



MD-88/90 Operations Manual Volume 1

Delta Air Lines, Inc.

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Preface

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Preface

Model Identification

Chapter P1

Section 1

General

The airplanes listed in the table below are covered in the operations manual. 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	Model Miscellaneous Data
0901	N901DL	49532	MD-88
0902	N902DL	49533	MD-88
0903	N903DL	49534	MD-88
0904	N904DL	49535	MD-88
0905	N905DL	49536	MD-88
0906	N906DL	49537	MD-88
0907	N907DL	49538	MD-88
0908	N908DL	49539	MD-88
0909	N909DL	49540	MD-88
0910	N910DL	49541	MD-88
0911	N911DL	49542	MD-88
0912	N912DL	49543	MD-88
0913	N913DL	49544	MD-88
0914	N914DL	49545	MD-88
0915	N915DL	49546	MD-88
0916	N916DL	49591	MD-88
0917	N917DL	49573	MD-88
0918	N918DL	49583	MD-88
0919	N919DL	49584	MD-88
0920	N920DL	49644	MD-88



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Airplane Number	Registry Number	Serial Number	Model Miscellaneous Data
0921	N921DL	49645	MD-88
0922	N922DL	49646	MD-88
0923	N923DL	49705	MD-88
0924	N924DL	49711	MD-88
0925	N925DL	49712	MD-88
0926	N926DL	49713	MD-88
0927	N927DL	49714	MD-88
0928	N928DL	49715	MD-88
0929	N929DL	49716	MD-88
0930	N930DL	49717	MD-88
0931	N931DL	49718	MD-88
0932	N932DL	49719	MD-88
0933	N933DL	49720	MD-88
0934	N934DL	49721	MD-88
0935	N935DL	49722	MD-88
0936	N936DL	49723	MD-88
0937	N937DL	49810	MD-88
0938	N938DL	49811	MD-88
0939	N939DL	49812	MD-88
0940	N940DL	49813	MD-88
0941	N941DL	49814	MD-88
0942	N942DL	49815	MD-88
0943	N943DL	49816	MD-88
0944	N944DL	49817	MD-88
0945	N945DL	49818	MD-88
0946	N946DL	49819	MD-88
0947	N947DL	49878	MD-88
0948	N948DL	49879	MD-88

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Airplane Number	Registry Number	Serial Number	Model Miscellaneous Data
0949	N949DL	49880	MD-88
0950	N950DL	49881	MD-88
0951	N951DL	49882	MD-88
0952	N952DL	49883	MD-88
0953	N953DL	49884	MD-88
0954	N954DL	49885	MD-88
0955	N955DL	49886	MD-88
0956	N956DL	49887	MD-88
0957	N957DL	49976	MD-88
0958	N958DL	49977	MD-88
0959	N959DL	49978	MD-88
0960	N960DL	49979	MD-88
0961	N961DL	49980	MD-88
0962	N962DL	49981	MD-88
0963	N963DL	49982	MD-88
0964	N964DL	49983	MD-88
0965	N965DL	49984	MD-88
0966	N966DL	53115	MD-88
0967	N967DL	53116	MD-88
0968	N968DL	53161	MD-88
0969	N969DL	53172	MD-88
0970	N970DL	53173	MD-88
0971	N971DL	53214	MD-88
0972	N972DL	53215	MD-88
0973	N973DL	53241	MD-88
0974	N974DL	53242	MD-88
0975	N975DL	53243	MD-88
0976	N976DL	53257	MD-88



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Airplane Number	Registry Number	Serial Number	Model Miscellaneous Data
0977	N977DL	53258	MD-88
0978	N978DL	53259	MD-88
0979	N979DL	53266	MD-88
0980	N980DL	53267	MD-88
0981	N981DL	53268	MD-88
0982	N982DL	53273	MD-88
0983	N983DL	53274	MD-88
0984	N984DL	53311	MD-88
0985	N985DL	53312	MD-88
0986	N986DL	53313	MD-88
0987	N987DL	53338	MD-88
0988	N988DL	53339	MD-88
0989	N989DL	53341	MD-88
0990	N990DL	53342	MD-88
0991	N991DL	53343	MD-88
0992	N992DL	53344	MD-88
0993	N993DL	53345	MD-88
0994	N994DL	53346	MD-88
0995	N995DL	53362	MD-88
0996	N996DL	53363	MD-88
0997	N997DL	53364	MD-88
0998	N998DL	53370	MD-88
0999	N999DN	53371	MD-88
9000	N900DE	53372	MD-88
9001	N901DE	53378	MD-88
9002	N902DE	53379	MD-88
9003	N903DE	53380	MD-88
9004	N904DE	53409	MD-88

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Model Identification**

Airplane Number	Registry Number	Serial Number	Model Miscellaneous Data
9005	N905DE	53410	MD-88
9006	N906DE	53415	MD-88
9007	N907DE	53416	MD-88
9008	N908DE	53417	MD-88
9009	N909DE	53418	MD-88
9010	N910DE	53419	MD-88
9011	N911DE	49967	MD-88
9012	N912DE	49997	MD-88
9013	N913DE	49956	MD-88
9014	N914DE	49957	MD-88
9015	N915DE	53420	MD-88
9016	N916DE	53421	MD-88
9017	N917DE	49958	MD-88
9018	N918DE	49959	MD-88
9019	N919DE	53422	MD-88
9020	N920DE	53423	MD-88
9201	N901DA	53381	MD-90-30
9202	N902DA	53382	MD-90-30
9203	N903DA	53383	MD-90-30
9204	N904DA	53384	MD-90-30
9205	N905DA	53385	MD-90-30
9206	N906DA	53386	MD-90-30
9207	N907DA	53387	MD-90-30
9208	N908DA	53388	MD-90-30
9209	N909DA	53389	MD-90-30
9210	N910DN	53390	MD-90-30
9211	N911DA	53391	MD-90-30
9212	N912DN	53392	MD-90-30



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Airplane Number	Registry Number	Serial Number	Model Miscellaneous Data
9213	N913DN	53393	MD-90-30
9214	N914DN	53394	MD-90-30
9215	N915DN	53395	MD-90-30
9216	N916DN	53396	MD-90-30

Preface

Introduction

Chapter P1

Section 2

Purpose

The Boeing Company developed normal and non-normal procedures for the MD-88/90 aircraft. Delta Air Lines has modified some of the procedures for simplification and standardization, when appropriate with other Delta aircraft. Finally, the FAA has approved the procedures presented in the Operations Manual, with the exception of flight crew bulletins.

These procedures are company policy for pilots to follow during ground operations and in flight. Deviations from these policies and procedures should be made only with good cause and based on the safest course of action. If an abnormality occurs that is not covered by these procedures, the Captain must use his best judgement.

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Corrections to the Manual

To correct any errors or discrepancies discovered in this manual, or to submit a suggested change to any Aircraft Operating Manual (Volume 1, Volume 2, QRH, Flight Crew Training Manual), Normal Checklist, Airway Manual, Flight Operations Manual (FOM), OE/TOE Guide, Flight Crew Bulletin (FCB), or Flight Operations Bulletin (FOB):

Log on to the Delta Flight Operations Portal; <http://dalweb.delta.com/portal> and submit a Publications Change Request (PCR).

There are links to the PCR form on each fleet page and also on the Flight Ops Manuals/Library Services page.

Once submitted, the PCR is automatically routed to the applicable Fleet Technical Manager and Technical Writer for that manual.

Organization

The operations manual 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, a list of effective pages, and bulletins.
- 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.
- Aircraft Differences chapter notes differences between aircraft types.

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.

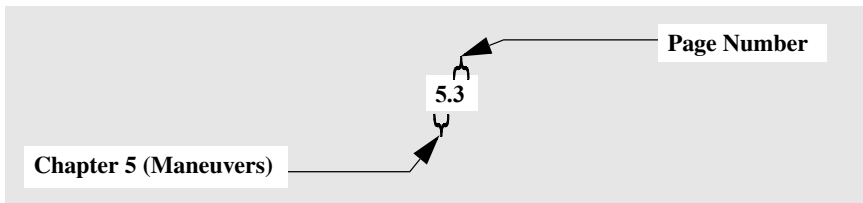
Quick Reference Handbook (QRH) - The QRH covers normal checklists, non-normal checklists, and non-normal maneuvers.

Flight Crew Training Manual (FCTM) - The Flight Crew Training Manual provides information and recommendations on maneuvers and techniques.

Page Numbering

The operations manual uses a decimal page numbering system. The page number is divided into two fields; chapter and page. An example of a page number for the Maneuvers chapter follows:

Example Page Number



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.*

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Abbreviations

Chapter P1

Section 3

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. Since this list is compiled across several fleets, there may be some abbreviations that do not apply to this specific fleet.

A	
ABV	Above
AC	Alternating Current or Aircraft
ACARS	Aircraft Communications Addressing and Reporting System
ACE	Actuator Control Electronics
ACP	Audio Control Panel
ACT	Active
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
ADM	Air Data Module
AED	Automatic External Defibrillator
AFDC	Autopilot Flight Director Computer

AFDS	Autopilot Flight Director System
AFE	Above Field Elevation
AFM	Airplane Flight Manual (FAA approved)
AFM - DPI	Airplane Flight Manual - Digital Performance Information
AFS	Automatic Flight System (Autopilot or Autothrottle)
A/G	Air/Ground
AGL	Above Ground Level
AH	Alert Height
AHRS	Attitude Heading Reference System
AI	Anti-Ice
AIL	Aileron
ALFA	Safe Stall Margin Speed
ALT	Altitude
ALT ACQ	Altitude Acquire
ALT HOLD	Altitude Hold
ALTN	Alternate
AM	Amplitude Modulation

AIMS	Airplane Information Management System
AMI	Airline Modifiable Information
ANP	Actual Navigational Performance
ANT	Antenna
ANU	Aircraft Nose Up
AOA	Angle of Attack
AOC	Airline Operational Communication Data Link
A/P	Autopilot
APL	Airplane
APP	Approach
APU	Auxiliary Power Unit
AR	Authorization Required
ARINC	Aeronautical Radio, Incorporated
ARM	Aircraft Restrictions Manual
ARPT	Airport
ARR	Arrival
ART	Automatic Reserve Thrust
ASA	Autoland Status Annunciator
ASI	Airspeed Indicator
ASR	Airport Surveillance Radar
ASYM	Asymmetry
A/T	Autothrottle
ATA	Actual Time of Arrival

ATC	Air Traffic Control
ATIS	Automated Terminal Information Service
ATM	Assumed Temperature Method
ATT	Attitude
AUTO	Automatic
AUTO-THROT	Autothrottle
AUX	Auxiliary
AVAIL	Available
AWABS	Automated Weight and Balance System
B	
BARO	Barometric
BAT	Battery
B/C or B/CRS or BAC or BCS	Back Course
BFO	Beat Frequency Oscillator
BITE	Built-In Test Equipment
BKR	Breaker
BLD	Bleed
BLW	Below
BRG	Bearing
BRT	Bright
BTL	Bottle
BTL DISCH	Bottle Discharge (fire extinguisher)
BTMS	Brake Temperature Monitoring System

C	
C	Captain or Celsius or Center or Cool
CAA	Civil Aviation Authority
CADC	Central Air Data Computer
CALSEL	Call Select
CANC/RCL	Cancel/Recall
CANPA	Constant Angle Non-Precision Approach
CAP	Capture
CAPT	Captain
CAWS	Central Aural Warning System
CB	Circuit Breaker
CCD	Cursor Control Device
CDS	Common Display System
CDU	Control Display Unit
CFIT	Controlled Flight Into Terrain
CG	Center of Gravity
CHKL	Checklist
CHR	Chronograph
CKD	Checked
CKT	Circuit
CL	Close
CLB	Climb
CLMP	Computer Lockout Manual Power
CLR	Clear

CMD	Command
CO	Company
COMM	Communication
COMP	Comparator
COMPT	Compartment
CON	Continuous
CONFIG	Configuration
CONT	Control
COOL	Cooling
CRM	Crew Resource Management
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CTL	Control
CTR	Center
CWS	Control Wheel Steering
D	
DA	Decision Altitude
DA(H)	Decision Altitude (Height)
DC	Direct Current
DCU	Display Concentrator Unit
D/D	Direct Descent
DDA	Derived Decision Altitude (MDA +50 feet)
DDG	Dispatch Deviations Guide
DEL	Delete
DEP	Departure
DEP ARR	Departure Arrival

DEPR	Depressurize
DES	Descent
DEU	Display Electronic Unit
DFCS	Digital Flight Control System
DFGC	Digital Flight Guidance Computer
DFGS	Digital Flight Guidance System
DH	Decision Height
DIFF	Differential
DIR	Direct
DISC	Disconnect
DISCH	Discharge
DK	Deck
DME	Distance Measuring Equipment
DN	Down
DPC	Display Processing Computer
DSP	Display Select Panel
DSPL	Display
DTG	Distance to Go
DTW	Distance to Waypoint
DU	Display Unit
E	
EADI	Electronic Attitude Director Indicator
ECON	Economy
E/D	End of Descent
E/E	Electrical/Electronic

EEC	Electronic Engine Control
EFI	Electronic Flight Instruments
EFIS	Electronic Flight Instrument System
EGPWS	Enhanced Ground Proximity Warning System
EGT	Exhaust Gas Temperature
EHSI	Electronic Horizontal Situation Indicator
EICAS	Engine Indication and Crew Alerting System
EIS	Electronic Instrument System
ELEC	Electrical
ELEV	Elevator
EMER	Emergency
ENG	Engine
ENG OUT	Engine Out
ENT	Entry
EO or E/O	Engine Out
EOAP	Electronic Overhead Annunciation Panel
EPR	Engine Pressure Ratio
EQPT or EQUIP	Equipment
ETOPS	Extended Range Operation with Twin Engine Airplanes
EVAC	Evacuation
EXEC	Execute
EXT	Extend or External

F	
F	Fahrenheit
FAC	Final Approach Course
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FAF	Final Approach Fix
FAR	Federal Aviation Regulation
FCB	Flight Crew Bulletin
FCC	Flight Control Computer
FCTL	Flight Control
FCTM	Flight Crew Training Manual
FD, F/D or FLT DIR	Flight Director
FF	Fuel Flow
FFM	Force Fight Monitor
FGCP	Flight Guidance Control Panel
FGS	Flight Guidance System
FILT	Filter
FIR	Flight Information Region
FL CH or FLCH	Flight Level Change
FLT	Flight
FLT CTRL	Flight Control
FLPRN	Flaperon
FMA	Flight Mode Annunciator
FMC	Flight Management Computer

FMS	Flight Management System
F/O or F O	First Officer
FOM	Flight Operations Manual
FPA	Flight Path Angle
FPM	Feet Per Minute
FPV	Flight Path Vector
FREQ	Frequency
F/S	Fast/Slow
FT	Feet
FWD	Forward
FWSOV	Fire Wall Shut Off Valve
FX	Fix
G	
GA	Go-Around
GEN	Generator
GLS	GNSS Landing System
GMT	Greenwich Mean Time
GND	Ground
GNSS	Global Navigation Satellite System
GP or G/P	Glide Path
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GS	Ground Speed
G/S	Glide Slope
GW	Gross Weight
H	
HAA	Height Above Airport

HAT	Height Above Touchdown
HDG	Heading or Hydraulic Driven Generator
HDG REF	Heading Reference
HDG SEL	Heading Select
HF	High Frequency
HGS	Head-Up Guidance System (HGS® is a registered trademark of Flight Dynamics)
HI	High
HLD	Hold
HPA	Hectopascals
HPSOV	High Pressure Shut Off Valve
HSI	Horizontal Situation Indicator
HUD	Head-Up Display
HYD	Hydraulic
I	
IAF	Initial Approach Fix
IAN	Integrated Approach Navigation
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organization
IDENT	Identification
IFE	In-Flight Entertainment System
IFR	Instrument Flight Rules
IGN	Ignition

IGS	Instrument Guidance System
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
IN	Inches
INBD	Inboard
IND	Indicator
IND LTS	Indicator Lights
INOP	Inoperative
INIT	Initialization
INSTR	Instrument
INT or INTPH	Interphone
INTC	Intercept
INTC CRS	Intercept Course
IP	Instructor Pilot
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ISDU	Inertial System Display Unit
ISFD	Integrated Standby Flight Display
ISLN	Isolation
J	
JAA	Joint Aviation Authority
K	

K or KTS	Knots
KCAS	Knots Calibrated Airspeed
KGS	Kilograms
KIAS	Knots Indicated Airspeed
L	
L	Left
LAT	Latitude
LBS	Pounds
LD	Load
LDA	Localizer-type Directional Aid
LDG	Landing
LDG ALT	Landing Altitude
LE	Leading Edge
LIM	Limit
LIM SPD	Limit Speed
LKD	Locked
L NAV or LNAV	Lateral Navigation
LOC	Localizer
LOC-BC	Localizer Back Course
LOM	Locator Outer Marker
LON	Longitude
LRC	Long Range Cruise
LRU	Line Replaceable Unit
LSK	Line Select Key
LT	Light
LWR CTR	Lower Center
LWR DSPLY or LWR DSPL	Lower Display

M	
M	Mach
MAG	Magnetic
MAHP	Missed Approach Holding Point
MAN	Manual
MAP	Missed Approach Point
MASI	Mach/Airspeed Indicator
MAX	Maximum
MCC	Maintenance Control Center
MCDU	Multi-purpose Control and Display Unit
MCO	Maintenance Carry Over
MCP	Mode Control Panel
MCT	Maximum Continuous Thrust
MDA	Minimum Descent Altitude
MDA(H)	Minimum Descent Altitude (Height)
MDM	Mechanical Dispatch Manual
MEA	Minimum Enroute Altitude
MEL	Minimum Equipment List
MFD	Multifunction Display
MHZ	Megahertz
MIC	Microphone
MIN	Minimum
MKR	Marker

MLS	Microwave Landing System
MM	Middle Marker
MMO	Maximum Mach Operating Speed
MNPS	Minimum Navigation Performance Specification
MOCA	Minimum Obstruction Clearance Altitude
MOD	Modify
MORA	Minimum Off Route Altitude
MSA	Minimum Safe Altitude
MSG	Message
MSGS RCVD	Messages Received
MSL	Mean Sea Level
MTRS	Meters
MUH	Minimum Use Height
N	
N	Normal
NADP	Noise Abatement Departure Procedures
NAR	North American Route
NAV	Navigation
NAV RAD	Navigation Radio
ND	Navigation Display
NLT	No Later Than
NM	Nautical Mile(s)
NNC	Non-Normal Checklists
NNM	Non-Normal Maneuvers

NPS	Navigation Performance Scales
NORM	Normal
N1	Low Pressure Rotor Speed
N2	High Pressure Rotor Speed (Pratt & Whitney and GE engines) or Intermediate Pressure Rotor Speed (Rolls Royce Engines)
N3	High Pressure Rotor Speed (Rolls Royce Engines)
O	
OAP	Overhead Annunciator Panel (a.k.a. EOAP)
OAT	Outside Air Temperature
OCC	Operations Control Center
ODM	Operational Data Manual
OFST	Offset
OHU	Overhead Unit
OM	Outer Marker
OP	Open
OUTBD DSPL	Outboard Display
OVHD	Overhead
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY or O2	Oxygen
P	



MD-88/90 Operations Manual

PA	Passenger Address
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
PASS	Passenger
PBE	Protective Breathing Equipment
PCP	Pilot Call Panel
PDC	Pitch Data Computer or Performance Data Computer or Pre-Departure Clearance
PERF	Performance
PERF INIT	Performance Initialization
PES	Pitch Enhancement System
PF	Pilot Flying
PFC	Primary Flight Computer
PFD	Primary Flight Display
PI	Performance Inflight
PIP	Product Improvement Package
PLI	Pitch Limit Indicator
PM	Pilot Monitoring
PMC	Power Management Control
PNL	Panel
POS	Position
POS INIT	Position Initialization
POS REF	Position Reference

PPI	Planned Position Indicator
PPOS	Present Position
PRES or PRESS	Pressure
PREV	Previous
PRI	Primary
PROG	Progress
PROX	Proximity
P/RST	Push To Reset
PRV	Pressure Regulating Valve
PSI	Pounds Per Square Inch
PTH	Path
PTT	Push To Talk
PTU	Power Transfer Unit
PWR	Power
PWS	Predictive Windshear System
Q	
Q	Quantity
QFE	Local Station Pressure
QNH	Altimeter Setting
QRH	Quick Reference Handbook
QTY	Quantity
R	
R	Right
RA	Radio Altitude or Resolution Advisory
RAD	Radio

RAT	Ram Air Temperature or Ram Air Turbine
RCL	Request for Clearance
RDMI	Radio Distance Magnetic Indicator
REC	Recorder
RECIR or RECIRC	Recirculation
REF	Reference
RET	Retract
REV	Reverse
RF	Radius-to-Fix (RF) Legs or Refill
RMI	Radio Magnetic Indicator
RNAV or RNV	Area Navigation
RNP	Required Navigational Performance
RPL	Rudder Pressure Limiter
RPM	Revolutions Per Minute
RPR	Rudder Pressure Reducer
RSEP	Rudder System Enhancement Program
RST	Reset
RSVR	Reservoir
R/T	Radio Transmit
RTE	Route
RTO	Rejected Takeoff
RTP	Radio Tuning Panel
RUD	Rudder
RVR	Runway Visual Range

RVSM	Reduced Vertical Separation Minimum
S	
SAAAR	Special Aircraft and Aircrew Authorization Required
SAARU	Secondary Attitude Air Data Reference Unit
SAT	Static Air Temperature or Satellite
SB	Service Bulletin
S/B	Speedbrake
S/C	Step Climb
SDF	Simplified Directional Facility
SEI	Standby Engine Indicator
SEL	Select
SELCAL	Selective Calling
SENS	Sensitivity
SERV	Service
SG	Symbol Generator
SPD	Speed
SPDBRK	Speedbrake
STA	Station
STAB	Stabilizer
STAT	Status
STBY	Standby
STD	Standard
SYS	System
T	
T or TRU	True

▲ DELTA
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**Preface -
Abbreviations**

T or TK or TRK	Track (to a Navaid)
TA	Traffic Advisory
TAA	Terminal Arrival Area
TACAN	Tactical Air Navigation
TAC	Thrust Asymmetry Compensation
TAI	Thermal Anti-Ice
TAS	True Airspeed
TAT	Total Air Temperature
T/C	Top of Climb
TCA	Terminal Control Area
TCAS	Traffic Alert and Collision Avoidance System
T/D	Top of Descent
TDZ	Touch Down Zone
TDZE	Touch Down Zone Elevation
TE	Trailing Edge
TEMP	Temperature
TERR	Terrain
TFC	Traffic
TFR	Transfer
THR	Throttle or Thrust
THR HOLD	Throttle Hold
TMC	Thrust Management Computer
TMI	Track Message Identifier
TMSP	Thrust Mode Select Panel
TO or T/O	Takeoff

TOC	Top of Climb
TOD	Top of Descent
TO/GA	Takeoff/Go-Around
TR	Traffic Resolution
TRK	Track
TRP	Thrust Rating Panel
TRU	Transformer Rectifier Unit
TURB	Turbine or Turbulence
U	
UNLKD	Unlocked
UNSCHD or UNSCHED	Unscheduled
UPR DSPL	Upper Display
U.S.	United States
USB	Upper Side Band
UTC	Universal Time Coordinated
UTIL	Utility
V	
VA	Design maneuvering speed
VAL	Valve
VANP	Vertical Actual Navigational Performance
VASI	Visual Approach Slope Indicator
VDP	Visual Descent Point
VEF	Speed at Engine Failure
VERT	Vertical

VFR	Visual Flight Rules
VG	Vertical Gyro
VHF	Very High Frequency
VIB	Vibration
VLV	Valve
VMC	Visual Meteorological Conditions
VMCA	Minimum Control Speed Air or Single Engine Minimum Control Airspeed
VMCG	Minimum Control Speed Ground
VMO	Maximum Operating Speed
V NAV or VNAV	Vertical Navigation
VOR	VHF Omnidirectional Range
VR	Rotation Speed
VREF	Reference Speed
VRNP	Vertical Required Navigation Performance
V/S	Vertical Speed
VSCF	Variable Speed Constant Frequency
VSD	Vertical Situation Display
VSI	Vertical Speed Indicator
VTK	Vertical Track
V1	Takeoff Decision Speed
V1 (MCG)	Minimum V1 for Control on the Ground
V2	Scheduled Takeoff Target Speed

W	
W	Warm
WATRS	Western Atlantic Route System
WDR	Weight Data Record
WGS-84	World Geodetic System of 1984
WHL	Wheel
WPT	Waypoint
WT	Weight
WXR	Weather Radar
X	
X-FEED	Crossfeed
XPDR or XPNDR	Transponder
XTK	Cross Track

Preface
Revision Record

Chapter P1
Section 4

Revision Transmittal Letter

To: All holders of Delta Air Lines, Inc. MD-88/90 Operations Manual, Volume 1.
Subject: Operations Manual Revision.

This revision reflects the most current information available to Delta Air Lines, Inc. through 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
0	April 01, 2004	
2	January 24, 2005	
4	November 2, 2005	
6	October 16, 2006	
8	December 25, 2006	
10	December 20, 2007	

No.	Revision Date	Date Filed
1	May 17, 2004	
3	August 29, 2005	
5	March 27, 2006	
7	November 27, 2006	
9	May 7, 2007	
11	June 2, 2008	

General

Delta Air Lines, Inc. issues operations manual revisions to provide new or revised procedures and information. Formal revisions also incorporate appropriate information from previously issued operations manual bulletins.

The revision date is the approximate date the revision material is distributed and considered current. The revision should be incorporated as soon as it is received, but may be incorporated as much as 21 days after the revision 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 operations manual content.

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

Filing Instructions

Consult the List of Effective Pages (P1.5). Pages identified with an asterisk (*) are either replacement pages, new (original) issue pages, or deleted pages. Remove corresponding old pages and replace or add new pages. Remove pages marked DELETED; there are no replacement pages for deleted pages.

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

Revision Highlights

This section (P1.4) replaces the existing section P1.4 in your manual.

Pages containing revised technical and non-technical material have revision bars associated with the changed text or illustration.

Repaginated materials not containing technical revisions are identified only by a new page date.

Note: This revision of the MD-88/90 Volume 1 has new formatting and fonts which have been adopted for use. This will bring the MD-88/90 Volume 1 into standardization with the rest of Delta's fleets Volume 1s. These changes affect the appearance of the information, but not the technical information, and will not be identified by revision bars.

Note: In this revision, for cross-fleet standardization purposes, "cockpit" is now "flight deck." The only exception to this rule is where a switch or selector is labeled using the term cockpit; e.g. "Cockpit Voice Recorder". No revision bars are used to denote these changes.

Chapter P1 - Preface

Section 2- Introduction

Corrections to the Manual

P1.2.2 - Removed "Specialist" from automatic PCR routing.

Section 3- Abbreviations

General

P1.3.1-12 - Updated list of abbreviations for cross-fleet standardization. Change bars were not used in this section.

Section 4 - Revision Record

Revision Highlights

P1.4.1-8 - Explanations for each item identified by a change bar in the latest revision.

Section 5 - List of Effective Pages

P1.5.1-2 - Reflects current pages for latest revision.

Section 6- Bulletin Record

P1.6.1-2 - Reflects bulletins for latest revision.

Chapter L - Limitations

Section 10 - Operating Limitations

Weather Radar

L.10.10 - Added "Do not operate weather radar in a hangar or within 50 feet of fueling operations or fuel spills. Do not operate weather radar within 160 feet of personnel."

Chapter NP - Normal Procedures

Section 0 - Table of Contents

NP.TOC.0.1-4 - Revised TOC to reflect content changes in this revision.

Section 10 - Introduction

Standard Callouts

NP.10.14 - Combined "All ILS APPROACHES", "CAT I APPROACHES" and "CAT II & III APPROACHES" into one callout table. "At or before minimums" now precedes "At minimums" callout to more accurately describe the timing of the callouts.

NP.10.15 - Repaginated.

Section 20 - Amplified Procedures

First Flight of the Day

NP.20.1 - Removed "(88) Arm Overwing Heater" from the table because the status of the system is continuously monitored by the heater control units.

Walkaround

NP.20.5 - Under Lower wing surface, added allowance of up to 1/8 inch of frost on the lower wing surface from cold soaked fuel.

Interior Preflight

NP.20.8 - Under Flight Deck, Emergency Locator Transmitter, added "Check the ARMED/OFF/ON toggle switch located is in the ARMED position."

NP.20.9 - Under Logbook/Manuals, revised Note related to the effective dates of all checklists and manuals.

NP.20.10 - Under Cockpit Voice Recorder, removed "Modified recorders do not indicate any dips" because it was discovered that modified recorders may indicate dips.

NP.20.11 - Under Battery switch, relocated "During APU start, battery voltage must be at least 22 volts" to SP 7.1, APU Start.

NP.20.21 - Under FMS, removed requirement to "Verify clean maneuver speed/2500 feet AFE on CLIMB page."

NP.20.22 - Repaginated.

Engine Start Procedure

NP.20.26 - Under (90) Start switch, added “(90) If START switch will not remain latched, pull and hold START switch.”

NP.20.27 - Under Fuel lever/switch, added flashing fuel flow note.

NP.20.27 - Under (90) Start switch, added, “(90) If START switch will not remain latched, release or manually push in START switch when engine reaches between 43% and 45% N2.”

NP.20.28 - Relocated engine instruments table from After Start or Delayed Start Procedure to Engine Start Procedure.

NP.20.28 - Under Abnormal Engine Starts, revised “(88) Fuel flow digits are flashing combined with one or more of the abnormal engine indications listed above.”

After Start or Delayed Start Procedure

NP.20.29 - Added Note at beginning of checklist: Bleed extractions should only be made once the engine has stabilized at idle RPM. A 4-5% decrease in N2 due to bleed extraction is considered normal. This reduction in engine idle speed may result in an N2 RPM less than 50% and is acceptable provided other engine indications are stable.

NP.20.29 - Under Air Conditioning panel, relocated “Bleed extractions should only be made once the engine has stabilized at idle RPM” to Note in beginning of checklist.

NP.20.29 - Under Engine instruments, relocated engine instruments table to Engine Start Procedure.

NP.20.30 - Revise PNEU X-FEED procedure for optimum cooling from leaving right crossfeed OPEN to leaving both crossfeeds OPEN. Added statement to “Close left crossfeed prior to starting the second engine.” Reformat to make statement applicable to both left and right crossfeeds.

Takeoff Procedure

NP.20.40 - Under Airspeed, revised Caution to state: If a tailstrike is suspected, depressurize aircraft (time permitting).

Climb Procedure

NP.20.44 - Added “Aircraft performance . . . Check” to Climb procedure.

Cruise Procedure

NP.20.45 - Added “Engine and aircraft systems . . . Check” to Cruise procedure.

NP.20.45 - Under Engine Performance Report, added "using the Engine Performance Report form" to ensure crews understand a manual report is required if ACARS is inoperative or automatic reporting is not possible.

NP.20.46 - Under VHF Navigation radios, added "A Navigation Accuracy Check must be performed by the PM prior to entry into Class II airspace."

NP.20.46 - Added guidance to call for and read the Cruise checklist.

NP.20.47-60 - Repaginated.

Section 30 - Flight Patterns

Takeoff Considerations

NP.30.2 - Under Static Takeoff, removed reference to the FOM.

NP.30.3 - Under Takeoff Speeds, replaced "Airspeed command bug" with "Airspeed reference bug."

NP.30.3 - Under Takeoff and Area Departure, changed "Use of Autoland" to "Use of Automation."

Stabilized Approach Requirements

NP.30.7 - Under IMC and VCM, replace "sink rate" with "descent rate."

Non-ILS Approach

NP.30.11 - Under LOC Back Course Approaches, add "The MAP display may be used as a monitor for situational awareness if desired."

Missed Approach/Rejected Landing

NP.30.16 - Under Considerations, replaced FOM with Vol. 1.

Normal Maneuver Tolerances

NP.30.17 - Under Visual Approach and Landing, replace "sink rate" with "descent rate."

NP.30.17 - Under Visual Approach and Landing, replace "1,000 fpm maximum below 500 feet AFE" with "1,000 fpm maximum below 1,000 AFE."

NP.30.18 - Under Circling Approach, replace "Approximately 1,000 fpm prior to 500 feet AFE" with "1,000 fpm maximum below 1,000 AFE."

Flight Profiles

NP.30.20 - Revised Normal Takeoff Profile (Distant/ICAO NADP 2) to allow acceleration to 250 knots at 1,000 feet AFE.

NP.30.23 - Under ILS Autoland Approach Profile, Descend to DA(H), removed "Monitor VNAV path."

Supplementary Procedures

Section 0 - Table of Contents

SP.TOC.0.1-8 - Revised TOC to reflect content changes in this revision.

Section 5-Communications

Aircraft Communication Addressing and Reporting System (ACARS)

SP.5.22-23 - Under Postflight, remove guidance under "CYCLES - APU" and replaced with "No entry required" because it is for reference only.

Section 6-Electrical

SP.6.1-6 - Reissued all pages in chapter due to formatting; technical changes will be marked with a revision bar.

Electrical Power Up

SP.6.1 - Procedure added for cross-fleet standardization.

Section 7-Engines, APU

APU Start (Ground and In Flight)

SP.7.1 - Under Battery switch, relocated "During APU start, battery voltage must be at least 22 volts" from NP.20 Interior Preflight.

Section 8-Fire Protection

SP.8.1-4 - Reissued all pages in chapter due to formatting; technical changes will be marked with a revision bar.

Cargo Fire Warning Test

SP.8.2 - Under Fire Control Panel, added Note stating "Breakaway lockwire is not authorized on BTL DISCH/AGT LOW switch guards."

Section 11-Flight Management, Navigation

SP.11.1-24 - Reissued all pages in chapter due to formatting; technical changes will be marked with a revision bar.

FMS Initialization

SP.11.1 - Under Position Initialization, reorganize setting initial position priorities. Delete bullet under "Reference Gate LAT LON" and relocate to fourth choice, "Reference airport LAT LON."

SP.11.2 - Added "FMS Preflight for Origins/Destinations not contained in FMS Database" for cross-fleet standardization.

SP.11.4-5 - Under Route Initialization, added procedures programming an R/D STAR.

FMS Lateral Navigation

SP.11.14 - Under Navigation Accuracy Check, added “Manually tune a VOR that is between 30-130 nm from the known aircraft position.” And revised sentence to state, “Center the VOR deviation indicator on the Navigation Display.”

Section 15-Warning Systems

GPWS TEST

SP.15.1 - Under GND PROX WARN SWITCH, added Note, “PFD WX display knob must be out of OFF for Terrain test pattern to appear.”

Section 16-Adverse Weather

Cold Weather Operation

SP.16.2-3 - Under Before Start, Exterior Preflight, reformatted tactile wing inspection procedures for clarity.

Ground De/Anti-Icing

SP.16.33 - Under Reconfigure aircraft, reorder steps from “Engines, APU, Outflow valve” to “APU, Outflow valve, Engines.”

Hot Weather Operation

SP.16.39 - Added for cross-fleet standardization.

Windshear

SP.16.40 - Under Precautions, Takeoff, changed “pilot not flying” to “PM.”

SP.16.40-44 - Repaginated.

Chapter DF- MD-88/90 Differences

Section 0 - Table of Contents

DF.TOC.0.1-2 - Revised TOC to reflect content changes in this revision.

Section 10

DF.10.1-16 - Reissued all pages in chapter due to formatting; technical changes will be marked with a revision bar.

DF.10.1 - Removed Aircraft General because minimum taxiway width for a 180 degree turn for both aircraft is 125 feet.

DF.10.1 - Removed Normal Operations and Limitations for cross-fleet standardization. Content of these sections found in applicable chapters in Vol. 1.

Preface

Chapter P1

List of Effective Pages - FAA Approved

Section 5

Page	Date
Volume 1	
* Title Page	June 2, 2008
Preface (tab)	
P1.TOC.0.1-2	April 01, 2004
P1.1.1-6	April 01, 2004
P1.2.1	May 17, 2004
* P1.2.2	June 2, 2008
P1.2.3	May 7, 2007
P1.2.4	April 01, 2004
* P1.3.1-12	June 2, 2008
* P1.4.1-8	June 2, 2008
* P1.4.9-14	Deleted
* P1.5.1-2	June 2, 2008
Bulletins (tab)	
P1.6.1-2	See Bulletin Log
Limitations (tab)	
L.TOC.0.1	December 25, 2006
L.TOC.0.2	May 7, 2007
L.10.1-2	December 25, 2006
L.10.3	May 7, 2007
L.10.4-5	December 25, 2006
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L.10.7-9	December 25, 2006
* L.10.10	June 2, 2008
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* NP.10.14-15	June 2, 2008
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* NP.20.8-11	June 2, 2008
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* NP.20.26-30	June 2, 2008
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* NP.20.44-60	June 2, 2008
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* NP.30.7-8	June 2, 2008
NP.30.9-10	December 20, 2007
* NP.30.11	June 2, 2008
NP.30.12-15	December 20, 2007
* NP.30.16-20	June 2, 2008
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* NP.30.23	June 2, 2008
NP.30.24-28	December 20, 2007



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SP.1.1-4	October 16, 2006
SP.2.1-2	April 01, 2004
SP.3.1-4	April 01, 2004
SP.4.1-2	August 29, 2005
SP.5.1-20	March 27, 2006
SP.5.21	October 16, 2006
* SP.5.22-23	June 2, 2008
SP.5.24-29	October 16, 2006
SP.5.30-32	March 27, 2006
* SP.6.1-6	June 2, 2008
* SP.7.1	June 2, 2008
SP.7.2	April 01, 2004
SP.7.3	August 29, 2005
SP.7.4	April 01, 2004
SP.7.5	March 27, 2006
SP.7.6-8	April 01, 2004
* SP.8.1-4	June 2, 2008
SP.9.1-2	May 17, 2004
SP.10.1-2	April 01, 2004
* SP.11.1-24	June 2, 2008
* SP.11.25-26	Deleted
SP.12.1-4	April 01, 2004
SP.13.1-2	April 01, 2004
SP.14.1-2	April 01, 2004
* SP.15.1	June 2, 2008
SP.15.2-32	August 29, 2005
SP.16.1	December 20, 2007
* SP.16.2-3	June 2, 2008
SP.16.4-32	December 20, 2007
* SP.16.33	June 2, 2008

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* SP.16.39-44	June 2, 2008
Aircraft Differences (tab)	
* DF.TOC.0.1-2	June 2, 2008
* DF.10.1-16	June 2, 2008

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Limitations

Operating Limitations

Chapter L

Section 10

General

This section contains limitations on aircraft and systems operation pertinent to flight crew operation of the aircraft. It is not intended to include items peculiar to aircraft certification data, or information peculiar to other manuals on board the aircraft.

MD-88/90 aircraft must be operated in compliance with Certificate Limitations of the applicable FAA Approved Airplane Flight Manual (AFM) and the Minimum Equipment List contained in the Aircraft Restrictions Manual (ARM) and Mechanical Dispatch Manual (MDM) respectively.

Note: The pound symbol (#) indicates recall limitations. Recall limitations are those operationally significant limitations that must be committed to memory. Memorization is necessary because there are no placards, display indications, or markings indicating a limitation exists.

Airplane General, Emergency Equipment, Doors, Windows

Operational Limitations

General Operating Limits

# Maximum Takeoff and Landing Tailwind Component	10 knots, or as permitted by Delta 10-0 special pages
# Maximum Operating Altitude	37,000 feet
Maximum Takeoff and Landing Pressure Altitude	8,500 feet

Center of Gravity

See Center of Gravity envelope chart in the respective ARM Weight and Balance section.

