke detection and fire suppression systems under all operating conditions, a placard, located on the inside sidewall panel of the cargo compartment, clearly visible when the cargo door is opened, is installed in the compartment to restrict cargo from being loaded to within 2 inches (51 mm) of the cargo compartment ceiling. Cargo loaded up to the ceiling may cause a baffle effect and prevent dispersion of smoke in the compartment, resulting in delays in detection time. The proper dispersion of fire suppression agent in the compartment may also be affected if the cargo is installed in such a manner that it blocks the area surrounding the protection cage of the suppression nozzle.

To load the baggage compartment, the forward cargo compartment

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should be loaded before the aft cargo compartment, while the aft cargo compartment should begin to be unloaded before the forward cargo compartment, in order to avoid airplane taildown.

PACKAGE SIZE TABLES

The tables below show the maximum package dimensions which pass through the cargo compartments doors without interference with airplane fuselage or cargo compartments interior.

Enter the package width and height and read the maximum package length that can be stowed in the cargo compartment.

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FORWARD CARGO COMPARTMENT

MAXIMUM PACKAGE SIZE

	WIDTH in (cm)							
	5.00 (12.70)	**10.00 (25.40)**	**15.00 (38.10)**	**20.00 (50.80)**	**25.00 (63.50)**	**30.00 (76.20)**	**35.00 (88.90)**	**40.00 (101.60)**
HEIGHT in (cm)	**MAXIMUM PACKAGE LENGTH in (cm)**							
5.00 (12.70)	224.41 (570.00)	224.41 (570.00)	144.09 (366.00)	122.44 (311.00)	110.24 (280.00)	106.30 (270.00)	86.61 (220.00)	78.74 (200.00)
8.00 (20.32)	203.15 (516.00)	178.35 (453.00)	139.37 (354.00)	114.17 (290.00)	110.24 (280.00)	94.49 (240.00)	86.61 (220.00)	78.74 (200.00)
10.00 (25.40)	200.79 (510.00)	176.38 (448.00)	137.01 (348.00)	114.17 (290.00)	102.36 (260.00)	90.55 (230.00)	78.74 (200.00)	66.93 (170.00)
13.00 (33.02)	198.82 (505.00)	163.78 (416.00)	133.86 (340.00)	110.24 (280.00)	102.36 (260.00)	90.55 (230.00)	78.74 (200.00)	66.93 (170.00)
16.00 (40.64)	196.85 (500.00)	161.42 (410.00)	122.05 (310.00)	110.24 (280.00)	94.49 (240.00)	82.68 (210.00)	74.80 (190.00)	62.99 (160.00)
19.00 (48.26)	194.88 (495.00)	157.48 (400.00)	122.05 (310.00)	106.30 (270.00)	94.49 (240.00)	82.68 (210.00)	66.93 (170.00)	59.06 (150.00)
22.00 (55.88)	190.16 (483.00)	155.91 (396.00)	115.75 (294.00)	84.65 (215.00)	70.87 (180.00)	66.93 (170.00)	59.06 (150.00)	51.18 (130.00)
25.00 (63.50)	135.43 (344.00)	100.79 (256.00)	87.01 (221.00)	70.87 (180.00)	66.93 (170.00)	59.06 (150.00)	51.18 (130.00)	51.18 (130.00)
28.00 (71.12)	118.90 (302.00)	98.43 (250.00)	84.65 (215.00)	59.06 (150.00)	55.12 (140.00)	55.12 (140.00)	51.18 (130.00)	47.24 (120.00)

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AFT CARGO COMPARTMENT

MAXIMUM PACKAGE SIZE

	WIDTH in (cm)							
	5.00 (12.70)	**10.00 (25.40)**	**15.00 (38.10)**	**20.00 (50.80)**	**25.00 (63.50)**	**30.00 (76.20)**	**35.00 (88.90)**	**40.00 (101.60)**
HEIGHT in (cm)	**MAXIMUM PACKAGE LENGTH in (cm)**							
5.00 (12.70)	185.04 (470.00)	177.17 (450.00)	165.35 (420.00)	149.61 (380.00)	137.80 (350.00)	118.11 (300.00)	98.43 (250.00)	82.68 (210.00)
8.00 (20.32)	185.04 (470.00)	149.61 (380.00)	133.86 (340.00)	110.24 (280.00)	98.43 (250.00)	90.55 (230.00)	74.80 (190.00)	66.93 (170.00)
10.00 (25.40)	185.04 (470.00)	141.73 (360.00)	125.98 (320.00)	102.36 (260.00)	90.55 (230.00)	82.68 (210.00)	66.93 (170.00)	59.06 (150.00)
13.00 (33.02)	181.10 (460.00)	137.80 (350.00)	114.17 (290.00)	98.43 (250.00)	82.68 (210.00)	78.74 (200.00)	66.93 (170.00)	59.06 (150.00)
16.00 (40.64)	177.17 (450.00)	133.86 (340.00)	110.24 (280.00)	94.49 (240.00)	82.68 (210.00)	78.74 (200.00)	61.02 (155.00)	57.09 (145.00)
19.00 (48.26)	177.17 (450.00)	133.86 (340.00)	110.24 (280.00)	92.52 (235.00)	78.74 (200.00)	76.77 (195.00)	59.06 (150.00)	57.09 (145.00)
22.00 (55.88)	157.48 (400.00)	133.86 (340.00)	106.30 (270.00)	90.55 (230.00)	78.74 (200.00)	76.77 (195.00)	57.09 (145.00)	57.09 (145.00)

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CARGO NETS

Cargo door nets prevent cargo doors from being damaged or jammed.

Attachments in the forward and aft cargo compartments allow the installation of optional vertical cargo nets. The vertical cargo nets prevent the luggage shifting and optimizes the loading.

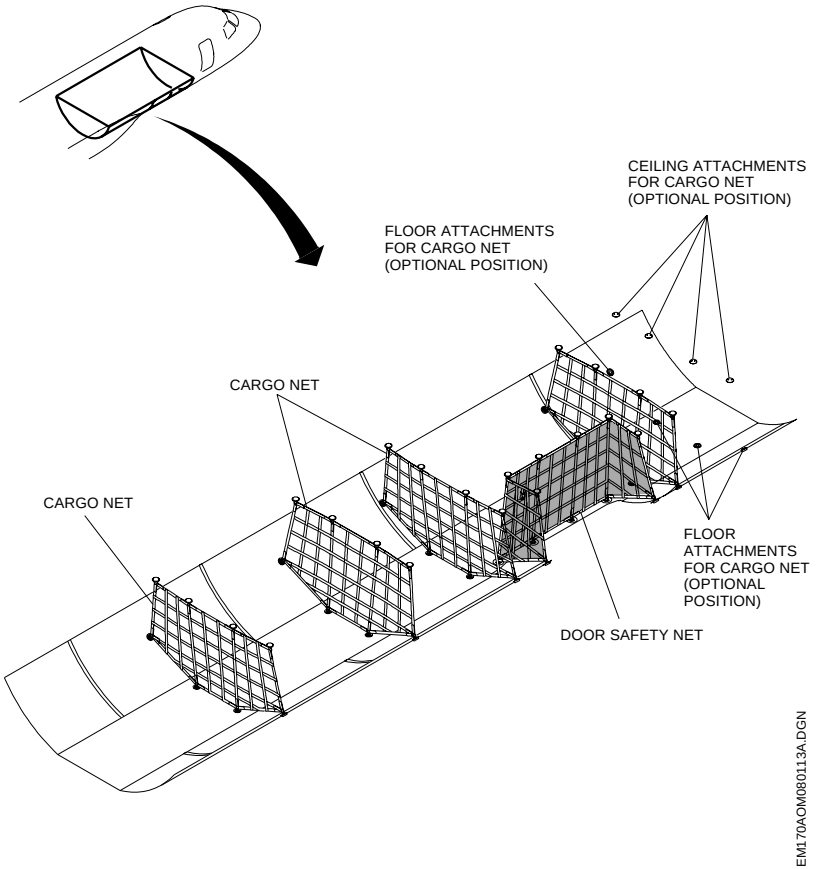
The use of vertical cargo nets is not required. In case of total or partial use of vertical nets in the forward or aft cargo compartments, maximum cargo compartment section weights must be observed. These weights must be observed even when the vertical cargo nets are not installed.

Decals on the net assembly indicate orientation (FWD, AFT, UP, or RIGHT/LEFT).

Positioning of Cargo Compartment Divisions and Vertical Cargo Nets Attachments - m (ft) - in transversal way, are shown in the table below.

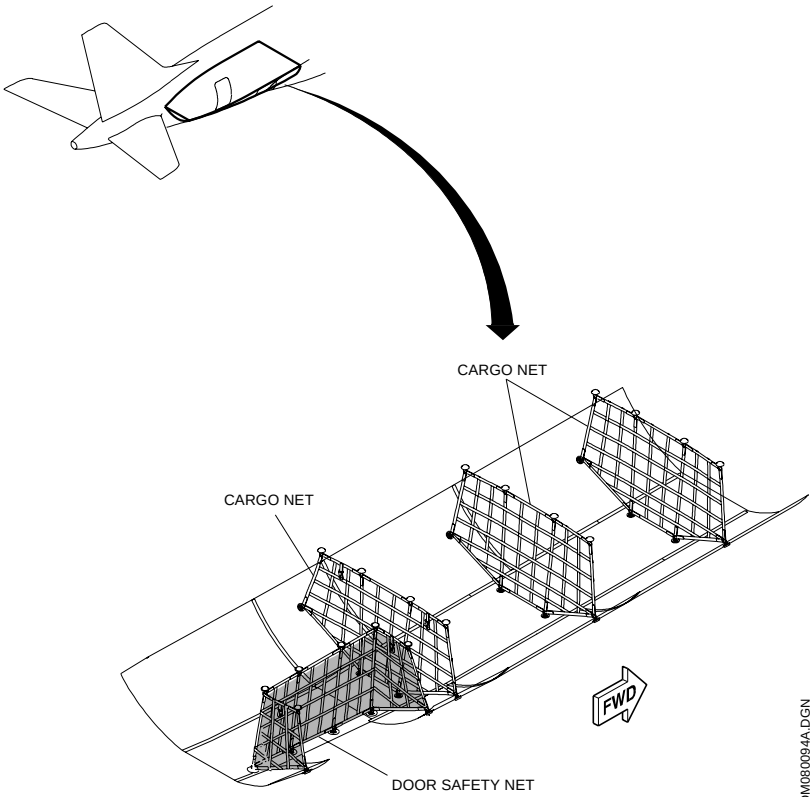
	FORWARD	AFT
Forward Bulkhead Position	5.00 m (16.40 ft)	20.40 m (66.94 ft)
1st Vertical Net Attachment Position	5.64 m (18.50 ft)	21.10 m (69.23 ft)
2nd Vertical Net Attachment Position	6.37 m (20.90 ft)	22.56 m (74.01 ft)
3rd Vertical Net Attachment Position	8.45 m (27.72 ft)	24.17 m (79.29 ft)
4th Vertical Net Attachment Position	9.59 m (31.46 ft)	NA
5th Vertical Net Attachment Position	11.30 m (37.07 ft)	NA
Aft Bulkhead Position	12.83 m (42.09 ft)	26.17 m (85.85 ft)

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FORWARD CARGO COMPARTMENT

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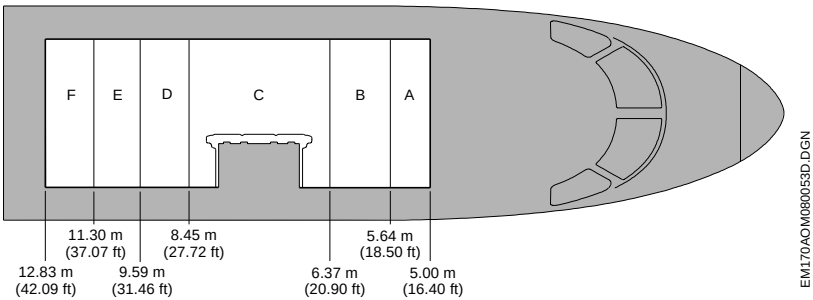


AFT CARGO COMPARTMENT

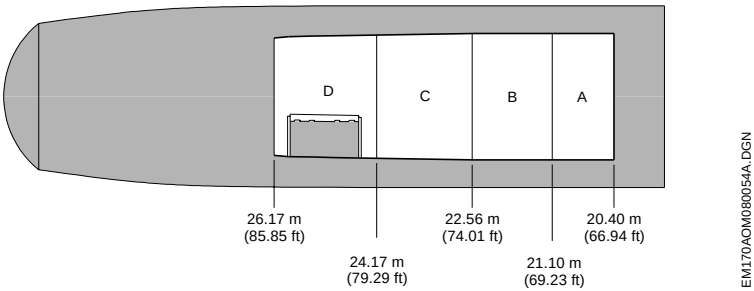
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VERTICAL NETS AND SECTION LOADING DISTRIBUTION

Each vertical net attachment position divides the cargo compartment in different cargo compartment sections as depicted below:



FORWARD COMPARTMENT



AFT COMPARTMENT

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MAXIMUM CARGO COMPARTMENT WEIGHTS

The table below details the maximum cargo compartment weights allowable for each section:

COMPARTMENT	MAXIMUM COMPARTMENT WEIGHT	MAXIMUM SECTION WEIGHT		MAXIMUM DISTRIBUTED LOAD
FORWARD	1850 kg/ 4079 lb	A	220 kg/ 485 lb	488 kg/m^2/ 100 lb/ft^2
		B	220 kg/ 485 lb	
		C	430 kg/ 948 lb	
		D	240 kg/ 529 lb	
		E	370 kg/ 816 lb	
		F	370 kg/ 816 lb	
AFT	1440 kg/ 3175 lb	A	260 kg/ 573 lb	
		B	445 kg/ 981 lb	
		C	395 kg/ 871 lb	
		D	340 kg/ 750 lb	

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MAXIMUM WEIGHTS ADJACENT TO VERTICAL NETS

Each vertical cargo net withstands a maximum adjacent weight according to the following table:

		MAXIMUM ALLOWABLE WEIGHT	
COMPARTMENT	**ATTACHMENT POSITION**	**FWD (⇒)**	**AFT (⇐)**
FORWARD	5.64 m (18.50 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
	6.37 m (20.90 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
	8.45 m (27.72 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
	9.59 m (31.46 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
	11.30 m (37.07 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
AFT	21.05 m (69.06 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
	22.51 m (73.85 ft)	456 kg/ 1005 lb	456 kg/ 1005 lb
	24.12 m (79.13 ft)	343 kg/ 756 lb	395 kg/ 871 lb

NOTE: – Maximum allowable FWD weight is the maximum cargo weight withstood by the vertical net considering a forward acceleration of the cargo located behind the net.

– Maximum allowable AFT weight is the maximum cargo weight withstood by the vertical net considering an aft acceleration of the cargo located in front of the net.

– Should the operator use the vertical nets in different positions or quantities than the ones described above, the limiting cargo weight should be the smaller value between the MAXIMUM WEIGHTS ADJACENT TO VERTICAL NETS and MAXIMUM CARGO COMPARTMENT WEIGHTS tables.

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DRY ICE TRANSPORTATION

This section presents the general conditions for dry ice (carbon solid dioxide) transportation in the forward cargo compartment. The aft cargo compartment does not have adequate ventilation to transport this kind of material.

The main reference that regulates and state methods and procedures to handling, appropriate packaging, legal aspects for dry ice transportation, etc. is the IATA Dangerous Goods Regulations.

GENERAL RECOMMENDATIONS

It is not recommended to transport dry ice in the cabin and in the galleys. If small quantities are present in the galley, it is required to compute this dry ice mass in the calculation of the total dry ice.

Prior to enter into the forward cargo compartment, in which a large amount of dry ice has been loaded, ensure that adequate ventilation is provided checking that the cargo ventilation system is running properly. If this condition is not met, avoid storing dry ice on airplanes for extended periods of time.

Similar precautions must be followed when entering any area, adjacent to a cargo compartment, loaded with dry ice. If adequate ventilation is not provided, it is recommended to wear oxygen mask and portable oxygen cylinder inside these areas. In addition, animals should not be transported on a forward cargo compartment loaded with dry ice.

Both air conditioning packs (or equivalent ground cart ventilation) shall be operating while persons are on board of an airplane transporting dry ice.

In case of failure of the cargo ventilation system during flight, the CO_2 sublimated in the cargo compartment may spread in the airplane, but the fresh air flow that comes from the packs dilutes the CO_2 concentration below 0.5% CO_2 in volume. The airplane can continue the flight normally, but after landing it is required to follow special procedures to ventilate the place in which CO_2 buildup is suspected.

Notify the flight crew whenever the amount of dry ice stowed in the cargo compartment exceeds 440 lb (200 kg), as recommended by the IATA Dangerous Goods Regulations.

In case of suspect of CO_2 leakage from forward cargo compartment, the crew may start Emergency Procedures. If large quantities of dry ice appear in the cabin, it is recommended to start an emergency descent to

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FL100 to allow activate the emergency ram air ventilation. It is also necessary to alert personnel for symptoms of excessive CO_2 gas concentrations when around dry ice.

LOAD LIMITATIONS

Significant concentration of gaseous CO_2 by sublimation of dry ice in airplanes may affect the breathing of passengers and crew. For this reason, it is necessary to establish dry ice carriage limits.

Dry ice sublimation rates may be affected by many factors, which include:

- Amount of insulation surrounding the dry ice;
- Type of container;
- Compartment ambient temperature;
- Amount of dry ice surface area;
- Cargo temperature being cooled by the dry ice.

Sublimation rates may be obtained from shippers or may be calculated from service experience by measuring the percentage of dry ice sublimated over time. Table 1 provides an example of sublimation rates and the values presented are used as reference only.

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Table 1 – SAMPLE SUBLIMATION RATES [1]		
Approximate Sublimation Rate	Characteristics Parameters	Ambient Compartment Temperature
1.0% per hour	FAA Advisory Circular AC 103-4	unknown
2.0% per hour [2]	Paper wrapped 50 pound block	0°F
2.3% per hour [2]	Paper wrapped 50 pound block	32°F
3.0% per hour [2]	Paper wrapped 50 pound block	75°F
---	Exposed 50 pound block	0°F
4.0% per hour [2]	Exposed 50 pound block	32°F
6.0% per hour [2]	Exposed 50 pound block	75°F
11.0% per hour [3]	Exposed 7 pound block	unknown

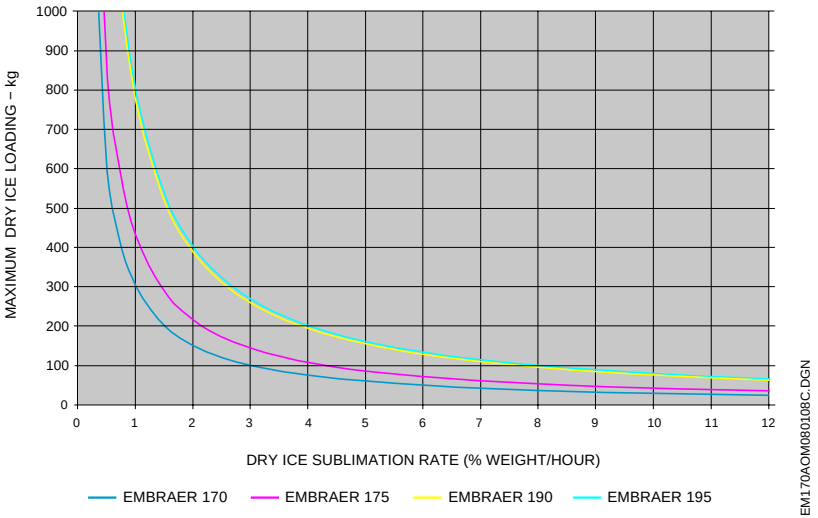
1. Sublimation rates are approximate and will vary widely depending on the compartment temperature, packaging, and form (snow, nuggets or blocks). Operators should independently determine their own sublimation rates by contacting the shipper or by determining the percentage of dry ice lost (sublimated) over a given amount of time.
2. Reference values obtained from a manufacturer of dry ice.
3. Reference values calculated by an operator.

The following graphics provide recommended maximum allowable dry ice carriage load based upon sublimation rates. In general, higher sublimation rates will reduce the amount of dry ice which may be carried.

The recommended dry ice carriage limits were calculated based upon the limits for CO_2 concentration defined by FAR, part 25, Paragraph 25.831. To calculate the carriage limits, it was conservatively assumed that the gaseous CO_2 sublimating from a cargo of dry ice dissipates and distributes uniformly throughout the passenger cabin. Additionally, the analysis took into consideration CO_2 generated by passenger and crew respiration and the amount introduced from the outside air.

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RECOMMENDED DRY ICE MAXIMUM LOAD



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SECTION 9

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CONFIGURATION DEVIATION LIST

This Configuration Deviation List contains additional certificate limitations for operation of the airplane without certain secondary airframe and engine parts.

This section is reserved for the operator to include its approved CDL. The CDL is an approved document and published as an Appendix of the AFM. EMBRAER issues an illustrated version of the CDL on the Dispatch Deviation Procedures Manual (DDPM) as Section 6.

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SECTION 10

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GENERAL

This section is reserved for the operator to include its approved Minimum Equipment List.

The Minimum Equipment List – MEL is a list developed to provide for the operation of the airplane with some instruments, equipment or functions inoperative at the beginning of the flight.

The MEL is prepared by the operator for his own particular airplane taking account of their airplane configuration and the relevant operational and maintenance conditions in accordance with procedures approved by the Authority.

The MEL shall be based upon, but no less restrictive than, the airplane manufacturer MMEL approved by the Authority. The operator is responsible to ensure that the MEL reflects the guidance given in the MMEL on the effects of multiple unserviceabilities.

Operators shall take operational and maintenance procedures referenced in the MMEL into account when preparing their MEL. Appropriate procedures are required to be published as a part of the operator MEL. Embraer provides operational and maintenance procedures in the Dispatch Deviation Procedures Manual – DDPM.

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INTRODUCTION

This Section presents emergency information, which may be used at operator's discretion to develop customized emergency procedures. Such procedures may be associated to contingencies not related to the airplane.

Emergency equipment includes those items used during in-flight emergencies (such as first-aid kits and fire extinguishers), and to assist in the airplane evacuation (such as crash hatchet and escape ropes).

The information presented herein is focused on its technical aspects. Being so, it is not mandatory.

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EQUIPMENT CHECKLIST

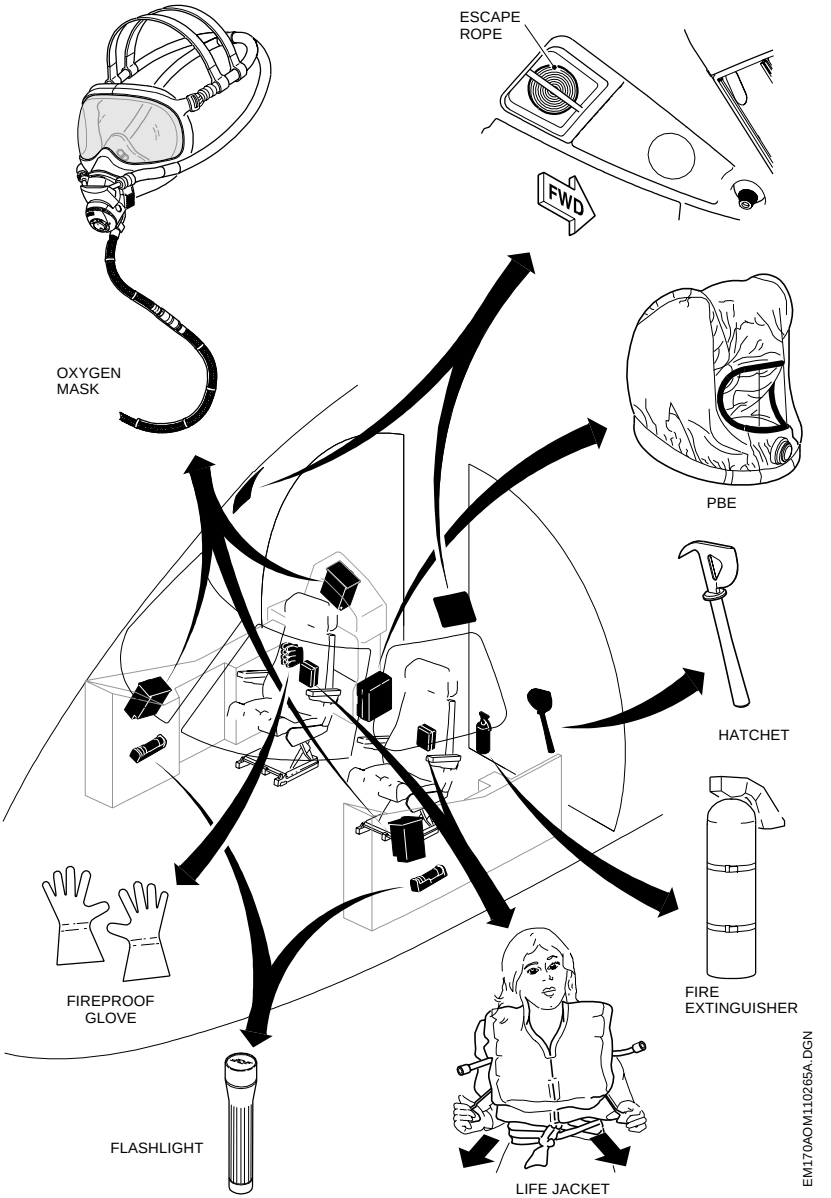
COCKPIT AREA

Escape Rope..... ON BOARD
Hatchet..... ON BOARD
Fire Extinguisher..... CONDITION
Fireproof Gloves..... ON BOARD
Flashlight..... CHECK LED ON
Life Vest..... ON BOARD
Oxygen Mask/Goggle..... CHECK
PBE..... SEALED

CONTINUED...

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...CONTINUED



COCKPIT AREA

CONTINUED...

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...CONTINUED

FRONT PASSENGER CABIN AREA

Automatic Fire Extinguisher..... ON BOARD
Demo Kit..... ON BOARD
Fire Extinguishers..... CONDITION
First Aid Kit..... SEALED
Flashlight..... CHECK LED ON
Life Rafts..... ON BOARD
Life Vests..... ON BOARD
Manual Deployment Tool..... ON BOARD
Megaphone..... ON BOARD
Medical Kit..... ON BOARD
Portable Oxygen Cylinder..... CONDITION
PBE..... SEALED

REAR PASSENGER CABIN AREA

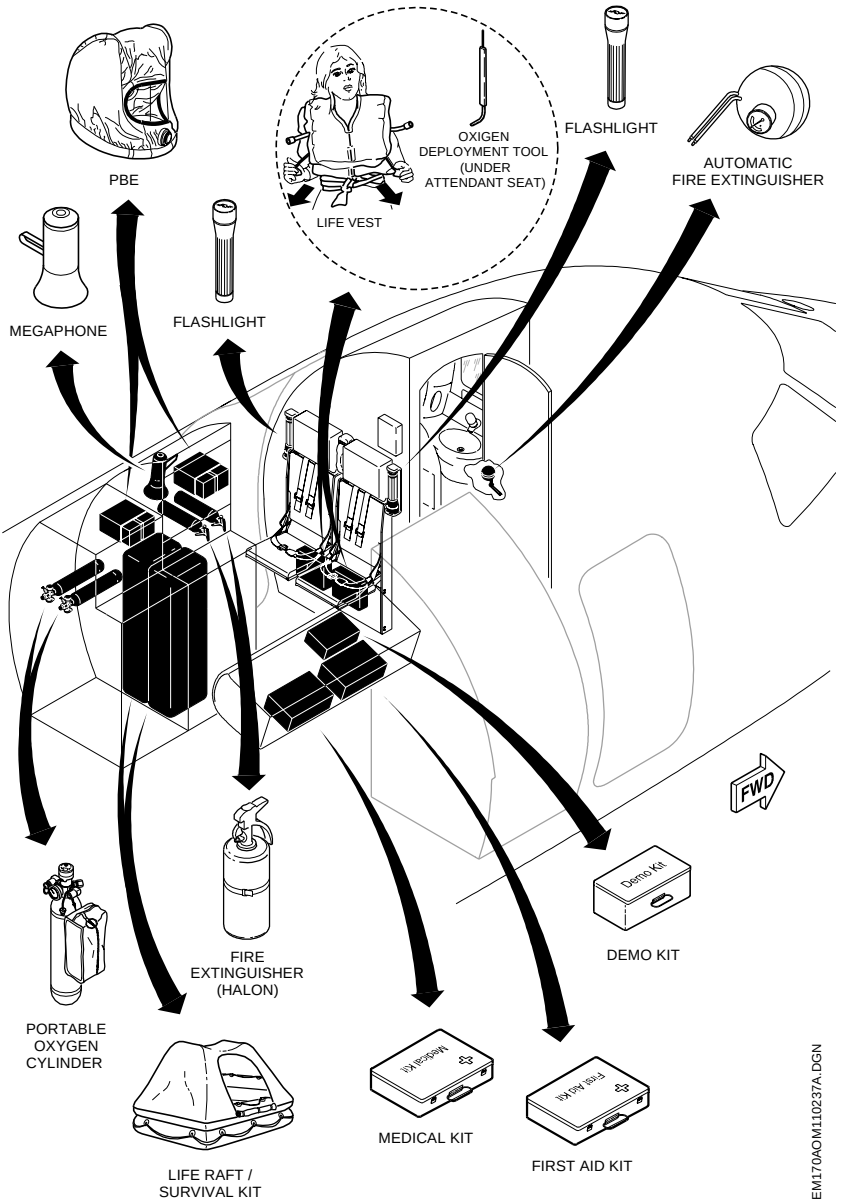
Automatic Fire Extinguisher..... ON BOARD
Demo Kit..... ON BOARD
ELT..... ON BOARD
Fire Extinguishers..... CONDITION
First Aid Kit..... SEALED
Flashlights..... CHECK LED ON
Life Rafts..... ON BOARD
Life Vests..... ON BOARD
Manual Deployment Tools..... ON BOARD
Medical Kit..... ON BOARD
Megaphone..... ON BOARD
Portable Oxygen Cylinders..... CONDITION
PBE..... SEALED
Seat Belt Extensions..... ON BOARD
Wheelchair..... ON BOARD

NOTE: Emergency equipment set may be different than the one presented here in this manual depending on specific client's request.

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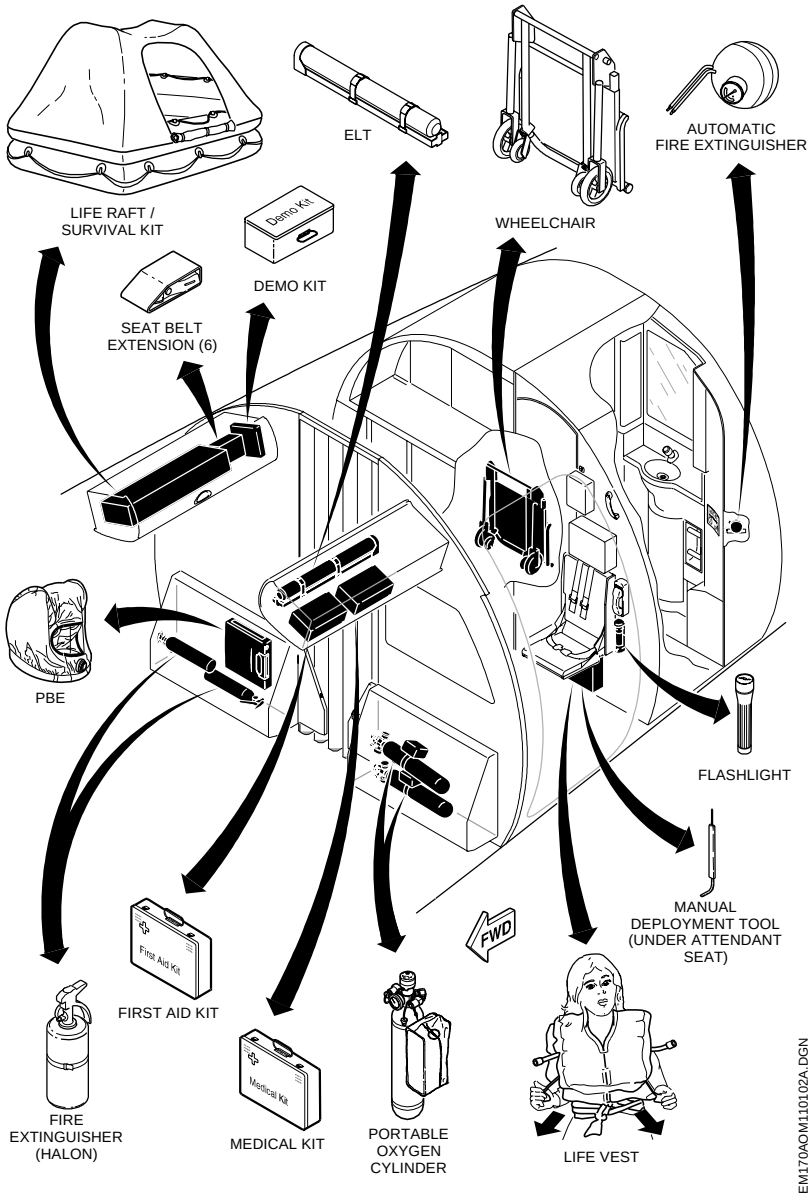


FWD PASSENGER CABIN AREA

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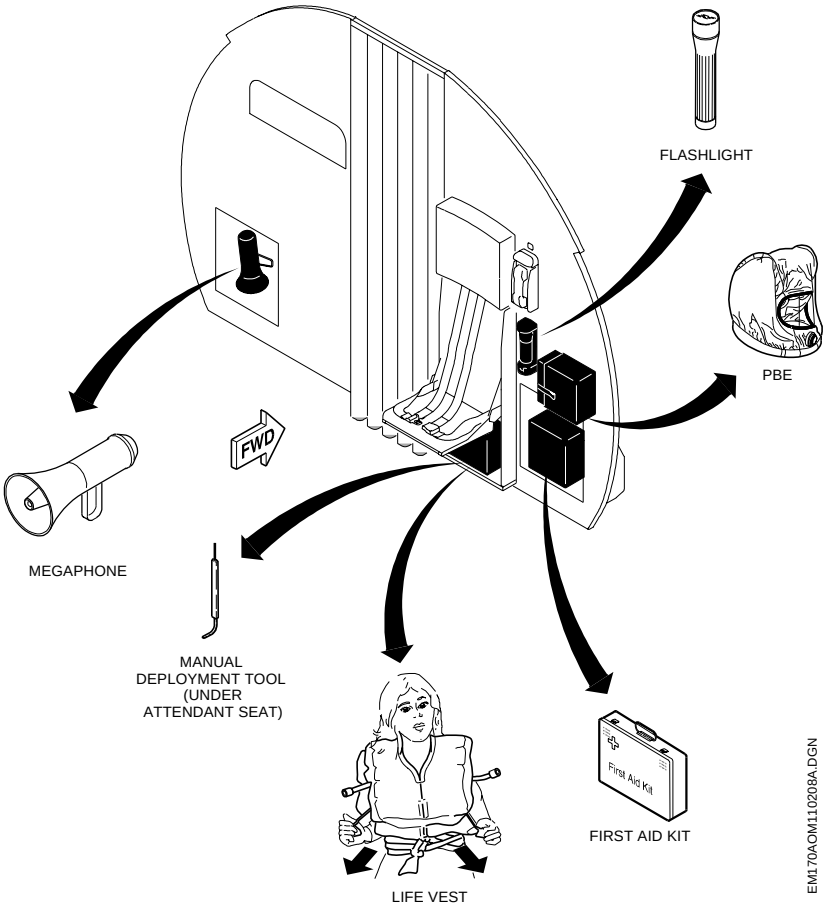
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REAR PASSENGER CABIN AREA

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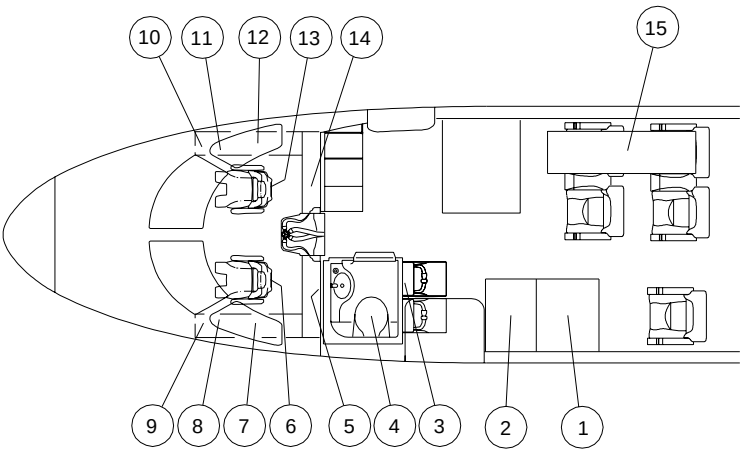


REAR PASSENGER CABIN AREA

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EMERGENCY EQUIPMENT PLAN VIEW

FORWARD



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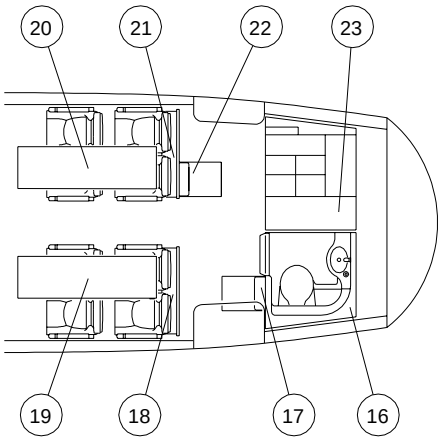
ITEM	EQUIPMENT
1	2 Portable Oxygen Cylinders
2	2 Fire Extinguisher 2PBE 1 Megaphone 1 Life Raft
3	2 Flashlights 2 Life Vests 2 Oxygen box deploy tools
4	1 Automatic Fire Extinguisher
5	1 Hatchet 1 Fire Extinguisher

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ITEM	EQUIPMENT
6	2 Life Vests
7	1 Escape Rope
8	1 Pilot Oxygen Mask
9	1 Flashlight
10	1 Flashlight
11	1 Co-Pilot Oxygen Mask
12	1 Escape Rope
13	1 Life Vest 1 Fire Protection Glove
14	1 Observer Oxygen Mask 1 PBE
15	1 Demo Kit 1 First Aid Kit 1 Medical Kit

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AFTWARD



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ITEM	EQUIPMENT
16	1 Automatic Fire Extinguisher
17	1 Flashlight 1 Life Vest 1 Oxygen box deploy tool
18	2 Portable Oxygen Cylinders 1 Megaphone
19	1 ELT 1 First AidKit 1 Medical Kit
20	1 Life Raft 1 Demo Kit 5 Seat Belt Extensions

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ITEM	EQUIPMENT
21	1 First Aid Kit 2 PBE 2 Fire Extinguisher (Halon)
22	1 Flashlight 1 Life Vest 1 Manual Deployment tool
23	1 Wheelchair

96 PAX Life Vests (one under each seat).

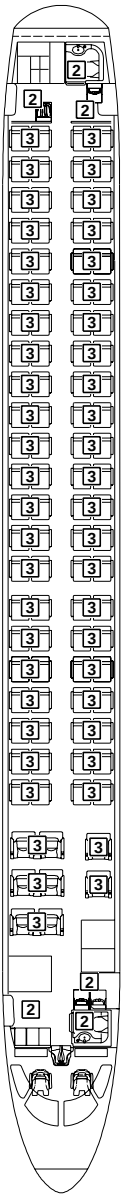
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PASSENGER OXYGEN MASKS LOCATION

Two oxygen masks are installed at each cabin crew's dispensing unit. As primary option, the mask with longer hose must be donned in an emergency.

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QUANTITY AND LOCATION



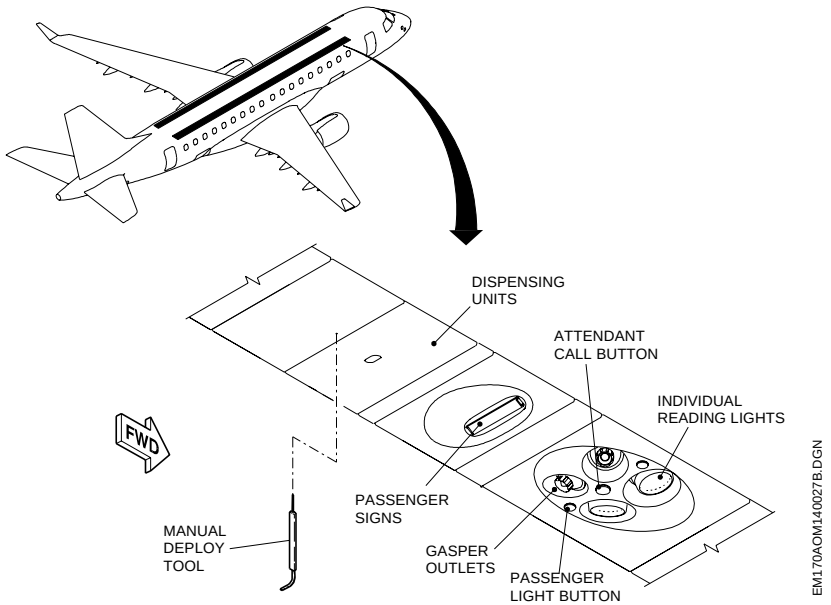
96 SEATS INTERIOR ARRANGEMENT

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OXYGEN MASK MANUAL DEPLOYMENT

A manual deploy tool is provided near each cabin crew station. Placards indicate their location.

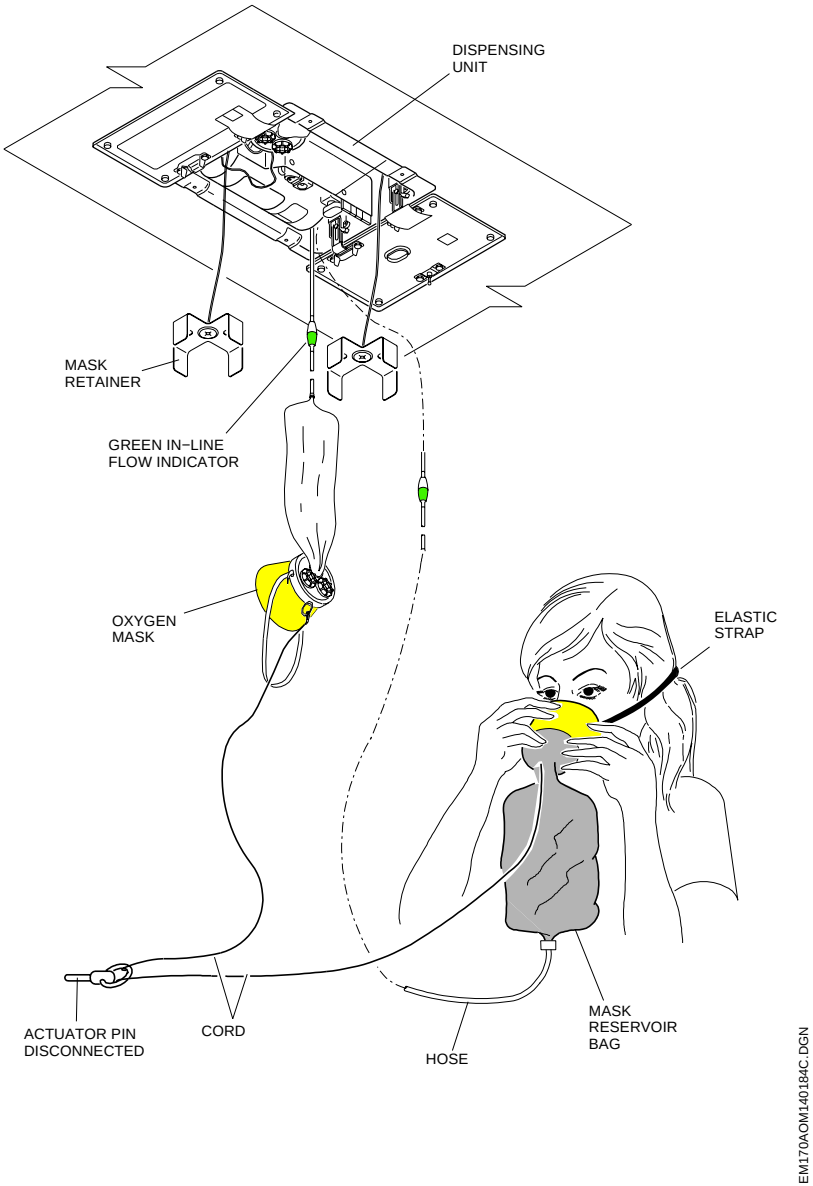
If a dispensing unit door fails to open and the automatic deployment of passenger oxygen masks is not commanded, insert the manual deploy tool in the small hole diameter in the PSU to manually actuate the electrical latch. The masks are deployed and oxygen is available to the occupant.



PASSENGER SERVICE UNIT

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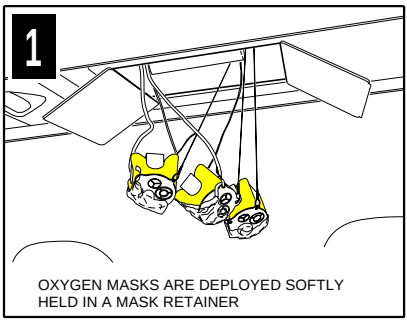
OXYGEN MASKS DEPLOYED

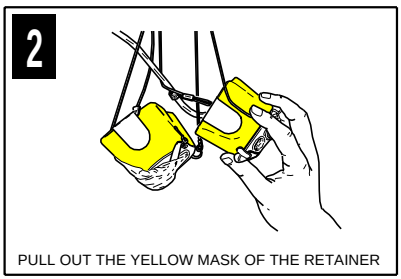


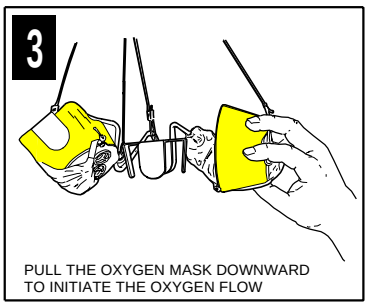
PASSENGER OXYGEN MASKS DEPLOYED AND MASKS RETAINERS

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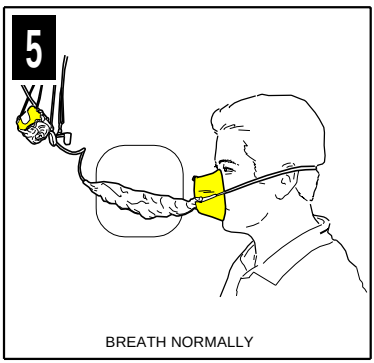
OXYGEN MASK USAGE PROCEDURE













PROCEDURE FOR PASSENGER AND CABIN CREW OXYGEN MASKS

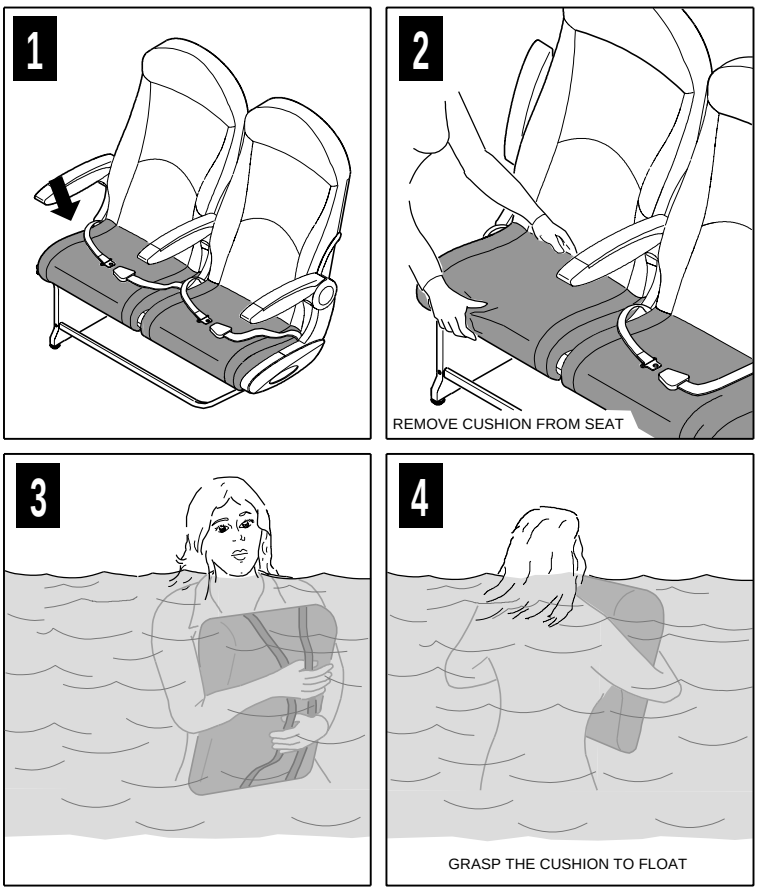
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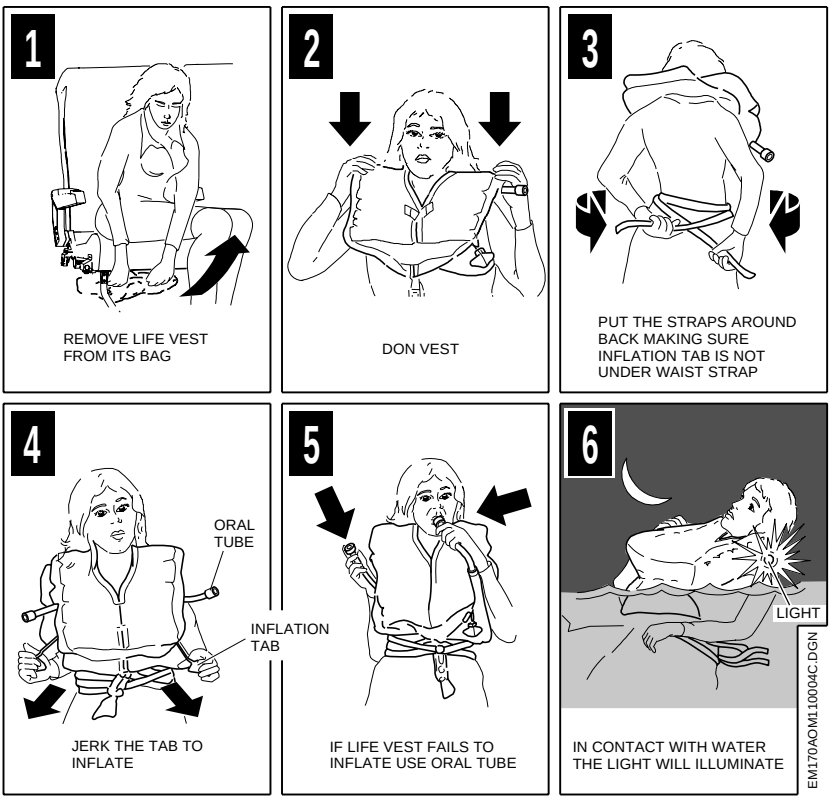
PASSENGER FLOATABLE SEAT AND LIFE JACKET

PASSENGER FLOATABLE SEAT



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LIFE JACKET



LIFE JACKET OPERATION

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LIFERAFT DESCRIPTION

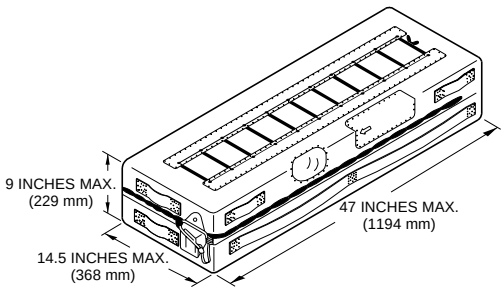
For extended overwater flights, the airplane is equipped with 36 person liferaft designed to provide a reliable and safe flotation in the event of an emergency water landing. The liferaft incorporates means for manual deployment and inflation.

The liferaft is a Type I dual tube reversible liferaft and consists of a inflation system and a survival kit including canopy.

The liferaft is packed in a carrying case, which is provided by a window to view the pressure gauge on the reservoir and valve and monitor the gas charge pressure in the bottle.

The reservoir bottle capacity is 300 in^3 and contains a gas charge mixture of 42% CO_2 and 58% N_2 at a pressure of 3120 psig at 21°C (aproximately 70°F). A valve connected to the reservoir regulates and controls the gas flow.

The weight of the liferaft is 31.18 kg (68.74 lb).

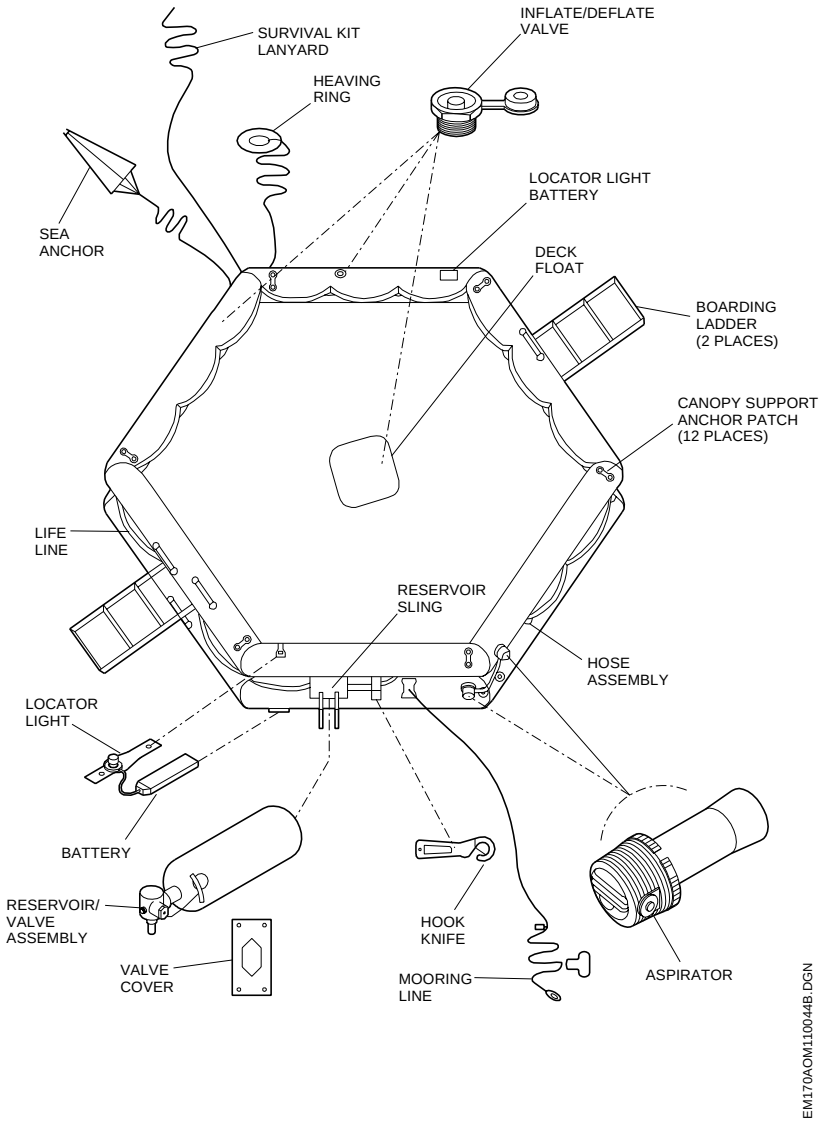


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PACKED LIFERAFT

The liferaft inflates in a two hexagonal shaped tubes. The tubes are structurally joined but are fully independent. A non-inflatable fabric floor is attached and suspended between the tubes.

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LIFERAFT

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A manually inflatable deck float at the center of liferaft provides additional buoyancy.

Lifelines on the outboard perimeter are installed for survivors to grasp from the water. Internal lifelines allows survivors to steady themselves on the liferaft.

Boarding handles and ladders are located at each end of lifelines to enable survivors to climb aboard.

A mooring line can be attached to the airplane by means of a snap hook to prevent the liferaft of blowing away from survivors as they are boarding. The mooring line is attached to the inflation system and is used with the inflation pull handle to initiate the inflation of liferaft.

A floating knife is provided to cut the mooring line in the event of airplane is sinking or on fire.

Manual inflate/deflate valves allow survivors to increase air pressure connecting a hand pump supplied in the survival kit. The pump must be squeezed until the desired pressure has been obtained.

A heaving ring and line is provided as a rescue aid and can be thrown to survivors in the water.

The sea anchor is used to control the drift rate and orientation of liferaft.

Two locator lights provide ais in locating liferaft at night. The lights are operated by water-activated batteries.

The survival kit is available in the liferaft and includes:

– Liferaft manual;

– First aid equipment;

– Tube repair kit;

– Hand pump with adapter;

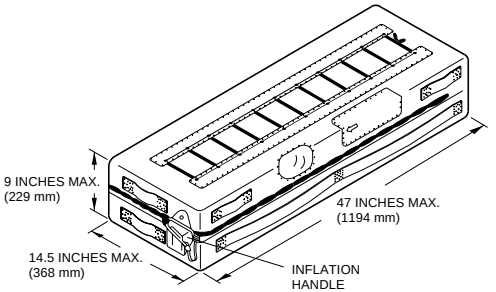
– Signaling devices, such as flash light and flares;

– Orange canopy to provide protection against enviromental conditions.

The canopy may be attached to the liferaft and supported by metal rods. The rods are snapped into holders around the inside perimeter of the liferaft with the canopy spread and snapped over the rods.

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LIFERAFT OPERATION



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The inflation handle is located under the inflation handle pocket, which is located at the front end of the carrying case.

Snap Hook and Mooring Line..... RELEASE

To deploy the unit un-snap the handle pocket and uncoil mooring line.

Snap Hook..... ATTACH

Attach the snap hook to the inside of the airplane fuselage.

Inflation Handlek..... GRASP

Packed Liferaft..... DROP

With one hand holding the inflation handle, drop the unit into the water.

Inflation Handle..... JERK

Allow unit to drift a few feet from airplane, and with the mooring line taut, jerk the handle to initiate inflation. Inflation of the liferaft in the water may occur on either side of the inflatable since both sides are identical.

Survivals Boarding..... INITIATE

Occupants may begin boarding the liferaft immediately after full round out of the tubes.

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HALON FIRE EXTINGUISHER

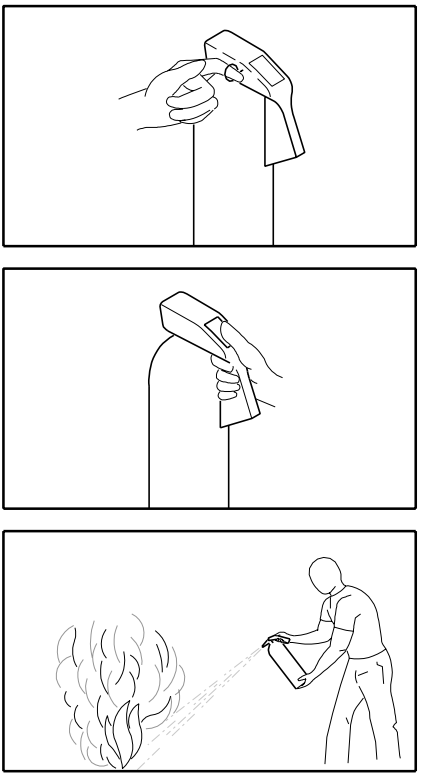
The fire extinguisher contains a Halon blend composed by two different fire-fighting agents.

This blend evaporates on contact, leaving no damaging powdery residue. It may be used to extinguish the following classes of fire:

- Class A (paper, wood, fabric, rubber);
- Class B (oils, greases, flammable liquids);
- Class C (electrical or electronic equipment, live electrical).

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FIRE EXTINGUISHER OPERATION



FIRE EXTINGUISHER OPERATION

Precautions after fire extinguishing:

- Look out for “flashback”;
- Ventilate the compartment as promptly as possible.

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EMERGENCY LOCATOR TRANSMITTER (ELT)

Transmitting a radio signal on frequencies of 121.5 MHz, 243.0 MHz and 406 MHz when activated, the Emergency Locator Transmitter (ELT) assists in the swift location of the airplane during search and rescue operations.

The system comprises a transmitter with an ON/OFF switch and an impact switch installed in the rear rack, an antenna located on the top rear and a remote panel located in the cockpit.

The ELT may be manually or automatically activated. In both cases, a red light flashes on the cockpit panel to indicate the ELTs activation.

Manual activation may be performed when any switch is set to the ON position.

Automatic activation occurs when the transmitter switch is set to the OFF position, the cockpit switch is set to the ARM position and the airplane suffers a deceleration whose intensity triggers the impact switch.

Using an optional configuration with the ELT/NAV interface unit, the ELT is able to transmit the geographical position of the airplane when activated.

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CONTROLS AND INDICATIONS

REMOTE PANEL

1 - ELT ALERT LIGHT (RED)

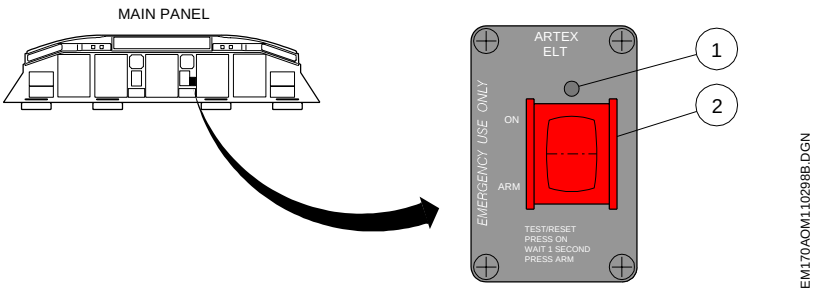
– Flashes when the ELT is transmitting.

2 - ELT SWITCH (GUARDED)

ON: Activates the ELT.

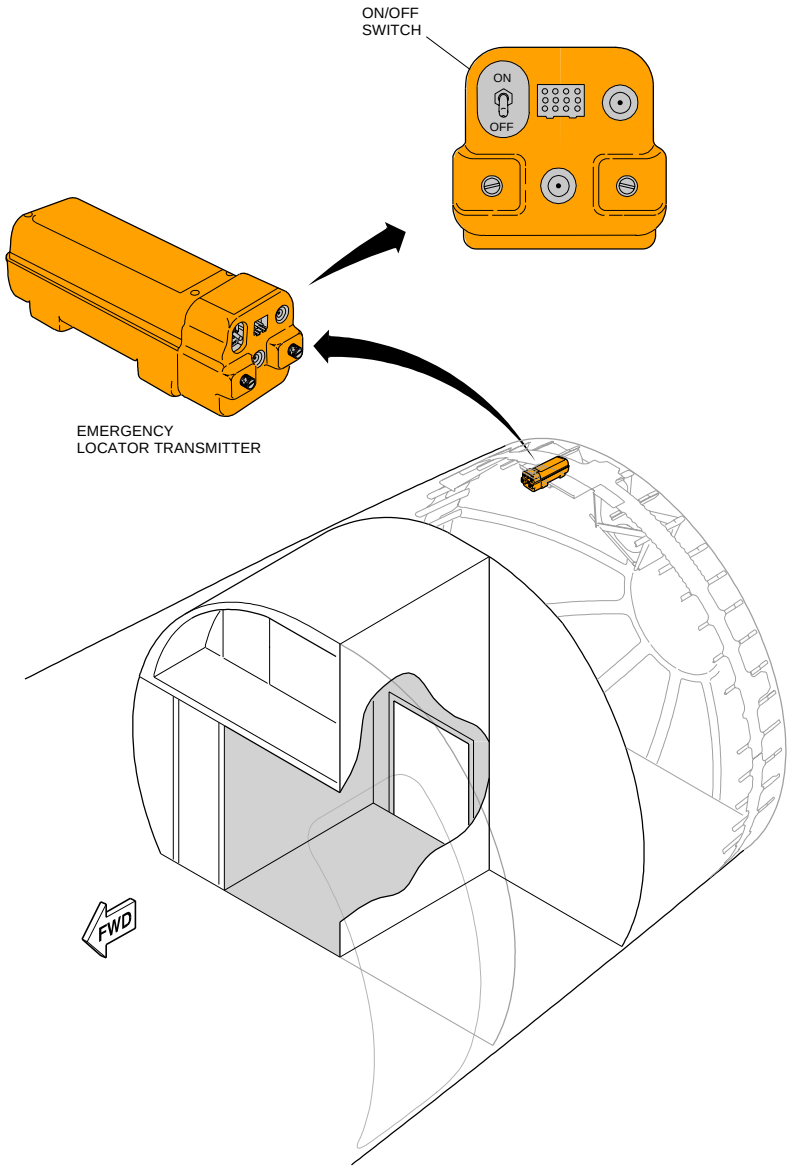
ARM: Allows the ELT to be automatically activated.

NOTE:
– The TEST/RESET function is provided by pressing ON, waiting 1 second and then pressing ARM.
– RESET function allows ELT deactivating, after a manual or automatic activation.
– During TEST/RESET function, the ELT alert light flashes to indicate that the system is transmitting.



REMOTE PANEL

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EMERGENCY LOCATOR TRANSMITTER

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LIGHTING

Refer to AOM - Section 14-01 – AIRPLANE GENERAL.

OXYGEN

Refer to AOM - Section 14-14 – OXYGEN.

NAVIGATION AND COMMUNICATION

Refer to AOM – Section 14-09 – FLIGHT INSTRUMENTS/COMM/NAV/FMS.

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LEAST RISK LOCATION

The location inside the airplane's cabin where structural or system damage are least likely to jeopardize flight safety. The Least Risk Location is sited aft, as close as possible to the center of the second window from the last window on the airplane left side.

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SECTION 12

EMERGENCY EVACUATION

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DOORS AND EXITS	12-40	1
PASSENGER AND SERVICE DOORS	12-40	1
OVERWING EMERGENCY EXITS (OWE)	12-40	6
ESCAPE SLIDE	12-40	11
COCKPIT EVACUATION	12-40	15

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INTRODUCTION

This Section presents information, which may be used at operator's discretion to develop customized evacuation procedures.

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EMERGENCY EVACUATION PROCEDURE

Emergency/Parking Brake	ON
Slat/Flap Lever	5
Thrust Levers	IDLE
Start/Stop Selector Knobs	STOP
Fire Extinguishing Handles	PULL AND ROTATE (1-L and 2-R)
APU Emergency Stop Button	PUSH IN
APU Fire Extinguishing Button	PUSH
Pressurization Dump Button	PUSH
Emergency Evacuation	ANNOUNCE
Batteries	OFF

END

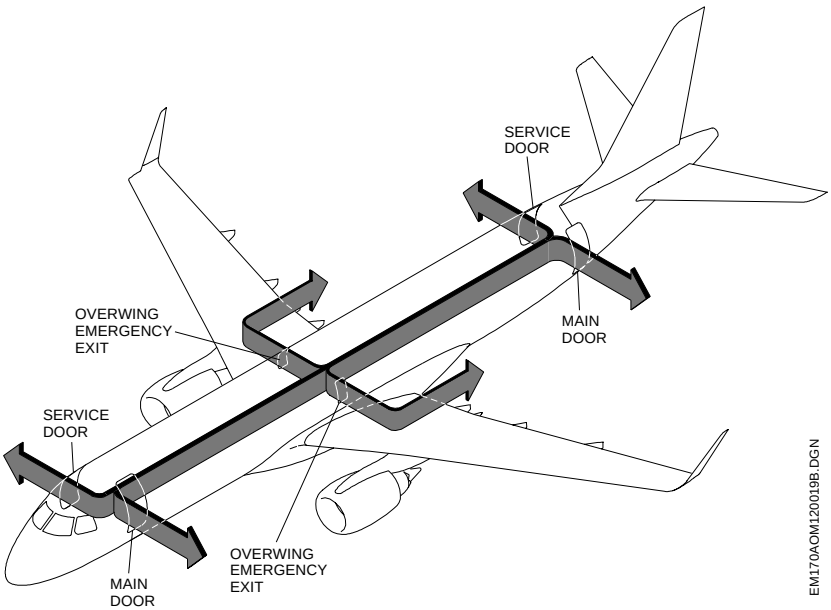
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DOORS AND EXITS

This airplane has two jetway passenger doors on the left side (forward and aft location), two jetway services doors on the right side (forward and aft location), two overwing emergency exits and two cockpit windows, one each side, that can be used for emergency evacuation.



DOORS AND EXIT LOCATION

PASSENGER AND SERVICE DOORS

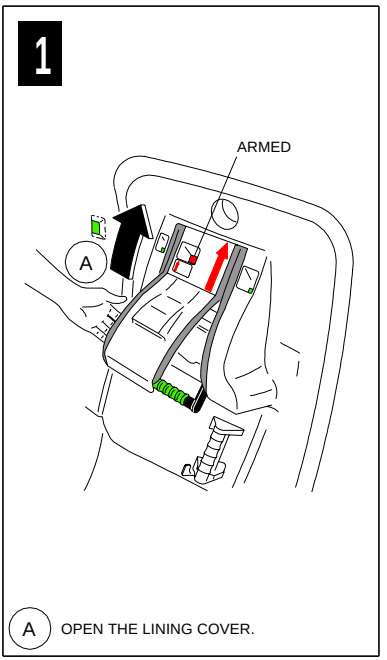
This airplane has one passenger door located at the left forward fuselage section and another located at the aft fuselage section. Passenger door operation is manual and it is identical for both passenger doors. Passenger doors are semi-plug-in type and they are designed as type I doors.

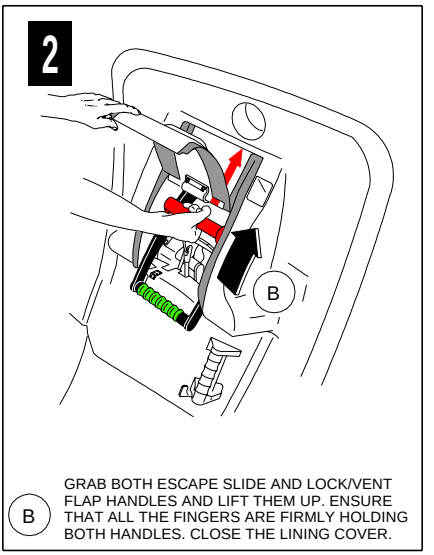
One service door is located at the right forward fuselage section and another located at the aft fuselage section. Service doors are used for galley servicing and cabin cleaning between flights. It may also be used as an emergency exit. The operation of service and passenger doors is similar.

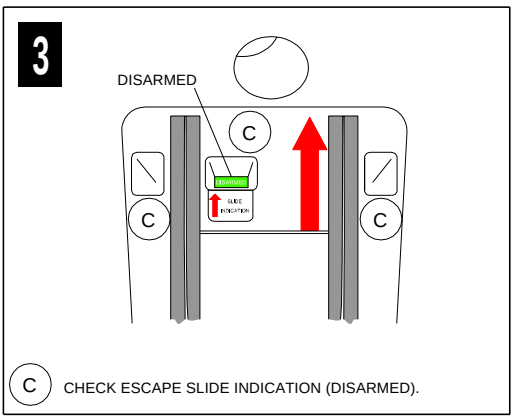
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DOOR OPENING

TO OPEN:



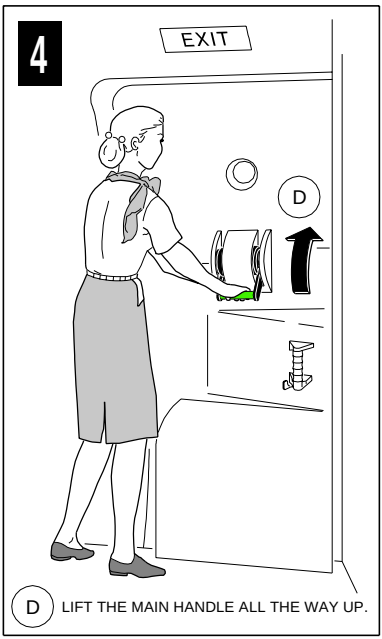




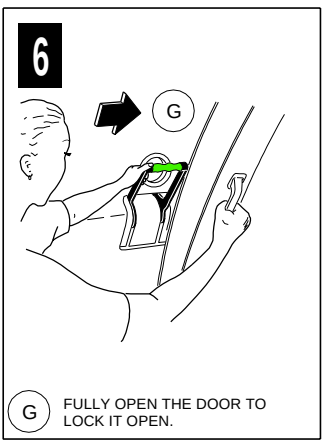
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ESCAPE SLIDE DISARM

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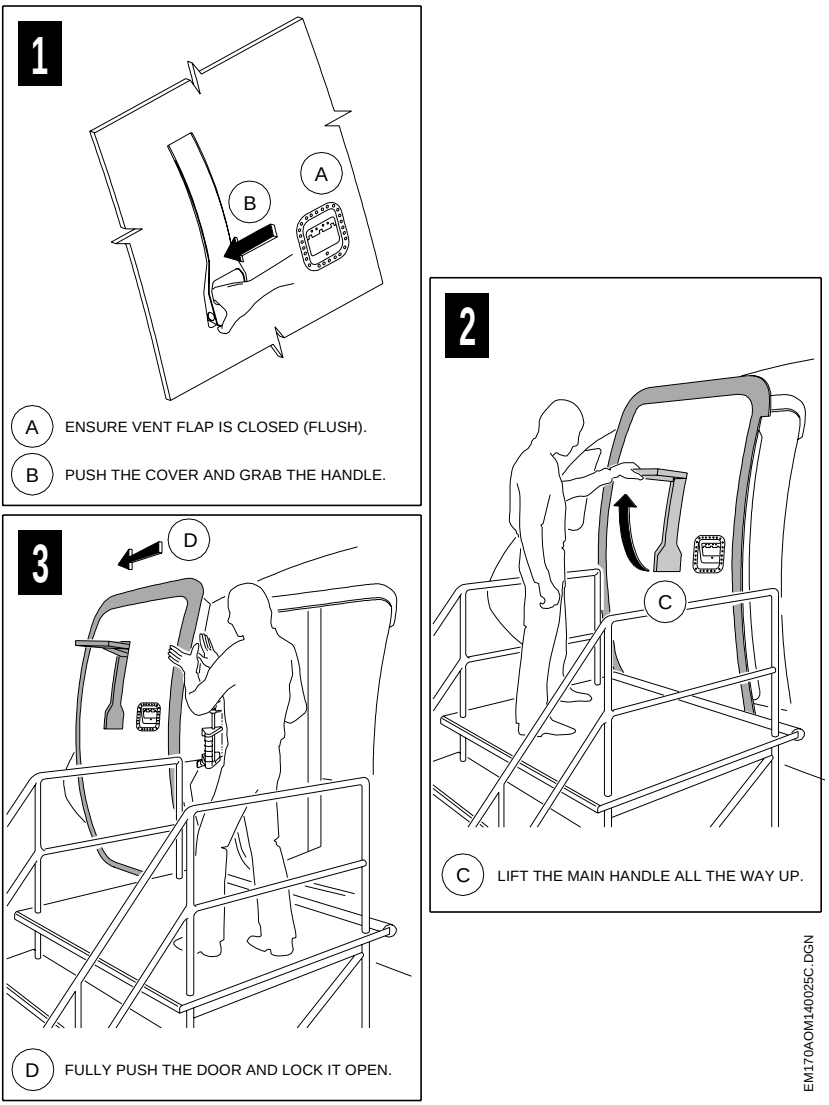
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MAIN HANDLE ACTUATION

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DOOR OUTSIDE OPENING

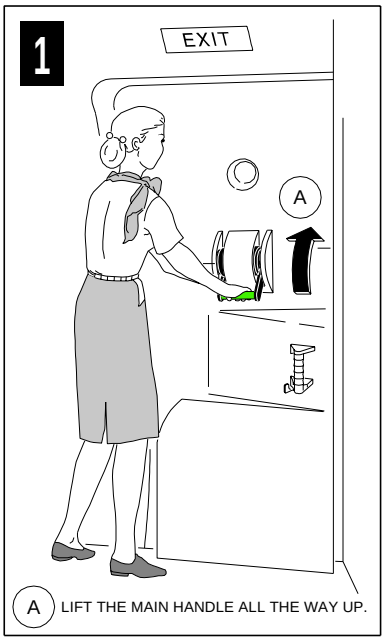
TO OPEN:



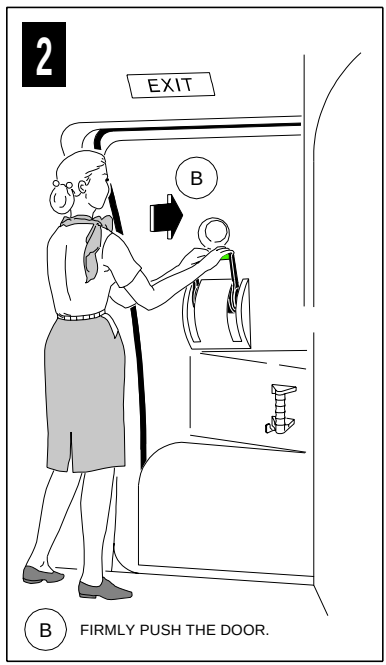
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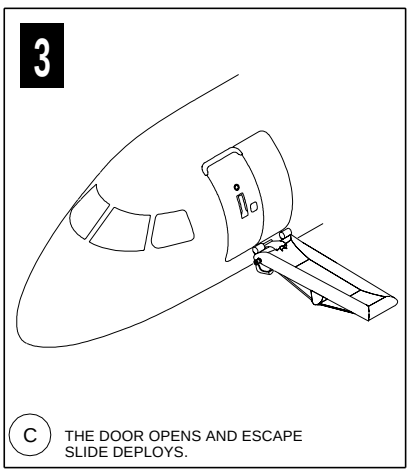
DOOR EMERGENCY OPENING



A LIFT THE MAIN HANDLE ALL THE WAY UP.



B FIRMLY PUSH THE DOOR.



C THE DOOR OPENS AND ESCAPE SLIDE DEPLOYS.

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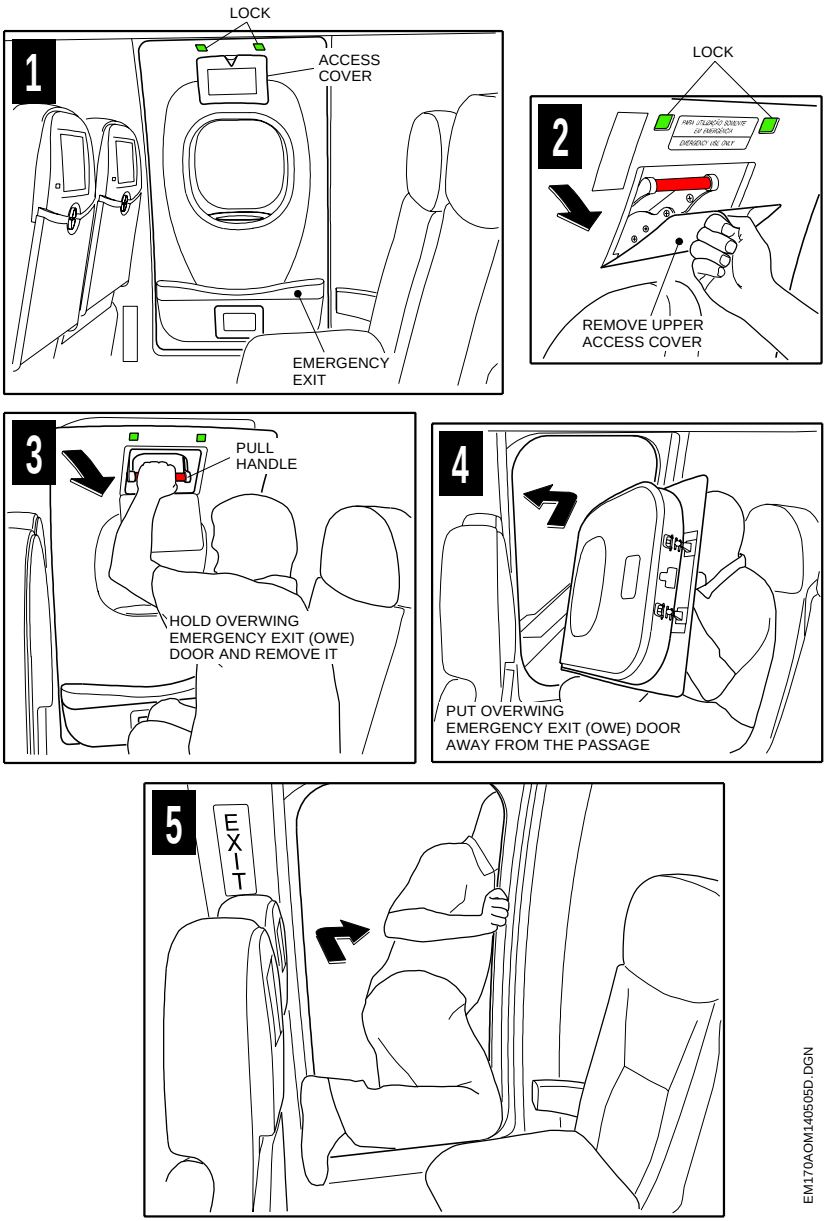
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OVERWING EMERGENCY EXITS (OWE)

Two OWEs exist for passenger evacuation in the event of an emergency. They are located on each side of airplane, centered over the wings. The OWE doors are designed as type III emergency doors.

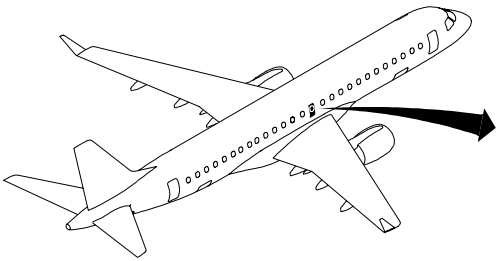
The OWE can be opened from inside or from outside. They can be closed only from inside. Green indication windows at the door ensure that the door is locked.

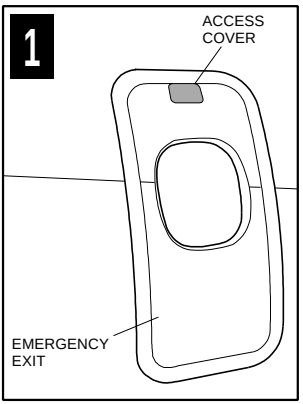
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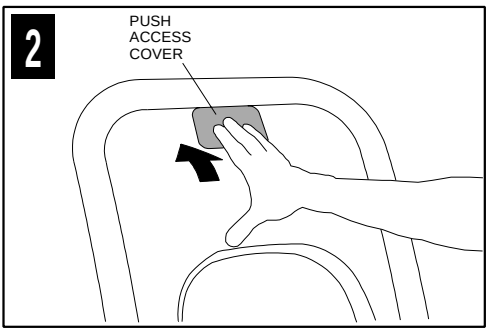


OWE DOOR OPERATION (INSIDE CABIN)

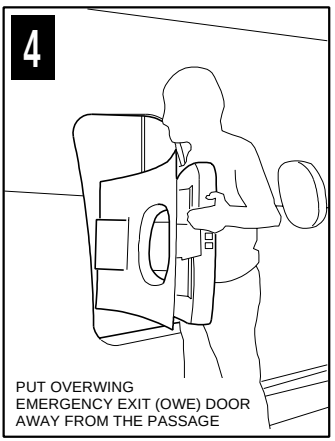
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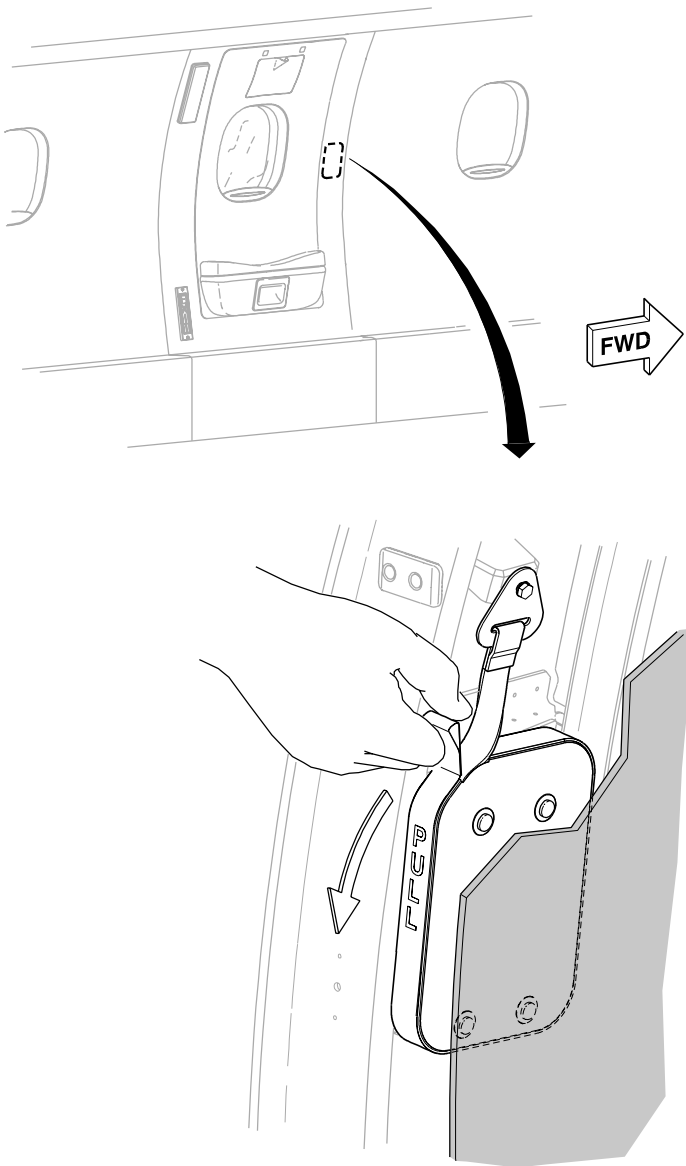






OWE DOOR OPERATION (OUTSIDE CABIN)

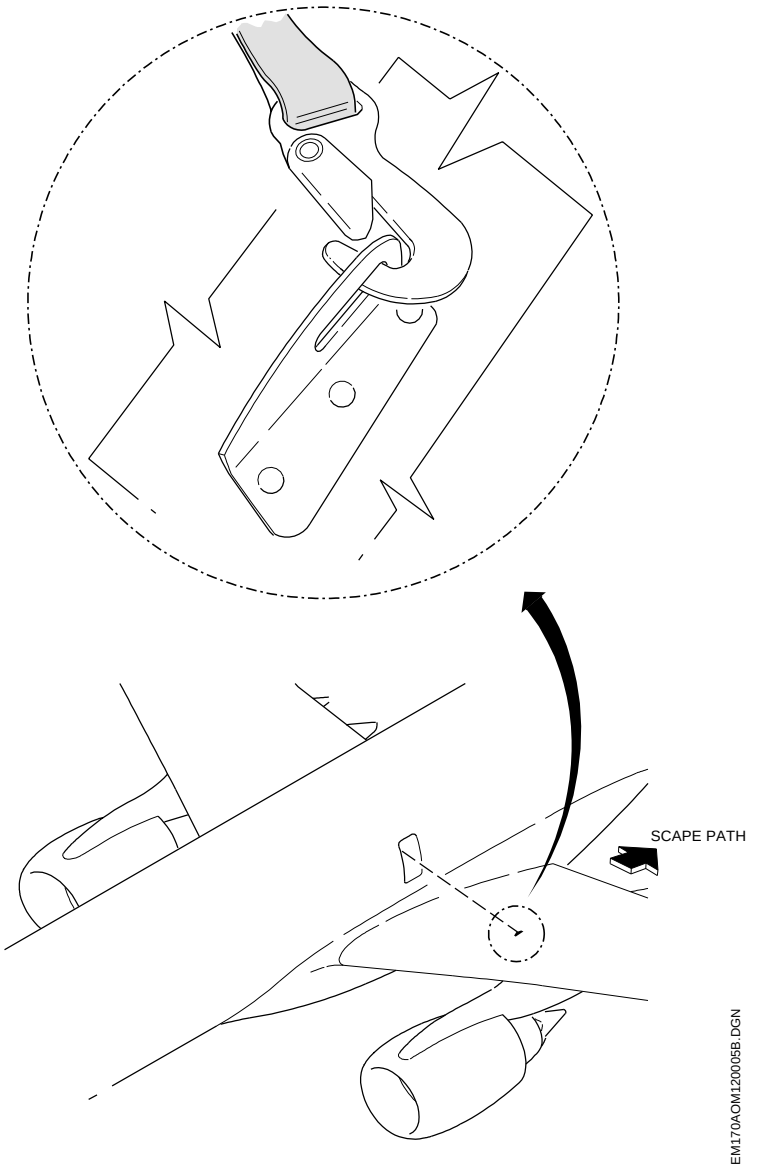
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LIFELINE OPERATION (INTERNAL VIEW)

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LIFELINE OPERATION (WING ATTACHMENT)

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ESCAPE SLIDE

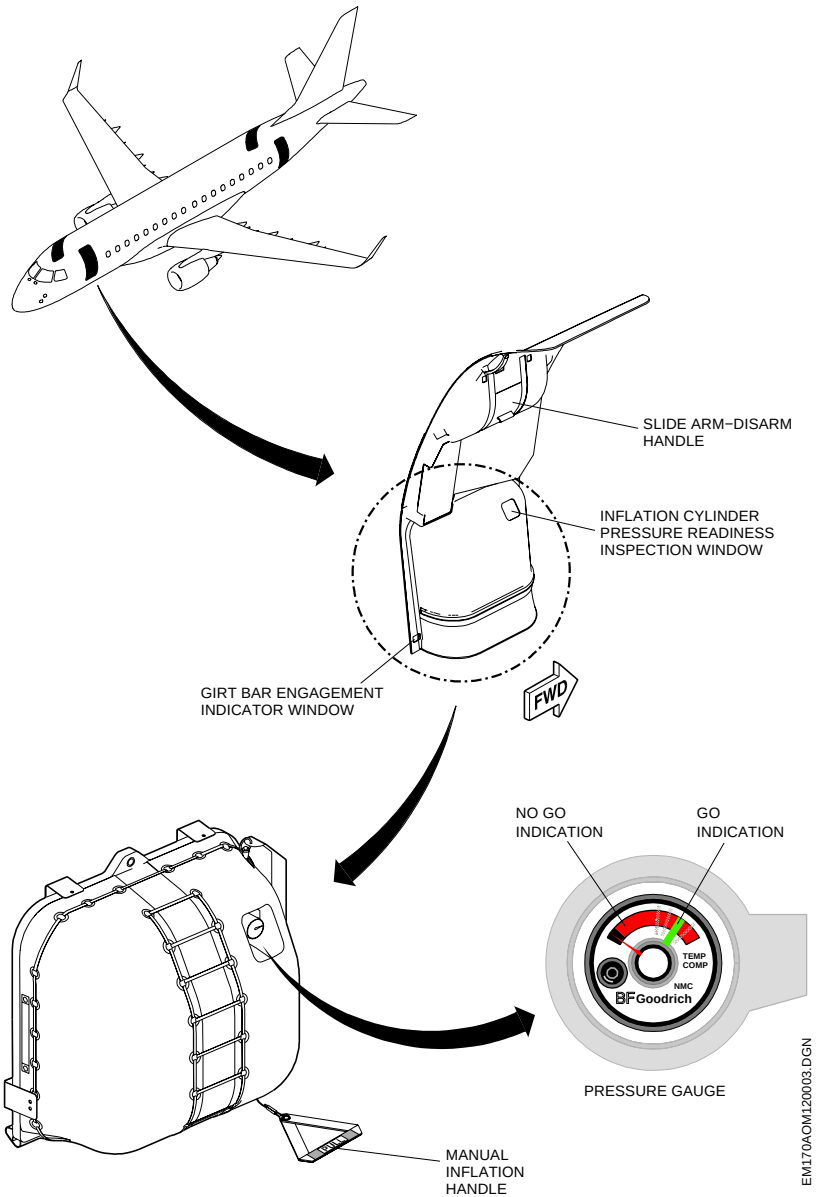
The evacuation slides are designed to provide passengers and crew a means to safely descend from the airplane to the ground during an emergency evacuation. In the event of emergency evacuation, the slides deploy automatically when the exit door is opened.

Upon completion of the inflation sequence, the slide is fully inflated and ready to assist passengers and crew in descending to the ground.

The evacuation slides are armed by raising the slide arming lever cover located on the door and moving the slide arming lever to the “armed” position. The lever attaches the girt bar to the cabin floor brackets. The evacuation slide is attached to the girt bar by means of a fabric girt.

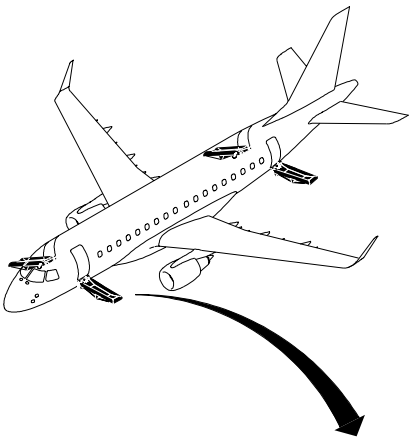
Opening the door from the outside automatically disengages the girt bar from the floor fittings, disarming the slide.

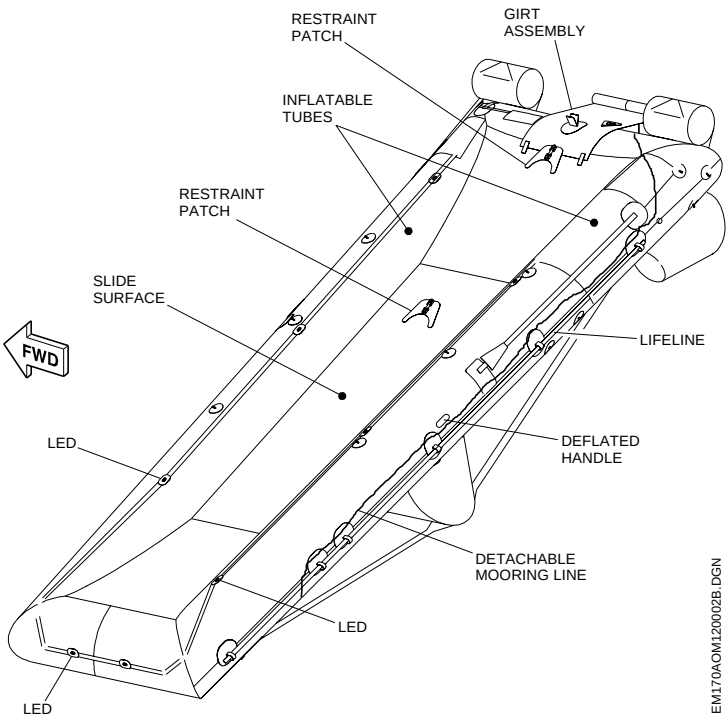
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ESCAPE SLIDE – PACKED

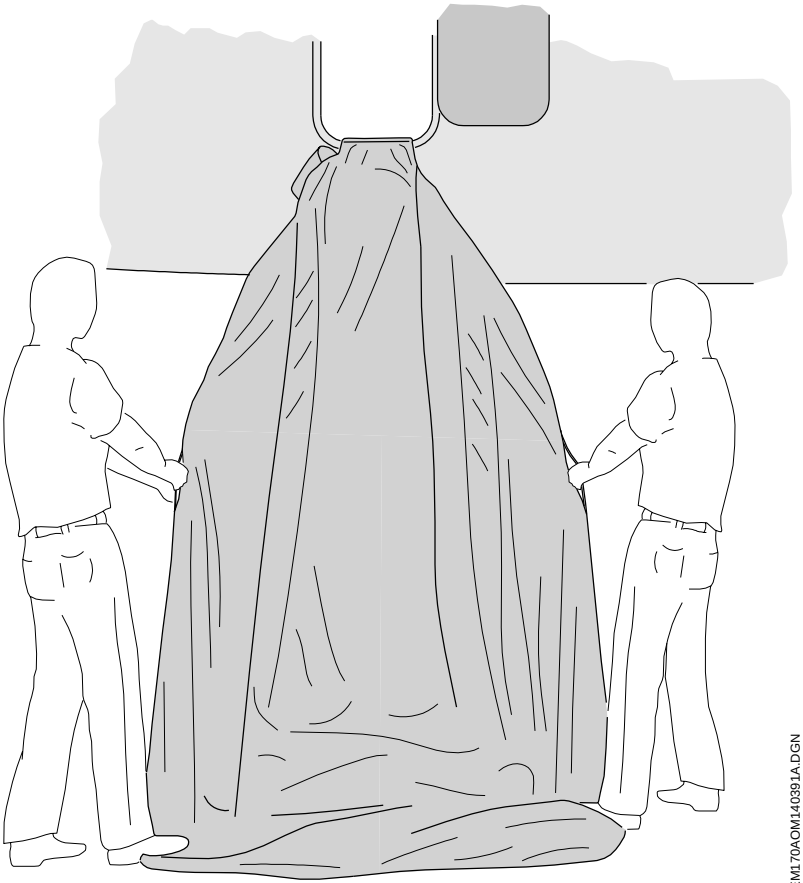
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ESCAPE SLIDE – DEPLOYED

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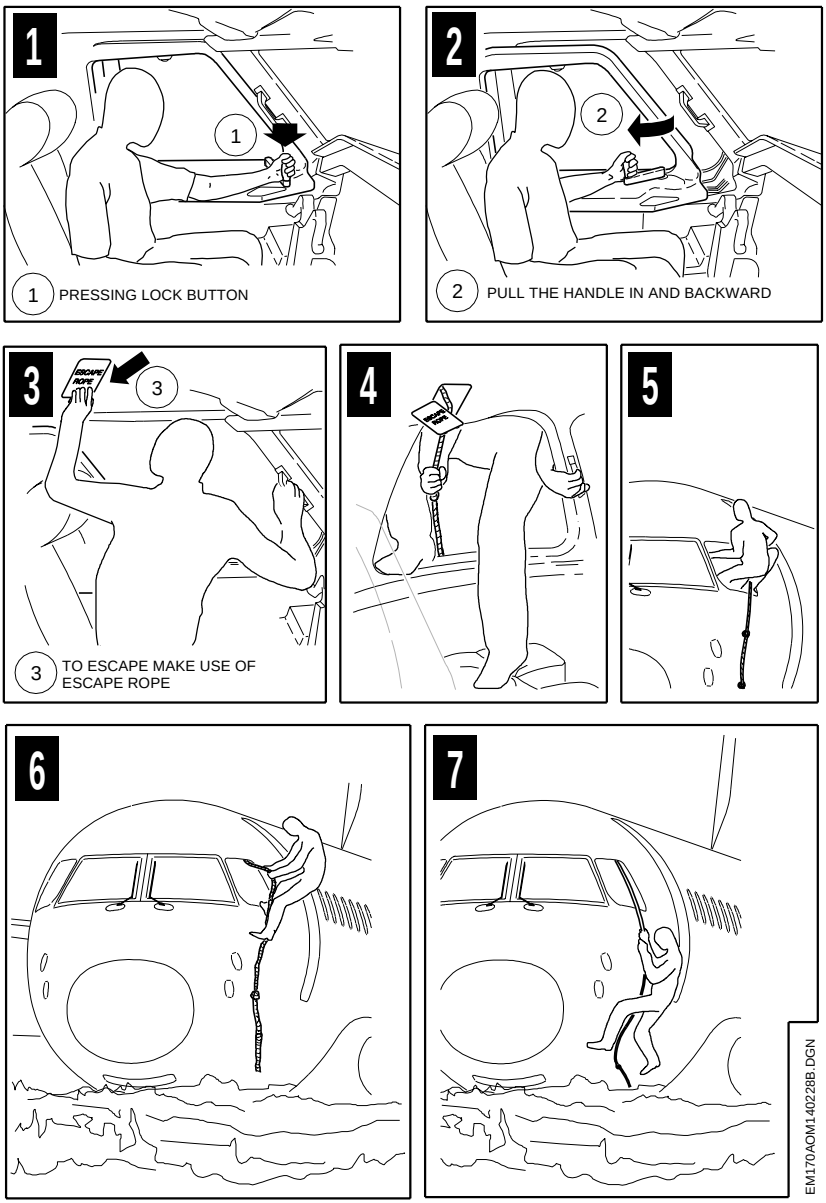


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DEFLATED ESCAPE SLIDE

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COCKPIT EVACUATION



COCKPIT WINDOW EMERGENCY EXIT

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SECTION 13

GROUND SERVICING

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INTRODUCTION

General guidelines are provided herein related to the ground handling and servicing of the airplane. They are intended to make flight crews familiar with the ordinary aspects of the subject, as those tasks described herein normally are the responsibility of the maintenance personnel.

For further instructions pertaining the subjects covered herein refer to the Aircraft Maintenance Manual.

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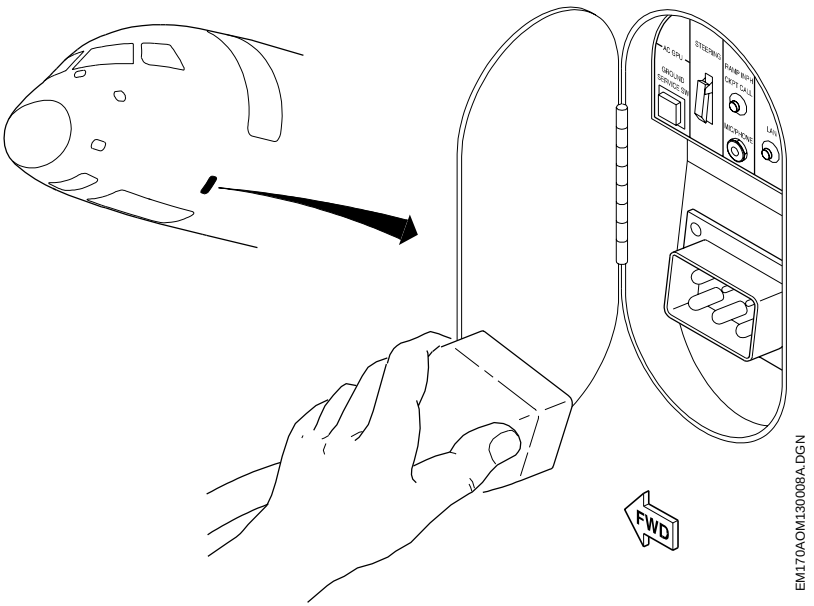
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ELECTRICAL POWER SUPPLY

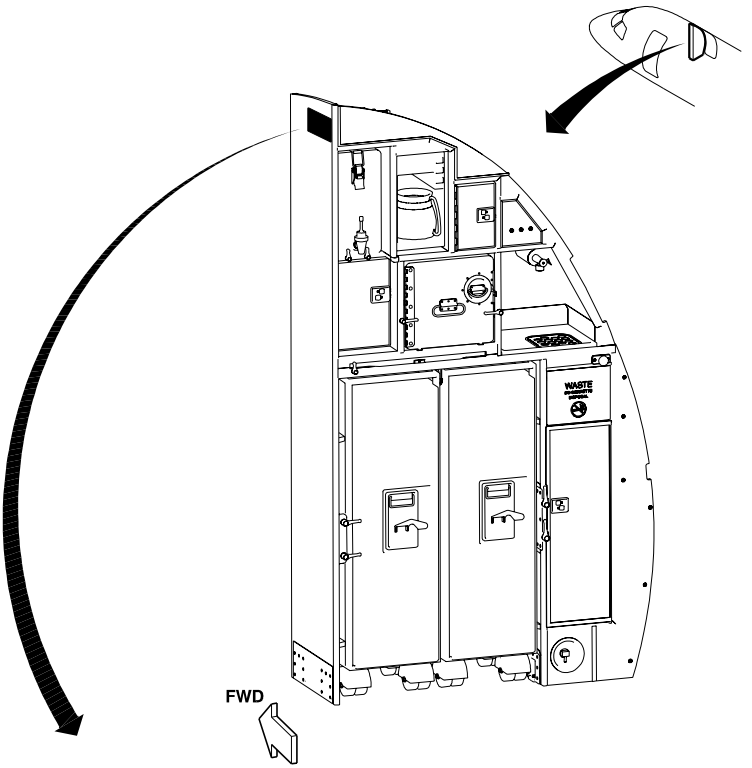
AC POWER SUPPLY

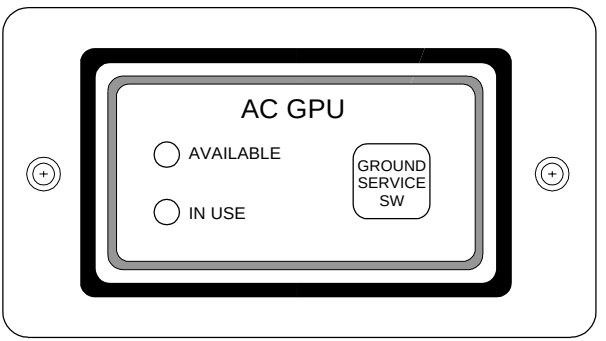
The 115/200 VAC, three-phase, 400 Hz AC external power supply is connected to the airplane through the receptacle installed on the left side of the forward fuselage.



AC EXTERNAL POWER CONNECTION

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GROUND SERVICE PANEL – G1 GALLEY

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EXTERNAL AC POWER SUPPLY PROCEDURES

CONNECTION

Make sure that the external power supply has an earth grounded neutral with no open or floating ground in the neutral circuit. An open or floating ground can cause an electrical potential in the airplane ground circuit.

Make sure that the external power supply operates correctly before supplying power to the airplane. If the ground return circuit of the external power supply does not operate correctly, do the Static Grounding Safety Procedure.

Static Grounding Safety Procedures..... ACCOMPLISH

When using an AC-fed external power source, a ground connection between the hangar structure and the power source, and another one between the power source and the airplane are necessary. Attach the ground cable to the ground connection before attach it to the airplane.

GPU..... ON

Output Voltage..... SET

Adjust the output voltage of the external AC power supply to 115 +3/-2 VAC.

GPU..... OFF

AC Power Supply Connection Door..... OPEN

GPU..... CONNECT

Connect the GPU cable to the external AC power supply receptacle.

GPU..... ON

The AVAIL indication on the Ground Power Unit button (cockpit) turns on.

BATT 1..... ON

BATT 2..... AUTO

Check if only pilot MFD and EICAS displays are turned on.

Batteries Voltage..... CHECK

Ground Service Pushbutton..... CHECK

Make sure that the IN USE indication is OFF at the external AC power receptacle or at forward RH G1 galley.

Ground Power Unit Button..... PUSH IN

The IN USE indication turns on.

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DISCONNECTION

Ground Power Unit Button..... PUSH OUT

The AVAIL indication turns on.

BATT 1 & 2..... OFF

GPU..... OFF

The AVAIL indication turns off.

GPU..... DISCONNECT

AC Power Supply Connection Door..... CLOSE

EXTERNAL PNEUMATIC POWER SOURCE PROCEDURE

The pneumatic start unit is connected to the airplane through the engine start ground connection (HP ground connection) installed in the wing-to-fuselage fairing. Pressure supplied by the unit should be set above the minimum bleed duct pressure to compensate for pressure drop.

Engine..... CHECK

Check if the engines are stopped.

APU Bleed Button..... PUSHED OUT

APU..... AS REQUIRED

PACKS..... PUSHED OUT

CAUTION: MAKE SURE TO KEEP PACKS 1 AND 2 OFF WHILE PNEUMATIC PRESSURE SOURCE IS IN USE. DAMAGE CAN OCCUR AND DIRT CAN GET INTO THE AIRPLANE AIR CONDITIONING DUCTS IF PACKS 1 AND 2 ARE ON.

Pneumatic Connections Access Door..... OPEN

Hose Adapter..... CONNECT

Connect the hose adapter of the pneumatic start unit to the airplane engine start ground connection.

External Pneumatic Power Source..... START

Set the pneumatic start unit to ON and check the minimum recommended bleed duct pressure on STATUS synoptic page at 40 psi minus 0.5 psi for every 1000 ft above sea level. If the equipment

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does not have an adjustment feature, set the pressure just above the minimum bleed duct pressure required. Do not set the pressure higher than 100 psi.

External Pneumatic Power Source Valve..... OPEN
Engine Start..... ACCOMPLISH
External Pneumatic Power Source Valve..... CLOSE
External Pneumatic Power Source..... STOP
Hose Adapter..... DISCONNECT
Pneumatic Connections Access Door..... CLOSE
APU Bleed Button..... PUSH IN
PACKS..... AS REQUIRED

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AIR CONDITIONING GROUND UNIT PROCEDURE

A ground air conditioning source can be connected to the airplane to supply hot or cold air directly into the cabin.

Cooling packs should be OFF, given that they are not able to control air temperature when a ground air source is being operated at the same time.

NOTE: – If the cooling packs and the ground air conditioning source are used simultaneously, the air conditioned pressure may become excessive.

– Open at least one airplane entrance or cargo door, and keep it open when operating the ground conditioned-air source. This is to prevent an increase in cabin pressure during the ground source operation.

CONNECTION

PACKS 1 & 2..... OFF

Pneumatic Connections Access Door..... OPEN

Air Conditioning Ground Unit..... CONNECT

Connect the air conditioning unit to the airplane. The maximum permitted value of pressure airflow to the aircraft is 203.2 mm H_2O (8 in H_2O).

Conditioned Air..... SUPPLY

DISCONNECTION

Conditioned Air..... STOP

Air Conditioning Ground Unit..... DISCONNECT

Carefully disconnect the air conditioning unit from the airplane.

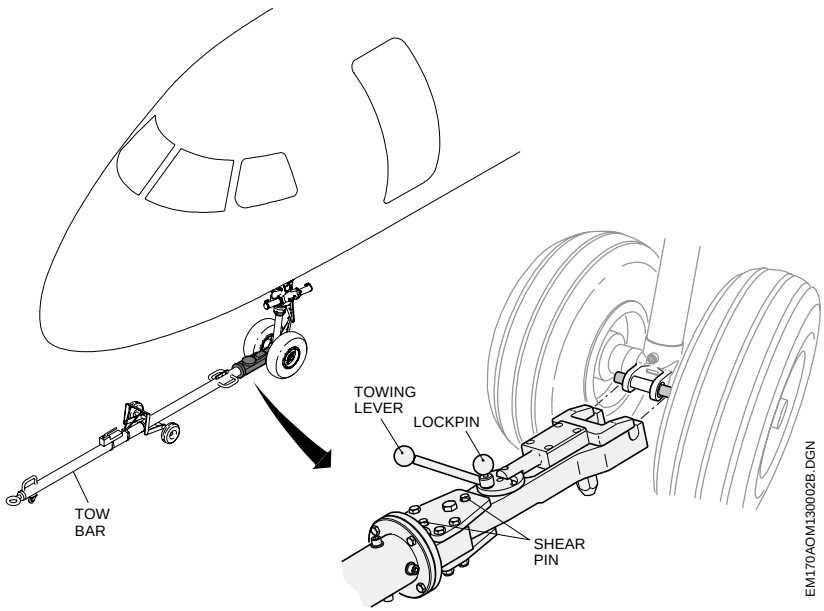
Pneumatic Connections Access Door..... CLOSE

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TOWING WITH TOWBAR

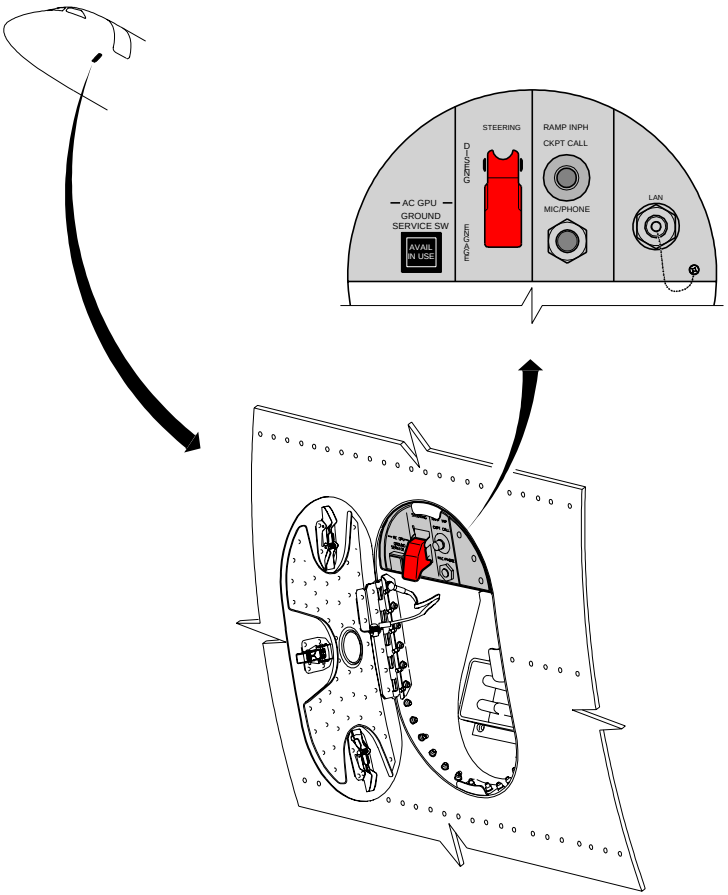
Ground towing can be accomplished by using a tow bar coupled to the landing gear.

The tow bar incorporates breakable sections (fuse) with the purpose of causing the tow bar to break in case of any towing abnormality, to protect the airplane structure or the nose landing gear from damage.



TOWING EQUIPMENT

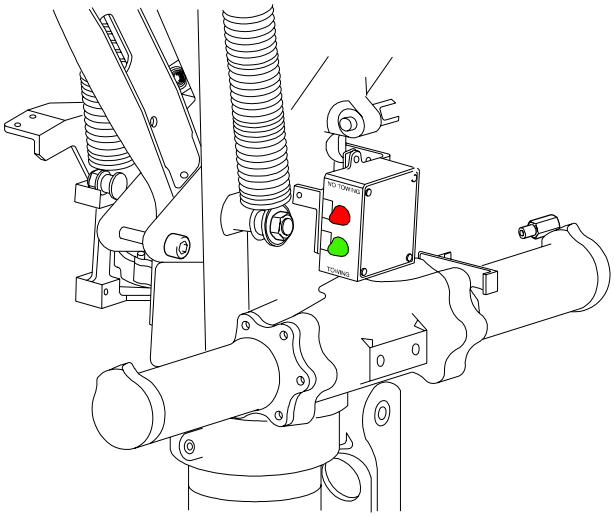
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EXTERNAL STEERING DISENGAGEMENT SWITCH

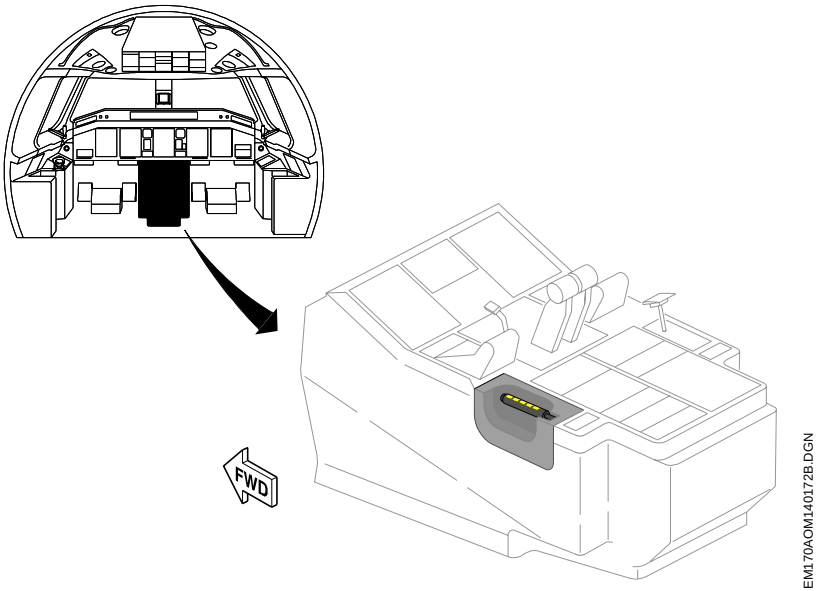
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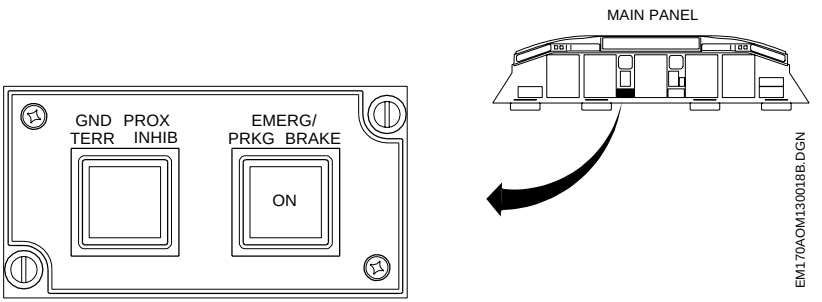
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TOWING LIGHTS

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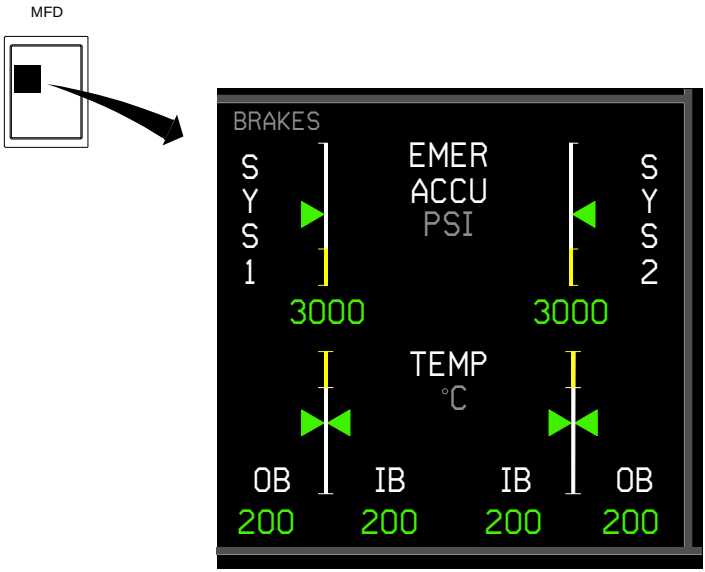


EMERGENCY/PARKING BRAKE HANDLE



EMERGENCY/PARKING BRAKE LIGHT

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MFD STATUS PAGE

TOWING PROCEDURES

Doors..... CLOSED

Close passenger doors, service doors, cargo doors and engine cowls.

Seatbelts..... FASTEN

All the persons in the cockpit must be in a seat and seatbelts must be fastened.

Emergency/Parking brake..... SET

Landing Gear Safety Pins..... INSTALLED

Make sure that the landing gear downlock safety pins are correctly installed on the main and nose landing gears.

Landing Gear Shock Struts..... CHECK

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Make sure that the main landing gear and nose landing gear shock struts have sufficient extension.

RAT Stow Lock Pin..... INSTALL

Lock the RAT with stow lock pin and install the REMOVE-BEFORE-FLIGHT streamer.

APU..... ON

Energize the airplane with the APU

Emergency/Parking Brake..... CHECK

Check if emergency/parking brake accumulator is pressurized. Pull the emergency/parking brake handle and check if emergency/parking brake light is ON.

Steering System..... DISENGAGE

Disengage the steering system setting the external steering switch to the “DISENGAGE” position.

EICAS message..... CHECK

Check the STEER OFF message is displayed on EICAS.

Towing Indication Light..... RED

Tow Bar..... INSTALL

Pull the locking pin and put the towing lever in the released position. Install the towbar on the towing attachment on the NLG. Pull the locking pin and set the towing lever to the towing position.

Install the other end of the towbar to the tow tractor.

Wheel Chocks..... REMOVE

Remove the wheel chocks from all tires.

Emergency/Parking brake..... RELEASE

Release the emergency/parking brake handle in the cockpit (brakes off).

Towing Indication Light..... GREEN

Make sure that the towing-indication light box shows the green light on.

Towing..... ACCOMPLISH

Tow the airplane slowly straight ahead before turn. Complete the airplane towing in a straight line for a minimum of 3 m (10 ft) or until the nose wheel steering system is in the range of $\pm$ 170°.

Emergency/Parking brake..... SET

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Check if Emergency/Parking Brake light is ON.

Wheel Chocks..... INSTALL

Install the wheel chocks around all tires.

Tow Bar..... REMOVE

Remove the tow bar from the tractor. Pull the locking pin and set the towbar lever to the released position. Remove the tow bar from the nose landing gear.

Steering System..... ENGAGE

Set the external steering switch to the “ENGAGE” position.

EICAS Message..... CHECK

Press and release the handwheel in the cockpit and check if the STEER OFF message on EICAS goes off.

Towing Indication Light..... RED

APU..... OFF, IF APPLICABLE

RAT Stow Lock Pin..... REMOVE

Landing Gear Safety Pins..... REMOVE

Make sure that the landing gear downlock safety pins are removed from the main and nose landing gears.

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PUSHBACK PROCEDURES

The pushback is accomplished by using a tow bar coupled to the landing gear.

Pushback procedure is used to move the airplane from the terminal gate before flight, with passengers and flight crew members on board and to push an airplane back with the ground towing crew only.

One towing supervisor is necessary to control the towing operation. One pushback crew at each wing tip and one pushback crew behind the tail are necessary to monitor sufficient clearance during the turns.

The towing supervisor must have visual and radio communication with all the towing and flight crewmembers at all times.

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

Autobrake will be automatically disarmed if the pushback speed is higher than 5 kt and either Hydraulic System 1 or 2 is depressurized . Consequently, EICAS messages BRK LH (RH) FAULT or BRK LH (RH) FAIL will be displayed until the wheel speed is reduced or the referred Hydraulic Systems are pressurized.

◄

Seatbelts..... FASTEN

All the persons in the cockpit must be in a seat and seatbelts must be fastened.

RAT Stow Lock Pin..... CHECK

Make sure that the stow lock pin is removed from the RAT.

Landing Gear Safety Pins..... CHECK

Make sure that the landing gear downlock safety pins are removed from the main and nose landing gears.

Wheel Chocks..... INSTALL

Install the wheel chocks around all tires.

Emergency/Parking Brake..... SET

Check if emergency/parking brake accumulator is pressurized. Pull the emergency/parking brake handle and check if emergency/parking brake light is ON.

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Towing Indication Light..... RED

Steering System..... DISENGAGE

Disengage the steering system setting the external steering switch to the “DISENGAGE” position.

EICAS Message..... CHECK

Check if the STEER OFF message is displayed on EICAS.

Ground Equipment..... CHECK

Make sure that all ground equipment is removed from areas adjacent to the airplane and all external services are disconnected from the airplane.

Doors..... CLOSED

Close passenger doors, service doors, cargo doors and engine cowls.

Tow Bar..... INSTALL

Pull the locking pin and set the towing lever to the released position. Install the towbar on the towing attachment on the NLG. Pull the locking pin and set the towing lever to the towing position.

Install the other end of the towbar to the tow tractor.

Wheel Chocks..... REMOVE

Remove the wheel chocks from all tires.

Emergency/Parking Brake..... RELEASE

Release the emergency/parking brake handle in the cockpit (brakes off).

Towing Indication Light..... GREEN

Make sure that the towing-indication light box shows the green light on.

Pushback..... ACCOMPLISH

Tow the airplane slowly straight ahead before turn. Complete the airplane towing in a straight line for a minimum of 3 m (10 ft) or until the nose wheel steering is in the range of ±170°.

Emergency/Parking Brake..... SET

Check if emergency/parking brake light is ON.

Towing Indication Light..... RED

Tow bar..... REMOVE

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Remove the tow bar from the tractor. Pull the locking pin and set the towbar lever to the released position. Remove the tow bar from the nose landing gear.

Flight Crew..... ADVISE

Notify the pilot that towbar is removed.

Steering System..... ENGAGE

Set the external steering switch to the “ENGAGE” position.

EICAS Message..... CHECK

Press and release the handwheel in the cockpit and check if the STEER OFF message on EICAS goes off.

Access Door ..... CLOSE

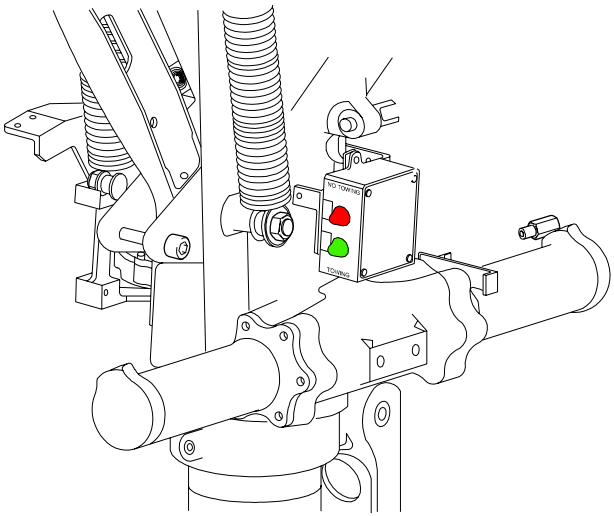
Close and latch the external steering access door.

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TOWBARLESS TOWING

Towbarless towing is prohibited, unless the towbarless towing operations are performed in compliance with the appropriate operational requirements using towbarless towing vehicles that are designed and operated to preclude damage to the airplane nose landing gear, steering system and associated fuselage structure. For steering system, if damage cannot be precluded a reliable and unmistakable warning must be provided when damage to the steering system may have occurred.

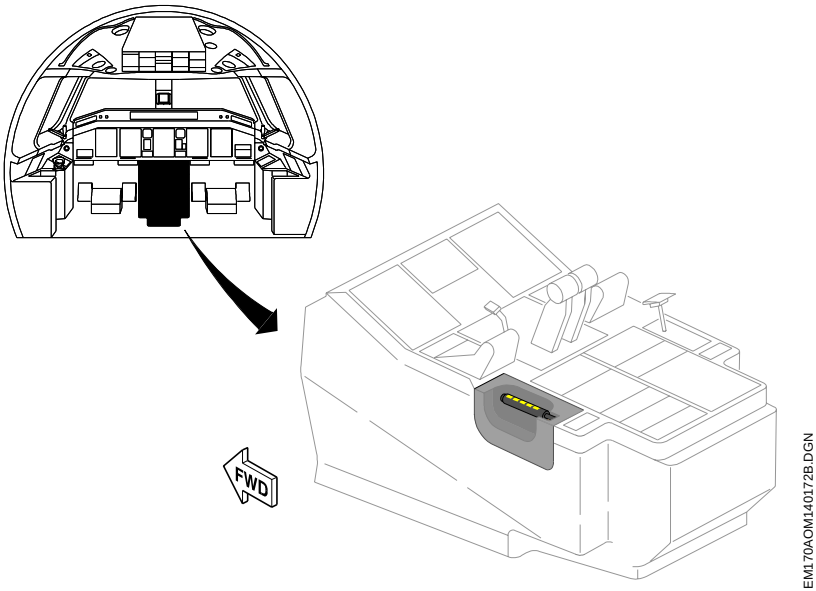
Towbarless towing vehicles that are specifically accepted for this type of airplane are listed in the AMM Chapter 9.



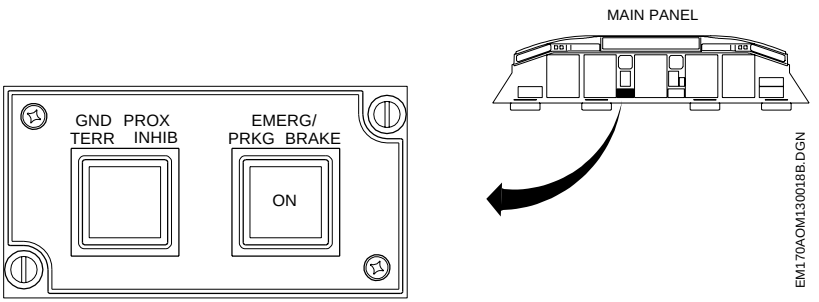
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TOWING LIGHTS

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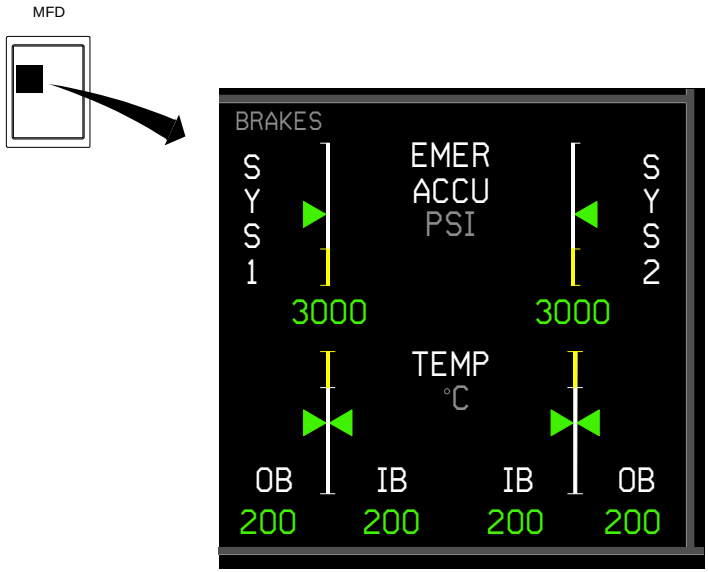


EMERGENCY/PARKING BRAKE HANDLE



EMERGENCY/PARKING BRAKE LIGHT

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TOWBARLESS TOWING PROCEDURES

Landing Gear Safety Pins..... INSTALLED

Make sure that the landing gear downlock safety pins are correctly installed on the main and nose landing gears.

Doors..... CLOSED

Close passenger doors, service doors, cargo doors and engine cowls.

Emergency/Parking Brake..... CHECK

Check if emergency/parking brake accumulator is pressurized. Pull the emergency/parking brake handle and check if emergency/parking brake light is ON.

Steering System..... DISENGAGE

Disengage the steering system setting the external steering switch to the “DISENG” position.

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EICAS Message..... CHECK

Check if the STEER OFF message is displayed on EICAS.

Ground Equipment..... CHECK

Make sure that all ground equipment is removed from areas adjacent to the airplane and all external services are disconnected from the airplane.

Tug Vehicle..... POSITION

Make sure that the tug vehicle is in the correct position near the nose wheels.

Wheel Chocks..... REMOVE

Make sure that the wheel chocks are removed.

Emergency/Parking Brake..... RELEASE

Release the emergency/parking brake of the airplane as directed by ground handling personnel. Check if emergency/parking brake light is OFF.

Tug Vehicle..... COUPLE

Make sure that the tug vehicle is coupled and correctly set to tow the airplane.

Towing..... ACCOMPLISH

Tow the airplane slowly straight ahead before turn. Complete the airplane towing in a straight line for a minimum of 3 m (10 ft) in order to align the steering as close as possible to the zero-degree position.

NOTE: Make sure that nose wheel displacement is below the maximum operational limit. Handwheel actuation with nose wheels beyond their operational limits may cause damage to the steering system.

Emergency/Parking Brake..... SET

Check if emergency/parking brake light is ON.

Tug Vehicle..... REMOVE

Make sure that the tug vehicle is away from the airplane.

Steering System..... ENGAGE

Set the external steering switch to the “ENGAGE” position.

Press and release the handwheel to engage the steering system.

EICAS Message..... CHECK

Check if the STEER OFF message is not displayed on EICAS.

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Landing Gear Safety Pins..... REMOVE

Make sure that the landing gear downlock safety pins are removed from the main and nose landing gears.

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PARKING

When parking, a minimum distance should be kept regarding other airplanes in order to permit airplane movement.

Landing gear control lever should be in the down position and downlock pins must be installed given that a landing gear retraction could occur and cause injuries to persons and damage to the equipment.

If the parking area has ice or snow, a mat, a layer of thick sand or other applicable material should be placed under the tires in order to prevent them from freezing.

Emergency/parking brake should be set to the PARKING position and flaps retracted if they are extended.

Having the airplane in the desired position, chocks may be placed against the landing gear wheels and covers for sensors may be installed.

PARKING PROCEDURE

Landing Gear lever..... CHECK

Check if landing Gear Lever is set to DOWN position.

Landing Gear Safety Pins..... INSTALLED

Make sure that the landing gear downlock safety pins are correctly installed on the main and nose landing gears.

RAT Stow Lock Pin..... INSTALLED

Make sure that the RAT is locked with stow lock pin, and the REMOVE-BEFORE-FLIGHT streamer is installed.

Airplane to Parking Position..... TAXI/TOWING

Taxi or tow the airplane to the position specified for parking. If there is ice or snow in the parking area, put a mat and a layer of thick sand or other applicable material to prevent freezing of tires on ground.

Mooring..... ACCOMPLISH, IF NECESSARY

Emergency/Parking brake..... SET

Flaps..... RETRACT

Retract the flaps if they are extended.

Covers..... INSTALL

Install covers to antennas, wheels, TAT sensor, ice-detector, smart probes, flaps trailing edge and winglets.

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MOORING

Mooring is necessary when the weather conditions are bad or unknown. The area where the airplane is to be parked in and moored must be paved and level, with ground tie down anchors available.

There is one mooring attachment point installed on each primary brace strut of the main landing gear.

MOORING PROCEDURE

Parking Procedures..... ACCOMPLISH

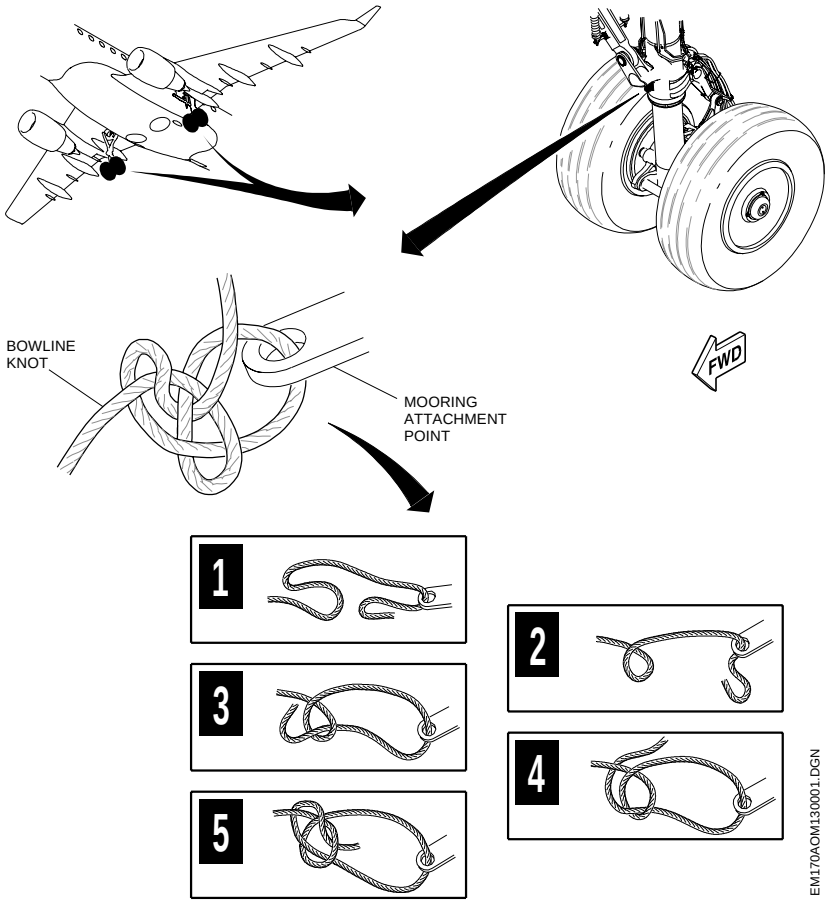
Mooring..... PROCEED

Hold the airplane in the parking area with nylon ropes. Attach the rope to the mooring attachment point and attach the anchor with a bowline knot.

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MOORING THE AIRPLANE

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GRAVITY FUELING

Emergency/Parking Brake..... ON
Chocks..... IN PLACE
Aircraft and Fuel Nozzle..... STATICALLY GROUNDED

Use an AC GPU or start the APU. If the power is not available use the fuel stick level indicator. Refer to fuel stick level indicator supplementary procedure.

NOTE: The battery use may cause its discharge.

Gravity Fill Cap (left/right)..... OPEN

Introduce the fueling nozzle into the gravity refueling adapter.

Start the fueling operation and monitor the fuel quantity in the tank.

When the fueling operation is completed:

Gravity Fill Cap (left/right)..... CLOSED

Remove the grounding cables.

PRESSURE FUELING

Emergency/Parking Brake..... ON
Chocks..... IN PLACE
Aircraft and Fuel Nozzle ..... STATICALLY GROUNDED

Use an AC GPU or start the APU and then set the POWER SELECTION switch to the NORMAL position on the refueling/defueling control panel. If AC power source is not available, set the POWER SELECTION switch to the BATTERY position. Gain access to the refueling/defueling control panel.

LH and RH refueling indication lights..... VERIFY OFF
Defueling indication light..... VERIFY OFF

For Pressure Fueling in AUTO Mode

REFUEL SELECTION switch..... AUTO

Fuel Quantity on Repeater indicator..... SET

Pressure refueling/defueling adapter assembly cap..... REMOVE

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Connect the fuel nozzle to the pressure refueling/defueling adapter assembly.

Valve handle on fuel nozzle..... OPEN

Pressurize the fuel system from 241.32 kPa - 344.74 kPa (35 psig - 50 psig).

LH and RH refueling indication lights..... VERIFY ON

Make sure that there is no fuel flow while the lights are illuminated.

REFUELING switch..... OPEN

LH and RH refueling indication lights..... VERIFY OFF

When reaching the pre-set fuel quantity:

LH and RH refueling indication lights..... VERIFY ON

Make sure that there is no fuel flow while the lights are illuminated.

REFUELING switch..... CLOSED

Valve handle on fuel nozzle..... CLOSE

Disconnect the fuel nozzle from the pressure refueling/defueling adapter assembly.

Pressure refueling/defueling adapter assembly cap..... INSTALL

For Pressure Fueling in MANUAL Mode:

REFUEL SELECTION switch..... MANUAL

Pressure refueling/defueling adapter assembly cap..... REMOVE

Connect the fuel nozzle to the pressure refueling/defueling adapter assembly.

Valve handle on fuel nozzle..... OPEN

Pressurize the fuel system from 241.32 kPa - 344.74 kPa (35 psig - 50 psig).

LH and RH refueling indication lights..... VERIFY ON

Make sure that there is no fuel flow while the lights are illuminated.

REFUELING switch..... OPEN

LH and RH refueling indication lights..... VERIFY OFF

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When reaching the required fuel quantity:

REFUELING switch..... CLOSED

LH and RH refueling indication lights..... VERIFY ON

Make sure that there is no fuel flow while the lights are illuminated.

Valve handle on fuel nozzle..... CLOSE

Disconnect the fuel nozzle from the pressure refueling/defueling adapter assembly.

Pressure refueling/defueling adapter assembly cap..... INSTALL

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DEFUELING

Airplane..... STATICALLY GROUNDED

AC GPU..... CONNECTED

Defueling Open Light (Refuel/Defuel Control Panel)..... OFF

Remove the cap from the pressure refueling/defueling adapter assembly and connect the fueling nozzle to the pressure refueling/defueling adapter assembly. Open the valve handle on the fuel nozzle.

Defueling Switch (Refuel/Defuel Control Panel)..... OPEN

Check that the defueling open light illuminates.

To defuel both wing tanks:

Crossfeed Selector Knob..... LOW 1

Fuel AC Pump 1 and 2 Selector Knobs..... ON

The fuel pumps must be in ON position if no suction on the fuel nozzle is applied.

To defuel the left wing tank:

Crossfeed Selector Knob..... OFF

Fuel AC Pump 1 Selector Knob..... ON

The fuel pump must be in ON position if no suction on the fuel nozzle is applied.

To defuel the right wing tank:

Crossfeed Selector Knob..... LOW 1

Fuel AC Pump 2 Selector Knob..... ON

The fuel pump must be in ON position if no suction on the fuel nozzle is applied.

After defueling is completed:

Defueling Switch (Refuel/Defuel Control Panel). . CLOSED

Check the defueling open light extinguished.

Crossfeed Selector Knob..... OFF

Fuel AC Pump 1 and 2 Selector Knobs..... AUTO

Remove the grounding cable and the fuel nozzle.

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FUEL TRANSFER BETWEEN WING TANKS

Emergency/Parking Brake..... ON
Chocks..... IN PLACE

Use an AC GPU or start the APU.

On the refueling/defueling control panel:

POWER SELECTION switch..... NORMAL

DEFUELING switch..... OPEN

Defueling indication light..... VERIFY ON

In the cockpit:

AC Pumps selector knobs..... AUTO

For Fuel Transfer from RH to LH Tank

REFUEL 1 Circuit Breaker..... PULL AND SAFETY

XFEED selector knob..... LOW 1

For Fuel Transfer from LH to RH Tank

REFUEL 2 Circuit Breaker..... PULL AND SAFETY

XFEED selector knob..... LOW 2

After the desired fuel transfer is completed:

XFEED selector knob..... OFF

REFUEL 1 or 2 Circuit Breaker..... RESET

On the refueling/defueling control panel:

DEFUELING switch..... CLOSED

Defueling indication light..... VERIFY OFF

FUEL MAGNETIC LEVER

The best readings are within the values:

- Pitch up:from -0.75 to 0°.
- Roll: from -0.25 up to 0.25°.

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For other ranges of airplane leveling refer to AMM Part II - Chapter 12.

LEVER INDICATION	FUEL QUANTITY					
	INTERNAL		MIDDLE		EXTERNAL	
	LITERS	US GAL	LITERS	US GAL	LITERS	US GAL
0.0	313	83	2541	671	6096	1610
0.2	334	88	2587	683	6131	1620
0.4	356	94	2632	695	6166	1629
0.6	378	100	2677	707	6200	1638
0.8	401	106	2723	719	6235	1647
1.0	423	112	2768	731	6269	1656
1.2	446	118	2813	743	6304	1665
1.4	469	124	2859	755	6338	1674
1.6	493	130	2904	767	6372	1683
1.8	516	136	2949	779	6406	1692
2.0	540	143	2995	791	6441	1702
2.2	564	149	3040	803	6475	1711
2.4	588	155	3085	815	6509	1719
2.6	613	162	3130	827	6543	1728
2.8	637	168	3176	839	6577	1737
3.0	662	175	3221	851	6610	1746
3.2	687	181	3266	863	6644	1755
3.4	713	188	3312	875	6678	1764
3.6	738	195	3357	887	6712	1773
3.8	764	202	3402	899	6745	1782
4.0	790	209	3447	911	6779	1791
4.2	816	216	3493	923	6812	1800
4.4	843	223	3538	935	6846	1809
4.6	869	230	3583	947	6879	1817
4.8	896	237	3628	958	6912	1826
5.0	923	244	3673	970	6945	1835
5.2	951	251	3719	982	6979	1844
5.4	978	258	3764	994	7012	1852
5.6	1006	266	3809	1006	7045	1861
5.8	1034	273	3854	1018	7078	1870

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LEVER INDICATION	FUEL QUANTITY					
	INTERNAL		MIDDLE		EXTERNAL	
	LITERS	US GAL	LITERS	US GAL	LITERS	US GAL
6.0	1062	281	3900	1030	7111	1879
6.2	1091	288	3945	1042	7144	1887
6.4	1119	296	3990	1054	7176	1896
6.6	1148	303	4035	1066	7209	1904
6.8	1177	311	4080	1078	7242	1913
7.0	1207	319	4126	1090	7274	1922
7.2	1236	327	4171	1102	-	-
7.4	1266	334	4216	1114	-	-
7.6	1296	342	4261	1126	-	-
7.8	1327	351	4306	1138	-	-
8.0	1357	358	4351	1149	-	-
8.2	1388	367	4397	1162	-	-
8.4	1419	375	4442	1173	-	-
8.6	1450	383	4487	1185	-	-
8.8	1481	391	4532	1197	-	-
9.0	1513	400	4577	1209	-	-
9.2	1545	408	4622	1221	-	-
9.4	1577	417	4667	1233	-	-
9.6	1609	425	4713	1245	-	-
9.8	1642	434	4758	1257	-	-
10.0	1674	442	4803	1269	-	-
10.2	1707	451	4848	1281	-	-
10.4	1741	460	4893	1293	-	-
10.6	1774	469	4938	1304	-	-
10.8	1808	478	4983	1316	-	-
11.0	1841	486	5028	1328	-	-
11.2	1876	496	5073	1340	-	-
11.4	1910	505	5119	1352	-	-
11.6	1944	514	5164	1364	-	-
11.8	1979	523	5209	1376	-	-
12.0	2014	532	5254	1388	-	-
12.2	2049	541	5299	1400	-	-

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LEVER INDICATION	FUEL QUANTITY					
	INTERNAL		MIDDLE		EXTERNAL	
	LITERS	US GAL	LITERS	US GAL	LITERS	US GAL
12.4	2085	551	5344	1412	-	-
12.6	2121	560	5389	1424	-	-
12.8	2156	570	5434	1436	-	-
13.0	2193	579	5479	1447	-	-
13.2	2229	589	5524	1459	-	-
13.4	2265	598	5569	1471	-	-
13.6	2302	608	5614	1483	-	-
13.8	2339	618	5659	1495	-	-
14.0	2377	628	5704	1507	-	-
14.2	2414	638	5749	1519	-	-
14.4	2452	648	5794	1531	-	-
14.6	2490	658	5839	1543	-	-
14.8	2528	668	5884	1554	-	-
15.0	2566	678	5929	1566	-	-
15.2	2605	688	5974	1578	-	-
15.4	2643	698	6019	1590	-	-
15.6	2683	709	6064	1602	-	-
15.8	2722	719	6109	1614	-	-
16.0	2761	729	6154	1626	-	-
16.2	2801	740	6199	1638	-	-
16.4	2841	751	6244	1649	-	-
16.6	2881	761	6289	1661	-	-
16.8	2921	772	6334	1673	-	-
17.0	2962	782	6379	1685	-	-
17.2	3003	793	6424	1697	-	-
17.4	3044	804	6469	1709	-	-
17.6	3085	815	6514	1721	-	-
17.8	3127	826	6559	1733	-	-
18.0	3169	837	6604	1745	-	-
18.2	3210	848	-	-	-	-
18.4	3253	859	-	-	-	-
18.6	3295	870	-	-	-	-

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LEVER INDICATION	FUEL QUANTITY					
	INTERNAL		MIDDLE		EXTERNAL	
	LITERS	US GAL	LITERS	US GAL	LITERS	US GAL
18.8	3338	882	-	-	-	-
19.0	3381	893	-	-	-	-
19.2	3424	905	-	-	-	-
19.4	3467	916	-	-	-	-
19.6	3511	928	-	-	-	-
19.8	3554	939	-	-	-	-
20.0	3598	950	-	-	-	-
20.2	3642	962	-	-	-	-
20.4	3687	974	-	-	-	-
20.6	3732	986	-	-	-	-
20.8	3776	998	-	-	-	-
21.0	3822	1010	-	-	-	-
21.2	3867	1022	-	-	-	-
21.4	3912	1033	-	-	-	-
21.6	3958	1046	-	-	-	-
21.8	4004	1058	-	-	-	-
22.0	4050	1070	-	-	-	-

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REFUELING WITH ONE ENGINE RUNNING

Refueling the airplane with an engine running is a special procedure and should be kept to a minimum. Apart from the risk of fire, there is the risk posed for the maintenance and other personnel who are required to move around the airplane. There may be circumstances in which an Airport Authority agrees with a detailed procedure that offers an acceptable level of safety to all parts involved. This would, however, be a matter between the Airport Authority and the individual operator. Therefore, contact the Airport Authority prior to performing this operation and/or obtain the necessary approval from the operations inspector.

BASIC STATEMENTS

- This procedure must only be used when the APU is unserviceable and no ground pneumatic power is available at the airport;
- Only pressure refueling is permitted;
- Normal refueling electrical bonding procedures between the aircraft and the refueling equipment must be performed. Refer to AMM Part II Chapter 20;
- Refueling is permitted to a maximum volume of 90% of each tank capacity;
- Refueling should account for the additional fuel consumption of the operating engine to avoid jeopardizing flight autonomy and the fuel tanks balance;
- At least one pilot must remain in the cockpit throughout the refueling procedure. This pilot should be responsible for informing all flight and ground crew that the airplane is being refueled and the engine is running;
- The airplane must be parked in an area designated by the Airport Authority;
- Coordination with the Airport Authority on the possibility of the Airport Fire Department to standby the airplane during the refueling procedure should be conducted;
- Maintenance and other servicing operations are prohibited during the refueling procedure;
- Qualified personnel on board of the airplane must be prepared for an immediate emergency evacuation;

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– Smoking and the use of portable electronic devices is prohibited during the refueling, both inside and outside the cabin;

To refuel the airplane with an engine running, proceed as follows:

– Obtain ATC clearance;

– Shut down engine 2 and set engine 1 to idle;

– Whenever practical, turn off pack 2 when using the air conditioning system. This avoids blowing hot air from the pack 2 heat exchangers exhaust towards the refueling personnel;

– Deplane all passengers through the forward service door (1R) and suspend all ground support operations; ensure the passengers and personnel are directed away from the operating engine;

– Ensure at least one jetway door is open and a passenger stairs or bridge is connected to it;

– Set all airplane systems before initiating refueling in order to avoid moving controls during refueling. Avoid turning switches to on, except those required to operate the fuel system. Sparks of any kind must be avoided;

– Maintain all electric/electronic equipment unnecessary to the operation de-energized;

– Follow the PRESSURE FUELING procedure, as specified earlier in this section, disregarding the instruction to use either a GPU or the APU as power source;

– Monitor the fuel quantity indications throughout procedure;

– In case of fuel spillage, shut down the operating engine immediately;

– Once the refueling is completed, authorize the ground support teams to proceed with cleaning, cargo loading, galley loading, etc; always by the opposite side of the operating engine;

– Proceed with passengers boarding through 1R door.

NOTE: At stations where a passenger bridge is available, the use of the main passenger door in lieu of the forward service door for passengers planning/deplaning is subject to the Airport Authority approval.

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REFUELING WITH APU RUNNING

If the APU is operating during refueling, in case of an APU fire:

- Stop the refueling operation.
- Accomplish the APU FIRE procedure.

In case of fuel spillage:

- Stop the refueling operation.
- Shut down the APU.
- Do not start the APU until the spillage is removed.

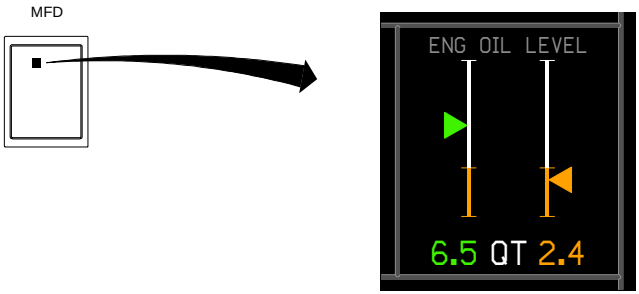
NOTE: – Do not start the APU during refueling/defueling procedures after an automatic shutdown or a failed start of the APU.
– If fuel spillage occurs, stop the APU and do not start it again.

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ENGINE OIL SERVICING

Engine oil check may be done from 15 min up to 2 h after engine stop. After 2 h from the last engine stop, it is necessary to start the engine to do the oil level check again.

The oil level can be checked in the MFD Status page or directly in the engine.



ENGINE OIL INDICATION ON MFD

The oil level check direct in the engine is performed removing the oil tank access door. A sight glass shows oil level. It is not necessary to energize the airplane for oil level check.

Engine oil is toxic and flammable, use personal protection equipment and manipulate the oil in a well-ventilated area.

ENGINE OIL LEVEL CHECK - MFD

Power Up..... ACCOMPLISH

MFD..... SET

Select the Status Page on the MFD positioning the cursor at the Systems menu.

Engine Oil Level..... CHECK

Check if the engine oil level in Full position. Fill the engine oil if necessary.

Power Off..... ACCOMPLISH

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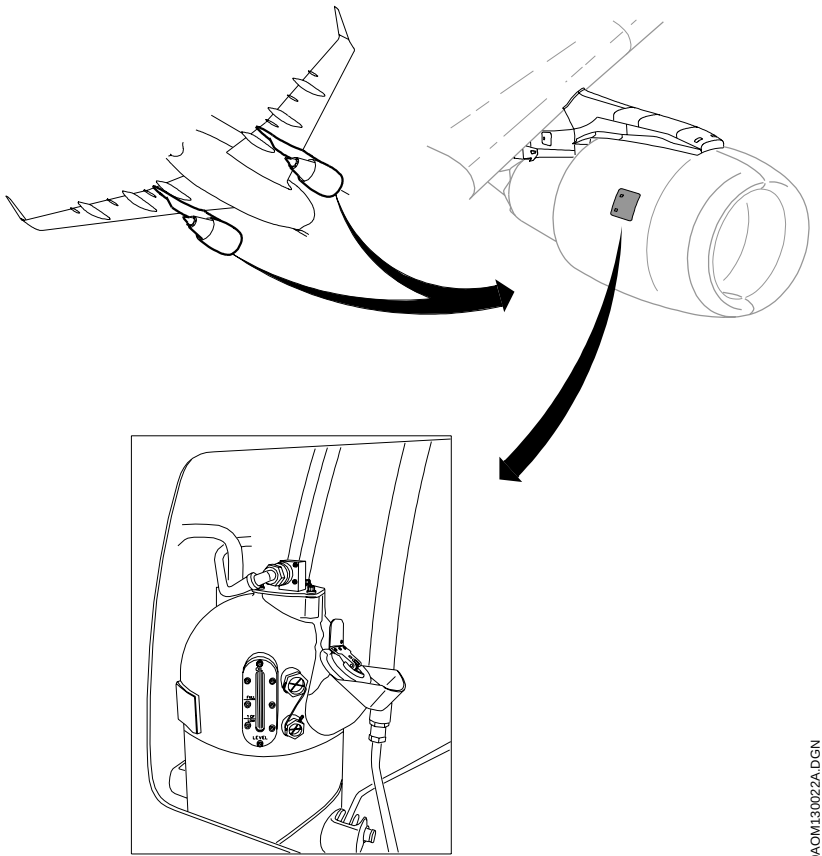
ENGINE OIL - FILLING

Access Panels..... OPEN
Engine-Oil Filler Cap..... OPEN
Follow the instructions on the cap.
Oil Reservoir..... FILL
Engine-Oil Filler Cap..... CLOSE
Follow the instructions on the cap.
Access Panels..... CLOSE

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ENGINE OIL LEVEL CHECK

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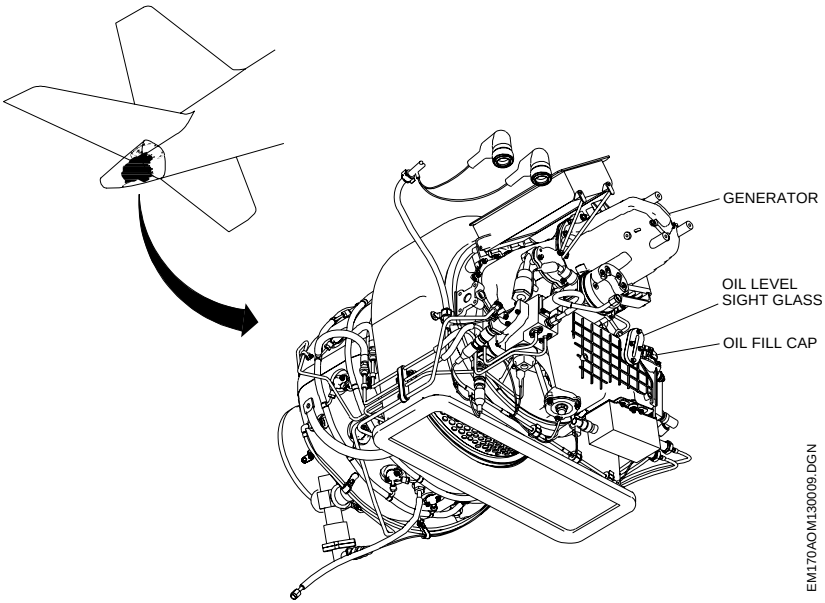
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APU OIL SERVICING

APU oil tank servicing is done through the access at the airplane tail cone, which provides access to a sight glass and an oil filler cap when open.

The sight glass has a FULL indication that must never be exceeded. The APU oil capacity is 3.90 ℓ (4.12 qt).



APU OIL LEVEL CHECK

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APU OIL LEVEL CHECK

APU selector knob..... OFF

AC GPU..... CONNECT

Power Up..... ACCOMPLISH

Circuit Breakers..... OPEN

Open the following circuit breakers on the MCDU:

- APU START CMD-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FADEC-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FUEL SOV OPN-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)

Access Panel..... REMOVE

Inlet Silencer ..... UNLATCH AND OPEN

Oil Level Sight Glass..... CHECK

The oil level must be between the FULL mark and ADD mark on the oil level sight glass. Fill the oil system to the FULL mark on the oil level sight glass, if necessary.

Inlet Silencer ..... CLOSE AND LATCH

Access Panel..... INSTALL

Circuit Breakers..... CLOSE

Close the following circuit breakers on the MCDU:

- APU START CMD-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FADEC-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FUEL SOV OPN-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)

Power Off..... ACCOMPLISH

AC GPU..... DISCONNECT

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APU OIL FILLING

APU selector knob..... OFF
AC GPU..... CONNECT
Power Up..... ACCOMPLISH
Circuit Breakers..... OPEN

Open the following circuit breakers on the MCDU:

- APU START CMD-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FADEC-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FUEL SOV OPN-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)

Access Panel..... REMOVE
Inlet Silencer ..... UNLATCH AND OPEN
Magnetic Drain Plug..... INSTALLED
APU Oil Fill Cap..... OPEN
Oil Reservoir..... FILL

Fill the oil system to the FULL mark on the oil level sight glass.

APU Oil Fill Cap..... CLOSE AND LOCK

Inlet Silencer ..... CLOSE AND LATCH
Access Panel..... INSTALL
Circuit Breakers..... CLOSE

Close the following circuit breakers on the MCDU:

- APU START CMD-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FADEC-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)
- APU FUEL SOV OPN-SPDA2 (CBMENU/CB BY SYSTEM/CB SYSTEM-APU)

Power Off..... ACCOMPLISH
AC GPU..... DISCONNECT

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TIRE PRESSURE CHECK

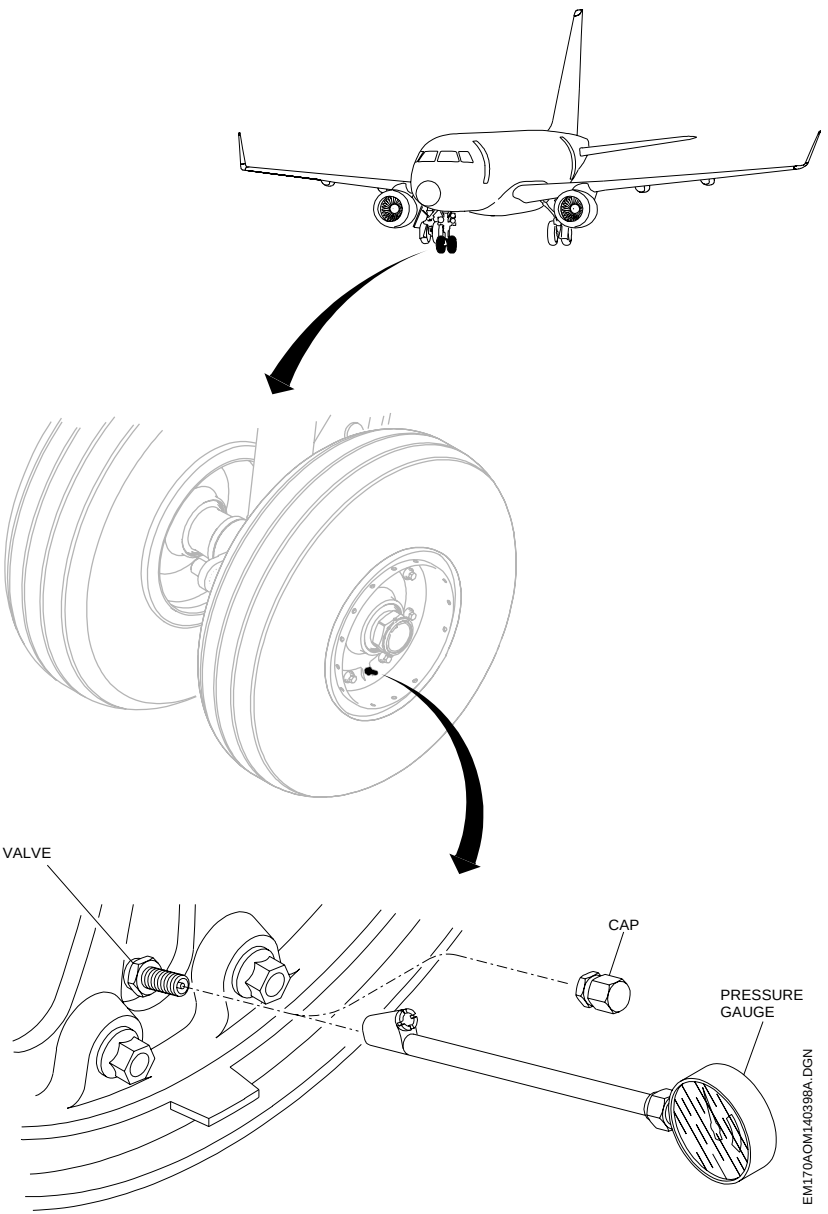
The procedure is the same for the tires of the left and the right MLG.

Do not go near the airplane's tires while it is hot. If the measure of tires temperature is necessary, go to them from the front. There is tire explosion risk while tire is hot.

Tire pressure must be measured with the tires cold and on ground.

A calibrated pressure gauge is necessary to check the pressure gauge.

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PRESSURE CHECK

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MAIN LANDING GEAR TIRE PRESSURE CHECK

Tire Temperature..... CHECK

Check if the tire temperature is the same as the ambient temperature.

Wheel's Valve Cap..... REMOVE

Pressure Gauge..... CONNECT

Pressure..... CHECK

Tire pressure must be between 157 psi (1082 kPa) and 167 psi (1151 kPa) with airplane on ground.

If tire pressure is at (or close to) the bottom limit of the range, it is recommended to inflate the tire to 167 psi (1151 kPa).

With the airplane on jack, the pressure in the tire must be 4% lower than the pressure with airplane on ground.

If the temperature at destination airport is lower than the temperature at the departure airport and the difference is greater than 25°C (77°F), increase the tire pressure by 1% for each 3°C (5.4°F) of temperature difference.

Pressure Gauge..... DISCONNECT

If tire pressure is between 142 psi (979 kPa) and 157 psi (1082 kPa) connect the hose of tire inflation trolley to the valve on the wheel and adjust the pressure. Replacement of wheel is necessary for tire pressures below 142 psi (979 kPa). Refer to AMM.

Leakage..... CHECK

Check if there is no gas leakage from the valve.

Wheel's Valve Cap..... INSTALL

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NOSE LANDING GEAR TIRE PRESSURE CHECK

Tire Temperature..... CHECK

Check if the tire temperature is the same as the ambient temperature.

Wheel's Valve Cap..... REMOVE
Pressure Gauge..... CONNECT
Pressure..... CHECK

Tire pressure must be between 131 psi (903 kPa) and 141 psi (972 kPa) with airplane on ground.

If tire pressure is at (or close to) the bottom limit of the range, it is recommended to inflate the tire to 141 psi (972 kPa).

If the temperature at destination airport is lower than the temperature at departure airport and the difference is greater than 25°C (77°F), increase the tire pressure by 1% for each 3°C (5.4°F) of temperature difference.

Pressure Gauge..... DISCONNECT

If tire pressure is above 141 psi (972 kPa), adjust the tire pressure to maximum of usual range.

If tire pressure is between 118 psi (813 kPa) and 131 psi (903 kPa), connect the hose of tire inflation trolley to the valve on the wheel and adjust the pressure. Replacement of wheel is necessary for tire pressures below 118 psi (813 kPa). Refer to AMM.

Leakage..... CHECK

Check if there is no gas leakage from the valve.

Wheel's Valve Cap..... INSTALL

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BRAKE WEAR INDICATOR CHECK PROCEDURE

Wheel Chock..... IN PLACE

Put the wheel chocks around all tires.

Emergency/Parking Brake..... RELEASE

External AC Power..... CONNECT

Connect the external AC power supply to the airplane.

Hydraulic Systems 1 & 2..... PRESSURIZE

Emergency/Parking Brake..... SET

Set the emergency/parking brake handle totally to the parking position.

Brake Wear Pins..... CHECK

Brake wear indicators flush with the bracket outer face or less indicate necessity of brakes replacement. Check both main landing gear brakes.

Emergency/Parking brake..... RELEASE

Hydraulic Systems 1 & 2..... DEPRESSURIZE

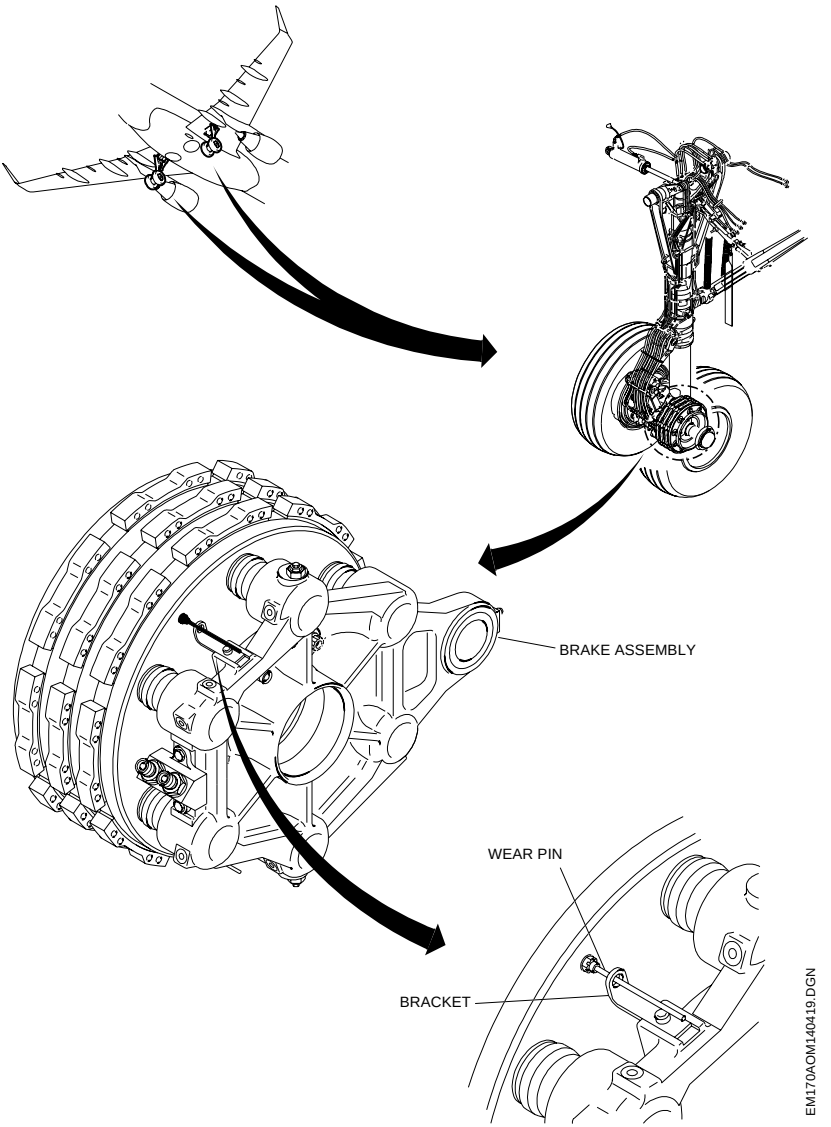
External AC Power..... DISCONNECT

Disconnect the external AC power supply from the airplane.

Emergency/Parking Brake..... SET

Wheel Chock..... REMOVE

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BRAKE WEAR INDICATOR CHECK

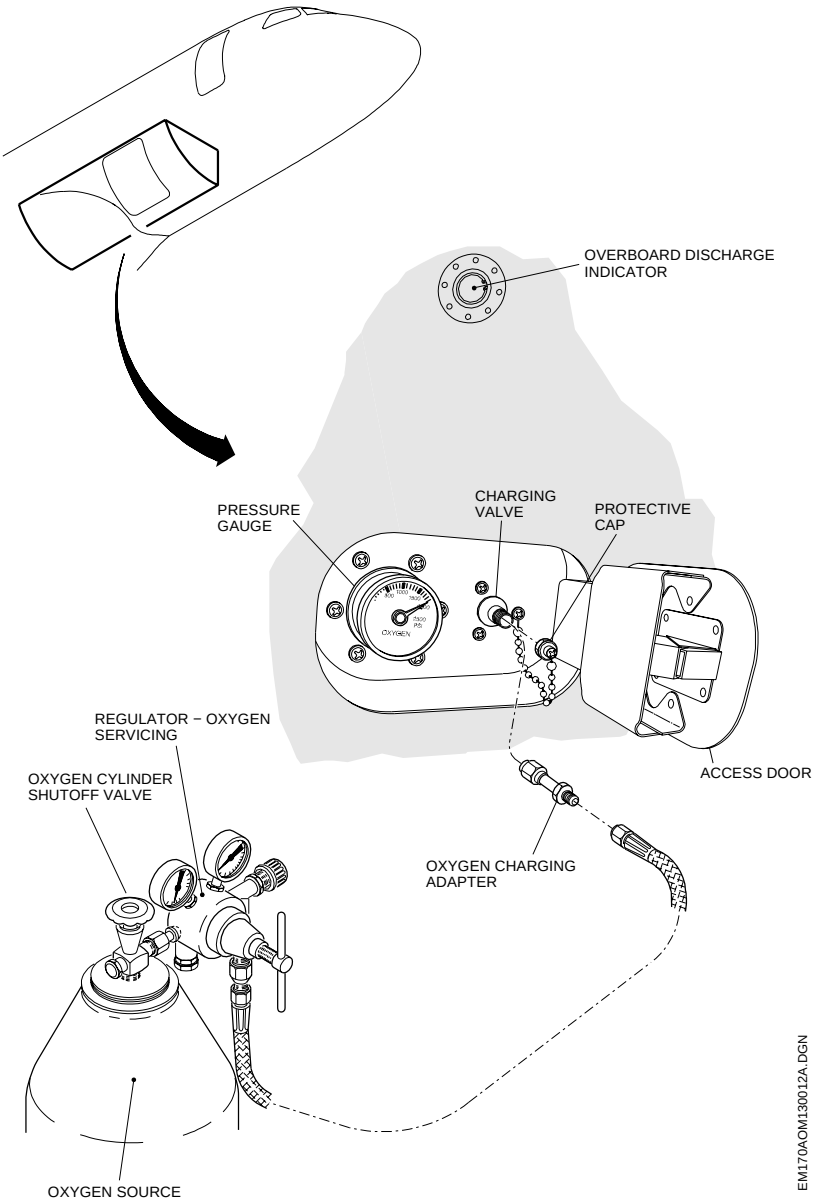
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OXYGEN

Flight crew oxygen is provided via a conventional, high-pressure, gaseous-type system in which the oxygen is stored in a standard 50-cu.ft., or an optional 77-cu. ft. cylinder, pressurized to 1850 psi at 21°C/70°F. The cylinder is installed in the forward cargo compartment.

When servicing crew oxygen, shutoff valve on the oxygen cylinder should be open slowly; otherwise oxygen can become hot and can cause sudden combustion.

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CREW OXYGEN REFILL POINT LOCATION

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CREW OXYGEN FILLING

Refill Point Location Access Door..... OPEN

Protective Cap..... REMOVE

Connect the oxygen source to the cockpit oxygen cylinder charging valve, make sure that there is no leakage and do not let oil, grease, flammable solvents, dust metal filings and others materials that burn touch the components that will be open to pressurized oxygen.

Fill the cockpit oxygen cylinder slowly until it reaches the required pressure.

Gauge Pressure..... MONITOR

After reaching the required pressure, carefully disconnect the oxygen source from the charging valve and make sure that there is no leakage.

NOTE: The filling nominal pressure is 1850 psi at an ambient temperature of 21°C (70°F). For other temperature values, refer to Oxygen Pressure Correction Chart.

Refill Point Location Access Door..... CLOSE

MINIMUM CREW OXYGEN PRESSURE FOR DISPATCH

Minimum oxygen pressure for dispatch in the cockpit oxygen cylinder is depicted below:

	Minimum Pressure for Dispatch (psi)	
Number of Flight Crewmembers in the Cockpit	Oxygen Cylinder Volume (ft^3)	
	50	77
2 (pilot and co-pilot)	1190	842
3 (pilot, co-pilot and observer)	1664	1150

NOTE: The minimum crew oxygen pressure for dispatch was calculated at an ambient temperature of 21°C (70°F). If reading the External Gauge, for other temperature values, refer to Oxygen Pressure Correction Chart.

CREW OXYGEN PRESSURE CHECK - EXTERNAL

Refill Point Location Access Door..... OPEN

CONTINUED...

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Gauge Pressure..... CHECK

Read the oxygen pressure gauge to make sure that the oxygen pressure is above the minimum required for dispatch. If necessary, fill the cockpit oxygen cylinder.

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

Refill Point Location Access Door..... CLOSE

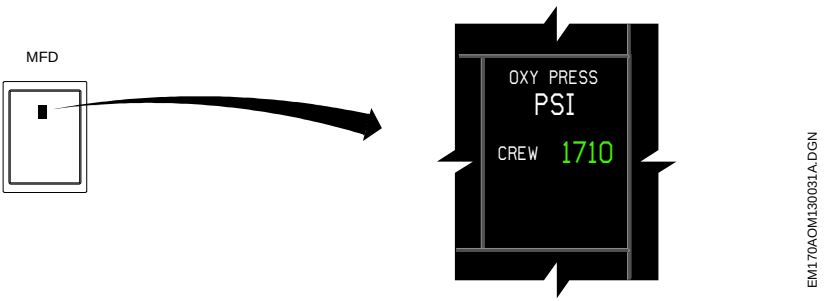
CREW OXYGEN PRESSURE CHECK - COCKPIT

Power Up..... ACCOMPLISH

MFD..... SET

Select the Status Page on the MFD, which provides oxygen pressure indication.

►*Commercial airplanes equipped with MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*



◄

Crew Oxygen Pressure..... CHECK

Check the crew oxygen pressure range according to the following colors definition:

– Digital Pressure GREEN/Scale WHITE/Pointer GREEN: Normal operating range.

  • Crew Oxygen Pressure: minimum for dispatch with three crew members in the cockpit.

– Digital Pressure CYAN/Scale CYAN/Pointer CYAN: Advisory operating range.

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- Crew Oxygen Pressure: minimum for dispatch with two crew members in the cockpit.

– Digital Pressure AMBER/Scale AMBER/Pointer AMBER: Cautionary operating range.

- Crew Oxygen Pressure: dispatch is not allowed.

Power Off..... ACCOMPLISH

CREW OXYGEN PRESSURE CORRECTION CHART

An Oxygen Pressure Correction Chart is provided for maintenance personnel or flight crew use when recharging the oxygen cylinder. Additionally, it may be used to check if the oxygen cylinder pressure is above the minimum oxygen pressure for dispatch.

To use the chart for recharging purposes:

– Enter the chart with the ambient temperature then go vertically up to the desired pressure at 21°C. From the intersection point, trace to the left to read the indicated gauge pressure to be attained.

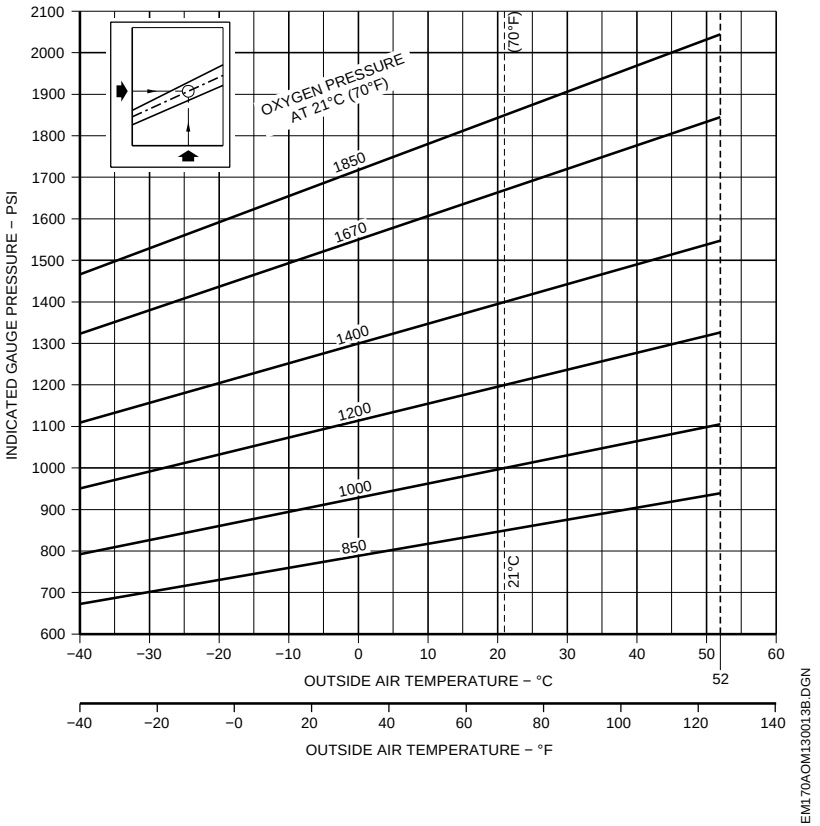
To use the chart for dispatching purposes:

– Enter the chart simultaneously with the ambient temperature and indicated gauge oxygen pressure. The intersection determines the oxygen cylinder equivalent pressure at 21°C, by interpolating the two adjacent standard curves.

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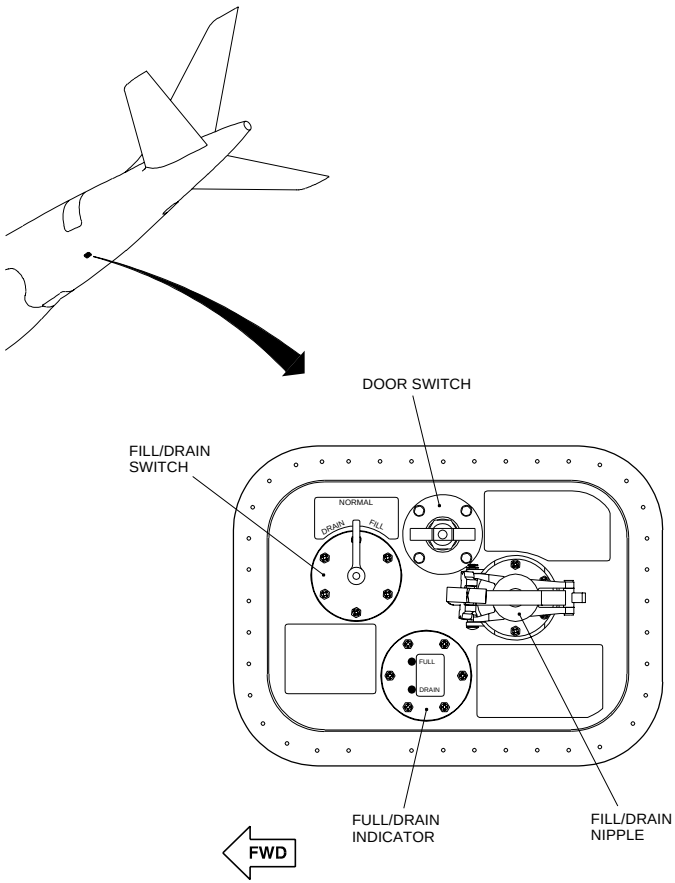
CREW OXYGEN PRESSURE CORRECTION CHART

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POTABLE WATER TANK SERVICING

Potable water tank filling and draining is done through a panel installed on the rear left side of the fuselage.

CAUTION: DO NOT TOUCH THE DRAIN MAST, IT HAS A HEATER INSTALLED AND CAUSES BURNS.



POTABLE WATER TANK DRAINING AND FILLING

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POTABLE WATER TANK FILL

AC GPU..... CONNECT
Power Up..... ACCOMPLISH
MID Avionics Compartment..... ACCESS
Open the access panel and open and remove the access door.
Circuit Breakers..... CHECK
Check if the following circuit breakers are closed:
- WATER WASTE HTR-LICC (AC GND SVC BUS)
- WATER WASTE CTRL1-LICC (DC GND SVC BUS)
- WATER WASTE CTRL2-LICC (DC BUS 1)
- SPDA1 AC GND SVC-LICC (AC GND SVC BUS)

Aft Avionics Compartment..... ACCESS
Open the access door.
Circuit Breakers..... CHECK
Check if the following circuit breaker is closed:
- WATER WASTE CTRL3-AICC (HOT BATT BUS 2)

Potable Water Access Door..... OPEN
Protection Cap..... REMOVE
Remove the protection cap from the fill/drain nipple.
Hose..... CONNECT
Connect the hose to the water fill/drain nipple.
Fill/Drain Switch..... FILL
Fill the tank with water until the full/drain indicator shows FULL.
Aft Flight Attendant Panel..... CHECK
Check if the potable water level is correct on the aft FAP.
Fill/Drain Switch..... NORMAL
Water Supply..... CLOSE
Hose..... DISCONNECT
Protection Cap..... INSTALL
Let all excess water drain out before close the fill/drain nipple. Install the protection cap in the fill/drain nipple.
Power Off..... ACCOMPLISH
AC GPU..... DISCONNECT
Aft Avionics Compartment..... CLOSE
Mid Avionics Compartment ..... CLOSE

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Install and close the access door and close the access panel.

Potable Water Access Door..... CLOSE AND LATCH

POTABLE WATER TANK DRAIN

AC GPU..... CONNECT

Power Up..... ACCOMPLISH

MID Avionics Compartment..... ACCESS

Open the access panel and open and remove the access door.

Circuit Breakers..... CHECK

Check if the following circuit breakers are closed:

- WATER WASTE HTR-LICC (AC GND SVC BUS)
- WATER WASTE CTRL1-LICC (DC GND SVC BUS)
- WATER WASTE CTRL2-LICC (DC BUS 1)
- SPDA1 AC GND SVC-LICC (AC GND SVC BUS)

Aft Avionics Compartment..... ACCESS

Open the access door.

Circuit Breakers..... CHECK

Check if the following circuit breaker is closed:

- WATER WASTE CTRL3-AICC (HOT BATT BUS 2)

Potable Water Access Door..... OPEN

Protection Cap..... REMOVE

Remove the protection cap from the fill/drain nipple.

Hose..... CONNECT

Connect the hose to the water fill/drain nipple. Use a container for liquids as auxiliary equipment to drain the water tank.

Fill/Drain Switch..... DRAIN

Make sure that the full/drain indicator shows DRAIN. Let all the water drain.

Aft Flight Attendant Panel..... CHECK

Check if the potable water level is correct on the aft FAP.

Fill/Drain Switch..... NORMAL

Water Supply..... CLOSE

Hose..... DISCONNECT

Protection Cap..... INSTALL

Let all excess water drain out before close the fill/drain nipple. Install the protection cap in the fill/drain nipple.

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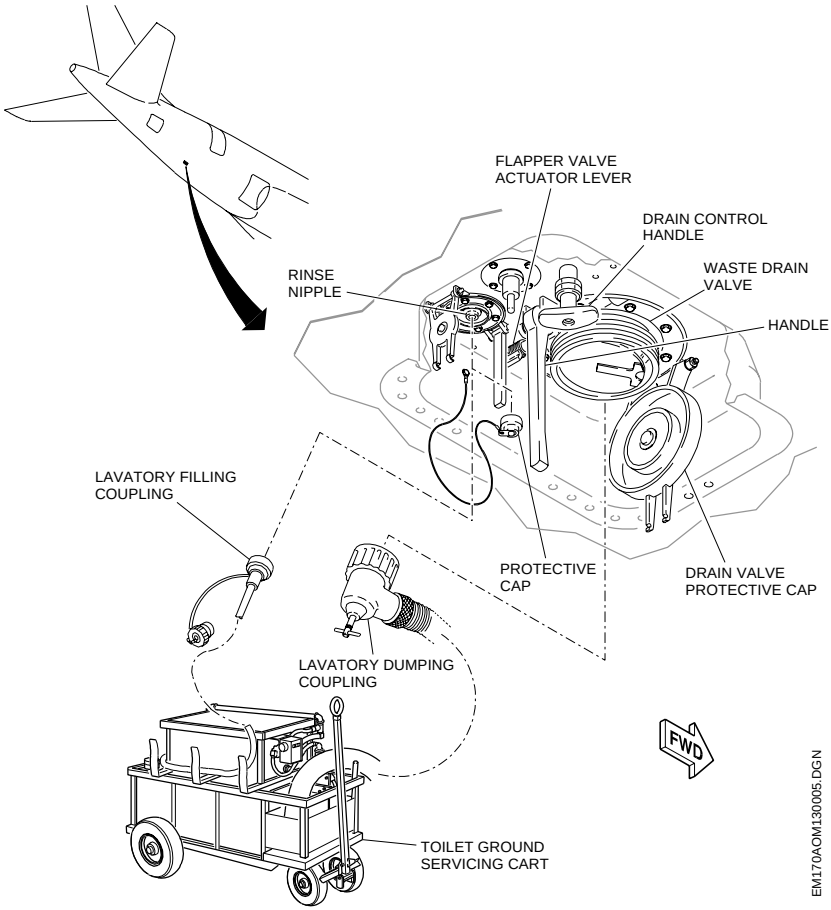
Power Off..... ACCOMPLISH
AC GPU..... DISCONNECT
Aft Avionics Compartment..... CLOSE
MID Avionics Compartment..... CLOSE
Install and close the access door and close the access panel.
Potable Water Access Door..... CLOSE AND LATCH

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WASTE TANK SERVICING

Toilet waste disposal servicing is accomplished by accessing a panel on the rear right side of the fuselage.

Do not let the toilet system cleaner touch the eyes or skin. If it happens, flush the eyes or skin with water and get medical aid.



WASTE TANK SERVICING

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WASTE TANK SERVICING PROCEDURES

Waste Tank Panel Door..... OPEN

Handle..... PULL

Drain Valve Protective Cap..... OPEN

Lavatory Dumping Coupling..... INSTALL

Install the lavatory dumping coupling in the waste drain valve. Check if the lavatory dumping coupling is correctly installed.

Rinse Nipple Protective Cap..... REMOVE

Lavatory Filling Coupling..... INSTALL

Install the lavatory filling coupling in the rinse nipple.

Flapper Valve Actuator..... PUSH

Push the flapper-valve actuator lever to open the waste drain valve.

Drain Control Handle..... PULL

Pull the drain control handle to empty the waste tank.

Rinse Fluid..... SUPPLY

Make sure that the waste tank is completely drained before you start to supply the rinse fluid. Supply the rinse fluid for at least 2 min.

Pre-charge the waste tank with 6 - 8 ℓ(1.6 US Gal - 2.1 US Gal) of rinse fluid.

Drain Control Handle..... PUSH

Flapper Valve Actuator..... PULL

Lavatory Filling Coupling..... REMOVE

Rinse Nipple Protective Cap..... INSTALL

Lavatory Dumping Coupling..... INSTALL

Slowly remove the lavatory dumping coupling from the waste drain valve.

Drain Valve Protective Cap..... CLOSE

Handle..... LOCK

Waste Tank Panel..... CLEAN

Waste Tank Panel Door..... CLOSE AND LATCH

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GENERAL

The purpose of this chapter is to provide flight crew with information and procedures to clear nuisance EICAS messages and miscellaneous nuisance faults detected during power on and other ground operations.

This chapter does not cover all messages/faults that may be detected on the airplane. Any message/fault not covered by this document must be reported to the maintenance personnel.

Standard procedures must be established to instruct the flight crew how to proceed when a nuisance message/fault is presented before starting to follow this chapter after dispatch. These procedures may vary for different airports.

This chapter is organized in a four-column table, as follows:

– ATA column: gives the ATA number for the related message/fault;
– EICAS MESSAGE/CONDITION column: provides the EICAS messages/faults or fault condition, alphabetically ordered;
– MSG LEVEL/LOCATION column: indicates the type of the message displayed – for EICAS messages – or the location of the fault or annunciation:
  – W for EICAS warning message;
  – C for EICAS caution message;
  – A for EICAS advisory message;
  – S for EICAS status message.
– PROCEDURES column: provides the proper procedures required to clear the nuisance EICAS message/fault. It may also provide the effectivity of the procedure and/or Fault Condition in which the procedure applies.

NOTE: – In the effectivity field, airplanes defined as E170 comprises EMBRAER 170 and 175, and the airplanes defined as E190 comprises EMBRAER 190 and 195. If no effectivity is referenced, the procedure is applicable to the E170 and E190.

This chapter is based on the FAULT ISOLATION MANUAL (FIM). Therefore, in case a discrepancy is found between this chapter and FIM, the FIM shall prevail.

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The final solution for most of these nuisance messages/faults requires software upgrades of specific equipments. As soon as the final solutions become available and incorporated in the fleet, the related procedures will be removed.

NOTE: This chapter should be used for reference only. Special approval from regulatory authorities must be granted to use the information contained herein.

LIMITATIONS

This chapter shall be used under the following condition:

– Airplane on the ground with parking brake set;

– Each procedure may be executed only once. If the nuisance EICAS message/fault is not cleared, if applicable, the maintenance personnel must be notified to clear the condition.

– Effectivity and Fault Condition must be observed.

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GROUND RESET PROCEDURES

MAU SAFETY PROCEDURES

This procedure must be accomplished when a reset of the MAU 1, 2 or 3 is necessary.

MAU 1 OR 3 RESET

If APU is running and MAU 3 PWR 1 CB is to be opened:

Electrical..... ON GPU

APU..... SHUTDOWN

Electric Hydraulic Pumps 1, 2, 3A and 3B..... OFF

Both Engines..... SHUTDOWN

NOTE: – Shut down the engines before attempting a MAU reset in order to avoid engine related messages being displayed on the EICAS.

– When resetting the MAU 1 or 3, the SPOILER FAULT and A-I WING FAIL EICAS messages may be displayed.

When all procedures have been completed:

Electric Hydraulic Pumps 1, 2 and 3B..... AUTO

Electric Hydraulic Pump 3A..... OFF

APU..... AS REQUIRED

Engines..... AS REQUIRED

MAU 2 RESET

Both Engines..... SHUTDOWN

NOTE: Shut down the engines before attempting a MAU reset in order to avoid engine related messages being displayed on the EICAS.

When all procedures have been completed:

Engines..... AS REQUIRED

AIRPLANE POWER RESET

This procedure is to be considered when a complete power reset (power down – power up) is necessary.

Emergency/Parking Brakes..... SET

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Electric Hydraulic Pumps 1, 2 and 3B..... AUTO
Electric Hydraulic Pumps 3A..... OFF
Electrical..... ON GPU/APU
Thrust Levers..... IDLE
Start/Stop Selector knobs 1 and 2..... STOP
Hydraulic System 1, 2 and 3 Pressure..... BELOW 500 PSI

NOTE: – Do not move the flight controls surfaces to lower the hydraulic pressure.
– Moving the flight controls surfaces will speed up the hydraulic pressure bleed down process but may cause a discrepancy between surface position and yoke command triggering the FLT CTRL NO DISPATCH message on the EICAS.

Electrical..... OFF GPU/APU

If APU is available turn the APU OFF by selecting the APU Master Selector knob to OFF and after the 2 minute cool down period, wait until the APU RPM drops below 3%, before positioning both battery selectors to OFF.

NOTE: For airplanes Post-Mod SB 170-49-0003 or SB 190-49-0001 (APU FADEC 02.00) or with an equivalent modification factory incorporated, the cooldown period is 1 minute, followed by a spooldown period. The EICAS message APU SHUTTING DOWN disappears at the end of spool down period, afterwards turn both battery selectors to the OFF position.

If a GPU is available, push out the GPU button.

Batteries 1 and 2..... OFF

Wait 1 minute.

Power up using normal procedures.

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NUISANCE EICAS MESSAGE OR FAULT

NOTE: Some procedures may require the reset of more than one CB. In these cases, unless specified, the CBs can be reset one by one or open all of them at one time then reset all of them next.

ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
23	ACARS Frozen	A C A R S	**Effectivity:** Airplanes with CMF. **CAUTION:** MAKE SURE THAT THE INTEGRATED PITOT/STATIC/AOA SENSORS, TAT SENSORS, ICE DETECTORS AND STATIC PORTS HAVE NO COVERS ON THEM BEFORE ACCOMPLISHING THIS PROCEDURE. THESE COMPONENTS CAN BECOME HOT DURING THIS PROCEDURE DAMAGING THEM. **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CBs, wait 5 seconds, then reset: RHCBP MAU 3 PWR 2
34	ADS 1 FAIL	C	Open the following CBs, wait 5 seconds, then reset: LHCBP ADS 1 PROBE 1A-2A LHCBP ADS FC PROBE 1B-2B
34	ADS 2 (3) FAIL	C	Open the following CBs, wait 5 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 3B RHCBP ADS 3/STBY PROBE 4B

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
30	ADS 1 HTR FAIL	C	**Fault Condition:** During power-up. Open the following CBs, wait 30 seconds, then reset: LHCBP ADS 1 PROBE 1A-2A LHCBP ADS FC PROBE 1B-2B
30	ADS 2 HTR FAIL	C	**Fault Condition:** During power up. Open the following CBs, wait 30 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 3B RHCBP ADS 3/STBY PROBE 4B
30	ADS 3 HTR FAIL	C	**Fault Condition:** During power-up. Open the following CBs, wait 30 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 3B RHCBP ADS 3/STBY PROBE 4B
30	ADS 4 HTR FAIL	C	**Fault Condition:** During power-up. Open the following CBs, wait 30 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 3B RHCBP ADS 3/STBY PROBE 4B
30	ADS 1 HTR FAULT	A	**Fault Condition:** During power-up. Open the following CBs, wait 30 seconds, then reset: LHCBP ADS 1 PROBE 1A-2A LHCBP ADS FC PROBE 1B-2B

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
30	ADS 2 HTR FAULT	A	**Fault Condition:** During power-up. Open the following CBs, wait 30 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 3B RHCBP ADS 3/STBY PROBE 4B
34	ADS 3 (4) SLIPCOMP FAIL	A	Open the following CBs, wait 5 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 3B RHCBP ADS 3/STBY PROBE 4B
34	ADS PROBE 1 (2) FAIL	A	**Fault Condition 1:** Message displayed any time until Clear Into Position and ADS 1 FAIL caution message is not displayed. Power down then power up the airplane, using the Airplane Power Reset procedures. **Fault Condition 2:** Message displayed upon landing. Open the following CBs, wait 5 seconds, then reset: LHCBP ADS 1 PROBE 1A-2A LHCBP ADS FC PROBE 1B-2B

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
34	ADS PROBE 3 FAIL	A	**Fault Condition 1:** Message displayed any time until Clear Into Position and ADS 2 FAIL and ADS 3 FAIL caution messages are not displayed. Power down then power up the airplane, using the Airplane Power Reset procedure. **Fault Condition 2:** Message displayed upon landing. Open the following CBs, wait 5 seconds, then reset: RHCBP ADS 2 PROBE 3A RHCBP ADS 3/STBY PROBE 3B
34	ADS PROBE 4 FAIL	A	**Fault Condition 1:** Message displayed any time until Clear Into Position and ADS 2 FAIL and ADS 3 FAIL caution messages are not displayed. Power down then power up the airplane, using the Airplane Power Reset procedure. **Fault Condition 2:** Message displayed upon landing. Open the following CBs, wait 5 seconds, then reset: RHCBP ADS 2 PROBE 4A RHCBP ADS 3/STBY PROBE 4B
22	AFCS FAULT	A	Power down then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
30	A-I ENG 1 (2) FAULT	A	**Effectivity: E190** with Load 4.4 or previous. **Fault Condition 1:** A-I ENG 1 FAULT EICAS message displayed 30 seconds after landing, due to the respective bleed system being OFF during any flight phase; OR **Fault Condition 2:** Bleed System 1 or 2 is OFF and the Cross Bleed valve is closed. Push out the ENGINE 1 and ENGINE 2 Ice Protection buttons on the ICE PROTECTION control panel. **NOTE:** After 10 seconds, the A-I SWITCH OFF advisory message is displayed on the EICAS. Push in the ENGINE 1 and ENGINE 2 Ice Protection buttons on the ICE PROTECTION control panel. **NOTE:** The A-I SWITCH OFF advisory message extinguishes.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
30	A-I WING FAIL	C and PFD	**Fault Condition 1:** The A-I WING FAIL message displayed on the EICAS during the BIT (Built-in Test). OR **Fault Condition 2:** The A-I WING FAIL message displayed on the EICAS and the CAS MSG annunciation displayed on both PFDs. – Turn the Ice Protection TEST Selector knob on the ICE PROTECTION control panel to the WING position. – Push out the WING Ice Protection button. – After 10 seconds, the A-I SWITCH OFF advisory message is displayed on the EICAS. – Push in the WING Ice Protection button. – The A-I SWITCH OFF advisory message extinguishes. Wait 60 seconds and check if the message is not displayed on the EICAS.
21	Amber X on the Recirculation Fan Indication (ECS Synoptic Page)	MFD	**Fault Condition:** RECIRC button is pushed in, batteries are set to ON/AUTO, and the GPU is OFF for more than 1 minute. Push out the RECIRC button on the AIR COND/PNEUMATIC control panel, wait 60 seconds and push it in. If the message is still displayed, power down and then power up the airplane, using the Airplane Power Reset procedure.
27	AOA LIMIT FAIL	C	On the maintenance panel, ensure that the FCS MAINT switch is in the OFF position.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
22	APPR 2 NOT AVAIL	A	Ensure that: – The same ADS and IRS sources are not selected on PFD 1 and PFD 2. – The indications of RALT/IRS/ ADS/FD are normal and there are no associated messages displayed on the EICAS.
49	APU FAIL	C	On the MCDU, press CB key then CB MENU/CB BY SYS/APU. Open these electronic CBs, wait 10 seconds, then reset: APU FADEC ABC CMD PWR ASC CMD PWR Try another APU start.
28	APU FUEL SOV FAIL	C	**Fault Condition:** Message displayed during power-up and an APU start has not been attempted. Push in the EMER STOP button on the APU CONTROL panel, then push out.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
22	AT FAIL	C	**Fault Condition 1:** Message displayed together with ENG TLA TRIM FAIL advisory message after engine shutdown. Power down and then power up the airplane, using the Airplane Power Reset procedure, then start one of the engines, using normal procedures. If both messages are still displayed, start the remaining engine, using normal procedures. **Fault Condition 2:** Message displayed together with ENG TLA TRIM FAIL advisory message after power-up. Start one of the engines, using normal procedures. If both messages are still displayed, start the remaining engine, using normal procedures.
23	Audio Control Panel Inoperative	ACP	**Fault Condition:** Audio Control Panel not energized after airplane power up. Open the CB related to the inoperative ACP as indicated below, wait 5 seconds, then reset: ACP 1: LHCBP — AUDIO 1 ACP 2: RHCBP — COMM AUDIO 2 ACP 3: LHCBP — COMM AUDIO 3
31	AVNX MAU 1 (2, 3)A (B) FAIL	C	Power down and then power up the airplane, using the Airplane Power Reset procedure.
31	AVNX MAU 1 (2, 3)A (B) FAULT	A	Power down and then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
36	BLEED 1 (2) FAIL	C	**Fault Condition 1:** BLEED 1 (2) FAIL EICAS message displayed together with CAS MSG annunciation on both PFDs or displayed during the BIT (Built-in Test). Push out the associated BLEED Air button on the AIR COND/ PNEUMATIC control panel, then push in. **Effectivity: E170** with Black Label 6 and on or Post-Mod. SB 170-21-0016. **E190** with Black Label 6 and on or Post-Mod. SB 190-21-0002. **Fault Condition 2:** BLEED 1 (2) FAIL message displayed on the EICAS, but the associated BLEED OFF message is not displayed. Push out the associated BLEED Air button on the AIR COND/ PNEUMATIC control panel, then push in.
36	BLEED 1 (2) OFF	A	Check if the associated BLEED Air button is pushed in.
32	BRK CONTROL FAULT	A	**NOTE:** Refer to MAU SAFETY PROCEDURES before accomplishing this procedure. Open the following CB, wait 3 s but not more than 5 s, then reset: LHCBP MAU 1 PWR 1 If the message is still displayed, open the following CB, wait 3 s but not more than 5 s, then reset: RHCBP MAU 2 PWR 2 PRI RHCBP MAU 2 PWR 2 SEC If after CB reset the message persists, accomplish AIRPLANE POWER RESET procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
32	BRK LH (RH) FAULT	A	**Effectivity: E190.** **Fault Condition:** Message displayed any moment until Clear Into Position. **NOTE:** Refer to the MAU SAFETY PROCEDURES before accomplishing the following procedure. Shut off hydraulics. Open the following CB, wait 5 seconds but not more than 20 seconds, then reset: LHCBP MAU 1 PWR 1 If after CB reset the message persists, accomplish AIRPLANE POWER RESET procedure. If the message was cleared: Cycle the brake pedals 5 times. Hold both pedals in the max position. While holding both pedals, turn on hydraulics and wait 5 seconds. Cycle the right pedal 5 times while holding the left pedal. While cycling the pedal, do not fully release it for more than 1 second. Repeat this step for the left pedal. **NOTE:** Do not cycle left and right pedals at the same time with hydraulics on during this procedure.
23	CMF 1 FAIL	A	**NOTE:** Refer to MAU SAFETY PROCEDURES before accomplishing this procedure. Open the following CB, wait 5 s, then reset: RHCBP MAU 3 PWR 2
31	CVR AFT FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/FDR/CVR. Open the following electronic CBs, wait 10 seconds, then reset: FDR ACCEL-SPDA2 DVDR 2-SPDA2

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
31	CVR FWD FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/FDR/CVR. Open the following electronic CBs, wait 10 seconds, then reset: FDR ACCEL-SPDA2 DVDR 1-SPDA1
23	DATALINK TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
31	EICAS FAULT	C	Open the following CB, wait 5 seconds, then reset: LHCBP EICAS
27	ELEVATOR FAULT	C	Ensure that the hydraulic systems are ON. On the FLIGHT CONTROL MODE panel, push out the ELEVATORS button, wait 3 seconds, then push in.
27	ELEVATOR LH (RH) FAIL	C	**Fault Condition 1:** Hydraulic systems are OFF. Pressurize hydraulic systems 1, 2 and 3, using normal procedures. **Fault Condition 2:** Hydraulic systems are ON. Push in the ELEVATORS button on the FLIGHT CONTROL MODE panel, wait 3 seconds, then push out.
32	EMER BRK FAULT	A	**Fault Condition:** Message displayed after landing. Cycle the Emergency/Parking Brake handle 2 or 3 times. If brakes are hot, release Emergency/Parking brake.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
73	ENG 1 (2) FADEC FAULT	A	**Fault Condition:** Message displayed during power-up and the airplane has no engine failure record. **NOTE:** If the ENG 1 (2) FADEC FAULT EICAS message is displayed during any other flight phase, even if the message disappears after engines shutdown, this procedure must not be performed and the maintenance personnel must be notified. Power down and then power up the airplane, using the Airplane Power Reset procedure.
72	ENG 1 (2) NO DISPATCH	C	**Fault Condition:** Message displayed during power-up. **NOTE:** If the ENG 1 (2) NO DISPATCH EICAS message is displayed during any other flight phase, even if the message disappears after engines shutdown, this procedure must not be performed and the maintenance personnel must be notified. Power down and then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
72	ENG 1 SHORT DISPATCH	A	**Fault Condition:** Message displayed during power-up. **NOTE:** If the ENG 1 SHORT DISPATCH EICAS message is displayed during any other flight phase, even if the message disappears after engines shutdown, this procedure must not be performed and the maintenance personnel must be notified. Open the following CBs, wait 5 seconds, then reset: LHCBP FADEC 1A RHCBP FADEC 1B
72	ENG 2 SHORT DISPATCH	A	**Fault Condition:** Message displayed during power-up. **NOTE:** If the ENG 2 SHORT DISPATCH EICAS message is displayed during any other flight phase, even if the message disappears after engine shutdown, this procedure must not be performed and the maintenance personnel must be notified. Open the following CBs, wait 5 seconds, then reset: LHCBP FADEC 2A RHCBP FADEC 2B

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
22	ENG TLA TRIM FAIL	A	**Effectivity: E190** **Fault Condition 1:** Message displayed together with AT FAIL caution message after engine shutdown. Power down and then power up the airplane, using the Airplane Power Reset procedure, then start one of the engines, using normal procedures. If both messages are still displayed, start the remaining engine, using normal procedures. **Fault Condition 2:** Message displayed together with AT FAIL caution message after power-up. Start one of the engines, using normal procedures. If both messages are still displayed, start the remaining engine, using normal procedures.
23	FAULT (light)	P R I N T E R	If any of the following conditions exist, perform the correction properly and check if the light extinguishes: – Paper is over. – Printer door open. If the conditions above are not found or the light is still illuminated: – Reset the Printer through the OFF button. If the light is still illuminated: – Power down and then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
31	FDR AFT FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/FDR/CVR. Open the following electronic CBs, wait 10 seconds, then reset: FDR ACCEL-SPDA2 DVDR 2-SPDA2
31	FDR FWD FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/FDR/CVR. Open the following electronic CBs, wait 10 seconds, then reset: FDR ACCEL-SPDA2 DVDR 1-SPDA1

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
27	FLT CTRL BIT EXPIRED	C	Perform the flight controls hydraulic Power up Built In Test (PBIT): set Electric Hydraulic Pumps 1, 2 and 3A to ON. Wait 1 minute. Set Electric Hydraulic Pumps 1 and 2 to AUTO, and 3A to OFF. **NOTE:** – Do not move the flight controls until the flight control actuators engage in the daily switch configuration. – Ensure that the rudder surface is not fully deflected to the LEFT position (due to wind action, for instance). If message is still displayed: Perform the Airplane Power Reset procedure. **NOTE:** – Do not move the flight controls while hydraulic pressure is OFF. – The flight controls electrical PBIT takes 3 minutes after the AC power is connected to the airplane to complete. If any hydraulic pump is set to ON before that, the flight controls PBIT is canceled.
27	FLT CTRL FAULT	A	Power down and then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
27	FLT CTRL NO DISPATCH	C	**Fault Condition 1:** Message displayed during power-up. – On the maintenance panel, ensure that the FCS MAINT switch is in the OFF position. – Ensure that the hydraulic pumps 1, 2 and 3A are set to ON. – Push in the ELEVATORS, RUDDER and SPOILERS buttons on the FLIGHT CONTROL MODE panel, wait 3 seconds, then push them out. If message is still displayed: – Power down and then power up the airplane, using the Airplane Power Reset procedure. **Fault Condition 2:** Message displayed after landing. – Ensure that the hydraulic pumps 1, 2 and 3A are set to ON. – Push in the ELEVATORS, RUDDER and SPOILERS buttons on the FLIGHT CONTROL MODE panel, wait 3 seconds, then push them out.
34	FMS1(2) TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
	FMS1-2 TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
28	FUEL DC PUMP FAIL	C	Set DC PUMP knob to ON on the FUEL control panel, wait 10 seconds, then set it back to AUTO.
28	FUEL EQUAL-XFEED OPEN	A	Ensure that the XFEED knob is in the OFF position.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
28	FUEL FEED 1 (2) FAULT	A	**NOTE:** The associated Engine must be running to accomplish this procedure. – Ensure that the associated AC PUMP knob, on the FUEL control panel, is in the AUTO position. – Advance the associated Engine Thrust Lever to a N2 above 65%. – Set the associated AC PUMP knob to ON, wait 5 seconds, then set it back to AUTO. **NOTE:** If the message does not disappearGROUND RESET PROCEDURES at this point, report to maintenance. – Reduce associated Engine Thrust Lever to IDLE.
34	GND PROX FAIL	C	**Fault Condition:** GND PROX FAIL EICAS message displayed together with TERRAIN FAIL and WINDSHEAR FAIL EICAS messages. Power down and then power up the airplane, using the Airplane Power Reset procedure.
34	HUD FAIL	A	Open the following circuit breakers, wait at least 60 seconds, then reset: RHCBP COMPUTER RHCBP OVHD UNIT
34	HUD 1 FAIL	A	Open the following circuit breakers, wait at least 60 seconds, then reset: RHCBP COMPUTER RHCBP OVHD UNIT
34	HUD 2 FAIL	A	Open the following circuit breakers, wait at least 60 seconds, then reset: LHCBP COMPUTER LHCBP OVHD UNIT

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
30	ICE DETECTOR 1 (2) FAIL	C	**Effectivity: E170** with Primus EPIC Load 17.1 and on or Post-Mod. SB 170-31-0010/01. **E190** with Primus EPIC Load 4.2 and on. **WARNING: • DO NOT OPERATE THE ENGINE OR PRESSURIZE THE BLEED AIR SYSTEM. THE BLEED AIR WILL FLOW OUT OF THE BLEED AIR LINE AND MAY CAUSE INJURIES TO PERSONS.** **• DO NOT TOUCH THE INTEGRATED PITOT/STATIC/AOA SENSOR, TAT SENSOR, STATIC PORT AND ICE DETECTORS IMMEDIATELY AFTER THE HEATER WAS SET TO OFF TO PREVENT INJURY.**

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
30	ICE DETECTOR 1 (2) FAIL (continued)	C	**CAUTION:** MAKE SURE THAT THE INTEGRATED PITOT/STATIC/AOA SENSORS, TAT SENSORS, ICE DETECTORS AND STATIC PORTS HAVE NO COVERS ON THEM BEFORE ACCOMPLISHING THIS PROCEDURE. THESE COMPONENTS CAN BECOME HOT DURING THIS PROCEDURE DAMAGING THEM. – On the ICE PROTECTION control panel, turn the Ice Protection System TEST Selector knob to the WING or ENG position and hold for 3 seconds, then release. – Wait 60 seconds and check if the ICE DETECTOR 1 FAIL message is not displayed on the EICAS again.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
24	INVERTER FAIL	C	Reset the inverter as follows: – On the MCDU, press the CB key. Then, press the MAINT key to enter the MAINT page. – On the MAINT page, press the INV RESET key. Then, press the INV RESET key. – After the message IN PROGRESS appears, if the reset is confirmed, the message INV RESET is displayed on the MCDU. If the reset is not confirmed, the message INV NOT RESET is displayed on the MCDU. – After the reset, press the key related to INV RESET. Then, press the key related to MAINT.
34	IRS 1 FAIL	C	Open the following CBs, wait 5 seconds, then reset: LHCBP IRS 1 PWR 1 RHCBP IRS 1 PWR 2
34	IRS 2 FAIL	C	Open the following CBs, wait 5 seconds, then reset: RHCBP IRS 2 PWR 1 LHCBP IRS 2 PWR 2

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
32	LG NO DISPATCH	C	**Fault Condition:** Message displayed during power-up. **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CB, wait 5 seconds, then reset: LHCBP MAU 1 PWR 1 If the message is still displayed, open the following CB, wait 5 seconds, then reset: RHCBP MAU 3 PWR 1 If the message is still displayed, power down and then power up the airplane, using the Airplane Power Reset procedure.
32	LG NOSE DOOR OPEN	C	**Fault Condition:** Message displayed during power-up. **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CB, wait 5 seconds, then reset: LHCBP MAU 1 PWR 1 If the message is still displayed, open the following CB, wait 5 seconds, then reset: RHCBP MAU 3 PWR 1 If the message is still displayed, power down and then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
32	LG WOW SYS FAIL	C	**Fault Condition:** Message displayed during power-up. **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CB, wait 5 seconds, then reset: LHCBP MAU 1 PWR 1 If the message is still displayed, open the following CB, wait 5 seconds, then reset: RHCBP MAU 3 PWR 1 If the message is still displayed, power down and then power up the airplane, using the Airplane Power Reset procedure.
23	LOW PPR (light)	P R I N T E R	If any of the following conditions exist, perform the correction properly and check if the light extinguishes: – Paper is over. – Printer door open. If the conditions above are not found or the light is still illuminated: – Reset the Printer through the OFF button. If the light is still illuminated: Power down and then power up the airplane, using the Airplane Power Reset procedure.
34	MCDU 1 FROZEN/ BLANK/ BLINKING/ RED X/ TIMEOUT MSG	MCDU	Open the following CB, wait 5 seconds, then reset: LHCBP MCDU 1

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
34	MCDU 2 FROZEN/ BLANK/ BLINKING/ RED X/ TIMEOUT MSG	MCDU	Open the following CB, wait 5 seconds, then reset: RHCBP MCDU 2
31	MFD 1 FAULT	C	Open the following CB, wait 5 seconds, then reset: RHCBP MFD 1
31	MFD 2 FAULT	C	Open the following CB, wait 5 seconds, then reset: LHCBP MFD 2
34	NAVCOM 1 FAIL	C	Open this circuit breaker and, after approximately 5 seconds, close it: LHCBP MRC 1
34	NAVCOM 2 FAIL	C	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait 10 seconds, then reset: MRC 2-SPDA2
28	NO LEFT FUEL QTY INDICATION ON EICAS	EICAS	Open the following CB, wait 5 seconds, then reset: LHCBP FUEL QTY 1
28	NO RIGHT FUEL QTY INDICATION ON EICAS	EICAS	Open the following CB, wait 5 seconds, then reset: RHCBP FUEL QTY 2
28	NO TOTAL FUEL QTY INDICATION ON EICAS	EICAS	Open the following CBs, wait 5 seconds, then reset: LHCBP FUEL QTY 1 RHCBP FUEL QTY 2

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
31	PFD 1 FAULT	C	Open the following CB, wait 5 seconds, then reset: LHCBP PFD 1
31	PFD 2 FAULT	C	Open the following CB, wait 5 seconds, then reset: RHCBP PFD 2
27	PITCH TRIM BKUP FL	A	Push out the SYS 1 CUTOUT and SYS 2 CUTOUT buttons simultaneously on the TRIM control panel. Push in the SYS 1 CUTOUT and SYS 2 CUTOUT buttons simultaneously and accomplish the following test: – Command the BACKUP PITCH TRIM switch to nose-up for 3 to 5 seconds. Ensure that the leading edge of the horizontal stabilizer moves down a short distance and then stops, and that the Pitch Trim indication on the EICAS moves up. – Command the BACKUP PITCH TRIM switch to nose-down for 3 to 5 seconds. Ensure that the leading edge of the horizontal stabilizer moves up a short distance and then stops, and that the Pitch Trim indication on the EICAS moves down.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
27	PITCH TRIM FAIL	C	Push out the SYS 1 CUTOUT and SYS 2 CUTOUT buttons simultaneously on the TRIM control panel. Push in the SYS 1 CUTOUT and SYS 2 CUTOUT buttons simultaneously and accomplish the following test: – Move the BACKUP PITCH TRIM switch to nose-up for 3 to 5 seconds. Ensure that the leading edge of the horizontal stabilizer moves down a short distance and then stops, and that the Pitch Trim indication on the EICAS moves up. – Move the BACKUP PITCH TRIM switch to nose-down for 3 to 5 seconds. Ensure that the leading edge of the horizontal stabilizer moves up a short distance and then stops, and that the Pitch Trim indication on the EICAS moves down.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
27	PITCH TRIM SW 1 (2) FAIL	A	Push out the SYS 1 CUTOUT and SYS 2 CUTOUT buttons simultaneously on the TRIM control panel. Push in the SYS 1 CUTOUT and SYS 2 CUTOUT buttons simultaneously and accomplish the following test: – Move the Pitch Trim through the Captain switch to nose up for 3 to 5 seconds. Ensure that the leading edge of the horizontal stabilizer moves down a short distance and then stops, and that the Pitch Trim indication on the EICAS moves up. – Move the Pitch Trim through the First Officer switch to nose down for 3 to 5 seconds. Ensure that the leading edge of the horizontal stabilizer moves up a short distance and then stops, and that the Pitch Trim indication on the EICAS moves down.
21	PRESN AUTO FAIL (FAULT)	C (A)	**Effectivity:** Airplanes with CPCS controller software PNs 21609-01AB, 21609-01AC and 21609-02AC. Set MODE knob to MAN on the PRESSURIZATION control panel, wait 5 seconds, then set it back to AUTO. **NOTE:** As an alternative procedure to reset this message, do as follows: Open the following CBs, wait a few seconds, then reset: RHCBP PRESN CPCS CTRL 1A LHCBP PRESN CPCS CTRL 1B LHCBP PRESN CPCS CTRL 2A LHCBP PRESN CPCS CTRL 2B

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
21	PRESN MAN FAIL	C	**Effectivity:** Airplanes with CPCS controller software PNs 21609-01AB, 21609-01AC and 21609-02AC. Set MODE knob to MAN on the PRESSURIZATION control panel, wait 5 seconds, then set it back to AUTO. **NOTE:** As an alternative procedure to reset this message, do as follows: Open the following CBs, wait a few seconds, then reset: RHCBP PRESN CPCS CTRL 1A LHCBP PRESN CPCS CTRL 1B LHCBP PRESN CPCS CTRL 2A LHCBP PRESN CPCS CTRL 2B
23	PRINTER FAULT	S	Ensure that the Printer door is completely latched. If it is not, close it properly and check if the message disappears. If Printer door is closed and message is still displayed: – Reset the Printer through the OFF button. If message is still displayed: – Power down and then power up the airplane, using the Airplane Power Reset procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
23	Printer not Working	PRINTER	**Fault Condition:** Printer does not print and the PRINTER FAULT message is not displayed, and FAULT and LOW PPR lights are not illuminated. If any of the following conditions exist, correct it properly and check if the printer works: – Paper roll not properly installed. – Paper jammed. If the conditions above are not found or printer still does not work: – Reset the Printer through the OFF button. If the printer still does not work: – Power down and then power up the airplane, using the Airplane Power Reset procedure.
31	QRH 1(2) TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
23	RADIOS TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
34	RALT 1 FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait 10 seconds, then reset: RALT 1-SPDA2
34	RALT 2 FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait 10 seconds, then reset: RALT 2-SPDA1

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
21	RAM AIR FAULT	A	**Effectivity:** All airplanes. On the MCDU, press CB key then CB MENU/CB BY SYS/ECS DIST. Open the following CBs, wait 10 seconds, then reset: RAM AIR VLV CLS-SPDA2 RAM AIR VLV OPN-SPDA2 **Effectivity:** Airplanes with SPDA Block 9 and AMS Black Label up to 4.0. **Fault Condition:** Airplane changes directly from Ground Service Mode to any other operating mode such as: – Ground Service to Batteries – Ground Service to GPU – Ground Service to APU Gen Push out the PACK 1 pushbutton on the AIR COND/PNEUMATIC control panel, wait 5 seconds, push in.
24	RAT FAIL	C	**Fault Condition:** Message displayed during power-up. **NOTE:** The power down/up procedure should not be accomplished if the message occurred during or after the flight. Power down then power up the airplane, using the Airplane Power Reset procedure.
34	REFUEL PG TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
24	REMOTE CB TRIP	A	**Effectivity:** Airplanes with SPDA Block up to 10.2. If the message is related to a system that was intentionally deactivated, do the thermal CB/SSPC status acknowledgement to clear the message on the MCDU. If the REMOTE CB TRIP continues to show on the EICAS, power down and then power up the airplane, using the AIRPLANE POWER RESET procedure. After power up, do the thermal CB/SSPC status acknowledgement to clear the message on the MCDU. **Effectivity:** Airplanes with SPDA Block 11.1 and on. If the message is related to a system that was intentionally deactivated, do the thermal CB/SSPC status acknowledgement to clear the message on the MCDU.
27	RUDDER FAIL	C	**Fault Condition:** Hydraulic systems OFF. Pressurize the hydraulic systems 1, 2 and 3, using normal procedures.
27	RUDDER FAULT	C	Ensure that the hydraulic systems are ON. Push in the RUDDER button on the FLIGHT CONTROL MODE panel, wait 3 seconds, then push out.
34	SETUP PG TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
27	SLAT-FLAP LEVER DISAG	C	– Set the SFCL to the 0 (UP) position. – Move the SFCL to the 1 position and wait until the surfaces reach the final position. – Move the SFCL to the 2 position and wait until the surfaces reach the final position. – Move the SFCL to the 3 position and wait until the surfaces reach the final position. – Move the SFCL to the 4 position and wait until the surfaces reach the final position. – Move the SFCL to the 5 position and wait until the surfaces reach the final position. – Move the SFCL to the FULL position and wait until the surfaces reach the final position. – Move the SFCL to the 0 (UP) position and wait until the surfaces reach the final position.
24	SPDA FAIL	A	Power down then power up the airplane the Airplane Power Reset normal procedure.
27	SPDBRK LEVER DISAG	A	Ensure that the Speed Brake lever and the surfaces are in the closed position.
27	SPOILER FAULT	C	Ensure that the hydraulic systems are ON. Push in SPOILERS button on the FLIGHT CONTROL MODE control panel, wait 3 seconds, then push it out.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
32	STEER FAIL	C	**Effectivity:** All airplanes **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CB, wait 5 seconds, then reset: RHCBP MAU 2 PWR 1 **Effectivity:** Airplanes Post-Mod SB 170-32-0034 or SB 190-32-0022 or with equivalent factory modification incorporated. Press and hold Steer Disc Switch, press and release the Nosewheel Steering Handle and then release Steer Disc Switch.
32	STEER FAULT	A	**Effectivity:** All airplanes **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CB, wait 5 seconds, then reset: RHCBP MAU 2 PWR 1 **Effectivity:** Airplanes Post-Mod SB 170-32-0034 or SB 190-32-0022 or with equivalent factory modification incorporated. Press and hold Steer Disc Switch, press and release the Nosewheel Steering Handle and then release Steer Disc Switch.
34	TAT 1 FAIL	A	Open the following CB, wait 5 seconds, then reset: LHCBP ADS 1 PROBE 1A-2A
34	TAT 2 FAIL	A	Open the following CB, wait 5 seconds, then reset: RHCBP ADS 2 PROBE 4A

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
34	TCAS FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait at least 10 seconds, then reset: TCAS-SPDA1
34	TERRAIN FAIL	C	**Fault Condition:** TERRAIN FAIL EICAS message displayed together with GND PROX FAIL and WINDSHEAR FAIL EICAS messages. Power down and then power up the airplane, using the Airplane Power Reset procedure.
34	TEST PG TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
76	THRUST MGT TIMEOUT	MCDU	Power down and then power up the airplane, using the AIRPLANE POWER RESET procedure.
24	TRU 1 FAIL	C	Cycle the TRU 1 toggle switch from AUTO to OFF to AUTO.
24	TRU 2 FAIL	C	Cycle the TRU 2 toggle switch from AUTO to OFF to AUTO.
24	TRU ESS FAIL	C	Cycle the TRU ESS toggle switch from AUTO to OFF to AUTO.

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
34	WINDSHEAR FAIL	C	**Fault Condition 1:** WINDSHEAR FAIL EICAS message displayed together with GND PROX FAIL and TERRAIN FAIL EICAS messages. Power down and then power up the airplane, using the Airplane Power Reset procedure. **Fault Condition 2:** GND PROX FAIL and TERRAIN FAIL EICAS messages NOT displayed. **NOTE:** Refer to the MAU Safety Procedures before accomplishing this procedure. Open the following CBs, wait 5 seconds, then reset: RHCBP MAU 2 PWR 1 RHCBP MAU 2 PWR 2 PRI RHCBP MAU 2 PWR 2 SEC
30	WINDSHIELD 1 (2) HTR FAIL	C	Push out the 1 and 2 buttons on the WINDSHIELD HEATING control panel, then push them in. Wait 120 seconds and check if the message extinguishes. If the message is still displayed, power down and then power up the airplane, using the Airplane Power Reset procedure.
34	WX FAIL	MFD	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait 15 seconds, then reset: WX RADAR-SPDA1
34	XPDR 1 FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait at least 10 seconds, then reset: TRANSPONDER 1-SPDA1

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ATA	EICAS MESSAGE/ CONDITION	MSG LEVEL/ LOCATION	PROCEDURES
34	XPDR 2 FAIL	A	On the MCDU, press CB key then CB MENU/CB BY SYS/NAV. Open the following electronic CB, wait at least 10 seconds, then reset: TRANSPONDER 2-SPDA1

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COLD SOAK PREPARATION

The general statements below must be taken into consideration in the event of extended airplane exposure to low temperatures.

PARKING

Emergency/Parking Brakes

The use of Emergency/Parking Brakes may result in brakes freezing in certain conditions. Emergency/Parking Brakes should only be applied in the case of sloping and/or icy ramps. Snow or ice may be melted by the heat retained in the brakes.

Wheels and tires

Parking main tires in a layer of sand or mat may prevent tires from freezing on pavement surfaces. Wheel chocks should be placed against the landing gear wheels.

Water and waste

Drain water and waste from all tanks, if cold soak temperature is expected to be below 0°C (32°F).

Covers

Install all the protective covers.

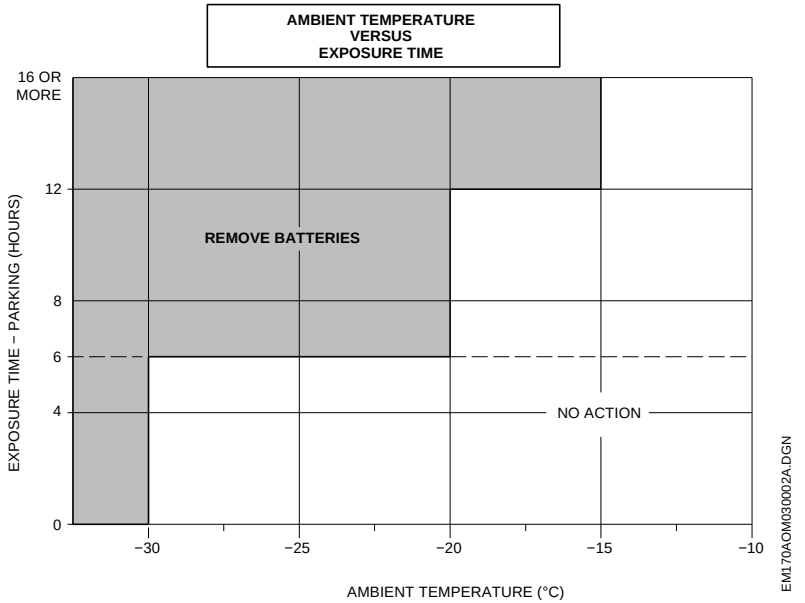
Flight Controls

Set pitch trim to full nose down and slat/flaps up.

Batteries

If the airplane is parked powered off and not heated by an external heat source remove the batteries according to the graphic below:

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NOTE: – The time count starts when the airplane is powered down.
– The ambient temperature to be used to enter the graphic must be lowest that the airplane is to be exposed.

Doors

All doors and windows must be closed to avoid moisture from entering the airplane.

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DEICING AND ANTI-ICING FLUIDS

GENERAL STATEMENTS

Airplane surfaces contaminated by ice, frozen precipitation or frost must be deiced before departure. The airplane must be anti-iced when the risk of freezing precipitation exists at dispatch or freezing precipitation is actually taking place. While deicing removes ice, anti-icing protects against additional icing for a certain period of time, called holdover time. A combination of both deicing and anti-icing may be performed based on the judgment of the flight crew and procedures developed by the operator.

For snow pellets, snow grains, ice pellets, moderate and heavy freezing rain and hail the anti-ice fluids have little or no effect. If these conditions exist, perform a careful contamination check shortly before takeoff.

HOW IT WORKS

Deicing and anti-icing fluids lower the freezing point of frozen precipitation thus delaying the accumulation of contamination on the airplane. When applied to a clean surface, the fluid forms a thin layer that has a lower freezing point than precipitation. The fluid is highly soluble in water, thus the precipitation or ice melts on contact with the fluid. These fluids also delay the onset of frost on airplane surfaces. As the ice melts, the fluid dilutes with the water, thereby causing the mixture to become less effective or to run off. Ice can begin to form again after enough dilution has occurred and the freezing point begins to rise.

DEICING

Deicing is required to clean airplane surfaces contaminated by ice, snow, frost or slush.

ANTI-ICING

Anti-icing is required to prevent ice accumulation.

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EFFECTS IN FLIGHT

Deicing/anti-icing fluids are not intended to provide icing protection during flight. The fluid must flow off the surface during takeoff. EMBRAER has performed flight tests to investigate the effects of approved fluids on performance and handling characteristics. The flight tests demonstrated these fluids did not have a measurable effect on takeoff and climb performance.

TYPES OF FLUIDS

Fluids are generally mixtures of glycol, water, inhibitors, thickening agents and wetting agents. Glycol lowers the freezing point and prevents the formation of ice contamination at temperatures below freezing. The wetting agent allows the fluid to conform to the airplane surfaces. The inhibitors prevent corrosion and increase the flash point. The thickening agent, normally propylene glycol with polymers, enables the coating of fluid to remain on airplane surfaces for longer periods.

All fluids must be used in accordance with the manufacturer recommendations.

ANTI ICE FLUIDS

Anti-icing fluids include fluid types I, II, III or IV, in a mixture with water or undiluted.

Type I Fluid

Type I fluid is not thickened and characteristically forms a thin wetting film which provides relatively limited hold-over time. Type I fluid is usually used for deicing and provides protection against refreezing when no precipitation is present.

Types II, III and IV Fluids

Types II, III and IV fluids form a thicker film that provides a longer holdover time.

The hold-over time of the type IV fluid is greater than that of type II, which in its turn has a longer hold-over time than type III fluid.

Type IV is an enhanced-performance fluid, with anti-icing effectiveness superior to Type II and provides an increased holdover time.

Type IV fluids offer significant operational advantages in terms of holdover times. However, all thickened fluids may dry out and residues may accumulate in aerodynamically quiet areas. The residues may

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rehydrate and refreeze during flight, which can potentially restrict the movement of flight controls. Operators are reminded to frequently inspect control surfaces, gaps and tab hinges for signs of fluid residues.

DE ICE FLUIDS

A deicing fluid is composed of heated water, or a mixture of water and type I, II, III or IV fluids. Heating is applied to a minimum temperature of 60°C to assure maximum deicing efficiency.

HOLDOVER TIME

Holdover times for the fluids are shown in tables derived for each specific fluid brand, under various temperatures, fluid concentration and precipitation category.

- The lower limit of the published holdover time is used to indicate the estimated time of protection during moderate precipitation;
- The upper limit indicates the estimated time during light precipitation;
- Heavy conditions are not covered.

Therefore, crew experience and airline operational guidelines are required to clearly settle what heavy, moderate or light conditions are.

The holdover time for the existing weather conditions has to be greater than the time from the start of fluid application to the start of takeoff roll.

Holdover times should be seen as rough approximations. They simply reflect the average estimated time that an anti-icing fluid should prevent the formation of frozen contaminants on the protected surfaces.

The following conditions can reduce actual holdover times:

- Windy conditions;
- Jet blast;
- Heavy precipitation or;
- High moisture content.

Recommended practice is to use holdover times in conjunction with a pre-takeoff check to ascertain that frozen deposits have not started to accumulate on treated surfaces. This is a check normally conducted from inside the cockpit.

In the case of ice build-up after deicing/anti-icing fluid application, do not

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assume that ice will be blown off during takeoff roll.

If the hold-over time expires, return for another deicing/anti-icing fluid application.

PRE-TAKEOFF CONTAMINATION CHECK

This check is normally accomplished from outside the airplane when the airplane cannot be effectively inspected by a pre-takeoff check or when the holdover times has been exceeded. It must be completed within 5 min prior to beginning takeoff.

The assistance of ground personnel trained and qualified to inspect the wing, empennage and fuselage is required.

It is the pilot's responsibility to decide whether or not to accept the airplane for flight. If contamination is suspected, the airplane should return for additional deicing or anti-icing.

Takeoff in conditions of moderate and heavy freezing rain is not approved.

DEICING AND ANTI-ICING PROCEDURES

GENERAL

Application of deicing and anti-icing fluid must be done by trained and qualified personnel.

If both anti-icing and deicing are required, the procedure may be performed in either one or two-step process.

However, a two-step deicing/anti-icing fluid application is recommended, so that residue accumulation in the critical areas is minimized.

Ensure that deicing and anti-icing are performed at the latest possible time before taxiing to the takeoff position.

ONE STEP DEICING / ANTI-ICING METHOD

In a one-step deicing/anti-icing procedure the holdover time starts to run from the beginning of the procedure.

TWO STEPS DEICING / ANTI-ICING METHOD

Mixing fluids in a two-step procedure may only be performed if approved by the fluid manufacturer.

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With a two-step procedure the holdover time starts to run at the beginning of the anti-icing procedure.

Deicing can be performed by using:

- Heated water only or
- Heated mixture of deicing or anti-icing fluid.

Anti-Icing must be applied before residual liquids from the first deicing step freezes (typically within three minutes). This is especially important when only heated water is used to de-ice.

Anti-icing can be performed with diluted or undiluted anti-icing fluid.

INFRARED DEICING

Infrared deicing is an alternative process to fluid ground deicing only. The InfraTek® infrared deicing system uses infrared (IR) energy of controlled amplitude and targeted wavelength to melt frozen ice and snowfrom airplane. This electromagnetic wave form strikes the surface of materials, causing the molecules of the surface to move rapidly and generate heat. Because the IR energy does not penetrate the surface, only the outermost layers experience any direct heat from the IR. During the IR deicing process, airplane surfaces that contain ice are not exposed to any infrared energy until after the surface contamination is completely removed.

NOTE: The InfraTek® Infrared deicing equipment must be FAA approved. The Infrared deicing facility operator is responsible for quality assurance during operations.

The infrared deicing facility operator needs to establish communication with the crew regarding aircraft preparation: engine status, aircraft configuration and clearance to taxi both into and out of the facility.

Airplane configuration:

Parking Brake..... ON
Doors..... CLOSED
Thrust Levers..... IDLE
Pitch Trim..... FULL NOSE DOWN

EMBRAER recommends that during the Infrared deicing process flaps stay in the retracted position.

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During the infrared deicing process, engines and APU may be running, bleeds can be ON and Packs can be ON as well.

However, if the airplane will be anti-iced after an infrared deicing, use APU bleed/Engine bleed/Air Conditioning OFF configuration during fluid application. Turn bleeds on 1 min after finishing fluid application, and packs 3 min later.

The Infrared deicing facility operator may request the status of contamination of aircraft being treated, request assistance on remaining contamination if not apparent from the control booth, and inform crew and the anti-ice team of the requirement to anti-ice, the type of fluid to be used and anti-icing start time.

NOTE: – More than one Infrared deicing cycle may be necessary to clean up the aircraft from frozen contamination; however, the skin temperature in any aircraft surface shall be under the maximum operational temperature specified by the IR equipment specification of 130°F (55°C).

– Anti-icing fluid must be applied after the IR de-ice either in case of precipitation or in case temperatures is below 35°F (2°C) and any residual water is present, so as to avoid water refreezing.

– An anti-iced aircraft cannot be deiced again with the Infrared process in case the holdover time expires. The aircraft shall be deiced with regular fluid de-ice procedure.

DEICING ANTI-ICING REPETITION

If the hold over time expires or contamination is found over the airplane before take off a complete deicing/anti-icing procedure must be performed.

Residues from previous treatment must be flushed off first.

Under no circumstances should an airplane that has been previously anti-iced receive a further spray of anti-icing fluid directly on top of the anti-icing contaminated film.

GROUND DEICING / ANTI-ICING STRATEGY

To prevent frozen contamination on airplane surfaces deice and anti-icing operation requires that fluids are distributed uniformly over surfaces. In order to control uniformity, all horizontal surfaces must be visually

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checked during fluid application. The correct amount is indicated by fluid just beginning to drip off the leading edge.

Do not use tools to scrape or scratch compacted snow from the airframe surfaces or from the gaps between fixed or movable surfaces. Once the airplane has been fully deiced, then it is time to consider the prevention of any further ice contamination prior to takeoff by application of an anti-icing treatment.

The following surfaces must be protected:

- wing upper surface and leading edge,
- horizontal stabilizer upper surface and leading edge,
- elevator upper surface,
- vertical stabilizer and rudder,

Soft Snow can be mechanically removed by blowing cold air across the airplane surface, using brooms, soft hand scrappers or rubber scrappers.

Airplane Configuration

- Doors and windows – CLOSED;
- THRUST LEVERS – IDLE;
- PARKING BRAKE – SET;
- FLAPS – UP;
- Pitch trim - full nose down to help in removing contaminants;
- Ailerons - neutral position;
- APU – is recommended to be OFF. If APU is required during the deicing procedure deicing/anti-ice fluids must not applied directly to or near the APU air inlet;
- Engine Bleeds – PUSH OUT;
- Air conditioning PACKS – PUSH OUT.

APU – Do not apply deice anti-ice fluid direct to the APU air inlets and exhaust duct.

Engines deposits of snow should be mechanically removed from engine intakes using brooms, soft hand scrapers or rubber scrappers. Frozen deposits adhering to the lower surface of the intake or to the fan blades should be removed by the applying hot air. To ensure the safety of

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ground personnel and passengers, this should be carefully coordinated with the flight crew.

Do not apply deice anti-ice fluid directly to the engine thrust reverser.

Fuselage – Remove all accumulated snow on the nose to avoid snow blowing back during takeoff and restricting pilot visibility. Do not apply deicing or anti-icing fluid directly on the windshield and on the cockpit windows.

Fluid should be sprayed along the top centerline of the fuselage and then outboard, letting the fluid cascade down and across the windows.

Fluid must not be sprayed directly onto windows and window seals, doors and doors seals, scoops or NACA air inlets. A thin layer of hoar frost on the fuselage is permitted, but only to the point you can still see the airplane markings.

Be careful not to cause damage to the antennas installed along the fuselage.

Landing gear and wheel bays – application of fluid in this area must be kept to a minimum. Do not allow water or fluid mixture spray on wheels and brakes to avoid damage to carbon brakes. In these areas of the airplane, it is preferable to clear snow or slush using a brush.

Smart probe sensors, TAT probes, pressurization static port, and ice detectors – The fluids should be sprayed along the top of the sensors, allowing the fluid to cascade down across the sensor and deice it.

Do not spray deicing fluid directly to the probes, scoops, vents, drains and static ports.

Vertical surfaces: start at the top and then work down. The rudder should be in the neutral position.

Wings and Stabilizer: Spray from the tip inboard to the root, sweeping from the leading edge in the aft direction. A 3 mm (1/8 in) frost layer is permitted under the wing surfaces. Frost is not permitted on the lower or upper surface of the horizontal stabilizer or the upper surface of the wing. It is important that the fluid be applied symmetrically to both wings so as to ensure that the aerodynamic effect of the fluid remaining is the same on both sides of the airplane.

Wait one minute to use the engine or open the APU bleed valve and

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three minutes to use the pack valves after the deicing and anti-icing procedures are complete. The vapor from the deicing and anti-icing fluid can go into the air conditioning system when the engine or APU is in operation. This can cause damage to the air conditioning system.

A check for fluid coverage and residual ice is required immediately following application of the deicing/anti-icing fluids and should be accomplished by a qualified person.

It is possible that the fluid may not flow evenly over the protected surfaces. It is essential that the wings, horizontal and vertical stabilizer are properly coated with fluid.

Only Deicing/Anti-icing fluids certified under specifications below are approved to be used in the EMBRAER-170/175/190/195 airplane models:

Deicing/Anti-icing Fluid	Specification
Type I	SAE AMS 1424
Types II, III and IV	SAE AMS 1428

Refer to the fluid manufacturer's recommendations for fluid mixture, if applicable, and holdover times.

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EMBRAER 190

AIRPLANE OPERATIONS MANUAL
VOLUME 2

EMPRESA BRASILEIRA DE AERONÁUTICA S.A.

TACA

This manual is applicable to the EMBRAER 190 airplanes AR model equipped with CF34-10E6 engines and operating under FAA certification.

THIS PUBLICATION IS INCOMPLETE WITHOUT AIRPLANE OPERATIONS MANUAL AOM-1502 VOLUME 1.

AOM-1502-017
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Airplane Operations Manual
AOM-1502-017

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

Sincerely,
Embraer Flight Operations Support

Please return this form to:

Embraer - Flight Operations Support - PC176
Av. Brigadeiro Faria Lima, 2170
CEP 12227-901
São José dos Campos - SP - BRASIL

Phone: +55 12 3927-1706
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14-05-40	11	Rev. 2	14-06-30	3	Rev. 3
14-05-40	12	Rev. 2	14-06-30	4	Rev. 3
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SECTION 14-01

AIRPLANE GENERAL DESCRIPTION

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GENERAL INFORMATION

This section provides a general overview of the airplane. More details of the airplane and its systems are given within each section of this manual.

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AIRPLANE BASIC DATA

The airplane is a low wing, conventional tail, pressurized airplane powered by two high by-pass ratio wing-mounted turbofan engines. The tricycle landing gear is fully retractable with dual wheels/tires for each strut.

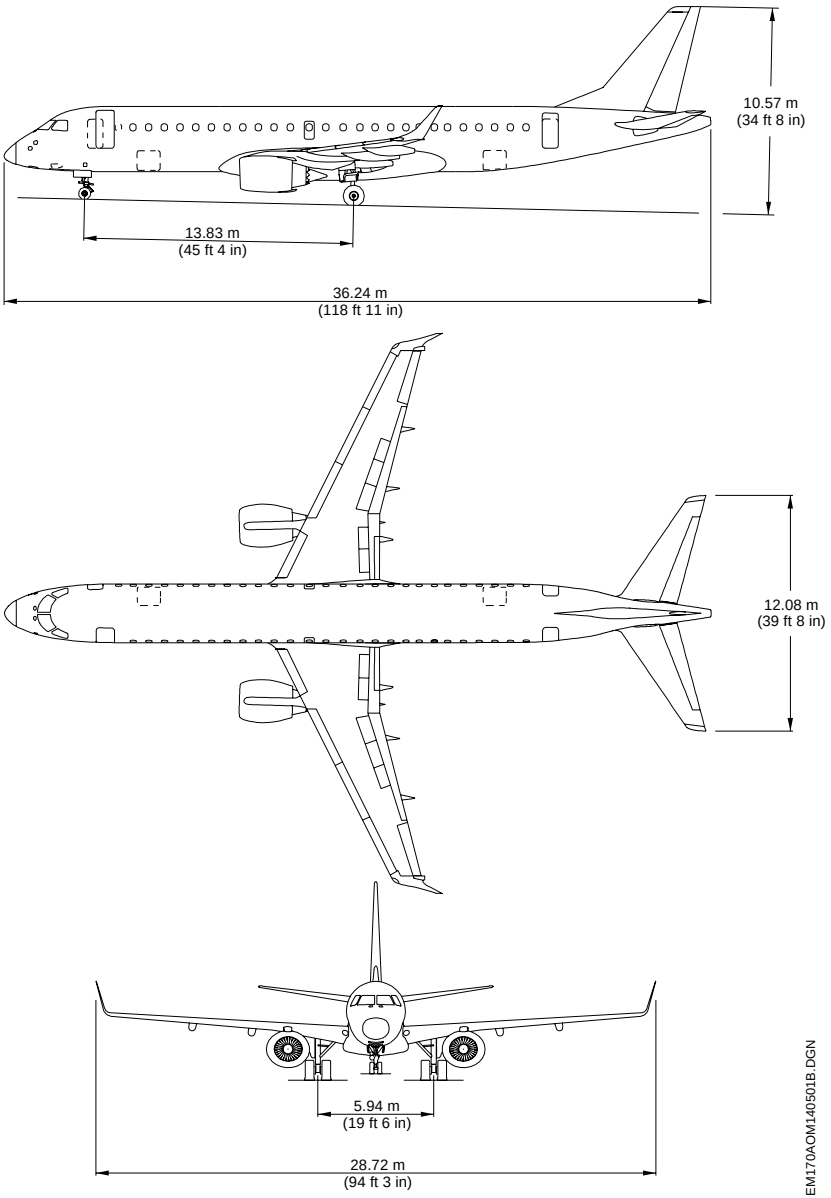
A glass panel cockpit is installed with a highly integrated on-board avionic system enabling the pilots to better monitor the airplane's operation.

The passenger configuration consists of four seats abreast (two to each side of the aisle) with a front galley and a rear toilet allowing up to 108 passengers to be carried. Configuration with first class seats is optional. Convenient accommodations are provided for the flight crew.

For detailed information on each system, refer to the appropriate section of this manual.

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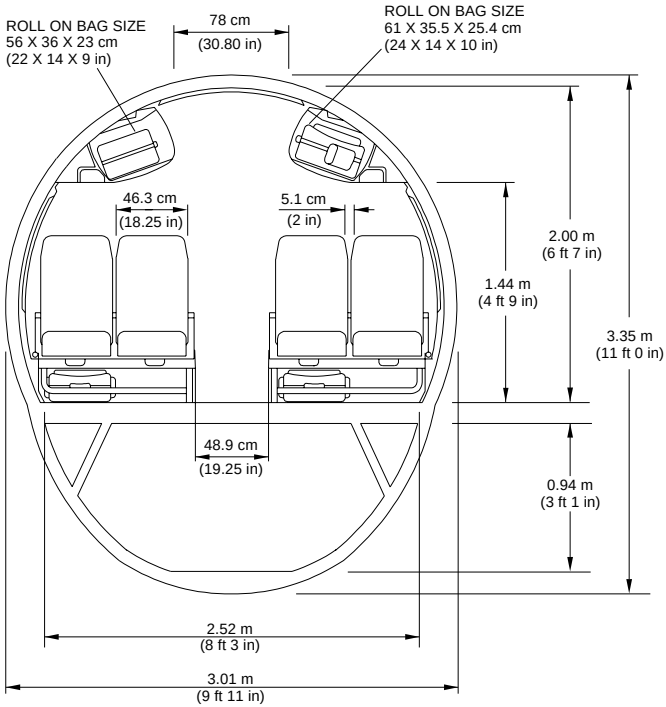
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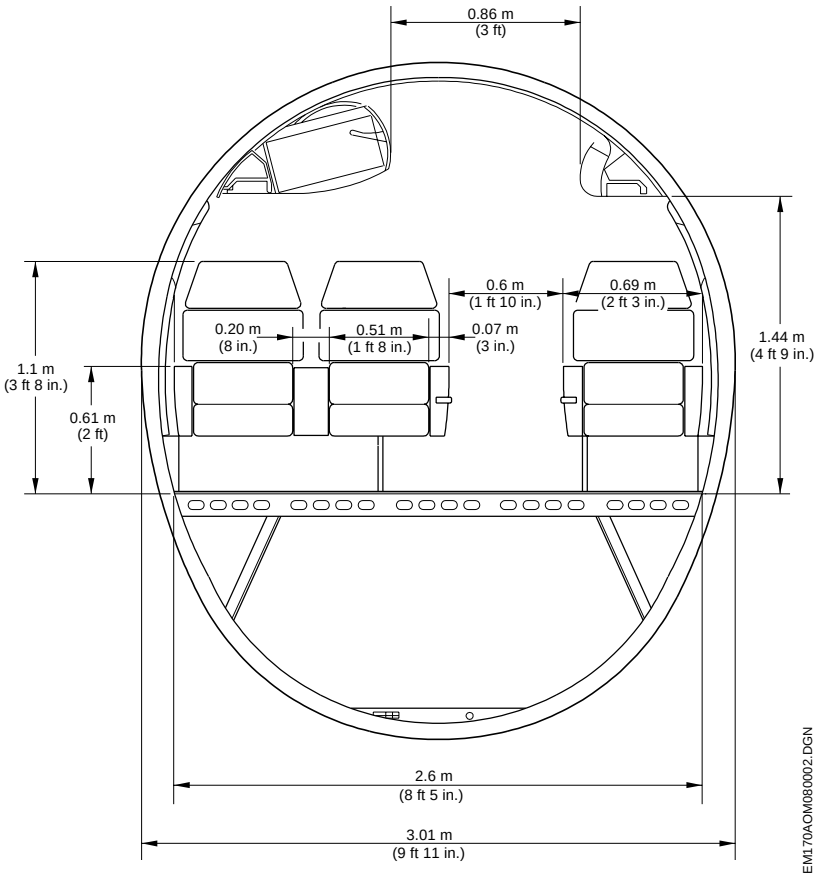
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CROSS SECTION



STANDARD CABIN

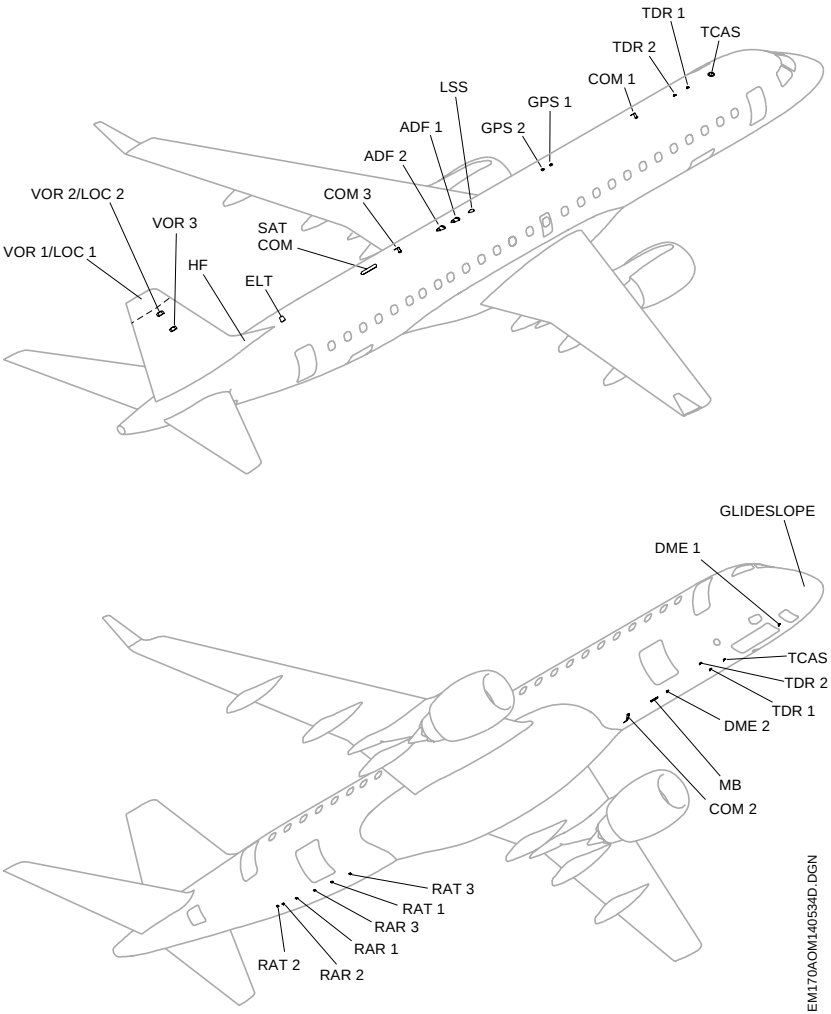
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FIRST CLASS

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AIRPLANE ANTENNAS

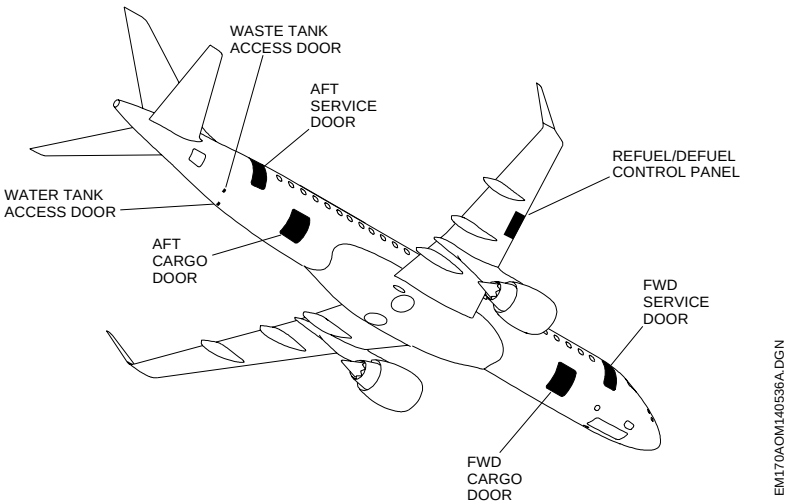


AIRPLANE ANTENNAS

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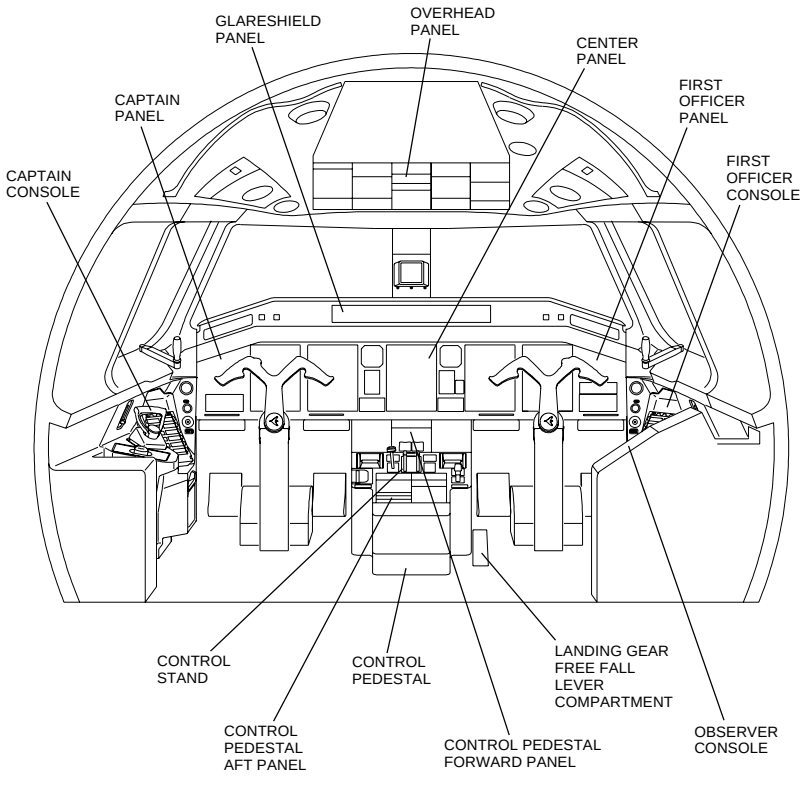
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MAIN SERVICE POINTS

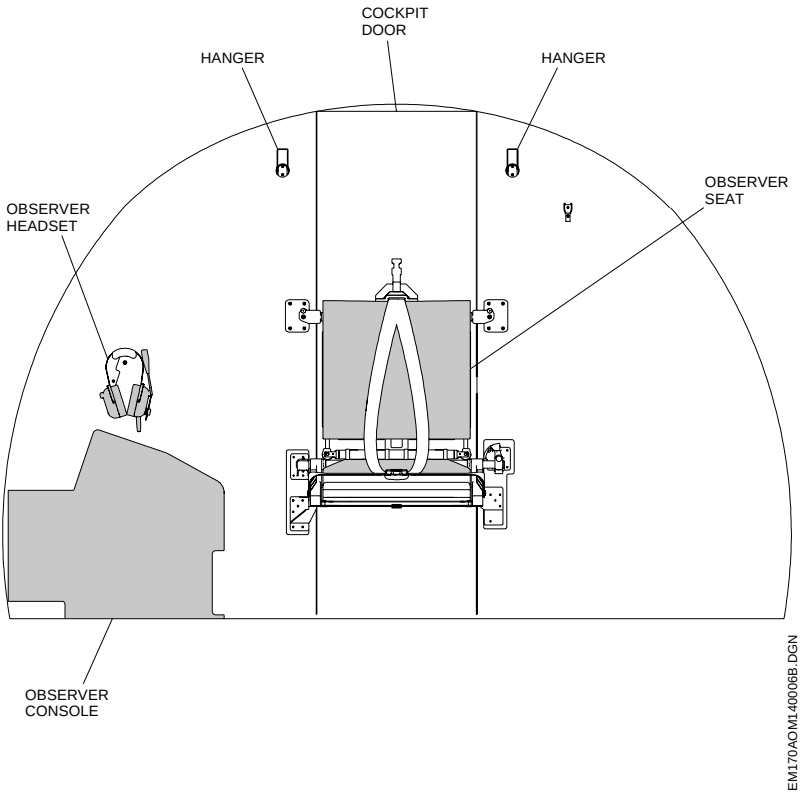
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COCKPIT ARRANGEMENT



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COCKPIT PARTITION



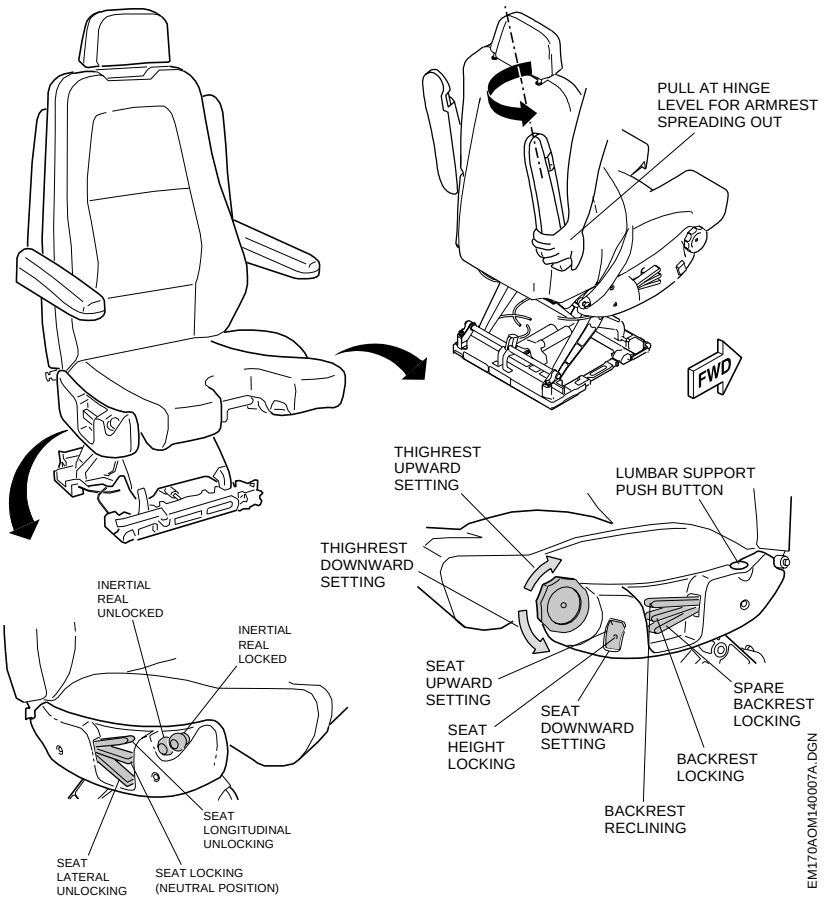
COCKPIT PARTITION

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COCKPIT SEATS

Pilot seats are fixed to slide rails that permit fore and aft adjustments. When the seats are in their aft most position, a lateral movement is also available in order to ease crew access to the seat.

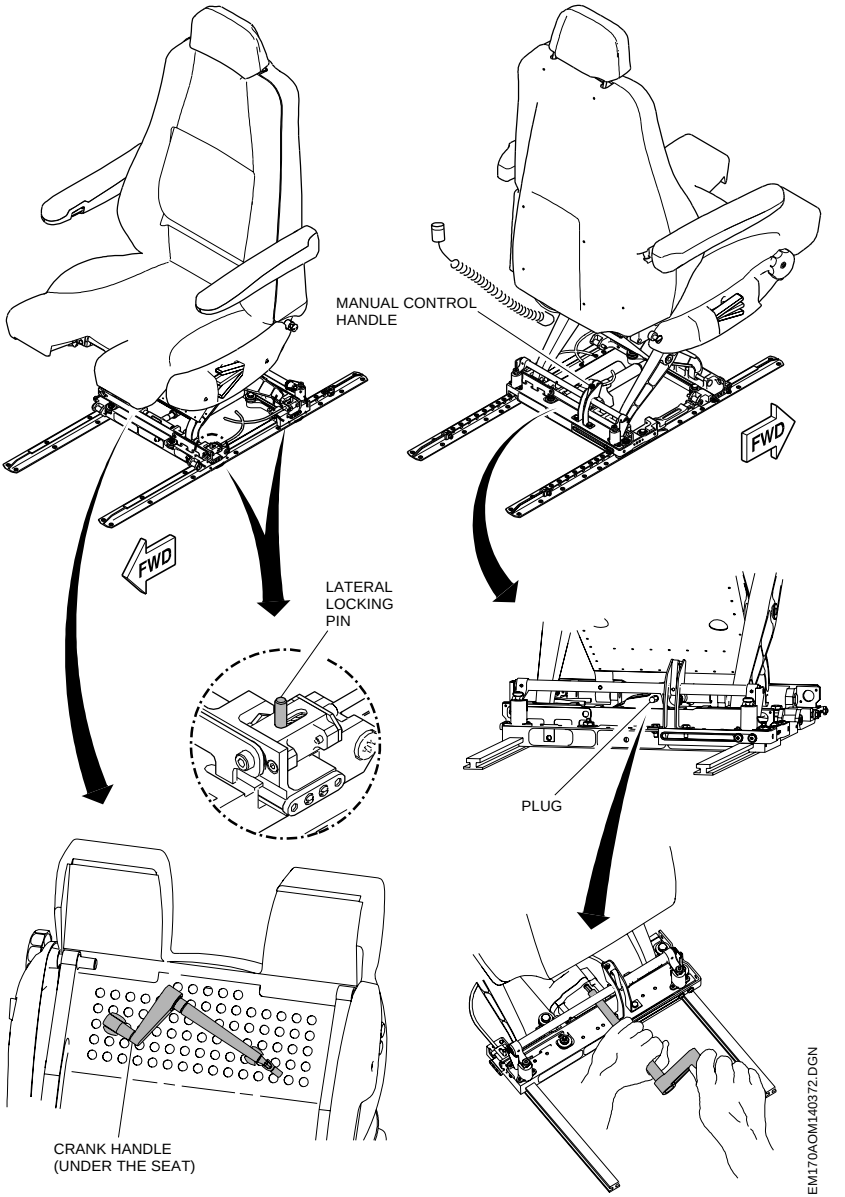
Manual adjustments of pilot seats are possible for vertical, lateral and aft and fore movements. A crank handle is located under the seat and allows vertical adjustments by attaching it to the plug at the aft lower part of the seat. The manual control handle allows aft and fore adjustments. Lateral movement is provided actuating both lateral locking pins.



COCKPIT SEATS

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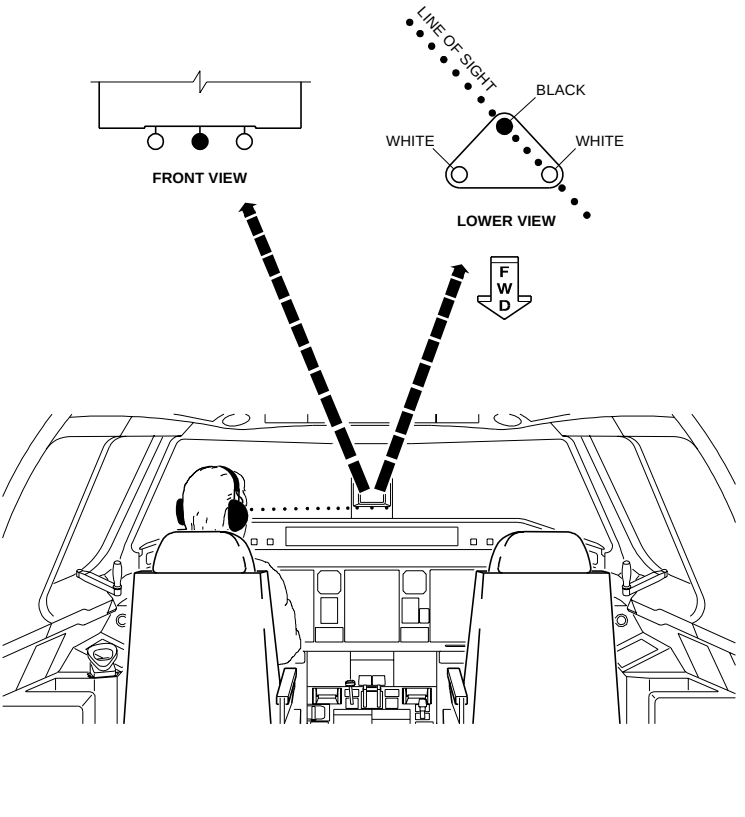


COCKPIT SEATS MANUAL ADJUSTMENTS

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PILOT SEAT ADJUSTMENT

The seat should be adjusted up or down until the pilot's line of sight reaches the same horizontal plane of a sight device made up of two white spheres and a black sphere. Then, move the seat forward or aft until the opposite white sphere is aligned with the black one.

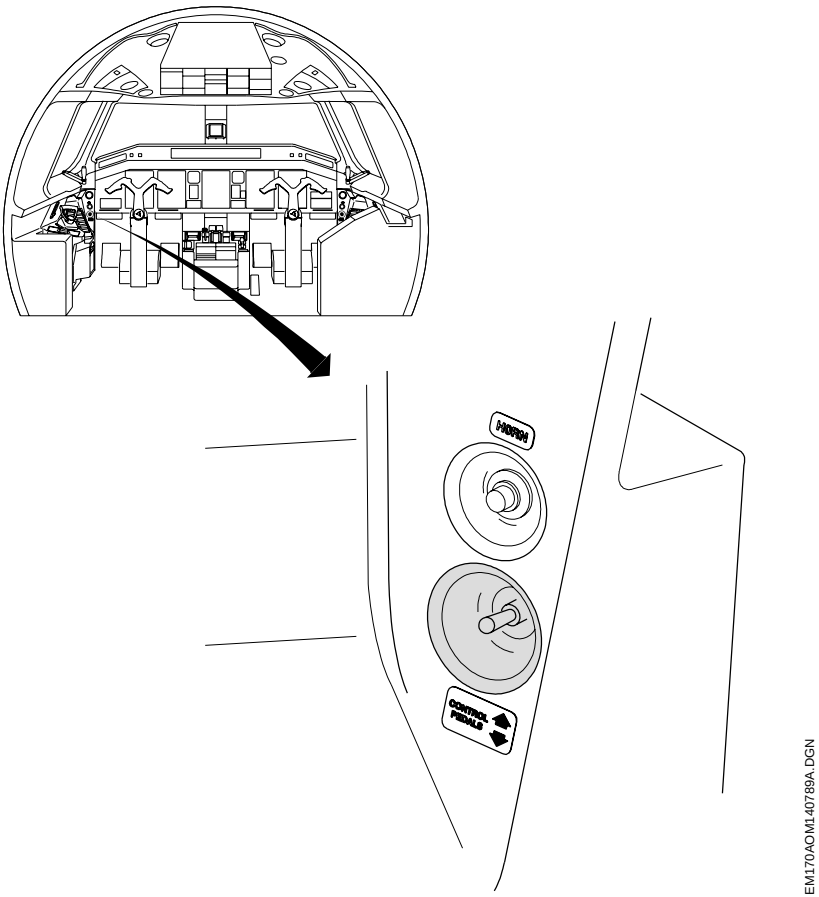


PILOT SEAT ADJUSTMENT

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PEDAL ADJUSTMENT

Spring-loaded switches installed on the captain's and first officer's panels allow rudder pedal adjustments performed by electric actuators. When operating the switch, the actuator moves the pedals forward or aft, to assure pilot comfort and full rudder throw from the adjusted seat position. For rudder pedal manual adjustment call maintenance.

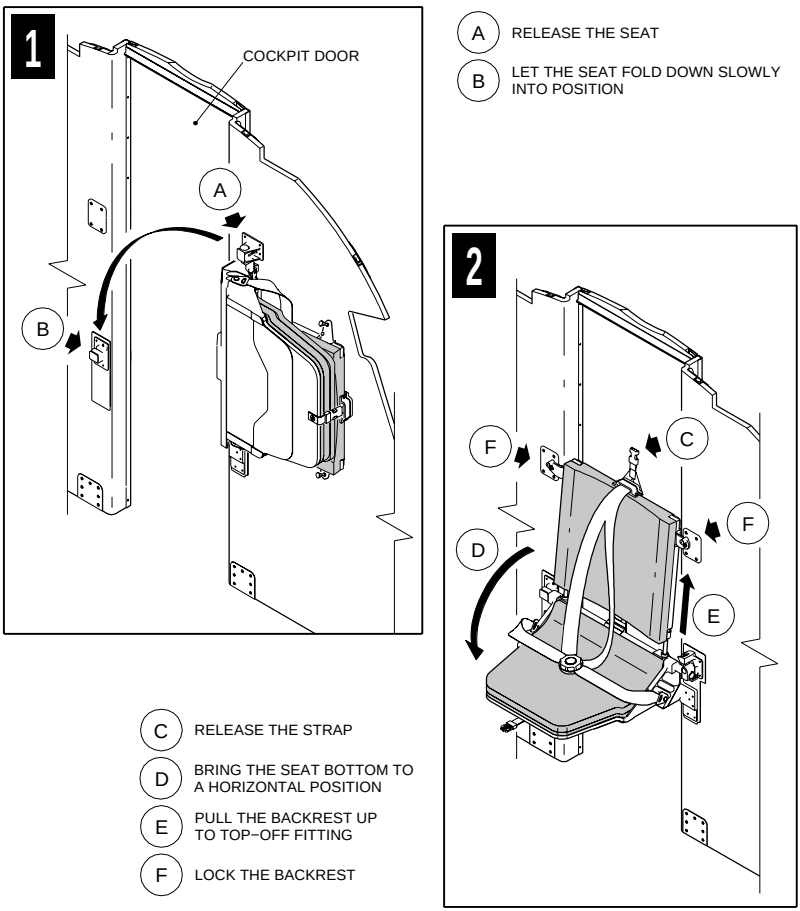


PEDAL ADJUSTMENT

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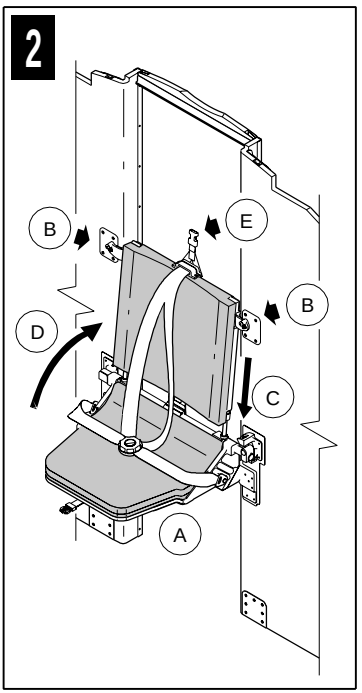
OBSERVER SEAT

The observer seat is located aft of and between the captain's and first officer's seats. When in use, it's positioned in front of the cockpit door. The seat can be stowed by folding and rotating it away from the door area against the left side of the cockpit partition behind the captain's seat. The cockpit door can be opened or closed when the observer seat is either stowed or in use.



OBSERVER SEAT - UNFOLD PROCEDURE

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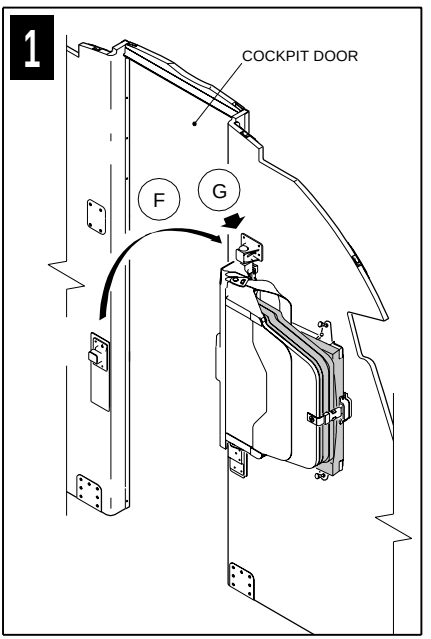
A FASTEN THE OBSERVER SEAT SEATBELT

B UNLOCK THE BACKREST

C LOWER THE BACKREST DOWN

D BRING THE SEAT BOTTOM TO VERTICAL POSITION

E CLOSE THE STRAP



F STOW THE SEAT BEHIND THE PILOT SEAT

G ENGAGE THE LATCH

EM170AOM141083A.DGN

OBSERVER SEAT - FOLD PROCEDURE

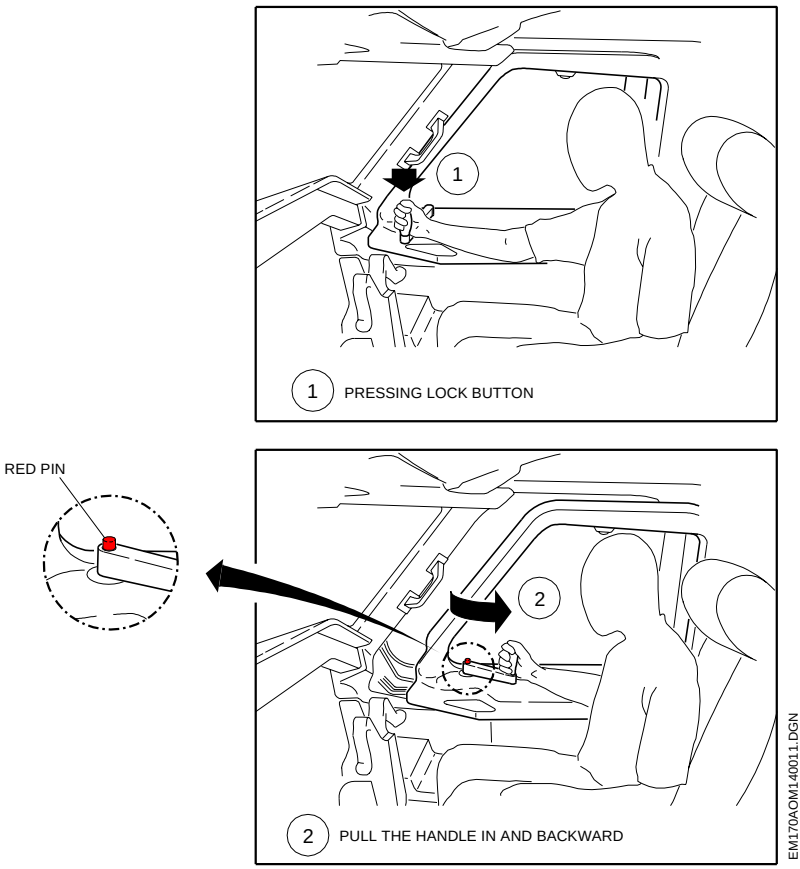
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COCKPIT WINDOW

Cockpit windows may be opened on the ground, in case of loss of visibility through the windshield or for cockpit emergency evacuation.

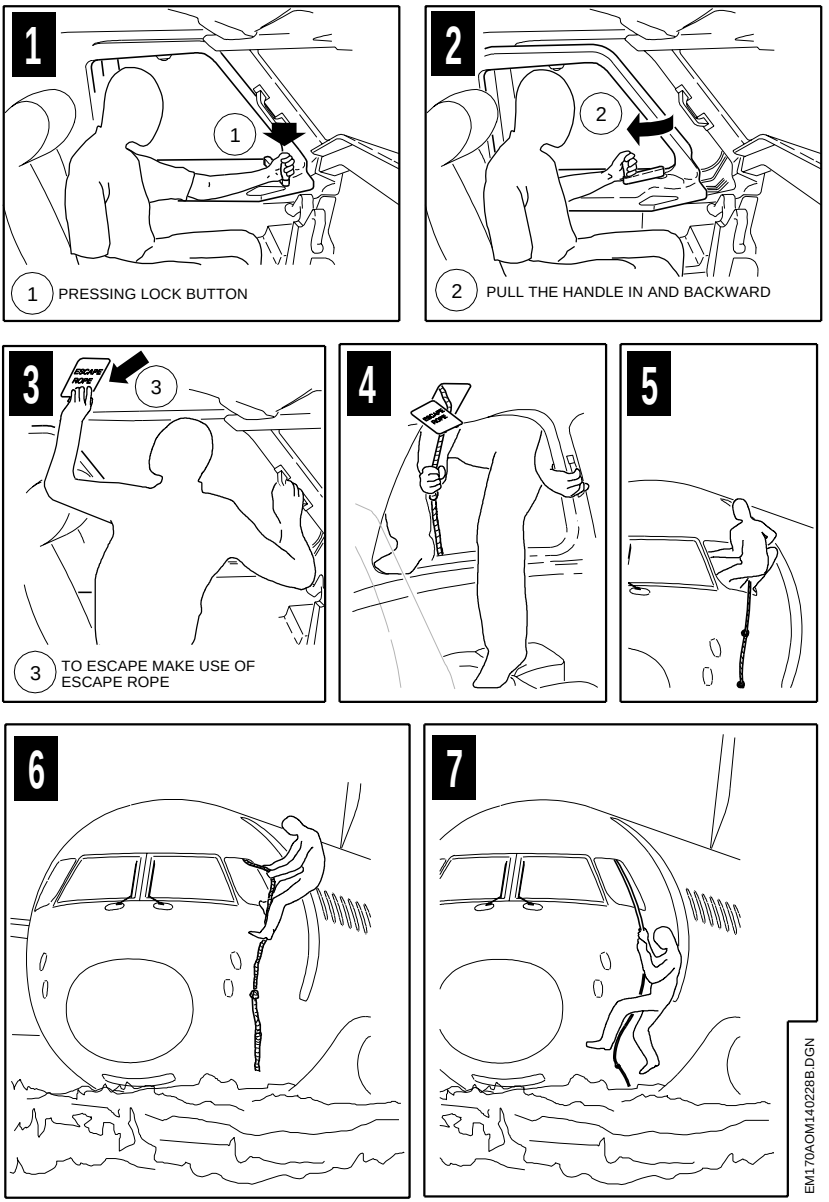
A pin protrudes near the opening handle when the window is not properly locked in the closed position.

NORMAL OPENING



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EMERGENCY OPENING



COCKPIT WINDOW EMERGENCY EXIT

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COCKPIT PHILOSOPHY

The airplane flight deck is designed to:

- Provide the necessary means to accomplish the required tasks.
- Provide acceptable and reasonable workloads.
- Minimize pilot errors and its consequences.
- Facilitate training with the commonality among the E-Jets Family.
- Provide optimized ergonomics aimed at safety, ease of operation, control and comfort requirements.

Both pilots can access all essential information and necessary controls for safe flying and landing. Control of the airplane systems is done via the overhead panel.

Some knobs on the overhead panel have detent protection and must be pulled out to allow knob rotation. This protection prevents inadvertent knob rotation and is indicated with a detent mark between knob positions. Knob stationary positions are marked with a white rectangle, and knob momentary positions are marked with a white triangle. To assure proper signal transmission when using the selector knobs that have momentary positions, hold the knob for at least two seconds at the positions before releasing it.

System failures are primarily monitored via EICAS message. The CCD and synoptics are included as an aid to the pilot monitoring systems status.

Critical systems give total authority to the pilot by employing intuitive procedures for maximum airplane performance with minimum workload. Cockpit design facilitates simple tasks as much as possible, thus leading to increased control of situation and systems. Automation is used only to improve the task accomplishment, complementing but not substituting for the crew.

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DARK AND QUIET COCKPIT

The concept used to design and operate the airplane was based on the assumption that while in flight, all systems are normal when:

- Overhead, main, glareshield and control pedestal panels have no lights on.
- No aural warnings are being issued.
- The selector knobs are positioned at twelve o'clock.

A white striped bar illuminates on any button to indicate that it is not in its normal position.

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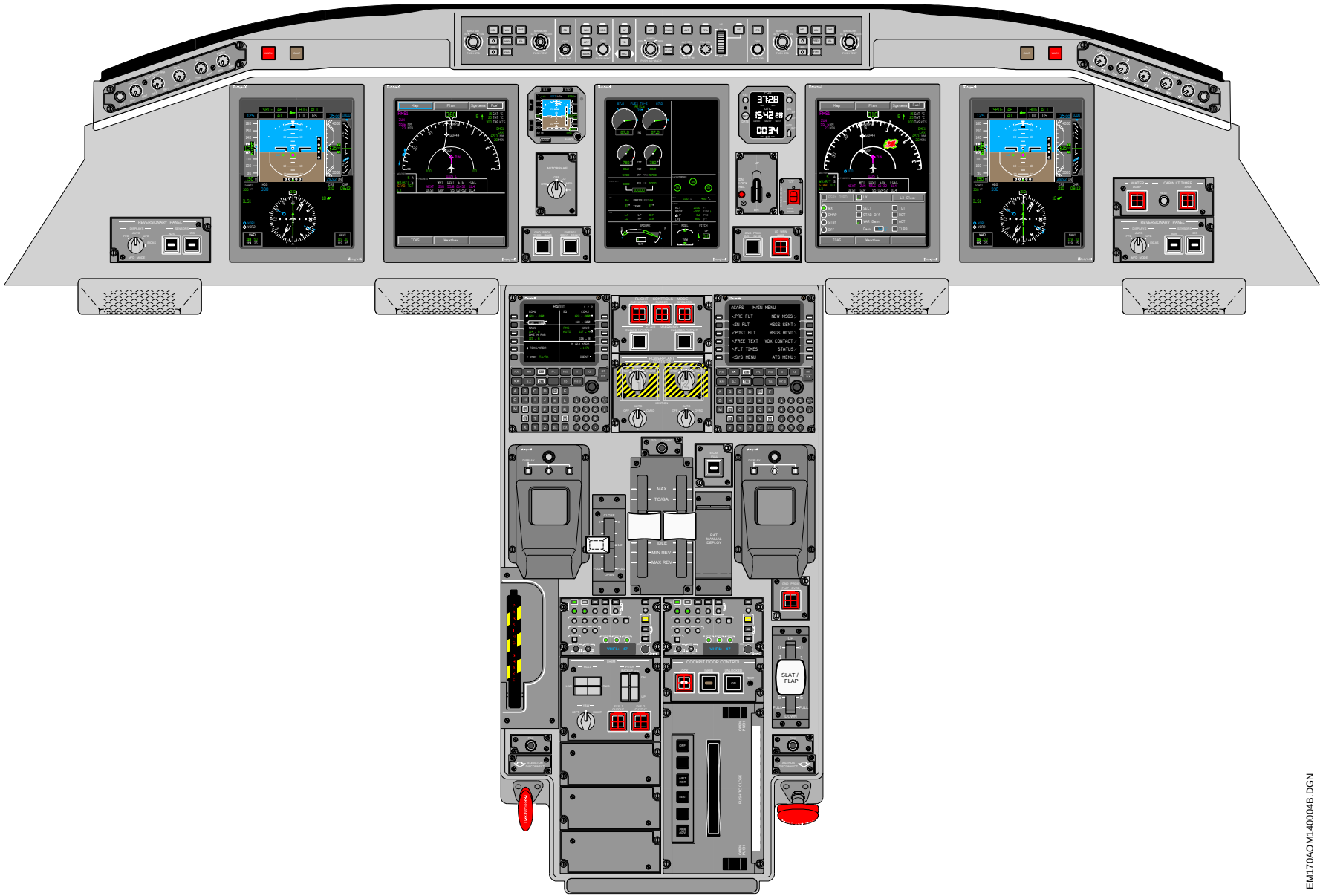
INSTRUMENTS PANELS

The Instruments Panels presented in this block are the Main/Glareshield/Control Pedestal Panels and the Overhead Panel.

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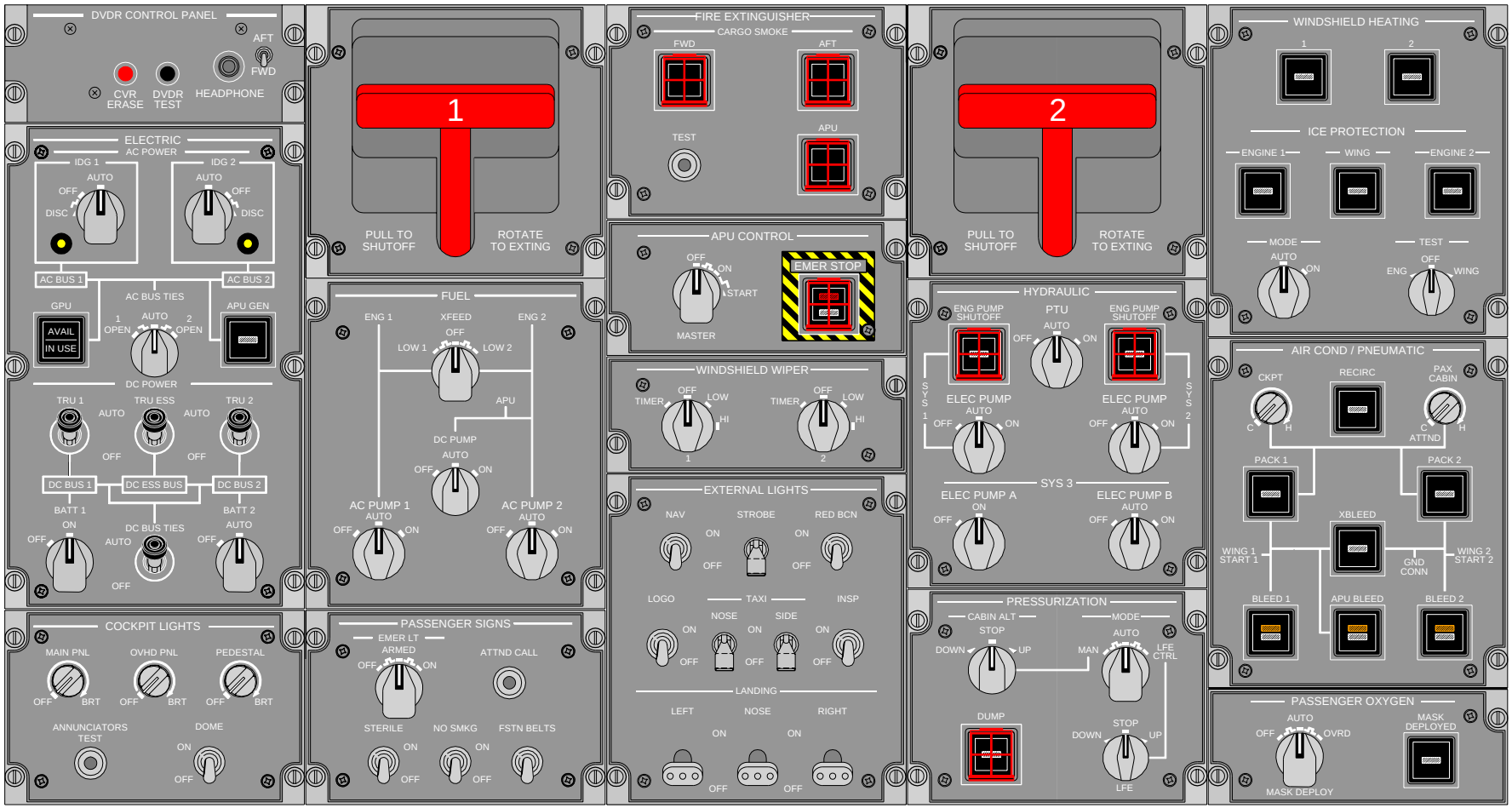
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MAIN/GLARESHIELD/CONTROL PEDESTAL PANELS

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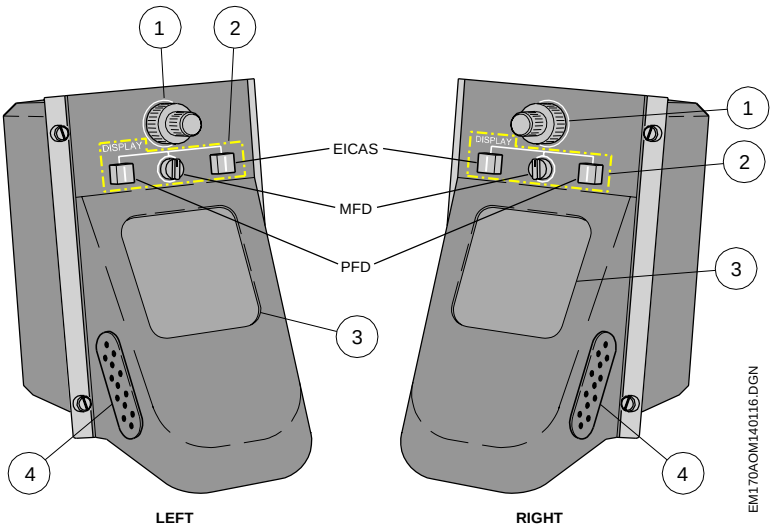
OVERHEAD PANEL

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AIRPLANE CONTROLS AND INDICATIONS

ELECTRONIC DISPLAY SYSTEM

CURSOR CONTROL DEVICE (CCD)



CURSOR CONTROL DEVICE

1 - TUNING KNOB

– Outer and inner knobs select value or mode in the data field enclosed by the cursor.

2 - FORMAT LOCATION BUTTONS

– Places cursor on associated display (PFD, MFD or EICAS).

3 - TOUCH PAD

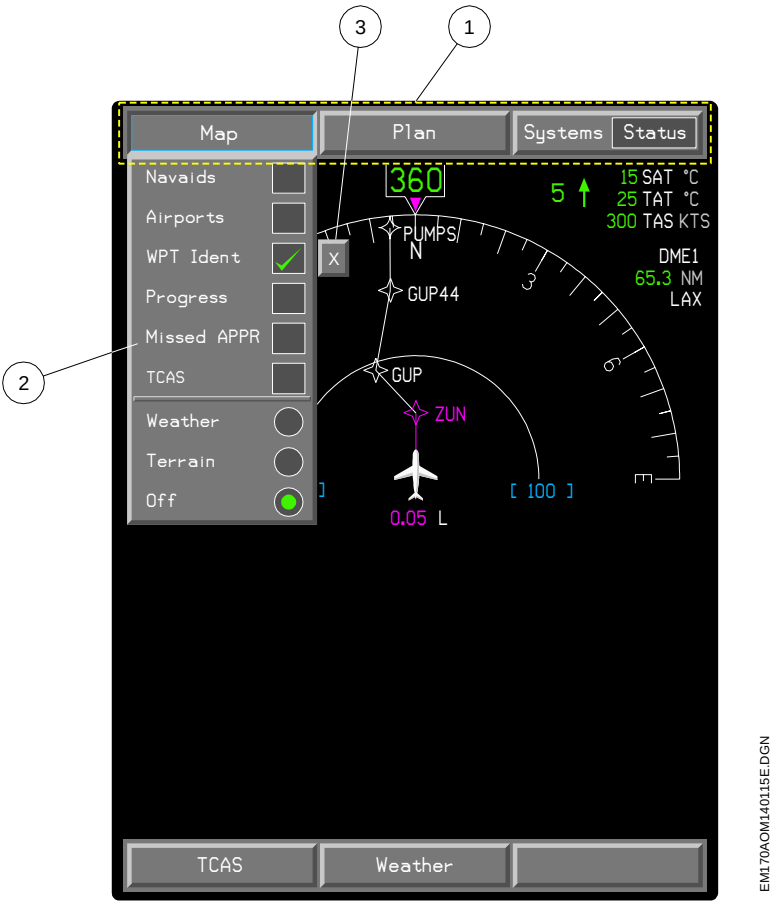
– Used to move cursor.

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4 - ENTER KEYS

– Used to select soft keys.

MULTI FUNCTION DISPLAY (MFD)



1 - SOFT KEYS

– Selected through the CCD cursor and enter key.

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2 - MENU CONTROLS

– Consist of checkboxes that can be selected and deselected for each function by using the CCD cursor and enter key. Square checkboxes are mutually selectable, while circle checkboxes are exclusively selectable.

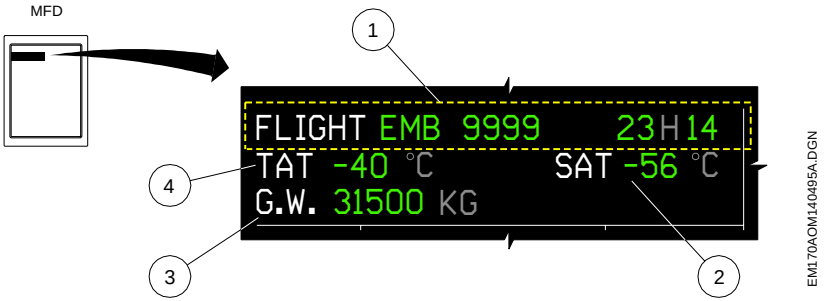
3 - EXIT KEY

– Allows quick exit of each MFD soft key's respective menu.

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FLIGHT STATUS INFORMATION

Flight number, flight time, total air temperature (TAT), static air temperature (SAT) and gross weight are displayed on the synoptic status page. It can be selected by flight crew on either MFDs.



1 - FLIGHT

– Displays airplane flight abbreviation, number and time.

2 - STATIC AIR TEMPERATURE (SAT)

– Displays static air temperature – information obtained from ADS/ADA.

3 - GROSS WEIGHT

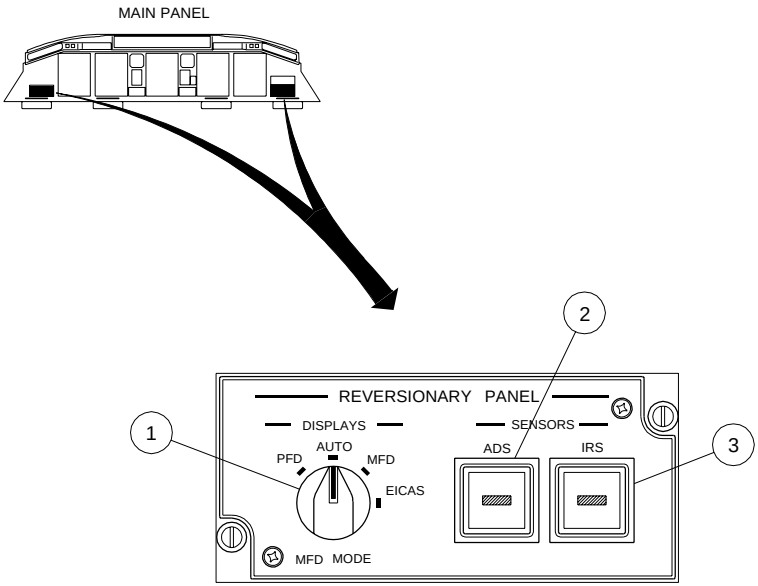
– Displays airplane gross weight – information obtained from FMS.

4 - TOTAL AIR TEMPERATURE (TAT)

– Displays total air temperature – information obtained from ADS/ADA.

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REVERSIONARY PANEL



1 - DISPLAY SELECTOR KNOB

PFD:	display PFD information in the associated display unit.
AUTO:	automatically reverts the MFD in case of display failure.
MFD:	display MFD information in the associated display unit.
EICAS:	display EICAS information in the associated display unit.

2 - ADS SENSOR BUTTON

Momentary action pushbutton:

– Reverts the ADS source.

– When ADS source reversion is selected, a white stripped bar illuminates on the button.

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3 - IRS SENSOR BUTTON

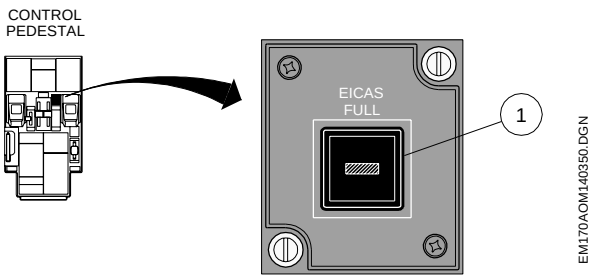
Momentary action pushbutton:

– Reverts the IRS source.

– When IRS source reversion is selected, a white stripped bar illuminates on the button.

NOTE: Associated ADS or IRS source flag is displayed on the PFD after a reversion takes place.

EICAS FULL PANEL



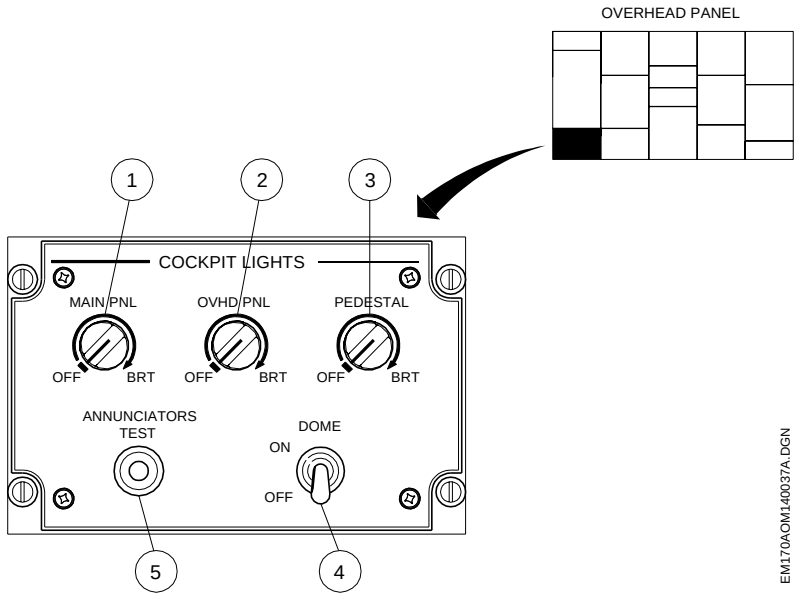
1 - EICAS FULL PUSHBUTTON

PUSH IN: EICAS full information presented.
PUSH OUT: Enables the automatic EICAS de-clutter logic.

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COCKPIT LIGHTING

COCKPIT LIGHTS CONTROL PANEL



COCKPIT LIGHTS CONTROL PANEL

1 - MAIN PANEL KNOB

– Turns on/off and regulates the lighting brightness of the main panel.

2 - OVERHEAD PANEL KNOB

– Turns on/off and regulates the brightness of the overhead panel's integral lighting.

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3 - PEDESTAL KNOB

– Turns on/off and regulates pedestal lighting brightness.

NOTE: When the DIM POT is at OFF position, the button/window indications remain illuminated full bright as a default operations configuration.

4 - DOME LIGHT SWITCH

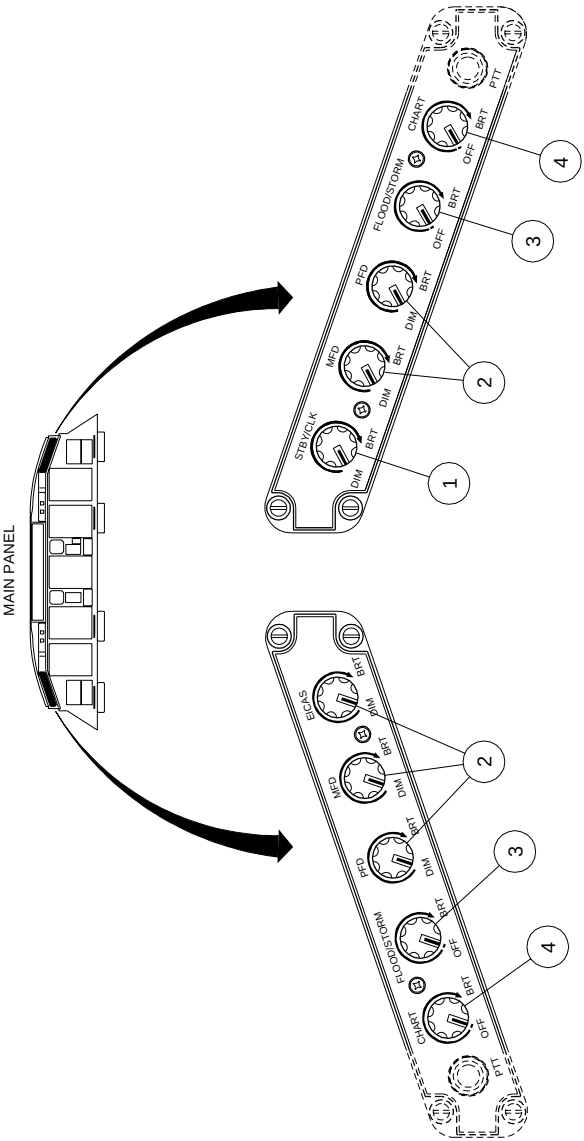
– Turns two cockpit dome lights on/off.

5 - ANNUNCIATORS TEST BUTTON

– When actuated to the TEST position (momentary position) allows checking of the striped bars and caption indications in all pushbuttons located on the main panel, overhead panel, control pedestal, allowing verification of lamp integrity.

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GLARESHIELD LIGHTS CONTROL PANEL



EM170AOM140039.DGN

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1 - STANDBY/CLOCK CONTROL KNOB

– Regulates the brightness of the standby/clock lighting.

2 - DISPLAY LIGHTING CONTROL KNOB

– Regulates the brightness of the associated electronic display.

3 - FLOOD/STORM LIGHTS CONTROL KNOB

– Turns on/off and regulates the brightness of the flood/storm panel lighting.

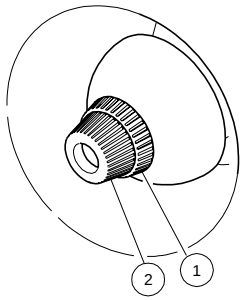
– Provides maximum brightness for storm conditions in the BRT position.

4 - CHART HOLDER LIGHTING CONTROL KNOB

– Turns on/off and regulates the brightness of associated chart holder lighting.

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FLIGHT CREW READING LIGHTS



EM170AOM140040A.DGN

1 - OUTER RING

– Turn on/off and provides dimming control.

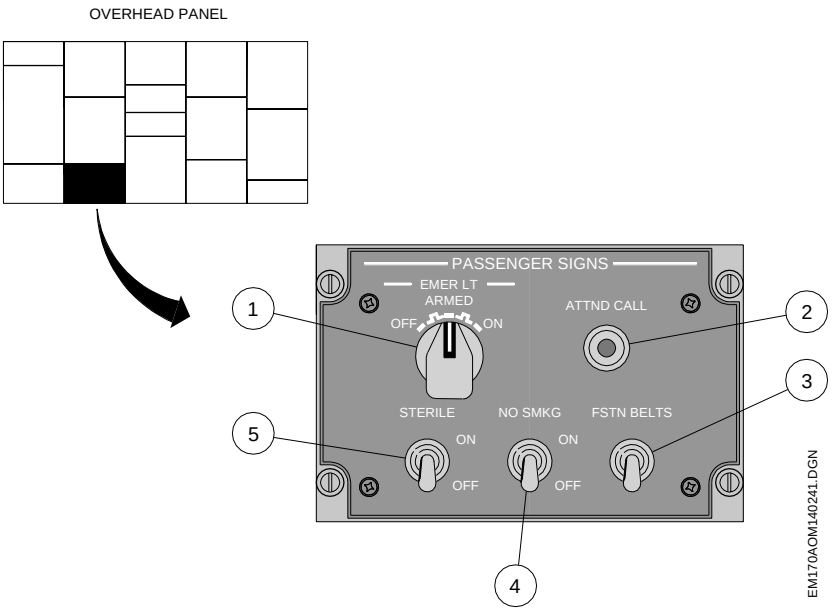
2 - INNER RING

– Adjusts aperture size of light pattern.

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PASSENGER CABIN

PASSENGER SIGNS CONTROL PANEL



1 - EMERGENCY LIGHT SELECTOR KNOB

OFF: prevents all emergency lights from illuminating if airplane electrical power is turned off or fails.

ARMED: automatically illuminates all emergency lights if DC buses lose electrical power or if airplane electrical power is turned off.

ON: turns on all emergency lights.

2 - ATTENDANT CALL BUTTON

– Pressing this button sounds a single hi/lo tone chime in the passenger cabin.

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3 - FASTEN SEAT BELTS TOGGLE SWITCH

ON: illuminates the FASTEN SEAT BELTS signs.

OFF: turns off the FASTEN SEAT BELTS signs.

FASTEN SEAT BELTS signs will automatically turn ON whenever the passenger mask doors are commanded open regardless of the switch position.

4 - PAX ILLUMINATED SIGNS SWITCH

ON: illuminates the NO SMOKING signs.

OFF: turns off the NO SMOKING signs.

NO SMOKING signs will automatically turn ON whenever the passenger mask doors are commanded open regardless of the switch position.

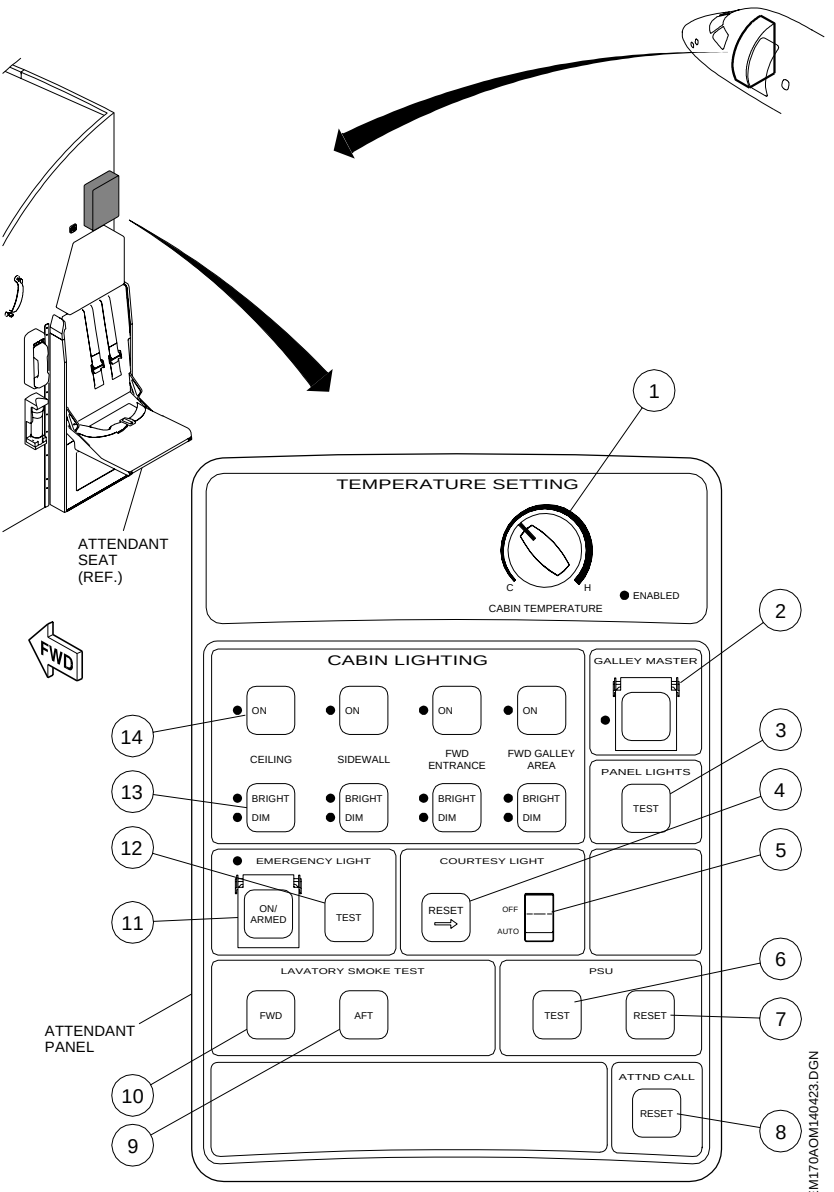
5 - STERILE TOGGLE SWITCH

ON: illuminates the sterile lights located in the rainbow lights.

OFF: turns off the sterile lights located in the rainbow lights.

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FORWARD ATTENDANT CONTROL PANEL



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1 - CABIN TEMPERATURE CONTROL

– Controls cabin temperature.

– The “ENABLED” led turns on to indicate the knob controls the cabin temperature. The led turns on only if the Passenger Cabin Temperature Rotating Knob in the cockpit is set to ATTND position (Refer to Section 14-02 – AMS).

2 - GALLEY MASTER SWITCH (GUARDED)

– Turns off all galleys (AC power off).

– Turns off the PC Power system.

3 - PANEL LIGHTS TEST SWITCH

– Provides a test of the attendant panel lights.

4 - COURTESY LIGHT RESET SWITCH

– Turns on all courtesy lights for 5 min.

5 - COURTESY LIGHT SWITCH

AUTO: turns on or off the courtesy lights according to passenger door position (OPEN or CLOSED).

OFF: turns off the courtesy lights regardless of passenger door position.

6 - PSU TEST SWITCH

– Allows the testing of the following lights:

  – flight attendant reading lights.

  – passenger reading lights.

  – lavatory dome light.

  – lavatory fluorescent light (from DIM to BRT mode).

  – attendant call indicator lights.

  – lavatory occupied signs.

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7 - PSU RESET SWITCH

– Turns off the lights previously turned on by the PSU test switch.

8 - ATTND CALL RESET SWITCH

– Turns off the attendant call indicator lights, zonal lights and PSU switch lights, previously turned on due to an attendant call.

9 - AFT LAVATORY SMOKE TEST SWITCH

– Provides a smoke test in the aft lavatory.

10 - FWD LAVATORY SMOKE TEST SWITCH

– Provides a smoke test in the forward lavatory.

11 - EMERGENCY LIGHT ON/ARMED SWITCH (GUARDED)

ON: – turns on all emergency lights.
– emergency light indication illuminates on the flight attendant control panel.

ARMED: automatically illuminates all emergency lights in case of DC bus electrical power loss or if airplane electrical power is turned off.

12 - EMERGENCY LIGHT TEST SWITCH

– Provides a one-minute test of all passenger cabin emergency lights.

13 - CABIN LIGHTING BRIGHT/DIM SWITCH

Momentary press.

BRIGHT: sets the lights of the respective area to full brightness.

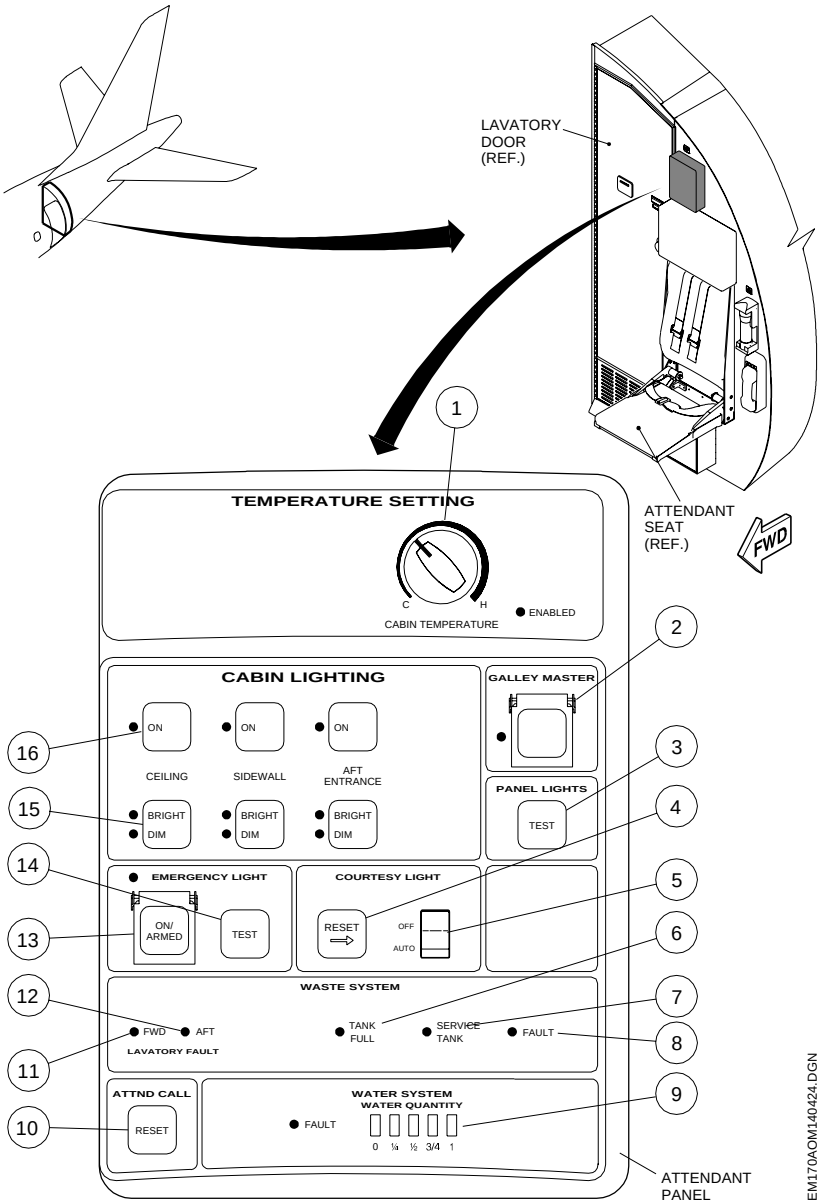
DIM: reduces the brightness of the respective area lights.

14 - CABIN LIGHTING ON SWITCH

– Turns the respective cabin light on and off.

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AFT ATTENDANT CONTROL PANEL



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1 - CABIN TEMPERATURE CONTROL

– Controls cabin temperature.

– The “ENABLED” led turns on to indicate the knob is controlling the cabin temperature. The led turns on when the Passenger Cabin Temperature Rotating Knob in the cockpit is set to ATTND position (Refer to Section 14-02 – AMS).

– Available only for airplanes with dual cabin temperature control.

2 - GALLEY MASTER SWITCH (GUARDED)

– Turns off all galleys (AC power off).

– Turns off the PC Power system.

3 - PANEL LIGHTS TEST SWITCH

– Provides a test of the attendant panel lights.

4 - COURTESY LIGHT RESET SWITCH

– Turns on all courtesy lights for 5 min.

5 - COURTESY LIGHT SWITCH

AUTO: turns on or off the courtesy lights according to passenger door position (OPEN or CLOSED).

OFF: turns off the courtesy lights despite of passenger door position.

6 - TANK FULL INDICATION

– Illuminates to indicate that the waste tank has reached 100% of its capacity.

7 - SERVICE TANK INDICATION

– Illuminates to indicate that the waste tank has reached 75% of its capacity.

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8 - FAULT INDICATION

– Illuminates to indicate that a fault in the waste system has been detected.

NOTE: Some FWD/AFT LAVATORY FAULT indications may be cleared by means of repeated toilet flush cycles. If the FAULT indication extinguishes after repeated flush cycles, the toilet may be normally operated. If the FAULT indication does not extinguish, report to maintenance personnel.

9 - WATER TANK CAPACITY AND FAULT INDICATION

– Indicates the water tank capacity. The fault light indicates one of the following conditions:

  – A fault in the respective (FWD or AFT) drain valve is detected.

  – Water level indication is not available.

  – In-flight drainage is not available due to a fault in the drain valve or in the drain mast heater.

10 - ATTND CALL RESET SWITCH

– Turns off the attendant call indicator lights, zonal lights and PSU switch lights, previously turned on due to an attendant call.

11 - FORWARD LAVATORY FAULT INDICATION

– Illuminates to indicate that the forward lavatory is out of order.

12 - AFT LAVATORY FAULT INDICATION

– Illuminates to indicate that the aft lavatory is out of order.

13 - EMERGENCY LIGHT ON/ARMED SWITCH (GUARDED)

ON: turns on all emergency lights.

ARMED: automatically illuminates all emergency lights in case of DC bus electrical power loss or if airplane electrical power is turned off.

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14 - EMERGENCY LIGHT TEST SWITCH

– Provides a one-minute test of all passenger cabin emergency lights.

15 - CABIN LIGHTING BRIGHT/DIM SWITCH

– Momentary press.

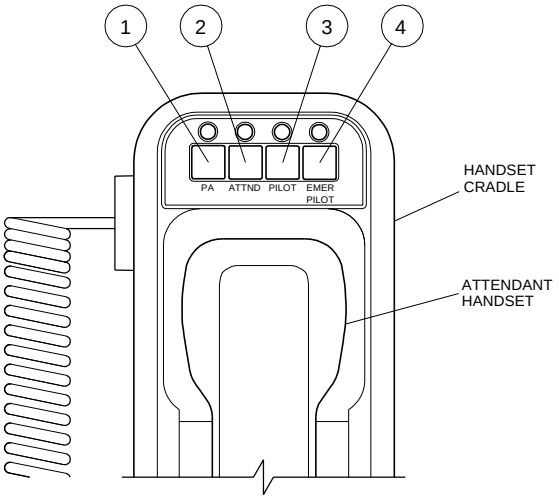
BRIGHT: sets the lights of the respective area to full brightness.
DIM: reduces light brightness of the respective area.

16 - CABIN LIGHTING SWITCH

– Turns on and off the respective cabin light.

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INTERPHONE HANDSET/CRADLE ASSEMBLY



EM170AOM9700023A.DGN

1 - PA BUTTON

– Provides passenger announcements.

2 - ATTND BUTTON

– Provides communication among flight attendants.

3 - PILOT BUTTON

– Provides communication among flight attendant and cockpit crew.

NOTE: If the “PILOT” button is pressed in the electrical emergency configuration (RAT deployed), the green light will illuminate and the call chime will be annunciated, but the communication channel will be unavailable. The “EMER PILOT” button can be used normally.

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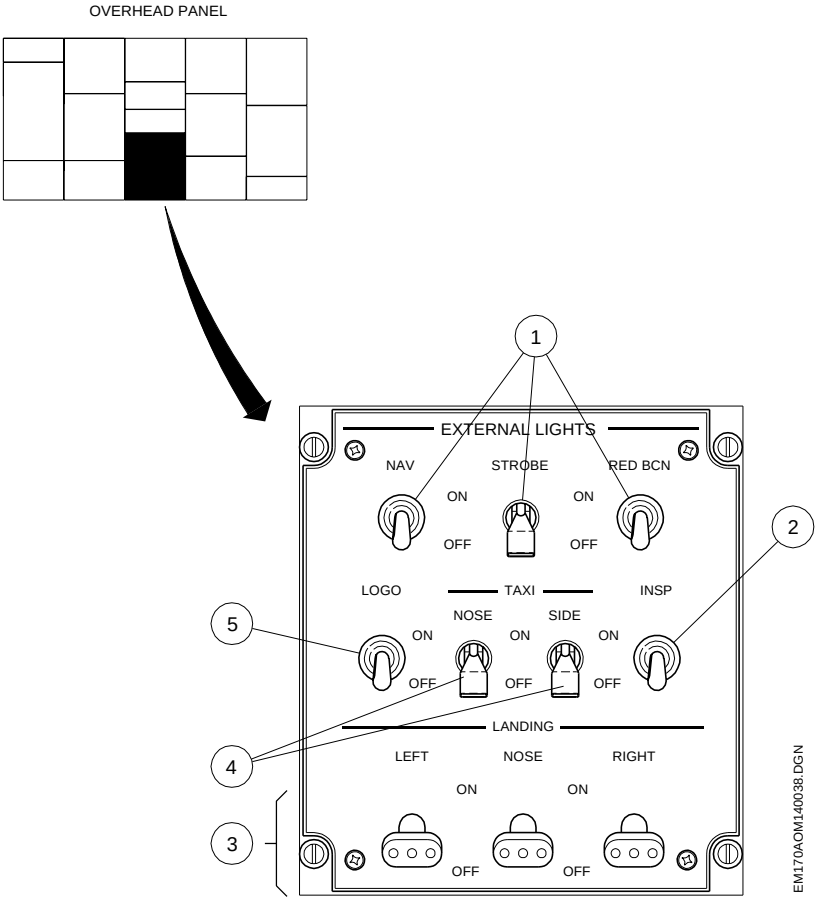
4 - EMER PILOT BUTTON

– Provides communication among flight attendant and cockpit crew in emergency condition.

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EXTERNAL LIGHTING

EXTERNAL LIGHTS CONTROL PANEL



1 - NAVIGATION, STROBE AND RED BEACON SWITCHES

– Turns the associated light on/off.

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2 - INSPECTION LIGHT SWITCH

– Turns the inspection lights on/off.

3 - LANDING LIGHT SWITCHES

– Turns the associated landing light on/off.

4 - TAXI LIGHT SWITCHES

– Turns the taxi lights on/off.

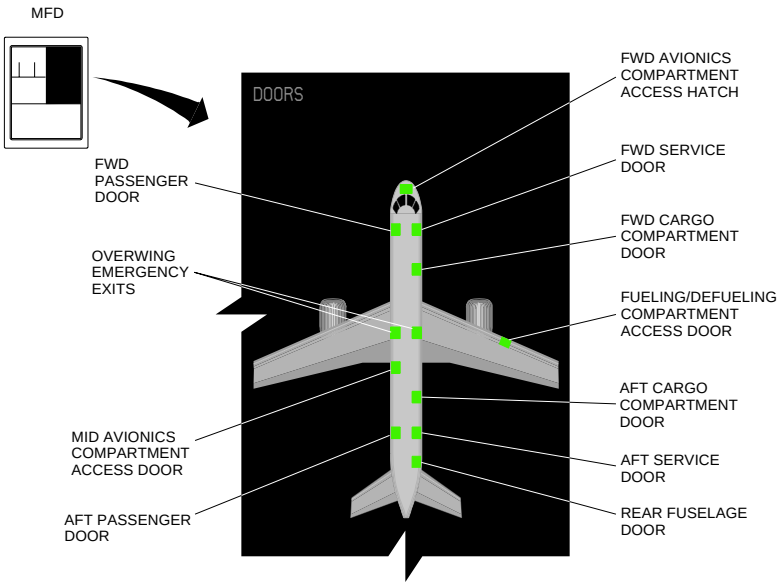
5 - LOGOTYPE LIGHT SWITCH

– Turns the logotype lights on/off.

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SYNOPTIC PAGE ON MFD

Door information is displayed on the synoptic status page. It can be selected by flight crew on either MFDs.



DOOR

– On synoptic page, the door is shown as a colored solid square.

GREEN: the associated door is closed.

RED: the associated passenger, service or cargo door is open.

AMBER: the associated access door is open.

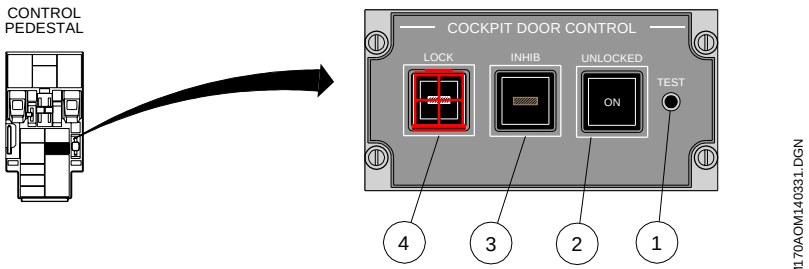
AMBER DASHED: the associated door status is undetermined.

NOTE: An annunciation is displayed at the right top of the doors status windows whenever the respective door is not properly closed.

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REINFORCED COCKPIT DOOR

CONTROL PANEL IN THE COCKPIT



1 - TEST BUTTON

– Continually tests the DING-DONG alarm while the test button is pressed, regardless of audio selection.

2 - UNLOCKED INDICATION

– Turns on when door is unlocked.

– Starts flashing when the EMERG ENTRY pushbutton on the passenger cabin control panel is pressed.

– Turns off when the INHIB pushbutton is pressed.

3 - INHIB PUSHBUTTON

– Inhibits the EMERG ENTRY command from cockpit door control panel in the passenger cabin for 500 s.

– Lights up the red LED in the passenger cabin control panel.

– The cockpit door opens if the INHIB pushbutton is not pressed up to 30 s after the EMERG ENTRY pushbutton on the passenger cabin control panel is pressed.

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4 - LOCK PUSHBUTTON (GUARDED)

– Controls the cockpit door's power supply.

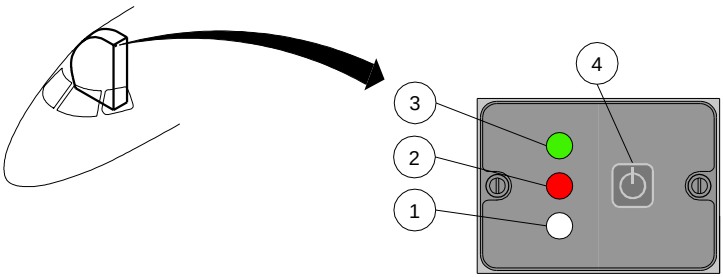
– Activates and deactivates the electromechanical door latch.

– Deactivates the inhibition control.

– Resets the DING-DONG alarm and EMERG ENTRY command.

– Resets the green led on the door's control panel in the passenger cabin.

CONTROL PANEL IN THE PASSENGER CABIN



1 - WHITE LED

– Indicates that the unlock sequence has been started.

2 - RED LED

– Indicates that the INHIB pushbutton in the cockpit was pressed and EMERG ENTRY is temporarily inhibited.

3 - GREEN LED

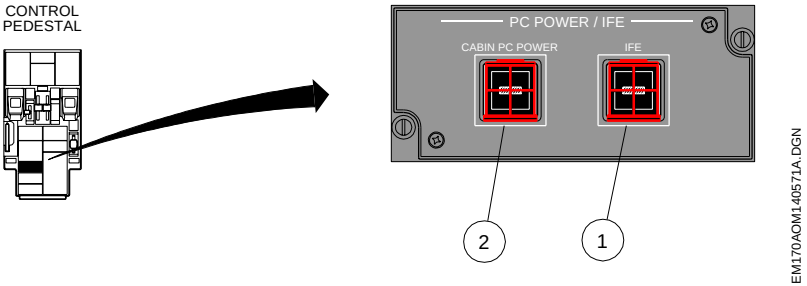
– Indicates the cockpit door is unlocked.

4 - EMERG ENTRY PUSHBUTTON

– The button needs to be pressed for 3 s to activate the DING-DONG alarm sequence in the cockpit.

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PC POWER/IFE PANEL



1 - IFE

PUSH IN: enables the IFE system.

PUSH OUT: disables the IFE system. A striped bar illuminates in the button.

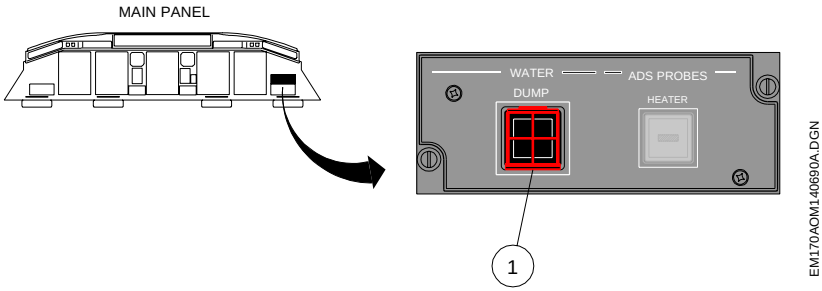
2 - PC POWER BUTTON

PUSH IN: supplies power to the AC-outlet units.

PUSH OUT: disables the power supply to the AC-outlet units. A striped bar illuminates in the button.

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WATER DUMP PANEL



1 - WATER DUMP BUTTON (GUARDED)

- Commands the potable water drainage during flight.
- When the button is pressed, the striped bar comes on.
- The striped bar will turn off if one of the following conditions occurs:
  - The Water Dump button is pressed again;
  - The landing gear is down;
  - Faulty drain mast heater indication in the aft flight attendant control panel.

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ELECTRONIC DISPLAY SYSTEM (EDS)

The EDS is an advanced system that displays primary flight, navigation and system information to the flight crew and consists of:

- Five Display Units (DU).
- One Guidance Panel.
- Two Cursor Control Devices (CCD).
- Two Multi-function Control Display Units (MCDU).
- One EICAS FULL panel.
- Two Reversionary Panels.
- MAU hardware.
- Control I/O modules.
- EDS application software on processor module.

Five display units (DUs) are located on the main instrument panel. There are two Primary Flight Displays (PFD), two Multifunction Displays (MFD) and one Engine Instrument and Crew Alerting System (EICAS). They are identical and interchangeable.

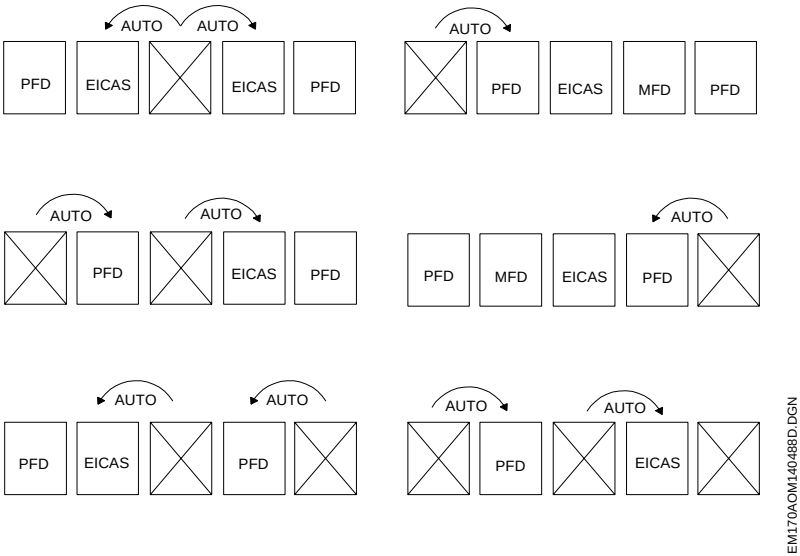
The guidance panel is located in the center of the glareshield above the DUs. The two CCDs, one EICAS FULL panel and the MCDUs are located on the pedestal, whereas the reversionary panels are located on the main instrument panel.

There are four different modes for the DU reversion control for each pilot: PFD, MFD, EICAS and AUTO. Only DU 2 and DU 4 can be reverted. DU 1 and DU 5 always operate as PFDs, and DU 3 is always an EICAS. In case of failure of one display, an automatic logic transfer will allow its information to be presented in the remaining units provided that the display selector knob is set to auto position. If the failed display is recovered, it is necessary to manually revert the display selector knob to have the MFD information on DU 2 or DU 4.

Rotating the display selector knob to a position other than AUTO forces that selection onto the MFD. When a pilot selected reversion occurs, the “failed/reverted from” DU is shutdown and the display will be blank.

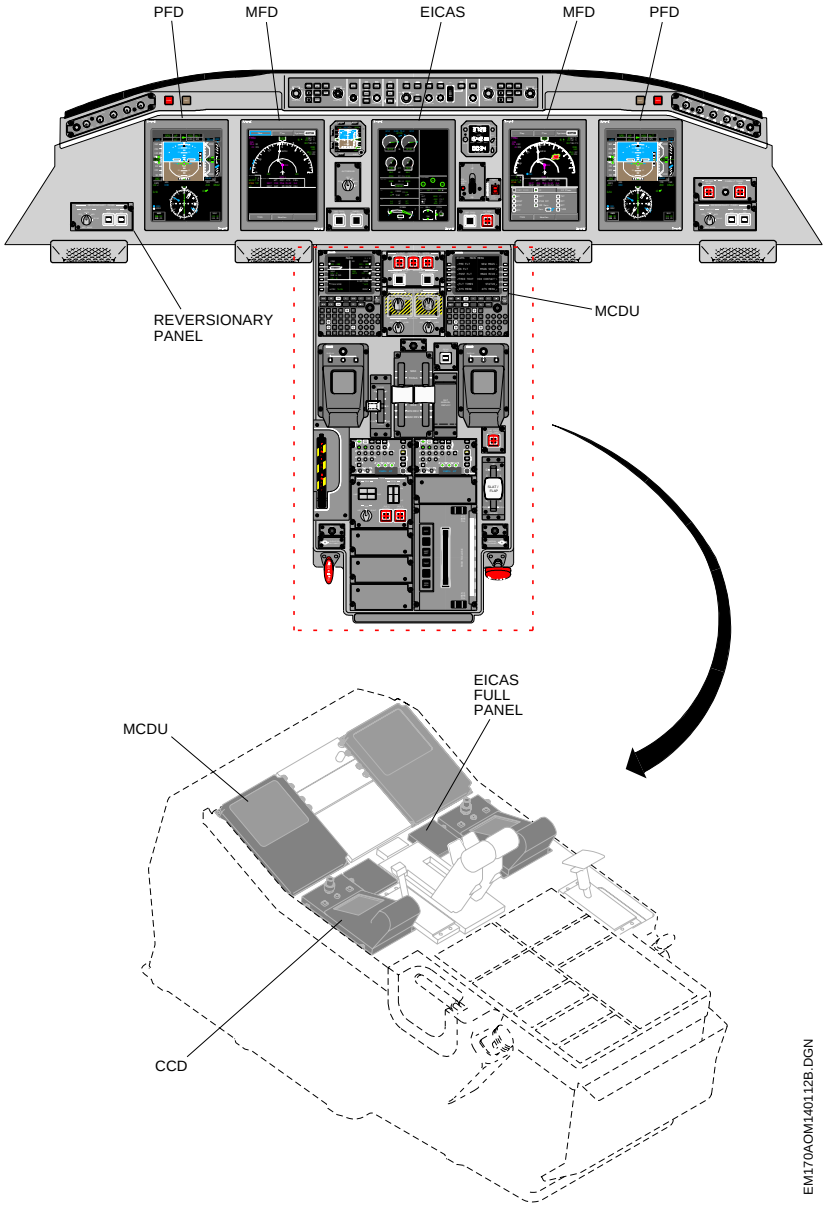
The auto DU reversion function will have the following display format reversion priority (highest to lowest): PFD, EICAS and MFD.

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EDS AUTO REVERSION LOGIC

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AIRPLANE DISPLAYS

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PRIMARY FLIGHT DISPLAY (PFD)

The PFD displays information such as airspeed indicator, altitude indicator, ADI, HSI, vertical speed indicator, radio aids, autopilot, flight director and radio altitude data. They are displayed in two sections, each one presenting a group of information.

In the event of a display failure, information may be presented in the MFD by appropriately setting the reversionary panel. Certain PFD internal failures will result in a large red “X” covering the PFD screen.

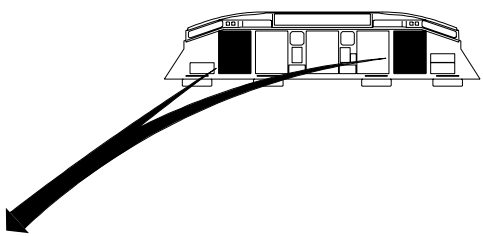
In case of mismatched information between two PFDs, a monitor warning annunciation is displayed when an unacceptable cross compare of any of the parameters that follow are detected.

– Pitch
– Roll
– Attitude
– Heading
– BARO altitude
– Airspeed
– Localizer
– Glideslope
– Radar altitude
– Flight path angle
– EICAS
– Crew Alerting System (CAS)

The display controller portion of the guidance panel allows the selection of PFD HSI formats, navigation sources, weather display, and bearing pointer selection.

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MAIN PANEL





AVIATE

- AUTOPILOT APPROACH STATUS ANNUNCIATOR
- FLIGHT MODE ANNUNCIATOR
- ATTITUDE AND SIDE SLIP
- ALTITUDE
- AIRSPEED/MACH
- AIRSPEED TREND VECTOR
- VERTICAL SPEED
- FLIGHT PATH ANGLE
- FPA ACCELERATION POINTER
- FLIGHT DIRECTOR
- TCAS RESOLUTION ADVISORY
- WINDSHEAR
- RADIO ALTIMETER
- MINIMUMS

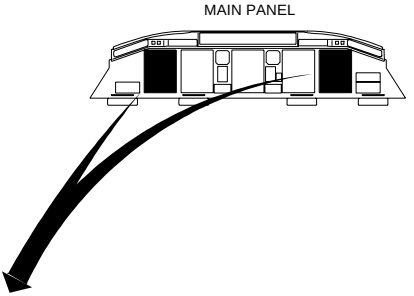
NAVIGATE AND COMMUNICATE

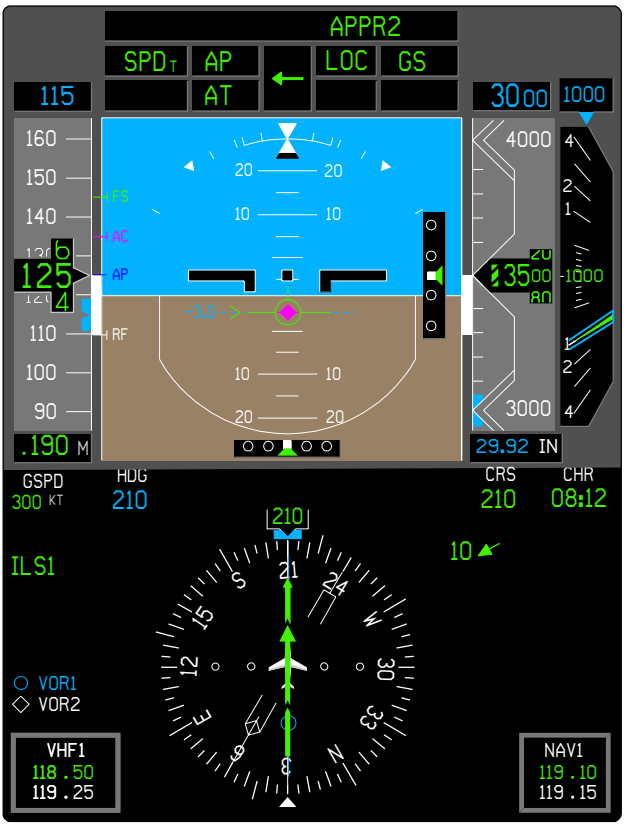
- HEADING
- ILS/VOR/DME
- ADF
- RADIO COMMUNICATION TUNING
- RADIO NAVIGATION TUNING
- FMS ANNUNCIATION/INDICATION
- WIND
- ELAPSED TIME
- GROUND SPEED
- RNP (FMS)

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PFD DISPLAY PHILOSOPHY

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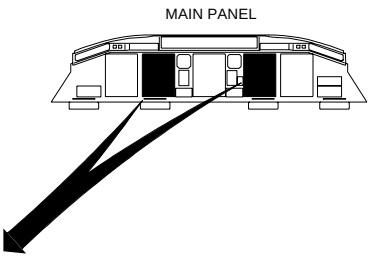


PFD DISPLAY

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MULTI FUNCTION DISPLAY (MFD)

The MFD displays map and plan navigation formats, various systems synoptic formats selectable by the flight crew, and also the status page. The MFD provides redundancy to display both the PFD and EICAS formats based upon reversion. It also has the ability to display maintenance information. The MFD consists of menu softkeys, on the top and bottom of the screen, which are used to select formats and control various systems.





NAVIGATE

- MAP
- PLAN
- SYSTEM SYNOPTIC PAGES
- TCAS
- WEATHER RADAR
- EGPWS (TERRAIN)
- PROGRESS

NAVIGATE (Vnav)

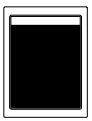
- TCAS ZOOM
- WEATHER RADAR CONTROLLER
- TCAS CONTROLLER
- VERTICAL PROFILE

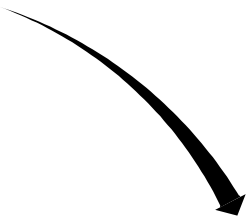
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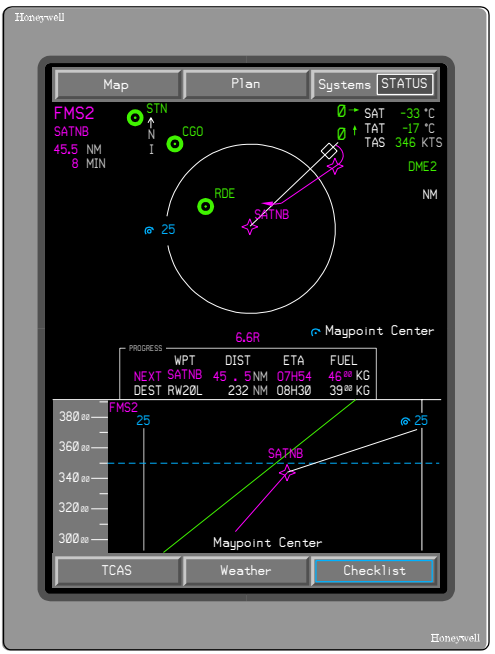
MFD DISPLAY PHILOSOPHY

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PFD







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MFD DISPLAY

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STATUS PAGE

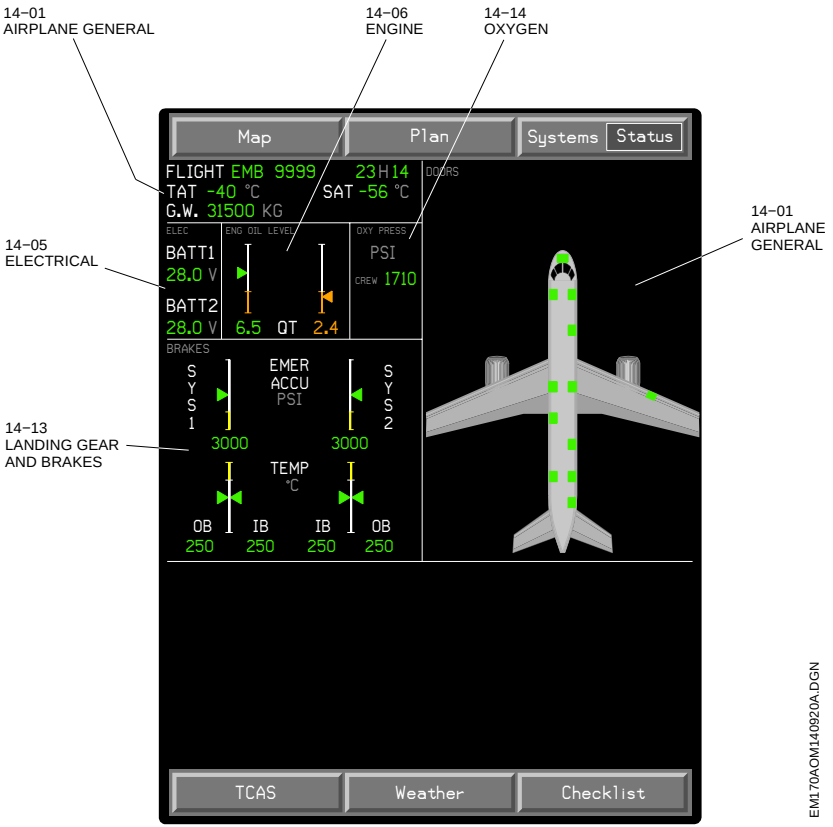
A dedicated page on MFD is available for pilots to achieve status information about:

- Flight;
- Battery;
- Engine Oil level;
- Brake;
- Crew oxygen;
- Door and Access Panel.

Refer to the associated section of the AOM for more information:

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►*EMBRAER 190/195 models except ECJ Model, units in kg, equipped with Load 21.2 and on*



◄

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ELECTRONIC CHECKLIST

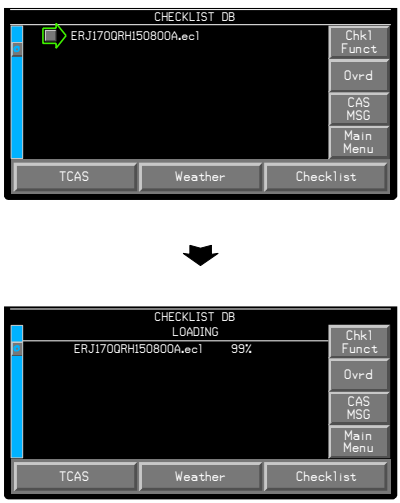
The airplane's Electronic Checklist (ECL) presents the checklists on the lower part of the MFDs. The ECL permits automation of checklist's items reducing crew workload.

The flight crew uses both the CCDs to respond manual checklist items and to navigate through the checklist pages.

ECL DATABASE LOADING PAGE

After an airplane Power Up, clicking the Checklist Softkey opens the ECL DATABASE LOADING page. At this page, the airplane available ECL Database names are displayed. Selecting the database and clicking enter with the CCD loads the database.

After loading the database, the ECL automatically opens the ECL NORMAL page.



EM170AOM140563A.DGN

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ECL OPERATION

Clicking the CHECKLIST softkey on the MFD allows access to ECL pages. When both MFDs are displaying the ECL pages, they are synchronized, however only one side at a time has control over the ECL.

The first side to access the ECL has the control over it through its respective CCD. In this condition, the ECL can be opened on the cross-side MFD, however, the cross-side CCD cannot do any input on the ECL.

If the side with control over the ECL allows one second without providing any input, the first side to do an input in ECL gains the control over it.

The ECL combines automatic and manual response functions. Automatic responses receive information from the airplane systems and sensors to verify an item's accomplishment (Closed Loops); manual responses are flight crew inputs from the CCD.

The following controls have closed loops in the normal checklists:

- Autobrake knob position (RTO selected or not).
- Brake Temperature (acceptable or not for takeoff).
- Engines Knobs position.
- Fuel AC Pumps Knobs position.
- Gear Lever position.
- Hydraulic Pumps Knobs position
- Pack Buttons status.
- Parking Brake Lever status.
- Flap/Slat Lever position (0 or FULL or neither 0 nor FULL).
- TLA Levers position (IDLE or TOGA or neither IDLE nor TOGA).

For the emergency and abnormal checklists there are no closed loops available.

The following softkeys are available on the ECL:

– Main Menu: Opens a new menu presenting the following checklist categories:

  - Normal.
  - Non Annunciated.

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- Emergency.
- Abnormal.
- User Defined.

Selecting one of the categories opens an index with all the associated procedures.

– **CAS MSG:** Opens the ECL ACTIVE ABNORMAL page.

– **Ovrd:** Allows the pilot to override a checklist step or an entire checklist.

– **Chkl Funct:** Opens three more softkeys:

- Undo: Undoes last pilot action on the checklist.
- Chkl Reset: Resets current or a selected checklist.
- Reset All: Resets all checklists.

Along the execution of each checklist, smart features are available to reduce crew workload. They are:

– **Timers:** automatically started when a checklist item requires so.

– **Branches:** the “if” clauses that, upon the “Yes or No” response from the pilot, displays only the applicable actions to be followed from that point on.

– **Hyperlinks:** links to synoptic pages are available (green button in the left side of the checklist item) when applicable during the procedures.

– **Closed loops:** items that are automatically checked by airplane systems upon action completion. (Closed loops are only available for NORMAL checklists).

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ECL PROCEDURES

ECL WINDOWS ORGANIZATION

The ECL has at least six groups where the checklists can be grouped: NORMAL, ABNORMAL, EMERGENCY, NON-ANNUNCIATED, ACTIVE ABNORMAL and USER DEFINED.

The procedures on the EMERGENCY and ABNORMAL pages have a priority according to the related EICAS message they are linked to, i.e., warning, caution or advisory. The NON-ANNUNCIATED and USER DEFINED categories permit to rate the procedures in emergency, abnormal, advisory or normal level.

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ECL ACTIVE ABNORMAL PAGE

The ACTIVE Abnormal PAGE presents the procedures related to the active EICAS messages. As in the EICAS, the messages are grouped according to the priority category: warning, caution or advisory; with the warning at top, followed by the caution and the advisory categories.

Within a category, the checklist that comes at the top is the last EICAS message generated of that category.

Once a checklist is completed or overridden, it is removed from the ACTIVE ABNORMAL PAGE. However, any checklist is still accessible navigating on the checklist's windows through the Main Menu.

Application of the function RESET ALL restores the checklists to the ACTIVE ABNORMAL PAGE if the respective message is still displayed in the EICAS.



ECL ACTIVE ABNORMAL PAGE

ENGINE INDICATION AND CREW ALERTING SYSTEM (EICAS) DISPLAY

The EICAS displays engine and system parameters such as flap, gear, spoilers and trim positions, total fuel quantity, APU and environmental information. The EICAS also displays crew awareness messages. For further information on engine parameters and CAS messages shown, refer to section 14-06 Engine and 14-15 Warnings respectively. In case of failure in the EICAS display, its information may be presented in the MFD by appropriately setting the reversionary panel.

An automatic mode de-clutters the EICAS after takeoff. De-cluttering occurs 30 seconds after landing gear retraction and flap/slat retraction, if all parameters are displaying normal indications.

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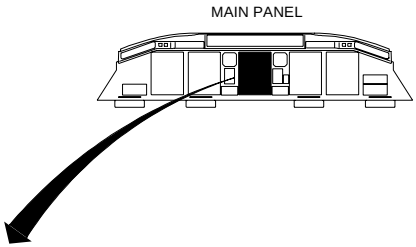
The following items are de-cluttered from EICAS:

- Oil pressure.
- Oil temperature.
- Engine vibration.
- Slat position.
- Flap position.
- Speed brake position.
- Landing gear position.
- Pitch trim green band.
- APU.

The EICAS FULL pushbutton on the control pedestal inhibits the automatic de-clutter of EICAS. The EICAS is fully displayed when a cautionary condition is detected on one of de-cluttered indications.

In normal conditions, de-clutter is disabled when the landing gear is extended and/or flap/slat is not at 0.

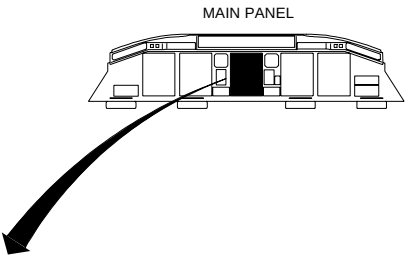
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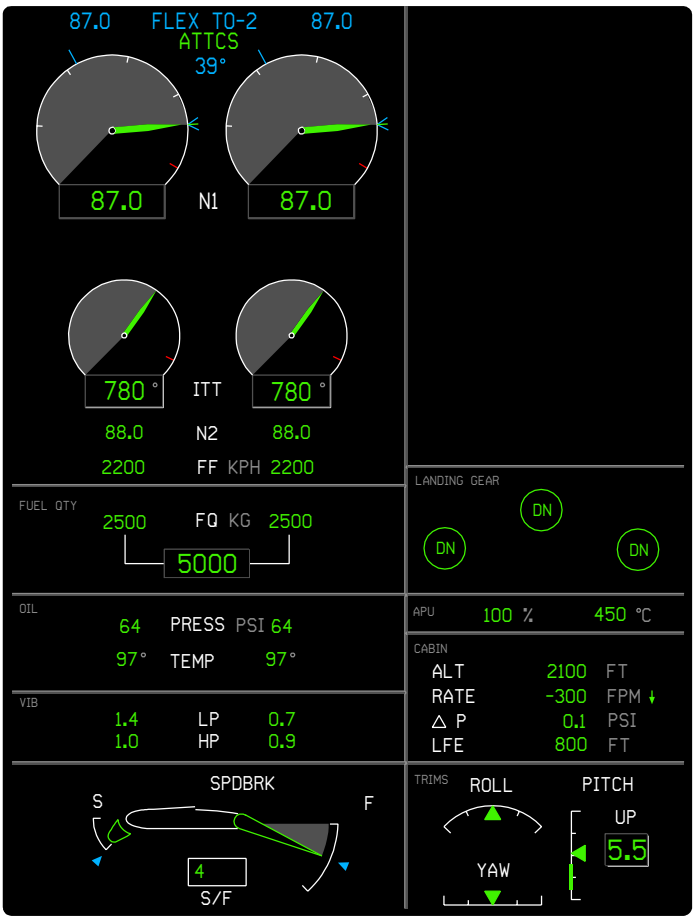




EICAS DISPLAY PHILOSOPHY

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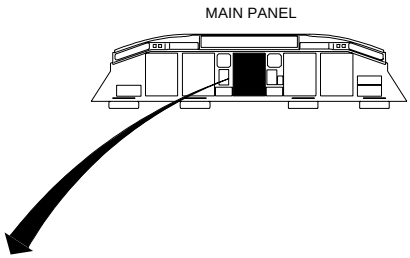


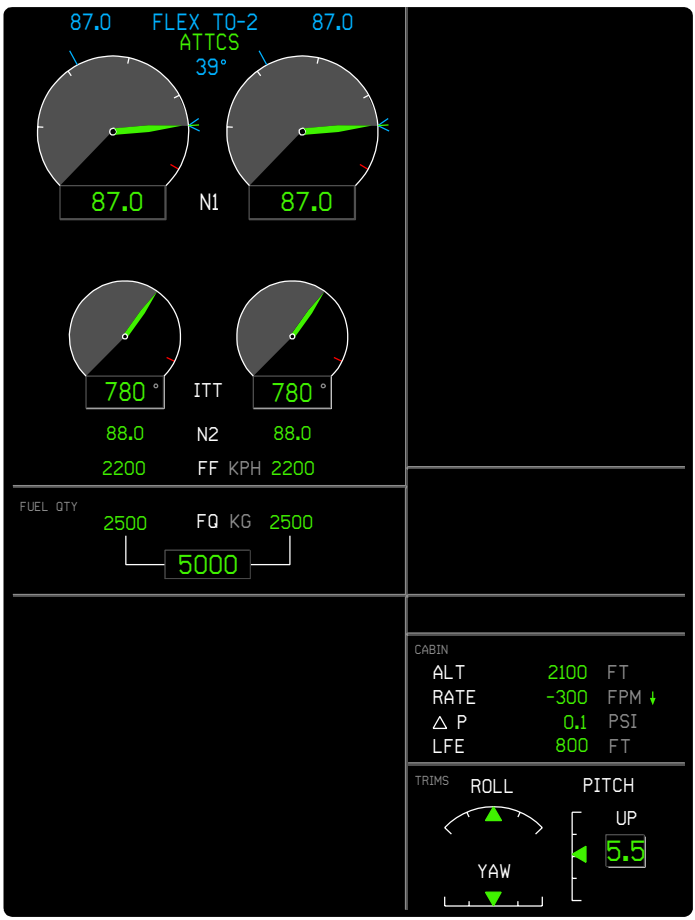


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FULL EICAS DISPLAY

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EM170AOM140431C.DGN

DECLUTTERED EICAS DISPLAY

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MULTIFUNCTION CONTROL DISPLAY UNIT (MCDU)

The MCDU allows radio tuning, PFD radio tuning display setup, manual engine rating selection, engine takeoff data set, avionics display setup and test, performance initialization, flight planning, access to electronics CBs, among others.

The EDS allows either MCDU to perform any of the functions available.



EM170AOM140196A.DGN

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CURSOR CONTROL DEVICE (CCD)

Two CCDs are installed on the control pedestal and allow the flight crew to quickly position the cursor within the different selectable menus and displays.

Each CCD has three function keys corresponding to the respective flight crew's display. Pressing a function key activates the CCD on the corresponding display (PFD, MFD or EICAS). The middle button has a different shape to make the identification easier under low visibility condition or turbulence.

ENTER buttons are provided on both sides of CCD.

A dual concentric rotary knob on the CCD is used to control the:

– WX radar tilt angle and range selection;
– Selection of Radio frequency;
– Scrolling of EICAS messages (caution, advisory, and status).

►*MAU load 4.5 and on AND previous than load 19.3 OR SB 0190-31-0007 AND PRE-MOD SB 0190-31-0009;*

Touching the touch pad moves the cyan box selector around the display. The touch pad has six hot spots: one in each corner and at top and bottom centers. Touching a hot spot instantly moves the cursor to correspondent position on the selected screen. A cyan box shows the menu in control whenever a display is selected.

◄

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

Touching the touch pad moves a crosshair pointer on the MFD selectable areas. The cyan selector box selects the soft key under the crosshair pointer. There are no hot spots in the MFD.

◄

The cursor automatically goes to a default position if the CCD is not operated for more than 20 s, provided there are no virtual control panel and pull-down menus opened.

An opened pull-down menu closes automatically if a different display is selected. This logic is not applicable for WX radar control panel on MFD.

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►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*



GUIDANCE PANEL

The guidance panel houses the display controllers, used for display control, autopilot and yaw damper engagement functions, flight director mode engagement and selection of display data source for the flight director.

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MODULAR AVIONICS UNIT (MAU)

MAUs are cabinets that house modules assigned to different functions in an integrated architecture and also avionics and non-avionics functions. Among the avionics functions are the air data application, autopilot, autothrottle, data acquisition, display control functions, flight director, Flight Management System (FMS), flight control modules, global position system, monitor/warning system, stall protection/warning and windshear guidance.

MAU 1 and 2 are located in the forward electronics bay and MAU 3 is located in the center electronics bay.

MAU 1 is a 20-slot cabinet while MAU 2 and MAU 3 are 16 slot cabinets. The typical layout of the MAUs, showing the location of each module, is provided on the next page.

Where each MAU module is named as:

NIC:	network interface controller.
AIOP:	actuator input/output processor.
PROC 1:	ADA 1(air data application), MW 1 (monitor warning), UTIL 1 (utility), CAL/MCDU 1, and CMS 1.
PROC 2:	CMF 2 (communication management function) - (optional).
PROC 3:	FMS 1.
PROC 4:	ADA 2, MW 2, UTIL 2 (utility), CAL/MCDU 2, and CMS 2 (configuration management system).
PROC 5:	FMS 2, ADA 3, FBW.
PROC 6:	CMF 1, ECL.

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MODULAR AVIONICS UNIT 1

SLOT	BUS	CH	POWER SUPPLY 3 DC 1	CH	BUS
20		B	SPARE		
19	2	B			
18	2	B	CMC		
17	2	B	GPS 1		
			POWER SUPPLY DC ESS 1		
16	2	B	FCM 1		
15				A	1
14	2	B	CUSTOM I/O 1		
13				A	1
	2	B	NIC 2		
	2	B	PROC 2		
12	2	B	GENERIC I/O		
11				A	1
10			AIOPB1	A	1
9					
			PROC 1	A	1
			NIC 1	A	1
8	2	B	FCM 2		
7				A	1
6			CONTROL I/O 1	A	1
5			BRAKES (OUTBD)	A	1
4			PSEM 1		
3				A	1
2			AIOPA1	A	1
1					
SLOT	BUS	CH	POWER SUPPLY 1 DC ESS 1	CH	BUS

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MODULAR AVIONICS UNIT 2

SLOT	BUS	CH	POWER SUPPLY 2 DC ESS 2/DC 2	CH	BUS
16	2	B	BRAKES (INBD)		
15	2	B	CONTROL I/O 2		
14			AIOPA2		
13	2	B			
12			SPARE		
11			SPARE		
10	2	B	GENERIC I/O 2		
9				A	1
	2	B	NIC 4		
	2	B	PROC 4		
			PROC 3	A	1
			NIC 3	A	1
8			SPARE		
7	2	B	DATABASE		
6			AUTOBRAKE	A	1
5	2	B	EGPWM		
4			NOSEWHEEL STEERING	A	1
3					
2			SPARE	A	1
1				A	
SLOT	BUS	CH	POWER SUPPLY 1 DC 2	CH	BUS

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MODULAR AVIONICS UNIT 3

SLOT	BUS	CH	POWER SUPPLY 2 DC 2	CH	BUS
16	1	B	ENGINE VIBE		
15			GPS 2	A	2
14			PSEM 2		2
13				A	
12	1	B	FCM 3		
11				A	2
10	1	B	GENERIC I/O 3		
9				A	2
	1	B	NIC 6		
	1	B	PROC 6		
			PROC 5	A	2
			NIC 5	A	2
8	1	B	CUSTOM I/O 2		
7				A	2
6			AIOPB2	A	2
5					
4			SPARE		
3			SPARE		
2	1	B	FCM 4		
1				A	2
SLOT	BUS	CH	POWER SUPPLY 1 DC ESS 2	CH	BUS

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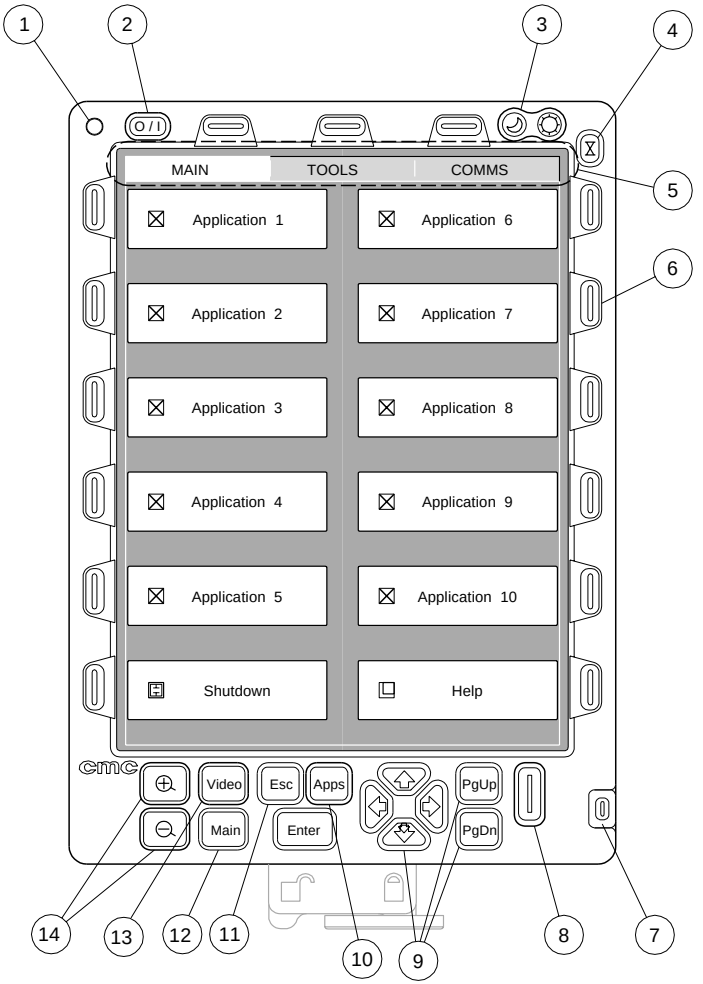
ELECTRONIC FLIGHT BAG (EFB)

The airplane may be optionally equipped with a CMA-1100 Pilot View Class II Electronic Flight Bag EFB Platform.

The EFB is designed to improve productivity by minimizing paper reference material and depending on the customized applications, improving accuracy of flight operations calculations.

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CONTROLS AND INDICATIONS



ELECTRONIC DISPLAY UNIT CONTROLS

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1 - AMBIENT LIGHT SENSOR

An integrated ambient light sensor adjusts initial brightness level at power up. The EDU Display has very low reflectance and is readable in direct sunlight.

2 - POWER BUTTON - “O/I”

The “0/I” power button is a multifunction control and indicator. The power button lights up and flashes to indicate different states.

State	Power Source	Power LED Indicator
System Off	No External Power.	No Light.
	With External Power.	Flashing Green.
Startup	Out of Temperature Range.	Flashing Amber.
System On	External Power.	Steady Green.
	Battery Powered.	Flashing Green.
	Battery Low.	Flashing Amber.

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3 - BRIGHTNESS/DIM BUTTON

These are the sun and moon shaped keys. Press to manually lighten or darken the display screen.

4 - CLOSE BUTTON

This key is located at the top right corner of the bezel and when pressed closes the currently active application.

5 - SOFT KEY MENU

Application links are gathered into three main groups: MAIN, TOOLS and COMMS for easy navigation.

MAIN MENU

The MAIN Menu provides access to applications selected by the operator.

TOOLS MENU

The TOOLS Menu provides access to several utilities including password-protected access to Windows.

COMMS MENU

The COMMS Menu is defined to provide a direct access to communication options available.

6 - BEZEL KEYS

Bezel keys provide direct access to key navigational functions of the PilotView™. These keys are used to facilitate easy access to information across applications.

7 - KEYBOARD LATCH - OPEN/CLOSE

To open the keyboard, pull the latch until it unlocks, then slide open the unit pushing on the top and bottom parts to separate. Push the latch to lock.

8 - HOTKEY (VERTICAL LINE SELECT KEY)

This key can be used for quick access to a user-defined application.

9 - ARROW KEYS/PAGE UP/PAGE DN

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These keys allow the user to scroll/pan within documents/graphic pages depending on the application.

10 - APPS

Shows a list of current active applications. Use the left and right arrow keys to select an application and then press the ENTER key to open the desired application.

11 - ESC

This key allows the user to cancel certain functions within an application. This will depend if the application supports this key.

12 - MAIN

This key shows the main menu.

13 - VIDEO (UNAVAILABLE)

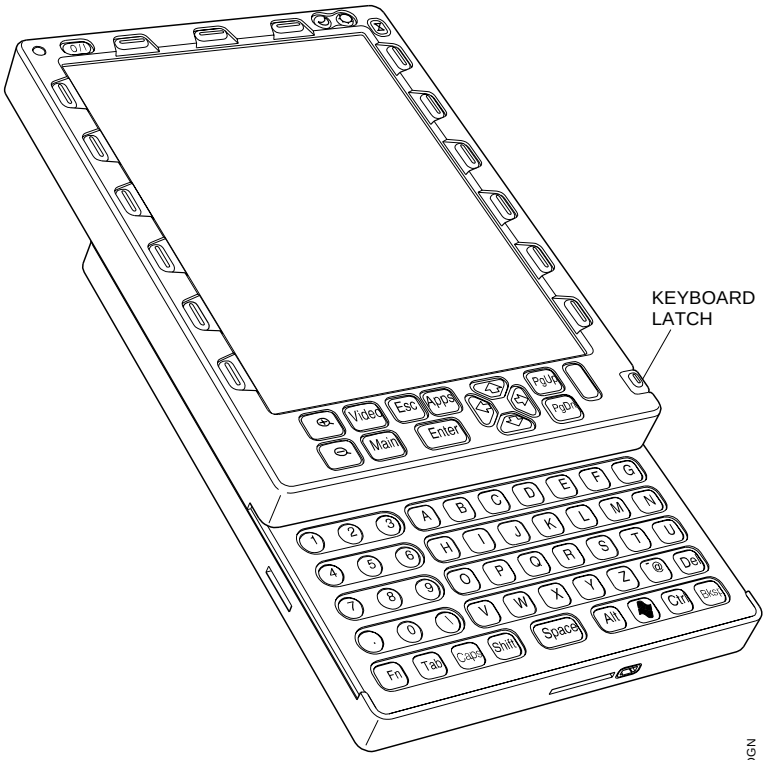
A message “No video source found” will be displayed.

14 - ZOOM IN/OUT

+/- keys enlarge or reduce the image or chart presented on screen.

NOTE: This function applies to properly configured applications.

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FMS-STYLE KEYBOARD

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GENERAL DESCRIPTION

The EFB is a touch screen device Windows XP based system that can support different applications such as: electronic documents and electronic charts.

The EFB configuration includes interfaces to receive:

– USB memory devices;

– Latitude/Longitude data from FMS output;

– Wireless High-Speed connection.

SCREEN USE

The EFB is designed to be operated by finger tips.

A round pointing device can be used if preferred provided it has a smooth tip.

Scratches may occur in case of use with hard point devices.

To clean it, use a soft cloth dampened with water. Chemical or abrasive cleaners must not be used.

EFB ELECTRICAL SUPPLY

NORMAL SUPPLY

The DC Bus 1 supplies electrical power to EFB 1 (left seat pilot) and DC Bus 2 to EFB 2 (right seat pilot).

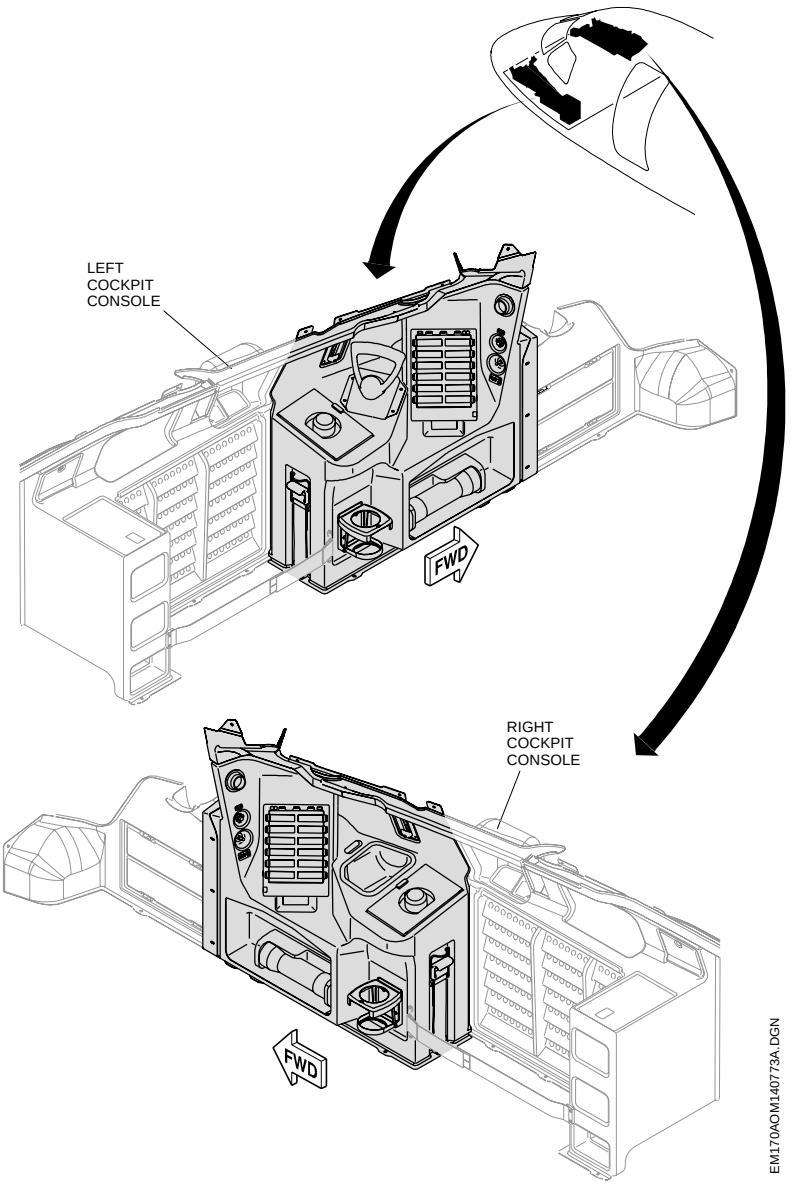
INTERNAL BATTERY

The EFB is equipped with an internal battery that keeps the system powered in case of a failure in the normal electrical supply.

The battery life can vary between 30 min to 2 h.

The battery full charge takes approximately 2 h whenever the normal electrical supply is available.

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ELECTRONIC DISPLAY UNIT

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NORMAL OPERATION

POWER UP SEQUENCE

– Press and hold the EDU power button for 1 s.

– The Master Menu will be displayed.

SHUTDOWN SEQUENCE

– Close all active applications that are running.

– On the EDU, press the MAIN key.

– Press SHUTDOWN.

– Press Turn Off.

– The unit will completely shut down.

NOTE: If the PilotView™ EFB is on, you can shut it down abruptly by pressing the EDU Power button for 5 seconds. To prevent potential loss of data, it is strongly recommended that you do not use this method.

SYSTEM RESET

If software reset is required on the system, it can be performed by reset button located in the small square hole at the top of the unit. Use a paperclip or other narrow stylus to press the reset. Pressing the reset button is equivalent to a system reboot.

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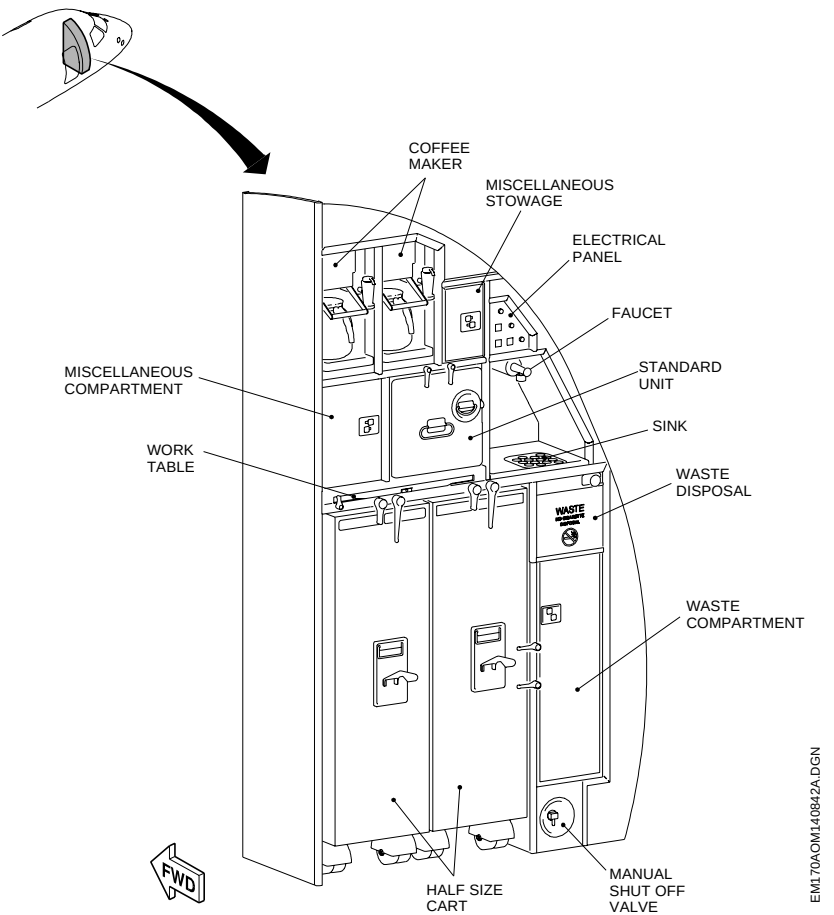
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PASSENGER CABIN

GALLEY

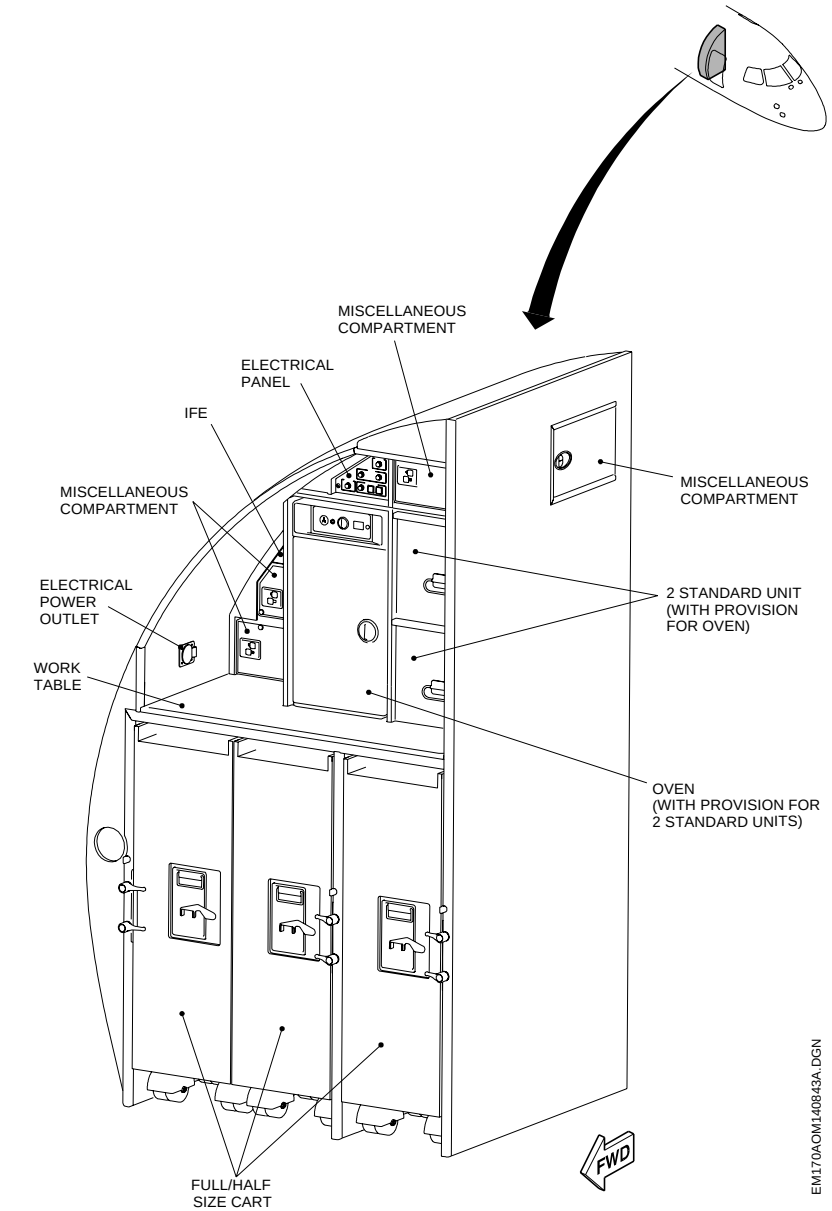
The galleys provide means for food preparation as well as stowage for food and miscellaneous items. A work deck is provided to assist flight attendants with their tasks.

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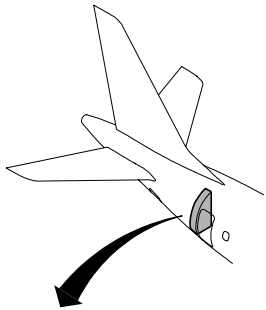
FORWARD GALLEY (G1)

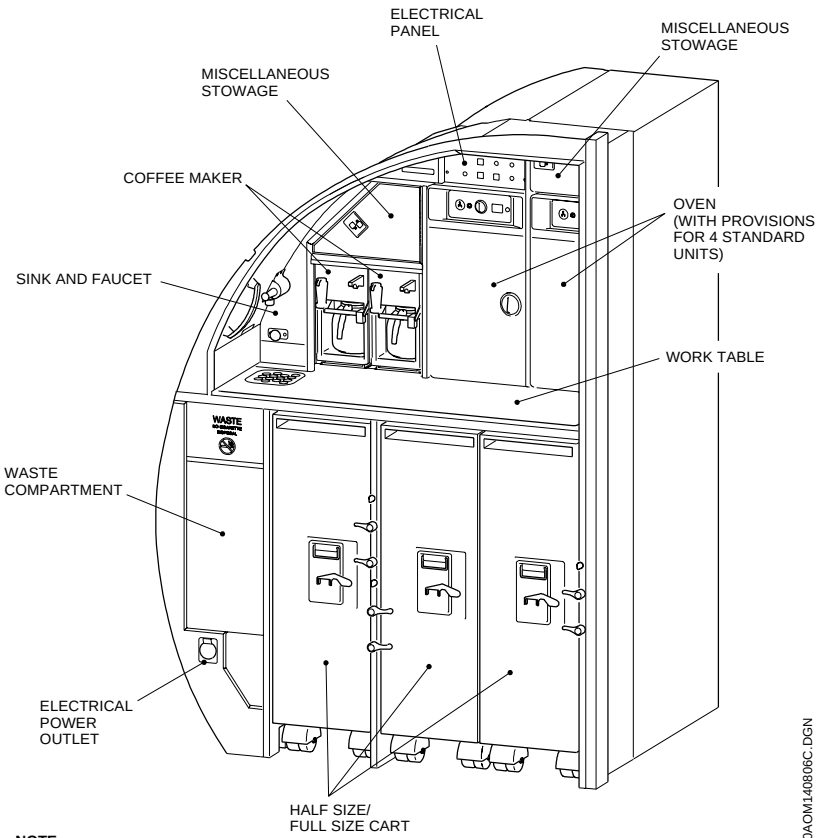
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FORWARD GALLEY (G2)

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NOTE:

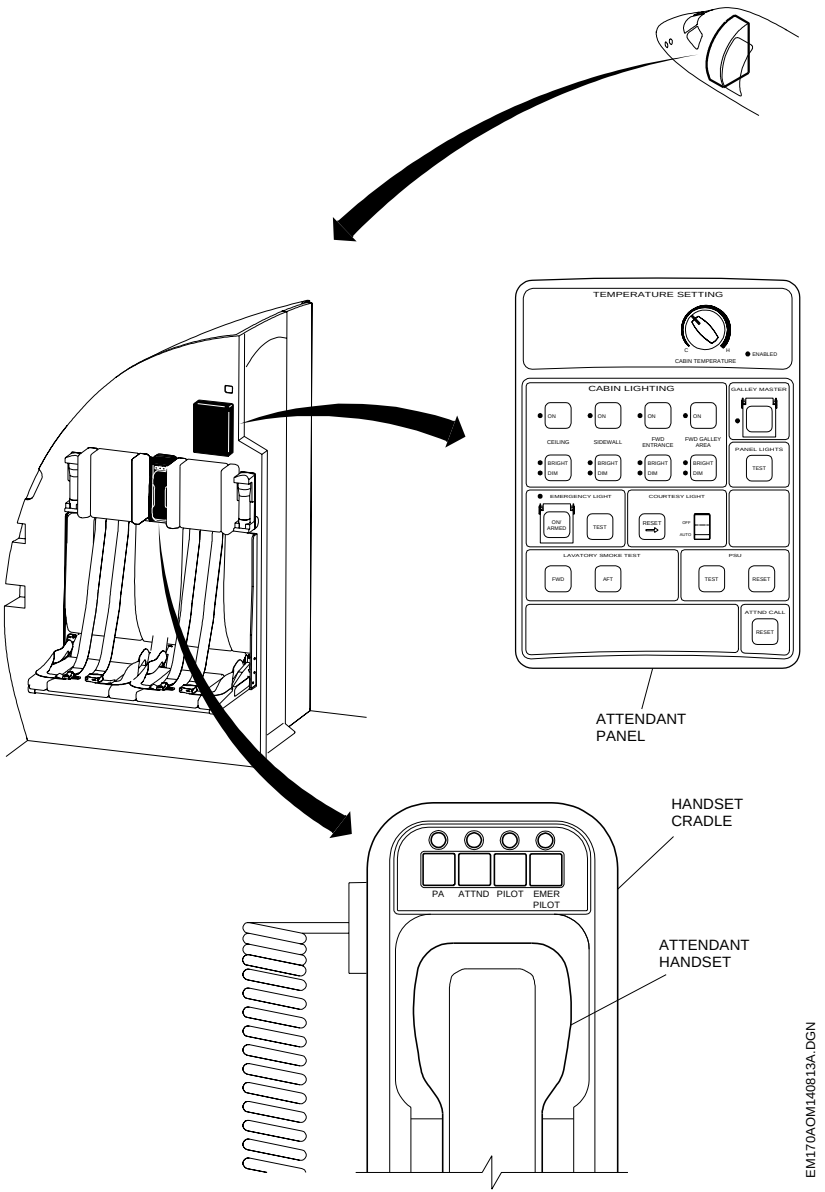
THERE ARE TWO MISCELLANEOUS STOWAGE COMPARTMENTS BEHIND THE CARTS.

