WARNING

DO NOT USE THIS MANUAL OR ANY OF THE RELATED MATERIALS IN ANY WAY IN THE OPERATION, USE OR MAINTENANCE OF ANY AIRCRAFT. THESE MATERIALS HAVE BEEN PREPARED AND ARE PROVIDED SOLELY TO GIVE GUIDANCE ON THE LAYOUT AND STRUCTURE OF A TYPICAL AIRCRAFT MANUAL. THESE MATERIALS HAVE NOT BEEN APPROVED BY ANY AVIATION ADMINISTRATION FOR USE ON ANY AIRCRAFT AND SHOULD NEVER BE SO USED UNDER ANY CIRCUMSTANCES. FAILURE TO FOLLOW THIS WARNING COULD LEAD TO SERIOUS INJURY OR DEATH.

737-200

Flight Crew Operations Manual

The Boeing Company

Document Number D6-27370-200A-TBC

Revision Number: 42

Revision Date: October 6, 2020

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Preface — Chapter 0

Chapter Table of Contents — Section TOC

Volume 1

Volume 2

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Preface — Chapter 0
Model Identification — Section 1

General

The airplanes listed in the table below are covered in the Flight Crew Operations Manual (FCOM). The table information is used to distinguish data peculiar to one or more, but not all of the airplanes. Where data applies to all airplanes listed, no reference is made to individual airplanes.

Airplane number is supplied by the operator. Registry number is supplied by the national regulatory agency. Serial and tabulation number are supplied by Boeing.

Airplane Number	Registry Number	Serial Number	Tab Number	Model Miscellaneous Data
1	BN200	BN200	BN200	737-200

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General

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

- provide the necessary operating limitations, procedures, performance, and systems information the flight crew needs to safely and efficiently operate the 737 airplane during all anticipated airline operations
- serve as a comprehensive reference for use during transition training for the 737 airplane
- serve as a review guide for use in recurrent training and proficiency checks
- provide necessary operational data from the FAA approved airplane flight manual (AFM) to ensure that legal requirements are satisfied
- establish standardized procedures and practices to enhance Boeing operational philosophy and policy.

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

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

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

This manual is structured in a two–volume format with a quick reference handbook (QRH). Volume 1 includes operational limitations, normal and supplementary procedures. Volume 2 contains systems information. The QRH contains all checklists necessary for normal and non–normal procedures as well as in–flight performance data.

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

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

Please submit all correspondence regarding the Flight Crew Operations Manual, including bulletin status, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

Organization

The FCOM is organized in the following manner.

Volume 1

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

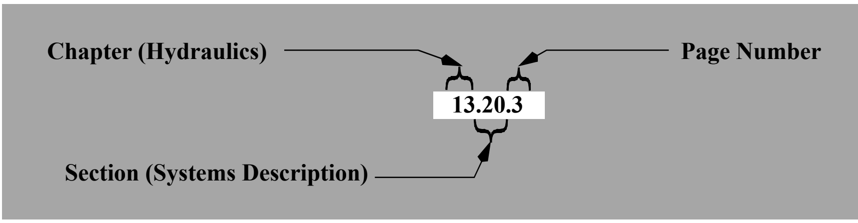
Volume 2 – Chapters 1 through 15 contain general airplane and systems information. These chapters are generally subdivided into sections covering controls and indicators and systems descriptions.

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

Page Numbering

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

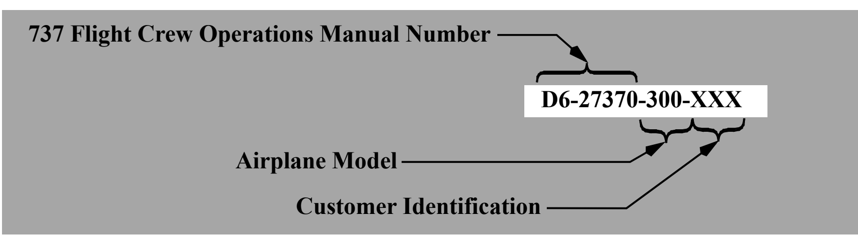
Example Page Number



Page Identification

Each page is identified by a customer document number and a page date. The customer document number is composed of the general 737 FCOM number, D6–27370–, and is followed by the customer identification. The page date is the date of publication of the manual or the most recent revision date.

Example Page Identification



Warnings, Cautions, and Notes

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

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

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

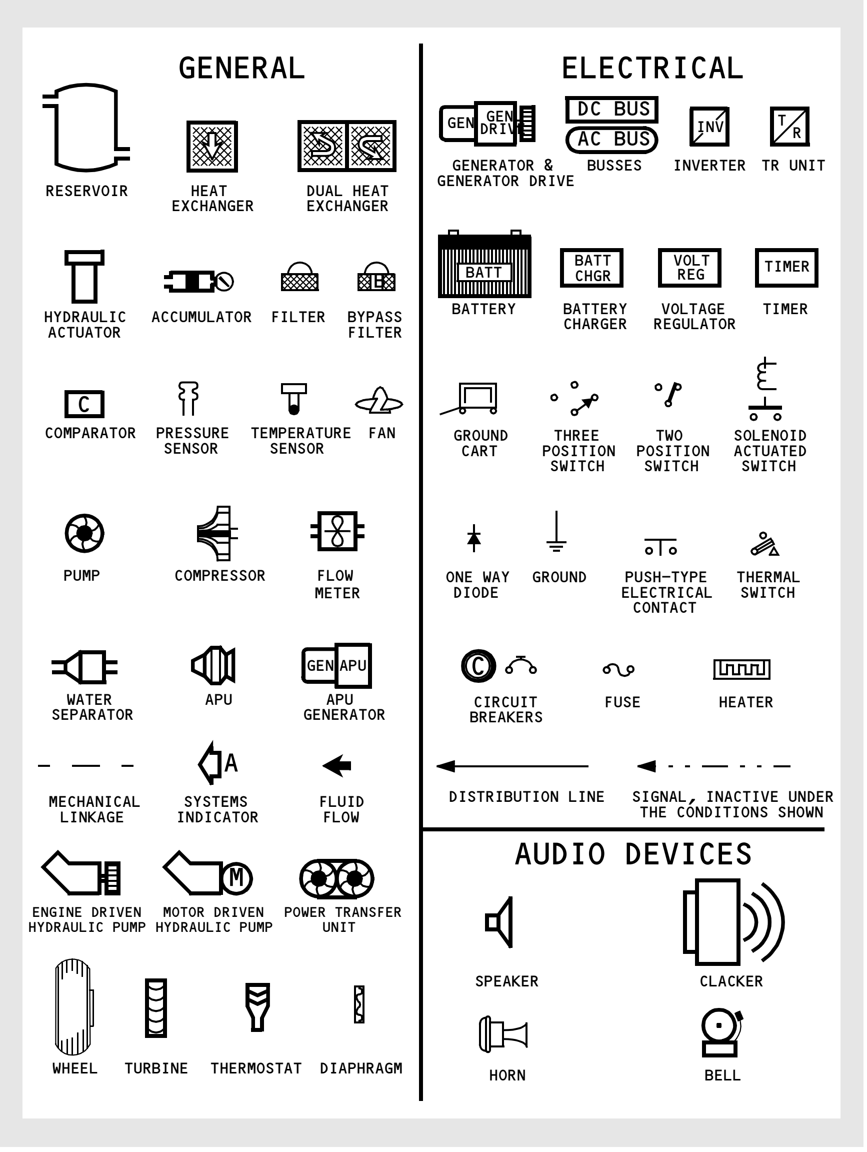
Note: An operating procedure, technique, etc., considered essential to emphasize. Information contained in notes may also be safety related.

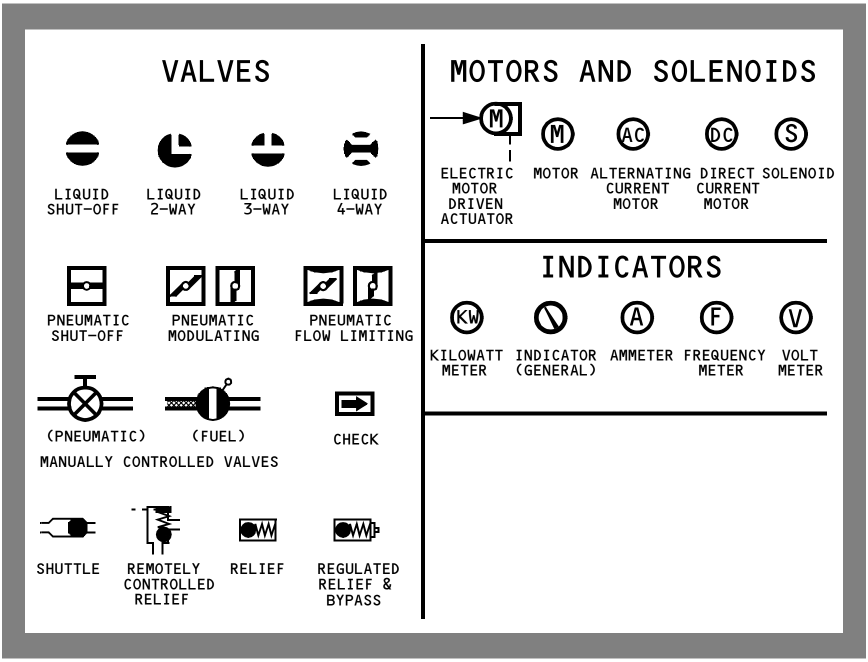
Flight Crew Operations Manual Configuration

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

Schematic Symbols

Symbols shown are those which may not be identified on schematic illustrations.




VALVES
LIQUID SHUT-OFF
LIQUID 2-WAY
LIQUID 3-WAY
LIQUID 4-WAY
PNEUMATIC SHUT-OFF
PNEUMATIC MODULATING
PNEUMATIC FLOW LIMITING
(PNEUMATIC)
(FUEL)
MANUALLY CONTROLLED VALVES
CHECK
SHUTTLE
REMOTELY CONTROLLED RELIEF
RELIEF
REGULATED RELIEF & BYPASS
MOTORS AND SOLENOIDS
M
ELECTRIC MOTOR DRIVEN ACTUATOR
M
MOTOR
AC
ALTERNATING CURRENT MOTOR
DC
DIRECT CURRENT MOTOR
S
SOLENOID
INDICATORS
KW
KILOWATT METER
INDICATOR (GENERAL)
A
AMMETER
F
FREQUENCY METER
V
VOLT METER

General

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

A	
AC	Alternating Current
ACARS	Aircraft Communications Addressing and Reporting System
ACT	Active
ADF	Automatic Direction Finder
AFDS	Autopilot Flight Director System
AFM	Airplane Flight Manual (FAA approved)
AGL	Above Ground Level
AI	Anti–Ice
AIL	Aileron
ALT	Altitude
ALTN	Alternate
AOA	Angle of Attack
A/P	Autopilot
APU	Auxiliary Power Unit
ARINC	Aeronautical Radio, Incorporated
ARPT	Airport
ATA	Actual Time of Arrival
ATC	Air Traffic Control
ATT	Attitude
AUTO	Automatic
AVAIL	Available
B	
BARO	Barometric
BRT	Bright
BTL DISCH	Bottle Discharge (fire extinguishers)
B/C	Back Course
C	
C	Captain Celsius Center
CANC/ RCL	Cancel/Recall
CB	Circuit Breaker
CDU	Control Display Unit
CG	Center of Gravity
CHKL	Checklist
CLB	Climb
COMM	Communication
CON	Continuous
CONFIG	Configuration
CRZ	Cruise
CTL	Control
D	

DC	Direct Current
DDG	Dispatch Deviations Guide
DEP ARR	Departure Arrival
DES	Descent
DISC	Disconnect
DME	Distance Measuring Equipment
E	
E/D	End of Descent
EGT	Exhaust Gas Temperature
ELEC	Electrical
ELEV	Elevator
ENG	Engine
EXEC	Execute
EXT	Extend
E/E	Electrical and Electronic
F	
F	Fahrenheit
FAF / FAP	Final Approach Fix / Final Approach Point (interchangeable)
FCTL	Flight Control
F/D or FLT DIR	Flight Director
F/O	First Officer
FWD	Forward
G	
GA	Go–Around
GEN	Generator
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
G/S	Glide Slope
H	
HDG	Heading
HDG REF	Heading Reference
HDG SEL	Heading Select
HPA	Hectopascals
HUD	Head-Up Display
I	
IAS	Indicated Airspeed
IDENT	Identification
IN	Inches
IND LTS	Indicator Lights
ILS	Instrument Landing System
INBD	Inboard
INOP	Inoperative
ISLN	Isolation
K	
K	Knots
KGS	Kilograms
KIAS	Knots Indicated Airspeed
L	
L	Left
LBS	Pounds
LDG ALT	Landing Altitude
LE	Leading Edge
LIM	Limit
M	
MAG	Magnetic

MAN	Manual
MCP	Mode Control Panel
MDA	Minimum Descent Altitude
MEA	Minimum Enroute Altitude
MEL	Minimum Equipment List
MIN	Minimum
MMO	Maximum Mach Operating Speed
MOD	Modify
MTRS	Meters
N	
NAV RAD	Navigation Radio
NM	Nautical Miles
NORM	Normal
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed
O	
OHU	Overhead Unit
OVHD	Overhead
OVRD	Override
P	
PASS	Passenger
PCU	Power Control Unit
PF	Pilot Flying
PM	Pilot Monitoring
PNL	Panel
POS	Position
POS INIT	Position Initialization

PRI	Primary
R	
R	Right
RA	Radio Altitude Resolution Advisory
REF	Reference
RET	Retract
RF	Refill
RVSM	Reduced Vertical Separation Minimum
S	
SEL	Select
SPD	Speed
STA	Station
STAB	Stabilizer
STAT	Status
STD	Standard
T	
T or TRU	True
TA	Traffic Advisory
TAI	Thermal Anti-Ice
TAT	Total Air Temperature
TCAS	Traffic Alert and Collision Avoidance System
T/D	Top of Descent
TE	Trailing Edge
TFC	Traffic
THR HOLD	Throttle Hold
TO	Takeoff
TO/GA	Takeoff/Go–Around

U	
UTC	Universal Time Coordinated
V	
VA	Design Maneuvering Speed
VMO	Maximum Operating Speed
VOR	VHF Omnidirectional Range
VR	Rotation Speed
VREF	Reference Speed
V/S	Vertical Speed
V1	Takeoff Decision Speed
V2	Takeoff Safety Speed
W	
WPT	Waypoint
WXR	Weather Radar

Revision Transmittal Letter

To: All holders of The Boeing Company 737 Flight Crew Operations Manual (FCOM), Boeing Document Number D6-27370-200A-TBC.

Subject: Flight Crew Operations Manual Revision.

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

Revision Record

No.	Revision Date	Date Filed	No.	Revision Date	Date Filed
31	April 3, 2015		32	November 13, 2015	
33	April 1, 2016		34	October 21, 2016	
35	April 6, 2017		36	October 5, 2017	
37	April 6, 2018		38	October 15, 2018	
39	April 5, 2019		40	October 15, 2019	
41	April 15, 2020		42	October 6, 2020	

General

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

The revision date is the approximate date the manual is approved for printing. The revision is mailed a few weeks after this date.

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

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

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

Filing Instructions

Consult the List of Effective Pages (0.5). Pages identified with an asterisk (*) are either replacement pages or new (original) issue pages. Remove corresponding old pages and replace or add new pages. Remove pages that are marked DELETED; there are no replacement pages for deleted pages.

Be careful when inserting changes not to throw away pages from the manual that are not replaced. Using the List of Effective Pages (0.5) can help determine the correct content of the manual.

Revision Highlights

This section (0.4) replaces the existing section 0.4 in your manual.

Throughout the manual, airplane effectivity may be updated to reflect coverage as listed on the Preface - Model Identification page, or to show service bulletin airplane effectivity. Highlights are not supplied.

This manual is published from a database; the text and illustrations are marked with configuration information. Occasionally, because the editors rearrange the database markers, or mark items with configuration information due to the addition of new database content, some customers may receive revision bars on content that appears to be unchanged. Pages may also be republished without revision bars due to slight changes in the flow of the document.

Chapter NP - Normal Procedures

Section 21 - Amplified Procedures

Preliminary Preflight Procedure – Captain or First Officer

NP.21.1 - Added a reference allowing the use of an observer station when doing the oxygen pressure drop test during the preliminary preflight procedure. An observer station can be used and may be easier.

NP.21.2 - Added a step to verify the OFF light is illuminated when checking that the flight recorder switch guard is closed. Deleted the word “TEST” for standardization with other 737 models.

Before Start Procedure

NP.21.25 - Standardized the conversion of 1,000 lbs to 453 kgs.

NP.21.25 - Standardized the conversion of 1,000 lbs to 453 kgs.

Descent Procedure

NP.21.38 - Moved this step earlier to ensure that landing data doesn’t require changing anything already set, such as changing the flap setting used and thus changing Vref.

NP.21.38 - Deleted table row "Check landing performance." because it was moved higher in the procedure.

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* = Revised, Added, or Deleted

* NP.21.7	October 6, 2020
* NP.21.8	October 6, 2020
* NP.21.9	October 6, 2020
* NP.21.10	October 6, 2020
* NP.21.11	October 6, 2020
* NP.21.12	October 6, 2020
* NP.21.13	October 6, 2020
* NP.21.14	October 6, 2020
* NP.21.15	October 6, 2020
* NP.21.16	October 6, 2020
* NP.21.17	October 6, 2020
* NP.21.18	October 6, 2020
* NP.21.19	October 6, 2020
* NP.21.20	October 6, 2020
* NP.21.21	October 6, 2020
* NP.21.22	October 6, 2020
* NP.21.23	October 6, 2020
* NP.21.24	October 6, 2020
* NP.21.25	October 6, 2020
* NP.21.26	October 6, 2020
* NP.21.27	October 6, 2020
* NP.21.28	October 6, 2020
* NP.21.29	October 6, 2020
* NP.21.30	October 6, 2020
* NP.21.31	October 6, 2020
* NP.21.32	October 6, 2020
* NP.21.33	October 6, 2020
* NP.21.34	October 6, 2020
NP.21.35	April 15, 2020
NP.21.36	April 15, 2020
NP.21.37	April 15, 2020
* NP.21.38	October 6, 2020
NP.21.39	April 15, 2020
NP.21.40	April 15, 2020
NP.21.41	April 15, 2020
NP.21.42	April 15, 2020
NP.21.43	April 15, 2020
NP.21.44	April 15, 2020
NP.21.45	April 15, 2020
NP.21.46	April 15, 2020
NP.21.47	April 15, 2020
NP.21.48	April 15, 2020

Supplementary Procedures (tab)

SP.TOC.1-6	April 5, 2019
SP.05.1	October 9, 2008
SP.05.2	April 7, 2000
SP.1.1	October 3, 2003
SP.1.2	October 3, 2003
SP.1.3	April 3, 2015
SP.1.4	April 3, 2015
SP.1.5	November 13, 2015
SP.1.6	November 13, 2015
SP.1.7	October 8, 2004
SP.1.8	April 3, 2015
SP.1.9	April 3, 2015
SP.1.10	April 9, 2009
SP.2.1	April 3, 2015
SP.2.2	April 3, 2015
SP.2.3	November 13, 2015
SP.2.4	November 13, 2015
SP.2.5	November 13, 2015
SP.2.6	April 5, 2019
SP.2.7	November 13, 2015
SP.2.8	November 13, 2015
SP.2.9	November 13, 2015
SP.2.10	November 13, 2015
SP.3.1	April 3, 2015
SP.3.2	October 7, 2005
SP.4.1	November 13, 2015
SP.4.2	November 13, 2015
SP.4.3	November 13, 2015
SP.4.4	November 13, 2015
SP.4.5	November 13, 2015
SP.4.6	April 3, 2015
SP.4.7	April 3, 2015
SP.4.8	April 3, 2015
SP.4.9	November 13, 2015
SP.4.10	November 13, 2015
SP.4.11	November 13, 2015
SP.4.12	November 13, 2015
SP.5.1	April 5, 2013
SP.5.2	April 7, 2000
SP.6.1	April 3, 2015
SP.6.2	April 3, 2015
SP.6.3	April 3, 2015
SP.6.4	April 3, 2015
SP.6.5	April 1, 2016
SP.6.6	April 3, 2015
SP.7.1	April 3, 2015
SP.7.2	April 3, 2015
SP.7.3	April 3, 2015
SP.7.4	October 21, 2016
SP.7.5	October 21, 2016

* = Revised, Added, or Deleted

SP.7.6	October 9, 2007
SP.7.7	October 9, 2007
SP.7.8	October 9, 2007
SP.7.9	October 9, 2007
SP.7.10	April 3, 2015
SP.7.11	April 3, 2015
SP.7.12	April 3, 2015
SP.7.13	April 3, 2015
SP.7.14	April 3, 2015
SP.7.15	April 3, 2015
SP.7.16	April 3, 2015
SP.7.17	April 3, 2015
SP.7.18	April 3, 2015
SP.7.19	April 3, 2015
SP.7.20	April 3, 2015
SP.7.21	April 3, 2015
SP.7.22	April 3, 2015
SP.7.23	April 3, 2015
SP.7.24	April 3, 2015
SP.7.25	April 3, 2015
SP.7.26	April 3, 2015
SP.7.27	April 3, 2015
SP.7.28	April 3, 2015
SP.9.1	October 9, 2007
SP.9.2	April 3, 2007
SP.10.1	October 5, 2001
SP.10.2	April 3, 2015
SP.11.1	April 9, 2010
SP.11.2	April 3, 2015
SP.11.3	April 3, 2015
SP.11.4	April 3, 2015
SP.11.5	April 3, 2015
SP.11.6	April 3, 2015
SP.11.7	April 3, 2015
SP.11.8	April 3, 2015
SP.11.9	April 3, 2015
SP.11.10	April 3, 2015
SP.11.11	April 3, 2015
SP.11.12	April 3, 2015
SP.11.13	April 3, 2015
SP.11.14	April 3, 2015
SP.12.1	April 7, 2000
SP.12.2	April 8, 2011
SP.12.3	October 3, 2014
SP.12.4	October 3, 2014
SP.12.5	October 3, 2014
SP.12.6	October 3, 2014
SP.15.1	October 8, 2010
SP.15.2	October 8, 2010
SP.16.1	October 9, 2009
SP.16.2	April 3, 2015
SP.16.3	April 3, 2015
SP.16.4	April 3, 2015
SP.16.5	April 3, 2015
SP.16.6	April 3, 2015
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SP.16.8	April 3, 2015
SP.16.9	April 3, 2015
SP.16.10	April 3, 2015
SP.16.11	October 5, 2017
SP.16.12	October 5, 2017
SP.16.13	April 1, 2016
SP.16.14	April 1, 2016
SP.16.15	April 1, 2016
SP.16.16	April 1, 2016
SP.16.17	April 1, 2016
SP.16.18	October 21, 2016
SP.16.19	October 21, 2016
SP.16.20	October 21, 2016
SP.16.21	October 21, 2016
SP.16.22	October 21, 2016
SP.16.23	October 21, 2016
SP.16.24	October 21, 2016
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SP.16.26	October 21, 2016
SP.16.27	October 21, 2016
SP.16.28	April 3, 2015
SP.16.29	April 3, 2015
SP.16.30	April 3, 2015
SP.16.31	October 15, 2018
SP.16.32	April 3, 2015

Performance Inflight (tab)

PI.TOC.1-2	October 9, 2008

737-200ADV JT8D-15A LB FAA

PI.TOC.10.1-2	April 6, 2017
PI.10.1	October 9, 2008
PI.10.2	April 3, 2015
PI.10.3	April 3, 2015
PI.10.4	April 3, 2015
PI.10.5	April 3, 2015
PI.10.6	April 3, 2015
PI.10.7	April 3, 2015
PI.10.8	April 3, 2015

* = Revised, Added, or Deleted

PI.10.9	April 3, 2015
PI.10.10	April 3, 2015
PI.10.11	April 3, 2015
PI.10.12	April 3, 2015
PI.10.13	April 3, 2015
PI.10.14	April 3, 2015
PI.10.15	April 3, 2015
PI.10.16	April 3, 2015
PI.11.1	April 5, 2013
PI.11.2	April 3, 2015
PI.11.3	April 3, 2015
PI.11.4	April 3, 2015
PI.11.5	April 3, 2015
PI.11.6	April 3, 2015
PI.12.1	April 6, 2017
PI.12.2	April 6, 2017
PI.12.3	April 6, 2017
PI.12.4	April 6, 2017
PI.12.5	April 6, 2017
PI.12.6	April 6, 2017
PI.12.7	April 6, 2017
PI.12.8	April 6, 2017
PI.12.9	April 6, 2017
PI.12.10	April 6, 2017
PI.12.11	April 6, 2017
PI.12.12	April 6, 2017
PI.13.1	April 5, 2013
PI.13.2	April 3, 2015
PI.13.3	April 3, 2015
PI.13.4	April 3, 2015
PI.13.5	April 3, 2015
PI.13.6	April 3, 2015
PI.14.1	April 3, 2015
PI.14.2	April 3, 2015
PI.14.3	April 3, 2015
PI.14.4	April 3, 2015
PI.15.1	April 8, 2011
PI.15.2	April 3, 2015
PI.15.3	April 3, 2015
PI.15.4	October 15, 2018
PI.15.5	April 3, 2015
PI.15.6	April 3, 2015
PI.15.7	April 3, 2015
PI.15.8	April 5, 2013
PI.15.9	April 5, 2013
PI.15.10	April 5, 2013
PI.15.11	April 5, 2013
PI.15.12	April 5, 2013

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PI.TOC.20.1-2	April 6, 2017
PI.20.1	October 9, 2008
PI.20.2	April 3, 2015
PI.20.3	April 3, 2015
PI.20.4	April 3, 2015
PI.20.5	April 3, 2015
PI.20.6	April 3, 2015
PI.20.7	April 3, 2015
PI.20.8	April 3, 2015
PI.20.9	April 3, 2015
PI.20.10	April 3, 2015
PI.20.11	April 3, 2015
PI.20.12	April 3, 2015
PI.20.13	April 3, 2015
PI.20.14	April 3, 2015
PI.21.1	April 5, 2013
PI.21.2	April 3, 2015
PI.21.3	April 3, 2015
PI.21.4	April 3, 2015
PI.21.5	April 3, 2015
PI.21.6	April 3, 2015
PI.22.1	April 6, 2017
PI.22.2	April 6, 2017
PI.22.3	April 6, 2017
PI.22.4	April 6, 2017
PI.22.5	April 6, 2017
PI.22.6	April 6, 2017
PI.22.7	April 6, 2017
PI.22.8	April 6, 2017
PI.22.9	April 6, 2017
PI.22.10	April 6, 2017
PI.22.11	April 6, 2017
PI.22.12	April 6, 2017
PI.23.1	April 5, 2013
PI.23.2	April 3, 2015
PI.23.3	April 3, 2015
PI.23.4	April 3, 2015
PI.23.5	April 3, 2015
PI.23.6	April 3, 2015
PI.24.1	April 3, 2015
PI.24.2	April 3, 2015
PI.24.3	April 3, 2015
PI.24.4	April 3, 2015
PI.25.1	April 8, 2011

* = Revised, Added, or Deleted

PI.25.2	April 5, 2013
PI.25.3	April 3, 2015
PI.25.4	April 3, 2015
PI.25.5	April 3, 2015
PI.25.6	April 3, 2015
PI.25.7	April 3, 2015
PI.25.8	April 3, 2015
PI.25.9	April 3, 2015
PI.25.10	April 3, 2015

737-200ADV JT8D-9 LB FAA

PI.TOC.30.1-2	April 6, 2017
PI.30.1	October 9, 2008
PI.30.2	April 3, 2015
PI.30.3	April 3, 2015
PI.30.4	April 3, 2015
PI.30.5	April 3, 2015
PI.30.6	April 3, 2015
PI.30.7	April 3, 2015
PI.30.8	April 3, 2015
PI.30.9	April 3, 2015
PI.30.10	April 3, 2015
PI.30.11	April 3, 2015
PI.30.12	April 3, 2015
PI.31.1	April 5, 2013
PI.31.2	April 3, 2015
PI.31.3	April 3, 2015
PI.31.4	April 3, 2015
PI.31.5	April 3, 2015
PI.31.6	April 3, 2015
PI.32.1	April 6, 2017
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* = Revised, Added, or Deleted

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* = Revised, Added, or Deleted

* = Revised, Added, or Deleted

* = Revised, Added, or Deleted

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11.10.6	October 5, 2012
11.10.7	April 6, 2012
11.10.8	April 9, 2009
11.20.1	April 7, 2000
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11.20.3	April 3, 2007
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12.20.1	October 9, 2009
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13.TOC.1-2	October 4, 2013
13.10.1	October 9, 2008
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* = Revised, Added, or Deleted

* = Revised, Added, or Deleted

General

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

Bulletins are dated and numbered sequentially for each operator. Each new bulletin is recorded in this record when received and filed as instructed. A bulletin may not apply to all airplane models. When appropriate, the next formal FCOM revision will include an updated bulletin record page to reflect current bulletin status.

Temporary information is normally incorporated into the manual at the next formal revision. When the condition remains temporary after a bulletin incorporation, the temporary paragraphs are identified by a heading referencing the originating bulletin. When the temporary condition no longer exists, the bulletin is cancelled and the original manual content is restored.

Bulletin status is defined as follows:

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

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

Number	Subject	Date	Status
TBC-4	Emergency Deployment of Escape Slides	October 13, 1995	IE
TBC-5	Auxiliary Power Unit (APU) Starting	October 13, 1995	IE
TBC-13	Maneuvering Speeds for 737-100/200/300/400/500	December 3, 1999	IE
TBC-19 R1	Trailing Edge Flaps - Outboard Flap Carriage Spindle Fractures	February 1, 2005	IE
TBC-21	Main Landing Gear (MLG) Actuator Beam Fracture and/or MLG Actuator Beam Arm Fracture	March 22, 2005	IE
TBC-26 R1	Cabin Altitude Warning Indications and Procedures Briefing	June 1, 2009	IE
TBC-27	Inflight Elevator Tab Vibration	June 2, 2009	IE

BOEING

Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

737

Number: TBC-4

IssueDate: October 13, 1995

Subject: Emergency Deployment of Escape Slides

Reason: This bulletin provides information contained in Red Bulletin 737- 200 85-4R1, dated June 1, 1992, which advised flight crews of possible jamming of cabin doors when deploying emergency escape slides.

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

It was reported that during a 737 emergency evacuation the right hand forward service door was opened with considerable force and speed. The escape slide compartment cover opened prematurely and the escape slide partially came out of the compartment onto the airplane floor. This initially prevented further opening of the door. The compartment cover was then pushed back toward the closed position, which permitted opening of the door. As the door was opened the escape slide was pushed out. The escape slide was then deployed and inflated normally.

Checks were accomplished on comparable but not identical configurations and revealed that in some instances the use of considerable force and speed during the initial door opening sequence could duplicate the reported condition. Doors and escape slides operated properly when excessive force and speed were not exerted.

System modifications were evaluated and Service Bulletin 737-25A1182 was issued to correct this condition. Until such modifications are incorporated, flight crew personnel are advise to open all doors smoothly during an emergency evacuation, avoiding excessive force or speed during the initial door opening sequence.

Administrative Information

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

This Operations Manual Bulletin will be cancelled after Boeing is notified that all affected airplanes in the operator’s fleet have been modified by Service Bulletin 737-25A1182. If the operator does not plan to modify all the airplanes and would like to have the contents of this Bulletin incorporated in the Operations Manual, please advise Boeing accordingly.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

Flight Crew Operations Manual Bulletin
for
The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

737

Number: TBC-5

IssueDate: October 13, 1995

Subject: Auxiliary Power Unit (APU) Starting

Reason: This bulletin provides information contained in Red Bulletin 737- 200 90-2R2, dated September 30, 1991, which advised flight crews of the requirement for a qualified ground observer to monitor subsequent starts following unsuccessful Auxiliary Power Unit (APU) ground start.

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

On January 22, 1990 an operator of a Boeing Model 737 series airplane experienced significant fire damage to the empennage. The damaged area was reported to be the elevator, trim tab and tail cone. This damage was due to Auxiliary Power Unit (APU) torching following an unsuccessful first start attempt. A previous incident occurred on March 17, 1989. Empennage damage similar to that of the most recent incident was reported.

A torching APU start occurs when leftover fuel from a previous unsuccessful start attempt does not drain from the APU properly and ignites during a subsequent start attempt. When a torching start occurs, the accumulated fuel in the APU tailpipe is consumed and the APU operation is otherwise normal. If unburned fuel mist is blown back onto the empennage surfaces during the initial unsuccessful start attempt, it is possible that a fire on the external surfaces of the empennage could occur if torching occurred during the next start attempt.

The only means to detect the torching start and/or flames on the empennage surfaces is by an external observer. By the time the observer communicates to the crew that a torching start has occurred, the excess fuel will most likely be consumed and the torching ceased. Unless the observer sees the evidence that a fire exists on the empennage surface, no other flight crew action is required except for a normal APU shutdown to allow the required inspections of the airplane surfaces.

If the observer sees fire on the airplane surfaces, the flight crew should advise the tower and request fire equipment. In this instance, the APU can be shut down by normal procedures since the APU fire extinguishing system would not be effective to combat either the APU torching or the external surface fire.

Inflight starting of the APU is not impaired because the fuel vapors are carried away from the airplane. Torching of any leftover fuel in the APU exhaust area will not damage the airplane.

The Federal Aviation Administration (FAA) issued an Airworthiness Directive (AD) effective March 12, 1990 requiring that after an unsuccessful ground start the APU be placarded to prohibit ground operation or that any subsequent APU ground start attempts be monitored by a “qualified ground observer”.

The Boeing Company designed a modified system to improve draining of leftover fuel after an unsuccessful APU start. These modifications are described under Administrative Information below.

Operating Instructions

For airplanes with unmodified APU drain systems, the following procedures apply:

After any unsuccessful APU ground start, either placard the APU “NO GROUND STARTING” or accomplish the following during the subsequent ground start attempt(s):

1. Following any unsuccessful APU start attempt, the subsequent APU ground start attempt(s) must be monitored by a qualified ground observer to assure that the airplane is not damaged due to torching.
2. The placard may be removed and APU ground starting resumed without an observer following appropriate maintenance action to determine and resolve the cause of the unsuccessful ground start, or successful ground or inflight starting and operation is accomplished.

Note: Inflight starting and operating of the APU is not impacted by this action.

Administrative Information

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

This Operations Manual Bulletin will be cancelled after Boeing is notified that all affected airplanes in the operator’s fleet have been modified by one of the following methods:

1. Installation of a Garrett GTCP 85-129 APU with PRR 33890-86 incorporated (installs a modified drain system on airplanes at production line number 20161 and on).

2. Incorporation of Service Bulletin 737-49-1073 (installs the modified drain system on airplanes delivered prior to incorporation of PRR 33890-86).

3. Installation of the Sundstrand APS 2000 alternative APU (includes the modified drain system).

4. Installation of the Garrett GTCP 36-280 alternative APU (includes the modified drain system).

The FAA has approved the above four options as acceptable means of compliance to the above Airworthiness Directive. If the operator does not plan to modify all of the airplanes and would like to have the content of this Bulletin incorporated in the Operations Manual, please advise Boeing accordingly.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

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Flight Crew Operations Manual Bulletin
for
The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

737

Number: TBC-13

IssueDate: December 3, 1999

Subject: Maneuvering Speeds for 737-100/200/300/400/500

Reason: To inform flight crews of recommended Block Speeds

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

In March 1999, the FAA released a Flight Standards Information Bulletin for Air Transportation (FSAT) number 99-2, titled “Maneuvering Speeds and Recovery Procedures for Boeing 737 Airplanes.” The FSAT recommended that “For the interim period and prior to completion of fleet retrofit” (of a redesigned rudder power control unit (PCU) and the installation of both a digital yaw damper system and a rudder pressure reducer (RPR)), “that all Block Speeds for flap settings of UP, 1, 5, and 10...be increased by at least 10 knots and that these increased speeds be used in lieu of the published Block Speeds.”

Boeing issued an Operations Manual Bulletin (OMB). dated May 28, 1999 that provided revised Block Speeds to be used in compliance with the FSAT pending installation of the RPR. Boeing also advised that analysis of crossover speeds with the RPR installed was in work, and upon completion of analysis updated Block Speeds would be provided. Boeing has completed this analysis. The purpose of this bulletin is to provide updated Block (maneuvering) Speeds for 737 airplanes with the RPR installed. This bulletin does not apply to the 737-600/700/800.

The maneuvering speeds recommended by Boeing are referred to as Block Speeds. Block Speeds are provided for a specific flap setting and a range of weights. The lateral-directional static balance speed has been referred to as “crossover” speed. This is the airspeed that requires full lateral (roll) control from the ailerons and spoilers to counteract roll due to yaw caused by a full rudder input. At speeds slower than the crossover speed, with full rudder input, the roll induced by the rudder starts to exceed the lateral control authority.

The Rudder Pressure Reducer (RPR) lowers hydraulic pressure to the rudder PCU during non-critical phases of flight, thereby limiting the amount of rudder deflection. Reduced rudder deflection lowers the speed at which crossover may occur. The crossover speed is not a fixed speed but varies as a function of g load and CG. Reducing g load lowers the crossover speed. As described in the Uncommanded Yaw and Roll non-normal checklist, if uncommanded yaw or roll is experienced, maintain control of the airplane with all available flight controls. If roll is uncontrollable, immediately reduce pitch attitude (angle of attack) and increase speed. Unloading the airplane by decreasing back pressure on the control column improves roll control effectiveness.

Analysis of the effect of the RPR determined that Block Speed changes are not required for the 737-100/200 (see Table 1). Block Speed changes are only required for 737-300/400/500 flaps 5 and flaps 10 (see Table 2). For all other flap positions, the crossover speed is below the Block Speed, and a maneuvering airspeed adjustment is not required. Until the RPR is installed and is operable, the Block Speeds provided in Table 3 should be followed for all 737’s.

Increasing Block Speeds during takeoff is not required due to the relatively short operating time at speeds below the crossover speed. In heavyweight return to land situations where the revised Block Speed is equal to the flap placard speed for the next flap position, Boeing recommends slowing below the Block Speed as necessary to protect the flap placard speed prior to flap extension. Airspeeds specified by non-normal procedures should be followed instead of Table 2 or Table 3 Block Speeds. If dispatch is required with the RPR inoperative, Boeing recommends using Table 3 speeds during approach maneuvering.

Speed tape equipped airplanes can use the “F” speeds for flap retraction. For approach operations using VNAV, speeds calculated by the FMC are based on gross weight and therefore may be below the Table 2 or Table 3 speeds. Pilots should use Speed Intervention mode (if installed) to follow the revised Block Speeds while remaining in VNAV. For airplanes without Speed Intervention, some other pitch mode is required for Block Speed compliance. FMC Update 10.3 will incorporate VNAV maneuvering speeds compatible with the crossover speeds with RPR operating.

Simulator software is available to incorporate revised aerodynamic data that more accurately model lateral-directional control static balance conditions. These updates are complete, and revised data are available for each 737 model by contacting Boeing Special Services Contract Manager at telephone 206-766-2418 or fax 425-237-1706.

Boeing, the FAA, and the NTSB conducted additional engineering simulator testing of the hypothetical rudder reversal and rate jams with the RPR installed. The NTSB was concerned that flight crews might believe a rudder jam or restriction was resolved and the non-normal procedure was complete if the rudder was centered by continuous rudder pedal pressure. After simulating this scenario it was agreed that it would be obvious to a flight crew that the procedure is not complete if the rudder centered but required significant rudder pedal force. As a result, the Jammed or Restricted Rudder non-normal procedure is not changed by installation of the RPR.

An airline industry team consisting of airplane manufacturers, regulators, and various airline operators developed an Airplane Upset Recovery Training Aid dated October, 1998. This document was sent to all airlines and provides an excellent source of information about recovery from an upset event regardless of the cause. We believe training in accordance with the Airplane Upset Recovery Training Aid would be more beneficial than training specifically for a full rudder deflection anomaly.

Operating Instructions

Tables 1 and 3 provide 737-100/200 Block Speeds to be used when the RPR is operating (Table 1) or when the RPR is not installed or not operating (Table 3). Tables 2 and 3 provide Block Speeds for the 737-300/400/500 to be used when the RPR is operating (Table 2) or when the RPR is not installed or not operating (Table 3).

Note: Note: Operators with mixed fleets can use 737-300/400/500 tables for their 737- 100/200’s

Table 1

737-100/200 (With RPR installed (Service Bulletin 737-27A1206))

FLAP POSITION	UP TO 117,000 LBS (53,070 KGS)
FLAPS UP	210
FLAPS 1	190
FLAPS 5	170
FLAPS 10	160

FLAP POSITION	UP TO 117,000 LBS (53,070 KGS)
FLAPS 15	150
FLAPS 25	140

Table 2

737-300/400/500 (With RPR installed (Service Bulletin 737-27A1206))

FLAP POSITION	UP TO 117,000 LBS (53,070 KGS)	ABOVE 117,000 LBS (53,070 KGS) UP TO 138,500 LBS (62,823 KGS)	ABOVE 138,500 LBS (62,823 KGS)
FLAPS UP	210	220	230
FLAPS 1	190	200	210
FLAPS 5	180	190	200
FLAPS 10	170	180	190
FLAPS 15	150	160	170
FLAPS 25	140	150	160

Table 3

737-100/200/300/400/500 (With RPR deactivated or not installed)

FLAP POSITION	UP TO 117,000 LBS (53,070 KGS)	ABOVE 117,000 LBS (53,070 KGS) UP TO 138,500 LBS (62,823 KGS)	ABOVE 138,500 LBS (62,823 KGS)
FLAPS UP	220	230	240
FLAPS 1	200	210	220
FLAPS 5	190	200	210
FLAPS 10	170	180	190
FLAPS 15	150	160	170
FLAPS 25	140	150	160

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-13 "In Effect" (IE).

This bulletin will be cancelled after Boeing is notified that all affected airplanes in your fleet have been modified by SB 737-27A1206.

The Block Speeds provided by this Operations Manual Bulletin will be incorporated in a future revision to the Operations Manual.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

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Flight Crew Operations Manual Bulletin
for
The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

737

Number: TBC-19 R1

IssueDate: February 1, 2005

Subject: Trailing Edge Flaps - Outboard Flap Carriage Spindle Fractures

Reason: To inform flight crews of outboard trailing edge flap carriage spindle fractures that could cause mid-flap displacement with associated inflight roll-off. In addition, to inform flight crews to report any unexpected roll-off condition to maintenance.

The purpose of this reissue is to amend the operating instruction.

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received reports of outboard mid-flap carriage spindle fractures from operators of 737-100 through -500 airplanes. Two carriage assemblies move on independent flap tracks and connect each outboard trailing edge mid-flap to the wing. Fractures have been found in varying locations along the length of the carriage spindle, which connects the carriage assembly to the mid-flap. A fracture can result in the displacement of the associated flap from the carriage assembly. This displacement can cause a change in the flap angle of attack resulting in airplane roll-off as the flaps extend. An airplane roll-off condition that requires one unit or more of rudder trim and/or 2.5 units or more of aileron trim to maintain wings level flight when the flaps are extended can be an indication of a spindle fracture. The flight deck flap indications are normal.

A fractured spindle will not cause roll changes when the trailing edge flaps are fully retracted. Roll changes should be minimal at flap positions 1, 2, 5, and 10. Depending upon the location of the fracture, roll changes are expected to be more pronounced as the flaps extend to 15 or greater. If one carriage spindle fractures at the critical location, the pilot can compensate for it with aileron and/or rudder inputs. However, if both the inboard and outboard spindles on an outboard flap fracture in the critical location, a large potentially uncontrollable rolling moment could occur.

Operating Instructions

During flap operation at flaps 15 or greater with normal flap indications, if an unexpected roll-off occurs, stop flap extension. If the roll-off requires one unit or more of rudder trim and/or 2.5 units or more of aileron trim to maintain wings level flight, retract flaps to flaps 1. Land using flaps 1 and Vref 40 + 30 knots. Report the roll-off condition to maintenance.

Administrative Information

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

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

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

Flight Crew Operations Manual Bulletin
for
The Boeing Company

The Boeing Company **Seattle, Washington 98124-2207** 737

Number: TBC-21

IssueDate: March 22, 2005

Subject: Main Landing Gear (MLG) Actuator Beam Fracture and/or MLG Actuator Beam Arm Fracture

Reason: This bulletin informs flight crews of a potential uncommanded control wheel roll input and/or control wheel jam or large increase in control wheel forces during landing gear retraction due to a MLG actuator beam and/or MLG actuator beam arm fracture.

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

There have been five (5) reported cases of MLG actuator beam fractures and nine (9) reported cases of MLG actuator beam arm fractures. After takeoff and during landing gear retraction, a fracture allows the MLG actuator to extend beyond its normal position and contact the spoiler and/or aileron cables. Contact with these cables can cause an uncommanded control wheel roll input with subsequent airplane roll, and/or a control wheel jam or a large increase in control wheel forces.

One operator reported an occurrence in which, after takeoff and during landing gear retraction, the airplane experienced an uncommanded control wheel roll input. An almost full opposite sustained control wheel input, using considerable force by both pilots, was required to correct the airplane roll. The crew was advised that the flight spoilers on one wing were fully raised. They also observed the illumination of a MLG red indicator light. They lowered the landing gear and noted that the roll problem diminished. Only a small amount of aileron was required to maintain straight and level flight. The flight was terminated and a normal landing was performed. Ground inspection of the MLG found fractured MLG actuator beam components along with damaged spoiler and aileron cables. Several hydraulic tubes were also crushed.

Corrective action for the MLG actuator beam fracture and MLG actuator beam arm fracture is being developed and will be provided to operators as soon as it is complete.

Operating Instructions

If, during or immediately after landing gear retraction, an uncommanded roll and/or control wheel jam or large increase in control wheel forces is experienced, extend the landing gear. Plan to land at the nearest suitable airport.

Administrative Information

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

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

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

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Flight Crew Operations Manual Bulletin
for
The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

737

Number: TBC-26 R1

IssueDate: June 1, 2009

Subject: Cabin Altitude Warning Indications and Procedures Briefing

Reason: This revision is to inform flight crews that the FAA has agreed to an Alternative Method of Compliance (AMOC) to the takeoff briefing mandated by AD 2008-23-07. The requirement to don oxygen masks only applies when the intermittent warning horn sounds and the airplane flight altitude is above 10,000 feet MSL.

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

The B737 cabin altitude warning system consists of an intermittent warning horn that sounds when cabin altitude exceeds 10,000 feet. Both the cabin altitude warning and takeoff configuration warning use the same intermittent horn.

Following a fatal accident in August 2005, the FAA initiated planned Airworthiness Directive (AD) action to provide additional cabin altitude warning information for B737 flight crews.

To support this planned AD, Boeing has designed a change to the warning system to provide separate “CABIN ALTITUDE” and “TAKEOFF CONFIG” warning lights to accompany the existing dual-purpose intermittent warning horn. This design change is now available on production airplanes. Service bulletin information to support the planned AD will become available in mid-2009.

To help mitigate any possible confusion associated with the B737 cabin altitude warning system, the FAA issued AD 2006-13-13 which required changes to the AFM procedures in Section 2 for responding to the intermittent cabin altitude/configuration warning horn. These AFM changes and associated Flight Crew Operations Manual (FCOM) Quick Reference Handbook (QRH) non-normal checklist changes were intended to make it easier for flight crews to determine whether the intermittent horn was sounding for cabin altitude or for takeoff configuration.

The FAA believed, however, that additional interim action was necessary until such time as the new warning lights could be fully implemented in the B737 fleet.

In mid-2008, the FAA determined that the most practical interim solution was to issue AD 2008-23-07. This AD requires flight crews to brief cabin altitude warning indications and procedures as part of the takeoff briefing before engine start on the first flight of the day or following a flight crew member change. This briefing is required in any B737 in which the CABIN ALTITUDE and TAKEOFF CONFIG lights are not installed, or are installed but not activated.

Following further discussions, the FAA has agreed that a need exists for crews to recognize the difference between an intermittent warning horn sounding in flight below 10,000 feet MSL, as opposed to sounding at or above 10,000 feet MSL. In flight below 10,000 feet MSL, the intermittent warning horn is associated with an inflight failure of the Air-Ground Sensor switch. At or above 10,000 feet MSL, sounding of the intermittent warning horn requires the crew to immediately don oxygen masks and set regulators to 100%.

The FAA has therefore approved an Alternative Method of Compliance (AMOC) to the Emergency Procedures mandated by AD 2006-13-13 and to the Takeoff Briefing mandated by AD 2008-23-07. The AMOC was approved by FAA Approval Letter 130S-09-134a dated April 28, 2009.

<u>AD 2006-13-13</u>

The current WARNING HORN – CABIN ALTITUDE OR CONFIGURATION Emergency Procedure in the AFM will be revised as follows:

1. The title will be changed to WARNING HORN OR WARNING LIGHT – CABIN ALTITUDE OR TAKEOFF CONFIGURATION.
2. The condition statement and the procedure will include reference to the CABIN ALTITUDE and TAKEOFF CONFIG lights.
3. The requirement to don oxygen masks, establish crew communications and do the CABIN ALTITUDE or Rapid Depressurization checklist will only apply if the intermittent warning horn sounds or a CABIN ALTITUDE light illuminates in flight at an airplane flight altitude above 10,000 feet MSL.
4. Reference to the steady horn in the condition statement will be deleted. The corresponding step in the procedure will be deleted.

A new AFM Emergency Procedure, LANDING CONFIGURATION, will be created to direct crews to assure correct landing configuration if the steady horn sounds in flight.

The current WARNING HORN – CABIN ALTITUDE OR CONFIGURATION QRH non-normal checklist will be revised in a future revision of the FCOM QRH to include the changes defined in the AMOC. In addition, a new checklist, titled LANDING CONFIGURATION will be added. The QRH checklists may not be an exact replica of the AFM procedures, but will be written for consistency with the Boeing format.

AD 2008-23-07

The Cabin Altitude Warning Takeoff Briefing in Section 3 of the AFM will be revised to clarify that immediate donning of oxygen masks and accomplishment of the subsequent memory item steps from the WARNING HORN OR WARNING LIGHT – CABIN ALTITUDE OR TAKEOFF CONFIGURATION non-normal checklist are only required if the intermittent warning horn sounds in flight at an aircraft flight altitude above 10,000 feet MSL.

The Takeoff briefing in the Before Start Procedure in the Normal Procedures section of the FCOM will be updated in a future revision to reflect this change.

Operating Instructions

To further reduce the risk of flight crew incapacitation due to hypoxia following loss of cabin pressurization, cabin altitude warning indications and memory item procedures must be briefed on airplanes in which the CABIN ALTITUDE and TAKEOFF CONFIG lights are not installed, or are installed but not activated. This briefing will be included as an additional item on the Takeoff briefing before engine start for the first flight of the day or following any change of either flight crew member.

The briefing must include the following:

- Whenever the intermittent warning horn sounds in flight at an airplane flight altitude above 10,000 feet MSL:

1. Immediately, don oxygen masks and set regulators to 100%.
2. Establish crew communications.
3. Do the CABIN ALTITUDE WARNING or Rapid Depressurization non-normal checklist.

- Both pilots must verify on the overhead Cabin Altitude Panel that the cabin altitude is stabilized at or below 10,000 feet before removing oxygen masks.

Operators may want to seek an Alternative Method of Compliance (AMOC) to develop a new crew briefing or to utilize current approved briefings to meet the compliance of this AD.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-26 R1 "In Effect" (IE).

This FCOM bulletin will remain in effect until Boeing is informed that all affected airplanes in your fleet have the CABIN ALTITUDE and TAKEOFF CONFIG lights installed and activated.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

BOEING

Flight Crew Operations Manual Bulletin for The Boeing Company

The Boeing Company
Seattle, Washington 98124-2207

737

Number: TBC-27

IssueDate: June 2, 2009

Subject: Inflight Elevator Tab Vibration

Reason: This bulletin informs 737-100/-200/-300/-400/-500 flight crews of the potential for elevator tab vibration that may lead to significant structural damage.

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

THE FOLLOWING PROCEDURE AND/OR INFORMATION IS EFFECTIVE UPON RECEIPT

Background Information

Boeing has received multiple reports of in-service vibration on 737-100/200/300/400/500 airplanes caused by worn or failed elevator tab assemblies. In one event, the flight crew experienced the partial loss of a right hand elevator and tab. The loss was discovered following several flight sectors in which aft cabin vibration was noted by the flight crew.

Flight crews should be aware that there are many causes of airframe vibration, including free-play in movable surfaces, system or engine malfunctions, and environmental factors. These most recent reports of in-flight vibration have been identified as resulting from worn or improperly installed hardware in the elevator tab system. In some cases, airframe vibration was reported on multiple flights over an extended period of time before identification and corrective actions were accomplished.

Elevator tab vibration can occur during any phase of flight and is characterized as a clearly noticeable moderate to severe vertical motion in the flight deck and aft cabin. This vibration is characterized as a low frequency vertical vibration in which motion of items attached to airplane structure, such as sun visors, may be noticeable. In some cases, pilots have reported feeling vibration in the controlcolumn and rudder pedals as this vertical motion is transmitted through the structure and cables to the controls. If the cause of the vibration is suspected to be due to empennage control surfaces, the discrepancy should be corrected prior to further revenue flight.

Boeing recommends that operators aggressively investigate, identify, and correct the cause of the vibration prior to returning the airplane to revenue service. If exposed to recurrent or chronic vibration, control surfaces can experience significant structural damage.

Additional maintenance guidance is provided in the latest version of Boeing Service Bulletin 737-55A1070.

Operating Instructions

If vibration is suspected due to the elevator tab, reduce airspeed smoothly until the vibration stops, using the thrust levers and pitch attitude. Do not use speed brakes or change airplane configuration to reduce airspeed. Do not reduce airspeed below the minimum speed for the existing flap setting and gross weight. Consider landing at the nearest suitable airport.

Stay at or below the reduced airspeed at which the vibration stopped for the rest of the flight. Limit bank angle to 15° until below 20,000 feet.

Do not deploy the speedbrakes for the remainder of the flight.

Flaps and landing gear can be extended normally during the approach and landing. The speedbrake can be armed for landing.

The vibration occurrence should be reported to maintenance for resolution before further flight. The logbook entry should emphasize that the vibration is suspected to be in the area of the elevator tab and tab control system.

Administrative Information

Insert this bulletin behind the Operations Manual Bulletin Record page in Volume 1 of your Operations Manual. Amend the Operations Manual Bulletin Record to show bulletin TBC-27 "In Effect" (IE).

This FCOM bulletin will be revised to include Service Bulletin information when available.

Please send all correspondence regarding Flight Crew Operations Manual Bulletin status, to the 737 Manager, Flight Technical Data, through the Service Requests Application (SR App) on the MyBoeingFleet home page.

Limitations — Chapter L
Table of Contents — Section TOC

Limitations — Chapter L

Limitations and Operational Information — Section 10

General

This chapter contains:

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

Limitations and operational information are included if they are:

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

Limitations and operational information are not included if they are:

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

Limitations and operational information listed in this chapter that must be memorized (memory items) are marked with a (#) symbol. They meet the following criterion - flight crew access by reference can not assure timely compliance, e. g., Maximum Takeoff and Landing Tailwind Component. They need only be memorized to the extent that compliance is assured. Knowing the exact wording of the limitation is not required.

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

Airplane General, Emergency Equipment, Doors, Windows

AFM Limitations

Runway slope	+/– 2%
# Maximum Takeoff and Landing Tailwind Component	15 knots
Maximum speeds	Observe Vmo pointer and gear/ flap placards
Mach trim inoperative	Max speed .74M
Maximum Operating Altitude	37,000 feet pressure altitude
Maximum Takeoff and Landing Altitude	8,300 feet pressure altitude

Verify that an operational check of the flight deck door access system (as installed) has been accomplished according to approved procedures once each flight day.

On revenue flights, the escape slide retention bar (girt bar) must be installed during taxi, takeoff and landing.

AFM Operational Information

Severe turbulent air penetration speed is 280 KIAS/.70M, whichever is lower.

Non-AFM Operational Information

Do not operate HF radios during refueling operations.

Altitude Display Limits for RVSM Operations

Note: The following items apply to airplanes equipped for RVSM operations.

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

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

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

Field Elevation	Max Difference Between Captain & F/O	Max Difference Between Captain or F/O & Field Elevation
Sea Level	40 feet	75 feet
5,000 feet	45 feet	75 feet
10,000 feet	50 feet	75 feet

Weight Limitations

Note: The maximum weight limitations can be further limited as referenced in the WEIGHT LIMITATIONS section of the CERTIFICATE LIMITATIONS chapter of the AFM.

AFM Limitations

737–200 Airplanes

Maximum Taxi Weight	117,500 lbs
Maximum Takeoff Weight	117,000 lbs (1)
Maximum Inflight Weight	
Flaps 0	116,500 lbs
Flaps 30/40	106,000 lbs
Maximum Landing Weight	105,000 lbs (2)
Maximum Zero Fuel Weight	95,000 lbs

All Airplanes

C. G. Limits	Use approved weight and balance system

(1) May be further restricted by takeoff, enroute, and landing performance.

(2) May be further restricted by field length or climb limit.

Air Systems

AFM Limitations

The maximum cabin differential pressure (relief valves) is 8.65 psi.

Anti–Ice, Rain

AFM Limitations

Engine TAI must be on when icing conditions exist or are anticipated, except during climb and cruise below –40°C SAT.

Minimum N1 RPM for operating in icing conditions except for landing: 40% when TAT between 0° and 10°C; 55% when TAT below 0°C; 70% in moderate to severe icing conditions when TAT below –6.5°C, except as required for landing.

Window heat inop: max speed 250 KIAS below 10,000 ft.

Gravel Protect switch: ANTI–ICE position when using engine inlet anti–ice.

Non-AFM Operational Information

Pitot heat must be on for takeoff.

Autopilot

AFM Limitations

Do not use the autopilot for takeoff or landing.

Do not use autopilot roll channel above 30,000 feet with yaw damper inoperative.

Do not use ALT HOLD mode when Captain's alternate static source is selected.

Non-AFM Operational Information

Do not use autopilot pitch channel above .81M with hydraulic system A or B depressurized.

Electrical Power

AFM Limitations

Maximum engine driven generator load: 111 amps.

Non-AFM Operational Information

Maximum generator drive oil temperature: 157° C.

Performance Data Computer System (PDCS)

AFM Limitations

Do not use the PDCS information unless the engine configuration displayed on the PDCS is the same as the engine configuration of the airplane.

Fuel management and range calculation values presented by the PDCS have not been evaluated by the FAA.

Verify that the representative takeoff EPR limits displayed on the CDU and EPR indicators agree with the limits in the Airplane Flight Manual.

Engines

AFM Limitations

Engine Limit Display Markings

Maximum and minimum limits are red.

Caution limits are amber.

General Engine Limitations

JT8D–9

Maximum N1 RPM	100.1%
Maximum N2 RPM	100%
# Maximum Acceleration EGT (2 minutes)	580° C
Maximum Takeoff EGT (5 minutes)	580° C
# Maximum Continuous EGT	540° C
# Maximum Start EGT	
Ambient Temperature above 15°C (momentary)	420° C
Ambient Temperature below 15°C	350° C
Maximum Oil Temperature (continuous)	120° C
(15 minutes)	121° C – 157° C

JT8D–9A

Maximum N1 RPM	100.1%
Maximum N2 RPM	100%
# Maximum Acceleration EGT (2 minutes)	590° C
Maximum Takeoff EGT (5 minutes)	590° C
# Maximum Continuous EGT	545° C
# Maximum Start EGT	
Ambient Temperature above 15°C (momentary)	420° C
Ambient Temperature below 15°C	350° C
Maximum Oil Temperature (continuous)	120° C
(15 minutes)	121° C – 157° C

JT8D–15

Maximum N1 RPM	102.4%
Maximum N2 RPM	100%
# Maximum Acceleration EGT (2 minutes)	630° C
Maximum Takeoff EGT (5 minutes)	620° C
# Maximum Continuous EGT	580° C
# Maximum Start EGT	
Ground (momentary)	550° C
Flight	620° C
Maximum Oil Temperature (continuous)	130° C
(15 minutes)	131° C – 165° C

JT8D–15A

Maximum N1 RPM	102.4%
Maximum N2 RPM	100%
# Maximum Acceleration EGT (2 minutes)	630° C
Maximum Takeoff EGT (5 minutes)	620° C
# Maximum Continuous EGT	580° C
# Maximum Start EGT Ground (momentary) Flight	 575° C 620° C
Maximum Oil Temperature (continuous) (15 minutes)	130° C 131° C – 165° C

JT8D–17

Maximum N1 RPM	102.4%
Maximum N2 RPM	100%
# Maximum Acceleration EGT (2 minutes)	660° C
Maximum Takeoff EGT (5 minutes)	650° C
# Maximum Continuous EGT	610° C
# Maximum Start EGT Ground (momentary) Flight	 550° C 650° C
Maximum Oil Temperature (continuous) (15 minutes)	130° C 131° C – 165° C

JT8D–17A

Maximum N1 RPM	102.4%
Maximum N2 RPM	100%
# Maximum Acceleration EGT (2 minutes)	660° C
Maximum Takeoff EGT (5 minutes)	650° C
# Maximum Continuous EGT	610° C
# Maximum Start EGT	
Ground (momentary)	575° C
Flight	650° C
Maximum Oil Temperature (continuous)	130° C
(15 minutes)	131° C – 165° C

Oil Pressure

Maximum Oil Pressure	55 psi
Minimum Oil Pressure	40 psi

Engine Ignition

Engine ignition must be on during takeoff and landing.

Reverse Thrust

Intentional selection of reverse thrust in flight is prohibited.

Gravel Takeoff

Vortex dissipaters must be on for gravel operation

Maximum taxi EPR on gravel: 1.4

When using reverse thrust on gravel, use approximately idle reverse, not to exceed 1.8 EPR. Stow reversers by approximately 60 knots.

Non-AFM Operational Information

Pneumatic pressure (prior to starter engagement): minimum 30 psig at sea level, decreasing 1/2 psig per 1,000 ft. above sea level.

Ignition Duty Cycle –

- LOW IGN –
  - continuous
  - FLT –
  - 2 minutes on, 3 minutes off
  - 2 minutes on, 23 minutes off

APU

AFM Limitations

Maximum start EGT is 760° C.

Maximum continuous EGT is 710° C.

With APU bleed + electrical load, maximum altitude is 10,000 ft.

With APU bleed, maximum altitude is 17,000 ft.

With APU electrical load, maximum altitude is 35,000 ft.

APU can operate up to 37,000 ft.

APU bleed valve must be closed when:

- ground air connected and isolation valve open
- engine no. 1 bleed valve open
- isolation valve and engine no. 2 bleed valve open.

APU bleed valve may be open during engine start, but avoid engine power above idle.

Non-AFM Operational Information

If there are multiple aborted start attempts, five minutes cooling is required between the second and third start attempt. A wait of one hour is required after the third start attempt.

Flight Controls

AFM Limitations

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

In flight, do not extend the SPEED BRAKE lever beyond the FLIGHT DETENT.

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

Non-AFM Operational Information

Do not deploy the speedbrakes in flight at radio altitudes less than 1000 feet.

Alternate flap duty cycle:

- When extending or retracting flaps with the ALTERNATE FLAPS position switch, allow 15 seconds after releasing the ALTERNATE FLAPS position switch before moving the switch again to avoid damage to the alternate flap motor clutch.
- After a completed extend/retract cycle, i.e., 0 to 15 and back to 0, allow 5 minutes cooling before attempting another extension.

Flight Management, Navigation

Non-AFM Operational Information

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

Avoid weather radar operation within 160 feet (48.8 meters) of personnel.

Warm up weather radar in STBY position only.

Fuel

AFM Limitations

Do not reset a tripped fuel pump circuit breaker.

Maximum fuel temperature is 49° C.

Minimum fuel temperature is fuel freeze point +3° C or – 45° C, whichever is higher.

For those airplanes with the center tank fuel pump auto shutoff system installed, intentional dry running of a center tank fuel pump (low pressure light illuminated) is prohibited.

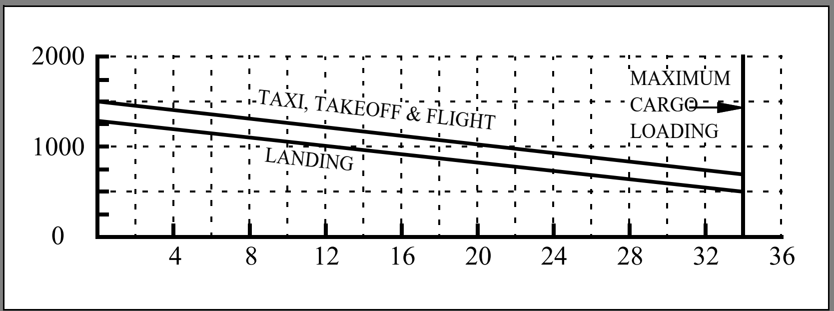
Fuel Balance

Symmetrical Load – All Passenger or All Cargo with 125” Pallets

Lateral imbalance between main tanks 1 and 2 must not exceed 1,500 lbs for taxi, takeoff, flight and 1,300 lbs for landing.

Unsymmetrical Load – Mixed Passenger and Cargo, or All Cargo with 108” Pallets

The maximum allowable fuel imbalance is as shown on the chart below.



Cargo Loading – 1000 LBS

Fuel loading

On the ground, main tanks 1 and 2 must be full if center tank contains more than 1000 lbs.

Landing Gear

AFM Limitations

Do not apply brakes until after touchdown.

Non-AFM Operational Information

For airplanes without nose wheel lockout pin –

Depressurize hydraulic system A for towing.

Autobrake: RTO or OFF for takeoff.

Intentionally
Blank

Normal Procedures — Chapter NP
Table of Contents — Section TOC

Normal Procedures — Chapter NP
Introduction — Section 11

General

This chapter gives:

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

Normal Procedures Philosophy and Assumptions

Normal procedures verify for each phase of flight that:

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

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

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

- all systems operate normally
- the full use of all automated features. This does not preclude the possibility of manual flight for pilot proficiency where allowed.

Normal procedures also assume coordination with the ground crew before:

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

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

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

Configuration Check

It is the crew member's responsibility to verify correct system response. Before engine start, use system lights to verify each system's condition or configuration. After engine start, the master caution system alerts the crew to warnings or cautions away from the normal field of view.

If there is an incorrect configuration or response:

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

Before engine start, use individual system lights to verify the system status. If an individual system light indicates an improper condition:

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

If, during or after engine start, a red warning or amber caution light illuminates:

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

If, during recall, an amber caution illuminates and then extinguishes after a master caution reset:

- check the DDG or the operator equivalent
- the respective non-normal checklist is not needed

Crew Duties

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

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

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

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

The general PF phase of flight responsibilities are:

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

The general PM phase of flight responsibilities are:

- checklist reading
- communications

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

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

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

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

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

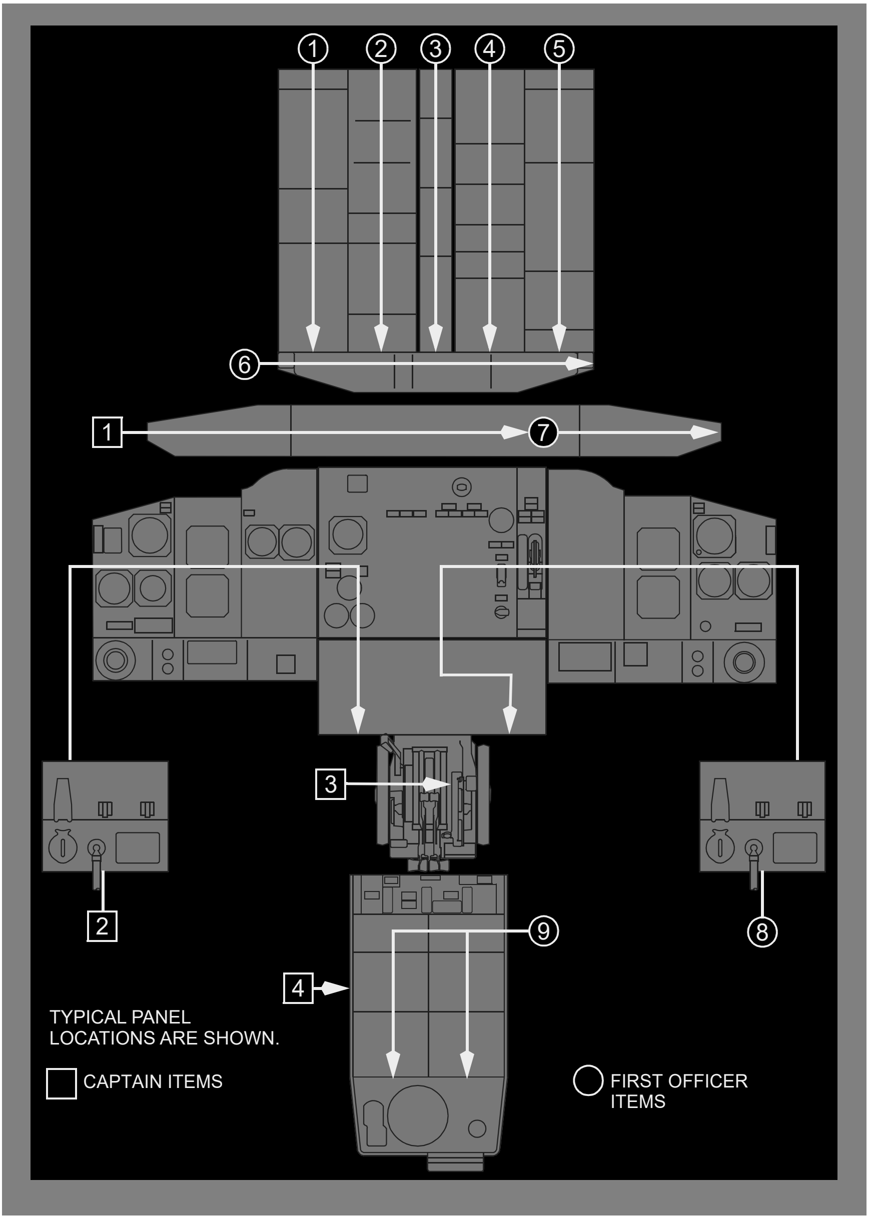
The captain is the final authority for all tasks directed and done.

Scan Flow and Areas of Responsibility

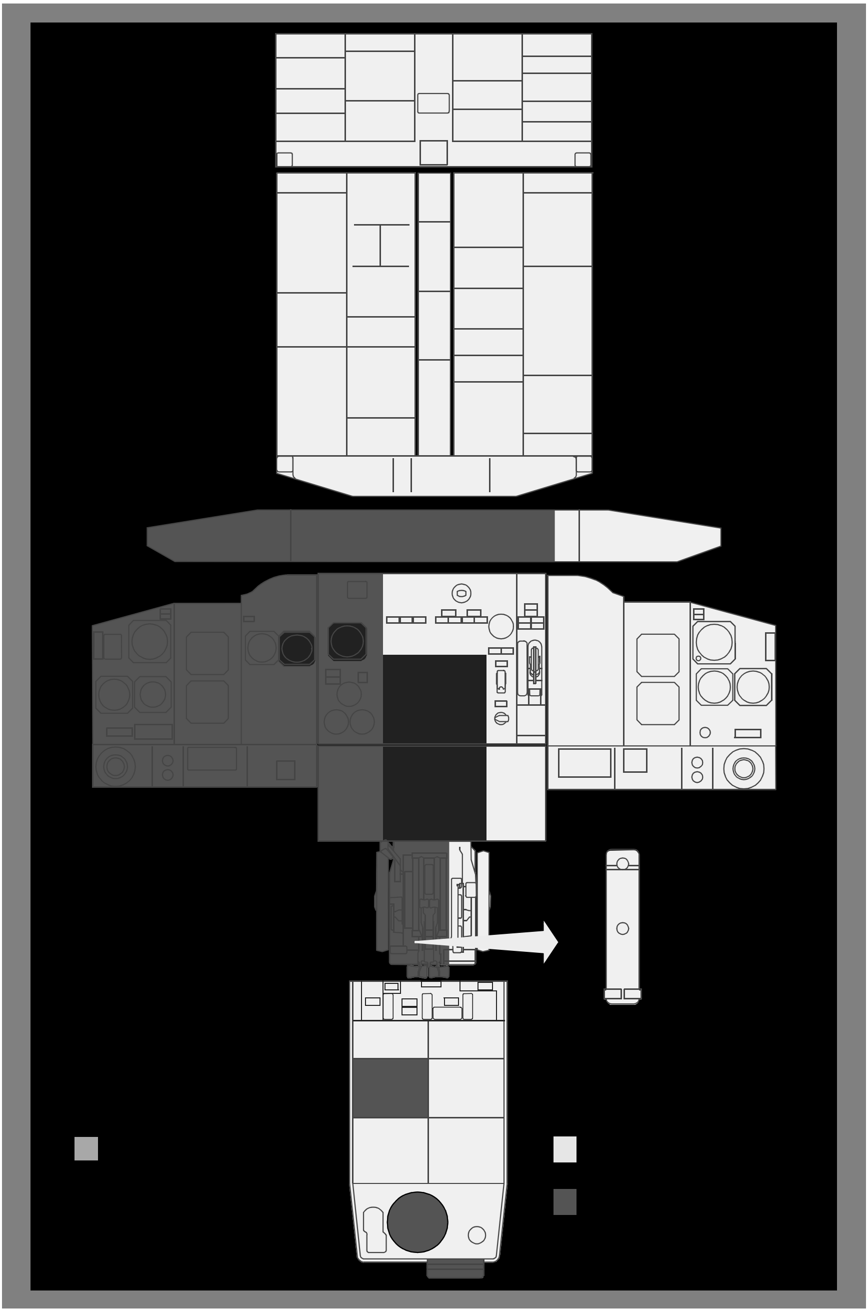
The scan flow and areas of responsibility diagrams shown below are representative and may not match the configuration of your airplane.

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

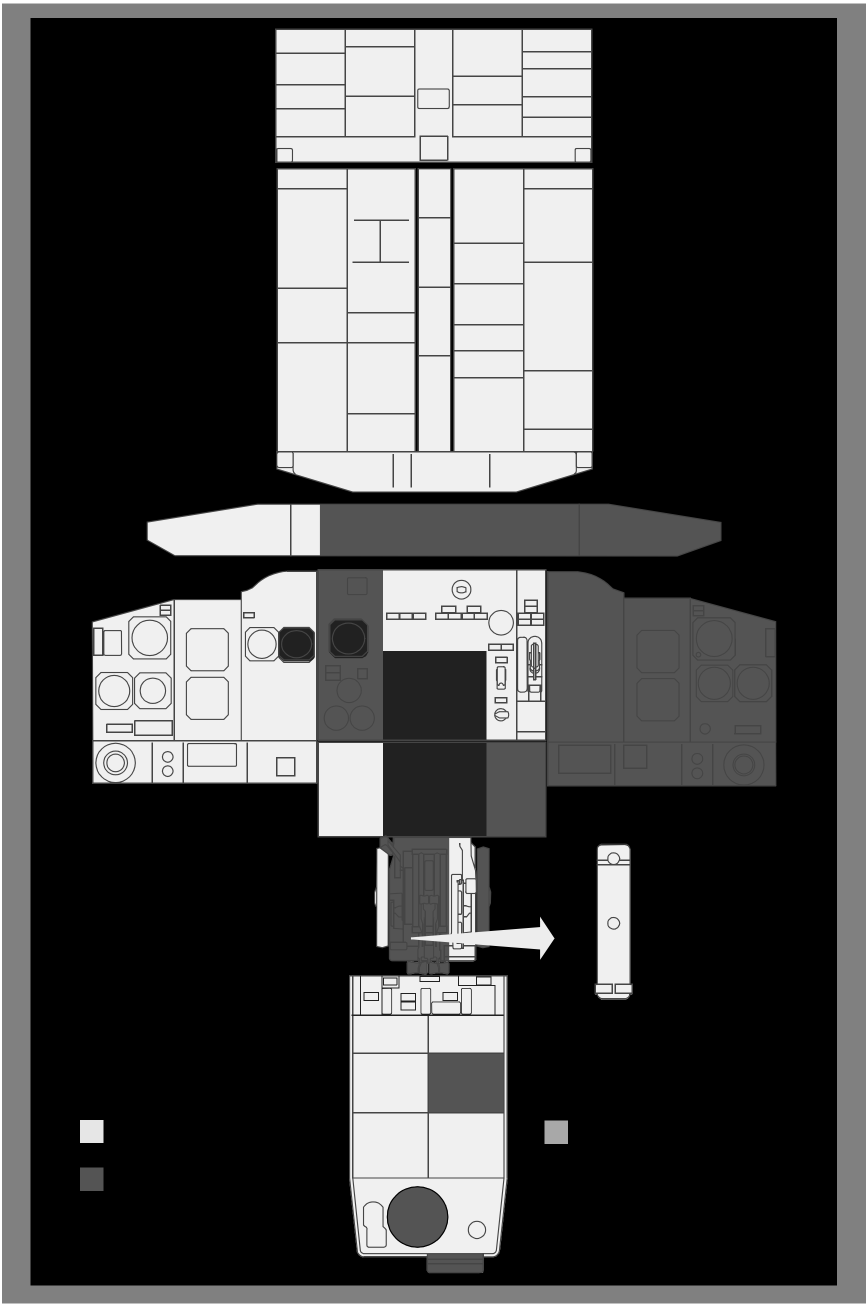
Preflight and Postflight Scan Flow



Areas of Responsibility - Captain as Pilot Flying or Taxiing



Areas of Responsibility - First Officer as Pilot Flying or Taxiing



Preliminary Preflight Procedure – Captain or First Officer

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

Passenger oxygen shutoff valve (cargo airplanes) .... Set

All cargo configuration ....CLOSED

Passenger configuration ....OPEN

Verify that the following are sufficient for flight:

- oxygen pressure
- hydraulic quantity
- engine oil quantity

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

Maintenance documents .... Check

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

FLIGHT DECK ACCESS SYSTEM switch .... Guard closed

Emergency equipment .... Check

Fire extinguisher ....Checked and stowed

Crash axe ....Stowed

Escape ropes ....Stowed

Other needed equipment ....Checked and stowed

THRUST REVERSER OVERRIDE switches ....Guards closed

SERVICE INTERPHONE switch .... OFF

OXYGEN panel .... Set

Note: PASSENGER OXYGEN switch activation causes deployment of the passenger oxygen masks.

PASSENGER OXYGEN switch ....Guard closed

Verify that the PASS OXY ON light is extinguished.

PASSENGER OXYGEN pressure indicator .... Check

Verify that the pressure meets dispatch requirements.

Alternate gear safe lights (as installed) .... Verify illuminated

FLIGHT RECORDER .... Set

FLIGHT RECORDER switch .... Guard closed.

Verify that the OFF light is illuminated.

Trip and Date Encoder .... Set

Electronic master switches .... ON

MACH AIRSPEED WARNING
TEST switches .... Push, one at a time

Verify that the clacker sounds.

STALL WARNING switch .... Hold in TEST

Verify that the OFF light extinguishes.

Verify that the TEST indicator spins.

Verify that both control columns vibrate.

Circuit breakers (P6 panel) .... Check

Crew oxygen valve .... Open

Manual gear extension access door .... Closed

Passenger oxygen manual actuation and reset access door Closed

Rain repellent .... Check

Verify that the float is above the line.

Verify that the shutoff valve handle is in the vertical position.

Circuit breakers (P18 panel) .... Check

Parking brake .... As needed

Set the parking brake if the brake wear indicators are to be checked during the exterior inspection.

Exterior Inspection

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

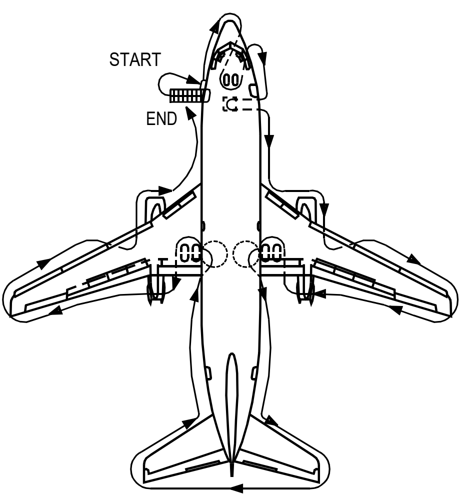
Items at each location may be checked in any sequence.

Use the detailed inspection route below to check that:

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

For cold weather operations see the Supplementary Procedures.

Inspection Route



Left Forward Fuselage

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

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

Main deck cargo door (as installed) .... Check

Verify that the external locking handle is flush.

Verify that the latch hooks are engaged.

Nose

Radome .... Check

Conductor straps .... Secure

Forward E and E door .... Secure

Nose Wheel Well

Tires and wheels .... Check

Gravel deflector (as installed) .... Check

Exterior light .... Check

Gear strut and doors .... Check

View port .... Clear and clean

Nose wheel steering assembly .... Check

Nose gear steering lockout pin .... As needed

Gear pin .... As needed

Nose wheel spin brake (snubbers).. In place

Right Forward Fuselage

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

Oxygen pressure relief green disc .... In place

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

Right Wing Root, Pack, and Lower Fuselage

Ram air deflector door .... Extended

Pack and pneumatic access doors .... Secure

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

Exterior lights .... Check

Leading edge flaps .... Check

Number 2 Engine

Exterior surfaces
(including the bottom of the nacelles) .... Check for damage

Access panels and fan cowl latches .... Latched

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

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

Thrust reversers .... Stowed

Exhaust area and tailcone .... Check

Right Wing and Leading Edge

Access panels .... Latched

Leading edge slats .... Check

Fuel drip sticks .... Flush and secure

Wing Surfaces .... Check

Fuel tank vent .... Check

Right Wing Tip and Trailing Edge

Position lights .... Check

Static discharge wicks .... Check

Aileron and trailing edge flaps .... Check

Exterior lights .... Check

Right Main Gear

Tires, brakes and wheels .... Check

Verify that the wheel chocks are in place as needed.

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

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

Hydraulic lines .... Secure

Gear pin .... As needed

Right Main Wheel Well

View port .... Clear and clean

APU FIRE CONTROL handle .... Up

Wheel well .... Check

Right Aft Fuselage

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

Negative pressure relief door .... Closed

Outflow valve .... Check

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

APU air inlet .... Check

APU fire bottle .... Check

Verify that the red and yellow discs show.

Tail

Vertical stabilizer and rudder .... Check

Elevator feel probes .... Check

Horizontal stabilizer and elevator .... Check

Static discharge wicks .... Check

APU exhaust outlet .... Check

Verify that there is no indication of scorch marks on the outlet.

Left Aft Fuselage

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

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

Left Main Wheel Well

View port .... Clear and clean

Wheel well .... Check

Engine fire bottle pressure .... Check

Left Main Gear

Tires, brakes and wheels .... Check

Verify that the wheel chocks are in place as needed.

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

Gear strut, actuators and doors .... Check

Hydraulic lines .... Secure

Gear pin .... As needed

Left Wing Tip and Trailing Edge

Aileron and trailing edge flaps .... Check

Static discharge wicks .... Check

Position lights .... Check

Exterior lights .... Check

Left Wing and Leading Edge

Fuel tank vent .... Check

Wing Surfaces .... Check

Fuel drip sticks .... Flush and secure

Leading edge slats .... Check

Access panels .... Latched

Number 1 Engine

Exhaust area and tailcone .... Check

Thrust reversers .... Stowed

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

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

Access panels and fan cowl latches .... Latched

Exterior surfaces
(including the bottom of the nacelles) .... Check for damage

Left Wing Root, Pack, and Lower Fuselage

Leading edge flaps .... Check

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

Exterior lights .... Check

Pack and pneumatic access doors .... Secure

Ram air deflector door .... Extended

Preflight Procedure – First Officer

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

Flight control panel .... Check

FLIGHT CONTROL switches .... Guards closed

Verify that the flight control LOW PRESSURE lights are illuminated.

Flight SPOILER switches .... Guards closed

YAW DAMPER switch .... ON

Verify that the YAW DAMPER light is extinguished.

Verify that the standby hydraulic LOW QUANTITY light is extinguished.

Verify that the standby hydraulic LOW PRESSURE light is extinguished.

Verify that the STBY RUD ON light (as installed) is extinguished.

ALTERNATE FLAPS master switch .... Guard closed

ALTERNATE FLAPS position switch .... OFF

Verify that the FEEL DIFF PRESS light is extinguished.

Verify that the MACH TRIM FAIL light is extinguished.

Instrument and NAV transfer switches .... NORMAL

Fuel panel ....Set

Verify that the FUEL VALVE CLOSED lights are illuminated dim.

Verify that the FILTER ICING lights are extinguished.

Fuel HEAT switches .... OFF

Verify that the VALVE OPEN lights are extinguished.

CROSSFEED selector ....CLOSED

Verify that the VALVE OPEN light is extinguished.

FUEL PUMP switches.. OFF

Verify that the center tank fuel pump LOW PRESSURE lights are extinguished.

Verify that the auxiliary tank fuel pump LOW PRESSURE lights (as installed) are extinguished.

Verify that the main tank fuel pump LOW PRESSURE lights are illuminated.

Electrical panel ....Set

BATTERY switch .... Guard closed

GALLEY power switch..ON

STANDBY POWER switch .... Guard closed

Verify that the STANDBY PWR OFF light is extinguished.

Generator drive DISCONNECT switches ....Guards closed

Verify that the LOW OIL PRESSURE lights are illuminated.

Verify that the HIGH OIL TEMP lights are extinguished.

DRIVE TEMPERATURE switch ....As needed

BUS TRANSFER switch .... Guard closed

Verify that the TRANSFER BUS OFF lights are extinguished.

Verify that the BUS OFF lights are extinguished.

Verify that the GEN OFF BUS lights are illuminated.

Overheat and fire protection panel
(Passenger airplanes) .... Check

Do this check if the flight crew did not do the Electrical Power Up supplementary procedure. This check is needed once each flight day.

Verify that the engine No. 1, APU, and engine No. 2 fire switches are in.

Alert ground personnel before the following test is accomplished:

OVERHEAT DETECTOR switches ....NORMAL

Note: The fire warning light flashes and the horn sounds on the APU ground control panel when this test is done with the APU running. This can be mistaken by the ground crew as an APU fire.

TEST switch .... Hold to OVHT/INOP

Verify that the MASTER CAUTION lights are illuminated.

Verify that the OVHT/DET annunciator is illuminated.

Verify that the ENG 1 OVERHEAT and ENG 2 OVERHEAT lights are illuminated.

Verify that the APU DET INOP light is illuminated.

Do not run the APU if the APU DET INOP light does not illuminate.

TEST switch .... Hold to FIRE

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Verify that the engine No. 1, APU, and engine No. 2 fire switches are illuminated.

Verify that the WHEEL WELL fire warning light is illuminated.

Master FIRE WARNING light .... Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the engine No. 1, APU, and engine No. 2 fire switches stay illuminated.

Verify that the WHEEL WELL fire warning light stays illuminated.

Overheat and fire protection panel
(Cargo airplanes) ....Check

Do this check if the flight crew did not do the Electrical Power Up supplementary procedure. This check is needed once each flight day.

Verify that the engine No. 1, APU, and engine No. 2 fire switches are in.

Alert ground personnel before the following test is accomplished:

OVERHEAT DETECTOR switches .... NORMAL

TEST switch .... Hold to OVHT/INOP/A SMOKE

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Verify that the MASTER CAUTION lights are illuminated.

Verify that the OVHT/DET annunciator is illuminated.

Verify that the ENG 1 OVERHEAT and ENG 2 OVERHEAT lights are illuminated.

Verify that the FWD and AFT CARGO SMOKE lights are illuminated.

Verify that the APU DET INOP light is illuminated.

Do not run the APU if the APU DET INOP light does not illuminate.

Note: The fire warning light flashes and the horn sounds on the APU ground control panel when this test is done with the APU running. This can be mistaken by the ground crew as an APU fire.

Master FIRE WARN light .... Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the MASTER CAUTION lights stay illuminated.

Verify that the OVHT/DET annunciator stays illuminated.

Verify that the ENG 1 OVERHEAT and ENG 2 OVERHEAT lights stay illuminated.

Verify that the FWD and AFT CARGO SMOKE lights stay illuminated.

Verify that the APU DET INOP light stays illuminated.

TEST switch .... Hold to FIRE/B SMOKE

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Verify that the engine No. 1, APU, and engine No. 2 fire switches are illuminated.

Verify that the WHEEL WELL fire warning light is illuminated.

Verify that the FWD and AFT CARGO SMOKE lights are illuminated.

Master FIRE WARNING light .... Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the engine No. 1, APU, and engine No. 2 fire switches stay illuminated.

Verify that the WHEEL WELL fire warning light stays illuminated.

Verify that the FWD and AFT CARGO SMOKE lights stay illuminated.

EXTINGUISHER TEST switch .... Check

TEST Switch .... Push and hold

Verify that the three green extinguisher test lights are illuminated.

TEST Switch .... Release

Verify that the three green extinguisher test lights are extinguished.

APU switch (as needed) .... START

Note: If extended APU operation is needed on the ground and the airplane buses are powered by AC electrical power, position an AC powered fuel pump ON. This extends the service life of the APU fuel control unit.

Note: If fuel is loaded in the center tank, position the left center tank fuel pump switch ON to prevent a fuel imbalance before takeoff.

CAUTION: Position the center tank fuel pump switches ON only if the fuel quantity in the center tank exceeds 1000 lbs.

CAUTION: Do not operate the center tank fuel pumps with the flight deck unattended.

When the APU GEN OFF BUS light is illuminated:

APU GENERATOR bus switches .... ON

Verify that the BUS OFF lights are extinguished.

Verify that the TRANSFER BUS OFF lights are extinguished.

Verify that the LOW OIL QUANTITY light is extinguished.

Verify that the APU LOW OIL PRESSURE light is extinguished.

Verify that the APU HIGH OIL TEMP light is extinguished.

Verify that the APU OVERSPEED light is extinguished.

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

EQUIPMENT COOLING switch .... NORMAL

Verify that the OFF light is extinguished.

EMERGENCY EXIT LIGHTS switch ....Guard closed

Verify that the NOT ARMED light is extinguished.

Passenger signs ....Set

NO SMOKING switch .... AUTO or ON

FASTEN BELTS switch .... AUTO or ON

Windshield WIPER selector .... OFF

If the windshield wipers are not stowed, place the selector to PARK then OFF.

WINDOW HEAT switches ....ON

Position the switches ON at least 10 minutes before takeoff.

Verify that the OVERHEAT lights are extinguished.

Verify that the ON lights are illuminated except at high ambient temperatures.

PITOT STATIC HEAT switches
(airplanes with automatic pitot static heat) ....AUTO

PITOT STATIC HEAT switches
(airplanes without automatic pitot static heat) .... OFF

Verify that all PROBE HEATER lights are illuminated.

WING ANTI–ICE switch .... OFF

Verify that the VALVE OPEN lights are extinguished.

ENGINE ANTI–ICE switches .... OFF

Verify that the VALVE OPEN lights are extinguished.

Hydraulic panel .... Set

GROUND INTERCONNECT switch .... CLOSE

ENGINE HYDRAULIC PUMPS switches .... ON

Verify that the LOW PRESSURE lights are illuminated.

ELECTRIC HYDRAULIC PUMPS switches .... OFF

Verify that the OVERHEAT lights are extinguished.

Verify that the LOW PRESSURE lights are illuminated.

Cabin altitude panel .... Set

SMOKE CLEARANCE switch .... Guard closed

Air conditioning panel .... Set

AIR TEMPERATURE source selector .... As needed

Verify that the DUCT OVERHEAT lights are extinguished.

Temperature selectors .... As needed

Verify that the RAM DOOR FULL OPEN lights are illuminated.

GASPER FAN switch .... As needed

Air conditioning PACK switches .... Set

One switch .... ON

Other switch .... OFF

ISOLATION VALVE switch .... AUTO

Engine BLEED air switches .... ON

APU BLEED air switch ....ON

Verify that the DUAL BLEED light is illuminated.

Verify that the PACK TRIP OFF lights are extinguished.

Verify that the WING-BODY OVERHEAT lights are extinguished.

Verify that the BLEED TRIP OFF lights are extinguished.

Cabin pressurization panel..Set

Verify that the AUTO FAIL light is extinguished.

Verify that the OFF SCHED DESCENT light is extinguished.

FLIGHT ALTITUDE indicator ....Cruise altitude

LANDING ALTITUDE indicator ....Destination field elevation

CABIN RATE selector .... Index

CABIN ALTITUDE indicator .....200 feet below destination field elevation

FLIGHT/GROUND switch ....GRD

Pressurization mode selector .... AUTO

Verify that the STANDBY light is extinguished.

Verify that the MANUAL light is extinguished.

Lighting panel..Set

LANDING light switches............................ RETRACT and OFF

RUNWAY TURNOFF light switches.................................... OFF

TAXI light switch .... OFF

ENGINE START switches .... OFF

GRAVEL PROTECT switch (as installed) .... OFF

Lighting panel..Set

POSITION light switch ....As needed

ANTI–COLLISION light switch .... OFF

WING illumination switch ....As needed

WHEEL WELL light switch ....As needed

Flight director panel .... Set

Mode selector ....OFF

ALTITUDE HOLD switch ....OFF

PITCH COMMAND control .... Full clockwise

Oxygen .... Test and set

Check mask, hose and fittings for grease or damage.

Hold the mask away from face.

Supply lever .... ON

Oxygen diluter lever 100%

Emergency lever .... ON

Verify that the flow indicator shows flow.

Supply and Emergency levers ....OFF

Adjust the mask to the face and inhale. Verify that the mask pulls to face.

Oxygen diluter lever ....NORMAL

Inhale and verify unrestricted flow. Verify that the flow indicator shows no flow.

Supply lever .... ON

Oxygen diluter lever 100%

Inhale and verify that the flow indicator shows flow.

Emergency lever .... ON

Verify that there is a slight pressure in the mask.

Emergency lever ....OFF

Stow oxygen mask.

Crew and passenger oxygen pressure ....Check

Verify that the pressure is sufficient for dispatch.

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

STATIC SOURCE SELECTOR switch .... NORMAL

Marker beacon lights .... Test

Clock .... Wind and set

Autopilot disengage light .... Push to test

Verify that the AUTOPILOT disengage light is illuminated.

Flight instruments .... Check

Set the altimeter.

Verify that the flight instrument indications are correct.

Verify that only these flags are shown:

- TCAS (as installed)
- expected RMI flags

Hydraulic system B LOW QUANTITY light .... Verify extinguished

SYSTEM A HYDRAULIC QUANTITY indicator .... Above RF

GROUND PROXIMITY panel .... Check

FLAP/GEAR INHIBIT switch .... Guard closed

Verify that the INOP light is extinguished.

Landing gear panel ....Set

LANDING GEAR lever ....DN

Verify that the green landing gear indicator lights are illuminated.

Verify that the red landing gear indicator lights are extinguished.

TAKEOFF CONFIG light (as installed) .... Verify extinguished

CABIN ALTITUDE light (as installed) .... Verify extinguished

ANTISKID switches .... Guards closed

Verify that the ANTISKID INOP lights are extinguished.

AUTO BRAKE select switch .... OFF

Verify that the AUTO BRAKE DISARM light is extinguished.

EPR reference selectors (on PDCS equipped airplanes) .... Push

Engine instruments .... Check

Verify that the REVERSER UNLOCKED lights are extinguished.

Verify that the START VALVE OPEN lights are extinguished.

Verify that the LOW OIL PRESSURE lights are illuminated.

Verify that the OIL FILTER BYPASS lights are extinguished.

Verify that the primary and secondary engine indications show existing conditions.

ENGINE OIL QUANTITY TEST switch .... Push

Verify that the oil quantity indicators move toward zero and return to the original position when the switch is released.

CARGO FIRE panel (as installed) .... Check

This check is needed once per flight day.

DETECTOR SELECT switches .... NORM

TEST switch .... Push

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Master FIRE WARN light .... Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the FWD and AFT cargo fire warning lights stay illuminated.

Verify that the DETECTOR FAULT light stays extinguished.

Verify that the green EXTINGUISHER test lights stay illuminated.

Verify that the DISCH light stays illuminated.

VHF communications radios .... Set

VHF NAVIGATION radios .... Set for departure

Audio selector panel .... Set

ADF radios .... Set

WARNING: Do not key the HF radio while the airplane is being fueled. Injury to personnel or fire can occur.

HF radios ....Set

WEATHER RADAR panel ....Set

Transponder panel ....Set

STABILIZER BRAKE RELEASE knob ....Verify released

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

Seat ....Adjust

Use the handhold above the forward window for assistance when pulling the seat forward. Do not use the glareshield as damage can occur.

Adjust the seat for optimum eye reference.

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

Rudder pedals ....Adjust

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

CAUTION: Turn the rudder pedal adjust crank no faster than approximately one turn per second to avoid damage. Do not apply force to the pedals during adjustment.

Seat belt and shoulder harness ....Adjust

Do the PREFLIGHT checklist on the captain's command.

Preflight Procedure – Captain

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

Lights ....Test

Master LIGHTS TEST and DIM switch ....TEST

The fire warning lights are not checked during this test. Use individual test switches or push to test features to check lights which do not illuminate during the light test. Use scan flow to verify that all other lights are flashing or illuminated. Verify that all system annunciator panel lights are illuminated.

Master LIGHTS TEST and DIM switch ....As needed

Flight director panel .... Set

Mode selector ....OFF

ALTITUDE HOLD switch..OFF

PITCH COMMAND control .... Full clockwise

Autopilot panel .... Set

Autopilot mode selector ....MAN

Autopilot system select switch .... As needed

Autopilot heading switch ....Centered position

Autopilot AILERON engage switch .... DISENGAGED

Autopilot ELEVATOR engage switch .... DISENGAGED

Autopilot pitch mode selector ....OFF

Oxygen .... Test and set

Check mask, hose and fittings for grease or damage.

Hold the mask away from face.

Supply lever .... ON

Oxygen diluter lever 100%

Emergency lever .... ON

Verify that the flow indicator shows flow.

Supply and Emergency levers ....OFF

Adjust the mask to the face and inhale. Verify that the mask pulls to face.

Oxygen diluter lever ....NORMAL

Inhale and verify unrestricted flow. Verify that the flow indicator shows no flow.

Supply lever .... ON

Oxygen diluter lever 100%

Inhale and verify that the flow indicator shows flow.

Emergency lever ....ON

Verify that there is a slight pressure in the mask.

Emergency lever .... OFF

Stow oxygen mask.

Crew and passenger oxygen pressure .... Check

Verify that the pressure is sufficient for dispatch.

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

STATIC SOURCE SELECTOR switch .... NORMAL

MARKER beacon sensitivity switch .... As needed

Marker beacon lights .... Test

Clock .... Wind and set

Autopilot disengage light .... Push to test

Verify that the AUTOPILOT disengage light is illuminated.

Flight instruments .... Check

Set the altimeter.

Verify that the flight instrument indications are correct.

Verify that only these flags are shown:

- TCAS (as installed)
- expected RMI flags

Standby instruments .... Check

Gyro caging control .... Pull, then release

Pitch trim control ....As needed

Set the altimeter

Verify that the flight instrument indications are correct

Verify that no flags are shown.

STAB OUT OF TRIM light .... Verify extinguished

SPEED BRAKE lever ....DOWN detent

Verify that the SPEED BRAKE ARMED light is extinguished.

Verify that the SPEED BRAKE DO NOT ARM light is extinguished.

Reverse thrust levers .... Down

Forward thrust levers...Closed

FLAP lever ....Set

Set the flap lever to agree with the flap position.

Parking brake ....Set

Verify that the parking brake warning light is illuminated

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

Engine start levers ....CUTOFF

STABILIZER TRIM cutout switches ....NORMAL

VHF communications radios ....Set

VHF NAVIGATION radios... Set for departure

Audio selector panel ....Set

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

Seat .... Adjust

Use the handhold above the forward window for assistance when pulling the seat forward. Do not use the glareshield as damage can occur.

Adjust the seat for optimum eye reference.

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

Rudder pedals .... Adjust

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

CAUTION: Turn the rudder pedal adjust crank no faster than approximately one turn per second to avoid damage. Do not apply force to the pedals during adjustment.

Seat belt and shoulder harness .... Adjust

Call "PREFLIGHT CHECKLIST."

Before Start Procedure

Start the Before Start Procedure after papers are on board.

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

Verify that the CAB DOOR UNLOCKED light (as installed) is extinguished.

Verify that the LOCK FAIL light (as installed) is extinguished.

Do the Performance Data Computer System (as installed) Preflight Supplementary Procedure.

PDCS CDU flight mode selector (as installed) ... As needed C, F/O

Takeoff data ....Complete C, F/O

Verify the takeoff data to include:

- EPR
- N1
- V1, VR, and V2
- flap setting
- zero fuel weight
- temperature
- altimeter setting
- gross weight
- stabilizer trim setting

Fuel quantity indicators ....Check C, F/O

Verify that the fuel on the dispatch papers and fuel quantity indicators agree.

Verify that the fuel is sufficient for flight.

Note: Do not push the QUANTITY TEST switch when the airplane is being refueled. This will cause incorrect indications at the external fueling panel.

Total fuel and VREF indicator .... Set C

Zero fuel weight ....Set

Flap selector .... As needed

Verify VREF on the VREF pointer.

On airplanes without PDCS,
EPR reference selectors... Set C

Verify that the EPR reference bugs and digital readouts are correct.

On airplanes with PDCS,
EPR reference selectors... In C

Verify that the PDCS reference bugs and digital readouts are correct.

IAS bugs .... Set C, F/O

Set the speed bugs at V1, VR, V2 + 15, and flaps up maneuvering speed.

Airspeed cursor controls ....Set V2 C, F/O

HSI HEADING selectors .... Set C, F/O

HSI course selectors .... Set C, F/O

ALTITUDE alert controller... Set C

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

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

As part of the takeoff briefing for the first flight of the day and following a change of either flight crew member, cabin altitude warning indications and memory item procedures must be briefed on airplanes in which the CABIN ALTITUDE and TAKEOFF CONFIG lights are not installed, or are installed but not activated. The briefing must contain the following information:

Whenever the intermittent warning horn sounds in flight at an airplane flight altitude above 10,000 feet MSL:

1. Immediately, don oxygen masks and set regulators to 100%.
2. Establish crew communications.
3. Do the CABIN ALTITUDE WARNING or Rapid Depressurization non-normal checklist.

Both pilots must verify on the overhead Cabin Altitude Panel that the cabin altitude is stabilized at or below 10,000 feet before removing oxygen masks.

Exterior doors ....Verify closed F/O

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

Start clearance.. Obtain C, F/O

Obtain a clearance to pressurize the hydraulic systems.

Obtain a clearance to start the engines.

If pushback is needed:

Verify that the nose gear steering lockout pin is installed, or, if the nose gear steering lockout pin is not used, depressurize hydraulic system A during the hydraulic panel set step.

Fuel panel ....Set F/O

If the center tank fuel quantity exceeds 1,000 pounds (453 kilograms):

LEFT and RIGHT CENTER FUEL PUMPS switches .... ON

Verify that the LOW PRESSURE lights illuminate momentarily and then extinguish.

If a LOW PRESSURE light stays illuminated turn off the affected CENTER FUEL PUMPS switch.

If the auxiliary tank (as installed) fuel quantity exceeds 1,000 pounds/453 kilograms:

FWD and AFT AUXILIARY FUEL PUMPS switches............ON

Verify that the LOW PRESSURE lights illuminate momentarily and then extinguish.

If a LOW PRESSURE light stays illuminated turn off the affected AUXILIARY tank FUEL PUMPS switch.

AFT and FORWARD FUEL PUMPS switches........................ON

Verify that the LOW PRESSURE lights are extinguished.

Hydraulic panel...Set F/O

If pushback is needed and the nose gear steering lockout pin is not installed:

WARNING: Do not pressurize hydraulic system A. Unwanted tow bar movement can occur.

System A HYDRAULIC PUMP switches ....OFF

Verify that the system A pump LOW PRESSURE lights are illuminated.

System B electric HYDRAULIC PUMP switches .... ON

Verify that the system B electric pump LOW PRESSURE lights are extinguished.

Verify that the brake pressure is 2,800 psi minimum.

Verify that the system B pressure is 2,800 psi minimum.

If pushback is not needed, or if pushback is needed and the nose gear steering lockout pin is installed:

Electric HYDRAULIC PUMP switches .... ON

Verify that the electric pump LOW PRESSURE lights are extinguished.

Verify that the brake pressure is 2,800 psi minimum.

Verify that the system B pressure is 2,800 psi minimum.

ANTI COLLISION light switch ....ON F/O

GRAVEL PROTECT switch (as installed) ....As needed F/O

If in icing conditions, set the switch to ANTI-ICE/TEST.

If not in icing conditions, set the switch to ON if the takeoff is from a gravel or contaminated runway.

Trim .... Set C

Check each trim for freedom of movement.

Stabilizer trim – ___ UNITS

Set the trim for takeoff.

Verify that the trim is in the green band.

Aileron trim – 0 units

Rudder trim – 0 units

Call “BEFORE START CHECKLIST.” C

Do the BEFORE START checklist. F/O

Pushback or Towing Procedure

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

Establish communications with ground handling personnel. C

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

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

Transponder .... As needed F/O

Select an active transponder setting with Mode S, but not a TCAS mode.

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

When pushback or towing is complete:

Verify that the tow bar is disconnected C

Verify that the nose gear steering lockout pin is removed C

System A HYDRAULIC PUMPS switches .... ON F/O

Engine Start Procedure

Starter duty cycle:

- normal start: 30 seconds on, 60 seconds off (3cycles only, then 5 minutes cooling)
- slow start: 60 seconds on, 60 seconds off, (2 cycles only, then 5 minutes cooling)
- motoring (fuel off): 2 minutes on, 5 minutes cooling

Normal engine start considerations:

- do not move an engine start lever to idle early or a hot start can occur
- keep a hand on the engine start lever while monitoring RPM, EGT and fuel flow until stable

- if fuel is shutoff accidentally (by closing the engine start lever) do not reopen the engine start lever in an attempt to restart the engine
- failure of the ENGINE START switch to stay in GRD until the starter cutout RPM can cause a hot start. Do not re–engage the ENGINE START switch until the engine has stopped rotating. The starter drive shaft can break if the starter is engaged before the engine stops.

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

- there is no N1 rotation by 20% N2
- there is no oil pressure increase by 30 seconds
- the fuel flow is greater than 1100 pph/500kgph at start
- the EGT does not increase by 20 seconds after the engine start lever is moved to IDLE
- the N1 or N2 does not increase or increases very slowly after the EGT increases
- the EGT quickly nears or exceeds the start limit

Air conditioning PACK switches .... OFF F/O

Start pressure ....___ PSI F/O

The minimum start pressure at sea level is 30 psi. Decrease the minimum start pressure 0.5 psi for each 1,000 feet above sea level.

Start sequence.. Announce C

Call “START ___ ENGINE” C

ENGINE START switch .... GRD F/O

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

Verify that the oil pressure increases and call “OIL PRESSURE RISING.” F/O

When N1 rotation is seen and N2 is at 20%, or (if 20% N2 is not possible), at maximum motoring and a minimum of 15% N2:

Engine start lever .... IDLE C

Monitor fuel flow and EGT indications. C, F/O

At 35-40% N2, verify that the ENGINE START switch moves to OFF. If not, move the ENGINE START switch to OFF. F/O

Verify that the duct pressure increases when the ENGINE START switch moves to OFF. F/O

Verify that the START VALVE OPEN light extinguishes when the ENGINE START switch moves to OFF.	F/O
Call "STARTER CUTOUT."	F/O
Monitor N1, N2, EGT, fuel flow and oil pressure for normal indications while the engine accelerates to a stable idle.	C, F/O

If the time from the initial EGT increase to stable idle is more than 30 seconds:

Make a maintenance logbook entry.

After the flight is completed, maintenance action is needed.

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

Before Taxi Procedure

Fuel HEAT switches	As needed	F/O

Before takeoff with tank fuel temperature 0° C or below, set the fuel HEAT switches to ON for one cycle.

Fuel heat must be OFF for takeoff.

GENERATOR 1 and 2 switches	ON	F/O
PITOT STATIC HEAT switches	ON	F/O
WING ANTI-ICE switch	As needed	F/O
ENGINE ANTI–ICE switches	As needed	F/O
Flight recorder REPEAT switch	Push	F/O
PACK switches	ON	F/O
ISOLATION VALVE switch	AUTO	F/O
APU BLEED air switch	OFF	F/O
Flight/Ground switch	FLT	F/O

On gravel or contaminated runways, the No Engine Bleed Takeoff Supplementary Procedure is recommended.

APU switch	OFF	F/O
ENGINE START switches	LOW IGN	F/O
Engine start levers	IDLE detent	C

Verify that the ground equipment is clear.	C, F/O
Call "FLAPS___" as needed for takeoff.	C

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

Verify that the LE FLAPS EXT green light is illuminated.

Flight controls .... Check   C

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

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

- freedom of movement
- that the controls return to center

Hold the nose wheel steering wheel during the rudder check to prevent nose wheel movement.

Move the rudder pedals to full travel in both directions and verify:

- freedom of movement
- that the rudder pedals return to center

Transponder ....As needed   F/O

Recall .... Check   C, F/O

Verify that all system annunciator panel lights illuminate and then extinguish.

Update changes to the taxi briefing, as needed.	C or PF
Call "BEFORE TAXI CHECKLIST."	C
Do the BEFORE TAXI checklist.	F/O

Before Takeoff Procedure

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

When the engines have been shut down more than 2 hours:

- run the engine for 5 minutes
- when taxi time is expected to be less than 5 minutes, start the engines as early as feasible
- use a thrust setting normally used for taxi operations.

Pilot Flying	Pilot Monitoring
	Notify the cabin crew to prepare for takeoff. Verify that the cabin is secure.

The pilot who will do the takeoff updates changes to the takeoff briefing as needed.	
Set the weather radar display as needed.	
Call "BEFORE TAKEOFF CHECKLIST."	Do the BEFORE TAKEOFF checklist.

Takeoff Procedure

Pilot Flying	Pilot Monitoring
Before entering the departure runway, verify that the runway and runway entry point are correct.	
	When entering the departure runway, use lights as needed. Set the transponder mode selector to TA/RA (as installed).
Verify that the brakes are released. Align the airplane with the runway.	
Verify that the airplane heading agrees with the assigned runway heading.	
	When cleared for takeoff, set the INBOARD LANDING light switches to ON.
Advance the thrust levers to approximately 1.4 EPR (levers in vertical position). Allow the engines to stabilize.	
Advance thrust levers to takeoff EPR.	
Verify that the correct takeoff thrust is set.	
	Monitor the engine instruments during the takeoff. Call out any abnormal indications. Adjust takeoff thrust before 60 knots as needed. Call "THRUST SET."
After takeoff thrust is set, the captain's hand must be on the thrust levers until V1.	

Monitor airspeed. Maintain light forward pressure on the control column.	Monitor airspeed and call out any abnormal incitations.
Verify 80 KIAS and call “CHECK”.	Call “80 KNOTS.”
Verify V1 speed.	Call “V1”.
At VR, rotate toward 15° pitch attitude.	At VR, call “ROTATE.” Monitor airspeed and vertical speed.
Establish a positive rate of climb.	
	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE.”
Verify a positive rate of climb on the altimeter and call “GEAR UP.”	
	Set the landing gear lever to UP.
Maintain a minimum of V2 + 15 to 25 after the initial climb is established.	
At thrust reduction height, reduce thrust to approximately 90% N1 and call “SET CLIMB THRUST.”	
	Set climb EPR.
Verify that climb thrust is set.	
At acceleration height, call for flaps up maneuvering speed.	
	Set the flaps up maneuvering speed.
Verify acceleration. Call “FLAPS___” according to the flap retraction schedule.	
	Set the FLAP lever as directed. Monitor flaps and slats retraction.

After flap retraction is complete and above minimum altitude for autopilot engagement: • engage the autopilot.	After flap retraction is complete: • Set or verify engine bleeds and air conditioning packs are operating • Set the engine start switches as needed • Set the AUTO BRAKE select switch to OFF. • Set the landing gear lever to OFF after landing gear retraction is complete
Call "AFTER TAKEOFF CHECKLIST."	
	Do the AFTER TAKEOFF checklist.

CAUTION: Do not allow the shoulder harness straps to retract quickly. Buckles can pull or damage circuit breakers.

Takeoff Flap Retraction Speed Schedule

Takeoff Flaps	At and Below 117,000 LB	Above 117,000 LB	Select Flaps
25	V2 + 15 150 170 190	V2 + 15 160 180 200	15 5 1 UP
15 or 10	V2 + 15 170 190	V2 + 15 180 200	5 1 UP
5 or 2	V2 + 15 190	V2 + 15 200	1 UP
1	190	200	UP
Limit bank angle to 15° until reaching V2 + 15.			

Climb and Cruise Procedure

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

<table>
<tr><th>Pilot Flying</th><th>Pilot Monitoring</th></tr>
<tr><td></td><td>At or above 10,000 feet MSL, set the LANDING light switches to OFF.</td></tr>
<tr><td></td><td>Set the passenger signs as needed.</td></tr>
<tr><td colspan="2">When climbing above transition altitude, set and crosscheck the altimeters to standard.</td></tr>
<tr><td></td><td>(Before Auto Shutoff and Master Caution System Service Bulletin changes):

During climb, on airplanes with auxiliary fuel tanks, set both auxiliary tank fuel pump switches to OFF when both auxiliary tank fuel pump LOW PRESSURE lights illuminate.

During climb, set both center tank fuel pump switches to OFF when both center tank fuel pump LOW PRESSURE lights illuminate.</td></tr>
<tr><td></td><td>(After Auto Shutoff and Master Caution System Service Bulletin changes):

During climb, on airplanes with auxiliary fuel tanks, set the affected auxiliary tank fuel pump switch to OFF when an auxiliary tank fuel pump LOW PRESSURE light illuminates.

Set both auxiliary tank fuel pump switches to OFF when an auxiliary tank fuel pump LOW PRESSURE light illuminates if the auxiliary tank is empty.

During climb, set the affected center tank fuel pump switch to OFF when a center tank fuel pump LOW PRESSURE light illuminates.

Set both center tank fuel pump switches to OFF when a center tank fuel pump LOW PRESSURE light illuminates if the center tank is empty.</td></tr>
</table>

	(Before Auto Shutoff and Master Caution System Service Bulletin changes): When established in a level flight attitude, on airplanes with auxiliary fuel tanks, if the auxiliary tank contains usable fuel and the auxiliary tank fuel pump switches are OFF, set both auxiliary tank fuel pump switches to ON again. Set both auxiliary tank fuel pump switches to OFF when both auxiliary tank fuel pump LOW PRESSURE lights illuminate.
	(After Auto Shutoff and Master Caution System Service Bulletin changes): When established in a level flight attitude, on airplanes with auxiliary fuel tanks, if the auxiliary tank contains usable fuel and an auxiliary tank fuel pump switch(es) is OFF, set the auxiliary tank fuel pump switch(es) to ON again. Set the affected auxiliary tank fuel pump switch to OFF when an auxiliary tank fuel pump LOW PRESSURE light illuminates. Set both auxiliary tank fuel pump switches to OFF when an auxiliary tank fuel pump LOW PRESSURE light illuminates if the auxiliary tank is empty.

	(Before Auto Shutoff and Master Caution System Service Bulletin changes): When established in a level flight attitude, if the center tank contains usable fuel and the center tank fuel pump switches are OFF, set both center tank fuel pump switches to ON again. Set both center tank fuel pump switches to OFF when both center tank fuel pump LOW PRESSURE lights illuminate.
	(After Auto Shutoff and Master Caution System Service Bulletin changes): When established in a level flight attitude, if the center tank contains usable fuel and a center tank fuel pump switch(es) is OFF, set the center tank fuel pump switch(es) to ON again. Set the affected center tank fuel pump switch to OFF when a center tank fuel pump LOW PRESSURE light illuminates. Set both center tank fuel pump switches to OFF when a center tank fuel pump LOW PRESSURE light illuminates if the center tank is empty.
	During an ETOPS flight, additional steps must be done. See the ETOPS supplementary procedure in SP.1.
	Before the top of descent, modify the route as needed for the arrival and approach.

Descent Procedure

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

Complete the Descent Procedure by 10,000 feet MSL.

Pilot Flying	Pilot Monitoring
	(Before Auto Shutoff and Master Caution System Service Bulletin changes): Set both center tank fuel pump switches to OFF when both center tank fuel pump LOW PRESSURE lights illuminate.
	(After Auto Shutoff and Master Caution System Service Bulletin changes): Set the affected center tank fuel pump switch to OFF when a center tank fuel pump LOW PRESSURE light illuminates. Set both center tank fuel pump switches to OFF when a center tank fuel pump LOW PRESSURE light illuminates if the center tank is empty.
	(Before Auto Shutoff and Master Caution System Service Bulletin changes): If established in a level flight attitude for an extended period of time with usable fuel in the center tank, and the center tank fuel pump switches OFF, both center tank fuel pump switches may be set to ON again. Set both center tank fuel pump switches to OFF when both center tank fuel pump LOW PRESSURE lights illuminate.

	(After Auto Shutoff and Master Caution System Service Bulletin changes): If established in a level flight attitude for an extended period of time with usable fuel in the center tank, and a center tank fuel pump switch(es) is OFF, set the center tank fuel pump switch(es) to ON again. Set the affected center tank fuel pump switch to OFF when a center tank fuel pump LOW PRESSURE light illuminates. Set both center tank fuel pump switches to OFF when a center tank fuel pump LOW PRESSURE light illuminates if the center tank is empty.
	Verify that pressurization is set to landing altitude.
	Set the gravel protect switch (as installed) as needed.
Review the system annunciator lights.	Recall and review the system annunciator lights.
Check landing performance	
Set the speed bugs at VREF, VREF + 15, and flaps up maneuvering speed.	
Set radio altimeter minimums as needed for the approach.	
	Check and set EPR bugs for the GO-AROUND, corrected for the bleed configuration.
Set or verify the navigation radios and course for the approach.	
	Set the AUTO BRAKE select switch to the needed brake setting.
Do the approach briefing.	
Call “DESCENT CHECKLIST.”	Do the DESCENT checklist.

Approach Procedure

The Approach Procedure is normally started at transition level.

Complete the Approach Procedure before:

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

If a flaps 15 landing is needed because of performance:

GROUND PROXIMITY FLAP/GEAR
INHIBIT switch .... FLAP/GEAR INHIBIT F/O

Pilot Flying	Pilot Monitoring
	Set the passenger signs as needed.
	At or above 10,000 feet MSL, set the INBOARD LANDING light switches to ON.
When descending below the transition level, set and crosscheck altimeters.	
Update changes to the arrival and approach, as needed.	
Update the approach briefing as needed.	
Call "APPROACH CHECKLIST."	Do the APPROACH checklist.

Flap Extension Schedule

Current Flap Position	At Speed (knots)	Select Flaps	Command Speed for Selected Flaps
Up	210	1	190
1	190	5	170
5	170	10*	160
10*	160	15	150/VREF
15	150/VREF	25	140
25	140	30 or 40	(VREF30 or VREF40) + wind additives

* As needed.

Landing Procedure

<table>
<tr><th>Pilot Flying</th><th>Pilot Monitoring</th></tr>
<tr><td></td><td>Notify the cabin crew to prepare for landing. Verify that the cabin is secure.</td></tr>
<tr><td>Initially
If on radar vectors:
• HDG SEL
• Pitch mode (as needed)
If enroute to a fix:
• Roll mode (as needed)
• Pitch mode (as needed)</td><td></td></tr>
<tr><td>Call “FLAPS___” according to the flap extension schedule.</td><td>Set the flap lever as directed. Monitor flaps and slats extension.</td></tr>
<tr><td colspan="2">When on localizer intercept heading:
• verify that the ILS is tuned and identified
• verify that the LOC and G/S pointers are shown</td></tr>
<tr><td>Select AUTO APP.</td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Use HDG SEL to intercept the final approach course as needed.</td><td></td></tr>
<tr><td colspan="2">Verify that the localizer is captured
Verify the final approach course heading</td></tr>
<tr><td></td><td>Call “GLIDESLOPE ALIVE.”</td></tr>
<tr><td>At glideslope alive, call:
• “GEAR DOWN”
• “FLAPS 15”</td><td></td></tr>
<tr><td></td><td>Set the landing gear lever to DN.
Verify that the green landing gear indicator lights are illuminated.
Set the flap lever to 15.
Set the engine start switches to LOW IGN.</td></tr>
</table>

Set the speedbrake lever to ARM. Verify that the SPEED BRAKE ARMED light is illuminated.	
At glideslope capture, call “FLAPS___” as needed for landing.	Set the flap lever as directed.
	Set the missed approach altitude on the ALTITUDE ALERT controller.
Call “LANDING CHECKLIST.”	Do the LANDING checklist.
At the final approach fix (LOM, MKR, DME), verify the crossing altitude.	
Monitor the approach.	
Disengage the autopilot before landing.	

Go–Around and Missed Approach Procedure

Pilot Flying	Pilot Monitoring
At the same time: • push either go-around switch • disengage autopilot • advance the thrust levers to go-around EPR • Rotate to go-around attitude • call “FLAPS 15”	Monitor EPR indication. Set the FLAP lever to 15 and monitor flap retraction. Adjust thrust as needed.
Verify: • the rotation to go–around attitude • that the thrust increases	
	Verify that the thrust is sufficient for the go-around or adjust as needed.
Verify a positive rate of climb on the altimeter and call “GEAR UP.”	Verify a positive rate of climb on the altimeter and call “POSITIVE RATE.” Set the landing gear lever to UP.
	Verify that the missed approach altitude is set.
Above 400 feet, select appropriate roll mode and verify proper mode annunciation.	Observe mode annunciation.

Call "TUNE RADIOS FOR MISSED APPROACH."	Tune the navigation radios as directed.
	Verify that the missed approach altitude is set.
Verify that the missed approach route is tracked.	
Verify that climb thrust is set.	
Verify that the missed approach altitude is captured.	
	Set the landing gear lever to OFF after landing gear retraction is complete. Set the engine start switches as needed.
Call "AFTER TAKEOFF CHECKLIST."	Do the AFTER TAKEOFF checklist.

Landing Roll Procedure

Pilot Flying	Pilot Monitoring
Verify that the thrust levers are closed. Verify that the SPEED BRAKE lever is UP. Without delay, fly the nose wheel smoothly onto the runway.	Verify that the SPEED BRAKE lever is UP. Call "SPEED BRAKES UP." If the SPEED BRAKE lever is not UP, call "SPEED BRAKES NOT UP."
Monitor the rollout progress.	
Verify correct autobrake operation.	
WARNING: After the reverse thrust levers are moved, a full stop landing must be made. If an engine stays in reverse, safe flight is not possible.	
CAUTION: Start to lower the nose before selecting reverse thrust to prevent the reverser doors from touching the runway.	

Without delay, move the reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Then apply reverse thrust as needed. Apply reverse thrust as needed.	Verify the forward thrust levers are closed. When both REVERSER UNLOCKED lights are illuminated, call "REVERSERS NORMAL." If a light(s) is not illuminated, call "NO REVERSER ENGINE NUMBER 1", or "NO REVERSER ENGINE NUMBER 2", or "NO REVERSERS."
By 60 KIAS, start movement of the reverse thrust levers to be at the reverse idle detent before taxi speed.	Call "60 KNOTS."
After the engines are at reverse idle, move the reverse thrust levers full down.	
Before taxi speed, disarm the autobrake. Use manual braking as needed.	

After Landing Procedure

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

Engine cooldown recommendations:

- Run the engines for at least 5 minutes
- Use a thrust setting no higher than that is normally used for all engine taxi operations.

Pilot Flying	Pilot Monitoring
The captain moves or verifies that the SPEED BRAKE lever is DOWN.	
	Start the APU, as needed.
	Set the PITOT STATIC HEAT switches to AUTO (airplanes with automatic pitot static heat).
	Set the PITOT STATIC HEAT switches to OFF (airplanes without automatic pitot static heat).
	Set the Flight/Ground switch to GRD.
	Set the exterior lights as needed.

	Set the ENGINE START switches to OFF.
	Set the AUTO BRAKE select switch to OFF.
	Set the flap lever to UP.
Set the weather radar to OFF.	
	Set the transponder as needed.

Shutdown Procedure

Start the Shutdown Procedure after taxi is complete.

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

Verify that the parking brake warning light is illuminated.

Electrical power .... Set F/O

If APU power is needed:

Verify that the APU GENERATOR OFF BUS light is illuminated.

APU GENERATOR bus switches ....ON

Verify that the BUS OFF lights are extinguished.

If external power is needed:

Verify that the GND POWER AVAILABLE light is illuminated.

GROUND POWER switch ....ON

Verify that the BUS OFF lights are extinguished.

Before engine shutdown, consider engine cooldown recommendations.

Engine start levers .... CUTOFF C

If towing is needed:

Establish communications with ground handling personnel C

WARNING: If the nose gear steering lockout pin is not installed and hydraulic system A is pressurized, any change to electrical or hydraulic power with the tow bar connected can cause unwanted tow bar movement.

Verify that the nose gear steering lockout pin is installed, or, if the nose gear steering lockout pin is not used:

System A HYDRAULIC PUMP switches ....OFF

Verify that the system A pump LOW PRESSURE lights are illuminated.

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

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

Set or release parking brake as directed by ground handling personnel C or F/O

When towing is complete:

System A HYDRAULIC PUMP switches .... ON

FASTEN BELTS switch ....OFF F/O

ANTI COLLISION light switch ....OFF F/O

FUEL PUMP switches ....OFF F/O

GALLEY power switch .... As needed F/O

WING ANTI–ICE switch ....OFF F/O

ENGINE ANTI–ICE switches ....OFF F/O

Hydraulic panel .... Set F/O

ENGINE HYDRAULIC PUMPS switches ....ON

ELECTRIC HYDRAULIC PUMPS switches .... OFF

GASPER FAN switch .... As needed F/O

Air conditioning PACK switches .... Set F/O

One air conditioning PACK switch ....ON

Other air conditioning PACK switch .... OFF

ISOLATION VALVE switch .... AUTO F/O

Engine BLEED air switches..ON F/O

APU BLEED air switch ....ON F/O

Exterior lights switches ....As needed F/O

GRAVEL PROTECT switch (as installed) .... OFF F/O

Flight director mode selector .... OFF C, F/O

Transponder mode selector .... STBY F/O

After the wheel chocks are in place:

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

APU switch ....As needed F/O

Run the APU for one full minute with no bleed air load before shutdown.

Note: If extended APU operation is needed on the ground and the airplane buses are powered by AC electrical power, position an AC powered fuel pump ON. This will extend the service life of the APU fuel control unit.

Note: If fuel is loaded in the center tank, position the left center tank fuel pump switch ON to prevent a fuel imbalance before takeoff.

CAUTION: Center tank fuel pump switches should be positioned ON only if the fuel quantity in the center tank exceeds 1000 lbs.

CAUTION: Do not operate the center tank fuel pumps with the flight deck unattended.

Flight deck door ....Unlock F/O

Verify that the CAB DOOR UNLOCKED light (as installed) is illuminated.

Oxygen regulators .... Set C, F/O

OXYGEN DILUTER lever 100%

SUPPLY lever ....OFF

Call “SHUTDOWN CHECKLIST.” C

Do the SHUTDOWN checklist. F/O

Secure Procedure

EMERGENCY EXIT LIGHTS switch	OFF	F/O
WINDOW HEAT switches	OFF	F/O
Air conditioning PACK switches	OFF	F/O
Call “SECURE CHECKLIST.”		C
Do the SECURE checklist.		F/O

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Supplementary Procedures — Chapter SP
Table of Contents — Section TOC

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Supplementary Procedures — Chapter SP
Introduction — Section 05

General

This section contains procedures (adverse weather operation, engine crossbleed start, and so on) that are accomplished as required rather than routinely performed on each flight.

Supplementary procedures may be required because of adverse weather, unscheduled maintenance or as a result of a procedure referenced in a Non–Normal Checklist. Additionally, some may be performed if the flight crew must accomplish preflight actions normally performed by maintenance personnel.

At the discretion of the captain, procedures may be performed by memory, by reviewing the procedure prior to accomplishment, or by reference to the procedure during its accomplishment.

Supplementary procedures are provided by section. Section titles correspond to the respective chapter title for the system being addressed except for the adverse weather section.

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Interior Inspection

Emergency exit lights .... Check

Passenger signs .... Check

Service and entry doors .... Check

Escape slides .... Check pressure

Emergency exits .... Check

Wing upper surfaces .... Check

Lavatory fire extinguishers .... Check

Emergency equipment .... Check

Check availability and condition of emergency equipment, as required.

Flight Deck Door Access System Test

Flight deck access system switch .... NORM

Flight deck door .... Open

Flight deck door lock selector .... AUTO

Emergency access code .... Enter

ENT key .... Push

Verify alert sounds.

Verify AUTO UNLK light illuminates.

Flight deck door lock selector .... DENY

Verify AUTO UNLK light extinguishes.

Flight deck door lock selector .... UNLKD

Flight deck access system switch .... OFF

Verify LOCK FAIL light illuminates.

Flight deck access system switch .... NORM

Guard .... Down

Verify LOCK FAIL light extinguishes.

Main Cargo Door Operation

Normal Operation

Normal operation requires electrical power, hydraulic pressure from system B and parking brake set.

Do not operate with winds in excess of 40 knots.

In the all cargo configuration the passenger oxygen supply to all outlets aft of the forward attendant panel and forward lavatory can be secured by closing the PSU shutoff valve located at the aft end of the forward lowered ceiling. Whenever passengers are carried this valve must be open.

Open to canopy position:

External lock handle .... UNLOCK

This illuminates the amber MAIN CARGO door light, the amber DOORS system annunciator light, the amber MASTER CAUTION light and the amber caution light on the main cargo control panel.

Check that the main cargo door is clear.

Switch No. 1 ....Up to CANOPY and hold

Cargo door unlatches and raises to the canopy position.

Switch No. 1 .... Release to OFF

Releasing a control switch while the door is in an intermediate position causes the door to lock hydraulically but not mechanically. The door is hydraulically locked in the canopy position. If system B hydraulic pressure is removed, the lift actuator mechanically locks the door in the canopy position.

CAUTION: With the main cargo door in an intermediate position and the B pumps off, pressing the No. 1 switch to close causes the door to free-fall slowly.

Open to full open position:

Switch No. 2 .... FULL OPEN and hold

The door automatically stops in the full open position and is hydraulically locked.

Switch No. 2 ....Release to OFF

Note: If the door is stopped in an intermediate position and hydraulic pressure is lost, pressing the No. 2 switch to DOWN TO CANOPY causes the door to free-fall slowly to the canopy position and mechanically lock.

Lower to canopy position:

Check that the main cargo door is clear.

Switch No. 2 ....DOWN TO CANOPY and hold

Switch No. 1 ....CLOSE and hold

Hydraulic pressure must be available to release the lift actuator internal cam locks and to close the door and engage the latch hooks.

External lock handle .... LOCKED

Cargo door latch indicators .... LOCK & check

Check a white horizontal line is visible in all eight (8) windows on the exterior side of the door.

Check MAIN CARGO door light extinguished and DOORS system annunciator light extinguished on the flight deck.

Manual Operation

Manual operation of the main cargo door requires that all electrical power be removed from the system (main cargo door circuit breaker pulled.) It is assumed hydraulic system B is inoperable.

CAUTION: Control valve motor burnout may occur if control valve is positioned when electrical power is on the system. Ensure the main cargo door circuit breakers is open and suitably tagged before manual operation.

Do not operate in winds in excess of 40 knots.

Open to canopy position:

Check for the following:

Cargo door control circuit breaker ....Pulled

External lock handle ....UNLOCKED

Parking brake .... ON

If no hydraulic pressure is available, chock airplane.

Motor operated control valve (left wheel well) .... Manually move to POS 1

This moves the valve to the “door open” position, allowing hydraulic fluid to be pumped to the “up” side of the door actuator.

Hydraulic hand pump (left wheel well) ....Engage handle and operate pump

Pump until the main cargo door is slightly above the canopy position (approximately 45 strokes.)

Motor operated control valve .... Manually move to POS 2

This moves the valve to the “door closed” position, removing the hydraulic uplock pressure.

The cargo door free-falls to the canopy position and mechanically locks.

Open to full open position (if required:)

Motor operated control valve .... Manually move to POS 1

Hydraulic hand pump .... Operate

Pump until the door is full open (approximately 70 strokes.) The door is hydraulically locked in the full open position.

Lower to canopy position:

Check that the door is clear.

Motor operated control valve .... Manually move to POS 2

Hydraulic hand pump .... Operate

The pump must be operated to move the door overcenter. The door free-falls to the canopy position.

Close from canopy position:

Hydraulic hand pump ....Operate

The pump must be operated to release the canopy position mechanical locks. Continue to operate the pump until the pressure required noticeably increases. The door is then latched.

External lock handle .... Lock

The amber caution light is inoperative with no AC power available. The handle cannot be locked unless the latches are engaged.

Cargo door latch indicators .... Check

Check a white horizontal line is visible in all eight (8) windows on the exterior side of the door.

Cargo door control circuit breaker ....Reset

Forward Airstair Operation

WARNING: Use care not to fall from the airstair platform when operating the forward entry door. The small platform area and bad weather can make the door difficult to operate.

CAUTION: Operation of airstair in winds exceeding 40 knots is not recommended.

CAUTION: Do not move airplane with stair extended.

Interior Control

WARNING: Open entry door to cocked position to allow clear visibility of area outside airplane to prevent injury to personnel. Do not open door beyond cocked position while operating airstair.

To Extend:

Forward Entry Door .... Open to Cocked Position

When operating the airstair from the interior control panel, the forward entry door must be open to the cocked position. Safety circuits prevent airstair operation if the entry door is closed.

Control Switch .... EXTEND

Note: For interior standby operation, the battery switch must be ON.

Hold until extension is complete.

The STAIRS OPERATING light illuminates during extension until the airstair is fully extended.

Note: The STAIRS OPERATING light will not illuminate with loss of AC power.

Control switch .... Release

Handrail Extensions ....Engage

Release latch and pull inboard and up, extend and engage on supports at sides of forward entry doorway.

To Retract:

Handrail Extensions ....Disengage

Disengage from door supports, depress latch at base of forward extension to permit retraction within upper segment of handrail. Slide right and left extensions down along upper rails. Stowing in appropriate stowage points provides circuit continuity for energizing retract relay.

CAUTION: Use of the standby control switch bypasses all safety circuits. Airstair handrail extensions must be stowed or substantial damage could result.

Control switch ....RETRACT

Hold until retraction is complete.

The STAIRS OPERATING light illuminates during retraction until the airstair door is fully closed.

Note: The STAIRS OPERATING light will not illuminate with loss of AC power.

Control switch .... Release

Exterior Control

To Extend:

Control Handle .... Push Button to Extend Handle

Control Handle ....Rotate to Extend

Hold control handle in position until entire extension cycle is complete.

Control Handle .... Release

Forward entry door .... Open to cocked position

WARNING: Extend and connect the airstair aft handrail to protect against falling and to prevent injuries to personnel.

Aft handrail extension .... Engage

Release latch and pull inward and up, extend and engage on the support at the side of the forward entry door.

WARNING: Step down the airstair as the forward entry door moves to the open position to prevent injuries to personnel.

Forward entry door .... Fully open

Forward handrail extension .... Engage

Release latch and pull inboard and up, extend and engage on the support side of the forward entry door.

To Retract:

WARNING: Do not disengage the airstair aft handrail at this time. Injuries to personnel can occur during forward entry door operations if the aft handrail is disengaged.

Forward handrail extension ....Disengage

Disengage from door support, depress latch at base of forward extension to permit retraction within upper segment of handrail. Slide extension down along the upper rail. Stowing in appropriate stowage points provides circuit continuity for energizing retract relay.

WARNING: Step down the airstair as the forward entry door moves to the cocked position to prevent injuries to personnel.

Forward entry door ....Close to cocked position

Aft handrail extension .... Disengage

Disengage from door support, depress latch at base of forward extension to permit retraction within upper segment of handrail. Slide extension down along the upper rail. Stowing in appropriate stowage points provides circuit continuity for energizing retract relay.

Forward entry door .... Fully close

CAUTION: Use of the standby control switch bypasses all safety circuits. Airstair handrail extension must be stowed or substantial damage could result.

Control handle .... Rotate to retract

When the airstair is retracted and the airstair door is fully closed, release and stow handle.

Water System Draining

In the event the passenger water system becomes contaminated, or the airplane is to be parked in freezing temperatures for an extended period, it may be necessary to completely drain the system to prevent damage to the water lines or other equipment.

The system may be drained either by pressure or by gravity.

Pressure Draining:

APU .... ON

APU bleed switch .... ON

This will pressurize the water tank. If the APU is not usable, an external pneumatic cart may be used by positioning the Isolation Valve switch ON. The tank may also be pressurized through a valve on the external servicing panel.

Water Heaters ....OFF

CAUTION: Failure to do this could cause damage to the heaters when the water is drained.

Tank drain valve .... OPEN

Shutoff/Drain valves .... DRAIN

When water stops flowing from outlets:

Tank Drain valve .... CLOSE

Shutoff/Drain valves .... ON

Allow 2 minutes for the pressure to stabilize. To exhaust residual water, turn each shutoff/drain valve to DRAIN and then ON. Open each water faucet, galley water drain shutoff valve and coffee maker drain for 2 minutes, and then close.

Lavatory vent valves .... ON/CLOSED

Open each lavatory water faucet to drain, then close. Depressurize the water tank by deactivating the air pressure source.

Gravity Draining:

Water Heaters .... OFF

Fill and Overflow valve .... OPEN

Tank Drain valve .... OPEN

Shutoff/Drain valves .... DRAIN

Lavatory vent valves .... DRAIN/OPEN

Open each lavatory faucet and galley outlet to drain residual water into containers or through the drain mast.

When water stops flowing from outlets:

Fill and Overflow valve .... CLOSE

Tank Drain valve .... CLOSE

Shutoff/Drain valves .... ON

Open each lavatory faucet and galley outlet to drain residual water.

Lavatory vent valves .... ON/CLOSED

Oxygen Mask Microphone Test

MASK-BOOM or OXY-BOOM switch..........................MASK or OXY

Flight interphone transmitter selector switch .... Push

Speaker switch .... ON

SUPPLY lever .... ON

EMERGENCY lever .... ON

Push-to-Talk switch .... Push PTT

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

Push-to-Talk switch ....Release

EMERGENCY lever ....OFF

Speaker switch .... As needed

MASK-BOOM or OXY-BOOM switch.................................... BOOM

ETOPS

Operators conducting ETOPS are required to comply with appropriate regulations. An operator must have an ETOPS configured and approved airplane, and approved flight operations and maintenance programs in place to support ETOPS.

APU Operation

Unless otherwise authorized, start the APU before the ETOPS segment. The APU must be on for the entire ETOPS segment.

Fuel Crossfeed Valve Check

During the last hour of cruise, do the following steps:

Crossfeed selector .... Open

Verify that the VALVE OPEN light illuminates bright, then dim.

Crossfeed selector ....Close

Verify that the VALVE OPEN light illuminates bright, then extinguishes.

Wing–Body Overheat Test

Wing–body OVHT TEST switch .... Push

Hold for a minimum of 5 seconds.

Both WING–BODY OVERHEAT lights .... illuminated

MASTER CAUTION .... illuminated

AIR COND system annunciator .... illuminated

Wing–body OVHT TEST switch .... Release

Both WING–BODY OVERHEAT lights .... extinguished

MASTER CAUTION lights .... extinguished

AIR COND system annunciator .... extinguished

External Air Cart Use

CAUTION: The BAT switch should always be on when using the airplane air conditioning system since the protective circuits are DC. This ensures protection in the event of loss of AC power.

Air temperature source selector .... As desired

Cabin temperature selectors .... AUTO

Set desired temperature.

Gasper fan switch .... As desired

ISOLATION VALVE switch .... OPEN

APU BLEED air switch .... OFF

Left and/or right air conditioning pack switch(es) .... ON

The operation of two packs from one air source is permitted provided the external air cart can maintain 20-25 psi with both packs operating.

Duct pressure .... 20 psi min.

If external air cannot hold 20 psi minimum and the APU is operating:

ISOLATION VALVE switch .... AUTO

APU BLEED air switch .... ON

APU supplies left pack and external air source supplies right pack.

Ground Conditioned Air Use

Before connecting ground conditioned air:

PACK switches ....OFF

Packs can be damaged if operated with conditioned air.

After disconnecting ground conditioned air:

PACK switches .... As needed

Using the APU for Heating (on the ground/engines shut down)

Under extremely cold conditions, both packs may be used for more rapid heating.

ISOLATION VALVE switch ....OPEN

Auto Trip and Standby Check

Pack switches ....OFF

Pressurization mode selector .... AUTO

FLT/GND switch ....GRD

Cabin Altitude indicator ....500 feet above field elevation

Captain and First Officer altimeters .... Set

Cabin Rate selector .... Index

Verify pressurization mode lights extinguish and the Outflow Valve Position indicator is at OPEN.

FLT/GND switch .... FLT

Verify Outflow Valve Position indicator moves toward CLOSE.

Pressurization mode selector .... Check

Verify the AUTO FAIL and STANDBY lights illuminated and the Outflow Valve Position indicator moves toward OPEN.

Cabin Altitude indicator .... 500 feet below field elevation

Verify the Outflow Valve Position indicator moves toward CLOSE.

FLT/GND switch .... GRD

Verify the AUTO FAIL and STANDBY lights extinguished and the Outflow Valve Position indicator moves toward OPEN.

FLT/GND switch .... FLT

Verify Outflow Valve Position indicator moves toward CLOSE.

Auto Trip and Manual Check

Note: This test must be performed immediately after the Auto Trip and Standby Check to test excessive pressurization rates. If the initial CHECK input has cleared (approximately 30 seconds) the AUTO FAIL and STANDBY lights do not illuminate.

Pack switches .... OFF

Pressurization mode selector .... AUTO

AUTO FAIL light .... illuminated

STANDBY light .... illuminated

Pressurization mode selector .... MAN AC

AUTO FAIL light .... extinguished

STANDBY light .... extinguished

MANUAL light .... illuminated

Outflow valve switch .... Hold OPEN

Verify Valve Position indicator moves toward OPEN.

Outflow valve switch .... Hold CLOSE

Verify Valve Position indicator moves toward CLOSE.

Pressurization Mode selector .... MAN DC

MANUAL light .... illuminated

Outflow valve switch ....Hold OPEN

Verify Valve Position indicator moves toward OPEN.

Outflow valve switch .... Hold CLOSE

Verify Valve Position indicator moves toward CLOSE.

FLT/GRD switch ....GRD

Pressurization mode selector .... AUTO

Verify Valve Position indicator moves toward OPEN.

MANUAL light .... extinguished

Standby Mode Operation

Before start:

Pressurization mode selector ....STBY

Standby light .... illuminated

Cabin Altitude indicator ....Set

CAB ALT .... takeoff field elevation minus 200 feet

Cabin Rate selector ....Index

FLT/GND switch.. GRD

Verify the Outflow Valve Position indicator is full OPEN.

After Start:

Air Conditioning Pack switches .... ON

FLT/GRD switch .... FLT

After takeoff:

Cabin Altitude indicator ....Set

Check the placard below the pressurization module for the cabin altitude corresponding to the planned flight altitude. Reset CAB ALT to this altitude.

Cabin Rate selector .... Adjust

Maintain normal proportional climb rate.

Cruise:

Cabin Altitude indicator ....Reset

Reset CAB ALT using the placard for flight altitude changes greater than 1000 feet.

Before descent:

Cabin Altitude indicator .... Set

CAB ALT .... landing field elevation minus 200 feet

Descent:

Cabin Rate selector ....Adjust

Maintain normal proportional descent rate (300-500 fpm).

After landing:

FLT/GND switch .... GRD

Manual Mode Operation

CAUTION: Switch actuation to the manual mode causes an immediate response by the outflow valve. Full range of motion of the outflow valve can take up to 20 seconds.

Pressurization mode selector .... MAN

MANUAL light .... illuminated

CABIN/FLIGHT ALTITUDE placard.. Check

Determine the desired cabin altitude.

If a higher cabin altitude is desired:

Outflow valve switch (momentarily) ....OPEN

Verify the outflow valve position indicator moves right, cabin altitude climbs at the desired rate, and differential pressure decreases. Repeat as necessary.

If a lower cabin altitude is desired:

Outflow valve switch (momentarily) ....CLOSE

Verify the outflow valve position indicator moves left, cabin altitude descends at the desired rate, and differential pressure increases. Repeat as necessary.

During Descent

Thrust lever changes should be made as slowly as possible to prevent excessive pressure bumps.

Outflow valve switch (momentarily) .... CLOSE

During descent, intermittently position the outflow valve switch toward CLOSE, observing cabin altitude decrease as the airplane descends.

Before entering the landing pattern, slowly position the outflow valve switch to full open to depressurize the airplane. Verify differential pressure is zero.

Pressurization Control Operation – Landing at Alternate Airport

At top of descent:

CAB ALT indicator .... SET

Set CAB ALT to new destination airport elevation minus 200 feet.

LAND ALT indicator .... Reset

Reset to new destination field elevation.

Automatic Pressurization Control – Landing Airport Elevation Above 6000 Feet but 8300 Feet and Below

Do the normal Preflight Procedure - First Officer except as modified below.

Prior to takeoff:

LAND ALT indicator .... 6000 feet

CAB ALT indicator .... 6000 feet

At initial descent or approximately 20 minutes prior to landing:

LAND ALT indicator .... Destination field elevation

CAB ALT indicator .... Reset

Reset CAB ALT to destination airport elevation minus 200 feet.

Unpressurized Takeoff and Landing

When making a no engine bleed takeoff or landing with the APU inoperative, or operative but not providing bleed air:

Takeoff

PACK switches ....ON

ISOLATION VALVE switch .... CLOSE

Engine BLEED air switches .... OFF

APU BLEED air switch .... OFF

CAB ALT indicator .... 2000 feet above field elevation

Cabin Rate selector .... Index

Pressurization mode selector .... STBY

FLT/GRD switch ....FLT

After Takeoff

Note: If engine failure occurs, do not position engine BLEED air switches ON until reaching 1500 feet or until obstacle clearance height has been attained.

At not less than 400 feet, and prior to 2000 feet above field elevation:

Engine No. 2 BLEED air switch .... ON

When CABIN rate of CLIMB indicator stabilizes:

Engine No. 1 BLEED air switch .... ON

ISOLATION VALVE switch .... AUTO

Pressurization Mode selector .... AUTO

Landing

When below 10,000 feet:

CAB ALT indicator .... 1500 feet above field elevation

Cabin rate selector .... Index

Pressurization Mode selector .... STBY

When starting the turn to final approach:

Engine BLEED air switches .... OFF

Avoid high rates of descent for passenger comfort.

No Engine Bleed Takeoff and Landing

When making a no engine bleed takeoff or landing with the APU operating.

Takeoff

Note: If anti–ice is required for taxi, configure for a “No Engine Bleed Takeoff” just prior to takeoff.

Note: If anti–ice is not required for taxi, configure for a “No Engine Bleed Takeoff” just after engine start.

Right PACK switch .... ON

ISOLATION VALVE switch .... CLOSE

Left PACK switch .... ON

Engine No. 1 BLEED air switch ....OFF

APU BLEED air switch .... ON

Engine No. 2 BLEED air switch ....OFF

WING ANTI-ICE switch ....OFF

The WING ANTI-ICE switch must remain OFF until the engine BLEED air switches are repositioned to ON and the ISOLATION VALVE switch is repositioned to AUTO.

After Takeoff

Note: If engine failure occurs, do not position engine BLEED air switches ON until reaching 1500 feet or until obstacle clearance height has been attained.

Engine No. 2 BLEED air switch .... ON

APU BLEED air switch ....OFF

When CABIN rate of CLIMB indicator stabilizes:

Engine No. 1 BLEED air switch ....ON

ISOLATION VALVE switch .... AUTO

Landing

If additional go-around thrust is desired, configure for a "No Engine Bleed Landing:"

When below 10,000 feet:

WING ANTI-ICE switch .... OFF

Right PACK switch .... ON

ISOLATION VALVE switch .... CLOSE

Left PACK switch .... ON

Engine No. 1 BLEED air switch .... OFF

APU BLEED air switch .... ON

Engine No. 2 BLEED air switch .... OFF

High Moisture Producing Cargo

During transportation of live main deck loads such as animals, fowl, etc., excessive moisture accumulates if the moisture produced exceeds the moisture removal capability of the air conditioning system. When this occurs, outflow valve restriction from ice may result. Therefore, the following supplementary procedures should be used when the main deck loads are primarily high moisture producers.

The following steps may be performed prior to takeoff to reduce inflight workload:

Cabin rate selector .... MAXIMUM INCR

Cabin altitude indicator .... Set

Set 500 feet higher than anticipated or indicated cabin altitude.

Pressurization mode selector .... STBY

Position mode selector to STBY and observe a normal response of the cabin rate of climb.

Pressurization mode selector .... AUTO

Following stabilization, position the mode selector back to AUTO and observe a normal response of the cabin rate of climb.

If response is not normal, refer to the Manual Mode Operation supplementary normal procedure. Manual control of the outflow valve may be adequate to free any ice blockage.

If manual control of the outflow valve cannot be established and the differential pressure is rising uncontrollably, shut down one pack to reduce mass airflow. Cabin differential pressure may rise to the relief valve setting and may be tolerated to destination.

Anti–Ice Operation

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

Rain Repellent Use

Do not actuate rain repellent unless windshield wipers are operating and medium or heavy rain conditions exist.

CAUTION: Do not use rain repellent in an attempt to clean a dry dirty windshield. If rain repellent is inadvertently applied, do not use the windshield wipers until required for rain removal.

Inflight operation:

Windshield Wiper selector .... Desired position

Rain Repellent switches .... Push and hold momentarily (one at a time)

Rain repellent may be used any time rain intensity requires the use of windshield wipers.

One application of repellent should be sufficient for an entire takeoff or landing. Additional applications may be required for takeoff or landing in very heavy rain.

Window Heat System Tests

Overheat Test

The overheat test simulates an overheat condition to check the overheat warning function of the window heat system.

WINDOW HEAT switches ....ON

WINDOW HEAT TEST switch .... OVHT

OVERHEAT lights .... On

ON lights ....Extinguish

Lights extinguish after approximately 1 minute.

MASTER CAUTION ....On

ANTI–ICE system annunciator ....On

WINDOW HEAT switches ....Reset

Position the WINDOW HEAT switches OFF, then ON.

Power Test

The power test verifies operation of the window heat system. The test may be accomplished when any of the window heat ON lights are extinguished and the associated WINDOW HEAT switch is ON.

WINDOW HEAT switches .... ON

Note: Do not perform the power test when all ON lights are illuminated

WINDOW HEAT TEST switch .... PWR

The controller is forced to full power, bypassing normal temperature control. Overheat protection is still available.

WINDOW HEAT ON lights ....Illuminated

If any ON light remains extinguished, the window heat system is inoperative. Observe the maximum airspeed limit of 250 kts below 10,000 feet.

Autopilot Preflight

Self-test switches .... OFF

[Any self-test switch left on in the electronic equipment compartment illuminates the AUTOPILOT disengage lights.]

Engaging:

Control wheel and column .... Center

Autopilot mode selector .... MAN

Autopilot aileron and elevator engage switches .... Engage

Manual Mode Test:

Control wheel steering:

Autopilot mode selector .... MAN

Control column and wheel .... Exert force in pitch and roll

[A force above low detent level will activate the flight controls and cause movement of the control column of control wheel.]

Altitude hold:

Autopilot mode selector .... MAN

Autopilot pitch mode selector .... ALT HOLD

Control column .... Exert force in pitch

[A force in excess of the high detent level will trip the autopilot pitch mode selector to OFF. Subsequent pitch inputs to the autopilot are by low detent CWS.]

Heading select:

Autopilot heading switch .... HDG SEL

Heading selector .... Rotate left and right through airplane heading

[The control wheel will follow the movement of the heading selector.]

Control wheel .... Exert force in roll

[A force in excess of the high detent level will trip the autopilot heading switch to the center position. Subsequent roll inputs to the autopilot are by low detent CWS.]

VOR/LOC Mode Test

VHF navigation radio ....Usable VOR frequency

Autopilot mode selector ....VOR/LOC

Check that the autopilot VOR/LOC annunciator illuminates amber. The control wheel remains centered. Roll inputs to the autopilot are by low detent CWS.

Course selector .... Rotate slowly to center the course deviation bar

Check that the autopilot VOR/LOC annunciator illuminates green at approximately 1/2 dot deviation. This simulates capture of the VOR. The control wheels rotate to complete capture. Subsequent roll inputs to the autopilot are from the VHF NAV radio.

Auto Approach Mode Test

VHF navigation radio ....Usable ILS frequency

Autopilot mode selector .... AUTO APP

Check that the autopilot VOR/LOC and GLIDE SLOPE annunciators illuminate amber. The control column remains centered. Subsequent pitch inputs to the autopilot are by low detent CWS.

Manual G/S Mode Test

Autopilot mode selector ....MAN G/S

Check that the autopilot GLIDE SLOPE annunciator illuminates green. The control column pitches forward. Pitch inputs to the autopilot are longer from CWS.

Control column .... Exert force in pitch

A force in excess of high detent level will trip the mode selector to MAN. Subsequent pitch inputs to the autopilot are by low detent CWS.

Disengage Test

Autopilot aileron and elevator engage switches .... Engage

Autopilot disengage switch .... Push

Note: The autopilot disengage light flashes when the autopilot is disengaged automatically.

Stabilizer Out of Trim Light Test

Autopilot .... Engage

Control column .... Pull back and hold

STAB OUT OF TRIM light .... Illuminated

Control column .... Release

STAB OUT OF TRIM light .... Extinguished

Flight Control Switches Test

To check system B:

- Autopilot system select switch .... B
- Autopilot .... Engage
- Yaw damper switch .... ON
- Flight control switch B .... OFF
- Autopilot .... Disengages
- Yaw damper .... Disengages
- Flight control switch B .... ON
- Yaw damper switch .... ON

Autopilot Operation

Manual Mode:

Yaw damper switch .... ON

Autopilot elevator and aileron engage switches .... Engaged

If bank angle is less than 5 degrees, the airplane will roll wings level and maintain heading. If bank angle is greater than 5 degrees, the airplane will maintain bank angle.

The airplane will maintain the pitch attitude at the time of engagement.

To maneuver in pitch and roll:

Use CWS at a force greater than LOW detent level. When CWS pitch force is relaxed below low detent level, the airplane maintains the existing pitch attitude. When CWS roll force is relaxed below low detent level, if the bank angle is less than 5 degrees, the airplane rolls wings level and maintains heading. If bank angle is greater than 5 degrees, the airplane maintains bank angle.

To maintain bank angle less than 5 degrees:

Autopilot heading switch .... HDG OFF

When CWS roll force is relaxed below low detent level, the airplane maintains the existing bank angle. Return the autopilot heading switch to remove this submode.

To maneuver in roll and hold altitude:

Pitch mode selector .... ALT HOLD

Use CWS to induce roll at low detent level force. Altitude is maintained by input from the air data computer at the time the pitch mode selector is positioned to ALT HOLD. CWS pitch input greater than high detent level trips the pitch mode selector to OFF.

To maneuver in pitch and hold heading:

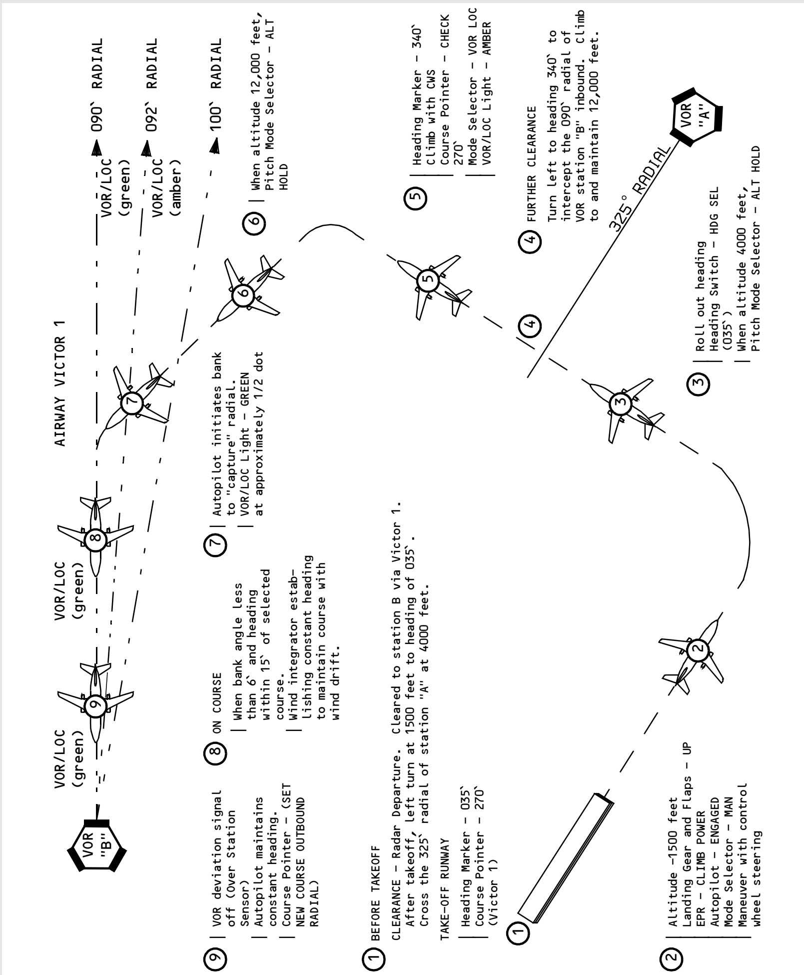
Autopilot heading switch .... HDG SEL

Use CWS to control pitch attitude at low detent level. The airplane turns to and maintains the heading selected on the HSI with the autopilot heading switch in HDG SEL. CWS roll input greater than high detent level trips the autopilot heading switch to the center position.

To maneuver in turbulence:

Pitch mode selector .... TURB

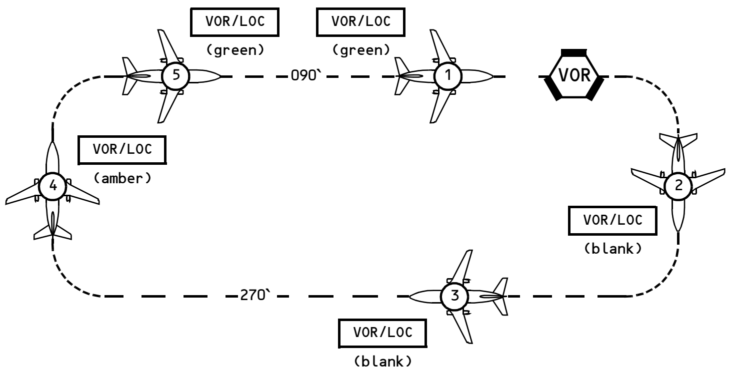
Use CWS at low detent level to control pitch and roll. Pitch signals are damped and roll is limited to 8 degrees bank.