Door Mounted Slides

Evacuation slide girt bars at forward entry and service door and aft left hand door must be engaged prior to departure until arrival at unloading ramp at destination.

Rear Passenger Entrance

Emergency operating handle must be exposed and normal operating handle covered prior to departure until arrival at unloading ramp at destination.

Crosswind

- # Maximum unrestricted rudder crosswind component is 30 knots.
- # Maximum restricted rudder crosswind component for landing is 12 knots.

Maximum Speeds

- Observe VMO pointer and aural warning. Observe gear and flap placard speeds.
- # Turbulent air penetration speed is 280 $\pm$ 5 KIAS/ .77 $\pm$.02 M (whichever is lower).

Landing Lights

- # Wing landing light motors should be allowed to cool for 1 1/2 minutes after initial extension or retraction and 3 1/2 minutes after each subsequent extension or retraction. Lamps should not be operated in still air for periods of over 10 minutes.

Maximum Weight Limitations

The weights below may be further restricted by Operating Limitations, Center of Gravity Envelope, Operating Envelope, Fuel Loading/Management Data, and other data in the ODM and ARM.

Weights	Pounds	
	MD-88	MD-90
# Maximum Taxi Weight (MTW)	150,500	161,000
# Maximum Takeoff Weight (MTOW)	149,500	160,500
# Maximum Landing Weight (MLW)	130,000	142,000
# Maximum Zero Fuel Weight (MZFW)	118,000	132,000

Landing up to maximum takeoff weight is permitted with a maximum sink rate of 360 fpm. An aircraft log book entry with a sink rate notation is required for a landing in excess of:

- (88) 130,000 pounds.
- (90) 142,000 pounds.

Note: An overweight landing inspection is not required for sink rates of less than 360 fpm.

Air Systems

Pressurization

Maximum relief valve pressure is 8.32 psi.

Maximum cabin differential pressure is 8.07 psi.

Anti-Ice, Rain

Engines

Use engine anti-ice during all ground and flight operations whenever icing conditions exist or are anticipated.

Wings

Use airfoil anti-ice in flight whenever icing conditions exist.

Windshields

The windshield anti-ice must be on for all flight operations except as follows:

- Outer Windshield ply cracked or Windshield heat inoperative - the maximum speed is 315 KIAS below 10,000 feet.
- Inner Windshield ply cracked - respective windshield heat must be turned off and the maximum speed for a cracked inner pane is 235 KIAS below 10,000 feet.

Note: These restrictions do not apply to clear view or eyebrow windows.

Automatic Flight

Autopilot

Do not engage autopilot for takeoff below 500 feet AGL.

On non-ILS approaches, disconnect the autopilot no later than 50 feet below MDA.

For autopilot coupled CAT I approaches not requiring the use of autoland, the autopilot must be disconnected and the approach flown manually if the AP TRIM light is illuminated in excess of three seconds after the airplane is stabilized and tracking the glideslope.

FMS Vertical and Lateral Engagement Limits

- NAV must not be engaged to the Flight Director and/or autopilot in climb until the aircraft is above 400 feet AGL.
- VNAV must not be engaged to the Flight Director and/or autopilot in climb until the aircraft is above 1,000 feet AGL.
- NAV and VNAV must be manually disengaged for landing approach when below 400 feet AGL.

One Engine Inoperative Limits

Engine out coupled ILS approaches are not permitted. Disconnect the autopilot prior to glideslope capture.

Use of windshear guidance (flight director or coupled) with one engine inoperative is prohibited.

Autoland

A successful autoland preflight test is required on the DFGC to be used for an autoland.

For approaches requiring the use of autoland, a missed approach must be executed if the AP TRIM light is illuminated in excess of three seconds after the airplane is stabilized and tracking the glideslope.

Do not conduct autoland operations if:

- ALIGN (ALN) mode is not annunciated on an FMA by 100 feet radio altitude.
- Either engine becomes inoperative greater than 50 feet AFE.
- Any unusual control position or other abnormal conditions exist in the manual flight control system.
- Autospoilers are inoperative.
- Both buses are powered by a single generator.

Wind Speeds

Maximum allowable wind speeds for autoland operations:

# Headwind	25 knots
# Crosswind	15 knots
# Tailwind	10 knots

Electrical

AC Power

AC voltage range is 115 ± 3 volts.

AC Frequency

- External power and engine generator range is 400 ± 4 Hz
- APU generator (on ground) range is 396 ± 8 Hz
- APU generator (in flight) range is 400 ± 10 Hz

AC Generator Loads

- Continuous generator load range is 0 to 1.0
- 5 minute maximum when overload is greater than 1.0 to 1.5
- 5 second maximum when overload is greater than 1.5.

DC Power

Maximum difference between same side DC loadmeters is 0.3.

MD-88:

DC load range is 0 to 1.0

MD-90:

DC load range is 0 to 1.5

Engines, APU

Engines

Engine Limitations - Emergency Conditions

The published operating limits for engines relate to predefined normal and abnormal operations. If, however, any crew finds itself in a life-threatening situation which requires an application of thrust beyond the certified takeoff limits, they can feel confident that the engine(s) will operate satisfactorily for whatever reasonable time is required to maintain safe control of the aircraft.

Engine Limit Display Markings

Maximum and minimum limits are displayed as a red radial or light.

Outside of limits is marked with a red arc.

Normal engine takeoff range is marked by an orange radial.

Cautionary range is marked by a yellow arc.

Normal operating range is marked by a green arc.

Engine Ignition

MD-88:

On for takeoff, landing, turning engine anti-ice on/off, severe turbulence, and heavy rain.

MD-90:

Auto for takeoff and landing.

On for heavy rain or severe turbulence, no time limits.

Reverse Thrust

Ground use only with nose wheel on the ground.

EGT Limits

Condition	MD-88		MD-90	
	Duration	EGT Limit (°C)	Duration	EGT Limit (°C)
# Starting				
Ground	Momentary	500	Momentary	635
Flight	Momentary	625	Momentary	635
# Takeoff				
Normal	*5 minutes	590	10 minutes	635
	*2 minutes	595		
Maximum	5 minutes	625	10 minutes	635
# Continuous		580		610
*The sum of time at both EGT limits must not exceed five minutes.				

Engine Synchronization

Engine synchronizer selector must be off below 1,500 feet AFE.

Automatic Reserve Thrust (ART)

MD-88:

Automatic reserve thrust system (ART) must be off when using the takeoff flex mode of the thrust rating system.

Engine Starter Limitations

MD-88:

90 cumulative seconds of starting and/or motoring. This may consist of 3 normal start cycles of 30 seconds each with engine allowed to stop turning between starts.

5 minutes off for cooling.

Subsequent start attempts: 30 seconds on and 5 minutes off.

MD-90:

3 start attempts of 2 minutes each with 15 seconds between each attempt, or 4 minutes continuous cranking.

30 minutes off for cooling.

APU

Starter Limits

Three consecutive start attempts with five (5) minutes cooling between starts.
After the third attempt, one hour off before any further attempts.

Generator Load

Condition	MD-88	MD-90
Ground	1.25	1.0
Below 25,000 feet	1.0	0.6
25,000 feet and above	0.6	0.6
Maximum Operating Altitude	37,000 feet	37,000 feet

Flight Controls

Speedbrakes

Speedbrakes may not be used with flaps extended.

Do not extend gear with speedbrakes extended.

Rudder

Rudder must be powered and unrestricted for takeoff.

Spoilers

Do not arm ground spoilers prior to gear extension.

Flight Instruments, Displays

Altimeters

Reduced Vertical Separation Minimums (RVSM)

Manual switching to the alternate static system is prohibited for RVSM operations.

Altimeter Crosscheck Limits for RVSM Operations

The maximum allowable on-the-ground altimeter reading differences at a known field elevation for RVSM operations are:

Max Difference Between Captain & F/O	Max Difference Between Captain or F/O & Field Elevation
60 feet	75 feet

The maximum allowable in-flight difference between Captain and First Officer altimeter readings for RVSM operations is 200 feet.

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

Displays

Do not select compact mode in flight except for a display failure.

When using FMS NAV mode, the pilot flying the aircraft must select the MAP mode on his ND.

The flight director must be operative on the PFD of each pilot who has MAP or PLAN mode selected on his ND during takeoff or approach.

During terminal area and approach operation, one EFIS NAV display must be in the ARC or ROSE mode during localizer capture in order to crosscheck FMS operation with navigation radio data.

Flight Management, Navigation

Inertial Reference System (IRS)

A minimum of one multifunction control display unit (MCDU) is required for ground alignment of the IRS.

Autoland is inhibited when either IRU is in the attitude mode or off mode.

Enhanced GPWS must be in OVRD when operating in ATT mode.

Fuel

Center Tank Fuel

If each main tank is not full but has at least 3800 pounds, the maximum zero fuel weight

- (88) 118,000 pounds.
- (90) 132,000 pounds.

must be reduced by the amount of center tank fuel in excess of

- (88) 11,000 pounds.
- (90) 3,000 pounds.

If either main tank has less than 3800 pounds, subtract any center tank fuel weight from the maximum zero fuel weight.

Lateral Imbalance

Main tanks must not differ by more than 1500 pounds.

Fuel Heat

MD-88:

Fuel heat must be OFF during takeoff, landing and go-around.

Landing Gear

Maximum landing gear retraction speed is 250 KIAS

Maximum landing gear extension speed is 300 KIAS/0.70 MACH

Warning Systems

Enhanced Ground Proximity Warning System (EGPWS)

Terrain Display

Do not use the terrain display for navigation.

Terrain Awareness Alerting

The use of terrain awareness alerting and terrain display functions is prohibited within 15NM of takeoff, approach or landing at an airport or runway not contained in the EGPWS airport/runway database. Crews will be notified of airports not included in the database via EFCB and flight plan remarks.

Traffic alert and collision avoidance system (TCAS)

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

Weather Radar

Do not operate weather radar in a hangar or within 50 feet of fueling operations or fuel spills. Do not operate weather radar within 160 feet of personnel.

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

Normal Procedures

Chapter NP

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Normal Procedures

Introduction

Chapter NP

Section 10

General

This chapter contains Normal Procedures. It incorporates routine normal procedures and associated flight patterns.

Controls and Indicators - Nomenclature

Controls and indications appear in all UPPERCASE type to correspond to the words on the control panel or display. For example, the following item has UPPERCASE words to match what is found on the panel:

LEFT GENERATOR switchON

The word GENERATOR is spelled out even though it is abbreviated on the panel.

The following appears in all lower case because there are no words identifying the panel name or control position.

Flight guidance control panel Check and set

Normal Procedures

Normal procedures are used by the trained flight crew to ensure airplane condition is acceptable and that the flight deck is correctly configured for each phase of flight. These procedures assume all systems are operating normally and automated features are fully utilized. The procedures also assume that systems are not deactivated unless directed by procedure or required by an emergency situation.

Procedures are performed from recall and follow a flow pattern. Checklists are used to verify that critical items affecting safety have been accomplished. These procedures are designed to minimize crew workload and are consistent with flight deck technology.

During accomplishment of procedures, it is the crew member's responsibility to ensure proper system response. If an improper indication is noted, first verify that the system controls are properly positioned. Then, if necessary, check the appropriate circuit breaker(s), and test related system light(s).

Before engine start, individual system lights are used to verify system status. If an individual system light is indicating an improper condition prior to engine start, determine if the condition may affect dispatch and require maintenance action or compliance with the Mechanical Dispatch Manual (MDM).

Continued on next page

After engine start, the MASTER CAUTION system, annunciator lights, and alerts are used as the primary means to alert the crew to a non-normal system condition. Illumination of the MASTER CAUTION and system annunciator lights requires accomplishment of the appropriate non-normal procedure. Upon completion of the procedure and prior to takeoff, the Mechanical Dispatch Manual (MDM) should be consulted to determine if MEL relief is available.

This section includes amplified (expanded) normal procedures and their flow patterns for preflight and normal aircraft operations. A normal flow pattern is encouraged; however, certain items may be handled in the most logical sequence for existing conditions.

General phase of flight responsibilities are as follows:

Pilot flying (PF):

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

Pilot Monitoring (PM):

- checklist reading
- communications
- tasks requested by PF
- fuel levers/switches and fire handles (with PF concurrence).

The First Officer, when flying the airplane, performs the duties listed under PF, and the Captain performs those duties listed under PM.

Note: During flight with the autopilot engaged, the PF is primarily responsible for updating the mode control panel. However, the PM may update the mode control panel as directed by the PF. During manual flight, the PM should manipulate the mode control panel as required.

The Captain retains final authority for all actions directed and performed.

Autopilot Flight Director System and Flight Management System Monitoring

When the autopilot, flight director, or autothrottles are in use and a FGCP change is selected or is scheduled to occur, the annunciation must be verified on the flight mode annunciation display. Airplane course, vertical path, and speed must always be monitored.

In NAV and VNAV, all airplane course, vertical path, thrust and speed changes must be verified.

Similarly, when a thrust mode change is selected or is scheduled to occur, the change must be verified on the appropriate display.

RVSM Operations and System Requirements

Refer to the Airway Manual, Chapter 7, Navigation, Reduced Vertical Separation Minimum (RVSM) section.

MCDU Operation

On the ground, the multi-purpose control display unit (MCDU) manipulations are normally performed by the PF and verified by the PM.

In flight, with the autopilot engaged, MCDU entries are normally accomplished by the PF and verified by the PM prior to execution. With the autopilot not engaged, MCDU entries are accomplished by the PM with concurrence from the PF. MCDU manipulations should be accomplished prior to high workload periods such as departure, arrival, or holding. During high workload periods, using autopilot modes such as heading select and IAS may be more efficient than entering complex route modifications into the MCDU.

Crew Duties Reference Chart

The Crew Duties Reference Chart below indicates normal divisions in pilot work load. This chart serves as a guide to help crew members coordinate their duties during a typical flight.

- Items not highlighted are required on every flight.
- Items highlighted with gray shading are required during Class II navigation only.
- If operating in class II airspace for one hour or less, the only class II navigation duties required are those identified with (N).

The chart delineates areas in which a crew member must remain reasonably proficient if crew coordination is to be maintained at an optimum level.

CREW DUTIES	C	F	PF	PM
FLIGHT PLANNING				
Sign In	•	•		
Confirm passports, visas, and/or appropriate documentation are current and in possession (see FOM)	•			
Review flight plan, weather and route information	•	•		
Flight attendant (Flight Leader) briefing	•			
FLIGHT DECK PREPARATION				
Exterior Preflight Inspection		•		
Interior Preflight Inspection				•
Check aircraft logbook	•	•		
Align and initialize IRSs			•	
Verify correct initialization				•
Load routing, performance, winds and climb profile into FMS			•	
Verify correct routing (including all Class II waypoints)				•
(N) Perform Selcal checks (as required)				•
(N) Receive security briefing	•			
(N) Check final documents on board	•			
Continued on next page				

▲ DELTA
MD-88/90 Operations Manual

**Normal Procedures -
Introduction**

CREW DUTIES	C	F	PF	PM
Departure ATIS		•		
ATC clearance	•	•		
Radio closeout (as required)	•	•		
Departure briefing			•	
TAXI AND BEFORE TAKEOFF				
Taxi clearance		•		
Takeoff briefing			•	
Check aircraft position on ND			•	•
Ensure minimum fuel for takeoff	•			
CRUISE				
Send company reports (as required)				•
Complete enroute items (ETAs, Fuel, etc.) on flight plan				•
(N) Perform nav accuracy checks				•
Log results of nav accuracy and RVSM check (if required)				•
PA announcements				•
Obtain oceanic clearance (as required)				•
Update enroute, ETP, destination, & alternate airport weather				•
Monitor enroute fuel temperatures			•	•
(N) Perform enroute SELCAL checks (as required)				•
APPROACHING WAYPOINT				
Read from flight plan to PF next way point, distance and zone time.				•
Confirm from FMS next waypoint desired, distance and zone time.			•	
Continued on next page				

CREW DUTIES	C	F	PF	PM
WAYPOINT PASSAGE				
Read NAV, and altimeters to PF				•
Confirm NAV and altimeters			•	
Complete AIREP data and HOWGOZIT				•
Transmit position report				•
APPROACH AND LANDING				
Arrival ATIS				•
Review STAR and altitude restrictions			•	•
Review approach plate			•	•
Approach briefing			•	
Ground control communications		•		
Ramp control communications		•		
POSTFLIGHT				
Perform ACARS postflight		•		
Submit time report (as required)		•		
Log book entries	•			

Lower Than Standard Minima

Takeoff Minima

Delta's Operations Specifications provide a standard takeoff minima of 1 mile for the MD-88/90 at all airports unless a higher minimum is specified in the takeoff section of the Jeppesen plate.

Authorization for lower than standard takeoff minima for a specific runway will be indicated on the Jeppesen plate if certain requirements outlined in the Operations Specifications are met. Either pilot may make the takeoff if the visibility is RVR 1600 or 1/4 mile or better.

Operating procedures for takeoffs with visibility less than RVR 1600 or 1/4 mile are:

- The Captain will make the takeoff.
- The Flight Director will be used in the “TAKEOFF” “TAKEOFF” mode.
- Takeoff must be initiated from a stop. No rolling takeoffs.
- A Takeoff Alternate is required whenever the weather at the departure airport is less than applicable landing minimums.
 - The MD-88/90 is not authorized CAT II/III with an engine inoperative.
 - Landing minimums are predicated on “engine out”.
 - The airport specified as a Takeoff Alternate must be within one hour, still air, engine out distance. Flight Control uses 330 NM as an approximate radius.

Note: When visibility is less than, or anticipated to be less than RVR 1200, review SMGCS (Surface Movement Guidance & Control System) LOW VISIBILITY TAXI ROUTES (less than RVR 1200) Chart, if one is published. See Delta Airways Manual Procedures/Ops Specs.

Landing Minima

For all precision and non-precision approaches, both the autopilot and flight director will be utilized if operable when the reported visibility is below RVR 4,000 or 3/4 mile.

For instrument approaches, the MD-88 is classified as Category C, and the MD-90 is classified as Category D. For each instrument approach, landing minima is published on the appropriate Delta Airway Manual approach plate for each category. For that airport to qualify for the listed minima, various requirements for ground equipment as outlined in the Operations Specifications must be met. It is the controller's duty to inform the pilot if any required ground component is out of service.

For non-precision and basic ILS approaches the required airborne equipment is listed in FAR 121. For CAT I, CAT II, and CAT III ILS approaches the required airborne equipment is listed on the following page. Consult the Operations Specifications for additional details concerning airborne equipment. The dispatch requirements listed in the MEL may differ from the approach requirements listed on the following page.

Note: When visibility is less than, or anticipated to be less than RVR 1200, review SMGCS (Surface Movement Guidance & Control System) LOW VISIBILITY TAXI ROUTES (less than RVR 1200) Chart, if one is published. See Delta Airways Manual Procedures/Ops Specs.

ILS Airborne Equipment Requirements

The following charts cover general enroute requirements for all ILS approaches and may vary from MEL dispatch requirements.

Equipment Required in addition to FAR 121.305	CAT I 1800 RVR 200' DH	CAT II 1200 RVR (1000 RVR) 100' DH	CAT III 600 RVR 50' DH
Localizer and Glide Slope Receiver	1	2	2
Flight Director Displays ^(A) and/or Autopilot	1 ^(G) OR 1 ^(G)	2 AND 1	2 AND 1 ^(H)
DFGC	1	1	1
Radio Altimeter	1	2	2
DH Light	0	2 (1/side)	2 (1/side)
Instrument Comparator System	0	1	1
CADC	1	2	2
EFIS Symbol Generator	2 OR 1 ^(B)	2	2
EFIS Display ^(C)	4 OR 3	4 OR 3	4 OR 3
IRS ^(D)	1	2	2
FMA	1	2	2
Autothrottles ^(E)	0	0 OR 1	1
Operating Engines	1 OR 2	2	2
Autospoilers ^(E)	0	0	1
Autobrakes ^(F)	0	0	0

(A) FD CMD Selector Switch may be in any position.

(B) EFIS CMD Selector Switch may be in any position.

(C) If either pilot's PFD fails, the other pilot can fly to CAT I minimums. If either pilot's ND fails, the other pilot can fly to his appropriate minimums.

(D) IRS may be in ATT or NAV, except Autoland requires NAV mode.

(E) Any Autoland requires use of Autothrottles and Autospoilers.

(F) If operable, must be used for CAT III.

(G) For CAT I approaches labeled "Special Aircrew & Acft Authorization Required," a coupled autopilot or F/D must be used for the approach and remain in use to DA or missed approach, unless the pilot establishes sufficient visual reference to safely continue and land.

(H) Both Flight Directors and one (1) Autopilot (including Autoland) must be operative.

Standard Callouts

The callouts in the following table are for normal line operations. During takeoffs and approaches, the Pilot Monitoring (PM) will monitor flight mode annunciator progression.

For aircraft equipped with modified EGPWS, the “1000” and “500” calls will be made automatically based on the radio altimeter during approach. The PM will make the “Approaching Minimums” call. If the electronic voice callout is not heard by the flight crew, the PM will make the callout. The PM is not required to make altitude callouts at/or below 100 feet RA.

For CAT I and Non-precision approaches, the “Approaching Minimums” and “Minimums” call will be made by the PM with reference to the barometric altimeter. For CAT II and CAT III approaches, the “Approaching Minimums” and “Minimums” call will be made with reference to the radio altimeter.

The “1000” and “500” (AGL) callouts will be made by reference to the radio altimeter. If the radio altimeters are inoperative, these callouts will be made by referencing AFE on the barometric altimeter.

The “1000” and “500” (AGL) altitude callouts are not required if made automatically.

On any approach, when the Pilot Flying (PF) can maintain visual contact with the runway, the “Approaching Minimums” and “Minimums” callouts are not required.

The following callouts will be verbalized by the appropriate crew member:

TAKEOFF		
Condition	Crew Member	Callout
• At autothrottles on	PM	“EPR XX”*
• At approximately 60 KIAS	PM	“CLAMP”*
• At 80 KIAS	PM	“80 KNOTS, ENGINE INSTRUMENTS CHECKED.”
• At V1, VR and V2.	PM	“V1” - “VR” - “V2”
• At positive rate of climb.	PM	“POSITIVE RATE”
* Note: If autothrottles are not used, EPR XX and CLAMP will not be annunciated.		

CLIMB		
Condition	Crew Member	Callout
1,000 feet below each assigned altitude.	PM	“OUT OF ____ FOR ____, ALTITUDE ARMED” or “OUT OF ____ FOR ____, ALTITUDE/ VNAV CAPTURE”
Approaching transition altitude (if other than 18,000 feet.)	PM	“ALTIMETERS SET TO 29.92.”

DESCENT		
Condition	Crew Member	Callout
1,000 feet above each assigned altitude.	PM	“OUT OF ____ FOR ____, ALTITUDE ARMED” or “OUT OF ____ FOR ____, ALTITUDE/ VNAV CAPTURE”
Approaching transition altitude (if other than 18,000 feet.)	PM	“ALTIMETERS SET TO ____”

ALL APPROACHES		
Condition	Crew Member	Callout
Any significant deviation from planned flight path, airspeed or descent rate.	PM	“BUG ± ____ KNOTS” or “SINK ____”, etc.
At approximately 1,000 AGL	PM	“1,000, CLEARED TO LAND” or “1,000, NO LANDING CLEARANCE”
At approximately 500 AGL	PM	“500”
Below 500 feet AGL, Any descent exceeding 1,000 feet per minute.	PM	“SINK ____”

LANDING		
Condition	Crew Member	Callout
• At touchdown, when spoiler handle is full aft and latched. • If spoiler handle is not full aft and latched. • At reverser deployment. • When airspeed decelerates to 60 knots.	PM	“SPOILERS UP”
	PM	“SPOILERS NOT DEPLOYED”*
	PM	“TWO IN REVERSE”
	PM	“60 KNOTS”
* Note: If spoilers do not extend automatically, the Captain must ensure the spoilers are extended manually.		

ALL INSTRUMENT APPROACHES		
Condition	Crew Member	Callout
Flight mode annunciator progression.	PM	“LOCALIZER CAPTURED,” “GLIDE SLOPE CAPTURED”, etc.

NON-ILS INSTRUMENT APPROACHES		
Condition	Crew Member	Callout
Within 5° of final approach course, or	PM	“APPROACHING INBOUND COURSE”
First positive movement of localizer.	PM	“LOCALIZER ALIVE”
At approximately 1,000 feet AGL.	PM	“1,000, CLEARED TO LAND” or “1,000, NO LANDING CLEARANCE”.
At approximately 500 feet AGL.	PM	“500”
At approximately 80 feet above Minimums.	PM	“APPROACHING MINIMUMS”
At Minimums.	PM	“MINIMUMS”
Prior to leaving Minimums.	CAPT	“APPROACH LIGHTS IN SIGHT”, or “RUNWAY IN SIGHT” or “MISSED APPROACH” F/O must acknowledge.
When runway in sight.	PM	“RUNWAY IN SIGHT”
At missed approach point	PM	“MISSED APPROACH POINT”

ALL ILS (CAT I, II & III) APPROACHES		
Condition	Crew Member	Callout
First positive movement of localizer.	PM	"LOCALIZER ALIVE"
First positive movement of glide slope bar.	PM	"GLIDE SLOPE ALIVE"
At approximately 1,000 feet AGL.	PM	"1,000, CLEARED TO LAND" or "1,000, NO LANDING CLEARANCE".
At approximately 500 feet AGL.	PM	"500"
At approximately 80 feet above minimums.	PM	"APPROACHING MINIMUMS"
At or before minimums.	CAPT	"APPROACH LIGHTS IN SIGHT" or "RUNWAY IN SIGHT" or "MISSED APPROACH" F/O must acknowledge.
At minimums.	PM	"MINIMUMS"

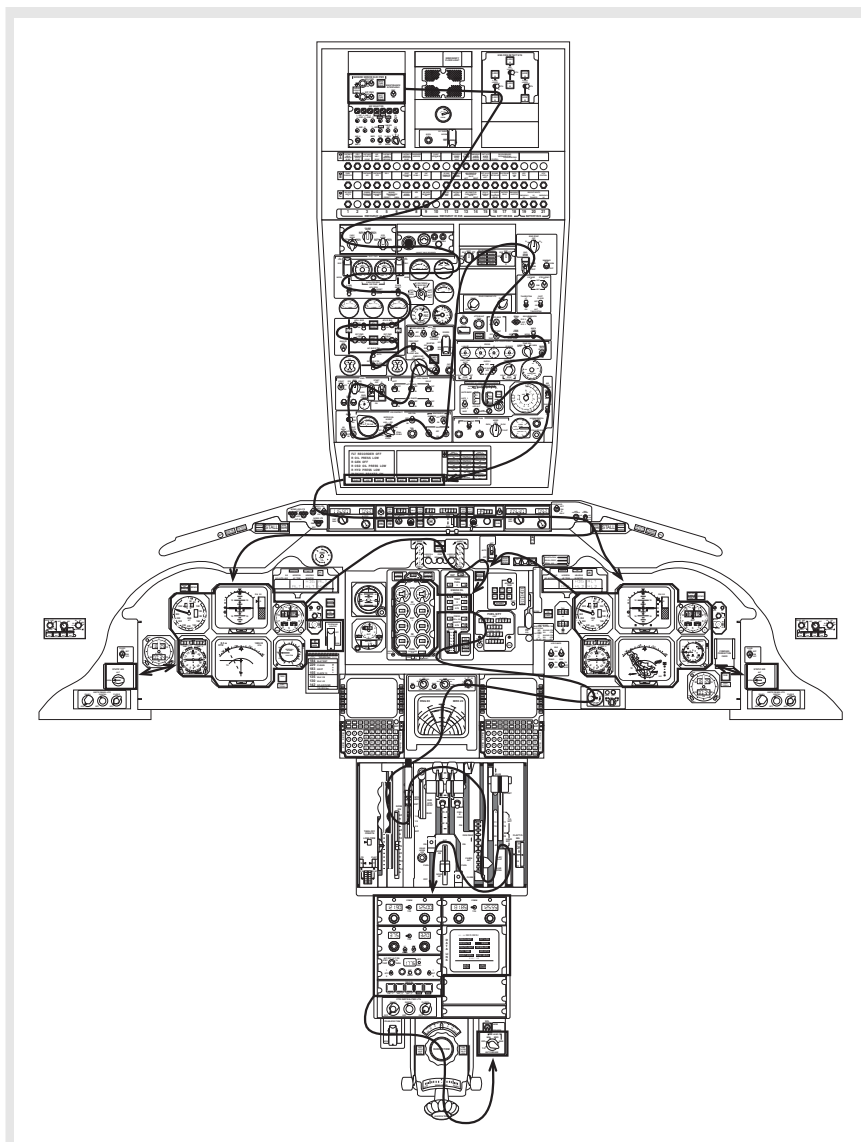
ALL AUTOLAND APPROACHES		
Condition	Crew Member	Callout
When annunciated (approximately 1500 feet RA.)	PM	"AUTO GO AROUND" or ("FLIGHT DIRECTOR GO AROUND" if annunciated), "AUTOLAND" "AUTOLAND"
When annunciated (approximately 150 feet RA, 100 feet minimum).	PM	"ALIGN"
When annunciated (approximately 50 feet RA)	PM	"RETARD" and "FLARE"
At main gear spinup.	PM	"ROLLOUT" "ROLLOUT"

Intentionally
Blank

Flow Patterns

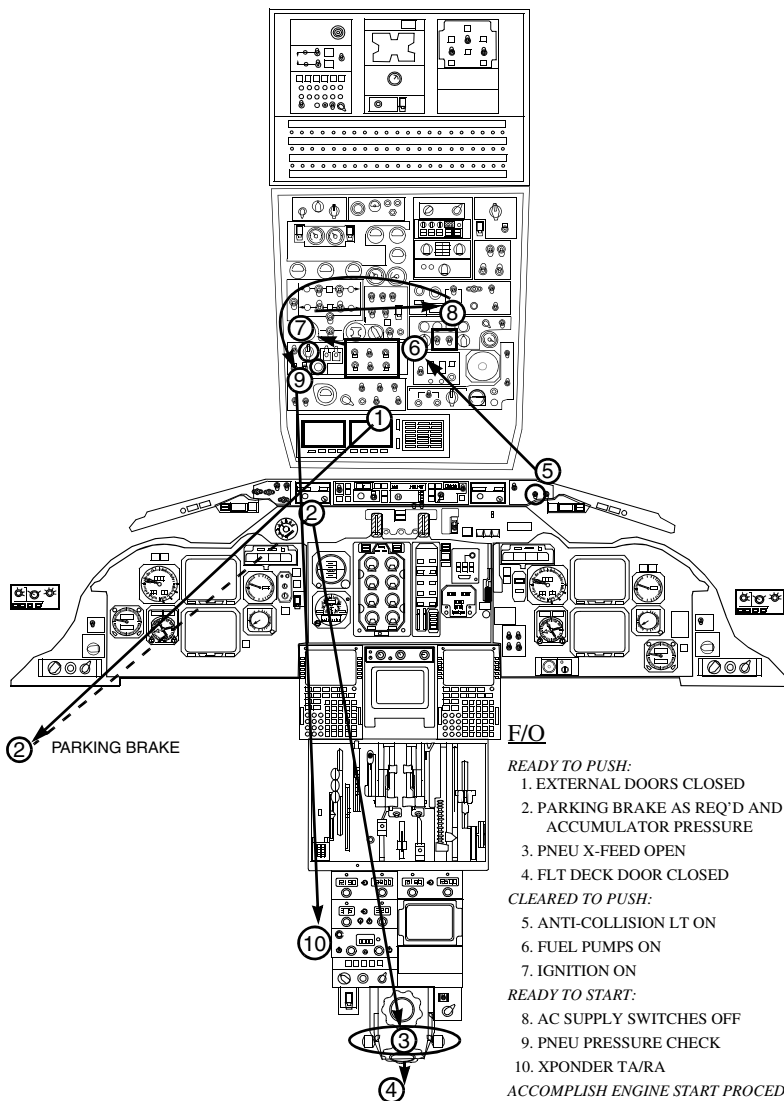
The following Flow Pattern diagrams represent the recommended scan flow pattern for accomplishing the expanded normal procedures.

Before Start

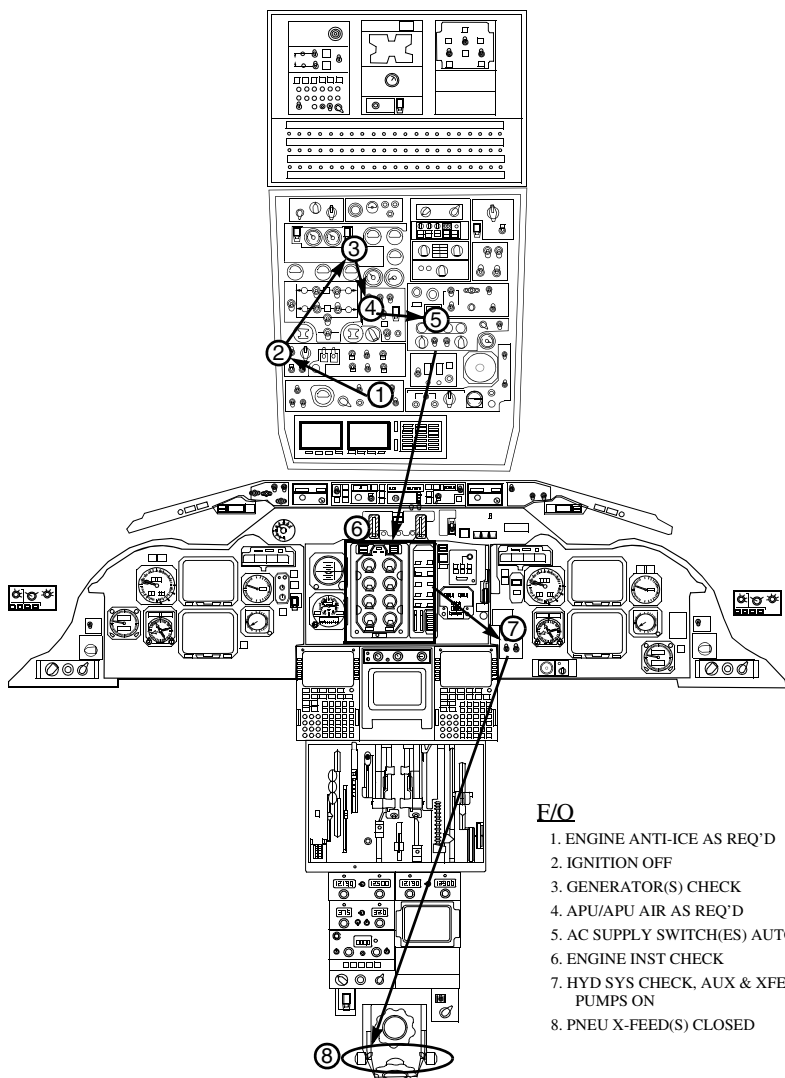


Pushback Start

Assumes APU running with air ON.

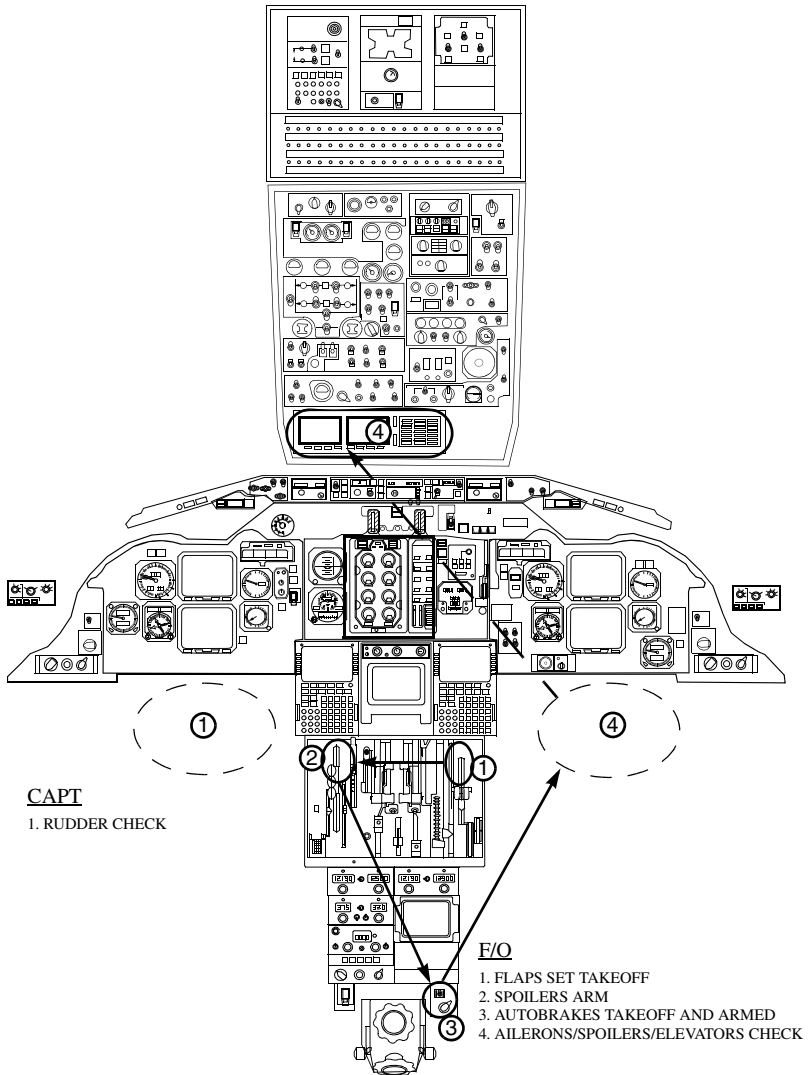


After Start/After Delayed Start



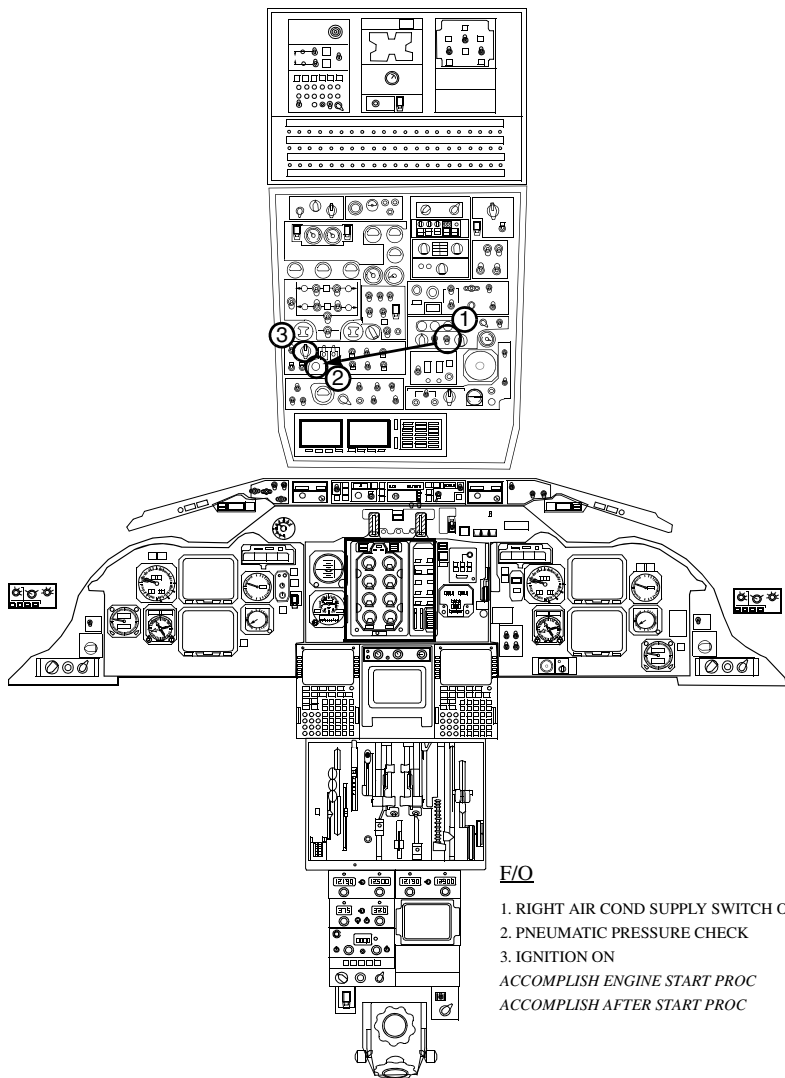
Note: If starting both (i.e., two engine taxi) engines accomplish flow steps 1, 3, 5, 6 and 8 after starting left engine. Then, after starting right engine accomplish entire after start flow.