AFT GALLEY (G3)

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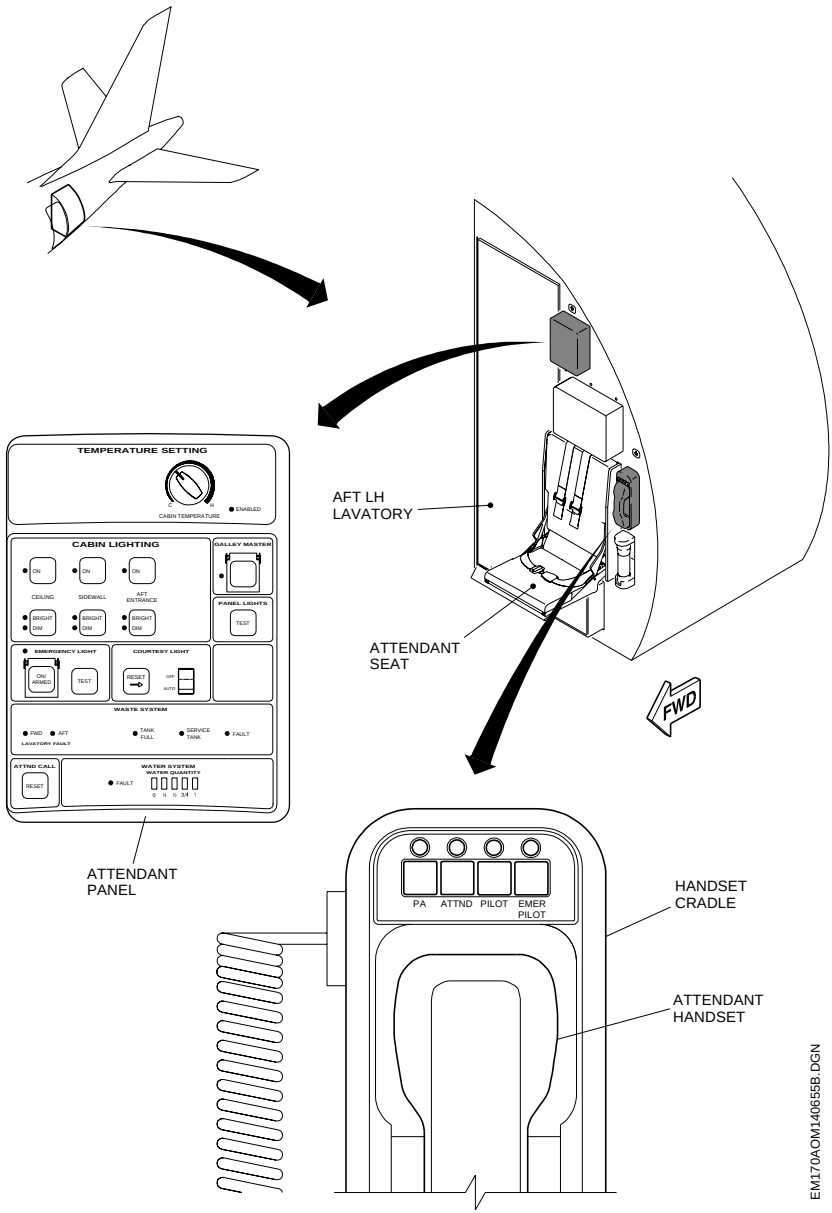
ATTENDANT STATIONS AND SEATS

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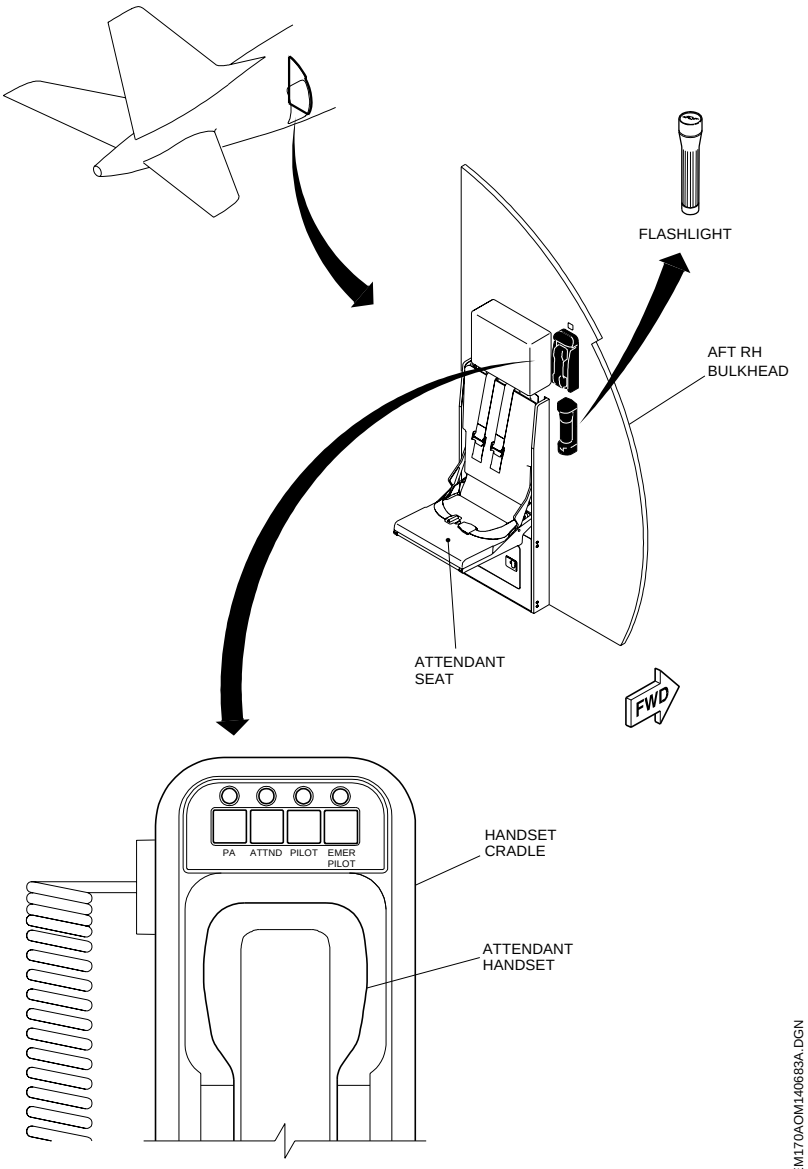
FWD FLIGHT ATTENDANT STATION AND SEAT (CC1/CC4)

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AFT FLIGHT ATTENDANT STATION AND SEAT (CC2)

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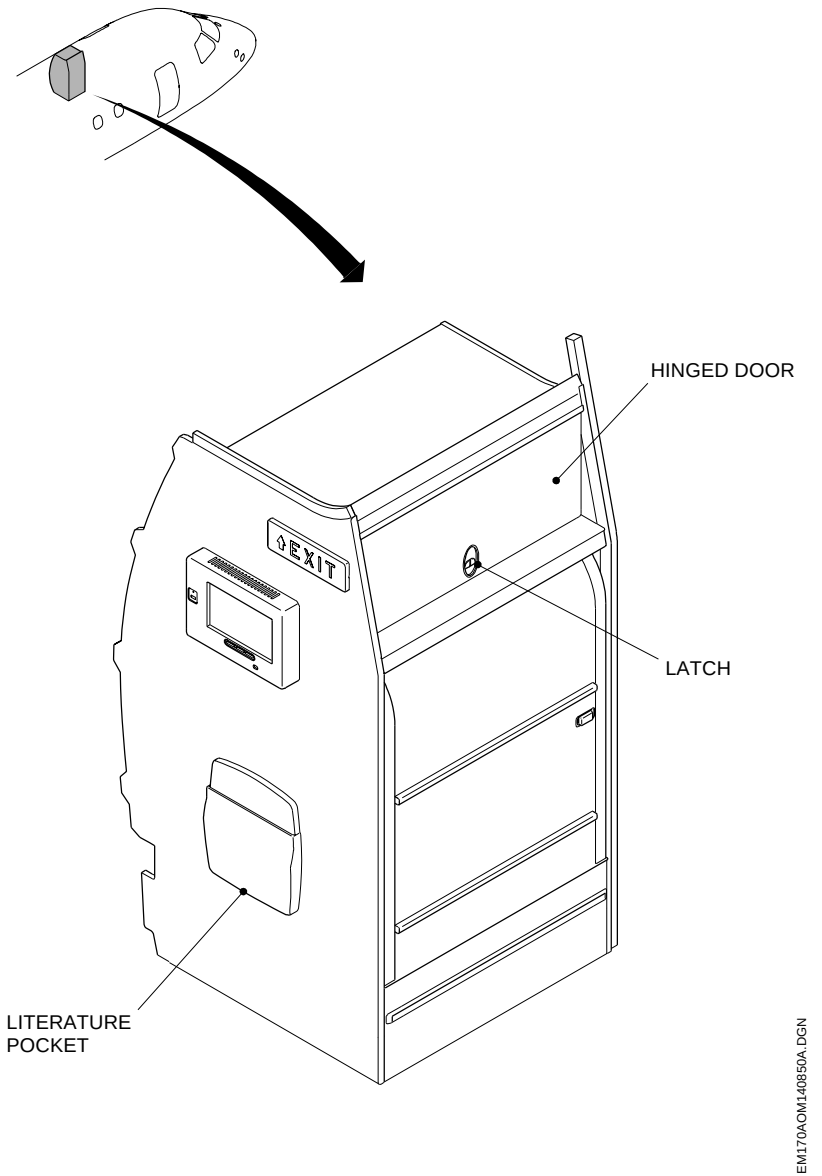


AFT FLIGHT ATTENDANT STATION AND SEAT (CC3)

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WARDROBE

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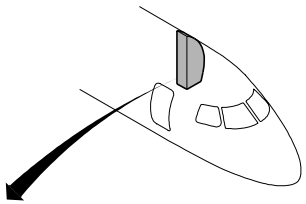


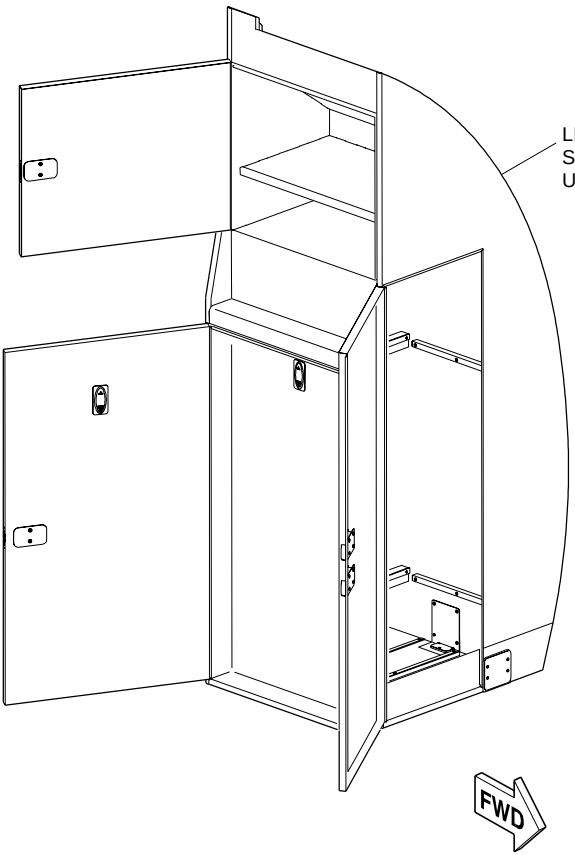
WARDROBE TYPE 4

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STOWAGE

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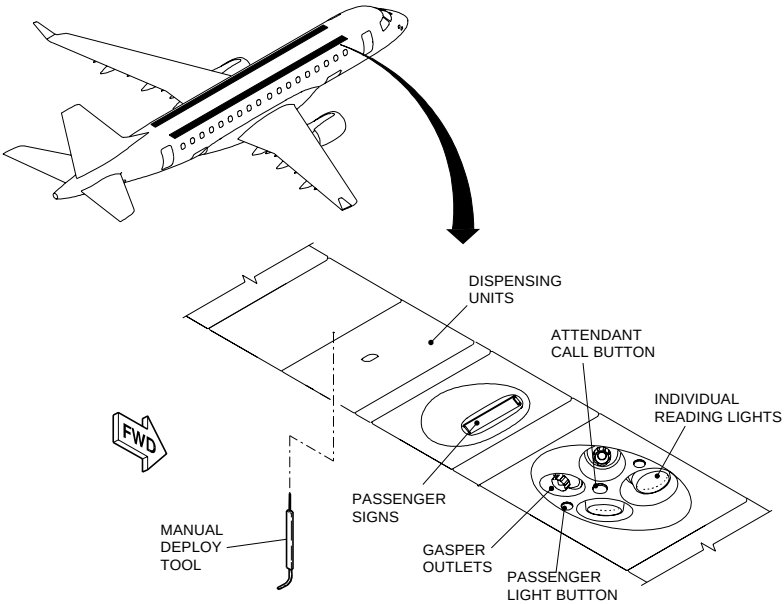
STOWAGE COMPARTMENT

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PASSENGER SERVICE UNIT

The PSU provides:

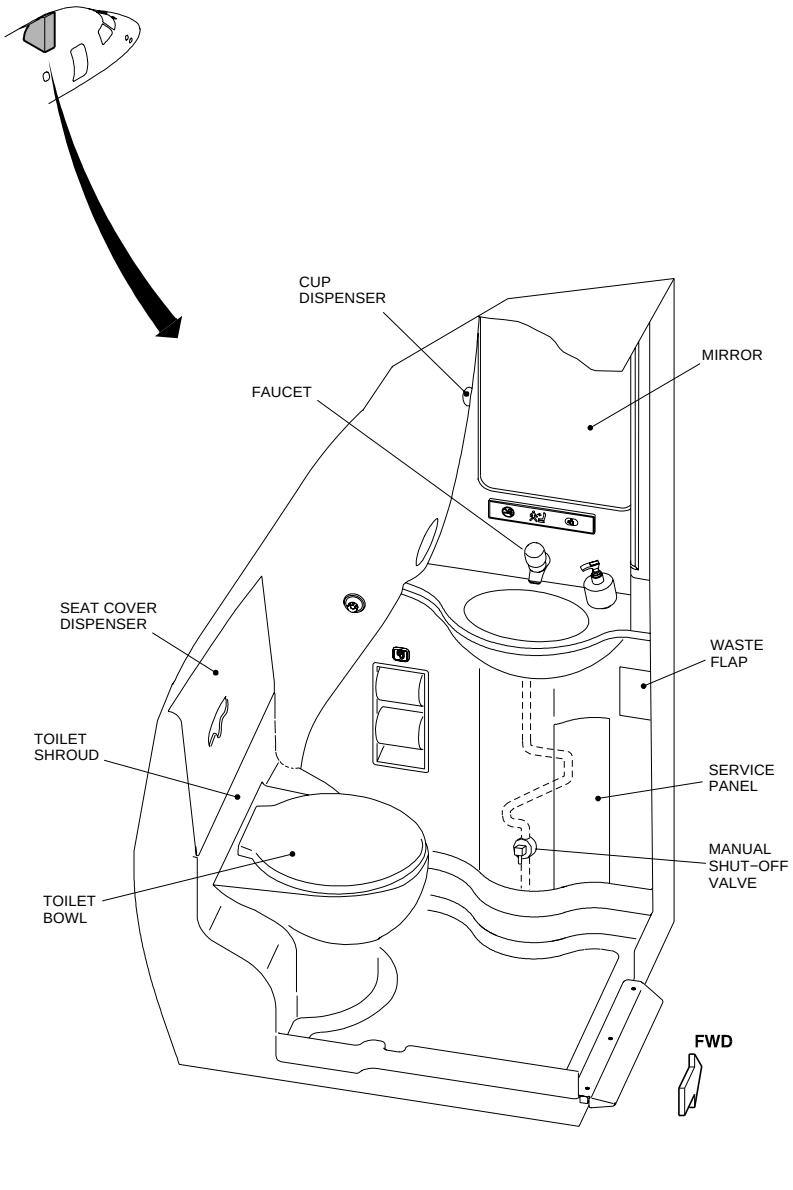
– Reading light at each passenger seat.
– NO SMOKING and FASTEN SEAT BELTS signs.
– Pushbutton and indicator for attendant call.
– Air gasper for each individual passenger seat.
– Oxygen mask dispensing unit.
– Loudspeaker for internal communication.



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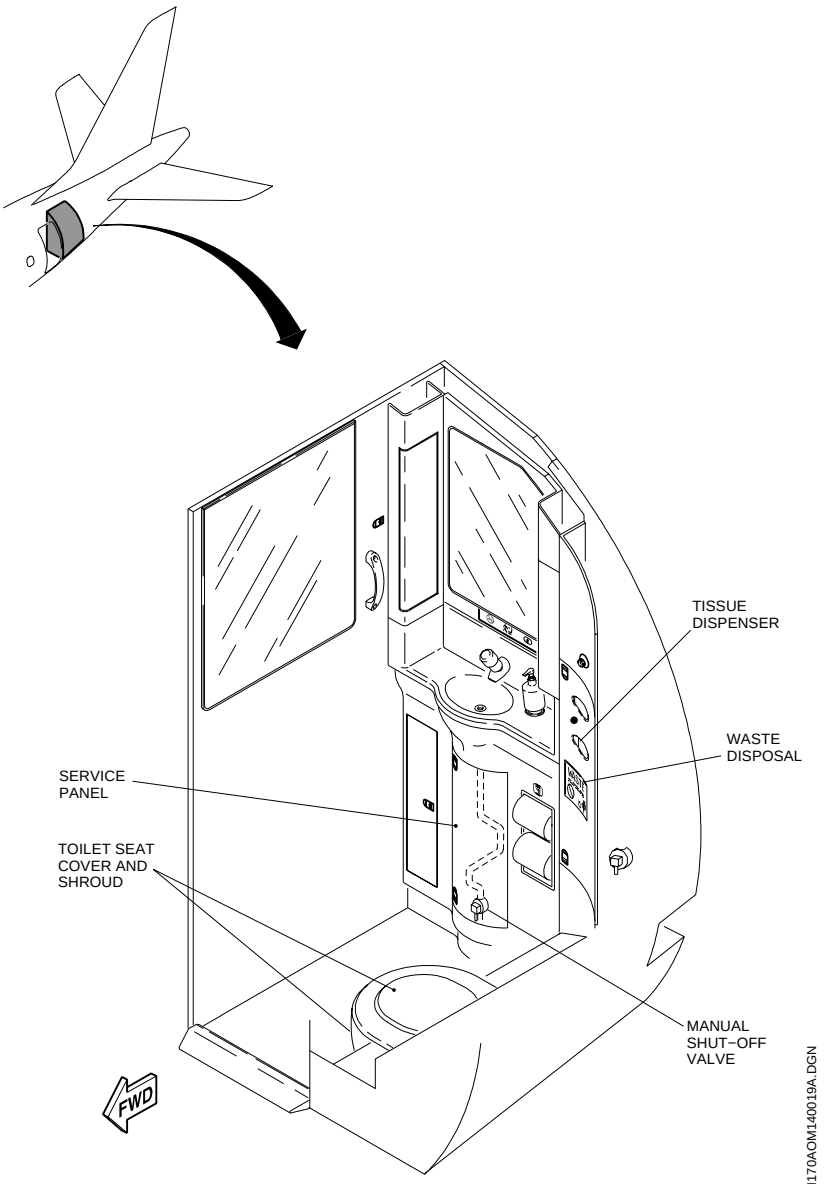
LAVATORY

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FORWARD LAVATORY

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AFT LAVATORY

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CABIN PC POWER SYSTEM

The PC Power system is designed to supply passenger seats with 110 V/60 Hz AC power for personal electronic devices (PED) such as laptop computers and other passenger equipment.

The AC BUS 1 supplies power to converters, which then provide AC power to all passenger seat outlets. The PC power system operates only if the electrical system is operating in normal mode. In case of loss of any of the electrical generators the system will not operate.

The PC Power/IFE panel for system operation is installed in the control pedestal. The galley master switch, installed on flight attendant panel, also turns off the system.

CABIN PC POWER OUTLET

Each outlet incorporates an LED that is visible to the passengers and indicates that AC power is available. The green color indicates power is supplied to the outlets and the red color indicates power is not available. The LED is turned off when the system is not energized. The outlet provides power for use only when the plug is correctly connected into the socket and PED power is available.

The cabin crew can monitor the power outlets in use by an outlets in-use panel installed in the passenger cabin.

CABIN PC POWER PROTECTIONS

A self-test is performed during power-up and will shut down the system if an error is detected.

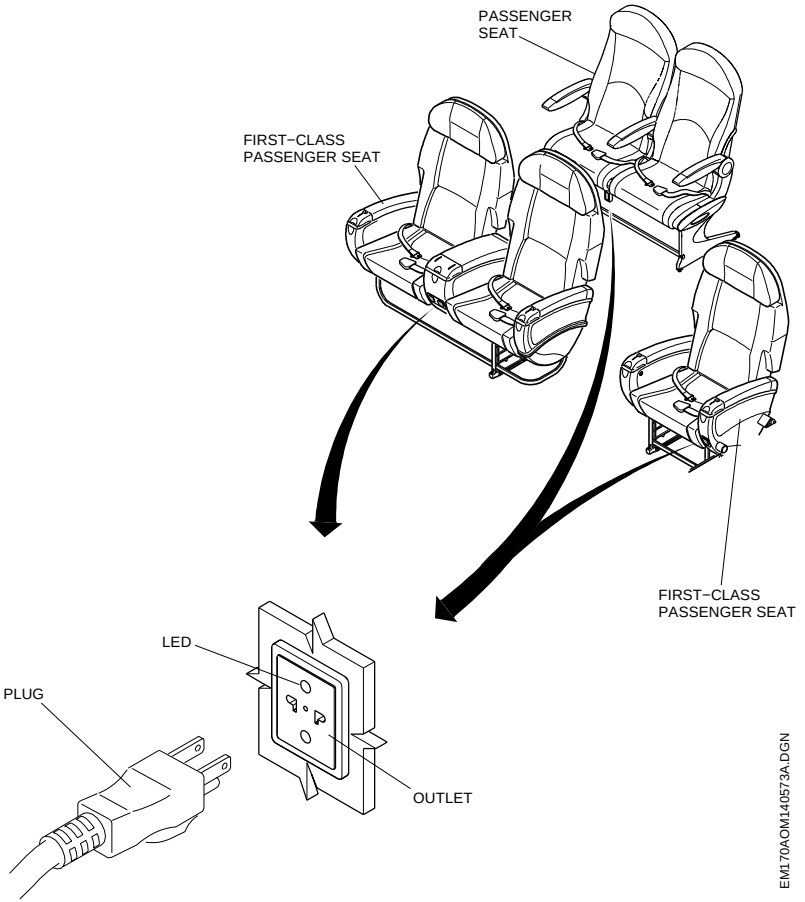
The system provides protection against under-voltage, over-voltage, over-current, short circuit and over temperature.

The PC power system controls the power available to the AC outlet units and monitors the total electrical current in use and, if necessary, disables or enables the power outlets.

The system is turned off automatically in case of cabin decompression. Pressing the cabin PC power button on the control panel resets the system.

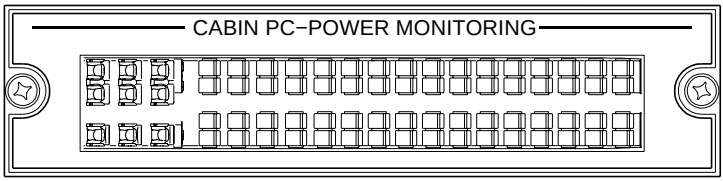
The outlet provides protection from thin metal objects being inserted into the sockets.

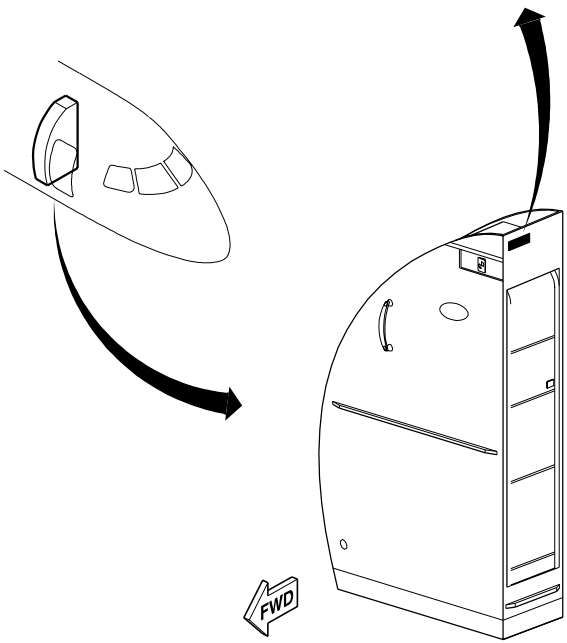
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PC POWER OUTLETS

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OUTLETS IN-USE PANEL

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COCKPIT PC POWER SYSTEM

The PC power system supplies 110 VAC/60 Hz two outlets installed in the cockpit, and/or two outlets installed into the forward and mid electronic compartments. The PC power outlets are used by the flight crew or maintenance personnel to connect laptops or other PEDs (Portable Electronic Devices).

Each PC power outlet unit is connected to an AC converter that is powered by the AC BUS 2. The PC power control switch is installed above the RH side PC power outlet and a striped bar illuminates when the AC power is available (pushed in).

The electronic compartment PC power outlets are intended for use only on ground while the cockpit PC power outlets can be used on ground or in flight. The use of cockpit PC power outlets in flight is restricted to equipment and procedures approved by the local authority.

NOTE: Ensure laptop batteries are charged (above 75%) before plugging them into the outlets. Low battery levels may require power greater than the designed limit for the outlet. If the power limit of the outlet is exceeded, the outlet will be disabled and maintenance action will be required to reset the system.

COCKPIT PC POWER OUTLET

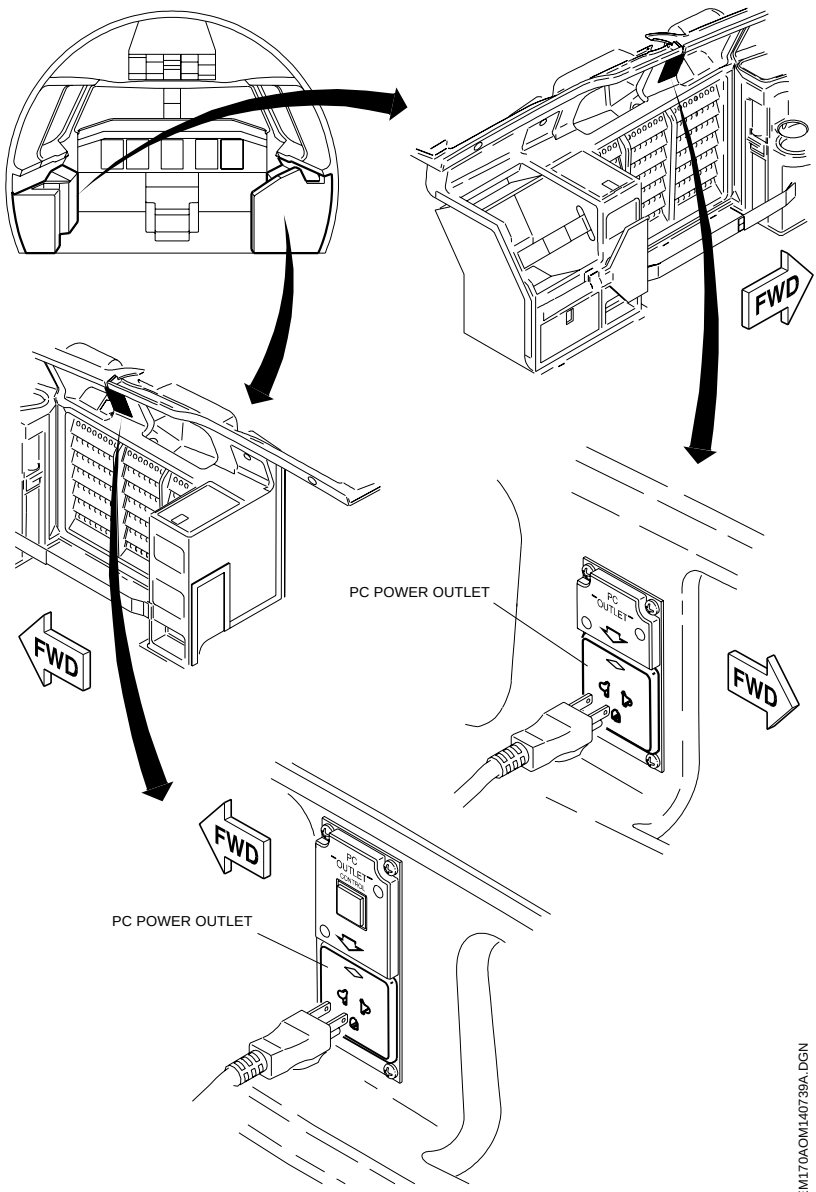
Pushing IN the PC Power Outlet Control button illuminates the striped bar on the button and a green LED at the outlet. Inserting the plug completely into the outlet makes the AC power available.

The LED is turned off when the system is not energized. The outlet provides power for use only when the plug is correctly connected into the socket and PED power is enabled.

The LED is shown in red color when a fault condition is detected or the over-temperature limit is exceeded.

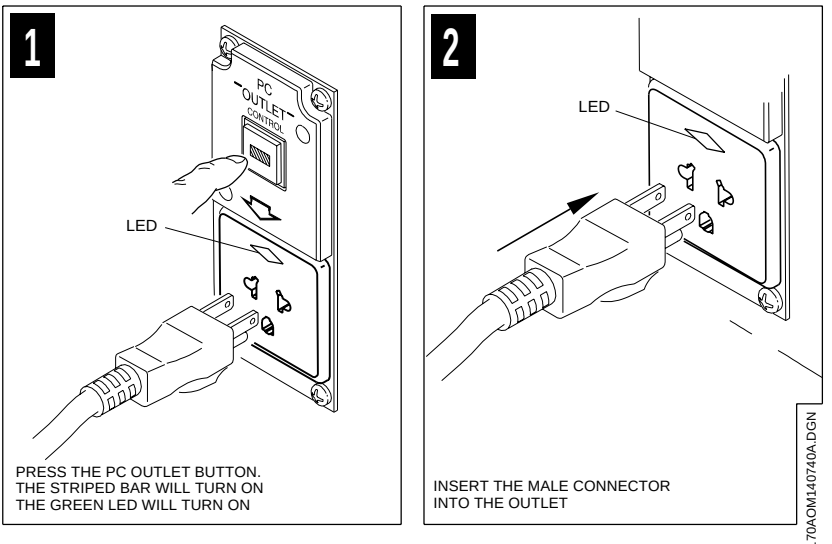
NOTE: Ensure the plug is not inserted into the outlet before power up of the airplane. If the plug is inside the outlet when the airplane is powered up the power outlet unit will not be energized. Remove the plug from the outlet and insert it again according to the procedures above to energize the power outlet unit.

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COCKPIT PC POWER OUTLETS

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COCKPIT PC POWER OUTLETS - PROCEDURES TO ENERGIZE THE PC POWER OUTLETS

COCKPIT PC POWER PROTECTIONS

The system provides protection against under-voltage, over-voltage, over-current, short circuit and over temperature.

The PC power system controls the power available to the AC outlet units and monitors the total electrical current in use and, if necessary, disables or enables the power outlets.

The system is turned off automatically in case of cabin decompression. Pressing the PC power control switch resets the system.

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IN-FLIGHT ENTERTAINMENT (IFE)

The Panasonic X-Series IFE system provides entertainment and information services to passengers via the in-seat Smart Display Unit (SDU), such as:

– Audio and Video on Demand (AVOD) where passengers may select, play, pause, rewind, fast-forward, and stop pre-recorded television programming and movies. The number of programs and movies varies by configuration;

– Boarding music and boarding video;

– Moving map (iXplor) that provides a set of high-resolution satellite images of the earth's surface, overlaid with lines and textual labels that identify various borders and geographical features. The airplane's current position is indicated, as well as the current flight path and associated in-flight information (for example, altitude and time-to-go).

Other potential and optional services might include Video Games.

During on-ground operation, passenger interface is disable. Audio for each in-seat headset jack is preset to the Passenger Address (PA) announcement channel so that passengers who use the IFE while on the ground can only listen to the boarding music and PA announcements. The safety briefing video program is presented at each passenger LCD monitor with audio presented over the aircraft public address system.

The IFE operates in either automatic or manual mode. In Automatic Mode, once the aircraft has reached a pre-determined safe altitude for IFE use, the pre-programmed scenario sequences through pre-recorded announcements and then initializes the IFE for passenger use. In Manual Mode, a cabin crew member using the Crew Panel (CP) initiates each announcement message and then enables the IFE for passenger use. In-flight announcements are processed similarly to on-ground announcements where passenger interface is disabled until all announcements are complete.

AVOD is stored in a flie server with capacity of 300 GB, using one internal hard disk drive dedicated to AVOD programming. Each file server provides an output capacity of 2 Mbps. Multiple file servers are used reduce the possibility of service interruption.

NOTE: The IFE system is designed to have no limitation for operation in any flight phase. However, it is highly recommended to be full operational to passengers after the airplane reaches a pre-determined safe altitude.

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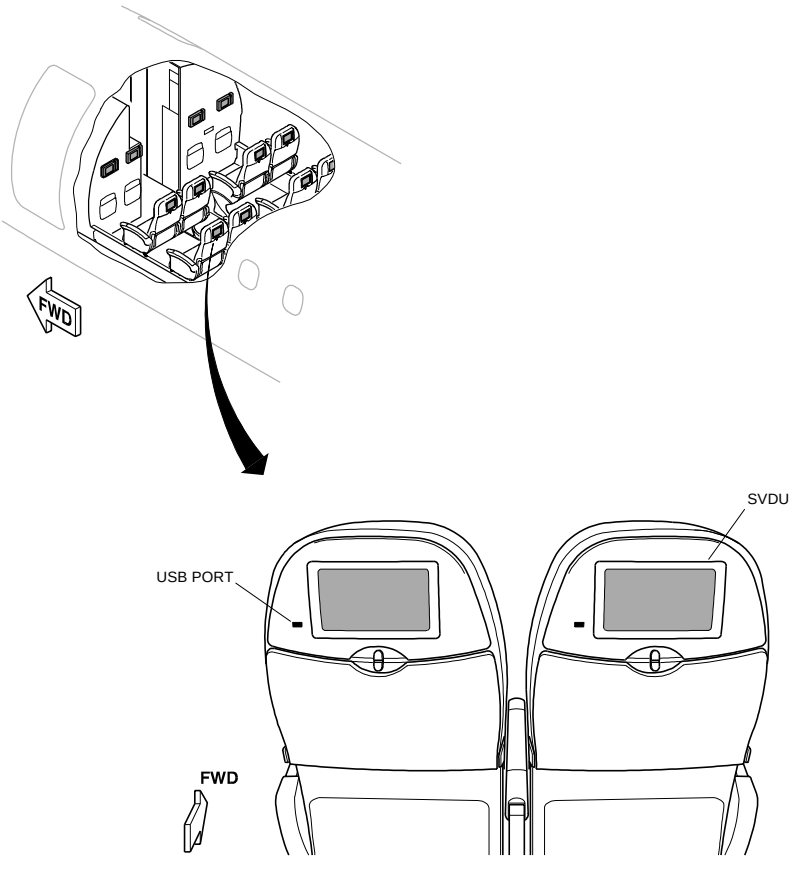
PASSENGER COMPONENTS

Every passenger seat has a set of electronic equipment, responsible for delivering IFE services (such as audio and video programming, moving map, etc.) to each individual Smart Display Unit (SDU). The SDUs are located in the seatback or in the bulkhead wall in front of the passengers.

The passenger uses the touch-screen or handset to control the available IFE services for their respective passenger class. Additional buttons allow passengers to change the brightness level of the LCD, to increase or decrease the volume level and to toggle LCD backlight ON/OFF. SDU provides a credit card reader that allows the passenger to swipe a credit card to purchase on-board services and programming.

Universal Serial Bus (USB) is available to all seat classes and located adjacent to the LCD screen.

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SDU AND USB PORT

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IFE RACK

The primary IFE components located on the IFE Equipment Rack are:

– File Server (FS);

– System Controller - Audio (SC-A);

– Advanced Master Control UNIT (AMCU).

The FS is a high-performance, high-capacity network server that provides extensive audio, video, and cached web content. It also contains interactive menus, media content, electronic catalog sales to passengers, and unit-downloadable software, as appropriate. The FS is designed to store all passenger revenue data collected during flight, decrypt 3DES (Triple Data Encryption Standard) hardware from stored MPEG files and send text and graphics information to the Seat Display Units (SDU).

The SC-A provides a minimum hard drive storage capacity of 160 GB and is used for storing digital media, system operational software, usage statistics (compiled from system BITE checks and accumulated user behavior), maintenance data, and configuration data. The SC-A also distributes boarding music and video, PA announcements and Pre-Recorded Announcements (PRA) audio to the IFE system.

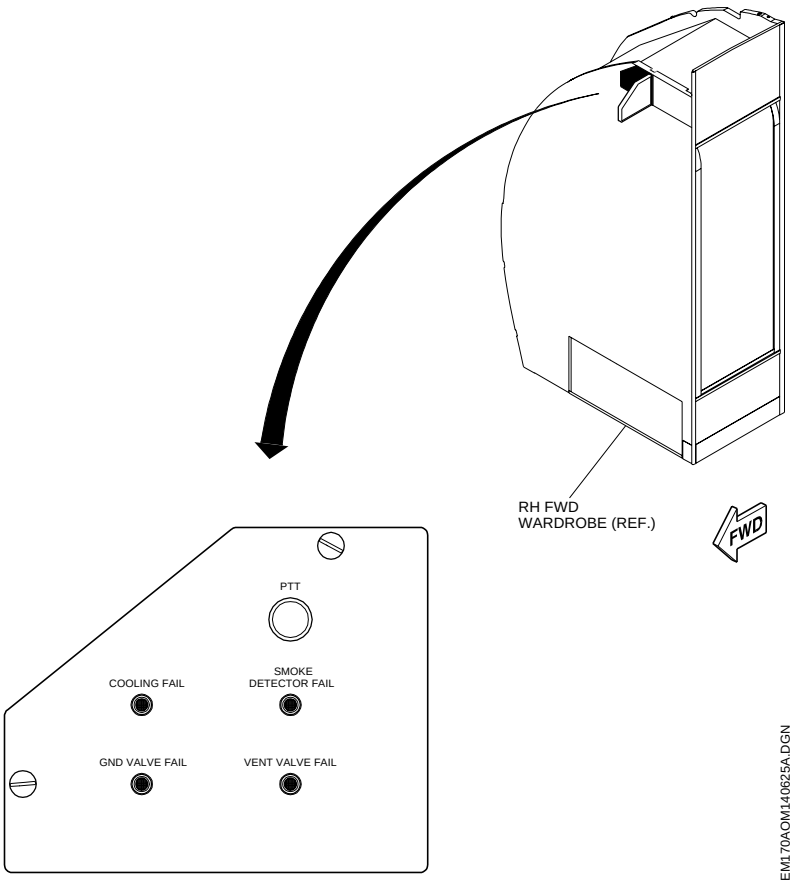
The Advanced Master Control Unit (AMCU) provides power distribution, electrical load management, and Built In Test (BIT). The AMCU obtains 115 VAC, 3-phase, 400 Hz power from the airplane's power distribution panel. The IFE system is powered by AC BUS 2.

A Configuration Module is installed on the AMCU to define airline-specific parameters for the operational parameters of the AMCU. The AMCU will operate without the Configuration Module, but will default to a configuration that provides basic functions and limited control features.

BIT is performed automatically when power is applied to the system. BIT can also be manually performed by depressing the manual BIT switch on the AMCU.

A maintenance panel located in wardrobe/galley zone 2, allows to the ground crew a quick diagnostic of the IFE ventilation AMS system. Its display is a partial replica of the Maintenance Test Panel (MTP) located at the aft E-bay. This maintenance panel is composed by a total of four indication LEDs that provide indication of failures related with smoke detection, cooling, ground and vent valves. There is also a test push button that verifies the functionality of all LEDs.

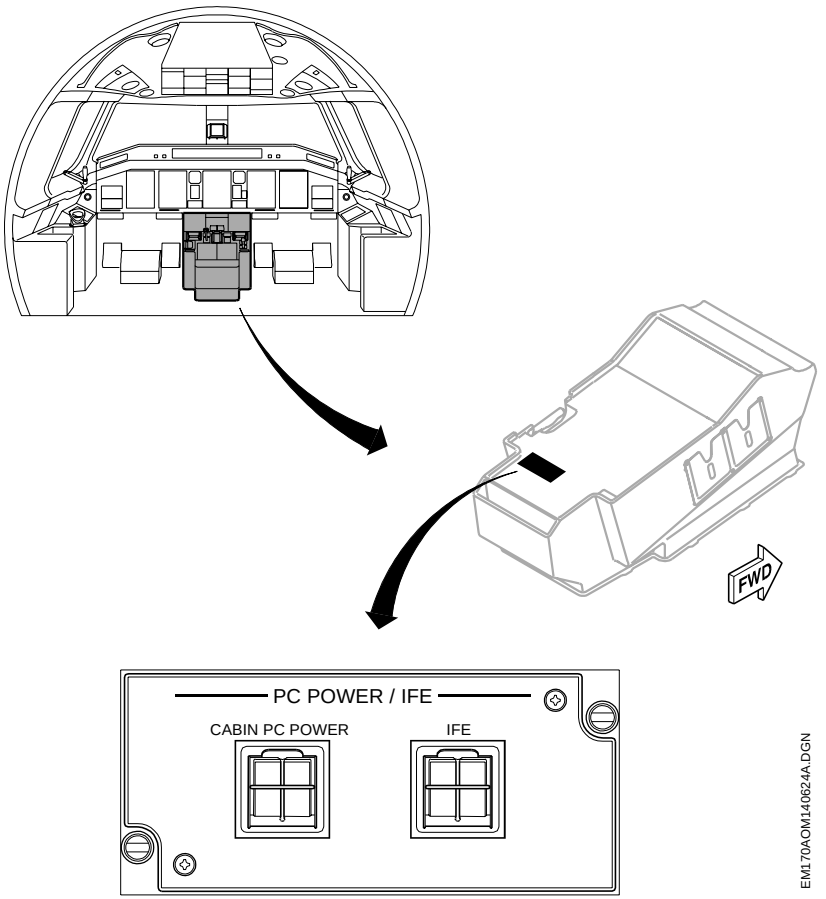
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MAINTENANCE PANEL

The PC Power/IFE Cockpit Control Panel in the cockpit, contains two guarded pushbutton switches labeled PC POWER and IFE, respectively. Through the IFE pushbutton, it is possible to perform the manual shed of all IFE loads. When the IFE pushbutton is selected to the OFF position, power is removed from IFE equipment in the cabin and rack. When the switch is moved to its ON position, the IFE system is enabled.

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PC POWER/IFE

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CREW PANEL

The Crew Panel (CP) provides the aircraft crew access to the configuration and maintenance control (such as configuration loading and extensive system diagnostic BITE capability) of the IFE. The CP has a color LCD display with optional built-in function keys for user interface. There is also a touchscreen user interface available.

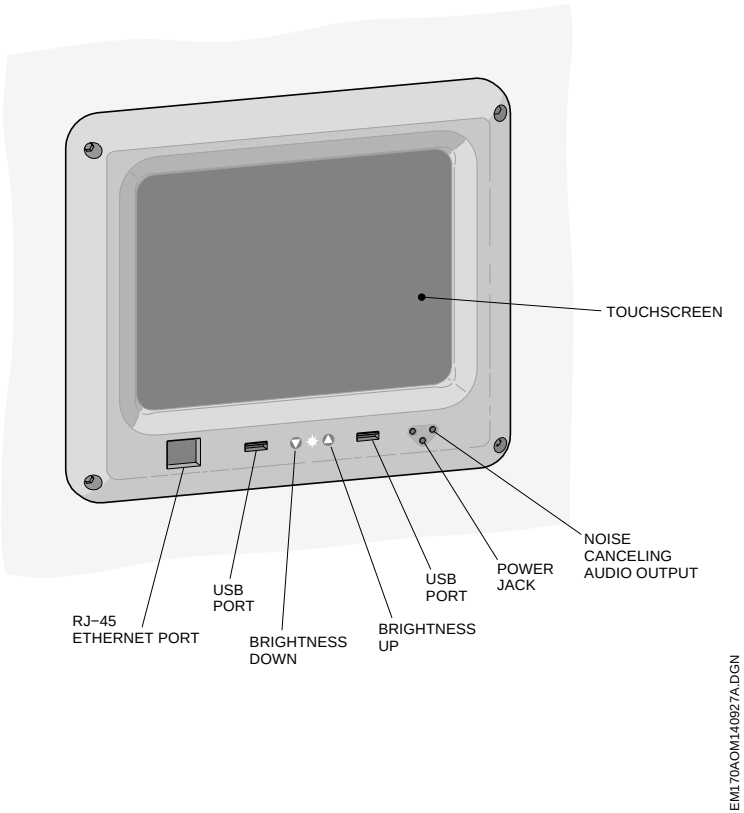
The CP provides the capabilities to store data and control cabin zones. The CP uses an Ethernet interface to communicate with other components of the IFE. The CP provides these functions, all of which are controlled through the CP software screens:

– Control of cabin zone to video source mapping
– Control of the entertainment and passenger address cabin zone configuration
– Initiation of Built-In Test Equipment (BITE) requests to all peripherals and storage of resulting BITE data for fault isolation
– Control of all peripherals, including preview of video and audio programs

The CP provides two USB ports for connecting peripheral devices and two noise canceling audio outputs for previewing audio or video. Additionally, a RJ-45 ethernet port is available for large content uploads as well as maintenance reports and data files downloads.

Crewmembers start boarding music and video, safety video presentation and PA announcements through the CP. All interactive features available to passengers, are disabled during the audio and video information commanded through the CP.

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CREW PANEL

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LIGHTING

INTRODUCTION

The lighting system provides lighting to all essential parts located inside and outside of the fuselage and ensures proper and safe operation of the airplane.

The lighting system includes:

- External Lights.
- Cockpit Lights.
- Passenger Cabin Lights.
- Emergency lighting.

The system also provides lighting for baggage and service compartments.

EXTERNAL LIGHTING

The external lights necessary for a proper and safe operation of the airplane are:

- Landing and taxi lights.
- Navigation and anti-collision lights.
- Wing inspection, logotype and overwing emergency lights.

LANDING AND TAXI LIGHTS

Landing and taxi lights are fitted to each wing roots behind glazed covers. A third landing light and a third taxi light are mounted on the nose gear structure.

The landing light units provide adequate lighting during final approach, flare out and takeoff. The taxi light provides sufficient intensity and beam spread to aid pilots during all taxi operation phases, covering the runway and adjacent areas.

Different switches for nose and root landing and taxi lights are located at the overhead panel.

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NAVIGATION AND ANTI COLLISION LIGHTS

The navigation lights, red on the left, green on the right and white on both wings, are fitted on each wing tip. A switch located at the overhead panel controls the navigation lights.

The anti collision lights, two white strobe lights per wing tip and two red beacon lights mounted on the upper and lower fuselage provide illumination for visual recognition and collision avoidance during all flight/taxi operations. Two different switches, one for strobe lights and another for the red beacon lights are located at the overhead panel.

Each navigation light assembly is composed of two lamps while the strobe light assembly is composed of only one lamp. Normally only one navigation lamp is on, while the second lamp is on standby. In case of failure, maintenance personnel through a maintenance panel in the cockpit manually switch navigation lights.

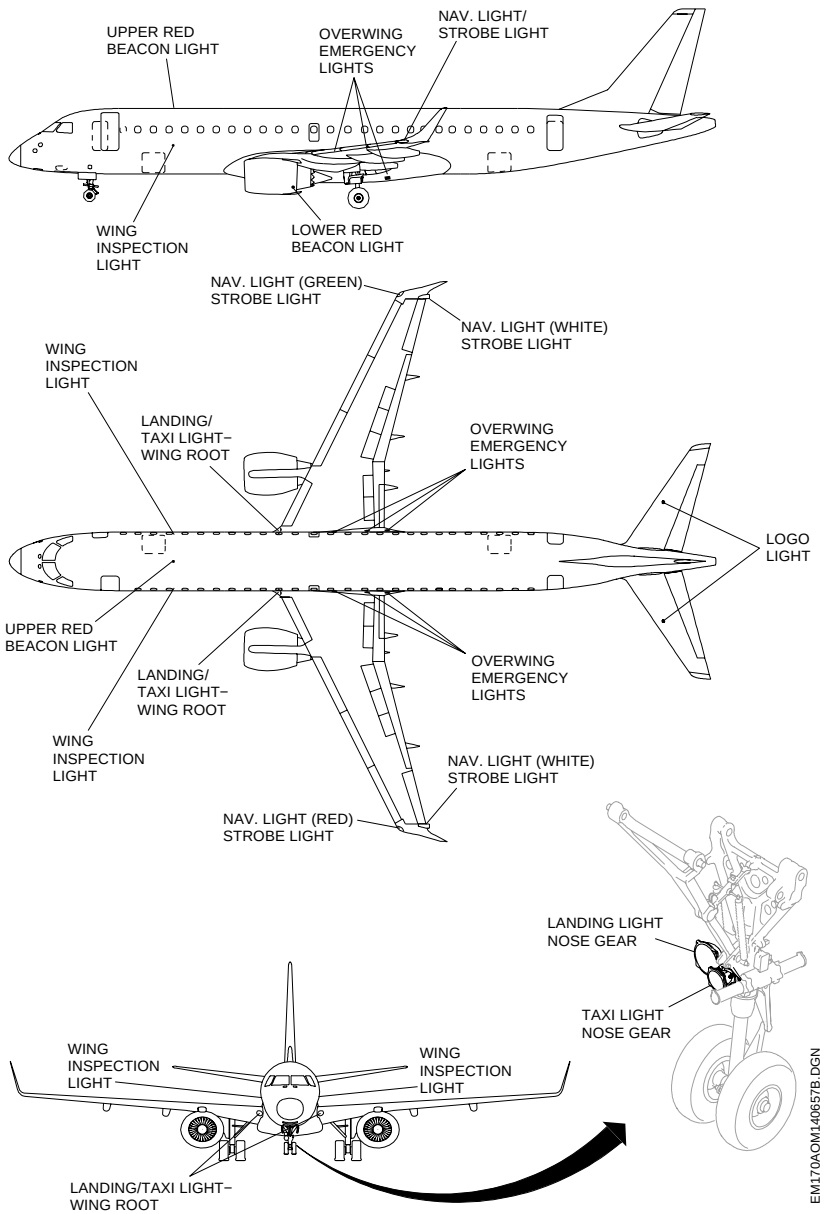
WING INSPECTION, LOGOTYPE AND OVERWING EMERGENCY LIGHTS

Provide proper illumination of the engine intake and of the wing leading edges of the wings for Captain and crew to inspect for ice formation. A switch located at the overhead panel controls the engine and wing illumination light system.

The logo lights are installed in the upper surface of both horizontal stabilizers and are directed to the vertical fin perpendicular to the centerline of the airplane, in order to provide adequate illumination of the airplane's logo during operation on the ground and in flight. A switch located at the overhead panel controls the logotype lights.

The overwing emergency lights are composed of three route lights at each side, located near of overwing emergency exits. The EMER LT knob at the overhead panel controls the overwing emergency lights.

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EXTERNAL LIGHTING

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INTERNAL LIGHTING

COCKPIT LIGHTS

Cockpit lighting consists of:

– Chart lights.

– Dome lights.

– Fluorescent flood/storm light.

– Reading lights.

The system provides lighting for instruments, control panels and buttons.

CHART LIGHTS

Provide variable intensity lights to illuminate chart holders located at the cockpit side windows.

DOME LIGHTS

Provide fixed intensity cockpit illumination above Captain and First Officer's seats.

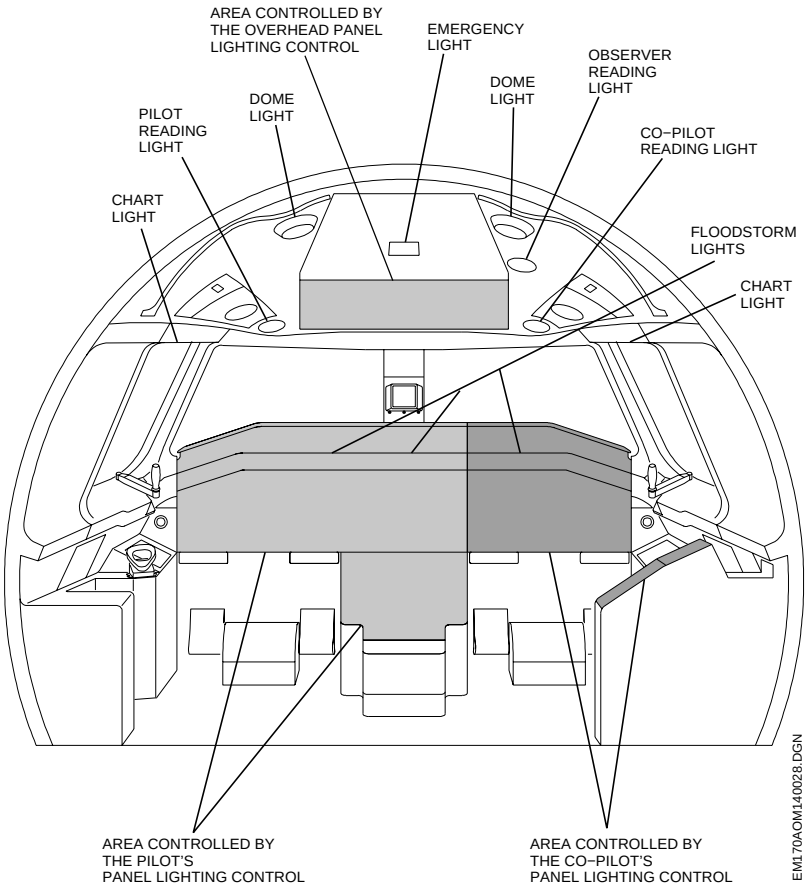
FLUORESCENT FLOOD/STORM LIGHT

Provide high quality illumination to ensure panel readability under high intensity ambient lighting (lightning).

READING LIGHTS

Provide illumination to help the pilots read maps, check lists and manuals.

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COCKPIT LIGHTS

COURTESY AND STAIRS LIGHTS

Provide lighting for safe boarding of crewmembers and passengers. Courtesy and stair lights consist of the main door light (entry area), service door light (galley area), stairway lights and cockpit step light.

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PASSENGER CABIN LIGHTS

A general passenger cabin illumination, reading lights in the passenger service unit, lavatory lights, galley lights and cabin signs make up the passenger cabin lighting.

PASSENGER CABIN SIGNS

Passenger cabin signs provide passengers and flight attendants with signs like:

- NO SMOKING.
- FASTEN SEAT BELTS.
- RETURN TO SEAT.
- LAVATORY OCCUPIED.

The signs are available on every passenger service unit (PSU). An aural signal sounds whenever any passenger sign is turned on or off by the crew. NO SMOKING and FASTEN SEAT BELTS signs are also activated when the oxygen dispensing units are open.

STERILE LIGHTS

Amber sterile light located in the passenger cabin rainbow light indicates that sterile operation is in progress.

COURTESY AND STAIRS LIGHTS

Provide lighting for safe boarding of crewmembers and passengers. Courtesy and stair lights consist of the main door light (entry area), service door light (galley area), stairway lights and cockpit step light.

SERVICE COMPARTMENT LIGHTS

Provide lighting in the service compartments for quick inspection and accomplishment of several tasks. Service lights are installed in the refueling panel, mid and forward electronic bays, APU, tail cone and rear hydraulic compartment.

The lights are controlled by door micro-switches or dedicated standard switches installed in each compartment, which turn on the associated light when the access door is open.

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RAINBOW LIGHTS

The rainbow lights located on the forward and aft main ceiling panel areas provide a visual indication to attendants when there is a call from the flight crew or passengers.

The rainbow lights consist of following colored indicator lights:

– ORANGE: a steady orange light illuminates when a passenger calls from the lavatory. Flashing orange light illuminates when smoke is detected in the lavatory.

– BLUE: a steady blue light illuminates when a passenger calls from the main cabin area.

– RED: a flashing red indicator illuminates when the flight crew makes an emergency call to the flight attendant from the cockpit. The light stops flashing after the call is taken.

– GREEN: a flashing green indicator illuminates when the pilot calls the flight attendant from the cockpit. The light stops flashing after the call is taken.

– AMBER: a steady amber light illuminates for a sterile light call.

An audible tone is sounded by the passenger address system whenever a passenger presses any attendant call switch located in a PSU or the attendant call switch in the lavatory or flight crew call switches. There is also a blue steady light on the cabin ceiling, indicating from which cabin area the respective passenger call was made.

NOTE: There is no indication on the rainbow lights when a flight attendant calls another flight attendant station. It only flashes green on both handset cradles.

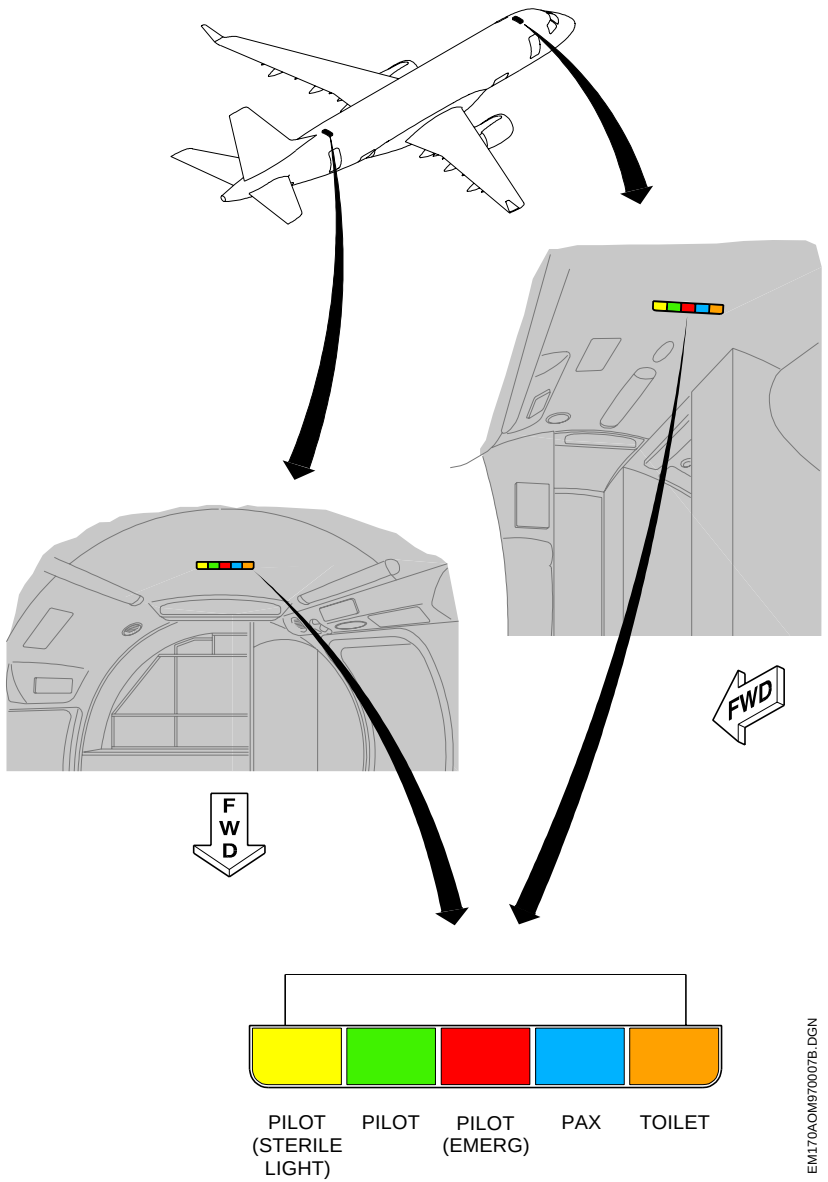
CALL SYSTEM TABLE

VISUAL INDICATION	AURAL INDICATION	FROM	TO
Steady ORANGE light	Single hi tone chime	Respective lavatory call	Attendant station
Flashing ORANGE light	Lavatory fire protection alarm	Respective lavatory smoke detection	Attendant station
Steady BLUE light	Single hi tone chime	Passenger PSU	Attendant station

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VISUAL INDICATION	AURAL INDICATION	FROM	TO
Flashing RED light	Triple hi/lo tone chime in PAX cabin	Cockpit	Attendant Station
	Triple hi/lo tone chime in cockpit	Attendant Station	Cockpit
Flashing GREEN light	Single hi/lo tone chime in PAX cabin	Cockpit	Attendant Station
	Single hi/lo tone chime in cockpit	Attendant Station	Cockpit
AMBER sterile cockpit light	Single hi tone chime	Cockpit	Attendant station
No smoking or fasten belt signs illuminate / extinguish	Single lo tone chime	Cockpit	Passenger cabin, lavatories and galleys

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ATTENDANT LIGHTS (RAINBOW LIGHTS)

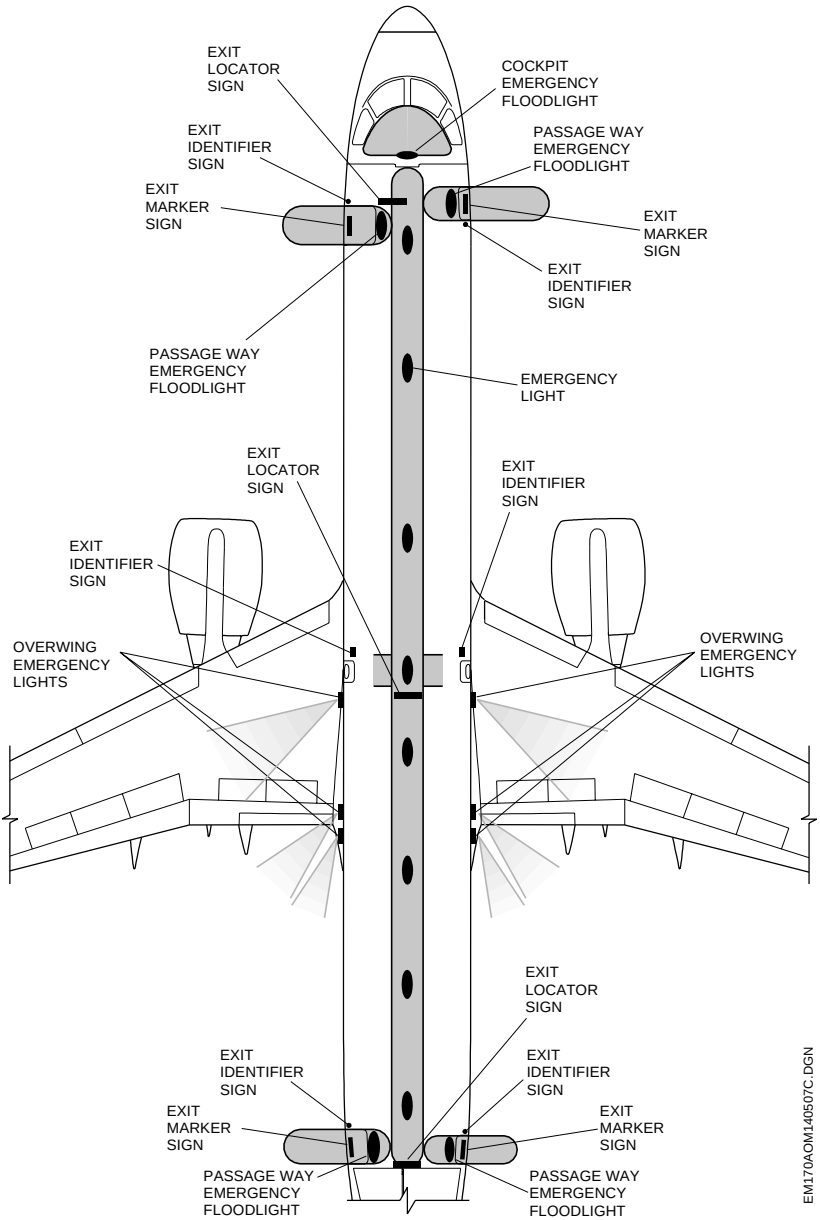
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EMERGENCY LIGHTING

Emergency lighting consists of internal and external lights. The internal emergency lights are powered by six dedicated Emergency Lights Power Units (ELPU) with internal batteries connected to the DC BUS 1. The charge of the batteries is sufficient to supply all emergency lights for approximately 10 minutes. External emergency lighting is provided by three route overwing lights at each side of airplane and also led lights on each escape slide.

Internal emergency lights comprise the exit locator signs, exit marker signs, exit identifier signs, cabin/cockpit emergency floodlights and passage way emergency exit floodlights. A cockpit light is located at the cockpit ceiling and provides general emergency illumination of the cockpit area.

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EMERGENCY LIGHTING

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PHOTOLUMINESCENT STRIPS

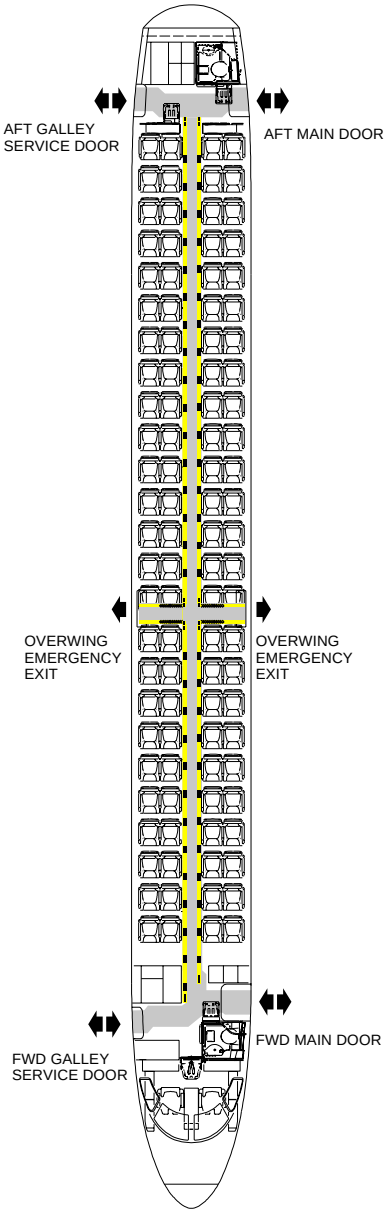
Photoluminescent strips are installed along the passenger cabin floor to provide means of identifying the emergency escape path even in dense smoke conditions. Double red dots on the strips indicate the end of each exit path.

Photoluminescent escape path strips must be charged prior to the first flight of the day by interior cabin lighting.

For 15 minutes of ceiling and entrance cabin lighting exposure in BRIGHT mode the strip luminescence will be available for 7 hours.

Luminescence time is not limited if during flight either daylight or cabin lighting exist in the cabin.

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PHOTOLUMINESCENT STRIPS

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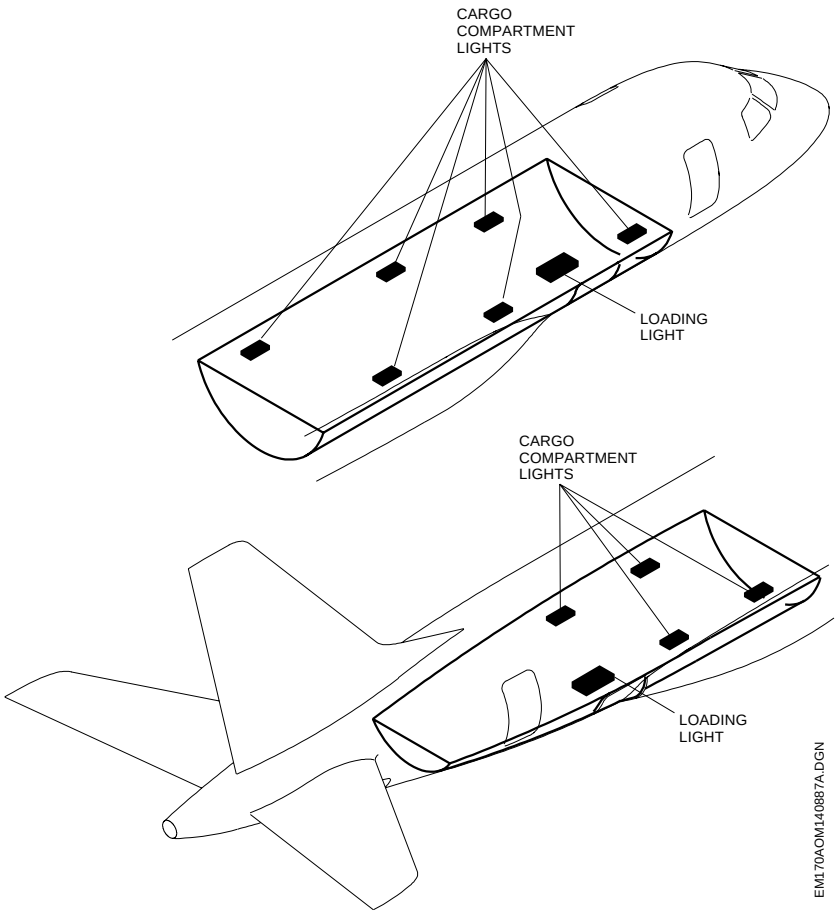
CARGO COMPARTMENTS LIGHTS

The forward cargo bay has 6 cargo lights and 1 loading light and the aft cargo bay has 4 cargo lights and 1 loading light.

There is a manual switch located at each cargo door that gives “AUTO” and “OFF” selections. In “AUTO” mode, the cargo lights come on when the cargo door is opened and turn off when the door is closed. The “OFF” mode turns off the lights regardless of the door position.

The cargo lights have protective grills installed to protect them against damage from the cargo.

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CARGO COMPARTMENT LIGHTS

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DOORS

This airplane has two jetway passenger doors on the left side (forward and aft location), two jetway service doors on the right side (forward and aft location), and a number of access doors for different airplane systems along the fuselage.

Two overwing emergency exit doors are located one on each side of the airplane, centered over the wing.

PASSENGER AND SERVICE DOORS

This airplane has one passenger door located at the left forward fuselage section and another located at the aft fuselage section. Passenger door operation is manual and it is identical for both passenger doors. Passenger doors are plug type and they are of type 1 design.

One service door is located at the right forward fuselage section and another located at the aft fuselage section. Service doors are used for galley servicing and cabin cleaning between flights. It may also be used as an emergency exit. The operation of service and passenger doors is identical.

One external, three internal handles and one vent flap are installed in each door for opening and closing operation.

The doors support maximum wind gusts of 40 kt, valid for positions between fully closed and fully open. For the open and locked position, the wind load limitation is 65 kt.

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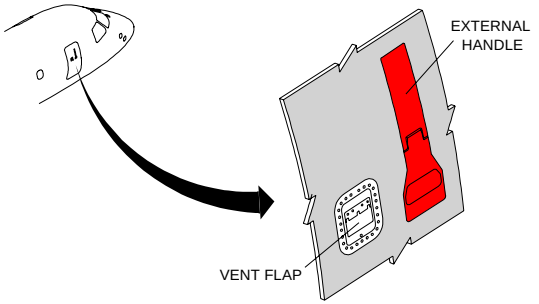
DOOR EXTERNAL HANDLE

The vent flap function ensures the correct latching and locking of the door so that the airplane can be pressurized.

The vent flap also ensures that there is no residual indoor pressure on the ground before the door opening.

The escape slide is automatically disarmed when door is opened from outside. The vent flap opens automatically when the lower part of the external handle is pulled.

For further information on the escape slide refer to escape slide description in this section.



EXTERNAL HANDLE AND VENT FLAP

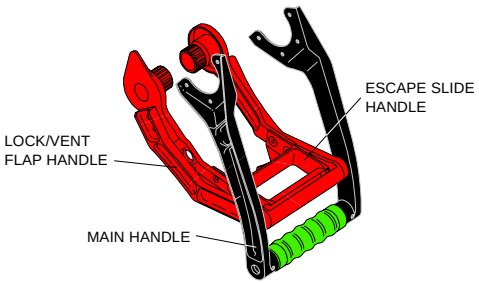
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DOOR INTERNAL HANDLES

The main handle activates the door's latch mechanism.

The vent flap and the door's lock mechanism are linked together. The airplane pressurization loads the vent flap against the door structure. The effort required to unlock the door (lift the lock/vent flap handle) increases with the airplane pressurization level.

The escape slide handle arms/disarms the emergency system (escape slide and door's emergency assisting system) and engages/disengages the girt bar.



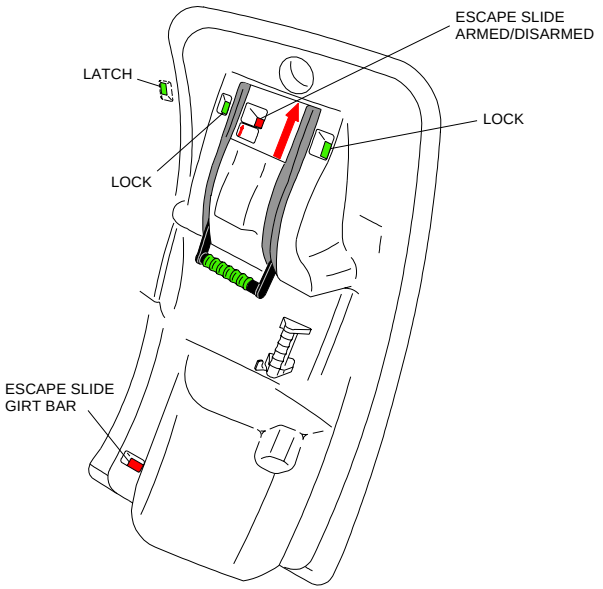
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INTERNAL HANDLES

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DOOR INDICATIONS

One green latch and two green lock indications are provided to ensure the door is secured in the locked position. An escape slide ARMED/DISARMED indication provides the escape slide armed/disarmed condition. A red indication in the bottom of the door provides means to verify if the girt bar is engaged.



DOOR INDICATIONS

Door indications change according to the handle's position.

MAIN HANDLE DOWN

- Door: Closed
- Latch indication: GREEN

MAIN HANDLE UP

- Door: Open
- Latch indication: NO green indication

LOCK/VENT FLAP HANDLE DOWN

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- Vent flap: Closed
- Lock indications: GREEN

LOCK/VENT FLAP HANDLE UP

- Vent flap: Open
- Lock indications: NO green indications

ESCAPE SLIDE HANDLE DOWN

- Escape slide: Armed
- Escape slide indication: RED ARMED
- Girt bar indication: RED – girt bar connected to airplane.

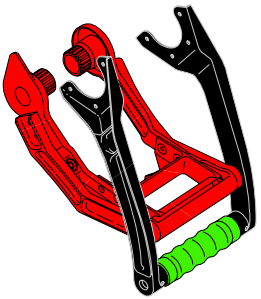
ESCAPE SLIDE HANDLE UP

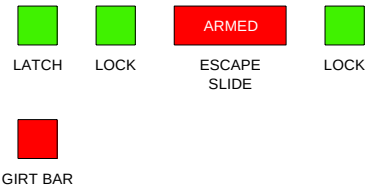
- Escape slide: Disarmed
- Escape slide indication: GREEN DISARMED
- Girt bar indication: NO red indication – girt bar disconnected from airplane.

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The following door indications are shown for different internal handles positions.

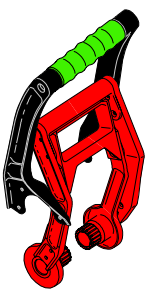
- Main handle DOWN (Door closed and latched)
- Lock/Vent Flap handle DOWN (Vent Flap closed and door locked)
- Escape Slide handle DOWN (Escape Slide ARMED)

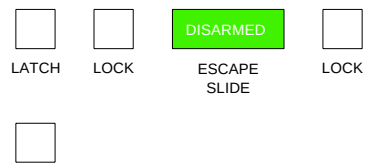




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- Main handle UP (Door unlatched and opened)
- Lock/Vent Flap handle UP (Vent Flap opened and door unlocked)
- Escape Slide handle UP (Escape Slide DISARMED)

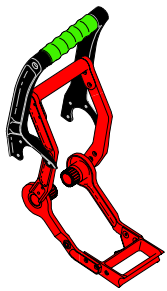


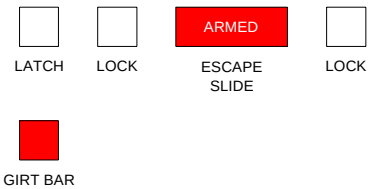


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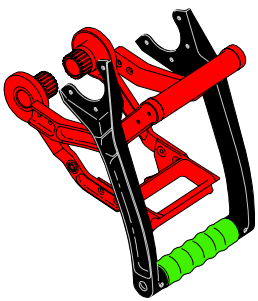
- Main handle UP (Door unlatched and opened)
- Lock/Vent Flap handle UP (Vent Flap opened and door unlocked)
- Escape Slide handle DOWN (Escape Slide DEPLOYED)

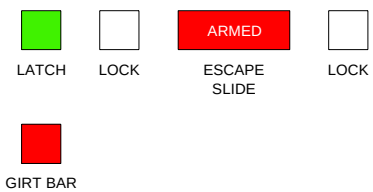




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- Main handle DOWN (Door closed and latched)
- Lock/Vent Flap handle UP (Vent Flap opened and door unlocked)
- Escape Slide handle DOWN (Escape Slide ARMED)

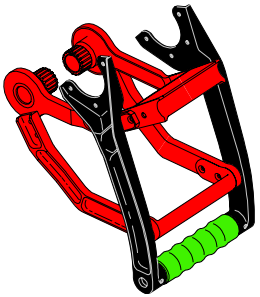


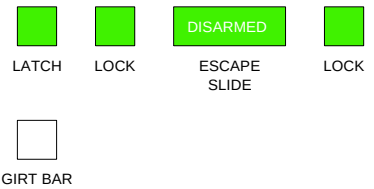


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- Main handle DOWN (Door closed and latched)
- Lock/Vent Flap handle DOWN (Vent Flap closed and door locked)
- Escape Slide handle UP (Escape Slide DISARMED)





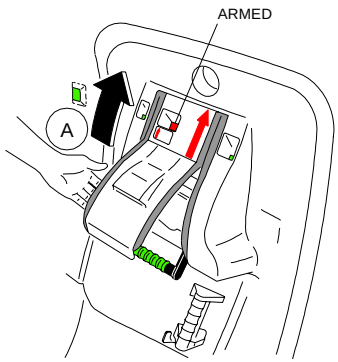
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DOOR OPENING – NORMAL OPERATION

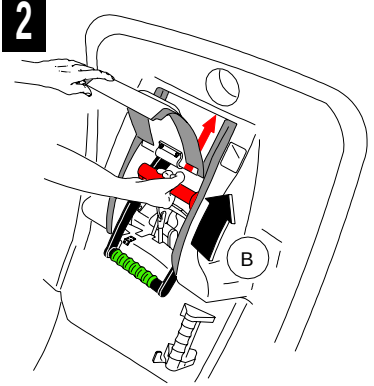
TO OPEN:

1



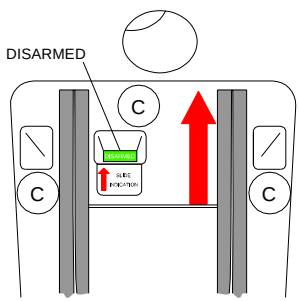
A OPEN THE LINING COVER.

2



B GRAB BOTH ESCAPE SLIDE AND LOCK/VENT FLAP HANDLES AND LIFT THEM UP. ENSURE THAT ALL THE FINGERS ARE FIRMLY HOLDING BOTH HANDLES. CLOSE THE LINING COVER.

3



C CHECK ESCAPE SLIDE INDICATION (DISARMED).

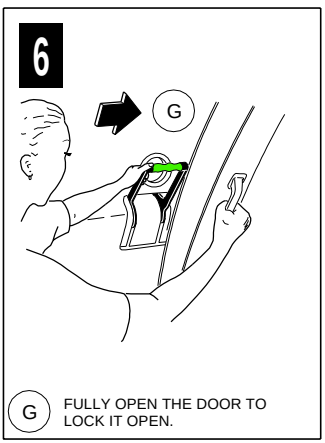
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ESCAPE SLIDE DISARM
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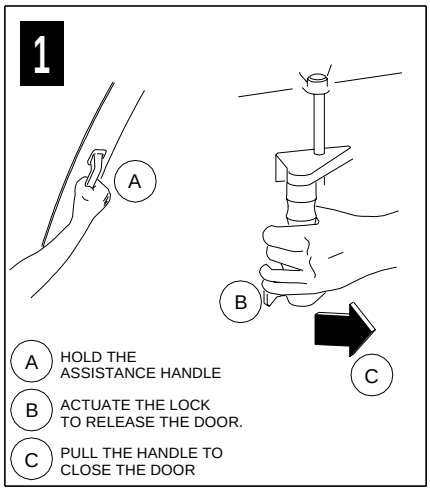
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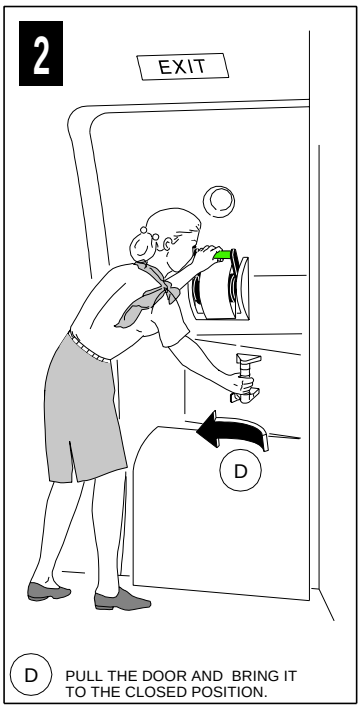
MAIN HANDLE ACTUATION

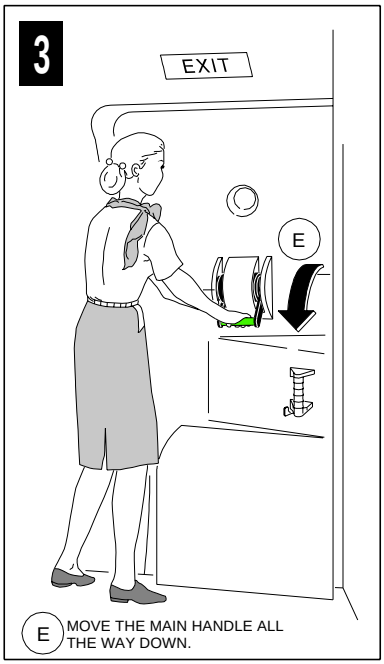
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DOOR CLOSING – NORMAL OPERATION

TO CLOSE:





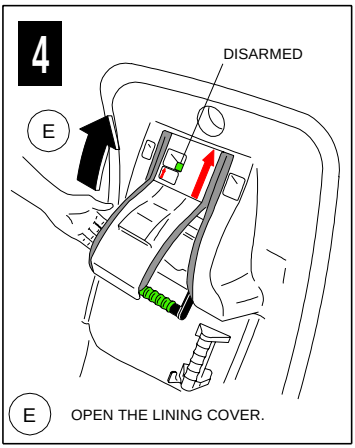


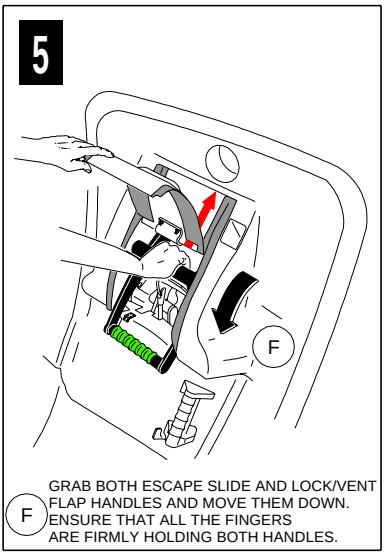
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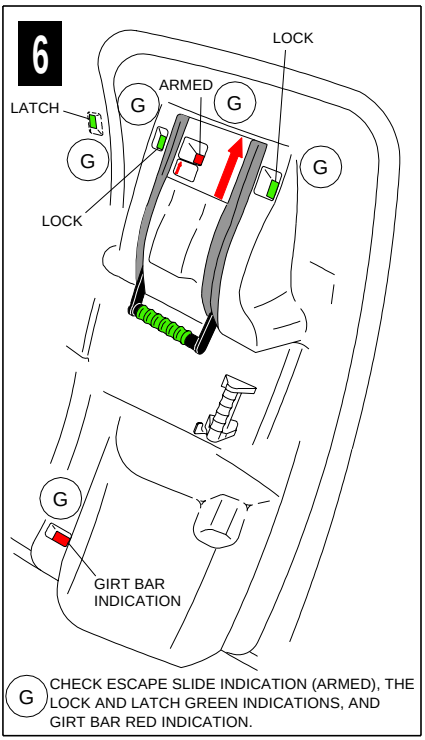
MAIN HANDLE ACTUATION

14-01-45

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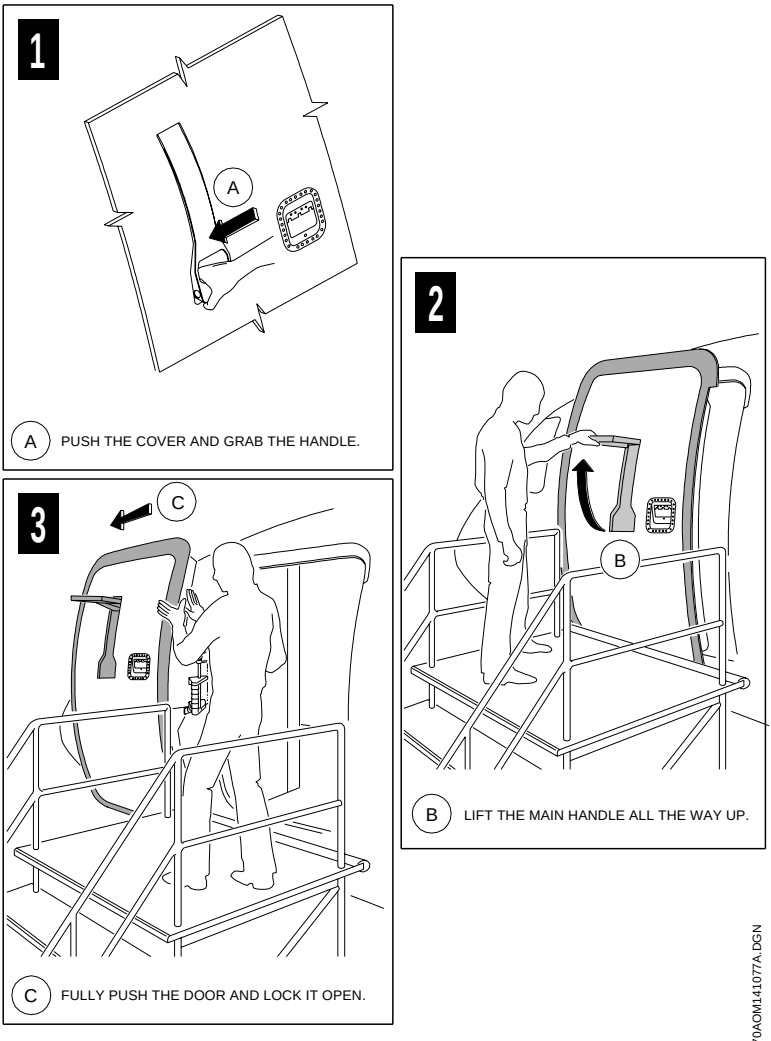
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ARMING ESCAPE SLIDE

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DOOR OUTSIDE OPENING

TO OPEN:

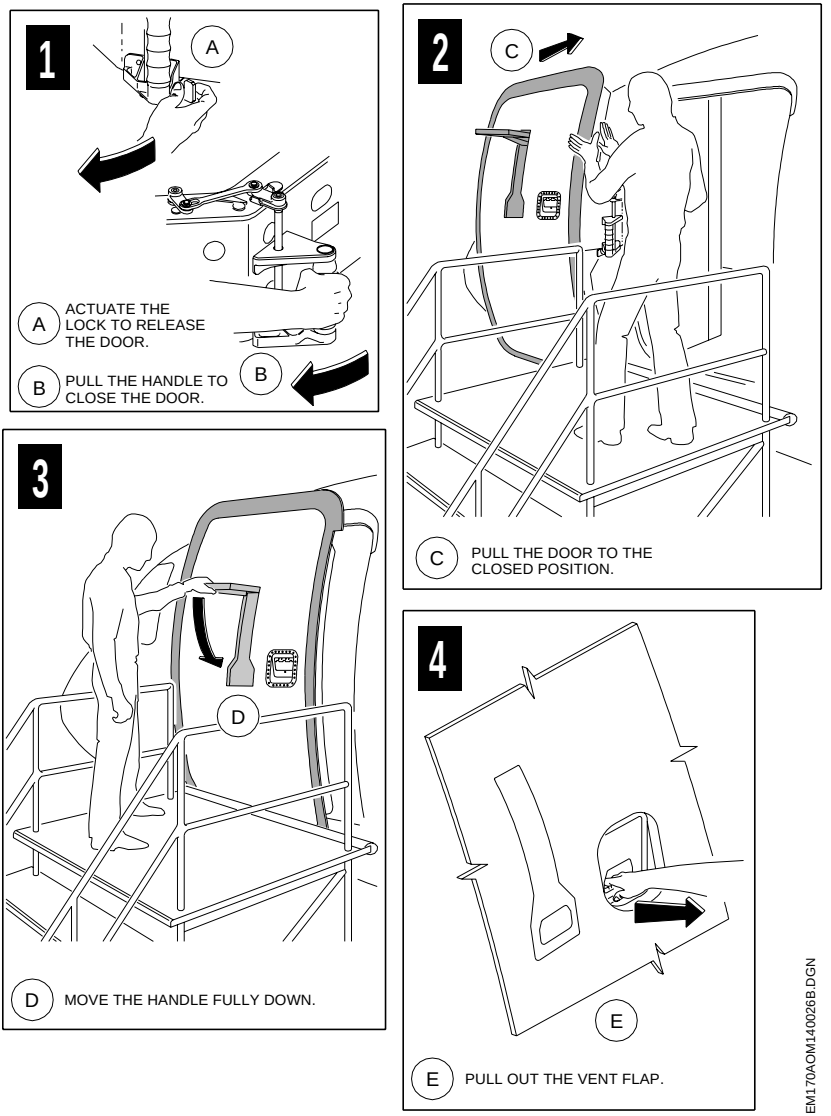


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DOOR OUTSIDE CLOSING

TO CLOSE:



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EMERGENCY EXITS

Both service and passenger doors are designed as type I emergency doors. Emergency slides are provided at both passenger and service doors. The direct vision windows in the cockpit are designed as emergency exits.

Opening the door from inside in emergency mode will activate the Emergency Assisting System that will fully open the door after lifting up the main internal handle. The Emergency Assisting System is installed in passenger and service doors.

In case of ditching, all emergency exits are supposed to be over the water line.

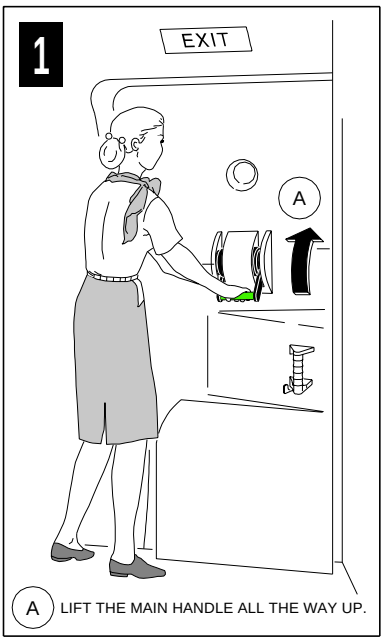
OVERWING EMERGENCY EXITS (OWE)

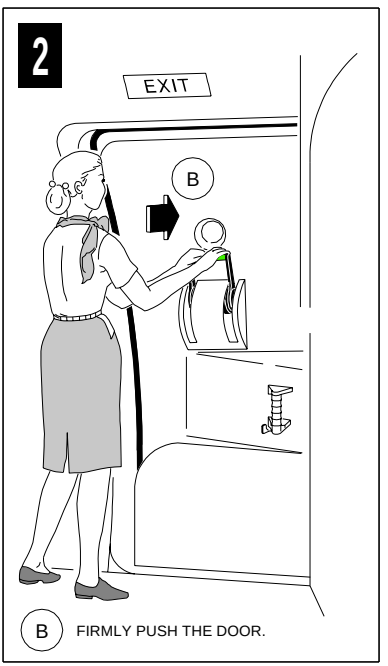
Two Overwing Emergency Exit doors (OWE) exist for passenger evacuation in the event of an emergency. They are located on each side of airplane, centered over the wings. The OWE doors are designed as type III emergency doors.

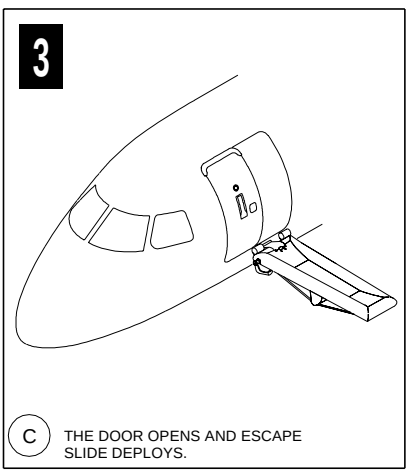
The OWE can be opened from inside or from outside. They can be closed only from inside. Green indication windows at the door ensure that the door is locked.

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DOOR OPENING – EMERGENCY OPERATION

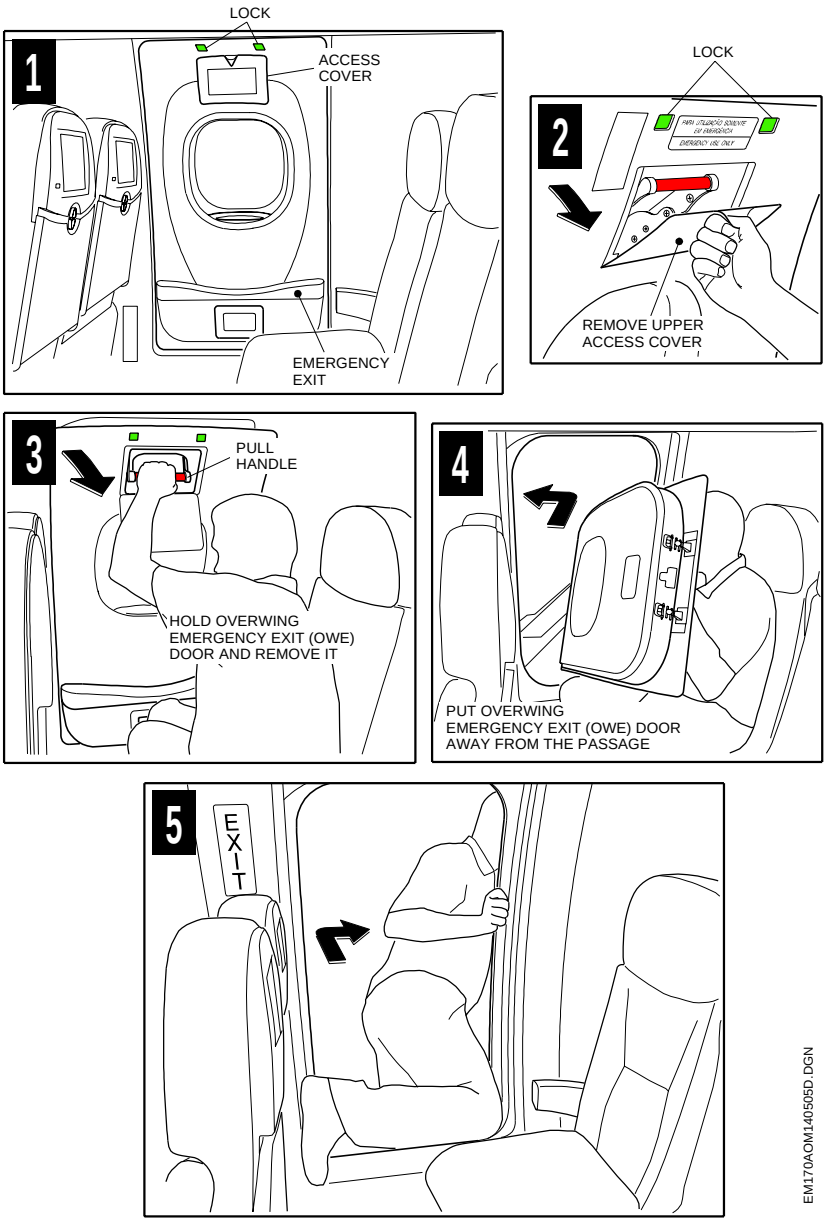






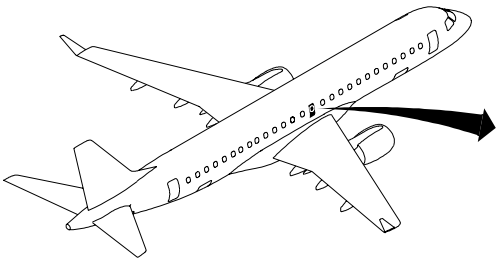
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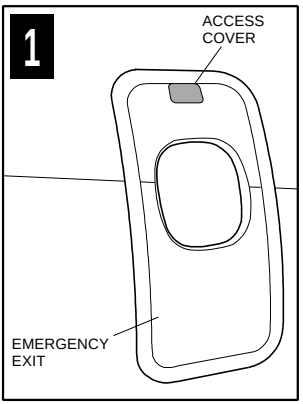
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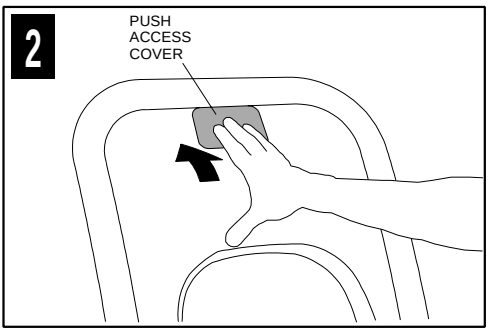


OVERWING EMERGENCY EXIT (OWE) DOOR OPERATION (INSIDE CABIN)

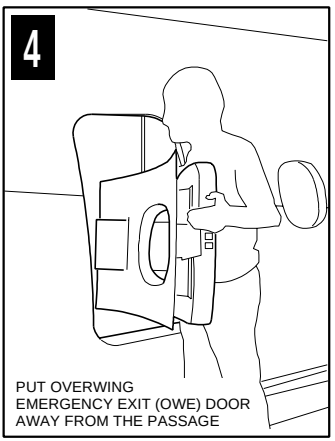
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OVERWING EMERGENCY EXIT (OWE) DOOR OPERATION (OUTSIDE CABIN)

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CARGO DOORS

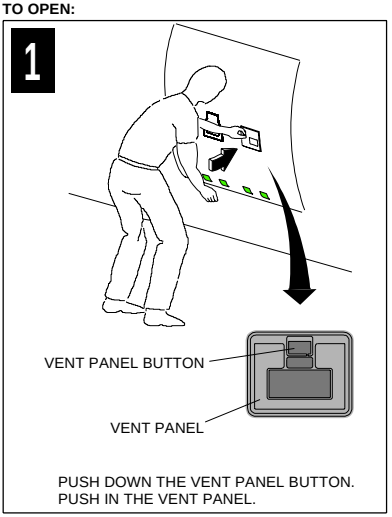
The cargo doors located aft and forward of the wing on the right side of the fuselage are manually operated from the outside. They have a locking mechanism controlled by an external handle, stowed in the lower half of the door. The vent flap prevents pressurization of the airplane above 0.5 psi when the door is not fully closed, latched and locked. The cargo doors open outward and are hinged along the upper edge and are latched at the lower edge with four hooks.

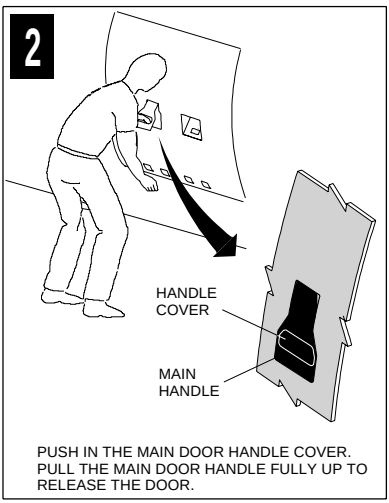
The cargo doors support maximum wind gusts of 40 kt, valid for positions between fully closed and fully open. For the open and locked position, the wind load limitation is 60 kt.

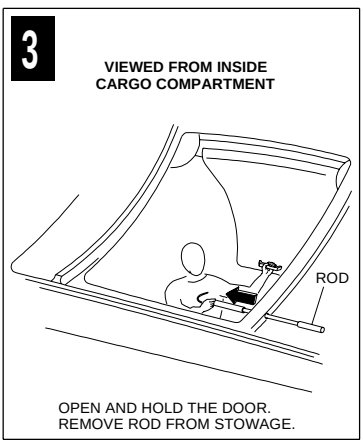
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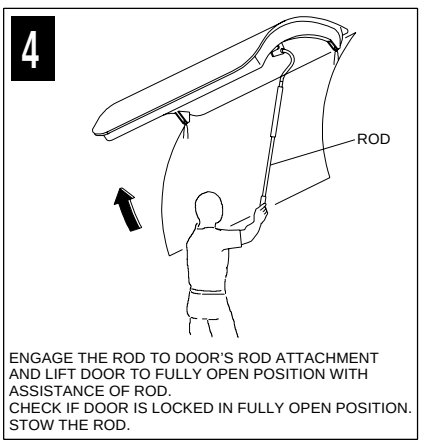
CARGO DOORS OPENING

TO OPEN:









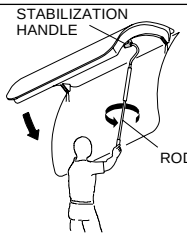
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CARGO DOORS CLOSING

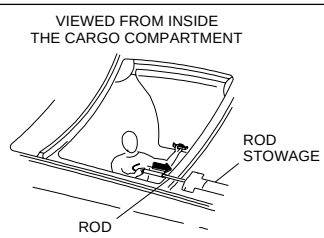
TO CLOSE:

1



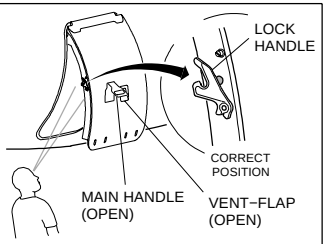
REMOVE THE ROD FROM THE STOWAGE.
ENGAGE THE ROD TO THE DOOR'S ROD ATTACHMENT (HANDLE), AND WHILE PUSHING IT UP, TURN IT CLOCKWISE.

2



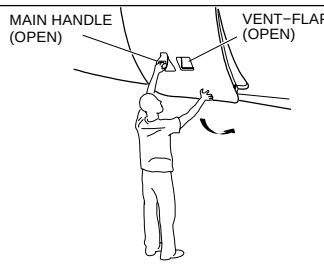
PULL THE DOOR DOWN WITH THE ROD AND GRASP THE INTERNAL HANDLE.
REMOVE THE ROD FROM THE DOOR AND PUT IT INTO THE CARGO COMPARTMENT STOWAGE.

3



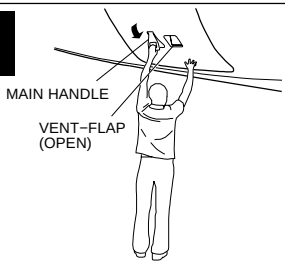
MAKE SURE THAT LOCK HANDLE IS IN THE OPEN POSITION (DOWN) BEFORE CLOSING THE DOOR.

4



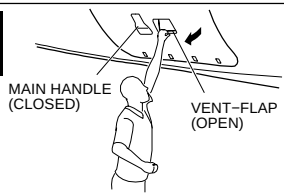
MOVE THE DOOR DOWN AND INTO THE FUSELAGE.

5



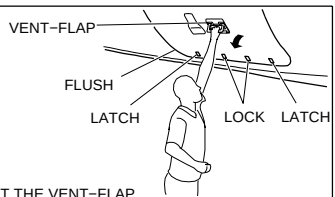
PUSH THE DOOR MAIN HANDLE FULLY DOWN.

6



CHECK IF THE DOOR IS LATCHED.
GRAB THE DOOR BY VENT−FLAP APERTURE AND PULL THE DOOR. IF THE DOOR MOVES, LIFT THE MAIN HANDLE AND LATCH THE DOOR AGAIN (STEP 5).

7



PULL OUT THE VENT−FLAP.
ENSURE THAT MAIN HANDLE AND VENT−FLAP ARE FLUSH WITH THE DOOR.
ENSURE THAT DOOR IS CORRECTLY CLOSED (FLUSH WITH FUSELAGE).
CHECK LOCK AND LATCH GREEN INDICATIONS.

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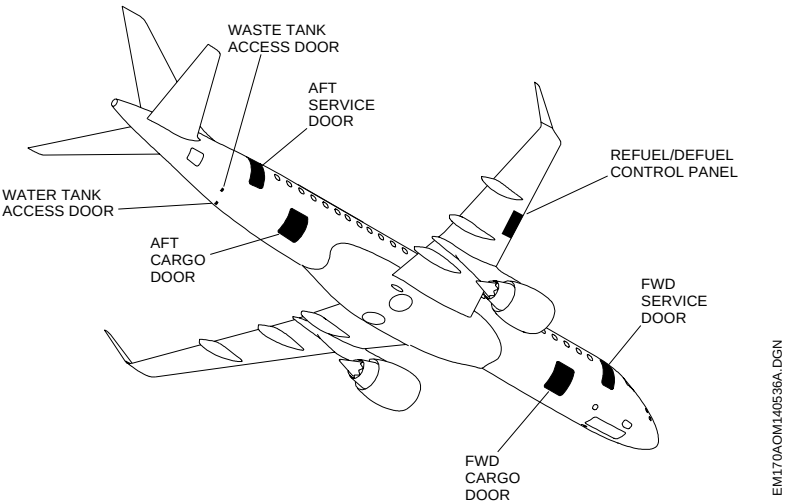
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ACCESS DOORS

A number of access doors, which provides access for servicing the airplane systems and equipment, can be found along the fuselage.

- Forward avionics compartment access door.
- Mid avionics compartment access door.
- Fueling/defueling compartment access door.
- Rear fuselage door.



ACCESS DOORS

DOORS WARNING SYSTEM

Door warning is provided for all external and access doors and hatches in the pressurized vessel. Proximity sensors processed by the proximity sensor evaluation modules (PSEM), monitor the doors.

An EICAS message displays whenever an unlocked condition of any external door has occurred. Additionally the MFD indicates the open door condition in a graphical representation.

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ESCAPE SLIDE

The escape slides are designed to provide passengers and crew a means to safely descend from the airplane to the ground during an emergency evacuation. In the event of emergency evacuation, the slides deploy automatically when the exit door is opened.

Upon completion of the inflation sequence, the slide is fully inflated and ready to assist passengers and crew in descending to the ground.

The emergency evacuation slides are equipped with a lighting system independent from the airplane. The unfolding process activates the lighting system illuminating the sliding surface and the area where evacuees make first contact with the ground. A battery contained within the slide provides electrical power to the lights.

The escape slides are armed by raising the slide arming lever cover located on the door and moving the slide arming lever to the “armed” position (down). The lever movement attaches the girt bar to the cabin floor brackets. The escape slide is attached to the girt bar by means of a fabric girt.

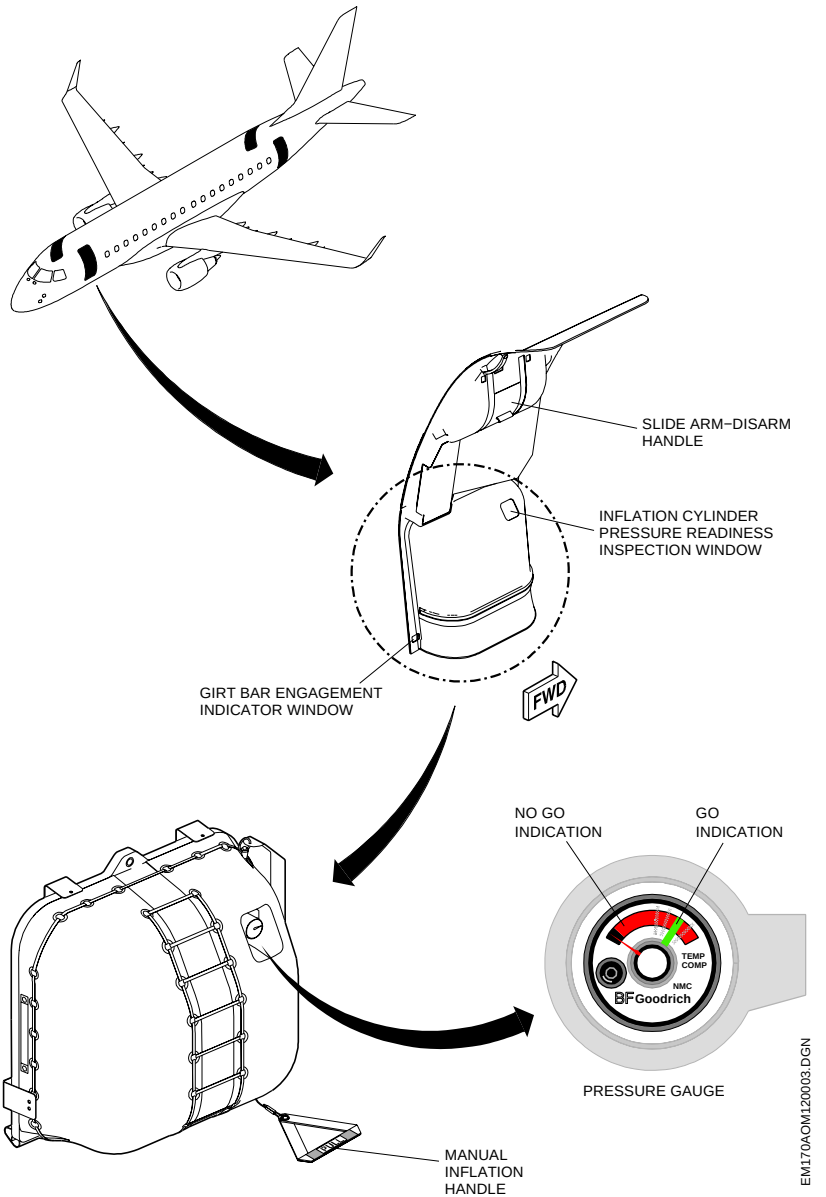
Opening the door from the outside automatically disengages the girt bar from the floor fittings, disarming the slide.

A dedicated battery powers the escape slide lights, which will be on for a minimum of 10 min even after the escape slide is disconnected.

The scape slide may be used as a flotation device after disconnection from airplane.

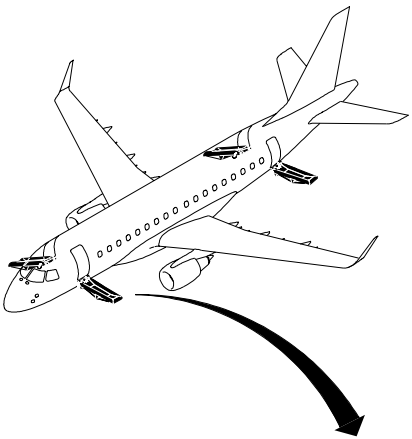
If the mooring line is not manually detached from the airplane in an emergency situation, the system is fail safe in that the mooring line will break free from the slide if enough load is applied.

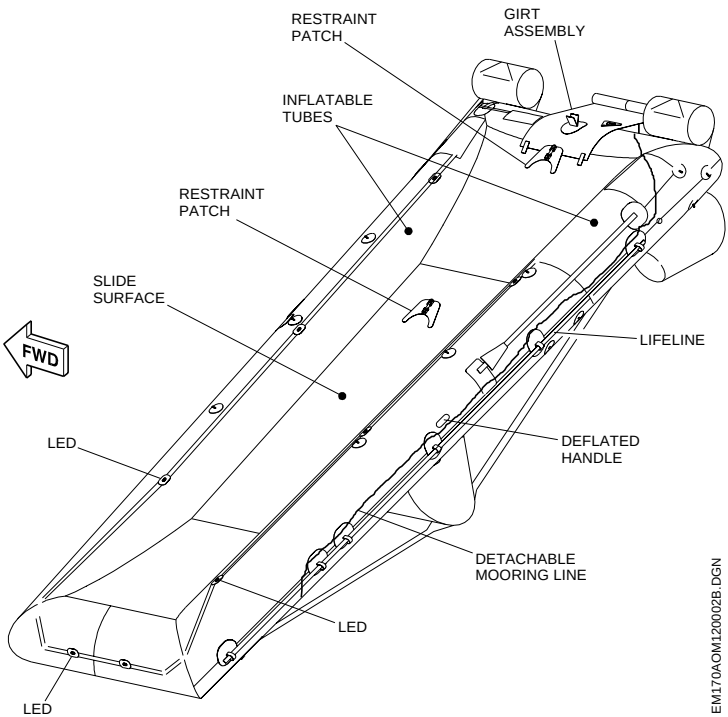
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ESCAPE SLIDE – PACKED

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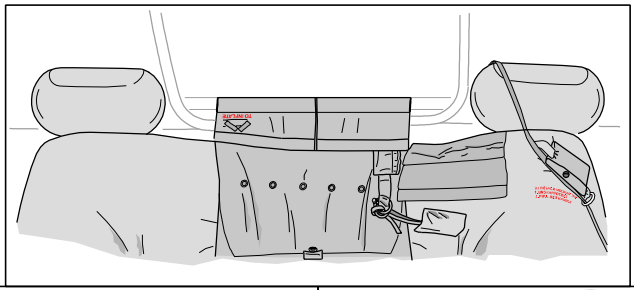


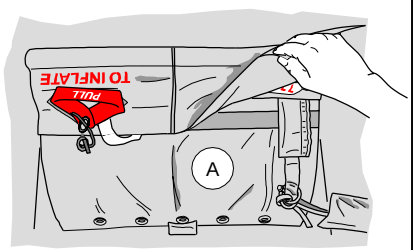
ESCAPE SLIDE – DEPLOYED

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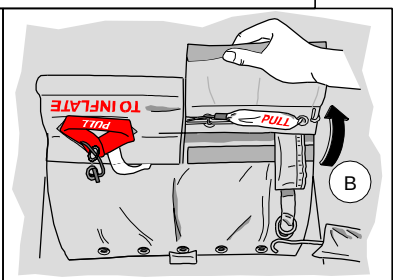
ESCAPE SLIDE DISCONNECTION

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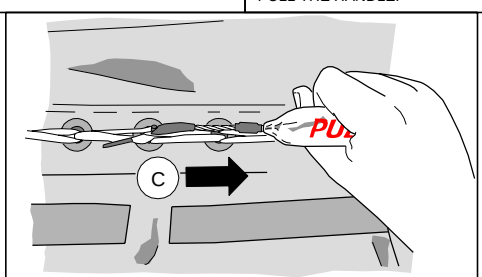




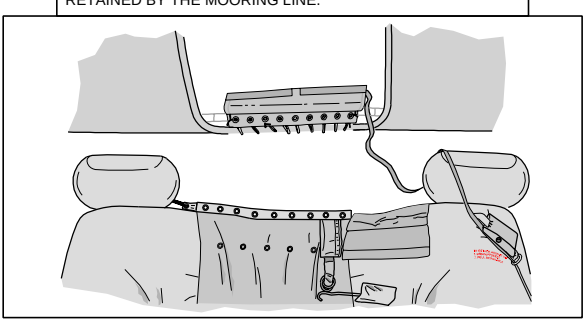
RAISE THE FLAP.



PULL THE HANDLE.



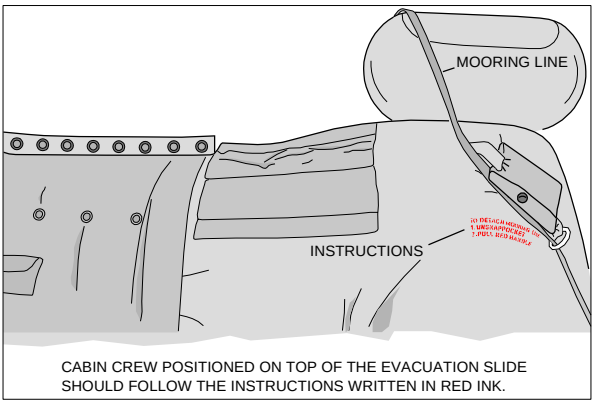
THE SLIDE BREAKS FREE FROM THE AIRPLANE, BUT IS RETAINED BY THE MOORING LINE.



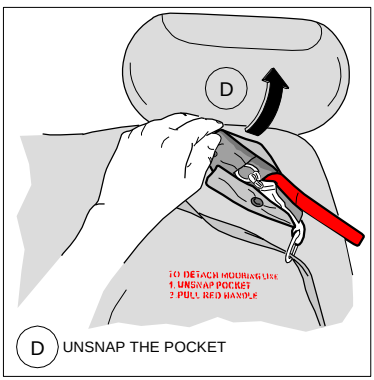
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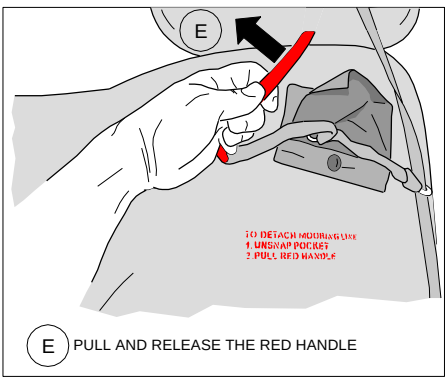
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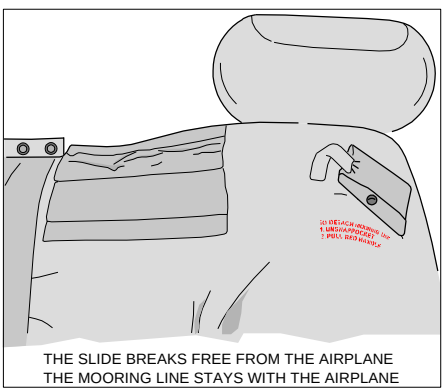
CABIN CREW POSITIONED ON TOP OF THE EVACUATION SLIDE
SHOULD FOLLOW THE INSTRUCTIONS WRITTEN IN RED INK.



D UNSNAP THE POCKET



E PULL AND RELEASE THE RED HANDLE



THE SLIDE BREAKS FREE FROM THE AIRPLANE
THE MOORING LINE STAYS WITH THE AIRPLANE

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MOORING LINE DISCONNECTION

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ABNORMAL OPERATION

The airplane escape slide is equipped with a manual inflation actuation control. In the event that the inflation system does not actuate automatically, the cabin attendant should pull on the manual inflation handle, which activates the inflation system and fully inflates the slide.

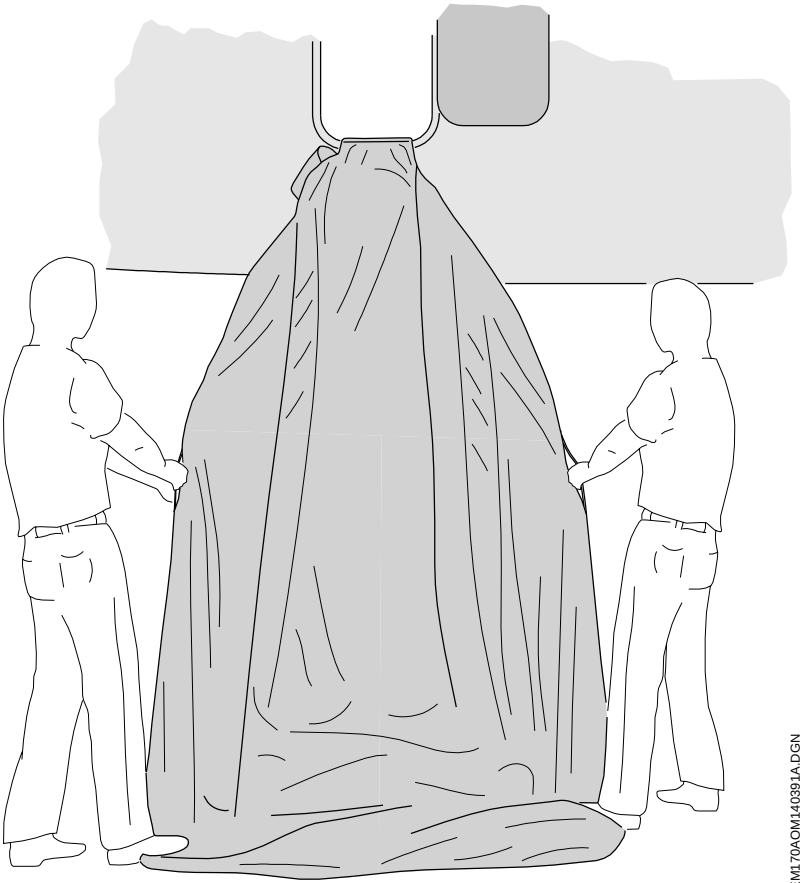
The airplane escape slide is designed to permit use with ground personnel assistance as a non-inflatable device in the event of puncture or tear. The resulting damage may render the device incapable of holding air and sustaining an inflated condition.

If the slide is not fully inflated during evacuation, people already positioned on the ground may pull the slide tightly by its handles while other passengers continue to evacuate the airplane.

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DEFLATED ESCAPE SLIDE OPERATION

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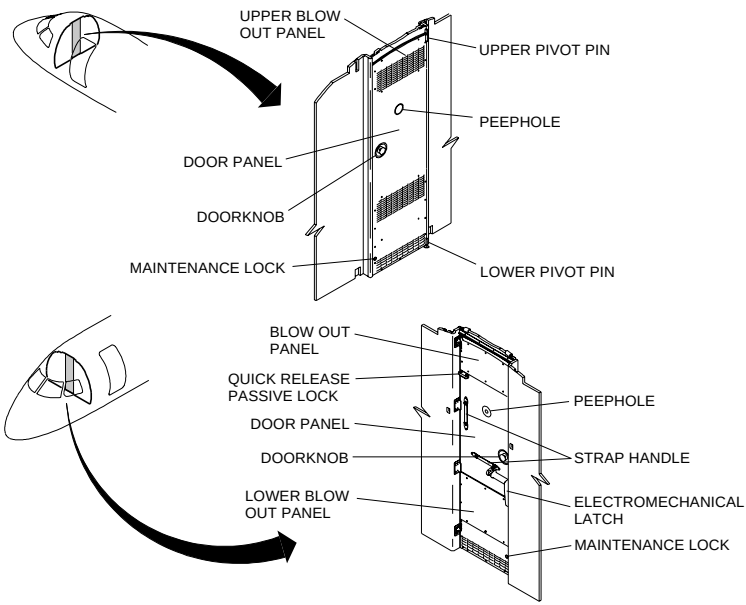
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REINFORCED COCKPIT DOOR

GENERAL

The Reinforced Cockpit Door is ballistic and intrusion resistant door designed in accordance with requirements issued by international airworthiness authorities. The door weight is approximately 25.4 kg (56 lb).

A Cockpit Door Control Panel and a passenger cabin control panel command the door latch. The door's electro-mechanical latch installed on the cockpit side can be remotely or manually operated.



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ELECTROMECHANICAL LATCH

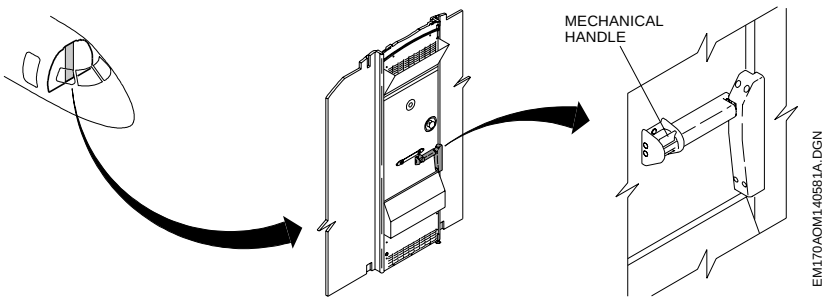
An electrically-actuated solenoid closes the electromechanical latch. The control panel in the cockpit sends an electrical pulse to the electromechanical latch, which actuates a bolt and locks the door. The door is unlocked when a new electrical pulse is sent to the electromechanical latch.

The DC BUS 2 powers the door's electromechanical latch. In case of electrical failure the door latch will stay in its previous setting. In this case the manual override inside the cockpit can be used to lock or unlock the door.

The door will not close if the electromechanical latch is locked while the door is opened. It is necessary to unlock the electromechanical latch to place the door to the closed position.

NOTE: – The electromechanical latch will not open if the flightcrew commands the reinforced cockpit door to UNLOCK while the door is pulled towards the cabin side. It is recommended to wait until latch is unlocked before pulling open the door. The sound of the mechanism is heard when the latch unlocks.

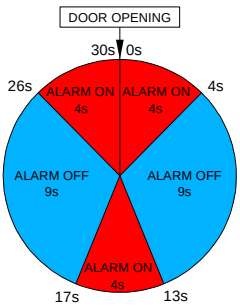
– A pre flight test should be performed daily to check the buzzer of the emergency access cycle aural alarm.



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SYSTEM LOGIC

Actuating the EMERG ENTRY pushbutton starts the chime alarm sequence. The DING-DONG sound chime remains on for 4 s and is repeated three times at 9-second intervals during which the sound chime remains paused. After the third chime cycle ends, the door will unlock if the INHIB pushbutton is not pressed within 30 s after EMERG ENTRY pushbutton actuation.

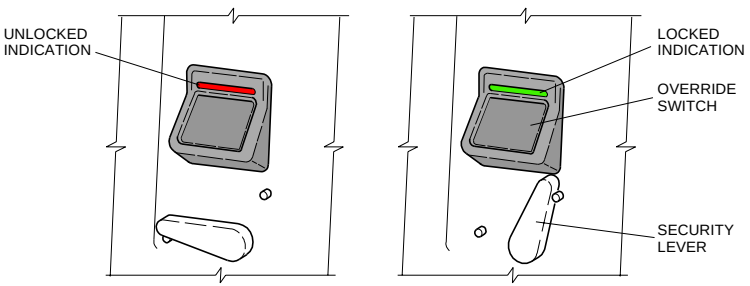


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►*Airplanes equipped with Electromechanical Door Latch with Security Lever*

Security Lever

In case of failure in the inhibition function, the security lever locks the override switch and prevents the door from opening 30 s after the beginning of the system's logic.



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SECURITY LEVER

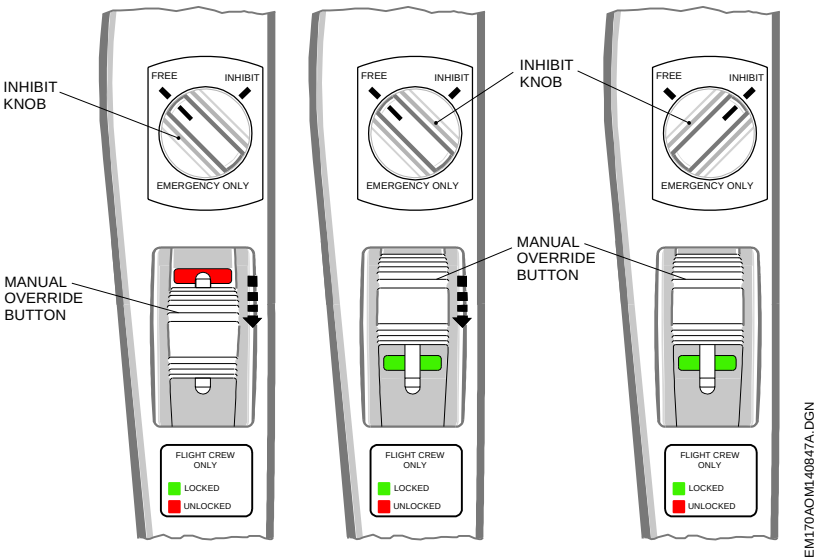
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►*Airplanes equipped with Electromechanical Door Latch with Inhibit Knob*

Inhibit Knob

In case of failure in the inhibition function, the inhibit knob locks the override switch and prevents the door from opening 30 s after the beginning of the system's logic.



◄

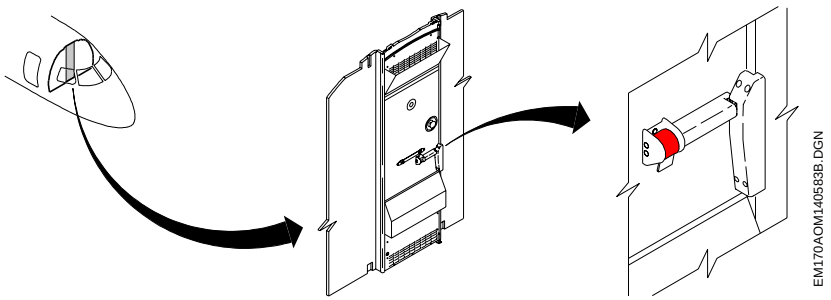
MANUAL OVERRIDE

The latch locking system can be overridden by actuating either a mechanical handle installed on the door or an override switch installed on the electromechanical latch.

The door lock bolt retracts by turning down the mechanical handle. It opens the door and allows an emergency egress. A red mark on the handle indicates that the door is unlocked. Turning the handle further upwards will set the bolt to the LOCKED position.

NOTE: Latch manual operation must be used to override the locking system only in case of system electrical failure.

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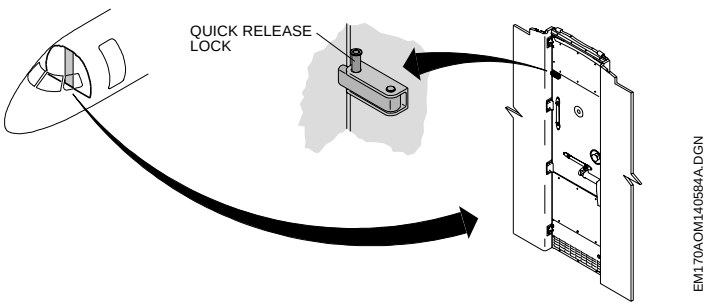
The override switch installed in the electromechanical latch manually unlocks the door. Actuating downwards the override switch alternates between locked and unlocked status. If the door is unlocked, a red indication is shown on the switch. The door is locked when a green indication is shown.

AUXILIARY LOCKS

PASSIVE LOCK

A passive lock installed on the cockpit door does not permit the door to be pushed towards the passenger cabin whenever the door is closed. The normal position of the quick release pin is locked. The passive lock is unlocked when the pin is removed.

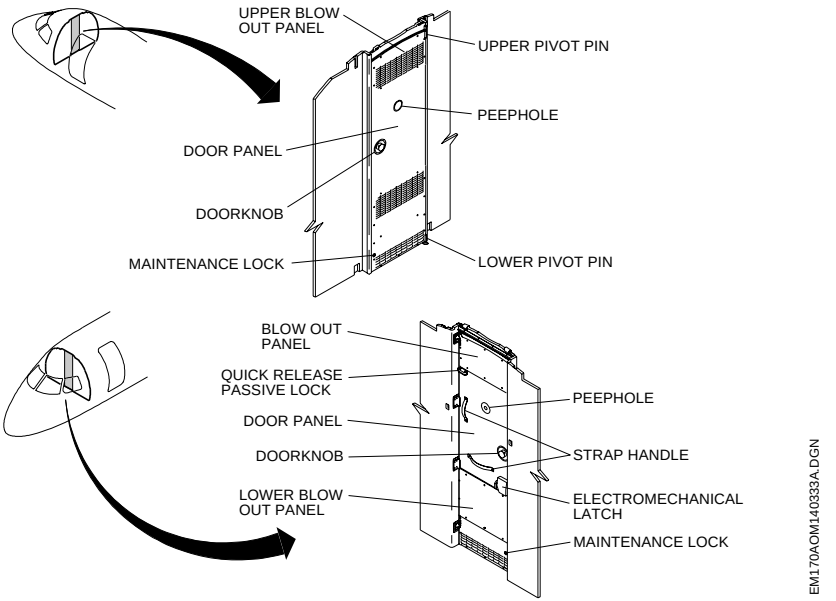
NOTE: The passive lock must be unlocked only under emergency conditions, for an emergency cockpit egress procedure.



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MAINTENANCE LOCK

A maintenance lock blocks the door during the airplane's overnight parking. A key is necessary to lock and unlock it. The keyhole is located on the passenger cabin side of the door.



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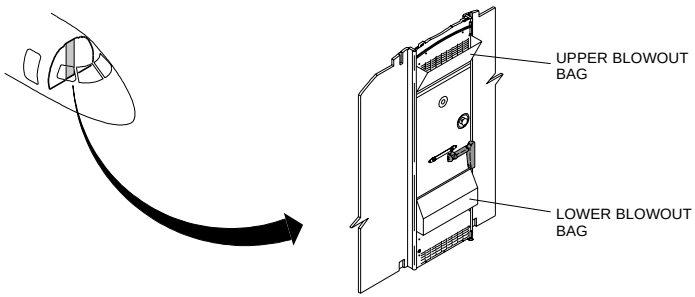
BLOWOUT PANELS

The reinforced cockpit door assembly possesses two blowout panels to equalize sudden decompression. When a sudden decompression occurs, the blowout bags automatically unfold and deploy forward.

The blowout bags installed within grill-protected openings maintain the door's full ballistic and impact-resistant characteristics even when deployed.

Both blowout bags can be deployed with the observer seat in use and without any type of interference or hazard to the observer.

A door grill opening equalizes the pressure in the event of decompression in the passenger cabin area.

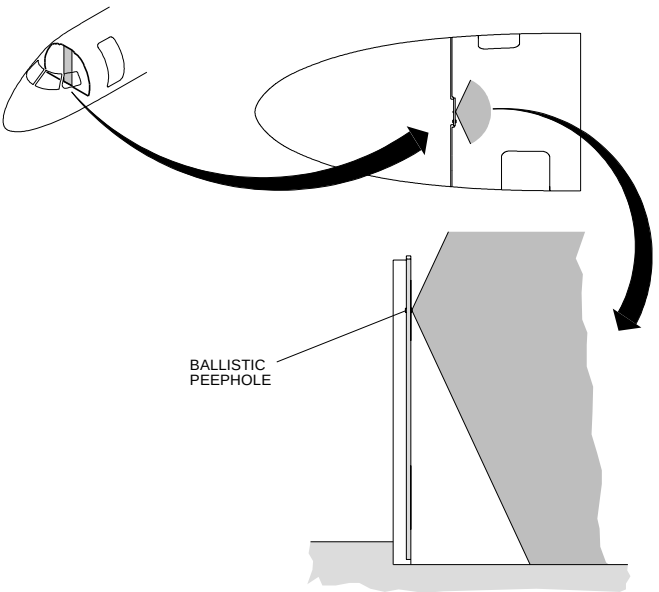


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PEEPHOLE

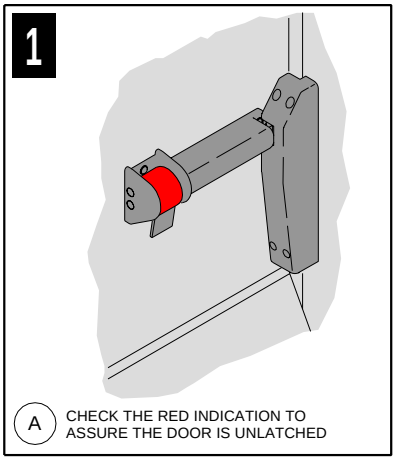
The reinforced cockpit door is equipped with a ballistic-resistant peephole. The peephole field of view inhibits any hidden threats.

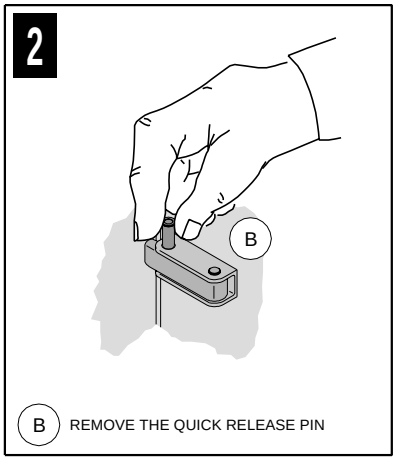


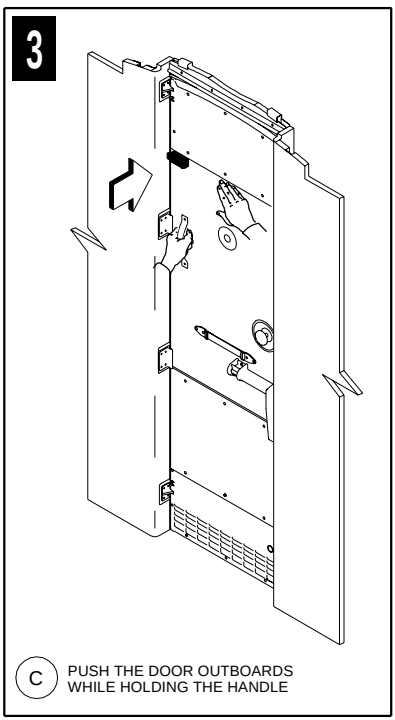
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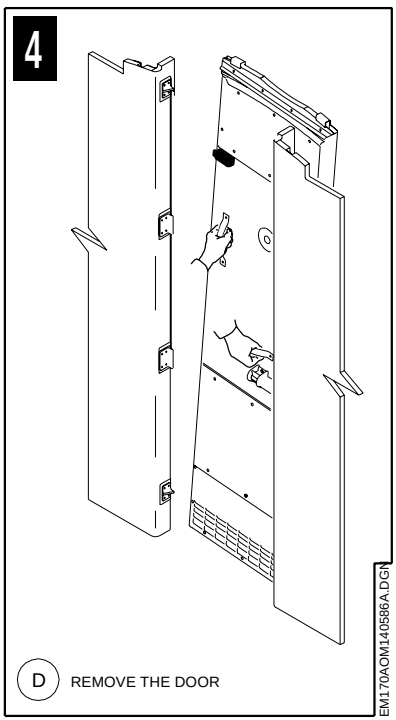
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JAMMED DOOR EMERGENCY EGRESS









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WATER

A central storage tank holds potable water. Pressurized water is supplied to the heaters and faucets in the lavatories and water spigots, and coffee makers in the galleys. Water is also supplied for flushing of the vacuum toilets in the lavatories.

Engine and APU bleed air pressurizes the potable water system. If the engines or APU are not running on the ground, or bleed air pressure is below the optimal range during the flight, an optional air compressor pressurizes the water system.

The potable water storage tank's maximum capacity can be configured to 35, 70, 90 or 110 liters. The AFT flight attendant panel indicates the percentage of total water quantity remaining in the tank.

The lavatory faucet has a single cap. Water flow is started by pressing the cap, while rotating it allows water temperature control.

Water from lavatory washbasins and galleys is automatically drained through forward and aft drain masts on ground and in flight.

In case of water system leakage at either the galley or the lavatory, the respective shutoff valve may be actuated to isolate the system.

If the auto-drain valve clogs, the flight attendant may manually actuate the remote actuation cable located on the front of the galley. Pulling on the self drain valve handle clears the galley drain valve. Access to the lavatory valve is through the under sink cabinet door. Pulling up on the ring handle clears the lavatory drain valve.

In-flight drainage is commanded by pressing the water dump pushbutton in the cockpit. Water is drained through aft and forward masts and the drainage may take up to 10 minutes. After a total drainage of water, toilets and other systems that use water will not be available until the next refilling. Pressing the water dump pushbutton again discontinues the drainage. Water drainage is automatically interrupted if the landing gear is lowered or under any faulty drain mast heater condition.

The flight attendant panel indicates a FAULT condition whenever:

– A fault in the respective (FWD or AFT) drain valve is detected;

– Water level indication is not available;

– In-flight drainage is not available due to a fault in the drain valve or in the drain mast heater.

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WASTE

The vacuum waste system collects waste from the lavatory toilets to an aft mounted vertical waste tank.

A vacuum generator is used to create differential pressure on the ground or at altitudes below 18000 ft. At higher altitudes, the differential between the airplane's cabin pressure and ambient pressure is sufficient to transport the waste.

Pushing the flushing switch located inside the lavatory initiates toiletflushing sequence. Water is introduced to rinse the bowl prior to opening of the toilet-flushing valve.

The usable capacity of the waste tank is 95 liters. The Service Tank indication illuminates on the flight attendant's panel when waste tank capacity reaches 75%. When the waste tank's full capacity is reached, the Tank Full indication illuminates and the vacuum toilets are disabled.

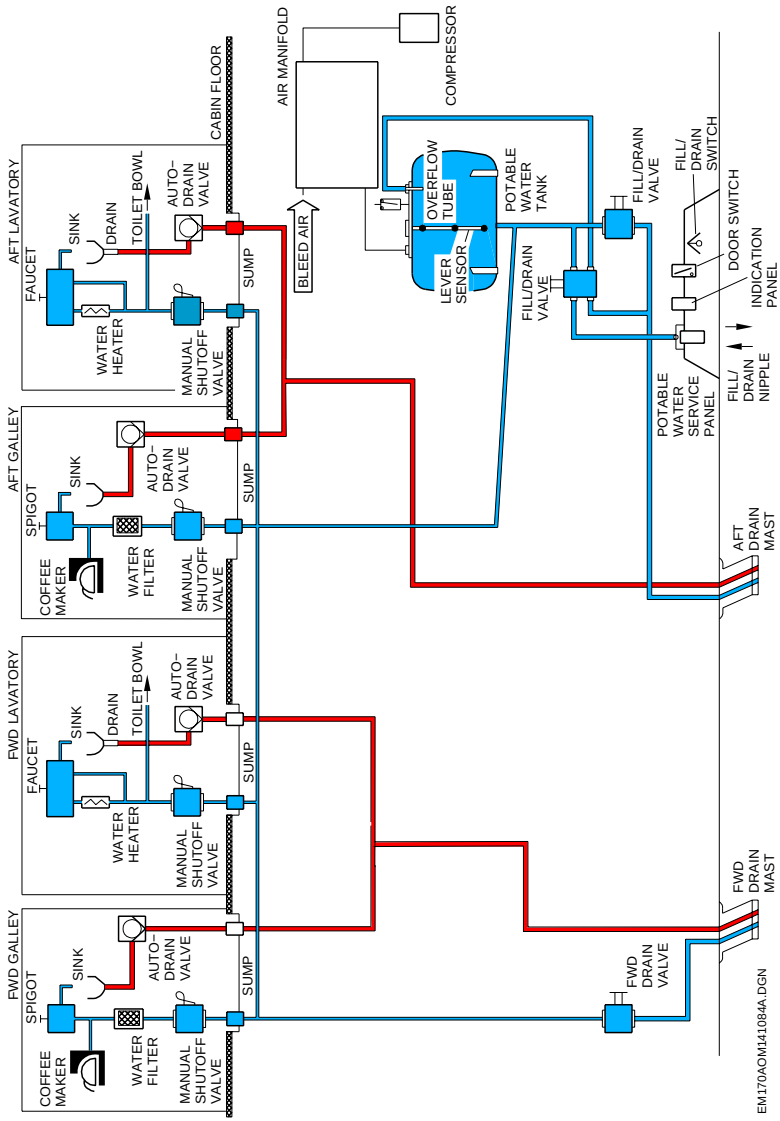
Waste tank draining is performed through the service panel on the aft right-hand side of the fuselage.

WATER AND WASTE HEATING SYSTEM

Electrical heating for the water and waste system is provided to prevent ice accumulation on fill/drain nipples and forward and rear drain masts. The water system controller monitors the system and indicates any failure on the flight attendant panel as described in the Airplane General – Controls and Indications section.

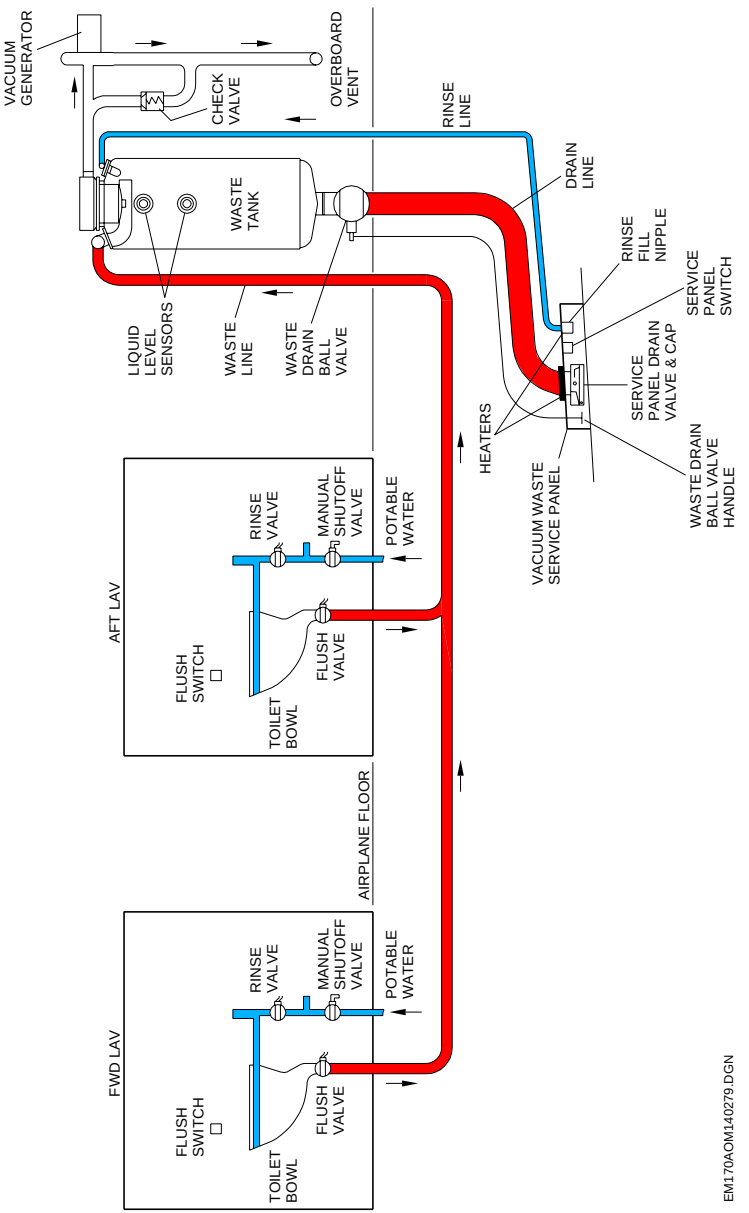
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POTABLE AND GRAY WATER SCHEMATIC



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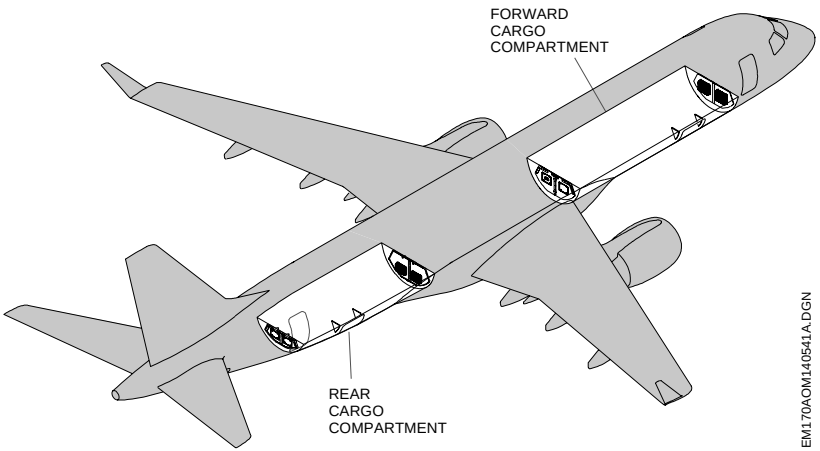
WASTE SCHEMATIC



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CARGO COMPARTMENTS

The airplane has two class C cargo compartments. Both compartments are equipped with fire detection and extinguishing systems providing protection against fire damage.



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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	DOOR CRG AFT (FWD) OPEN	Associated baggage door open or not properly locked.
	DOOR EMER LH (RH) OPEN	Associated overwing emergency door open or not properly locked.
	DOOR PAX AFT (FWD) OPEN	Main door is open or not properly locked either on the ground with any engine running or in flight.
	DOOR SERV AFT (FWD) OPEN	Service door is open or not properly locked either on the ground with any engine running or in flight.
CAUTION	APM FAIL	At least three APMs have failed.
	APM MISCOMP	One or more APMs do not match.
	AVNX MAU 1 (2) (3) A (B) FAIL	All functions in the associated MAU channel have failed.
	AVNX MAU 1 (2) (3) A (B) OVHT	None of the functions in the associated MAU channel is available.
	AVNX MAU 1 (2) (3) FAN FAIL	Associated fan cannot be turned on.
	CMS FAIL	Both CMSs have failed. No dispatch relief.
	DOOR CENTER (FWD) EBAY OPEN	Associated electronic bay is open or not properly locked.
	DOOR HYD OPEN	Hydraulic system 3 access door is open or not properly locked.
	EICAS FAULT	DU has suffered failure condition(s) that affect the functionality.

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TYPE	MESSAGE	MEANING
CAUTION	EICAS OVHT	DU has suffered an over temperature condition. Continued operation may result in the loss of DU.
	EMERG LT NOT ARMED	Emergency lighting system is not armed.
	EMERG LT ON	Emergency lighting system is on.
	MFD 1 (2) FAULT	DU has suffered failure condition(s) that affect the functionality.
	MFD 1 (2) OVHT	DU has suffered an over temperature condition. Continued operation may result in the loss of DU.
	PFD 1 (2) FAULT	DU has suffered failure condition(s) that affect the functionality.
	PFD 1 (2) OVHT	DU has suffered an over temperature condition. Continued operation may result in the loss of DU.
	SYS CONFIG FAIL	Automatic configuration monitoring system has found non-dispatchable configuration miscompare.

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TYPE	MESSAGE	MEANING
ADVISORY	APM FAULT	One or two APMs have failed.
	AVNX DB MODULE FAIL	On board database module has failed.
	AVNX MAU 1 (2) (3) A (B) FAULT	The associated MAU channel suffered failure condition(s) that does not affect its functionality, but may cause loss of redundancy.
	CCD 1 (2) FAULT	Cursor control of one or more DUs has been lost.
	CMS FAULT	One CMS has failed, dispatch relief possible.
	DOOR FUELING OPEN	Fueling door open or not properly locked.
	EMER LT BATT FAULT	One of the four emergency batteries is not working properly.

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SECTION 14-02

AIR MANAGEMENT SYSTEM

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GENERAL DESCRIPTION

The Air Management System (AMS) consists of:

– The Pneumatic System.

– The Environmental Control System (ECS).

The Cabin Pressure Control System (CPCS) is part of the AMS, but it has a separate controller.

The AMS controller provides primary control for various airplane subsystems such as bleed control, air conditioning control, hot air leak detection, crew oxygen monitoring and wing and engine ice protection. The AMS controller also interfaces with the smoke detectors providing fault detection, isolation, and reporting.

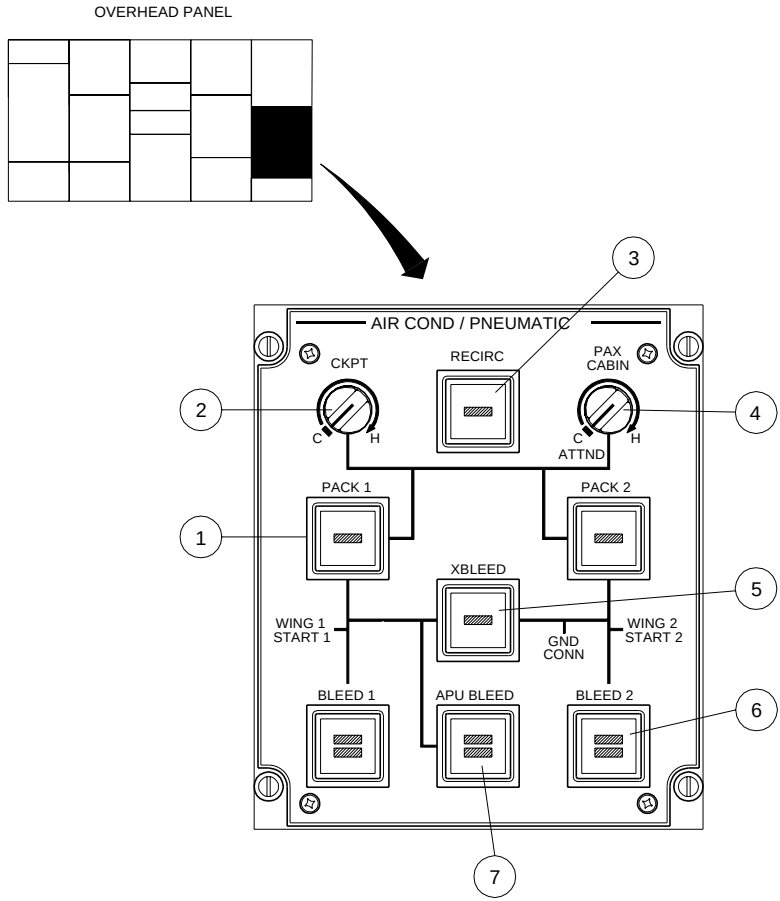
The AMS controller has two channels, which control the respective onside system. In case of a channel failure, the remaining channel is able to control the entire pneumatic, air conditioning and anti-ice systems.

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AIR CONDITIONING AND PNEUMATIC CONTROL PANEL



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1 - PACK 1 (2) BUTTON

PUSH IN: allows automatic operation by the AMS. This position opens the respective pack flow control valve.

PUSH OUT: manually closes the respective pack flow control valve.

2 - COCKPIT TEMPERATURE ROTATING KNOB

– Controls cockpit temperature relative to the knob position.

3 - RECIRCULATION BUTTON

PUSH IN: allows automatic operation by the AMS. This position turns on both recirculation fans, according to system operational logic.

PUSH OUT: turns off both recirculation fans.

4 - PASSENGER CABIN TEMPERATURE ROTATING KNOB

– Controls passenger cabin temperature relative to the knob position.

– Rotating the knob to the ATTND position allows the cabin temperature to be controlled by the flight attendant control panel.

5 - CROSS-BLEED BUTTON

PUSH IN: allows automatic operation by the AMS. This position opens the cross-bleed valve, according to system logic.

PUSH OUT: manually closes the cross-bleed valve.

6 - BLEED AIR BUTTON

PUSH IN: allows automatic operation by the AMS. This position commands the respective engine bleed valves, according to system logic.

PUSH OUT: manually closes the engine bleed valves.

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NOTE: When leak is detected, the button amber striped bar is illuminated.

7 - APU BLEED BUTTON

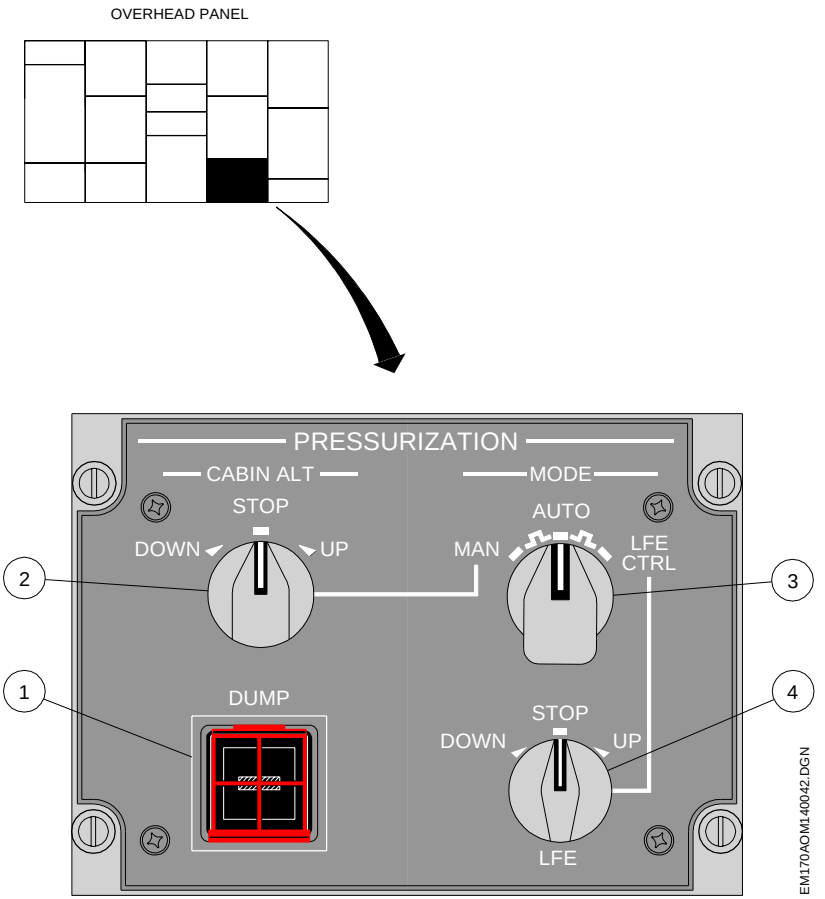
PUSH IN: allows automatic operation by the AMS. This position commands the APU bleed valve, according to system logic.

PUSH OUT: closes the APU bleed valve.

NOTE: When leak is detected, the button amber striped bar is illuminated.

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PRESSURIZATION CONTROL PANEL



1 - DUMP BUTTON (GUARDED)

Momentary pushbutton:

– Provides rapid cabin depressurization, by opening the outflow valve and commanding the packs and recirculation fans to off.

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– When pressed the dump function is activated and a white striped bar illuminates on the button. When pressed a second time the system returns to normal.

NOTE: When operating in manual mode, the outflow valve will not be commanded open.

2 - CABIN ALTITUDE SELECTOR KNOB

DOWN: (momentary action) manually closes the outflow valve, decreasing cabin altitude rate in 50 ft/min steps.

STOP: normal operation position.

UP: (momentary action) manually opens the outflow valve, increasing cabin altitude rate in 50 ft/min steps.

NOTE: Manual actuation of the outflow valve is possible only with the PRESSURIZATION MODE SELECTOR KNOB set to MAN position.

3 - PRESSURIZATION MODE SELECTOR KNOB

MAN: allows manual control of the outflow valve.

AUTO: allows automatic operation of the pressurization system.

LFE CTRL: allows manual input of landing field elevation, although the pressurization system will remain in automatic mode.

4 - LANDING FIELD ELEVATION (LFE) SELECTOR KNOB

DOWN: (momentary action) decreases the LFE in 100 ft increments.

STOP: normal operation position.

UP: (momentary action) increases the LFE in 100 ft increments.

NOTE: Manual input of the LFE is possible only with the PRESSURIZATION MODE SELECTOR KNOB set to LFE CTRL position.

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EICAS INDICATION



PRESSURE INDICATION ON EICAS

1 - CABIN ALTITUDE INDICATION

– Displays cabin altitude in feet, regardless of the operating mode.

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: warning operating range.

AMBER DASHED: invalid information.

2 - CABIN RATE OF CHANGE INDICATION

– Displays the cabin rate of change in feet per minute, regardless of the operating mode.

GREEN: normal operating range.

AMBER: cautionary operating range.

AMBER DASHED: invalid information or value out of displayable range.

3 - DIFFERENTIAL PRESSURE INDICATION

– Displays the differential pressure between the cabin interior and the outside in pounds per square inch, regardless of the operating mode.

GREEN: normal operating range.

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AMBER: caution operating range.

RED: warning operating range.

AMBER DASHED: invalid information.

4 - LANDING FIELD ELEVATION INDICATION

– Displays the landing field elevation in feet, regardless of the operating mode.

GREEN: inputs from FMS.

CYAN: manual input. A cyan “M” in front of altitude readout indicates manual input.

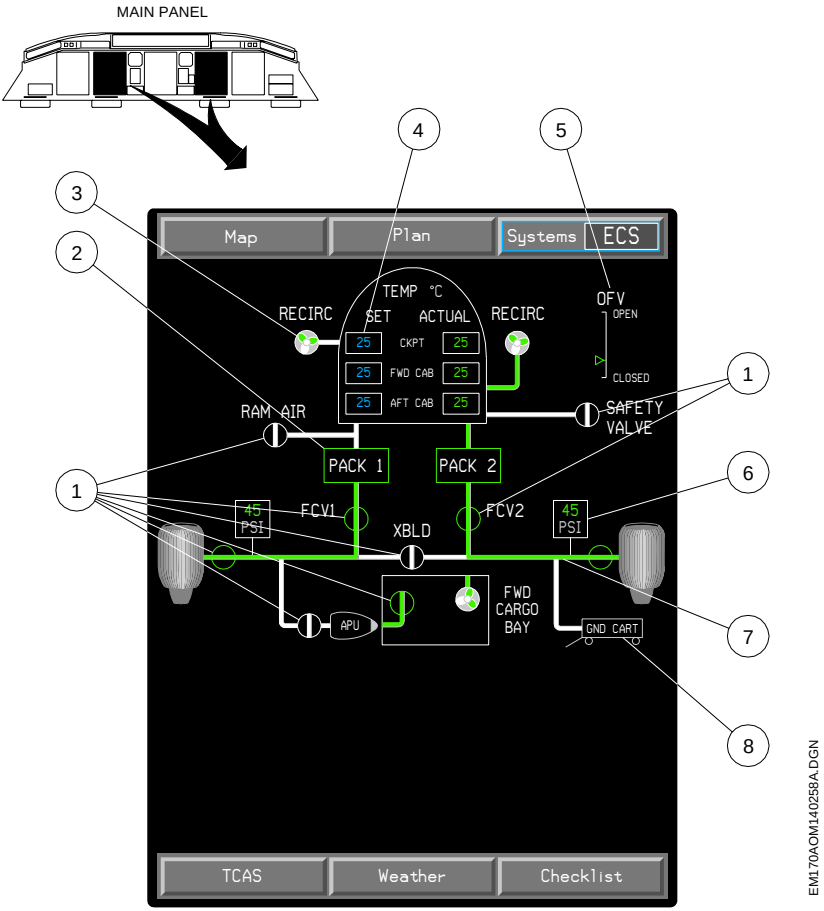
AMBER DASHED: invalid information or value out of displayable range. Manual operation is active.

NOTE: Flight plan on MCDU must be closed to display landing field elevation (LFE) on EICAS.

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SYNOPTIC PAGE ON MFD

The environmental control system synoptic page provides a visual representation of the system operation and parameters. It can be selected by flight crew on both MFDs.



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1 - AIR SHUTOFF VALVES STATUS

- Air shutoff valves are shown as a circle and an internal line representing the valve position.
  - OPEN: a green circle and a green line aligned with the flow line.
  - CLOSED: a white circle and a white line perpendicular to the flow line.
  - UNDETERMINED: an amber dashed circle with no line.
  - IN TRANSIT: a white circle and a white line in diagonal to the flow line.
  - FAILED CLOSED: a white circle and a white line perpendicular to the flow line covered by an amber cross.
  - FAILED OPEN: a green circle and a green line aligned with the flow line covered by an amber cross.

2 - PACK STATUS

- ON: a green rectangle.
- OFF: a white rectangle.
- UNDETERMINED: an amber dashed rectangle.
- FAILED: an amber dashed rectangle covered by an amber cross.

3 - RECIRCULATION FAN STATUS

- The recirculation fan is shown as a circle and an internal windmill, representing the fan status.
  - ON: a gray circle and a green windmill.
  - OFF: a gray circle and a gray windmill.
  - UNDETERMINED: an amber dashed circle and an amber windmill.
  - FAILED: a gray circle and a white windmill beneath an amber cross.

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4 - COCKPIT/CABIN TEMPERATURE INDICATION

– Digital Temperature.

– The digital information displays selectable and actual temperature for the cockpit, forward cabin and aft cabin.

GREEN: used for all actual temperature indication.

CYAN: used for all set temperature indication.

AMBER DASHED: invalid information or value out of displayable range.

Temperatures are set using the Cockpit/Passenger Cabin Temperature rotating knob on the Air Conditioning and Pneumatic control panel. Cabin temperatures can also be set on the Flight Attendant panel.

5 - OUTFLOW VALVE (OFV) POSITION INDICATION

– Outflow Valve Scale/Pointer:
The pointer on the scale indicates the actual OFV position. When the OFV is fully open at 90°, the pointer will be parked at the OPEN position, at the top of the scale. When the OFV is fully closed at 0°, the pointer will be parked at the CLOSED position, at the bottom of the scale. If the OFV signal is invalid the pointer will be removed from view.

– Scale:
WHITE: always, despite of OFV position.

– Pointer:
GREEN (hollow): always, despite of OFV position.

6 - MANIFOLD PRESSURE INDICATION

– Digital Pressure.

– Colors:
GREEN: normal operating range.
AMBER: caution operating range.
GRAY: label (psi).
AMBER DASHED: invalid information or value out of displayable range.

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7 - FLOW LINE

– The flow line is shown as a colorful line.

GREEN: indicates an air flow condition.

WHITE: indicates a no air flow condition.

WHITE/AMBER DASHED: the associated line flow information is invalid.

AMBER: overheat condition.

8 - GROUND CART

– Ground cart connection is displayed only when it is connected to the airplane.

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PNEUMATIC SYSTEM

Bleed air is provided to the Air Management System by the engines, or the APU. The bleed air is used for:

– Environmental Control System (ECS);

– Engine start;

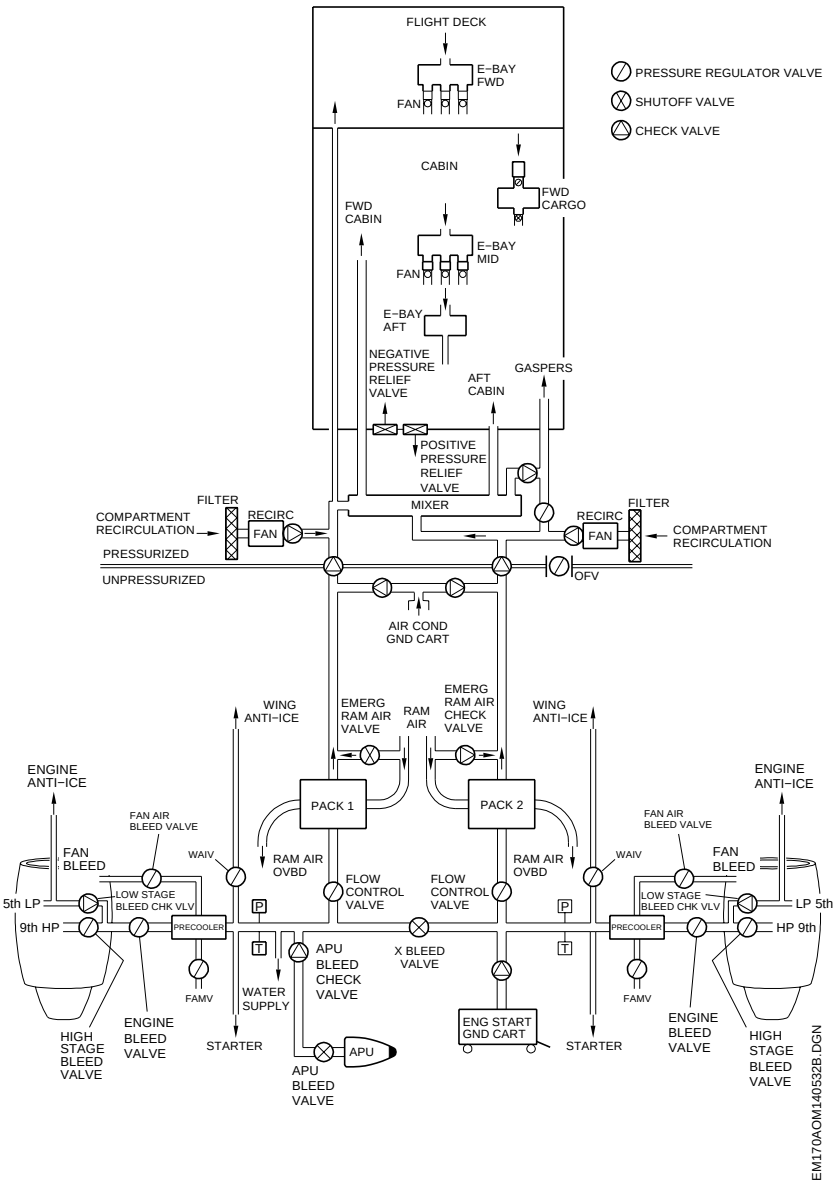
– Engine anti-ice and wing anti-ice;

– Water pressurization.

The external ground connections can also be used to supply pressurized air for engine start and for air conditioning.

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SYSTEM SCHEMATIC



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ENGINE BLEED SYSTEM

The engine bleed system alternately selects between low pressure and high pressure engine bleed sources in order to maintain adequate and safe bleed supply pressure at any engine-operating condition.

This control is established via opening/closing of the Low Pressure Check Valve and of the High Stage Bleed Valve located in the nacelle.

The Engine Bleed Valve EBV is installed at the nacelle to regulate the bleed pressure provided by the engine bleed system.

Engine bleed air temperature is regulated by the precooler and the Fan Air Valve (FAMV) which modulates fan air to cool the hot bleed air.

The bleed system control functions are integrated with anti-ice and air conditioning functions through the AMS controller.

NORMAL OPERATION

The Engine Bleed Valve is commanded open when the following conditions occur simultaneously:

– Respective bleed switch is set to AUTO.

– Respective engine bleed is available.

– No fire is detected in the respective engine.

– No bleed duct leak is detected.

ABNORMAL OPERATION

The system will automatically shut down the affected bleed system by closing the engine bleed valves when a leak, overpressure or fail condition is identified.

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APU BLEED

The APU supplies bleed air on the ground or inflight. However, it is used primarily as a ground pneumatic source for the air conditioning packs (ECS) and engine starting. The APU Bleed Check Valve prevents engine bleed air from flowing to the APU when the engine bleed is the pneumatic source.

The APU Bleed Valve (ABV) controls the APU bleed airflow to the pneumatic system.

The APU Bleed Valve is commanded open when the following conditions occur simultaneously:

– APU switch is set to AUTO.
– APU Bleed is available.
– No APU and left bleed duct leak.
– Left engine bleed is unavailable.
– Anti-ice system not requested (or anti-ice system requested ON and anti-ice system is failed).

CROSS BLEED (XBLEED)

NORMAL OPERATION

The cross bleed is commanded open when the XBLEED button is pushed in (AUTO) and any of the following conditions are met:

– One side provides manifold pressure and there is not a bleed air source on the opposite side.
– APU Bleed button pushed out for main engine start.
– Engine #2 start in the air.
– APU bleed OFF and engine #1 start in the air.
– No bleed leak, unless starting an engine.

ABNORMAL OPERATION

The Engine Bleed #1 will be commanded closed if the cross bleed fails OPEN and the other bleed source is the #2 engine.

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GROUND CONNECTION

A dedicated high pressure Engine Start Ground Connection is available for engine starting and a low pressure Air Conditioned Ground Connection is available for air conditioning.

Both pneumatic ground connection ports are located on the lower section of the fairing area of the airplane.

OVERHEAT DETECTION SYSTEM

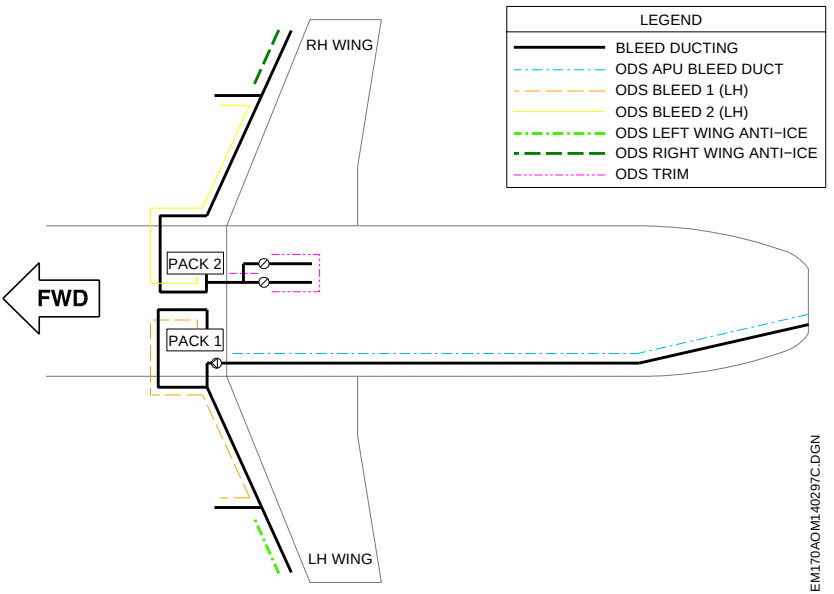
The Overheat Detection System (ODS) consists of overheat sensors and electronic control which provide rapid and reliable overheat and leak detection for the engine bleed, air conditioning ducts, APU bleed air distribution and anti-ice supply ducting.

Normally the overheat sensors use dual loop sensing. In this configuration an overheat is indicated only when both loops detect an overheat condition.

If a single loop fails, the remaining will monitor for an overheat condition (single loop operation).

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BLEED AIR DISTRIBUTION



BLEED AIR DISTRIBUTION AND OVERHEAT DETECTION ZONES

OVERHEAT DETECTION ZONES

ZONE	MONITORED AREA
APU	APU Bleed Duct
LEFT ANTI-ICE	Left slat anti-ice supply ducts
LEFT AIR SUPPLY	Left bleed system ducts and left air conditioning ducts
RIGHT ANTI-ICE	Right slat anti-ice supply ducts
RIGHT AIR SUPPLY	Right bleed system ducts and right air conditioning ducts
OPTIONAL TRIM SYSTEM	Optional trim pressure ducts

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BLEED SOURCE PRIORITIZATION

The AMS controller automaticaly selects the bleed source on ground and during flight between the engines, the APU and the external connections. The selection is based on input from the flight deck control panel, takeoff data setting, engine status, APU status, flow demands, fault status, manifold pressures, and valve position switches.

The AMS controller will choose one bleed source between the APU bleed and the engine bleeds when both are available. It is not possible to have both the APU and the engines as bleed sources simultaneously.

APU AS BLEED SOURCE

While the airplane is on the ground and with an engine and APU bleed available simultaneously, the AMS gives priority to APU supply bleed when all of the following conditions are met:

– The opposite engine bleed pressure is below the minimum for engine start.

– Ground speed is below 50 kt.

– The cross bleed valve is operating normally.

– Wing anti-ice is not requested.

The APU bleed cannot be used for the anti-ice system operation.

During airborne engine start without Anti-Ice the left engine will be started with the opposite engine if the right bleed pressure is greater than the minimum required for engine start. The right engine will be started with the bleed source that is available at engine start (APU or left engine).

ENGINE AS BLEED SOURCE

The AMS gives priority to the Engine supply bleeds when the following conditions are simultaneously met, with the engine and APU bleed available simultaneously:

– Engine bleed is available.

– The XBLEED valve is operating normally.

– ENG REF ECS is selected ON.

During engine start with Anti-ice, the AMS controller will prioritize cross bleed start.

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BLEED SOURCE PRIORITIZATION LOGIC

The following tables describe bleed priority logic until liftoff. The logic considers bleed source availability, takeoff data setting on the MCDU, anti-ice requirements and the flight phase.

The tables show the bleed valve position to identify the bleed source and the air conditioning availability according to the ECS and Anti-ice pre takeoff selection, APU bleed availability and the flight phase.

NOTE: – No selection changes are evaluated.
– Ice conditions are known and pre-selected.
– APU bleed selection is retained untill liftoff.

	MCDU T/O DATASET page Setting and APU bleed availability			
Flight Phase	**ENG REF ECS ON ENG REF AI OFF APU bleed AUTO**	**ENG REF ECS ON ENG REF AI OFF APU bleed OFF**	**ENG REF ECS ON ENG REF AI ALL APU bleed AUTO**	**ENG REF ECS ON ENG REF AI ALL APU bleed OFF**
1st engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart
Taxi single engine	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
2nd engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start

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	MCDU T/O DATASET page Setting and APU bleed availability			
Flight Phase	**ENG REF ECS ON ENG REF AI OFF APU bleed AUTO**	**ENG REF ECS ON ENG REF AI OFF APU bleed OFF**	**ENG REF ECS ON ENG REF AI ALL APU bleed AUTO**	**ENG REF ECS ON ENG REF AI ALL APU bleed OFF**
Taxi with 2 engines	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
Takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON - SAI ON after WSPEED>40kt	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON - SAI ON after WSPEED>40kt
500 ft after takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON

	MCDU T/O DATASET page Setting and APU bleed availability			
Flight Phase	**ENG REF ECS OFF ENG REF AI OFF APU bleed AUTO**	**ENG REF ECS OFF ENG REF AI OFF APU bleed OFF**	**ENG REF ECS OFF ENG REF AI ALL APU bleed AUTO**	**ENG REF ECS OFF ENG REF AI ALL APU bleed OFF**
1st engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: closed - ABV: closed - Bleed Source: GND Cart - PACKS OFF with GND Cart

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	MCDU T/O DATASET page Setting and APU bleed availability			
Flight Phase	**ENG REF ECS OFF ENG REF AI OFF APU bleed AUTO**	**ENG REF ECS OFF ENG REF AI OFF APU bleed OFF**	**ENG REF ECS OFF ENG REF AI ALL APU bleed AUTO**	**ENG REF ECS OFF ENG REF AI ALL APU bleed OFF**
Taxi single engine	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
2nd engine start	- EBV: closed - ABV: open - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: APU - PACKS OFF during eng start	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during eng start
Taxi with 2 engines	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON
Takeoff	- EBV: closed - ABV: open - Bleed Source: APU - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during takeoff - SAI ON after WSPEED>40kt	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS OFF during takeoff - SAI ON after WSPEED>40kt
500 ft after takeoff	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON	- EBV: open - ABV: closed - Bleed Source: ENG - PACKS ON -SAI ON

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ENVIRONMENTAL CONTROL SYSTEM

GENERAL

The Environmental Control System (ECS) provides pressurized and conditioned air for the flight deck and passenger cabin, filtered cabin air recirculation, conditioned air supply for gaspers, fan air cooling for avionics and emergency ram air ventilation for flight deck smoke clearance.

The ECS can also provide cargo bay ventilation. The cargo bay ventilation system is optional.

AIR CONDITIONING PACKS

Two ECS cooling packs are installed in the wing-to-fuselage fairings. The AMS controller sets the bleed airflow to each pack independently, through the respective pack flow control valve (FCV). Each engine normally supplies bleed air to the respective pack. A single pack is capable of keeping adequate cabin/cargo hold pressurization and temperature. Single engine bleed can supply both ECS packs using the cross bleed.

CABIN AIR DISTRIBUTION

During normal operation, pack 1 adjusts the airflow and flight deck temperature according to the CKPT temperature selector knob position. Pack 2 adjusts the airflow to control passenger cabin temperature according to PAX CABIN selector knob position.

SINGLE PACK OPERATING INFORMATION

When operating with a single air conditioning pack, the zone related to the disabled pack will receive air from the operational pack through the mixer. The temperature selector knob associated with the disabled pack will have no effect on the temperature of the disabled pack zone.

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GASPER VENTILATION

The gasper air distribution system provides air to each pilot and passenger position. Air flowing from the mixing manifold through the gasper check valve supplies the gasper ventilation system. When the gasper valve is opened, air from the right recirculation fan supplies the gasper system.

During normal system operation the gasper shutoff valve remains closed. It automatically opens whenever the gasper air supply exceeds 35°C (95°F). This prevents hot air from blowing on the passengers during cabin heating.

TWO-ZONE AIR CONDITIONING CONTROL (TRIM AIR)

The trim air system controls the amount of hot bleed air provided from pack 2 into the mixer for independent control of forward and aft cabin zone temperatures.

RECIRCULATION FANS

Recirculated air from the passenger cabin and cockpit is ducted to the mixing manifold via two recirculation fans located in the pressurized section of the airplane. The recirculation fans draw air from the recirculation bays and impel the air back into the flight deck and cabin distribution system.

The total flow entering the cockpit and the passenger cabin is made up of approximately 52% of fresh air and 48% of recirculation air.

NORMAL OPERATION

Recirculation fans are automatically ON during ground and in flight.

On hot and humid days, with doors opened, the recirculation fans may be switched OFF to avoid fog in the cockpit.

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ABNORMAL OPERATION

The recirculation fans are commanded OFF when:

– Both packs are commanded OFF;

– During on ground, cabin warm-up mode with the APU as bleed source according to a function of ambient temperature and altitude;

– The cargo bay fire signal activates.

– The DUMP button is pressed;

– Smoke is detected in the recirculation bay;

ELECTRONIC COMPARTMENTS VENTILATION

FORWARD ELECTRONIC BAY (E-BAY)

The forward e-bay ventilation consists of three fans, which provide forced cooling air for # 1 Secondary Power Distribution Assembly (SPDA 1), Emergency Integrated Control Center (EICC) and all other avionics located in this e-bay. The fans draw air from the cockpit and expel air toward the underfloor recirculation bay. A flow sensor is used for fan/flow health monitoring.

CENTER ELECTRONIC BAY (E-BAY)

The center e-bay ventilation consists of three fans, which provide forced cooling air for the center e-bay electronics, Left Integrated Control Center (LICC), Right Integrated Control Center (RICC) and SPDA 2. The fans draw air from the rear cabin return and expel it towards the underfloor recirculation bay.

Flow sensors are used for fans/flow health monitoring.

AFT ELECTRONIC BAY (E-BAY)

Forced cooling is not necessary in the aft e-bay and, therefore, no fan is installed in this compartment. Air flowing from passenger cabin provides cooling of the aft e-bay and is expelled towards the underflow recirculation bay.

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EMERGENCY RAM AIR VENTILATION

Emergency ram air ventilation is provided in case of pack shutdown or for smoke removal.

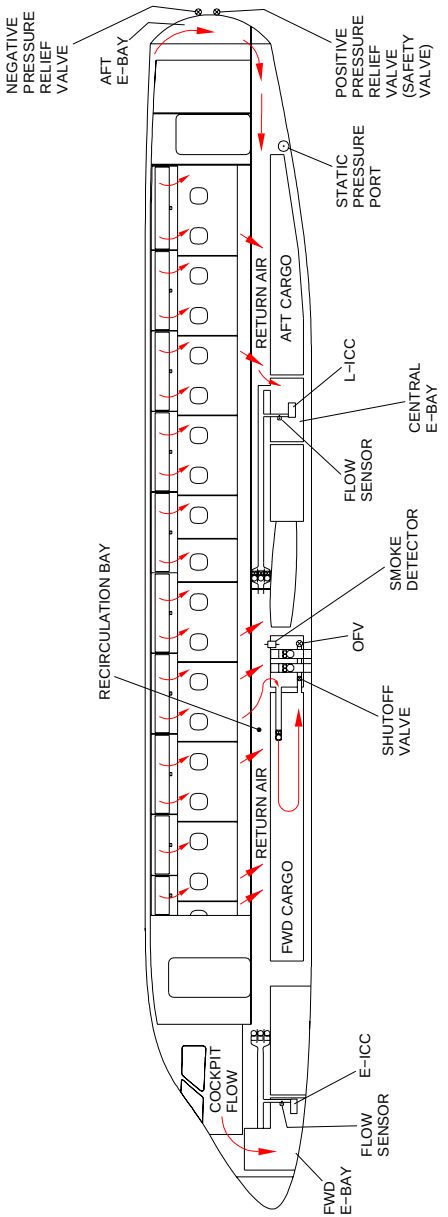
The flight deck pack emergency ram air ventilation valve is commanded OPEN only if both ECS cooling packs are commanded OFF or failed OFF and the plane's altitude is less than 25000 ft.

An emergency ram air ventilation check valve is provided and does not require electronic control. The emergency ram air check valve will be open whenever the pressure in the ram air circuit is greater than cabin pressure.

During smoke removal, both ECS cooling packs will be commanded OFF and therefore, the flight deck emergency ram air ventilation valve will be commanded OPEN.

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ECS DISTRIBUTION



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AMS AUTOMATION

AMS Controller functional logic provides automatic control of engine bleed, APU bleed, ECS packs, Anti-Ice systems, Pressurization and recirculation bay smoke detection according to the airplane's operation and condition.

ECS PACKS LOGIC

The ECS packs 1 or 2 will be CLOSED if any of the following conditions occur:

– A Bleed Air Source is NOT available for the pack.

– The respective Pack button is OFF.

– Any engine is starting and there is weight-on-wheels (both packs close).

– The respective engine is starting, there is no weight-on-wheels and the opposite engine is not starting.

– Any engine is starting AND APU is the bleed source (both packs close).

– Respective bleed system duct leak.

– Respective packs BIT shutdown failures are present (PACK 1(2) FAIL EICAS message displayed).

FADEC ECS OFF SIGNAL

The FADEC may send an ECS OFF signal to the AMS controller, requesting that no bleed is extracted from the engine for the air-conditioning system. The FADEC sets this signal depending on the T/O DATASET input (REF ECS OFF), pressure altitude, flight phase, and engine inoperative detection. The AMS controller disregards the ECS OFF signal when the airplane is above 15000 ft.

The ECS OFF signal CLOSES the packs during takeoff if any of the following conditions occur:

– One engine inoperative and APU bleed is not available;

– Thrust levers set to MAX position and APU bleed is not available;

– T/O DATASET REF ECS set to OFF on the MCDU and APU bleed is not available;

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– T/O DATASET REF ECS set to OFF and T/O DATASET REF A/I set to ALL on the MCDU.

The ECS OFF signal CLOSES both packs during go-around if any of the following conditions occur:

– One engine inoperative and APU bleed is not available up to 9700 ft;

– Thrust levers set to MAX position and APU bleed is not available;

– Thrust levers set to MAX position and Wing Ice Protection System is requested ON.

The packs are recovered if any of the following conditions occur:

– Thrust lever reduction below TO/GA;

– The airplane is taking off with two engines operating 500 ft above takeoff field altitude.

– The airplane is above 9700 ft, for takeoff fields at 8000 ft or below and one engine inoperative;

– The airplane is above 15000 ft, for takeoff fields above 8000 ft and one engine inoperative.

– The airplane is above 9700 ft during go around, in case one engine is inoperative.

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CABIN PRESSURE CONTROL SYSTEM

GENERAL

The Cabin Pressure Control System (CPCS) controls cabin pressurization and provides maximum safety and comfort during every segment of flight and ground operations.

The CPCS operates in automatic and manual modes. Normal operation of the CPCS is automatic.

The system consists of:

- Cabin pressure controller (CPC).
- One cabin outflow valve (OFV).
- One negative pressure relief valve (NPRV).
- One positive pressure relief valve (Safety valve).
- Static Pressure Port.

SYSTEM COMPONENTS

CABIN PRESSURE CONTROLLER (CPC)

The basic function of the controller is to control cabin pressure by commanding the outflow valve to modulate airflow through the valve from the pressurized airplane volume to the surrounding environment.

The CPC has two fully independent automatic channels, which are alternated following each flight.

Both channels provide a manual function as backup, enabling the crew to control cabin pressure by directly actuating the outflow valve (OFV) position.

OUTFLOW VALVE (OFV)

The outflow valve modulates airflow from the pressurized cabin into surrounding environment. It can be modulated automatically or manually.

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NEGATIVE PRESSURE RELIEF VALVE (NPRV)

The negative pressure relief valve is a spring loaded check valve that works without any electrical power, and is independent of the CPCS. Its function is to protect the airplane structure against damages due to a negative differential pressure.

The negative pressure relief valve opens if differential pressure between cabin and surrounding environment exceeds-0.5 psi

POSITIVE PRESSURE RELIEF VALVE (SAFETY VALVE)

The positive pressure relief valve is a spring loaded check valve that works without any electrical power, and is independent the CPCS. Its function is to protect the airplane's structure against damage due to positive overpressure. In case of outflow valve failure, the positive pressure relief valve opens if the pressure differential between cabin and surrounding environment exceeds 8.6 psi.

STATIC PRESSURE PORT

The static pressure port senses the environmental static pressure and mechanically transmits it to the positive pressure relief valve in order to allow the overpressure relief device to work.

The static port is electrically heated to assure there are no obstructions of sensing orifices due to ice accumulation.

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OPERATING MODES

The CPCS can be operated in automatic and manual mode.

AUTOMATIC MODE

The CPCS automatic operation uses different information inputs from the airplane to control the cabin altitude, the differential pressure and the cabin altitude rate of change.

In the automatic mode the information required for the CPCS operation can be retrieved from the FMS or, if the FMS data is not available, it can be manually set by the pilot.

The CPCS internal logic is divided in flight modes to better control the cabin altitude change rate in accordance with the flight phase.

A high altitude takeoff and landing is also supported automatically by the system.

The automatic mode incorporates logic for dumping the airplane pressure with a minimal pilot workload.

AUTOMATIC OPERATION WITH FMS DATA AVAILABLE

The CPCS uses the gross weight, the cruise altitude set by the pilot and the landing field elevation retrieved from the FMS data base to schedule the target cabin altitude and the cabin pressure variation rate.

– LANDING FIELD ELEVATION:
  It is retrieved from the FMS data base after the input of a destination on the active flight plan. In this case the landing field elevation is shown green on EICAS.

– CRUISE ALTITUDE:
  It is set on PERFORMANCE INIT page 3/3 > INIT CRZ ALT. Changing the cruise altitude in flight requires an update on FMS cruise altitude to readjust the pressurization schedule of operation.

– GROSS WEIGHT:
  The airplane gross weight is retrieved after the confirmation of the inputs on the PERFORMANCE INIT page 3/3.

AUTOMATIC OPERATION WITH FMS DATA NOT AVAILABLE

If any FMS data is not available, the CPCS is still capable of automatic operation:

– LANDING FIELD ELEVATION:

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If not available from the FMS data base, LFE must be manually selected on the pressurization panel by the pilot. In this case the landing field elevation is shown in cyan. A default value of 8000 ft is used if no input is made on LFE.

– CRUISE ALTITUDE:
  If it is not possible to enter the cruise altitude on the FMS, the cabin pressure schedule is calculated based on the ambient pressure.

– GROSS WEIGHT:
  If the gross weight is not available from the FMS the CPCS uses a default value to determine the CABIN ALTITUDE RATE OF VARIATION.

DIFFERENTIAL PRESSURE SCHEDULE

Two nominal differential pressures are provided by the CPCS:

– If the FMS cruise flight level is set below 37000 ft the nominal differential pressure of 7.8 psi is used.

– If either the FMS cruise flight level is set higher than 37000 ft or the airplane is actually flying above 37000 ft the nominal differential pressure switches to 8.4 psi.

NOTE: The nominal differential pressure of 7.8 psi was specified in order to reduce fatigue and structural stress during flight. Selecting a cruise altitude in the FMS higher than the actual airplane altitude may unnecessarily stress the airplane structure with a higher differential pressure.

HIGH ALTITUDE OPERATION

The CPCS automatically identifies when the airplane is operating in airports above 8000 ft.

If the operation is at an airport above 9400 ft , the “CABIN ALTITUDE HI” EICAS message trigger point is automatically adjusted to a plus of 500 ft AGL.

There is no special procedure for the high altitude operation.

DUMP FUNCTION

This function is used in the event of emergency evacuation, smoke evacuation or for fast cabin depressurization.

MODE ACTIVATION

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The DUMP function is activated pushing in the DUMP button on the pressurization panel.

SYSTEM OPERATION

The CPCS system automatically:

– Sets the ECS packs and recirculation fans to OFF;

– Controls the OUT FLOW VALVE to maintain the cabin altitude rate of climb at 2000 ft/min up to 12400 ft.

– When the cabin altitude reaches 12400 ft it commands the OUT FLOW VALVE full closed. From this point the cabin altitude rises by natural leak.

If the cabin altitude is above 12400 ft when the dump is activated, the cabin altitude may be rising due to a normal leak. To achieve a higher rate of climb the manual mode can be used.

DUMP MODE DEACTIVATION

Pushing out the DUMP button commands the system back to normal operation opening the ECS packs and turning on the recirculation fan.

MANUAL MODE

MODE ACTIVATION

The manual mode is activated rotating the pressurization mode selector knob to the MAN position. When manual mode is selected, both channels of the CPCS controller revert to standby state, but only one channel performs the manual operation. The channel selection is automatic.

SYSTEM OPERATION

With the pressurization system in manual mode the pilot is responsible to open or close the OUT FLOW VALVE to maintain the desired cabin altitude.

NOTE: In manual mode there is no automatic cabin depressurization on the ground (after landing).

The Dump Function is not available in Manual Mode.

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CPCS FLIGHT MODES

The CPCS automatic mode splits a typical flight into different CPCS flight modes.

Information from engine N2, landing gear status, FADEC, ADC and FMS are used within the cabin pressure controller to determine the current flight mode.

The system calculates a target cabin pressure from the outside pressure, the maximum differential pressure limiter and a corresponding pressure rate of variation data for each of the following CPCS flight modes:

- GROUND;
- TAXI;
- TAKEOFF;
- CLIMB;
- CRUISE;
- DESCENT;
- GROUND;
- ABORT.

The CPCS sequences the flight modes in the order presented here.

During flight mode transitions, or thrust lever transitions, higher rates of pressure change might occur for a few seconds. During these transitions, the cabin pressure rate might be approximately twice as defined at each flight mode, for a maximum of 5 s, but still being under comfort recommendations.

GROUND MODE

MODE ACTIVATION:

– Weight on wheels status on ground and;

– Engines running below the takeoff thrust.

SYSTEM OPERATION

– OFV - is set fully open;

– CABIN PRESSURE - is set to 0.01 psid lower than cabin pressure (causing a permanent command to position the OFV in the fully open position);

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– CABIN ALTITUDE CHANGE RATE - the system internal range is between 500 ft/min and -300 ft/min.

TAXI MODE

MODE ACTIVATION:

This mode is a sequence from the GROUND mode. Starting the engines with the doors closed cause the CPCS to activate momentarily the GROUND mode and switch to TAXI mode.

– Weight on wheels status on ground;

– Doors closed and;

– Engines running at 60% N2 or higher.

SYSTEM OPERATION

During the TAXI mode, the CPCS starts the first pre-pressurization step, increasing the differential pressure.

– CABIN PRESSURE - is set to the ambient pressure plus an offset of 0.11 psid.

– CABIN ALTITUDE CHANGE RATE - the system internal range is ±300 ft/min.

TAKEOFF MODE

MODE ACTIVATION

– Weight on wheels status on ground and;

– Engines running at takeoff thrust.

SYSTEM OPERATION

– CABIN PRESSURE - is set to 0.15 psid above the ambient pressure.

– CABIN ALTITUDE CHANGE RATE - the system internal range is 500 ft/min and -400 ft/min.

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CLIMB MODE

MODE ACTIVATION

– Weight on wheels status in flight.

SYSTEM OPERATION

The Climb mode operation varies depending on the availability of the cruise flight level in the FMS:

- CRUISE FLIGHT LEVEL DATA AVAILABLE IN THE FMS:
  - CABIN ALTITUDE CHANGE RATE - The CPCS calculates the most comfortable rate of climb according to the cruise altitude set in the FMS. The system internal range is +750 ft/min and -600 ft/min.
- CRUISE FLIGHT LEVEL DATA NOT AVAILABLE IN THE FMS:
  - CABIN ALTITUDE CHANGE RATE- The target cabin pressure is calculated depending on the ambient pressure. The system internal range is +750 ft/min and -500 ft/min.

CRUISE MODE

MODE ACTIVATION

The CRUISE mode is set when the airplane reaches the cruise flight level set in the FMS or the airplane stops climbing.

SYSTEM OPERATION

- CABIN PRESSURE
  - If the FMS cruise level is set below 37000 ft the nominal differential pressure is set to 7.8 psid and at 37000 ft the cabin altitude will be 7000 ft.
  - If either the FMS cruise flight level is set higher than 37000 ft or the airplane is actually flying above 37000 ft the nominal differential pressure is set to 8.4 psid. At 37000 ft and above the cabin altitude remains at 8000 ft.

  If no cruise flight level is available on the FMS the target cabin altitude depends on the ambient pressure and the differential pressure from climb mode.

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If the cruise flight level is changed in the FMS to a higher value only the differential pressure varies and the cabin altitude will be held constant.

- CABIN ALTITUDE CHANGE RATE - the system internal range is +500 ft/min and -300 ft/min.

DESCENT MODE

MODE ACTIVATION

The DESCENT mode is set when the airplane starts a descent after CRUISE mode activation.

– CABIN PRESSURE - the target cabin altitude during descent mode is the Landing Field Elevation. It can be automatically retrieved from the FMS data base or manually set by the pilot.

– CABIN ALTITUDE CHANGE RATE - the altitude rate of change depends on the airplane descent rate, cabin pressure, landing field pressure and ambient pressure. The systems internal range is -200 ft/min and -750 ft/min.
If the cabin altitude is below the landing field altitude the increase rate depends on the cabin pressure, landing field pressure and ambient pressure and is calculated within the range of +300 ft/min and +750 ft/min.

ABORT MODE

MODE ACTIVATION

The ABORT mode is set when:

- The airplane stops climbing;
- Cruise mode was not activated;
- Pressure altitude is lower than 10000 ft or,
- Airplane is lower than 5000 ft above takeoff field elevation.

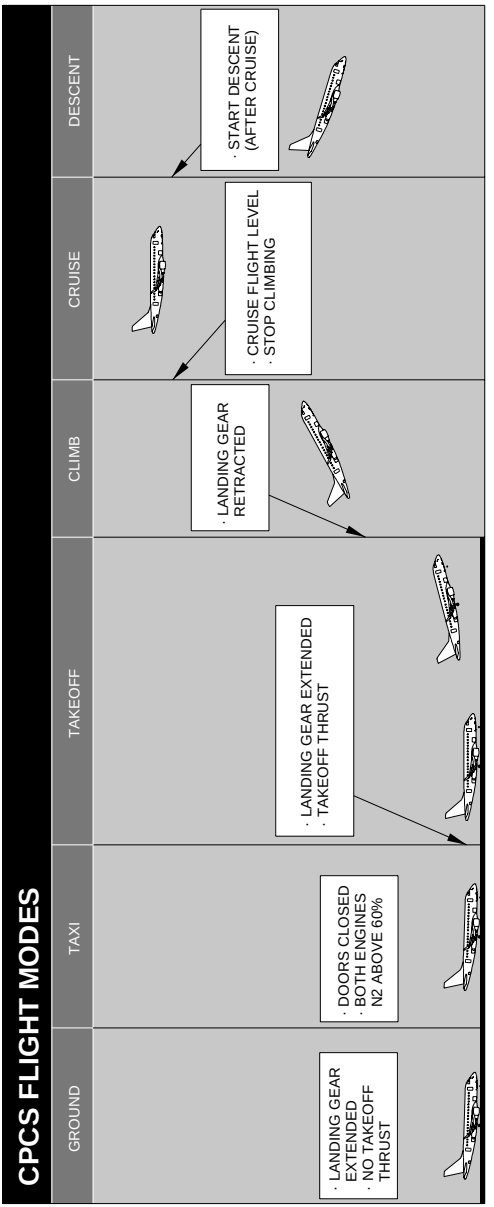
SYSTEM OPERATION

– CABIN PRESSURE - the cabin altitude is scheduled back to the takeoff altitude.

– CABIN ALTITUDE CHANGE RATE - the climb mode is used in reverse direction. The system internal range is +500 ft/min and

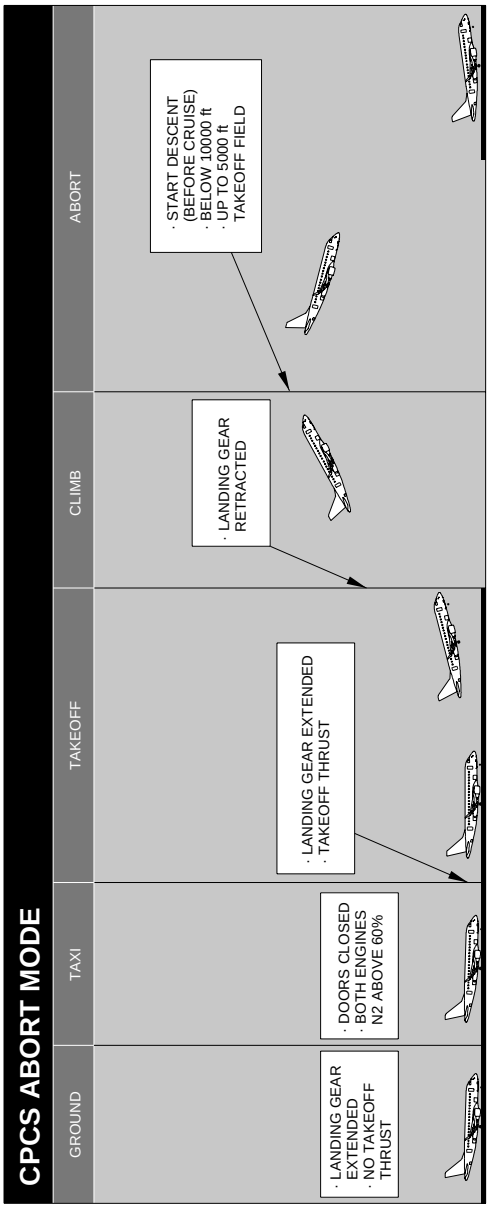
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-600 ft/min.