AUTOPILOT OPERATION
(DEPARTURE)

(5) On course inbound to station

(1)
Mode Selector - VOR/LOC
Course Pointer - 90°
Pitch Mode Selector - ALT HOLD
Heading Marker - APPROXIMATELY 225°
Over VOR:
Mode Selector - MAN
Heading Select Switch - HDG SEL

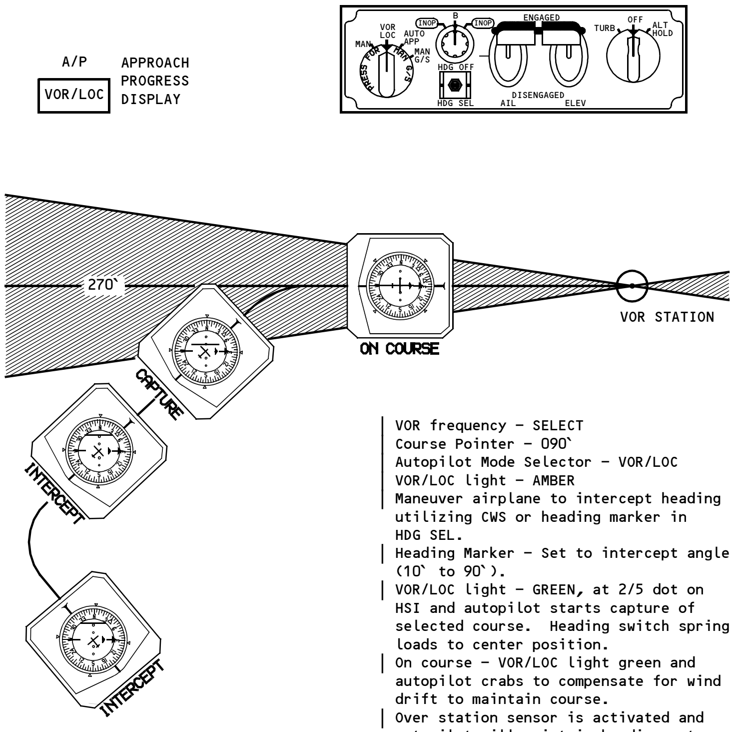


(4)
Heading Marker - ROTATE RIGHT TO HEADING OF 045°
Mode Selector - VOR/LOC
Will capture VOR when HSI indicates approximately 1/2 dot deviation.

(3) Roll out on a heading of approximately 270°. The heading marker may be reset to compensate for wind drift.

(2) Heading Marker - 270°

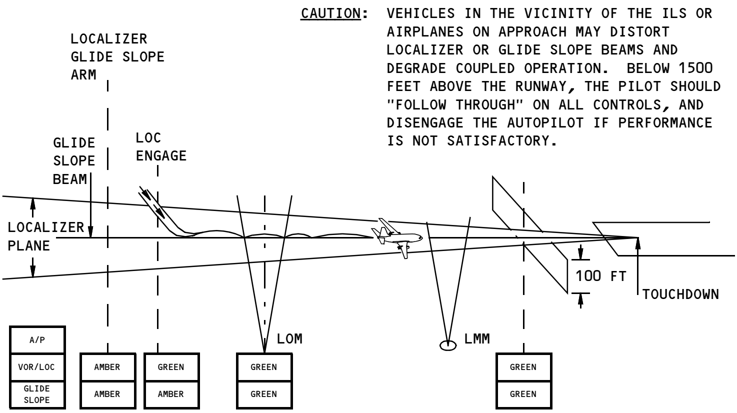
AUTOPILOT OPERATION
(HOLDING-VOR)



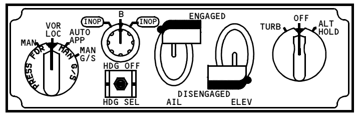
- VOR frequency - SELECT
- Course Pointer - 090°
- Autopilot Mode Selector - VOR/LOC
- VOR/LOC light - AMBER
- Maneuver airplane to intercept heading utilizing CWS or heading marker in HDG SEL.
- Heading Marker - Set to intercept angle (10° to 90°).
- VOR/LOC light - GREEN, at 2/5 dot on HSI and autopilot starts capture of selected course. Heading switch spring loads to center position.
- On course - VOR/LOC light green and autopilot crabs to compensate for wind drift to maintain course.
- Over station sensor is activated and autopilot will maintain heading at cone of confusion.
- Departing station - select new course with course pointer or select MAN mode and maneuver with CWS if course change is more than 15°.
- CWS at low detent level for pitch before and after capture and at high detent level for roll after capture.

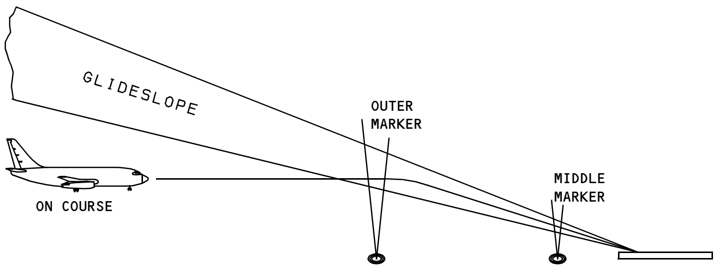
AUTOPILOT OPERATION
(NAVIGATION-VOR/LOC)

PRE-REQUISITES	VOR/LOC	GLIDE SLOPE	1500 FEET	DECISION HEIGHT	GO-AROUND
Autopilot engaged Localizer tuned Select "AUTO APP" Utilize CWS or HDG SEL for intercept	VOR LOC armed Engaged 2 dots from localizer beam	Glide slope armed Engaged at approx. 1/3 dot HSI fly up Airplane sets up descent approx. 700 fpm for 10 seconds and then follows the beam	Localizer and glide slope gain programming function of radio altimeter inputs	Disengage autopilot prior to landing	Disengage autopilot and fly manually. or Revert to CWS mode.



AUTOPILOT OPERATION
(ILS-AUTO APP)





SPLIT AXIS OPERATION (ROLL CHANNEL ONLY)

Autopilot control in roll axis only.
- VOR or localizer signal - SELECTED
- Autopilot Mode Selector - VOR LOC
- VOR/LOC Light - AMBER
- Autopilot Elevator Engage Switch - DISENGAGED
- Intercept Localizer Course - VOR/LOC LIGHT GREEN

Localizer capture is identical to AUTO APP mode or VOR LOC mode as previously described. Heading select may be utilized until localizer on-course where the Heading Select Switch moves to the spring-loaded center position.

Outer Marker or Approximate Glide Slope Intercept Point.
Utilize control column for pitch inputs. Pitch Mode Selector does not hold in ALT HOLD or TURB with Autopilot Elevator Engage Switch in the DISENGAGED position.

NOTE: Roll channel may be used in MAN and VOR LOC modes with inoperative pitch channel and operates normally as previously described.

AUTOPILOT OPERATION
(SPLIT AXIS APPROACH)

Non-ILS Approach (VOR/LOC/LOC-BC/NDB/ASR/LDA/SDF)

DME or other appropriate fix information is required to determine distance to the landing runway on final approach. The INS, Omega or equivalent navigation system (as installed) may be used to determine distance to the landing runway provided the flight crew verifies present position accuracy before to commencing the approach.

This procedure assumes the following approach preparations are complete:

- Navaids tuned and identified
- Final approach course set (VOR, localizer, etc.)
- RDMI/RMIs (as installed) show the appropriate course or bearing information
- Minimum descent altitude is set on altimeter reference marker (as installed)
- Approach briefing is complete
- For a straight-in approach, the landing configuration is established when on the final approach descent path
- For a circling approach, the circling configuration (gear down, flaps 15 or gear up, flaps 10) is established at or before the final approach descent point and landing configuration is established when intercepting the landing profile.

Recommended roll modes:

- VOR, localizer, LDA or SDF: VOR LOC
- LOC-BC, NDB or ASR: HDG SEL

Initially If on radar vectors: • HDG SEL • Pitch mode (as needed) If enroute to a fix: • Roll mode (as needed) • Pitch mode (as needed)	
Call "FLAPS___" according to the flap extension schedule.	Set the flap lever as directed.

When on an intercept heading to the final approach course:

Roll mode (as needed) .... Select

Approximately 2 NM before the final approach fix: • "GEAR DOWN" • Arm the speedbrake • Set the MDA(H) on the MCP	Approximately 2 NM before the final approach fix, call "APPROACHING GLIDE PATH."

At the final approach descent point (FAF or other appropriate fix):

Vertical Speed .... Select/Establish

Select or establish an appropriate vertical speed resulting in a constant angle approach (constant descent final approach) Initially, use a vertical speed corresponding to the airplane ground speed (shown on the approach chart). Once established on the final approach descent path, use distance and recommended height information on the approach chart (if available) to determine relative height to recommended vertical path. Make small and frequent adjustments to the vertical speed to maintain proper path and to comply with minimum altitudes on final approach. The MDA(H) will be reached at approximately the same position as the Visual Descent Point (VDP) shown on some approach charts.

If recommended height information is not available, use a path that approximates 3 degrees. To maintain a 3 degree constant angle approach path, make small but frequent adjustments to the vertical speed to comply with the following recommended heights above touchdown (HAT) and comply with the minimum altitudes on final approach:

Distance remaining to the Runway, NM										
NM	10	9	8	7	6	5	4	3	2	1
HAT (ft)	3000	2700	2400	2100	1800	1500	1200	900	600	300

On descent to MDA(H): • Call “FLAPS ___” as needed for landing. • Use CSWS pitch mode	
Call “LANDING CHECKLIST”	Do the LANDING checklist.
At the final approach fix, crosscheck the altimeters. Verify they agree within 100 feet.	
When at least 300 feet above the MDA(H), set the missed approach altitude on the MCP.	

For a straight-in approach:

At approximately 50 feet above MDA (H) and suitable visual reference established:

Autopilot .... Disengage

If suitable visual reference is not established:

Execute a missed approach.

For a circling approach:

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

Configuration at MDA(H):

- Gear down
- Flaps 15
- Arm speedbrake

Approaching MDA (H) and suitable visual reference is established:

Altitude Hold .... Engage

Maintain level flight and suitable visual reference while circling.

Set the missed approach altitude.

Use HDG SEL or CWS to maneuver.

Before starting the turn to base:

- Landing flaps
- Do the LANDING checklist

Intercepting the landing profile:

Autopilot .... Disengage

If suitable visual reference not established or is lost:

Execute a missed approach. If a missed approach is started while circling, make a climbing turn in the shortest direction toward the landing runway and comply with the published missed approach procedure.

Supplementary Procedures — Chapter SP

Communications — Section 5

Cockpit Voice Recorder Test

Test switch ....Push

After a slight delay, observe that the monitor indicator rises into the green band. A tone may be heard through a headset plugged into the headset jack.

The indicator remains in the green band and the tone continues until the switch is released.

Intentionally
Blank

Electrical Power Up

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

BATTERY switch .... Guard closed

STANDBY POWER switch .... Guard closed

ALTERNATE FLAPS master switch .... Guard closed

Windshield WIPER selector(s) .... OFF

ELECTRIC HYDRAULIC PUMPS switches .... OFF

LANDING GEAR lever ....DN

Verify that the green landing gear indicator lights are illuminated

Verify that the red landing gear indicator lights are extinguished

WEATHER RADAR .... Off

If external power is needed:

Verify that the GRD POWER AVAILABLE light is illuminated.

GRD POWER switch ....ON

Verify that the BUS OFF lights are extinguished.

Verify that the TRANSFER BUS OFF lights are extinguished.

Verify that the STANDBY PWR OFF light is extinguished.

If APU power is needed:

Verify that the engine No. 1, APU, and the engine No. 2 fire switches are in.

Alert ground personnel before the following test is accomplished.

Overheat and fire protection panel
(Passenger airplanes) .... Check

OVHT DET switches .... NORMAL

TEST switch .... Hold to OVHT/INOP

Verify that the MASTER CAUTION lights are illuminated.

Verify that the OVHT/DET annunciator is illuminated.

Verify that the ENG 1 OVERHEAT and ENG 2 OVERHEAT lights are illuminated.

Verify that the APU DET INOP light is illuminated.

Do not run the APU if the APU DET INOP light does not illuminate.

TEST switch ....Hold to FIRE

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Verify that the engine No. 1, APU, and engine No. 2 fire switches are illuminated.

Master FIRE WARN light ....Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the engine No. 1, APU, and engine No. 2 fire switches stay illuminated.

Overheat and fire protection panel (Cargo airplanes) ....Check

OVHT DET switches ....NORMAL

TEST switch ....Hold to OVHT/INOP/A SMOKE

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Verify that the MASTER CAUTION lights are illuminated.

Verify that the OVHT/DET annunciator is illuminated.

Verify that the ENG 1 OVERHEAT and ENG 2 OVERHEAT lights are illuminated.

Verify that the FWD and AFT CARGO SMOKE lights are illuminated.

Verify that the APU DET INOP light is illuminated.

Do not run the APU if the APU DET INOP light does not illuminate.

Master FIRE WARN light ....Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the MASTER CAUTION lights stay illuminated.

Verify that the OVHT/DET annunciator stays illuminated.

Verify that the ENG 1 OVERHEAT and ENG 2 OVERHEAT lights stay illuminated.

Verify that the FWD and AFT CARGO SMOKE lights stay illuminated.

Verify that the APU DET INOP light stays illuminated.

TEST switch .... Hold to FIRE/B SMOKE

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights are illuminated.

Verify that the engine No. 1, APU, and engine No. 2 fire switches are illuminated.

Verify that the FWD and AFT CARGO SMOKE lights are illuminated.

Master FIRE WARN light .... Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the engine No. 1, APU, and engine No. 2 fire switches stay illuminated.

Verify that the FWD and AFT CARGO SMOKE lights stay illuminated.

Extinguisher test switch .... Check

TEST EXT switch .... Push and hold

Verify that the three green extinguisher test lights are illuminated.

TEST EXT switch .... Release

Verify that the three green extinguisher test lights are extinguished

APU .... Start

Note: If extended APU operation is needed on the ground and the airplane busses are powered by AC electrical power, position an AC powered fuel pump ON. This will extend the service life of the APU fuel control unit.

Note: If fuel is loaded in the center tank, position the left center tank fuel pump switch ON to prevent a fuel imbalance before takeoff.

CAUTION: Center tank fuel pump switches should be positioned ON only if the fuel quantity in the center tank exceeds 1000 lbs.

CAUTION: Do not operate the center tank fuel pumps with the flight deck unattended.

When the APU GEN OFF BUS light is illuminated:

APU GENERATOR bus switches ....ON

Verify that the BUS OFF lights are extinguished.

Verify that the TRANSFER BUS OFF lights are extinguished.

Verify that the STANDBY PWR OFF light is extinguished.

Verify that the LOW OIL QUANTITY light is extinguished.

Verify that the APU LOW OIL PRESSURE light is extinguished.

Verify that the APU HIGH OIL TEMP light is extinguished.

Verify that the APU OVERSPEED light is extinguished.

Wheel well fire warning system .... Test

TEST switch .... Hold to FIRE only

Verify that the fire warning bell sounds.

Verify that the master FIRE WARN lights illuminate.

Verify that the WHEEL WELL light is illuminated.

Fire warning BELL CUTOUT switch ....Push

Verify that the master FIRE WARN lights are extinguished.

Verify that the fire warning bell cancels.

Verify that the WHEEL WELL light stays illuminated.

Electrical Power Down

This procedure assumes the Secure procedure is complete.

If APU was operating:

It is recommended that the APU be operated for one full minute with no pneumatic load prior to shutdown.

APU switch and/or GROUND POWER switch .... OFF

If APU was operating:

Delay approximately 20 seconds after APU shutdown for the APU door to close to assure the APU will start on the next flight.

BATTERY switch .... OFF

Standby Power Test

Battery switch .... ON

AC and DC meter selectors .... STBY PWR

APU GEN No. 2 switch or GRD PWR switch .... OFF

Turn OFF appropriate switch depending on power source in use. Removes power from TR3.

STANDBY POWER switch .... OFF

Check STANDBY PWR OFF light illuminated.

AC–DC voltmeters .... Zero

Captain's ADI (ATT/GYRO) flag .... In view

STANDBY POWER switch .... BAT

Check STANDBY PWR OFF Light extinguished

AC–DC voltmeters .... Check

AC voltmeter 115 +/- 5 volts

DC voltmeter 26 +/- 4 volts

Frequency meter .... Check

Check frequency meter for normal indication: 400 +/- 10 CPS.

Captain's ADI (ATT/GYRO) flag .... Out of view

Verifies that the AC standby bus is powered by the inverter (flag retraction may take up to 10 seconds.)

STANDBY POWER switch .... AUTO

APU GEN No. 2 switch or GRD PWR switch .... ON

Battery Start

(With APU bleed or ground air available)

Passenger oxygen shutoff valve (cargo airplanes) .... Set

- All cargo configuration .... CLOSED
- Passenger configuration .... OPEN

Maintenance documents .... Check

FLIGHT DECK ACCESS SYSTEM switch .... Guard closed

THRUST REVERSER OVERRIDE switches .... Guards closed

BATTERY switch .... Guard closed

System B HYDRAULIC PUMPS switches .... OFF

LANDING GEAR lever ....DN

Verify that the green landing gear indicator lights are illuminated.
Verify that the red landing gear indicator lights are extinguished.
Verify that the alternate gear safe lights are illuminated.

Weather radar .... OFF

Emergency equipment .... Check

- Fire extinguisher .... Checked and stowed
- Crash axe .... Stowed
- Escape ropes .... Stowed
- Other needed equipment .... Checked and stowed.

Flight recorder switch .... Guard closed

Circuit breakers (P6 panel) .... Check

Crew oxygen valve ....Open

Rain repellent .... Check

Verify that the float is above the line and the shutoff valve handle is in the vertical position.

Circuit breakers (control stand, P18 panel) .... Check

Accomplish the Interior and Exterior Inspection if required, except for items requiring electrical or hydraulic power.

Verify that the oxygen pressure is sufficient for flight.

Accomplish the following Preflight Procedure ....First Officer items:

Overheat and fire protection panel .... Check

OVERHEAT DETECTOR switches .... NORMAL

TEST switch ....Hold to OVHT/INOP

TEST switch ....Hold to FIRE

EXTINGUISHER TEST switch .... Check

APU switch
(bleed air source, if available) .... START

On the captain's command, the first officer reads and the captain does the following items:

Oxygen ....Test and set

Standby power switch .... BAT

GALLEY power switch .... ON

EMERGENCY EXIT LIGHTS switch ....Guard closed

Passenger signs ....Set

HYDRAULIC PUMP switches .... ON

Air conditioning panel ....Set

PACK switches ....One switch AUTO or HIGH, one switch OFF

Engine BLEED air switches ....ON

APU BLEED air switch ....ON

SPEED BRAKE lever ....DOWN detent

Reverse thrust levers ....Down

Forward thrust levers .... Closed

Parking brake .... Set

Note: The wheels should be chocked in case the brake pressure has bled down.

Engine start levers .... CUTOFF

Papers .... Aboard

When cleared for Engine Start, do the following:

Air conditioning PACK switches .... OFF

ANTICOLLISION light switch ....ON

Gravel protect switch (as installed) ....As required

Engine Start

Engine No. 2 start .... Accomplish

Only the self-generating and standby bus powered engine instruments will be operative (N1, N2 and EGT.)

If APU air is being used, starter cutout can be confirmed by a definite drop in APU EGT. The START VALVE OPEN light extinguishes.

Generator 2 switch ....ON

Engine instruments .... Check

Verify that the following are sufficient for flight:

- hydraulic quantity
- engine oil quantity

Engine No. 1 start .... Accomplish

Generator 1 switch ....ON

Cabin pressurization panel .... Set

FLIGHT ALTITUDE indicator .... Cruise altitude

LANDING ALTITUDE indicator Destination field elevation

CABIN rate selector ....Index

CABIN ALTITUDE indicator ..... 200 feet below destination field elevation

FLT/GRD switch .... GRD

Pressurization mode selector .... AUTO

Verify that the STANDBY light is extinguished.

Verify that the MANUAL light is extinguished.

Complete the Preliminary Preflight Procedure - Captain or First Officer by doing the following items:

SERVICE INTERPHONE switch.. OFF

Oxygen panel .... Set

CREW OXYGEN pressure indicator .... Check

Verify that the pressure meets dispatch requirements.

Note: PASSENGER OXYGEN switch activation causes deployment of the passenger oxygen masks.

PASSENGER OXYGEN switch .... Guard closed

Verify that the PASS OXY ON light is extinguished.

Manual gear extension access door .... Closed

Accomplish the normal Preflight Procedure -First Officer, Preflight Procedure - Captain, Before Start Procedure and Before Taxi Procedure to ensure that the flight deck preparation procedure is complete.

BEFORE TAXI checklist .... Accomplish

The airplane is ready for taxi. Refer to the normal checklists for subsequent checks.

Engine Crossbleed Start

Do not accomplish a crossbleed start during pushback.

Before using this procedure, ensure that the area to the rear is clear.

Increase thrust on the operating engine until there is a minimum of 30 psi duct pressure.

Engine BLEED air switches .... ON

APU BLEED air switch .... OFF

PACK switches .... OFF

ISOLATION VALVE switch ....AUTO

Ensures bleed air supply for engine start.

Engine thrust lever (operating engine) .... Advance thrust lever until bleed duct pressure indicates 30 PSI

CAUTION: With gravel protection installed, do not exceed 1.4 EPR on gravel or contaminate surfaces.

Non–operating engine .... Start

Use normal start procedures with crossbleed air.

After starter cutout, adjust thrust on both engines, as required.

Manual Engine Start

An engine with an inoperative starter valve may be started by operating the valve manually. When this procedure is used, review the items listed and coordinate the procedure closely with ground personnel.

Use normal start procedures with the following additions:

Direct ground crewman to open the starter valve when “START ENGINE NO. ____ “is announced.

Direct ground crewman to release starter valve override when “RELEASE” is announced.

Engine start switch .... GRD

The captain announces over interphone, and to flight crew, “START ENGINE NO. _____.”

Inform ground crewman when N2 is rotating.

Normal start procedures .... Observe

When N2 RPM indicates 35%, the captain announces over interphone, “RELEASE.”

Engine start switch .... OFF

Observe the start switch moves to OFF and duct pressure increases to the prestart value.

Starting at High Airport Elevation

During engine start at very high altitude airports, if an engine will not accelerate to idle and fails to respond to thrust lever movement; shut down the engine by placing the start lever to CUTOFF, and continue motoring the engine until fuel is purged from the aft section (observe starter limitations.)

Set the thrust lever approximately one inch forward of the closed position and restart the engine. Normal engine start and acceleration should result. Maintain RPM slightly above idle. Minimum duct pressure for start may be reduced 0.5 psi per 1000 feet above sea level.

Performance Data Computer System

MODE	PAGE	PAGE NO.	DESCRIPTION
STBY	 STANDBY CONFIG SELF TEST	 (1-3) (2-3) (3-3)	Standby is used for data entry and automatic system verification. µ Indication of system power status and program number. µ Airplane and engine identification. µ Indication of system self test results.
TO	 FULL REDUCED	 (1-2) (2-2)	Displays takeoff EPR limits for the temperature entered and takeoff mode. µ Full takeoff thrust. µ Reduced thrust takeoff.
CLB	ECON RATE MANUAL LIMIT	(1-4) (2-4) (3-4) (4-4)	Climb EPR and speeds for the desired climb profile. µ Best economy schedule; minimizes overall operating expense. µ Maximum rate of climb to minimize climb time. µ Crew selected climb speed. µ Maximum climb Eprs.
CRZ	ECON LRC MANUAL LIMIT	(1-4) (2-4) (3-4) (4-4)	Cruise EPR and speeds for the desired cruise schedule: µ Most economical cruise speed for altitude and gross weight. µ Approximates best operational fuel mileage. µ Crew selected speed. µ Maximum cruise EPR.
DES	ECON MANUAL	(1-2) (2-2)	Descent speed, time, and distance. µ Most economical schedule. µ Crew selected speed.
HOLD	HOLD	1 page	Holding EPR, speed and endurance time.
CON	E/OUT MAX E/OUT LRC LIMIT	(1-3) (2-3) (3-3)	Continuous EPR limit and engine out data. µ EPR limits, speed guidance to maximize altitude capability and new flight level. µ Same as (1-3) except flight level is for LRC. µ EPR limits.
GA	LIMIT	1 page	Go-around EPR limit for existing altitude and temperature and V_{REF}.
TURB	TURB	1 page	Turbulent air penetration speed, pitch attitude, and N1 for level flight.

FLIGHT MODES SUMMARY

PERFORMANCE FUNCTIONS	PAGE	PAGE NO.	DESCRIPTION
LOAD			Permits flight data entry to enable the system to compute takeoff EPR, gross weight, optimum descent distance, and airspeeds.
	LOAD	(1-2)	µ Outside air temperature, destination elevation, reserves and alternate fuel, and zero fuel weight.
	LOAD	(2-2)	µ Flight index, flight level restriction, speed restriction.
ALTITUDE INTERCEPT			Used to solve time/distance and flight level intercept problems during climb and descent.
	X↑ECON	(1-5)	µ Most economical schedule to climb to desired altitude.
	X↑RATE	(2-5)	µ Schedule for maximum rate of climb to desired altitude.
	X↑MANUAL	(3-5)	µ Schedule for crew-selected climb speed to desired altitude.
	↓XECON	(4-5)	µ Most economical schedule to descend to desired altitude.
	↓XMAN	(5-5)	µ Schedule for crew-selected descent speed to desired altitude.
FLIGHT			Used to determine optimum flight level, maximum altitude capability, and the wind altitude trade considerations.
	FL ECON	(1-3)	µ Flight level information for ECON speed schedule.
	FL LRC	(2-3)	µ Flight level information for LRC speed schedule.
	FL MANUAL	(3-3)	µ Flight level for manually entered speed schedules.
GROUND SPEED	GS	1 page	Computes groundspeed and wind, or time and distance to a waypoint or destination.
RANGE			Displays total endurance, distance and time remaining to reserve fuel quantity or empty tanks at any flight level.
	RNG ECON	(1-5)	µ Endurance, distance and time remaining to reserves at flight level shown, for economy speed schedule.
	RNG LRC	(2-5)	µ Same as RNG ECON except LRC schedule is used.
	RNG MANUAL	(3-5)	µ Same as RNG ECON except crew selects speed schedule. Also displays MACH and IAS.
	RNG E/OUT	(4-5)	µ Same as RNG ECON but for engine out. Also displays MACH and IAS.
	RNG HOLD	(5-5)	µ Endurance and time to reserves at flight level shown for race track holding pattern.

PERFORMANCE FUNCTIONS SUMMARY

PERFORMANCE FUNCTIONS	PAGE	PAGE NO.	DESCRIPTION
FUEL			Displays total fuel, fuel reserves and fuel over destination, (FOD).
	FUEL ECON	(1-4)	µ For inserted distance, displays, FOD, RSV + ALT, total fuel weight, and wind for CRZ ECON speed schedule.
	FUEL LRC	(2-4)	µ Same as FUEL ECON except CRZ LRC speed schedule is used.
	FUEL MAN	(3-4)	µ Same as above for manual speed schedule.
	FUEL E/OUT	(4-4)	µ Same as above for CON ENG OUT speed schedule.
TEMPERATURE			Displays temperatures for ISA¯, TAT, and SAT, and TAS.
	TEMP	(1-2)	µ Displays ISA¯, TAT, SAT, and TAS.
	TEMP	(2-2)	µ Calculates ISA¯ or SAT for given FL.
REFERENCE SPEED	VREF	1 page	Displays reference speed for landing.
TRIP PLANNING	TRIP	1 page	Displays most economical cruise flight level for trip distances, ISA¯, and wind.
WIND			Displays automatically computed or manually entered wind data.
	WIND Ω	(1-4)	µ OMEGA wind data and update status for OMEGA input.
	WIND AUTO	(2-4)	µ DME wind data and update status for 1st DME input.
	WIND AUTO	(3-4)	µ Same as above for 2nd DME input (if installed).
	WIND MAN	(4-4)	µ Wind direction, wind velocity, course, longitudinal wind component and update status for manually entered wind direction, wind velocity and airplane course.

PERFORMANCE FUNCTIONS SUMMARY (cont)

Note: The CDU displays shown in this section are representative only and may not reflect the precise values for any airplane/engine configuration.

Preflight

Checking the System

Flight mode selector .... STBY

```
STANDBY   1-3


PART NO.
10-61962
```

Confirm that the correct program number and part number are in use by comparing this number to the correct number provided by the airline.

Page forward key .... Push

```
CONFIG     2-3
  737-200
WEIGHTS    KGS
ENGINES  JT8D

-15        -15
```

Confirm that the correct airplane type, weight units and engine type are stored in the computer.

PAGE forward key .... Push

```
SELF TEST 3-3

  VALID
```

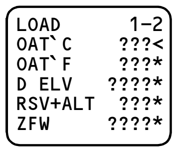
The computer will perform a self-test. If the self-test is not satisfactory, it will display INVALID and in some cases the type of failure. Partial capability may still exist.

ENGAGE key .... Push

Observe the mode annunciator cycles through all modes and return to STBY, the airspeed bugs drive to 110 knots and return to the stowed position at 440 knots, and the EPR bugs drive to 2.60 and return to the stowed position at 1.00.

Entering flight data:

LOAD key .... Push



OAT .... Enter

Push the CLR key with the caret on either the °C or °F line. The question marks erase and the caret blinks. Push the numbered keys. Check the number on the display for correctness and then push the ENT key.

Remaining data .... Enter

Enter the destination airport elevation, reserve plus alternate fuel quantity and zero fuel weight in the same manner.

Note: If any parameter on the load page is changed when engaged in any mode other than standby, in order to ensure data is duplicated on all applicable pages, accomplish the following:

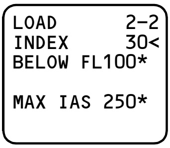
RCL key .... Push

Observe that the page for the engaged mode is displayed and that the light in the ENGAGE key illuminates.

ENGAGE key .... Push

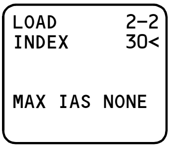
The changed information is now duplicated on all applicable pages.

PAGE forward key .... Push



Line 2 displays the flight index number.

Lines 3 and 4 display the preset low altitude/airspeed restrictions. If restrictions have not been pre-entered, the bottom line will read: MAX IAS NONE.

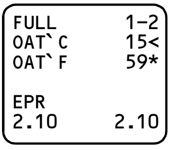


Flight index numbers and low altitude flight levels and airspeeds can be entered from the CDU, if required.

Flight Modes:

Takeoff

Flight mode selector .... TO



Crew calculated and PDCS takeoff EPR are checked to ensure that they are consistent. If there is a difference in value of more than .01 EPR, check initial data loaded and performance chart EPR. PDCS and calculated EPR will not be the same if existing aircraft bleed configuration is different from that used for calculations. Should a difference still exist, use manual EPR bug operation and calculate EPR values for takeoff.

If a reduced thrust takeoff is desired, select page 2:

```
REDUCED 2 - 2
OAT`C    ??? <
OAT`F    ??? *

EPR
```

The EPR values are not displayed until the assumed takeoff temperature is entered into the computer.

The assumed takeoff temperature may be determined from airport analysis data.

ENGAGE key .... Push

Observe the ENGAGE light extinguishes, TO is annunciated and the EPR bugs drive to the displayed values.

Airspeed selector .... Pulled out

Set airspeed bug(s) for manual operation.

Climb

When climb thrust is desired:

Flight mode selector .... CLB

```
ECON     1 - 4
IAS        311
MACH      .700
WIND         0
EPR
2.06      2.06
```

Select the desired page for climb.

Page 1 displays values for ECON; maximum economy climb.

Page 2 displays values for RATE; maximum rate of climb.

Page 3 displays values for MANUAL; a manually entered speed schedule.

Page 4 displays EPR limit; climb limit thrust only.

Airspeed selector .... Pushed in

ENGAGE key .... Push

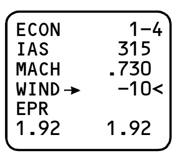
Observe the ENGAGE light extinguishes, CLB is annunciated and the EPR bugs drive to the displayed values.

Note: All CLB pages use the low altitude/speed restriction as discussed on page 2 of LOAD.

Cruise

Prior to the top of climb the PDCS should be set for cruise:

Flight mode selector .... CRZ



Select the desired page for cruise.

Page 1 displays values for ECON; the most economical cruise.

Page 2 displays values for LRC; long range cruise.

Page 3 displays data for MANUAL; a manually entered cruise speed schedule.

All values are computed for the present gross weight and altitude. An updated wind component should be entered if available.

Engage the preselected PDCS cruise flight mode after the displayed cruise airspeed/Mach is achieved.

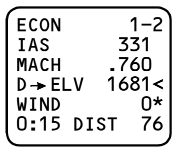
ENGAGE key ....Push

Observe the ENGAGE light extinguishes, CRZ is annunciated and the EPR bugs drive to the displayed values.

Descent

When approaching the area where the start of descent is anticipated, the PDCS should be set for descent:

Flight mode selector ....DES



Select the desired page for descent.

Page 1 displays values for ECON; the most economical descent profile.

This display indicates descent from present altitude to destination, elevation 1681 feet, requires 15 minutes and 76 miles if the ECON airspeed/Mach is maintained.

The time and distance display blanks when the airplane is less than 2000 feet above the destination airport.

Page 2 displays MANUAL; a manually selected MACH/airspeed schedule.

Engage the preselected PDCS descent flight mode when the descent is initiated:

ENGAGE key ....Push

Observe the ENGAGE light extinguishes, DES is annunciator illuminates and airspeed bug(s) drive to the displayed value.

The EPR bugs drive to 1.0 EPR. Descend maintaining target airspeed. Both descent pages assume idle thrust, or 55% N1 if anti-ice is on. EPR bug settings should not be used in this mode.

If anti-ice is turned on during descent, time and distance calculations assume the throttles are set at 55% N1 and change accordingly. Descent IAS does not change as a function of anti-ice.

Note: DES pages use the low altitude speed restriction as displayed on page 2 of LOAD.

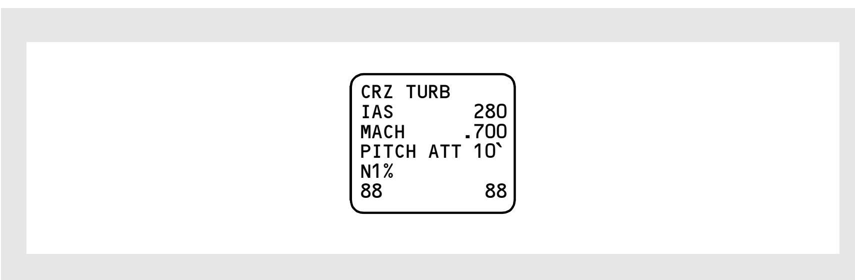
Turbulent Air Penetration

The TURB key displays information for turbulent air penetration information in cruise. It is necessary to have the flight mode selector positioned to CRZ to engage the turbulence mode of operation. CRZ must be engaged:

Flight mode selector .... CRZ

ENGAGE key .... Push

TURB key .... Push



CRZ and TURB are annunciated. Target Mach/airspeed, N1 and pitch attitude necessary to maintain present altitude at turbulence penetration airspeed are displayed.

Note: TURB data is displayed for reference during manual flight.

To disengage TURB:

TURB key .... Push

The mode annunciator returns to the cruise mode.

Holding

The information displayed on the HOLD page is based on minimum fuel usage at present holding altitude, at the present gross weight, with flaps up in a standard race track holding pattern:

Flight mode selector .... HOLD

```
HOLD
M.680 IAS 210
TIME→R+A 3:55
     →E   4:55
EPR
1.86      1.86
```

Line 2 indicates MACH and/or airspeed for holding.

Line 3 displays endurance time in hours and minutes to reserve fuel levels (R+A.)

Line 4 shows endurance time in hours and minutes to empty fuel tanks.

ENGAGE key ....Push

Observe the ENGAGE light extinguishes, HOLD is annunciated and the airspeed and EPR bugs drive to displayed values.

Continuous Thrust

Pages 1 and 2 provide data for one engine inoperative operation. They display maximum continuous thrust EPR limits, time and distance and MACH/airspeed for driftdown to, or climb to, a maximum flight level which can be maintained with one engine inoperative.

Page 3 displays maximum continuous thrust EPR limits only.

Example: Engine failure at an altitude above maximum flight level for one engine inoperative.

Flight mode selector .... CON

```
E/OUT MAX 1-3
0:8 DIST   35
MAX FL    260
M.700 IAS 280
EPR
2.26     1.00
```

Line 2 is in the time and distance to level off at the maximum flight level (line 3.)

Line 4 is the target MACH/airspeed for the best possible driftdown flight path.

EPR values are for MCT

Page 2 displays data similar to page 1 except the flight level displayed is the maximum flight level at which LRC speed can be maintained using MCT with one engine inoperative.

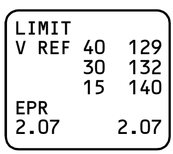
ENGAGE key .... Push

Observe the ENGAGE light extinguishes, CON is annunciated and the airspeed and EPR bugs drive to displayed values.

Go–Around

Prior to commencing approach:

Flight mode selector .... GA



VREF speeds are based on present gross weight. Go-around EPR limits are based on present total air temperature and pressure altitude.

Airspeed selector ....Pulled out

Set airspeed bugs for manual operation.

Engage the GA flight mode when it is desired to have the EPR bugs drive to the displayed EPR values.

ENGAGE key .... Push

Observe the ENGAGE light extinguishes, GA is annunciated and the EPR bugs drive to the displayed values.

Note: If the airspeed selector remains in PDCS control, the airspeed bugs drive to the stowed position, 440 KTS.

Performance functions:

Checking Altitude Intercepts

Displays time and distance to intercept of a selected altitude from the airplane’s present altitude. Any one of the three variables, altitude, time or distance may be entered into the PDCS in order to obtain the other two values. Five pages are provided to display intercept data.

Climb intercept – ECON – most economical climb.

Climb intercept – RATE – maximum rate of climb.

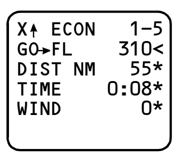
Climb intercept – MANUAL – climb with a manually selected airspeed.

Descent intercept – ECON – most economical descent.

Descent intercept – MANUAL – descent with a manually selected airspeed.

Example: The airplane’s present altitude is 27,000 feet in economy cruise. It is desired to find time and distance to 35,000 feet.

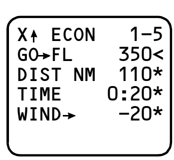
Intercept key .... Push



The initial display always shows time and distance for present altitude plus 4000 feet (or minus in the case of descent) of altitude change.

To display time and distance to 35,000 feet, enter 350 on the GO-FL line and if a new wind component is available enter it on the WIND line.

Now the display shows:



Lines 3 and 4 display time and distance required to reach the new altitude.

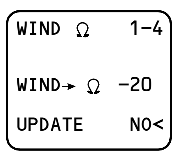
Checking the Wind (WIND)

The WIND performance function automatically computes the wind component from DME-1, DME-2 or from manually entered values of wind direction, wind velocity and airplane course direction.

The displayed headwind/tailwind component is only valid if the airplane is flying directly to or from the DME station.

A displayed minus sign (-) indicates a headwind component. Absence of a sign indicates a tailwind component.

WIND key .... Push



Line 2 is the wind component.

To update the PDCS with this wind information:

CLR key .... Push

The caret blinks. NO changes to YES.

ENT key .... Push

The caret stops blinking. The PDCS is now updated.

When the wind component is “updated” all flight mode and performance function pages which specify wind are simultaneously updated.

Page 2 displays the wind component computed from DME–1.

Page 3 displays the wind component computed from DME–2.

Page 4 is used for computation of the wind component from manually entered data:

```
WIND MAN   4-4
W/DIR     ???<
W/VEL     ???*
COURSE    ???*
WIND →
UPDATE     NO*
```

Checking the Flight Level (FL)

FL furnishes data the crew requires to fly an optional step climb schedule in cruise. FL displays provide continuously updates values of maximum and optimum cruise flight levels for ECON, LRC and MANUAL speed schedules based on current flight conditions. Each display also contains present flight level information making deviations from the optimum flight level readily apparent. Buffet margin for each flight level and wind-altitude trade data is also displayed.

Example: The airplane's present altitude is 27,000 feet in economy cruise. It is desired to check optimum flight level for ECON CRZ.

FL key ....Push

```
FL ECON    1-3
OPT 1.54.310
MAX 1.41/330
FL  1.70/270<
‾ WIND      0
```

Line 2 is the optimum altitude of 31,000 feet with a buffet margin of 1.54 gs.

Line 3 is the maximum altitude of 33,000 feet with a buffet margin of 1.41 gs.

Line 4 is present flight level and buffet margin.

To check wind-altitude trade data for 31,000 feet, enter flight level 31,000 on line 4.

```
FL ECON    1-3
OPT 1.54/310
MAX 1.41/330
FL  1.49/310<
¯ WIND    -10
```

Line 5 now shows you can accept 10 knots less tailwind or 10 knots more headwind at FL 310 without affecting your fuel mileage.

Checking the Temperature and TAS (TEMP)

When desired, the PDCS may be used to check the SAT, TAT, ISA deviation and TAS.

TEMP key .... Push

```
TEMP        1-2
ISA   ¯`C    5
TAT `C    -20
SAT `C    -40
SAT `F    -40
TAS KT    320
```

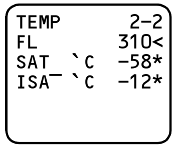
This display is information only; no entries can be made.

Page 2 converts SAT to ISA deviation at any altitude; this is most frequently done as part of the preflight planning activity.

PAGE FORWARD key .... Push

```
TEMP        2-2
FL         ???<
SAT_  `C   ???*
ISA¯   `C ???*
```

Entering flight level and SAT causes the PDCS to compute and display the ISA deviation.



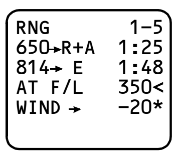
Alternately, entering the flight level and ISA deviation causes the computer to display the corresponding SAT.

Checking the Range (RNG)

RNG is operational only when CRZ, CON or HOLD is selected.

To find the range capability on the remaining fuel quantity at the present flight level or any other flight level:

RNG key .... Push



The display shows range data corresponding to the engaged cruise speed:

Line 2 is range to total fuel reserve fuel quantity. Line 3 is range to empty tanks. The flight level and wind may be changed as desired.

Page 2 displays RNG LRC.

Page 3 RNG MANUAL provides data for a manually selected airspeed.

Page 4 displays RNG E/OUT information for one inoperative engine and maximum continuous thrust (MCT.)

Page 5 RNG HOLD gives endurance data for holding.

Checking the Fuel (FUEL)

The FUEL performance function is operational only when CRZ or CON is selected.

To determine the total fuel on board or the fuel remaining over destination:

FUEL key .... Push

```
FUEL ECON 1-4
DIST NM   850<
RSV+ALT   4.4
FOD       8.4
WIND →    -10*
FUEL WT   15.7
```

The display shows range data corresponding to the engaged cruise page.

Line 2 - enter distance to go. The display shows entered distance to go.

Line 3 displays total of reserve fuel plus alternative fuel entered on the load page in thousands of KGS.

Line 4 displays fuel remaining over destination or waypoint at the CRZ ECON speed for the present altitude and distance to go in thousands of KGS.

Line 5 displays the wind component the data is based on.

Line 6 displays total fuel quantity remaining in thousands of KGS.

Page 2 FUEL LRC is the same as ECON except CRZ LRC speed is used.

Page 3 FUEL MAN is the same as ECON except CRZ MAN speed is used.

Page 4 FUEL E/OUT is the same as ECON except CON ENG OUT speed is used.

Checking the Ground Speed (GS)

GS is operational only if CRZ or CON is selected.

The ground speed performance function enables the crew to determine the present ground speed and to solve time/distance/speed problems.

GS key .... Push

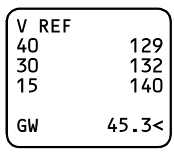
```
GS         437<
TAS        427
WIND→       10*
TIME      ????*
DIST NM   ????*
```

The ground speed initially shown is current ground speed; it may be changed. Changing the ground speed causes the PDCS to compute and display the corresponding wind or vice versa. For any two entered numbers the system computes and displays the remaining two; thus entering GS and DIST results in a display of computed WIND and TIME, etc.

Checking V REF (V REF)

When desired, the PDCS can be used to check V REF speeds for flaps 15, 30 and 40.

V REF key .... Push

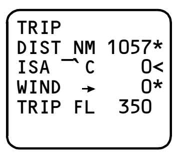


The initial display shows data for the airplane's current gross weight. However, other GW's such as predicted landing GW may be entered to provide V REF for landing.

Checking Optimum Trip Flight Level (TRIP)

After LOAD data has been entered:

TRIP key .... Push



Enter the trip distance.

Line 2 displays entered trip distance.

Lines 3 and 4 display 0 for ISA deviation in °C and the WIND component. If known, these values may be entered.

Line 5 displays optimum flight level for economy cruise.

Changing ISA deviation in °C or WIND may change the displayed optimum TRIP FL.

Error and alert message displays:

The PDCS provides error and alert message displays as a crew advisory.

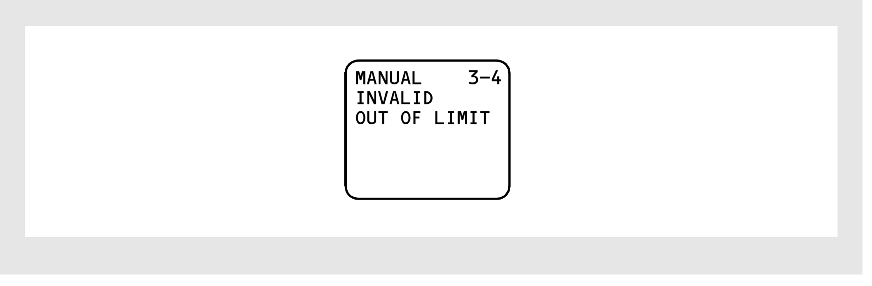
Error messages are in two categories:

Crew correctable errors – such as invalid entry or an invalid flight configuration. These can be cleared by pressing recall.

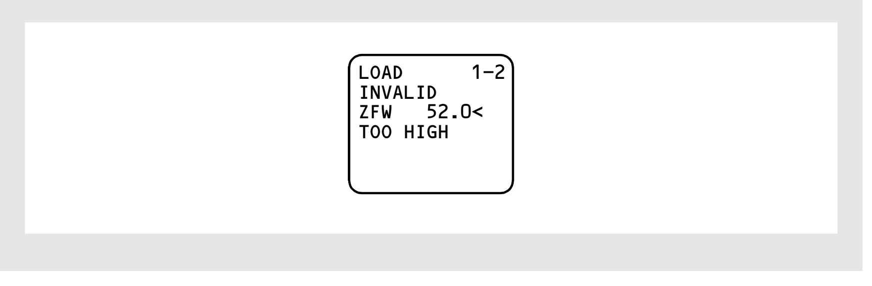
System failures – such as the failure of an input or a system self-test failure. System failures are discussed in Malfunctions.

Some typical crew correctable errors are shown in the following displays.

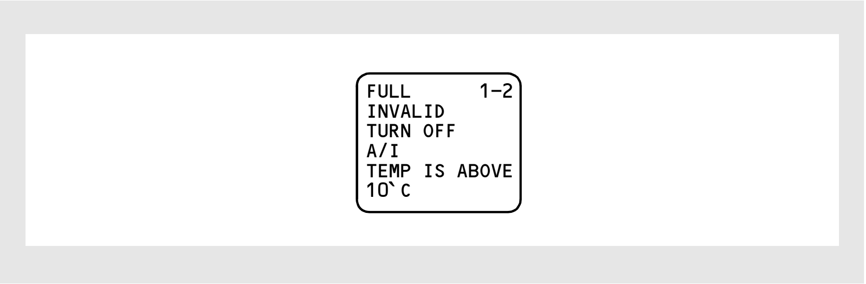
An invalid entry is displayed in the example:



“OUT OF LIMIT” indicates that the value entered is outside the airplane’s performance flight envelope.



This example displays a situation concerned with an entered ZFW that is higher than MAX ZFW.



The first page of TO indicates that engine anti-ice has been switched on when the temperature is greater than 10° C. Push recall to clear the message.

For all flight modes and the appropriate performance functions; when the displayed (or engaged) speed and altitude put the airplane closer to buffet than an internal PDCS preset value allows, an alert message is displayed.

This example is a typical alert message display for buffet:

Line 2 for flight modes shall show DISPLAYED or ENGAGED, determined by which data caused the alert message.

Lines 3, 4 and 5 display the alert information.

To clear the buffet margin ALERT message and to continue operation with the reduced level, push RECALL.

Malfunctions:

Blank display

A blank display indicates an internal power supply failure, a character generator failure or a lack of signals between the CDU and the computer. The PDCS cannot be used.

Failure messages

A failure message is displayed if there is a PDCS input failure or an internal PDCS failure. Except for the failures noted below, the PDCS is unusable.

Use EPR limit

A display of USE EPR LIMIT indicates a failure of the fuel summation unit. This failure causes the PDCS to lose its gross weight information.

Note: There is not a failure message for an inoperative fuel quantity indicator; however an inoperative indicator creates an error in the PDCS gross weight computation.

In the event of a USE EPR LIMIT display or an inoperative fuel quantity indicator, the PDCS may only be used to display limit EPR for each thrust rating.

Max Climb EPR is displayed on CLB page 4. Max Continuous EPR is displayed on CON page 3. Go-Around EPR is displayed on the GA page.

The TO mode is not affected by the failures.

Ind F/B

A display of IND F/B indicates failure of the engine's EPR input to the PDCS computer. This failure affects only the K–factor calculation, if active, (actual EPR is adjusted for drag.) All other modes and performance functions are normal.

DME failure

A display of DME FAILURE indicates a failure of the DME system input to the PDCS computer. The WIND information associated with the failed system is unusable.

Mach Trim Test

Prior to test:

System B hydraulic pumps ....ON

Flight control switches ....ON

Flaps .... UP

Autopilot .... DISENGAGE

MACH TRIM FAIL light .... Extinguished

Test:

MACH TRIM
TEST switch .... Push and hold for 10 seconds

The MACH TRIM FAIL light illuminates and the control columns move aft approximately one inch. Upon release of the TEST switch, the control columns reposition forward and the MACH TRIM FAIL light extinguishes.

Stabilizer Trim Operation with a Forward or Aft CG

In the event the stabilizer is trimmed to the end of the electrical trim limits, additional trim is available through the use of the manual trim wheels. If manual trim is used to position the stabilizer beyond the electrical trim limits, the stabilizer trim switches may be used to return the stabilizer to the electrical trim limits.

Intentionally
Blank

Altitude Alert Test

Acquisition test:

Altitude selector ....Rotate

Set the altitude counter to be more than 1000 feet higher or lower than the captain’s altimeter indication.

Altitude selector .... Reset

Reset the altitude counter to agree with the captain’s altimeter. When the altitude counter indicates a difference from the captain’s altimeter of approximately 1000 feet, the audio tone sounds for two seconds and the ALTITUDE ALERT lights illuminate steady.

The light extinguishes when the altitude counter indicates a difference from the captain’s altimeter of approximately 375 feet.

Altimeter Difference

Note: If flight in RVSM airspace is planned, use the RVSM table in the limitations section.

This procedure is accomplished when there is a noticeable difference between the altimeters. Accomplish this procedure in stabilized level flight or on the ground.

Altimeters .... Set

The reference barometric setting for this check is field barometric pressure or standard barometric pressure (29.92 in Hg or 1013 mb) as appropriate. Perform the following for all altimeters:

- First rotate the Baro Set knob clockwise to a higher barometric setting than the reference.
- Then rotate the Baro Set knob counterclockwise back to the reference barometric setting.

Altimeters .... Crosscheck

Maximum differences between the altimeter readings:

ALTITUDE	ELEC/ELEC	ELEC/STBY
Sea level	50 feet	50 feet
5,000 feet	50 feet	80 feet
10,000 feet	60 feet	120 feet
15,000 feet	70 feet	see note
20,000 feet	80 feet	see note
25,000 feet	100 feet	see note
30,000 feet	120 feet	see note
35,000 feet	140 feet	see note
40,000 feet	160 feet	see note

Note: Above 10,000 feet and .4 Mach, position error causes the tolerance to diverge rapidly and direct crosscheck becomes inconclusive. Between 10,000 feet and 29,000 feet, differences greater than 400 feet should be suspect and verified by ground maintenance checks. Between 29,000 feet and the maximum operating altitude, differences greater then 500 feet should be suspect and verified by ground maintenance checks.

If it is not possible to identify which altimeter is indicating the correct altitude:

ATC ....Notify

QFE Operation

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

Cabin pressure barometric counter .... Set QFE

Altimeters ....Set

Set altimeters to QFE when below transition altitude/level.

Note: If the QFE altimeter setting is beyond the range of the altimeters, QNH procedures must be used with QNH set in the altimeters.

Landing Altitude Indicator .... Set at zero

Cabin Altitude Indicator ....Set at -200

Navigation/General

Flight Director Tests

Mode selector .... OFF

Verify the flight director command bars are out of view.

HDG Mode

Mode selector .... HDG

Heading selector .... Rotate

Rotate the heading cursor left and right through the airplane heading. The flight director command bars display roll commands to follow the heading cursor.

Pitch command .... Rotate

Rotate the pitch command control up and down. The flight director command bars display pitch command to follow the movement of the pitch command control.

Altitude hold switch .... ON

Pitch command control .... Rotate

The flight director command bars should not move.

MAN GS Mode

This test may be made in conjunction with the HSI test.

VHF navigation radio .... Set

Tune radio to a non-receivable LOC frequency.

Verify the flight director command bars are straight and level.

Mode selector .... MAN GS

Verify VOR/LOC and GLIDE SLOPE annunciator lights illuminate green when MAN GS is selected. Align HSI course pointer with the lubber line.

ILS test switch .... LEFT

Verify flight director command bars up and left, glideslope pointer one dot up and course deviation bar one dot left.

ILS test switch .... RIGHT

Verify flight director command bars down and right, glideslope pointer one dot down and course deviation bar one dot right.

HSI and VHF NAV Tests

HSI/VOR RMI Test

If this test is conducted in flight, it affects the flight director in VOR/LOC, AUTO APP and MAN GS modes.

No. 1 VHF navigation radio .... Set

Tune radio to a VOR frequency.

Course selector .... Set

Set course 000 in course selector window.

VOR TEST switch .... Push

Verify course deviation bar centered, TO/FROM flag indicates FROM and the No. 1 VOR pointer indicates approximately 180 degrees.

HSI/ILS Test

Note: Operating the ILS test switch causes the autopilot mode selector to trip to MAN mode.

No. 1 VHF navigation radio .... Set

Tune radio to an ILS frequency.

Verify navigation and glide slope warning flags are out of view.

ILS test switch .... LEFT and hold

Verify glideslope pointer indicates one dot up and course deviation bar one dot left.

ILS test switch .... RIGHT and hold

Verify glideslope pointer indicates one dot down and course deviation bar one dot right.

NAV test switch .... Release

Instrument Comparator Test

No. 1 VHF navigation radio .... Set

Tune radio to an ILS frequency.

Instrument comparator test switch .... Push

Verify the comparator light (pilots' panels) illuminate.

Instrument comparator test switch .... Release

Verify the comparator light extinguish.

Low Range Radio Altimeter Test

MDA cursor .... Set

Set MDA cursor 100 feet above test altitude.

[MDA light illuminates.]

Test switch .... Push and hold

Warning flag appears and altitude pointer moves to preset test altitude.

MDA cursor .... Reset

While holding the test switch, rotate MDA cursor to zero feet. The MDA light extinguishes when the MDA cursor goes below test altitude.

Test switch .... Release

Altitude pointer returns to zero and warning flag is out of view.

DME Test

Airplanes with indicator in HSI:

VHF navigation radio .... Select VOR frequency

DME test switch .... Push

Verify that both DME indicators for the DME being tested drive to 000 miles.

DME test switch .... Release

Airplanes with separate digital indicator:

VHF navigation radio .... Select VOR frequency

DME switch .... TEST

Verify both DME indicators being tested go blank for one second, then display dashes for one second, then display zeroes until the switch is released.

Transponder Test

ATC transponder test switch ....TEST

Check that the REPLY light illuminates.

On airplanes with TCAS, verify "TCAS SYSTEM TEST OK" aural sounds.

Note: The REPLY light will also illuminate if the system is being interrogated by a ground station.

Aural Alerts	Definition
"TCAS SYSTEM TEST FAIL"	Test failed. Maintenance required.
"TCAS SYSTEM TEST OK"	Test complete. System operable.

ADF Radio and RMI Test

ADF/VOR test switch
(on RMI) .... ADF

ADF mode selector .... Push

The ADF pointer on the RMI should point approximately 45 degrees left of the lubber line.

Instrument Transfer Switching Tests

Fail the captain's equipment by pulling the appropriate circuit breakers.

Appropriate transfer switch .... Transfer to alternate or auxiliary system

Check that operation of the system is restored; also check that the flags are out of view and the instrument comparator lights are extinguished.

Circuit breakers .... Reset

Transfer switches ....NORMAL

Repeat the above steps for the first officer's equipment.

Compass Switching

In the event that an RDMI and HSI HDG flag appears, or a compass system is giving erroneous headings (even without an OFF flag,) accomplish the following:

Determine which system is accurate.

Note flags, or absence of flags in level flight, check the two systems with the standby compass.

Position the compass transfer switch from NORMAL to the operative system (BOTH ON 1 or BOTH ON 2.)

The compass card that has been switched must be aligned (using the HDG SET knob on the compass control panel) to agree with the operative compass card.

Weather Radar Test - Monochromatic Radar

CAUTION: Tests involving radiation of RF energy by the radar antenna must not be made while radar antenna is directed toward people, nearby large metal objects, during refueling operations or in the vicinity of trucks or containers holding flammable or explosive liquids.

Function selector .... STBY

Allow three to five minutes for radar warm-up.

Brightness control .... Full counterclockwise

Panel dim control .... Full counterclockwise

Gain control .... FIXED

Antenna tilt .... Full up

Range selector 180

Function selector .... TEST

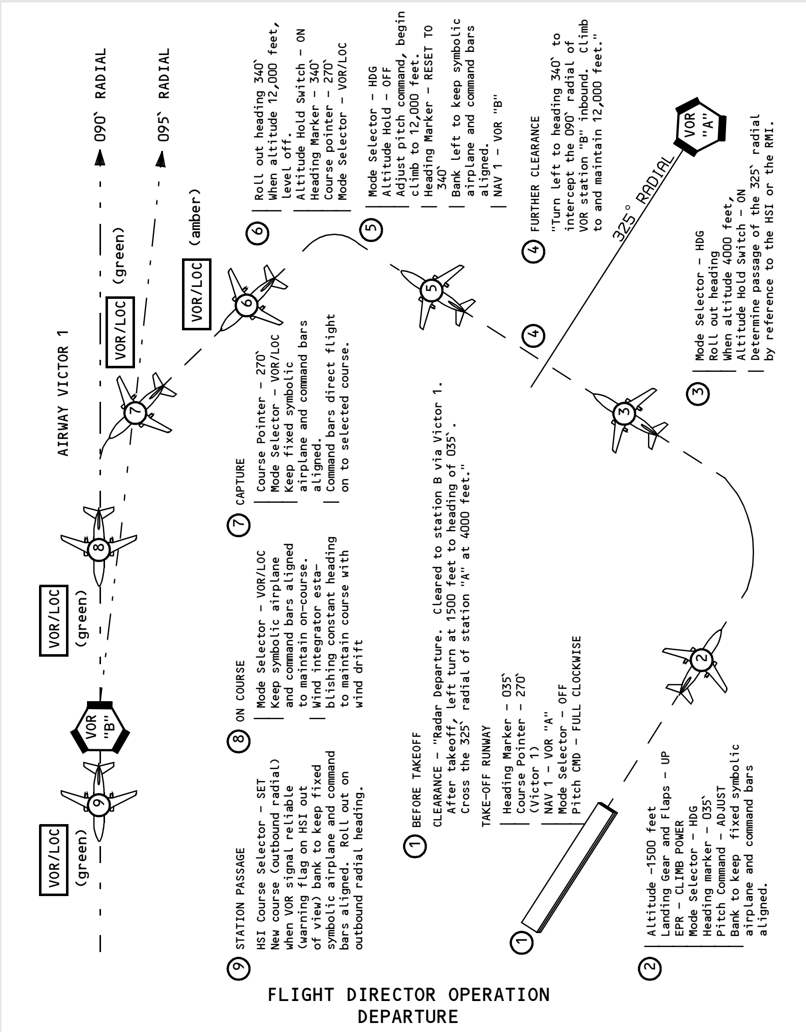
[A distinctive test pattern is displayed.]

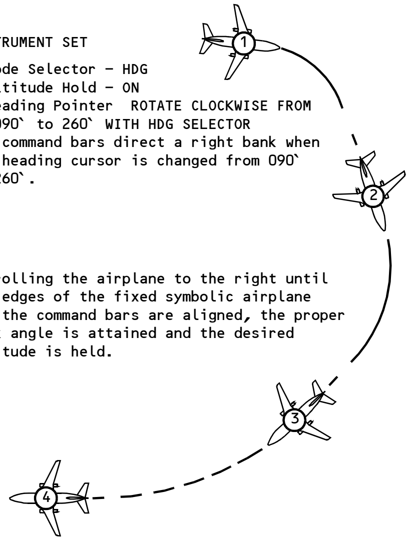
Brightness control .... Clockwise until marks appear

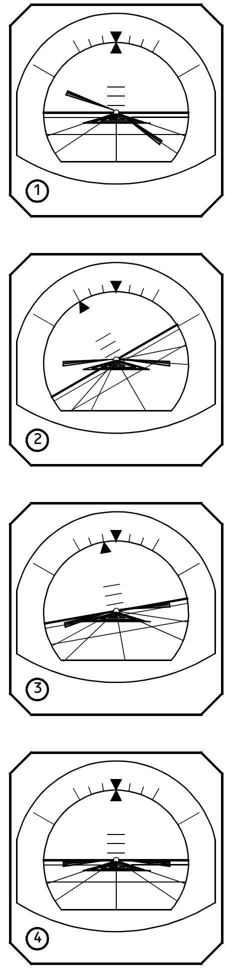
Panel dim control .... Clockwise for desired light

Function selector .... As desired

Flight Director Operation







(1) INSTRUMENT SET

Mode Selector - HDG
Altitude Hold - ON
Heading Pointer ROTATE CLOCKWISE FROM 090° to 260° WITH HDG SELECTOR

The command bars direct a right bank when the heading cursor is changed from 090° to 260°.

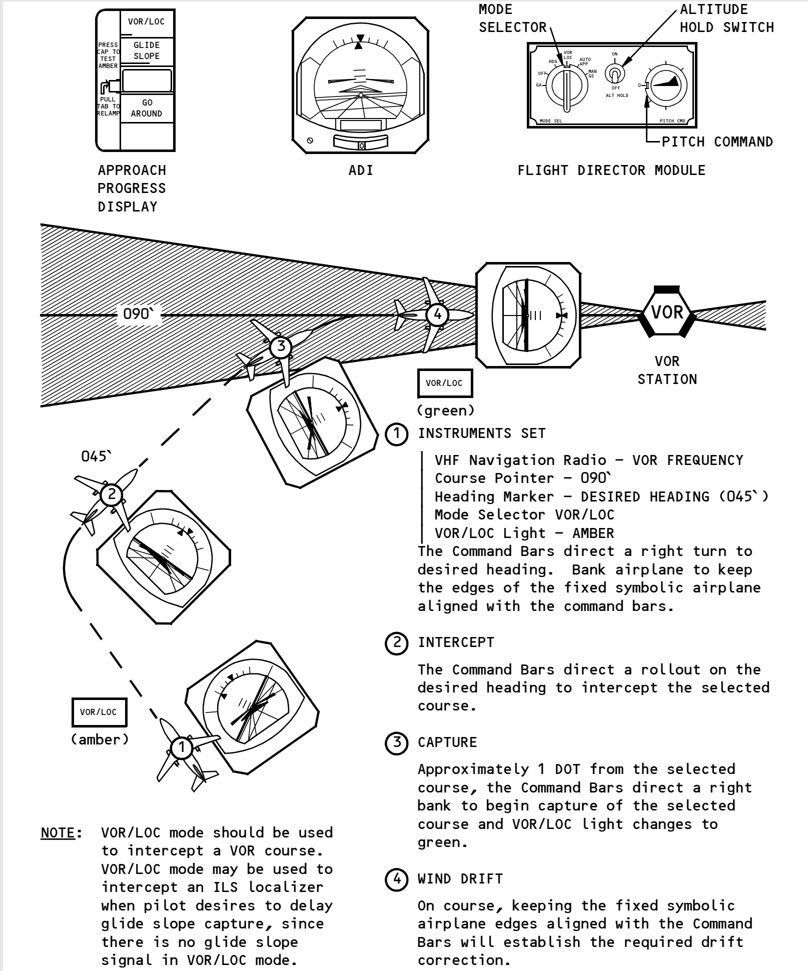
(2) By rolling the airplane to the right until the edges of the fixed symbolic airplane and the command bars are aligned, the proper bank angle is attained and the desired altitude is held.

(3) The command bars direct a roll back left to wings level as the 260° heading is approached, thereby directing the airplane to roll out on the 260° heading with the wings level and still hold the desired altitude.

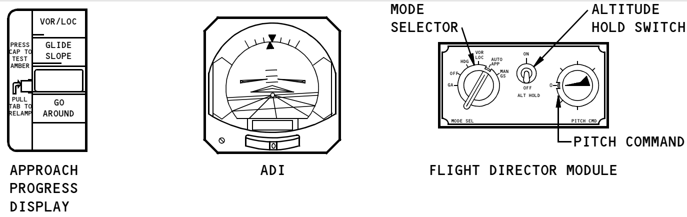
(4) When the edges of the fixed symbolic airplane and the command bars are aligned with wings level, the airplane is on the selected heading and holding the desired altitude.

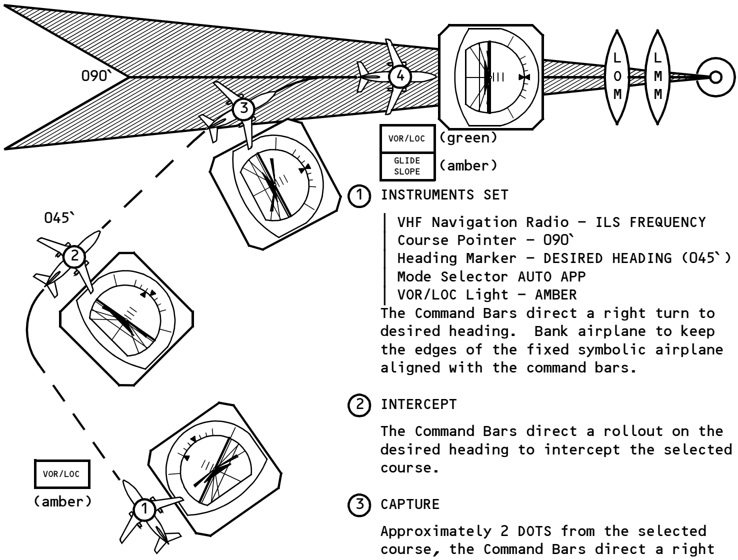
The heading submode is used to navigate without radio aids or to position the airplane on an intercept heading to a desired VOR radial or an ILS course.

HDG MODE TURN



FLIGHT DIRECTOR OPERATION
VOR/LOC MODE INTERCEPT - VOR





① INSTRUMENTS SET

VHF Navigation Radio - ILS FREQUENCY
Course Pointer - 090°
Heading Marker - DESIRED HEADING (045°)
Mode Selector AUTO APP
VOR/LOC Light - AMBER

The Command Bars direct a right turn to desired heading. Bank airplane to keep the edges of the fixed symbolic airplane aligned with the command bars.

② INTERCEPT

The Command Bars direct a rollout on the desired heading to intercept the selected course.

③ CAPTURE

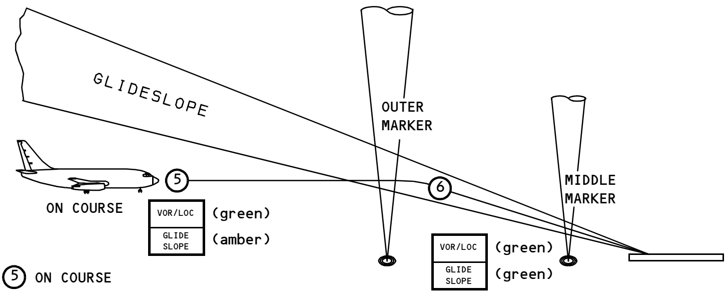
Approximately 2 DOTS from the selected course, the Command Bars direct a right bank to begin capture of the selected course and VOR/LOC light changes to green. GLIDE SLOPE light illuminates amber.

④ WIND DRIFT

On course, keeping the fixed symbolic airplane edges aligned with the Command Bars will establish the required drift correction.

NOTE: AUTO APP mode should be used to intercept an ILS localizer when airplane is below the glide slope.

FLIGHT DIRECTOR OPERATION
AUTO APP MODE INTERCEPT - ILS



5 ON COURSE

- Mode Selector - AUTO APP
- Altitude Hold Switch - ON
- VOR/LOC Light - GREEN
- GLIDE SLOPE Light - AMBER
- Keep fixed symbolic airplane and command bars aligned to maintain LOC course and assigned altitude

6 GLIDE SLOPE CAPTURE

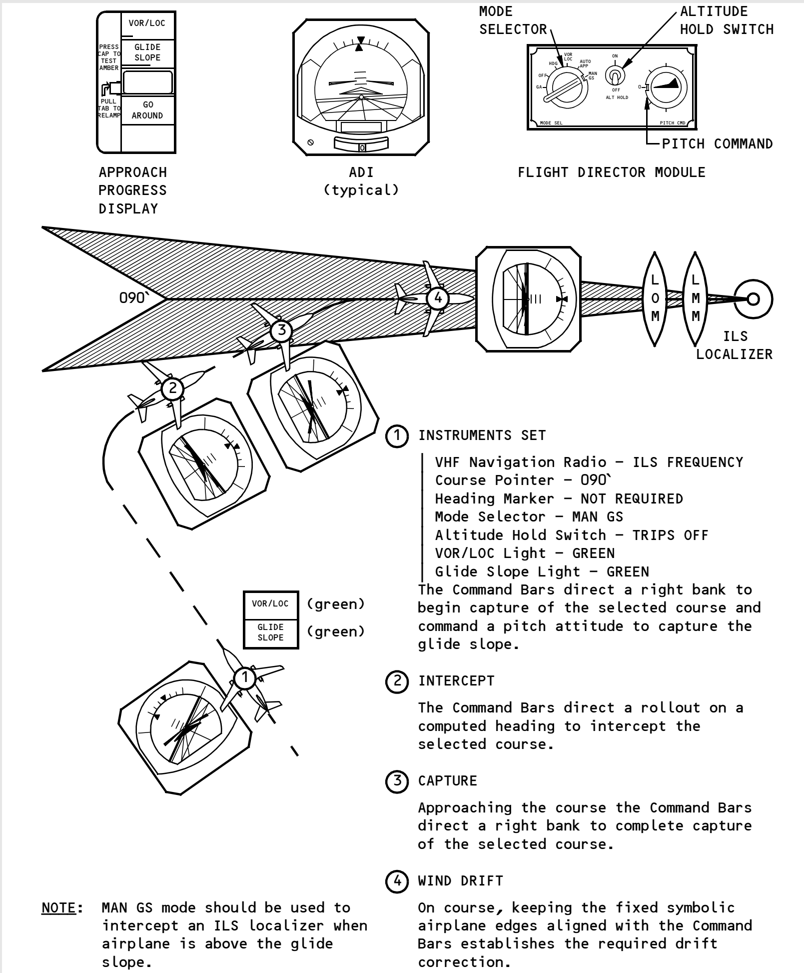
- Mode Selector - AUTO APP
- Altitude Hold Switch - Trips OFF
- VOR/LOC Light - GREEN
- GLIDE SLOPE Light - GREEN
- Keep fixed symbolic airplane and command bars aligned to maintain LOC course and Glide Slope beam center.

GO-AROUND

- Either Go-Around Switch - PRESS
- Mode Selector - TRIPS TO GA
- ADI - PITCH UP ATTITUDE, WINGS LEVEL commands.
- Go-Around Light - ILLUMINATES
- Keep airplane symbol and command bars aligned.
- Mode Selector - HDG (At safe altitude) This will extinguish the GO-AROUND light, eliminate the go-around command on the ADI, and give selected heading commands as selected on the HSI.

<u>NOTE</u>: The 14 degree go-around command is not the optimum pitch attitude for all go-around conditions (1 engine out).

AUTO APP MODE FINAL APPROACH - ILS

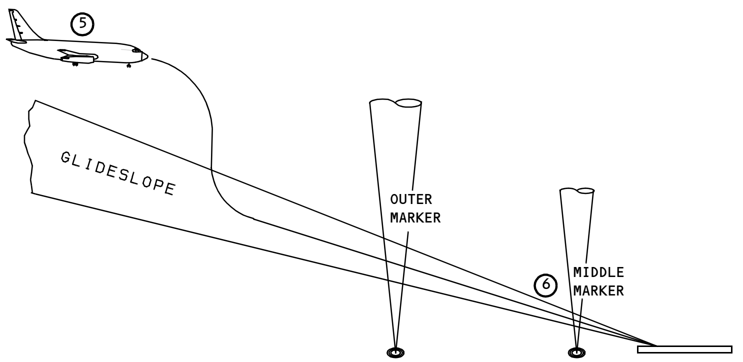


FLIGHT DIRECTOR OPERATION
MAN GS MODE - LOCALIZER INTERCEPT

5 GLIDE SLOPE INTERCEPT

Command Bars direct pitch down to intercept and capture glide slope.

VOR/LOC	(green)
GLIDE SLOPE	(green)



6 GO-AROUND

Either Go-Around Switch - PRESS
Mode Selector - TRIPS TO GA
ADI - PITCH UP ATTITUDE, WINGS LEVEL
Go-Around Light - ILLUMINATES
Keep airplane symbol and command bars aligned.
Mode Selector - HDG (At safe altitude)
This will extinguish the go-around light, eliminate the go-around command on the ADI, and give heading commands as selected on the HSI if mode selector is rotated slowly to OFF then HDG. If Mode Selector is rotated rapidly to HDG, the pitch up command will remain and the go-around light will remain ON; however the roll commands will now follow the heading selector input.

NOTE: The 14 degree go-around command is not the optimum pitch attitude for all go-around conditions (1 engine out).

MAN GS MODE - GLIDE SLOPE INTERCEPT

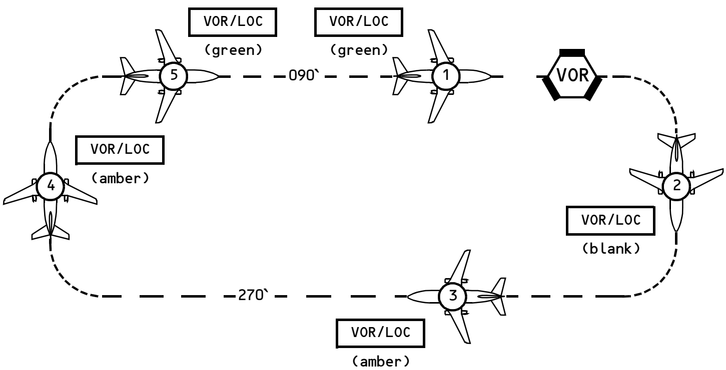
5 CAPTURE INBOUND

The command bars will direct when to roll out on course.

keep fixed symbolic airplane and command bars aligned.

1 INSTRUMENTS SET

Mode Selector - VOR/LOC
Course Pointer - 090°
Heading Cursor - 270°
Altitude Hold Switch - ON
Keep fixed symbolic airplane and command bars aligned until signal unreliable.
(Warning flag on HSI may appear).



4 TURN INBOUND

Heading Cursor - 045°
Bank to keep fixed symbolic airplane and command bars aligned.

3 WIND DRIFT OUTBOUND

The heading cursor may be reset to compensate for wind drift.

Mode Selector - VOR LOC
The command bars will continue to be referenced to the selected heading (until course capture).

2 TURN OUTBOUND

Bank right to establish turn away from station
Mode Selector - HDG
If HDG mode is selected over the station, the command bars will not necessarily direct a right bank.
Keep fixed symbolic airplane and command bars aligned
The command bars will direct a roll-out on heading 270°.

FLIGHT DIRECTOR OPERATION
(HOLDING-VOR)

Intentionally
Blank

Auxiliary Tank Refueling

Fuel, in excess of full wing and center tank capacities is loaded into the auxiliary fuel tanks.

Auxiliary fueling panel door .... Open

Refueling panel access door .... Open

Manual defueling valve .... OPEN

Engine No. 2 start lever .... IDLE

Fueling valve switch(es)
(FWD, MID or AFT) .... OPEN

VALVES OPEN light(s) .... Illuminated

Close when selected tanks are full, or when filled to the desired quantity. Each tank is a selected group and can fill simultaneously but may not fill evenly. Tank valve green lights extinguish when all tanks in a group are full.

Fueling valve switch(es) .... CLOSE

VALVES OPEN lights .... Extinguished

Manual defueling valve .... CLOSED

Refueling panel access door .... Closed & secured

Auxiliary fueling panel door .... Closed & secured

Engine No. 2 start lever .... CUTOFF

Refueling With Battery Only

When the APU is inoperative and no external power source is available, refueling can be accomplished as follows:

Battery switch .... ON

Standby power switch .... BAT

The battery operates the entire fueling system normally, including the gages and fuel shutoff system. The only limitation during this type of operation is the battery life.

Fuel Balancing

If an engine fuel leak is suspected:

Accomplish the Fuel Leak Engine Checklist.

Maintain main tank No. 1 and No. 2 fuel balance within limitations.

Fuel pump pressure should be supplied to the engines at all times. At high altitude, without fuel pump pressure, thrust deterioration or engine flameout may occur.

If the center/auxiliary tank contains fuel:

Center/auxiliary tank fuel pump switches ....OFF

Crossfeed selector .... Open

Fuel pump switches (low tank) ....OFF

When quantities are balanced:

Fuel pump switches (main tank).....................................ON

Center/auxiliary tank fuel pump switches ....ON

Crossfeed selector .... Close

If the center/auxiliary tank contains no fuel:

Crossfeed selector .... Open

Fuel pump switches (low tank) ....OFF

When quantities are balanced:

Fuel pump switches ....ON

Crossfeed selector .... Close

Fuel Balancing before Engine Start

If extended APU operation is required on the ground and fuel is loaded in the center tank:

CAUTION: Center tank fuel pump switches should be positioned ON only if the fuel quantity in the center tank exceeds 1000 lbs.

CAUTION: Do not operate the center tank fuel pumps with the flight deck unattended.

Left center tank fuel pump switch ....ON

This precludes fuel from being used from main tank No. 1 and prevents a fuel imbalance before takeoff.

Refueling

Fuel Load Distribution

Main tanks No. 1 and No. 2 should normally be serviced equally until full. Additional fuel is loaded into the center tank until the desired fuel load is reached. If the airplane is equipped with an aux tank, additional fuel can be loaded into the aux tank for greater desired fuel loading.

Fuel Pressure

Apply from a truck or fuel pit. A nozzle pressure of 50 psi. provides approximately 300 U.S. gallons per minute.

Normal Refueling

When a full fuel load is required, the fuel shutoff system closes the fueling valves automatically when the tanks are full. When a partial fuel load is required, the fuel quantity indicators are monitored and the fueling valves are closed by manually positioning the fueling valve switches to CLOSED when the desired fuel quantity is aboard the airplane.

Auxiliary Tank

Note: Ensure all fuel pump switches are off during pressure refueling of the auxiliary tank to avoid an inadvertent transfer of fuel into the auxiliary tank.

The manual defueling and crossfeed valves must be open when pressure refueling the auxiliary tank.

Refueling With Battery Only

When the APU is inoperative and no external power source is available, refueling can be accomplished as follows:

Battery switch .... ON

Standby power switch .... BAT

The battery operates the entire fueling system normally, including the gages and fuel shutoff system. The only limitation during this type of operation is the battery life.

Refueling With No AC or DC Power Source Available

When it becomes necessary to refuel with the APU inoperative, the aircraft battery depleted, and no external power source available, refueling can still be accomplished:

Fueling hose nozzle ....Attached to the refueling receptacle

Fueling valves .... Open for the tanks to be refueled

Note: Main tanks No. 1 and No. 2, and the center tank refueling valves each have a red override button that must be pressed and held while fuel is being pumped into the tank. Releasing the override button allows the spring in the valve to close the valve.

Caution must be observed not to overfill a tank, since there is no automatic fuel shutoff during manual operation. When the desired amount of fuel has been pumped into the tanks, the refueling valves for the respective tanks can be released. Main tanks No. 1 and No. 2 may also be refueled through filler ports over the wing. It is not possible to refuel the center tank externally.

Ground Transfer of Fuel

Fuel can be transferred from one tank to another tank using the fuel pumps, fueling valve, defueling valve, and crossfeed valve. AC power must be available.

Note: Before transferring fuel, ensure that the associated FUEL PUMP LOW PRESSURE lights are operating.

CAUTION: On airplanes with the center tank fuel pump automatic shutoff system installed, transferring fuel with passengers onboard is prohibited, unless the fuel quantity in the tank from which fuel is being taken is maintained at or above 2000 pounds/900 kilograms.

To transfer fuel from the main tanks to the center tank:

Main tank fuel pump switches ....ON

Crossfeed selector .... Open

Engine No. 2 start lever (airplanes without aux tank) ....IDLE

Manual defueling valve .... Open

Center tank fueling valve switch (if fuel transfer into center tank is desired) .... OPEN

Auxiliary tank fueling valve switch (if fuel transfer into aux tank is desired)... OPEN

Fuel transfer ....Monitor

The center tank fuel quantity indicator shows an increase in fuel. The main tank indicators show a decrease in fuel.

When a FUEL PUMP LOW PRESSURE light illuminates, turn OFF the associated fuel pump.

When the required amount of fuel has been transferred:

Center and aux (as installed) tank fueling valve switches ....CLOSED

Manual defueling valve ....Close

Engine No. 2 start lever (airplanes without aux tank) .... CUTOFF

Crossfeed selector ....Close

Main tank fuel pump switches .... OFF

Main Tanks ....Refill

Refueling panel and defuel panel access door ....Close

Fuel Crossfeed Valve Check

Crossfeed selector ....Open

Verify Crossfeed VALVE OPEN light illuminates bright and then dim.

Crossfeed selector ....Close

Verify Crossfeed VALVE OPEN light illuminates bright and then extinguishes.

Fuel Quantity Indicators Test

Note: With a fuel quantity indicator inoperative, a zero fuel quantity input will be sent to the fuel summation unit causing a possible FMC gross weight error.

Fuel quantity test switch .... Push and hold

Hold until the fuel quantity indicators drive to zero.

Note: Do not push the QTY TEST switch when the airplane is being fueled. This will cause inaccurate indications at the external fueling panel.

Fuel quantity test switch ....Release

Indicators return to previous reading.

Ground Proximity Warning System (GPWS) Test

Verify that the guards are closed for all GROUND PROXIMITY INHIBIT switches.

Ground proximity SYS TEST switch .... Push momentarily

Verify the following:

- BELOW G/S, PULL UP and GPWS INOP lights illuminate
- “GLIDESLOPE” and “WHOOP, WHOOP, PULL UP” aurals sound.

Note: If the test switch is held until the aurals begin, additional GPWS aural warnings are tested.

Intentionally
Blank

Introduction

Airplane operation in adverse weather conditions may require additional considerations due to the effects of extreme temperatures, precipitation, turbulence, and windshear. Procedures in this section supplement normal procedures and should be observed when applicable.

Takeoff - Wet or Contaminated Runway Conditions

The following information applies to takeoffs on wet or contaminated runways:

- For wet runways, reduced thrust (assumed temperature method) is allowed provided suitable takeoff performance accountability is made for the increased stopping distance on a wet surface
- For runways contaminated by slush, snow, standing water, or ice, reduced thrust (assumed temperature method) is not allowed
- V1 may be reduced to minimum V1 to provide increased stopping margin provided the field length required for a continued takeoff from the minimum V1 and obstacle clearance meet the regulatory requirements. The determination of such minimum V1 may require a real-time performance calculation tool or other performance information supplied by dispatch
- Takeoffs are not recommended when slush, wet snow, or standing water depth is more than 1/2 inch (13 mm) or dry snow depth is more than 4 inches (102 mm).

Cold Weather Operations

Considerations associated with cold weather operation are primarily concerned with low temperatures and with ice, snow, slush, and standing water on the airplane, ramps, taxiways, and runways.

Icing conditions exist when OAT (on the ground) or TAT (in flight) is 10°C or below, and any of the following exist:

- visible moisture (clouds, fog with visibility of one statute mile (1600 m) or less, rain, snow, sleet, ice crystals, and so on) is present, or
- ice, snow, slush, or standing water is present on the ramps, taxiways, or runways.

CAUTION: Do not use engine or wing anti-ice when OAT (on the ground) or TAT (in flight) is above 10°C.

Exterior Inspection

Although removal of surface snow, ice and frost is normally a maintenance function, during preflight procedures, the captain or first officer should carefully inspect areas where surface snow, ice or frost could change or affect normal system operations.

Do the normal Exterior Inspection with the following additional steps:

Surfaces ....Check

Takeoff with light coatings of frost, up to 1/8 inch (3mm) in thickness on lower wing surfaces due to cold fuel is allowable; however, all leading edge devices, all control surfaces, tab surfaces, upper wing surfaces and control surface balance panel cavities must be free of snow, ice and frost.

Thin hoarfrost is acceptable on the upper surface of the fuselage provided all vents and ports are clear. Thin hoarfrost is a uniform white deposit of fine crystalline texture, which usually occurs on exposed surfaces on a cold and cloudless night, and which is thin enough to distinguish surface features underneath, such as paint lines, markings or lettering.

Control surface balance panel cavities ....Check

Check drainage after snow removal. Puddled water may freeze in flight.

Pitot probes and static ports ....Check

Verify that all pitot probes and static ports are free of snow and ice. Water rundown after snow removal may freeze immediately forward of static ports and cause an ice buildup which disturbs airflow over the static ports resulting in erroneous static readings even when static ports are clear.

Air conditioning inlets and exits ....Check

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

If the APU is operating, verify that the outflow valve is fully open.

Engine inlets ....Check

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

Verify that the fan is free to rotate.

Snow or ice that accumulates on the fan spinner or fan blades during extended shutdown periods must be removed by maintenance or other means before engine start.

Snow or ice that accumulates on the fan spinner or fan blades as a result of operation in icing conditions, such as during approach or taxi in, is allowed if the fan is free to rotate and the snow or ice is removed using the ice shedding procedure during taxi out and before setting takeoff thrust.

Fuel tank vents .... Check

Verify that all traces of ice and frost are removed.

Landing gear doors .... Check

Landing gear doors should be free of snow and ice.

APU air inlets .... Check

The APU inlet door and cooling air inlet must be free of snow and ice before APU start.

Preflight Procedure - First Officer

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

Under extremely cold conditions, both packs may be used for more rapid heating:

APU switch ....START F/O

Air conditioning PACK switches ....ON F/O

ISOLATION VALVE switch .... OPEN F/O

APU BLEED air switch ....ON F/O

Note: Keep all doors to the airplane closed as much as possible.

During right pack operation only, under cold conditions, if the left PACK TRIP OFF light illuminates, position the recirculation fan OFF until the cabin temperature stabilizes.

Do the following step after completing the normal Preflight Procedure - First Officer:

PITOT STATIC HEAT switches .... ON F/O

Verify that all pitot static heat lights are extinguished.

Engine Start Procedure

Do the normal Engine Start Procedure with the following modifications:

- If the START VALVE OPEN light does not illuminate or the air duct pressure drop is not observed, the start valve solenoid may be frozen. If the engine will not start, use ground heating to warm the starter valve, fuel control unit and the ignition system.
- If the START VALVE OPEN light is still not observed, use the Manual Engine Start supplementary procedure.
- If N2 is not observed, apply external heat. Start the engine as soon as possible after thawing to prevent freezing.
- If ambient temperature is below -35°C, idle the engine for two minutes before changing thrust lever position.
- Oil pressure may not indicate any increase until oil temperature rises. Immediately shut down the engine if there is no indication of oil pressure within 30 seconds. Following a precautionary shutdown due to no indication of oil pressure, allow 10 to 15 minutes for internal heat to warm the oil system.
- Up to three and one-half minutes may be allowed for oil pressure to reach the minimum operating pressure. During this period, the LOW OIL PRESSURE light may remain illuminated, pressure may go above the normal range and the OIL FILTER BYPASS light may illuminate. Operate the engine at idle thrust until oil pressure returns to the normal range.

Engine Anti-ice Operation - On the Ground

Engine anti-ice must be selected ON immediately after both engines are started and remain on during all ground operations when icing conditions exist or are anticipated.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when OAT is above 10°C.

When engine anti-ice is needed:

ENGINE START switches .... LOW IGN F/O

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

Verify that all engine anti-ice VALVE OPEN lights illuminate bright, then dim.

When engine EPR has stabilized:

ENGINE START switches ....OFF F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE switches .... OFF F/O

Verify that all engine anti-ice VALVE OPEN lights illuminate bright, then extinguish.

Wing Anti-ice Operation - On the Ground (as installed)

On airplanes with ground operational wing anti-ice, use wing anti-ice during all ground operations between engine start and takeoff when icing conditions exist or are anticipated, unless the airplane is, or will be protected by the application of Type II or Type IV fluid in compliance with an approved ground de-icing program.

WARNING: Do not use wing anti-ice as an alternative for ground de-icing/anti-icing. Close inspection is still needed to ensure that no frost, snow or ice is adhering to the wing, leading edge devices, stabilizer, control surfaces or other critical airplane components at takeoff.

CAUTION: Do not use wing anti-ice when OAT is above 10°C.

When wing anti-ice is needed:

WING ANTI-ICE switch ....ON F/O

Verify that the L and R VALVE OPEN lights illuminate bright, then dim.

Note: The wing anti-ice VALVE OPEN lights may cycle bright/dim due to the control valves cycling closed/open in response to thrust setting and duct temperature logic.

When wing anti-ice is no longer needed:

WING ANTI-ICE switch .... OFF F/O

Verify that the L and R VALVE OPEN lights illuminate bright, then extinguish.

Before Taxi Procedure

Do the normal Before Taxi Procedure with the following modifications:

GENERATOR 1 and 2 switches ....ON F/O

Normally the generator drives stabilize within one minute, although due to cold oil, up to five minutes can be needed to produce steady power.

If there is snow or ice accumulation on the wing, consider delaying the flight control check until after de-icing/anti-icing is accomplished.

Flight controls .... Check C

An increase in control forces can be expected at low temperatures.

CAUTION: The flap position indicator and the leading edge devices annunciator panel should be closely observed for positive movement. If the flaps should stop, the flap lever should be placed immediately in the same position as indicated.

Flaps .... Check F/O

Move flaps from Flaps up to Flaps 40 back to Flaps up (i.e., full travel) to ensure freedom of movement.

If taxi route is through ice, snow, slush, or standing water in low temperatures or if precipitation is falling with temperatures below freezing, taxi out with the flaps up. Taxiing with the flaps extended subjects the flaps and flap drives to contamination. Leading edge devices are also susceptible to slush accumulations.

Call “FLAPS ___” as needed. C

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

Taxi–Out

When standing water, snow or ice is present on the ramps, taxiways or runways, maintain a greater distance than normal between airplanes. Engine exhaust may form ice on the ramp and takeoff areas of the runway or blow snow or slush which freezes on the surfaces it contacts.

Idle reverse thrust can be used during taxi to reduce brake usage on clean, paved taxiways and runways. Do not use reverse thrust on snow, ice, or slush covered surfaces.

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

CAUTION: When operating the engines over significant amounts of standing de-icing or anti-icing fluid, limit thrust to the minimum required. Excessive ingestion of de-icing or anti-icing fluid can cause the fluid to build up on the engine compressor blades, resulting in compressor stalls and engine surges.

When moderate to severe icing conditions are present during prolonged ground operation, do an engine run up, as needed, to minimize ice build-up. Use the following procedure:

Check that the area behind the airplane is clear. C

Run-up to a minimum of 70% N1 for approximately 15 seconds duration at intervals no greater than 15 minutes. C

Note: Fan blade ice build up is cumulative. If the fan spinner and fan blades were not deiced prior to taxi out, the time the engines were operating during the taxi in should be included in the 15 minute interval.

If airport surface conditions and the concentration of aircraft do not allow the engine thrust level to be increased to 70% N1, then set a thrust level as high as practical and time at that thrust level. C

De-icing / Anti-icing

Testing of undiluted de-icing/anti-icing fluids has shown that some of the fluid remains on the wing during takeoff rotation and initial climb. The residual fluid causes a decrease in lift and increase in drag; however, the effects are temporary. Use the normal takeoff rotation rate.

Although no performance adjustments are required, it is recommended that a 5°C (9°F) buffer on the maximum assumed temperature be used when performing reduced thrust takeoffs (assumed temperature method). Use a takeoff flap setting of flaps 10 or greater whenever possible.

CAUTION: Operate the APU during de-icing only if necessary. If the APU is running, ingestion of de-icing fluid causes objectionable fumes and odors to enter the airplane. Ingestion of snow, slush, ice, or de-icing/anti-icing fluid can also cause damage to the APU.

If de-icing / anti-icing is needed:

APU .... As needed F/O

The APU should be shut down unless APU operation is necessary.

Call "FLAPS UP". C

Flaps ....UP F/O

Prevents ice and slush from accumulating in flap cavities during de-icing.

Thrust levers .... Idle C

Reduces the possibility of injury to personnel at inlet or exhaust areas.

WARNING: Ensure that the stabilizer trim wheel handles are stowed before using electric trim to avoid personal injury.

Stabilizer trim ....___ UNITS C

Set the trim for takeoff.

Verify that the trim is in the green band.

If the engines are running:

FLT/GRD switch ....GRD F/O

Reduces possible pressure changes when the engine BLEED air switches are turned OFF.

Engine BLEED air switches... OFF F/O

Reduces the possibility of fumes entering the air conditioning system.

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

Reduces the possibility of fumes entering the air conditioning system.

After de-icing / anti-icing is completed:

APU .... As needed F/O

CAUTION: After de-icing, the use of APU bleed air during takeoff can cause smoke in the airplane.

APU BLEED air switch .... As needed FO

Wait approximately one minute after de-icing is completed to turn engine BLEED air switches on to ensure all de-icing fluid has been cleared from the engines:

Engine BLEED air switches .... ON F/O

If the engines are running:

FLT/GRD switch ....FLT F/O

Flight controls ....Check, as needed C

An increase in control forces can be expected at low temperatures.

Before Takeoff Procedure

Do the normal Before Takeoff Procedure with the following modification:

When tank fuel temperature is 0° C or below:

Fuel HEAT switches .... ON PM

Fuel heat switches must remain on for one cycle just prior to takeoff.

Call “FLAPS ___” as needed for takeoff. PF

Flap lever .... Set takeoff flaps, as needed PM

Extend the flaps to the takeoff setting at this time if they have been held because of slush, standing water, or icing conditions, or because of exterior de-icing / anti-icing.

Verify that the LE FLAPS EXT green light is illuminated.

Fuel HEAT switches ....OFF PM

Fuel heat switches must be OFF for takeoff.

Takeoff Procedure

Do the normal Takeoff Procedure with the following modification:

When moderate to severe icing conditions are present during prolonged ground operation, the takeoff must be preceded by a static engine run-up. Use the following procedure:

Run-up to a minimum of 70% N1 and confirm stable engine operation before the start of the takeoff roll.

Crosscheck EPR and N1 to ensure the required takeoff thrust has been obtained. A blocked PT2 probe may occur during operations in icing conditions and cause incorrect EPR indications.

Engine Anti-ice Operation - In Flight

Engine anti-ice must be ON during all flight operations when icing conditions exist or are anticipated, except during climb and cruise when the temperature is below -40°C SAT. Engine anti-ice must be ON before, and during descent in all icing conditions, including temperatures below -40°C SAT.

When operating in areas of possible icing, activate engine anti-ice before entering icing conditions.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

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

When penetrating or operating in icing conditions, maintain a minimum of 40% N1 when TAT is between 10°C and 0°C or 55% N1 when TAT is below 0°C.

When engine anti-ice is needed:

ENGINE START switches .... LOW IGN PM

ENGINE ANTI-ICE switches .... ON PM

Verify that all engine anti-ice VALVE OPEN lights illuminate bright, then dim.

EPR indications - Observe decrease and adjust thrust as required.

When engine EPR has stabilized:

ENGINE START switches .... OFF PM

When engine anti-ice is no longer needed:

ENGINE ANTI–ICE switches .... OFF PM

Verify that all engine anti-ice VALVE OPEN lights illuminate bright, then extinguish.

EPR indications - Observe increase and adjust thrust as required.

Fan Ice Removal

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

Prolonged operation in moderate to severe icing conditions can lead to fan blade/spinner icing and engine vibration. Severe icing can usually be avoided by a change in altitude and/or airspeed. If flight in moderate to severe icing conditions cannot be avoided, maintain a minimum of 70% N1. Necessary thrust reductions to not less that 55% N1 should be limited in duration to a maximum of one minute.

Engine vibration can occur due to fan blade icing. If engine vibration continues after increasing thrust, do the following on both engines, one engine at a time:

ENGINE START switch..................................... FLT PM

Thrust .... Adjust PF

Adjust thrust to 70% N1 for approximately 1 minute.

If vibration does not decrease, consider shutting down the engine.

Wing Anti-ice Operation - In Flight

Ice accumulation on the flight deck window frames, windshield center post, or on the windshield wiper arm may be used as an indication of structural icing conditions and the need to turn on wing anti-ice.

In flight, the wing anti-ice system may be used as a de-icer or as an anti-icer.The primary method is to use it as a de-icer by allowing ice to accumulate before turning wing anti-ice on. This procedure provides the cleanest airfoil surface, the least possible runback ice formation, and the least thrust and fuel penalty. Normally it is not necessary to shed ice periodically unless extended flight through icing conditions is necessary (holding).

The secondary method is to use wing anti-ice before ice accumulation. Operate the wing anti-ice system as an anti-icer only during extended operations in moderate or severe icing conditions, such as holding.

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

Note: Prolonged operation in icing conditions with the leading edge and trailing edge flaps extended is not recommended.

When wing anti–ice is needed:

WING ANTI-ICE switch .... ON PM

Verify that the L and R VALVE OPEN lights illuminate bright, then dim.

When wing anti–ice is no longer needed:

WING ANTI–ICE switch ....OFF PM

Verify that the L and R VALVE OPEN lights illuminate bright, then extinguish.

Cold Temperature Altitude Corrections

Extremely low temperatures create significant altimeter errors and greater potential for reduced terrain clearance. When the temperature is colder than ISA, true altitude will be lower than indicated altitude. Altimeter errors become significantly larger when the surface temperature approaches -30°C or colder, and also become larger with increasing height above the altimeter reference source.

Apply the altitude correction table when needed:

- apply corrections to all published minimum departure, en route and approach altitudes, including missed approach altitudes, according to the table below. Advise ATC of the corrections.
- MDA/DA settings should be set at the corrected minimum altitudes for the approach
- corrections apply to QNH and QFE operations

To determine the correction from the Altitude Correction Table:

- subtract the elevation of the altimeter barometric reference setting source (normally the departure or destination airport elevation) from the published minimum altitude to be flown to determine “height above altimeter reference source”
- if the corrected indicated altitude to be flown is between 100 foot increments, set the MCP altitude to the closest 100 foot increment above the corrected indicated altitude to be flown.

- enter the table with Airport Temperature and with “height above altimeter reference source.” Read the correction where these two entries intersect. Add the correction to the published minimum altitude to be flown to determine the corrected indicated altitude to be flown. To correct an altitude above the altitude in the last column, use linear extrapolation (e.g., to correct 6000 feet or 1800 meters, use twice the correction for 3000 feet or 900 meters, respectively). The corrected altitude must always be greater than the published minimum altitude
- do not correct altitmeter barometric reference settings

An altitude correction due to cold temperature is not needed for the following conditions:

- While under ATC radar vectors
- When maintaining an ATC assigned flight level (FL)
- When the reported airport temperature is above 0°C or if the airport temperature is at or above the minimum published temperature for the procedure being flown

Note: Regulatory authorities may have other requirements for cold temperature altitude corrections.

Altitude Correction Table (Heights and Altitudes in Feet)

Airport Temp °C	Height Above Altimeter Reference Source											
	200 feet	300 feet	400 feet	500 feet	600 feet	700 feet	800 feet	900 feet	1000 feet	1500 feet	2000 feet	3000 feet
0°	20	20	30	30	40	40	50	50	60	90	120	170
-10°	20	30	40	50	60	70	80	90	100	150	200	290
-20°	30	50	60	70	90	100	120	130	140	210	280	420
-30°	40	60	80	100	120	140	150	170	190	280	380	570
-40°	50	80	100	120	150	170	190	220	240	360	480	720
-50°	60	90	120	150	180	210	240	270	300	450	590	890

Altitude Correction Table (Heights and Altitudes in Meters)

Airport Temp °C	Height Above Altimeter Reference Source											
	60 m	90 m	120 m	150 m	180 m	210 m	240 m	270 m	300 m	450 m	600 m	900 m
0°	5	5	10	10	10	15	15	15	20	25	35	50
-10°	10	10	15	15	20	20	25	30	30	45	60	90
-20°	10	15	20	25	25	30	35	40	45	65	85	130
-30°	15	20	25	30	35	40	45	55	60	85	115	170
-40°	15	25	30	40	45	50	60	65	75	110	145	220
-50°	20	30	40	45	55	65	75	80	90	135	180	270

Approach and Landing

If ice formations are observed on the airplane surfaces (wings, windshield wipers, window frames, etc.):

VREF ....Add 10 knots PF

This ensures maneuvering capability.

Note: The combined airspeed corrections for ice formations, steady wind and gust should not exceed 20 knots.

Note: To prevent increased landing distance due to high airspeed, bleed off airspeed in excess of VREF + 5 knots + gust correction when below 200 feet AGL. Maintain the gust correction to touchdown.

After Landing Procedure

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

CAUTION: When operating the engines over significant amounts of standing de-icing or anti-icing fluid, limit thrust to the minimum required. Excessive ingestion of de-icing or anti-icing fluid can cause the fluid to build up on the engine compressor blades, resulting in compressor stalls and engine surges.

Do the normal After Landing Procedure with the following modifications:

After prolonged operation in icing conditions with the flaps extended, or when an accumulation of airframe ice is observed, or when operating on a runway or taxiway contaminated with ice, snow, or slush, or standing water:

Do not retract the flaps to less than flaps 15 until the flap areas have been checked to be free of contaminates.

Engine anti-ice must be selected ON and remain on during all ground operations when icing conditions exist or are anticipated.

WARNING: Do not rely on airframe visual icing cues before activating engine anti-ice. Use the temperature and visible moisture criteria because late activation of engine anti-ice may allow excessive ingestion of ice and result in engine damage or failure.

CAUTION: Do not use engine anti-ice when OAT is above 10°C.

When engine anti-ice is needed:

ENGINE START switches ....LOW IGN F/O

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

Verify that all engine anti-ice VALVE OPEN lights illuminate bright, then dim.

When engine EPR has stabilized:

ENGINE START switches ....OFF F/O

When engine anti-ice is no longer needed:

ENGINE ANTI-ICE switches .... OFF F/O

Verify that all engine anti-ice VALVE OPEN lights illuminate bright, then extinguish.

When moderate to severe icing conditions are present during prolonged ground operation, do an engine run up, as needed, to minimize ice build-up. Use the following procedure:

Check that the area behind the airplane is clear	C
Run-up to a minimum of 70% N1 for approximately 15 seconds duration at intervals no greater than 15 minutes	C
If airport surface conditions and the concentration of aircraft do not allow the engine thrust level to be increased to 70% N1, then set a thrust level as high as practical and time at that thrust level.	C

Shutdown Procedure

Do the following step before doing the normal Shutdown Procedure:

After landing in icing conditions:

WARNING: Ensure that the stabilizer trim wheel handles are stowed before using electric trim to avoid personal injury.

Stabilizer trim .... Set 5 units C

Prevents melting snow and ice from running into the tail cone. Excessive water in the tailcone can freeze and lock controls.

Secure Procedure

Do the normal Secure Procedure with the following modifications:

If the airplane will be attended and warm air circulation throughout the cargo and E/E compartments is desired:

CAUTION: Do not leave the interior unattended with a pack operating and all doors closed. With the airplane in this configuration, accidental closure of the main outflow valve can cause unscheduled pressurization of the airplane.

APU ....Start F/O

APU GENERATOR switches .... ON F/O

One PACK switch .... ON F/O

ISOLATION VALVE switch........................... AUTO F/O

Pressurization mode selector .... MAN AC		F/O
FLT/GRD switch .... GRD		F/O
Outflow valve switch .... OPEN		F/O

Prevents aircraft pressurization.

Note: The airplane must be parked into the wind when the outflow valve is full open.

APU BLEED air switch .... ON	F/O

If the airplane will not be attended, or if staying overnight at off-line stations or at airports where normal support is not available, the flight crew must arrange for or verify that the following steps are done:

Pressurization mode selector .... MAN AC	F/O
Outflow valve switch .... CLOSE	F/O

Position the outflow valve fully closed to inhibit the intake of snow or ice.

Wheel chocks .... Verify in place	C or F/O
Parking brake .... Released	C

Reduces the possibility of frozen brakes.

Cold weather maintenance procedures for securing the airplane may be required. These procedures are normally done by maintenance personnel, and include, but are not limited to:

- protective covers and plugs installed
- water storage containers drained
- toilets drained
- doors and sliding windows closed
- battery removed. If the battery will be exposed to temperatures below -18° C, the battery should be removed and stored in an area warmer than -18° C, but below 40° C. Subsequent installation of the warm battery ensures the starting capability of the APU.

Ice Crystal Icing (ICI)

At temperatures below freezing near convective weather, the airplane can encounter visible moisture made up of high concentrations of small ice crystals. Ice crystals can accumulate aft of the engine fan, in the engine core. Ice shedding can cause engine vibration, engine power loss, and engine damage.

Ice crystal icing is difficult to detect because ice crystals do not cause significant weather radar returns. They are often found in high concentrations above and near regions of heavy precipitation. Ice crystals do not stick to cold aircraft surfaces.

Avoid ICI conditions. Flight in clouds containing high concentration of ice crystals has been associated with engine vibration, engine power-loss, and engine damage.

Because these conditions can be difficult to recognize, careful preflight planning is a key component of in-flight situational awareness. When ICI is encountered or suspected, do the QRH Ice Crystal Icing NNC to mitigate the effect on the flight.

Recognizing Ice Crystal Icing

Ice crystals are most frequently found in areas of visible moisture and above altitudes normally associated with icing conditions. Their presence can be indicated by one or more of the following:

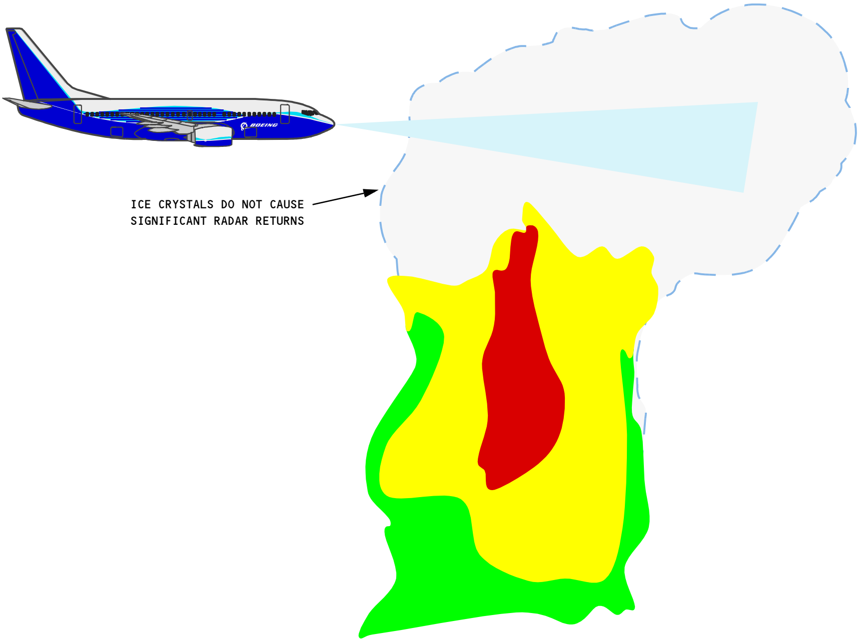
- Appearance of rain on the windshield at temperatures too cold for liquid water to exist. This is due to ice crystals melting on the heated windows (sounds different than rain)
- Areas of light to moderate turbulence
- In IMC with:
  - No significant airframe icing and
  - No significant radar returns at airplane altitude and
  - Heavy precipitation below the airplane, identified by amber and red radar returns on weather radar
- Cloud tops above typical cruise levels (above the tropopause)
- Smell of ozone or sulfur
- Humidity increase
- Static discharge around the windshield (St. Elmo’s fire)

Note: The ice detection system does not detect ice crystal icing. It is designed to detect supercooled water only.

Avoiding Ice Crystal Icing

During flight in IMC, avoid flying directly over significant amber or red radar returns, even if there are no returns at airplane altitude.

Use the weather radar controls to assess weather radar reflectivity below the airplane flight path. Refer to weather radar operating instructions for additional information.



Areas with a higher risk of High Ice Water Content (HIWC) are identified by some aviation weather vendors. In these areas, ICI should be suspected while operating in IMC. Use of this of HIWC information is recommended for strategic preflight planning and in-flight adjustments in order to avoid potential ICI conditions.

Ice Crystal Icing Suspected

Exit the ice crystal icing conditions. Request a route change to minimize the time above red and amber radar returns.

Do the Ice Crystal Icing non-normal checklist.

Hot Weather Operation

During ground operation the following considerations will help keep the airplane as cool as possible:

- If cooling air is available from an outside source, the supply should be plugged in immediately after engine shutdown and should not be removed until just prior to engine start.
- Keep all doors and windows, including cargo doors, closed as much as possible.
- Electronic components which contribute to a high temperature level in the flight deck should be turned off while not needed.
- Open windshield air, foot air vents and all air outlets on the flight deck.
- Open all passenger cabin gasper outlets and close all window shades on the sun–exposed side of the passenger cabin.

Do the following for maximum cooling on the ground:

If ground air source is available:

APU BLEED air switch ....OFF

ISOLATION VALVE switch .... OPEN

GASPER FAN .... ON

Air conditioning PACK switches .... ON

Duct pressure .... 20 – 25 PSI

If the ground air source supply will not maintain 20 – 25 psi:

ISOLATION VALVE switch ....CLOSE

GASPER FAN ....ON

APU BLEED air switch ....ON

The APU supplies the left pack and the ground air source supplies the right pack.

If the APU is the only source of pneumatic air pressure:

APU BLEED air switch .... ON

One PACK switch .... ON

ISOLATION VALVE switch ....As needed

Position the ISOLATION VALVE switch as needed to supply the selected pack.

GASPER FAN ....ON

Temperature selectors .... AUTO

Brake temperature levels may be reached which can cause the wheel fuse plugs to melt and deflate the tires. Consider the following actions:

- Be aware of brake temperature buildup when operating a series of short flight sectors. The energy absorbed by the brakes from each landing is accumulative
- Extending the landing gear early during the approach provides additional cooling for tires and brakes
- In–flight cooling time can be determined from the "Brake Cooling Schedule" in the Performance–Inflight section of the QRH.

At the pilot's discretion, reverse thrust may be used during taxi to control forward speed. The procedure should be used to maintain normal taxi speeds and should be considered when operating under the following conditions:

- High ambient temperatures
- Following an excessively braked landing
- Downslope taxi
- Tailwinds
- Light gross weight
- Any combination of the above.

When using reverse thrust to reduce taxi speed, a smooth rearward movement of the reverse thrust levers is desired to avoid overshooting the limit of the interlock position. If an EPR of more than 1.1 results, modulate the reverse thrust levers forward until 1.1 EPR or less is reached. The 1.1 EPR setting will normally preclude foreign object ingestion and air conditioning contamination. If the odor of exhaust gases is detected or excessive dust is generated, return the thrust levers to forward thrust to avoid contamination. Reverse thrust for taxi should be used with caution on airports with dirty runway or taxi conditions.

During flight planning consider the following:

- High temperatures inflict performance penalties which must be taken into account on the ground before takeoff.
- Alternate takeoff procedures (No Engine Bleed Takeoff, Improved Climb Performance, etc.).

Operation in a Sandy or Dusty Environment

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

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

Exterior Inspection

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

Do the normal Exterior Inspection with the following additional steps:

Windshield ....Check

Verify that the windshield has been cleaned.

Note: Do not use windshield wipers for sand or dust removal. Wash deposits off with water and wipe residue off with a soft cloth.

Surfaces ....Check

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

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

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

Verify that the left and right ram air inlets are free of sand and dust.

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

Leading edge flaps .... Check

Verify that all leading edges are undamaged.

Engine inlets .... Check

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

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

Fuel tank vents .... Check

Verify that all vents are free of sand and dust.

Landing gear .... Check

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

Vertical and horizontal stabilizers .... Check

Verify that all leading edges are undamaged.

APU air inlet .... Check

Ensure that the APU inlet door and cooling air inlet are free of sand and dust before APU start.

Preflight Procedure - First Officer

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

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

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

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

APU switch .... START F/O

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

Engine BLEED air switches .... OFF F/O

APU BLEED air switch .... ON F/O

Engine Start Procedure

Do the normal Engine Start Procedure with the following modifications:

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

Before Taxi Procedure

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

If bleed air is needed to maintain tolerable flight deck and cabin temperatures, use APU bleed air rather than engine bleed air during the taxi out. Limit APU bleed air use as much as possible to reduce sand and dust ingestion.

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

APU switch .... START F/O

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

Engine BLEED air switches .... OFF F/O

APU BLEED air switch .... ON F/O

Flight controls .... Check C

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

Taxi–Out

Do the following, conditions permitting, to minimize sand and dust ingestion by the engines and to improve visibility during taxi:

- Use all engines during taxi and taxi at low speed. Limit ground speed to 10 knots and maintain thrust below 40% N1 whenever possible to avoid creating engine vortices during ground operations.
- Maintain a greater than normal separation from other aircraft while taxiing and avoid the ingestion of another engine's wake.
- Avoid engine overhang of unprepared surfaces.
- In the event of a crosswind during 180° turns, turn away from the wind if possible to minimize sand and dust ingestion.

- Whenever possible, avoid situations that would require the airplane to be brought to a complete stop.
- Avoid excessive braking. The presence of sand or dust will increase brake wear.
- Use reverse thrust during taxi for emergency stopping only.

Takeoff

Do the following to minimize sand and dust ingestion by the engines during takeoff:

- Use the maximum fixed derate and/or assumed temperature thrust reduction that meets performance requirements.
- Make an No Engine Bleed Takeoff if operations permit. If cabin and flight deck temperatures can be maintained at a tolerable temperature, consider an Unpressurized Takeoff.
- Before takeoff, allow sand and dust to settle if conditions allow.
- Do not take off into a sand or dust cloud.
- Use a rolling takeoff. Whenever possible, avoid setting high thrust at low speed.
- When visible sand and dust exist, consider delaying flap retraction until above the dust cloud, if operations permit.

Approach

Do the following, conditions permitting, to minimize sand and dust ingestion:

- Make an No Engine Bleed Landing if operations permit. If cabin and flight deck temperatures can be maintained at a tolerable temperature, consider an Unpressurized Landing.

Landing

Do the following to minimize sand and dust ingestion by the engines during landing:

- Use autobrakes on landing to help minimize the need for reverse thrust.
- Performance permitting, minimize the use of reverse thrust to prevent ingestion of dust and sand and to prevent reduction of visibility. Reverse thrust is most effective at high speed.

After Landing Procedure

Do the normal After Landing Procedure with the following modifications:

If bleed air is needed to maintain tolerable flight deck and cabin temperatures, use APU bleed air rather than engine bleed air during the taxi in. Limit APU bleed air use as much as possible to reduce sand and dust ingestion.

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

APUswitch .... START PM

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

Engine BLEED air switches .... OFF PM

APU BLEED air switch .... ON PM

Taxi-In

Do the following, conditions permitting, to minimize sand and dust ingestion by the engines and to improve visibility during the taxi-in:

- Use all engines and taxi at low speed. Limit ground speed to 10 knots and maintain thrust below 40% N1 whenever possible.
- Maintain a greater than normal separation from other aircraft while taxiing and avoid the ingestion of another engine's wake.
- Avoid engine overhang of unprepared surfaces.
- In the event of a crosswind during 180° turns, turn away from the wind if possible to minimize sand and dust ingestion.
- Whenever possible, avoid situations that would require the airplane to be brought to a complete stop.
- Avoid excessive braking. The presence of sand or dust will increase brake wear.
- Use reverse thrust during taxi for emergency stopping only.

Secure Procedure

Do the normal Secure Procedure with the following modifications:

CAUTION: Do not leave the the interior unattended with a pack operating and all doors closed. With the main outflow valve closed, an unscheduled pressurization of the airplane may occur.

PACK switches .... Verify OFF F/O

Pressurization mode selector ....MAN DC F/O

Outflow VALVE switch ....CLOSE F/O

Position the outflow valve fully closed to inhibit the intake of sand or dust.

Additional procedures for securing the airplane during sandy or dusty conditions may be needed. These procedures are normally done by maintenance personnel, and include, but are not limited to:

- engine covers installed, if applicable.
- protective covers and plugs installed (streamers should be used to remind personnel to remove before flight).
- doors and sliding windows closed.
- all compartments closed.

Moderate to Heavy Rain, Hail or Sleet

Flights should be conducted to avoid thunderstorm or hail activity. If visible moisture is present at high altitude, avoid flight over the storm cell. (Storm cells that do not produce visible moisture at high altitude can be overflown safely.) To the maximum extent possible, moderate to heavy rain, hail or sleet should also be avoided.

If moderate to heavy rain, hail or sleet is encountered or anticipated:

Note: Start descent early. For each 1,000 feet of descent that 55% N1 is expected to be used, start descent one mile earlier than the computed top of descent point.

ENGINE START switches .... LOW IGN

Minimum engine N1 .... 55%

Thrust levers .... Adjust slowly.

If thrust changes are necessary, move the thrust levers slowly. Avoid changing thrust lever direction until engines have stabilized at a selected setting. Maintain an increased minimum thrust setting.

CAUTION: Do not shutdown an engine if the engine does not respond normally to thrust lever movement if the EGT is stable and is within limits. Normal engine response will return upon leaving the area of heavy precipitation.

ENGINE ANTI-ICE switches .... As required

Consider starting the APU (if available).

Severe Turbulence

The best airspeed and flight configuration to use in severe turbulence is that which affords ample protection from stall and high speed buffet and which also provides structural integrity. The recommended procedures for flight in severe turbulence are summarized as follows:

Structural

Flap extension in an area of know turbulence should be delayed as long as possible because the airplane can withstand higher gust loads in the clean configuration. Diversion to another airfield is the best policy if severe turbulence persists in the area.

Seat Belts

Advise passengers to fasten seat belts prior to entering areas of reported or anticipated turbulence. Instruct flight attendants to check all passengers' seat belts are fastened.

Power Plant

Flying in turbulence or hail may cause engine inlet airflow distortion. this distortion, along with engine icing, angle of attack changes and high altitude surge margins can result in engine surge and flameout. Activate ignition as soon as turbulence is encountered.

Yaw Damper

Flight test data substantiates that important benefits are obtained from the use of yaw damping during turbulence penetration. Excursions in sideslip and roll are minimized and, even though the rudder control may be more active, the structural loads imposed on the vertical tail are considerably reduced.

Climb and Cruise

The autoflight system may be used in turbulence at the discretion of the flight crew. After takeoff and retraction of the gear and flaps, use climb thrust and the recommended climb airspeed for penetration of turbulence.

When operating in severe turbulence, refer to the use of the PDC to obtain recommended thrust setting, pitch attitude and airspeed. If without operable PDC, refer to the TURBULENT AIR PENETRATION charts in the CRUISE pages. This provides approximate RPM settings that will maintain near optimum penetration airspeed. The most important objective is to obtain an initial thrust setting close to the correct one. Once the proper thrust setting for the recommended penetration speed is achieved, it is undesirable to make thrust changes during severe turbulence. Large variations in airspeed and altitude can occur in severe turbulence.

Auto Flight in Severe Turbulence

When penetrating areas of severe turbulence, the autopilot should be engaged in the TURB mode. Maintain altitude and heading by manual autopilot controls. If sustained trimming occurs, disengage the autopilot.

Manual Flight in Severe Turbulence

Trim the airplane for penetration speed, then do not change stabilizer position. Control the airplane pitch attitude with the elevators using the attitude indicator as the primary instrument. In extreme drafts, large attitude changes may occur. Do not make sudden large elevator control inputs. Corrective actions to regain the desired attitude should be smooth and deliberate. Altitude variations are probable in severe turbulence and should be allowed to occur if terrain clearance is adequate. Control airplane attitude first, then make corrections for airspeed, altitude and heading.

Descent

If severe turbulence is encountered at altitudes below 15,000 feet and the airplane gross weight is less than the maximum landing weight, the airplane may be slowed to 250 knots in the clean configuration. Adequate stall margin exists under these conditions.

Turbulent Air Penetration

In the event that severe turbulence is encountered:

Yaw Damper .... ON

A/P selector .... TURB

ENGINE START switches .... LOW IGN

Engine anti-ice switches
(if needed) .... ON

Thrust .... Adjust

Adjust thrust to achieve turbulent air penetration speed (280 knot or.70 Mach.) Refer to Unreliable Airspeed page in the Performance-Inflight section of the QRH for approximate N1 settings that maintain near optimum penetration airspeed.

Windshear

Windshear is a change of wind speed and/or direction over a short distance along the flight path. Indications of windshear are listed in the Windshear non-normal maneuver in this manual.

Avoidance

The flight crew should search for any clues to the presence of windshear along the intended flight path. Presence of windshear may be indicated by:

- Thunderstorm activity
- Virga (rain that evaporates before reaching the ground)
- Pilot reports
- Low level windshear alerting system (LLWAS) warnings

Stay clear of thunderstorm cells and heavy precipitation and areas of known windshear. If the presence of windshear is confirmed, delay takeoff or do not continue an approach.

Precaution

If windshear is suspected, be especially alert to any of the danger signals and be prepared for the possibility of an inadvertent encounter. The following precautionary actions are recommended if windshear is suspected:

Takeoff

- Takeoff with full rated takeoff thrust is recommended.
- For optimum takeoff performance, use flaps 5, 10 or 15 unless limited by obstacle clearance and/or climb gradient
- Use the longest suitable runway provided it is clear of areas of known windshear

- Consider increasing Vr speed to the performance limited gross weight rotation speed, not to exceed actual gross weight Vr + 20 knots. Set V speeds for the actual gross weight. Rotate at the adjusted (higher) rotation speed. This increased rotation speed results in an increased stall margin, and meets takeoff performance requirements. If windshear is encountered at or beyond the actual gross weight Vr, do not attempt to accelerate to the increased Vr, but rotate without hesitation
- Be alert for any airspeed fluctuations during takeoff and initial climb. Such fluctuations may be the first indication of windshear
- Know the all–engine initial climb pitch attitude. Rotate at the normal rate to this attitude for all non–engine failure takeoffs. Minimize reductions from the initial climb pitch attitude until terrain and obstruction clearance is assured, unless stick shaker activates
- Crew coordination and awareness are very important. Develop an awareness of normal values of airspeed, attitude, vertical speed, and airspeed build–up. Closely monitor vertical flight path instruments such as vertical speed and altimeters. The pilot monitoring should be especially aware of vertical flight path instruments and call out any deviations from normal
- Should airspeed fall below the trim airspeed, unusual control column forces may be required to maintain the desired pitch attitude. Stick shaker must be respected at all times

Approach and Landing

- Use flaps 30 for landing
- Establish a stabilized approach no lower than 1000 feet above the airport to improve windshear recognition capability
- Use the most suitable runway that avoids the areas of suspected windshear and is compatible with crosswind or tailwind limitations. Use electronic or visual glide path indications to detect flight path deviations and help with timely detection of windshear
- Avoid large thrust reductions or trim changes in response to sudden airspeed increases as these may be followed by airspeed decreases
- Crosscheck flight director commands using vertical flight path instruments
- Crew coordination and awareness are very important, particularly at night or in marginal weather conditions. Closely monitor the vertical flight path instruments such as vertical speed, altimeters, and glideslope displacement. The pilot monitoring should call out any deviations from normal. Use of the autopilot for the approach may provide more monitoring and recognition time

Recovery

Accomplish the Windshear Escape Maneuver found in the Non–Normal Maneuvers section of this manual.

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737-200ADV JT8D-15A LB FAA

Performance Inflight — Chapter PI
General — Section 10

Takeoff Speeds

V1, VR, V2 — ANTI-SKID ON

PRESSURE ALTITUDE 1000 FT		OAT																	
9 TO 10	°F / °C										-65 TO -2 °F / -54 TO -19 °C			-1 TO 32 °F / -18 TO 0 °C			33 TO 85 °F / 1 TO 29 °C		
7 TO 9	°F / °C							-65 TO 5 °F / -54 TO -15 °C			6 TO 36 °F / -14 TO 2 °C			37 TO 85 °F / 3 TO 29 °C			86 TO 103 °F / 30 TO 39 °C		
5 TO 7	°F / °C				-65 TO 14 °F / -54 TO -10 °C			15 TO 42 °F / -9 TO 5 °C			43 TO 86 °F / 6 TO 30 °C			87 TO 101 °F / 31 TO 38 °C			102 TO 112 °F / 39 TO 44 °C		
3 TO 5	°F / °C	-65 TO 23 °F / -54 TO -5 °C			24 TO 49 °F / -4 TO 9 °C			50 TO 92 °F / 10 TO 32 °C			93 TO 105 °F / 33 TO 40 °C			106 TO 120 °F / 41 TO 48 °C					
1 TO 3	°F / °C	-65 TO 71 °F / -54 TO 22 °C			72 TO 93 °F / 23 TO 33 °C			94 TO 107 °F / 34 TO 41 °C			108 TO 126 °F / 42 TO 52 °C								
-1 TO 1	°F / °C	-65 TO 93 °F / -54 TO 34 °C			94 TO 110 °F / 35 TO 43 °C			111 TO 121 °F / 44 TO 49 °C			122 TO 131 °F / 50 TO 55 °C								
FLAPS	**WT 1000 LB**	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	V_1	V_R	V_2
1	130	157	160	165	158	161	165	158	161	165									
	120	150	153	158	150	153	158	151	154	158	152	155	158	152	155	158			
	110	143	145	151	144	146	151	145	147	151	145	147	151	145	147	151	146	148	151
	100	136	137	144	137	138	144	138	139	144	138	139	144	138	140	144	138	140	144
	90	128	129	136	129	130	136	129	130	136	130	131	136	131	132	136	131	132	136
	80	119	120	128	120	121	128	121	122	128	121	122	128	122	123	128	122	123	128
	70	111	111	120	111	111	120	113	113	120	113	113	120	114	114	120	114	114	120
2	130	152	155	160	152	155	160												
	120	145	148	153	145	148	153	146	149	153	147	150	153						
	110	139	141	146	139	141	146	140	142	146	140	142	146	141	143	146			
	100	132	133	139	133	134	139	133	134	139	134	135	139	134	135	139	134	135	139
	90	124	125	132	124	125	132	125	126	132	125	126	132	126	127	132	126	127	132
	80	115	116	124	116	117	124	116	117	124	117	118	124	118	119	124	118	119	124
	70	106	107	116	107	107	116	108	108	116	109	109	116	110	110	116	110	110	116
5	130	149	152	156	149	152	156												
	120	143	145	150	143	145	150	144	146	150									
	110	135	138	143	136	138	143	137	139	143	137	139	143	138	140	143			
	100	129	130	136	130	131	136	130	131	136	131	132	136	131	132	136	132	133	136
	90	121	122	129	122	123	129	122	123	129	123	124	129	123	124	129	124	125	129
	80	113	114	122	114	115	122	114	115	122	115	116	122	115	116	122	116	117	122
	70	105	105	114	105	106	114	106	106	114	107	107	114	108	108	114	108	108	114
10	120	139	140	146	140	141	146	140	141	146	141	142	146						
	110	131	132	138	132	133	138	132	133	138	133	134	138						
	100	123	124	131	124	125	131	125	126	131	125	126	131	125	126	131			
	90	116	117	124	117	118	124	117	118	124	118	119	124	118	119	124	118	119	124
	80	107	108	117	109	110	117	109	110	117	110	111	117	110	111	117	111	112	117
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110
15	110	127	128	134	128	129	134	129	130	134	129	130	134	130	131	134			
	100	120	121	127	121	122	127	121	122	127	122	123	127	122	123	127			
	90	112	113	121	113	114	121	114	115	121	114	115	121	115	116	121	115	116	121
	80	105	105	113	105	105	113	106	107	113	106	107	113	107	108	113	107	108	113
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110
25	110	125	126	131	125	126	131	126	127	131									
	100	118	119	125	119	120	125	119	120	125	120	121	125						
	90	110	111	118	111	112	118	111	112	118	112	113	118	112	113	118			
	80	105	105	110	105	105	110	105	105	110	105	105	110	105	106	111	105	106	111
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110

BOXED AREA INDICATES PERFORMANCE AFFECTED BY MINIMUM CONTROL SPEED, MINIMUM FIELD LENGTH FOR LIGHTEST WEIGHT ABOVE BOXED AREA IS REQUIRED.

REDUCE V1 AND VR BY 1 KNOT AND V2 BY 2 KNOTS WITH 15% FWD C.G. LIMIT.

V1 ADJUSTMENTS	
WIND	SLOPE
SUBTRACT 1 KT PER 5 KTS TAILWIND	SUBTRACT 1 KT PER 1% DOWN SLOPE

VMCG

OAT (°C)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
50	95	91	88			
40	99	95	92	89	85	
30	103	99	95	92	88	85
20	103	101	97	94	90	87
10	103	101	97	94	90	87
0	103	104	99	96	92	89
-10	103	104	101	98	94	90
-20	103	104	103	99	96	92
-30	103	104	103	99	96	92
-40	103	104	103	99	96	92

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)			
	100	120	140	160
900	-3	-3	-3	-3
600	-2	-2	-2	-2
300	-1	-1	-1	-1
0	0	0	0	0
-300	1	1	1	1
-600	2	2	2	2
-900	3	3	3	3

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
4000	450
6000	600
8000	700
10000	800

Stab Trim Setting

Max Takeoff Thrust

C.G. %MAC	6	10	14	18	22	26	30	32
FLAPS 1 THRU FLAPS 10	7 3/4	7	6 1/4	5 1/2	4 3/4	4	3 1/4	2 3/4
FLAPS 15 & FLAPS 25	8 3/4	7 3/4	7	6	5	4	3 1/4	2 3/4

VREF (KIAS)

WEIGHT (1000 LB)	FLAPS		
	40	30	15
130	149	154	161
125	146	150	158
120	142	146	154
115	139	142	150
110	135	139	146
105	132	135	142
100	128	131	138
95	124	127	134
90	121	124	131
85	117	120	127
80	113	116	123
75	110	112	119
70	106	109	115

For approach speed add wind factor of 1/2 headwind component + gust (max 20 knots).

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED (KIAS)		
	WEIGHT		
	AT OR BELOW 117000 LB	ABOVE 117000 LB AND AT OR BELOW 138500 LB	ABOVE 138500 LB
UP	210	220	230
1	190	200	210
5	170	180	190
10	160	170	180
15	150	160	170
25	140	150	160

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Weight Adjustment (1000 LB)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			*0.25 INCHES (6 mm)			**0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
140	-18.2	-18.7	-18.6	-23.0	-23.5	-23.0	-31.5	-32.9	-32.5
130	-16.2	-17.2	-17.9	-21.0	-22.0	-23.0	-29.4	-30.9	-31.5
120	-14.3	-15.7	-16.9	-18.8	-20.6	-22.3	-26.8	-28.3	-30.0
110	-12.2	-13.7	-15.3	-15.4	-18.2	-20.0	-23.0	-25.8	-27.2
100	-10.6	-12.1	-13.6	-13.2	-15.6	-18.2	-18.9	-23.0	-24.2
90	-8.8	-9.9	-11.4	-10.9	-12.3	-15.0	-14.1	-19.8	-20.8
80	-6.9	-7.4	-9.1	-8.7	-8.7	-11.6	-9.7	-16.6	-17.4
70	-5.0	-4.9	-6.7	-6.5	-5.1	-8.2	-5.3	-13.4	-14.0

***For flaps 10, 15 and 25, increase slush/standing water limited weight by 1000 lb.**
****For flaps 10, 15 and 25, increase slush/standing water limited weight by 2500 lb.**

VMCG Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3800				51.9			55.0		
4200	59.3			64.8	52.2		69.3	59.5	
4600	72.5	57.0		77.7	63.3	52.3	83.6	69.7	58.0
5000	85.8	68.6	59.8	90.6	74.4	62.6	98.8	80.0	67.8
5400	99.0	80.2	69.7	103.5	85.6	72.8	112.9	90.3	77.6
5800	111.8	91.8	79.6	116.7	96.9	83.1	127.1	101.6	87.3
6200	125.1	103.2	89.5	130.0	107.6	93.5	141.4	112.1	96.7
6600	138.4	114.5	99.4	143.3	118.9	104.0	155.7	122.6	106.0
7000	151.8	126.2	109.5	156.7	130.3	114.3		133.2	115.3
7400		137.9	119.6		141.7	125.1		143.7	124.7
7800		149.5	129.6		153.1	135.9		154.2	134.0
8200			139.6			146.8			143.3
8600			149.7			157.6			152.6
9000			159.7						

1. **Enter Weight Adjustment table with slush/standing water depth and dry field/obstacle limit weight to obtain slush/standing water weight adjustment.**
2. **Adjust field length available -110 ft/+110 ft for every 10°F above/below 40°F.**
3. **Find VMCG limit weight for adjusted field length and pressure altitude.**
4. **Max allowable slush/standing water limited weight is lesser of weights from 1 and 3.**

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH								
	0.12 INCHES (3 mm)			0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
130	-12	-10	-8	-5	-5	-5	1	1	1
120	-14	-12	-9	-6	-5	-4	1	1	1
110	-16	-13	-10	-9	-5	-3	1	1	1
100	-18	-15	-11	-12	-8	-3	1	1	1
90	-20	-18	-13	-15	-11	-5	-3	0	1
80	-22	-20	-15	-18	-14	-8	-9	-2	1
70	-23	-22	-18	-20	-17	-11	-16	-4	1
60	-24	-24	-20	-23	-21	-15	-23	-6	1

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

Slippery Runway Takeoff

Weight Adjustment (1000 LB)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
140	-0.6	-0.6	-0.6	-7.9	-7.9	-7.9	-14.2	-14.2	-14.2
130	-1.4	-1.4	-1.4	-7.9	-7.9	-7.9	-13.5	-13.5	-13.5
120	-1.8	-1.8	-1.8	-7.8	-7.8	-7.8	-12.9	-12.9	-12.9
110	-2.0	-2.0	-2.0	-7.3	-7.3	-7.3	-12.1	-12.1	-12.1
100	-2.0	-2.0	-2.0	-7.0	-7.0	-7.0	-11.2	-11.2	-11.2
90	-1.5	-1.5	-1.5	-6.5	-6.5	-6.5	-9.8	-9.8	-9.8
80	-1.5	-1.5	-1.5	-5.5	-5.5	-5.5	-7.9	-7.9	-7.9
70	-1.5	-1.5	-1.5	-4.5	-4.5	-4.5	-5.6	-5.6	-5.6

VMCG Limit Weight (1000 LB)

ADJUSTED FIELD LENGTH (FT)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
3000	52.5								
3400	72.5								
3800	92.6	67.5		54.3					
4200	113.0	87.5	62.5	68.6	50.7				
4600	133.0	108.0	82.5	82.9	65.0		56.7		
5000	153.0	128.0	103.0	98.0	79.3	61.4	67.1		
5400		148.0	123.0	113.1	94.0	75.7	77.5	59.3	
5800			143.0	126.9	109.6	90.0	87.9	69.7	51.5
6200				140.7	123.4	105.8	98.8	80.0	61.9
6600				154.5	137.2	120.0	110.2	90.6	72.3
7000					151.0	133.8	121.9	101.6	82.7
7400						147.6	134.0	113.1	93.3
7800							146.3	124.9	104.4
8200							158.7	137.1	116.0
8600								149.4	127.9
9000									140.2
9400									152.5

1. **Enter Weight Adjustment table with reported braking action and dry field/obstacle limit weight to obtain slippery runway weight adjustment.**
2. **Adjust "Good" field length available by -100 ft/+100 ft for every 10°F above/below 40°F.**
   Adjust "Medium" field length available by -100 ft/+100 ft for every 10°F above/below 40°F.
   Adjust "Poor" field length available by -120 ft/+120 ft for every 10°F above/below 40°F.
3. **Find V1(MCG) limit weight for adjusted field length and pressure altitude.**
4. **Max allowable slippery runway limited weight is lesser of weights from 1 and 3.**

V1 Adjustment (KIAS)

WEIGHT (1000 LB)	REPORTED BRAKING ACTION								
	GOOD			MEDIUM			POOR		
	PRESS ALT (FT)			PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000	S.L.	4000	8000
130	-6	-3	1	-14	-11	-8	-24	-20	-16
120	-7	-4	-1	-16	-13	-10	-26	-22	-18
110	-9	-6	-3	-18	-15	-12	-28	-24	-20
100	-10	-7	-4	-20	-17	-14	-30	-26	-22
90	-12	-9	-6	-22	-19	-16	-31	-27	-23
80	-13	-10	-7	-23	-20	-17	-32	-28	-24
70	-14	-11	-8	-25	-22	-19	-33	-29	-25
60	-15	-12	-9	-26	-23	-20	-34	-30	-26

1. **Obtain V1, VR and V2 for the actual weight.**
2. **If VMCG limited, set V1 = VMCG. If not VMCG limited, enter V1 Adjustment table with the actual weight to obtain V1 speed adjustment. If adjusted V1 is less than VMCG, set V1 = VMCG.**

Takeoff EPR

Based on engine bleed for packs on and anti-ice on or off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)					
°F	°C	-1000	0	1000	2000	3000	3856 & ABOVE
130	55	1.84	1.84	1.84	1.84	1.84	1.84
122	50	1.90	1.90	1.90	1.90	1.90	1.90
113	45	1.94	1.94	1.94	1.94	1.94	1.94
104	40	1.99	1.99	1.99	1.99	1.99	1.99
95	35	2.04	2.04	2.04	2.04	2.04	2.04
86	30	2.05	2.09	2.09	2.09	2.09	2.09
77	25	2.05	2.10	2.13	2.12	2.12	2.12
68	20	2.05	2.10	2.13	2.14	2.14	2.14
59	15	2.05	2.10	2.13	2.14	2.14	2.14
50	10	2.05	2.10	2.14	2.14	2.14	2.14
41	5	2.05	2.10	2.16	2.17	2.17	2.17
32	0	2.05	2.10	2.16	2.20	2.21	2.21
23	-5	2.05	2.10	2.16	2.21	2.23	2.23
14	-10	2.05	2.10	2.16	2.21	2.26	2.26
5	-15	2.05	2.10	2.16	2.21	2.27	2.28
-4	-20	2.05	2.10	2.16	2.21	2.27	2.30
-13 to -65	-25 to -54	2.05	2.10	2.16	2.21	2.27	2.31

When operating in shaded area with engine anti-ice on, decrease EPR limit by 0.03.

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-1000	3856 & ABOVE
PACKS OFF	0.03	0.03

With Gravel Protect switch in "ON" position, decrease EPR by 0.01.

%N1 vs EPR Crosscheck

(Takeoff and Go-around)

AIRPORT OAT		TARGET %N1						
		EPR						
°F	°C	1.70	1.80	1.90	2.00	2.10	2.20	2.30
130	54	90	93	96	99	102	107	111
122	50	89	92	95	98	102	106	110
104	40	88	91	94	97	100	104	108
86	30	87	90	92	95	99	102	106
68	20	85	88	91	94	97	101	105
50	10	84	87	89	92	95	99	103
32	0	82	85	88	90	94	97	101
14	-10	81	84	86	89	92	95	99
-4	-20	79	82	84	87	90	94	97
-22	-30	78	80	83	85	88	92	95
-40	-40	76	78	81	84	87	90	94
-58	-50	75	77	79	82	85	88	92
-65	-54	74	76	78	81	84	87	91

Use scheduled Takeoff or Go-around EPR.
Use actual OAT only.
%N1 operating tolerance ±2%
%N1 limit 102.45%
A/C on or off
For engine anti-icing on, increase %N1 by 1%.

Reduced Takeoff EPR
Based on engine bleed for packs on or off
1000 FT Pressure Altitude and Below
Takeoff EPR Reduction

SURPLUS WEIGHT (LB)	FIELD LENGTH LIMITED										CLIMB LIMITED (ALL TEMPS)
	OAT										
	°C	-10 TO -6	-5 TO -1	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 33	34 AND ABOVE	
	°F	14 TO 22	23 TO 31	32 TO 40	41 TO 49	50 TO 58	59 TO 67	68 TO 76	77 TO 85	86 TO 92	93 AND ABOVE	
1000 TO 1999										0.01	0.01
2000 TO 2989										0.02	0.02
3000 TO 3999									0.01	0.04	0.03
4000 TO 4999								0.01	0.03	0.05	0.04
5000 TO 5999							0.01	0.03	0.04	0.06	0.05
6000 TO 6999						0.01	0.03	0.04	0.06	0.08	0.06
7000 TO 7999					0.01	0.03	0.04	0.06	0.07	0.09	0.07
8000 TO 8999				0.02	0.03	0.04	0.06	0.07	0.08	0.10	0.08
9000 TO 9999		0.01	0.02	0.03	0.04	0.06	0.07	0.08	0.10	0.12	0.09
10000 TO 10999	0.01	0.02	0.03	0.04	0.06	0.07	0.08	0.10	0.11	0.13	0.10
11000 TO 11999	0.02	0.03	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.15	0.11
12000 TO 12999	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.13	0.14	0.17	0.12
13000 TO 13999	0.05	0.06	0.07	0.08	0.10	0.11	0.13	0.14	0.16	0.18	0.13
14000 TO 14999	0.06	0.07	0.09	0.10	0.11	0.13	0.14	0.16	0.17	0.20	0.14
15000 TO 15999	0.08	0.09	0.10	0.11	0.13	0.14	0.16	0.17	0.19	0.21	0.15
16000 TO 16999	0.09	0.10	0.11	0.13	0.14	0.16	0.17	0.19	0.20	0.23	0.16
17000 TO 17999	0.10	0.12	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.24	0.17
18000 TO 18999	0.12	0.13	0.14	0.16	0.17	0.19	0.20	0.22	0.23	0.26	0.18
19000 TO 19999	0.13	0.15	0.16	0.17	0.19	0.20	0.22	0.23	0.25	0.27	0.19
20000 TO 20999	0.15	0.16	0.17	0.19	0.20	0.22	0.23	0.25	0.26	0.29	0.20
21000 TO 21999	0.16	0.18	0.19	0.20	0.22	0.23	0.25	0.26	0.28	0.30	0.21
22000 TO 22999	0.18	0.19	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.32	0.22
23000 TO 23999	0.19	0.21	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.33	0.23
24000 TO 24999	0.21	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.35	0.24
25000 TO 25999	0.22	0.24	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.36	0.25
26000 TO 26999	0.24	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.35	0.36	0.26
27000 TO 27999	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.35	0.36	0.36	0.27
28000 TO 28999	0.27	0.28	0.30	0.31	0.32	0.34	0.35	0.36	0.36	0.36	0.28
29000 TO 29999	0.28	0.30	0.31	0.32	0.34	0.35	0.36	0.36	0.36	0.36	0.29
30000 TO 30999	0.30	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.36	0.30
31000 TO 31999	0.31	0.33	0.34	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.31
32000 TO 32999	0.33	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.32
33000 TO 33999	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.33
34000 TO 34189	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.34
34190 TO 35159	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.35
35160 AND ABOVE	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Minimum EPR

PRESSURE ALTITUDE (1000 FT)											
-1	0	1	2	3	4	5	6	7	8	9	10
1.91	1.91	1.91	1.91	1.92	1.94	1.96	1.98	1.99	2.01	2.07	2.10
1.85	1.85	1.87	1.89	MINIMUM EPR WHEN TAKEOFF ABOVE 49°C (120°F) IS PERMITTED.							

Increase Minimum EPR by 0.03 for bleeds off.
Use actual weight and OAT to determine takeoff speeds. Increase V1 and VR by 1 kt for each 0.12 EPR reduction, except when speeds are found in shaded area of the Takeoff Speeds chart.
If V1 prior to adjustment is found in the shaded area of the Takeoff Speeds chart, find the lightest weight above the shaded area and using the weight as the actual weight recalculate the surplus weight and the Takeoff EPR reduction.

Based on engine bleed for packs on or off
Above 1000 FT Pressure Altitude
Takeoff EPR Reduction

SURPLUS WEIGHT (LB)	FIELD LENGTH LIMITED										CLIMB LIMITED (ALL TEMPS)
	OAT										
°C	-10 TO -6	-5 TO -1	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 33	34 AND ABOVE	
°F	14 TO 22	23 TO 31	32 TO 40	41 TO 49	50 TO 58	59 TO 67	68 TO 76	77 TO 85	86 TO 92	93 AND ABOVE	
1000 TO 1999					0.01			0.01	0.01	0.01	0.01
2000 TO 2989				0.01	0.01		0.01	0.02	0.03	0.03	0.02
3000 TO 3999			0.01	0.03	0.01	0.01	0.02	0.03	0.04	0.04	0.03
4000 TO 4999		0.01	0.03	0.03	0.02	0.02	0.03	0.05	0.06	0.06	0.04
5000 TO 5999	0.01	0.03	0.03	0.03	0.03	0.03	0.05	0.06	0.07	0.07	0.05
6000 TO 6999	0.03	0.03	0.03	0.03	0.04	0.05	0.06	0.08	0.09	0.09	0.06
7000 TO 7999	0.03	0.03	0.03	0.04	0.06	0.06	0.08	0.10	0.10	0.10	0.07
8000 TO 8999	0.03	0.03	0.04	0.06	0.08	0.08	0.10	0.11	0.12	0.12	0.08
9000 TO 9999	0.03	0.05	0.06	0.07	0.09	0.09	0.11	0.13	0.13	0.13	0.09
10000 TO 10999	0.05	0.06	0.07	0.08	0.11	0.11	0.13	0.14	0.15	0.15	0.10
11000 TO 11999	0.06	0.07	0.08	0.10	0.12	0.13	0.14	0.16	0.17	0.16	0.11
12000 TO 12999	0.07	0.09	0.10	0.12	0.14	0.14	0.16	0.17	0.18	0.18	0.12
13000 TO 13999	0.09	0.10	0.12	0.13	0.15	0.16	0.17	0.19	0.20	0.19	0.13
14000 TO 14999	0.10	0.12	0.13	0.15	0.17	0.17	0.19	0.20	0.21	0.21	0.14
15000 TO 15999	0.12	0.13	0.15	0.16	0.18	0.19	0.20	0.22	0.23	0.23	0.15
16000 TO 16999	0.14	0.15	0.16	0.18	0.20	0.20	0.22	0.23	0.24	0.24	0.16
17000 TO 17999	0.15	0.16	0.18	0.20	0.22	0.22	0.23	0.25	0.26	0.26	0.17
18000 TO 18999	0.17	0.18	0.19	0.21	0.23	0.23	0.25	0.26	0.27	0.27	0.18
19000 TO 19999	0.18	0.20	0.21	0.22	0.25	0.25	0.26	0.28	0.29	0.29	0.19
20000 TO 20999	0.20	0.21	0.22	0.24	0.26	0.26	0.28	0.29	0.30	0.30	0.20
21000 TO 21999	0.21	0.23	0.24	0.25	0.28	0.28	0.30	0.31	0.32	0.32	0.22
22000 TO 22999	0.23	0.24	0.25	0.27	0.29	0.29	0.31	0.33	0.33	0.33	0.23
23000 TO 23999	0.24	0.26	0.27	0.28	0.31	0.31	0.33	0.34	0.35	0.35	0.24
24000 TO 24999	0.26	0.27	0.28	0.30	0.32	0.32	0.34	0.36	0.36	0.36	0.25
25000 TO 25999	0.27	0.29	0.30	0.32	0.34	0.34	0.36	0.36	0.36	0.36	0.26
26000 TO 26999	0.29	0.30	0.32	0.33	0.35	0.35	0.36	0.36	0.36	0.36	0.27
27000 TO 27999	0.30	0.32	0.33	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.28
28000 TO 28999	0.32	0.33	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.29
29000 TO 29999	0.33	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.30
30000 TO 30999	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.31
31000 TO 31429	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.32
31430 TO 32379	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.33
32380 TO 33329	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.34
33330 TO 34279	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.35
34280 AND ABOVE	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Minimum EPR

PRESSURE ALTITUDE (1000 FT)											
-1	0	1	2	3	4	5	6	7	8	9	10
1.91	1.91	1.91	1.91	1.92	1.94	1.96	1.98	1.99	2.01	2.07	2.10
1.85	1.85	1.87	1.89	MINIMUM EPR WHEN TAKEOFF ABOVE 49°C (120°F) IS PERMITTED.							

Increase Minimum EPR by 0.03 for bleeds off.
Use actual weight and OAT to determine takeoff speeds. Increase V1 and VR by 1 kt for each 0.12 EPR reduction, except when speeds are found in shaded area of the Takeoff Speeds chart.
If V1 prior to adjustment is found in the shaded area of the Takeoff Speeds chart, find the lightest weight above the shaded area and using the weight as the actual weight recalculate the surplus weight and the Takeoff EPR reduction.

Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (FT)						
	0	1000	1500	2000	3000	3900 TO 10000	37000
50	1.65	1.65	1.65	1.65	1.65	1.65	1.63
45	1.68	1.68	1.68	1.68	1.68	1.68	1.65
40	1.72	1.72	1.72	1.72	1.72	1.72	1.69
35	1.76	1.76	1.76	1.76	1.76	1.76	1.73
30	1.80	1.80	1.80	1.80	1.80	1.80	1.77
25	1.84	1.84	1.84	1.84	1.84	1.84	1.81
20	1.88	1.88	1.88	1.88	1.88	1.88	1.85
15	1.93	1.93	1.93	1.93	1.93	1.93	1.91
10	1.98	1.98	1.98	1.98	1.98	1.98	1.95
5	2.03	2.03	2.03	2.03	2.03	2.03	2.00
0	2.07	2.09	2.09	2.09	2.09	2.09	2.07
-5	2.07	2.13	2.14	2.14	2.14	2.14	2.12
-10	2.07	2.13	2.16	2.18	2.18	2.18	2.16
-15	2.07	2.13	2.16	2.19	2.21	2.21	2.19
-20	2.07	2.13	2.16	2.19	2.24	2.24	2.22
-25	2.07	2.13	2.16	2.19	2.25	2.26	2.24
-30	2.07	2.13	2.16	2.19	2.25	2.28	2.25
-35	2.07	2.13	2.16	2.19	2.25	2.29	2.27
-40 TO -50	2.07	2.13	2.16	2.19	2.25	2.30	2.28

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	0	37000
PACKS OFF	0.03	0.03
ENGINE ANTI-ICE ON	-0.08	-0.08
ENGINE AND WING ANTI-ICE ON*	-0.12	-0.12
ENGINE AND WING ANTI-ICE ON**	-0.15	-0.15

***Dual Bleed Source**
****Single Bleed Source**
With Gravel Protect switch in "Anti-Ice/Test" position and up to 15000 ft, decrease EPR by 0.01.
With Gravel Protect switch in "Anti-Ice/Test" position and above 15000 ft, decrease EPR by 0.02.

Go-around EPR

Based on engine bleed for packs on, wing anti-ice off

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)					
°F	°C	°C	-1000	0	1000	2000	3000	3900 TO 10000
131	55	57	1.81	1.81	1.81	1.81	1.81	1.81
127	53	55	1.83	1.83	1.83	1.83	1.83	1.83
118	48	50	1.89	1.89	1.89	1.89	1.89	1.89
109	43	45	1.94	1.94	1.94	1.94	1.94	1.94
100	38	40	1.99	1.99	1.99	1.99	1.99	1.99
91	33	35	2.02	2.04	2.04	2.04	2.04	2.04
82	28	30	2.02	2.07	2.07	2.07	2.07	2.07
73	23	25	2.02	2.07	2.10	2.10	2.10	2.10
64	18	20	2.02	2.07	2.10	2.13	2.13	2.13
55	13	15	2.02	2.07	2.10	2.13	2.13	2.13
46	8	10	2.02	2.07	2.13	2.13	2.13	2.13
37	3	5	2.02	2.07	2.13	2.17	2.17	2.17
27	-3	0	2.02	2.07	2.13	2.19	2.21	2.21
18	-8	-5	2.02	2.07	2.13	2.19	2.24	2.24
9	-13	-10	2.02	2.07	2.13	2.19	2.24	2.26
0	-18	-15	2.02	2.07	2.13	2.19	2.24	2.28
-10 TO -61	-23 TO -52	-20 TO -50	2.02	2.07	2.13	2.19	2.24	2.30

When operating in shaded area with engine anti-ice on, decrease EPR limit by 0.03.