Taxi



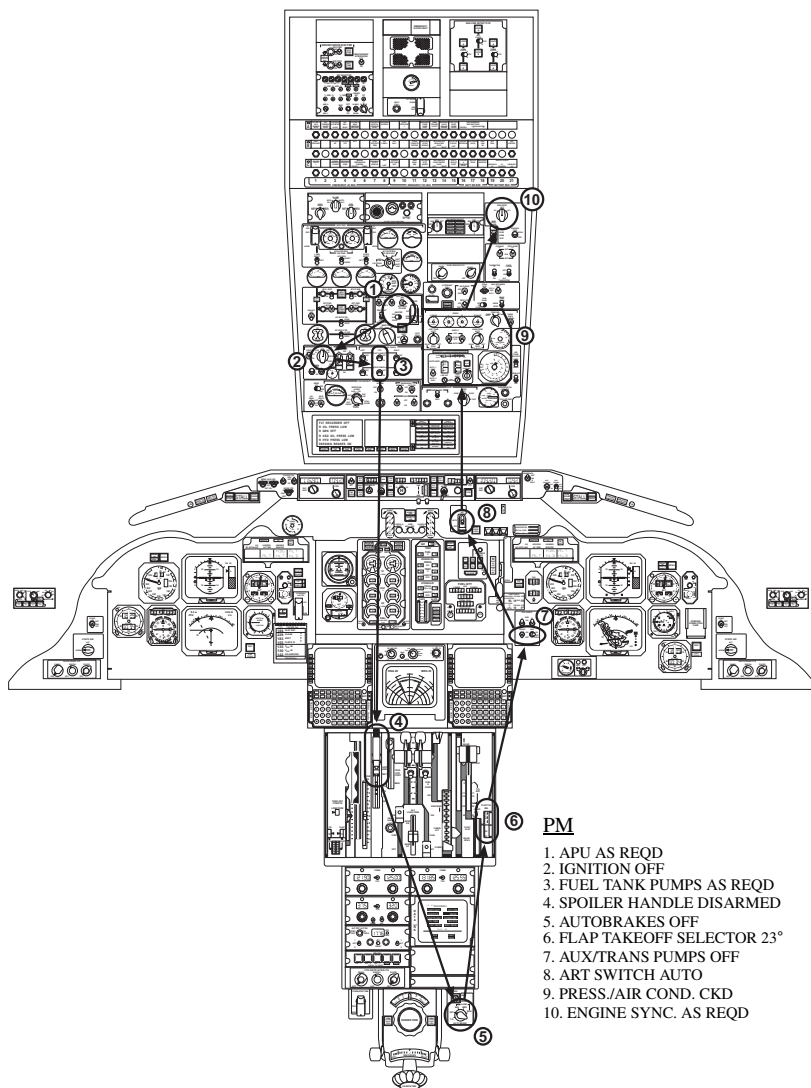
Note: After the agent's salute, the F/O may extend the flaps and set autobrakes/autospoilers in preparation for taxi and call (ATC) for taxi instructions. Only after clear of congested areas may F/O continue with his flow.

Delayed Engine Start

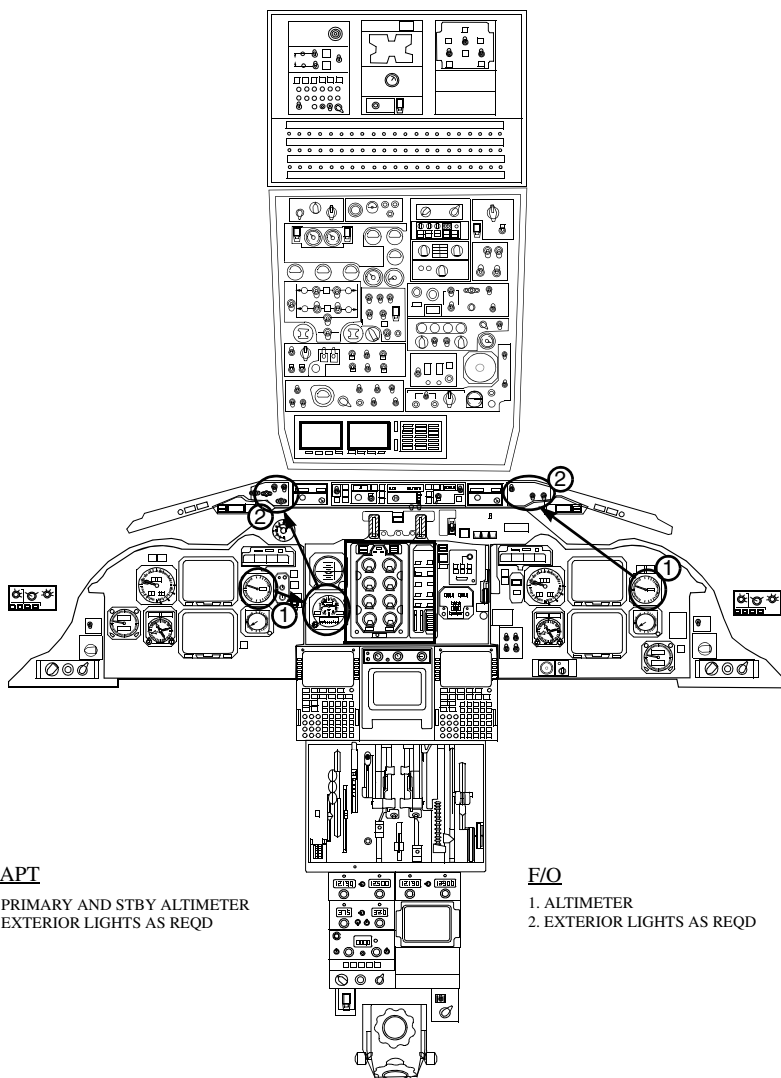


After Takeoff

Assumes aircraft configuration is clean and above 2,500 feet AGL.

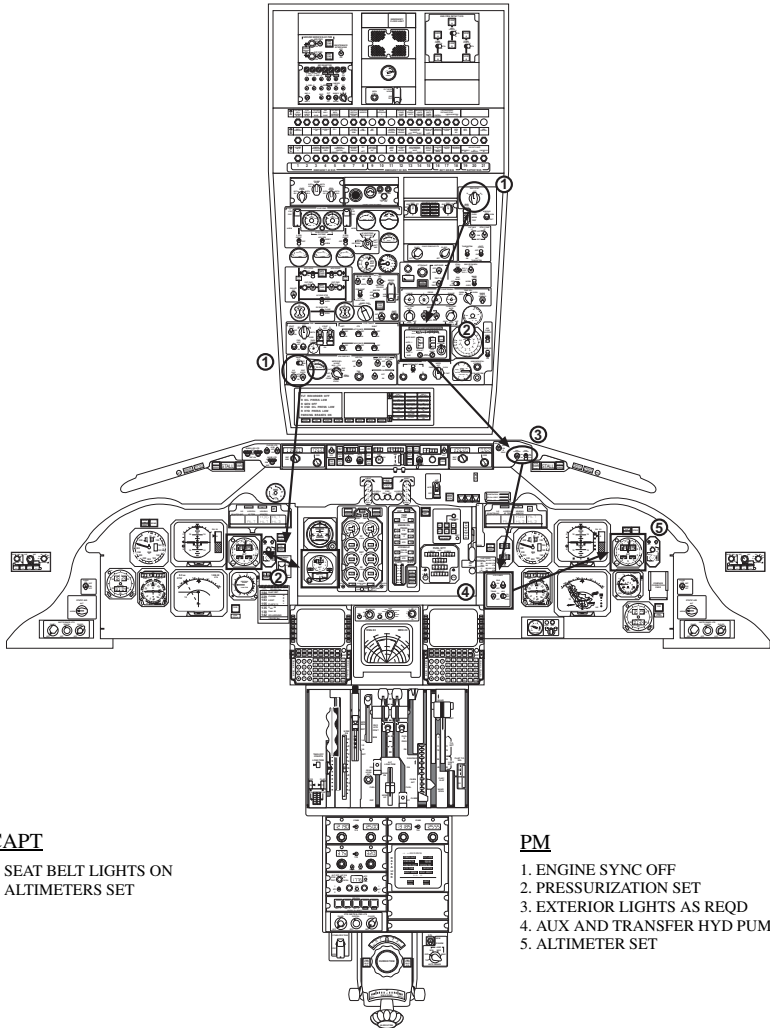


Climb



Note: Refer to FOM Chapter 3 for exterior lights usage policy.

Descent

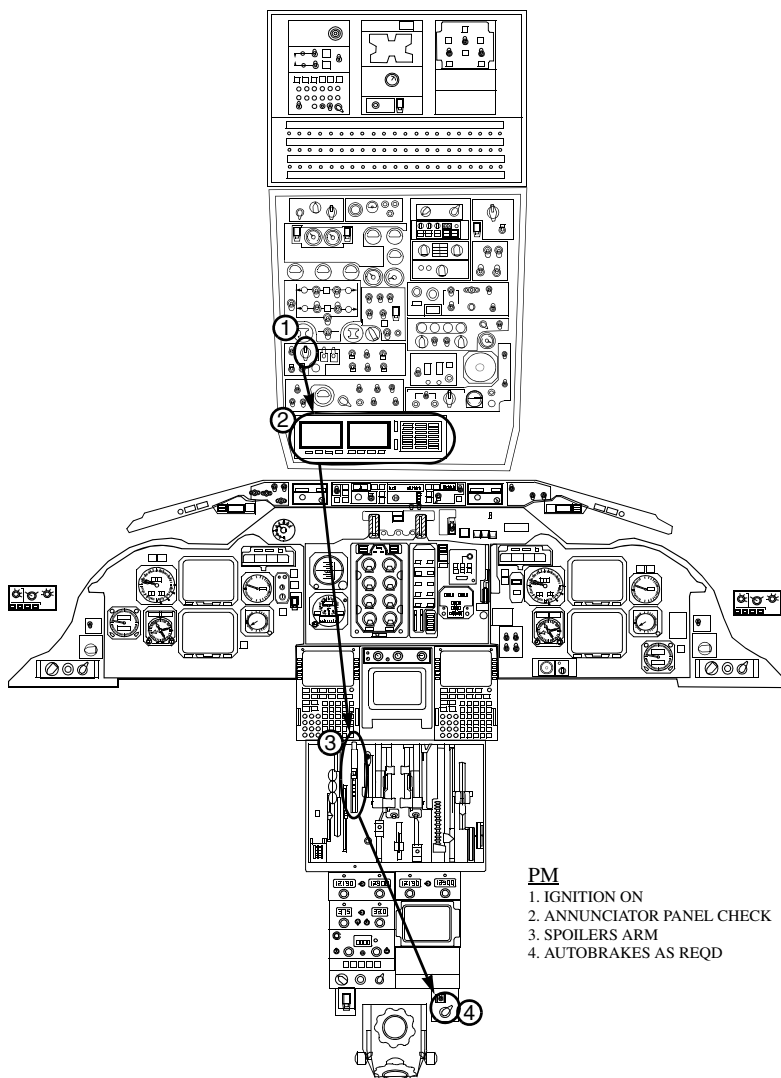


Note: Refer to FOM Chapter 3 for exterior lights usage policy.

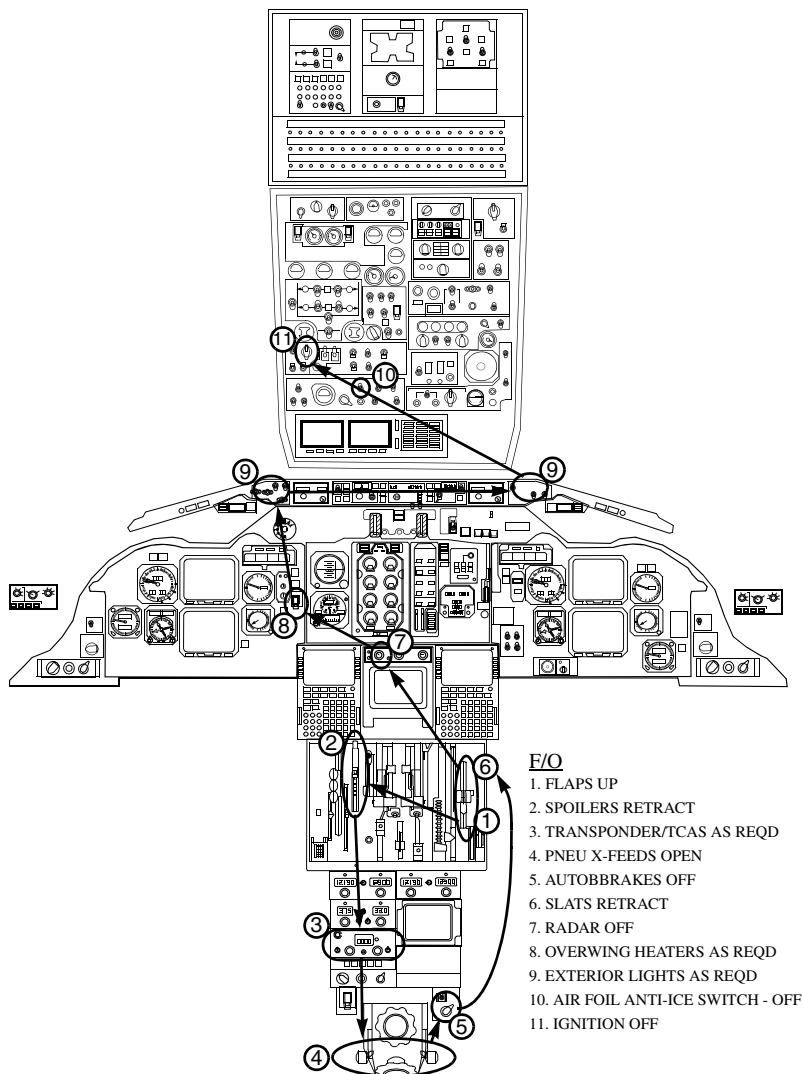
Note: Captain will handle the SEAT BELTS light and his altimeter and STBY altimeter.

Landing

Assumes gear, slats and flaps have been positioned for landing at PF's direction.



After Landing



Note: Refer to FOM Chapter 3 for exterior lights usage policy.

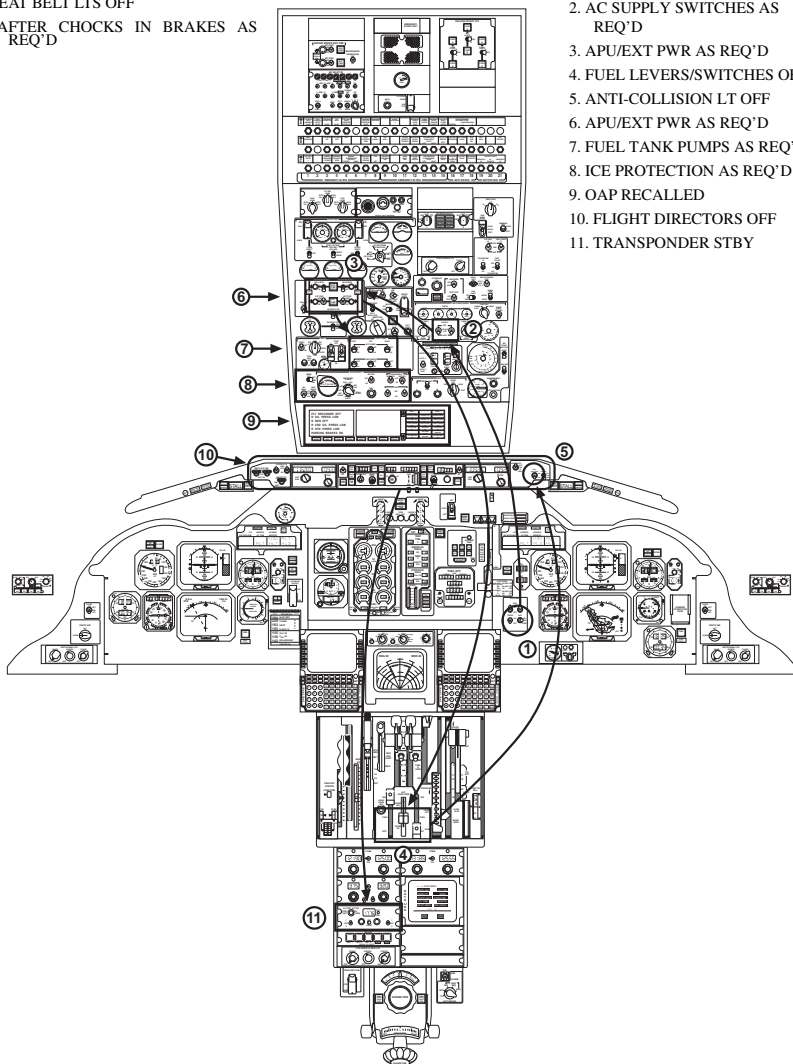
Shutdown

CAPT

1. SET PARKING BRAKE
2. SEAT BELT LTS OFF
3. AFTER CHOCKS IN BRAKES AS REQ'D

F/O

1. AUX & XFER PUMPS OFF
2. AC SUPPLY SWITCHES AS REQ'D
3. APU/EXT PWR AS REQ'D
4. FUEL LEVERS/SWITCHES OFF
5. ANTI-COLLISION LT OFF
6. APU/EXT PWR AS REQ'D
7. FUEL TANK PUMPS AS REQ'D
8. ICE PROTECTION AS REQ'D
9. OAP RECALLED
10. FLIGHT DIRECTORS OFF
11. TRANSPONDER STBY



Note: "Pumps, PACs, Swap, Chop, Beacon, 5 Rows" - can serve as a memory aid to accomplish steps 1 through 10 of this flow.

Normal Procedures
Amplified Procedures

Chapter NP
Section 20

First Flight Of The Day

First Flight Of The Day items Check

Full functional check required on First Flight Of The Day items.

These checks or tests need only be accomplished prior to the first flight each day (after midnight local time).

Refer to Supplementary Procedures section for all First Flight of Day procedures. Checking these items may be accomplished within the Before Start flow as the crew comes to the appropriate switch or control or as a separate set of checks performed before or after accomplishing the Before Start flow.

System Function	SP Section
• Flight Recorder	Flight Instruments, Displays
• GPWS	Warning Systems
• Windshear	Warning Systems
• Transponder/TCAS	Warning Systems
• Flight Deck Access System	Airplane General, Emergency Equipment, Doors, Windows
• Emergency Power	Electrical
• Max Speed Warning	Warning Systems
• Hydraulic Systems	Hydraulics
• Gear Lights/Horn	Landing Gear
• (88) Thrust Rating Panel (TRP)	Engines, APU
• (90) Ice FOD Alert	Anti-Ice, Rain

Note: A SELCAL check is required on aircraft with an inoperative touchscreen ACARS.

Before Start Procedure - Captain or First Officer

The APU should be started five (5) minutes prior to scheduled departure to ensure that the aircraft systems will function/operate properly on ship's power.

Note: Considerations for starting the APU earlier include inadequate cooling/heating requirements from ground based systems

Exterior and Interior Preflight Complete

WARNING: If a red A/C OUT-OF-SERVICE tag is installed, personnel are not to activate any system, control, switch, or circuit breaker without obtaining verbal approval of maintenance personnel (preferably the AMT actually performing the repairs).

Exterior Inspection - Captain or First Officer

Prior to each flight the pilots or Maintenance must verify the airplane condition is acceptable for flight.

A flight crew member shall make a complete exterior preflight inspection, review the aircraft log book and report any discrepancy to the Captain and to Maintenance as soon as possible. Emphasis should be placed on tire wear, airframe/control damage, or leaking fluids.

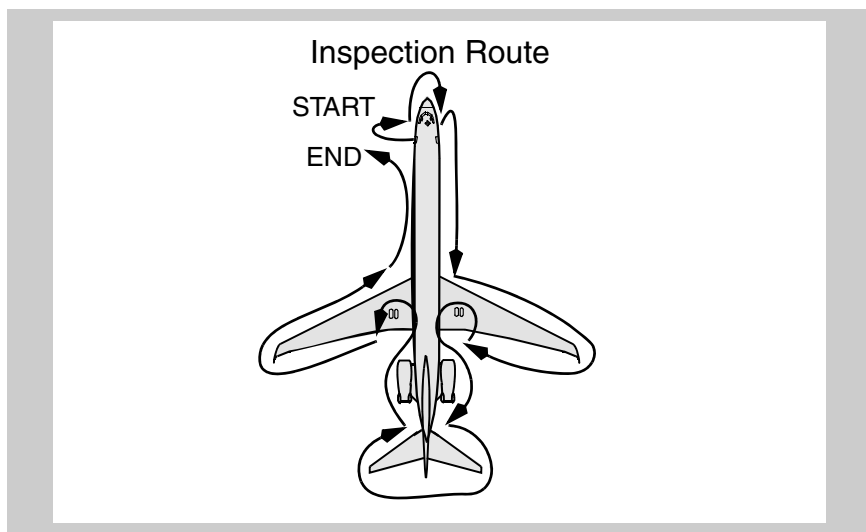
The MD-88/90 has a history of forming wing ice due to cold fuel with the ambient temperature well above freezing.

Frost has been known to form on the upper wing surface of aircraft that land with high amounts of cold soaked fuel in the wing tanks. This phenomenon is usually associated with tankering fuel and can occur under various conditions of temperature and humidity - even in temperatures well above freezing. Upper wing frost should always be considered a possibility if lower wing frost is present. Upper wing frost must be removed prior to takeoff.

Walkaround

CAUTION: Airplanes that are exposed to high-sustained winds, or wind gusts, greater than 75 mph (approximately 65 knots) are susceptible to elevator damage and/or jamming. In accordance with the Aircraft Maintenance Manual, airplanes suspected to have been subjected to these conditions must have visual and physical inspections (moving the surfaces by hand) of all flight controls and an operational check of these systems.

Check the following specific items during the exterior inspection:



Left Forward Fuselage

- (90) TAT probe - Condition.
- Left side strake - Check.
- Electrical ground service panel - Turn lights on.
- Left stall warning vane - Check.
 - Ensure vane is approximately parallel with the ground.

Nose

- Pitot tubes (3) - Check.
- Wiper/windshields - Check.
- Radome/radome fasteners - Check.

Nose Wheel Well

- Wheel well area - Check for damage, evidence of fluid leaks.
- Tires and wheels - Check.
 - Notify maintenance if:
 - Any tread groove worn away completely around the tire.
 - Any layer of cord showing.
 - A questionable cut.
 - Any appearance of improper inflation.
- Spray deflector - Check.
 - Approximately 2 inches above the ground.
- Taxi and landing light - Check condition.
- Strut extension - Inner liner visible.
- Ground shift linkage - Check condition.
- Steering bypass - Note position.
- Gear downlock pin - Removed
- Doors/hinges/linkages - Check condition.
- E/E door - Check closed

Right Forward Fuselage

- Right stall warning vane - Check.
 - Ensure vane is approximately parallel with the ground.
- Right side strake - Check.
- RAT probe - Check.
- (90) Right VSCF inlet - Check.
- Oxygen blowout plug - Green disc in place.
- Water service panel - Check.
- Right static/alt static ports - Clear.
- (90) Left VSCF inlet - Check.

Tactile Wing Inspection

Note: The tactile wing inspection if required, should be accomplished as close to departure time as practical. Refer to Supplemental Procedures, Adverse Weather section.

The flight crew is responsible for the initial check at all stations. Stations personnel are responsible for positioning ladders approximately 8 feet outboard of the wing root along the leading edge.

The tactile wing inspection is the physical check for upper wing surface ice using an inspection pole to assure that the wing surface is rough where there are black paint stripes, and smooth between the black paint stripes. When the wing surface in the area of the black paint stripes has a consistent texture, either rough or smooth, ice may be present and further check of the wing surface is required. Only the rough - smooth - rough contrast felt with an inspection pole indicates no ice is present.

Right Wing

- Wing area - Check for damage, dents in leading edge, skin damage, evidence of fuel leakage; access panels secure.
- Slats - Check condition.
- Vortilon - Check condition.
- Wing tip position/strobe lights - Check condition.
- Aileron and tab - Check
 - Move the aileron full travel in both directions, and leave fully displaced in one direction. When checking the left aileron, note that its direction of displacement is opposite to that of the right aileron.

Note: When checking aileron for freedom of movement, do not move tab as damage to gear mechanism may result.

- Static discharge wicks - Check condition.
- Flaps and actuators - Check condition and no hydraulic leaks.
- Spoilers - Check flush.
- Lower wing surface - Check
 - Check for ice formation due to cold soaked fuel and evidence of runback icing.
 - A coating of frost up to 1/8 inch (3.2mm) thick on the lower wing surface need not be removed provided it is caused by fuel cooling of the adjacent air.

Right Main Landing Gear

- Shimmy damper - Check serviced above refill lines.
- Spray deflector - Check.
- Strut extension - Inner liner visible.
- Gear downlock pin - Removed

-
- Tires and wheels - Inspect
 - Notify maintenance if:
 - Any tread groove worn away completely around the tire.
 - Any layer of cord showing.
 - A questionable cut.
 - Any appearance of improper inflation.

Right Wheel Well

- Main landing gear bypass lever - Check.
 - If lever is out of the stowed position, ensure it is stowed prior to pushback
- Wheel Well - Check general area for damage and evidence of hydraulic fluid leaks.
- Doors, hinges/linkages - Check condition and latched.
- MLG down lock indicators - Check clean.
- Well area lights (2) - Check on.
- Spoiler bypass valve - Check in ON position (9 o'clock position).

Right Aft Fuselage

- Overwing emergency exits - Flush.

Right Engine

- Nacelle - Check area for general condition and evidence of fluid leaks
- Engine inlet - Check condition.
- (90) Rubber-tipped bullet nose - Check for damage or ice accumulation.
- Access panels - Check closed.
- Cowling latches - Check secured.
- Engine exhaust - Check condition.
- (90) C-Duct grabber pin - Check retracted.
- (90) Pylon flap - Check faired.

Tail

- APU and heat exchanger outlets - Check.
- Horizontal and vertical stabilizers and control surfaces - Check for evidence of damage.
- Leading edges - Check condition.
- Elevator - Check condition and for hydraulic leaks.
- Rudder limit pitot - Check clear.

-
- APU access panels - Secured.
 - Tail cone assembly - Secured.
 - Tail skid - check.
 - Check condition of tail skid.
 - Check indicator horizontal and safetied.
 - APU fire control panel - Latched.

Left Engine

- Same as right engine.

Left Aft Fuselage

- Lav service panel - Secure.
 - Evidence of leakage (blue stain) should be investigated.
- Cabin outflow valves - Clear.

Left Wheel Well

- Same as right wheel well area.
- Spoiler bypass valve - check in ON position (8 o'clock position)

Left Wing

- Same as right wing area.

Note: After verifying left aileron position is opposite right aileron, move aileron to faired position.

Left Forward Fuselage

- Cabin pressure relief valves - Clear.
- Left static/alt static ports - Clear.
- (88) Lav service panel - Secure.
 - Evidence of leakage (blue stain) should be investigated.
- Electrical ground service panel - Lights off/latched.

Interior Preflight

CABIN

Note: For flights without flight attendants on board, refer to Supplementary Procedures, Airplane General, Emergency Equipment, Doors, Windows section, Cabin Inspection procedure.

WARNING: If a red A/C OUT-OF-SERVICE Tag is installed, personnel are not to activate any system, control, switch, or circuit breaker without obtaining verbal approval of Maintenance personnel (preferably the AMT actually performing the repairs)

FLIGHT DECK

Emergency equipment Check

Crash axe – Stowed

Emergency Locator Transmitter – Check the ARMED/OFF/ON toggle switch is in the ARMED position.

PBE – Stowed, tamper seals intact.

Smoke goggles (3) – Stowed.

Life vests (3) – Stowed

Halon 1211 Fire extinguisher – Checked, stowed, seal installed.

Jumpseat Secure

Shoulder harness and lap belt secured.

Flight deck door decompression panels Check

Verify the decompression latch indicator for each panel is aligned with the green band.

Crew baggage strap Fastened

Spare gear pins Stowed

Check pins are stowed in pouch.

Crew oxygen Check

Supply valve OPEN

Minimum Pressure 1,000 psi

Logbook/Manuals Check

Check the aircraft log book to be familiar with the history and maintenance status of the aircraft. MCO's should be reviewed using the MDM to ensure compliance when special operating procedures are applicable. Ensure the Airworthiness Release has been signed by Maintenance.

The First Officer must report anything which relates to the operation of the aircraft, such as MCO's, placards, etc. He/she shall check all reports from the incoming crew on all conditions of the aircraft including the passenger compartment, lavatories, and galley facilities.

Ensure the following documents are on-board:

- Logbook
- Normal Checklists (2 each)
- Quick Reference Handbook (QRH) (2 each)
- Operations Manual Volume 2
- Mechanical Dispatch Manual (MDM)
- Aircraft Restrictions Manual (ARM)
- Operational Data Manual (ODM)
- Speed booklet
- Engine Performance Logbook
- Offline Airports Airway Manual (“Brick”)

Note: The effective dates for all checklists and manuals may be found by clicking on the Revision Dates link from the Delta Flight Operations portal.

Circuit breakers..... Check

Verify circuit breakers are in or collared in compliance with dispatch requirements.

Note: If external power is to be used, external power BUS CONTROL switches should be OFF and remain OFF until the unit being connected has been checked for the correct volts and frequency.

Oxygen mask, regulator, interphone Check

Refer to Supplementary Procedures, Airplane General, Emergency Equipment, Doors, Windows section, Oxygen Masks and Interphone Test procedure.

Smoke goggles Check

Verify condition and proper adjustment.

Aft overhead panel Check

Maintenance interphone/GROUND SERVICE POWER switches - OFF.

Engine and APU fire detect loops - BOTH

CADC, FLIGHT DIRECTOR, EFIS switches NORM

COCKPIT VOICE RECORDER Check

Press and hold TEST button approximately 5 seconds. Observe indicator remains in green band, except for momentary dip (4) during channel switching. Needle stays in green band.

Note: If indicator fails to remain in the green band, plug headset into recorder jack. A tone should be heard for each channel during test.

ELEC PWR panel Set

(88) L/R CSD DISCONNECT switches – Guards down and safetied.

L/R GENERATOR switches – ON

Check APU or external power on.

APU L/R BUS switches - OFF, unless APU generator is powering the aircraft.

Refer to FOM Chapter 3 for APU Policy.

Refer to Supplementary Procedures, Engines APU Section, APU Start procedure.

EXT PWR L/R BUS switches – As required

Switch(es) should be ON only if external power is in use, and OFF for all other operations.

GALLEY power switch – ON

(88) AC BUS X TIE switch – AUTO

(90) L/R BUS X TIE switches – AUTO

DC BUS X TIE switch – OPEN

(88) EMERGENCY POWER switch – OFF

(90) EMERGENCY POWER switch – ARM

BATTERY switch ON, locked

Check battery voltage.

If battery voltage is less than 25 with no load, battery must be replaced/allowed to recharge.

FUEL TANKS PUMPS, X-FEED Check

Check DC start pump.

Place START PUMP switch to ON, observing that R INLET FUEL PRESS LOW message extinguishes.

Place START PUMP switch to OFF. Observe R INLET FUEL PRESS LOW message illuminates.

Main fuel tank pumps – Check

One at a time, turn main tank pumps on then off, checking that associated L or R INLET FUEL PRESS LOW message extinguishes, then illuminates when pump is turned off.

With one right main tank pump on:

Position FUEL X FEED lever to ON. Observe L INLET FUEL PRESS LOW message extinguishes.

Position FUEL X FEED lever to OFF. Observe L INLET FUEL PRESS LOW message illuminates.

If APU is operating:

RIGHT AFT FUEL TANK PUMP switch - ON

Note: For APU operation on the ground while parked at the gate, use a right tank fuel pump (or a left tank fuel pump with crossfeed open) ONLY - an aft pump is preferred. This prevents possible cavitation and APU flameout.

CAUTION: Providing APU fuel from the center tank is prohibited while parked at the gate.

(88) ENG IGN switch OFF

(90) ENG IGN switch AUTO

Passenger signs Set

EMER LTS switch - ARM

Flight deck emergency lights and EMER LTS NOT ARMED
message should be extinguished.

NO SMOK switch - ON

(90) No smoking switch is labeled CHIME

SEAT BELTS switch - ON

ICE PROTECTION panel Set

Rotate METER SEL & HEAT selector to each position and observe
HEATER CUR gauge indication.

Note: RAT PROBE position will not indicate a current flow when
aircraft is on ground.

Rotate METER SEL & HEAT selector to CAPT.

Note: When in emergency power and battery is the only source of
power, CAPT pitot will be only position operable and meter
will indicate current flow.

AIR FOIL switch - OFF

WINDSHIELD ANTI-FOG switch - As required

WINDSHIELD ANTI-ICE switch - ON

L & R ENG anti-ice switches - OFF

(90) HYDRAULIC CONTROL ELEVATOR OFF
light Extinguished

CARGO FIRE warning Check

Refer to Supplementary Procedures, Cargo Fire Warning Test
procedure.

ENG SYNC switch OFF

GND PROX WARN switch NORM

IRS MODE SELECT selectors NAV

Full alignment is required for the first flight of the day and any flight with planned routing into Class II airspace; all other flights only require fast realignment.

Refer to Supplementary Procedures, Navigation section, IRS Operation, Initial Alignment Procedures.

ANTI-SKID switch.....ARM

ANTI-SKID messages - Extinguished

STALL warning Check

STALL TEST switch - SYS 1, then SYS 2

Verify control column vibration, the STALL warning and STICK PUSHER PUSH TO INHIBIT lights illuminate, the stall warning horn sounds, and the “STALL” aural alert is activated when each position is selected.

STALL TEST switch - OFF

YAW DAMPER switch ON

MACH TRIM COMP switch NORM

(MD-88) Observe that Mach trim indicator is fully retracted.

(MD-88) MACH TRIM INOP message extinguished.

(MD-90) MACH TRIM OFF message - Extinguished

RADIO RACK switch FAN

AIR CONDITIONING panelSet

Check instrument cooling fan flow.

Prior to air conditioning on, check instrument airflow indicator.

CKPT and CABIN TEMP controls - 12 and 2 o'clock, respectively.

AIR CONDITIONING SUPPLY switches - as required.

Refer to Supplementary Procedures, Air Systems, APU Ground Air Conditioning procedure.

Pressurization panel Set

SYSTEM SELECTOR switch - SYS 1

LDG ALT indicator – Set destination field elevation

LDG BARO pressure - Set (if known)

RATE LIMIT control knob - INDEX

Press FLOW light to test.

AUTO INOP, AUTO 1 INOP, AUTO 2 INOP, and FLOW lights
should illuminate.

AIR COND SHUTOFF switch AUTO

RAM AIR switch OFF

Note: Use of the RAM AIR switch to ventilate airplane on the ground
is prohibited. Consider using ground pneumatic air if APU
pneumatic air and ground conditioned air are not available.

Annunciator panel and digital lights Recall & check

Depress each OAP cue button and ensure no abnormal system
indications for current aircraft configuration.

(90) Aux/transfer hydraulic pumps may need to be turned on to ensure
certain CTRL fault messages extinguish.

Depress the ANNUN/DIGITAL LTS TEST button and observe test
patterns on the OAP, the engine indication panel, and the MASTER
CAUTION, MASTER WARNING lights, all digital lights, and the
AGENT LOW lights illuminate.

Flight Guidance System panels Check & set

FD switches - FD

Observe HDG HOLD and ALT HLD in both flight mode
annunciators.

Command bars should appear and be centered.

Set SPD/Mach readout.

Set MACH to desired cruise Mach.

Set V2 in SPD/MACH window.

AUTOTHROTTLE switch - OFF

Set HDG bank angle limiter to 15°.

Set HEADING readout as required.

AUTOPILOT switch - OFF

DIGITAL FLIGHT GUIDANCE COMPUTER switch - As required.

 Select DFGC 1 on Captain's leg; 2 on F/O's leg.

Set ALT readout.

 Set altitude to first level off altitude, and pull to arm.

 Observe FMA for proper annunciation.

Set VHF NAV radios.

 Set desired frequency and course in VHF nav radios.

Perform autoland availability test on both DFGC's prior to any leg in which autoland may be used.

 Refer to Supplementary Procedures, Automatic Flight, Autoland Availability Test procedure.

Exterior lights Set

 POS/STROBE lights switch - BOTH

 ANTI-COLLISION LTS - OFF

 All other exterior lights - As required

ALTIMETERS ____, Crosscheck

 Set both primary barometric altimeters to current altimeter setting.

 Crosscheck altimeters.

 Ensure altimeters are within tolerance per the Altimeter Crosscheck Limits for RVSM Operations in the Limitations chapter.

Flight & navigation instruments Checked

 AIRSPEED/MACH indicators - check at rest indication.

 Standby horizon - pull to cage; check OFF flag retracted.

Check IRS.

Compare Captain's and First Officer's compasses, RDMI's, and standby compass for approximate agreement. Check OFF flags retracted.

Check for absence of IRS FAULT lights and HEADING flags.

Realign IRS anytime IRS FAULT lights or HEADING flags are present. Do not move aircraft during realignment.

TA/VSI - ZERO.

Set current altimeter in standby altimeter/airspeed indicator.

Check TAS/SAT.

TAS = 130 knots.

SAT = OAT.

STATIC AIR selectors - NORM.

Check/set both clocks as required.

Tactile wing inspection & WARM light As required

Overwing heaters inoperative:

A tactile check (poles and ladders) must be accomplished if required. Refer to SP.16 Supplementary Procedures, Adverse Weather, Cold Weather Operation.

Overwing heaters operative:

If snow/ice is present on either wing:

OVERWING HEATER switch must be OFF.

If icy precipitation exists and:

The aircraft is to be de-iced: OVERWING HEATER switch must remain OFF until the de-ice crew calls for the aircraft to be configured for de-icing.

The aircraft is not to be de-iced: OVERWING HEATER switch may be in the ARM position as long as the Captain determines that precipitation will not adhere to the upper wing surface during taxi.

If no icy precipitation exists:

Verify system is armed.

L/R FAIL lights should be extinguished.

Verify WARM light is illuminated.

If not illuminated, press switchlight to initiate a reset of the WARM light. Call for poles and ladders as a precaution in case WARM light does not illuminate within 12 minutes.

Note: If WARM light illuminates within 12 minutes, a visual check of the heater blanket surface from the ground is sufficient to ensure there is no ice on the overwing heater surface.

Fire warning Check

(88) Press LOOPS A and B TEST buttons simultaneously.

(90) Press FIRE TEST switch.