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EM170AOM140375C.DGN

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	CABIN ALTITUDE HI	Cabin altitude is 9700 ft or higher, or if cabin altitude is higher than +500 ft above LFE for LFE higher than 9400 ft.
CAUTION	AMS CTRL FAIL	Both AMS controller channels have failed. AMS controller is not in control
	BLEED 1 (2) FAIL	A bleed failure has been detected. Bleed is no longer available.
	BLEED 1 (2) LEAK	An overheat condition has been detected at the associated bleed system or pack.
	BLEED APU LEAK	An overheat condition has been detected in the APU bleed or both APU overheat detection system loops have failed.
	BLEED 1 (2) OVERPRESS	An overpressure condition has been detected at the associated bleed system or pack.
	CABIN DIFF PRESS FAIL	Cabin differential pressure is higher than 8.5 psid or lower than -0.3 psid.

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TYPE	MESSAGE	MEANING
CAUTION	CENTER E-BAY FANS FAIL	Center E-BAY fans have failed.
	CRG FWD VENT FAIL	Forward cargo fan has failed ON or if the cargo shutoff valve is failed OPEN associated with smoke detected in the cargo compartment.
	FWD E-BAY FANS FAIL	Forward e-bay fans have failed.
	PACK 1 (2) FAIL	Associated pack is no longer available.
	PACK 2 LEAK	An overheat condition has been detected at the pack 2 optional trim air ducts.
	PRESN AUTO FAIL	Both pressurization controller channels have failed in the automatic mode.
	PRESN MAN FAIL	Both pressurization controller channels have failed in the manual mode.
	RECIRC SMK DET FAIL	Smoke detector has failed.
	RECIRC SMOKE	Smoke has been detected in the recirculation bay.

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TYPE	MESSAGE	MEANING
ADVISORY	AMS CTRL FAULT	One of the two AMS controller channels has failed.
	BLEED 1 (2) OFF	Associated bleed is turned off.
	PACK 1 (2) OFF	Associated pack is off in flight.
	PRESN AUTO FAULT	Loss of automatic mode redundancy. One CPCS controller channel has failed.
	RAM AIR FAULT	Forward emergency ram valve has failed closed.
	XBLEED FAIL	Either bleed isolation valve has failed closed and cross bleed is no longer available, or the bleed isolation valve failed open and engine is the source for the right side bleed (Bleed 2).
	XBLEED SW OFF	Bleed isolation button has been pushed out.
STATUS	BLEED APU VLV OPEN	APU bleed valve is commanded open.

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SECTION 14-03

AUTOMATIC FLIGHT

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GENERAL DESCRIPTION

The Automatic Flight Control System (AFCS) is an integrated system that processes inputs from several airplane systems and sensors. The AFCS supplies this data to the Flight Guidance Control System (FGCS) and Thrust Management System (TMS), thus enabling their operation and producing visual and aural information.

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GUIDANCE PANEL

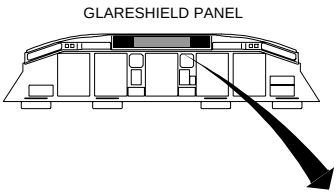
The Guidance Panel (GP) provides means for selecting functions and modes as follows:

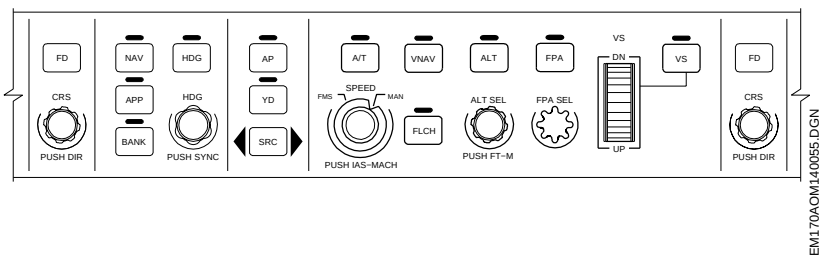
– Lateral Guidance Control.

– AFCS Management Control.

– Vertical Guidance Control.

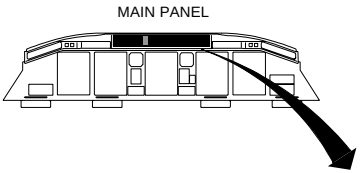
The GP contains two independent channels (A and B), each one providing independent communication to the FGCS.

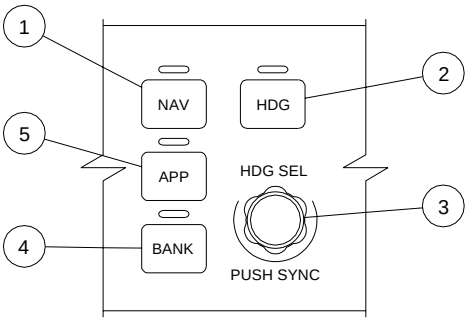




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LATERAL GUIDANCE CONTROLS





EM170AOM140262.DGN

1 - NAV BUTTON

According to the presentation selected for the CDI the NAV Button engages:

– LOC: if the CDI is selected V/L (Green) and the source ILS frequency is tuned.

– LNAV: if the CDI is selected FMS (Magenta).

Pressing NAV with LOC or LNAV engaged reverts the lateral guidance to ROLL.

2 - HDG BUTTON

– Selects and deselects the heading select mode.

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3 - HDG SELECTOR KNOB

- Manually selects the desired heading.
- Pressing this knob synchronizes the heading select to the current heading.

4 - BANK BUTTON

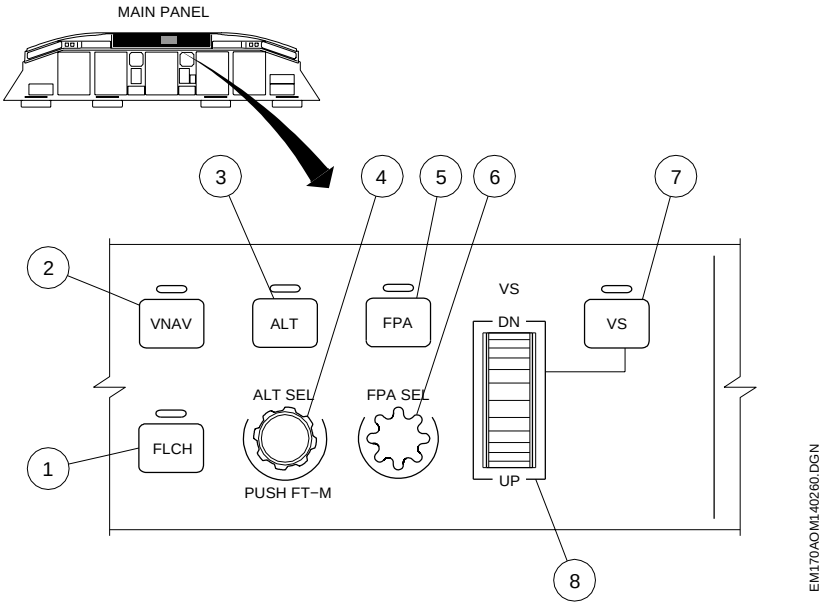
- Enables and disables bank angle limit of 17° used by the Heading Mode.

5 - APP BUTTON

- Activates and deactivates the mode for interception of an ILS.
- The FMA lateral mode annunciation displays the following:
  - LOC: ILS approach mode.
- The FMA vertical mode annunciation displays the following:
  - GS: ILS approach mode.
- The Autopilot Approach Status Annunciator displays the engaged mode.

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VERTICAL GUIDANCE CONTROLS



1 - FLCH BUTTON

– Selects and deselects the Flight Level Change mode.

2 - VNAV BUTTON

– Selects and deselects the VNAV mode (FMS vertical navigation).

3 - ALT BUTTON

– Selects and deselects the altitude holding mode (ALT).

4 - ALT SELECTOR KNOB

– Selects the desired altitude.

  – Clockwise rotation: increases the altitude target.

  – Counter clockwise rotation: decreases the altitude target.

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– Pressing this knob displays the selected altitude in meters in the metric selected altitude readout above the selected altitude readout window on the PFD and displays the actual airplane altitude in meters above the altitude rolling digits readout window on the PFD.

5 - FPA BUTTON

– Selects and deselects the Flight Path Angle mode.

6 - FPA SELECTOR KNOB

– Manually selects the desired Flight Path Angle.

7 - VS BUTTON

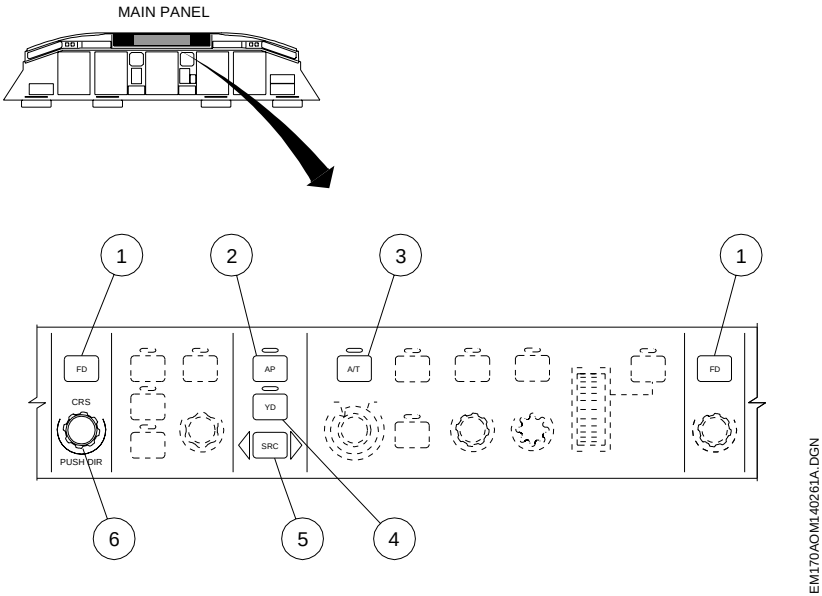
– Selects and deselects the Vertical Speed mode.

8 - VS THUMB WHEEL SELECTOR

– The thumb wheel selector manually selects the desired vertical speed rate.
  – Rolling the wheel upward selects the desired rate of descent.
  – Rolling the wheel downward selects the desired rate of climb.

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AFCS GUIDANCE CONTROLS



1 - FD BUTTON

– Turns ON and OFF the Flight Director presentation on PFD.

– If the AP is engaged it is not possible to turn off the FD presentation on the PFD being used as source for the AP.

►*Airplanes Pre-Mod MAU load 23.1*

NOTE: This button does not engage nor disengage any Flight Director Mode.

◄

►*MAU load 23.1 and on*

NOTE: Pressing the FD button on the coupled side with AP disengaged, the Flight Director Modes are disengaged.

◄

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2 - AP BUTTON

– Engages or disengages the Autopilot.

3 - A/T BUTTON

– Engages or disengages the Autothrottle.

4 - YD BUTTON

– Engages or disengages the Yaw Damper/Turn Coordination function.

5 - SRC BUTTON

– Alternates between the lefthand or righthand FMA modes as source for the autopilot. A green arrowhead on the FMA indicates the respective source selected.

6 - CRS BUTTON

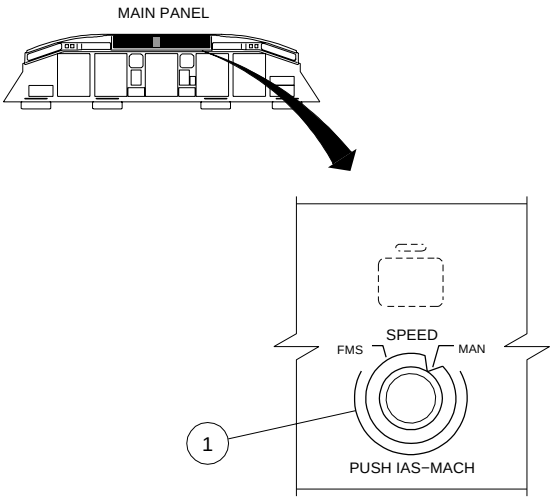
– Manually sets the desired course on CDI as described below:

  – CDI displaying FMS: sets preview course.

  – CDI displaying V/L: sets CDI course.

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SPEED AND MODE CONTROLS



EM170AOM140259.DGN

1 - SPEED SELECTOR KNOB

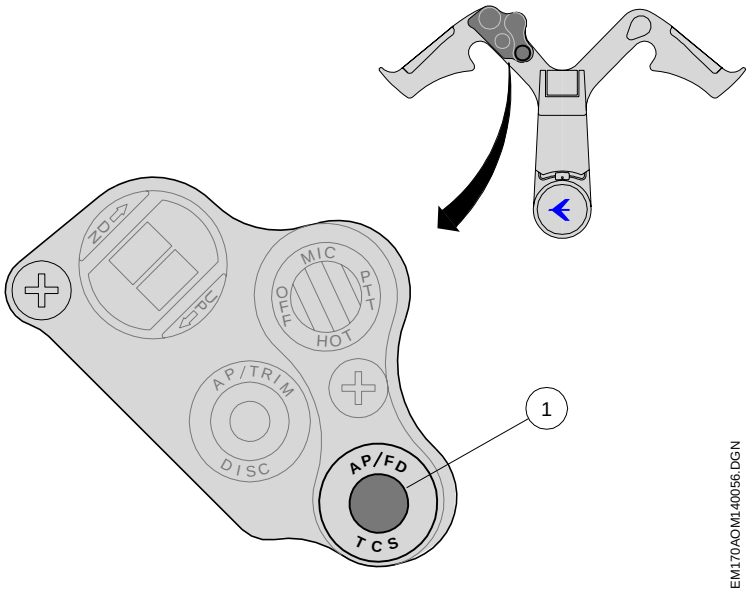
FMS: Selected airspeed readout is controlled by the FMS logic.

MAN: Selected airspeed readout is controlled manually.

– Pressing this knob alternates the speed presentation on PFD selected airspeed readout window between IAS and MACH.

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AUTOPILOT/FD TCS BUTTON



1 - TOUCH CONTROL STEERING BUTTON (TCS)

The AP/FD button has authority over the autopilot and flight director.

Flight director interface with the AP/FD button:

– Press and Hold the TCS:

  – Synchronizes the Flight Director with the current airplane attitude.

– Release the TCS:

  – The Flight Director returns to the lateral and vertical selection when the TCS was pressed.

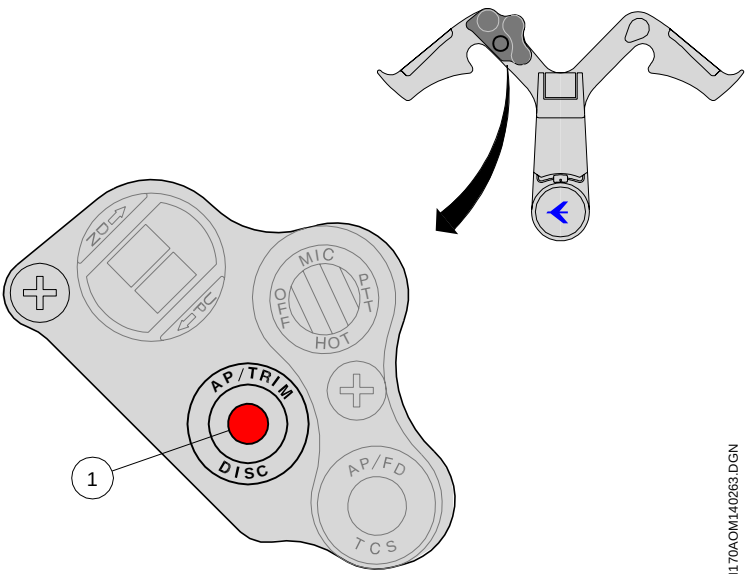
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– With Roll/VS/FPA modes the FD maintains the airplane attitude when the TCS is released.

Autopilot interface with the AP/FD button:

If the AP is engaged, pressing and holding the TCS will momentarily override the AP. Releasing the TCS, the AP resumes airplane control.

AUTOPILOT QUICK DISCONNECT BUTTON



1 - AP/TRIM DISCONNECT BUTTON

Autopilot

– Normal means of disengaging the autopilot.

– Pressing once disengages the Autopilot.

– Second press cancels the Autopilot aural alarm and FMA AP Warning.

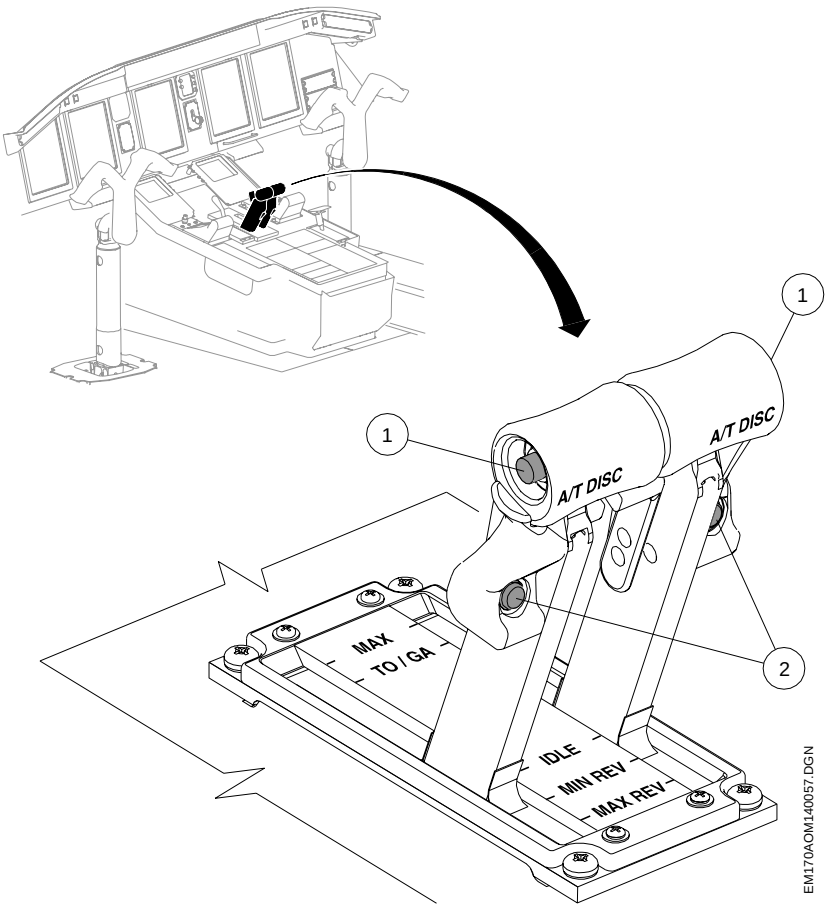
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Trim

– Refer to Flight Control.

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AUTOTHROTTLE DISCONNECT AND GO AROUND BUTTONS



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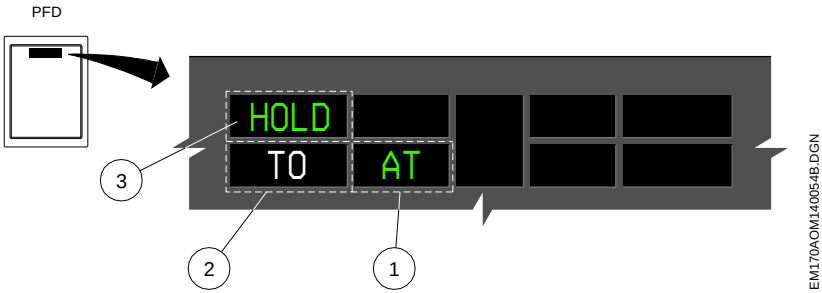
1 - AUTOTHROTTLE DISCONNECT BUTTON

– Disengages the autothrottles.

2 - TAKEOFF AND GO AROUND BUTTON

– Selects the TO, GA or Windshear Flight Director Modes.

AUTOTHROTTLE INDICATIONS ON FLIGHT MODE ANNUNCIATIONS



The AT mode labels displayed on Flight Mode Annunciator FMA are the following:

– SPD_T

– SPD_E

– TO

– GA

– HOLD

– LIM

– OVRD

– RETD

1 - AUTOTHROTTLE ENGAGEMENT ANNUNCIATION

– Color:

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GREEN: Autothrottle engaged.

AMBER: Autothrottle failed.

2 - AUTOTHROTTLE ARMED MODE

– Color: WHITE.

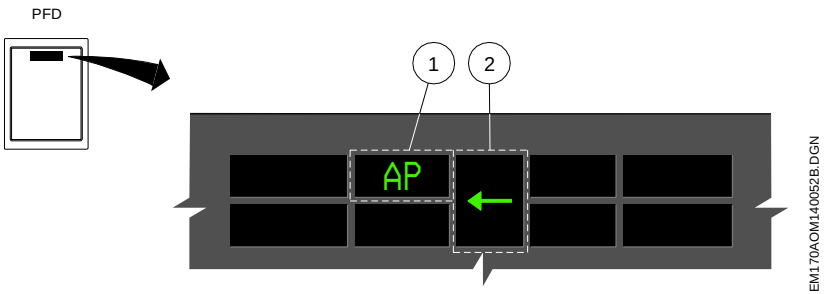
3 - AUTOTHROTTLE ACTIVE MODE

– Color:

GREEN: Autothrottle active mode.

AMBER: LIM is displayed to indicate that vertical speed and target speed are incompatible with thrust rating available.

AUTOPILOT INDICATIONS ON FMA



1 - AUTOPILOT ENGAGED ANNUNCIATION

– Color:

GREEN: Autopilot engaged.

RED: Autopilot failed.

2 - FLIGHT DIRECTOR SOURCE ANNUNCIATOR

– A green arrow indicated the selected AFCS source.

NOTE: Mode annunciation is removed if Flight Director fails.

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LATERAL MODE INDICATIONS ON FMA



The lateral mode labels displayed on FMA are the following:

– ROLL (Green)
– HDG (Green)
– NAV (Magenta)
– LOC (Green)
– BC (Green)
– TRACK (Green)

1 - FGCS LATERAL ACTIVE MODE

– Color:

GREEN: manually commanded on the GP.

MAGENTA: FMS commanded.

2 - FGCS LATERAL ARMED MODE

– Color: WHITE.

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VERTICAL MODE INDICATIONS ON FMA



The vertical mode labels displayed on FMA are the following:

– ALT (Green or magenta)
– ASEL (Green or magenta)
– FLCH (Green or magenta)
– FPA (Green)
– GA (Green)
– GS (Green)
– OVSP (Green)
– TO (Green)
– GP (Magenta)
– PTH (Magenta)
– VS (Green)
– WSHR (Green)

1 - FGCS VERTICAL ACTIVE MODE

– Color:

GREEN: manually commanded on the GP.

MAGENTA: FMS commanded.

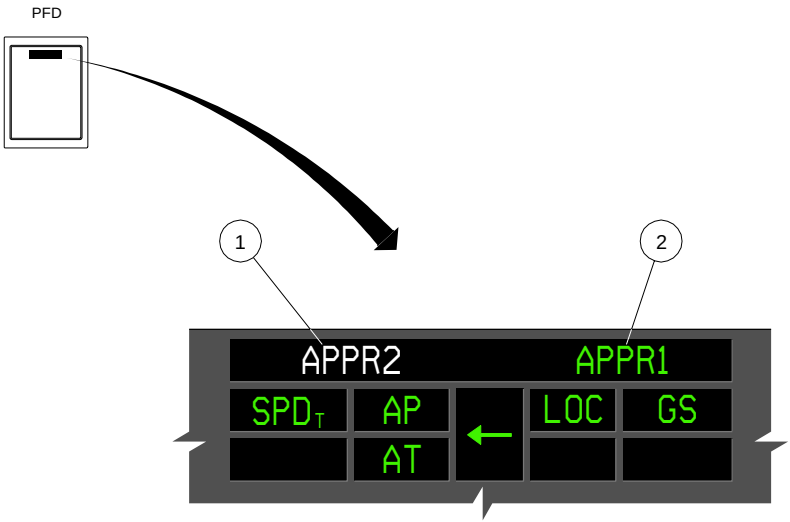
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2 - FGCS VERTICAL ARMED MODE

– Color: WHITE.

NOTE: In event of AFCS fails the respective mode annunciation is removed.

AUTOPILOT APPROACH STATUS ANNUNCIATOR



The autopilot approach labels displayed are the following:

– APPR 2
– APPR 1
– APPR 1 ONLY

1 - ARMED STATUS

– Color:

WHITE: Approach mode is armed.

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AMBER: Alert condition.

RED: Warning condition.

2 - ENGAGED STATUS

– Color:

GREEN: Approach mode is engaged.

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AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The Automatic Flight Control System (AFCS) provides flight guidance to the PFD Display and the Autopilot.

The AFCS includes:

– Flight Director (FD);

– Autopilot (AP) with coupled Go-Around (GA) and

– Yaw Damper (YD).

FLIGHT DIRECTOR (FD)

The flight director provides lateral and vertical guidance on both PFD's from the FMS commands and through pilot selections on the guidance panel.

FLIGHT DIRECTOR PRESENTATION

A magenta diamond displayed on the Primary Flight Display (PFD) represents the FD.

REMOVAL OF FLIGHT DIRECTOR PRESENTATION

Pressing the FD button on the display control panel removes the flight director presentation on the PFD under the following conditions:

– AP engaged: the Flight Director presentation can be removed by pressing the FD button on the non-coupled display control panel side.
  On the coupled side it is not possible to remove the FD from the PFD.

– AP disengaged: the Flight Director presentation can be removed from both PFD's by pressing the FD button on the respective display control panel.

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FLIGHT DIRECTOR MODES ACTIVATION

The FD automatically turns on under the following conditions:

– TO/GA button actuation or;

– Manual selection of any vertical or lateral mode or;

– Autopilot engagement or;

– Windshear detection.

FLIGHT DIRECTOR MODES DE-ACTIVATION

►*Airplanes Pre-Mod MAU load 23.1*

Pressing the FD button does not deactivate the current lateral and vertical modes.

◄

►*MAU load 23.1 and on*

Pressing the FD button on the coupled side with AP disengaged, the Flight Director Modes are disengaged (FD cue is removed from both PFDs, FD modes are removed from both FMAs and AT mode changes to SPDt tracking the airspeed target).

◄

To turn off the flight director, press the FPA button on the guidance panel when the active vertical mode is FPA.

If any other vertical mode is active, press FPA button once to activate the FPA mode and then press it again to turn off the Flight Director.

AUTOPILOT (AP)

The E-JETS have a single autopilot with a dual channel configuration.

One channel is active while the other works as a hot spare.

The system alternates the channel automatically in case of a failure of the active channel and also after each landing.

The autopilot has one servo for pitch control, one for roll control and one or two optionally for rudder control.

As the AP servos are connected to the controls, the AP commands may be observed by the movement of the control column, control wheel or rudder to keep pilots aware of any AP input.

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AP ENGAGEMENT/DISENGAGEMENT

ENGAGEMENT

Autopilot engagement is inhibited on the ground.

In flight the autopilot is engaged pushing the AP button on the guidance panel. The AP engagement is verified on the FMA on both PFD′s.

With the confirmation of the AP label on the FMA the autopilot is controlling the airplane pitch, roll and yaw according to the flight director selections.

DISENGAGEMENT

NORMAL DISENGAGEMENT

The autopilot is normally disengaged by pressing the quick disconnect PB on either control wheel.

Pressing the button once:

– Disengages the autopilot;

– Triggers the aural warning “AUTOPILOT”;

– The FMA “AP” annunciation blinks in red.

Pressing the button the second time cancels the aural warning and the FMA annunciation.

The autopilot may be momentarily overriden by pressing the TCS button on the control wheel. Releasing the TCS, the autopilot resumes airplane control.

NON-NORMAL DISENGAGEMENT

The autopilot also disengages if one of the following conditions occurs:

– AP button is pressed on the guidance panel;

– Either manual pitch trim switch is actuated;

– Either stick shaker is activated.

– Windshear escape guidance is activated.

ABNORMAL DISENGAGEMENT

The following events cause an autopilot disconnect and EICAS message:

– Reversion of the fly-by-wire system to direct mode.

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– Either the aileron or elevator control system is disconnected.

– A pilot input contrary to the autopilot is made on the controls with a long time light force or a short time stronger force.

– Internal monitor failure.

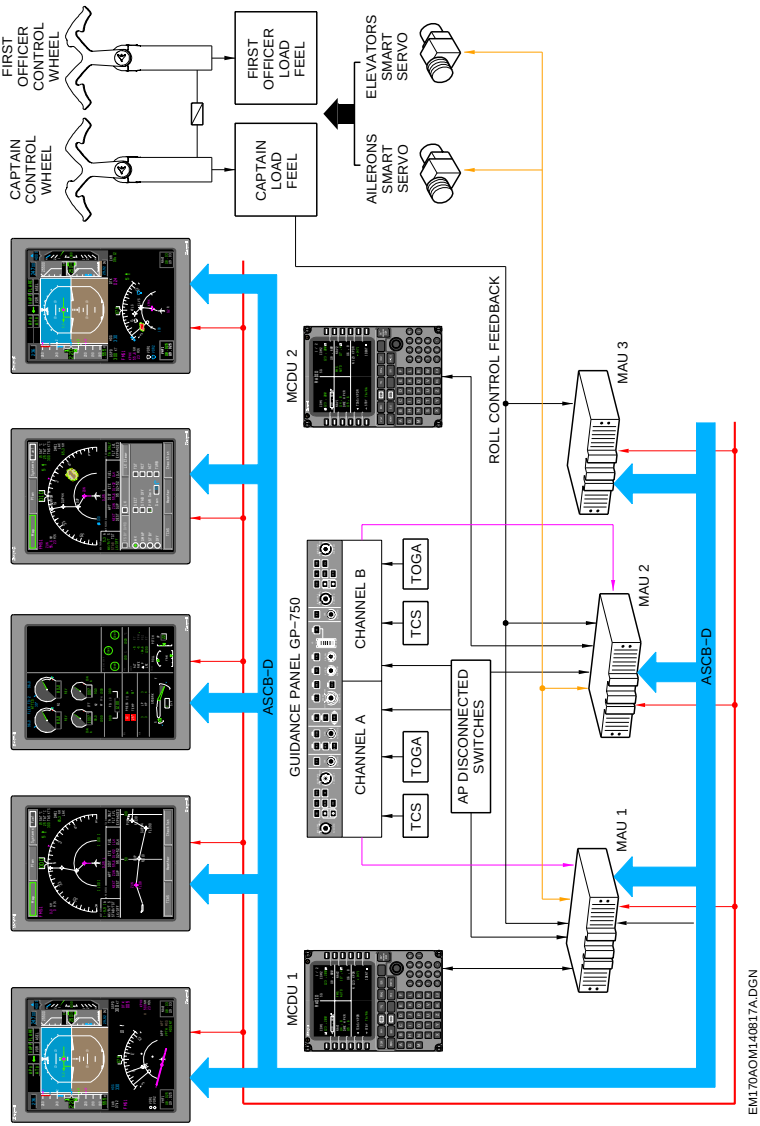
After Non-Normal or Abnormal Disengagement, pressing either AP disconnect button once cancels the flashing “AP” on the FMA and silences the aural alarm.

NOTE: AP disengagement by application of force on control column, through the forward and after movement, and control wheel, lateral movement, is indicated in red on FMA. The AP disengagement by application of force only on control wheel may be indicated in red on FMA and AP FAIL message may be displayed on the EICAS.

YAW DAMPER

The yaw damper automatically engages on AP engagement, although the yaw damper can be engaged or disengaged independently of the AP status.

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AFCS INDICATIONS ON PFD

FLIGHT MODE ANNUNCIATION (FMA)

The Flight Mode Annunciation FMA is displayed on the top of PFD. The FMA displays indications of autothrottle, autopilot, flight director source for the autopilot, lateral and vertical modes.

The FMA color code for normal operation is as follows:

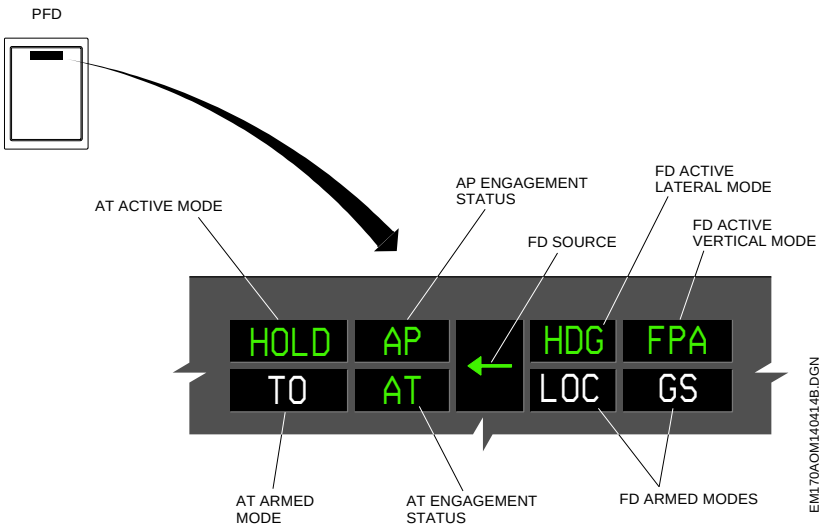
– Magenta: FMS commanded active/engaged mode.

– Green: Non-FMS commanded active/engaged mode.

– White: Armed mode.

– Amber: Alert condition.

– Red: Abnormal condition.



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AUTOPILOT APPROACH STATUS ANNUNCIATOR

Autopilot Approach Status Annunciator is displayed at the top of the FMA upon pressing the APP button on the guidance panel.

Left side of the annunciator displays either the armed status (white) or a discrepancy (amber) and on the right side the current engaged status (green).

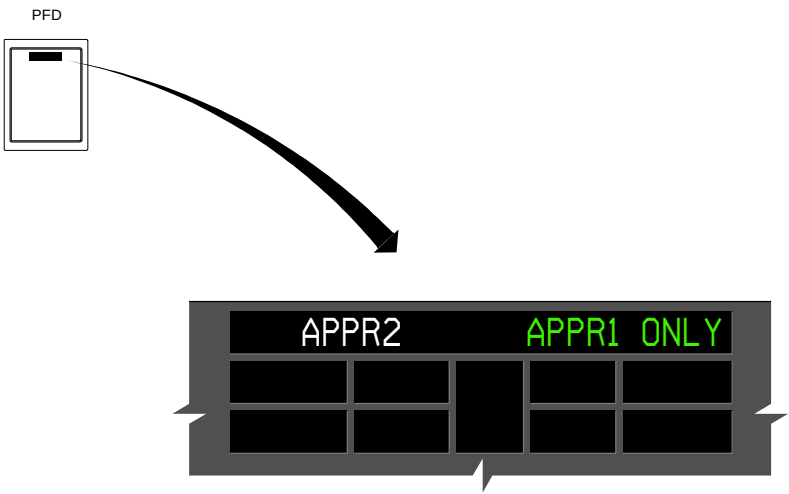
The BARO/RA window on the PFD 1 and on the PFD 2 must be on the same selection (BARO-BARO or RA-RA). If there is a discrepancy the BARO/RA window on the side selected to RA will flash amber.

The system will not indicate discrepancy in selected values between PFD 1 and PFD 2.

The terminology used for the system capability levels are:

– APPROACH 2 (APPR 2) – ILS CAT II capable.

– APPROACH 1 (APPR 1) – ILS CAT I capable.



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FGCS LATERAL MODES

The FGCS pilot selectable lateral navigation modes are:

– Roll Hold (ROLL).
– Heading Select (HDG).
– Lateral Navigation (LNAV).
– Localizer (LOC).
– Back-course (BC).

Pilot non-selectable mode is:

– Track Hold (TRACK).

ROLL HOLD (ROLL)

This is the basic lateral mode and does not provide any airplane guidance.

Depending on the airplane bank angle at the moment of ROLL activation, the autopilot will maintain the following bank angles until another lateral mode is selected:

– Bank angle at 6° or below: AP levels the wings.
– Bank angle above 6° and below 35°: AP holds present bank angle.
– Bank angle at 35° or above: AP maintains bank angle at 35°.

ROLL MODE ACTIVATION:

The ROLL Mode is activated under any of the following conditions:

– Pressing TOGA button while on the ground and IAS is below 100 kt;
– There is no lateral mode active and a vertical mode is selected;
– Deselecting an active lateral mode;
– COURSE TO INTERCEPT on the FMS is activated.

ROLL MODE DE-ACTIVATION:

– The ROLL Mode is de-activated when another lateral mode becomes active.

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HEADING SELECT (HDG)

This mode provides airplane lateral guidance through the HDG SEL knob.

Pressing the center of the HDG selector knob synchronizes the heading bug to the current heading.

The FD follows the selected heading and respects the direction in which the turn on the HDG SEL knob was commanded, regardless if the turn being commanded is greater than 180°.

HDG MODE ACTIVATION

– HDG button is pressed on the Guidance Panel.

HDG MODE DE-ACTIVATION

– HDG button is pressed on the Guidance Panel.

– When another lateral mode becomes active.

LATERAL NAVIGATION (LNAV)

The LNAV mode is selected by pressing the NAV button on the GP.

The FMS becomes the source for lateral navigation providing guidance through the Flight Director.

LOCALIZER (LOC)

The LOC mode is selected via the APP button on the GP.

The FD automatically manages the LOC and Back-Course according to Localizer frequency, PFD information and airplane's position.

The FD is capable of intercepting the LOC when there is no GS signal. Other vertical navigation modes such as FPA or VS can be used for vertical navigation.

The FD opens the bank angle command limit to 35° during Localizer capture.

BACK-COURSE (BC)

The FD will automatically select a BC approach on the PFD.

The FGCS provides commands for capture and tracking of BC localizer indicated on the selected PFD.

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TRACK HOLD (TRACK)

The track select mode is used to intercept and maintain an inertial derived airplane track from the IRS. This mode is used for Takeoff and Go-Around.

TAKEOFF

The automatic transition from ROLL to TRACK during takeoff occurs when:

– IAS is greater than 100 kt and;

– Bank angle is at 3° or below for more than 10 s.

GO AROUND

TRACK ACTIVATION

– TOGA button is pressed for go-around.

TRACK DE-ACTIVATION

– Another lateral mode is selected.

Canceling the vertical mode of GA does not disengage the TRACK lateral mode.

FGCS VERTICAL MODES

The FGCS vertical navigation modes are:

– Flight Path Angle (FPA).
– Takeoff (TO).
– Altitude Select (ASEL).
– Flight Level Change (FLCH).
– Altitude Hold (ALT).
– Vertical Speed (VS).
– Vertical Navigation (VNAV).
– Overspeed (OVSP).
– Glide Slope (GS).
– Go around (GA).
– VGP (VGP).

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FLIGHT PATH ANGLE (FPA)

The FPA is the basic vertical mode (except for the TO).

The FPA can be used for vertical navigation by selecting a higher or lower altitude on the ALTSEL and then pressing the FPA button.

The flight path reference line (FPR) is displayed when the FPA is active. Pressing the FPR button in the display controller panel displays the FPR line, regardless of vertical mode active.

Flight path angle (± 9.9°) is selected in the FPA SEL selector knob on the guidance panel.

FPA ACTIVATION:

– When the autopilot is engaged and no FD mode is active;

– Pressing the FPA button on the guidance panel.

– A lateral mode is activated and there is no vertical mode active.

– Deselecting the current vertical mode.

TAKEOFF (TO)

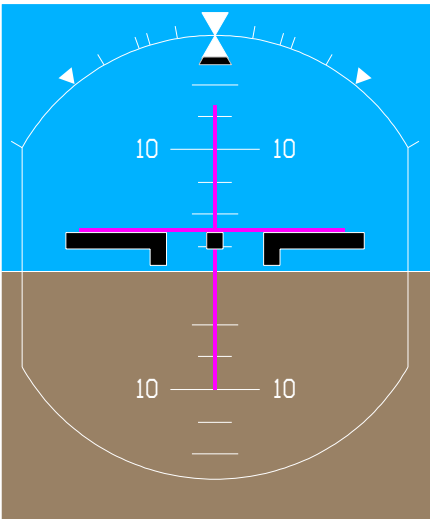
►*MAU load 4.5 and on AND previous than load 19.3 OR SB 0190-31-0007 AND PRE-MOD SB 0190-31-0009;*

The takeoff mode is a FD only mode and is represented by crossbars on PFD. TO mode commands the airplane to maintain a pitch attitude reference. In takeoff the autopilot engagement is not accept and FPA mode is inhibited. Lateral mode changes are allowed.

FPA indication (green symbol on the ADI) is inhibited for 30 s after lift-off when taking off with flight director OFF (no active mode on the FD).

Pressing the TOGA button activates the TO mode. Following a landing, the TO mode can be enabled after 5 seconds on ground (main gear weight on wheels).

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PFD TAKEOFF MODE CROSSBAR

The TO mode is deactivated when:

– Another vertical mode is selected.

– AP/FD TCS button is pressed.

– AP is activated.

The TO mode first guidance is the flap-pitch based guidance:

– FLAP 1 – pitch 11º.

– FLAP 2 – pitch 10º.

– FLAP 4 – pitch 12º.

When airborne and IAS is greater than speed target, the guidance will be speed target according to the following:

– All engines operating: V2 + 10 kt.

– One engine inoperative:

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– Engine failure below V2: guides V2.

– Engine failure between V2 and V2 + 10 kt: guides present speed.

– Engine failure above V2 + 10 kt: guides V2 + 10 kt.

The V2 is inserted on the MCDU (PERF > PERF INDEX > PERF DATA > TAKEOFF 3/3).

If speed target is not valid, the airplane guides to a fixed pitch according to the flaps in use.

In TO mode the pitch is limited to a minimum of 8° and a maximum of 18°. The maximum speed target is Vfe - 5 kt and minimum speed target is Vshaker + 10 kt for all engines operating. For one engine inoperative the minimum speed target is Vshaker + 3 kt.

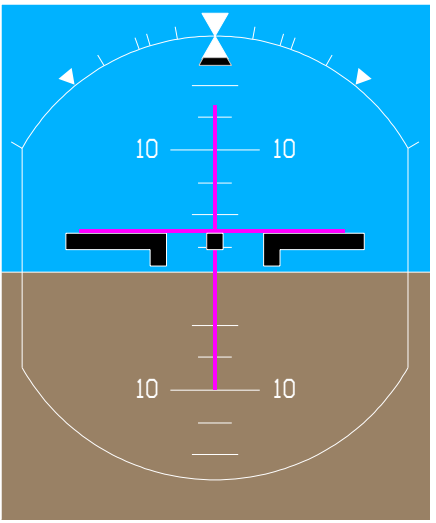
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TAKEOFF (TO)

▶*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

The takeoff mode is represented by crossbars and is used during the takeoff phase to maintain a pitch attitude based on flap selection, airplane weight and V2 speed.



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PFD TAKEOFF MODE CROSSBAR

TO MODE ACTIVATION

– TOGA button is pressed on ground.

TO MODE DE-ACTIVATION

– When another vertical mode is selected.

– If the AP is engaged TO mode is cancelled and FPA becomes the active vertical mode.

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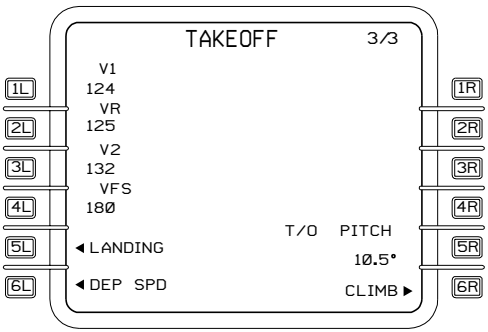
TO PITCH ANGLE CALCULATION

To calculate the TO pitch angle the FMS uses the actual airplane weight and the following information inserted in the MCDU TAKE OFF page:

– Flap position (page 2/3).

– V2 speed (page 3/3).

TO pitch will be dashed if necessary information is not inserted.



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TO PITCH ANGLE LOGIC

The system will guide the Pitch initially to the calculated angle. When airborne and IAS is greater than speed target, the guidance will be as follows:

– All engines operating: V2 + 10 kt.

– One engine inoperative:

  – Engine failure below V2: guides V2.

  – Engine failure between V2 and V2 + 10 kt: guides present speed.

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– Engine failure above V2 + 10 kt: guides V2 + 10 kt.

In TO mode the pitch is limited to a minimum of 8° and a maximum of 18°. The maximum speed target is Vfe - 5 kt and minimum speed target is Vshaker + 10 kt for all engines operating. For one engine inoperative the minimum speed target is Vshaker + 3 kt.

NOTE: If actual flap selection does not agree with FMS selection, the aural warning “NO TAKE OFF FLAPS” will be triggered whenever the airplane is on ground and take off thrust is applied or Take off configuration button is pressed.

◄

ALTITUDE SELECT (ASEL)

The altitude select mode captures and levels off at the selected altitude. A green ASEL is displayed on the FMA while altitude select mode captures the pre-selected altitude, followed by a green ALT display when level off at the selected altitude.

NOTE: Altitude select is automatically armed whenever a vertical FD mode is used to fly towards the desired altitude.

FLIGHT LEVEL CHANGE (FLCH)

FLCH provides commands to Climb or Descend to the altitude selected (ALTSEL) according to the speed selected.

During FLCH the speed selected will be controlled via pitch changes through elevator inputs, and the FMA will show SPD_E.

FLCH ACTIVATION:

– Pressing the FLCH button.

FLCH DE-ACTIVATION:

– Pressing the FLCH button.

– When another vertical mode is selected.

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FLCH LOGIC:

The FLCH mode can be FMS (magenta) or non-FMS (green).

During a FLCH descent, selecting an altitude above the current airplane altitude will command the airplane to climb. The airplane will not reach the altitude selected if AT is disengaged and sufficient thrust to climb is not available.

During a climb, selecting an altitude below the current airplane altitude will command the airplane to descend. The rate of descent is a result of the amount of engine thrust being used.

TRANSITION FROM MACH / IAS

The selected speed is displayed in the box on the top of the speed tape. When the altitude is approximately to 29000 ft the display switches from IAS to Mach readout during climb and from Mach to IAS readout during descent.

ALTITUDE HOLD (ALT)

The ALT mode indication on the FMA indicates the altitude hold mode and the altitude selected is being maintained.

ALT MODE DISENGAGEMENT:

The ALT mode can be disengaged by selecting a different altitude via ALTSEL knob and activating a new vertical mode.

This logic is valid for all vertical modes except for Glide Slope (GS) and VGP. Switching from ALT mode to GS or VGP mode occurs without change in ALT SEL selection.

ALTITUDE HOLD BUTTON (ALT)

Pressing the ALT button on the GP engages the altitude hold mode. The altitude hold mode maintains the altitude displayed on the Altimeter at the moment the ALT button is pressed.

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VERTICAL SPEED (VS)

The VS mode maintains a vertical speed rate. The VS mode is activated by pressing the VS button on the GP. Vertical speed is selected rotating the vertical speed thumbwheel on the GP.

The vertical speed command range goes from -8000 ft/min to +6000 ft/min.

The increments of the Vertical Speed target value are: 50 ft/min (below 1000 ft) and 100 ft/min (above 1000 ft).

OVERSPEED PROTECTION (OVSP)

The FD provides overspeed detection and protection through pitch variation in order to maintain the speed below V_{mo}/M_{mo} limits.

When the autopilot is engaged, pitch and/or thrust will be adjusted to prevent overspeed.

When the autopilot is disengaged only aural warning (“OVERSPEED”) will be triggered requiring pilot input to avoid overspeeds.

When the OVSP protection activates, an amber OVSP indication displays on the FMA. The previous active mode is displayed as armed (white) and becomes active again when OVSP protection is no longer active.

GLIDE SLOPE (GS)

The GS approach mode allows the ILS approach mode functions. The GS mode arms when the APP button is pressed and activates when the glide slope is captured.

GO-AROUND (GA)

The go-around mode automatically provides go-around guidance and thrust by pressing the TOGA switch. The TRACK HOLD mode is engaged when TOGA is pressed.

GA MODE ACTIVATION:

– Pressing TOGA switch when inflight.

GA MODE DE-ACTIVATION:

– When another vertical mode is selected.

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GA LOGIC:

The GA mode first guidance sets pitch at 8°.

When IAS is greater than the speed target, the guidance will be the speed target according to the following:

– All engines operating: V_{REF} + 20 kt.

– One engine inoperative: V_{AC} (approach climb).

The V_{REF} and V_{AC} are inserted on the MCDU (PERF > LANDING 3/3).

If speed target is not valid, the airplane guides to pitch 8°.

In GA mode the pitch is limited to a minimum of 8° and a maximum of 18°. The maximum speed target is Vfe - 5 kt and minimum speed target is Vshaker + 10 kt for all engines operating. For one engine inoperative the minimum speed target is Vshaker + 3 kt.

WINDSHEAR (WSHR)

This mode provides FD escape guidance in case of Windshear detection below 1500 ft AGL.

The system provides flight path guidance angle limited to stick shaker, commands wings level and provides aural alerts.

The label “WSHR” is displayed when the Windshear Guidance mode is activated.

The autopilot is disengaged when the Windshear Guidance mode becomes active.

Windshear alerts are associated with vertical winds and rapidly changing horizontal winds and are divided as follows:

WINDSHEAR CAUTION:

– Associated with increasing head wind and severe up drafts. A detection of a caution level Windshear is indicated by amber WSHR on the PFD and aural alert “CAUTION WINDSHEAR”.

WINDSHEAR WARNING:

– Associated with decreasing head wind (or increasing tail wind) and severe vertical down drafts. A detection of a warning level Windshear is indicated by a red WSHR on the PFD and aural alert “WINDSHEAR, WINDSHEAR, WINDSHEAR”.

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WINDSHEAR GUIDANCE MODE ACTIVATION:

– Windshear warning or caution condition is detected and TOGA switch is pressed.

– Windshear Warning condition is detected and thrust lever is set to TO/GA position.

– Automatically when windshear warning condition is detected and the FD mode is in TO or GA.

A green WSHR annunciation is displayed on the FMA when the Windshear guidance mode is activated.

VERTICAL NAVIGATION (VNAV)

The VNAV engages when:

– VNAV mode is armed, VNAV will automatically engage when passing through 400 ft during a climb.

– The airplane is above 400 ft and the VNAV button is pressed.

According to the required vertical profile the VNAV automatically selects its sub-modes.

VARM SUB-MODE

When VNAV is selected on the GP, the initial mode is VARM. The FMS remains in VARM mode until the appropriate vertical mode to be used is determined.

While in the VARM mode the previous AFCS vertical mode remains engaged.

VFLCH SUB-MODE

VFLCH is VNAV Flight Level Change and can be automatically selected by the FMS or manually by the flight crew for climb or descent.

During climbs the VNAV sub mode will always be VFLCH.

VFLCH engages when the Alt Selector is set to an altitude different than the current airplane altitude, VNAV is engaged and the FLCH button is pressed.

VASEL SUB-MODE

VASEL is the VNAV altitude capture mode. It captures the Alt Selector altitude or the FMS waypoint altitude constraint.

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VALT SUB-MODE

Maintains the altitude commanded by the FMS or the Alt Selector.

VGP SUB-MODE

The VNAV Glide Path (VGP) mode is an FMS based non-precision approach mode created to provide a constant final approach descent path. In this mode, the FMS flies a constant glide path approach from the Final Approach Fix (FAF) to the Missed Approach Point (MAP) regardless the Alt Selector altitude which may be set to the missed approach altitude.

►*Airplanes Pre-mod MAU load 21.4*

Temperature compensation calculated by the FMS does not compensate for VNAV temperature deviations to follow the desired geometric glide path when performing VGP approaches. Thus, if the outside air temperature is above ISA, the VGP flight path is higher than the geometric glide path and, if the outside air temperature is below ISA, the VGP flight path is lower.

◄

VGP ACTIVATION

The VGP mode can be armed by pressing the APP button on the Guidance Panel when within 30 nm radial distance from the FAF, and a non-localizer based approach with a published constant glide path angle is selected in the FMS. The VGP mode is engaged when the airplane is within 5 NM from the FAF along track distance or at any distance within 30 NM from the destination whenever using ACTIVATE VECTORS and the first approach waypoint is the FAF. The VGP does not engage if any change in the vertical procedure profile is made.

NOTE: – If the glide path is below the current aircraft position and the APP button is pressed the VGP will engage and command a descend to intercept final approach path.
– If performing HOLD PATTERN the VGP should be armed only after exiting the HOLD, otherwise the VGP may intercept the final approach descent path during the HOLD track.

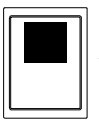
VGP DE-ACTIVATION

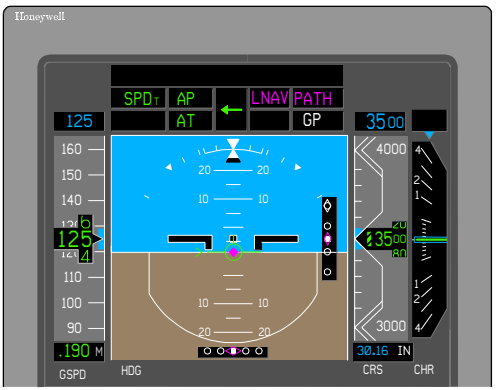
– Selecting another vertical mode.

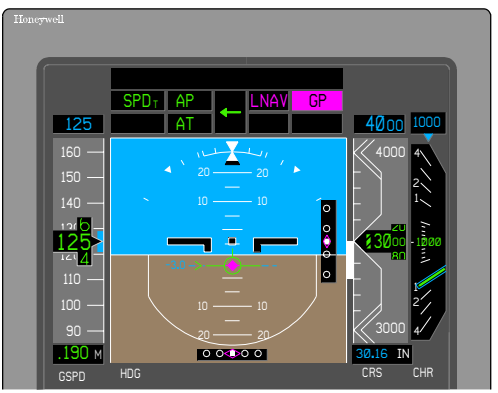
– Pressing the APP button on the GP after engagement.

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PFD







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VGP ARMED AND ENGAGED

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VPATH SUB-MODE

The Vpath is a Vnav sub mode used for constant geometric path descents downwards to an waypoint constraint.

The FMS path angle can be defined by pilot entries, procedures within the database or by default.

By default the FMS path angle is 3°.

When required it can be manually varied from 1 to 6 degrees.

VPATH LOGIC

Flying VPATH (fixed descent angle) speed changes are accomplished through thrust variations.

An amber LIM on the FMA indicates that insufficient thrust variation is available to maintain or to reach the required speed.

VPATH SPEED/ALTITUDE LIMIT LOGIC

In order to comply with Speed/Altitude limit protection selected on the PERF INIT 1/3 page when the speed limit is exceeded by more than 5 kt, the system reverts to VALT or VASEL momentarily leveling the airplane thus reducing the speed. Once the desired speed is reached the system returns to VFLCH which is maintained until reaching the altitude selected in the ALTSEL window.

When the autothrottle is not engaged the FMS may continue the descent through the speed/altitude limit. In this case, manual speed control is necessary to meet the speed/altitude limit.

Speed/Altitude Limit protection is also given during VFLCH descents. Under these conditions, the FMS slows the airplane by thrust variation to the speed limit when approaching the altitude associated with it.

The deletion of SPD/ALT LIM from the FMS will dash the field and FMS will understand that no Speed/Altitude Limit applies.

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VNAV APPROACH TEMPERATURE COMPENSATION

►*MAU load 21.4 and on*

The VNAV temperature compensation technique function adjusts all FMS waypoint altitude constraints for the defined approach, approach transitions, and missed approach segments of the flight plan for non-standard day temperatures.

TEMP COMP MODES

The flight crew configures the FMS for three modes of VNAV approach temperature compensation on the TEMP COMP page (Nav Index 2/2>Maintenance>Setup>Flight Config 2/2):

– OFF: assumes standard day temperature.

– COLD: applies temperature compensation only when approach is flown in COLD conditions.

– HOT/COLD: applies temperature compensation when approach is flown in any temperature.

TEMP COMP REQUIREMENTS

– One of its modes (COLD or HOT/COLD) enabled.

– An arrival procedure loaded on the active flight plan.

– An outside temperature for the destination airport is entered on the Landing 1/2 page.

TEMP COMP ACTIVATION

Since all requirements described above are met the TEMP COMP feature may be activated on the TEMP COMP page.

The TEMP COMP page is accessible pressing the TEMP COMP prompt on the LANDING page or on the ACTIVE FLIGHT PLAN page when within 30 NM from destination.

Pressing the prompt a MOD FLIGHT PLAN with the proposed altitudes is shown. The flight plan must be activated to incorporate the compensated altitude constraints.

NOTE: The temperature compensation is applied only to the altitude constraints from the navigation database. No changes are applied to the pilot-entered constraints.

It is possible to remove the compensated altitudes by selecting the REMOVE prompt on the TEMP COMP page.

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TEMP COMP PRESENTATION

The compensated altitudes for each of the arrival flight plan constraints are displayed in reverse video on the MCDU and VSD.

TEMP COMPENSATED MDA

The TEMP COMP page displays the compensated MDA.

If the procedure installed in the database does not contain a waypoint that corresponds to the MDA then four dashes are displayed in its place. Values can be entered or deleted by the flight crew to find out what is the compensated MDA for temperature inserted in the LANDING 1/2 page.

◀

SPEED CONTROL

Speed control can be manual or automatic depending on the selection on the Speed Selector Knob. The FMS selection allows the FMS to send its internally defined speeds as target speeds for FGCS.

MANUAL SPEED CONTROL

If the Speed Selector Knob is set to MANUAL the pilot is responsible for controlling the speed during all flight phases.

FMS SPEED CONTROL

In this mode the speed command is sent to the AFCS by the FMS. The departure, climb, cruise, descent, approach and go-around speeds are set in the PERFORMANCE INITIALIZATION. If a new schedule is desired, these settings can be modified in flight.

SPEED PROTECTION

The FMS incorporates speed reversion (transition from VPATH to VFLCH) and latched speed protection.

Transition from VPATH to VFLCH: Speed reversion is active when the descent is too steep and it is not possible to maintain the selected speed. In this case, the FMS transitions to VFLCH, which maintains the speed within limits. The transition from VPATH to VFLCH automatically occurs if:

– The speed exceeds V_{MO}/M_{MO} + 10 kt during VPATH descents;

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– FMS passes through a speed/altitude limit with a speed greater than 5 kt. In this case, the command is to level off until the speed deviation is below + 2 kt. Afterwards, the FMS commands VFLCH down to the Alt Selector altitude;

– Landing Gear/Flap speed limit is exceeded by more than 10 kt;

– In VPATH and the speed is less than V_{REF} – 10 kt.

NOTE: If the Auto Throttle is not engaged the pilot is responsible for maintaining the speed.

ILS APPROACH

The ILS approach is a non-FMS navigation. The automatic transition from FMS navigation into an ILS approach is done through the use of the preview mode.

The transition can also be manually done by pressing the V/L button on the guidance panel.

ILS APPROACH ACTIVATION

– Pressing the APP button on the GP when an ILS frequency is tuned.

ILS APPROACH CAPABILITY

The FMA shows current system capability based on the intended approach to be flown.

The intended approach capability is determined by the selection of the (RA/BARO) on the Guidance Panel. All other operational conditions must be met in order for the capability to be validated.

Selecting BARO indicates APPR 1 capability for an ILS CAT I approach.

Selecting RA indicates APPR 2 capability for an ILS CAT II approach.

The Altitude (BARO) or Height (RA) inserted in the BARO/RA window on the PFD through the Minimums Knob on the guidance panel determines the EGPWS callouts for the minimums (MDA or DA).

Selecting the RA/BARO to off (setting minimums to 0 ft) disables the EGPWS minimums call outs.

The system will not indicate discrepancy in selected values between PFD1 and PFD2.

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CAPABILITY REQUIREMENTS

When ILS modes are requested via the APP button, the system arms for the highest capability available as long as all conditions are satisfied, according to the following:

APPR 1

The APPR 1 is the flight director mode used for ILS CAT I approaches.

The requirements to engage APPR 1 are:

– RA/BARO selector set to BARO.

– NAV frequency set to the correct LOC frequency in the MCDU.

– V/L or preview selected.

These selections are necessary only on the PFD where the FD source is pointing.

When APP button is pressed, the system attempts to arm to the highest capability available, this case APPR 1.

APPR 2

The APPR 2 is the flight director mode used for ILS CAT II approaches.

The requirements to engage APPR 2 are:

– Both RA/BARO set to RA and Minimums set at 800 ft or above.

– Both NAV frequencies set to correct LOC frequency in the MCDU.

– Both PFD′s set to correct LOC inbound course (V/L or Preview).

– Flaps 5.

– Altimeters within prescribed limits.

All conditions described above are established at or above 800 ft RA.

These selections are necessary on both PFD′s.

The BARO/RA window on the PFD 1 and on the PFD 2 must be on the same selection (RA-RA) for CAT II approaches. If there is a discrepancy the BARO/RA window on the non coupled side will flash amber upon crossing 1500 ft when APPR mode is selected.

An EICAS message APPR 2 NOT AVAILABLE is presented inflight if the required items to engage are not met or a system failure exists.

If the flap setting is the only remaining condition to be satisfied for CAT

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II, the armed status will remain displayed down to 800 ft RA, suggesting there is still one pilot's action pending.

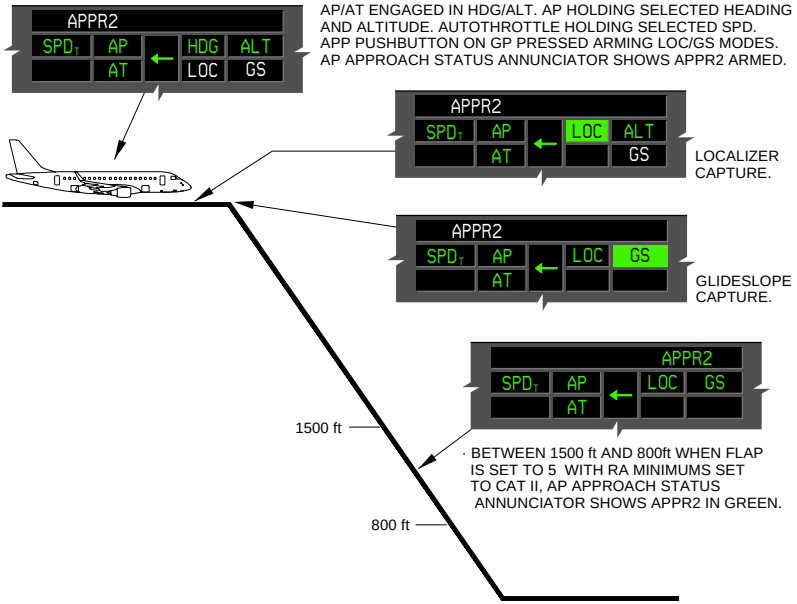
ILS APPROACH CHECK POINTS

– 1500 ft RA – system starts trying to engage highest capability available.

– 800 ft RA – system "freezes" highest capability available, no longer allowing approach "upgrades".

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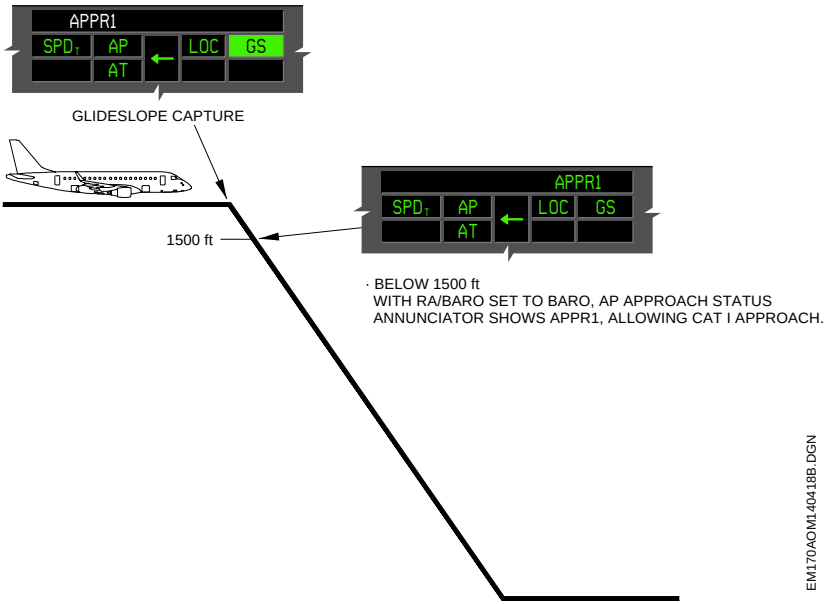
APPROACH SEQUENCE – CAT II



CAT II APPROACH

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APPROACH SEQUENCE – CAT I

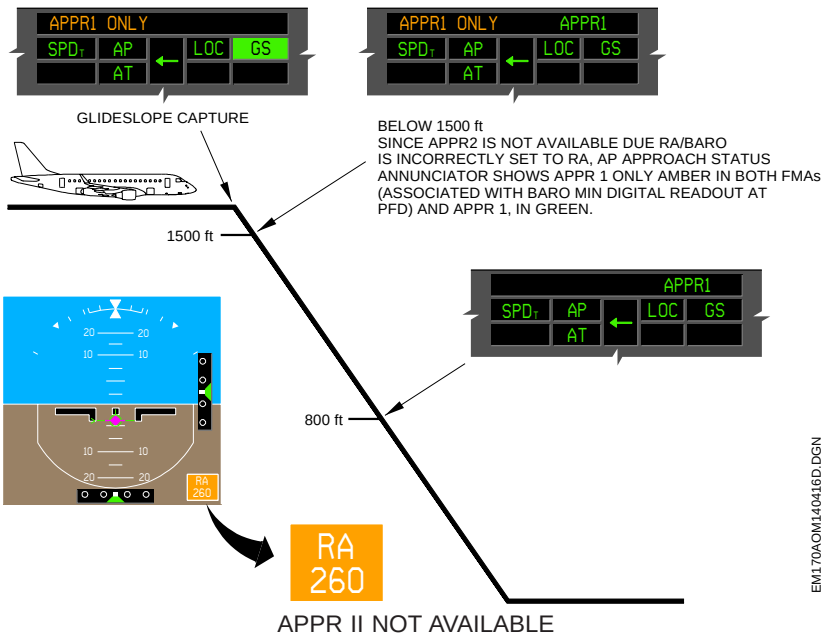


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APPROACH SEQUENCE – CAT I (RA/BARO SET RA)

Example:

– Either BARO/RA window incorrectly set to RA.



MACH TRIM

The mach trim (MT) function positions the horizontal stabilizer surface as function of Mach number. The MT function is computed in the AFCS and the command is transmitted to HS-ACE via FCM.

Increase of Mach number moves aft the wing aerodynamic center of pressure, causing an pitch down moment. Horizontal stabilizer mach trim up command is required to compensate the pitch down moment.

MT function automatically engages when the conditions below are satisfied:

– Autopilot is not engaged.

– Indicated airspeed is above 0.70 M.

– Manual trim of horizontal stabilizer is not in progress.

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– Neither of the quick disconnect switches are pressed.
– Any other trim function is not commanding.

If MT function disengages if at least one of conditions above is not satisfied. It also disengages if MT monitor detects a fault in trim rate command.

Mach trim is disabled with AP engagement due to AP trim operation.

PREVIEW FEATURE

The preview feature provides a transition from FMS navigation into ILS approach course (V/L).

When FMS is selected as the primary navigation source the system automatically selects the ILS frequency and Localizer course when:

►*Airplanes Pre-Mod MAU load 23.1*

– The airplane is within 25 NM from destination;

◄

►*MAU load 23.1 and on*

– The airplane is within 30 NM from destination;

◄

– The PREV function is used;
– AUTO tuning is enabled on the MCDU radio page;
– An ILS or BC procedure is part of the active flight plan in the FMS.

The PFD will automatically display the Localizer course if the PREVIEW MODE is selected with the ILS frequency already autotuned.

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THRUST MANAGEMENT SYSTEM

The TMS is comprised of:

– Auto Throttle (AT).

– Thrust Rating Selection (TRS).

– Thrust Lever Angle (TLA) Trim.

AUTOTHROTTLE

The E-JETS AUTOTHROTTLE moves the thrust levers to maintain the desired airspeed or thrust according to the appropriate mode.

The AT system has various modes of operation to help maintain airplane operation within the normal operating envelope.

The AT system is designed to operate in single engine condition with the same modes as in the dual engine condition.

AUTOTHROTTLE OPERATION

The Auto throttle system function sets the correct engine thrust with the synchronized N1 for its various operating modes.

AUTOTHROTTLE ENGAGEMENT

The AT normally engages on ground when:

– No AT system active failures exist;

– AT button is pressed on the guidance panel;

– Both thrust levers are above 50° TLA.

The AT normally engages in flight when:

– No AT system active failures exist;

– AT button is pressed on the guidance panel;

– The airplane is at or above 400 ft AGL.

NOTE: When the auto throttle is engaged the thrust levers may have a misalignment of up to half of thrust lever head diameter.

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AUTOTHROTTLE NORMAL DISENGAGEMENT

Normal AT disengagement is accomplished by pressing either AT disconnect button on the thrust levers.

Alternatively the AT can be normally disengaged by pressing the AT button on the guidance panel.

The AT system is also automatically disengaged:

– After touch down.

– When thrust lever is moved beyond TO/GA position.

– Thrust reverse operation during RTO.

NORMAL DISENGAGEMENT ANNUNCIATION

– AURAL

Anytime the auto Throttle is disengaged in flight an aural alarm “THROTTLE” is triggered. Pressing the AT Disconnect button at a second time cancels the aural alarm.

– FMA

The “AT” annunciation flashes in green for 5 s.

AUTOTHROTTLE NON NORMAL DISENGAGEMENT

The AT system disengages with:

– TLA difference greater than 8°.

– AT system failure.

NON NORMAL DISENGAGEMENT ANNUNCIATION

– AURAL

The “AUTOTHROTTLE” aural alarm sounds in flight until the AT disconnect button is pressed on the thrust levers.

– FMA

The “AT” annunciation flashes in red.

– EICAS

The EICAS message “AT FAIL” is displayed.

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AUTOTHROTTLE MODES

The AT modes are described as follows:

– Takeoff Mode (TO).

– Takeoff Hold Mode (HOLD).

– Speed on Thrust Mode (SPD_T).

– FLCH mode – Speed on Elevator (SPD_E).

– Low speed protection.

– Gust compensation.

– Go-Around Mode (GA).

– Retard Mode (RETD).

– Limited thrust (LIM).

– Override (OVRD).

TAKEOFF THRUST CONTROL MODE (TO)

The TO mode is armed on ground pressing the AT button on the guidance panel.

It engages when the thrust levers are beyond 50° of TLA.

TAKEOFF THRUST HOLD CONTROL MODE (HOLD)

The HOLD mode prevents undesired thrust levers movement during the takeoff phase of flight.

HOLD mode is activated at or above 60 KIAS during the takeoff roll.

The AT servos are de-energized and thrust lever movements are not commanded up to 400 ft AGL.

SPEED ON THRUST MODE (SPD_T)

In this mode the system controls the selected airspeed adjusting the engine thrust by moving the thrust levers.

The flight director vertical modes related to SPD_T mode are:

– Flight Path Angle (FPA).

– Vertical Speed (VS).

– Glide Slope (GS).

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– VPTH (PTH).

– VGP (GP).

– Altitude Hold (ALT).

– Altitude Select (ASEL).

The SPD_T is also the Auto Throttle mode when the FD is turned OFF (no active modes on FMA).

FLCH MODE – SPEED ON ELEVATOR (SPD_E)

The AT maintains a fixed thrust setting, and the flight director adjusts the pitch attitude to maintain the selected airspeed.

For small altitude changes the Auto Throttle commands only the necessary thrust in order to maintain a comfortable predetermined schedule based on vertical speed.

For large altitude changes the Auto Throttle commands:

– Idle thrust for descent.

– Maximum thrust limited by the N1 target chevron.

The vertical modes related to SPD_E mode are:

– Flight Level Change (FLCH).

– Overspeed (OVSP).

– VFLCH (FLCH magenta).

NOTE: With the AT mode in the SPD_E and the AP off, deviating from the flight director commands may lead to an undesired airspeed as the AT keeps the engine thrust at maximum or at idle and the pitch attitude change controls the airspeed.
In this case, turn the flight director OFF to revert the AT to SPD_T to have the engine thrust controlling the airspeed.

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LOW SPEED PROTECTION

The AT provides the following low speed protection whenever it is engaged:

Altitude	Flaps 0	Flaps 1 to Full
Above 30000 ft	2% over amber Low Speed Awareness tape (LSA)	1.2 Vs
Between 20000 ft and 30000 ft	Linear interpolation between 1.2 Vs and 2% over LSA	
Below 20000 ft	1.2 Vs	

GO-AROUND THRUST CONTROL MODE (GA)

The Go-Around thrust mode (GA) advances the thrust levers to the TO/GA position.

RETARD MODE (RETD)

The Retard mode reduces the thrust levers to the idle during flare on landing.

CONDITION TO ARM RETARD MODE

– Radio Altimeter with valid information;

– Autothrottle engaged;

– Flaps at 5 or FULL position and landing gear down;

– Radio Altitude below 150 ft AGL;

CONDITION TO ENGAGE RETARD MODE

Retard mode engages at or below 30 ft.

In a normal flare, it is scheduled to reduce thrust levers to idle so that idle thrust is achieved upon airplane touch down.

LIMITED THRUST (LIM)

Limited Thrust (LIM) is displayed on the FMA when the auto throttle authority is not sufficient to achieve or maintain the selected airspeed.

LIM is associated with Speed on Thrust mode (SPD_T).

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OVERRIDE (OVRD)

The AT can be overridden by moving the thrust levers in any direction without causing its disengagement. If the AT is overridden by a pilot, a green annunciation “OVRD” is displayed on the FMA.

When the thrust levers are released the AT will once again return the thrust levers to their commanded position.

AT SINGLE ENGINE OPERATION

The AT deactivates the respective thrust lever when an engine failure occurs.

The operating engine’s thrust lever remains active for AT operation.

Reducing the thrust lever to simulate an engine failure will cause AT disengagement due to a split in thrust lever position.

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TLA TRIM

The TLA trim function synchronizes the engine's N1 when the AT is disengaged.

TLA trim can be turned ON or OFF on the MCDU TRS page.

TLA trim is defaulted to ON whenever the AT system is disengaged.

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THRUST RATING SELECTION

The (TRS) automatically determines the appropriated maximum engine thrust rating according to the flight phase.

The maximum engine thrust rating can also be manually selected via TRS page on the MCDU.

The thrust ratings computed by the TRS are the following:

– Take-off (TO).

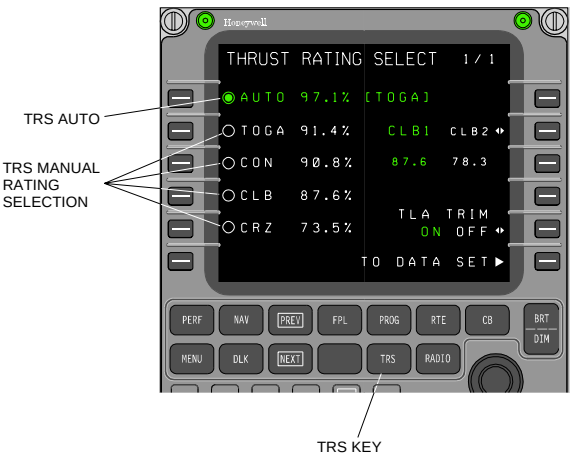
– Go-Around (GA).

– Climb-1 (CLB-1).

– Climb-2 (CLB-2).

– Cruise (CRZ).

– Continuous (CON).



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THRUST RATE SELECT PAGE

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AUTOMATIC OPERATION

The TRS system has the ability to determine the flight phase, airplane configuration and number of engines running and automatically set the appropriate thrust rating.

On the MCDU > TRS page AUTO is the default mode after power up. The system automatically sets the appropriate TRS mode only if AUTO is selected.

On the right side of the AUTO label, the system shows between brackets which TRS mode is active according to system logic.

The current thrust rating label is displayed on the EICAS between both engine N1 indicators.

The resultant maximum N1 is digitally displayed above the N1 indicators and a chevron on each N1 dial provides the analog presentation.

TO THRUST RATING

TO is set on MCDU > TAKEOFF DATA SET MENU page.

On takeoff it is not possible to switch to another TRS mode up to 400 ft. Until reaching this altitude only the RSV mode is possible to be activated automatically by system or manually setting the thrust lever to MAX position.

CLB

The E-JETS incorporate 2 climb modes labeled CLB 1 with highest thrust and CLB 2 reduced thrust.

CLB 1 AND CLB 2 LOGIC

CLB 1 is the default mode after an airplane power up.

If the CLB 1 thrust is higher than the selected takeoff thrust (TO-X), the system automatically selects CLB 2 which becomes the default until the next power down/power up.

This logic is to prevent the system from increasing instead of reducing it during the transition from TO to CLB after the takeoff.

On the TRS page it is possible to switch from CLB 1 to CLB 2 with the system still in automatic mode by selecting the desired mode on line select key 2R.

On the ground this selection is only possible if the selected takeoff thrust (TO-X) is higher than CLB 1, otherwise only CLB 2 is available.

CLB MODE ACTIVATION

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The CLB mode automatically becomes active according to the following criteria when both engines are running:

Takeoff with Flight Director ON

– Landing gear is retracted and;

– Airplane altitude is above 400 ft AGL and;

– Any change in the flight director vertical mode.

Takeoff with Flight Director OFF

– Landing gear is retracted and;

– Airplane altitude is above 3000 ft AGL and;

In flight:

– Anytime in flight the CLB TRS mode is active if the altitude pre selector is set higher than the airplane current altitude.

CRZ

The active TRS flight phase is set to CRZ when:

– The airplane is leveled at the altitude set on the altitude pre selector for 90 s and;

►*Airplanes Pre-Mod MAU load 23.1*

– The airspeed is within 1 kt from the pre selected airspeed.

◄

►*MAU load 23.1 and on*

– The airspeed is within 5 kt (or 0.01 Mach) from the pre selected airspeed.

◄

GA

The GA mode is active anytime in flight with the landing gear extended.

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SINGLE ENGINE

During takeoff:

The automatic transition from TO mode to CON only happens at 3000 ft AGL when in single engine condition.

In flight:

Anytime a single engine condition is recognized the TRS automatically sets CON mode.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	AP FAIL	Autopilot function is inoperative.
	AP PITCH MISTRIM	Pitch trim and autopilot commanding pitch trim control in opposite directions.
	AP PITCH TRIM FAIL	Autopilot stabilizer trim is no longer operative.
	AP ROLL MISTRIM	Roll trim and autopilot commanding roll trim control in opposite directions.
	AT FAIL	Both AT have failed. Selected AT function is unavailable.
	AT NOT IN HOLD	AT not in TO Hold following the transition above 60 kt during TO roll and until the airplane transitions 400 ft AGL and GA.
	FD LATERAL MODE OFF	Disconnected lateral mode due to invalid conditions.
	FD VERT MODE OFF	Disconnected vertical mode due to invalid conditions.
	MACH TRIM FAIL	The Mach Trim function in both channel is failed.
	SHAKER ANTICIPATED	Indication that Shaker activation angles have been advanced to conservative settings.
	STALL PROT FAIL	Stall Warning function and Stall Protection functions are inoperative.

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TYPE	MESSAGE	MEANING
ADVISORY	AFCS FAULT	AFCS has detected a fault.
	AFCS PANEL FAIL	Both channels of the GP have failed.
	AFCS PANEL FAULT	A single channel of the GP has failed.
	AP FAULT	The AP has one channel failed.
	AP PITCH TRIM FAULT	The AP pitch trim has one channel failed.
	AP RUDDER NOT AVAIL	Autopilot rudder control is not available.
	APPR 2 NOT AVAIL	The AP is not capable of aCAT II precision approach.
	AT FAULT	The AT has one channel failed.
	AUTOLAND 1 NOT AVAIL	System not capable to perform Autoland.
	ENG TLA TRIM FAIL	Selected Sync function is unavailable due to an internal or required input failure. AT function is available.
	FD FAIL	FD is inoperative.
	FD FAULT	A single FD channel is inoperative.
	HUD LVTO NOT AVAIL	The HGS is not receiving the selected ILS system.
	MACH TRIM FAULT	Loss of one MT channel.

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TYPE	MESSAGE	MEANING
ADVISORY	SHAKER 1 (2) FAIL	Stall warning function has failed.
	STALL PROT FAULT	AOA Miscompare Monitor (Stall Warning Subsystem) has failed.
	STALL PROT ICE SPEED	The reference speed has changed. Set reference speed to ice speed. Once the ice condition is detected, the system latches the ice condition active until 30 seconds after WOW becomes valid.
	YD FAIL	Yaw damper function is inoperative.
	YD FAULT	The yaw damper has one channel failed.
	YD OFF	Yaw damper function is off.

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SECTION 14-04

AUXILIARY POWER UNIT

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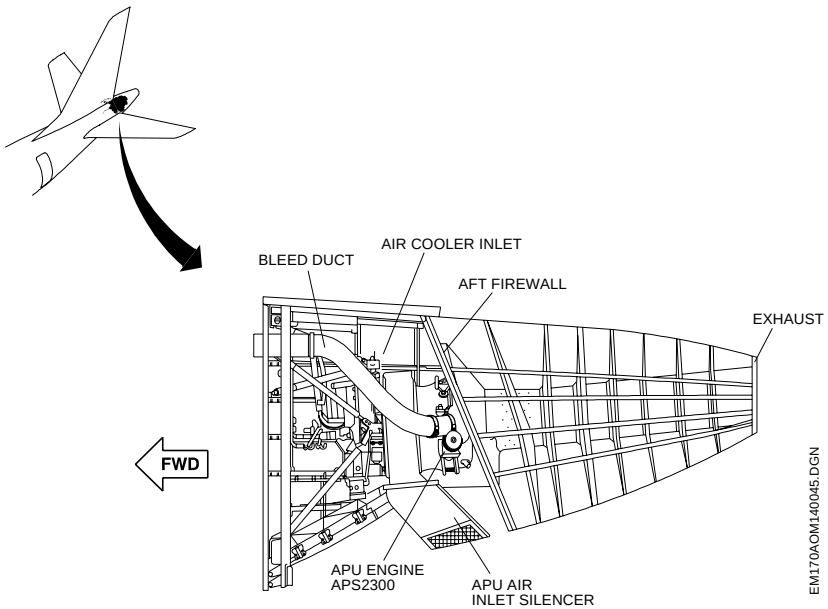
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GENERAL DESCRIPTION

The Auxiliary Power Unit (APU) is a gas turbine engine located in the airplane tailcone, which provides pneumatic and electrical AC power. The pneumatic power is used for engine starting and to supply bleed air to the air conditioning packs of the Environmental Control System (ECS). An electrical AC generator supplies 115 V 40 kVA to the electrical system.

The APU is automatically monitored and controlled through a dedicated Full Authority Digital Electronic Control (FADEC) unit.



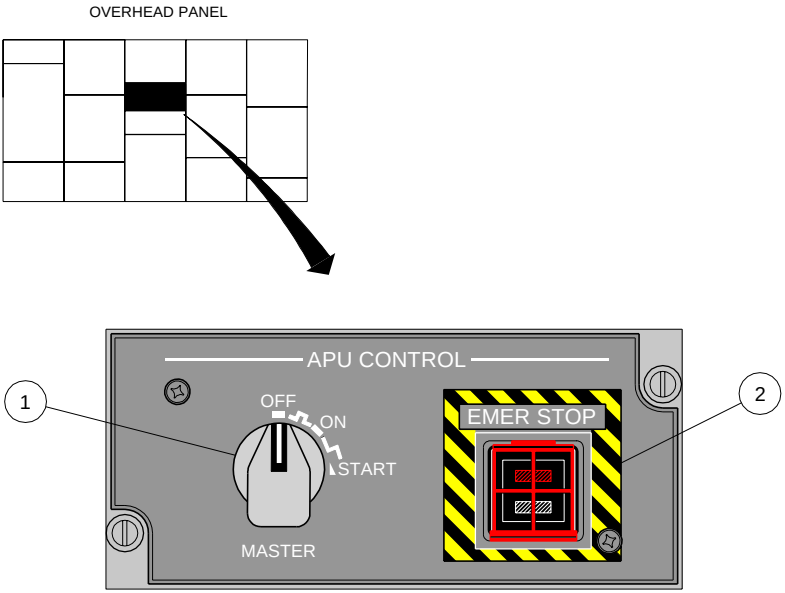
APU LOCATION

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APU CONTROL PANEL



1 - APU SELECTOR KNOB (ROTARY ACTION)

OFF: initiates normal APU shutdown.

ON: normal position when the APU is running.

START: (momentary action) initiates the APU start cycle. When released, the switch moves to the ON position.

2 - APU EMERGENCY STOP BUTTON (GUARDED)

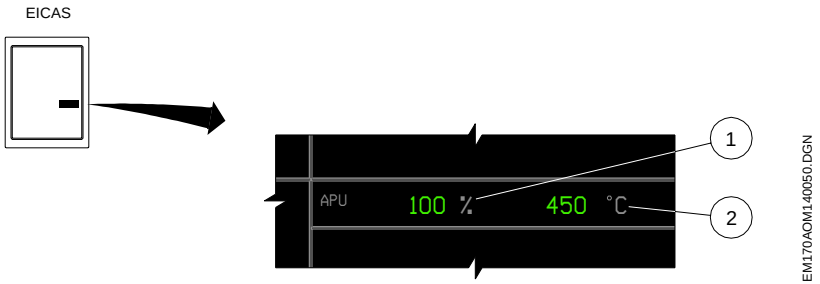
PUSH IN: closes the APU fuel shutoff valve, shutting down the APU with no cooldown period. A white striped bar illuminates on the lower half of the button.

PUSH OUT: normal position, with the fuel shutoff valve open.

NOTE: When an APU fire is detected, the upper half of the button illuminates red.

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EICAS INDICATION



1 - APU RPM INDICATION

– Displays the APU RPM (%).

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: operating limit exceeded.

2 - APU EGT (EXHAUST GAS TEMPERATURE) INDICATION

– Displays the APU temperature in degrees Celsius (°C).

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: operating limit exceeded.

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APU FUEL SUPPLY

When only DC power is available, the DC fuel pump, located in the right wing tank, provides fuel to the APU. If AC power is available and the engine is not running, fuel will be provided by the AC fuel pump.

When the engine is running, the ejector fuel pump provides fuel to the APU from the right wing tank. However, it is also possible to provide fuel to the APU from the left wing tank via a crossfeed valve.

APU BLEED

The APU supplies bleed air on the ground or inflight. However, it is used primarily as a ground pneumatic source for the air conditioning packs (ECS) and engine starting. The Air Management System (AMS) controls the operation of the APU and engine bleed valves. For logic details refer to Section 14-02 (AMS).

APU OPERATION

A dedicated Full Authority Digital Electronic Control (FADEC) monitors and controls the start/shutdown sequence, fault detection and APU status.

The flight crew controls the normal APU start/shutdown sequence, using the APU selector knob.

In an abnormal condition, the flight crew can shut down the APU through a dedicated emergency stop button.

The APU is able to supply:

– Electrical AC power up to 33000 ft.
– Bleed air for engine starting up to 21000 ft.
– Bleed air for air conditioning up to 15000 ft.

Maximum altitude for APU start is 30000 ft.

APU START

Rotating the APU master switch to ON powers the FADEC and APU fuel shutoff valve opens.

NOTE: The SPDA sends power to APU FADEC energization only 30 s after its power-up, so APU start is not available before this time period.

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The APU indication on the EICAS changes from OFF to the APU control parameters (speed and EGT).

Rotating the APU selector knob from ON to START (momentary position), initiates the APU automatic starting cycle. During the automatic starting cycle the FADEC commands the electronic starter controller to energize the brushless starter generator, initiating APU rotation.

Three seconds after APU speed has reached 95%, electrical and pneumatic loading are available. If the APU does not reach proper speed or acceleration rate within the starting cycle time, the APU will automatically shut down.

GROUND START

The FADEC initiates ignition at approximately 6% rpm and the fuel flow after 0.5 s. The battery #2 energizes the electronic starter controller. After a light off occurs, the FADEC commands the starter to cutout at approximately 50% rpm.

IN FLIGHT START

The FADEC initiates ignition at approximately 7% to 17% rpm and the fuel flow after 0.5 s. After a light off occurs, the FADEC commands the starter to cutout at approximately 50% rpm.

APU SHUTDOWN

NORMAL APU SHUTDOWN

Rotating the APU selector knob from ON to OFF initiates a normal APU shutdown, which is monitored and controlled by the FADEC. During a normal shutdown sequence, the APU pneumatic power is removed immediately and the electrical power is removed at the end of a 2 minutes cooldown period. The EICAS message APU SHUTTING DOWN disappears at the end of that period.

►*APU FADEC 02.00*

The cooldown period is 1 minute, followed by a spooldown period. The EICAS message APU SHUTTING DOWN disappears at the end of spooldown period.

◄

NOTE: Turning the APU selector knob back to ON position during the shutdown sequence cancels the shutdown.

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EMERGENCY APU SHUTDOWN

In the event the APU emergency stop button has been selected, the APU fuel shutoff valve closes and the APU shuts down without a two-minute cooldown period.

APU PROTECTION

The FADEC provides automatic APU shutdown protection on ground and in flight as follows. The appropriate EICAS message is displayed for each situation.

On the ground	In flight
Overspeed	Overspeed
Underspeed	Underspeed
FADEC critical fault	FADEC critical fault
APU fire	-
APU EGT overtemperature	-
APU high oil temperature	-
APU low oil pressure	-
Sensor fail	-

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	APU FAIL	APU automatic shutdown has occurred. APU cannot be restarted, except if the automatic shutdown occurred during the starting cycle and according to the restriction defined in the AFM.
	APU FAULT	APU automatic shutdown inhibited in-flight. An anomaly has been detected. Maintenance action is required.
	APU OIL HI TEMP	APU automatic shutdown inhibited in-flight. Oil temperature is above maximum limit.
	APU OIL LO PRESS	APU automatic shutdown inhibited in-flight. Oil pressure is below minimum limit.
	APU ALTITUDE EXCEED (Post-Mod. Load 21.2)	APU operational ceiling has been exceeded. For non-ETOPS airplanes, the airplane is flying at or above 33500 ft with the APU running. For ETOPS airplanes, the airplane is flying with the APU running at or above 37500 ft or above the maximum associated temperature for altitudes between 33000 ft and 37000 ft. Refer to APU limitations block 2-00-38.

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TYPE	MESSAGE	MEANING
STATUS	APU SHUTTING DOWN	A normal APU shutdown has been commanded via the APU selector knob.

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SECTION 14-05

ELECTRICAL

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GENERAL DESCRIPTION

The Electrical System generates and distributes both AC and DC power to airplane systems.

The AC system is composed of:

- Two integrated drive generators (IDGs).
- One auxiliary power unit (APU) generator.
- One inverter.
- One ram air turbine (RAT).
- One AC external power unit.

The DC system is composed of:

- Two NiCd batteries.
- Three transformer rectifier units (TRU)s.
- One DC external power input.

Normal operation of the electrical system is automatic.

Two independent networks provide complete segregation for electrical fault isolation purposes. In the event of a power-generating source failure, bus ties automatically connect between the networks with no significant operational degradation nor additional workload.

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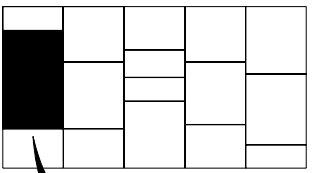
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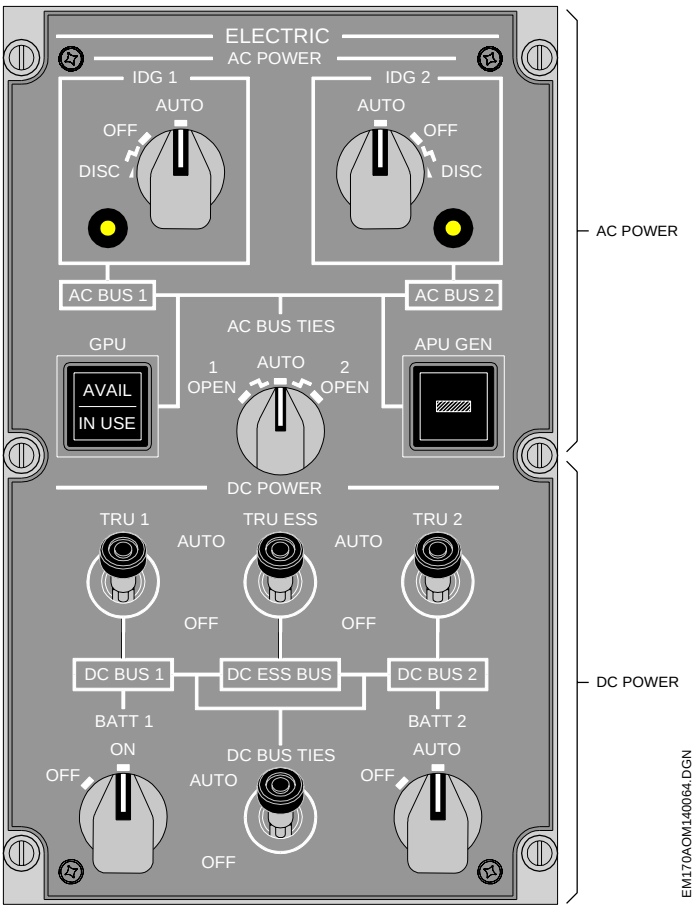
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ELECTRICAL POWER CONTROLS AND INDICATIONS

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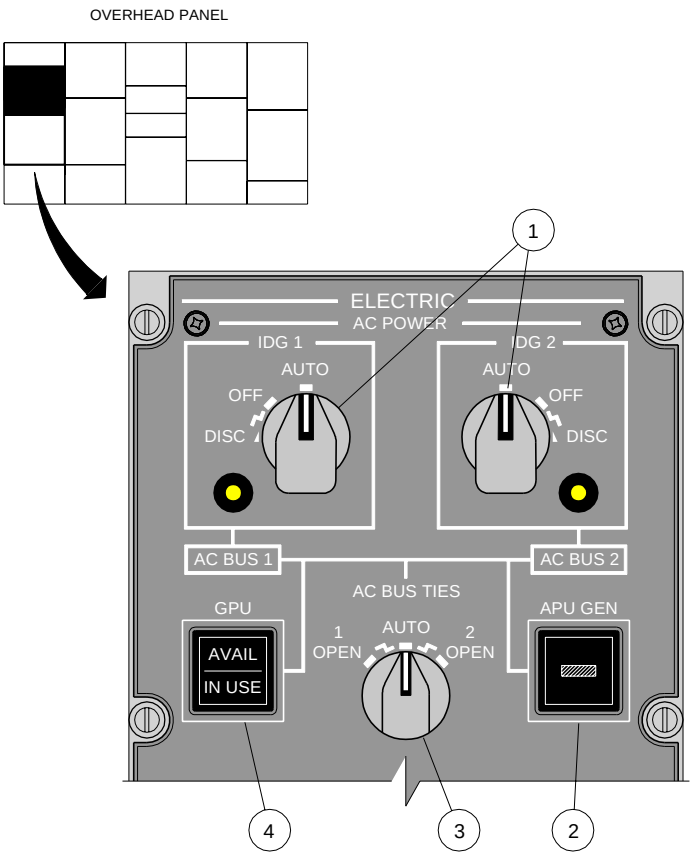
OVERHEAD PANEL





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ELECTRICAL AC POWER



1 - IDG 1 AND IDG 2 SELECTOR KNOB

AUTO: allows automatic operation of the electrical system.

OFF: opens the IDG contactor isolating the IDG from the respective AC BUS.

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DISC: must be held in this position for one second to mechanically disconnect the IDG.

NOTE: An amber led, associated with the EICAS message IDG 1 (2) OIL illuminates, indicating to the pilot which IDG must be disconnected. The led will be off after IDG disconnection.

2 - APU GENERATOR BUTTON

PUSH IN: allows automatic operation of the electrical system.

PUSH OUT: opens the APU generator contactor and isolates the APU generator from the AC BUS TIE.

3 - AC BUS TIES SELECTOR KNOB

1 OPEN: opens the Bus Tie Contactor (BTC) 1, segregating AC BUS 1 from AC BUS 2.

AUTO: This position controls the operation of the BTCs, according to system operational logic.

2 OPEN: opens the Bus Tie Contactor (BTC) 2, segregating AC BUS 2 from AC BUS 1.

4 - GROUND POWER UNIT (GPU) BUTTON

PUSH IN: connects the AC GPU to the AC system, according to the source priority.

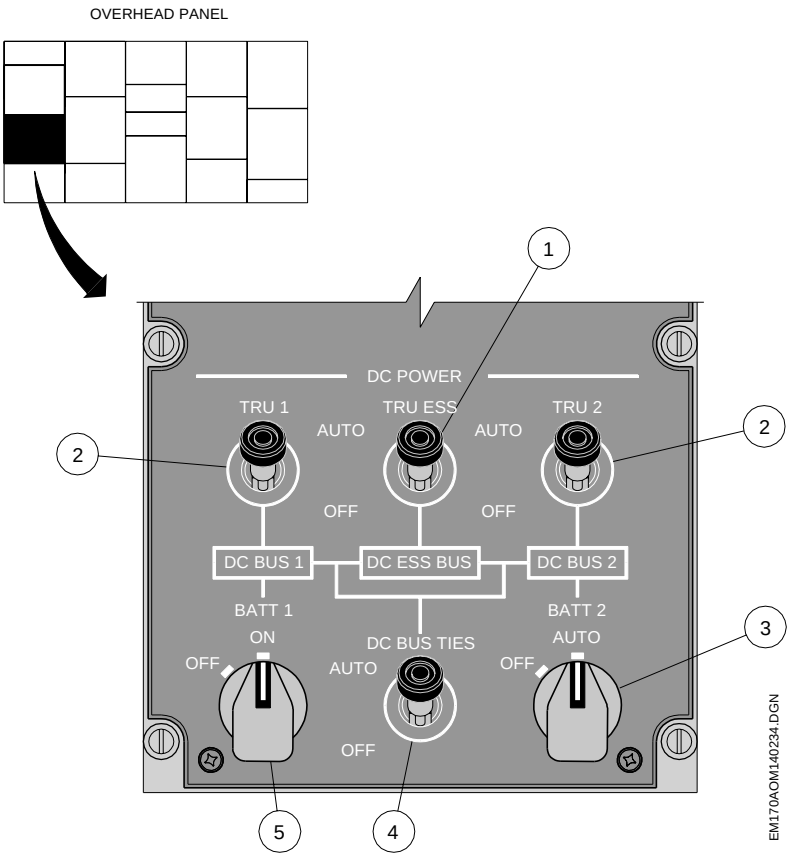
PUSH OUT: isolates the AC GPU from the system.

AVAIL: illuminates inside the button when the AC GPU is connected to the airplane and AC power quality requirements (voltage/amperage/frequency) are satisfied.

IN USE: illuminates inside the button when the AC GPU is powering the airplane AC electrical system.

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ELECTRICAL DC POWER



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1 - TRU ESS TOGGLE SWITCH

AUTO: allows automatic operation of the electrical system.
OFF: isolates the TRU ESS from the ESS BUS 3.

2 - TRU 1 AND TRU 2 TOGGLE SWITCH

AUTO: allows automatic operation of the electrical system.
OFF: isolates the TRU from the respective DC BUS.

3 - BATTERY 2 SELECTOR KNOB

AUTO: allows automatic operation of the electrical system.
OFF: the battery supply power to the HOT BATT BUS 2 only and is no longer connected to the airplane electrical system.

4 - DC BUS TIE TOGGLE SWITCH

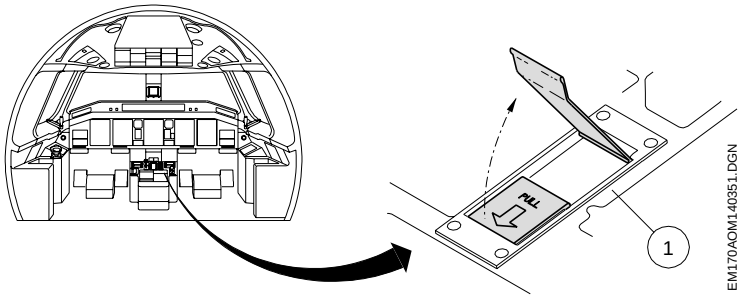
AUTO: allows automatic operation of the electrical system.
OFF: opens both essential tie contactors (ETCs) and a DC tie contactor (DCTC).

5 - BATTERY 1 SELECTOR KNOB

ON: the battery is connected to the DC ESS BUS 1.
OFF: the battery supply power to the HOT BATT BUS 1 only and is no longer connected to the airplane electrical system.

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RAM AIR TURBINE DEPLOYMENT HANDLE



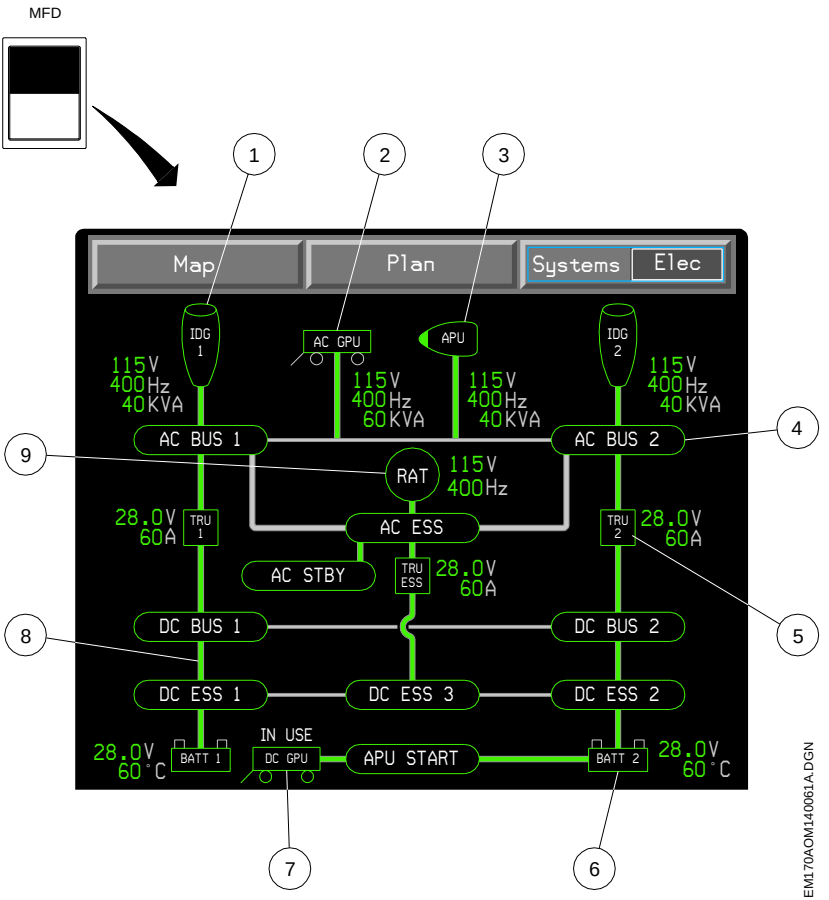
1 - RAM AIR TURBINE DEPLOYMENT HANDLE

– Manually deploys the Ram Air Turbine.

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ELECTRICAL SYNOPTIC PAGE ON MFD

The electrical synoptic page provides a visual representation of the electrical system operation and parameters, and can be selected for viewing by the flight crew on either MFD.



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1 - IDG (INTEGRATED DRIVE GENERATOR)

– The IDG icon and its outputs (voltage/frequency/amperage) are always displayed, even when readings are zero. If an output is invalid or out of range, the digits are replaced by three amber dashes.

– IDG icon:

GREEN: IDG available and the IDG selector knob in AUTO position.

WHITE: IDG available and the IDG selector knob in OFF position, or the engine is not running.

AMBER DASHED: invalid information.

– IDG parameters (voltage, frequency and amperage):

GREEN: for valid information.

AMBER DASHED: for invalid information or a value out of the valid range.

2 - AC EXTERNAL POWER (AC GPU)

– The AC GPU icon and its outputs (voltage/frequency/amperage) are displayed only when the AC GPU is connected and available. If any output is invalid or out of range, the digits are replaced by three amber dashes.

– AC GPU icon:

GREEN: AC GPU connected and the GPU button is pushed in.

WHITE: AC GPU connected and the GPU button is pushed out.

AMBER DASHED: invalid information.

– AC GPU parameters:

GREEN: AC GPU is available and the information is valid.

AMBER DASHED: invalid information.

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3 - APU

– The APU icon and its outputs (voltage/frequency/amperage) are not displayed until the APU is available (3 seconds after 95% rpm). If any output is invalid or out of range, the digits are replaced by three amber dashes.

– APU icon:

GREEN: APU available and the APU GEN button pushed in.

WHITE: APU available and the APU GEN button pushed out.

AMBER DASHED: invalid information.

NOTE: Whenever the EICAS CAUTION message APU FAIL is displayed, the APU icon will be white beneath an amber cross.

– APU parameters (voltage/frequency/amperage):

GREEN: for valid information.

AMBER DASHED: for invalid information or a value out of the valid range.

4 - ELECTRICAL BUSES

– The electrical bus icons are always displayed.

– BUS icons:

GREEN: energized bus.

WHITE: de-energized bus.

AMBER DASHED: invalid information.

5 - TRU (TRANSFORMER RECTIFIER UNIT)

– The TRU icon and its outputs (voltage/amperage) are always displayed.

– TRU icon:

GREEN: TRU available, and the associated toggle switch is in AUTO position.

WHITE: TRU available, and the associated toggle switch is in OFF position.

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AMBER DASHED: invalid information.

NOTE: Whenever the EICAS CAUTION message TRU 1 (2) FAIL is displayed, the TRU icon will be white beneath an amber cross.

– TRU parameters (voltage/amperage):

GREEN: for valid information.

AMBER DASHED: for invalid information or a value out of the valid range.

6 - BATTERIES

– Battery icons and their outputs (voltage/temperature) are always displayed.

– BATTERY icons:

GREEN: voltages are greater than 18 V.

WHITE: voltages are less than 18 V.

AMBER DASHED: invalid information or a value out of the valid range.

– BATTERY parameters (voltage/temperature):

GREEN: for valid information.

AMBER DASHED: for invalid information.

7 - DC EXTERNAL POWER (DC GPU)

– The DC GPU icon is displayed only when the DC GPU is connected and available.

– DC GPU icon:

GREEN: DC GPU connected and available.

AMBER DASHED: invalid information.

NOTE: A white IN USE indication is displayed, centered above the DC GPU icon, whenever the DC GPU is connected and supplying power to the airplane electrical system.

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8 - ELECTRICAL FLOW LINE

– Flow line icons illustrate voltage sensing.

– FLOW LINE icon:

GREEN: voltage is sensed.

WHITE: voltage is not sensed.

AMBER DASHED: invalid information.

9 - RAT (RAM AIR TURBINE)

– The RAT icon and its output (voltage and frequency) are displayed only when the RAT is deployed.

– RAT icon:

GREEN: RAT is deployed and operating.

AMBER DASHED: invalid information.

– RAT parameter (voltage and frequency):

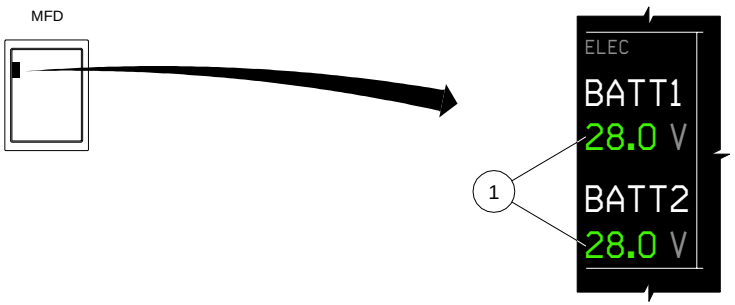
GREEN: for valid information.

AMBER DASHED: for invalid information or a value out of the valid range.

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STATUS PAGE ON MFD

Batteries voltage is displayed on the synoptic status page. It can be selected by flight crew on either MFDs.



1 - BATTERIES VOLTAGE INDICATION

– Displays batteries 1 and 2 voltage.

GREEN: valid battery voltage.

AMBER DASHED: invalid information.

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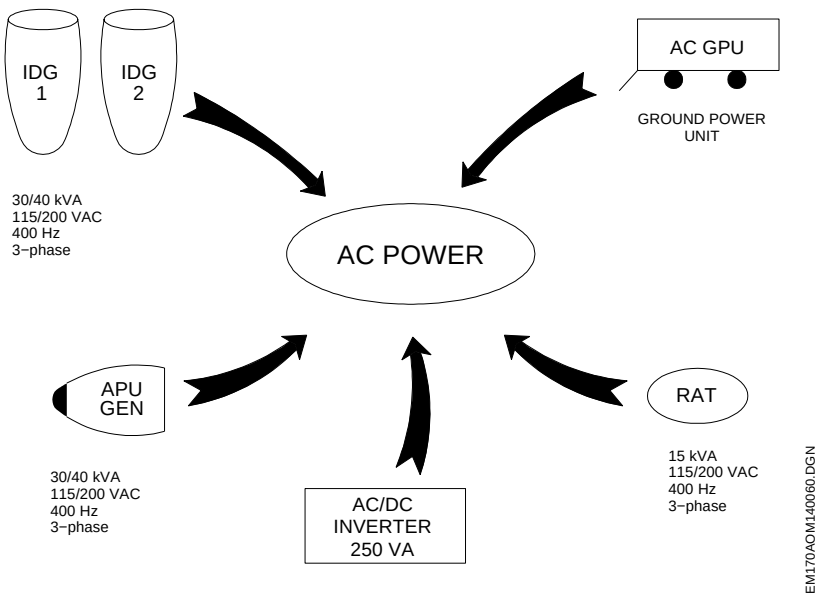
AC ELECTRICAL POWER DESCRIPTION

AC electrical power is the main source for airplane systems and comprises:

- Two integrated drive generators (IDGs).
- An auxiliary power unit (APU) generator.
- A ram air turbine (RAT).
- An inverter.

Both IDGs and the APU generator are rated at 40 kVA, 115 VAC, 400 Hz, three-phase.

On ground, the APU AC generator or AC ground power unit (AC GPU) can supply power to all AC BUSES. The APU generator may also be used in flight, as a replacement to an IDG, according to the APU operational envelope. In flight, the RAT is used as an emergency generator, supplying power to the ESS BUSES when both AC BUSES 1 and 2 are not powered.



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AC COMPONENTS AND OPERATION

INTEGRATED DRIVE GENERATOR (IDG)

Each engine has an IDG monitored and controlled by a dedicated generator control unit (GCU). When an engine starts, the IDG will automatically come on line, powering the respective AC BUS. The previous power source is disconnected from that AC BUS.

For automatic operation of the electrical system, the IDG selector knob must be set to the AUTO position. Moving the selector knob to OFF position, the generator line contactor opens, tripping off-line and de-exciting the selected IDG.

Manual disconnection is achieved by selecting the respective knob to the DISC position. The flight crew cannot reconnect the IDG.

APU GENERATOR

Before engine starting, when the APU becomes available, the APU generator automatically connects to the AC BUS TIES, disconnecting the AC GPU.

During the APU starting cycle, BATT 2 is isolated from the network, powering the APU START BUS exclusively. In flight, the APU can be started up within operational limits, and replaces any IDG sources with no operational degradation.

AC EXTERNAL POWER SOURCE (AC GPU)

The AC GPU button, located on the electrical system panel, controls the AC external power. Once the AC GPU is connected to the airplane and power quality requirements (voltage/amperage/frequency) are within accepted limits, an AVAIL light illuminates on the GPU button. The AC GPU has priority over the batteries to power the electrical system.

Pushing the AC GPU button in connects external power to the AC BUS TIE, according to AC source priority. The AVAIL light extinguishes and an IN USE light illuminates.

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When the APU is started, the system operational logic automatically isolates the GPU from the AC BUS TIE. In this case, the IN USE light extinguishes and an AVAIL light illuminates on the GPU button.

NOTE: Before disconnecting the AC GPU from the airplane, the flight crew must push out the AC GPU pushbutton, even if the IN USE light has already extinguished. The AC GPU pushbutton has to be pushed out for the next connection.

Ground staff can connect the GPU directly to the AC/DC GND SVC BUSES for ground maintenance and flight preparation, by pushing the respective button located on the front ramp panel or on the flight attendant panel at the forward right galley.

INVERTER

The AC/DC inverter converts 28 V DC power from batteries to 115 V AC power to supply the STANDBY AC BUS when an AC power source is not available.

RAM AIR TURBINE (RAT)

The RAT is an AC electrical device installed in the airplane nose section, which converts the kinetic energy of airflow across the turbine into AC power. The electrical power produced is rated at 15 kVA, 115 V AC, 400 Hz, three-phase.

Whenever AC power sources are not powering AC buses, the RAT is automatically deployed, and after 8 s, supplies power to the AC ESS BUS. Once deployed it will create a very loud noise due to the high rotation speed, and cannot be stowed back in flight, even if normal electrical power is reestablished. DC ESS BUSES are powered through the ESS TRU. To avoid total loss of power during this 8 s period, batteries are used as backup to power the DC ESS BUSES and the STANDBY AC BUS.

The RAT electrical power drives the AC Motor-driven Pump (ACMP 3A) for primary flight control tasks. These include high lift system actuation and power for essential avionics, communication and battery recharging.

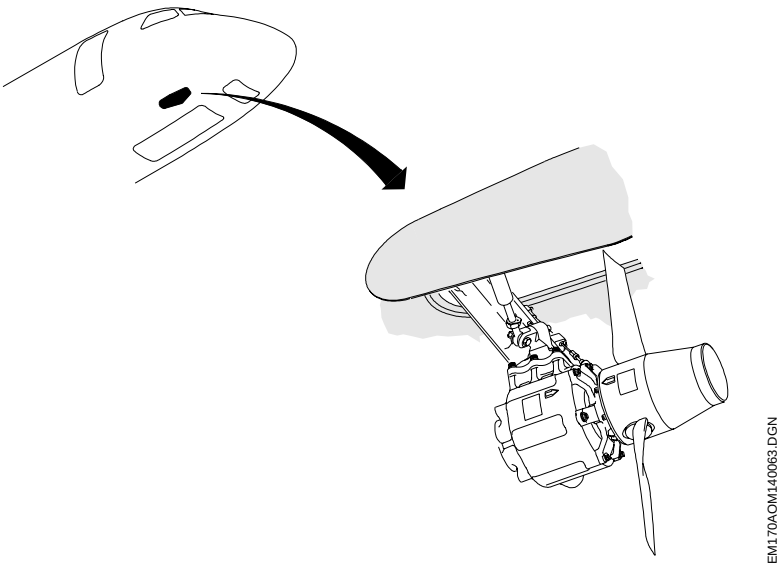
In flight, there is no altitude restriction for RAT deployment.

130 kt is required to ensure the RAT continues supplying AC/DC ESS BUSES. At speeds below this, the RAT may only supply the AC ESS BUS, and the batteries will automatically provide electrical power to the DC ESS BUSES and the STANDBY AC BUS through an AC/DC inverter.

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As airspeed decreases, load shedding occurs and the AC ESS BUS is no longer powered.

In case of automatic RAT deployment failure, a deployment handle is provided to manually deploy the RAT.



RAM AIR TURBINE

NO BREAK POWER TRANSFER (NBPT)

The E-Jets Electrical System has a protection feature, the NBPT, which avoids electrical transient in case of power transfer when the airplane is on the ground. The NBPT allows the momentary paralleling between two AC power sources: the IDGs, GPU and the APU generator, at any possible combination.

After achieving the auto-parallel condition, the system is able to parallel the sources for a short period (milliseconds). If the system does not achieve the auto-parallel requirements within the allowed time delay, the transfer will be concluded with a break-transfer of minimum power interruption.

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DC ELECTRICAL POWER DESCRIPTION

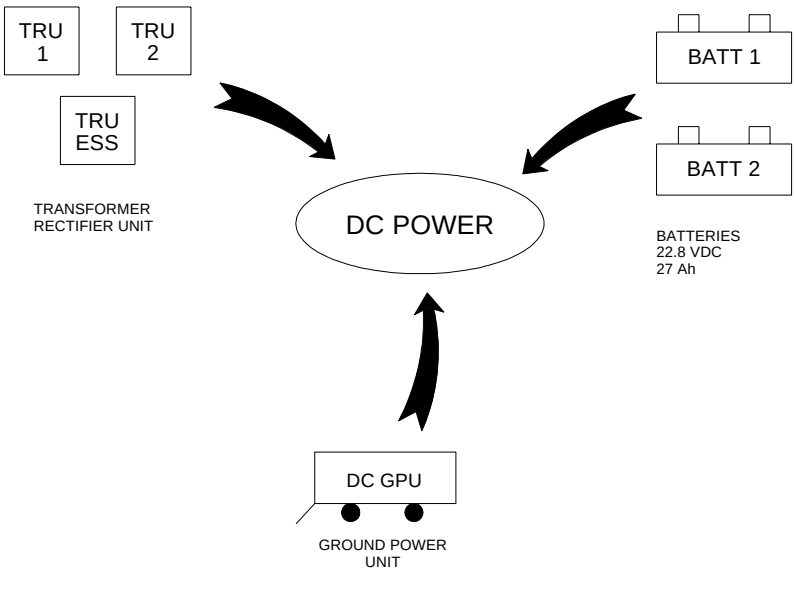
The DC electrical system comprises:

- Three transformer rectifier units (TRU)s;
- Two batteries.

On ground, a DC ground power unit (DC GPU) can be connected to the airplane supplying power to only the APU START BUS.

The TRU, rated at 300 A, are used as a primary source of the DC electrical system, converting AC power from the AC BUSES into DC power.

In certain conditions, batteries #1 and #2 are used to backup all DC ESS BUSES and the AC STBY BUS. Battery #2 also supplies the APU START BUS, during APU starting.



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DC COMPONENTS AND OPERATION

TRANSFORMER RECTIFIER UNIT (TRU)

Three TRUs convert 115 VAC power into 28 VDC. Each TRU works in isolation. If one of them fails, the BUSES will automatically be powered by the remaining TRUs, as long as the DC BUS TIES toggle switch is selected to AUTO.

TRU 1 provides DC power to DC BUS 1, DC ESS BUS 1, DC GND SVC BUS, HOT BATT BUS 1 and battery #1 charging.

TRU 2 provides DC power to DC BUS 2, DC ESS BUS 2, HOT BATT BUS 2 and battery #2 charging.

TRU ESS provides DC power to DC ESS BUS 3.

BATTERIES

Two NiCd 22.8 VDC, 27 A batteries power up the airplane and are also used as a backup for the DC essential electrical system.

The batteries are constantly charged by any AC source through the TRUs, including the AC GPU and the RAT.

In an ELECTRICAL EMERGENCY, batteries are capable to supply airplane essential systems for at least 10 minutes, even if the RAT is failed.

Whenever the battery temperature reaches 70°C for at least 2 seconds, the associated indication becomes red and the EICAS WARNING message BATT 1 (2) OVERTEMP is triggered.

The minimum battery #2 temperature for APU starting is -20°C.

DC EXTERNAL POWER SOURCE (DC GPU)

When DC GPU is connected during the APU starting cycle, the DC external power source, and not battery #2, provides 28 VDC power to the APU START BUS.

The DC GPU is used when the battery is no longer available or the battery #2 temperature is below -20°C.

A suitable DC GPU should be able to supply the airplane systems with at least 24 VDC and no more than 29 VDC, when under use. The voltage may be checked on the synoptic page on MFD.

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ELECTRICAL POWER DISTRIBUTION AND CONTROL

Four Integrated Control Centers (ICCs) and two Secondary Power Distribution Assemblies (SPDAs) provide distribution and control of the electrical power, and interface with other systems.

INTEGRATED CONTROL CENTER (ICC)

The ICC is an electrical-electronic integrated device, providing power distribution and protection for the airplane electrical loads, the secondary power distribution assemblies (SPDAs) and the circuit breakers that are located on the cockpit sidewall panels.

A total of four ICCs are implemented in the electrical system.

- Left Integrated Control Center (LICC).
- Right Integrated Control Center (RICC).
- Emergency Integrated Control Center (EICC).
- Auxiliary Integrated Control Center (AICC).

Each ICC, installed in the electronics bay, incorporates thermal circuit breakers (CBs), line replaceable units (LRUs), line replaceable modules (LRMs) and AC/DC electrical buses. The LRUs and LRMs allow quick access and easy replacement of electrical components, thereby minimizing any delays due to maintenance servicing.

AC/DC electrical buses are the primary source of electrical power distribution. These buses are located inside the respective ICCs:

LICC	**RICC**	**EICC**	**AICC**
AC BUS 1	AC BUS 2	AC ESS BUS	HOT BATT BUS 2
AC GND SVC BUS	DC BUS 2	STBY AC BUS	APU START BUS
DC GND SVC BUS	DC ESS BUS 2	DC ESS BUS 1	
DC BUS 1		DC ESS BUS 3	
		HOT BATT BUS 1	

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SECONDARY POWER DISTRIBUTION ASSEMBLIES (SPDA)

An SPDA is an electrical load management unit, which receives power from the ICC AC/DC electrical buses and distributes it to the airplane systems, according to system distribution logic.

Two independent SPDAs replace thermal circuit breakers (CBs) and electromechanical relays used in other airplanes, thereby reducing the amount of electrical hardware as well as flight crew workload.

SPDAs also have the advantage of integrating protection, logic/control and power supply. Each SPDA has a specific number of slots, into which different electronic modules are plugged. Each module has an associated function such as providing communication, data processing and power distribution.

Communication modules use ARINC 429 to integrate SPDAs, ICCs and multi-function control units (MCDUs).

Four independent DC BUSES power the SPDAs providing redundancy and ensuring system segregation:

SPDA1

- DC BUS 1
- DC ESS BUS 1
- DC ESS BUS 2
- DC GND SVC

SPDA2

- DC BUS 2
- DC ESS BUS 1
- DC ESS BUS 2
- DC GND SVC

SPDA 1 is located at the forward electronics bay and SPDA 2 is located at the center electronics bay.

Each SPDA incorporates ELECTRONIC CBs (solid state power controllers - SSPC), which protect load distribution to the following systems.

- AMS
- Electrical
- Fuel
- Hydraulic
- Anti-ice
- Lighting
- Oxygen
- Engine ignition and starting
- Water
- APU
- Fire protection

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CIRCUIT BREAKERS (CB)

Circuit Breakers are classified as either thermal or electronic CBs.

Some thermal CBs are located on the cockpit sidewall panels and others inside the ICCs in the electronics bays.

The electronic CBs are located inside the SPDAs, in the electronics bays.

All CBs situated in the electronics bays are considered remote CBs.

The flight crew can visually monitor all circuit breakers located inside the cockpit and, via MCDUs, the remote CBs in the electronics bays.

The ICC remote thermal CBs can only be reset by maintenance personal when the airplane is on ground.

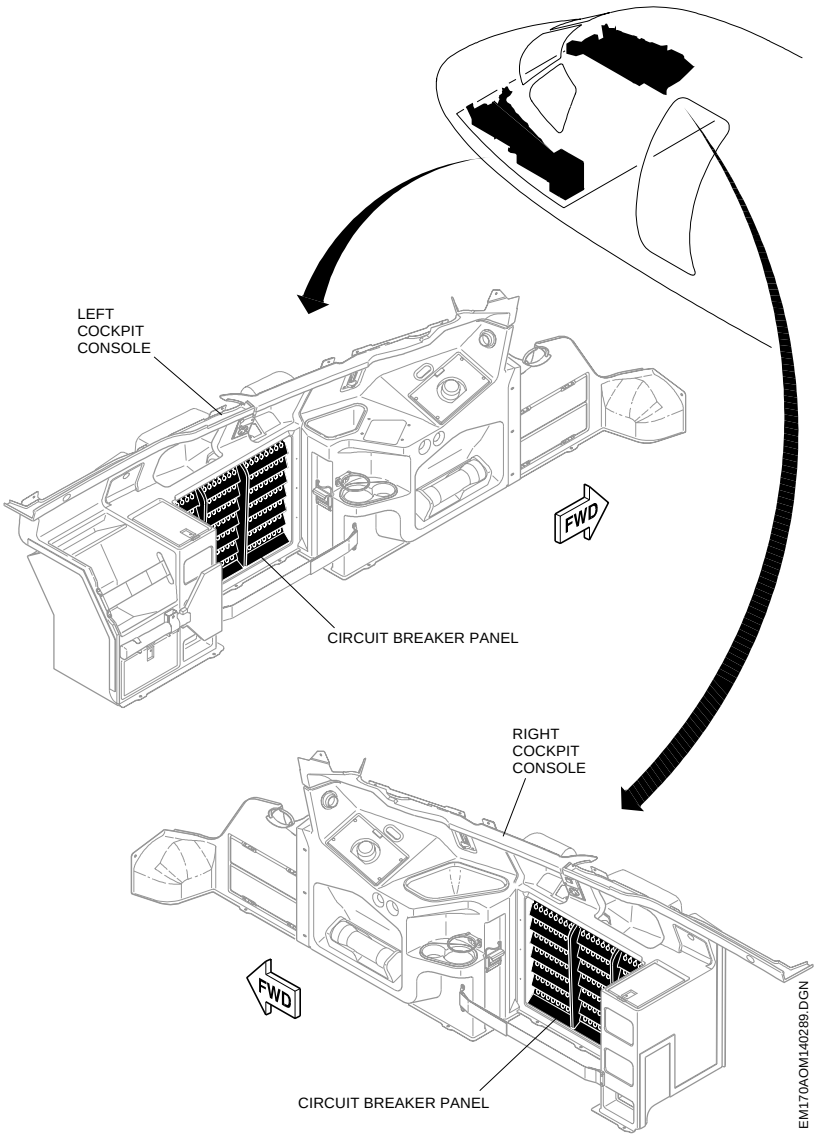
The flight crew can reset the SPDA remote electronic CBs via the MCDU.

Circuit breakers types and location		
LOCATION	TYPE	
	THERMAL	ELECTRONIC
Remote	ICCs	SPDAs
Non remote	Cockpit	----------

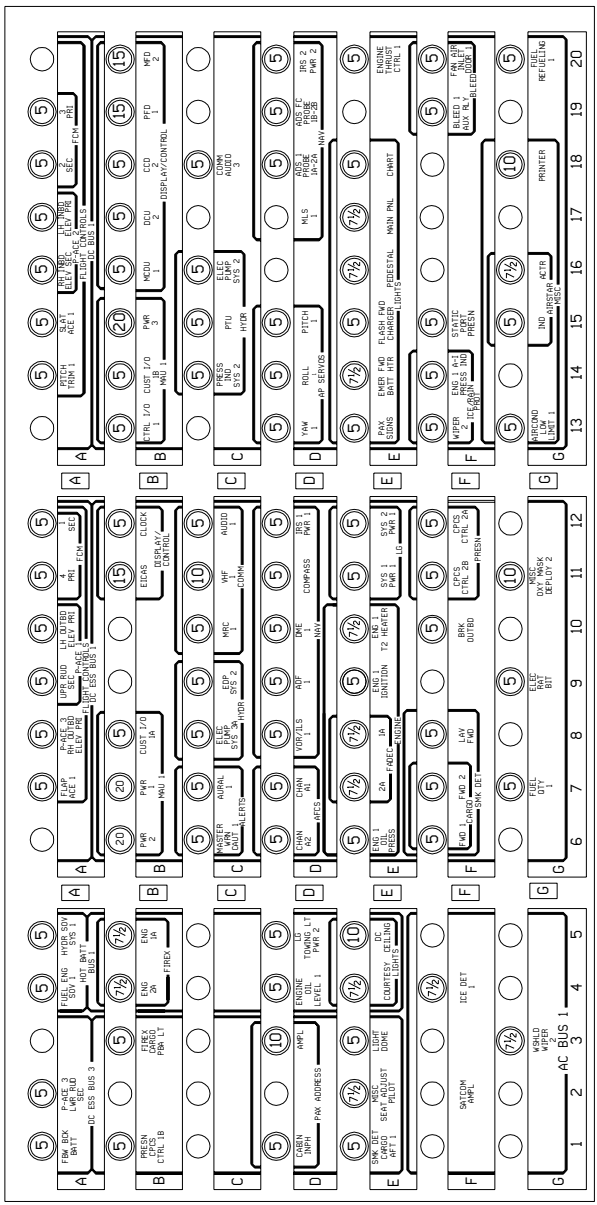
CIRCUIT BREAKER PANEL

Columns and rows on the CB panel are identified through an alphanumeric naming convention.

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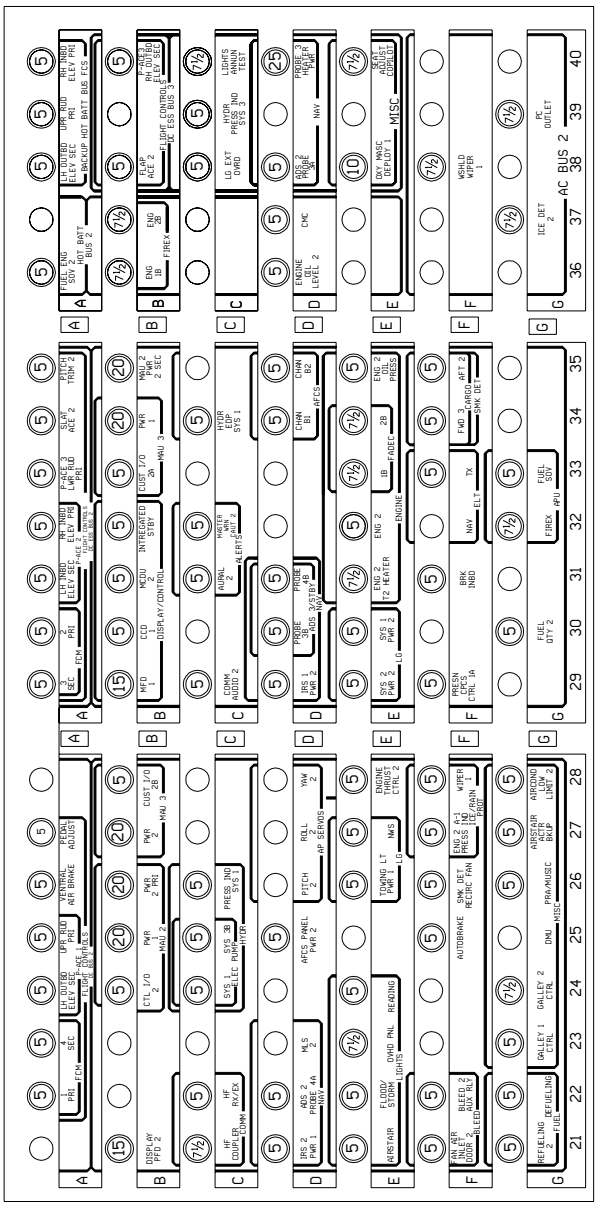


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LEFT STANDARD CB PANEL

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RIGHT STANDARD CB PANEL

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REMOTE CBS

The flight crew can visually monitor remote circuit breakers located inside the electronics bays through the MCDU CB page by pressing the CB function key on the MCDU. Regardless of the page currently displayed on the MCDU, the page OUT/LOCK displays.

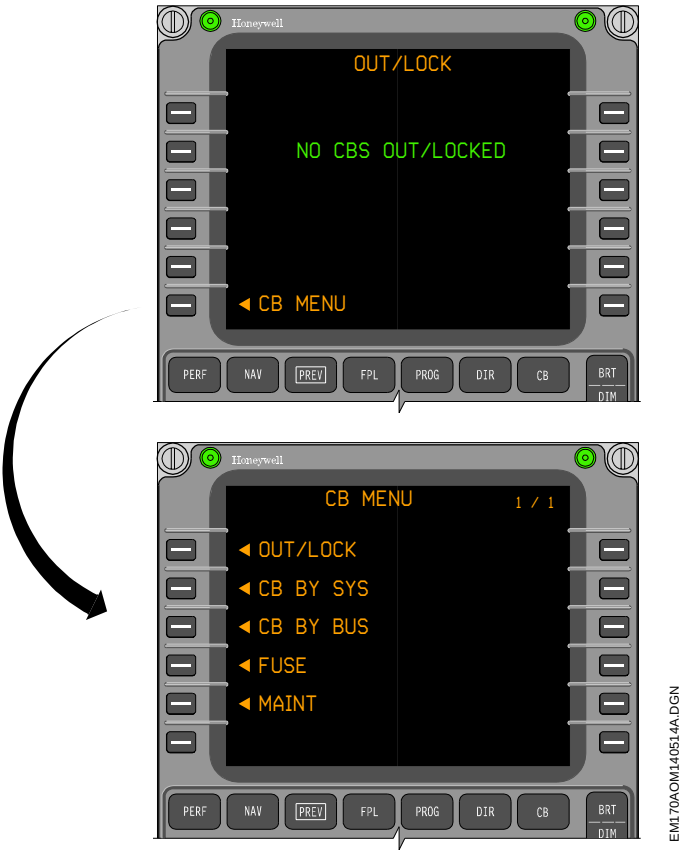
CB MENU status page is achieved when the line select key 6L is pressed. The following options are presented:

- OUT/LOCK (1L): displays all OUT or LOCKED CBs.
- CB BY SYS (2L): displays the status of CBs associated with the selected system.
- CB BY BUS (3L): displays the status of CBs associated with the selected BUS.
- FUSE (4L): displays fuse status.
- MAINT (5L): maintenance page.

The CB MENU page displays “NEW TRIP” on line select key 6R when a CB/SSPC trip occurs. Pressing the key (6R) displays the tripped CB/SSPC on the OUT/LOCK page. Pressing the line select key on left side of respective tripped remote CB/SSPC, sets the CB/SSPC condition to acknowledged and extinguishes the EICAS message REMOTE CB TRIP.

NOTE: CB menu status page is for CB status monitoring only. Report maintenance when a CB trip occurs.

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CB MENU PAGE ON MCDU

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AC/DC BUSSES LOAD DISTRIBUTION

The following list identifies the electrical buses and the equipment powered by them. An asterisk (*) precedes optional equipments.

	DC BUS 1
	AFT ENTRANCE LIGHTS
	AFT FLASH LIGHTS CHARGER / AFT LAV LIGHTS
*	AIRSTAIR ACTUATOR
	COCKPIT CHART LIGHTS
	COCKPIT MAIN PANEL LIGHTING
	COCKPIT PEDESTAL LIGHTING
	COPILOT CURSOR CONTROL DEVICE
	COPILOT MFD
	CURSOR CONTROL DEVICE 2
	DIGITAL AUDIO CONTROL PANEL 3
*	EFB 1 and 2
	EMERGENCY LIGHTS POWER UNITS (ELPU)
	ENGINE 1 THRUST QUADRAND
	ENGINE 1 THRUST REV LEVER SW
	ENGINE 1 NACELLE ANTI-ICE VALVE
	FWD FLASH LIGHT CHARGER / WARDROBE LIGHT
	FWD LAV LIGHTS
	FWD LAV / RECIRCULATION
	FWD / MAIN ENTRANCE LIGHTS
	GALLEY AREA LIGHTS
	GALLEY G3 CONTROL
	GASPER VALVE
	GUIDANCE PANEL 2 (DISPLAY CONTROLLER 2)
	HS-ACE CH 1
	HYD MOTOR PUMP 2 COMMAND
	LEFT IDLE LOCK SOLENOID
	LH FLIGHT ATTND READING LT 1 COMMAND
	LH FLIGHT ATTND READING LT 2 COMMAND
	LH FLIGHT ATTND SEAT READING LT
	MAU 1 FCM 1 PWR B
	MAU 1 FCM 2 PWR B

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	DC BUS 1
	MAU 1 PWR SUPPLY 3
	MICRO IRU 2 (PWR 2)
*	MLS RECEIVER 1
	OXYGEN DEPLOY 1
	P-ACE #2-1 LEFT INBOARD ELEVATOR (P)
	P-ACE #2-2 RIGHT INBOARD ELEVATOR (S)
	PASSENGER SIGNS
	PILOT MCDU
	PILOT PFD
	PITOT / STATIC / AOA1 HEATER PWR
	PITOT / STATIC / AOA1 SENSOR
	PITOT / STATIC / AOA2 HEATER PWR
	PITOT / STATIC / AOA2 SENSOR
*	PRINTER
	RADIO ALTIMETER 1
	READING LIGHTS AFT LEFT
	READING LIGHTS FWD LEFT
	REFUEL 1
	RH FLIGHT ATTND SEAT READING LT
	SATELITE DATA UNIT
	SF-ACE 1 SLAT CH 1 DC FEED
	SPDA1 PWR SUPPLY FEED 1
	TAT 1 HEATER PWR
*	VHF COMM MOD 3
	VOR 3
	WATER AND WASTE SYSTEM CONTROLLER PWR 2
	WEATHER RADAR CONTROL 1
	WEATHER RADAR RECEIVER / TRANSMITTER (WEATHER RADAR / ANTENNA)
	WINDSHIELD HEATER 2 CONTROL
	WINDSHIELD WIPER 2 CONTROL
	WING INSPECTION LIGHTS

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	DC BUS 2
*	ADF MODULE 2
*	AIRSTAIR LIGHTS
*	AUTO-BRAKE MODULE
	CARGO SHUTTOFF VALVE
	COCKPIT FLOOD / STORM LIGHTS
	COCKPIT OVERHEAD PANEL LIGHTING
	COCKPIT READING LIGHTS
	COPILOT PFD
	DEFUEL
	DME MODULE 2
*	DMU
	ENGINE 2 THRUST QUADRAND
	ENGINE 2 THRUST REV LEVER SW
	ENGINE 2 NACELLE ANTI-ICE VALVE COMMAND
	FDR / CVR 1 (DVDR 1)
	GALLEY G1 CONTROL
	GALLEY G2 CONTROL
	GUIDANCE PANEL 2 (GP2)
	HF RECEIVER / EMITTER (Single HF)
	HF RECEIVER / EMITTER 2 (Dual HF)
	HYD MOTOR PUMP 1 COMMAND
	HYD MOTOR PUMP 3B COMMAND
*	INFLIGHT ENTERTAINMENT
	LOGOTYPE LIGHTS
	MAU 2 PWR 2 PRIMARY
	MAU 2 PWR SUPPLY 1
	MAU 3FCM 3 PWR B
	MAU 3 FCM 4 PWR B
	MAU 3 PWR SUPPLY 2
	MICRO IRU 2 (PWR 1)
*	MLS RECEIVER 2
	MODE S DIVERSITY TRANSPONDER MOD 2
	NAVIGATION MODULE 2
	NOSEWHEEL STEERING

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	DC BUS 2
	OXYGEN DEPLOY 2
	P-ACE #1-1 LEFT OUT ELEVATOR (S)
	P-ACE #1-2 UPPER RUDDER (P)
	PEDALS ADJUSTMENTS
	PITOT / STATIC / AOA4 HEATER PWR
	PITOT / STATIC / AOA4 SENSOR
*	PRE-RECORDED ANNOUNCEMENT
*	RADIO ALTIMETER 2
	READING LIGHTS AFT RIGHT
	READING LIGHTS FWD RIGHT
	READING LIGHTS MID LEFT
	READING LIGHTS MID RIGHT
	REFUEL 2
	RIGHT IDLE LOCK SOLENOID
	ROLL TRIM
	SMOKE DET RECIRC FAN
	SPDA2 PWR SUPPLY FEED 1
	TAT 2 HEATER PWR
	TCAS 2000
	VHF COMM MOD 2
	WINDSHIELD HEATER 1 CONTROL
	WINDSHIELD WIPER 1 CONTROL

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	DC ESS BUS 1
	ADF MODULE 1
	AFT CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 2
	FWD CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 2
	AFT CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 2
	FWD CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 2
	AFT FLIGHT ATTND PANEL INDICATION LEDS
	APU FADEC
	AFCS CH 1A (AIOP 1A)
	AFCS CH 2A (AIOP 2A)
	BRAKE CONTROL MODULE 1
	BRAKE CONTROL SOV OUTBOARD MOD1
	BRAKE SHUTOFF VALVE SWITCHED OUTBOARD
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 2A
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 2B
	CLOCK
	COMPASS
	DC APU / ENGINE PUMP COMMAND
	DIGITAL AUDIO CONTROL PANEL 1
	DME MODULE 1
*	DOOR SILL HEATER COMMAND
	EICAS
	ENGINE 1 EXCITER 1A COMMAND
	ENGINE 1 START VALVE
	ENGINE 1 OIL PRESSURE
	FADEC 1 CH A FEED 1 & FEED 2
	FADEC 2 CH A FEED 1 & FEED 2
	FDR ACCELEROMETER
	FUEL QUANTITY 1
	FWD GALLEY HEATER COMMAND
	FWD LAV SMOKE DETECTOR
	GALLEY 2 FEED 1 COMMAND
	GALLEY 3 FEED 4 COMMAND
	GUIDANCE PANEL 1 (GP1)
	HYD MOTOR PUMP 3A COMMAND

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DC ESS BUS 1
IDG1 DISCONNECT SOLENOID
INTEGRATED STANDBY
INVERTER DC FEED
LANDING GEAR SYS 1 PWR 1
LANDING GEAR SYS 2 PWR 1
MAU 1 FCM 1 PWR A
MAU 1 FCM 2 PWR A
MAU 1 PWR SUPPLY 1
MAU 1 PWR SUPPLY 2
MICRO IRU 1 (PWR 1)
MODE S DIVERSITY TRANSPONDER MOD 1
NAVIGATION MODULE 1
P-ACE #1-1 LEFT OUT ELEVATOR (P)
P-ACE #1-2 UPPER RUDDER (S)
P-ACE #3-1 RIGHT OUT ELEVATOR (P)
PAX OXY DEPLOY 1 (MANUAL)
PILOT MASTER WRN / CAUTION 1
PITCH TRIM 1 CONTROL
PITOT / STATIC / AOA4 COMMAND
RAT BIT
RAT DEPLOY SOLENOID
RIGHT SMOKE DET F1-CARGO BAY
RIGHT SMOKE DET F2-CARGO BAY
SF-ACE 1 FLAP CH 1 DC FEED
SPDA 1 PWR SUPPLY FEED 3
SPDA 2 PWR SUPPLY FEED 3
VHF COMM MOD 1

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	DC ESS BUS 2
	AC FUEL PUMP 1 COMMAND
	AC FUEL PUMP 2 COMMAND
	ADS 3 / STBY PROBE 4B
	AFT FLIGHT ATTND PANEL GALLEY MASTER SW OUT
	AFT GALLEY HEATER COMMAND
	AFT LAV SMOKE DET
	APU FIRE DETECTION
	APU FIRE EXTINGUISH
	APU FUEL SHUTOFF VALVE
	AFCS CH 1B (AIOP 1B)
	AFCS CH 2B (AIOP 2B)
	BRAKE CONTROL SOV INBOARD MOD 2
	BRAKE CONTROL MODULE 2
	BRAKE SHUTOFF VALVE SWITCHED INBOARD
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 1A
	COPILOT MASTER WRN / CAUTION 2
	COPILOT MCDU
	CURSOR CONTROL DEVICE 1
	DC APU / ENGINE PUMP
	DIGITAL AUDIO CONTROL PANEL 2
*	ELT (TRANSMITTER)
*	ELT NAV UNIT
	ENGINE 2 EXCITER 2A COMMAND
	ENGINE 2 START VALVE
	ENGINE 2 OIL PRESSURE
	FADEC 1 CH B FEED1 & FEED2
	FADEC 2 CH B FEED1 & FEED2
	FDR / CVR 2 (DVDR 2)
	FUEL QUANTITY 2
	GUIDANCE PANEL 1 (DISPLAY CONTROLLER 1)
	HS-ACE CH 2
	HS-ACE CH 2 PWR
	INTEGRATED STANDBY
	LEFT SMOKE DET A2-CARGO BAY

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DC ESS BUS 2
LEFT SMOKE DET F3-CARGO BAY
LANDING GEAR SYS 1 PWR 2
LANDING GEAR SYS 2 PWR 1
MAU 2 PWR SUPPLY 2
MAU 3 FCM 3 PWR A
MAU 3 FCM 4 PWR A
MAU 3 PWR SUPPLY 1
MICRO IRU 1 (PWR 2)
P-ACE #2-1 LEFT INBOARD ELEVATOR (S)
P-ACE #2-2 RIGHT INBOARD ELEVATOR (P)
P-ACE #3-2 LOWER RUDDER ACT (P)
PILOT CURSOR CONTROL DEVICE
PILOT MFD
PITOT / STATIC / AOA1 AND AOA2 COMMANDS
PITOT / STATIC / AOA3 HEATER PWR
PITOT / STATIC / AOA3 SENSOR
RAM AIR DOOR 1
RIGHT SMOKE DET A3-CARGO BAY
RIGHT SMOKE DET F4-CARGO BAY
SF-ACE 2 SLAT CH 2 DC FEED
SMOKE DET TEST
SPDA1 PWR SUPPLY FEED 2
SPDA2 PWR SUPPLY FEED 2
VALVE APU FEED MOTOR OPERATED SHUTOFF FUEL

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	DC ESS BUS 3
	ADS 2 PROBE 3A
	CABIN INTERPHONE (PA HANDSET)
	CABIN PRESSURIZATION CONTROL SYSTEM CONTROLLER 1B
	COCKPIT DOME LIGHTS
	COCKPIT PUSH BUTTON LIGHTS
	CROSS FEED VALVE
	FIREX SWITCHES
	AFT CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 1
	FWD CARGO BAY BOTTLE 1 ELECTRO-EXPLOSIVE DEVICE FEED 1
	AFT CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 1
	FWD CARGO BAY BOTTLE 2 ELECTRO-EXPLOSIVE DEVICE FEED 1
	HF RECEIVER / EMITTER 1 (Dual HF)
	IDG 2 DISCONNECT SOLENOID
	LANDING GEAR LEVER LOCK
	LANDING GEAR OVERRIDE SWITCH
	MID EMERG FAN COMMAND
	P-ACE #3-1 RIGHT OUT ELEVATOR (S)
	P-ACE #3-2 LOWER RUDDER ACT (S)
	PAX OXY DEPLOY 2 (OVRD COMMAND)
	PITCH TRIM 2 CONTROL
	PROBE 3 HEATER PWR 2
*	RADIO ALTIMETER 3
	RAM AIR DOOR 2
	RIGHT SMOKE DET A1-CARGO BAY
	RUDDER TRIM
	SEAT 1 ADJUSTMENT
	SEAT 2 ADJUSTMENT
	SF-ACE 2 FLAP CH 2 DC FEED

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DC GND SVC
AFT CARGO COMPARTMENT LIGHTS
AFT CARGO LOADING LIGHTS
AFT ENTRANCE LIGHTS
AFT FLASH LIGHTS CHARGER / AFT LAV LIGHTS
AFT LAV LIGHTS
COURTESY LIGHTS
FWD CARGO LIGHTS
FWD LAV LIGHTS
FWD / MAIN ENTRANCE LIGHTS
GALLEY AREA LIGHTS
SERVICE COMPARTMENT LIGHTS AFT / FWD
SPDA 1 PWR SUPPLY FEED 4
SPDA 2 PWR SUPPLY FEED 4
WATER AND WASTE SYSTEM CONTROLLER PWR1

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DC HOT BAT BUS 1
BATTERY 1
COURTESY / SERVICE LIGHTS FWD
DC CEILING LIGHTS
ENGINE 1 OIL LEVEL INDICATION
ENGINE 1A FIRE EXTINGUISH
ENGINE 2A FIRE EXTINGUISH
ENGINE FUEL SHUTOFF VALVE 1
HYD SYS SOV 1

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DC HOT BAT BUS 2
BATTERY 2
CMC
ENGINE 1B FIRE EXTINGUISH
ENGINE 2 OIL LEVEL INDICATION
ENGINE 2B FIRE EXTINGUISH
ENGINE FUEL SHUTOFF VALVE 2
HYD SYS SOV 2
PANEL REFUEL 3
WATER AND WASTE SYSTEM CONTROLLER PWR 3

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APU BUS
APU START

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	AC BUS 1
	AC FUEL PUMP 1
	ENGINE 1 EXCITER 1B
*	FAN CARGO BAY
	GALLEY 2 FEED 1 (COFFEE MAKER)
	GALLEY 3 FEED 4 (STEAM OVEN)
	GREEN / WHITE STBY POSITION LT'S RIGHT
	HYD MOTOR PUMP 2
	ICE DET 1
	LEFT LANDING LIGHT
	LEFT RECIRC FAN
	LEFT TAXI LIGHT
	PITCH TRIM 1 AC POWER
	RED BEACON LIGHT UPPER / LOWER
	RED / WHITE STBY POSITION LT'S LEFT
	SF-ACE 1 SLAT CH 1 AC FEED
	WINDSHIELD HEATER 2 PWR
	WINDSHIELD WIPER 2 PWR

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	AC BUS 2
*	AFT DOOR SILL HEATER
	AFT GALLEY HEATER
*	COCKPIT LAPTOP AC OUTLETS
	ENGINE 2 EXCITER 2B
	FAN 2 FWD BAY
	FAN 2 MID BAY
*	FWD DOOR SILL HEATER
	GALLEY 2 FEED 3 (STEAM OVEN 1)
	GALLEY 3 FEED 1 (COFFEE MAKER)
	GALLEY 3 FEED 2 HOT JUG
	GALLEY 3 FEED 5 (CHILLER)
	GREEN / WHITE MAIN POSITION LT'S RIGHT
	HYD MOTOR PUMP 1
	HYD MOTOR PUMP 3B
	ICE DET 2
	RED / WHITE MAIN POSITION LT'S LEFT
	RIGHT LANDING LIGHT
	RIGHT TAXI LIGHT
	SF-ACE 2 FLAP CH 2 AC FEED
	STROBE LIGHTS WHITE LH / RH
	WINDSHIELD HEATER 1 PWR
	WINDSHIELD WIPER 1 PWR

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AC ESS BUS
AC FUEL PUMP 2A
HYD MOTOR PUMP 3A
PITCH TRIM 2 AC PWR
SF-ACE 1 FLAP CH 1 AC FEED
SF-ACE 2 SLAT CH 2 AC FEED

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AC GND SVC
AC OUTLET PWR1
AC OUTLET PWR2
CEILING LIGHTS
DRAIN MAST AFT
DRAIN MAST FWD
FAN 1 FWD BAY
FAN 1 MID BAY
FILL/DRAIN NIPPLE HEATER
GALLEY 1 HOT JUG
GALLEY 3 HOT JUG
WASTE SVC PANEL RINSE NIPPLE / VALVE HEATER
NOSE LANDING LIGHT
NOSE TAXI LIGHT
RAT HEATER
SIDEWALL LIGHTS
VACUUM MOTOR GEN
WATER COMPRESSOR
WATER HEATER AFT LAV
WATER HEATER FWD LAV

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STBY AC BUS
ENGINE 1 EXCITER 1A
ENGINE 2 EXCITER 2A

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ELECTRICAL DISTRIBUTION AND SYSTEM CONFIGURATION

The electrical system normal and some abnormal operations are automatic.

ELECTRICAL SYSTEM BASIC DISTRIBUTION

ELECTRICAL POWER GENERATORS

The electrical power generated from the IDG, APU, GPU or batteries is directed to the electrical buses.

SPDA

From the electrical buses the power is directed to the airplane systems and components through the SPDA.

The SPDA works as circuit breaker or relay interfacing the electrical buses with the airplane systems and components.

MAU

The airplane systems that require a complex logic for the normal operation are connected to the MAUs which have the ability to process various inputs and define either ON / OFF or OPEN / CLOSE status for a specific system.

Some airplane components have an alternate direct connection with the electrical buses allowing normal operation even in the event of a SPDA or MAU failure.

ELECTRICAL SYSTEM BUSES POWER SOURCE

	ELECTRICAL POWER SOURCE	
ELECTRICAL BUS	**NORMAL SOURCE**	**NON-NORMAL SOURCE**
AC BUS 1	IDG 1, APU or AC GPU on ground.	AC BUS 2
AC BUS 2	IDG 2, APU or AC GPU on ground.	AC BUS 1
AC ESS	AC BUS 2	AC BUS 1 RAT (electrical emergency)

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	ELECTRICAL POWER SOURCE	
ELECTRICAL BUS	**NORMAL SOURCE**	**NON-NORMAL SOURCE**
AC STBY	AC ESS	INVERTER
AC GND SVC	AC BUS 1 or AC GPU on ground.	N/A
DC BUS 1	TRU 1 via AC BUS 1	DC BUS 2
DC BUS 2	TRU 2 via AC BUS 2	DC BUS 1
DC ESS 1	DC BUS 1	DC ESS 3
DC ESS 2	DC BUS 2	DC ESS 3
DC ESS 3	TRU ESS through the AC ESS	DC ESS 1 or DC ESS 2
APU START BUS	BATTERY 2	N/A
HOT BATT 1	BATTERY 1	N/A
HOT BATT 2	BATTERY 2	N/A
DC GND SVC	TRU 1 through the AC GPU.	N/A

ELECTRICAL SYSTEM NORMAL OPERATION

After the initial power up the electrical system is design to operate in automatic mode provided all switches on the electrical panel are in AUTO or ON position.

The source priority order for powering the airplane is:

- Respective IDG.
- APU generator.
- GPU (on ground without APU).
- Opposite IDG.

If required the DC GPU can be used for the APU start.

ELECTRICAL SYSTEM ABNORMAL OPERATION

If a power-generating source fails, the electrical system redirects power from another available source according to the priority order.

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AC BUSES

If one of the AC power sources fails, both AC electrical networks are automatically connected by bus tie contactors (BTCs).

One AC power source is sufficient to supply the whole system without significant degradation or additional workload.

LOAD SHED

For overload protection whenever the electrical load increases beyond the system limit the SPDA commands the load shedding protection.

The components turned off by the load shedding are:

- Galleys and;
- Right windshield heating.

When possible the electrical system restores the electrical power to deprived components.

TRU FAILURE

In case of a TRU failure the respective DC BUS is automatically powered connected to the DC electrical network through both essential tie contactors (ETCs) and a DC tie contactor (DCTC) according to the system logic.

TOTAL AC POWER SOURCE FAILURE

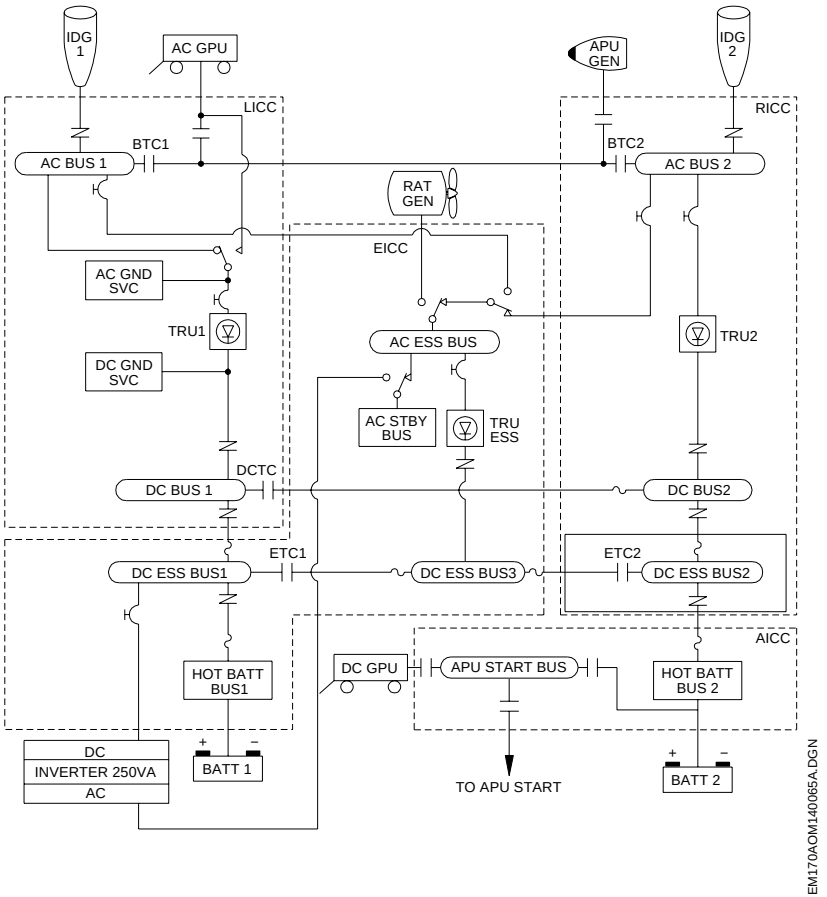
In the event of a total loss of AC power the RAT is automatically deployed and it powers all ESS BUSES.

SYSTEM CONFIGURATIONS

The following are some important examples of electrical load distribution achieved by the system logic.

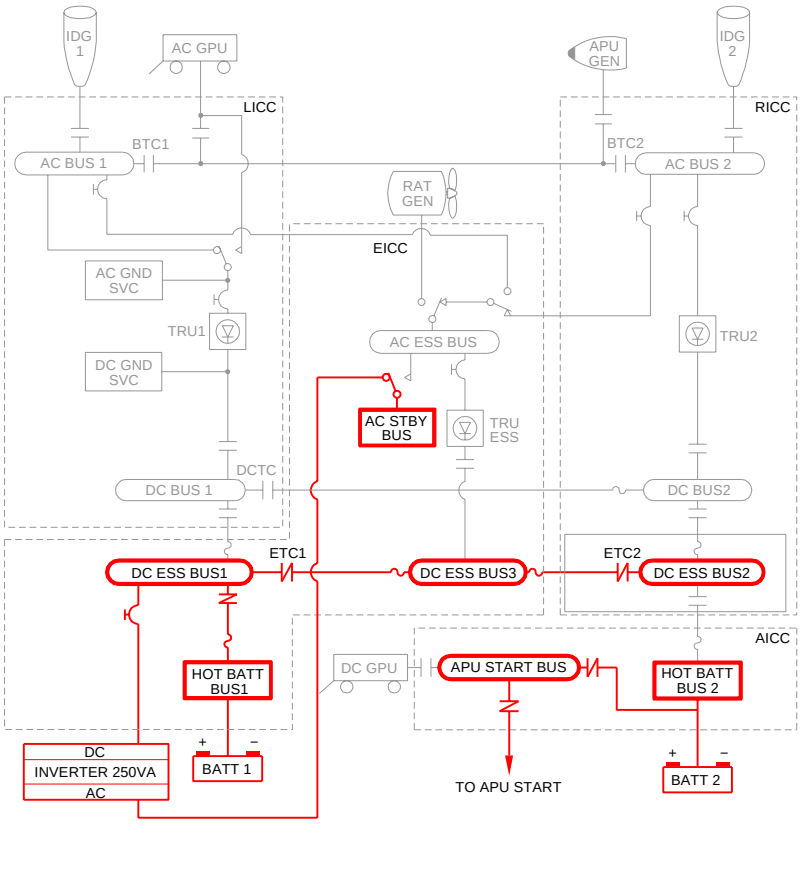
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ELECTRICAL NETWORK UNPOWERED



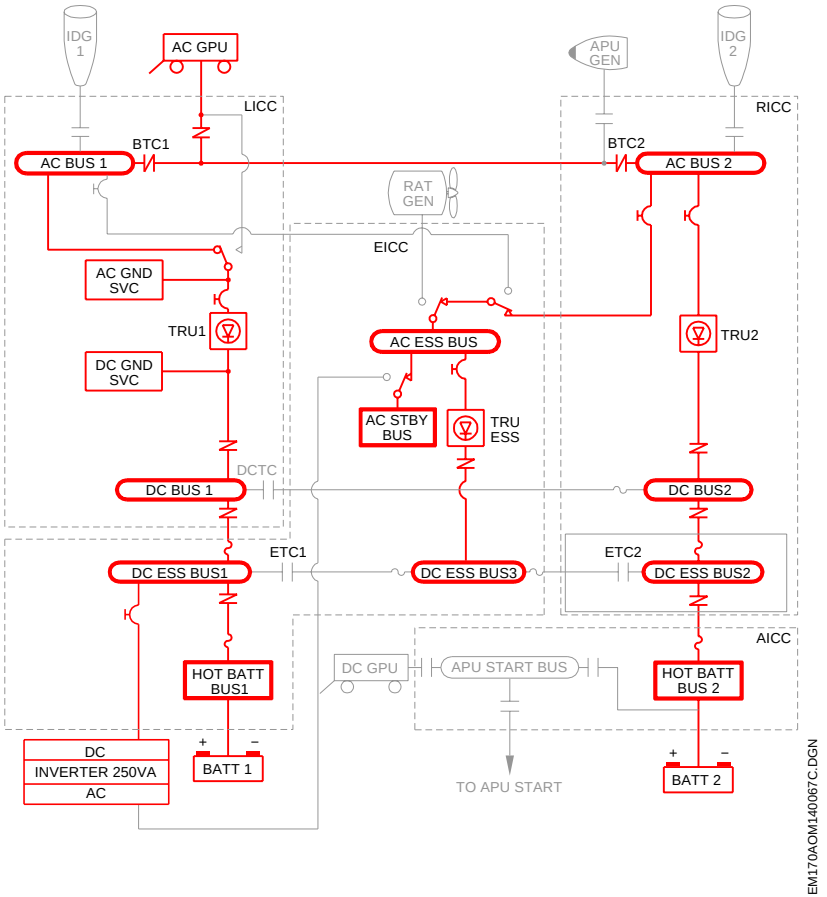
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BATTERIES ONLY/APU START IN PROGRESS



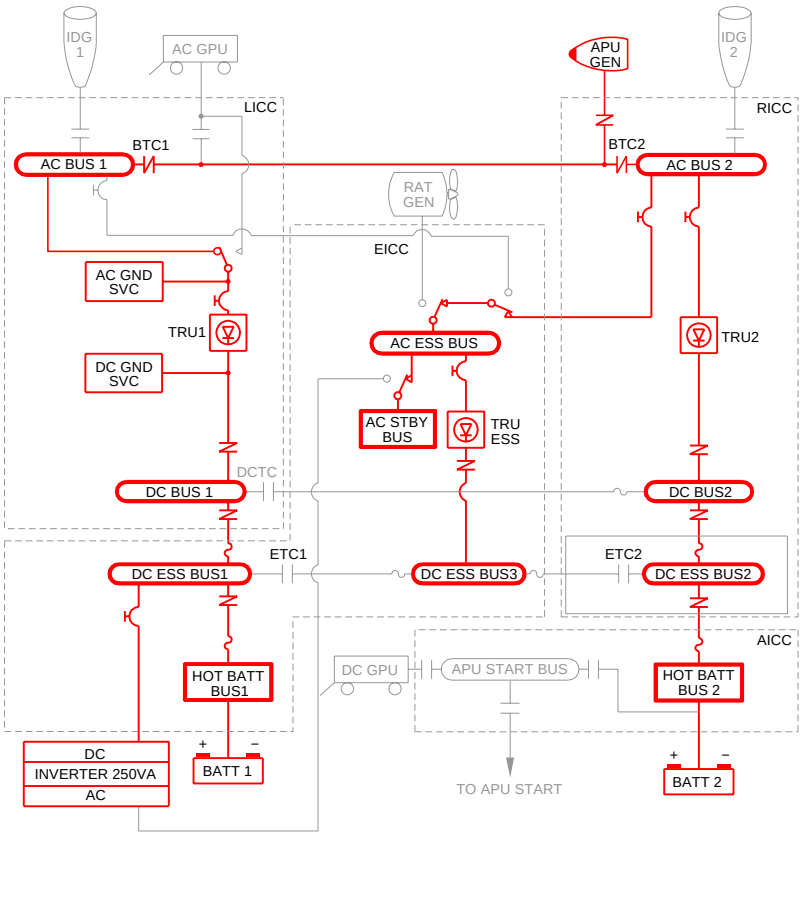
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AC GPU



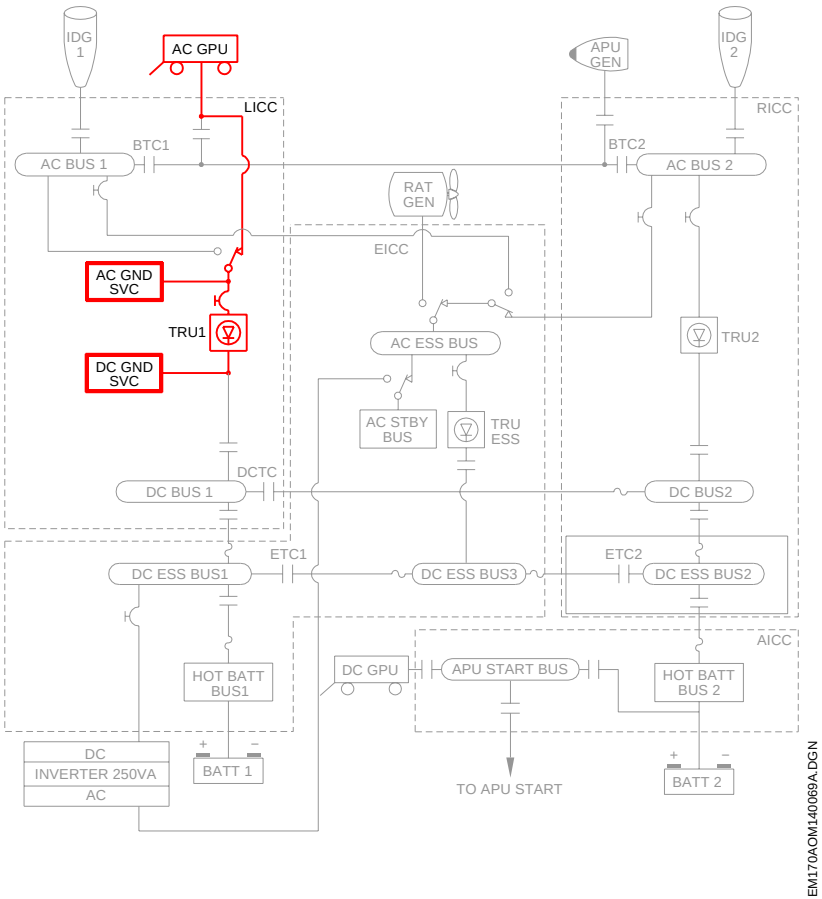
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APU POWER



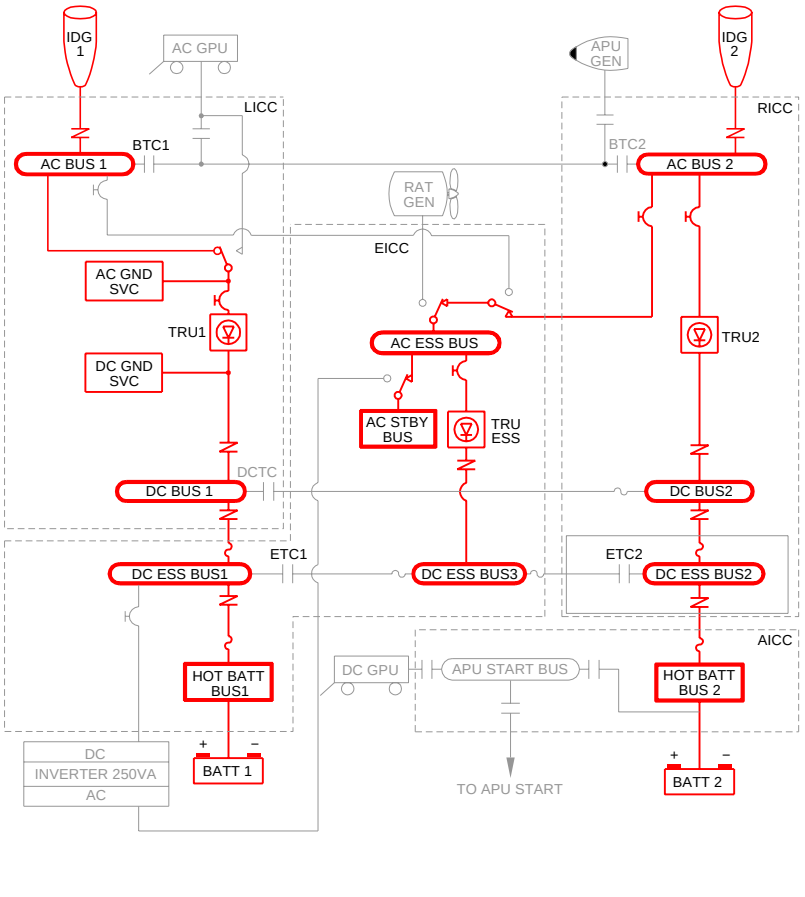
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GROUND SERVICE MODE



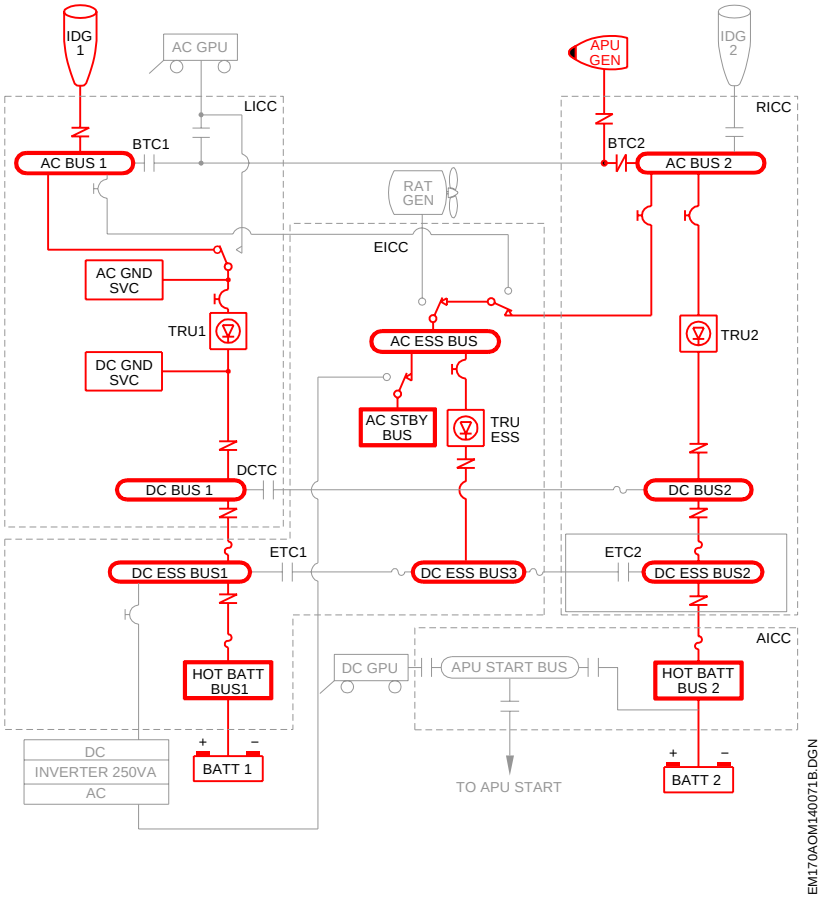
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TWO IDG POWER



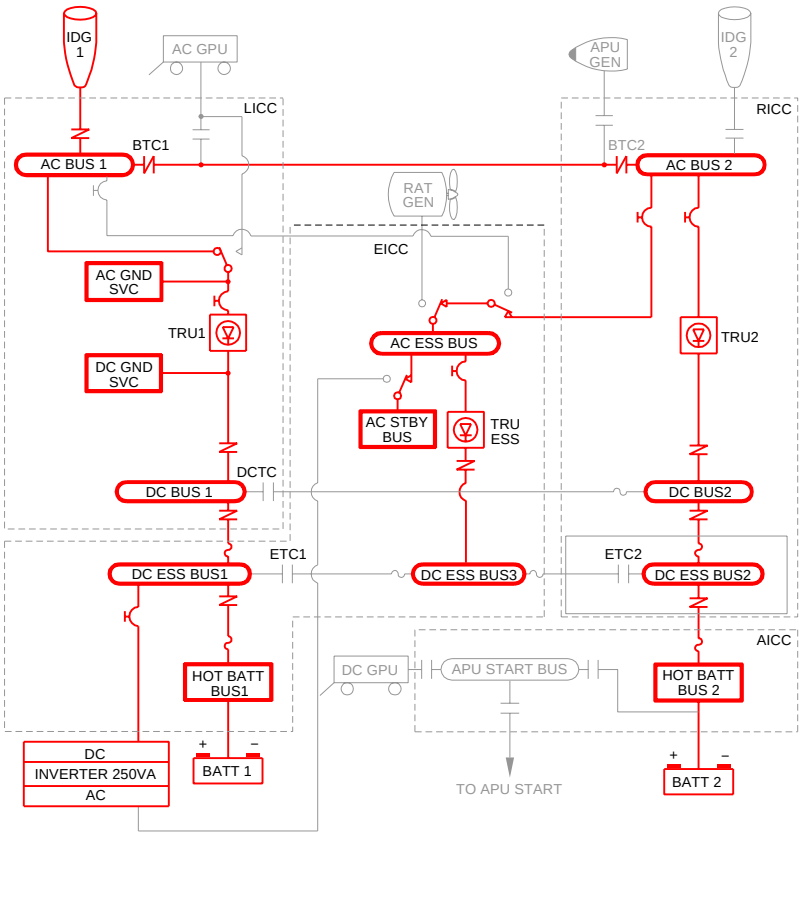
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IDG FAILED AND APU GENERATOR IN USE



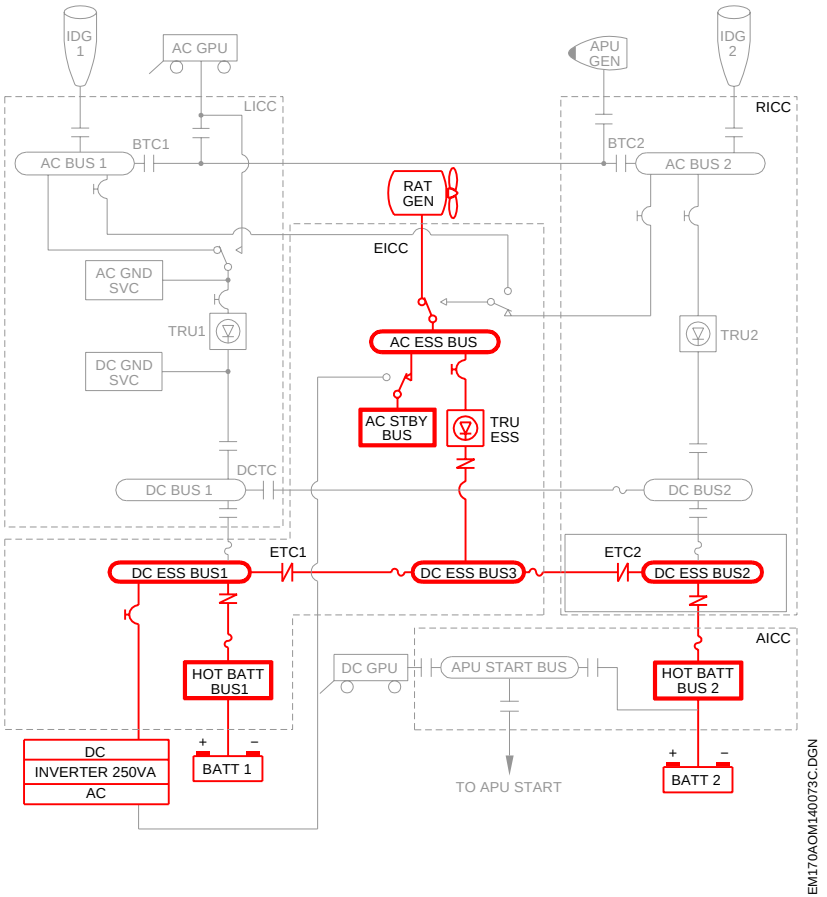
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IDG FAILED AND APU GENERATOR NOT IN USE



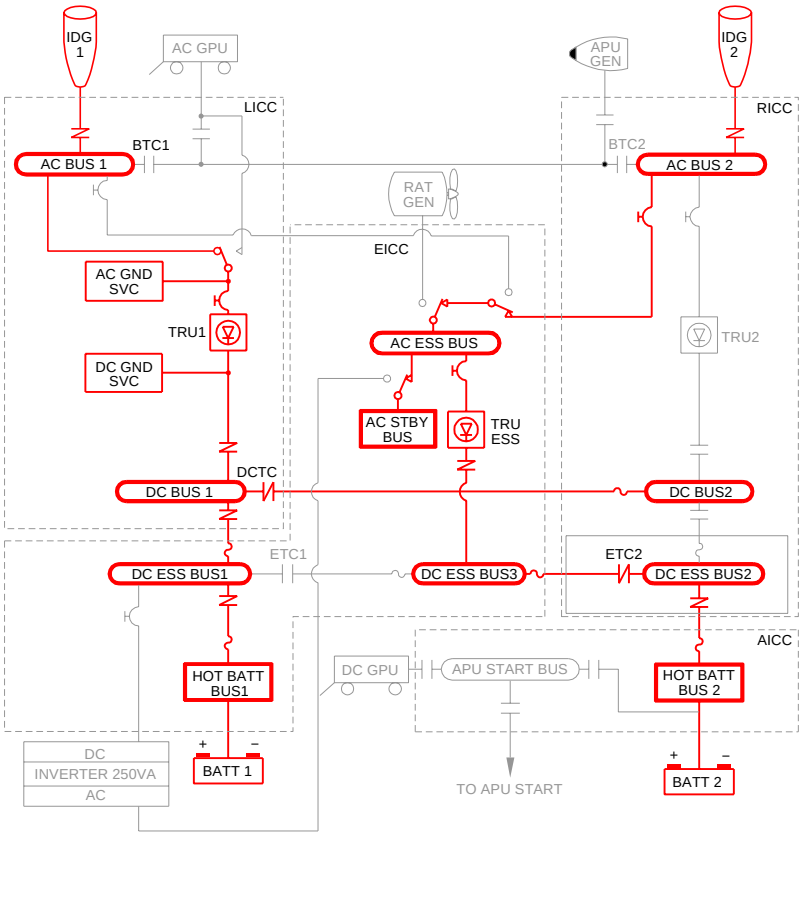
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RAT POWER



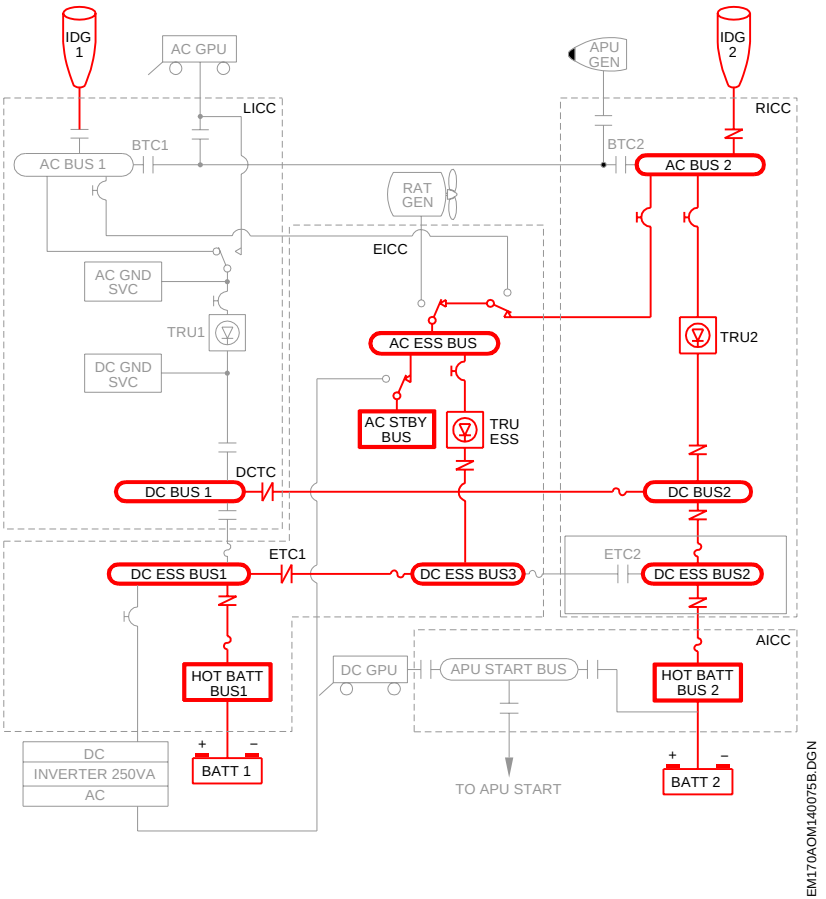
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TRU FAILED



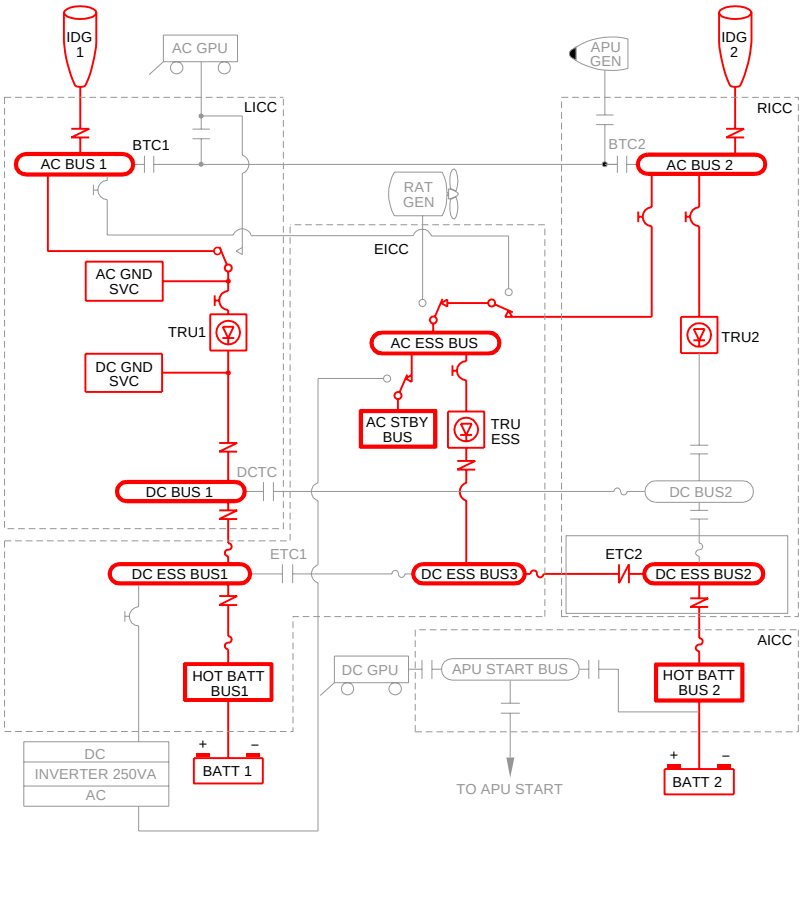
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AC BUS OFF



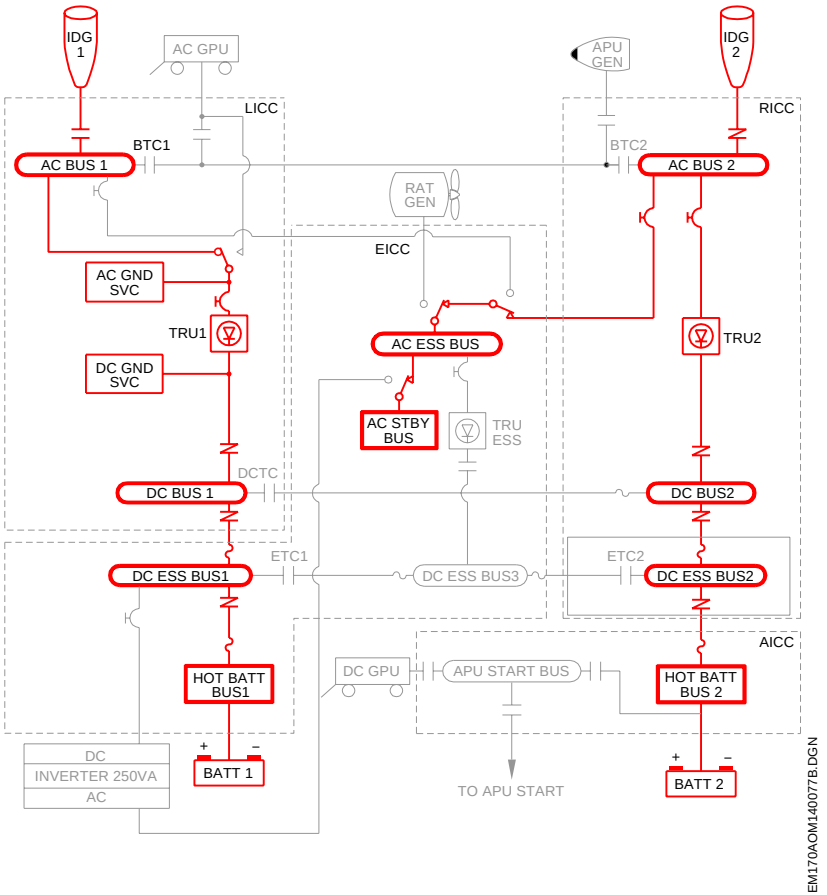
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DC BUS OFF



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DC ESS BUS OFF



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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	BATT 1 (2) OVERTEMP	Associated battery temperature is above 70°C.
	BATT 1-2 OFF	Battery #1 and #2 are isolated from the electrical network.
	BATT DISCHARGING	Batteries are discharging in an electrical emergency with no RAT assistance, or on ground when the battery is the only power source supplying the airplane.
	ELEC EMERGENCY	In flight, AC main buses are de-energized.
CAUTION	AC BUS 1 (2) OFF	Associated AC BUS is de-energized.
	AC ESS BUS OFF	AC ESS BUS is de-energized.
	AC STBY BUS OFF	AC STBY BUS is de-energized.
	APU GEN OFF BUS	APU generator failure or APU GEN button is pushed out.
	BATT 1 (2) DISCHARGING	Associated battery is discharging due to electrical system automation failure, or when battery is the only source supplying the system.
	BATT 1 (2) OFF	Associated battery is isolated from the electrical network.
	BATT 1 (2) TEMP SENS FAULT	A discrepancy between battery sensors has been detected.

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TYPE	MESSAGE	MEANING
CAUTION	DC BUS 1 (2) OFF	Associated DC BUS is de-energized.
	DC ESS BUS 1 (2) (3) OFF	Associated DC ESS BUS is de-energized.
	GPU CONNECTED	AC or DC GPU connected (AVAIL or IN USE indication turned on) and parking brake released.
	IDG 1 (2) OFF BUS	IDG failure or IDG control knob is turned OFF.
	IDG 1 (2) OIL	High oil temperature or low oil pressure has been detected.
	INVERTER FAIL	An inverter failure has been detected during power up built-in test.
	RAT FAIL	A failure was detected during power up built-in test in a RAT system component.
	TRU 1 (2) (ESS) FAIL	An associated TRU failure has been detected.
ADVISORY	LOAD SHED	Load shed automatically commanded.
	REMOTE CB TRIP	A remote thermal or electronic CB has been tripped.
	SPDA FAIL	A significant failure has been detected.

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SECTION 14-06

ENGINE

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GENERAL DESCRIPTION

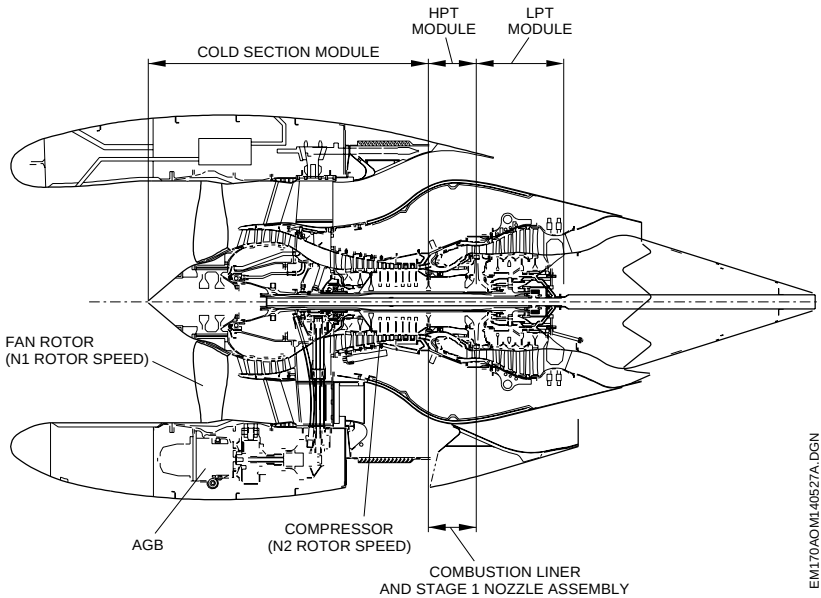
Two wing-mounted General Electric CF34-10E engines produce power to the airplane.

The General Electric CF34-10E is a high-bypass and dual rotor turbofan, fully integrated with a nacelle and thrust reverse.

The N1 and N2 rotors are mechanically and independently operated.

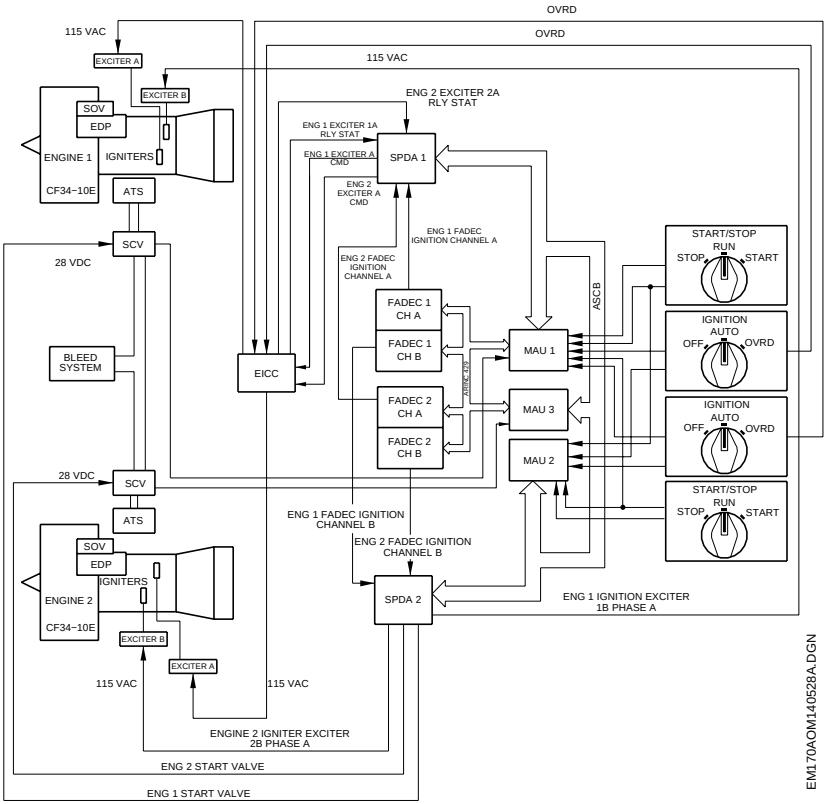
The engine is controlled via a dual channel FADEC system providing flexible engine operation and reduced workload.

Engine indications and alerts are displayed on the Engine Indications and Crew Alerting System (EICAS).



CF34-10E ENGINE

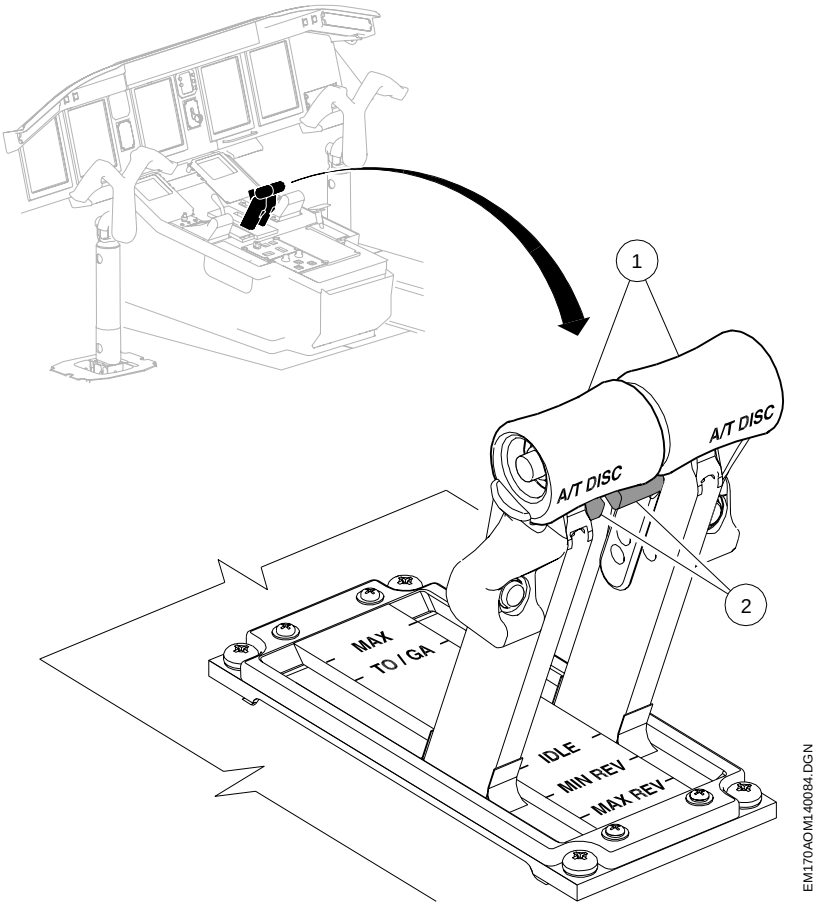
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ENGINE SCHEMATIC

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CONTROL PEDESTAL



1 - THRUST LEVER DETENTS

MAX: provides the maximum thrust rating available for dual or single engine operation.

TO/GA: selects takeoff, maximum continuous, and go-around mode settings.

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IDLE: selects flight idle, approach idle, final approach idle and ground idle thrust settings.