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-1000	10000
PACKS OFF	0.03	0.03
ENGINE AND WING ANTI-ICE ON*	-0.04	-0.04
ENGINE AND WING ANTI-ICE ON**	-0.07	-0.07

***Dual bleed source**
****Single bleed source**
With Gravel Protect switch in “ON” position, decrease limit EPR by 0.01.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (280/.70)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)			
		80	100	120	130
37000	**PITCH ATT**	**6.0**	**6.0**		
	V/S (FT/MIN)	1200	400		
35000	**PITCH ATT**	**6.0**	**6.0**	**6.0**	
	V/S (FT/MIN)	1600	800	100	
30000	**PITCH ATT**	**6.0**	**6.0**	**6.0**	**6.0**
	V/S (FT/MIN)	2400	1600	900	600
27000	**PITCH ATT**	**6.0**	**5.0**	**5.0**	**5.0**
	V/S (FT/MIN)	2700	1900	1300	1000
25000	**PITCH ATT**	**5.0**	**5.0**	**5.0**	**5.0**
	V/S (FT/MIN)	2300	1700	1200	900
20000	**PITCH ATT**	**6.0**	**6.0**	**6.0**	**6.0**
	V/S (FT/MIN)	2900	2100	1600	1300
15000	**PITCH ATT**	**8.0**	**7.0**	**7.0**	**7.0**
	V/S (FT/MIN)	3400	2500	1900	1700
5000	**PITCH ATT**	**9.0**	**8.0**	**8.0**	**8.0**
	V/S (FT/MIN)	4300	3300	2600	2300
SEA LEVEL	**PITCH ATT**	**12.0**	**10.0**	**9.0**	**9.0**
	V/S (FT/MIN)	4700	3600	2900	2600

Cruise (.70/280)

Flaps Up, EPR for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)					
		80	90	100	110	120	130
37000	**PITCH ATT**	**3.8**	**4.5**	**5.2**			
	EPR	1.83	1.95	2.09			
30000	**PITCH ATT**	**2.5**	**2.9**	**3.3**	**3.8**	**4.3**	**5.2**
	EPR	1.68	1.72	1.78	1.84	1.91	2.00
10000	**PITCH ATT**	**2.0**	**2.3**	**2.7**	**3.1**	**3.5**	**3.7**
	EPR	1.31	1.33	1.34	1.36	1.39	1.42

Descent (.70/280)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)			
		80	90	100	110
37000	**PITCH ATT**	**0.8**	**1.5**	**2.1**	**2.4**
	V/S (FT/MIN)	-2100	-2100	-2200	-2400
30000	**PITCH ATT**	**-1.5**	**-0.9**	**-0.3**	**0.2**
	V/S (FT/MIN)	-2900	-2700	-2700	-2600
10000	**PITCH ATT**	**-1.5**	**-0.9**	**-0.3**	**0.2**
	V/S (FT/MIN)	-2000	-1800	-1700	-1700

Holding

Flaps Up, EPR for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)				
		80	90	100	110	120
10000	**PITCH ATT**	**5.8**	**5.9**	**6.4**	**6.3**	**6.4**
	EPR	1.24	1.26	1.30	1.33	1.36
	KIAS	210	210	210	220	230

Terminal Area (0 to 10000 FT)
EPR for Level Flight

FLAP POSITION (SPEED)		WEIGHT (1000 LB) 70	80	90	100	110
FLAPS UP (GEAR UP) (210 KIAS)	**PITCH ATT**	**4.0**	**4.8**	**5.5**	**6.3**	**7.1**
	EPR	1.21	1.23	1.26	1.30	1.33
FLAPS 1 (GEAR UP) (190 KIAS)	**PITCH ATT**	**4.1**	**4.8**	**5.6**	**6.4**	**7.2**
	EPR	1.27	1.30	1.33	1.36	1.40
FLAPS 5 (GEAR UP) (170 KIAS)	**PITCH ATT**	**4.2**	**5.1**	**6.1**	**7.0**	**7.9**
	EPR	1.28	1.31	1.35	1.40	1.44
FLAPS 15 (GEAR DOWN) (150 KIAS)	**PITCH ATT**	**3.8**	**4.9**	**6.1**	**7.2**	**8.4**
	EPR	1.43	1.48	1.52	1.58	1.64
FLAPS 25 (GEAR DOWN) (140 KIAS)	**PITCH ATT**	**3.3**	**4.7**	**6.0**	**7.3**	**8.6**
	EPR	1.45	1.50	1.56	1.63	1.70

Final Approach (0 to 10000 FT)
Gear Down, EPR for 3° Glideslope

FLAP POSITION		WEIGHT (1000 LB) 70	80	90	100	110
FLAPS 40	**PITCH ATT**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	EPR	1.25	1.29	1.33	1.38	1.41
	KIAS	115	123	130	137	145
FLAPS 30	**PITCH ATT**	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**
	EPR	1.17	1.20	1.23	1.26	1.28
	KIAS	118	125	133	141	149
FLAPS 15	**PITCH ATT**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**
	EPR	1.13	1.15	1.17	1.18	1.20
	KIAS	125	133	140	148	156

Performance Inflight — Chapter PI
All Engines — Section 11

Long Range Cruise Maximum Operating Altitude
Max Cruise Thrust
ISA + 10°C and Below

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28700	-6	30600*	30600*	30600*	30000	28500
120	30400	-10	32900*	32900*	32900*	31800	30300
110	32300	-14	35000*	35000*	35000*	33600	32100
100	34400	-19	37000	37000	37000	35600	34200
90	36600	-22	37000	37000	37000	37000	36400
80	37000	-22	37000	37000	37000	37000	37000
70	37000	-22	37000	37000	37000	37000	37000
60	37000	-19	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28700	-1	28800*	28800*	28800*	28800*	28500
120	30400	-5	31800*	31800*	31800*	31800	30300
110	32300	-9	34300*	34300*	34300*	33600	32100
100	34400	-13	36600*	36600*	36600*	35600	34200
90	36600	-17	37000	37000	37000	37000	36400
80	37000	-17	37000	37000	37000	37000	37000
70	37000	-17	37000	37000	37000	37000	37000
60	37000	-13	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28700	5	22900*	22900*	22900*	22900*	22900*
120	30400	1	29600*	29600*	29600*	29600*	29600*
110	32300	-3	33400*	33400*	33400*	33400*	32100
100	34400	-8	36000*	36000*	36000*	35600	34200
90	36600	-11	37000	37000	37000	37000	36400
80	37000	-11	37000	37000	37000	37000	37000
70	37000	-11	37000	37000	37000	37000	37000
60	37000	-8	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)								
		21	23	25	27	29	31	33	35	37
130	EPR	1.70	1.75	1.81	1.88	1.96	2.07			
	MACH	.692	.713	.724	.729	.728	.728			
	KIAS	313	311	303	293	280	268			
	FF/ENG	3421	3391	3313	3235	3176	3222			
120	EPR	1.65	1.70	1.76	1.82	1.89	1.97	2.09		
	MACH	.674	.693	.714	.725	.729	.728	.728		
	KIAS	305	302	299	291	281	268	257		
	FF/ENG	3176	3141	3110	3040	2967	2918	2976		
110	EPR	1.60	1.65	1.70	1.76	1.82	1.89	1.98	2.10	
	MACH	.658	.673	.693	.715	.725	.729	.728	.728	
	KIAS	297	292	289	287	279	269	257	245	
	FF/ENG	2964	2897	2863	2839	2773	2705	2663	2726	
100	EPR	1.56	1.60	1.64	1.69	1.75	1.82	1.89	1.98	2.10
	MACH	.639	.656	.672	.691	.714	.724	.729	.728	.728
	KIAS	288	284	280	277	274	267	257	245	234
	FF/ENG	2754	2686	2624	2592	2572	2512	2450	2412	2474
90	EPR	1.51	1.55	1.59	1.63	1.68	1.75	1.81	1.88	1.97
	MACH	.613	.635	.652	.668	.687	.711	.724	.729	.728
	KIAS	276	275	271	267	263	261	255	245	234
	FF/ENG	2522	2475	2415	2359	2321	2307	2258	2203	2168
80	EPR	1.45	1.49	1.53	1.57	1.62	1.67	1.73	1.79	1.86
	MACH	.579	.604	.627	.647	.663	.681	.705	.721	.728
	KIAS	260	261	260	258	253	249	248	243	234
	FF/ENG	2257	2234	2202	2151	2100	2058	2045	2012	1966
70	EPR	1.39	1.42	1.47	1.51	1.55	1.60	1.64	1.70	1.77
	MACH	.546	.566	.589	.616	.637	.656	.672	.694	.717
	KIAS	245	244	244	245	243	240	235	233	230
	FF/ENG	2022	1983	1951	1936	1894	1847	1804	1786	1773
60	EPR	1.33	1.36	1.40	1.43	1.48	1.52	1.57	1.61	1.66
	MACH	.511	.530	.550	.571	.596	.623	.644	.661	.680
	KIAS	228	228	227	226	226	227	225	221	217
	FF/ENG	1790	1763	1725	1698	1676	1652	1614	1574	1550

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
290	266	245	228	213	200	190	181	173	166	159
583	535	493	458	427	400	381	363	347	332	319
879	806	742	688	641	600	572	545	521	499	479
1178	1079	992	919	856	800	762	726	694	665	639
1480	1354	1243	1150	1071	1000	952	908	867	831	798
1785	1631	1496	1383	1286	1200	1143	1090	1041	997	957
2094	1911	1750	1616	1502	1400	1333	1271	1214	1163	1116
2407	2193	2006	1850	1718	1600	1523	1451	1386	1327	1274
2725	2479	2263	2085	1934	1800	1713	1633	1559	1492	1432

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	3.4	0:41	3.0	0:40	2.6	0:38	2.3	0:37	2.1	0:36
400	6.8	1:20	6.1	1:16	5.3	1:11	4.8	1:08	4.4	1:06
600	10.1	1:59	9.2	1:53	7.9	1:45	7.2	1:39	6.7	1:36
800	13.4	2:38	12.2	2:30	10.6	2:19	9.7	2:11	8.9	2:07
1000	16.7	3:19	15.1	3:08	13.2	2:53	12.1	2:43	11.1	2:38
1200	19.9	4:00	18.0	3:47	15.7	3:28	14.4	3:16	13.3	3:08
1400	23.0	4:43	20.9	4:26	18.3	4:04	16.7	3:49	15.4	3:40
1600	26.1	5:26	23.8	5:06	20.8	4:40	19.0	4:23	17.5	4:11
1800	29.2	6:11	26.6	5:47	23.2	5:17	21.3	4:57	19.6	4:43

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.2	0.5	0.7
10	-0.8	-0.4	0.0	0.5	1.1	1.7
15	-1.2	-0.6	0.0	0.8	1.7	2.6
20	-1.6	-0.8	0.0	1.1	2.3	3.5
25	-2.0	-1.0	0.0	1.4	2.9	4.4
30	-2.3	-1.2	0.0	1.7	3.4	5.3
35	-2.6	-1.4	0.0	1.9	3.9	6.1

Long Range Cruise Enroute Fuel and Time - High Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
271	253	237	223	211	200	191	182	174	167	160
537	503	473	446	422	400	382	365	349	334	322
804	754	708	668	632	600	572	547	524	502	483
1071	1004	944	891	843	800	763	729	698	670	645
1339	1256	1180	1113	1054	1000	954	912	873	838	806
1608	1507	1416	1336	1265	1200	1145	1094	1048	1005	967
1877	1759	1652	1559	1476	1400	1336	1277	1222	1173	1128
2147	2012	1889	1782	1687	1600	1527	1459	1397	1341	1290
2418	2265	2127	2006	1898	1800	1718	1642	1572	1508	1451
2689	2519	2364	2229	2109	2000	1909	1824	1747	1676	1612
2962	2773	2602	2453	2321	2200	2100	2007	1921	1843	1773
3236	3029	2841	2678	2532	2400	2291	2189	2096	2011	1934
3511	3285	3081	2902	2744	2600	2482	2372	2270	2178	2094
3788	3542	3321	3128	2956	2800	2672	2554	2445	2345	2255
4066	3801	3562	3353	3168	3000	2863	2736	2619	2512	2415
4346	4060	3803	3579	3381	3200	3053	2918	2792	2678	2575
4627	4321	4045	3806	3593	3400	3244	3099	2966	2844	2734
4911	4584	4289	4033	3806	3600	3434	3280	3139	3010	2893
5196	4847	4533	4260	4019	3800	3624	3461	3312	3175	3052
5482	5112	4778	4488	4232	4000	3814	3643	3485	3341	3211

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	2.1	0:36	2.0	0:36	1.9	0:35	1.8	0:35	1.8	0:36
400	4.3	1:06	4.1	1:05	4.0	1:04	3.9	1:04	3.8	1:04
600	6.5	1:36	6.3	1:34	6.1	1:33	5.9	1:33	5.8	1:33
800	8.7	2:06	8.4	2:03	8.2	2:02	7.9	2:01	7.8	2:02
1000	10.9	2:36	10.5	2:33	10.2	2:30	9.9	2:30	9.7	2:30
1200	13.0	3:07	12.6	3:03	12.2	3:00	11.8	2:59	11.6	2:59
1400	15.1	3:38	14.6	3:34	14.2	3:29	13.8	3:28	13.5	3:28
1600	17.2	4:09	16.6	4:04	16.1	3:59	15.6	3:57	15.3	3:57
1800	19.2	4:40	18.6	4:35	18.0	4:29	17.5	4:26	17.1	4:25
2000	21.3	5:12	20.5	5:06	19.9	5:00	19.3	4:56	18.9	4:54
2200	23.3	5:44	22.4	5:37	21.7	5:30	21.1	5:26	20.6	5:23
2400	25.2	6:17	24.3	6:09	23.6	6:01	22.9	5:56	22.3	5:53
2600	27.2	6:49	26.2	6:40	25.4	6:32	24.7	6:26	24.0	6:22
2800	29.1	7:23	28.1	7:13	27.1	7:04	26.4	6:57	25.7	6:52
3000	31.0	7:56	29.9	7:45	28.9	7:35	28.1	7:28	27.4	7:22
3200	32.9	8:31	31.7	8:18	30.6	8:07	29.7	7:59	29.0	7:52
3400	34.8	9:05	33.5	8:51	32.4	8:39	31.4	8:30	30.6	8:23
3600	36.6	9:41	35.3	9:25	34.1	9:12	33.0	9:02	32.2	8:54
3800	38.5	10:17	37.0	9:59	35.8	9:45	34.7	9:34	33.8	9:24
4000	40.3	10:53	38.7	10:34	37.4	10:18	36.3	10:06	35.3	9:56

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.5	1.3	2.7
10	-1.0	-0.5	0.0	1.0	2.4	4.8
15	-1.5	-0.8	0.0	1.4	3.4	6.6
20	-2.1	-1.1	0.0	1.8	4.3	8.1
25	-2.6	-1.3	0.0	2.2	5.1	9.4
30	-3.0	-1.6	0.0	2.5	5.8	10.5
35	-3.5	-1.8	0.0	2.8	6.4	11.2
40	-3.9	-2.1	0.0	3.1	6.8	11.8

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 LB)										
	130	125	120	115	110	105	100	95	90	85	80
37							15	4	0	1	6
35					15	5	1	1	4	10	18
33			13	4	1	0	3	8	15	23	32
31	10	3	0	0	3	7	13	20	28	37	47
29	0	1	3	7	12	19	26	34	43	52	62
27	4	8	13	19	25	32	40	48	57	67	78
25	14	19	25	32	39	46	54	63	73	83	95
23	26	32	38	46	53	61	70	79	89	100	112

The above wind factor tables are for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:
1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); This difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .70/280/250

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33	35	37
DISTANCE (NM)	24	44	60	66	72	79	85	92	98	103	109	114	119	125
TIME (MINUTES)	7	11	14	15	16	17	18	19	19	20	21	22	22	23

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	37000
130	EPR	1.28	1.32	1.40	1.50	1.62	1.78	2.00		
	KIAS	243	246	246	247	250	253	246		
	FF/ENG	3380	3300	3180	3090	3030	3030	3110		
120	EPR	1.25	1.29	1.37	1.46	1.57	1.72	1.91		
	KIAS	232	236	236	237	239	243	241		
	FF/ENG	3140	3070	2960	2870	2800	2770	2820		
110	EPR	1.23	1.27	1.33	1.41	1.52	1.66	1.82	2.09	
	KIAS	220	223	227	227	228	232	233	222	
	FF/ENG	2910	2840	2730	2640	2570	2530	2560	2680	
100	EPR	1.21	1.24	1.30	1.37	1.47	1.59	1.75	1.97	2.09
	KIAS	210	211	216	216	217	219	223	218	211
	FF/ENG	2690	2610	2510	2420	2350	2310	2290	2350	2430
90	EPR	1.18	1.21	1.26	1.33	1.42	1.53	1.67	1.85	1.95
	KIAS	210	210	210	210	210	210	210	211	210
	FF/ENG	2500	2420	2310	2220	2150	2090	2050	2080	2120
80	EPR	1.16	1.18	1.23	1.29	1.37	1.46	1.59	1.75	1.83
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2350	2260	2160	2070	1990	1930	1880	1860	1880
70	EPR	1.14	1.16	1.21	1.26	1.32	1.41	1.52	1.66	1.73
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2220	2130	2030	1950	1860	1800	1740	1700	1710
60	EPR	1.13	1.15	1.18	1.23	1.29	1.37	1.47	1.59	1.65
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2120	2010	1930	1850	1740	1680	1620	1580	1580

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight — Chapter PI
Advisory Information — Section 12

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System
Flaps 15
Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF15	ONE REV	NO REV
MAX MANUAL	2820	180/-110	90	-140	510	30	-30	50	-50	330	90	200
MAX AUTO	3730	150/-140	90	-150	520	0	0	50	-50	400	0	0
MED AUTO	4730	210/-190	120	-210	720	0	0	70	-70	550	0	0
MIN AUTO	6090	350/-300	220	-300	1050	160	-180	90	-90	500	920	1010

Good Reported Braking Action

MAX MANUAL	3600	150/-130	90	-150	550	70	-70	40	-40	270	280	710
MAX AUTO	3770	160/-140	90	-160	570	40	-10	50	-50	400	130	550
MED AUTO	4730	210/-190	120	-210	730	0	0	70	-70	550	0	80
MIN AUTO	6090	350/-300	220	-300	1050	160	-180	90	-90	500	920	1010

Medium Reported Braking Action

MAX MANUAL	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MAX AUTO	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MED AUTO	4930	220/-200	140	-240	890	100	-60	70	-70	500	470	1960
MIN AUTO	6090	350/-300	220	-300	1090	170	-180	90	-90	500	960	1570

Poor Reported Braking Action

MAX MANUAL	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MAX AUTO	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MED AUTO	5650	300/-260	190	-300	1250	250	-180	80	-80	470	1430	5640
MIN AUTO	6220	360/-310	230	-330	1340	260	-220	90	-90	500	1400	5130

Reference distance is for sea level, standard day, no wind or slope, VREF15 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 30
Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2560	170/-80	80	-100	520	30	-30	40	-40	330	60	140
MAX AUTO	3410	140/-120	80	-140	490	0	0	40	-40	370	0	0
MED AUTO	4290	200/-170	110	-200	680	0	0	60	-60	510	0	0
MIN AUTO	5430	300/-260	190	-280	980	150	-160	70	-80	420	800	930

Good Reported Braking Action

MAX MANUAL	3350	140/-120	80	-150	530	70	-60	40	-40	270	250	620
MAX AUTO	3450	140/-120	80	-150	540	50	-20	40	-40	360	140	520
MED AUTO	4290	200/-170	110	-200	680	0	0	60	-60	510	0	70
MIN AUTO	5430	300/-260	190	-280	980	150	-160	70	-80	420	800	930

Medium Reported Braking Action

MAX MANUAL	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MAX AUTO	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MED AUTO	4460	210/-180	120	-220	840	100	-50	60	-70	470	410	1670
MIN AUTO	5440	300/-260	190	-280	1020	160	-160	70	-80	420	840	1410

Poor Reported Braking Action

MAX MANUAL	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MAX AUTO	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MED AUTO	5080	270/-230	170	-280	1190	220	-160	70	-70	420	1190	4600
MIN AUTO	5560	320/-270	200	-310	1270	230	-200	80	-80	420	1230	4240

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 40

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF40	ONE REV	NO REV
MAX MANUAL	2480	160/-70	80	-90	510	30	-20	40	-30	320	50	120
MAX AUTO	3300	130/-120	80	-140	480	0	0	40	-40	370	0	0
MED AUTO	4140	180/-160	100	-190	660	0	0	60	-60	490	0	0
MIN AUTO	5120	270/-240	170	-270	950	150	-150	70	-70	370	750	970

Good Reported Braking Action

MAX MANUAL	3250	130/-110	80	-140	520	70	-60	40	-40	260	230	580
MAX AUTO	3350	130/-120	80	-150	530	50	-20	40	-40	350	140	490
MED AUTO	4140	180/-160	100	-190	670	0	0	60	-60	490	0	70
MIN AUTO	5120	270/-240	170	-270	950	150	-150	70	-70	370	750	970

Medium Reported Braking Action

MAX MANUAL	4050	190/-170	120	-200	790	130	-110	50	-60	310	590	1730
MAX AUTO	4050	190/-160	120	-200	790	130	-110	50	-60	310	590	1730
MED AUTO	4280	190/-170	110	-220	830	90	-40	60	-60	470	370	1510
MIN AUTO	5130	270/-240	170	-270	990	160	-160	70	-70	370	780	1400

Poor Reported Braking Action

MAX MANUAL	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MAX AUTO	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MED AUTO	4830	240/-210	150	-270	1160	200	-150	70	-70	380	1060	4040
MIN AUTO	5240	280/-250	180	-300	1230	230	-190	70	-80	370	1140	3810

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System
Flaps 15
Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF15	ONE REV	NO REV
MAX MANUAL	2820	180/-110	90	-140	510	30	-30	50	-50	330	90	200
MAX AUTO	3840	150/-140	90	-150	520	10	-10	50	-50	380	0	0
MED AUTO	5380	250/-240	150	-250	840	40	-70	80	-80	530	50	50
MIN AUTO	6170	350/-310	230	-310	1080	200	-200	90	-90	470	1070	1250

Good Reported Braking Action

MAX MANUAL	3600	150/-130	90	-150	550	70	-70	40	-40	270	280	710
MAX AUTO	3890	160/-140	90	-160	580	40	-20	50	-50	380	170	630
MED AUTO	5380	250/-240	150	-250	840	40	-70	80	-80	530	50	50
MIN AUTO	6170	350/-310	230	-310	1080	200	-200	90	-90	470	1070	1250

Medium Reported Braking Action

MAX MANUAL	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MAX AUTO	4680	230/-200	150	-220	850	150	-130	60	-70	350	770	2290
MED AUTO	5450	260/-250	160	-260	960	80	-90	80	-80	530	280	1610
MIN AUTO	6170	350/-310	230	-310	1110	210	-210	90	-90	470	1100	1710

Poor Reported Braking Action

MAX MANUAL	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MAX AUTO	5590	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5710
MED AUTO	5830	310/-280	200	-310	1270	240	-180	80	-90	470	1270	5490
MIN AUTO	6280	360/-320	240	-330	1350	280	-240	90	-90	470	1500	5160

Reference distance is for sea level, standard day, no wind or slope, VREF15 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2560	170/-80	80	-100	520	30	-30	40	-40	330	60	140
MAX AUTO	3500	140/-120	80	-140	490	10	-10	40	-40	350	0	0
MED AUTO	4830	230/-210	130	-230	790	40	-60	70	-70	480	50	50
MIN AUTO	5480	310/-260	190	-290	1010	180	-170	80	-80	410	910	1130

Good Reported Braking Action

MAX MANUAL	3350	140/-120	80	-150	530	70	-60	40	-40	270	250	620
MAX AUTO	3560	140/-130	80	-150	550	50	-30	40	-40	340	180	580
MED AUTO	4830	230/-210	130	-230	790	40	-60	70	-70	480	50	60
MIN AUTO	5480	310/-260	190	-290	1010	180	-170	80	-80	410	910	1130

Medium Reported Braking Action

MAX MANUAL	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MAX AUTO	4260	210/-180	130	-210	810	140	-110	60	-60	330	650	1930
MED AUTO	4890	240/-210	140	-240	910	80	-80	70	-70	480	260	1380
MIN AUTO	5480	310/-260	190	-290	1040	190	-170	80	-80	410	940	1530

Poor Reported Braking Action

MAX MANUAL	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MAX AUTO	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4660
MED AUTO	5230	270/-240	170	-290	1210	220	-160	70	-80	420	1070	4480
MIN AUTO	5590	320/-270	200	-310	1270	250	-210	80	-80	410	1290	4270

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 40

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF40	ONE REV	NO REV
MAX MANUAL	2480	160/-70	80	-90	510	30	-20	40	-30	320	50	120
MAX AUTO	3370	130/-120	70	-140	480	10	-10	40	-40	340	0	0
MED AUTO	4600	210/-200	130	-220	760	50	-60	70	-70	440	70	70
MIN AUTO	5160	270/-240	180	-270	970	160	-160	70	-70	370	820	1140

Good Reported Braking Action

MAX MANUAL	3250	130/-110	80	-140	520	70	-60	40	-40	260	230	580
MAX AUTO	3430	140/-120	80	-150	540	50	-30	40	-40	330	180	550
MED AUTO	4600	210/-200	130	-220	760	50	-60	70	-70	440	70	70
MIN AUTO	5160	270/-240	180	-270	970	160	-160	70	-70	370	820	1140

Medium Reported Braking Action

MAX MANUAL	4050	190/-170	120	-200	790	130	-110	50	-60	310	590	1730
MAX AUTO	4080	190/-170	120	-210	790	130	-110	50	-60	310	590	1740
MED AUTO	4670	220/-200	130	-240	880	80	-80	70	-70	440	270	1250
MIN AUTO	5160	270/-240	180	-270	1000	170	-160	70	-70	370	840	1500

Poor Reported Braking Action

MAX MANUAL	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MAX AUTO	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MED AUTO	4950	250/-220	160	-280	1180	200	-150	70	-70	420	960	3940
MIN AUTO	5260	280/-250	180	-300	1240	240	-190	70	-80	370	1170	3850

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Dry Runway

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT) REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	4400	370 / -210	440	-200	810	60	-60	420
ANTI-SKID INOPERATIVE	VREF40	3640	135 / -120	75	-160	560	60	-55	275
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	3400	220 / -150	190	-170	620	60	-50	440
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	3100	190 / -130	130	-150	570	40	-40	360
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	3850	260 / -170	230	-200	710	80	-70	530
STABILIZER TRIM INOPERATIVE	VREF15	2800	170 / -110	150	-140	500	30	-30	310
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	2800	170 / -110	150	-140	500	30	-30	310
LEADING EDGE FLAPS TRANSIT	VREF15+5	3050	190 / -130	180	-160	520	40	-40	320
ONE ENGINE INOPERATIVE	VREF15	2850	190 / -120	160	-150	540	40	-30	350
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	3700	260 / -180	290	-160	640	50	-40	330
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	3400	220 / -170	230	-150	570	40	-40	300

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Good Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT): REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS: HEAD WIND	WIND ADJ PER 10 KTS: TAIL WIND	SLOPE ADJ PER 1%: DOWN HILL	SLOPE ADJ PER 1%: UP HILL	APPROACH SPEED: PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	4900	170 / -170	410	-180	630	80	-80	280
ANTI-SKID INOPERATIVE	VREF40	4270	180 / -155	105	-215	800	115	-90	305
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	4000	160 / -150	210	-170	590	90	-80	350
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	3620	150 / -130	150	-150	540	70	-60	280
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	4200	190 / -160	230	-170	610	100	-90	400
STABILIZER TRIM INOPERATIVE	VREF15	3500	140 / -120	170	-150	530	60	-60	250
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	3500	140 / -120	170	-150	530	60	-60	250
LEADING EDGE FLAPS TRANSIT	VREF15+5	3750	160 / -130	200	-160	550	70	-70	290
ONE ENGINE INOPERATIVE	VREF15	3750	150 / -140	190	-160	580	80	-80	290
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	4300	160 / -150	290	-160	580	70	-70	250
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	4050	150 / -100	250	-160	560	70	-60	250

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Medium Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT): REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS: HEAD WIND	WIND ADJ PER 10 KTS: TAIL WIND	SLOPE ADJ PER 1%: DOWN HILL	SLOPE ADJ PER 1%: UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	6200	280 / -240	530	-260	940	160	-150	360
ANTI-SKID INOPERATIVE	VREF40	4880	225 / -195	135	-280	1135	265	-145	330
HYDRAULICS- LOSS OF SYSTEM A (FLAPS 15)	VREF15	4950	230 / -210	260	-230	870	150	-140	400
HYDRAULICS- LOSS OF SYSTEM B (FLAPS 15)	VREF15	4510	210 / -190	190	-220	820	130	-110	340
HYDRAULICS- MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	5150	250 / -220	290	-240	890	170	-150	450
STABILIZER TRIM INOPERATIVE	VREF15	4400	200 / -180	220	-210	800	120	-110	310
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	4400	200 / -180	220	-210	800	120	-110	310
LEADING EDGE FLAPS TRANSIT	VREF15+5	4730	230 / -190	260	-220	840	140	-120	350
ONE ENGINE INOPERATIVE	VREF15	5000	240 / -210	270	-250	940	190	-160	390
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	5450	240 / -210	380	-230	870	140	-120	320
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	5100	230 / -200	320	-230	850	130	-120	320

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Poor Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT) REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	7400	360 / -330	650	-340	1330	270	-230	410
ANTI-SKID INOPERATIVE	VREF40	5630	280 / -245	170	-390	1865	1140	-265	350
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	5700	310 / -250	310	-300	1230	250	-210	430
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	5290	280 / -240	220	-290	1180	220	-180	380
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	5950	320 / -280	340	-310	1250	260	-220	470
STABILIZER TRIM INOPERATIVE	VREF15	5150	270 / -230	260	-280	1160	210	-170	350
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	5150	270 / -230	260	-280	1160	210	-170	350
LEADING EDGE FLAPS TRANSIT	VREF15+5	5570	300 / -250	310	-300	1200	230	-190	400
ONE ENGINE INOPERATIVE	VREF15	6300	330 / -300	340	-360	1430	380	-300	460
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	6450	310 / -280	460	-310	1250	240	-200	370
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	6080	300 / -260	390	-300	1220	230	-190	370

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Brake Cooling Schedule

Reference Brake Energy (Millions of Foot Pounds)

WEIGHT (1000 LB)	OAT (°F)	BRAKES ON SPEED (KIAS) 60 PRESS ALT 0	60 / 2	60 / 4	80 / 0	80 / 2	80 / 4	100 / 0	100 / 2	100 / 4	120 / 0	120 / 2	120 / 4	140 / 0	140 / 2	140 / 4
130	40	4.8	5.2	5.7	8.5	9.2	9.9	13.0	14.1	15.3	18.3	19.9	21.5	22.2	24.0	25.9
	80	5.2	5.7	6.1	9.2	10.0	10.7	14.1	15.3	16.5	19.8	21.4	23.2	23.9	25.9	27.9
	120	5.6	6.1	6.6	9.9	10.7	11.5	15.1	16.4	17.7	21.2	23.0	24.9	25.7	27.8	30.0
120	40	4.5	4.9	5.3	7.9	8.6	9.2	12.0	13.0	14.0	15.8	17.2	18.6	20.4	22.2	24.0
	80	4.9	5.3	5.8	8.6	9.3	10.0	12.9	14.0	15.2	17.0	18.6	20.0	22.0	24.0	25.9
	120	5.2	5.7	6.2	9.2	10.0	10.8	13.8	15.1	16.3	18.3	19.9	21.5	23.6	25.7	27.8
110	40	4.2	4.5	4.9	7.2	7.8	8.5	11.1	12.1	13.0	15.1	16.5	17.8	18.5	20.1	21.7
	80	4.5	4.9	5.3	7.8	8.5	9.2	12.0	13.0	14.1	16.3	17.8	19.2	20.0	21.7	23.4
	120	4.8	5.2	5.6	8.4	9.1	9.9	12.8	14.0	15.2	17.5	19.0	20.6	21.4	23.3	25.2
100	40	3.9	4.2	4.5	6.6	7.1	7.7	10.0	10.9	11.8	13.5	14.7	15.8	16.8	18.2	19.7
	80	4.2	4.5	4.9	7.1	7.7	8.3	10.8	11.8	12.7	14.6	15.8	17.0	18.1	19.6	21.2
	120	4.5	4.9	5.2	7.6	8.3	9.0	11.6	12.6	13.6	15.7	17.0	18.3	19.4	21.1	22.7
90	40	3.4	3.7	4.0	6.0	6.5	7.1	9.0	9.7	10.5	11.8	12.8	13.8	14.8	16.1	17.4
	80	3.6	4.0	4.3	6.5	7.0	7.6	9.7	10.5	11.4	12.7	13.8	14.9	16.0	17.4	18.8
	120	3.9	4.2	4.6	6.9	7.5	8.2	10.4	11.3	12.2	13.6	14.9	16.1	17.2	18.7	20.2
80	40	3.1	3.4	3.7	5.2	5.7	6.2	7.9	8.6	9.2	10.0	10.9	11.8	13.0	14.1	15.3
	80	3.3	3.6	3.9	5.6	6.1	6.6	8.5	9.3	10.0	10.8	11.8	12.7	14.1	15.3	16.5
	120	3.6	3.9	4.2	6.0	6.6	7.1	9.2	10.0	10.8	11.6	12.6	13.6	15.1	16.4	17.7

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind, altitude, and OAT effects.

Adjusted Brake Energy per Brake (Millions of Foot Pounds)

EVENT	REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS) 2	4	6	8	10	12	14	16	18	20
RTO MAX MAN	2	4	6	8	10	12	14	16	18	20
MAX AUTO	1.8	3.5	5.3	7.1	8.7	10.2	11.7	13.1	14.4	15.7
MED AUTO	1.5	3.2	4.8	6.3	7.6	8.8	10.0	10.8	11.7	12.5
MIN AUTO	1.4	3.0	4.0	4.9	5.8	6.2	6.6	7.5	7.5	7.6

Cooling Time (Minutes)

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS) 6 & BELOW	8	10	12	14	15.9	16 TO 20	20 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1.0	2.9	4.9	7.0	8.8	CAUTION	FUSE PLUG MELT ZONE
GROUND		15	28	38	48	56		

Observe maximum quick turnaround limit.
Table does not consider the benefit of reverse thrust.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds for each taxi mile.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after 30 minutes. If overheat occurs after takeoff, extend gear soon for at least 9 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not approach gear or attempt to taxi for 50 minutes. Alert fire equipment.

Intentionally
Blank

Performance Inflight — Chapter PI
Engine Inoperative — Section 13

ENGINE INOP

Max Continuous EPR

Based on engine bleed for packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (FT)							
	0	1000	1499	1500	2000	3000	3900 TO 10000	37000
60	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.62
55	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.67
50	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.73
45	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.78
40	1.84	1.84	1.84	1.85	1.85	1.85	1.85	1.84
35	1.84	1.84	1.84	1.91	1.91	1.91	1.91	1.88
30	1.84	1.84	1.84	1.96	1.96	1.96	1.96	1.93
25	1.84	1.84	1.84	2.00	2.00	2.00	2.00	1.98
20	1.88	1.88	1.88	2.05	2.05	2.05	2.05	2.03
15	1.93	1.93	1.93	2.09	2.09	2.09	2.09	2.07
10	1.98	1.98	1.98	2.13	2.13	2.13	2.13	2.11
5	2.03	2.03	2.03	2.16	2.16	2.17	2.17	2.16
0	2.07	2.09	2.09	2.16	2.19	2.21	2.21	2.18
-5	2.07	2.13	2.14	2.16	2.19	2.23	2.23	2.22
-10	2.07	2.13	2.16	2.16	2.19	2.25	2.26	2.24
-15	2.07	2.13	2.16	2.16	2.19	2.25	2.28	2.26
-20	2.07	2.13	2.16	2.16	2.19	2.25	2.30	2.28
-25	2.07	2.13	2.16	2.16	2.19	2.25	2.30	2.28
-30 TO -50	2.07	2.13	2.16	2.16	2.19	2.25	2.30	2.28

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	0	37000
PACKS OFF	0.03	0.03
ENGINE ANTI-ICE ON	-0.08	-0.08
ENGINE AND WING ANTI-ICE ON	-0.15	-0.15

With Gravel Protect switch in “Anti-Ice/Test” position and up to 15000 ft, decrease limit EPR by 0.01.
With Gravel Protect switch in “Anti-Ice/Test” position and above 15000 ft, decrease limit EPR by 0.02.

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

WEIGHT (1000 LB)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	123	231	13400	12300	11000
120	113	222	16000	15100	14100
110	104	213	18800	17900	17000
100	95	204	21500	20900	20100
90	85	194	24400	23900	23300
80	76	183	27400	27000	26600
70	67	171	30500	30300	30000
60	57	158	33900	33700	33600

For A/C pack off below 17000 ft, increase level off altitude by 800 ft.

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
293	268	247	229	214	200	188	177	168	159	152
581	533	492	457	427	400	377	356	337	320	305
865	795	735	684	639	600	565	535	507	482	459
1146	1055	977	910	851	800	754	714	677	644	615
1426	1314	1218	1136	1064	1000	944	893	848	807	770
1706	1574	1460	1362	1276	1200	1133	1073	1019	970	925
1988	1834	1702	1588	1488	1400	1322	1252	1189	1132	1080
2273	2097	1946	1815	1701	1600	1511	1430	1359	1293	1234
2563	2363	2191	2043	1914	1800	1699	1608	1527	1454	1387

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 LB)							TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 LB)							
	70	80	90	100	110	120	130	
200	2.0	2.1	2.3	2.6	2.9	3.1	3.3	0:38
400	4.1	4.6	5.1	5.8	6.5	7.1	7.7	1:15
600	6.1	6.9	7.7	8.7	9.7	10.6	11.4	1:50
800	8.1	9.1	10.2	11.5	12.8	13.9	15.1	2:25
1000	10.0	11.3	12.7	14.2	15.7	17.2	18.6	2:59
1200	11.9	13.5	15.1	16.9	18.7	20.3	22.1	3:34
1400	13.8	15.5	17.4	19.4	21.5	23.5	25.5	4:09
1600	15.6	17.6	19.7	22.0	24.3	26.5	28.8	4:44
1800	17.4	19.6	21.9	24.5	27.0	29.5	32.1	5:22

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

Long Range Cruise Altitude Capability

100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESS ALT (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	7500	3600	
120	10800	9000	5100
110	14100	12700	10900
100	17700	16300	15100
90	21300	20000	18700
80	24800	24000	23000
70	28500	27800	27200
60	31700	31300	30800

With engine anti-ice on, decrease altitude capability by 2000 ft.
With engine and wing anti-ice on, decrease altitude capability by 4400 ft.

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)									
		10	13	15	17	19	21	23	25	27	29
130	EPR	2.04									
	MACH	.541									
	KIAS	300									
	FF/ENG	6933									
120	EPR	1.96	2.08	2.16							
	MACH	.519	.549	.566							
	KIAS	288	288	286							
	FF/ENG	6251	6363	6398							
110	EPR	1.88	1.99	2.07	2.15						
	MACH	.501	.527	.548	.564						
	KIAS	277	276	276	274						
	FF/ENG	5664	5706	5778	5809						
100	EPR	1.81	1.90	1.97	2.06	2.14	2.23				
	MACH	.487	.505	.523	.544	.562	.579				
	KIAS	269	264	264	264	262	260				
	FF/ENG	5190	5097	5123	5196	5224	5294				
90	EPR	1.73	1.82	1.88	1.95	2.04	2.12	2.20			
	MACH	.469	.489	.500	.517	.539	.557	.575			
	KIAS	259	256	252	251	251	250	248			
	FF/ENG	4722	4622	4550	4550	4619	4651	4709			
80	EPR	1.65	1.73	1.79	1.85	1.92	2.00	2.09	2.17	2.27	
	MACH	.447	.469	.482	.495	.509	.530	.551	.569	.593	
	KIAS	247	245	242	240	237	237	237	235	235	
	FF/ENG	4245	4159	4086	4030	3995	4040	4090	4132	4246	
70	EPR	1.57	1.64	1.70	1.75	1.81	1.88	1.95	2.04	2.13	2.22
	MACH	.423	.444	.460	.473	.487	.500	.517	.540	.559	.578
	KIAS	234	232	231	228	227	223	222	223	221	219
	FF/ENG	3779	3692	3642	3576	3527	3474	3477	3537	3565	3614
60	EPR	1.48	1.55	1.59	1.65	1.70	1.76	1.83	1.90	1.99	2.08
	MACH	.395	.417	.431	.446	.461	.475	.491	.511	.532	.555
	KIAS	218	217	216	215	214	212	210	210	210	210
	FF/ENG	3301	3230	3178	3126	3085	3027	2999	3011	3045	3082

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
297	272	249	230	214	200	190	181	173	166	159
600	547	501	462	429	400	380	362	345	330	317
906	824	753	694	644	600	570	542	517	494	474
1214	1104	1007	927	860	800	759	722	689	658	631
1526	1385	1262	1161	1076	1000	949	902	860	821	787
1840	1668	1519	1396	1292	1200	1139	1082	1031	984	943
2157	1953	1776	1630	1508	1400	1328	1262	1202	1147	1099
2478	2242	2036	1867	1725	1600	1517	1441	1371	1309	1253
2802	2531	2296	2103	1942	1800	1706	1620	1542	1471	1408

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		16		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	3.2	0:43	2.8	0:41	2.5	0:40	2.4	0:38	2.2	0:37
400	6.5	1:24	5.7	1:20	5.3	1:16	5.1	1:13	4.9	1:09
600	9.7	2:06	8.5	1:59	8.0	1:53	7.7	1:48	7.4	1:41
800	12.9	2:48	11.4	2:38	10.7	2:30	10.3	2:23	10.0	2:14
1000	15.9	3:31	14.1	3:18	13.3	3:08	12.7	2:58	12.4	2:48
1200	19.0	4:14	16.8	3:58	15.8	3:46	15.2	3:34	14.8	3:21
1400	22.0	4:59	19.5	4:39	18.3	4:25	17.6	4:11	17.2	3:56
1600	25.0	5:44	22.1	5:20	20.8	5:05	19.9	4:48	19.4	4:31
1800	27.9	6:30	24.7	6:02	23.2	5:45	22.2	5:26	21.6	5:07

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.4	0.8	1.6
10	-0.9	-0.5	0.0	0.9	1.8	3.3
15	-1.4	-0.7	0.0	1.4	2.8	4.8
20	-1.9	-1.0	0.0	1.8	3.7	6.2
25	-2.4	-1.2	0.0	2.3	4.7	7.5
30	-2.9	-1.5	0.0	2.8	5.6	8.6

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
130	EPR	1.66	1.77	1.95	2.18			
	KIAS	243	246	246	247			
	FF/ENG	6090	6080	6130	6460			
120	EPR	1.60	1.70	1.87	2.08			
	KIAS	232	236	236	237			
	FF/ENG	5610	5570	5560	5780			
110	EPR	1.54	1.63	1.79	1.98	2.22		
	KIAS	220	223	227	227	228		
	FF/ENG	5150	5090	5060	5140	5440		
100	EPR	1.49	1.57	1.71	1.89	2.11		
	KIAS	210	211	216	216	217		
	FF/ENG	4700	4630	4570	4570	4760		
90	EPR	1.43	1.50	1.63	1.79	1.99	2.24	
	KIAS	210	210	210	210	210	210	
	FF/ENG	4330	4250	4150	4100	4170	4440	
80	EPR	1.39	1.45	1.56	1.70	1.88	2.11	
	KIAS	210	210	210	210	210	210	
	FF/ENG	4010	3930	3820	3750	3740	3890	
70	EPR	1.35	1.41	1.51	1.63	1.79	2.00	2.24
	KIAS	210	210	210	210	210	210	210
	FF/ENG	3740	3660	3550	3460	3420	3480	3680
60	EPR	1.32	1.37	1.46	1.57	1.72	1.90	2.13
	KIAS	210	210	210	210	210	210	210
	FF/ENG	3500	3420	3310	3230	3160	3160	3270

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN

220 KIAS Cruise Altitude Capability
Max Cruise Thrust, 100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	13700	9700	
120	16200	13000	7700
110	18400	15800	11800
100	20400	18100	14900
90	22200	20000	17200
80	23600	21800	19100
70	24800	23200	21000
60	25800	24300	22400

220 KIAS Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)						
		10	13	15	17	19	21	23
130	EPR	1.73	1.83	1.91	2.00			
	MACH	.399	.422	.438	.456			
	KIAS	220	220	220	220			
	FF/ENG	4482	4474	4496	4562			
120	EPR	1.69	1.78	1.86	1.94	2.03		
	MACH	.399	.422	.438	.456	.474		
	KIAS	220	220	220	220	220		
	FF/ENG	4263	4247	4247	4280	4352		
110	EPR	1.64	1.74	1.81	1.88	1.97	2.06	
	MACH	.399	.422	.438	.456	.474	.493	
	KIAS	220	220	220	220	220	220	
	FF/ENG	4071	4043	4033	4044	4086	4165	
100	EPR	1.61	1.70	1.76	1.83	1.91	2.00	2.09
	MACH	.399	.422	.438	.456	.474	.493	.513
	KIAS	220	220	220	220	220	220	220
	FF/ENG	3905	3866	3850	3846	3866	3922	4012
90	EPR	1.58	1.66	1.72	1.79	1.87	1.95	2.04
	MACH	.399	.422	.438	.456	.474	.493	.513
	KIAS	220	220	220	220	220	220	220
	FF/ENG	3765	3720	3699	3689	3692	3725	3805
80	EPR	1.55	1.63	1.69	1.76	1.83	1.91	2.00
	MACH	.399	.422	.438	.456	.474	.493	.513
	KIAS	220	220	220	220	220	220	220
	FF/ENG	3649	3601	3575	3559	3553	3572	3635
70	EPR	1.53	1.61	1.67	1.73	1.80	1.87	1.96
	MACH	.399	.422	.438	.456	.474	.493	.513
	KIAS	220	220	220	220	220	220	220
	FF/ENG	3550	3500	3470	3449	3438	3447	3493
60	EPR	1.52	1.59	1.64	1.71	1.77	1.85	1.93
	MACH	.399	.422	.438	.456	.474	.493	.513
	KIAS	220	220	220	220	220	220	220
	FF/ENG	3472	3419	3388	3364	3349	3351	3387

220 KIAS Enroute Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
335	297	264	239	218	200	189	179	170	161	154
678	599	531	479	437	400	378	357	339	323	308
1021	901	799	720	656	600	566	535	507	483	461
1364	1204	1067	961	875	800	755	714	677	644	614
1707	1506	1334	1201	1093	1000	943	892	845	804	767
2050	1808	1602	1442	1312	1200	1132	1071	1015	964	920
2393	2111	1871	1683	1531	1400	1321	1248	1183	1125	1074
2736	2413	2138	1923	1750	1600	1510	1427	1353	1286	1227
3079	2715	2406	2164	1969	1800	1698	1605	1521	1446	1380

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	5.6	0:50	5.1	0:47	4.7	0:45	4.4	0:43	4.2	0:41
400	11.4	1:37	10.5	1:32	9.7	1:27	9.2	1:22	9.0	1:18
600	17.1	2:24	15.8	2:16	14.7	2:08	13.9	2:01	13.6	1:54
800	22.7	3:11	21.0	3:00	19.5	2:50	18.5	2:40	18.1	2:31
1000	28.2	3:58	26.1	3:45	24.3	3:32	23.0	3:19	22.6	3:08
1200	33.7	4:45	31.2	4:29	29.0	4:13	27.5	3:59	27.0	3:44
1400	39.1	5:32	36.2	5:13	33.7	4:55	31.9	4:38	31.3	4:21
1600	44.5	6:20	41.2	5:58	38.4	5:37	36.3	5:17	35.6	4:58
1800	49.8	7:07	46.1	6:42	43.0	6:18	40.7	5:56	39.8	5:34

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.2	-0.1	0.0	0.2	0.5	0.8
10	-0.5	-0.3	0.0	0.5	1.1	1.7
15	-0.7	-0.4	0.0	0.7	1.6	2.6
20	-0.9	-0.5	0.0	0.9	2.1	3.4
25	-1.1	-0.6	0.0	1.1	2.5	4.1
30	-1.2	-0.7	0.0	1.3	2.8	4.7
35	-1.3	-0.7	0.0	1.4	3.2	5.2
40	-1.4	-0.8	0.0	1.5	3.4	5.6
45	-1.5	-0.9	0.0	1.6	3.6	5.9

Descent at 220 KIAS

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33
DISTANCE (NM)	19	28	43	47	51	54	58	62	66	70	74	78
TIME (MINUTES)	7	9	13	14	15	16	17	17	18	19	19	20

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
130	EPR	1.55	1.65	1.80			
	KIAS	243	246	246			
	FF/ENG	5310	5310	5250			
120	EPR	1.50	1.59	1.73	1.92		
	KIAS	232	236	236	237		
	FF/ENG	4870	4880	4820	4850		
110	EPR	1.45	1.52	1.67	1.83	2.05	
	KIAS	220	223	227	227	228	
	FF/ENG	4460	4440	4410	4380	4540	
100	EPR	1.40	1.46	1.59	1.75	1.94	
	KIAS	210	211	216	216	217	
	FF/ENG	4090	4020	4010	3960	4000	
90	EPR	1.38	1.44	1.54	1.68	1.86	2.08
	KIAS	210	210	210	210	210	210
	FF/ENG	3920	3840	3730	3650	3630	3780
80	EPR	1.36	1.41	1.51	1.64	1.81	2.02
	KIAS	210	210	210	210	210	210
	FF/ENG	3780	3700	3590	3510	3470	3570
70	EPR	1.34	1.39	1.49	1.61	1.77	1.98
	KIAS	210	210	210	210	210	210
	FF/ENG	3670	3580	3470	3390	3340	3400
60	EPR	1.33	1.38	1.47	1.59	1.74	1.94
	KIAS	210	210	210	210	210	210
	FF/ENG	3570	3480	3380	3290	3230	3270

This table includes 5% additional fuel for holding in a racetrack pattern.

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Performance Inflight — Chapter PI
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Introduction

This chapter contains information required to complete a normal flight. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

Takeoff Speeds

The speeds presented in the Takeoff Speeds table can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, anti-skid inoperative, improved climb, contaminated runway situations or brake energy limitations. These speeds may be used for weights less than or equal to the performance limited weight.

Normal takeoff speeds, V1, VR and V2, with anti-skid on, are read from the table by entering with station pressure altitude and moving horizontally to the appropriate outside air temperature (OAT) column. Proceed down and read V1, VR and V2 for the anticipated takeoff weight and flap setting. Slope and wind adjustments to V1 are obtained by entering the V1 Adjustments chart. Adjusted V1 must not exceed VR.

VMCG

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, VMCG. Therefore compare the adjusted V1 to the VMCG. To find VMCG, enter the VMCG table with the airport pressure altitude and actual OAT. If VR is less than VMCG, set VR equal to VMCG, and determine a new V2 by adding the difference between the normal VR and VMCG to the normal V2.

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the appropriate column. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

Stab Trim

To find takeoff stabilizer trim setting, enter the Stab Trim Setting table with takeoff flap setting and center of gravity (C.G. % MAC) and read required stabilizer trim units.

VREF

The Reference Speed table contains flaps 40, 30 and 15 landing speeds for a given weight. Apply wind adjustments shown as required.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuvering speed. The speed schedule is a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when reaching the maneuver speed for the existing flap.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in runway/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and assume an engine failure at the critical point during the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush/standing water depths greater than 0.50 inches (13 mm) are not recommended because of possible airplane damage as a result of slush/standing water impingement on the airplane structure. The use of assumed temperature method for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight determination:

1. Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the weight reduction for the slush/standing water depth and airport pressure altitude.

2. Adjust field length available for temperature by amount shown on chart.

3. Enter the VMCG Limit Weight table with the adjusted field length and pressure altitude to obtain the slush/standing water limit weight with respect to minimum field length required for VMCG speed.

4. The maximum allowable takeoff weight in slush/standing water is the lesser of the limit weights found in steps 1 and 3.

Takeoff speed determination:

1. Determine takeoff speeds V1, VR and V2 for actual brake release weight using the Takeoff Speeds table in this section.

2. If VMCG limited, set V1=VMCG. If not limited by VMCG considerations, enter the V1 Adjustment table with actual brake release weight to determine the V1 reduction to apply to V1 speed. If the adjusted V1 is less than VMCG, set V1=VMCG.

Slippery Runway Takeoff

Airplane braking action is reported as good, medium or poor, depending on existing runway conditions. If braking action is reported as good, conditions should not be expected to be as good as on clean dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when stopping. The performance level used to calculate the “good” data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate the “poor” data reflects a runway covered with wet ice. Performance is based on reversers operating and a 15 ft. screen height at the end of the runway. The tables provided are used in the same manner as the Slush/Standing Water tables.

Anti-skid Inoperative

For anti-skid inoperative, the runway limited maximum gross weight at brake release and the V1 speed must be reduced to allow for the effect on accelerate-stop performance as detailed in the Approved Airplane Flight Manual. Obstacle clearance capability must also be considered since the reduced V1 speed will increase the distance required to achieve a given height above the runway following engine failure. A simplified method which conservatively accounts for the effects of anti-skid inoperative is shown below. Reduce the dry runway/obstacle limited weight at brake release obtained from the takeoff performance charts in this section or from the specific airport analysis and the associated V1 (i.e., V1 for the runway/obstacle limited weight at brake release) by the weight and V1 values shown in the table below. (Note that the resulting V1 must not be less than VMCG value.)

For takeoff below the anti-skid inoperative limited weight it is only necessary to ensure that the V1 speed set does not exceed the anti-skid limited V1 value.

ANTI-SKID INOPERATIVE ADJUSTMENTS		
RUNWAY LENGTH (FT)	WEIGHT ADJUSTMENT (LB)	V1 ADJUSTMENT (KTS)
LESS THAN 5000	CHECK AFM	
5000	-13000	-28
6000	13000	-25
7000	-13000	-23
8000	-13000	-22
9000	-13000	-20
10000	-13000	-19
11000	-13000	-18
12000	-13000	-17
13000	-13000	-16

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to VMCG.

Detailed analysis for the specific case from the AFM may yield a less restrictive penalty.

Takeoff EPR

To find Takeoff EPR based on normal engine bleed for air conditioning packs on, enter Takeoff EPR table with airport pressure altitude and airport OAT and read EPR. For packs off operation, apply the EPR adjustment shown below the table. No takeoff EPR adjustment is required for wing anti-ice operation.

Reduced Takeoff EPR

The tables present the allowable Takeoff EPR Reduction as a function of Actual OAT and Surplus Weight which is defined as the difference between the Performance Limited TOGW and the Actual TOGW. These tables are valid for engine A/C bleed on or off, any flap setting. They are not valid when the maximum takeoff weight is limited by obstacles, brake energy or tire speed. Since the tables are conservative, larger reductions in EPR may be achieved under some conditions by using the Assumed Temperature Method described in the AFM Appendix.

Enter the Field Length Limited section of the table appropriate for the airplane pressure altitude with the Surplus Weight based on the field length limit (i.e., Field length limited weight minus actual weight). Read the allowable Takeoff EPR Reduction. Then enter the Climb Limited section of the table with the Surplus Weight based on the climb limit and determine the allowable Takeoff EPR Reduction. Use the smaller of the two reductions. Enter the Minimum EPR table with the pressure altitude. The Takeoff EPR, after the reduction is applied, should not be less than this minimum. Apply the noted V1, VR and V2 adjustments.

Takeoff with assumed temperature reduced thrust is not permitted when: runway is contaminated with water, ice, slush or snow; anti-skid is inoperative. Use of this procedure is not recommended if potential windshear conditions exist.

Max Climb EPR

This table shows Max Climb EPR based on normal engine bleed for packs on and anti-ice off. Enter the table with pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Go-around EPR

To find Go-around EPR based on normal engine bleed for packs on and wing anti-ice off, enter the Go-around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. For packs off, apply the EPR adjustment shown below the table. EPR adjustments are also shown for engine and wing anti-ice operations.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

Maximum altitudes are shown for a given cruise weight and maneuver capability. This table considers both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 15° may cause the airplane to lose speed and/or altitude.

Note that the altitudes shown in the table are limited to the maximum certified altitude of 37000 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, KIAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude .72M approximates the Long Range Cruise Mach schedule.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .70/280/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .70/280/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, KIAS and fuel flow per engine.

Advisory Information

Autobrake Landing Distance

The Autobrake Landing Distance tables are provided as advisory information to assist in the selection of the most desirable autobrake setting for a given field length. It is not to be used to determine required field length. This data reflects actual landing distances on a dry runway for setting MINIMUM through MAXIMUM, from touchdown to full stop, with or without reverse thrust. The tables include typical flare distances from threshold.

To use the Autobrake Landing Distance table, determine the appropriate table to use. The Digital Autobrake Landing Distance table is only applicable if Autobrake Control Valve Module, Boeing part number 60800263 is installed. Enter the chart with the estimated approach speed and determine the actual stopping distance from touchdown for a given autobrake setting. If airspeed is used for approach speed, adjust landing distance for pressure altitude and tailwind effects.

Selection of an autobrake setting results in a constant rate of deceleration. Maximum effort manual braking should achieve shorter landing distance than the MAXIMUM setting.

Slippery Runway Landing Distance

Landing distances are the actual landing distances and do not include the 1.67% regulatory factor. Therefore they cannot be used to determine dispatch required landing field length. When landing on slippery runways or runways contaminated with ice, snow, slush or standing water, the reported braking action must be considered. If the surface is affected by water, snow or ice, and the braking action is reported as “good,” conditions should not be expected to be as good as on clean dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the “good” data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate the “poor” data reflects runways covered with wet ice. Read landing distance for the reported braking action at the airplane weight, and then apply the adjustments for airport pressure altitude and approach speed as required.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances are shown for dry runway and good, medium and poor reported braking action. Each non-normal configuration is listed with its recommended approach speed. Landing distance can be determined for the reference landing weight and then adjusted for actual weight and pressure altitude.

Brake Cooling Schedule

Advisory information is provided to assist in avoiding the problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the Adjusted Brake Energy Per Brake table with the reference brake energy per brake and the type of braking used during landing (RTO Max Man, Max Auto, Med Auto or Min Auto). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing.

The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Engine Inoperative

Max Continuous EPR

Power setting is based on one engine operating with one A/C pack operating and all anti-ice bleeds off. Enter the table with pressure altitude and TAT to read EPR.

It is desirable to maintain engine thrust within the limits of the Max Cruise thrust rating. However, where thrust in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/LRC Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. Cruise is continued at level off altitude and Long Range Cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and adjust for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude are used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, KIAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn. To conservatively account for APU fuel burn, add 115 kg/hr to fuel flow values.

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .70/280/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down

This section contains performance data for airplane operation with the landing gear extended. The data include engine bleed effects for normal air conditioning operation; i.e., two packs on at normal flow with all engines operating, and one pack normal flow with engine inoperative.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

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Takeoff Speeds

V1, VR, V2 — ANTI-SKID ON

PRESSURE ALTITUDE 1000 FT		OAT					
9 TO 10	°F				-65 to 10	11 to 36	37 to 85
	°C				-54 to -12	-11 to 2	3 to 29
7 TO 9	°F			-65 to 9	10 to 33	34 to 85	86 to 103
	°C			-54 to -13	-12 to 0	1 to 29	30 to 39
5 TO 7	°F		-65 to 16	17 to 42	43 to 86	87 to 100	101 to 112
	°C		-54 to -9	-8 to 5	6 to 30	31 to 37	38 to 44
3 TO 5	°F	-65 to 30	31 to 65	66 to 87	88 to 101	102 to 119	120 to 130
	°C	-54 to -1	0 to 18	19 to 31	32 to 38	39 to 48	49 to 54
1 TO 3	°F	-65 to 76	77 to 94	95 to 107	108 to 121	122 to 130	
	°C	-54 to 24	25 to 34	35 to 41	42 to 49	50 to 54	
-1 TO 1	°F	-65 to 98	99 to 110	111 to 121	122 to 130		
	°C	-54 to 36	37 to 43	44 to 49	50 to 54		

FLAPS	WT 1000 LB	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	V_1	V_R	V_2
1	130	157	160	165	158	160	165	159	161	165									
	120	150	153	158	150	153	158	150	153	158	151	154	158	152	155	158	152	155	158
	110	142	145	151	143	145	151	144	146	151	145	147	151	145	147	151	145	147	151
	100	135	137	144	136	137	144	137	138	144	138	139	144	138	139	144	138	140	144
	90	127	128	136	128	129	136	129	130	136	129	130	136	130	131	136	131	132	136
	80	118	120	128	119	120	128	120	121	128	121	122	128	121	122	128	122	123	128
	70	109	110	120	111	111	120	111	111	120	113	113	120	113	113	120	114	114	120
2	130	152	154	159	152	155	159	153	155	159									
	120	145	147	153	145	148	153	145	148	153	146	149	153	147	150	153			
	110	139	140	146	139	141	146	139	141	146	140	142	146	140	142	146	141	143	146
	100	131	133	139	132	133	139	133	134	139	133	134	139	134	135	139	134	135	139
	90	123	124	132	124	125	132	124	125	132	125	126	132	125	126	132	126	127	132
	80	114	116	124	115	116	124	116	117	124	116	117	124	117	118	124	118	119	124
	70	105	106	116	106	107	116	107	108	116	108	108	116	109	109	116	110	110	116
5	130	148	151	156	149	152	156												
	120	143	144	150	143	145	150	143	145	150	144	146	150						
	110	135	137	143	135	138	143	136	138	143	137	139	143	137	139	143	138	140	143
	100	128	130	136	129	130	136	130	131	136	130	131	136	131	132	136	131	132	136
	90	120	122	129	121	122	129	122	123	129	122	123	129	123	124	129	123	124	129
	80	112	113	122	113	114	122	114	115	122	114	115	122	115	116	122	115	116	122
	70	105	105	114	105	105	114	105	106	114	106	106	114	107	107	114	108	108	114
10	120	137	139	145	137	139	145	137	139	145	138	140	145						
	110	130	132	138	131	132	138	132	133	138	132	133	138	133	134	138			
	100	123	124	131	123	124	131	124	125	131	125	126	131	125	126	131	125	126	131
	90	115	116	124	116	117	124	117	118	124	117	118	124	118	119	124	118	119	124
	80	107	108	117	107	109	117	109	110	117	109	110	117	110	111	117	110	111	117
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110
15	110	127	128	134	127	128	134	128	129	134	129	130	134	129	130	134	130	131	134
	100	119	121	127	120	121	127	121	122	127	121	122	127	122	123	127	122	123	127
	90	112	113	121	112	113	121	113	114	121	114	115	121	114	115	121	115	116	121
	80	105	105	113	105	106	113	105	106	113	106	107	113	106	107	113	107	108	113
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110
25	100	117	118	125	118	119	125	119	120	125	119	120	125	120	121	125			
	90	109	111	118	110	111	118	111	112	118	111	112	118	112	113	118	112	113	118
	80	105	105	111	105	105	111	105	105	111	105	105	111	105	105	111	105	106	111
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110

BOXED AREA INDICATES PERFORMANCE AFFECTED BY MINIMUM CONTROL SPEED, MINIMUM FIELD LENGTH FOR LIGHTEST WEIGHT ABOVE BOXED AREA IS REQUIRED.

REDUCE VR BY 1 KNOT AND V2 BY 2 KNOTS WITH 15% FWD C.G. LIMIT.

V1 ADJUSTMENTS	
WIND	SLOPE
SUBTRACT 1 KT PER 5 KTS TAILWIND	SUBTRACT 1 KT PER 1% DOWN SLOPE

VMCG

OAT (°C)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
50	97	93	90			
40	101	97	93	90	87	
30	105	101	97	94	90	87
20	105	103	99	95	92	88
10	105	103	99	96	92	89
0	105	105	101	97	94	90
-10	105	105	103	99	96	92
-20	105	105	104	101	97	93
-30	105	105	104	101	97	93
-40	105	105	104	101	97	93

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)			
	100	120	140	160
900	-3	-3	-3	-3
600	-2	-2	-2	-2
300	-1	-1	-1	-1
0	0	0	0	0
-300	1	1	1	1
-600	2	2	2	2
-900	3	3	3	3

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
4000	450
6000	600
8000	700
10000	800

Stab Trim Setting

Max Takeoff Thrust

C.G. %MAC	6	10	14	18	22	26	30	32
FLAPS 1 THRU FLAPS 10	7 3/4	7	6 1/4	5 1/2	4 3/4	4	3 1/4	2 3/4
FLAPS 15 & FLAPS 25	8 3/4	7 3/4	7	6	5	4	3 1/4	2 3/4

VREF (KIAS)

WEIGHT (1000 LB)	FLAPS		
	40	30	15
130	149	154	161
125	146	150	158
120	142	146	154
115	139	142	150
110	135	139	146
105	132	135	142
100	128	131	138
95	124	127	134
90	121	124	131
85	117	120	127
80	113	116	123
75	110	112	119
70	106	109	115

For approach speed add wind factor of 1/2 headwind component + gust (max 20 knots).

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED (KIAS)		
	WEIGHT		
	AT OR BELOW 117000 LB	ABOVE 117000 LB AND AT OR BELOW 138500 LB	ABOVE 138500 LB
UP	210	220	230
1	190	200	210
5	170	180	190
10	160	170	180
15	150	160	170
25	140	150	160

ALL ENGINES

ADVISORY INFORMATION

Slush/Standing Water Takeoff

Weight Adjustment (1000 LB)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH					
	0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000
140	-7.6	-8.9	-9.0	-18.1	-21.0	-24.0
130	-7.0	-7.8	-9.8	-15.4	-18.2	-23.3
120	-6.0	-7.0	-9.5	-12.8	-15.8	-21.3
110	-4.8	-6.0	-8.3	-10.2	-13.4	-18.3
100	-3.8	-5.0	-6.9	-7.5	-10.6	-15.0
90	-2.2	-3.7	-5.5	-4.6	-7.7	-11.7
80	-0.2	-1.8	-3.9	-2.0	-4.5	-7.3

For Flaps 10, 15 and 20 increase allowable weight limit on slush/standing water by 1000 lb (0.25 in) or 1500 lb (0.50 in).
Interpolate as required using dry runway as zero slush/standing water depth.

Takeoff EPR

Based on engine bleed for packs on and anti-ice on or off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)					
°F	°C	-1000	0	1000	2000	3000	10000 & ABOVE
130	54	1.89	1.89	1.89	1.89	1.89	1.89
122	50	1.95	1.95	1.95	1.95	1.95	1.95
113	45	1.99	1.99	1.99	1.99	1.99	1.99
104	40	2.04	2.04	2.04	2.04	2.04	2.04
95	35	2.08	2.09	2.09	2.09	2.09	2.09
86	30	2.09	2.14	2.14	2.14	2.14	2.14
77	25	2.09	2.15	2.17	2.17	2.17	2.17
68	20	2.09	2.15	2.18	2.19	2.19	2.19
59	15	2.09	2.15	2.18	2.20	2.20	2.20
50	10	2.09	2.15	2.19	2.20	2.20	2.20
41	5	2.09	2.15	2.21	2.22	2.22	2.22
32	0	2.09	2.15	2.21	2.26	2.26	2.26
23	-5	2.09	2.15	2.21	2.26	2.29	2.29
14	-10	2.09	2.15	2.21	2.26	2.31	2.32
5	-15	2.09	2.15	2.21	2.26	2.31	2.34
-4	-20	2.09	2.15	2.21	2.26	2.31	2.35
-13 TO -65	-25 TO -54	2.09	2.15	2.21	2.26	2.31	2.35

When operating in shaded area with engine anti-ice on, decrease EPR limit by 0.03.

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-1000	10000 & ABOVE
PACKS OFF	0.03	0.03

With Gravel Protect switch in "ON" position, decrease EPR by 0.01.

%N1 vs EPR Crosscheck

(Takeoff and Go-around)

AIRPORT OAT		TARGET %N1						
		EPR						
°F	°C	1.70	1.80	1.90	2.00	2.10	2.20	2.30
130	54	90	93	96	99	102	107	111
122	50	89	92	95	98	102	106	110
104	40	88	91	94	97	100	104	108
86	30	87	90	92	95	99	102	106
68	20	85	88	91	94	97	101	105
50	10	84	87	89	92	95	99	103
32	0	82	85	88	90	94	97	101
14	-10	81	84	86	89	92	95	99
-4	-20	79	82	84	87	90	94	97
-22	-30	78	80	83	85	88	92	95
-40	-40	76	78	81	84	87	90	94
-58	-50	75	77	79	82	85	88	92
-65	-54	74	76	78	81	84	87	91

Use scheduled Takeoff or Go-around EPR.
Use actual OAT only.
%N1 operating tolerance ±2%
%N1 limit 102.45%
A/C on or off
For engine anti-icing on, increase %N1 by 1%.

Reduced Takeoff EPR

Based on engine bleed for packs on or off
1000 FT Pressure Altitude and Below
Takeoff EPR Reduction

SURPLUS WEIGHT (LB)	FIELD LENGTH LIMITED										CLIMB LIMITED (ALL TEMPS)
	OAT										
	°C	-10 TO -6	-5 TO -1	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 33	34 AND ABOVE	
	°F	14 TO 22	23 TO 31	32 TO 40	41 TO 49	50 TO 58	59 TO 67	68 TO 76	77 TO 85	86 TO 92	93 AND ABOVE	
1000 TO 1999										0.01	0.00
2000 TO 2999									0.02	0.02	0.01
3000 TO 3999								0.02	0.03	0.04	0.02
4000 TO 4999							0.02	0.03	0.04	0.05	0.03
5000 TO 5999						0.02	0.03	0.04	0.06	0.06	0.03
6000 TO 6999					0.02	0.03	0.04	0.06	0.07	0.08	0.04
7000 TO 7999				0.01	0.03	0.04	0.06	0.07	0.09	0.09	0.05
8000 TO 8999			0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.10	0.06
9000 TO 9999		0.01	0.03	0.04	0.06	0.07	0.08	0.10	0.11	0.12	0.07
10000 TO 10999	0.01	0.02	0.04	0.05	0.07	0.08	0.10	0.11	0.13	0.13	0.08
11000 TO 11999	0.02	0.04	0.05	0.07	0.08	0.10	0.11	0.13	0.14	0.14	0.09
12000 TO 12999	0.04	0.05	0.07	0.08	0.10	0.11	0.13	0.14	0.15	0.16	0.10
13000 TO 13999	0.05	0.06	0.08	0.10	0.11	0.12	0.14	0.15	0.17	0.17	0.11
14000 TO 14999	0.06	0.08	0.09	0.11	0.12	0.14	0.15	0.17	0.18	0.19	0.11
15000 TO 15999	0.08	0.09	0.11	0.12	0.14	0.15	0.17	0.18	0.20	0.20	0.12
16000 TO 16999	0.09	0.11	0.12	0.14	0.15	0.17	0.18	0.20	0.21	0.21	0.13
17000 TO 17999	0.10	0.12	0.13	0.15	0.17	0.18	0.20	0.21	0.22	0.23	0.14
18000 TO 18999	0.12	0.13	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.24	0.15
19000 TO 19999	0.13	0.15	0.16	0.18	0.19	0.21	0.22	0.24	0.25	0.26	0.16
20000 TO 20999	0.14	0.16	0.18	0.19	0.21	0.22	0.24	0.25	0.27	0.27	0.17
21000 TO 21999	0.16	0.17	0.19	0.21	0.22	0.24	0.25	0.27	0.28	0.28	0.18
22000 TO 22999	0.17	0.19	0.21	0.22	0.24	0.25	0.27	0.28	0.29	0.30	0.18
23000 TO 23999	0.20	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.31	0.19
24000 TO 24999	0.20	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.33	0.20
25000 TO 25999	0.21	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.34	0.21
26000 TO 26999	0.23	0.24	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.35	0.22
27000 TO 27999	0.24	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.36	0.36	0.23
28000 TO 28999	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.36	0.36	0.24
29000 TO 29999	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.36	0.36	0.36	0.25
30000 TO 30999	0.28	0.30	0.32	0.33	0.35	0.36	0.36	0.36	0.36	0.36	0.25
31000 TO 31999	0.30	0.31	0.33	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.26
32000 TO 32999	0.31	0.33	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.27
33000 TO 33999	0.33	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.28
34000 TO 34999	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.29
35000 TO 35999	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.30
36000 TO 36869	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.31
36870 TO 38009	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.32
38010 TO 39149	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.33
39150 TO 40299	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.34
40300 TO 41439	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.35
41440 AND ABOVE	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Minimum EPR

PRESSURE ALTITUDE (1000 FT)		
-1	0	1
1.95	1.95	1.95

Increase Minimum EPR by 0.03 for bleeds off.
Use actual weight and OAT to determine takeoff speeds. Increase V1 and VR by 1 kt for each 0.09 EPR reduction, except when speeds are found in shaded area of the Takeoff Speeds chart.
If V1 prior to adjustment is found in the shaded area of the Takeoff Speeds chart, find the lightest weight above the shaded area and using the weight as the actual weight recalculate the surplus weight and the Takeoff EPR reduction.

Based on engine bleed for packs on or off
Above 1000 FT Pressure Altitude
Takeoff EPR Reduction

SURPLUS WEIGHT (LB)	FIELD LENGTH LIMITED OAT										CLIMB LIMITED (ALL TEMPS)
°C	-10 TO -6	-5 TO -1	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 33	34 AND ABOVE	
°F	14 TO 22	23 TO 31	32 TO 40	41 TO 49	50 TO 58	59 TO 67	68 TO 76	77 TO 85	86 TO 92	93 AND ABOVE	
1000 TO 1999					0.01			0.01	0.01	0.01	0.01
2000 TO 2999				0.02	0.01		0.02	0.02	0.03	0.02	0.02
3000 TO 3999				0.03	0.01	0.01	0.03	0.04	0.04	0.04	0.03
4000 TO 4999				0.03	0.02	0.03	0.05	0.05	0.05	0.05	0.04
5000 TO 5999			0.02	0.03	0.03	0.04	0.06	0.07	0.07	0.07	0.05
6000 TO 6999			0.03	0.05	0.05	0.06	0.08	0.08	0.08	0.08	0.06
7000 TO 7999		0.01	0.03	0.06	0.06	0.07	0.09	0.10	0.10	0.10	0.07
8000 TO 8999		0.03	0.03	0.07	0.08	0.09	0.11	0.11	0.11	0.11	0.08
9000 TO 9999		0.03	0.05	0.09	0.09	0.10	0.12	0.13	0.13	0.13	0.09
10000 TO 10999	0.02	0.03	0.06	0.10	0.11	0.12	0.14	0.14	0.14	0.14	0.10
11000 TO 11999	0.03	0.04	0.07	0.12	0.12	0.13	0.15	0.16	0.16	0.16	0.11
12000 TO 12999	0.03	0.05	0.09	0.13	0.14	0.15	0.17	0.17	0.17	0.17	0.12
13000 TO 13999	0.03	0.07	0.10	0.15	0.15	0.16	0.18	0.19	0.19	0.18	0.13
14000 TO 14999	0.05	0.08	0.12	0.16	0.17	0.18	0.20	0.20	0.20	0.20	0.14
15000 TO 15999	0.06	0.10	0.13	0.18	0.18	0.19	0.21	0.22	0.22	0.21	0.15
16000 TO 16999	0.07	0.11	0.15	0.19	0.20	0.21	0.23	0.23	0.23	0.23	0.16
17000 TO 17999	0.09	0.13	0.16	0.21	0.21	0.22	0.24	0.24	0.24	0.24	0.17
18000 TO 18999	0.10	0.14	0.18	0.22	0.23	0.24	0.25	0.26	0.26	0.25	0.18
19000 TO 19999	0.12	0.15	0.19	0.24	0.24	0.25	0.27	0.27	0.27	0.27	0.19
20000 TO 20999	0.13	0.17	0.21	0.25	0.26	0.26	0.28	0.29	0.29	0.28	0.21
21000 TO 21999	0.15	0.18	0.22	0.27	0.27	0.28	0.30	0.30	0.30	0.30	0.22
22000 TO 22999	0.16	0.20	0.24	0.28	0.28	0.29	0.31	0.31	0.31	0.31	0.23
23000 TO 23999	0.18	0.21	0.25	0.29	0.30	0.31	0.32	0.33	0.33	0.32	0.24
24000 TO 24999	0.19	0.23	0.27	0.31	0.31	0.32	0.34	0.34	0.34	0.34	0.25
25000 TO 25999	0.21	0.25	0.28	0.32	0.33	0.33	0.35	0.36	0.36	0.35	0.26
26000 TO 26999	0.22	0.26	0.29	0.34	0.34	0.35	0.36	0.36	0.36	0.36	0.27
27000 TO 27999	0.24	0.27	0.31	0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.28
28000 TO 28999	0.25	0.29	0.32	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.29
29000 TO 29999	0.27	0.30	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.30
30000 TO 30999	0.28	0.32	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.31
31000 TO 31999	0.29	0.33	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.32
32000 TO 32999	0.31	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.33
33000 TO 33999	0.32	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.35
34000 TO 34999	0.34	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
35000 TO 35999	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
36000 AND ABOVE	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36

Minimum EPR

PRESSURE ALTITUDE (1000 FT)													
1	2	3	4	5	6	7	8	9	10	11	12	13	13.5
1.95	1.95	1.96	1.98	2.00	2.02	2.04	2.06	2.12	2.15	2.16	2.17	2.18	2.18

Increase Minimum EPR by 0.03 for bleeds off.
Use actual weight and OAT to determine takeoff speeds. Increase V1 and VR by 1 kt for each 0.09 EPR reduction, except when speeds are found in shaded area of the Takeoff Speeds chart.
If V1 prior to adjustment is found in the shaded area of the Takeoff Speeds chart, find the lightest weight above the shaded area and using the weight as the actual weight recalculate the surplus weight and the Takeoff EPR reduction.

Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (FT)										
	0	1000	2000	3000	5000	10000	15000	20000	25000	30000	37000
50	1.72	1.72	1.72	1.72							
45	1.77	1.77	1.77	1.77	1.77						
40	1.82	1.82	1.82	1.82	1.82						
35	1.87	1.87	1.87	1.87	1.87	1.86					
30	1.89	1.91	1.92	1.92	1.92	1.91	1.91				
25	1.89	1.91	1.92	1.94	1.97	1.97	1.96	1.96			
20	1.92	1.92	1.92	1.94	1.98	2.02	2.02	2.01	2.01		
15	1.97	1.97	1.97	1.97	1.98	2.06	2.07	2.07	2.06	2.06	
10	2.03	2.03	2.03	2.03	2.03	2.06	2.09	2.12	2.12	2.12	2.11
5	2.08	2.08	2.08	2.08	2.08	2.08	2.09	2.13	2.16	2.16	2.15
0	2.13	2.13	2.13	2.13	2.13	2.12	2.12	2.13	2.21	2.21	2.20
-5	2.13	2.18	2.18	2.18	2.18	2.17	2.17	2.17	2.21	2.24	2.24
-10	2.13	2.18	2.22	2.22	2.22	2.22	2.21	2.21	2.21	2.27	2.27
-15	2.13	2.18	2.23	2.26	2.26	2.26	2.25	2.25	2.25	2.28	2.29
-20	2.13	2.18	2.23	2.29	2.29	2.29	2.28	2.28	2.28	2.28	2.30
-25	2.13	2.18	2.23	2.29	2.30	2.31	2.30	2.30	2.30	2.30	2.32
-30	2.13	2.18	2.23	2.29	2.30	2.32	2.32	2.32	2.31	2.31	2.32
-35	2.13	2.18	2.23	2.29	2.30	2.33	2.33	2.33	2.32	2.32	2.32
-60	2.13	2.18	2.23	2.29	2.30	2.33	2.33	2.33	2.32	2.32	2.32

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	0	37000
PACKS OFF	0.03	0.03
ENGINE ANTI-ICE ON	-0.08	-0.08
ENGINE AND WING ANTI-ICE ON*	-0.12	-0.12
ENGINE AND WING ANTI-ICE ON**	-0.15	-0.15

***Dual Bleed Source**
****Single Bleed Source**
With Gravel Protect switch in “Anti-Ice/Test” position and up to 15000 ft, decrease EPR by 0.01.
With Gravel Protect switch in “Anti-Ice/Test” position and above 15000 ft, decrease EPR by 0.02.

Go-around EPR

Based on engine bleed for packs on, wing anti-ice off

REPORTED OAT		TAT (°C)	PRESSURE ALTITUDE (FT)					
°F	°C		-1000	0	1000	2000	3000	12000 & ABOVE
137	58	60	1.83	1.83	1.83	1.83	1.83	1.82
128	53	55	1.89	1.89	1.89	1.89	1.89	1.88
119	48	50	1.95	1.95	1.95	1.95	1.95	1.94
110	43	45	2.00	2.00	2.00	2.00	2.00	1.99
100	38	40	2.05	2.05	2.05	2.05	2.05	2.04
91	33	35	2.08	2.10	2.10	2.10	2.10	2.09
83	28	30	2.08	2.13	2.13	2.13	2.13	2.12
73	23	25	2.08	2.13	2.14	2.16	2.16	2.15
64	18	20	2.08	2.13	2.14	2.17	2.17	2.16
55	13	15	2.08	2.13	2.14	2.17	2.17	2.16
47	8	10	2.08	2.13	2.18	2.18	2.18	2.17
38	3	5	2.08	2.13	2.18	2.22	2.22	2.21
27	-3	0	2.08	2.13	2.18	2.23	2.26	2.25
18	-8	-5	2.08	2.13	2.18	2.23	2.29	2.28
10	-13	-10	2.08	2.13	2.18	2.23	2.29	2.31
0	-18	-15	2.08	2.13	2.18	2.23	2.29	2.33
-10 TO -61	-23 TO -52	-20 TO -50	2.08	2.13	2.18	2.23	2.29	2.33

When operating in shaded area with engine anti-ice on, decrease EPR limit by 0.03.

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-1000	12000 & ABOVE
PACKS OFF	0.03	0.03
ENGINE AND WING ANTI-ICE ON*	-0.04	-0.04
ENGINE AND WING ANTI-ICE ON**	-0.07	-0.07

***Dual bleed source**
****Single bleed source**
With Gravel Protect switch in “ON” position, decrease limit EPR by 0.01.

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (280/.70)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB) 80	100	120	130
37000	**PITCH ATT** V/S (FT/MIN)	**6.0** 1200	**6.0** 400		
35000	**PITCH ATT** V/S (FT/MIN)	**6.0** 1600	**6.0** 800	**6.0** 100	
30000	**PITCH ATT** V/S (FT/MIN)	**6.0** 2400	**6.0** 1600	**6.0** 900	**6.0** 600
27000	**PITCH ATT** V/S (FT/MIN)	**6.0** 2700	**5.0** 1900	**5.0** 1300	**5.0** 1000
25000	**PITCH ATT** V/S (FT/MIN)	**5.0** 2300	**5.0** 1700	**5.0** 1200	**5.0** 900
20000	**PITCH ATT** V/S (FT/MIN)	**6.0** 2900	**6.0** 2100	**6.0** 1600	**6.0** 1300
15000	**PITCH ATT** V/S (FT/MIN)	**8.0** 3400	**7.0** 2500	**7.0** 1900	**7.0** 1700
5000	**PITCH ATT** V/S (FT/MIN)	**9.0** 4300	**8.0** 3300	**8.0** 2600	**8.0** 2300
SEA LEVEL	**PITCH ATT** V/S (FT/MIN)	**12.0** 4700	**10.0** 3600	**9.0** 2900	**9.0** 2600

Cruise (.70/280)

Flaps Up, EPR for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB) 80	90	100	110	120	130
37000	**PITCH ATT** EPR	**3.8** 1.83	**4.5** 1.95	**5.2** 2.09			
30000	**PITCH ATT** EPR	**2.5** 1.68	**2.9** 1.72	**3.3** 1.78	**3.8** 1.84	**4.3** 1.91	**5.2** 2.00
10000	**PITCH ATT** EPR	**2.0** 1.31	**2.3** 1.33	**2.7** 1.34	**3.1** 1.36	**3.5** 1.39	**3.7** 1.42

Descent (.70/280)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB) 80	90	100	110
37000	**PITCH ATT** V/S (FT/MIN)	**0.8** -2100	**1.5** -2100	**2.1** -2200	**2.4** -2400
30000	**PITCH ATT** V/S (FT/MIN)	**-1.5** -2900	**-0.9** -2700	**-0.3** -2700	**0.2** -2600
10000	**PITCH ATT** V/S (FT/MIN)	**-1.5** -2000	**-0.9** -1800	**-0.3** -1700	**0.2** -1700

Holding

Flaps Up, EPR for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB) 80	90	100	110	120
10000	**PITCH ATT** EPR KIAS	**5.8** 1.24 210	**5.9** 1.26 210	**6.4** 1.30 210	**6.3** 1.33 220	**6.4** 1.36 230

Terminal Area (0 to 10000 FT)
EPR for Level Flight

FLAP POSITION (SPEED)		WEIGHT (1000 LB)				
		70	80	90	100	110
FLAPS UP (GEAR UP) (210 KIAS)	**PITCH ATT**	**4.0**	**4.8**	**5.5**	**6.3**	**7.1**
	EPR	1.21	1.23	1.26	1.30	1.33
FLAPS 1 (GEAR UP) (190 KIAS)	**PITCH ATT**	**4.1**	**4.8**	**5.6**	**6.4**	**7.2**
	EPR	1.27	1.30	1.33	1.36	1.40
FLAPS 5 (GEAR UP) (170 KIAS)	**PITCH ATT**	**4.2**	**5.1**	**6.1**	**7.0**	**7.9**
	EPR	1.28	1.31	1.35	1.40	1.44
FLAPS 15 (GEAR DOWN) (150 KIAS)	**PITCH ATT**	**3.8**	**4.9**	**6.1**	**7.2**	**8.4**
	EPR	1.43	1.48	1.52	1.58	1.64
FLAPS 25 (GEAR DOWN) (140 KIAS)	**PITCH ATT**	**3.3**	**4.7**	**6.0**	**7.3**	**8.6**
	EPR	1.45	1.50	1.56	1.63	1.70

Final Approach (0 to 10000 FT)
Gear Down, EPR for 3° Glideslope

FLAP POSITION		WEIGHT (1000 LB)				
		70	80	90	100	110
FLAPS 40	**PITCH ATT**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
	EPR	1.25	1.29	1.33	1.38	1.41
	KIAS	115	123	130	137	145
FLAPS 30	**PITCH ATT**	**2.6**	**2.6**	**2.6**	**2.6**	**2.6**
	EPR	1.17	1.20	1.23	1.26	1.28
	KIAS	118	125	133	141	149
FLAPS 15	**PITCH ATT**	**4.5**	**4.5**	**4.5**	**4.5**	**4.5**
	EPR	1.13	1.15	1.17	1.18	1.20
	KIAS	125	133	140	148	156

Intentionally
Blank

DO NOT USE FOR FLIGHT

Performance Inflight — Chapter PI

All Engines — Section 21

Long Range Cruise Maximum Operating Altitude

Max Cruise Thrust

ISA + 10°C and Below

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28700	-6	32500*	32500	31600	30000	28500
120	30400	-10	34300*	34200	33300	31800	30300
110	32300	-14	36100*	36000	35200	33600	32100
100	34400	-19	37000	37000	37000	35600	34200
90	36600	-22	37000	37000	37000	37000	36400
80	37000	-22	37000	37000	37000	37000	37000
70	37000	-22	37000	37000	37000	37000	37000
60	37000	-19	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28700	-1	32100*	32100*	31600	30000	28500
120	30400	-5	34000*	34000*	33300	31800	30300
110	32300	-9	35900*	35900*	35200	33600	32100
100	34400	-13	37000	37000	37000	35600	34200
90	36600	-17	37000	37000	37000	37000	36400
80	37000	-17	37000	37000	37000	37000	37000
70	37000	-17	37000	37000	37000	37000	37000
60	37000	-13	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28700	5	31600*	31600*	31600	30000	28500
120	30400	1	33700*	33700*	33300	31800	30300
110	32300	-3	35700*	35700*	35200	33600	32100
100	34400	-8	37000	37000	37000	35600	34200
90	36600	-11	37000	37000	37000	37000	36400
80	37000	-11	37000	37000	37000	37000	37000
70	37000	-11	37000	37000	37000	37000	37000
60	37000	-8	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT) 21	23	25	27	29	31	33	35	37
130	EPR	1.68	1.74	1.80	1.87	1.95	2.06	2.23		
	MACH	.692	.713	.724	.729	.728	.728	.728		
	KIAS	313	311	303	293	280	268	257		
	FF/ENG	3430	3395	3318	3241	3177	3219	3451		
120	EPR	1.64	1.69	1.75	1.81	1.88	1.96	2.08		
	MACH	.674	.693	.714	.725	.729	.728	.728		
	KIAS	305	302	299	291	281	268	257		
	FF/ENG	3186	3149	3113	3044	2971	2918	2974		
110	EPR	1.59	1.63	1.69	1.75	1.81	1.88	1.97	2.09	
	MACH	.658	.673	.693	.715	.725	.729	.728	.728	
	KIAS	297	292	289	287	279	269	257	245	
	FF/ENG	2973	2906	2872	2843	2776	2708	2662	2725	
100	EPR	1.54	1.58	1.63	1.68	1.75	1.81	1.88	1.97	2.09
	MACH	.639	.656	.672	.691	.714	.724	.729	.728	.728
	KIAS	288	284	280	277	274	267	257	245	234
	FF/ENG	2761	2694	2631	2600	2576	2516	2452	2411	2473
90	EPR	1.50	1.53	1.58	1.62	1.67	1.74	1.80	1.87	1.96
	MACH	.613	.635	.652	.668	.687	.711	.724	.729	.728
	KIAS	276	275	271	267	263	261	255	245	234
	FF/ENG	2527	2481	2422	2366	2328	2312	2262	2205	2168
80	EPR	1.43	1.48	1.52	1.56	1.61	1.66	1.72	1.78	1.85
	MACH	.579	.604	.627	.647	.663	.681	.705	.721	.728
	KIAS	260	261	260	258	253	249	248	243	234
	FF/ENG	2261	2238	2208	2157	2106	2064	2049	2016	1969
70	EPR	1.38	1.41	1.45	1.50	1.54	1.58	1.63	1.69	1.76
	MACH	.546	.566	.589	.616	.637	.656	.672	.694	.717
	KIAS	245	244	244	245	243	240	235	233	230
	FF/ENG	2024	1986	1954	1940	1899	1854	1811	1791	1777
60	EPR	1.32	1.35	1.39	1.42	1.47	1.51	1.55	1.60	1.65
	MACH	.511	.530	.550	.571	.596	.623	.644	.661	.680
	KIAS	228	228	227	226	226	227	225	221	217
	FF/ENG	1792	1765	1728	1700	1679	1656	1619	1581	1558

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS) 100	80	60	40	20	GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS) 20	40	60	80	100
290	266	245	228	213	200	190	181	173	166	159
584	536	493	458	427	400	381	363	347	332	319
880	807	742	688	641	600	572	545	521	499	479
1179	1080	992	919	856	800	762	727	694	665	638
1480	1354	1243	1150	1071	1000	952	908	867	831	798
1786	1632	1496	1383	1286	1200	1142	1089	1040	996	957
2094	1911	1750	1616	1502	1400	1332	1270	1213	1161	1115
2407	2193	2006	1850	1718	1600	1523	1451	1386	1327	1274
2725	2479	2263	2085	1934	1800	1713	1633	1559	1492	1432

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	3.4	0:41	3.0	0:40	2.6	0:38	2.3	0:37	2.1	0:36
400	6.8	1:20	6.1	1:16	5.3	1:11	4.8	1:08	4.4	1:06
600	10.1	1:59	9.2	1:53	8.0	1:45	7.3	1:39	6.7	1:37
800	13.4	2:38	12.2	2:30	10.6	2:19	9.7	2:11	8.9	2:07
1000	16.7	3:19	15.2	3:08	13.2	2:53	12.1	2:43	11.1	2:38
1200	19.9	4:00	18.1	3:47	15.8	3:28	14.5	3:16	13.3	3:09
1400	23.0	4:43	21.0	4:26	18.3	4:04	16.8	3:49	15.5	3:40
1600	26.1	5:26	23.8	5:06	20.8	4:40	19.1	4:23	17.6	4:11
1800	29.2	6:11	26.6	5:47	23.3	5:17	21.4	4:57	19.7	4:43

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.2	0.5	0.7
10	-0.8	-0.4	0.0	0.5	1.1	1.6
15	-1.2	-0.6	0.0	0.8	1.7	2.6
20	-1.6	-0.8	0.0	1.1	2.3	3.5
25	-2.0	-1.0	0.0	1.4	2.9	4.4
30	-2.3	-1.2	0.0	1.7	3.4	5.2

Long Range Cruise Enroute Fuel and Time - High Altitudes

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
272	254	237	223	211	200	190	181	173	166	160
538	504	473	446	422	400	381	364	348	334	322
805	754	708	668	632	600	572	547	524	502	483
1072	1005	944	891	843	800	763	729	698	670	644
1340	1256	1180	1113	1054	1000	954	912	873	837	805
1609	1508	1416	1336	1265	1200	1145	1094	1048	1005	967
1878	1760	1653	1559	1476	1400	1336	1277	1222	1173	1128
2148	2013	1890	1783	1687	1600	1527	1459	1397	1341	1290
2419	2266	2128	2006	1898	1800	1718	1642	1572	1508	1451
2690	2520	2365	2230	2110	2000	1909	1824	1747	1676	1612
2963	2774	2604	2454	2321	2200	2100	2007	1921	1843	1773
3237	3029	2842	2678	2532	2400	2291	2189	2096	2011	1934
3512	3285	3081	2902	2744	2600	2482	2372	2270	2178	2094
3788	3542	3321	3128	2956	2800	2672	2553	2444	2345	2255
4066	3801	3562	3353	3168	3000	2862	2735	2618	2511	2415
4346	4061	3804	3580	3381	3200	3053	2916	2791	2677	2575
4628	4322	4047	3806	3593	3400	3243	3098	2965	2844	2734
4911	4584	4290	4033	3806	3600	3434	3280	3139	3010	2893
5196	4848	4534	4261	4019	3800	3624	3461	3312	3175	3052
5483	5112	4779	4489	4232	4000	3814	3642	3484	3340	3210

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	2.1	0:36	2.0	0:36	1.9	0:36	1.9	0:36	1.8	0:36
400	4.3	1:06	4.2	1:05	4.0	1:04	3.9	1:04	3.8	1:05
600	6.6	1:36	6.4	1:34	6.1	1:33	6.0	1:33	5.9	1:33
800	8.8	2:06	8.5	2:04	8.2	2:02	8.0	2:02	7.8	2:02
1000	10.9	2:36	10.6	2:33	10.2	2:31	10.0	2:30	9.7	2:31
1200	13.1	3:07	12.6	3:04	12.2	3:00	11.9	2:59	11.6	2:59
1400	15.2	3:38	14.7	3:34	14.2	3:30	13.8	3:28	13.5	3:28
1600	17.3	4:09	16.7	4:04	16.1	4:00	15.7	3:57	15.3	3:57
1800	19.3	4:41	18.7	4:35	18.1	4:30	17.6	4:26	17.2	4:26
2000	21.3	5:12	20.6	5:06	19.9	5:00	19.4	4:56	18.9	4:55
2200	23.3	5:44	22.5	5:37	21.8	5:31	21.2	5:26	20.7	5:24
2400	25.3	6:17	24.4	6:09	23.6	6:02	23.0	5:56	22.4	5:53
2600	27.3	6:49	26.3	6:41	25.5	6:33	24.7	6:26	24.1	6:22
2800	29.2	7:23	28.2	7:13	27.2	7:04	26.4	6:57	25.8	6:52
3000	31.1	7:56	30.0	7:45	29.0	7:36	28.2	7:28	27.4	7:22
3200	33.0	8:31	31.8	8:18	30.7	8:08	29.8	7:59	29.1	7:52
3400	34.9	9:06	33.6	8:51	32.5	8:40	31.5	8:31	30.7	8:23
3600	36.7	9:41	35.4	9:25	34.2	9:12	33.2	9:02	32.3	8:54
3800	38.6	10:17	37.1	9:59	35.9	9:45	34.8	9:34	33.9	9:25
4000	40.4	10:54	38.9	10:35	37.5	10:18	36.4	10:07	35.4	9:56

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.5	1.2	2.7
10	-1.0	-0.5	0.0	1.0	2.4	4.9
15	-1.5	-0.8	0.0	1.4	3.4	6.7
20	-2.1	-1.1	0.0	1.8	4.3	8.3
25	-2.6	-1.3	0.0	2.2	5.1	9.4
30	-3.1	-1.6	0.0	2.5	5.7	10.4
35	-3.5	-1.8	0.0	2.8	6.2	10.8
40	-4.0	-2.1	0.0	3.0	6.5	11.0
45	-4.5	-2.3	0.0	3.2	6.7	10.9

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 LB)										
	130	125	120	115	110	105	100	95	90	85	80
37							15	4	0	1	6
35					15	5	1	1	4	10	18
33			13	4	1	0	3	8	15	23	32
31	10	3	0	0	3	7	13	20	28	37	47
29	0	1	3	7	12	19	26	34	43	52	62
27	4	8	13	19	25	32	40	48	57	67	78
25	14	19	25	32	39	46	54	63	73	83	95
23	26	32	38	46	53	61	70	79	89	100	112

The above wind factor tables are for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); This difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .70/280/250

PRESSURE ALT (1000 FT)	21	23	25	27	29	31	33	35	37
DISTANCE (NM)	82	89	96	102	108	113	118	124	129
TIME (MINUTES)	17	18	19	20	21	22	22	23	24

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	37000
130	EPR	1.28	1.32	1.40	1.49	1.61	1.77	2.00		
	KIAS	243	246	246	247	250	253	246		
	FF/ENG	3380	3300	3190	3100	3030	3040	3110		
120	EPR	1.26	1.30	1.36	1.45	1.56	1.71	1.90		
	KIAS	232	236	236	237	239	243	241		
	FF/ENG	3150	3070	2960	2870	2810	2780	2820		
110	EPR	1.23	1.27	1.33	1.41	1.51	1.65	1.82	2.09	
	KIAS	220	223	227	227	228	232	233	222	
	FF/ENG	2910	2840	2740	2650	2580	2540	2560	2670	
100	EPR	1.21	1.24	1.30	1.37	1.46	1.58	1.74	1.96	2.09
	KIAS	210	211	216	216	217	219	223	218	211
	FF/ENG	2690	2610	2520	2430	2360	2310	2300	2350	2430
90	EPR	1.19	1.22	1.26	1.33	1.41	1.52	1.66	1.85	1.95
	KIAS	210	210	210	210	210	210	210	211	210
	FF/ENG	2510	2420	2320	2230	2160	2100	2060	2090	2120
80	EPR	1.17	1.19	1.24	1.29	1.36	1.46	1.58	1.74	1.82
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2350	2270	2160	2080	2000	1940	1880	1870	1890
70	EPR	1.15	1.17	1.21	1.26	1.32	1.40	1.51	1.65	1.72
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2230	2130	2040	1950	1860	1810	1750	1710	1720
60	EPR	1.14	1.16	1.19	1.23	1.29	1.36	1.45	1.58	1.64
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2120	2020	1930	1850	1740	1680	1620	1580	1590

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

Performance Inflight — Chapter PI
Advisory Information — Section 22

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System
Flaps 15
Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF15	ONE REV	NO REV
MAX MANUAL	2820	180/-110	90	-140	510	30	-30	50	-50	330	90	200
MAX AUTO	3730	150/-140	90	-150	520	0	0	50	-50	400	0	0
MED AUTO	4730	210/-190	120	-210	720	0	0	70	-70	550	0	0
MIN AUTO	6090	350/-300	220	-300	1050	160	-180	90	-90	500	920	1010

Good Reported Braking Action

MAX MANUAL	3600	150/-130	90	-150	550	70	-70	40	-40	270	280	710
MAX AUTO	3770	160/-140	90	-160	570	40	-10	50	-50	400	130	550
MED AUTO	4730	210/-190	120	-210	730	0	0	70	-70	550	0	80
MIN AUTO	6090	350/-300	220	-300	1050	160	-180	90	-90	500	920	1010

Medium Reported Braking Action

MAX MANUAL	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MAX AUTO	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MED AUTO	4930	220/-200	140	-240	890	100	-60	70	-70	500	470	1960
MIN AUTO	6090	350/-300	220	-300	1090	170	-180	90	-90	500	960	1570

Poor Reported Braking Action

MAX MANUAL	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MAX AUTO	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MED AUTO	5650	300/-260	190	-300	1250	250	-180	80	-80	470	1430	5640
MIN AUTO	6220	360/-310	230	-330	1340	260	-220	90	-90	500	1400	5130

Reference distance is for sea level, standard day, no wind or slope, VREF15 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2560	170/-80	80	-100	520	30	-30	40	-40	330	60	140
MAX AUTO	3410	140/-120	80	-140	490	0	0	40	-40	370	0	0
MED AUTO	4290	200/-170	110	-200	680	0	0	60	-60	510	0	0
MIN AUTO	5430	300/-260	190	-280	980	150	-160	70	-80	420	800	930

Good Reported Braking Action

MAX MANUAL	3350	140/-120	80	-150	530	70	-60	40	-40	270	250	620
MAX AUTO	3450	140/-120	80	-150	540	50	-20	40	-40	360	140	520
MED AUTO	4290	200/-170	110	-200	680	0	0	60	-60	510	0	70
MIN AUTO	5430	300/-260	190	-280	980	150	-160	70	-80	420	800	930

Medium Reported Braking Action

MAX MANUAL	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MAX AUTO	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MED AUTO	4460	210/-180	120	-220	840	100	-50	60	-70	470	410	1670
MIN AUTO	5440	300/-260	190	-280	1020	160	-160	70	-80	420	840	1410

Poor Reported Braking Action

MAX MANUAL	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MAX AUTO	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MED AUTO	5080	270/-230	170	-280	1190	220	-160	70	-70	420	1190	4600
MIN AUTO	5560	320/-270	200	-310	1270	230	-200	80	-80	420	1230	4240

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 40

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF40	ONE REV	NO REV
MAX MANUAL	2480	160/-70	80	-90	510	30	-20	40	-30	320	50	120
MAX AUTO	3300	130/-120	80	-140	480	0	0	40	-40	370	0	0
MED AUTO	4140	180/-160	100	-190	660	0	0	60	-60	490	0	0
MIN AUTO	5120	270/-240	170	-270	950	150	-150	70	-70	370	750	970

Good Reported Braking Action

MAX MANUAL	3250	130/-110	80	-140	520	70	-60	40	-40	260	230	580
MAX AUTO	3350	130/-120	80	-150	530	50	-20	40	-40	350	140	490
MED AUTO	4140	180/-160	100	-190	670	0	0	60	-60	490	0	70
MIN AUTO	5120	270/-240	170	-270	950	150	-150	70	-70	370	750	970

Medium Reported Braking Action

MAX MANUAL	4050	190/-170	120	-200	790	130	-110	50	-60	310	590	1730
MAX AUTO	4050	190/-160	120	-200	790	130	-110	50	-60	310	590	1730
MED AUTO	4280	190/-170	110	-220	830	90	-40	60	-60	470	370	1510
MIN AUTO	5130	270/-240	170	-270	990	160	-160	70	-70	370	780	1400

Poor Reported Braking Action

MAX MANUAL	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MAX AUTO	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MED AUTO	4830	240/-210	150	-270	1160	200	-150	70	-70	380	1060	4040
MIN AUTO	5240	280/-250	180	-300	1230	230	-190	70	-80	370	1140	3810

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 15

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF15	ONE REV	NO REV
MAX MANUAL	2820	180/-110	90	-140	510	30	-30	50	-50	330	90	200
MAX AUTO	3840	150/-140	90	-150	520	10	-10	50	-50	380	0	0
MED AUTO	5380	250/-240	150	-250	840	40	-70	80	-80	530	50	50
MIN AUTO	6170	350/-310	230	-310	1080	200	-200	90	-90	470	1070	1250

Good Reported Braking Action

MAX MANUAL	3600	150/-130	90	-150	550	70	-70	40	-40	270	280	710
MAX AUTO	3890	160/-140	90	-160	580	40	-20	50	-50	380	170	630
MED AUTO	5380	250/-240	150	-250	840	40	-70	80	-80	530	50	50
MIN AUTO	6170	350/-310	230	-310	1080	200	-200	90	-90	470	1070	1250

Medium Reported Braking Action

MAX MANUAL	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MAX AUTO	4680	230/-200	150	-220	850	150	-130	60	-70	350	770	2290
MED AUTO	5450	260/-250	160	-260	960	80	-90	80	-80	530	280	1610
MIN AUTO	6170	350/-310	230	-310	1110	210	-210	90	-90	470	1100	1710

Poor Reported Braking Action

MAX MANUAL	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MAX AUTO	5590	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5710
MED AUTO	5830	310/-280	200	-310	1270	240	-180	80	-90	470	1270	5490
MIN AUTO	6280	360/-320	240	-330	1350	280	-240	90	-90	470	1500	5160

Reference distance is for sea level, standard day, no wind or slope, VREF15 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2560	170/-80	80	-100	520	30	-30	40	-40	330	60	140
MAX AUTO	3500	140/-120	80	-140	490	10	-10	40	-40	350	0	0
MED AUTO	4830	230/-210	130	-230	790	40	-60	70	-70	480	50	50
MIN AUTO	5480	310/-260	190	-290	1010	180	-170	80	-80	410	910	1130

Good Reported Braking Action

MAX MANUAL	3350	140/-120	80	-150	530	70	-60	40	-40	270	250	620
MAX AUTO	3560	140/-130	80	-150	550	50	-30	40	-40	340	180	580
MED AUTO	4830	230/-210	130	-230	790	40	-60	70	-70	480	50	60
MIN AUTO	5480	310/-260	190	-290	1010	180	-170	80	-80	410	910	1130

Medium Reported Braking Action

MAX MANUAL	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MAX AUTO	4260	210/-180	130	-210	810	140	-110	60	-60	330	650	1930
MED AUTO	4890	240/-210	140	-240	910	80	-80	70	-70	480	260	1380
MIN AUTO	5480	310/-260	190	-290	1040	190	-170	80	-80	410	940	1530

Poor Reported Braking Action

MAX MANUAL	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MAX AUTO	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4660
MED AUTO	5230	270/-240	170	-290	1210	220	-160	70	-80	420	1070	4480
MIN AUTO	5590	320/-270	200	-310	1270	250	-210	80	-80	410	1290	4270

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 40
Dry Runway

BRAKING CONFIGURATION	REF DIST 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	TEMP ADJ PER 10°F ABV ISA	TEMP ADJ PER 10°F BLW ISA	VREF ADJ PER 10 KTS ABOVE VREF40	REVERSE THRUST ADJ ONE REV	REVERSE THRUST ADJ NO REV
MAX MANUAL	2480	160/-70	80	-90	510	30	-20	40	-30	320	50	120
MAX AUTO	3370	130/-120	70	-140	480	10	-10	40	-40	340	0	0
MED AUTO	4600	210/-200	130	-220	760	50	-60	70	-70	440	70	70
MIN AUTO	5160	270/-240	180	-270	970	160	-160	70	-70	370	820	1140

LANDING DISTANCE AND ADJUSTMENT (FT)

Good Reported Braking Action

MAX MANUAL	3250	130/-110	80	-140	520	70	-60	40	-40	260	230	580
MAX AUTO	3430	140/-120	80	-150	540	50	-30	40	-40	330	180	550
MED AUTO	4600	210/-200	130	-220	760	50	-60	70	-70	440	70	70
MIN AUTO	5160	270/-240	180	-270	970	160	-160	70	-70	370	820	1140

Medium Reported Braking Action

MAX MANUAL	4050	190/-170	120	-200	790	130	-110	50	-60	310	590	1730
MAX AUTO	4080	190/-170	120	-210	790	130	-110	50	-60	310	590	1740
MED AUTO	4670	220/-200	130	-240	880	80	-80	70	-70	440	270	1250
MIN AUTO	5160	270/-240	180	-270	1000	170	-160	70	-70	370	840	1500

Poor Reported Braking Action

MAX MANUAL	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MAX AUTO	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MED AUTO	4950	250/-220	160	-280	1180	200	-150	70	-70	420	960	3940
MIN AUTO	5260	280/-250	180	-300	1240	240	-190	70	-80	370	1170	3850

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Dry Runway

LANDING CONFIGURATION	VREF	REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
		LANDING DISTANCE AND ADJUSTMENT (FT)							
ALL FLAPS UP	VREF40+55	4400	370 / -210	440	-200	810	60	-60	420
ANTI-SKID INOPERATIVE	VREF40	3640	135 / -120	75	-160	560	60	-55	275
HYDRAULICS- LOSS OF SYSTEM A (FLAPS 15)	VREF15	3400	220 / -150	190	-170	620	60	-50	440
HYDRAULICS- LOSS OF SYSTEM B (FLAPS 15)	VREF15	3100	190 / -130	130	-150	570	40	-40	360
HYDRAULICS- MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	3850	260 / -170	230	-200	710	80	-70	530
STABILIZER TRIM INOPERATIVE	VREF15	2800	170 / -110	150	-140	500	30	-30	310
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	2800	170 / -110	150	-140	500	30	-30	310
LEADING EDGE FLAPS TRANSIT	VREF15+5	3050	190 / -130	180	-160	520	40	-40	320
ONE ENGINE INOPERATIVE	VREF15	2850	190 / -120	160	-150	540	40	-30	350
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	3700	260 / -180	290	-160	640	50	-40	330
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	3400	220 / -170	230	-150	570	40	-40	300

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Good Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT)							
		REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		APPROACH SPEED
					HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	4900	170 / -170	410	-180	630	80	-80	280
ANTI-SKID INOPERATIVE	VREF40	4270	180 / -155	105	-215	800	115	-90	305
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	4000	160 / -150	210	-170	590	90	-80	350
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	3620	150 / -130	150	-150	540	70	-60	280
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	4200	190 / -160	230	-170	610	100	-90	400
STABILIZER TRIM INOPERATIVE	VREF15	3500	140 / -120	170	-150	530	60	-60	250
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	3500	140 / -120	170	-150	530	60	-60	250
LEADING EDGE FLAPS TRANSIT	VREF15+5	3750	160 / -130	200	-160	550	70	-70	290
ONE ENGINE INOPERATIVE	VREF15	3750	150 / -140	190	-160	580	80	-80	290
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	4300	160 / -150	290	-160	580	70	-70	250
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	4050	150 / -100	250	-160	560	70	-60	250

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Medium Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT) REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	6200	280 / -240	530	-260	940	160	-150	360
ANTI-SKID INOPERATIVE	VREF40	4880	225 / -195	135	-280	1135	265	-145	330
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	4950	230 / -210	260	-230	870	150	-140	400
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	4510	210 / -190	190	-220	820	130	-110	340
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	5150	250 / -220	290	-240	890	170	-150	450
STABILIZER TRIM INOPERATIVE	VREF15	4400	200 / -180	220	-210	800	120	-110	310
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	4400	200 / -180	220	-210	800	120	-110	310
LEADING EDGE FLAPS TRANSIT	VREF15+5	4730	230 / -190	260	-220	840	140	-120	350
ONE ENGINE INOPERATIVE	VREF15	5000	240 / -210	270	-250	940	190	-160	390
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	5450	240 / -210	380	-230	870	140	-120	320
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	5100	230 / -200	320	-230	850	130	-120	320

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Poor Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT) REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	7400	360 / -330	650	-340	1330	270	-230	410
ANTI-SKID INOPERATIVE	VREF40	5630	280 / -245	170	-390	1865	1140	-265	350
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	5700	310 / -250	310	-300	1230	250	-210	430
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	5290	280 / -240	220	-290	1180	220	-180	380
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	5950	320 / -280	340	-310	1250	260	-220	470
STABILIZER TRIM INOPERATIVE	VREF15	5150	270 / -230	260	-280	1160	210	-170	350
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	5150	270 / -230	260	-280	1160	210	-170	350
LEADING EDGE FLAPS TRANSIT	VREF15+5	5570	300 / -250	310	-300	1200	230	-190	400
ONE ENGINE INOPERATIVE	VREF15	6300	330 / -300	340	-360	1430	380	-300	460
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	6450	310 / -280	460	-310	1250	240	-200	370
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	6080	300 / -260	390	-300	1220	230	-190	370

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Brake Cooling Schedule

Reference Brake Energy (Millions of Foot Pounds)

WEIGHT (1000 LB)	OAT (°F)	BRAKES ON SPEED (KIAS) 60 PRESS ALT 0	60: 2	60: 4	80 PRESS ALT 0	80: 2	80: 4	100 PRESS ALT 0	100: 2	100: 4	120 PRESS ALT 0	120: 2	120: 4	140 PRESS ALT 0	140: 2	140: 4
130	40	4.8	5.2	5.7	8.5	9.2	9.9	13.0	14.1	15.3	18.3	19.9	21.5	22.2	24.0	25.9
	80	5.2	5.7	6.1	9.2	10.0	10.7	14.1	15.3	16.5	19.8	21.4	23.2	23.9	25.9	27.9
	120	5.6	6.1	6.6	9.9	10.7	11.5	15.1	16.4	17.7	21.2	23.0	24.9	25.7	27.8	30.0
120	40	4.5	4.9	5.3	7.9	8.6	9.2	12.0	13.0	14.0	15.8	17.2	18.6	20.4	22.2	24.0
	80	4.9	5.3	5.8	8.6	9.3	10.0	12.9	14.0	15.2	17.0	18.6	20.0	22.0	24.0	25.9
	120	5.2	5.7	6.2	9.2	10.0	10.8	13.8	15.1	16.3	18.3	19.9	21.5	23.6	25.7	27.8
110	40	4.2	4.5	4.9	7.2	7.8	8.5	11.1	12.1	13.0	15.1	16.5	17.8	18.5	20.1	21.7
	80	4.5	4.9	5.3	7.8	8.5	9.2	12.0	13.0	14.1	16.3	17.8	19.2	20.0	21.7	23.4
	120	4.8	5.2	5.6	8.4	9.1	9.9	12.8	14.0	15.2	17.5	19.0	20.6	21.4	23.3	25.2
100	40	3.9	4.2	4.5	6.6	7.1	7.7	10.0	10.9	11.8	13.5	14.7	15.8	16.8	18.2	19.7
	80	4.2	4.5	4.9	7.1	7.7	8.3	10.8	11.8	12.7	14.6	15.8	17.0	18.1	19.6	21.2
	120	4.5	4.9	5.2	7.6	8.3	9.0	11.6	12.6	13.6	15.7	17.0	18.3	19.4	21.1	22.7
90	40	3.4	3.7	4.0	6.0	6.5	7.1	9.0	9.7	10.5	11.8	12.8	13.8	14.8	16.1	17.4
	80	3.6	4.0	4.3	6.5	7.0	7.6	9.7	10.5	11.4	12.7	13.8	14.9	16.0	17.4	18.8
	120	3.9	4.2	4.6	6.9	7.5	8.2	10.4	11.3	12.2	13.6	14.9	16.1	17.2	18.7	20.2
80	40	3.1	3.4	3.7	5.2	5.7	6.2	7.9	8.6	9.2	10.0	10.9	11.8	13.0	14.1	15.3
	80	3.3	3.6	3.9	5.6	6.1	6.6	8.5	9.3	10.0	10.8	11.8	12.7	14.1	15.3	16.5
	120	3.6	3.9	4.2	6.0	6.6	7.1	9.2	10.0	10.8	11.6	12.6	13.6	15.1	16.4	17.7

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind, altitude, and OAT effects.

Adjusted Brake Energy per Brake (Millions of Foot Pounds)

EVENT	REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS) 2	4	6	8	10	12	14	16	18	20
RTO MAX MAN	2	4	6	8	10	12	14	16	18	20
MAX AUTO	1.8	3.5	5.3	7.1	8.7	10.2	11.7	13.1	14.4	15.7
MED AUTO	1.5	3.2	4.8	6.3	7.6	8.8	10.0	10.8	11.7	12.5
MIN AUTO	1.4	3.0	4.0	4.9	5.8	6.2	6.6	7.5	7.5	7.6

Cooling Time (Minutes)

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS) 6 & BELOW	8	10	12	14	15.9	16 TO 20	20 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1.0	2.9	4.9	7.0	8.8	CAUTION	FUSE PLUG MELT ZONE
GROUND		15	28	38	48	56		

Observe maximum quick turnaround limit.
Table does not consider the benefit of reverse thrust.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds for each taxi mile.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after 30 minutes. If overheat occurs after takeoff, extend gear soon for at least 9 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not approach gear or attempt to taxi for 50 minutes. Alert fire equipment.

Intentionally
Blank

Performance Inflight — Chapter PI
Engine Inoperative — Section 23

ENGINE INOP

Max Continuous EPR

Based on engine bleed for packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (FT)								
	0	1000	1499	1500	2000	3000	10000	15000	35000
50	1.79	1.79	1.79	1.79	1.79	1.79	1.78	1.78	1.77
45	1.84	1.84	1.84	1.84	1.85	1.85	1.84	1.84	1.83
40	1.87	1.87	1.87	1.90	1.90	1.90	1.89	1.89	1.88
35	1.87	1.87	1.87	1.95	1.95	1.95	1.94	1.94	1.93
30	1.92	1.92	1.92	2.00	2.00	2.00	1.99	1.99	1.98
25	1.98	1.98	1.98	2.05	2.05	2.05	2.04	2.04	2.02
20	2.03	2.03	2.03	2.10	2.10	2.10	2.09	2.09	2.08
15	2.08	2.08	2.08	2.14	2.14	2.14	2.14	2.13	2.12
10	2.13	2.13	2.13	2.19	2.19	2.19	2.18	2.17	2.16
5	2.13	2.18	2.18	2.20	2.23	2.23	2.22	2.21	2.20
0	2.13	2.18	2.20	2.20	2.23	2.26	2.25	2.25	2.24
-5	2.13	2.18	2.20	2.20	2.23	2.27	2.28	2.28	2.27
-10	2.13	2.18	2.20	2.20	2.23	2.27	2.31	2.31	2.30
-15	2.13	2.18	2.20	2.20	2.23	2.27	2.31	2.33	2.32
-20	2.13	2.18	2.20	2.20	2.23	2.27	2.31	2.33	2.32
-25	2.13	2.18	2.20	2.20	2.23	2.27	2.31	2.33	2.32
-40TO-50	2.13	2.18	2.20	2.20	2.23	2.27	2.31	2.33	2.32

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	0	35000
PACKS OFF	0.03	0.03
ENGINE ANTI-ICE ON	-0.08	-0.08
ENGINE AND WING ANTI-ICE ON	-0.15	-0.15

With Gravel Protect switch in “Anti-Ice/Test” position and up to 15000 ft, decrease limit EPR by 0.01.
With Gravel Protect switch in “Anti-Ice/Test” position and above 15000 ft, decrease limit EPR by 0.02.

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

WEIGHT (1000 LB)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	123	231	14800	13700	12400
120	113	223	17500	16500	15400
110	104	214	20200	19300	18500
100	95	204	22900	22200	21500
90	86	194	25500	25100	24600
80	76	183	28100	28000	27900
70	67	171	31000	31000	31000
60	57	158	34200	34200	34200

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEAD WIND COMPONENT (KTS)						TAIL WIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
291	267	246	229	213	200	188	178	168	160	152
577	530	490	456	426	400	377	356	338	321	306
859	791	733	682	639	600	566	535	508	483	461
1139	1050	974	908	851	800	755	715	679	646	617
1417	1308	1215	1134	1063	1000	944	895	850	809	772
1697	1567	1456	1359	1275	1200	1134	1074	1021	972	928
1978	1827	1698	1585	1487	1400	1323	1254	1191	1135	1083
2262	2089	1941	1812	1699	1600	1512	1432	1361	1296	1238
2551	2355	2186	2040	1913	1800	1700	1610	1530	1457	1390

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 LB)							TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 LB)							
	70	80	90	100	110	120	130	
200	2.0	2.1	2.3	2.7	2.9	3.2	3.4	0:38
400	4.1	4.6	5.1	5.8	6.5	7.1	7.7	1:14
600	6.1	6.9	7.7	8.7	9.7	10.5	11.4	1:49
800	8.1	9.1	10.2	11.4	12.7	13.8	15.0	2:23
1000	10.0	11.3	12.6	14.1	15.6	17.0	18.5	2:57
1200	11.9	13.4	15.0	16.8	18.5	20.2	21.9	3:31
1400	13.7	15.5	17.3	19.3	21.3	23.3	25.3	4:05
1600	15.5	17.5	19.6	21.8	24.1	26.3	28.5	4:41
1800	17.3	19.5	21.8	24.3	26.8	29.2	31.7	5:18

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

Long Range Cruise Altitude Capability

100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	9000	6900	3000
120	12600	10700	8500
110	16100	14300	12600
100	19500	18200	16500
90	23000	21900	20700
80	26300	25600	24700
70	29400	29200	28800
60	32400	32300	32100

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)										
		10	13	15	17	19	21	23	25	27	29	31
130	EPR	2.04	2.15									
	MACH	.541	.566									
	KIAS	300	297									
	FF/ENG	6928	6970									
120	EPR	1.95	2.07	2.15	2.24							
	MACH	.519	.549	.566	.584							
	KIAS	288	288	286	284							
	FF/ENG	6262	6352	6380	6463							
110	EPR	1.87	1.98	2.07	2.15	2.23						
	MACH	.501	.527	.548	.564	.582						
	KIAS	277	276	276	274	272						
	FF/ENG	5684	5708	5767	5792	5861						
100	EPR	1.80	1.89	1.97	2.05	2.13	2.22					
	MACH	.487	.505	.523	.544	.562	.579					
	KIAS	269	264	264	264	262	260					
	FF/ENG	5205	5108	5125	5186	5208	5271					
90	EPR	1.73	1.81	1.87	1.94	2.03	2.11	2.20	2.30			
	MACH	.469	.489	.500	.517	.539	.557	.575	.601			
	KIAS	259	256	252	251	251	250	248	249			
	FF/ENG	4729	4634	4561	4553	4611	4638	4690	4839			
80	EPR	1.64	1.73	1.78	1.84	1.91	1.99	2.08	2.17	2.27		
	MACH	.447	.469	.482	.495	.509	.530	.551	.569	.593		
	KIAS	247	245	242	240	237	237	237	235	235		
	FF/ENG	4253	4165	4092	4039	4000	4035	4079	4115	4232		
70	EPR	1.56	1.63	1.69	1.74	1.81	1.87	1.94	2.03	2.12	2.21	
	MACH	.423	.444	.460	.473	.487	.500	.517	.540	.559	.578	
	KIAS	234	232	231	228	227	223	222	223	221	219	
	FF/ENG	3784	3698	3648	3579	3532	3479	3476	3526	3553	3600	
60	EPR	1.48	1.54	1.58	1.64	1.69	1.75	1.82	1.90	1.98	2.07	2.17
	MACH	.395	.417	.431	.446	.461	.475	.491	.511	.532	.555	.579
	KIAS	218	217	216	215	214	212	210	210	210	210	210
	FF/ENG	3305	3235	3183	3133	3091	3030	3003	3013	3039	3074	3131

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
303	276	252	232	215	200	190	181	173	166	159
615	557	506	465	431	400	380	362	345	330	317
930	841	764	700	647	600	570	542	517	494	474
1248	1127	1022	936	864	800	759	722	689	658	631
1570	1415	1281	1172	1080	1000	949	902	860	822	787
1896	1706	1542	1408	1298	1200	1139	1082	1031	984	943
2227	2000	1805	1646	1515	1400	1328	1262	1202	1147	1098
2562	2298	2070	1886	1734	1600	1517	1441	1371	1309	1253
2902	2598	2336	2126	1952	1800	1706	1620	1542	1471	1408

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT) 10		16		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	3.3	0:43	2.8	0:41	2.5	0:40	2.4	0:38	2.2	0:37
400	6.5	1:24	5.7	1:20	5.3	1:16	5.1	1:13	4.9	1:09
600	9.7	2:06	8.5	1:59	8.0	1:53	7.6	1:48	7.4	1:41
800	12.9	2:48	11.4	2:38	10.7	2:30	10.2	2:23	10.0	2:14
1000	16.0	3:31	14.1	3:18	13.3	3:08	12.7	2:59	12.4	2:48
1200	19.1	4:15	16.9	3:58	15.9	3:46	15.2	3:34	14.8	3:22
1400	22.1	4:59	19.6	4:39	18.4	4:25	17.6	4:11	17.1	3:56
1600	25.0	5:44	22.2	5:20	20.8	5:05	19.9	4:48	19.4	4:31
1800	28.0	6:30	24.8	6:02	23.2	5:45	22.2	5:26	21.6	5:07

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB) 70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.4	0.8	1.5
10	-0.9	-0.4	0.0	0.9	1.9	3.2
15	-1.3	-0.7	0.0	1.4	2.9	4.7
20	-1.8	-0.9	0.0	1.9	3.9	6.2
25	-2.2	-1.1	0.0	2.4	4.9	7.6
30	-2.7	-1.4	0.0	2.9	5.8	8.9

Holding
Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
130	EPR	1.65	1.76	1.95	2.17			
	KIAS	243	246	246	247			
	FF/ENG	6110	6090	6150	6440			
120	EPR	1.59	1.69	1.87	2.08			
	KIAS	232	236	236	237			
	FF/ENG	5630	5590	5590	5780			
110	EPR	1.54	1.62	1.78	1.98	2.22		
	KIAS	220	223	227	227	228		
	FF/ENG	5160	5110	5070	5150	5430		
100	EPR	1.48	1.56	1.70	1.88	2.10		
	KIAS	210	211	216	216	217		
	FF/ENG	4710	4640	4580	4580	4750		
90	EPR	1.43	1.50	1.62	1.78	1.99	2.23	
	KIAS	210	210	210	210	210	210	
	FF/ENG	4340	4260	4160	4110	4170	4430	
80	EPR	1.39	1.45	1.56	1.70	1.88	2.10	
	KIAS	210	210	210	210	210	210	
	FF/ENG	4020	3940	3830	3760	3750	3880	
70	EPR	1.35	1.40	1.50	1.62	1.79	1.99	2.24
	KIAS	210	210	210	210	210	210	210
	FF/ENG	3740	3660	3560	3470	3420	3480	3660
60	EPR	1.32	1.37	1.45	1.57	1.71	1.90	2.12
	KIAS	210	210	210	210	210	210	210
	FF/ENG	3510	3430	3320	3230	3160	3160	3250

This table includes 5% additional fuel for holding in a racetrack pattern.

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GEAR DOWN

220 KIAS Cruise Altitude Capability

Max Cruise Thrust, 100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	19200	17600	15500
120	21100	19700	17900
110	22700	21700	20100
100	24200	23300	22200
90	25500	24700	23700
80	26600	25900	25000
70	27600	27000	26200
60	28400	27800	27200

220 KIAS Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)								
		10	13	15	17	19	21	23	25	27
130	EPR	1.72	1.83	1.91	1.99	2.09				
	MACH	.399	.422	.438	.456	.474				
	KIAS	220	220	220	220	220				
	FF/ENG	4495	4489	4510	4569	4649				
120	EPR	1.68	1.78	1.85	1.93	2.02	2.12			
	MACH	.399	.422	.438	.456	.474	.493			
	KIAS	220	220	220	220	220	220			
	FF/ENG	4278	4257	4262	4291	4355	4435			
110	EPR	1.64	1.73	1.80	1.88	1.96	2.05	2.15		
	MACH	.399	.422	.438	.456	.474	.493	.513		
	KIAS	220	220	220	220	220	220	220		
	FF/ENG	4084	4052	4044	4057	4093	4161	4266		
100	EPR	1.60	1.69	1.76	1.83	1.91	1.99	2.09	2.20	
	MACH	.399	.422	.438	.456	.474	.493	.513	.534	
	KIAS	220	220	220	220	220	220	220	220	
	FF/ENG	3917	3877	3858	3858	3875	3924	4003	4129	
90	EPR	1.57	1.65	1.72	1.79	1.86	1.94	2.04	2.14	
	MACH	.399	.422	.438	.456	.474	.493	.513	.534	
	KIAS	220	220	220	220	220	220	220	220	
	FF/ENG	3776	3732	3708	3696	3703	3732	3800	3894	
80	EPR	1.55	1.62	1.69	1.75	1.82	1.90	1.99	2.09	2.20
	MACH	.399	.422	.438	.456	.474	.493	.513	.534	.557
	KIAS	220	220	220	220	220	220	220	220	220
	FF/ENG	3659	3612	3585	3566	3562	3580	3634	3710	3828
70	EPR	1.53	1.60	1.66	1.72	1.79	1.87	1.95	2.05	2.15
	MACH	.399	.422	.438	.456	.474	.493	.513	.534	.557
	KIAS	220	220	220	220	220	220	220	220	220
	FF/ENG	3559	3510	3480	3457	3445	3456	3497	3562	3659
60	EPR	1.51	1.58	1.64	1.70	1.77	1.84	1.92	2.02	2.12
	MACH	.399	.422	.438	.456	.474	.493	.513	.534	.557
	KIAS	220	220	220	220	220	220	220	220	220
	FF/ENG	3480	3429	3398	3374	3355	3360	3392	3450	3531

220 KIAS Enroute Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
335	297	264	239	218	200	189	179	170	161	154
678	599	531	479	437	400	378	357	339	323	308
1021	901	799	720	656	600	566	535	507	483	461
1364	1204	1067	961	875	800	755	714	677	644	614
1707	1506	1334	1201	1093	1000	943	892	845	804	767
2050	1808	1602	1442	1312	1200	1132	1071	1015	964	920
2393	2111	1871	1683	1531	1400	1321	1248	1183	1125	1074
2736	2413	2138	1923	1750	1600	1510	1427	1353	1286	1227
3079	2715	2406	2164	1969	1800	1698	1605	1521	1446	1380

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	5.7	0:50	5.2	0:47	4.7	0:45	4.4	0:43	4.2	0:41
400	11.5	1:37	10.5	1:32	9.8	1:27	9.2	1:22	9.0	1:18
600	17.2	2:24	15.8	2:16	14.7	2:08	13.9	2:01	13.6	1:54
800	22.8	3:11	21.1	3:00	19.6	2:50	18.5	2:40	18.1	2:31
1000	28.3	3:58	26.2	3:45	24.4	3:32	23.1	3:20	22.5	3:08
1200	33.8	4:45	31.3	4:29	29.1	4:13	27.6	3:59	26.9	3:44
1400	39.2	5:32	36.3	5:13	33.8	4:55	32.0	4:38	31.2	4:21
1600	44.6	6:20	41.3	5:58	38.4	5:37	36.4	5:17	35.5	4:58
1800	49.9	7:07	46.3	6:42	43.0	6:18	40.7	5:56	39.7	5:34

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.2	-0.1	0.0	0.2	0.5	0.8
10	-0.5	-0.3	0.0	0.5	1.1	1.8
15	-0.7	-0.4	0.0	0.7	1.6	2.6
20	-0.9	-0.5	0.0	0.9	2.1	3.4
25	-1.1	-0.6	0.0	1.1	2.5	4.1
30	-1.2	-0.7	0.0	1.3	2.8	4.7
35	-1.4	-0.8	0.0	1.4	3.1	5.2
40	-1.5	-0.8	0.0	1.5	3.4	5.6
45	-1.5	-0.9	0.0	1.6	3.6	5.9

Descent at 220 KIAS

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33
DISTANCE (NM)	19	28	37	41	45	49	52	56	60	64	67	71
TIME (MINUTES)	7	9	11	12	13	14	14	15	16	16	17	18

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
130	EPR	1.55	1.64	1.80	2.00		
	KIAS	243	246	246	247		
	FF/ENG	5330	5320	5260	5400		
120	EPR	1.49	1.58	1.73	1.91		
	KIAS	232	236	236	237		
	FF/ENG	4890	4900	4830	4870		
110	EPR	1.44	1.52	1.66	1.83	2.04	
	KIAS	220	223	227	227	228	
	FF/ENG	4470	4450	4430	4400	4540	
100	EPR	1.40	1.46	1.59	1.74	1.93	2.19
	KIAS	210	211	216	216	217	219
	FF/ENG	4100	4030	4020	3960	4010	4310
90	EPR	1.37	1.43	1.54	1.67	1.85	2.07
	KIAS	210	210	210	210	210	210
	FF/ENG	3930	3840	3740	3660	3640	3770
80	EPR	1.36	1.41	1.51	1.64	1.80	2.02
	KIAS	210	210	210	210	210	210
	FF/ENG	3790	3700	3600	3520	3480	3560
70	EPR	1.34	1.39	1.49	1.61	1.77	1.97
	KIAS	210	210	210	210	210	210
	FF/ENG	3680	3590	3480	3400	3340	3400
60	EPR	1.33	1.38	1.47	1.58	1.74	1.93
	KIAS	210	210	210	210	210	210
	FF/ENG	3580	3490	3380	3300	3240	3270

This table includes 5% additional fuel for holding in a racetrack pattern.

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Performance Inflight — Chapter PI
Text — Section 25

Introduction

This chapter contains information required to complete a normal flight. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

Takeoff Speeds

The speeds presented in the Takeoff Speeds table can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, anti-skid inoperative, improved climb, contaminated runway situations or brake energy limitations. These speeds may be used for weights less than or equal to the performance limited weight.

Normal takeoff speeds, V1, VR and V2, with anti-skid on, are read from the table by entering with station pressure altitude and moving horizontally to the appropriate outside air temperature (OAT) column. Proceed down and read V1, VR and V2 for the anticipated takeoff weight and flap setting. Slope and wind adjustments to V1 are obtained by entering the V1 Adjustments chart. Adjusted V1 must not exceed VR.

VMCG

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, VMCG. Therefore compare the adjusted V1 to the VMCG. To find VMCG, enter the VMCG table with the airport pressure altitude and actual OAT. If VR is less than VMCG, set VR equal to VMCG, and determine a new V2 by adding the difference between the normal VR and VMCG to the normal V2.

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the appropriate column. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

Stab Trim

To find takeoff stabilizer trim setting, enter the Stab Trim Setting table with takeoff flap setting and center of gravity (C.G. % MAC) and read required stabilizer trim units.

VREF

The Reference Speed table contains flaps 40, 30 and 15 landing speeds for a given weight. Apply wind adjustments shown as required.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuvering speed. The speed schedule is a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when reaching the maneuver speed for the existing flap.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in field/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and are based on all engines operating throughout the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush/standing water depths greater than 0.50 inches (13 mm) are not recommended because of possible airplane damage as a result of slush/standing water impingement on the airplane structure. The use of assumed temperature method for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight determination:

Instructions for Using Tables:

1. Determine the dry field/obstacle limit weight for the anticipated flap setting.

2. Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the slush/standing water weight adjustment for the slush depth and airport pressure altitude.

3. Determine takeoff speeds VR and V2 for the actual brake release weight from the Takeoff Speeds chart.

Interpolate for intermediate slush depths as required using the dry runway condition as zero slush depth.

Anti-skid Inoperative

For anti-skid inoperative, the runway limited maximum gross weight at brake release and the V1 speed must be reduced to allow for the effect on accelerate-stop performance as detailed in the Approved Airplane Flight Manual. Obstacle clearance capability must also be considered since the reduced V1 speed will increase the distance required to achieve a given height above the runway following engine failure. A simplified method which conservatively accounts for the effects of anti-skid inoperative is shown below. Reduce the dry runway/obstacle limited weight at brake release obtained from the takeoff performance charts in this section or from the specific airport analysis and the associated V1 (i.e., V1 for the runway/obstacle limited weight at brake release) by the weight and V1 values shown in the table below. (Note that the resulting V1 must not be less than VMCG value.)

For takeoff below the anti-skid inoperative limited weight it is only necessary to ensure that the V1 speed set does not exceed the anti-skid limited V1 value.

ANTI-SKID INOPERATIVE ADJUSTMENTS		
RUNWAY LENGTH (FT)	WEIGHT ADJUSTMENT (LB)	V1 ADJUSTMENT (KTS)
LESS THAN 5000	CHECK AFM	
5000	-11000	-26
6000	-11000	-23
7000	-11000	-22
8000	-11000	-21
9000	-11000	-20
10000	-11000	-19
11000	-11000	-18
12000	-11000	-17

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to VMCG.

Detailed analysis for the specific case from the AFM may yield a less restrictive penalty.

Takeoff EPR

To find Takeoff EPR based on normal engine bleed for air conditioning packs on, enter Takeoff EPR table with airport pressure altitude and airport OAT and read EPR. For packs off operation, apply the EPR adjustment shown below the table. No takeoff EPR adjustment is required for wing anti-ice operation.

Reduced Takeoff EPR

The tables present the allowable Takeoff EPR Reduction as a function of Actual OAT and Surplus Weight which is defined as the difference between the Performance Limited TOGW and the Actual TOGW. These tables are valid for engine A/C bleed on or off, any flap setting. They are not valid when the maximum takeoff weight is limited by obstacles, brake energy or tire speed. Since the tables are conservative, larger reductions in EPR may be achieved under some conditions by using the Assumed Temperature Method described in the AFM Appendix.

Enter the Field Length Limited section of the table appropriate for the airplane pressure altitude with the Surplus Weight based on the field length limit (i.e., Field length limited weight minus actual weight). Read the allowable Takeoff EPR Reduction. Then enter the Climb Limited section of the table with the Surplus Weight based on the climb limit and determine the allowable Takeoff EPR Reduction. Use the smaller of the two reductions. Enter the Minimum EPR table with the pressure altitude. The Takeoff EPR, after the reduction is applied, should not be less than this minimum. Apply the noted V1, VR and V2 adjustments.

Takeoff with assumed temperature reduced thrust is not permitted when: runway is contaminated with water, ice, slush or snow; anti-skid is inoperative. Use of this procedure is not recommended if potential windshear conditions exist.

Max Climb EPR

This table shows Max Climb EPR based on normal engine bleed for packs on and anti-ice off. Enter the table with pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Go-around EPR

To find Go-around EPR based on normal engine bleed for packs on and wing anti-ice off, enter the Go-around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. For packs off, apply the EPR adjustment shown below the table. EPR adjustments are also shown for engine and wing anti-ice operations.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

Maximum altitudes are shown for a given cruise weight and maneuver capability. This table considers both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 15° may cause the airplane to lose speed and/or altitude.

Note that the altitudes shown in the table are limited to the maximum certified altitude of 37000 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, KIAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude .72M approximates the Long Range Cruise Mach schedule.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .70/280/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .70/280/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, KIAS and fuel flow per engine.

Advisory Information

Autobrake Landing Distance

The Autobrake Landing Distance tables are provided as advisory information to assist in the selection of the most desirable autobrake setting for a given field length. It is not to be used to determine required field length. This data reflects actual landing distances on a dry runway for setting MINIMUM through MAXIMUM, from touchdown to full stop, with or without reverse thrust. The tables include typical flare distances from threshold.

To use the Autobrake Landing Distance table, determine the appropriate table to use. The Digital Autobrake Landing Distance table is only applicable if Autobrake Control Valve Module, Boeing part number 60800263 is installed. Enter the chart with the estimated approach speed and determine the actual stopping distance from touchdown for a given autobrake setting. If airspeed is used for approach speed, adjust landing distance for pressure altitude and tailwind effects.

Selection of an autobrake setting results in a constant rate of deceleration. Maximum effort manual braking should achieve shorter landing distance than the MAXIMUM setting.

Slippery Runway Landing Distance

Landing distances are the actual landing distances and do not include the 1.67% regulatory factor. Therefore they cannot be used to determine dispatch required landing field length. When landing on slippery runways or runways contaminated with ice, snow, slush or standing water, the reported braking action must be considered. If the surface is affected by water, snow or ice, and the braking action is reported as “good,” conditions should not be expected to be as good as on clean dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the “good” data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate the “poor” data reflects runways covered with wet ice. Read landing distance for the reported braking action at the airplane weight, and then apply the adjustments for airport pressure altitude and approach speed as required.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances are shown for dry runway and good, medium and poor reported braking action. Each non-normal configuration is listed with its recommended approach speed. Landing distance can be determined for the reference landing weight and then adjusted for actual weight and pressure altitude.

Brake Cooling Schedule

Advisory information is provided to assist in avoiding the problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the Adjusted Brake Energy Per Brake table with the reference brake energy per brake and the type of braking used during landing (RTO Max Man, Max Auto, Med Auto or Min Auto). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing.

The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Engine Inoperative

Max Continuous EPR

Power setting is based on one engine operating with one A/C pack operating and all anti-ice bleeds off. Enter the table with pressure altitude and TAT to read EPR.

It is desirable to maintain engine thrust within the limits of the Max Cruise thrust rating. However, where thrust in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/LRC Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. Cruise is continued at level off altitude and Long Range Cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and adjust for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude are used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, KIAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn. To conservatively account for APU fuel burn, add 115 kg/hr to fuel flow values.

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .70/280/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down

This section contains performance data for airplane operation with the landing gear extended. The data include engine bleed effects for normal air conditioning operation; i.e., two packs on at normal flow with all engines operating, and one pack normal flow with engine inoperative.

Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

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DO NOT USE FOR FLIGHT

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Takeoff Speeds

V1, VR, V2 — ANTI-SKID ON

PRESSURE ALTITUDE 1000 FT	OAT					
9 TO 10			°F: -65 to -22 °C: -54 to -30	°F: -21 to 7 °C: -29 to -14	°F: 8 to 34 °C: -13 to 1	°F: 35 to 86 °C: 2 to 30
7 TO 9		°F: -65 to -25 °C: -54 to -32	°F: -24 to 2 °C: -31 to -17	°F: 3 to 31 °C: -16 to - 1	°F: 32 to 56 °C: 0 to 13	°F: 57 to 97 °C: 14 to 36
5 TO 7	°F: -65 to -20 °C: -54 to -29	°F: -19 to 11 °C: -28 to -12	°F: 12 to 34 °C: -11 to 1	°F: 35 to 58 °C: 2 to 14	°F: 59 to 97 °C: 15 to 36	°F: 98 to 115 °C: 37 to 46
3 TO 5	°F: -65 to 16 °C: -54 to - 9	°F: 17 to 40 °C: - 8 to 4	°F: 41 to 85 °C: 5 to 29	°F: 86 to 99 °C: 30 to 37	°F: 100 to 115 °C: 38 to 46	
1 TO 3	°F: -65 to 47 °C: -54 to 8	°F: 48 to 88 °C: 9 to 31	°F: 89 to 101 °C: 32 to 38	°F: 102 to 115 °C: 39 to 46		
-1 TO 1	°F: -65 to 92 °C: -54 to 33	°F: 93 to 103 °C: 34 to 39	°F: 104 to 115 °C: 40 to 46			

FLAPS	WT 1000 LB	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	V_1	V_R	V_2
1	120	151	153	158	152	154	158	153	155	158	153	155	158						
	110	144	146	151	145	147	151	145	147	151	145	147	151	146	148	151			
	100	137	138	144	138	139	144	138	139	144	139	140	144	139	140	144	140	141	144
	90	129	130	136	129	130	136	130	131	136	131	132	136	131	132	136	132	133	136
	80	120	121	128	121	122	128	121	122	128	121	123	128	122	123	128	123	124	128
	70	110	111	120	112	113	120	112	113	120	113	114	120	113	114	120	114	115	120
2	120	146	148	153	147	149	153	148	150	153									
	110	140	141	146	141	142	146	141	142	146	142	143	146						
	100	133	134	139	133	134	139	134	135	139	134	135	139	134	135	139	135	136	139
	90	125	125	132	126	126	132	126	126	132	126	127	132	126	127	132	127	128	132
	80	117	117	124	117	117	124	118	118	124	119	119	124	119	119	124	120	120	124
	70	107	107	116	108	108	116	109	109	116	110	110	116	110	110	116	111	111	116
5	120	144	145	150	145	146	150												
	110	137	138	143	138	139	143	138	139	143	139	140	143						
	100	131	131	136	131	131	136	132	132	136	132	132	136	133	133	136			
	90	123	123	129	123	123	129	123	124	129	124	124	129	125	125	129	125	125	129
	80	115	115	122	115	115	122	116	116	122	116	116	122	117	117	122	117	117	122
	70	105	106	114	105	106	114	106	107	114	107	108	114	107	108	114	108	109	114
10	110	132	133	138	132	133	138	133	134	138									
	100	124	125	131	125	126	131	125	126	131	125	126	131						
	90	117	118	124	117	118	124	118	119	124	118	119	124	118	119	124	119	120	124
	80	109	110	117	109	110	117	110	111	117	110	111	117	111	112	117	111	112	117
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110
15	110	129	129	134	130	130	134	130	130	134	131	131	134						
	100	122	122	127	122	122	127	123	123	127	123	123	127						
	90	114	114	121	115	115	121	115	115	121	116	116	121	116	116	121			
	80	106	106	113	107	107	113	107	107	113	108	108	113	108	108	113	109	109	113
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110
25	100	120	120	125	120	120	125	121	121	125									
	90	112	112	118	112	112	118	113	113	118	113	113	118						
	80	105	105	110	105	105	110	105	105	110	106	106	111	106	106	111	107	107	111
	70	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110	105	105	110

BOXED AREA INDICATES PERFORMANCE AFFECTED BY MINIMUM CONTROL SPEED, MINIMUM FIELD LENGTH FOR LIGHTEST WEIGHT ABOVE BOXED AREA IS REQUIRED.

V1 ADJUSTMENTS	
WIND	SLOPE
SUBTRACT 1 KT PER 5 KTS TAILWIND	SUBTRACT 1 KT PER 1% DOWN SLOPE

VMCG

OAT (°C)	PRESSURE ALTITUDE (FT)					
	0	2000	4000	6000	8000	10000
50	95	91	88			
40	99	95	92	88	85	
30	103	99	96	92	89	85
20	103	100	96	92	89	86
10	103	101	97	94	90	87
0	103	103	100	96	92	89
-10	103	103	102	98	94	91
-20	103	103	104	100	96	93
-30	103	103	104	102	98	94
-40	103	103	104	103	100	96

Clearway and Stopway V1 Adjustments

CLEARWAY MINUS STOPWAY (FT)	NORMAL V1 (KIAS)			
	100	120	140	160
900	-3	-3	-3	-3
600	-2	-2	-2	-2
300	-1	-1	-1	-1
0	0	0	0	0
-300	1	1	1	1
-600	2	2	2	2
-900	3	3	3	3

Maximum Allowable Clearway

FIELD LENGTH (FT)	MAX ALLOWABLE CLEARWAY FOR V1 REDUCTION (FT)
4000	450
6000	600
8000	700
10000	800

Stab Trim Setting
Max Takeoff Thrust

C.G. %MAC	6	10	14	18	22	26	30	32
FLAPS 1 THRU FLAPS 10	7 3/4	7	6 1/4	5 1/2	4 3/4	4	3 1/4	2 3/4
FLAPS 15 & FLAPS 25	8 3/4	7 3/4	7	6	5	4	3 1/4	2 3/4

VREF (KIAS)

WEIGHT (1000 LB)	FLAPS		
	40	30	15
130	149	154	161
125	146	150	158
120	142	146	154
115	139	142	150
110	135	139	146
105	132	135	142
100	128	131	138
95	124	127	134
90	121	124	131
85	117	120	127
80	113	116	123
75	110	112	119
70	106	109	115

For approach speed add wind factor of 1/2 headwind component + gust (max 20 knots).

Flap Maneuver Speeds

FLAP POSITION	MANEUVER SPEED (KIAS)		
	WEIGHT		
	AT OR BELOW 117000 LB	ABOVE 117000 LB AND AT OR BELOW 138500 LB	ABOVE 138500 LB
UP	210	220	230
1	190	200	210
5	170	180	190
10	160	170	180
15	150	160	170
25	140	150	160

ALL ENGINES

ADVISORY INFORMATION

Slush/Standing Water Takeoff
Weight Adjustment (1000 LB)

DRY FIELD/ OBSTACLE LIMIT WEIGHT (1000 LB)	SLUSH/STANDING WATER DEPTH					
	0.25 INCHES (6 mm)			0.50 INCHES (13 mm)		
	PRESS ALT (FT)			PRESS ALT (FT)		
	S.L.	4000	8000	S.L.	4000	8000
140	-10.0	-11.1	-12.4	-21.8	-25.6	-30.8
130	-8.4	-10.6	-12.6	-19.2	-23.2	-29.2
120	-7.3	-8.9	-11.1	-16.0	-20.0	-26.1
110	-5.8	-7.3	-10.0	-12.5	-16.5	-22.5
100	-4.5	-6.1	-8.7	-9.4	-13.0	-18.4
90	-3.7	-5.0	-6.4	-6.7	-9.5	-14.0
80	-2.0	-3.5	-4.2	-4.2	-5.9	-8.7

For flaps 10, 15 and 25 increase allowable weight limit on slush/standing water by 1000 lb (0.25 in) or 2000 lb (0.50 in).
Interpolate as required using dry runway as zero slush/standing water depth.

Takeoff EPR

Based on engine bleed for packs on and anti-ice on or off

AIRPORT OAT		AIRPORT PRESSURE ALTITUDE (FT)										
°F	°C	-1000	0	1000	2000	3000	4000	5000	5660	6000	7000	8000
120	49	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
104	40	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91
95	35	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95
86	30	1.96	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
77	25	1.96	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
68	20	1.96	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
59	15	1.96	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
50	10	1.96	2.01	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
41	5	1.96	2.01	2.06	2.07	2.07	2.07	2.07	2.07	2.07	2.07	2.07
32	0	1.96	2.01	2.06	2.11	2.11	2.11	2.11	2.11	2.11	2.11	2.11
23	-5	1.96	2.01	2.06	2.11	2.14	2.14	2.14	2.14	2.14	2.14	2.14
14	-10	1.96	2.01	2.06	2.11	2.16	2.17	2.17	2.17	2.17	2.17	2.17
5	-15	1.96	2.01	2.06	2.11	2.16	2.19	2.19	2.19	2.19	2.19	2.19
-4	-20	1.96	2.01	2.06	2.11	2.16	2.22	2.22	2.22	2.22	2.22	2.22
-13	-25	1.96	2.01	2.06	2.11	2.16	2.22	2.24	2.24	2.24	2.24	2.24
-22	-30	1.96	2.01	2.06	2.11	2.16	2.22	2.27	2.27	2.27	2.27	2.27
-31	-35	1.96	2.01	2.06	2.11	2.16	2.22	2.27	2.29	2.29	2.29	2.29
-40	-40	1.96	2.01	2.06	2.11	2.16	2.22	2.27	2.31	2.31	2.31	2.31
-49	-45	1.96	2.01	2.06	2.11	2.16	2.22	2.27	2.31	2.31	2.31	2.31
-65	-54	1.96	2.01	2.06	2.11	2.16	2.22	2.27	2.31	2.31	2.31	2.31

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-1000	8000
PACKS OFF	0.03	0.03

%N1 vs EPR Crosscheck

(Takeoff and Go-around)

AIRPORT OAT		TARGET %N1						
		EPR						
°F	°C	1.70	1.80	1.90	2.00	2.10	2.20	2.30
130	54	90	93	96	99	102	107	111
122	50	89	92	95	98	102	106	110
104	40	88	91	94	97	100	104	108
86	30	87	90	92	95	99	102	106
68	20	85	88	91	94	97	101	105
50	10	84	87	89	92	95	99	103
32	0	82	85	88	90	94	97	101
14	-10	81	84	86	89	92	95	99
-4	-20	79	82	84	87	90	94	97
-22	-30	78	80	83	85	88	92	95
-40	-40	76	78	81	84	87	90	94
-58	-50	75	77	79	82	85	88	92
-65	-54	74	76	78	81	84	87	91

Use scheduled Takeoff or Go-around EPR.
Use actual OAT only.
%N1 operating tolerance ±2%
%N1 limit 102.45%
A/C on or off
For engine anti-icing on, increase %N1 by 1%.

Reduced Takeoff EPR

Based on engine bleed for packs on or off
1000 FT Pressure Altitude and Below
Takeoff EPR Reduction

SURPLUS WEIGHT (LB)	FIELD LENGTH LIMITED										CLIMB LIMITED (ALL TEMPS)
	OAT										
	°C -10 TO -6 / °F 14 TO 22	°C -5 TO -1 / °F 23 TO 31	°C 0 TO 4 / °F 32 TO 40	°C 5 TO 9 / °F 41 TO 49	°C 10 TO 14 / °F 50 TO 58	°C 15 TO 19 / °F 59 TO 67	°C 20 TO 24 / °F 68 TO 76	°C 25 TO 29 / °F 77 TO 85	°C 30 TO 33 / °F 86 TO 92	°C 34 AND ABOVE / °F 93 AND ABOVE	
1000 TO 1999										0.01	0.00
2000 TO 2999									0.01	0.03	0.01
3000 TO 3999								0.01	0.03	0.04	0.02
4000 TO 4999							0.02	0.03	0.04	0.06	0.03
5000 TO 5999					0.01	0.02	0.03	0.05	0.06	0.08	0.04
6000 TO 6999				0.01	0.03	0.04	0.05	0.06	0.08	0.10	0.05
7000 TO 7999			0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.11	0.06
8000 TO 8999		0.02	0.03	0.05	0.06	0.07	0.08	0.10	0.11	0.13	0.07
9000 TO 9999	0.02	0.03	0.05	0.06	0.08	0.09	0.10	0.11	0.13	0.15	0.08
10000 TO 10999	0.04	0.05	0.07	0.08	0.09	0.10	0.12	0.13	0.14	0.16	0.09
11000 TO 11999	0.05	0.07	0.08	0.10	0.11	0.12	0.13	0.15	0.16	0.18	0.10
12000 TO 12999	0.07	0.08	0.10	0.11	0.13	0.14	0.15	0.16	0.18	0.20	0.11
13000 TO 13999	0.09	0.10	0.12	0.13	0.14	0.16	0.17	0.18	0.19	0.21	0.12
14000 TO 14999	0.10	0.12	0.13	0.15	0.16	0.17	0.18	0.20	0.21	0.23	0.13
15000 TO 15999	0.12	0.14	0.15	0.16	0.18	0.19	0.20	0.21	0.23	0.25	0.14
16000 TO 16999	0.14	0.15	0.17	0.18	0.19	0.21	0.22	0.23	0.24	0.26	0.14
17000 TO 17999	0.15	0.17	0.18	0.20	0.21	0.22	0.24	0.25	0.26	0.28	0.15
18000 TO 18999	0.17	0.19	0.20	0.21	0.23	0.24	0.25	0.27	0.28	0.30	0.16
19000 TO 19999	0.19	0.20	0.22	0.23	0.24	0.26	0.27	0.28	0.29	0.30	0.17
20000 TO 20999	0.20	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.30	0.30	0.18
21000 TO 21999	0.22	0.24	0.25	0.26	0.28	0.29	0.30	0.30	0.30	0.30	0.19
22000 TO 22999	0.24	0.25	0.27	0.28	0.29	0.30	0.30	0.30	0.30	0.30	0.20
23000 TO 23999	0.25	0.27	0.28	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.21
24000 TO 24999	0.27	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.22
25000 TO 25999	0.29	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.23
26000 TO 26779	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.24
26780 TO 27859	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.25
27860 TO 28929	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.26
28930 TO 29999	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.27
30000 TO 31069	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.28
31070 TO 32149	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.29
32150 AND ABOVE	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

Minimum EPR

PRESSURE ALTITUDE (1000 FT)															
-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	13.5
1.82	1.82	1.82	1.82	1.83	1.85	1.86	1.88	1.90	1.92	1.99	2.01	2.01	2.01	2.01	2.01

Increase Minimum EPR by 0.03 for bleeds off.
Use actual weight and OAT to determine takeoff speeds. Increase V1 and VR by 1 kt for each 0.10 EPR reduction, except when speeds are found in shaded area of the Takeoff Speeds chart.
If V1 prior to adjustment is found in the shaded area of the Takeoff Speeds chart, find the lightest weight above the shaded area and using the weight as the actual weight recalculate the surplus weight and the Takeoff EPR reduction.

Based on engine bleed for packs on or off
Above 1000 FT Pressure Altitude
Takeoff EPR Reduction

SURPLUS WEIGHT (LB)	FIELD LENGTH LIMITED										CLIMB LIMITED (ALL TEMPS)
	OAT										
	°C	-10 TO -6	-5 TO -1	0 TO 4	5 TO 9	10 TO 14	15 TO 19	20 TO 24	25 TO 29	30 TO 33	34 AND ABOVE	
	°F	14 TO 22	23 TO 31	32 TO 40	41 TO 49	50 TO 58	59 TO 67	68 TO 76	77 TO 85	86 TO 92	93 AND ABOVE	
1000 TO 1999					0.02	0.02				0.01	0.01	0.00
2000 TO 2999				0.02	0.04	0.02				0.03	0.02	0.01
3000 TO 3999			0.02	0.04	0.04	0.02				0.04	0.04	0.02
4000 TO 4999		0.02	0.04	0.04	0.05	0.03				0.06	0.05	0.03
5000 TO 5999		0.04	0.04	0.04	0.05	0.03			0.02	0.07	0.07	0.04
6000 TO 6999		0.04	0.05	0.05	0.05	0.03	0.01	0.02	0.04	0.09	0.08	0.05
7000 TO 7999		0.04	0.05	0.05	0.05	0.04	0.03	0.04	0.05	0.10	0.09	0.07
8000 TO 8999		0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.07	0.12	0.11	0.08
9000 TO 9999		0.05	0.08	0.06	0.08	0.07	0.06	0.07	0.08	0.13	0.12	0.09
10000 TO 10999		0.05	0.06	0.08	0.10	0.09	0.07	0.08	0.10	0.14	0.14	0.10
11000 TO 11999		0.06	0.08	0.09	0.11	0.10	0.09	0.10	0.11	0.16	0.15	0.12
12000 TO 12999		0.08	0.10	0.11	0.13	0.12	0.10	0.11	0.12	0.17	0.16	0.13
13000 TO 13999		0.10	0.11	0.12	0.14	0.13	0.12	0.13	0.14	0.19	0.18	0.14
14000 TO 14999		0.11	0.13	0.14	0.16	0.14	0.13	0.14	0.15	0.20	0.19	0.15
15000 TO 15999		0.12	0.14	0.15	0.17	0.16	0.14	0.15	0.17	0.22	0.21	0.16
16000 TO 16999		0.14	0.16	0.17	0.18	0.17	0.16	0.17	0.18	0.23	0.22	0.18
17000 TO 17999		0.15	0.17	0.18	0.20	0.19	0.17	0.18	0.19	0.24	0.23	0.19
18000 TO 18999		0.17	0.18	0.19	0.21	0.20	0.19	0.20	0.21	0.26	0.25	0.20
19000 TO 19999		0.18	0.20	0.21	0.23	0.21	0.20	0.21	0.22	0.27	0.26	0.21
20000 TO 20999		0.20	0.21	0.22	0.24	0.23	0.21	0.22	0.24	0.29	0.28	0.22
21000 TO 21999		0.21	0.23	0.24	0.25	0.24	0.23	0.24	0.25	0.30	0.29	0.23
22000 TO 22999		0.22	0.24	0.25	0.27	0.26	0.24	0.25	0.26	0.30	0.30	0.25
23000 TO 23999		0.24	0.25	0.26	0.28	0.27	0.26	0.27	0.28	0.30	0.30	0.26
24000 TO 24999		0.25	0.27	0.28	0.30	0.29	0.27	0.28	0.29	0.30	0.30	0.27
25000 TO 25999		0.27	0.28	0.29	0.30	0.30	0.29	0.30	0.30	0.30	0.30	0.28
26000 TO 26999		0.28	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.29
27000 AND ABOVE		0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30

Minimum EPR

PRESSURE ALTITUDE (1000 FT)															
-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	13.5
1.82	1.82	1.82	1.82	1.83	1.85	1.86	1.88	1.90	1.92	1.99	2.01	2.01	2.01	2.01	2.01

Increase Minimum EPR by 0.03 for bleeds off.
Use actual weight and OAT to determine takeoff speeds. Increase V1 and VR by 1 kt for each 0.10 EPR reduction, except when speeds are found in shaded area of the Takeoff Speeds chart.
If V1 prior to adjustment is found in the shaded area of the Takeoff Speeds chart, find the lightest weight above the shaded area and using the weight as the actual weight recalculate the surplus weight and the Takeoff EPR reduction.

Max Climb EPR

Based on engine bleed for packs on and anti-ice off

TAT (°C)	PRESSURE ALTITUDE (1000 FT)/SPEED (KIAS OR MACH)												
	0	1	2	3	4	5.66	10	15	20	25	30	35	37
	320	320	320	320	320	320	320	320	320	.70	.70	.70	.70
50	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64		
45	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67	1.67		
40	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70		
35	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73	1.73		
30	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76		
25	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79		
20	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82		
15	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86		
10	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90		
5	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.92	1.92
0	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.99	1.97	1.97
-5	1.98	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.02	2.02
-10	1.98	2.04	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.09	2.07	2.07
-15	1.98	2.04	2.09	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.12	2.11	2.11
-20	1.98	2.04	2.09	2.14	2.15	2.15	2.15	2.15	2.15	2.15	2.15	2.14	2.14
-25	1.98	2.04	2.09	2.14	2.18	2.18	2.18	2.18	2.18	2.18	2.18	2.17	2.17
-30	1.98	2.04	2.09	2.14	2.20	2.21	2.21	2.21	2.21	2.21	2.21	2.20	2.20
-35	1.98	2.04	2.09	2.14	2.20	2.23	2.23	2.23	2.23	2.23	2.23	2.22	2.22
-40	1.98	2.04	2.09	2.14	2.20	2.25	2.25	2.25	2.25	2.25	2.25	2.24	2.24

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	0	37000
PACKS OFF	0.04	0.04
ENGINE ANTI-ICE ON	-0.08	-0.08
ENGINE AND WING ANTI-ICE ON*	-0.04	-0.04
ENGINE AND WING ANTI-ICE ON**	-0.06	-0.06

***Dual Bleed Source**
****Single Bleed Source**

Go-around EPR

Based on engine bleed for packs on, wing anti-ice off

REPORTED OAT		TAT	AIRPORT PRESSURE ALTITUDE (FT)									
°F	°C	(°C)	-1000	0	1000	2000	3000	4000	5000	5660	6000	8000
119	48	50	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
100	38	40	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90	1.90
91	33	35	1.93	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94	1.94
83	28	30	1.93	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98
73	23	25	1.93	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98
64	18	20	1.93	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98
55	13	15	1.93	1.98	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
47	8	10	1.93	1.98	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
38	3	5	1.93	1.98	2.04	2.07	2.07	2.07	2.07	2.07	2.07	2.07
27	-3	0	1.93	1.98	2.04	2.09	2.10	2.10	2.10	2.10	2.10	2.10
18	-8	-5	1.93	1.98	2.04	2.09	2.13	2.13	2.13	2.13	2.13	2.13
10	-13	-10	1.93	1.98	2.04	2.09	2.15	2.16	2.16	2.16	2.16	2.16
0	-18	-15	1.93	1.98	2.04	2.09	2.15	2.19	2.19	2.19	2.19	2.19
-10	-23	-20	1.93	1.98	2.04	2.09	2.15	2.20	2.21	2.21	2.21	2.21
-17	-27	-25	1.93	1.98	2.04	2.09	2.15	2.20	2.24	2.24	2.24	2.24
-25	-32	-30	1.93	1.98	2.04	2.09	2.15	2.20	2.26	2.26	2.26	2.26
-36	-37	-35	1.93	1.98	2.04	2.09	2.15	2.20	2.26	2.29	2.29	2.29
-43	-42	-40	1.93	1.98	2.04	2.09	2.15	2.20	2.26	2.30	2.30	2.30
-52	-47	-45	1.93	1.98	2.04	2.09	2.15	2.20	2.26	2.30	2.30	2.30
-61	-52	-50	1.93	1.98	2.04	2.09	2.15	2.20	2.26	2.30	2.30	2.30

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	AIRPORT PRESSURE ALTITUDE (FT)	
	-1000	8000
A/C PACKS OFF	0.03	0.03
ENGINE ANTI-ICE ON	0	0
ENGINE AND WING ANTI-ICE ON*	-0.04	-0.04
ENGINE AND WING ANTI-ICE ON**	-0.06	-0.06

***Dual Bleed Source**
****Single Bleed Source**

Flight With Unreliable Airspeed / Turbulent Air Penetration

Altitude and/or vertical speed indications may also be unreliable.