For either test above, verify both fire/aural warnings sound, and the following lights/messages should illuminate:

- MASTER WARNING (2)
- (88) MASTER CAUTION (2)
- L/R ENGINE FIRE WARNING (2)
- (88) FIRE DETECTOR LOOP
- APU FIRE
- (88) LOOP A and LOOP B (6)

Press FIRE BELL OFF button.

- Fire/aural warning should silence.

(88) Release LOOPS A and B TEST buttons.

(90) Release FIRE TEST switch.

ART switch AUTO

Verify READY and ART lights and ART INOP message are extinguished.

Engine Instruments Check

Check engine instruments for normal static indications.

Observe normal OIL QUANTITY indication for full tanks is (88) 12 - 16 quarts; (90) 25 - 27 quarts. If the engines have been shut down for more than 30 minutes, oil quantity may indicate less than full.

- Minimum quantity for pushback at a non-maintenance station is (88) 8 quarts; (90) 12 quarts.
- Minimum quantity for pushback at a maintenance station is (88) 12 quarts; (90) 16 quarts.

Reset FUEL USED COUNTERS.

Momentarily hold the FUEL USED RESET button to Reset.

Ensure FUEL USED counters go to zero.

Verify HYDRAULIC QUANTITY - normal.

Fuel required , on board ____

(88) FUEL QTY TEST button - push.

Observe left, right, and center readouts change to 3,000 pounds (± 100) TOTAL FUEL should indicate 9,000 pounds, GROSS WT should indicate zero fuel weight set plus 9,000 pounds.

Release TEST button and quantities should return to current fuel on board. Fueling status should be ascertained at this time.

Note: When dispatched with full L/R main tanks, the normal fuel weight is 9,250 pounds. Different fuel densities can cause volumetrically full L/R main tanks to indicate between 8,700 and 9,800 pounds.

Verbalize flight plan block fuel and actual fuel on board.

Compare actual fuel onboard to MIN FUEL FOR T/O to prevent delays.

Brake temperature Check, ALL

Observe OVHT light is extinguished.

(88) Push TEST button and observe temperature indicator moves into test band and OVHT light illuminates steady.

(90) A flashing light indicates a fault.

Release TEST button and observe normal indications.

Radar & predictive windshear Check

Refer to Supplementary Procedures, Warning Systems, Radar/PWS System Test procedure.

WARNING: Do not place radar in an operating mode during ground operations unless aircraft is headed away from people, large metal objects, any refueling operation, flammable containers, or explosive liquids.

Stabilizer trim Check

Operate alternate trim levers, suitcase handles, and Captain's and First Officer's control wheel trim switches in both directions.

Observe proper trim rate and direction.

Spoilers RET

Check SPEED BRAKE lever full forward and retracted.

Observe top of the red arming band on SPEED BRAKE lever is visible.

RUD HYD CONT lever PWR

FUEL X-FEED lever OFF

Throttles Check, idle

Advance both throttles to takeoff position.

Ensure the takeoff warning sounds.

Retard throttles to idle.

(90) Check that overrated thrust gate is in RESET (aft) position.

Push either throttle TOGA button.

Observe TAK OFF, TAK OFF in both flight mode annunciators.

Outflow valve AUTO

Place the CABIN ALTITUDE control lever in AUTO.

Observe that the outflow valve position indicator drives to the full OPEN (aft) position.

CAUTION: If outflow valve control lever is in manual, ensure recirculation hose is clear of outflow valve prior to selecting AUTO.

FLAPS & SLATS UP & RET

WARNING: Obtain ground clearance prior to adjusting flap/slat position when the aircraft is parked.

FLAP/SLAT handle - check UP/RETRACT.

FLAPS position indicator - UP.

SLATS advisory lights - extinguished.

Note: On the ground, a single hydraulic system may not fully retract the flaps.

(88) FUEL levers OFF

(90) FUEL switches OFF

Radios, Transponder, ACARS Check & set

It is suggested to use #1 VHF for all ATC comm and #2 VHF for ATIS and company comm. If required obtain a comm check.

Set ADF.

- Frequency windows as desired.
- Switches in NORM and ADF positions.

Set transponder to STBY.

Select No. 1 for Captain's Leg, No. 2 for F/O's Leg.

Set ACARS.

Refer to SP.5 Supplementary Procedures, Communications section for ground set-up.

STABILIZER TRIM brake switch NORM

Rudder & aileron trim 0, 0

PNEU X-FEED VALVES L/R OPEN

Autobrake selector OFF

Autobrake switches DISARM/OFF

Flight Attendant briefing Complete

Refer to FOM for expanded briefing format.

Departure briefing Complete

All pilots will be included in the Departure briefing. Pilots should develop a brief that incorporates the highest threats (i.e., weather, security, terrain, etc.).

Refer to FOM for expanded briefing format.

The Captain calls “Before Start Checklist.”

The First Officer reads the BEFORE START checklist up to “After paperwork received:” items.

After paperwork received:

Two crew members must refer to final AWABS/WDR information and verify flight number and date, takeoff flap setting, trim and power settings, V-speeds, and other pertinent performance information.

Zero fuel weight Set

Enter AWABS ZFW into fuel panel.

If ballast/unusable fuel is loaded in center tank, subtract this amount from the AWABS ZFW for fuel panel entry and FMS.

FMS Set

Reconcile differences between flight plan ramp weight and AWABS actual gross weight before entering final ZFW on PERF INIT page, or

If any ballast/unusable fuel is loaded, add all ballast/unusable fuel to FMS reserves fuel block.

Note: If CLEAN SPD is greater than 250 knots, clean speed/10000 must be entered into the Speed Restriction line or the default 250/10000 Speed Transition will be used.

Enter V_1 , V_R , and V_2 on the TAKEOFF page.

Takeoff condition computer ____, ____, Set

Rotate the CG thumbwheel until the AWABS CG setting is in the CG readout.

Rotate the FLAP thumbwheel until the AWABS required takeoff flap setting is in the FLAP readout.

Compare LONG TRIM readout with AWABS stab setting and set trim to trim index.

Verbalize CG setting and FLAP readout.

Stabilizer Set
Flap takeoff selector Set

Unless otherwise required, 23° should be set.

Airspeed bugs & TRP ____, Crosscheck

Set airspeed command bug to:

- V_2

Set external bugs to:

- V_1
- $V_2 + 20$
- Slat retract speed
- Clean speed

Both pilots must verbalize V_1 , V_R , V_2 , $V_2 + 20$, slat retract, and clean speeds.

CAUTION: Do not use Assumed Temperature (AT) thrust when:

- Restricted at particular airports (refer to Delta Airway Manual 10-0 special pages)
- Unstable weather conditions exist
- AWABS is inoperative.

(88) Set Thrust Rating Panel (TRP) to:

Alternate Power:

- Select T.O. FLX.
- Position ARTS switch OFF.
- Set Assumed Temperature.
- Verify ART INOP message displayed.

Normal Power:

- Select T.O.
- Position ART switch to AUTO.

Note: For normal power takeoffs: the ART INOP message should be extinguished and READY light illuminated when both engines are operating and the slats are extended.

Maximum Power:

- Select T.O.
- Position ART switch to OFF.
- Verify ART INOP message displayed.

Continued on next page

Continued from previous page

Note: A maximum power takeoff requires a logbook entry.

CAUTION: Do not use Maximum power unless:

- **Directed by MEL and performance data precludes use of alternate power, or**
- **Performance limited at normal thrust with a field elevation of greater than 5,000 feet MSL.**

(90) Set Thrust Rating Panel (TRP) to:

Alternate Power:

- Select TO/GA and 25K.
- Set Assumed Temperature.
- Verify 25K displayed in thrust rating window.
- Verify FLX XX (XX = temperature) in thrust mode window and FMA.

Normal Power:

- Select TO/GA and 25K.
- Verify 25K displayed in thrust rating window.
- Verify TO/GA displayed in thrust mode window.

Maximum Power:

- Select TO/GA and 28K.

Note: 28K may only be used when approved by AWABS or Airway Manual Special Pages.

Note: 28K CL, MCT, and CR may not be used at any time; however, windshear detection allows for 28K thrust.

EPR Limit Readout - check.

EPR Limit Readout should show allowable EPR for takeoff.

EPR gauges - check.

EPR Limit Reference bugs should drive to same value as in EPR Limit Readout. If they do not, set CMD EPR Readouts manually.

In addition to airspeed bug settings and speeds, both pilots must verbalize TRP selection, FMA Throttle Window readout, ART switch position, and EPR Limit Readout/EPR Limit Reference bug settings.

The First Officer reads the “After Paperwork Received” items of the BEFORE START checklist.

Pushback/Start Procedure - First Officer

Note: When starting engine(s) at the gate, ensure the parking brakes are set and chocks removed prior to engine start.

All appropriate procedural items will be completed prior to aircraft movement.

At the Captain's discretion, considering gross weight, ramp and taxiway conditions, and maneuvering requirements, taxi is normally accomplished using only one engine. The following restrictions apply for single engine taxi out:

- Ensure all hydraulic pump switches ON and normal system pressure on both sides.
- Left or right engine driven generator must be operating to power the respective generator bus.
- Normally, the APU is used to power the other generator bus.
- Start second engine in sufficient time (5 minutes minimum if possible if engine has been shut down more than two hours) to achieve 2 minutes at idle prior to takeoff. This timely starting of the engines also provides adequate time for the orderly accomplishment of required checklists.
- The left engine is normally started first and used for single engine taxi. However, it is permissible to start the right engine first and taxi single engine. If the right engine is started first, modify flows and the Amplified Procedures accordingly.

Doors Close

Ensure all doors are closed - all door lights and messages extinguished.

Receive "CABIN IS READY FOR PUSHBACK" verbal from Flight Leader.

Parking brake As required

Minimum brake pressure required to set brakes is:

- (88) 1400 psi.
- (90) 1700 psi.

Before pushback, verify brake accumulator pressure is available for parking brakes to be set at completion of the push. If not, pressurize the hydraulic system.

Maximum brake temperature for setting parking brakes is:

- (88) 300°C.
- (90) 500°C.

PNEUMATIC CROSSFEED VALVES OPEN

Flight deck door Closed & locked

After pushback clearance or engine start clearance:

ANTI COLLISION switch ON

Select ON immediately prior to aircraft movement or immediately prior to engine start if starting at gate.

Fuel tank pumps ON

Both PUMP switches for each main tank should be ON. If center tank contains fuel, position both CTR PUMP switches to ON.

(88) IGN switch ON

Use SYS A on Captain's leg; SYS B on F/O's leg.

When ready to start:

AIR CONDITIONING SUPPLY switches OFF

Pneumatic pressure Check

(88) Positive pneumatic pressure indication for engine start is required.

(90) Pressure indication may only be observed after START switch is pulled.

Transponder As required

At all US airports:

- Select TA/RA.

At all non-US airports:

- Select STBY or an active mode as required by local airport operating procedures.

The Captain calls "PUSHBACK/START CHECKLIST."

The First Officer reads the Pushback/Start Checklist.

Engine Start Procedure

Note: One pilot will accomplish the engine start procedure; the other will monitor outside the flight deck. The Captain will brief start duties and announce the start sequence.

Note: The pilot activating the fuel lever will be responsible for monitoring the engine instruments until the N2 is stabilized at or above: (88) 50%; (90) 55%.

Note: (88) For first flight of the day engine starts, when the OAT is at or below - 6° C (20° F), refer to Supplementary Procedures, Adverse Weather, Cold Weather Operation - Pushback/Start, for additional steps.

(88) START switch Hold to ON

(90) START switch Pull

(90) If START switch will not remain latched, pull and hold START switch.

CAUTION: Do not reengage the starter while the engine is accelerating or decelerating except for a tailpipe fire.

Check START VALVE OPEN message illuminated.

Check for N₂ rotation.

(90) Monitor vibrations.

Check hydraulic pressure rise.

Check oil pressure rise.

(90) May not indicate until 20% N₂.

Check for N₁ rotation.

(90) N₁ rotation may be observed, but is not required until 33% N₂.

FUEL lever/switch ON

(88) Put FUEL lever ON at max motoring RPM with EGT below 100°C. Max motoring is usually 22- 24% N₂. Minimum N₂ for FUEL lever ON is 20%.

(90) Put FUEL switch ON at max motoring RPM with EGT below 250. Max motoring is usually 25-26% N₂. Minimum N₂ for FUEL switch ON is 15%. Fuel flow will not begin until 30 seconds after start valve opens.

(88) Observe fuel flow indication and EGT rise within 20 seconds after placing fuel lever ON.

(90) Observe EGT rise within 20 seconds after fuel flow.

Initial fuel flow is approximately 800 to 1100 pph.

Note: A starting fuel flow of 1100 pph or more may be an indication of an impending hot start and the start should be carefully monitored.

Note: If flashing fuel flow is observed, carefully monitor EGT and other engine indications for evidence of a hot start and act accordingly.

(88) START switch Release at 40% N₂

(90) START switch Released and light out at 45% N₂

(90) If START switch will not remain latched, release or manually push in START switch when engine reaches between 43% and 45% N₂.

Check START VALVE OPEN message extinguished.

Monitor EGT until N₂ is stabilized at or above:

(88) 50%.

(90) 55%.

(88) If N₂ is greater than 42% but below 50%, advance throttle to increase N₂ RPM to 65% momentarily while monitoring EGT. This should close the surge valve and result in increased idle RPM and decreased EGT.

NORMAL IDLE INDICATIONS	88	90
N2	50 - 60%	55 - 60%
EGT	300° - 480°C	300° - 530°C *
OIL PRESSURE	40 psi minimum	80 psi minimum
FUEL FLOW	800 - 1100 pph	
Note: MD-90 Idle EGT is an approximate value under normal conditions. With high ambient conditions, idle EGT may be in excess of 530°C, but must not exceed the MCT limitation of 610°C.		

Abnormal Engine Starts

Accomplish MANUAL ABORTED START abnormal procedure in the QRH, NNC.7 Engines, APU section if:

No N₂ rotation.

No oil pressure prior to 20% N₂.

Note: (90) Oil pressure may not indicate until 20% N₂.

No N₁ rotation prior to:

- (88) 20% N₂
- (90) 33% N₂

Note: (90) At N₂ rotation, between 20% and max motoring, N₁ could be just beginning to indicate in the 0 - 1% range.
However, N₁ must begin to indicate by 33% N₂.

(90) Engine vibrations above 4.0.

No EGT rise 20 seconds after FUEL CONTROL lever/switch ON.

Rapid EGT rise toward limit.

(88) Hung start (N₂ fails to increase above 42%).

(88) Fuel flow digits are flashing combined with one or more of the abnormal engine indications listed above.

After Start or Delayed Start Procedure - First Officer

Note: Bleed extractions should only be made once the engine has stabilized at idle RPM. A 4-5% decrease in N2 due to bleed extraction is considered normal. This reduction in engine idle speed may result in an N2 RPM less than 50% and is acceptable provided other engine indications are stable.

Engine anti-ice As required
 (88) IGN switch OFF
 Generator(s) Check

L/R GEN OFF messages should be extinguished. APU GEN OFF message should be illuminated if both engine generators are operating or extinguished if a single engine generator is operating.

Ensure external power bus control:

- (88) Switches OFF.
- (90) Switch OFF.

Check generator volts and frequencies.

- 115 ± 3 V. A. C.
- 400 ± 4 Hz.

AIR CONDITIONING panel Set

L and R AIR CONDITIONING SUPPLY switches - AUTO.

Engine instruments Check

Hydraulic panel Check & set

All hydraulic pumps - ON.

Note: After a delayed start - turn aux and transfer pumps OFF while observing hydraulic pressure. Lack of significant pressure loss in 5 seconds verifies an operable right engine driven hydraulic pump. Turn aux and transfer pumps back to ON.

Left/right system hydraulic pressure - normal.

Left/right system hydraulic fluid quantity - normal.

Left/right brake hydraulic pressure - green band

CAUTION: Do not begin taxi until all hydraulic pumps are on.

PNEU X-FEEDS As required

Left engine pneumatic crossfeed valve - CLOSE.

Right engine pneumatic crossfeed valve - as required.

OPEN for single engine taxi with APU.

If required to augment pneumatic pressure, optimum cooling is achieved by leaving the crossfeeds OPEN with APU AIR switch in the ON position. Close left crossfeed prior to starting the second engine.

Do not use the AIR CONDITIONING COLDER position with engine(s) running.

Note: When both engines are started in sequence prior to taxi (i.e., NOT a delayed start) the following steps on the After Start Procedure are accomplished after the left engine N2 has stabilized above 50% (88), 55% (90) and before starting the right engine:

Left engine anti-ice As required

Left generator Check

Left AIR CONDITIONING SUPPLY switch AUTO

Left engine instruments Check

Left PNEU X-FEED CLOSE

After starting the right engine re-accomplish the entire After Start procedure.

The Captain calls "AFTER START CHECKLIST."

The First Officer reads the AFTER START checklist.

Taxi Procedure - First Officer

After the agent's salute, the First Officer may extend the flaps and set autobrakes/autospoilers in preparation for taxi and call for taxi instructions. Only after clear of congested areas may the First Officer continue with his taxi check flow pattern in anticipation of the Captain calling for the TAXI checklist.

CAUTION: Due to brake chatter which is inherent to the design of MD-88 brakes, plan braking requirements well in advance of planned stopping point.

Note: Slow speed taxi over an arresting cable prior to takeoff or after landing is considered acceptable. However, the nosewheel must be inspected at the next aircraft block-in. If required, accomplish OPERATING OVER A RAISED ARRESTING CABLE procedure in SP.14 Supplementary Procedures, Landing Gear section.

Flaps & Slats __, __, T/O

Flaps 11 is the normal takeoff flap setting. All flap settings from 0 to 24 (except 14, the slat decision area) are valid.

Flap setting should correspond with that listed on the AWABS. Changes in parameters upon which the dispatch setting was based (runway, temperature, wind, etc.), may dictate a different flap setting.

CAUTION: Always ensure selected flaps correspond to desired AWABS setting, since improper setting of flaps and airspeed bugs significantly increases the incidence of tailstrikes.

Ensure flap setting and takeoff condition computer agree. A disagreement will cause a takeoff warning when throttles are advanced for takeoff.

FLAP POSITION indicator - indicating desired selection.

Slat TAKEOFF advisory light - illuminated.

Slat DISAGREE advisory light - extinguished.

AUTO light - extinguished.

Slat LAND advisory light - extinguished.

Autobrakes & spoilers As required

Place AUTO BRAKE switches to the T.O. and ARM positions.

Squeeze spoiler handle and pull up to arm.

Flight controls Check

Note: Avoid hitting the stops with excessive force.

Check rudder.

The Captain will normally check rudder for freedom of movement and full travel while taxiing.

Hold the steering wheel firmly when checking rudder to avoid abrupt turns and/or nosewheel scuffing.

Check ailerons/spoilers/elevators.

The First Officer will normally check ailerons/spoilers/elevators for freedom of movement and full travel.

The First Officer will normally check spoiler operation and ailerons for freedom of movement and full travel. Turn the control wheel full deflection to each side, and center. SPOILER DEPLOYED message should illuminate and extinguish as appropriate with throttles at idle.

(88) Move control column full aft then full forward and hold. The ELEVATOR PWR ON light should illuminate. Release the control column and observe that the light extinguishes.

(90) Move control column full aft then full forward. Observe ELEVATOR AT LIMIT light is illuminated at both aft and forward limits. Observe that light extinguishes when not at either limit. Perform control column checks only with the elevator system in powered mode. Attempting to achieve full column deflection in manual mode while on the ground requires excessive amounts of force on column and may result in a control column disconnect.

WARNING: (90) If the opposite control column seems to lag behind or not move to the aft or forward stop completely or simultaneously, the control columns may be disconnected. Contact maintenance if this is suspected. Do not takeoff in this condition.

(88) It is recommended that the elevators freedom of movement check be made with the aircraft headed into the wind. Unusual pressures may be felt when check is made with a tailwind or attempting to pull the control column quickly aft after elevator hydraulic pressure has been applied to elevator.

Note: If flaps are up for taxi, delay completing the TAXI and BEFORE TAKEOFF checklists until the flaps are properly positioned and a control check has been accomplished.

The Captain calls "TAXI CHECKLIST."

The First Officer reads the TAXI checklist.

Delayed Start Procedure - First Officer

Note: With inoperative APU and ground pneumatic air unavailable, refer to Supplementary Procedures, Engines, APU; Crossbleed Start procedure.

RIGHT AIR CONDITIONING SUPPLY switch OFF

Pneumatic pressure Check

Check pneumatic pressure.

(88) IGNITION ON

The Captain calls "DELAYED START CHECKLIST."

The First Officer reads the DELAYED START checklist.

Engine Start Procedure Accomplish

After Start Procedure Accomplish

The Captain calls "AFTER START CHECKLIST."

The First Officer reads the AFTER START checklist.

Before Takeoff Procedure - First Officer

If AWABS/WDR is received and within tolerance:

Previously entered data is sufficient. No further action required.

If AWABS/WDR is received and NOT within tolerance:

FMS data must be modified using updated AWABS/WDR information. Refer to FMS step in the Before Start Procedure, After paperwork received items, for specifics.

Two crew members must refer to the final AWABS and WDR information and verify flight number, ship number, date, release number, takeoff flap settings, trim and power settings, V-speeds, and other pertinent performance information.

(88) Fuel heat As required

Shoulder harness On

Annunciator panel & warn lights Check

(88) RUDDER TRAVEL UNRESTRICTED light should be illuminated.

All other annunciator lights/messages should be extinguished except those of an advisory nature such as (L/R) ENG ANTI-ICE ON or APU GEN OFF.

Warning lights should agree with particular system mode of operation selected, such as ART INOP message illuminated for T.O. FLX operations.

Flaps & slats ___, ___, T/O

Check flaps/slats in proper configuration for assigned runway.

Verify flap handle position and indicator are in agreement.

Takeoff warning Check

Advance both throttles momentarily with the parking brake released. CAWS T/O warning should not occur.

If takeoff warning is received, check those items associated with respective warnings as listed in Volume 2, Chapter 15, Warning Systems.

Note: Cycling throttles to approximately 3 units on throttle quadrant scale and back within 2 seconds will ensure CAWS switch activation and prevent excessive jet blast.

Brake temperature Check

Verify temperature is less than (88) 205°C, (90) 440°C, and OVHT light extinguished.

(90) To determine the maximum allowable brake temperature for takeoff, subtract the following from 440°C:

For each 1°F above 100°F, subtract 2°C

and/or

For each 1 knot of tail wind, subtract 15°C

For airports above 1100' MSL, see Airway Manual special (green) pages limitations charts or the ODM for airports without green pages.

Windows Close & locked

ALTIMETERS ___, crosscheck

Crosscheck Captain's and First Officer's altimeters for agreement.

Runway, departure, first fix ___, ___, ___,

Verify the selected runway, departure, and associated fix in the FMS match the latest ATC departure clearance.

Verbalize the runway, departure procedure, and first fix.

Takeoff briefing Complete

All pilots will be included in the Takeoff briefing. Pilots should develop a brief that incorporates the highest threats (i.e., weather, security, terrain, etc.).

Refer to FOM for expanded briefing format.

Flight Attendants Notify & acknowledge

Notify the flight attendants to prepare the cabin for departure with a PA announcement. A suggested PA is:

" LADIES AND GENTLEMEN, WE WILL SOON TAXI ONTO THE RUNWAY FOR TAKEOFF. FLIGHT ATTENDANTS, PLEASE PREPARE THE CABIN FOR DEPARTURE."

The Flight Leader must acknowledge "CABIN IS READY FOR TAKEOFF."

APU air, APU, PNEU X-FEED VALVES As required

APU AIR switch OFF.

Pneumatic crossfeed valves may be opened if airfoil anti-ice will be required after takeoff.

After APU is shut down, it will run at no bleed load for 1 minute.

The APU may be used as a backup source of electrical power until completion of the AFTER TAKEOFF checklist when any of the following conditions exist:

- Moderate or heavy rain.
- Standing water, snow, or slush on the runway.
- Low ceilings/visibility.
- Night operation when visual reference to the ground is poor.

The Captain calls "BEFORE TAKEOFF CHECKLIST."

The First Officer reads the BEFORE TAKEOFF checklist up to "Final Items."

Final items:

Normally accomplished when cleared on runway.

Prior to entering a runway, confirm aircraft location utilizing an outside source such as runway signage, painted runway number markings, and/or aircraft heading.

FMS runway update Complete

Perform as close to takeoff runway as possible.

Check aircraft versus runway position on ND (10 nm scale).

Radar & transponder Set

RADAR - as required.

Verify Transponder is set to TA/RA

(88) IGN selector As required

Select SYS A for Captain's legs; SYS B for F/O's legs.

Select OVRD during moderate to heavy rain or on runways having slush, snow, or standing water.

Exterior lights Set

Landing/strobe lights may be turned off when reduced visibility conditions exist, in close proximity to other aircraft awaiting takeoff at night, or when flying through clouds.

Refer to Flight Operations Manual, Chapter 3, Exterior Light Usage, for further guidance.

Note: Landing lights may be retracted after takeoff if their extension causes excessive aircraft vibration.

The First Officer reads remaining BEFORE TAKEOFF checklist items.

Takeoff Procedure

Takeoff Thrust Set

Advance throttles to approximately (88) 1.4 EPR (or 80% N2) or (90) 1.2 EPR (throttles approximately vertical) and allow engines to stabilize.

CAUTION: (90) Do not allow engines to stabilize between 60% and 66% N1 during ground operation. Damage to fan blades can occur.

Note: (88) When both engines are operating above 64% N1 and the ART system READY light is illuminated, selecting alternate position on the DFGC will activate the ART system on both engines.

Note: Allowing the engines to stabilize for more than approximately 2 seconds prior to advancing throttles to takeoff thrust may adversely affect takeoff distance.

AUTO THROT switch ON

PF calls "AUTOTHROTTLES."

PM places the AUTO THROT switch to AUTO THROT.

Ensure the throttles advance to takeoff EPR prior to 60 knots.

Note: If the throttles clamp prior to takeoff EPR, advance the throttles manually.

Note: For manual takeoff advance throttles in a rapid but smooth manner to takeoff EPR.

Note: If the First Officer is making the takeoff, the First Officer may advance the throttles to the takeoff setting. After takeoff power is set, the Captain's hand must be on the throttles until V_1 .

Approximate N1 crosscheck readings		
Power Selection	MD-88	MD-90
Alternate	88%	78%
Normal	92%	82%
Maximum	95%	85%

Maintain directional control.

Note: Nose wheel steering via the tiller should not be used above taxi speed.

Hold light forward pressure on the control column until 80 knots.

The PM should monitor engine instruments throughout takeoff.

Airspeed Check

PM calls "80 KNOTS", "ENGINE INSTRUMENTS CHECKED."

Above 80 knots, PF relaxes forward column pressure to the neutral position.

Monitor airspeed.

At V_R rotate smoothly (approximately 3° per second) through liftoff (approximately 8° pitch attitude).

CAUTION: Early or rapid rotation may cause tail strike. Do not chase the Flight Director or rotate to an excessive attitude. If a tailstrike is suspected, depressurize aircraft (time permitting). Structural damage can be aggravated by pressurization.

After liftoff, continue rotation to maintain a minimum speed of V_2+10 , limiting pitch to a maximum of 20°.

Note: Speeds slightly higher than V_2+10 may be required to keep pitch attitude below 20° and will not significantly affect the climb profile.

Monitor airspeed and vertical speed and call out any anomalies.

Landing gear UP

PM calls "POSITIVE RATE" when positive rate of climb is indicated.

PF calls "GEAR UP."

PM positions the landing gear lever UP.

Note: Do not apply brakes after becoming airborne, braking is automatically applied when the landing gear lever is placed in the up position.

Flight instruments Check

Crosscheck flight progress.

After Takeoff Procedure

Roll mode Select

Above 400 feet:

PF calls for appropriate roll mode (if required) when stabilized climb attitude is established.

PM selects appropriate roll mode.

Verify proper mode annunciation on FMA.

When above minimum altitude for autopilot engagement, select the AP switch to ON if desired.

Note: Due to autopilot trim rate (.1°/second), which is approximately one-third the manual trim rate, the autopilot should not be engaged in large out-of-trim conditions.

Verify mode annunciation on FMA.

Climb power Set

PF calls for "CLIMB POWER."

PM selects climb power on the Thrust Rating Panel.

(90) If directed to use reduced thrust climb power, use the following:

Takeoff Thrust	Climb Setting
28K Takeoff	25CL (unless otherwise directed by 10-0 page)
25K Takeoff	CL (to obtain 25CL)
25K Flex 50	CL2 (to obtain 25CL-2)
25 Flex 45 25 Flex 40 25 Flex 35	CL1 (to obtain 25CL-1)
When vertical velocity decreases to 1,000 fpm, select the next higher climb thrust. Climb thrust ratings (in order of increasing thrust) are: CL2, CL 1, CL.	

Flaps & slats Up, retract

At acceleration height, adjust pitch & accelerate to flap retract speed.

- Flaps 1-13 takeoff: V_2+5 knots.
- Flaps 15-24 takeoff: V_2+15 knots.

PF calls "FLAPS UP."

PM moves FLAP/SLAT handle to 0.

Continue acceleration to slat retract speed.

PF calls "SLATS RETRACT."

PM moves FLAP/RETRACT handle to UP/RET.

Observe SLAT T/O light extinguishes.

Note: If flaps and/or slats cannot be retracted observe placarded limit speed.

APU As required

IGNITION As required

(88) Ignition should normally be turned OFF.

(90) Ignition should normally remain in AUTO.

Ignition should be on for:

- Heavy rain.
- Severe turbulence.
- (88) Turning engine anti-ice on or off.

Note: (88) For optimum life of ignition system components, recommend using system A and B in alternating 10 minute intervals if the ignition is required for an extended time.

Note: (90) The ignition may be used continuously when required.

Fuel tank pumps As required

If center tank is empty, turn CTR tank pumps OFF.

(88) If center tank contains fuel and overwing heaters are inoperative, turn CTR tank pumps to AUTO. If overwing heaters are operative, leave center tank pumps on.

(90) Leave CTR tank pumps ON with operable RTT (return-to-tank) system. Select AUTO for inop RTT system.

Spoilers Disarm

Speed Brake lever forward, down, and red placard out of view.

AUTO BRAKE switches DISARM/OFF

Flap T/O selector 23

Do not attempt to move until flaps/slats are fully retracted as a jam in the flap/slat handle may occur.

Set flap T/O SEL to 23°.

AUX & TRANS HYD PUMPS OFF

(88) ART switch AUTO

Air conditioning & pressurization Check

Check pressurization system for normal operation.

Consider passenger comfort; check both supply temperature and cabin temperature and adjust as required.

ENGINE SYNC selector As required

Use of N1 sync is recommended.

Annunciator panel Check

Observe annunciations are normal.

The Pilot Flying calls "AFTER TAKEOFF CHECKLIST."

The Pilot Monitoring reads the AFTER TAKEOFF checklist.

Climb Procedure

Altimeters (transition altitude) 29.92, crosscheck

Exterior lights (18,000 feet) As required

PM will verify landing lights are retracted, FLOOD LTS and
WING/NACL are OFF above 18,000 feet.

Aircraft performance Check

Flight crew shall verify maximum altitude capability. Ensure FMS
performance page reflects fuel on board and ZFW accurately.
Anticipate considerations that affect aircraft performance (e.g., use of
engine bleeds, turbulence, requirement for maneuvering).

Note: The FMS-generated OPT/MAX cruise altitudes are the
primary reference for altitude capability. However, the FMS
altitudes do not forecast or consider Engine or Airfoil Anti-
Ice ON during the climb or sustained cruise. At high gross
weights or high ISA deviations the use of engine bleeds,
especially during turbulence or maneuvering, (e.g.,
holding) may limit available thrust and affect maximum
altitude capability. If there is any question about cruise
altitude capability or if FMS is inoperative, refer to the
Maximum Recommended Initial Cruise Altitude chart in
the ODM.

CAUTION: Use VNAV if available. VERT SPD is not
recommended due to lack of speed protection.

Note: If VNAV is inoperative, maintain 250 knots (or clean speed,
if higher) until 10,000 ft., 310 knots (or FMS climb speed if
available) until FL 270, and flight plan cruise mach
thereafter.

The Pilot Flying calls "CLIMB CHECKLIST."

The Pilot Monitoring reads the CLIMB checklist.

Cruise Procedure

Engine and aircraft systems Check

Check FMS to confirm cost index and appropriate cruise speed for current altitude, weight and temperature. Determine a minimum cruise airspeed by adding 10 knots to clean speed. Operate at FMS-computed econ cruise speed (orange bug). Do not operate below minimum cruise speed for any reason, including holding.

Note: TRP should remain in CL mode.

Note: Limit bank angle to 15° if operationally feasible.

Maintain a continuous cross check of flight parameters, including engine instruments. An erroneous EPR reading can result from a leak in the pressure sensing system or PT2 probe icing.

Approximate N1 Readings in Cruise	
MD-88	MD-90
76% - 84%	72% - 82%

Note: Actual N1 reading is dependent upon the OAT and aircraft speed and weight.

(88) Undetected, PT2 probe icing can result in erroneous EPR indications and the possibility of an insidious, slow decay in airspeed during cruise. Use engine anti-ice in accordance with the Limitations chapter.

Radar Check

Each originating crew will turn the weather radar on and check for proper operation. If no weather returns are present, check radar operation using ground returns.

Engine Performance Report Complete

A minimum of one report is required each day.

- On aircraft with operable ACARS, reports are sent automatically.
- For aircraft with inoperative ACARS, a manually recorded report (using the Engine Performance Report form) is required for every flight segment of 45 minutes or longer.

Reference Mechanical Dispatch Manual (MDM) for specific instructions.

Fuel Quantity Check

A cross check of flight plan estimated fuel remaining versus actual fuel remaining should be accomplished at enroute waypoints.

Update fuel in FMS as required.

At a minimum, this check should be accomplished at all flight plan reporting points or in the absence of reporting points, once prior to the top of descent at a flight plan waypoint.

VHF NAVIGATION radios Tune

During cruise operations crews should manually tune VOR radios to a valid VOR station to provide the most accurate position data to the FMC.

A Navigation Accuracy Check must be performed by the PM prior to entry into Class II airspace. Refer to SP.11, Flight Management, Navigation.

The Pilot Flying calls "CRUISE CHECKLIST."

The Pilot Monitoring reads the CRUISE checklist.

Descent Procedure

Approach Briefing Complete

All pilots will be included in the approach briefing. Pilots should develop a brief that incorporates the highest threats (i.e., weather, security, terrain, etc.) Whenever possible complete the approach briefing prior to top of descent.

Refer to FOM, Chapter 3 for expanded briefing format.

Seat belt lights On

Exterior lights (18,000 feet) As required

Conditions permitting, use all available exterior lights below 18,000 feet.

ENGINE SYNC selector OFF

Note: ENGINE SYNC selector must be OFF below 1,500 feet AGL.

Pressurization Check

Verify destination altitude and altimeter are set.

Check system for proper descent rates.

AUX & TRANS HYD PUMPS switches ON

Brake pressure gauge should be the same or higher than respective system pressure.

Pumps should be on prior to actuation of flaps/slats or landing gear.

CAUTION: Failure to select the auxillary and transfer pumps ON prior to inducing a high hydraulic demand may result in hydraulic pump cavitation and/or pressure fluctuations.

Altimeters ____, crosscheck

Set local altimeter setting when descending below transition level.

Crosscheck Captain's and First Officer's altimeters for agreement.

RADIO & BARO altimeter bugs ____, crosscheck

Set radio altimeter bugs.

Set barometric altimeter bugs.

Note: DH settings lower than 65 feet could result in only one or possibly no “MINIMUMS” annunciation. Consult Volume 2, Chapter 15, WARNING SYSTEMS.

The following table details the proper settings for barometric altimeter and radio altimeters.

APPROACH TYPE	BARO	RADIO
ILS TO CAT I	PUBLISHED DA	OFF
CAT II ⁽¹⁾	PUBLISHED DA	PUBLISHED RA
CAT III ⁽¹⁾	TDZE + 50’	50’
STRAIGHT IN (NON-PRECISION)	DDA (PUBLISHED MDA + 50’)	OFF
CIRCLE TO LAND (NON-PRECISION)	HIGHER OF: PUBLISHED MDA OR FIELD ELEV +1000’	OFF
VISUAL	APPROACH MINIMUMS ⁽²⁾	OFF

Notes:

⁽¹⁾ CAT II and CAT III DH will be made by reference to the radio altimeter (RA) only.

⁽²⁾ Set the approach minimums for the instrument approach used to back up the visual approach. If no instrument approach is available, any number may be set to aid in the approach. Both altimeter bugs should agree.

WINDSHIELD ANTI-FOG switch As required

Turn ANTI-FOG switch ON for descent into high humidity conditions when flight has been conducted above FL250.

Shoulder harness On

Airspeed bugs ____, crosscheck

Compute aircraft weight for landing.

Refer to Speed Booklet or ODM for landing data.

Set, verbalize, and crosscheck Captain and First Officer external airspeed bugs as follows:

- Clean maneuvering.
- Flaps 0/slats extend maneuvering.
- Flaps 15 maneuvering.
- Go-around climb safety speed.

Verbalize VREF and airspeed command bug speed for landing flaps.

The Pilot Flying calls "DESCENT CHECKLIST."

The Pilot Monitoring reads the DESCENT checklist.

Approach Procedure

FUEL TANK PUMPS, X FEED As required, OFF

Both PUMP switches for each main tank should be ON.

CTR PUMP switches may be AUTO, ON or OFF (OFF if center tank is empty) as desired.

FUEL X FEED lever should be in the OFF position.

Spoilers Retract, disarm

WARNING: Spoilers must be fully retracted prior to flap extension to provide a safe stall margin. Spoilers must be disarmed prior to landing gear extension.

Flight & navigation instruments Check

Verify flight and nav instruments are set, including the correct FMS approach (when appropriate) is selected in the MCDU.

Verify radios tuned to proper frequency and identified.

Check flight guidance system panel and FMAs for proper annunciations.

Prior to beginning the approach, consult the appropriate Jeppesen approach chart to determine the altitude at the final approach fix.

At least one ND must be in ARC or ROSE as follows.

- On ILS/LOC approach during LOC capture.
- Throughout VOR or LOC/backcourse approaches.

Altimeters ____, crosscheck

Set altimeters to local setting and crosscheck.

NO SMOKING/CHIME switch Cycle, ON

- (88) NO SMOKING switch.
- (90) CHIME switch.

No landing imminent PA will be made.

The Pilot Flying calls "APPROACH CHECKLIST."

The Pilot Monitoring reads the APPROACH checklist.

Landing Procedure

Crossing altitude (where published) Verify

At final approach fix or OM, verify crossing altitude.

Landing gear DOWN, 3 green

GEAR lever - DOWN detent

Gear lights - 3 green.

GEAR DOOR OPEN light - extinguished.

Left/right hydraulic system pressure - normal.

Left/right hydraulic quantity - normal.

Left/right hydraulic brake pressure - green band.

Flaps & slats ____, ____, LAND

Slat LAND light - illuminated.

FLAP handle/indicator - as desired/in agreement.

(88) IGNITION selector As required

Select SYS A for Captain leg; SYS B for F/O leg.

Select OVRD during moderate to heavy rain or on runways having
slush, snow, or standing water.

Annunciator panel Check

(88) RUDDER TRAVEL UNRESTRICTED light must be
illuminated by 144 KIAS.

All other lights/messages should be extinguished except those of an
advisory nature.

Spoilers Arm

**CAUTION: Do not arm spoilers until landing gear indicates
down and locked.**

**CAUTION: Do not arm spoilers with AUTOSPOILER FAIL
message on OAP.**

Spoilers must be ARMED for all landings unless restricted by the MEL.