MIN REV: provides minimum reverse thrust.

MAX REV: provides maximum reverse thrust. The thrust lever must be pulled against a spring to achieve the MAX REV position. If the thrust lever is released it goes back to MIN REV position.

NOTE: Positioning the thrust lever between the thrust control quadrant detents selects intermediate thrust settings.

2 - THRUST REVERSER TRIGGER

– Pulling the thrust reverser trigger allows reverser activation on the ground and REV thrust commands from IDLE to MAX REV.

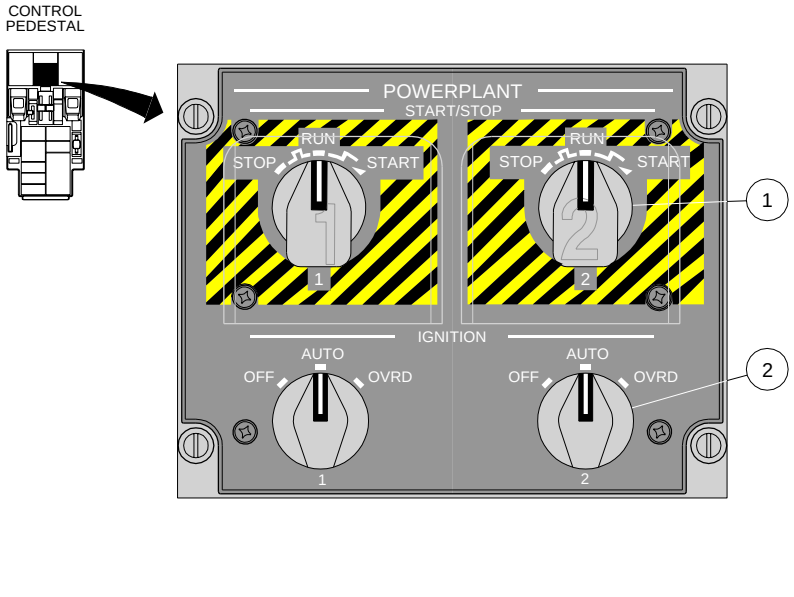
For TOGA and A/T DISC buttons descriptions, refer to Section 14-03 – Automatic Flight.

FIRE HANDLE

The Fire Handle, located on the Fire Protection Control Panel, enables emergency engine shutdown. For further information on fire protection system controls, refer to Section 14-07 – Fire Protection.

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ENGINE CONTROL PANEL



1 - START/STOP SELECTOR KNOB

STOP: commands the FADEC to shut down the engine, provided the associated thrust lever is in the IDLE position.

RUN: normal position for engine operation.

START: (momentary action) initiates the engine start sequence.

2 - IGNITION SELECTOR KNOB

OFF: deactivates the ignition system. FADEC disregards OFF position in flight.

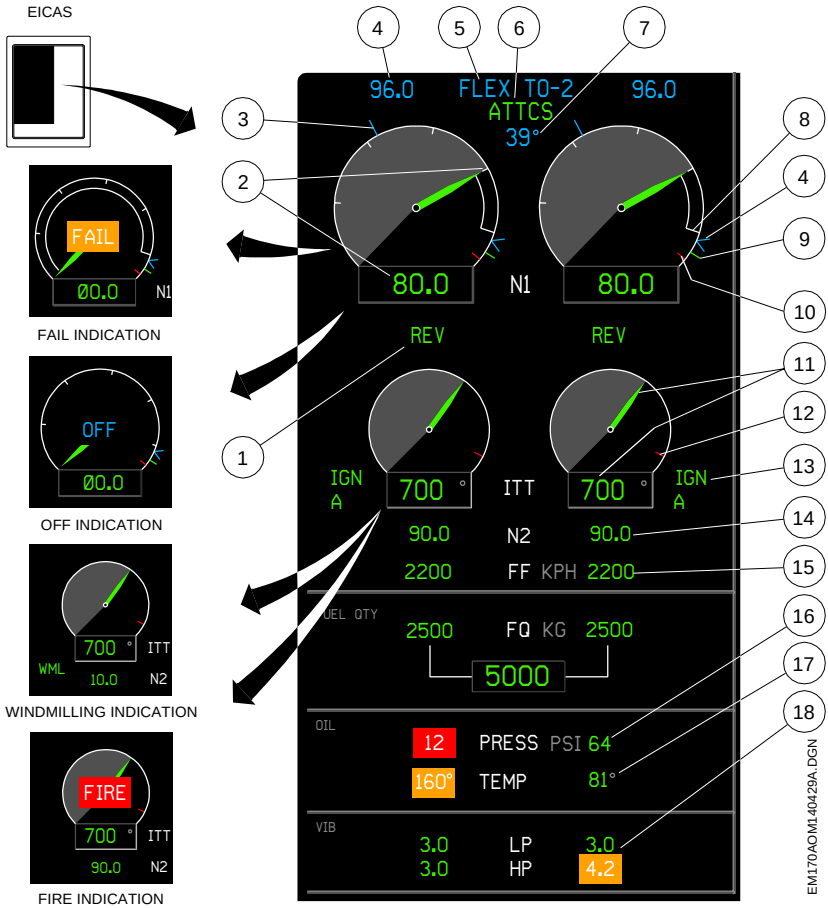
AUTO: FADEC automatically controls the ignition system, depending on engine requirements.

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OVRD: enables FADEC to continuously activate both exciters when the engine is running.

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EICAS INDICATION



ENGINE INDICATION - EICAS

1 - THRUST REVERSER INDICATION

– Indicates the thrust reverser position.

– Label: REV

GREEN: fully deployed.

AMBER: in transition.

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RED: discrepancy between selected and actual reverser positions.

2 - N1 INDICATION

– Digital Indication.

  – Displays the percentage of N1 rpm.
    GREEN: normal operating range.
    RED: operating limit exceeded.
    AMBER DASHED: invalid information or value out of displayable range.

– Quantity Scale/Pointer.

  – The pointer on the scale indicates a value equal to that shown on the digital readout.

  – Scale:
    GREEN: normal operating range.
    RED: operating limit exceeded.

– The amber boxed FAIL indication is displayed on the center of the N1 dial when an engine has flamed out or shut down without pilot action. The cyan OFF indication is displayed when the engine is shut down in- flight by pilot action.

3 - N1 WING ANTI-ICE CYAN LINE

– Displayed only in icing conditions during final approach (radio altimeter below 1200 ft) with landing gear down or flaps extended.

– Indicates the minimum thrust level (N1 value) to meet bleed requirements.

4 - N1 TARGET INDICATION

– Maximum N1 for the engine thrust rating mode indicated on EICAS.

– If the requested value is invalid, the digits will be removed from the display.

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– A cyan V-shaped bug represents the N1 target on the dial indicator.

– Digits:

CYAN: normal indication.

AMBER DASHED: invalid information or value out of displayable range.

5 - THRUST RATING MODE INDICATION

– Indicates the current thrust-rating mode. Indications are displayed in cyan.

– Label: TO-1, TO-2, TO-3, TO-1 RSV, TO-2 RSV, TO-3 RSV, FLEX TO-1, FLEX TO-2, FLEX TO-3, CLB-1, CLB-2, CON, CRZ, GA or GA-RSV.

6 - ATTCS INDICATION

– An ATTCS indication is displayed to indicate the Automatic Takeoff Thrust Control System status.

– Label: ATTCS

GREEN: engaged.

WHITE: armed.

BLANK: not selected.

7 - ASSUMED TEMPERATURE INDICATION

– Displays the temperature set on the MCDU. This indication is also used as a reference for flexible thrust.

8 - N1 REQUEST INDICATION

– Indicates the momentary difference (transient) between actual N1 and requested N1 applied by thrust lever position (TLA).

9 - MAXIMUM N1 INDICATION

– Green tick-mark.

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– Indicates the maximum allowable N1 (maximum thrust) for the current thrust rating and operating conditions. If the thrust lever is set to MAX position, the N1 Request value will be equal to the Maximum N1 value.

10 - N1 RED LINE

– Indicates the N1 limit.

– The digital and dial readout colors change if this value is exceeded.

11 - INTERTURBINE TEMPERATURE (ITT) INDICATION

– Quantity Scale/Pointer.

  – The pointer on the scale indicates a value equal to that shown on the digital readout.

  – Scale:
  GREEN: normal operating range.
  RED: operating limit exceeded.

– AMBER dashes will display on digital readout when invalid information or a value out of displayable range is available.

– A red fire warning indication is displayed on the center of ITT dial to indicate engine fire condition.

12 - ITT RED/AMBER LINE

– Maximum allowable ITT for the current flight phase.

– Limits thrust, thereby avoiding the maximum allowable ITT to be exceeded.

– The red line will change to amber after the end of the takeoff phase. The red line will be shown in flight if the ITT goes above the CON thrust rating limit.

13 - IGNITION CHANNEL INDICATION

– Indicates the enabled ignition channel.

– Colors:

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GREEN: IGN A, IGN B or IGN AB.

CYAN: IGN OFF.

– A WML icon is displayed whenever the FADEC has detected an engine flameout and the auto re-light system is actuating to restart the engine. It is also displayed whenever an assisted start is commanded.

14 - N2 INDICATION

– Digital Indication.

– Displays the percentage of N2 rpm.

GREEN: normal operating range.

RED: operating limit exceeded.

AMBER DASHED: invalid information or value out of displayable range.

15 - FUEL FLOW INDICATION

– Indicates fuel flow in kilograms per hour (KPH) or pounds per hour (PPH).

– Digit colors:

GREEN: normal indication.

AMBER DASHED: invalid information or value out of displayable range.

16 - OIL PRESSURE INDICATION

– Indicates the engine oil pressure.

– Digit colors:

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: operating limit exceeded.

AMBER DASHED: invalid information or value out of displayable range.

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17 - OIL TEMPERATURE INDICATION

– Indicates the engine oil temperature.

– Digit colors:

GREEN: normal operating range.

AMBER: cautionary operating range.

AMBER DASHED: invalid information or value out of displayable range.

18 - ENGINE VIBRATION INDICATION

– Indicates low-pressure (LP) and high-pressure (HP) vibration levels for both engines.

– Digit colors:

GREEN: normal operating range (0 to 3.9).

AMBER: cautionary operating range (4.0 to 5.0).

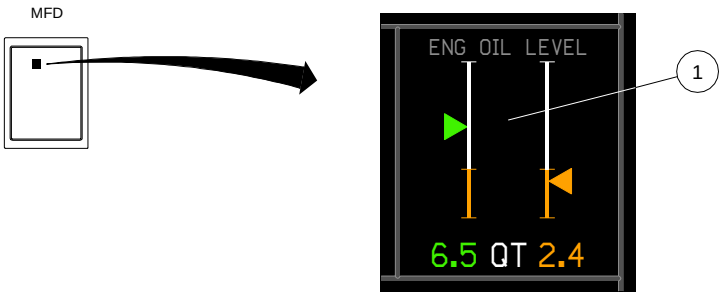
AMBER DASHED: invalid information or value out of displayable range.

NOTE: – For the first 60 s during engine start and with thrust levers at IDLE, the engine vibration indication will be displayed in amber for values equal to or greater than 5.0 units, for HP indication only.

– Transient LP or HP high vibration indication without any other abnormal engine parameter indication may be considered normal according to the engine manufacturer.

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STATUS PAGE



ENGINE OIL LEVEL INDICATION ON MFD

1 - OIL LEVEL INDICATION

– Indication colors:

GREEN: normal operating range.

AMBER: cautionary operating range.

– AMBER dashes will display on digital readout when invalid information or a value out of displayable range is available.

NOTE: The limit indication of amber line changes according to the engine status (running/shutdown).

FLEX TAKEOFF

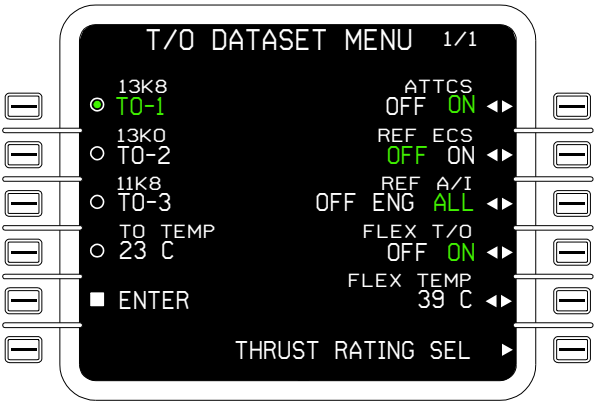
All the inputs required by the FADEC for the takeoff N1 computations are made through the T/O DATASET MENU, on the MCDU.

The T/O dataset is performed according to the sequence:

– Press TRS (mode button).

– Press TO DATA SET (line select key - 6R) on THRUST RATING SELECT page.

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T/O DATASET MENU ON THE MCDU

MCDU INDICATION

For airplanes Post-Mod FADEC 5.32 (SB 190-73-0010), the thrust ratings displayed on MCDU T/O DATASET MENU page indicates the engine model installed in the airplane. For the engines thrust ratings refer to AOM section 14-06-30.

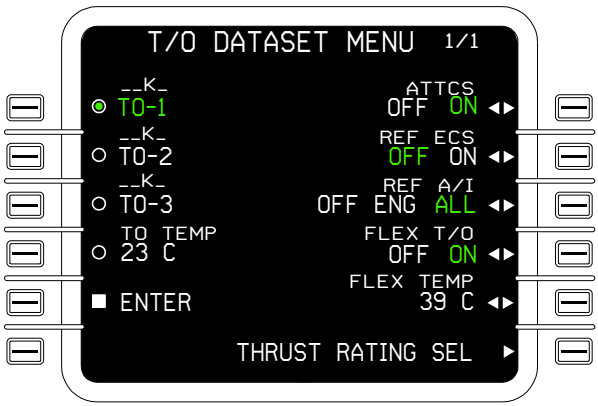
The engine model installed in the airplane can be verified on MCDU according to the table below:

ENGINES THRUST RATINGS ON MCDU

THRUST RATING	TO-1	TO-2	TO-3
CF-34-10E7	18K7	17K1	15K5
CF-34-10E7B	18K7	17K1	15K5
CF-34-10E6A1	18K6	17K2	15K5

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THRUST RATING	TO-1	TO-2	TO-3
CF-34-10E6	17K2	15K5	NOT APPLICABLE
CF-34-10E5A1	18K5	17K1	15K5
CF-34-10E5	17K1	15K5	NOT APPLICABLE
CF-34-10E2A1	16K7	15K5	NOT APPLICABLE



EM170AOM140845A.DGN

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ENGINE FUEL SYSTEM

The engine fuel system provides fuel pressurization, filtering, heat exchange and operation of engine vanes and bleed valves.

FUEL PUMP

Fuel supplied by the airplane fuel tanks flows to the engine fuel pumps. Upon exiting the tanks, the fuel flows through the low-pressure pump and then divides into two paths. One flows through the high-pressure fuel pump and returns to the fuel tank as motive flow.

The second flows through the fuel/oil heat exchanger to the high-pressure fuel pump. The flow leaves the pump and passes through the fuel filter. Once filtered, the fuel flows to the FMU.

FUEL/OIL HEAT EXCHANGER

The fuel-cooled oil cooler (FCOC) maintains the oil temperature within an acceptable range and heats the engine fuel to prevent freezing.

FUEL METERING UNIT

The FMU, controlled by the FADEC, meters and distributes the proper amount of fuel for combustion to the injectors under all operating conditions. The FMU controls the shutoff valve used during all normal shutdowns and provides overspeed protection.

FUEL FILTER

The fuel filter removes contaminants from the engine fuel. The impending bypass switch indicates fuel filter blockage and an imminent bypass condition.

VARIABLE STATOR VANES

The Variable Stator Vanes system consists of two fuel driven actuators controlled by the FADEC via FMU.

The purpose of the actuators is to optimize the position of the compressor stators as a function of corrected N2 to provide optimum compressor efficiency.

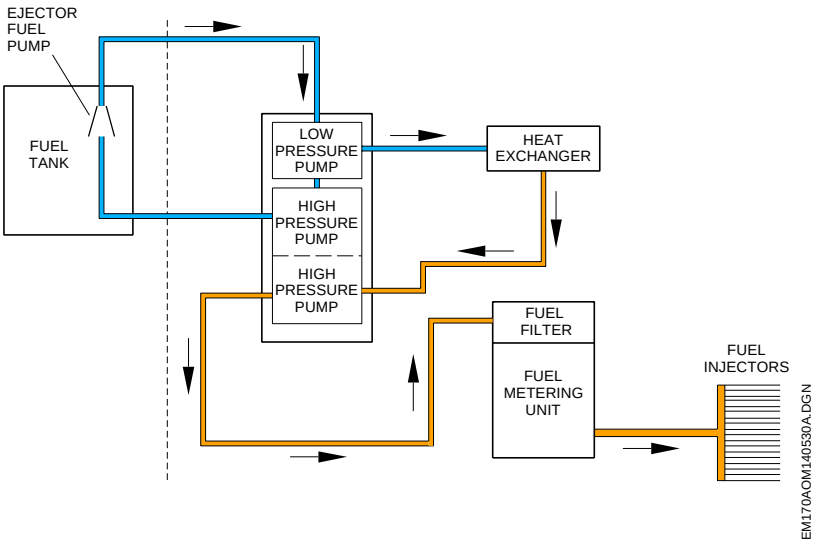
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FUEL INJECTORS

The fuel injectors atomize the fuel from the FMU and direct it into the combustion chamber.

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FUEL SCHEMATIC



FUEL SYSTEM SCHEMATIC

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LUBRICATION SYSTEM

GENERAL

Each engine has an independent lubrication system.

The oil system lubricates and cools the turbine engine main shaft bearings and the accessory gearbox.

Oil is pressurized in the lubrication pump, it then passes through the filter, the fuel-oil heat exchanger and is then divided into several circuits to lubricate the engine.

OIL TANK

Oil quantity indication is provided for each engine oil tank and is displayed on the MFD.

Oil quantity sensors in the tank detect low oil quantity and trigger the low oil level caution at a specific level.

OIL PUMPS

The pump provides oil flow any time the core engine is turning.

The pump contains one supply and four scavenge pumping elements.

The lube and scavenge pumps deliver oil under pressure to the engine bearings and gears, and then recovers the oil to the tank for reuse.

NOTE:

– After engine shutdown the scavenge system is no longer effective. A small amount of oil may leak through the aft sump drain and pool in the engine chevron nozzle.
– If the puddle size exceeds 9 in x 6 in (229 mm x 152 mm), maintenance should be contacted.

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OIL FILTER

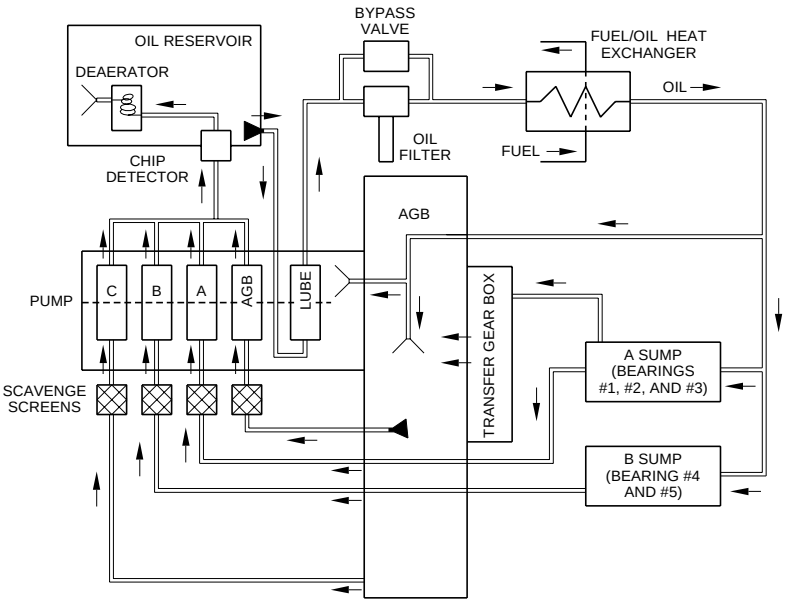
The oil filter module incorporates a filter bypass and cold start relief valve.

The oil filter bypass valve permits oil flow if the filter becomes clogged. The filter impending bypass switch monitors the differential pressure at the filter.

The filter module has a relief valve to bypass high viscosity oil during cold start conditions.

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LUBRICATION SCHEMATIC



LUBRICATION SYSTEM SCHEMATIC

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STARTING AND IGNITION SYSTEMS

STARTING SYSTEM

The engine starting system consists of:

– Air Turbine Starter (ATS).

– Starter control valve (SCV).

The pneumatic system provides bleed air to the ATS to rotate the rotor speed and start the engine.

The FADEC opens the Starter Control Valve (SCV), providing bleed air from the APU, a ground source, or the opposite engine. The Air Turbine Starter (ATS) is a turbine that accelerates the engine to a self-sustaining rpm level.

The FADEC closes the SCV when the starter cutout speed is reached.

IGNITION SYSTEM

The ignition system provides an electrical spark for fuel combustion during ground/in-flight start attempts and for automatic re-light.

The FADEC energizes one igniter for on-ground engine starts and both igniters for in-flight engine starts.

When the ignition selector knob is placed on the OVRD position, both igniters on each engine are energized. Igniters 1B and 2B are connected to SPDA 2. In case of SPDA 2 failure, setting the selector knob to OVRD energizes at least the igniter A.

NOTE: The frequent use of ignition selector knob at the OVRD position causes the significative reduction of ignitor's lifetime.

STARTER OPERATION

The engine starter is controlled via the engine start selector knob on the powerplant control panel. For on ground starts, the SCV opens providing bleed air to the ATS to increase rotor speed for engine start.

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GROUND START

The FADEC initiates ignition at approximately 7% N2 and the fuel flow (metering valve opens) from 20% to 25% N2, depending on the engine start altitude. If no light off is detected within 15 s of fuel on, FADEC will automatically turn off ignition and fuel, continue dry motoring for 30 s, then turn on both igniters and turn on fuel again. Subsequently, if no light off is detected after the reintroduction of fuel, the FADEC will not turn off fuel or ignition and the start must be manually aborted 15 s after the reintroduction of fuel flow or start duty limit, whichever occurs first.

After a light off occurs, the FADEC commands the starter to cutout at approximately 50% N2, and commands the FMU fuel metering valve to accelerate the engine to ground idle speed. At high altitudes, the fuel flow schedule is also increased to provide higher torque and therefore quicker starts.

IN FLIGHT START

Engine cross-bleed air, APU bleed air, or windmilling can be used for in flight engine starts.

An in flight cross-bleed start is identical to an on ground start, but the FADEC automatically controls fuel flow to initiate (Metering valve opens) if N2 has not reached 15% after 15 s.

For windmill starting, the SCV configures the pneumatic system. The engine start is controlled by the START/STOP selector knob and the FADEC commands ignition at 7% N2 and fuel flow at a minimum of 7.2% N2, or after 15 s, whichever occurs first.

The FADEC has no protection for hot starts, hung starts or failure to light off for in flight engine starts.

If no light off is detected within 30 s after fuel flow is started, the start should be manually aborted.

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AUTO RELIGHT

The FADEC monitors N2 and automatically turns on both igniters and schedules the relight fuel flow in the event of an engine flameout. In addition a WML icon is displayed next to the respective engine N2 and represents an auto relight actuation during the engine auto relight attempts.

If the engine relight does not occur within 30 s or N2 falls below 7.2%, the automatic relight can be considered unsuccessful and should be manually terminated by moving the START/STOP selector knob to the STOP position.

During ground operations, auto relight attempts are terminated and fuel is shutoff if the engine rpm falls below 52 percent N2.

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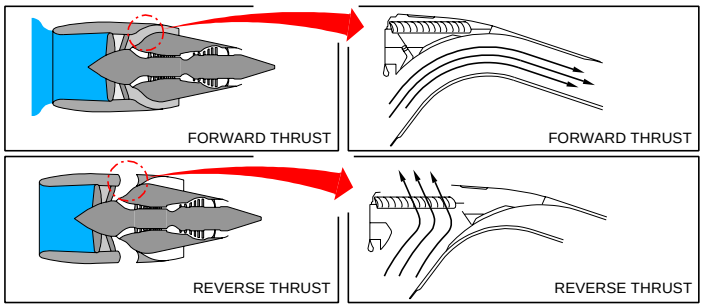
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THRUST REVERSER SYSTEM

The Thrust Reverser System is hydraulically actuated and controlled from the cockpit via the thrust lever.

Thrust reverses 1 & 2 operate independently, and are actuated by the respective hydraulic system.



THRUST REVERSER ACTUATION

The FADEC provides an interlock function to protect against inadvertent thrust reverser deployment and also to protect against inadvertent thrust reverser stowing.

A locking system consists of two actuator locks and the independent cowl lock. The cowl lock prevents inadvertent deployment of the thrust reverser.

THRUST REVERSER OPERATION

Moving the thrust lever to Idle enables the lifting of the Thrust Reverser Trigger. Moving the thrust lever to the reverse position commands thrust reverser deployment.

Thrust reverser deployment occurs only if the airplane is on the ground. The thrust reverser trigger can be lift up to 30 seconds after an engine inoperative condition is detected. After 30 seconds the engine inoperative condition does not release the thrust reverse trigger, so the respective thrust lever cannot be moved to reverse position.

The IDLE REV thrust is commanded until the thrust reverser cowls are not totally deployed, after total deployment the MAX REV is commanded if thrust levers are held in MAX REV position.

In the event of one reverser failure, when selecting both TLA to MAX

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REV position, the operating reverser will provide minimum reverse thrust only. Selecting just the operating reverser TLA to MAX REV position enables maximum reverse thrust on this engine.

The thrust reverser is not designed to operate in flight. Uncommanded thrust reverser deployment limits engine thrust to idle.

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ENGINE CONTROL SYSTEM

GENERAL

The engine control system performs engine control and thrust management, provides information to the cockpit, maintenance reporting and engine condition monitoring.

The engine control system is consists of the FADEC, thrust lever, T2 and N1 sensors.

The FADEC uses inputs from the airplane and engine to monitor and manage the engine control system.

The thrust lever receives the inputs of the desired thrust from the pilots or from the autothrottle.

The T2 sensor monitors the engine inlet air temperature for use in FADEC control calculations.

The N1 sensor provide fan speed data for the FADEC and airplane vibration monitoring system.

FULL AUTHORITY DIGITAL ELECTRONIC CONTROL (FADEC)

The FADEC is the main component of the engine control system.

Its functions include:

- Engine protection;
- Control of the requested and max N1;
- Control of the ATTCS.

The FADEC has two identical but isolated channels. One operates as the in-control channel and the other as a standby. The standby channel constantly processes all the data and is always ready to take control of the engine in case the active channel fails.

The FADEC in-control channel is switched on every engine start.

FADEC ELECTRICAL POWER

Above approximately 50% N2 the FADEC is powered by the Permanent Magnet Alternator (PMA). Below this value or in case the PMA becomes inoperative; the airplane's electrical system provides the backup power.

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FADEC INTERFACES

The FADEC receives data from all engine control system sensors and the airplane air data system to control the operation and performance characteristics of the engine, exercising control over the:

- Engine fuel metering unit to adjust the fuel flow;
- Variable geometry valve to improve N1 efficiency;
- Bleed valve to set the engine bleed extraction;
- T2 sensor heater to prevent ice accumulation;
- Thrust reverser actuation to adjust and control N1 values and allowances;
- Engine starting to optimize the temperatures, start up time and to provide the available protections;
- Ignition for engine start and automatic dry motoring, to prevent engine flame out during operation.

AUTOMATIC TAKEOFF THRUST CONTROL SYSTEM (ATTCS)

The ATTCS is controlled by the FADEC and is available on takeoff and go around.

TAKEOFF

The ATTCS can be selected ON or OFF for takeoff. By default, ATTCS will be selected ON.

The selection is made on the MCDU - TAKEOFF DATA SET MENU page and the indication is displayed on the EICAS as follows:

- ATTCS label in white - system is armed;
- ATTCS label in green - system is engaged. The engagement only happens when the thrust levers reach the TO/GA set position.

The selection from ON to OFF must be in accordance with the performance calculations.

GO AROUND

In flight the ATTCS is automatically armed anytime the thrust rate mode is GA making the GA RSV possible whenever activation criteria are met.

ATTCS ACTIVATION LOGIC

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The ATTCS automatically commands RSV whenever it is armed, thrust levers are at TOGA position, and one of following conditions occurs:

– Difference between both engine N1 values is greater than 15%;
– One engine failure during takeoff;
– One engine failure during go-around;
– Windshear detection.

The RSV mode is manually activated by moving the thrust levers to MAX position whenever the ATTCS is armed.

Whenever the ATTCS is activated, the green ATTCS indication on the EICAS disappears and the cyan thrust mode will be displayed with an additional “RSV” indication.

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ATTCS LOGIC TABLE

Condition	Phase of Flight	ATTCS Status	Thrust Lever Set	Engine Thrust
One Engine Failure	Takeoff	ATTCS ON	TOGA	TO-x RSV
			MAX	TO-x RSV
		ATTCS OFF	TOGA	No Thrust Increase
			MAX	No Thrust Increase
	Go-Around	ATTCS ON	TOGA	GA RSV
			MAX	GA RSV
Windshear	Takeoff	ATTCS ON	TOGA	TO-x RSV
			MAX	GA RSV
		ATTCS OFF	TOGA	No Thrust Increase
			MAX	GA RSV
	Go-Around	ATTCS ON	TOGA	GA RSV
			MAX	GA RSV
All Engines Operative	Takeoff	ATTCS ON	TOGA	No Thrust Increase
			MAX	TO-x RSV
		ATTCS OFF	TOGA	No Thrust Increase
			MAX	No Thrust Increase
	Go-Around	ATTCS ON	TOGA	No Thrust Increase
			MAX	GA RSV

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FLEXIBLE TAKEOFF

Flexible takeoff is a reduced takeoff thrust based on assumed temperature.

All takeoff modes are eligible for a flexible takeoff.

The assumed temperature must be higher than the TO TEMP and is set on the MCDU TAKEOFF DATA SET MENU page.

The indication FLEX TO-1, FLEX TO-2 or FLEX TO-3 will be displayed on the EICAS for the respective flexible takeoff thrust.

The minimum flex takeoff thrust is limited to 75% maximum rated takeoff thrust or CLB-2 + 1% N1, whichever is higher.

Flexible takeoff is possible with ATTCS ON or OFF.

ENGINE THRUST RATINGS

The FADEC calculates the maximum N1 for each thrust rate mode adjusted for altitude, temperature and airspeed and displays both digital and analogical readings on the N1 indicator.

The thrust rate modes are the following:

- Takeoff (TO-1, TO-2, TO-3)
- Takeoff Reserve (TO-1 RSV, TO-2 RSV, TO-3 RSV)
- Go-Around (GA)
- Go Around Reserve (GA-RSV)
- Maximum Continuous Thrust (CON)
- Maximum Climb (CLB-1, CLB-2)
- Maximum Cruise (CRZ)
- Idle

TAKEOFF (TO-1, TO-2, TO-3)

TO-x is thrust used for a normal takeoff.

Based on the inputs made on MCDU – TAKEOFF DATA SET MENU page the FADEC calculates the maximum N1 for the given conditions.

The takeoff N1 is only achieved when the thrust levers are set to TO/GA position.

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MAXIMUM TAKEOFF RESERVE (TO-1 RSV, TO-2 RSV, TO-3 RSV)

Whenever the ATTCS is triggered, TO-x RSV automatically becomes the maximum N1, as long as the thrust levers are set to TO/GA.

The TO-x RSV can be manually activated by setting the thrust lever to MAX position, given that the ATTCS is ON and TO-x mode is active.

GO-AROUND (GA)

The go around mode is activated in flight whenever the landing gear is down.

However the go around thrust can be achieved anytime in flight when the thrust rate mode is other than takeoff and the thrust levers are set to TO/GA.

GO-AROUND RESERVE (GA-RSV)

The GA RSV is the highest engine thrust possible and it is to be used in extreme situations where extra thrust is required when maneuvering for landing.

MAXIMUM CONTINUOUS RATING (CON)

The maximum continuous thrust is to be used on emergency situation where thrust higher than usual is required.

It is the highest thrust the engines can operate continuously without reducing the time between overhauls.

MAXIMUM CLIMB RATING (CLB-1, CLB-2)

During aircraft power up, CLB-1 is the default mode setting. Whenever the selected takeoff thrust is lower than CLB-1 the CLB-2 mode becomes the default until the next airplane power down / power up.

Manual switching between the climb modes is possible anytime in flight on the MCDU - TRS page.

On ground the CLB-1 mode is inhibited if the take off thrust selected is lower than CLB-1 thrust.

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MAXIMUM CRUISE RATING (CRZ)

The CRZ mode is the maximum N1 that can be used for a normal cruise flight.

IDLE

The IDLE modes are automatically adjusted by the FADEC in order to maintain the minimum thrust necessary to provide the required bleed pressure to the airplane.

Flight Idle N1 varies with altitude and can change as a function of ECS and anti-ice bleed requirements.

The idle mode selections are the following:

- Flight Idle.
- Approach Idle.
- Final Approach Idle.
- Ground Idle.

IDLE THRUST IN ICE CONDITIONS

Whenever ICE CONDITION is sensed the N1 for the FLIGHT IDLE and APPROACH IDLE is automatically increased to maintain the minimum bleed pressure required for the ANTI ICE system operation.

With the FINAL APPROACH IDLE there is no N1 automatic increase but a cyan dash is displayed on both EICAS N1 dial to show the minimum thrust required to maintain the bleed pressure required by the ANTI ICE system.

FLIGHT IDLE

The flight idle mode is active anytime in flight when the approach idle is not selected.

APPROACH IDLE

Approach Idle is used in flight to enable rapid acceleration to go-around thrust. Approach idle is activated as follows:

- Altitude less than 15000 ft;
- In flight;
- Flaps 1 or greater; and

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- Landing gear down.

FINAL APPROACH IDLE

Final Approach Idle is active as follows:

- Altitude lower than 1200 ft AGL;
- Landing flaps;
- Landing gear down.

GROUND IDLE

Ground Idle is the minimum thrust setting. Ground Idle provides the minimum stable engine thrust level for ground operations.

MINIMUM REVERSE

Min reverse is idle thrust with the thrust reverser cowl opened.

MAX REVERSE

Max reverse is the maximum thrust available with the thrust reverser opened.

THRUST RATINGS TABLE

		CF34-10E7		CF34-10E5A1		CF34-10E5		CF34-10E2A1	
Ratings		Thrust (lbf)		Thrust (lbf)		Thrust (lbf)		Thrust (lbf)	
Thrust Mode	ATTCS	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.
T/O-1	ON	18500	20000	–	–	17100	18500	–	–
	OFF	18500	18500	18500	18500	17100	17100	16650	16650
T/O-2	ON	17100	18500	17100	18500	15450	16650	15450	16650
	OFF	17100	17100	17100	17100	15450	15450	15450	15450
T/O-3	ON	15450	16650	15450	16650	–	–	–	–
	OFF	15450	15450	15450	15450	–	–	–	–
GA	ON	18500	20000	17100	18500	17100	18500	16650	16650
CON	–	16255	16255	16255	16255	16255	16255	14310	14310
CLB-1	–	15950	–	15950	–	15950	–	14020	–
CLB-2	–	14020	–	14020	–	14020	–	–	–

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		CF34-10E7		CF34-10E5A1		CF34-10E5		CF34-10E2A1	
Ratings		Thrust (lbf)		Thrust (lbf)		Thrust (lbf)		Thrust (lbf)	
Thrust Mode	ATTCS	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.
CRZ	–	13830	–	13830	–	13830	–	12080	–

NOTE: – Thrusts values for sea level and ISA conditions.
– Engines with flat rated temperature up to ISA+15°C.

		CF34-10E6A1		CF34-10E6	
Ratings		Thrust (lbf)		Thrust (lbf)	
Thrust Mode	ATTCS	All Engine Oper.	One Engine Inop.	All Engine Oper.	One Engine Inop.
T/O-1	ON	–	–	17100	18500
	OFF	18500	18500	17100	17100
T/O-2	ON	17100	18500	15450	16650
	OFF	17100	17100	15450	15450
T/O-3	ON	15450	16650	–	–
	OFF	15450	15450	–	–
GA	ON	17100	18500	17100	18500
CON	–	16255	16255	16255	16255
CLB-1	–	15950	–	15950	–
CLB-2	–	14020	–	14020	–
CRZ	–	13830	–	13830	–

NOTE: – Thrusts values for sea level and ISA conditions.
– Engines with flat rated temperature up to ISA+20°C.

DERATED TAKEOFF ITT LIMITS

During the initial takeoff run the ITT red line marks the temperature limit for the actual thrust rating, changing according to the takeoff mode selected. After V_1 - 15 KIAS however, the ITT red line will mark the temperature limit for maximum takeoff thrust rating (TO-1 RSV), assuring that the engine has enough ITT margin to achieve maximum rated thrust.

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ENGINE PROTECTION

FADEC ENGINE PROTECTION

The FADEC provides engine start protection on the ground as follows:

– Hung start.

– Hot start.

– No light-off

OVERSPEED PROTECTION

Whenever N2 reaches 102% the FADEC automatically commands an engine shutdown.

In the event of three consecutive overspeed detection events within 30 s the FADEC will not relight the engine.

OVERTEMPERATURE PROTECTION

The FADEC controls the ITT limits for engine start and throughout engine operation.

ITT limit is variable according to the engine operation phase.

ITT OVER LIMIT PROTECTION

During engine start if the ITT reaches its limit the FADEC automatically shuts off the fuel flow aborting the start sequence. In this case the start control valve is not automatically closed. Pilot intervention is needed to close the SCV by selecting the START/STOP switch to STOP.

ENGINE START HIGH ITT PREVENTION

To improve the ITT control on engine ground starts the FADEC will not allow fuel flow if ITT is above 120°C.

In this case when the pilot sets the START/STOP selector to START the start control valve is commanded open but the fuel flow only starts when the ITT drops below 120°C.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	ENG 1 (2) OIL LO PRESS	Engine 1 (2) oil pressure is low.
	ENG 1 (2) REV DEPLOYED	Thrust reverser deployed unexpectedly, or not stowed when ordered to stow or thrust reverse position is undetermined.
CAUTION	ENG 1 (2) CONTROL FAULT	Thrust modulate is unenabled. OBV has failed open or engine will respond slowly.
	ENG 1 (2) FADEC OVERTEMP	FADEC overtemperature has been detected.
	ENG 1 (2) FAIL	Engine 1 (2) shutdown has occurred.
	ENG 1 (2) FUEL IMP BYPASS	Fuel filter impending bypass.
	ENG 1 (2) FUEL LO PRESS	Engine 1 (2) Fuel pressure low. Airplane backup fuel pump is active.
	ENG 1 (2) NO DISPATCH	No dispatch condition detected by FADEC.
	ENG 1 (2) OIL LO LEVEL	Engine 1 (2) oil level is below minimum.
	ENG 1 (2) REV FAIL	Thrust Reverser is not available.

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TYPE	MESSAGE	MEANING
CAUTION	ENG 1 (2) REV PROT FAULT	Reverser fault detected, operation not inhibited.
	ENG 1 (2) REV TLA FAIL	Respective reverser solenoid protection has failed.
	ENG 1 (2) START VLV OPEN	Start valve not closed while engine running.
	ENG 1 (2) TLA FAIL	Dual thrust lever angle sensor failure.
	ENG EXCEEDANCE	In flight engine limit exceedance detected.
	ENG NO TAKEOFF DATA	Takeoff data not entered successfully. Discrepancy between information entered in FMS for engine 1 and 2 detected.
	ENG REF A-I DISAG	Ice protection mode selector knob set to the ON position with OFF or ENG in the take-off data set (TDS) menu.
	ENG REF ECS DISAG	Discrepancy between REF. ECS input and actual ECS bleed configuration.

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TYPE	MESSAGE	MEANING
CAUTION	ENG THR RATING DISAG	Discrepancy between maximum thrust rating of engines 1 and 2. Possible asymmetric engine thrust.
	ENG TLA NOT TOGA	TLA not at TOGA position during takeoff and/or go-around phases.
ADVISORY	ENG 1 (2) FADEC FAULT	One FADEC channel no longer sending data.
	ENG 1 (2) FUEL SW FAIL	Fuel pressure switch indicates pressure is not low while all fuel pumps are off.
	ENG 1 (2) OIL IMP BYPASS	Oil filter impending bypass.
	ENG 1 (2) OIL SW FAIL	Oil pressure switch failure detected.
	ENG 1 (2) SHORT DISPATCH	Short-time dispatch fault condition detected by FADEC.

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TYPE	MESSAGE	MEANING
STATUS	ENG 1 (2) REV INHIBIT	Reverser inhibited by maintenance action.
	ENG 1 (2) TLA NOT IDLE	Thrust Lever Angle not set to idle position during either engine start or engine shutdown. A thrust higher than the expected will be reached if the TLA is above idle during engine start. Set the thrust lever to idle position within 30 s to shut down the engine. If the 30 s period is exceeded, cycle the START/STOP selector knob to RUN then to STOP to reset the time and shutdown the engine.
	ENG TDS REF A-I ALL	REF A-I ALL is selected on take-off data set page on MCDU.
	ENG TDS REF A-I ENG	Ice protection mode selector knob set to the AUTO position and REF A-I ENG is selected on take-off data set page on MCDU.

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SECTION 14-07

FIRE PROTECTION

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GENERAL DESCRIPTION

The fire protection system provides fire detection and extinguishing capabilities for:

- Engines
- APU
- Cargo Compartments
- Lavatories

In addition, portable fire extinguishers are located in the cockpit and cabin.

In the event of fire protection system component failure, an EICAS message will be displayed.

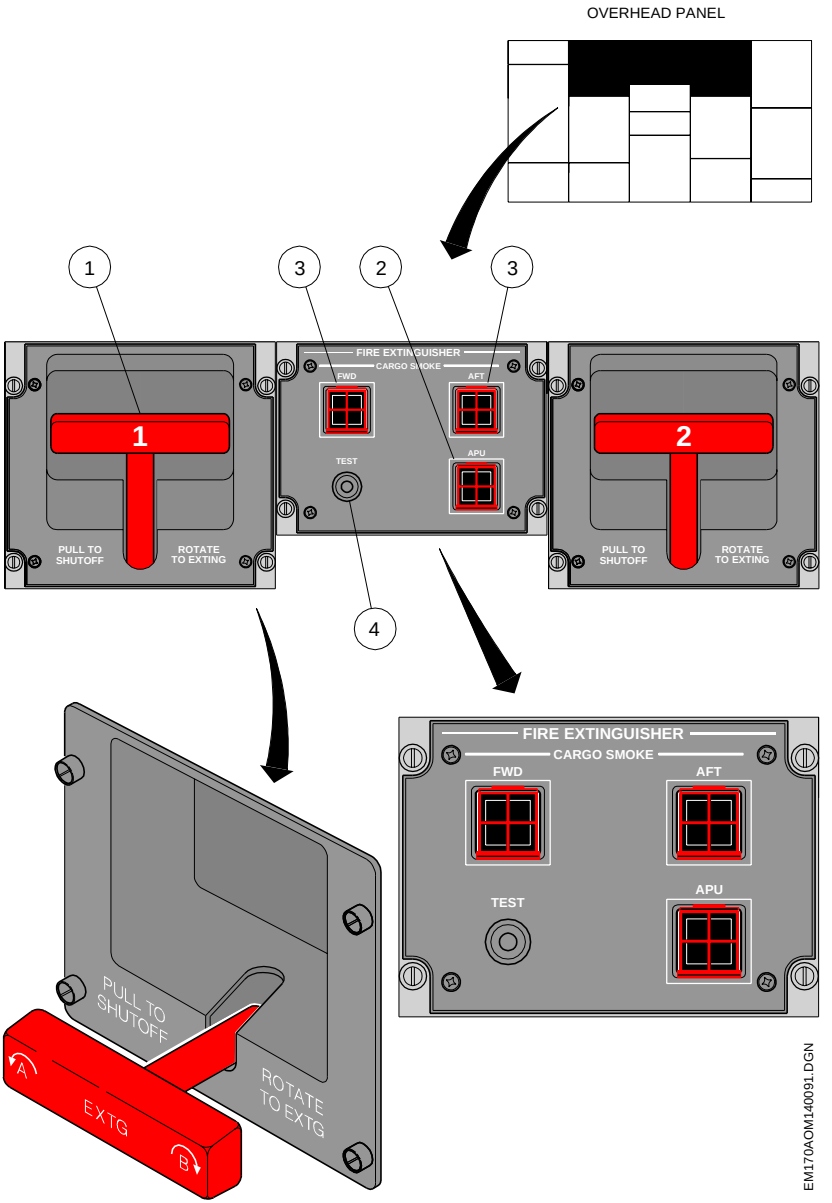
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FIRE PROTECTION CONTROL PANEL

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1 - ENGINE FIRE EXTINGUISHER HANDLE

PULL: closes the associated engine bleed air, fuel and hydraulic shutoff valves.

ROTATE (left/right): discharges fire extinguisher bottles into the associated engine.

2 - APU FIRE EXTINGUISHER BUTTON (GUARDED)

Momentary action pushbutton:

– Closes the APU fuel shutoff valve and discharges the APU fire extinguisher bottle.

3 - CARGO FIRE DETECTION/EXTINGUISHER BUTTON (GUARDED)

Momentary action pushbutton:

– According to the system logic, discharges the high and low-rate cargo extinguisher bottles of the associated cargo compartment when the button is lit.

– Pressing the pushbutton when it is not illuminated arms the associated extinguisher bottle and the button illuminates red.

4 - FIRE DETECTION SYSTEM TEST BUTTON

Momentary action button:

– Tests the cargo smoke, engine and APU fire detection systems.

– If the button is pressed for more than 10 seconds the APU automatically shuts down.

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ENGINE FIRE PROTECTION SYSTEM

The Engine Fire Protection System is designed to provide:

– Engine fire detection;

– Engine fire extinguishing and;

– Continuous Built-In Tests to detect internal faults.

SYSTEM ELECTRICAL SUPPLY

The electrical power is supplied by:

– Engine fire detection:
MAU 1 (DC ESS BUS 1) and MAU 3 (DC ESS BUS 2).

– Engine fire extinguishing:
HOT BATT BUS 1 and HOT BATT BUS 2.

ENGINE FIRE DETECTION

The Engine Fire Detection System is monitored by two detector loops.

When a fire condition is detected the signal goes to the MAU which generates the associated EICAS messages and alarms.

ENGINE FIRE EICAS MESSAGES AND ALARMS

When a fire is detected the following EICAS messages and alarms are triggered:

AURAL

– aural warning;

LIGHTS

– the fire extinguisher handle illuminates;

– the master WARNING lights illuminate;

EICAS MESSAGES

– the FIRE warning light on the respective ITT indicator illuminates;

– the EICAS WARNING message ENG 1 (2) FIRE is displayed.

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ENGINE FIRE EXTINGUISHING

The Engine Fire Extinguishing System is comprised of:

– two fire handles and;

– two fire-extinguishing bottles.

ENGINE FIRE HANDLE

Anytime the fire handle is pulled it commands the following shutoff valves to close:

– the engine fuel shutoff valve;

– the engine hydraulic shutoff valves and;

– the engine bleed air shutoff valve.

Each fire handle is associated with one engine.

ENGINE EXTINGUISHER BOTTLE

A total of two fire extinguisher bottles named A and B are installed in the airplane to serve either or both engines.

OPERATION

Once the FIRE HANDLE has been pulled the extinguisher bottles can be operated.

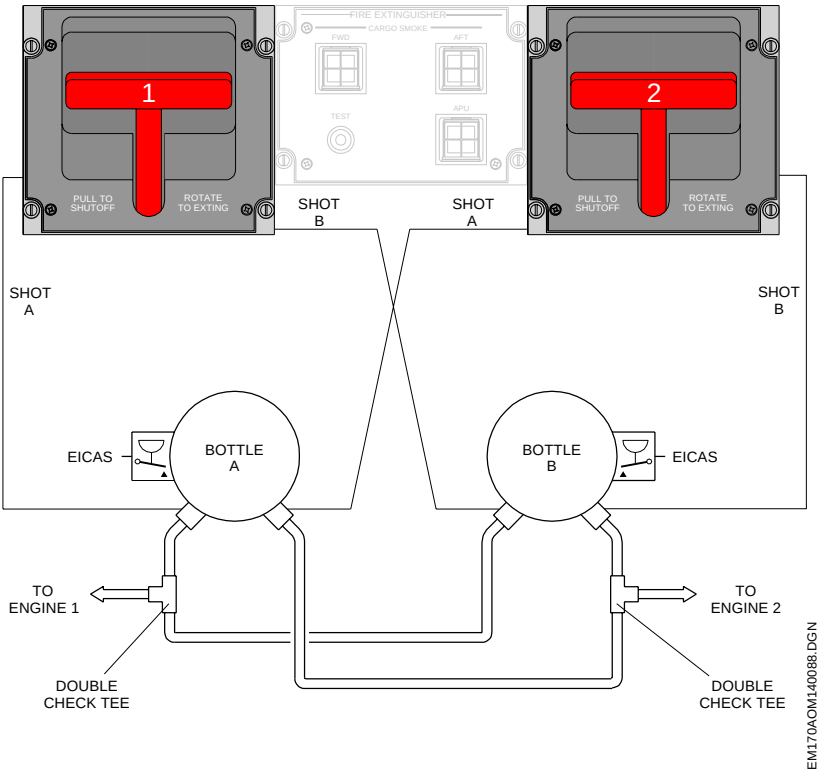
Rotating the FIRE HANDLE counter clockwise discharges extinguisher bottle A into the associated engine.

Rotating clockwise discharges extinguisher bottle B into the same engine.

NOTE: When an engine fire extinguishing bottle is discharged, fire handle illumination may be lost. In this case if the CAS message is still active the fire condition persists.

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ENGINE FIRE PROTECTION SYSTEM SCHEMATIC



ENGINE FIRE PROTECTION SCHEMATIC

SYSTEM CONTINUOUS SELF MONITORING

Except for illumination of the button, all system components are continuously monitored.

In case of an internal failure a CAS message is generated to alert the crew of the failed condition.

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APU FIRE PROTECTION SYSTEM

The APU Fire Protection System is designed to provide:

– APU fire detection;

– APU fire extinguishing and;

– Continuous Built-In Test to detect internal faults.

SYSTEM ELECTRICAL SUPPLY

The electrical power is supplied by:

– APU fire detection:
MAU 1 (DC ESS BUS 1) and MAU 3 (DC ESS BUS 2).

– APU fire extinguishing:
DC ESS BUS 2.

APU FIRE DETECTION

The APU Fire Detection System is comprised of two detectors loops.

When a fire condition is detected the signal goes to the MAU which generates the associated EICAS messages and alarms.

APU FIRE EICAS MESSAGES AND ALARMS

When a fire is detected the following EICAS messages and alarms are triggered:

AURAL

– aural warning;

LIGHTS

– the red stripped bar of the APU emergency stop button illuminates;

– the master WARNING lights illuminate;

EICAS MESSAGES

– the EICAS WARNING message APU FIRE is displayed.

All alarms and indications cease when fire conditions are no longer present.

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APU FIRE EXTINGUISHING

The APU Fire Extinguishing System is comprised of:

– one pushbutton;

– one fire-extinguishing bottle.

APU FIRE EXTINGUISHER PUSHBUTTON

When the APU FIRE EXTINGUISHER button is pressed the system:

– discharges the APU fire bottle.

– shuts down the APU through the APU FADEC.

– closes the APU fuel shutoff valve (SOV).

– displays an EICAS ADVISORY message APU FIREX BTL DISCH.

APU EXTINGUISHER BOTTLE

One fire-extinguishing bottle is installed in the rear fuselage.

OPERATION

As soon as the APU EMER STOP pushbutton is pressed the red strip bar is replaced by the white stripe bar indicating that the APU has shut down.

After the APU EMER STOP pushbutton is pressed the APU fire extinguisher pushbutton illuminates indicating that the extinguisher bottle is armed.

Pressing the pushbutton discharges the extinguishing bottle.

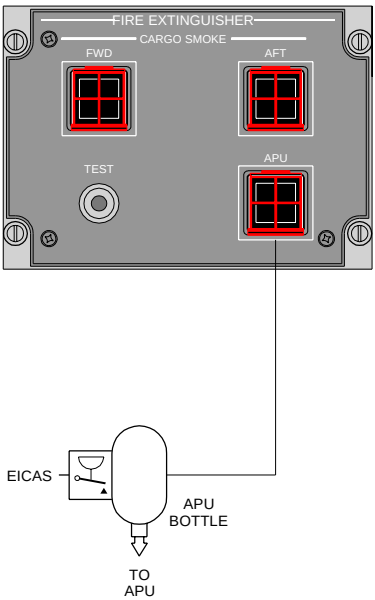
NOTE: If a fire condition is still present and the APU emergency stop button is not pressed, the APU fire extinguisher pushbutton illuminates after 1 minute indicating that the extinguisher bottle is armed.

APU AUTO SHUTDOWN

On ground, the APU will automatically shut down 10 seconds after the fire condition is present.

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APU FIRE PROTECTION SYSTEM SCHEMATIC



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APU FIRE PROTECTION SYSTEM SCHEMATIC

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CARGO COMPARTMENT FIRE PROTECTION SYSTEM

The forward and aft cargo compartments on the E-JETS are class C.

Both cargo compartments are protected by the CARGO SMOKE DETECTION SYSTEM and CARGO FIRE PROTECTION SYSTEM.

Both systems can generate EICAS messages to alert for malfunctions.

CARGO COMPARTMENT SMOKE DETECTION

Each cargo compartment has an independent smoke detection system.

The forward cargo compartment has four smoke detectors.

The aft cargo compartment has three smoke detectors.

The system is monitored by a periodic built-in test, generating the associated alarms and EICAS messages.

After smoke detection in the forward compartment, the air circulation fan in the forward compartment automatically turns off and the ventilation outflow valve closes.

SYSTEM INDICATIONS

AURAL

– Aural warning.

LIGHTS

– The master WARNING lights flashing.

– The associated cargo compartment extinguishing button illuminates.

EICAS

– CRG AFT SMOKE;

– CRG FWD SMOKE.

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SYSTEM AUTOMATION

FORWARD CARGO COMPARTMENT

After fire or smoke is detected in the forward cargo compartment the following actions are automatically commanded by the system:

– The FWD fire extinguishing bottle is armed and;

– The forward cargo compartment ventilation outflow valve is commanded closed.

AFT CARGO COMPARTMENT

After fire or smoke is detected in the aft cargo compartment the following actions are automatically commanded by the system:

– The AFT fire extinguishing bottle is armed and;

CARGO COMPARTMENT FIRE EXTINGUISHING

The Cargo Fire Extinguishing System is comprised of:

– One high-rate extinguisher bottle and;

– One low-rate extinguisher bottle.

Both extinguisher bottles are installed in the center avionics bay and used in either forward or aft cargo compartment.

ANNUNCIATED FIRE EXTINGUISHING

After the annunciation of smoke detection in the cargo compartment, pressing the associated cargo compartment button causes:

– the high-rate fire-extinguishing bottle to discharge immediately into the selected cargo compartment.

– the EICAS ADVISORY message CRG FIREX HI DISCH to display.

One minute later, the second fire-extinguishing bottle discharges automatically at a reduced flow rate and the agent remains in the selected cargo compartment for 60 minutes.

NOTE: – Pressing the associated pushbutton before the one-minute period immediately discharges the low-rate extinguishing bottle.

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– In case of fire on ground, the low-rate fire-extinguishing bottle is not automatically discharged. The flight crew must push the cargo fire-extinguishing pushbutton once again to discharge the low-rate bottle.

CARGO COMPARTMENT FIRE EXTINGUISHING - WITH MESSAGE		
Bottle Discharge	**High-rate Bottle**	**Low-rate Bottle**
In-flight	Push the button once	Automatic after 1 minute
On-ground	Push the button once	Push the button once

NON-ANNUNCIATED FIRE EXTINGUISHING

The system can be used even without a cargo smoke warning. In this case, the high-rate bottle is armed by pushing the respective cargo fire extinguisher button and is indicated by the red button light and the associated EICAS message. If the button is pushed again within the next two minutes, the high-rate bottle is discharged. At this time the low-rate bottle is armed. If the button is not pressed a second time within two minutes after arming, the system will reset.

In flight, the second bottle will automatically fire after one minute. On ground the button has to be pushed again after the EICAS message CRG FWD (AFT) FIREX LO ARM is displayed to fire the low-rate bottle. When the fire test button is pressed the system will reset.

CARGO COMPARTMENT FIRE EXTINGUISHING - WITHOUT MESSAGE		
Bottle Discharge	**High-rate Bottle**	**Low-rate Bottle**
In-flight	Push the button twice	Automatic after 1 minute
On-ground	Push the button twice	Push the button once

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LAVATORY FIRE PROTECTION SYSTEM

The Lavatory Smoke Detection and Fire Extinguishing Systems protect the forward and aft lavatories. Each lavatory has a dedicated fire protection system.

LAVATORY SMOKE DETECTION

The Lavatory Smoke Detection System consists of one smoke sensor installed on each lavatory ceiling.

If smoke is detected in either lavatory:

– the master WARNING lights illuminate.

– the EICAS WARNING message LAV SMOKE is displayed.

– in the lavatory where the smoke has been detected an alarm sounds and the smoke detector light comes on.

– a flashing amber light on the respective attendant lights panel (rainbow lights) illuminates.

LAVATORY FIRE EXTINGUISHING

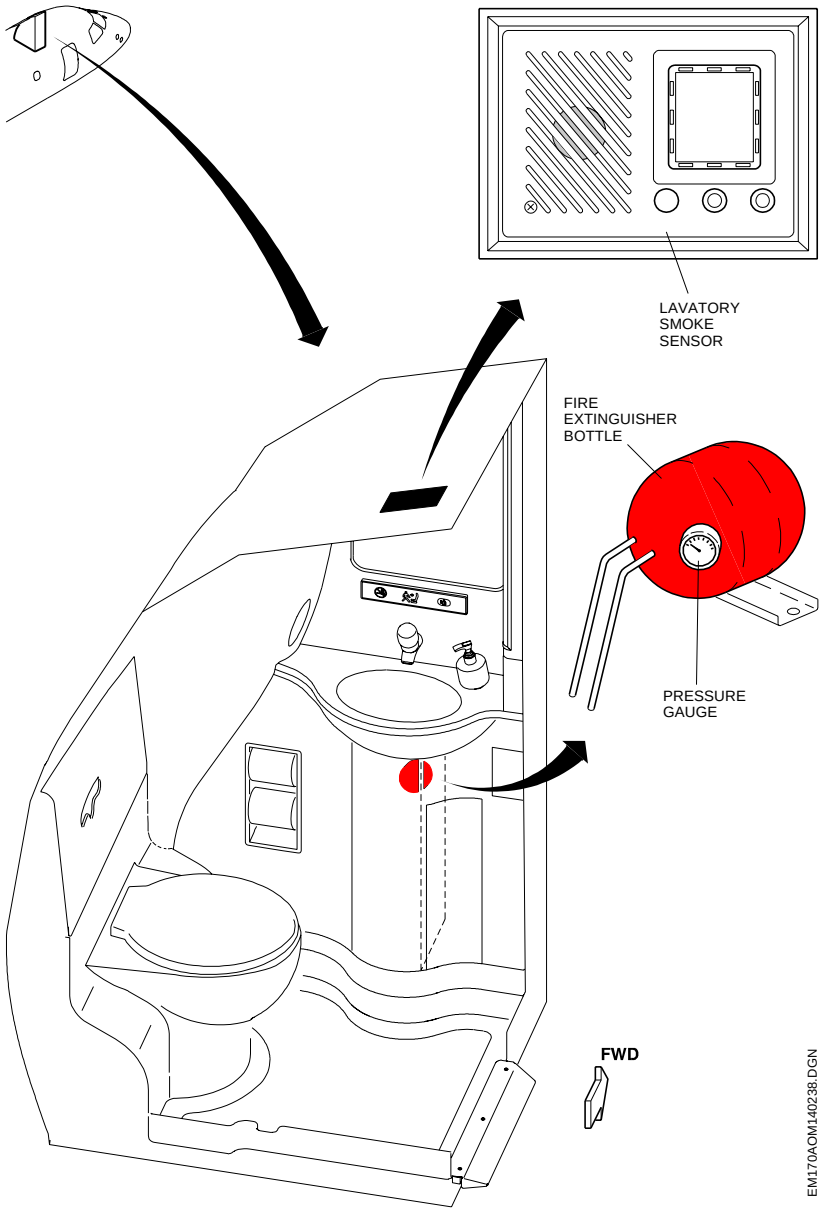
The Fire Extinguishing System consists of one fire-extinguisher bottle installed on each lavatory waste container.

When the temperature inside the waste container exceeds a certain limit, the system automatically discharges the extinguishing agent. If required, the flight attendant can suppress the fire by using a portable fire extinguisher.

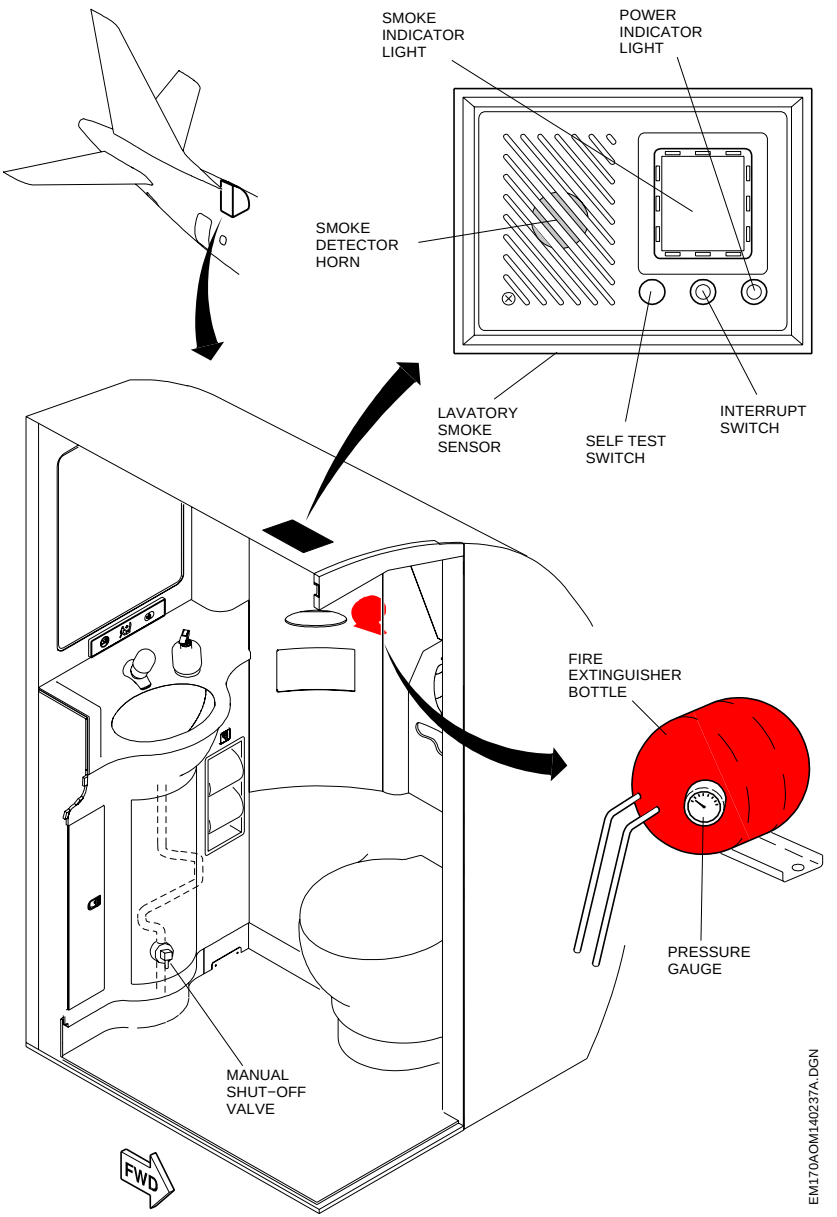
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LAVATORY DETECTORS AND EXTINGUISHERS LOCATION

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FIRE DETECTION SYSTEM TEST

The fire detection test button on the control panel provides a manual test for the following systems:

– Engine fire detection;

– APU fire detection;

– Cargo smoke detection.

When the TEST button on the fire protection panel is pressed, it initiates the following:

AURAL

– The fire aural warnings sound.

LIGHTS

– The master WARNING lights flash.

– The fire extinguisher handles illuminate steady.

– The cargo fire-extinguishing buttons illuminate steady.

– The APU fire-extinguishing button and the upper half of the APU emergency stop button to illuminate.

EICAS MESSAGES

– ENG 1 FIRE;

– ENG 2 FIRE;

– APU FIRE;

– CRG AFT SMOKE;

– CRG FWD SMOKE.

EICAS INDICATIONS

– The FIRE warning light on the ITT indicators illuminate.

SYSTEM CONFIGURATIONS

– The cargo compartment ventilation outflow valve closes – only when bleed air is being provided by the engines or the APU.

CAUTION: IF THE FIRE DETECTION TEST BUTTON IS PRESSED FOR 10 SECONDS, THE APU WILL SHUTDOWN.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	APU FIRE	A fire condition has been detected in the APU.
	CRG AFT (FWD) SMOKE	Smoke has been detected in the associated cargo compartment.
	ENG 1 (2) FIRE	A fire condition has been detected in the associated engine.
	LAV SMOKE	Smoke has been detected in the lavatory.
CAUTION	APU FIRE DET FAIL	APU fire detection system has failed.
	APU FIREX FAIL	APU fire-extinguisher bottle has failed.
	CRG AFT (FWD) FIRE SYS FAIL	All smoke detectors have failed in the associated compartment, or Pressure in any extinguisher bottle is low and the cartridges are intact, or any of the cartridge circuits are opened.
	ENG 1 (2) FIRE DET FAIL	Engine fire detection system has failed.
	LAV SMOKE DET FAIL	Lavatory smoke detection system has failed.
	IFE RACK SMOKE	Smoke has been detected in the IFE rack.

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TYPE	MESSAGE	MEANING
ADVISORY	APU FIREXBTL DISCH	APU fire-extinguisher bottle has been discharged.
	CRG FIRE PROT FAULT	Failures of smoke detectors in a Cargo Compartment or any SPDA internal failure, which does not render the smoke detection completely inoperative.
	CRG FWD (AFT) FIREX HI ARM	High rate Cargo Firex system armed either automatically or manually.
	CRG FWD (AFT) FIREX LO ARM	Low rate Cargo Firex system armed after High rate bottle discharged.
	ENG 1 (2) FIREXBTL A (B) FAIL	Associated fire-extinguisher bottle has failed.
	ENG FIREXBTL A (B) DISCH	Associated fire-extinguisher bottle has been discharged.
STATUS	CRG FIREX HI (LO) DISCH	Cargo high-rate (low-rate) discharge fire-extinguisher bottle has been discharged.

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SECTION 14-08

FLIGHT CONTROLS

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GENERAL DESCRIPTION

The Flight Control System is comprised of the primary and the secondary flight control systems and their associated system components.

The primary flight control system consists of:

- Ailerons and the multi function roll spoilers for roll axis control.
- Elevators for pitch axis control.
- Rudder for yaw axis control.

The secondary flight control system consists of:

- Horizontal stabilizer.
- Flaps and Slats.
- The multi-function spoiler (when used as speed brakes or ground spoilers).
- Dedicated ground spoilers.

Hydraulic actuators control the respective flight control surfaces. These are referred to as Power Control Units (PCUs).

The ailerons are commanded by conventional control cables that run from each control wheel back to a pair of hydro-mechanical actuators.

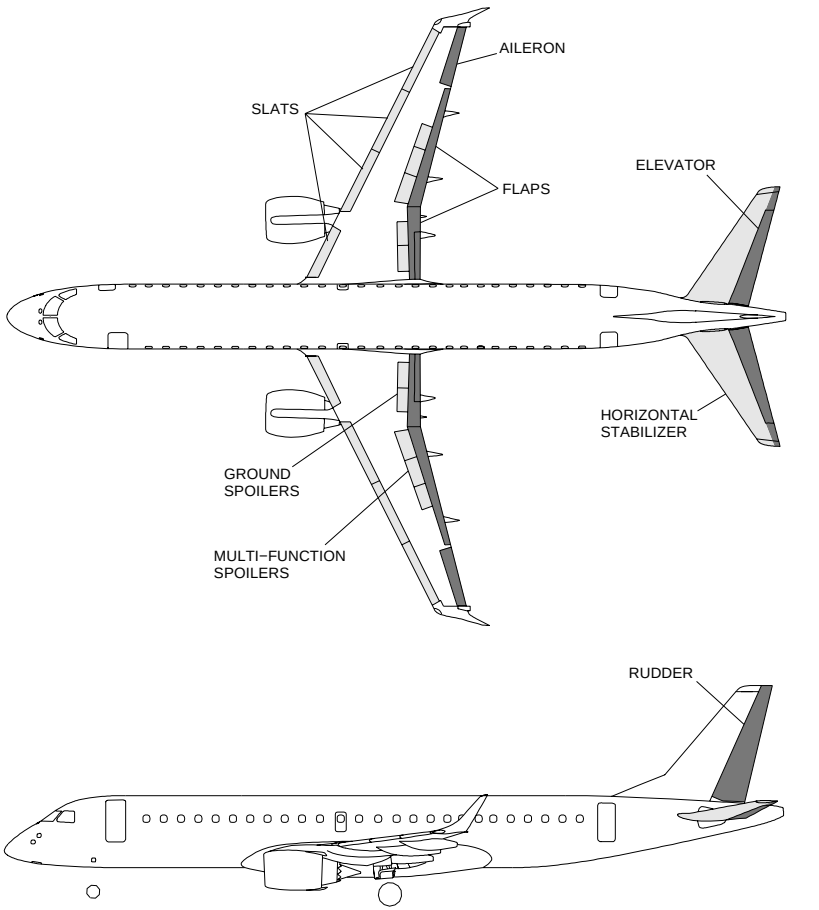
Elevators, rudders, roll spoilers as well as all secondary flight control systems, including the horizontal stabilizer, flaps and slats, ground spoilers and speed brakes, are controlled electronically using Fly-by-Wire (FBW) technology.

The primary flight control electronics include two complementary parts:

- The Primary Actuator Control Electronics (P-ACE).
- The Flight Control Module (FCM).

Primary Actuator Control Electronics (P-ACE) and/or Flight Control Modules (FCM) are employed to operate the respective electro-hydraulic or electro-mechanical actuators.

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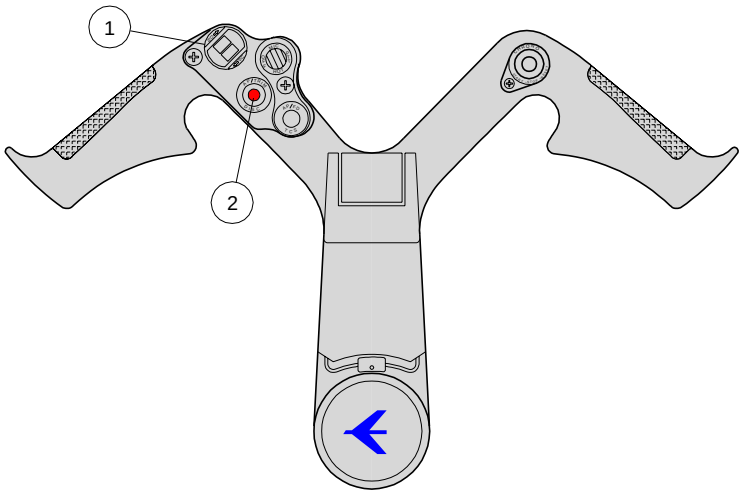


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CONTROL SURFACE LOCATION

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CONTROL WHEEL



1 - PITCH TRIM SWITCH (SPRING-LOADED TO NEUTRAL)

– Trims the airplane when the autopilot is not engaged.

– If only half of the switch is actuated for more than 7 s, the switch will be automatically deactivated.

– Manual pilot trim commands are limited to 3 s.

NOTE: Captain's pitch trim switch actuation has priority over the first officer's.

2 - AP/TRIM DISCONNECT BUTTON

Trim

– Disables both HS-ACE channels when the switches remain pressed, thus disconnecting the autopilot and stopping any active trim command.

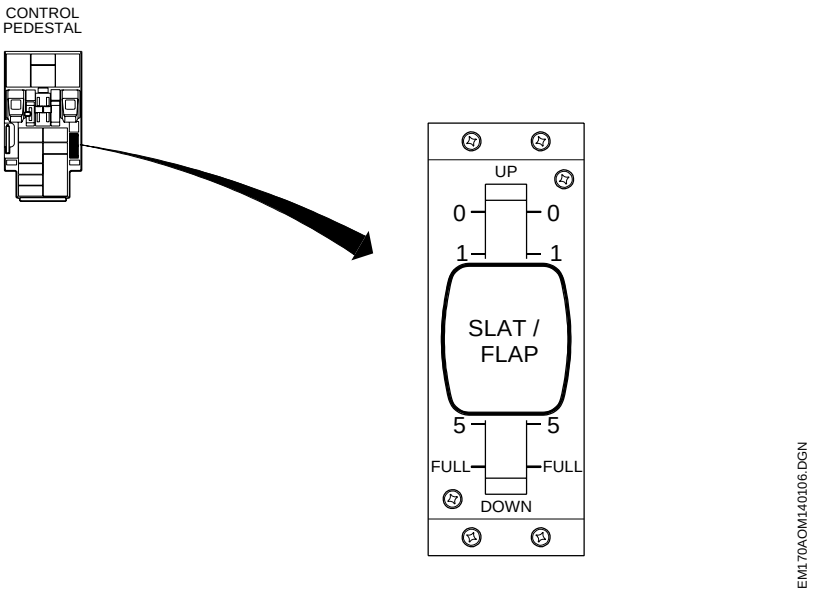
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– Releasing the button will activate the channel again.

Autopilot

– Refer to Automatic Flight.

SLAT/FLAP SELECTOR LEVER



– Selects slat/flap position by unlatching the lever and lifting a trigger below the head.

– Intermediate positions are not enabled. If lever is left at an intermediate position, flaps/slats remain in the last selected position. Position 4 is gated for normal Go Around and Takeoff. Position 5 is used for landing.

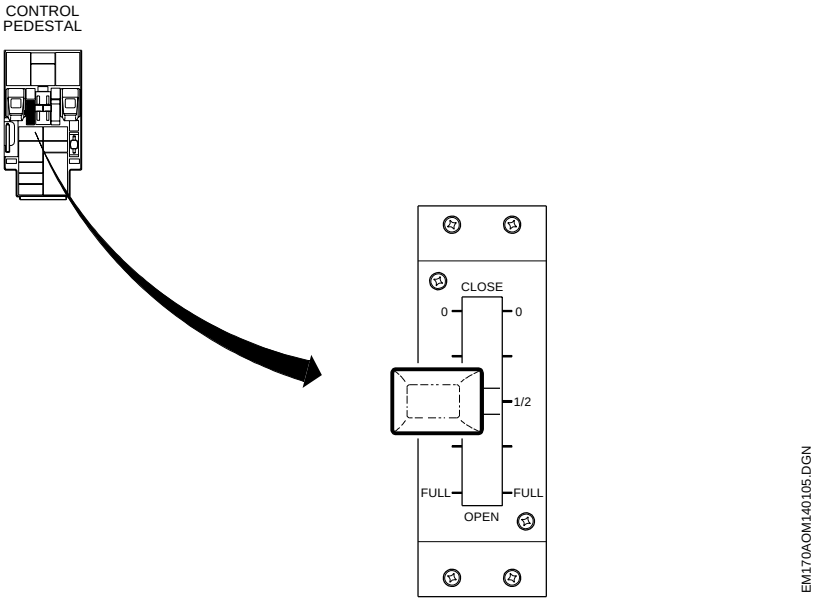
Lever position	Slat position	Flap position	Detent/Gated
0	0°	0°	Detent/Stop
1	15°	7°	Detent
2	15°	10°	Detent

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Lever position	Slat position	Flap position	Detent/Gated
3	15°	20°	Detent
4	25°	20°	Gated/Stop
5	25°	20°	Detent
Full	25°	37°	Detent/Stop

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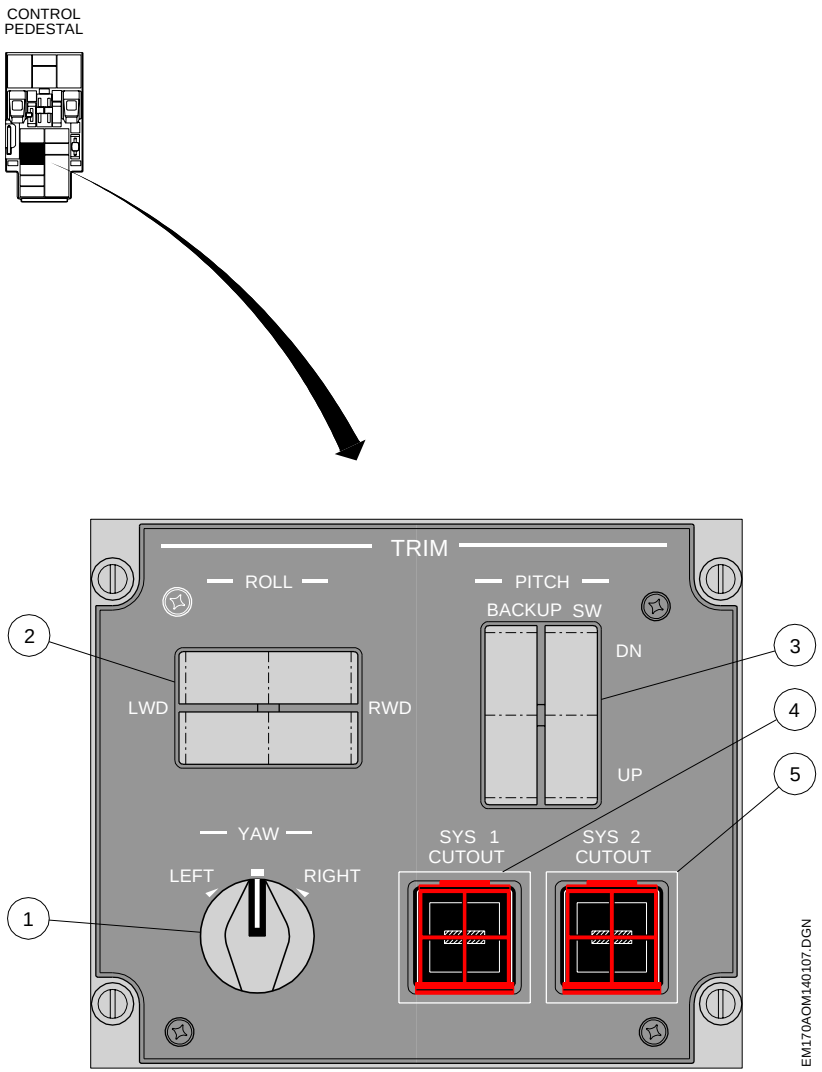
SPEED BRAKE LEVER



– Symmetrically deploys the multi-function panels. All multi function spoiler panels deploy at the same angle in response to the speed brake lever position.

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TRIM PANEL



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1 - YAW TRIM KNOB (SPRING-LOADED TO NEUTRAL)

– Actuates the yaw trim to left or right.

– Manual pilot trim commands are limited to 3 seconds.

2 - ROLL TRIM SWITCH (SPRING-LOADED TO NEUTRAL)

– Actuates the roll trim to left or right.

– Manual pilot trim commands are limited to 3 seconds.

3 - PITCH TRIM BACK-UP SWITCH (SPRING-LOADED TO NEUTRAL)

– Actuates the pitch trim through the back-up channel.

– Operation of the switch while the autopilot is engaged causes the autopilot to disengage.

– Manual pilot trim commands are limited to 3 seconds.

4 - PITCH TRIM SYS 1 CUTOUT BUTTON (GUARDED)

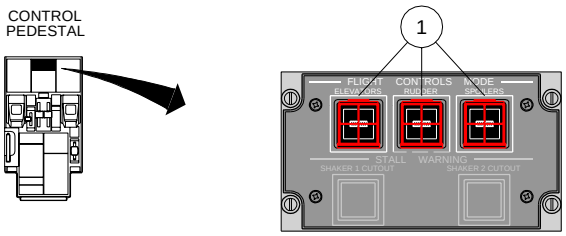
PUSH IN: disables the HS-ACE channel 1.
PUSH OUT: enables the HS-ACE channel 1.

5 - PITCH TRIM SYS 2 CUTOUT BUTTON (GUARDED)

PUSH IN: disables the HS-ACE channel 2.
PUSH OUT: enables the HS-ACE channel 2.

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FLIGHT CONTROL MODE PANEL



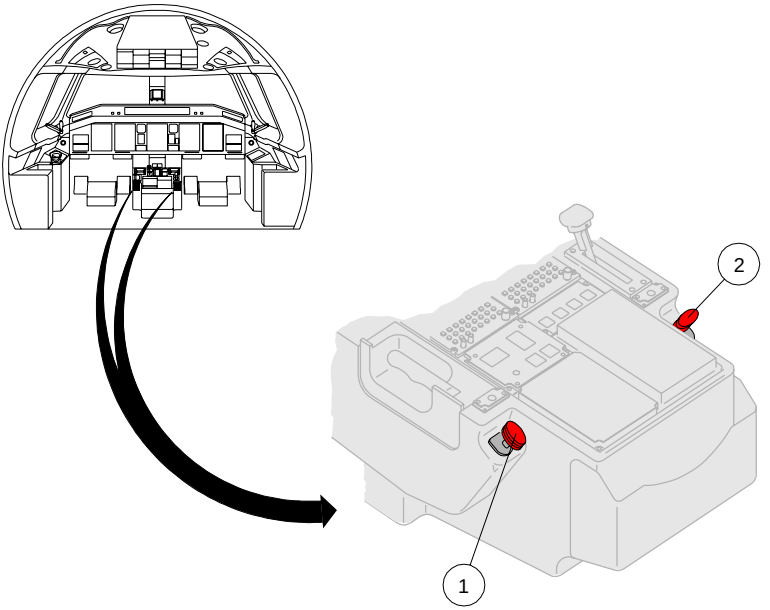
1 - FLIGHT CONTROL MODE BUTTON (GUARDED)

PUSH IN: places the associated flight system into direct mode.

PUSH OUT: places the associated flight system into normal mode.

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DISCONNECT HANDLE



1 - ELEVATOR DISCONNECT HANDLE

PULL: isolates the Captain and First Officer's control columns for elevator control.

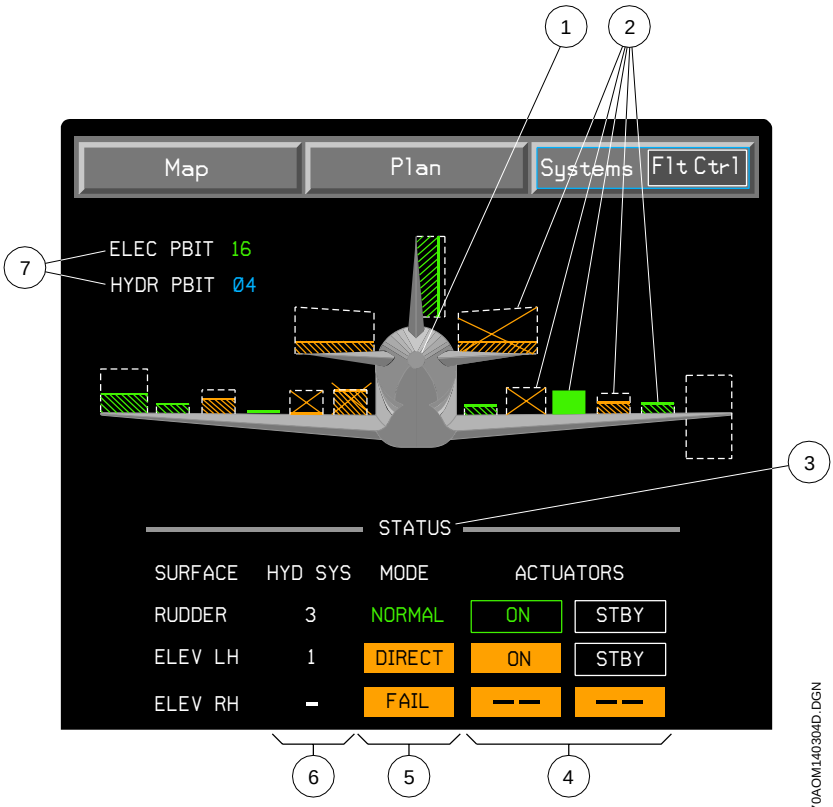
2 - AILERON DISCONNECT HANDLE

PULL: isolates the Captain and First Officer's control wheel for aileron control.

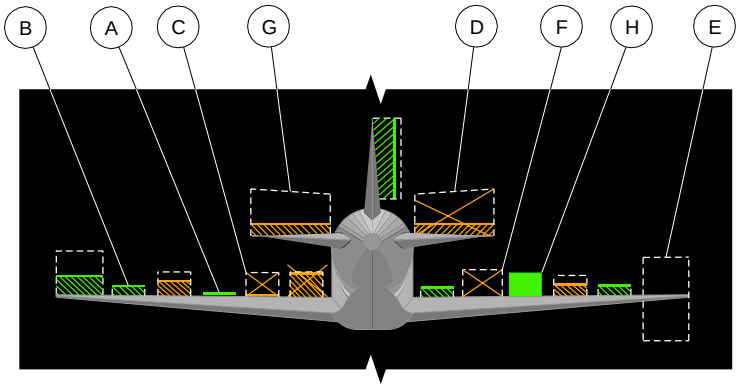
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FLIGHT CONTROLS SYNOPTIC PAGE ON MFD

The flight controls synoptic page provides a visual representation of the flight controls system operation and parameters, and can be selected by the flight crew for viewing on either MFD.



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EM170AOM140852A.DGN

1 - AIRPLANE GRAPHIC

– A static display that shows the location of flight control surfaces, status of the flight control actuators and flight controls mode of operation.

2 - SURFACE POSITION STATUS

A. RETRACTED: a green line aligned with the wings, elevator or rudder.

B. DEPLOYED: a green line and the surface with green stripes. A white dashed box is shown only for surface position greater than 50% of its deflection.

C. FAILED RETRACTED: an amber line, a white dashed box and an amber cross.

D. FAILED DEPLOYED: white dashed box, surface with amber stripes and amber cross.

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E. NOT AVAILABLE WITH NO FAIL INDICATION: shows a white dashed box for surfaces with deflection in one direction (e.g. spoilers) and two white dashed box for surfaces with deflection in two directions (e.g. ailerons).

F. NOT AVAILABLE WITH FAILURE INDICATION: shows a white dashed box and an amber cross for surfaces with deflection in one direction (e.g. spoilers) and two white dashed box and two amber crosses for surfaces with deflection in two directions (e.g. rudder).

G. DIRECT MODE: shows the surface with amber stripes. A white dashed box is shown only for surface position greater than 50% of its maximum deflection.
As for flap zero the maximum surface deflection is about 50% of the full deflection, the white dashed box may not be shown, due to system tolerances.

H. FULL DEPLOYED: solid green box.

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3 - FLIGHT CONTROL SYSTEM STATUS ANNUNCIATIONS

– The status annunciations are shown in a table format for three surfaces. Three surfaces are listed in a column labeled SURFACE: RUDDER, ELEV LH, and ELEV RH.

4 - ACTUATOR STATUS ANNUNCIATION

– The rudder has two actuators, upper and lower. Each left and right elevator surfaces have two actuators, inboard and outboard.

– NORMAL/ACTIVE: a green ON annunciation inside a green rectangle box.

– NORMAL/STANDBY: a white STBY annunciation inside a white rectangle box.

– DIRECT/STANDBY: a white STBY annunciation inside a white rectangle box.

– DIRECT/ACTIVE: an ON annunciation presented in an amber rectangle box background.

– FAIL: a "—" annunciation displayed in an amber rectangle box background.

5 - AXES MODE ANNUNCIATION

– Axes mode annunciations are shown for the rudder, the left and the right elevator. It is presented as NORMAL, DIRECT, FAIL or "-", which indicates an invalid axes mode.

6 - HYDRAULIC SYSTEM SOURCE ANNUNCIATION

– Hydraulic system source annunciations are shown for the rudder, the left and the right elevator. It is presented as 1, 2, 3 or "-", which indicates an invalid source.

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7 - PBIT REMAINING TIME READOUT

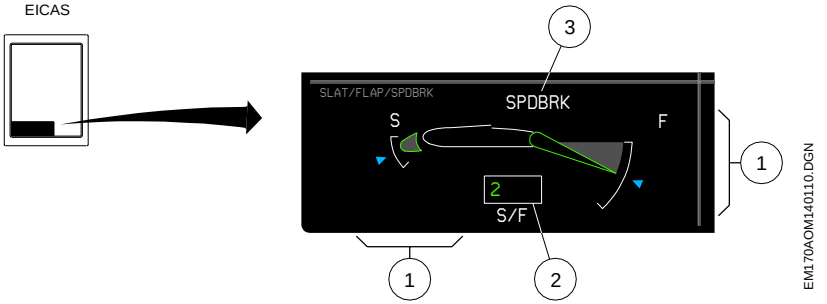
– A digital remaining time readout displays the hours until the electrical and hydraulic PBITexpire.

– If the value of the PBIT remaining time readout is higher or equal to 5, the numbers will be displayed in green, otherwise will be cyan. Invalid data will be represented by 2 dashes (″- -″) in amber.

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EICAS INDICATION

SLAT/FLAP/SPEEDBRAKE INDICATION ON EICAS



1 - SLAT/FLAP POSITION

– Displays the slat/flap position. If the information is invalid, the indication will be removed from the display.

GREEN: real-time surface position.

– The cyan pointers show the slat/flap commanded position and the green slat/flap depictions show actual slat/flap position. The flap scale has tic marks at each end, representing positions at 0° and 35° while the slat scale has tic marks at each end, representing positions at 0° and 25°.

2 - SLAT/FLAP READOUT

– Displays the slat/flap surface position. If the information is invalid, the indication will be removed from the display.

GREEN DASHES: slat/flap in transit.

NOTE: In case of slat/flap surface jamming, an additional box will be displayed in amber, as well as the readout. Whenever two boxes are displayed the possible values are 0, 3 or FULL for the slats and 0, 1, 2, 4 or FULL for the flaps based on the value of the surface angle.

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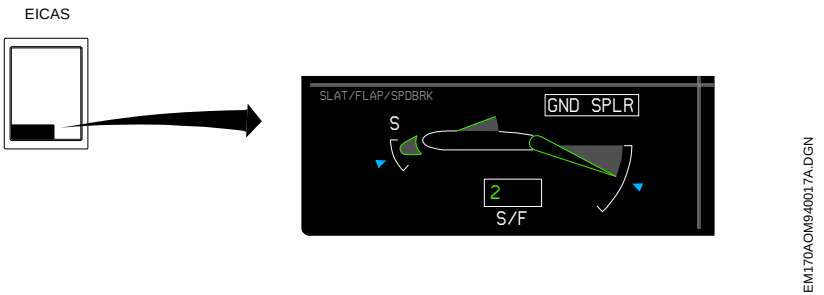
3 - SPEEDBRAKE INDICATION

– Displays a white SPDBRK annunciation when the airplane is in air.

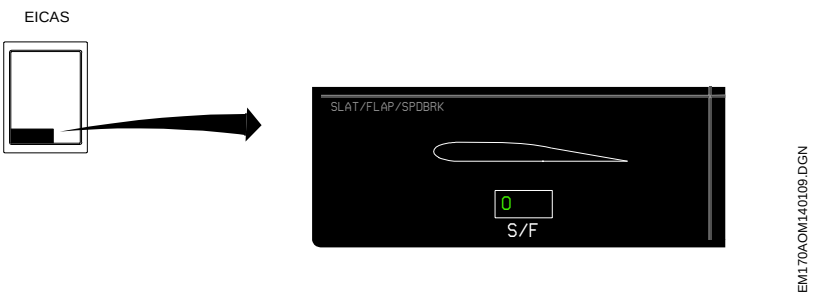
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AMBER BOXED: in case of failure.

NOTE: An OPEN and GREEN speedbrake position indication and a white GND SPLR annunciation display on EICAS after airplane touchdown when one of the Ground Spoiler panels open.



NOTE: For SLAT/FLAP/SPDBRK position 0 the legend and arrows will be removed from the display as presented below:



►*Airplanes Pre-Mod MAU load 23.1*

NOTE: If SLAT/FLAP surface stops in an intermediate position, amber dashes are displayed on EICAS.

◄

►*MAU load 23.1 and on*

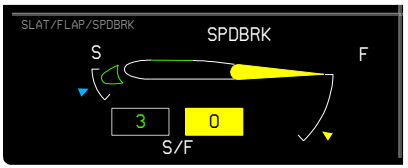
NOTE: If SLAT/FLAP surface stops in an intermediate position, the

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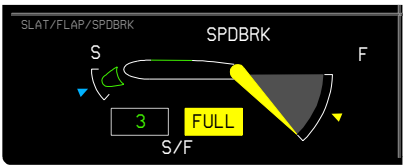
SLAT/FLAP READOUT will display the more retracted surface position. As an example, if flap fails between positions 2 and 3, the EICAS will indicate position 2.
The FLAPS or SLATS indication 0 in amber indicate the surface may be between 0 and 1. Thus maximum altitude for flaps extended (20000 ft) must be respected.

◄

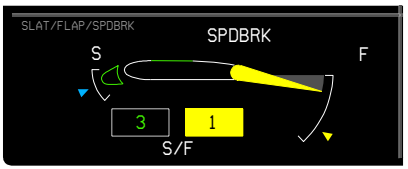
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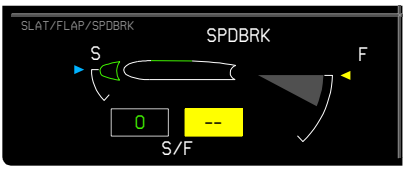
FLAP FAIL IN 0



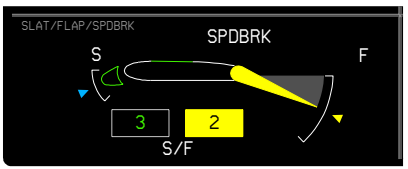
FLAP FAIL IN FULL



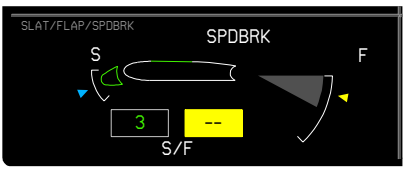
FLAP FAIL IN 1



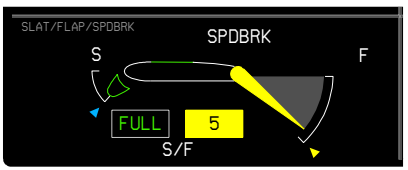
FLAP DATA INVALID OR UNAVAILABLE WHEN
SLAT/ FLAP LEVER IS IN ZERO POSITION



FLAP FAIL IN 2



FLAP DATA INVALID OR UNAVAILABLE WHEN
SLAT/ FLAP LEVER IS NOT IN ZERO POSITION



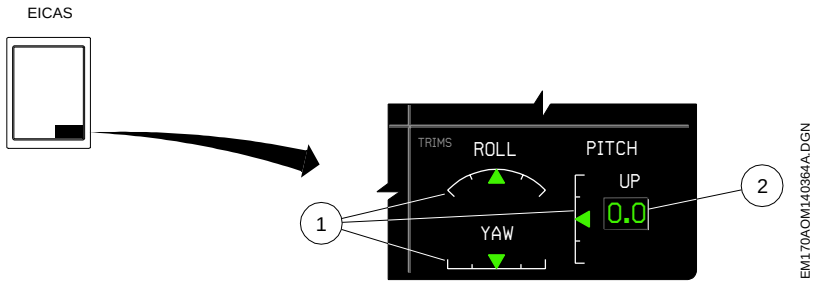
FLAP FAIL IN 5

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OVERALL DISPLAY SITUATIONS

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ROLL/PITCH/YAW TRIM INDICATION ON EICAS



1 - ROLL/PITCH/YAW TRIM SCALE

- Trim position configuration is indicated by a solid green pointer in the scale.
- There are five tic marks displayed along the roll and yaw scale, positioned at –100%, –50%, 0%, 50%, 100%.
- There are five tic marks displayed along the pitch trim scale, positioned at 4°, 0.25°, –3.5°, –7.25°, and –11°. There is a green takeoff band on the scale extending from 2° to –4°, corresponding to the allowable pitch trim position for takeoff.

2 - PITCH TRIM DIGITAL READOUT

- Digital indication of the horizontal stabilizer trim position in tenths of a degree increments.
- An UP or DN indication displays above or below the readout according to the trim set.

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FLY BY WIRE COMPONENTS

Fly-by-wire is an electronic system designed to operate the flight controls replacing the control cables of a conventional airplane.

The EMBRAER FBW system is composed of a set of nine Actuator Control Electronics (ACEs) and four Flight Control Modules (FCMs):

– Three Primary-ACEs (P-ACE).

– Two Slat/Flap ACEs (SF-ACE).

– One Horizontal Stabilizer ACE (HS-ACE).

– Three Spoiler ACEs (S-ACE).

– Four Flight Control Modules (FCM).

ACTUATOR CONTROL ELECTRONICS (ACE)

The ACE units connect the control column electronically to the respective control surface, providing direct analog control of the surface.

There are four different ACE units:

PRIMARY CONTROL ELECTRONICS (P-ACE)

The P-ACE units control the rudder and the elevator surfaces.

There are three P-ACE units, two installed in the forward electronics bay and one installed in the aft electronics bay.

Each P-ACE has two channels one is the active and the other is the standby.

SLAT/FLAP ACTUATOR CONTROL ELECTRONICS (SF-ACE)

The SF-ACE units control the slat and flaps surface.

There are two SF-ACE units installed in the middle electronics bay.

Each SF-ACE has two channels one channel for flap and one channel for slat.

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HORIZONTAL STABILIZER ACTUATOR CONTROL ELECTRONICS (HS-ACE)

The HS-ACE unit controls the horizontal stabilizer surface.

The Horizontal Stabilizer ACE (HS-ACE) is installed in the aft electronics bay.

The HS-ACE has two channels one is the active and the other is the standby.

SPOILER ACTUATOR CONTROL ELECTRONICS (S-ACE)

The S-ACE resides within the FCMs and is used to control the multifunction spoilers. Each FCM controls one pair of multi-function spoiler.

FCM #1, FCM #3 and FCM #4 have wiring to control spoilers. FCM #2 does not control any spoiler pair.

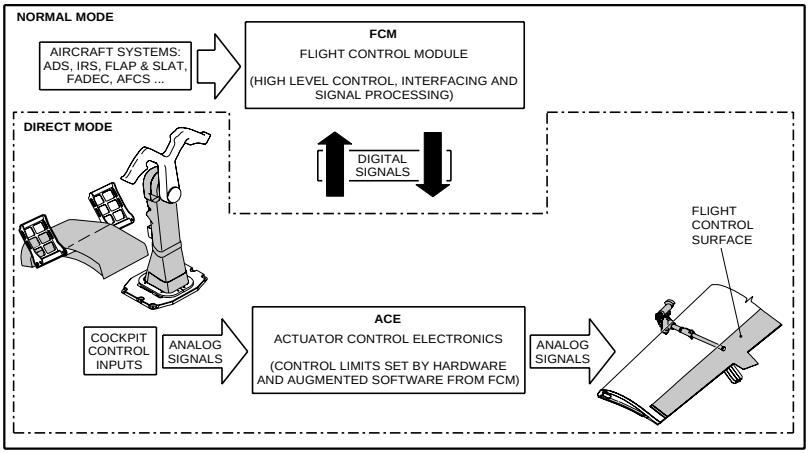
FLIGHT CONTROL MODULES (FCMs)

The FCMs provide software-based assistance to the P-ACE and is required for normal-mode operation of the flight controls system.

The FCM units are connected to the P-ACE via the Controller Area Network Bus (CAN BUS), providing digital inputs to the P-ACE, which are combined with pilot inputs. This is used to augment pilot inputs for different airspeeds, and provides other high-level functions such as Angle-of-attack (AOA) limiting to the P-ACE units.

FCM 1 and 2 are located in the Modular Avionics Units # 1 (MAU 1) and FCM 3 and 4 are located in the Modular Avionics Unit # 3 (MAU 3).

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FLY-BY-WIRE SCHEMATIC

MODES OF OPERATION

The Flight Control System provides two basic modes of operation:

– NORMAL MODE: The Flight Control Module (FCM) provides software based airspeed gain schedules and control limits to the P-ACE, as well as high level functions such as:

  – Elevator control laws scheduling with airspeed.
  – Auto-thrust compensation with elevator.
  – Angle-of-Attack (AOA) limiting with elevator offset.
  – Rudder airspeed gain scheduling and stroke limiting.
  – Yaw damper and turn coordination via AFCS.
  – Rudder flight authority.
  – Roll spoiler scheduling with airspeed and speedbrake deployment.
  – Mach Trim as a function of Mach number.

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  - Configuration change compensation with elevators and horizontal stabilizer due to landing gear, flap/slat and speed brakes actuation.
- DIRECT MODE: The FCM is removed from the control loop (for instance, due to loss of airspeed data) and the control limits default to values set by hardware in the P-ACE.
  - Direct mode of operation is primarily the result of loss of data from all FCM (no airspeed input) or; multiple ACE failures.
  - Operation is defaulted to fixed control laws configuration.
  - Control input provided by Captain and First Officer's sensors is sent directly to the surface.

NORMAL MODE vs DIRECT MODE SELECTION

The mode selection is automatic when a channel failure is detected or manually selected by using a "Mode Select" switch on the Flight Control Panel.

The "Mode Selection" switch provides the capability to the flight crew to reset the system to Normal Mode in case of the system defaulting to Direct Mode, or to manually default the flight control system to Direct Mode in case of a wrong gain computed by the FCMs being transmitted to the P-ACEs or S-ACEs. In this case the "Mode Selection" switch toggles the Normal Channel of the active P-ACE to the Direct Channel of the standby P-ACE.

The pilot always has supreme control authority of the airplane since the FCMs cannot override a pilot input.

FCM, P-ACE AND AIRPLANE LEVEL COMMUNICATION

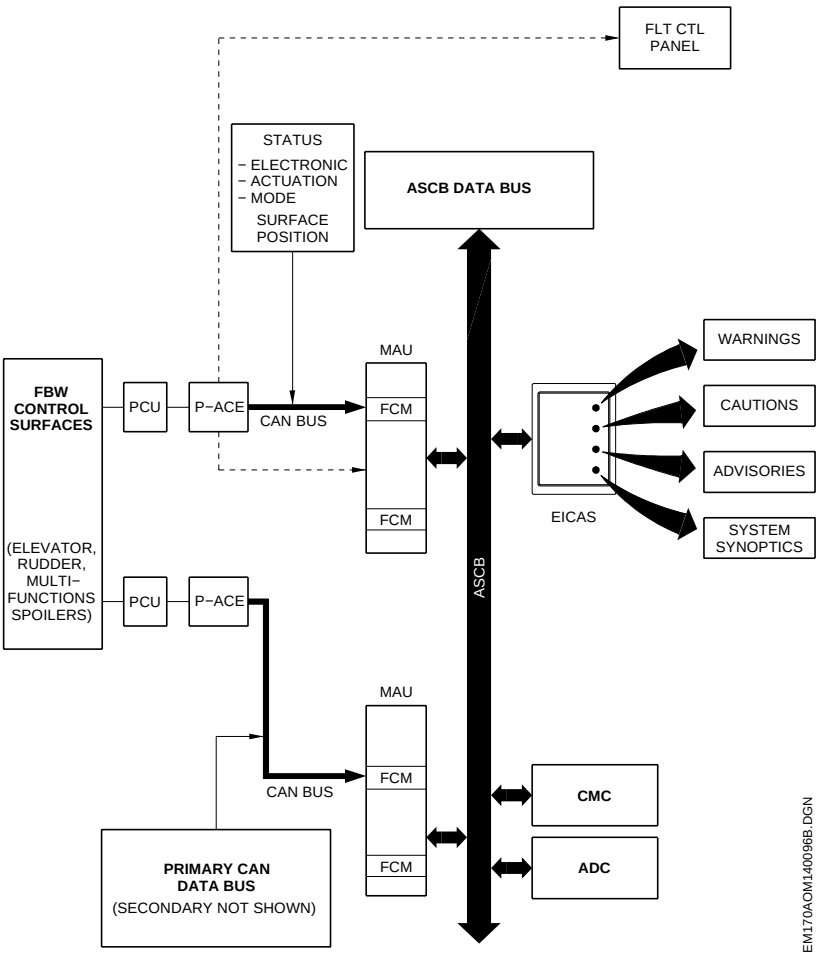
The Controller Area Network BUS (CAN BUS) is the communication link between the FCMs and the P-ACE units while the Avionics Standard Communication Bus (ASCB) provides data exchange between all FCMs, and with other components of the avionic system. The following systems provide data to the flight controls system:

- Smart probes and the Air Data Application (ADA) modules provide air data for various airspeed augmentation commands.
- The IRS provides airplane attitude and accelerations to the FCMs used for AOA limiting function computation.

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– The Proximity Sensor Electronic Module (PSEM) provides Weight-On-Wheels (WOW) and ground spoiler position data to the FCMs.
– Brake Control Modules (BCM) provide wheel speed signals used for ground spoiler deployment.
– The FADEC provide Thrust Lever Angle (TLA) to the FCMs used for elevator thrust compensation, and the Automatic Flight Control System (AFCS) provides autopilot commands.
– Data is shared for the EICAS to display warnings, cautions, advisory and system status and also provided to the central maintenance computer (CMC) for system diagnostics.

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AIRPLANE COMMUNICATION INTERFACE

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POWER UP BUILT IN TEST (PBIT)

The Power Up Built in Test (PBIT) reduces the flight control system exposition to latent faults, ensuring that the system components remain capable of executing their functions.

The PBIT is provided for both the Electrical and Hydraulic systems.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

The PBIT expires after 50 hours (elapsed time) since the last successful PBIT. Once the PBIT is expired, FLT CTRL BIT EXPIRED EICAS CAUTION message is displayed. This EICAS CAUTION message is provided for both Electrical PBIT and Hydraulic PBIT. The message remains displayed on EICAS until a new Electrical and Hydraulic PBIT is successfully performed.

No action is required if the PBIT expires in-flight, as the EICAS CAUTION message will only be displayed after landing.

◄

ELECTRICAL POWER UP BUILT IN TEST

The Electrical PBIT provides detection of out-of-tolerance conditions and failures in the FCMs, P-ACEs and SF-ACEs.

The Electrical PBIT is automatically performed during power up after the airplane is powered by any AC source and takes approximately 3 min to complete. If the FLT CTRL BIT EXPIRED message is displayed, the hydraulic built in test must be performed.

►*MAU load 4.5 and on*

The FLT CTRL TEST IN PROG Status message is displayed while electrical PBIT is in progress.

◄

If the airplane is already powered up, the crew may check the PBIT REMAINING TIME READOUT before starting the taxi out procedure. If the remaining time is sufficient for the taxi and takeoff, the crew may elect to reset the PBIT on the next flight.

The Electrical PBIT will be interrupted if any electric hydraulic pump is turned ON, if the FCP switches are cycled or if AC power is interrupted while the test is running.

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HYDRAULIC POWER UP BUILT IN TEST

The Hydraulic PBIT provides functional test of the flight control actuators.

The Hydraulic PBIT is performed automatically, only on the ground when all three hydraulic systems are pressurized.

The test takes 1 minute to complete and will be interrupted if any flight control surface is moved while the test is in progress.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

The FLT CTRL TEST IN PROG Status message is displayed while hydraulic PBIT is in progress.

◄

FLIGHT CONTROLS ODD EVEN DAY ENGAGE CONFIGURATION

For the rudder, elevator and stabilizer control surfaces which have two controlling channels, the flight control system has a function to select which set of channels would be the active channels for a particular day.

This function, called the 'Odd-Even Day Engage' configuration is implemented to reduce the latency in the flight control system and to allow for even wear of the flight control system components.

The 'Odd-Even Day Engage' function provides the following selection grouping for the rudder, elevator and horizontal stabilizer surfaces which can be view in the flight controls synoptic page on either MFD.

	Odd	**Even**
Rudder	Upper Channel Hydraulics 1	Lower Channel Hydraulics 3
Left Elevator	Inboard Channel Hydraulics 2	Outboard Channel Hydraulics 1
Right Elevator	Outboard Channel Hydraulics 3	Inboard Channel Hydraulics 2

During normal operation, the Odd-Even Day Engage function may engage in a different configuration from that shown above. If this scenario occurs, no maintenance action will be required to release the airplane for service unless there is a CAS message related to the flight controls system.

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FLY BY WIRE (FBW) BACKUP BATTERY

In case of an extremely improbable failure that would render complete loss of normal and emergency electrical power to the FBW, the backup power system, with no pilot intervention, keeps the appropriate number of elevator and rudder actuators operating for at least 15 min. There is no dedicated message to indicate the failure of this system; therefore there is no flight crew action required if this happens.

This backup system is comprised by a dedicated battery, distribution bus and circuit breakers.

The backup battery is charged by the DC ESS 3 bus during normal operation and consists of sealed lead acid cells with built-in-test (BIT) capability and an internal heater that guarantees the minimum battery temperature.

Although the battery is connected to the airplane buses, the use of an internal rectifier keeps it from powering back the buses, assuring isolation in case of failure in the main electrical power system.

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PITCH CONTROL

Pitch axis control is by means of electro-hydraulic commanded elevators and an electro-mechanical horizontal stabilizer.

ELEVATOR CONTROL SYSTEM

Pilot's inputs to the elevators are through the cockpit control columns in normal or direct mode. The elevators can be automatically controlled through the FCM via the autopilot.

ELEVATOR CONTROL SYSTEM COMPONENTS

A total of four P-ACE channels are used to independently control each of the four PCUs, providing the analog elevator control functions implemented in the P-ACE units.

Four independent FCM units, located in the MAU 1 and 3, provide high-level system augmentation to the P-ACE units, such as gain scheduling as a function of airspeed, elevator thrust compensation and AOA limiting.

ELEVATOR CONTROL SYSTEM OPERATION MODE

NORMAL MODE: With the elevator control system operating in normal mode, the elevator moves according to gain scheduling as a function of airspeed, reducing elevator movement with increasing airspeeds. In the event of loss of airspeed information, the FCM is removed from the control loop, and the associated P-ACE reverts to direct mode. FCM functions and AOA limiting are then no longer available.

DIRECT MODE: When the FCM is removed from the control loop the elevator system is reverted to direct mode automatically and the operation is defaulted to fixed control laws configuration.

Elevator high level functions as well as the auto pilot are no longer available.

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POWER CONTROL UNIT (PCU)

The elevator surfaces are hydraulically actuated through the PCU units.

The hydraulic systems responsible for powering the actuators are:

– Hydraulic System 1: left outboard actuator.

– Hydraulic System 2: left & right inboard actuators.

– Hydraulic System 3: right outboard actuator.

Since the actuators on each surface operate on active/standby mode, the P-ACE automatically alternates the active actuator every time the elevator system is powered up. The loss of hydraulic supply forces the standby PCU to become active.

ELEVATOR JAM

If a jam in one of the elevator actuator is detected, the respective elevator surface will remain fixed at the position where the jam occurred. The pilot will be able to control the airplane using the remaining elevator.

ELEVATOR FLIGHT CONTROL PANEL BUTTON

A dedicated button on the Flight Control Mode panel provides the capability to the pilots to reset the elevator system to Normal Mode in case of the system defaulting to Direct Mode, or to manually default the elevator system to Direct Mode.

When the flight control panel elevator button is pushed in, it commands all four elevator channel to change from Normal to Direct mode. In addition, pushing the button also results in the active elevator channels transitioning to the standby state, and the channels that were previously in standby would become active. This feature is also included to allow the system to transition away from the present controlling channels.

When the flight control panel elevator button is pushed out, the system reverts to the Normal Mode.

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ELEVATOR THRUST COMPENSATION FUNCTION (ETC)

This function helps to reduce the pilot workload by applying elevator commands to reduce the pitching moment produced by increasing or decreasing engine thrust. The ETC function is computed in the FCM as a function of N1, mach and pressure altitude. Elevator command is limited to plus or minus 5°, and is applied proportional to the amount of engine thrust above or below the reference thrust setting.

If one or more sensors required to perform the ETC function fail, the function is no longer available and the respective message will be displayed on the EICAS.

TAIL STRIKE AVOIDANCE (TSA)

Tail Strike Avoidance (TSA) function is a fly-by-wire feature designed to help avoiding tail strikes occurrences during takeoffs an landings.

TSA function controls airplane pitch angle by reducing control column authority in the nose up direction. The maximum pitch angle that can be achieved by the airplane is a function of height above ground level (HAGL), measured at the main landing gear wheel. HAGL calculation depends on:

– Landing: HAGL calculated via two radio altimeters.

– Takeoff: estimated HAGL by means of the vertical speed.

The authority of TSA function depends on whether in takeoff or landing configuration.

TAKEOFF OPERATION

The TSA function will be ENABLED for takeoff at estimated altitudes less than 20 ft.

The function maximum pitch down elevator deflection in order to correct airplane attitude by reducing its pitch rate is limited to 8°. In case of a negative pitch rate, the maximum pitch up elevator deflection is limited to 0°.

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LANDING OPERATION

The TSA function will be ENABLED for landing at estimated altitudes less than 70 ft. It is also necessary to have the flaps at position 5 or FULL. The function maximum pitch down authority is also limited to 8° of elevator deflection, while pitch up is limited to Normal Mode commands generated by other fly-by-wire functionalities.

For GO AROUND scenarios, TSA operates as follows: for HAGL calculation it is assumed that the airplane is in landing configuration, however, the elevator command authority is the same as the takeoff configuration. The TSA mode changes from landing to go-around after TOGA is selected (TLA greater than 70°) and positive rate of climb is attained.

NOTE: – In case of exceedance of the angle of attack threshold defined by the AOA limiter due to a TSA elevator command, the AOA limiter operation has priority over TSA.
– There is no cockpit indication for the flight crew that the TSA function has been activated.
– TSA commands are limited to only 8° of elevator deflection, thus do not provide full protection against tail strikes. Pitch angles should be maintained below 10° to ensure clearance.

►*190/195 models, MAU load 23.1 and on*

For landings and GO AROUND with flap 5, it is not possible to engage TSA function before 5 min have elapsed from takeoff.

◄

ARTIFICIAL FEEL UNITS (AFU)

With no mechanical connection between the control column and the elevator surfaces, two independent feel units provide artificial feel and centering to the control columns, which increase as a function of control column displacement.

The feel units consist of a preloaded spring, which returns the columns to the neutral position. There is one feel unit attached to each torque tube, in case of separation of the control columns commands, the feel system is still active for the non-jammed column.

With the columns disconnected or with a single AFU disconnected, the feel loads on the column are reduced to one half of the normal loads.

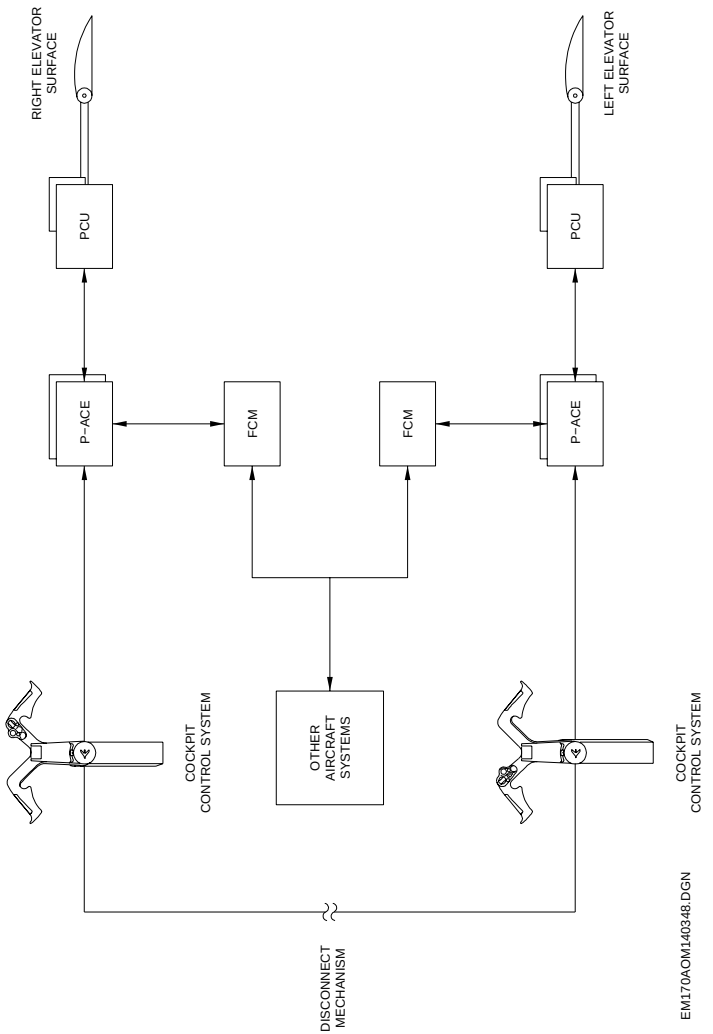
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DISCONNECT MECHANISM (JAMMED COLUMN)

A disconnect mechanism is provided to allow separation of the First Officer and Captain's control columns. In the event of a jam in one of the control columns, the disconnect mechanism can be actuated by pilots through the disconnect handle in the cockpit.

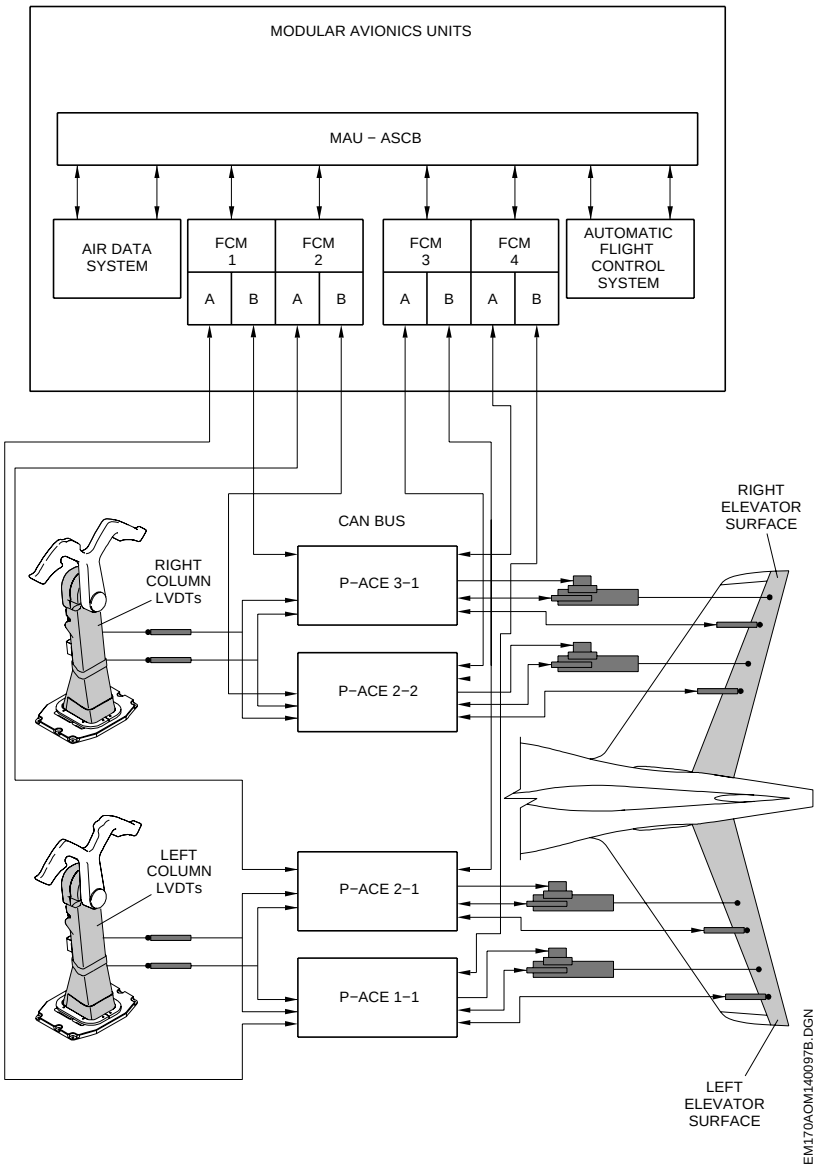
Following a disconnection, the pilot of the non-jammed side retains pitch control by means of the on-side elevator. The system will remain disconnected for the remainder of the flight and ground maintenance is required to reset the disconnected unit.

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ELEVATOR SYSTEM SCHEMATIC

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ELEVATOR SYSTEM INTERFACE

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HORIZONTAL STABILIZER CONTROL SYSTEM

Control of the horizontal stabilizer is by means of an electromechanical system commanded by either:

– The manual selection of the Captain or First Officer's wheel main trim switches or pedestal mounted backup trim switches which directly control an electrical servo motor coupled to the Horizontal Stabilizer Actuator (HSA).

– Or the Flight Control Module (FCM) for autopilot trim and speed brake auto trim which actuate the electrical servo-motor coupled to the Horizontal Stabilizer Actuator (HSA).

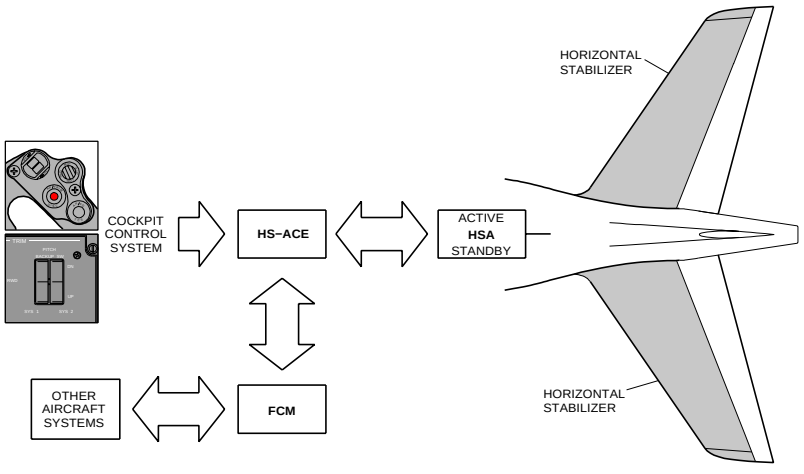
HORIZONTAL STABILIZER SYSTEM COMPONENTS

Horizontal Stabilizer Actuator Control Electronics (HS-ACE) and one Horizontal Stabilizer Actuator (HSA) are used to move the control surface.

HORIZONTAL STABILIZER ACTUATOR

The HSA is a single electrical-mechanical actuator. Two AC motors drive the actuator in an active/standby configuration. Stabilizer position is provided to the HS-ACE and is used for monitoring and EICAS indication.

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STABILIZER TRIM

MANUAL TRIM

The manual trim is commanded through switches installed on the control columns or a backup switch located on the main pedestal. Signals from either the control columns switches or the backup switch controls the electric trim motor.

The backup trim switch and the control wheel trim switches are dual split switches which have a 7 second time limitation when actuated separately. If only one half of the switch is actuated for more than 7 seconds, that switch is automatically deactivated.

In order to avoid a possible pitch trim runaway condition, manual pilot trim commands are limited to 3 seconds. In case of stick shaker activation, the HS-ACE is prevented from responding to any pitch trim commands by a stick shaker signal from the AFCS.

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Stabilizer Trim priority Logic

The HS-ACE responds to all trim commands with the following priority:

1. Backup switches.
2. Captain.
3. First Officer.
4. FCM (auto-trim) commands.

AUTOPILOT TRIM

The autopilot can directly operate the electric trim motor when the autopilot is engaged. If the autopilot trim function is inoperative, the autopilot cannot be engaged. If this function is lost during autopilot operation, the autopilot will be disengage.

Autopilot trim function will be active only if:

– Autopilot is engaged.

– Configuration trim is operational.

– Manual electric trim is not active.

– On-side autopilot channel is priority.

NOTE: In case of an electrical failure, followed by RAT deployment, the trim function will work at half speed operation, for either manual trim or autopilot trim.

MACH TRIM

Automatic Mach Trim compensates pitch down tendency caused by changes on the aerodynamic center position, which moves backwards as Mach number increases.

For further information on Mach Trim operation refer to chapter 14–03 Automatic Flight.

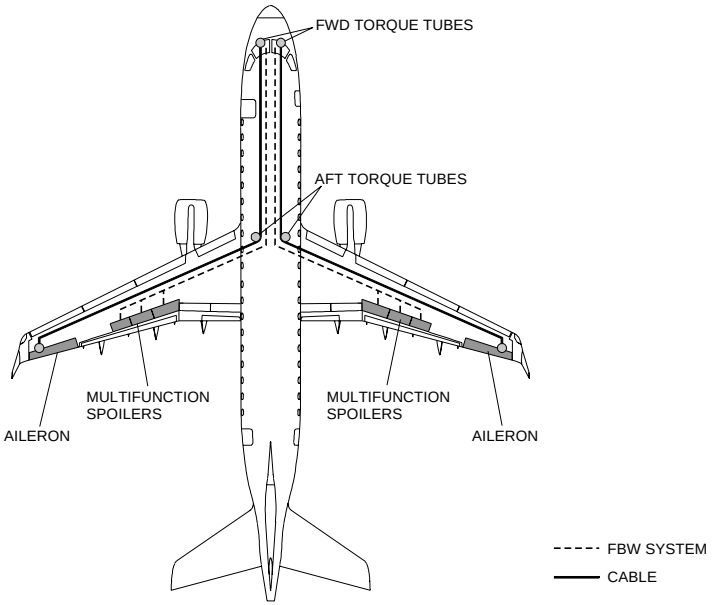
ELECTRICAL EMERGENCY

In the event of an electrical emergency, only the HS-ACE channel 2 is operational at low rate. A loss of airspeed data from the FCM also results in low rate operation of the horizontal stabilizer, providing structural protection for the surface.

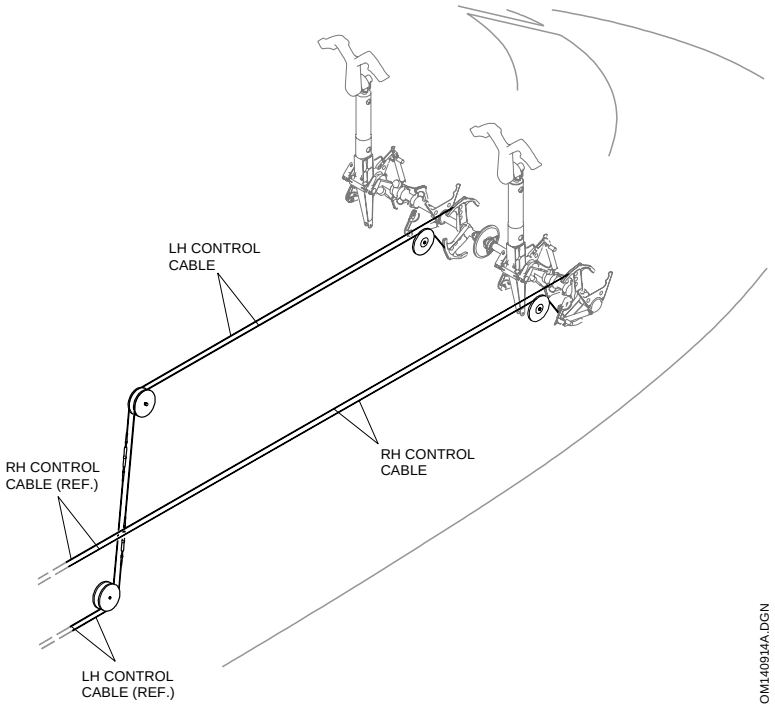
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ROLL CONTROL

Lateral control system includes both conventional ailerons and the fly by wire multi function spoilers witch provides the roll axis control.



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AILERON CABLES SCHEMATIC

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AILERON CONTROL SYSTEM

Aileron control is accomplished through a conventional cable system, which transmits control wheel and autopilot inputs to the ailerons power control units.

The power control units are driven by the following hydraulic systems:

– Hydraulic System 2: left & right inboard PCU.

– Hydraulic System 3: left & right outboard PCU.

AILERONS JAM

The aileron control system is divided into left and right half systems. The two halves are designed to tolerate single-point jams without loss of lateral control. In the event of a jam, the left and right sub-systems may be disconnected, thereby allowing command movements in the functional half-system.

The jammed half of the aileron system can be disconnected by pulling the aileron disconnect handle located in the cockpit.

Following a disconnect, the system remains separated for the remainder of the flight. Maintenance action is required to reconnect the disconnect device.

RIGHT AILERON JAM

The First Officer's half of the system is jammed.

The Captain retains control of the left aileron and the pair #5 of multi-function spoilers will remain available with normal artificial feel.

LEFT AILERON JAM

The Captain's half of the system is jammed.

The First Officer retains control of the right aileron without artificial feel and roll trim since the feel mechanism is attached to Captain's half of the system, the pair #4 of multi-function spoilers will remain available.

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PCU DISCONNECT

In the event of a disconnection of one aileron PCU from the surface or wing structure, the other PCU attached to the surface will operate normally, but the force authority will be halved. Hence the aileron PCUs normally share air-loads during flight, if the FCM detects a difference in load sharing from the actuators, a message will be displayed on the EICAS.

MULTIFUNCTION SPOILER CONTROL SYSTEM

The multifunction spoiler control system consists of 6 panels numbered from inboard to outboard as:

– L3, L4, L5 (left wing) and

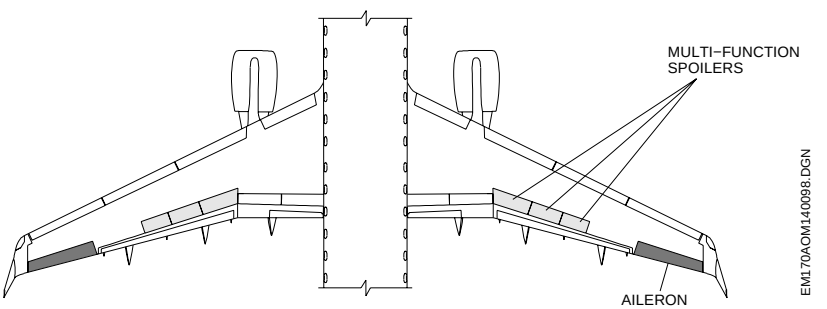
– R3, R4, R5 (right wing).

The roll spoiler function drives all six multifunction spoiler panel deployment asymmetrically as a function of control wheel position.

MULTIFUNCTION SPOILER OPERATION MODE

– **NORMAL MODE:** The Flight Control Module (FCM) provides software based airspeed gain schedules and control limits to the S-ACE, the spoiler deploys as a function of airspeed, reducing spoiler deployment with increasing airspeeds.

– **DIRECT MODE:** In the event of a FCM failure, the spoiler associated with the FCM turns to the direct mode. The other spoilers remain in the normal mode.



ROLL CONTROL SURFACES POSITION

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ROLL TRIM

The aileron control system is manually trimmed by using the roll trim switch on the trim control panel, located in the cockpit on the center pedestal. The trim system is operated via the roll trim switch on the trim control panel, commanding the actuator to move, and repositioning neutral feel position of the aileron system.

The actuator is equipped with a timer, limiting a single trim command to three seconds. A quick disconnect switch, located on the control wheels, disables the roll trim actuator by interrupting DC power to the trim motor, as long as the switch remain depressed.

AILERON TRIM SERVO FAILURE

In the event of a runaway of the aileron trim servo, the control wheel neutral point will shift and the pilot will be required to hold a constant force to maintain neutral lateral control. The pilot will retain full lateral control authority albeit with asymmetrical control forces.

In the event a disconnection of the trim actuator occurs the feel and centering for the lateral control will be lost.

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YAW CONTROL

Yaw control is performed by means of an electronic control system that commands electrohydraulic actuators of the rudders.

RUDDER CONTROL SYSTEM

The rudder control system is controlled either by the pilots, FCM high-level functions and additionally, for airplanes equipped with Autoland.

The rudder control system moves a single rudder surface attached to the vertical stabilizer. Two actuators, or PCUs, electrically commanded and hydraulically powered, are connected to the rudder control surface, receiving signals from the rudder control's Fly By Wire system (FBW).

Either the upper or the lower rudder actuator can control the rudder surface. The Captain commands only the upper actuator and the First Officer commands only the lower actuator.

The rudder actuators operate in an active/standby configuration, hence the P-ACEs alternate between the active PCU every time the rudder system is powered-up.

The hydraulic systems responsible for actuating the actuators are:

Hydraulic System 1: upper actuator, or PCU.

Hydraulic System 3: lower actuator, or PCU.

RUDDER CONTROL SYSTEM COMPONENTS

Two independent P-ACE modules drive the upper and lower PCU, providing the analog rudder control functions implemented in the P-ACE hardware.

Four independent FCM units, located in MAU 1 and 3, provide highlevel system augmentation on the P-ACE units, such as yaw damping, turn coordination, as well as gain scheduling as a function of airspeed.

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RUDDER FLIGHT CONTROL PANEL BUTTON

A dedicated button on the Flight Control Mode panel provides the capability to the pilots to alternate from Normal mode to Direct mode and vice-versa.

PUSHED IN

When the flight control panel rudder button is pushed in, it commands both rudder channels to change from Normal to Direct mode.

It also results in the active rudder channels transitioning to the standby state, and the channels that were previously in standby would become active.

This feature also allows the system to transition away from the current controlling channels to the standby channels.

PUSHED OUT

When the flight control panel rudder button is pushed out, the system recovers the Normal Mode.

RUDDER CONTROL SYSTEM OPERATION MODE

Normal Mode: In the normal mode, the FCMs add further high-level functions to the pilot pedal inputs. With increasing airspeed, rudder gain is reduce by the FCM in order to compensate for the increase in rudder effectiveness, and providing structural protection to the rudder surface.

Direct Mode: In the event of loss of airspeed information to the flight control system, the P-ACEs will revert to Direct mode using a fixed gain. There are two Direct mode fixed gains that are selected as a function of flaps/slats positions.

LOW-SPEED FIXED GAIN
Is selected for Flaps/Slats extended.
The rudder is set at the maximum authority to ensure that the pilot has sufficient authority to control the aircraft during the approach and landing.

HIGH SPEED FIXED GAIN
Is selected for flaps/slats retracted.
Ensures that the rudder movement is limited at high speeds, providing structural protection.

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RUDDER JAM

PEDAL JAMMED

In case of pedal assemblies jammed, the rudder remains active and will be actuated by high-level functions (yaw dumping and turn coordination).

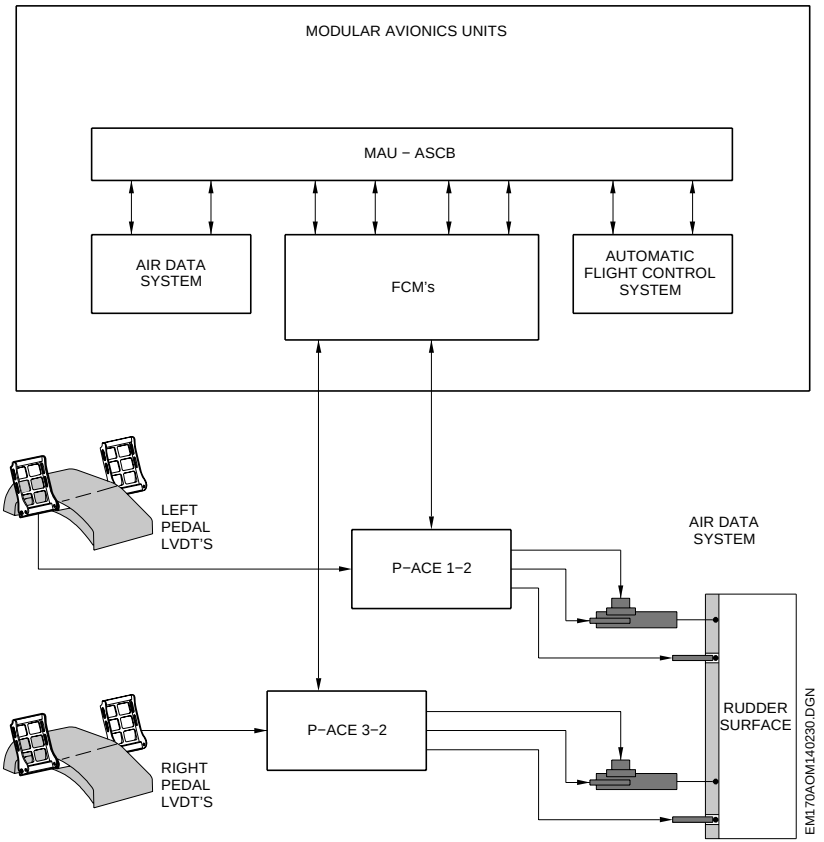
PCU JAMMED

In case of a jammed PCU actuator the rudder will be hydraulically locked at the current position. Aircraft control will be established through the ailerons and roll spoilers.

RUDDER TRIM SYSTEM

Rudder trim function is limited to three seconds. If further displacement of the trim system is required the command must be released and reapplied. Position indication of the trim actuator is provided on the EICAS.

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RUDDER SYSTEM INTERFACE

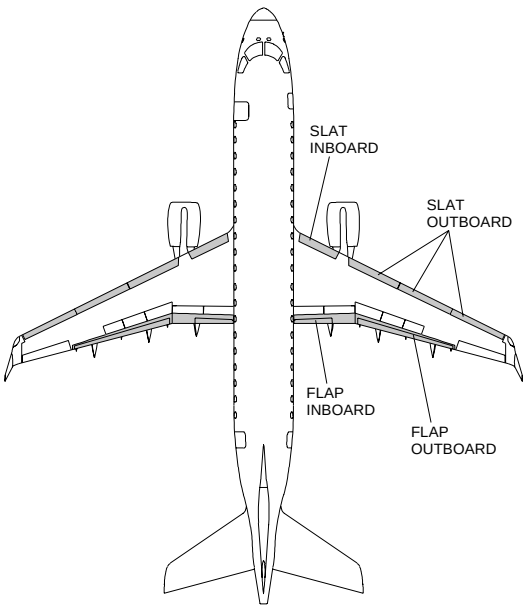
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SLAT/FLAP SYSTEM

The high lift control system consists of flaps and slats.

The slat system controls eight slat surfaces on the leading edge of the wing (four per wing) and the flap system controls four double slotted flap surfaces on the trailing edge (two per wing).

Surface position commands are given to the Slat/Flap-ACE (SF-ACE) via a Slat/Flap control lever installed on the center pedestal in the cockpit.



SLAT/FLAP PANEL LOCATION

There are seven slat/flap control lever positions. Slat and flap motion is sequenced such that slats extend first and flaps retract first when the motion command requires both surfaces to move. The system uses electrical power to move the surfaces.

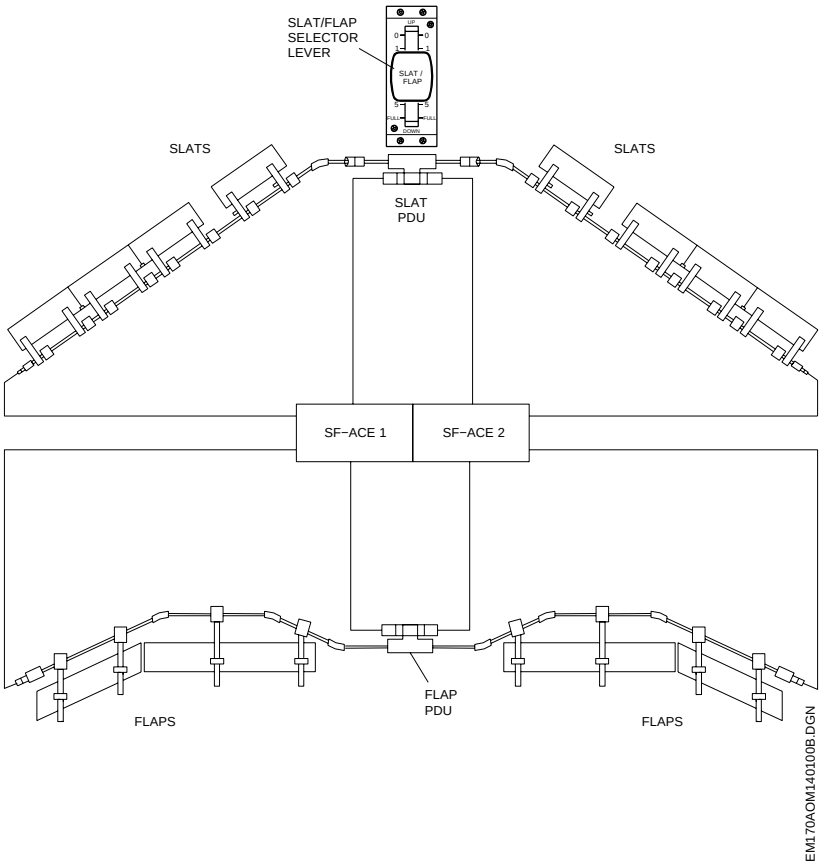
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SLAT/FLAP SYSTEM COMPONENTS

Deployment of both slats and flaps surfaces is commanded by two SF-ACEs and electrically operated using Power Driver Units (PDUs). Each SF-ACE is a dual channel unit, with one channel for flap control and one channel for slat control.

A total of four flap actuators per side provide the actuation force to extend and retract the flap panels mounted on the trailing edge of each wing. The double-slotted flap consists of a main flap panel and an aft flap panel for both inboard and outboard flaps.

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SLAT/FLAP SYSTEM SCHEMATIC

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SLAT/FLAP PROTECTION LOGIC

SKEW PROTECTION

Electronic skew sensors monitor differential movement between neighboring panels of flap (slat). If differential movement of a panel exceeds acceptable limits, the SF-ACES shuts down the flap (slat) system and the FLAP (SLAT) FAIL message displays on EICAS.

The SLAT-FLAP LEVER DISAG may appear if the respective surface has not reached the position selected on the Slat/Flap Lever. The affected surface is inoperative for the remainder of the flight whereas the non-affected surface operates normally (i.e., in case of FLAP FAIL the Slats operates normally and vice-versa).

STRIKE PROTECTION

The SF-ACE monitors PDU load and if an excessive load is detected it stops the electrical power to the respective PDU for further movement to the selected direction. The FLAP (SLAT) FAIL message displays and the SLAT-FLAP LEVER DISAG also displays, as the affected surface has not reached the selected position.

In such cases, the affected surface can be commanded in the opposite direction (i.e., for FLAP FAIL during retraction, the Flap can be commanded for extension and vice-versa).

When the strike protection actuates, the affected surface can be commanded in both directions if it is returned to the previously selected position. After three unsuccessful attempts to select a position, the strike protection cuts the PDU power for both directions.

SLAT/FLAP SYSTEM INTERLOCKS

OPERATING WITH RAM AIR TURBINE (RAT)

The SF-ACE has two independent channels that are powered by different electrical power sources.

If the Ram Air Turbine RAT is the only source of electric power, the flaps and slats operate in half speed, as only one channel remains available. Additionally, when RAT is the only source of electrical power, the SF-ACE prevents deployment of slats and flaps beyond position three to assure adequate airspeed for the RAT.

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SLAT OR FLAP FAILURE

In case of a Flap or Slat failure, when the affected surface is de-energized, the SF-ACE still commands the non-affected surface upon S/F Lever movement. This allows improved landing performance even in the event of failure by selecting a more appropriate position of the non-affected surface.

However, there are some slat/flap combinations that are automatically protected by the system, as they would induce poor airplane controllability. Thus, the SF-ACE does not command the Flaps beyond 10° (S/F Lever on position 2) with the Slats below 15°. In this failure scenario, if the S/F Lever is commanded beyond the position 2, the SF-ACE limits the Flap deflection to 10° and the SLAT-FLAP LEVER DISAG message displays.

The slat/flap interlock is disabled on ground allowing either surface be extended or retracted to any valid position regardless of the position of the other surface.

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SPOILER SYSTEM

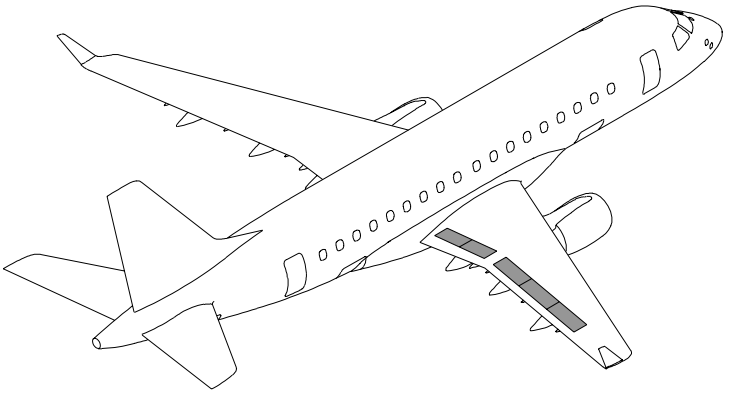
The spoiler control system consists of ten spoiler panels numbered inboard to outboard as follows:

- L1, L2, L3, L4, L5 (left wing) and
- R1, R2, R3, R4, R5 (right wing).

Panels L3, R3, L4, R4, L5 and R5 are called multifunction spoilers and have three modes of operation:

- Roll Control: deployed asymmetrically for roll augmentation as commanded by the pilots control wheel. Displacement angle is proportional to control wheel displacement.
- Speed Brakes: deployed symmetrically during flight by speed brake handle to increase aerodynamic drag to reduce airspeed or increase rate of descent. Panel displacement is proportional to speed brake handle position.
- Ground Spoilers: deployed symmetrically during landing roll to increase wheel braking efficiency and aerodynamic drag to reduce the stopping distance. Panels are fully and automatically extended when ground spoiler deployment conditions are met.

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SPOILERS LOCATION

HYDRAULIC SYSTEM ASSOCIATED WITH EACH ACTUATOR

The hydraulic systems responsible for actuating the multi function PCUs are:

- Hydraulic System 1: left and right inboard and middle PCUs (L3, R3, L4, R4).
- Hydraulic System 2: left and right outboard PCUs (L5, R5).

The hydraulic systems responsible for actuating the dedicated ground spoilers PCUs are:

- Hydraulic System 1: left and right outboard PCUs (R2, L2).
- Hydraulic System 2: left and right inboard PCUs (R1, L1).

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GROUND OPERATION

The spoiler control system provides automatic ground spoiler deployment to increase wheel-braking efficiency reducing the lift generated by each wing and to reduce the stopping distance producing aerodynamic drag.

During ground operation, all spoiler panels function as ground spoilers and are commanded to the fully extended or fully retracted positions.

The ground spoiler function drives all ten spoiler's panels to the limit deflection of the actuators.

MULTI-FUNCTION AND GROUND SPOILERS DEPLOYMENT

After touchdown the FCM will command all multifunction spoiler surfaces to the 40 degrees extended position and the ground spoiler surfaces to 60 degrees when the following conditions are simultaneously met:

- Weight on wheels on ground.
- Wheel speed is above 45 kt or airspeed is above 60 KIAS.
- Thrust Lever Angle (TLA) below 26 degrees.

Following rollout, the spoilers will automatically retract when wheel speed is below 45 kt for at least 5 seconds. If the throttles are moved beyond 35 degrees (TLA) after landing, the spoiler panels will automatically retract.

NOTE: In the direct mode, ground spoilers are not available.

IN-FLIGHT OPERATION

ROLL SPOILERS

The roll spoiler function drives the multifunction spoiler panels asymmetrically as a function of control wheel position.

For further information on the roll spoilers operation, refer to AOM 14-08-20.

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SPEED BRAKES

When actuating as speed brakes, the spoiler control system deploys all six multi function spoiler panels symmetrically up to the in-flight limit of 30 degrees following speed brake handle position.

If extended during approach, the speed brakes will automatically retract upon selection of slat/flap 2 or above.

Speed brakes will not be deployed if airspeed is below 180 KIAS, and will also automatically retract if airspeed decreases below this threshold.

In order to prevent inadvertent operation during a go-around maneuver the speed brakes will automatically retract anytime the thrust levers are advanced beyond Thrust Lever Angle (TLA) 70 degrees.

In the event of a disagreement of the speed brake handle position with actual surface position, the EICAS advisory message SPDBRK LEVER DISAG is displayed on the EICAS.

NOTE: In the direct mode, speed brakes are not available.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	ELEV (RUDDER) (SPOILER) NML MODE FAIL	Normal mode of the associated system is no longer operative.
	GROUND SPOILERS FAIL	One of the ground spoiler surfaces has extended inadvertently or has failed to extend when commanded.
CAUTION	AOA LIMIT FAIL	Stall protection function has failed.
	ELEV THR COMP FAIL	One or more sensors required to perform Elevator Thrust Compensation function have failed and the function is no longer available.
	ELEVATOR FAULT	Left and right elevator control system has reverted to direct mode.
	ELEVATOR LH (RH) FAIL	Left (right) elevator control system is no longer available.
	FLAP FAIL	Both flaps electronic control channels are inoperative and the flaps system is no longer available or there is a jam in the mechanical portion that precludes the flaps from moving.

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TYPE	MESSAGE	MEANING
CAUTION	FLT CTRL BIT EXPIRED	(Pre-Mod. Load 21.2) 20 hours or more has passed since the last time PBIT was activated. (Post-Mod. Load 21.2) 50 hours or more has passed since the last time PBIT was activated.
	FLT CTRL NO DISPATCH	One of the components associated with the flight control system has failed to a No-Go condition.
	PITCH TRIM FAIL	Pitch trim function is no longer available.
	RUDDER FAIL	Active and standby rudder channels have failed or rudder has jammed.
	RUDDER FAULT	Indicates that the rudder control system has reverted to direct mode.
	RUDDER LIMITER FAIL	Indicates that rudder ground authority is retained after take-off.
	SLAT FAIL	Both slats electronic control channels are inoperative and the slats system is no longer available or there is a jam in the mechanical portion that precludes the slats from moving.

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TYPE	MESSAGE	MEANING
CAUTION	SLAT-FLAP LEVER DISAG	Difference between commanded position and surface position.
	SPOILER FAULT	Airspeed gain scheduling has failed in one or more pairs of multifunction spoilers, and the system(s) has defaulted to a fixed gain.
	STAB LOCK FAULT	The mechanical device, which locks the horizontal stabilizer, has failed. Direct mode is not allowed.
ADVISORY	AILERON LH (RH) FAIL	Indicates that the left (right) aileron is no longer available or there is a mechanical disconnection in the left (right) aileron surface.
	AUTO CONFIG TRIM FAIL	Pitch Trim Auto Configuration function is inoperative.
	FLAP LO RATE	One of the flaps electronic control channels is inoperative and the flap system is still available but running at low speed.

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TYPE	MESSAGE	MEANING
ADVISORY	FLT CTRL FAULT	One of the components associated with the flight control system has failed.
	PITCH CONTROL DISC	Control columns are disconnected.
	PITCH TRIM BKUP FL	Backup pitch trim switch is inoperative.
	PITCH TRIM SW 1 FAIL	Captain's pitch trim switch is inoperative.
	PITCH TRIM SW 2 FAIL	First Officer's pitch trim switch is inoperative.
	PITCH TRIM LO RATE	Pitch trim system can only operate at a low rate.
	ROLL CONTROL DISC	Control wheels are disconnected.
	SLAT LO RATE	One of the Slats electronic control channels is inoperative and the slat system is still available but in low speed.
	SPDBRK LEVER DISAG	A mismatch exists between the speedbrake handle position and the multifunction spoiler surfaces or the ventral speed brake.
	TAILSTRIKE PROT FAIL (Pre-Mod. Load 23.1)	TSA function is no longer available.

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TYPE	MESSAGE	MEANING
ADVISORY	TAILSTRIKE AVOID FAIL (Post-Mod. Load 23.1)	TSA function is no longer available.
STATUS	FLT CTRL TEST IN PROG	Electrical PBIT in progress.

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SECTION 14-09

FLIGHT INSTRUMENTS/COMM/NAV/FMS

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GENERAL DESCRIPTION

The airplane is equipped with a complete set of Communication and Navigation functions. The main interface for the system is done through the Audio Control Panel (ACP) and the Multi-function Control Display Unit (MCDU).

The MCDUs provide radio frequency and mode control. The frequencies can also be selected on the Primary Flight Displays (PFDs) through the Cursor Control Devices (CCDs). The system provides a backup tuning page that may be used when a failure is detected. This backup page is displayed on MCDU 2 and enables tuning for COM 1, NAV 1 and Transponder (XPDR) 1.

The audio system is controlled via three individual ACPs that are available to the captain, first officer and observer, and also provides interface with the Passenger Address (PA), Aural Warning, and Digital Voice and Data Recorder (DVDR) systems.

Optional communications equipment includes a third VHF COM, HF and Selcal systems.

Navigation may be performed using only the navigation radio sensors or Flight Management System (FMS) resources. The FMS uses the standard navigation radio sensors, Global Positioning System (GPS) and Inertial Reference System (IRS) for positioning and navigation.

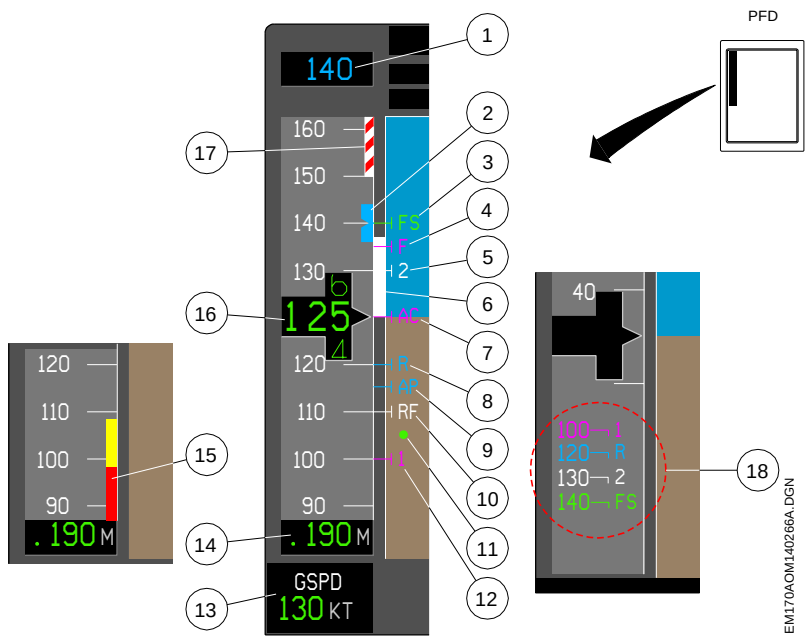
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FLIGHT INSTRUMENTS

AIRSPEED TAPE INDICATIONS



1 - SELECTED AIRSPEED/MACH READOUT

– Displays speed/mach values.

MAGENTA: automatically set by the FMS.

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CYAN: manually entered by the flight crew.

AMBER DASHED: invalid information.

2 - SELECTED AIRSPEED BUG

– Displayed when the FMS/AFCS commanded speed is in the displayed range of speed tape.

MAGENTA: automatically set by the FMS.

CYAN: manually entered by flight crew.

3 - V_{FS} SPEED (FS)

– Takeoff final segment speed.

4 - FLAP RETRACTION SPEED REFERENCE (F)

– Flap retraction speed reference for both dual engine and single engine takeoffs.

5 - V_2 SPEED (2)

– Takeoff V_2 speed.

6 - AIRSPEED TREND VECTOR

– Shows the airspeed which the airplane will be within 10 s, if the present acceleration/deceleration rate is maintained.

7 - V_{AC} SPEED (AC)

– Approach Climb Speed.

8 - V_R SPEED (R)

– Indicates rotation speed.

9 - V_{APP} SPEED (AP)

– Indicates approach speed.

10 - V_{REF} SPEED (RF)

– Indicates reference speed.

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11 - IDEAL FLAP SELECTION SPEED (DOT)

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

– Indicates the Drift Down speed when SLAT/FLAP is retracted, and the Flap Maneuvering Speeds for other SLAT/FLAP settings.

◄

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

NOTE: – The green dot speed indication does not account for ice accretion. In use of green dot guidance on icing condition is recommended fly green dot + 10 kt when the EICAS message STALL PROT ICE SPEED is displayed.
– The green dot is temporarily removed from the PFD during SLAT/FLAP transition.
– The green dot logic does not account for speed brakes actuation.

◄

12 - V_1 SPEED (1)

– Decision Speed.

13 - GROUND SPEED

– Displays IRS-based ground speed.

14 - MACH AIRSPEED READOUT

– Displays the actual airplane Mach number.

GREEN: normal range.

AMBER: airspeed is reaching an overspeed or it is at or below shaker speed and above stall speed.

RED INVERSE VIDEO: airspeed at or above overspeed or, at or below stall speed.

AMBER DASHED: invalid information.

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15 - LOW SPEED AWARENESS TAPE

– Indicates proximity to stall speed.

AMBER: from 1.13 of V_{stall} down to V_{shaker} (for airspeeds below Mach 0.45).

For airspeeds above Mach 0.45, the top of amber tape may be less than 1.13 of V_{stall}, depending on Mach number.

RED: at or below V_{shaker}.

16 - AIRSPEED ROLLING DIGITS

– Displays the indicated airspeed (IAS), above 30 kt.

GREEN: normal range.

AMBER: airspeed trend vector (when displayed) is reaching the V_{MO}/M_{MO} or it is at yellow low speed awareness tape or the actual airspeed is at yellow low speed awareness tape.

RED INVERSE VIDEO: airspeed trend vector (when displayed) or actual airspeed is at red low speed awareness tape or at V_{MO}/M_{MO} barber pole.

– The airspeed trend vector when displayed has the priority over actual airspeed to define the airspeed rolling digits color.

17 - V_{MO}/M_{MO} BARBER POLE

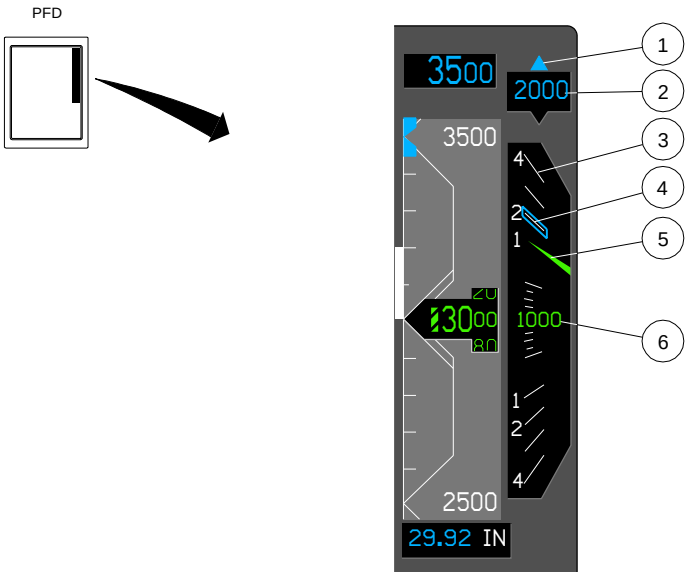
– Displayed when the V_{MO}/M_{MO} is within the viewable range, and covers speeds at or above V_{MO}/M_{MO} (red and white).

18 - SPEED DIGITAL READOUT

– Preview readout for takeoff bugs.

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VERTICAL SPEED INDICATIONS



1 - SELECTED VERTICAL SPEED DIRECTION ARROW

– Indicates either up or down direction. Used in conjunction with the selected vertical speed readout.

2 - SELECTED VERTICAL SPEED READOUT

– Displays selected climb or descent rate.

3 - VERTICAL SPEED SCALE

– Extends from -4000 ft/min to 4000 ft/min, with an expanded scale between 1000 ft/min and -1000 ft/min.

– From 0 ft/min to ±500 ft/min:
One tick mark at every 100 ft/min.

– From ±1000 ft/min to ±4000 ft/min:
One tick mark at every 1000 ft/min.

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4 - SELECTED VERTICAL SPEED BUG

– Displays selected climb or descent rate on the vertical speed scale.

5 - VERTICAL SPEED POINTER

– Displays the actual vertical speed if within the viewable range; parks at the limit if beyond viewable range.

– If the current rate is greater than ±9999 ft/min, or the altitude data received is not valid, the vertical speed pointer is removed.

6 - VERTICAL SPEED READOUT

– Displayed when the vertical speed increases above 550 ft/min or decreases below -550 ft/min.

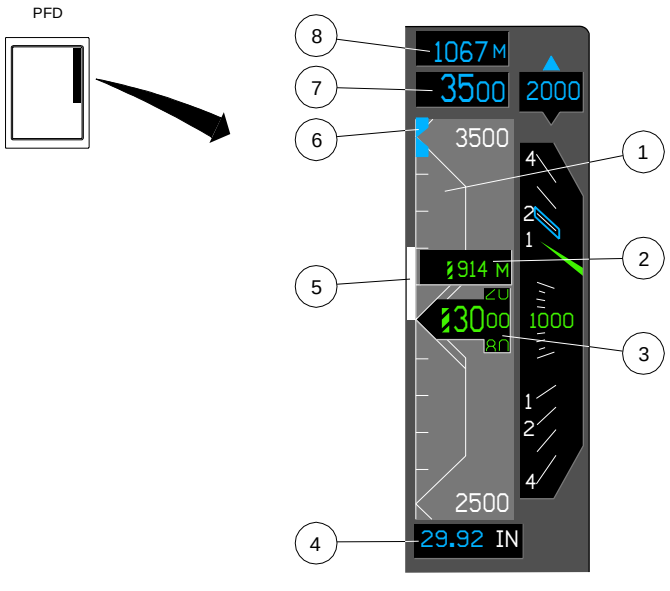
– Removed when the vertical speed decreases below 500 ft/min or increases above -500 ft/min.

GREEN: normal range.

AMBER DASHES: invalid information.

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ALTITUDE TAPE INDICATIONS



1 - ALTITUDE TAPE

– Indicates actual airplane altitude. The altitude tape is labeled with tick marks every 100 ft and single or double-lined chevrons at 500 ft or 1000 ft intervals, respectively.

2 - METRIC ALTITUDE READOUT

– Indicates actual airplane altitude in meters, with a resolution of 5 m.

– Displayed when selected in the altitude selector knob.

– A green hashed box appears on the left side of the numeric digits when altitude is below 10000 m.

– A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

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3 - ALTITUDE ROLLING DIGITS READOUT

– Indicates actual airplane altitude in feet. Digits are displayed with a resolution of 20 ft.

– A green hashed box appears on the left side of the numeric digits when altitude is below 10000 ft.

– A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

4 - BAROMETRIC CORRECTION

– Displays the barometric correction as selected.

5 - ALTITUDE TREND VECTOR

– Indicates the projected altitude, which the airplane will be within 6 seconds, based on the current vertical speed.

– This vector is displayed along the left edge of the altitude tape as a wide white line.

6 - SELECTED ALTITUDE BUG

– Positioned at the selected altitude.

CYAN: manually entered by the flight crew.

AMBER: actual airplane altitude is between 1000 and 200 ft from the preselected altitude. An audio alert is sounded after the airplane has captured the altitude and departs more than 200 ft from the selected altitude.

7 - SELECTED ALTITUDE READOUT

– Displays digital selected altitude in feet.

CYAN: manually entered by the flight crew.

AMBER: actual airplane altitude is between 1000 and 200 ft from the preselected altitude. An audio alert is sounded after the airplane has captured the altitude and departs more than 200 ft from the selected altitude.

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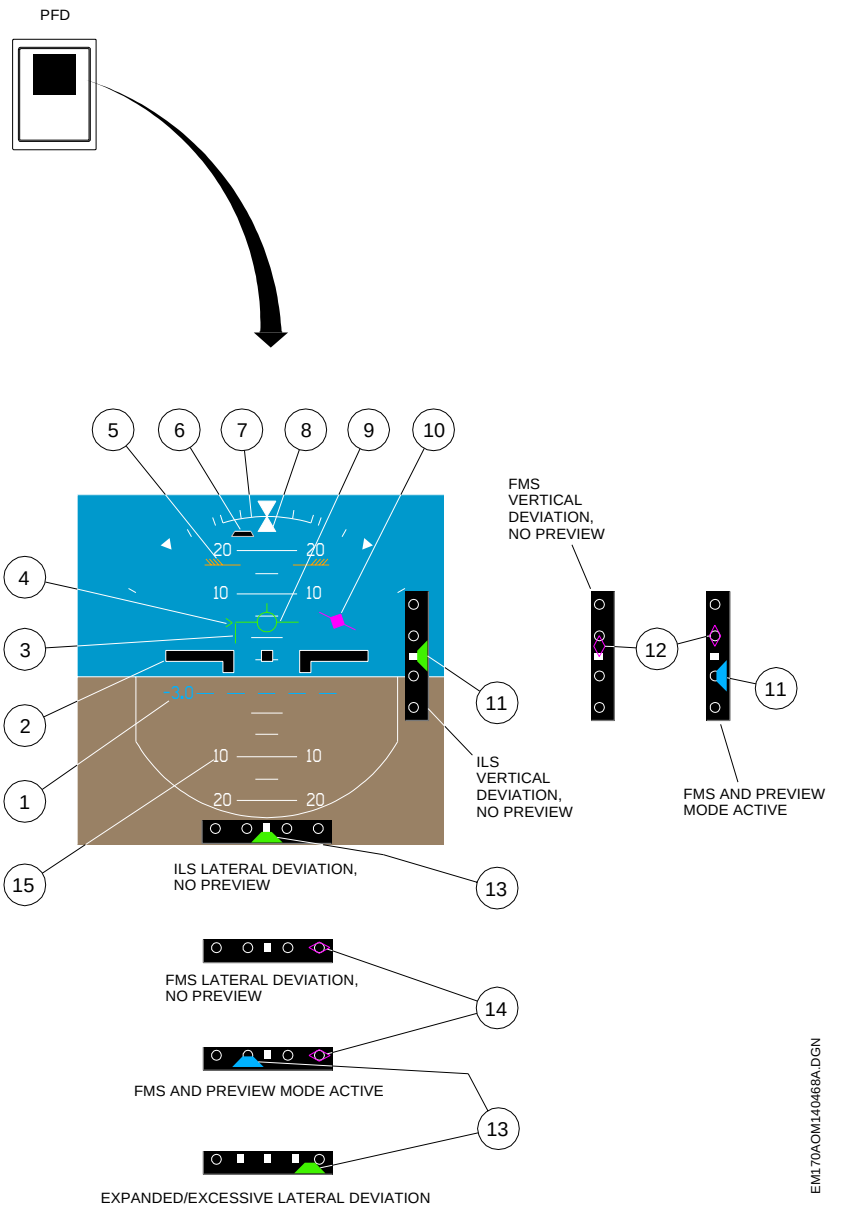
8 - METRIC SELECTED ALTITUDE READOUT

– Displays digital selected altitude in meters.

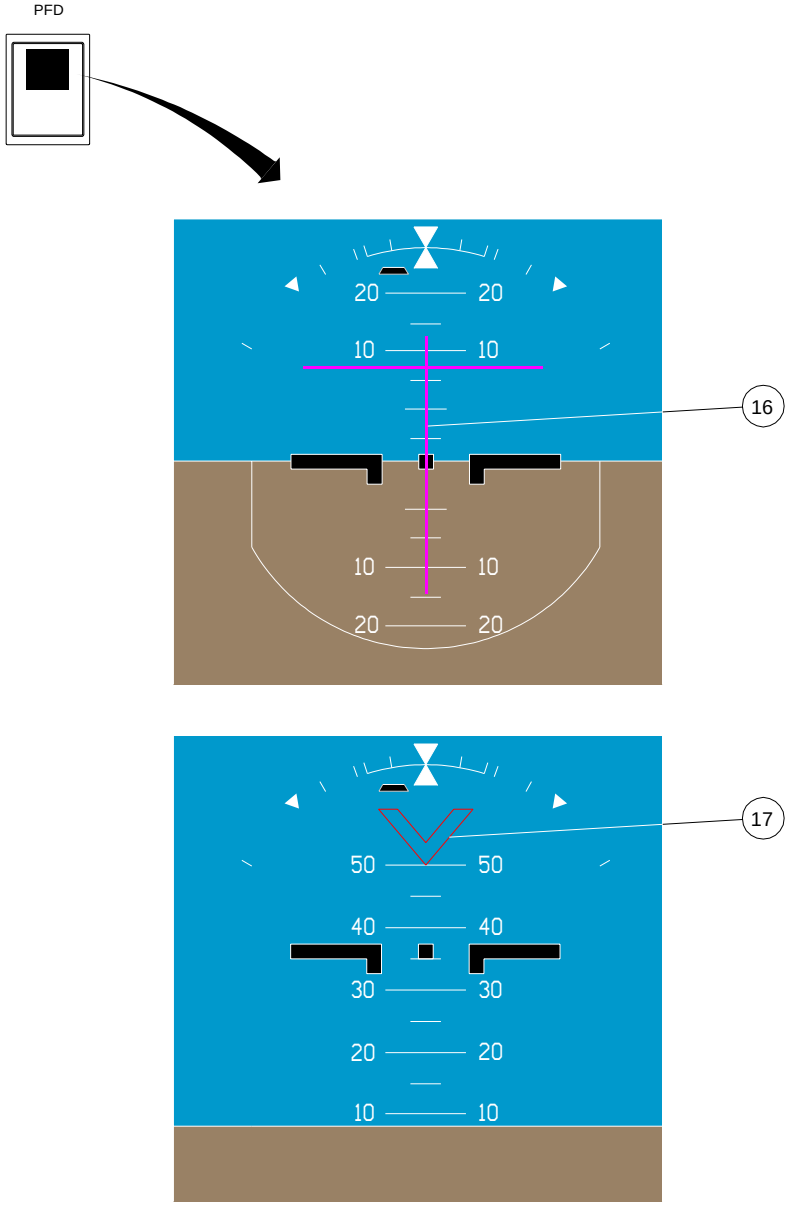
– Displayed when selected in the altitude selector knob.

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ADI INDICATIONS



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1 - FLIGHT PATH REFERENCE LINE/READOUT (FPR)

– Indicates a selected path angle for reference, when the FPR button is pressed.

2 - AIRPLANE SYMBOL

– Fixed and used with the pitch tape to reflect airplane pitch attitude in relation to the horizon line.

3 - FLIGHT PATH VECTOR SPEED ERROR TAPE

– Indicates the difference between actual and the selected airspeed.

– Down/Up Tape indicates current airspeed is less/greater than the selected airspeed.

4 - FPA ACCELERATION POINTER

– Provides an indication of acceleration and deceleration rates along the flight path.

– Moves upward/downward for increasing/decreasing values of flight path acceleration.

5 - PITCH LIMIT INDICATOR

– Pitch based indication between stick shaker angle of attack and actual angle of attack.

GREEN: from 1.2 of V_S down to 1.13 of V_S.

AMBER: from 1.13 of V_S down to V_{shaker}.

RED: at or below V_{shaker}.

6 - SLIP/SKID INDICATOR

– Indicates slip or skid if flight is not coordinated.

7 - ROLL SCALE/LOW BANK LIMIT ARC

– Indicates the current airplane roll attitude. The scale has tick marks at 10, 20, 30 and 60 degrees and inverted triangles at 0 and 45 degrees.

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– A low bank limit arc helps the pilot to fly with low bank angles during turns (0° up to 17°).

8 - ROLL POINTER

– Indicates the current airplane roll attitude.

9 - FLIGHT PATH ANGLE (FPA)

– Indicates the current flight path in reference to the horizon line (green).

10 - FLIGHT DIRECTOR

– Shows lateral and vertical FD guidance cue.

11 - ILS GLIDE SLOPE DEVIATION

– Pointer: indicates current glide slope position.

GREEN: when neither FMS nor preview mode is in use.

CYAN: when the preview mode is selected.

AMBER: when the deviation from the APPR 2 vertical approach path becomes out of range of the normal scale.

– Scale: indicates deviation position:

WHITE: indicates normal deviation from the vertical path.

AMBER FLASHING: when the deviation from the APPR 2 vertical approach path becomes out of range of the normal scale.

12 - FMS VERTICAL DEVIATION

– Pointer: indicates current vertical path (magenta). Displayed in trapezoidal form when no ILS is in use. Otherwise it is presented in diamond format.

– Scale: indicates deviation (white).

13 - ILS/VOR LATERAL DEVIATION

– Pointer: indicates current localizer position.

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GREEN: when neither FMS nor preview mode is in use. Also displayed in the expanded mode for APPR 2 operations.

CYAN: when the preview mode is selected.

AMBER: when the deviation from the APPR 2 lateral approach path becomes out of range of the normal scale.

– Scale: indicates deviation position.

WHITE: indicates normal deviation from the lateral path or expanded scale for APPR 2 operation.

AMBER FLASHING: when the deviation from the APPR 2 lateral approach path becomes out of range of the expanded scale.

14 - FMS LATERAL DEVIATION

– Pointer: indicates current lateral path (magenta). Displayed in trapezoidal format when no ILS is in use. Otherwise, it is displayed in lozenge format.

– Scale: indicates deviation (white).

15 - PITCH TAPE

– Provides a pitch angle indication between the airplane symbol and the horizon line or an angle indication for the flight path angle.

16 - TAKEOFF CROSSBAR

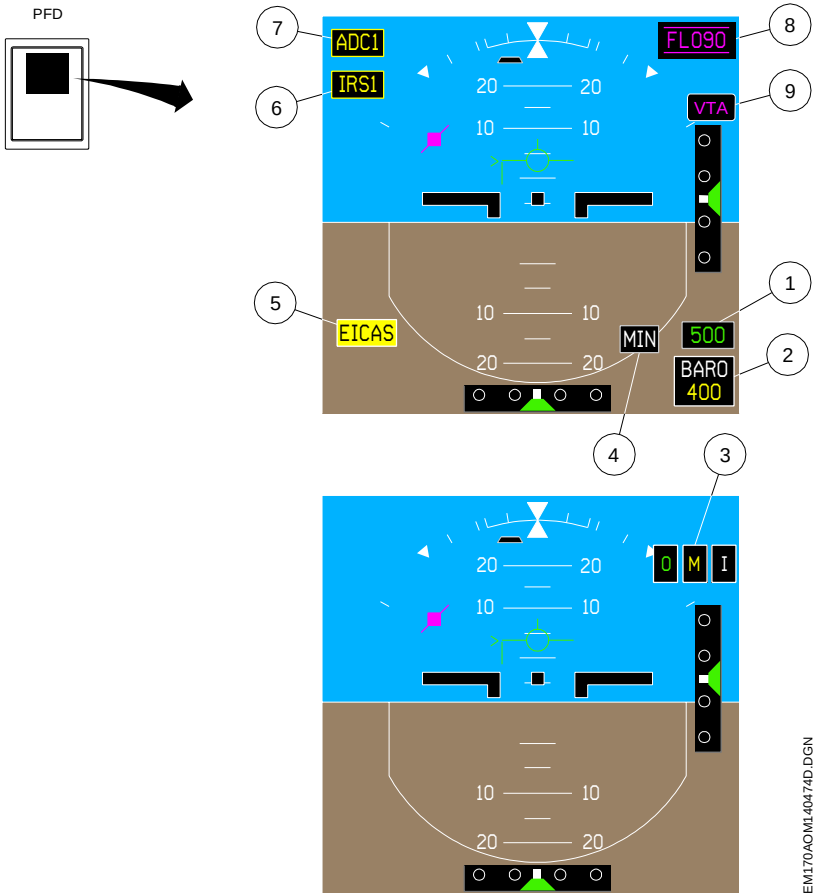
– In the takeoff mode, the takeoff crossbar is displayed. The horizontal line moves vertically along the center of the Airplane Symbol to provide vertical guidance. The vertical line moves horizontally along the center of the Airplane Symbol to provide horizontal guidance.

17 - EXCESSIVE PITCH CHEVRON ANNUNCIATION

– Displayed whenever excessive pitch attitude is detected.

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ADI ANNUNCIATIONS



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1 - RADAR ALTITUDE INDICATION

– Displays actual radar altitude.

GREEN: normal operation.

AMBER: failure of one of the radar altimeters, in a dual system installation.

2 - MINIMUMS SELECTED READOUT

– Displays the selected minimum barometric or radar altitude.

WHITE: BARO/RA label.

CYAN: radar or barometric altitude readout.

3 - MARKER BEACON ANNUNCIATIONS

– Displays I for inner, M for the middle or O for outer marker annunciations.

4 - MINIMUM ANNUNCIATION

– Advises that the airplane is near or at the minimum altitude preselected by the pilot.

5 - MONITOR ANNUNCIATIONS

The annunciator and the trigg limits for ADI/HSI miscompare annunciations are:

– PIT: Pitch > 5°

– ROL: Rol > 6°

– ATT: ATT - Both Monitors Tripped

– HDG: > 6°

NOTE: The HDG mode is inhibited if one of the HDG indicators is set to a different mode.

– ALT: > 200 ft

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– IAS: > 5 KIAS

NOTE: The IAS monitor is inhibited if both airspeed indicators show below 100 KIAS.

– LOC: >1/2 dot

NOTE: The LOC monitor is inhibited if both navigation sources are not set to LOC.

– GS: > 2/3 dot

– RA: 10 ft (dual configuration only)

– FPA: > 2°

– EICAS: A Graphics Data Test Monitor failure is detected and is annunciated on the EICAS.

– CAS MSG: CAS miscompare monitoring is performed continuously on all valid sources of CAS data. If a miscompare is detected it will be annunciated on each available PFD.

6 - ATTITUDE SOURCE ANNUNCIATION

– Displays IRS1 or IRS2 to indicate that a system other than the on-side system (normal operation) is providing the data, or that both sides are using the same system.

7 - AIR DATA SOURCE ANNUNCIATION

– Displays ADC1, ADC2 or ADC3 to indicate that a system other than the on-side system (normal operation) is providing the data, or that both sides are using the same system.

8 - VNAV ALTITUDE CONSTRAINT ANNUNCIATION

– Annunciates a VNAV waypoint constraint.

– Altitude constraints are displayed as follows:

  – At constraint: a bar is displayed above and below the altitude.

  – At or above constraint: a bar is displayed below the constraint value.

  – At or below constraint: a bar is displayed above the constraint value.

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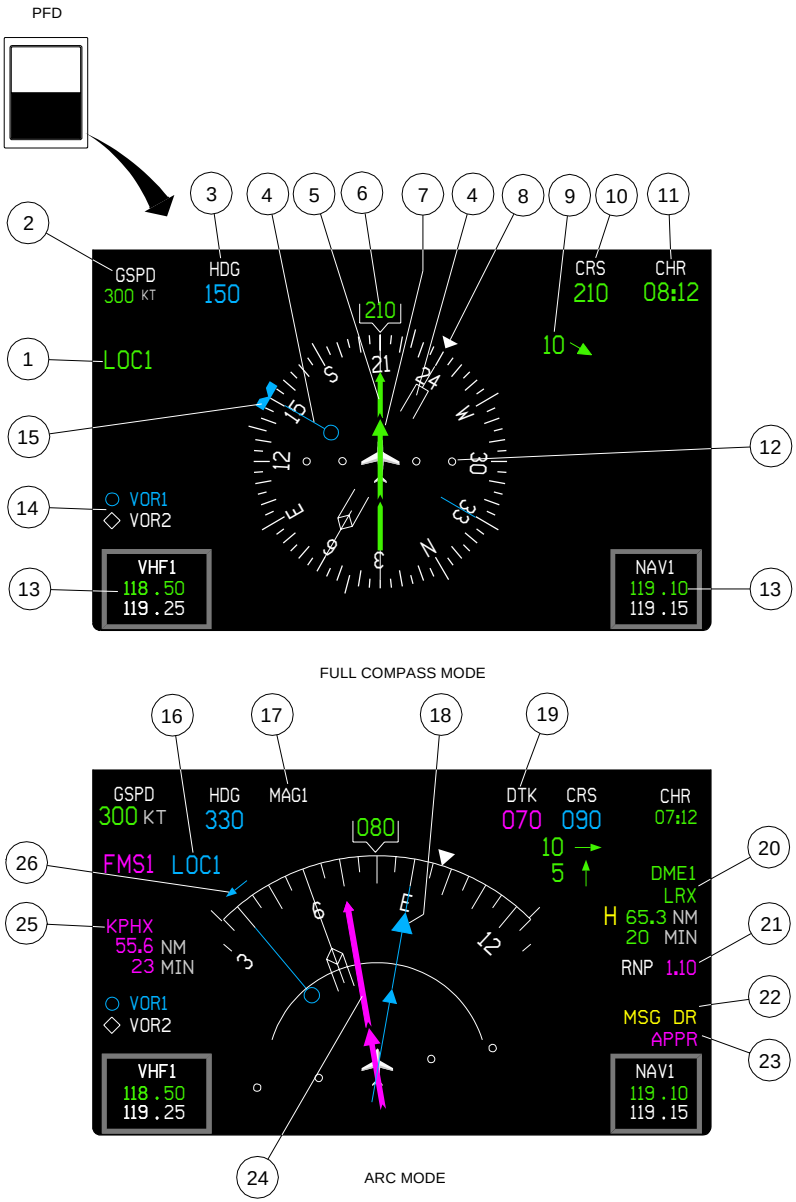
– Constraint window: a bar is displayed above upper altitude and a bar is displayed below lower altitude.

9 - VERTICAL TRACK ALERT ANNUNCIATION

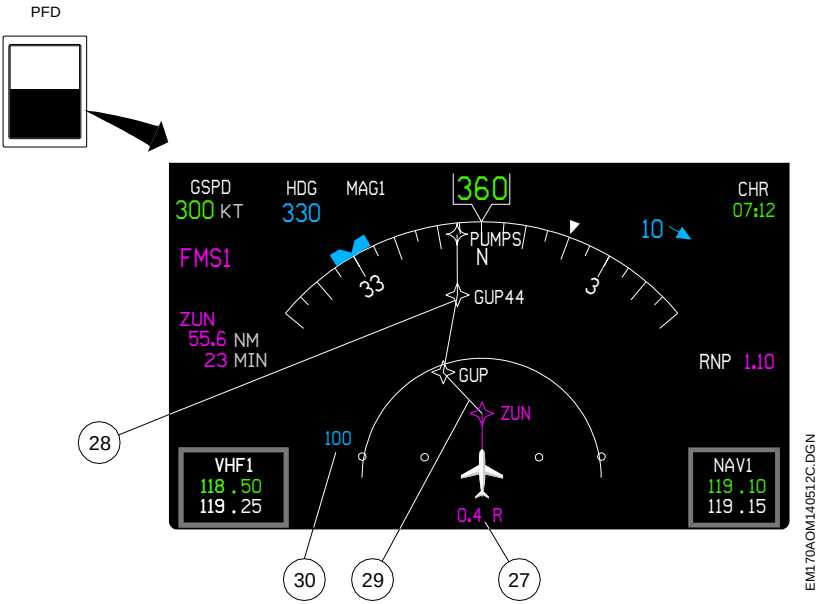
– Annunciates the transition from climbing or descending to level flight and from level flight to climbing or descending during VNAV operations.

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HSI INDICATIONS



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1 - PRIMARY NAVIGATION SOURCE ANNUNCIATION

– Displays the selected navigation source.

GREEN: onside V/L navigation source is selected.

AMBER: cross-side navigation or cross-side FMS navigation source is selected.

MAGENTA: FMS navigation source is selected.

2 - GROUND SPEED READOUT

– Displays Ground speed based on IRS information.

3 - SELECTED HEADING READOUT

– Displays the selected airplane heading.

CYAN: valid information.

AMBER DASHES: invalid information.

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4 - BEARING POINTERS

– Displays up to two bearing pointers.

CYAN: indicates bearing for ADF1, VOR1 or FMS1 (circle head).

WHITE: indicates bearing for ADF2, VOR2 or FMS2 (diamond head).

5 - COURSE SELECT POINTER

– Displays the selected course anytime the primary navigation source is a VOR or localizer, controlled by the CRS knob on the guidance panel.

GREEN: onside navigation source is selected.

AMBER: cross-side navigation source is selected.

CYAN: preview course pointer.

6 - HEADING READOUT

– Displays the actual airplane heading.

GREEN: valid information.

AMBER DASHES: invalid information.

– When an invalid information occurs a label HDG FAIL is also displayed.

7 - LATERAL DEVIATION INDICATOR

– Displays the deviation from the intended course. Indicates whether the airplane is flying left or right of the selected navigation reference.

– Incorporates the to/from pointer that indicates if the airplane is flying to or away from the selected navigation reference.

GREEN: onside navigation source is selected.

AMBER: cross-side navigation source is selected.

MAGENTA: FMS navigation source is selected.

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8 - DRIFT ANGLE BUG

– Displays the actual airplane ground track. Its offset relative to the top mark is the drift angle, that is, difference between ground track and heading.

9 - WIND DISPLAY

– Indicates wind magnitude and direction.

– Direction can be displayed as a single arrow (default) or as parallel and perpendicular arrows.

10 - COURSE SELECT/DESIRED TRACK POINTER

– Displays the selected course, controlled by the CRS knob on the guidance panel or the selected track according to data from the FMS.

– The word CRS is displayed anytime the primary navigation source is a VOR or localizer.

GREEN: onside V/L navigation source is selected.

MAGENTA: onside FMS navigation source is selected.

AMBER: cross-side navigation source is selected.

CYAN: preview course.

AMBER DASHES: invalid information.

11 - CHRONOMETER READOUT

– Displays chronometer.

– Information removed after 30 seconds of inactivity (chronometer in stop or reset).

12 - LATERAL DEVIATION DOTS

13 - SECONDARY RADIO TUNING

– Always displayed in left and right boxes and shows VHF NAV/COMM frequencies, when radio data is valid.

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– The multifunction control display unit (MCDU) is the primary means for radio tuning, while the control cursor device (CCD) and display unit (DU) are the secondary means of radio tuning.

GREEN: active frequency.

WHITE: standby frequency.

AMBER DASHES: radio data invalid.

14 - BEARING SOURCE ANNUNCIATIONS

– Display the bearing pointer sources.

CYAN (circle): displays the related VOR1, ADF1 or FMS1 source selected.

WHITE (diamond): displays the related VOR2, ADF2 or FMS2 source selected.

15 - SELECTED HEADING BUG

– Displays the airplane selected heading on both the full compass and arc modes controlled by the heading selector knob on the guidance panel.

16 - PREVIEW NAVIGATION SOURCE ANNUNCIATION

– Displays the preview VOR or localizer navigation.

17 - HEADING SOURCE ANNUNCIATION

– Indicates a non-normal source condition (e.g., Captain side is using IRS 2), a same source condition (e.g., both Captain and First Officer using IRS 1) or the selection of True heading reference.

18 - COURSE SELECT PREVIEW POINTER

– Displays the selected course preview (VOR or LOC) anytime the primary navigation source is a FMS, controlled by the CRS knob on the guidance panel.

19 - DESIRED TRACK READOUT

– Displays the selected track according to data from the FMS.

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MAGENTA: onside navigation source is selected.

AMBER: cross-side navigation source is selected.

AMBER DASHES: invalid information.

20 - DME DATA BLOCK INDICATIONS

– Display DME source, identifier, distance and time to the selected station.

– H label is displayed whenever the DME is in hold.

21 - RNP DATA BLOCK INDICATIONS

– Displayed when the FMS required navigation precision is the primary navigation source.

22 - MCDU ANNUNCIATIONS

– MSG label is displayed whenever a caution message appears in the MCDU.

– DR label is displayed whenever the FMS is operating in dead reckoning mode.

– DGRAD label is displayed whenever the FMS is operating in degrade mode.

23 - FMS MODE ANNUNCIATOR

– APPR label indicates Approach Sensitivity mode.

– TERM label indicates Terminal Approach mode.

– WPT label indicates Waypoint Alert.

– OFFSET indicates Lateral Offset.

24 - COURSE SELECT/DESIRED TRACK POINTER

– Displays the selected course controlled by the CRS knob on the guidance panel or the selected track according to data from the FMS.

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– The word CRS is displayed anytime the primary navigation source is a VOR or localizer.

– GREEN: onside V/L navigation source is selected.

– MAGENTA: onside FMS navigation source is selected.

– AMBER: cross-side navigation source is selected.

– CYAN: preview course.

– AMBER DASHES: invalid information.

25 - WAYPOINT DATA BLOCK INDICATIONS

– Display the identifier, distance and time to the next waypoint.

26 - SELECTED HEADING OUT OF VIEW ARROW

– Displayed on arc mode when the selected heading is not within the viewable range, and shows which way is shortest to the selected heading.

27 - FMS LATERAL DEVIATION INDICATION

– Indicates airplane's lateral deviation from the desired track.

– R/L label indicates right/left deviation.

28 - WAYPOINT DISPLAY

– Indicates waypoint symbol.

– If selected, also indicates waypoint identifier.

MAGENTA: next waypoint.

WHITE: other waypoints.

Up to five waypoints shall be displayed on the HSI Display subject to the range considerations.

29 - HORIZONTAL TRACK LINE

– Connects waypoints.

MAGENTA: connects with next waypoint.

WHITE: connects other waypoints.

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30 - RANGE SELECTION

– Displayed only in MAP mode, provides the selected half-ring range.

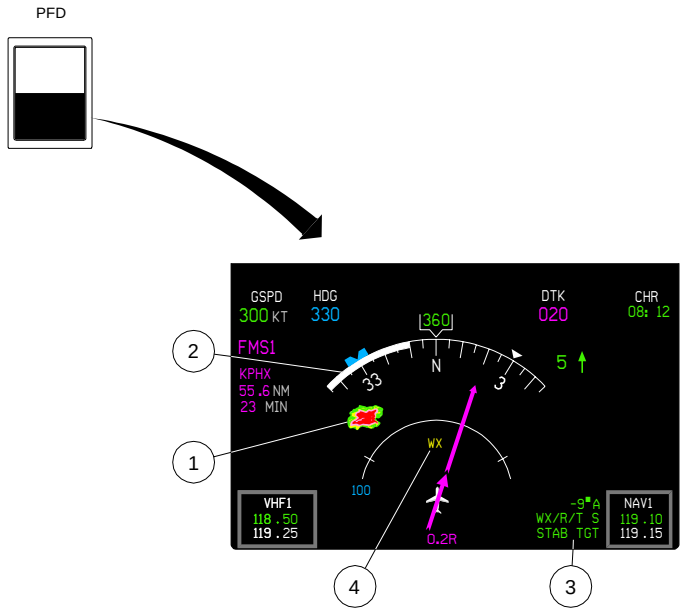
– Once selected by the CCD touchpad the knob icon is displayed, indicating that the range is set and changeable by turning the CCD knob.

– The possible range values are from 2.5 up to 1000 NM.

NOTE: It is not possible to change the range when the weather overlay is active.

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HSI WEATHER RADAR INDICATIONS



1 - WEATHER RADAR RETURNS

- Displays target in colors.
- WX mode: the color indicates rain intensity in order of increasing ‘intensity: green, yellow, red and magenta.
- RCT mode: attenuation is too high, hiding possible severe weather areas (cyan).
- GMAP mode: color indicates surface information: black, cyan, yellow and magenta.
- TURB mode: areas of potentially hazardous turbulence (white).

2 - ANTENNA POSITION INDICATOR

- Indicates that antenna scan is active.

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3 - WEATHER RADAR ANNUNCIATIONS

- First line:
  - CCD inner knob icon: tilt angle is modifiable.
  - Tilt angle readout: displays the tilt angle.
  - ACT annunciation: ACT is an active submode.
  - Fault code data (entire line): fault has been detected.
- Second line:
  - Weather radar mode annunciation:

    GREEN (WX): normal WX.

    GREEN (WX/R): normal WX with RCT.

    GREEN (WX/T): normal WX with TURB.

    GREEN (WX/R/T): normal WX with RCT and TURB.

    GREEN (WX/TX): Weather transmitting, but not selected for display on the PFD or MFD, when the airplane is in air.

    GREEN (GMAP): GMAP mode.

    GREEN (FSBY): forced standby.

    GREEN (TEST): test mode and no faults.

    AMBER (WX/TX): Weather transmitting, but not selected for display on the PFD or MFD, when the airplane is on ground.

    AMBER (WX CTRL): invalid WX control bus.

    AMBER (FAIL): failure is detected.

    AMBER (OVRNG): MAP range greater than 300 NM.

    WHITE (WX OFF): WX is OFF.

    WHITE (WAIT): power up.

    WHITE (STBY): normal standby.

    WHITE (S): slave mode is active.
- Third line:
  - Stabilization annunciation: radar stabilization is inhibited.
  - Target and gain mode annunciation.

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GREEN (TGT): TGT selected.

FLASHING AMBER (TGT): TGT selected and alert condition.

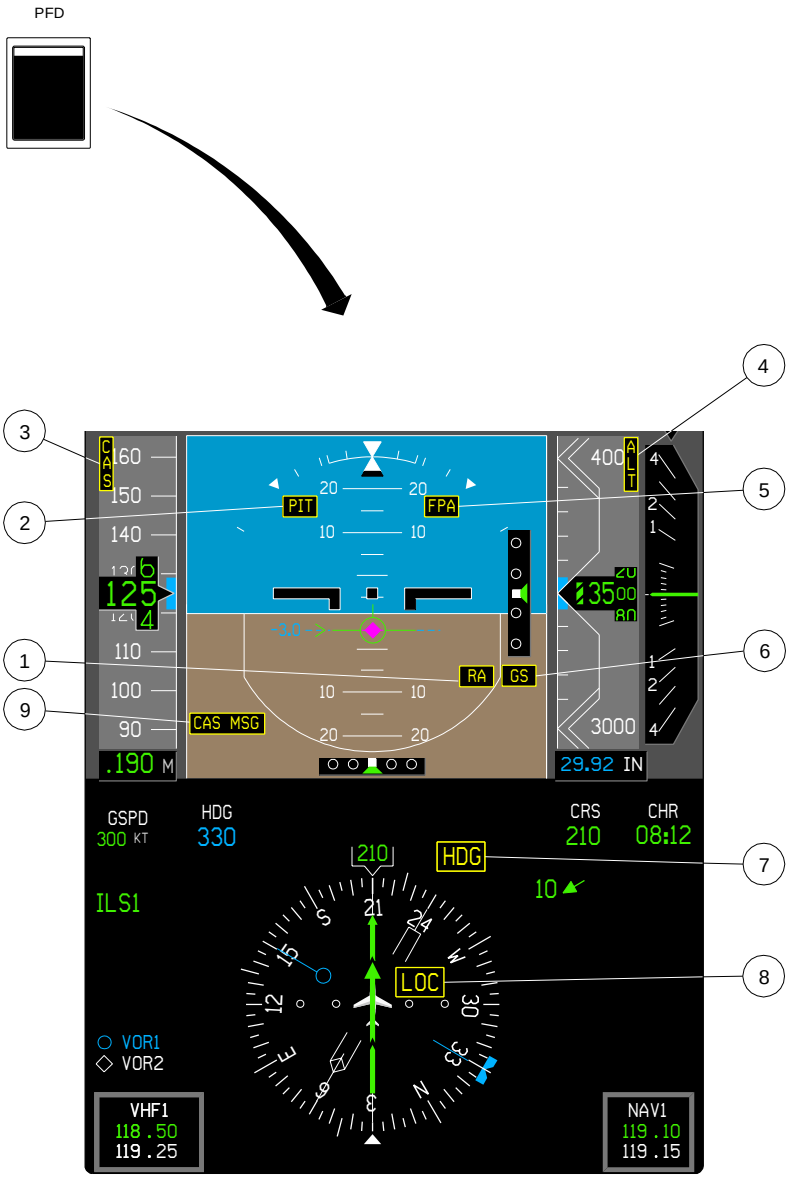
AMBER (VAR): variable gain selected.