Climb (280/.70)

Flaps Up, Set Max Climb Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)		
		80	100	120
35000	**PITCH ATT**	**6.0**	**6.0**	
	V/S (FT/MIN)	1300	600	
30000	**PITCH ATT**	**6.0**	**6.0**	**6.0**
	V/S (FT/MIN)	2000	1300	700
27000	**PITCH ATT**	**6.0**	**6.0**	**6.0**
	V/S (FT/MIN)	2100	1500	1000
25000	**PITCH ATT**	**5.0**	**5.0**	**6.0**
	V/S (FT/MIN)	1900	1400	900
20000	**PITCH ATT**	**6.0**	**6.0**	**6.0**
	V/S (FT/MIN)	2600	1800	1300
15000	**PITCH ATT**	**7.0**	**7.0**	**7.0**
	V/S (FT/MIN)	2900	2100	1700
5000	**PITCH ATT**	**10.0**	**9.0**	**8.0**
	V/S (FT/MIN)	3900	2900	2300
SEA LEVEL	**PITCH ATT**	**11.0**	**10.0**	**9.0**
	V/S (FT/MIN)	4500	3500	2700

Cruise (.70/280)

Flaps Up, EPR for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)			
		80	90	100	110
30000	**PITCH ATT**	**2.8**	**3.4**	**3.9**	**4.4**
	EPR	1.68	1.71	1.78	1.84
10000	**PITCH ATT**	**2.2**	**2.6**	**3.0**	**3.4**
	EPR	1.31	1.33	1.35	1.37

Descent (.70/280)

Flaps Up, Set Idle Thrust

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)		
		80	90	100
30000	**PITCH ATT**	**-0.8**	**-0.3**	**0.5**
	V/S (FT/MIN)	-2500	-2400	-2300
10000	**PITCH ATT**	**-1.9**	**-1.2**	**-0.6**
	V/S (FT/MIN)	-2300	-2200	-2000

Holding

Flaps Up, EPR for Level Flight

PRESSURE ALTITUDE (FT)		WEIGHT (1000 LB)			
		80	90	100	110
10000	**PITCH ATT**	**4.8**	**4.8**	**4.8**	**4.8**
	EPR	1.22	1.26	1.29	1.33
	KIAS	210	225	235	245

Terminal Area (0 to 10000 FT)
EPR for Level Flight

FLAP POSITION (SPEED)		WEIGHT (1000 LB) 70	80	90	100
FLAPS UP (GEAR UP) (210 KIAS)	**PITCH ATT**	**4.0**	**4.8**	**5.5**	**6.3**
	EPR	1.21	1.24	1.27	1.29
FLAPS 1 (GEAR UP) (190 KIAS)	**PITCH ATT**	**4.1**	**4.8**	**5.6**	**6.4**
	EPR	1.27	1.30	1.33	1.35
FLAPS 5 (GEAR UP) (170 KIAS)	**PITCH ATT**	**4.2**	**5.1**	**6.1**	**7.0**
	EPR	1.28	1.31	1.35	1.40
FLAPS 15 (GEAR DOWN) (150 KIAS)	**PITCH ATT**	**4.1**	**5.2**	**6.4**	**7.5**
	EPR	1.41	1.46	1.51	1.57
FLAPS 25 (GEAR DOWN) (140 KIAS)	**PITCH ATT**	**3.9**	**5.1**	**6.4**	**7.7**
	EPR	1.41	1.47	1.53	1.60

Final Approach (0 to 10000 FT)
Gear Down, EPR for 3° Glideslope

FLAP POSITION		WEIGHT (1000 LB) 70	80	90	100
FLAPS 40	**PITCH ATT**	**0.0**	**0.0**	**0.0**	**0.0**
	EPR	1.25	1.29	1.33	1.38
	KIAS	115	123	130	137
FLAPS 30	**PITCH ATT**	**2.6**	**2.6**	**2.6**	**2.6**
	EPR	1.17	1.20	1.23	1.26
	KIAS	118	125	133	141
FLAPS 15	**PITCH ATT**	**4.5**	**4.5**	**4.5**	**4.5**
	EPR	1.13	1.15	1.17	1.18
	KIAS	125	133	140	148

Performance Inflight — Chapter PI
All Engines — Section 31

Long Range Cruise Maximum Operating Altitude
Max Cruise Thrust
ISA + 10°C and Below

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28400	-6	26900*	26900*	26900*	26900*	26900*
120	30200	-10	31500*	31500*	31500*	31500*	30200
110	32100	-14	35400*	35400*	35100	33600	32100
100	34100	-19	37000	37000	37000	35600	34200
90	36300	-23	37000	37000	37000	37000	36400
80	37000	-23	37000	37000	37000	37000	37000
70	37000	-23	37000	37000	37000	37000	37000
60	37000	-19	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

ISA + 15°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28400	-1	24100*	24100*	24100*	24100*	24100*
120	30200	-5	27400*	27400*	27400*	27400*	27400*
110	32100	-9	34500*	34500*	34500*	33600	32100
100	34100	-13	36800*	36800*	36800*	35600	34200
90	36300	-18	37000	37000	37000	37000	36400
80	37000	-18	37000	37000	37000	37000	37000
70	37000	-17	37000	37000	37000	37000	37000
60	37000	-13	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

ISA + 20°C

WEIGHT (1000 LB)	OPTIMUM ALT (FT)	TAT (°C)	MARGIN TO INITIAL BUFFET 'G' (BANK ANGLE)				
			1.20 (33°)	1.25 (36°)	1.30 (39°)	1.40 (44°)	1.50 (48°)
130	28400	5	18100*	18100*	18100*	18100*	18100*
120	30200	1	23900*	23900*	23900*	23900*	23900*
110	32100	-3	29000*	29000*	29000*	29000*	29000*
100	34100	-8	36200*	36200*	36200*	35600	34200
90	36300	-12	37000	37000	37000	37000	36400
80	37000	-12	37000	37000	37000	37000	37000
70	37000	-11	37000	37000	37000	37000	37000
60	37000	-8	37000	37000	37000	37000	37000

***Denotes altitude thrust limited in level flight, 100 fpm residual rate of climb.**

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)								
		21	23	25	27	29	31	33	35	37
130	EPR	1.70	1.76	1.81	1.88	1.97	2.07			
	MACH	.684	.698	.709	.716	.720	.717			
	KIAS	310	304	296	287	277	264			
	FF/ENG	3527	3470	3420	3385	3365	3398			
120	EPR	1.66	1.71	1.76	1.82	1.89	1.98	2.09		
	MACH	.670	.685	.699	.710	.717	.720	.716		
	KIAS	303	298	292	285	276	265	252		
	FF/ENG	3292	3240	3185	3141	3109	3096	3140		
110	EPR	1.61	1.65	1.71	1.76	1.82	1.89	1.98	2.10	
	MACH	.653	.669	.685	.699	.710	.717	.720	.715	
	KIAS	295	291	286	280	273	264	253	241	
	FF/ENG	3052	3006	2956	2907	2866	2839	2830	2877	
100	EPR	1.56	1.60	1.65	1.70	1.76	1.82	1.89	1.98	2.10
	MACH	.633	.651	.668	.684	.698	.709	.717	.720	.715
	KIAS	285	282	278	273	268	261	252	242	230
	FF/ENG	2811	2769	2724	2678	2633	2595	2573	2564	2619
90	EPR	1.51	1.55	1.59	1.64	1.69	1.75	1.81	1.88	1.97
	MACH	.611	.629	.647	.665	.681	.696	.708	.716	.720
	KIAS	275	272	269	265	261	255	249	241	231
	FF/ENG	2569	2530	2488	2445	2404	2361	2327	2308	2309
80	EPR	1.46	1.50	1.54	1.58	1.62	1.67	1.73	1.79	1.86
	MACH	.586	.604	.622	.641	.659	.676	.692	.705	.715
	KIAS	263	261	258	255	252	248	243	237	229
	FF/ENG	2329	2287	2250	2204	2169	2133	2095	2068	2056
70	EPR	1.41	1.44	1.48	1.52	1.55	1.60	1.65	1.70	1.76
	MACH	.558	.575	.594	.613	.632	.651	.669	.686	.700
	KIAS	250	248	246	243	241	238	234	230	224
	FF/ENG	2096	2047	2007	1970	1929	1904	1870	1838	1828
60	EPR	1.36	1.39	1.42	1.45	1.49	1.53	1.57	1.61	1.67
	MACH	.527	.543	.561	.580	.599	.618	.638	.657	.675
	KIAS	236	234	232	230	227	225	222	219	216
	FF/ENG	1866	1822	1776	1744	1705	1672	1651	1621	1598

Shaded area approximates optimum altitude.

Long Range Cruise Enroute Fuel and Time - Low Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
286	264	244	227	213	200	190	181	173	166	159
575	529	489	455	426	400	381	363	347	332	319
866	797	736	684	640	600	571	544	520	498	479
1159	1066	983	914	854	800	762	727	694	665	638
1453	1335	1231	1143	1068	1000	952	908	867	830	797
1750	1607	1480	1374	1282	1200	1142	1089	1040	996	956
2050	1880	1730	1605	1497	1400	1333	1270	1213	1161	1114
2352	2156	1982	1836	1712	1600	1522	1451	1385	1325	1272
2656	2432	2234	2068	1926	1800	1712	1631	1557	1490	1430

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		20		24		28	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	3.4	0:40	3.0	0:39	2.6	0:38	2.4	0:37	2.1	0:36
400	6.8	1:17	6.2	1:15	5.4	1:11	4.9	1:08	4.5	1:06
600	10.2	1:55	9.3	1:50	8.1	1:44	7.4	1:40	6.9	1:37
800	13.5	2:33	12.3	2:27	10.8	2:17	9.9	2:12	9.2	2:08
1000	16.8	3:11	15.3	3:03	13.4	2:51	12.4	2:44	11.5	2:38
1200	20.0	3:51	18.3	3:41	16.0	3:26	14.8	3:17	13.7	3:10
1400	23.2	4:30	21.2	4:18	18.6	4:01	17.2	3:50	15.9	3:41
1600	26.3	5:11	24.1	4:57	21.1	4:36	19.5	4:24	18.1	4:13
1800	29.4	5:52	26.9	5:36	23.6	5:12	21.8	4:58	20.2	4:45

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.4	-0.2	0.0	0.2	0.5	0.8
10	-0.8	-0.4	0.0	0.6	1.2	1.8
15	-1.2	-0.6	0.0	0.9	1.8	2.8
20	-1.7	-0.8	0.0	1.2	2.5	3.8
25	-2.1	-1.0	0.0	1.5	3.1	4.8
30	-2.5	-1.3	0.0	1.9	3.8	5.8

Long Range Cruise Enroute Fuel and Time - High Altitudes
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
272	254	237	223	211	200	191	182	174	167	160
538	504	472	446	422	400	381	364	348	334	321
805	754	708	668	632	600	572	546	522	501	482
1073	1006	945	891	843	800	763	729	697	669	643
1342	1258	1181	1114	1054	1000	954	911	872	836	804
1611	1509	1418	1337	1265	1200	1144	1093	1046	1003	965
1881	1762	1655	1560	1476	1400	1335	1275	1220	1170	1125
2152	2016	1892	1784	1688	1600	1526	1458	1395	1337	1286
2424	2270	2130	2008	1899	1800	1717	1640	1569	1505	1446
2697	2525	2369	2232	2111	2000	1908	1822	1744	1672	1607
2971	2780	2607	2456	2322	2200	2098	2004	1918	1839	1767
3246	3036	2846	2681	2534	2400	2289	2186	2091	2005	1927
3522	3293	3086	2906	2746	2600	2479	2367	2265	2171	2087
3799	3551	3327	3131	2958	2800	2670	2549	2439	2338	2247
4078	3810	3568	3357	3170	3000	2860	2731	2612	2504	2406
4358	4070	3810	3583	3382	3200	3050	2912	2785	2669	2565
4639	4330	4052	3809	3595	3400	3240	3093	2958	2835	2724
4921	4591	4295	4036	3807	3600	3431	3274	3131	3000	2883
5205	4854	4538	4263	4020	3800	3621	3456	3304	3166	3041
5491	5118	4782	4490	4233	4000	3811	3637	3477	3331	3199

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	29		31		33		35		37	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	2.1	0:36	2.0	0:36	2.0	0:36	1.9	0:36	1.8	0:36
400	4.4	1:06	4.3	1:05	4.2	1:05	4.1	1:05	4.0	1:05
600	6.8	1:36	6.6	1:35	6.4	1:34	6.2	1:34	6.2	1:34
800	9.0	2:07	8.7	2:05	8.5	2:04	8.3	2:03	8.3	2:03
1000	11.3	2:37	10.9	2:35	10.6	2:33	10.4	2:33	10.3	2:32
1200	13.5	3:08	13.1	3:05	12.7	3:03	12.4	3:02	12.3	3:01
1400	15.7	3:39	15.2	3:36	14.7	3:33	14.5	3:32	14.3	3:31
1600	17.8	4:11	17.2	4:07	16.7	4:04	16.4	4:02	16.2	4:00
1800	19.9	4:43	19.3	4:38	18.7	4:34	18.3	4:32	18.1	4:30
2000	22.0	5:15	21.3	5:09	20.7	5:05	20.2	5:02	20.0	4:59
2200	24.0	5:47	23.3	5:41	22.6	5:36	22.1	5:32	21.8	5:29
2400	26.0	6:20	25.2	6:13	24.5	6:07	23.9	6:03	23.6	5:59
2600	28.0	6:53	27.2	6:45	26.4	6:38	25.7	6:33	25.4	6:29
2800	30.0	7:27	29.0	7:18	28.2	7:10	27.5	7:05	27.1	7:00
3000	31.9	8:00	30.9	7:50	30.0	7:42	29.3	7:36	28.8	7:30
3200	33.8	8:35	32.7	8:24	31.8	8:14	31.0	8:07	30.4	8:01
3400	35.7	9:09	34.5	8:57	33.5	8:47	32.7	8:39	32.1	8:32
3600	37.5	9:45	36.3	9:31	35.3	9:20	34.4	9:11	33.7	9:03
3800	39.4	10:20	38.1	10:06	37.0	9:53	36.0	9:44	35.3	9:35
4000	41.2	10:56	39.8	10:41	38.7	10:27	37.7	10:16	36.9	10:07

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)					
	70	80	90	100	110	120
5	-0.5	-0.2	0.0	0.3	1.2	2.8
10	-1.2	-0.6	0.0	0.7	2.4	5.1
15	-1.8	-0.9	0.0	1.2	3.5	7.0
20	-2.4	-1.2	0.0	1.6	4.5	8.6
25	-2.9	-1.5	0.0	2.1	5.4	10.0
30	-3.5	-1.8	0.0	2.5	6.1	11.0
35	-4.0	-2.1	0.0	2.8	6.7	11.7
40	-4.5	-2.3	0.0	3.2	7.2	12.1
45	-4.9	-2.5	0.0	3.6	7.6	12.2

Long Range Cruise Wind-Altitude Trade

PRESSURE ALTITUDE (1000 FT)	CRUISE WEIGHT (1000 LB)									
	115	110	105	100	95	90	85	80	75	70
37				6	2	0	0	0	2	5
35		6	2	0	0	0	2	5	8	13
33	2	0	0	0	2	5	8	13	18	23
31	0	0	2	5	8	13	18	23	29	36
29	2	5	8	13	18	23	29	36	43	50
27	8	13	18	23	29	36	43	50	58	67
25	18	23	29	36	43	50	58	67	77	88
23	29	36	43	50	58	67	77	88	102	118

The above wind factor tables are for calculation of wind required to maintain present range capability at new pressure altitude, i.e., break-even wind.

Method:

1. **Read wind factors for present and new altitudes from table.**
2. **Determine difference (new altitude wind factor minus present altitude wind factor); This difference may be negative or positive.**
3. **Break-even wind at new altitude is present altitude wind plus difference from step 2.**

Descent at .70/280/250

PRESSURE ALT (1000 FT)	21	23	25	27	29	31	33	35	37
DISTANCE (NM)	79	85	92	98	103	109	114	119	125
TIME (MINUTES)	17	18	19	20	20	21	22	23	23

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)								
		1500	5000	10000	15000	20000	25000	30000	35000	37000
130	EPR	1.29	1.34	1.41	1.51	1.63	1.79	2.02		
	KIAS	243	246	246	247	250	253	246		
	FF/ENG	3310	3270	3170	3120	3100	3180	3330		
120	EPR	1.27	1.31	1.38	1.47	1.58	1.73	1.93		
	KIAS	232	236	236	237	239	243	241		
	FF/ENG	3080	3040	2940	2880	2850	2900	3000		
110	EPR	1.24	1.28	1.34	1.43	1.53	1.66	1.84	2.11	
	KIAS	220	223	227	227	228	232	233	222	
	FF/ENG	2860	2800	2720	2650	2610	2630	2690	2880	
100	EPR	1.21	1.25	1.31	1.38	1.48	1.60	1.76	1.98	2.11
	KIAS	210	211	216	216	217	219	223	218	211
	FF/ENG	2650	2570	2500	2420	2370	2360	2400	2520	2630
90	EPR	1.19	1.22	1.27	1.34	1.43	1.54	1.68	1.87	1.97
	KIAS	210	210	210	210	210	210	210	211	210
	FF/ENG	2480	2390	2300	2220	2160	2120	2120	2200	2270
80	EPR	1.17	1.19	1.24	1.30	1.38	1.48	1.60	1.76	1.84
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2340	2240	2140	2070	2000	1950	1920	1950	2000
70	EPR	1.15	1.17	1.21	1.27	1.34	1.42	1.53	1.67	1.74
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2220	2110	2010	1940	1860	1810	1760	1780	1790
60	EPR	1.13	1.15	1.19	1.24	1.30	1.38	1.48	1.59	1.65
	KIAS	210	210	210	210	210	210	210	210	210
	FF/ENG	2120	2000	1900	1820	1750	1680	1640	1630	1630

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 15

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF15	ONE REV	NO REV
MAX MANUAL	2820	180/-110	90	-140	510	30	-30	50	-50	330	90	200
MAX AUTO	3730	150/-140	90	-150	520	0	0	50	-50	400	0	0
MED AUTO	4730	210/-190	120	-210	720	0	0	70	-70	550	0	0
MIN AUTO	6090	350/-300	220	-300	1050	160	-180	90	-90	500	920	1010

Good Reported Braking Action

MAX MANUAL	3600	150/-130	90	-150	550	70	-70	40	-40	270	280	710
MAX AUTO	3770	160/-140	90	-160	570	40	-10	50	-50	400	130	550
MED AUTO	4730	210/-190	120	-210	730	0	0	70	-70	550	0	80
MIN AUTO	6090	350/-300	220	-300	1050	160	-180	90	-90	500	920	1010

Medium Reported Braking Action

MAX MANUAL	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MAX AUTO	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MED AUTO	4930	220/-200	140	-240	890	100	-60	70	-70	500	470	1960
MIN AUTO	6090	350/-300	220	-300	1090	170	-180	90	-90	500	960	1570

Poor Reported Braking Action

MAX MANUAL	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MAX AUTO	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MED AUTO	5650	300/-260	190	-300	1250	250	-180	80	-80	470	1430	5640
MIN AUTO	6220	360/-310	230	-330	1340	260	-220	90	-90	500	1400	5130

Reference distance is for sea level, standard day, no wind or slope, VREF15 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2560	170/-80	80	-100	520	30	-30	40	-40	330	60	140
MAX AUTO	3410	140/-120	80	-140	490	0	0	40	-40	370	0	0
MED AUTO	4290	200/-170	110	-200	680	0	0	60	-60	510	0	0
MIN AUTO	5430	300/-260	190	-280	980	150	-160	70	-80	420	800	930

Good Reported Braking Action

MAX MANUAL	3350	140/-120	80	-150	530	70	-60	40	-40	270	250	620
MAX AUTO	3450	140/-120	80	-150	540	50	-20	40	-40	360	140	520
MED AUTO	4290	200/-170	110	-200	680	0	0	60	-60	510	0	70
MIN AUTO	5430	300/-260	190	-280	980	150	-160	70	-80	420	800	930

Medium Reported Braking Action

MAX MANUAL	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MAX AUTO	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MED AUTO	4460	210/-180	120	-220	840	100	-50	60	-70	470	410	1670
MIN AUTO	5440	300/-260	190	-280	1020	160	-160	70	-80	420	840	1410

Poor Reported Braking Action

MAX MANUAL	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MAX AUTO	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MED AUTO	5080	270/-230	170	-280	1190	220	-160	70	-70	420	1190	4600
MIN AUTO	5560	320/-270	200	-310	1270	230	-200	80	-80	420	1230	4240

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Autobrake System

Flaps 40

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF40	ONE REV	NO REV
MAX MANUAL	2480	160/-70	80	-90	510	30	-20	40	-30	320	50	120
MAX AUTO	3300	130/-120	80	-140	480	0	0	40	-40	370	0	0
MED AUTO	4140	180/-160	100	-190	660	0	0	60	-60	490	0	0
MIN AUTO	5120	270/-240	170	-270	950	150	-150	70	-70	370	750	970

Good Reported Braking Action

MAX MANUAL	3250	130/-110	80	-140	520	70	-60	40	-40	260	230	580
MAX AUTO	3350	130/-120	80	-150	530	50	-20	40	-40	350	140	490
MED AUTO	4140	180/-160	100	-190	670	0	0	60	-60	490	0	70
MIN AUTO	5120	270/-240	170	-270	950	150	-150	70	-70	370	750	970

Medium Reported Braking Action

MAX MANUAL	4050	190/-170	120	-200	790	130	-110	50	-60	310	590	1730
MAX AUTO	4050	190/-160	120	-200	790	130	-110	50	-60	310	590	1730
MED AUTO	4280	190/-170	110	-220	830	90	-40	60	-60	470	370	1510
MIN AUTO	5130	270/-240	170	-270	990	160	-160	70	-70	370	780	1400

Poor Reported Braking Action

MAX MANUAL	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MAX AUTO	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MED AUTO	4830	240/-210	150	-270	1160	200	-150	70	-70	380	1060	4040
MIN AUTO	5240	280/-250	180	-300	1230	230	-190	70	-80	370	1140	3810

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 15

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF15	ONE REV	NO REV
MAX MANUAL	2820	180/-110	90	-140	510	30	-30	50	-50	330	90	200
MAX AUTO	3840	150/-140	90	-150	520	10	-10	50	-50	380	0	0
MED AUTO	5380	250/-240	150	-250	840	40	-70	80	-80	530	50	50
MIN AUTO	6170	350/-310	230	-310	1080	200	-200	90	-90	470	1070	1250

Good Reported Braking Action

MAX MANUAL	3600	150/-130	90	-150	550	70	-70	40	-40	270	280	710
MAX AUTO	3890	160/-140	90	-160	580	40	-20	50	-50	380	170	630
MED AUTO	5380	250/-240	150	-250	840	40	-70	80	-80	530	50	50
MIN AUTO	6170	350/-310	230	-310	1080	200	-200	90	-90	470	1070	1250

Medium Reported Braking Action

MAX MANUAL	4630	230/-200	140	-220	850	150	-130	60	-70	350	760	2260
MAX AUTO	4680	230/-200	150	-220	850	150	-130	60	-70	350	770	2290
MED AUTO	5450	260/-250	160	-260	960	80	-90	80	-80	530	280	1610
MIN AUTO	6170	350/-310	230	-310	1110	210	-210	90	-90	470	1100	1710

Poor Reported Braking Action

MAX MANUAL	5580	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5700
MAX AUTO	5590	310/-270	200	-300	1240	270	-210	80	-80	410	1500	5710
MED AUTO	5830	310/-280	200	-310	1270	240	-180	80	-90	470	1270	5490
MIN AUTO	6280	360/-320	240	-330	1350	280	-240	90	-90	470	1500	5160

Reference distance is for sea level, standard day, no wind or slope, VREF15 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 30

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF30	ONE REV	NO REV
MAX MANUAL	2560	170/-80	80	-100	520	30	-30	40	-40	330	60	140
MAX AUTO	3500	140/-120	80	-140	490	10	-10	40	-40	350	0	0
MED AUTO	4830	230/-210	130	-230	790	40	-60	70	-70	480	50	50
MIN AUTO	5480	310/-260	190	-290	1010	180	-170	80	-80	410	910	1130

Good Reported Braking Action

MAX MANUAL	3350	140/-120	80	-150	530	70	-60	40	-40	270	250	620
MAX AUTO	3560	140/-130	80	-150	550	50	-30	40	-40	340	180	580
MED AUTO	4830	230/-210	130	-230	790	40	-60	70	-70	480	50	60
MIN AUTO	5480	310/-260	190	-290	1010	180	-170	80	-80	410	910	1130

Medium Reported Braking Action

MAX MANUAL	4230	200/-180	130	-210	810	140	-120	60	-60	330	640	1910
MAX AUTO	4260	210/-180	130	-210	810	140	-110	60	-60	330	650	1930
MED AUTO	4890	240/-210	140	-240	910	80	-80	70	-70	480	260	1380
MIN AUTO	5480	310/-260	190	-290	1040	190	-170	80	-80	410	940	1530

Poor Reported Braking Action

MAX MANUAL	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4650
MAX AUTO	5030	270/-230	170	-280	1180	240	-190	70	-70	370	1250	4660
MED AUTO	5230	270/-240	170	-290	1210	220	-160	70	-80	420	1070	4480
MIN AUTO	5590	320/-270	200	-310	1270	250	-210	80	-80	410	1290	4270

Reference distance is for sea level, standard day, no wind or slope, VREF30 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Normal Configuration Landing Distance - Digital Autobrake System

Flaps 40

Dry Runway

	LANDING DISTANCE AND ADJUSTMENT (FT)											
	REF DIST	WT ADJ	ALT ADJ	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		TEMP ADJ PER 10°F		VREF ADJ	REVERSE THRUST ADJ	
BRAKING CONFIGURATION	100000 LB LANDING WEIGHT	PER 5000 LB ABV/BLW 100000 LB	PER 1000 FT ABOVE SEA LEVEL	HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	ABV ISA	BLW ISA	PER 10 KTS ABOVE VREF40	ONE REV	NO REV
MAX MANUAL	2480	160/-70	80	-90	510	30	-20	40	-30	320	50	120
MAX AUTO	3370	130/-120	70	-140	480	10	-10	40	-40	340	0	0
MED AUTO	4600	210/-200	130	-220	760	50	-60	70	-70	440	70	70
MIN AUTO	5160	270/-240	180	-270	970	160	-160	70	-70	370	820	1140

Good Reported Braking Action

MAX MANUAL	3250	130/-110	80	-140	520	70	-60	40	-40	260	230	580
MAX AUTO	3430	140/-120	80	-150	540	50	-30	40	-40	330	180	550
MED AUTO	4600	210/-200	130	-220	760	50	-60	70	-70	440	70	70
MIN AUTO	5160	270/-240	180	-270	970	160	-160	70	-70	370	820	1140

Medium Reported Braking Action

MAX MANUAL	4050	190/-170	120	-200	790	130	-110	50	-60	310	590	1730
MAX AUTO	4080	190/-170	120	-210	790	130	-110	50	-60	310	590	1740
MED AUTO	4670	220/-200	130	-240	880	80	-80	70	-70	440	270	1250
MIN AUTO	5160	270/-240	180	-270	1000	170	-160	70	-70	370	840	1500

Poor Reported Braking Action

MAX MANUAL	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MAX AUTO	4770	250/-210	160	-270	1150	220	-170	70	-70	340	1120	4100
MED AUTO	4950	250/-220	160	-280	1180	200	-150	70	-70	420	960	3940
MIN AUTO	5260	280/-250	180	-300	1240	240	-190	70	-80	370	1170	3850

Reference distance is for sea level, standard day, no wind or slope, VREF40 approach speed and two engine detent reverse thrust.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above threshold (1000 ft of air distance).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Dry Runway

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT)							
		REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		APPROACH SPEED
					HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	4400	370 / -210	440	-200	810	60	-60	420
ANTI-SKID INOPERATIVE	VREF40	3640	135 / -120	75	-160	560	60	-55	275
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	3400	220 / -150	190	-170	620	60	-50	440
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	3100	190 / -130	130	-150	570	40	-40	360
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	3850	260 / -170	230	-200	710	80	-70	530
STABILIZER TRIM INOPERATIVE	VREF15	2800	170 / -110	150	-140	500	30	-30	310
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	2800	170 / -110	150	-140	500	30	-30	310
LEADING EDGE FLAPS TRANSIT	VREF15+5	3050	190 / -130	180	-160	520	40	-40	320
ONE ENGINE INOPERATIVE	VREF15	2850	190 / -120	160	-150	540	40	-30	350
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	3700	260 / -180	290	-160	640	50	-40	330
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	3400	220 / -170	230	-150	570	40	-40	300

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Good Reported Braking Action

		LANDING DISTANCE AND ADJUSTMENT (FT)							
		REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		APPROACH SPEED
LANDING CONFIGURATION	VREF				HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	4900	170 / -170	410	-180	630	80	-80	280
ANTI-SKID INOPERATIVE	VREF40	4270	180 / -155	105	-215	800	115	-90	305
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	4000	160 / -150	210	-170	590	90	-80	350
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	3620	150 / -130	150	-150	540	70	-60	280
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	4200	190 / -160	230	-170	610	100	-90	400
STABILIZER TRIM INOPERATIVE	VREF15	3500	140 / -120	170	-150	530	60	-60	250
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	3500	140 / -120	170	-150	530	60	-60	250
LEADING EDGE FLAPS TRANSIT	VREF15+5	3750	160 / -130	200	-160	550	70	-70	290
ONE ENGINE INOPERATIVE	VREF15	3750	150 / -140	190	-160	580	80	-80	290
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	4300	160 / -150	290	-160	580	70	-70	250
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	4050	150 / -100	250	-160	560	70	-60	250

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Medium Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT) REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS HEAD WIND	WIND ADJ PER 10 KTS TAIL WIND	SLOPE ADJ PER 1% DOWN HILL	SLOPE ADJ PER 1% UP HILL	APPROACH SPEED PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	6200	280 / -240	530	-260	940	160	-150	360
ANTI-SKID INOPERATIVE	VREF40	4880	225 / -195	135	-280	1135	265	-145	330
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	4950	230 / -210	260	-230	870	150	-140	400
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	4510	210 / -190	190	-220	820	130	-110	340
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	5150	250 / -220	290	-240	890	170	-150	450
STABILIZER TRIM INOPERATIVE	VREF15	4400	200 / -180	220	-210	800	120	-110	310
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	4400	200 / -180	220	-210	800	120	-110	310
LEADING EDGE FLAPS TRANSIT	VREF15+5	4730	230 / -190	260	-220	840	140	-120	350
ONE ENGINE INOPERATIVE	VREF15	5000	240 / -210	270	-250	940	190	-160	390
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	5450	240 / -210	380	-230	870	140	-120	320
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	5100	230 / -200	320	-230	850	130	-120	320

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Non-Normal Configuration Landing Distance

Poor Reported Braking Action

LANDING CONFIGURATION	VREF	LANDING DISTANCE AND ADJUSTMENT (FT): REF DIST FOR 100000 LB LANDING WEIGHT	WT ADJ PER 5000 LB ABV/BLW 100000 LB	ALT ADJ PER 1000 FT ABOVE SEA LEVEL	WIND ADJ PER 10 KTS		SLOPE ADJ PER 1%		APPROACH SPEED
					HEAD WIND	TAIL WIND	DOWN HILL	UP HILL	PER 10 KTS ABOVE VREF
ALL FLAPS UP	VREF40+55	7400	360 / -330	650	-340	1330	270	-230	410
ANTI-SKID INOPERATIVE	VREF40	5630	280 / -245	170	-390	1865	1140	-265	350
HYDRAULICS-LOSS OF SYSTEM A (FLAPS 15)	VREF15	5700	310 / -250	310	-300	1230	250	-210	430
HYDRAULICS-LOSS OF SYSTEM B (FLAPS 15)	VREF15	5290	280 / -240	220	-290	1180	220	-180	380
HYDRAULICS-MANUAL REVERSION (LOSS OF BOTH SYSTEM A & B)	VREF15	5950	320 / -280	340	-310	1250	260	-220	470
STABILIZER TRIM INOPERATIVE	VREF15	5150	270 / -230	260	-280	1160	210	-170	350
JAMMED OR RESTRICTED FLIGHT CONTROLS	VREF15	5150	270 / -230	260	-280	1160	210	-170	350
LEADING EDGE FLAPS TRANSIT	VREF15+5	5570	300 / -250	310	-300	1200	230	-190	400
ONE ENGINE INOPERATIVE	VREF15	6300	330 / -300	340	-360	1430	380	-300	460
TRAILING EDGE FLAP ASYMMETRY (1≤ FLAPS <15)	VREF40+30	6450	310 / -280	460	-310	1250	240	-200	370
TRAILING EDGE FLAPS UP (FLAPS < 1)	VREF40+40	6080	300 / -260	390	-300	1220	230	-190	370

Reference distance assumes sea level, standard day, with no wind or slope.
Actual (unfactored) distances are shown.
Includes distance from 50 ft above runway threshold (1000 ft of air distance).
Assumes maximum manual braking and maximum reverse thrust when available on operating engine(s).

ADVISORY INFORMATION

Brake Cooling Schedule

Reference Brake Energy (Millions of Foot Pounds)

		BRAKES ON SPEED (KIAS)														
		60			80			100			120			140		
WEIGHT (1000 LB)	OAT (°F)	PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT			PRESS ALT		
		0	2	4	0	2	4	0	2	4	0	2	4	0	2	4
	40	4.8	5.2	5.7	8.5	9.2	9.9	13.0	14.1	15.3	18.3	19.9	21.5	22.2	24.0	25.9
130	80	5.2	5.7	6.1	9.2	10.0	10.7	14.1	15.3	16.5	19.8	21.4	23.2	23.9	25.9	27.9
	120	5.6	6.1	6.6	9.9	10.7	11.5	15.1	16.4	17.7	21.2	23.0	24.9	25.7	27.8	30.0
	40	4.5	4.9	5.3	7.9	8.6	9.2	12.0	13.0	14.0	15.8	17.2	18.6	20.4	22.2	24.0
120	80	4.9	5.3	5.8	8.6	9.3	10.0	12.9	14.0	15.2	17.0	18.6	20.0	22.0	24.0	25.9
	120	5.2	5.7	6.2	9.2	10.0	10.8	13.8	15.1	16.3	18.3	19.9	21.5	23.6	25.7	27.8
	40	4.2	4.5	4.9	7.2	7.8	8.5	11.1	12.1	13.0	15.1	16.5	17.8	18.5	20.1	21.7
110	80	4.5	4.9	5.3	7.8	8.5	9.2	12.0	13.0	14.1	16.3	17.8	19.2	20.0	21.7	23.4
	120	4.8	5.2	5.6	8.4	9.1	9.9	12.8	14.0	15.2	17.5	19.0	20.6	21.4	23.3	25.2
	40	3.9	4.2	4.5	6.6	7.1	7.7	10.0	10.9	11.8	13.5	14.7	15.8	16.8	18.2	19.7
100	80	4.2	4.5	4.9	7.1	7.7	8.3	10.8	11.8	12.7	14.6	15.8	17.0	18.1	19.6	21.2
	120	4.5	4.9	5.2	7.6	8.3	9.0	11.6	12.6	13.6	15.7	17.0	18.3	19.4	21.1	22.7
	40	3.4	3.7	4.0	6.0	6.5	7.1	9.0	9.7	10.5	11.8	12.8	13.8	14.8	16.1	17.4
90	80	3.6	4.0	4.3	6.5	7.0	7.6	9.7	10.5	11.4	12.7	13.8	14.9	16.0	17.4	18.8
	120	3.9	4.2	4.6	6.9	7.5	8.2	10.4	11.3	12.2	13.6	14.9	16.1	17.2	18.7	20.2
	40	3.1	3.4	3.7	5.2	5.7	6.2	7.9	8.6	9.2	10.0	10.9	11.8	13.0	14.1	15.3
80	80	3.3	3.6	3.9	5.6	6.1	6.6	8.5	9.3	10.0	10.8	11.8	12.7	14.1	15.3	16.5
	120	3.6	3.9	4.2	6.0	6.6	7.1	9.2	10.0	10.8	11.6	12.6	13.6	15.1	16.4	17.7

To correct for wind, enter table with the brakes on speed minus one half the headwind or plus 1.5 times the tailwind.
If ground speed is used for brakes on speed, ignore wind, altitude, and OAT effects.

Adjusted Brake Energy per Brake (Millions of Foot Pounds)

	REFERENCE BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)									
EVENT	2	4	6	8	10	12	14	16	18	20
RTO MAX MAN	2	4	6	8	10	12	14	16	18	20
MAX AUTO	1.8	3.5	5.3	7.1	8.7	10.2	11.7	13.1	14.4	15.7
MED AUTO	1.5	3.2	4.8	6.3	7.6	8.8	10.0	10.8	11.7	12.5
MIN AUTO	1.4	3.0	4.0	4.9	5.8	6.2	6.6	7.5	7.5	7.6

Cooling Time (Minutes)

	ADJUSTED BRAKE ENERGY PER BRAKE (MILLIONS OF FOOT POUNDS)							
	6 & BELOW	8	10	12	14	15.9	16 TO 20	20 & ABOVE
INFLIGHT GEAR DOWN	NO SPECIAL PROCEDURE REQUIRED	1.0	2.9	4.9	7.0	8.8	CAUTION	FUSE PLUG MELT ZONE
GROUND		15	28	38	48	56		

Observe maximum quick turnaround limit.
Table does not consider the benefit of reverse thrust.
Table shows energy per brake added by a single stop with all brakes operating. Energy is assumed to be equally distributed among the operating brakes. Total energy is the sum of residual energy plus energy added.
Add 1.0 million foot pounds for each taxi mile.
When in caution zone, wheel fuse plugs may melt. Delay takeoff and inspect after 30 minutes. If overheat occurs after takeoff, extend gear soon for at least 9 minutes.
When in fuse plug melt zone, clear runway immediately. Unless required, do not set parking brake. Do not approach gear or attempt to taxi for 50 minutes. Alert fire equipment.

Intentionally
Blank

Performance Inflight — Chapter PI
Engine Inoperative — Section 33

ENGINE INOP

Max Continuous EPR

Based on engine bleed for packs on, engine and wing anti-ice off

TAT (°C)	PRESSURE ALTITUDE (FT)													
	0	1000	1500	2000	3000	4000	5660	10000	15000	20000	25000	30000	35000	37000
50	1.64	1.64	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.64	1.64		
45	1.67	1.67	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.71	1.67	1.67		
40	1.70	1.70	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.70	1.70		
35	1.73	1.73	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.73	1.73		
30	1.76	1.76	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.86	1.76	1.76		
25	1.79	1.79	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.91	1.79	1.79		
20	1.82	1.82	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.95	1.82	1.82		
15	1.86	1.86	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.86	1.86		
10	1.90	1.90	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	1.90	1.90		
5	1.94	1.94	2.06	2.07	2.07	2.07	2.07	2.07	2.07	2.07	1.94	1.94	1.92	1.92
0	1.98	1.99	2.06	2.09	2.10	2.10	2.10	2.10	2.10	2.10	1.99	1.99	1.97	1.97
-5	1.98	2.04	2.06	2.09	2.13	2.13	2.13	2.13	2.13	2.13	2.04	2.04	2.02	2.02
-10	1.98	2.04	2.06	2.09	2.14	2.16	2.16	2.16	2.16	2.16	2.09	2.09	2.07	2.07
-15	1.98	2.04	2.06	2.09	2.14	2.19	2.19	2.19	2.19	2.19	2.12	2.12	2.11	2.11
-20	1.98	2.04	2.06	2.09	2.14	2.20	2.21	2.21	2.21	2.21	2.15	2.15	2.14	2.14
-25	1.98	2.04	2.06	2.09	2.14	2.20	2.24	2.24	2.24	2.24	2.18	2.18	2.17	2.17
-30	1.98	2.04	2.06	2.09	2.14	2.20	2.26	2.26	2.26	2.26	2.21	2.21	2.20	2.20
-35	1.98	2.04	2.06	2.09	2.14	2.20	2.28	2.28	2.28	2.28	2.23	2.23	2.22	2.22
-40	1.98	2.04	2.06	2.09	2.14	2.20	2.30	2.30	2.30	2.30	2.25	2.25	2.24	2.24

EPR Adjustments for Engine Bleeds

BLEED CONFIGURATION	PRESSURE ALTITUDE (FT)	
	BELOW 1500 & ABOVE 20000	1500 THRU 20000
ENGINE ANTI-ICE ON	0.08	0.08
ENGINE AND WING ANTI-ICE ON*	0.12	0.12
ENGINE AND WING ANTI-ICE ON**	0.14	0.15

***Dual Bleed Source**
****Single Bleed Source**

ENGINE INOP

MAX CONTINUOUS THRUST

Driftdown Speed/Level Off Altitude

100 ft/min residual rate of climb

WEIGHT (1000 LB)		OPTIMUM DRIFTDOWN SPEED (KIAS)	LEVEL OFF ALTITUDE (FT)		
START DRIFT DOWN	LEVEL OFF		ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	122	231	10300	8700	6700
120	113	222	13100	11800	10300
110	104	213	16000	14900	13600
100	95	203	18900	18000	17000
90	84	193	20500	19900	20000
80	75	182	24300	23200	21800
70	66	170	28200	27400	26400
60	57	158	32300	31600	30900

Driftdown/LRC Cruise Range Capability

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
302	274	251	231	214	200	187	176	166	157	150
602	547	501	462	429	400	375	353	333	315	300
893	813	747	691	642	600	563	530	501	475	452
1179	1077	991	918	855	800	752	709	671	636	605
1463	1339	1234	1145	1068	1000	940	888	840	798	760
1747	1601	1477	1372	1280	1200	1129	1066	1010	960	914
2034	1865	1722	1599	1493	1400	1318	1245	1179	1121	1067
2326	2133	1969	1828	1707	1600	1506	1422	1348	1280	1219
2627	2406	2219	2059	1921	1800	1693	1599	1514	1438	1369

Driftdown/Cruise Fuel and Time

AIR DIST (NM)	FUEL REQUIRED (1000 LB)							TIME (HR:MIN)
	WEIGHT AT START OF DRIFTDOWN (1000 LB)							
	70	80	90	100	110	120	130	
200	2.1	2.3	2.4	2.7	2.9	3.1	3.4	0:41
400	4.5	5.1	5.6	5.9	6.7	7.3	7.9	1:20
600	6.7	7.5	8.4	9.0	10.1	11.0	11.9	1:58
800	8.8	9.9	11.1	12.0	13.3	14.6	15.8	2:34
1000	10.8	12.3	13.7	14.9	16.5	18.1	19.6	3:10
1200	12.8	14.5	16.3	17.7	19.6	21.5	23.3	3:45
1400	14.7	16.8	18.8	20.4	22.6	24.8	26.9	4:22
1600	16.6	18.9	21.2	23.1	25.6	28.0	30.5	4:60
1800	18.5	21.0	23.6	25.8	28.5	31.2	33.9	5:40

Includes APU fuel burn.
Driftdown at optimum driftdown speed and cruise at LRC speed.

Long Range Cruise Altitude Capability

100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
120	5700	2300	
110	10300	7600	4200
100	14000	12200	9900
90	17800	16400	14700
80	20000	20000	19600
70	23900	22200	20000
60	29000	27800	26400

Long Range Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)										
		10	13	15	17	19	21	23	25	27	29	31
120	EPR	1.97										
	MACH	.521										
	KIAS	289										
	FF/ENG	6538										
110	EPR	1.89	2.00									
	MACH	.502	.529									
	KIAS	278	277									
	FF/ENG	5898	5982									
100	EPR	1.81	1.91	1.99	2.07							
	MACH	.482	.507	.525	.545							
	KIAS	266	265	265	265							
	FF/ENG	5294	5332	5383	5454							
90	EPR	1.73	1.82	1.89	1.96	2.04						
	MACH	.461	.484	.501	.519	.539						
	KIAS	255	253	252	252	251						
	FF/ENG	4727	4728	4746	4780	4844						
80	EPR	1.64	1.73	1.79	1.86	1.93	2.01	2.10				
	MACH	.440	.461	.476	.493	.511	.531	.553				
	KIAS	243	241	240	239	238	238	238				
	FF/ENG	4202	4169	4162	4166	4191	4253	4339				
70	EPR	1.57	1.63	1.69	1.75	1.81	1.88	1.96	2.05	2.14		
	MACH	.418	.437	.451	.466	.483	.500	.519	.540	.564		
	KIAS	231	228	227	225	224	223	223	223	223		
	FF/ENG	3719	3656	3628	3610	3606	3631	3678	3736	3805		
60	EPR	1.49	1.55	1.59	1.64	1.69	1.76	1.83	1.91	1.99	2.09	2.18
	MACH	.395	.412	.425	.438	.453	.471	.491	.511	.532	.555	.579
	KIAS	218	215	213	211	210	210	210	210	210	210	210
	FF/ENG	3271	3184	3137	3101	3078	3094	3129	3167	3203	3252	3319

Long Range Cruise Diversion Fuel and Time

Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
306	277	252	232	215	200	190	181	173	166	159
620	561	509	467	431	400	380	362	345	330	316
938	846	766	701	647	600	570	542	516	493	473
1258	1133	1025	937	864	800	759	722	687	656	629
1581	1423	1285	1174	1081	1000	949	901	858	820	785
1908	1715	1547	1412	1299	1200	1138	1081	1029	982	940
2238	2008	1810	1649	1517	1400	1327	1259	1198	1143	1094
2572	2305	2074	1888	1735	1600	1516	1438	1368	1304	1248
2910	2604	2339	2128	1953	1800	1704	1616	1536	1464	1401

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		14		18		22		26	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	3.3	0:44	3.0	0:42	2.7	0:40	2.6	0:39	2.4	0:37
400	6.6	1:26	6.1	1:22	5.7	1:18	5.4	1:14	5.2	1:09
600	9.8	2:08	9.1	2:02	8.6	1:56	8.2	1:50	7.9	1:43
800	13.0	2:51	12.1	2:43	11.4	2:34	11.0	2:25	10.6	2:16
1000	16.1	3:35	15.0	3:24	14.2	3:13	13.6	3:02	13.2	2:51
1200	19.2	4:19	17.9	4:06	16.9	3:53	16.2	3:39	15.8	3:25
1400	22.2	5:04	20.7	4:49	19.5	4:33	18.8	4:17	18.2	4:01
1600	25.1	5:50	23.5	5:32	22.1	5:14	21.2	4:56	20.6	4:37
1800	28.0	6:36	26.2	6:16	24.6	5:56	23.7	5:35	23.0	5:13

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)						
	60	70	80	90	100	110	120
5	-0.7	-0.4	-0.2	0.0	0.2	1.0	2.3
10	-1.4	-1.0	-0.5	0.0	0.7	2.1	4.2
15	-2.1	-1.5	-0.7	0.0	1.2	3.1	5.9
20	-2.8	-2.0	-1.0	0.0	1.7	4.1	7.3
25	-3.4	-2.4	-1.2	0.0	2.1	5.0	8.5
30	-4.1	-2.9	-1.5	0.0	2.6	5.7	9.4

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)						
		1500	5000	10000	15000	20000	25000	30000
130	EPR	1.67	1.78	1.96				
	KIAS	243	246	246				
	FF/ENG	6160	6220	6370				
120	EPR	1.61	1.71	1.88	2.09			
	KIAS	232	236	236	237			
	FF/ENG	5620	5670	5760	6010			
110	EPR	1.55	1.64	1.80	1.99			
	KIAS	220	223	227	227			
	FF/ENG	5110	5130	5180	5360			
100	EPR	1.50	1.57	1.71	1.90	2.11		
	KIAS	210	211	216	216	217		
	FF/ENG	4630	4610	4640	4750	4970		
90	EPR	1.44	1.51	1.64	1.80	2.00		
	KIAS	210	210	210	210	210		
	FF/ENG	4250	4200	4170	4220	4350		
80	EPR	1.40	1.46	1.57	1.71	1.89	2.11	
	KIAS	210	210	210	210	210	210	
	FF/ENG	3920	3870	3820	3820	3890	4100	
70	EPR	1.36	1.41	1.51	1.64	1.80	2.00	
	KIAS	210	210	210	210	210	210	
	FF/ENG	3650	3590	3530	3500	3530	3670	
60	EPR	1.33	1.38	1.47	1.58	1.73	1.91	2.13
	KIAS	210	210	210	210	210	210	210
	FF/ENG	3420	3360	3290	3240	3240	3330	3450

This table includes 5% additional fuel for holding in a racetrack pattern.

Intentionally
Blank

DO NOT USE FOR FLIGHT

Performance Inflight — Chapter PI
Gear Down — Section 34

GEAR DOWN

220 KIAS Cruise Altitude Capability
Max Cruise Thrust, 100 ft/min residual rate of climb

WEIGHT (1000 LB)	PRESSURE ALTITUDE (FT)		
	ISA + 10°C & BELOW	ISA + 15°C	ISA + 20°C
130	7900		
125	9500		
120	10900	5200	
115	12300	7800	
110	13800	10000	
105	15300	11700	
100	16700	13200	
95	17800	14500	9500
90	18900	15800	11700
85	19800	16900	13200
80	20600	17800	14400
75	21300	18700	15400
70	22000	19600	16300
65	22600	20300	17100
60	23100	21100	17900

220 KIAS Cruise Control

WEIGHT (1000 LB)		PRESSURE ALTITUDE (1000 FT)										
		6	8	10	12	13	15	17	19	21	23	25
130	EPR	1.62	1.67	1.74	1.81	1.84	1.92					
	MACH	.370	.384	.399	.414	.422	.438					
	KIAS	220	220	220	220	220	220					
	FF/ENG	4556	4554	4564	4602	4626	4686					
120	EPR	1.58	1.63	1.69	1.76	1.79	1.87	1.95				
	MACH	.370	.384	.399	.414	.422	.438	.456				
	KIAS	220	220	220	220	220	220	220				
	FF/ENG	4331	4321	4323	4349	4366	4410	4465				
110	EPR	1.55	1.60	1.65	1.71	1.75	1.82	1.89	1.97			
	MACH	.370	.384	.399	.414	.422	.438	.456	.474			
	KIAS	220	220	220	220	220	220	220	220			
	FF/ENG	4131	4115	4107	4123	4135	4167	4208	4268			
100	EPR	1.52	1.57	1.62	1.67	1.70	1.77	1.84	1.92	2.00		
	MACH	.370	.384	.399	.414	.422	.438	.456	.474	.493		
	KIAS	220	220	220	220	220	220	220	220	220		
	FF/ENG	3957	3938	3921	3929	3936	3958	3987	4033	4111		
90	EPR	1.49	1.54	1.59	1.64	1.67	1.73	1.80	1.88	1.96		
	MACH	.370	.384	.399	.414	.422	.438	.456	.474	.493		
	KIAS	220	220	220	220	220	220	220	220	220		
	FF/ENG	3812	3792	3770	3770	3773	3786	3808	3842	3906		
80	EPR	1.47	1.51	1.56	1.61	1.64	1.70	1.77	1.84	1.92	2.00	
	MACH	.370	.384	.399	.414	.422	.438	.456	.474	.493	.513	
	KIAS	220	220	220	220	220	220	220	220	220	220	
	FF/ENG	3692	3670	3646	3639	3639	3646	3661	3687	3740	3826	
70	EPR	1.45	1.50	1.54	1.59	1.62	1.67	1.74	1.81	1.88	1.97	
	MACH	.370	.384	.399	.414	.422	.438	.456	.474	.493	.513	
	KIAS	220	220	220	220	220	220	220	220	220	220	
	FF/ENG	3589	3565	3542	3528	3526	3528	3537	3557	3601	3678	
60	EPR	1.44	1.48	1.52	1.57	1.60	1.65	1.71	1.78	1.86	1.94	2.03
	MACH	.370	.384	.399	.414	.422	.438	.456	.474	.493	.513	.534
	KIAS	220	220	220	220	220	220	220	220	220	220	220
	FF/ENG	3509	3484	3460	3443	3439	3436	3442	3457	3494	3563	3648

220 KIAS Enroute Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM)					GROUND DISTANCE (NM)	AIR DISTANCE (NM)				
HEADWIND COMPONENT (KTS)						TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
323	288	259	236	217	200	189	180	171	162	155
652	582	521	474	434	400	378	358	340	324	310
982	876	784	711	652	600	567	537	510	485	464
1311	1169	1047	949	870	800	756	716	679	647	618
1640	1462	1309	1187	1087	1000	945	895	850	809	773
1970	1756	1572	1425	1305	1200	1134	1074	1019	970	927
2299	2049	1834	1663	1523	1400	1323	1253	1189	1132	1082
2629	2342	2096	1900	1740	1600	1512	1431	1359	1293	1236
2958	2636	2358	2138	1958	1800	1701	1611	1529	1455	1390

Reference Fuel and Time Required at Check Point

AIR DIST (NM)	PRESSURE ALTITUDE (1000 FT)									
	10		12		16		20		24	
	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)	FUEL (1000 LB)	TIME (HR:MIN)
200	5.7	0:50	5.4	0:48	5.0	0:46	4.7	0:44	4.5	0:42
400	11.4	1:37	11.0	1:34	10.4	1:29	9.8	1:24	9.5	1:20
600	17.1	2:24	16.5	2:20	15.6	2:12	14.8	2:05	14.4	1:58
800	22.7	3:11	22.0	3:06	20.7	2:55	19.7	2:45	19.2	2:36
1000	28.2	3:58	27.3	3:51	25.7	3:38	24.5	3:25	23.9	3:13
1200	33.7	4:45	32.6	4:37	30.7	4:21	29.2	4:06	28.6	3:51
1400	39.1	5:32	37.8	5:23	35.6	5:04	33.9	4:46	33.2	4:29
1600	44.4	6:20	43.0	6:09	40.5	5:47	38.6	5:27	37.7	5:07
1800	49.7	7:07	48.1	6:54	45.4	6:30	43.2	6:07	42.2	5:45

Fuel Required Adjustment (1000 LB)

REFERENCE FUEL REQUIRED (1000 LB)	WEIGHT AT CHECK POINT (1000 LB)						
	60	70	80	90	100	110	120
5	-0.3	-0.2	-0.1	0.0	0.2	0.5	0.8
10	-0.6	-0.5	-0.3	0.0	0.5	1.0	1.8
15	-1.0	-0.7	-0.4	0.0	0.7	1.6	2.6
20	-1.2	-0.9	-0.5	0.0	0.9	2.1	3.4
25	-1.5	-1.1	-0.6	0.0	1.1	2.5	4.1
30	-1.7	-1.3	-0.7	0.0	1.3	2.9	4.7
35	-1.9	-1.4	-0.8	0.0	1.4	3.2	5.2
40	-2.0	-1.5	-0.9	0.0	1.5	3.4	5.7
45	-2.1	-1.6	-0.9	0.0	1.6	3.6	6.0

Descent at 220 KIAS

PRESSURE ALT (1000 FT)	5	10	15	17	19	21	23	25	27	29	31	33
DISTANCE (NM)	18	28	37	40	44	47	51	55	58	62	66	69
TIME (MINUTES)	7	9	11	12	13	13	14	15	15	16	17	17

Holding

Flaps Up

WEIGHT (1000 LB)		PRESSURE ALTITUDE (FT)					
		1500	5000	10000	15000	20000	25000
130	EPR	1.56	1.66	1.81			
	KIAS	243	246	246			
	FF/ENG	5300	5380	5410			
120	EPR	1.50	1.60	1.74	1.93		
	KIAS	232	236	236	237		
	FF/ENG	4830	4910	4920	5060		
110	EPR	1.45	1.53	1.67	1.84		
	KIAS	220	223	227	227		
	FF/ENG	4390	4420	4470	4540		
100	EPR	1.41	1.47	1.60	1.75	1.95	
	KIAS	210	211	216	216	217	
	FF/ENG	4010	3960	4020	4060	4180	
90	EPR	1.39	1.44	1.55	1.69	1.87	
	KIAS	210	210	210	210	210	
	FF/ENG	3840	3780	3720	3710	3780	
80	EPR	1.37	1.42	1.52	1.65	1.82	2.03
	KIAS	210	210	210	210	210	210
	FF/ENG	3700	3640	3570	3550	3590	3760
70	EPR	1.35	1.40	1.50	1.62	1.78	1.98
	KIAS	210	210	210	210	210	210
	FF/ENG	3590	3520	3450	3420	3440	3590
60	EPR	1.34	1.39	1.48	1.60	1.75	1.94
	KIAS	210	210	210	210	210	210
	FF/ENG	3490	3430	3350	3310	3320	3440

This table includes 5% additional fuel for holding in a racetrack pattern.

Performance Inflight — Chapter PI
Text — Section 35

Introduction

This chapter contains information required to complete a normal flight. In the event of conflict between data presented in this chapter and that contained in the Approved Flight Manual, the Flight Manual shall always take precedence.

General

Takeoff Speeds

The speeds presented in the Takeoff Speeds table can be used for all performance conditions except where adjustments must be made to V1 for clearway, stopway, anti-skid inoperative, improved climb, contaminated runway situations or brake energy limitations. These speeds may be used for weights less than or equal to the performance limited weight.

Normal takeoff speeds, V1, VR and V2, with anti-skid on, are read from the table by entering with station pressure altitude and moving horizontally to the appropriate outside air temperature (OAT) column. Proceed down and read V1, VR and V2 for the anticipated takeoff weight and flap setting. Slope and wind adjustments to V1 are obtained by entering the V1 Adjustments chart. Adjusted V1 must not exceed VR.

VMCG

Regulations prohibit scheduling takeoff with a V1 less than minimum V1 for control on the ground, VMCG. Therefore compare the adjusted V1 to the VMCG. To find VMCG, enter the VMCG table with the airport pressure altitude and actual OAT. If VR is less than VMCG, set VR equal to VMCG, and determine a new V2 by adding the difference between the normal VR and VMCG to the normal V2.

Clearway and Stopway V1 Adjustments

Takeoff speed adjustments are to be applied to V1 speed when using takeoff weights based on the use of clearway and stopway.

Adjust V1 speed by the amount shown in the appropriate column. The adjusted V1 speed must not exceed VR.

Maximum allowable clearway limits are provided for guidance when more precise data is not available.

Stab Trim

To find takeoff stabilizer trim setting, enter the Stab Trim Setting table with takeoff flap setting and center of gravity (C.G. % MAC) and read required stabilizer trim units.

VREF

The Reference Speed table contains flaps 40, 30 and 15 landing speeds for a given weight. Apply wind adjustments shown as required.

Flap Maneuver Speeds

This table provides the flap speed schedule for recommended maneuvering speed. The speed schedule is a function of weight and will provide adequate maneuver margin above stall at all weights.

During flap retraction/extension, movement of the flap to the next position should be initiated when reaching the maneuver speed for the existing flap.

Slush/Standing Water Takeoff

Experience has shown that aircraft performance may deteriorate significantly on runways covered with snow, slush, standing water or ice. Therefore, reductions in field/obstacle limited takeoff weight and revised takeoff speeds are necessary. The tables are intended for guidance in accordance with advisory material and are based on all engines operating throughout the takeoff.

The entire runway is assumed to be completely covered by a contaminant of uniform thickness and density. Therefore this information is conservative when operating under typical colder weather conditions where patches of slush exist and some degree of sanding is common. Takeoffs in slush/standing water depths greater than 0.50 inches (13 mm) are not recommended because of possible airplane damage as a result of slush/standing water impingement on the airplane structure. The use of assumed temperature method for reduced thrust is not allowed on contaminated runways. Interpolation for slush/standing water depths between the values shown is permitted.

Takeoff weight determination:

Instructions for Using Tables:

1. Determine the dry field/obstacle limit weight for the anticipated flap setting.

2. Enter the Weight Adjustment table with the dry field/obstacle limit weight to obtain the slush/standing water weight adjustment for the slush depth and airport pressure altitude.

3. Determine takeoff speeds VR and V2 for the actual brake release weight from the Takeoff Speeds chart.

Interpolate for intermediate slush depths as required using the dry runway condition as zero slush depth.

Anti-skid Inoperative

For anti-skid inoperative, the runway limited maximum gross weight at brake release and the V1 speed must be reduced to allow for the effect on accelerate-stop performance as detailed in the Approved Airplane Flight Manual. Obstacle clearance capability must also be considered since the reduced V1 speed will increase the distance required to achieve a given height above the runway following engine failure. A simplified method which conservatively accounts for the effects of anti-skid inoperative is shown below. Reduce the dry runway/obstacle limited weight at brake release obtained from the takeoff performance charts in this section or from the specific airport analysis and the associated V1 (i.e., V1 for the runway/obstacle limited weight at brake release) by the weight and V1 values shown in the table below. (Note that the resulting V1 must not be less than VMCG value.)

For takeoff below the anti-skid inoperative limited weight it is only necessary to ensure that the V1 speed set does not exceed the anti-skid limited V1 value.

ANTI-SKID V1 ADJUSTMENTS						
RUNWAY LENGTH (FT)	V1 ADJUSTMENTS					
	FLAPS 1	FLAPS 2	FLAPS 5	FLAPS 10	FLAPS 15	FLAPS 25
5000			-25	-22		
5500*			-24	-21	-19	-19*
6000		-22	-22	-20	-18	-18
6500		-21	-21	-20	-18	-18
7000	-20	-20	-20	-19		
8000	-20	-19	-18			
9000	-18	-17				
10000	-16					

***Minimum anti-skid inop runway length at flaps 25**
Decrease weight by 10000 lb for all flaps shown above.

If the resulting V1 is less than minimum V1, takeoff is permitted with V1 set equal to VMCG.

Detailed analysis for the specific case from the AFM may yield a less restrictive penalty.

Takeoff EPR

To find Takeoff EPR based on normal engine bleed for air conditioning packs on, enter Takeoff EPR table with airport pressure altitude and airport OAT and read EPR. For packs off operation, apply the EPR adjustment shown below the table. No takeoff EPR adjustment is required for wing anti-ice operation.

Reduced Takeoff EPR

The tables present the allowable Takeoff EPR Reduction as a function of Actual OAT and Surplus Weight which is defined as the difference between the Performance Limited TOGW and the Actual TOGW. These tables are valid for engine A/C bleed on or off, any flap setting. They are not valid when the maximum takeoff weight is limited by obstacles, brake energy or tire speed. Since the tables are conservative, larger reductions in EPR may be achieved under some conditions by using the Assumed Temperature Method described in the AFM Appendix.

Enter the Field Length Limited section of the table appropriate for the airplane pressure altitude with the Surplus Weight based on the field length limit (i.e., Field length limited weight minus actual weight). Read the allowable Takeoff EPR Reduction. Then enter the Climb Limited section of the table with the Surplus Weight based on the climb limit and determine the allowable Takeoff EPR Reduction. Use the smaller of the two reductions. Enter the Minimum EPR table with the pressure altitude. The Takeoff EPR, after the reduction is applied, should not be less than this minimum. Apply the noted V1, VR and V2 adjustments.

Takeoff with assumed temperature reduced thrust is not permitted when: runway is contaminated with water, ice, slush or snow; anti-skid is inoperative. Use of this procedure is not recommended if potential windshear conditions exist.

Max Climb EPR

This table shows Max Climb EPR based on normal engine bleed for packs on and anti-ice off. Enter the table with pressure altitude and TAT and read EPR. EPR adjustments are shown for anti-ice operation.

Go-around EPR

To find Go-around EPR based on normal engine bleed for packs on and wing anti-ice off, enter the Go-around EPR table with airport pressure altitude and reported OAT or TAT and read EPR. For packs off, apply the EPR adjustment shown below the table. EPR adjustments are also shown for engine and wing anti-ice operations.

Flight with Unreliable Airspeed / Turbulent Air Penetration

Pitch attitude and average EPR information is provided for use in all phases of flight in the event of unreliable airspeed/Mach indications resulting from blocking or freezing of the pitot system. Loss of radome or turbulent air may also cause unreliable airspeed/Mach indications. The cruise table in this section may also be used for turbulent air penetration.

Pitch attitude is shown in bold type for emphasis since altitude and/or vertical speed indications may also be unreliable.

All Engines

Long Range Cruise Maximum Operating Altitude

Maximum altitudes are shown for a given cruise weight and maneuver capability. This table considers both thrust and buffet limits, providing the more limiting of the two. Any data that is thrust limited is denoted by an asterisk and represents only a thrust limited condition in level flight with 100 ft/min residual rate of climb. Flying above these altitudes with sustained banks in excess of approximately 15° may cause the airplane to lose speed and/or altitude.

Note that the altitudes shown in the table are limited to the maximum certified altitude of 37000 ft.

Long Range Cruise Control

These tables provide target EPR, Long Range Cruise Mach number, KIAS and standard day fuel flow per engine for the airplane weight and pressure altitude. As indicated by the shaded area, at optimum altitude .72M approximates the Long Range Cruise Mach schedule.

Long Range Cruise Enroute Fuel and Time

Long Range Cruise Enroute Fuel and Time tables are provided to determine remaining time and fuel required to destination. The data is based on Long Range Cruise and .70/280/250 descent. Tables are presented for low altitudes and high altitudes.

To determine remaining fuel and time required, first enter the Ground to Air Miles Conversion table to convert ground distance and enroute wind to an equivalent still air distance for use with the Reference Fuel and Time tables. Next, enter the Reference Fuel and Time table with air distance from the Ground to Air Miles Conversion table and the desired altitude and read Reference Fuel and Time Required. Lastly, enter the Fuel Required Adjustment table with the Reference Fuel and the actual weight at checkpoint to obtain fuel required to destination.

Long Range Cruise Wind-Altitude Trade

Wind is a factor which may justify operations considerably below optimum altitude. For example, a favorable wind component may have an effect on ground speed which more than compensates for the loss in air range.

Using this table, it is possible to determine the break-even wind (advantage necessary or disadvantage that can be tolerated) to maintain the same range at another altitude and long range cruise speed. The tables make no allowance for climb or descent time, fuel or distance, and are based on comparing ground fuel mileage.

Descent

Distance and time for descent are shown for a .70/280/250 descent speed schedule. Enter the table with top of descent pressure altitude and read distance in nautical miles and time in minutes. Data is based on flight idle thrust descent in zero wind. Allowances are included for a straight-in approach with gear down and landing flaps at the outer marker.

Holding

Target EPR, indicated airspeed and fuel flow per engine information is tabulated for holding with flaps up based on the optimum holding speed schedule. This is the higher of the maximum endurance speed and the maneuvering speed. Small variations in airspeed will not appreciably affect the overall endurance time. Enter the table with weight and pressure altitude to read EPR, KIAS and fuel flow per engine.

Advisory Information

Autobrake Landing Distance

The Autobrake Landing Distance tables are provided as advisory information to assist in the selection of the most desirable autobrake setting for a given field length. It is not to be used to determine required field length. This data reflects actual landing distances on a dry runway for setting MINIMUM through MAXIMUM, from touchdown to full stop, with or without reverse thrust. The tables include typical flare distances from threshold.

To use the Autobrake Landing Distance table, determine the appropriate table to use. The Digital Autobrake Landing Distance table is only applicable if Autobrake Control Valve Module, Boeing part number 60800263 is installed. Enter the chart with the estimated approach speed and determine the actual stopping distance from touchdown for a given autobrake setting. If airspeed is used for approach speed, adjust landing distance for pressure altitude and tailwind effects.

Selection of an autobrake setting results in a constant rate of deceleration. Maximum effort manual braking should achieve shorter landing distance than the MAXIMUM setting.

Slippery Runway Landing Distance

Landing distances are the actual landing distances and do not include the 1.67% regulatory factor. Therefore they cannot be used to determine dispatch required landing field length. When landing on slippery runways or runways contaminated with ice, snow, slush or standing water, the reported braking action must be considered. If the surface is affected by water, snow or ice, and the braking action is reported as “good,” conditions should not be expected to be as good as on clean dry runways. The value “good” is comparative and is intended to mean that airplanes should not experience braking or directional control difficulties when landing. The performance level used to calculate the “good” data is consistent with wet runway testing done on early Boeing jets. The performance level used to calculate the “poor” data reflects runways covered with wet ice. Read landing distance for the reported braking action at the airplane weight, and then apply the adjustments for airport pressure altitude and approach speed as required.

Non-normal Configuration Landing Distance

Advisory information is provided to support non-normal configurations that affect landing performance of the airplane. Landing distances are shown for dry runway and good, medium and poor reported braking action. Each non-normal configuration is listed with its recommended approach speed. Landing distance can be determined for the reference landing weight and then adjusted for actual weight and pressure altitude.

Brake Cooling Schedule

Advisory information is provided to assist in avoiding the problems associated with hot brakes. For normal operation, most landings are at weights below the AFM quick turnaround limit weight.

Use of the recommended cooling schedule will help avoid brake overheat and fuse plug problems that could result from repeated landings at short time intervals or a rejected takeoff.

Enter the Brake Cooling Schedule table with the airplane weight and brakes on speed, adjusted for wind at the appropriate temperature and altitude condition. Instructions for applying wind adjustments are included below the table. Linear interpolation may be used to obtain intermediate values. The resulting number is the reference brake energy per brake in millions of foot-pounds, and represents the amount of energy absorbed by each brake during a rejected takeoff.

To determine the energy per brake absorbed during landing, enter the Adjusted Brake Energy Per Brake table with the reference brake energy per brake and the type of braking used during landing (RTO Max Man, Max Auto, Med Auto or Min Auto). The resulting number is the adjusted brake energy per brake and represents the energy absorbed in each brake during the landing.

The recommended cooling time is found in the final table by entering with the adjusted brake energy per brake. Times are provided for ground cooling and inflight gear down cooling.

Engine Inoperative

Max Continuous EPR

Power setting is based on one engine operating with one A/C pack operating and all anti-ice bleeds off. Enter the table with pressure altitude and TAT to read EPR.

It is desirable to maintain engine thrust within the limits of the Max Cruise thrust rating. However, where thrust in excess of Max Cruise rating is required, such as for meeting terrain clearance, ATC altitude assignments, or to attain maximum range capability, it is permissible to use the thrust needed up to the Max Continuous thrust rating. The Max Continuous thrust rating is intended primarily for emergency use at the discretion of the pilot and is the maximum thrust that may be used continuously.

Driftdown Speed/Level Off Altitude

The table shows optimum driftdown speed as a function of cruise weight at start of driftdown. Also shown are the approximate weight and pressure altitude at which the airplane will level off considering 100 ft/min residual rate of climb.

The level off altitude is dependent on air temperature (ISA deviation).

Driftdown/LRC Range Capability

This table shows the range capability from the start of driftdown. Driftdown is continued to level off altitude. As weight decreases due to fuel burn, the airplane is accelerated to Long Range Cruise speed. Cruise is continued at level off altitude and Long Range Cruise speed.

To determine fuel required, enter the Ground to Air Miles Conversion table with the desired ground distance and adjust for anticipated winds to obtain air distance to destination. Then enter the Driftdown/Cruise Fuel and Time table with air distance and weight at start of driftdown to determine fuel and time required. If altitudes other than the level off altitude are used, fuel and time required may be obtained by using the Engine Inoperative Long Range Cruise Diversion Fuel and Time table.

Long Range Cruise Altitude Capability

The table shows the maximum altitude that can be maintained at a given weight and air temperature (ISA deviation), based on Long Range Cruise speed, Max Continuous thrust, and 100 ft/min residual rate of climb.

Long Range Cruise Control

The table provides target EPR, engine inoperative Long Range Cruise Mach number, KIAS and fuel flow for the airplane weight and pressure altitude. The fuel flow values in this table reflect single engine fuel burn. To conservatively account for APU fuel burn, add 115 kg/hr to fuel flow values.

Long Range Cruise Diversion Fuel and Time

Tables are provided for crews to determine the fuel and time required to proceed to an alternate airfield with one engine inoperative. The data is based on single engine Long Range Cruise speed and .70/280/250 descent. Enter with Air Distance as determined from the Ground to Air Miles Conversion table and read Fuel and Time required at the cruise pressure altitude. Adjust the fuel obtained for deviation from the reference weight at checkpoint as required by entering the Fuel Required Adjustment table with the fuel required for the reference weight and the actual weight at checkpoint.

Holding

Single engine holding data is provided in the same format as the all engine holding data and is based on the same assumptions.

Gear Down

This section contains performance data for airplane operation with the landing gear extended. The data include engine bleed effects for normal air conditioning operation; i.e., two packs on at normal flow with all engines operating, and one pack normal flow with engine inoperative.

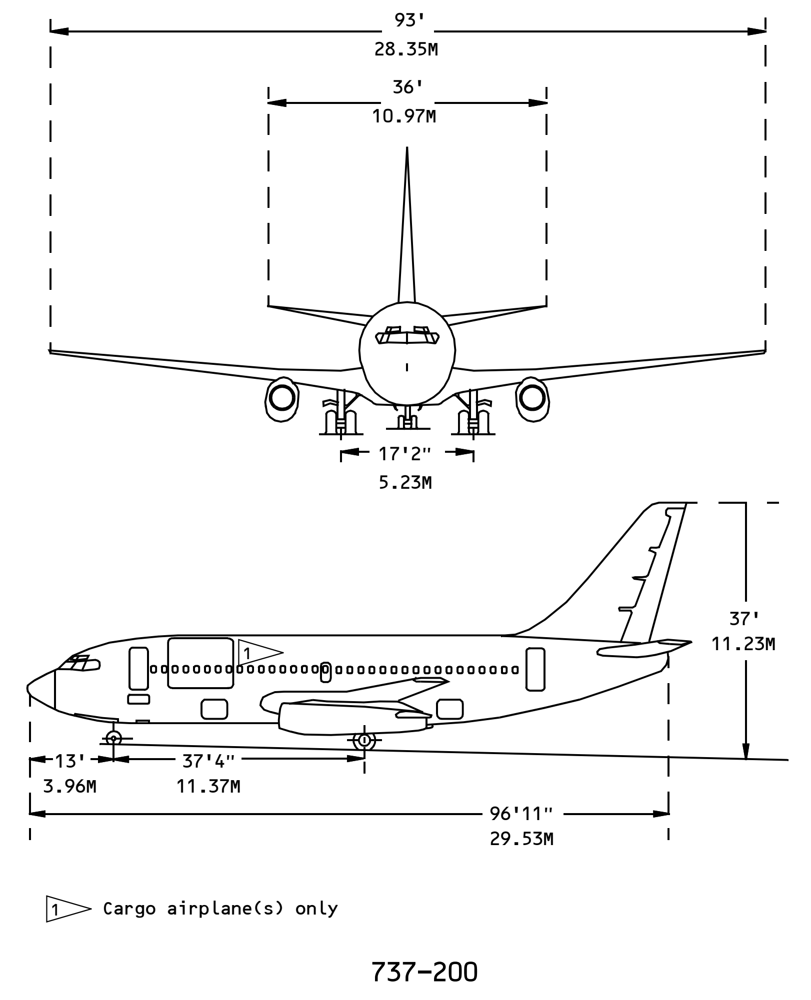
Tables for gear down performance in this section are identical in format and used in the same manner as tables for the gear up configuration previously described.

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

Table of Contents — Section TOC

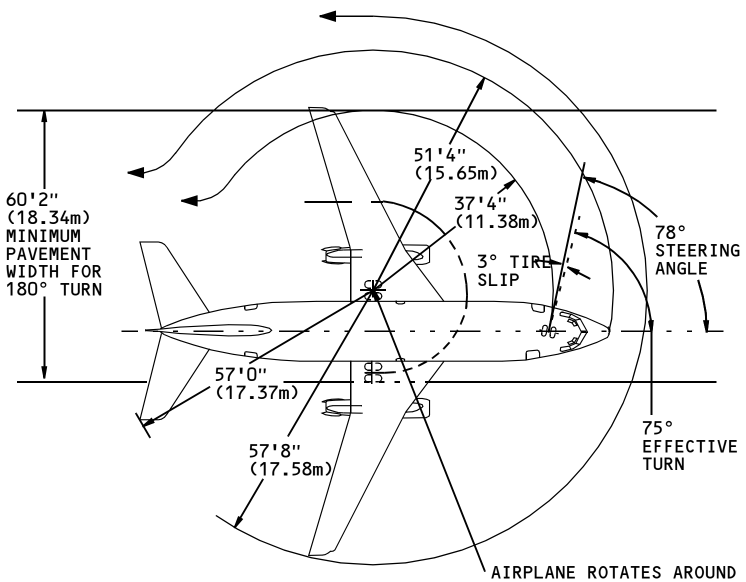
Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Dimensions — Section 10

Principal Dimensions



Ground Maneuver Capability

CAUTION: Landing gear geometry and sweep back of 737 airplane wings results in an outward motion of the wing tips and tail during turns.



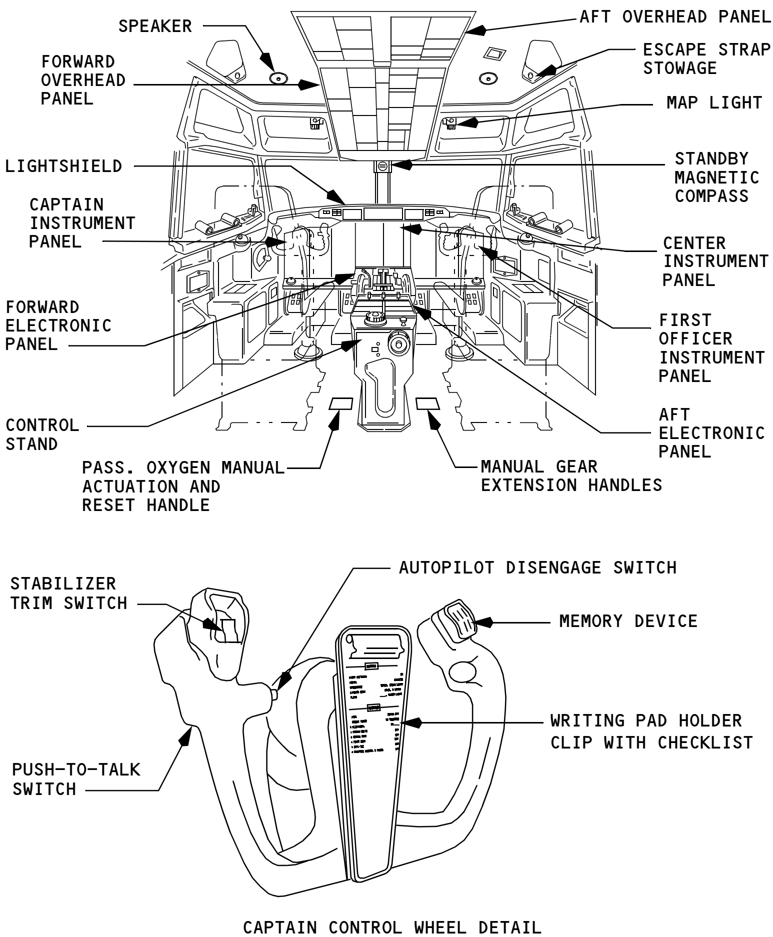
NOTE:
- Turn initiated with airplane in motion.
- Approximately idle thrust on both engines.
- No differential braking.

GROUND MANEUVER CAPABILITY

737-200

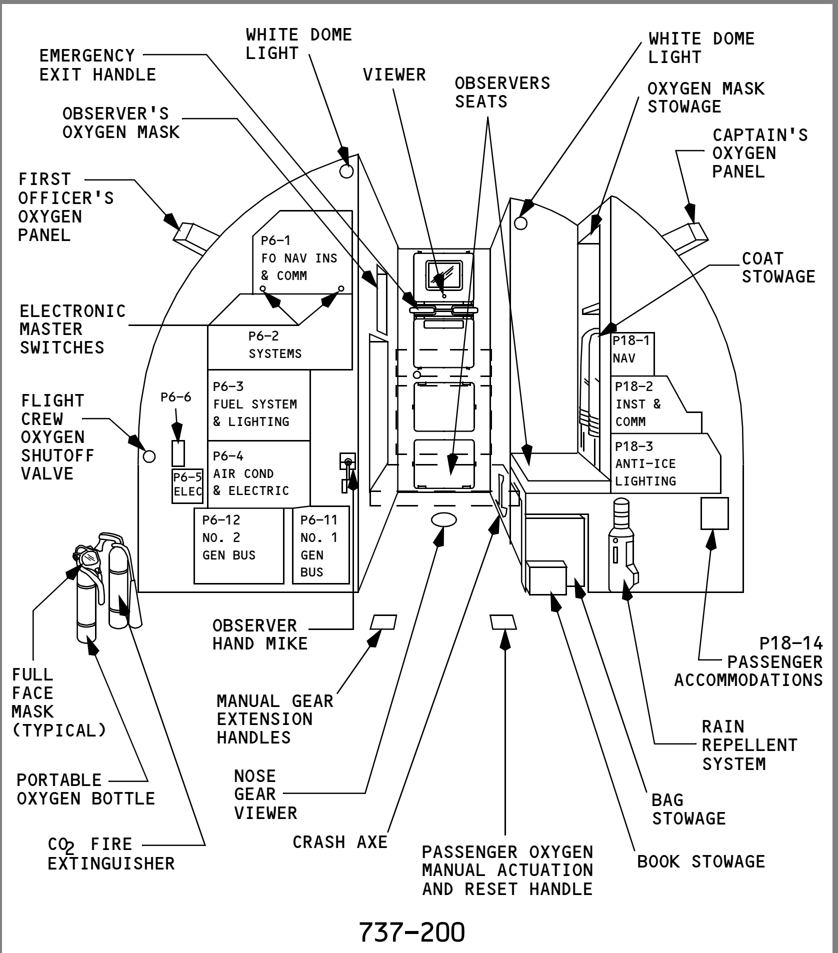
Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Instrument Panels — Section 20

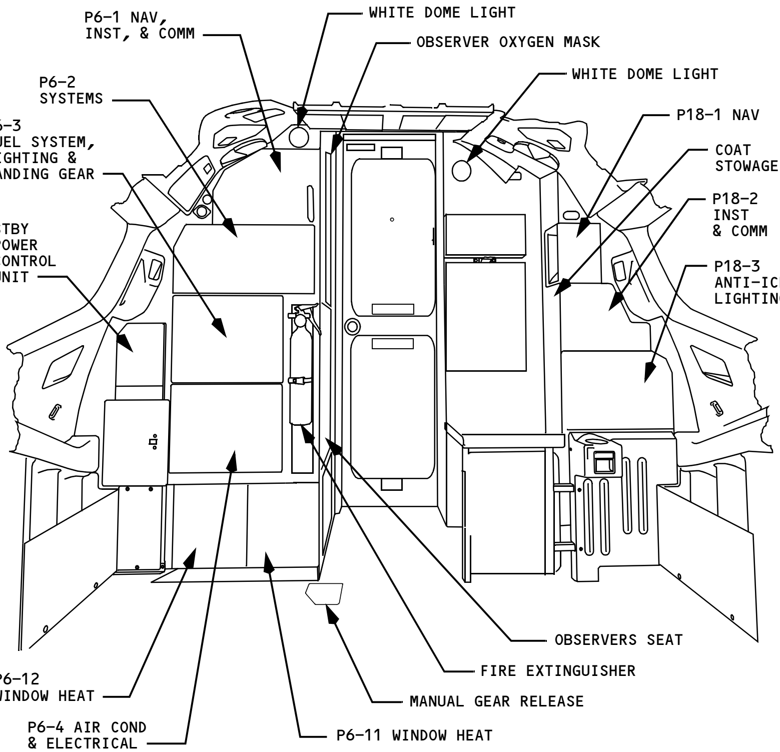
Panel Arrangement



737-200

Aft Flight Deck Overview





AFT FLIGHT DECK OVERVIEW

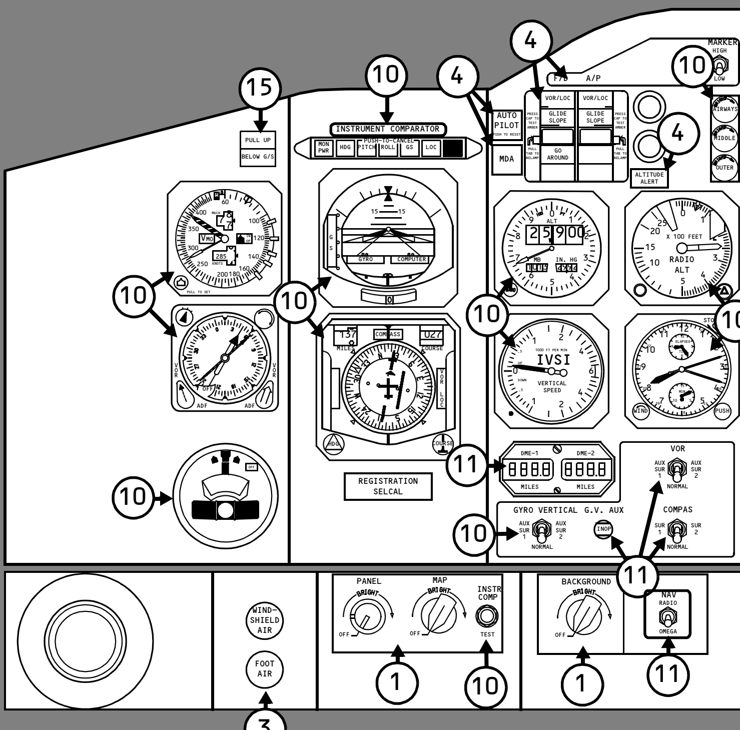
737 - 200

1 As installed

Intentionally
Blank

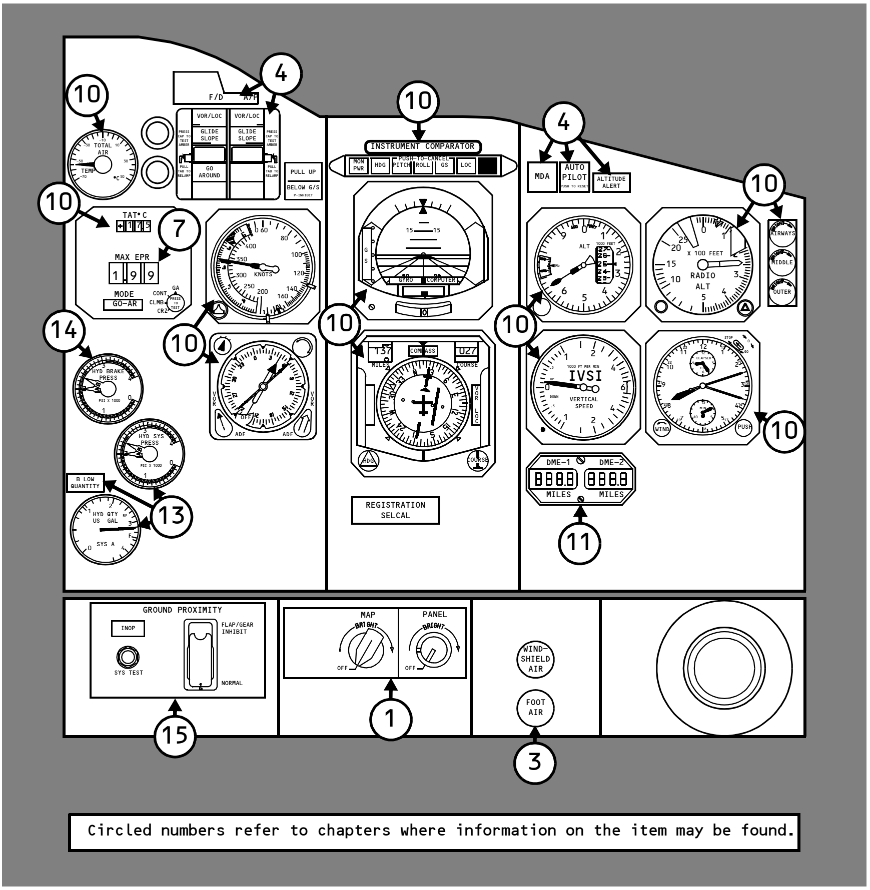
Captain’s Instrument Panel

Note: The controls, panels and indicators shown in this chapter are representative of installed units and may not exactly reflect the details of the latest configuration. Refer to the corresponding chapter under system descriptions for current chapter information.

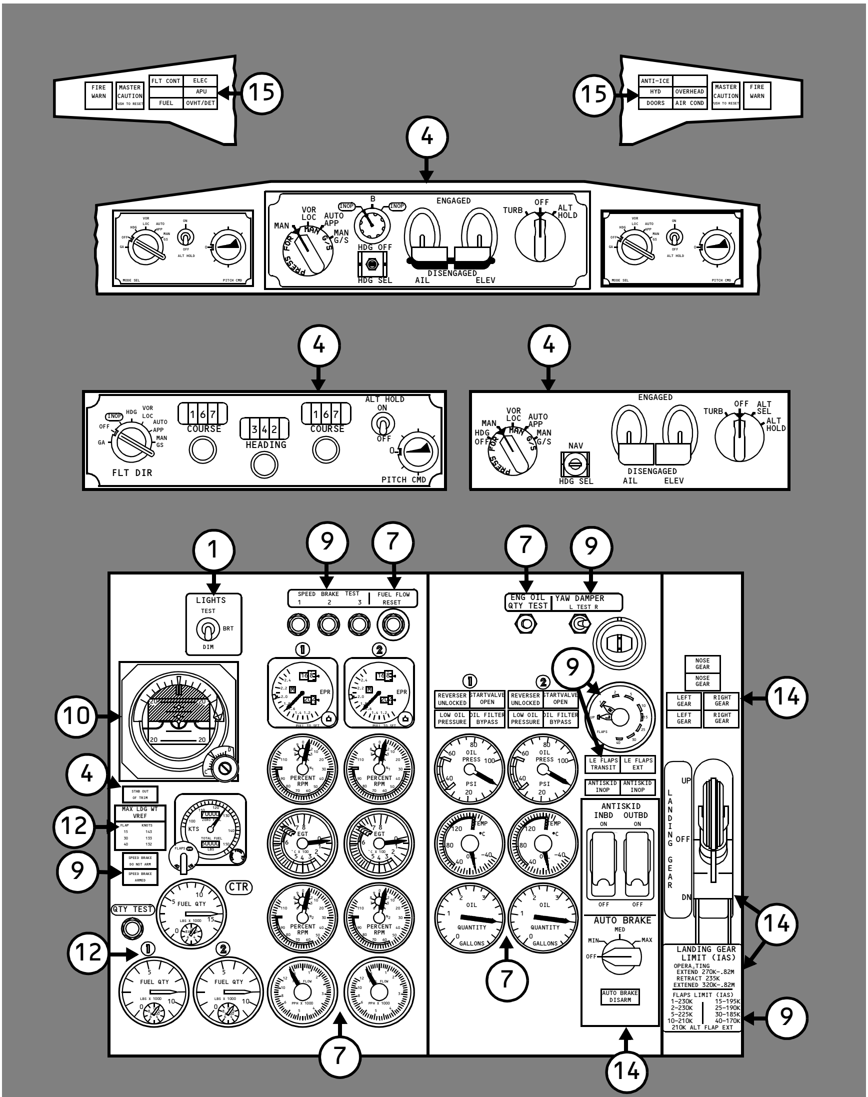


Circled numbers refer to chapters where information on the item may be found.

First Officer's Instrument Panel



Center Instrument Panel and Lightshield



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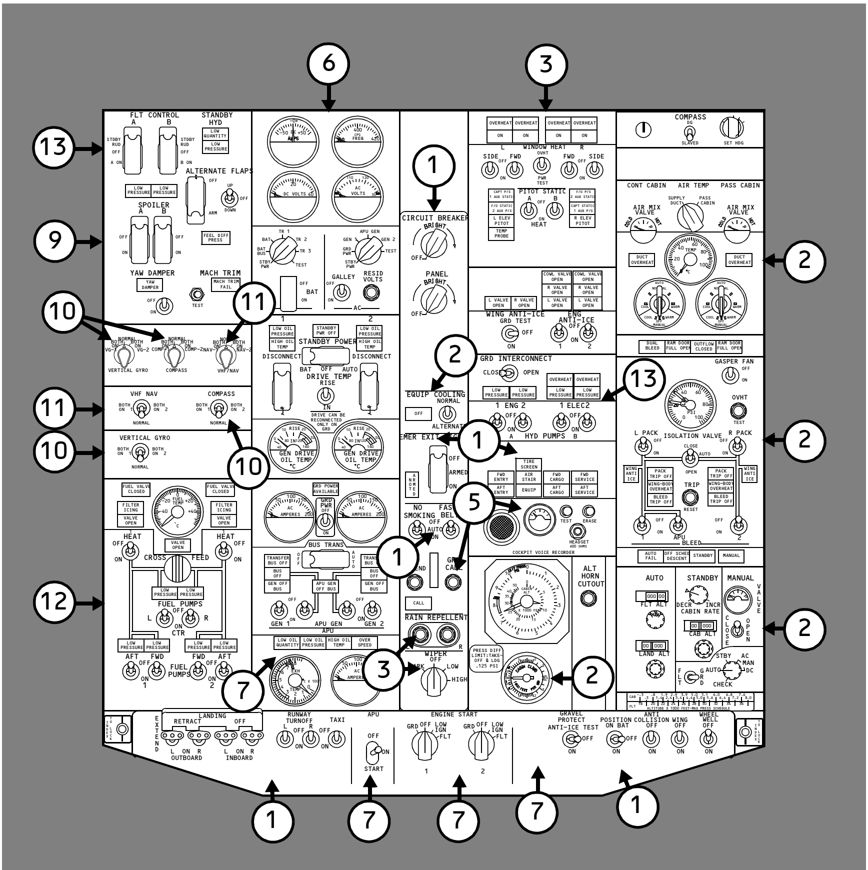
Forward Overhead Panel



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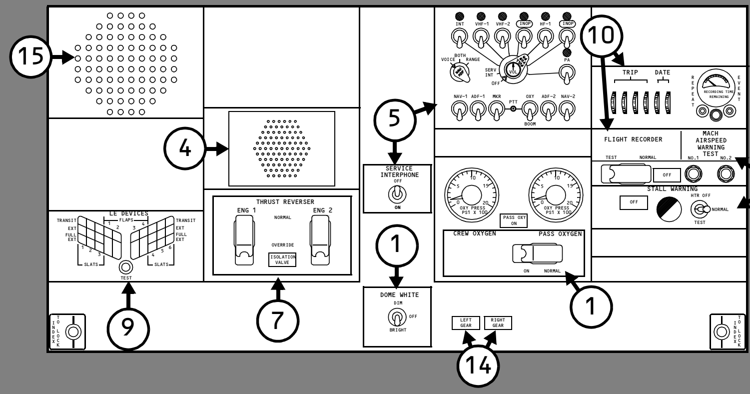
Aft Overhead Panel



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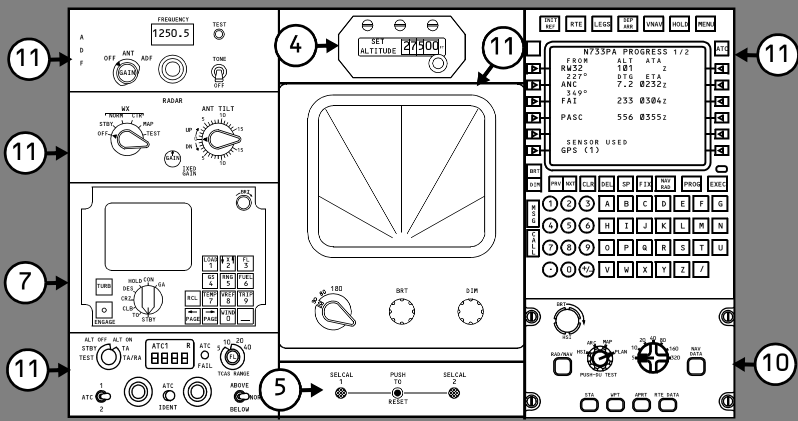
Forward Electronic Panel



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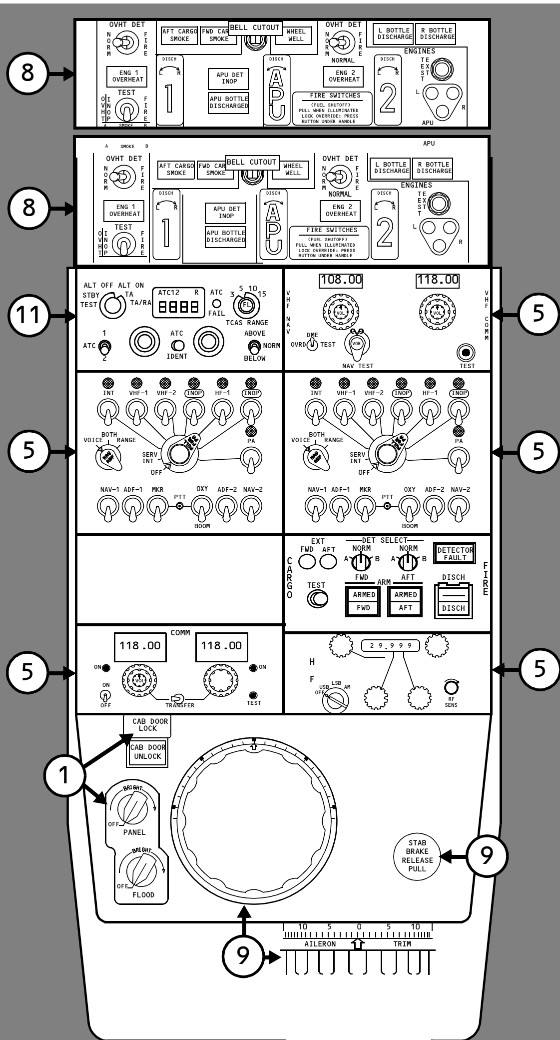
Aft Electronic Panel



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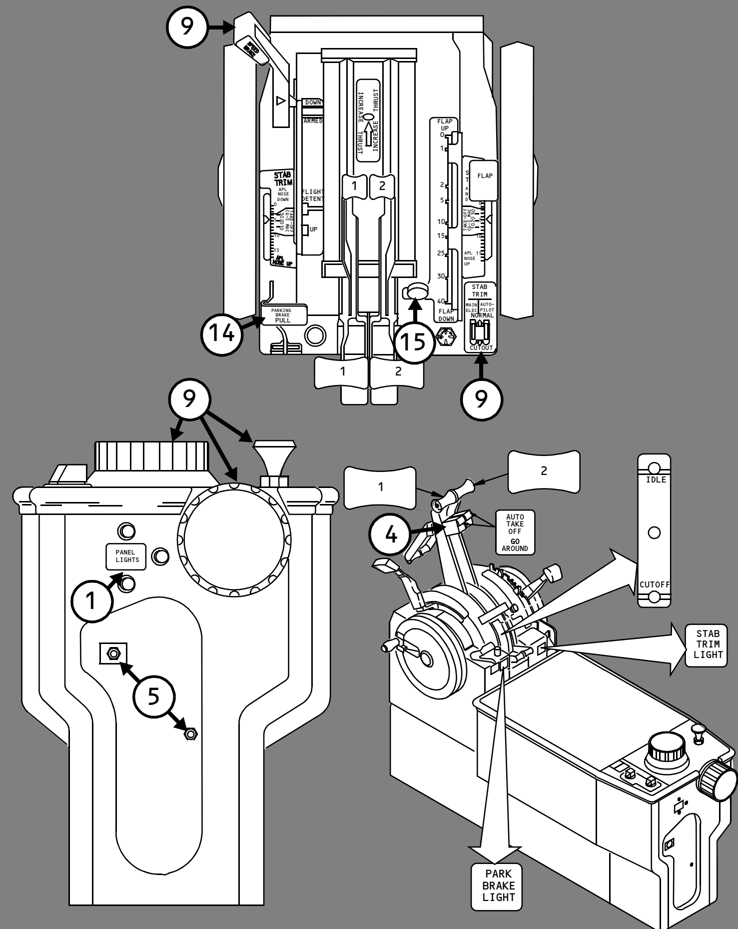
Control Stand



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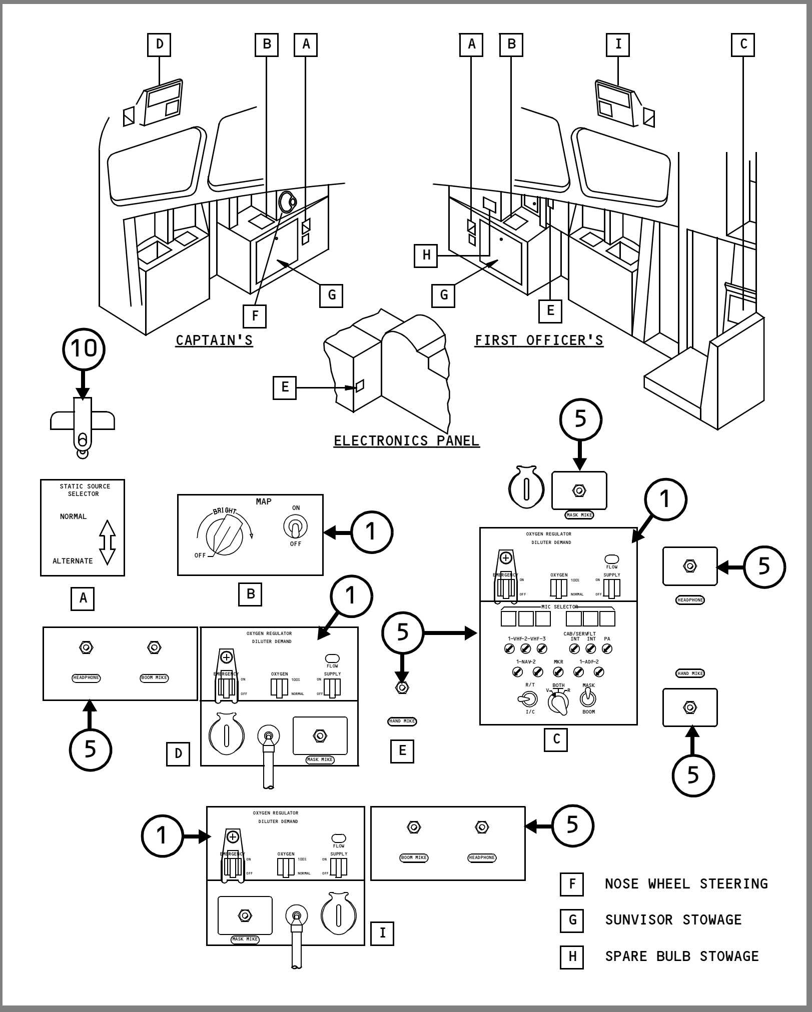
Auxiliary Panels



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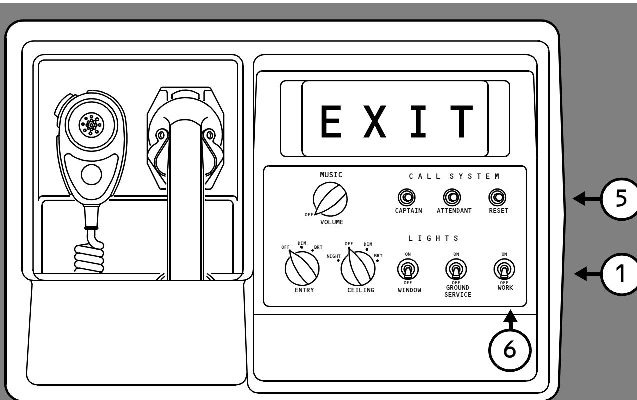
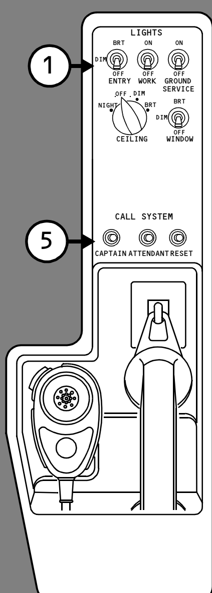
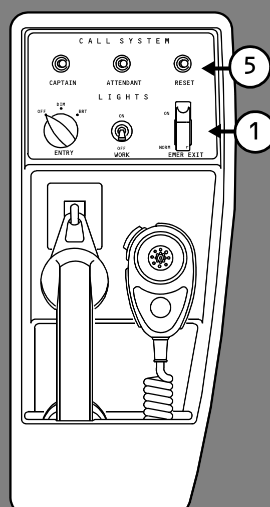
Attendant Panels



FORWARD ATTENDANT'S PANEL





AFT ATTENDANT'S PANEL

Circled numbers refer to chapters where information on the item may be found.

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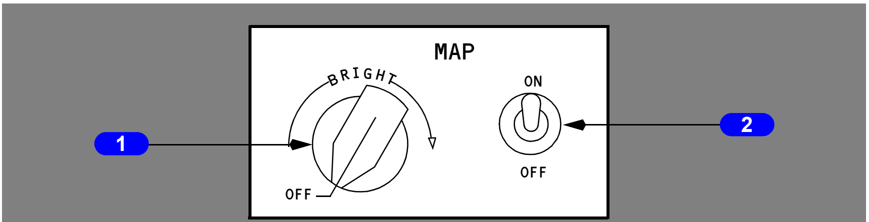
Flight Deck Lighting

Map Light Controls



SIDEWALL PANELS

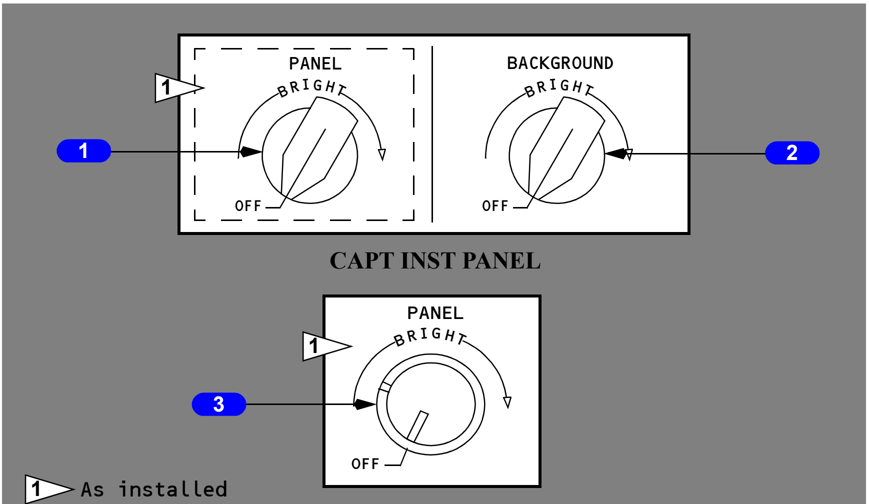
1 MAP Light Control

Rotate – adjusts brightness of Captain/First Officer map lights.

2 MAP Light Switch

ON/OFF - controls map light which illuminates control wheel checklists.

Panel and Background Lighting



CAPT INST PANEL
F/O INST PANEL

1 PANEL Light Control

Rotate –

- Left panel control regulates the intensity of the integral instrument lights in the Captain's and center instrument panels
- Right panel control regulates the F/O instrument panel and integral instrument lights.

2 BACKGROUND Light Control

Rotate –

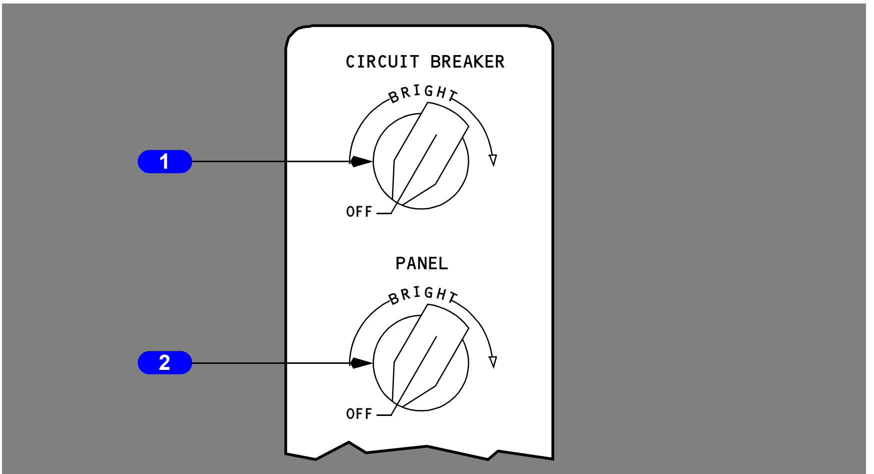
- Regulates intensity of the incandescent flood lights for the Captain's instrument panel, First Officer's instrument panel, and center instrument panel
- Movement beyond the detent turns on the fluorescent flood lights.

3 PANEL Light Control

Rotate –

- Outer knob controls the integral instrument lights
- Inner knob controls the electronic DME indicator lights.

Overhead/Circuit Breaker Panel Light Controls



FORWARD OVERHEAD PANEL

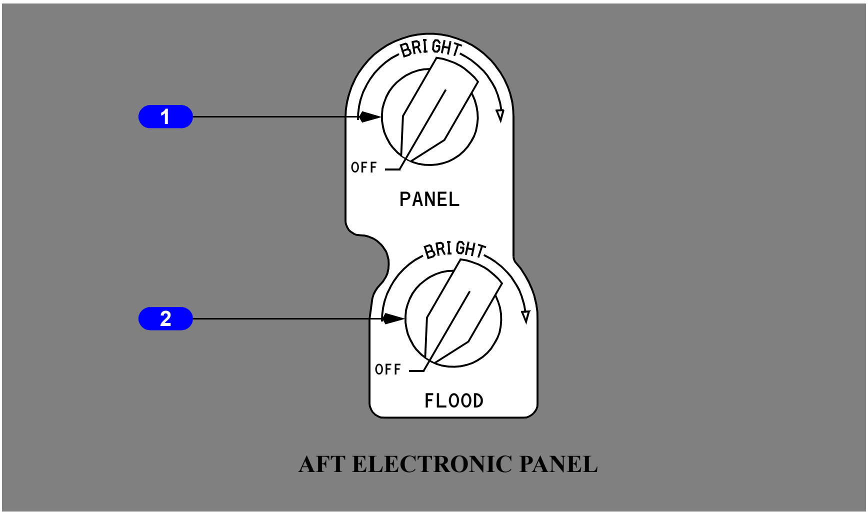
1 CIRCUIT BREAKER Light Control

Rotate – controls brightness of P–6 and P–18 circuit breaker panel lights.

2 **PANEL Light Control**

Rotate – controls brightness of forward and aft overhead panel lights.

Flood and Aft Electronic Panel Lights Controls



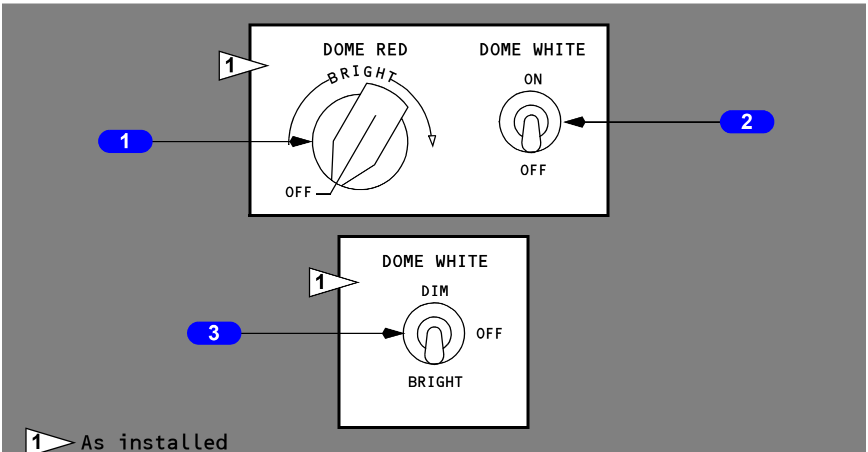
1 **PANEL Light Control**

Rotate – controls brightness of forward and aft electronic control panel lights.

2 **FLOOD Light Control**

Rotate – controls brightness of overhead spotlight directed at thrust lever quadrant.

Dome Light Control



AFT OVERHEAD PANEL

1 Red DOME Light Control

ROTATE – controls variable intensity red dome lights overhead and on sidewalls.

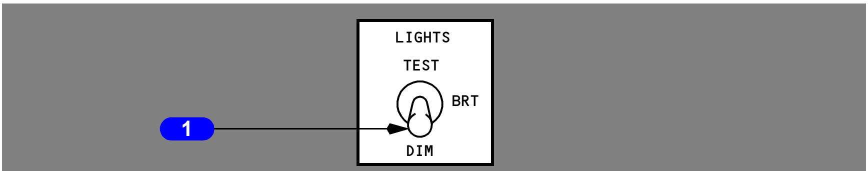
2 White DOME Light Switch

ON-OFF – controls two overhead white lights.

3 White DOME Light Control

DIM-OFF-BRIGHT – controls two overhead white lights.

Master Lights Test and Dim Switch



CENTER INSTRUMENT PANEL

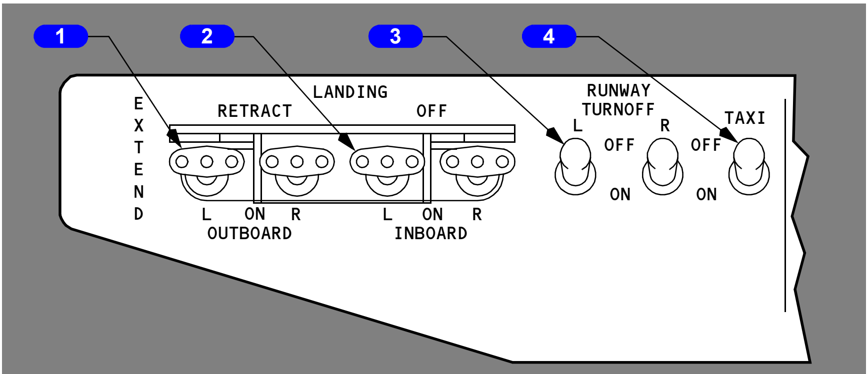
1 Master LIGHTS TEST and DIM Switch

TEST – illuminates all system lights on forward and aft overhead panels, and some lights on Captain’s and First Officer’s instrument panels to full brightness.

BRT (bright) – sets all system lights on forward and aft overhead panels, and some lights on Captain’s and First Officer’s panels to full brightness.

DIM – sets all system lights on forward and aft overhead panels, and some lights on Captain’s and First Officer’s panels to low brightness.

Exterior Lighting
Landing, Runway Turnoff and Taxi Lights



FORWARD OVERHEAD PANEL

1 OUTBOARD LANDING Light Switch (3-position)

RETRACT – outboard landing lights are retracted and extinguished

EXTEND – outboard landing lights are extended and extinguished

ON – outboard landing lights are extended and illuminated.

2 INBOARD LANDING Light Switch

OFF – inboard landing lights are extinguished

ON – inboard landing lights are illuminated.

3 RUNWAY TURNOFF Light Switch

OFF – runway turnoff lights located in leading edge of wing root are extinguished.

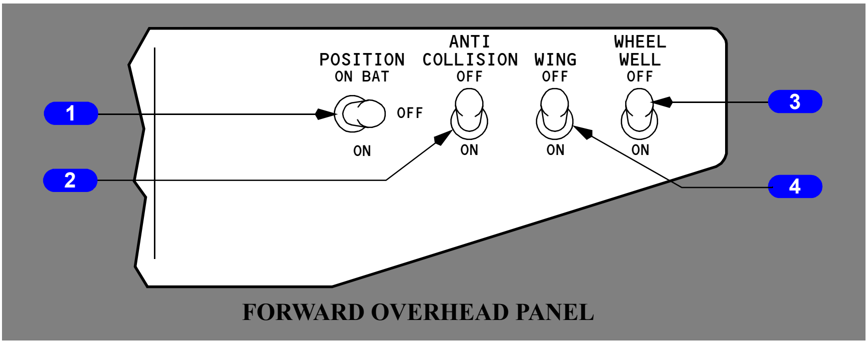
ON – runway turnoff lights are illuminated.

4 TAXI Light Switch

OFF – nose wheel taxi light extinguished.

ON – nose wheel taxi light illuminated.

Miscellaneous Exterior Lights



1 POSITION Light Switch

ON BAT – illuminates the red and green wingtip position lights, the white trailing edge wingtip lights from the battery bus if no other power is available. Battery Switch must be positioned to ON.

OFF – position lights extinguished.

ON – illuminates the red and green wingtip position lights and the white trailing edge wingtip lights.

2 ANTI–COLLISION Light Switch

OFF – red high intensity strobe lights extinguished.

ON – red high intensity strobe lights on upper and lower fuselage illuminated.

3 WHEEL WELL Light Switch

OFF – three wheel well lights extinguished.

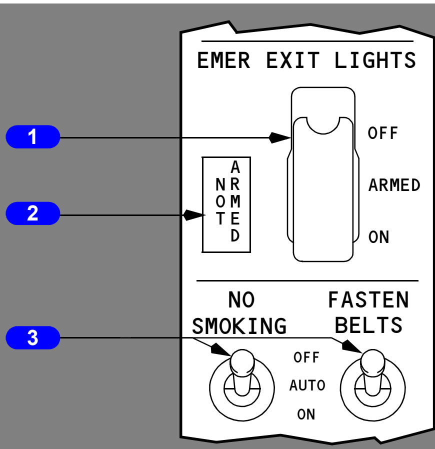
ON – wheel well lights illuminated for checking landing gear down and locked stripes.

4 WING Illumination Switch

OFF – wing leading edge lights extinguished.

ON – wing leading edge lights on fuselage forward of wing illuminated.

Emergency Lighting and Passenger Signs
Flight Deck



FORWARD OVERHEAD PANEL

1 Emergency Exit Lights (EMER EXIT LIGHTS) Switch (guarded)

OFF – prevents emergency lights system operation if airplane electrical power fails or is turned off.

ARMED - illuminates all interior and exterior emergency lights automatically if DC power fails or is turned off.

ON – all emergency lights illuminate.

2 Emergency Exit Lights (EMER EXIT LIGHTS) NOT ARMED Light

Illuminated (amber) – EMER EXIT LIGHTS switch not in ARMED position.

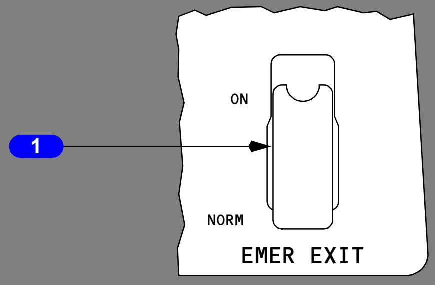
3 NO SMOKING/FASTEN SEAT BELTS Light Switches

OFF – extinguishes the associated passenger signs.

AUTO – illumination of the associated passenger signs is automatic.

ON – illuminates the associated passenger signs.

Passenger Cabin



AFT FLIGHT ATTENDANT PANEL

1 Passenger Cabin Emergency Exit Lights Switch (guarded, red)

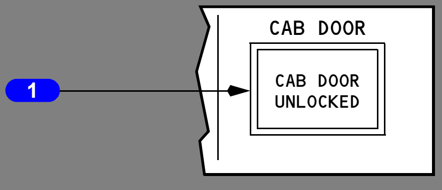
ON – all interior and exterior emergency lights are illuminated. Bypasses flight deck control.

NORM – emergency lights OFF unless activated by the flight deck switch.

Note: Whenever these switches are ON, the Emergency Exit Lights are being powered by their own individual NiCad batteries and last approximately 20 minutes.

Doors

Cabin Door (As Installed)



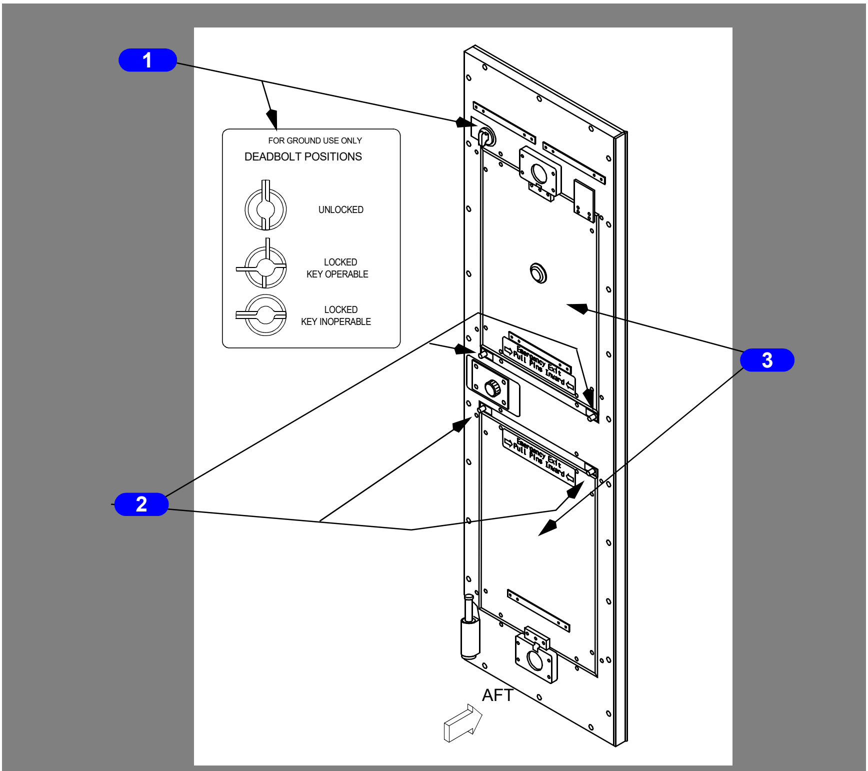
AFT ELECTRONIC PANEL

1 Cabin Door (CAB DOOR) Lock Switch

Illuminated (amber) – cabin door is unlocked.

Push – with AC power available, locks cabin door.

Flight Deck Door (As Installed)



FLIGHT DECK DOOR

1 Deadbolt and Deadbolt Placard

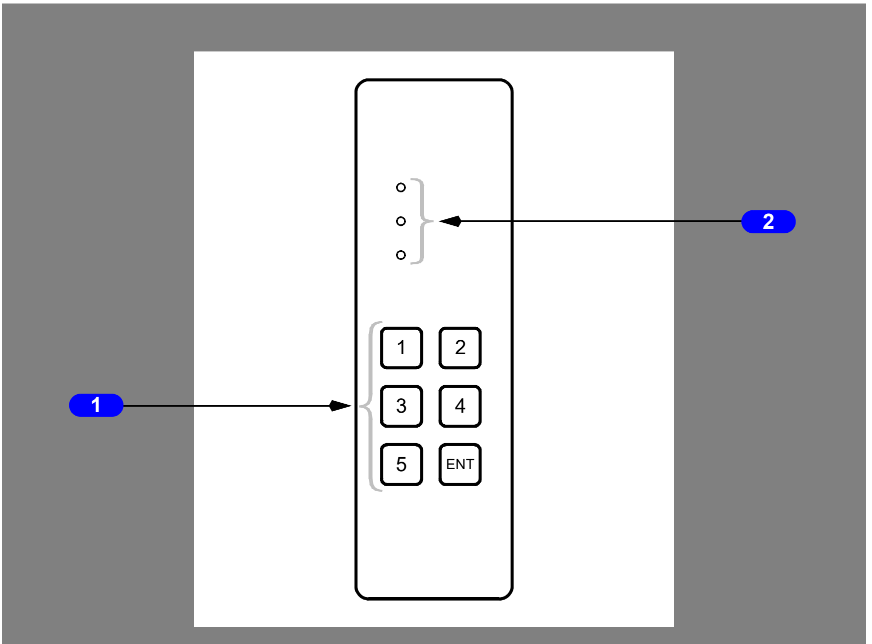
2 Release Pins

Pull pins inward - manually separates decompression panel from a jammed door to allow panel opening and egress.

3 Decompression Panel

Provides emergency egress path and automatically opens during cabin depressurization.

Flight Deck Emergency Access Panel



PASSENGER SIDE DOOR POST

1 Keypad

Push - enters 3 to 8 digit emergency access code by pressing numeric then “ENT” keys. Entry of correct emergency access code sounds flight deck chime.

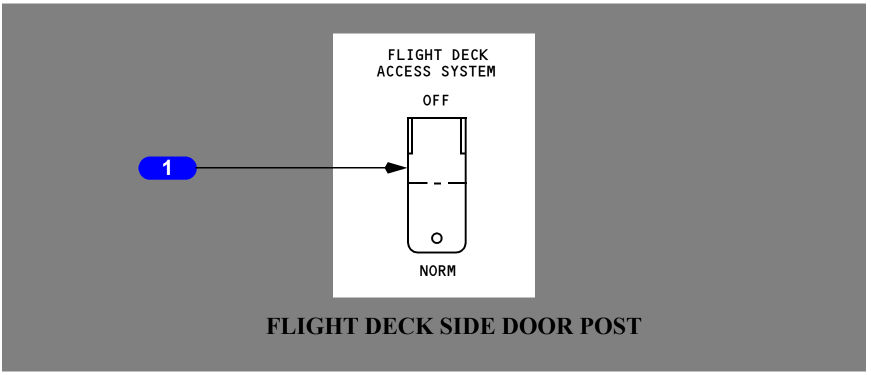
2 Access Lights

Illuminated (red) - door locked or Flight Deck Access System switch OFF.

Illuminated (amber) - correct emergency access code entered.

Illuminated (green) - door unlocked.

Flight Deck Access System Switch



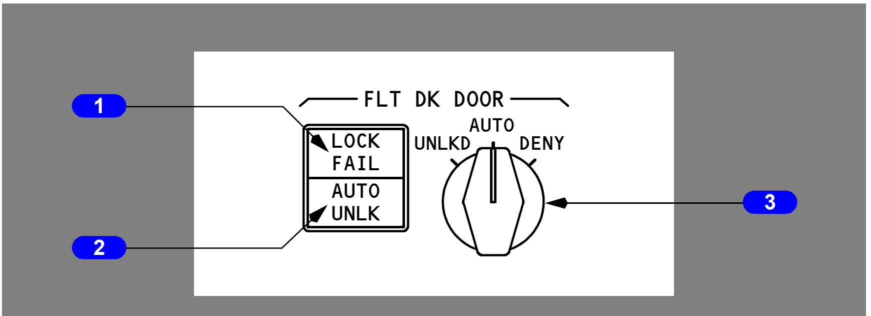
FLIGHT DECK SIDE DOOR POST

1 Flight Deck Access System Switch

OFF - removes electrical power from door lock.

NORM (Normal) - flight deck access system configured for flight.

Flight Deck Door Lock Panel



AISLE STAND

1 LOCK FAIL Light

Illuminated (amber) - Flight Deck Door Lock selector in AUTO and door lock has failed or Flight Deck Access System in OFF.

2 AUTO Unlock (UNLK) Light

Illuminated (amber) - correct emergency access code entered in keypad. AUTO UNLK light flashes and continuous chime sounds before timer expires and door unlocks.

3 Flight Deck (FLT DK) Door Lock Selector

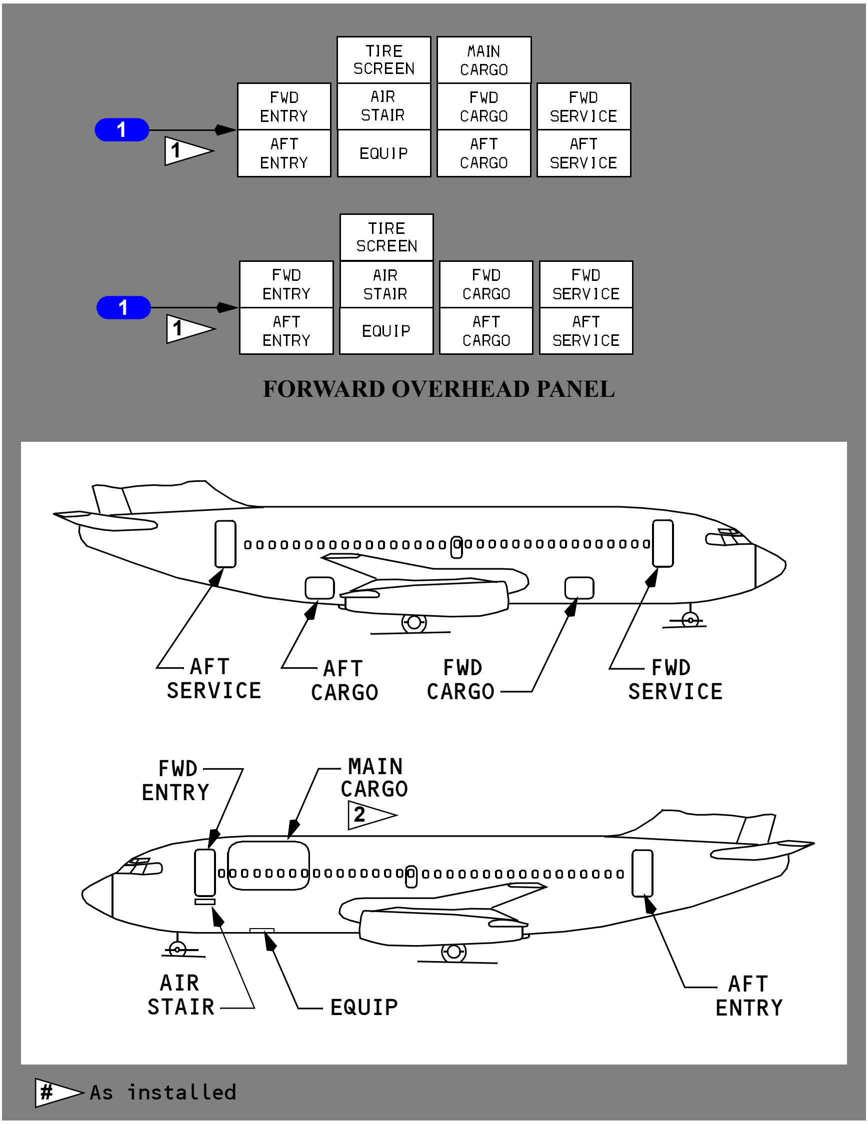
Spring loaded to AUTO. Selector must be pushed in to rotate from AUTO to UNLKD. Selector must not be pushed in to rotate from AUTO to DENY position.

UNLKD - door unlocked while selector in UNLKD.

AUTO - door locked. Allows door to unlock after entry of emergency access code and expiration of timer, unless crew takes action.

DENY - rejects keypad entry request and prevents further emergency access code entry for a time period.

Exterior Door Annunciator Lights

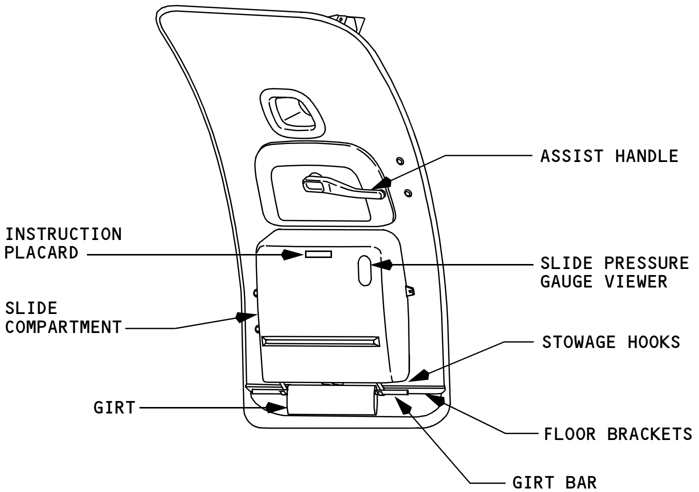


FORWARD OVERHEAD PANEL

1 Interior Door Annunciations

Illuminated (amber) – related door is unlocked.

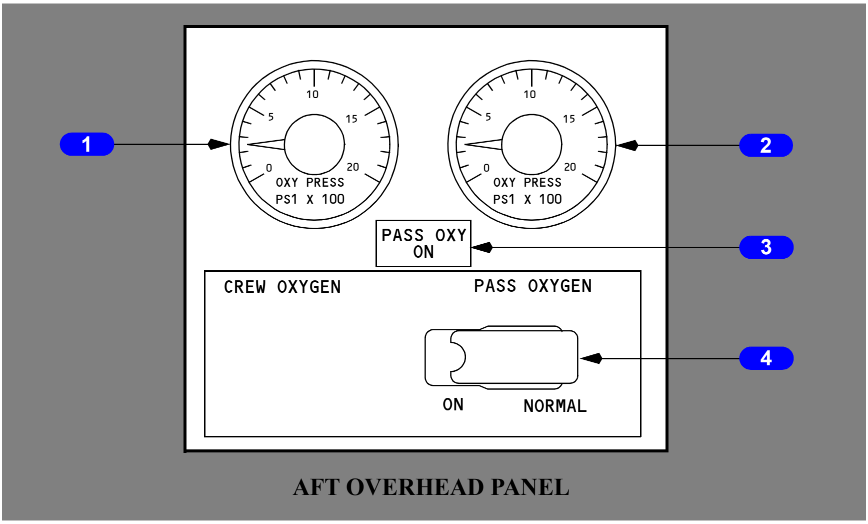
Passenger Entry/Galley Service Doors



PASSENGER CABIN

CAUTION: Do not operate the entry or cargo with winds at the door of more than 40 knots. Do not keep doors open when wind gusts are more than 65 knots. Strong winds can cause damage to the structure of the airplane.

Oxygen
Oxygen Controls and Indicators



1 Flight Crew Oxygen (CREW OXYGEN) Pressure Indicator

Indicates pressure at the crew oxygen cylinder.

2 Passenger Oxygen (PASS OXYGEN) Pressure Indicator

Indicates pressure at the passenger oxygen cylinder.

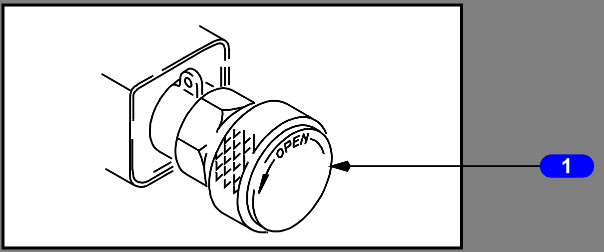
3 Passenger Oxygen On (PASS OXY ON) Light

Illuminated (amber) – system pressure activated.

4 Passenger Oxygen (PASS OXYGEN) Switch

NORMAL – passenger masks drop and passenger oxygen system is activated automatically if cabin altitude climbs to approximately 14,000 feet.

ON – activates system and drops masks if automatic function fails.

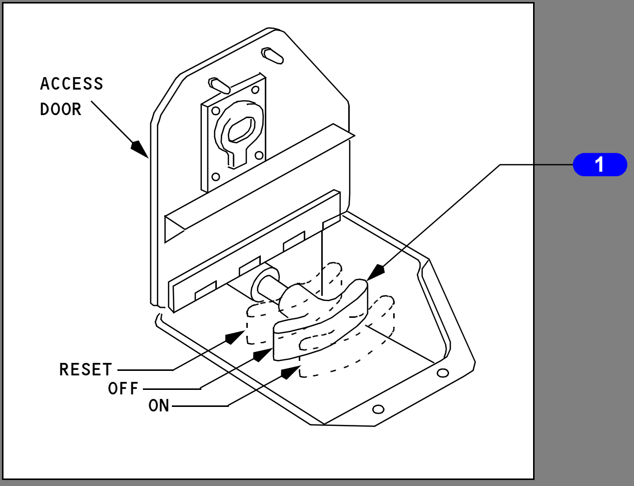


RIGHT FLIGHT DECK BULKHEAD
BEHIND FIRST OFFICER'S SEAT

1 Flight Crew Oxygen (CREW OXYGEN) Shutoff Valve

TURN COUNTERCLOCKWISE - allows oxygen to flow.

TURN CLOCKWISE - shuts off oxygen flow.



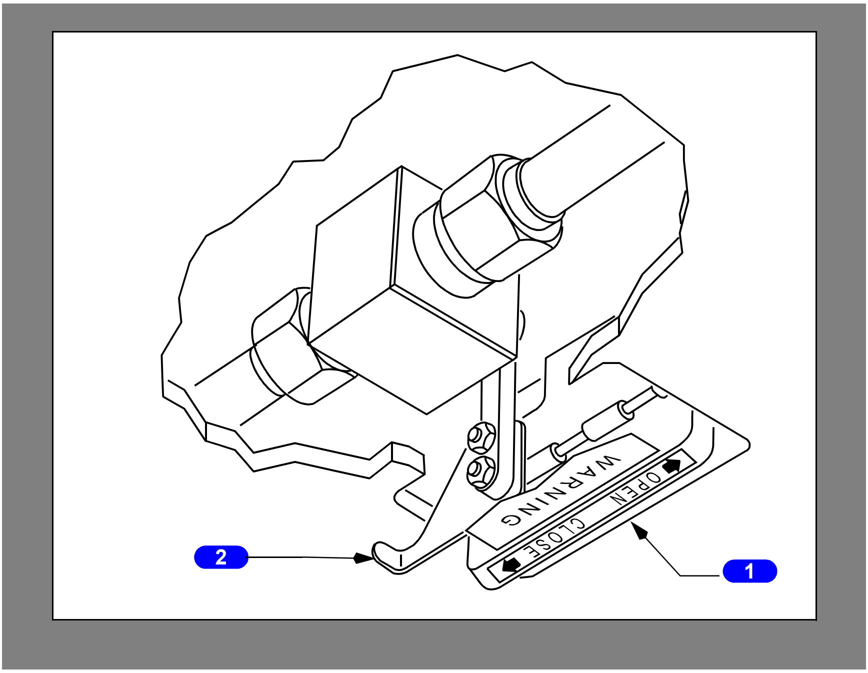
COCKPIT FLOOR

1 Manual Actuation and Reset Handle.

PULL ON – activates oxygen system.

PUSH TO RESET (push handle in for 5 seconds) – closes flow control valves and resets system when cabin altitude is below 14,000 feet.

Passenger Oxygen Shutoff Valve (As Installed)

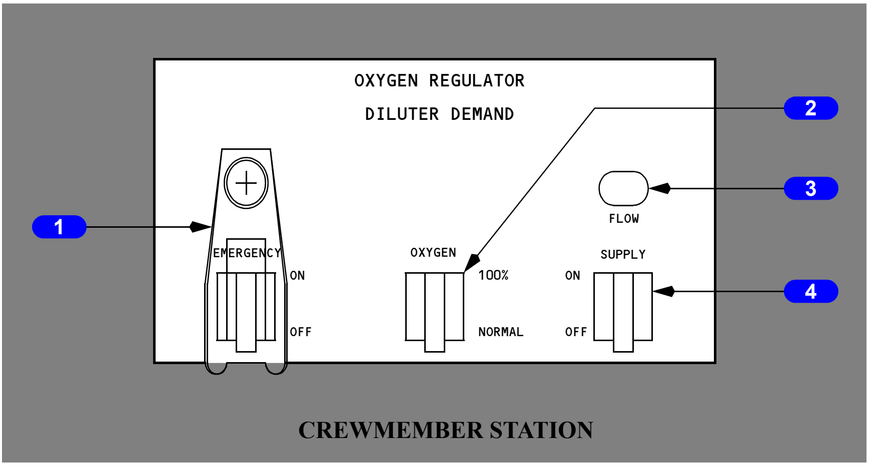


1 Handle Access Door

Located at the aft end of the forward lowered ceiling

2 Valve Handle (Closed Position)

Oxygen Regulator



1 Emergency Lever

ON – supplies 100% oxygen under positive pressure

OFF – air/oxygen mixture is determined by the position of Oxygen Diluter Lever.

2 Oxygen Diluter Lever

100% – provides pure oxygen on demand

NORMAL – provides an air/oxygen mixture, dependent on cabin altitude, on demand.

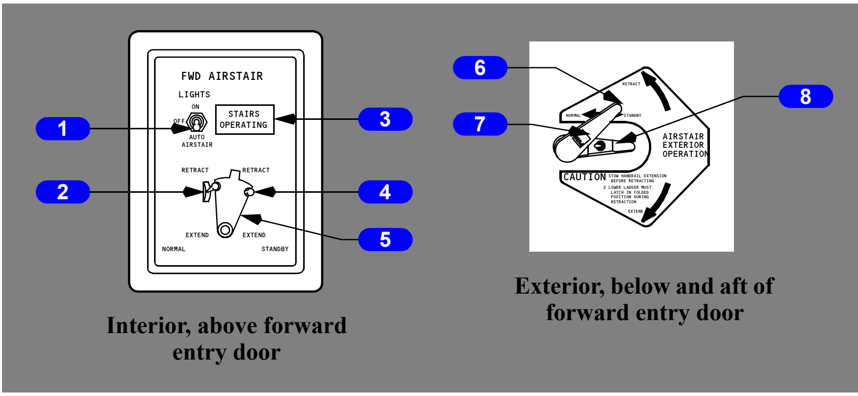
3 Flow Indicator

Indicates oxygen flow through the regulator to the mask.

4 Supply Lever

ON/OFF – controls oxygen supply to the regulator.

Forward Airstair
Interior and Exterior Controls



Interior, above forward entry door

Exterior, below and aft of forward entry door

1 LIGHTS Switch

ON – illuminates the airstair tread lights.

OFF – airstair tread lights extinguish.

AUTO – the airstair tread lights illuminate automatically upon airstair extension and extinguish upon retraction.

2 Normal Control Switch

Note: AC and DC electrical power must be available on airplane.

RETRACT – retracts the airstair. The handrail extensions must be stowed prior to retracting the airstair.

EXTEND – extends the airstair.

3 STAIRS Operating Light

Illuminated (amber) – indicates the airstair is in transit.

4 STANDBY Control Switch

Note: AC and DC electrical power must be available on airplane.

Retract – retracts the airstair.

Extend – extends the airstair.

CAUTION: Use of standby bypasses all safety circuits. Airstair handrail extensions must be stowed, or substantial damage could result.

5 Guard

(spring-loaded to the right)

Note: Must be held to the left to operate the standby control switch.

6 Exterior Control Handle

Rotate clockwise – airstair extends.

Rotate counterclockwise – airstair retracts.

7 Control Handle Release

Push – extends the exterior control handle.

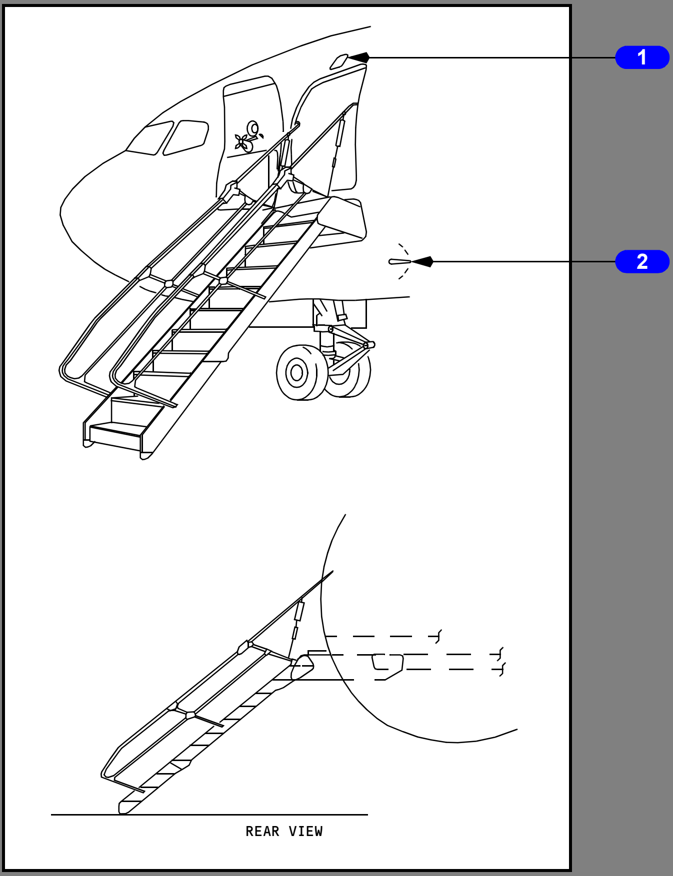
8 NORMAL/STANDBY Switch

(spring–loaded to NORMAL)

NORMAL – requires both AC and DC power.

STANDBY – requires DC power.

Exterior Controls



FORWARD AIRSTAIR

1 Interior Airstair Control Panel

Normal and standby operating modes.

Entry door must be partially open in order to extend airstair.

2 Exterior Airstair Control Handle

To operate, push button in center and rotate handle either direction.

Entry door need not be open in order to extend airstair.

Cargo Configuration

Main Deck Cargo Door (As Installed)

The main deck cargo door is opened with a hydraulic actuator powered from hydraulic system B. However, the cargo door may also be opened using a manual pump to supply hydraulic pressure for the actuator. The latching and latch locking mechanism is installed along the lower portion of the door. The latch mechanism consists of eight mechanical latches which pull the door completely closed and latch the door to the latch pins on the fuselage door sill. The lock mechanism consists of eight locking pins, with interconnecting mechanism and a manually operated external lock handle. The locking pins prevent the latch mechanism from operating until the door is unlocked. The door is unlocked with a flush mounted external lock handle on the forward outboard side of the door.

After the main deck cargo door is manually unlocked, the cargo door can then be hydraulically unlatched and opened. Hydraulic system pressure for operation of the main deck cargo door actuator is controlled from the cargo door control panel. The panel contains two cargo door position switches, an amber light, and cargo area lighting switches. One switch raises the cargo door to the canopy position and closes the door. The second switch raises the door from the canopy position to the full open position and back to the canopy position. Releasing a control switch while the door is in transit causes the door to hydraulically lock in the interim position. If the switch is operated again the door will continue to raise or lower, depending on the position of the switch. In addition to the hydraulic locking feature, mechanical locks extend to hold the door in the canopy position (approximately 87 degrees) if hydraulic pressure is lost. The lock is released by hydraulic pressure within the actuator. The door is actuated by system B pressure or by pressure from the hand pump in the left wheel well.

Electric heating blankets are used to heat the inside wall of the cargo door. The cargo door heat switch is located on the cargo attendant’s panel. Cargo door heat may be used on the ground as desired for passenger comfort to limit cold soak effect at the main deck cargo door location.

One amber caution light on the cargo door control panel, and one MAIN CARGO door light located on the forward overhead panel, indicate to the flight crew that the main deck cargo door is not closed and locked.

Visual confirmation that latch hooks are engaged is provided by eight latch hook viewing windows on the lower outside edge of the cargo door. A horizontal white line shows the end of each latch hook in the latched position.

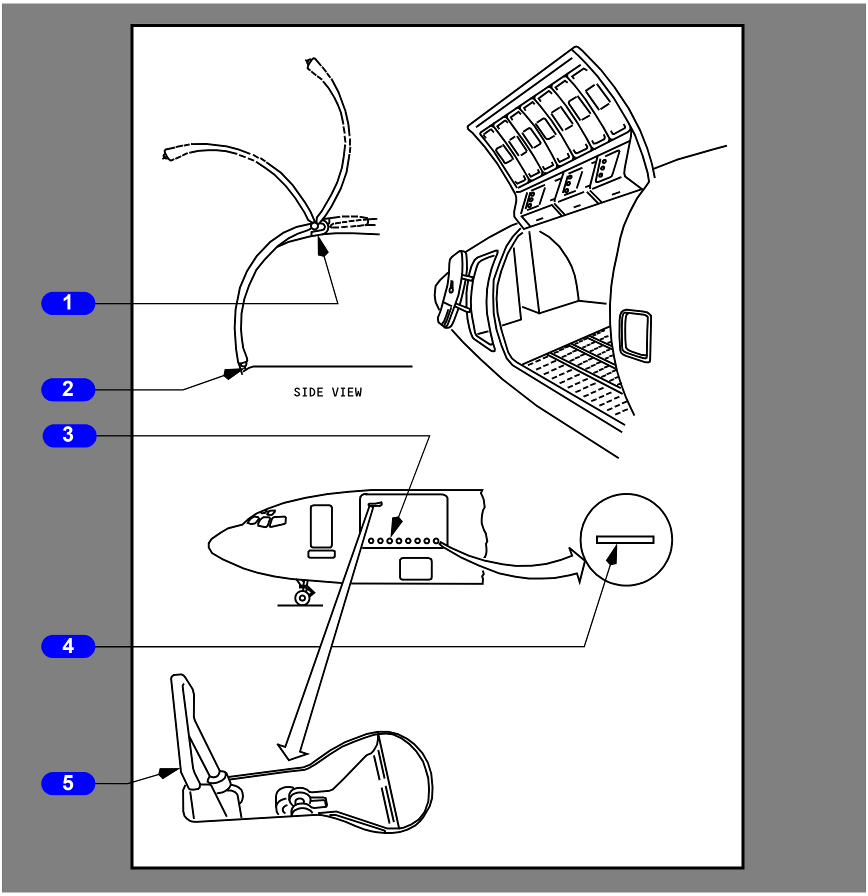
An indicating light inside the No. 2 and No. 7 windows will be illuminated when the No. 3 and No. 6 latch hooks are locked. This provides additional confidence that all latch hooks are properly locked.

Three conditions must be satisfied to extinguish the amber “door unlocked” caution light: (1) door closed, (2) door latched and locked, (3) external door handle stowed. If the light illuminates in flight, it is probably due to the rigging tolerance of the door position proximity switch. The door cannot be mechanically unlocked except from outside.

The passenger cabin can be converted to a main cargo compartment using a cargo conversion kit. The compartment is equipped with a hydraulically operated main deck cargo door located just aft of the forward entry door. The door opening upward and outward permits easy loading of the various commercial/military cargo pallets when the airplane has the cargo conversion kit installed.

This seven pallet configuration kit contains all the parts required for conversion of any of several combination cargo/passenger configurations, permitting mixed loads of passengers and cargo to be carried.

Main Deck Cargo Door



1 Actuation Linkage

Shown in closed position

2 Latch Pin

Typical (8) places

3 Indicating Lights (white)

Installed in windows 2 and 7

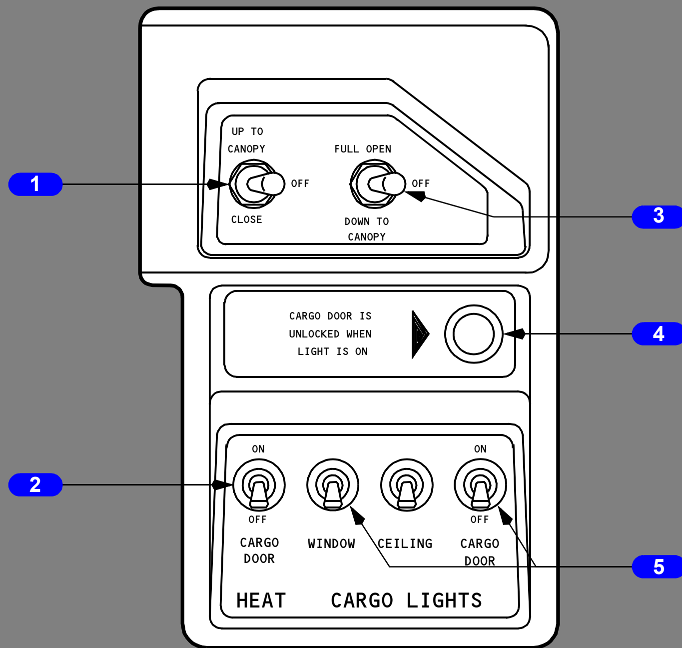
4 Latch Hook Viewing Windows (8)

End of latch hook (white) shown in center of window.

5 **External Locking Handle**

PULL OUT AND FORWARD – unlocks latch hooks and connects electrical power to the opening system (shown in unlock position).

Main Deck Cargo Door Control Panel



CARGO DOOR ATTENDANT'S PANEL

1 **Switch No. 1**

- Requires DC electrical power.

UP TO CANOPY– cargo door unlatches and raises to the canopy position.

CLOSE – cargo door closes and latch hooks engage.

2 **Cargo Door Heat**

- Controls heat to cargo door for comfort and to prevent cold soak.

3 **Switch No. 2**

FULL OPEN – cargo door raises from the canopy position and locks in the full open position.

DOWN TO CANOPY– cargo door lowers to the canopy position.

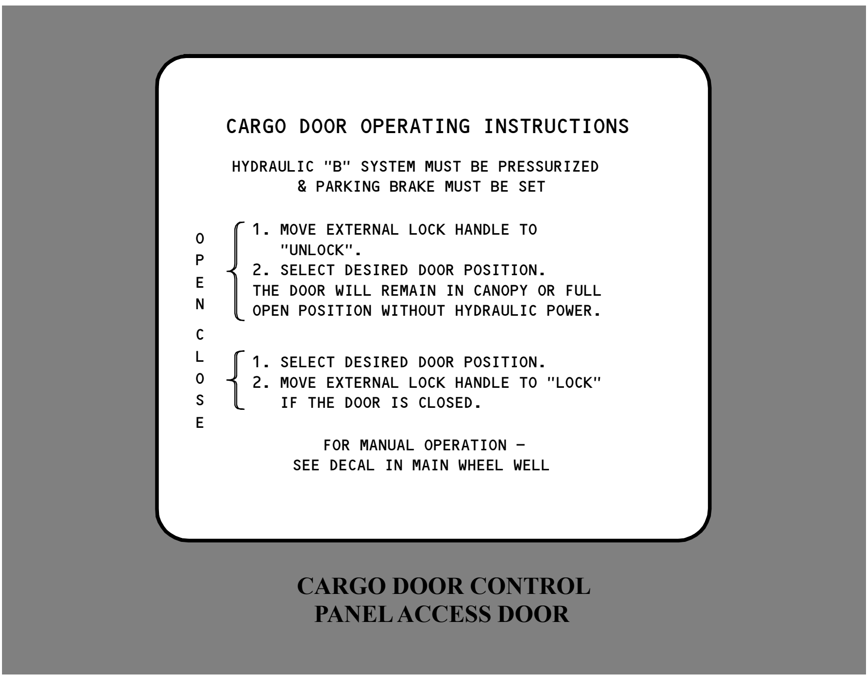
4 **Cargo Door Unlocked Light**

ILLUMINATED – indicates the main cargo door is unlocked.

5 **Recessed Lighting Switches**

- Controls cabin and cargo door lights.

Cargo Door Operating Instructions Placard



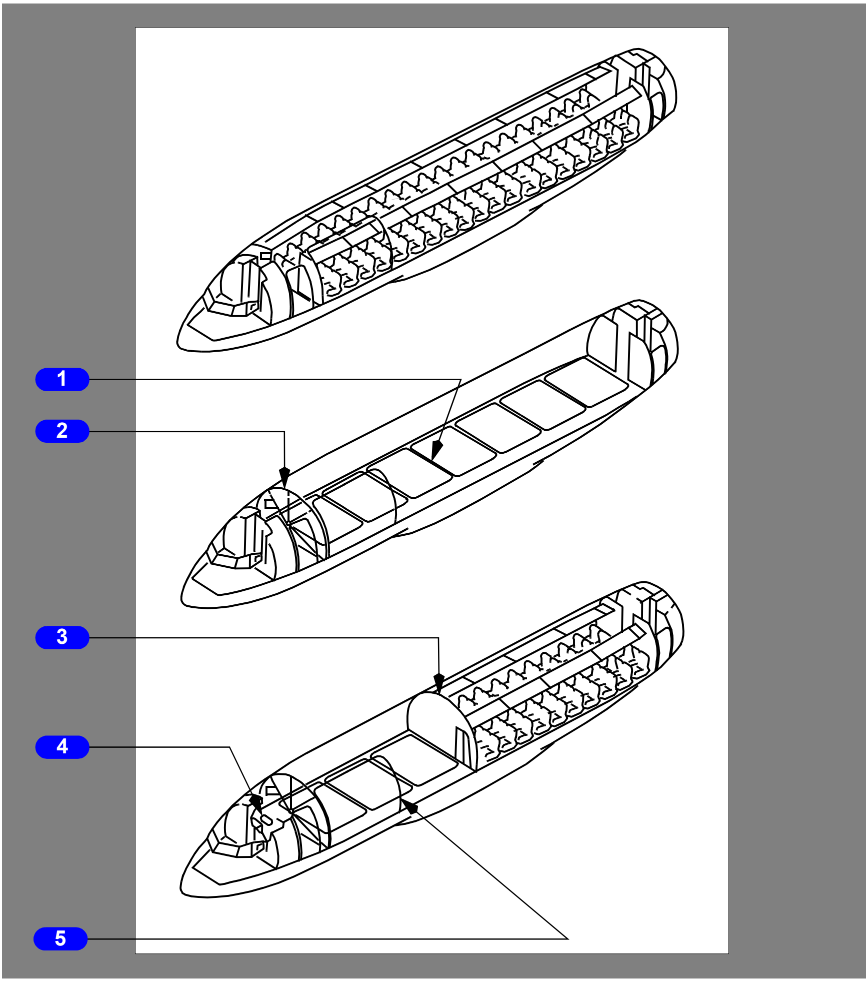
Passenger/Cargo Combinations

The cabin may be configured to carry from 2 to 6 pallets with the remainder of the cabin allocated to passenger seating. Installation of the cargo conversion kit requires removal or storage of passenger features in the affected portion of the main cabin area. The plug(s) must also be removed from the cargo compartment vent and replaced with grills to insure smoke evacuation. The vent is located on the floor over the E/E compartment; if two vents are installed, the second is over the attendant's seat. All window shades must be pulled down, all air outlets must be closed, and all reading lights must be off along both sides of the cabin section being converted for cargo.

The passenger compartment will be separated from the main cargo compartment by a fire-resistant smoke barrier partition with a door. A smoke detection system provides monitoring of the air in the main cargo compartment when the equipment cooling fan is operating.

A floor-mounted portable dry chemical fire extinguisher and applicator or, as installed, a BCF fire extinguisher, is installed over the smoke evacuation grill in the forward part of the cabin. Cargo loading must permit an aisle for access between the crew and passenger compartments, and must permit the use of the portable fire extinguisher to effectively reach fires in all areas of the cargo compartment.

Passenger/Cargo Configurations



1 Cargo Pallet

2 Cargo Barrier Net

3 Smoke Partition Barrier

4 Fire Extinguisher

Dry chemical with applicator, or BCF.

5 Main Deck Cargo Door

Top-hinged with eight latches along bottom edge.

Aft Entry Door and Airstair

The aft entry door and airstair is a self-contained unit which provides rapid access to, or departure from, the cabin.

The aft airstair is integral with the aft entry door. When the door is opened, the airstair unfolds from the door and forms a stairway for passengers and crew.

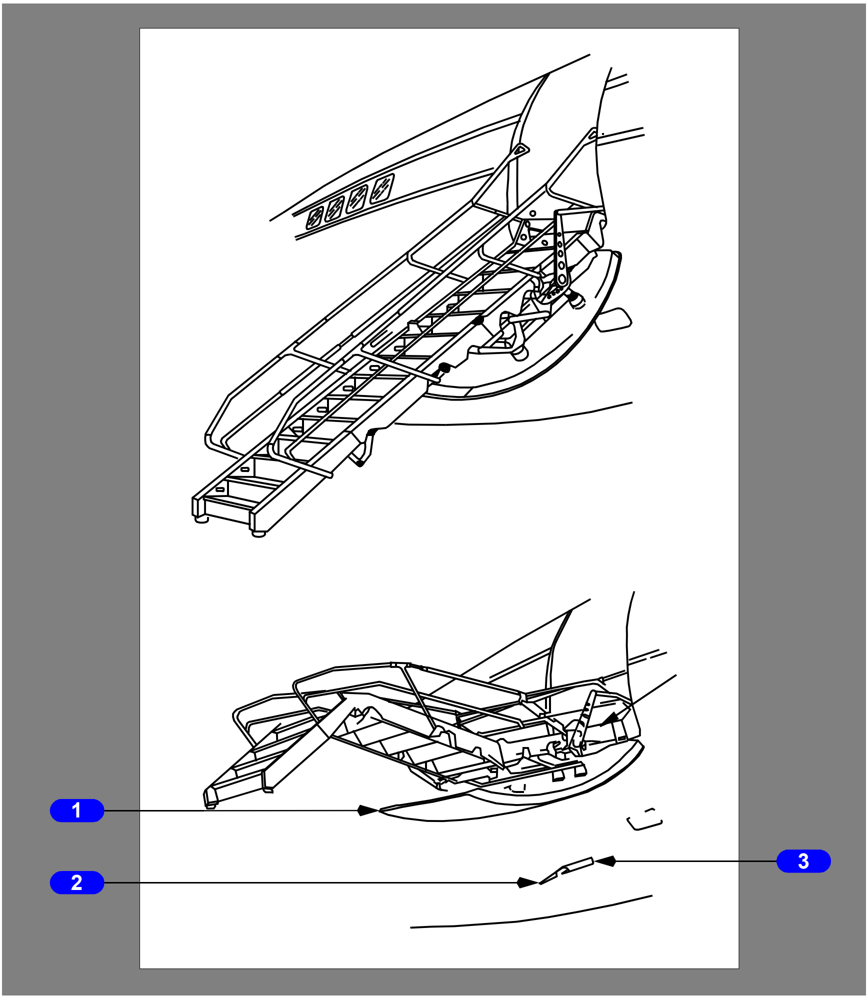
The airstair can be extended and retracted from inside the airplane, electrically or manually.

Note: Exterior control extends electrically or manually, but retracts only electrically.

When the aft airstair is retracted, it folds in three sections and is stowed inboard of the entry door. The aft entry door is included in the door warning system.