Pull the spoiler lever straight up to arm.

Lever should remain locked in position with the entire red arming band visible.

Autobrakes As required

If autobrakes are used, place AUTO BRAKE selector to MED or MAX (MIN is not recommended) and ARM the system.

The Pilot Flying calls "LANDING CHECKLIST."

The Pilot Monitoring reads the LANDING checklist.

Landing Roll Procedure

Throttles Idle

Main gear touchdown should occur with throttles reaching idle.

CAUTION: If throttles are forward of idle during main wheel spin-up, autospoilers may deploy and then immediately close and disarm. The autobrake system may also disarm.

After touchdown:

Smoothly fly the nose to the runway.

Spoilers Extend

If spoilers do not extend automatically, the Captain must ensure the spoilers are extended manually.

Thrust reversers Extend

WARNING: After reverse thrust is initiated, a full stop landing must be made.

CAUTION: Do not select reverse thrust until nose wheel is on runway.

CAUTION: (MD-90) Do not move reverse throttles through reverse thrust detent unless emergency reverse thrust is required.

CAUTION: Do not use more than reverse idle thrust below 60 knots (unless required for adverse conditions).

CAUTION: If difficulty in maintaining directional control is experienced during reverse thrust operation, reduce reverse thrust to reverse idle (or forward idle thrust if required), regain directional control, and reapply reverse thrust as necessary. Do not attempt to maintain directional control by using asymmetric reverse thrust.

Maintain directional control.

- Rudder control is effective to approximately 60 knots.
- Rudder pedal steering is normally sufficient for maintaining directional control during roll out.
- Do not use nose wheel steering tiller until reaching taxi speed.

Autobrakes Disarm

Prior to taxi speed, disarm the autobrakes and continue manual braking as required.

Note: Slow taxi over arresting cables is authorized. However, a nose wheel inspection will be required at next block-in. Refer to the OPERATING OVER A RAISED ARRESTING CABLE procedure in the Supplementary Procedures, Landing Gear section of this manual.

After Landing Procedure - First Officer

CAUTION: Due to brake chatter which is inherent to the design of MD-88 brakes, plan braking requirements well in advance of planned stopping point.

When clear of the active runway, the following tasks are accomplished to configure the airplane for parking:

- Flaps Up
- Spoilers Retract
- Transponder As required

Select TA/RA at all US airports.

Select STBY or an active mode as required by local procedures at non-US airports.

- PNEU X-FEEDS OPEN
- AUTO BRAKE switches DISARM/OFF
- Slats Retract

CAUTION: Do not retract slats until flaps are fully UP. If the flap/slat handle is out of sequence with the flap/slat position, the slat follow-up mechanism can be damaged.

- Radar OFF

CAUTION: Assure the radar is off prior to taxiing into areas where radiation is hazardous to personnel.

- (88) OVERWING HEATER switch As required

If environmental icing conditions exist or if aircraft will need to be deiced, switch must be OFF.

- Exterior lights Set

When in congested area, consider turning off lights that may adversely affect the vision of ground personnel or other aircraft.

Normally, the NOSE LTS DIM position provides adequate illumination for night taxi. Use wing landing lights only when necessary during ground operations, as there is insufficient cooling airflow.

AIRFOIL anti-ice switch OFF

(88) IGN selector OFF

APU/APU AIR As required

Consider availability of ground power, taxi time, and air conditioning requirements.

Left/right engine As required

At the Captain's discretion, taxi is accomplished with one engine, no APU operating.

Note: Single engine taxi is typically accomplished using the left engine to accommodate ground personnel. It is acceptable to use the right engine if required.

Note: Consider crossing all active runways prior to single engine taxi.

(88) Engines require a one minute cool down prior to shutdown.

(90) Engines require a three minute cool down prior to shutdown.
ENGINES COOL light illuminates after 90 seconds.

Note: Normal use of power during taxi operations, including break-away power, does not require restarting the cool down period.

The following restrictions apply for single engine taxi.

- Auxiliary hydraulic pump and one engine driven hydraulic pump must be operating, and transfer pump on.
- One engine generator must be operative.

The Captain calls "AFTER LANDING CHECKLIST."

The First Officer reads the AFTER LANDING checklist.

Shutdown Procedure - Captain and First Officer

In line operations, the flight crew usually leaves the aircraft powered since another crew will continue with the aircraft. Even when the aircraft is not scheduled to depart right away, Maintenance usually expects the aircraft to be left powered.

Seat belt lights Off

AUX & TRANS HYD PUMPS switches OFF

Air conditioning panel As required

Pack fans will continue to operate for 5 seconds after respective AIR
CONDITIONING SUPPLY switch is turned OFF.

(90) AC load meters < .5 indicate pack fans are off.

Switch packs to OFF prior to switching to external power.

APU & external power As required

Note: Reduce electrical loads prior to switching to external power.

Consider using ground power/air where available and operate the
APU as required for air conditioning and power.

FUEL levers/switches OFF

ANTI COLLISION LTS switch OFF

Fuel tank pumps As required

Right main tank pump - as required

Leave pump on if APU is on.

Turn off all other fuel tank pumps.

ICE PROTECTION panel Set

Windshield anti-ice - AS REQD

If outside air temperature is above freezing, turn windshield
anti-ice off.

If outside air temperature is below freezing, leave windshield
anti-ice on.

Engine Anti-ice - OFF

Pitot Heat - OFF

Airfoil Anti-ice - OFF

Annunciator panel Recall

Depress each system OAP cue button.

Contact Maintenance if any messages other than normal are present,
i.e., ENG SYS FAIL, STALL IND FAIL.

Hydraulic pressure may be required for certain control CONT faults.

Flight directors Off

Turn flight directors off if leaving aircraft.

Turn all CRT's/MCDU's to DIM/OFF if leaving the aircraft.

Transponder STBY

Parking brake As required

When wheels are chocked, release parking brake.

The Captain calls "SHUTDOWN CHECKLIST. "

The First Officer reads the SHUTDOWN checklist.

After the Shutdown checklist is complete:

Enter appropriate ACARS information.

Enter fuel remaining, T.O. power setting, APU cycles, and autoland
information. Allow the ACARS to automatically transmit the data 5
minutes after block-in.

Check oxygen, hydraulic & engine oil quantities.

Ensure sufficient quantities exist for next flight. If not, make a
logbook entry and notify maintenance as soon as possible.

Oxygen dispatch requirements:

Minimum pressure 1,000 psi.

Hydraulic dispatch requirements:

Left

(88) 8 quarts.

(90) 9 quarts.

Right

(88) 9 quarts.

(90) 10 quarts.

Engine oil dispatch requirements:

At a non-maintenance station

(88) 8 quarts.

(90) 12 quarts.

At a maintenance station

(88) 12 quarts.

(90) 16 quarts.

Check logbook for appropriate entries.

Maintenance contact should be made when aircraft log book write-up exists.

Pull red color coded circuit breakers as required.

Pull red color-coded circuit breakers in accordance with the aircraft placard located behind Captain's seat.

Secure Procedure - Captain and First Officer

Note: In line operations the aircraft may remain powered.

Accomplish the SECURE checklist when:

- the aircraft is to remain overnight, or
- the aircraft is to remain several hours, or
- requested by Maintenance or Operations.

When operating the last flight of the day into a limited or non-maintenance station, accomplish the following:

If a maintenance discrepancy is noted and entered in the log book, the MCC must be contacted through the Dispatcher as soon as possible to facilitate corrective action and avoid delays. If a flight crew placard is applicable, it should be installed prior to departing the aircraft.

Perform a postflight walk around. Emphasis should be placed on tire condition, fluid leaks, oil quantity and possible airframe or control surface damage.

If the aircraft will layover in cold weather, ensure it is configured as described in Supplementary Procedures, Section 16.

APU AIR & AIR CONDITIONING SUPPLY switches OFF

Galley power OFF

Emergency lights OFF

IRS MODE selectors OFF

Note: Failure to turn off either IRU with power removed from the aircraft will cause discharge of internal IRS batteries.

(88) OVERWING HEATER switch OFF

Outflow valve As required

If stations have not connected recirculating hose to the outflow valve, manually set and lock the outflow valve position indicator to abeam the 15° flap position to prevent precipitation from entering the aircraft.

PNEU X-FEED VALVES Close
APU MASTER switch OFF
 APU will run at no bleed load for 1 minute prior to shutdown.
Fuel tank pumps OFF
Emergency power Check
(88) Emergency power OFF
(90) Emergency power ARM
BATTERY switch As required

If possible, allow APU to shut down prior to placing BATTERY switch OFF.

In all cases, BATTERY switch should be OFF unless APU is required.
In this case, rotate BATTERY switch from lock to unlock and leave ON.

(88) Note: Leave aircraft on GROUND SERVICE BUS. Turn on appropriate GROUND SERVICE BUS POWER switch and turn off L & R EXT PWR and L & R APU PWR BUS switches.

(90) Note: Leave aircraft on GROUND SERVICE BUS. Turn on appropriate GROUND SERVICE BUS power switch and leave main BUS TIE switches OPEN.

The Captain calls "SECURE CHECKLIST."

The First Officer reads the SECURE checklist.

Normal Procedures**Chapter NP****Flight Patterns****Section 30**

Flight Pattern Principles

The profiles in this section are not designed to be comprehensive in nature. They have been developed as a tool for the experienced crew member. A quick review may be obtained by referencing a profile and its associated text. For a complete analysis of a particular maneuver, the Flight Crew Training Manual (FCTM) should be consulted in addition to the material in this section.

Maneuver profiles in this section do not include all standard callouts. A comprehensive listing of standard callouts can be found in the Normal Procedures chapter, Introduction section. Other recommended and standard callouts phraseology may be found in the FCTM.

The maneuver profiles in this section also do not include every pilot action recommended to fly a particular profile. Actions which cause the aircraft to change direction or configuration are included in the maneuver profile drawing.

Takeoff Considerations

Takeoff Alternate

Refer to Airway Manual - Procedures (Ops. Specs.).

Minimum Fuel for Takeoff

Refer to FOM - Normal Operations.

Lower Than Standard Takeoff Minima

Refer to Delta Airway Manual - Procedures (Ops. Specs), and Volume 1, NP.10, Normal Procedures.

Static Takeoff

Refer to FCTM.

Normal Takeoff Flaps

The normal flap setting for takeoff on the MD-88/90 is 11; however, full variable takeoff flap settings may be used as required by AWABS for increased takeoff performance.

Variable Flaps Takeoff

All flap settings from 0 to 24 (except 14, the slat decision area) are valid. If a variable flaps takeoff is anticipated, consider the following.

- V speeds are located in the AWABS or ODM (for flaps 5, 11, & 18).
- Check AWABS and/or ODM for capability.
- Use normal rotation rate of 3° per second.
- Engine failure procedures remain the same as for flaps 11.
- Use appropriate flap retract speed.
 - Flaps 13 or less - $V_2 + 5$.
 - Flaps 15 or more - $V_2 + 15$.

CAUTION: Early or fast rotation may cause a tail strike.

Takeoff Speeds

Airspeed bug settings for takeoff are as follows.

- Airspeed command bug:
 - V_2 .
- Airspeed reference bug:
 - V_1
 - $V_2 + 20$
 - Slat retract speed
 - Clean speed.

Use the V speeds listed on the AWABS for takeoff. If AWABS is unavailable, obtain the V speeds from the ODM.

Refer to the Speed Booklet for slat retract and clean speeds.

Takeoff and Area Departure

Use of Automation

Normally, use the flight director, autothrottles and autobrakes for all takeoffs. The flight director must be used when visibility is less than 1/4 mile or RVR 1600.

Takeoff and Departure Profiles

There are two types of takeoff and departure profiles.

- Normal (Distant /ICAO NADP 2).
- Special (Close-In/ICAO NAPD 1).

RNAV Departure

Preflight:

- RNAV SIDs are runway specific. Enter runway, departure, and transition as appropriate. Ensure the waypoints, speed and altitude constraints of the RNAV SID selected from the database match those depicted on the published procedure for your departure runway.

Before Takeoff:

- Verify the aircraft symbol is in close proximity to the departure end of the runway symbol on the ND.
Note: The base of the airplane symbol represents 1nm in the 10nm scale. This reference can be used to verify nav accuracy for takeoff. Once nav accuracy is determined, expand the view to display at least the first fix.
Note: Do not use NAV for departure if FMS position is incorrect.
- Prior to takeoff ensure the departure procedure and runway selected in the FMS match the latest ATC departure clearance.
- Verify that the appropriate first fix is displayed on the ND

Initial Climb:

- When accomplishing an RNAV departure, path keeping accuracy must be maintained within 0.5 nm XTK of the published segment as displayed on PROG page 2/2.
 - Crews are encouraged to use the autopilot for improved path keeping accuracy and to reduce workload.
 - Notify ATC of any degradation of performance or inability of the FMS to provide accurate navigation and request amended clearance.
- After the “Climb power, Flaps up, VNAV” call and the pitch is lowered to 10 degrees, autopilot engagement is strongly recommended.
- For departures including turns of near or greater than 90 degrees shortly after takeoff, a bank angle of 25 to 30 degrees will be required to maintain XTK limits. Consider leaving the slats extended until clean speed to allow for increased bank angles.

Climb

At 10,000 Feet MSL

Use the same climb procedures for normal takeoff, special takeoff, and airport specific takeoff procedures.

- If using FMS, climb at ECON speed as displayed on the CLB page.
- If not using FMS, climb at 330 knots or flight plan enroute climb speed until passing approximately 27,000 feet MSL. Transition to flight plan climb Mach at this time by reselecting the IAS/MACH button on the FGCP.

At 18.000 Feet

Accomplish the CLIMB checklist.

Approach and Landing - General

Scan Policy

- Approach scan policy is set to ensure someone is always focused on airspeed, altitude, and profile.
- Approach scan responsibilities for the PF and PNF are listed below. OUT means primary responsibility is outside the aircraft. Parenthesis () means secondary responsibility.

	PF	PNF
Runway environment not in sight	IN (out)	IN (out*)
Runway environment in sight	OUT (in)	IN (out)
*For CAT II and CAT III approaches, the PNF remains IN.		

Maximum Airspeed

- In Class B airspace, maximum speed is normally 250 KIAS (or minimum maneuvering clean speed if higher) below 10,000 MSL.
- In Class C and D airspace, no person may operate an aircraft at or below 2,500 feet AGL within 4 nm of the primary airport at more than 200 KIAS (or minimum maneuvering clean speed if higher), unless otherwise authorized or required by ATC.

Airspeed Bug Settings

Airspeed bug settings for landing are as follows.

- Set the airspeed command bug to the final approach speed. Final approach speed is:
 - $V_{REF} + 1/2$ of the estimated steady headwind component + all the gust factor.
 - Minimum additive is + 5 knots.
 - Maximum additive is + 20 knots.
 - In all cases, the gust correction should be maintained to touchdown while the steady headwind correction may be bled off as the airplane initiates the landing flare.

Example 1:

Runway 36

Wind = 090° at 10 gust to 18

Bug speed is $V_{REF} + 8$ knots (0 + 8)

Example 2:

Runway 36

Wind = 360° at 12 gust to 16

Bug speed is $V_{REF} + 10$ knots (6 + 4)

Example 3:

Runway 36

Wind = 180° at 10

Bug speed is $V_{REF} + 5$ knots (0 + min. of 5)

- When using autothrottles to touch down (autoland), position the airspeed cursor to $V_{REF} + 5$ knots. Approach speed corrections are not required. Sufficient wind protection (steady state plus gust) is available with autothrottles engaged.
- External bug settings.
 - Clean maneuvering.
 - Flaps 0/slats extend maneuvering.
 - Flaps 15 maneuvering.
 - Go-around climb safety speed.

Stabilized Approach Requirements

Maintaining a stable speed, descent rate, and vertical/lateral flight path in landing configuration is commonly referred to as the stabilized approach concept.

Any significant deviation from planned flight path, airspeed, or descent rate must be verbalized. The decision to execute a go-around is no indication of poor performance.

WARNING: Do not attempt to land from an unstable approach.

IMC

At 1,000 feet AGL, and on final, the aircraft must be:

- Configured for landing.
- Maintaining stabilized descent rate not to exceed 1,000 FPM.

Note: If a published approach procedure requires a descent rate greater than 1,000 FPM, a special briefing should be conducted.

- On target airspeed within tolerance, or speed being reduced toward target airspeed if higher was necessary.
- Established on course.

By 500 feet AGL, the aircraft must be:

- On target airspeed within tolerance.

WARNING: These conditions must be maintained throughout the rest of the approach for it to be considered a stabilized approach. If the above criteria cannot be established and maintained, initiate a go around.

At 100 feet HAT for all approaches, the aircraft must be positioned so the flight deck is within, and tracking so as to remain within, the lateral confines of the runway extended.

VMC

At 1,000 feet AGL and on final, the aircraft must be:

- Configured for landing.
- Maintaining stabilized descent rate not to exceed 1,000 FPM.

Note: If a published approach procedure requires a descent rate greater than 1,000 FPM, a special briefing should be conducted.

By 500 feet AGL, the aircraft must be:

- On target airspeed within tolerance.
- Lined up with runway except:
 - Where the instrument approach or local procedures (such as River Visual at DCA) dictate otherwise.
 - Maneuvering (including runway changes). Maneuvering below 500 feet is not recommended unless the Captain has determined the operation to be safe after considering:
 - Descent rate change to acquire glidepath not excessive.
 - Runway lateral displacement.
 - Runway threshold stagger.
 - Tailwind/crosswind components.
 - Runway length available.

WARNING: These conditions must be maintained throughout the rest of the approach for it to be considered a stabilized approach. If the above criteria cannot be established and maintained, initiate a go-around.

At 100 feet HAT for all visual approaches, the aircraft must be positioned so the flight deck is within, and tracking so as to remain within, the lateral confines of the runway extended.

Crossing The Runway Threshold

As the aircraft crosses the runway threshold it must be:

- Stabilized within tolerance on target airspeed until arresting descent rate at flare.
- On a stabilized flight path using normal maneuvering.

Positioned to make a normal landing in the touchdown zone, i.e., first 3,000 feet or first third of the runway, whichever is less.

WARNING: Initiate a go-around if the above criteria cannot be maintained.

Tail Strike During Landing

WARNING: Tail strike will occur if the aircraft touches down at 11 degrees or greater pitch attitudes.

Visual Approach and Landing

General

Use all suitable electronic and visual systems to assist in identifying the airport and landing runway.

Approach and landing should be planned to maintain minimum drag configurations as long as possible, safety and conditions permitting, while still meeting the stabilized approach requirements.

Considerations

Weather

- The pilot must have either the airport or the preceding identified aircraft in sight.
- Reported weather at the airport must have a ceiling at or above 1,000 feet and visibility 3 miles or greater.

FMS/ND Utilization

- Using the FMS during visual approaches is optional.
- Program the landing runway as the active waypoint if desired.

Non-ILS Approach

General

Use all suitable electronic and visual systems to assist in identifying the airport and landing runway.

Approach and landing should be planned to maintain minimum drag configurations as long as possible, safety and conditions permitting, while still meeting the stabilized approach requirements.

Both the autopilot and flight director will be utilized, if operable, when the visibility is below 4,000 or 3/4 mile.

NAVAID Setup

Both pilots should be on the NAV radio frequency which provides final approach information no later than the final approach fix or segment. If necessary, the second radio can be tuned to a different frequency to provide information for crossing altitudes.

Altitude and instruments should be crosschecked when crossing the FAF, or FAP, for the approach being flown.

Note: All available NAVAIDs must be identified and utilized to ensure proper identification of the runway/airport.

NAV Display (ND) Setup

Since the data displayed in the MAP mode may be unreliable at low altitudes, one pilot should monitor raw data during all non-precision instrument approaches. Recommended NAV set-ups are found in the Flight Crew Training Manual.

LOC, ILS (G/S OUT) Approach

- Set appropriate ILS frequency and front course.
- Select VOR/LOC to track inbound course.
- Use V/S selector to control descent inside the FAF.
- One pilot must be in ARC or ROSE to verify capture of correct LOC course, then may return to ND map display.

LDA Approach

- Set appropriate ILS frequency and front course.
- Select VOR/LOC or ILS to track inbound course.
- One pilot must be in ARC or ROSE to verify capture of correct LOC course, then may return to ND map display.
- Use vertical speed or glide slope to control descent inside the FAF.

VOR Approach

- Set appropriate VOR frequency and course.
- Select VOR/LOC to track inbound course.
- One pilot may use the MAP display as a monitor for situational awareness if desired.
- Use vertical speed to control descent inside the FAF.

NDB Approach

- Set appropriate NDB frequency.
- Select presentation to observe ADF raw data.
 - Select ADF to ON on the EFIS control panel. This will display the ADF needle on the ND in the ARC, ROSE and MAP modes.
 - Select the RDMI selector switch to ADF to display raw data on the RDMI.
- Use HDG SEL or NAV to track inbound course.
 - HDG SEL must be used from FAF inbound.
- Use V/S selector to control descent inside the FAF.
- The MAP display may be used as a monitor for situational awareness if desired.

If the runway or ILS approach is available in the FMS, consider selecting either of these displays for situational awareness.

LOC Back Course Approaches

- Observe raw data during the LOC B/C by using:
 - ARC mode.
 - ROSE mode.
- MAP display may be used as a monitor for situational awareness if desired.
- Set the localizer front course on the CDI to compensate for reverse sensing.
- Ignore any glide slope information as the glide slope signal will be unreliable.
- Be aware that the expanded localizer on the PFD is not directional.
- Use vertical speed to control descent inside the FAF.
- Use HDG SEL to track inbound course.

CAUTION: Automatic flight guidance and autopilot tracking of the back course are not available. Do not arm the localizer function of the DFGS during a back course approach.

Circling Approach

- The MD-88 and the MD-90 are both category D aircraft for circling.
- Weather requirements are a ceiling of 1,000 feet or the published category D HAA (height above airport) whichever is higher and visibility 3 statute miles or the published category D visibility whichever is higher.
- The barometric altimeter bug should be set to the higher of the published category D circling MDA or airport elevation plus 1,000 feet.
- After visual contact with the airport is established, you should remain at or above the circling altitude until the aircraft is continuously in a position from which a descent to a landing on the intended runway can be made at a normal rate of descent using normal procedures.
- Once the visual portion of the maneuver is begun and descent below MDA has been initiated, stabilized approach criteria applies.

If visual contact with the airport can not be maintained during the circling maneuver, a missed approach should be executed. Follow the missed approach procedure for the approach that was flown. If a missed approach is executed while circling the initial turn should be toward the runway.

ILS Precision Runway Monitor (PRM) Approach - “Breakout” Procedure

Note: All “Breakouts” will be handflown.

If ATC calls "Traffic Alert" during a PRM approach:

- Autopilot Disengage
- FLIGHT DIRECTOR switches (both) OFF
- Maneuver As directed by ATC

If descending, vertical speed should not exceed 1,000 fpm.

Note: If ATC “breakout” instructions coincide with a TCAS RA, follow the vertical guidance of the RA and the lateral guidance directed by ATC.

- When “breakout” complete:
 - Reset automation to the appropriate level.

Category I Approaches

Considerations

- One autopilot or flight director required.
- For inoperative equipment, refer to ILS Airborne Equipment Requirement Chart, NP.10 Normal Procedures.
- Both the autopilot and flight director will be utilized, if operable, when the reported visibility is below RVR 4,000 or 3/4 mile.

Review runway approach lighting system (Delta Airway Manual 11-1 or 10-9A)

Category II Approaches

Requirements

Pilot Qualifications

- Captain must conduct approach..
- Refer to FOM for expanded explanation of pilot requirements.

Airborne Equipment

- One autopilot and 2 flight directors required.
- For inoperative equipment, refer to ILS Airborne Equipment Requirement Chart, NP.10 Normal Procedures.

Ground Equipment

- ALSF-1 or ALSF-2 Approach lighting system including SFL (sequence flashing lights) must be operative for CAT II approaches in the U.S.
- If only TDZ RVR is operative, reported RVR must be 1600 or greater.
- If TDZ and either MID or ROLLOUT RVR are operative, reported RVR must be 1200 or greater.
- Refer to the Delta Airways Manual for expanded explanation of ground equipment requirements.

Weather

- The lowest authorized landing minimums are RVR 1200 (RVR 1000/Autoland required) with a DH of 100 feet.
- Maximum crosswind to initiate approach: 15 knots.
- Autoland system limitations.
 - Maximum headwind component: 25 knots.
 - Maximum crosswind component: 15 knots.
 - Maximum tailwind component: 10 knots.
- Maximum crosswind on final approach segment for a manual landing is 15 knots.

Considerations

- Set Baro/Radio bugs to published DA/RA.
 - CAT II minimums for RVR 1600 approaches may be set to the lowest charted CAT II minimums, but no lower than 100 feet DA(H).
- Recommended configuration is flaps 40. This provides a 1° lower pitch attitude than 28.
- Use of the autoland feature of the autopilot is recommended.
- Recommend starting the APU for an electrical back-up source.
- F/O should have the airport diagram out for taxi assistance.
- Use landing/strobe lights and windshield wipers appropriately.

Category III Approaches

Requirements

Pilot Qualifications

- Captain must conduct approach..
- Refer to FOM for expanded explanation of pilot requirements.

Airborne Equipment

- Use of AUTOLAND is required.
- Autothrottles are required for AUTOLAND function to operate.
- Autospoilers are required.
- Autobrakes must be used if operative.
- For complete list of required equipment, refer to ILS Airborne Equipment Requirement Chart, NP.10, Normal Procedures.

Ground Equipment

- Touchdown, mid and rollout RVR are required. (Touchdown and mid control).
- Refer to the Delta Airway Manual for expanded explanation of ground equipment requirements.

Weather

- The lowest authorized landing minimums are RVR 600 with a DH of 50 feet.
- Maximum crosswind to initiate approach: 15 knots.
- Autoland system limitations.
 - Maximum headwind component: 25 knots.
 - Maximum crosswind component: 15 knots.
 - Maximum tailwind component: 10 knots.

Considerations

- Set altimeter bugs to:
 - Baro: TDZE + 50 feet.
 - Radio: 50 feet.
- Recommended configuration is flaps 40. This provides a 1° lower pitch attitude than 28.
- Recommend starting the APU for an electrical back-up source.
- F/O should have the airport diagram out for taxi assistance.
- Use landing/strobe lights and windshield wipers appropriately.

Missed Approach/Rejected Landing

Missed Approach Procedure

- Generally, published missed approach procedures provide adequate terrain clearance; however, further planning is required if:
 - The missed approach has a published minimum climb gradient, or
 - The departure procedure for the runway has a published minimum climb gradient, or
 - The missed approach procedure requires that you comply with a published Delta special engine-out takeoff procedure.
- A missed approach may be initiated at any time; however, no turns should be made until the missed approach point.
- Visual and charted visual approaches are not instrument approach procedures and, therefore, do not have a missed approach procedure. A few charted visuals have published go-around procedures.

WARNING: When rejecting a landing past the published missed approach point, pilots must be aware of any published special departure procedure for terrain clearance. Consult the applicable 10-0 Delta Special Pages (green pages), 10-3, and 10-9 pages for the runway in use.

Considerations

- During all approaches, the pilot must execute a missed approach if stabilized approach requirements cannot be maintained throughout the approach. Refer to Vol. 1, Normal Operations, for stabilized approach requirements.
- The decision to execute a go-around is no indication of poor performance.

WARNING: Do not attempt to land from an unstable approach.

- During all instrument approaches, regardless of who is flying, the Captain shall announce his decision to allow the aircraft to continue to a landing or to execute a missed approach.

The pilot may initiate a missed approach at any point when flying an instrument approach. However, do not make any turns until reaching the missed approach point.

Normal Maneuver Tolerances

The tolerances described below represent the performance expected in good flying conditions.

Basic Aircraft Tolerances

Aircraft Control

Maneuver Component	Tolerance
Airspeed	± 10 knots
Heading	± 10°
Altitude	± 100 feet

Normal/Special Takeoff

Maneuver Component	Tolerance
Airspeed V2 + 10	- 0 to + 10
Assigned Heading	± 5°
Pitch	20° maximum

Visual Approach and Landing

Maneuver Component	Tolerance
Final Approach Airspeed	-5/ +10 knots
Descent Rate	1,000 fpm maximum below 1,000 AFE
Within 1 nm	Maintain track on centerline

Non-ILS Approach

Maneuver Component	Tolerance
Final Approach Airspeed	-5/ +10 knots
NDB Bearing	± 5°
LOC Course	1 dot or less*
VOR Radial	± 5°

*Arrive at DDA within 1/2 dot or less

Circling Approach

Maneuver Component	Tolerance
Final Approach Airspeed	-5/ +10 knots
Track	Runway centerline
Descent Rate	1,000 fpm maximum below 1,000 feet AFE
Altitude at MDA	published +0 to 50 feet

ILS Approach

Category I ILS Approach

Maneuver Component	Tolerance
Final Approach Airspeed	-5/ +10 knots
LOC Course	± 1/2 dot or less at DA
Glide path	± 1/2 dot or less at DA

Category II Approach

Maneuver Component	Tolerance
Final Approach Airspeed	-5/ +10 knots
LOC Course	± 1/3 dot or less at Decision Region*
Glide path	± 1/2 dot or less at Decision Region*

* Decision Region is defined as the region from 300 feet above the TDZE to the minimums appropriate to the low minima approach being flown.

Category III Approach

Maneuver Component	Tolerance
Final Approach Airspeed	-5/ +10 knots
LOC Course	± 1/3 dot or less at Decision Region*
Glide path	± 1/2 dot or less at Decision Region*

* Decision Region is defined as the region from 300 feet above the TDZE to the minimums appropriate to the low minima approach being flown.

Missed Approach / Rejected Landing

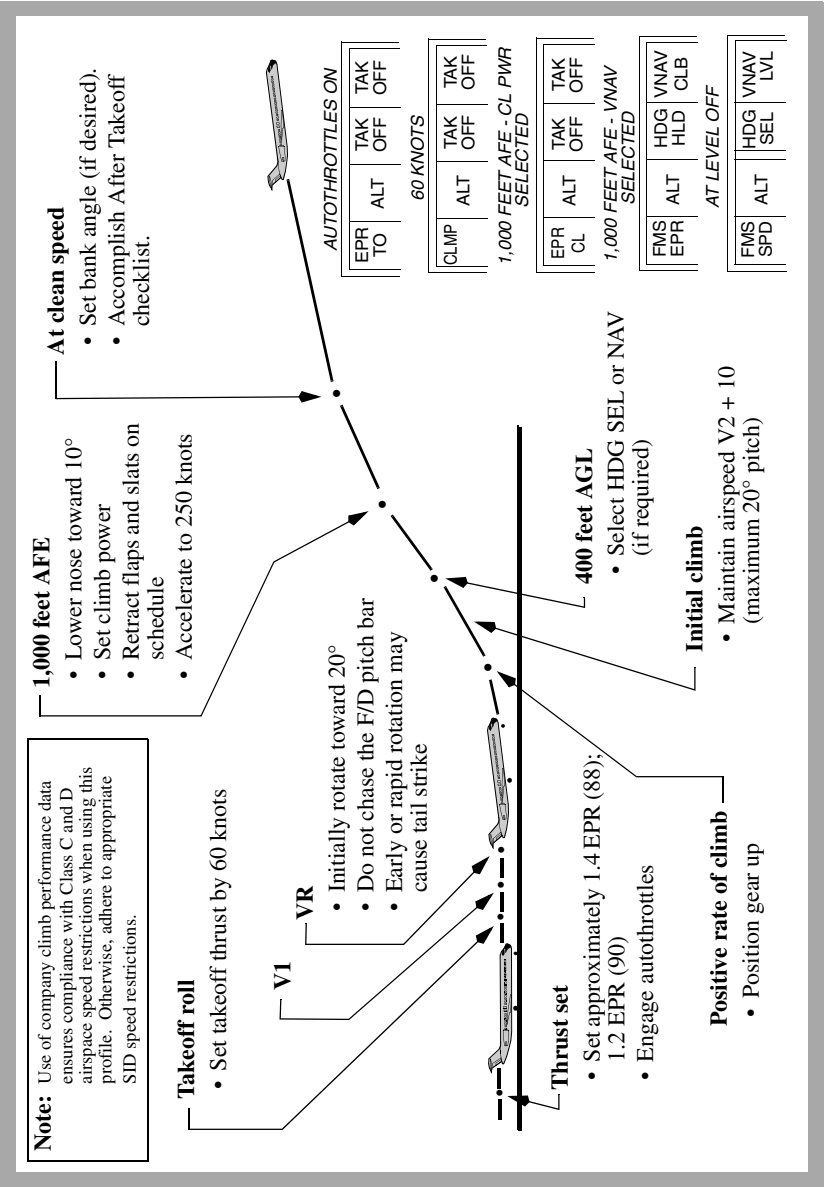
Maneuver Component	Tolerance
Airspeed	Go-around +10 knots

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Flight Profiles

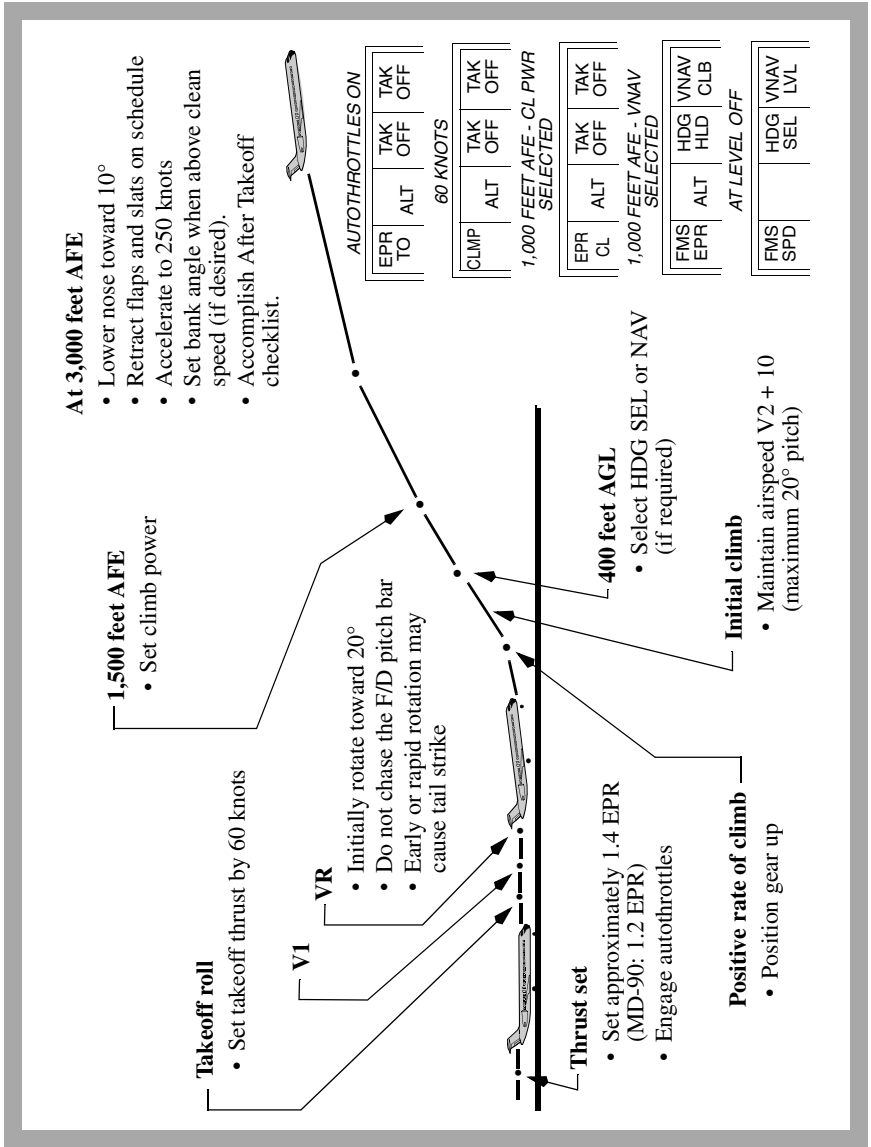
Normal Takeoff Profile (Distant/ICAO NADP 2)

The following profile satisfies typical vertical noise abatement requirements.

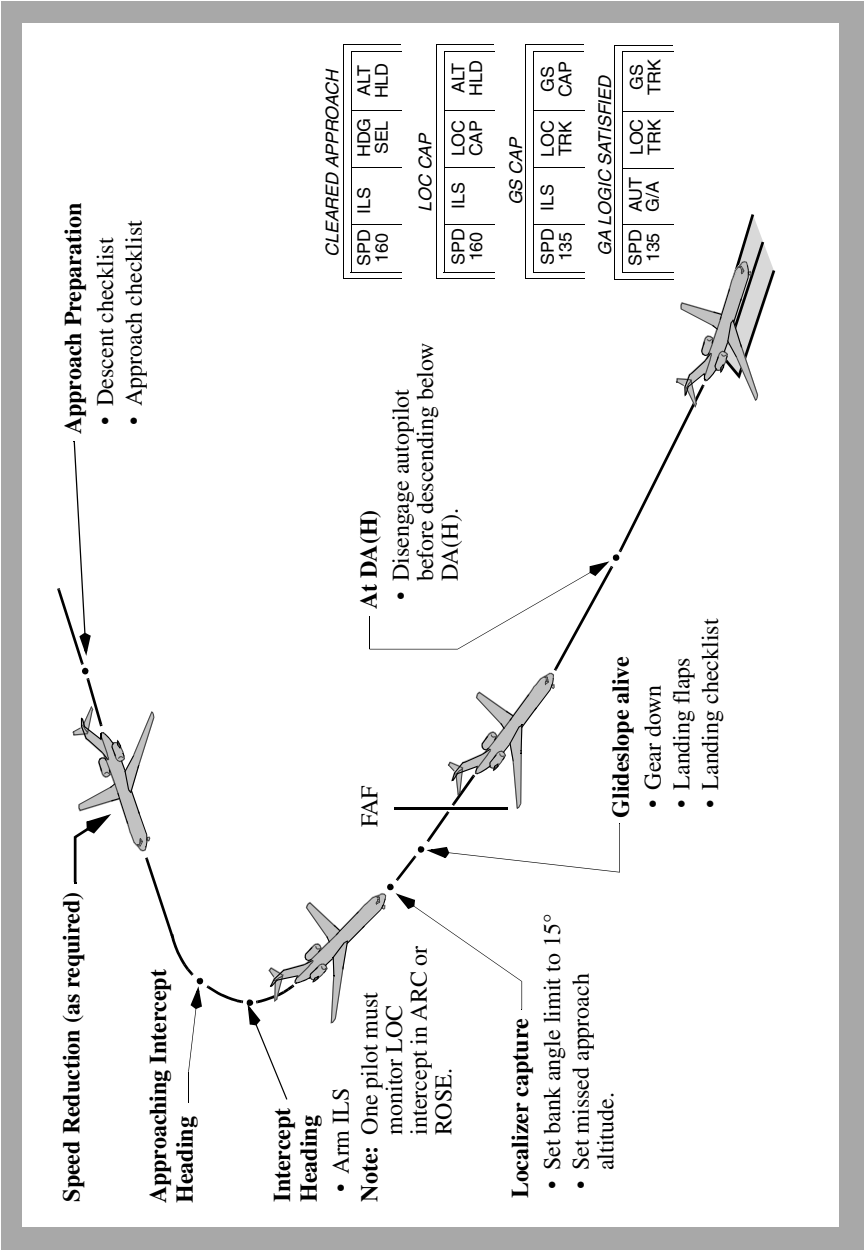


Special Takeoff Profile (Close-In /ICAO NADP 1)

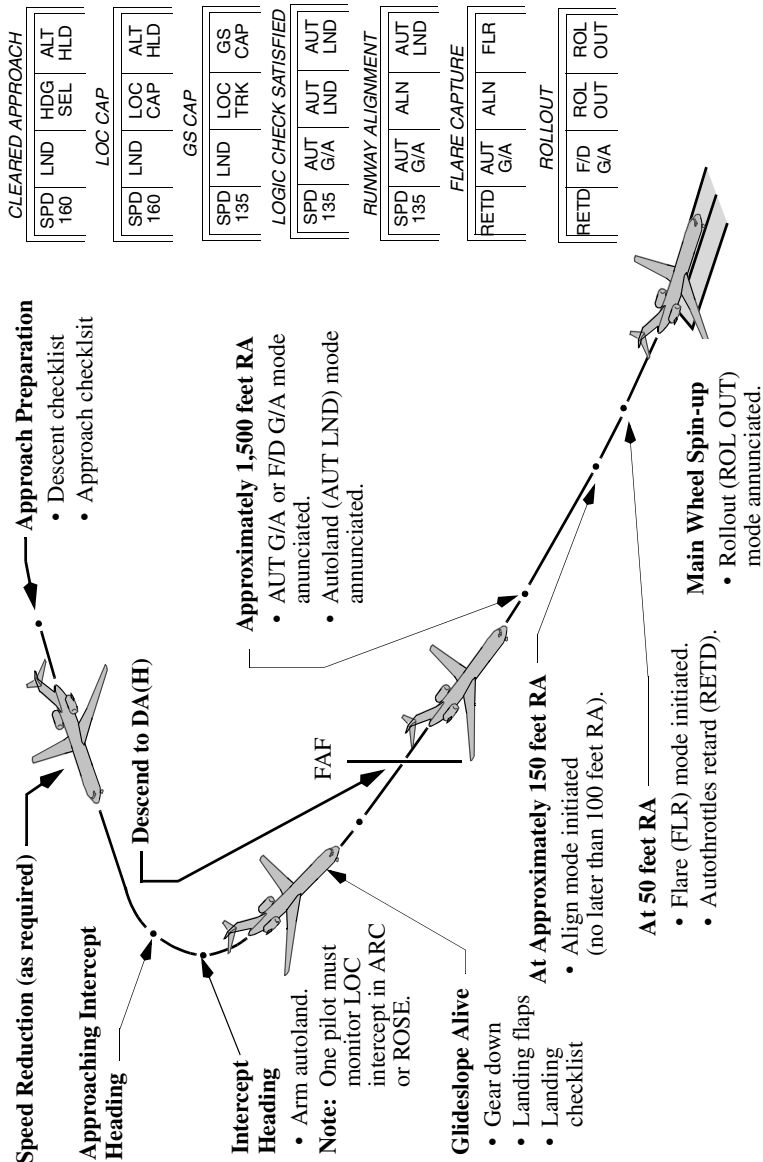
The following profile satisfies noise abatement requirements for noise sensitive areas in close proximity to the departure end of an airport runway.