4 - WEATHER RADAR VIDEO ANNUNCIATION

– Indicates weather radar video failure.

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ADI/HSI MISCOMPARES



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1 - RADIO ALTITUDE MISCOMPARE ANNUNCIATION

– Displayed whenever the radio altimeter has failed or the difference between the Captain and First Officer's radio altitude is greater than a set point.

2 - PITCH, ROLL AND ATTITUDE MISCOMPARE ANNUNCIATION

– Displayed whenever a pitch, roll or attitude miscompare is detected.

3 - AIRSPEED MISCOMPARE ANNUNCIATION

– Displayed whenever airspeed miscompare is detected.

4 - ALTITUDE MISCOMPARE ANNUNCIATION

– Displayed whenever altitude miscompare is detected.

5 - FLIGHT PATH ANGLE MISCOMPARE ANNUNCIATION

– Displayed whenever miscompare is detected for FPA.

6 - GLIDE SLOPE MISCOMPARE ANNUNCIATION

– Displayed whenever glideslope/glidepath miscompare is detected.

7 - HEADING MISCOMPARE ANNUNCIATION

– Displayed whenever a heading miscompare is detected.

8 - LOC MISCOMPARE ANNUNCIATION

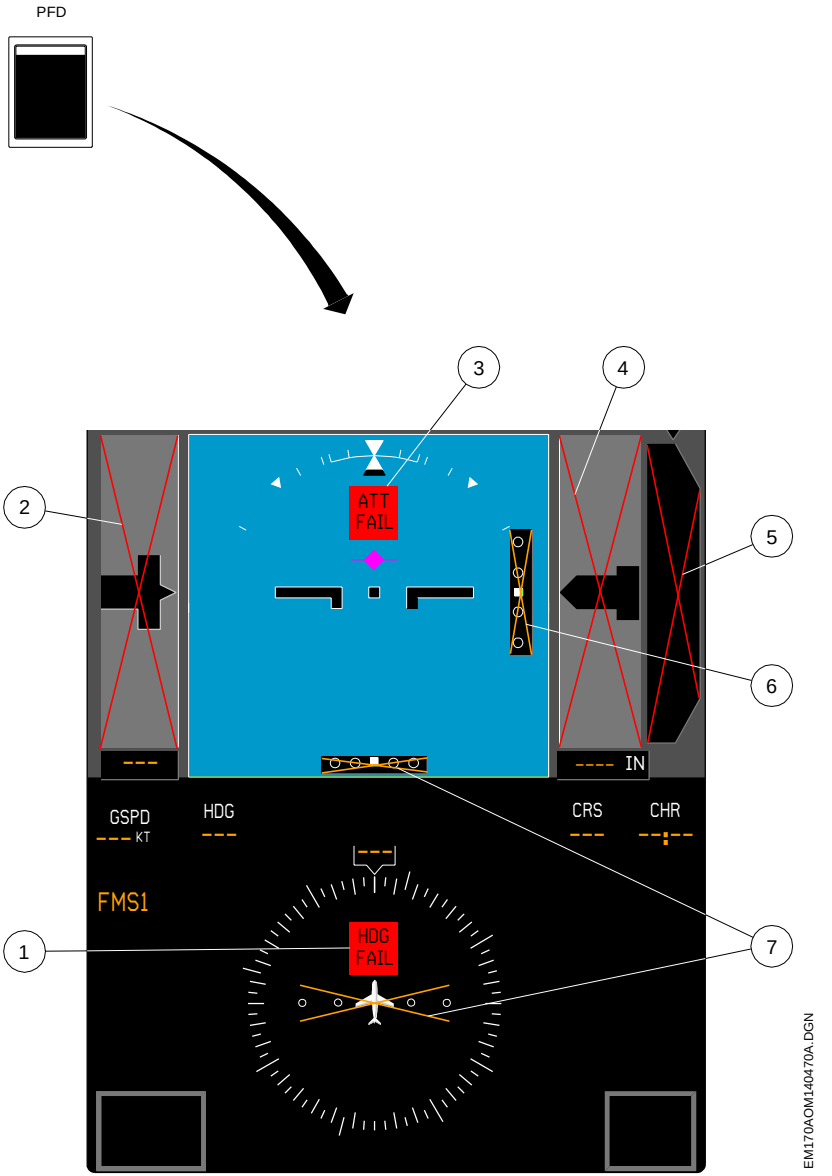
– Displayed whenever localizer miscompare is detected.

9 - EICAS MESSAGE MISCOMPARE ANNUNCIATION

– Displayed whenever the EICAS message list from both monitor warnings (MW 1 and MW 2) do not match.

ADI/HSI FAILS

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1 - HDG FAIL

– An ‘x’ appears whenever HDG indication is lost. It is still possible to revert the HDG source from IRS 1 to IRS 2, in case of a PFD 1 Heading Indication failure, and the opposite in case of HDG 2 failure.

2 - AIRSPEED ANNUNCIATION FAIL

– Airspeed Indication disappears and an ‘x’ displays.

3 - ATTITUDE INDICATION FAIL

– Attitude indication disappears and a message ATT FAIL displays on PFD.

4 - ALTITUDE INDICATION FAIL

– Altitude Indication disappears and the message ALT FAIL displays on PFD. The barometric pressure correction appears dashed.

5 - VERTICAL SPEED INDICATION FAIL

– Vertical Indication disappears and an ‘x’ displays.

6 - ILS/FMS VERTICAL DEVIATION INDICATION FAIL

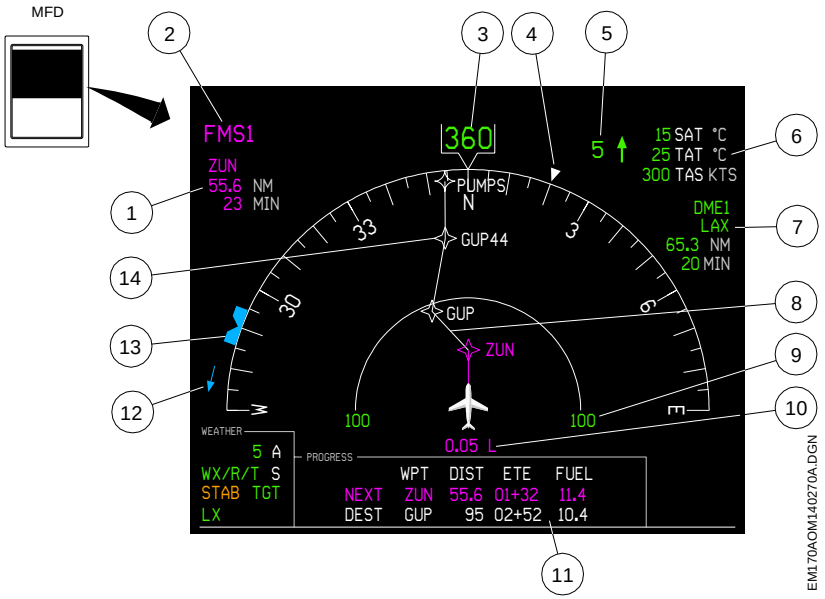
– Vertical Deviation indication disappears and an ‘x’ displays.

7 - LATERAL DEVIATION INDICATION FAIL

– Lateral Deviation Indication disappears and an ‘x’ displays.

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HORIZONTAL PROFILE INDICATIONS



1 - WAYPOINT DATA BLOCK INDICATIONS

– Display the identifier, distance and time to the next waypoint.

2 - FMS SOURCE INDICATION

– Displays the selected FMS source.

MAGENTA: onside FMS is selected.

AMBER: cross-side FMS is selected.

3 - HEADING READOUT

– Displays airplane's actual heading.

GREEN: valid information.

AMBER DASHES: invalid information.

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4 - DRIFT ANGLE BUG

– Displays airplane's actual ground track. Its offset relative to the top mark is the drift angle, that is, difference between ground track and heading.

5 - WIND DISPLAY

– Indicates wind magnitude and direction of the wind.

– Direction can be displayed as a single arrow (default) or as parallel and perpendicular arrows.

6 - AIR DATA SYSTEM INDICATIONS

– Information not available when:

  – Temperature indication of either TAT 1 or TAT 2 is above 60°C, or;

  – Airplane is on ground and any engine is running.

– Indicates static air temperature (SAT), total air temperature (TAT) and true air speed (TAS), sourced by the selected Air Data System.

  GREEN: all operating ranges.

  AMBER DASHED: invalid information or ADS failure, TAT and SAT may be different.

7 - DME DATA BLOCK INDICATIONS

– Display DME source, identifier, distance and time to the selected station.

– H label is displayed whenever the DME is in hold.

8 - HORIZONTAL TRACK LINE

– Connects waypoints.

  MAGENTA: connects with next waypoint.

  WHITE: connects other waypoints.

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9 - RANGE SELECTION

– Displayed when MAP mode is selected, as an outer compass ring and an inner half-range ring. The half-range ring is labeled with the half-range distance.

– The Plan format displays only a half-range ring, which is labeled with the range distance.

– Both range labels are shown with the knob icon, indicating that the range is set and changed by turning the CCD knob.

– The possible values for range are 2.5 NM to 1000 NM.

NOTE: It is not possible to change the range when the on-side weather virtual controller is selected to OFF and the slave mode is active.

10 - FMS LATERAL DEVIATION INDICATION

– Indicates airplane's lateral deviation from the desired track.

– R/L label indicates right/left deviation.

11 - FMS PROGRESS WINDOW

– Data contained in the box is arranged in two rows. The upper row lists data for the next waypoint (NEXT) and the lower row lists data for the destination (DEST). The following information is displayed: waypoint name, distance to go, estimated time enroute and fuel remaining at the waypoint.

12 - SELECTED HEADING OUT OF VIEW ARROW

– Displayed when the selected heading is not within the viewable range, and shows which way is shortest to the selected heading.

13 - SELECTED HEADING BUG

– Displays the airplane selected heading controlled by the heading select knob on the guidance panel.

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14 - WAYPOINT DISPLAY

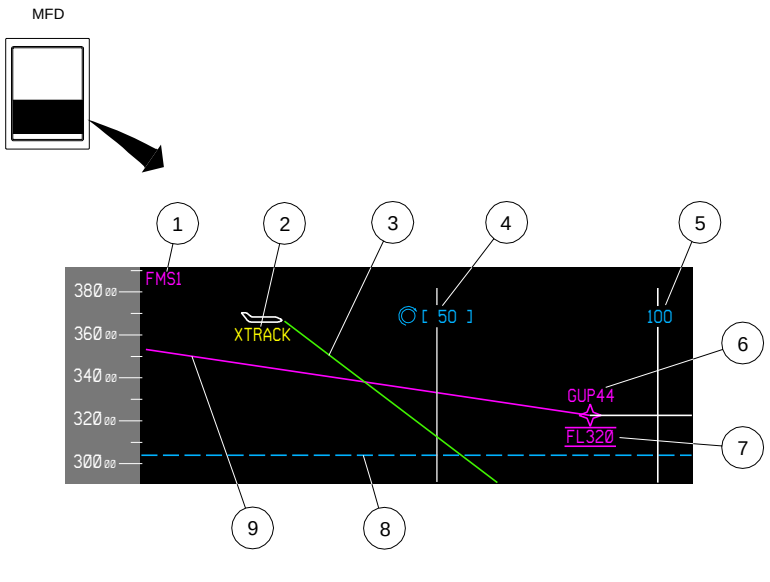
– Indicates waypoint symbol.

– If selected, also indicates waypoint identifier.

MAGENTA: next waypoint.

WHITE: other waypoints.

VERTICAL PROFILE INDICATIONS



1 - FMS SOURCE INDICATION

– Displays the selected FMS source.

MAGENTA: on-side FMS is selected.

AMBER: cross-side FMS is selected.

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2 - CROSS TRACK ANNUNCIATION

– Indicates a significant deviation from the planned horizontal flight path.

– The vertical track line from the left of the vertical profile window to the next waypoint changes to a dashed amber line.

3 - AIRPLANE TRAJECTORY LINE

– Shows the vector trend of the airplane along the vertical axis, based on the current flight path angle.

4 - HALF/FULL CURL ICON INDICATION

– Can be changed using the CCD outer knob.

5 - HALF/FULL RANGE INDICATIONS

– Show the selected horizontal ranges.

6 - WAYPOINT DISPLAY

– Indicates waypoint symbol.

– If selected, also indicates waypoint identifier with altitude and, if applicable, a HOLD label that indicates a holding pattern.

MAGENTA: next waypoint.

WHITE: other waypoints.

7 - VNAV ALTITUDE CONSTRAINT INDICATION

– Indicates a VNAV waypoint constraint.

– Altitude constraints are displayed as follows:

  – At an altitude: constraint value is displayed without bars.

  – At or above an altitude: a bar is displayed below the constraint value.

  – At or below an altitude: a bar is displayed above the constraint value.

  – Altitude window: the constraint value is displayed between bars.

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8 - SELECTED ALTITUDE INDICATION

– Indicates the selected altitude in the guidance panel.

9 - VERTICAL TRACK LINE

– Connects waypoints.

MAGENTA: connects with next waypoint.

WHITE: connects other waypoints.

DASHED AMBER: airplane has significantly deviated from the planned horizontal flight path.

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MFD WEATHER RADAR



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1 - WEATHER RADAR RETURNS

– Displays target in colors.

– WX mode: the color indicates rain intensity. In increasing order of intensity: green, yellow, red and magenta.

– RCT mode: attenuation is too high, hiding possible severe weather areas (cyan).

– GMAP mode: color indicates surface information: black, cyan, yellow and magenta.

– TURB mode: areas of potentially hazardous turbulence (white).

2 - TARGET ALERT CHECKBOX

– Enables and disables the radar target feature. Can only be selected in the WX mode and at selected ranges of 200 NM or less.

3 - RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE CHECKBOX

– Enables REACT function in all modes, except GMAP.

4 - ALTITUDE COMPENSATED TILT CHECKBOX

– Enables automatic adjustment of the antenna tilt in relation to the altitude and selected range.

5 - TURBULENCE DETECTION CHECKBOX

– Enables the turbulence function only in the WX mode and at selected ranges of 50 NM or less.

6 - GAIN INDICATION DISPLAY

– Indicates receiver sensitivity level from 0 to 100.

7 - RECEIVER GAIN CHECKBOX

– Enables manual variation of the receiver sensitivity.

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8 - ANTENNA STABILIZATION CHECKBOX

– Enables/disables automatic antenna stabilization.

– An amber STAB label is displayed within the weather box when automatic antenna stabilization is disabled.

9 - SECTOR SCAN CHECKBOX

– Enables the sector scan function for both pilots' displays.

10 - OFF MODE

– Turns off the weather mode, provided OFF is selected in both weather radar virtual controllers.

– In flight only, a single virtual controller selected to OFF operates in SLAVE mode.

11 - STANDBY MODE

– Selects the radar system into a standby mode, provided STBY is selected in both weather radar virtual controllers.

– A green FSBY label is displayed within the weather box when forced standby is active, on the ground.

12 - GROUND MAPPING MODE

– Enables ground mapping mode.

13 - RADAR MODE

– In flight, activates the radar mode.

14 - FORCED STANDBY OVERRIDE

– Enables WX on the ground, when selected on both pilots' virtual control panel.

NOTE: Selection of Antenna Stabilization checkbox (STAB OFF) 4 times in less than 3 seconds enables the forced Standby Override function (FSBY OVRD).

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15 - WEATHER RADAR ANNUNCIATIONS

- First line:
  - CCD inner knob icon: tilt angle is modifiable.
  - Tilt angle readout: displays the tilt angle.
  - ACT annunciation: ACT is active.
  - Fault code data (entire line): fault has been detected.
- Second line:
  - Weather radar mode annunciation:

    GREEN (WX): normal WX.

    GREEN (WX/R): normal WX with RCT.

    GREEN (WX/T): normal WX with TURB.

    GREEN (WX/R/T): normal WX with RCT and TURB.

    GREEN (GMAP): GMAP mode.

    GREEN (FSBY): forced standby.

    GREEN (TEST): test mode and no faults.

    AMBER (WX CTRL): invalid WX control bus.

    AMBER (FAIL): failure is detected.

    AMBER (OVRNG): MAP range greater than 300 NM.

    WHITE (WX OFF): WX is OFF.

    WHITE (WAIT): power up.

    WHITE (STAB): STAB OFF function selected.

    WHITE (STBY): normal standby.

    WHITE (S): slave mode is active.
- Third line:
  - Stabilization annunciation: radar stabilization is inhibited.
  - Target and gain mode annunciation.

    GREEN (TGT): TGT selected.

    FLASHING AMBER (TGT): TGT selected and alert condition.

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AMBER (VAR): variable gain selected.

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MFD LIGHTNING SENSOR



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1 - RATE OF OCCURRENCE SYMBOLS

– Represent the lightning rate of occurrence for the last two minutes in a given location.

RATE 1: represents a single strike.

RATE 2: represents three strikes.

RATE 3: represents six or more strikes.

2 - ALERT SYMBOL

– Displayed for 5 s near the outer range arc providing only bearing information.

3 - LIGHTNING MODE

– Enables/disables lightning mode.

4 - LIGHTNING CLEAR FUNCTION

– Clears all past strikes symbols, activating self-test mode after 3 s.

5 - LIGHTNING ANNUNCIATIONS

– Lightning mode annunciations displayed on fourth line of the weather data box.

AMBER (LX FAIL): self-test has detected a fault.

GREEN (LX STBY): standby mode.

GREEN (LX CLR): clear mode.

GREEN (LX TST): test mode.

AMBER (LX INHB): transmission inhibition mode.

GREEN (LX HDG): lightning-heading input is invalid.

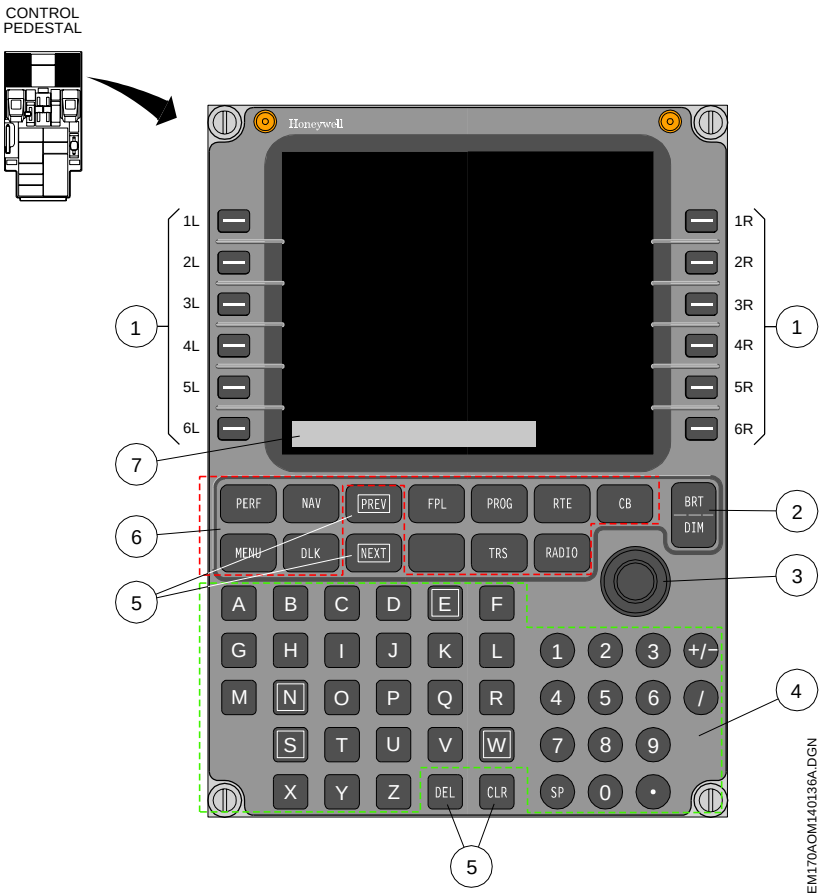
GREEN (LX CAL): self-calibration mode.

GREEN (LX): system is in the normal operating mode.

AMBER (LX): MFD is not receiving data from the LSS processor.

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MCDU CONTROLS



1 - LINE SELECT KEYS

– Data is selected to a line from the scratchpad or vice-versa.

– Selects a page if the line shows an index display (arrow).

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2 - BRIGHTNESS CONTROL BUTTON

- Controls display brightness.
- A control bar will be displayed in the scratchpad.

3 - TUNING KNOB

- Rotating this knob selects frequencies or other numeric values.

4 - ALPHANUMERIC BUTTONS

- Enter alphanumeric inputs.
- Space key (SP) is used to insert a space.
- A toggle plus/minus key inserts the corresponding signal.

5 - PREV/NEXT AND CLR/DEL BUTTONS

- Previous (PREV): Changes the current page to the previous page.
- Next (NEXT): Changes the current page to the next page.
- Clear (CLR): Clears alphanumeric entries or messages in the scratchpad.
- Delete (DEL): Works together with line select buttons in order to delete waypoints and other items displayed. This button is inhibited when a message is displayed.

6 - FUNCTION BUTTONS

- Menu (MENU): Displays the menu page.
- Data link (DLK): Displays ACARS main menu page.
- Radio (RADIO): Displays the radio page.
- Circuit breaker (CB): Displays the circuit breaker page.
- Thrust Rating Selection (TRS): Display the engine thrust ratings for various flight phases.
- Performance (PERF): Displays the performance page (FMS function).

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– Navigation (NAV): Displays the navigation page (FMS function).

– Flight plan (FPL): Displays the flight plan page (FMS function).

– Progress (PROG): Displays the progress page (FMS function).

– Route (RTE): Display the route page (FMS function).

7 - SCRATCHPAD

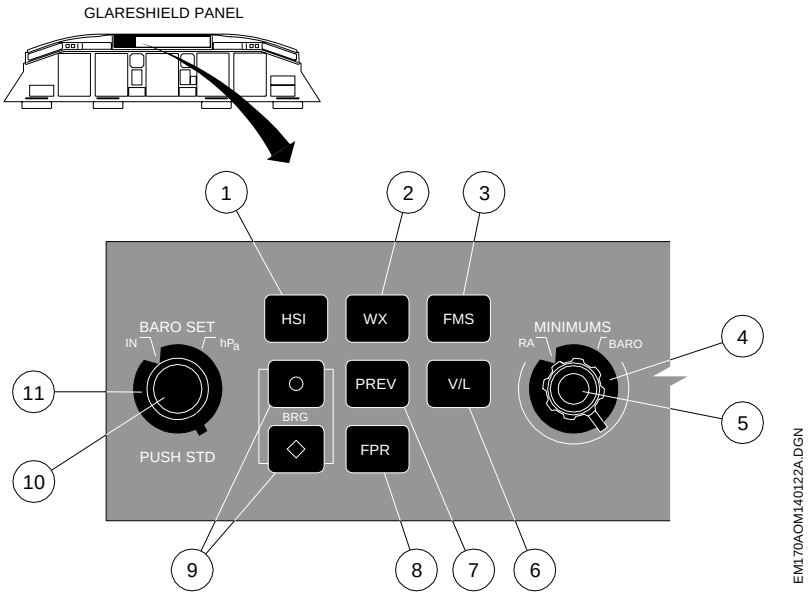
– It is the working area, located on the bottom line of the display, where the pilot can enter data and/or verify data before line selecting the data into its proper position.

– Data is retained on the scratchpad throughout all mode and page changes.

– The scratchpad also provides advisory and alerting messages to be displayed.

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DISPLAY CONTROLLER PANEL



1 - HORIZONTAL SITUATION INDICATOR (HSI) BUTTON

– Selects between full compass, arc or map mode for the on-side PFD.

2 - WEATHER RADAR (WX) BUTTON

– Displays WX Radar information on PFD (HSI in arc or map mode only).

3 - FMS SELECTION/FMS SOURCES

– Selects FMS as the primary navigation source for the on-side PFD and toggles between FMS1 and FMS2.

4 - RA OR BARO MINIMUMS SELECTOR KNOB (OUTER)

– RA: sets radio altimeter minimums.

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– BARO: sets barometric minimums.

5 - DECISION HEIGHT OR MINIMUM DESCENT (INNER)

– Selects decision height (DH), decision altitude or minimum descent altitude based on position of RA/BARO selector knob.

6 - VOR/LOC BUTTON (V/L)

– Selects VOR or LOC as the primary navigation source for the on side PFD and toggles between VOR/LOC1 and VOR/LOC2.

7 - PREVIEW BUTTON (PREV)

– Selects the preview mode when the FMS is the primary navigation source. The course and the lateral/vertical deviation can be previewed.

  – Pressing the first time: enables the on-side VOR/LOC preview.

  – Pressing a second time: enables the opposite side VOR/LOC preview.

  – Pressing a third time: disables the preview mode.

– The previewed navigation source will automatically transition as the primary navigation source when capture on LOC mode.

8 - FLIGHT PATH REFERENCE (FPR) BUTTON

– Commands the flight path reference line and the flight path digital readout.

9 - BEARING SOURCES (BRG) BUTTONS

– CIRCLE (o): allows VOR1, ADF1 or FMS1 selection for the on-side PFD display.

– DIAMOND (◊): allows VOR2, ADF2 or FMS2 selection for the on-side PFD display.

10 - BAROMETIC CORRECTION CONTROL (INNER)

– Sets barometric altimeter correction.

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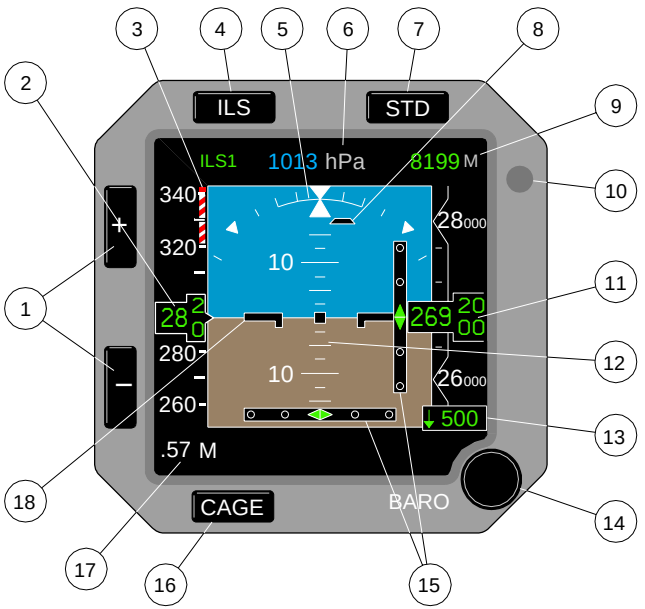
– Pushing this control knob sets barometric correction to standard.

11 - BAROMETIC CORRECTION SELECTOR KNOB (OUTER)

– IN: sets barometric correction format to inches of mercury.

– HPA: sets barometric correction format to hectopascals.

INTEGRATED ELECTRONIC STANDBY SYSTEM (IESS)



1 - BRIGHTNESS ADJUSTMENT BUTTONS

– Adjust brightness.

2 - AIRSPEED ROLLING DIGITS

– Indicates actual calibrated airspeed.

– In case of failure the airspeed tape and the pointer will be removed and replaced by a red cross.

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3 - V_{MO}/M_{MO} BARBER POLE

– Displayed when V_{MO}/M_{MO} is within the viewable range, and covers speeds at or above V_{MO}/M_{MO} (red and white).

– An amber V_{MO} Flag being displayed on the IESS means that the maximum speed indication is lost, because flap/slat information is unavailable to the standby system.

4 - ILS BUTTON

– Selects the display of ILS 1 deviations and the label LOC 1 is annunciated on the left top corner. In case of failure, a red cross replaces the annunciation.

5 - ROLL INDICATION

– Indicates the bank angle of the airplane.

6 - REFERENCE BAROMETRIC PRESSURE INDICATION

– Indicates the barometric pressure as set by the barometric rotary knob.

7 - STANDARD BUTTON

– Sets the barometric pressure to standard atmospheric pressure.

8 - SLIP/SKID INDICATION

– Indicates slip or skid angle if flight is not coordinated.

9 - METER ALTITUDE INDICATION

– Indicates the actual altitude in meters.

– A green hashed box appears on the left side of the numeric digits when altitude is below 10000 m.

– A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

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10 - BRIGHTNESS CELL

– Automatically adjusts the instrument brightness according to the ambient lighting.

11 - ALTITUDE INDICATION

– Indicates actual altitude, with graduated scale of 20 ft.

– A NEG indication is displayed vertically in white in case of negative altitude.

– In case of failure the altitude tape will be removed and replaced by a red cross, and an ALT flag is displayed.

– A green hashed box appears on the left side of the numeric digits when altitude is below 10000 ft.

– A minus (-) symbol appears on the left side of the numeric digits when altitude is below sea level.

12 - PITCH ANGLE SCALE

– Provides a pitch angle indication between the airplane symbol and the horizon line.

13 - VERTICAL SPEED

– Indicates the actual vertical speed in feet per minute (ft/min).

– An arrow indicates climb or descent.

– In case of failure the corresponding pointer and scale will be removed.

14 - BARO ROTARY KNOB

– Allows barometric settings.

15 - ILS DEVIATIONS

– Vertical scale: green diamond indicates glide slope position.

– Horizontal scale: green diamond indicates localizer position.

– Vertical and horizontal scales are not displayed when ILS is not selected.

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– In case of failure, the pointer and the scale are removed from view and replaced by a red cross.

16 - CAGE BUTTON

– Resets attitude to zero, eliminating accumulated drift when the button is pressed for more than two seconds.

– Not operational during the initialization mode and must be used with wings leveled on stabilized flight conditions.

– When pressed, an amber CAGE flag is displayed on the upper right corner of the IESS.

17 - MACH NUMBER INDICATION

– Displayed whenever Mach increases above 0.45 and will be removed when Mach decreases below 0.40.

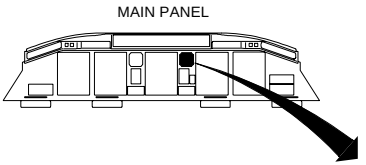
18 - AIRPLANE SYMBOL

– Reference for airplane attitude indication.

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CLOCK/CHRONOMETER

MAIN PANEL





MAIN PANEL CHRONOMETER

1 - DATE/SET KNOB/BUTTON

– Allows time setting when GPS/INT/SET selector is in the SET position. Repeated pressings of the SET button causes the selector to cycle between minute, hour, year, month and day. The desired digits flashes and the setting is obtained by rotating the DATE/SET button clockwise to increase and counter-clockwise to decrease.

– Selects the date to be displayed on the associated indicator, when GPS/INT/SET selector is in GPS or INT.

2 - RESET BUTTON

– Reset the chronometer to zero if chronometer is stopped.

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– LCD display is blanked when the RST button is pressed and the chronometer is running.

3 - CHRONOMETER BUTTON

– Starts/stops the chronometer.

4 - GPS/INT/SET SELECTOR

– GPS: synchronizes with UTC and DATE from GPS.

– INT: displays information from the internal clock.

– SET: sets the clock modes.

5 - ELAPSED TIME SELECTOR

– AUTO: automatically starts the chronometer on liftoff.

– RST (spring loaded): resets the elapsed time if WOW is present.

6 - CLOCK/CHONOMETER DISPLAY

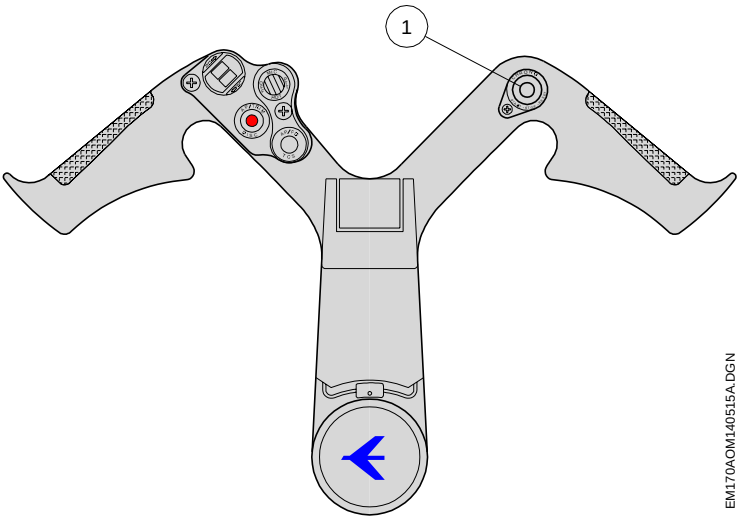
– Displays chronometer, time/date and elapsed time.

– If no GPS signal is detected, the clock will display dashes and only the positions INT and SET on the GPS/INT/SET selector will be available.

– The chronometer display is blanked in the non-operating mode.

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CONTROL WHEEL



CONTROL WHEEL CHRONOMETER

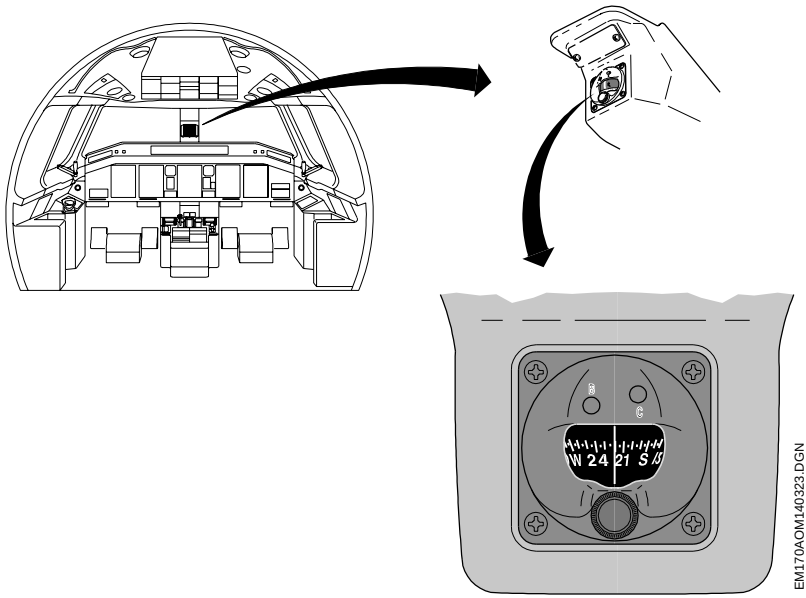
1 - CHRONOMETER BUTTON

– Starts/stops/resets the chronometer displayed on PFD.

– Independent information/functioning for each control wheel.

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STANDBY MAGNETIC COMPASS

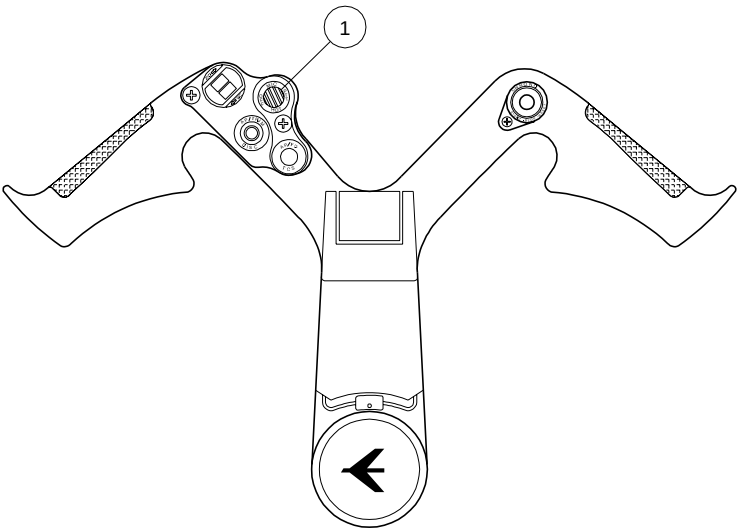


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COMMUNICATION

CONTROL WHEEL

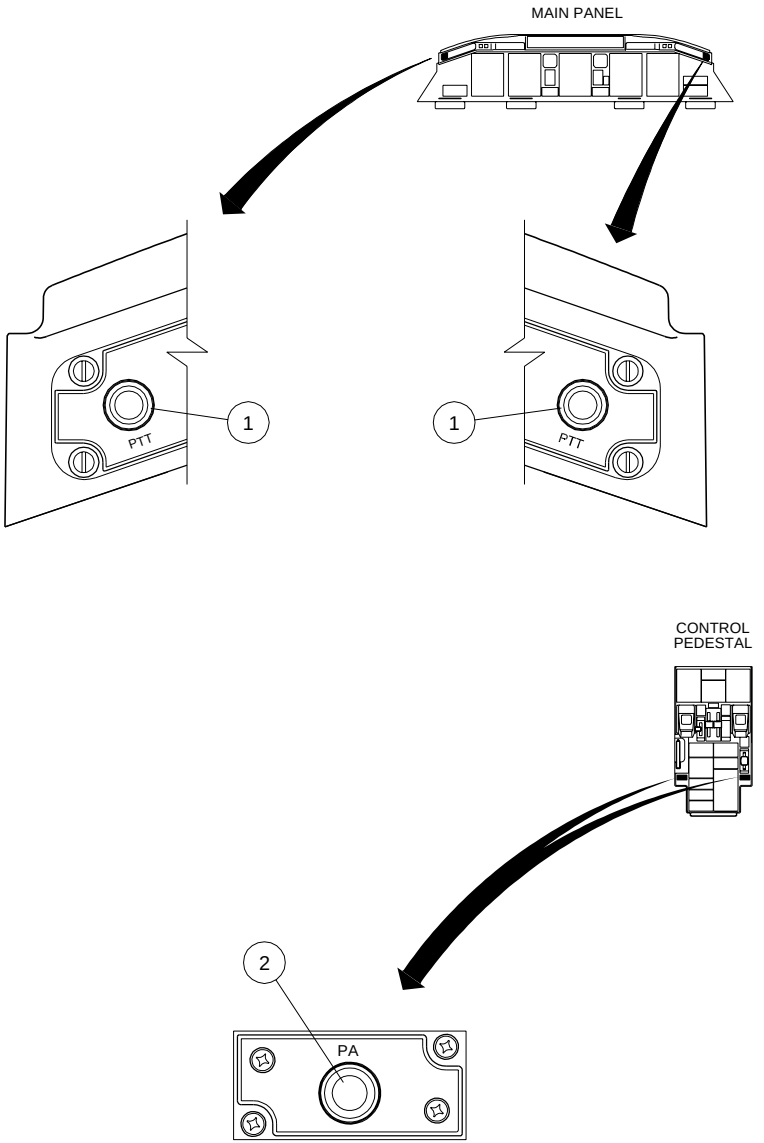


1 - CONTROL WHEEL COMMUNICATIONS SWITCH

- PTT (momentary): allows VHF transmissions, as well as voice communications to passengers.
- HOT: allows communication between crewmembers and between crewmembers and ramp station.
- OFF: allows only audio reception.

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GLARESHIELD COMMUNICATION



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1 - GLARESHIELD PTT BUTTON

– Allows VHF transmissions and voice communications to passengers.

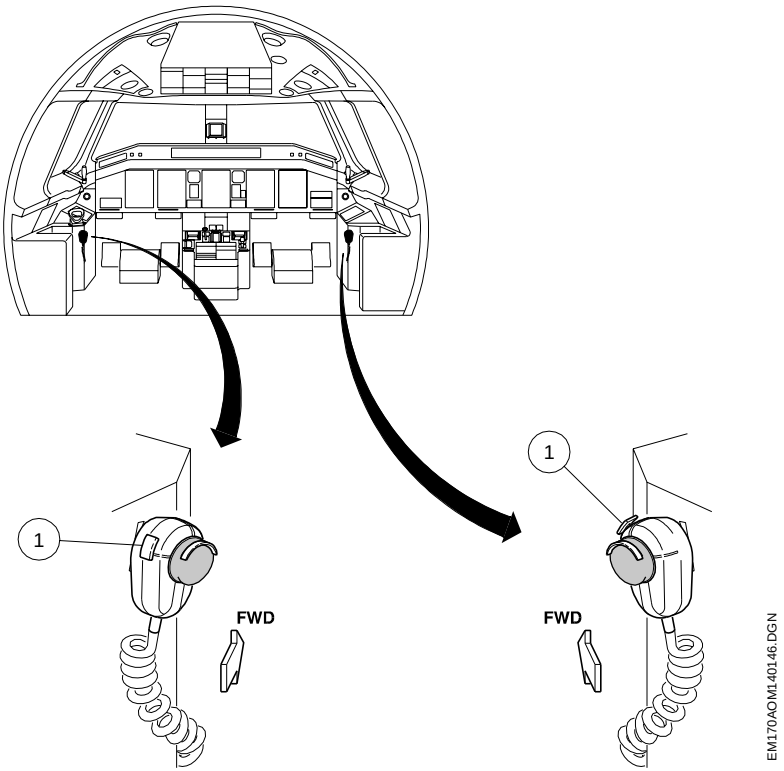
2 - PASSENGER ADDRESS PTT BUTTON

– Allows voice communications to passengers, regardless of any selection in the audio control panel.

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HAND MICROPHONE CONTROLS

PILOT AND COPILOT CONSOLES

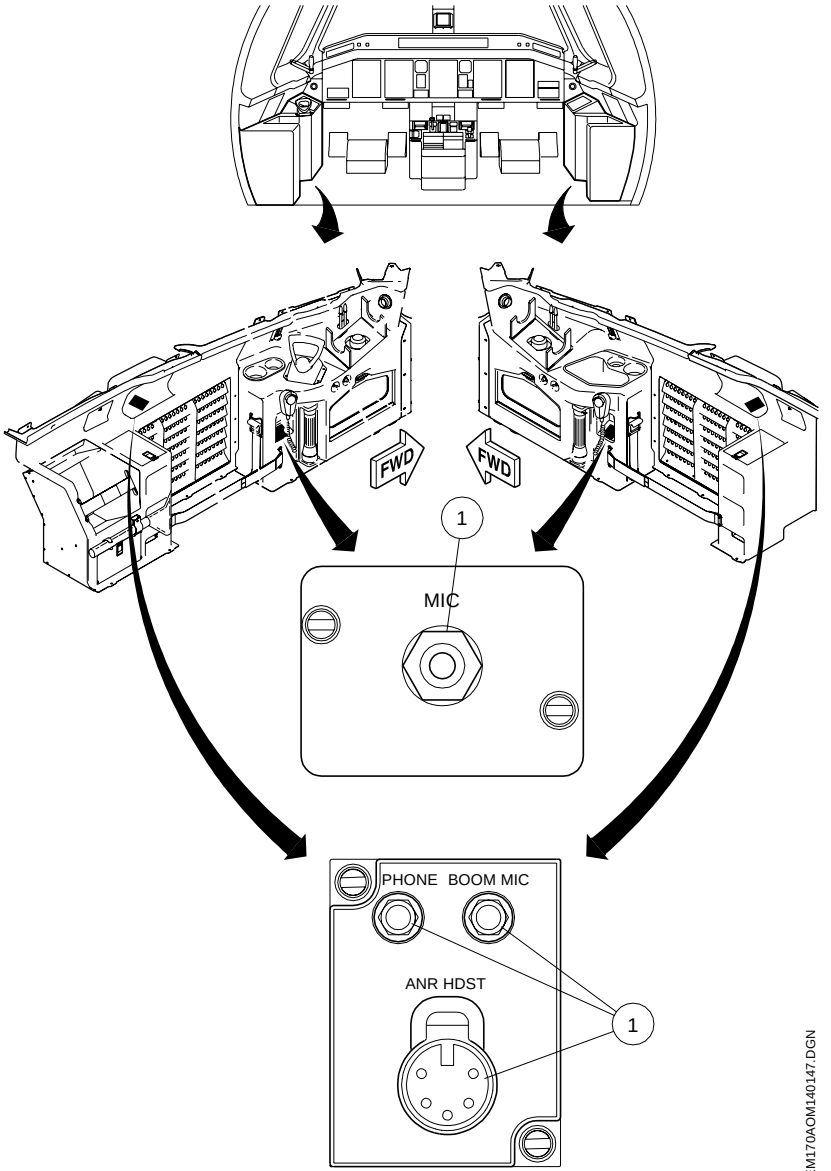


1 - HAND MIC PTT BUTTON

– Allows transmission through the ACP, as well as communication to passengers.

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CAPTAIN AND FIRST OFFICER JACK PANELS



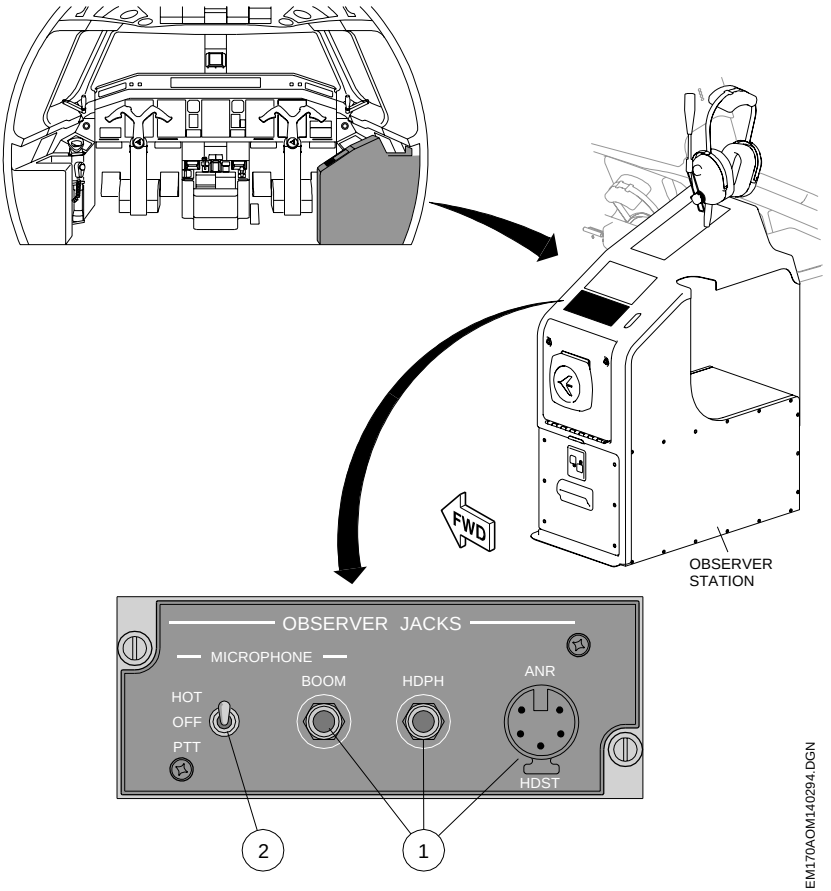
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1 - CAPTAIN AND FIRST OFFICER JACKS

– Allows plugging in headphone (PHONE), headset (ANR HDST), hand microphone (HAND MIC) and boom microphone (BOOM MIC).

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OBSERVER JACK PANEL



1 - OBSERVER JACKS

– Allows plugging in headphone (HDPH), headset (ANR HDST) and boom microphone (BOOM).

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2 - OBSERVER COMMUNICATIONS SWITCH

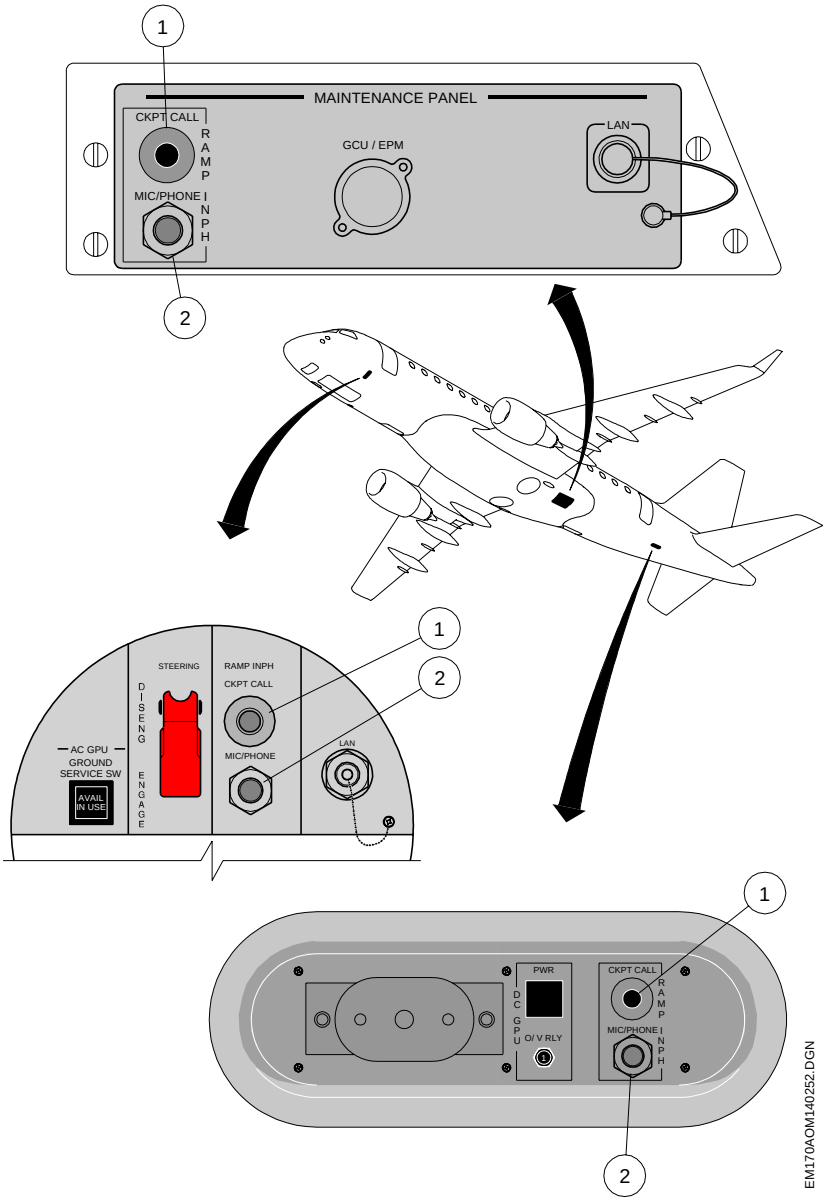
– PTT (momentary): allows VHF and voice communications with passengers.

– HOT: allows communication between crewmembers and between crewmembers and ramp station.

– OFF: allows only audio reception.

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RAMP STATION



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1 - COCKPIT CALL BUTTON (momentary action)

– When pressed, generates a single HI/LO tone chime and the RAMP annunciator button flashes on the audio control panel.

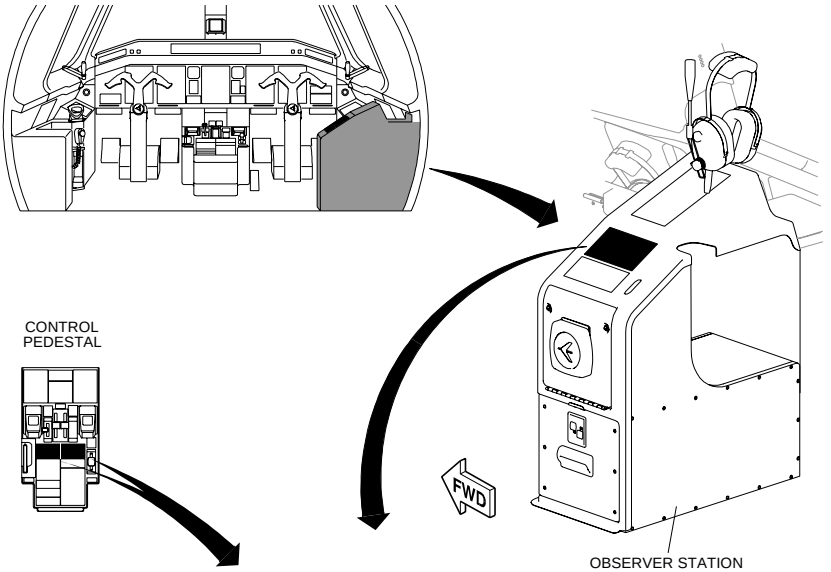
2 - MICROPHONE/HEADPHONE JACK

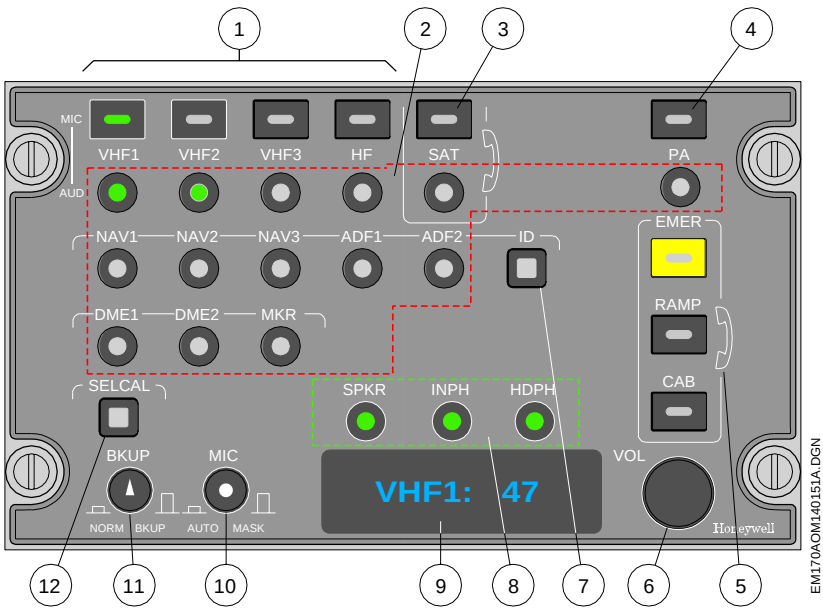
– Allow ground personnel to plug in a headphone and a microphone equipped with a PTT Button.

NOTE: Ground personnel panel is linked to the hot mic once the ramp button is selected.

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AUDIO CONTROL PANEL (ACP)





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1 - MICROPHONE SELECTOR BUTTONS

– Related communication channel is enabled for transmission and reception.

– When selected, a green bar illuminates inside the button.

2 - AUDIO CONTROL BUTTONS

– Related audio channel is enabled for reception.

– Automatically activated when a transmission channel is selected.

– More than one audio channel may be selected at the same time.

– When selected, a green dot illuminates inside the button.

3 - SATCOM CONTROL BUTTON (UNAVAILABLE)

4 - PASSENGER ADDRESS CONTROL BUTTON

– Enables PA announcements.

– When selected, a green bar illuminates on the transmission button and a green dot illuminate on the reception button.

5 - SERVICES INTERPHONE CONTROL BUTTONS

– EMER: sounds a triple HI/LO tone chime through the PA system and illuminates a red light at ceiling of the flight attendant station. When selected, a green bar flashes on button until the flight attendant picks up the call. Once the flight attendant picks up the call the green bar flashes faster. Pressing the button again, the light becomes steady and the communication with the flight attendant is enabled.

– RAMP: enables communication with the ground personnel. For an incoming call, the ramp annunciator flashes and remains steady on when active. A single HI/LO tone chimes.

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– CABIN: sounds a single HI/LO tone chime through the PA system and illuminates a green light at ceiling of the flight attendant station. When selected, a green bar flashes on button until the flight attendant picks up the call. Once the flight attendant picks up the call the green bar flashes faster. Pressing the button again, the light becomes steady and the communication with the flight attendant is enabled.

6 - MASTER VOLUME CONTROL KNOB

– Allows adjustment of the most recently selected audio.

7 - ID FILTER BUTTON

– Activates a filter that eliminates voice on VOR and ADF audio so the identification can be heard.

8 - AUDIO SELECTION BUTTONS

– Enables the respective audio to be summed into the output on the headphone (HDPH), interphone (INPH) or cockpit speaker (SPKR).

– When selected, a green dot illuminates inside the button.

9 - ACP DISPLAY

– Displays the selected transmission channel and digital volume information.

10 - AUTO/MASK MICROPHONE SWITCH

– AUTO (PUSH IN): allows audio communication via oxygen masks.

– MASK (PUSH OUT): activates oxygen masks microphone when auto mode fails.

– Oxygen mask stowage box doors must be closed and reset in order to enable hand or headset microphone booms after using the oxygen mask microphone.

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11 - BACKUP VOLUME CONTROL BUTTON/KNOB

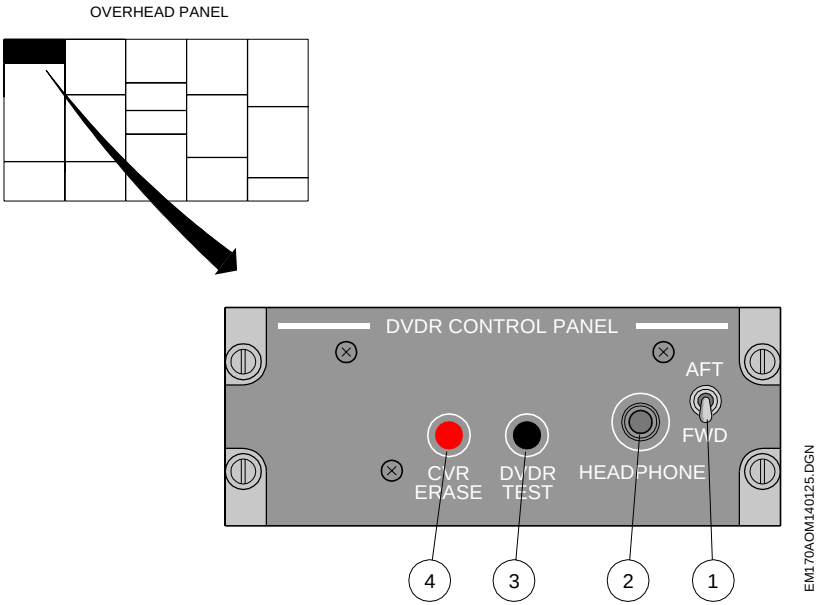
- NORM (PUSH IN): normal operation mode.
- BKUP (PUSH OUT): activates backup operation when audio panel power fails or both digital audio buses fail.
- Minimum volume is at the extreme counterclockwise position and the maximum volume is at the extreme clockwise position.
- The VHF 1 is the radio available for Captain ACP and VHF 2 is the radio available for the First Officer ACP.

12 - SELCAL ANNUNCIATOR BUTTON

- Flashes when an incoming call is displayed.
- Pressing shows the code on the ACP display.
- Remains steady when active for transmission.

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DIGITAL VOICE-DATA RECORDER



1 - SELECTOR SWITCH

– Selects forward and afterward DVDR switch to set the source of the headphone audio for the aural indication when the DVDR test is successful (to maintenance task only).

2 - HEADPHONE JACK

– Monitors tone transmission during test or to monitor playback of voice audio.

▶*Airplanes equipped with Honeywell DVDR*

3 - TEST BUTTON

– Simultaneously tests all CVR and FDR functions on both DVDR.

◀

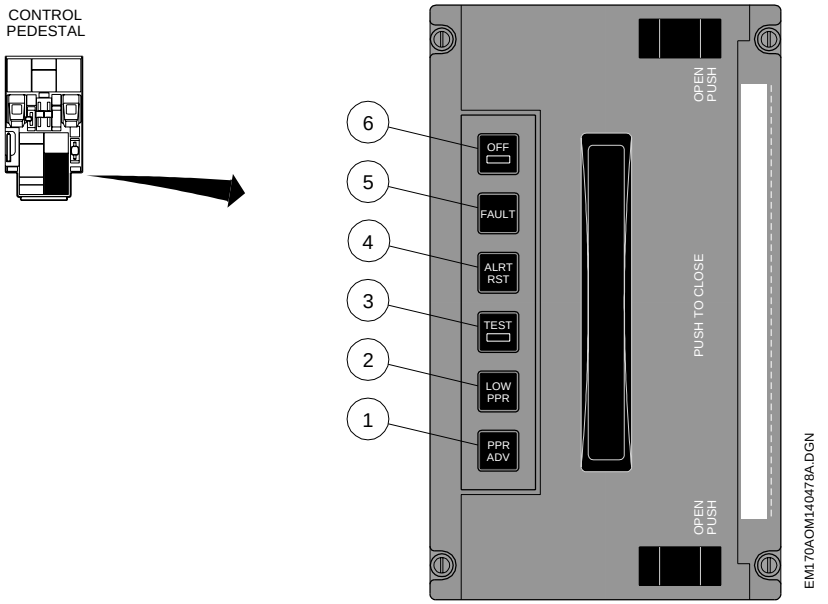
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4 - CVR ERASE BUTTON

– Erases the recorded audio information, provided that the airplane is on the ground and parking brake is set.

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PRINTER



1 - PPR ADV

– Continuously advances paper while pushbutton is depressed.

2 - LOW PPR

– Illuminates when the printer senses the last remaining 10 feet of paper on the paper supply roll.

3 - TEST BUTTON

– Illuminates all indicators followed by a printout of test results and a test pattern.

– ″TEST″ button indicator bar will remain lit in conjunction with the ″FAULT″ indicator to report a self test failure.

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4 - ALRT RST BUTTON

– Not functional.

5 - FAULT BUTTON

– Illuminates when senses no paper or printer door open.

– Illuminates in conjunction with test button in case of self-test failure.

6 - OFF BUTTON

– Alternatively turns the printer off and on. When power is applied to the printer, it automatically is in the on state.

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AIR DATA SYSTEM

The E-JETS are equipped with 5 independent ADSs.

Each ADS receives and computes the data collected by its components to provide air data information to the following systems:

– Airspeed indicator;

– Altimeter;

– Vertical speed indicator;

– Side slip indicator;

– Flight controls;

– IESS airspeed indicator;

– IESS altitude indicator;

– IESS vertical speed indicator;

– Static air temperature;

– Total air temperature;

Each ADS is composed by a specific set of sensors. The following list shows the structure of each system:

– ADS 1: TAT 1, ADSP 1/2 and ADA 1.

– ADS 2: TAT 2, ADSP 3/4 and ADA 2.

– ADS 3: TAT 1, ADSP 3/4 and ADA 3.

– ADS 4: ADSP 3/4 and IESS.

The ADS 5 sends information to the flight control system.

SYSTEM COMPONENTS

The ADS components are:

– Air Data Smart Probes (ADSP);

– Total Air Temperature (TAT) probes and

– Air Data Applications (ADA).

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AIR DATA SMART PROBES AND TAT PROBES

The E-JETS are equipped with four air data smart probes (ADSP).

The ADSP are composed of:

– Multi function probes and

– Air data computer.

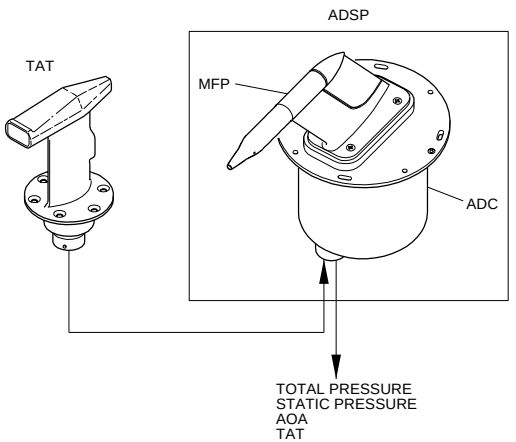
The ADSP/TAT will sense and transmit static pressure, total pressure, angle of attack and TAT to the Air Data System.

The angle of attack is calculated based on an interface between the static pressure of the smart probes.

– ADSP 1 interfaces with ADSP 2.

– ADSP 3 interfaces with ADSP 4.

Each ADSP and TAT are heated to provide protection for icing build up maintaining continued sensor accuracy in icing conditions.



TAT AND ADSP

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AIR DATA APPLICATION (ADA)

The ADA computes final air data (altitude, airspeed, etc.) and transmits this information to the appropriate airplane systems (PFD, stall protection system, flight controls system, etc).

NORMAL OPERATION

During normal operation, air data readouts are as follows:

– Left PFD - ADS 1.

– Right PFD - ADS 2.

– IESS – ADS 4.

ABNORMAL OPERATION

ADS FAILURE

If a failure occurs on ADS 1 or ADS 2, the affected PFD loses all air data information and a red cross is shown over the failed indication and an EICAS message is generated alerting the crew of the failure.

SENSOR FAILURE

If a single sensor failure occurs, like the static air pressure or total air pressure the affected indication will be lost or unreliable.

In case of unreliable information the indicator presentation looks normal but the information will be incorrect when compared to the other similar indicators and a flag may be presented on the PFD indicating a split between similar indicators.

In case of lost information a red flag is displayed over the failed indicator.

ABNORMAL OPERATION LOGIC

If a failure of the ADS occurs the failed ADS automatically revert to ADS 3 or the pilot can manually revert to any available ADS to recover the information on the affected PFD.

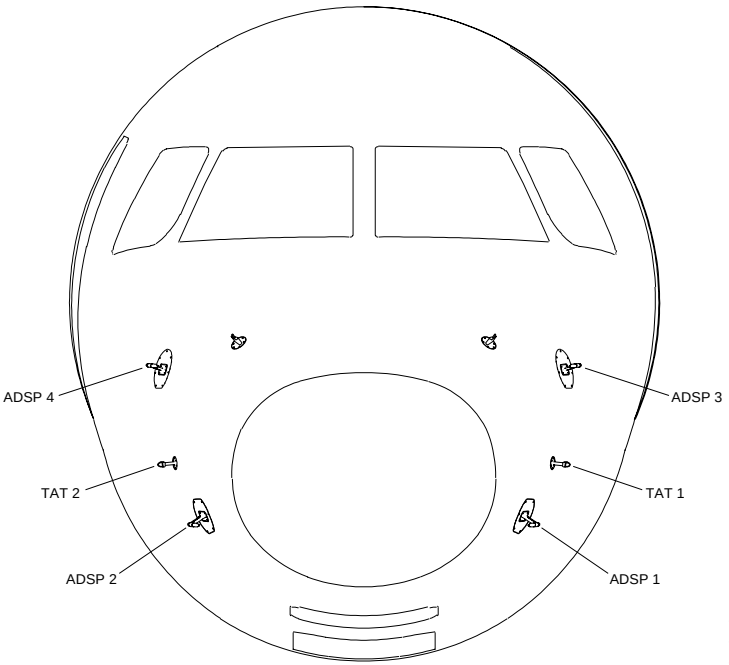
After manual or automatic reversion, the selected source is displayed on a flag on the affected PFD and a stripe bar illuminates on the affected side reversionary button.

The reversionary logic cycle for the left and right PFDs are as follows:

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	Reversionary Logic		
	Normal Operation	**1st reversion**	**2nd reversion**
Captain	ADS 1	ADS 3	ADS 2
First Officer	ADS 2	ADS 3	ADS 1

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PROBE LOCATION

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RADAR ALTIMETER SYSTEM

The radar altimeter function measures the airplane height above terrain and sends this information to be displayed on the PFD and to be used by the other airplane systems.

To determine the height the radar altimeter transmits a signal to the ground and processes the time it takes to receive the signal return converting it into radio altitude.

The radar altimeter range of operation is -20 ft to 2500 ft.

RADAR ALTIMETER INTERFACE

The system interfaces with the TCAS, which uses the radio altitude information to inhibit descend resolution advisories. The system also interfaces with the modular avionics unit (MAU), for data distribution and integrity checking.

In addition, other interfaces are performed such as with the EGPWS, to determine airplane sink rate variation, with the DVDR system, in order to record mandatory parameters.

DUAL INSTALLATION

NORMAL OPERATION

In a dual system installation, the PFD 1 displays the system 1 radio altitude and the PFD 2 displays the system 2 radio altitude.

ABNORMAL OPERATION

If a difference between both radio altitudes occurs a flag RA in amber above the radio altitude box will be displayed.

If one radar altimeter is lost in a dual installation the remaining radar altimeter provides the radio altitude information for both PFDs. In this case the radio altitude readout is shown in amber and an EICAS message is posted indicating the failed system.

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RADAR ALTIMETER TEST

The system has a self test that may be performed by the pilot on the MENU page on the MCDU performing the following steps:

– Push the LSK 1L (MISC);

– Push the LSK 4R (TEST);

– On the TEST page 2/2, push the LSK 3L (RAD ALT) and check the MCDU showing RAD ALT test ON and the radar altitude indication showing 5050 ft ± 5 ft on PFDs 1 and 2.

– Push the LSK 4R (TEST) again to stop the test.

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INTEGRATED ELECTRONIC STANDBY SYSTEM

The IESS computes and displays the primary flight information:

– Attitude (pitch and roll).

– Standard or barometric-corrected altitude and associated barometric pressure.

– Indicated airspeed.

In addition, the IESS provides the following secondary functions or displays:

– Indicated Mach number.

– V_{MO}/M_{MO}.

– Side slip indication.

– Vertical speed.

– Localizer and glide slope presentation from the NAV 1 ILS frequency.

– Barometric pressure.

– Altitude in meters.

NORMAL OPERATION

The IESS is powered as soon as the airplane battery 1 is selected to ON and airplane battery 2 is selected to AUTO. Then, the IESS starts its alignment phase.

The initial IESS alignment takes about 90 seconds to be completed and can be identified on the screen by the “INIT 90 s” flag.

NOTE: The airplane must not be moved during the first 90 seconds after power-up, while the IESS is undergoing alignment. Moving the airplane during this period can cause in-flight attitude indication errors that may not be noticeable on ground.

ABNORMAL OPERATION

In case of failure, attitude display information (e.g. brown and blue background, pitch scale, roll scale and roll pointer) is removed and replaced by a black background and a red cross, and an ATT flag is displayed. In case of a loss of data, an OUT OF ORDER page is displayed.

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CLOCK

The electronic clock provides the flight crew with the following information:

– Universal time coordinated (UTC);

– Date (day/month and year);

– Elapsed time (ET) and

– Chronometer (CHR).

NORMAL OPERATION

GPS TIME

With the switch set to GPS the system receives the UTC time from the GPS automatically as long as the GPS is receiving a satellite signal.

INTERNAL TIME

The clock can be set to operate without the GPS.

To adjust the internal time proceed as follows:

– Turn the GPS – INT switch to SET position;

– Rotate the SET switch to adjust the blinking field;

– Press the SET switch to move to another clock field;

– Repeat the process until all clock field are as desired;

– Turn the GPS – INT switch to INT to start the clock internal operation.

ELAPSED TIME

The elapsed time starts automatically when the airplane is airborne and stops when the airplane returns to the ground state.

There is no automatic reset between flights.

To reset the counter set the AUTO - RST switch to RST and release it.

CHRONOMETER

The CHR switch starts and stops the chronometer.

The RST switch resets the chronometer when it is stopped.

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STANDBY MAGNETIC COMPASS

The illuminated magnetic compass has a rotating compass card marked with white legend on black background, with the cardinal points appropriately marked as “N”, “S”, “E”, and “W”. Each 30-degree line, except the cardinals, is identified by numerals representing degrees. Headings are read against a vertical lubber line engraved and filled white on the inside surface of the bowl.

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GENERAL

The communication system comprises the radio communication (VHF), interphone, audio control panels and digital data voice recorder.

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RADIO COMMUNICATION SYSTEM

VERY HIGH FREQUENCY

The VHF digital radios (VDR) 1 and 2 are located in the Modular Radio Cabinets (MRC). VDR 1 and 2 interfaces with the audio system through the audio/microphone busses, and with the MCDU/PFD through the ASCB. VDR channels 1 and 2 are for voice communication only.

VDR 3 interfaces with audio system and MCDU/PFD indirectly via MRC 2 and directly to MAU 1 to data transmission. The VHF radio 3 is located on a separated radio Mini Cabinet. VDR 3 provides voice communication as well as data communications through ACARS (Aircraft Communication Addressing and Reporting System) applications.

The VHF frequency is tuned/activated through the MCDU (primary mean) or CCD (PFD).

A tuning backup is available in MCDU 2 in case of loss of both MAUs. In the same way, if the audio bus is lost there are audio backups.

The flight crew may tune the VHF frequency on the MCDU as follows:

VHF 1/2

– Press RADIO button on the MCDU to go to RADIO page 1/2.

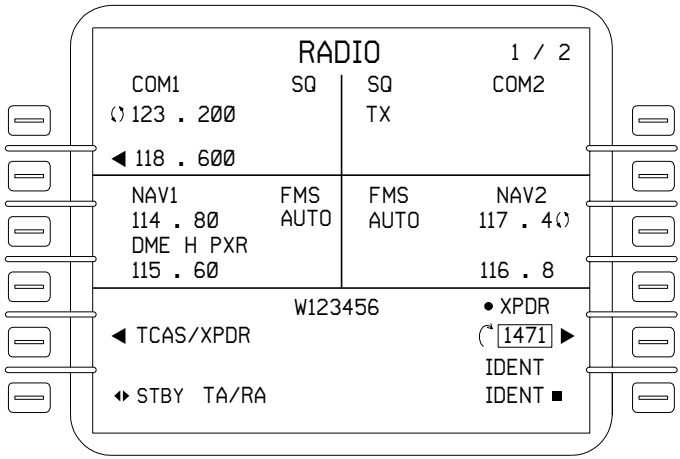
RADIO PAGE 1/2:

– The frequency is changed using either the scratchpad or the tuning knob on the MCDU.

– To change a frequency value with the scratchpad, use the keypad to enter the new frequency value, and then push the LSK next to the frequency to be modified. This transfers the value from the scratchpad to the selected frequency.

– To change a frequency value with the MCDU tuning knob, the standby frequency must prior be boxed pressing the LSK 2L/2R. Tune the frequency. With the cursor around the standby frequency and the swap icon displayed, push the LSK to swap the standby and active frequencies.

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RADIO PAGE 1/2

COM 1 (2) PAGE 1/1:

– Press the respective standby frequency twice if not boxed, otherwise press once, to go to NAV page 1.

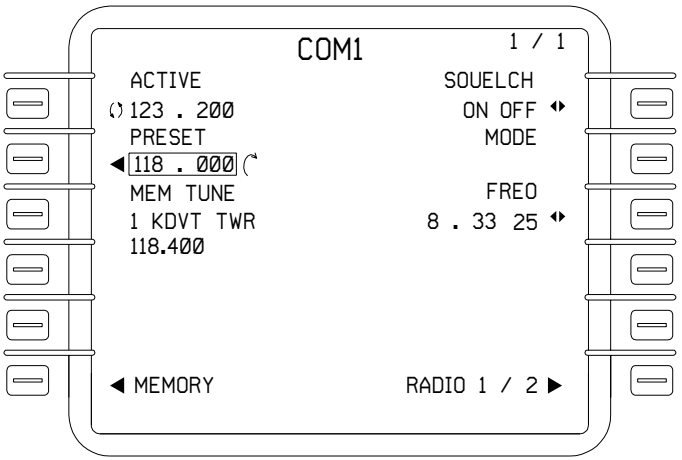
– On the COM page it is possible to capture a frequency tuned in memory. Press LSK 3L to box the memory tune and use the tuning knob to cycle the stored frequencies. Press the active frequency to capture the selected memory tune.

– Press LSK 1R to cycle to the squelch on or off.

– Press LSK 3R to cycle to the frequency spacing:
8.33: frequency has three decimal places.
25: frequency has two decimal places.

– Press LSK 6L to go to COM MEMORY page 1/2.

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COM PAGE 1/1

The VHF frequency selection through the CCD is as follows:

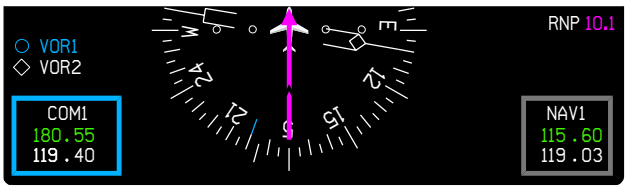
– Select the PFD through the CCD. The left and right format location buttons select respectively pilot's and copilot's PFDs.

– Through the touch pad move the cursor to the navigation frequency window.

– Tune the standby frequency through the tuning knob.

– Activate the standby frequency by pressing the enter key.

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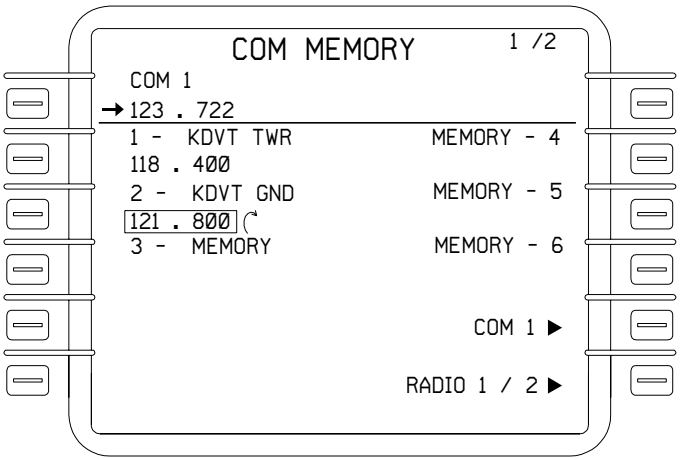


EM170AOM140893A.DGN

COM MEMORY PAGES:

– On the COM MEMORY page it is possible to capture a frequency tuned in memory or store a frequency/identification. To capture a frequency press the respective memory frequency to box it and press 1L to activate the frequency. To store a frequency or its identification use the alphanumeric keys and press the respective memory line select key. Additionally the frequency can also be stored pressing the receptive memory line select key and rotating the tuning knob.

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COM MEMORY PAGES

VHF 3

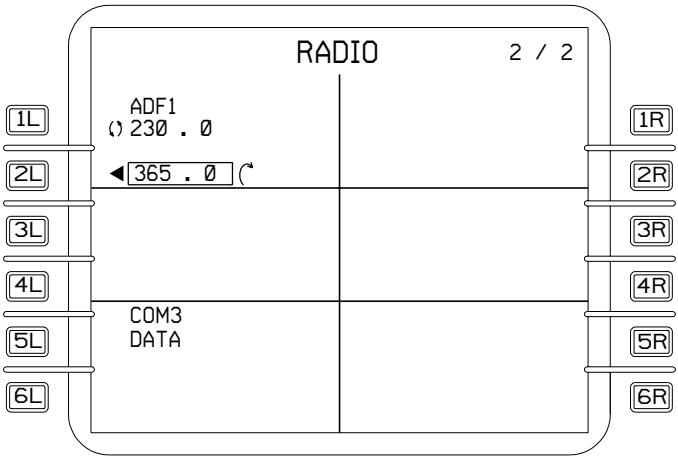
RADIO PAGE 2/2:

– To bring up the RADIO PAGE 2/2, with the radio PAGE 1/2 displayed, press the NEXT button.

– On RADIO page 2/2 it is possible to tune and activate the VHF 3 frequencies for voice mode. Press LSK 6L twice to go to COM 3 page 1/1, and then press LSK 2R to cycle the operational mode (data or voice). It is possible to tune a radio frequency in the same manner as VHF 1 and 2.

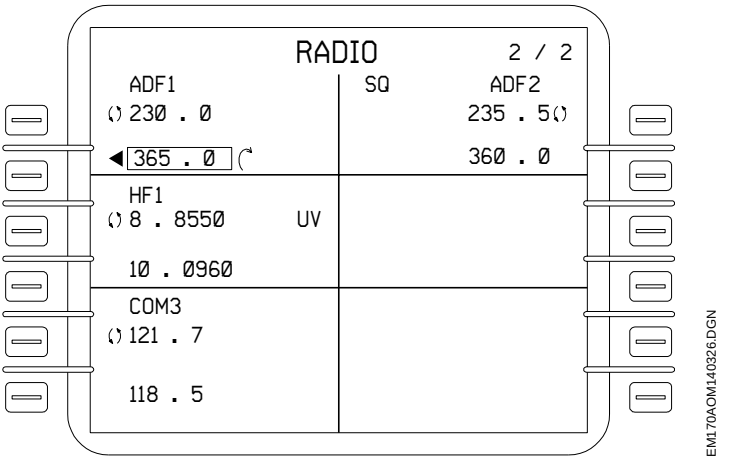
– The frequencies for data transmission are selected on a specific ACARS page. With data mode selected, the indication ‘DATA’ displays, otherwise VHF 3 active and standby frequencies display.

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RADIO PAGE 2/2 (DATA MODE)

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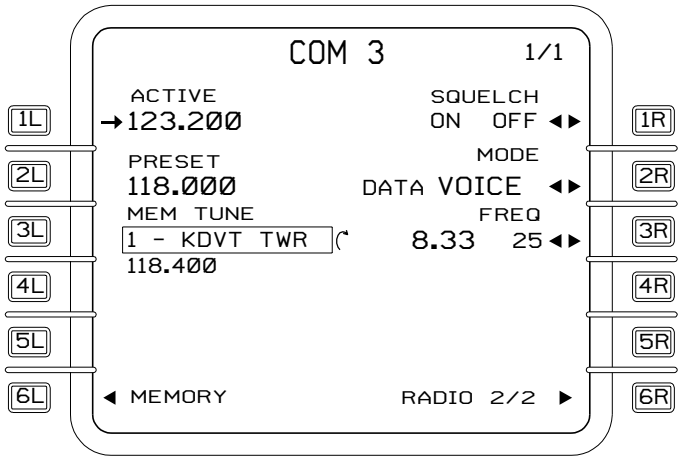


RADIO PAGE 2/2 (VOICE MODE)

COM 3 PAGE 1/1:

– The COM 3 page provides the same options as COM 1 (2) pages, except that is possible to select the transmission mode for VHF 3. The transmission mode is selected by pressing LSK 2R to cycle the operational mode (data or voice).

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COM 3 PAGE 1/1

HIGH FREQUENCY

The HF frequency transceiver is tuned/activated through the MCDU.

When an HF transmitter is keyed after a frequency change, the antenna tunes to the selected frequency. While the frequency is being tuned, a steady tone may be heard through the audio system.

The flight crew may tune the HF frequency on the MCDU as follows:

– Press RADIO button on the MCDU to go to RADIO page 1/2.

RADIO PAGE 1/2:

– Press NEXT button to go to RADIO page 2/2.

RADIO PAGE 2/2:

– On RADIO page 2/2 it is possible to tune and activate the HF frequency. Tuning can be accomplished using the tuning knob or the numeric buttons. If the tuning knob is used, the standby frequency must be boxed prior to tuning by pressing its respective line select

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key. In case of the numeric keys use, the standby frequency has to be entered in the scratchpad and press the respective line select key. To activate the standby frequency, press the respective active frequency.

– Press the respective standby frequency twice if not boxed, otherwise press once, to go to HF page 1/2.

HF PAGE 1/2:

– Press LSK 5L to cycle to the operational mode:

SMPL: transmission and reception on the same frequency.

SPLT: transmission and reception frequencies differ.

ITU: frequencies in accordance with International Telecommunication Union channel designations.

EMRG: single button access to six pre-stored emergency frequencies.

– Press LSK 1R to cycle the squelch type:

SBH - Syllabic Squelch High: This is the basic squelch type and is usually best for normal voice communications. A syllabic squelch opens upon receiving a signal with voice-like characteristics while ignoring other signals.
With syllabic squelch, there is the possibility that the first syllable of a voice reception may be partially squelched. The possible adjustment levels are OFF, meaning no squelch action, minimum (MIN), medium (MED) and maximum (MAX).

SBL - Syllabic Squelch Low: This squelch is also a syllabic squelch and is intended for voice communications where the desired signal is very weak and noisy. This squelch is more prone to opening (no squelch action) on noise than the SBH squelch. The possible adjustment levels are OFF (no squelch action), minimum (MIN), medium (MED) and maximum (MAX).

SQH - (Signal/Noise Squelch High): This is a traditional signal-to-noise squelch best suited for listening to non-voice signals, or voice signals that do not respond well to one of the syllabic squelches. Compared to the syllabic squelches, a higher signal level is generally required for this squelch to perform well. The possible adjustment levels are 0-31, where 0 is off squelch.

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SQL - (Signal Level Squelch): This is a signal strength squelch which opens on any strong input signal. It opens quickly on strong signals, however also opens on strong noise or static. Use of SQL is recommended for use only with strong signals and under low noise conditions. This squelch is well suited for music broadcasts. The possible adjustment levels are 0-31, where 0 is off squelch.

– Selection of squelch level:

If SQL/SQH squelch type is selected, the squelch level defaults to 0. The entry of an update value can be done via the scratch pad or through the tuning knob on the MCDU. If the tuning knob will be used, the squelch level value must prior be boxed, pressing the LSK 3R. In the case of numeric keys, enter the squelch level value and press the LSK 3R.

If SBL/SBH squelch type is selected, the squelch defaults to OFF. Pressing the respective LSK varies the squelch mode. During the Power Up, the HF type defaults to SQL.

– Press LSK 5R to select EM MODE (emission mode):

UV: conventional upper sideband. It is considered the standard for HF transmission and reception and is the most commonly used. After the Power Up, the EM MODE defaults to the UV mode.

LV: conventional lower sideband.

AM: amplitude modulated communication. Some older stations may still use AM signals. AM is the best selection for listening to broadcast stations.

RC: reduced carrier power single sideband for frequency tracked receivers. The HF signal transmitted in some frequency is actually transmitted in a band of frequencies. When the station being contact has the ability to lock onto a transmitted frequency, it is possible to reduce power dispersion, thus reducing the transmission power requirements. When communicating with one these stations, the RC mode may be used.

– Press NEXT button to go to HF page 2/2.

HF PAGE 2/2:

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– The CLARIFIER is fine tuning of the HF frequency. The CLARIFIER varies from -250 to 250. The entry of the clarifier value can be done via the scratch pad or through the tuning knob on the MCDU. If the tuning knob will be used, the clarifier value must prior be boxed, pressing the LSK 1L. In case of the numeric keys, enter the clarifier level value and press the LSK 1L. Upon changing the HF frequency, the CLARIFIER value defaults to 0.

– There are three transmission power selections, LO, MED or HI. After a communication system reset (power down and power up) the transmission power defaults to HI. During the normal operation, the HI transmission power should be used.

– Press LSK 6L to go to HF MEMORY page 1/2.

HF MEMORY PAGE 1/2:

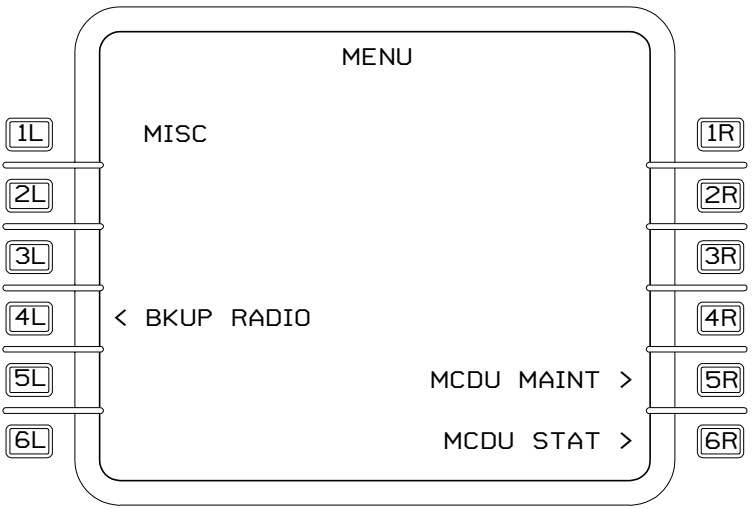
– On the HF MEMORY page it is possible to capture a frequency tuned in memory or store a frequency/identification. To capture a frequency press the respective memory frequency to box it, and press 1L to activate the frequency. To store a frequency or its identification use the alphanumeric keys and press the respective memory line select key. Additionally the frequency can also be stored pressing the receptive memory line select key and rotating the tuning knob.

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BACKUP RADIO PAGE:

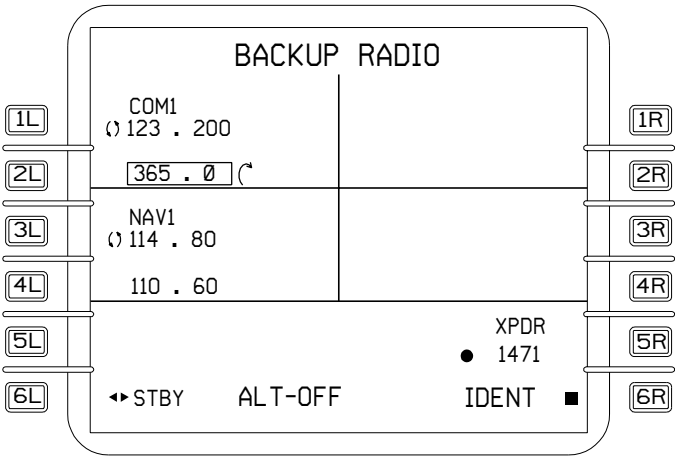
– The BACKUP RADIO page provides means for tunning COM 1, VHF NAV 1 and XPDR 1 (ALT OFF mode) in case of loss of primary and secondary tuning means (tuning using MCDU and CCD). In such cases, radio access is done via backup connection available on MCDU 2.

– The BACKUP RADIO page is available by pressing the MENU function button on the MCDU and then LSK 4L on Menu page. The BACKUP RADIO page displays automatically on MCDU 2 for some failure conditions.



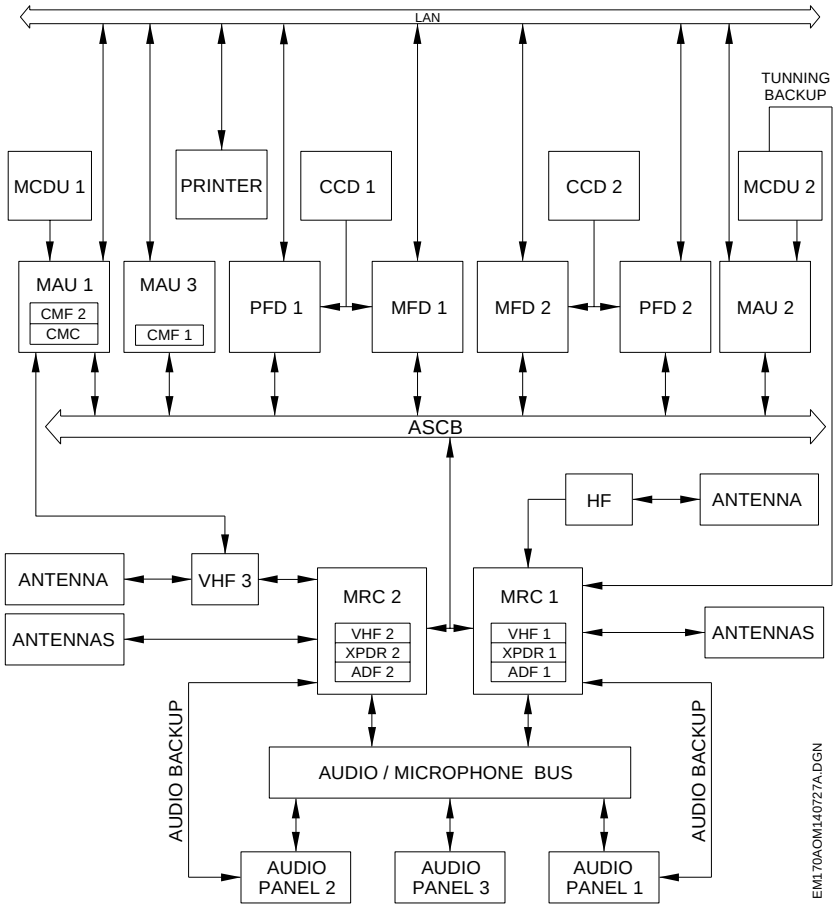
MENU PAGE 1/1

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BACKUP RADIO PAGE 1/1

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NAVIGATION AND COMMUNICATION SYSTEM SCHEMATIC

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SELECTIVE CALLING

Selective Calling (SELCAL) monitors selected frequencies on the VHF and HF radios in case the ground station desires to communicate with the flight crew. Each airplane is assigned a unique four-letter SELCAL code.

INTERPHONE SYSTEM

The interphone system provides communication between the flight crew, flight attendants and ramp personnel.

The flight attendants communicate between flight attendant stations or with the flight crew using any of the attendant handsets.

Communication between flight crew and flight attendants may be done through the ACP.

Call chimes are annunciated at the beginning of the call from the cockpit to the flight attendants and vice-versa.

PASSENGER ADDRESS (PA)

The PA system allows flight crew in the cockpit and flight attendants to make announcements to the passengers. Announcements are heard through speakers located in the cabin and in the lavatories.

The pilots can make announcements using a hand microphone, headset boom or oxygen mask microphones. The flight attendants can use the PAPA handset located at their stations.

Pre-recorded announcements may be provided as well as recorded music for passenger entertainment.

PA system use is prioritized. Cockpit announcements have first priority and override all others. Flight attendant announcements override the pre-recorded announcements which override the music system.

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ATTENDANT CALL

The call system is used as a mean for crewmembers to gain the attention of other crewmembers and to indicate that interphone communication is desired.

Attention is gained through the use of lights and aural signals (chimes or horn). The cockpit may be called from either flight attendant station or by the ground personnel. The ground personnel may only be called from the cockpit. Flight attendants may be called from the cockpit through interphone buttons on the ACPs or flight attendant call button on the overhead panel, the other attendant station, or from any passenger seat (PSU) or lavatory. Call lights in the passenger cabin identify the source of incoming calls to the attendants.

Call system chime signals low, high or high/low tones are audible in the passenger cabin through the PA system speakers. The PA speakers also provide an alerting chime signal whenever the NO SMOKING, FASTEN SEAT BELT or RETURN TO SEAT (in the lavatory) signs and STERILE COCKPIT light illuminate or extinguish.

The attendant call lights located on the forward and aft main ceiling panel areas provide a visual indication to attendant when there is a call from the flight crew or passengers.

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ATTENDANT CALL TABLE

Calling originator	Called position	Visual signal at called position	Aural signal at called position
Cockpit	Attendant Station	Green light	Single high/low tone chime
		Red light	Triple high/low tone chime
		Amber sterile cockpit light	Single high tone chime
	Passenger cabin, lavatories and galleys	No smoking or fasten belt signs illuminate/ extinguish	Single low tone chime
Cockpit (lateral console)	Ramp station	-	Horn in the nose wheel well
Cockpit (Overhead Panel)	Attendant station	-	Single high/low tone chime
Attendant station	Cockpit	CAB or EMERG annunciator button flashes on the ACP	Single or triple high/low tone chime for CABor EMERG, respectively
	Attendant station	-	Single high/low tone chime
Ramp station	Cockpit	RAMP annunciator button flashes on the ACP	Single high/low tone chime
Lavatory	Attendant station	Orange light	Single high tone chime
Passenger PSU	Attendant station	Blue	Single high tone chime

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AUDIO CONTROL PANEL

There are three Audio Control Panels (ACP), located at the control pedestal and observer station. Each panel controls an independent crew station audio system and allows the flight crew to select the desired radios, navigation aids, interphones and PA systems for monitoring and transmission.

The audio panel receives inputs from all audio communication channels and aural warnings. Audio warning for altitude alert, ground proximity warning system (GPWS), traffic collision avoidance system (TCAS), and windshear among others, are also heard through the speakers and headsets. These warnings cannot be controlled or turned off by the flight crew. Audio from each ACP is monitored using a headset, headphone or the related speaker, except for the observer speaker.

DIGITAL VOICE DATA RECORDER (DVDR) SYSTEM

The digital voice data recorder system (DVDR) combines a flight data recorder (FDR) and a cockpit voice recorder (CVR) in a single unit. Two DVDR units are installed. DVDR 1 is installed in the forward electronic bay, and the DVDR 2 in the aft electronic bay. Each unit receives, records and preserves all required data parameters and voice recordings from the cockpit crew and area microphones.

The DVDR unit is capable of recording the last 120 min of audio information from cockpit area microphone and primary crew microphones, 25 h of flight data, 120 min of digital communication messages and GMT as well.

The DVDR automatically starts recording audio information as soon as power up is performed and continues until the power down. The flight data begins to be recorded when the first engine is started.

The DVDR's FDR data is available through the MCDU for maintenance purposes only.

If the DVDR power system fails, an EICAS message is generated to indicate the failure. All DVDR EICAS messages are advisory and some of them are inhibited in critical phases of flight, such as takeoff.

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COMMUNICATION MANAGEMENT FUNCTION (CMF)

The Communication Management Function (CMF) is an airborne communications router that supports datalink services access between airplane datalink applications and their corresponding ground service providers. The following functionalities are available through the CMF:

– Character-oriented communication through ACARS network.

– Communication between different airplane devices.

CMF is a dual mode active/stand by system. CMF 1 resides in MAU 3 and is powered by DC bus 2.

CMF has the following interfaces:

– ACARS network.

– MCDUs are the primary flight crew interface with CMF providing display and control for the CMF. CMF becomes available pressing MCDU DLK button.

– Printer receives ACARS exchanged messages via CMF.

– CMC receives fault/events reports from the CMF. CMC also provides communication between the CMF and Printer device.

– PFD displays a “MSG” flag when uplink messages are received from ground.

– EICAS alerts crew members of CMF faults.

– AWS alerts crewmembers of new ATS (Air Traffic Services) uplink messages.

CMF DISPLAYS

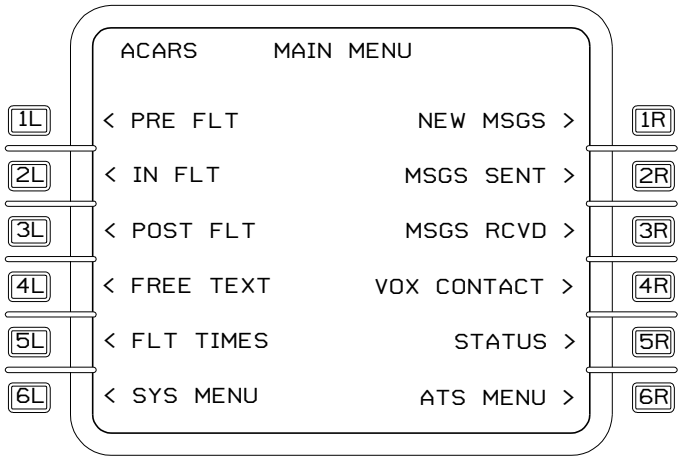
The CMF contains three different types of screens. The first type is the Airline Operational Communication (AOC) screens. The AOC screens are defined within the CMF AMI (Airline Modifiable Information) database and can vary from airline to airline. The AMI pages are identified by “ACARS” that appears in the upper left hand corner of each page.

The second set of screens is the system displays, which are controlled via a system manager. For example: Datalink Manager, Time/Date and APM Data Display, etc. The system manager is typically accessed from the main menu.

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The Air Traffic Service (ATS) is the third set of screens. These displays are controlled from the ATS menu, which is typically accessed from the main menu.

An example of main menu is shown below. As described above, the system menu and ATS menu are accessed from this main menu.



ACARS MAIN MENU

Access to the CMF system on the MCDU is performed by selecting the ACARS prompt on the MCDU MISC menu or the DLK button on the MCDU. Further access to other pages is provided through the LSK on MCDU.

If it is the first access of the CMF pages since power up, the CMF main menu appears. If it is not the first access since power up and there are new messages, the NEW MESSAGES display appears. If it is not the first access since power up and there are no new messages, the last CMF page accessed is displayed.

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ACARS

ACARS is a data link system that allows real time communication between ground stations and the airplane. Through the use of the ACARS the airline will be able to:

– Monitor in real time the fuel consumption and fuel cost;

– Have a report about the airplane position;

– Manage delay and passenger connection;

– Receive weather information and ATC clearance on board the airplane;

– Transmit and receive messages from and to the airplane.

The messages exchanged are divided in two groups:

– Addressed to or by crewmembers: data link requests or free text reports;

– Automatically sent: reports of flight data, performance data and routine events.

Communication to ground stations is made through the VDR 3 channel. The MCDU provides ACARS applications interface for crewmembers. For airplanes equipped with VDL mode 2, the Mode X indicates that the CMF has no communication with any ground station. This indication changes according to the mode of the ground station.

ACARS applications are:

AIR TRAFFIC SERVICE APPLICATIONS

– ATIS (Air Traffic Information Service) Reports application enables the flight crew to send a downlink message requesting an uplink report that may be a specific airport information or an en route information.

– Departure Clearance Application is used to request a departure clearance through character-oriented messages instead of voice communication.

– Expected Taxi Clearance is used to request a taxi clearance through character-oriented messages instead of voice communication.

– Flight System Message Application is used to display unsolicited uplink messages that provide additional information then that provide in an Oceanic or Departure Clearance.

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– Oceanic Clearance Application makes the oceanic clearance request through character-oriented messages instead of voice communication.

– Pushback Clearance is used to request a pushback clearance through character-oriented messages instead of voice communication.

– TWIP (Terminal Weather Information for Pilots) provides meteorological information to the flight crew.

AIRLINE OPERATIONAL COMMUNICATIONS APPLICATIONS (AOC)

The airline may customize AOC applications supported by CMF using a ground-based tool. Examples of AOC applications are:

– Flight Initialization.

– Free Text.

– Weather Request.

– Out, Off, On and In events (OOOI events) are automatic reports sent to the airline operations control. Both reports and trigger events are configurable by the airline. Examples are:

  – Out events – doors closed and parking brake released.

  – Off events – take off.

  – On events – landing.

  – In events – parking brake applied and doors opened.

The following section describes a baseline AOC that contains the most functions required by airlines.

ACARS INITIALIZATION

In order to activate the flight as an ACARS flight, the pilot must perform the system initialization through the MCDU . After initialization, the crew will receive a message to confirm that the flight has been recognized as an ACARS flight.

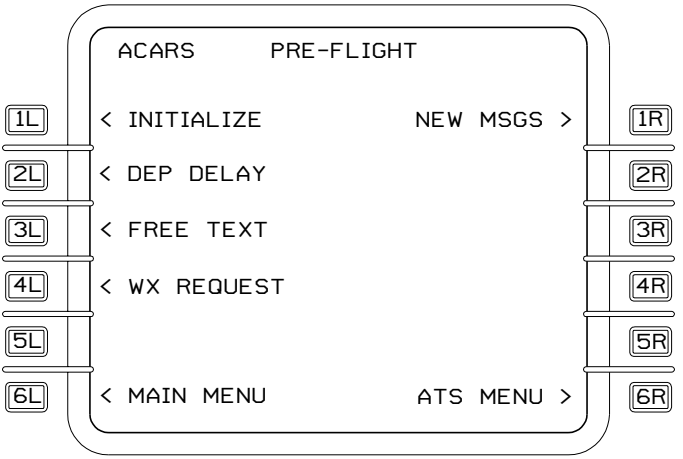
When the initialization has been performed, some items will be transferred directly from FMS to ACARS, while others have to be inserted by the pilots.

The ACARS system uses the VHF COM 3 when in DATA mode.

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PRE FLIGHT MENU

Pre Flight Menu is used to open the INITIALIZE page.



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The Initialization display provides flight number, departing and destination stations, and crewmember information.

If FLT PLAN and RTE pages have already been initialized, the following items will be automatically shown:

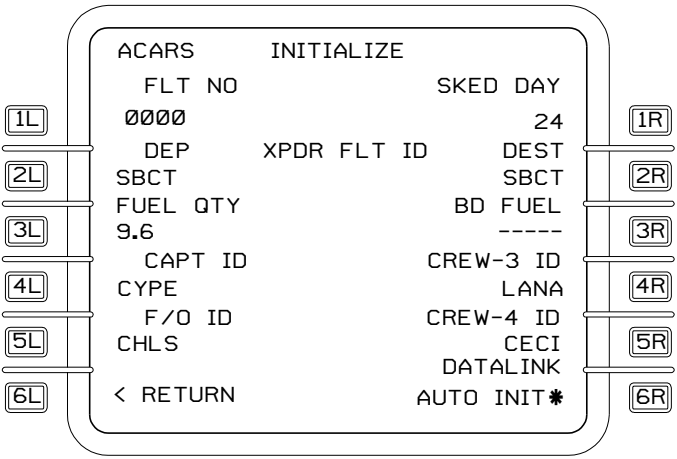
– Departure;

– Destination;

– Call sign;

– Fuel on board.

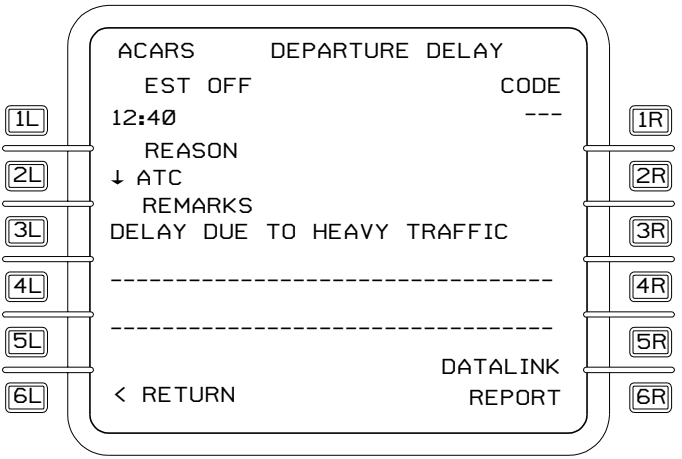
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The Departure Delay Report display provides the crew with the ability to inform the AOC of a departure delay.

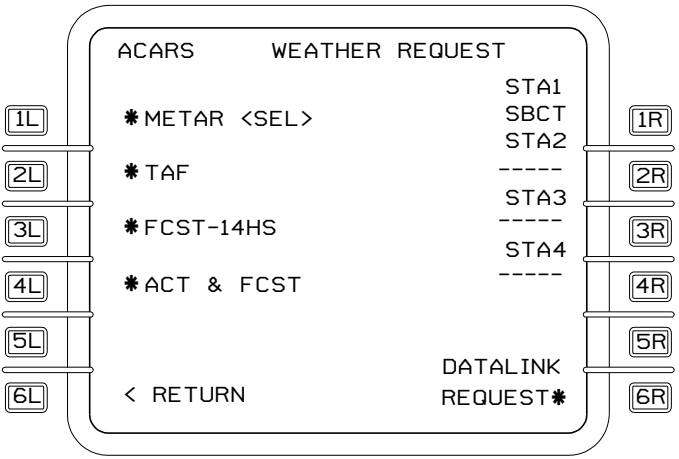
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The Weather Request Page provides the crew with the ability to request weather information. After selecting the desired one, it is necessary to insert the airport ICAO code in the respective LSK (1R to 4R).

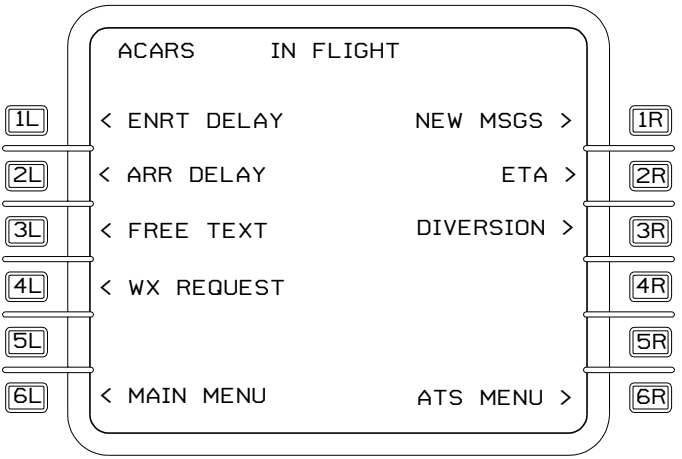
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IN FLIGHT MENU

In Flight Menu provides information that may be used by the crew during the flight. It is available during all flight phases.

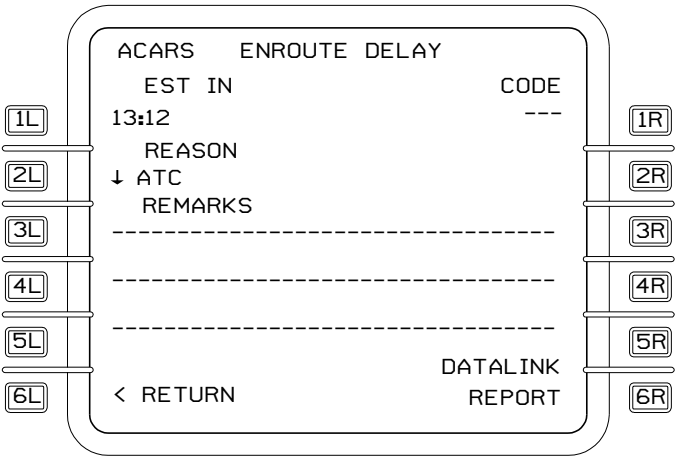
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The Enroute Delay Report provides the crew with the ability to inform the AOC of an enroute delay.

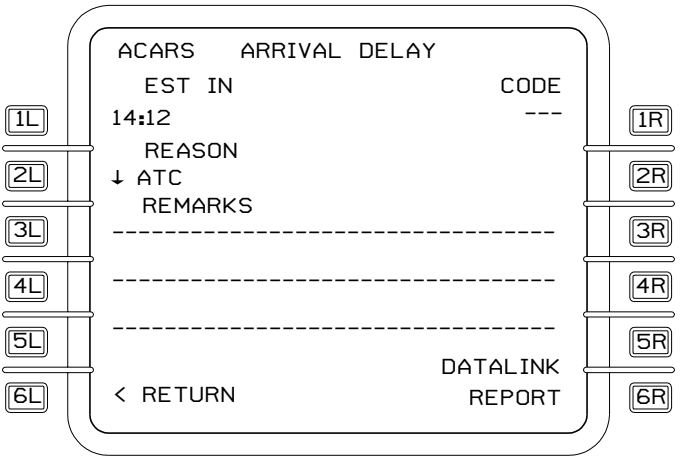
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The Arrival Delay Report provides the crew with the ability to inform the AOC of an arrival delay.

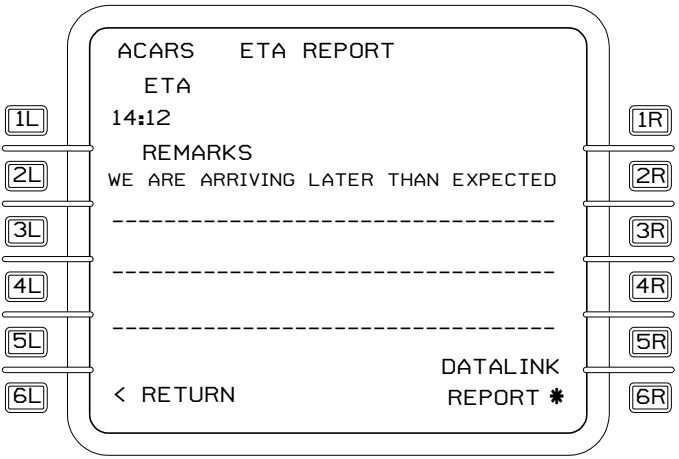
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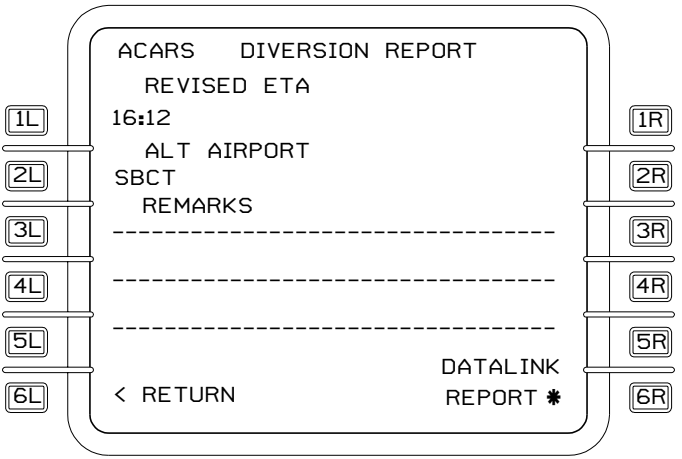
The ETA Report Display provides the crew with the ability to inform the AOC of the estimated time of arrival.

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The Diversion Report Display provides the crew with the ability to inform the AOC of a diversion to another airport.

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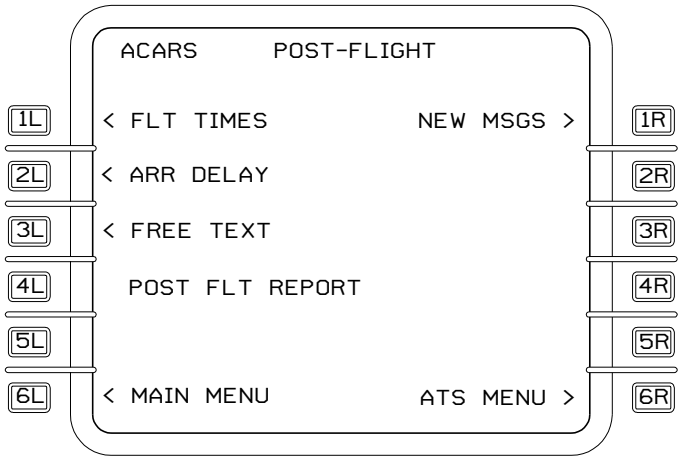


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POST FLIGHT MENU

This display provides information that may be used by the crew after the flight. It is available during all flight phases.

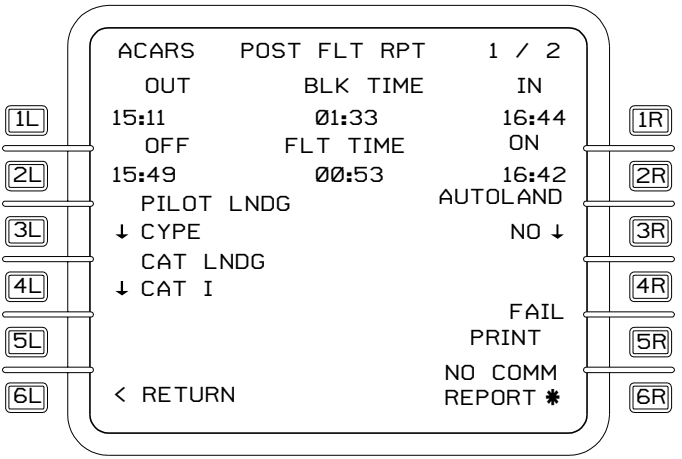
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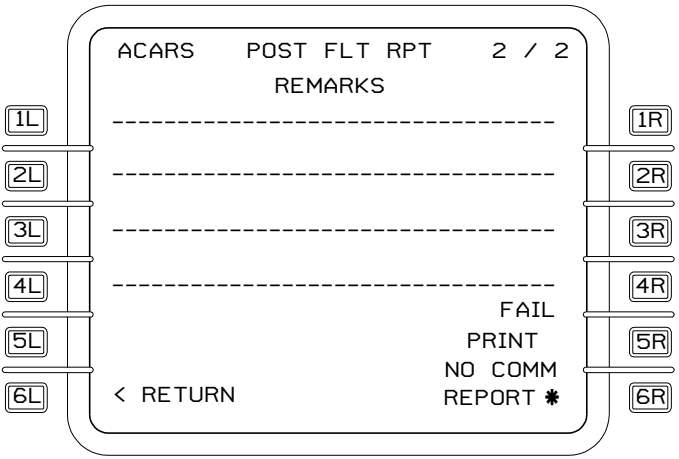
The Post Flight Report display provides the crew with the ability to inform the AOC of flight data. This display will only be accessible from the ON event until the end of the flight.

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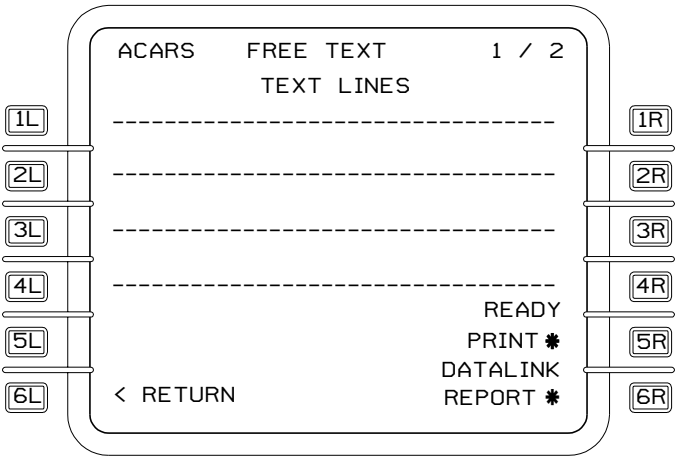
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FREE TEXT MESSAGE MENU

The free text display allows the crew to send a free text message to the AOC.

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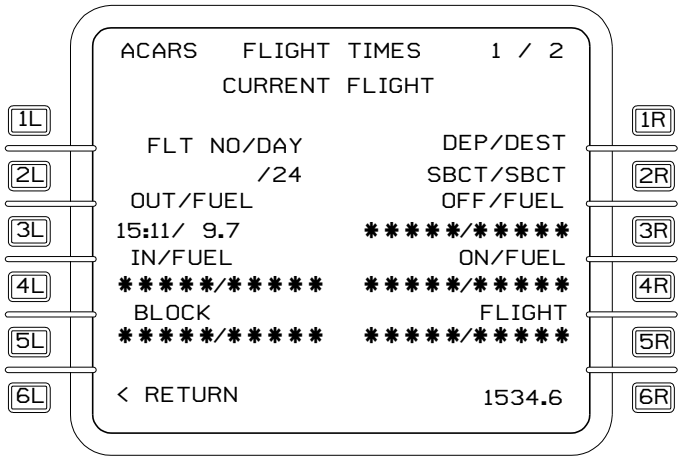
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FLIGHT TIMES MENU

The FLIGHT TIMES Page displays the flight number, the day of the flight and the ACARS times (Out, Off, On and In events).

The current and previous flight times are displayed on two pages. At the end of a flight event, all the parameters on the current Flight Times page will be copied onto the previous Flight Times page and the parameters on the current Flight Times page will be cleared.

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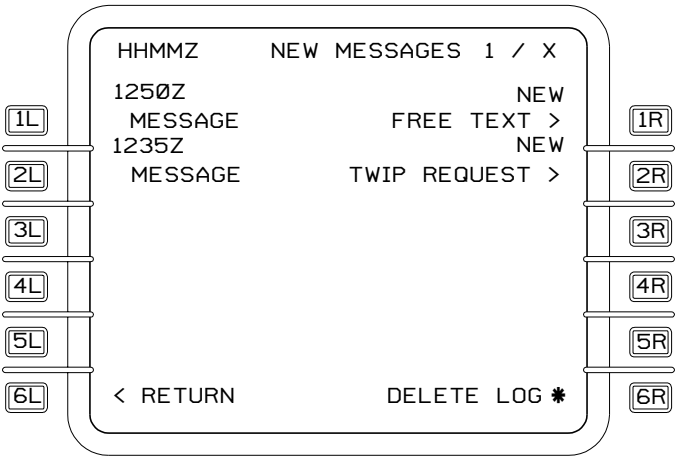


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NEW MESSAGES LOG MENU

The New Message Log lists all the messages received that have not been viewed by the crew. The New Message log file holds 30 messages and all uplinked messages are routed to the New Message log. When the New Message log file reaches 28 messages, a “Respond to Uplinks” scratchpad message is displayed and continues to be displayed until 30 messages are stored in the log. If a 31st message is received the message can not be stored in the New Message log since it is full. The “Respond to Uplinks” message is again displayed and since the uplink has already been acknowledged by the CMF as received, it is discarded.

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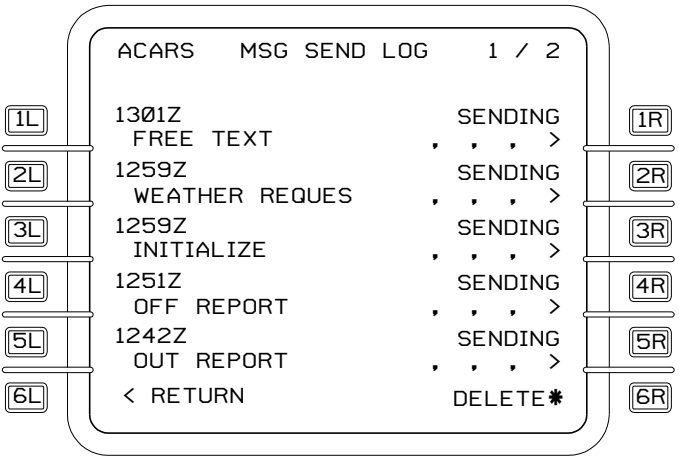


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MESSAGES SEND LOG MENU

The Message Send Log lists all messages that have been sent.

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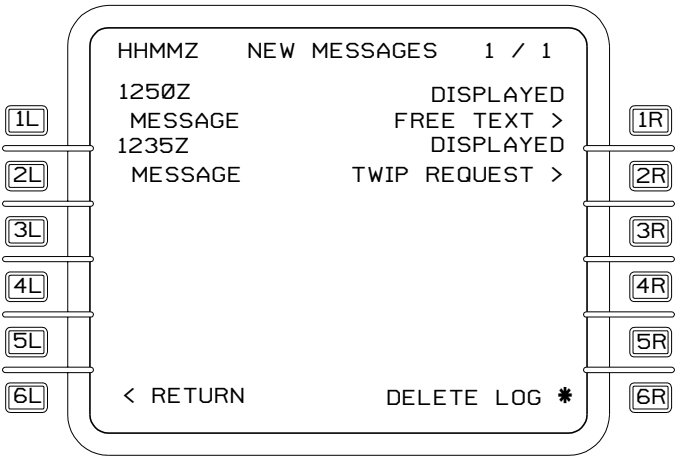


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MESSAGES RECEIVED LOG MENU

The Message Received Log lists all uplink messages that have been received and viewed by the crew.

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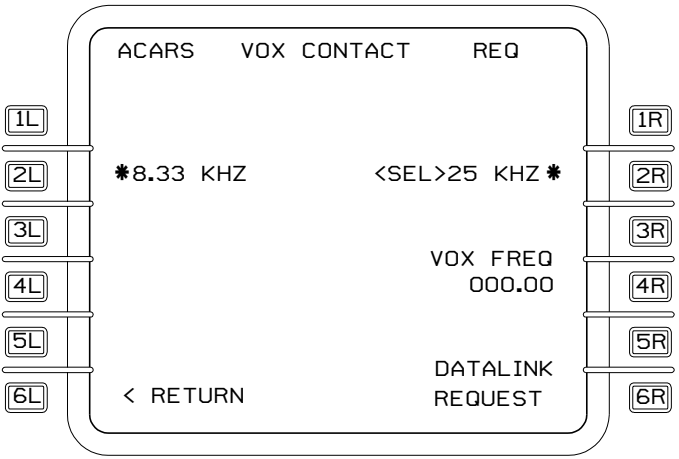


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VOX MENU

The VHF Voice Contact Request display provides a method for the crew to downlink a request to the AOC on the selected frequency.

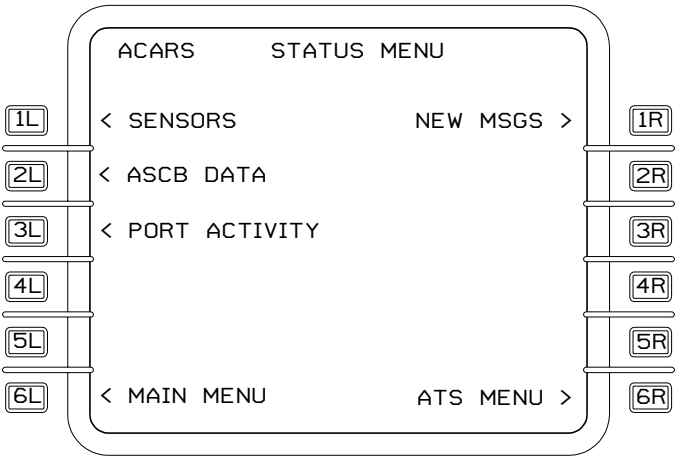
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STATUS MENU

The Status Menu provides access to the sensors and FMS displays.

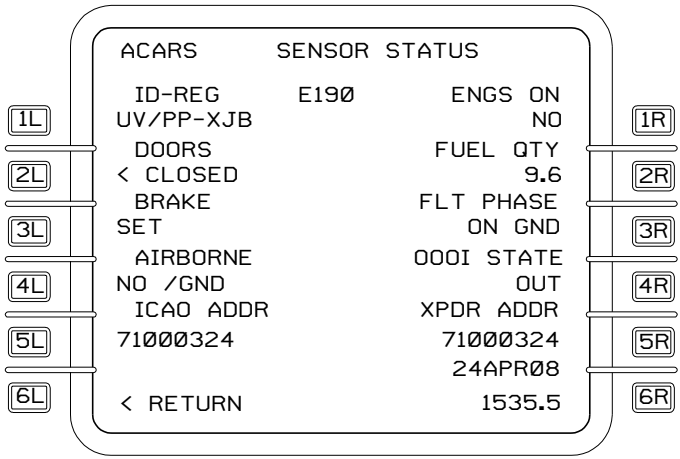
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EM170AOM140872A.DGN

The Sensor Status display provides information on the sensors.

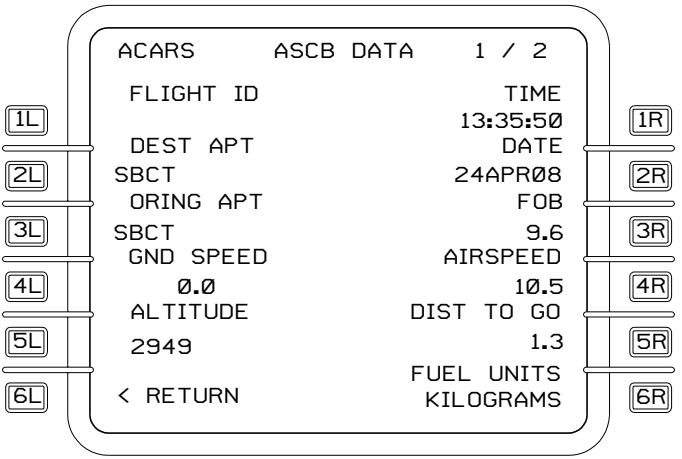
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EM170AOM140873A.DGN

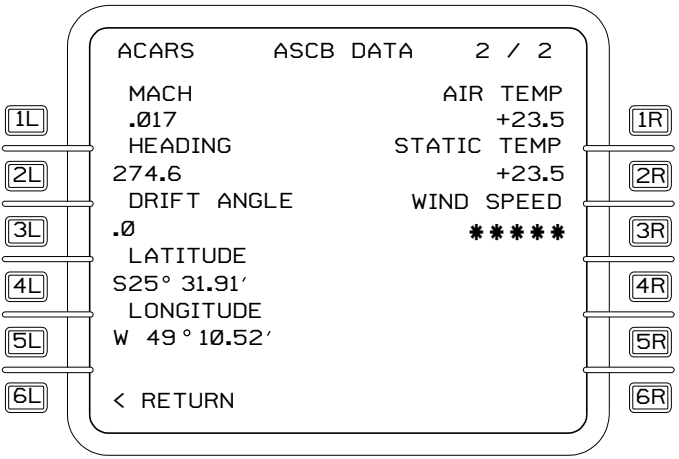
The ASCB display provides ASCB-related information.

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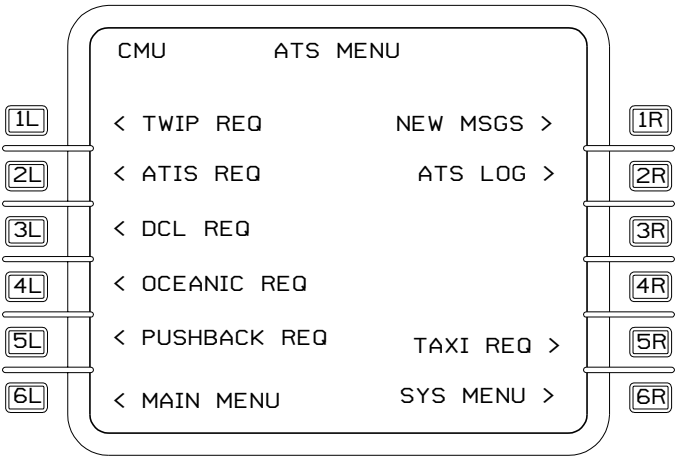


EM170AOM140875A.DGN

ATS MENU

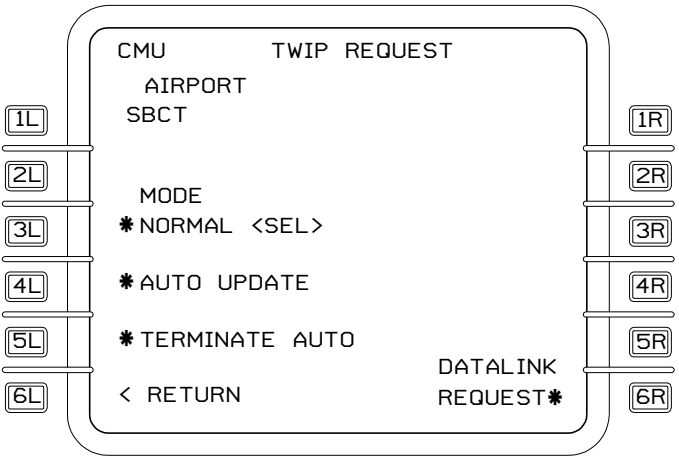
The ATS Menu display provides access to all ATS applications.

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The Terminal Weather Information for Pilots (TWIP) Request display is used to send a downlink request for a TWIP Report uplink.

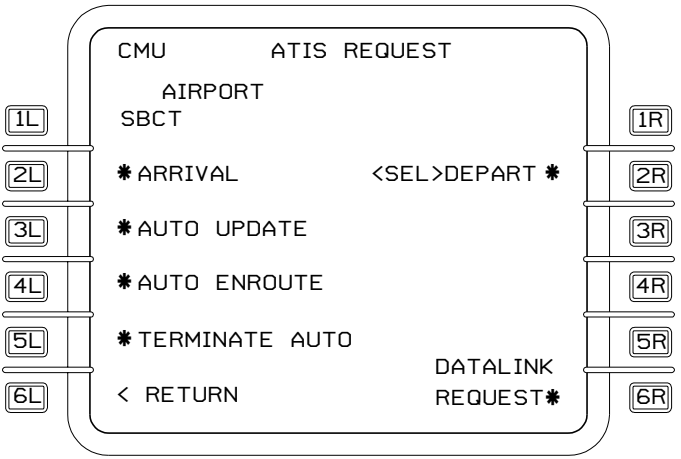
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The Air Traffic Information Service (ATIS) Request display is used to send a downlink request for an ATIS Report Uplink.

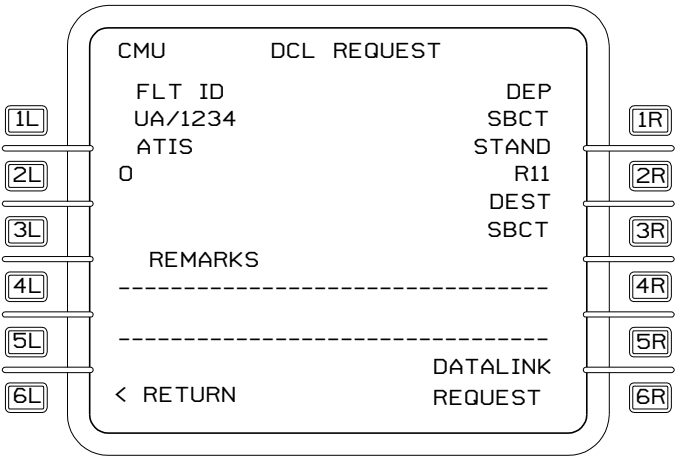
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EM170AOM140878A.DGN

The Departure Clearance (DCL) Request display is used to send a downlink request for a DCL uplink.

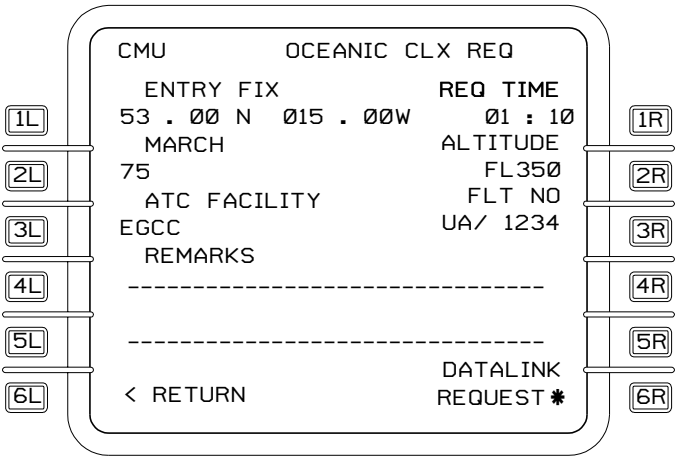
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EM170AOM140879A.DGN

The Oceanic Clearance (CLX) Request display is used to send a downlink request for an Oceanic Clearance uplink.

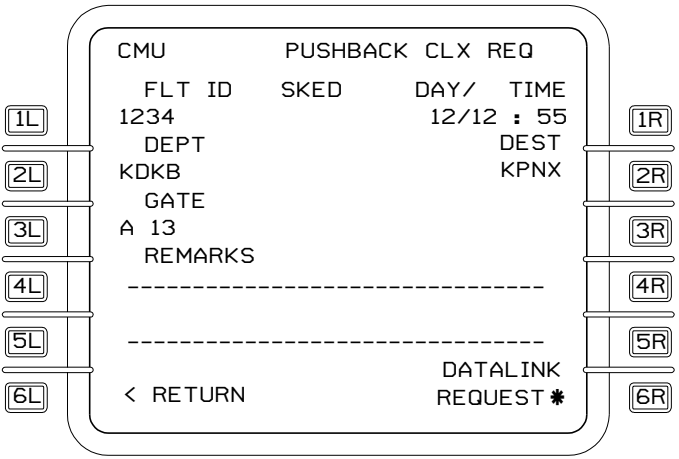
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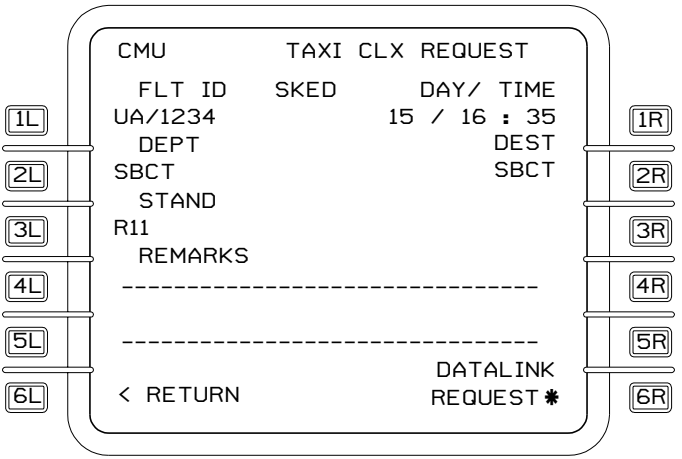
The Pushback CLX Request display is used to send a downlink request for a Pushback Clearance uplink.

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The Taxi CLX Request display is used to send a downlink request for a Taxi Clearance uplink.

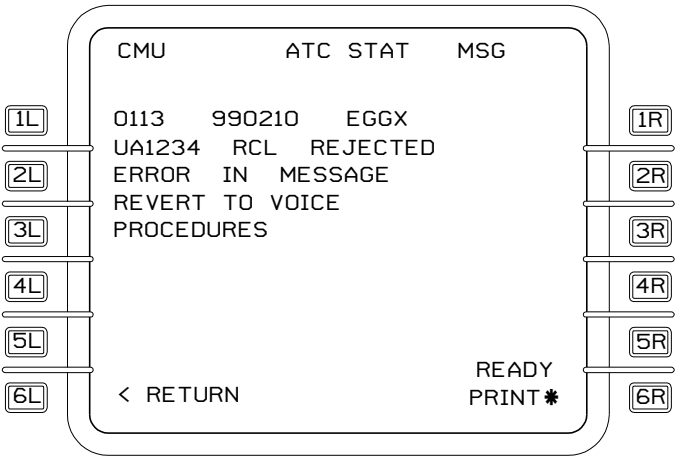
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EM170AOM140882A.DGN

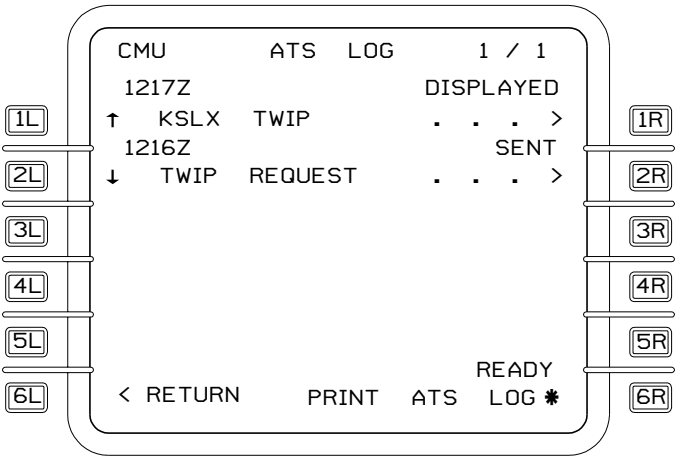
The Flight System Message display is used to display unsolicited uplink messages that provide additional information that the Departure and Oceanic Clearance uplink messages did not provide.

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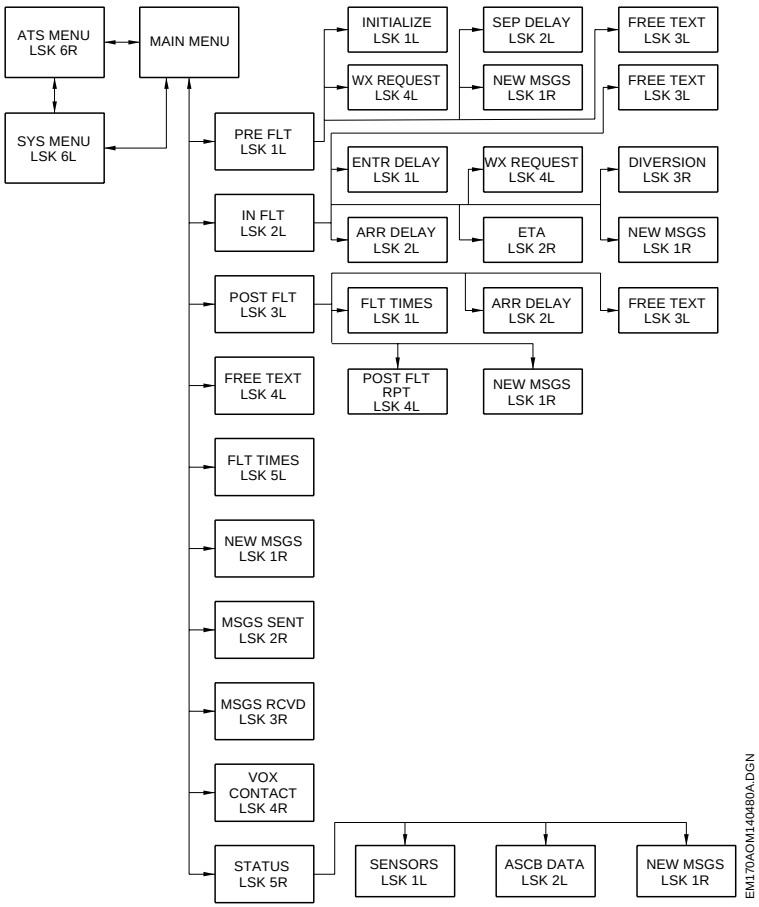
The ATS Log display is used to display all uplink and downlink ATS messages.

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PRINTER

The airplane is equipped with a full-format thermal line printer device installed in the cockpit on the control pedestal. DC BUS 1 powers the printer and a CB located in the cockpit Circuit Breaker Panel provides electrical protection.

The flight crew accesses printer via MCDU by CMF during all flight phases. On ground, maintenance personnel accesses printer via MFD 2 to print maintenance reports. CMF and CMC communicate with the printer via the LAN BUS.

The printer provides a self test which, in case of failure, illuminates the printer fault indicator in conjunction with printer test indicator. The Fault light also illuminates when printer door is open or paper out is sensed.

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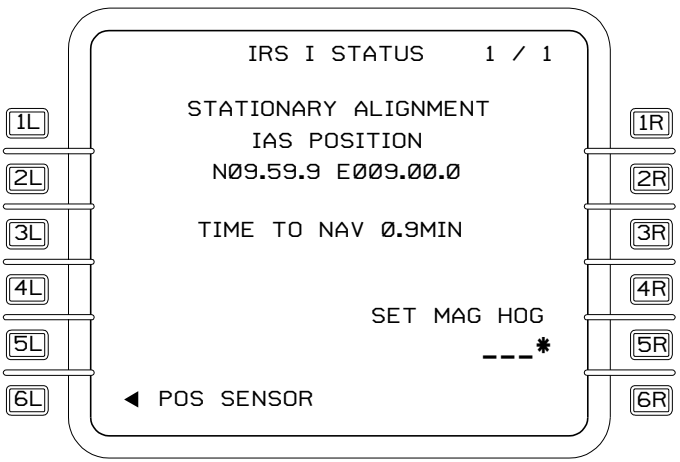
INERTIAL REFERENCE SYSTEM (IRS)

The inertial system computes airplane position, ground speed, heading and attitude.

The main component of the IRS is the Inertial Reference Unit (IRU), which interfaces with the Modular Avionic Unit (MAU), Global Positioning System (GPS) and the Air Data Computer (ADC). The IRU provides output data to the PFD, weather radar, Multifunction Control Display Unit (MCDU), Flight Management System (FMS) and reversionary panel.

Primary source for the Captain′s PFD is the IRS 1 and for the First Officer′s PFD is IRS 2. In case of mode failure, power loss or loss of one IRU, the affected station can source select the other side station by means of the IRS reversionary panel button.

An automatic power up (on ground) and alignment is provided. The alignment on ground (up to 17 min) must be performed with the airplane not in movement and position manually entered primarily via MCDU or obtained automatically from theGPS. In flight alignment is also possible to recover navigation capability using data from the GPS. The alignment time can be checked on the IRS STATUS PAGE 1/1 on the MCDU.



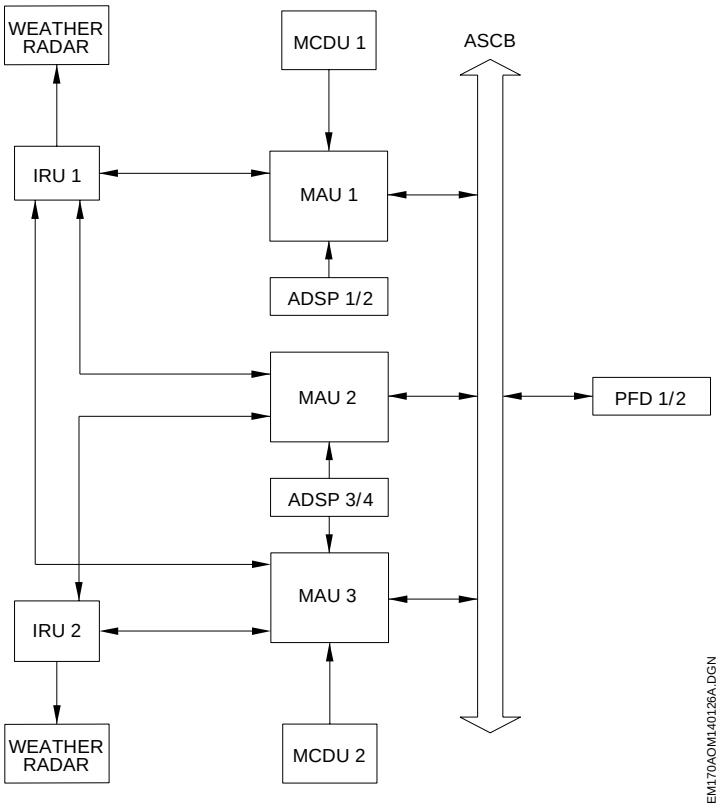
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IRU outputs digital data including the following:

– Primary airplane attitude in pitch and roll;
– Magnetic and true heading;
– Body linear acceleration;
– Body angular rate;
– Inertial velocity;
– Navigation Position;
– Wind Data;
– Calculated data.

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IRS SCHEMATIC

The position can be entered on MCDU as follows:

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– Press NAV button on the MCDU to go to NAV INDEX page 1/2.

NAV INDEX PAGE 1/2:

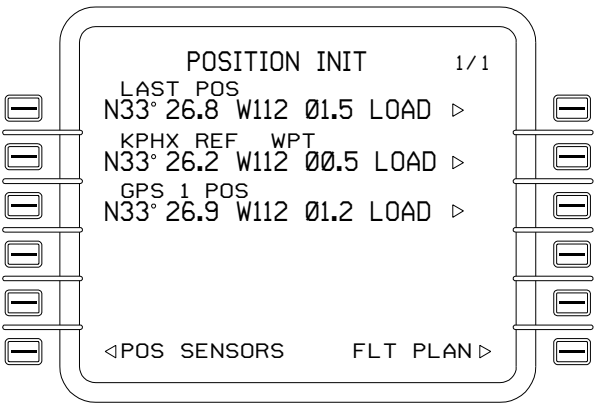
– Press line select key 1L or 4L to go respectively to NAV IDENT or POS SENSORS page 1/1.

NAV IDENT or POS SENSORS page 1/1:

– Press line select key 6R to go to POSITION INIT page 1/1.

POSITION INIT PAGE 1/1:

– The POSITION INIT page will list positions that can be line-selected for initialization of the FMS using the LOAD line select key. Any of the positions listed can be used for the initialization. The pilot may also enter the appropriate latitude/longitude or reference waypoint using the alphanumeric keys and pressing the line select key 2L.



EM170AOM140127.DGN

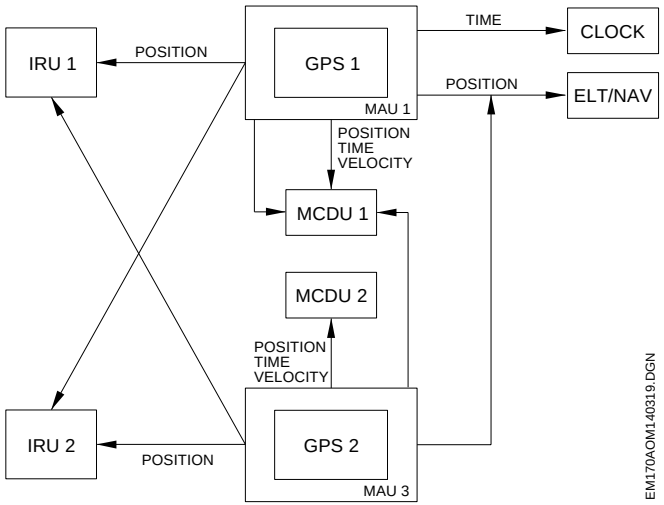
MCDU POSITION INIT PAGE

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GLOBAL POSITIONING SYSTEM (GPS)

The Global Positioning System (GPS) is a satellite navigation sensor, which receives satellite signals from an active antenna in order to compute airplane position, velocity and time.

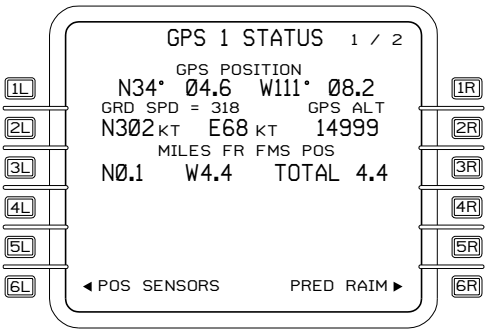
The baseline GPS module is contained within MAU 1, located in the forward fuselage avionics bay. If the optional second GPS is installed, it is contained in MAU 3.



GPS SCHEMATIC

The performance of both GPS system is monitored (GPS 1(2) STATUS 1/2 and 2/2) by selecting the MCDU NAV button and selecting the POS SENSOR pages.

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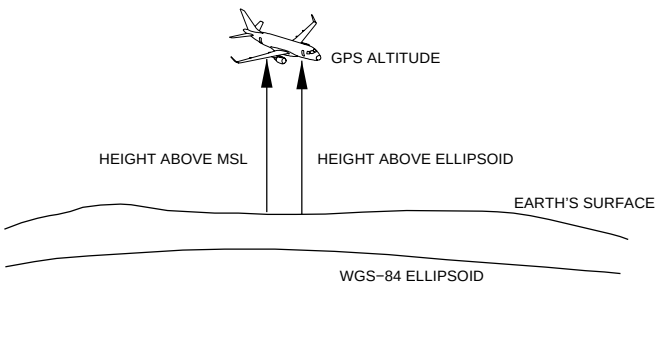


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GPS 1 STATUS PAGE 1/2

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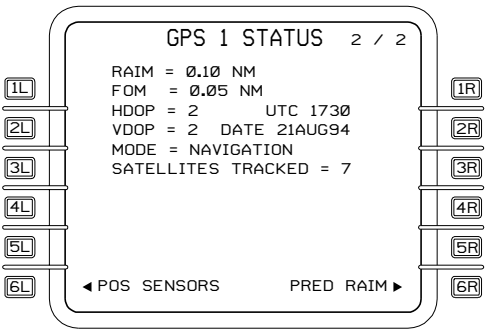
GPS altitude displayed is the World Geodetic System 1984 (WGS–84) height above the ellipsoid (geoid height + height above MSL). The GPS altitude is not relative to pressure altitude but is referenced to an earth–centered earth–fixed (ECEF) coordinate system. Pressure altitude is not relative to the same reference frame, but relative to the standard pressure or local pressure settings. Therefore, significant differences can be seen between GPS altitude and pressure altitude.



GPS ALTITUDE

On GPS 1(2) STATUS PAGE 2/2 is displayed information about receiver autonomous integrity monitor (RAIM), figure of merit (FOM), horizontal dilution of precision (HDOP), vertical dilution of precision (VDOP), time (UTC) and date, operating mode and satellites tracked.

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GPS 1 STATUS PAGE 2/2

RAIM and FOM indicate current uncertainty of position expressed in nautical miles. HDOP and VDOP are numbers that rate current satellite geometry in the horizontal and vertical axis with 1 being the best geometry. Normally, HDOP and VDOP numbers are below 10.

The fifth line displays the operational mode of the GPS. Possible operational modes are displayed as SELF–TEST, INITIALIZATION, ACQUISITION, NAVIGATION, DIFFERENTIAL, ALTITUDE AIDING, VELOCITY AIDING, FAILED. The acquisition mode is used to acquire satellites after power is applied. The GPS tracks four satellites to acquire its position. After being in the navigation mode, altitude aiding is the mode entered when fewer than four satellites are being tracked. In this mode, the GPS uses altitude from the digital air data computer (ADS) to aid in determining position.

NOTE: If the GPS is operated inside a hangar or other areas where signals cannot be received, the GPS can detect this as a failure. In this case, cycling the power is necessary to restart the GPS.

The last line of the GPS STATUS page indicates the number of satellites that are being tracked and used by the GPS.

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Any faults within the GPS module will be reported on the MCDU. The Message (“MSG”) indicator on the PFD will illuminate, and “GPS 1 FAILED” or “GPS 2 FAILED”, as appropriate, will be displayed in the scratchpad area.

RECEIVER AUTONOMOUS INTEGRITY MONITOR (RAIM)

The GPS module executes a RAIM test to insure the integrity of the data transmitted by the satellite. RAIM is a software function that supplies an alert to the cockpit when the integrity limit exceeds a flight phase dependant threshold.

The GPS has RAIM outputs for the current position and time in the form of horizontal and vertical integrity limit (HIL and VIL) at some future place and time.

In order to compute RAIM, the GPS must have a minimum of five satellite signals. The FMS does not accept GPS data unless a valid RAIM figure is available.

The FMS produces an alert for the flight crew on the MCDU when the GPS has lost integrity: “GPS RAIM ABOVE LIMITS”. Also an alert is generated by the FMS when the integrity will exceed the limit: “RAIM WILL EXCEED LIMIT”. A third alert will be generated by the FMS when RAIM is not available: “GPS RAIM UNAVAILABLE”.

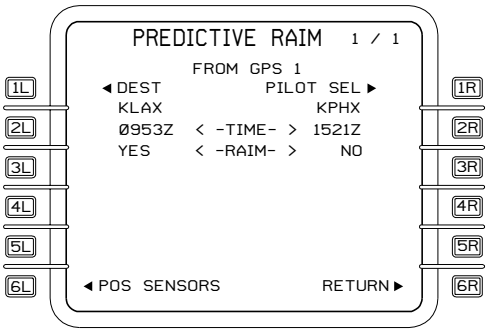
PREDICTIVE RAIM (PRAIM)

The GPS also has a predictive RAIM function that provides the following types of RAIM predictions: Destination and Alternate waypoint (Pilot Select). Predictive RAIM uses an almanac function that is updated whenever the GPS is tracking satellites. Satellites can be manually deselected or enabled for destination and alternate waypoint prediction.

This function calculates whether the satellite geometry is acceptable for approach at the expected destination at the estimated time of arrival (ETA). On ground, in order for an ETA to be computed, the pilot must enter an ETD (ORIGIN/ETD) in line select key 1L on the initial FLT PLAN page.

The predictive RAIM page is accessed by selecting the PRED RAIM prompt from any GPS STATUS page. When selected, the PREDICTIVE RAIM page is displayed. YES indicates RAIM is predicted to be within approach criteria. NO indicates RAIM is predicted to be unacceptable or unavailable.

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PREDICTIVE RAIM PAGE

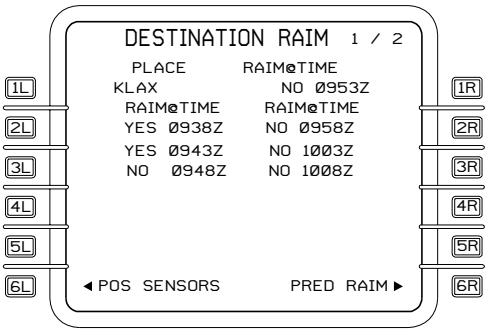
The FMS uses the high priority GPS for predictive RAIM. The priority order for FMS 1 is GPS 1, GPS 2. The priority order for FMS 2 is GPS 2, GPS 1. If only a single GPS is available, both FMSs use it for predictive RAIM.

Should the GPS fail or the interface between the FMS and GPS not work properly, the FMS displays the message PREDICTIVE RAIM UNAVAILABLE on the PREDICTIVE RAIM page.

Predictive RAIM is calculated using GPS almanac information. The almanac within the GPS is automatically updated whenever the GPS is on and tracking satellites. The almanac within the GPS is set invalid if it is older than 3.5 days. Should this occur, the message ALMANAC EXPIRED is displayed on the PREDICTIVE RAIM page. The almanac takes approximately 12–25 minutes to update once the GPS is tracking satellites. RAIM predictions are not possible with an expired almanac.

Selecting the DEST prompt from the PREDICTIVE RAIM page displays DESTINATION RAIM page 1/2.

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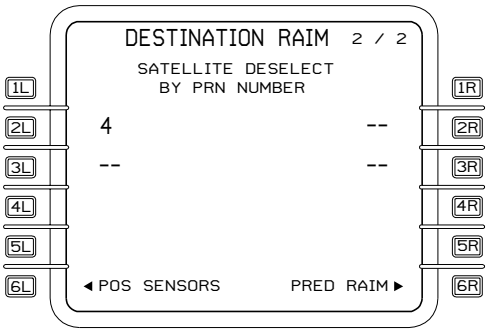


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DESTINATION RAIM PAGE 1/2

DESTINATION RAIM page 2/2 supports satellite deselection. From this page, the pilot selects which GPS satellites are to be excluded from the DESTINATION RAIM predictions. The pilot enters the Pseudo–Random Noise (PRN) code for the satellite that is scheduled to be out of service according to published GPS NOTAMs.

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DESTINATION RAIM PAGE 2/2

The satellite deselection can also be done in the PILOT SELECT RAIM page 2/2.

RADIO NAVIGATION SYSTEM

The radio navigation equipment is located in the Modular Radio Cabinet (MRC).

The interface with the audio is through the audio/microphone bus, and with the MCDU/PFD/MFD through the ASCB. The main components are:

– Very-high-frequency Omni-directional Range (VOR).
– Automatic Direction Finder (ADF).
– Distance Measuring Equipment (DME).
– Instrument Landing System (ILS).
– Transponder System (XPDR).

The MCDU is the primary means for radio tuning (RADIO PAGE and

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PROGRESS PAGE), while the CCD and PFD are the secondary means.

A tuning backup is available in MCDU 2 in case of loss of both MAUs. If the audio bus is lost there are audio backups also.

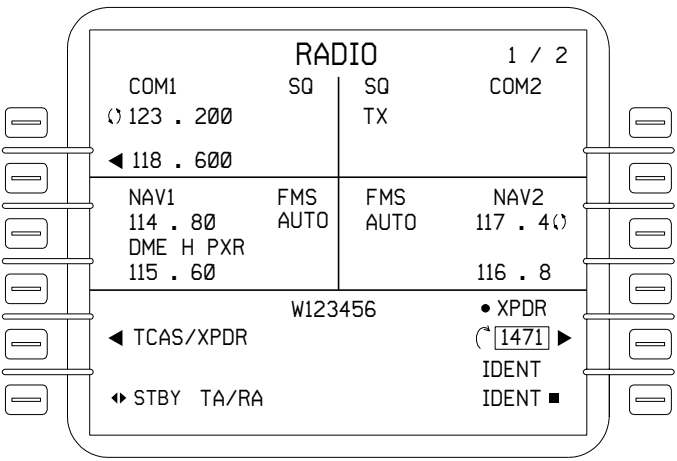
VOR/ILS

RADIO PAGE 1/2:

– The frequency is changed using either the scratchpad or the tuning knob on the MCDU.

– To change a frequency value with the scratchpad, use the keypad to enter the new frequency value, and then push the LSK next to the frequency to be modified. This transfers the value from the scratchpad to the selected frequency.

– To change a frequency value with the MCDU tuning knob, the standby frequency must be boxed prior to pressing the LSK 4L/4R. Tune the frequency with the cursor around the standby frequency and the swap icon displayed, push the LSK to swap the standby and active frequencies.



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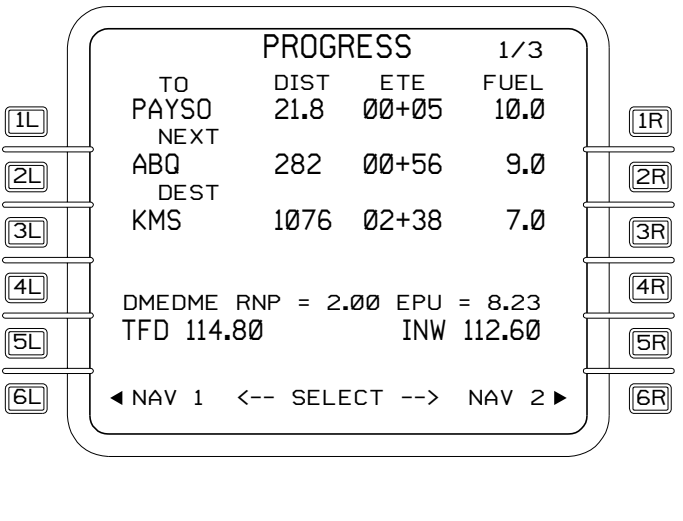
RADIO PAGE 1/2

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PROGRESS PAGE 1/3

– It is possible to tune the NAV radio using either the identifier or the frequency.

– Enter the identifier or the frequency value into the scratchpad and then push the LSK 5L or 5R. The FMS tunes the NAV radio on the PROGRESS PAGE.



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NAV PAGE 1/1:

– Press the respective standby frequency twice if it is not boxed, otherwise press once, to go to NAV page 1.

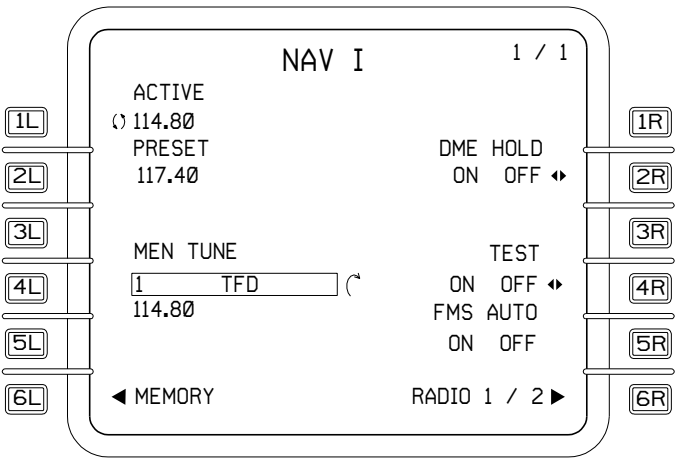
– Pushing LSK 1L swaps the active and preset frequencies (when the cursor is on field 2L).

– On the NAV page is possible to capture a frequency tuned in memory. Press 4L to box the memory tune and use the tuning knob to cycle the stored frequencies. Press the active frequency to capture the selected memory tune.

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– Press LSK 2R to cycle DME hold on or off.

– Press LSK 5R to toggle the FMS autotune feature ON and OFF for the selected VHF NAV radio. Autotune is indicated by the magenta NAV active frequency on the PFD and it can be only selected ON when the primary navigation source is FMS.



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The VOR/ILS frequency selection through the CCD is as follows:

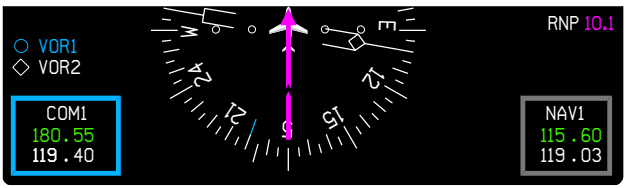
– Select the PFD through the CCD. The left and right format location buttons select respectively pilot's and copilot's PFDs.

– Through the touch pad move the cursor to the navigation frequency window.

– Tune the standby frequency through the tuning knob.

– Activate the standby frequency by pressing the enter key.

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ADF

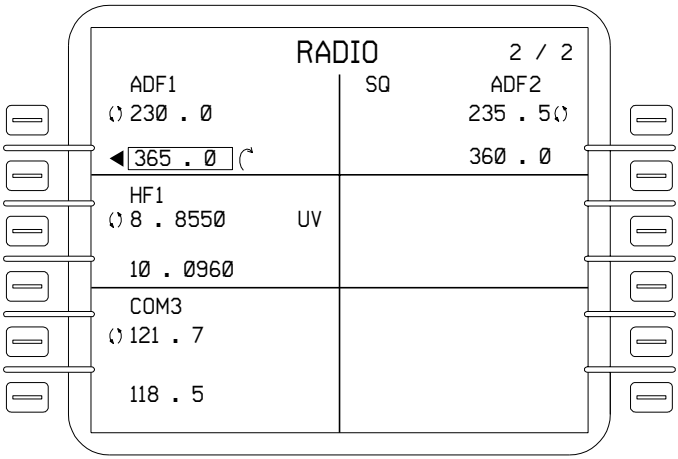
RADIO PAGE 2/2:

The frequency is changed using either the scratchpad or the tuning knob on the MCDU.

To change a frequency value with the scratchpad, use the keypad to enter the new frequency value, and then push the LSK next to the frequency to be modified. This transfers the value from the scratchpad to the selected frequency.

To change a frequency value with the MCDU tuning knob, the standby frequency must be boxed prior to pressing the LSK 4L/4R. Tune the frequency. With the cursor around the standby frequency and the swap icon displayed, push the LSK to swap the standby and active frequencies.

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ADF PAGE 1/1:

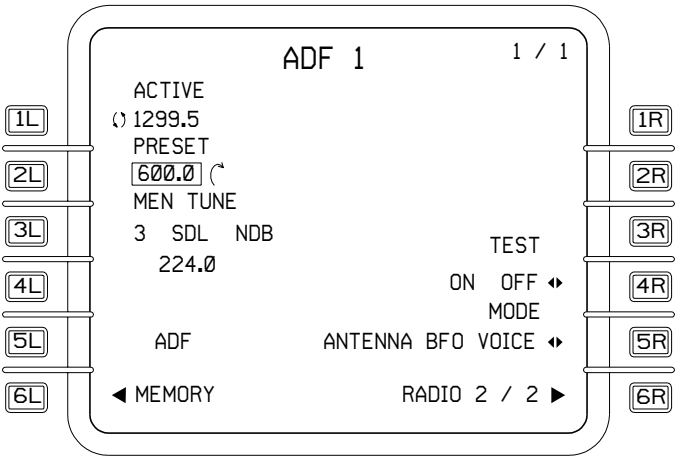
– Press the respective standby frequency twice if it is not boxed, otherwise press once, to go to ADF page 1.

– Pushing LSK 1L swaps the active and preset frequencies (when the cursor is on field 2L).

– On the ADF page is possible to capture a frequency tuned in memory. Press LSK 4L to box the memory tune and use the tuning knob to cycle the stored frequencies. Press the active frequency to capture the selected memory tune.

– Press LSK 5R to cycle ADF mode:
ADF - receives static signal and computes bearing to station.
ANT - receives ADF static signal only.
BFO - adds a beat frequency oscillation for reception of signals.
VOICE - permits voice to be received and transmitted over radio speakers.

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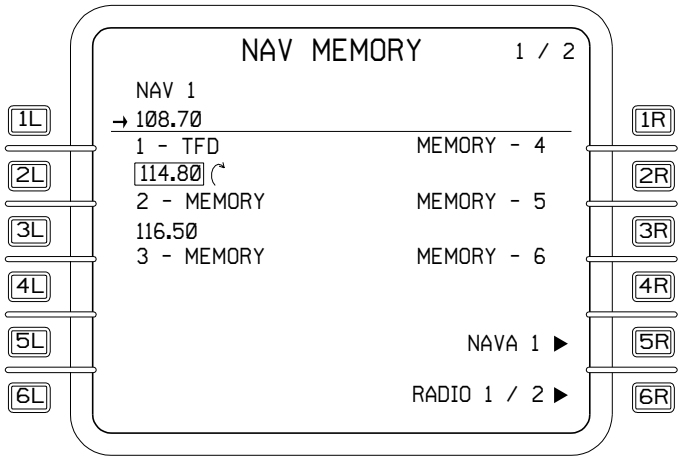


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NAV/ADF MEMORY PAGES:

– On the NAV/ADF MEMORY pages it is possible to capture a frequency tuned in memory or store a frequency/identification. To capture a frequency press the respective memory frequency to box it and press 1L to activate the frequency. To store a frequency or its identification use the alphanumeric keys and press the respective memory line select key. Additionally the frequency can also be stored pressing the receptive memory line select key and rotating the tuning knob.

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TRANSPONDER

The transponders are located in the Modular Radio Cabinet (MRC). Each transponder provides conventional ATC functions. The dual Mode S XPDR system enables secondary surveillance by transmission of airplane identification information, altitude (barometric) and coded message data to ATC ground stations and TCAS installations on other airplane.

The transponder code is entered/activated through the MCDU. A tuning backup is available in MCDU 2 in case of loss of both MAUs.

The transponder receives altitude information from the ADS. Flight ID information is provided by the FMS, or it can be entered by the pilot. The XPDR also receives the ICAO address programmed into the airplane personality module (APM) and the pilot enters the squawk code.

For Airplanes Post-Mod. SB 170-34-0017 or equipped with an equivalent modification factory incorporated, the installed Transponder Mode S Enhanced Surveillance system satisfies the data requirements of ICAO Doc 7030/4, Regional Supplementary Procedures for SSR Mode S

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Enhanced Surveillance in designated European airspace.

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

The following table presents the XPDR and TCAS modes of operation:

MODE	XPDR	TCAS
STANDBY	The XPDR system is energized but does not transmit the altitude data.	Disabled.
ALT-OFF	The XPDR system transmits the reply in mode A and mode S, but it does not transmit the altitude data.	Disabled.
ALT-ON	The XPDR system transmits the reply in mode A, mode C and mode S, and transmits the altitude data.	Disabled.
TA	The XPDR system transmits the reply in mode A, mode C and mode S, and transmits the altitude data.	The TCAS is in the TA (Traffic Advisory) mode.
TA/RA	The XPDR system transmits the reply in mode A, mode C and mode S, and transmits the altitude data.	The TCAS is in the TA/RA (Resolution Advisory) mode.

On ground, and in any mode except Standby, the XPDR only replies to discretely addressed mode S interrogations. The replies in mode A and mode C will occur when the airplane is airborne and the XPDR/TCAS mode is not set to Standby or ALT-OFF.

The flight crew may enter the transponder code on the MCDU as follows:

– Press radio button on the MCDU to go to RADIO page 1/2.

RADIO PAGE 1/2:

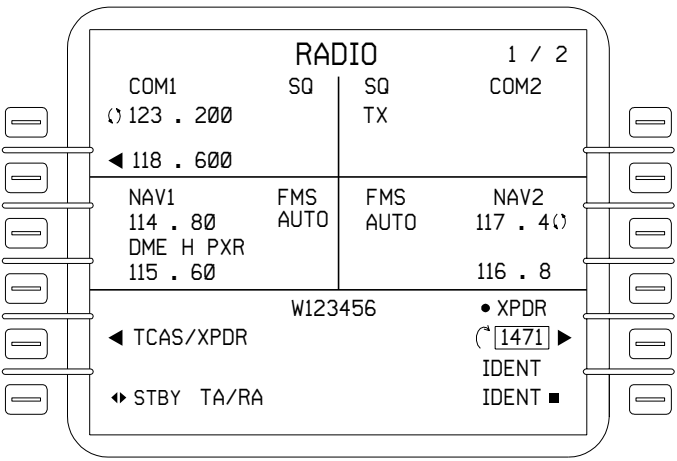
– On RADIO page 1/2 it is possible to enter the transponder code. The entering can be accomplished using the tuning knob or the numeric buttons. If the tuning knob will be used the transponder field must be boxed prior to pressing its respective line select key. In case of the numeric keys, enter the transponder code and press the respective line select key.

– Press LSK 5L to go to TCAS/XPDR page 1/2.

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– Press LSK 6L to alternately select STBY or the selected active mode. The active mode can be set on TCAS/XPDR page 2/2.

– Press LSK 6R to select identification mode.



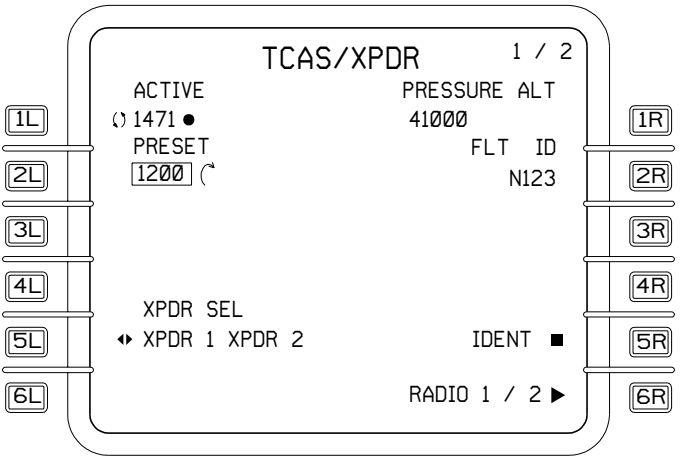
TCAS/XPDR PAGE 1/2:

– On TCAS/XPDR page 1/2 is possible to enter and activate the transponder code. The entering can be accomplish using the tuning knob or the numeric buttons. If the tuning knob will be used, the standby code must be boxed prior to pressing its respective line select key. In case of the numeric keys use, enter the standby code and press the respective line select key. To activate the standby code, press the respective active code.

– Press LSK 5L to cycle the transponder selection 1 or 2.

– Press NEXT button to go to TCAS/XPDR page 2/2.

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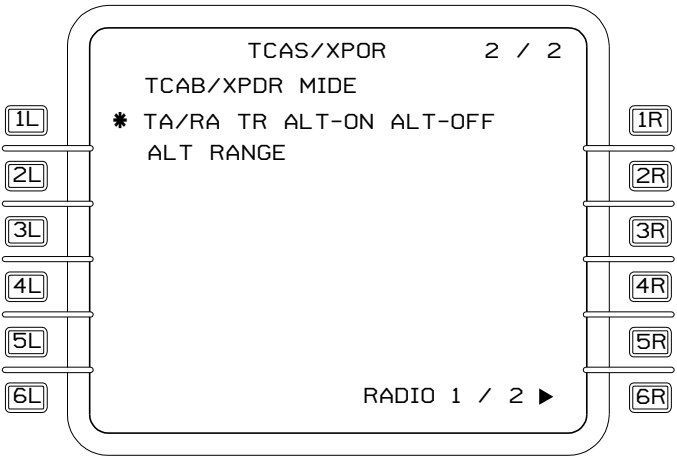


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TCAS/XPDR PAGE 2/2:

– Press LSK 1L to cycle the transponder mode:
  TA/RA.
  TA.
  ALT-ON.
  ALT-OFF.

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MISSED APPROACH PREVIEW

The MFDs MAP menu has the option to select the preview of the Missed Approach procedure on the MFD. The presentation is in cyan and follows the flight plan sequence.

WEATHER RADAR SYSTEM

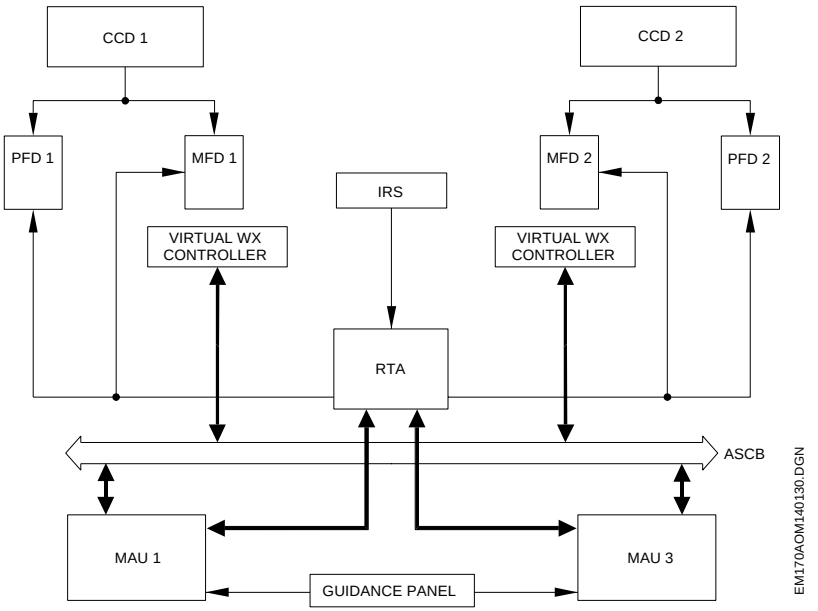
The airplane can be equipped with WU-660 or WU-880 weather radar system models. The system is designed primarily for detection and analysis of the weather during flight and for ground mapping. The MFD handles the display of radar data and, in addition provides virtual controllers for weather radar control. Weather data is displayed on both MFDs, as well as on the PFDs.

When operating in ground mapping prominent landmarks are displayed which allow identification of coastlines, hilly or mountainous regions, cities or even, large structures.

The weather radar system consists of an integrated Receiver Transmitter

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Antenna unit (RTA) and two virtual weather radar controllers. The RTA is mounted in the nose of the airplane, whereas the virtual controllers consist of the CCDs and the weather mode information displayed on the MFDs below the weather information.



WEATHER RADAR SCHEMATIC

Display of weather data is available on the MFDs and PFDs. Selection of weather data display is accomplished via CCD actuating in the MFD using a soft key to select MAP menu. This act will enable weather information and virtual controller on the MFD.

Five modes and ten functions are available. Each one will be discussed in the following sections.

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WX RADAR MODES

RADAR WEATHER DETECTION MODE (WX)

The WX mode is used to detect areas of severe weather. This will allow the pilots to avoid areas of dangerous weather conditions and possible turbulence. If WX is selected before the initial RTA warm-up period is over (approximately 90s), WAIT is displayed in the mode field. In the wait mode, the transmitter and antenna scan are inhibited.

GROUND MAPPING MODE (GMAP)

This mode is used to alert the flight crew about hazards caused by ground targets. This is especially useful in areas of rapidly changing terrain, such as hilly mountainous areas.

The selection of preset gain will generally provide the desired mapping display, however the gain can also be manually operated. It is possible to have one pilot working the GMAP while the other is using the WX mode.

It is not intended to be used or relied for ground proximity warning.

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STANDBY (STBY)/FORCED STANDBY (FSBY) MODE

The weather radar remains in a ready state, with the antenna scan motionless and stowed in a tilt-up position. In addition, the transmitter is inhibited and the display memory is erased.

The following table shows the RTA modes for each WX radar configuration:

LEFT CONTROLLER	RIGHT CONTROLLER	LEFT SIDE	RIGHT SIDE	RTA MODE
OFF	OFF	OFF	OFF	OFF
OFF	Standby	Slave Standby	Standby	Standby
Standby	OFF	Standby	Slave Standby	Standby
OFF	ON	Slave ON	ON	ON
ON	OFF	ON	Slave ON	ON
Standby	ON	Standby	ON	ON
ON	Standby	ON	Standby	ON
ON	ON	ON	ON	ON
Standby	Standby	Standby	Standby	Standby

FSBY is displayed when the airplane is on the ground. The RTA is in forced standby mode when the airplane is on the ground, the transmitter and antenna scan are both inhibited, display memory is erased, and FSBY is displayed in the mode field. Overriding the forced standby requires that both pilots select the FSBY OVRD menu item on the respective weather controllers or one pilot selects the Antenna Stabilization checkbox (STAB OFF) 4 times in less than 3 seconds enabling the WX mode on ground.

OFF MODE

Turns the radar off, provided OFF is selected on both virtual controllers. The system is no longer radiating power and the antenna is stowed.

SLAVE MODE

One controller is in OFF position whereas the other controller is in an operating mode. The operating one is in control of both sweeps.

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TURBULENCE DETECTION (TURB) FUNCTION

The radar processes return signals in order to determine if a turbulence signature is present. Areas of moderate, severe, or extreme turbulence are displayed in soft white. TURB may only be engaged in the WX mode and at selected ranges of 50 NM or less.

NOTE: – It may occur that the Turbulence function annunciation in MFD and PFD to remain displayed for ranges above 50 NM even though the function is deactivated.
– Range selections of 200 NM or greater always clear Turbulence function annunciation.

ANTENNA STABILIZATION FUNCTION

The antenna is stabilized in pitch and roll using attitude information from the IRU. Momentarily selecting the STAB OFF checkbox disables antenna stabilization and causes an amber STAB to be displayed.

RECEIVER GAIN (GAIN) FUNCTION

The GAIN control varies the RTA receiver gain. There are two modes: variable and calibrated. The normal preset is calibrated mode and is used for weather avoidance. The system will be forced into calibrated gain when RCT or TGT are selected. The variable mode is useful for additional weather analysis and for ground mapping. In WX mode, variable gain can increase receiver sensitivity over the calibrated level to show weak targets or it can be reduced below the calibrated level to eliminate weak returns.

RANGE FUNCTION

The range can be manually set (CCD) to a desirable value (10 NM, 25 NM, 50 NM, 100 NM, 200 NM, 300 NM). The label OVRG is shown whenever the Map range is greater than 300 NM.

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TARGET ALERT (TGT) FUNCTION

The TGT function monitors for weather beyond the selected range and 7.5° on each side of the airplane heading. If such weather is detected within the monitored heading, outside the selected range until a range of 200 NM , the TGT annunciation changes from a green-armed condition to an amber alert condition on the MFD.

This annunciation advises the flight crew that potentially hazardous weather lies directly in front and outside of the selected range. When this warning is received, the flight crew should select longer ranges to view the questionable target. Note that TGT is inactive when hazards are within the selected range.

Selecting the TGT function forces the system to preset gain and turns off variable gain mode. Selections of ranges of 200 NM or greater automatically turns off TGT function and allows variable gain mode. It can only be selected in the WX mode.

NOTE: – The TGT annunciation on MFD may occur when the range is increased to 200 NM or greater, even though the function is deactivated.
– In such cases, system logic follows the TGT function annunciation, and gain is automatically preset.
– Selection of 1000 NM range always clears TGT annunciation.

SECTOR SCAN (SECT) FUNCTION

The normal radar sweep is ± 60 degrees from the airplane nose, at a rate of 12 sweeps per minute. Selecting the SECT pushbutton reduces the angle of sweep to ± 30 degrees and increases the sweep rate to 24 sweeps per minute.

TILT FUNCTION

The inner knob on the CCD provides tilt control giving the pilot manual control of the antenna tilt angle. The CCD inner knob is a dedicated tilt knob if VAR Gain is not active. Tilt can be varied between 15 degrees up (clockwise rotation) and 15 degrees down (counterclockwise rotation).

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ALTITUDE COMPENSATED TILT (ACT) FUNCTION

Automatically adjusts the antenna tilt according to the altitude and selected range. The TILT knob can be used for fixed offset corrections of up to 2.0 degrees.

RAIN ECHO ATTENUATION COMPENSATION TECHNIQUE (REACT) FUNCTION

Used in WX mode to compensate for attenuation of the radar signal as it passes through a storm. It does this by increasing the gain of the receiver as weather is detected.

The cyan field indicates areas where further compensation is not possible. This is a warning indicating that attenuation is hiding possible severe weather and should be considered dangerous.

The REACT compensation is active in all modes except GMAP mode.

The REACT compensation can be active in all modes except GMAP mode.

TEST FUNCTION

The test function is selected on MCDU avionics test page. The test is used to select a special test pattern to allow verification of system operation. If fault codes are detected they will be displayed at the same location where tilt angle is displayed in the Weather mode field.

NOTE: Output power is radiated in test mode, unless the WX radar is in FSBY mode.

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FLIGHT MANAGEMENT SYSTEM

The Flight Management System (FMS) manages navigation sensors to produce the airplane position. The system provides data for the cockpit displays and flight control system. The FMS serves as aid to flight planning, navigation, performance, database and redundancy management. The system may be installed in a single or dual configuration.

For additional information on functions and operation, refer to the manufacturer's manual.

For additional information on limitations, refer to the Supplemental Flight Management System Limitations of this manual (Chapter 2).

The FMS 1 and 2 reside respectively in MAU 2 and MAU 3.

The FMS interfaces with the followings systems and equipment:

- GPS: the FMS uses inputs from the GPS to calculate airplane position and perform navigation functions.
- IRS: the FMS uses inputs from the IRS to obtain airplane position and perform navigation functions.
- MFD and PFD: the FMS provides data for display navigation guidance on the PFD and navigation map data on the MFD.
- VOR/DME: the FMS uses inputs from the VOR/DME to perform navigation functions.
- MCDU: the Multifunction Control Display Unit, located on the control pedestal, provides control functions management and operating modes for proper FMS operation. It is the interface between the FMS and the flight crew.

FLIGHT PLANNING

In general, flight plans may be divided in four categories: active, stored, lateral or vertical.

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ACTIVE FLIGHT PLAN

This is the flight plan currently being flown. The active flight plan can be entered waypoint by waypoint, loaded from an external source, or recalled from storage.

At a minimum, active flight plans must contain a “FROM” waypoint (possibly the origin), a “TO” waypoint, and a destination. A flight plan is considered “closed” when the last waypoint is the destination.

STORED FLIGHT PLAN

The flight plan is stored when it is saved in the computer’s memory and can be recalled later and become an active flight plan. When entering a flight plan to store, the flight plan must have an origin and destination waypoint, and both must be database waypoints.

When recalling a flight plan, entering the name of the flight plan results in the flight plan becoming active. If the name of the flight plan can not be found, the flight crew can enter the origin and destination. If any are found, the FLIGHT PLN LIST page is displayed to allow selection of a flight plan.

LATERAL FLIGHT PLAN

The lateral flight plan begins at the origin. The default origin in the active flight plan is the nearest airport to the present aircraft position that is within three miles, but it may be changed by the flight crew. The flight plan ends at the destination, which must be entered by the pilot as there is no default destination. The flight plan is built by inserting waypoints or strings of waypoints between the origin and destination. Examples of strings of waypoints are standard instrument departure procedures (SIDs), airways, standard terminal arrival procedures (STARs), and approach transitions.

VERTICAL FLIGHT PLAN

Vertical navigation (VNAV) is a FMS function that calculates a vertical profile, based on performance initialization data, and defines vertical modes to the FGCS.

Once the FMS has generated a vertical profile, VNAV information can be accessed any time via PROG < PROGRESS 2/3 < VNAV DATA. Moreover, FMS VNAV sends inputs for display on the PFD and MFD.

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GENERAL RULES FOR VNAV OPERATION

– In order to use the VNAV function, the FMS Performance Initialization must be completed and confirmed.

– VNAV never exceeds the set altitude in the Altitude Selector.

– The airplane climbs whenever the FMS VNAV is in the climb phase, and the altitude set in the Altitude Selector is above the present airplane altitude.

– The airplane descends whenever the FMS VNAV is in the descent phase and the altitude set in the Altitude Selector is below the present airplane altitude.

– A Vertical Track Alert (VTA) is issued 60 seconds before the FMS commands a climb or a descent, or 1000 ft before the level off altitude. There is no VTA if leveling-off is based on the altitude set in the Altitude Selector.

– VNAV, whenever existing constraints allows it, defines constant climb or descent paths.

NORMAL OPERATION

Climb: VNAV performs all climb profiles contained in the VFLCH mode. If the FMS levels-off at an altitude constraint defined over a waypoint, it resumes the climb automatically upon sequencing the waypoint. If the FMS levels-off at an altitude set on the Altitude Pre Selector, after setting the Altitude Pre Selector to a higher altitude, the FLCH button must be pressed on the guidance panel in order for the VNAV to transition from VALT to VFLCH.

Cruise: The FMS will transition to cruise phase when reaching the initial cruise altitude set in the PERF INIT page. If the airplane levels at an altitude lower than the initial cruise altitude, the FMS does not transition to cruise.

If the ALT SEL is set to an altitude higher than the FMS cruise altitude, after few seconds, the cruise altitude in the PERF INIT page is reset to match with the ALT SEL selection.

NOTE: To reset the FMS cruise altitude to an altitude lower than the current FMS cruise altitude, it may be necessary to delete the current cruise altitude in the FMS CRUISE PAGE 1/1 prior to insert the new altitude.

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To leave cruise level to either climb or descent, the altitude selector must be set to an altitude higher or lower than the present altitude and a vertical DIRECT-TO or VFLCH must be commanded.

When TCS is used to exit a leveled altitude, the command logic is to return to the original altitude when the change is less than 50 ft. For changes greater than 50 ft, the new achieved altitude is maintained.

TOD: The Top of Descent is calculated using the values inserted in the PERF INIT page and is displayed in the VNAV page and on the PFD/MFD.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

The DES NOW prompt is displayed on the FMS DESCENT, FLIGHT PLAN and ROUTE pages providing an easy command to start the descent when the airplane is 50 NM or less from the calculated TOD.

When selected, the Flight Director commands the airplane to descent according to the airplane position relative to the predicted TOD.

– Early Descent: selecting the DES NOW prompt before the TOD is reached enables the Early Descent mode, where the FD commands a 1000 FPM descent up to the point where the planned descent path or the next altitude constraint is intercepted.

– Late Descent: selecting the DES NOW prompt after the planned TOD is reached enables the Late Descent mode, where the FD commands a descent angle 1.5° steeper than the planned descent angle to intercept the planned path.

NOTE: If this descent angle is not enough to intercept the previously planned path a UNABLE PATH INTERCEPT scratchpad message is displayed.

◄

Descent: One minute prior to the TOD, a vertical track alert is given. When reaching the TOD, the FMS automatically starts the descent in VFLCH or VPATH if the altitude selector is set to a lower altitude.

– VFLCH Descents – The descent is in VFLCH mode if there is no altitude constraint down to 1500 ft/10 NM prior to the destination airport. VFLCH also complies with the speed/altitude limit. After an intermediate level-off at the altitude selector altitude, the next descent must be initiated selecting the altitude selector to a lower altitude and pressing FLCH on the GP.

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– VPATH Descents – The descent is in VPATH anytime an altitude constraint exists in the descent path and the airplane is within the capture logic of VPATH mode. FMS must be the navigation source and LNAV must be engaged in order the VPATH to become available. When the FMS passes through the last altitude constraint waypoint, it reverts to VFLCH to complete the descent.
  During VPATH descents, significant modifications of the flight plan may result the VPATH mode to drop to FPA mode.

Vertical DIRECT-TO: This operation is similar to the lateral DIRECT-TO. It is performed selecting the desired altitude from the scratch pad to the line adjacent to the desired waypoint.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

The FMS calculates the predicted altitudes at which the airplane should pass the waypoints and then applies the altitude constraints to these altitudes, if necessary.

◄

VNAV and HOLDING PATTERNS: The following applies:

– If descending on VFLCH and a holding pattern is entered, the active mode remains VFLCH;

– If a PPOS holding is entered while in VPATH, the active mode changes to VFLCH;

– If a hold is entered while in VPATH descent, the command changes to VALT.

FMS SPEED PLAN

FMS Speed Plan is a function that calculates speeds for a specified navigation based on performance initialization data, and sends speed targets to the FGCS.

Once the performance is initialized and confirmed, FMS speeds can be accessed in the ACTIVE FLT PLAN pages.

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SPEED COMMAND FLIGHT PHASES

In order to perform the speed calculations and to define the FGCS targets in automatic mode, the FMS divides the flight in flight phases as follows:

Takeoff: The FMS speed control does not provide guidance while in the Take Off mode. However, it sends inputs to the PFD to show the V2, until V2 is reached, then it ramps to V2 + 10 kt until the vertical mode is changed.

Departure: Speed command is the one selected on the DEP/APP speeds page. The default departure speed is 200 kt for 4 NM below 2500 ft.

Climb: Following departure, the command is the speed restriction set on the PERF INIT page 3/3. The default limit is 250 kt below 10000 ft. After clearing the limitation, the FMS commands the lower value between MACH or CAS set on the climb schedule. The default climb schedule is 280 kt/0.73 M. During step climbs the FMS commands climb speed schedule if the difference between the current and the intended level is more than 5000 ft, otherwise it remains in cruise speed schedule.

Cruise: When in VALT or ALT and the present altitude is equal to the cruise altitude selected on the PERF INIT, the speed command is the cruise schedule selected. If the airplane levels-off at an altitude lower than the Initial Cruise altitude, the speed command continues on the climb schedule.

Descent: The default descent speed schedule is 290 kt/0.76 M/3.0°. During step descents, the descent speed schedule will be the default speed commanded by the FMS. After level off FMS commands cruise speed schedule if the aircraft is before 50 NM from the TOD or descend speed schedule if it is within this range. Approaching the set limitation in the Speed/Altitude limit of the PERF INIT page 3/3, the FMS commands a speed reduction to comply with any existing the speed constraint.

Approach: The transition to approach speeds is at 15 flight plan nautical miles from the destination or 5 NM from the first approach fix. This selection is made on the DEP/APP speeds pages.
When the flaps are set to position 1, the FMS commands speeds for the next flap. These speeds are calculated by the FMS for the actual airplane weight.

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►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

The approach speed limit activation logic considers the distance to destination airport and altitude AGL (default values are 15.0 NM and 3000 ft AGL).

◄

Go-around – When the flight director is set to G/A the FMS speeds schedule changes for go-around as defined in the PERF INIT.
If a new approach is set while in go-around speed schedule the FMS reverts to approach speeds.
While in go-around, if a new destination is set, the FMS transitions to climb schedule speeds.

Waypoint Speed Constraints – If a speed is set in a flight plan waypoint, the FMS guides the AFCS to comply with this speed.
During a climb, the FMS commands the speed set in the speed constraint waypoint for all previous waypoints. After passing the speed constraint waypoint, the FMS reverts to the speed schedule set in the initialization up to the TOC.
During cruise and descent, the FMS commands the AFCS to cross the waypoint at the selected speed and applies this speed for the subsequent waypoints.

DATA BASE

The FMS has three databases in its memory, a navigation database, a custom database, and an aircraft database.

NAVIGATION DATABASE

This database contains data on NAVAIDS, airports and airways. The information in the navigation database is updated every 28 days. The database contains two consecutive effectively cycles, and the correct database may be automatically or manually selected. Automatic selection occurs upon entry of a valid date. Dates are valid if they are greater than or equal to the expiration date of the current cycle.

CUSTOM DATABASE

The custom database contains information entered by the pilot. This is where the pilot can create and store flight plans and waypoints. This database is not updated on a scheduled basis.

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AIRCRAFT DATABASE

The airplane database contains all airplane-specific performance parameters. The performance learning function within the FMS, known as SmartPerf, has the ability to “learn” performance characteristics based on information gathered on previous flights. This performance learning requires no pilot action. Therefore, all performance data (learned and fixed) is contained in the file.

FUNCTIONS

PERFORMANCE (PERF)

This function gives access to performance related pages including performance initialization, climb, cruise, descent, wind, fuel management and takeoff and landing data. In addition, permits the initialization of stored flight plans and execute performance computations.

NAVIGATION (NAV)

This function gives access to Index providing access to position sensor data, stored flight plans, FIX INFO, selection of waypoints and maintenance pages. In addition, in this page is possible to perform data loading using a remote terminal or DMU.

FLIGHT PLAN (FPL)

This function Provides flight plan data for each leg in the planned (active) flight plan, including course, distance and FPA/altitude constraints. It is also possible to create a flight plan, select a stored flight plan and loading of a flight plan from a disk.