Aft Airstair and Entry Door

Exterior Controls



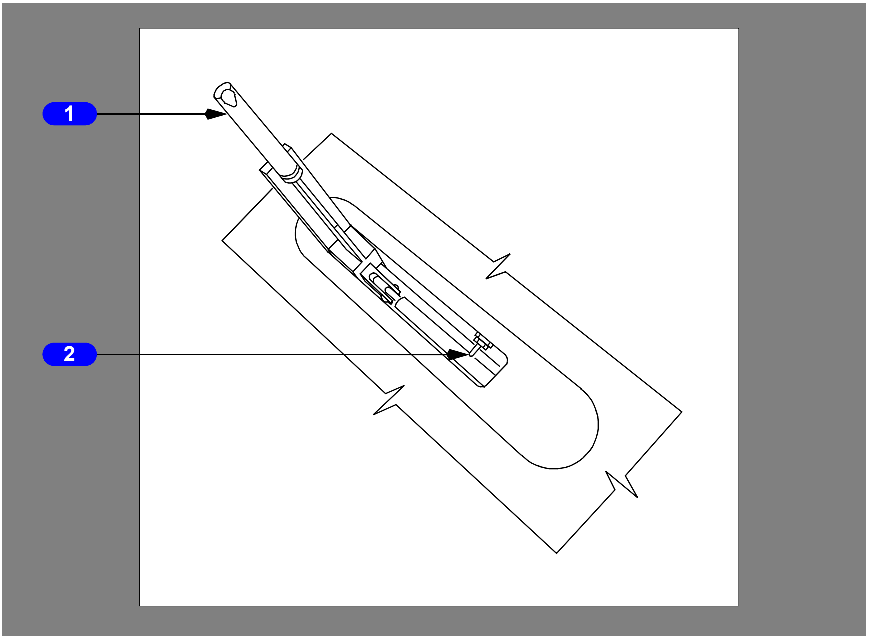
1 **Aft Entry Door**

2 **Exterior Airstair Control Handle**

3 **Extend/Retract Switch**

Electrical or manual extension. Retraction is electrical only.

Exterior Control Below Aft Entry Door



1 Exterior Airstair Control Handle

- Locks and unlocks the aft entry door
- When pulled to the EMERGENCY position, airstair free-falls to the extended position.

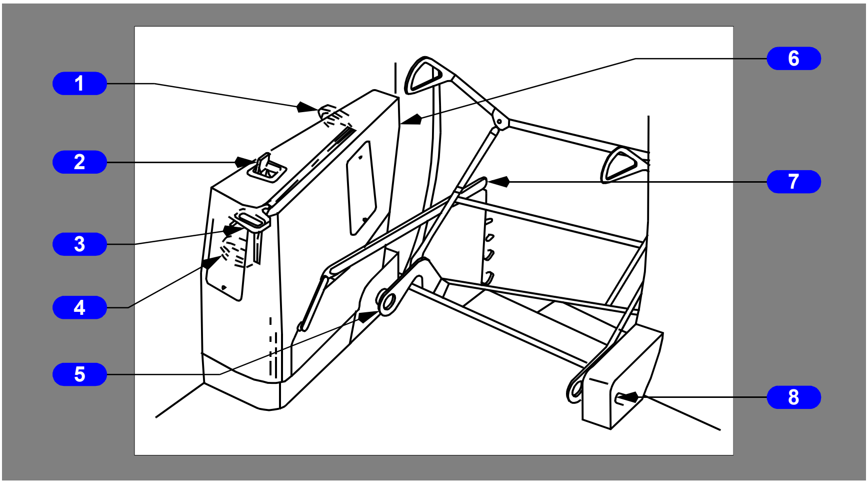
2 Extend/Retract Switch

Note: AC and DC electrical power must be available on airplane.

Extend – extends the airstair.

Retract – retracts the airstair.

Interior Controls



1 **Latched Position**

2 **Extend/Retract Switch**

3 **Door Unlatched Detent Position (unmarked)**

4 **Emergency Position**

5 **Emergency Roller Arm**

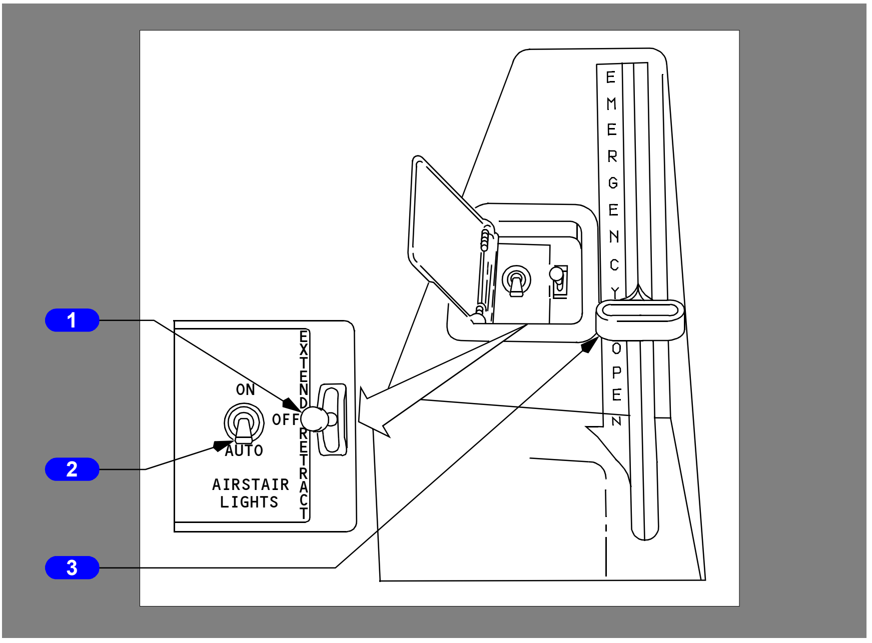
6 **Interior Airstair Control Console**

7 **Programming Arm**

8 **Manual Drive**

Stairs may be extended manually when electrical power is unavailable.

Airstair Control Panel at Aft Entry Door



1 Extend/Retract Switch

Note: AC and DC electrical power must be available on airplane.

EXTEND – extends the airstair.

RETRACT – retracts the airstair.

OFF – removes power and stops airstair.

2 Airstair Lights Switch

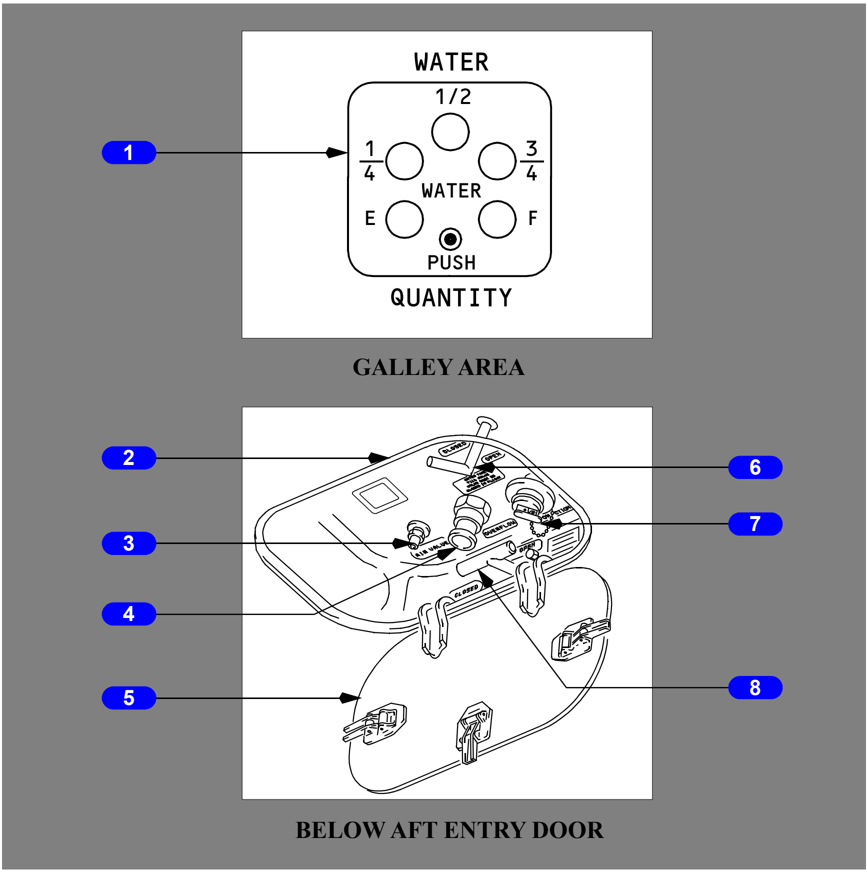
ON – illuminates the airstair tread lights.

AUTO – the airstair tread lights illuminate automatically upon airstair extension and extinguish upon retraction.

3 Control Handle

- Locks and unlocks the aft entry door
- When pulled to the EMERGENCY position, airstair free-falls to the extended position.

Water System Controls



GALLEY AREA

BELOW AFT ENTRY DOOR

1 Water Quantity Indicator

Push – lights illuminate to indicate quantity of water in reservoir.

Example: With reservoir half full, the E, 1/4, and 1/2 lights illuminate.

2 Water System Service Panel

3 Air Valve

Pressurizes tank and system when normal pressure sources are not available.

4 Overflow Fitting

Prevents overfilling of tank and allows venting of tank when gravity draining.

5 **Access Panel**

Cannot be closed unless the fill and overflow valve and tank drain valve handles are in the closed position.

6 **Fill and Overflow Valve Handle**

OPEN – enables filling or gravity draining water tank.

CLOSED – normal position.

7 **Fill Fitting**

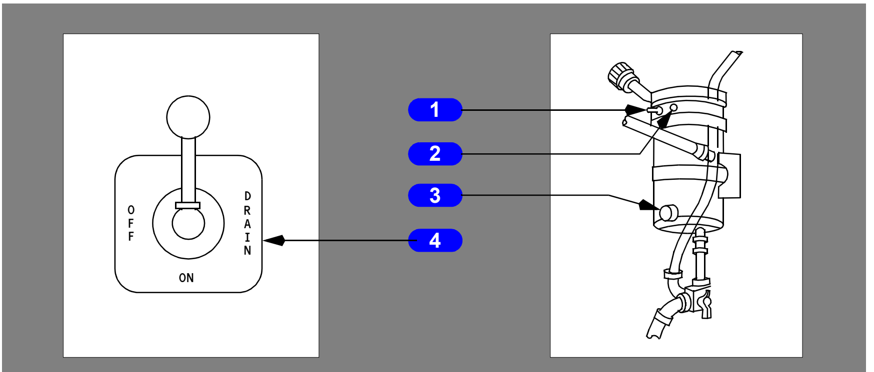
Used to fill tank.

8 **Tank Drain Valve Handle**

OPEN – drains water from tank.

CLOSED – normal position.

Lavatory Controls



LAVATORY SINK CABINET

1 **Water Heater Switch**

ON – activates the water heater.

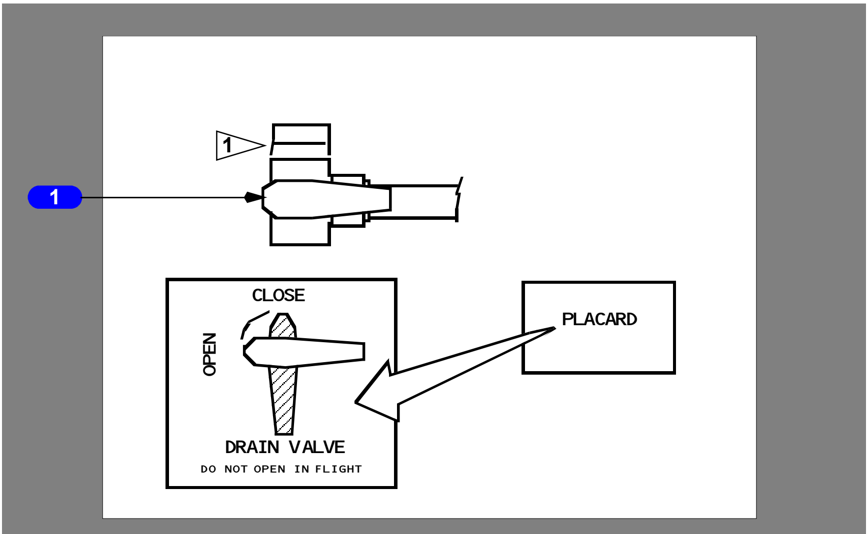
2 **Water Heater Light**

Illuminated – heater operating.

3 **Temperature Control Switch**

4 **Water Shutoff and Drain Valve Control**

- ON – provides water to lavatory sink faucets and heater (normal position)
- OFF – shuts off water to lavatory sink faucets and heater
- DRAIN – drains water overboard through respective drain fitting.

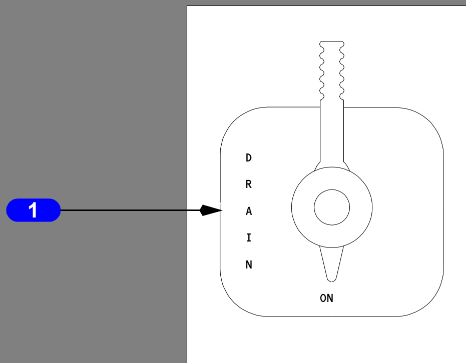


FWD LAVATORY SINK CABINET

1 As installed

1 **Water Supply Drain Valve**

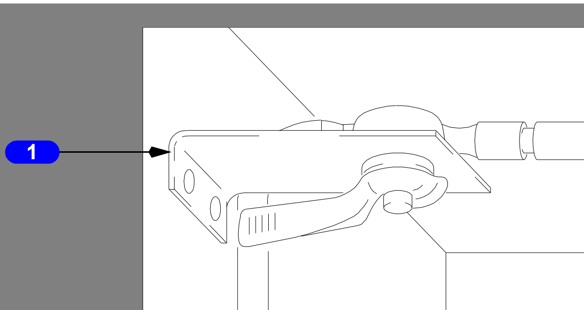
- OPEN - the drain valve allows the water to drain from all the Lavatory A and galley supply lilnes.
- CLOSE - the water from the supply lines flows to the lavatory and galley components and dows not flow overboard.



FWD LAVATORY SINK CABINET

1 Fwd Vent Valve Control

- ON – normal position for valve
- DRAIN – enables pressure or gravity draining of system when Water Shutoff and Drain Valve Control is positioned to DRAIN.



AFT LAVATORY SINK CABINET

1 Aft Vent Valve Control

- CLOSED (valve handle pointing into cabinet) – normal position
- OPEN (valve handle parallel to airplane centerline) – Enables system draining when Water Shutoff and Drain Valve Control positioned to DRAIN.

Airplane General, Emergency Equipment, Doors, Windows — Chapter 1
Systems Description — Section 40

Introduction

This chapter describes miscellaneous airplane systems, including:

- lighting systems
- oxygen systems
- fire extinguishers
- emergency equipment
- doors and windows
- cargo compartments
- emergency egress
- flight deck seats
- galleys
- water systems
- lavatories
- airstairs.

Lighting Systems

Lighting systems described in this chapter include:

- exterior lighting
- flight deck lighting
- passenger cabin lighting
- emergency lighting.

Exterior Lighting

Exterior lighting consists of these lights:

- landing
- runway turnoff
- taxi
- position (navigation)
- anti–collision
- wing illumination
- wheel well

Outboard Landing Lights

Outboard landing lights are installed in the outboard flap track fairings. The lights are designed to extend and shine forward, parallel to the waterline of the airplane.The lights may be extended at any speed.

Inboard Landing Lights

Two inboard landing lights are in the wing leading edge. The lights shine forward and down in a fixed position.

Runway Turnoff Lights

Runway turnoff lights are in each wing root. The lights illuminate the area in front of the main gear.

Taxi Lights

The taxi light is mounted on the nose wheel strut and points in the same direction as the nose wheel. The light will not extinguish automatically when the nose gear is retracted. For increased service life of the taxi light, it is recommended that the taxi light not be used for takeoffs or landings.

Position Lights

The navigation lights are the standard red (left forward wingtip), green (right forward wingtip), and white (aft tip of both wings) position lights.

Anti–collision Lights

Two red anti–collision strobe lights are located on the top and bottom of the fuselage.

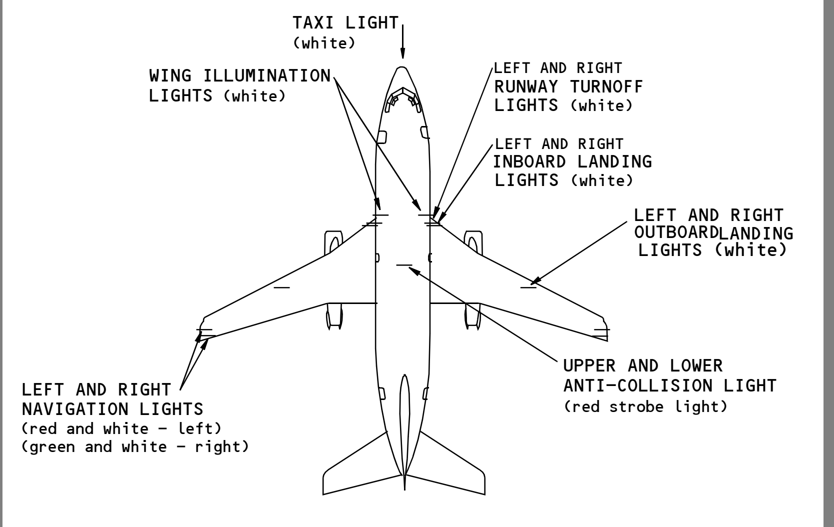
Wing Illumination Lights

Wing lights are installed on the fuselage and illuminate the leading edge of the wing.

Wheel Well Lights

Lights are installed in the wheel well of the nose gear and each main gear.

Exterior Lighting Locations



Flight Deck Lighting

White dome lights provide general flight deck flood lighting. When red dome lights are installed, a separate switch provides variable intensity control of the red dome lights overhead and on the sidewalls. The Captain's and First Officer's instruments are illuminated by white flood lights under the light shield and by integral white lights in the panels. Flight kit, map, reading, and circuit breaker panel lights are controlled by individual switches. A separate switch at the base of the standby magnetic compass controls compass illumination.

Panel and Background Lights

The variable intensity switch marked BACKGROUND on the Captain's instrument panel provides control of the background lights. Rotating the switch clockwise to the detent increases the brightness of the incandescent lights. Movement beyond the detent turns on the fluorescent flood lights. The background (flood) lights illuminate the Captain's, First Officer's, and center instrument panels.

The controls marked PANEL activate the integral instrument lighting for the associated panel. The center instrument panel integral lights are controlled by the Captain's panel control.

On panel light controls with two knobs, the outer knob controls the instrument lighting, and the inner knob controls the lights in the electronic DME miles indicator.

Passenger Cabin Signs

The passenger cabin signs are controlled by a switch on the forward overhead panel. With AUTO selected, the signs are controlled automatically by reference to landing gear and flap positions:

NO SMOKING signs:

- Illuminate when gear is extended
- Extinguish when gear is retracted.

FASTEN BELTS and RETURN TO SEAT signs:

- Illuminate when flaps or gear are extended
- Extinguish when flaps and gear are retracted.

All passenger signs can be controlled manually by positioning the respective switch to ON or OFF.

When the passenger cabin signs illuminate or extinguish, a low tone chime sounds over the PA system.

Master Lights Test and Dim Switch

Certain cockpit indicator lights may be tested with a switch on the center instrument panel. The switch has three positions:

TEST:

- The majority of the cockpit indicators will illuminate BRIGHT.
- The fire warning lights are tested as a part of the functional checks of the fire warning system
- The master caution system will not RECALL with the switch in the TEST position.

BRT:

- Light intensity is bright.

DIM:

- Light intensity is dim for the majority of the indicator lights.

Passenger Cabin Lighting

Passenger cabin lighting is supplied by incandescent and fluorescent lights. General cabin lighting is provided by window lights, ceiling lights, and entry lights. Reading lights are located above each passenger seat in the passenger service unit. Lights are also installed in the lavatories and galleys.

Power Sources

Flight deck and passenger cabin lights are divided between the two main AC busses so that failure of either bus will result in only partial loss of lighting.

Hot Battery Bus

With the battery switch OFF, and external power connected, the dim entry lights will be illuminated from the hot battery bus. The fluorescent mirror lights in the lavatories will also be illuminated.

Battery Bus

Loss of all AC power will leave only the following lights powered from the battery bus:

Flight Deck Lights:

- Standby compass light
- White dome lights
- Emergency instrument flood lights
- Selected system information and warning lights.

Passenger Cabin Lights:

- Emergency exit lights.

Note: Failure of AC transfer bus No. 2 (TRANSFER BUS OFF Light illuminated) will automatically turn on the emergency instrument flood lights.

Emergency Lighting

Clearly marked exit lights are located throughout the passenger cabin to indicate the approved emergency exit routes. All of the lights are powered by individual nicad batteries with a charging, monitoring, and voltage regulator circuit.

The system is controlled by a switch on the overhead panel. The switch has three positions, OFF, ARMED and ON and is guarded to the ARMED position. With the switch in the ARMED position, the emergency exit lights are normally extinguished. If electrical power to the 28 volt DC bus No. 1 fails or if AC power has been turned off, the emergency exit lights illuminate automatically. An amber NOT ARMED light adjacent to the switch will illuminate if the switch is not in the ARMED position.

The emergency exit lights may also be illuminated by a switch on the aft attendant’s panel. This switch has two positions, NORMAL and ON, and is guarded to the NORMAL position.

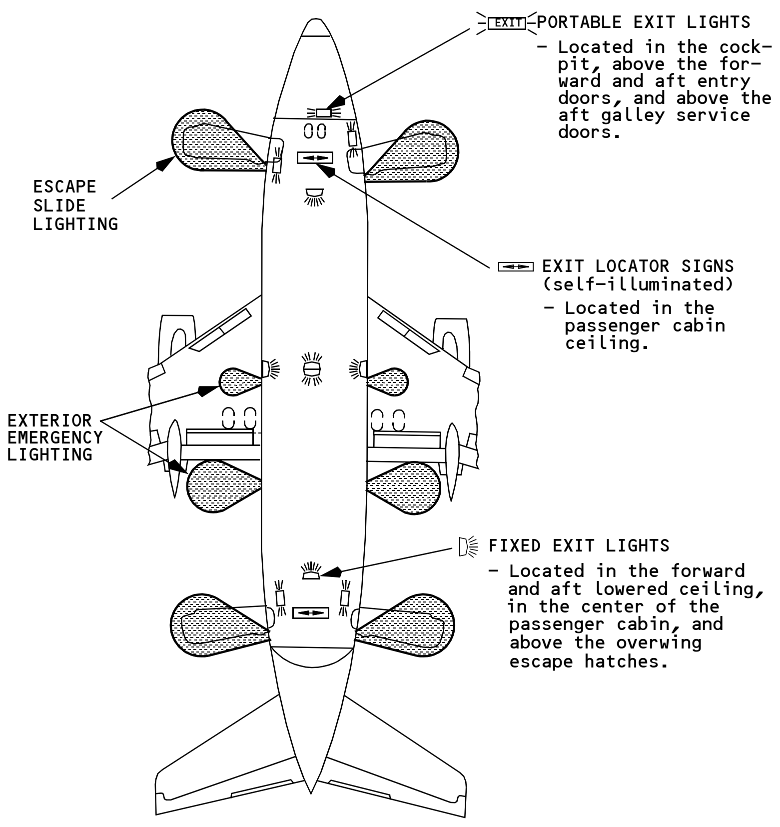
With the switch in the NORMAL position the lights are controlled from the flight deck. Lifting the guard and pushing the switch ON overrides the flight deck control and illuminates all the emergency exit lights. Control from this panel is available in the event of failure of the automatic control.

Portable emergency exit lights are located in the flight deck and over the entry/service doors. These lights may be removed and used as flashlights. With the the cover removed, latches on either end of the light may be depressed to remove the light. If the flight deck Emergency Exit Light Switch is in the ARMED position, and the ARM-ON switch on the light is in the ARMED position, the light illuminates as it is removed from the receptacle. Positioning the ARM-ON switch on the light to ON activates the light.

Fixed lights are located above the overwing emergency hatches and in the ceiling to locate the exits and provide general illumination in the area of the exits. Self-illuminating exit locator signs are installed at the forward, the middle, and aft ends of the passenger cabin.

Exterior emergency lights illuminate the escape slides. The fuselage-installed escape slide lights are adjacent to the forward and aft service and entry doors. Two lights are also installed on the fuselage to illuminate the overwing escape routes and ground contact area. The exterior overwing lights will illuminate if the system is ARMED and the escape hatches are removed.

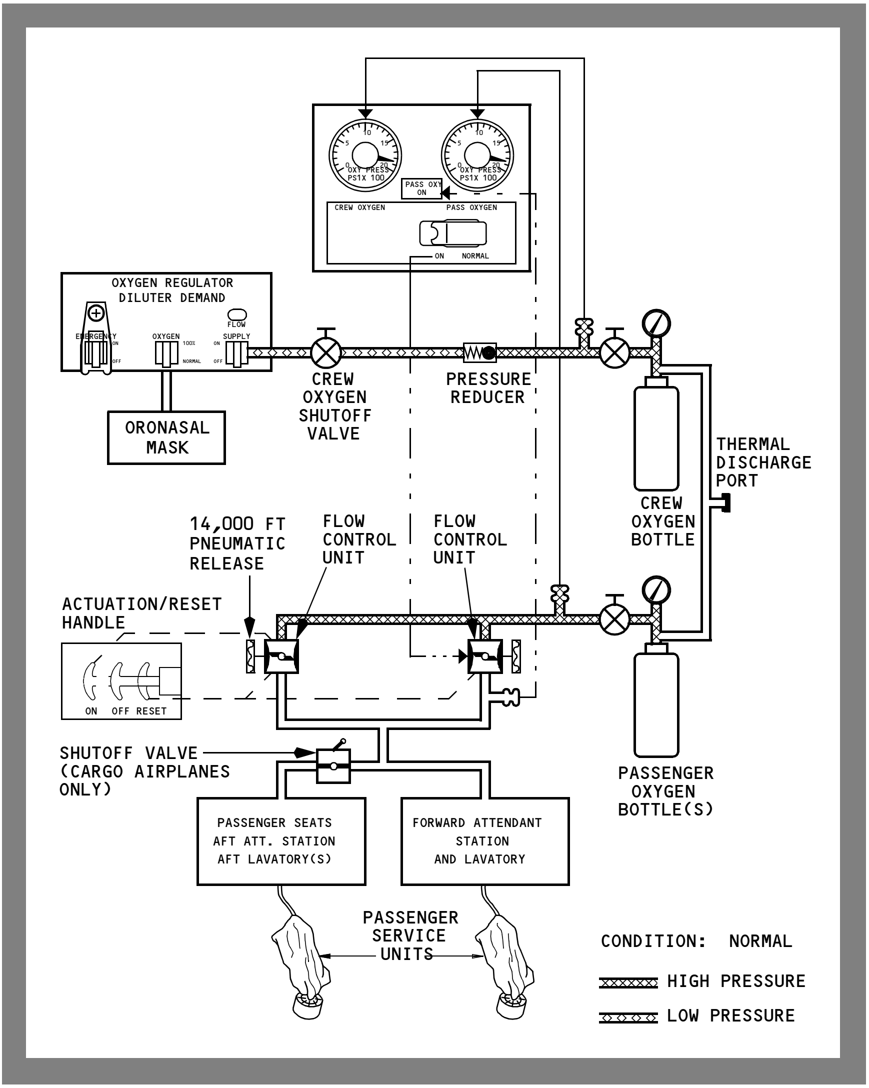
Emergency Exit Lighting



Oxygen Systems

Two independent oxygen systems are provided, one for the flight crew and one for the passengers. Portable oxygen cylinders are located throughout the airplane for emergency use.

Oxygen System Schematic



Flight Crew Oxygen System

On cargo airplanes, the passenger oxygen supply to all outlets aft of the forward attendant's panel and forward lavatory can be secured by closing the PSU shutoff valve located at the aft end of the forward lowered ceiling. Whenever passengers are carried in the cargo airplane, this valve must be open.

The flight crew oxygen system is completely separate from the passenger oxygen system. It uses quick–donning diluter demand masks/regulators located at each crew station. Oxygen is supplied by a single cylinder. Pressure is read on the indicator located on the aft overhead panel when the Battery Switch is ON. Oxygen flow is controlled through a pressure–reducing regulator to supply low pressure oxygen to a shut-off valve located behind the First Officer's seat. Normal pressure is 1850 psi.

A quick-donning mask is located within easy reach of each crew member. Oxygen flow is controlled by a diluter–demand type regulator located immediately adjacent to each crew station.

With the crew shutoff valve open, oxygen flows to each crewmember diluter–demand regulator and oronasal mask. The regulator has three levers which control the flow of oxygen to the mask. The Supply Lever controls the flow of oxygen to the regulator, the Oxygen Diluter Lever controls the air/oxygen mixture being supplied, and the Emergency Lever provides the capability to select 100% oxygen supplied under pressure.

Flight Crew Portable Oxygen

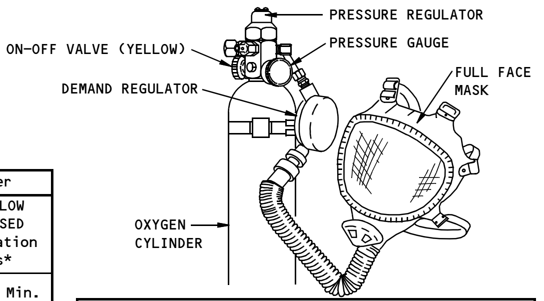
The flight crew portable oxygen unit is a completely self–contained oxygen system, offering both demand and constant flow capabilities. It consists of a portable oxygen cylinder, a pressure regulator (constant flow), a shutoff valve, a quantity indicator to show oxygen supply, a demand regulator, and a sling–type carrying strap.

The portable oxygen cylinder is installed behind and adjacent to the First Officer's seat. When charged to 1800 psi at 70° Fahrenheit (21° Celsius), it contains 11 cubic feet (311 liters) of free oxygen.

The demand regulator has a connection for a demand type full–face mask and supplies 100% oxygen. Normally, the full face mask is attached to the unit and provides portable full–face and respiratory protection from hazardous smoke and fumes.

For constant flow oxygen, a bayonet–type fitting accommodates a disposable continuous flow mask. The cylinder provides oxygen for a duration of approximately 103 minutes using the 3 liter constant flow outlet.

Flight Crew Portable Oxygen Equipment



11 Cu. Ft. Cylinder			
Alt (Feet) or Cabin Alt. Equiv.	IF DEMAND FLOW OUTLET IS USED Estimate Duration in minutes*		
	Max.	Mean	Min.
0	21	12	7
5000	25	15	9
10000	31	18	11
15000	37	22	13
20000	46	27	16
25000	57	33	20
30000	71	41	25

*Estimated duration based on an assumed use rate of 14 LPM-ATPD (sedentary), 24 LPM-ATPD (normal activity), 40 LPM-ATPD (severe activity).

	TO USE
FOR 100% OXYGEN (DEMAND FLOW) USE FULL FACE MASK	1. TURN YELLOW KNOB OPEN 2. ATTACH FULL FACE MASK TO LARGE OUTLET. 3. APPLY MASK TO FACE (TIGHTEN LOWER STRAPS FIRST)
FOR SUPPLEMENTAL OXYGEN (CONSTANT FLOW) USE REBREATHER TYPE MASK	1. TURN YELLOW KNOB OPEN 2. ATTACH MASK HOSE TO SMALL CONSTANT FLOW OUTLET 3. APPLY REBREATHER TYPE MASK TO FACE

Passenger Oxygen System

The passenger oxygen system is normally inactive. System pressurization occurs in one of three ways:

- Automatically when cabin altitude reaches approximately 14,000 feet
- The Passenger Oxygen Switch on the overhead panel is positioned ON
- The Manual Actuation and Reset Handle in the cockpit floor is pulled ON

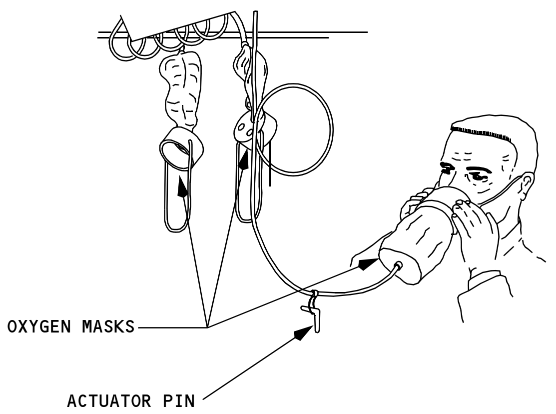
The passenger oxygen system is continuous flow, and is pressurized to 1850 psi.

An amber PASS OXY ON Light on the overhead panel illuminates when pressure is sensed in the system.When the system is activated, the masks in the passenger cabin drop from their stowed position. Pulling the mask to one’s face pulls the actuator pin and allows oxygen to flow through the mask at a constant rate. The oxygen provided to the passenger mask is diluted by cabin air in variation with cabin altitude.

When cabin altitude is below 14,000 feet, the oxygen system may be shut off by using the Manual Actuation and Reset Handle in the cockpit floor. To reset, the handle must be pushed and held in the reset position for five seconds.

To shut off an individual passenger service unit (PSU) mask, reset the valve or replace the pin which is secured to the hose.

PSU Oxygen Mask Compartment



WARNING: When using passenger oxygen, the "NO SMOKING" sign should be strictly observed. Once in use, the flow of oxygen is constant, whether or not the mask is being worn, until shut off at the PSU or by the Manual Activation Handle.

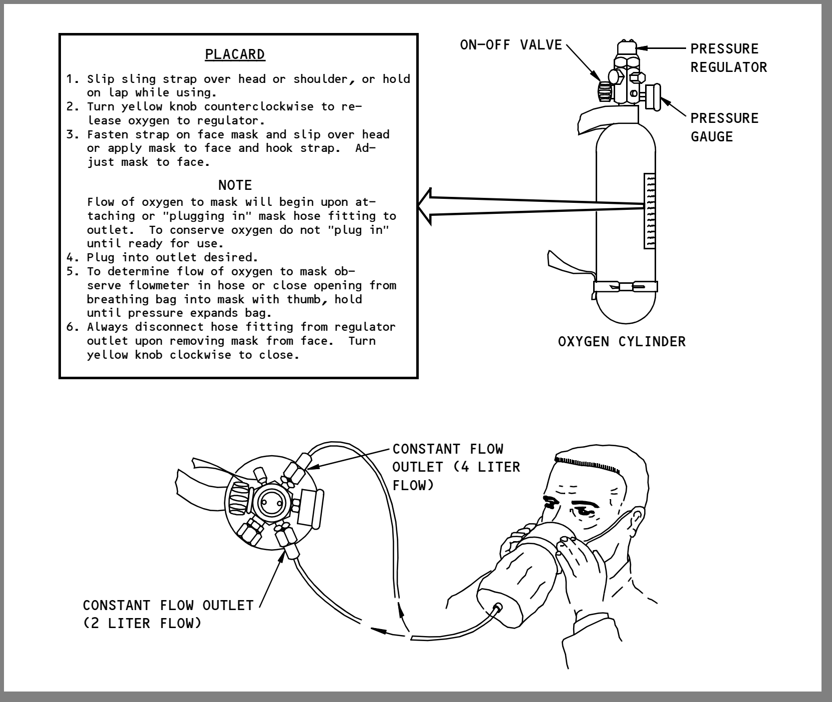
WARNING: Do not use passenger oxygen with cabin altitude below 14,000 feet when smoke or an abnormal heat source is present. The use of passenger oxygen does not prevent the passengers from inhaling smoke. Air inhaled is a mixture of oxygen and cabin air.

Passenger Portable Oxygen

First aid and sustaining portable oxygen cylinders are installed at suitable locations in the passenger cabin. The cylinders are fitted with a pressure gauge, pressure regulator and on-off valve. The cylinders are pressurized to 1800 psi. At this pressure and a temperature of 70° Fahrenheit (21° Celsius), the cylinders have a capacity of 4.25 cubic feet (120 liters) of free oxygen. Two continuous flow outlets are provided on each cylinder. One regulates flow at two liters per minute for walk–around; the second outlet provides flow at four liters per minute. The four liter flow is used for first aid.

Duration can be determined by dividing capacity by outflow (120 liters divided by 4 liters/minute = 30 minutes).

Passenger Portable Oxygen Equipment



Fire Extinguishers

Fire extinguishers are located in the flight deck and passenger cabin.

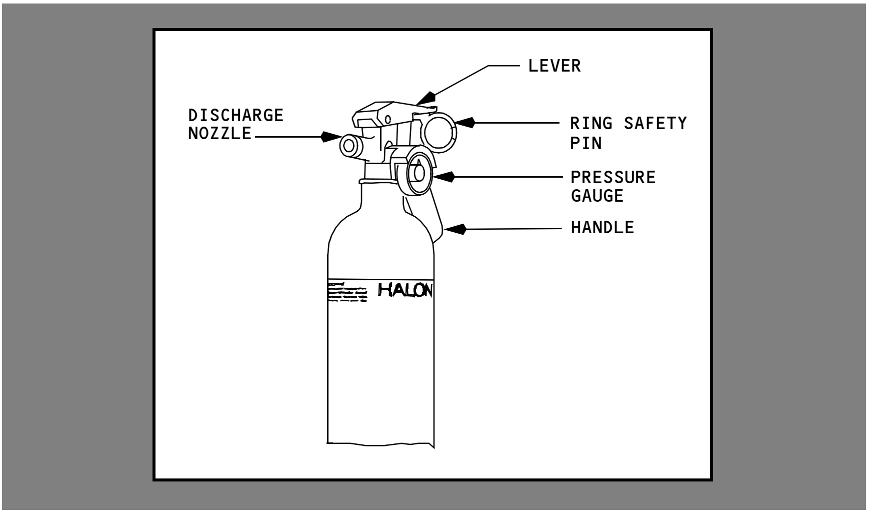
Halon (BCF) Fire Extinguishers

Halon (BCF) fire extinguishers contain a liquefied gas agent under pressure. The pressure indicator shows an acceptable pressure range, a recharge range, and an overcharged range. A safety pin with a pull ring prevents accidental trigger movement. When released the liquefied gas agent vaporizes and extinguishes the fire. The extinguisher is effective on all types of fires, but primarily on electrical, fuel and grease fires.

To use the Halon fire extinguisher:

- Remove from stowage
- Hold upright and remove ringed safety pin
- Aim at base of fire from a distance of six feet and press top lever
- Use side to side motion to suppress fire.

BCF Fire Extinguisher (Halon 1211)



Water Fire Extinguishers

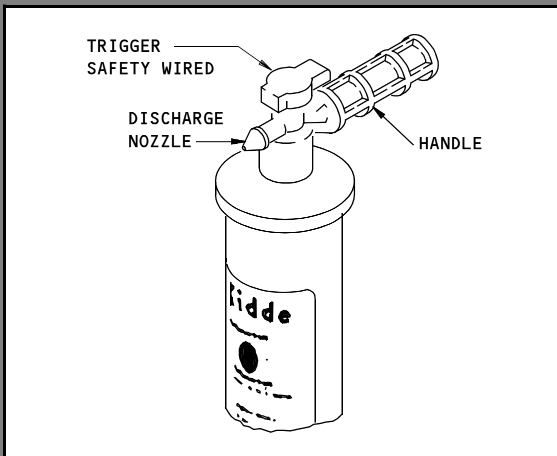
Water fire extinguishers contain a solution of water mixed with antifreeze. The extinguisher should be used on fabric, paper or wood fires only.

To use the water fire extinguisher:

- Remove from stowage
- Remove the safety pin or wire
- Aim at base of fire
- Rotate the handle.
- Depress the discharge trigger.

CAUTION: Do not use on electrical or grease type fires.

Water Fire Extinguisher



Carbon Dioxide Fire Extinguishers

A carbon dioxide (CO2) extinguisher is identified by the horn type nozzle and is intended primarily for use in extinguishing electrical fires. Operation is controlled by a trigger in the handle. Until operated, the trigger is lockwired and sealed.

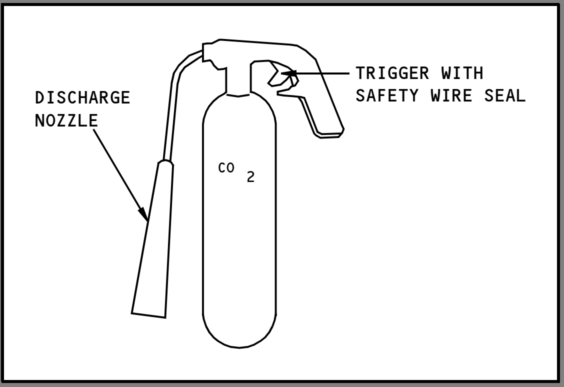
To use the carbon dioxide fire extinguisher:

- Remove from stowage
- Rotate nozzle upright
- Pull the locking pin or the seal at the trigger
- Squeeze the lever and direct the discharge at base of fire.

Note: The compressed CO2 gas is discharged from 4 to 6 feet.

CAUTION: Carbon dioxide is not harmful to fabrics or instruments, but will cause frost bite if directed on bare skin. Avoid grasping the discharge nozzle. In confined areas, don portable oxygen equipment to prevent asphyxiation. Use 100% oxygen until proper ventilation is established.

Carbon Dioxide Fire Extinguisher



Fire Extinguisher Usage

Each class of fire calls for specialized action. Using the wrong extinguisher may do more harm than good. For your own protection, you should know these basic types, how to use them, and why.

CLASSES OF FIRE There are three common classes of fire:			EXTINGUISHER TYPE
CLASS A	combustible MATERIALS	– paper, wood, fabric, rubber, certain plastics, etc., where quenching by water is effective.	TYPE A Water (H_2O) saturates material and prevents rekindling.
CLASS B	FLAMMABLE LIQUIDS	– gasoline, oils, greases, solvents, paints, burning liquids, cooking fats, etc., where smothering action is required.	TYPE B 1. Carbon dioxide (CO_2) 2. BCF (Halon 1211) 3. Dry chemical
CLASS C	LIVE ELECTRICAL	– fires started by short circuit or faulty wiring in electrical, electronic equipment, or fires in motors, switches, galley equipment, etc., where a nonconducting extinguisher agent is required. NOTE: Whenever possible, electrical equipment should be de-energized before attacking a class C fire.	TYPE C 1. Carbon dioxide (CO_2) 2. BCF (Halon 1211) 3. Dry chemical

WARNING: The wrong extinguisher on a fire could do more harm than good. For example, a B C rated extinguisher is not as effective as H2O on a class A fire. Water on flammable liquid fires spread the fire. Water on a live electrical fire could cause severe shock or death.

WARNING: Carbon dioxide (CO2) in excess of 3 percent by volume (sea level equivalent) is considered hazardous in the case of crew members. Higher concentrations of CO2 may not necessarily be hazardous in crew compartments if appropriate protective breathing equipment is available. The CO2 concentration may exceed 3 percent for a minute or so after discharging one CO2 fire extinguisher in the crew compartment.

WARNING: The concentrated agent, or the by–products created by the heat of the fire, are toxic when inhaled. If a fire extinguisher is to be discharged in the flight deck, then all crewmembers are to wear oxygen masks and use 100% oxygen with emergency selected. Whenever fire is encountered on the airplane, landing at the nearest suitable airport is recommended.

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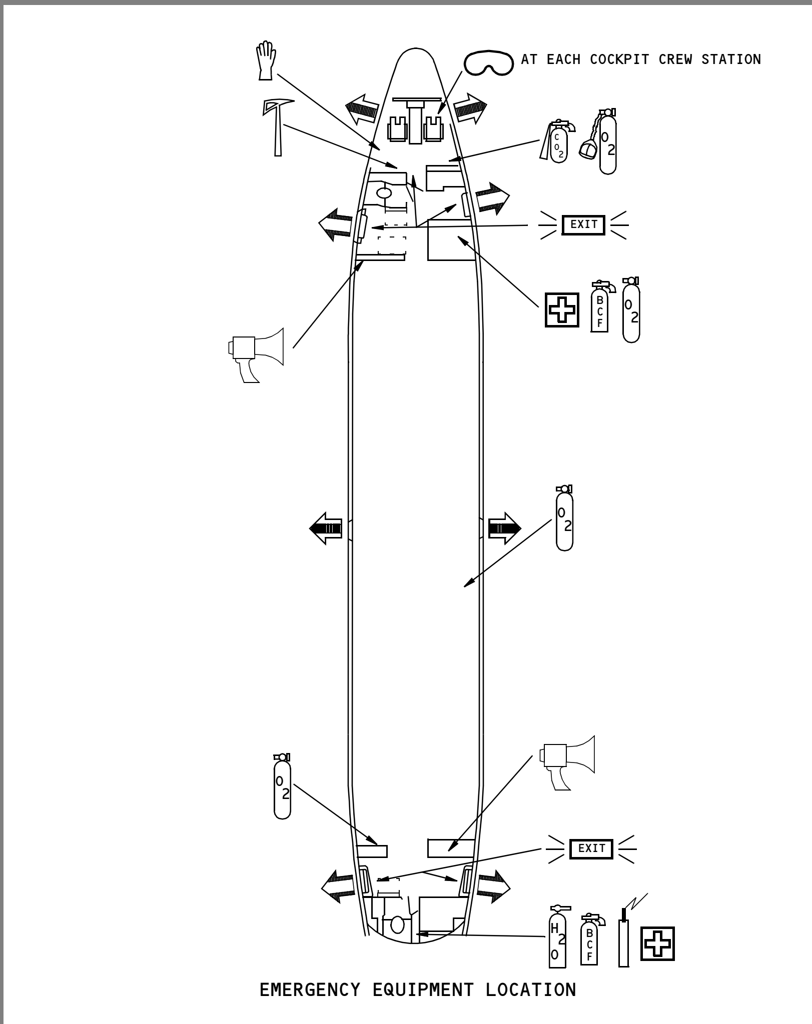
Emergency Equipment Symbols

Emergency Equipment Locations



Doors and Windows

The airplane has two passenger entry doors, one cabin door (the flight deck/passenger cabin entry), and two cargo doors. It also has one center electrical and electronic (E/E) equipment access door on the bottom of the airplane.

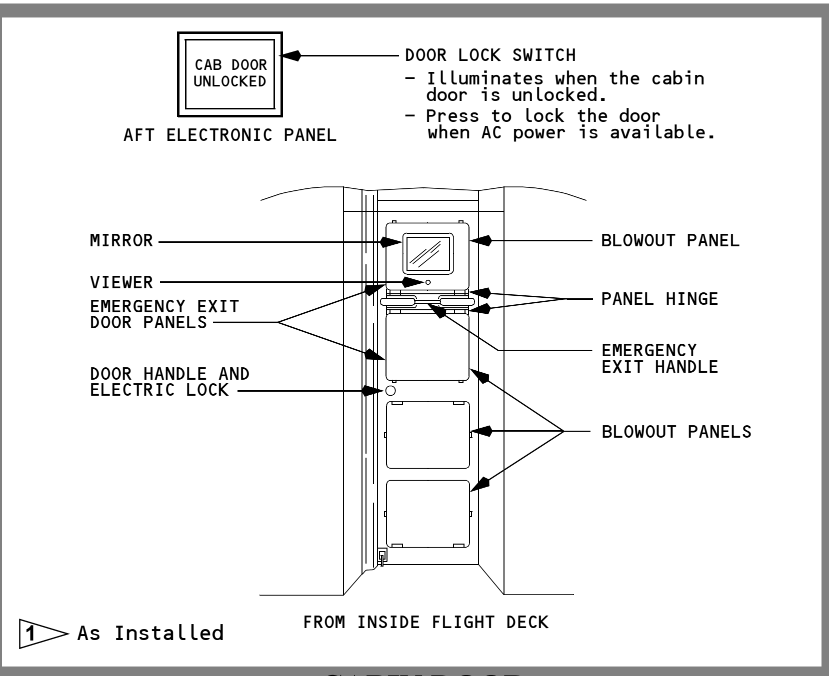
The flight deck number two windows, one on the left and one on the right, can be opened by the flight crew.

Cabin Door

An electrical and keyed lock permits the door to be opened, closed, and locked from either side. With 115 volt AC power available, the door may be electrically locked or unlocked by pressing the door lock switch on the control stand; entrance from the passenger cabin requires a key when the door is electrically locked. The door cannot be locked without electrical power.

There are four blowout panels located in the cabin door. In the event of a sudden depressurization of the flight deck, the blowout panels hinge out from the door. This uncovers openings in the door and allows the air pressure in the flight deck and passenger cabin to equalize.

An emergency exit feature is also provided which permits the release and removal of the two upper blowout panels from the door. To operate, grasp the emergency exit handle on the upper part of the door and pull forward. Panel will not release unless both ends of handle have been pulled away from their locked position.



CABIN DOOR

The flight deck door meets requirements for resistance to ballistic penetration and intruder entrance. The door opens into the passenger cabin. When closed, the door locks when electrical power is available and unlocks when electrical power is removed. A viewing lens in the door allows observation of the passenger cabin.

The door can be manually opened from the flight deck by turning the door handle. The door incorporates a deadbolt with a key lock on the passenger cabin side. Rotating both concentric deadbolt levers to the locked (horizontal) position prevents the passenger cabin key from unlocking the door. Rotating only the forward deadbolt lever to locked allows the key to unlock the door.

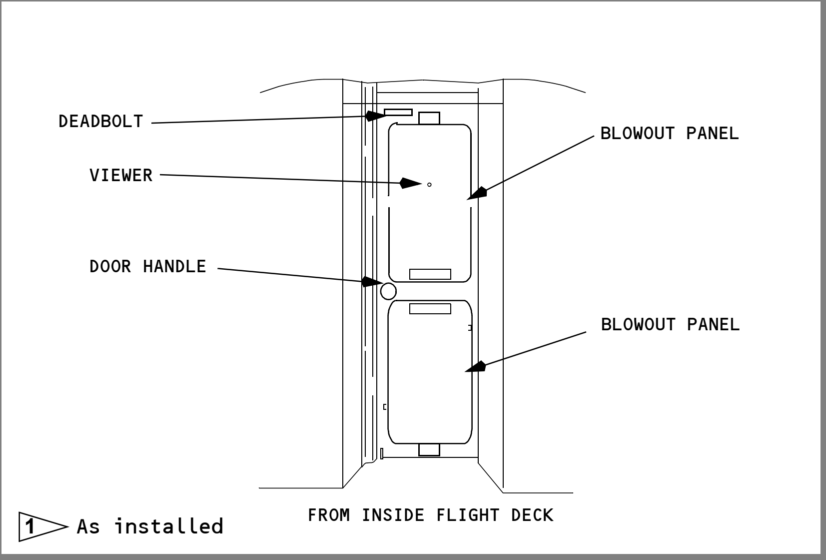
The flight deck access system consists of an emergency access panel, chime module, three position door lock selector, two indicator lights, and an access system switch. The emergency access panel includes a six button keypad for entering the numeric access code along with red, amber, and green lights. The red light illuminates to indicate the door is locked. When the correct emergency access code is entered, the amber light illuminates. The green light illuminates to indicate the door is unlocked.

Illumination of the amber LOCK FAIL light indicates the door lock has failed or the Access System switch is in the OFF position.

The emergency access code is used to gain access to the flight deck in case of pilot incapacitation. A flight deck chime and illumination of the amber AUTO UNLK light indicates the correct emergency access code has been entered and the door is programmed to unlock after a time delay. Selecting the DENY position on the Door Lock selector denies entry and prevents further keypad entry for several minutes. To allow entry, the selector is turned to the UNLKD position which unlocks the door while held in that position. If the emergency access code is entered and the pilot takes no action, the door unlocks after expiration of the time delay. Before the door unlocks, the chime sounds continuously and the AUTO UNLK light flashes.

By pressing "1" then "ENT" keys on the emergency access panel, the flight deck chime will sound (if programmed).

The door incorporates two pressure sensors that unlock the decompression panels in the event pressurization is lost. The decompression panels have manual release pins. Pulling the pins frees the panels allowing egress in the event the door is jammed.

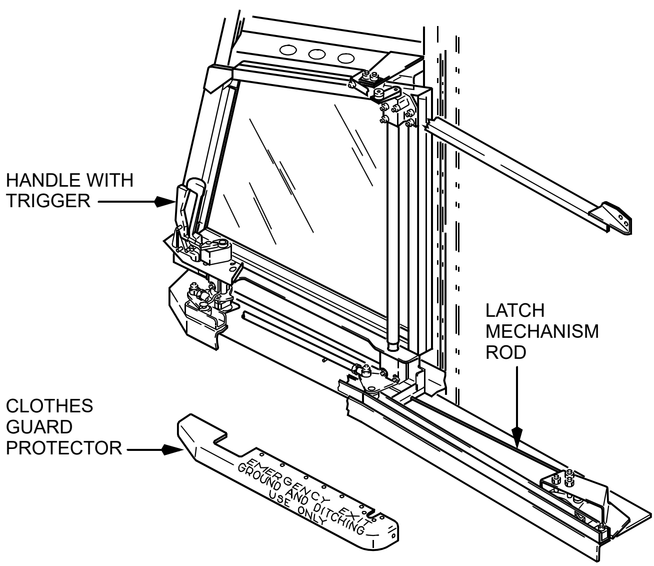


FLIGHT DECK DOOR

Flight Deck Number Two Windows

The flight deck number two windows can be opened on the ground or in flight and can be used for emergency evacuation. To open the window, depress the trigger and turn the handle back and inboard. After the window moves inboard, move it back until it locks in the open position.

To close the window, it must first be unlocked. Pull forward on the latch mechanism rod to unlock the window. Depress the trigger and move the window forward until the handle can be turned forward and outboard. When the trigger is released, the window latches.



FLIGHT COMPARTMENT WINDOW NO. 2
(RIGHT SIDE SHOWN)

Lower Cargo Compartments

The lower cargo compartments, if equipped with smoke and fire detectors and with a built-in fire extinguisher system controlled from the flight deck, satisfy the requirements for Class C compartments.

Note: The certification standards for fire safety in Class D cargo and baggage compartments have been changed. Class D compartments in airplanes used for passenger service must now comply with the standards for Class C compartments. Class C standards require that a compartment be equipped with smoke and fire detectors and with a built-in fire extinguisher system controlled from the flight deck. No inflight access is necessary, but the flight crew must be able to control the ventilating airflow into these compartments. Class D compartments in airplanes used only for cargo service must also comply with the standards for Class C, or with the detection standards for Class E compartments.

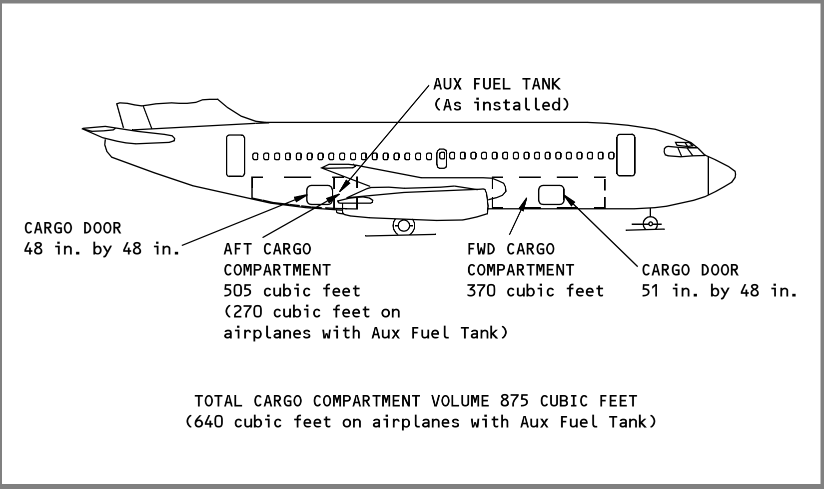
There are two cargo compartment doors on the lower right side of the fuselage. Both are plug type, inward opening pressure doors, hinged at their upper edges and operated manually from either inside or outside the airplane. Except for slight difference in shape, both doors are similar in design and operation. The door is locked closed by four latches. Each door has a balance mechanism which creates door–open force slightly more than equal to the weight of the door. The door can therefore, with little effort, be swung open, until it engages a mechanical lock. The door can be closed easily by pulling a lanyard attached to the door, releasing the uplatch, grasping the handle and closing the door.

Note: When the doors are not locked, the MASTER CAUTION light and DOOR annunciator are illuminated.

A pressure equalization value is in the aft bulkhead of each compartment. The valves let only enough air flow into or out of the cargo compartments to keep the pressures nearly the same as the cabin pressure.

Blowout panels in the lower cargo compartments provide pressure relief at a greater rate than the pressure equalization valve in case the airplane should suddenly lose pressurization.

Lower Cargo Compartments



Emergency Escape

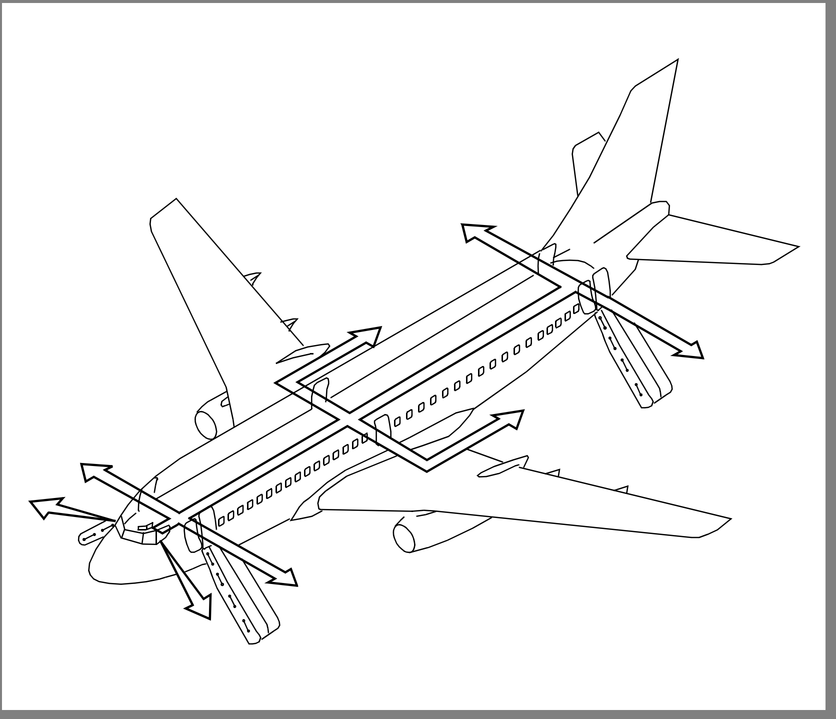
Emergency escape information included in this chapter includes:

- Emergency evacuation routes
- Flight deck windows
- Escape slides
- Escape straps
- Escape hatches.

Emergency Evacuation Routes

Emergency evacuation may be accomplished through four entry/service doors and two overwing escape hatches. Flight deck crew members may evacuate the airplane through two sliding flight deck windows.

Emergency Evacuation Routes



Flight Deck Number Two Windows

Flight deck sliding windows are opened by squeezing the lock release in the handle, rotating the handle inward, and sliding the window aft until it locks. Window unlocking can also be accomplished using an exterior handle: For passenger airplanes, at the First Officer's window only; for cargo airplanes, at both windows.

Flight Deck Escape Straps

An escape strap is attached to a compartment above each No. 2 window. The straps may be used by a crewmember for escape.

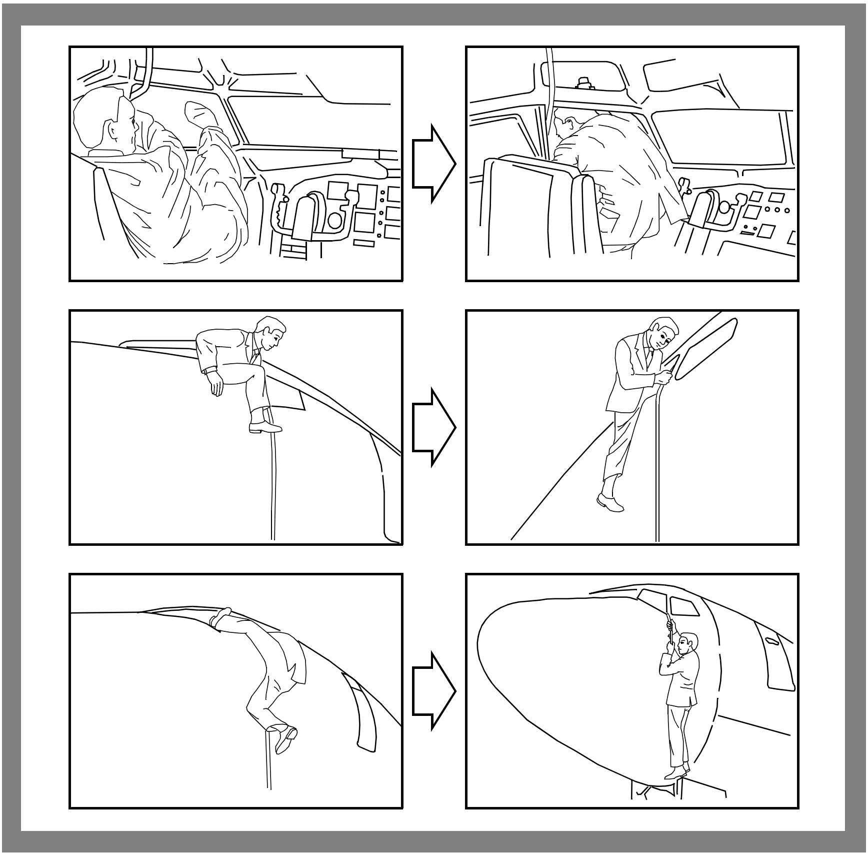
Flight Deck Window Emergency Egress

If the flight deck number two windows must be used for emergency egress, use the following procedure:

- Open the window
- Open the escape strap compartment (above and aft of window)

- Pull on the escape strap to ensure it is securely attached
- Throw the strap out the window
- Sit on the window sill with upper body outside
- Exit in accordance with the following illustration.

CAUTION: Ensure the escape strap is securely fastened to the airplane.

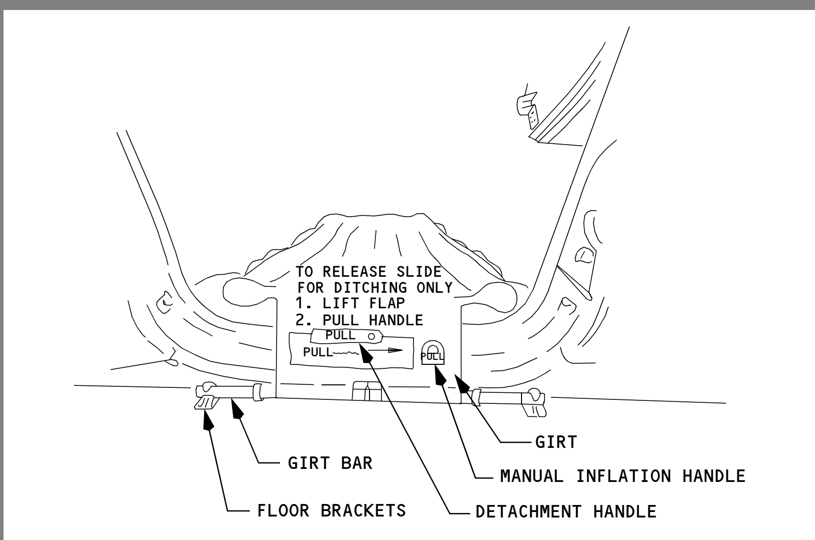


The above illustrated method of departure would probably be the easiest for most crewmembers. This technique is difficult and should be used only in extreme emergency.

Escape Slide Detachment Handle

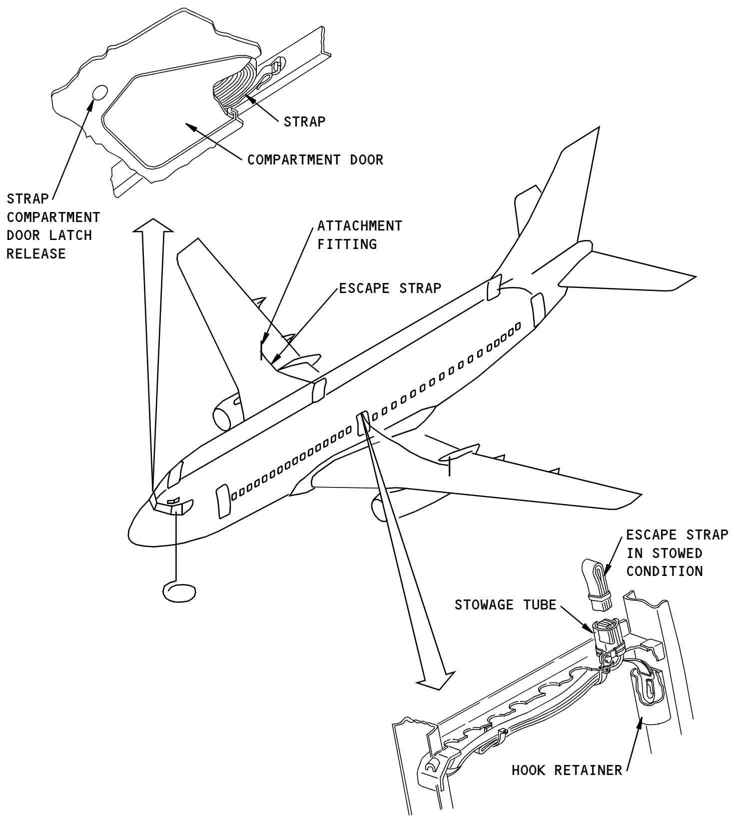
The slide has not been certified to be part of the water landing emergency equipment. In a water environment, the slide may not properly inflate when deployed. If the deployed slide is recognized to be a potential obstruction to egress, a quick release handle is provided near thew top of the slide. This handle is protected by a cover and is placarded. The escape slide is detached from the airplane by pulling the quick release handle. Once detached from the door sill, the slide is tethered to the door sill by a lanyard. A properly inflated slide could be buoyant, and useful as a flotation device for passengers in the water. Hand grips are positioned along the sides of the slide.

Escape Slide Detachment Handle



Overwing Escape Straps

Escape straps are installed above each emergency escape hatch frame. The overwing escape hatches must be removed to expose the straps. One end of the strap is attached to the hatch frame. The remainder of the strap is stowed in a tube extending into the cabin ceiling. To use, the strap is pulled free from its stowage and attached to a ring on the top surface of the wing. The escape strap can be used as a hand hold in a ditching emergency for passengers to walk out on the wing and step into a life raft.



OVERWING ESCAPE STRAP

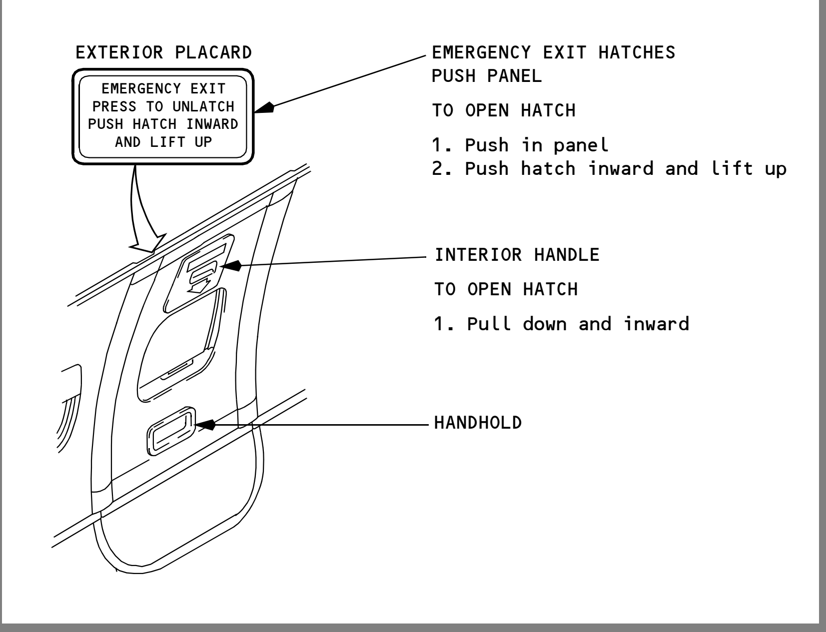
Overwing Escape Hatches

Two escape hatches are located in the passenger cabin over the wings. These are plug type hatches and are held in place by mechanical locks and airplane cabin pressure. The hatches can be opened from the inside or from outside of the airplane by a spring–loaded handle at the top of the hatch.

A seat back blocking an exit may be pushed forward by applying force to the top of the seat back. For safety reasons, hatches should not be removed in flight.

Hatch removal illuminates the overwing emergency exit lights on the same side, provided the flight deck Emergency Exit Light Switch is in the ARMED position.

Overwing Escape Hatches



WARNING: Do not remove hatches in flight in preparation for passenger evacuation. For emergency evacuation on the ground or in water, remove hatch and place so as not to obstruct egress. The hatch may be thrown out onto the wing, placed on the seat arm rests, or placed in any other suitable location as dictated by the conditions at the time of airplane evacuation.

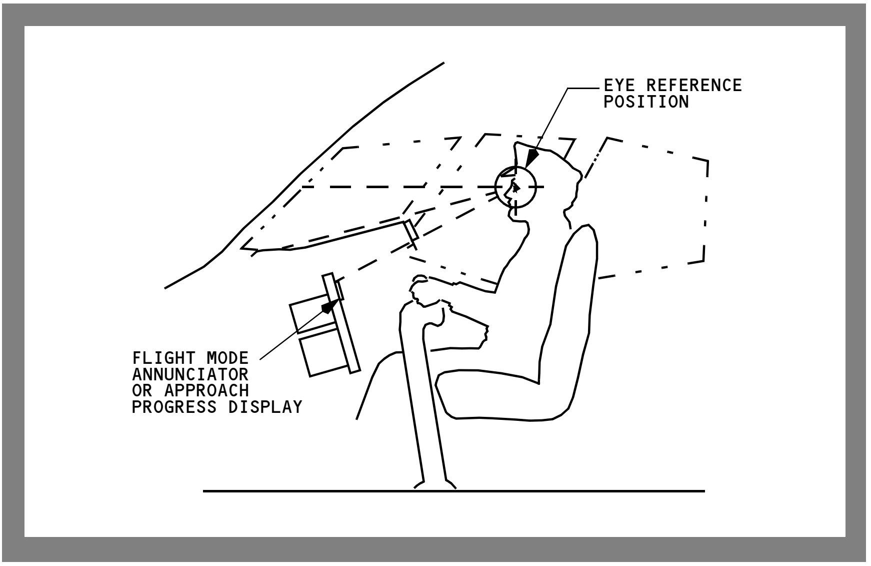
Pilot Seat Adjustment

Adjust the seat position with the appropriate controls to obtain the optimum eye reference position. Use the handhold above the forward window to assist.

The correct eye reference position is established when:

- The topmost flight mode annunciators or approach progress displays are just in view below the glareshield
- A slight amount of the aircraft nose structure is visible above the forward lower window sill.

Pilot Seat Adjustment



Galleys

Galleys are located in the passenger cabin to provide convenient and rapid service to the passengers. Generally, they are installed in the cabin adjacent to the forward and aft galley service doors.

In general the equipment of the galley unit consists of the following main items:

- High speed ovens
- Hot beverage containers
- Hot cup receptacles
- Refrigeration and main storage compartments.

Electrical control panel switches and circuit breakers to operate the above equipment are conveniently located within the galley work area. Storage space, miscellaneous drawers, and waste containers are also integrated in the galley units.

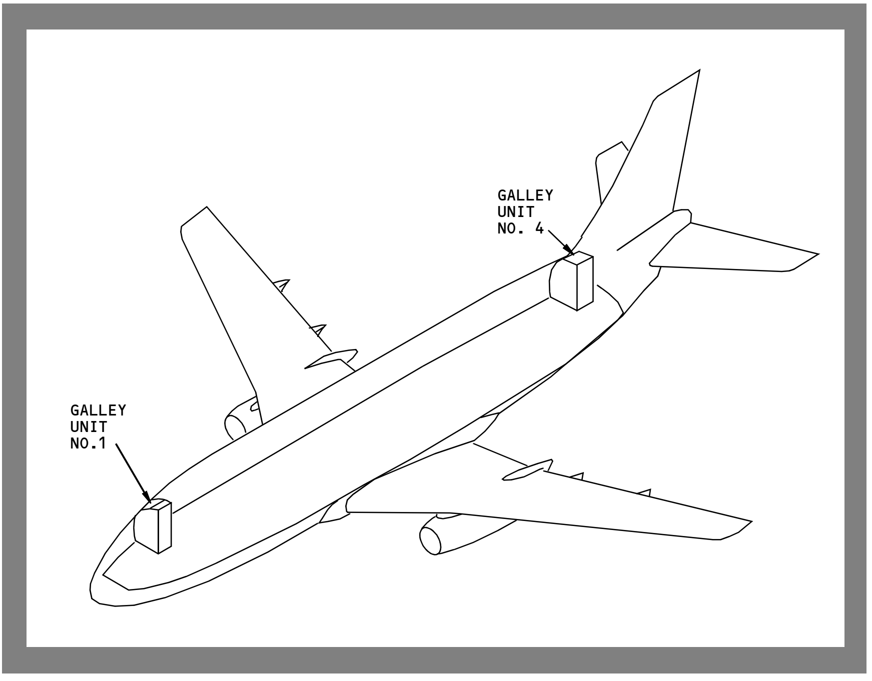
Electrical Service

Electricity for the galleys is 115V AC 400 Hz supplied from the airplane transfer buses and controlled by a switch on the overhead panel. Circuit breakers are located on the galleys and on the P-6 circuit breaker panel.

Water Service

Water is supplied to the galleys from the airplane pressurized water system and, in an emergency, may be shut off at the galleys. Waste water is drained into containers in the galleys.

Galleys



Water System

General

The potable airplane water system is supplied from a single tank located behind the aft cargo compartment. Fresh water is supplied to the galleys and lavatory sinks.

Quantity Indication and System Operation

A quantity indicator is located above the aft service door. When the “PUSH” button on the indicator is pressed, lights illuminate to show the water level. When full, approximately 20 U.S. gallons are available. The system is pressurized when the left engine or the APU is running. A shutoff valve is located in the cabinet below the sink in each lavatory. The drain position of this valve is used to drain all water overboard. Normally, the drain shutoff valves are ON, and the vent valves closed.

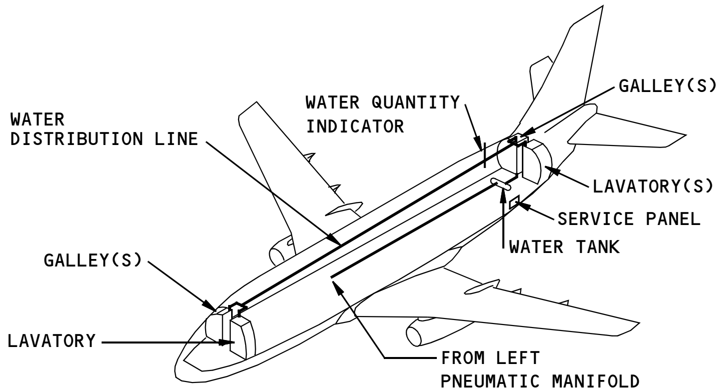
Hot Water

Hot and cold water is available in the lavatories. The water heater is located below the lavatory sink and maintains a water temperature of 125°F to 133°F (52°C to 56°C). When emptied, it heats a new water charge in four minutes. An amber light is ON when the heater is operating normally. The heater has an overheat switch which turns off the heating element if a temperature of 190°F (88°C) is reached. The heater may be turned off at any time by using a manual switch on the heater. Hot and cold water is also supplied at the galleys.

Servicing

The system is serviced from an exterior panel on the aft left side of the airplane. Pressure filling is required. Waste water from the galleys and lavatory wash basins is drained into the containers in the galley.

Water System



WATER AND WASTE SYSTEMS
(Typical)

Forward Airstair

General

The forward airstair provides the capability of boarding passengers without relying on the availability of airport ground equipment. The airstair is electrically operated and may be controlled from either inside or outside the airplane. The airstair is stowed in a compartment just below the forward entry door. The compartment has a pressure door that automatically opens before the airstair will operate. For passenger safety, upper handrails are attached to support brackets inside the entry door after the airstair is fully extended.

Interior Control

The interior control panel is located above the forward entry door. An amber STAIRS OPERATING light on the panel illuminates when the airstair is in transit. The airstair tread lights on the airstair steps are controlled by a single three–position airstair tread LIGHTS switch. With the switch in the AUTO position, the tread lights illuminate when the airstair makes contact with the ground and extinguish when the airstair retracts. The interior control panel has two modes of operation, normal and standby. The standby system provides an alternate means of electrical control in the event the normal mode of operation is not available. Normal and standby operations require both AC and DC power. Both operating modes require the forward entry door to be partially open. The two airstair control switches have three positions - EXTEND, RETRACT, and a center neutral (off) position. For standby operation, hold the spring-loaded guard lever to the left, then select either EXTEND or RETRACT. The lever is spring-loaded to the right to prevent inadvertent operation of the airstair in standby.

Exterior Control

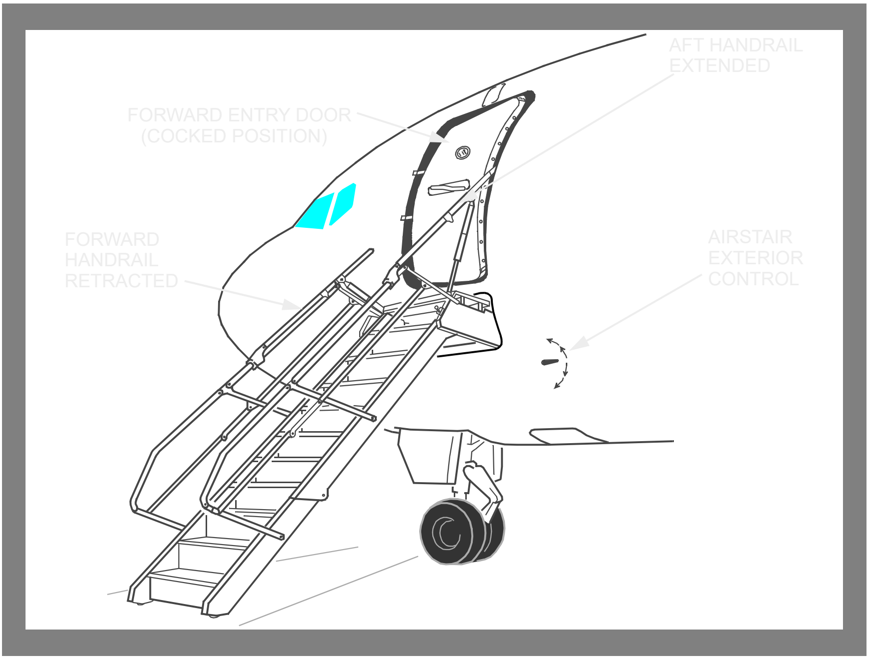
The exterior control is located to the right and below the airstair compartment. Operating instructions are located around the handle. When operating the airstair with the exterior control, the forward entry door need not be open. The exterior control handle by–passes the door–open requirement.

The control handle is normally flush with the fuselage. Pushing the button in the center of the handle extends the handle for easy operation. The handle rotates clockwise or counterclockwise to extend or retract the airstair.

A two–position switch, labeled NORMAL and STANDBY, is located in the exterior handle recess. The switch is spring–loaded to NORMAL. Holding the NORMAL/STANDBY Switch to STANDBY provides DC power from the battery bus for airstair operation. The BAT switch on the flight deck does not need to be ON when operating the airstair on standby from the exterior control panel. The control handle rotates to extend or retract airstair. The use of the standby system from either the interior or exterior control by–passes the handrail and lower ladder safety circuits. Caution must be exercised when using the standby system. If the upper handrail extensions are not properly stowed before retraction, damage to the airplane structure or damage to the airstair's handrail may result.

An amber AIRSTAIR light, located on the overhead door caution annunciator panel illuminates when the airstair pressure door is unlocked. Illumination of the AIRSTAIR light also activates the DOORS annunciator light and the MASTER CAUTION lights. The Airstair light is inoperative when the main AC bus is not powered. The MASTER CAUTION and DOORS lights illuminates in normal or standby operation of the airstair.

Airstairs



WARNING: Use care not to fall from the airstair platform when operating the forward entry door. The small platform area and bad weather can make the door difficult to operate.

Air Systems — Chapter 2
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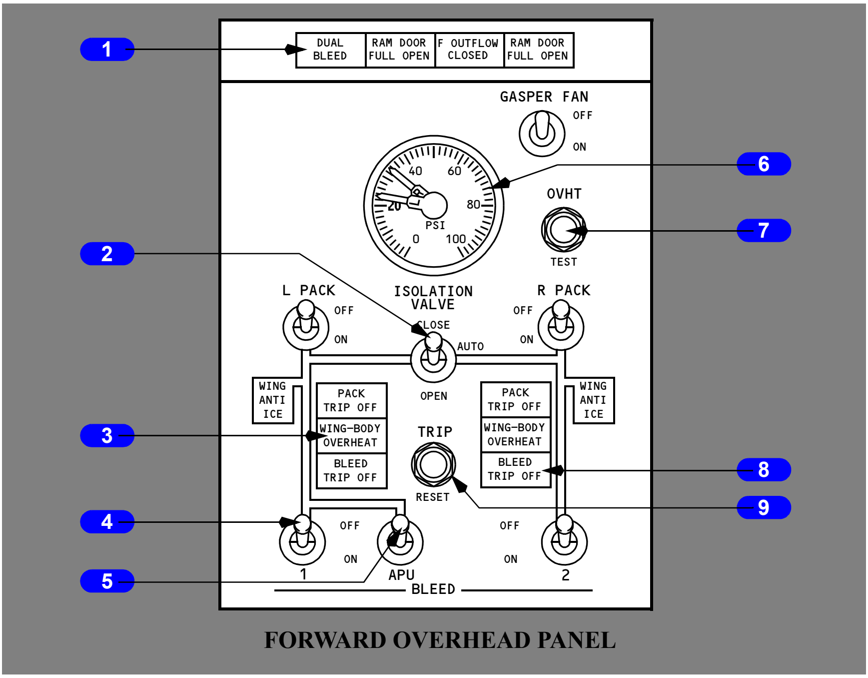
Bleed Air Controls and Indicators



FORWARD OVERHEAD PANEL

1 DUAL BLEED Light

Illuminated (amber) –

- Either APU bleed air valve open and engine No. 1 BLEED air valve open, or
- APU bleed air valve open, engine No. 2 BLEED air valve open and ISOLATION VALVE open.

2 ISOLATION VALVE Switch

CLOSE – closes isolation valve.

AUTO –

- closes isolation valve if all engine BLEED air and air conditioning PACK switches ON
- opens isolation valve automatically if either engine BLEED air or air conditioning PACK switch positioned OFF.

OPEN – opens isolation valve.

3 WING–BODY OVERHEAT Light

Illuminated (amber) –

- left light indicates overheat from bleed air duct leak in left inboard wing leading edge, left air conditioning bay, keel beam or APU bleed air duct
- right light indicates overheat from bleed air duct leak in right inboard wing leading edge or right air conditioning bay.

4 Engine BLEED Air Switches

OFF – closes engine bleed air valve.

ON – opens engine bleed air valve.

5 APU BLEED Air Switch

OFF – closes APU bleed air valve.

ON – opens APU bleed air valve when APU is operating.

5 Bleed Air DUCT PRESSURE Indicator

Indicates pressure in L and R (left and right) bleed air ducts.

7 Wing–Body Overheat (OVHT) TEST Switch

PUSH –

- tests wing–body overheat detector circuits.
- illuminates both WING–BODY OVERHEAT lights.

8 BLEED TRIP OFF Light

Illuminated (amber) – indicates excessive engine bleed air temperature

rela

- ted engine bleed air valve closes automatically
- requires reset.

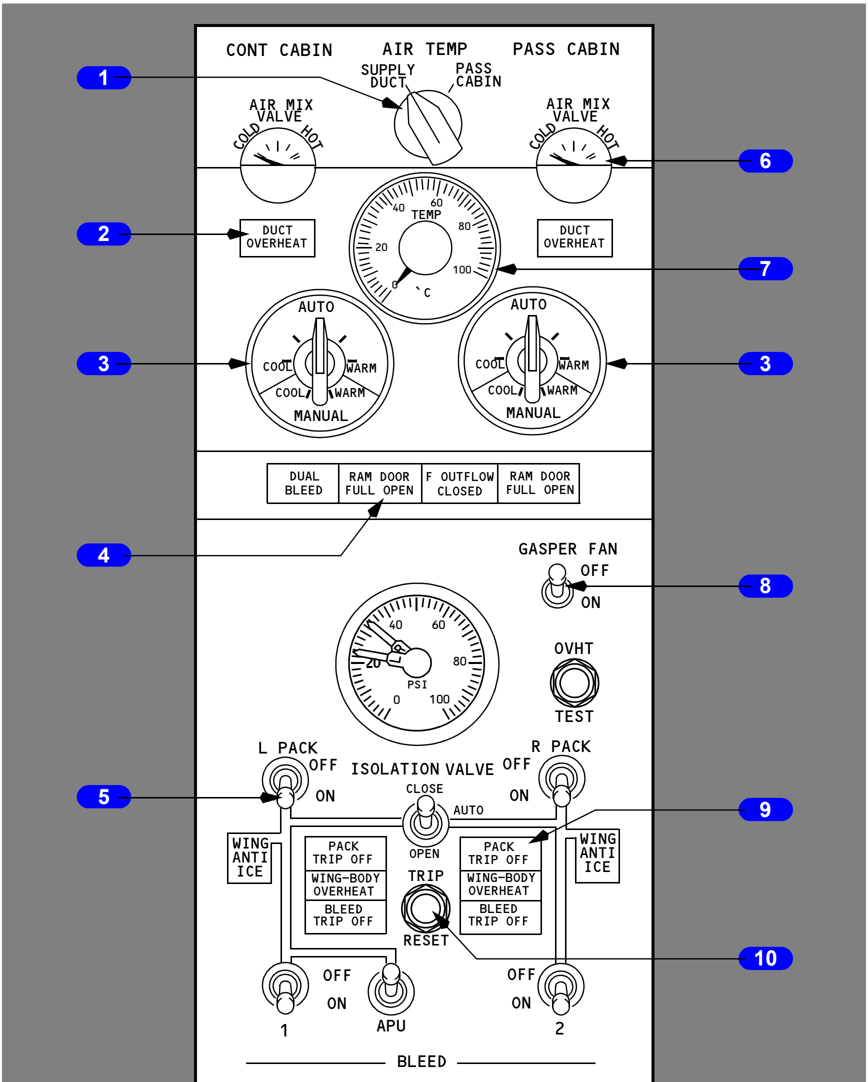
9 TRIP RESET Switch

PUSH (if fault condition is corrected) –

- resets BLEED TRIP OFF, PACK TRIP OFF or DUCT OVERHEAT lights

Lights remain illuminated until reset.

Air Conditioning Controls and Indicators



FORWARD OVERHEAD PANEL

1 AIR Temperature (TEMP) Source Selector

SUPPLY DUCT – selects main distribution supply duct sensor for TEMP indicator.

PASS CABIN – selects passenger cabin sensor for TEMP indicator.

2 DUCT OVERHEAT Light

Illuminated (amber) –

- bleed air temperature in related duct exceeds limit
- air mix valves drive full cold
- requires reset.

3 Control (CONT) CABIN and Passenger (PASS) CABIN Temperature Selector

AUTO – automatic temperature controller controls passenger cabin or flight deck temperature as selected.

MANUAL – air mix valves controlled manually. Automatic temperature controller bypassed.

4 RAM DOOR FULL OPEN Light

Illuminated (blue) – indicates ram door in full open position.

5 Air Conditioning PACK Switch

OFF – pack signalled OFF.

ON – opens pack valve to allow bleed air to enter pack. Valve is electrically controlled, pneumatically operated.

6 AIR MIX VALVE Indicator

Indicates position of air mix valves:

- controlled automatically with related temperature selector in AUTO
- controlled manually with related temperature selector in MANUAL.

7 Air Temperature (TEMP) Indicator

Indicates temperature at location selected with AIR TEMP source selector.

8 GASPER FAN Switch

OFF – gasper fan signalled off.

ON – increases airflow to individual gasper outlets.

9 PACK TRIP OFF Light

Illuminated (amber) –

- indicates pack temperature has exceeded limits
- related pack valve automatically closes and mix valves drive full cold
- requires reset.

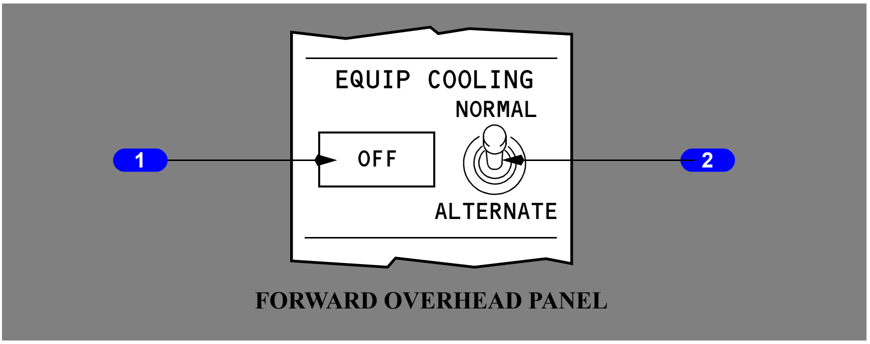
10 **TRIP RESET Switch**

PUSH (if fault condition is corrected) –

- resets BLEED TRIP OFF, PACK TRIP OFF or DUCT OVERHEAT lights

Lights remain illuminated until reset.

Equipment Cooling Panel



1 **Equipment Cooling OFF Light**

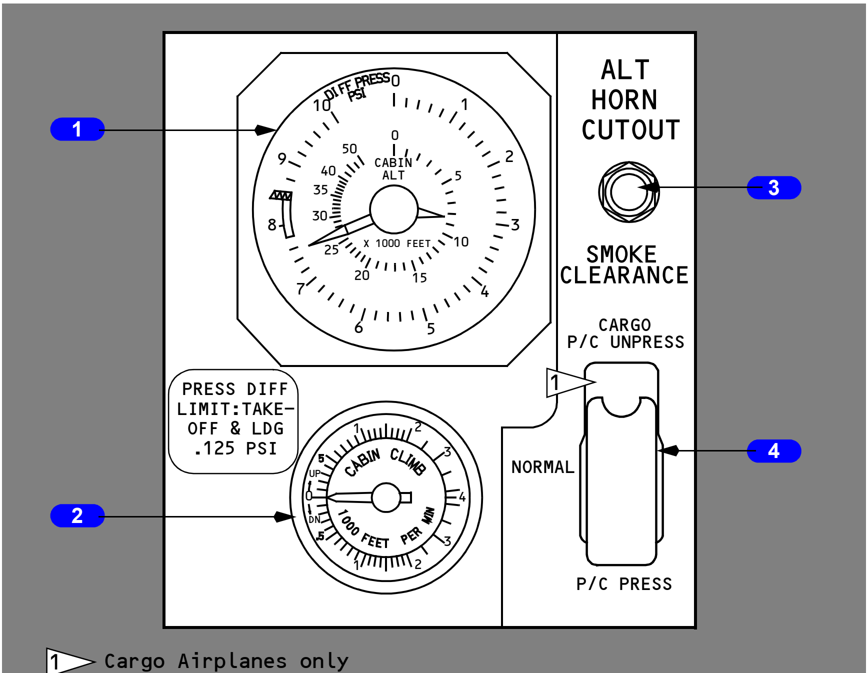
Illuminated (amber) – no airflow from selected cooling fan.

2 **Equipment (EQUIP) COOLING Switch**

NORMAL – normal cooling fan activated.

ALTERNATE – alternate cooling fan activated.

Cabin Altitude Panel



FORWARD OVERHEAD PANEL

1 CABIN Altitude (ALT)/Differential Pressure (DIFF PRESS) Indicator

Inner Scale – indicates cabin altitude in feet.

Note: The CABIN ALT indicator can show a cabin altitude of less than 0 feet and reach the upper end of the cabin altitude scale. This can occur under the following conditions:

- on the ground at airports close to or below seal level.
- in flight when the cabin is pressurized below sea level.

Outer Scale – indicates the difference between cabin pressure and ambient pressure in psi.

2 CABIN Rate of CLIMB Indicator

Indicates cabin rate of climb or descent in feet per minute.

3 Altitude (ALT) HORN CUTOUT Switch

PUSH –

- cuts out intermittent cabin altitude warning horn.
- altitude warning horn sounds when cabin exceeds 10,000 feet altitude.

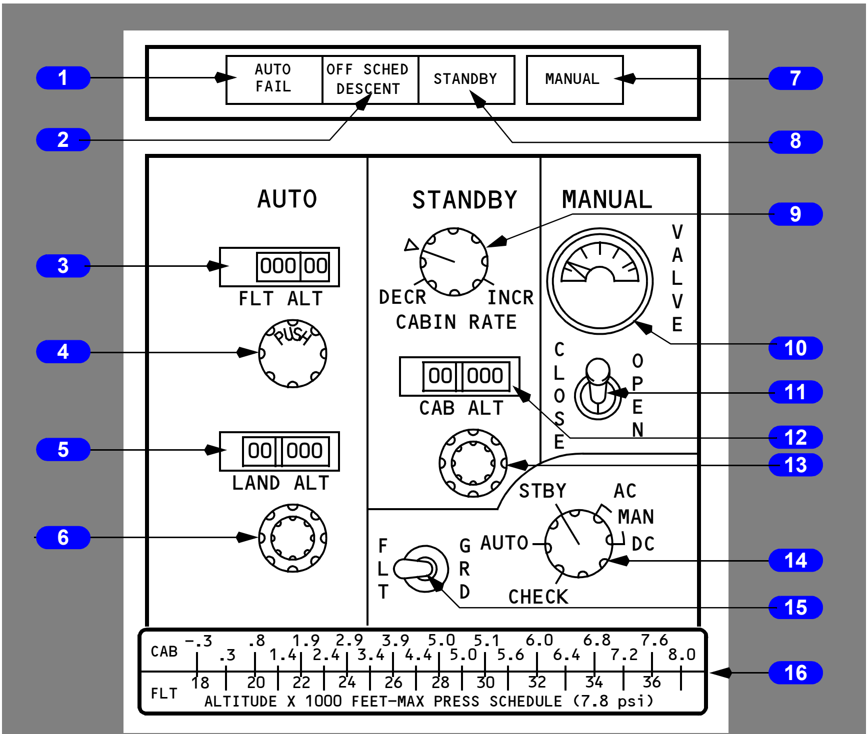
4 SMOKE CLEARANCE Switch (Cargo airplanes only)

CARGO P/C UNPRESS - Used to evacuate smoke in the main cargo compartment in an all-cargo configuration.

NORMAL - Position for all normal pressurized operations.

P/C PRESS - Used to evacuate smoke in the main cargo compartment in a combined passenger/cargo configuration.

Cabin Pressurization Panel



FORWARD OVERHEAD PANEL

1 **AUTO FAIL Light**

Illuminated (amber) – automatic pressurization control failure. Control automatically transfers to the standby mode.

2 **OFF Schedule (SCHED) DESCENT Light**

Illuminated (amber) – airplane descended before reaching the planned cruise altitude set in the FLT ALT indicator.

3 **Flight Altitude (FLT ALT) Indicator**

- indicates selected cruise altitude.
- set before takeoff.

4 **Flight Altitude Selector**

Push/Rotate to set planned cruise altitude.

5 **Landing Altitude (LAND ALT) Indicator**

- indicates altitude of intended landing field.
- set before takeoff.

6 **Landing Altitude Selector**

Rotate to select planned landing field altitude.

- large diameter control sets 1000 foot increments and negative elevations.
- small diameter control sets 10 foot increments.

7 **MANUAL Light**

Illuminated (green) – pressurization system operating in the manual mode.

8 **STANDBY Light**

Illuminated (green) – pressurization system operating in the standby mode.

9 **Cabin Rate Selector**

- DECR – cabin altitude rate of change equals 50 ft/min.
- INCR – cabin altitude rate of change equals 2000 ft/min.
- Index – cabin altitude rate of change equals 300 ft/min.

10 **Outflow VALVE Position Indicator**

- indicates position of outflow valve.
- operates in all modes.

Note: Indicator moves to the full left position when no AC power is available.

11 **Outflow Valve Switch (spring–loaded to center)**

CLOSE – closes main cabin outflow valve electrically with pressurization mode selector in MAN position.

OPEN – opens main cabin outflow valve electrically with pressurization mode selector in MAN position.

12 **Cabin Altitude (CAB ALT) Indicator**

- Indicates selected cabin altitude.
- Set before takeoff.

13 **Cabin Altitude Selector**

Rotate to select desired cabin altitude.

- large diameter control sets 1000 foot increments and negative elevations.
- small diameter control sets 10 foot increments.

14 **Pressurization Mode Selector**

AUTO – pressurization system controlled automatically.

STBY – pressurization system controlled through the standby mode.

MAN –

- pressurization system controlled manually by Outflow Valve Switch.
- AC – outflow valve operates from AC power.
- DC – outflow valve operates from DC power.
- all auto and standby circuits bypassed.

CHECK – Tests auto failure function of AUTO system.

15 **Flight /Ground Switch**

AUTO mode –

- GND – on the ground, drives the pressurization outflow valve full open at a controlled rate and depressurizes the airplane. After takeoff, inhibited; functions the same as FLT position
- FLT – on the ground, pressurizes the cabin to approximately 200ft. below airport elevation. After takeoff, cabin pressure is automatically controlled in climb and descent as a function of airplane altitude. In cruise, cabin pressure is held constant.

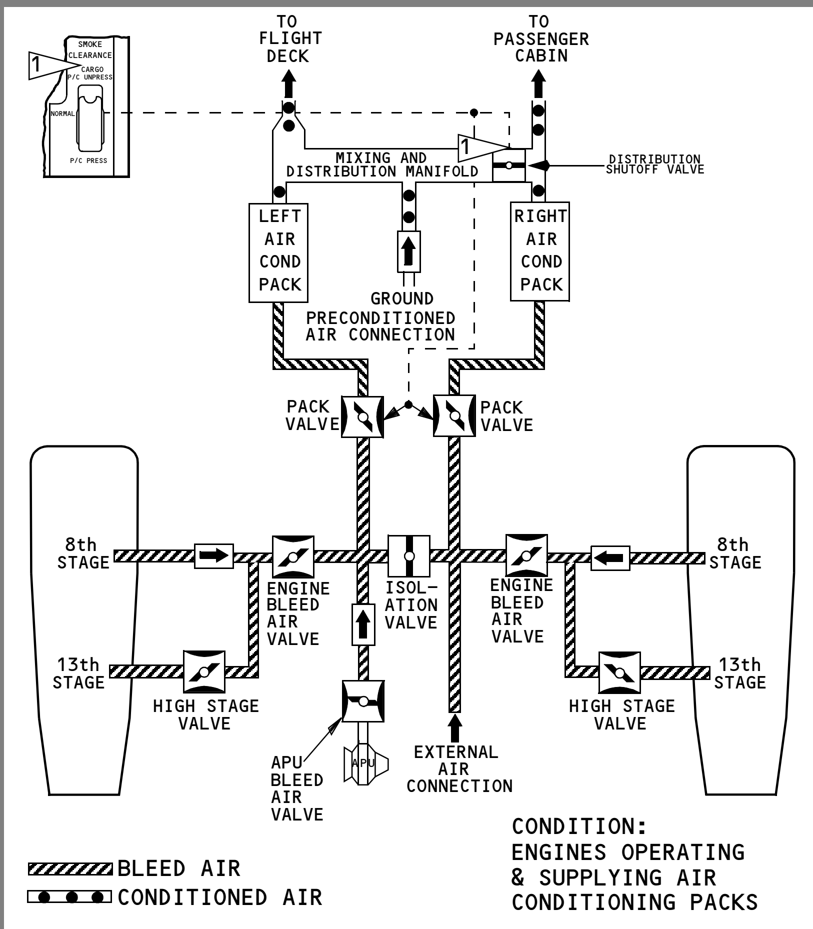
STANDBY mode –

- GND – on the ground, drives the main outflow valve full open. After takeoff, inhibited; functions the same as FLT position
- FLT – pressurizes the airplane by driving the main outflow valve to attempt to pressurize the cabin to the selected CAB ALT (normally set 200ft. below takeoff field elevation).

16 Cabin /Flight Altitude (CAB ALT)(FLT ALT) Placard

Used to determine setting for cabin altitude when operating in standby and manual modes.

Air Systems Schematic



1 Cargo airplanes only

Intentionally
Blank

Introduction

Air for the bleed air system can be supplied by the engines, APU, or an external air cart/source. The APU or external cart supplies air to the bleed air duct prior to engine start. After engine start, air for the bleed air system is normally supplied by the engines.

The following systems rely on the bleed air system for operation:

- Air conditioning/pressurization
- Wing and engine thermal anti-icing
- Engine starting
- Hydraulic reservoirs pressurization
- Water tank pressurization

Switches on the air conditioning panel operate the APU and engine bleed air supply system.

Engine Bleed System Supply

Engine bleed air is obtained from the 8th and 13th stages of the compressor section. When 8th stage bleed air is insufficient for system requirements, the 13th stage valve automatically modulates to maintain constant airflow in response to demand from the respective cooling pack valves. The 13th stage valve is also temperature sensitive, automatically closing to prevent exceeding a predetermined temperature.

Engine Bleed Air Valves

The engine bleed valve is opened to supply bleed air to the air conditioning, pressurization and wing TAI systems. The valves are AC operated.

Bleed Trip Sensors

Bleed trip sensors illuminate the respective BLEED TRIP OFF light when engine bleed air temperature exceeds a predetermined limit. The respective engine bleed air valve closes automatically.

Duct Pressure Transmitters

Duct pressure transmitters provide bleed air pressure indications to the respective (L and R) pointers on the bleed air duct pressure indicator. The indicator is AC operated.

Isolation Valve

The isolation valve isolates the left and right sides of the bleed air duct during normal operations. The isolation valve is AC operated.

With the isolation valve switch in AUTO, both engine bleed air switches ON, and both air conditioning pack switches ON, the isolation valve is closed. The isolation valve opens if either engine bleed air switch or air conditioning pack switch is positioned OFF. Isolation valve position is not affected by the APU bleed air switch.

External Air Connection

An external air cart/source provides an alternate air source for engine start or air conditioning.

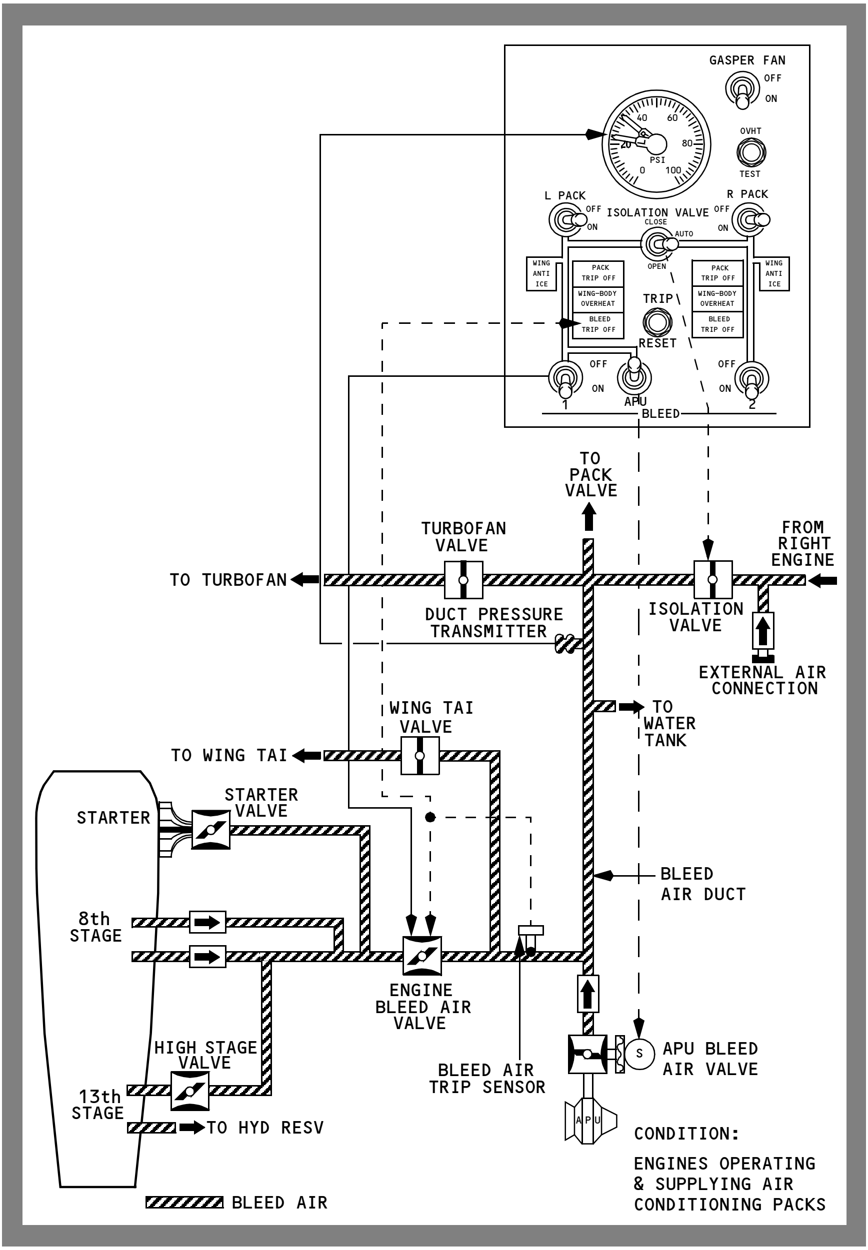
APU Bleed Air Valve

The APU bleed air valve permits APU bleed air to flow to the bleed air duct. The valve closes automatically when the APU is shut down. The APU bleed air valve is DC controlled and pressure operated.

DUAL BLEED Light

The DUAL BLEED light illuminates whenever the APU bleed air valve is open and the position of the engine bleed air valves and isolation valve would permit possible backpressure of the APU. Therefore, thrust must be limited to idle with the DUAL BLEED light illuminated.

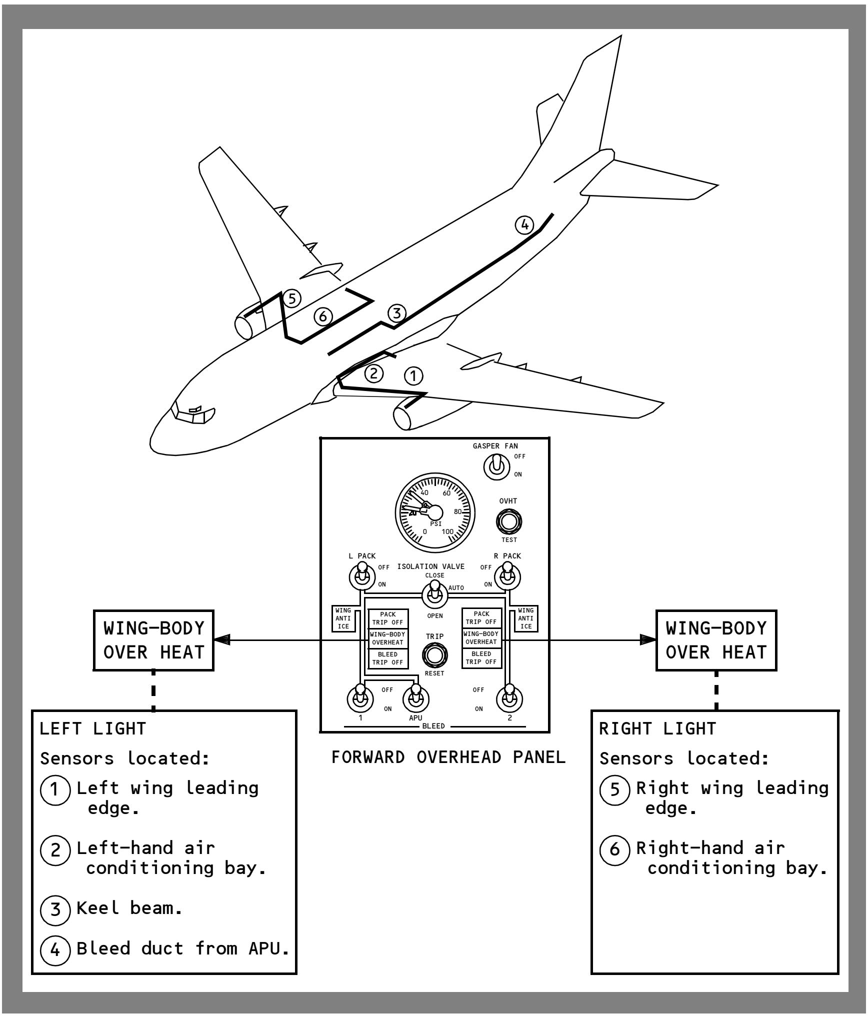
Bleed Air System Schematic



Wing-Body Overheat

A wing-body overheat condition is caused by a bleed air duct leak. It is sensed by the overheat sensors located as shown.

Wing-Body Overheat Ducts and Lights



Introduction

Conditioned air for the cabin comes from either the airplane air conditioning system or a preconditioned ground source. Air from the preconditioned ground source enters the air conditioning system through the mixing and distribution manifold to the cabin distribution ducts.

The air conditioning system provides temperature controlled air by processing bleed air from the engines, APU, or a ground air source in air conditioning packs. This temperature controlled air is distributed to the cockpit and passenger cabin.

Passenger/Cargo convertible airplanes have an additional valve in the supply duct. This Distribution Shutoff Valve is activated by the Smoke Clearance switch. See Chapter 8 for additional information.

Conditioned air from the left pack flows directly to the flight deck. Excess air from the left pack and the air from the right pack are mixed in a common manifold. The mixed air is then distributed by the sidewall risers to the passenger cabin.

Air Conditioning Pack

The flow of bleed air from the main bleed air duct through each air conditioning pack is controlled by the respective pack valve. The left and right packs are completely independent. Normally the left pack uses bleed air from engine No. 1 and the right pack uses bleed air from engine No. 2. A single pack in high flow is capable of maintaining pressurization and acceptable temperatures throughout the airplane up to the maximum certified ceiling.

Two pack operation from a single bleed air source is not recommended due to excessive bleed air requirements.

Ram Air System

The ram air system provides cooling air for the heat exchangers. Operation of the system is automatically controlled by the packs through operation of a ram door.

On the ground, or in-flight with the flaps not fully retracted, or during high ambient temperatures, the ram door moves to the full open position for maximum cooling. In normal cruise, the doors modulate between open and closed. The RAM DOOR FULL OPEN light illuminates whenever the ram door is fully open.

A turbofan is located in each ram air exit duct just upstream of the exit louvres. It augments the ram airflow on the ground or during slow flight (flaps not retracted). The fan operates pneumatically using bleed air. It is activated electrically, when the pack is on, by the air-ground safety sensor or flap limit switch.

A deflector door is installed forward of the ram air inlet doors to prevent slush ingestion prior to liftoff and after touchdown. The deflector door extends when activated electrically by the air–ground safety sensor.

Cooling Cycle

The flow through the cooling cycle starts with bleed air passing through a heat exchanger for cooling. The air then flows to an air cycle machine for refrigeration and to a water separator which removes moisture. The processed cold air is delivered to the mixing chamber and distribution manifold.

Overheat protection is provided by temperature sensors located in the cooling cycle. An overheat condition causes the pack valve to close and the PACK TRIP OFF light to illuminate.

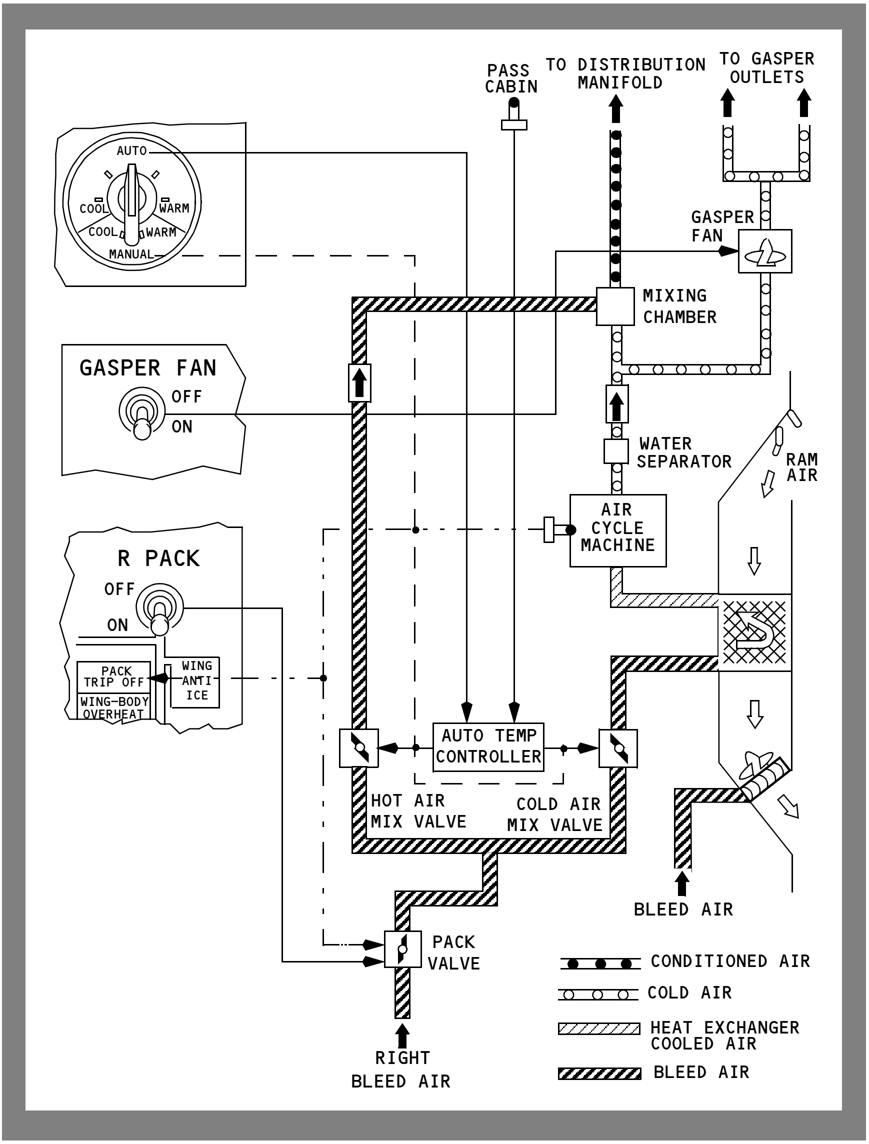
Air Mix Valves

The two air mix valves for each pack combine hot and cold air in a mixing chamber according to the setting of the CONT CABIN or PASS CABIN temperature selector. In the automatic temperature mode, the air mix valves are operated by the automatic temperature controller. The automatic temperature controller uses inputs from the respective temperature selector and cabin temperature sensor. The automatic temperature controller is bypassed when the temperature selector is positioned to MANUAL.

Hot air flows through the hot air mix valve directly into the mixing chamber. Air that flows to the cold air mix valve is processed through a cooling cycle and then delivered to the mixing chamber.

Anytime the pack valve closes, the air mix valves are driven to the full cold position automatically. This aids start-up of the cooling cycle and prevents nuisance hot air trips when the pack is turned on.

Air Conditioning Pack Schematic



Air Conditioning Distribution

Conditioned air is collected in the mixing and distribution manifold. The temperature of the air will be directly related to the setting of the CONT CABIN and PASS CABIN temperature selectors.

Overheat detection is provided by temperature sensors located in the supply duct. An overheat condition causes the appropriate mix valves to drive full cold and the DUCT OVERHEAT light to illuminate. A temperature higher than the duct overheat causes the appropriate pack valve to close and the PACK TRIP OFF light to illuminate.

On cargo airplanes, the SMOKE CLEARANCE switch controls the distribution shutoff valve in the main distribution supply duct.

Flight Deck

Since the flight deck does not require all the air supply provided by the left pack, part of the left pack air output is mixed with the right pack supply and routed to the passenger cabin.

Conditioned air for the flight deck branches into several risers which end at the floor, ceiling, and foot level outlets. Air diffusers on the floor under each seat deliver continuous air flow as long as the manifold is pressurized.

Overhead diffusers are located on the flight deck ceiling, above and aft of the No. 3 windows. Each of these outlets can be opened or closed as desired by turning a slotted adjusting screw.

There is also a dual purpose valve behind the rudder pedals of each pilot. These valves provide air for warming the pilots' feet and for defogging the inside of the No. 1 windshields. Each valve is controlled by knobs located on the Captain's and First Officer's panel, respectively.

Passenger Cabin

The passenger cabin air supply distribution system consists of the main distribution manifold, sidewall risers, and an overhead distribution duct.

Sidewall risers go up the right wall of the passenger cabin to supply air to the overhead distribution duct. The overhead distribution duct routes conditioned air to the passenger cabin. It extends from the forward to the aft end of the ceiling along the airplane centerline and also supplies the sidewall diffusers.

Gasper Air System

The gasper air distribution system provides air to individual crew and passenger positions. This air is colder than that being supplied by the main air conditioning system. A movable control nozzle at each crew and passenger outlet can change the direction and amount of airstream. Normally the right pack supplies cold air to the gasper air system. With the right pack inoperative, conditioned air from the supply duct can flow through the gasper air system.

Equipment Cooling

The equipment cooling system cools electronic equipment in the flight deck and the E & E bay.

The equipment cooling system consists of a duct, a normal fan and an alternate fan. The duct collects and discards warm air from the circuit breaker panels in the flight deck and electronic equipment in the E & E bay.

Loss of airflow due to failure of an equipment cooling fan results in illumination of the equipment cooling OFF light. Selecting the alternate fan should restore airflow and extinguish the OFF light.

Forward Cargo Compartment

The equipment cooling system circulates air from the passenger cabin around the lining of the forward cargo compartment.

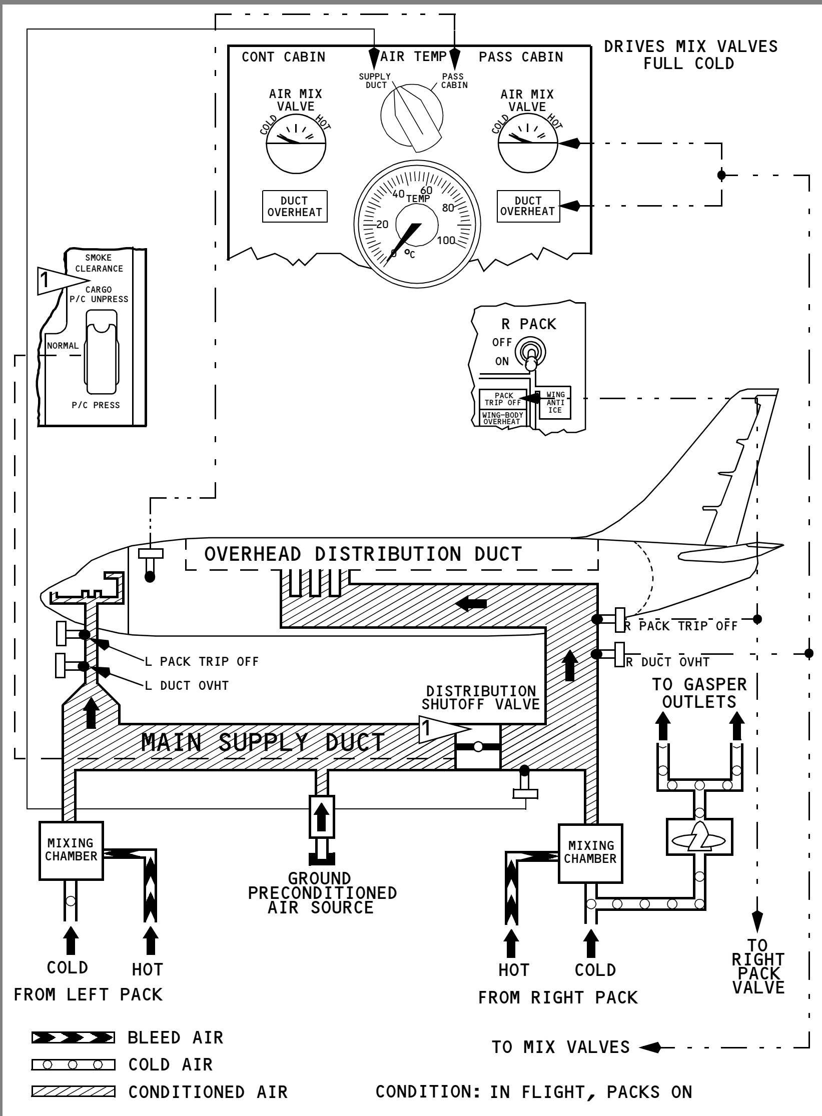
On the ground, or with the cabin differential pressure less than 2.5 psi, the exhaust fan air is blown through a flow control valve and exhausted out the bottom of the airplane.

With increasing airflow at greater cabin differential pressures, the flow control valve closes and exhaust air from the equipment cooling system is now diffused to the lining of the forward cargo compartment for in-flight heating.

Conditioned Air Source Connection

A ground air conditioning source may be connected to the main distribution manifold so that preconditioned air can be distributed throughout the airplane.

Air Conditioning Distribution Schematic



1 Cargo airplanes only

Air Systems — Chapter 2
Pressurization System Description — Section 40

Introduction

Cabin pressurization is controlled during all phases of airplane operation by the cabin pressure control system (CPCS). The CPCS includes one automatic controller and one standby controller available by selecting AUTO or STBY, and two manual (MAN) pilot-controlled modes.

The system uses bleed air supplied to and distributed by the air conditioning system. Pressurization and ventilation are controlled by modulating the outflow valves.

Pressure Relief Valves

Two pressure relief valves provide safety pressure relief by limiting the differential pressure to a maximum of 8.65 psi. A negative relief valve prevents external atmospheric pressure from exceeding internal cabin pressure.

Cabin Pressure Controller

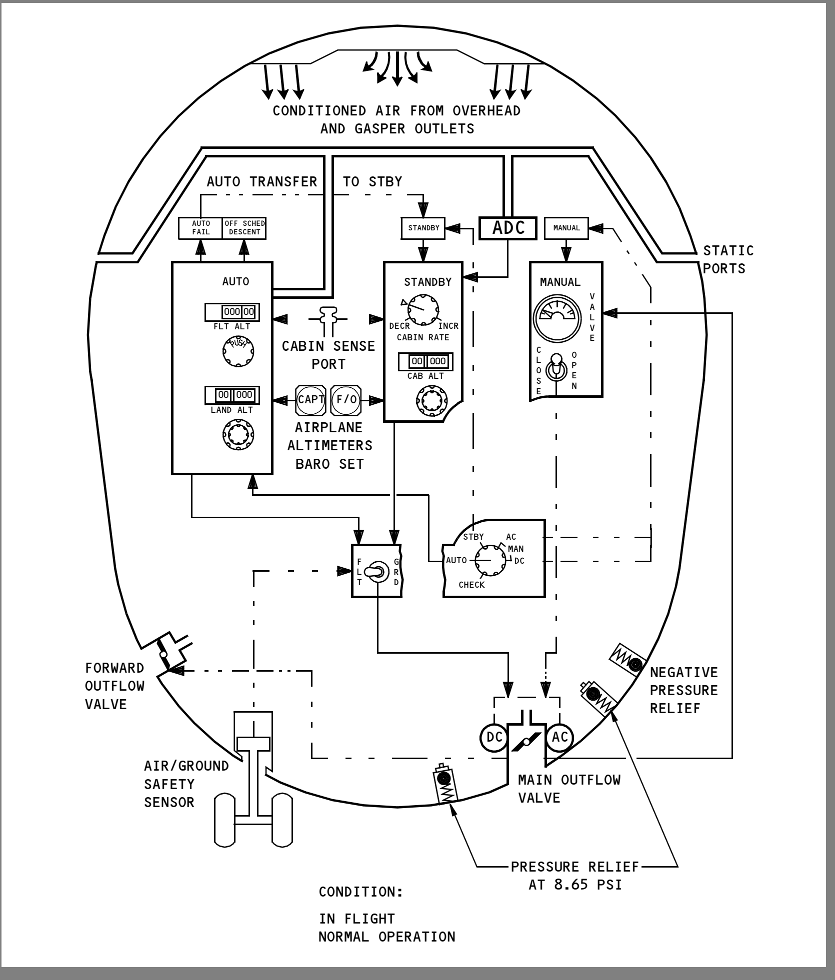
Cabin altitude is normally rate-controlled by the cabin pressure controller up to a cabin altitude of 8,000 feet at the airplane maximum certified ceiling of 37,000 feet. The cabin pressure controller controls cabin altitude in the following modes:

- AUTO – Automatic pressurization control; normal mode of operation. Uses AC motor.
- STBY – Semi-automatic pressurization control; standby mode of operation. Uses DC motor.
- MAN AC – Manual control of the system using the AC motor.
- MAN DC – Manual control of the system using the DC motor.

In the automatic mode, airplane altitude is sensed electrically from the air data computer (ADC). In the standby mode of operation, airplane altitude is sensed directly from the static ports. Barometric corrections to these pressures come from the Captain’s altimeter in AUTO and the First Officer’s altimeter in STANDBY.

The controller receives additional information from the air/ground sensor and the cabin pressure altitude sensing port.

Cabin Pressure Control System Schematic



Pressurization Outflow

Cabin air outflow is controlled by the main outflow valve, the forward outflow valve and the flow control valve. During pressurized flight, the flow control valve is closed, and the majority of the overboard exhaust is through the main and forward outflow valves. A small amount is also exhausted through toilet and galley vents, miscellaneous fixed vents, and by seal leakage.

Flow Control Valve

The flow control valve opens to exhaust the cooling air from the E & E compartment overboard during ground operation, unpressurized flight and pressurized flight below a cabin differential pressure of 2.5 psi.

When the flow control valve closes, air is directed around the forward cargo compartment liner for inflight heating.

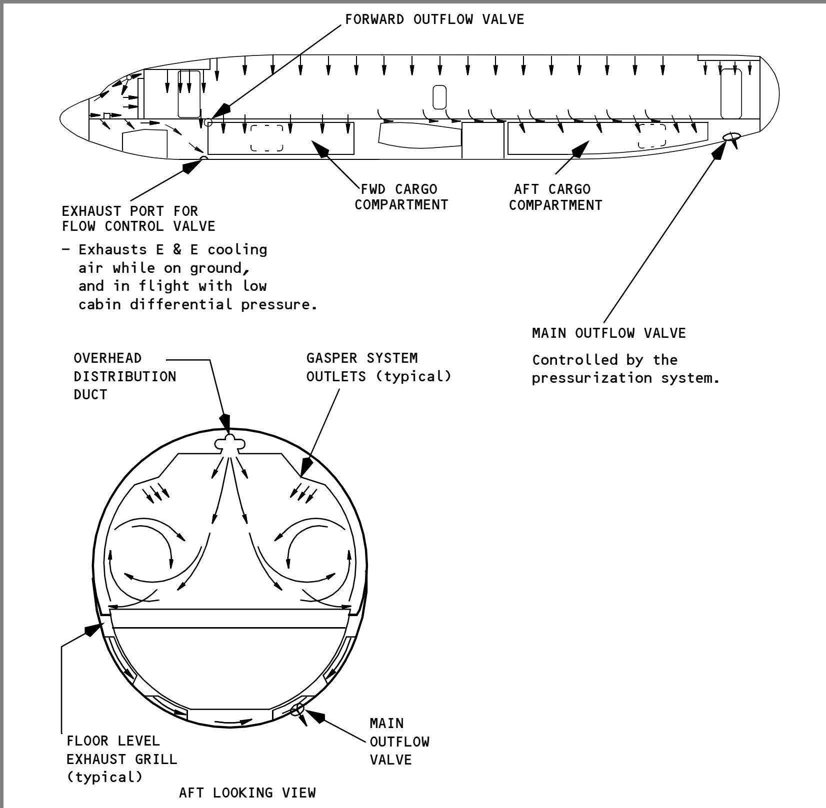
Outflow Valves

The main outflow valve can be actuated by either an AC or a DC motor. The AC motor is used during AUTO and MAN AC operation. The DC motor is used during STANDBY and MAN DC operation.

The forward outflow valve closes automatically to assist in maintaining cabin pressure when the main outflow valve is almost closed. When the cabin differential pressure exceeds approximately 2.5 psi, this valve is the overboard discharge exit for air circulated through the E & E compartment and around the forward cargo compartment.

The main outflow valve is the overboard exhaust exit for the majority of the air circulated through the passenger cabin. Passenger cabin air is drawn through foot level grills, down around the aft cargo compartment, where it provides heating, and is discharged overboard through the main outflow valve.

Pressurization Outflow Schematic



Auto Mode Operation

In AUTO, the pressurization control panel is used to preset two altitudes into the pressure controller:

- FLT ALT (flight or cruise altitude).
- LAND ALT (landing or destination airport altitude).

Takeoff airport altitude (actually cabin altitude) is input into the pressurization controller at all times when on the ground.

The air/ground safety sensor signals whether the airplane is on the ground or in the air. On the ground, the FLT/GRD switch is used to keep the cabin depressurized by driving the main outflow valve full open when the switch is in the GRD position. With the switch in the FLT position, the controller modulates the main outflow valve toward close, slightly pressurizing the cabin. This ground pressurization of the cabin makes the transition to pressurized flight more gradual for the passengers and crew, and also gives the system better response to ground effect pressure changes during takeoff.

In the air, the pressure controller maintains a proportional pressure differential between airplane and cabin altitude. By climbing the cabin altitude at a rate proportional to the airplane climb rate, cabin altitude change is held to the minimum rate required.

Approximately 1000 feet below flight altitude a cruise relay will trip, scheduling the controller to begin maintaining an isobaric 7.80 psi differential between flight and cabin altitudes.

An amber OFF SCHED DESCENT light illuminates if the airplane begins to descend without having tripped the cruise relay; for example, a flight aborted in climb and returning to the takeoff airport. The controller programs the cabin to land at the takeoff field elevation without further pilot inputs. If the flight altitude indicator is changed or the flight altitude selector is depressed during climb, the automatic cabin abort capability to the original takeoff field elevation will be lost.

During isobaric cruise, minor airplane excursions from flight altitude may cause the pressure differential to go as high as 7.90 psid to maintain a constant cabin altitude.

Note: Below a flight altitude of 19,500 feet, the cabin maintains landing field elevation minus 300 feet.

Beginning descent, approximately 1000 feet below cruise altitude, a descent relay trips, scheduling the cabin to begin a proportional descent to the selected LAND ALT. The controller programs the cabin to land slightly pressurized so that rapid changes in altitude during approach result in minimum cabin pressure changes.

Taxiing in, the controller drives the main outflow valve slowly to full open when the FLT/GRD switch is positioned to GRD, thereby depressurizing the cabin. Having the main outflow valve full open also prevents the equipment cooling fan from depressurizing the airplane to a negative pressure.

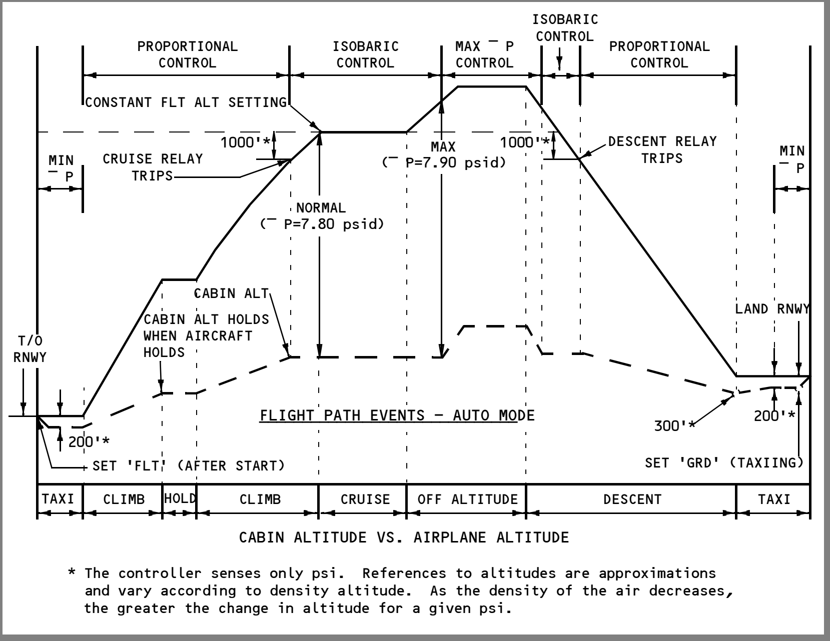
The forward outflow valve remains open at all times to ensure heating of the forward cargo as air from the E & E compartment flows up around the cargo area and out the forward outflow valve. If, however, the main outflow valve programs to within 1/2 degree of full closed in order to maintain pressurization, the forward outflow valve will close.

An amber AUTO FAIL light illuminates if any one of three conditions occurs:

- Loss of AUTO AC power.
- Excessive rate of cabin pressure change (+/- 1890 feet/minute).
- High cabin altitude (13,875 feet).

With illumination of the AUTO FAIL Light, the pressure controller automatically trips to STANDBY mode; however, the Pressurization Mode Selector will remain in AUTO. Positioning the Mode Selector to STBY will extinguish the light.

Flight Path Events – Auto Mode



Standby Mode Operation

A green STANDBY light will be illuminated when the pressure controller is in the STANDBY mode.

On the ground, the GRD position of the FLT/GRD switch drives the main outflow valve full open. The FLT position drives the main outflow valve to attempt to pressurize the cabin to the selected CAB ALT. CAB ALT should be set 200 feet below the takeoff airport altitude to pressurize the cabin properly when the FLT/GRD switch is placed to FLT prior to takeoff.

In the air, by referring to the placard below the pressurization control panel, the cabin altitude indicator is set to the isobaric cabin altitude, based on the proposed flight altitude and a pressure differential or 7.8 psi.

Cabin rate of climb or descent is controlled by the cabin rate selector. In descent, the Cabin Altitude Indicator is set 200 feet below landing field altitude to insure a pressurized cabin during landing.

Manual Mode Operation

A green MANUAL Light illuminates with the Pressurization Mode Selector in MAN AC or MAN DC.

Operation in the MAN modes assumes failure of the AUTO and STANDBY modes. Manual mode allows the pilot, by using the Outflow Valve Switch, to modulate the main outflow valve while monitoring the Outflow Valve Position Indicator. MAN AC mode uses the AC motor to control the main outflow valve; MAN DC uses the DC motor. The rate of operation in MAN AC is faster than that in MAN DC.

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Anti-Ice, Rain — Chapter 3
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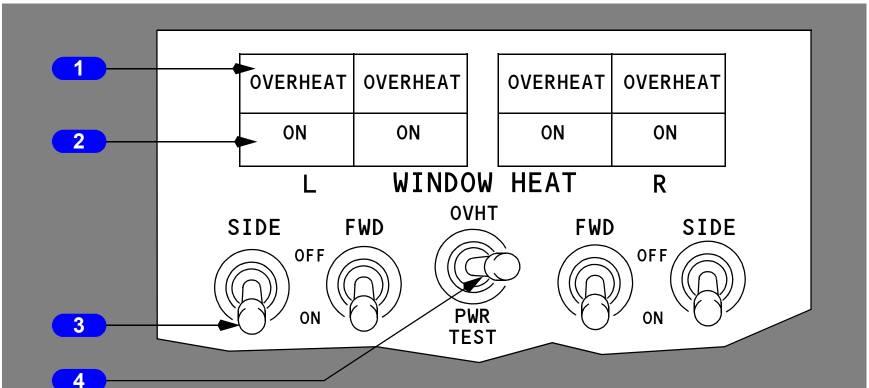
Window Heat Panel



FORWARD OVERHEAD PANEL

1 Window OVERHEAT Lights

Illuminated (amber) – overheat condition is detected.

Note: OVERHEAT light also illuminates if electrical power to window is interrupted.

2 Window Heat ON Lights

Illuminated (green) – window heat is being applied to selected window.

Extinguished –

- switch is OFF, or
- an overheat is detected, or
- a system failure has occurred.

3 WINDOW HEAT Switches

ON – window heat is applied to selected window.

OFF – window heat not in use.

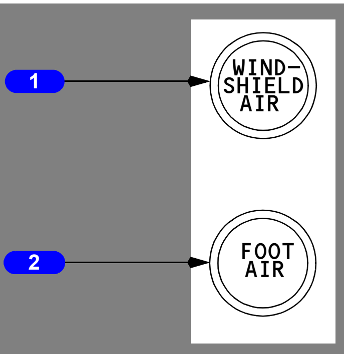
4 WINDOW HEAT Test Switch (spring–loaded to neutral)

OVHT – simulates an overheat condition.

PWR TEST – provides a confidence test.

Note: Refer to Supplementary Procedures for Window Heat Test procedures.

Windshield/Foot Air Controls



BELOW CAPTAIN AND FIRST OFFICER
INSTRUMENT PANELS

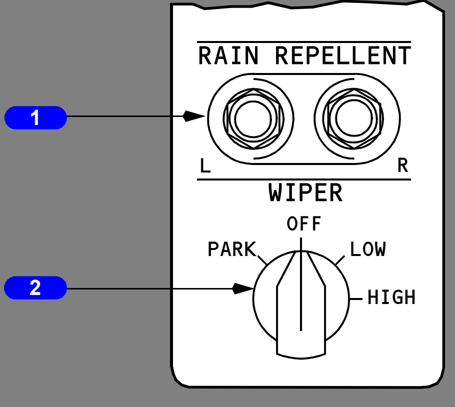
1 WINDSHIELD AIR Controls

PULL – supplies conditioned air to No. 1 windows for defogging.

2 FOOT AIR Controls

PULL – supplies conditioned air to pilots' leg positions.

Windshield Wiper Panel



FORWARD OVERHEAD PANEL

1 Rain Repellent Switches

Push – applies measured amount of repellent on related window 1.

2 Windshield WIPER Selector

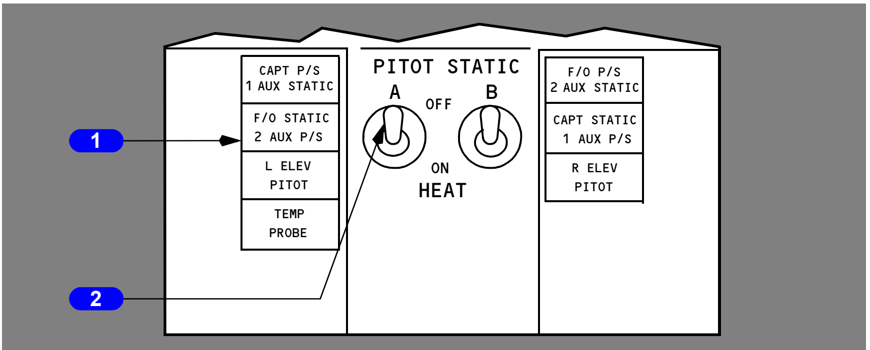
PARK – turns off wiper motors and stows wiper blades.

OFF – turns off wiper motors.

LOW – low speed operation.

HIGH – high speed operation.

Pitot Static Heat Panel



FORWARD OVERHEAD PANEL

1 PROBE HEATER Lights

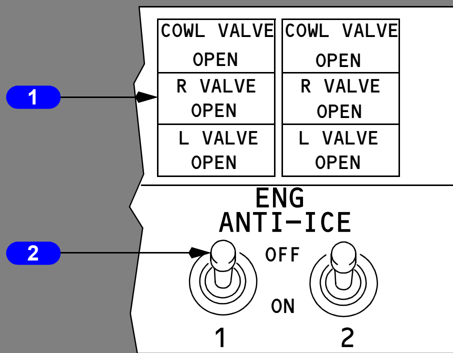
Illuminated (amber) – related probe not heated.

2 PITOT STATIC HEAT Switches

ON – power is supplied to heat related system.

OFF – power off.

Engine Anti–Ice Panel



FORWARD OVERHEAD PANEL

1 VALVE OPEN Lights

Illuminated (blue) –

- bright – related control valve is in transit, or the valve position disagrees with related ENGINE ANTI–ICE switch position
- dim – related control valve is open (switch ON).

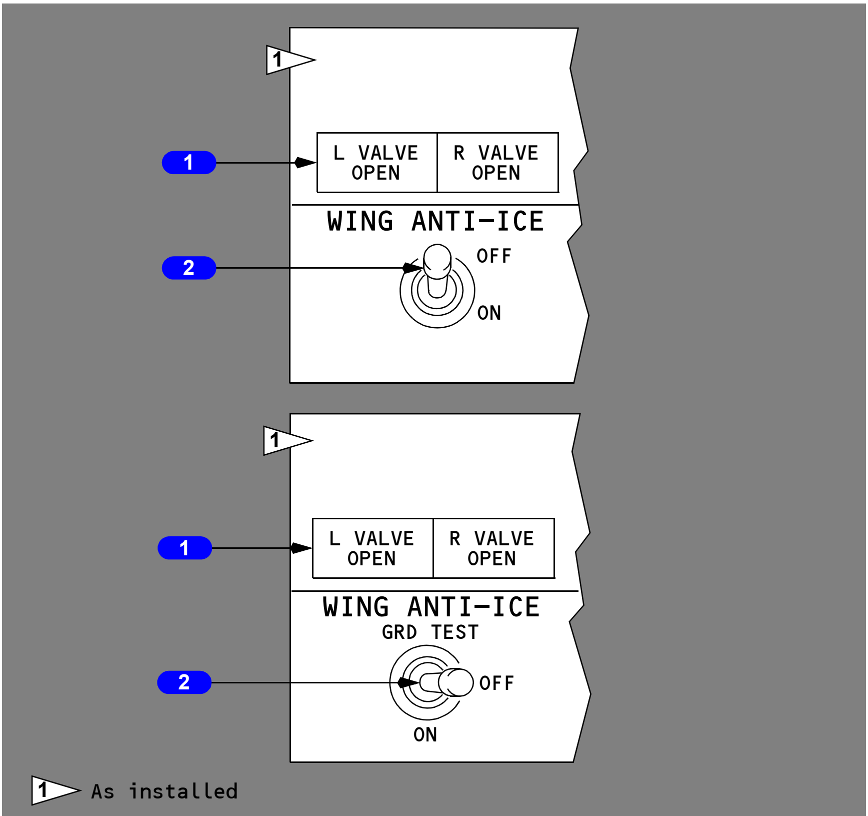
Extinguished – related control valve is closed (switch OFF).

2 ENGINE ANTI-ICE Switch

ON – related engine anti–ice valve opens.

OFF – related engine anti–ice valve closes.

Wing Anti–Ice Panel



FORWARD OVERHEAD PANEL

1 Wing Anti–Ice VALVE OPEN Lights

Illuminated (blue) –

- bright – related wing anti–ice control valve is in transit, or related wing anti–ice control valve position disagrees with WING ANTI–ICE switch position.
- dim – related wing anti–ice control valve is open (switch ON).

Extinguished – related wing anti–ice control valve is closed (switch OFF).

2 WING ANTI–ICE Switch

OFF – wing anti–ice control valves close.

ON (in flight) – wing anti–ice control valves open.

ON (on the ground) – on airplanes with GRD TEST– wing anti-ice valves are closed, but are armed to open after liftoff (switch remains ON).

ON (on the ground) – on airplanes with ground wing anti-ice –

- wing anti–ice control valves open if thrust on both engines is below takeoff warning setting and temperature inside both distribution ducts is below thermal switch activation temperature
- control valves close if either engine thrust is above takeoff warning setting or thermal switch is activated in either distribution duct. Switch remains ON
- switch trips OFF at lift–off.

GRD TEST (spring loaded to OFF) – on airplanes with ground test, opens wing anti–ice control valves unless either engine thrust is above the takeoff warning setting or the thermal switch is activated in either distribution duct.

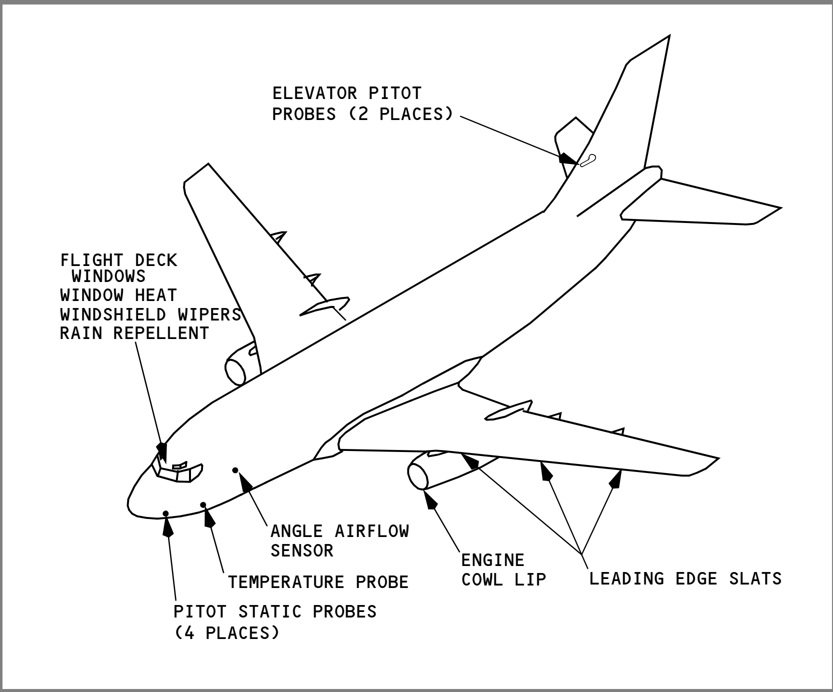
Introduction

Thermal anti-icing (TAI), electrical anti-icing, rain repellent, and windshield wipers are the systems provided for ice and rain protection.

The anti-ice and rain systems include:

- Flight Deck Window Heat
- Windshield Wipers and Rain Repellent
- Probe and Sensor Heat
- Engine Anti-Ice System
- Wing Anti-Ice System

Anti-Ice Components Diagram



Flight Deck Window Heat

Flight deck windows 1, 2, 4 and 5 consist of glass panes laminated to each side of a vinyl core. Flight deck window 4 has an additional vinyl layer and acrylic sheet laminated to the inside surface. Flight deck window 3 consists of two acrylic panes separated by an air space.

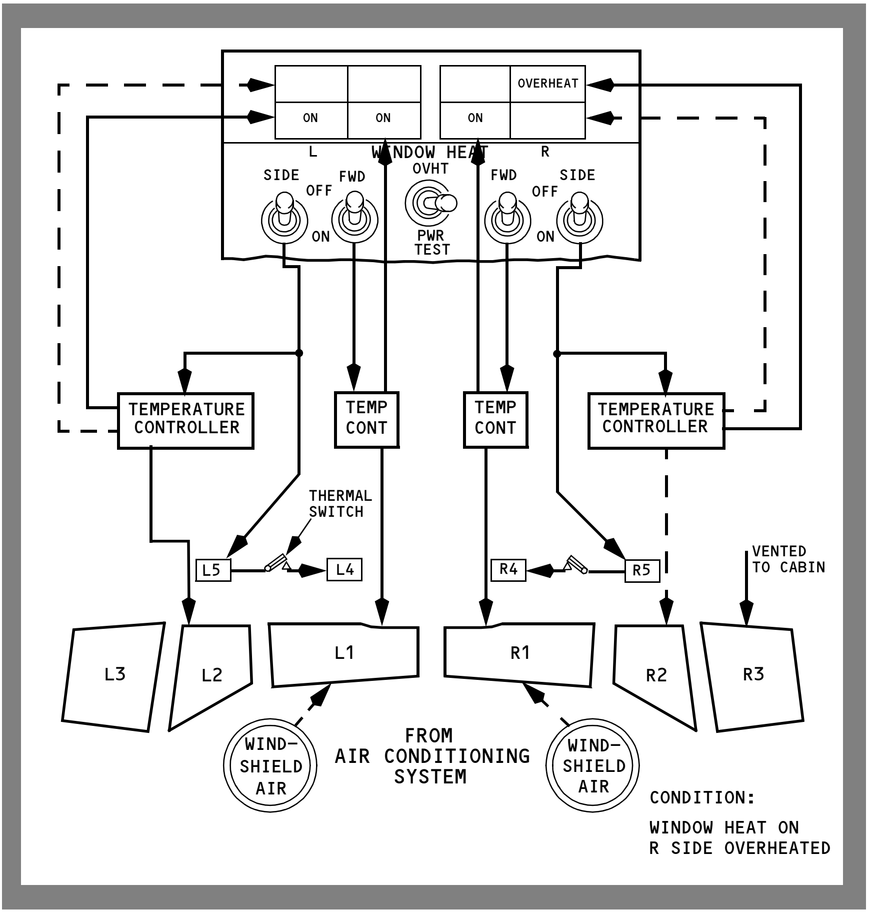
A conductive coating on the outer glass pane of windows 1 and 2 permits electrical heating to prevent ice build–up and fogging. A conductive coating on the inner glass pane of windows 4 and 5 permits electrical heating to prevent fogging. Window 3 is not electrically heated.

Flight Deck Window Heat Operation

The FWD WINDOW HEAT switches control heat to window 1. The SIDE WINDOW HEAT switches control heat to window 2, 4 and 5.

Temperature controllers maintain windows 1 and 2 at the correct temperature to ensure maximum strength of the windows in the event of bird impact. Power to windows 1 and 2 is automatically removed if an overheat condition is detected. A thermal switch located on window 5 opens and closes to maintain the correct temperature of windows 4 and 5.

Flight Deck Window Heat Schematic



Windshield Wipers and Rain Repellent

The rain removal system for the forward windows consists of windshield wipers and rain repellent. One windshield wiper is located on each No. 1 window. Each wiper is electrically operated by separate systems. Both wiper systems are controlled by a common switch. Each push of a rain repellent switch applies a measured amount of repellent on the related No. 1 windshield.

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

Probe and Sensor Heat

All pitot-static probes, the total air temperature probe, and angle airflow sensors are electrically heated to prevent the formation of ice. Alternate static ports are not heated.

Engine Anti–Ice System

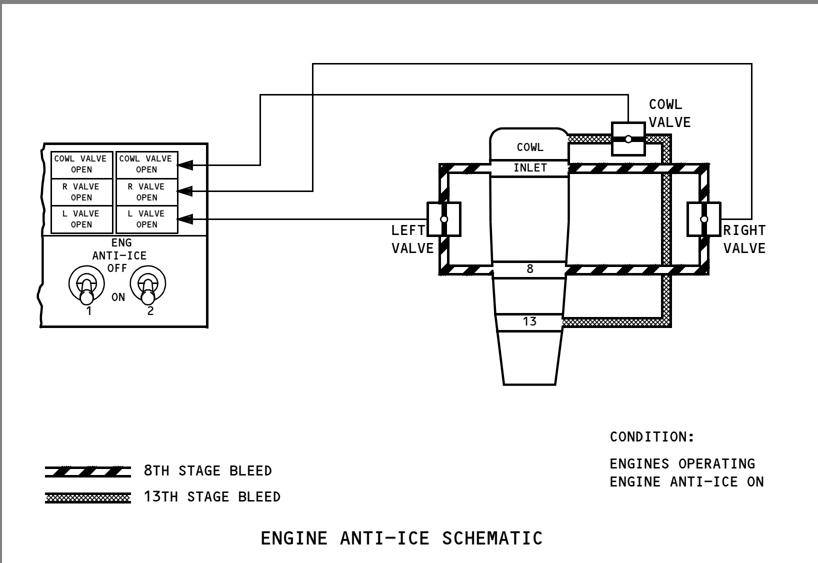
Engine bleed air thermal anti–icing prevents the formation of ice on the engine nose cowl lip, compressor area, and EPR probe. Engine anti–ice operation is controlled by individual ENG ANTI–ICE switches. The engine anti–ice system may be operated on the ground and in flight.

Engine Anti–Ice System Operation

Each cowl anti–ice valve is electrically controlled and actuated. Positioning the ENG ANTI–ICE switches to ON allows engine bleed air to flow through the cowl anti–ice valve for nose cowl lip anti–icing, and through the right and left valves for compressor area and EPR probe anti-icing. If either the right or left valve is open, adequate inlet anti-ice protection will be obtained.

If any anti–ice valve fails to move to the position indicated by the ENG ANTI–ICE switch, the associated VALVE OPEN light remains illuminated bright blue.

Engine Anti–Ice System Schematic



Wing Anti–Ice System

The wing anti–ice system provides protection for the leading edge slats by using bleed air. The wing anti–ice system does not include the leading edge flaps.

The wing anti–ice control valves are AC motor–operated. With a valve open, bleed air flows to the leading edge slats through a telescoping duct, and is then exhausted overboard. The wing anti–ice system is effective with the slats in any position.

Wing Anti–Ice System Operation

Airplanes with Ground-Operational Wing Anti-Ice

On the ground, positioning the WING ANTI–ICE switch ON opens both control valves if thrust on both engines is below the setting for takeoff warning activation and the temperature inside both wing distribution ducts is less than the thermal switch activation temperature.

Both valves close if either engine thrust is above the takeoff warning setting or either temperature sensor senses a duct overtemperature. The valves automatically reopen if thrust on both engines is reduced and both temperature sensors are cool.

With the air/ground sensor in the ground mode and the WING ANTI–ICE switch ON, the switch remains in the ON position regardless of control valve position. The WING ANTI–ICE switch automatically trips OFF at lift–off when the air/ground sensor goes to the air mode.

In flight, both control valves open when the WING ANTI–ICE switch is positioned ON. Duct temperature and thrust setting logic are disabled and have no affect on control valve operation in flight.

Valve position is monitored by the blue VALVE OPEN lights.

Airplanes with Ground–Inhibited Wing Anti-Ice

The air/ground sensor prevents the wing anti–ice control valves from opening on the ground except during ground test.

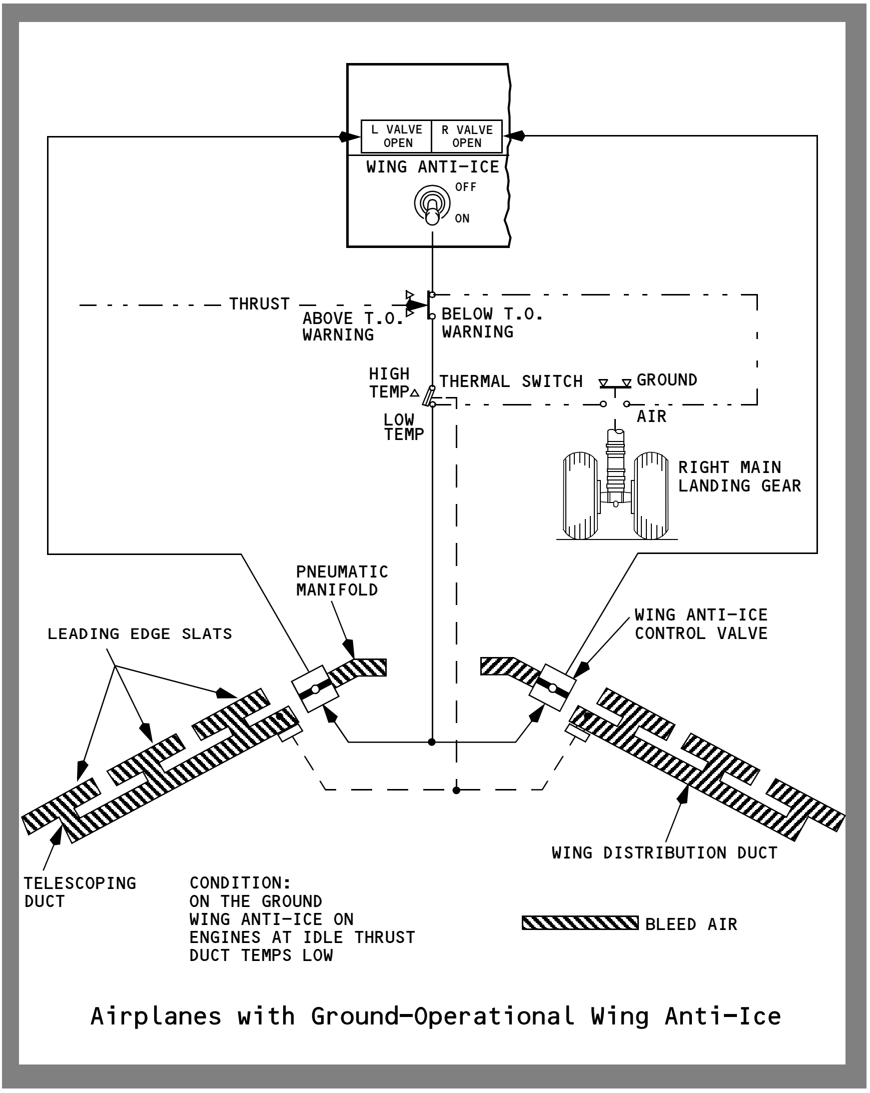
A ground overheat thermal switch in each wing closes the wing anti–ice control valves if bleed air temperature is excessive during ground test. Activation of either thermal switch closes both valves. The thermal switches are deactivated in flight.

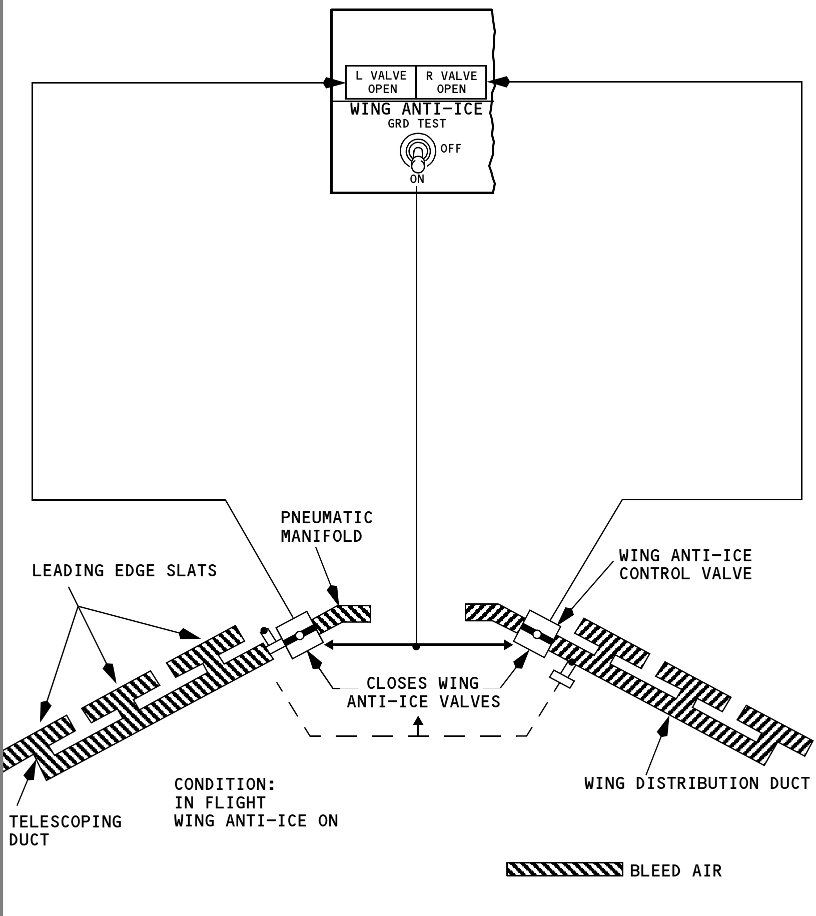
In flight, both control valves open when the WING ANTI–ICE switch is positioned ON. Duct temperature and thrust setting logic are disabled and have no affect on control valve operation in flight.

Valve position is monitored by the blue VALVE OPEN lights.

If low-altitude icing conditions exist or are anticipated, the non-ground operable system’s ON-OFF-GRD TEST switch is placed in the ON position on the ground. The WTAI valves are closed, but the system is armed for flight. During liftoff, the air/ground relay enables the WTAI system and both valves open, providing ice protection to the wing’s leading edge. A thrust penalty is taken due to WTAI bleed air extraction.