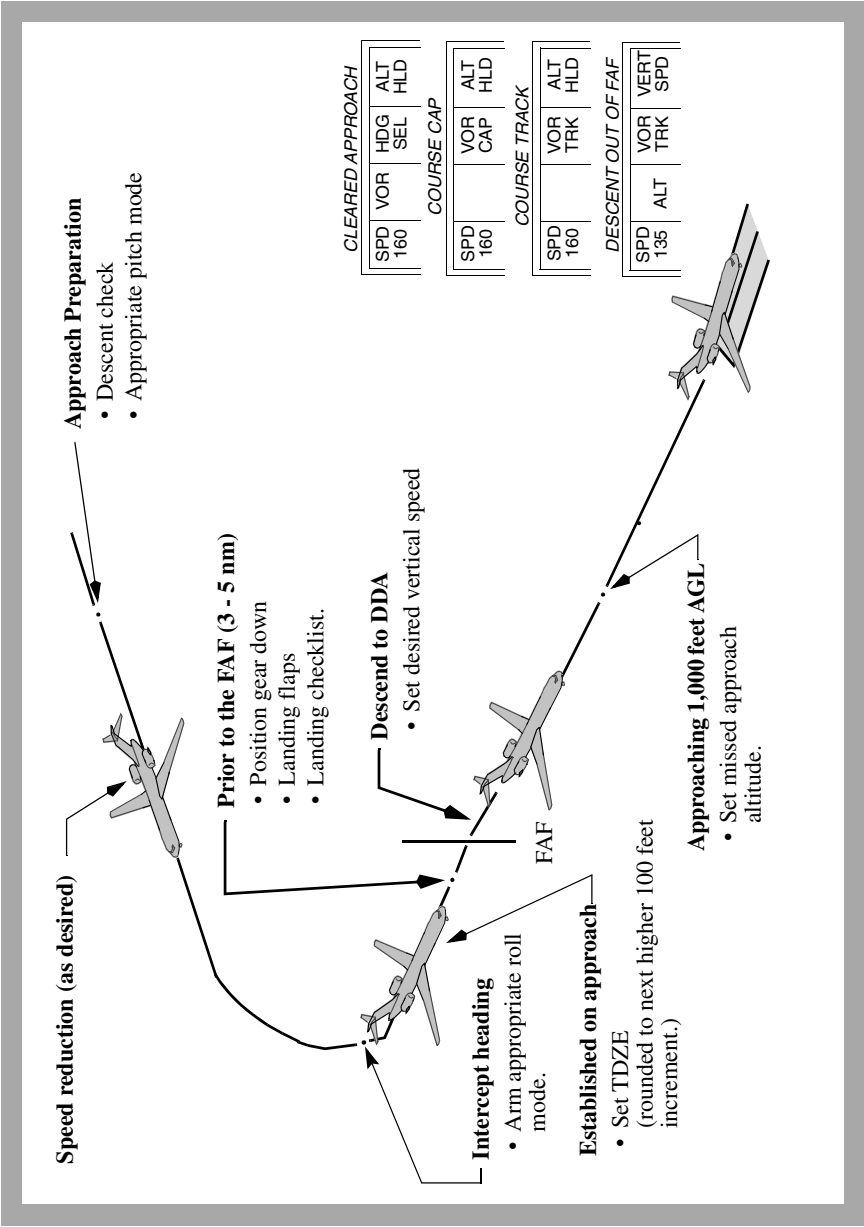
ILS Approach Profile



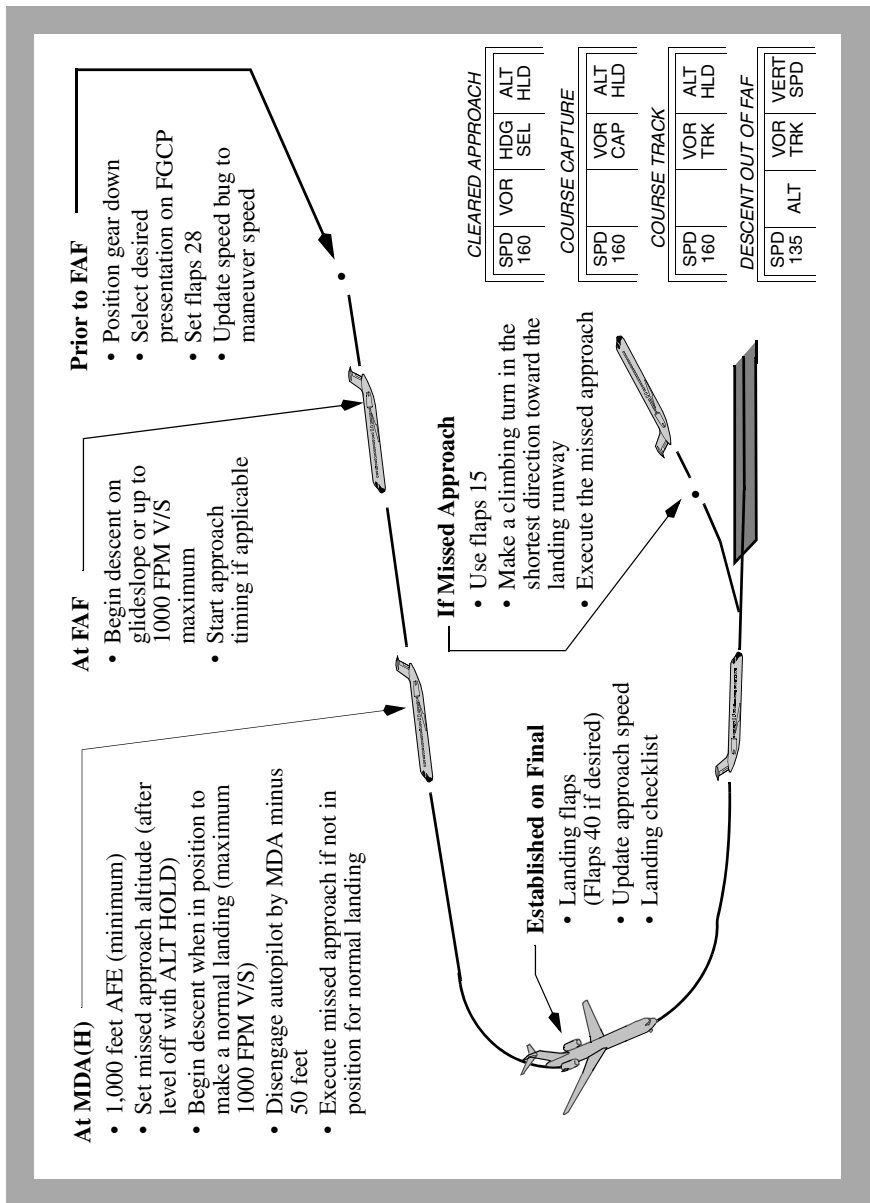
ILS Autoland Approach Profile



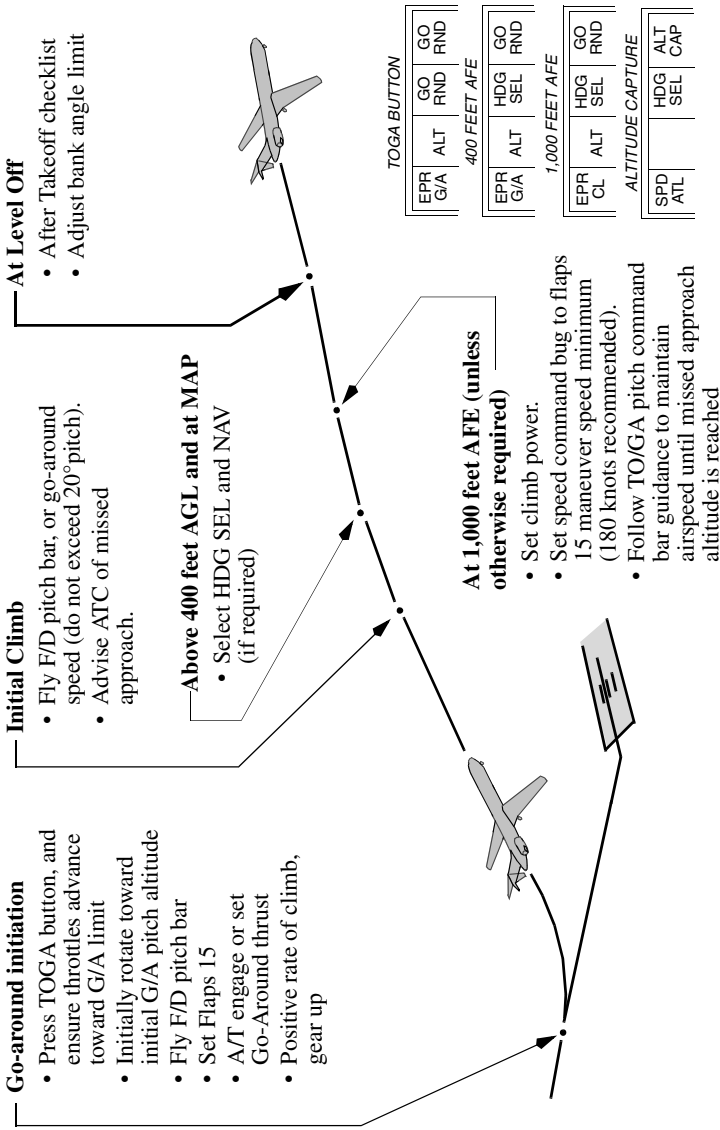
Instrument Approach Using V/S Profile (CANPA)



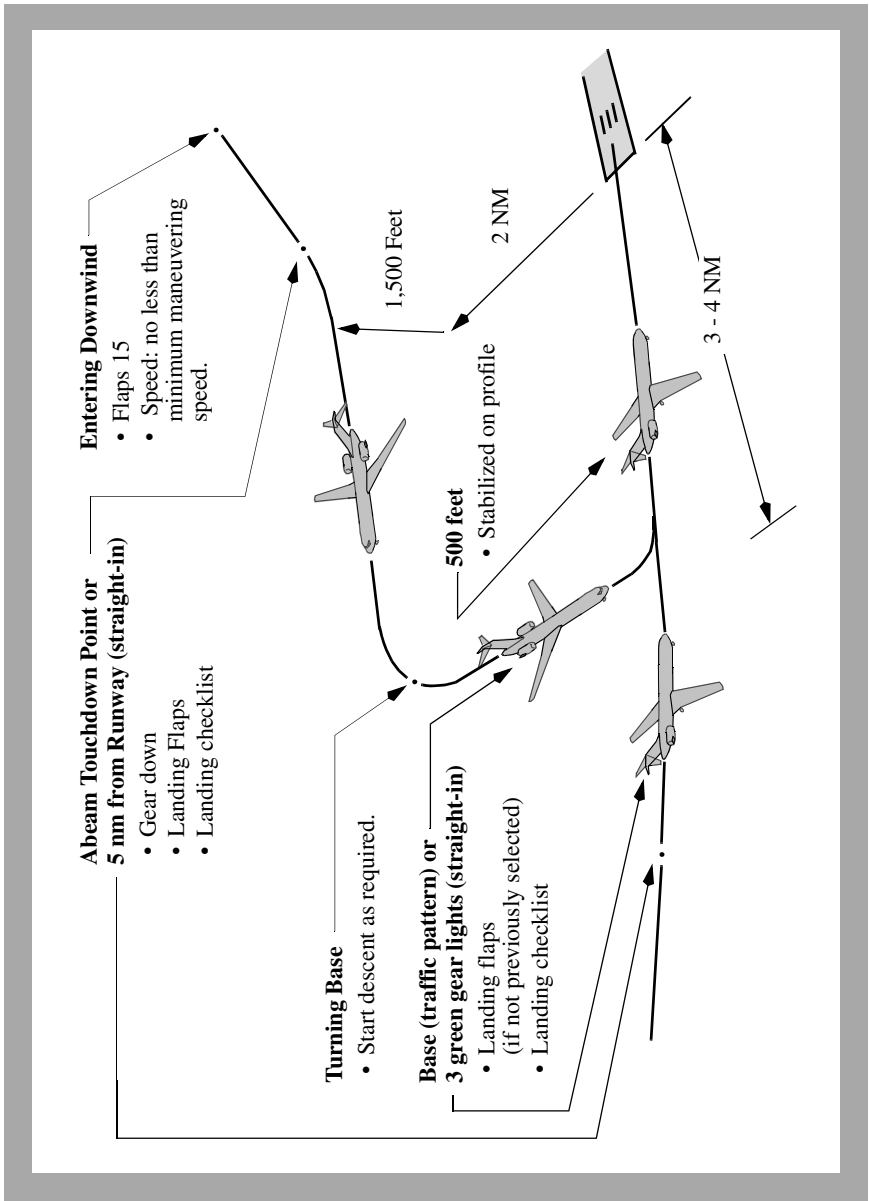
Circling Approach Profile



Missed Approach/Go-Around Profile - All Approaches



Visual Traffic Pattern Profile



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Supplementary Procedures

Introduction

Chapter SP

Section 05

General

This chapter contains procedures that may be required during routine operations, due to unusual situations, or as a result of a procedure referenced in a Non-Normal Checklist. Additionally, some procedures that are normally performed by maintenance personnel are included.

At the discretion of the Captain, procedures may be performed by recall, 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 system titles, except for the adverse weather section.

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Supplementary Procedures

Chapter SP

Airplane General, Emergency Equipment, Doors, Windows

Section 1

CABIN INSPECTION

For a flight without a flight attendant staff (ferry flight, verification flight, functional check flight, delivery flight, training flight, etc.) the pilots must verify the following:

- Doors - Secured and at least the forward entry door armed.
- Beverage carts - Stowed and locked in position.
- Galley (coffee pots, doors, and drawers, etc.) - Secured.
- Overhead bins - Closed.
- Closets - Closed and locked.
- Lavatories - Inspect for general security; doors closed.

After block-in, pilots must disarm all doors and partially open the main entry door, to be fully opened by the gate agent.

FLIGHT DECK ACCESS SYSTEM TEST

Aircraft that are equipped with the new enhanced security flight deck door require a functional check of the Remote Access System (RAS) prior to the first flight of the day.

NOTE: *This check is not required if the RAS is inoperative.*

ENTER THE FOUR DIGIT ACCESS CODE INTO THE KEYPAD FOLLOWED BY THE # KEY.

- The four digit entry code is located on the flight crew and in-flight service crew rotations and is identified with three (3) asterisks (**).
- Verify that the “AUTO UNLK” light illuminates and the aural alert sounds.
- Verify Amber LED illuminated on keypad.

SELECT “DENY” USING THE FLIGHT DECK CONTROL PANEL SWITCH.

- Verify the “AUTO UNLK” light extinguishes.
- Verify that no aural alert sounds after approximately 30 seconds following the keypad entry.
- Verify Red LED illuminated on keypad.

(Continued on next page)

FLIGHT DECK ACCESS SYSTEM TEST

SELECT “UNLK” USING THE FLIGHT DECK DOOR CONTROL PANEL SWITCH.

- Push switch in.
- Turn CCW and hold.
- Verify continuous aural warning.
- Verify “LOCK FAIL” light illuminates.
- Verify green LED illuminated on keypad.

RELEASE FLIGHT DECK DOOR CONTROL PANEL SWITCH.

- Verify switch returns to “AUTO” position.
- Verify aural warning ceases.
- Verify “LOCK FAIL” light extinguishes.

➤ *If any part of the test fails:*

CONTACT MAINTENANCE.

———— END OF PROCEDURE ————

OXYGEN MASKS AND INTERPHONE TEST

OXYGEN PANEL CHECK

- Set flow control to 100%.
 - Lock in down position.
- Position and Hold RESET/TEST lever to TEST (in direction of arrow)
 - Oxygen flow indicator displays yellow cross momentarily, then turns black.
- Push EMERGENCY/TEST control knob.
 - While continuing to hold the RESET/TEST lever, push the EMERGENCY/TEST control knob.
 - Listen for continuous flow and check oxygen flow indicator displays yellow cross.
 - Release EMERGENCY/TEST control knob and observe oxygen flow indicator displays black.
- Squeeze the right oxygen mask release lever (red).
 - Check mask harness inflation and oxygen flow indicator momentarily displays yellow cross.
- Release the RESET/TEST lever.

INTERPHONE SYSTEM CHECK

- Select the microphone and receiver INTERPHONE switches.
- Position MASK/BOOM switch in MASK and adjust speaker volume to comfortable level, and ensure mask stowage box doors are closed.
- Depress and hold control wheel PUSH TO TALK switch.
 - Tap on oxygen mask box cover and listen for tapping sound through speaker.
- Release PUSH TO TALK switch.
- Position MASK/BOOM switch to BOOM.
- Check communications with the cabin using handset.

——— **END OF PROCEDURE** ———

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Supplementary Procedures

Chapter SP

Air Systems

Section 2

APU GROUND AIR CONDITIONING

CABIN ALT CONTROL LEVER **AUTO (UP)**
 PNEUMATIC X FEED VALVES **OPEN**
 SET APU AIR SWITCH.

► *If cabin is above 75°F:*

SELECT AIR COND COLDER.

► *If cabin is below 75°F:*

SELECT ON.

AIR CONDITIONING SUPPLY SWITCHES AUTO

- AIR CONDITIONING SUPPLY switches are normally in the **AUTO** position.
- If (88) pack pressure is <12 psi; (90) cabin temperature is 75° or greater, with both packs on, selecting **AIR COND COLDER** may increase cooling.
- With both packs on, if left or right air conditioning (88) pressure remains or is <12 psi; (90) FLOW indicator is less than 12:00 position, operate only one pack.
- Turn packs to **AUTO** one at a time to minimize heat exchanger fan (electrical) starting loads.
- When using the APU for electrical power, the APU ground limit should not be exceeded.
 - (88) 1.25.
 - (90) 1.0.

NOTE: *The right pack should be operated during hot ramp conditions. The right pack heat exchanger draws air from the tail compartment. This reduces the likelihood of a (88) **TAIL COMP TEMP HIGH** light, (90) **TAIL TEMP HIGH** light.*

COCKPIT / CABIN TEMP SELECTORS AUTO

———— **END OF PROCEDURE** ————

TAKEOFF WITH AIR CONDITIONING PACKS OFF

➤ ***Prior to takeoff:***

CHECK EPR.

- Thrust rating computer should increase T/O EPR setting by .02 when packs are turned off.

AIR CONDITIONING SUPPLY SWITCHES.OFF

➤ ***After takeoff (not below 400 feet AFE):***

**AIR CONDITIONING SUPPLY SWITCHES
(ONE AT A TIME)AUTO**

- AIR CONDITIONING SUPPLY switches must be in **AUTO** prior to selecting climb power to prevent **NO MODE** light from illuminating.

———— **END OF PROCEDURE** ————

Supplementary Procedures

Chapter SP

Anti-Ice, Rain

Section 3

ENGINE ANTI-ICE OPERATION

(88) ENGINE IGNITION ON

ANTI-ICE SWITCHES ON (ONE AT A TIME)

- Turn ENGINE ANTI-ICE switches **ON** one at a time. Wait until engine is stabilized before turning on opposite engine anti-ice.

CAUTION

Periodic engine run-ups are necessary during prolonged ground operation, including taxi-in, taxi-out, and ground holding, when in icing conditions. These run-ups must be to a minimum of (88) 70% N_1 for 15 seconds, or 60% N_1 for 40 seconds, (90) 50% N_1 momentary every 10 minutes to shed ice from the low pressure compressor (LPC) stators.

WARNING

(90) During engine runups, do not stabilize the engine in the 61% to 74% N_1 speed band.

ENG ANTI-ICE ON LIGHTS ON

ENG VALVE MESSAGES OFF

- Message illumination indicates one or more engine anti-ice valves has malfunctioned. Depart icing area as soon as possible.

(88) ENGINE IGNITION OFF

- Ignition may be turned **OFF** after engines have stabilized.

► **When engine anti-ice is no longer required:**

(88) ENGINE IGNITION ON

ANTI-ICE SWITCHES OFF

- Autothrottles may disconnect if ENGINE ANTI-ICE switches are moved to **OFF** while wing anti-ice or tail de-ice is on. Thrust rating panel **NO MODE** light will illuminate.

ENG ANTI-ICE ON LIGHTS OFF

ENG VALVE MESSAGES OFF

(88) ENGINE IGNITION OFF

— END OF PROCEDURE —

AIRFOIL ICE PROTECTION

PNEUMATIC X FEED VALVES OPEN

AIRFOIL ANTI-ICE SWITCH ON

WING ANTI-ICE ON LIGHT ILLUMINATED

CHECK PNEUMATIC PRESSURE GAUGE.

- L and R ICE PROT TEMP LOW and WING ICE PRESS ABNML Messages should be extinguished within one minute.
- Pneumatic pressure should be above yellow arc on pneumatic pressure gauge.
 - If necessary, increase engine power.
- Every 15 minutes of operation, tail de-ice system will automatically be operated for 2 1/2 minutes.
 - Wing will not be anti-iced during that time.
 - At completion of tail de-ice cycle, system will revert to wing anti-ice and start a new 15 minute cycle.
- (88) Manual tail de-ice should be initiated 1 minute prior to extension of landing flaps (normally just prior to landing gear extension).
- (90) Moving the flaps to 40 will activate both wing and tail anti-ice simultaneously, and the **WING ANTI-ICE ON** and **TAIL DE-ICE ON** will illuminate until the aircraft is on the ground or flaps are repositioned to less than 40.

➤ *When icing conditions no longer exist:*

AIRFOIL ANTI-ICE SWITCH OFF

- Tail de-ice will be provided for 2 1/2 minutes after AIRFOIL ANTI-ICE switch is moved to **OFF**.

➤ *After completion of tail de-ice cycle:*

PNEUMATIC X FEED VALVES CLOSE

———— **END OF PROCEDURE** ————

MD-90 PRIMARY ICE DETECTION TEST

System test required for first flight of the day.

ICE FOD SWITCH. TEST

- Hold switch in TEST position and observe that the following four messages are displayed on the EOAP:
 - L/R ICE FOD ALERT and L/R ICE FOD SYS INOP.
- Release switch. Observe that all messages extinguish.

———— **END OF PROCEDURE** ————

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Supplementary Procedures

Chapter SP

Automatic Flight

Section 4

AUTOLAND AVAILABILITY TEST

NOTE: Test must be performed while airplane is on ground. Headings must agree within 4 degrees. If headings disagree due to magnetic anomalies, perform the test away from the gate in an area of no magnetic anomaly.

SET VHF NAV RADIOS.

- Set both VHF NAV radios to same ILS frequency.
- Use an inoperative ILS frequency (an example is 108.1).

PUSH AUTOLAND BUTTON.

- Observe the following:
 - Autothrottle, arm, roll and pitch mode annunciators display **AUTO LND/PRE/FLT/TEST** light during autoland test for selected DFGC FMA's.
 - R/A's, PFD's and ILS indications display test functions.
 - After approximately 55 seconds, flight mode annunciator goes blank or reverts to previous display.
 - The **NO AUTOLAND** light extinguishes indicating a valid test.
- If test is invalid, **NO AUTOLAND** light remains illuminated until the FMA RESET button is pushed.
- DO NOT initiate test on other side until entire test is complete.
- Move DFGC 1-2 switch to opposite position and repeat test.

SET VHF NAV RADIOS.

- Captain and First Officer set desired departure VHF NAV frequency and course.

——— END OF PROCEDURE ———

88	AUTOTHROTTLE ADVANCE	88
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Observe the following caution when operating the autothrottles during takeoff.

CAUTION

During takeoff, the DFGC engine failure logic is armed if:

- ***The flight director pitch axis is in takeoff mode.***
- ***The aircraft is above 400 feet radio altitude and***
- ***Both engine EPR's are below the go-around EPR limit.***

If the DFGC detects an EPR drop greater than or equal to 0.25 EPR and 7% N_1 from the same engine, as compared to the other engine, the engine failure logic is satisfied and the DFCG will change the thrust rating panel (TRP) to go-around (GA). This will cause the autothrottle system to unclamp and enter normal EPR limit (EPR LIM) mode where the throttles will maintain the higher engine EPR at the selected go-around thrust limit. Such an EPR and N_1 drop may also result from an engine surge (stall). Advancing thrust levers on a surging engine will hinder surge recovery and may result in eventual engine failure.

———— **END OF PROCEDURE** ————

Supplementary Procedures

Communications

Chapter SP

Section 5

Aircraft Communication Addressing and Reporting System (ACARS)

Pre-Departure Clearance

The flight crew shall compare the filed flight plan versus the digital pre-departure clearance and shall initiate voice contact with Air Traffic Control if any question/confusion exists between the filed flight plan and the digital pre-departure clearance.

Digital-Automatic Information Service

The flight crew shall verify that the D-ATIS altimeter setting numeric value and alpha value are identical. The alpha value is the numeric altimeter setting spelled out (i.e., two niner niner two). This will be depicted on the ACARS ATIS message. If the D-ATIS altimeter setting altimeter numeric value and alpha values are different, the flight crew must not accept the D-ATIS altimeter setting.

Company Communications Sequence

The COMMUNICATIONS SEQUENCE chart depicts DATA LINK functions that are currently in effect for Delta Air Lines. The chronological sequence in which DATA LINK messages should be sent is shown as a function of flight phase. The messages that appear above the profile are ROUTINE and should be sent whenever appropriate on every flight. The messages below the profile are NON ROUTINE and should be sent as needed.

Messages are delivered to the Flight Control dispatcher's cue and are also directly processed by Flight Following. This direct processing of DATA LINK messages results in system wide updates.

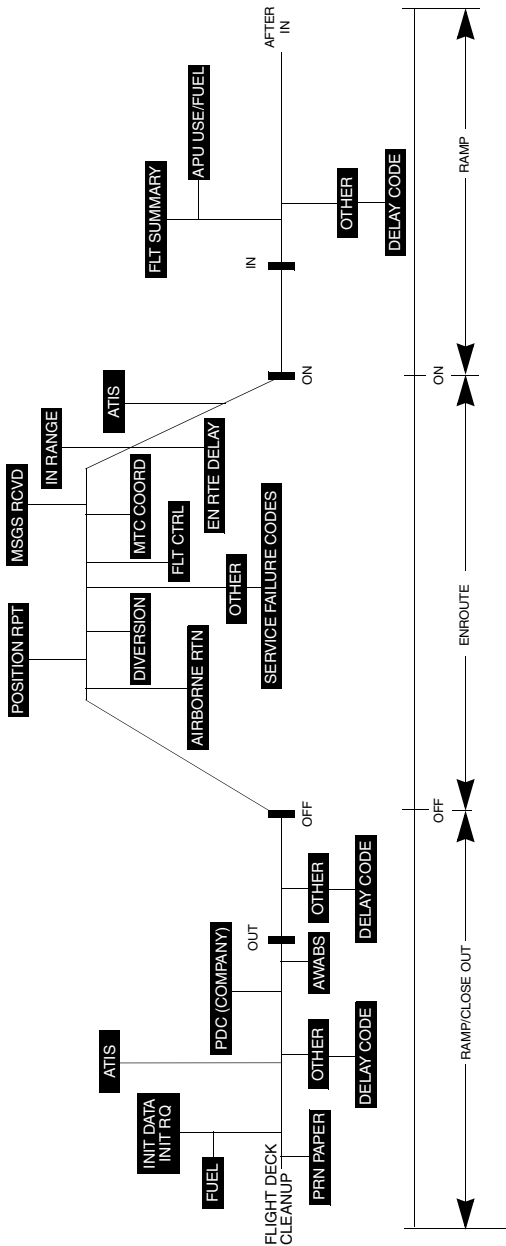
Continued on next page

Communications Sequence Chart

COMPANY COMMUNICATIONS

ABOVE PROFILE LINE – ROUTINE
BELOW PROFILE LINE – NON ROUTINE

NOTE: All items shown on MISC MENU and DOWNLINKS MENU (except CALSEL) are operative at any time.

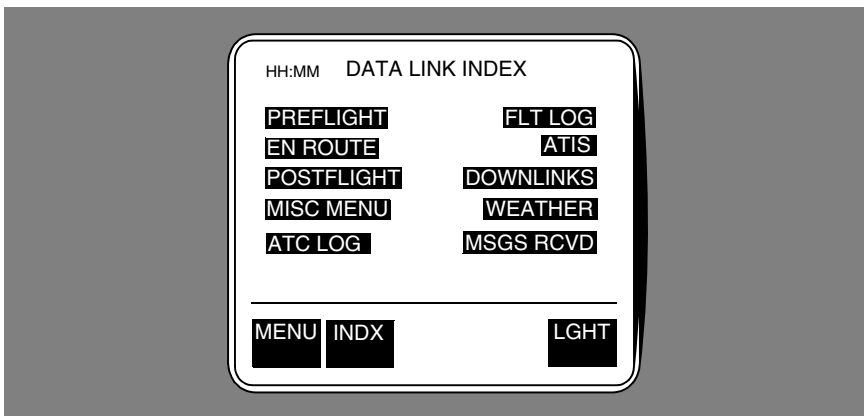


Menu Layout

This section provides general usage information and menu layouts for operating the Collins ACARS unit. The system is interactive, and methods for using it are consistent for all messages.

Some functions of the ACARS are not currently supported and therefore should not be used. Refer to the DATA LINK INDEX menu tree on the next page to determine which functions are available. If in doubt about the status of an operational message, use normal company radio procedures.

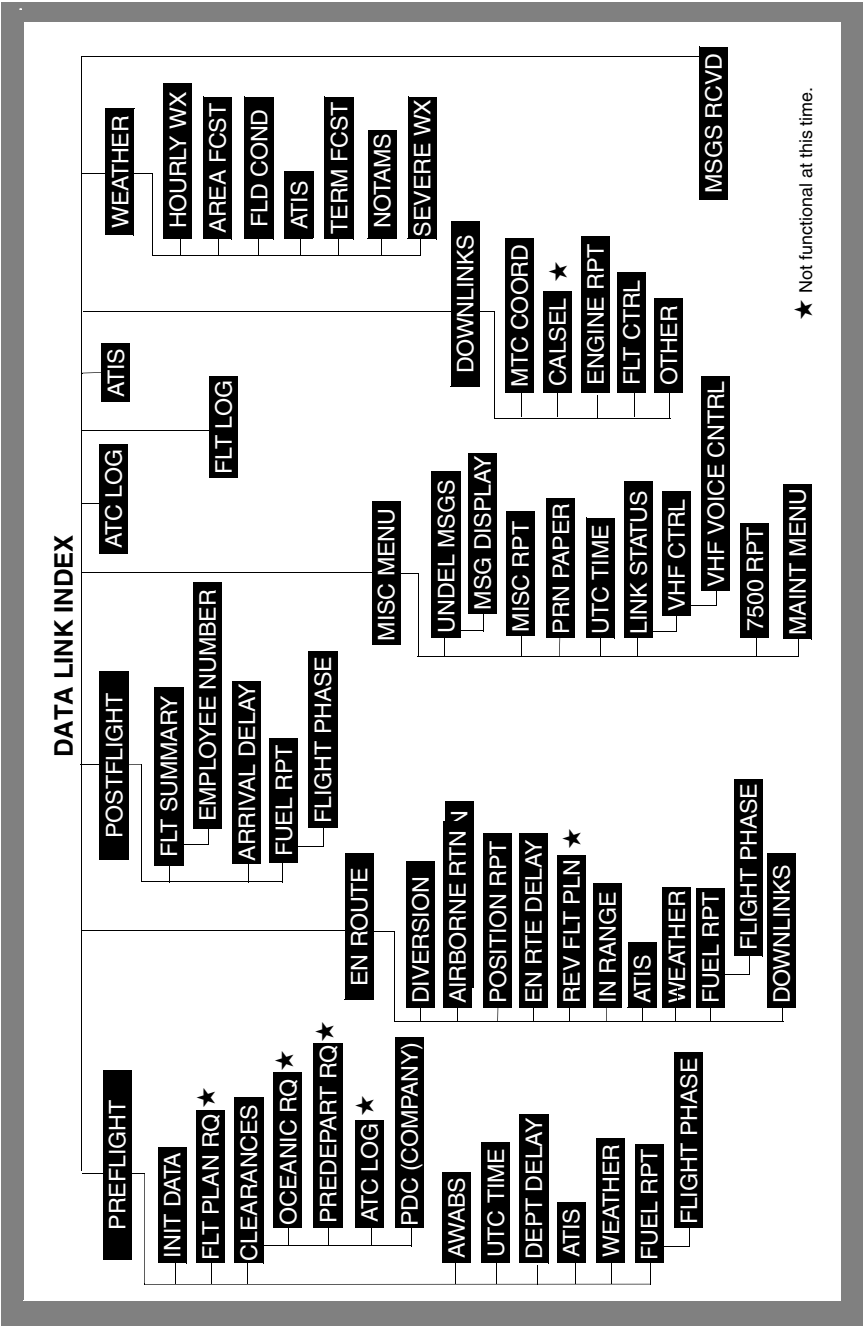
Reports can be accessed through the ACARS DATA LINK INDEX page shown below.



The menu tree on the next page shows the menu/submenu layout and can be referenced to assist the flight crew in transmission of desired/required reports.

Continued on next page

Menu Layout Charts



Advisory Messages

Alert Advisories

Alert advisories appear on the IDU signifying that either a condition requires attention, a function is available, or an uplink has been received. Selecting the advisory will access the required menu. The advisories are listed below in order from highest to lowest priority.

FAIL	Internal failure of MU. Refer to the ACARS SYSTEM INOP Non-Normal Checklist in the QRH.
POWER	Power interruption resulting in loss of initialization data.
SELCAL	SELCAL uplink message received.
ATC MSG	ATC uplink message received.
OCEANCL	ATC oceanic clearance uplink message received.
DEPT CL	ATC predeparture clearance message received.
MESSAGE	Non ATC uplink message received.
INIT	Initialization data incomplete.
DATAMD	Datalink attempted with ACARS in VOICE mode, or ACARS in VOICE mode for greater than 3 minutes.
ATIS	ATC ATIS message received and not viewed.
INRANGE	Alert to send the In Range Report.
ARRDLA	Alert to send the Arrival Delay Report.
DEPDLA	Alert to send the Departure Delay Report (“Off” event message not within 20 minutes of “Out” message)..
SUMMARY	Summary Report has not been sent.
PAPER	Printer is out of paper.

Continued on next page

Continued from previous page

Informational Advisories

Informational advisories appear on the IDU indicating system status. The advisories are listed below in order of priority.

VHF IN PROG	Message is actively being sent/received.
UTC OK	UTC TIME updated by uplink.
NO COMM	No DATA LINK is available.
VNNN.NN	VHF-3 is in voice mode and frequency selected is NNN.NN. ACARS downlinks will be cued. Downlink messages will be transmitted when ground network access is restored.

Note: If the DATA LINK is functioning normally in the DATA mode, there will be no advisory shown.

Preflight

INIT DATA Page

Access the INIT DATA page from the DATA LINK INDEX page.

ACARS mode (VHF # 3) DATA

Ensure NO COMM is not displayed.

Confirm UTC time is correct.

PREFLIGHT Select

INIT DATA Select

INIT RQ Select

Verify datalink information is correct. Manually enter values as necessary.

The following page will be displayed.

The screenshot shows the 'INIT DATA' page with the following fields and callouts:

- 1** points to the **FLT NO** field (HH:MM).
- 2** points to the **ORIG** field (four digit boxes).
- 3** points to the **FOB** field (four digit boxes).
- 4** points to the **GW** field (four digit boxes).
- 5** points to the **DATE** field (two digit boxes).
- 6** points to the **DEST** field (four digit boxes).
- 7** points to the **FUEL BOARDED** field (four digit boxes).
- 8** points to the **ETE** field (four digit boxes).
- 9** points to the **INIT RQ** field (four digit boxes).

Other fields visible include **PRINT**, **RETURN**, **MENU**, **INDX**, and **LGHT**.

1 FLT NO

Automatically updates when INIT RQ selected, or may be manually entered.

2 ORIG

Automatically updates when INIT RQ selected, or may be manually entered.

3 FOB (Fuel On Board)

Enter total pounds of fuel onboard manually.

Continued on next page

Continued from previous page

4 GW

Enter aircraft gross weight manually.

5 DATE

Automatically updates when INIT RQ selected, or may be manually entered.

6 DEST

Automatically updates when INIT RQ selected, or may be manually entered.

7 FUEL BOARDED

Enter manually. This is the amount of fuel listed on the fuel service record.

8 ETE

Enter Estimated Time Enroute manually.

9 INIT RQ

Automatically updates FLT NO, DATE, ORIG, and DEST.

ATIS Page

Access the ATIS page from the DATA LINK INDEX page.

PREFLIGHT Select

ATIS Select

This page allows request of digital ATIS information, when provided by airport.