PROGRESS (PROG)

This function summarizes important dynamic flight parameters and the airplane relationship with the active flight plan, such as Estimated Time Enroute (ETE), distance to go, fuel information, current NAV mode, number of long range NAVs used, NAVAIDS that are presently tuned, FMS navigation mode, closest NAVAIDS, and air data information (current speed, altitude and temperature).

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COMPANY ROUTE (RTE)

Route planning allows a quicker flight planning by the pilot. It can be performed either by selecting a company route from the database or by entering flight plan legs and procedures using Air Traffic Control (ATC) language, saving time during the preflight phase. This function displays the active route with origin, destination, runway and company route identifier information.

FMS ANNUNCIATORS

Annunciators are displayed on the electronic display system (EDS). Magenta indicates an advisory annunciator and amber indicates an alerting annunciators.

– Dead Reckoning (DR) - DR is an alerting (amber) annunciator. This annunciator is displayed or lit when operating in the DR mode. The FMS enters DR mode after loss of required navigation performance (see DGRAD) and loss of radio updating and all other position sensors (IRS and GPS) for greater than 2 minutes.

– Degraded (DGRAD) - DGRAD is an alerting (amber) annunciator. This annunciator is displayed or lit when the FMS loses required navigation performance (RNP). This is accompanied by the UNABLE RNP scratchpad message.
  The DGRAD annunciator is displayed on the HSI and LNAV display when FMS is the selected airplane navigation source on EDS and any of the following conditions exist:

  – FMS EPU is greater than RNP.

  – FMS position integrity estimate is greater than the integrity alarm limit (this can occur when EPU is slightly less than RNP).

  – GPS is not available and GPS is required for the selected flight plan procedure.

If the DR annunciator is displayed or lit when the DGRAD annunciator is displayed or lit, the DGRAD annunciator is removed or turned off.

– Message (MSG) - MSG is an alerting (amber) annunciator. This annunciator is displayed when a message is shown in the MCDU scratchpad. The annunciator is removed or turned off after the message(s) has been cleared from the scratchpad.

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Messages are displayed in the MCDU scratchpad at various times. They inform or alert the pilot as to system status. Messages are divided into the following two major groups:

– ADVISORY MESSAGES - Advisory messages are usually the result of a pilot action on the MCDU (e.g., making an entry with the incorrect format). These messages do not turn on The MSG annunciator.

– ALERTING MESSAGES - Alerting messages alert the pilot to the FMS status, assuming the pilot is not looking at the MCDU (e.g., a message annunciating a sensor failure).

Messages are stacked for display in priority order on a first in, last out basis. In cases where there are multiple messages stacked, the message annunciator remains displayed or lit until all messages are cleared. Only one message can be cleared per CLR key push.

– Approach (APPR) - APPR is an advisory (magenta) annunciator. The annunciator indicates the FMS is in the approach mode of operation. In this mode, the EDS deviation sensitivity and FMS tracking gains are increased. The approach annunciator is displayed if ALL of the following conditions are valid:

  – The FMS is the selected airplane navigation source on EDS.

  – A non–precision instrument approach must have been activated from the navigation database. If no approach, or an ILS, LOC, LOC-BC, LDA), simplified directional facility (SDF), or MLS approach is selected, the APPR annunciator does not light.

  – The airplane position is between 2 NM outside the final approach fix (FAF) and the missed approach point (MAP).

  – The DGRAD annunciator must be removed or turned off.

  – When the approach requires the use of GPS, GPS navigation mode must be valid.

– Terminal (TERM) - TERM is an advisory (Magenta) annunciator. TERM indicates the FMS is in the terminal area and that required navigation accuracy has increased.

– Lateral Track Alert (WPT) - WPT is an advisory (magenta) annunciator. FMS gives a WPT 30 seconds prior to sequencing a waypoint.

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– Vertical Track Alert (VTA) - VTA is an advisory (magenta) annunciator. A vertical track annunciation is given to warn of an impending FMS vertical track command change.
  A VTA is issued for the following conditions:
  – The airplane is within 1000 ft of capturing an altitude constraint that is not collocated with the altitude preselect.
  – In CRUISE, one minute prior to TOD.
  – One minute prior to resuming a climb or descent from a constrained waypoint.
  – Prior to resuming a vertical flight level change (VFLCH) descent due to a speed limit altitude level-off.
  – In CRUISE, one minute prior to executing a step Climb. The VTA is also issued as an audible annunciation.
– Lateral Offset (OFFSET) - OFFSET is an advisory (magenta) annunciator. FMS gives the capability to define and fly a parallel offset of up to 30 NM on any TF or CF leg that is not included in a SID, STAR, Approach or Hold. A parallel offset can also be flown to a DF leg following the final turn.
– Altitude Alert - The altitude alert generated by the FMS is used by EDS in a fashion similar to that used to alert the flight crew of the impending altitude preselect target (i.e., amber speed tape display).
– Required Navigation Performance (RNP) - RNP is an advisory (magenta) annunciator.

The APRCH annunciator must turn on 2 NM before the final approach fix. It remains lit for the remainder of the approach. This is a positive cue to the flight crew that the sensor configurations is correct and sensor integrity is within limits for the approach. The approach annunciator is not lit during localizer based approaches since the FMS is not authorized to be coupled during localizer approaches. The DGRAD annunciator must be off throughout the approach. If DGRAD annunciator turns on, the FMS should not be used for the remainder of the approach. The flight crew can continue the approach using raw data or perform the missed approach procedure.

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PREFLIGHT

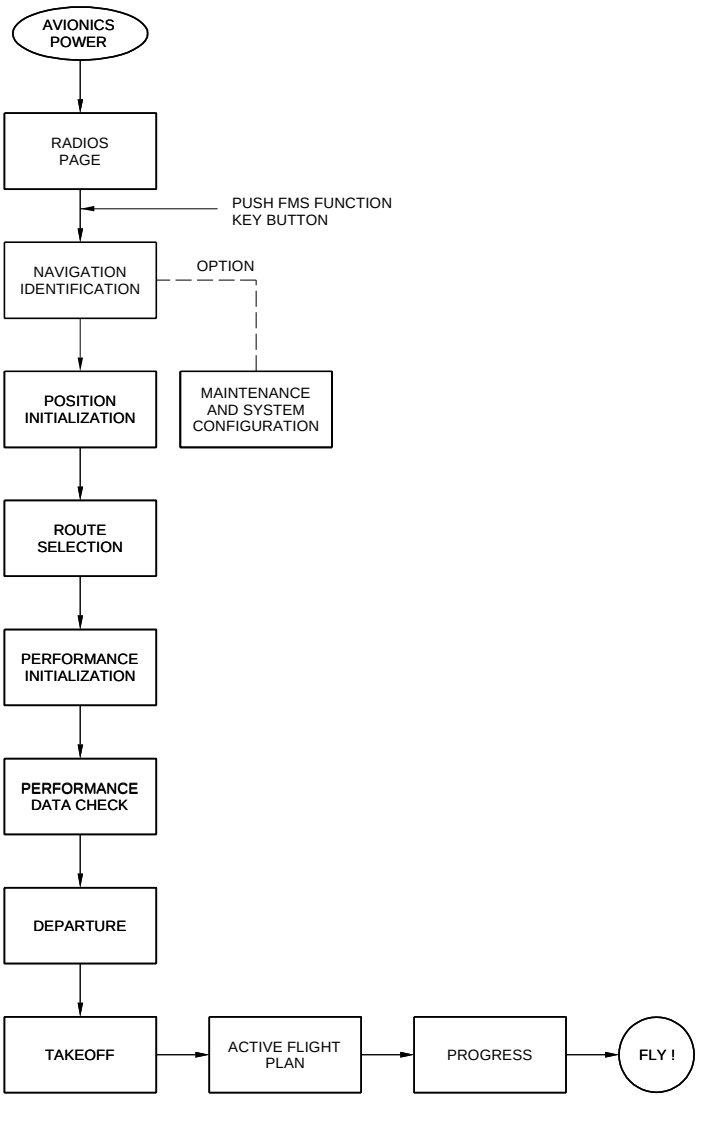
A preflight procedure for a normal flight can be accomplished on the ground with the following steps:

– Radios page.
– Navigation identification.
– Position initialization.
– Route selection.
– Departure.
– Performance initialization.
– Performance data check.
– Takeoff.
– Preflight status verification.

In order to clarify the steps required in the preflight procedure a navigation example is considered.

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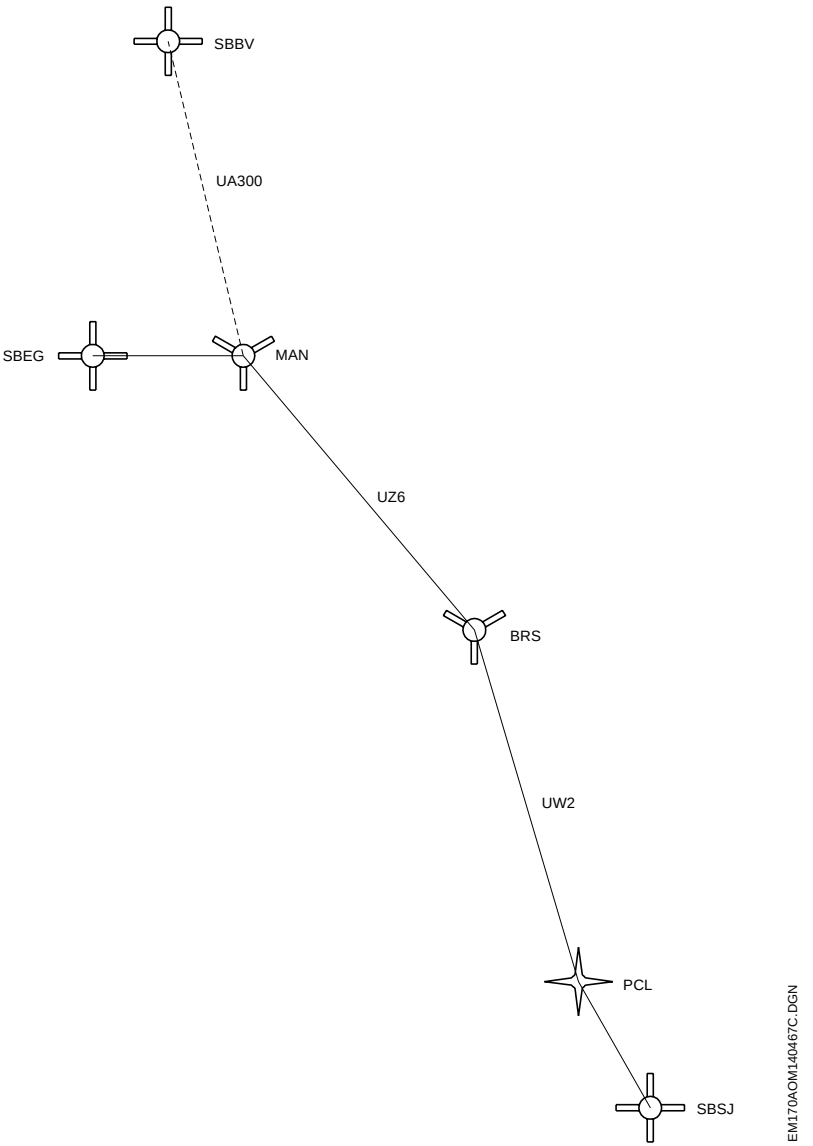
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PREFLIGHT FLOW CHART

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NAVIGATION EXAMPLE

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NAVIGATION IDENTIFICATION AND POSITION INITIALIZATION

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1 - After power up the RADIO page will be displayed as default. Press NAV button to enter the NAV IDENT 1/1 page.

2 - On NAV IDENT 1/1 page the following items must be checked:

- Date and time: This data comes from the GPS. If the GPS is failed or the data is not valid, date and time can be changed.
- Navigation data base: Active data base and alternate period dates.
- Worldwide coverage.

Press LSK 6L (MAINTENANCE) to go to FMS MAINTENANCE 1/3 page. Check if active mode is dual. In case of not operating in dual mode the navigation must be entered in both MCDUs.

3 - Press LSK 6R (NAV IDENT) to go back to NAV IDENT 1/1 page.

4 - On NAV IDENT 1/1 page press LSK 6R (POS INIT).

5 - The POSITION INIT 1/1 page presents a maximum of 3 options to be loaded as initial position pressing respectively 1R, 2R or 3R:

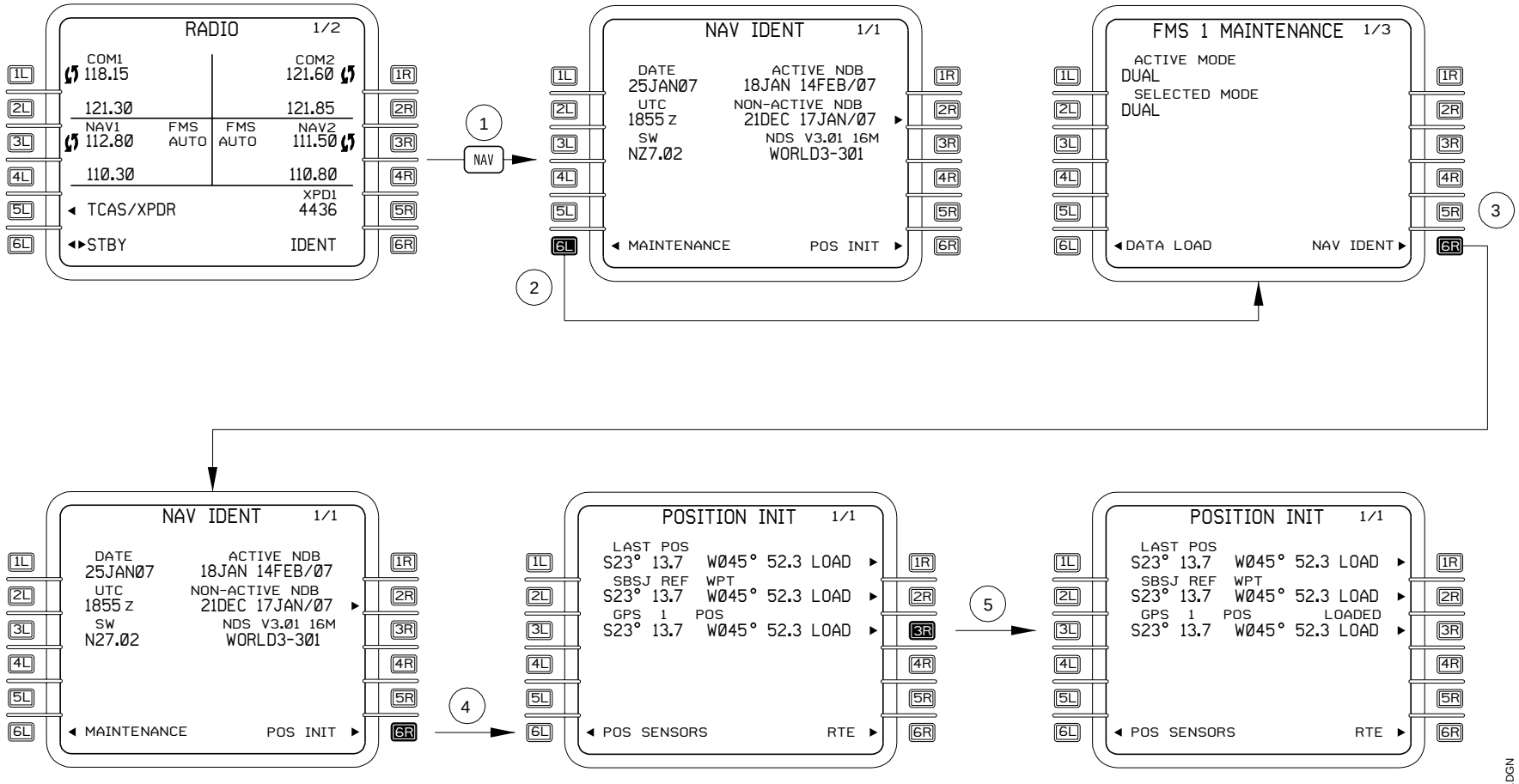
- Last position: The FMS stores the last position when the airplane is powered down.
- Reference waypoint: Displays the closest ramp x or airport reference point within 3 NM of the last position. Additionally the pilot may type a waypoint or coordinates on the scratchpad through alphanumeric keys, and enter it pressing LSK 2L.
- GPS position.

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NAVIGATION IDENTIFICATION AND POSITION INITIALIZATION

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ROUTE SELECTION - CREATING A FLIGHT ROUTE

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1 - On POSITION INIT 1/1 page press LSK 6R (RTE). On RTE 1/1 page it is possible to create/store a flight plan or load a flight plan from the memory.

2 - If the initialization coordinates are within 3 NM of the airport data base the origin airport is already loaded, otherwise enter the origin airport in the scratchpad through alphanumeric keys and press LSK 1L.

3 - Enter the destination airport in the scratchpad through alphanumeric keys and press LSK 1R.

4 - Press NEXT key to go to RTE 2/3 page.

5 - Enter the waypoints in the scratchpad through alphanumeric keys and press LSK correspondent to VIA.TO:

- In case of waypoints entries, enter the airway identifier followed by the last desired waypoint of the airway. Both must be separated by a period.
- If a waypoint entry corresponds to more than one option in the memory, all options are displayed and selection of the desired one is made by pressing the respective LSK.
- When entering a waypoint and no VIA.TO is displayed press NEXT button until VIA.TO is displayed.

6 - When entry of all waypoints is finished, press LSK correspondent to DEST and press LSK correspondent to VIA.TO to close the flight plan.

7 - On RTE page press LSK 6R (ACTIVATE) to activate the flight plan.

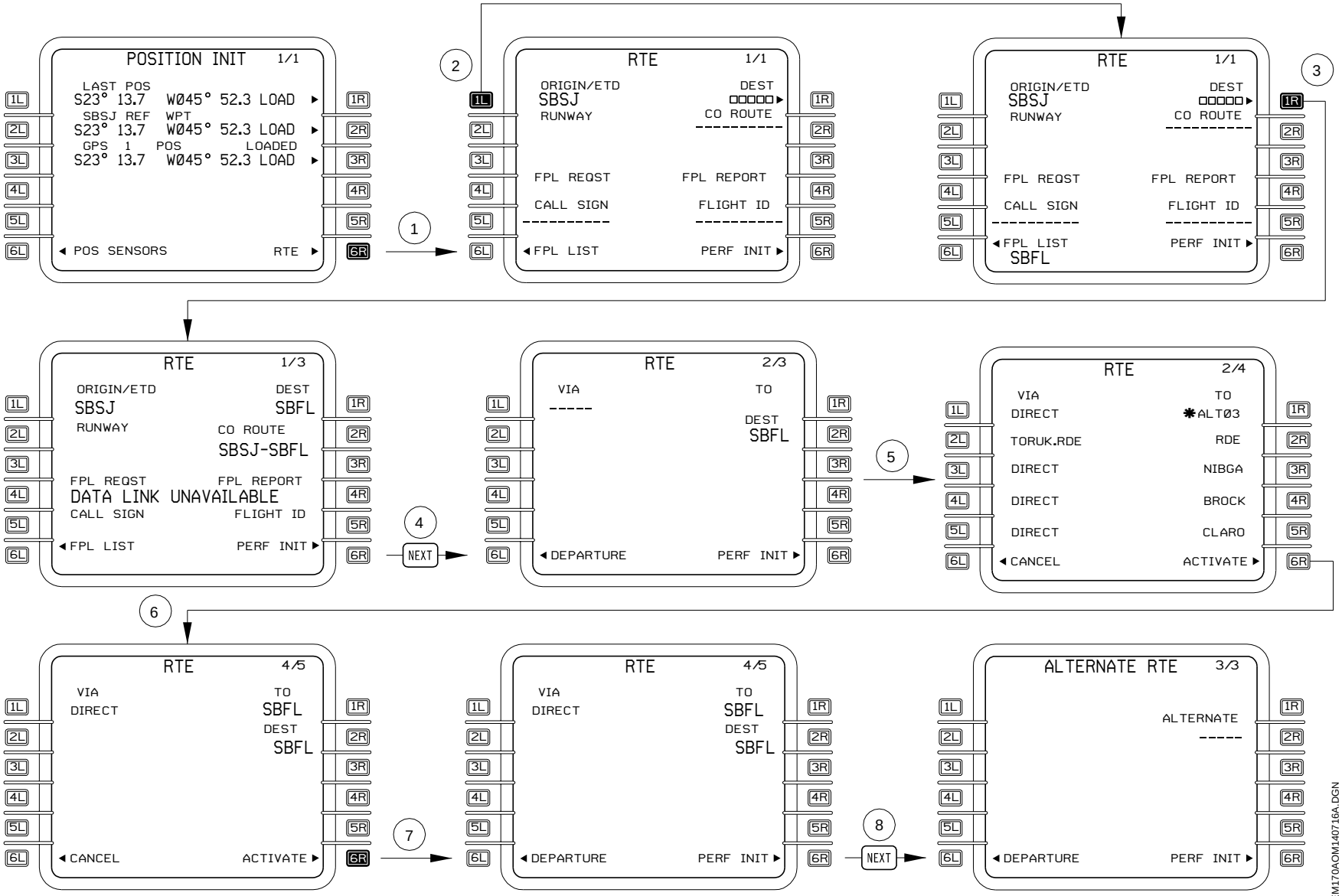
8 - Access the last page (ALTERNATE RTE) by pressing the NEXT button.

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CREATING A FLIGHT ROUTE

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ROUTE SELECTION - LOADING A FLIGHT PLAN

1 - Press Flight Plan (FPL key to go to FLT PLN 1/1 page. On this page it is possible to create/store a flight plan or load a flight plan from the memory.

2 - Press LSK 6L (FP LIST) or enter the flight plan name in the scratchpad through alphanumeric keys to access the FLIGHT PLAN LIST page.

3 - In the FLIGHT PLAN LIST page, select the desired flight plan by pressing the respective LSK flight plan that appears in the scratch pad.

4 - Press LSK 1L (SHOW FPL). Verify the loaded flight plan by pressing NEXT button to scroll on the pages.

5 - Press LSK 6R (FPL SEL) to go to FLIGHT PLAN SELECT 1/1 page.

6 - On FLIGHT PLAN SELECT 1/1 page press LSK 1R (INSERT) to insert the flight plan.

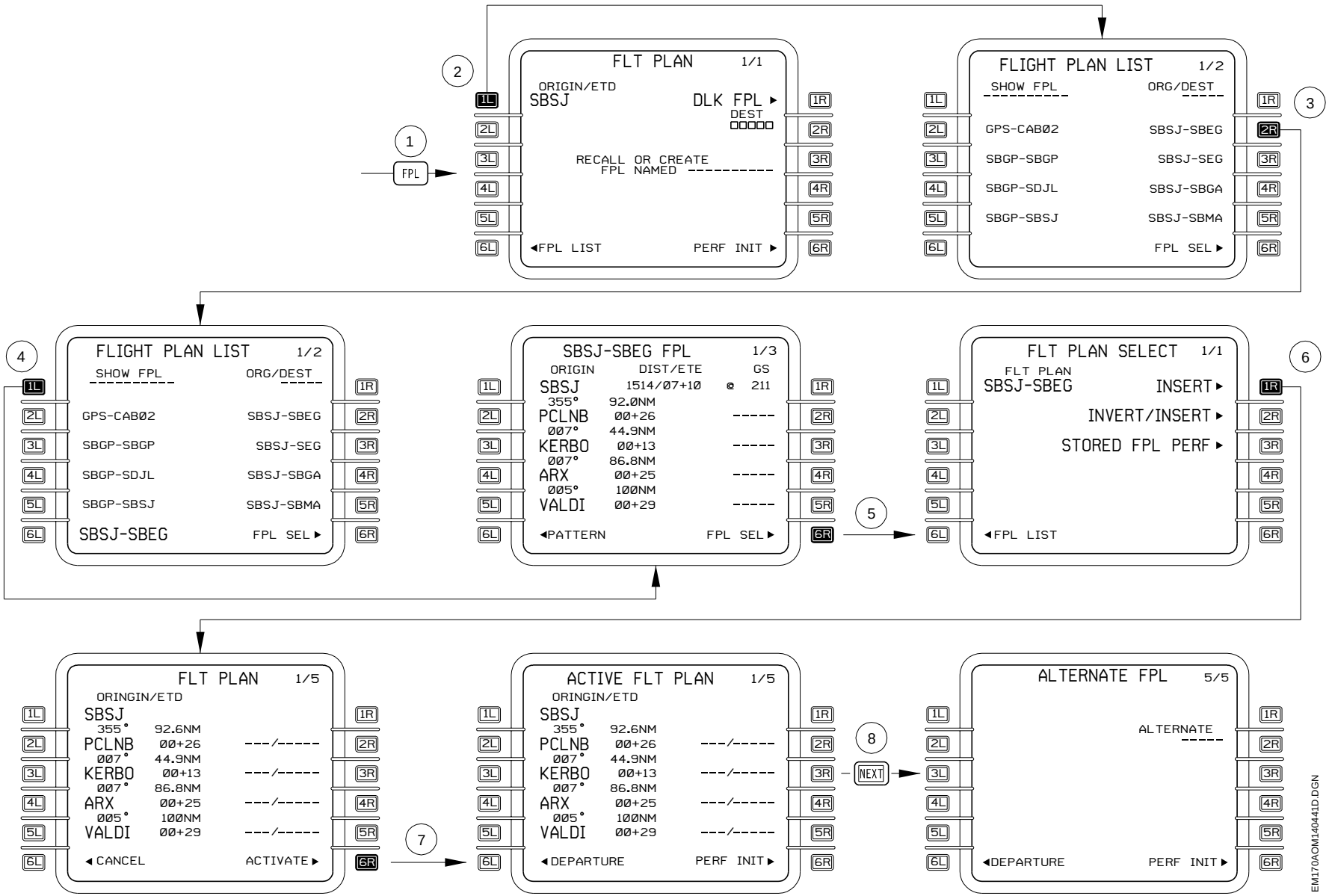
7 - On FLT PLAN page press LSK 6R (ACTIVATE) to activate the flight plan.

8 - Access the last page (ALTERNATE FPL) by pressing the NEXT key.

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LOADING A FLIGHT PLAN

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CREATING AN ALTERNATE FLIGHT ROUTE

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1 - On ALTERNATE RTE page enter the alternate airport in the scratchpad through alphanumeric keys and press LSK 2R.

2 - Enter the waypoints in the scratchpad through alphanumeric keys and press LSK correspondent to VIA.TO:

- In case of waypoints entries, enter the airway identifier followed by the last desired waypoint of the airway. Both must be separated by a period.
- If a waypoint entry corresponds to more than one option in the memory, all options are displayed and selection of the desired one is made by pressing the respective LSK.
- When entering a waypoint and no VIA.TO is displayed press NEXT button until VIA.TO is displayed.

3 - When entry of all waypoints is finished, press LSK correspondent to DEST and press LSK correspondent to VIA.TO to close the flight plan.

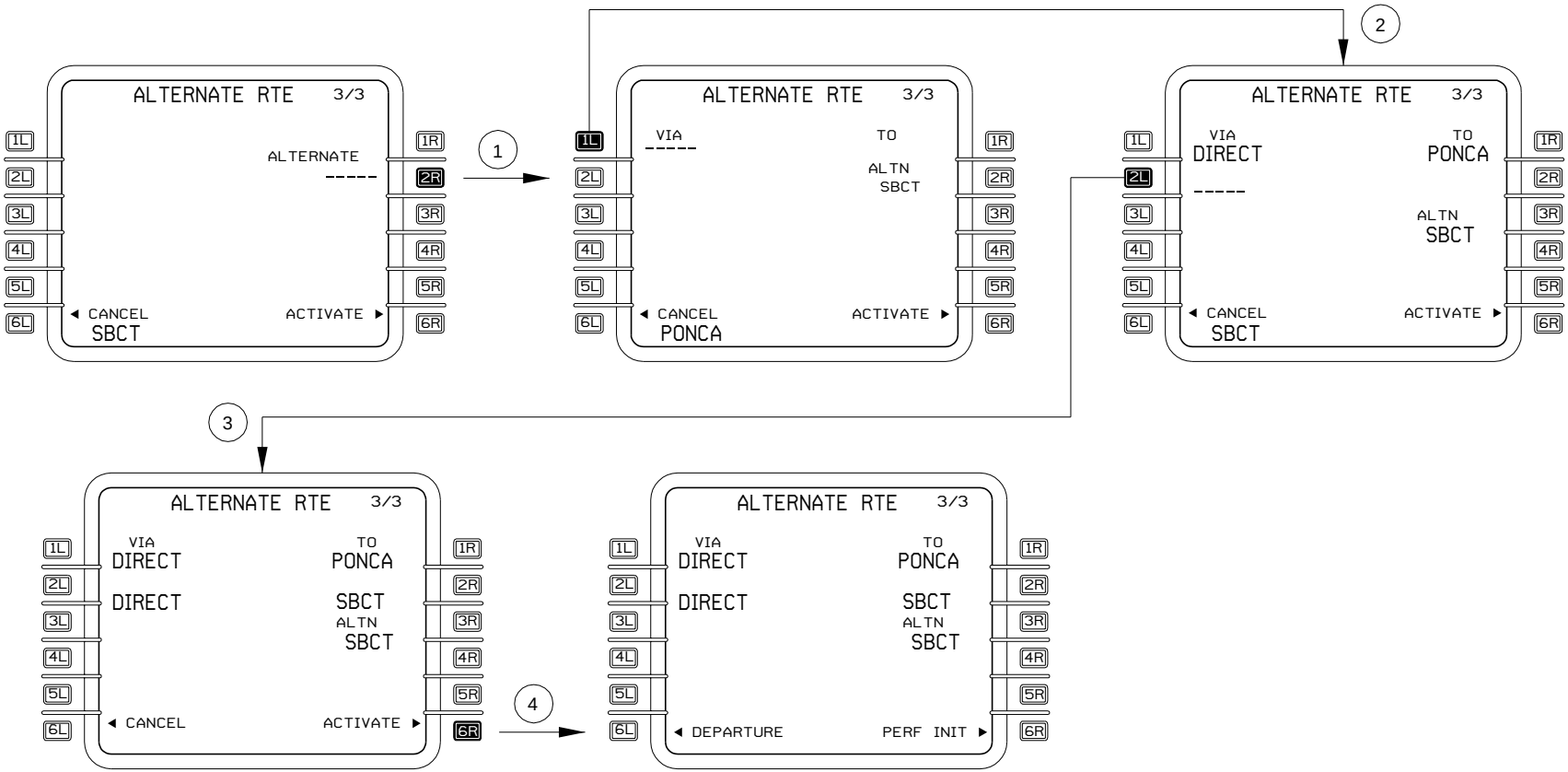
4 - Activate the alternate flight route by pressing the LSK 6R (ACTIVATE).

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ALTERNATE FLIGHT ROUTE

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PERFORMANCE INITIALIZATION

1 - On ALTERNATE FPL or ALTERNATE RTE page press LSK 6R (PERF INIT) to enter in the PERFORMANCE INIT page. The following items must be checked:

- Aircraft type.
- Tail number.

2 - Select the performance mode by pressing LSK 2R to enter in the PERF MODE page. Press the respective LSK performance mode and LSK 1R (RETURN). Three modes are available for selection:

- Full performance: The performance is based according to pilot selections. The following pages/datas are only available in full performance:
- PERF DATA pages.
- CLIMB pages.
- CRUISE pages.
- DESCENT pages.
- Point of no return page.
- Equal time point page.
- Optimum and maximum altitude.
- Cruise speed schedules: long range cruise, maximum speed, maximum endurance and maximum range.

In order to calculate the performance data the following entries are required:

- **Zero Fuel Weight.**
- **Current groundspeed and fuel flow:** The performance is based according to current groundspeed and fuel flow. On the ground a default value for groundspeed is used, once airborne the current value is used. The fuel flow can be overridden by a pilot entry.

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– **Speed schedules and cruise fuel flow:** The performance is based according to pilot entered speed schedules and cruise fuel flow.

3 - Enter the climb speed in the scratchpad through alphanumeric keys and press LSK 3L. The entry can be CAS, MACH or both CAS/MACH (separated by a slash). The active speed is the one that provides the lowest TAS. Entering “delete” returns the default values.

Selection can also be provided by pressing LSK 3R and entering the CLIMB MODES page. On CLIMB MODES page select the respective LSK climb mode and LSK 1R (RETURN).

4 - Enter the cruise speed in the scratchpad through alphanumeric keys and press LSK 4L. The entry can be CAS, MACH or both CAS/MACH (separated by a slash). The active speed is the one that provides the lowest TAS. Entering “delete” returns the default values.

Selection can also be provided by pressing LSK 4R and entering the CRUISE MODES page. On CRUISE MODES page select the respective LSK cruise mode and LSK 1R (RETURN). Four cruise mode are available:

– Long range cruise.

– Maximum speed.

– Maximum endurance.

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– Maximum range speed.

If long range cruise or maximum speed are selected, the active speed at high altitudes is MACH and at low altitudes is CAS.

For maximum endurance always CAS is the active speed.

5 - Enter the descent speed and angle in the scratchpad through alphanumeric keys and press LSK 3L. The entry can be CAS, MACH, ANGLE, both CAS/MACH or CAS/MACH/ANGLE (separated by slashes). The active speed is the one that provides the lowest TAS. Entering “delete” returns the default values.

Selection can also be provided by pressing LSK 5R and entering the DESCENT MODES page. On DESCENT MODES page select the respective LSK climb mode and LSK 1R (RETURN).

6 - Press the LSK 6L to enter in the DEP/APP SPD pages. On the DEPARTURE SPEED 1/3, it is possible to set the speed restriction during the departure as well as the altitude and the distance where the departure speed limit applies.

7 - Press the NEXT button to go to APPROACH SPEEDS 2/3 page. On this page it is possible to enter the approach speeds depending the flap setting. It is also possible to enter the approach speed limit. The FMS logic is to command the speed for the next flap up to flaps full.

In the LSK 4L, it is possible to access the radial distance in nautical miles where FMS begins the approach schedule.

In the LSK 5R or 5L it is possible to select if the approach speed schedule is to be initiate at further out distance than the one set in 4L or not.

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In the LSK 4L it is also possible to access the altitude AGL in feet and in the LSK 4R it is possible to access the radial distance in nautical miles.

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8 - Press the NEXT button to go to GO-AROUND SPEEDS 3/3 page. On this page it is possible to set go around speeds depending on flap settings. Press the RETURN prompt at 1R to go back to PERFORMANCE INIT 1/3.

9 - Press NEXT button to go to PERFORMANCE INIT 2/3 page.

10 - On PERFORMANCE INIT 2/3 page it is possible to enter the data below. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.

- Step climb increment (unavailable).
- Fuel reserve. Additionally fuel reserve can also be entered by pressing LSK 2R to access FUEL RESERVE page. On FUEL RESERVE page it is possible to enter the fuel reserve in kilograms or in minutes. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.
  Press LSK 1R (RETURN) to go back to PERFORMANCE INIT page.
  The fuel reserve applies at destination or at the alternate destination if one has been entered.
- Fuel allowance for takeoff and landing.
- Contingency fuel.

11 - Press NEXT button to enter in the PERFORMANCE INIT page 3/3. On this page it is possible to enter the data below. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.

- Transition altitude.
- Initial cruise altitude. Altitudes above the transition altitude are displayed as flight levels and below in feet. The cruise altitude must be equal to or greater than the Altitude Selector, otherwise the message RESET ALT SEL? is displayed. If the full performance mode is selected the initial cruise altitude is displayed as OPTIMUM.
- Average cruise wind and corresponding altitude.

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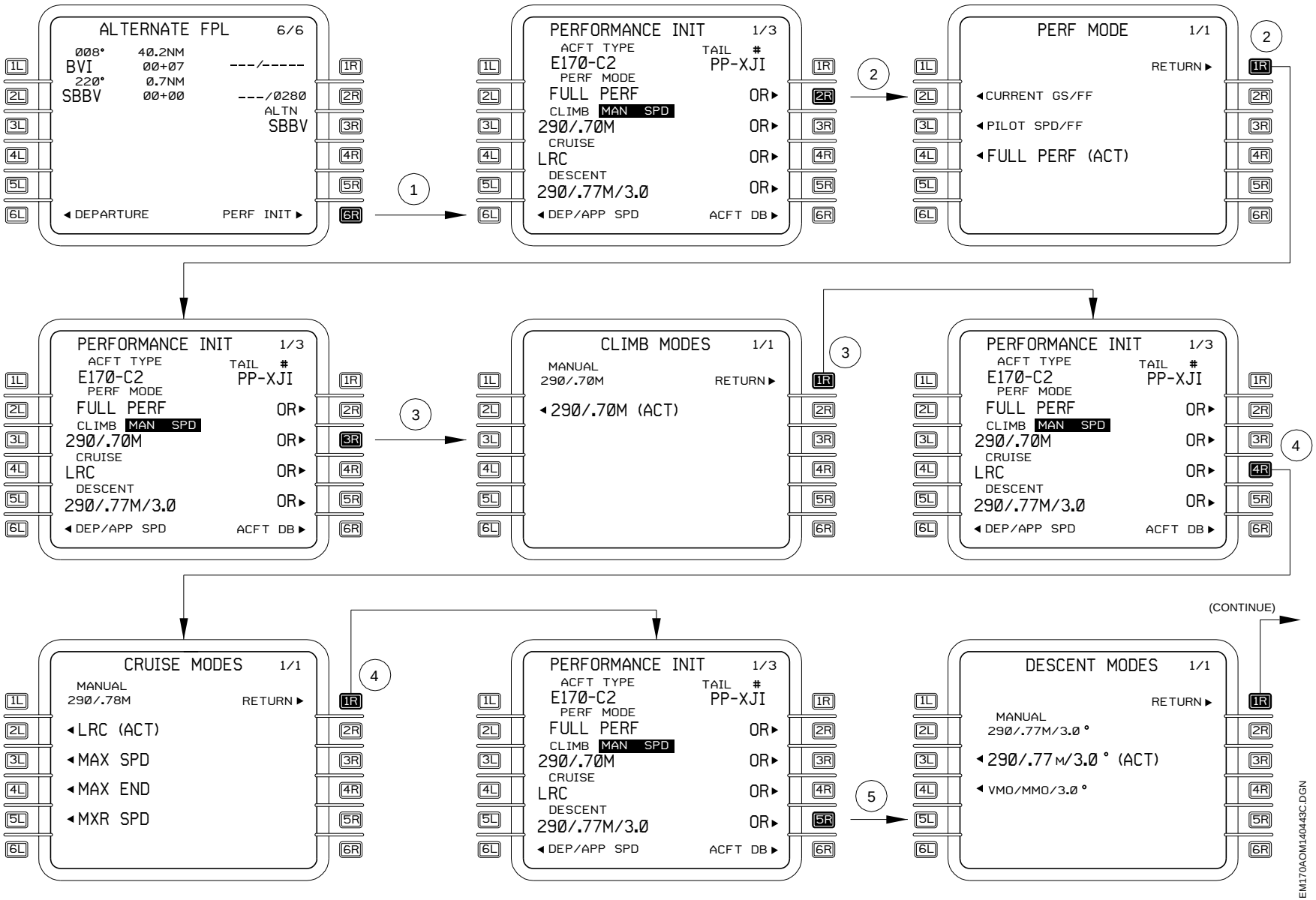
– Zero fuel weight.
– Speed limits associated with altitudes.
– Temperature deviation.
– Fuel weight.

If the maximum gross weight is exceeded the message EXCEEDS MAX GROSS WEIGHT is displayed.

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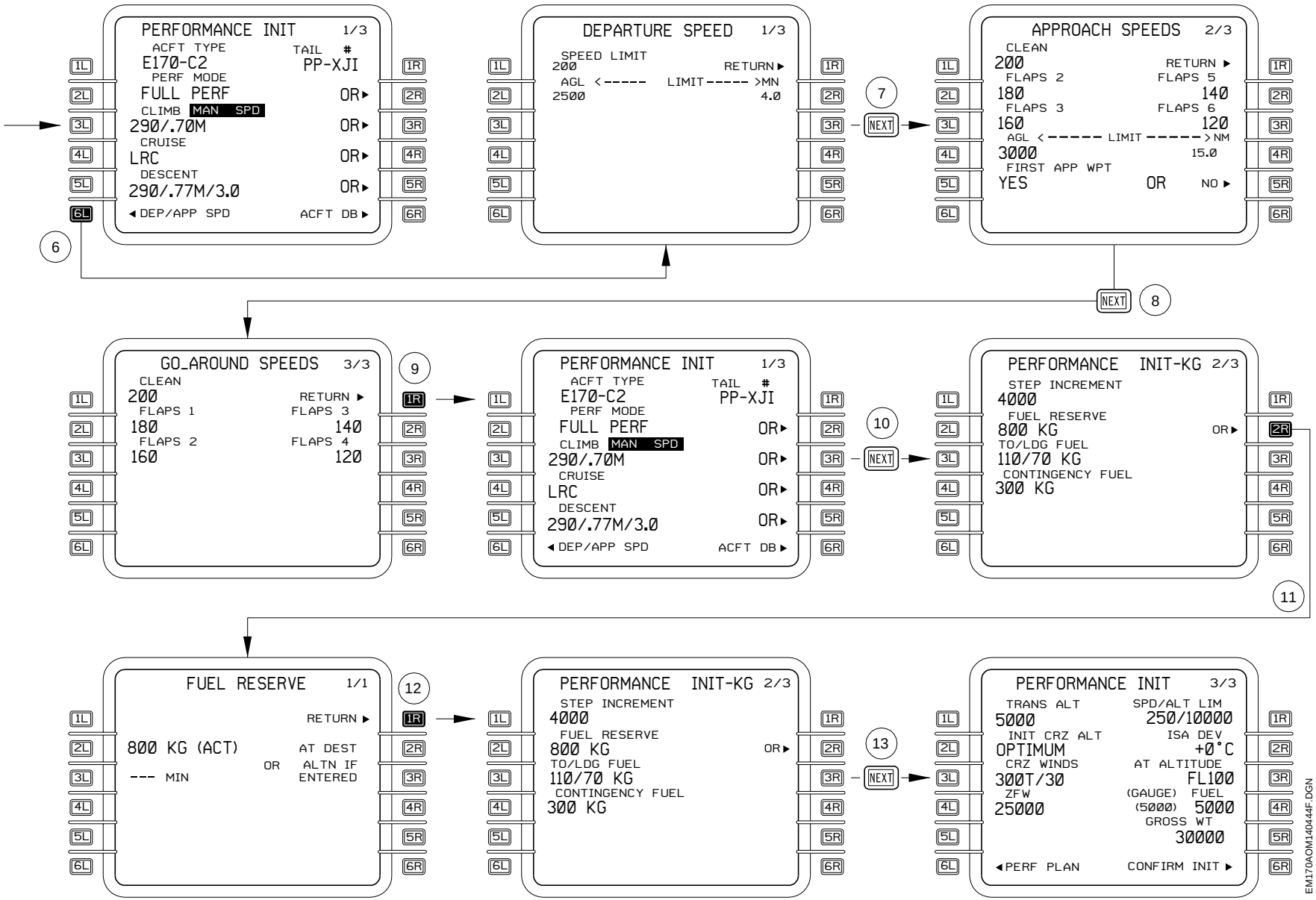
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PERFORMANCE INITIALIZATION 1/2

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PERFORMANCE INITIALIZATION 2/2

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PERFORMANCE DATA CHECK

1 - On PERFORMANCE INIT 3/3 page press LSK 6R (CONFIRM INIT).

On the PERF DATA page the following data displays for destination and alternate:

- Cruise and ceiling altitudes.
- Step increments.
- Estimated time enroute.
- Estimated time arrival.
- Distance.
- Fuel requirement.
- Fuel figure of merit (accuracy of the fuel required).
- Fuel remaining.
- Gross weight.

The cruise altitude and step increments can be changed by entering in the scratchpad through alphanumeric keys and pressing respectively LSK 1L or LSK 1R.

2 - Press NEXT button to go to PERF DATA 2/3 page. On this page the following information is displayed:

- Average cruise wind.
- Preflight fuel remaining.
- Latest estimated fuel remaining.
- Difference between preflight and estimated fuel remaining.

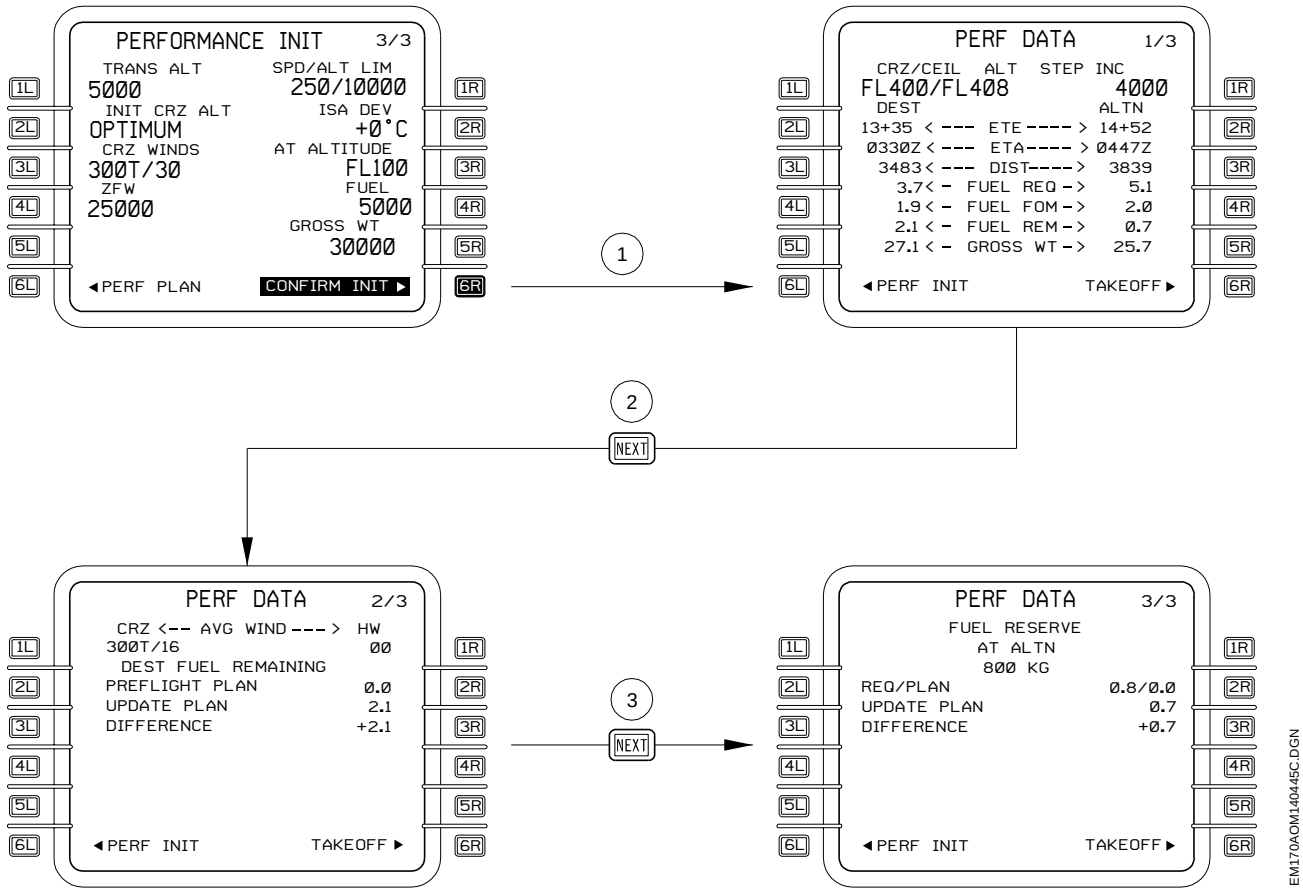
3 - Press NEXT button to go PERF DATA 3/3 page. On this page the following information is displayed:

- Required fuel reserve.
- Predicted fuel remaining.
- Updated plan (most recent of the fuel remaining).

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PERFORMANCE DATA CHECK

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TAKEOFF

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1 - On PERF DATA page press LSK 6R (TAKEOFF) to enter in the TAKEOFF 1/3 page.

On TAKEOFF 1/3 page the following information is displayed:

– Runway heading.

– Takeoff weight.

– Static air temperature.

– Surface wind.

– Pressure altitude.

– Baro settings.

– Runway slope.

– Headwind/tailwind and crosswind.

– Runway elevation.

– Runway condition.

Takeoff weight, temperature, surface wind, baro settings and runway condition can be entered. The entry is accomplished in the scratchpad through alphanumeric keys and/or pressing the respective LSK.

NOTE: If no departure runway is selected on the FMS or the runway heading is manually inserted by the pilot on the TAKEOFF page, the scratchpad will present the EXCEEDS P ALTITUDE LIMIT message every time the airplane climbs through 15000 ft.

2 - Press NEXT button to go to TAKEOFF 2/3 page. The following information is displayed:

– Flaps.

– Takeoff mode.

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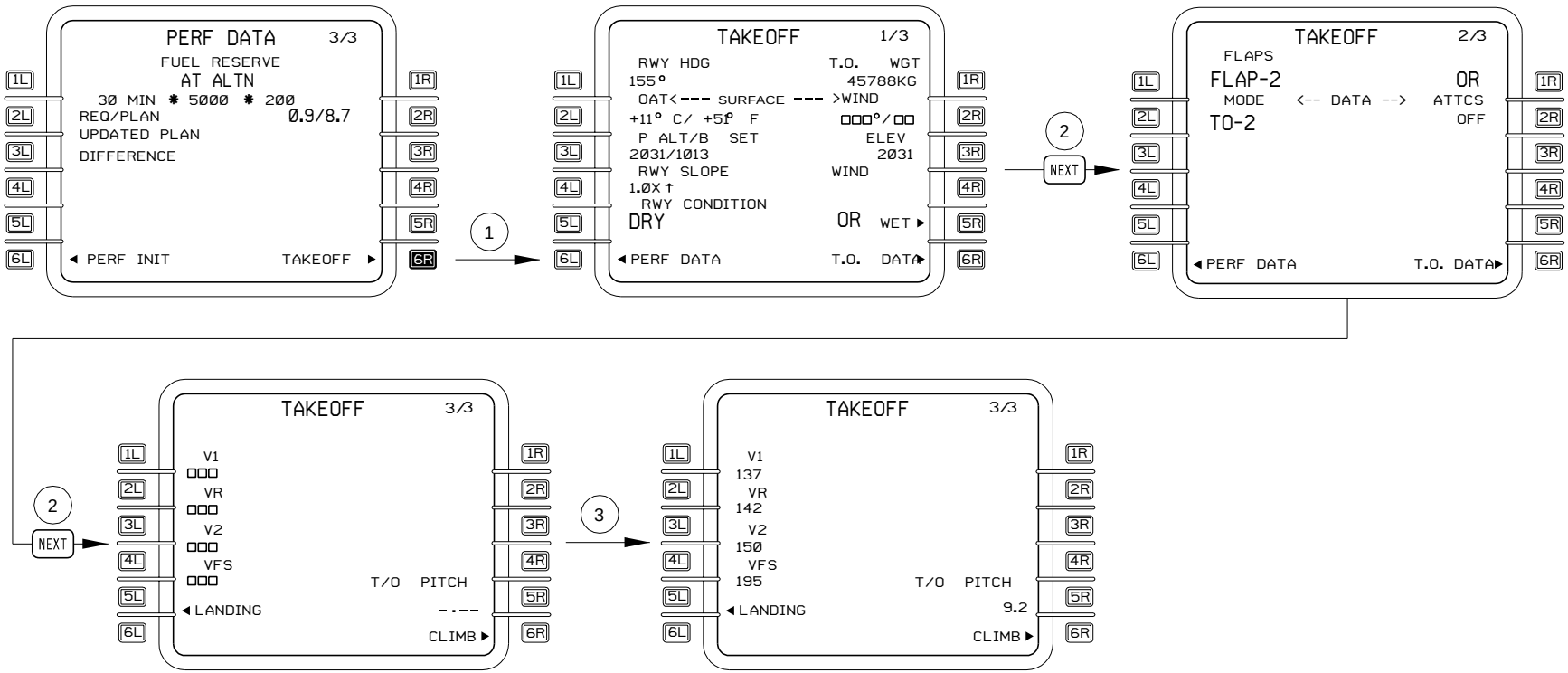
– ATTCS.

The entry of the information is accomplished in the scratchpad through the respective LSK.

3 - Press NEXT button to go to TAKEOFF page 3/3. Enter with V1, VR, V2, VFS and crosscheck the takeoff pitch angle. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.

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TAKEOFF

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DEPARTURE

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1 - The DEPARTURE page can be selected either on NAV INDEX or RTE pages by pressing the respective LSK.

2 - On the DEPARTURE RUNWAYS page selects the runway by pressing the respective LSK.

3 - On SIDs page selects the SID by pressing the respective LSK.

4 - On the DEPARTURE TRANS page selects the departure transition by pressing the respective LSK.

5 - On PROCEDURE page press LSK 6R (INSERT).

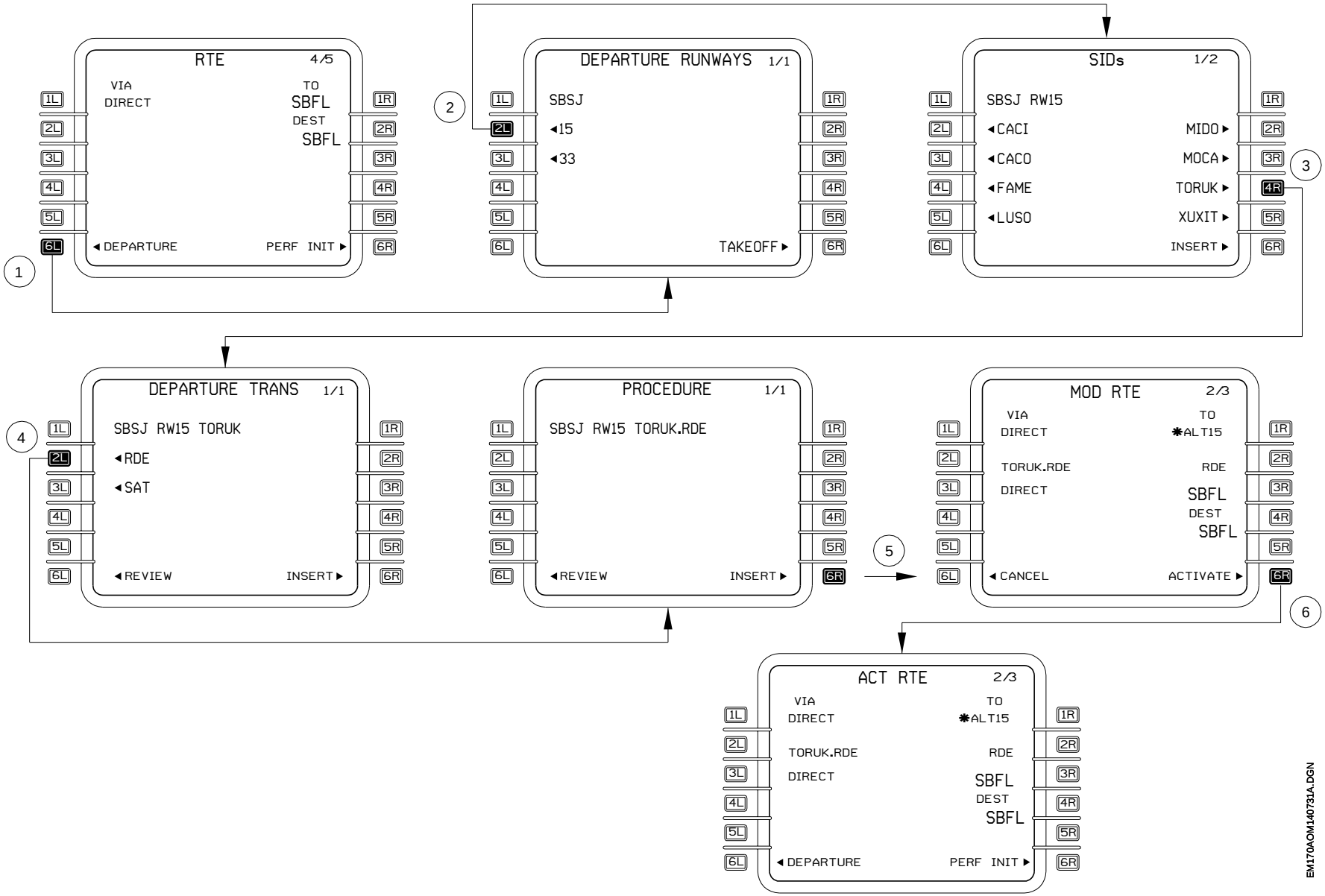
6 - Activate the flight route by pressing the LSK 6R (ACTIVATE) on the MOD RTE page. Check if there is no discontinuity between waypoint scrolling with the next button.

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DEPARTURE

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LANDING SPEEDS

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1 - Press Perf button to go to PERF INDEX 1/2 page.

2 - Press LSK 4R (LANDING) to go to LANDING 1/2 page.

3 - Access the LANDING 2/2 page by pressing the NEXT button.

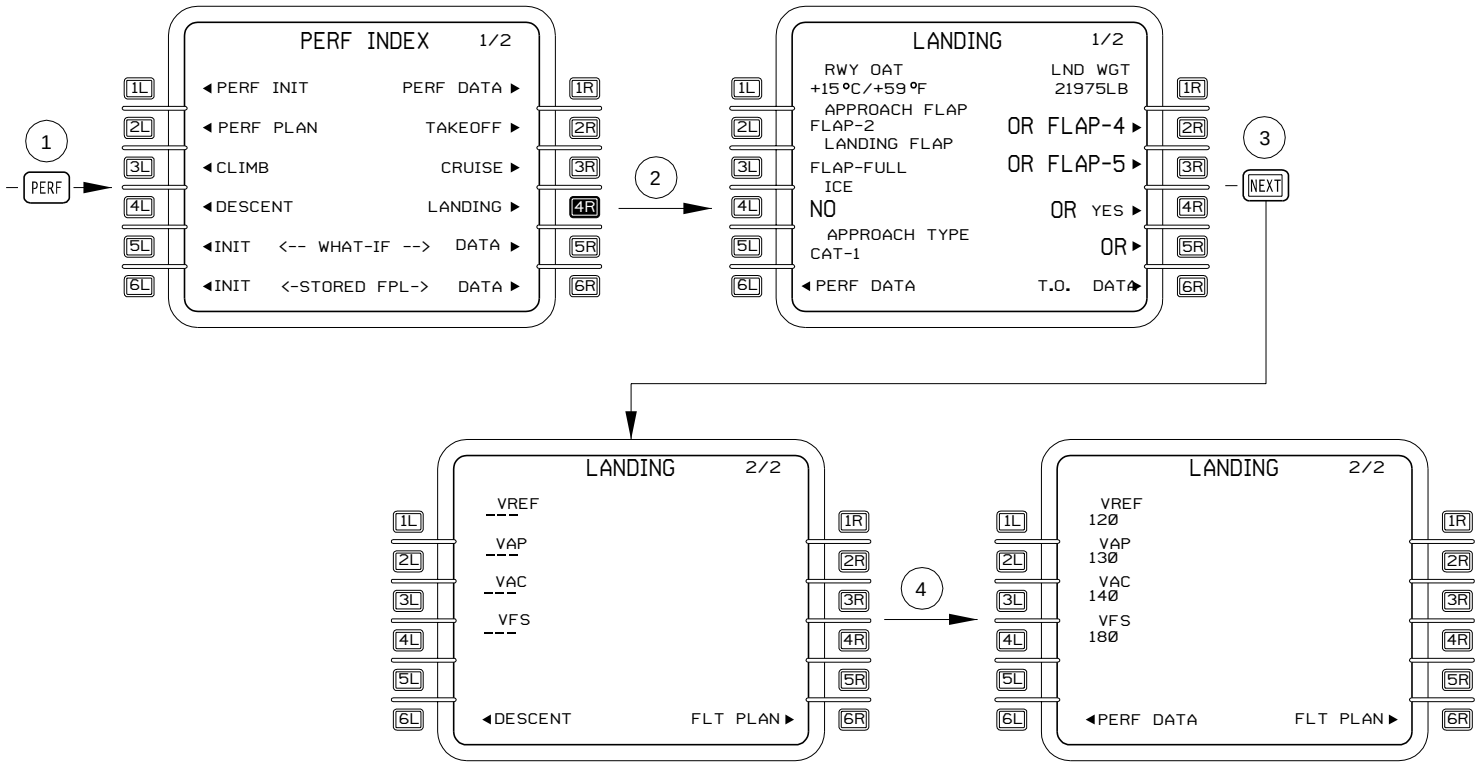
4 - Enter with VREF, VAP, VAC and VFS for the departure runway. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.

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LANDING SPEEDS

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PROGRESS

1 - Press PROG button to go to PROGRESS 1/3 page.

On PROGRESS 1/3 page the following information is displayed for the to, next and destination waypoints:

- Distance to go.
- Estimated time enroute.
- Estimated fuel remaining.
- Primary navigation source.
- Required navigation performance (RNP) value.
- Estimated position uncertainty (EPU) value. If EPU becomes greater than RNP the message UNABLE RNP is displayed.
- Tuned navigation radios frequencies.

Any active waypoint entry is permitted. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK (1L or 2L).

2 - Pressing LSK 6L or 6R (NAV 1/NAV 2) enters respectively in the NAV 1 or NAV 2 page.

3 - A list of 10 closest navigation frequencies is displayed. To tune a frequency press the respective LSK or press LSK 6L (PROGRESS) to return to PROGRESS 1/3 page.

4 - Press NEXT button to go to PROGRESS 2/3 page. The following information is displayed:

- Current fuel quantity.
- Current airplane Gross weight.

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5 - Pressing LSK 6L (RNP) enters in the RNP 1/1 page. The following information is displayed:

- Manual override RNP value at LSK 1L. If one does not exist, then entry prompts are displayed. Entry of DELETE clears the manual override RNP value.
- Departure RNP value at LSK 2L.
- Approach RNP value at LSK 2R.
- Enroute /remote RNP values at LSK 3L.
- Missed approach RNP value at LSK 3R.

The default RNP values for each phase of flight are displayed in small characters. The pilot can manually enter new RNP values that are displayed in large characters. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK. Entry of DELETE returns the default value.

A confirm entry prompt is displayed if the pilot has entered a manual override RNP value that is higher than default. The selection of the YES prompt at LSK 6R accepts the entered value as the new manual override RNP value and the selection of the NO prompt at LSK 6L causes the manual override RNP to return to the original value. A lower RNP value is accepted and gives access to PROGRESS page 2.

6 - Press LSK 6R (PROGRESS 2) to return to PROGRESS 2/3 page.

7 - Press the LSK 6R to enter the VNAV DATA page. On this page, the following information displays.

- VNAV Figure of Merit at LSK 1L.
- Vertical Deviation at LSK 1R.
- TOC pseudo waypoint distance/time to go at LSK 2L and TOC altitude at LSK 2R.
- TOD pseudo waypoint distance/time to go at LSK 3L and TOD altitude at LSK 3R.

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– Bottom of Descent (BOD) pseudo waypoint distance/time to go at LSK 3L and BOD altitude at LSK 3R.

8 - Press NEXT button to go to PROGRESS 3/3 page.

The following information is displayed:

– Cross track error.
– Off set entry.
– Airplane track.
– Airplane drift.
– Airplane heading.
– Wind.
– Ground speed.

9 - Pressing LSK 6L (AIR DATA) enters in the AIR DATA 1/1 page.

The following information is displayed:

– Pressure altitude.
– Barometric altitude.
– Vertical speed.
– Static air temperature.
– ISA deviation.
– Total air temperature.

10 - Press LSK 6R (PROGRESS 3) to return to PROGRESS 3/3 page.

11 - Pressing LSK 6R (FLT SUM) entries in the FLIGHT SUMMARY 1/1 page.

The following information is displayed:

– Takeoff time.
– Enroute time.
– Landing time.

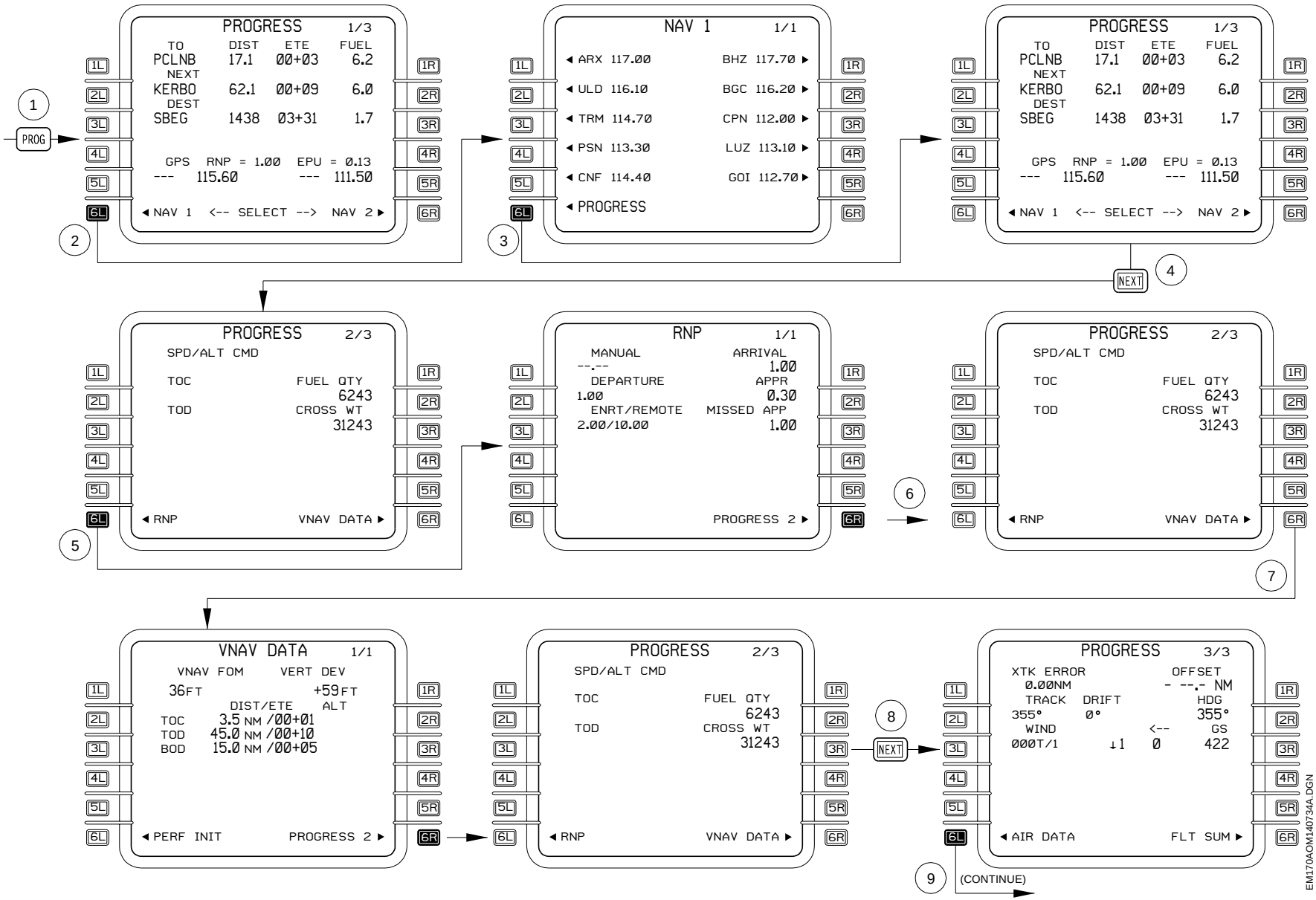
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– Fuel used.
– Average true air speed/ground speed.
– Air distance.
– Ground distance.

12 - Press LSK 6R (PROGRESS 3) to return to PROGRESS 3/3 page.

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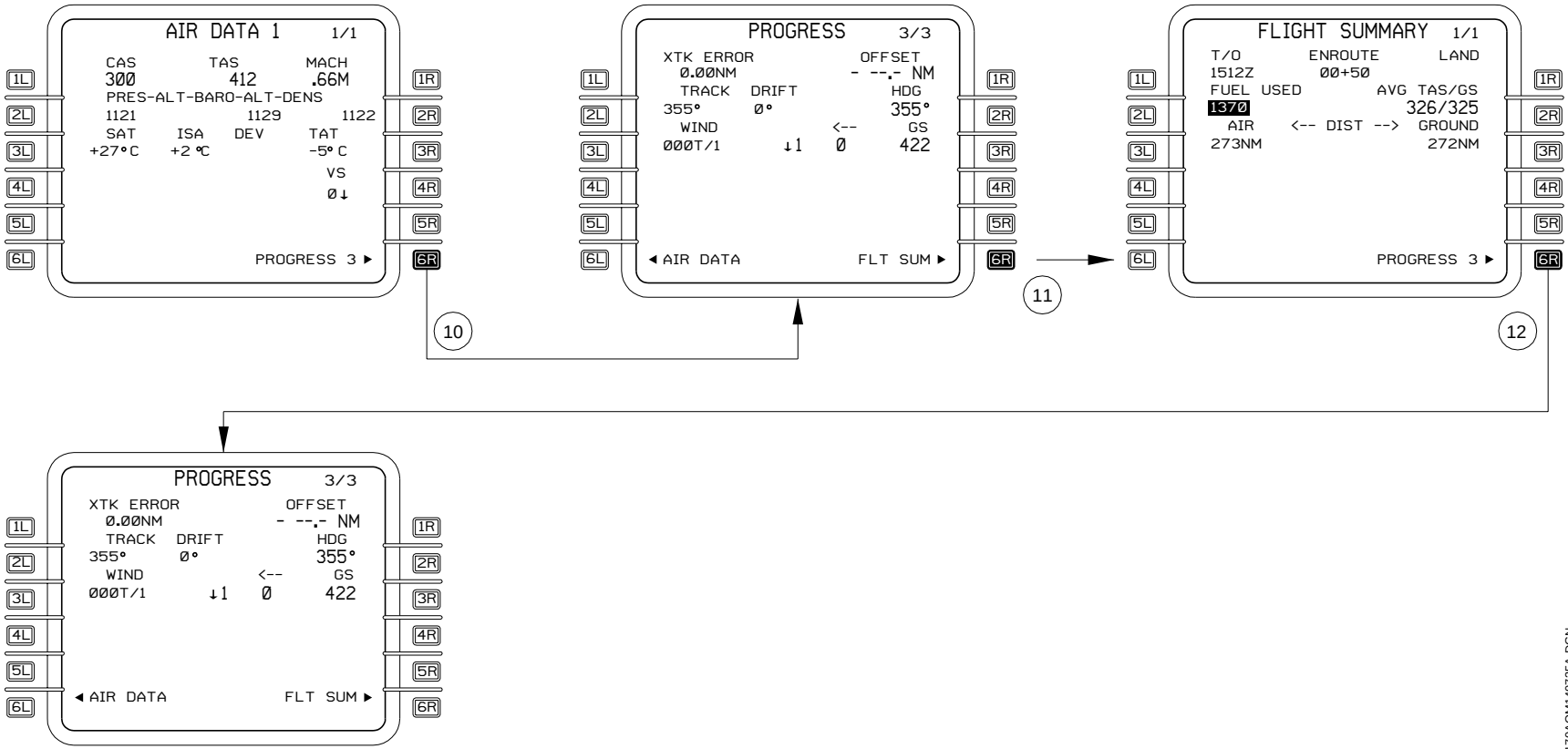


PROGRESS 1/2

◄

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PROGRESS 2/2

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DIRECT-TO

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1 - Press FPL button to go to ACTIVE FLT PLAN page.

2 - Press the respective LSK correspondent to the desired direct-to waypoint. If the desired direct-to waypoint is not displayed press NEXT button until it appears.

3 - Press LSK 1L of the first page (previous waypoint) to go to DIRECT-TO page.

4 - Press LSK 1L (DIRECT) to fly direct to the desired waypoint and no other waypoints are removed.

NOTE: A discontinuity is inserted after the desired waypoint followed by the previous waypoint sequence.

5 - Press LSK 2L (ACTIVE) to fly direct to a waypoint in the active flight plan, deleting all preceding waypoints. Displayed only if the selected waypoint is part of the active flight plan.

6 - Press LSK 3L (MISSED APPROACH) to fly direct to a waypoint in the selected missed approach procedure, deleting all preceding waypoints. Displayed only if the selected waypoint is part of the missed approach procedure inserted on the active flight plan.

7 - Press LSK 4L (ALTERNATE) to fly direct to a waypoint in the alternate flight plan, deleting all preceding waypoints. Displayed only if the selected waypoint is part of the alternate flight plan.

8 - Press LSK 6R (ACTIVATE).

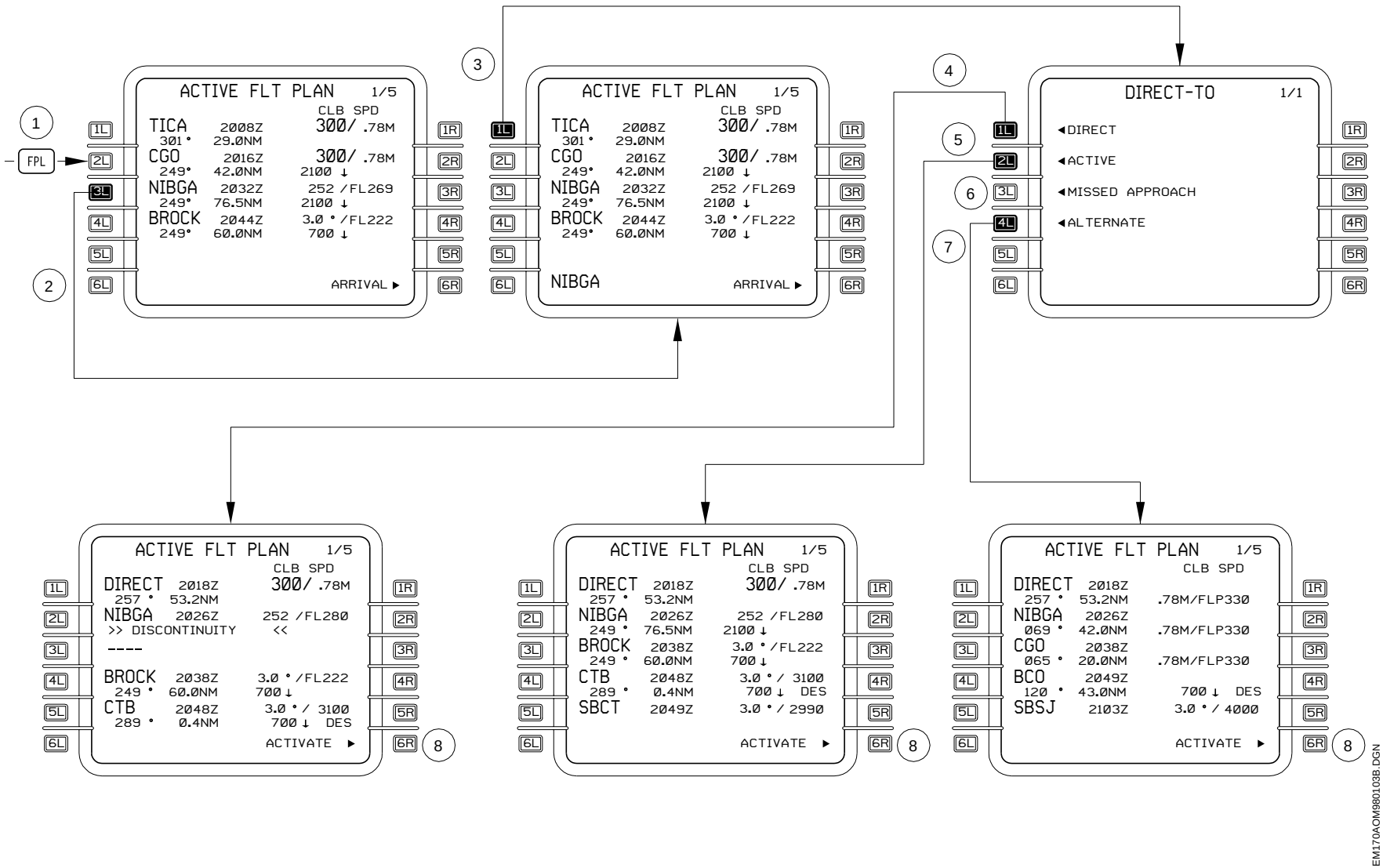
NOTE: If the selected waypoint is not present on any of these flight phases, the DIRECT option is automatically selected and the DIRECT TO 1/1 page is not displayed.

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DIRECT-TO

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PATTERNS

HOLDING

1 - Press NAV button to go to NAV INDEX 1/2 page.

2 - On NAV INDEX 1/2 page press LSK 5R (HOLD).

3 - On ACTIVE FLT PLAN page press the respective LSK correspondent to the desired holding waypoint. If the desired hold waypoint is not displayed press NEXT button until it appears.

On the HOLDING PATTERN 1/1 page the following information is displayed:

- Hold fix name.
- Speed.
- Quadrant entry. The possible entries are N, NE, E, SE, S, SW, W or NW.
- Entry type.
- Leg time.
- Inbound course/turn direction. The possible entries are course followed by a slash and then a L (left) or R (right), only the course or only the slash followed by a L (left) or R (right).
- Leg distance.
- Expected further clearance (EFC) time. When a valid Hold EFC time is inserted and activated, all time and fuel predictions for waypoints beyond the Hold are based on remaining in the hold until the expected clearance time has elapsed.

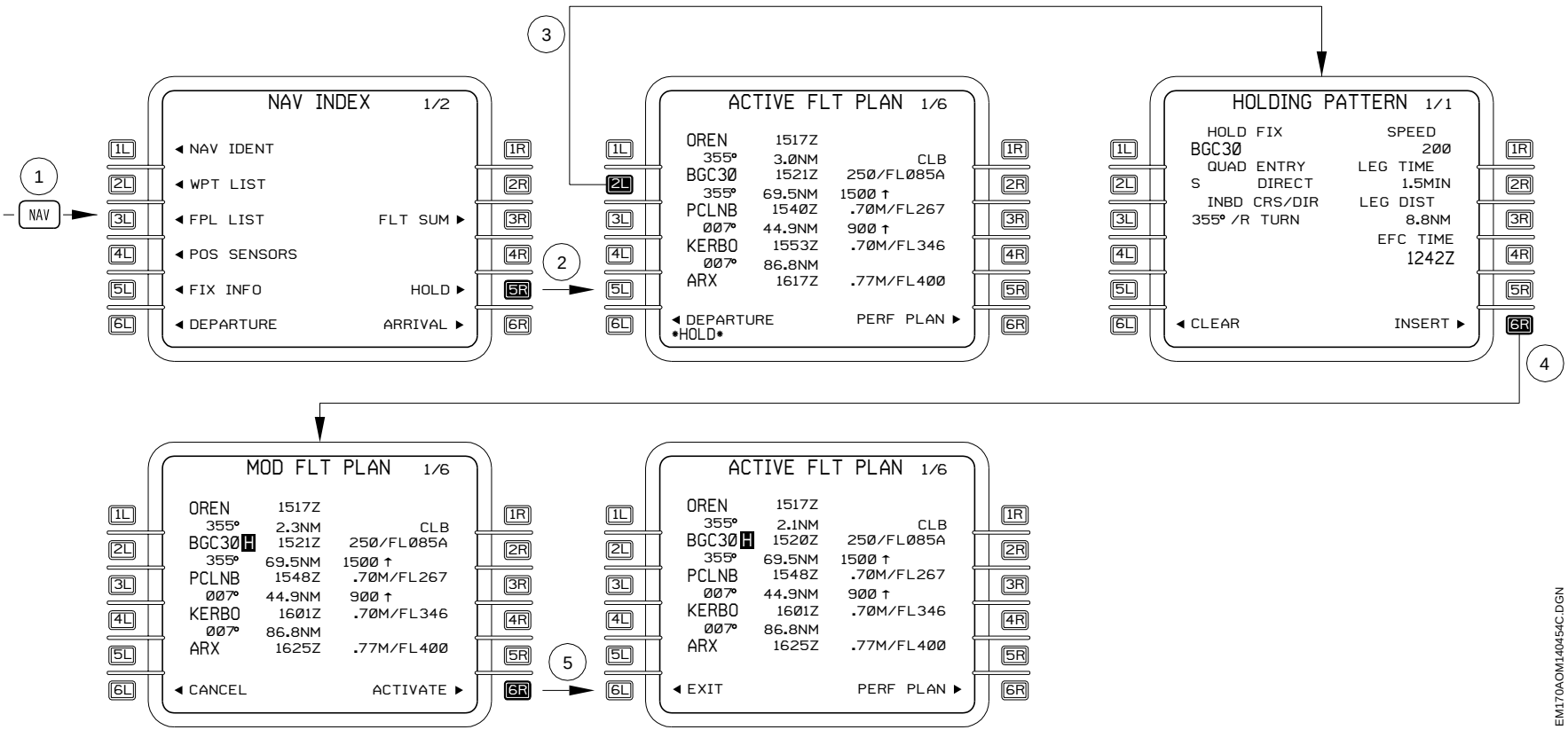
4 - Press LSK 6R (INSERT).

5 - On MOD FLT PLAN page press LSK 6R (ACTIVATE).

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HOLDING

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FLYOVER

The flyover is used to proceed to a waypoint before commencing the turn.

1 - Press NAV button to enter in the NAV INDEX 1/2 page.

2 - Press NEXT button to go to NAV INDEX 2/2 page.

3 - Press LSK 3L (PATTERNS) to enter in the PATTERNS 1/1 page.

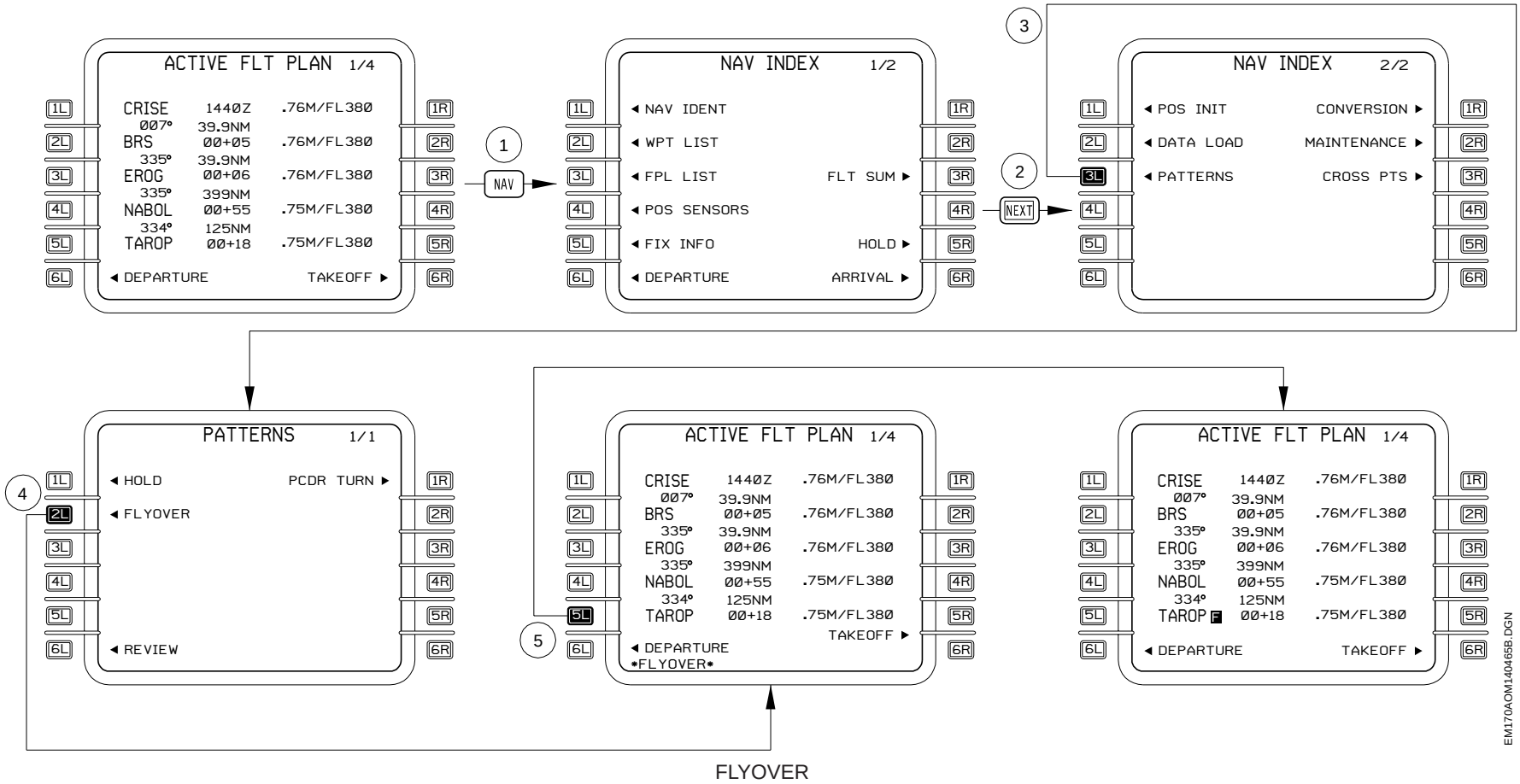
4 - Press LSK 2L (FLYOVER).

5 - On ACTIVE FLT PLAN page press the respective LSK correspondent to the desired flyover waypoint. If the desired flyover waypoint is not displayed press NEXT button until it appears.

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PROCEDURE TURN

The procedure turn is used to reverse the course during an approach. A procedure turn is only available from approaches in the navigation data base.

1 - Press NAV button to enter in the NAV INDEX 1/2 page.

2 - Press NEXT button to enter in the NAV INDEX 2/2 page.

3 - Press LSK 3L (PATTERNS) to go to PATTERNS 1/1 page.

4 - Press LSK 1R (PCDR TURN) to go to PROCEDURE TURN 1/1 page.

5 - On the PROCEDURE TURN 1/1 page the following information is displayed:

- Procedure turn fix.
- Boundary distance.
- Procedure turn angle. The entry is L (left) or R (right) followed by the turn angle.
- Inbound course.
- Outbound time.
- Outbound distance.

The outbound time/distance and procedure turn angle can be changed. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK.

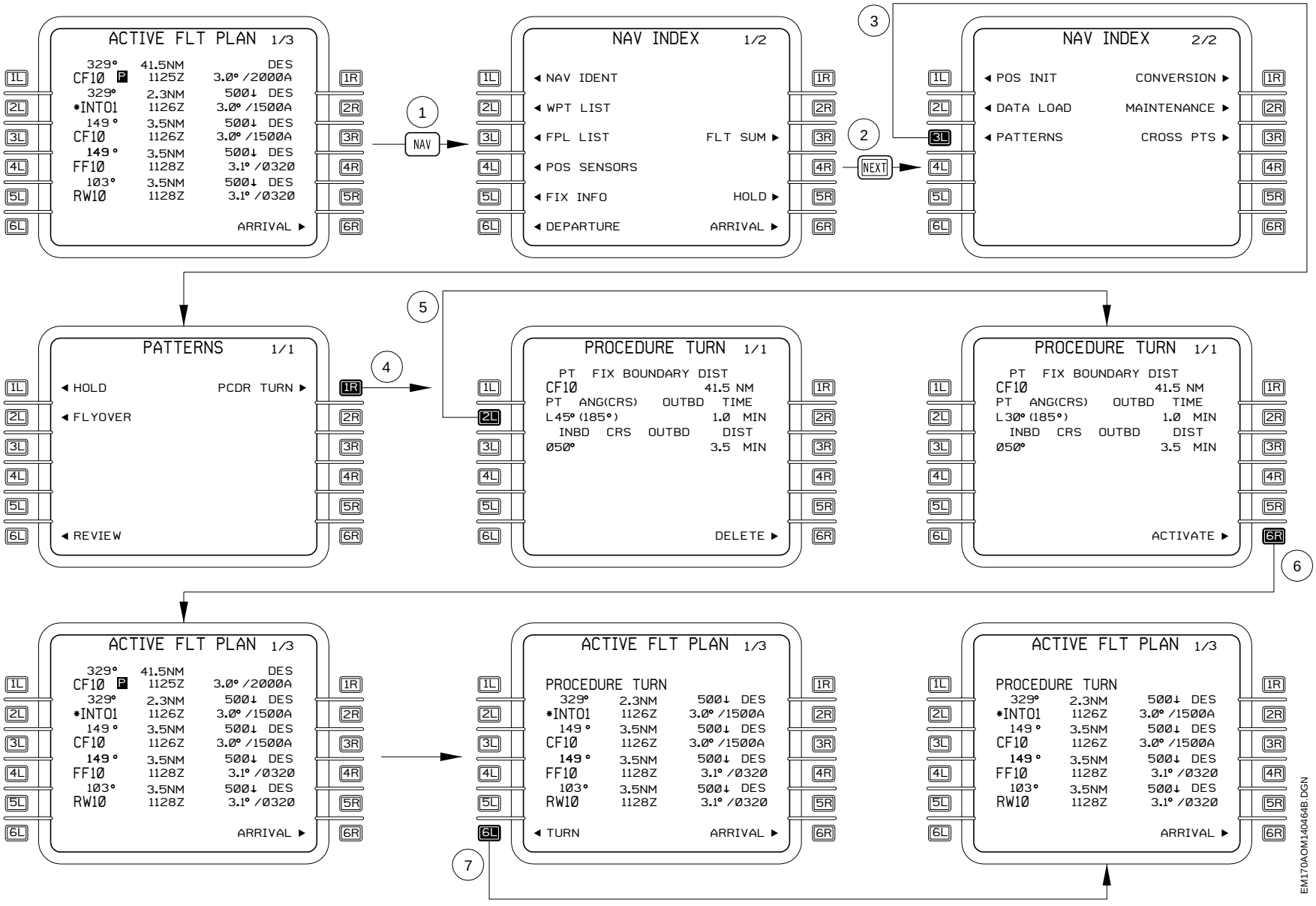
6 - Press LSK 6R (ACTIVATE) to go to ACTIVE FLT PLAN page.

7 - After passing the procedure turn fix press LSK 6L (TURN).

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PROCEDURE TURN

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CROSSING POINTS

The crossing points are used to determine some information regarding a waypoint relative to the current airplane position. The following types of crossing points are presented:

– Present position direct to a waypoint from the current airplane position.
– Crossing radial from a waypoint for the current airplane position.
– Equal time point between any two given waypoints. This option is only available when operating in full performance mode.
– Latitude/longitude crossing for the current flight plan.
– Point abeam a waypoint for current flight plan.
– Point of no return from any given waypoint. This option is only available when operating in full performance mode.

1 - Press NAV button to go to NAV INDEX 1/2 page.

2 - Press NEXT button to go to NAV INDEX 2/2 page.

3 - Press LSK 3R (CROSS PTS) to enter in the CROSSING POINTS 1/1 page.

PRESENT POSITION DIRECT

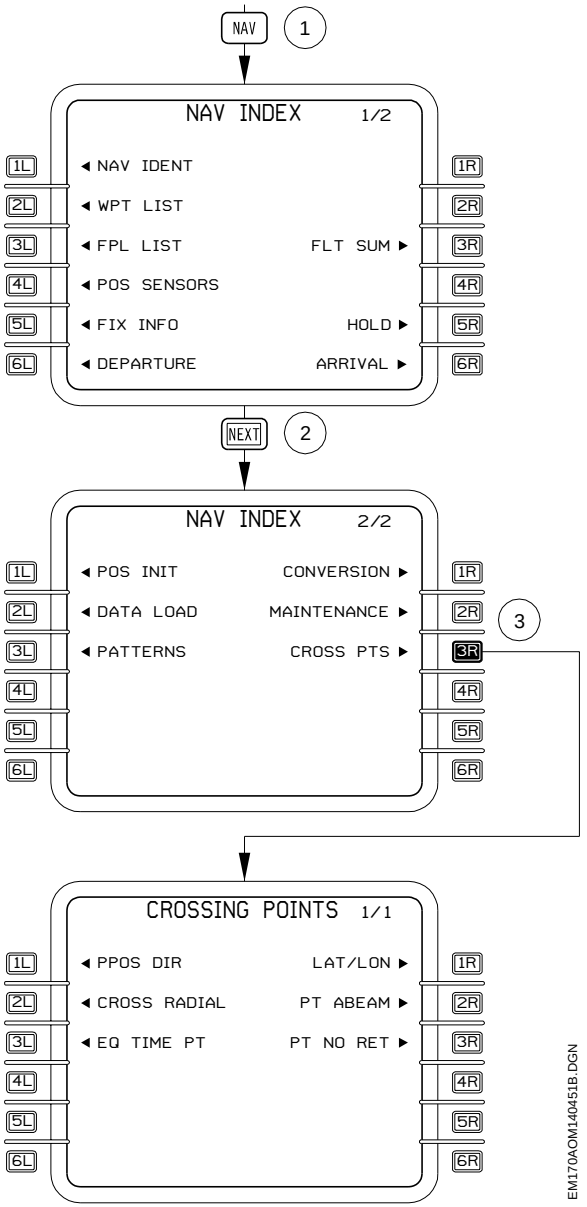
1 - On CROSSING POINTS 1/1 page press LSK 1L (PPOS DIR) to go to PPOS DIRECT 1/1 page.

2 - Enter with the waypoint name. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L.

After the entry the following information is displayed:

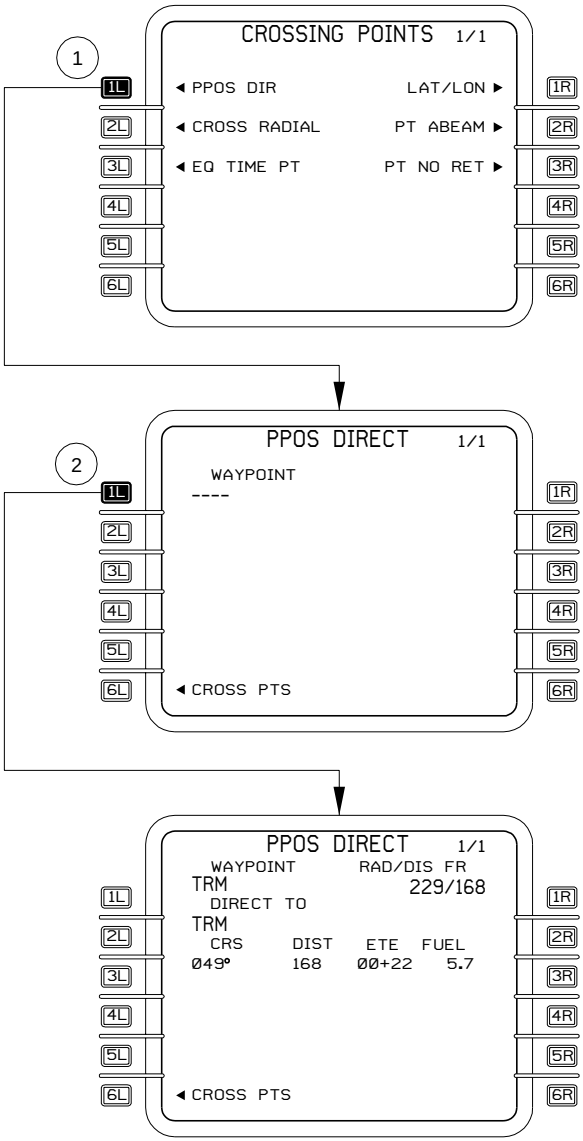
– Course to the waypoint.
– Distance to the waypoint.
– Estimated time enroute.
– Remaining fuel in the waypoint.

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CROSSING POINTS

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PRESENT POSITION DIRECT

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CROSSING RADIAL

1 - On the CROSSING POINTS 1/1 page press LSK 2L (CROSS RADIAL) to go to CROSS RADIAL 1/1 page.

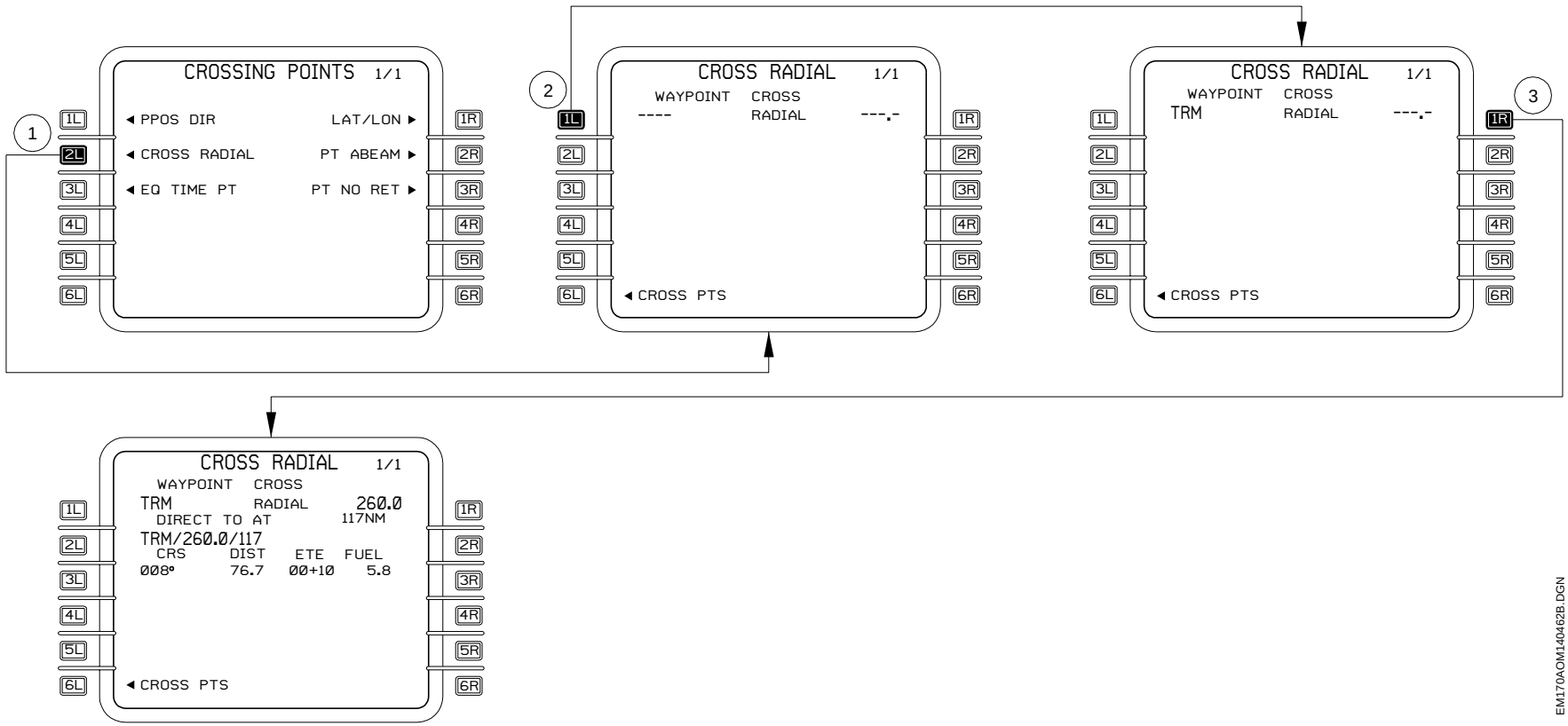
2 - Enter with the waypoint name. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L.

3 - Enter with the cross radial. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1R.

After the entry the following information is displayed:

- The distance from the waypoint where the airplane will cross the selected radial.
- Course to the waypoint.
- Distance to the waypoint.
- Estimated time enroute.
- Remaining fuel in the waypoint.

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CROSSING RADIAL

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EQUAL TIME POINT

1 - On the CROSSING POINTS 1/1 page press LSK 3L (EQ TIME PT) to go to EQUAL TIME POINT 1/1 page.

2 - On EQUAL TIME POINT 1/1 page the following information is displayed to the waypoints 1/2 and Equal Time Point (ETP):

- Distance to the waypoint.
- Estimated time enroute.
- Remaining fuel in the waypoint.

The default waypoints are origin and destination. It is possible to enter other waypoints. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L or 1R.

If the airplane has passed the ETP the message PAST is displayed.

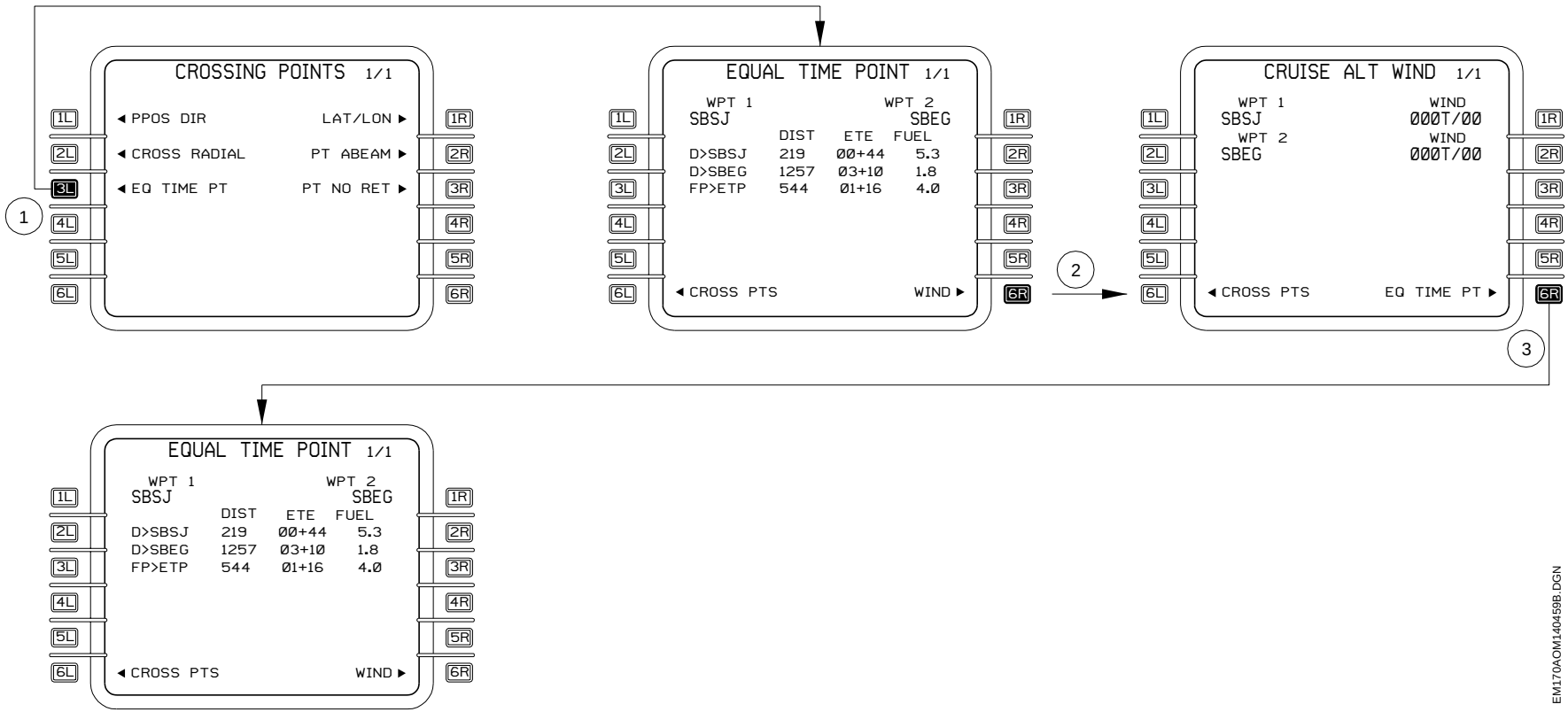
3 - Pressing LSK 6R (WIND) enters in the CRUISE ALT WIND 1/1 page. Cruise wind entry can be done for the selected waypoints. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK (1R or 2R).

4 - Press LSK 6R (EQ TIME PT) to return to EQUAL TIME POINT 1/1 page.

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EQUAL TIME POINT

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LATITUDE/LONGITUDE CROSSING

1 - On the CROSSING POINTS 1/1 page press LSK 1R (LAT/LON) to go to CROSS LAT/LON 1/1 page.

2 - Enter with the latitude and/or longitude. The entry is accomplished in the scratchpad through alphanumeric keys and pressing the respective LSK (1L or 1R).

After the entry the following information is displayed:

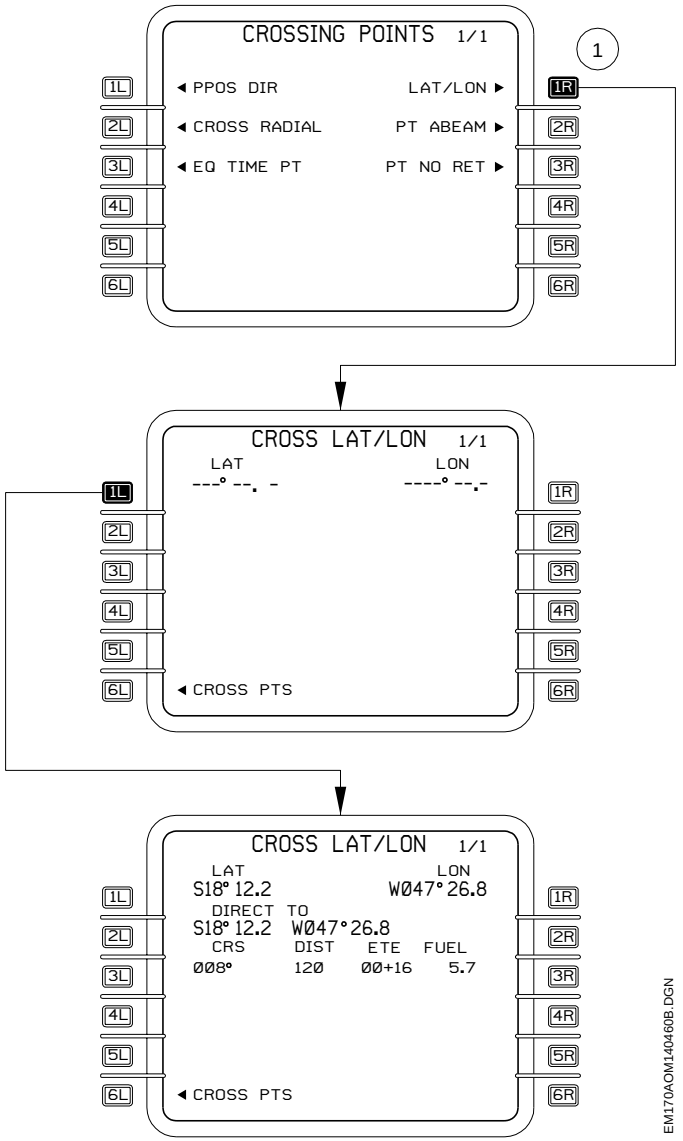
– Course to the waypoint.

– Distance to the waypoint.

– Estimated time enroute.

– Remaining fuel in the waypoint.

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LATITUDE/LONGITUDE CROSSING

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POINT ABEAM

1 - On the CROSSING POINTS 1/1 page press LSK 2R (PT ABEAM) to go to POINT ABEAM 1/1 page.

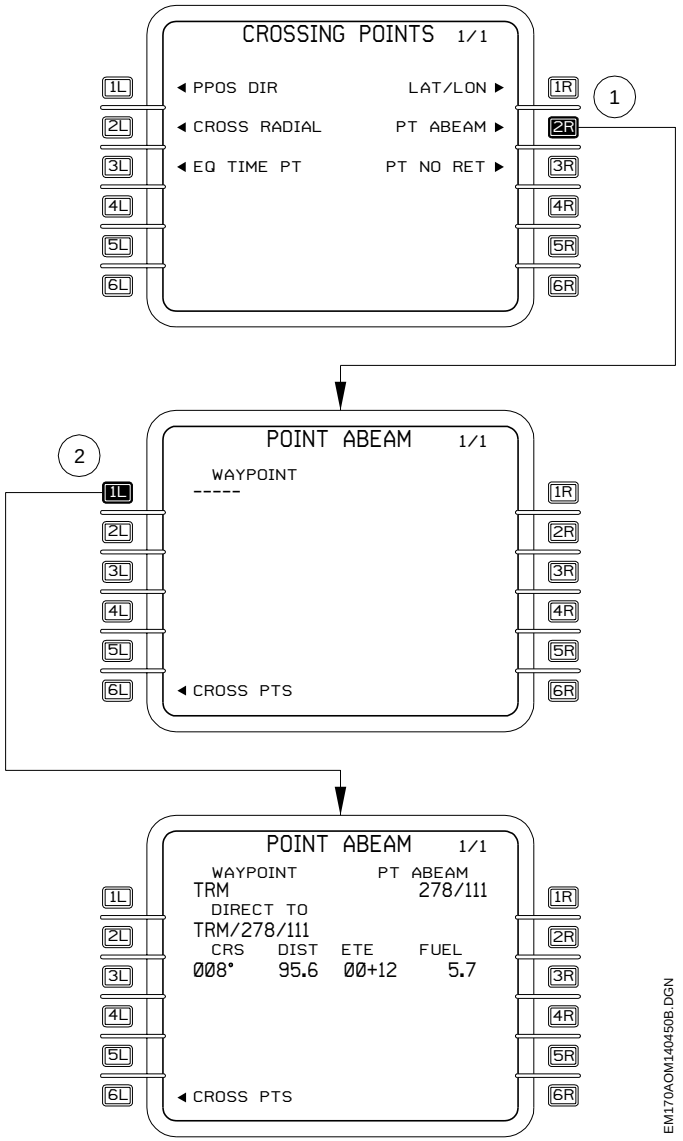
2 - Enter with the waypoint name. The entry is accomplished in the scratchpad through alphanumeric keys and pressing LSK 1L.

After the entry the following information is displayed:

- The radial and distance from the waypoint where the airplane will cross the point abeam.
- Course to the waypoint.
- Distance to the waypoint.
- Estimated time enroute.
- Remaining fuel in the waypoint.

If no point abeam exists for the current flight plan the message NO CROSSING POINT FOUND is displayed.

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POINT ABEAM

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POINT OF NO RETURN

1 - On the CROSSING POINTS 1/1 page press LSK 3R (PT NO RET) to go to POINT OF NO RETURN 1/1 page.

2 - On POINT OF NO RETURN 1/1 page the following information is displayed for the selected waypoint and point of no return:

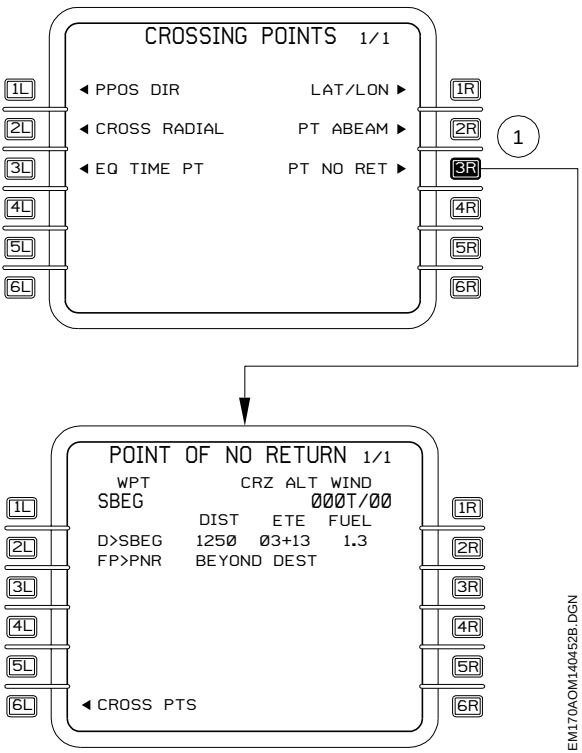
- Distance to the waypoint.
- Estimated time enroute.
- Remaining fuel in the waypoint.

The default waypoint is the origin. It is possible to enter other waypoints and/or cruise wind. The entry is accomplished in the scratchpad through alphanumeric keys and pressing respectively LSK 1L or 1R.

If the airplane has passed the point of no return a message PAST is displayed.

If the point of no return is beyond the destination a message BEYOND DEST is displayed.

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POINT OF NO RETURN

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ARRIVAL

1 - When the airplane is within 200 NM to the destination the prompt ARRIVAL appears. Press LSK 6R (ARRIVAL) to enter in the ARRIVAL 1/1 page.

2 - On ARRIVAL page select LSK 1L (RUNWAY) to go to RUNWAY page.

3 - On RUNWAY page select the runway by pressing the respective LSK.

4 - On APPROACH page select approach procedure by pressing the respective LSK.

5 - On APROACH TRANS page select the approach transition by pressing the respective LSK.

6 - On STAR page select the STAR by pressing the respective LSK.

7 - On STAR TRANS page select the STAR transition by pressing the respective LSK.

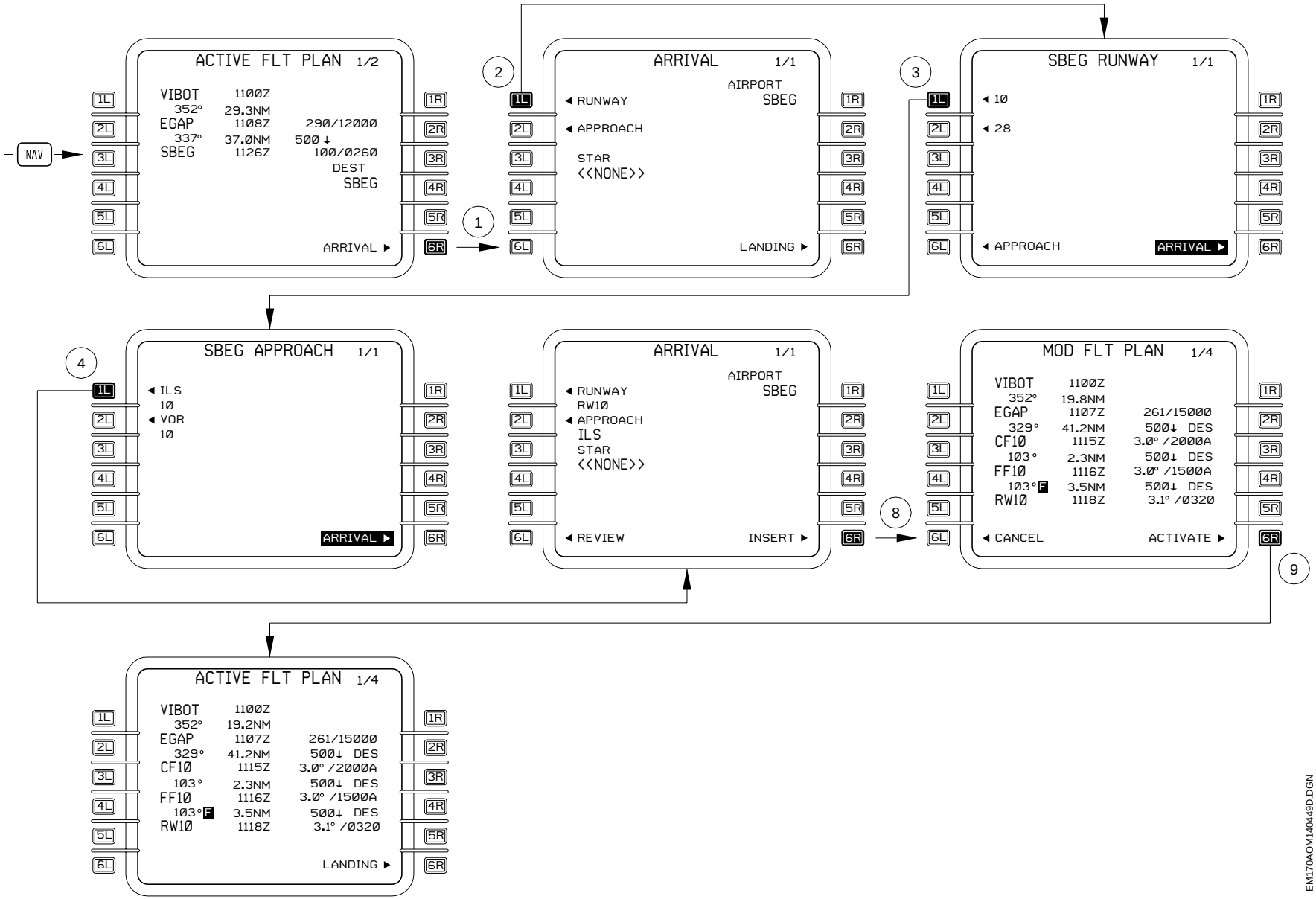
8 - Press LSK 6R (INSERT) to insert the arrival.

9 - On MOD FLT PLAN page press LSK 6R (ACTIVE) to activate the flight plan.

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ARRIVAL

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LANDING

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1 - When the airplane is within 200 NM to the destination the prompt LANDING appears. Press LSK 6R (LANDING) to enter in the LANDING 1/2 page.

On LANDING 1/2 page the following information is displayed:

– Runway outside air temperature.

– Landing weight.

– Approach flaps.

– Landing flaps.

– Ice.

– Approach type.

For landing, surface temperature is required. With exception to landing weight, all the other information can be entered. The entry is accomplished in the scratchpad through alphanumeric keys and pressing respective LSK.

The landing weight displayed in LANDING 1/2 page is based on the following logic:

– If time since airborne is less than or equal to 15 min, the landing weight will be the FMS takeoff weight minus the fuel burn allowance.

– If time since airborne is greater than 15 min, the landing weight will be the predicted landing gross displayed in PERF DATA 1/3.

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2 - Press NEXT button to go to LANDING 2/2 page.

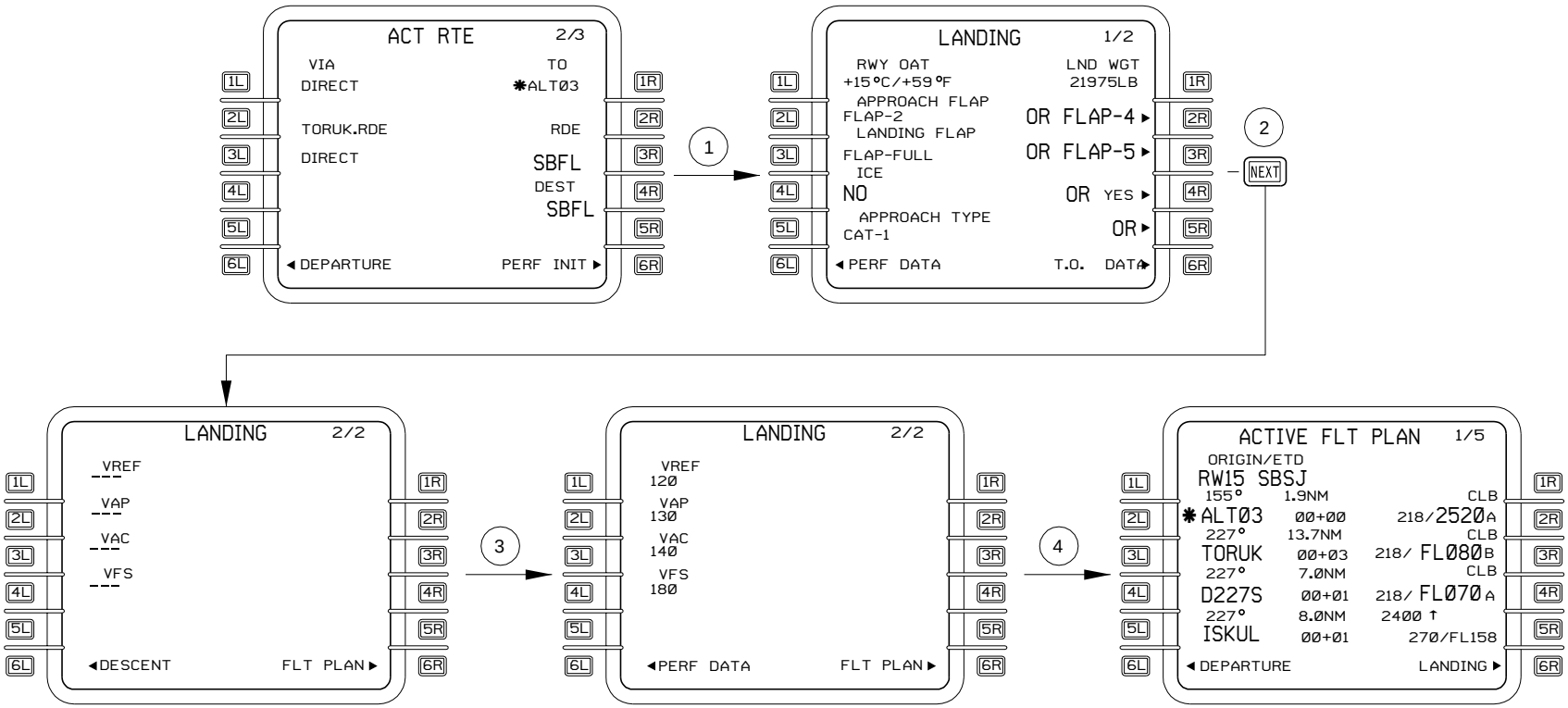
If the landing V-Speeds inserted on the LANDING 2/2 page before the takeoff are not being displayed on the PFD, they are deleted on the FMS 15 min after takeoff.

3 - Enter with VREF, VAP, VAC and VFS. The entry is accomplished in the scratchpad through alphanumeric keys and pressing respective LSK.

4 - Press LSK 6R (FLT PLAN) to go to ACTIVE FLT PLAN page.

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LANDING

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VNAV TEMPERATURE COMPENSATION

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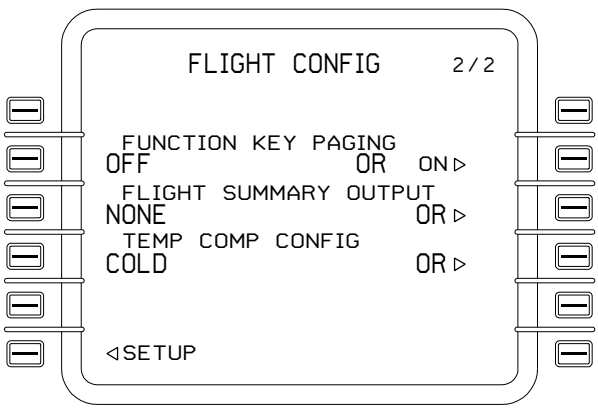
The FMS provides the capability to create constant angle vertical paths for the final approach segment of the non-precision approaches and vertical descent profiles for transition to the final approach segment based on the altitude constraints in the navigation database.

These descent profiles are flown by reference to the indicated barometric altitude. However, barometric altimeters are calibrated to indicate true altitude under ISA conditions of temperature and sea level pressure.

The VNAV temperature compensation provides the capability to compensate the altitude constraints for all the waypoints in approach, approach transitions and missed approach segments of the flight plan during non-standard temperature conditions.

The temperature compensation configuration feature is presented in FLIGHT CONFIG 2/2 page. This page is accessed through the MAINTENANCE 2/3 page.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	ADS 1 (2) (3) FAIL	Associated ADS has failed.
	ADS 1 (2) (3) (4) HTR FAIL	At least one of the two smart probes that feed a respective Air Data System has the associated heater failed.
	AVNX ASCB FAULT	One or more ASCB buses have failed.
	DISPLAY CTRL FAIL	Display controller is no longer operating.
	DISPLAY CTRL FAULT	Loss of a display controller channel. Maintenance is required.
	FMS POS DISAG	A position disagreement between FMSs was detected.
	FMS 1 (2) GPS POS DISAG	A position disagreement between the associated FMS and GPS was detected.
	FMS-GPS POS DISAG	Associated FMS computed position and GPS position do not agree.
	IRS 1 (2) FAIL	Associated IRS has failed.
	IRS EXCESSIVE MOTION	Excessive motion of airplane is disturbing associated IRS aligning sequence.

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TYPE	MESSAGE	MEANING
CAUTION	MCDU 1 (2) (3) OVHT	Associated MCDU has suffered an overheat condition.
	NAVCOM 1 (2) FAIL	All functions hosted in associated MRC are unavailable.
	NAVCOM 1 (2) OVHT	MRC NIM has suffered an overheat condition.
	VALIDATE CONFIG	Top level system part number was updated.
	VHF 1 (2) (3) OVHT	VHF COM has suffered an overheat condition.
	VHF 3 FAIL	Radio 3 COM and ACARS functions have failed.
	XPDR 1 (2) IN STBY (Post-Mod. Load 23.1)	Transponder is at STBY mode in flight.

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TYPE	MESSAGE	MEANING
ADVISORY	ADS 1 (2) HTR FAULT	The electronics in the MFP heater portion of the ADSP has failed.
	ADS 3 (4) SLIPCOMP FAIL	ADS 3 sideslip comparison function has failed.
	ADS-B FAIL	2 GPS has failed or GPS signal has degraded.
	ADS PROBE 1 (2) (3) (4) FAIL	Integrated Pitot/Static/AOA sensor 1 (2) (3) (4) has failed.
	CMC FAIL	CMC has failed.
	CMF 1 (2) FAIL	The respective CMF has failed.
	CVR AFT (FWD) FAIL	Respective DVDR CVR function has failed.
	FDR AFT (FWD) FAIL	Respective DVDR FDR function has failed.
	FLT CTRL ADS FAIL	The electronics in the ADC portion of the ADSP has failed.
	FMS 1 (2) FAIL	Associated FMS has failed.
	HF 1 (2) FAIL	The respective HF has failed. These messages are displayed only for dual installation.
	IRS ALIGNING	Associated IRS is in aligning sequence.
	IRS 1 (2) NAV MODE FAIL	Associated IRS is no longer providing navigation information.

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TYPE	MESSAGE	MEANING
ADVISORY	IRS PRES POS INVALID	Associated IRS did not receive present position or received an invalid one.
	RALT 1 (2) (3) FAIL	Associated Radio Altimeter has failed.
	SATCOM FAIL	The SATCOM System has failed.
	TAT 1 (2) FAIL	The associated Total Air Temperature measurement system or its heater has failed.
	XPDR 1 (2) FAIL	MRC 1 (2) has detected a transponder failure.
STATUS	PRINTER FAULT	Printer functionality is degraded.

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SECTION 14-10

FUEL

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	Block	Page
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EICAS INDICATION	14-10-05	7
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GENERAL DESCRIPTION

The fuel system is designed to continuously provide fuel to the engines and APU.

Fuel is stored in two integral wing tanks, interconnected by a crossfeed valve.

The fuel system incorporates:

- Storage: vented integral fuel tanks in the airplane.
- Distribution: engine/APU feeding and tank refueling/defueling.
- Indication.

The fuel system parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS display.

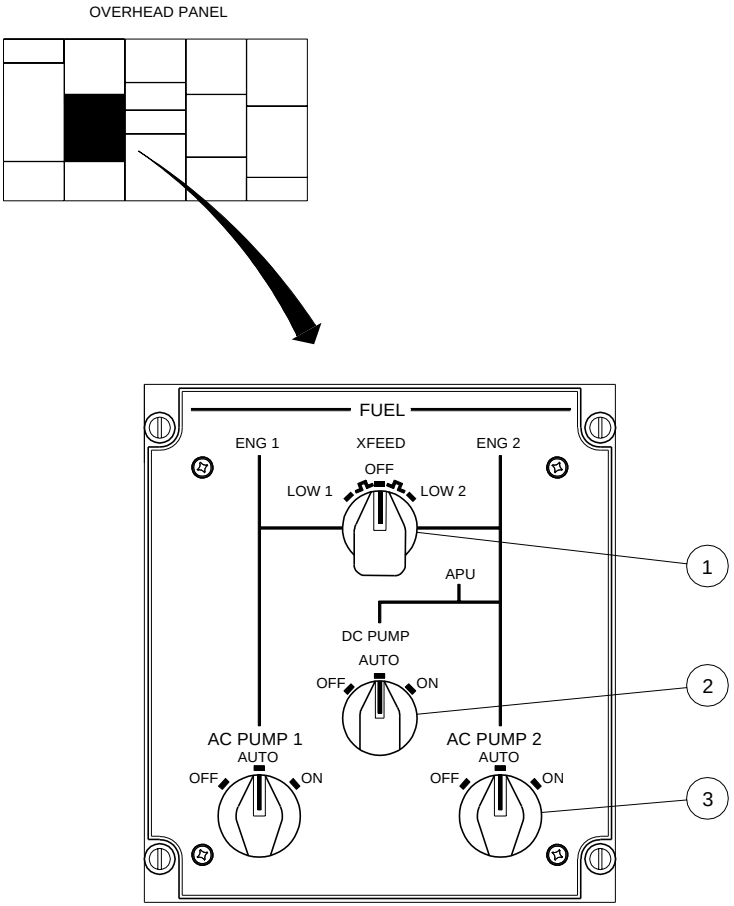
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FUEL CONTROL PANEL

►*190 Models Commercial Airplanes Non-ETOPS Configured - partially compliant or not at all compliant with FAA CMP-2925 or ANAC CMP-2356*



◄

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1 - CROSSFEED SELECTOR KNOB

LOW 1: opens the crossfeed valve and automatically activates the right AC fuel pump (AC PUMP 2), supplying fuel to both engines from the right wing tank.

OFF: closes the crossfeed valve.

LOW 2: opens the crossfeed valve and automatically activates the left AC fuel pump (AC PUMP 1), supplying fuel to both engines from the left wing tank.

2 - DC FUEL PUMP SELECTOR KNOB

OFF: deactivates the DC fuel pump.

AUTO: automatically operates the DC fuel pump according to the system's logic.

ON: activates the DC fuel pump.

3 - AC FUEL SELECTOR KNOBS

OFF: deactivates the associated AC fuel pump.

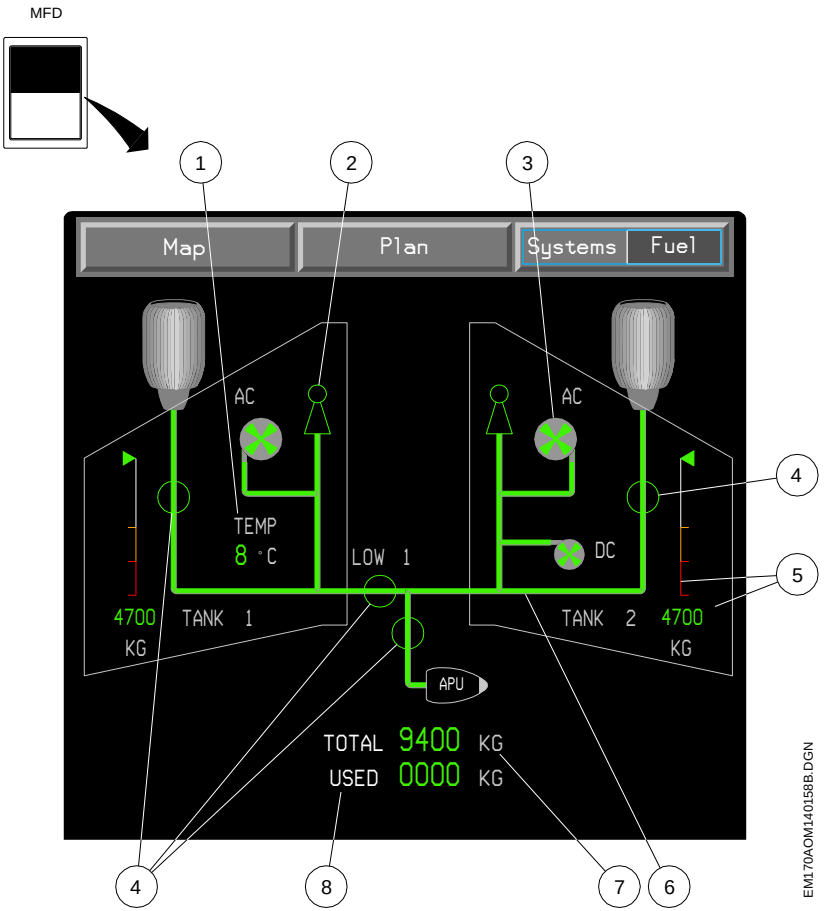
AUTO: automatically operates the associated AC fuel pump according to the system's logic.

ON: activates the associated AC fuel pump.

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FUEL SYNOPTIC PAGE ON MFD

The fuel synoptic page provides a visual representation of the fuel system operation and parameters, and can be monitored by the flight crew on either MFD.



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1 - TEMPERATURE INDICATION

– Digital Temperature.

The digital information indicates the fuel temperature measured in the left fuel tank.

GREEN: normal operating range.

AMBER: cautionary operating range.

AMBER DASHED: invalid information.

2 - JET PUMP INDICATION

GREEN: the associated jet pump is activated.

WHITE: the associated jet pump is deactivated.

AMBER DASHED: invalid information.

3 - ELECTRIC FUEL PUMP STATUS

– The electric pumps are depicted as circles with an internal windmill, representing the pump status.

ON: a gray circle with a green windmill.

OFF: a gray circle with a white windmill.

UNDETERMINED: an amber dashed circle with an amber windmill.

FAILED ON: a gray circle with a green windmill beneath an amber cross.

FAILED OFF: a gray circle with a white windmill beneath an amber cross.

4 - FUEL SYSTEM VALVES STATUS

– The fuel system valves are depicted as circles with an internal line representing the valve position. Above the fuel crossfeed valve, the label LOW 1 or LOW 2 is indicated whenever one engine is being fed by the opposite wing tank.

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OPEN: a circle with a line aligned with the flow line, both the circle and the line either green (positive fuel pressure) or white (no fuel pressure).

CLOSED: a white circle with a white line perpendicular to the flow line.

UNDETERMINED: an amber dashed circle with no line.

IN TRANSIT: a circle with a line diagonal to the flow line, both the circle and the line either green (positive fuel pressure) or white (no fuel pressure).

FAILED CLOSED: a white circle with a white line perpendicular to the flow line, beneath an amber cross.

FAILED OPEN: a circle with a line aligned with the flow line, beneath an amber cross. Both the circle and the line either green (positive fuel pressure) or white (no fuel pressure).

5 - FUEL TANK QUANTITY INDICATION (TANK 1 and TANK 2)

– The fuel tank quantity indication is the total amount of fuel remaining in the associated wing tank.

– Digital Quantity:

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: low fuel quantity.

– Scale:

WHITE: normal operating range.

AMBER: cautionary operating range.

RED: low fuel quantity.

6 - FUEL FLOW LINE

GREEN: the associated flow line is pressurized.

WHITE: the associated flow line is not pressurized.

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AMBER DASHED: the associated flow line pressure is undetermined.

NOTE: When Engine N2 speeds are below 60% it is a normal system behavior not to display fuel flow in the fuel lines (green) or display unknown status (dashed).

7 - TOTAL FUEL QUANTITY INDICATION

– Indicates the total fuel quantity in all tanks.

GREEN: normal operating range.

AMBER: cautionary operating range.

AMBER DASHED: invalid information.

RED: low level.

8 - TOTAL FUEL USED INDICATION

– Indicates the total fuel used.

GREEN: normal operating range.

AMBER DASHED: invalid information.

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EICAS INDICATION



1 - FUEL FLOW INDICATION

– Indicates the left and right engine fuel flow.

GREEN: normal operating range.

AMBER DASHED: invalid information.

2 - FUEL QUANTITY INDICATION

– Indicates left and right wing tanks fuel quantities separately. Total fuel in all tanks is indicated inside a gray box.

GREEN: normal operating range.

AMBER DASHED: invalid information.

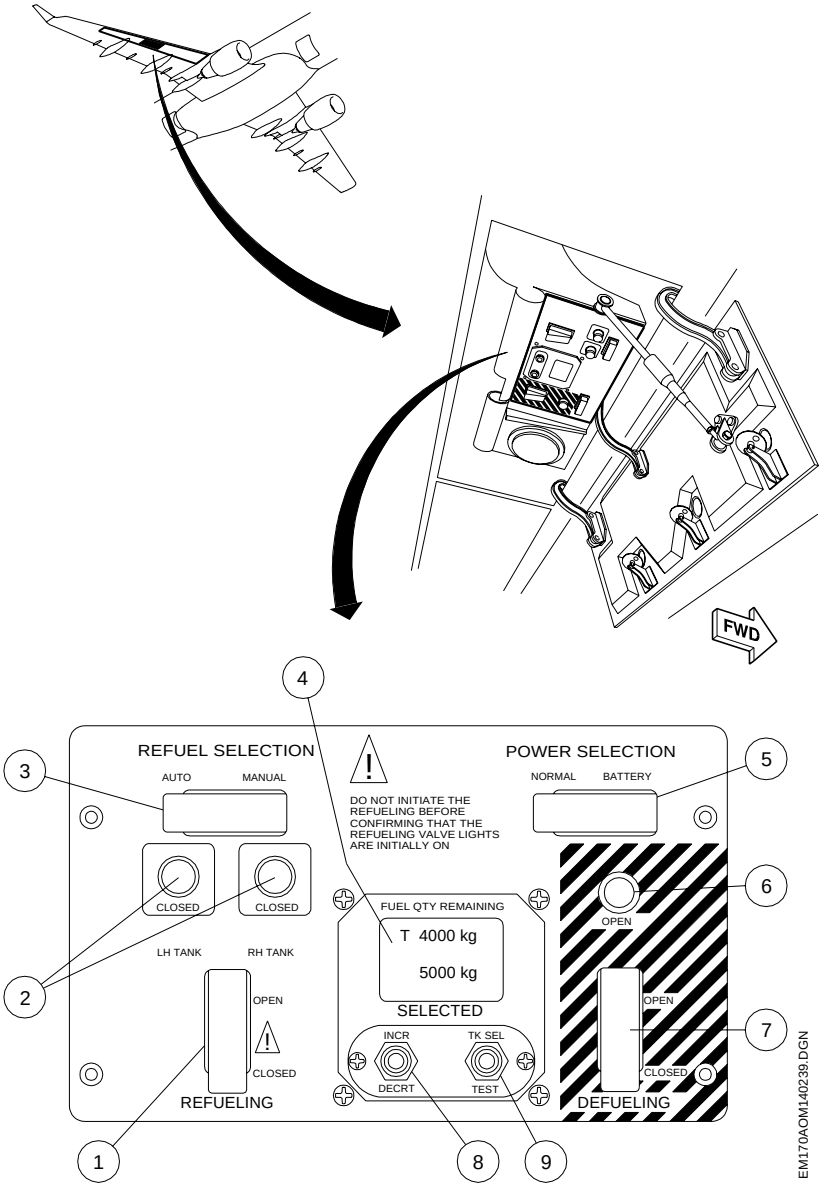
AMBER: cautionary operating range.

RED: low fuel quantity.

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REFUELING/DEFUELING CONTROL PANEL

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1 - REFUELING SWITCH (GUARDED)

OPEN: opens the refueling valve.
CLOSED: closes the refueling valve.

2 - REFUELING CLOSED LIGHTS

– Illuminate indicating that the corresponding wing tank refueling shutoff valve is closed.

3 - REFUEL SELECTION SWITCH (GUARDED)

AUTO: automatic mode of operation.
MANUAL: manual mode of operation.

4 - DISPLAY

– The upper display indicates the fuel remaining in the associated tank as selected by the TK SEL/TEST switch (L for the left tank, R for the right tank and T for both tanks).

– The lower display indicates the total fuel quantity pre-selected via the INCR/DECRT switch. Zero is indicated when the refueling compartment door is opened.

5 - POWER SELECTION SWITCH (GUARDED)

NORMAL: DC BUS 1 and 2 power the refueling system.
BATTERY: HOT BATT BUS 2 powers the refueling system.

6 - DEFUELING OPEN LIGHT

– Illuminates indicating that the defueling shutoff valve is open.

7 - DEFUELING SWITCH (GUARDED)

OPEN: opens the defueling valve.
CLOSED: closes the defueling valve.

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8 - INCR/DECR SWITCH

– Spring-loaded switch.

– Increases or decreases the value for fuel quantity selected.

9 - TK SEL/TEST SWITCH

– Spring-loaded switch.

TK SEL: selects the fuel quantity that is indicated on the upper display. When the display is first powered on, the total fuel quantity is shown. Sequentially actuating the switch will select, in order: left tank fuel quantity, right tank fuel quantity and total fuel quantity.

TEST: performs a repeater display indication test.

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FUEL TANKS

The fuel system comprises two integral fuel tanks, with one tank located in each wing. Each wing tank incorporates:

– a collector tank

– a surge tank

The collector tank (inboard section) keeps the fuel pumps submerged, ensuring a constant fuel flow to the respective engine. The surge tank is designed to collect any fuel that may enter the vent system during wing down and uncoordinated maneuvers.

A vent system is designed to ensure that the differential pressure between the tank and surrounding environment remains within structural limits and to prevent fuel spillage during flight maneuvers and hard breaking. Each fuel tank is vented through a vent tank in the outboard section (surge tank) of the wing. Vent lines provide adequate capacity for tank venting and are supplemented by a high capacity pressure relief valve to protect from fuel tank over-pressurization.

One water drain valve collect water by gravity in each tank.

FUEL QUANTITY INDICATION

Electrical sensors measure the fuel quantity in each tank. One additional independent fuel low-level sensor installed in each tank detects the fuel low-level condition.

On ground, three magnetic level indicators (dripsticks) mounted under each wing, provide an alternate means for fuel measuring. They are numbered as LH3, LH2 and LH1 (left hand wing – from outboard to inboard) and RH1, RH2 and RH3 (right hand wing – from inboard to outboard). The stick indication is related to the fuel quantity through the correlation table provided on AOM – Ground Servicing – Fuel Servicing.

The maximum fuel quantities indicated to the flight crew are given below:

TANK	VOLUME	WEIGHT [1]
1 (left)	8076.5 ℓ	6550 kg
2 (right)	8076.5 ℓ	6550 kg
TOTAL	16153.0 ℓ	13100 kg

1. Fuel density = 0.811 kg/ℓ.

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MCDU FUEL USED RESET

The used fuel reset is performed through the MCDU as follows:

– Press NAV button to enter in the navigation index page.

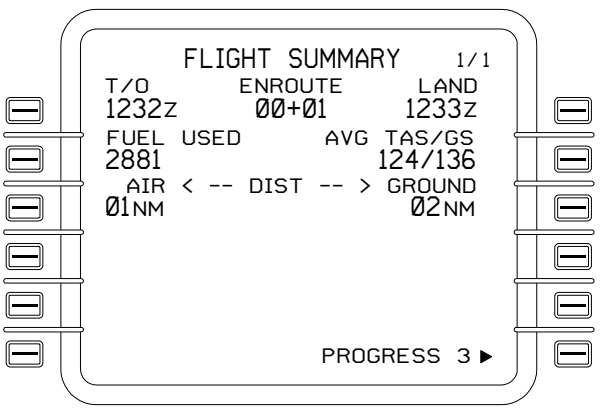
– Press LSK 3R (FLT SUM) to enter in the flight summary page.

– Press DEL button.

– Press LSK 2L to select the fuel used.
▶*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

NOTE: The FUEL USED indication is automatically reset by the FMS upon the first engine start.

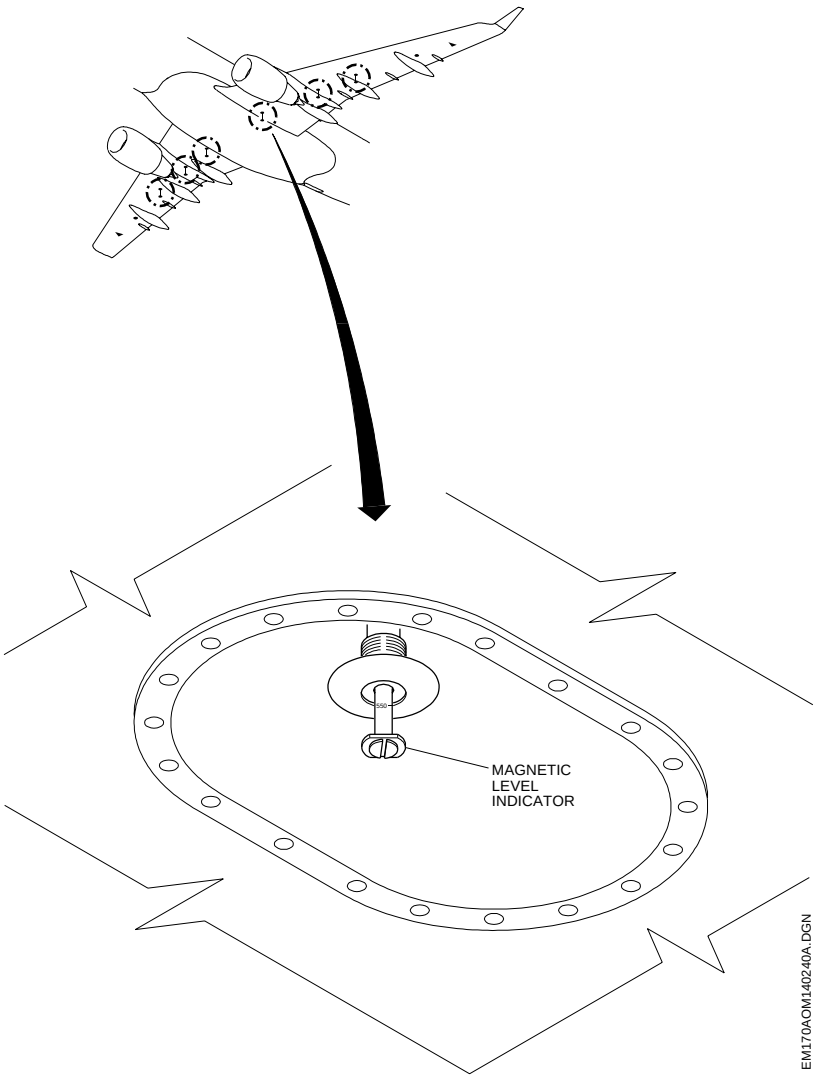
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EM170AOM140353.DGN

MCDU FLIGHT SUMMARY PAGE

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MAGNETIC LEVER INDICATORS

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FUEL PUMPS

Each wing fuel tank contains the following pumps:

- Ejector fuel pump.
- Wing AC electric fuel pump.
- Three scavenge ejector pumps.
- DC electric fuel pump (right tank only).

EJECTOR FUEL PUMP

The primary wing fuel pump is a venturi ejector pump (jet pump) with no moving parts, and is powered by the respective engine motive flow. It is a self-sustained pump and does not require electrical power to operate.

WING AC FUEL PUMP

The wing tanks AC electric fuel pump supplies fuel to the following components:

- Onside engine during engine starts.
- Cross side engine during crossfeed operations.
- APU, when engine is not running.

It is also a backup pump in the event of ejector pump failure.

The left wing AC electric fuel pump (AC PUMP 1) is powered by AC BUS 1. The right wing AC electric fuel pump (AC PUMP 2) is powered by AC ESS BUS.

SCAVENGE PUMPS

Three scavenge jet pumps maintain the fuel level in the collector tank, ensuring a constant flow of fuel to the engine during normal flight.

DC FUEL PUMP

A DC electric fuel pump is installed only in the right wing tank. It provides pressurized fuel for normal APU operation and engine start, when AC power or the AC fuel pump is not available. The DC electric fuel pump is powered by the DC ESS BUS 2 and can be used in flight or on ground.

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FUEL CROSSFEED

The crossfeed valve permits fuel supply to both engines from one tank in order to correct and avoid wings fuel imbalance condition during dual and single engine operations. Setting the crossfeed selector knob to LOW 1 position opens the crossfeed valve and activates the AC PUMP 2, feeding both engines from wing tank 2. Setting the crossfeed selector knob to LOW 2 position opens the crossfeed valve and activates AC PUMP 1, feeding both engines from wing tank 1.

When the crossfeed knob is selected (LOW 1 or LOW 2) at low thrust settings, the amount of fuel supplied by the activated AC PUMP to the opposite engine may be more than the current burned fuel, consequently, the remaining non burned fuel will be sent to the respective tank through the ejector inlet port. The association of this system characteristic to a crossfeed operation at low thrust setting may cause the fuel to be transferred from one tank to the other tank.

NOTE: – Setting AC PUMP 1 or 2 selector knob to any position different than AUTO overrides fuel crossfeed pumps command.
– During crossfeed operation, the fuel line between EJECTOR PUMP and AC PUMP on fuel synoptic page may become white.

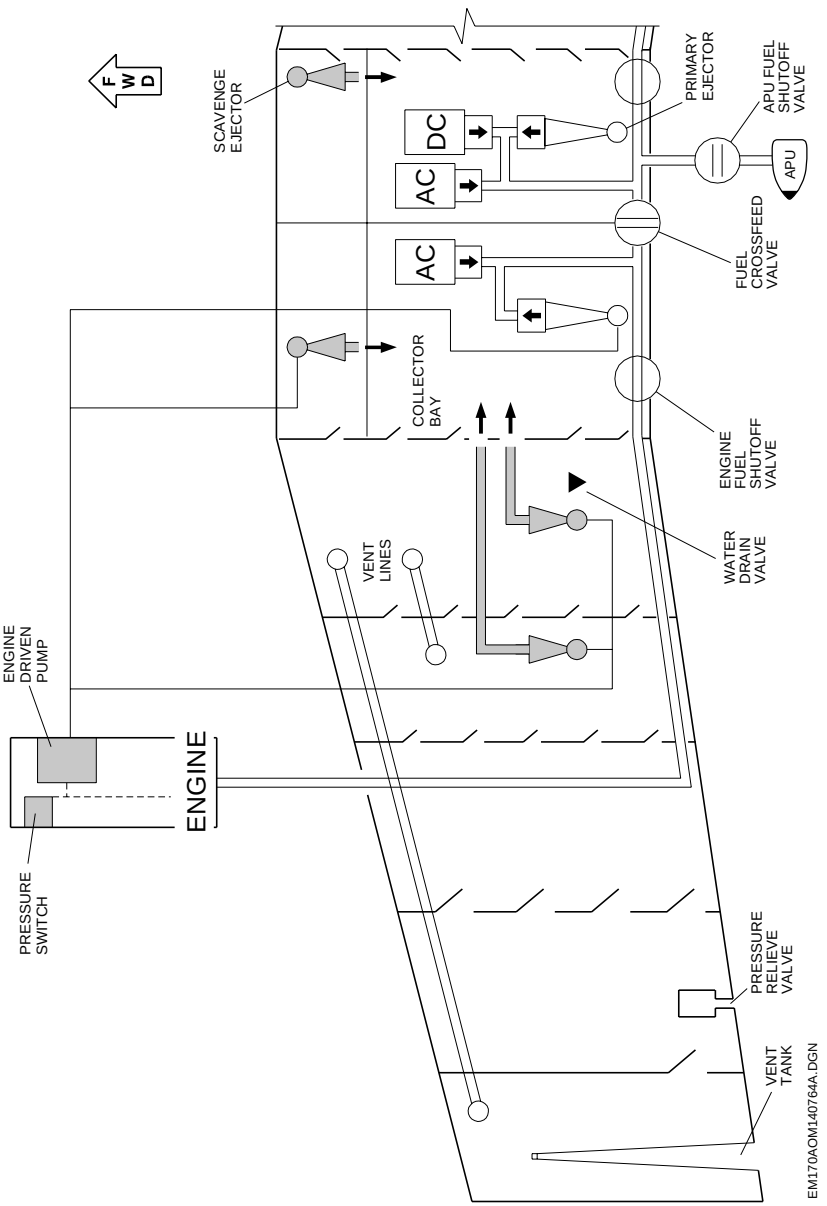
When the wings fuel imbalance reaches its maximum operational limit (360 kg), the EICAS CAUTION message FUEL IMBALANCE is displayed. When the wings fuel imbalance reduces to 45 kg, the EICAS ADVISORY message FUEL EQUAL – XFEED OPEN is displayed, indicating that there is no fuel imbalance condition and the crossfeed valve is open.

NOTE: If the crossfeed valve is open prior to reaching the wings fuel imbalance condition (360 kg), the message FUEL EQUAL – XFEED OPEN is displayed even if wings fuel imbalance is more than 45 kg.

ENGINE FUEL SHUTOFF VALVE

The engine fuel shutoff valve is installed in each wing feed line to prevent hazardous quantities of fuel from flowing into the fire zones. The shutoff valves are normally open. Only the actuation of the fire handles on the cockpit closes the shutoff valves.

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NORMAL ENGINE FEED OPERATION

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FUEL LOW LEVEL WARNING

Each wing tank has a dedicated Fuel Low Level sensor located in the collector box. The Fuel Low Level sensor is independent of the fuel quantity indication system. Whenever the fuel level in the collector box is below the sensor level, it sends a fuel low level signal to the warning system, thus triggering the FUEL LO LEVEL warning EICAS message.

Under normal conditions, the low level warning message activation point is set at 400 kg of fuel in the associated wing tank.

If any scavenge pump stops transferring fuel to the Collector Box, which might be caused by an engine failure, loss of motive flow or scavenge pumps failure/blockage, the fuel contained in the Collector Box flows out so that the fuel level inside the Collector Box and the rest of the tank reaches the same level.

Under this condition, if there is up to 2800 kg (approximately) of fuel inside that tank it is possible that the level equivalent to the low level warning activation point will be reached as the fuel level inside the collector box decreases, then FUEL 1 (2) LO LEVEL warning EICAS message displays indicating that fuel level is below the low level sensor.

Therefore, in case of loss of the transfer system to the Collector Box, the EICAS WARNING message FUEL 1 (2) LO LEVEL may display even though fuel quantity indication on the EICAS or MFD Fuel System Synoptic Page is up to 2800 kg in that tank.

NOTE: – In case of loss of the transfer system to the Collector Box followed by the EICAS warning message, fuel quantity indication monitoring during the flight is achieved through EICAS, or MFD Fuel System synoptic page.

– Engine flameout due to fuel starvation may occur if the airplane is subjected to attitudes greater than 15° nose up or down, uncoordinated maneuvers or negative g's.

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REFUELING AND DEFUELING

There is a single pressurized refueling point and a refuel/defuel control panel located under the right wing. When the access panel door is opened, an overhead panel lamp comes on for night or low light operations.

Pressurized refueling is performed with the airplane energized either by AC or battery power. A switch located on the refueling panel enables selection of either power sources.

Refueling operation modes can be either AUTO or MANUAL. When the refueling switch is in the OPEN position, the refuel control valves open enabling fuel flow. Refueling in AUTO mode the FCU (Fuel Conditioning Unit) controls the refuel shutoff valves, automatically halting refueling when the pre-selected value is reached. In MANUAL mode, the FCU is bypassed. Setting of the CLOSED position in the refueling control switch halts refueling.

In automatic mode, the desired wing tank fuel quantity may be selected on the fuel quantity remaining display via the INCR/DECRT switch.

In the pressurized refueling, the system will automatically close the shutoff to prevent overfilling whenever the fuel rises up to a certain level. Moreover, the STOP L/R OVR message(s) will appear on the Refueling/Defueling control panel display when the quantity in the right, left or both wing tanks, respectively, is above its capacity.

The wing fuel tanks may be partially or completely refueled using the gravity refuel port located on top of each wing. The individual fuel quantity can be determined using the EICAS or the magnetic level indicators.

The airplane can be defueled by suction and/or pressure. The defuel shutoff valve is controlled by the DEFUEL switch located on the refuel/defuel control panel.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	FUEL 1 (2) LO LEVEL	Low-level sensors indicate that 400 kg (880 lb) of fuel remain in the respective tank.
CAUTION	APU FUEL SOV FAIL	Shutoff valve is not in the commanded position.
	ENG 1 (2) FUEL SOV FAIL	Associated shutoff valve is not in the commanded position.
	FUEL AC PUMP 1 (2) FAIL (Pre-Mod. Load 19.3 or SB 190-31-0009)	Indicates a discrepancy between the commanded and actual associated pump state.
	FUEL IMBALANCE	Indicates an imbalance of fuel between the two tanks greater than or equal to 360 kg (800 lb). It remains displayed until the imbalance is reduced to 45 kg (100 lb).

NOTE: FUEL 1 (2) LO LEVEL may appear spuriously when flying with high pitch and/or bank angles.

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TYPE	MESSAGE	MEANING
CAUTION	FUEL TANK LO TEMP (Post-Mod. Load 17.5 or SB 190-31-0007)	Temperature sensed in the left collector bay is less than or equal to -37°C.
	FUEL XFEED FAIL	Indicates a discrepancy between the cockpit control position and either the valve position or the affected pump status.
	FUEL XFEED OVRD FAIL (only for ETOPS airplanes)	Crossfeed valve position status OR AC pumps operating status is not in the commanded position, while the crossfeed override is used.
ADVISORY	DEFUEL SOV OPEN	Defuel shutoff valve is open.
	FUEL AC PUMP 1 (2) FAIL (Post-Mod. Load 19.3 or SB 190-31-0009)	Indicates a discrepancy between the commanded and actual associated pump state.
	FUEL DC PUMP FAIL	Indicates a discrepancy between the commanded and actual pump state.
	FUEL EQUAL-XFEED OPEN	Crossfeed valve commanded open before fuel imbalance has reached 360 kg (800 lb) and the FUEL IMBALANCE message has been triggered or crossfeed valve is still open and fuel imbalance condition is suppressed after FUEL IMBALANCE message has been triggered.

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TYPE	MESSAGE	MEANING
ADVISORY	FUEL FEED 1 (2) FAULT	Respective backup AC fuel pump is ON due to failure of the associated main engine fuel feed system (motive flow).
	FUEL KG-LB MISMATCH	Label units defined at FCU do not agree with label units set on the EICAS.
	FUEL TANK LO TEMP (Pre-Mod. Load 17.5 or SB 190-31-0007)	Temperature sensed in the left collector bay is less than or equal to -37°C.
STATUS	APU FUEL SOV CLOSED	APU fuel shutoff valve is fully closed.
	ENG 1 (2) FUEL SOV CLOSED	Associated engine shutoff valve is fully closed.
	FUEL XFEED SOV OPEN	Crossfeed valve is open.
	FUEL XFEED OVRD LOW1 (only for ETOPS airplanes)	Wing tank 2 (RH) is feeding both engines or engine 1 (LH), while the crossfeed override button is pressed.
	FUEL XFEED OVRD LOW2 (only for ETOPS airplanes)	Wing tank 1 (LH) is feeding both engines or engine 2 (RH), while the crossfeed override button is pressed.

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SECTION 14-11

HYDRAULIC

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GENERAL DESCRIPTION

The airplane has three independent hydraulic systems to provide power for:

- Flight controls
- Spoilers
- Landing gear
- Nose wheel steering
- Wheel brakes
- Thrust reversers

Normal operation of the hydraulic system is automatic.

The hydraulic systems do not have any fluid communication point, therefore, hydraulic fluid cannot be transferred from one system to another. All three systems use skydrol hydraulic fluid and operate at a nominal pressure of 3000 psig.

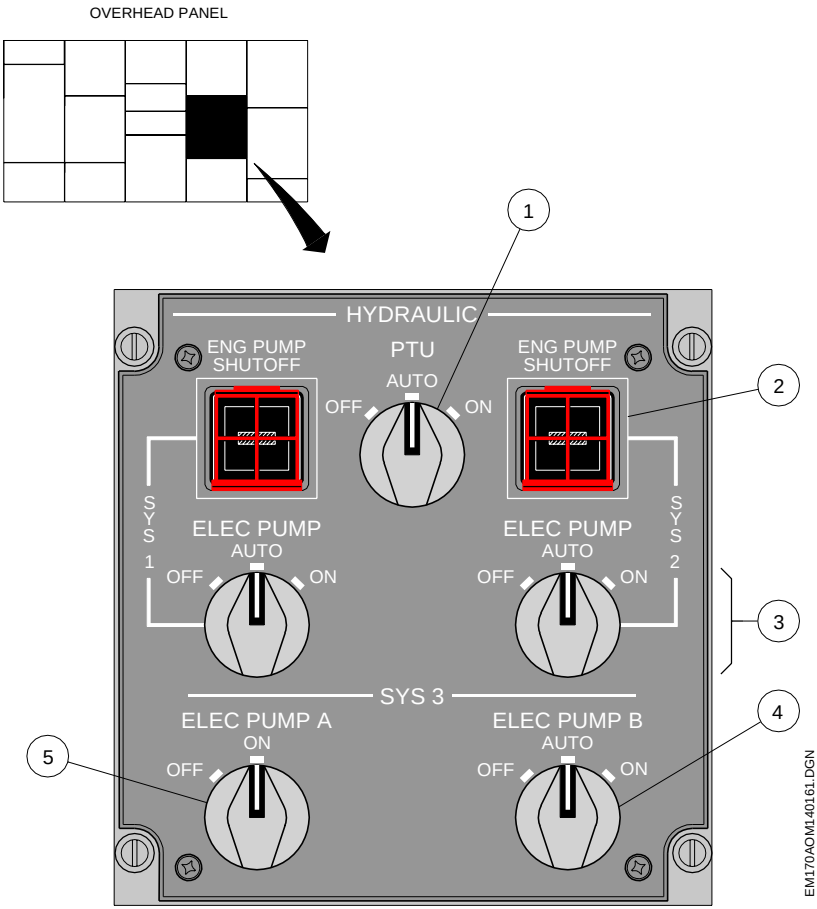
The hydraulic system's parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on the EICAS display.

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HYDRAULIC SYSTEM PANEL



HYDRAULIC SYSTEM PANEL

1 - POWER TRANSFER UNIT (PTU) CONTROL KNOB (ROTARY ACTION)

OFF: turns the PTU off.

AUTO: allows the PTU to operate automatically, according to hydraulic system logic.

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ON: operates the PTU continuously, overriding the hydraulic system logic.

2 - SYS 1 AND SYS 2 ENGINE PUMP SHUTOFF VALVE BUTTONS (GUARDED)

Pushbuttons:

– Closes the hydraulic shutoff valve (SOV), isolating the respective engine driven pump (EDP) from the associated hydraulic system.

3 - SYS 1 AND SYS 2 ELECTRIC HYDRAULIC PUMP SELECTOR KNOBS (ROTARY ACTION)

OFF: turns the associated electrical pump off.

AUTO: allows the associated electrical pump to operate automatically, according to hydraulic system logic.

ON: operates the associated electrical pump continuously, overriding the system logic.

4 - SYS 3 ELECTRIC HYDRAULIC PUMP B SELECTOR KNOB (ROTARY ACTION)

OFF: turns the electrical pump off.

AUTO: allows the electrical pump to operate automatically, according to hydraulic system logic.

ON: operates the electrical pump continuously, overriding the system logic.

5 - SYS 3 ELECTRIC HYDRAULIC PUMP A SELECTOR KNOB (ROTARY ACTION)

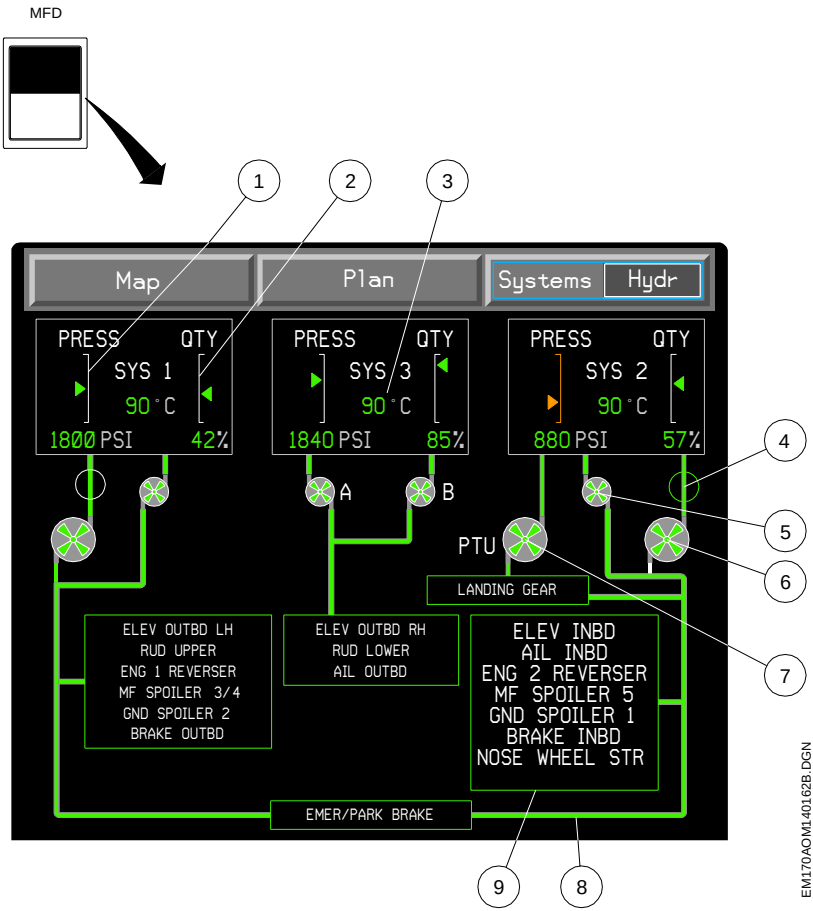
OFF: turns the electrical pump off.

ON: turns the electrical pump on.

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HYDRAULIC SYNOPTIC PAGE ON MFD

The hydraulic synoptic page provides a visual representation of the hydraulic system operation and parameters. The page can be selected by the flight crew for viewing on either MFD. In the event of any system failure, the size of the letters inside the associated distribution box (9) increase to attract the attention of the flight crew.



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1 - PRESSURE INDICATION

– Digital Pressure

GREEN: normal operating range.

AMBER: cautionary operating range.

GRAY: label (PSI).

AMBER DASHED: invalid information or a value out of the valid range.

– Pressure Scale/Pointer
The pointer on the scale indicates a value equal to that shown on the digital display. If the value is invalid, the pointer will be removed from the display.

  – Scale:
  WHITE: normal operating range.
  AMBER: cautionary operating range.

  – Pointer:
  GREEN: normal operating range.
  AMBER: cautionary operating range.

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2 - QUANTITY INDICATION

– Digital Quantity
Displays the percentage of fluid remaining for each hydraulic system.

GREEN: normal quantity.

CYAN: reservoir requires refilling.

AMBER DASHED: invalid information or a value out of displayable range.

GRAY: label (%)

– Quantity Scale/Pointer
The pointer on the scale indicates a value equal to that shown on the digital display. If the value is invalid, the pointer will be removed from the display.

  – Scale
  WHITE: normal quantity.
  CYAN: reservoir requires refilling.

  – Pointer
  GREEN: normal quantity.
  CYAN: reservoir requires refilling.

3 - TEMPERATURE INDICATION

– Digital Temperature
Indicates the hydraulic fluid temperature measured in the reservoir.

GREEN: normal operating range.

AMBER: cautionary operating range.

RED: operating limit exceeded.

AMBER DASHED: invalid information or a value out of the valid range.

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4 - ENGINE PUMP SHUTOFF VALVE STATUS

On the synoptic page, the shutoff valve is depicted as a circle with an internal line representing the valve position.

– OPEN: a green circle and a green line aligned with the flow line.

– CLOSED: a white circle and a white line perpendicular to the flow line.

– UNDETERMINED: an amber dashed circle with no line.

– IN TRANSIT: a white circle and a white line diagonal to the flow line.

– FAILED: a white circle beneath an amber cross.

5 - ELECTRIC HYDRAULIC PUMP STATUS

On the synoptic page, the electrical pump is depicted as a circle with an internal windmill.

– ON: a gray circle and a green windmill.

– OFF: a gray circle and a white windmill.

– UNDETERMINED: an amber dashed circle and an amber windmill.

– FAILED: a gray circle and a white windmill beneath an amber cross.

NOTE: The icons that represent electrical pumps are smaller than the engine-driven pump and PTU icons.

6 - ENGINE DRIVEN HYDRAULIC PUMP STATUS

On the synoptic page, the engine pump is depicted as a circle with an internal windmill.

– ON: a gray circle and a green windmill.

– OFF: a gray circle and a white windmill.

– UNDETERMINED: an amber dashed circle and an amber windmill.

– FAILED: a gray circle and a white windmill beneath an amber cross.

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7 - POWER TRANSFER UNIT STATUS

On the synoptic page, the PTU is depicted as a circle with an internal windmill.

– ON: a gray circle and a green windmill.

– OFF: a gray circle and a white windmill.

– UNDETERMINED: an amber dashed circle and an amber windmill.

– FAILED: a gray circle and a white windmill beneath an amber cross.

8 - HYDRAULIC FLOW LINE

On the synoptic page, the flow line is depicted as a colorful line.

GREEN: the associated flow line is pressurized.

WHITE: the associated flow line is not pressurized.

WHITE/AMBER DASHED: the associated flow line pressure is undetermined.

9 - HYDRAULIC SYSTEM DISTRIBUTION BOX

Each distribution box indicates the airplane's systems supplied by the respective hydraulic system.

GREEN: the associated hydraulic system is pressurized.

WHITE: the associated hydraulic system is not pressurized.

WHITE/AMBER DASHED: the associated hydraulic system pressure is undetermined.

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HYDRAULIC SYSTEM

The airplane has three independent hydraulic systems, which provide power to the primary and secondary flight controls, the landing gear, the brakes, the nose wheel steering and the thrust reversers.

The hydraulic system is designed in such a way that even a failure of two hydraulic systems will not result in a complete loss of flight-critical functions.

NORMAL OPERATION

The operation of the hydraulic system is mostly automatic and requires little pilot action. The system architecture and level of redundancy allows it to accommodate most system failures without degradation to the airplane's safe operation.

HYDRAULIC SYSTEM 1

Hydraulic System 1 is comprised of one reservoir, one Engine-Driven Pump (EDP 1), one electric hydraulic pump and one accumulator. Hydraulic System 1 supplies the following systems:

- Elevator (left hand outboard actuators)
- Rudder (upper actuator)
- Thrust reverser (engine 1)
- Multi-function spoilers (left and right panels 3 and 4)
- Ground spoilers (left and right panel 2)
- Outboard brake
- Emergency parking brake

ABNORMAL OPERATION

The hydraulic system 1 is equipped with an overheating protection system.

When the hydraulic fluid temperature increases to 100°C, the HYD 1 HI TEMP EICAS caution message will be displayed.

If the fluid temperature reaches 125°C, the shutoff valve (SOV) will automatically actuate, thus isolating the EDP 1 from the respective hydraulic flow line.

In the event of hydraulic system overheat (fluid temperature above 145°C), the HYD 1 OVERHEAT EICAS warning message will be

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displayed. In this case, the SOV can be manually commanded through a guarded pushbutton on the hydraulic system control panel.

Also, in the event of engine flameout, the FADEC will depressurize the respective EDP in order to reduce the torque loads on the engine and facilitate a windmill restart.

HYDRAULIC SYSTEM 1 RESERVOIR

A mechanical piston pressurizes the hydraulic system 1 reservoir, which supplies fluid to the pump. From the pump , fluid is then directed to the manifold, where it is filtered and routed to user systems.

In the return line, all the fluid is re-filtered and depending on the temperature, part of the fluid will either be routed to the heat exchanger or directed back to the reservoir.

A quantity measuring system and a temperature transducer are located at the reservoir, providing information to both MFD (synoptic page) and EICAS displays.

ENGINE DRIVEN PUMP (EDP 1)

The EDP 1 is connected to the engine 1 accessories gearbox and it is the primary power source for Hydraulic System 1. Its normal operation requires no pilot action.

ELECTRIC HYDRAULIC PUMP 1

The Electric Hydraulic Pump 1 serves as a backup for the EDP 1 and it is powered by the AC BUS 2.

A three-position selector knob located on the hydraulic panel enables the flight crew to select OFF, AUTO or ON positions. In normal operation, selected position is AUTO.

In flight, with the selector knob set to AUTO position, the Hydraulic System logic activates the electric pump in case of:

- EDP or engine fail, or
- Flaps selected to any position greater than 0°.

During landing operations, the Electric Hydraulic Pumps will be activated for 60 seconds to avoid abrupt hydraulic pressure variations in an event of engine failure.

On ground, with the selector knob set to AUTO position, the Hydraulic

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System logic activates the electric pump in case of:

- Flaps selected to any position greater than 0° and:
  – Thrust levers set to takeoff thrust, or
  – Ground speed greater than 50 kt.

Also, during takeoff when thrust levers are set to TOGA, the Electric Hydraulic Pumps will be activated for 60 s to avoid abrupt hydraulic pressure variations in an event of engine failure.

HYDRAULIC SYSTEM 1 ACCUMULATOR

A pressure accumulator is designed to maintain a constant pressure during periods of transient flow demands in the operation of the Hydraulic System. The accumulator also keeps a residual pressure in the hydraulic reservoir in order to avoid pump cavitations.

HYDRAULIC SYSTEM 2

Hydraulic System 2 is comprised of one reservoir, one engine-driven pump (EDP 2), one electric hydraulic pump, one accumulator and one PTU. The Hydraulic System 2 supplies the following systems:

- Elevator (left and right hand inboard actuators)
- Ailerons (right and left inboard actuators)
- Thrust reverser (engine 2)
- Multi-function spoilers (left and right panels 5)
- Ground spoilers (left and right panel 1)
- Inboard brake
- Nose wheel steering
- Landing gear (retraction and extension)
- Emergency parking brake

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ABNORMAL OPERATION

The Hydraulic System 2 is also equipped with an overheat protection system.

When the hydraulic fluid temperature reaches 100°C, the HYD 2 HI TEMP EICAS caution message will be displayed.

If the fluid temperature reaches 125°C, the shutoff valve (SOV) will automatically actuate, thus isolating the EDP 2 from the respective hydraulic flow line.

In the event of hydraulic system overheat (fluid temperature above 145°C), the HYD 2 OVERHEAT EICAS warning message will be displayed. In this case, the SOV can be manually actuated through a guarded pushbutton on the hydraulic system control panel.

Also, in the event of engine flameout, the FADEC will depressurize the respective EDP in order to reduce the torque loads on the engine and facilitate a windmill restart.

HYDRAULIC SYSTEM 2 RESERVOIR

The reservoir is hydraulically pressurized by a mechanical piston and has a greater capacity than hydraulic system 1 reservoir.

ENGINE DRIVEN PUMP (EDP 2)

The engine driven pump is connected to the engine 2 accessories gearbox and it is the primary power source for Hydraulic System 2. Its normal operation is identical to EDP 1.

ELECTRIC HYDRAULIC PUMP 2

The Electric Hydraulic Pump 2 is used as a backup for the engine driven pump (EDP 2) and it is powered by the AC BUS 1.

The operation of the Electric Hydraulic Pump 2 is similar to Electric Hydraulic Pump 1.

Also, on ground, the Electric Hydraulic Pump 2 will be automatically activated when the following conditions occur:

– Engine 1 running and parking brake released;

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– During Engine 1 start (once N2 reaches 40%) if parking brake has been applied within the last 6 min.

NOTE: The Electric Hydraulic Pump 2 will be automatically turned off after 6 min have elapsed from parking brake application.

HYDRAULIC SYSTEM 2 ACCUMULATOR

The Hydraulic System 2 Accumulator is similar to the Hydraulic System 1 accumulator and their operation is identical.

POWER TRANSFER UNIT (PTU)

The PTU consists of a hydraulic pump in Hydraulic System 2 driven by a hydraulic motor installed in Hydraulic System 1.

The PTU assists the landing gear retraction or extension, should a right engine or right EDP failure occur.

NORMAL OPERATION

A three-position selector knob located on the hydraulic panel enables the flight crew to select OFF, AUTO or ON positions. Normal operation is automatic.

During takeoff and landing, with the selector knob in the AUTO position the hydraulic system logic activates the PTU if the engine 2 or EDP 2 fails. The PTU will be automatically started when all the following conditions are met:

– Flaps not set to zero or Landing Gear not up and locked;

– EDP 1 not fail;

– Hydraulic reservoir 2 quantity above 12%.

NOTE: PTU will not be activated if the airplane is on ground.

ABNORMAL OPERATION

If any malfunction is detected in the PTU, the HYD PTU FAIL EICAS caution message will be displayed. In this case, the PTU selector knob may be set to ON or OFF position, overriding the system logic, according to the applicable abnormal procedure.

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HYDRAULIC SYSTEM 3

Hydraulic System 3 is comprised of one reservoir, two electric hydraulic pumps and one accumulator. The Hydraulic System 3 supplies the following systems:

- Elevator (right hand outboard actuators);
- Rudder (lower actuator);
- Ailerons (left and right outboard actuators).

ABNORMAL OPERATION

The Hydraulic System 3 is also equipped with an overheat protection system.

When the hydraulic fluid temperature reaches 100°C, the HYD 3 HI TEMP EICAS caution message will be displayed.

If the fluid temperature increases up to 125°C, both Electric Hydraulic Pumps (3A and 3B) will automatically be turned OFF.

In the event of hydraulic system overheating (fluid temperature above 145°C), the HYD 3 OVERHEAT EICAS warning message will be displayed. In this case, the flight crew can manually switch OFF pumps 3A and 3B on the hydraulic system control panel.

NOTE: During an Electrical Emergency condition the Hydraulic System 3 overheating protection system will be inhibited, therefore preventing the Electric Hydraulic Pumps from being turned off automatically. In this condition, the associated EICAS messages HYD 3 HI TEMP and HYD 3 OVERHEAT will also be inhibited, preventing the flight crew from switching off the only source of hydraulic power available.

HYDRAULIC SYSTEM 3 RESERVOIR

The reservoir is also hydraulically pressurized by a mechanical piston and is similar to Hydraulic Systems 1 and 2 reservoirs.

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ELECTRIC HYDRAULIC PUMPS

Both Electric Hydraulic Pumps are alternating current motor pumps (ACMP). Electric Hydraulic Pump 3A is the primary power source for Hydraulic System 3 and it is powered by the AC ESS BUS.

A two-position selector knob located on the hydraulic panel enables the flight crew to select OFF or ON positions. There is no automation associated with this pump. So in normal operation, the flight crew will turn the pump ON and OFF during engine start and shut down, respectively.

Electric Hydraulic Pump 3B is the backup for the Electric Hydraulic Pump 3A and it is powered by the AC BUS 2. The flight crew selects manual or automatic operation through the three-position selector knob on the hydraulic control panel. Normal operation is automatic.

In flight, with the selector knob in the AUTO position, the hydraulic system logic turns on the electric pump 3B whenever the electric pump 3A fails. When the selector knob is set to the ON position, the electric pump operates continuously overriding the system automation.

HYDRAULIC SYSTEM 3 ACCUMULATOR

The Hydraulic System 3 accumulator is similar to the Hydraulic System 1 and 2 accumulators, except for its operation during an electrical emergency. In this condition, the Hydraulic System 3 accumulator will provide hydraulic power to the associated flight controls from the beginning of RAT deployment until the ACMP 3A is powered by the AC ESS BUS.

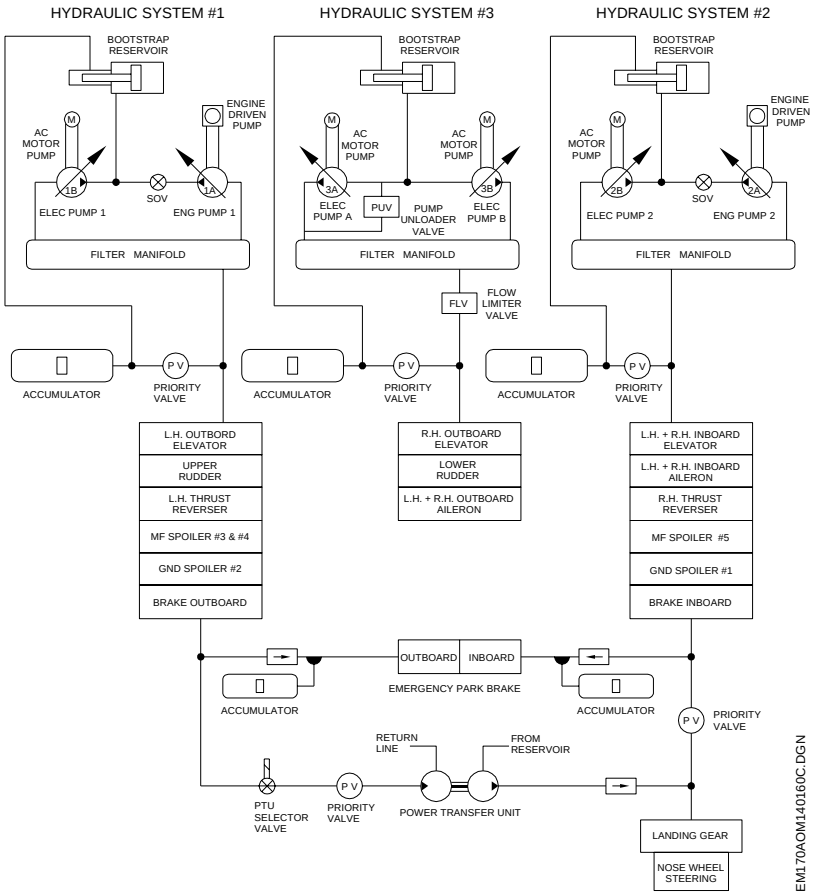
PUMP UNLOADER VALVE/ FLOW LIMITER VALVE

Hydraulic system 3 has two dedicated valves which are used only in an electrical emergency to avoid overload in the RAT.

The pump unloader valve is used to reduce the discharge pressure of ACMP 3A during its start-up. This will reduce the pump torque and therefore reduce the electrical power required to start the pump.

The flow limiter valve is used to reduce the amount of flow provided by the ACMP 3A. This will limit the electrical power that the pump can draw and prevent the electric hydraulic pump from stalling the RAT.

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HYDRAULIC SYSTEM SCHEMATIC

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	HYD 1 (2) (3) OVERHEAT	Associated hydraulic system temperature exceeded the caution operational range.
CAUTION	HYD 1 (2) (3) HI TEMP	Associated hydraulic system temperature exceeded the normal operational range.
	HYD 1 (2) (3) LO PRESS	Associated hydraulic system pressure is low.
	HYD PTU FAIL	– PTU is not supplying hydraulic power to hydraulic system 2 or; – PTU automatic operation is compromised.
	HYD 1 (2) EDP NOT D-PRESS	Depressurization of the associated engine-driven pump has failed.
	HYD 3 VLV FAIL	One or both hydraulic system # 3 valves, used during an electrical emergency condition, have failed.

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TYPE	MESSAGE	MEANING
ADVISORY	HYD 1 (2) EDP FAIL	Associated engine-driven pump is not providing hydraulic power to the system.
	HYD 1 (2) ELEC PUMP FAIL	Associated electric pump is not providing hydraulic power to the system.
	HYD3 ELEC PUMP A (B) FAIL	Associated system 3 electric pump is not providing hydraulic power to the system.
	HYD 1 (2) (3) LO QTY	Fluid level in the associated reservoir is low.
	HYD 1 (2) SOV FAIL	Associated SOV is not in commanded position.
	HYD 3 PUMP A NOT ON	ACMP 3A is not set to ON position.
	HYD PTU NOT AUTO	PTU is not in AUTO position.
	HYD PUMP NOT AUTO	SYS 1, 2 or 3 electric pump is not in AUTO position.
	HYD TEMP SENS FAIL	At least one of the hydraulic temperature sensors are failed and the system is unable to monitor the temperature of that system.
STATUS	HYD 1 (2) SOV CLOSED	Associated SOV closed.

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SECTION 14-12

ICE AND RAIN PROTECTION

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GENERAL DESCRIPTION

The Ice and Rain Protection System provides pneumatic anti-ice protection for the engine cowls and wing slats. The pitot and static port heating systems, windshield anti-ice system, and water lines heating system use electrical power to prevent icing.

The ice and rain protection system includes:

- Wing anti-ice system.
- Engine anti-ice system.
- Windshield heating system.
- Air Data Smart Probe (ADSP)/TAT heating system.
- Windshield wiper system.

The ice and rain protection system's parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS displays.

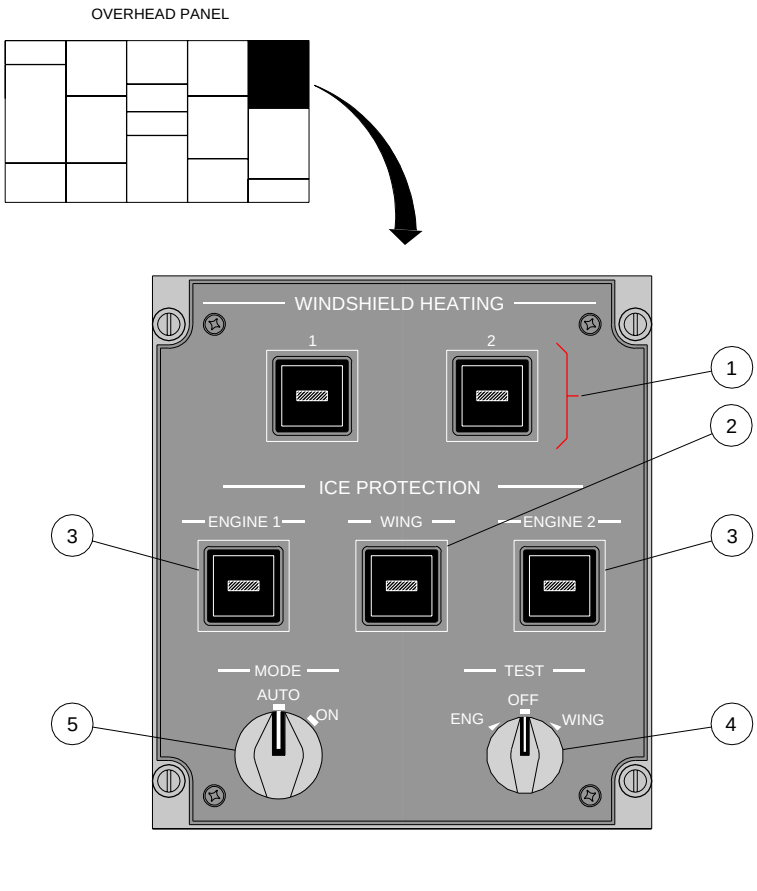
Normal operation of the anti-ice system is automatic.

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ICE PROTECTION CONTROL PANEL



1 - WINDSHIELD HEATING BUTTON

PUSH IN: activates the associated windshield heating system.

PUSH OUT: deactivates the associated windshield heating system.

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2 - WING ICE PROTECTION BUTTON

PUSH IN: automatic operation of the wing anti-ice system.
PUSH OUT: deactivates the wing anti-ice system.

3 - ENGINE ICE PROTECTION BUTTON

PUSH IN: automatic operation of the associated engine anti-ice system.
PUSH OUT: deactivates the associated engine anti-ice system.

4 - ICE PROTECTION SYSTEM TEST SELECTOR KNOB

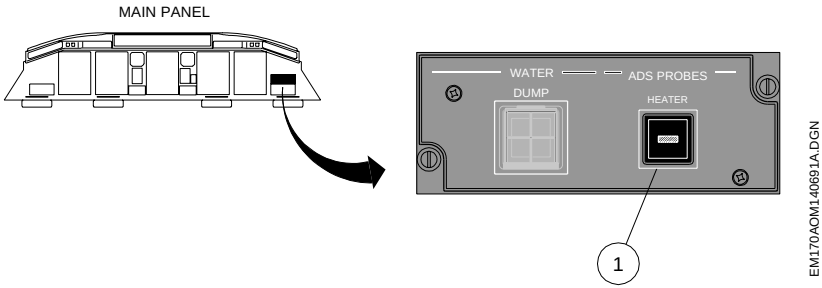
ENG: initiates the engine anti-ice system test.
OFF: spring-loaded position.
WING: provides a test for the wing anti-ice system.

5 - ICE PROTECTION MODE SELECTOR KNOB

AUTO: automatic operation of the wing and engine anti-ice systems.
ON: overrides the system logic inflight, activating the anti-ice system regardless of icing condition. It also activates the anti-ice on ground according to the system logic.

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ADS PROBES HEATER PANEL



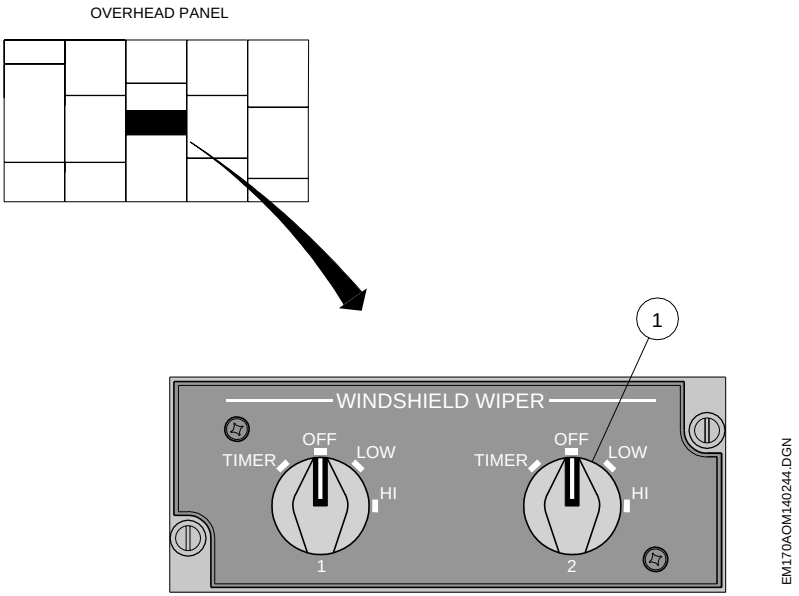
1 - HEATER BUTTON

PUSH IN: activates the ADS probes heater. A striped bar illuminates in the button.

PUSH OUT: the ADS probes heater operates in AUTO mode.

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WINDSHIELD WIPER CONTROL PANEL



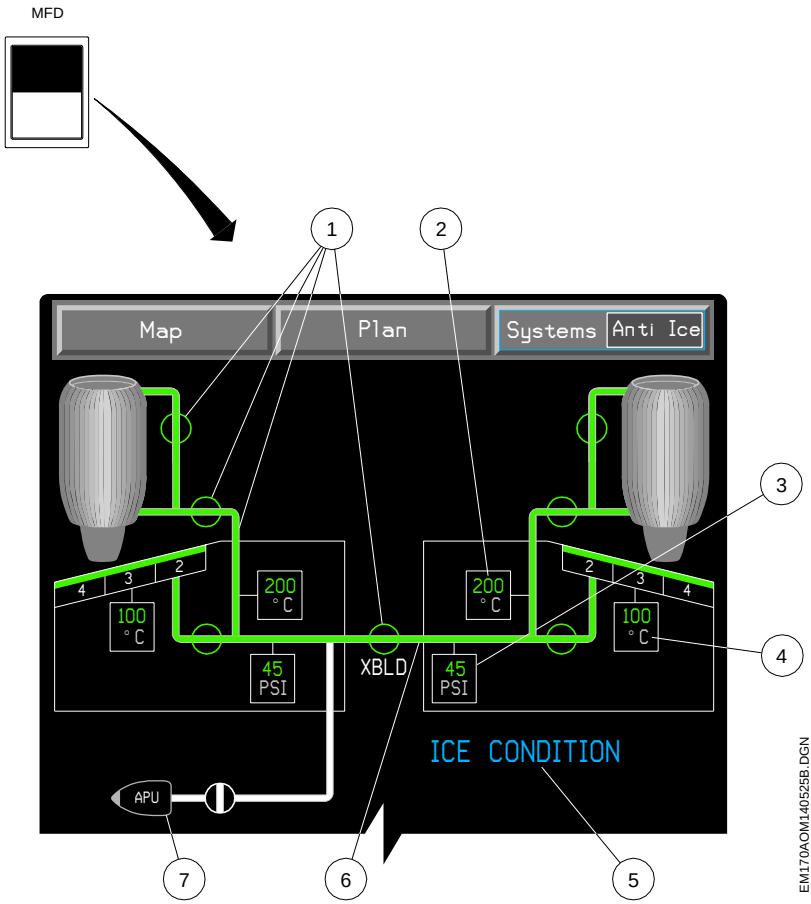
1 - WINDSHIELD WIPER SELECTOR KNOB

TIMER: eight-second intermittent operation.
OFF: stops windshield wipers in the stowed position.
LOW: windshield wipers operate at low speed.
HIGH: windshield wipers operate at high speed.

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SYNOPTIC PAGE ON MFD

The anti-ice synoptic page provides a visual representation of the anti-ice system operation and parameters, and can be selected by the flight crew for viewing on either MFD.



1 - BLEED AIR SYSTEM VALVES STATUS

– OPEN: a green circle with a green line aligned with the flow line.

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– CLOSED: a white circle with a white line perpendicular to the flow line.

– UNDETERMINED: an amber dashed circle with no line.

– IN TRANSIT: a white circle with a white line diagonal to the flow line.

– FAILED CLOSED: a white circle with a white line perpendicular to the flow line beneath an amber cross.

– FAILED OPEN: a green circle with a green line aligned with the flow line, beneath an amber cross.

2 - BLEED AIR TEMPERATURE INDICATION

– Digital Temperature

GREEN: normal operating range.

AMBER DASHED: invalid information or a value out of range.

3 - BLEED AIR PRESSURE INDICATION

– Digital Pressure

GREEN: normal operating range.

AMBER DASHED: invalid information or a value out of range.

4 - WING ANTI-ICE TEMPERATURE INDICATION

– Digital Temperature

GREEN: normal operating range.

AMBER DASHED: invalid information or a value out of range.

5 - ICE CONDITION ANNUNCIATION

– The ICE CONDITION annunciation is displayed below the right bleed air manifold pressure icon, indicating that an icing condition has been detected.

6 - ANTI-ICE FLOW LINE

– The anti-ice flow line is depicted in color.

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GREEN: the associated flow line is pressurized.

WHITE: the associated flow line is not pressurized.

AMBER: the associated flow line is overheated.

WHITE/AMBER DASHED: the associated flow line pressure is undetermined.

7 - APU ICON

– The APU icon is only displayed on ground.

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ICE PROTECTION SYSTEM

The ice protection system includes the engine anti-ice, wing anti-ice, windshield heaters and the ice detectors. The engines and wings anti-ice use bleed air from the engines as a heat source.

During normal operation the system automatically controls the engine and the wing anti-ice valves operation. There is a special logic to configure and prepare the FADEC for takeoff in icing conditions.

In case of a dual ice detector failure, the anti-ice system can be manually operated.

The windshield heaters have a dedicated controller for operation.

ENGINE ICE PROTECTION SYSTEM

NORMAL OPERATION

The engines cowls are heated with air from the low stage bleed, extracted from the respective engine. Each engine anti-ice system is independent.

ABNORMAL OPERATION

The engine bleed valve is fail safe open if either the electrical or pressure signal are not present.

WING ICE PROTECTION SYSTEM

NORMAL OPERATION

All three outboard leading edges are heated by bleed air extracted from the engines. Each engine provides bleed air for the respective wing anti-ice.