Wing Anti–Ice System Schematic





Airplanes with Ground-Inhibited Wing Anti-Ice

Automatic Flight — Chapter 4

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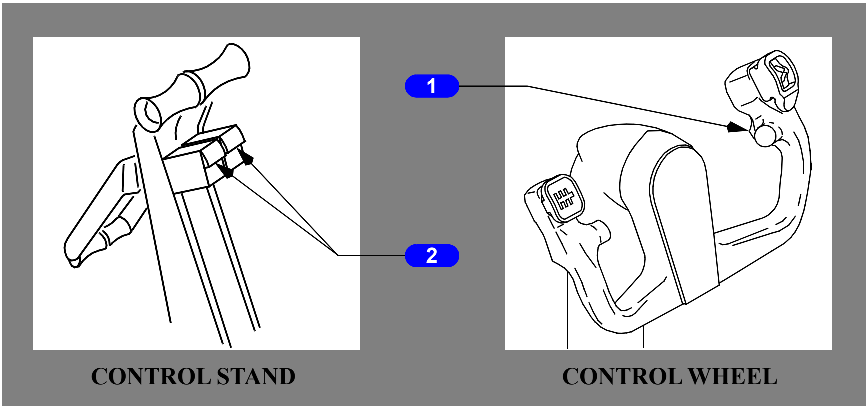
Automatic Flight — Chapter 4
Controls and Indicators — Section 10

Autopilot Controls



1 Autopilot Disengage Switch

- Disengages the autopilot
- A/P disengage light illuminates
- Resets the Autopilot Disengage Light after automatic disengagement.

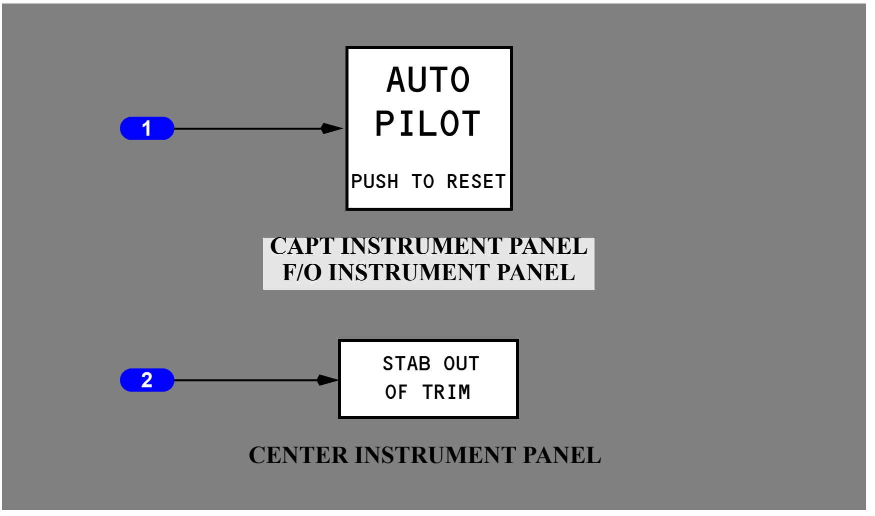
Note: Each time the autopilot is disengaged, the pilot should guard the controls for an undetected out-of-trim condition.

2 GO–AROUND SWITCHES

– Armed with flight director Mode Selector in the AUTO APP or MAN GS positions.

PRESS (either or both switches) – Provides flight director commands for wings level with a pitch up of 14 degrees.

Autopilot Indicators



1 Autopilot Disengage Light (red)

PRESS – Resets the Autopilot Disengage Light after automatic disengagement.

ILLUMINATED FLASHING – The autopilot is automatically disengaged.

- The light is pressed to test
- The Autopilot Disengage Switch is pushed
- Either manual disengage switch (aileron or elevator) is moved to DISENGAGED
- Pushing the light resets the system after automatic disengagement

ILLUMINATED STEADY – The self-test switch in the E/E compartment is on.

EXTINGUISHED – The Autopilot Disengage Switch is released.

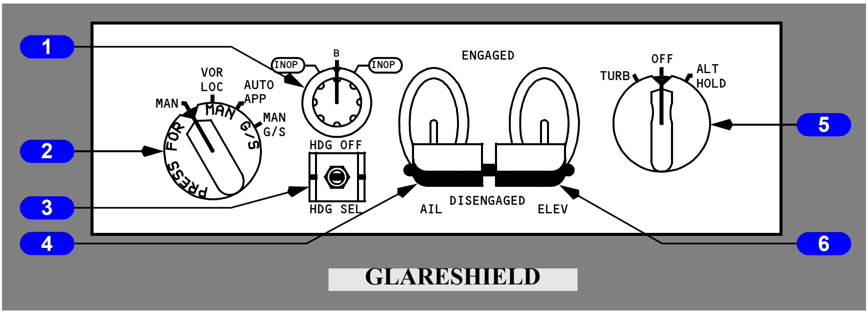
- The Autopilot Disengage Light is reset.

2 Stabilizer Out Of Trim Light (amber)

Functions only with the Autopilot Elevator Engage Switch ENGAGED.

ILLUMINATED – The stabilizer is out-of-trim for the condition required by the autopilot.

Autopilot Panel



1 Autopilot System Select Switch

Selects the hydraulic system used by the autopilot and yaw damper. Transfer of systems will disengage the autopilot and yaw damper.

2 Autopilot Mode Selector (spring-loaded to MAN)

MAN (Manual Mode) – CWS low detent is used to maneuver the airplane with either or both channels engaged.

- ALT HOLD or TURB is selectable
- HDG SEL or HDG OFF is selectable.

VOR LOC (VOR/LOC Mode) – Used to automatically intercept the selected radio course.

- HDG SEL or CWS is used to achieve the intercept heading
- Captain’s HSI is used to select heading and course
- Course capture occurs at 2/5 dot (VOR), 2 dots (LOC), the HDG Switch centers at capture (if HDG SEL is used)
- Roll commands can be increased or reduced manually during the capture phase prior to ON COURSE
- When ON COURSE, CWS roll is high detent
- Crosswind compensation occurs after ON COURSE
- ALT HOLD or TURB is selectable (TURB in VOR only).

AUTO APP (Auto Approach Mode) - Used to automatically capture ILS Localizer and glide slope.

- HDG SEL or CWS is used to achieve the intercept heading
- LOC CAPTURE is the same as VOR/LOC mode
- LOC and G/S are armed when:
  - ILS frequency is tuned
  - Front Course is selected
  - AUTO APP is selected.

- G/S is captured at 1/3 dot
- ALT HOLD trips OFF at G/S capture
- Gain programming occurs after G/S capture at 1500 feet radio altitude or below. LOC sensitivity is reduced from 100% to 50% as altitude decreases to 100 feet. G/S sensitivity is reduced to 0% as altitude decreases to 50 feet
- When ON COURSE and on G/S, CWS roll and pitch are high detent
- Autopilot reverts to MAN if TURB is selected
- AUTO APP is not selectable unless ILS frequency is selected.

MAN G/S (Manual Glide Slope Mode) - Used to capture G/S from above or to re-capture after autopilot disengagement.

- When selected, the airplane pitches down for 10 seconds (700 ft/min) then tracks G/S

Note: Do not select MAN G/S when the airplane is more than 1/2 dot, as depicted on the HSI, from the glide slope.

- GLIDE SLOPE light illuminates green immediately after selecting MAN G/S
- Operates the same as AUTO APP after G/S capture
- Mode selector must be pressed in to select MAN G/S.

3 Autopilot Heading Switch

HDG OFF – Autopilot maintains any bank attitude within limits.

- Selectable in MANUAL mode only.

HDG SEL (solenoid-held on, spring-loaded to the center position) – Establishes preselected heading mode.

- Maintains the heading selected for the Captain’s HSI.

HEADING HOLD (center position) –

- Autopilot engaged:
  - Bank angle < 5 degrees - Airplane rolls wings level and maintains heading
  - Bank angle > 5 degrees - Airplane maintains bank attitude.
- CWS input:
  - Bank angle < 5 degrees - When the force is released, the airplane rolls wings level
  - Bank angle > 5 degrees - When the force is released, the airplane maintains bank attitude.

4 Autopilot Aileron (ROLL) Engage Switch

The aileron (roll) channel may be operated independently of the pitch channel in the MAN or VOR LOC modes of operation.

DISENGAGED – Mechanically locked until interlock circuitry is satisfied.

- Spring-loaded to DISENGAGED if interlock is broken.

ENGAGED – Solenoid-held if interlocks are satisfied.

- The Mode Selector must be in MAN
- Will not engage if force is being applied to the control wheel.

5 Autopilot Pitch Mode Selector

TURB (Turbulence) – Decreases pitch attitude and rate gains.

- Bank angle is limited to 8 degrees in VOR
- CWS pitch is low detent after selection
- CWS, HDG SEL, HDG HOLD, and VOR modes are available
- Deselected by manually positioning switch to OFF.

OFF – Pitch Attitude hold or glide slope engaged.

- Spring-loaded to OFF at glide slope engagement
- Spring-loaded to OFF if force greater than high detent level is exerted.

ALT HOLD (Altitude Hold) – Pitch reference is to pressure altitude.

6 Autopilot Elevator (PITCH) Engage Switch

The elevator (pitch) channel may be operated independently of the roll channel in the MAN mode only.

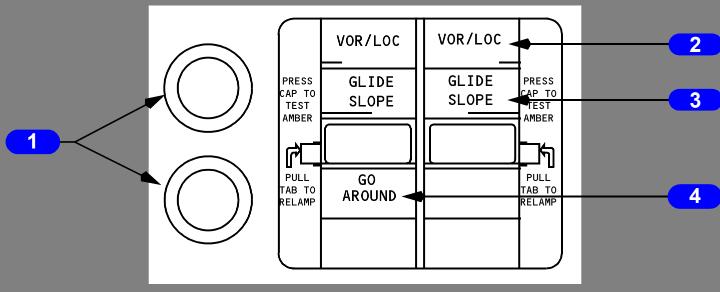
DISENGAGED – Mechanically locked until interlock circuitry is satisfied.

- Spring-loaded to DISENGAGED if interlock is broken.

ENGAGED – Solenoid-held if interlocks are satisfied.

- The Mode Selector must be in MAN
- Will not engage if force is being exerted on the control column.

Approach Progress Display



CAPT INSTRUMENT PANEL
F/O INSTRUMENT PANEL

1 Photoelectric Cells

- Control intensity of lighting for the approach progress display if the Master Lights Test and Dim Switch is in DIM
- Overridden by positioning the Master Lights Test and Dim Switch to BRT.

2 VOR/LOC

AMBER - Radio mode selected.

- Prior to VOR or localizer capture.

GREEN – Radio mode selected.

- Capture initiated.

3 GLIDE SLOPE

AMBER – AUTO APP selected.

- Prior to glide slope capture.

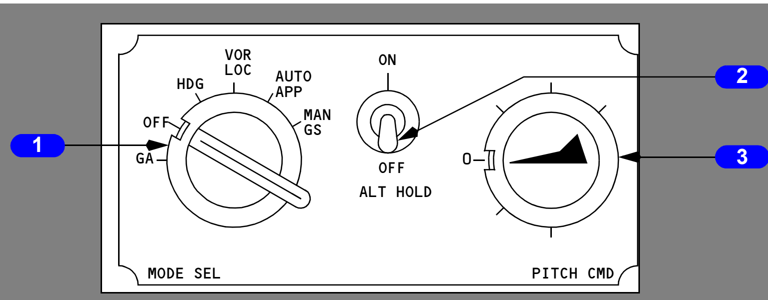
GREEN – AUTO APP selected and glide slope captured.

- MAN G/S selected.

4 GO AROUND

GREEN – Captured.

Flight Director



GLARESHIELD

1 Mode Selector (MODE SEL)

Rotate – selects flight director computer reference signals provided to command bars.

GA (Go–Around) –

- GA light illuminated (green) –
  - command bars provide commands for wings level and a pitch attitude of 14 degrees until the Mode Selector is changed to another position
  - mode Selector in AUTO APP or MAN GS, go–around is initiated by pushing the Go–Around switches on the thrust levers
  - manual selection to GA can be initiated anytime by positioning the Mode Selector to GA.

OFF – removes command bars.

HDG – command bars provide commands to fly to and maintain selected heading on HSI.

VOR/LOC –

- VOR/LOC light illuminated (amber/armed) –
  - command bars provide commands to fly to and maintain selected heading on HSI
- VOR/LOC light illuminated (green/capture) –
  - command bars provide commands to fly to and maintain VOR radial or localizer course selected on HSI
  - VOR capture – 1 dot (5 degrees)
  - LOC capture – 2 dots (2 degrees).

AUTO APP –

- VOR/LOC light illuminated (amber/armed) –
  - command bars provide commands to fly to and maintain selected heading on HSI
- VOR/LOC light illuminated (green/capture) –
  - command bars provide commands to fly to and maintain localizer course
  - LOC capture – 2 dots (2 degrees)
- GLIDE SLOPE light illuminated (amber/armed) –
  - command bars provide commands to fly existing attitude commands
- GLIDE SLOPE light illuminated (green/capture) –
  - command bars provide commands to fly to and maintain glide slope.

MAN GS –

- VOR/LOC and GLIDE SLOPE lights illuminated (green/capture) –
  - command bars provide commands for fixed intercept angle to the localizer
  - command bars provide commands to fly to pitch up or down to intercept the glide slope.

2 Altitude Hold (ALT HOLD) Switch

OFF (spring loaded) –

- Deselects altitude hold
- Trips off at glide slope capture.

ON –

- Command bars reference to pressure altitude from ADC
- Cannot be selected when Mode Selector is in GA position.

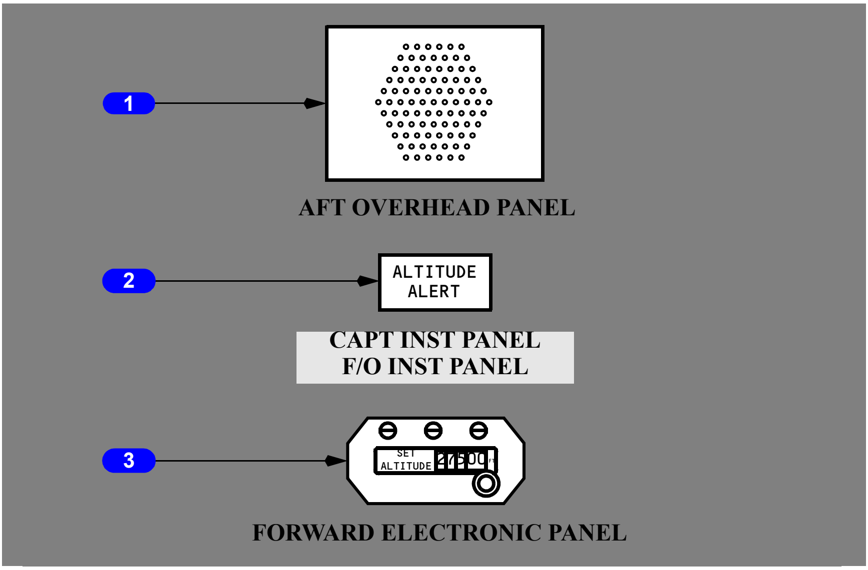
3 Pitch Command (PITCH CMD) Control

- Selects fixed pitch angle for climb or descent
- Command bars can be selected to 10 degrees down to 15 degrees up.

Not effective if:

- ALT HOLD switch is ON
- Glide slope is captured
- GA mode is active.

Altitude Alert



1 Speaker

Transmits alert tone when airplane approaches or departs selected altitude.

2 ALTITUDE ALERT Light

Illuminated (amber)

Airplane is within the range of 1000 to 375 feet of the selected altitude.

3 ALTITUDE ALERT Controller

- Displays the selected alerting altitude
- Covered by a warning flag if the Captain's altimeter signal is lost or if electrical power is lost.

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General

Autopilot

The autopilot is made of two independent channels – roll and pitch – and may be used with or without the yaw damper engaged. (see the limitation section in Volume 1 for operation above 30,000 feet.) The two channels may be engaged simultaneously or independently and only in the MANUAL mode.

The roll channel uses signals from the vertical gyro (roll attitude), directional gyro (heading), Captain's HSI (heading and course), ADC (airspeed signal), VHF navigation radio (VOR/LOC deviation), and control wheel steering. These inputs are converted to mechanical control of the ailerons by the aileron power control unit. Movement of the ailerons causes the control wheel to turn, which then causes the spoilers to operate normally.

The pitch channel uses signals from the vertical gyro (pitch attitude), ADC (altitude and airspeed), VHF navigation radio (glideslope deviation), and control wheel steering. Additionally, signals from the radio altimeter are used to desensitize ILS signals while in the AUTO APPROACH or MAN G/S modes. These inputs are converted to mechanical control of the elevators by the elevator power control unit. Large elevator movements cause the stabilizer to re-trim automatically.

Autopilot Modes

The following modes are available and will be described in detail later in this section:

- MANUAL
- VOR/LOC
- AUTO APPROACH
- MANUAL GLIDE SLOPE

In conjunction with these modes, the following submodes are available:

- CONTROL WHEEL STEERING
- HEADING OFF
- HEADING HOLD
- HEADING SELECT
- TURBULENCE
- ALTITUDE HOLD

Hydraulic Failure

Loss of hydraulic system pressure will not cause autopilot disengagement. The autopilot will be inoperative due to the loss of flight control hydraulic power.

Loss of Navigation Signal

Loss of valid navigation signals will not cause autopilot disengagement or mode change if in VOR/LOC, AUTO APP or MAN G/S. Manual mode may be selected or the autopilot disengaged to continue safely.

Autopilot System

Autopilot Heading Switch

The autopilot heading switch may be used to operate the autopilot in HEADING OFF, HEADING HOLD, or HEADING SELECT. This switch is spring–loaded to the center, HEADING HOLD, position. HEADING SELECT may be used in any mode until VOR/LOC capture, when it trips to the center position automatically.

When in HEADING SELECT, the autopilot uses the Captain’s heading marker for reference. The autopilot roll channel is in CWS high detent. If high detent force is exceeded, the heading switch trips to HEADING HOLD.

Pitch modes such as ALT HOLD or TURB may be used independently of the heading mode. Bank angles for all modes are limited to 32 degrees.

Autopilot Pitch Mode Selector

The autopilot pitch mode selector is used for altitude hold (ALT HOLD) and turbulence (TURB) mode selection.

The Altitude Hold mode causes the autopilot to level at the altitude at which the autopilot mode selector is positioned to ALT HOLD.

Turbulence (TURB) mode softens autopilot control to reduce gust loads.

In VOR/LOC (localizer operation only), AUTO APP, and MAN G/S modes, selection of TURB will cause automatic reversion to the MANUAL mode.

LOC, AUTO APP, and MAN G/S cannot be selected while TURB mode is active.

Approach Progress Display

The approach progress display provides annunciation of autopilot status while in VOR/LOC, AUTO APP, and MAN G/S.

VOR/LOC Mode

The VOR/LOC light:

- Illuminates amber immediately after mode selection
- Illuminates green when capture occurs (2/5 dot in VOR and 2 dots in LOC).

The GLIDE SLOPE light is inoperative in the VOR/LOC mode.

AUTO APP Mode

In the auto approach AUTO APP mode, the VOR/LOC light provides the same annunciations as in the VOR/LOC mode.

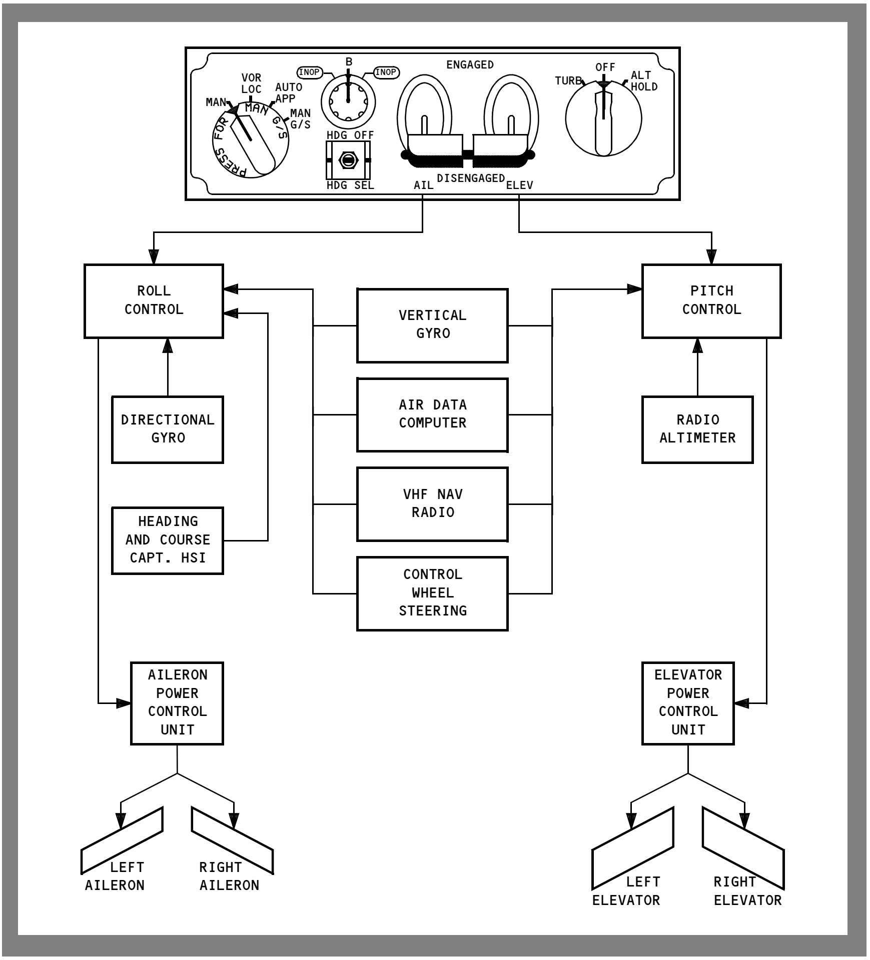
The GLIDE SLOPE light:

- Illuminates amber at AUTO APP mode selection
- Illuminates green at glide slope capture (1/3 dot).

MAN G/S Mode

Selection of the Manual Glide Slope (MAN G/S) mode illuminates the green GLIDE SLOPE light, regardless of glide slope deviation.

Autopilot Schematic



Engagement Interlocks

The autopilot engage switches will be mechanically locked in the disengage position until the following conditions are satisfied:

Roll (AIL) Channel

- Autopilot roll computer is valid
- ADC airspeed signal is valid
- Vertical and directional gyros are valid.
- B flight control switch is ON.

- No force on control wheel
- Standby power switch is in AUTO position.

Pitch (ELEV) Channel

- Autopilot pitch computer is valid
- ADC airspeed signal is valid
- Vertical gyro is valid
- Flight control switch is ON
- Electric trim is not operating
- A/P trim cutout switch is NORMAL
- No force on control column
- Standby power switch is in AUTO position.

Automatic Disengagements

Roll and Pitch

Automatic disengagement of both channels occurs when:

- Either autopilot disengage switch is pushed
- The vertical gyro signal is lost or transferred
- The airspeed signal from the ADC is lost.
- The B flight control switch is positioned to OFF
- The autopilot system select switch is repositioned
- The standby power switch is positioned to BAT.

Roll Only

Automatic disengagement of the roll channel only occurs when:

- Autopilot roll channel power is lost
- The compass signal is lost or transferred.

Pitch Only

Automatic disengagement of the pitch channel only occurs when:

- Autopilot pitch channel power is lost
- The control wheel stabilizer trim switches are used
- The stabilizer trim autopilot cutout switch is positioned to CUTOUT.

Autopilot Revert–to–Man Conditions

The autopilot will revert to MANUAL if the following conditions exist:

- TURB mode selected (with mode selector in AUTO APP, MAN G/S, or in VOR/LOC with ILS frequency selected)
- ILS test performed in radio modes

- ILS frequency changed or transfer switch moved in AUTO APP or MAN G/S
- high detent CWS force applied while in VOR/LOC, AUTO APP, or MAN G/S modes after VOR or LOC on course
- loss of altitude input from the ADC while in AUTO APP or MAN G/S.

Control Wheel Steering (CWS)

The airplane may be maneuvered in pitch and roll after autopilot engagement using the control wheel and column. Manual inputs by the pilots using CWS are the same as required for manual flight. Autopilot system feel control is designed to simulate control input resistance similar to manual flight configuration. Two force levels are required to move the control column or wheel out of the center (detent) position to induce pitch or roll commands.

Low Detent Level

After autopilot engagement, a low level force (4 pounds in the roll axis and 5 pounds in the pitch axis) is required to move the control wheel out of the center (detent) position. This force is comparable to the force required during manual flight. After overcoming this resistance, the command to pitch or roll is at a rate proportional to control wheel or column force.

High Detent Level

High detent level force (8 pounds in the roll axis and approximately 18 pounds in the pitch axis) is provided to prevent inadvertent disengagement of various submodes. The force required to move the control wheel or column out of the detent position is increased. If reversion to CWS inputs only (no automatic heading, course, radio, or pitch commands) is desired, this may be accomplished by exerting a force greater than high detent level.

CWS Operation

CWS operates in low or high detent level, depending on which modes or submodes are active:

MAN Mode

CWS pitch and roll are low detent unless various submodes are active.

VOR/LOC Mode

CWS pitch and roll are low detent until VOR or localizer ON COURSE. CWS roll then becomes high detent, and CWS pitch remains low detent unless ALT HOLD is active. CWS roll may be used to override during the capture phase until ON COURSE. Exceeding high detent in roll reverts the autopilot to MAN.

AUTO APP or MAN G/S Modes

Same as VOR/LOC mode until G/S engaged. Pitch and roll CWS are then high detent. Exceeding high detent reverts the autopilot to MAN.

ALT HOLD Submode

CWS pitch is high detent. Exceeding high detent will revert the Pitch Mode Selector Switch to OFF.

TURB Submode

CWS pitch is low detent.

HDG HOLD/HDG OFF Submodes

CWS roll is low detent.

HDG SEL Submode

CWS roll is high detent. Exceeding high detent causes the heading switch to move to the center (HEADING HOLD) position.

Flight Director

The flight director computers receive constant inputs from various airplane systems. Loss of one of these inputs will adversely affect the flight director.

The command bars are dependent upon the position of the Flight Director Mode, Selector, Altitude Hold Switch, and Pitch Command Control. The following is a condensed description of the inputs to the computers and the commands to the indicator:

Air data computer – a pitch command to hold altitude if the Altitude Hold Switch is ON.

Radio altimeter and marker beacon receiver – at 1500 feet, gain for pitch commands to maintain glide slope is reduced. Gain is further reduced at 200 feet, or the middle marker, whichever is first.

GA (Go–Around) – a pitch–up command and a wings level roll command.

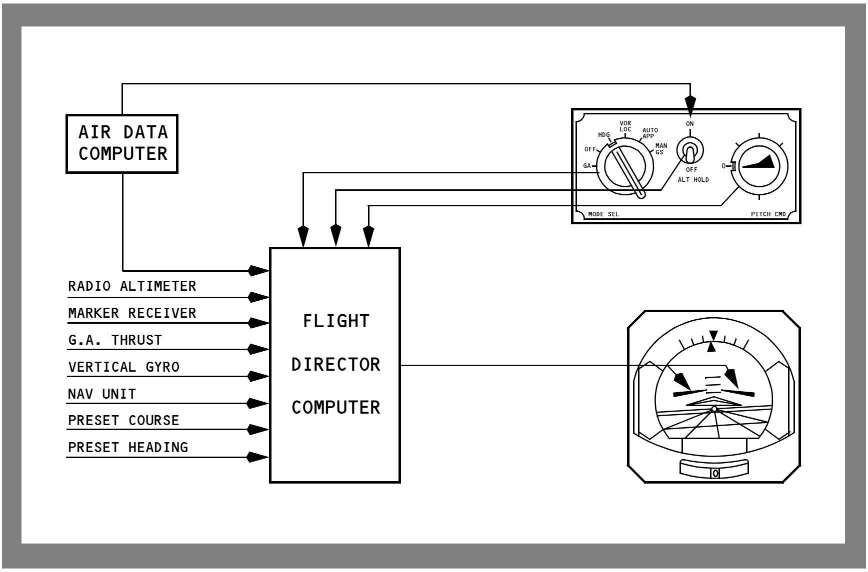
Vertical gyro – pitch and roll commands for stabilization of the indicator

Navigation unit – pitch and roll signals for capturing and tracking VOR radials, localizer courses, and glide slope beams.

Preset course – roll commands to remain on selected course.

Preset heading – roll commands to remain on selected heading.

Flight Director Schematic



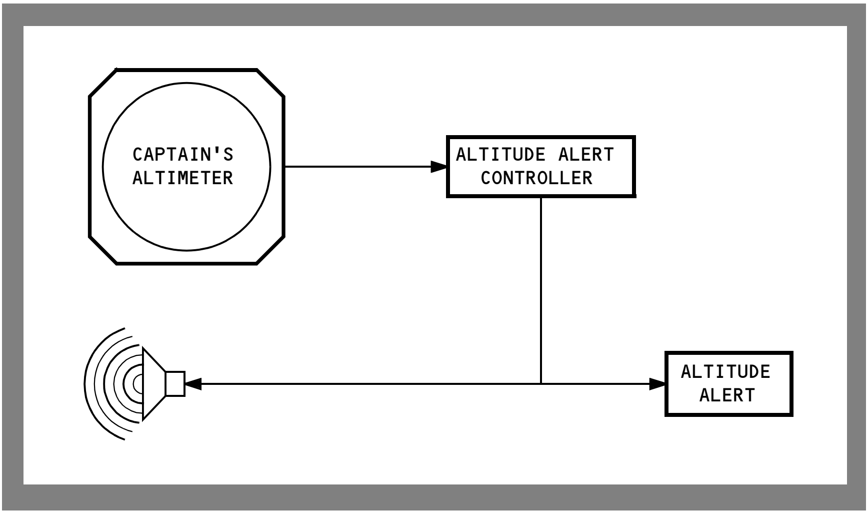
Altitude Alert System

The altitude alert system provides visual and aural reminders when approaching a pre-selected altitude. The system uses the Captain’s altimeter to compare actual altitude to the alerting altitude set in the Altitude Alert Controller.

Acquisition Mode

When approaching the selected altitude, a two second tone sounds and the ALTITUDE ALERT lights illuminate 1000 feet above or below the selected altitude. The lights extinguish 375 feet above or below the selected altitude.

Altitude Alert System



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Communications — Chapter 5

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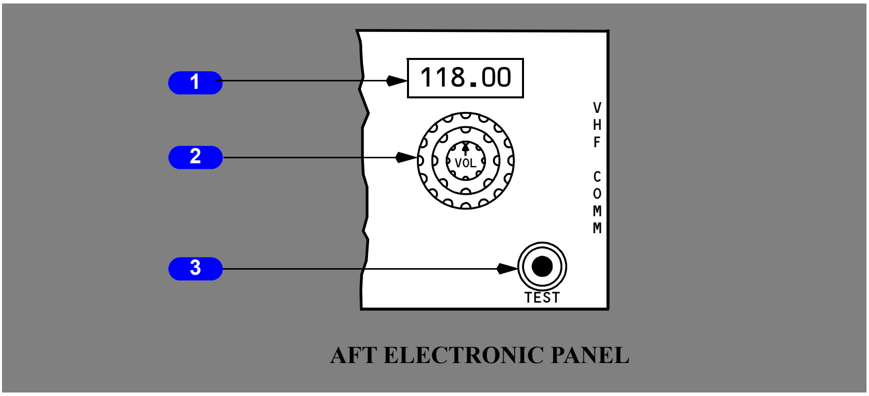
VHF Communication Panel



1 Frequency Indicator

Indicates selected frequency.

2 Frequency Selector

Rotate – selects frequency in related indicator:

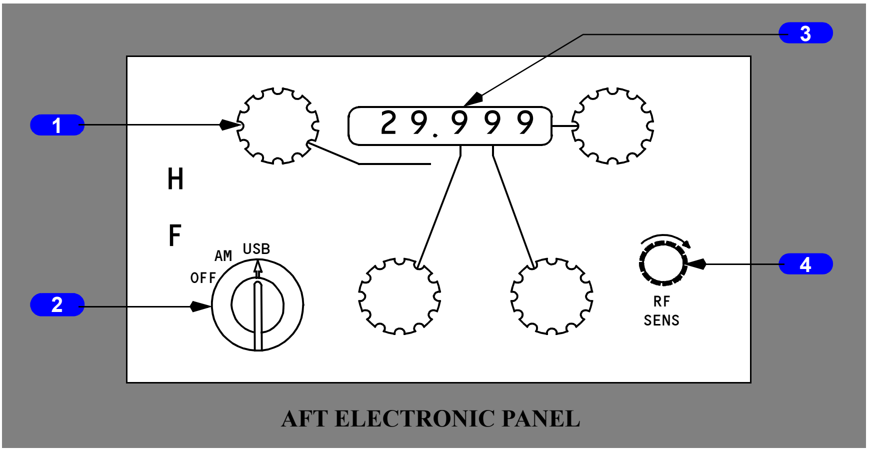
- outer selector changes three left digits
- middle selector changes two right digits.
- inner selector changes receiver volume, but not side tone.

3 Communication (COMM) TEST Switch

Push –

- removes automatic squelch feature, permitting reception of background noise and thereby testing receiver operation
- improves reception of weak signals.

HF Communication Panel



1 Frequency Selector

Rotate – selects frequency.

2 Mode Selector

OFF – transceiver not powered.

USB (Upper Sideband) – transmits and receives on higher side of frequency.

AM (Amplitude Modulation) – transmits and receives on selected frequency with a carrier wave.

3 Frequency Indicator

- indicates selected frequency
- frequency range from 2,000 to 29,000 megahertz.

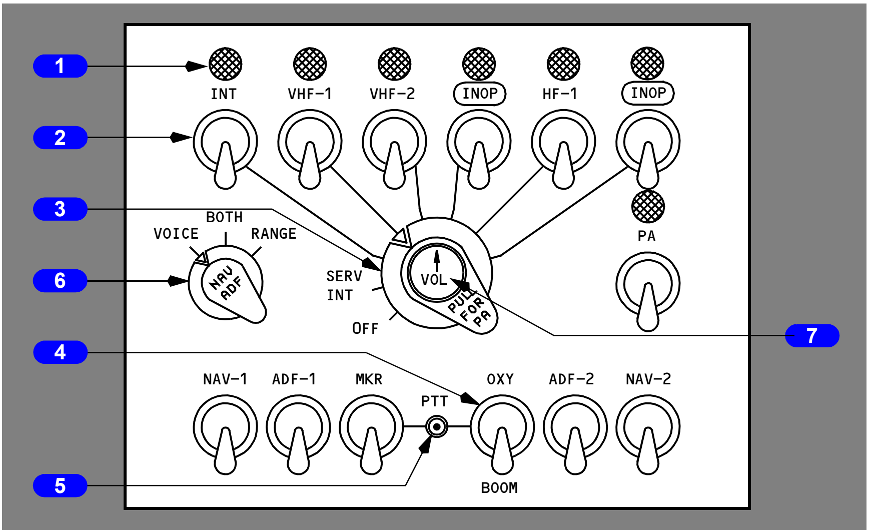
4 RF/HF Sensitivity Control

Rotate–controls sensitivity of receiver.

- (clockwise) increases sensitivity for reception of weak or distant stations
- (counterclockwise) decreases sensitivity to reduce noise and static.

Note: decreasing sensitivity too far prevents reception, including SELCAL monitoring of HF radio.

Audio Selector Panel (ASP)



FLIGHT DECK CREW STATIONS

1 Transmitter Light

Illuminated (green) – related switch is active.

2 Receiver Switches

Up –

- receiver selected for related communication system or navigation receiver
- multiple switches may be selected

3 Transmitter Selector

Rotate –

- selects related communication system for transmission
- receiver also selected on regardless of whether related receiver switch is on.
- must be pulled up to select PA.

4 OXY–BOOM Switch

OXY – selects oxygen mask for transmissions.

BOOM – selects boom microphone for transmissions.

5 Push–to–Talk Switch

Push – keys the oxygen mask or boom microphone for transmission, as selected by the transmitter selector.

6 Filter Switch

Voice – receive NAV and ADF voice audio.

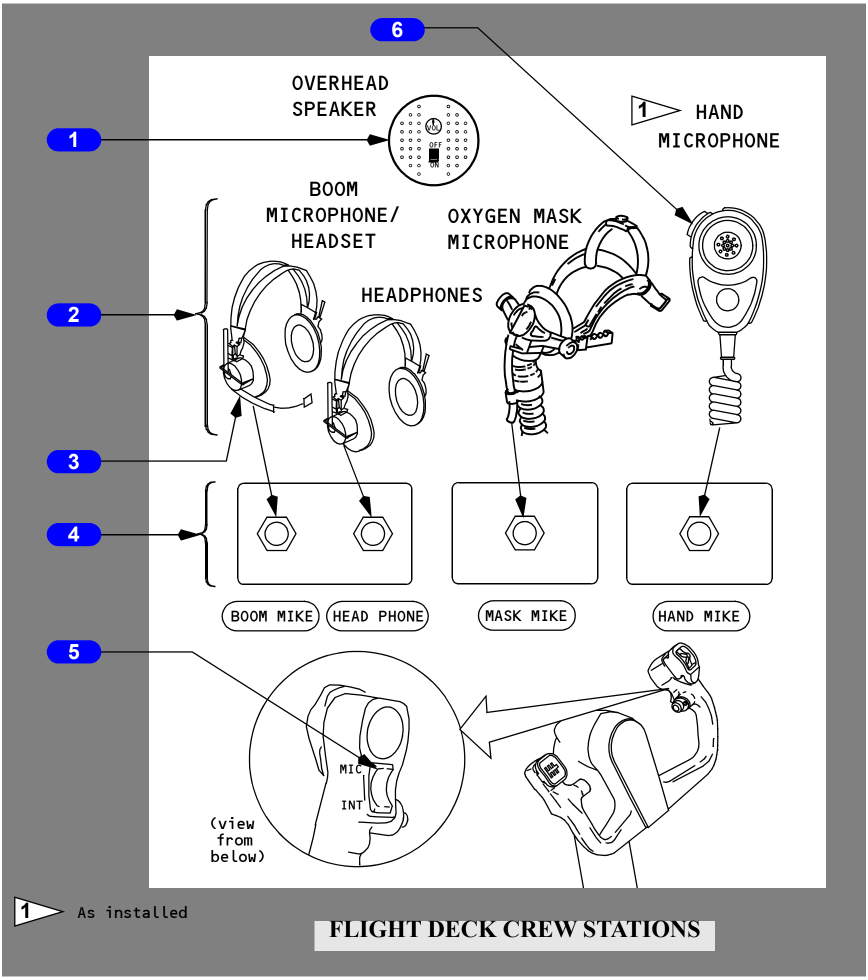
Both – receive NAV and ADF voice and range audio

Range – receive NAV and ADF station identifier range (code) audio.

7 Volume Control

Rotate – adjusts volume. of all receivers.

Miscellaneous Communication Controls (Typical)



1 Overhead Speaker

Monitors audio from related pilot's ASP.

2 Standard Microphones

Choose desired microphone for voice transmission through selected radio, interphone system, or passenger address (PA).

3 Headset or Headphones

Monitors audio from related ASP.

4 Communication Jacks

Used for appropriate microphone or headphone plugs.

5 Push–To–Talk Switch

MIC (microphone) –

- selects oxygen mask or boom microphone for transmission, as selected by ASP transmitter selector.
- Same as using ASP PTT switch (R/T position).

OFF – center position.

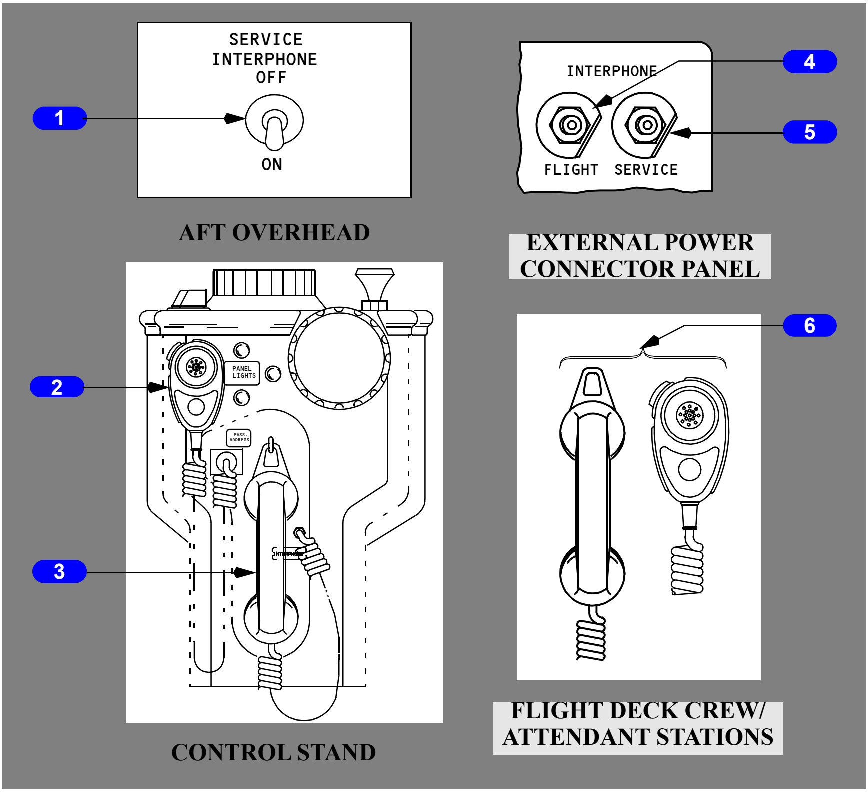
INT (interphone) –

- selects oxygen mask or boom microphone for direct transmission over flight interphone
- bypasses ASP transmitter selector
- same as using ASP PTT switch (I/C position).
- Locks in INT position until selected to either OFF or MIC.

6 Push–To–Talk Switch

Push – keys hand microphone for transmission, as selected by ASP transmission selector.

Interphone and Passenger Address Controls



1 SERVICE INTERPHONE Switch

OFF –

- external jacks are deactivated
- communication between flight deck and flight attendants is still possible.

ON – adds external jacks to service interphone system.

2 Passenger Address (PASS ADDRESS) Hand Microphone

- used to make PA announcements
- bypasses ASP.

3 Service INTERPHONE Handset

- used to communicate with flight attendant stations
- With SERVICE INTERPHONE switch ON, also used to communicate with any external jack location
- bypasses ASPs.

4 FLIGHT INTERPHONE Jack

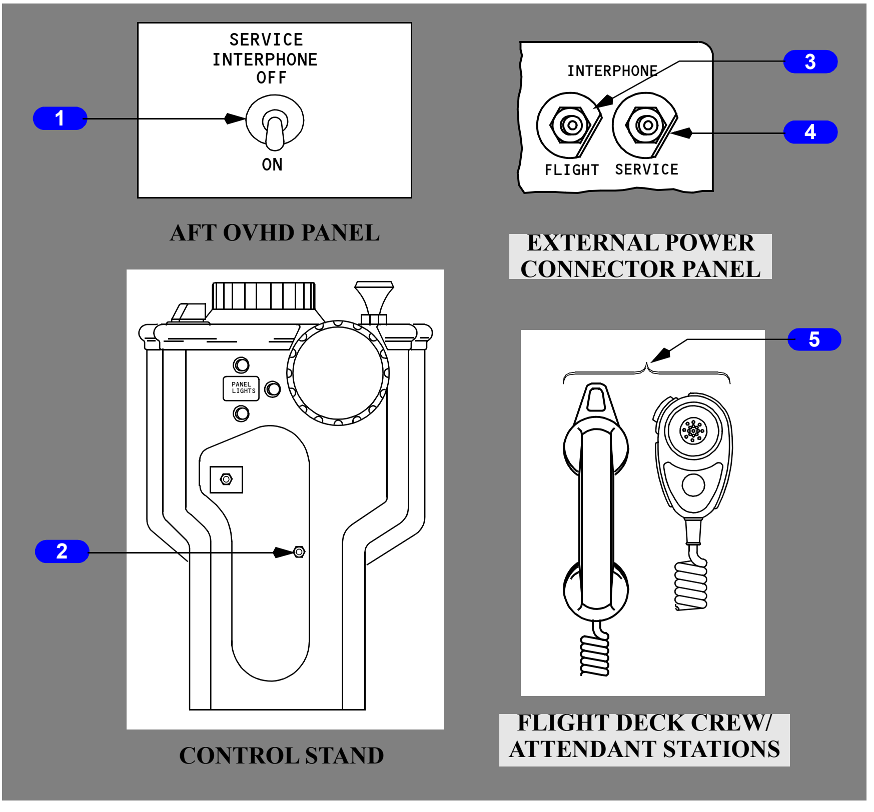
Connects ground crew to Flight Interphone system.

5 SERVICE INTERPHONE Jack

Connects ground crew to Service Interphone system if Service Interphone switch is ON.

6 Flight Deck / Attendant PA Hand Microphone

Used to make PA announcements.



1 SERVICE INTERPHONE Switch

OFF –

- external jacks are deactivated
- communication between flight deck and flight attendants is still possible.

ON – adds external jacks to service interphone system.

2 Service INTERPHONE Handset Jack

- used to communicate with flight attendant stations
- With SERVICE INTERPHONE switch ON, also used to communicate with any external jack location
- bypasses ASPs.

3 FLIGHT INTERPHONE Jack

Connects ground crew to Flight Interphone system.

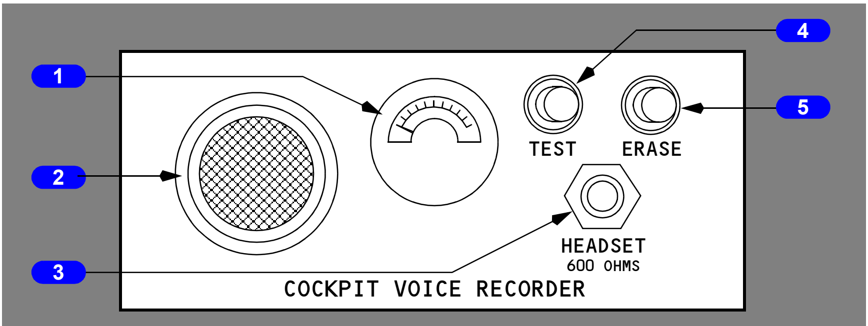
4 SERVICE INTERPHONE Jack

Connects ground crew to Service Interphone system if Service Interphone switch is ON.

5 Flight Deck / Attendant PA Hand Microphone

Used to make PA announcements.

Cockpit Voice Recorder



FORWARD OVERHEAD PANEL

1 Monitor Indicator

Pointer deflection indicates recording or erasure on all four channels (approximately a one second delay); during test, pointer rises into green band.

2 Area Microphone

Active anytime 115V AC is applied to airplane.

3 HEADSET Jack

Headset may be plugged into jack to monitor tone transmission during test, or to monitor playback of voice audio.

4 TEST Switch

Push –

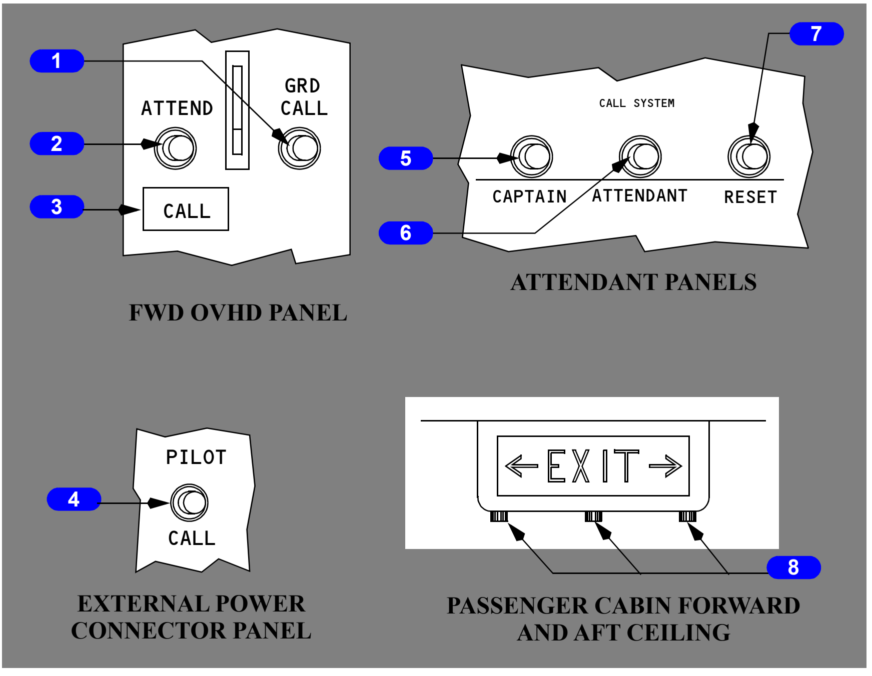
- after a slight delay, monitor indicator rises into green band
- a tone may be heard through a headset plugged into HEADSET jack.

5 ERASE Switch

Push (2 seconds) –

- all four channels are erased
- monitor indicator momentarily deflects
- operates only when airplane is on ground and parking brake is set.

Call System



1 Ground Call (GRD CALL) Switch

Push – sounds a horn in nose wheel well until released.

2 Attendant Call (ATTEND CALL) Switch

Push –

- sounds a two–tone chime in the passenger cabin.

3 Flight Deck CALL Light

Illuminated (blue) – flight deck is being called by flight attendants or ground crew.

Extinguished when Captain Call or Pilot Call switch released.

4 PILOT CALL Switch

Push – sounds a single–tone chime in flight deck.

Flight deck CALL light extinguished when switch is released.

5 CAPTAIN Call Switch

Push – sounds a single–tone chime in flight deck

Flight deck CALL light extinguished when switch is released.

6 ATTENDANT Call Switch

Push –

- sounds a two–tone chime in passenger cabin
- illuminates both pink master call lights.

7 Call RESET Switch

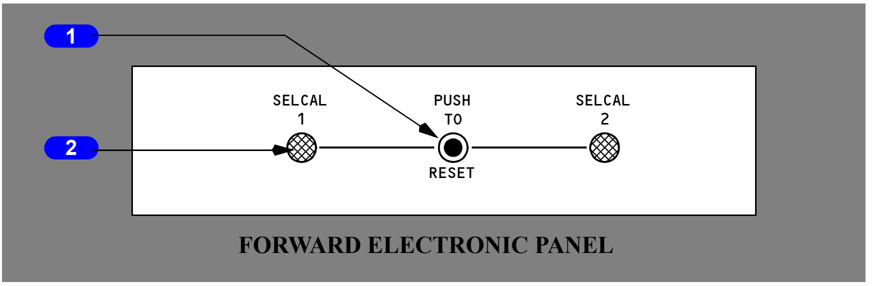
Push – extinguishes both pink master call lights.

8 Master Call Light

Illuminated –

- amber – a lavatory call switch is activated
- pink – flight deck or other flight attendant station is calling
- blue – a passenger seat call switch is activated.

Selective Calling Panel (SELCAL)



1 SELCAL Reset Switch

Push – extinguishes SELCAL light and resets decoder.

2 SELCAL Light

Illuminated –

- alerts crew that communication is desired on a communication radio
- SELCAL 1 light illuminates for a call on VHF –1 or HF
- SELCAL 2 light illuminates for a call on VHF– 2.

Communications Chapter 5
System Description Section 20

Introduction

The communication system includes:

- radio communication system
- interphone communication system
- cockpit voice recorder system
- communication crew alerting system

The communication systems are controlled using the:

- audio control panels
- radio tuning panels

Audio Systems and Audio Selector Panels

An ASP is installed at the Captain, First Officer, and Observer stations. Each panel controls an independent crew station audio system and allows the crewmember to select the desired radios, navigation aids, interphones, and PA systems for monitoring and transmission.

Transmitter selectors on each ASP select one radio or system for transmission by that crewmember. Any microphone at that crew station may then be keyed to transmit on the selected system.

Receiver switches select the systems to be monitored. Any combination of systems may be selected. Receiver switches also control the volumes at the respective crew stations. Audio from each ASP is monitored using a headset/headphones or the related pilot’s speaker.

Speakers and Headsets

Each crew station has a headset or headphone jack. The Captain and First Officer have speakers on the ceiling above their seats. There is no speaker at the observer station. Headset volume is controlled by the receiver switches. Speaker volume is controlled by the receiver switches and also the speaker switch.

Audio warnings for altitude alert, GPWS, and windshear are heard at preset volumes. They cannot be controlled or turned off by the crew.

Microphones

Hand microphones and boom microphones may be plugged into the related jacks at the flight deck crew stations. Each oxygen mask also has an integral microphone.

Each hand microphone has a PTT switch to key the selected audio system. The PTT switches on the control wheel or ASP are used to key the oxygen mask or boom microphone, as selected by the OXY–BOOM switch. The OXY–BOOM switch does not affect the operation of the hand microphone.

Normal Audio System Operation

The Captain, First Officer, and Observer audio systems are located in a common remote electronics unit in the E & E compartment. They function independently and have separate circuit breakers. The audio systems are normally controlled by the related ASPs through digital or computerized control circuits.

Flight Interphone System

The flight interphone system is an independent communication network. Its primary purpose is to provide private communication between flight deck crewmembers without intrusion from the service interphone system. The ground crew may also use the flight interphone through a jack at the external power receptacle.

The pilots can transmit directly over the flight interphone by using the control wheel PTT switch. Alternatively, any crewmember with an ASP can transmit/receive over the flight interphone by using their related ASP and normal PTT switches. Any standard microphone may be used with the flight interphone system.

Service (Attendant) Interphone System

The service interphone system provides intercommunication between the flight deck, Flight Attendants, and ground personnel. Flight deck crewmembers communicate using either a separate handset (if installed) or their related ASP and any standard microphone.

The Flight Attendants communicate between flight attendant stations or with the flight deck using any of the attendant handsets. Anyone who picks up a handset/microphone is automatically connected to the system.

External jacks for use by maintenance or service personnel can be added to the system by use of the service interphone switch.

Passenger Address System

The passenger address (PA) system allows flight deck crewmembers and flight attendants to make announcements to the passengers. Announcements are heard through speakers located in the cabin and in the lavatories.

The flight deck crewmembers can make announcements using a PA hand microphone or by using any standard microphone and the related ASP. Flight Attendants make announcements using PA hand microphones located at their stations. The attendants use the PA to play recorded music for passenger entertainment.

PA system use is prioritized. Flight deck announcements have first priority and override all others. Flight Attendant announcements override the music system. The forward attendant has priority over the aft attendant.

Call System

The call system is used as a means for various 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 system can be activated from the flight deck, either flight attendant station, or from the external power receptacle. Passengers may also use the system to call an attendant, through the use of individual call switches at each seat.

The flight deck may be called from either flight attendant station or by the ground crew. The ground crew may only be called from the flight deck. Flight Attendants may be called from the flight deck, the other attendant station, or from any passenger seat or lavatory. Master call lights in the passenger cabin identify the source of incoming calls to the attendants.

Call system chime signals are audible in the passenger cabin through the PA system speakers. The PA speakers also provide an alerting chime signal whenever the NO SMOKING or FASTEN SEAT BELT signs illuminate or extinguish.

Location of Call Originator	Called Position	Visual Signal at Called Position	Aural Signal at Called Position
Flight deck	Attendant station	Pink master call light	Two–tone chime
Flight deck	Nose wheel well		Horn in nose wheel well
Attendant station	Flight deck	Blue flight deck call light	Single high–tone chime
External Power Panel	Flight deck	Blue flight deck call light	Single high–tone chime
Flight deck	Passenger cabin	NO SMOKING or FASTEN BELT signs illuminate/ extinguish	Single low–tone chime

Selective Calling (SELCAL)

A ground station desiring communication with the flight deck can use the SELCAL system. SELCAL monitors selected frequencies on VHF and HF radios. Each airplane is assigned a unique four–letter SELCAL identification code. When the system receives an incoming call from a ground station, a two–tone chime sounds, and the related SELCAL light illuminates.

VHF Communications

Primary short–range voice communications is provided in the VHF range by two independent radios. Each radio provides for selection of an active frequency and an inactive (preselected) frequency. Voice transmission and reception are controlled at the related ASP.

VHF–1 is located on the left aft electronic panel, VHF–2 on the right. The VHF–1 antenna is located on the upper fuselage, VHF–2 on the lower fuselage.

HF Communications

HF transmission and reception are controlled at the related ASP. When the HF transmitter is keyed after a frequency change, the antenna tunes. While the antenna is tuning, a steady or intermittent tone may be heard through the audio system (tuning takes a maximum of 15 seconds). The antenna is located in the vertical stabilizer.

Note: Keying HF transmitter on the ground may cause oil and fuel quantity indicators to fluctuate if one or more of the following conditions exist:

- cargo or passenger entry door open
- service interphone microphone plugged into service interphone jack
- airplane grounding wire attached to airplane
- ground power cart connected.

Cockpit Voice Recorder

The cockpit voice recorder uses four independent channels to save the last 30 minutes of flight deck audio. Recordings older than 30 minutes are automatically erased. One channel records flight deck area conversations using the area microphone. The other channels record individual ASP output (headset) audio and transmissions for the pilots and observer.

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Electrical — Chapter 6
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Electrical — Chapter 6
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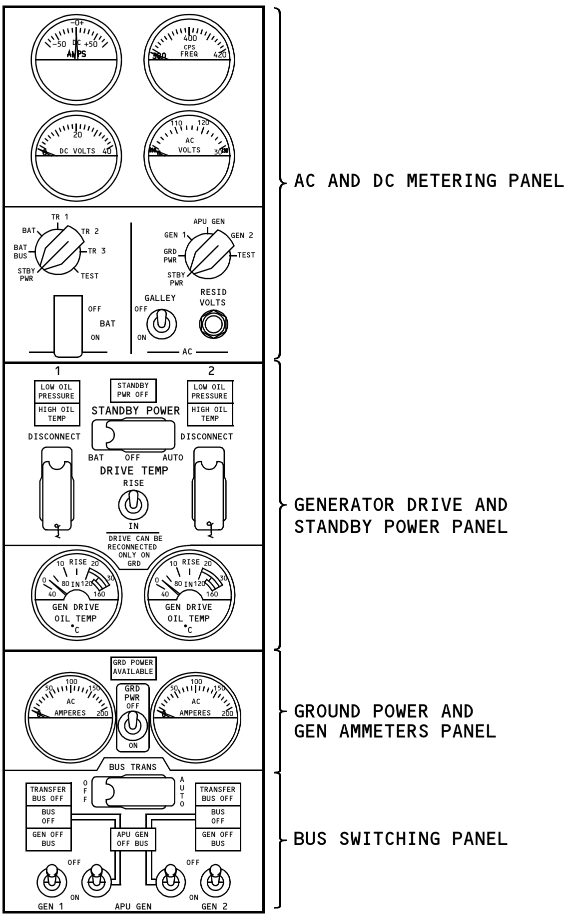
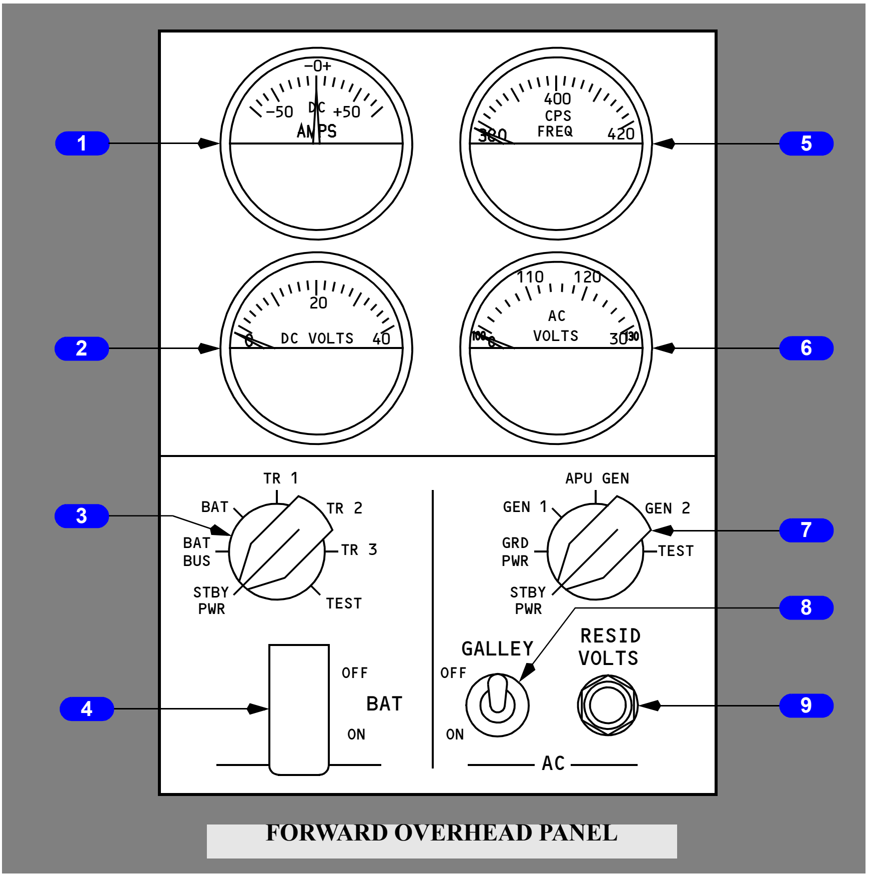
Electrical Panel



FORWARD OVERHEAD PANEL

AC and DC Metering Panel



1 DC Ammeter

Indicates current of source selected by DC meter selector.

2 DC Voltmeter

Indicates voltage of source selected by DC meter selector.

3 DC Meter Selector

Selects the DC source for the DC voltmeter and DC ammeter indications

TEST - used by maintenance.

4 Battery (BAT) Switch

OFF –

- removes power from the battery bus.

ON (guarded position) -

- provides power to the battery bus from TR3 when main bus No. 2 is energized.
- provides power to the battery bus from the hot battery bus when main bus No. 2 is not energized.

5 AC Frequency Meter

Indicates frequency of source selected by AC meter selector.

6 AC Voltmeter

130V scale - indicates voltage of source selected on the AC meter selector.

30V scale - indicates residual voltage of generator selected when RESID VOLTS switch is pressed.

7 AC Meter Selector

Selects the AC source for the AC frequency meter and AC voltmeter.

TEST - used by maintenance.

8 GALLEY Power Switch

OFF – removes electrical power from galleys.

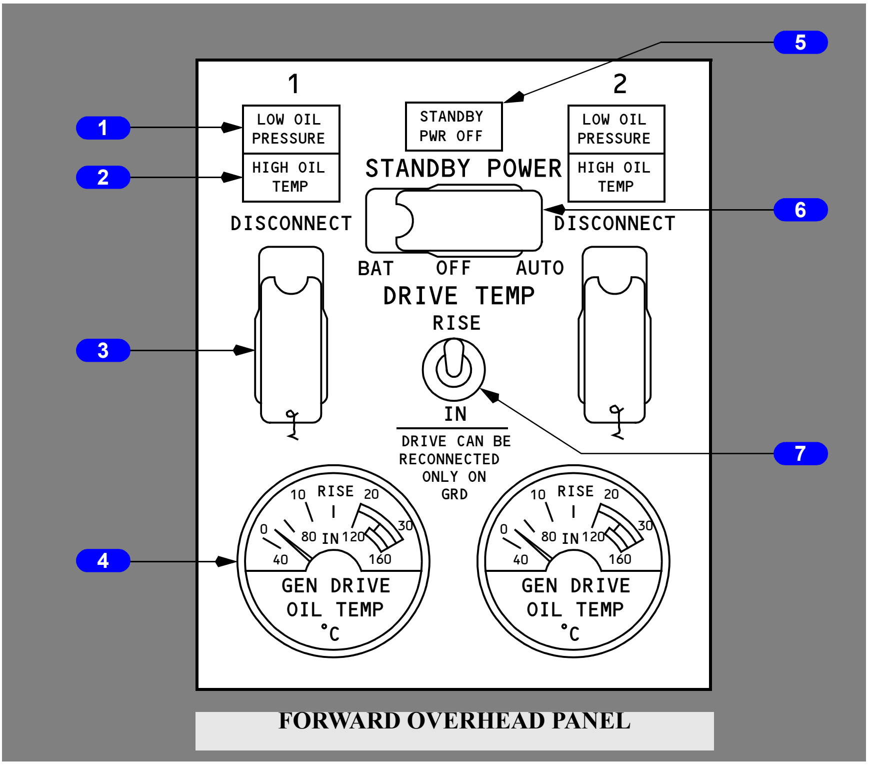
ON – electrical power is supplied to galleys when both AC generator busses are powered.

9 Residual Volts (RESID VOLTS) Switch

PRESS - 30V scale of AC voltmeter indicates residual voltage of generator selected.

Associated generator switch must be OFF. With associated generator switch ON, AC voltmeter drives off scale and residual voltage cannot be read.

Generator Drive and Standby Power Panel



1 LOW OIL PRESSURE Lights

Illuminated (amber) – generator drive oil pressure is below minimum operating limits.

2 High Oil Temperature (HIGH OIL TEMP) Lights

Illuminated (amber) - generator drive oil temperature exceeds operating limits.

3 DISCONNECT Switches (guarded and safetied)

Disconnects generator drive.

Generator drive cannot be re-engaged in the air.

4 Generator Drive Oil Temperature (GEN DRIVE OIL TEMP) Indicator

Displays the temperature of the oil used in the generator drive.

IN scale (inner) - Displays the temperature of the oil entering the generator drive.

RISE scale (outer) - Displays the temperature rise within the generator drive.

- Higher than normal temperature rise indicates excessive generator load or poor condition of the generator drive.
- Lack of adequate cooling will generally cause the temperature RISE to decrease.

5 Standby Power (STANDBY PWR OFF) Light

Illuminated (amber) - AC standby bus is inactive.

6 STANDBY POWER Switch

AUTO (guarded position) –

- In flight, or on the ground, and AC transfer busses powered:
  - AC standby bus is powered by AC transfer bus 1
  - DC standby bus is powered by DC bus 1.
- In flight, loss of all AC power.
  - AC standby bus is powered by the battery bus through the static inverter
  - DC standby bus is powered by the battery bus.
- On the ground, loss of all AC power
  - No automatic transfer of power. AC and DC standby busses are not powered on 737-200 models with unmodified standby system.

OFF (center position) –

- STANDBY PWR OFF light illuminates
- AC standby bus, static inverter, and DC standby bus are not powered.
- STANDBY PWR OFF light illuminates
- AC standby bus and static inverter are not powered.

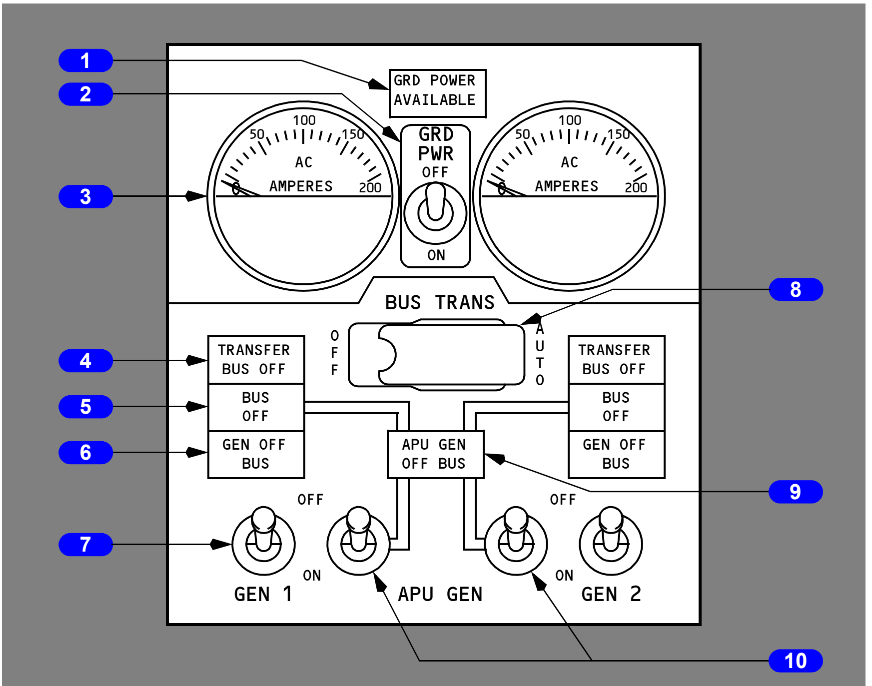
BAT (unguarded position) –

- AC standby bus is powered by the battery bus through the static inverter.
- DC standby bus is powered by the battery bus.

7 Drive Temperature (DRIVE TEMP) Switch

RISE/IN - Selects RISE or IN temperature to be displayed on the GEN DRIVE OIL TEMP indicator.

Bus Switching



FORWARD OVERHEAD PANEL

1 Ground Power (GRD POWER AVAILABLE) Light

Illuminated (blue) – external power bus is powered by ground power supply.

Remains illuminated as long as an AC ground power source is attached outside the airplane.

2 Ground Power (GRD PWR) Switch

Three position switch, spring–loaded to neutral.

OFF – disconnects ground power from both generator busses.

ON – if momentarily moved to ON position and ground power is available:

- removes previously connected power from AC generator busses
- connects ground power to both AC generator busses if power quality is correct
- switches the ground service bus to the generator bus 1
- deactivates the ground service switch.

3 **AC Ammeter**

Indicates engine generator load in amperes.

4 **TRANSFER BUS OFF Light**

Illuminated (amber) – related transfer bus is inactive.

5 **BUS OFF Light**

Illuminated (amber) – related generator bus is inactive.

6 **Generator Off Bus (GEN OFF BUS) Light**

Illuminated (blue)- related generator is not supplying the generator bus.

7 **Generator Switch (GEN 1/GEN 2)**

Three position switch, spring–loaded to neutral.

OFF - disconnects related engine generator from the generator bus.

ON - connects related engine generator to the generator bus if the power quality is correct. Disconnects the previous power source.

8 **Bus Transfer (BUS TRANS) Switch**

AUTO (guarded position) - upon failure of one engine generator bus, its transfer bus is switched to the active generator bus. Allows TR3 to supply DC bus No.1 if TR1 fails.

OFF - Isolates transfer busses by preventing operation of the bus transfer relays, and opens TR3 disconnect relay. Prevents the battery charger from switching to its alternate source of power, main bus 2. Isolates TR3 from DC bus No.1

9 **APU Generator Off Bus (GEN OFF BUS) Light**

Illuminated (blue) – APU is at its operating speed and not powering a generator bus.

10 **APU Generator (GEN) Switch**

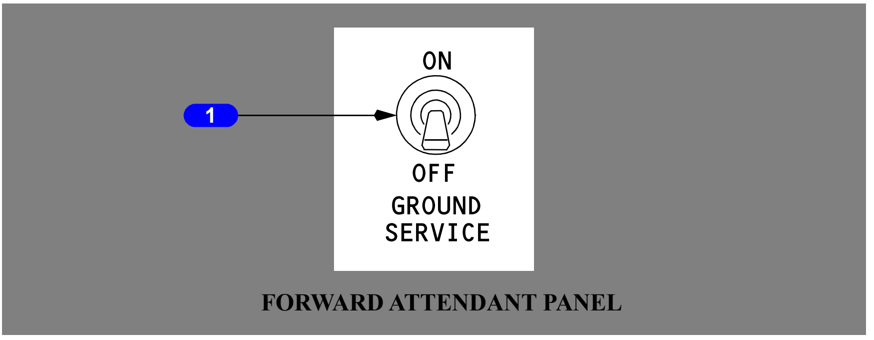
Three position switch, spring–loaded to center position.

OFF - disconnects the APU from the generator bus.

ON – connects the APU generator output to the generator bus if the quality is correct.

Note: In flight, if one generator bus is powered by the APU and the other APU GEN switch is moved to ON, the second generator bus will not connect to the APU generator.

Ground Service Switch



1 GROUND SERVICE Switch

Solenoid held ON, spring-loaded to OFF.

Provides manual control of ground service bus. Enables servicing airplane using external power without activating generator busses.

- ON – connects the ground service bus to the external AC bus. Trips off when the GRD PWR switch is ON
- OFF – disconnects external AC bus from the ground service bus.

Electrical — Chapter 6
System Description — Section 20

Introduction

Primary electrical power is provided by two engine driven generators which supply three-phase, 115 volt, 400 cycle alternating current. Each generator supplies its own bus system in normal operation and can also supply essential loads of the opposite side bus system when one generator is inoperative. Transformer rectifier (TR) units and a battery supply DC power. The battery also provides backup power for the AC and DC standby systems. The APU operates a generator and can supply power to both AC generator busses on the ground or one AC generator bus in flight.

There are two basic principles of operation for the 737 electrical system:

- There is no paralleling of the AC sources of power.
- The source of power being connected to a generator bus automatically disconnects an existing source.

The electrical power system may be categorized into three main divisions: the AC power system, the DC power system, and the standby power system.

Electrical Power Generation
Engine Generators

Primary power is obtained from two 40 KVA, engine driven generators. Each generator is part of a generator drive unit which maintains a constant frequency throughout the normal operating range of the engine. The generator is coupled directly to the engine and operates whenever the engine is running.

APU Generator

The APU generator can supply primary power on the ground and can serve as a backup for either generator in flight. The APU generator is identical to the engine generators but has no generator drive unit, since the APU itself is governed and will maintain a constant speed. As the only power source, the APU generator can meet electrical power requirements for all ground conditions and all essential flight requirements. The APU generator is rated at 40 KVA in flight and 45 KVA on the ground.

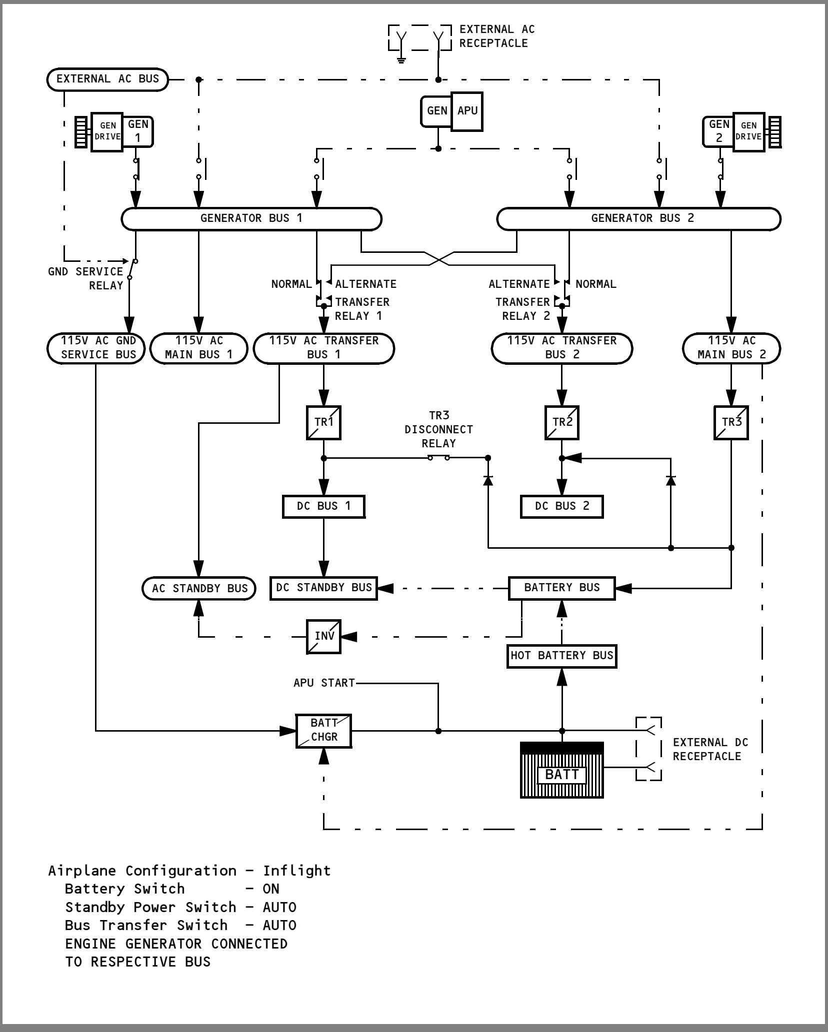
External Ground Power

An external AC power receptacle located near the nose gear wheel well, on the lower right side of the fuselage, allows the use of an external power source. Status lights on a panel adjacent to the receptacle permit the ground crew to determine if external power is being used. A GRD POWER AVAILABLE light provides flight deck indication that an AC ground power source is attached outside the airplane. A GRD PWR switch allows connection of external power to both generator busses.

Ground Service

For ground servicing, a ground service switch is located on the forward attendant's panel. The switch provides ground power directly to the AC ground service bus for utility outlets, cabin lighting and the battery charger without powering all airplane electrical busses. The ground service switch is magnetically held in the ON position and is overridden when the GRD PWR switch is positioned to ON.

Electrical Power Schematic



AC Power System

Each AC power system consists of a generator bus, a main bus, and a transfer bus. The left AC power system also includes a ground service bus. Transfer bus 1 supplies power to the AC standby bus. If the source powering either AC power system fails or is disconnected, a transfer relay automatically selects the opposite generator bus as an alternate power source for the transfer bus.

Generator busses can be powered from the engine generators by momentarily positioning the related generator switch to ON. This connects the voltage regulator to the generator and connects the generator to its associated generator bus. Selecting a new power source disconnects the existing power source.

When the APU is operating, selecting either APU GEN switch ON connects APU power to its associated generator bus. On the ground, the APU can supply electrical power to both generator busses.

With the airplane on the ground and external power is available, selecting the GRD PWR switch ON connects external power to both generator busses. An engine generator can supply power to one generator bus while external power supplies the other generator bus.

With external power supplying both generator busses, selecting either APU GEN switch ON disconnects external power.

In flight, each engine generator normally powers its own generator bus. If an engine generator is no longer supplying power, the APU generator may be used to power one generator bus. Since the entire electrical system is powered from the two generator busses, all electrical components can be powered with any two operating generators.

Bus Transfer System

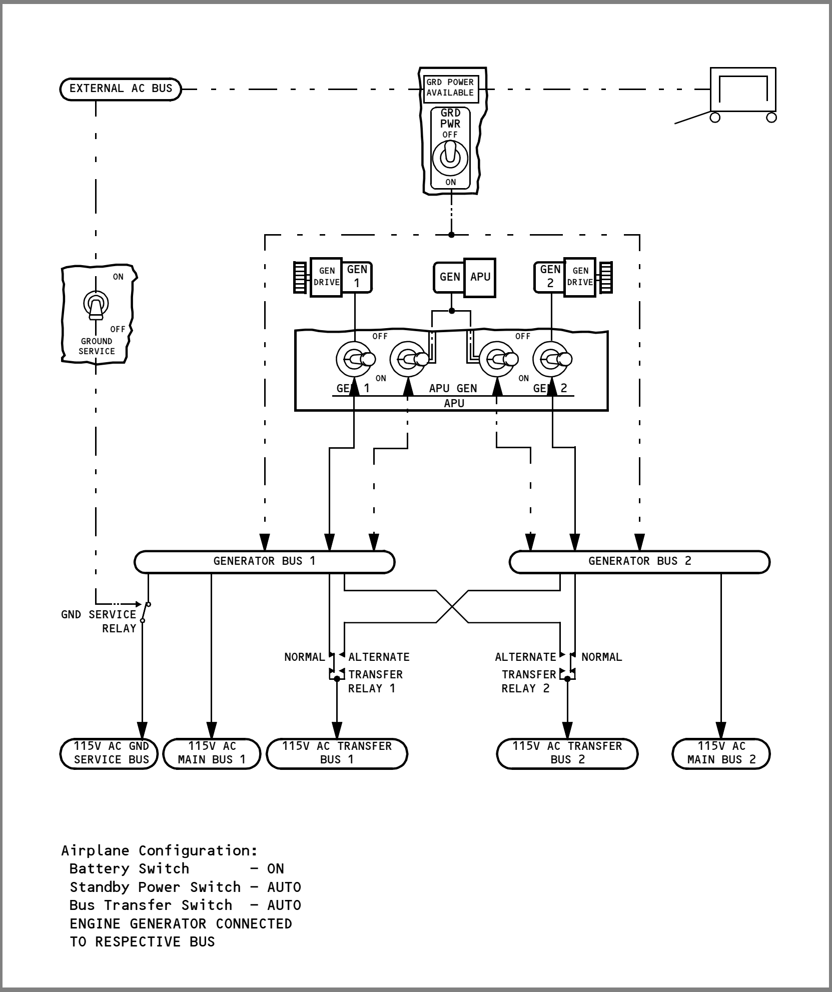
The generator busses supply the heavy electrical loads including supplying power to the transfer and main busses. The transfer busses carry the essential electrical loads, and the main busses carry the non-essential loads.

If a generator trips off, its generator bus and main bus will not be powered. Each transfer bus has a transfer relay which automatically selects the opposite generator bus as its power source. The BUS TRANS switch must be in the AUTO position to enable this transfer.

Automatic Load Shedding

In flight, all galley power and the respective system B hydraulic pump power is automatically removed when operating on one generator. (The switches remain in the ON position.) However, if one system B hydraulic pump switch is already off, the remaining system B hydraulic pump will be transferred to the generator bus that is powered. This automatic load shedding feature reduces the total electrical load on the remaining generator, protecting it from overload.

AC Power Schematic



Electrical Power Controls and Monitoring

Generator Drive

Each engine driven generator is connected to its engine through a generator drive unit. Each generator drive is a self-contained unit consisting of an oil supply, cooler, instrumentation and disconnect device which provides for complete isolation of the generator in the event of a malfunction.

Operating conditions of the generator drive can be observed on the generator drive oil temperature indicator. Oil temperature is measured as it enters and leaves the generator drive. Temperature of oil entering the generator is indicated on the IN scale. Temperature differential between outlet and inlet is indicated as RISE - (out temperature minus in temperature). During normal operation, the oil temperature rise should be less than 20 deg. C. Readings above 20 deg. C indicate excessive generator load or poor condition of the drive and are used by maintenance in troubleshooting drive problems.

The amber HIGH OIL TEMPERATURE light illuminates when oil temperature in the internal oil tank exceeds limitations. The amber LOW OIL PRESSURE light illuminates when oil pressure is below the operating limit. When the generator has been disconnected, the LOW OIL PRESSURE light will be on, and the HIGH OIL TEMPERATURE light remains on until the oil is cooled.

A generator drive disconnect switch is installed. This switch disconnects the generator from the engine in the event of a generator drive malfunction. Reactivation of the generator may be accomplished only on the ground by maintenance personnel.

AC Voltmeter and Frequency Meter

AC voltage and frequency may be read on the AC voltmeter and frequency meter for unit selected on the AC meter switch. Frequency is indicated only when the generator is electrically excited. The voltage regulator automatically controls the generator output voltage.

Current readings for the two engine generators and the APU generator may be read on the AC ammeter.

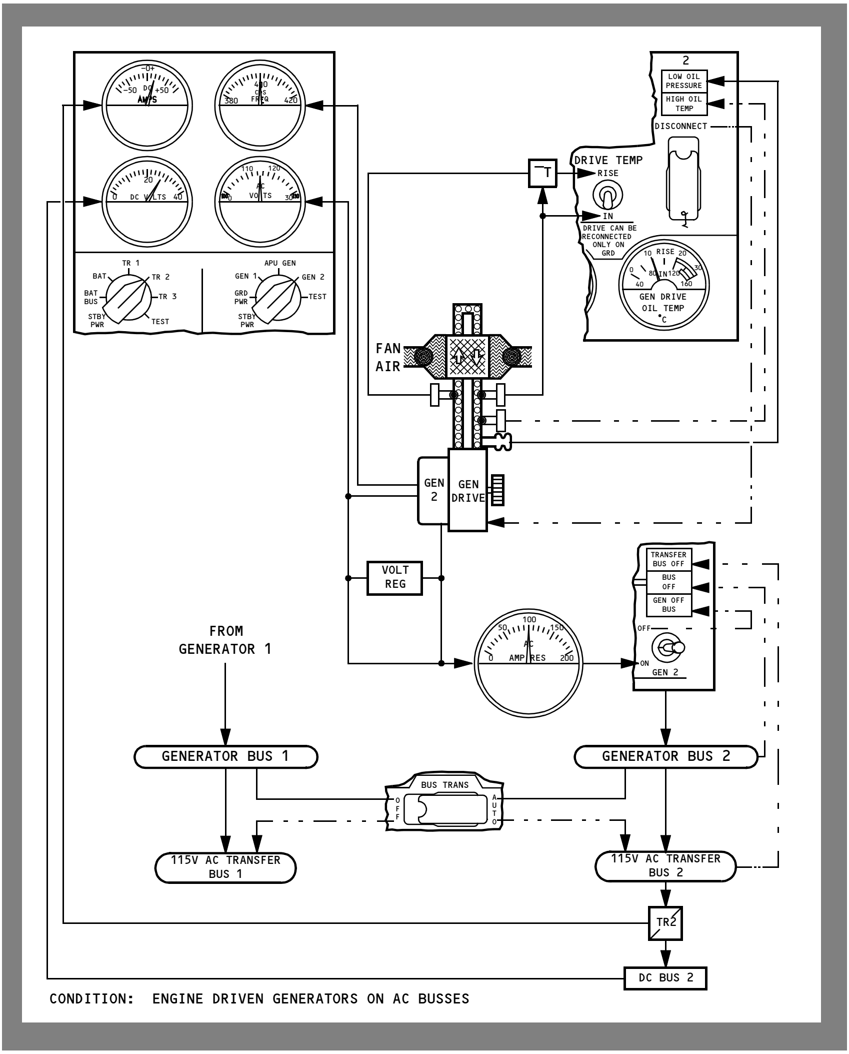
The TEST position is used by maintenance and connects the voltage and frequency meter to the power systems test module for selection of additional reading points.

DC Voltmeter and Ammeter

DC voltage and amperage may be read on the DC voltmeter and ammeter for the battery and each of the three TRs. Standby power and the battery bus will display only DC voltage.

The TEST position is used by maintenance.

Electrical Power Controls and Monitoring Schematic



DC Power System

28 volt DC power is supplied by three TR units, which are energized from the AC transfer busses and main bus 2. The battery provides 28V DC power to loads required to be operative when no other source is available.

Transformer Rectifier Units

The TRs convert 115 volt AC to 28 volt DC, and are identified as TR1, TR2, and TR3.

TR1 and TR2 receive AC power from transfer bus 1 and transfer bus 2, respectively. TR3 receives AC power from main bus 2.

Under normal conditions, TR1 and TR2 are each powering DC bus 1 and DC bus 2. TR3 powers the battery bus and serves as a backup power source for TR1 and TR2 with the Bus Transfer Switch in the AUTO position.

- Maximum TR Load (with cooling) – 65 amps.
- Maximum TR Load (without cooling) – 50 amps.
- TR voltage range – 24 - 30V

Battery Power

A 24 volt nickel–cadmium battery is located in the electronics compartment. The battery can supply part of the DC system. Battery charging is automatically controlled. A fully charged battery has sufficient capacity to provide standby power for a minimum of 30 minutes. Battery voltage range is 22–30 volts.

DC busses powered from the battery following a loss of both generators are:

- battery bus
- DC standby bus
- hot battery bus

The hot battery bus is always connected to the battery. There is no switch in this circuit. The battery must be above minimum voltage to operate units supplied by this bus.

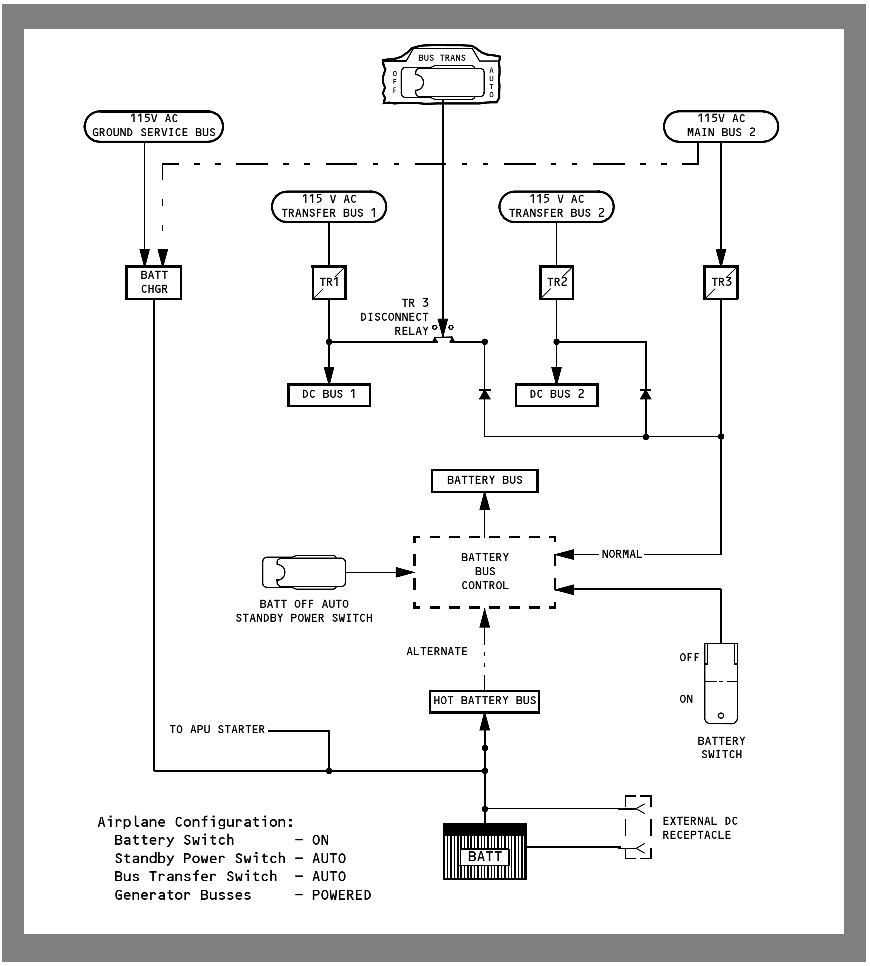
Battery Charger

The purpose of the battery charger is to restore and maintain the battery at full electrical power. The battery charger is powered through AC ground service bus with provisions for automatic switching to main bus 2 when the ground service bus is unpowered.

DC Power Receptacle

An auxiliary 28V DC power receptacle is provided near the battery in the electronic compartment. A placard located adjacent to the receptacle gives complete instruction for connecting external DC power. With external DC power connected, the battery is paralleled with the DC external power source and the external power source will power all circuits normally supplied by the battery. In the event that the airplane battery is depleted, the APU can be started using DC external power.

DC Power System Schematic



Standby Power System
Normal Operation

The standby system is used to supply power to essential AC and DC systems. During normal operation the guarded standby power switch is in AUTO and the battery switch is ON. Under normal conditions the AC standby bus is energized from the 115 V AC transfer bus no. 1 and the DC standby bus is energized from DC bus no. 1.

Alternate Operation

The alternate power source for standby busses is the battery. With a complete generator power failure the AC standby bus is powered from the battery bus through the static inverter. The DC standby bus is powered by the battery bus. A fully charged battery has sufficient capacity to provide power to the minimum essential flight instruments, communications and navigation equipment for a minimum of 30 minutes.

In flight, automatic switching is provided from the normal power sources to the alternate power sources when the standby power switch is in the AUTO position. If either transfer bus 1 or DC bus 1 loses power, the AC standby bus automatically switches to the battery bus via the static inverter, and the DC standby bus switches to the battery bus.

The automatic transfer of power is an inflight feature only. The air/ground safety sensor prevents the battery from powering the airplane when the airplane is on the ground. The air/ground safety sensor inhibits the transfer to battery power to prevent discharging the battery. If the standby power switch is positioned to BAT, the air/ground safety sensor is bypassed and the AC and DC standby busses are powered.

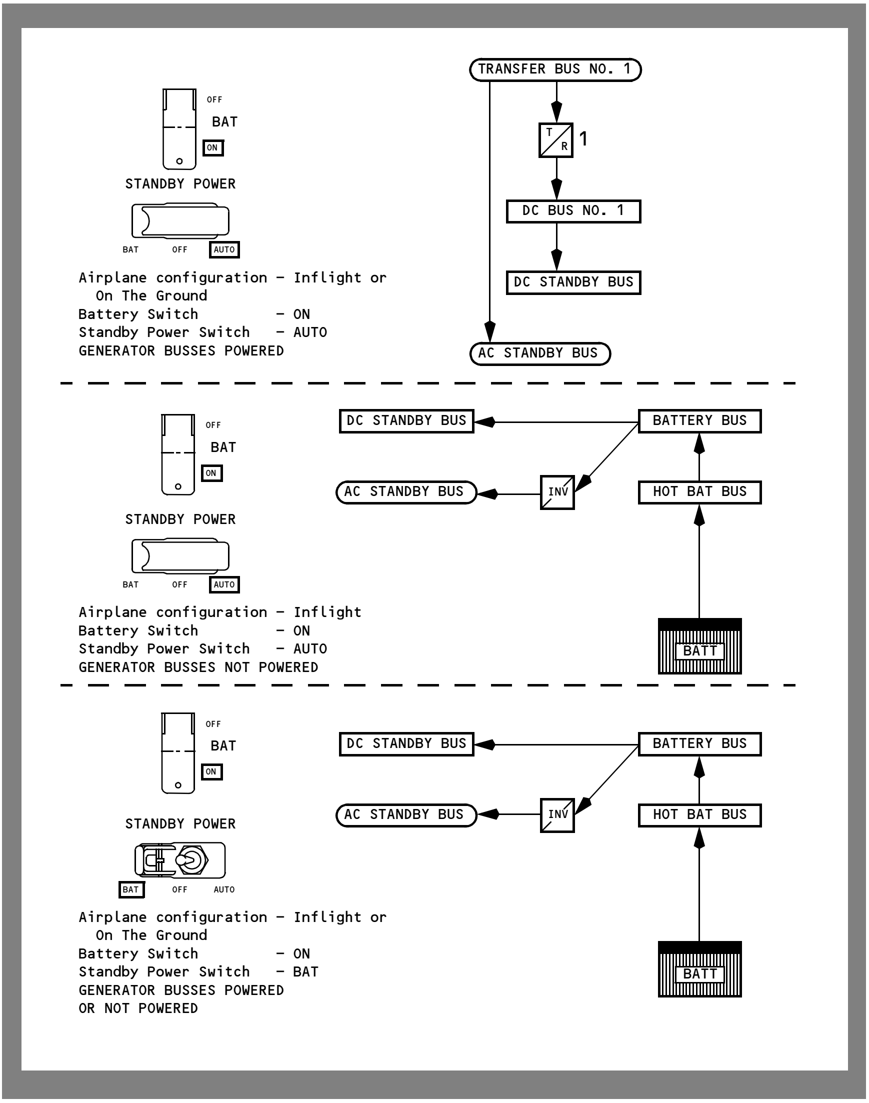
When the standby power switch is OFF, the STANDBY PWR OFF light will be ON indicating the standby busses are de-energized.

Static Inverter

The static inverter converts 24 volt DC power from the battery to 115V AC power to supply the AC standby bus during the loss of normal electrical power. The power supply to the inverter is controlled by the standby power switch and the battery switch on the overhead panel.

On the unmodified standby system, the static inverter is operating only when the battery bus is powering the AC standby bus.

Standby Power System Schematic



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All Generators Inoperative

The following list identifies the significant equipment that operates when the battery is the only source of electrical power and is powering the standby busses.

Airplane General, Emergency Equipment, Doors, and Windows

- emergency instrument flood lights
- entry lights (dim) (hot battery bus)
- position lights
- standby compass light
- white dome lights
- oxygen indicator and valve
- forward airstair control

Air Systems

- A/C pack valves
- altitude warning horn
- manual pressurization control
- cabin airflow fan
- PACK TRIP OFF lights

Engines, APU

- EPR warning
- engine start ignition
- starter valves
- thrust reversers
- APU operation (start attempts not recommended above 25,000 feet)

Communications

- flight interphone system
- passenger address system
- VHF No. 1

Electrical

- STANDBY POWER OFF light
- external power control (hot battery bus)
- APU & engine generator power control

Flight Instruments

- standby airspeed indicator
- standby horizon indicator

- standby magnetic compass
- captain's horizon indicator

Fire Protection

- APU and engine fire extinguisher bottles (hot battery bus)
- APU and engine fire detection system

Fuel

- crossfeed valve
- engine fuel shutoff valves (hot battery bus)
- fuel quantity indicators
- FUEL VALVE CLOSED lights (hot battery bus)

Landing Gear

- autobrake failure warning
- anti-skid failure and parking brake
- landing gear indicator lights
- auxiliary landing gear indicator lights (as installed)

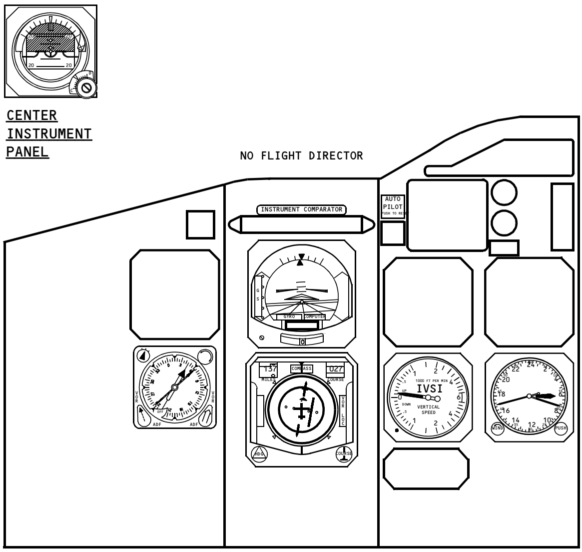
Navigation

- ADF No. 1
- captain's RMI
- VHF NAV No. 1

Warnings

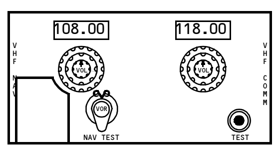
- aural warnings
- master caution (AIR COND, FUEL, ANTI-ICE)

Basic Equipment Operating – Instrument Panels
Captain Instrument Panel



STANDBY BUS POWER SOURCES (ELECTRONICS)

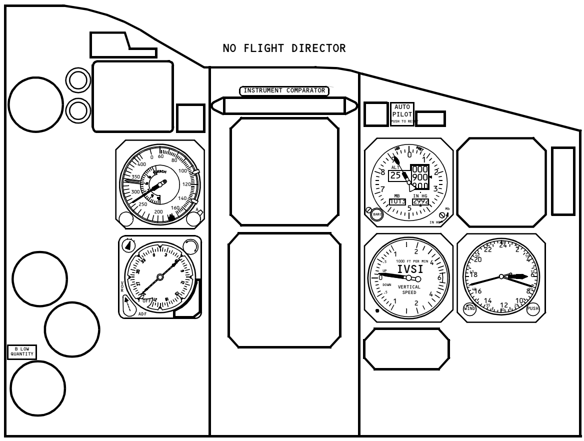
28 VOLT DC	115 VOLT AC
Capt G/S	Capt Compass
Capt VOR/LOC	Capt Inst Transformer
ADF-1	Capt Vertical Gyro
Capt Instr Transfer	Capt Horizon
Capt VHF-1	STBY Horizon



CAUTION: AS SOON AS THE AIRPLANE LANDS, THE STANDBY POWER SWITCH SHOULD BE POSITIONED TO "BAT" TO ENERGIZE THE ABOVE ELECTRONICS AND FOR VHF-1 COMMUNICATIONS.

Airplane Configuration – In Flight Battery Switch – ON Standby Power Switch – AUTO	This illustration shows the instruments which are useable with only the battery and standby busses powered.	☐	Indicates Inoperative Instruments

First Officer Instrument Panel



COCKPIT COMMUNICATION

Audio Selector Panels
Flight Interphone
Passenger Address System

COCKPIT LIGHTS

Standby Instrument Flood Light
White Dome Light
Magnetic Compass Light

Airplane Configuration – In Flight Battery Switch – ON Standby Power Switch – AUTO	This illustration shows the instruments which are useable with only the battery and standby busses powered.	Indicates Inoperative Instruments

Electrical System Power Distribution
No. 1 Generator Inoperative

Failure In Flight, Transfer Busses Normal

Inoperative Components	Indication
No.1 tank forward fuel pump Center tank right fuel pump Aux. tank aft fuel pump (as installed)	LOW PRESSURE light LOW PRESSURE light LOW PRESSURE light
Galley(s)	Inoperative
No.1 Generator Generator bus No. 1	GEN OFF BUS light BUS OFF light
Left forward window heat Right side window heat Left No. 4 & 5 window heat	ON light – extinguished ON light – extinguished Inoperative
Left elevator pitot heat	L ELEV PITOT light
No.1 system B hydraulic pump	LOW PRESSURE light (if no. 2 system B pump is on)
Left outboard landing light Right inboard landing light Left runway turnoff light Nose gear taxi light (as installed)	Inoperative Inoperative Inoperative Inoperative
Equipment cooling normal	OFF light

No. 2 Generator Inoperative

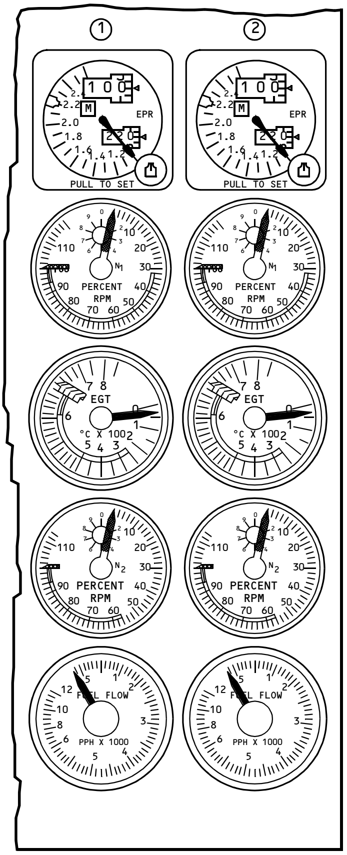
Failure In Flight, Transfer Busses Normal

Inoperative Components	Indication
No.2 tank forward fuel pump Center tank left fuel pump Aux. tank forward fuel pump (as installed) Fuel temperature indicator	LOW PRESSURE light LOW PRESSURE light LOW PRESSURE light Inoperative
Galley(s)	Inoperative
No.2 Generator Generator bus No. 2 TR unit No. 3	GEN OFF BUS light BUS OFF light TR No. 3 voltage - Zero
Left side window heat Right forward window heat Right No. 4 & 5 window heat	ON light – extinguished ON light – extinguished Inoperative
Right elevator pitot heat TEMP PROBE Heat	R ELEV PITOT light TEMP PROBE light
No. 2 system B hydraulic pump	LOW PRESSURE light (if no. 1 system B pump is on)
Gasper fan	Inoperative
Right outboard landing light Left inboard landing light Right runway turnoff light	Inoperative Inoperative Inoperative
Equipment cooling - Alternate	If switch is to alternate, OFF light

Engines, APU — Chapter 7
Table of Contents — Section TOC

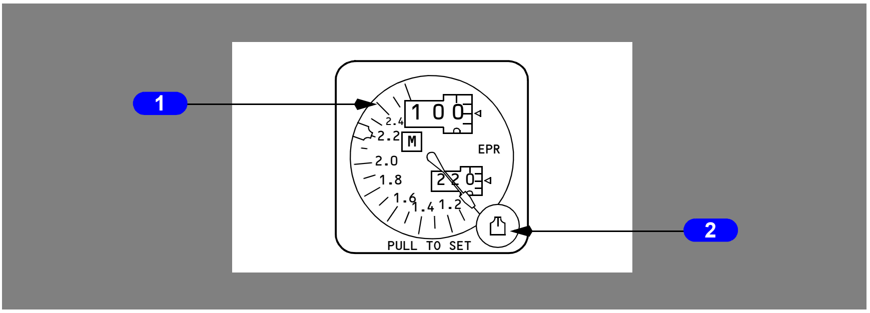
Engines, APU — Chapter 7
Controls and Indicators — Section 10

Engine Instruments Primary Panel



CENTER INSTRUMENT PANEL

Engine Pressure Ratio (EPR) Indications



1 Engine Pressure Ratio (EPR) Indicator

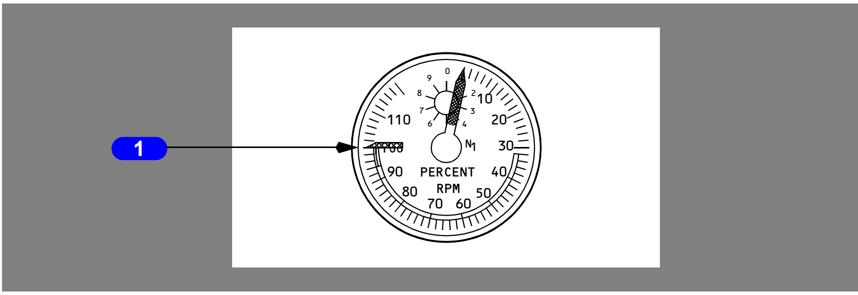
- Indicates the ratio of turbine discharge pressure (Pt7) to compressor inlet pressure (Pt2)
- Used as the primary thrust setting reference
- Provides digital display of indicated EPR; Read EPR on outer scale and in the large upper digital display for thrust settings
- Warning flag covers the indicated EPR digital display with electrical power loss or instrument failure. Failure of the PDC will result in a flag covering the lower digital window.

2 EPR Reference Selector

ROTATE – Positions the EPR reference “bug” and changes the reference EPR digital readout in the lower window correspondingly

- When the reference selector is pushed in, the lower digital window and “bug” will be set by an input signal from the PDC
- Pulling out the reference selector disconnects the PDC, and an “M” (indicating manual mode) appears on the dial face
- When pulled out, the reference selector can be rotated to set desired EPR in the lower digital window, the “bug” moves to the corresponding position on the outer scale.

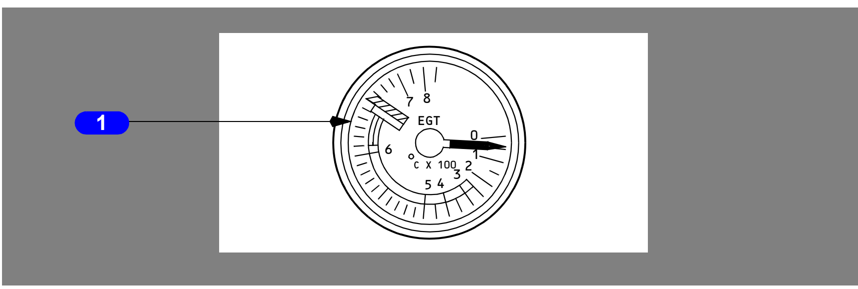
N1 Indications



1 N1 RPM Indicator

- Indicates low pressure compressor speed in percent of RPM
- Self-powered.

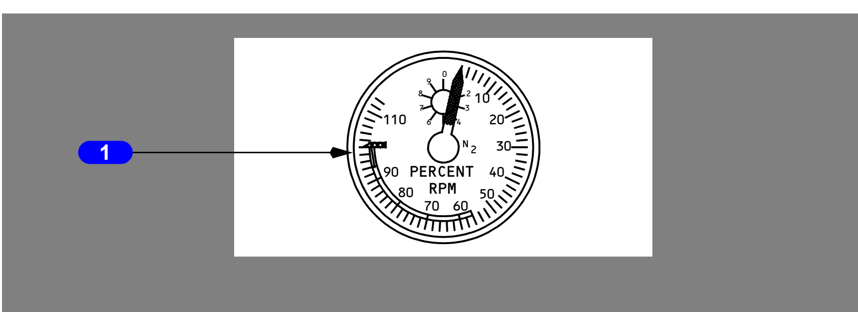
EGT Indications



1 Exhaust Gas Temperature (EGT) Indicator

- Indicates turbine exhaust gas temperature in degrees C as sensed by thermocouples
- Uses AC power from the Standby Bus.

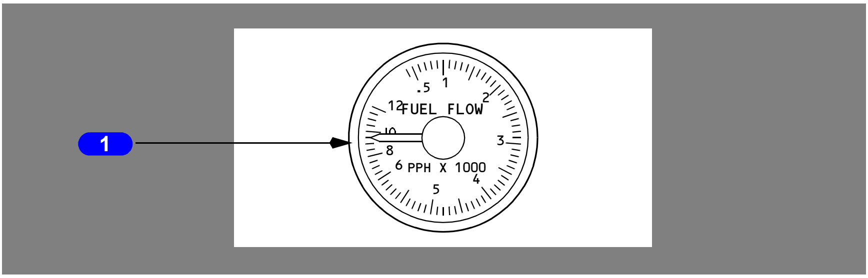
N2 Indications



1 **N2 Indicator**

- Indicates high pressure compressor speed in percent of RPM
- Self-powered.

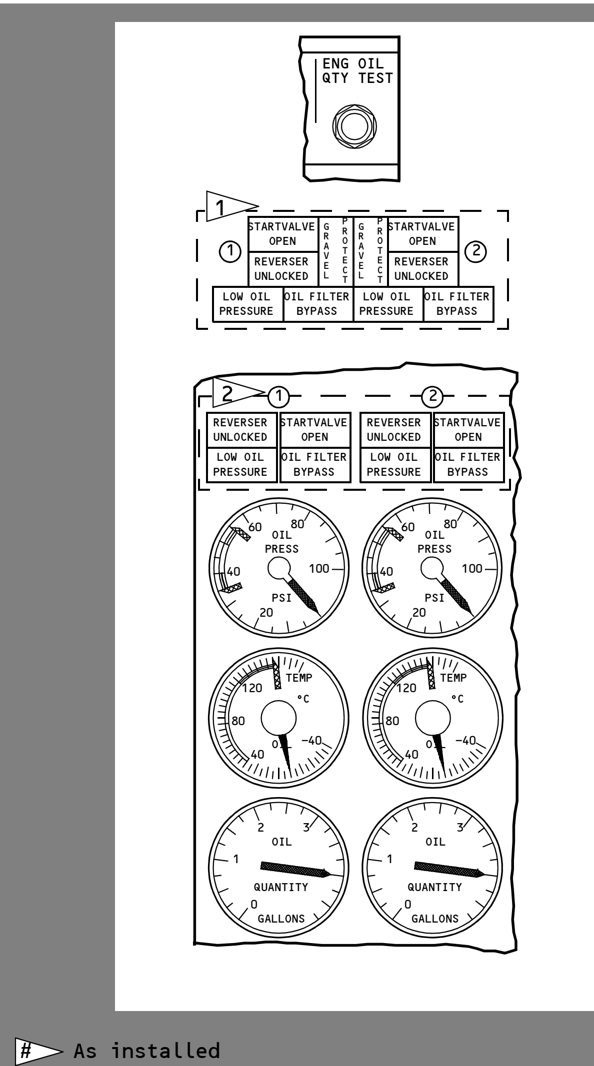
Fuel Flow Indications



1 **Fuel Flow Indicator**

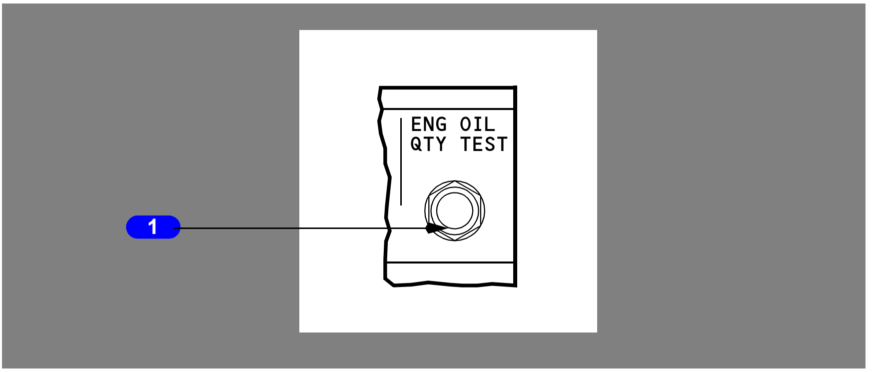
Indicates fuel consumption rate in pounds per hour.

Engine Instruments Secondary Panel



CENTER INSTRUMENT PANEL

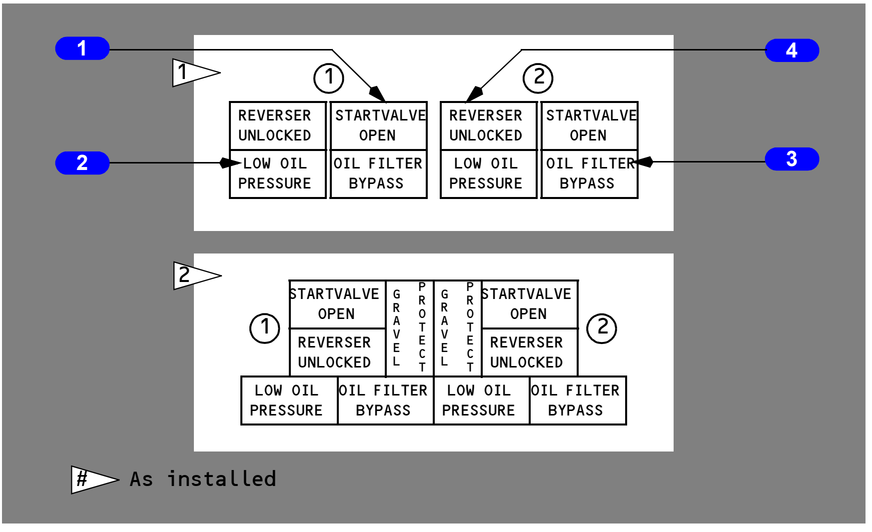
Engine Oil Quantity Test Switch



1 Engine Oil Quantity Test (ENG OIL QTY TEST) Switch

Push – oil quantity indicators move toward zero.

Caution Lights



1 START VALVE OPEN Light

Illuminated (amber) – indicates the engine starter valve is open and air is being supplied to the starter motor.

2 LOW OIL PRESSURE Light

Illuminated (amber) – indicates engine oil pressure is below 35 psi.

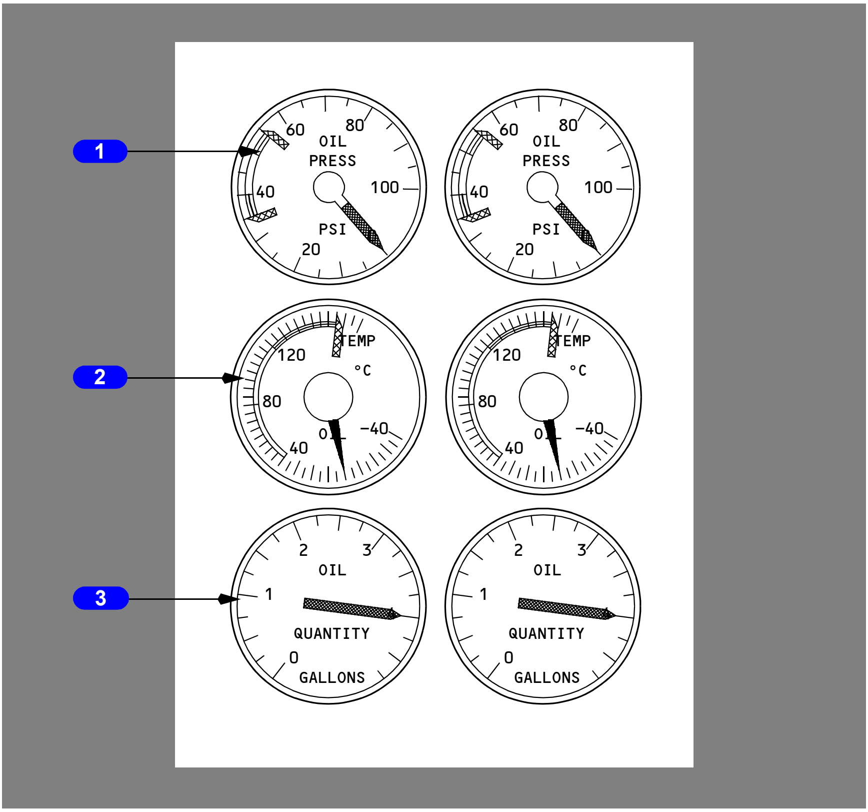
3 **OIL FILTER BYPASS Light**

Illuminated (amber) – indicates an impending bypass of the main oil filter.

4 **REVERSER UNLOCKED Light**

Illuminated (amber) – indicates the thrust reverser doors are not locked.

Engine Oil Indications



1 **Oil Pressure (OIL PRESS) Indicator**

Displays engine oil pressure in psi.

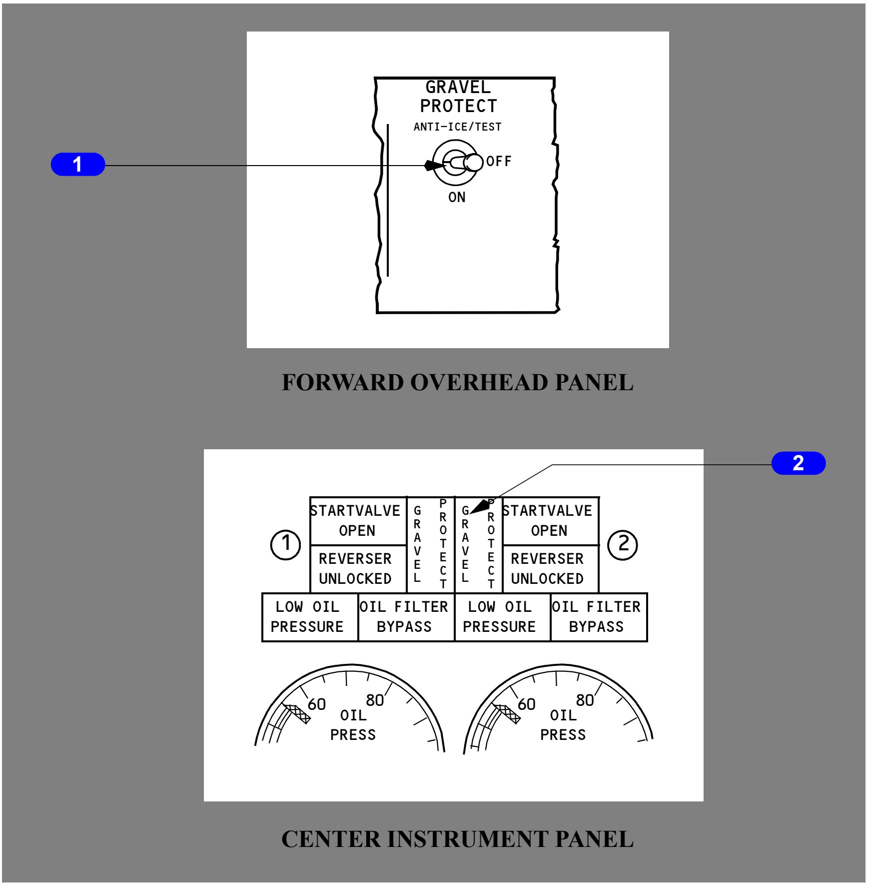
2 **Oil Temperature (OIL TEMP) Indicator**

Displays engine oil temperature in degrees C.

3 **Oil Quantity (OIL QTY) Indicator**

Displays engine oil quantity in gallons.

Gravel Protection (As Installed)



1 GRAVEL PROTECT Switch

ANTI-ICE TEST – activates the vortex dissipator for anti-icing or test of the system.

ON –

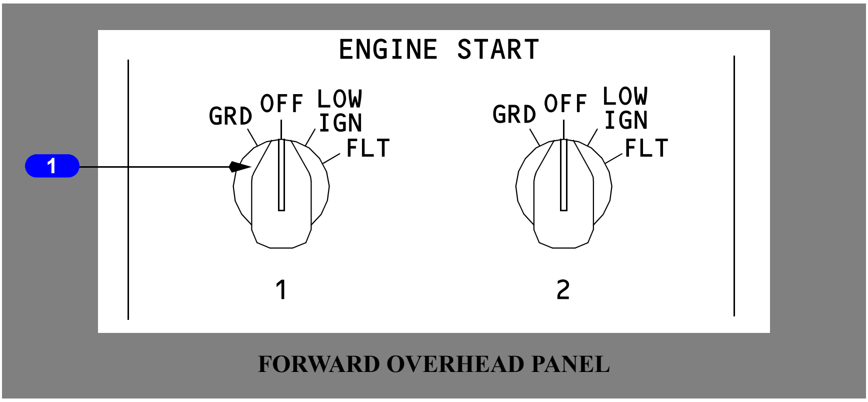
- Arms the vortex dissipator system in the air for actuation on touchdown
- The vortex dissipator operates only when the airplane is on the ground with the engines running.

OFF – The vortex dissipator system is deactivated.

2 GRAVEL PROTECT Light

Illuminated (green) – Vortex dissipators are operating.

Engine Start Switches



1 ENGINE START Switch

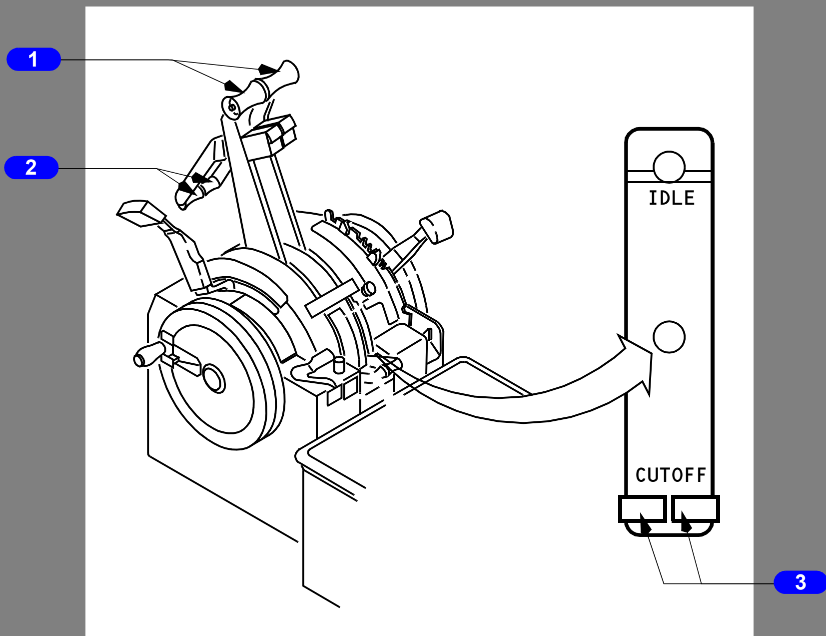
GRD – (solenoid held – spring loaded to OFF) Opens the starter valve and provides high energy ignition to two igniters when the Engine Start Lever is moved from CUTOFF to IDLE

OFF – No ignition

LOW IGN– Provides low energy ignition to one igniter with the Engine Start Lever in IDLE

FLT – Provides high energy ignition to two igniters when the Engine Start Lever is in IDLE.

Engine Controls



CONTROL STAND

1 Forward Thrust Lever

- Controls engine thrust
- Cannot be advanced if the reverse thrust lever is in the reverser deployed position.

2 Reverse Thrust Lever

- Controls engine reverse thrust
- Reverse thrust cannot be selected unless the forward thrust levers are in IDLE.

Note: When the reverse thrust levers are moved out of IDLE towards reverse thrust, pawls are forced into openings locking the forward thrust levers in the idle position.

Note: The ability of each reverse thrust lever and its corresponding forward thrust lever to move depends on the position of the other lever because each is capable of "locking out" the other pawl attached to the forward thrust levers.

3 Engine Start Lever

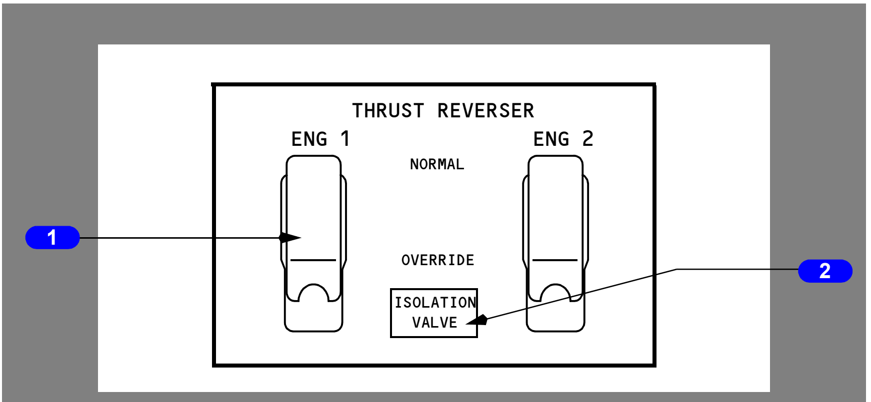
IDLE

- Controlled fuel flow is supplied to the engine, and ignition circuits are energized.

CUTOFF

- Closes the main fuel shutoff valve and the main engine control shutoff valve
- Ignition system is de-energized.

Thrust Reverser Override Switches



AFT OVERHEAD PANEL

1 OVERRIDE Switch

NORMAL

- The thrust reverser may be operated if the engine oil pressure is more than 35 psi, the fire switch is down and the air/ground safety sensor is in the ground mode (if hydraulic pressure is available).

OVERRIDE

- Bypasses the engine oil pressure switch and the air/ground safety sensor
- Opens the isolation valve directing available hydraulic pressure to the thrust reverser selector valve.

2 ISOLATION VALVE LIGHT (amber)

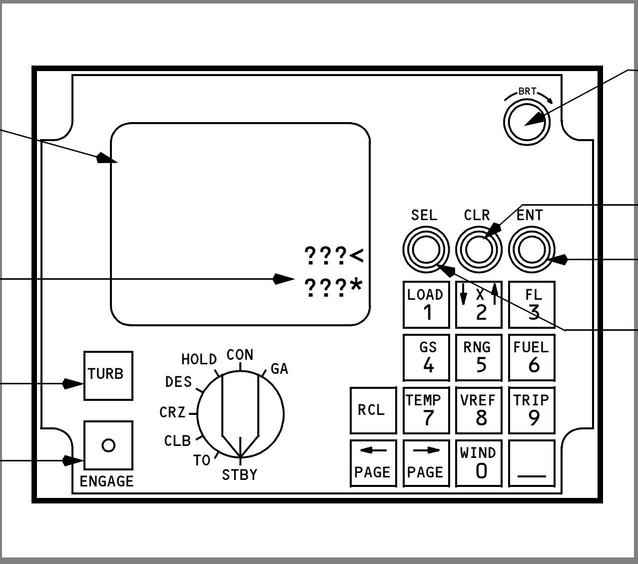
ILLUMINATED IN FLIGHT

- Hydraulic pressure is available to either or both thrust reverser selector valve
- The isolation valve is open.

ILLUMINATED ON THE GROUND

- Hydraulic pressure is not available to either or both thrust reverser selector valves
- The isolation valve is closed.

PDCS Control Display Unit (CDU)



FORWARD ELECTRONIC PANEL

1 Cathode Ray Tube (CRT) Display

- Displayed data is called a page
- Each page can display 6 lines, 13 characters per line.

2 CRT Display Symbols

??? (question marks)

- Indicates lines of unentered data.

CARET

- Indicates the place where information is to be inserted
- Displaces the asterisk on that line.

* (asterisk) - Identifies the line where an ENT (entry) can be made.

3 TURB (turbulence) KEY

PRESS –

- Causes the CRT to display the turbulent air penetration speed, pitch attitude and N1 settings
- The EPR indicator bugs move to values corresponding to the N1 values
- Overrides the CRZ flight mode position.

4 ENGAGE KEY

PRESS (with a flight mode selected) –

- Drives the EPR and/or airspeed bugs to the displayed values
- The key light extinguishes and the engaged mode is displayed on the flight mode annunciator
- Other CDU displays can be selected without changing the engaged mode.

ILLUMINATED –

- Indicates the data displayed is not driving the bugs
- When a performance function is displayed, the Engage Key does not illuminate since performance functions cannot be engaged.

5 BRT (brightness) Control

ROTATE – Controls CRT brightness.

6 CLR (Clear)

PRESS –

- Causes data on the line corresponding to the Caret to be removed from the display
- The CLR key must be pressed any time a new numeric entry is desired.

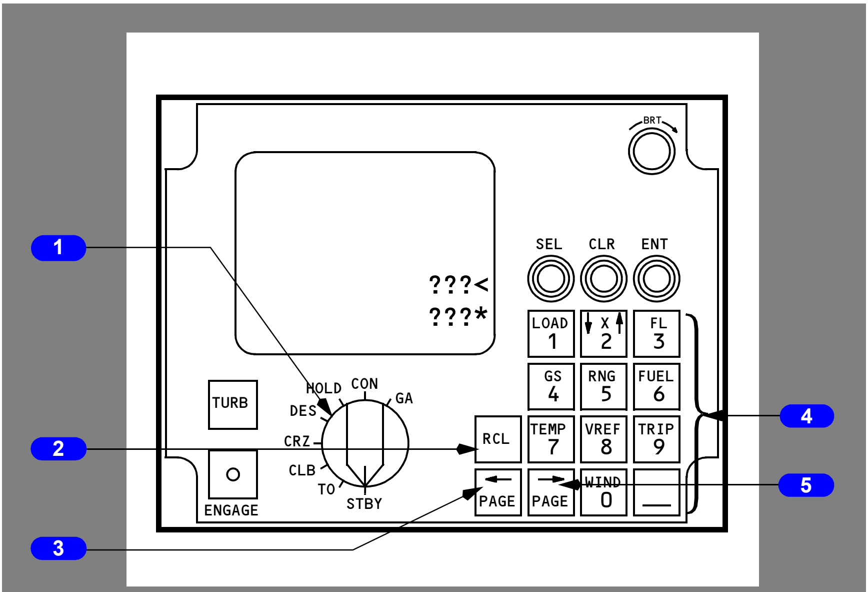
7 ENT (Enter)

PRESS – Commands the computer to accept the data which has been keyed in and displayed.

8 SEL (Select)

PRESS –

- Moves the Caret down one line each time it is pressed
- The possible Caret positions are limited to those lines which display an asterisk
- The Caret cycles to the top line if at the lowest line.



FORWARD ELECTRONIC PANEL

1 FLIGHT MODE SELECTOR

ROTATE – Selects the phase of flight for which data is desired.

STBY (Standby) – Used for data entry and automatic system verification.

TO (Takeoff) – Displays takeoff EPR limits for the temperature entered.

CLB (Climb) – Displays climb EPR and speeds for the desired climb profile: Best economy, maximum rate or crew selected speeds.

CRZ (Cruise) – Displays cruise EPR and speeds for the desired cruise schedule: Best economy, LRC (long range cruise) or crew selected speeds.

DES (Descent) – Provides descent speed, time and distance for best economy or crew selected speeds.

HOLD (Holding) – Used to obtain holding EPR, speed and endurance time.

CON (Continuous) – Provides maximum continuous EPR limit and engine out data.

GA (Go Around) – Displays go-around EPR limit for existing altitude and temperature.

2 RCL (Recall)

PRESS (with performance function displayed) – Changes the display to the selected flight mode.

3 PAGE REVERSE KEY

PRESS –

- Reverse the display one page for both flight modes and performance functions wit multiple pages.
- After the first page is reached, the system cycles back to the last page.

4 KEYBOARD

- The keyboard contains double function keys for entering numerics and selecting performance functions for display.

LOAD key – Permits flight data entry to enable the system to compute takeoff EPR, gross weight, optimum descent distance, and airspeeds.

ALTITUDE INTERCEPT key – Used to solve time, distance, and flight level intercept problems during climb and descent.

FL (Flight) key – Used to determine optimum flight level, maximum altitude capability and wind altitude trade considerations.

GS (Ground Speed) key – Computes ground speed and wind, or time and distance to a waypoint or destination.

RNG (Range) key – Displays total endurance, distance and time remaining to reserve fuel quantity or empty tanks at any flight level.

FUEL key – Displays total fuel, fuel reserves and fuel over destination.

TEMP (Temperature) key – Displays ISA deviation, TAT, SAT, TAS.

VREF key – Displays reference speeds for landing flaps and the current gross weight.

TRIP key – Displays most economical cruise flight level for trip distances, ISA deviation, and wind, if known.

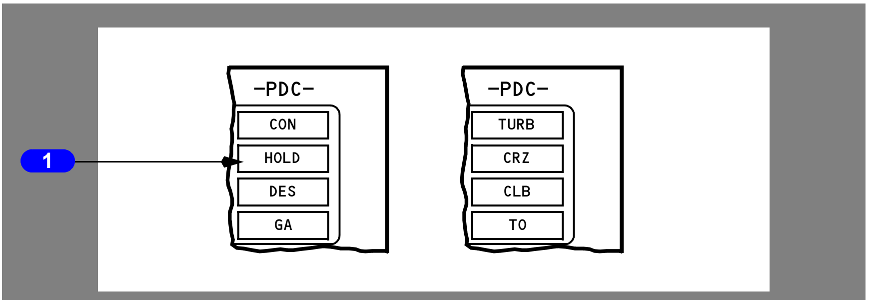
WIND key – Displays automatically computed or manually entered wind data.

5 PAGE FORWARD KEY

PRESS –

- Advances the display one page for both flight modes and performance functions with multiple pages.
- After the last page is reached, the system cycles back to the first page.

Flight Mode Annunciator

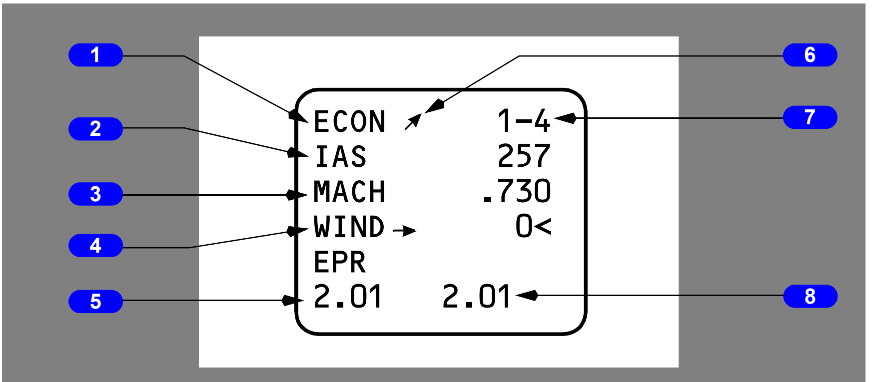


CAPTAIN'S AND FIRST OFFICER'S INSTRUMENT PANEL

1 Flight Mode Annunciator

Indicates the flight mode to which the driven airspeed and EPR bugs are engaged.

PDCS Displays (Typical)



FLIGHT MODE – CRUISE

1 Page Title

2 Target Airspeed

3 Target MACH

4 Wind Component

Unless a wind is entered the component reads zero.

5 No. 1 Engine Target/Limit EPR

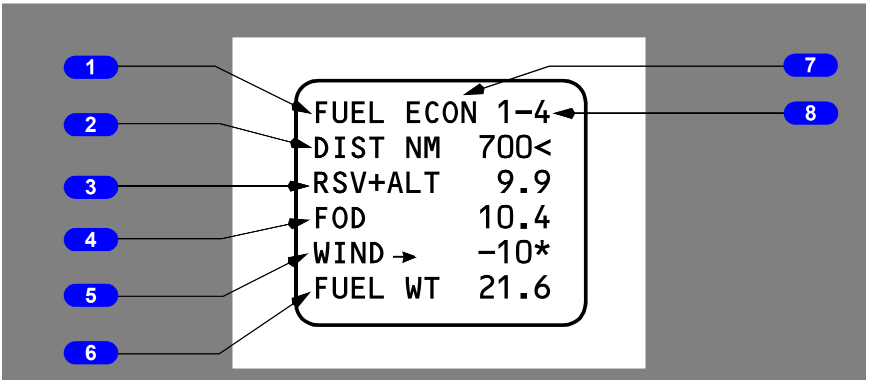
6 **Indicating Arrow**

IN VIEW –

- Optimum altitude is still more than 2000 feet above (or below if down arrow is showing)
- Arrow disappears when within 2000 feet of optimum altitude.

7 **Page 1 of 4**

8 **No. 2 Engine Target/Limit EPR**



PERFORMANCE FUNCTION – FUEL

1 **Performance Function**

2 **DIST NM (Distance Nautical Miles**

Distance to go as entered. May be to a checkpoint or over destination.

3 **RSV+ALT (Reserve + Alternate)**

Reserve and alternate fuel quantity (LBS X 1000).

4 **FOD (Fuel over distance)**

Fuel remaining over destination or waypoint at the CRZ ECON speed for the present altitude and entered distance to go (LBS X 1000).

5 **Wind**

Wind component entered into computer (based on 10 kt. headwind).

6 **Total fuel quantity remaining**

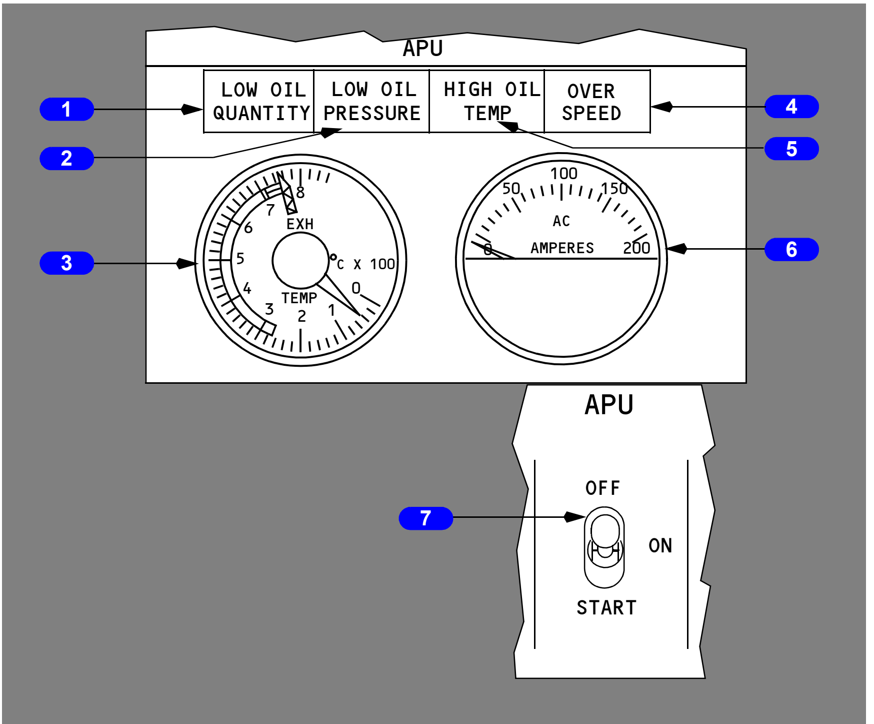
(LBS X 1000)

DO NOT USE FOR FLIGHT

7 Page Title

8 Page 1 of 4

APU



FORWARD OVERHEAD PANEL

1 LOW OIL QUANTITY Light

Illuminated (blue) –

- APU oil quantity is insufficient for extended operation.
- light is disarmed when APU switch is OFF.

2 APU LOW OIL PRESSURE Light

Illuminated (amber) –

- during start until the APU oil pressure is normal
- oil pressure is low causing an automatic shutdown (after start cycle is complete)
- light is disarmed when APU switch is OFF.

3 APU Exhaust Gas Temperature (EGT) Indicator

Displays APU EGT

4 APU OVERSPEED Light

Illuminated (amber) –

- APU RPM limit has been exceeded resulting in an automatic shutdown
- overspeed shutdown protection feature has failed a self–test during a normal APU shutdown
- APU start is aborted prior to reaching governed speed (light will extinguish following a normal start)
- light is disarmed when APU switch is OFF.

5 APU HIGH OIL TEMPERATURE Light

Illuminated (amber) –

- APU oil temperature is excessive, causing APU to initiate an automatic shutdown
- light is disarmed when APU switch is OFF.

6 APU Generator AC Ammeter

Displays APU generator load current

7 APU Switch

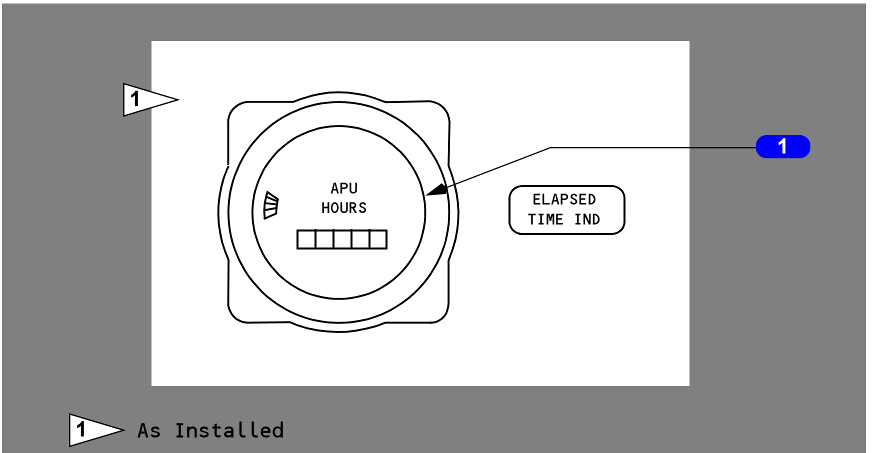
OFF – normal position when APU is not running.

- positioning switch to OFF with APU running initiates APU shutdown, trips APU generator off the bus(es), if connected, and closes APU bleed air valve.

ON – normal position when APU is running.

START (momentary) – positioning APU switch from OFF to START and releasing it to ON initiates an automatic start sequence.

APU Hours Indicator



AFT OVERHEAD PANEL

1 APU Hours Indicator

Indicates elapsed hours of APU operation since last reset.

Engines, APU — Chapter 7
Engine System Description — Section 20

System Description

The airplane is equipped with two Pratt and Whitney JT8D ducted turbofan engines having two rotors in series – N1 and N2.

This is a forward fan type engine with a twin spool axial compressor, consisting of a low pressure unit (N1) and a high pressure unit (N2). The low pressure unit is connected by a through shaft to the turbine wheels for the low pressure compressor, and the high pressure compressor is connected independently by a hollow shaft to the turbine wheel for the high pressure compressor. The compressors deliver highly compressed air to the engine burner section, where a fuel/air mixture is ignited. The resulting high energy gasses enter the turbines, producing the power to drive the compressors and accessories as well as the fan at the front of the engine. Propulsion is produced by the forces within the engine that result in the discharge of high velocity gasses through the nozzle at the rear. A fuel controller schedules fuel flow to provide the thrust called for by the thrust lever setting in the cockpit.

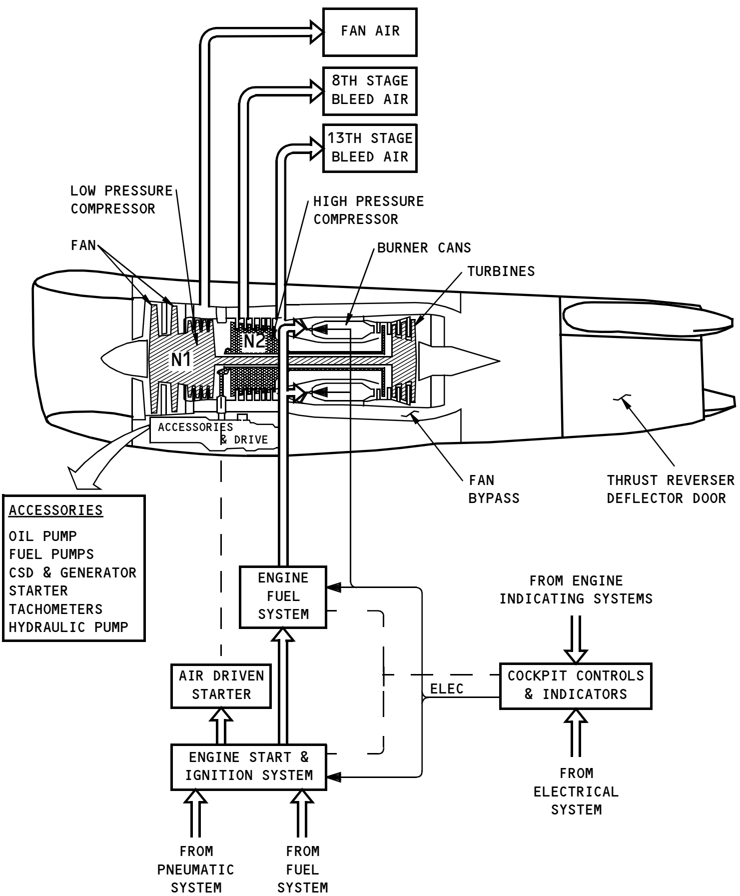
The accessories are driven by the N2 compressor through a gear train and cooled by the fan duct air. A thrust reverser provides reverse thrust by blocking the engine exhaust gas flow and deflecting the flow forward.

Each engine has individual flight deck controls. Thrust is set by positioning the thrust levers. The forward thrust levers control forward thrust from idle to maximum. Advancing the thrust levers full forward provides some overboost and should be considered only during emergency situations when all other available actions have been taken and terrain contact is imminent. The reverse thrust levers control thrust from reverse idle to maximum reverse.

In the event of an N2 signal fail to the fuel control unit, engine RPM may change to or remain at high thrust with no observable movement of thrust lever and no engine response to thrust lever movement. This may be due to either complete or partial loss of the N2 signal to the fuel control unit (FCU). The FCU is designed to ensure the engine delivers high power during a critical phase of flight, such as takeoff or go-around should one of these conditions occur. Thrust will be set to 90–95% N2 (complete loss) or the FCU will add fuel in an attempt to reach target N2 (partial loss). Either of these conditions can occur any time, in-flight or on the ground and the only control the flight crew has is to shutdown the affected engine with the engine start lever or engine fire warning switch. This malfunction may be difficult to identify because, depending upon thrust setting at the time of occurrence, thrust on the affected engine may increase, decrease or remain nearly the same.

Note: It is recommended the flight crew not attempt to shut down the engine until a safe altitude is achieved, flight path is stabilized and the malfunctioning engine has been positively identified. If this condition occurs during ground maneuvers, landing rollout or rejected takeoff, thrust lever response will be lost and the engine must be shut down immediately to prevent possible loss of directional control.

Power Pliant Schematc



Engine Fuel System

Fuel is delivered to the engines at pressures and flow rates required to obtain desired engine thrust. Fuel leaves the fuel tank and enters through the engine fuel shutoff valve. The engine fuel shutoff valve is controlled by the engine start lever and the engine fire warning switch. When the engine fuel shutoff valve is closed, the FUEL VALVE CLOSED light located on the forward overhead panel will illuminate dim.

Fuel passes from the first stage of the engine driven fuel pump to a fuel heater and fuel filter. The heater uses 13th stage bleed air to increase fuel temperature and prevent blocking of the filter due to icing. The FILTER ICING light will illuminate when the filter is blocked. Provisions are made to bypass the first stage of the pump, the heater, or the filter in the event of failure or blockage.

The second stage of the fuel pump provides high pressure fuel to the fuel control unit (FCU). The FCU uses thrust lever position, diffuser case pressure, compressor inlet temperature, and N2 RPM to meter the correct amount of fuel to the burner cans. A fuel flow transmitter measures the rate of fuel flow from the FCU and provides an indication on the fuel flow indicator located on the center instrument panel. Fuel from the FCU passes through an oil cooler which is used to cool engine oil. Oil temperature varies with fuel flow or fuel temperature.

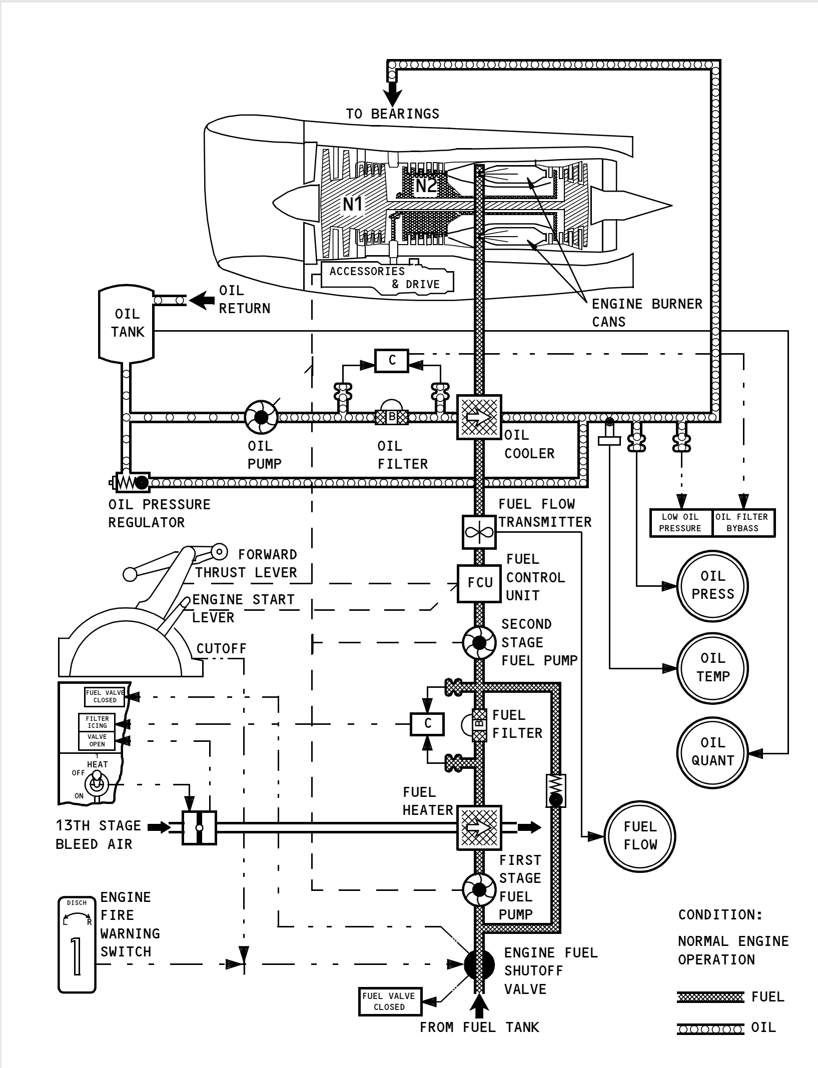
Oil System

Oil from the individual engine tank is circulated under pressure, through the engine to lubricate the engine bearings and accessory gearbox. Oil quantity is displayed on the oil quantity indicator located on the center instrument panel.

The oil system is pressurized by the engine driven oil pump. The oil leaves the oil pump, passes through an oil filter, and continues to the engine bearings and gearbox. Should the filter become saturated with contaminants, oil will automatically bypass the filter. Prior to the oil bypassing the filter, the OIL FILTER BYPASS light, located on the center instrument panel, will illuminate.

The oil then passes through an oil cooler which requires fuel flow through the cooler to maintain proper oil temperature. The oil leaves the oil cooler, where sensors for the oil temperature indicator, oil pressure indicator and the LOW OIL PRESSURE light are located, and continues to the engine bearings and gearbox.

Engine Fuel and Oil system Schematic



Engine Start System

Low pressure air, a pneumatic starter, and electrical power are required for starter operation. The engines may be started with air from the APU, from a ground source, or by using engine crossbleed. Engine bleed air valves must be open to allow air from any source to reach the selected engine starter.

The Engine Start Switch GRD position uses DC power from the battery bus to open the starter valve and allow pressure from the pneumatic manifold to rotate the starter. When the starter valve is open, the amber START VALVE OPEN light, located on the center instrument panel, will illuminate. Should the engine start switch fail to open the starter valve, a manual control handle on the engine may be used to open the valve. The starter is a turbine-type air motor which rotates the N2 compressor through the accessory drive gear system. At cutout speed (35 to 40% N2 RPM), power is interrupted to the start switch holding solenoid, allowing the engine start switch to return to the OFF position and the starter valve to close.

Starter valve closure is indicated by a rapid rise in duct pressure. The START VALVE OPEN light monitors air pressure downstream of the starter valve. The light extinguishes shortly after closure of the starter valve.

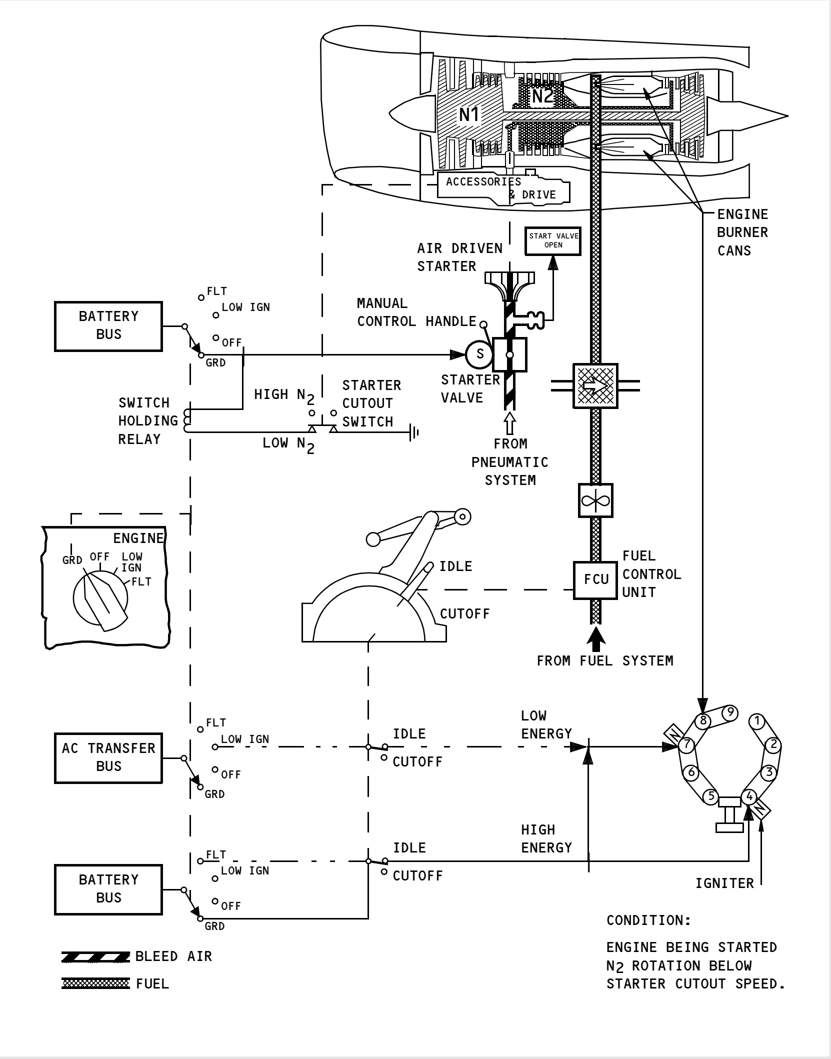
When the engine has accelerated to the starting speed, and with the engine start lever advanced to the IDLE position, fuel ignites, resulting in an engine start.

Engine Ignition System (4-Position Start Switch)

Two systems are provided. A high energy system is energized with the engine start switch in either the GRD or FLT position when the engine start lever is placed to the IDLE position. The high energy system furnishes pulsating power to ignitors in both No. 4 and No. 7 burner cans. The high energy system is used for all engine starts.

Low energy continuous ignition is provided when the engine start switch is in the LOW IGN position and the engine start lever is in the IDLE position. The low energy system furnishes continuous ignition through one plug only in the No. 7 burner can. The low energy system is used to improve igniter service life while minimizing the possibility of an engine flameout during takeoff and landing, in turbulence, or in icing conditions.

Engine Start and Ignition System Schematic



Thrust Reverser

Reverse thrust is accomplished by two doors which block engine exhaust and deflect the exhaust flow forward. The doors operate by system A hydraulic pressure through the gear down hydraulic line. Alternate operation at a reduced rate is available with the standby hydraulic system (the reverser may not stow). A REVERSER UNLOCKED light located on the center instrument panel will illuminate when either thrust reverse door is not in the stowed and locked position.

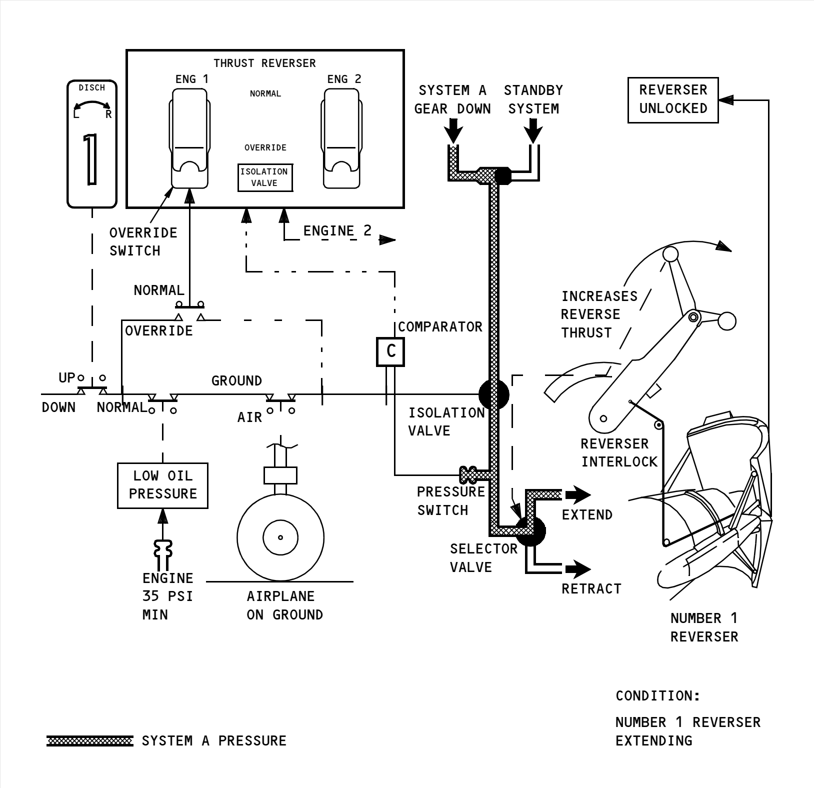
With the engine fire warning switch down and the engine low oil pressure switch sensing pressure, an electrical circuit including the nose gear, or main gear air/ground safety sensors, allows the thrust reversers to deploy. When all three electrical conditions are satisfied, the isolation valve will be solenoid-held to the open position. Loss of any electrical condition will cause the isolation valve to spring closed. The selector valve is controlled by the reverse thrust lever and directs hydraulic pressure to unlock, extend, retract or lock the doors.

The amber ISOLATION VALVE light will illuminate whenever a comparator senses a disagreement between the electrical condition to either isolation valve and the hydraulic pressure condition (the isolation valve open in flight, or closed on the ground). Positioning the guarded switch to the OVERRIDE position bypasses the oil pressure switch and the air/ground safety sensor and opens the isolation valve (if the fire switch is down). The override switches should not be used by flight crews for normal operations in flight or on the ground.

An engine control/reverser interlock system is provided. This interlock limits the thrust increase command if the reverser remains stowed when the reverse thrust lever is moved to a reverse position. The interlock is withdrawn during reverser translation from the stowed position to the deployed position. If the reverser remains deployed when the reverse thrust lever is moved to the forward thrust position, thrust increase commanded by the forward thrust lever is limited. The interlock is withdrawn during reverser translation from the deployed position to the stowed (flight) position. Freedom of motion of the forward thrust levers is not an absolute indication that the thrust reverser is fully deployed or stowed and locked, since the interlocks are withdrawn during reverser motion.

WARNING: Actuation of the thrust reversers on the ground without suitable precautions is dangerous to ground personnel.

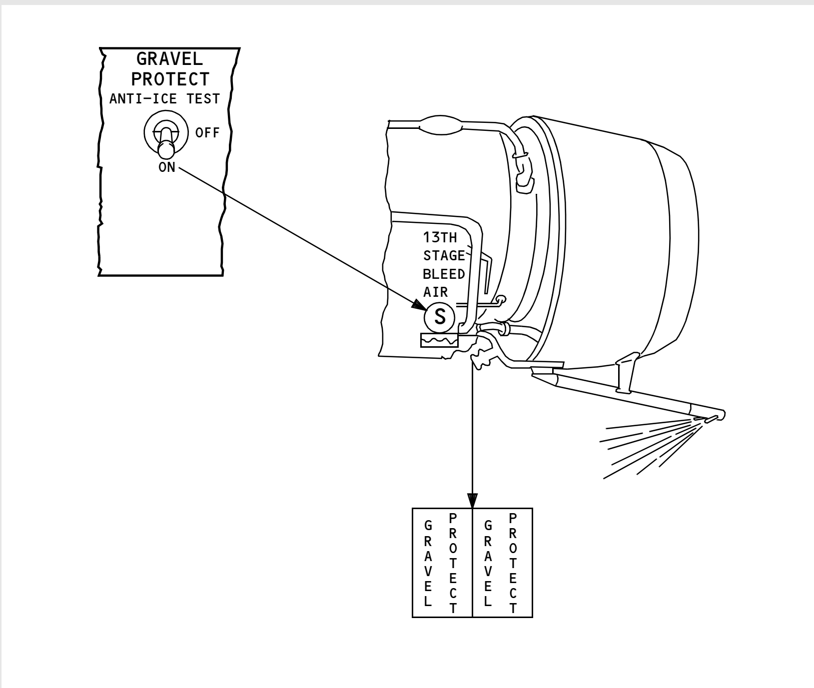
Thrust Reverser Schematic



Gravel Protection (As Installed)

Airplanes with gravel protection have a vortex dissipator boom installed below and forward of each engine nose cowl. High pressure air is discharged toward the ground through nozzles at the boom end.