Note: Availability of digital ATIS is indicated on airport diagrams (XX-9 Jeppesen plate) by “D-ATIS” in the “ACARS” communications block.

The following page will be displayed.

The screenshot shows the ATIS page interface. At the top left is a time field labeled 'HH:MM'. To its right is the title 'ATIS'. Below the time field is the 'AIRPORT' field, which contains four small square boxes. To the right of the 'AIRPORT' field is a button labeled 'ATIS MSG'. Below the 'AIRPORT' field is the 'TYPE' field, which contains a long string of 'A' characters. Below the 'TYPE' field is the 'AUTO UPDATE' field, which contains a string of 'A' characters. To the right of the 'AUTO UPDATE' field is a button labeled 'SEND'. At the bottom left is a button labeled 'RETURN'. At the bottom center are two buttons labeled 'MENU' and 'INDX'. At the bottom right is a button labeled 'LGHT'. Three numbered callouts (1, 2, 3) point to the 'AIRPORT', 'TYPE', and 'AUTO UPDATE' fields respectively.

1 AIRPORT

The AIRPORT field defaults to departure airport prior to “OFF” time, then defaults to arrival airport after “OFF” time. If diversion page is transmitted with an airport other than planned arrival airport, the default will be the diversion airport.

2 TYPE

The TYPE field allows selection of Departure, Arrival, Departure/Arrival (used in conjunction with Auto Update Mode), and Enroute Information Services weather products.

Continued on next page

Continued from previous page

3 AUTO UPDATE

The AUTO UPDATE field allows enabling/disabling of automatic ATIS update feature.

- Sending an ATIS request with START in this field enables the function; sending a request with STOP disables the function
 - When STOP is requested, one more ATIS report will be received, and then the AUTO function is disabled.
- Displays an “ATIS” prompt every time a new ATIS is transmitted at the selected airport
- Selection of Arrival or Departure ATIS is automatic, and is dependent on “OFF” time.

Pushback Delays

For any pushback delays, refer to the OTHER page in this section for information on how to submit the report.

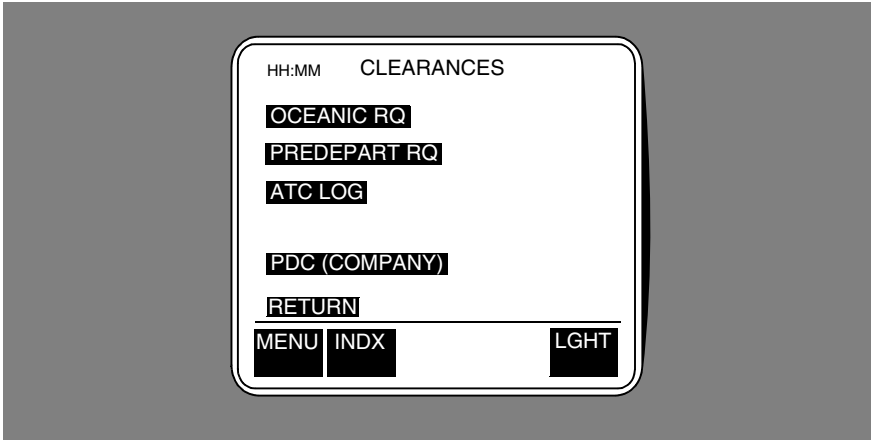
Pre-Departure Clearance

Access the CLEARANCES page from the DATA LINK INDEX page.

PREFLIGHT Select

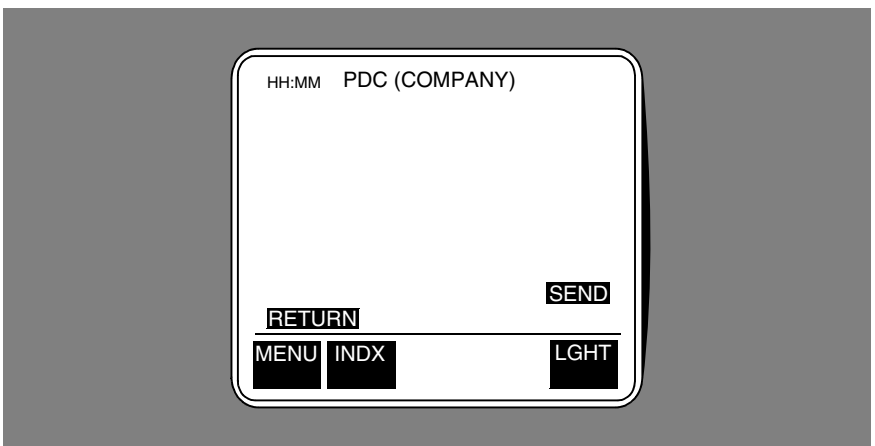
CLEARANCES Select

The following page will be displayed.



PDC (COMPANY) Select

Selecting PDC (COMPANY) causes a delivery request message to be readied for downlink.



SEND Select

AWABS Update

AWABS page 1/2

If after push back, it becomes necessary to update the AWABS:

Access the AWABS page from the DATA LINK INDEX page.

PREFLIGHT Select

AWABS Select

The following page will be displayed. Fill in each field as described below.

The screenshot shows the AWABS 1/2 page with the following fields and buttons:

- 1** points to the **SN/RWY/CONT** field, which is a boxed field containing a sequence number and runway identifier.
- 2** points to the **FC /CC /YC** field, which is a boxed field containing fuel, climb, and yield data.
- 3** points to the **TOLERANCE** field, which is a boxed field containing tolerance data.
- 4** points to the **TEMP** field, which is a boxed field containing temperature data.
- 5** points to the **WIND (DIR/VEL)** field, which is a boxed field containing wind direction and velocity data.
- 6** points to the **ALTIMETER** field, which is a boxed field containing altimeter data.

At the bottom of the page, there are buttons for **PRINT**, **RETURN**, **MENU**, **INDX**, **PREV**, **NEXT**, and **LGHT**.

1 SN/RWY/CONT (Mandatory)

The following fields (boxed fields) on AWABS page 1/2 are Mandatory entries.

- SN (Sequence Number) - is reserved for future use. Enter the digits 88 in order to satisfy ACARS requirements.
- RWY (Runway identifier) - Enter the desired takeoff runway. AWABS data will only be sent for this runway. This identifier must be recognizable by AWABS (consult the existing WDR or ARM for the exact label).

Examples include:

26R - Runway 26 Right

26LTWYE13 - Runway 26 Left at taxiway E 13

25LPOSNF - Runway 25 Left at takeoff position NF

If the runway ID is not recognized, the system will uplink a message with a list of possible runway labels.

▲ Delta
MD-88/90 Operations Manual

- **CONT (Contamination)** - The runway contaminant condition you desire. Choices are:

D	Dry (default entry)
W	Wet
I	Icy
Q	Quarter Clutter (25 CTR)
H	Half Clutter (50 CTR)

If you are overweight for the requested contaminant, you will receive a message uplink advising you of this, but you will not receive a WDR uplink.

2 FC/CC/YC (Optional)

Passenger count. Enter only changes from the existing WDR passenger distribution. Example: To change 16/00/130 to 16/00/132, enter “//132”.

3 TOLERANCE (Optional)

Passenger/Cargo tolerance. Choices are “OFF,” “ON,” and “---.”

- “---” (default) will leave tolerance the same as it was on the latest WDR
- “OFF” forces the tolerance off
- “ON” forces tolerance on.

4 TEMP (Optional)

Current temperature in degrees Fahrenheit (default) or Celsius (C).

To enter new Fahrenheit temperature value, simply enter a temperature number. To enter a Celsius value, you must type a temperature number, a slash “/” and then the character “C.”

5 WIND (DIR/VEL) (Optional)

Use 360 for North. Range of directions is 001 - 360.

Separate direction and velocity with slash “/” (i.e., 270/20).

6 ALTIMETER (Optional)

Altimeter setting. Any entry greater than 2000 is considered inches of mercury (inHG). Any entry less than or equal to 2000 is considered Hectopascals (hPa).

Continued on next page

Continued from previous page

AWABS - continued (Page 2/2)

After completing the required entries on AWABS page 1/2, you must move to page 2/2 in order to access the SEND prompt.

NEXT page button Select

The following page will be displayed.

Note: All fields on AWABS page 2/2 are for future use and should be left blank.

HH:MM

AWABS

2/2

CGO - FUEL E1 INC ADJ ZFW

CGO - FUEL E2 MEL CDL

PRINT

SEND

RETURN

MENUINDXPREVNEXTLGHT

SEND Select

Note: Use this AWABS update procedure only as required. The time it takes to uplink a new WDR is directly related to the number of system requests being processed at that time.

Departure Delays

For any departure delays, refer to the OTHER page in this section for information on how to submit the report.

En Route

Position Report

Access the POSITION RPT page from the DATA LINK INDEX page.

EN ROUTE Select

POSITION RPT Select

This report consists of 2 pages, the second of which can be accessed through the use of the PREV or the NEXT prompt.

The following page will be displayed.

The screenshot shows the 'POSITION RPT' page with the following fields and callouts:

- 1** points to the 'POSITION' field, which is a 10-character alphanumeric display.
- 2** points to the 'FLT LEVEL ALT' field, which is a 3-digit display.
- 3** points to the 'NEXT POSITION' field, which is a 10-character alphanumeric display.
- 4** points to the 'TEMP' field, which is a 4-character display.
- 5** points to the 'WIND (DIR/VEL)' field, which is a 4-character display.
- 6** points to the 'ALTIMETER' field, which is a 4-character display.

Other fields on the page include 'HH:MM' (time), '1/2' (page indicator), 'ENSUING POSITION' (10-character alphanumeric display), and a 'RETURN' button. At the bottom are four buttons: 'INDX', 'PREV', 'NEXT', and 'LGHT'.

1 POSITION

Enter report point (R) identifier from the flight plan.

2 FLT LEVEL ALT

Enter the three digit flight level the plane is currently cruising at.

3 NEXT POSITION

- If NEXT POSITION and ETA are entered, they will automatically move to POSITION and TIME for the next POSITION RPT once SEND is pressed.
- Partially completed pages will retain entered data until report is sent or the end of the flight.

Continued on next page

Continued from previous page

Position Report - continued (Page2/2)

After completing the required entries on page 1/2, move to page 2/2.

NEXT page button Select
The following page will be displayed.

The screenshot shows a flight deck display titled "POSITION RPT 2/2". It contains several data entry fields and a set of control buttons at the bottom. Numbered callouts point to the following elements:

- 1**: Points to the "WIND (DIR/VEL)" field, which shows "-- / --".
- 2**: Points to the "TURBULENCE" field, which shows "AAAAAAAAAA".
- 3**: Points to the "SAT" field, which shows "--".
- 4**: Points to the "ICING" field, which shows "AAAAAAA".
- 5**: Points to the "SKY COND" field, which shows "AAAAAAA".

At the bottom of the screen, there is a "RETURN" button and a row of four buttons: "INDX", "PREV", "NEXT", and "LGHT".

1 WIND

Enter direction and velocity.

2 TURBULENCE

Touch to scroll through selections and select one of the following:

SMOOTH	LT CHOP	MOD CHOP	SEV TURB
	LT TURB	MOD TURB	EXT TURB

3 SAT

Temperature must be entered manually.

4 ICING

Touch to scroll through selections and select one of the following:

NONE	TRACE	MODERATE
	LIGHT	SEVERE

5 SKY COND

Touch to scroll through selections and select one of the following:

CLEAR	BROKEN	UNDERCAST	BTWTN LAYER
SCATTERED	OVERCAST	IN CLOUD	CIRRUS

Note: Select SEND to downlink report before leaving second page.

In Range

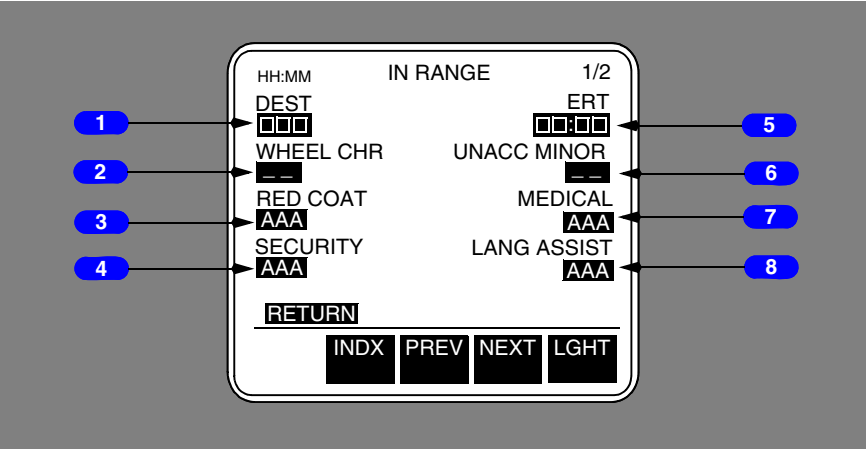
Access the IN RANGE page from the DATA LINK INDEX page.

EN ROUTE Select

IN RANGE Select

This report consists of 2 pages, the second of which can be accessed through the use of the PREV or the NEXT prompt.

The following page will be displayed.



The screenshot shows the 'IN RANGE' page with the following fields and callouts:

- 1: DEST (Destination)
- 2: WHEEL CHR (Wheel Chair)
- 3: RED COAT (Red Coat)
- 4: SECURITY (Security)
- 5: ERT (Estimated Return Time)
- 6: UNACC MINOR (Unaccompanied Minor)
- 7: MEDICAL (Medical)
- 8: LANG ASSIST (Language Assistance)

At the bottom of the page are the following prompts: RETURN, INDX, PREV, NEXT, and LGHT.

1 DEST

Automatically fills in using information from INIT DATA or DIVERSION pages (if report was sent).

2 WHEEL CHAIR

Enter total number of wheel chairs required at destination.

3 RED COAT

Toggle YES or NO.

4 SECURITY

Toggle YES or NO.

5 ERT

Automatically fills in using information from INIT DATA or DIVERSION pages (if report was sent).

6 UNACC MINOR

Enter total number of unaccompanied minors onboard.

4 MEDICAL

Toggle YES or NO.

4 LANG ASSIST

Toggle YES or NO.

In Range - Continued (Page 2/2)

After completing the required entries on page 1/2, move to page 2/2.

NEXT page button Select

The following page will be displayed.

HH:MM IN RANGE 2/2

LAV SRVC CABIN SRVC

AAA AAA

[]

[]

[]

PRINT SEND

RETURN

INDX PREV NEXT LGHT

1 points to LAV SRVC field

2 points to CABIN SRVC field

3 points to EDIT TEXT button

1 LAV SRVC

Toggle YES or NO.

Continued on next page

Continued from previous page

2 CABIN SRVC

Toggle YES or NO.

3 EDIT TEXT

Use text field for sending special requests not listed in the report.

Note: Select SEND to downlink report before leaving second page.

Service Failure During Flight

If a service failure was reported during the flight or a service failure was accepted prior to pushback, refer to the OTHER page in this section for information on how to submit the report.

Arrival Delays

For any arrival delays, refer to the OTHER page in this section for information on how to submit the report.

Postflight

FLT SUMMARY (Page 1/2)

Access the FLIGHT SUMMARY page from the DATA LINK INDEX page.

POSTFLIGHT Select

FLT SUMMARY Select

The following page will be displayed. Fill in each field as described below.

The screenshot shows the 'FLT SUMMARY' page with the following fields and callouts:

- 1** points to the 'EMP NO' field under 'TAKEOFF'.
- 2** points to the 'EMP NO' field under 'LANDING'.
- 3** points to the 'HOURS' field under 'APU'.
- 4** points to the 'T/O PWR' field.
- 5** points to the 'OTHER PWR' field.
- 6** points to the 'FOB' field.
- 7** points to the 'CYCLES' field.

Other visible fields include 'HH:MM', 'HI MAIN FUEL', and a 'RETURN' button. At the bottom are navigation buttons: MENU, INDX, PREV, NEXT, and LGHT.

1 EMP NO - TAKEOFF (Not used, for reference only)

Employee number of crew member that performed the takeoff.

- Selection causes EMPLOYEE NUMBER page to be displayed. Employee number received in the INIT DATA uplink, when available, may be chosen or manual data entry may be made.

2 EMP NO - LANDING (Not used, for reference only)

Employee number of crew member that performed the landing.

- Selection causes EMPLOYEE NUMBER page to be displayed. Employee number received in the INIT DATA uplink, when available, may be chosen or manual data entry may be made.

3 HOURS - APU (Not used, for reference only)

Actual APU hours.

Continued on next page

Continued from previous page

4 T/O PWR

Enter takeoff power from the following range:

- TO - (Default)
- OTHER - (Select to input Assumed Temperature takeoffs.).

5 OTHER PWR

Selection is available only if OTHER is selected in T/O PWR field.

- Enter “AT XX” as appropriate.

6 FOB (Fuel On Board)

Enter actual fuel onboard manually.

7 CYCLES - APU

I No entry required.

FLT SUMMARY (Page 2/2)

After completing the required entries on FLT SUMMARY page 1/2, you must move to page 2/2 in order input autoland information.

NEXT page button Select

The following pages will be displayed. Fill in each field as described below.

If an autoland was not accomplished:

HH:MM FLT SUMMARY 2/2
AUTOLAND IRU ERROR
NO

LEFT
RIGHT

PRINT SEND
RETURN
MENU INDX PREV NEXT LGHT

1 points to NO
5 points to LEFT
6 points to RIGHT
7 points to SEND

Continued on next page

Continued from previous page

If an autoland was accomplished:

The screenshot shows the 'FLT SUMMARY' screen with the following fields and buttons:

- 1** points to the **AUTOLAND** field, which currently displays **AAA**.
- 2** points to the **AIRPORT** field, which displays four empty boxes.
- 3** points to the **RUNWAY** field, which displays two empty boxes.
- 4** points to the **SAT / UNSAT** field, which currently displays **SAT**.
- 5** points to the **LEFT** field, which displays two empty boxes.
- 6** points to the **RIGHT** field, which displays two empty boxes.
- 7** points to the **SEND** button.

Other visible elements include: 'HH:MM' at the top left, '2/2' at the top right, 'IRU ERROR' below 'FLT SUMMARY', and a row of buttons at the bottom: **PRINT**, **RETURN**, **MENU**, **INDX**, **PREV**, **NEXT**, and **LGHT**.

1 AUTOLAND

- Default value is NO, indicating an autoland was not performed.
- If an autoland was performed, select the AUTOLAND box, the default will change to YES, then complete the following fields:

2 AIRPORT

Default value is landing airport.

3 RUNWAY

Runway upon which autoland was performed.

4 SAT/UNSAT

Default value is SAT. Select the SAT/UNSAT box to indicate UNSAT.

Note: Parameters for a successful autoland attempt are delineated in the MDM, TOPP Dispatch Documents Section, Aircraft Log System, Completed Log Sheet Example.

Note: SATISFACTORY autoland information is only required to be recorded under the Autoland column of the aircraft logsheet, next to the T/O Power column.

Note: UNSATISFACTORY autoland attempts must also be recorded in the aircraft logbook as an irregularity.

5 LEFT

No entry required.

6 RIGHT

No entry required.

7 SEND

After completing all entries do not manually send the report. Allow ACARS to do so automatically. This will allow for proper sequencing in the TIMES report.

Other

Use this page to submit Pushback Delays, Departure Delays, Arrival Delays, and Service Failures.

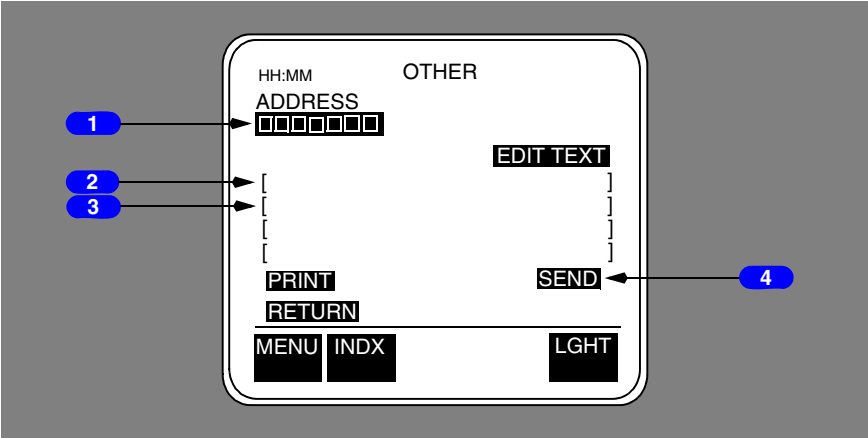
Note: The OTHER page can also be used to request game scores. Use the address ATLXGDL for game day listings, and place appropriate information in the EDIT TEXT field.

Access the OTHER page from the DATA LINK INDEX page.

DOWNLINKS Select

OTHER Select

The following page will be displayed. Fill in each field as described below.



The screenshot shows a terminal window titled "OTHER". At the top left is a clock display "HH:MM". Below it is the label "ADDRESS" followed by a box containing eight empty square characters. To the right of this is the label "EDIT TEXT" above a large rectangular text input area. At the bottom left are three buttons: "PRINT", "RETURN", and "MENU". To the right of these is a "SEND" button. Further right, below the "EDIT TEXT" area, is a "LGHT" button. Numbered callouts point to specific fields: 1 points to the ADDRESS box, 2 points to the first line of the EDIT TEXT area, 3 points to the second line of the EDIT TEXT area, and 4 points to the SEND button.

1 Address

Enter ATLWDDL in the address box

2 First line of Edit Text field

Enter the primary code (see Report Codes below) for the delay followed by any secondary codes in the first line only of the text field. Enter a maximum of four codes. Separate codes with one space.

Reports may be combined; e.g., Pushback Delay, Departure Delay.

If over four codes are needed, send a second report. Codes entered after line one are not recorded in the database.

Note: The database will automatically capture only the codes entered on line one of the Edit Text field.

Note: If submitting a COR, mention "Operation Clockwork" in the narrative. If submitting a POE, select ACARS Metrics, then Clockwork Metrics.

3 Second line of Edit Text field

Any additional free text remarks may be entered starting on line two.

Note: Any information entered on line two or after is not automatically captured by the database. The information is manually read.

4 SEND

Send the reports when crew workload permits and safety is not compromised.

Pushback Delay Report Codes

Report any pushback delay that exceeds D-0. If a delay or service failure occurs up to dispatch agent salute:

Code	Reason
PBRD	Boarding not complete/paperwork not available
PCAB	Cabin not ready for pushback/passenger issue
PATC	ATC wheels up time
PPSH	Pushback clearance not available/ramp blocked
PFUL	Fueling not completed/late completion
PCAT	Catering not completed/late completion
PCLN	Cabin cleaning not completed/late completion
PCRW	Flight crew (Pilot or FA) late to aircraft (less than 30 minutes prior to departure)
PEQP	Late arriving equipment to gate
PCGO	Ground crew servicing (e.g., loading cargo, water servicing, late bags, etc.)
PMTC	Maintenance issue
PLAV	Lavatory service not completed/late completion
PSEC	Security issues

Departure Delay Report Codes

Report any departure delay that exceeds planned taxi time by 15 minutes or more. If a delay occurs after dispatch agent salute and prior to takeoff:

Code	Reason
DATC	ATC flow control issues/runway change
DWAY	Airport/taxiway congested
DRMP	Ramp congested
DWDR	AWABS update/closeout required
DICE	De/Anti-icing delay
DMTC	Maintenance issue which delayed takeoff

Service Failure During Flight Report Codes

If a service failure is reported during the flight or the service failure was accepted prior to pushback:

Note: A flight attendant will contact the cockpit and provide a list of services that were not available.

Code	Reason
SICE	Ice or beverages serviced to min specs
SWTR	Aircraft not serviced with potable water
SBEE	Aircraft had "B spec" cleaning to expedite on-time departure
SLAV	Lavatories poorly cleaned/strong odor present
SBKT	Aircraft not stocked with adequate blankets
SGAL	Aircraft missing galley equipment
SCAT	Flight not fully catered
SPAX	Failed to load pax/non-revs with seats available.

Arrival Delays

If a delay occurs upon arrival at the gate:

Code	Reason
AANA	Gate agent not available
AGNA	Gate not available (e.g., departing aircraft still in the gate)
AGAT	Gate change after landing
AJNP	Jetway not pre-positioned
ALNO	Parking light not on
ANGC	No ground crew/ground crew not prepared
AOBS	Obstructions within safety lines
ARMP	Ramp congestion

FRM/FIM/CDL Code Downlinks

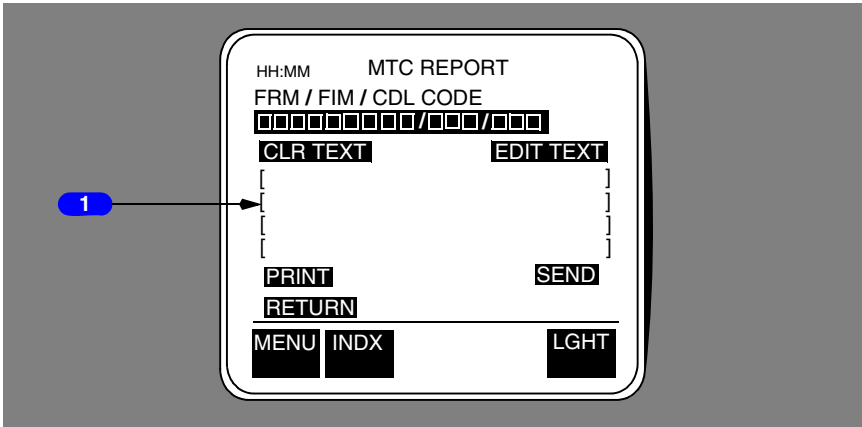
MTC REPORT page

Access the MTC REPORT page from the DATA LINK INDEX page.

DOWNLINKS Select

MTC REPORT Select

The following page will be displayed. Fill in each field as described below.



1 Free Text Field

EDIT TEXT Select

Enter maintenance discrepancies, CDL faults, etc., as required. Do not use the FRM/FIM/CDL CODE blocks at the top of the page.

Note: Use the CDL sheet completed by the cabin crew.

Note: The CLR TEXT and SEND prompts are not displayed until text has been entered in the free text field.

ENTER Select

SEND Select

Cockpit Voice Recorder Test

TEST switch Push and hold for a minimum of 5 seconds.

After a slight delay:

Monitor indicator Green band

A tone may be heard through a headset plugged into the headset jack.

TEST switch Release

Flight Deck Interphone Operation with Oxygen Masks

MASKS/BOOM switch MASKS

Select when intra-flight deck communications is desired.

To activate flight deck speakers:

Intercom (I/C) switch Select

Depress the switch on the Captain's and First Officer's audio control panels and rotate to adjust volume.

Microphone switch Push

Momentarily push the Control Wheel Push-to-Talk (INT) switch forward or push the Audio Control Panel Push-to-Talk (R/T-I/C) switch.

Intentionally
Blank

Supplementary Procedures
Electrical

Chapter SP
Section 6

Electrical Power Up

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

Circuit breakers	Check
Throttles	Idle
Fuel Lever	OFF
Battery switch	ON, Locked
(88) Emergency Power switch	OFF
(90) Emergency Power switch	ARM
Aux and Trans Hydraulic switches	OFF
Landing Gear Handle	DOWN
Electrical Power	Establish
(88) AC Bus X Tie switches	AUTO
(90) L/R Bus Tie switches	AUTO
DC Bus X Tie switch	OPEN
If external power is desired:	
External Power Avail light	Illuminated
(88) L/R External Power Bus switches	ON
(90) External Power switch	ON
If APU power is desired:	
APU	Start
APU Power Avail light	Illuminated
(88) L/R APU Bus switches	ON

Emergency Power Check

System test required for first flight of the day.

EMER PWR switch ON

- Captain's flight instruments - No flags.
- AC EMER BUS OFF and DC EMER BUS OFF lights - extinguished.
- EMER PWR IN USE light - illuminated.

VOLT/FREQ selector BATT VOLT

Observe minimum battery voltage of 25 volts.

VOLT/FREQ selector BATT AMP

Observe amps discharge rate on ammeter (to the right).

- (88) 10-50
- (90) 10-70

EMER PWR switch OFF

- Observe charge (to the left) on ammeter and return to zero.
- #1 VOR course select readout may be erratic during check.

Note: Some aircraft have pulse chargers which cycle the ammeter to the left and back to zero until the battery is fully charged. Others have constant current chargers which show a steady charge until the battery is fully charged. An indication of no charge could result from a faulty charger or a battery being fully charged. To determine if the system is operational, turn the EMER PWR switch to ON to deplete the battery enough to trigger charging.

(90) EMER PWR switch ARM

Battery charger has three different charging modes:

- Main mode - initial mode after power up or APU start. Up to 75 amps DC deflection to the left until battery is 90 - 95% charged.
- Topping mode - the ammeter will indicate a pulsed, two second ON and eight second OFF, 26 amp DC deflection to the left for 30 minutes.
- TR mode - a continuous 0-5 amp DC deflection to the left.

AC CROSSTIE LOCKOUT RESET/AC CROSSTIE LOCKOUT on the Ground

MD-88

This procedure will be utilized on the ground when Maintenance personnel are not readily available.

AC CROSSTIE LOCKOUT RESET switch Reset

Reset switch located on CB panel behind Captain.

Note: If reset attempt is not successful, a complete shutdown of aircraft electrical power is required to reset the crosstie lockout protective circuitry.

If AC CROSSTIE LOCKOUT message remains illuminated after reset attempt:

APU. Shut down

Engines. Shut down

Battery switch. OFF

After engines come to a complete stop:

Battery switch. ON/Lock

Check AC CROSSTIE LOCKOUT message.

If AC CROSSTIE LOCKOUT message is extinguished:

APU/Engines Restart

If AC CROSSTIE LOCKOUT message is illuminated:

Consult MEL.

AC Crosstie Relay Operation Verification

MD-88

- APU BUS switches OFF
- LEFT and RIGHT GEN switches ON
- Each engine driven generator should be powering its own bus.
- AC X TIE switch AUTO
- LEFT GEN switch OFF
- L GEN OFF message should illuminate
 - Right generator is powering all buses
- LEFT GEN switch ON
- L GEN OFF message should extinguish
- RIGHT GEN switch OFF
- R GEN OFF message should illuminate
 - Left generator is powering all buses
- RIGHT GEN switch ON
- R GEN OFF message should extinguish

Emergency Power Summary of Operative Equipment

Air Conditioning/Pressurization

- Manual pressurization
- Manual temperature control

APU

- (88) Windmill start.
- (90) Battery start (in flight, one attempt only)
- APU OIL PRESS LOW and APU OIL TEMP HIGH messages.

Communications/Navigation

- Captain's VHF and flight deck speaker.
- Captain's ND and VHF NAV (no marker beacons). No DME.
- PA and flight interphone.
- Flight guidance panel- Captain's nav frequency only.

Electrical

- Captain's pitot heater.
- Captain's and First Officer's white instrument flood lights (incandescent).
- Cabin standby lighting.
- MASTER WARNING and MASTER CAUTION lights.
- Annunciator lights/messages (left screen of OAP is operative).
 - (88) AC CROSSTIE LOCKOUT
 - L and R GEN OFF
 - L and R AC BUS OFF
 - DC BUS OFF
- Buses
 - Emergency AC and DC
 - DC transfer
 - Battery direct
 - Battery

Flight Controls

- All except automatic ground spoilers and stabilizer trim, slat extension beyond mid sealed, and auto slat extension

Continued on next page

Continued from previous page

- Continuous “SLAT OVERSPEED” warning, if IAS is greater than 280/.57 M.

Flight Instruments

- Captain’s flight instruments (no RDMI or marker beacon indications in PFD)
- F/O’s RDMI (No DME)
- STANDBY HORIZON indicator

Fire Protection

- Detection and protection (no AGENT LOW lights)

Fuel

- DC start pump

Hydraulics

- Both engine driven hydraulic pumps, (No pressure indication)

Ice Protection

- Engine anti-ice if operating at time of power failure
- WINDSHIELD OVERHEAT message but no anti-icing

Landing Gear

- Extension and retraction (no position indicating lights, no horn)
- Alternate gear extension (no wheel well inspection lights)
- Manual brakes (no anti-skid)
- Nose wheel steering

Oxygen

- All oxygen equipment (if O2 required, all passenger oxygen modules must be manually opened)

Pneumatics

- Only low stage air available
- Pneumatic pressure indicator

Power Plant

- OIL PRESS LOW messages, EGT, N1, and N2
- Thrust Reversing (no indicator lights)
- Ignition
- Left EPR gauge

Supplementary Procedures

Chapter SP

Engines, APU

Section 7

APU START (GROUND AND IN FLIGHT)

(88) NOTE: For in flight starts, refer to APU START ENVELOPE.

(90) NOTE: APU IN FLIGHT START ENVELOPE is the same as the aircraft flight envelope, but is currently limited to FL 350 and below. All starts are electric. Only three attempts should be made.

BATT SWITCH ON / LOCK

- Check battery voltage.
 - If battery voltage is less than 25 with no load, battery must be replaced/allowed to recharge.
 - During APU start, battery voltage must be at least 22 volts.

TEST FIRE WARNING.

- Not necessary if previously tested.

APU FIRE CONT SWITCH NORM

(88) APU DOORS SWITCH AUTO

APU AIR SWITCH. OFF

FUEL PUMP. ON

- If AC power is available from aircraft or external source, turn on one fuel tank boost pump.

NOTE: Use right fuel pump (or left with crossfeed open) at all times. Do not operate APU from center tank to prevent possible cavitation and APU flameout at low fuel quantities.

- If AC power is not available, move DC start pump switch to **ON**.

APU MASTER SWITCH. START / RUN

NOTE: Momentary off-scale deflections of EGT and rpm indications may occur during normal start.

CHECK APU OIL PRESS LOW MESSAGE OFF.

- Message normally extinguishes by 35%, but no later than 95% rpm.

(Continued on next page)

APU START (GROUND AND IN FLIGHT) (Continued)

CHECK APU EGT AND RPM.

- Note limits on gauges are not exceeded.
- Unusual starting trends should be noted in the aircraft log book, as they may indicate an impending APU malfunction.

CHECK VOLTAGE AND FREQUENCY.

- If no voltage or frequency is indicated, reset the APU GEN switch.
- Until accomplishment of required E.O.'s, Ships 937 and subs may have interference in the power feeder cables and require a reset of the generator. If needed, refer to QRH, NNC.6, Electrical for APU GEN OFF message procedure.

FUEL PUMPAS REQD

- After start turn on AC boost pump, if needed, and turn off DC start pump, if required, to supply fuel pressure for APU.

NOTE: Use right fuel pump (or left with crossfeed open) at all times. Do not operate APU from center tank to prevent possible cavitation and APU flameout at low fuel quantities.

APU AIR SWITCH.AS REQD

CHECK PNEU PRESS GAUGE INDICATION.

- Air pressures up to 61 psi from the APU are normal.

AIR CONDITIONING SYSTEMAS REQD

ACCOMPLISH APU GROUND AIR CONDITIONING SYSTEM OPERATION, IN SP.2, SUPPLEMENTARY PROCEDURES, AIR SYSTEMS, IF NECESSARY.

———— **END OF PROCEDURE** ————

APU SHUTDOWN

APU AIR SWITCH OFF

APU MASTER SWITCH OFF

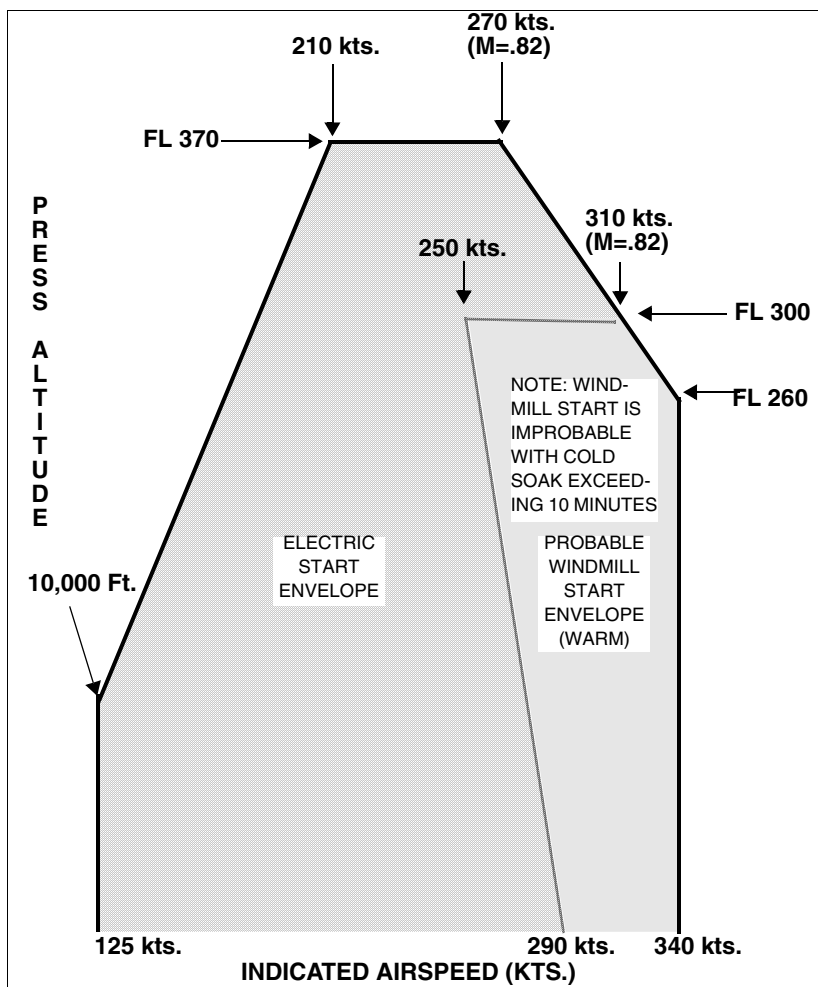
- The **OFF** position of the APU MASTER switch automatically shuts bleed air off regardless of the APU AIR switch position and activates a timer to provide a cool-down period of 60 seconds before automatic shutdown.
- If APU does not shut down when APU MASTER switch is moved to **OFF** (after 60 second cool-down), move APU FIRE CONT switch to **OFF AND AGENT ARM**. After APU shuts down, return switch to **NORM**.

(88) NOTE: *The APU BUS switches are normally left in the **ON** position for flight unless a non-normal checklist places them **OFF**.*

(90) NOTE: *The APU GEN switch is always left in the **ON** position.*

——— **END OF PROCEDURE** ———

88	APU IN FLIGHT START ENVELOPE	88
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NOTE: For the APU, there may be no rpm indications for over one minute and a completed start may take in excess of two minutes. If the OAT is below 0°F, an off-scale EGT indication can be seen during start; however, as the EGT increases (10 - 20 seconds), the cockpit EGT gauge should display normal indications.

———— **END OF PROCEDURE** ————

CROSSBLEED START

PNEU X FEED VALVES. OPEN

AIR CONDITIONING SUPPLY SWITCHES. OFF

CHECK RAMP AREA / TAXIWAY.

- Ensure ramp area/taxiway is clear of personnel, baggage carts, etc.

CHECK PNEUMATIC PRESSURE.

- Advance throttle of operating engine to obtain:
 - (88) 36 psi minimum at sea level less 1 psi per 1000 feet pressure altitude above sea level.
 - (90) 25 psi minimum.

NOTE: Nominal recommended operating pressure range is 25 to 45 psi. Pressure above 25 psi may be required based on existing conditions, i.e., crosswinds, tailwinds. Pressure in excess of 45 psi may cause starter damage on both 88 and 90 aircraft.

(88) IGNITION SWITCH. ON

ACCOMPLISH ENGINE START PROCEDURE.

ACCOMPLISH AFTER START PROCEDURE.