The APU is not capable of supplying bleed air for the anti-ice operation.

ABNORMAL OPERATION

If one bleed air fails, the anti-ice system automatically opens the cross bleed valve and uses the opposite bleed for both wings anti-ice.

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ICE DETECTORS

NORMAL OPERATION

The airplane is equipped with two ice detectors installed on the left and right side of the nose section.

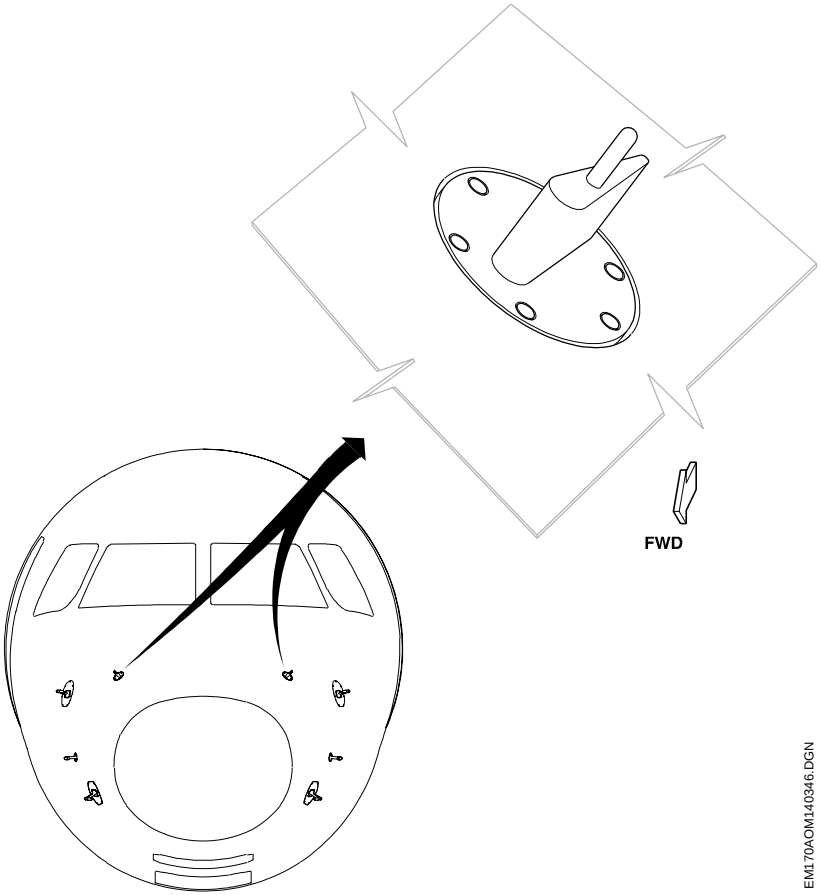
If an icing condition is detected during flight, the ice detectors command the wing and engine anti-ice valves to open and remain activated for 5 minutes after the icing condition is no longer detected.

ABNORMAL OPERATION

Failure of one ice detector results in the loss of system redundancy. If an icing condition is detected by the remaining sensor, the engine and wing anti-ice systems will automatically activate.

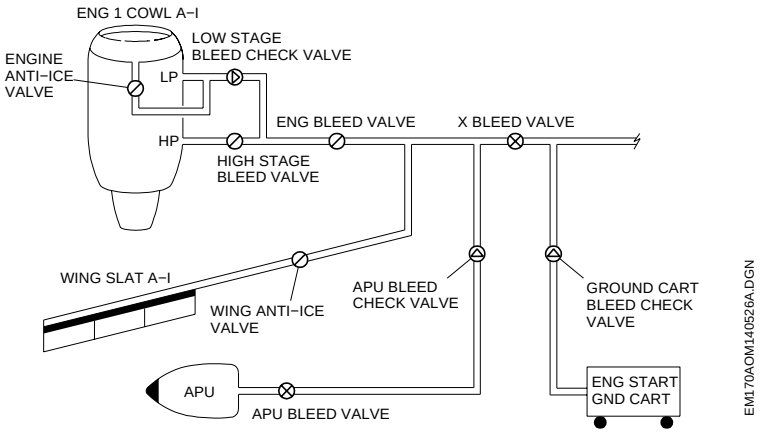
In case of a dual ice detector failure, the anti-ice operation is only possible in the manual mode.

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ICE DETECTORS LOCATION

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ICE PROTECTION SYSTEM SCHEMATIC

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ICE PROTECTION AUTO MODE

The anti-ice system automatic mode is active anytime the mode selector knob is set to AUTO position. During ground operation and takeoff, there is a specific logic for activating the anti-ice system and configuring the FADEC.

ON GROUND AND TAKEOFF OPERATION

The operation of the anti-ice valves during takeoff affects the engine performance. The FADEC needs to be configured before takeoff in icing conditions.

During ground operation, at low speeds and visible moisture, ice could accumulate at the engine cowls without being detected by the ice detectors.

The setting of the REF A/I modes for Before Takeoff and Takeoff phases are made on the TAKEOFF DATA SET MENU. By setting the modes on this page the engine FADEC and the ice protection system are adjusted in a single action.

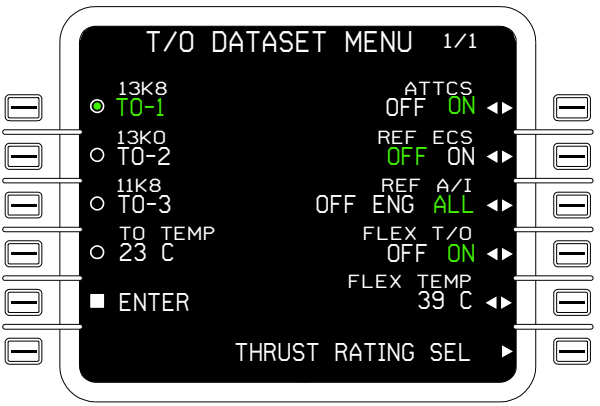
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MCDU SETTING

To set the anti-ice condition on the TAKE OFF DATA SET MENU page on MCDU press:

– TRS button;

– TO DATA SET (line select key – 6R).



EM170AOM140295A.DGN

TO DATA SET MENU PAGE

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REF A/I MODES OF OPERATION

The REF A/I mode of operation can be selected on ground using the table below as a guidance.

ON GROUND			
Static Air Temperature	**Visible Moisture**	**MCDU (Takeoff Dataset Menu)**	**Ice Protection Mode Selector**
Higher than 10°C	YES/NO	OFF	AUTO
Higher than 5°C and lower than 10°C	YES	ENG	
Lower than 5°C	YES	ALL	

The MCDU setting operates the anti-ice system and inhibits the ice detectors activation logic during takeoff until 1700 ft AGL or 2 min after liftoff, whichever occur first. The settings actuate as described below:

OFF – The anti-ice valves will be inhibited closed until the end of takeoff phase, considered in the logic as 1700 ft AGL or 2 min after liftoff. After that, the engine and wing anti-ice valves will open if ice is detected.

ENG – Only the engine anti-ice valve will be kept open after engine start. The wing anti-ice valves remains inhibited closed. The EICAS status message ENG TDS REF A-I ENG will be displayed to confirm the MCDU selection.

ALL – The engine anti-ice valves are commanded open after completion of engine start and the wing anti-ice valves are commanded open with wheel speed above 40 kt. The EICAS status message ENG TDS REF A-I ALL will be displayed to confirm the MCDU selection.

In **ENG** or **ALL** operation modes, the anti-ice valves will rely on ice detection above 1700 ft AGL or 2 min after liftoff.

In **OFF** or **ENG** operation modes and anti-ice mode selector knob set to ON position, the caution message “ENG REF A-I DISAG” and the advisory message “A-I MODE NOT AUTO” will be displayed on the EICAS. In this case, the pilot needs to rotate the selector knob to AUTO position.

If the REF A/I is set to ENG on the MCDU and the OAT temperature entered at the Takeoff Data Setting is below 5°C, the CAS message “ENG REF A-I DISAG” will be displayed.

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The table below presents a resume for all modes:

ENGINE AND WING ANTI-ICE SYSTEMS OPERATION

TO DATASET MENU	MODE SELECTOR KNOB	ICE CONDITION	ENGINE A/I ACTIVATION	WING A/I ACTIVATION	EICAS CAUTION MESSAGE
OFF	AUTO	NOT DETECTED	-	-	-
		DETECTED	1700 ft AGL or 2 min after liftoff	1700 ft AGL or 2 min after liftoff	-
	ON	NOT DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
		DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
ENG	AUTO	NOT DETECTED	ENGINE RUNNING	-	-
		DETECTED	ENGINE RUNNING	1700 ft AGL or 2 min after liftoff	-
	ON	NOT DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
		DETECTED	ENGINE RUNNING	LIFTOFF	ENG REF A-I DISAG
ALL	AUTO	NOT DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
		DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
	ON	NOT DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-
		DETECTED	ENGINE RUNNING	WSPEED > 40 kt	-

After takeoff, the settings in the MCDU will be ignored by the airplane and the engine and wing anti-ice valves will open anytime an icing condition is detected, or the Ice Protection Panel Mode Switch is set to ON position.

The T/O DATASET MENU page on the MCDU will become available thirty seconds after the airplane touches the ground.

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After landing, the Ice Protection System should be activated if icing conditions exist.

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AUTOMATIC OPERATION

During specific conditions, the wing anti ice system will be activated, regardless of the airplane being in icing conditions. In this case the system will be activated but the message ICE CONDITION will not be displayed.

These conditions are the following:

- Airplane in flight.
- Altitude below 22000 ft.
- Combination of air temperature, altitude and speed indicators.
- Airspeed between 150 KIAS and 320 KIAS.
- Vertical speed within 200 ft/min.

If all these conditions are true during 2 min the system will be activated, and will stay activated by 2 min after one or more of these conditions become false.

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WINDSHIELD HEATING SYSTEM

The windshields are electrically heated for anti-icing and anti-fogging purposes.

NORMAL OPERATION

The windshield heating button remains pushed in allowing the system to automatically control the windshield temperature to a specific range. Left and right windshields heating are controlled by individual pushbuttons on the overhead panel.

The system only operates if there are at least two AC electrical sources.

GROUND OPERATION

When a single AC power is available (e.g. one IDG) each windshield heating controller performs its standard power-up BIT routine heating the corresponding windshield for 120 seconds.

ABNORMAL OPERATION

In case of a single AC electrical source in-flight only the left windshield heating is powered. If the left windshield heating system fails, the right windshield heating becomes available.

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AIR DATA SMART PROBE/TAT HEATING SYSTEM

Air Data Smart Probe (ADSP)/TAT heating operation can be fully automatic or manually overridden on ground.

A total of four smart and two TAT probes are installed on the nose fuselage section of the airplane. Each probe has a dedicated heater.

AUTO MODE

The ADSP and TAT are heated whenever an engine is running or airborne.

MANUAL OVERRIDE

The ADSP Heater pushbutton is installed on the main control panel to allow the heating of ADSPs with the airplane on the ground.

If the ADSP pushbutton is pushed IN, the ADSP heating system will be powered, overriding the system logic on ground. When the batteries are the only electrical source to the airplane, only the ADSP 3 will be heated.

The ADSP Heater pushbutton should be pushed OUT with one or both engines running.

WINDSHIELD WIPER SYSTEM

This airplane is equipped with two independent wipers operated through dedicated control knobs on the overhead panel.

The windshield wipers will stop if operated on a dry windshield. The system remains inoperative until the wiper control knob is set to ON position.

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ICE PROTECTION SYSTEM

The Ice Protection System Test selector knob provides a manual test for the wing and engine anti-ice systems for maintenance use.

The wing anti-ice system tests itself during flight (SAI IBIT) 10 min after takeoff or at 10000 ft AGL, whichever occurs first. At this time the Slat Anti-Ice Valves will be opened (EICAS messages A-I WING VLV OPEN and A-I Synoptic page will indicate that valves have opened).

If a failure occurs during IBIT, the message A-I WING FAIL will be displayed.

The SAI IBIT duration is 60 seconds (maximum). The test can be finished earlier if all slat temperature sensors have an increase of 10°F.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	A-I WING 1 (2) LEAK	An overheating or leakage is detected in the associated wing anti-ice system.
CAUTION	A-I ENG 1 (2) FAIL	Engine anti-ice bleed valve is closed when commanded open, or duct failure detected.
	A-I LO CAPACITY	Wing anti-ice bleed air pressure and temperature capacity is low.
	A-I WING FAIL	A wing anti-ice system failure has been detected.
	A-I WING NO DISPATCH	Wing anti-ice bleed valve has failed to open. Maintenance action is required.
	ICE DETECTOR 1 (2) FAIL	Associated ice detector has failed.
	WINDSHIELD 1 (2) HTR FAIL	Associated windshield heating system has failed or is overheated.
ADVISORY	A-I MODE NOT AUTO	Ice protection selector knob is not in the AUTO position.
	A-I SWITCH OFF	Ice protection button for engine and/or wing anti-ice system is pushed out.
	ICE CONDITION	An icing condition has been detected.
	A-I ENG 1 (2) FAULT	Displayed during test if there is loss of the capacity to monitor the adequate functioning of the system.

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TYPE	MESSAGE	MEANING
STATUS	A-I ENG 1 (2) VLV OPEN	Engine anti-ice valve is open.
	A-I WING VLV OPEN	Wing anti-ice valve is open. Also displayed during test after every takeoff, (crossing 10000 ft or 10 minutes after takeoff, whichever occurs first).

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SECTION 14-13

LANDING GEAR AND BRAKES

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GENERAL DESCRIPTION

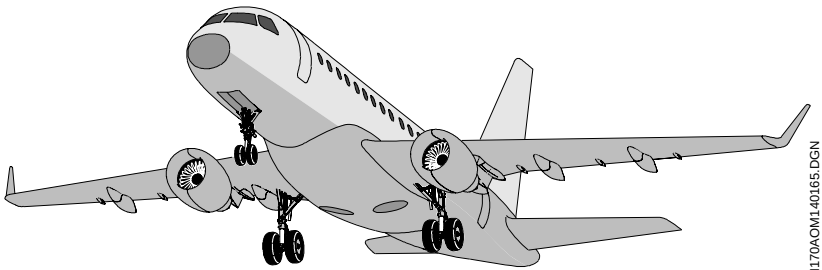
The landing gear system provides ground-rolling capability to the airplane, thus enabling take-off, landing and taxi operations.

The airplane is equipped with a retractable tricycle landing gear hydraulically operated. Each landing gear is a conventional dual wheel unit.

The nose landing gear incorporates a powered steering system, which performs the airplane directional control on the ground.

The brake system is designed to provide manual or automatic (if applicable) airplane deceleration during ground operations.

The landing gear and brake system parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS displays.



MAIN AND NOSE LANDING GEARS

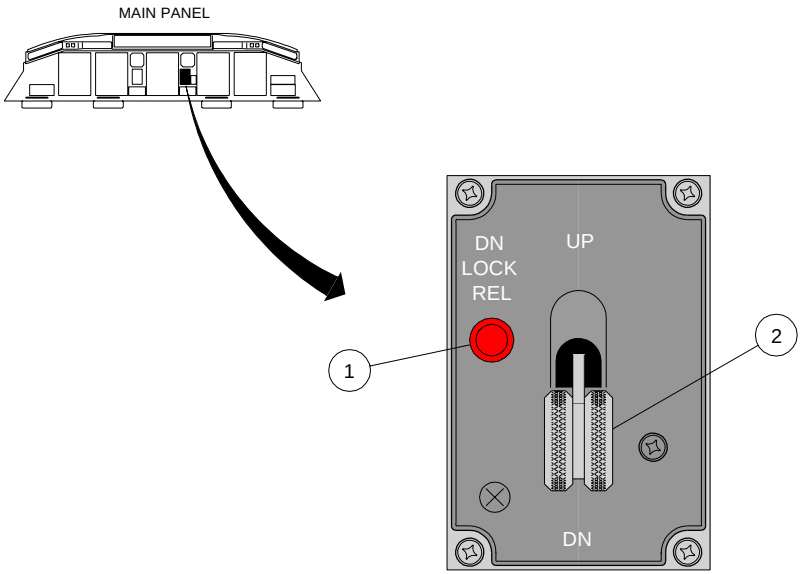
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LANDING GEAR CONTROLS AND INDICATIONS

LANDING GEAR CONTROL PANEL



1 - DOWNLOCK RELEASE BUTTON (MOMENTARY ACTION)

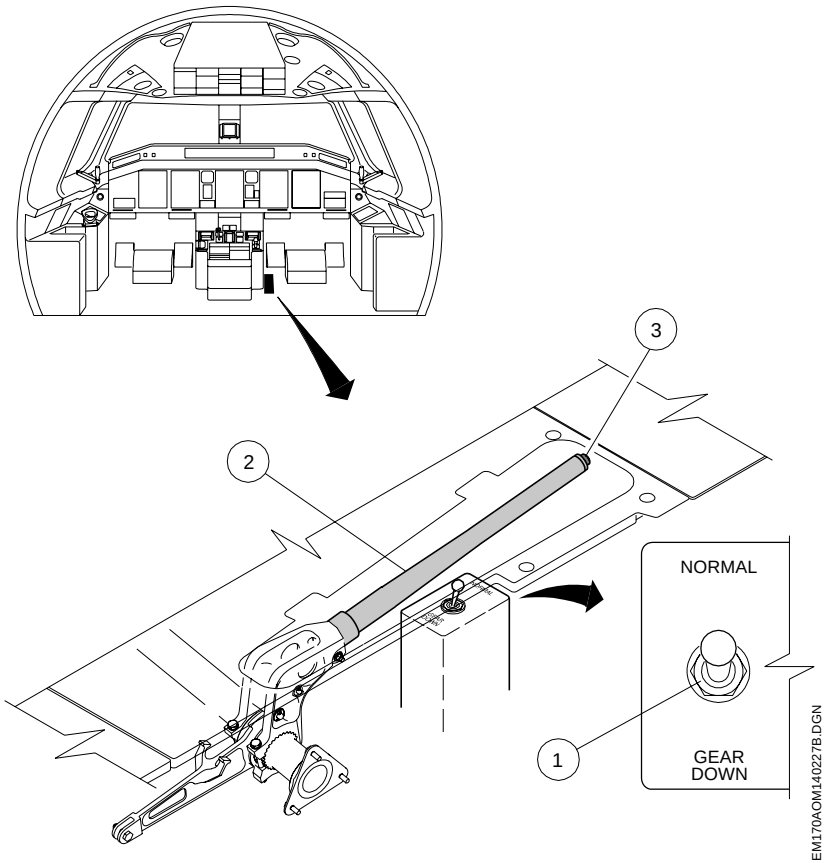
– Manually releases the landing gear lever lock.

2 - LANDING GEAR LEVER

UP:	retracts the landing gear.
DOWN:	extends the landing gear.

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ALTERNATE GEAR EXTENSION COMPARTMENT



1 - ELECTRICAL OVERRIDE SWITCH

NORMAL: the landing gear lever performs landing gear retraction and extension.

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GEAR DOWN: electronically bypasses the PSEM, opens the forward and aft doors and extends the landing gear.

2 - ALTERNATE GEAR EXTENSION LEVER (TWO-POSITION)

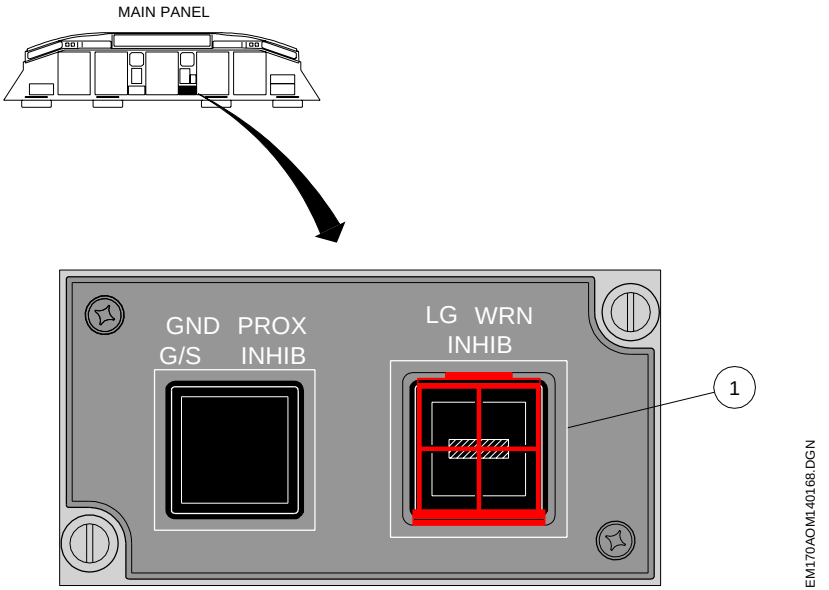
– When pulled, relieves hydraulic pressure in the landing gear lines and releases all landing gear uplocks.

3 - ALTERNATE GEAR EXTENSION LEVER UNLOCK PUSHBUTTON

– When pressed, releases the handle from the actuated position.

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LANDING GEAR WARNING INHIBITION BUTTON



1 - LANDING GEAR WARNING INHIBITION BUTTON (GUARDED-MOMENTARY ACTION)

Inhibits the landing gear aural warning in the event of dual radio altimeter failure.

A white striped bar will illuminate when pushed.

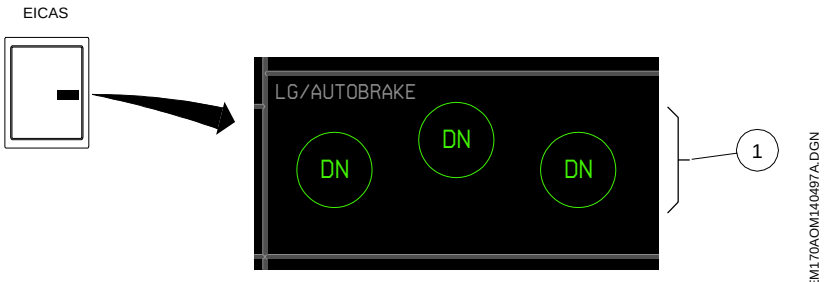
The white striped bar will extinguish if:

- Thrust levers are advanced beyond 38° thrust lever angle (TLA) for two engines or;
- Thrust levers are advanced beyond 57° TLA for one engine inoperative or;
- The flap selector lever is set to 5 or full without any landing gear down and locked.

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LANDING GEAR POSITION INDICATION

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

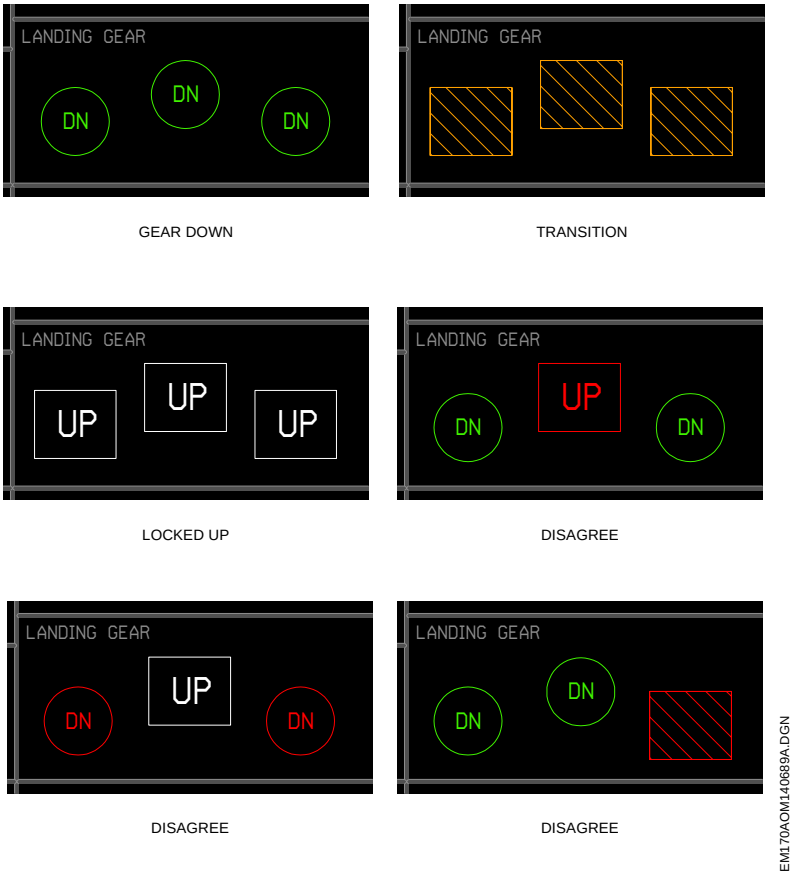


◄

1 - LANDING GEAR POSITION INDICATION

- DOWN: the green DN label inside a green circle indicates that the respective landing gear is down and locked.
- UP: the white UP label inside a white box indicates that the respective landing gear is up and locked.
- TRANSIT: the amber cross-hatched box indicates that the respective landing gear is in transit.
- DISAGREEMENT: the indication changes from its previous color to red 20 seconds after the discrepancy is detected.
  - The red cross-hatched box indicates that the respective landing gear is kept in transit and is not locked in the commanded position.
  - The red DN label inside a red circle and the red UP label inside a red box indicate a discrepancy between landing gear lever position and the respective landing gear position.

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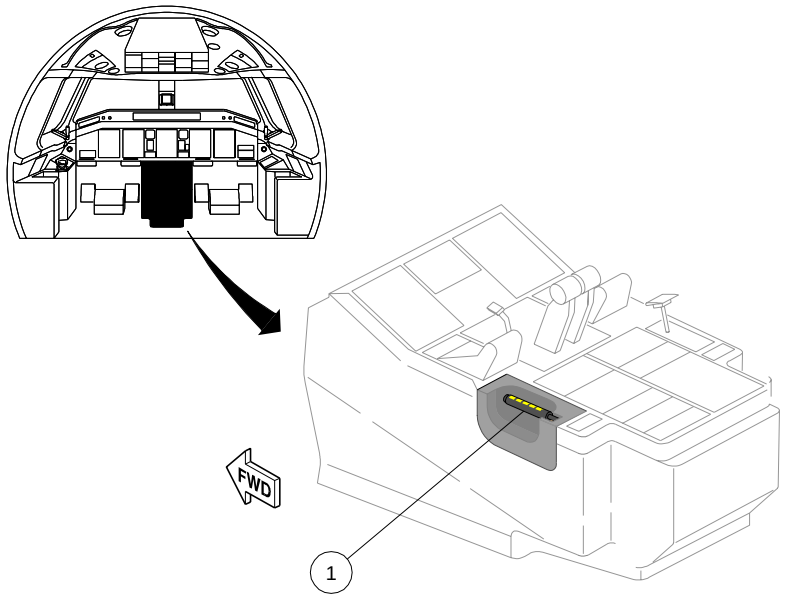


LANDING GEAR POSITION INDICATION ON EICAS

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BRAKES

EMERGENCY PARKING BRAKE HANDLE

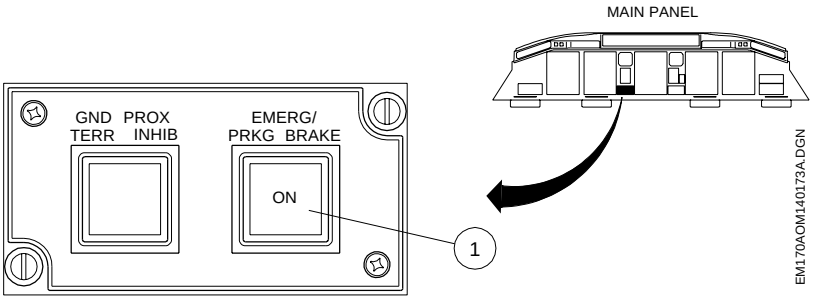


1 - EMERGENCY/PARKING BRAKE HANDLE

- Actuates the emergency/parking brake.
- The handle will lock when pulled up to the fully actuated position.
- To release the handle from the fully actuated position, the top button must be pressed.

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EMERGENCY PARKING BRAKE LIGHT



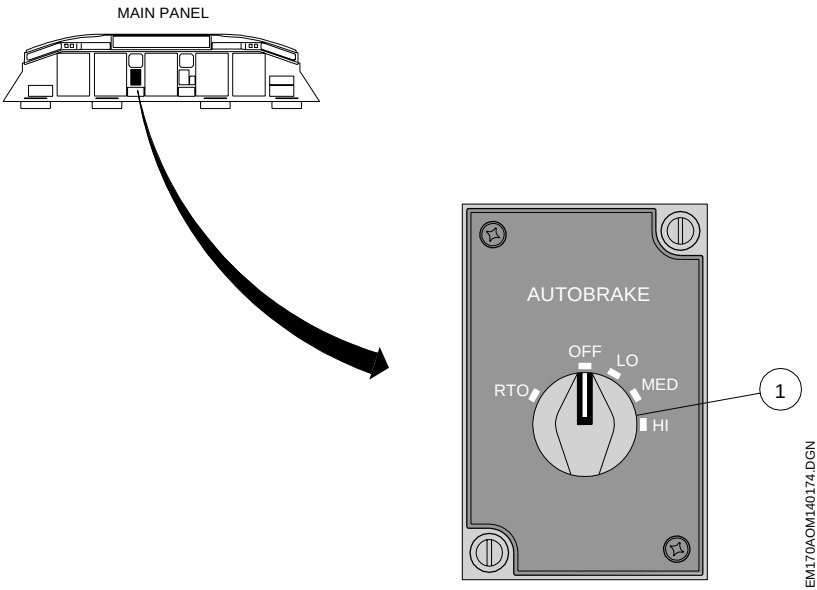
1 - EMERGENCY/PARKING BRAKE LIGHT

– ON: the indicator illuminates when the emergency/parking brake is actuated and there is hydraulic pressure on the brake line.

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AUTOBRAKE SELECTION

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*



1 - AUTOBRAKE SELECTOR KNOB (ROTARY ACTION)

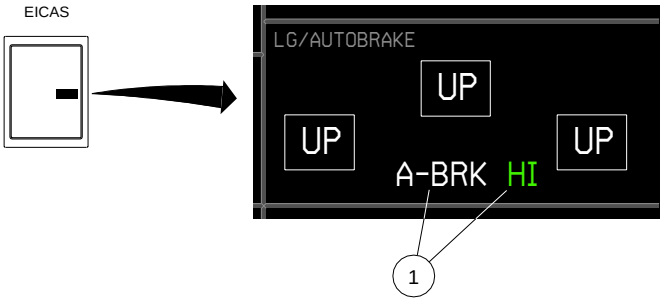
- RTO: Selects RTO deceleration rate.
- OFF: Autobrake is deactivated.
- LO: Selects the low deceleration rate.
- MED: Selects the medium deceleration rate.
- HI: Selects the high deceleration rate.

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AUTOBRAKE EICAS INDICATION

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*



EM170AOM140176.DGN

1 - AUTOBRAKE INDICATION

- A-BRK: the white A-BRK label indicates the autobrake is armed.
- RTO, HI, MED or LO: green labels indicating the selected autobrake mode.
- AMBER DASHED: indicates that the data is invalid.

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AUTOBRAKE RTO



AUTOBRAKE OFF



AUTOBRAKE LO



AUTOBRAKE MED



AUTOBRAKE HI



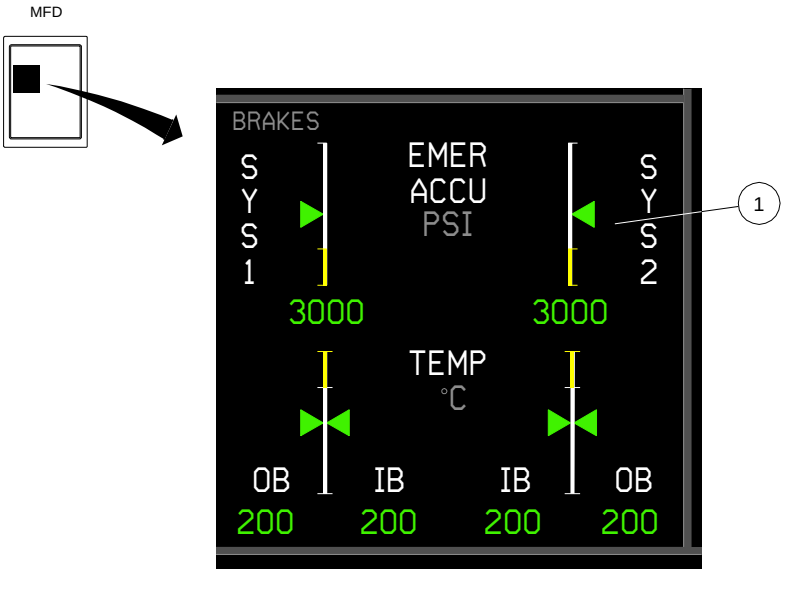
AUTOBRAKE DATA INVALID OR UNAVAILABLE

EM170AOM140170.DGN

AUTOBRAKE EICAS INDICATIONS

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MFD STATUS PAGE INDICATIONS



1 - EMERGENCY/PARKING BRAKE ACCUMULATOR PRESSURE INDICATION

– Digital Pressure

GREEN: normal operating range.

AMBER: emergency/parking brake effectiveness is degraded.

AMBER DASHED: invalid information or a value out of the valid range.

– Pressure Scale/Pointer
If the value is invalid, the pointer disappears from the display.

– Scale:

WHITE: normal operating range.

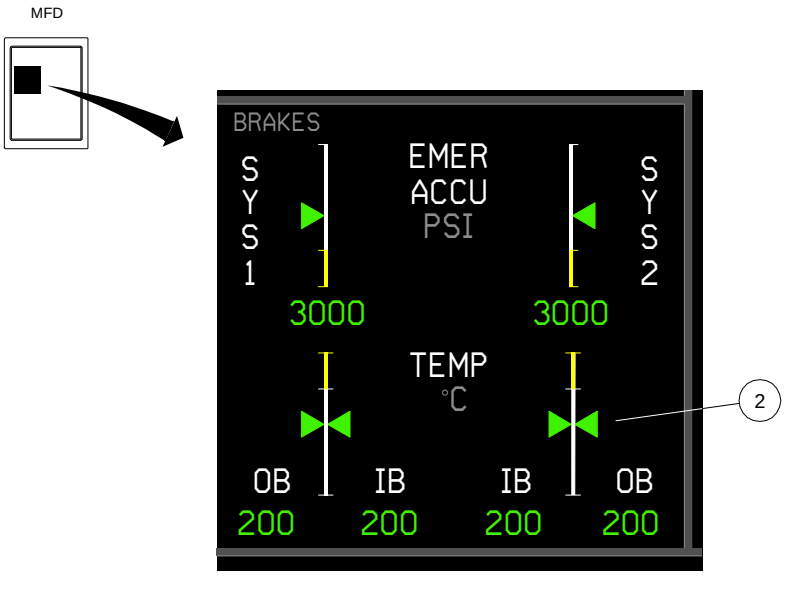
AMBER: emergency/parking brake effectiveness is degraded.

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– Pointer:

GREEN (hollow): normal operating range.

AMBER (solid): emergency/parking brakes effectiveness is degraded.



2 - BRAKE TEMPERATURE INDICATION

– Digital Temperature
Displays brake temperature in degrees Celsius (°C).

GREEN: normal operating range.

AMBER: cautionary operating range (no takeoff range).

AMBER DASHED: invalid information or a value out of the valid range.

– Temperature Scale/Pointer
If the value is invalid, the pointer will disappear from the display.

– Scale:

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WHITE: normal operating range.

AMBER: cautionary operating range.

– Pointer:

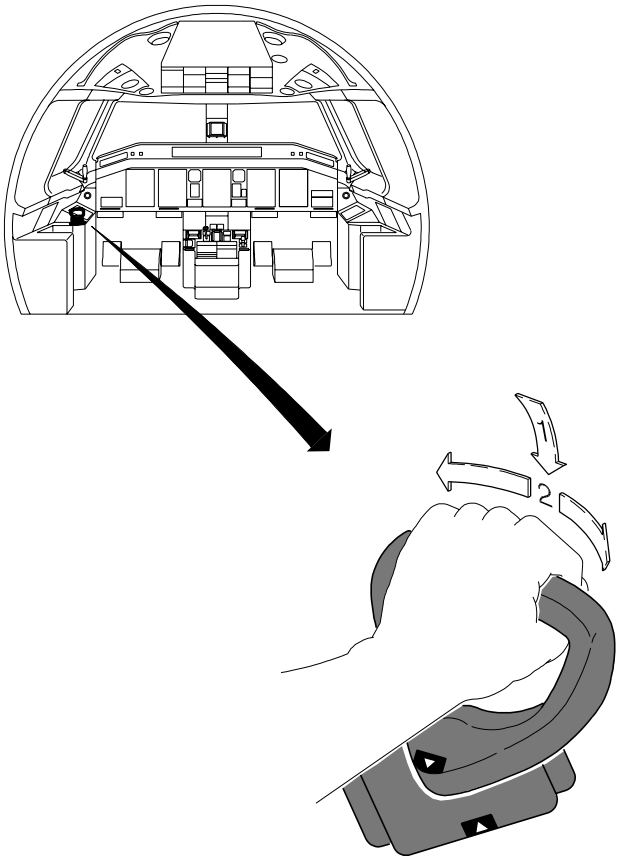
GREEN (hollow): normal operating range.

AMBER (solid): cautionary operating range.

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STEERING

STEERING HANDLE

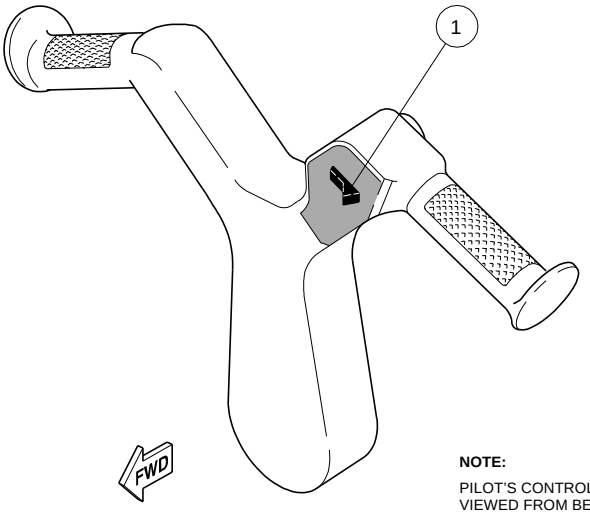


EM170AOM140178.DGN

– The handle must be pushed down (1) to engage the steering system. Releasing the handle will enable rudder pedals mode, keeping it pressed enables handwheel mode. Rotating the handwheel left or right (2) commands steering.

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STEERING DISENGAGE SWITCH



NOTE:

PILOT'S CONTROL WHEEL SHOWN, VIEWED FROM BEHIND.

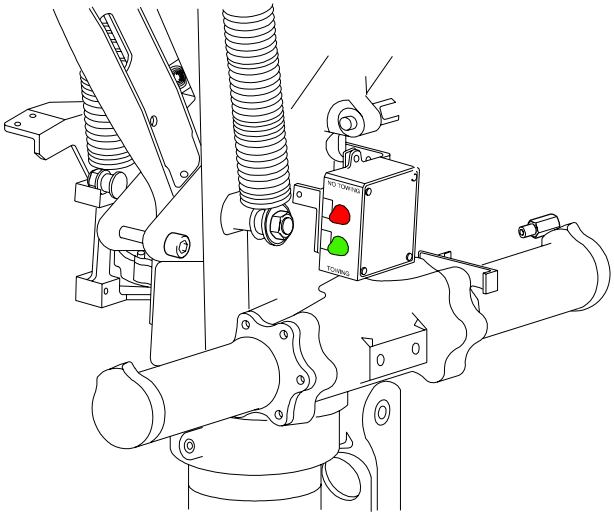
EM170AOM140179C.DGN

1 - STEERING DISENGAGE SWITCH (MOMENTARY ACTION)

– Disengages the nosewheel steering system.

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TOWING LIGHTS



EM170AOM140286B.DGN

1 - TOWING LIGHTS

GREEN:

- Steering disengaged through the external steering disengage switch and
- Parking brakes not applied and
- Main brakes not applied.

RED:

- External steering disengage switch in the engaged position or
- Parking brakes applied or
- Main brakes applied.

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AIR GROUND POSITIONING SYSTEM

Two proximity sensor electronic modules (PSEM) process signals from the six weight-on-wheels (WOW) proximity sensors to determine if the airplane is on ground or in flight. Two WOW sensors are installed on each landing gear.

Each PSEM monitors the six WOW proximity sensors. The inputs are logically combined by the PSEMs, and other airplane systems, to provide the overall airplane air/ground (WOW) indication to those systems.

If two WOW sensors on the same landing gear leg fail, the PSEMs will activate a logic that prevents the landing gear lever from moving up.

In this case, with the airplane on ground, the LG NO DISPATCH caution message is displayed on the EICAS. In-flight the failure is recognized through the landing gear lever stuck in the DOWN position and the EICAS message LG WOW SYS FAIL may be presented.

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LANDING GEAR CONTROL SYSTEM

Normal operation of the landing gear is commanded through the landing gear lever located on the main instrument panel and controlled by the SPDA.

In the event of a failure of the landing gear lever, landing gear extension can be performed by the landing gear override switch located on the landing gear free fall lever compartment.

Hydraulic pressure is necessary for retraction and normal extension of the landing gear. In the event of a hydraulic pressure failure, landing gear extension is possible through the alternate landing gear lever.

The landing gear operation is monitored by the PSEM and the downlock sensors.

A landing gear aural warning alerts the crew whenever any landing gear is not down and locked and the system recognizes the intention to land.

LANDING GEAR OPERATION

LANDING GEAR RETRACTION

Positioning the landing gear lever to the UP position releases hydraulic pressure for the nose and main landing gear locks, and pressurizes the respective actuators to retract the landing gear. When retraction is completed, the landing gear is held in place by uplocks.

Whenever the PSEM computes a signal of weight on wheels (airplane on ground status) the SPDA commands the landing gear lever to lock mechanically in the DOWN position.

When the weight on wheels signal is no longer valid (airplane in-flight status) the mechanical lock is released allowing the landing gear lever to move to the UP position.

NOTE: – If for any reason the shock absorber of any landing gear does not extend completely the PSEM keeps computing a signal of airplane on ground.
– With this condition the landing gear lever is locked down and there is no EICAS message indicating this condition.
– To prevent structural damage to the airplane the landing gear must be retracted only in case of an emergency that requires climb performance improvement.

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LANDING GEAR NORMAL EXTENSION

Normal landing gear extension is used when the electrical and hydraulic systems are operating normally and there is no failure in the landing gear lever control box.

Setting the landing gear lever DOWN releases hydraulic pressure for the nose and main landing gear uplocks, as well as for the retraction actuators. The landing gear doors are mechanically opened.

When extension is completed, the landing gear is locked in the fully extended position by the downlock springs.

ELECTRICAL OVERRIDE EXTENSION

When the landing gear lever control box fails the electrical override system is used to extend the landing gear.

The electrical override system bypasses the PSEM and commands gear extension in the same sequence as the normal operation.

ALTERNATE GEAR EXTENSION

If hydraulic pressure is not available for landing gear operation or the electrical system fails, landing gear extension is performed by the alternate gear extension lever.

Pulling up the alternate gear lever releases residual hydraulic pressure in the landing gear lines and opens all landing gear uplocks.

The landing gear extends in a free fall with the aid of gravitational and aerodynamic forces.

In the unlikely event that one main gear does not lock down, it may be necessary to slip the airplane using aerodynamic drag to lock the affected leg.

With the landing gear down and locked the EICAS indication displays the label DOWN.

The label will be DOWN with a red color if the landing gear lever is set to UP or in green if set to DOWN.

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DOWN/UP LOCK SENSORS

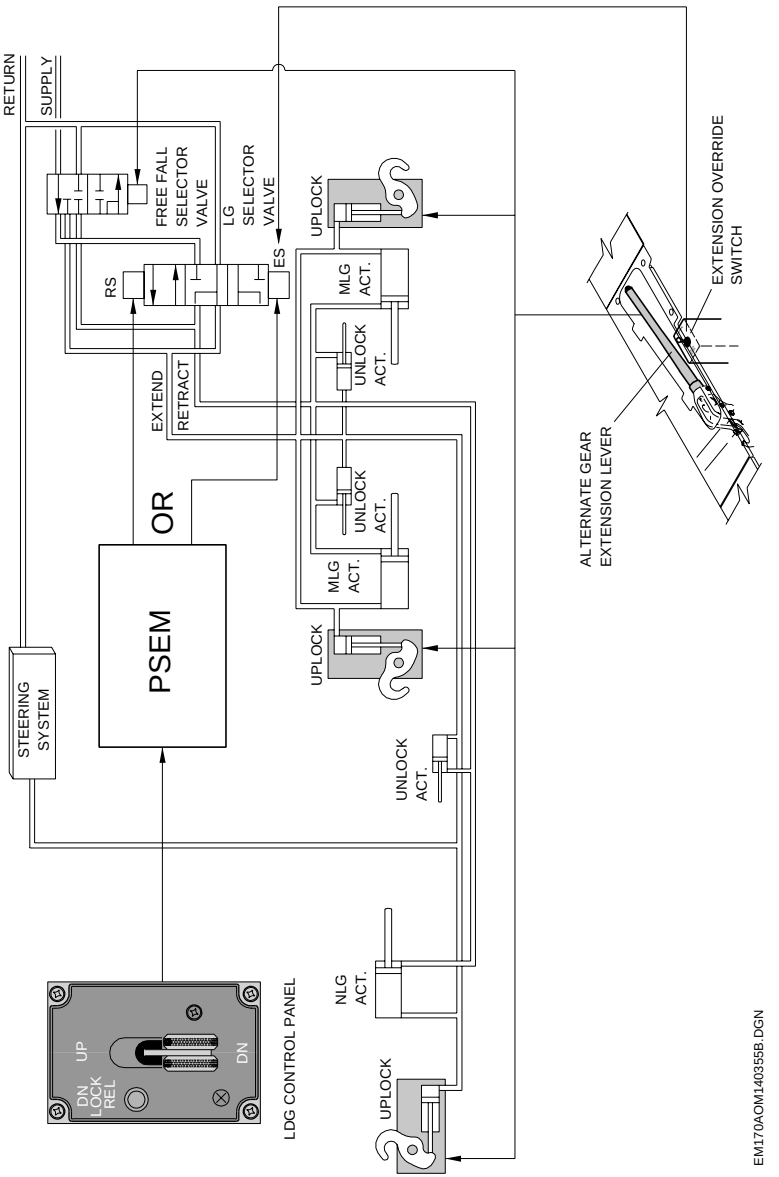
Each landing gear has two uplock sensors and two downlock sensors.

In the event of a discrepancy between both uplock or downlock sensors of the same landing gear, the sensor in agreement with the landing gear lever position will be considered valid.

DOWNLOCK RELEASE BUTTON

The downlock release button mechanically bypasses the system protection logic. It should be used only in the event of a landing gear control lever failure or when it is necessary to clear obstacles.

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LANDING GEAR OPERATION SCHEMATIC

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LANDING GEAR AURAL WARNING

The landing gear aural logic uses the thrust lever angle, flap setting and radio altimeter to define the intention to land the airplane.

The aural warning “LANDING GEAR” is announced and can not be silenced in the following situations:

SLAT/FLAP lever in a landing position (5 or FULL)

- Regardless of thrust lever position and radio altitude.

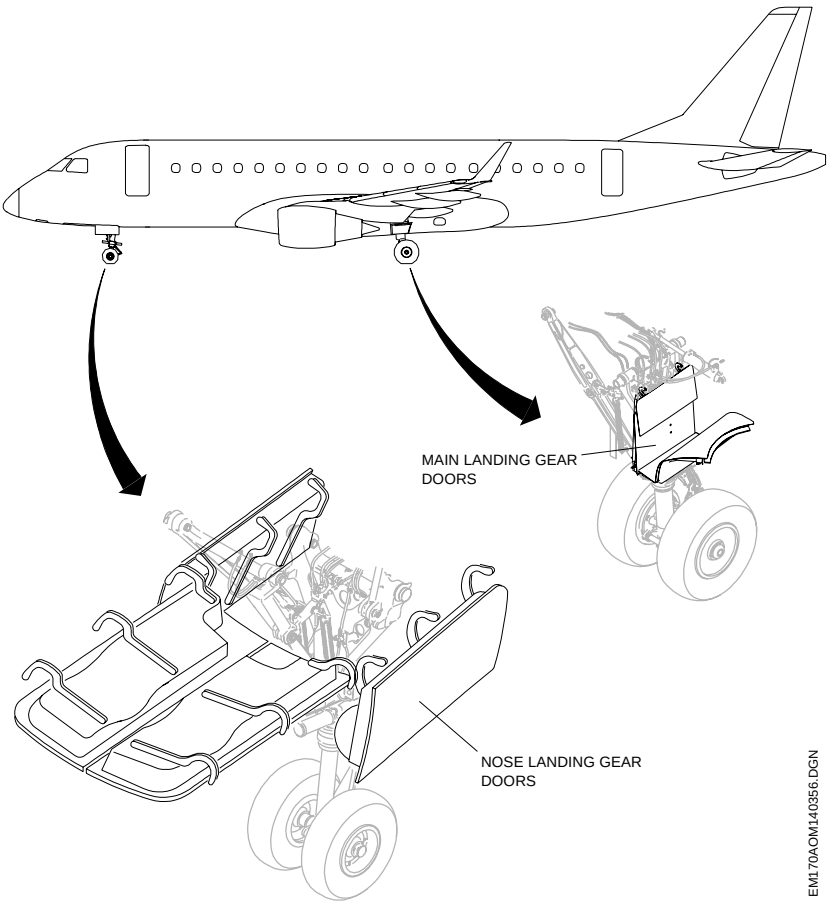
SLAT/FLAP lever in the 0, 1, 2, 3 or 4 position

- Radio altitude below 700 ft AGL, and
- Either thrust lever is set below 38° for two operative engines, or
- Thrust lever is set below 57° for a one-engine inoperative condition.

Radio Altimeter Fail

- In the event of dual radio altimeter failure, the warning inhibition button silences the aural warning only if the SLAT/FLAP lever is in the 0, 1, 2, 3 or 4 position.

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LANDING GEAR DOORS

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BRAKES

The brake system employs brake-by-wire rudder pedals located at both pilot stations. Hydraulic system 1 provides pressure to the outboard brakes and hydraulic system 2 provides pressure to the inboard brakes.

The Emergency/Parking brake has the ability to stop the airplane if a failure happens simultaneously on both hydraulic systems or if both brake control modules fail.

The brake wear can be monitored through the brake wear pins located on each main wheel.

NORMAL OPERATION

The system has two brake control modules (BCM) and one optional auto brake control module (ABM).

- BCM 1 is connected to DC ESS BUS 1 and controls the outboard brakes.
- BCM 2 is connected to DC ESS BUS 2 and controls the inboard brakes.
- ABM is connected to DC BUS 2.

During normal operation the BCM provides protection from skidding and locking of the main wheels. It also has some functions to improve the braking performance. The BCM main functions are:

- Locked wheel protection.
- Antiskid protection.
- Automatic wheel braking.
- Touchdown protection.

LOCKED WHEEL PROTECTION

Locked wheel protection is active anytime on ground and at wheel speeds above 30 kt.

The system logic compares wheel speed signals between the left and the right inboard brakes or between the left and the right outboard brakes. If a wheel speed is 33% or below its associated paired wheel speed, the brake control module commands zero pressure to the brake of the slower wheel, thus allowing speed equalization.

The tolerance between wheel speeds is provided to permit differential braking, for steering purposes.

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ANTISKID PROTECTION

Anti skid protection prevents tire skidding and maximizes brake efficiency according to the runway surface.

The system controls the amount of hydraulic pressure applied to the brakes and, if necessary, reduces the wheel brake pressure in order to recover wheel speed and prevent tire skidding.

For wheel speeds below 10 kt, the anti skid protection is deactivated, thus allowing the pilot to lock and pivot on a wheel for maneuvering.

Anti skid protection is not available for the emergency/parking brake system.

AUTOMATIC WHEEL BRAKING

Automatic wheel braking prevents the main landing gear from being retracted with the wheels spinning.

A dedicated device inside the nose landing gear bay stops the nose landing gear wheels from spinning.

TOUCHDOWN PROTECTION

Touchdown protection prevents the airplane from touching down with the main landing gear brakes applied.

It is deactivated:

- Three seconds after WOW has sensed the ground; or
- When wheel speed is above 50 kt.

EMERGENCY/PARKING BRAKE

The Emergency/Parking brake is operated through a handle located on the pedestal control panel and is powered by hydraulic systems 1 and 2.

The emergency/parking brake system has pressure accumulators isolated from both normal hydraulic systems. The accumulators have sufficient pressure to provide six full-brake applications.

PARKING BRAKE OPERATION

When used as a parking brake, the handle must be pulled until it locks at the upper position.

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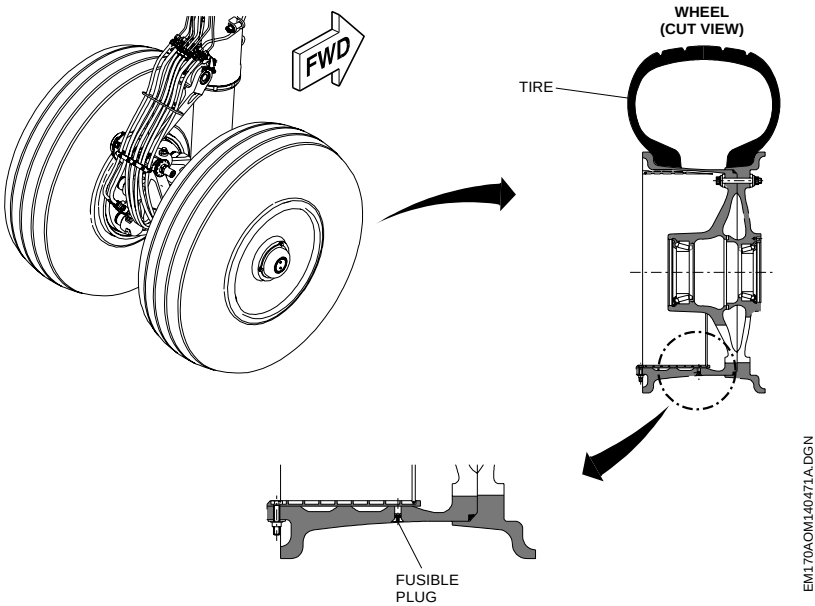
EMERGENCY BRAKE OPERATION

If both normal brakes fail the handle will actuate as an emergency brake. In this case it has to be pulled carefully and slowly as there is no anti-skid protection while braking with the Emergency/Parking brake.

At high speeds, the deflection of the emergency/parking brake handle when the brake indicating light comes ON, provides sufficient pressure to start braking. As speed decreases the required deflection increases to maintain continuous braking.

FUSIBLE PLUGS

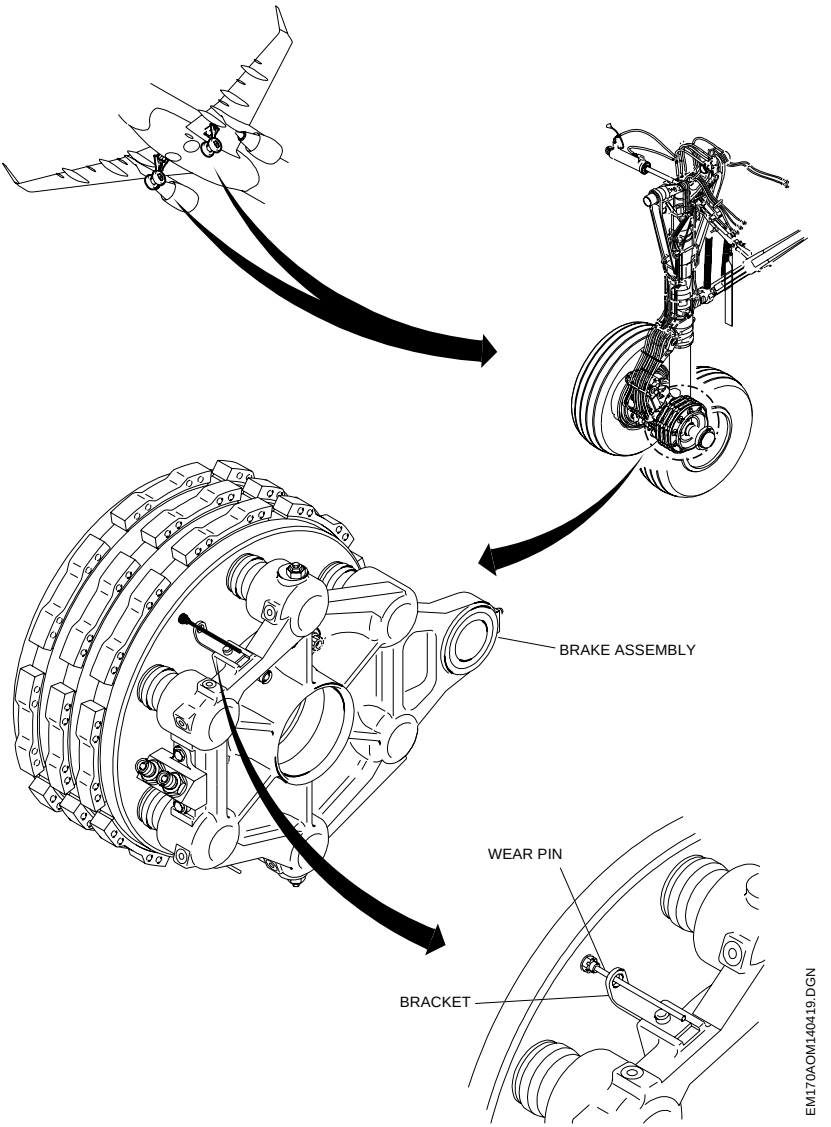
The fusible plugs are pins attached to the wheels, which melt relieving tire pressure in case of tire overheat.



BRAKE WEAR PINS

Brake Wear Pins indicate that brakes are worn-out and when the pins are flush with Brake Bracket Outer Face assembly, the brakes need replacement.

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AUTOBRAKE

The autobrake system provides automatic braking at maximum deceleration rates, which may vary according to runway conditions, for landings and rejected takeoffs. The system modulates hydraulic pressure to the brakes in order to provide a constant deceleration rate corresponding to the level selected. If reverse thrust is actuated, the autobrake system will modulate the brake pressure to maintain the deceleration rate constant.

The autobrake system can only be armed if the normal brake system is operational. Anti skid, touchdown and locked wheel protections are provided during autobrake operation.

Four autobrake levels of deceleration (RTO, LO, MED, HI) are available via a selector knob on the cockpit main instrument panel.

There are two modes of autobrake control:

- Landing mode (LO, MED, HI).
- Rejected take-off mode (RTO).

NOTE: RTO is the selected takeoff mode with the maximum deceleration rate. This deceleration is equivalent to the maximum manual braking.

AUTOBRAKE LANDING AND RTO MODE

Autobrake will be armed if the following conditions are met:

	LANDING MODE	REJECTED TAKEOFF MODE
Selector Knob Position	LO, MED or HI	RTO
WOW Indication	In flight	On ground
Wheel Speed	Below 60 kt	
Brake Control System	No faults	
Brake Pedal Position	Not pressed	Any
Thrust Levers Position	Any	Idle or REV

Autobrake will be applied if the following conditions are met:

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	LANDING MODE	REJECTED TAKEOFF MODE
Condition	ARMED	
Selector Knob Position	LO, MED or HI	RTO
WOW Indication (MLG)	On ground	
Wheel Speed	Above 60 kt	
Brake Control System	No faults	
Brake Pedal Position	Not pressed	
Thrust Levers Position	Idle or REV	

NOTE: For landing mode, the main landing gear WOW must indicate the airplane is on ground for more than 2 seconds to allow autobrake application.

Landing and RTO modes will be disarmed if one of the following conditions occurs:

- The selector switch is set to the OFF position.
- Pedal braking is applied (while wheel speed is above 60 kt if RTO is selected).
- Brake control system failure is detected (while wheel speed is below 60 kt if RTO is selected).
- Either thrust lever is advanced beyond idle during autobrake application.

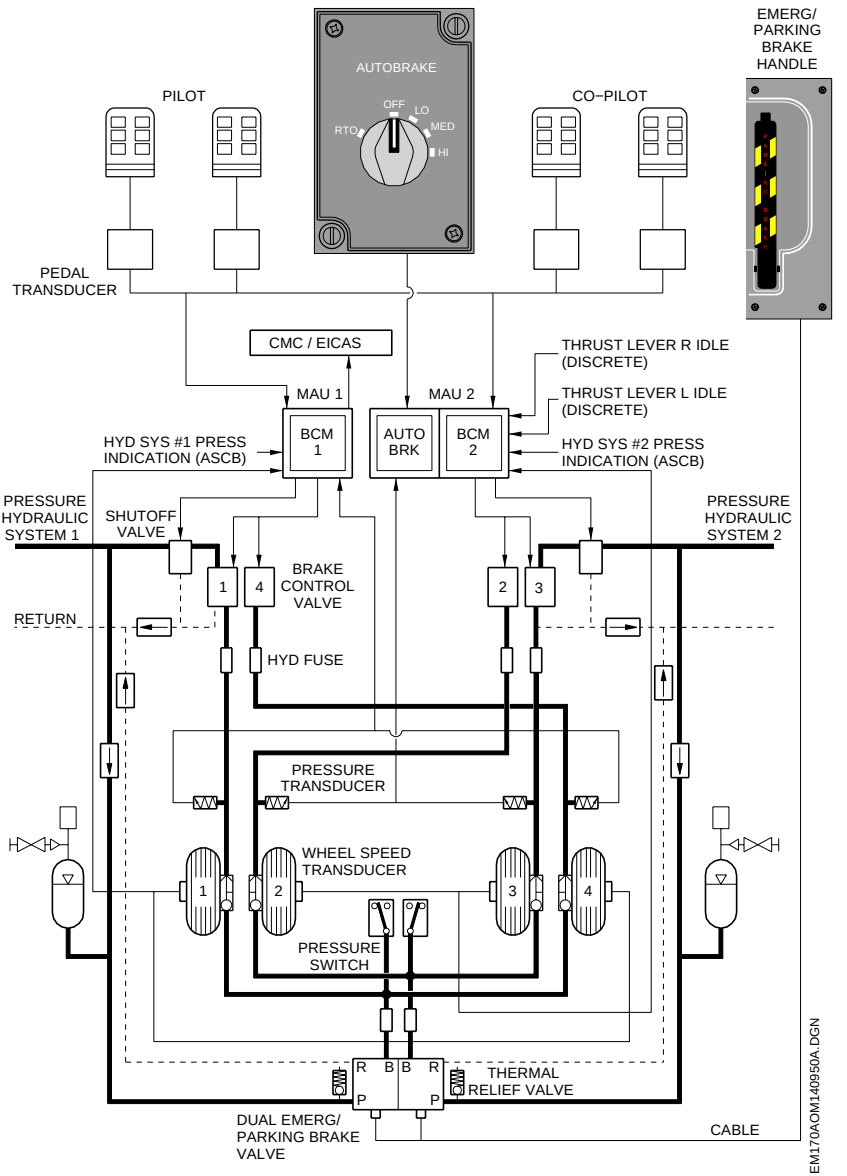
Autobrake will be disarmed if the following conditions are met:

	LANDING MODE	REJECTED TAKEOFF MODE
Selector Knob Position	OFF or RTO	OFF, LO, MED or HI
WOW Indication	-	In flight
Brake Control System	Faults detected	Faults detected below 60 kt of wheel speed
Brake Pedal Position	Pressed (more than 20%)	Pressed while Autobrake is being applied
Thrust Levers Position	Above idle while Autobrake is being applied	

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The aural message “AUTOBRAKE” is activated when “armed” condition (LO, MED, HI or RTO) is changed to “disarmed” by autobrake module (ABM) or brake control module (BCM) failure during parking, taxiing, takeoff roll or landing.

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BRAKE SYSTEM SCHEMATIC

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NOSEWHEEL STEERING SYSTEM

The airplane nose landing gear has steer-by-wire control powered by hydraulic system 2 and electronically controlled by the Nosewheel Steering Control Module.

OPERATION

To engage the nose wheel steering system:

– The hydraulic system 2 needs to be pressurized.

– The external steering disengage switch must be in the engaged position.

– The handwheel steering must be pressed and released for rudder pedal steering or kept pressed for handwheel steering.

NOTE: After a power up, the first steering engagement must be performed with the airplane stopped. If this condition is not met, the hardover test might not be successfully accomplished by the system and STEER FAIL message may be displayed.

The nose wheel steering has three modes of operation: the handwheel steering mode, the rudder pedal steering mode and the free wheel steering mode.

HANDWHEEL STEERING MODE

The handwheel steering mode is used for low speed control and whenever a wider turn angle is required.

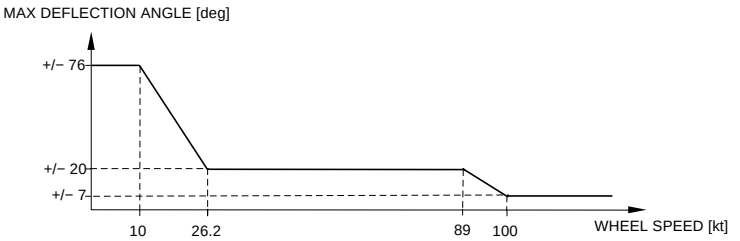
OPERATION

To operate in handwheel steering mode the handwheel steering must be kept pressed.

The steering handwheel command is limited to a maximum steering angle of ± 76° allowed up to 10 kt. Over around 26 kt the maximum steering deflection is 20°. Over 100 kt the maximum deflection is ± 7°.

Upon releasing the handwheel steering, the system reverts to rudder pedal steering mode.

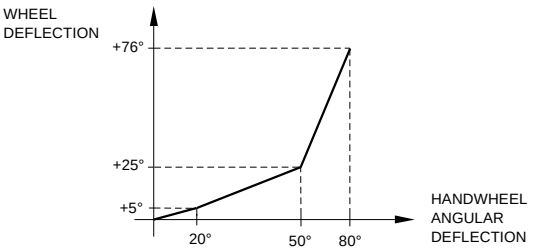
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MAXIMUM STEERING ANGLE

The wheel deflection as function of the handwheel angular deflection is not linear.

The functional characteristic of the steering handwheel angle is divided into separated linear parts with different gradients.



HANDWHEEL GAIN

RUDDER PEDAL STEERING MODE

The rudder pedal steering mode is designed to be used on high speed operations on ground or whenever a wider angle turn is not required.

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OPERATION

Rudder pedal steering is active on ground any time the STEER OFF message is not displayed on EICAS. If in handwheel steering mode, the handwheel steering must be pressed and released to activate rudder pedal steering mode.

The maximum steering angle of the rudder pedal is ±7°.

FREE WHEEL STEERING MODE

The free wheel steering mode is mostly used for towing or when the normal steering system fails.

OPERATION

The steering system can be disengaged reverting to free wheel by means of:

– The steering disengage button located on both control wheels.

– The external steering disengage switch located on the external power connection access.

In the free wheel mode, the airplane steering can be carried out by use of rudder, differential brake or asymmetrical thrust.

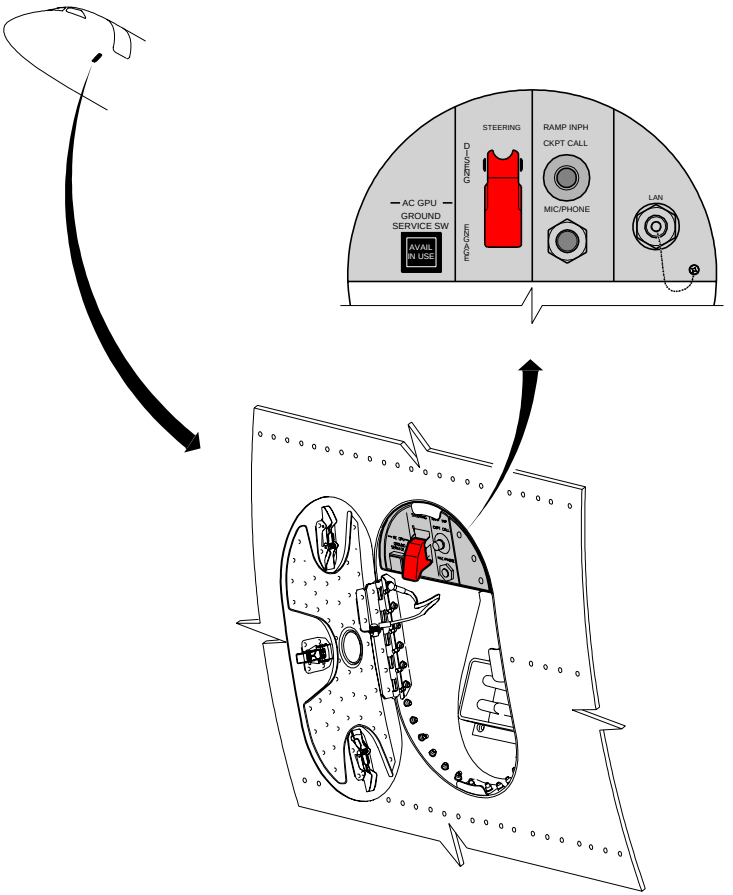
The free wheel mode is automatically selected when:

– Failure of the Air/Ground signal occurs.

– Nose wheel angle is greater than 76°.

– Nose wheel steering system failure is detected.

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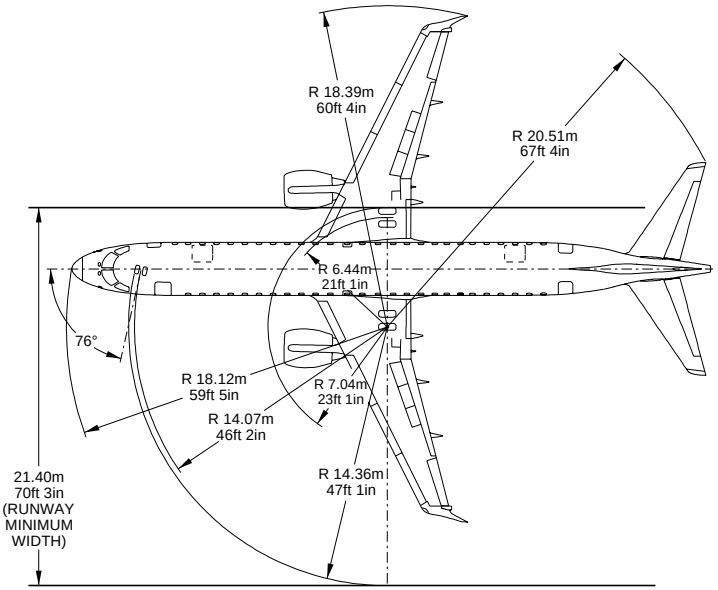


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EXTERNAL STEERING DISENGAGEMENT SWITCH

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MINIMUM TURNING RADII



MINIMUM TURNING RADII

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EICAS MESSAGES

►*Airplanes equipped with Autobrake OR POST-MOD SB 190-32-0006*

TYPE	MESSAGE	MEANING
WARNING	LG LEVER DISAG	A discrepancy between the position of the landing gear control lever and at least one landing gear is detected.
CAUTION	AUTOBRAKE FAIL	Autobrake function is no longer available.
	BRK OVERHEAT	Brake temperature has exceeded the normal operating range.
	BRK LH (RH) FAIL	Loss of both wheel brakes (inboard and outboard) of either the left or right landing gear.
	EMER BRK FAIL	Both brake accumulator pressures are low and low pressure of hydraulic systems 1 and 2 is detected.
	LG NO DISPATCH	Landing gear dispatchability is affected.
	LG NOSE DOOR OPEN	Nose landing gear is locked up and nose landing gear door is open.
	LG WOW SYS FAIL	Indicates a failure condition in the WOW indication system.
	PRK BRK NOT RELEASED	Parking brake not fully released.
	STEER FAIL	Indicates a steering system failure condition when the landing gear is down.

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TYPE	MESSAGE	MEANING
ADVISORY	BRK CONTROL FAULT	At least one pressure transducer has failed. Associated wheel operates with degraded braking capability.
	BRK LH (RH) FAULT	Loss of one wheel brake (inboard or outboard) of either the left or right landing gear.
	BRK PEDL LH (RH) SEAT FAIL	One pedal of the left or right hand seat has failed.
	EMER BRK FAULT	Pressure on one brake accumulator is low or the inboard and outboard park brake pressures are in disagreement.
	LG TEMP EXCEEDANCE	Indicates non-dispatch condition related to the landing gear after a brake overheat.
	STEER FAULT	Steering system is degraded.
STATUS	STEER OFF	Steering is disconnected.

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SECTION 14-14

OXYGEN

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GENERAL DESCRIPTION

The oxygen system provides supplemental oxygen to the flight crew and passengers when a lack of oxygen supply occurs on board.

The airplane oxygen system is comprised of two systems and other oxygen devices.

Oxygen system parameters and indications are displayed on both MFD synoptic pages. System messages are displayed on EICAS displays.

FLIGHT CREW OXYGEN SYSTEM

This system provides supplemental oxygen stored in a rechargeable cylinder and also provides protection to the flight crew in event of smoke and other harmful gases.

PASSENGER OXYGEN SYSTEM

This system provides only supplemental chemically generated oxygen to passengers and flight attendants.

PROTECTIVE BREATHING EQUIPMENT (PBE)

The PBE provides the crew with positive pressure oxygen for respiratory and visual protection against the effects of smoke and other harmful gases.

PORTABLE OXYGEN CYLINDERS

Portable oxygen cylinders are located throughout the airplane for use by the flight attendants to assist passengers in case of sudden decompression or first aid purposes.

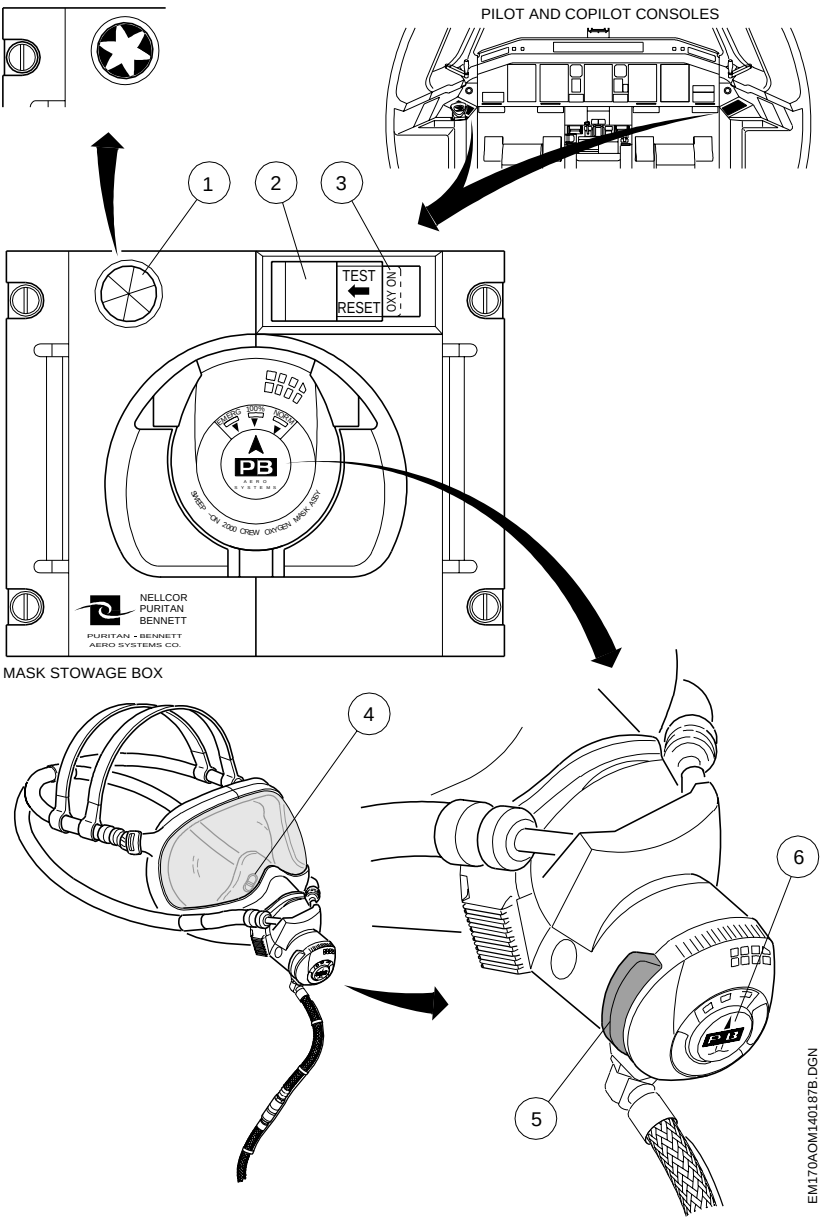
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MASK STOWAGE BOX AND CREW MASK

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1 - FLOW INDICATOR

– A bright yellow star when visible indicates that oxygen is flowing.

2 - TEST/RESET BUTTON (SPRING LOADED)

– Pressing this button with the mask stowed tests the oxygen mask and activates the microphone. The flow indicator star momentarily blinks and oxygen flow will be audible through audio system.

– Pressing this button with the mask not stowed and the mask box door closed shuts off the oxygen flow, turns off mask's microphone and returns the communication from the cockpit speakers to the headsets.

3 - OXY ON FLAG

– This flag appears whenever oxygen is supplied to the mask.

4 - PURGE VALVE

– This valve allows oxygen flow into the face seal, purging any smoke and fumes.

– This valve automatically opens when the oxygen supply control knob is rotated to the emergency mode position.

5 - HARNESS INFLATION CONTROL VALVE

– Pressing this valve inflates the harness so that the mask may be donned. Releasing the button deflates the harness securing the mask in place.

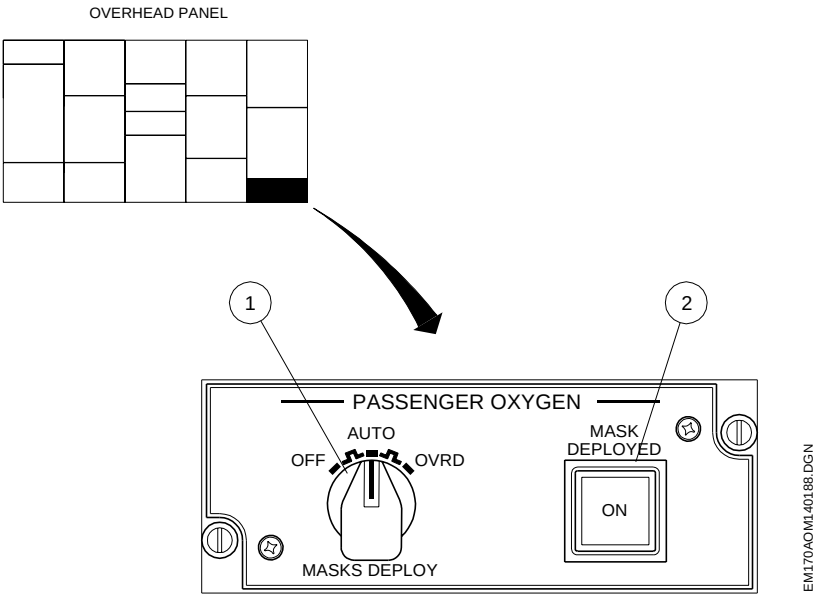
6 - OXYGEN SUPPLY CONTROL KNOB (ROTARY ACTION)

– Rotating the knob selects the mode of oxygen supply.

EMERG: supplies pure oxygen under positive pressure.
100%: supplies pure oxygen at all cabin altitudes.
NORM: supplies an oxygen/air mixture on demand (the ratio depends on cabin altitude).

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OXYGEN CONTROL PANEL



1 - MASKS DEPLOY SELECTOR KNOB (ROTARY ACTION)

OFF: disables automatic deployment of passenger oxygen masks.

AUTO: enables automatic deployment of passenger oxygen masks when cabin pressure altitude is above 14000 ft.

OVRD: deploys the passenger oxygen masks regardless of cabin altitude.

2 - MASK DEPLOYED INDICATOR LIGHT

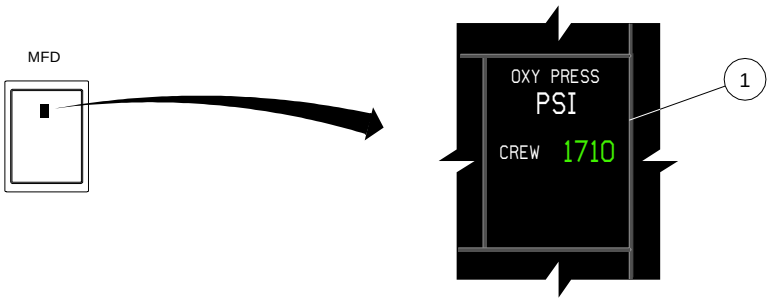
– An ON light illuminates, indicating that the passenger and flight attendant oxygen masks have been deployed.

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SYNOPTIC PAGE ON MFD

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*

The status synoptic page provides digital oxygen pressure indication.
►►*Commercial airplanes equipped with MAU load 21.2 and on OR POST-MOD SB 0190-31-0015*



◄◄

A difference in pressure indication between the MFD and the oxygen pressure gauge outside the airplane may be observed. The difference occurs due to a temperature correction in the MFD that does not occur on the oxygen pressure gauge.

1 - COCKPIT OXYGEN PRESSURE INDICATION

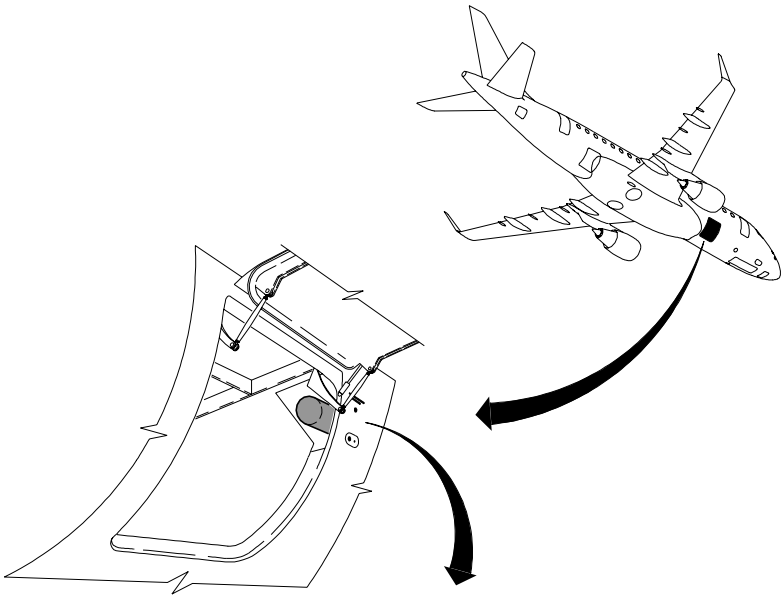
GREEN: normal operating range (minimum for three crew members in the cockpit).
CYAN: advisory operating range (minimum for two crew members in the cockpit).
AMBER: cautionary operating range (no dispatch).
AMBER DASHED: invalid information or a value out of the valid range.

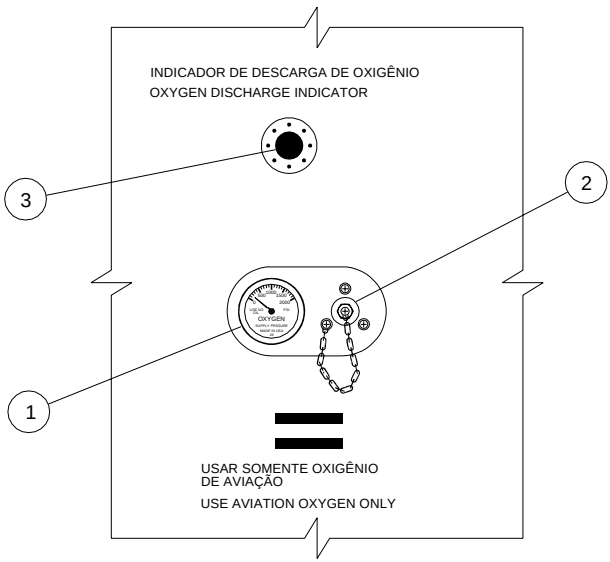
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CREW OXYGEN CYLINDER AND REFILL POINT LOCATION

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1 - OXYGEN PRESSURE GAUGE

– Displays the cylinder static pressure.

2 - OXYGEN RECHARGE VALVE

– The valve is used to recharge the cylinder by maintenance personnel.

3 - DISCHARGE INDICATOR DISC

GREEN: normal operating range.

The green oxygen cylinder pressure relief disc blows out in the event of an overpressure.

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GENERAL

Flight crew oxygen is provided via a conventional, high-pressure, gaseous-type system in which the oxygen is stored in a rechargeable cylinder.

OXYGEN CYLINDER

Oxygen is stored in standard 50 ft^3, or an optional 77 ft^3 cylinder, pressurized up to 1850 psi at 21°/70°F. The cylinder is installed in the forward cargo compartment and does not need to be removed to recharge.

FLIGHT CREW FULL-FACE MASKS

Flight crew and observer full-face, quick donning masks and regulators are stowed in oxygen mask storage boxes near each seat. The masks provide supplemental oxygen and protection from smoke and other harmful gases.

FLIGHT CREW FULL-FACE MASKS TEST

The masks are tested utilizing the TEST/RESET button. With the mask stowed and the regulator knob set to 100%, pressing and holding the TEST/RESET button will cause a short blink of flow indicator and an oxygen flow sound will be audible in the speakers. On the radio panel, the SPKR Indicator will illuminate. Once the mask fully pressurizes the indicator must go out showing the system is leak free. Releasing the TEST/RESET button will terminate the test.

FLIGHT CREW FULL-FACE MASKS OPERATION

Opening the stowage box's mask automatically initiates the oxygen flow. Pressing the harness inflation control valve will inflate the harness, enabling its quick donning. Releasing the button will deflate the harness, firmly fitting it to the head. The mask is designed to be donned within 5 s. The oxygen will flow until the stowage box's doors are closed.

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FLIGHT CREW FULL-FACE MASKS COMMUNICATION

The mask is also connected to the communications system.

When the oxygen mask stowage box door is opened the mask's microphone is automatically activated and the headset boom microphone is deactivated.

The speakers are also automatically activated and the communication reception is possible through the speakers or the headsets.

When the oxygen mask stowage box is closed and the TEST/RESET switch is pressed the headset boom microphone is restored and the mask's microphone is turned off.

FULL FACE MASK OPERATING MODES

Normal: Normal Mode provides supplemental oxygen diluted with cabin air according to the cabin pressure altitude until a preset point where the user inhales 100% oxygen. This feature is to conserve the amount of oxygen consumed from the supply source while still maintaining protective physiological levels.

100%: 100% Mode provides non-diluted oxygen to the crew regardless of cabin altitude.

Emergency: The "EMER" setting provides non-diluted oxygen regardless of cabin altitude, with a slightly positive pressure. This setting should be used to eliminate condensation or to purge smoke and toxic fumes that may get into the mask.

When the mask is on emergency mode, the air pressure and flow make communication more difficult. To avoid communication disruption it is recommended not to use the EMER setting continuously, selecting the mode back to 100% or Normal after the mask is clear of smoke, fumes or condensation.

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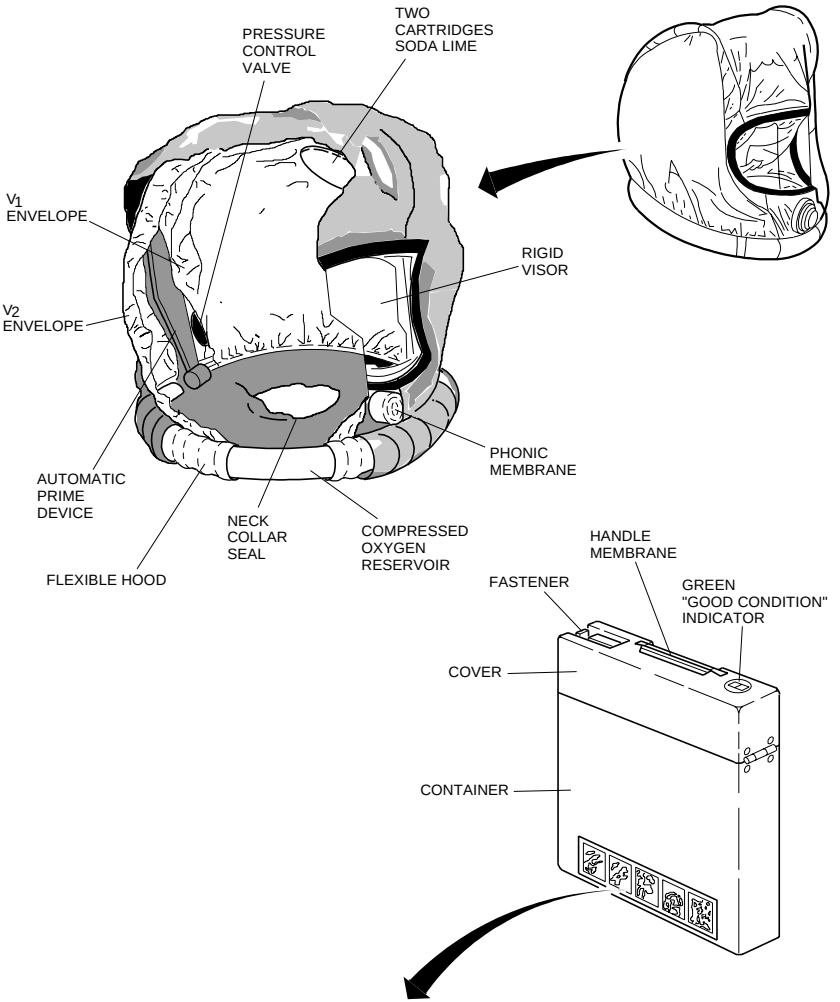
PROTECTIVE BREATHING EQUIPMENT (PBE)

The PBE unit is for emergency use only. It is vacuum-sealed in a small bag inside a box. The box is equipped with a green “good condition indicator”.

The equipment hood isolates the user’s head from the external ambient gases by means of an elastic neck seal. Oxygen flow starts automatically after hood donning and will be supplied for at least 15 min.

The PBE unit provides the crew with positive pressure oxygen for respiratory and visual protection against the effects of smoke and other harmful gases at altitudes up to 25000 ft.

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PROTECTIVE BREATHING EQUIPMENT

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PASSENGER OXYGEN SYSTEM

Individual chemical oxygen generators supply the passenger oxygen system during an emergency descent in the event of cabin depressurization. The passenger oxygen system provides supplemental oxygen only to the following: passenger service units (PSU), flight attendant stations, lavatories, and galley areas.

PASSENGER OXYGEN MASKS

Passenger oxygen masks are located in the PSUs above the passenger seats.

Each PSU contains either two or three masks that supply oxygen only for approximately 12 min (standard), 14 min (optional) or 22 min (optional).

The masks do not provide smoke protection and once the system starts supplying oxygen, they cannot be shut off.

OXYGEN SUPPLY

The supplemental oxygen is diluted with ambient air according to the cabin altitude. At higher cabin altitudes, the mask provides 100% supplemental oxygen.

PASSENGER OXYGEN SYSTEM OPERATION

Passenger oxygen mask can be automatically or manually deployed.

PASSENGER OXYGEN MASKS AUTOMATIC DEPLOYMENT

The masks are automatically deployed when the cabin altitude is between 14000 ft to 14750 ft.

PASSENGER OXYGEN MASKS MANUAL DEPLOYMENT

Manual deployment can be performed from the cockpit by positioning the passenger oxygen selector knob to the OVRD position. A manual release tool located near each flight attendant station can be used in case dispensing unit door fails.

The flight crew monitors the passenger oxygen mask deployment status through EICASmessages and an indicator light on the overhead panel.

PASSENGER MASKS DEPLOY INDICATION

The ON light on the overhead OXYGEN PANEL illuminates indicating that the passenger mask doors are commanded open.

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PASSENGER SIGNS AUTOMATION

When the passenger mask doors are automatic or manual commanded open the system automatically turns ON the FASTEN SEAT BELT and the NO SMOKING (NO ELEC DEVICE optional) regardless of the switch position.

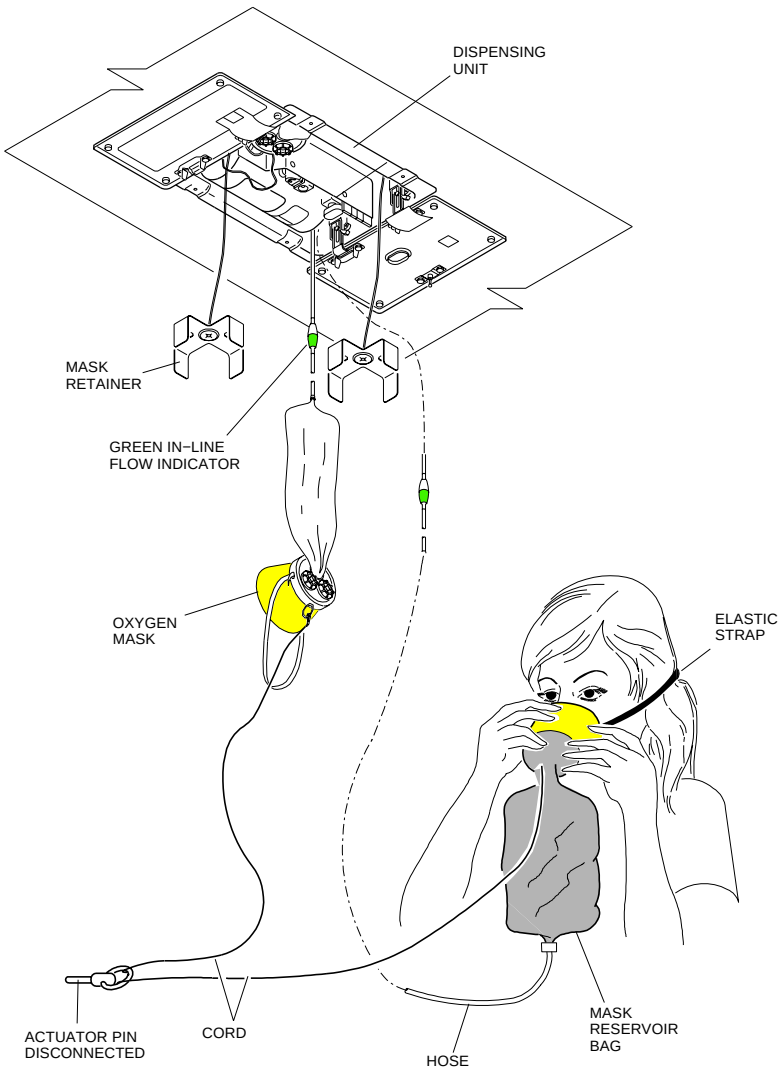
The switch normal operation is inhibited until the MASKS DEPLOY switch is set to OFF position.

PASSENGER MASKS USAGE

The oxygen masks are held in a mask retainer. The yellow mask must be pulled out of the retainer. Oxygen flows throughout all masks in the dispensing unit whenever any yellow mask hanging from the dispensing unit is pulled downward.

A green, in-line flow indicator is visible in the transparent oxygen hose whenever oxygen is flowing to the masks.

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DISPENSING UNITS/PASSENGER MASKS

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PORTABLE OXYGEN CYLINDER

The portable oxygen cylinders are for flight attendants use to assist passengers in case of sudden cabin decompression or for first aid purposes.

The cylinders store 312 ℓ (11 ft^3) of oxygen, pressurized to 1800 psi. at 21°/70°F.

PORTABLE OXYGEN CYLINDER COMPONENTS

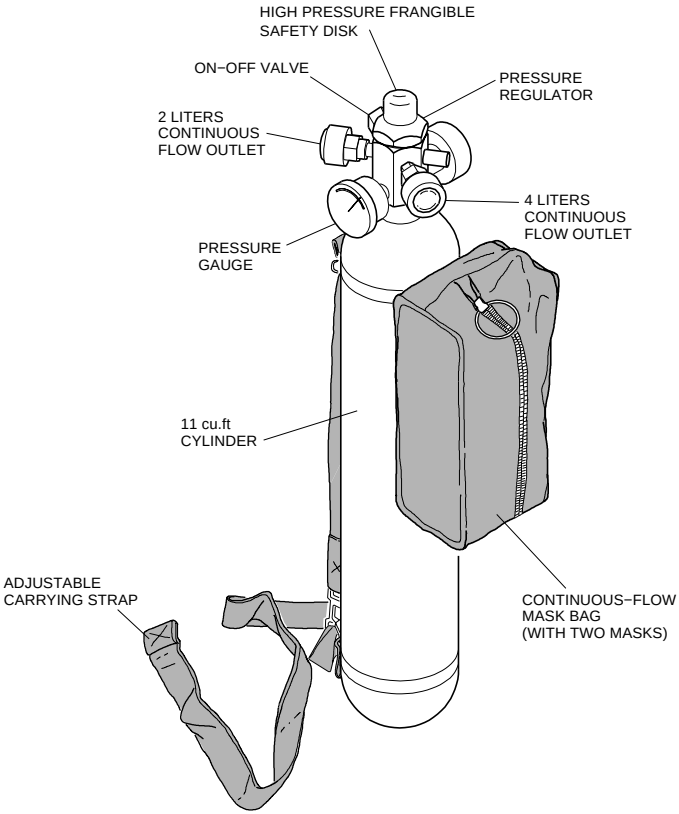
The cylinders are fitted with a pressure gauge, a pressure regulator and an ON/OFF valve.

A high-pressure frangible safety disk ruptures within a cylinder pressure of 2700 psi to 3000 psi. For airplane dispatchability, the minimum pressure shown on the gauge of portable oxygen cylinder, must be in accordance with the minimum guideline set either for airline or regulatory authority.

PORTABLE OXYGEN CYLINDER USE

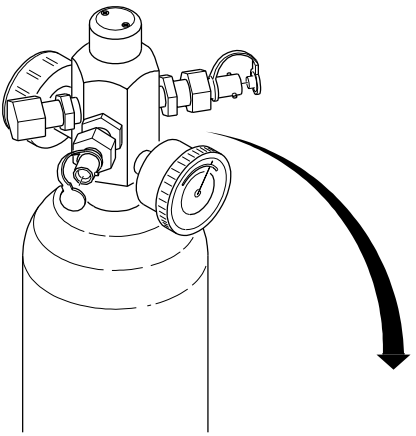
Two continuous flow outlets are available; one regulates flow at 2 ℓ per minute for walk-around use and the second provides flow at 4 ℓ per minute for first aid use.

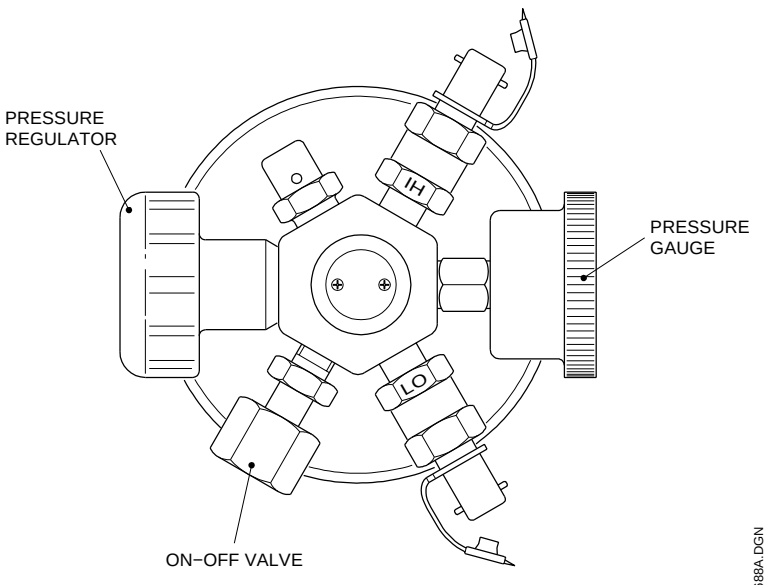
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PORTABLE OXYGEN CYLINDER

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
CAUTION	CREW OXY LO PRESS	Oxygen cylinder pressure is below minimum safety limits, or the pressure sensor has failed.
	PAX OXY NOT DEPLOYED	Masks are not deployed after an automatic or manual command.
ADVISORY	PAX OXY SW NOT AUTO	Passenger oxygen selector is set to the OFF position.
	OBSERVER OXY LO PRESS	Oxygen cylinder pressure is below minimum safety limits for 3 crew members, or the pressure sensor has failed.

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SECTION 14-15

WARNING SYSTEM

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GENERAL DESCRIPTION

The airplane is provided with a variety of warnings to notify crew on systems status, malfunctions, and abnormal airplane configurations.

Alarm lights provide indication of a system status. An Engine Indication and Crew Alerting System (EICAS) provides the flight crew with a four-level alert messaging system. A fifth level is provided for maintenance purposes only.

Besides the five displays in the main panel, two displays are provided through the Multi-function Control Display Unit (MCDU). Some of the more critical messages also generate an aural warning.

Sensitive warning is available through the Stall Protection System (SPS), which shakes the control column if an impending stall is verified.

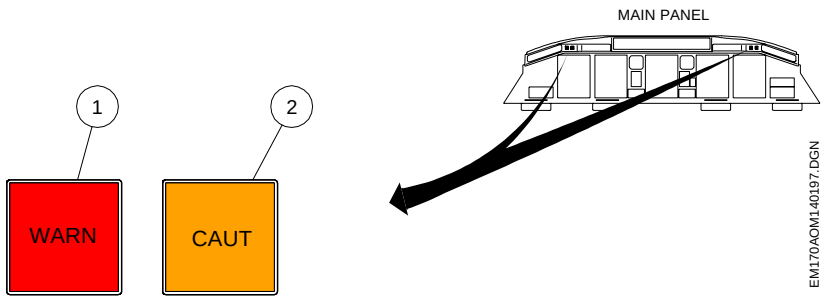
To aid navigation and approach procedures, an Enhanced Ground Proximity Warning System (EGPWS), Traffic Alert and Collision Avoidance System (TCAS), and a Windshear Detection and Escape Guidance System are also provided.

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GLARESHIELD PANEL



1 - MASTER WARNING PUSHBUTTON

– A red light blinks inside the button when a new warning message is displayed on the EICAS.

– Acknowledges the warning messages and extinguishes the associated blinking.

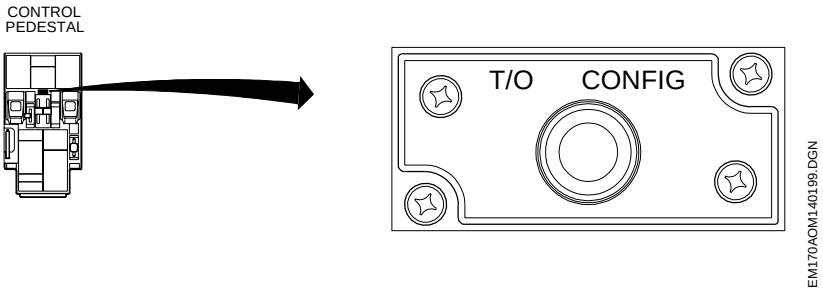
2 - MASTER CAUTION PUSHBUTTON

– An amber light blinks inside the button when a new caution message is displayed on the EICAS.

– Acknowledges the caution messages and extinguishes the associated blinking.

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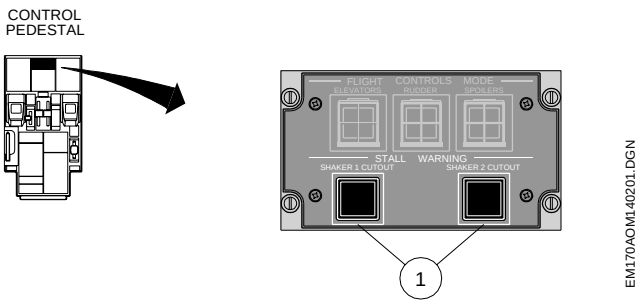
TAKEOFF CONFIG CHECK BUTTON



1 - TAKEOFF CONFIGURATION CHECK BUTTON

– Checks the takeoff configuration.

STALL WARNING PANEL



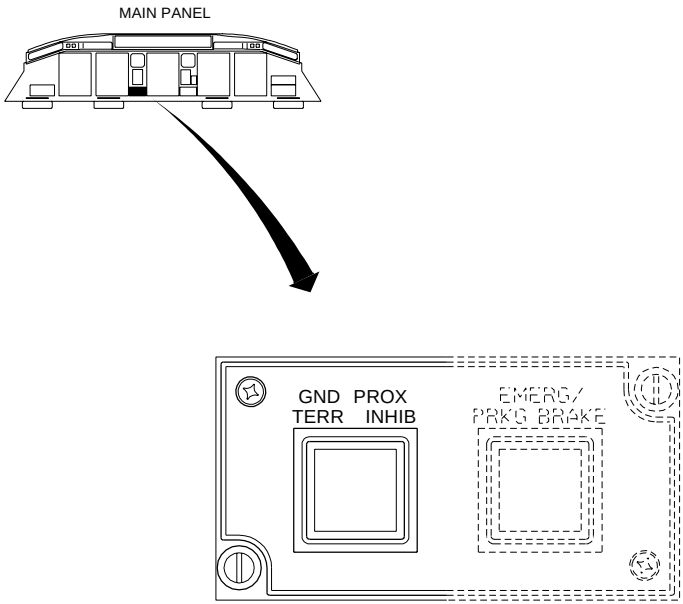
1 - SHAKER CUTOUT BUTTON

– When pushed in, cuts out the associated shaker channel.

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GLARESHIELD EGPWS PANEL

EGPWS TERRAIN SYSTEM OVERRIDE

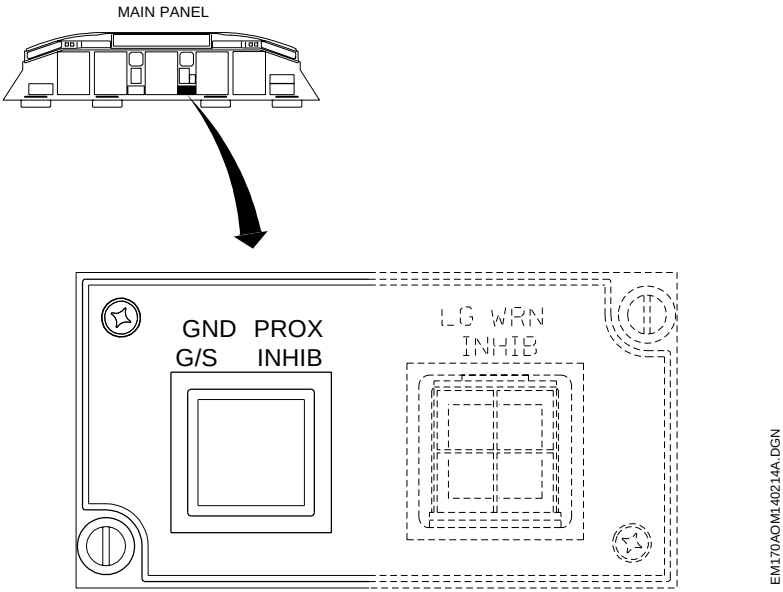


GROUND PROXIMITY TERRAIN INHIBIT PUSHBUTTON

– When pushed in, inhibits EGPWS and thus avoids unwanted terrain alerts in airports not covered by EGPWS database.

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EGPWS GLIDESLOPE CANCELLATION



GROUND PROXIMITY GLIDESLOPE INHIBIT

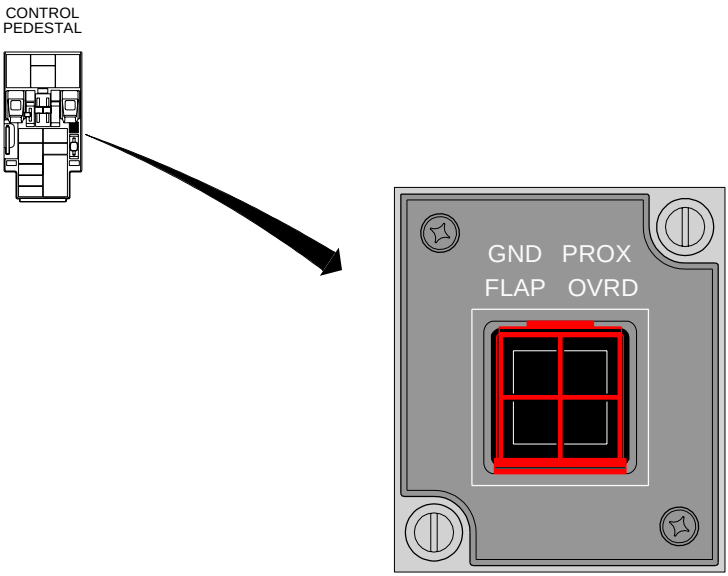
– Momentary pushbutton annunciator used to manually cancel glideslope alerts.

– Illuminates when pressed any time below 2000 ft nominal radar altitude and will be automatically reset (light off) by climbing above 2000 ft nominal or descending below 30 ft.

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CONTROL PEDESTAL EGPWS PANEL

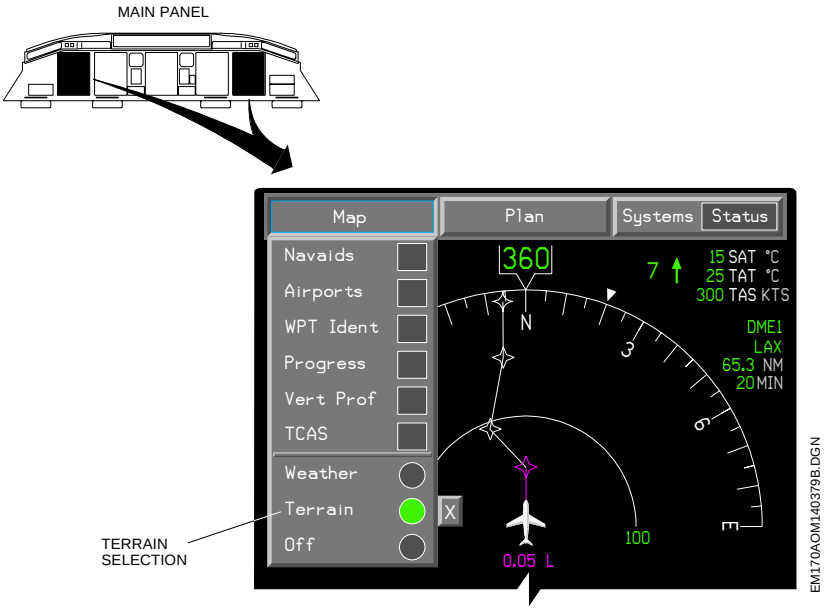
FLAP OVERRIDE SWITCH (GUARDED)



– Inhibits triggering flap alerts in case of landings where flap configuration is different from normal landing flap configuration.

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EGPWS SELECTION ON MFD



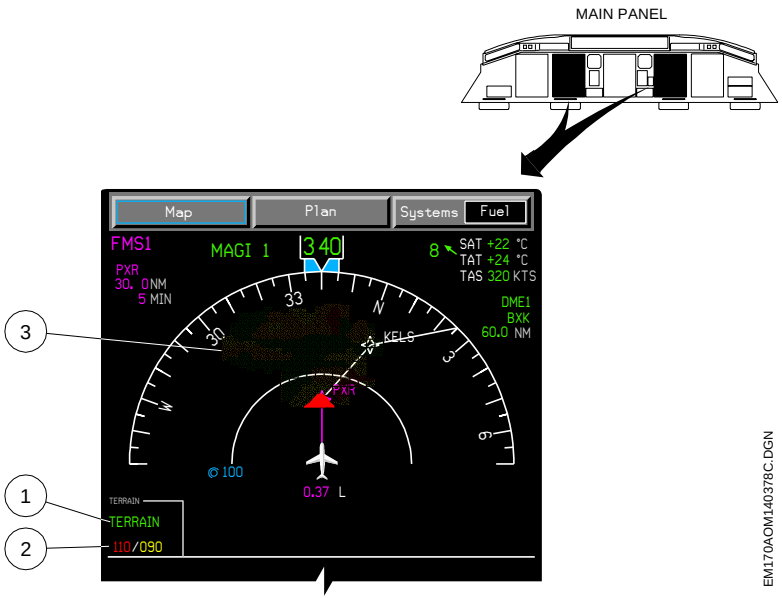
EGPWS MAP MENU FUNCTION

– The TERRAIN mode enables the EGPWS terrain depiction to be displayed on the map overlay format window in solid or lower density colors including the sea level (0 ft MSL).

– The ranges allowed are: 5 NM, 10 NM, 25 NM, 50 NM, 100 NM, 200 NM, 300 NM, 500 NM and 1000 NM.

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EGPWS DISPLAY ON MFD



1 - TERRAIN ANNUNCIATION

Labels and colors:

– TERRAIN

GREEN: EGPWS is scanning the terrain.

AMBER: system failure.

– TERRAIN INHIBIT

WHITE: terrain inhibit button is pressed in approach mode.

– TERRAIN N/A

AMBER: terrain awareness not available due to position accuracy degradation.

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– TERRAIN TEST

WHITE: self- test activated.

2 - TERRAIN DIGITAL DISPLAY

– Displays the highest and lowest terrain/obstacle.

3 - TERRAIN INDICATION

– Displays images of surrounding terrain. Different colors and their intensity represent the terrain elevation.

– Colors:

Solid red: warning terrain threat area.

Solid yellow: caution terrain threat area.

High-density red dots: terrain more than 2000 ft above airplane altitude.

High-density yellow dots: terrain between 1000 ft and 2000 ft above airplane altitude.

Low-density yellow dots: terrain between 500 ft (250 ft with gear down) below and 1000 ft above airplane altitude.

Solid green: the highest terrain is not within 500 ft (250 ft with gear down) of airplane altitude. It may be displayed with dotted yellow when the airplane altitude is near than 500 ft (250 ft with gear down) of terrain.

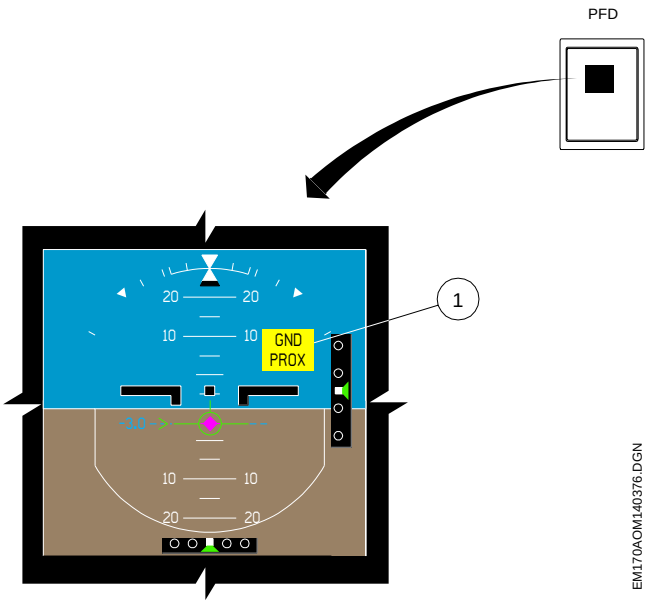
High-density green dots: terrain between 1000 ft and 500 ft below the airplane altitude.

Low-density green dots: terrain between 2000 ft and 1000 ft below the airplane altitude.

Low-density cyan dots: sea level.

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EGPWS DISPLAY ON PFD



1 - GROUND PROXIMITY/PULL UP ANNUNCIATIONS

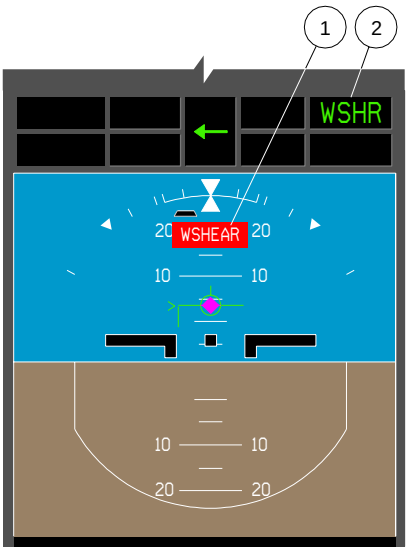
– Label and colors:

  – GND PROX
    - Color: amber.

  – PULL UP
    - Color: red.

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WINDSHEAR INDICATION ON PFD



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1 - WINDSHEAR INDICATION (WSHEAR)

– Indicates that a windshear has been detected.

– Color:

AMBER: caution windshear.

RED: warning windshear.

2 - FLIGHT GUIDANCE ESCAPE MODE ENGAGEMENT

– Indicates the FGCS Windshear Escape Mode engagement.

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TCAS MAP OVERLAY FORMAT WINDOW



1 - TCAS SELECTION IN MAP MENU

– Actives the TCAS information to be displayed on the map overlay format window.

2 - RESOLUTION ADVISORY (RA) INDICATION

– Symbol: Solid square.

– Color: Red.

3 - TRAFFIC ADVISORY (TA) INDICATION

– Symbol: Solid circle.

– Color: Amber.

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4 - PROXIMATE TRAFFIC INDICATION

– Symbol: Solid diamond.

– Color: Cyan.

5 - OTHER TRAFFIC INDICATION

– Symbol: Hollow diamond.

– Color: Cyan.

6 - TCAS MODE

– Annunciates the TCAS operating mode.

– Labels and Colors:

TCAS FAIL: amber.

TCAS TEST: green.

TCAS OFF: amber.

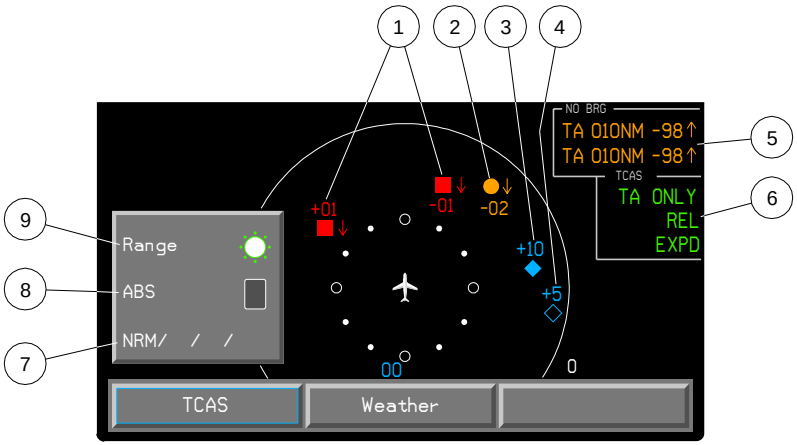
TA ONLY: green.

TCAS TA/RA: green.

NOTE: The TA ONLY flashes amber when it is the active mode and a RA condition is detected.

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TCAS ZOOM FORMAT WINDOW



1 - RESOLUTION ADVISORY (RA) INDICATION

- Symbol: Solid square.
- Color: Red.

2 - TRAFFIC ADVISORY (TA) INDICATION

- Symbol: Solid circle.
- Color: Amber.

3 - PROXIMATE TRAFFIC INDICATION

- Symbol: Solid diamond.
- Color: Cyan.

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4 - OTHER TRAFFIC INDICATION

– Symbol: Hollow diamond.

– Color: Cyan.

5 - NO BEARING INDICATION

– TCAS temporarily unable to determine the bearing of other airplanes when a steep bank angle masks the directional antenna.

6 - TCAS MODE

– Annunciates the TCAS operating mode.

– Labels and Colors:

TCAS FAIL: amber.

TCAS TEST: green.

TCAS OFF: amber.

TA ONLY: green.

TCAS TA/RA: green.

NOTE: The TA ONLY flashes amber when it is the active mode and a RA condition is detected.

7 - MODE SELECTION

– Selects the vertical mode to be displayed on TCAS.

8 - ABS SELECTION

– Selects the absolute altitude mode to be displayed on TCAS. Deselecting this item enables the relative altitude mode. Absolute altitude mode will be replaced by relative altitude mode in the following situations:

  – An RA or TA intruder is displayed;

  – Deselection of the mode; or

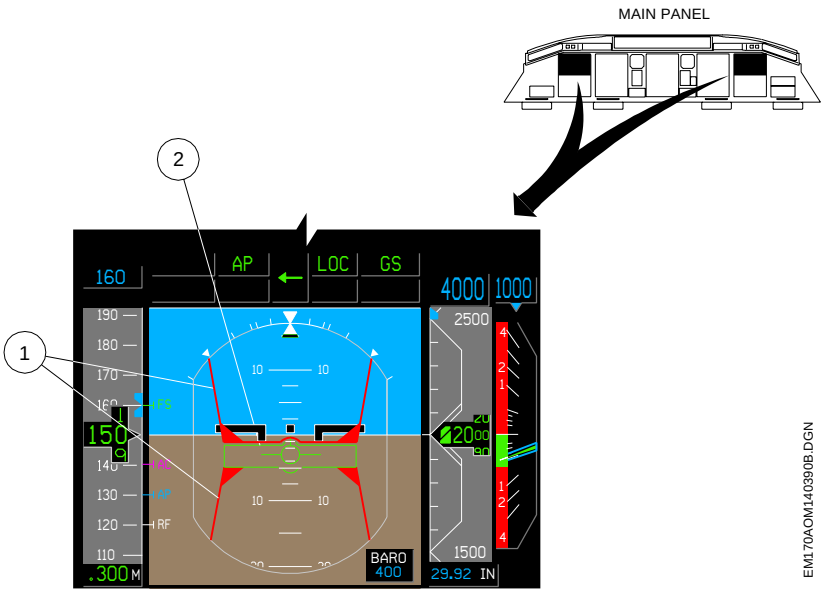
  – 15 seconds after being selected.

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9 - RANGE SELECTION

– Enable the selection of the range to be displayed. The selection is changed through the selector knob in the CCD.

TCAS INDICATION ON PFD



The commands provide pitch guidance information to the flight crew to recommend or prohibit a maneuver and prevent hazardous encounters with other airplane.

The vertical speed scale is used to display TCAS resolution advisories.

The red range is the avoidance zone and the green range is the fly-to-zone.

1 - AVOIDANCE ZONE

– Symbol: Trapezoid.

– Color: Red.

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2 - FLY-TO ZONE

– Symbol: Rectangle.

– Color: Green.

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MONITOR WARNING FUNCTION (MWF)

Two monitor warning function computers in separate modular avionics units (MAUs) continually monitor the status of various airplane and avionics systems.

One MWF has priority and alerts the flight crew by generating alert messages in the CAS display window. Some warnings also have sounds (voice and/or tone). The other MWF is a backup. If the priority MWF fails, the display computer automatically selects and uses the data from the backup MWF.

Alert messages are prioritized and color-coded for display. The MWF also controls message timing, flight crew acknowledgement, and the scrolling of the CAS messages in the CAS display window.

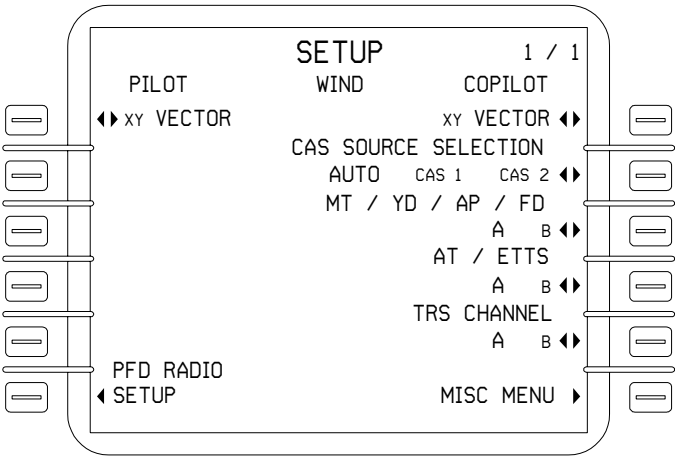
CAS SOURCE SELECTION

The CAS List Message Comparison Annunciation is shown on both PFDs to indicate that the CAS lists from the two monitor warning systems do not match. The annunciation consists of the letters ″CAS MSG″ displayed inside a cutout box. If the two CAS message lists are continuously different for 20 s, a miscompare indication is annunciated.

The CAS MSG source can be visualized or manually changed on the MCDU avionics SETUP page through LSK 2R from CAS 1 to CAS 2 or vice versa.

CAS SOURCE SELECTION options are only enable on the MCDU SETUP page 1/1 when a miscompare is detected between CAS 1 and CAS 2 lists, otherwise just the label CAS SOURCE SELECTION is displayed.

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MCDU AVIONICS SETUP PAGE

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VISUAL WARNING

Visual warnings are provided through illuminated warning buttons, displays indications and EICAS messages.

WARNING LIGHTS

Master warning and caution lights are installed on the glareshield panel and blink when any warning or caution message shows on the EICAS or triggered by the Aural Warning Unit. It alerts to conditions that require action or caution related to the operation of the airplane.

MESSAGES ON EICAS

EICAS MESSAGES MNEMONICS

CAS messages mnemonic are generally presented in three elements, as shown in the example:

General Header or System	Specific Subsystem or location	Nature of the Problem	CAS Message Mnemonic
ENGINE	Left side	Fire detected	ENG 1 FIRE
FUEL SOV	Left side	Valve is closed	FUEL SOV CLOSED
ADS	Third system	ADS standby failed	ADS 3 FAIL

NOTE: – The above format may not be applicable for all CAS messages. Therefore, although the standard is desirable, it shall be subordinated to a clear statement of the nature of the problem.

– Throughout the manual, number 1 is used to identify the left side, number 2 to identify the right side and number 3 for triple systems (usually for backup and standby systems).

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EICAS MESSAGES CATEGORIZATION

There are four message priority levels:

– Warning.

– Caution.

– Advisory.

– Status.

WARNING (red): indicates an emergency operational or airplane system conditions that require immediate corrective or compensatory crew action.

CAUTION (amber): indicates an abnormal operational or airplane system conditions that require immediate crew awareness and should require a subsequent corrective or compensatory action.

ADVISORY (cyan): indicates operational or airplane conditions that require crew awareness. Subsequent or future crew action may be required.

STATUS (white): indicates information/status messages. The pilot can use the system efficiently when the appropriate action is accomplished.

A fifth level is provided for maintenance and is not available during flight operation. It is accessed only on ground.

Messages with the higher priority precede other messages when shown simultaneously. The EICAS displays up to 15 messages simultaneously.

The MCDU displays some messages in the event of a failure of both MFD and the EICAS.

STATUS LINE

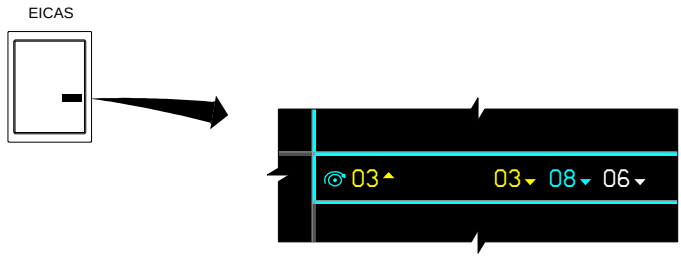
The CAS window is selected by a CCD when a cyan curl with arrow icon (meaning knob adjustable data) is displayed, and the alert window border changes from gray to cyan. In case of an overflow (exceeding the display capacity – 15 messages), turning the active CCD scroll knobs scrolls the alert message stack list under the CAS window.

The status line indicates the number (count) and type (color) of messages out of the CAS window, and if they are located above or below the window.

The out-of-view message display (digits and arrows) flashes continuously when there are unacknowledged messages out of view.

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Warning messages are not scrolled out of the window.



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ROOT EICAS MESSAGES

Some single failures may trigger more than one EICAS message at a time. In the event of multiple EICAS messages, identifying the true nature of the failure and taking the appropriate corrective action is an important role.

EICAS messages which may generate more messages with them are called Root EICAS messages and they are highlighted by a preceding chevron “>”.

In most cases the corrective action will be to perform only the procedure associated with the ROOT EICAS message, but some situations may require additional actions. The pilot must always review all messages displayed on the EICAS and check if they are associated to the root EICAS message and take additional actions if required.

ROOT EICAS message procedures do not necessarily have to be performed first.

If more than one root message is displayed at the same time or displayed together with a WARNING message, the priority order to be evaluated is:

– WARNING messages;

– ELECTRICAL BUSES and;

– MAU.

Below is the list of all the ROOT EICAS messages:

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CENTER EBAY FANS FAIL	DC BUS 1 OFF
FWD EBAY FANS FAIL	DC BUS 2 OFF
AVNX MAU 1A FAIL	DC ESS BUS 1 OFF
AVNX MAU 1B FAIL	DC ESS BUS 2 OFF
AVNX MAU 2A FAIL	DC ESS BUS 3 OFF
AVNX MAU 2B FAIL	ELEC EMERGENCY
AVNX MAU 3A FAIL	LG WOW SYS FAIL
AVNX MAU 3B FAIL	HYD 1 LO PRESS
AC BUS 1 OFF	HYD 2 LO PRESS
AC BUS 2 OFF	HYD 3 LO PRESS
AC ESS BUS OFF	

EICAS MESSAGES INHIBITION

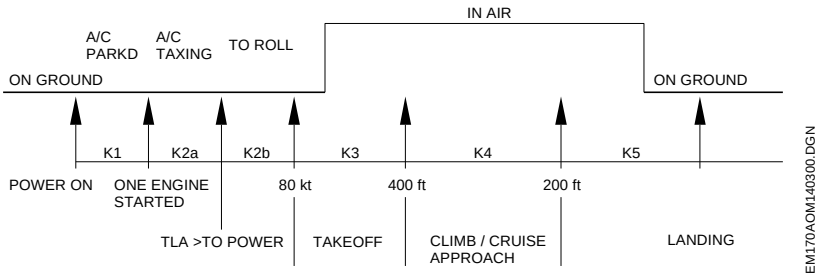
Some EICAS messages are inhibited on takeoff or approach and landing to prevent it from being a nuisance.

Inhibition logic considers the following k-codes to inhibit the messages:

CODE	AFTER	BEFORE	DESCRIPTION
K1	Electrical Power ON	1st Engine Started	A/C parked
K2a	1st Engine Started	TLA > TO Power	A/C taxiing
K2b	TLA > TO Power	80 kt	TO Roll
K3	80 kt	400 ft (takeoff)	Takeoff
K4	400 ft (takeoff)	200 ft (landing)	Climb, cruise, approach
K5	200 ft (landing)	30 seconds after touchdown and wheelspeed below 30 kt.	Landing

EICAS MESSAGE INHIBITION SCHEMATIC

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EICAS MESSAGES PRESENTATION

The messages are grouped and presented in a chronological order accordingly to its category. The Warning category is placed at the top of the EICAS display. Below this category the system presents the Caution, Advisory and Information/Status category, in this order.

When new Warning, Caution and Advisory alert messages are displayed, they are presented flashing in inverse video for crew acknowledgment.

The warning and caution alert messages shall remain flashing in inverse video until manual crew acknowledgment via Master Warning or Caution button (respectively) is pressed. Advisory messages will automatically revert from inverse to normal video after 5 seconds they started to be displayed.

After the acknowledgment, the new message shall remain in steady normal video, at the top of its category on the EICAS display, until a new message belonging to that group appears.

The EICAS messages cannot be cancelable. They shall remain active as long as its activation condition exists.

The following table presents all EICAS messages. The type column indicates the message priority level:

– (W) Warning.

– (C) Caution.

– (A) Advisory.

– (S) Status.

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The INHIBITION column indicates the k-codes.

SECTION	TYPE	MESSAGE	INHIBITION
14-01 AIRPLANE GENERAL	W	DOOR CRG AFT (FWD) OPEN	K3, K5
		DOOR EMER LH (RH) OPEN	None
		DOOR PAX AFT (FWD) OPEN	K3, K5
		DOOR SERV AFT (FWD) OPEN	
	C	APM FAIL	K2b, K3, K4, K5
		APM MISCOMP	
		AVNX MAU 1 (2) (3) A (B) FAIL	K3, K5, and inhibited from 80 kt to 400 ft by logic.
		AVNX MAU 1 (2) (3) A (B) OVHT	
		AVNX MAU 1 (2) (3) FAN FAIL	
		CMS FAIL	K2b, K3, K4, K5
		DOOR CENTER (FWD) EBAY OPEN	K3, K5
		DOOR HYD OPEN	
		EICAS FAULT	None
		EICAS OVHT	K3, K5
		EMER LT NOT ARMED	K2b, K3, K5
		EMER LT ON	
		MFD 1 (2) FAULT	None
		MFD 1 (2) OVHT	K3, K5
		PFD 1 (2) FAULT	None
		PFD 1 (2) OVHT	K3, K5
		SYS CONFIG FAIL	K2a, K2b, K3, K4, K5
	A	APM FAULT	K2b, K3, K4, K5
		AVNX DB MODULE FAIL	K2a, K2b, K3, K4, K5
		AVNX MAU 1 (2) (3) A (B) FAULT	K2b, K3, K4, K5
		CCD 1 (2) FAULT	K2b, K3, K5
		CMS FAULT	K2b, K3, K4, K5
		CRG AFT ACCESS OPEN	None
		DOOR FUELING OPEN	K2b, K3, K4, K5
		DOORS NOT STOWED	K1, K2b, K3, K5
		EMER LT BATT FAULT	K2b, K3, K4, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-02 AMS	W	CABIN ALTITUDE HI	K1, K2a, K2b, K3, K5
	C	AMS CTRL FAIL	K2b, K3, K5
		BLEED 1 (2) FAIL	
		BLEED 1 (2) LEAK	
		BLEED 1 (2) OVERPRESS	
		BLEED APU LEAK	
		CABIN DIFF PRESS FAIL	
		CENTER EBAY FANS FAIL	
		CRG FWD VENT FAIL	
		FWD EBAY FANS FAIL	
		PACK 1 (2) FAIL	
		PACK 1 (2) LEAK	
		PAX OXY LO PRESS	
		PRESN AUTO FAIL	
		PRESN MAN FAIL	
		RECIRC SMK DET FAIL	K2a, K2b, K3, K5
		RECIRC SMOKE	K2b, K3, K5
	A	AMS CTRL FAULT	K2a, K2b, K3, K4, K5
		BLEED 1 (2) OFF	K2b, K3, K5
		CRG AFT VENT FAIL	
		PACK 1 (2) OFF	
		PRESN AUTO FAULT	
		RAM AIR FAULT	K2b, K3, K4, K5
		XBLEED FAIL	K2b, K3, K5
		XBLEED SW OFF	
	S	BLEED APU VLV OPEN	K2b, K3, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-03 AUTO-MATIC FLIGHT	C	AP FAIL	K2b, K3, K5
		AP PITCH MISTRIM	K3
		AP PITCH TRIM FAIL	K2b, K3, K5
		AP ROLL MISTRIM	K3
		AT FAIL	K3, K5
		AT NOT IN HOLD	None
		FD LATERAL MODE OFF	K3
		FD VERT MODE OFF	
		MACH TRIM FAIL	K2b, K3, K5
		SHAKER ANTICIPATED	K2b, K3, K5
		STALL PROT FAIL	K2b, K3
	A	AFCS FAULT	K2b, K3, K4, K5
		AFCS PANEL FAIL	K3, K5
		AFCS PANEL FAULT	K2a, K2b, K3, K4, K5
		AP FAULT	K2b, K3, K4, K5
		AP PITCH TRIM FAULT	
		APPR 2 NOT AVAIL	K2b, K3
		AT FAULT	K2b, K3, K4, K5
		AUTOLAND 1 (2) NOT AVAIL	K2b, K3
		ENG TLA TRIM FAIL	K2b, K3, K5
		FD FAIL	K3, K5
		FD FAULT	K2b, K3, K4, K5
		HUD LVTO NOT AVAIL	K2b, K3, K4, K5
		MACH TRIM FAULT	K2b, K3, K4, K5
		SHAKER 1 (2) FAIL	K2b, K3, K5
		STALL PROT FAULT	K2b, K3, K4, K5
		STALL PROT ICE SPEED	K2b, K3, K5 and inhibited 5 minutes after weight-on-wheels off.
		YD FAIL	K2b, K3, K5
		YD FAULT	K2b, K3, K4, K5
		YD OFF	None

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SECTION	TYPE	MESSAGE	INHIBITION
14-04 AUXILIARY POWER UNIT	C	APU ALTITUDE EXCEED	K1, K2A, K2B, K3, K5
		APU FAIL	K2b, K3, K5
		APU FAULT	
		APU OIL HI TEMP	
		APU OIL LO PRESS	
	S	APU SHUTTING DOWN	K2b, K3, K5
14-05 ELEC-TRICAL	W	BATT 1 (2) OVERTEMP	None
		BATT 1-2 OFF	
		BATT DISCHARGING	
		ELEC EMERGENCY	
	C	AC BUS 1 (2) OFF	K3, K5
		AC ESS BUS OFF	
		AC STBY BUS OFF	
		APU GEN OFF BUS	
		BATT 1 (2) DISCHARGING	None
		BATT 1 (2) OFF	K3, K5
		BATT 1 (2) TEMP SENS FAULT	K2a, K2b, K3, K4, K5
		DC BUS 1 (2) OFF	K3, K5
		DC ESS BUS 1 (2) (3) OFF	
		GPU CONNECTED	K3, K4, K5
		IDG 1 (2) OFF BUS	K3, K5
		IDG 1 (2) OIL	
		INVERTER FAIL	K2a, K2b, K3, K4, K5
		RAT FAIL	
		TRU 1 (2) FAIL	K3, K5
		TRU ESS FAIL	
	A	LOAD SHED	K3, K4, K5
		REMOTE CB TRIP	K2b, K3, K4, K5
		SPDA FAIL	K3, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-06 ENGINE	W	ENG 1 (2) OIL LO PRESS	K3, K5
		ENG 1 (2) REV DEPLOYED	None
	C	ENG 1 (2) CONTROL FAULT	K3, K5
		ENG 1 (2) FADEC OVERTEMP	
		ENG 1 (2) FAIL	K3
		ENG 1 (2) FUEL IMP BYPASS	K3, K5
		ENG 1 (2) FUEL LO PRESS	
		ENG 1 (2) NO DISPATCH	K2b, K3, K4, K5
		ENG 1 (2) OIL LO LEVEL	K3, K4, K5
		ENG 1 (2) REV FAIL	
		ENG 1 (2) REV PROT FAULT	
		ENG 1 (2) REV TLA FAIL	K3, K5
		ENG 1 (2) START VLV OPEN	
		ENG 1 (2) T2 HEAT FAIL	
		ENG 1 (2) TLA FAIL	
		ENG EXCEEDANCE	K2b, K3, K4, K5
		ENG NO TAKEOFF DATA	K3, K4, K5
		ENG REF A-I DISAG	K1, K3, K4, K5
		ENG REF ECS DISAG (Pre-Mod Load 23.1)	K3, K4, K5
		ENG REF ECS DISAG (Post-Mod Load 23.1)	K2b, K3, K4, K5
		ENG THR RATING DISAG	K3, K4, K5
		ENG TLA NOT TOGA	None
	A	ENG 1 (2) FADEC FAULT	K3, K4, K5
		ENG 1 (2) FUEL SW FAIL	K3, K5
		ENG 1 (2) OIL IMP BYPASS	
		ENG 1 (2) OIL SW FAIL	K3, K4, K5
		ENG 1 (2) SHORT DISPATCH	K2b, K3, K4, K5
	S	ENG 1 (2) REV INHIBIT	K3, K5
		ENG 1 (2) TLA NOT IDLE	None
		ENG TDS REF A-I ALL	K3, K4, K5
		ENG TDS REF A-I ENG	

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SECTION	TYPE	MESSAGE	INHIBITION
14-07 FIRE PROTEC-TION	W	APU FIRE	None
		CRG AFT (FWD) SMOKE	
		ENG 1 (2) FIRE	
		CABIN SMOKE	K3, K5
		LAV SMOKE	K2b, K3, K5
	C	APU FIRE DET FAIL	K3, K5
		APU FIREX FAIL	
		CRG AFT (FWD) FIRE SYS FAIL	K2b, K3, K5
		ENG 1 (2) FIRE DET FAIL	K3, K5
		IFE RACK SMOKE	K2b, K3, K5
		LAV SMOKE DET FAIL	K2a, K2b, K3, K4, K5
	A	APU FIREX BTL DISCH	K3, K5
		CABIN SMOKE DET FAIL	
		CRG FIRE PROT FAULT	K2a, K2b, K3, K4, K5
		CRG FWD (AFT) FIREX HI ARM	K2b, K3, K5
		CRG FWD (AFT) FIREX LO ARM	
		ENG 1 (2) FIREXBTL A (B) FAIL	
		ENG FIREXBTL A (B) DISCH	
	S	CRG FIREX HI (LO) DISCH	K2b, K3, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-08 FLIGHT CON-TROLS	W	GROUND SPOILERS FAIL	None
		ELEV (RUDDER) (SPOILER) NML MODE FAIL	K1, K2a, K2b, K3, K5
	C	AOA LIMIT FAIL	K2b, K3, K5
		ELEV THR COMP FAIL	K3, K5
		ELEVATOR FAULT	K3
		ELEVATOR LH (RH) FAIL	
		FLAP FAIL	K3, K5
		FLT CTRL NO DISPATCH	K2b, K3, K4, K5
		FLT CTRL BIT EXPIRED	K2a, K2b, K3, K4, K5
		PITCH TRIM FAIL	K3, K5
		RUDDER FAIL	K3
		RUDDER FAULT	
		RUDDER LIMITER FAIL	K3, K5
		SLAT FAIL	
		SLAT-FLAP LVR DISAG	
		SPOILER FAULT	(Pre-Mod. Load 21.2) K2b, K3 (Post-Mod. Load 21.2) K1, K2a, K2b, K3
		STAB LOCK FAULT	K3, K5
		STEEP APPR FAIL	K1, K2a, K2b, K3
	A	AILERON LH (RH) FAIL	K3, K5
		AUTO CONFIG TRIM FAIL	
		FLAP LO RATE	
		FLT CTRL FAULT	K3, K4, K5
		PITCH CONTROL DISC	K3, K5
		PITCH TRIM BKUP FAIL	
		PITCH TRIM LO RATE	
		PITCH TRIM SW 1 (2) FAIL	
		ROLL CONTROL DISC	
		SLAT LO RATE	

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SECTION	TYPE	MESSAGE	INHIBITION
14-08 FLIGHT CONTROLS	A	SPDBRK LEVER DISAG	K3, K5
		TAILSTRIKE PROT FAIL (Pre-Mod. Load 23.1)	K1
		TAILSTRIKE AVOID FAIL (Post-Mod. Load 23.1)	K1
		STEEP APPR NOT AVAIL	K2b, K3, K5
	S	FLT CTRL TEST IN PROG	(Pre-Mod. Load 21.2) K2a, K2b, K3, K4, K5 (Post-Mod. Load 21.2) K2b, K3, K4, K5
14-09 FLIGHT INSTRU-MENTS, COMM, NAV & FMS	C	ADS 1 (2) FAIL	K3, K5
		ADS 3 FAIL	K2b, K3, K5
		ADS 1 (2) HTR FAIL	K5
		ADS 3 (4) HTR FAIL	K2b, K3, K5
		AVNX ASCB FAULT	K2b, K3, K4, K5
		DISPLAY CTRL FAIL	K3, K5.
		DISPLAY CTRL FAULT	K2b, K3, K4, K5
		FMS 1 (2) GPS POS DISAG	K1, K2a, K2b, K3, K5
		FMS POS DISAG	K1, K2a, K2b, K3, K5
		HF 1 (2) FAIL	None
		IRS 1 (2) FAIL	
		IRS EXCESSIVE MOTION	K2b, K3, K4, K5
		MCDU 1 (2) (3) OVHT	K2b, K3, K5
		NAV 3 FAIL	K3, K5
		NAVCOM 1 (2) FAIL	
		NAVCOM 1 (2) OVHT	
		VALIDATE CONFIG	K2b, K3, K4, K5
		VHF 1 (2) (3) OVHT	K3, K5
		VHF 3 FAIL	
		XPDR 1 (2) IN STBY (Post-Mod. Load 23.1)	K1, K2a, K2b, K3, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-09 FLIGHT INSTRU-MENTS, COMM, NAV & FMS	A	ADS 1 (2) HTR FAULT	K3, K4, K5
		ADS-B FAIL	K2b, K3, K5
		ADS 3 SLIPCOMP FAIL	K2b, K3, K5
		ADS PROBE 1 (2) (3) (4) FAIL	K2b, K3, K4, K5
		CMC FAIL	K2a, K2b, K3, K4, K5
		CMF 1 (2) FAIL	K3, K5
		CVR AFT (FWD) FAIL	
		FDR AFT (FWD) FAIL	
		FLT CTRL ADS FAIL	K2b, K3, K4, K5
		FMS 1 (2) FAIL	K3, K5
		HUD 1 (2) FAIL	K2b, K3, K5
		IRS 1 (2) (3) NAV MODE FAIL	K1, K2a, K2b, K3, K5
		IRS ALIGNING	K2b, K3, K4, K5
		IRS PRES POS INVALID	K2a, K2b, K3, K4, K5
		RALT 1 (2) (3) FAIL	None
		SATCOM FAIL	K2b, K3, K5
		TAT 1 (2) FAIL	K3, K5
		XPDR 1 (2) FAIL	
	S	PRINTER FAULT	K2a, K2b, K3, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-10 FUEL	W	FUEL 1 (2) LO LEVEL	K1, K2a, K2b, K3, K5
	C	APU FUEL SOV FAIL	K3, K5
		ENG 1 (2) FUEL SOV FAIL	
		FUEL AC 1 (2) PUMP FAIL (Pre-Mod. SB 170 31 0019 or SB 190 31 0009)	
		FUEL AFT OVRD FAIL	
		FUEL IMBALANCE	
		FUEL FUSELAGE IMBAL	
		FUEL FWD OVRD FAIL	
		FUEL TANK LO TEMP (Post-Mod. SB 170-31-0017 or SB 190-31-0007)	K2b, K3, K5
		FUEL WING OVERFILL	K3, K5
		FUEL XFEED FAIL	
		FUEL XFR AUTO FAIL	
		FUEL XFR PUMP FAIL	
	A	DEFUEL SOV OPEN	K3, K4, K5
		FUEL AC 1 (2) PUMP FAIL (Post-Mod. SB 170 31 0019 or SB 190 31 0009)	K3, K5
		FUEL DC PUMP FAIL	K2a, K2b, K3, K4, K5
		FUEL EQUAL-XFEED OPEN	K3, K5
		FUEL FEED 1 (2) FAULT	K2b, K3, K5
		FUEL KG-LB MISMATCH	K2a, K2b, K3, K4, K5
		FUEL TANK LO TEMP (Pre-Mod. SB 170-31-0017 or SB 190-31-0007)	K2b, K3, K5
		FUEL XFR FAULT	K2b, K3, K4, K5
		FUEL XFR ISOL FAIL	K3, K5
		FUEL XFR SW NOT AUTO	
		FUEL XFR VENT FAIL	K2b, K3, K4, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-10 FUEL	S	APU FUEL SOV CLOSED	K3, K5
		ENG 1 (2) FUEL SOV CLOSED	
		FUEL XFEED SOV OPEN	
		FUEL XFR ISOL CLOSED	
14-11 HYDRAU-LIC	W	HYD 1 (2) (3) OVERHEAT	None
	C	HYD 1 (2) EDP NOT D-PRESS	K3, K5
		HYD 1 (2) (3) HI TEMP	
		HYD 1 (2) (3) LO PRESS	K3 and inhibited from 80 kt to 400 ft.
		HYD 3 VLV FAIL	K3, K5 and inhibited from 80 kt to 400 ft.
		HYD PTU FAIL	K3, K5
	A	HYD 1 (2) EDP FAIL	K3, K5 and inhibited from 80 kt to 400 ft.
		HYD 1 (2) ELEC PUMP FAIL	K2a, K2b, K3, K5
		HYD 1 (2) (3) LO QTY	K2b, K3, K5
		HYD 1 (2) SOV FAIL	K3, K5
		HYD 3 PUMP A NOT ON	(Pre-Mod. Load 21.2) K3, K5 (Post-Mod. Load 21.2) K1, K3, K5
		HYD PTU NOT AUTO	K3, K5
		HYD PUMP NOT AUTO	
		HYD TEMP SENS FAIL	K2b, K3, K5
		HYD3 ELEC PUMP A FAIL	K3, K5 and inhibited from 80 kt to 400 ft.
		HYD3 ELEC PUMP B FAIL	K2a, K2b, K3, K5
	S	HYD 1 (2) SOV CLOSED	K3, K5

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SECTION	TYPE	MESSAGE	INHIBITION
14-12 ICE & RAIN PROTEC-TION	W	A-I WING 1 (2) LEAK	K3, K5
	C	A-I ENG 1 (2) FAIL	K3, K5
		A-I LO CAPACITY	K1, K2a, K2b, K3, K5
		A-I WING FAIL	K3, K5
		A-I WING NO DISPATCH	K2a, K2b, K3, K4, K5
		ICE DETECTOR 1 (2) FAIL	K2b, K3, K5
		WINDSHIELD 1 (2) HTR FAIL	
	A	A-I MODE NOT AUTO	K2b, K3, K5
		A-I SWITCH OFF	
		A-I ENG 1 (2) FAULT	
		A-I ENG 1 (2) LEAK	
		ICE CONDITION	Inhibited on ground until 1700 ft AGL or 2 minutes after takeoff. Inhibited on ground below 40 kt, if MCDU ENG REF A/I selected to ALL.
	S	A-I ENG 1 (2) VLV OPEN	None
		A-I WING VLV OPEN	

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SECTION	TYPE	MESSAGE	INHIBITION
14-13 LANDING GEAR & BRAKES	W	LG LEVER DISAG	None
	C	BRK OVERHEAT	K3
		BRK RH (LH) FAIL	
		EMER BRK FAIL	
		LG NO DISPATCH	K2b, K3, K4, K5
		LG NOSE DOOR OPEN	K3, K5
		LG WOW SYS FAIL	None
		STEER FAIL	K3
	A	BRK CONTROL FAULT	K3, K5
		BRK RH (LH) FAULT	K3
		BRK PEDL RH (LH) SEAT FAIL	
		EMER BRK FAULT	K3, K4, K5
		LG TEMP EXCEEDANCE	K3, K5
		STEER FAULT	K3, K4, K5
	S	STEER OFF	K3, K4
14-14 OXYGEN	C	CREW OXY LO PRESS	K2a, K2b, K3, K5
		PAX OXY NOT DEPLOYED	
	A	PAX OXY SW NOT AUTO	K2b, K3, K5
		OBSERVER OXY LO PRESS	K2a, K2b, K3, K5.
14-15 WARNING SYSTEM	W	NO TAKEOFF CONFIG	K3, K4, K5
	C	AURAL WRN SYS FAIL	K3, K5
		CREW WRN SYS FAULT	K2b, K3, K4, K5
		GND PROX FAIL	K3, K5
		TERRAIN FAIL	
		WINDSHEAR FAIL	None
	A	AURAL WRN SYS FAULT	K2b, K3, K4, K5
		RAAS FAIL	K3, K5
		RAAS INHIBIT	
		RAAS NOT AVAIL	
		TCAS FAIL	K3, K5
		TERRAIN NOT AVAILABLE	

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AURAL WARNING

The electronic display system has two aural warning drivers, which are responsible for generating and prioritizing aural warnings.

Aural warnings sound in a sequence, are never truncated, and are automatically canceled when the alerting situation no longer exists, or when they are reset manually by the pilot. In the event of multiple alerts, the highest priority alerts sound first.

Aural warnings are used when pilots need immediate knowledge of a condition without having to look at a visual display or indicator. Aural warnings are alert tones, bells, horns, clicks, beeps and voice messages.

AURAL WARNING PRIORITY LEVELS

There are four aural warning priority levels, from the highest to the lowest:

– Emergency (level 3).

– Abnormal (level 2).

– Advisory (level 1).

– Information (level 0).

Emergency: corresponds to a situation that requires the pilot's immediate action. The master warning annunciator is repeated with three-second intervals between alerts until the master warning reset switch is pressed.

Abnormal: corresponds to an abnormal situation such as system malfunction or failures that have no immediate impact on safety. Whenever an abnormal fault occurs, a master caution tone is presented every five seconds until the master caution reset switch is pressed.

Advisory: corresponds to the recognition of a situation such as system malfunction or failures leading to loss of redundancy or degradation of a system.

Information: corresponds to an information situation.

PRIORITY	ALERT	TONE/VOICE MESSAGE
3	EGPWS WARNING	See 14-15-30.
3	TCAS CORRECTIVE ADVISORY	See 14-15-40.

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PRIORITY	ALERT	TONE/VOICE MESSAGE
3	TCAS PREVENTIVE ADVISORY	See 14-15-40.
3	FIRE	BELL
3	MASTER WARNING	TRIPLE CHIME
3	OVERSPEED	“HIGH SPEED”
3	LANDING GEAR (With Radar Altitude Valid)	“LANDING GEAR”
3	CABIN ALTITUDE	“CABIN”
3	NO TAKEOFF (slat/flap out of configuration)	“NO TAKEOFF FLAP”
3	NO TAKEOFF (pitch trim out of configuration)	“NO TAKEOFF TRIM”
3	NO TAKEOFF (brakes out of configuration)	“NO TAKEOFF BRAKES”
3	NO TAKEOFF (spoilers out of configuration)	“NO TAKEOFF SPOILER”
3	AUTOPILOT (normal or abnormal)	“AUTOPILOT”
2	MASTER CAUTION	SINGLE CHIME
1	ALTITUDE ALERT (departure)	C CHORD (twice) + “ALTITUDE”
1	ALTITUDE ALERT (capture)	C CHORD
1	AUTOTHROTTLE (normal or abnormal)	“THROTTLE”
0	TAKEOFF CONFIGURATION	“TAKEOFF OK”
0	AURAL WARNING A PIT	“AURAL WARNING TEST A”
0	AURAL WARNING B PIT	“AURAL WARNING TEST B”

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PRIORITY	ALERT	TONE/VOICE MESSAGE
0	SELECTIVE CALLING	“SELCAL”
0	TRIM MALFUNCTION	“TRIM” (7 seconds)

VOICE MESSAGES

Voice messages are generated whenever a potentially dangerous condition exists, as determined by the EGPWS, TCAS, and windshear detection system.

Some voice messages may be canceled, but others are only canceled when the cause that activates them ceases. When a windshear, TCAS or EGPWS alert condition takes place, a special situation exists. In that case, no other voice messages are presented so that the flight crew can clearly hear the information messages. Only a stall condition takes precedence over windshear, EGPWS and TCAS alerts.

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TAKEOFF CONFIGURATION WARNING

A dedicated aural warning indicates that airplane configuration is not in suitable takeoff condition. The aural warning is activated whenever the airplane is on the ground, thrust is applied and at least one of the following conditions is met:

– Flaps are not in takeoff position (“NO TAKEOFF FLAPS”).

►*MAU load 19.3 and on OR POST-MOD SB 190-31-0009*

– Flaps position is not in agreement with the Flaps position selected in the FMS Takeoff page 2/2. (“NO TAKEOFF FLAPS”).

◄

– Parking brakes are applied (“NO TAKEOFF BRAKES”).

– Pitch trim is out of green range (“NO TAKEOFF TRIM”).

– Any spoiler panel is deployed (“NO TAKEOFF SPOILER”).

More than one warning may be generated if more than one condition is met.

A test button is provided to allow checking the takeoff configuration by simulating power levers in the advanced position. If the airplane is in takeoff configuration, the voice message “TAKEOFF OK” is generated. If the airplane is not set to takeoff configuration, the aural warning referred to the associated takeoff configuration deviation is generated.

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STALL PROTECTION SYSTEM

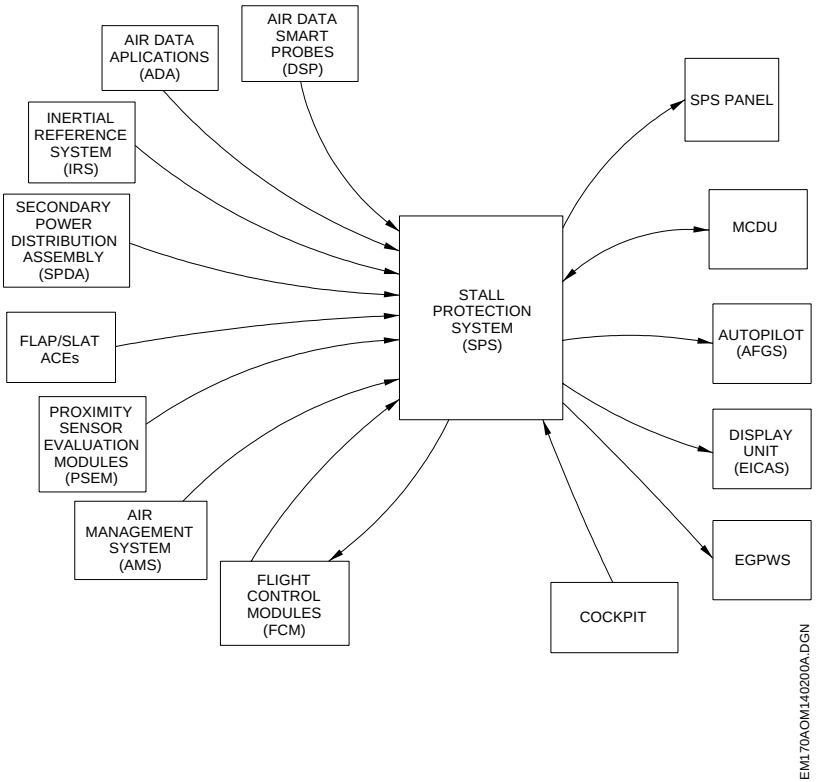
The stall protection system provides warning to the pilot when the airplane's speed is approaching stall speed. It is provided by the Auto Flight Control System (AFCS) by activating the stick shaker motor on the control column. The Flight Control Module (FCM) provides stall protection by means of angle-of-attack (AOA) limiting function.

STALL PROTECTION ACTIVATION

Once the stick shaker is activated by the AFCS, the AOA limiting function reduces control column authority in the nose up direction gradually until the control column reaches the aft stop, thereby limiting the angle of attack. The FCM computes AOA limiting command using angle of attack data, control column position and inertial feedback.

If one or more sensors required performing the AOA limiting fails, the function is no longer available, and the respective message is displayed on the EICAS.

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STALL PROTECTION ACTIVATION

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ENHANCED GROUND PROXIMITY WARNING SYSTEM (EGPWS)

GENERAL

The primary purpose of the EGPWS is to give aural visual alerts and warnings in the avoidance of controlled flight into terrain and to give the flight crew detected windshear warnings.

The EGPWS uses airplane position information, airplane configuration information, and terrain database information to provide the flight crew with increased awareness of the terrain along the projected flight path.

EGPWS consists of:

– Forward Looking Terrain Awareness Function

– Terrain Clearance Floor Function

– Ground Proximity Warning Function

– Terrain Awareness Display

EGPWS INPUTS

The main systems that the EGPWS receives inputs from are the following:

– Air data system (ADS)

– Flight management system (FMS)

– Global positioning system (GPS)

– Inertial reference system (IRS)

– Radar altimeter

– Slats and flaps control system

EGPWS DATABASE

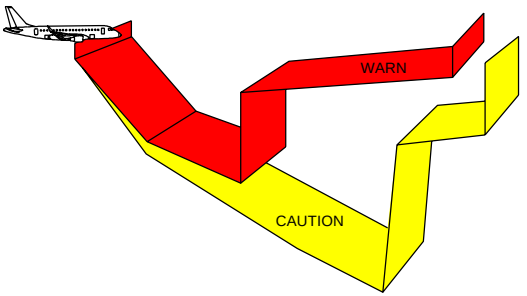
The database consists of all hard surfaces runways greater than 1067 m (3500 ft) in length.

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FORWARD LOOKING TERRAIN AWARENESS FUNCTION

This function is used to look ahead of the airplane and detect terrain or obstacle conflicts with greater alerting time.

The Forward Looking Terrain compare the airplane current position using both lateral and vertical positional information and flight path with the terrain database to determine if there is a potential threat of collision with terrain.



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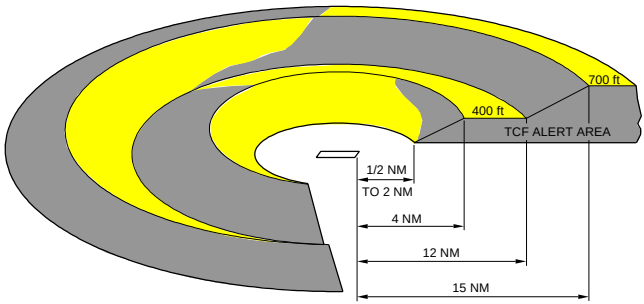
TERRAIN CLEARANCE FLOOR

The Terrain Clearance Floor (TCF) provides a circular terrain clearance envelope around the airport runway.

TCF mode complements existing mode 4 protection by providing an alert based on insufficient terrain clearance.

The TCF is active during takeoff, cruise and final approach and is based on airplane present position, nearest runway and radio altitude.

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GROUND PROXIMITY WARNING FUNCTION

The EGPWS calculates these seven basic functions by comparing the airplane position to an internal terrain database to output alerts and displays that show the airplane situation.

Mode 1 - Excessive descent rates with SINK RATE and PULL UP aural warnings.

Mode 2 - Excessive terrain closure rates with TERRAIN, TERRAIN and PULL UP aural warnings.

Mode 3 - Altitude loss after takeoff with a DON'T SINK, DON'T SINK AURAL WARNING.

Mode 4 - Unsafe terrain clearance with TOO LOW TERRAIN, TOO LOW GEAR and TOO LOW FLAPS aural warnings.

Mode 5 - Excessive deviation below glideslope with a GLIDESLOPE aural warning.

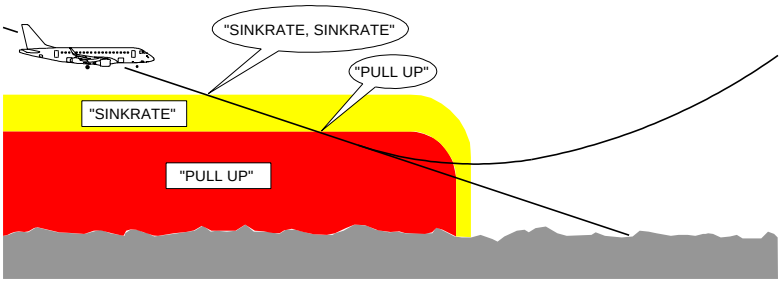
Mode 6 - Advisory callouts with BANK ANGLE, MINIMUMS and selected altitudes aural warnings.

Mode 7 - Windshear alerting as CAUTION WINDSHEAR and WINDSHEAR, WINDSHEAR, WINDSHEAR.

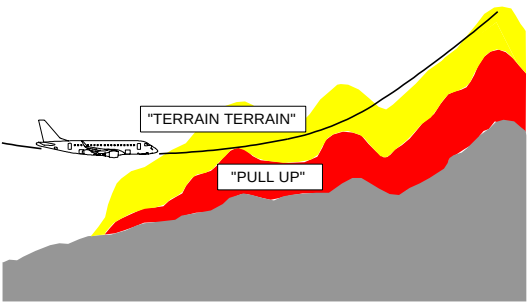
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EGPWS AURAL WARNINGS

EXCESSIVE DESCENT RATE

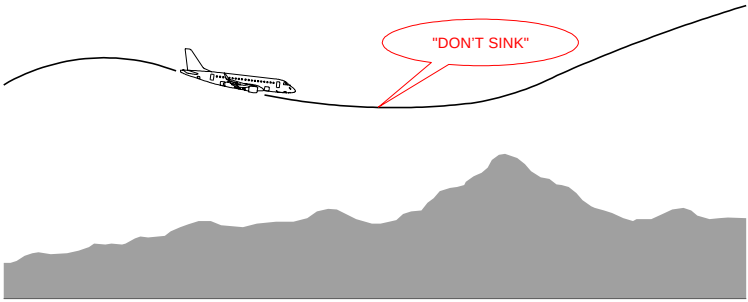


EXCESSIVE CLOSURE TO TERRAIN



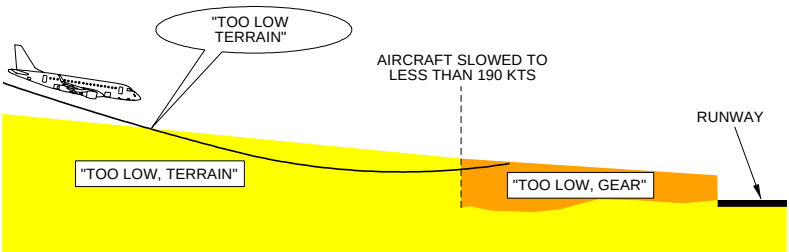
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ALTITUDE LOSS AFTER TAKEOFF



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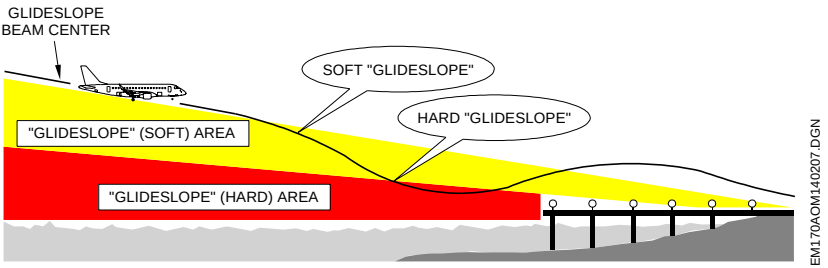
UNSAFE TERRAIN CLEARANCE



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DESCENT BELOW GLIDESLOPE



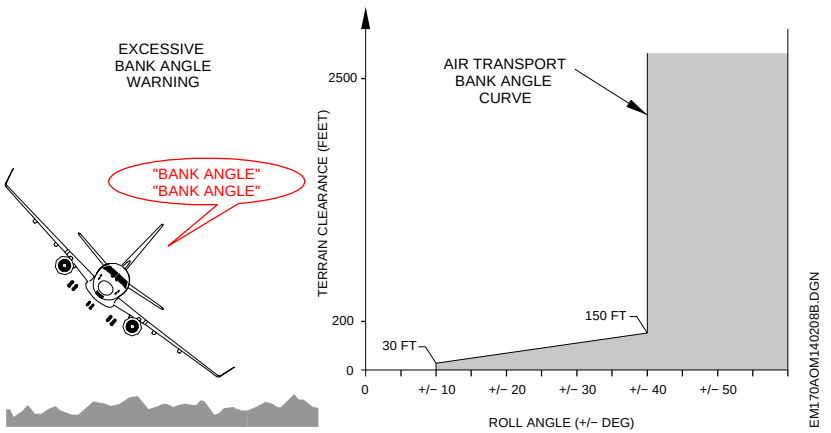
EXCESSIVE BANK ANGLE

The bank angle feature provides protection for over banking during maneuvering on approach or climb out and while at altitude.

In addition, it protects against wing or engine strikes close to the runway.

The graphic below shows the bank angle limit according to the radar altitude:

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TERRAIN MAPPING SELECTION

Terrain mapping is provided by EGPWS and is displayed on the navigation map of the MFD display when selected. There are two selection modes:

– Display selection through the MFDs MAP menu function.

– EGPWS Auto pop-up request during a terrain/obstacle caution warning.

When an auto pop-up occurs, the MFD range is automatically changed to 10 NM. Terrain mapping is removable from the display via the MFD menu function. EGPWS modes and status are displayed adjacent to the navigation display. Weather radar data is disabled while terrain data is displayed. EGPWS range is controlled with the overall range control in the CCD. The range selections are 5, 10, 25, 50, 100, 200, 300 and 500 NM.

The TERRAIN digital display shows the highest and lowest terrain/obstacle elevations.

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TERRAIN AWARENESS DISPLAY

The EGPWS terrain display is designed to increase flight crew awareness of the surrounding terrain in varying density dots patterns of green, yellow and red. These dot patterns represent specific terrain separation from the airplane.

COLOR	MEANING
Solid red	Warning Terrain (Approximately 30 s from impact).
Solid yellow	Caution Terrain (Approximately 60 s from impact).
High density red dots	Terrain that is more than 2000 ft above airplane altitude.
High density yellow dots	Terrain that is between 1000 ft and 2000 ft above airplane altitude.
Low density yellow dots	Terrain that is between 500 ft (250 ft with gear down) below and 1000 ft above airplane altitude.
Solid green	Highest terrain not within 500 (250 ft with gear down) ft of airplane altitude. May appear with dotted yellow terrain when the airplane altitude is within 500 ft (250 ft with gear down) of terrain.
High density green dots	Terrain that is the middle elevation band when there is no red or yellow terrain areas within range on the display.
Low density green dots	Terrain that is the lower elevation band when there is no red or yellow terrain areas within range on the display.
Light density cyan dots	Terrain elevation equal to 0 ft MSL.

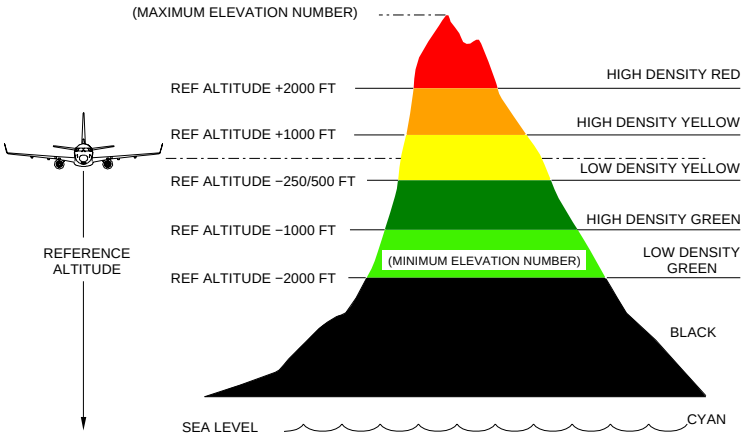
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The Peaks mode is a Terrain Alerting and Display (TAD) supplemental feature providing additional terrain display features for enhanced situational awareness, dependent of both relative and absolute terrain indication.

At low altitudes (with respect to displayed terrain) the terrain is displayed using colors and shading patterns corresponding to the vertical displacement between the terrain elevation and the current airplane altitude. As the airplane altitude increases (with respect to displayed terrain) the Peaks mode applies additional density patterns and color level thresholds based on absolute terrain elevations relative to the range and distribution of terrain in the display area. At altitudes safely above all terrain for the display range chosen, the terrain is displayed independent of airplane altitude emphasizing the highest and lowest elevations to provide increased situational awareness.

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The illustration below shows the Peaks display at a low relative altitude:



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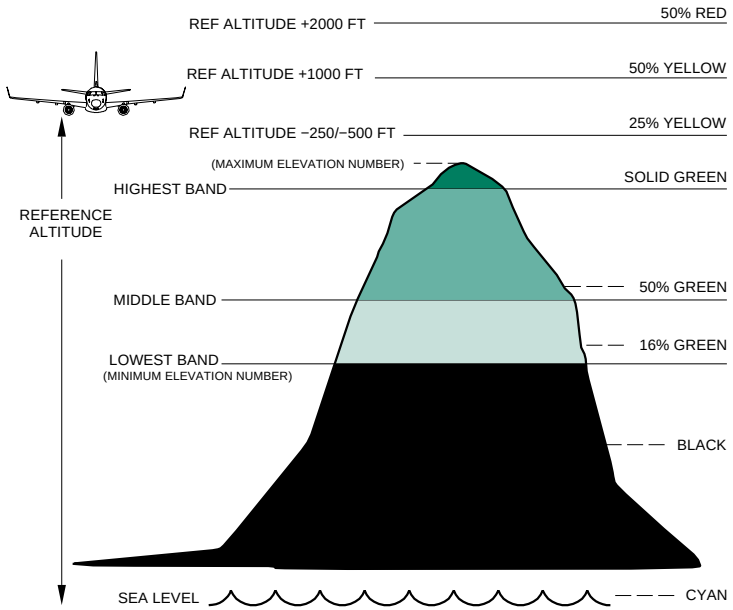
REFERENCE ALTITUDE IS PROJECT DOWN FROM ACTUAL AIRCRAFT ALTITUDE TO PROVIDE A 30 SECOND ADVANCE DISPLAY 01 TAMA IN WHEN DESCENDING MORE THAN 1000 fpm.

TERRAIN IS NOT SHOWN IF IT IS BELLOW THE LOWEST BAND AND/OR IS WITH IN 4000 feet OF THE RUNWAY ELEVATION NEAREST THE AIRCRAFT. SEA LEVEL WATER IS DISPLAYED IF SUPPORTED BY THE DISPLAY.

EGPWS DISPLAY COLOR CODING

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The following illustration represents the Peaks display at a high relative altitude:



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EGPWS DISPLAY COLOR CODING

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EGPWS MESSAGES

The EGPWS provides the following aural and visual messages:

AURAL MESSAGE	VISUAL MESSAGE	MEANING
OBSTACLE OBSTACLE, PULL UP	PULL UP; and terrain shown in red on the MAP page display.	Warning proximity to the projected impact terrain. The terrain is shown in red on the MAP page display.
CAUTION OBSTACLE; CAUTION OBSTACLE	GND PROX; Terrain shown in amber on MFD	The projected impact terrain is between 40 and 60 s from the airplane. The terrain is shown in amber on the MAP page display.
TERRAIN TERRAIN, PULL UP	PULL UP; and terrain shown in red on the MAP page display.	Warning proximity to the projected impact terrain. The terrain is shown in red on the MAP page display.
CAUTION TERRAIN; CAUTION TERRAIN	GND PROX; Terrain shown in amber on MFD	The projected impact terrain is between 40 and 60 s from the airplane. The terrain is shown in amber on the MAP page display.
TERRAIN; TERRAIN	GND PROX	Excessive and hazardous terrain closure rate. Leveled flight or even climb towards obstructing terrain also set the alarm. A continuous TERRAIN aural alert will be annunciated if landing gear and flaps are set to landing configuration.
PULL UP; PULL UP; PULL UP	PULL UP	Excessive and hazardous terrain closure rate becomes severe. Follows the TERRAIN aural annunciation.
DON'T SINK; DON'T SINK	GND PROX	Excessive loss of altitude after a takeoff or go-around.
SINKRATE; SINKRATE	GND PROX	Excessive descent rate.

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AURAL MESSAGE	VISUAL MESSAGE	MEANING
PULL UP; PULL UP; PULL UP	PULL UP	Excessive descent rate becomes severe. Follows the SINKRATE aural annunciation.
GLIDESLOPE; GLIDESLOPE	GND PROX	Airplane excessively below from glideslope on ILS approach at low altitudes.
GLIDESLOPE	GND PROX	Airplane is below glideslope on ILS approach. Aural warning is annunciated at half-volume.
TOO LOW TERRAIN	GND PROX	Unsafe terrain clearance at high speed. Flaps and landing gear not in landing configuration.
TOO LOW TERRAIN	GND PROX	Descent below the approach path while too far from the airport in the database.
TOO LOW FLAPS	GND PROX	Unsafe terrain clearance at low speed. Landing gear down, but flaps not in landing configuration.
TOO LOW GEAR	GND PROX	Unsafe terrain clearance at low speed. Flaps and landing gear not in landing configuration.
BANK ANGLE; BANK ANGLE	None	Excessive roll or bank angle maneuver.
APPROACHING MINIMUMS	None	Descent below Decision Height (DH) or Minimum Descent Altitude (MDA) setting, plus 80 ft.
MINIMUMS; MINIMUMS	None	Descent below Decision Height (DH) or Minimum Descent Altitude (MDA) bug setting.
MINIMUMS (Post-Mod. Load 21.2)	None	Descent below Decision Height (DH) or Minimum Descent Altitude (MDA) bug setting.

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AURAL MESSAGE	VISUAL MESSAGE	MEANING
ONE THOUSAND	None	Radio altimeter callout for descent below 1000 ft (*). (*) By default this feature is inhibited. Contact maintenance personnel to enable this callout.
FIVE HUNDRED	None	Radio altimeter callout for descent below 500 ft.
TWO HUNDRED	None	Radio altimeter callout for descent below 200 ft.
ONE HUNDRED	None	Radio altimeter callout for descent below 100 ft (*). (*) By default this feature is inhibited. Contact maintenance personnel to enable this callout.
FIFTY	None	Radio altimeter callout for descent below 50 ft.
FORTY	None	Radio altimeter callout for descent below 40 ft.
THIRTY	None	Radio altimeter callout for descent below 30 ft.
TWENTY	None	Radio altimeter callout for descent below 20 ft.
TEN	None	Radio altimeter callout for descent below 10 ft.

►*MAU load 21.2 and on OR POST-MOD SB 0190-31-0015, standard callouts*

NOTE: For decision heights (DH) below 100 ft, the aural “ONE HUNDRED” sounds first than “MINIMUMS”. Therefore, a delay for the aural “MINIMUMS” is expected.

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GENERAL

The E-jets are equipped with the Windshear Detection and Escape Guidance System. This system provides Detection and Escape Guidance in case of a Windshear condition is encountered.

WINDSHEAR DETECTION

Windshear detection is activated between 10 ft and 1500 ft radio altitude during the initial takeoff, go-around and final approach phases of flight.

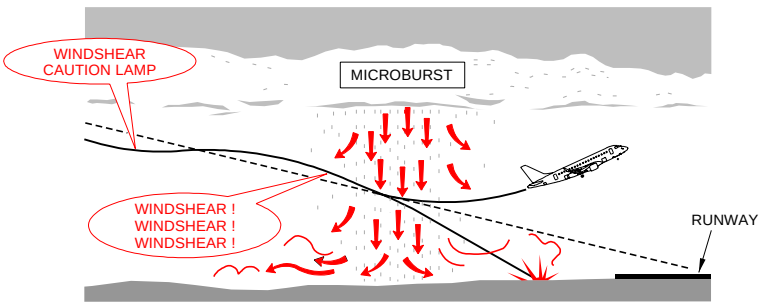
The label “WSHR” is displayed on the PFD when the Windshear Detection detects a windshear condition.

Windshear conditions will not be detected if either EGPWS or the Radar Altimeter is unavailable.

According to the windshear insensitivity it is divided in two levels. Each one has distinctive aural and visual indications:

– Windshear Caution.

– Windshear Warning.

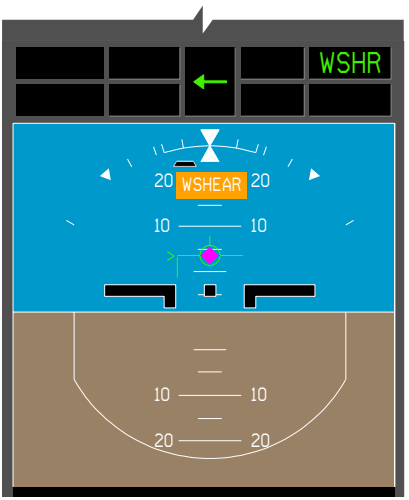


WINDSHEAR DETECTION

WINDSHEAR CAUTION

Increasing headwind and up drafts detection cause the annunciation of an amber WSHEAR on PFD and a CAUTION WINDSHEAR voice message.

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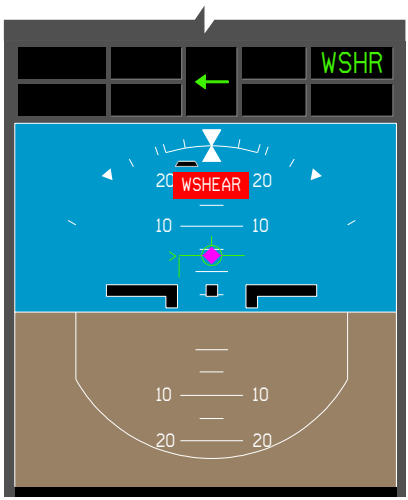


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WINDSHEAR WARNING

Decreasing headwind (or increasing tailwind) and down drafts detection cause the annunciation of a warning windshear condition through a red WSHEAR on PFD and a “WINDSHEAR; WINDSHEAR; WINDSHEAR” voice message.

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WINDSHEAR ESCAPE GUIDANCE MODE

The Windshear Escape Guidance Mode provides through the Flight Director a pitch command limited to sticker shaker, and commands wings level to recover from a windshear, it minimizes altitude and airspeed loss during a windshear encounter.

It is indicated by a green “WSHR” annunciation on the FMA when activated.

The other flight director modes are canceled and the altitude pre-select, go-around and takeoff modes are inhibited while in a caution or warning windshear condition. No lateral mode is inhibited while in windshear mode.

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WINDSHEAR ESCAPE GUIDANCE MODE ACTIVATION

The Windshear Escape Guidance Mode is activated in the following conditions:

– Manually when windshear warning or caution condition is detected and TOGA switch is pressed.

– Automatically when windshear warning condition is detected and thrust lever is set to TO/GA position.

– Automatically when windshear warning condition is detected and the FD mode is in TO or GA.

AUTOPILOT OPERATION DURING WINDSHEAR ESCAPE GUIDANCE

The Autopilot automatically disconnects and is accompanied by appropriate visual and aural alerts when the Windshear Guidance is activated.

THRUST RATE SYSTEM (TRS)

When a Windshear Caution or Warning condition is detected the FADEC cancels any Flex or derated thrust requirements and reschedules the thrust to GA thrust.

AUTOTHROTTLE OPERATION DURING ESCAPE GUIDANCE

Autothrottle engaged:

– The Autothrottle positions the Thrust levers to the TO/GA position.

NOTE: If the pilot manually advances the throttle lever beyond the TO/GA position, the Autothrottle will disconnect. The Autothrottle disconnection is accompanied by the appropriate visual and aural alerts.

Autothrottle disengaged:

– The pilot may engage the Autothrottle or manually position the thrust levers to TO/GA position.

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WINDSHEAR SYSTEM TEST

All EGPWS warning functions including the windshear warning function are tested during cockpit self-test prior to takeoff. The self-test is activated using the MCDU test page.

During the test, an amber “WINDSHEAR FAIL” message is displayed on the EICAS. A red “WSHEAR” message is displayed on the PFD and a “WINDSHEAR; WINDSHEAR; WINDSHEAR” aural message is annunciated. If the windshear warning function of the EGPWS is inoperative during the test, a “WINDSHEAR INOP” aural message is annunciated.

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TRAFFIC COLLISION AVOIDANCE SYSTEM (TCAS)

The TCAS detects the nearby airplanes and display symbols to represent them. The relative or absolute altitude and the vertical motion of the other airplanes are information displayed with each symbol.

The TCAS monitors a potential collision hazard and alerts the flight crew. It interrogates the mode A, mode C and mode S operating transponders in other airplanes and calculates the flight path of the possible intruder airplane.

If the intruder airplane is also equipped with operating TCAS, the systems will communicate with each other to coordinate and generate guidance for the optimal avoidance maneuver.

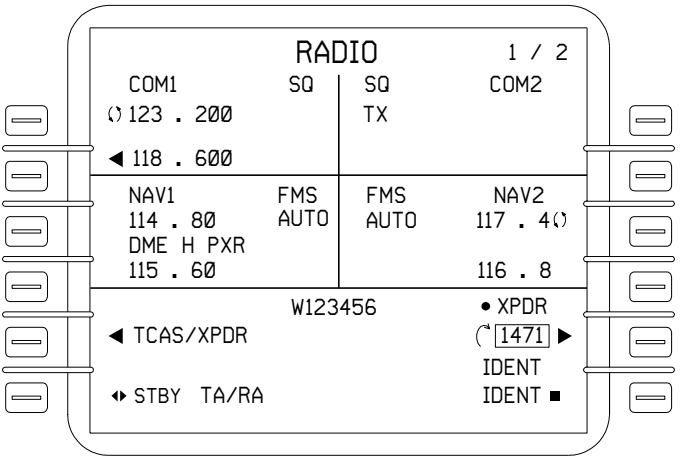
NOTE: Intruder airplanes that do not have operating transponders are invisible to the TCAS.

TCAS OPERATION ON THE FMS

Pressing the radio button on the MCDU, the display will show the radio pages. On the lower portion of the radio menu page 1/2 is shown the TCAS/XPDR modes. By pressing the LSK 6L is possible to select the TCAS mode to TA/RA or STBY.

On LSK 4R and 6R are displayed the selected XPDR code and the IDENT request, respectively.

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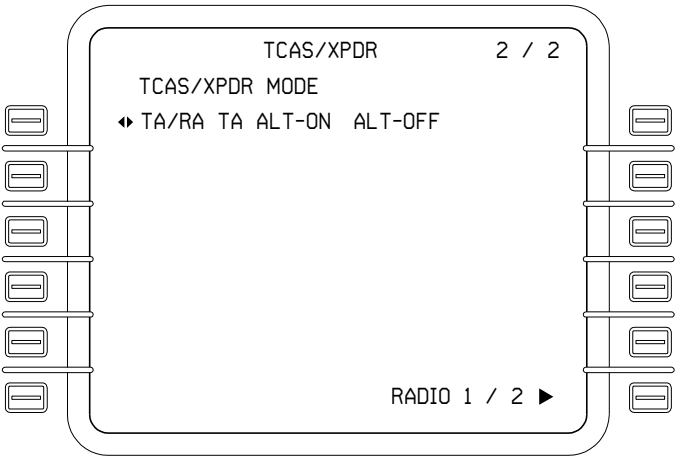


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By pressing line select key 5L the TCAS/XPDR detail page 2 of 2 will be displayed. To select the desired mode the LSK 1L needs to be pressed as many times as needed. The modes are the following:

Mode	XPDR replies	TCAS
Standby	Do not reply (in any mode)	Disabled
ALT-OFF	Mode A and Mode S	Disabled
ALT-ON	Mode A, Mode C and Mode S	Disabled
TA	Mode A, Mode C and Mode S	Traffic Advisory only
TA/RA	Mode A, Mode C and Mode S	Traffic Advisory/Resolution Advisory

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TCAS STATUS ANNUNCIATIONS

The TCAS information is displayed on the MFD and PFD. There are six types of TCAS mode annunciations:

– TCAS FAIL – This annunciation is displayed when a TCAS failure is indicated by TCAS data, when TCAS data is invalid or when TCAS data was not correctly received for 10 s.

– TCAS TEST – This annunciation is displayed when the TCAS computer indicates functional test is active.

– TCAS OFF – This annunciation is displayed when TCAS provides a valid indication that the computer is in stand by mode.

– TA ONLY – This annunciation indicates that the TCAS is not selected to provide resolution advisories or is inhibited. The TA mode provides only surveillance of the surrounding airspace. In this mode, TCAS tracks proximate airplane and generates traffic advisories; no resolution advisories are issued in this mode.

– TA/RA – This annunciation is displayed when TCAS provides a valid indication that the computer is in TA/RA mode. This annunciation is only displayed on both TCAS MFD displays. TA/RA mode is the normal operation mode providing full TCAS coverage. In this mode, TCAS tracks airplane in the surrounding airspace and generates traffic advisories or resolution advisories, as the situation requires.

– TCAS RA FAIL – This annunciation indicates that TCAS is not able to provide resolution advisories. The annunciation is displayed if the resolution advisory data is invalid or not received for 5 s or if information required to display the TCAS RA data on the PFD is missing or failed (e.g., if attitude, or groundspeed is failed or missing). This annunciation is only displayed on the PFD.

TCAS ALTITUDE RANGE MODES

The altitude range is an altitude region in which targets will be displayed from the present position altitude. There are four different ways to set the TCAS altitude range:

– NORMAL: shows targets that are within 2700 ft above or below current airplane altitude.

– ABOVE: shows targets that are within 9900 ft above and 2700 ft below current airplane altitude.

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– BELOW: shows targets that are within 2700 ft above to 9900 ft below current airplane altitude.

– EXPANDED: shows targets that are within 9900 ft above or below current airplane altitude.

TRAFFIC DATA

The traffic data, made up of two or three-digit number, a plus (+) or a minus (-) sign, and which may also include an arrow, appears either above or below the intruder airplane symbol on the MFD.

– RELATIVE ALTITUDE: two digit numbers, preceded by a plus (+) or a minus (-) sign, represents the altitude in hundreds of feet. The digits are displayed above or below the symbol, according to position of other airplane.

– ABSOLUTE ALTITUDE: the default altitude display is relative to the airplane. When ABS is selected, the absolute altitude of the targets is displayed. The display automatically reverts to the relative altitude display when a TA or RA intruder is displayed or after 15 s. The flight level is displayed with three digital numbers above the symbol for airplanes above the reference. For airplanes below the reference, two digits followed by a minus (-) sign are displayed below the symbol.

– ARROW: a vertical arrow is displayed at the right side of each TA or RA symbol indicates vertical motion information greater than 550 ft/min.

TCAS PRESENTATION ON MFD

The TCAS system can be controlled through the MCDU and on the MFD by the CCD.

The TCAS map overlay and TCAS zoom format are available on the MFD. The map overlay format displays the TCAS information on the navigation MAP mode, on MFD.

To show TCAS on the Map Overlay is necessary to open the MAP menu on the MFD and then select TCAS.

The zoom format is displayed in the lower portion of MFD and has a range control. Only one format can be displayed at a time.

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The range is selected using the CCD knob. The ranges selectable are 6, 12, 20, 40, 80 and 120 NM.

Zoom display shows up when the Map Overlay is deselected.

Captain and First Officer's TCAS controls on the MFD's are totally independent from each other. That means, each pilot can controls the TCAS as desirable independent of the control of the other side.

NOTE: If neither map overlay nor zoom format is displayed and the range is lower than 50 NM and a TA or RA condition is encountered, the zoom format is automatically displayed.

TCAS PRESENTATION ON PFD

When the TCAS detects an RA condition and a maneuver is recommended to increase the vertical separation (corrective RA), the flight director command bars are removed and one or two red trapezoidal avoidance zones and a green rectangular fly to zone are displayed. For RA condition where certain ranges of vertical speed are not recommended (preventive RA), only one red trapezoidal avoidance zone is displayed.

In the left lower portion of the PFD the TCAS status annunciation is displayed.

TCAS TRAFFIC IDENTIFICATION

The TCAS provides the following traffic identification:

RESOLUTION ADVISORY (RA)

– Is annunciated when other airplane is approximately 20 s to 30 s from the TCAS collision area.

– The TCAS provides recommended vertical maneuver to avoid traffic collision.

– Aural Warnings are sounded.

– It is represented as a red solid square.

TRAFFIC ADVISORY (TA)

– Is annunciated when other airplane is approximately 35 s to 45 s from the TCAS collision area.

– An Aural Warning is sounded.

– It is represented as an amber solid circle.

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PROXIMATE TRAFFIC

– Cyan solid diamond: the other traffic is within 6.5 NM and 1200 ft above or below the airplane.

– Cyan hollow diamond: the other traffic is beyond 6.5 NM and within 2700 ft above or below the airplane.

NOTE: Other traffic is inhibited during TA or RA condition.

AURAL ANNUNCIATION

For TA conditions, the aural alert “TRAFFIC–TRAFFIC” is annunciated once.

The RA aural messages associated to displayed advisories may be the following:

– “INCREASE CLIMB; INCREASE CLIMB”: Increase immediately the rate of climb.

– “INCREASE DESCENT; INCREASE DESCENT”: Increase immediately the rate of descent.

– “CLIMB, CLIMB NOW!; CLIMB, CLIMB NOW!”: The airplane is descending and stop descending and immediate climbing is necessary to provide adequate separation.

– “DESCEND, DESCEND NOW! DESCEND, DESCEND NOW!”: The airplane is climbing and stop climbing and immediate descending is necessary to provide adequate separation.

– “CLIMB; CLIMB”: Begin to climb immediately at the indicated rate of climb.

– “DESCEND; DESCEND”: Begin to descent immediately at the indicated rate of descent.

– “ADJUST VERTICAL SPEED, ADJUST”: Adjust smoothly the vertical speed to the indicated rate.

– “CLIMB, CROSSING CLIMB; CLIMB, CROSSING CLIMB”: Start a climb at indicated rate. The flight path will cross traffic’s altitude.

– “DESCEND, CROSSING DESCEND; DESCEND, CROSSING DESCEND”: Start a descent at indicated rate. The flight path will cross traffic’s altitude.

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– “MONITOR VERTICAL SPEED”: Certain changes in vertical speed may not be safe.

– “MAINTAIN VERTICAL SPEED, MAINTAIN”: Maintain vertical speed rate.

– “MAINTAIN VERTICAL SPEED, CROSSING MAINTAIN”: Adjust vertical speed to the rate indicated.

When the TCAS confirms no conflict condition and the separation is increasing, a “CLEAR OF CONFLICT” advisory is announced.

TCAS WARNING INHIBITIONS

The INCREASE DESCENT command is inhibited at altitudes below 1450 ft AGL during descent, or below 1650 ft AGL during climb.

The DESCENT command is inhibited at altitudes below 1000 ft AGL during descent, or below 1200 ft AGL during climb.

The TCAS automatically reverts to TA ONLY mode and inhibits RAs for altitudes below 900 ft AGL during descent, or below 1000 ft during climb.

The TAs are inhibited for airplanes at altitudes below 380 ft AGL.

All TCAS aural advisories are inhibited when the present position altitude is below 400 ft AGL during descent, or 600 ft AGL during climb.

No Climb commands or Increased Climb commands are issues at or above 34000 ft MSL. No other inhibits are implemented for the Climb or Increased Climb functions.

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EICAS MESSAGES

TYPE	MESSAGE	MEANING
WARNING	NO TAKEOFF CONFIG	Airplane is not in a valid takeoff configuration.
CAUTION	AURAL WRN SYS FAIL	Both aural warning channels are failed or off.
	CREW WRN SYS FAULT	Monitor warning A or B has failed.
	GND PROX FAIL	Ground proximity function in EGPWS has failed; or GND PROX - G/S INHIB is pushed in for more than 15 s; or GND PROX - FLAP OVRD is pushed in for more than 60 s with airspeed above 250 kt.
	NO ETOPS SEL (only for airplanes ETOPS configured)	Flight was not confirmed as ETOPS ENABLE or ETOPS OFF on MCDU.
	TERRAIN FAIL	Terrain function in EGPWS has failed.
	WINDSHEAR FAIL	Windshear function in EGPWS has failed.
ADVISORY	AURAL WRN SYS FAULT	One aural warning channel is failed or off.
	AVNX MAU 1 (2) (3) A (B) FAULT	The associated MAU channel suffered failure condition(s) that does not affect its functionality, but may cause loss of redundancy.
	TCAS FAIL	TCAS has failed.
	TERRAIN NOT AVAILABLE	Terrain databases do not cover the airplane flying area.

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