This prevents dirt, gravel and other debris which lie below the engine from being picked up by vortices and entering the engine.



PDCS System Description
General

The performance data computer system (PDCS) provides the crew with flight guidance data to assist in achieving the most efficient and economical operation of the airplane. The data is presented in the form of digital displays on the CDU and bug displays on the EPR indicator(s).

The PDCS is controlled by the crew and consists of a computer, a control display unit (CDU) and mode annunciator.

The primary function of the PDCS is to compute and display target airspeed and EPR settings for each phase of flight: takeoff, climb, cruise, descent, holding, and go-around. For each of these phases of flight (flight modes) the PDCS computes and displays optimum EPR and airspeed values on the CDU and drives the EPR bug(s) to the computed values.

In addition to the phase of flight data, other flight guidance data (performance functions) are available from the PDCS. These functions are: altitude intercept, flight level calculations, ground speed, range, fuel, temperature, reference speed, trip altitude and wind. Performance functions are displayed on the CDU only and cannot drive the airspeed or EPR bugs.

Most flight modes and performance functions have too much data available to be displayed at one time. The data is therefore divided into separate displays called pages. Each page of data is selected individually for display.

The mode annunciator indicates when a flight mode is engaged.

To allow the crew to “look ahead” in the flight, a performance function or another flight mode may be selected for display on the CDU without disengaging the original mode.

Computer Inputs

Some inputs from other airplane systems are required for system operation and performance computations.

Temperature

The PDCS receives a total air temperature input for use in temperature dependent computations.

Altitude and Airspeed

Pressure altitude and airspeed are obtained from the Air Data Computer.

Fuel Weight

The total weight of fuel aboard the airplane is provided by a fuel summation unit which receives inputs from each of the airplane’s fuel tank transmitters.

Bleed Logic

The PDCS receives switch position logic to adjust limit EPR for engine anti-ice bleed, wing anti-ice bleed (except when PDCS is in takeoff mode), gravel protection (on some airplanes), and engine bleed air configurations.

EPR

The existing EPR for each engine is furnished to the PDCS for use in computing actual airplane performance.

Distance

The system also uses distance information from the airplane's DME. This data is used for automatic computation of wind and airplane ground speed.

Computer Outputs

Speed Schedules

For climb, cruise and descent, the PDCS provides a variety of speed schedules, enabling the crew to select that schedule which is best suited to their requirements.

For climb, there is a choice of ECON (minimum cost), RATE (maximum rate of climb) or MANUAL (the crew manually enters a desired speed). ECON is always the first page of data.

For cruise, the crew can select either ECON, LRC or MANUAL. The LRC mode differs from economy Cruise in that LRC computes speed for 99% best range where economy cruise computes speed for minimum trip cost. There is also the TURB (turbulence) speed schedule available in cruise by pressing the TURB key.

For descent, the PDCS offers ECON or MANUAL schedules.

The ECON schedule of climb cruise and descent is computed to provide data for minimum trip cost based on the "flight index" provided to the computer. Flight index is a number between zero and 200 which is a measure of the relative cost effects of flight time and fuel.

An index of zero implies that fuel economy is the exclusive criterion and the PDCS will schedule the ECON speed to minimize fuel consumption. A high flight index infers that flying time is of greater value than fuel. The ECON speed will then be faster, thus reducing flying time at the expense of fuel.

The flight index is programmed into the computer by the airline, but may be changed for any flight if desired from the CDU keyboard.

Engaging the Output

Whenever the display can be engaged, the engage key is illuminated. Pressing the key causes the ENGAGE light to extinguish and the EPR bugs to drive to the displayed values. Engaging any PDC mode causes the EPR bugs to drive to the displayed values.

The PDC drives the airspeed cursors only when PDC SPEED is selected.

Automatic Page Selection

Whenever a page of flight mode data has been engaged, pressing one of the performance function keys causes the PDCS to compute and display the data for the corresponding page of the performance function. For example, if CRZ LRC has been engaged and the RNG key is pressed, the display immediately shows RNG LRC.

Display of Speeds

When a Mach/airspeed schedule is displayed on the manual page of the CDU the controlling value is underlined. For example, if climbing at a speed schedule of 320/.72 at low altitudes the 320 is underlined and at high altitudes the.72 underlined

When accelerating, Mach numbers less than .65 are not displayed; when decelerating, Mach numbers are not displayed after the speed falls below Mach .60.

Systems Safeguards

The PDCS has been integrated into the airplane in such a way that it is isolated from each of the primary instruments and sensors. This assures that failures within the PDCS do not affect the other systems.

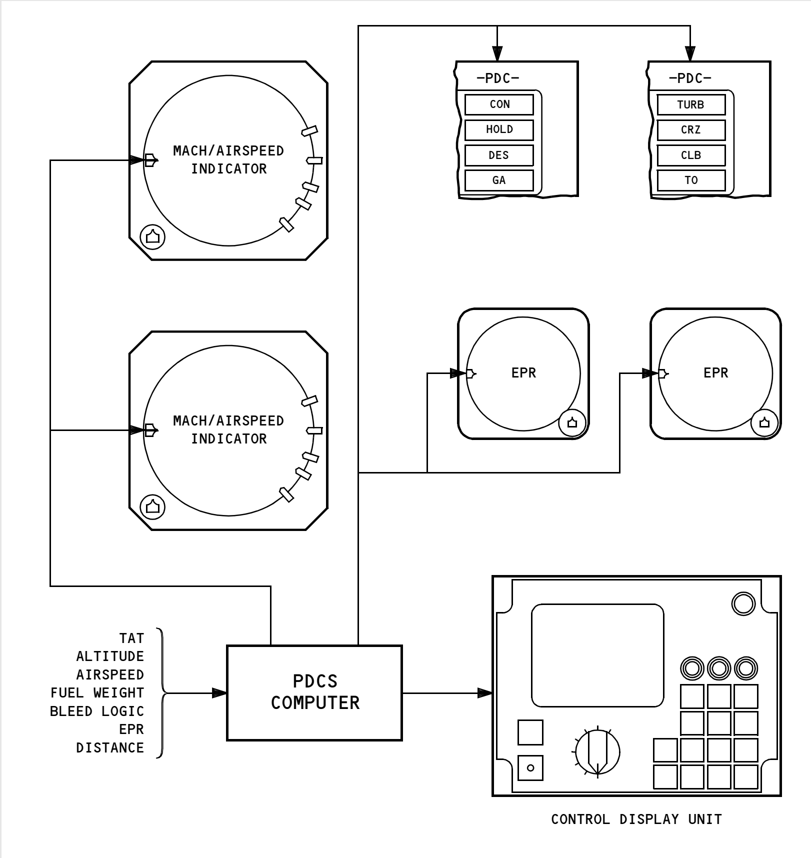
The performance data computer has a complete built-in self-test capability which allows a complete checkout of the computer and all inputs and outputs. If the PDCS fails, the screen becomes blank. In addition, under some failure conditions, the airspeed bug moves to 440 knots, the EPR bugs move to 1.0, and the indicator inoperative flags appear. If the air data computer fails, the CDU displays a CADC fail message. Failure of CADC causes the PDCS to be inoperative.

Under certain mode conditions, if the fuel totalizer signal fails, the screen displays “Use EPR limit.” Flight crews can initiate self-test procedures if desired.

When either airspeed or EPR validity is questioned, or a self-detection fault develops in the computation process, the computer normally drives the appropriate bugs to 440 knots and 1.0 EPR.

See Supplementary Normal Procedures for PDCS malfunctions.

PDCS Schematic



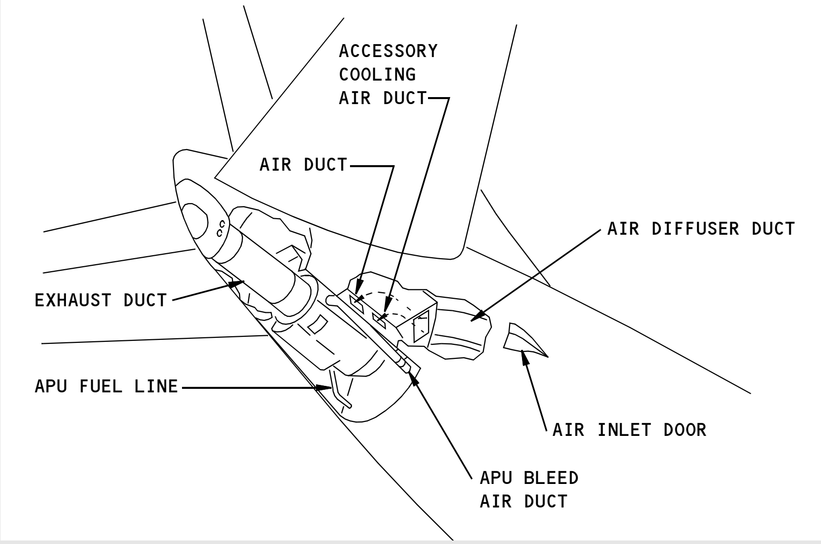
Engines, APU — Chapter 7
APU System Description — Section 30

Introduction

The auxiliary power unit (APU) is a self–contained gas turbine engine installed within a fireproof compartment located in the tail of the airplane.

The APU supplies bleed air for engine starting or air conditioning. An AC electrical generator on the APU provides an auxiliary AC power source.

APU Location



APU Operation

The APU operates up to the airplane maximum certified altitude.

The APU supplies bleed air for one air conditioning pack either on the ground or in flight. Both generator busses can be powered on the ground. In flight only one generator bus can be powered.

APU Fuel Supply

Fuel to start and operate the APU comes from the left side of the fuel manifold when the AC fuel pumps are operating. If the AC fuel pumps are not operating, fuel is suction fed from the No. 1 tank. During APU operation, fuel is automatically heated to prevent icing.

With the APU operating and AC electrical power on the airplane busses, operate at least one fuel boost pump to supply fuel under pressure to the APU.

A DC operated APU fuel boost pump provides positive fuel pressure to the APU fuel control unit. During APU start and operation, the pump operates automatically.

APU Engine and Cooling Air

APU engine and cooling air is routed to the APU through an automatically operated air inlet door located on the right side of the fuselage. APU exhaust gases are discharged overboard through an exhaust muffler.

The APU oil cooler and electrical generator are provided positive cooling airflow by a gear-driven fan.

Electrical Requirements for APU Operation

APU operation requires the following:

- APU fire switch on the overheat/fire panel must be IN
- APU fire control handle on the APU ground control panel must be IN
- Battery switch must be ON.

Electrical power to start the APU comes from the airplane battery.

Moving the battery switch to OFF on the ground shuts down the APU.

APU Start

The automatic start sequence begins by moving the APU switch momentarily to START. This initiates opening of the air inlet door. When the APU inlet door reaches the full open position the start sequence begins. After the APU reaches the proper speed, ignition and fuel are provided. When the APU is ready to accept a bleed air or electrical load the APU GEN OFF BUS light illuminates.

If the APU does not reach the proper speed with the proper acceleration rate within the time limit of the starter, the start cycle automatically terminates. The start cycle may take as long as 135 seconds.

Operate the APU for one full minute before using it as a bleed air source. This one minute stabilization is recommended to extend the service life of the APU.

APU Shutdown

Operate the APU for one full minute with no bleed air load prior to shutdown. This cooling period is recommended to extend the turbine wheel life of the APU.

Moving the APU switch to OFF shuts down the APU, trips the APU generator, and closes the APU bleed air valve. Shutdown can also be accomplished by pulling the APU fire switch.

Fuel Control Unit (FCU)

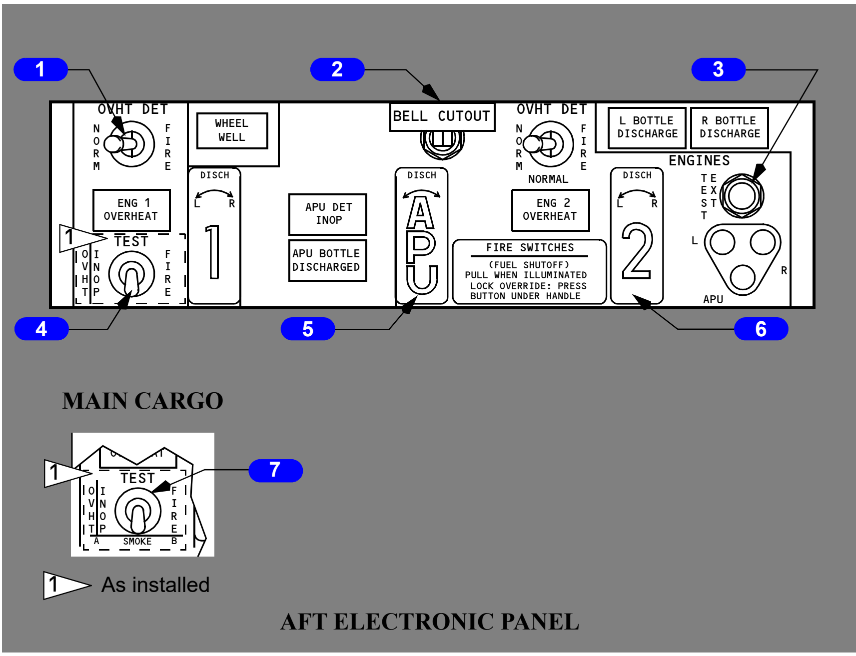
A Fuel Control Unit (FCU) controls APU engine speed and exhaust gas temperature. Automatic shutdown protection is provided for overspeed conditions, low oil pressure, high oil temperature, APU fire, and fuel control unit failure. Control air input is provided to the fuel control unit through a solenoid operated three-way control valve.

The control air pressure is modulated in response to EGT changes. When electrical load and bleed air extraction combine to raise the EGT above acceptable levels, the bleed air valve will modulate toward the closed position. In the event of an over temperature, the bleed air valve will close rapidly, but the APU will continue to run without initiating an automatic shutdown.

Intentionally
Blank

Fire Protection — Chapter 8
Table of Contents — Section TOC

Overheat/Fire Protection Panel Switches



1 Overheat Detector (OVHT DET) Switch

NORMAL – detection system is connected to the amber OVERHEAT light

FIRE – detection system is connected to the fire warning lights bell.

2 Fire Warning BELL CUTOUT Switch

Push –

- extinguishes both master FIRE WARN lights
- silences the fire warning bell
- silences the remote APU fire warning horn (on the ground only)
- resets the system for additional warnings.

3 Extinguisher Test (TEST EXT) Switch

PRESS – tests all three bottle discharge circuits and engine selector valves.

4 Overheat (OVHT)/Inoperative (INOP) and FIRE TEST Switch

(spring–loaded to center)

OVHT/INOP – tests the engine overheat detector loops and the APU fire detection circuit.

FIRE – tests the fire detection loops on both engines and the fire detector on the APU, and wheel well fire detector

Note: See Fire and Overheat System Test in Section 20.

5 APU Fire Switch

Illuminated (red) –

- indicates fire in APU
- unlocks APU fire switch.

Note: Master FIRE WARN lights illuminate, fire warning bell sounds, APU fire warning horn in main wheel well sounds (on ground only), and APU fire warning light in the wheel well flashes.

In – normal position, mechanically locked if no fire signal.

Up –

- arms APU extinguisher circuit
- closes fuel shutoff valve, bleed air valve, and APU inlet door
- trips generator control relay and breaker
- allows APU fire switch to rotate.

Rotate (left or right) –

- discharges APU fire bottle.

6 Engine Fire Switch

Illuminated (red) –

- indicates fire in related engine
- unlocks related engine fire switch.

Note: Master FIRE WARN lights illuminate and fire warning bell sounds.

In – normal position, mechanically locked if no fire signal.

Up –

- arms one discharge squib on each engine fire extinguisher
- closes fuel, hydraulic shutoff and engine bleed air valves
- disables thrust reverser
- trips generator control relay and breaker
- deactivates engine driven hydraulic pump LOW PRESSURE light
- allows engine fire switch to rotate.

Rotate (left or right) – discharges related fire bottle.

7 Overheat/Inoperative (OVHT/INOP) and FIRE TEST Switch (Cargo)

(spring–loaded to center)

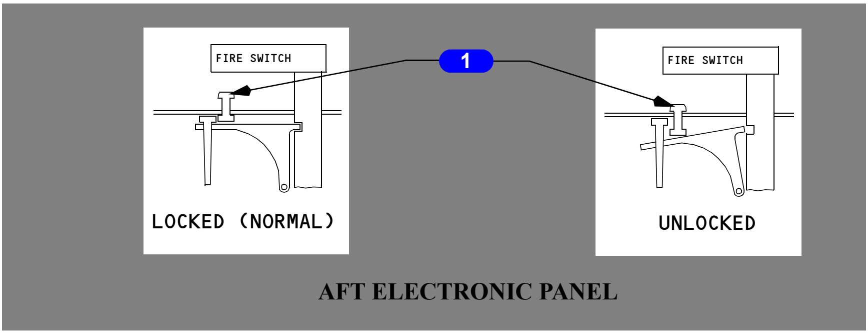
OVHT INOP A – tests engine overheat detector loops, aft “A” and forward “A” smoke detectors, and APU fire detection circuit.

Note: See Fire and Overheat System Test in Section 20.

FIRE B – tests fire detector loops on both engines, the APU, and the main wheel well, and aft “B” and forward “B” smoke detectors.

Note: See Fire and Overheat System Test in Section 20.

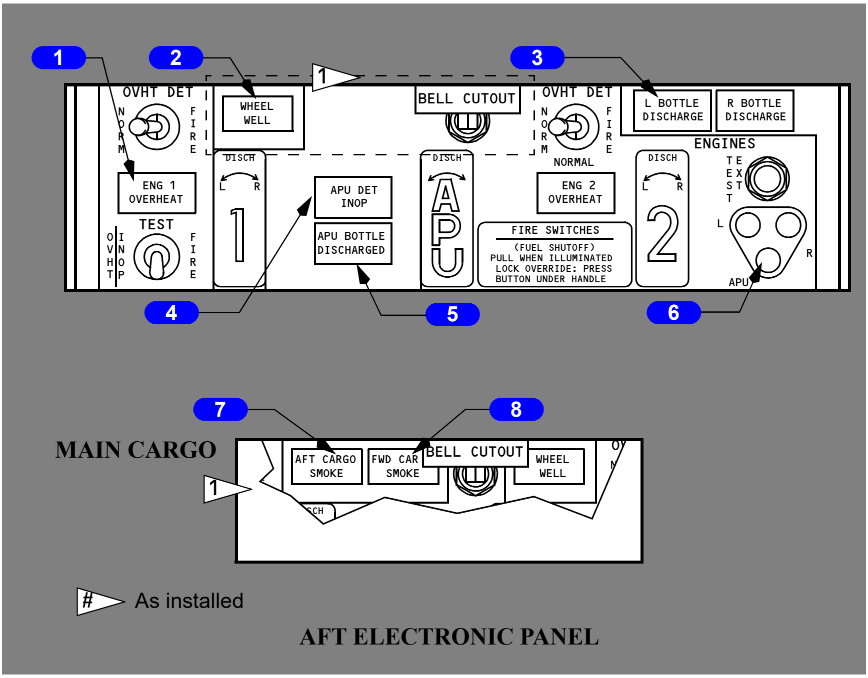
Fire Switch Override



1 Fire Switch Override

Push – unlocks fire switch.

Overheat/Fire Protection Panel Lights



1 Engine (ENG) OVERHEAT Light

Illuminated (amber) – indicates overheat in related engine.

Note: MASTER CAUTION and OVHT/DET system annunciator lights illuminate.

2 WHEEL WELL Fire Warning Light

Illuminated (red) – indicates fire in main gear wheel well

Note: Master FIRE WARN lights illuminate and fire warning bell sounds.

3 Engine BOTTLE DISCHARGE Light

Illuminated (amber) – indicates related fire extinguisher bottle has discharged.

4 APU Detector Inoperative (DET INOP) Light

Illuminated (amber) – indicates APU detector loop has failed.

Note: MASTER CAUTION and OVHT/DET system annunciator lights illuminate.

5 **APU BOTTLE DISCHARGE Light**

Illuminated (amber) – indicates APU extinguisher bottle has discharged.

6 **Extinguisher Test (TEST EXT) Lights**

Illuminated (green) – EXT TEST switch is pressed and the discharge circuits are normal.

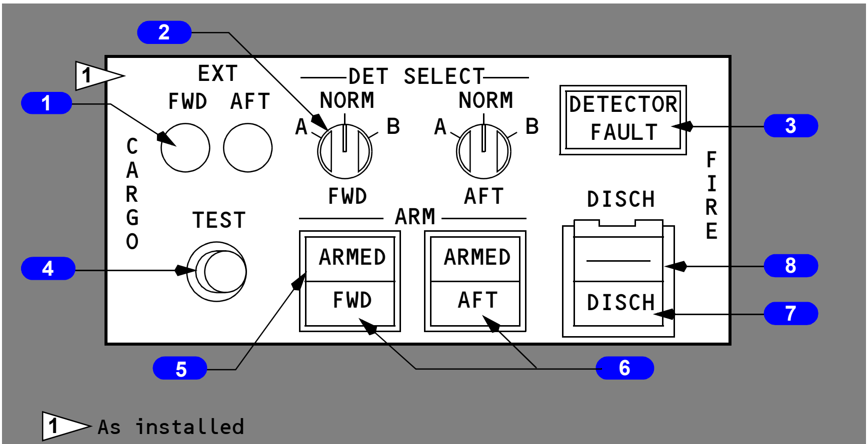
7 **AFT CARGO SMOKE Light**

Illuminated (amber) – indicates smoke in AFT “A” or “B” area

8 **FWD CARGO SMOKE Light**

Illuminated (amber) – indicates smoke in forward “A” or “B” area

Cargo Fire Panel



AFT ELECTRONIC PANEL

1 **Extinguisher (EXT) Test Lights**

Illuminated (green) - Cargo Fire TEST switch is pushed and fire bottle discharge squib circuit continuity is normal.

2 **Detector Select (DET SELECT) Switches**

NORM - detection loop A and B are active.

A - detection loop A is active.

B - detection loop B is active.

3 DETECTOR FAULT Light

Illuminated (amber) - one or more detectors in the related loop(s) has failed.

4 Cargo Fire TEST Switch

PUSH - tests circuits for both forward and aft cargo fire detector loops and suppression system.

Note: See Cargo Fire System Tests in Section 20.

5 Cargo Fire ARMED Switches

PUSH -

- FWD ARMED - extinguisher armed for the forward cargo compartment
- AFT ARMED - extinguisher armed for the aft cargo compartment.

6 Cargo Fire (FWD/AFT) Warning Lights

Illuminated (red) -

- at least one detector in each loop detects smoke
- with power failed in one loop, at least one detector on the remaining loop detects smoke.

Note: Master FIRE WARN lights illuminate and fire warning bell sounds.

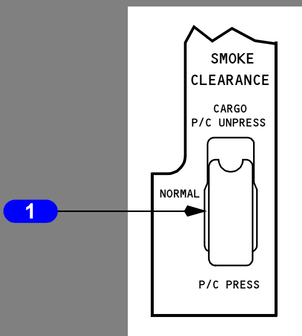
7 Cargo Fire Bottle Discharge (DISCH) Light

Illuminated (amber) - indicates the extinguisher bottle has discharged

8 Cargo Fire Discharge (DISCH) Switch

PUSH - if system is armed, discharges the extinguisher bottle.

Cargo Compartment Smoke (Cargo airplanes only)
SMOKE CLEARANCE Switch



FORWARD OVERHEAD PANEL

1 SMOKE CLEARANCE Switch

CARGO P/C UNPRESS – used to evacuate smoke in the main cargo compartment in an all–cargo configuration.

Depressurizes the airplane by causing the following:

- forward outflow valve drives open
- gasper fan off
- right A/C pack off
- left A/C pack low flow
- distribution shut–off valve closes.

NORMAL – used for all normal pressurized operations.

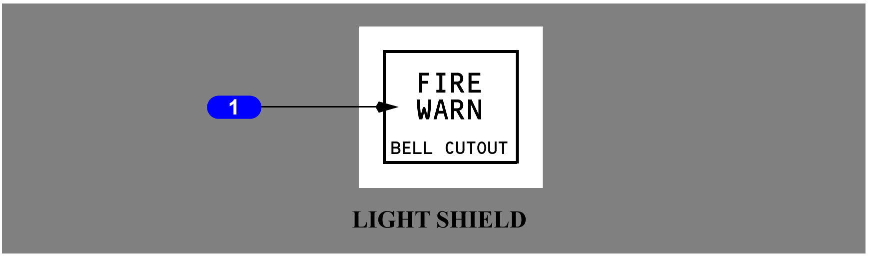
P/C PRESS – used to evacuate smoke in the main cargo compartment in a combined passenger/cargo configuration.

Airplane remains pressurized.

Causes the following:

- forward outflow valve drives open
- gasper fan off
- right A/C pack off
- left A/C pack normal flow
- distribution shut–off valve remains open
- E & E cooling fan off.

Master Fire Warning Light



1 Master Fire Warning (FIRE WARN) Light

Illuminated (red) – indicates a fire warning (or system test) in engine, APU, main gear wheel well, or cargo compartments (on some airplanes)

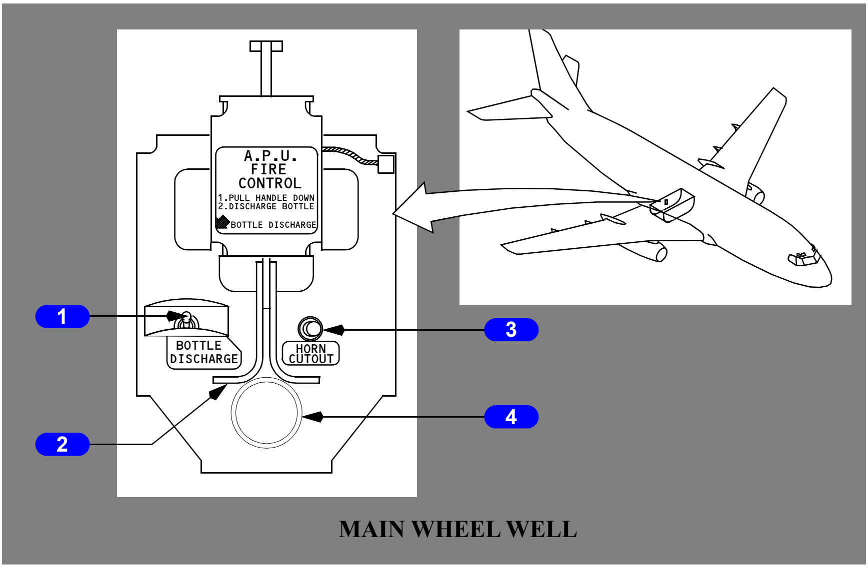
- fire warning bell sounds
- if on ground, remote APU fire warning horn sounds.

Push –

- extinguishes both master FIRE WARN lights
- silences the fire warning bell
- silences the remote APU fire warning horn
- resets the system for additional warnings.

Note: Pushing fire warning bell cutout switch on overheat/fire protection panel results in same actions.

APU Ground Control Panel



1 APU BOTTLE DISCHARGE Switch

(spring–loaded to center)

Left or right – discharges APU extinguisher.

Note: Armed only if APU fire control handle is pulled at this panel.

2 APU Fire Control Handle

Up – normal position.

Down –

- arms APU BOTTLE DISCHARGE switch (on this panel only)
- closes APU fuel shutoff, bleed air valve and APU inlet door
- trips generator control relay and breaker.

3 APU Fire Warning HORN CUTOUT Switch

Push –

- silences fire alarm bell
- silences APU fire warning horn
- causes APU fire warning light to stop flashing but remain illuminated.

4 **APU Fire Warning Light**

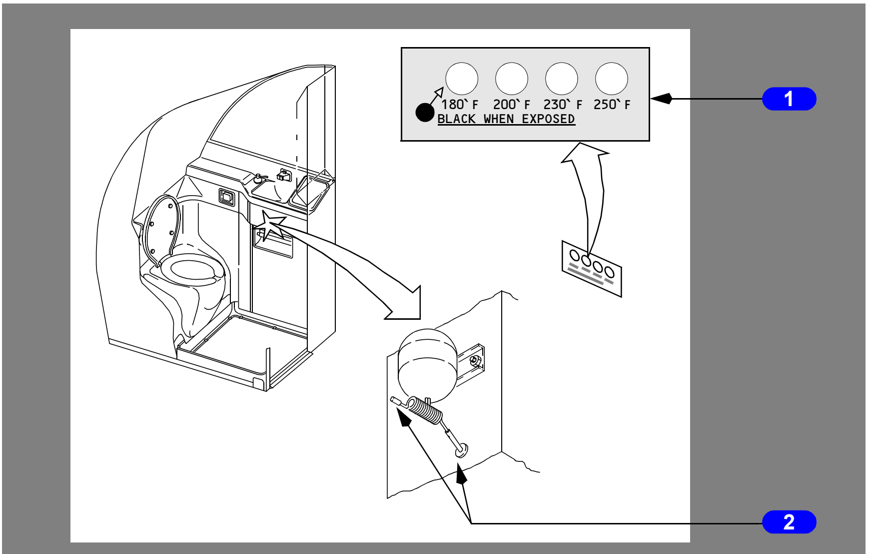
Illuminated (red flashing) – indicates fire in APU.

Note: Also, flight deck fire warning bell sounds and APU fire warning horn in main wheel well wails.

Illuminated (red steady) – indicates APU fire warning HORN CUTOUT switch has been pushed following an APU fire indication.

Lavatory Fire

Lavatory Fire Extinguisher



BELOW LAVATORY SINK

1 **TEMPERATURE INDICATOR Placard**

White – normal condition.

Black – exposed to high temperatures.

2 **Heat Activated Nozzles**

Flat black – normal condition.

Aluminum – indicates extinguisher has discharged.

One nozzle discharges toward the towel disposal container, the other under the sink.

Introduction

There are fire detection and extinguishing systems for:

- engines
- APU
- lavatories
- cargo compartments (As Installed).

The engines also have overheat detection systems.

The main gear wheel well has a fire detection system, but no fire extinguishing system.

Cargo airplanes have main cargo compartment smoke and fire detection systems and a smoke evacuation system.

Engine Fire Protection

Engine fire protection consists of these systems:

- engine overheat and fire detection powered by the battery bus
- engine fire extinguishing powered by the hot battery bus.

Engine Overheat and Fire Detection

Each engine contains two overheat detector loops and two fire detection loops. Short circuit discriminators are installed to prevent shorts from causing false overheat or fire warnings. Amber INOP lights in the lower E & E compartment indicate "shorts" in the overheat or fire circuits.

If the fire detection circuit fails to test, placing the OVHT DET switch in the FIRE position allows the overheat circuit to be used to provide fire warning in order to dispatch.

The indications of an engine overheat are:

- both MASTER CAUTION lights illuminate
- the OVHT/DET system annunciator light illuminates
- the related ENG OVERHEAT light illuminates.

The indications of an engine fire are:

- the fire warning bell sounds
- both master FIRE WARN lights illuminate
- the related engine fire switch illuminates

Engine Fire Extinguishing

The engine fire extinguisher system consists of two engine fire extinguisher bottles, two engine fire switches, two BOTTLE DISCHARGE lights, and an EXT TEST switch. Either or both bottles can be discharged into either engine.

The engine fire switches are normally locked down to prevent inadvertent shutdown of an engine. Illumination of an engine fire switch or ENG OVERHEAT light unlocks the engine fire switch. The switches may also be unlocked manually.

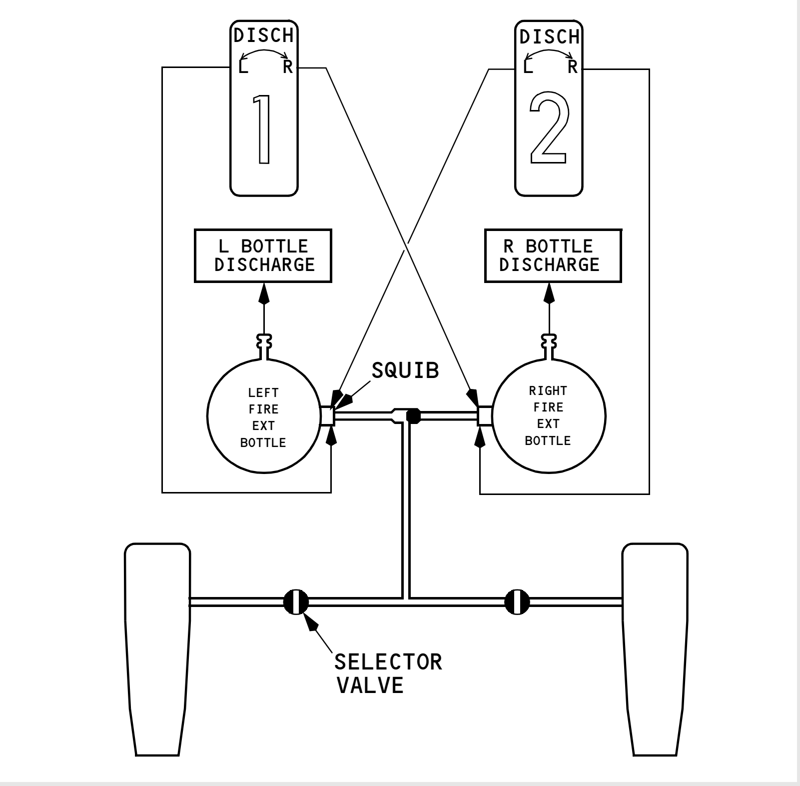
Pulling the engine fire switch up:

- closes the related engine fuel shutoff valve
- closes the related engine bleed air valve resulting in loss of wing anti–ice to the affected wing and closure of bleed air operated pack valve
- trips the generator control relay and breaker
- closes the hydraulic fluid shutoff valve. The engine driven hydraulic pump LOW PRESSURE light is deactivated
- disables thrust reverser for the related engine.
- allows the engine fire switch to be rotated for discharge
- arms the discharge squib on each engine fire extinguisher bottle.

Rotating the engine fire switch electrically “fires” the squib, discharging the extinguishing agent into the related engine. Rotating the switch the other way discharges the remaining bottle into the same engine.

The L or R BOTTLE DISCHARGE light illuminates a few seconds after the engine fire switch is rotated, indicating the bottle has discharged.

Engine Fire Extinguisher Schematic



APU Fire Protection

APU fire protection consists of these systems:

- APU fire detection powered by the battery bus
- APU fire extinguishing powered by the hot battery bus.

APU Fire Detection

A single fire detection loop is installed on the APU. As the temperature of the detector increases to a predetermined limit, the detector senses a fire condition. The APU fire switch remains illuminated until the temperature of the detector has decreased below the onset temperature.

The system contains a fault monitoring circuit. If the loop fails, the APU DET INOP light illuminates indicating the APU fire detection system is inoperative.

The indications of an APU fire are:

- the fire warning bell sounds
- both master FIRE WARN lights illuminate
- the APU fire switch illuminates
- the APU automatically shuts down
- the APU fire warning horn in the main wheel well sounds (on the ground only), and the APU fire warning light flashes.

APU Fire Extinguishing

The APU fire extinguisher system consists of one APU fire extinguisher bottle, one APU fire switch, an APU BOTTLE DISCHARGE light, and an EXT TEST switch. The APU ground control panel located in the right main wheel well also contains an APU fire warning light, an APU BOTTLE DISCHARGE switch, an APU fire control handle and APU HORN CUTOUT switch.

The APU fire switch is normally locked down to prevent inadvertent shutdown of the APU. Illumination of the APU fire switch unlocks the switch. The switch may also be unlocked manually.

Pulling the APU fire switch up:

- provides backup for the automatic shutdown feature
- deactivates the fuel solenoid and closes the APU fuel shutoff valve
- closes the APU bleed air valve
- closes the APU air inlet door
- trips the APU generator control relay and generator breaker
- allows the APU fire switch to be rotated for discharge
- arms the APU fire extinguisher bottle squib.

Rotating the APU warning switch electrically “fires” the squib, discharging the extinguishing agent into the APU. The APU BOTTLE DISCHARGED light illuminates after a few seconds, indicating the bottle has discharged.

Main Wheel Well Fire Protection

Main wheel well fire protection consists of fire detection powered by the No. 1 AC transfer bus.

Note: The main wheel well has no fire extinguishing system. The nose wheel well does not have a fire detection system.

Main Wheel Well Fire Detection

A single fire detector loop is installed in the main wheel well. As the temperature of the detector increases to a predetermined limit, the detector senses a fire condition. The WHEELWELL fire warning light remains illuminated until the temperature of the detector has decreased below the onset temperature.

The indications for a main wheel well fire are:

- the fire warning bell sounds
- both master FIRE WARN lights illuminate
- the WHEEL WELL fire warning light illuminates.

Cargo Compartment Fire Protection (As Installed)

Cargo fire protection consists of these systems:

- cargo compartment smoke detection powered by DC bus 1 and DC bus 2
- cargo compartment fire extinguishing powered by the hot battery bus.

Cargo Compartment Smoke Detection

The forward and aft cargo compartments each have smoke detectors in a dual loop configuration. Normally, both detection loops must sense smoke to cause an alert. These loops function in the same manner as the engine overheat/fire detection loops.

Cargo Compartment Fire Warning

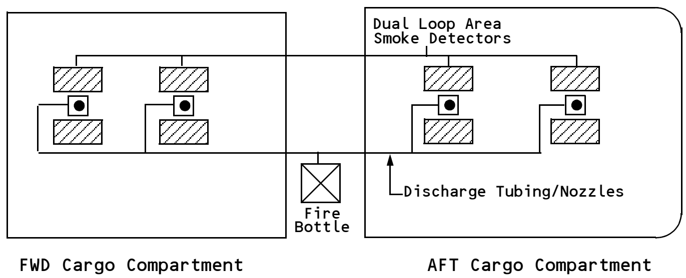
The indications of a cargo compartment fire are:

- the fire warning bell sounds
- both master FIRE WARN lights illuminate
- the FWD/AFT cargo fire warning light(s) illuminates.

Cargo Compartment Fire Extinguishing

A single fire extinguisher bottle is installed in the air conditioning mix bay on the forward wing spar. Detection of a fire in either the forward or aft compartment will cause the FWD or AFT cargo fire warning light to illuminate. The extinguisher is armed by pushing the appropriate cargo fire ARMED switch. Once armed, the system is discharged by pushing the cargo fire DISCH switch. This results in the total discharge of the bottle contents into the selected compartment. The cargo fire DISCH light illuminates once the bottle is discharged. It may take up to 30 seconds for the light to illuminate.

Cargo Fire Extinguisher Schematic



Lavatory Fire Protection

Lavatory fire protection consists of these systems:

- lavatory smoke detection
- lavatory fire extinguishing (heat activated).

Lavatory Smoke Detection (As Installed)

The lavatory smoke detection system monitors for the presence of smoke. When smoke is detected:

- an aural warning sounds over the passenger address system.
- the red alarm indicator light on the lavatory smoke detector panel illuminates
- pressing the interrupt switch silences the aural warning. If smoke is still present when the switch is released, the alarm will sound again.

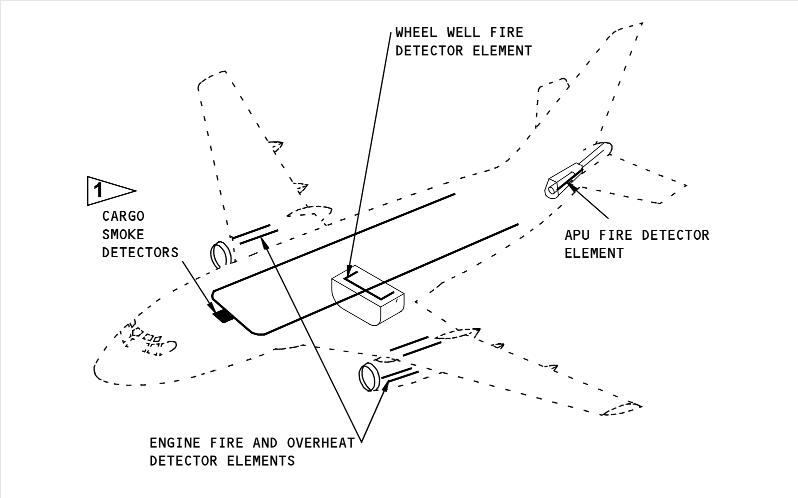
There is no flight deck indication. When smoke is no longer present the system automatically resets.

Lavatory Fire Extinguisher System

A fire extinguisher system is located beneath the sink area in each lavatory. When a fire is detected:

- fire extinguisher operation is automatic
- flight deck has no indication of extinguisher discharge.

Fire and Overheat Detector Element Locations



1 As installed

Fire and Overheat System Tests

The fire and overheat detection systems can be tested by pushing and holding the OVHT/INOP and FIRE TEST switch. Extinguisher continuity can be tested by pushing and holding the TEST EXT switch. All test indications clear when switches are released.

Overheat/INOP Test Detection

The fault detection circuits for both the engines and the APU are tested by pushing and holding the OVHT/INOP and FIRE TEST switch in the OVHT/INOP position.

The indications for the OVHT/INOP test are:

- both MASTER CAUTION lights illuminate
- the OVHT/DET system annunciator light illuminates
- the ENG 1 and ENG 2 OVERHEAT lights illuminate
- the APU DET INOP light illuminates.
- on cargo airplanes the MASTER FIRE WARN, and the AFT and FWD CARGO SMOKE lights illuminate.

FIRE Test Detection

The overheat and fire detection loops on both engines, the APU, and the fire detector in the wheel well are tested by pushing and holding the OVHT/INOP and OVHT/FIRE TEST switch in the OVHT/FIRE position.

The indications for the OVHT/FIRE test are:

- the fire warning bell sounds
- both master FIRE WARN lights illuminate
- both engine fire switches illuminate
- the APU fire switch illuminates
- the WHEEL WELL fire warning light illuminates if AC power is available
- the APU fire warning horn sounds and the APU fire warning light in the main wheel well flashes
- on cargo airplanes, the AFT and FWD CARGO SMOKE lights illuminate.

Extinguisher Test

When the TEST EXT switch is pressed, the green TEST EXT lights illuminate, verifying circuit continuity from the squib to the engine fire switch.

Cargo Fire System Tests (As Installed)

The cargo fire detection and suppression system can be tested by pushing and holding the cargo fire TEST switch. This sends a test signal to the forward and aft cargo fire detector loops and verifies continuity of the extinguisher bottle squib circuits. All test indications clear when the TEST switch is released

Cargo Fire TEST

The indications for the Cargo Fire test are:

- the fire warning bell sounds
- both master FIRE WARN lights illuminate
- the extinguisher test lights illuminate

- the FWD and AFT cargo fire warning lights illuminate when all detectors in selected loop(s) respond to the fire test
- the cargo fire bottle DISCH light illuminates

Note: The fire warning BELL CUTOUT switch on the Overheat/Fire Protection panel can silence the fire warning bell and extinguish the master FIRE WARN lights

Note: During a Cargo Fire Test, the DETECTOR Fault light will illuminate if one or more detectors in the loop(s) has failed.

Note: Individual detector faults can only be detected by a manually initiated test. The MASTER CAUTION light does not illuminate.

Note: At the end of cargo fire testing, a four second delay allows all applicable indications to extinguish at the same time.

Cargo Fire Extinguisher Test

When the Cargo Fire TEST button is pushed, the green EXT lights illuminate, verifying the fire bottle discharge squib circuit continuity is normal.

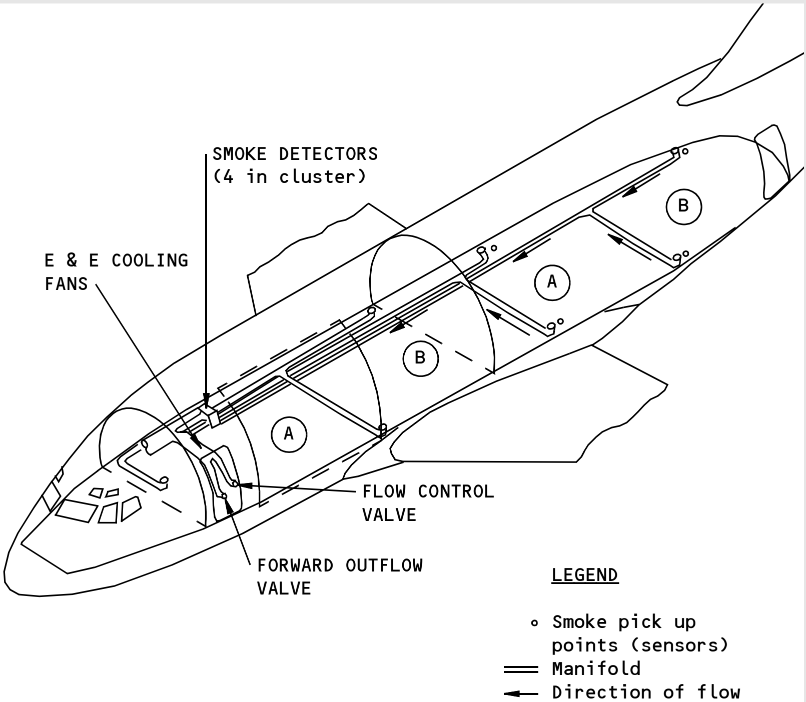
Main Cargo Compartment Smoke and Fire Detection (Cargo airplanes)

The smoke detection system monitors main cabin air for the presence of smoke and provides visual and aural warning if smoke is detected. The fire alarm bell sounds, and the cargo smoke and master warning lights illuminate.

The equipment cooling fan draws air through the smoke detection tubing, past the detectors, and exhausts it overboard. Separate “A” and “B” detectors for both the forward and aft main cargo areas provide system redundancy.

If the FWD CARGO SMOKE light illuminates, smoke is present in the main cabin forward of the overwing emergency exits. If the AFT CARGO SMOKE light illuminates, smoke is present in the main cabin aft of the overwing emergency exits.

Main Cargo Smoke Detector Locations



Smoke is evacuated from the airplane by actuating the SMOKE CLEARANCE switch which is located in the cockpit on the forward overhead panel.

The CARGO P/C UNPRESS position is to combat smoke/fire in the all–cargo configuration (class E cargo compartment).With the switch in this position, the airplane depressurizes. Ventilating airflow in the main cargo compartment reduces to a minimum, and the cockpit receives a supply of conditioned air. Smoke exits the main cargo compartment primarily through the main compartment vent located in the floor above the E & E compartment, then out of the airplane through the flow control valve. This position also provides smoke evacuation protection in the event the airplane is dispatched on a combined passenger/cargo unpressurized flight.

The P/C PRESS position of the switch is to combat smoke in the combined passenger/cargo configuration (class B cargo compartment). With the switch in this position, the airplane remains pressurized. A fire resistant smoke barrier partition separating the passenger and cargo areas, and the flight deck door (closed) prevent a hazardous quantity of smoke or extinguishing agent from entering any compartment occupied by crew or passengers. Smoke exits the main cargo compartment vent, then out of the airplane through the forward outflow valve. In this configuration, sufficient access is retained in flight for a crew member to reach any part of the cargo with the contents of a hand fire extinguisher.

Note: When the airplane is on the ground, if the equipment cooling fans become inoperative or are de–activated, the smoke detector system is inoperative. When airborne, air is forced through the system by pressure from the air conditioning system, therefore, the smoke detectors remain operative.

Cargo Compartment Fire Classifications

The flight deck and passenger cabin are designated Class A compartments, meaning that a fire may be visually detected, reached, and combatted by a crew member. The engines are Class C compartments, and fire warning is provided by fire detectors. There two basic type of cargo compartments: class B, in which the crew member may reach and combat a source of fire; and Class D (now designated as C) or E, in which a crew member cannot reach the source of fire.

Class A

Compartments are classified Class A when they comply with the following:

- provide for the visual detection of smoke
- accessible in flight
- fire extinguisher is available.

Class B

Cargo and baggage compartments are classified Class B when they comply with the following:

- sufficient access provided while in flight to enable member of the crew to move by hand all contents; and to reach effectively all parts of the compartment with a hand extinguisher
- when the access provisions are being used, no hazardous quantity of smoke, flames, or extinguishing agent will enter any compartment occupied by the crew or passengers

- each compartment shall be equipped with a separate system of an approved type smoke detector or fire detector to give warning at the pilot station
- hand fire extinguishers shall be readily available for use in all compartments of this category.

Class C

Compartments are classified Class C when they comply with the following:

- smoke and fire detectors installed
- built–in fire extinguisher system controlled from the flight deck.

Class D

Cargo and baggage compartments are classified Class D if they are so designed and constructed that a fire occurring therein will be completely confined without endangering the safety of the airplane and its occupants. Compliance is required with the following:

- means provided to exclude hazardous quantities of smoke, flames or other noxious gases from entering into any compartment occupied by the crew or passengers
- ventilation and drafts controlled within each compartment so that any fire likely to occur in the compartment will not progress beyond safe limits
- compartment completely lined with fire resistant material.

Note: The certification standards for fire safety in Class D cargo and baggage compartments have been changed. Class D compartments in airplanes used for passenger service must now comply with the standards for Class C compartments. Class C standards require that a compartment be equipped with smoke and fire detectors and with a built-in fire extinguisher system controlled from the flight deck. No inflight access is necessary, but the flight crew must be able to control the ventilating airflow into these compartments. Class D compartments in airplanes used only for cargo service must also comply with the standards for Class C, or with the detection standards for Class E compartments.

Class E

On airplanes used to carry cargo only, the cabin area can be classified as a Class E compartment when it complies as follows:

- the window shades must be closed
- completely lined with fire–resistant material
- equipped with a separate system of an approved type smoke or fire detector

- means provided to shut off the ventilating air flow to or within the compartment. Controls for such means shall be accessible to the flight crew on the flight deck
- means provided to exclude hazardous quantities of smoke, flames or noxious gasses from entering the flight deck
- required crew emergency exits accessible under all cargo loading conditions.

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Flight Controls — Chapter 9
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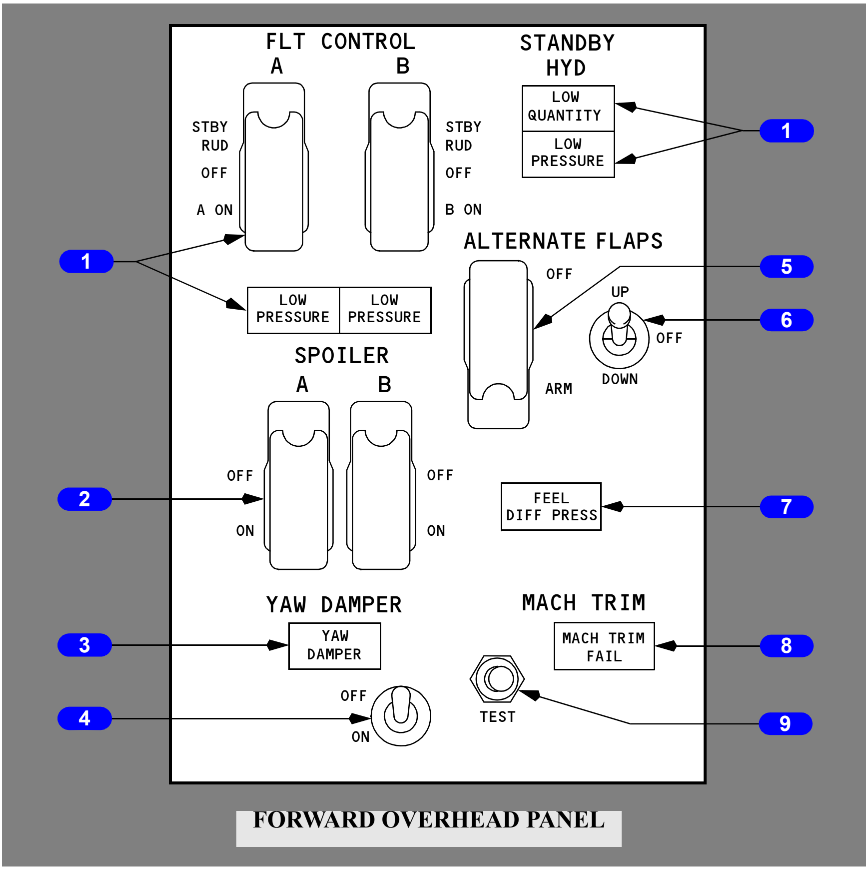
Flight Control Panel (before Rudder System Enhancement Program (RSEP) modification)



1 **Refer to Chapter 13 – Hydraulics**

2 **Flight SPOILER Switches (guarded to ON)**

Used for maintenance purposes only.

OFF – closes the respective flight spoilers shutoff valve.

3 **YAW DAMPER Light**

Illuminated (amber) – yaw damper is not engaged.

4 YAW DAMPER Switch

OFF – disengages yaw damper.

ON – engages yaw damper to rudder power control unit.

5 ALTERNATE FLAPS Master Switch (guarded to OFF)

OFF – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms the ALTERNATE FLAPS position switch.

6 ALTERNATE FLAPS Position Switch

Functions only when the ALTERNATE FLAPS master switch is in ARM.

UP –

- electrically retracts trailing edge flaps
- leading edge devices remain extended and cannot be retracted by the alternate flaps system.

OFF – normal operating position.

DOWN (spring loaded to OFF)–

- (momentary) fully extends leading edge devices using standby hydraulic pressure
- (hold) electrically extends trailing edge flaps.

7 Feel Differential Pressure (FEEL DIFF PRESS) Light

- Armed when the trailing edge flaps are up.

Illuminated (amber) – indicates excessive differential pressure in the elevator feel computer.

8 MACH TRIM Failure (FAIL) Light

Armed when the trailing edge flaps are up.

Illuminated (amber) –

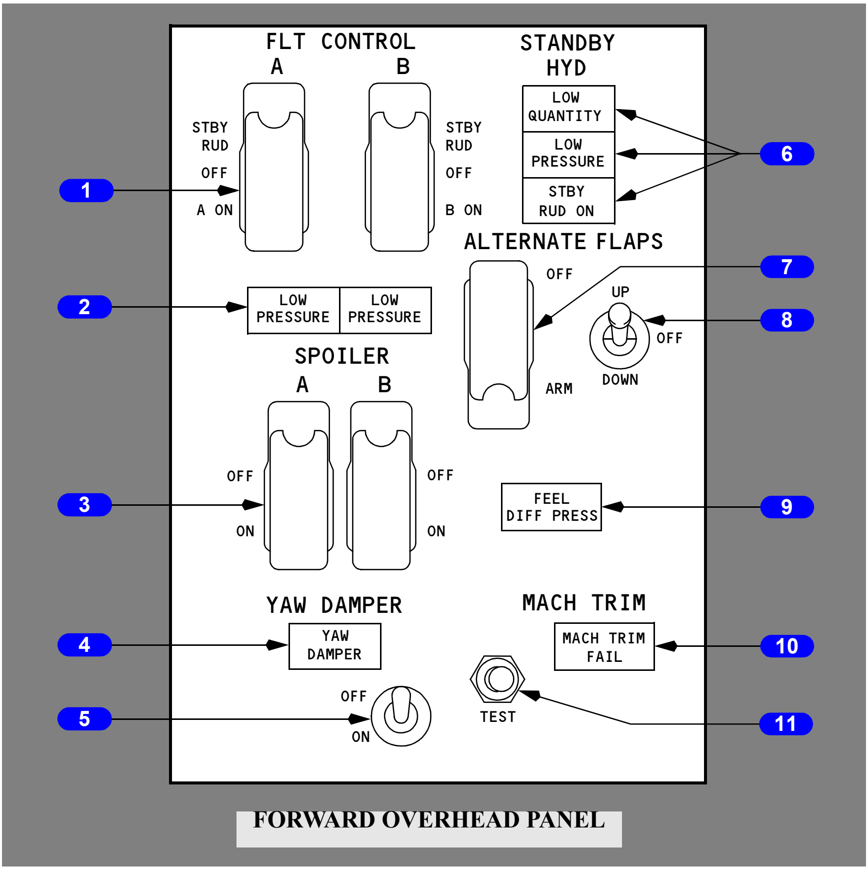
- indicates unreliable Mach Trim system or Mach Trim test in progress

9 MACH TRIM TEST switch

Press – tests Mach Trim system

- MACH TRIM FAIL light illuminates
- elevator surfaces moves up
- control column moves aft.

Flight Control Panel (after RSEP modification)



1 FLIGHT CONTROL Switches

STBY RUD - activates standby pump, opens standby shutoff valve to pressurize standby rudder power control unit, and illuminates amber STBY RUD ON light.

OFF - closes flight control shutoff valve isolating ailerons, elevators and rudder from associated hydraulic system pressure.

ON (guarded position) - normal operating position.

2 Flight Control LOW PRESSURE Lights

Illuminated (amber) -

- indicates low hydraulic system (A or B) pressure to ailerons, elevator and rudder.
- deactivated when associated FLIGHT CONTROL switch is positioned to STBY RUD and standby rudder shutoff valve opens.
- indicates A system pressure is low when normal system pressure is commanded.

Note: The A system light will remain illuminated for approximately five seconds after A hydraulic system has been activated.

3 Flight SPOILER Switches (guarded to ON)

Used for maintenance purposes only.

OFF – closes the respective flight spoilers shutoff valve.

4 YAW DAMPER Light

Illuminated (amber) – yaw damper is not engaged.

5 YAW DAMPER Switch

OFF – disengages yaw damper.

ON – engages yaw damper to rudder power control unit.

6 STANDBY HYD Lights

STANDBY HYD LOW QUANTITY Light

Illuminated (amber) –

- indicates low quantity in standby hydraulic reservoi.r
- always armed.

STANDBY HYDRAULIC LOW PRESSURE Light

Illuminated (amber)

- indicates output pressure of standby pump is low
- armed only when standby pump operation has been selected or automatic standby function is activated.

STBY RUD ON Light

Illuminated (amber) - indicates the standby hydraulic system is commanded on to pressurize the standby rudder power control unit.

7 ALTERNATE FLAPS Master Switch (guarded to OFF)

OFF – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms the ALTERNATE FLAPS position switch.

8 ALTERNATE FLAPS Position Switch

Functions only when the ALTERNATE FLAPS master switch is in ARM.

UP –

- electrically retracts trailing edge flaps
- leading edge devices remain extended and cannot be retracted by the alternate flaps system.

OFF – normal operating position.

DOWN (spring loaded to OFF)–

- (momentary) fully extends leading edge devices using standby hydraulic pressure
- (hold) electrically extends trailing edge flaps.

9 Feel Differential Pressure (FEEL DIFF PRESS) Light

- Armed when the trailing edge flaps are up.

Illuminated (amber) – indicates excessive differential pressure in the elevator feel computer.

10 MACH TRIM Failure (FAIL) Light

Armed when the trailing edge flaps are up.

Illuminated (amber) –

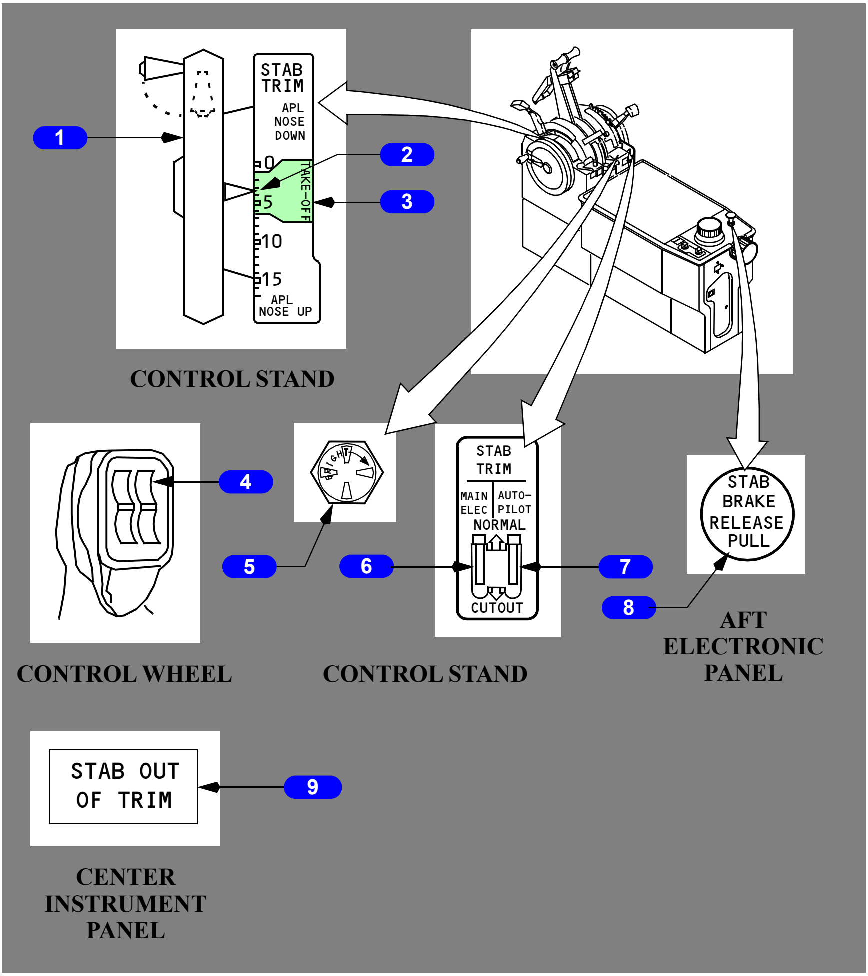
- indicates unreliable Mach Trim system or Mach Trim test in progress

11 MACH TRIM TEST switch

Press – tests Mach Trim system

- MACH TRIM FAIL light illuminates
- elevator surfaces moves up
- control column moves aft.

Stabilizer



1 Stabilizer Trim Wheel

- provides for manual operation of stabilizer
- overrides any other stabilizer trim inputs
- rotates when stabilizer is in motion.

Note: handle should be folded inside stabilizer trim wheel for normal operation

2 Stabilizer Trim Indicator

Indicates units of airplane trim on the adjacent scale.

3 **Stabilizer Trim Green Band Range**

Corresponds to allowable range of trim settings for takeoff.

4 **Stabilizer Trim Switches (spring–loaded to neutral)**

Push (both) –

- electrically commands stabilizer trim in desired direction
- autopilot disengages if engaged.

5 **Stabilizer Trim Light**

Illuminated (amber) – indicates main electric trim motor is operating.

6 **Stabilizer Trim Main Electric (MAIN ELECT) Cutout Switch**

NORMAL – normal operating position.

CUTOUT – removes power from stabilizer main electric trim motor.

7 **Stabilizer Trim AUTOPILOT Cutout Switch**

NORMAL – normal operating position.

CUTOUT – removes autopilot servo power to stabilizer drive.

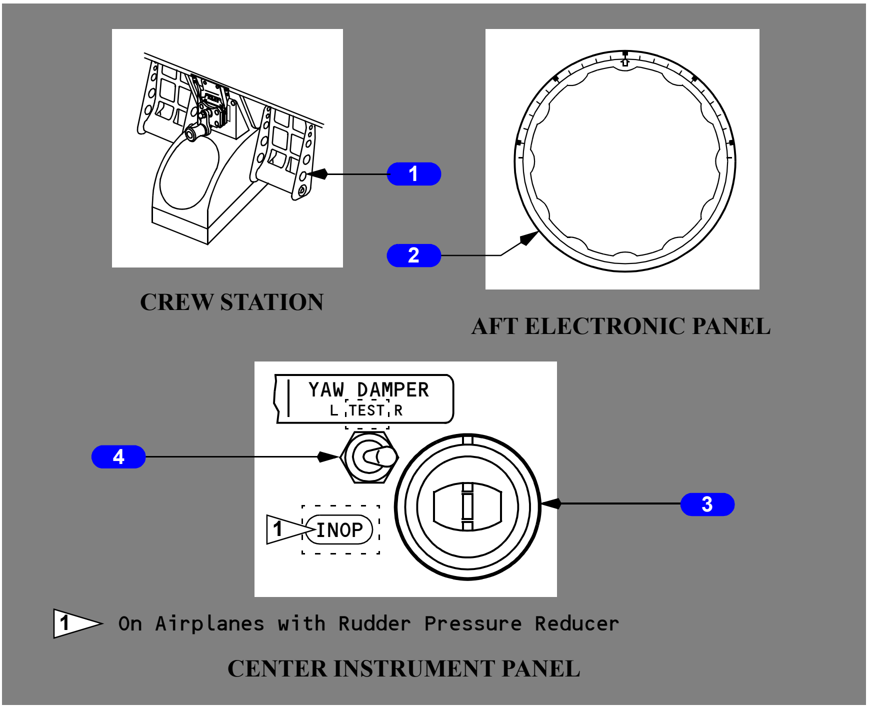
8 **Stabilizer BRAKE RELEASE Knob**

Pull – releases stabilizer brake.

9 **STAB OUT OF TRIM Light**

Refer to Chapter 4 – Automatic Flight.

Rudder



1 Rudder Pedals

Push –

- controls rudder position
- permits limited nose gear steering up to 7 degrees each side of center.

2 Rudder Trim Wheel

Rotate – repositions the rudder neutral control position.

3 YAW DAMPER Indicator

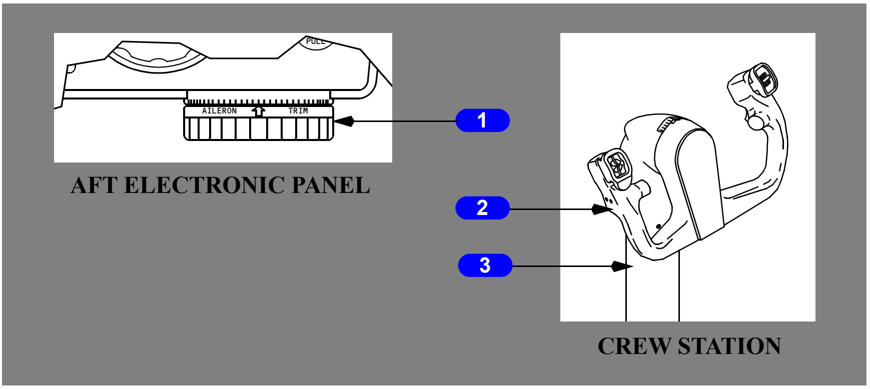
- indicates yaw damper movement of rudder due to yaw damper input on the ground, in the air and during test.
- pilot rudder pedal inputs are not indicated.

4 YAW DAMPER TEST Switch

With the yaw damper engaged and hydraulic power available:

- L – the YAW DAMPER indicator moves left; the YAW DAMPER indicator moves right when the TEST switch is released
- R – the YAW DAMPER indicator moves right, the YAW DAMPER indicator moves left when the TEST switch is released

Aileron / Elevator / Flight Spoilers



1 AILERON TRIM Wheel

Rotate – repositions the aileron neutral control position.

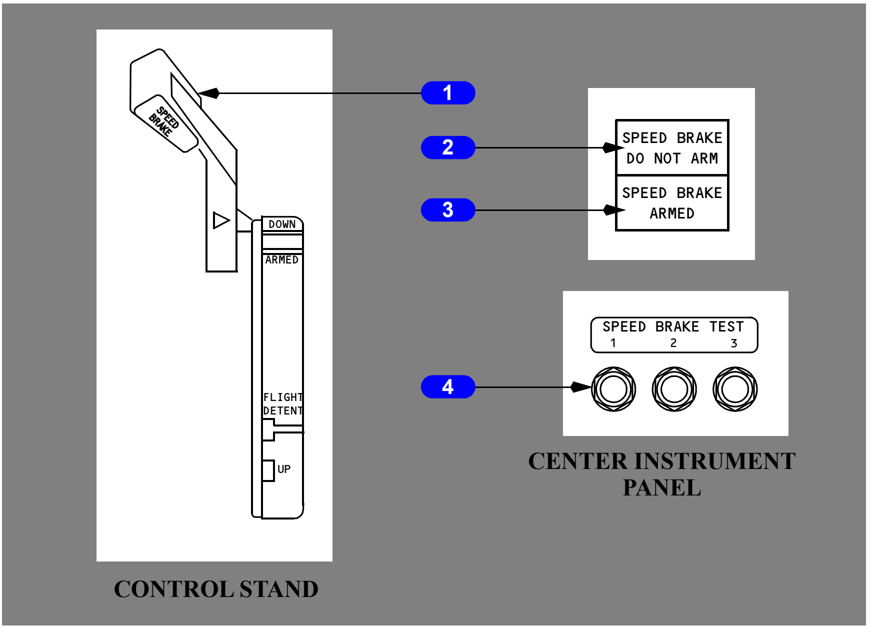
2 Control Wheel

Rotate – operates ailerons and flight spoilers in desired direction.

3 Control Column

Push/Pull – operates elevators in the desired direction. Movement opposing stabilizer trim stops electric trimming.

Speed Brakes



1 SPEED BRAKE Lever

DOWN (detent) – all flight and ground spoiler panels in faired position.

ARMED –

- automatic speed brake system armed
- upon touchdown, the SPEED BRAKE lever moves to the UP position, and all flight and ground spoilers extend.

FLIGHT DETENT – all flight spoilers are extended to their maximum position for inflight use.

UP – all flight and ground spoilers are extended to their maximum position for ground use.

2 SPEED BRAKE DO NOT ARM Light

Light deactivated when SPEED BRAKE lever is in the DOWN position.

Illuminated (amber) – indicates abnormal condition or test inputs to the automatic speed brake system.

3 SPEED BRAKE ARMED Light

Light deactivated when SPEED BRAKE lever is in the DOWN position.

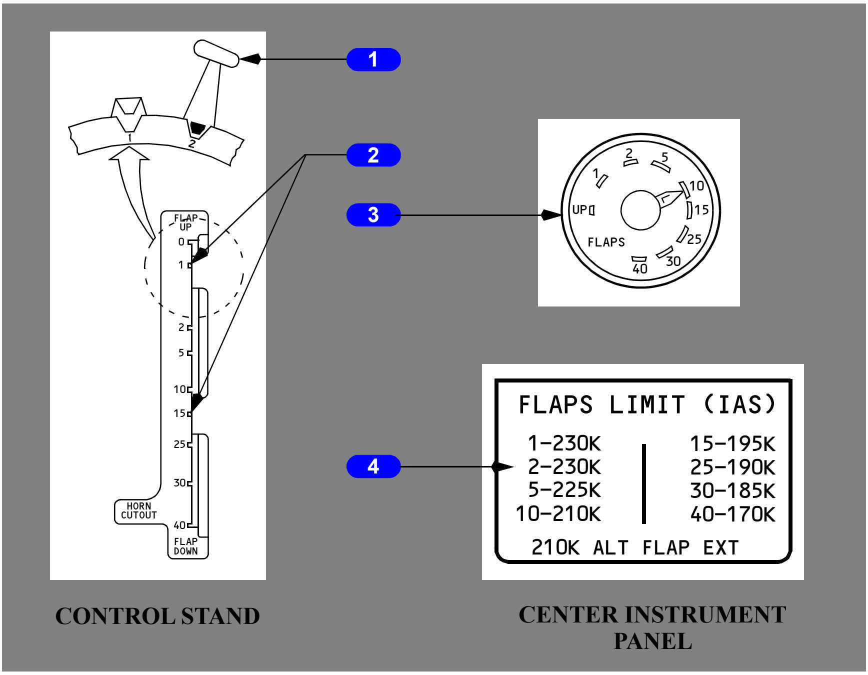
Illuminated (green) – indicates valid automatic speed brake system inputs.

4 SPEED BRAKE Test Switches

Used for maintenance purposes only.

Tests fault detection circuits of the automatic speed brake system.

Trailing Edge Flaps



1 Flap Lever

- selects position of flap control valve, directing hydraulic pressure for flap drive unit
- position of the leading edge devices is determined by selecting trailing edge flap position
- At flaps position 40, arms the flap load relief system, which automatically will cause flap retraction to position 30 in the event of excess airspeed.

2 Flap Gates

Prevents inadvertent flap lever movement beyond:

- position 1 – to check flap position for one engine inoperative go–around
- position 15 – to check flap position for normal go–around.

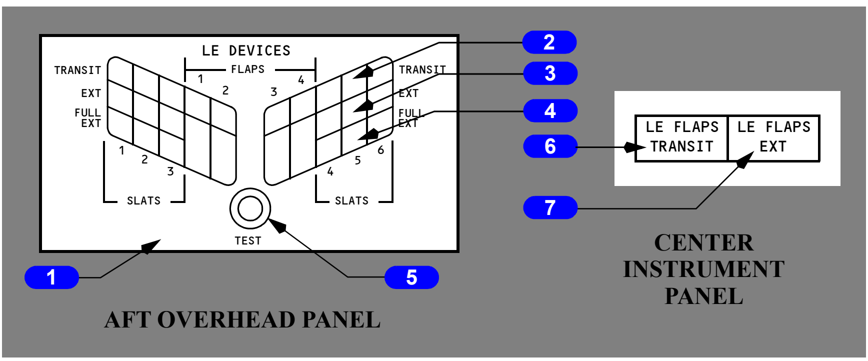
3 Flap Position Indicator

- indicates position of left and right trailing edge flaps
- provides trailing edge flaps asymmetry protection circuit.

4 FLAPS LIMIT Placard

Indicates maximum speed for each flap setting.

Leading Edge Devices



1 Leading Edge Devices (LE DEVICES) Annunciator Panel

Indicates position of individual leading edge flaps and slats.

Extinguished – corresponding leading edge device retracted.

2 Leading Edge Devices TRANSIT Lights

Illuminated (amber) – corresponding leading edge device in transit.

3 Leading Edge Devices Extended (EXT) Lights

Illuminated (green) – corresponding leading edge slat in extended (intermediate) position.

4 Leading Edge Devices FULL Extended (FULL EXT) Lights

Illuminated (green) – corresponding leading edge device in full extended position.

5 Leading Edge Annunciator Panel TEST Switch

Press – tests all annunciator panel lights.

6 Leading Edge Flaps Transit (LE FLAPS TRANSIT) Light

Illuminated (amber) – any leading edge device in transit, or not in programmed position with respect to trailing edge flaps.

7 Leading Edge Flaps Extended (LE FLAPS EXT) Light

Illuminated (green) –

- all leading edge flaps extended and all leading edge slats in extended (intermediate) position (trailing edge flap positions 1, 2 and 5)

OR:

- all leading edge devices fully extended (trailing edge flap positions 10 through 40).

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Flight Controls — Chapter 9
System Description — Section 20

Introduction

The primary flight control system uses conventional control wheel, column, and pedals linked mechanically to hydraulic power control units which command the primary flight control surfaces; ailerons, elevators and rudder. The flight controls are powered by redundant hydraulic sources; system A and system B. Either hydraulic system can operate all primary flight controls. The ailerons and elevators may be operated manually if required. The rudder may be operated by the standby hydraulic system if system A and system B pressure is not available.

The secondary flight controls, high lift devices consisting of Trailing Edge (TE) flaps and Leading Edge (LE) flaps and slats (LE devices), are powered by hydraulic system A. In the event hydraulic system A fails, the TE flaps can be operated electrically. The leading edge devices may be extended by the Standby hydraulic system. No alternate retraction system is provided for the leading edge devices.

Pilot Controls

The pilot controls consist of:

- two control columns
- two control wheels
- two pairs of rudder pedals
- SPEED BRAKE lever
- FLAP lever
- STAB TRIM cutout switches
- stabilizer trim switches
- stabilizer trim wheel
- AILERON trim wheel
- RUDDER trim wheel
- YAW DAMPER switch
- ALTERNATE FLAPS master switch
- alternate flaps position switch
- FLT CONTROL switches
- flight SPOILER switches

The control wheels are connected through transfer mechanisms which allow the pilots to bypass a jammed control or surface.

There is a rigid connection between both pairs of rudder pedals.

The SPEED BRAKE lever allows manual or automatic symmetric actuation of the spoilers.

Flight Control Surfaces

Pitch control is provided by:

- two elevators
- a movable horizontal stabilizer.

Roll control is provided by:

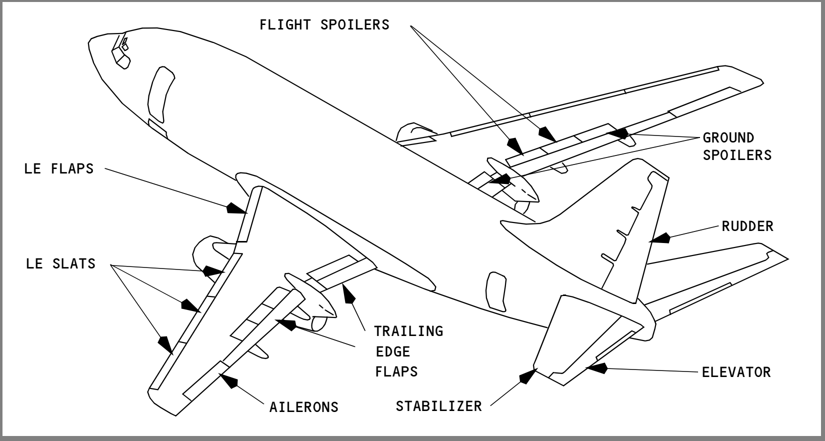
- two ailerons
- four flight spoilers.

Yaw control is provided by a single rudder. During takeoff, the rudder becomes aerodynamically effective between 40 and 60 knots.

TE flaps, and LE flaps and slats provide high lift for takeoff, approach, and landing.

In the air symmetric flight spoilers are used as speed brakes. On the ground symmetric flight and ground spoilers destroy lift and increase braking efficiency.

Flight Control Surfaces Location



Roll Control

The roll control surfaces consist of hydraulically powered ailerons and flight spoilers, which are controlled by rotating either control wheel.

Ailerons

The ailerons provide roll control around the airplane’s longitudinal axis. The ailerons are positioned by the pilots' control wheels, which are linked together by cables to supply the mechanical input to two separate hydraulic power control units. Hydraulic Systems A and B provide pressure to the power control units to operate the ailerons. The A and B FLT CONTROL switches control hydraulic pressure shutoff valves for each aileron. Note that these same switches control hydraulic pressure to the elevator and rudder.

The Captain's control wheel is connected by cables to the aileron Power Control Units (PCUs) through the aileron feel and centering unit. The First Officer's control wheel is connected by cables to the spoiler PCUs through the spoiler mixer. The two control wheels are connected by a cable drive system which allows actuation of both ailerons and spoilers by either control wheel. With total hydraulic power failure the ailerons can be mechanically positioned by rotating the pilots' control wheels. Control forces are higher due to friction and aerodynamic loads.

Aileron Transfer Mechanism

The right and left ailerons are bussed together by the cable-drive system. Either hydraulic system is capable of providing full power control. In the event of total hydraulic power failure, rotation of the pilots' control wheels mechanically position the ailerons. Manual control forces required are higher due to frictional and aerodynamic loads. If the aileron system were to jam, a transfer mechanism allows the First Officer to bypass the aileron system and operate the flight spoilers for roll control.

Aileron Trim

Aileron trim is accomplished by rotating the Aileron Trim Wheel on the control stand. Rotating the trim wheel repositions the aileron feel and centering mechanism and redefines the ailerons' neutral position.

If aileron trim is used with the autopilot engaged, the aileron neutral point is repositioned. When the autopilot is disengaged, the wheel and ailerons move to the repositioned aileron neutral point. The airplane responds with roll proportional to the amount of aileron trim input.

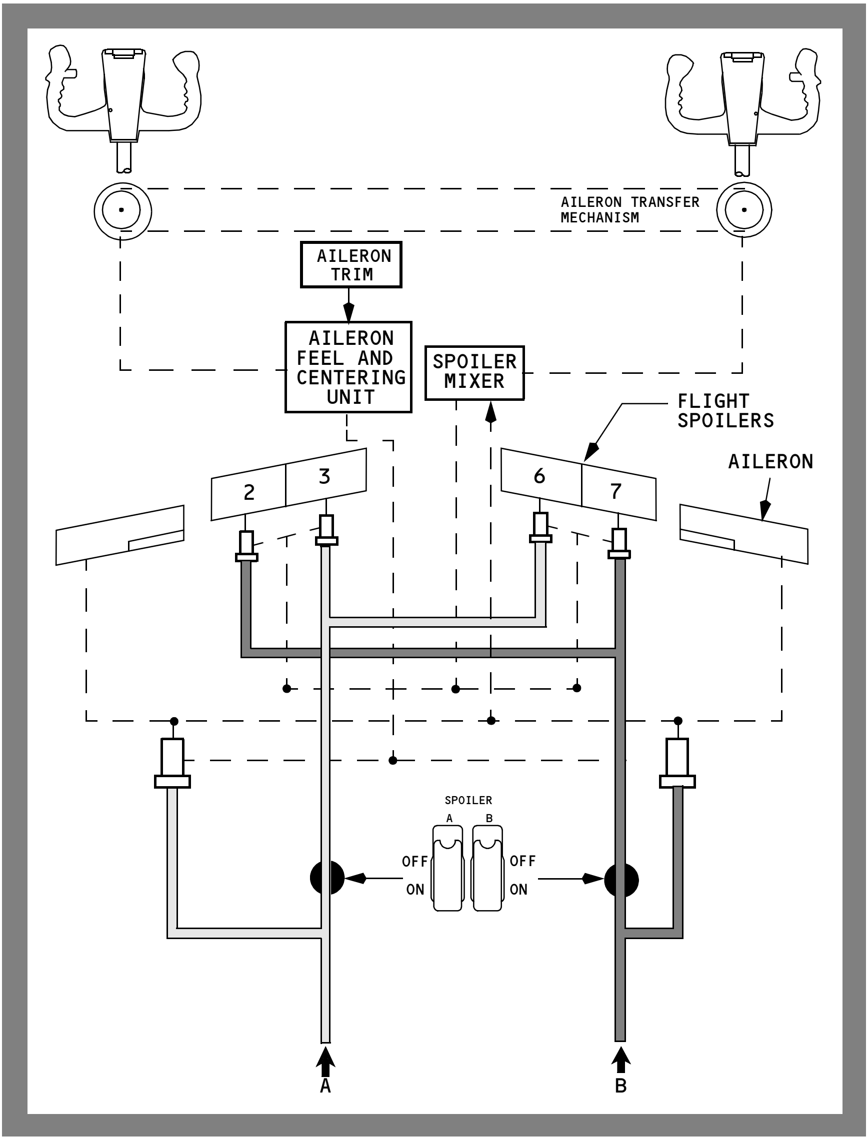
Flight Spoilers

Two flight spoilers are located on the upper surface of each wing. Hydraulic system A provides power to the inboard spoilers and Hydraulic system B provides power to the outboard spoilers. This provides isolation and maintains symmetric operation in the event of hydraulic system failure. Hydraulic pressure shutoff valves are controlled by the two flight SPOILER switches.

Flight spoiler panels are used as speed brakes to increase drag and reduce lift, both in flight and on the ground. The flight spoilers also supplement roll control in response to control wheel commands. A spoiler mixer, connected to the aileron cable–drive, controls the hydraulic power control units on each spoiler panel to provide spoiler movement proportional to aileron movement.

The flight spoilers rise on the wing with up aileron and remain faired on the wing with down aileron. When the control wheel is displaced more than approximately 10°, spoiler deflection is initiated.

Roll Control Schematic



Pitch Control

The pitch control surfaces consist of hydraulically powered elevators and an electrically powered stabilizer. The elevators are normally controlled by forward or aft movement of the control column. The stabilizer is normally controlled by either the stabilizer trim switches on the control wheel or the autopilot.

Elevators

The elevators provide primary pitch control around the airplane's lateral axis. The elevators are interconnected by a torque tube and are normally powered by system A and system B power control units. Hydraulic pressure to the units is controlled by A and B FLT CONTROL switches on the forward overhead panel.

In the event of failure of both hydraulic system A and B, the elevators are controlled manually from either control column. During manual operation, elevator tabs operate to reduce the forces required to control the elevators.

Elevator Feel System

Elevator system feel is provided by the elevator feel computer. The computer senses airspeed through the elevator pitot system, and stabilizer position to simulate aerodynamic forces to the control columns through the elevator feel and centering unit.

The elevator feel computer utilizes system A and system B pressure to operate the feel system. If either system A or system B were to fail, the computer will sense the imbalance and the FEEL DIFF PRESS light will illuminate when the flaps are up. The feel system will continue to operate normally with only one hydraulic system operating.

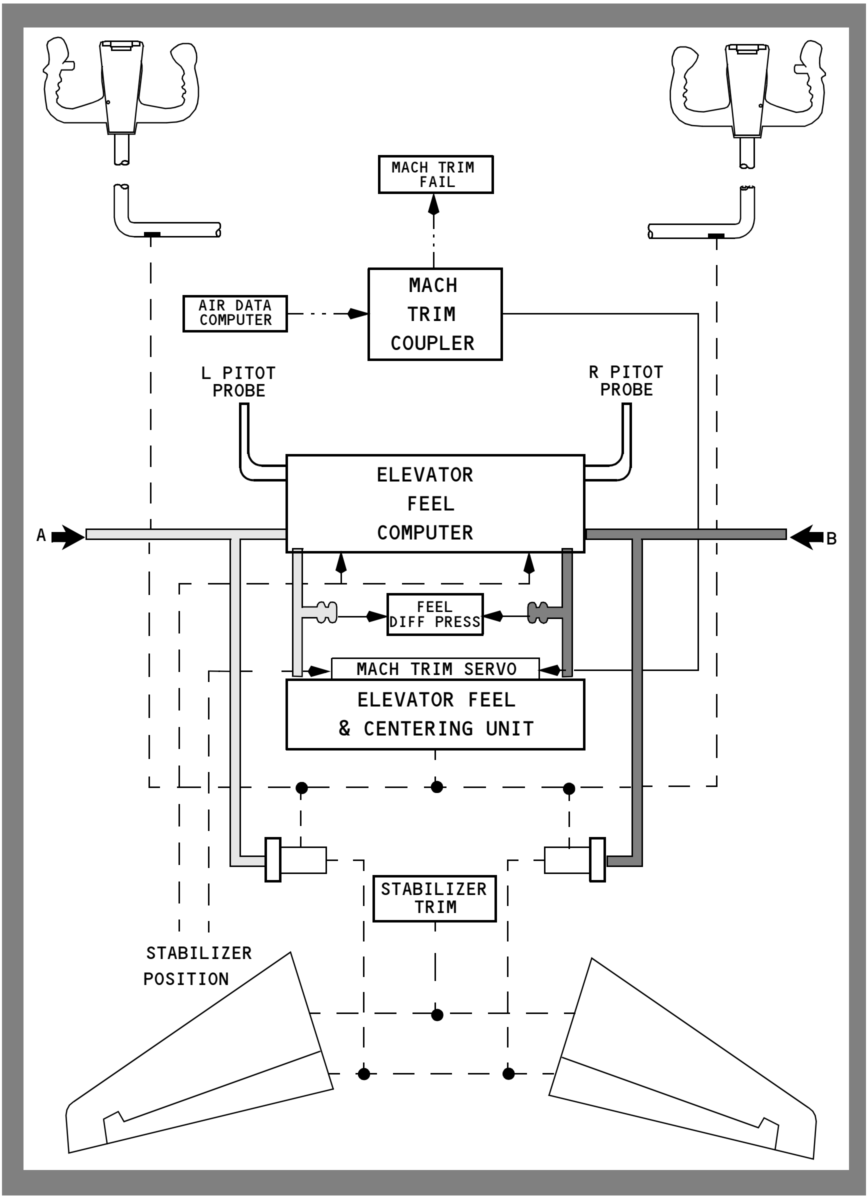
Mach Trim System

The Mach trim system provides speed stability at the higher Mach numbers. Mach trim is automatically accomplished above Mach .715 by a programmed elevator adjustment with respect to the stabilizer as speed is increased. Engagement and disengagement are automatic as a function of airspeed.

Mach information received from the air data computer is used by the flight control computers to generate a servo position command signal. The signal causes a rotation of the elevator feel and centering unit which adjusts the control column neutral position.

Failure or unreliable Mach trim is indicated by the illumination of the MACH TRIM FAIL light. The light is armed only when trailing edge flaps are up.

Pitch Control Schematic



Stabilizer

The horizontal stabilizer is positioned by the main electric trim motor controlled through either the stabilizer trim switches on the control wheel or by the autopilot trim servo motor. The stabilizer may also be positioned by manually rotating the stabilizer trim wheel.

Stabilizer Trim

Stabilizer trim switches on each control wheel actuate the electric trim motor through the main electric stabilizer trim circuit when the airplane is flown manually. With the autopilot engaged, stabilizer trim is accomplished through the autopilot stabilizer trim circuit. If the autopilot is engaged, actuating either pair of stabilizer trim switches automatically disengages the autopilot. The stabilizer trim wheels rotate whenever electric stabilizer trim is actuated. The Stab Trim light will illuminate only when the main electric trim motor is operating.

The STAB TRIM MAIN ELEC cutout switch and the STAB TRIM AUTOPILOT cutout switch, located on the control stand, are provided to allow the autopilot or main electric trim inputs to be disconnected from the stabilizer trim motor.

Control column actuated stabilizer trim cutout switches stop operation of the main electric and autopilot trim when the control column movement opposes trim direction.

Manual stabilizer control is accomplished through cables which allow the pilot to position the stabilizer by rotating the stabilizer trim wheels.

A stabilizer brake can be applied to stop unwanted trim motion by moving the control columns opposite to the trim motion. The brake is released by pulling a Stabilizer Brake Release Knob on the control stand or by reversing the trim direction. Manual rotation of the trim wheels can be used to override autopilot or main electric trim. The effort required to manually rotate the stabilizer trim wheels may be higher under certain flight conditions. Grasping the stabilizer trim wheel will stop stabilizer motion.

Stabilizer Trim Operation with forward or AFT CG

In the event the stabilizer is trimmed to the end of the electrical trim limits, additional trim is available through the use of the manual trim wheels. If manual trim is used to position the stabilizer beyond the electrical trim limits, the stabilizer trim switches may be used to return the stabilizer to electrical trim limits.

Stabilizer Position Indication and Green Band

Stabilizer position is displayed in units on two STAB TRIM indicators located inboard of each stabilizer trim wheel. The STAB TRIM indicators also display the TAKEOFF green band indication.

The trim authority for each mode of trim is limited to:

- Main Electric Trim 2.6 to 12.5 units
- Autopilot Trim 2.3 to 13.0 units
- Manual Trim 0 to 17.0 units

The green band range of the STAB TRIM indicator shows the permissible takeoff trim range. An intermittent horn sounds if takeoff is attempted with the stabilizer trim outside the takeoff trim range.

Yaw Control (before Rudder System Enhancement Program (RSEP) modification)

Yaw control is accomplished by a hydraulically powered rudder and a yaw damper system. The rudder is controlled by displacing the rudder pedals. The yaw damping functions are controlled by the yaw damper rate gyro.

Rudder

Each set of rudder pedals is connected by cables to the main and standby rudder PCUs through the rudder feel and centering unit. The main rudder PCU is powered by hydraulic systems A and B while the standby rudder PCU is powered by the standby hydraulic system. The standby hydraulic system is provided as a backup if system A and/or B pressure is lost. It can be activated manually through the FLT CONTROL switches or automatically. (Refer to Chapter 13, Hydraulics, Standby Hydraulic System)

On some airplanes, a rudder pressure reducer is connected to the A system hydraulic line upstream of the main rudder PCU. Hydraulic pressure to the rudder is reduced when the airplane climbs above 1000 feet AGL. Hydraulic pressure returns to normal when the airplane descends through 700 feet AGL or if B hydraulic system depressurizes.

Rudder Trim

The Rudder Trim Wheel is located on the control stand. Operation of the trim wheel mechanically repositions the rudder feel and centering unit which results in a shift in the rudder neutral position. The rudder pedals are displaced proportionately. The rudder trim indicator displays the rudder trim position in units.

Yaw Damper

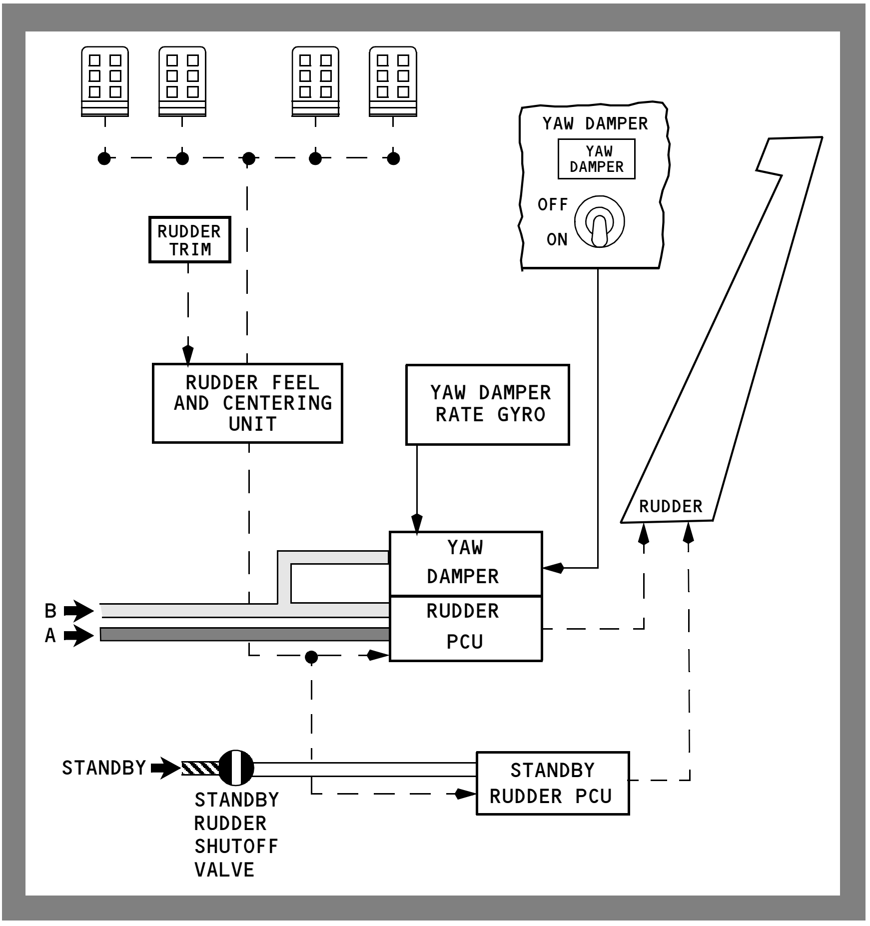
The yaw damper system prevents unwanted (Dutch) roll. The yaw damper coupler receives inputs from the yaw rate gyro and the air data computer. It then provides inputs to the rudder through the main rudder PCU. At higher airspeeds the amount of yaw damper rudder deflection decreases. No rudder pedal movement results from yaw damper operation.

The yaw damper uses hydraulic system B pressure only. If hydraulic system B pressure is lost the yaw damper system is inoperative but the YAW DAMPER switch remains in the ON position until the B FLT CONTROL switch is positioned to OFF or STBY RUD. Then the YAW DAMPER switch disengages and the amber YAW DAMPER light illuminates and the YAW DAMPER cannot be reengaged.

Note: Moving the Yaw Damper Test switch causes rudder movement in the air as well as on the ground.

On airplanes with the rudder pressure reducer installed, the yaw damper test switch is inoperative.

Yaw Control Schematic (before RSEP modification)



Yaw Control (after RSEP modification)

Yaw control is accomplished by a hydraulically powered rudder and a yaw damper system. The rudder is controlled by displacing the rudder pedals. The yaw damping functions are controlled by the Yaw Damper Coupler (YDC).

Rudder

The rudder provides yaw control about the airplane's vertical axis. The A and B FLT CONTROL switches control hydraulic shutoff valves for the rudder and the standby rudder.

Each set of rudder pedals is mechanically connected by cables to the input levers of the main and standby rudder PCUs. The main PCU consists of two independent input rods, two individual control valves, and two separate actuators; one for Hydraulic system A and one for Hydraulic system B. The standby rudder PCU is controlled by a separate input rod and control valve and is powered by the standby hydraulic system. All three input rods have individual jam override mechanisms that allow input commands to continue to be transferred to the remaining free input rods if an input rod is hindered or jammed.

A Rudder Pressure Reducer (RPR) is connected to the Hydraulic system A line upstream of the main rudder PCU. A Rudder Pressure Limiter (RPL) is incorporated in the Hydraulic system B part of the main rudder PCU. Both the RPR and RPL limit hydraulic pressure to the rudder when full rudder authority is not required. Hydraulic pressure to the rudder is reduced when the airplane climbs above 1000 feet AGL. Hydraulic pressure returns to normal when the airplane descends through 700 feet AGL or if B hydraulic system depressurizes. This function limits full rudder authority in flight after takeoff and before landing. The Yaw Damper Coupler (YDC) module controls both the RPR and RPL respectively, for Hydraulic system A and Hydraulic system B of the main rudder PCU.

The main rudder PCU contains a Force Fight Monitor (FFM) that detects opposing pressure (force fight) between A and B actuators. This may occur if either system A or B input is jammed or disconnected. The FFM output is used to automatically turn on the Standby Hydraulic pump pressurizing the standby rudder PCU.

The standby rudder PCU is powered by the standby hydraulic system. The standby hydraulic system is provided as a backup if system A and/or B pressure is lost. With the standby PCU powered the pilot retains adequate rudder control capability. It can be operated manually through the FLT CONTROL switches or automatically by the Force Fight Monitor. (Refer to Chapter 13, Hydraulics, Standby Hydraulic System)

An amber STBY RUD ON light illuminates when the standby rudder hydraulic system is commanded on. The standby rudder system can be commanded on with either the FLT CONTROL switch or automatically by the Force Fight Monitor. The STBY RUD ON light illumination activates Master Caution and Flight Control warning lights on the Systems Annunciation Panel.

Rudder Trim

The Rudder Trim Wheel is located on the control stand. Operation of the trim wheel mechanically repositions the rudder feel and centering unit which results in a shift in the rudder neutral position. The rudder pedals are displaced proportionately. The rudder trim indicator displays the rudder trim position in units.

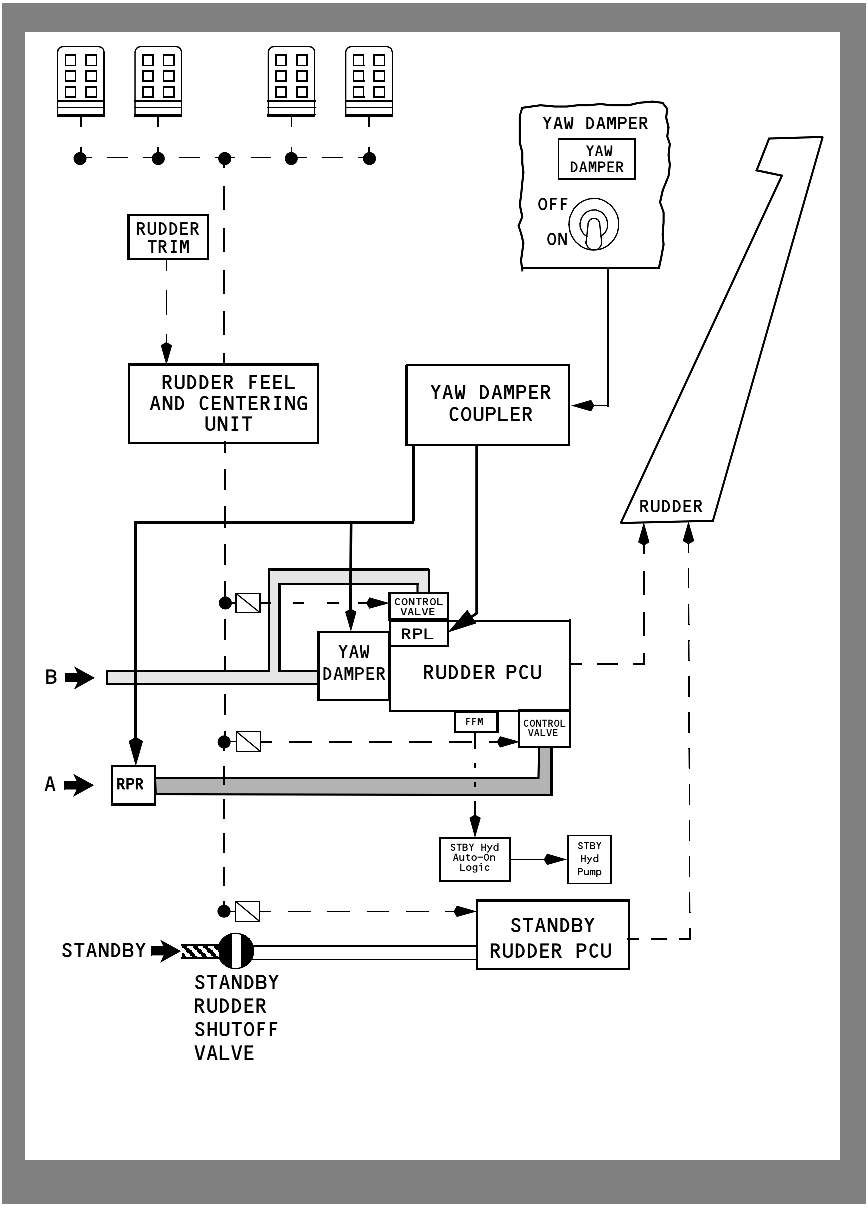
Yaw Damper

The yaw damper system prevents unwanted (Dutch) roll. The yaw damper coupler receives inputs from the yaw rate gyro and the air data computer. It then provides inputs to the rudder through the main rudder PCU. At higher airspeeds the amount of yaw damper rudder deflection decreases. No rudder pedal movement results from yaw damper operation.

The yaw damper uses hydraulic system B pressure only. If hydraulic system B pressure is lost the yaw damper system is inoperative but the YAW DAMPER switch remains in the ON position until the B FLT CONTROL switch is positioned to OFF or STBY RUD. Then the YAW DAMPER switch disengages and the amber YAW DAMPER light illuminates and the YAW DAMPER cannot be reengaged.

On airplanes with the Rudder System Enhancement Program (RSEP) installed, the yaw damper test switch is inoperative.

Yaw Control Schematic (after RSEP modification)



Speed Brakes

The speed brakes consist of flight spoilers and ground spoilers. Hydraulic system A powers all four ground spoilers, two on the upper surface of each wing. The SPEED BRAKE lever controls the spoilers. When the SPEED BRAKE lever is actuated all the spoilers extend when the airplane is on the ground, and only the flight spoilers extend when the airplane is in the air.

In Flight Operation

Operating the SPEED BRAKE lever in flight causes all flight spoiler panels to rise symmetrically to act as speed brakes. Caution should be exercised when deploying flight spoilers during a turn, as they greatly increase roll rate. When the speed brakes are in an intermediate position roll rates increase significantly. Moving the SPEED BRAKE lever past the FLIGHT detent causes buffeting and is not recommended in flight.

Ground Operation

During landing, the auto speed brake system operates when these conditions occur:

- SPEED BRAKE lever is in the ARMED position
- SPEED BRAKE ARMED light is illuminated
- both thrust levers are retarded to IDLE
- main landing gear wheels spin up (more than 60 kts) – SPEED BRAKE lever automatically moves to the UP position, and the flight spoilers deploy
- right main landing gear strut compresses on touchdown, causing the mechanical linkage to open the ground spoiler interlock valve, and the ground spoilers deploy

If a wheel spin–up signal is not detected when the air/ground system senses ground mode (right main landing gear strut compressed), the SPEED BRAKE lever moves to the UP position, and all spoiler panels deploy automatically.

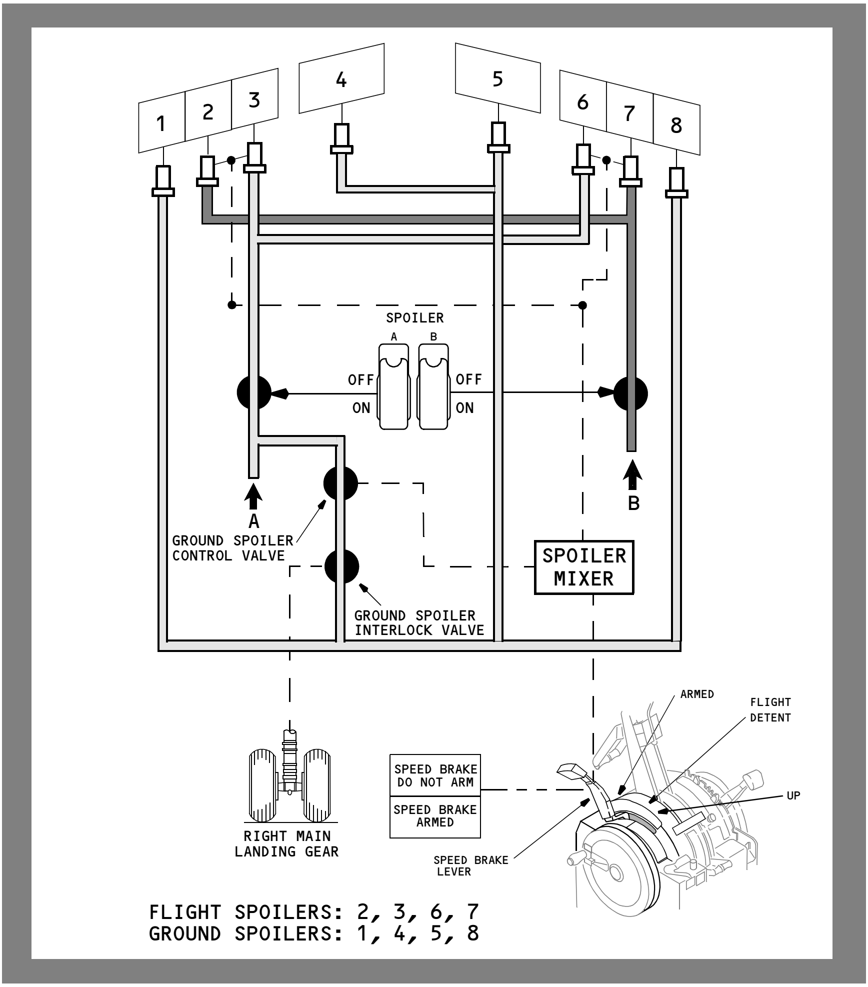
During a Rejected Takeoff (RTO), the auto speed brake system operates when these conditions occur:

- main landing gear wheels spin up (more than 60 kts)
- takeoff is rejected, both thrust levers are retarded to IDLE and the reverse thrust levers are positioned for reverse thrust – SPEED BRAKE lever automatically moves to the UP position and all spoilers deploy.

After a RTO or landing, if either thrust lever is advanced, the SPEED BRAKE lever automatically moves to the DOWN detent and all spoiler panels retract. The spoiler panels may also be retracted by manually moving the SPEED BRAKE lever to the DOWN detent.

A failure in the automatic functions of the speed brakes is indicated by the illumination of the SPEED BRAKE DO NOT ARM light. In the event the automatic system is inoperative, the SPEED BRAKE lever must be moved manually to the UP position.

Speed Brakes Schematic



Flaps and Slats

The flaps and slats are high lift devices that increase wing lift and decrease stall speed during takeoff, low speed maneuvering and landing.

LE devices consist of four flaps and six slats: two flaps inboard and three slats outboard of each engine. Flaps are hinged surfaces that extend by rotating downward from the lower surface of the wing leading edge. Slats are sections of the wing leading edge that extend forward to form a slotted leading edge. The TE devices consist of double slotted flaps inboard and outboard of each engine.

TE flap positions 1–15 provide increased lift; positions 15–40 provide increased lift and drag to permit slower approach speeds and greater maneuvering capability. Flaps 15, 30 and 40 are normal landing positions. Flaps 15 is normally limited to airports where approach climb performance is a factor. Runway length and condition must be taken into account when selecting a landing flap position.

To prevent excessive structural loads from increased Mach at higher altitude, flap extension above 20,000 feet should not be attempted.

Flap and Slat Sequencing

LE devices and TE flaps are normally extended and retracted by hydraulic power from system A. When the FLAP lever is in the UP detent, all flaps and LE devices are commanded to the retracted or up position. Moving the FLAP lever aft allows selection of flap detent positions 1, 2, 5, 10, 15, 25, 30 or 40. The LE devices deployment is sequenced as a function of TE flaps deployment.

When the TE flaps leave the UP position, the LE:

- flaps extend to the full extended position, and
- slats extend to the extend (intermediate) position.

As the TE flaps extend past the 5 position the LE:

- flaps remain at the full extended position, and
- slats extend to the full extended position.

The LE devices sequence is reversed upon retraction.

Mechanical gates hinder inadvertent FLAP lever movement beyond flaps 1 for one engine inoperative go–around, and flaps 15 for normal go–around.

Indicator lights on the center instrument panel provide overall LE devices position status. The LE DEVICES annunciator on the aft overhead panel indicates the positions of the individual flaps and slats.

Flap Load Relief

A flap load limiter provides a TE flap load relief function which protects the flaps from excessive air loads. This function is operative at the flaps 40 position only. The FLAP lever does not move, but the flap position indicator displays flap retraction and re–extension.

When the flaps are set at 40 the TE flaps:

- retract to 30 if airspeed exceeds 157 knots
- re–extend when airspeed is reduced to 152 knots.

Alternate Extension

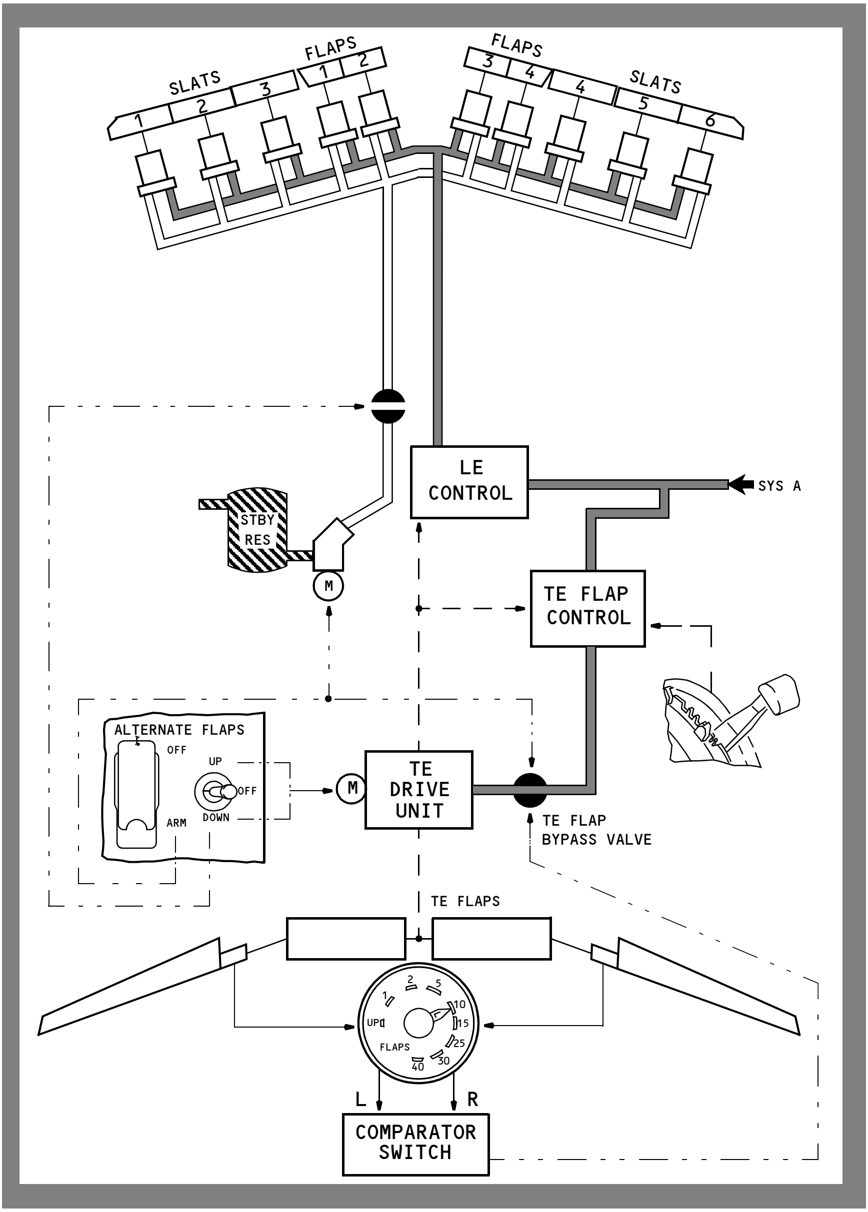
In the event that hydraulic system A fails, an alternate method of extending the LE devices, and extending and retracting the TE flaps is provided.

The TE flaps can be operated electrically through the use of two alternate flap switches. The guarded ALTERNATE FLAPS master switch closes a flap bypass valve to prevent hydraulic lock of the flap drive unit and arms the ALTERNATE FLAPS position switch. The ALTERNATE FLAPS position switch controls an electric motor that extends or retracts the TE flaps. The switch must be held in the DOWN position until the flaps reach the desired position. No asymmetry protection is provided through the alternate (electrical) flap drive system.

When using alternate flap extension the LE flaps and slats are driven to the full extended position using power from the standby hydraulic system. In this case the ALTERNATE FLAPS master switch energizes the standby pump, and the ALTERNATE FLAPS position switch, held in the down position momentarily, fully extends the LE devices.

Note: The LE devices cannot be retracted by the standby hydraulic system.

Leading Edge Devices and Trailing Edge Flaps Schematic



High Lift Device Protection and Indication

Trailing Edge Flap Asymmetry

When a trailing edge asymmetry develops, a comparator switch closes the TE flap bypass valve, removing hydraulic power from the flap drive unit. The flap position will be displayed as a needle split on the flap position indicator.

Leading Edge Device Improper Position

When a leading edge device is in an improper position the LE FLAPS TRANSIT light remains illuminated and one of the following indications is displayed on the LE Devices Annunciator Panel:

- amber TRANSIT light illuminated
- incorrect green EXT or FULL EXT light illuminated
- no light illuminated.

Intentionally
Blank

Flight Instruments, Displays — Chapter 10

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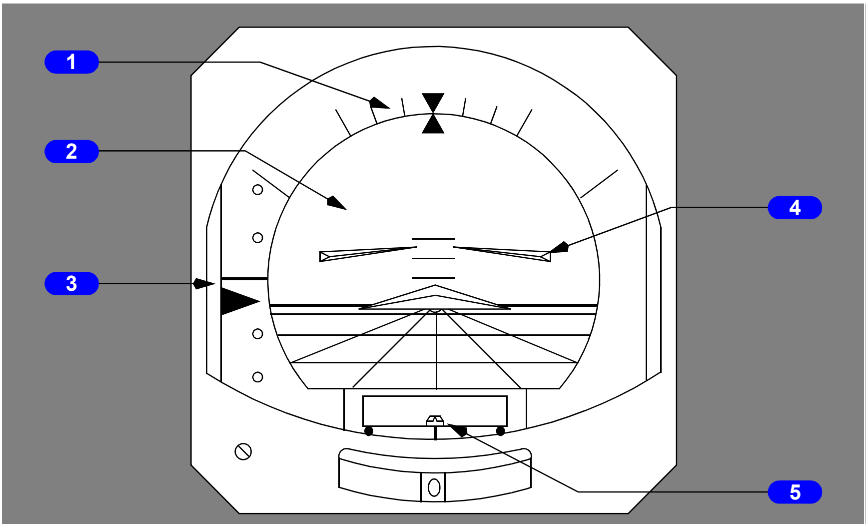
Attitude Director Indicator (ADI)



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 Bank Indicator and Scale

- index indicates roll angle against calibrated scale
- scale has minor markings at 10 degrees and 20 degrees and major markings at 30 degrees and 60 degrees.

2 Attitude Display

- tape moves relative to symbolic airplane, displaying pitch and roll signals from the vertical gyro
- pitch up scaled in 5 degree increments to 15 degrees then with marks at 30, 50, 70, and 90 degrees
- pitch down scaled with marks at 5, 10, 20, 30, 50, 70, and 90 degrees.

3 Glideslope Pointer and Deviation Scale

- pointer indicates glideslope position
- scale indicates deviation
- glideslope flag covers the display when the signal is not valid.

Pointer out of view – a VOR frequency is tuned.

4 Flight Director Command Bars

(yellow) – Displays computed pitch and/or roll commands.

Biased out of view –

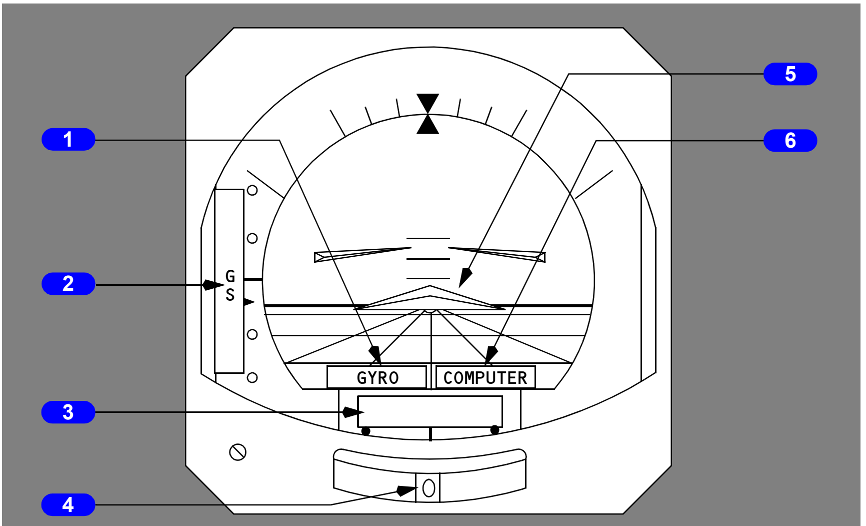
- flight director switch is positioned OFF
- the required signal inputs are unreliable.

Refer to Chapter 4, Automatic Flight.

5 Localizer Symbol and Deviation Scale

In view –

- localizer frequency is tuned and localizer signal is valid
- scale indicates localizer deviations of one dot or less (one dot is one degree displacement).



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 GYRO Warning Flag

In view –

- display is unreliable (some failures cause indications of 90 degrees left bank)
- electrical power loss.

2 **Glideslope (GS) Warning Flag**

In view –

- glideslope information is unreliable with ILS frequency tuned
- parallels the glideslope warning flag on the HSI.

3 **Localizer Symbol Shutter**

In view –

- glideslope not captured
- glideslope capture but VOR LOC flag on HSI in view.

4 **Slip/Skid Indicator**

Ball monitors slip or skid for coordinated flight.

5 **Symbolic Airplane**

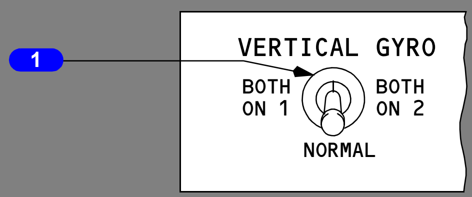
(orange) – Represents airplane attitude relative to the horizon.

6 **Flight Director COMPUTER Warning Flag**

In view –

- vertical gyro information unreliable
- electrical power loss
- causes flight director command bars to retract.

Vertical Gyro Transfer Switch

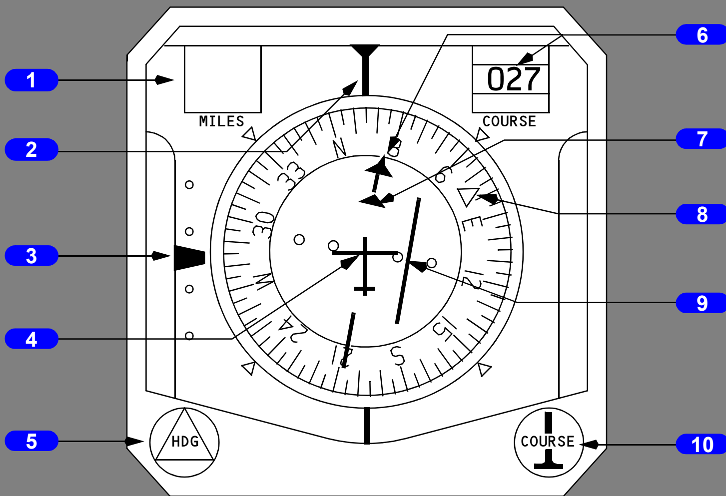


FORWARD OVERHEAD PANEL

1 **VERTICAL GYRO Transfer Switch**

- BOTH ON 1 – switches both attitude sources to vertical gyro No. 1
- NORMAL – captain's attitude source vertical gyro No. 1; first officer's attitude source vertical gyro No.2
- BOTH ON 2 – switches both attitude sources to vertical gyro No. 2.

Horizontal Situation Indicator (HSI)



CAPTAIN’S INSTRUMENT PANEL
FIRST OFFICER’S INSTRUMENT PANEL

1 DME MILES Window

Inoperative.

2 Lubber Line

Displays heading on compass card.

3 Glideslope Pointer and Scale

Indicates displacement above or below glideslope.

Pointer in view – localizer frequency tuned and HSI powered.

4 Airplane Symbol

- fixed in the center of the instrument
- displays position of the airplane in relation to movable portions of the indicator.

5 HSI Heading (HDG) Selector

- selects desired flight director heading
- captain’s selector can set desired heading for autopilot.

6 **Course Pointer and COURSE Counter**

Reflects the course set by the HSI course selector.

7 **To/From Ambiguity Indicator**

Displays direction to a VOR station along the radial selected by the HSI course selector.

8 **Heading Marker**

Displays the heading set by the HSI heading selector.

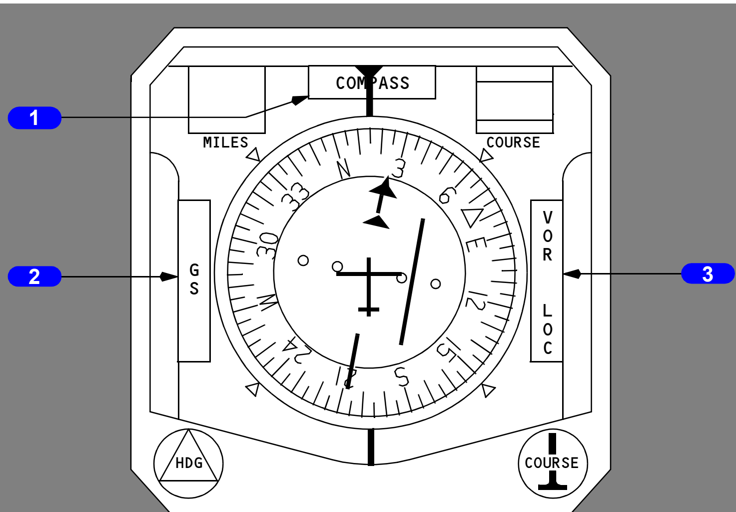
9 **Course Deviation Bar**

VOR: 1 dot = 5 degrees.

LOC: 1 dot = 1 degree.

10 **HSI COURSE Selector**

- selects VOR radial or LOC course for flight director
- captain’s selector can set VOR radial or localizer course for autopilot.



CAPTAIN’S INSTRUMENT PANEL
FIRST OFFICER’S INSTRUMENT PANEL

1 COMPASS Failure Flag

In view –

- selected compass is invalid
- electrical power loss to HSI
- compass card malfunction.

2 Glideslope (GS) Failure Flag

In view – only with localizer frequency tuned

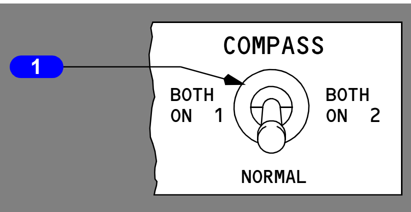
- glideslope signal below acceptable level
- failed glideslope receiver
- electrical power loss.

3 VOR LOC Failure Flag

In view –

- VOR or LOC signal below acceptable level
- NAV receiver malfunction
- electrical power loss.

Compass Transfer Switch

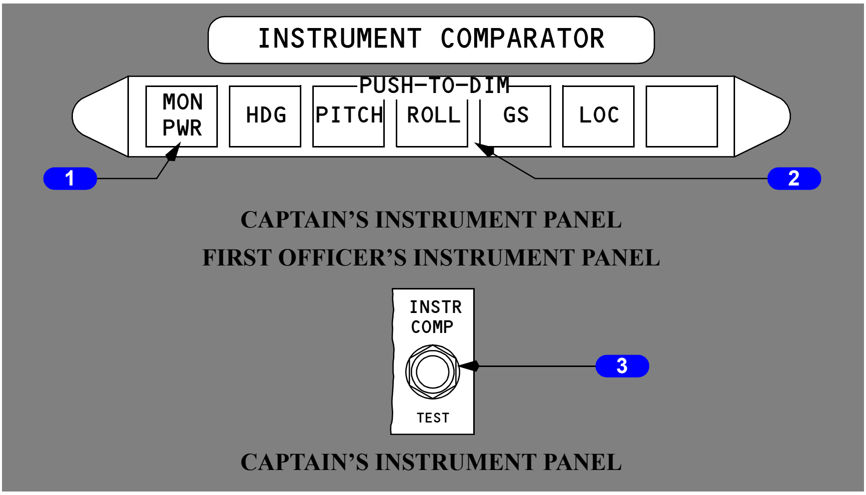


FORWARD OVERHEAD PANEL

1 COMPASS Transfer Switch

- BOTH ON 1 – switches both compass sources to the No. 1 compass system
- NORMAL – captain's compass source is the No. 1 compass system; first officer's compass source is the No. 2 compass system
- BOTH ON 2 – switches both compass sources to the No. 2 compass system.

Instrument Comparator



1 Monitor Power Light

Illuminated (amber) – 115 volt ac power loss to comparator unit.

2 Instrument Comparator Lights

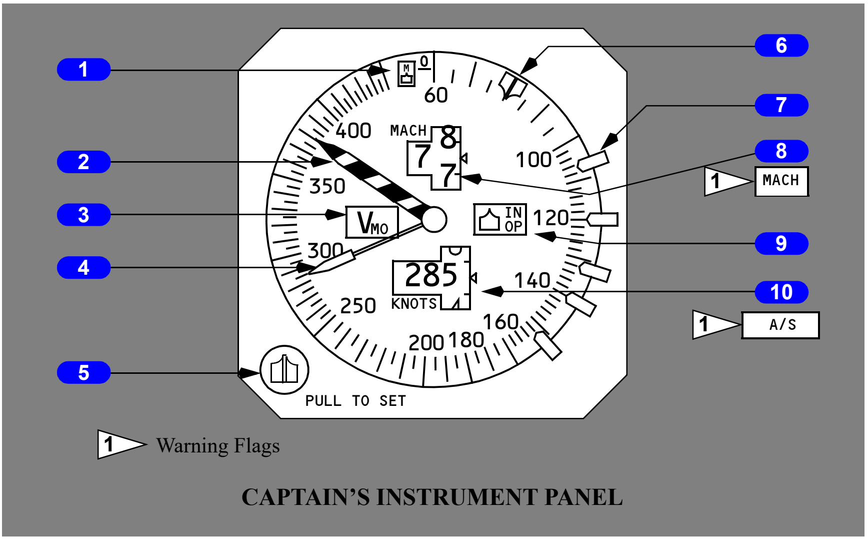
Illuminated (amber) – instrument being compared have exceeded established tolerances.

3 Instrument Comparator Test (INSTR COMP TEST) Switch

Push – illuminates all instrument comparator lights, except MON PWR.

Mach/Airspeed Indicator

Electric Mach/Airspeed Indicator



1 Airspeed Cursor Mode Annunciator

- auto mode: out of view
- manual mode: in view.

2 Vmo Pointer

Indicates the maximum operating (indicated) airspeed in knots.

3 Vmo Flag

In view – indicates the Vmo pointer is inoperative.

4 Airspeed Pointer

Indicates airspeed in knots.

5 Airspeed Cursor Control

Push in –

- auto mode
- airspeed cursor is positioned from the PDCS.

Pull out –

- manual mode
- airspeed cursor is positioned by rotating the control.

6 **Airspeed Cursor**

- indicates target airspeed
- positioned manually or automatically, as selected by the airspeed cursor control.

7 **Airspeed Reference Markers (Bugs)**

Positioned manually to the desired airspeed reference.

8 **MACH Digital Counter**

- shows Mach number, from .40 to .99 Mach, in digital form
- masked below .40 Mach
- digits are covered by a warning flag when the display is unreliable.

9 **Airspeed Cursor Flag**

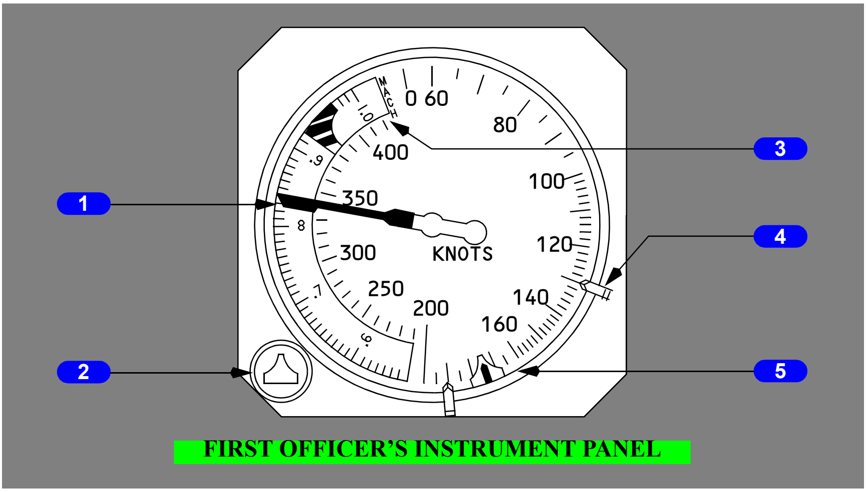
Manual mode: flag retracted.

Auto mode: flag in view if airspeed cursor signals, as determined by the PDCS, are unreliable.

10 **Airspeed Digital Counter**

- digital display of indicated airspeed in knots
- warning flag covers the counter when the airspeed pointer and airspeed digital counter are unreliable.

Pneumatic Mach/Airspeed Indicator



1 Mach/Airspeed Pointer

Indicates Mach and airspeed in knots.

2 Airspeed Cursor Control

Rotate – manually positions the airspeed cursor.

3 MACH Dial

Rotates – Mach number read under Mach/Airspeed pointer.

4 Airspeed Reference Markers (Bugs)

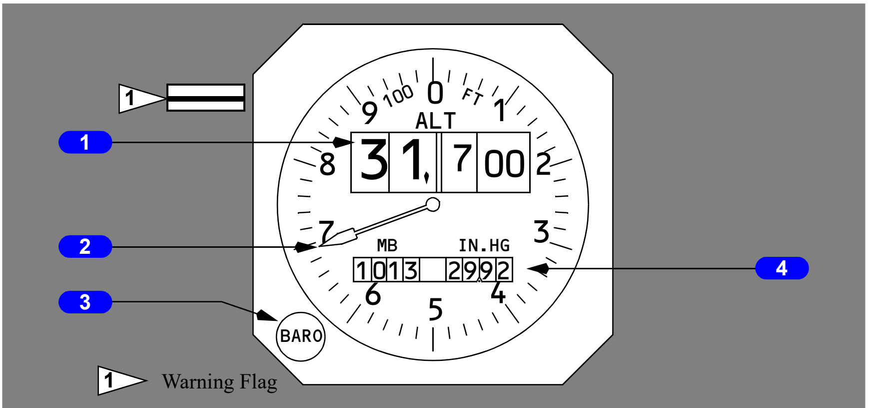
Positioned manually to the desired airspeed reference.

5 Airspeed Cursor

- indicates target airspeed
- positioned manually by the airspeed cursor control.

Altimeter

Electric Altimeter



CAPTAIN'S INSTRUMENT PANEL

1 Digital Altitude Counter

Indicates current altitude in increments of thousands, hundreds, and twenty feet.

- warning flag appears whenever the ADC signal is lost or a malfunction exists
- blue flag appears in the left window when the altitude is below 10,000 feet
- a NEG flag appears in the two left–hand windows when altitude below zero feet is displayed.

2 Altitude Pointer

Makes one revolution each one thousand feet.

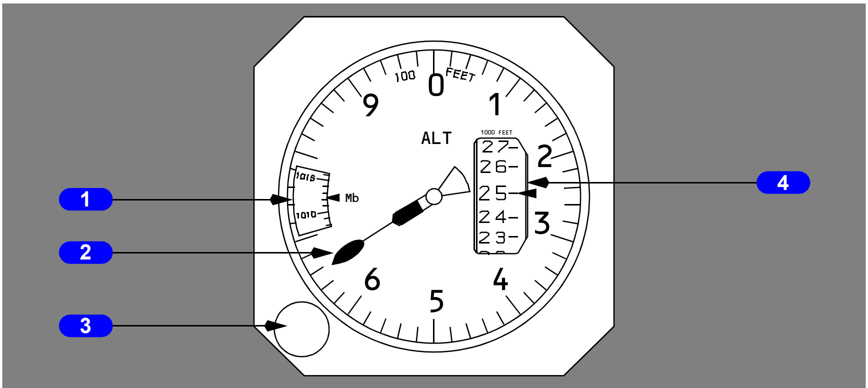
3 Barometric (BARO) Setting Control

Rotate – adjusts barometric settings.

4 Barometric Setting Window

Displays barometric correction (in millibars and inches of mercury) as set by the barometric setting control.

Pneumatic Altimeter



FIRST OFFICER’S INSTRUMENT PANEL

1 Barometric Setting Window

Displays barometric correction (in millibars of mercury) as set by the barometric setting control.

2 Altitude Pointer

Makes one revolution each one thousand feet.

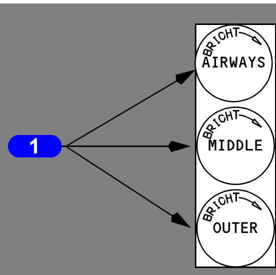
3 **Barometric Setting Control**

Rotate – adjusts barometric settings.

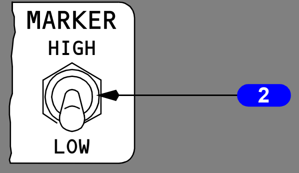
4 **Digital Altitude Counter**

Indicates current altitude in increments of thousands of feet.

Marker Beacon



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL



CAPTAIN'S INSTRUMENT PANEL

1 **Marker Beacon Lights**

AIRWAYS (white) – illuminates over an inner or airways marker beacon.

MIDDLE (amber) – illuminates over a middle marker beacon.

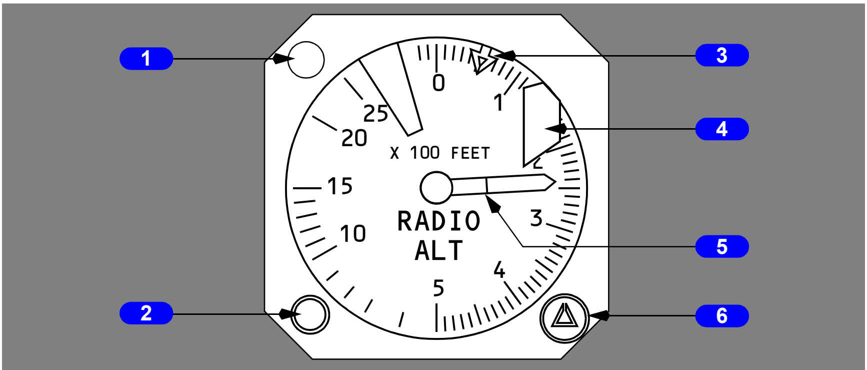
OUTER (blue) – illuminates over an outer marker beacon.

2 **Marker Beacon Sensitivity Switch**

HIGH – selects high sensitivity of receiver.

LOW – selects low sensitivity of receiver.

Radio Altimeter



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 Minimum Descent Altitude (MDA) Light

Illuminated (amber) – altitude pointer is at or below MDA cursor.

2 Radio Altimeter Test Switch

Push –

- altitude pointer drives to 100 feet
- warning flag in view
- the MDA light illuminates if the altitude pointer drives to a position at or below the altitude indicated by the minimum descent altitude cursor.

3 Minimum Descent Altitude (MDA) Cursor

Displays selected altitude reference selected by the MDA cursor control.

4 Warning Flag

In view –

- power failure
- loss of return signal below 2500 feet
- incorrect altitude tracking
- radio altimeter test switch pushed.

5 Altitude Pointer

Power off – pointer moves to the top of the scale under the mask.

Power on –

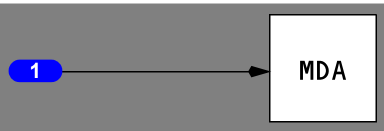
- up to 2500 feet – pointer reads true altitude above ground level
- above 2500 feet – pointer is behind the mask.

6 **Minimum Descent Altitude (MDA) Cursor Control**

Rotate – sets the MDA cursor.

Radio Altimeter Lights

Minimum Descent Altitude Light

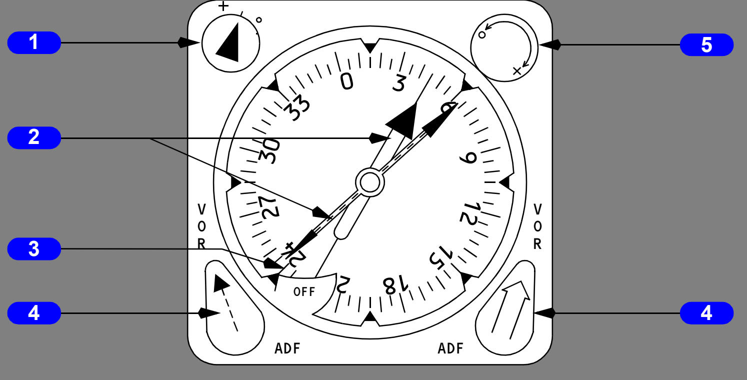


CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 **Minimum Descent Altitude (MDA) Light**

Illuminated (amber) – altitude pointer is at or below MDA cursor setting.

Radio Magnetic Indicator (RMI)



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 **Synchronizing Annunciator**

Indicates the compass is out of synchronization if arrow is pointed toward dot or cross.

2 **ADF/VOR Bearing Pointers**

- narrow pointer uses signals from selected ADF or VOR receiver No. 1
- wide pointer uses signals from selected ADF or VOR receiver No. 2.

3 **Compass Warning Flag**

In view – electrical power failure to compass system.

4 **ADF/VOR Bearing Pointer Switches**

Rotate – selects ADF or VOR bearing.

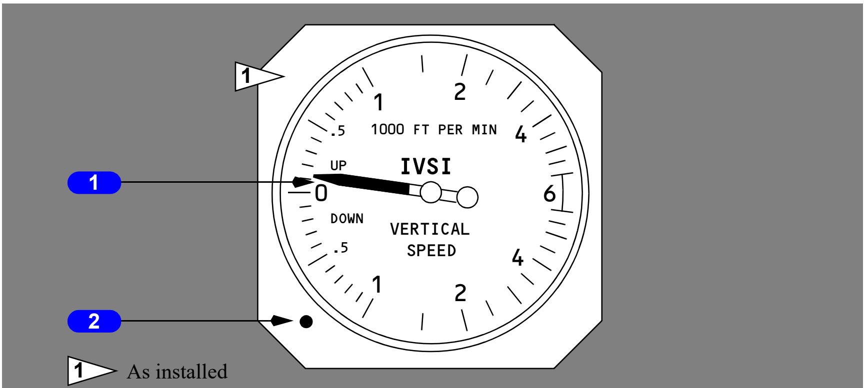
Note: Instrument transfer switching table provides VHF NAV signal sources to pointer.

5 **Synchronizing Control**

Rotate –

- synchronizes RMI with compass system
- direction of rotation determined by synchronizing annunciator.

Vertical Speed Indicator



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

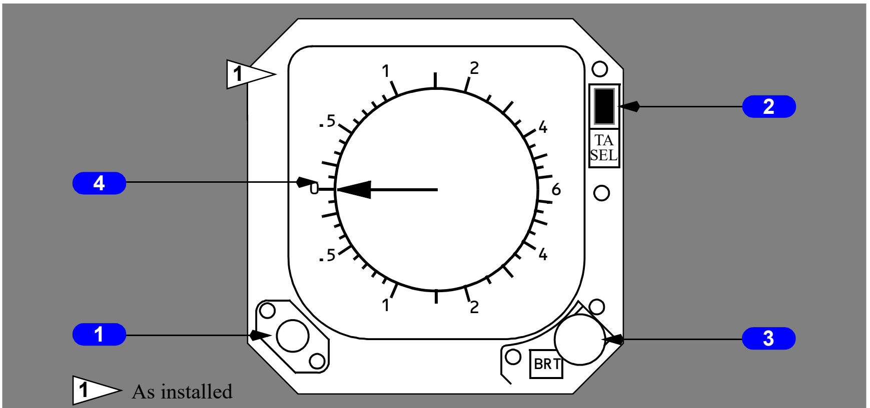
1 **Vertical Speed Pointer**

Displays rate of climb or descent from 0 to 6,000 feet per minute.

2 **Zero Adjustment Screw**

Used to set vertical speed pointer to zero.

Note: Airplane should be on the ground or stabilized in level flight during adjustment.



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 Light Sensor

Automatically adjusts display contrast for ambient light conditions.

2 TA Select Push–button

Push – changes display between modes:

- full–time mode – traffic information is displayed full–time
- popup mode – traffic information is displayed only when a TA or RA is generated. Display remains for the duration of the alert.

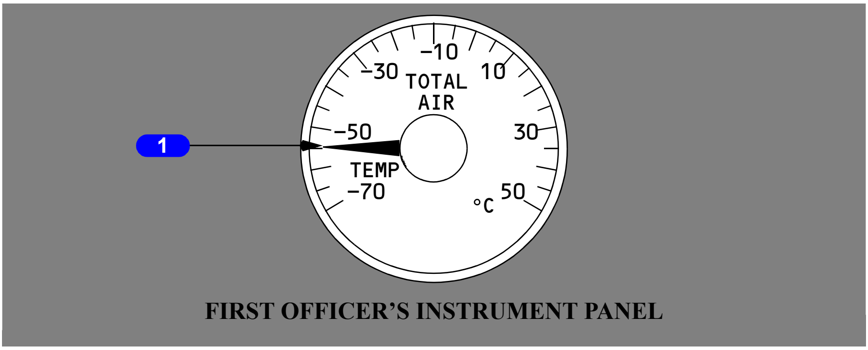
3 Brightness Control

Rotate – adjusts brightness of the VSI display.

4 Vertical Speed Pointer

Displays rate of climb or descent from 0 to 6,000 feet per minute.

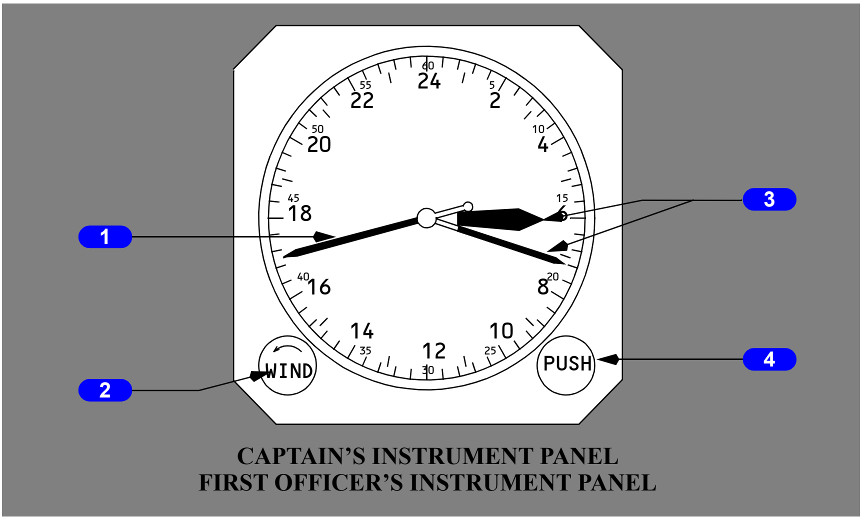
Total Air Temperature



1 Total Air Temperature Indicator

Displays TAT from -70 degrees C to +50 degrees C.

Clock



1 Sweep Second Hand

- controlled by push button
- rotates once each minute.

2 Winding (WIND) and Setting Control

Rotate counter clockwise –

- winds clock
- one winding powers clock for 8 days.

Pull – sets hour and minute hands.

3 Hour and Minute Hands

Twenty–four hour format.

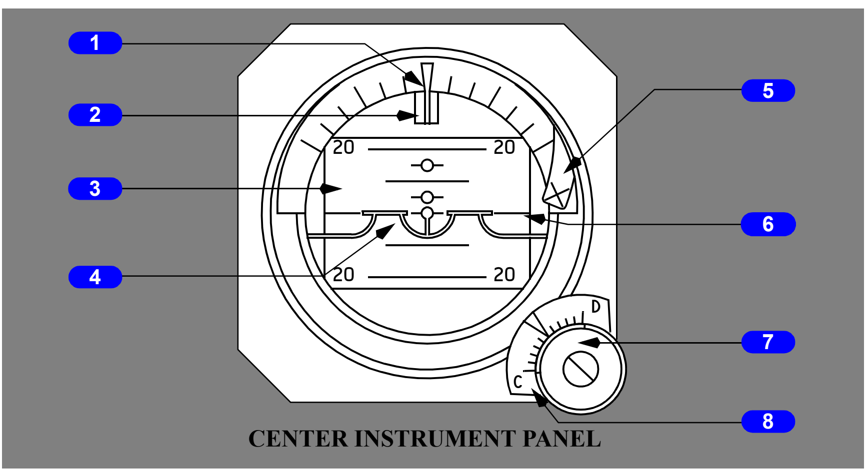
4 PUSH Control

Controls sweep hand.

With sweep second hand at zero (60):

- Push – starts sweep hand timing
- Push again – stops sweep hand timing
- Push again – resets sweep second hand to zero.

Standby Flight Instruments
Standby Horizon



1 Bank Angle Scale

Measures bank angles up to 60° in 10° increments (freedom of roll 360°).

2 Bank Angle Indicator

Indicates airplane bank angle against bank angle scale.

3 **Horizon Drum**

Provides indication of airplane pitch attitude (freedom of pitch 90°).

4 **Symbolic Airplane**

Provides an adjustable attitude reference.

5 **Warning Flag**

In view – loss of power.

6 **Horizon Bar**

7 **Pitch Trim and Gyro Caging Control**

In – rotate to adjust symbolic airplane pitch presentation.

Pull (momentary) – provides fast erection (caging) of gyro.

Release – control retracts.

Note: Airplane should be level during procedure.

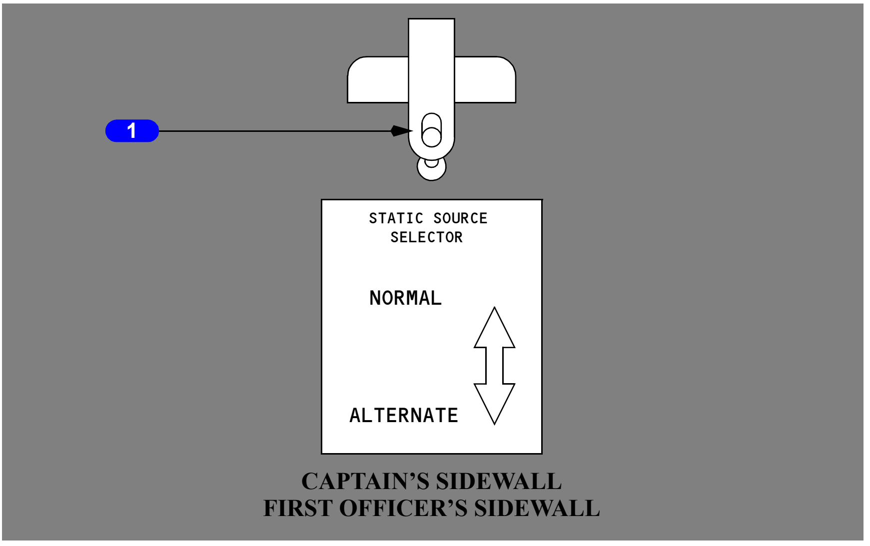
8 **Pitch Trim Scale**

Provides a reference for adjusting the symbolic airplane pitch presentation.

Marked in 1 degree increments

- C – climb
- D – dive.

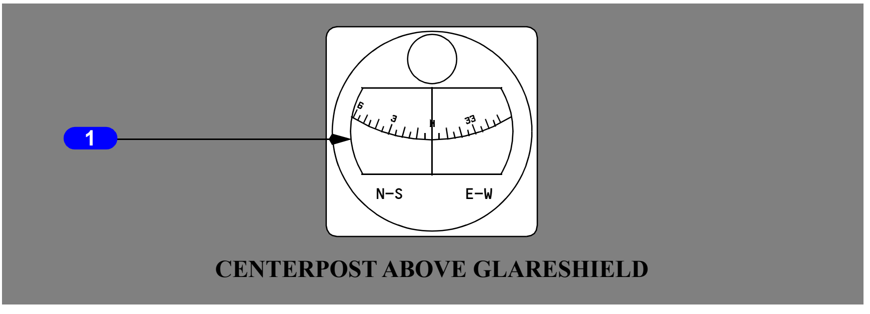
Static Source Selector



1 Static Source Selector Switch

- NORMAL (guarded position) – primary pitot–static system is providing static inputs to respective pilot's system
- ALTERNATE – alternate static system is providing static inputs to respective pilot's system.

Standby Magnetic Compass



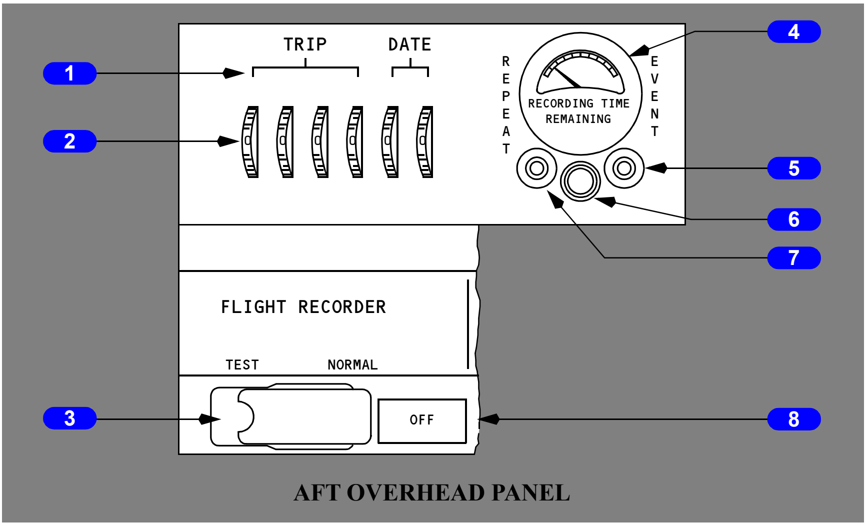
1 Standby Magnetic Compass

Displays magnetic heading.

The magnetic compass may be folded out of view for an unobstructed view through the windshield.

A standby magnetic compass correction card provides appropriate heading corrections.

Flight Recorder



1 TRIP and DATE Encoder

2 Trip and Date Selectors

Rotate – sets trip number and date.

3 FLIGHT RECORDER TEST Switch

NORMAL (guarded position) –

- in flight – the recorder operates anytime electrical power is available
- on the ground – either engine must also be operating.

TEST – bypasses the engine oil pressure switches and the air ground switch to power the flight recorder on the ground.

Allow 15 seconds for complete test.

4 RECORDING TIME REMAINING Indicator

- Displays the number of recording hours remaining on tape
- full scale deflection indicates more than 200 hours.

5 EVENT Switch

Push (5 seconds) – transcribes a mark on the tape to identify the time of an event. Do not use until 5 minutes after the trip and date light is extinguished.

6 Trip and Date Light

Illuminated (amber) –

- trip and date information is being recorded
- the 15 minute transcribing cycle does not interfere with the recording of other information.

7 REPEAT Switch

Push (5 seconds) – initiates or repeats transcribing of the trip and date information.

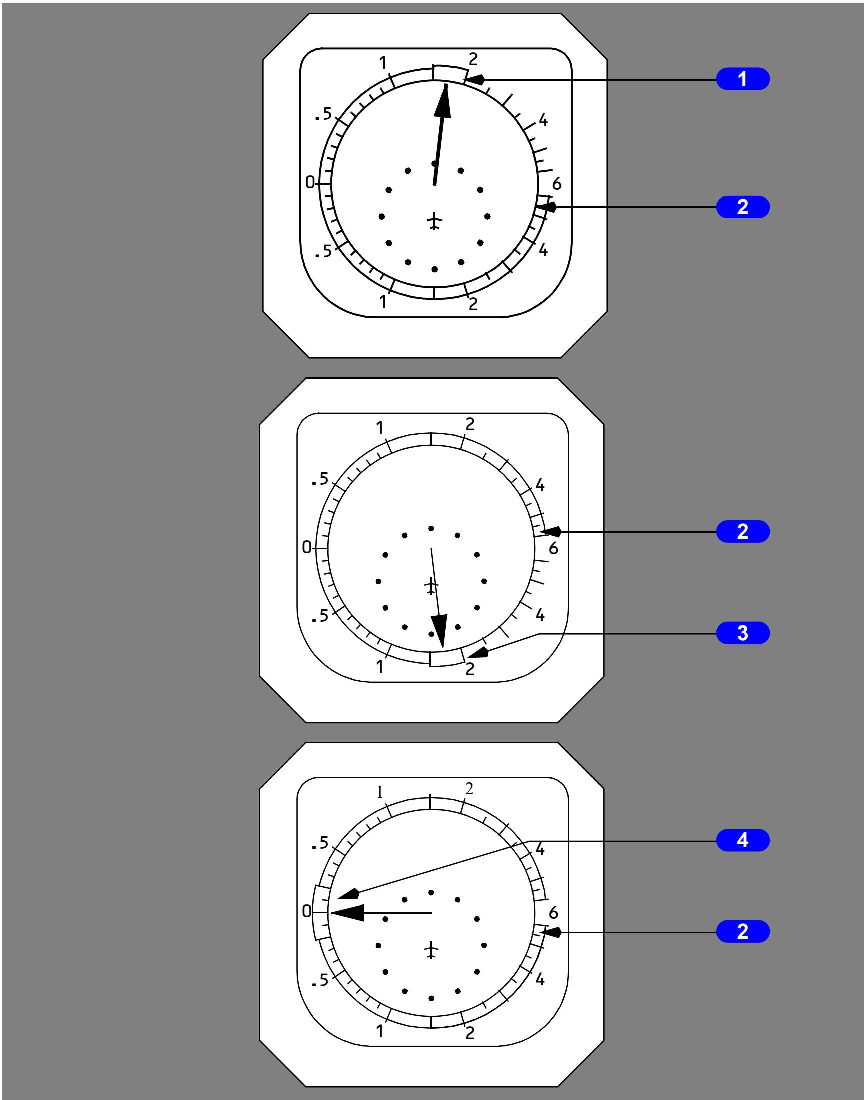
8 OFF Light

Illuminated (amber) –

- indicates the recorder is not operating or the test is invalid
- may indicate power failure, broken tape or not moving, or access door open.

TCAS

TCAS Resolution Advisory Commands



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 **RA Pitch Command (green) (UP Advisory)**

Indicates vertical speed range to ensure traffic separation.

2 **Command Arc (red)**

Indicates vertical speed range to avoid.

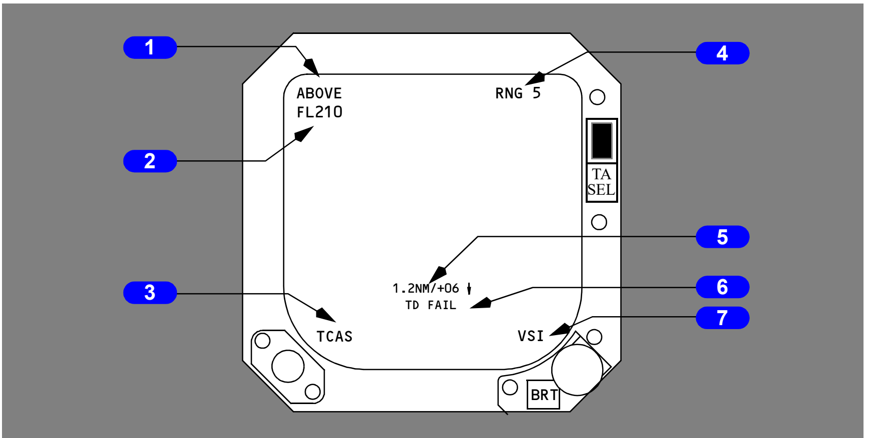
3 **RA Pitch Command (green) (DOWN Advisory)**

Indicates vertical speed range to ensure traffic separation.

4 **RA Pitch Command (green) (LEVEL Advisory)**

Indicates vertical speed range to ensure traffic separation.

TCAS VSI Messages



CAPTAIN'S INSTRUMENT PANEL
FIRST OFFICER'S INSTRUMENT PANEL

1 **ABOVE/NORM/BELOW Annunciation**

Shows the position of the TAU envelope switch on the transponder control panel

- ABOVE (blue) – vertical display range for other traffic is biased above the airplane
- BELOW (blue) – vertical display range for other traffic is biased below the airplane
- Blank – NORM is selected on the transponder control panel. Vertical display range for other traffic is equal above and below the airplane.

2 **Ownship Altitude Readout (blue))**

Shows FL followed by the first three numbers of the airplane's altitude if the FL switch is selected on the transponder control panel.

3 **TCAS Mode Display**

Indicates current TCAS mode/system status

- TCAS (amber) – TCAS system has failed
- TA ONLY (blue) – TCAS TA only mode is selected
- TCAS STBY (blue) – TCAS standby mode is selected
- TEST (amber) – TCAS is in test mode.

4 **TCAS Range**

Displays TCAS range in nautical miles.

5 **NO BEARING Messages**

Displayed when no bearing information is available for traffic (distance, altitude, trend arrow).

6 **Fault Annunciations**

TD FAIL (amber) – failure in the operation of the traffic display.

RA FAIL (amber) – RA information is not available.

7 **VSI Flag (amber)**

Indicates that vertical speed is unreliable.

Note: See Company provided material for specific TCAS VSI messages, and actual message locations.

TCAS Symbology

SYMBOL	NAME	REMARKS
■	RA traffic symbol (R)	Displayed during TCAS Resolution Advisory when traffic selected on the VSI or Weather Radar Indicator.
▬	RA off–scale traffic symbol (A)	Displayed when traffic selected on the VSI or Weather Radar Indicator and traffic is not within the display range.
●	TA traffic symbol (A)	Displayed during TCAS Traffic Advisory when traffic selected on the VSI or Weather Radar Indicator.
◖	TA off–scale traffic symbol (A)	Displayed when traffic selected on the VSI or Weather Radar Indicator and traffic is not within the display range.
◆	Proximate traffic symbol (W)	Displayed when traffic selected on the VSI or Weather Radar Indicator and traffic is within 1200 feet vertical and 6 miles horizontal from present position.
◇	Other traffic symbol (W/outlined)	Displayed when traffic selected on the VSI or Weather Radar Indicator and traffic is greater than 1200 feet vertical or 6 miles horizontal from present position.
+ 05 - 05	Relative altitude (R,A,W)	With traffic selected on the VSI or Weather Radar Indicator, displays relative traffic altitude in hundreds of feet.
↑	Vertical motion arrow (R,A,W)	Displayed when traffic vertical speed is greater than 500 feet per minute and traffic selected on the VSI or Weather Radar Indicator.
6.8NM/-11 3.6NM/+04	No bearing data (Red for RA; Amber for TA)	Displayed when no bearing information is available. Displays distance and altitude and trend arrow.

Introduction

The flight instruments provide information to aid the pilots in controlling the airplane throughout its flight regime. The electric flight instruments receive input from an air data computer. The pneumatic flight instruments receive input directly from the pitot–static system. An alternate static system is also available and may be selected from the flight deck.

Air Data System

The air data system consists of the pitot–static system and one or two air data computers. The system provides pitot and/or static pressure information to various flight instruments and airplane systems. The pressure information is provided in one of two ways; either directly from the pitot–static system, or indirectly from an air data computer.

Pitot Static System

The pitot–static (P/S) system provides pitot and static pressure inputs to pressure–sensing instruments and systems which have functions that vary with altitude and/or airspeed.

There are four primary P/S systems; the Captain's, the First Officer's, No. 1 auxiliary, and No. 2 auxiliary. The pilots' systems are used by the flight instruments and air data computer(s). The auxiliary systems are used by various airplane systems.

An alternate static system provides each pilot with a standby source of static pressure that may be selected with the related static source selector. The alternate static system cannot be connected to the auxiliary systems. There is no alternate pitot system.

Pressure inputs to the primary P/S systems are provided by four combination pitot and static probes located on the forward fuselage. Each probe provides one pitot and two static outputs. The alternate static ports are located on each side of the fuselage. All static systems are cross–connected for dynamic balance.

A separate pitot system with probes mounted on the vertical stabilizer is provided for the elevator feel system.

A blocked or frozen pitot and/or static system may affect the following primary airplane system:

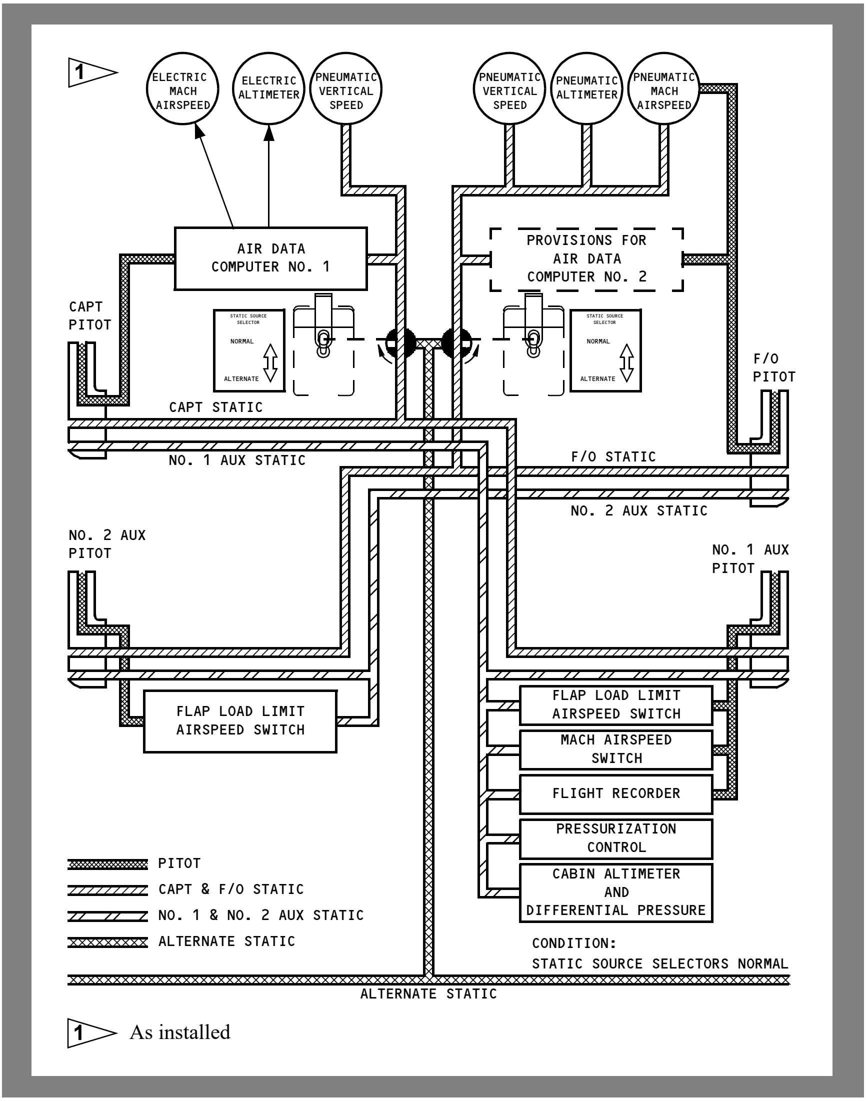
- Mach/airspeed indicator
- Vmo/Mmo warning

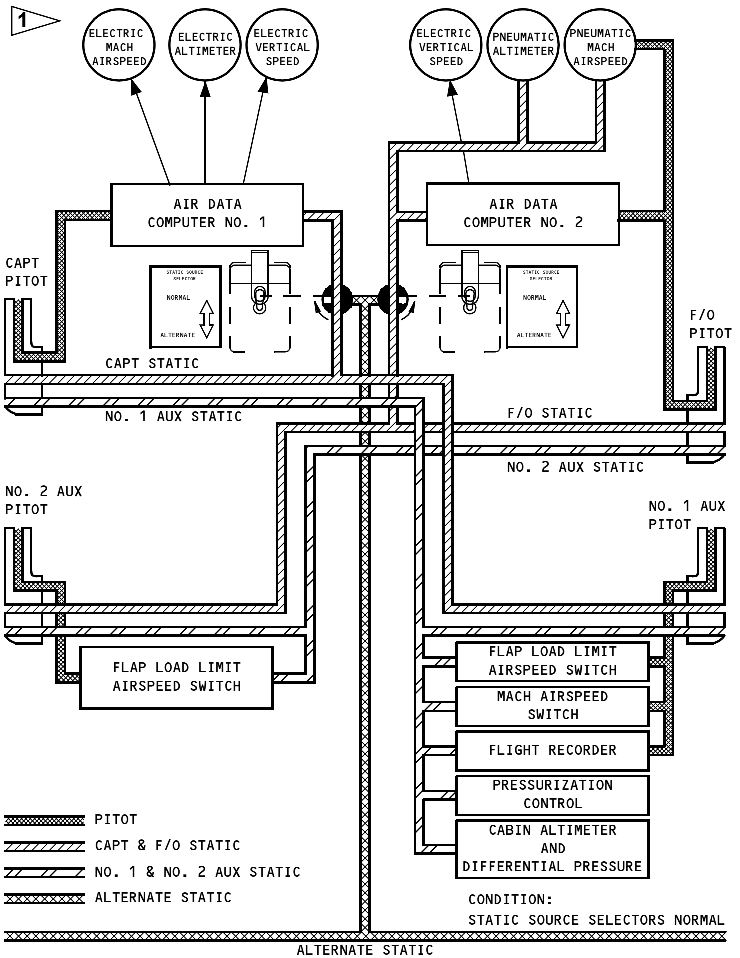
- altimeter
- vertical speed indicator
- true airspeed
- static air temperature
- flap load relief system
- elevator feel system
- autopilot
- ground proximity warning system
- altitude alert
- cabin pressure
- flight recorder
- transponder altitude reporting
- flight director altitude hold
- TAT or TAT/EPRL
- yaw damper
- Mach trim

Air Data Computer

One or two air data computers (ADCs) are installed. The ADC receives pitot and static pressure inputs from the respective pilot's P/S system, or from the alternate static system, if selected. The ADCs converts these pressure inputs to electrical signals used to operate various flight instruments and airplane systems. The ADC computers are powered whenever the AC busses are powered.

Pitot–Static System Schematic



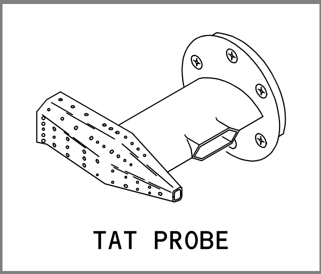


1 As installed

Total Air Temperature (TAT) System

One externally–mounted TAT probe is installed. The TAT indicator receives temperature information from the probe.

TAT indications are only valid in flight.



LEFT FORWARD FUSELAGE

The inflight TAT indication is comprised of outside air temperature (OAT) plus all of the ram rise. On the ground, the TAT indication is approximately OAT if pitot heat is OFF. In flight, the following table is used to convert indicated TAT to true OAT.

	INDICATED MACH NUMBER										
	.30	.40	.50	.60	.70	.73	.76	.78	.80	.82	.84
IND TAT – °C	TRUE OUTSIDE AIR TEMPERATURE – DEGREES C										
70				47	39	37	35	33	31	29	27
65			49	42	35	33	30	28	26	25	23
60		49	44	37	30	28	25	24	22	21	19
55	49	45	40	33	26	24	21	19	18	16	14
50	45	40	35	28	21	19	17	15	13	11	10
45	40	35	30	23	17	15	12	11	9	7	5
40	35	30	25	19	12	10	8	6	4	3	1
35	30	26	20	14	8	6	3	1	0	– 2	– 3
30	25	21	16	10	3	1	– 1	– 3	– 5	– 6	– 7
25	20	16	11	5	– 2	– 3	– 6	– 7	– 9	–11	–12
20	15	11	6	0	– 6	– 8	–10	–12	–13	–15	–16
15	10	6	2	– 5	–11	–13	–15	–16	–18	–19	–21
10	5	1	– 3	– 9	–15	–17	–19	–21	–22	–24	–25
5	0	– 3	– 8	–14	–20	–21	–24	–25	–27	–28	–29
0	– 5	– 8	–13	–18	–24	–26	–28	–30	–31	–33	–34
– 5	–10	–13	–18	–23	–29	–31	–33	–34	–35	–37	–38
–10	–15	–18	–22	–28	–33	–35	–37	–39	–40	–41	–43
–15	–20	–23	–27	–32	–38	–39	–42	–43	–44	–46	–47
–20	–24	–27	–32	–37	–42	–44	–46	–47	–49	–50	–51
–25	–29	–32	–36	–42	–47	–49	–51	–52	–53	–55	–56
–30	–34	–37	–41	–46	–51	–53	–55	–57	–58	–59	–60
–35	–39	–42	–46	–51	–56	–58	–60	–61	–62	–63	–65
–40	–44	–47	–51	–56	–61	–62	–64	–65	–66	–68	–69

NOTE: Probe Recovery Factor is 100%

Angle–of–Attack

There is one angle–of–attack sensor, located on the left side of the forward fuselage. The vane measures airplane angle–of–attack relative to the air mass.

Primary Flight Instruments

Attitude Director Indicator

An attitude director indicator (ADI), on each pilot's panel, displays a view of the pitch and roll attitude of the airplane. The attitude display is shown on a colored tape with pitch and roll reference provided by vertical gyros.

Computed steering commands from the flight director computer are presented on the ADI by command bars. These commands are viewed with respect to a fixed symbolic airplane.

When the GYRO warning flag is in view, use the Vertical Gyro transfer switch to transfer the associated systems to an operating vertical gyro. When the GS flag is in view, use the VHF NAV switch to transfer to an operating system.

The localizer symbol moves left or right to indicate deviation from localizer centerline. The localizer signal is covered by a mask until the flight director captures the glideslope. After glideslope capture, a VOR LOC failure flag on the HSI will cause the mask to cover the localizer symbol.

The localizer pointer and warning flag remain out of view with VOR frequencies selected.

The COMPUTER flag monitors the flight director system. Switching is not installed for this problem.

Attitude Systems

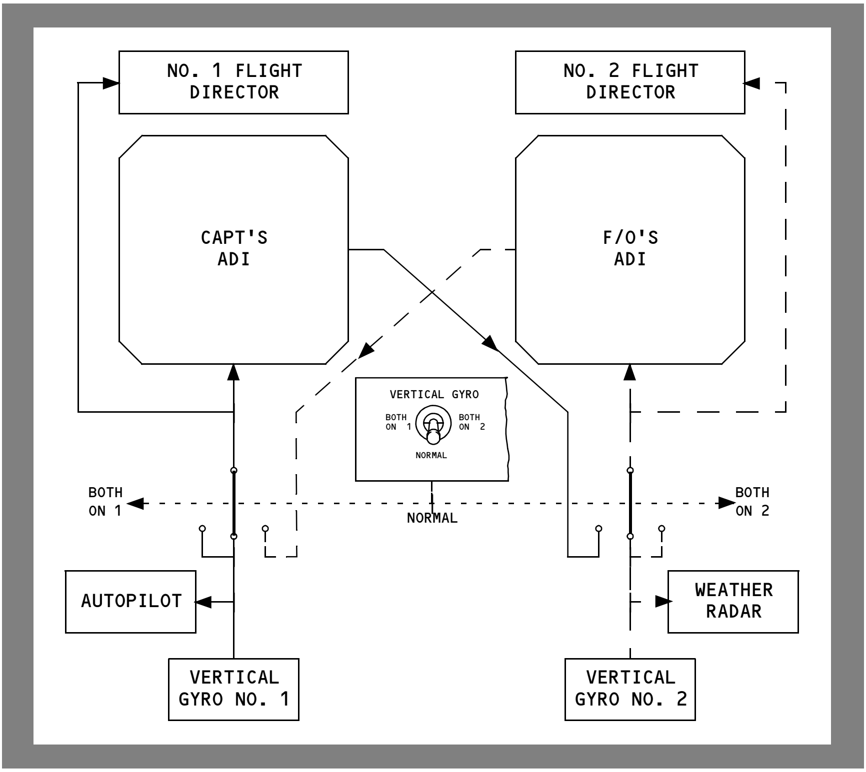
Two attitude systems are installed. The vertical gyros (VGs) provide attitude information.

Whenever a vertical gyro is unable to provide proper attitude reference, the Vertical Gyro transfer switch should be moved to an operating vertical gyro.

Vertical Gyro Attitude Error

Vertical gyros have an inherent characteristic that can cause associated ADI's to give false attitude indications in pitch and roll. The errors can be induced by slow longitudinal acceleration or deceleration, or prolonged shallow turns. Accelerations of 50 knots per minute or less, and bank angles of 6 degrees or less, can cause the gyro erection circuitry to establish a false vertical reference. If the airplane is flown straight and level following maneuvers that cause errors, the erection circuitry will correct the attitude errors. Corrections may require five minutes or more.

Attitude System Schematic



Attitude Switching Table

VERTICAL GYRO TRANSFER

VERTICAL GYRO (BOTH ON 1 / NORMAL / BOTH ON 2)	EQUIPMENT/INPUT					
	CAPT ADI	F/O ADI	AUTO-PILOT	WEATHER RADAR	NO. 1 FD	NO. 2 FD
NORMAL	1	2	1	2	1	2
BOTH ON 1	1	1	1	INOP	1	1
BOTH ON 2	2	2	INOP	2	2	2

Compass Systems

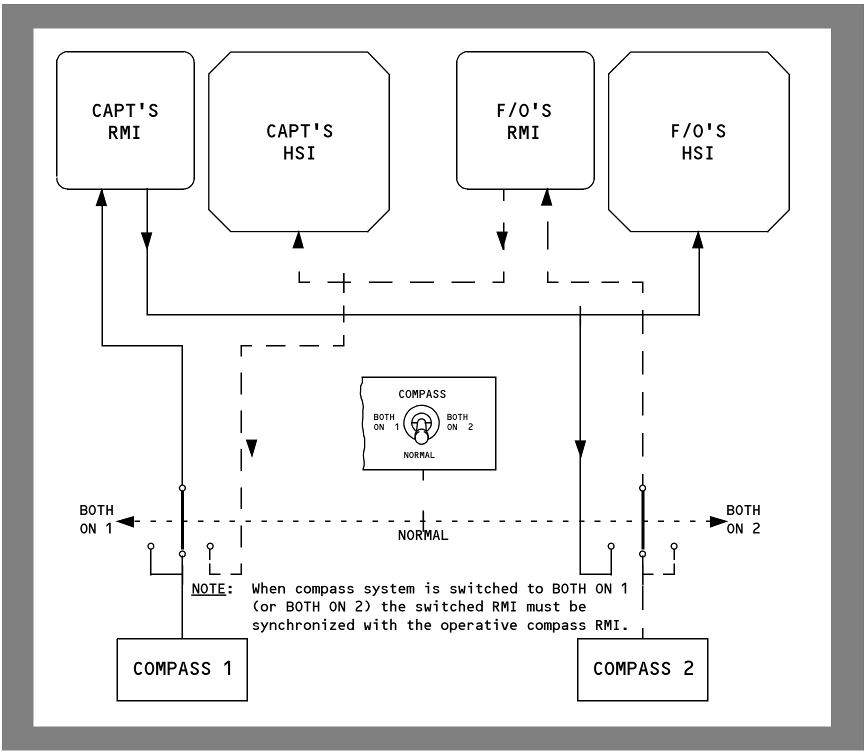
Two compass systems are installed. Directional gyros are connected to the RMI compass cards. The RMI compass card is then connected to the HSI compass card. The flux valves are installed in the vertical stabilizer.

The flux valves sense the direction of the earth's magnetic field. The directional gyros have random drift. Therefore, the flux valves are used to align the directional gyros with magnetic north and provide a stable compass system.

Synchronizing the flux valves and directional gyro can be observed with the synchronizing annunciator on the RMI.

The synchronizing process is relatively slow. The synchronizing control on the RMI can be used to manually provide rapid synchronizing of the flux valve and directional gyro.

Compass System Schematic



Compass Switching Table

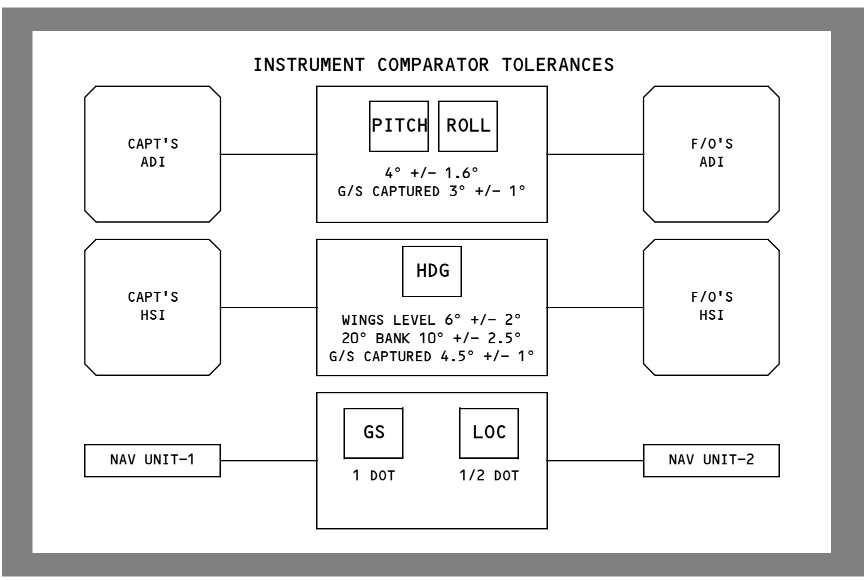
COMPASS TRANSFER

COMPASS (BOTH ON 1 / NORMAL / BOTH ON 2)	EQUIPMENT/INPUT									
	CAPT RMI	F/O RMI	CAPT HSI	F/O HSI	AUTO-PILOT	NO. 1 FD	NO. 2 FD	FLIGHT RECORDER	NO. 1 VHF NAV	NO. 2 VHF NAV
NORMAL	1	2	2	1	1	1	2	2	1	2
BOTH ON 1	1	1	1	1	1	1	1	1	1	1
BOTH ON 2	2	2	2	2	2	2	2	2	2	2

NOTE: When compass system is switched to BOTH ON 1 (or BOTH ON 2) the switched RMI must be synchronized with the good compass RMI.

Instrument Comparator

An instrument warning system is installed which provides comparison of the captain’s and first officer’s compass headings, pitch and roll attitude indications, localizer, and glideslope deviation outputs from the No. 1 and No. 2 VHF navigation unit.



Mach/Airspeed Indicators

Two Mach/airspeed indicators display indicated airspeed, Mach, and Vmo.

The electric Mach/Airspeed indicator displays information derived from the air data computer.

The pneumatic Mach/Airspeed indicators derives information from the respective captain's or first officer's pitot–static system (or an alternate static input, if selected).

Altimeters

An electric altimeter is installed on the captain's instrument panel. Altitude is derived from the air data computer.

A pneumatic altimeter is installed on the first officer's instrument panel. It utilizes the first officer's pitot–static source (or alternate static system, if selected).

Radio Altimeter

One low range radio altimeter and two indicators provide indication of airplane height above the ground up to 2500 feet absolute altitude. A radio altimeter indicator is located on each pilot instrument panel.

When the captain's radio altimeter is inoperative, all modes of the GPWS are inoperative.

Vertical Speed Indicators

Two pneumatic vertical speed indicators display vertical speed derived from the respective pilots' static system (or alternate static, if selected). On some airplanes, vertical speed information is displayed by two electric vertical speed indicators that receive information derived from their respective air data computer.

On some airplanes, a TCAS VSI display shows air traffic information detected by the TCAS system, and provides resolution advisory (RA) Pitch Commands (refer to Chapter 10-10; TCAS section, and Chapter 15, Warning Systems, for further information).

Marker Beacons

Each pilot has a set of marker beacon lights that show airways, middle, and outer beacon passage. Both sets are operated by one marker beacon receiver.

The marker beacon sensitivity switch is used to adjust the sensitivity of the receiver.

Clocks

Two spring powered, eight day clocks are installed.

Each clock displays time in a 24–hour format and has a stop–watch timer.

Standby Flight Instruments

Standby Horizon Indicator

The standby horizon indicator provides attitude information that is independent of the primary attitude displays. The indicator is powered by the battery bus and remains powered after the loss of all normal AC power as long as battery power is available. The gyro reaches operational speed approximately 60 seconds after power is applied. The indicator requires three minutes to achieve accuracy requirements.

Standby Magnetic Compass

A standard liquid–damped magnetic standby compass is provided. A card located near the compass provides heading correction factors.

Flight Recorder

The flight recorder provides a permanent record on tape of selected operational and systems information such as altitude, heading, and airspeed. The recorder is housed in a sealed, fire–resistant container located behind an access door in the aft cabin ceiling.

The pilots manually enter the trip number and date for subsequent transcribing onto the tape.

Operational and systems information is automatically recorded whenever the flight recorder is powered. Electrical power is provided from the transfer bus No. 1 and the battery bus. On the ground, the recorder begins operating as the low oil (35psi) pressure switch closes during either engine start. Oil pressure switches are bypassed in the air, and the flight recorder is powered, even with both engines shut down, as long as electrical power is available.

Flight Management, Navigation — Chapter 11
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Intentionally
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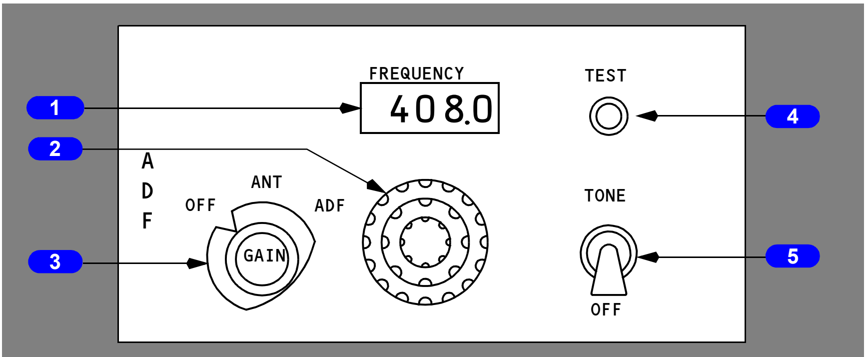
Radio Navigation Systems
Automatic Direction Finding (ADF) Control



FORWARD ELECTRONIC PANEL

1 FREQUENCY Indicator

Indicates the frequency selected with the related frequency selector.

2 Frequency Selector

Rotate –

- outer knob sets the hundreds number
- middle knob sets the tens number
- inner knob sets the tenths and ones number.

3 ADF Mode Selector

OFF – removes power from selected receiver.

ANT – only station audio received.

ADF – ADF bearing and station audio received.

GAIN – adjusts receiver gain.

4 TEST Switch

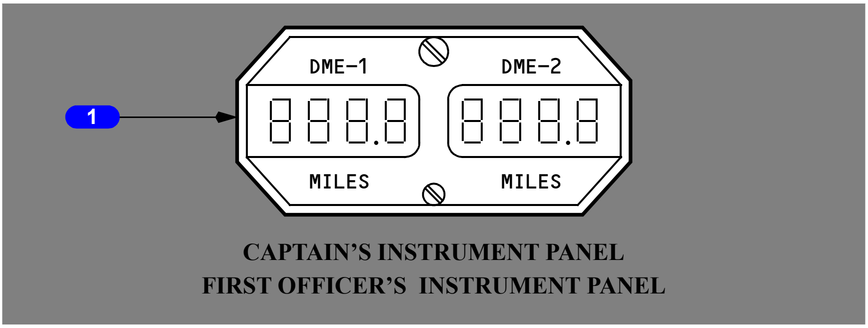
Push – ADF bearing pointer indicates 45 degrees left of lubber line.

5 TONE Switch

TONE – adds tone to receiver audio.

OFF – disables tones.

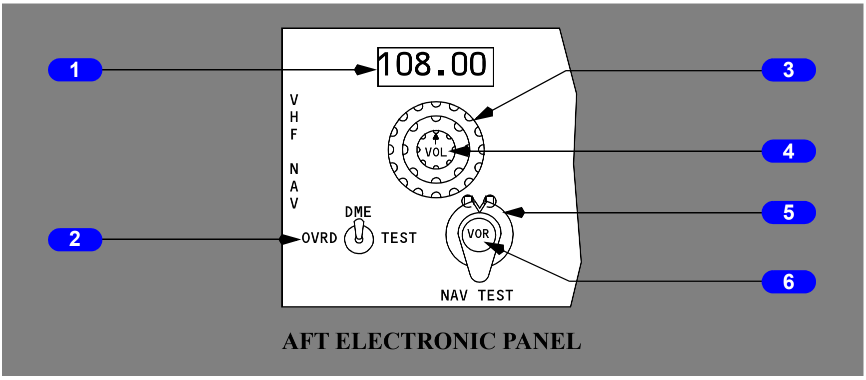
Distance Measuring Equipment (DME)



1 Digital DME Indicator

- displays slant range to DME station
- blank with electrical loss
- dashes when not receiving DME station
- brightness controlled by center knob located on pilot's light control panel.

VHF Navigation Control



1 Frequency Indicator

Indicates the frequency selected by the frequency selector.

2 DME Mode Selector

OVRD – DME searches to 390 nm.

DME – DME searches to 200 nm. Search limited to 50 nm for TVOR.

TEST – Digital DME indicator is:

- blank for one second
- dashes for one second
- zeros for as long as held in test position.

3 Frequency Selector

Rotate – manually selects the desired frequency.

4 Volume (VOL) Selector

Rotate – controls volume of selected station.

5 Navigation Test (NAV TEST) Switch

With an ILS frequency selected:

Rotate Knob Left –

- the glideslope indicates one dot up
- localizer indicates one dot left.

Rotate Knob Right –

- the glideslope indicates one dot down
- localizer indicates one dot right.

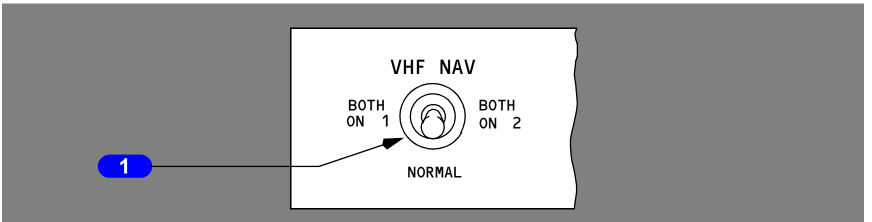
6 VOR TEST Switch

With a VOR frequency tuned and a course of 000 selected:

Push –

- course deviation bar centers
- VOR bearing pointer indicates 180 degrees
- TO–FROM ambiguity indicator show a FROM indication.

VHF NAV Transfer Switch



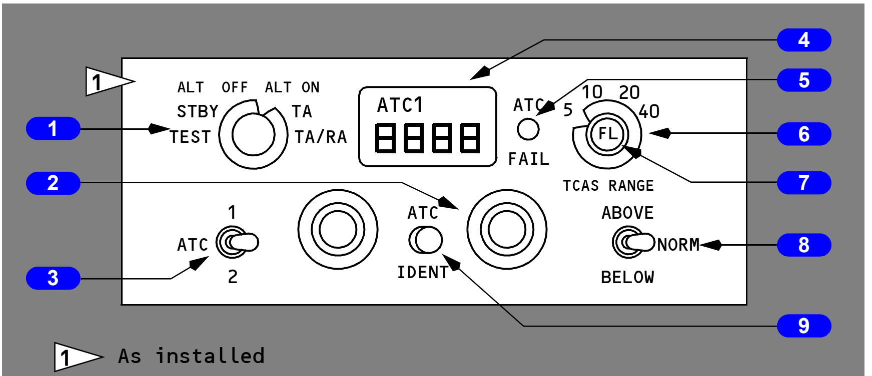
FORWARD OVERHEAD PANEL

1 **VHF NAV Transfer Switch**

- BOTH ON 1 – switches the VHF navigation source to VHF NAV receiver No. 1
- NORMAL – VHF navigation source is from default VHF NAV receiver
- BOTH ON 2 – switches the VHF navigation source to VHF NAV receiver No. 2.

Secondary Navigation Systems

Transponder Panel



FORWARD ELECTRONIC PANEL

1 **Transponder Mode Selector**

TEST – starts ATC transponder functional test.

STBY – does not transmit.

Note: Transponder modes are enabled only when the airplane is airborne, except for mode S, which operates continuously when the transponder mode selector is out of STBY.

ALT OFF – deactivates altitude reporting.

ALT ON – enables altitude reporting.

TA – enables display of traffic advisory TCAS targets. Refer to Chapter 15, Warning Systems.

TA/RA – enables display of traffic advisory and resolution advisory TCAS targets. Refer to Chapter 15, Warning Systems.

2 **Air Traffic Control (ATC) Code Selector**

Rotate – sets transponder code in transponder.

3 **Transponder (ATC) Switch**

1 – selects transponder No. 1.

2 – selects transponder No. 2.

4 **ATC Code Indicator**

Displays transponder code.

Displays operating transponder (1 or 2).

Displays response indicator (R).

5 **Transponder FAIL (ATC FAIL) Light**

Illuminated – indicates transponder malfunction.

6 **Traffic Collision Avoidance System (TCAS) Range Selector**

Selects range for TCAS operation.

7 **Flight Level (FL) Switch**

Push – displays relative altitude of TCAS information for 15 seconds.

8 **TAU Envelope Switch**

ABOVE – sets TCAS display at upper elevation limit.

NORM – sets TCAS display for normal limit.

BELOW – sets TCAS display at lower elevation limit.

8 **TAU Envelope Switch**

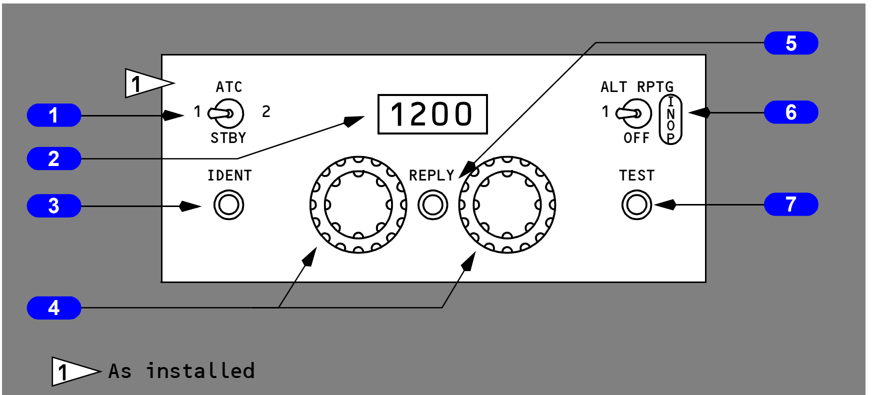
1 – sets TCAS display at upper elevation limit.

ALT – sets TCAS display for normal limit.

2 – sets TCAS display at lower elevation limit.

9 **Identification (ATC IDENT) Switch**

Push – transmits an identification signal.



FORWARD ELECTRONIC PANEL

1 Transponder Air Traffic Control (ATC) Switch

1 – selects transponder No. 1.

STBY – does not transmit.

2 – selects transponder No. 2.

2 ATC Code Indicator

Displays transponder code.

3 Identification (IDENT) Switch

Push – transmits an identification signal.

4 ATC Code Selectors

Rotate – sets transponder code in transponder.

5 REPLY Light

Illuminated (green) –

- transponder replying to ground interrogation
- test in progress.

6 Altitude Reporting (ALT RPTG) Switch

1 – enables altitude reporting from air data computer No. 1.

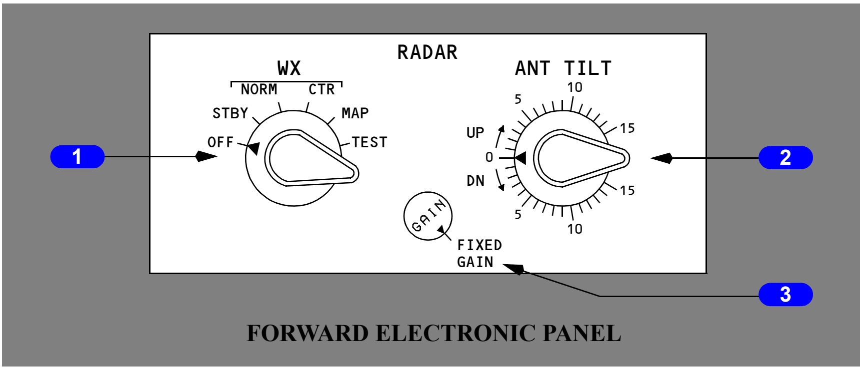
OFF – transponder operates without altitude reporting.

2 – inoperative.

7 **TEST Switch**

Push – with the transponder air traffic control (ATC) switch in position 1 or 2, the reply light illuminates to indicate the selected transponder is operational.

Weather Radar Panel



1 **Weather (WX) Radar Function Selector**

OFF – removes power to the radar system.

STBY (Standby) – apply warm–up power for 3 minutes prior to operation.

NORM (Normal) –

- antenna radiates symmetrical beam
- weather area of greatest intensity appears as brightest return.

CTR (Contour) –

- identifies areas of greatest intensity reversed
- weather area of greatest intensity appears as darkest return.

MAP – antenna radiates wide beam for ground mapping.

TEST – de–energizes transmitter and tests system. Displays test pattern.

2 **Antenna Tilt (ANT TILT) Control**

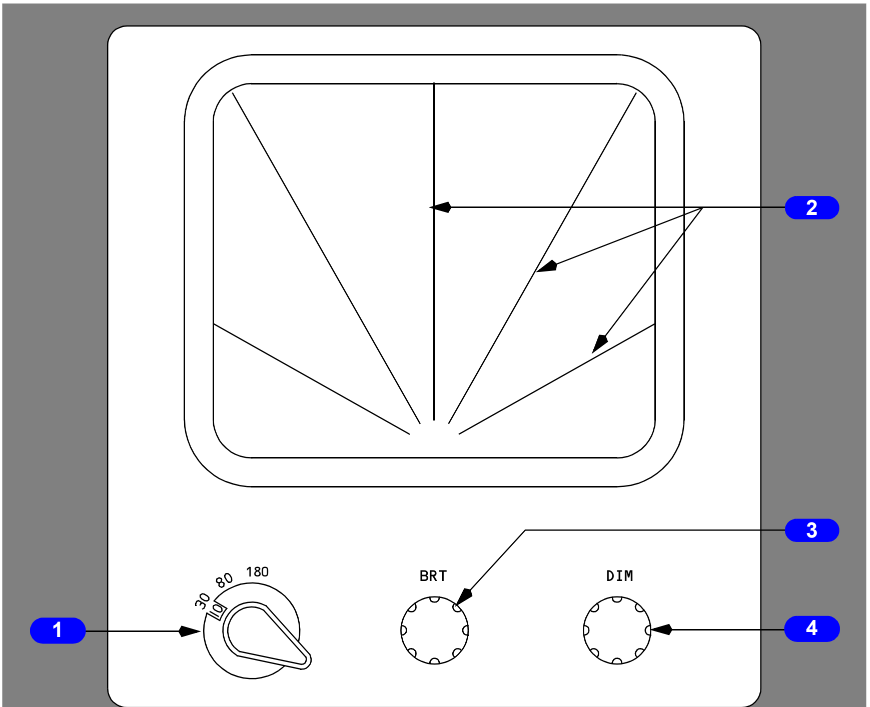
Rotate – radar antenna tilts 0 to 15 degrees above or below horizon.

Stabilization from vertical gyro maintains antenna sweep at a constant tilt angle relative to the earth’s horizon.

3 **GAIN Control**

Rotate – manually sets receiver sensitivity.

FIXED GAIN (detent) – used in NORM or CTR modes.



FORWARD ELECTRONIC PANEL

1 Range Selector

Rotate – selects desired range for weather radar indicator.

- 30 Miles – Three 10 mile range marks
- 80 Miles – Three 25 mile range marks
- 180 Miles – Seven 25 mile range marks.

2 Azimuth Marks

3 Brightness (BRT) Control

Rotate – controls brightness of display.

4 Dimmer (DIM) Control

Rotate – controls intensity of background panel lights.

Introduction

Navigation systems include the radio navigation systems, transponder, and weather radar.

Radio Navigation Systems

Automatic Direction Finding (ADF)

An automatic direction finding (ADF) system enables automatic determination of magnetic and relative bearings to selected facilities.

Two ADF receivers are installed. The No. 1 receiver uses the narrow pointer on the RMIs. The No. 2 receiver uses the wide pointer. The audio is heard by using the ADF receiver control on the audio selector panel.

ADF bearing pointers will not display correct magnetic bearing when the compass information is lost or invalid. Relative bearings are indicated by pointers if the receiver is operating.

VHF Navigation System (VHF NAV)

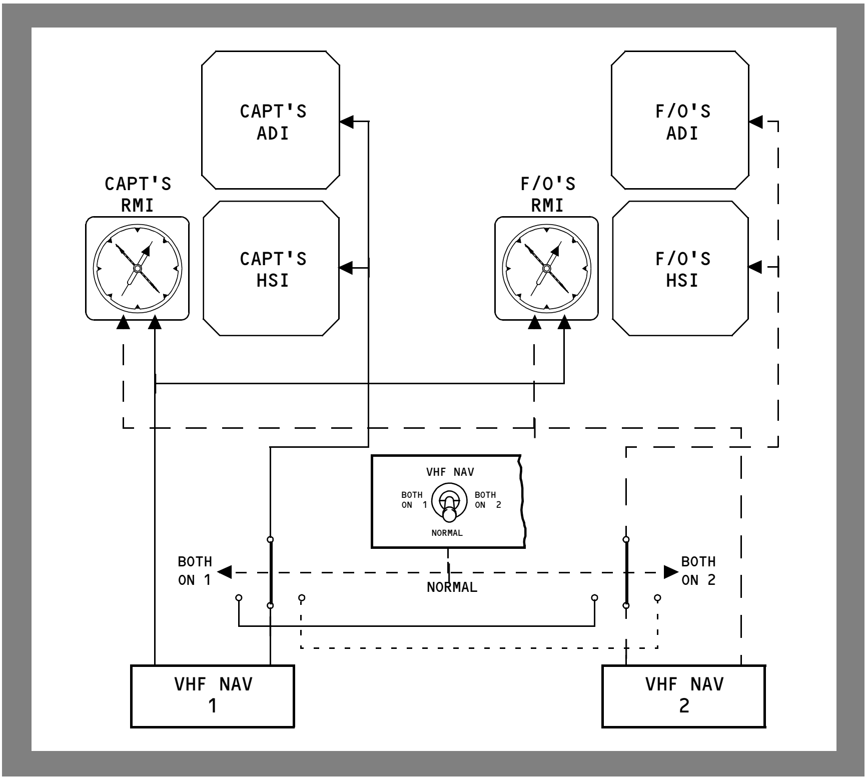
Two NAV receivers and controls panels are installed. The VHF navigation control panel is used to tune VOR and ILS frequencies.

VOR information is displayed on the RMIs when a valid in–range VOR station is tuned. The HSI displays course deviation when operating in the VOR mode.

Should either VHF NAV receiver fail, the VHF NAV transfer switch enables selection of the opposite VHF NAV receiver for display.

The deviation bar and glideslope pointer are controlled by the controls for the operating system.

VHF Navigation System Schematic



VHF Navigation Switching Table

VHF NAVIGATION TRANSFER

VHF NAV (BOTH ON 1 / NORMAL / BOTH ON 2)	EQUIPMENT/INPUT								
	CAPT HSI	F/O HSI	CAPT ADI	F/O ADI	RMI'S (single-bar pointer)	RMI'S (double-bar pointer)	NO. 1 FD	NO. 2 FD	AUTO-PILOT
NORMAL	1	2	1	2	1	2	1	2	1
BOTH ON 1	1	1	1	1	1	2	1	1	1
BOTH ON 2	2	2	2	2	1	2	2	2	2

Secondary Navigation Systems

ATC Transponder

Two ATC transponders are installed and controlled by a single control panel. The ATC transponder system transmits a coded radio signal when interrogated by ATC ground radar. Altitude reporting capability is provided allowing altitude information from the air data computer to be transmitted to an ATC radar facility.

Transponders may also transmit information, such as flight number, airspeed or groundspeed, magnetic heading, altitude, GPS position, etc., depending on the level of enhancement. Airport equipment monitors airplane position on the ground when the transponder is active through Mode S capability (mode selector not in STANDBY or OFF). TCAS modes should not be used on the ground for ground tracking.

On airplanes with TCAS, TCAS is controlled from the transponder panel. The TCAS system is described in Chapter 15.

Weather Radar

The weather radar system detects and locates various types of precipitation bearing clouds along the flight path of the airplane and gives the pilot a visual indication of the clouds' intensity.

In NORM mode, the radar displays a cloud's rainfall intensity by displaying areas of greatest intensity with the brightest returns.

In CTR mode, the areas of strongest return are inverted. This mode clearly defines the location and extent of a storm cell by blacking out all radar returns above a predetermined level. Weather areas of greatest intensity appear as a "black hole".

In MAP mode, a wide radar beam is used to display ground surfaces (the most reflective surfaces appear brighter).

These displays enable identification of coastlines, hilly or mountainous regions, cities, or large structures. Ground mapping mode can be useful in areas where ground–based navigation aids are limited.

The radar system performs only the functions of weather detection and ground mapping. It should not be used or relied upon for proximity warning or anticollision protection.

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Fuel — Chapter 12

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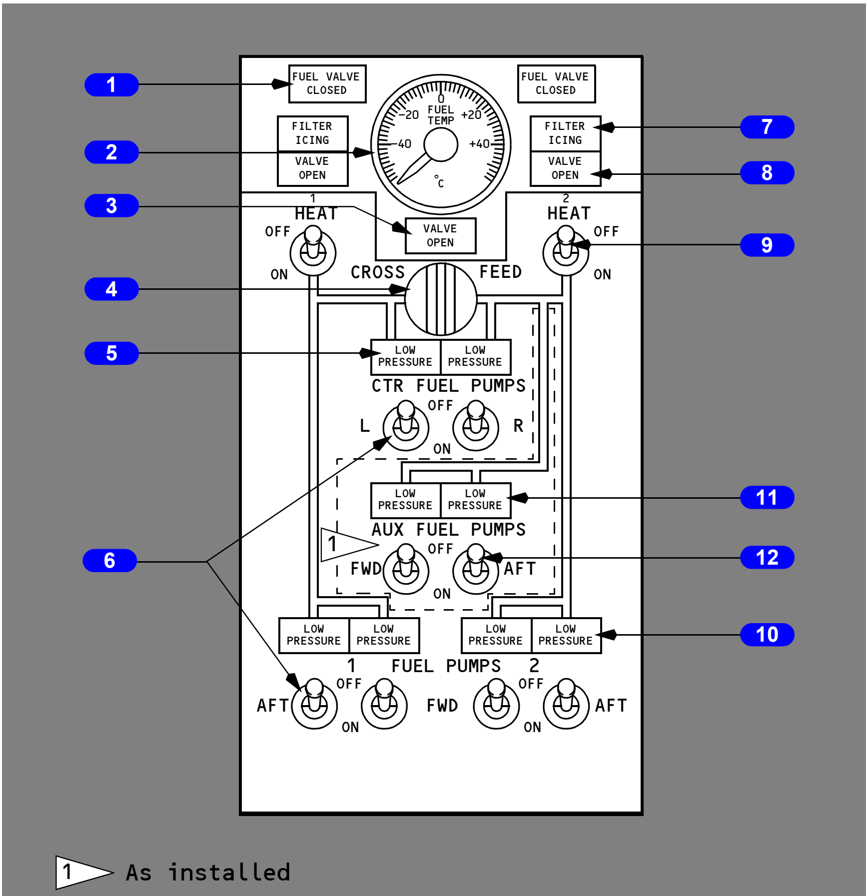
Fuel Control Panel



FORWARD OVERHEAD PANEL

1 FUEL VALVE CLOSED Light

Extinguished – related engine fuel shutoff valve is open.

Illuminated (blue) –

- bright – related fuel shutoff valve is in transit, or valve position and engine start lever or engine fire switch disagree.
- dim – related fuel shutoff valve is closed.

2 Fuel Temperature (FUEL TEMP) Indicator

Indicates fuel temperature in No. 1 tank.

3 Crossfeed VALVE OPEN Light

Illuminated (blue) –

- bright – crossfeed valve is in transit, or valve position and CROSSFEED selector disagree.
- dim – crossfeed valve is open.

Extinguished – crossfeed valve is closed.

4 CROSSFEED Selector

Controls fuel crossfeed valve.

Closed – isolates engine No. 1 and No. 2 fuel feed lines.

Open – connects engine No. 1 and No. 2 fuel feed lines.

5 Center Tank Fuel Pump LOW PRESSURE Light

Illuminated (amber) – fuel pump output pressure is low and FUEL PUMP switch is ON.

Note: With both Center(CTR) tank FUEL PUMP switches ON, illumination of both LOW PRESSURE lights illuminates MASTER CAUTION and FUEL system annunciator lights. Illumination of one LOW PRESSURE light illuminates MASTER CAUTION and FUEL system annunciator lights on MASTER CAUTION light recall.

Note: With one CTR tank FUEL PUMP switch OFF, illumination of opposite CTR tank LOW PRESSURE light illuminates the MASTER CAUTION and FUEL system annunciator lights.

Extinguished – fuel pump output pressure is normal, or FUEL PUMP switch is OFF.

6 FUEL PUMP Switch

ON – activates fuel pump.

OFF – deactivates fuel pump.

7 FILTER ICING Light

Extinguished – fuel filter operating normally.

Illuminated (amber) – indicates an iced or contaminated filter.

8 Fuel Heat VALVE OPEN Light

Illuminated (blue) –

- bright – fuel heat valve is in transit, or valve position and fuel HEAT switch disagree.
- dim – fuel heat valve is open.

Extinguished – fuel heat valve is closed.

9 Fuel HEAT Switch

ON – The solenoid switch opens the respective engine fuel heat valve allowing bleed air to heat the fuel and de-ice the fuel filter. The switch automatically moves to OFF after one minute.

10 Main Tank Fuel Pump LOW PRESSURE Light

Illuminated (amber) – fuel pump output pressure is low, or FUEL PUMP switch is OFF.

Note: Two LOW PRESSURE lights illuminated in same tank illuminates MASTER CAUTION and FUEL system annunciator lights. One LOW PRESSURE light causes MASTER CAUTION and FUEL system annunciator lights to illuminate on MASTER CAUTION light recall.

Extinguished – fuel pump output pressure is normal.

11 Aux Tank Fuel Pump LOW PRESSURE Light

Illuminated (amber) – fuel pump output pressure is low, or FUEL PUMP switch is OFF.

Note: Illumination of two LOW PRESSURE lights illuminates MASTER CAUTION and FUEL system annunciator lights. One LOW PRESSURE light causes MASTER CAUTION and FUEL system annunciator lights to illuminate on MASTER CAUTION light recall.

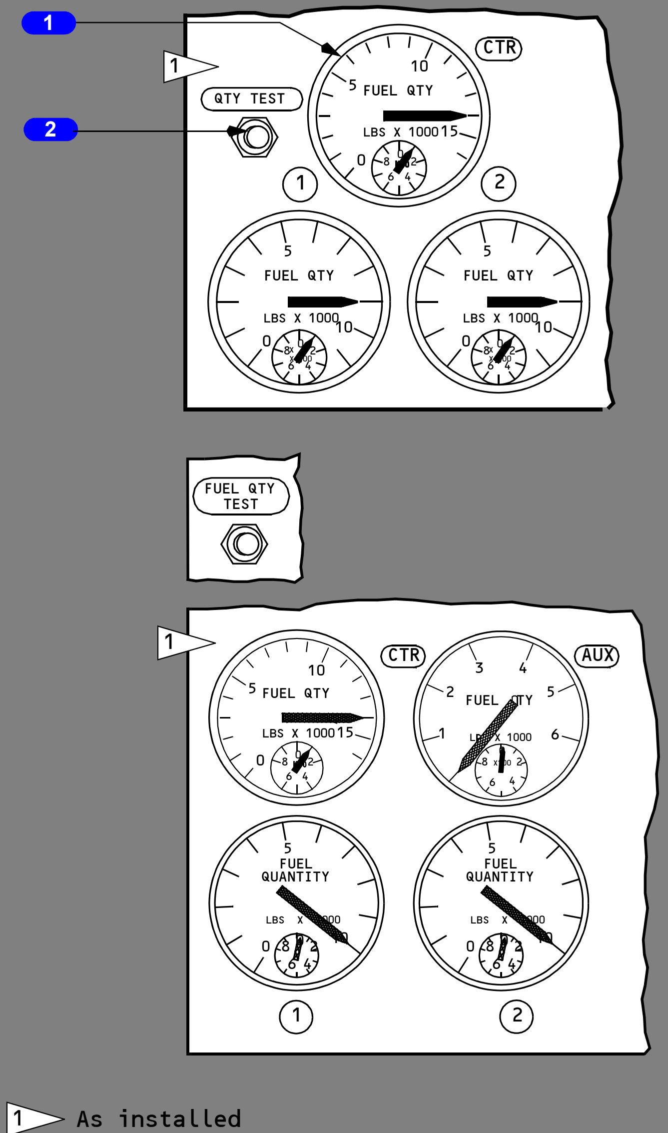
Extinguished – fuel pump output pressure is normal, or the FUEL PUMP switch is OFF.

12 Aux Tank FUEL PUMP Switch

ON – activates fuel pump.

OFF – deactivates fuel pump.

Fuel Quantity Indications



CENTER INSTRUMENT PANEL

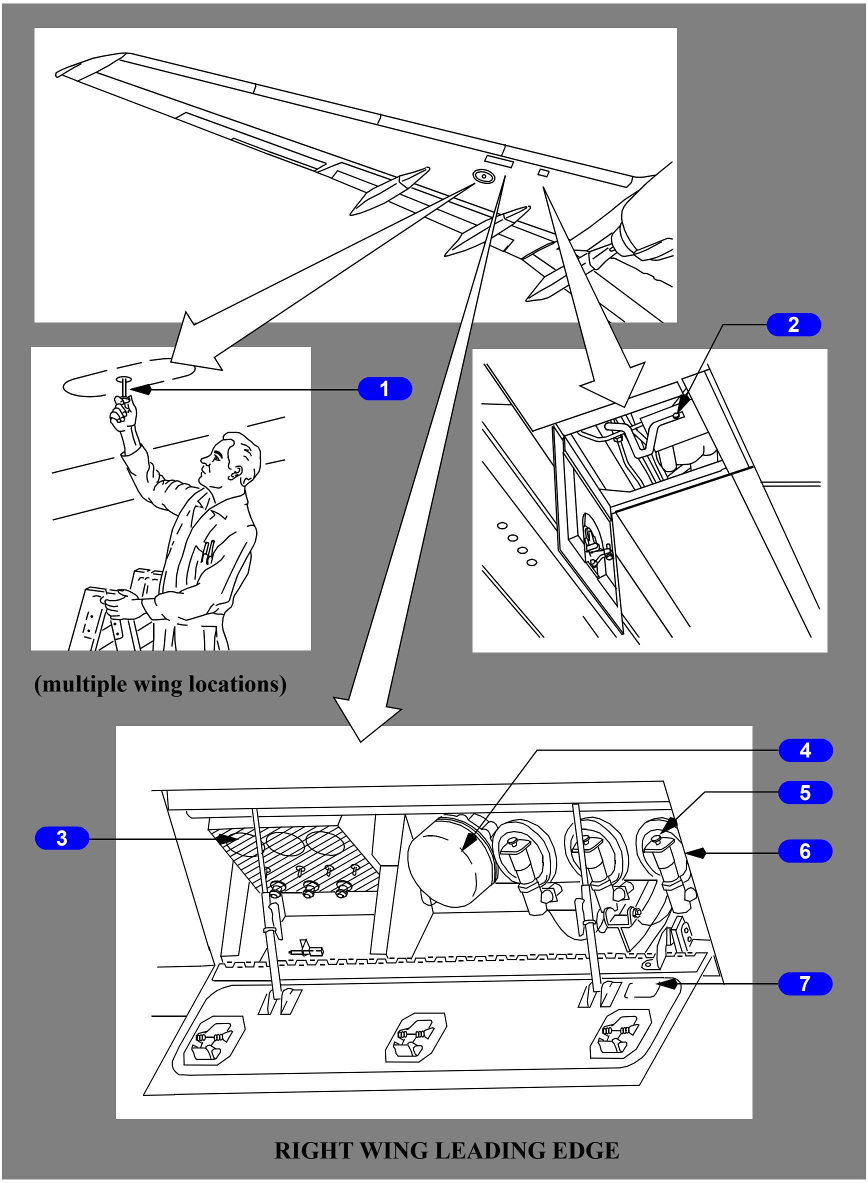
1 Fuel Quantity Indicator

- indicates usable fuel in the related tank.
- standby AC power is required.

2 Fuel Quantity Test (QTY TEST) Switch

Indicator test is described in Supplementary Procedures.

Fueling / Defueling / Measurement



1 Fuel Measuring Stick

Allows comparison of fuel quantity or weight as determined from measuring stick reading and fuel weight indicated by fuel quantity indicators.

- five fuel measuring sticks are installed in each main tank
- reading is obtained by withdrawing measuring stick from tank until a steady drip of fuel commences at the drip hole near the base.

2 Manual Defueling Valve

Open – interconnects engine feed system and fueling station for:

- defueling
- ground transfer of fuel.

Closed – isolates engine feed system from fueling station.

3 TEST GAUGES & FUELING Panel

See Test Gauges and Fueling Panel section.

4 Fueling Receptacle

Hose connection receptacle for single point underwing fueling.

5 Solenoid Override

Mechanically opens solenoid operated valve. Fuel valve opens if fuel pressure is available.

6 Fueling Valves

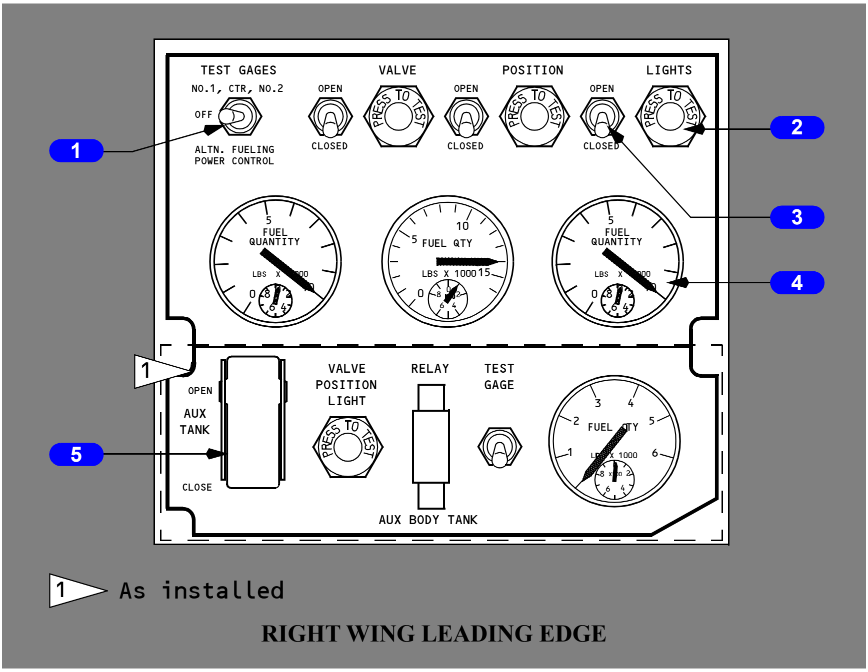
With battery switch ON, fuel pressure opens valve, if energized.

7 Fueling Power Control Switch

Door closed – proximity sensor deactivates power to fueling system.

Door open – the fueling system is powered and panel lights illuminate.

Test Gauges & Fueling Panel



1 **TEST GAUGES & FUELING Switch**

(spring–loaded to OFF position)

TEST GAUGES – checks operation of fuel quantity indicators.

AUX FUELING POWER CONTROL – energizes the fueling system if the fueling power control switch fails to activate the system when the door is open.

2 **Fueling VALVE POSITION Lights**

Extinguished –

- fueling valve switch is OPEN and related tank is full
- fueling valve switch is CLOSED.

Illuminated (blue) – fueling valve switch is OPEN and related tank is not full.

3 **Fueling Valve Switches**

OPEN – energizes fueling valve in related tank.

CLOSED – de–energizes fueling valve in related tank.

4 FUEL Quantity Indicators

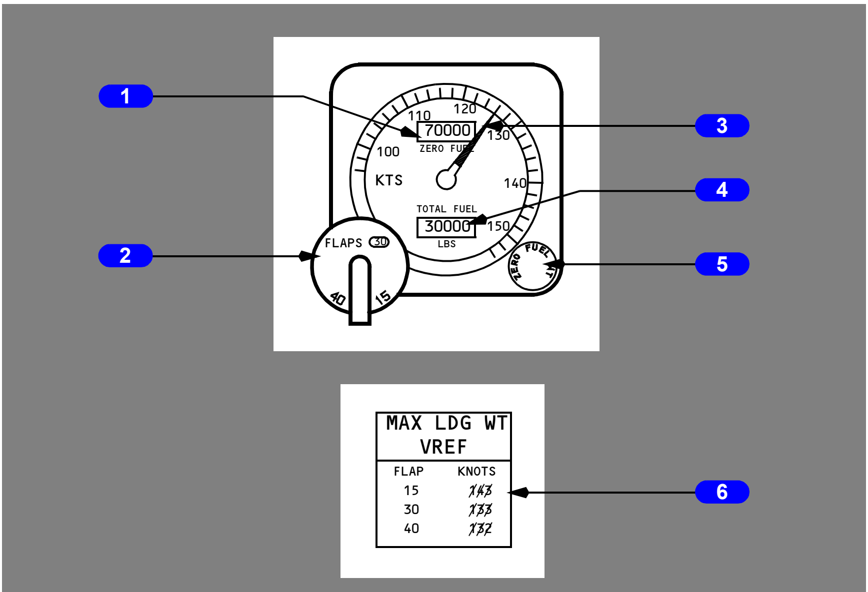
Indicates total usable fuel tank quantity in related tank.

5 AUX TANK Fueling Valve Switch

Controls refueling of the aft body auxiliary tank.

Raise – the crossfeed selector is overridden, and the crossfeed valve opens.

Total Fuel and VREF Indicator



CENTER INSTRUMENT PANEL

1 ZERO FUEL Weight Counter

Indicates airplane zero fuel weight selected by the ZERO FUEL weight selector.

2 Landing Flap Selector

Adjusts the VREF pointer for the landing flap setting.

3 Vref Pointer

Indicates VREF speed for landing.

4 TOTAL FUEL Weight Counter

Indicates the total usable fuel remaining in all tanks.

5 ZERO FUEL Weight Selector

Used to set the ZERO FUEL weight counter to the correct zero fuel weight.

6 Maximum Landing Weight VREF (MAX LDG WT VREF) Placard

Airspeeds on this placard depend on the maximum allowable landing gross weight of the airplane.

Fuel Chapter 12
System Description Section 20

Introduction

The fuel system supplies fuel to the engines and the APU. Fuel is contained in three tanks located within the wings and wing center section.

Refer to Engine and APU chapter for a description of the engine and APU fuel systems.

Airplanes with Auxiliary Fuel Tank

With an auxiliary fuel tank installed, fuel is contained in four tanks located within the wing, wing center section, and aft lower body. The auxiliary tank is comprised of two rubber bladder cells located at the forward end of the aft cargo compartment.

Fuel Feed

Both engines are normally pressure fed from the center tank until the center tank quantity decreases to near zero. The engines are normally then pressure fed from their respective main tanks. Check valves are located throughout the fuel system to ensure the proper direction of fuel flow and to prevent transfer of fuel between tanks.

Fuel Pumps

Each fuel tank uses two AC powered fuel pumps which are fuel cooled and lubricated. Center tank check valves open at a lower pressure than do the main tank check valves. This ensures that center tank fuel is used before main tank fuel, even though all fuel pumps are operating. Individual pressure sensors monitor the output pressure of each pump.

Mechanical engine–driven fuel pumps provide suction feed in the event that normal electrical fuel pump operation is not available. The engine pumps draw fuel through bypass valves located in main tanks No. 1 and No. 2. The main tank bypass valves may also be used for suction defueling. No bypass valves are provided in the center tank.

Note: Fuel pump LOW PRESSURE lights may flicker when tank quantity is low and the airplane is in a climb, descent, or on the ground with a nose-down attitude.

Note: Center tank fuel pump LOW PRESSURE lights may flicker when tank quantity is low and the airplane is in cruise. One pump may indicate low pressure sooner than the other due to aircraft attitude and/or slight variation between pump inlet position. Low pressure indication may occur after center tank quantity reads zero. Low pressure light flickering can continue for as long as 5 minutes before the Fuel System Annunciator light and the Master Caution lights are illuminated for the associated center tank pump.

Fuel Crossfeed

The engine fuel manifolds are interconnected by use of the crossfeed valve. The valve is DC motor operated from the battery bus. The valve provides a means of directing fuel to both engines from any tank.

Fuel Shutoff Valves

Fuel shutoff valves are located at the engine–mounting wing stations. The valves are DC motor operated from the hot battery bus. They close whenever the respective engine fire switch is pulled or engine start lever is placed to CUTOFF.

Fuel Vent System

The purpose of the fuel vent system is to prevent damage to wings due to excessive buildup or positive or negative pressures inside the fuel tanks and to provide ram air pressure within the tanks. The tanks are vented into surge tanks which vent through a single opening at each wing tip.

Fuel Temperature

The FUEL TEMP indicator located on the fuel control panel displays fuel temperature. A sensor in main tank No. 1 allows monitoring of fuel temperature. The temperature indicating system uses AC electrical power.

APU Fuel Supply

When AC fuel pumps are operating, fuel for the APU is supplied from the left side of the fuel manifold. If the AC fuel pumps are not operating, fuel is suction fed from main tank No. 1.

DC Operated APU Fuel Pump

The DC operated APU fuel boost pump is installed to ensure positive fuel pressure to the APU fuel control unit. The pump operates automatically.

Fueling/Defueling/Ground Transfer

Rapid fueling and defueling is accomplished at the single–point pressure fueling station in the right wing. The fueling station is also used for the ground transfer of fuel between tanks.

Standard overwing fueling receptacles for main tanks No. 1 and No. 2 are provided for gravity fueling. In the absence of underwing pressure fueling facilities, center tank servicing can only be accomplished through the ground tank to tank fuel transferring operation.

The manual defueling valve, located outboard of engine No. 2, interconnects the engine feed system and the fueling station. It is opened for defueling and tank to tank transfer operations.

A shutoff system is used during fueling to automatically close the fueling valve in each fuel tank when the tank is full.

Fuel Quantity Indication

The fuel quantity indication system calculates the usable fuel quantity in each tank. The fuel quantity in each tank is displayed on the center instrument panel and on the fueling station panel.

Total Fuel and VREF Indicator

This instrument uses airplane weight (zero fuel weight plus total fuel remaining) and landing flap selected to give the pilot a constant VREF speed indication.

The pilot can calculate airplane weight at any time by adding the zero fuel weight and total fuel weight counters. The instrument itself electronically sums the preset zero fuel weight and the existing total fuel weight.

Selection of desired landing flap on the flap selector knob biases the VREF pointer to the correct VREF speed.

Maximum landing weight VREF for the flaps selected may be read from a placard adjacent to the indicator.

Power for the instrument is 115V AC. A power failure will result in the pointer remaining at its last position to give an increasingly conservative VREF as more fuel is used.

Fuel Tank Location and Capacities (Usable Fuel)

Main tanks No. 1 and No. 2 are integral with the wing structure. The center tank lies between the wing roots within the fuselage area and extends out into the wing structure.

These figures represent approximate amounts of usable fuel. The appropriate weight and balance control and loading manual gives exact figures for all conditions.

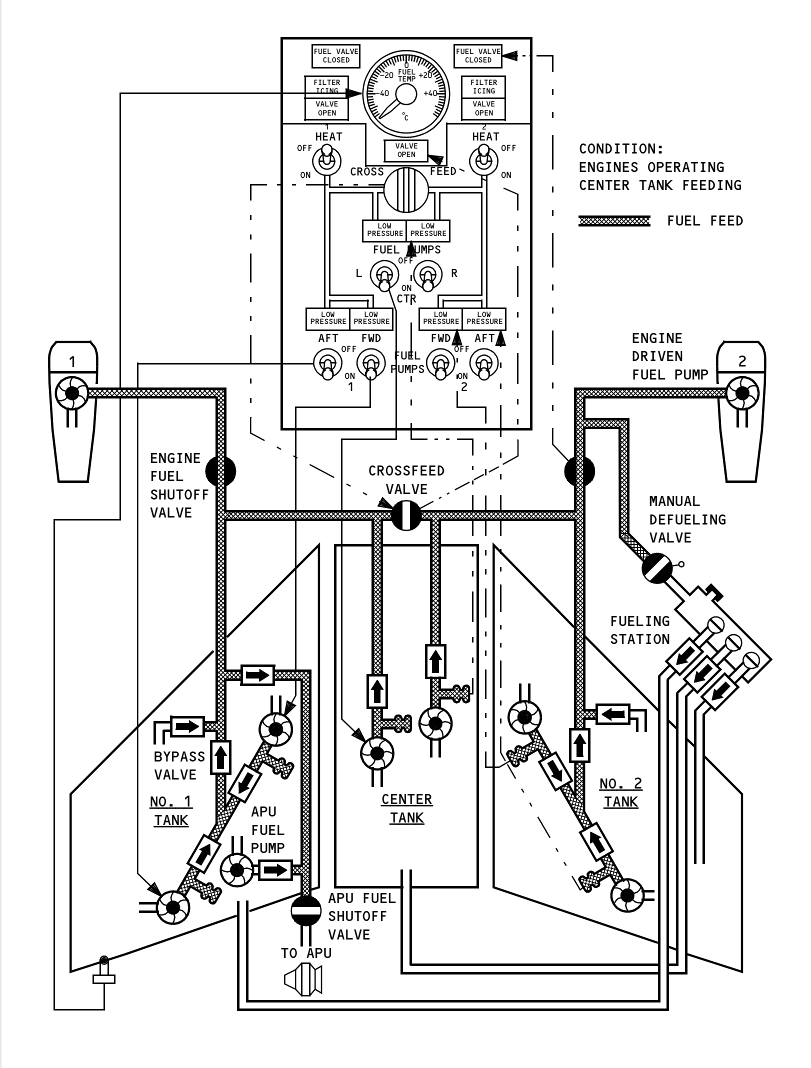
TANK	GALLONS	POUNDS*
NO. 1	1,430	9,580
NO. 2	1,430	9,580
CENTER	2,303	15,430
TOTAL	5,163	34,590

* Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon

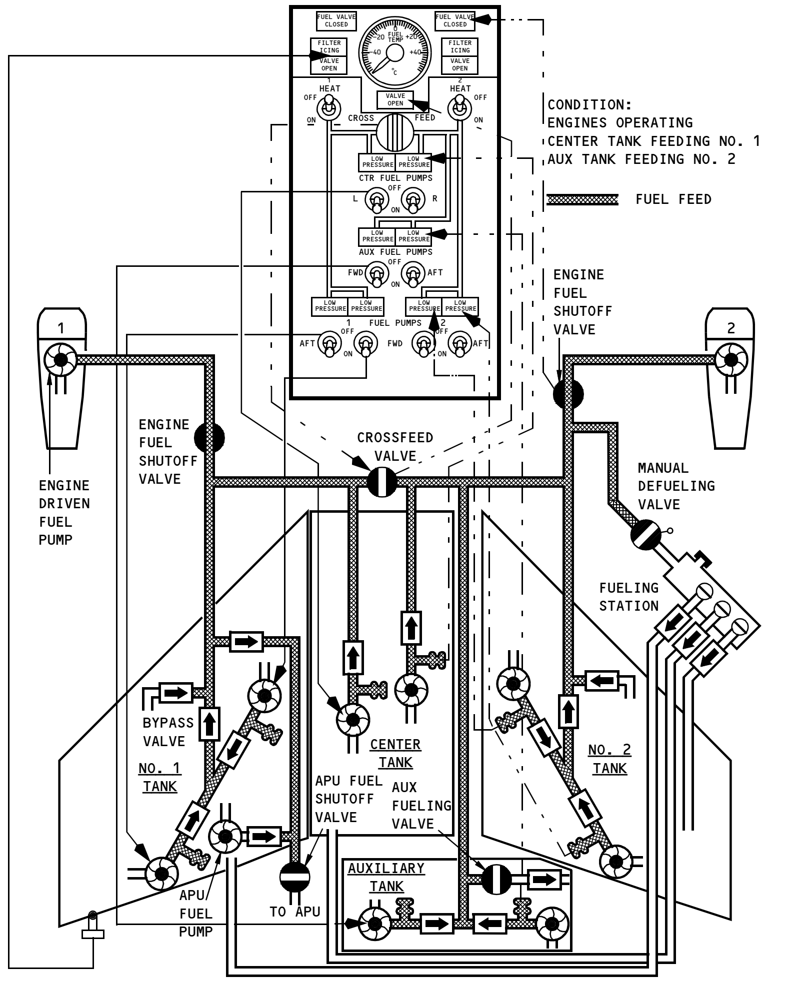
TANK	GALLONS	POUNDS*
AUXILIARY	810	5,429
TOTAL	5,973	40,019

* Usable fuel at level attitude, fuel density = 6.7 pounds per US gallon

Fuel Schematic



DO NOT USE FOR FLIGHT



Airplanes with Auxiliary Tank

Hydraulics — Chapter 13

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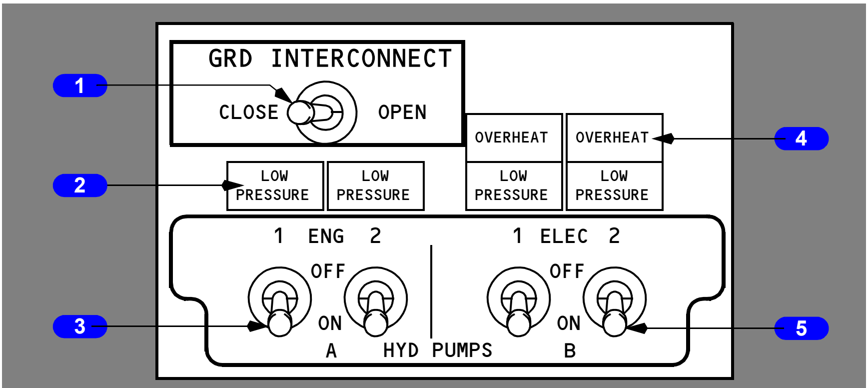
Hydraulic Panel



FORWARD OVERHEAD PANEL

1 GROUND INTERCONNECT Switch

CLOSE – isolates system A using units from system B output.

OPEN – connects system A pressure to system B pressure for ground functional checks. The ground interconnect valve will open only if the parking brake is set, the airplane is on the ground and electrical power is available.

2 Hydraulic Pump LOW PRESSURE Lights

Illuminated (amber) – output pressure of associated pump is low

Note: When an engine fire switch is pulled, the associated engine-driven hydraulic pump low pressure light is deactivated.

3 Engine Hydraulic Pump Switches

ON – de–energizes blocking valve in pump to allow pump pressure to enter system.

Note: Should remain ON at shutdown to prolong solenoid life.

OFF – energizes blocking valve to block pump output.

4 Electric Hydraulic Pump OVERHEAT Lights

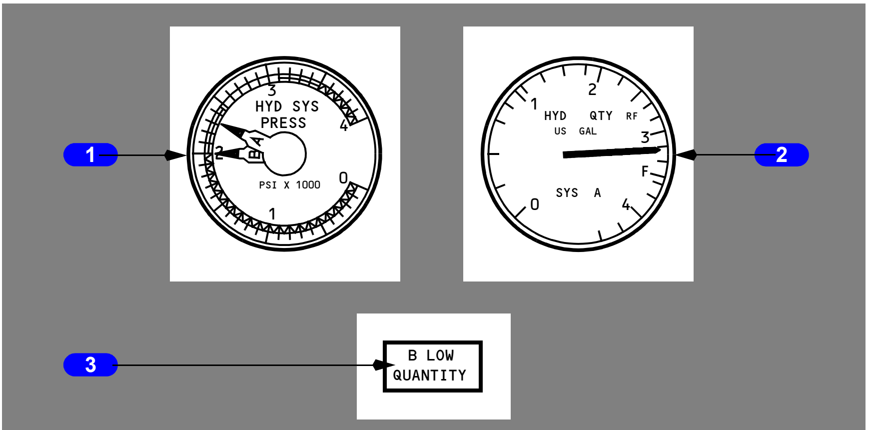
Illuminated (amber) – hydraulic pump or fluid used to cool and lubricate the corresponding electric motor driven pump has overheated.

5 Electric Hydraulic Pump Switches

ON – provides power to corresponding electric motor–driven pump.

OFF – electrical power removed from pump.

Hydraulic Indications



F/O INSTRUMENT PANEL

1 HYDRAULIC System PRESSURE Indications

Indicates system A and B pressures:

- Normal pressure – 3000 psi
- Maximum pressure – 3500 psi.

Note: When both pumps for a system are OFF, respective pointer reads zero.

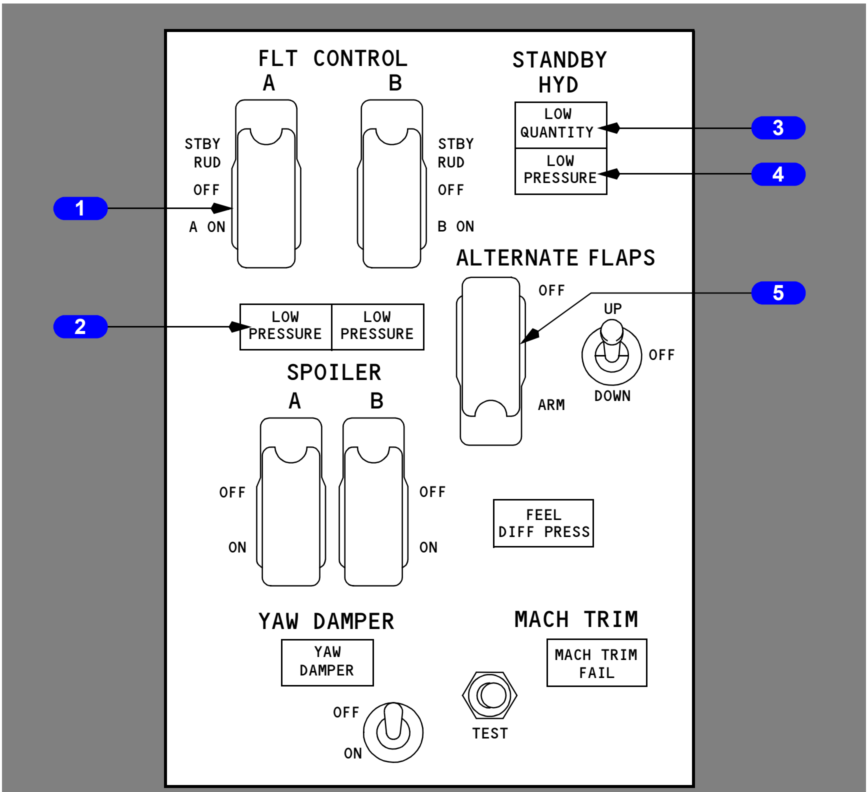
2 SYSTEM A HYDRAULIC QUANTITY Indicator

- Full – 3.5 U.S. gallons.
- Refill – 2.4 U.S. gallons.

3 Hydraulic System B LOW QUANTITY Light

Illuminated (amber) – indicates reservoir fluid level is low

Flight Control Panel (before Rudder System Enhancement Program (RSEP) modification)



FORWARD OVERHEAD PANEL

1 FLIGHT CONTROL Switches

STBY RUD – activates standby pump and opens standby rudder shutoff valve to pressurize standby rudder power control unit.

OFF – closes flight control shutoff valve isolating ailerons, elevators and rudder from associated hydraulic system pressure.

ON (guarded position) – normal operating position.

2 Flight Control LOW PRESSURE Lights

Illuminated (amber) –

- indicates low hydraulic system (A or B) pressure to ailerons, elevator and rudder.
- deactivated when associated FLIGHT CONTROL switch is positioned to STBY RUD and standby rudder shutoff valve opens.
- on airplanes with the rudder pressure reducer installed, indicates A system pressure is low when normal system pressure is commanded.

Note: On airplanes with the rudder pressure reducer installed, the A system light will remain illuminated for approximately five seconds after A hydraulic system has been activated.

3 STANDBY HYDRAULIC LOW QUANTITY Light

Illuminated (amber) –

- indicates low quantity in standby hydraulic reservoir.
- always armed.

4 STANDBY HYDRAULIC LOW PRESSURE Light

Illuminated (amber) –

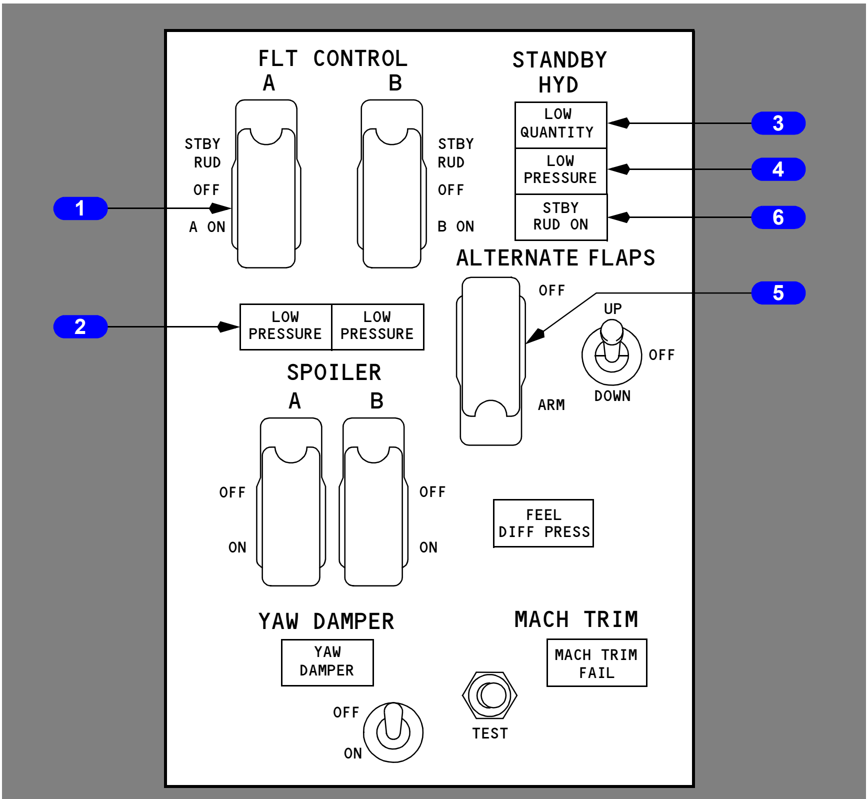
- indicates output pressure of electric motor driven standby pump is low.
- armed only when standby pump operation has been selected.

5 ALTERNATE FLAPS Master Switch

OFF (guarded position) – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms ALTERNATE FLAPS position switch.

Flight Control Panel (after Rudder System Enhancement Program (RSEP) modification)



FORWARD OVERHEAD PANEL

1 FLIGHT CONTROL Switches

STBY RUD – activates standby pump and opens standby rudder shutoff valve to pressurize standby rudder power control unit.

OFF – closes flight control shutoff valve isolating ailerons, elevators and rudder from associated hydraulic system pressure.

ON (guarded position) – normal operating position.

2 Flight Control LOW PRESSURE Lights

Illuminated (amber) –

- indicates low hydraulic system (A or B) pressure to ailerons, elevator and rudder.
- deactivated when associated FLIGHT CONTROL switch is positioned to STBY RUD and standby rudder shutoff valve opens.
- indicates A system pressure is low when full RPR pressure is commanded.

Note: The A system light will remain illuminated for approximately five seconds after A hydraulic system has been activated.

3 STANDBY HYDRAULIC LOW QUANTITY Light

Illuminated (amber) –

- indicates low quantity in standby hydraulic reservoir.
- always armed.

4 STANDBY HYDRAULIC LOW PRESSURE Light

Illuminated (amber) –

- indicates output pressure of electric motor driven standby pump is low.
- armed only when standby pump operation has been selected.

5 ALTERNATE FLAPS Master Switch

OFF (guarded position) – normal operating position.

ARM – closes trailing edge flap bypass valve, activates standby pump, and arms ALTERNATE FLAPS position switch.

6 STBY RUD ON Light

Illuminated (amber) - indicates the standby hydraulic system is commanded on to pressurize the standby rudder power control unit.

Hydraulics Chapter 13
System Description Section 20

Introduction

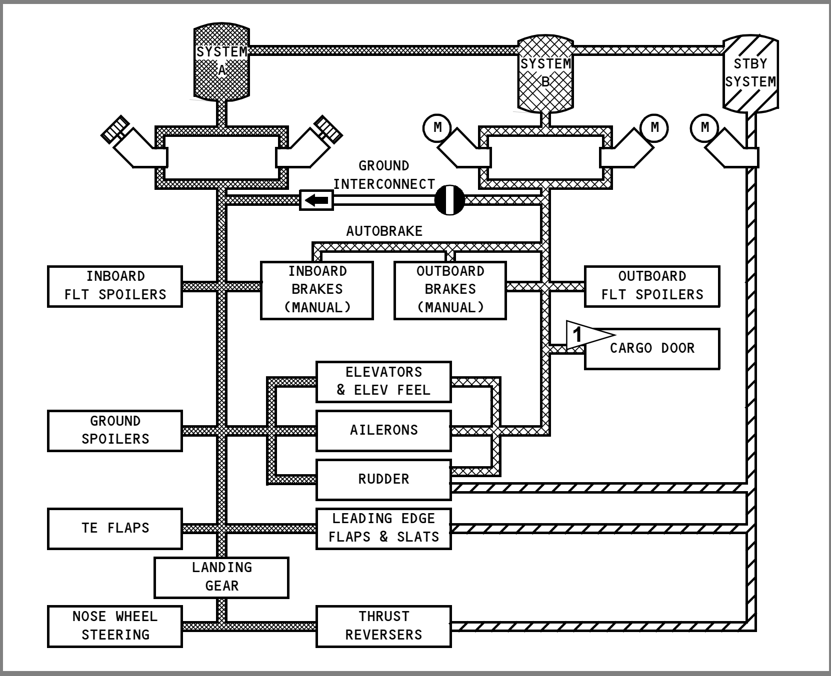
The airplane has three hydraulic systems: A, B and standby. The standby system is used if system A and/or B pressure is lost. The hydraulic systems power the following airplane systems:

- flight controls
- leading edge flaps and slats
- trailing edge flaps
- spoilers
- landing gear
- wheel brakes
- nose wheel steering
- thrust reversers
- yaw damper
- autopilots
- cargo door (cargo airplanes only)

Each hydraulic system has a fluid reservoir located in the main wheel well area. The reservoirs are pressurized by engine bleed air directed into the system A reservoir. Fluid balance lines interconnect all reservoirs. Pressurization of all reservoirs ensures positive fluid supply to all hydraulic pumps and controls the fluid level in the reservoirs.

The ground interconnect valve allows system B to pressurize system A for systems check when the airplane is on the ground, the parking brake is set and electrical power is available.

Hydraulic Power Distribution Schematic



1 As installed

A and B Hydraulic Systems

Components powered by hydraulic systems A and B are:

System A

- ailerons
- rudder
- elevator
- inboard flight spoilers
- inboard brakes
- ground spoilers
- thrust reversers
- nose wheel steering
- landing gear
- leading edge flaps and slats
- trailing edge flaps

System B

- ailerons
- rudder
- elevator
- outboard flight spoilers
- outboard brakes
- yaw damper
- autobrake
- autopilot B
- cargo door (cargo airplanes only)

Hydraulic System A

System A pressure is provided by an engine driven pump on each engine. The ENG 1 and ENG 2 pump ON/OFF switch controls the engine–driven pump output pressure. Positioning the switch to OFF isolates fluid flow from the system components. However, the engine–driven pump continues to rotate as long as the engine is operating. Pulling the engine fire switch shuts off the fluid flow to the engine–driven pump and deactivates the related LOW PRESSURE light.

Hydraulic fluid used for cooling and lubrication of the pumps passes through a heat exchanger before returning to the reservoir. The heat exchanger is located in main fuel tank No. 1 and must be covered with fuel for operation of the pumps.

Pressure switches, located in the pump output lines, send signals to illuminate the related LOW PRESSURE light if pump output pressure is low. A check valve, located in each output line, isolates each pump from the system. The A system pressure transmitter sends the combined pressure of the pumps to the A HYDRAULIC SYSTEM PRESSURE indicator needle.

Hydraulic System B

System B pressure is provided by two electrically driven hydraulic pumps. The ELEC 1 or ELEC 2 pump ON/OFF switch controls the related electric motors.

The system B reservoir is connected to the system A reservoir and the standby reservoir through balance lines for single point pressurization and servicing. The B LOW QUANTITY light illuminates when reservoir fluid is low.

Hydraulic fluid used for cooling and lubrication of the pumps passes through a heat exchanger before returning to the reservoir. The heat exchanger for system B is in main fuel tank No. 2. If a pump or the fluid becomes overheated, the OVERHEAT light illuminates.

CAUTION: Minimum fuel for ground operation of electric pumps is 760 Kgs (1675 Lbs) in fuel tank No. 2.

Pressure switches, located in the pump output lines, send signals to illuminate the related LOW PRESSURE light if pump output pressure is low. Check valves isolate the two pumps. The system pressure transmitter sends the combined pressure of the electric motor–driven pumps to the B HYDRAULIC SYSTEM PRESSURE indicator needle.

The automatic load shedding feature deactivates the respective system B hydraulic pump when a generator is lost. The LOW PRESSURE light illuminates and the pump switch remains in the on position. When the bus is powered again, the pump is activated and the LOW PRESSURE light extinguishes

Standby Hydraulic System

The standby hydraulic system is provided as a backup if system A and/or B pressure is lost. The standby system reservoir is connected to the System B reservoir through a balance line for pressurization and servicing. The standby system LOW QUANTITY light is always armed and indicates low quantity in the standby reservoir. The LOW PRESSURE light is armed only when standby pump operation has been selected. The standby system uses a single electric motor–driven pump to power:

- thrust reversers
- rudder
- leading edge flaps and slats (extend only)

System Operation

Positioning either FLT CONTROL switch to STBY RUD:

- activates the standby electric motor–driven pump
- shuts off the related hydraulic system pressure to ailerons, elevators and rudder by closing the flight control shutoff valve
- opens the standby rudder shutoff valve
- deactivates the related flight control LOW PRESSURE light when the standby rudder shutoff valve opens
- allows the standby system to power the rudder.
- (after RSEP modification) illuminates the STBY RUD ON, Master Caution, and Flight Controls (FLT CONT) lights.

Positioning the ALTERNATE FLAPS master switch to ARM (see the Flight Controls chapter for a more complete explanation):

- activates the standby electric motor–driven pump
- arms the ALTERNATE FLAPS position switch
- allows the standby system to power the leading edge flaps and slats and thrust reversers.

With the loss of System A the standby system will provide pressure to operate the thrust reversers.

Automatic Operation (after RSEP modification)

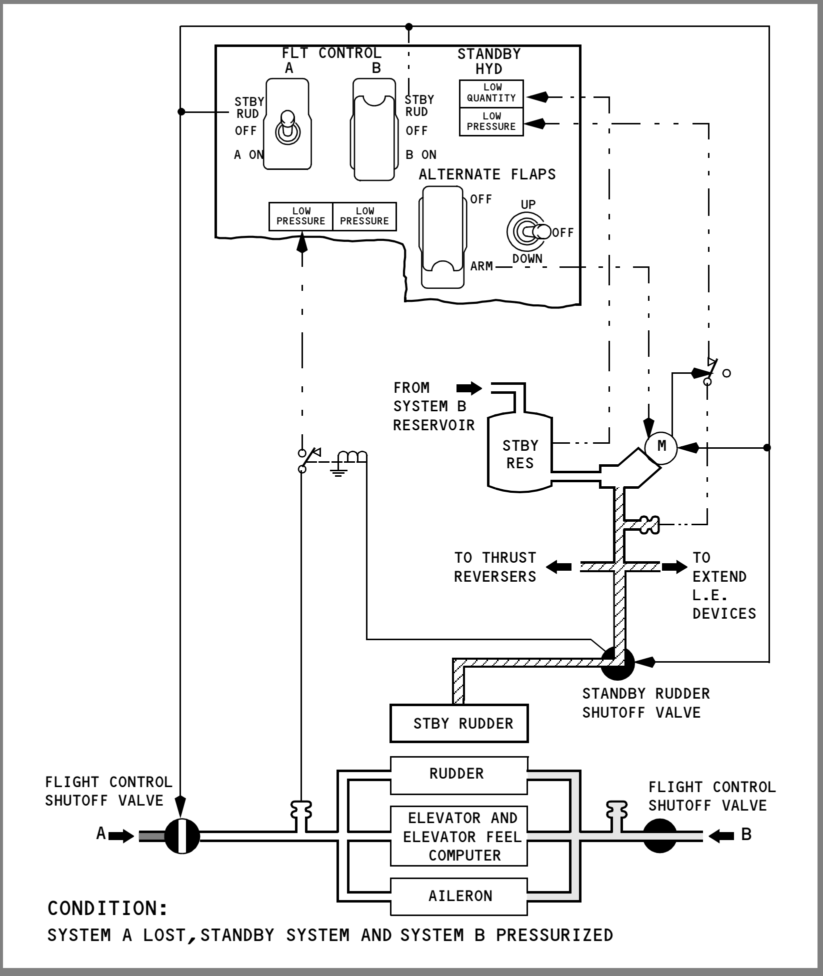
Automatic operation is initiated when the following conditions exist:

- FLT CONTROLS switch A is not in the STBY RUD position,
- FLT CONTROLS switch B is in the ON position,
- ALTERNATE FLAPS arming switch is in the OFF position
- the main PCU Force Fight Monitor (FFM) trips.

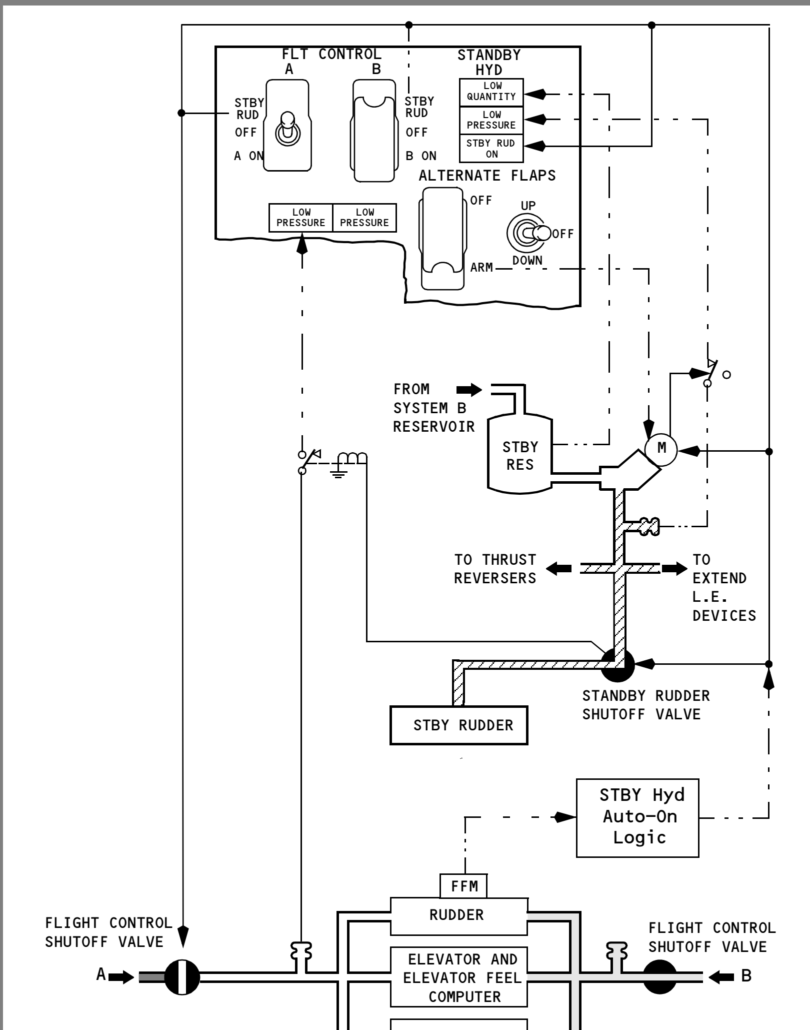
Automatic operation:

- opens the standby rudder shutoff valve
- activates the standby electric motor-driven pump
- allows the standby system to power the rudder
- illuminates the STBY RUD ON, Master Caution, and Flight Controls (FLT CONT) lights.

Standby Hydraulic System Schematic (before RSEP modification)



Standby Hydraulic System Schematic (after RSEP modification)



CONDITION:
SYSTEM A LOST, STANDBY SYSTEM AND SYSTEM B PRESSURIZED

Variations in Hydraulic Quantity Indications

During normal operations, variations in System A hydraulic quantity indications occur when:

- the system becomes pressurized after engine start
- raising or lowering the landing gear or leading edge devices
- cold soaking occurs during long periods of cruise.

These variations have little effect on systems operation.

If the hydraulic system is not properly pressurized, foaming can occur at higher altitudes. Foaming can be recognized by pressure fluctuations and the blinking of the related LOW PRESSURE lights.

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Landing Gear — Chapter 14
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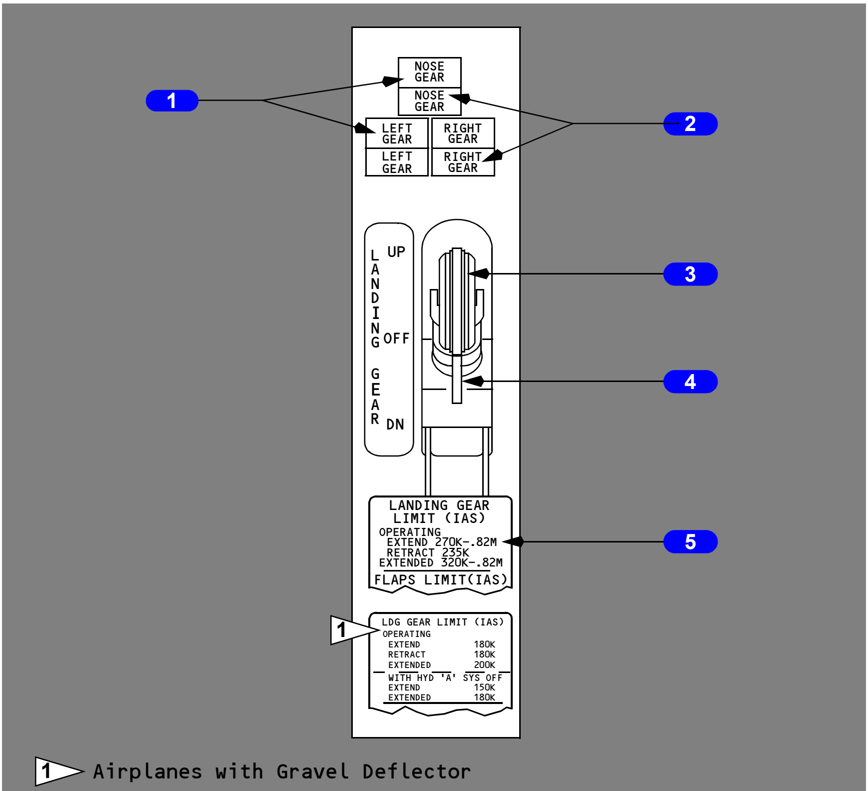
Landing Gear Panel



CENTER INSTRUMENT PANEL

1 Landing Gear Indicator Lights (top)

Illuminated (red) –

- landing gear is not down and either thrust lever is retarded to idle
- related landing gear is in disagreement with LANDING GEAR lever position (in transit or unsafe)
- gear is down and locked and lever is not in the down detent

Extinguished –

- landing gear is up and locked with landing gear lever UP or OFF
- landing gear is down and locked with landing gear lever DN.

2 Landing Gear Indicator Lights (bottom)

Illuminated (green) – related gear down and locked.

Note: Landing gear warning horn is deactivated with all gear down and locked.

Extinguished – landing gear is not down and locked.

3 LANDING GEAR Lever

UP – landing gear retract.

OFF – hydraulic pressure is removed from landing gear system.

DN – landing gear extend.

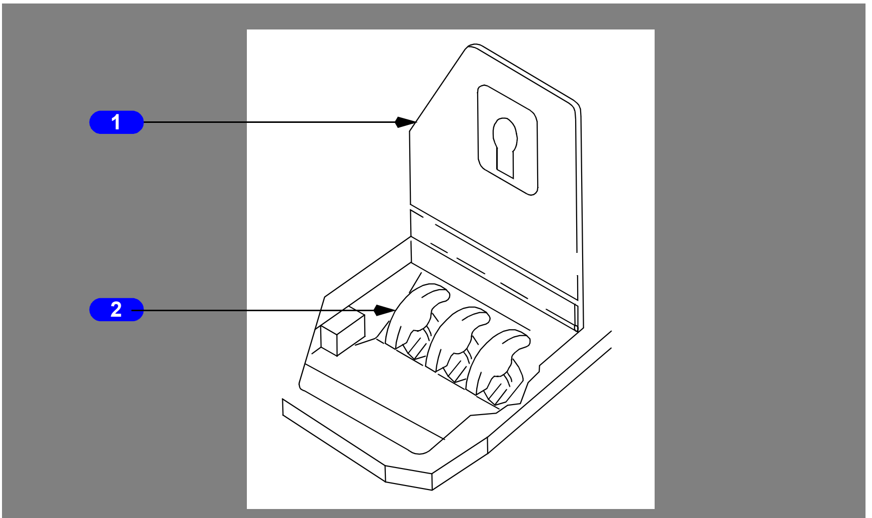
4 Override Trigger

Allows LANDING GEAR lever to be raised, bypassing lever lock.

5 LANDING GEAR LIMIT Speed Placard

Indicates maximum speed while operating landing gear and after gear extension.

Manual Gear Extension



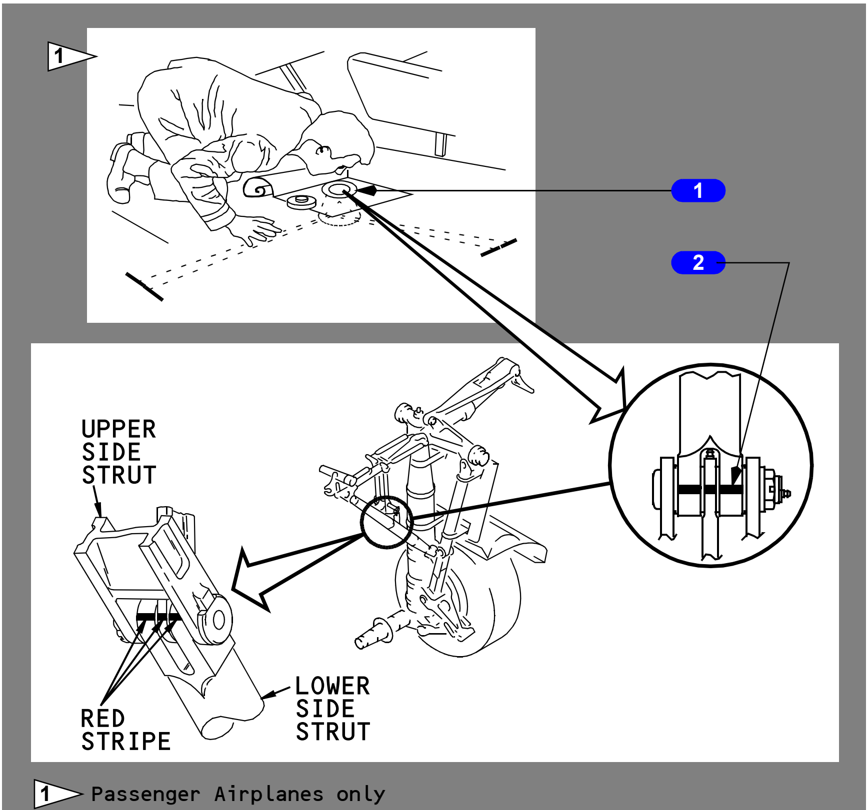
FLIGHT DECK FLOOR

1 Manual Extension Access Door

2 **Manual Gear Extension Handles**

Right main, nose, left main– With LANDING GEAR lever in the OFF position, each landing gear uplock is released when related handle is pulled to its limit, approximately 18 inches (45 cm) for the main gear, approximately 8 inches (20 cm) for the nose gear.

Main Gear Viewer



PASSENGER CABIN FLOOR and MAIN LANDING GEAR

1 **Main Gear Viewer Access (Passenger airplanes only)**

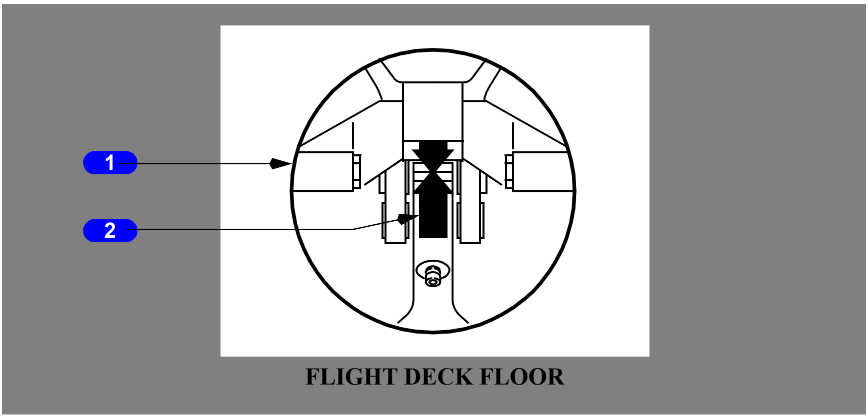
Opposite the 3rd window behind the aft overwing exit and one foot left of center. Pull up the carpet identified by a metal button to sight through viewer. Before leaving the cockpit, position the WHEEL WELL light switch ON.

Note: In some installations viewer may be under the aisle seat.

2 Paint Stripes (red)

Indication that the landing gear is down and locked is provided by observing the alignment of red paint stripes, located on the down lock and the side struts.

Nose Gear Viewer



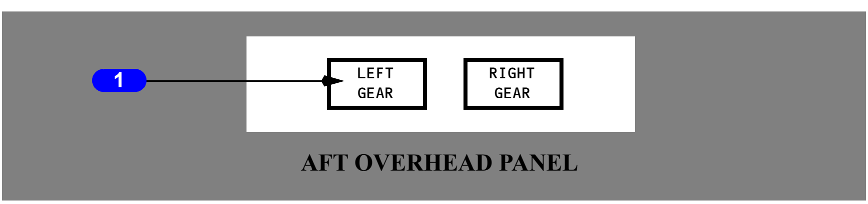
1 Viewer Access –

Cover plate for the nose landing gear viewer is located on the floor just inside the cockpit door. The WHEEL WELL light switch must be ON.

2 Arrow Head (red) –

Indication that the nose gear is down and locked is provided by observing the two red arrow heads on the down lock strut are in contact.

Alternate Gear Safe Lights (Cargo Airplanes only)

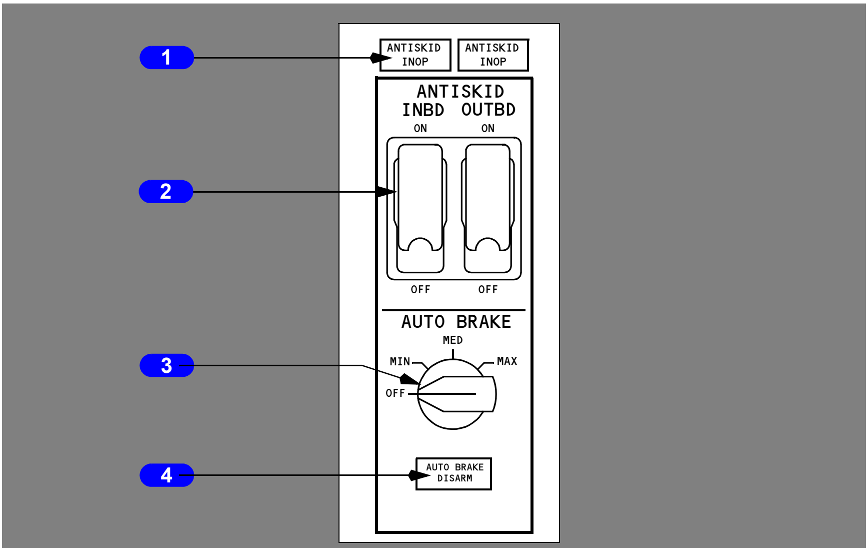


1 Alternate Gear Safe Lights

Illuminated (green) – provides alternate indication that the main gear is down and locked

Extinguished – main gear is not down and locked.

Autobrake and Antiskid Controls



CENTER INSTRUMENT PANEL

1 Antiskid Inoperative (ANTISKID INOP) Light

Illuminated (amber) – a system fault is detected by antiskid monitoring system.

Extinguished – antiskid system operating normally.

2 ANTISKID Control Switch

ON – guarded position.

OFF – turns off antiskid system to respective wheels and illuminates respective ANTISKID INOP light.

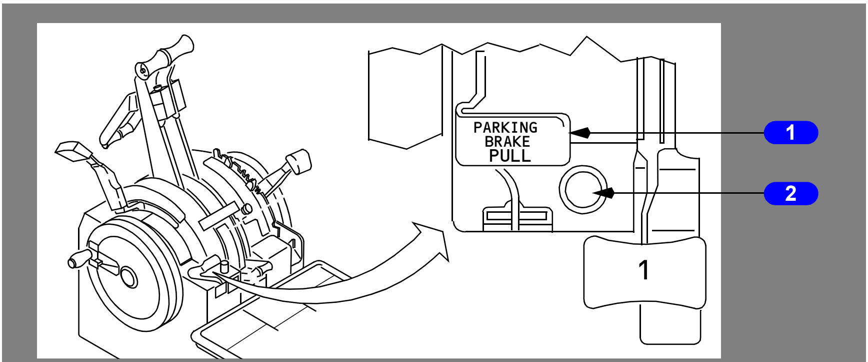
3 AUTO BRAKE Select Switch

Used to select the level of desired braking. The switch must be pulled out to select MAX deceleration.

4 AUTO BRAKE DISARM Light

Illuminated (amber) – a malfunction exists in the automatic braking system.

Parking Brake



CONTROL STAND

1 PARKING BRAKE Lever

Forward – parking brake is released.

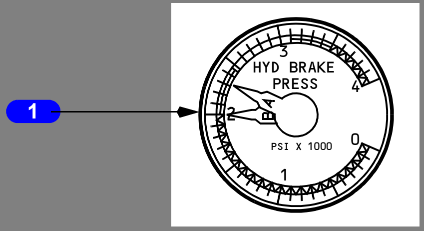
Aft – sets parking brakes when either Captain's or First Officer's brake pedals are fully depressed.

2 Parking Brake Warning Light

Illuminated (red) – parking brake is set (lights operate from battery power).

Extinguished – parking brake is released.

Hydraulic Brake Pressure Indicator



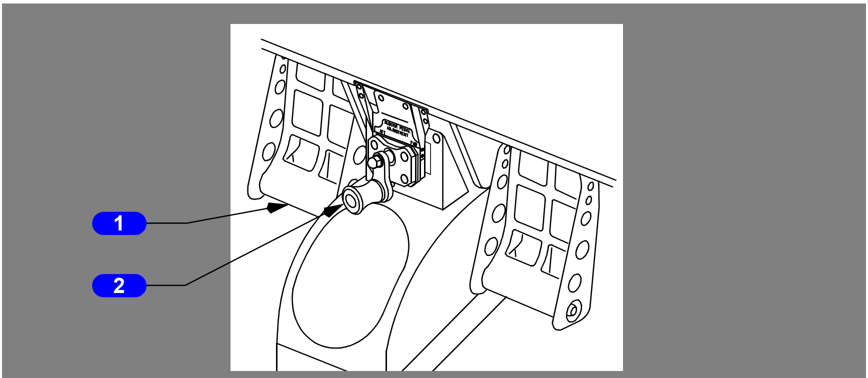
FIRST OFFICER'S INSTRUMENT PANEL

1 Hydraulic (HYD) BRAKE Pressure (PRESS) Indicator

Indicates system A and B brake system pressure:

- normal pressure – 3000 psi
- normal precharge – 1000 psi.

Rudder/Brake Pedals



CREW STATION

1 Rudder/Brake Pedals

Push full pedal – turns nose wheel up to 7 degrees in either direction.

Push top of pedal only – activates wheel brakes.

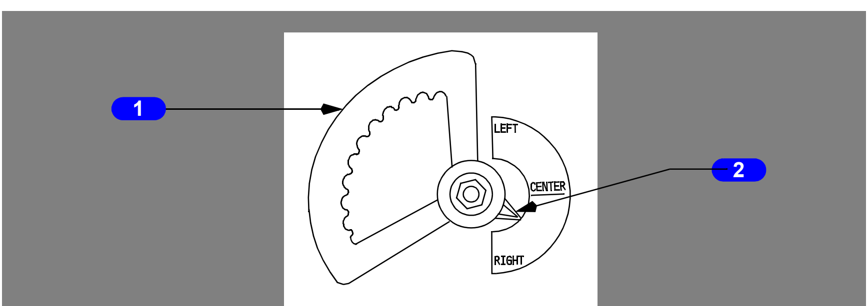
Refer to Chapter 9 Flight Controls for rudder description.

2 RUDDER PEDAL ADJUSTMENT Crank

AFT (counter–clockwise) – adjusts rudder pedals aft.

FWD (clockwise) – adjusts rudder pedals forward.

Nose Wheel Steering Wheel



CAPTAIN’S SIDE PANEL

1 Nose Wheel Steering Wheel

Rotate –

- turns nose wheel up to 78 degrees in either direction
- overrides rudder pedal steering.

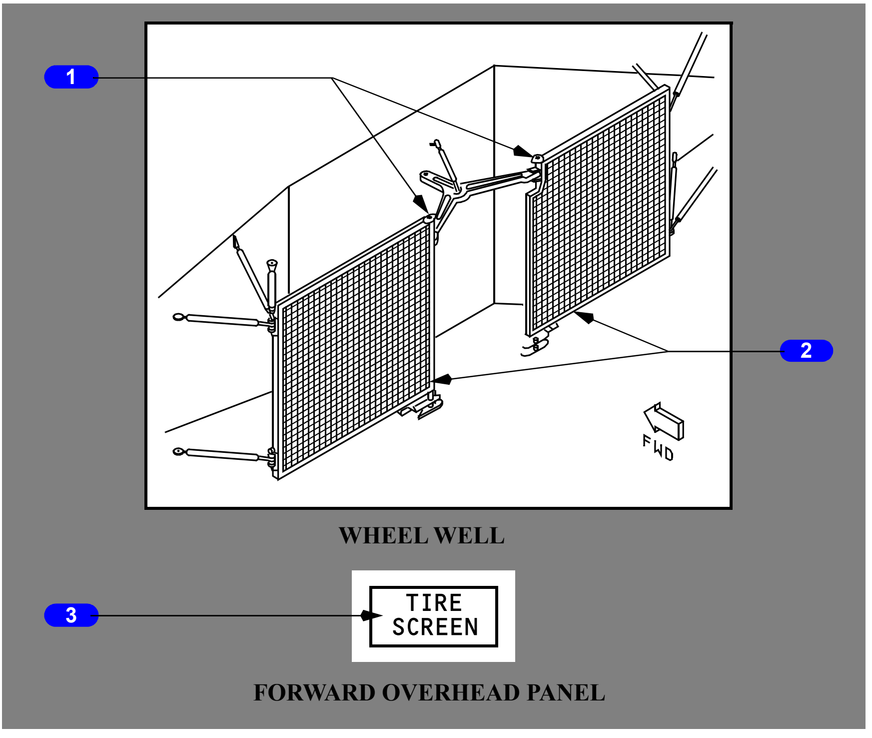
2 Nose Wheel Steering Indicator

LEFT – indicates nose wheel steering displacement left of center position.

CENTER – normal straight ahead position.

RIGHT – indicates nose wheel steering displacement right of center position.

Tire Screens



1 Screen Locking Pins

If unlocked, will cause illumination of the Tire Screen light.

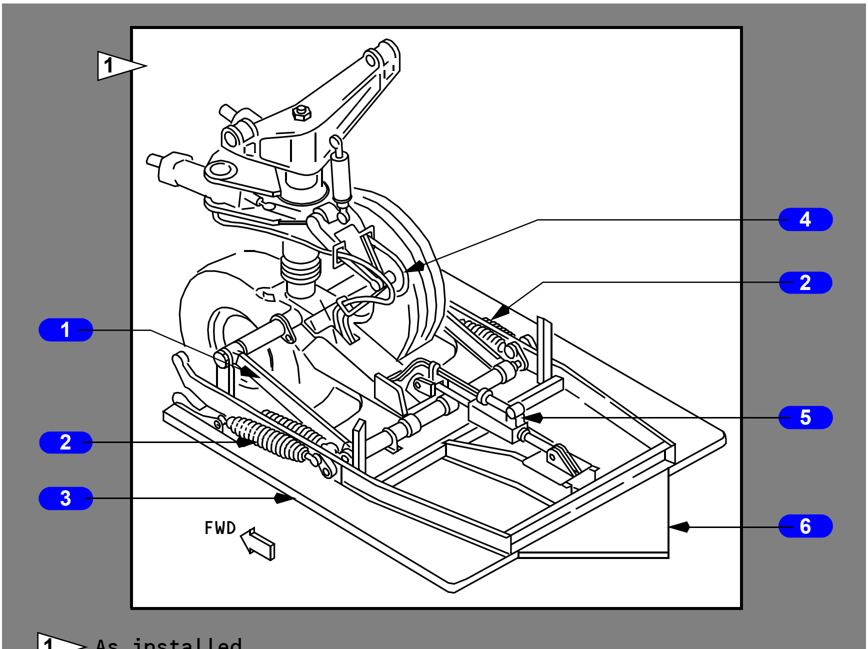
2 Tire Screen

Provides protection for critical hydraulic and flight control equipment in the event of tire burst upon landing gear retraction.

3 **TIRE SCREEN Light**

Illuminated (amber) – indication that the tire screens are not secure.

Nose Gear Gravel Deflector



NOSE WHEEL

1 **Side Brace**

2 **Tension Spring**

3 **Airfoil (Typical)**

4 **Hydraulic Lines**

5 **Hydraulic Actuator**

6 **Deflector Shield**

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Introduction

The airplane has two main landing gear and a single nose gear. Each main gear is a conventional two–wheel landing gear. The nose gear is a conventional steerable two–wheel unit.

Hydraulic power for retraction, extension, and nose wheel steering is normally supplied by hydraulic system A. A manual landing gear extension system is provided.

Normally, brakes are powered by hydraulic systems A and B. Antiskid protection is provided on all brakes. When the autobrake is selected, pressure is automatically applied in conjunction with the antiskid system.

Landing Gear Operation

The landing gear are normally controlled by the LANDING GEAR lever. On the ground, a landing gear lever lock prevents the LANDING GEAR lever from moving to the up position. An override trigger in the lever may be used to bypass the landing gear lever lock. In flight, the air/ground system energizes a solenoid which opens the lever lock.

Landing Gear Retraction

When the LANDING GEAR lever is moved to UP, the landing gear begins to retract. During retraction, the brakes automatically stop rotation of the main gear wheels. After retraction, the main gear are held in place by mechanical uplocks. Rubber seals and oversized hubcaps complete the fairing of the outboard wheels.

The nose wheels retract forward into the wheel well and nose wheel rotation is stopped by snubbers. The nose gear is held in place by an overcenter lock and enclosed by doors which are mechanically linked to the nose gear

Hydraulic pressure is removed from the landing gear system with the LANDING GEAR lever in the OFF position.

Landing Gear Extension

When the LANDING GEAR lever is moved to DN, hydraulic system A pressure is used to release the uplocks. The landing gear extends by hydraulic pressure, gravity and air loads. Overcenter mechanical and hydraulic locks hold the gear at full extension. The nose wheel doors stay open when the gear is down.

Landing Gear Manual Extension

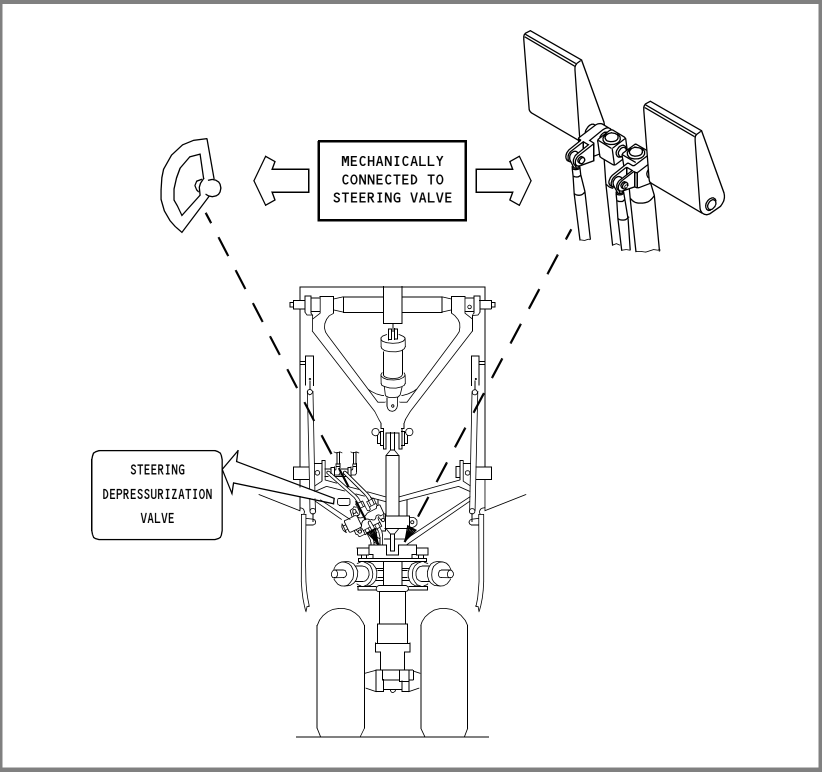
If hydraulic system A pressure is lost, the manual extension system provides another means of landing gear extension. Manual gear releases on the flight deck are used to release uplocks that allow the gear to free–fall to the down and locked position. The forces that pull the gear down are gravity and air loads.

Nose Wheel Steering

The airplane is equipped with nose wheel steering which is powered by hydraulic system A. Nose wheel steering is operative only when hydraulic system A is pressurized and the landing gear lever is in the down position.

Primary steering is controlled through the nose wheel steering wheel. Limited steering control is available through the rudder pedals. A pointer on the nose steering wheel assembly shows nose wheel steering position relative to the neutral setting. Rudder pedal steering is deactivated as the nose gear strut extends.

A lockout pin may be installed in the towing lever to depressurize nose wheel steering. This allows airplane pushback or towing without depressurizing the hydraulic system.



NOSE WHEEL STEERING

Nose Gear Gravel Deflector (As Installed)

The gravel deflector shield prevents engine gravel ingestion and reduces damage to the underside of the airplane. The deflector consists of a plywood sheet faced with corrosion resistant steel, a hydraulic actuator and four springs. The hydraulic actuator is supplied by hydraulic system A and functions to keep the deflector streamlined during gear retraction or extension.

The deflector shield covers the forward portion of the nose wheel well when the gear is retracted; the remaining portion is enclosed by clamshell doors mechanically linked to the nose gear. The four tension springs hold the deflector in the proper position during gear transit in the event that system A pressure is not available. The deflector is in effect an airfoil.

In the event that manual extension is required, the airspeed must be restricted to 150 knots for extension and 180 knots for gear-extended operation to insure that the springs maintain the deflector in the desired position.

The nose gear spray pattern is directly affected by taxi speed, runway condition and use of nose wheel steering. Under normal conditions, spray patterns become inherently safer as speed increases, deep ruts or soft gravel increase the nose gear spray, and large nose wheel steering inputs aggravate spray patterns.

Tire Burst Protection

The tire screens provide protection for critical hydraulic and flight control equipment in the event of tire burst when the main landing gear is retracted.

The TIRE SCREEN light monitors the screen locking pins in the wheel well.

Illumination of the TIRE SCREEN amber caution light activates the DOORS system annunciator and MASTER CAUTION lights on the light shield, indicating the screens are not secure. Pushing either MASTER CAUTION light to RESET extinguishes the DOORS annunciator and MASTER CAUTION lights. The TIRE SCREEN amber caution light remains illuminated until the fault is cleared.

CAUTION: If the tire screen light is illuminated and the cause is a tire burst screen not secure, equipment damage could result when the gear is retracted.

Brake System

Each main gear wheel has a multi–disc hydraulic powered brake. The brake pedals provide independent control of the left and right brakes. The brakes are powered by the two independent hydraulic systems. Hydraulic system A supplies pressure to the inboard brakes and hydraulic system B supplies pressure to the outboard brakes. The nose wheels have no brakes. The brake system includes:

- brake accumulator
- antiskid protection
- autobrake system
- parking brake

Brake Accumulators

Each brake system has an accumulator which stores hydraulic pressure and is used as a backup system in the event of a system hydraulic failure. If normal system pressure is lost, trapped hydraulic pressure in the brake accumulator can still provide several braking applications or parking brake application.

Antiskid Protection

The brake system provides each main gear wheel with individual antiskid protection. The ANTISKID control switches control power to the antiskid controllers. When the system detects a skid, the associated antiskid valve modulates brake pressure until skidding stops. The antiskid system also provides locked wheel, touchdown, and hydroplane protection.

An ANTISKID INOP light illuminates anytime there is a system malfunction. Both ANTISKID INOP lights illuminated indicates there is a disagreement between the PARKING BRAKE lever position and the parking brake shutoff valve position.

Antiskid protection is available even with loss of hydraulic pressure.

Autobrake System

The autobrake system uses hydraulic system B pressure to provide automatic braking at preselected deceleration rates immediately after touchdown. The system operates only when the normal brake system is functioning. Antiskid system protection is provided during autobrake operation.

Landing

The digital autobrake system arms for landing when:

- air/ground safety sensor is in the flight mode
- ANTISKID control switches are ON
- AUTO BRAKE select switch is positioned to MIN, MED, or MAX.

Three levels of deceleration can be selected for landing. However, on dry runways, the maximum autobrake deceleration rate in the landing mode is less than that produced by full pedal braking.

After landing, autobrake application begins when:

- both Thrust Levers are retarded to near IDLE, and
- the main wheels spin–up.

To maintain the selected landing deceleration rate, autobrake pressure is reduced as reverser thrust is applied. The total deceleration of reverse thrust and braking is equal to the selected deceleration rate. The autobrake system brings the airplane to a complete stop unless the braking is terminated by the pilot.

Autobrake – Disarm

The pilots may disarm the autobrake system by moving the selector switch to the OFF position. This action does not cause the AUTO BRAKE DISARM light to illuminate. After braking has started, any of the following pilot actions disarm the system immediately and illuminate the AUTO BRAKE DISARM light:

- moving the SPEED BRAKE lever to the down detent
- advancing the Thrust Levers (as for go-around), or
- applying manual brakes.

Parking Brake

The parking brake is set by depressing both brake pedals, pulling the PARKING BRAKE lever back, then releasing the pedals. This mechanically latches the pedals in the depressed position and commands the parking brake valve to close.

The parking brake is released by depressing the pedals until the PARKING BRAKE lever releases. A fault in the parking brake system may cause the ANTISKID INOP lights to illuminate.

Air/Ground System

In–flight and ground operation of various airplane systems are controlled by the air/ground system.

The system receives air/ground logic signals from sensors located on the right main gear and on some airplanes on the nose gear. These signals are used to configure the airplane systems to the appropriate air or ground status.

Air/Ground System Logic Table

SYSTEMS	NORMAL INFLIGHT OPERATION	NORMAL ON GROUND OPERATION	REFER TO CH
Main Cargo Door (as installed)	Electric door control inoperative.	Door system control fully operative.	1
Control Cabin Fan	Does not operate	Operates whenever only one air conditioning pack is operating.	2
Pressurization	Allows programmed pressurization in the standby and automatic modes.	Allows pressurization on the ground as determined by the FLT/GRD switch.	2

SYSTEMS	NORMAL INFLIGHT OPERATION	NORMAL ON GROUND OPERATION	REFER TO CH
Ram Air	Turbofan(s) operate only when air conditioning packs operate and flaps are not up.	Turbofans operate whenever air conditioning packs operate. Deflectors are extended.	2
Wing Anti–ice (As Installed)	Control valves open when switch is ON.	Control valves do not open except during ground test.	3
Wing Anti–ice Ground Operating System (As Installed)	Control valves open when switch is ON. Thrust setting and duct temperature logic are bypassed.	With switch ON, valves cycle open and closed. Switch trips to OFF at lift-off.	3
Voice Recorder	Prevents tape erasure.	Allows tape erasure when parking brake is set.	5
Standby Inverter	Automatically activated if either AC transfer bus No. 1 or DC bus No. 1 is lost.	Automatic operation disabled.	6
APU Control	APU operation possible with battery switch OFF.	APU shutdown if battery switch is positioned OFF.	7
APU Generator	May be connected to only one generator.	May be connected to two generator buses.	7
Thrust Reverser	Deflector deployment prevented if override is not used.	Deflector doors may be deployed.	7
Vortex Dissipator (as installed)	ON position disabled.	ON position enabled.	7
APU Fire Horn	Wheel well horn disabled.	Wheel well horn enabled.	8

SYSTEMS	NORMAL INFLIGHT OPERATION	NORMAL ON GROUND OPERATION	REFER TO CH
Speed Brake Lever Actuator	Can be armed to raise ground spoilers for landing.	Activates SPEED BRAKE lever on landing if armed. Rejected take–off feature available. Drives to DOWN when thrust lever advanced.	9
Flight Recorder	Operates anytime electric power is available.	Operates anytime electric power is available and either engine is operating.	10
Hydraulic Ground Interconnect	System disabled.	System enables when parking brake is set.	13
Antiskid	Releases normal brakes for touchdown protection.	Allows normal antiskid braking after wheel spin–up.	14
Autobrake	Allows selection of landing mode.		14
Landing Gear Lever Lock	Lever Lock solenoid released.	Lever Lock solenoid latched.	14
Stall Warning	Enabled.	Disabled.	15
Takeoff Warning	Disabled.	Enabled.	15

Warning Systems — Chapter 15

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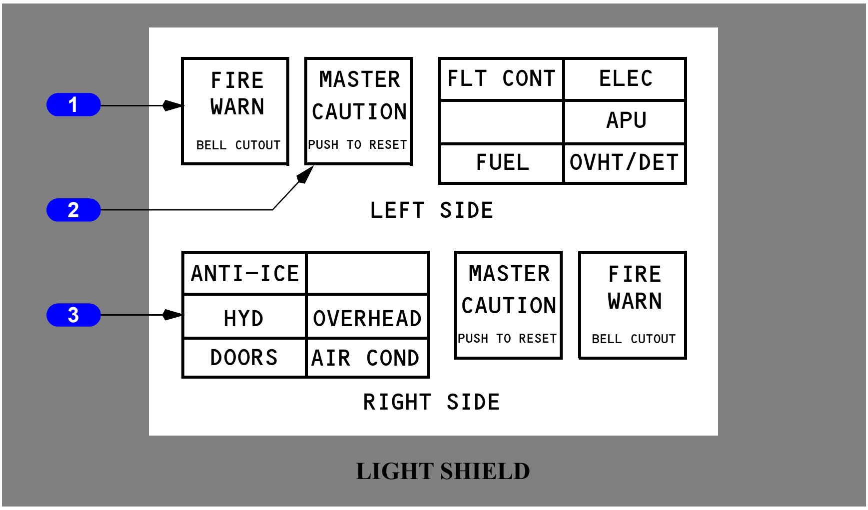
Fire Warning and Master Caution System



1 FIRE WARN Lights

Illuminated (red) – indicates a fire warning (or system test) in engine, APU or main gear wheel well

- fire warning bell sounds
- if on ground, remote APU fire warning horn sounds.

Push – extinguishes both master FIRE WARN lights

- silences fire warning bell
- silences remote APU fire warning horn
- resets system for additional warnings.

Note: Pushing fire warning bell cutout switch on overheat/fire protection panel results in same actions.

2 MASTER CAUTION Lights

Illuminated (amber) – a system annunciator light has illuminated.

Push – extinguishes both MASTER CAUTION lights

- system annunciator light(s) extinguish
- resets system for additional master caution conditions.

3 System Annunciator Panel

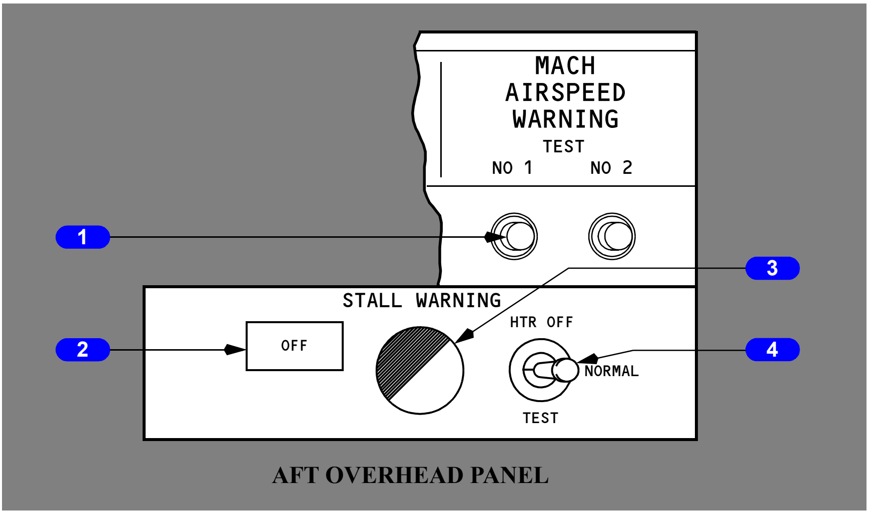
Illuminated (amber) – an amber light, relating to illuminated system annunciator, has illuminated on forward overhead, aft overhead or overheat/fire protection panel.

To extinguish – push either MASTER CAUTION light.

To recall – push and release either System Annunciator Panel

- if a master caution condition exists, appropriate system annunciator(s) and MASTER CAUTION lights illuminate.

Mach/Airspeed Warning and Stall Warning Test Switches



1 MACH AIRSPEED WARNING TEST Switch

Push –Tests respective Mach/Airspeed warning system

- clacker sounds
- inhibited while airborne.

2 STALL WARNING OFF Light

Illuminated (amber)– indicates a failure of the angle airflow sensor heater, a system signal failure, or a power failure.

3 TEST INDICATOR

Rotating – indicates electrical continuity through the angle airflow sensor and flap position transmitter during TEST.

4 **STALL WARNING SWITCH**

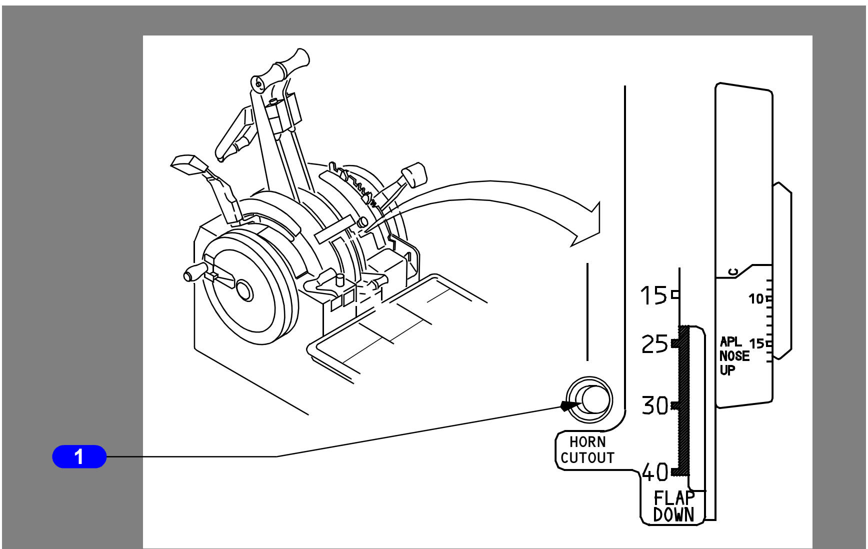
Normal – heater power for the angle airflow sensor is available only if engine 1 is operating or the air ground safety sensor is in the air mode.

Test – with engine 1 not operating: OFF light extinguishes, Test Indicator rotates, and the control columns vibrate.

– with engine 1 operating: OFF light remains extinguished, Test Indicator rotates, and the control columns vibrate.

HTR OFF (Heater Off) – locked toggle position--for maintenance checks only.

Landing Gear Warning Cutout Switch



CONTROL STAND

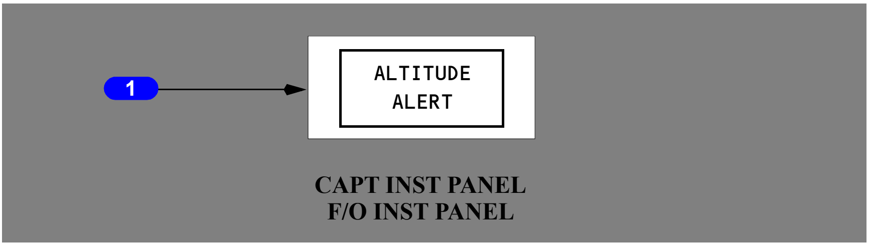
1 **Landing Gear Warning Cutout Switch**

Push – silences landing gear configuration warning aural indication:

- at flaps 1 through 10
- at flaps 15 or 25, when either forward thrust lever is between idle and approximately 10° and opposite forward thrust lever is greater than approximately 30°.

Note: Aural indication cannot be silenced with cutout switch at flaps greater than 25.

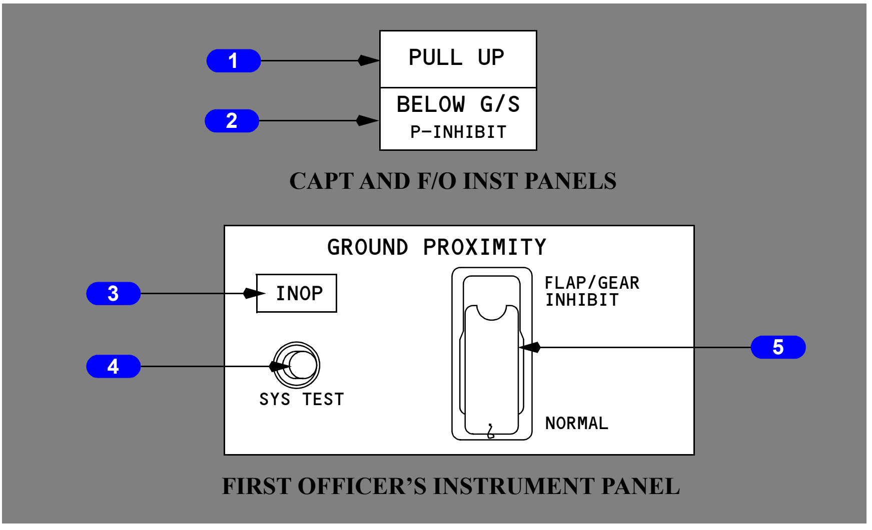
Altitude Alert



1 ALTITUDE ALERT Annunciation

Illuminated (amber) – Airplane is within the range of 1000 to 375 feet of the selected altitude.

GPWS Controls and Indicators



1 PULL UP WARNING LIGHT

Illuminated (red) – indicates one or more of the following exist:

- excessive descent rate
- excessive terrain closure rate
- altitude loss after takeoff or go–around
- unsafe terrain clearance when not in the landing configuration

2 BELOW G/S (Below Glide Slope) Alert Light, P-INHIBIT (Push to Inhibit) Alert Light and Switch

BELOW G/S illuminated (amber) – Indicates that aircraft is more than 1.3 dots below glide slope.

P-INHIBIT illuminated (amber) – Indicates glide slope alert is inhibited.

Push – Inhibits or cancels below glide slope alerting when pressed below 2000 feet AGL. Resets automatically when aircraft ascends above 2000 feet AGL or descends below 30 feet AGL.

2 BELOW G/S (Below Glide Slope) Alert Light, P-INHIBIT (Push to Inhibit) Alert Light and Switch

BELOW G/S illuminated (amber) – Indicates that aircraft is more than 1.3 dots below glide slope.

P-INHIBIT illuminated (amber) – Indicates glide slope alert is inhibited.

Push – Inhibits or cancels below glide slope alerting when pressed below 2000 feet AGL. Resets automatically when aircraft ascends above 2000 feet AGL or descends below 30 feet AGL.

3 GPWS Inoperative (INOP) Light

Illuminated (amber) – GPWS computer malfunction or power loss

- invalid inputs are being received from the VHF NAV receiver, ADC, or radio altimeter.

4 Ground Proximity System (SYS TEST) Switch

Push –

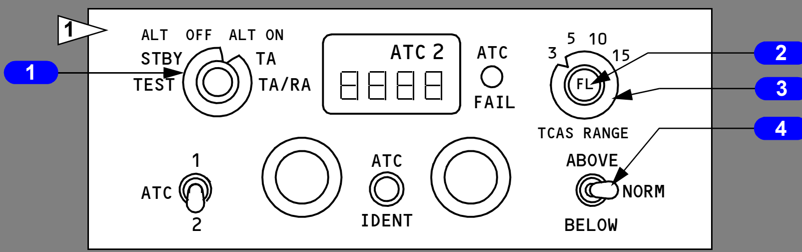
- momentarily on ground--with landing gear not in landing configuration-- or above 1,000 feet radio altitude in flight--with gear up and flaps in any configuration:
  - illuminates BELOW G/S, PULL UP and INOP lights, and causes the “GLIDE SLOPE” and “WHOOP, WHOOP, PULL UP” aurals to sound
- at least 10 seconds, on ground – above indications always occur first, followed by any additional aurals, as installed
- system test is inhibited from lift–off to 1000 feet radio altitude.

5 Ground Proximity FLAP/GEAR Inhibit Switch

FLAP/GEAR INHIBIT – inhibits or cancels warnings/alerts caused by flaps not in 30 or 40 position or landing gear not down.

NORMAL (guarded position) – flap and landing gear position logic is provided for GPWS.

Transponder Panel (TCAS)



AFT ELECTRONIC PANEL

1 As installed

1 Transponder Mode Selector

TEST – tests transponder units.

STBY – disables transponder modes.

Note: Transponder modes are enabled only when airplane is airborne except for Mode S, which operates continuously when the Transponder Mode Selector is out of STBY.

ALT OFF – deactivates altitude reporting.

ALT ON – transponder operates with altitude reporting.

TA – enables display of Traffic Advisory TCAS targets.

TA/RA – enables display of Traffic Advisory and Resolution Advisory TCAS targets.

2 Absolute Altitude Display Selector

Press – displays absolute altitudes of TCAS targets for 15 seconds.

3 TCAS Range Switch

Selects range for TCAS display when weather radar is operating in TCAS mode only.

4 Altitude Range Switch

Allows shifting of TCAS coverage up and down from baseline:

- ABOVE – sets TCAS display at upper elevation limit.
- NORM – sets TCAS display for normal limit.
- BELOW – sets TCAS display at lower elevation limit.

Warning Systems — Chapter 15
System Description — Section 20

Introduction

Aural, tactile and visual warning signals alert the flight crew to conditions requiring action or caution in the operation of the airplane. The character of the signals varies, depending upon the degree of urgency or types of hazards involved. Aural, tactile, and visual signals are used singularly or in combination to simultaneously provide both warnings and information regarding the nature of the condition.

Mach/airspeed warnings, landing gear warnings, takeoff configuration warnings, windshear warnings, and ground proximity warnings are discussed in this section. Cabin altitude warning is discussed in this section and in the Air Systems chapter, and autopilot and autothrottle disconnect warnings are discussed in the Automatic Flight chapter. The conditions which excite the fire warning bell are discussed in the Fire Protection chapter.

Conditions which require the immediate attention of the flight crew are indicated by red warning lights located in the area of the pilots' primary field of vision. These lights indicate APU, engine, or wheel well fires; autopilot and unsafe landing gear conditions.

Conditions which require the timely attention of the flight crew are indicated by amber caution lights.

Blue lights inform the flight crew of electrical power availability, valve position, equipment status, and flight attendant or ground communications. Blue lights are for information and do not require immediate flight crew attention. Some system blue lights indicate a transitional state by illuminating bright as valves or components reposition, then returning to a dim blue when the required configuration is reached.

Green lights indicate a fully extended configuration, e.g., landing gear and leading edge devices.

For specific information regarding red, amber, blue, and green lights refer to the appropriate systems chapters.

Stall warning is provided by a control column shaker on the captain's control column, or–as installed–on each control column.

Various aural signals call attention to warnings and cautions. An aural warning for airspeed limits is given by a clacker, the autopilot disconnect by a warning tone, takeoff configuration and cabin altitude by an intermittent horn, and landing gear positions by a steady horn. The fire warning is given by a fire warning bell. Ground proximity warnings and alerts–as well as windshear warnings and alerts–are given by voice warnings.

Generally, aurals automatically silence when the associated non–normal condition no longer exists.

Master Fire Warning Lights

Two master FIRE WARN lights illuminate when any fire warning condition occurs. The lights remain illuminated as long as the condition exists. Pushing either master FIRE WARN light or fire warning bell cutout switch extinguishes both lights, silences the fire warning bell and resets the system for future warnings. Further information appears in the Fire Protection chapter.

Master Caution Lights

Two MASTER CAUTION lights illuminate when any caution occurs outside the normal field of vision of the flight crew. The lights remain illuminated as long as the caution condition exists, or until the crew resets the system. Pushing either MASTER CAUTION light extinguishes both lights and resets the master caution system for further cautions. Pushing either annunciator light panel recalls all existing fault annunciations.

A single fault in certain redundant systems–also known as a "simple fault"–does not illuminate the MASTER CAUTION or system annunciator lights. However, this type of fault is stored in the master caution system. Pushing the system annunciator recalls the simple fault on the system annunciator panel.

System Annunciator Lights

Two system annunciator light panels are located on the glare shield. The annunciator light panels include only those systems located on the forward overhead, aft overhead, and fire control panels. If a caution condition exists, the appropriate system annunciator(s) and MASTER CAUTION lights illuminate.

When MASTER CAUTION recall is pressed, all twelve system lights should illuminate while the press-to-test feature is held. If a system annunciator light does not illuminate, refer to the Dispatch Deviation Guide (DDG).

System Annunciators and Related Amber Lights – Left Side

<table>
<tr>
<td>FLT CONT
FEEL DIFF PRESS
LOW PRESSURE
LOW QUANTITY
MACH TRIM FAIL
YAW DAMPER</td>
<td rowspan="3"><table><tr><td>FLT CONT</td><td>ELEC</td></tr><tr><td></td><td>APU</td></tr><tr><td>FUEL</td><td>OVHT/DET</td></tr></table>
LEFT SIDE
LIGHT SHIELD</td>
<td>ELEC
BUS OFF
HIGH OIL TEMP
LOW OIL PRESSURE
STANDBY PWR OFF
TRANSFER BUS OFF</td>
</tr>
<tr>
<td></td>
<td>APU
HIGH OIL TEMP
LOW OIL PRESSURE
OVERSPEED</td>
</tr>
<tr>
<td>FUEL
FILTER ICING
LOW PRESSURE</td>
<td>OVHT/DET
ENGINE 1 OVERHEAT
ENGINE 2 OVERHEAT
APU DET INOP</td>
</tr>
</table>

System Annunciators and Related Amber Lights – Right Side

<table>
<tr>
<td>ANTI–ICE
WINDOW OVERHEAT
PITOT HEAT</td>
<td rowspan="3"><table><tr><td>ANTI–ICE</td><td></td></tr><tr><td>HYD</td><td>OVERHEAD</td></tr><tr><td>DOORS</td><td>AIR COND</td></tr></table>
RIGHT SIDE
LIGHT SHIELD</td>
<td></td>
</tr>
<tr>
<td>HYD
OVERHEAT
LOW PRESSURE</td>
<td>OVERHEAD
EMER EXIT LIGHTS–NOT ARMED
EQUIP COOLING–OFF
FLIGHT RECORDER–OFF
ISOLATION VALVE–THRUST REVERSER
PASS OXY–ON
STALL WARNING–OFF</td>
</tr>
<tr>
<td>DOORS
EQUIP
FWD/AFT ENTRY
FWD/AFT CARGO
FWD/AFT SERVICE
AIRSTAIR
TIRE SCREEN</td>
<td>AIR COND
DUCT OVERHEAT
DUAL BLEED
PACK TRIP OFF
WING–BODY OVERHEAT
BLEED TRIP OFF
AUTO FAIL
OFF SCHED DESCENT</td>
</tr>
</table>

Warning Systems

Intermittent Cabin Altitude/Takeoff Configuration Warning

The takeoff configuration warning is armed when the airplane is on the ground and either or both forward thrust levers are advanced for takeoff. An intermittent warning horn sounds if:

- Leading Edge devices are NOT configured for takeoff, or
- Speed Brake lever is NOT in the DOWN position, or
- Stabilizer Trim is NOT set in the takeoff range, or
- Trailing Edge flaps are NOT in the flaps 1 through 25 takeoff range.

The warning indication is cancelled when the configuration error is corrected.

The Cabin Altitude Warning Horn activates when cabin altitude exceeds 10,000 feet. An intermittent warning horn is heard. The Cabin Altitude Warning Horn may be silenced by momentarily pressing the ALT HORN CUTOUT switch on the Cabin Altitude Panel.

Landing Gear Configuration Warnings

Visual indications and aural warnings of landing gear position are provided by the landing gear indicator lights and landing gear warning horn.

Visual Indications

The landing gear indication lights are activated by signals from each gear, the LANDING GEAR lever, and the forward thrust lever position as follows:

Green light illuminated – landing gear is down and locked.

Red light illuminated –

- landing gear position is in disagreement with LANDING GEAR control lever position (in transit or unsafe)
- landing gear is unlocked
- landing gear is not down and locked (with either or both forward thrust levers retarded to idle).

All lights extinguished – landing gear is up and locked with the LANDING GEAR lever UP or OFF.

Aural Indications

A steady warning horn is provided to alert the flight crew whenever the airplane is in a landing configuration and any gear is not down and locked. The landing gear warning horn is activated by forward thrust lever and flap position as follows:

Flaps 1 through 10–

- either or both forward thrust levers between idle and approximately 10 degrees thrust lever angle; the landing gear warning horn can be silenced (reset) with the landing gear warning HORN CUTOUT switch

Flaps 15 or 25–

- either–but not both–forward thrust levers retarded to idle; the landing gear warning horn can be silenced (reset) with the landing gear warning HORN CUTOUT switch
- both forward thrust levers set below approximately 30 degrees; the landing gear warning horn cannot be silenced with the landing gear warning HORN CUTOUT switch

Flaps greater than 25–

- forward thrust levers in any position; the landing gear warning horn cannot be silenced with the landing gear warning HORN CUTOUT switch.

The warning indication is cancelled when the configuration error is corrected.

Mach/Airspeed Warning System

Two independent Mach/airspeed warning systems provide a distinct aural warning–a clacking sound–any time the maximum operating airspeed of Vmo/Mmo is exceeded. Each system operates from a mechanism internal to the respective pilot's Mach/airspeed indicator. The warning clacker can be silenced only by reducing airspeed below Vmo/Mmo and can be tested at any time with the test switch.

Stall Warning System

Natural stall warning (buffet) usually occurs at a speed prior to stall. In some configurations the margin between stall and natural stall warning is less than desired. Therefore, an artificial stall warning device–a stick shaker–is used to provide the required warning.

The stall warning "stick shaker" consists of an eccentric, weighted motor on the captain's control column. Designed to alert the pilot before a stall develops, the warning is given by vibrating the control column. The system is armed in flight at all times. The system is deactivated on the ground.

The stall warning system consists of:

- a control column shaker,
- a heated angle of airflow sensor,
- a flap position sensor,
- a stall warning amplifier,
- an air-ground safety sensor, and
- a stall warning test panel on the aft overhead panel.

A test switch is installed in the aft overhead panel. Pushing the switch initiates a self-test of the stall warning channel.

Altitude Alerting System

Altitude alerting compares the altitude selected on the ALTITUDE ALERT CONTROLLER with the altitude shown in the captain's altimeter. Alerting consists of a two-second tone and the illumination of the ALTITUDE ALERT lights–located on the captain's and first officer's instrument panels–when 1000 feet above or below the selected altitude. The lights extinguish when 375 feet from the selected altitude.

Ground Proximity Warning System (GPWS)

WARNING: Do not deactivate the GPWS (by pulling the circuit breaker or using the inhibit switch) except for an approved procedure--where use of flaps at less-than-normal-landing-flap position, or leaving landing gear up is specified.

The GPWS provides alerts for potentially hazardous flight conditions. GPWS alerts--to the extent they are installed--are for imminent impact with the ground, detected windshear condition, excessive angle of bank, and glideslope deviation.

GPWS may also provide radio altitude and decision height callouts.

Note: GPWS does not provide alerts for flight toward vertically sheer terrain, or of shallow descents when the airplane is in landing configuration.

Alert Conditions

GPWS provides warnings and/ or alerts if one of the following conditions exists:

- excessive barometric descent rate
- excessive terrain closure rate
- altitude loss after takeoff or go–around
- unsafe terrain clearance (when not in the landing configuration)
- excessive deviation below glideslope

The GPWS alerts and the condition which causes each alert are presented on the following GPWS annunciation chart.

GPWS Annunciations

AURAL ALERT	VISUAL ALERT	DESCRIPTION
MODE 1, MK II “SINK RATE”	PULL UP lights	Excessive descent rate.
MODE 1, MK II (cont) “WHOOP WHOOP PULL UP”	PULL UP lights	Follows “SINK RATE” if excessive descent rate continues or increases. Also follows “TERRAIN” alert if excessive terrain closure rate continues and landing gear and/or flaps not in landing configuration.
MODE 2, MK II “TERRAIN”	PULL UP lights	Excessive terrain closure rate.
MODE 3, MK II “DON’T SINK”	PULL UP lights	Excessive altitude loss after takeoff or go–around.
MODE 4A, MK II “TOO LOW GEAR” or “TOO LOW TERRAIN”	PULL UP lights	Unsafe clearance during approach with landing gear up.
MODE 4B, MK II “TOO LOW FLAPS” or “TOO LOW TERRAIN”	PULL UP lights	Unsafe clearance during approach with flaps not in landing configuration.
MODE 5, MK II “GLIDESLOPE”	BELOW G/S w/ P–INHIBIT lights	Deviation below glideslope. The volume and repetition rate increase as deviation continues.

Traffic Alert and Collision Avoidance System (TCAS) (as installed)

TCAS alerts the crew to possible conflicting traffic. TCAS interrogates operating transponders in other airplanes, tracks the other airplanes by analyzing the transponder replies, and predicts the flight paths and positions. TCAS provides advisory and traffic displays of the other airplanes to the flight crew. Neither advisory, guidance, nor traffic display is provided for other airplanes which do not have operating transponders. TCAS operation is independent of ground–based air traffic control.

To provide advisories, TCAS identifies a three dimensional airspace around the airplane where a high likelihood of traffic conflict exists. The dimensions of this airspace are based upon the closure rate with conflicting traffic.

TCAS equipment interrogates the transponders of other airplanes to determine their range, bearing, and altitude. A traffic advisory (TA) is generated when the other airplane is approximately 40 seconds from the point of closest approach. If the other airplane continues to close, a resolution advisory (RA) is generated when the other airplane is approximately 25 seconds from the point of closest approach. The RA provides aural warning and guidance as well as maneuver guidance to maintain or increase separation from the traffic.

Non–transponder equipped airplanes are invisible to TCAS. RAs can be generated if the other airplane has a mode C transponder. Coordinated RAs require both airplanes to have mode S transponders.

Advisories and Displays

Annunciations associated with TCAS and the traffic displays are discussed further in Chapter 10.

TAs are indicated by the aural “TRAFFIC, TRAFFIC” which sounds once and is then reset until the next TA occurs. The TRAFFIC message appears on the traffic display(s). The range and relative bearing of the other airplane are also displayed. Altitude and vertical motion are included if the other airplane is using transponder mode S or C.

RAs are indicated by one or more aural listed in the RA aural table. The other airplane’s range, relative bearing, and altitude appear on the traffic display(s). An RA vertical speed restriction or maneuver appears on the VSI.

Note: Maneuvering is required if the existing vertical velocity is in the red band (RA VSI).

An OFFSCALE traffic symbol appears during a TA or RA if the traffic’s position is outside the selected traffic display’s range.

A TA or RA message followed by the traffic's range, altitude, and (if applicable), vertical motion arrow appear on the traffic display if TCAS cannot determine the other airplane's bearing.

Inhibits

TCAS alerts are inhibited by GPWS, windshear alerts and at low altitudes where traffic avoidance maneuvers are inappropriate.

If an inhibit occurs during an RA, the aural is silenced, vertical pitch commands cease, and the RA symbol changes to a TA symbol. TA aurals are silenced if present when an inhibit occurs.

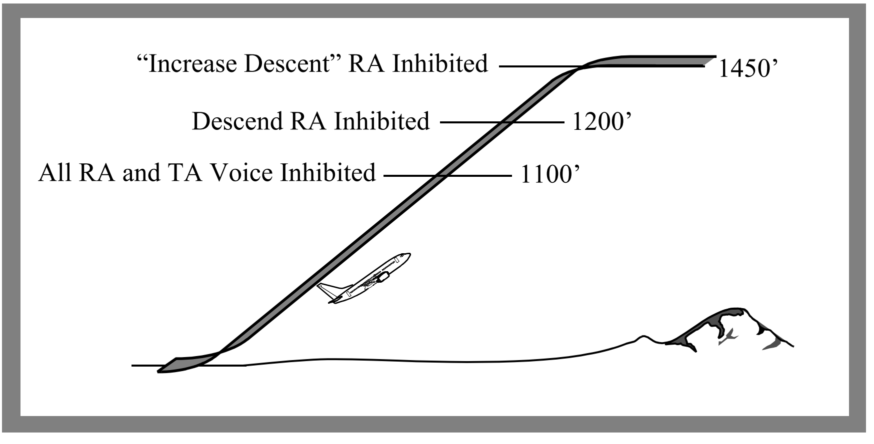
Radio Altitude Inhibits

INCREASE DESCENT RAs are inhibited below 1,450 feet radio altitude.

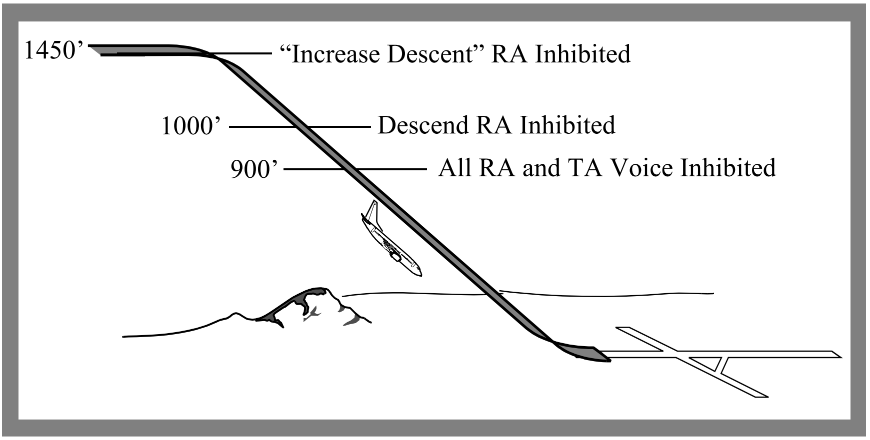
DESCEND RAs are inhibited below 1,200 feet radio altitude during climbs, and 1,000 feet radio altitude during descents.

All RAs and TCAS voice alerts are inhibited below 1,100 feet radio altitude during climbs, and 900 feet radio altitude during descents. Aural messages are inhibited below 600 feet while climbing and 400 feet while descending.

Climb Radio Altitude Inhibits



Descent Radio Altitude Inhibits



Mode Control

The TCAS operating mode is controlled from the transponder panel. TCAS is normally operated in the TA/RA mode. However, sometimes it is necessary to operate in the TA ONLY mode to prevent undesired RAs. For example, TA ONLY may be selected when intentionally operating near other airplanes such as might be found in VFR conditions at a busy airport, or on parallel approach.

TCAS equipped transponders communicate between airplanes to provide appropriate coordinated avoidance maneuvers. When performance is limited, such as with an inoperative engine, select TA ONLY to prevent receiving RAs beyond the airplane’s capabilities, and to prevent communicating to other airplanes an ability to perform an RA maneuver.

Resolution Advisory Aurals

The following table identifies the possible callouts associated with RAs and the vertical restrictions or maneuver recommended in each case.

Aural Alerts	Vertical Restrictions/Maneuver
MONITOR VERTICAL SPEED, MONITOR VERTICAL SPEED	Present pitch attitude is outside the TCAS vertical guidance command. Keep pitch attitude away from red area.
CLIMB, CLIMB, CLIMB	Climb at the displayed pitch
DESCEND, DESCEND, DESCEND	Descend at the displayed pitch
REDUCE CLIMB, REDUCE CLIMB	Reduce climb rate
REDUCE DESCENT, REDUCE DESCENT	Reduce descent rate
CLIMB, CROSSING CLIMB, CLIMB, CROSSING CLIMB	Climb at displayed pitch. Airplane climbs through traffic’s altitude.
DESCEND, CROSSING DESCEND DESCEND, CROSSING DESCEND	Descend at displayed pitch. Airplane descends through traffic’s altitude.
INCREASE CLIMB, INCREASE CLIMB	Increase climb rate from initial pitch attitude.
INCREASE DESCENT, INCREASE DESCENT	Increase descent rate from initial pitch attitude.
CLIMB – CLIMB NOW, CLIMB – CLIMB NOW	Reversal maneuver from initial descent RA.
DESCEND – DESCEND NOW, DESCEND – DESCEND NOW	Reversal maneuver from initial climb RA.
CLEAR OF CONFLICT	RA encounter terminated. Maneuver guidance no longer displayed.