COMPLETE AFTER START CHECKLIST.

——— **END OF PROCEDURE** ———

88	THRUST RATING PANEL CHECK	88
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System test required for first flight of the day.

PUSH TRP TEST BUTTON.

- Observe + 12° (± 1) in RAT readout and 2.08 ($\pm .01$) in EPR limit readout. All lights should be extinguished.

RELEASE TRP TEST BUTTON.

- Observe ambient temperature in RAT readout. EPR readout will display dashes. **NO MODE** light should be illuminated.
- Select T/O on TRP.
- RAT and SAT gauges should be approximately equal.

———— **END OF PROCEDURE** ————

AIR BOTTLE START PROCEDURE

NOTE: An air bottle start is accomplished without regard to pneumatic pressure buildup in the duct system. Continuous positive N_2 rotation to 20% is indicative of a good start regardless of reading on pneumatic pressure gauge. Start left engine with the bottle, then start right engine using CROSSBLEED START procedure.

COMPLETE PUSHBACK / START CHECKLIST.

- Complete applicable items for left engine start. Pneumatic pressure will not be indicated until air bottle is turned on.

RIGHT PNEU X FEED VALVE CLOSE

- This allows air only to left engine pneumatic duct for start.

LEFT GEN CONTROL SWITCH OFF

LEFT ENGINE HYDRAULIC PUMP OFF

COMPLETE ENGINE BOTTLE START.

- Engage left START switch.
- Advise ground crew to open the air bottle.
- Check L START VALVE OPEN message on OAP.
- Observe positive N_2 rotation.

► **At 20% N_2 :**

FUEL ON

- During hot summertime conditions, rotation increase may slow above 15% N_2 .
- Do not discontinue the start unless engine fails to reach 20% N_2 .
- (88) Release START switch at 40% N_2 and command air off.
- (90) Ensure START switch releases by 45% N_2 .

CAUTION

Monitor EGT until idle is stabilized at normal N_2 idle. A hotter than normal start generally occurs when using an air bottle. Abort start prior to reaching EGT ground start limit.

COMPLETE AFTER START CHECKLIST.

——— END OF PROCEDURE ———

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Supplementary Procedures
Fire Protection

Chapter SP
Section 8

Fire Warning System Test

Check MASTER WARNING and MASTER CAUTION lights OFF.

LOOP switches Both

(88) depress TEST buttons.

(90) test FIRE TEST switch.

Check fire bell/vocal warning.

Fire bell should sound followed by vocal warning of “FIRE LEFT (RIGHT) ENGINE.” Fire bell then sounds followed by vocal warning of “FIRE RIGHT (LEFT) ENGINE.”

Depress FIRE BELL OFF button.

Aural warning should stop.

FIRE warning lights (2) Illuminated

Lights in ENGINE FIRE SHUTOFF handles should be illuminated.

MASTER WARNING lights (2) Illuminated

(88) MASTER CAUTION lights (2) Illuminated

APU FIRE warning light (1) Illuminated

(88) Fire detector loop message (1) Illuminated

(88) LOOP lights (6) Illuminated

Release TEST buttons/switch.

All above warning lights should extinguish.

Note: The DIGITAL LIGHTS TEST button must be pressed to test the fire agent low lights and (90) fuel switches.

Cargo Fire Warning Test

- All cargo compartment loop selectors BOTH
- Cargo fire SYSTEM TEST switch. Press and hold

Ensure the following indications are observed:

- Glareshield
- MASTER WARNING and MASTER CAUTION lights illuminate.
- Overhead panel
- CARGO FIRE lights illuminate.
 - Fire warning will sound.

Cancel by pressing fire bell cut out or either Master Warning light.

- Fire Control Panel
- All cargo compartment FIRE/ARMED lights illuminate.
 - All cargo compartment FAULT lights remain extinguished.
 - Both BTL DISCH/AGT LOW lights remain extinguished.

- Note:** Breakaway lockwire is not authorized on BTL DISCH/AGT LOW switch guards.
- All SQUIB lights (6) illuminate.

- Cargo fire SYSTEM TEST switch. Release
- All lights extinguish.

Perform a detector loop test.

Note: The detector loop test ensures that a detector is not stuck in an alarm condition after a system test. The selector must remain in every position for approximately 2 seconds, otherwise a faulty condition may not be detected. At the pilot’s discretion, the loop selectors may either all be placed in A, then B, then returned to BOTH or each selector may be cycled through all positions one at a time.

- FORWARD, MID, AND AFT cargo compartment loop selectors (2 seconds) A
- FORWARD, MID, AND AFT cargo compartment loop selectors (2 seconds) B
- FORWARD, MID, AND AFT cargo compartment loop selectors (2 seconds) BOTH

Lavatory Smoke Alarms

MD-88

Location

Located in undersink compartment above waste receptacle (see illustration below).

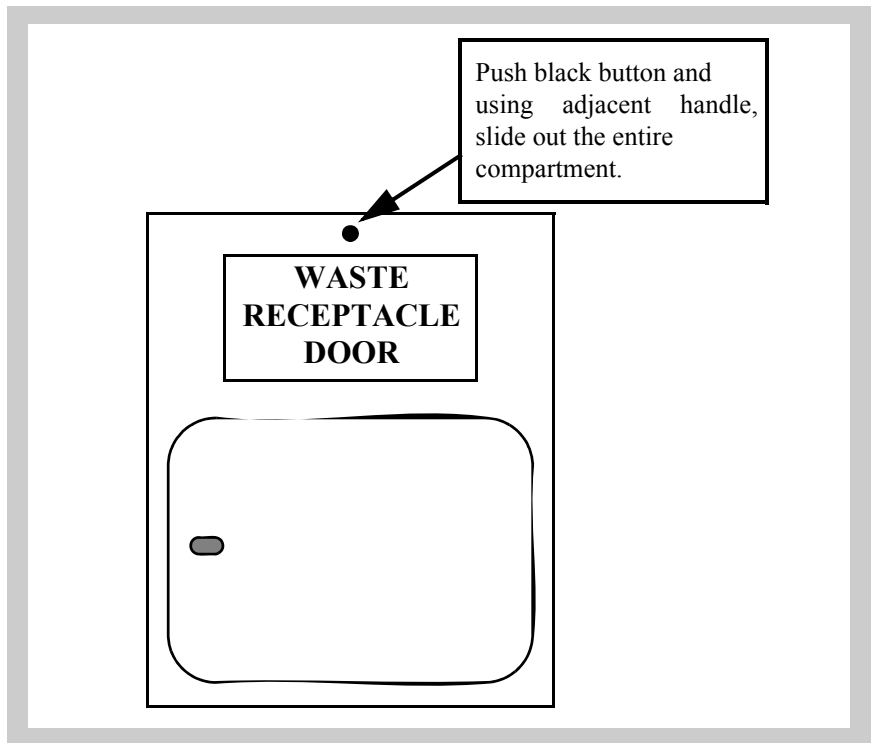
Operation

Will be activated by smoke in the lavatory.

- May be deactivated by opening cover and removing the battery.

Note: Battery is normally safetied in with wire. If needed, cutting pliers located behind Captain's seat in security kit.

- To test unit (if desired), press red TEST button on unit and release.



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Supplementary Procedures

Chapter SP

Flight Controls

Section 9

There are no Supplementary Procedures for Section 9, Flight Controls.

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FLIGHT RECORDER TEST

FLT RECORDER SWITCH GND TEST

- Observe FLT RECORDER OFF message extinguishes.

FLT RECORDER SWITCH NORM

- Verify guard is closed.

———— **END OF PROCEDURE** ————

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Supplementary Procedures

Flight Management, Navigation

Chapter SP

Section 11

FMS Initialization

Configuration Identification

IDENT page Select

Verify the following:

- Correct model (MD-88 or MD-90).
- Correct engines (JT8D-219 or V2528-D5).
- Correct Nav Data Active Date. If non current, update.

If current data base is not available: Verify all NAV DATA or do **not** use for navigation.

Position Initialization

POS INIT page Select

Using the most accurate information available, enter present position on the SET POS line. Confirm that the box prompts are replaced by the entered present position.

Set initial position using the following priorities:

- First choice – Gate position
- Second choice – Reference Gate LAT LON
- Third choice – Reference airport (using 4 letter ICAO Code)
- Fourth choice - Reference airport LAT LON

Verify GMT is correct.

FMS Preflight for Origins/Destinations not contained in FMS Database

Certain Offline Airports may not be in the FMS Database. If necessary use the following procedures when FMS database support is unavailable:

Conduct a full alignment of the IRS using the most accurate information available; gate coordinates, or Airport Reference Point.

Enter the closest online airport as the airdrome of Origin/Destination on the FMS Route page.

Create a waypoint for the actual Offline Airport using Lat/Long or an available navaid collocated on the field; load this waypoint in the appropriate sequence on the Route Legs page.

Display and use Raw data as applicable for all Departures/Arrivals/ Approaches/ Missed Approaches at airports not supported by the FMC database.

Route Initialization

RTE page Select

Note: The FMS data base contains all those victor airways within 75 nm of a Delta on-line airport, as well as those beyond 75 nm necessary to provide coverage of our route structure.

Previous routeClear

Entry or re-entry of origin clears previous route.

If EXEC light illuminates, execute. If this step is not performed, the RUNWAY prompt may not appear.

Runway and Route InformationEnter

If runway and/or SID is not known, it may be entered later.

To enter a SID

DEPARTURE page Select

Appropriate SID Select

If the SID is runway dependent, a runway must be selected before the ND will display the SID.

Note: Initial SID departures may show unconnected lines on the ND from the end of the runway to the departure route and from the departure route to the first fix. This is not a problem as long as a discontinuity is not shown on the MCDU.

To enter an airway

First waypoint of airway segment Enter

The beginning waypoint of the segment of interest must be entered before the airway entry will be accepted.

Entering an airway will provide boxes in the adjacent TO column for the entry of the airway endpoint.

Both the beginning and ending waypoints must be entered before the airway can be displayed on the HSI map.

To enter an NDB

Three letter code followed by NB Enter

To enter route termination

For routes ending with an arrival procedure then airport code:

Note: Pre-flight loading of the flight plan should stop with entry of the arrival procedure.

After ATC clearance is given:

Completion of Flight Plan in the arrival areaEnter
Allows connection of the arrival procedure to the approach.

For routes ending with a specified fix and then airport code:

Note: Preflight loading of the flight plan should stop with entry of the fix. When approach in use at destination is determined, the entry of flight plan can be completed.

DEP/ARR key Push
Calls up approaches.
Transition from the arrival fix when ATC clearance is received.

Note: When the approach transition is runway dependent, the runway must be selected before the transition can be selected.

For routes ending with an R/D STAR:

Verify that the waypoints and any associated altitude and airspeed restrictions match the charted procedure prior to selecting the EXECUTE key. Ensure FMC programming will comply with the ATC clearance.

One technique for selecting an R/D STAR is:

Arrival Select
Arrival transition Select (if required)
Approach Select
Approach transition Select (if required)
FMC LEGS page Select
Clean up any route discontinuities to the clearance limit.

Continued on next page

Continued from previous page

Verify that all FMC waypoints, altitudes and airspeeds match the charted procedure and will comply with the current clearance.

EXEC key Push

For routes ending with an airway designator and then airport code:

Terminate the airway with the charted waypoint nearest the airport.

- As determined from the airway chart
- May be the same as the airport code

Note: Entry of an excessive number of waypoints is indicated by the message, ROUTE FULL.

If the ROUTE FULL message occurs while entering a departure or arrival procedure:

Do not enter the procedure into the route, even though the DEP/ARR page shows SEL or ACT.

Verify route is correct.

Activate.

EXEC key Push

With ND in PLAN mode:

LEGS page Select

Verify each route leg is correct.

Use MAP CTR STEP prompt.

Note: A route must contain at least one waypoint, other than the departure runway before it can be executed.

(90) Select Documentary Data Page

Enter month/date.

Enter ship number, then flight number.

Performance initialization

PERF INIT page Select

(88) Enter actual fuel quantity followed by /A for alternate fuel burn or /N for normal fuel burn.

Dispatch fuel may be entered if fueling is not complete.

Flight Plan ramp weightEnter

Compare with AWABS data when received.

Fuel reserve (reserve plus alternate fuel)Enter

Include ballast/unusable fuel as part of the reserve fuel.

(88) Flight Plan Cost IndexEnter

- Speed is controlled in VNAV by the Cost Index
- A zero Cost Index yields minimum fuel burn
- Fly FMS ECON speed rather than the flight plan speed
- Advise ATC if cruise TAS is different from filed, or anytime TAS changes by 5% or 10 knots (whichever is greater)

Cruise altitudeEnter

Forecast cruise windsEnter

Cruise waypoint winds:

LEGS page Select

ROUTE DATA page Select

Cruise windsEnter

ISA deviation for top of climb temperatureEnter

TAKEOFF page Select

(90) Cutback EPR/Altitude (AFE), if requiredEnter

Press 6R to confirm and verify ACB in FMA ARM window.

Preflight complete Verify

If SID is not used, PRE-FLT STATUS and DEPARTURE prompt may be displayed.

Note: TAT and T/O EPR (Norm or FLX) will be displayed.

FMS Lateral Navigation

Proceeding Direct to a Waypoint

DIR INTC page (for active route) Select

Enter desired waypoint in the DIRECT TO boxes.

Observe ND for modified route.

EXEC key Push

NAV ARM

Intercepting a Leg to a Waypoint

DIR INTC page (for active route) Select

Enter first waypoint to be passed after intercepting leg in the INTC
LEG boxes.

Waypoint will display on upper left line.

If required, enter leg's inbound course in INTC CRS boxes.

Observe ND for modified route.

EXEC key Push

To establish an appropriate intercept track:

Use the HDG SEL mode and MAP display.

NAV ARM

Note: If the airplane heading will not intercept the selected leg, a NOT
ON INTERCEPT HEADING message will appear on the
scratch pad line.



Intercepting an Airway

Note: Use HDG HLD to deselect NAV if armed, then use HDG SEL to establish an intercept track.

DIR INTC page (for active route) Select

Enter into DIRECT TO boxes the VOR or waypoint that identifies airway behind where the aircraft will intercept airway.

EXEC key Push

RTE page Select

Enter airway number in dashes on left side of route page.

Enter airway end point specified in ATC Clearance in boxes on right side or route page.

EXEC key Push

DIR INTC page Select

Enter next waypoint downstream of intercept point into INTC LEG TO boxes.

Observe NAV display to ensure dashed magenta and white lines overlay each other.

EXEC key Push

NAV ARM

Note: Resolve any route discontinuities and delete all waypoints not in ATC clearance.

Route Discontinuity/Modification

LEGS or RTE page Select

Line select waypoints in the desired sequence.

Observe ND for modified route.

- The autopilot NAV mode will track the waypoint sequence shown on the active LEGS page.
- Therefore, after any route modification, always return to the LEGS pages to link discontinuity and to ensure the waypoint sequence is consistent with the clearance.
- Until this action is complete, the original and modified track will appear on the MAP display.

EXEC key Push

Deleting Waypoint

LEGS page Select

Note: The delete function cannot be used to erase the active waypoint or active holding pattern.

Remove waypoint(s) using delete key.

Link any discontinuity that exists.

EXEC key Push

Entering a Crossing Radial from a Fix as a Waypoint

FIX page Select

Enter desired fix identifier.

Enter desired radial from fix on the DNTKFX (Downtrack Fix) line or an ABM (Abeam) line if desired radial is perpendicular to course.

Line select DNTKFX or ABM line to scratch pad.

LEGS page Select

Select DIR INTC page if fix is prior to active waypoint.

Line select FIX/RADIAL/DISTANCE to desired waypoint sequence.

Observe ND for modified route.

EXEC key Push

Entering An Along Track Speed/Altitude Crossing Waypoint

LEGS page Select

Line select reference waypoint to scratch pad.

Enter slash mark (/) then a minus sign (-) if before the reference waypoint, followed by distance.

Line select scratch pad entry to reference waypoint.

Enter desired speed/altitude for crossing waypoint.

To Enter a Waypoint Not in the Database

LEGS, DIR INTC or RTE page Select

Construct the point by:

- Specified waypoint - radial - DME
- Specified VOR radial/VOR radial crossing
- Latitude and longitude

Line select waypoint in the desired sequence.

Observe ND for proper sequence.

EXEC key Push

Contingency Routing

Note: Used when an alternate route may be needed/required but not definite.

RTE page Select

Line select Route 2 page.

Enter desired route information.

Observe ND RTE 2 information is correct.

Active when desired.

Observe DIRECT TO and INTC LEG TO prompts appear.

Use appropriate prompt to link present position with new route.

EXEC key Push

Destination Change

RTE page Select

Enter new destination on DEST line.

Modify route as necessary using RTE or LEGS page.

EXEC key Push

Offset

RTE page Select

Enter desired offset direction (L or R) then distance (up to 20 NM) over prompt dashes (6R).

EXEC key Push

- FMS computes 45° intercept from original to offset path if outside 2 1/2 nm, 10° intercept within 2 1/2 nm.
- Offset automatically terminates at last waypoint, approach procedure, route discontinuity, or use of DIRECT INTERCEPT page, and FMA goes to HDG HOLD.

Navaid Inhibit

NAV DATA page Select

Enter NAVAID identifier below INHIBIT prompt.

- Two navaids can be entered.
- Overwriting or use of DELETE key clears previous entry.

System Status:

- A navaid remains inhibited until deleted or a new nav database is loaded.
- Manual tuning is not inhibited.

Holding

Note: When flying an offset, holding is in relation to the offset.

HOLD page Select

Observe HOLD AT and PPOS (Present Position) or NEXT HOLD prompt displayed.

If NEXT HOLD prompt displayed:

Line select NEXT HOLD (6L).

Observe HOLD AT and PPOS displayed.

Desired holding fixEnter

If holding at present position:

Line select PPOS (6R) to scratch pad, then to prompt boxes (6L).

Note: The INBD CRS/DIR for a Present Position hold cannot be changed.

If holding at waypoint:

Enter waypoint in scratch pad.

Line select to prompt boxes (6L).

Observe modified route correctly displayed on ND.

If holding details displayed are incorrect or inadequate:

Enter correct information on appropriate line.

Continued on next page

Continued from previous page

EXEC key Push

Note: Prior to entering the holding pattern, the HOLD may be deleted on the LEGS page.

To assure remaining within protected airspace:

Plan holding speed to be no more than the maximum holding speed (airplane configuration permitting).

Advise air traffic control if unable to comply with FAA/ICAO maximum holding speeds.

Reduce to holding airspeed prior to initial arrival at the holding fix.

If the winds are less than 50 knots when at or below 14,000 feet or less than 75 knots when above 14,000 feet:

LNAV may be used to track the holding pattern.

If the winds are greater when arriving at the holding fix:

Accomplish a minimum turn radius holding pattern.

Disengage LNAV.

Use heading select mode with maximum bank angle selected.

To assure remaining within protected airspace:

Plan holding speed to be no more than the maximum holding speed (airplane configuration permitting).

Advise air traffic control if unable to comply with FAA/ICAO maximum holding speeds.

Reduce to holding airspeed prior to initial arrival at the holding fix.

To Exit HOLD:

HOLD page Select

Line select EXIT HOLD.

Observe EXIT HOLD prompt changes to EXIT ARMED.

EXEC key PUSH

Note: When flying an offset path holding pattern, cancelling the offset deletes the holding pattern.

Navigation Accuracy Check

While still within VOR reception range, the FMS position and aircraft position are compared. The check is performed as follows:

Manually tune a VOR that is between 30-130 nm from the known aircraft position.

Select ARC mode on EFIS Control Panel.

Enter the VOR on an FMS FIX page.

Center the VOR deviation indicator on the Navigation Display.

Compare VOR radial and RDMI distance with the FIX page bearing and distance.

The acceptable tolerances are ± 4 degrees and ± 4 nm respectively.

FMS Vertical Navigation

Temporary Speed Restriction

If in VNAV:

FMS OVRD Push

To set desired speed in speed select readout:

Use SPD/MACH button.

To deselect:

FMS OVRD Push

FMS target speed will again be displayed.

Note: Using FMS OVRD will not update the descent profile. An entry on the DES page on the MCDU is required.

If speed change becomes permanent:

Make change on appropriate pages (CRZ, DES, CLB, etc.).

Re-select VNAV on FGCP.

Temporary Altitude Restriction

Set level off altitude on FGCP.

In VNAV:

Observe VNAV CAP, then VNAV LVL when altitude is reached.

When Resumption of Climb or Descent Desired

Set new altitude on FGCP.

VNAV Engage

Speed/Altitude Constraint at Waypoint

LEGS page Select

Enter speed/altitude.

If constraint is to cross the waypoint at a specific altitude:

Enter the altitude only.

If constraint is to cross at or above altitude:

Enter A after altitude.

If constraint is to cross at or below altitude:

Enter B after altitude.

If constraint is to cross between two altitudes:

Enter lower altitude followed by A.

Then enter upper altitude followed by B.

Note: Speed entry must be followed by a slash (/) mark and altitude.

EXEC key Push

To Delete Constraint

Use DEL key and line select to desired line.

Observe FMC computed values appear.

EXEC key Push

Speed/Altitude Transition and Restriction

CLB/DES page Select

Enter speed/altitude.

EXEC key Push

To Delete Transition or Restriction

Use DEL key and line select to desired line.

EXEC key Push

Climb/Cruise/Descent Speed Change

CLB/CRZ/DES page Select

Select desired schedule or enter desired speed on ECON SPD line (2L).

EXEC key Push

Climb or Descent Direct

To delete all altitude constraints at waypoints between current altitude and FGCP altitude:

CLB/DES page Select

CLB/DES DIR Select

CLB DIR or DES DIR prompt will only be displayed when climb/descent is active and an altitude constraint exists at a waypoint between current altitude and either cruise or end of descent altitude.

EXEC key Push

Cruise Altitude Change

Set new altitude on altitude select panel.

CRZ page Select

Enter new cruise altitude on CRZ ALT line.

EXEC key Push

VNAV (if not already) Engage

Note: Use of Cruise altitude change procedure will delete altitude constraint at waypoint if cruise altitude entered is equal to or below existing constraint altitude.

Descent

Prior to top of descent:

ARRIVALS page Select

Appropriate STAR, transition, & approach or runway Select

DESCENT page Select

Continued on next page

Continued from previous page

Fly ECON SPD unless directed by ATC.

Forecast Select

If required:

Enter expected icing altitude under TAI/ON prompt.

If only the destination has been entered, and no defined altitude/speed restriction below cruise altitude is entered:

System Status:

- No T/D calculation is displayed.
- A blank descent page will appear.

If only a runway is entered to define the end of descent (E/D) point:

System Status:

- A descent page is created to an E/D of 2,000 feet AGL with a target speed of 170 knots 8 nm from the runway.

When cleared to descend:

Set altitude on altitude select panel.

VNAV descent should occur at FMS computed T/D point.

System Status:

- DES NOW prompt will only be displayed prior to reaching programmed T/D.

If earlier than FMS computed T/D is desired:

Select DES NOW prompt.

EXEC key Select

Verify VNAV is engaged on flight mode annunciator.

System Status:

- Throttles will retard to idle.
- Descent will begin at 1,000-1,500 feet per minute until intercepting the ECON descent profile.

FMS Progress Functions

Flight Progress Data Check

PROG page Select

Check distance to go (DTG) and estimated time of arrival (ETA) for next two waypoints and destination.

Determining Distance to Cross Radial from a Fix:

FIX page Select

Enter desired fix identifier on FIX line.

Enter desired radial from fix on DNTKFX or select ABM line if desired radial from fix is perpendicular to course.

Observe distance to go.

DTG and ETA to Downpath Waypoint or Alternate

PROG page 1 Select

Enter downpath waypoint or alternate airport waypoint by overwriting the displayed destination waypoint (4L).

System Status:

DTG and ETA to waypoint (identified as ENROUTE WPT) will be displayed.

– Leaving and returning to page returns original destination.

FMS Performance Data Entry

Step Climb Evaluation

- CRZ page Select
- Step to altitudeEnter
- Wind direction/speedEnter
- Savings Check

Descent Forecasts

- DES page Select
- FORECAST page Select
- Transition level Check
- TAI on altitude (if required)Enter
- Wind altitudeEnter
- Wind direction/speedEnter

IRS Operation

True/Magnetic Heading Selection

The TRUE/MAG push-button on each pilot's instrument panel has been deactivated to the MAG operation only for all Delta Operations.

Ground Alignment

An operative MCDU is required for alignment.

Aircraft must remain stationary during ground alignment.

- Failure to do so will result in a flashing ALIGN light and an illuminated FAULT light.

Initial Alignment (Full Alignment)

IRS ALIGN lights must be extinguished prior to moving aircraft.

Primary Method

IRS mode selectorsNAV

Observe ON BAT annunciators illuminate during selftest, extinguish, then the ALIGN annunciators illuminate.

FMS POS/INIT page Select

Enter present position.

Enter present position in scratchpad by line selecting gate position or entering the most accurate LAT/LON information available using the following format: N3310.0W08130.6.

Note: At least one IRU ALIGN light must be on for the IRS to accept new present position.

Note: Disagreement of IRU stored position and the manually-entered position will generate a RE-ENTER IRS POSITION scratchpad message. Two consecutive identical latitude entries which disagree with IRS computed latitude will generate steady ALIGN and FAULT annunciators.

To reset:

Cycle the IRS selector switch to OFF until ALIGN light extinguishes, then to NAV.

Continued on next page

Continued from previous page

After present position has been accepted and IRUs have completed alignment:

Observe ALIGN mode annunciators extinguish.

- Normal PFD attitude will be restored.
- Full alignment requires from 2.5 to 10 minutes.

Alternate Method (may be used when FMS is inoperative)

IRS mode selectors NAV

MCDU MENU key Push

IRS INIT/REF (5L) Select

Displays IRS INIT/REF page.

Enter present position in scratch pad.

Line select present position to DATA FIELD (5R).

Note: Disagreement of IRU stored position and the manually entered position will generate a RE-ENTER IRS POSITION scratchpad message. Two consecutive identical latitude entries which disagree with IRS computed latitude will generate steady ALIGN and FAULT annunciators. To reset cycle the IRS selector switch to OFF until ALIGN light extinguishes, then to NAV.

After present position has been accepted and IRUs have completed alignment:

Observe ALIGN mode annunciators extinguish.

- Normal PFD attitude will be restored.
- Full alignment requires from 2.5 to 10 minutes.

Realign at Intermediate Stops (Quick or Down Mode Alignment)

IRS ALIGN lights must be extinguished prior to moving aircraft.

IRS mode selectors ALN

Rotate IRS mode selectors to ALIGN from NAV, and observe ALIGN lights illuminated.

POSITION INIT pageSet

Line select gate position to scratchpad and then into data box 4R SET IRS POSITION.

If not at the gate or gate data not available, obtain lat-long from Jeppesen airport diagram.

IRS mode selectorNAV

Observe ALIGN lights extinguish within 30 seconds.

Note: (90) If downmode alignment causes a nuisance anti-skid fault, message may be reset by turning the ANTI-SKID switch OFF then back to ARM.

Shutdown

IRS mode selectors OFF

IRU switches should be placed to OFF for securing the aircraft or if power is to be removed from aircraft.

- Failure to do so will cause internal IRS batteries to discharge.
- Mechanics' call horn in nose wheel well will sound if power is removed from aircraft with IRS mode select switches in other than the OFF position.

Intentionally
Blank

Supplementary Procedures

Chapter SP

Fuel

Section 12

**FUEL MANAGEMENT SCHEDULE
(ALL REGIMES OF FLIGHT)**

NOTE: *Alternate fuel burn schedule is not required on:*

- MD-88's with operable overwing heater blankets.
- MD-90's with operable return-to-tank system.

FUEL X FEED LEVEROFF

MAIN TANK BOOST PUMPS ON

CENTER TANK BOOST PUMPSAS REQD

- If center tank contains fuel, normally position both CTR PUMP switches to **ON** for engine start, taxi, and takeoff.
- Select **AUTO** after takeoff if alternate fuel burn is to be used, or select **ON** for MD-88's with operable overwing heaters and MD-90's with operable return-to-tank system.
- Do not use the **AUTO** position for any inoperative boost pump or any abnormal quantity indications.

► **When CENTER FUEL PRESS LO message illuminates:**

CENTER TANK BOOST PUMPOFF

► **After engine shutdown:**

MAIN TANK BOOST PUMP (ALL)OFF

- Continue appropriate pump operation if APU is running.

———— **END OF PROCEDURE** ————

ALTERNATE FUEL BURN SCHEDULE

BURN CENTER TANK FUEL QTY DOWN TO APPROX:

- (88) 10,000 pounds
- (90) 3,000 pounds

BURN WING TANK FUEL QTY DOWN TO APPROX 4,000 LBS.

BURN CENTER TANK FUEL TO EMPTY.

CONTINUE WITH FUEL FROM MAIN TANKS.

———— END OF PROCEDURE ————

CROSSFEED IN FLIGHT

NOTE: Use this procedure to correct main tank fuel imbalance. If imbalance is accompanied by an INLET FUEL PRES LO annunciation, refer to appropriate procedure.

SUPPLYING TANK PUMP SWITCHES ON
FUEL X FEED LEVER ON
TANK BOOST PUMPS
(TANK NOT SUPPLYING) (ONE AT A TIME). OFF
CENTER TANK BOOST PUMPS OFF

CAUTION

Monitor fuel quantity in order to remain within lateral fuel imbalance limits and to avoid fuel depletion which could result in two engine flameout.

► **When tanks are at desired level:**

MAIN TANK BOOST PUMPS (ALL) ON
CENTER TANK BOOST PUMPS. AS REQD
FUEL X FEED LEVER AS REQD

► **If unable to correct imbalance condition by crossfeed operation:**

ACCOMPLISH FUEL LEAK PROCEDURE.
--

——— END OF PROCEDURE ———

GROUND FUEL TRANSFER

CHECK GROUND CREW INTERPHONE.

SUPPLYING TANK BOOST PUMP SWITCHES ON

ALL OTHER TANK BOOST PUMP SWITCHES OFF

VERIFY THAT GROUND CREW HAS OPENED DEFUELING
VALVE.

VERIFY THAT GROUND CREW HAS OPENED FILL VALVE (TANK
TO BE FILLED).

► *If supplying tank is left main:*

FUEL X FEED LEVER ON

MONITOR QUANTITY GAUGES.

► *When tank quantities are as desired:*

TANK BOOST PUMP SWITCHES OFF

FUEL X FEED LEVER OFF

VERIFY THAT GROUND CREW HAS CLOSED DEFUELING
VALVE AND FILL VALVE.

——— END OF PROCEDURE ———

Supplementary Procedures

Chapter SP

Hydraulics

Section 13

HYDRAULIC SYSTEM CHECK

NOTE: This check need only be accomplished prior to the first flight each day (after midnight) for the aircraft.

The hydraulic pumps may be turned on with clearance from ground personnel, or without clearance, when the following three conditions are satisfied.

- **GEAR DOOR OPEN** light extinguished.
- Slat **DISAGREE** light extinguished.
- Flap position indicator agrees with flap handle position.

ENGINE HYDRAULIC PUMPS ON

AUXILIARY HYDRAULIC PUMP OVRD / ON

- Place AUX HYD PUMP switch to **OVRD** and observe right system pressure rise.
- Move AUX HYD PUMP switch to **ON** and observe right system pressure approximately 3000 psi (±200) and R HYD PRESS LOW message extinguished.
- **GEAR DOOR OPEN** light - extinguished.

TRANSFER PUMP ON

- Observe left system pressure rise above 2,000 psi and L HYD PRESS LOW message extinguished.

CAUTION

Illumination of HYD PRESS LOW message with normal pressure may indicate spoiler on/off/ system bypass valve in the OFF position or system malfunction. It must be investigated prior to dispatch.

CHECK BRAKE PRESSURE.

(Continued on next page)

HYDRAULIC SYSTEM CHECK

(Continued)

HYDRAULIC QUANTITIES NORMAL

- Check low quantity warning lights extinguished.
- On the ground, a single hydraulic system may not fully retract the flaps.
- Quantity minimums are:
 - Left.
 - (88) 8 quarts.
 - (90) 9 quarts.
 - Right.
 - (88) 9 quarts.
 - (90) 10 quarts.

AUXILIARY/TRANSFER PUMPS OFF

———— END OF PROCEDURE ————

Supplementary Procedures

Landing Gear

Chapter SP

Section 14

LANDING GEAR LIGHTS / HORN CHECK

PULL LANDING GEAR HANDLE OUT, DOWN, AND HOLD

- Landing gear green lights should extinguish.
- Landing gear red lights should illuminate.
- Aural warning should sound.
- Depress gear horn OFF button to silence warning horn.
- Advance and retard both throttles to reset aural warning.

RELEASE LANDING GEAR HANDLE.

- Landing gear green lights should illuminate.
- Landing gear red lights should extinguish.

NOSE GEAR DOWNLOCK INDICATOR PIN

- On the ground, must be extended approximately 1/4 inch with hydraulic pressure normal. May be less than 1/4 inch with right hydraulic pressure off due to weight of aircraft on gear.

———— **END OF PROCEDURE** ————

OPERATING OVER A RAISED ARRESTING CABLE

On approach, fly vertical path to minimums. Performance permitting, attempt to avoid landing prior to or on an arresting cable.

On departure, begin takeoff roll just past the cable (if installed). At the pilot's discretion, complete a back taxi, or taxi to the approach end on the parallel taxiway, onto the runway, then slowly past the cable to takeoff position.

NOTE: *Operate over a raised cable only at a slow taxi speed. Avoid "donuts" used to elevate the cable.*

If during landing, takeoff, or taxi the aircraft comes in contact with the cable, regardless of speed, the nose gear spray deflector must be inspected at the next aircraft block-in as follows:

- The aft center deflector should be checked for visible damage.
- The flexible deflector side plate should be checked for attachment/separation from deflector.
- A logbook entry is required if damage is found. Notify maintenance if a logbook entry is made.

———— **END OF PROCEDURE** ————

Supplementary Procedures
Warning Systems

Chapter SP
Section 15

GPWS TEST

System test required for first flight of the day.

GND PROX WARN SWITCH TEST

- Hold in TEST position momentarily and release.

Note: PFD WX display knob must be out of OFF for Terrain test pattern to appear.

- Observe the following:
 - **GPWS** and **BELOW G/S** lights illuminate.
 - GPWS FAIL message on OAP.
 - Aural warning.
- Aircraft with enhanced GPWS installed will also test:
 - **GPWS** and **BELOW G/S** lights illuminate.
 - “GLIDESLOPE” aural warning.
 - “WHOO-PP-OOO PULL-UP” and “TERRAIN, TERRAIN PULL-UP” aural warnings.
 - **TERR** lights illuminate.
 - Terrain test pattern on both NDs and blue TERR message appear.
 - **FAIL** light illuminates on center instrument panel.

GND PROX WARN SWITCH NORM

——— END OF PROCEDURE ———

MAX SPEED WARNING TEST

System test required for first flight of the day.

MAX SPD WARN TEST SWITCH.SYS 1

- Observe clacker and vocal “OVERSPEED” warning.

MAX SPD WARN TEST SWITCH.SYS 2

- Observe clacker and vocal “OVERSPEED” warning.

MAX SPD WARN TEST SWITCH.OFF

——— END OF PROCEDURE ———

RADAR/PWS SYSTEM TEST

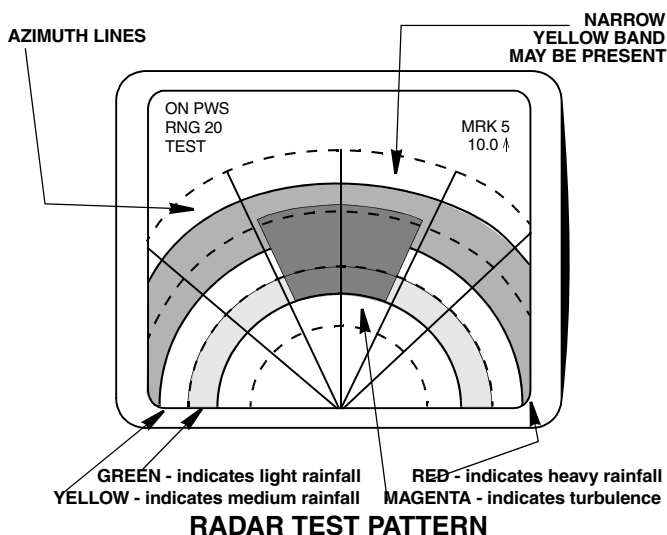
SET RANGE SELECTOR IN ANY POSITION EXCEPT 5 NM.

GAIN CONTROL AUTO

MODE SELECTOR TEST

- Observe the following during an approximate 8 second test:
 - Proper test pattern (Only item that will be applicable to test if PWS is not installed).
 - Amber NO PWS message is displayed in upper left corner of radar display.
 - Amber **PWS INOP** light is illuminated on the center instrument panel.
 - Amber **W/S AHEAD** light is illuminated and vocal “MONITOR RADAR DISPLAY” is heard.
 - Red **W/S AHEAD** light is illuminated and vocal “GO AROUND WINDSHEAR AHEAD, WINDSHEAR AHEAD” is heard.
- Verify **PWS INOP**, amber **W/S AHEAD** and red **W/S AHEAD** lights are no longer illuminated.
- Verify that the NO PWS message is no longer displayed in the upper left corner of radar display.

MODE SELECTOR TCAS



— END OF PROCEDURE —

RADAR OPERATION

NOTE: *The recommended tilt and range settings are guidelines for good radar operation. The flight crew is not limited to these settings. Operational needs often dictate flexibility in tilt and range selections.*

BEFORE TAKEOFF

➤ ***To confirm radar operation with a confidence check:***

SET TILT 15° UP, SELECT WX/TCAS, AND SHORT RANGE.

SLOWLY LOWER TILT UNTIL WEATHER OR GROUND RETURNS ARE DISPLAYED.

➤ ***If no returns can be detected:***
SUSPECT AN INOPERATIVE RADAR.

WARNING

Do not operate the radar in WX/TCAS, TURB, or MAP modes if within 100 feet of people, large reflective objects, or combustible liquids.

➤ ***To evaluate terminal area weather before takeoff:***

SET TILT AT 15° UP, RANGE AT 40 NM OR LESS.

- The radar height of weather targets displayed is **at least** (tilt X range X 100).
- Weather targets displayed at:
 - 10 nm are **at least** 15,000 feet
 - 15 nm 22,500 feet
 - 20 nm 30,000 feet

➤ ***While evaluating weather returns in the area:***
SLOWLY LOWER TILT FROM 15° UP TO 4° UP.

TAKEOFF

TILT IS INITIALLY SET AT 4° UP

RANGE AT SHORTEST APPROPRIATE FOR TERMINAL AREA CONDITIONS.

(Continued on next page)

RADAR OPERATION

(Continued)

➤ ***During initial climb (below 10,000 feet AGL):***

GRADUALLY LOWER TILT TO 1° - 2° UP.

➤ ***While displaying weather returns:***

MAINTAIN THE RADAR DISPLAY CLEAR OF GROUND RETURNS.

CAUTION

Failing to lower tilt from initial takeoff setting will cause overscanning of weather areas enroute.

CLIMB

➤ ***As climb continues above 10,000 feet AGL:***

LOWER TILT AS NECESSARY TO MAINTAIN GROUND RETURNS AT THE OUTER EDGE OF THE DISPLAY.

NOTE: A range selection of 80 nm or less is optimal during climb, unless a longer range setting is needed for deviation planning.

CRUISE

➤ ***To establish enroute park:***

SET RANGE AT 80 NM OR LESS.

ADJUST TILT TO PRODUCE GROUND RETURNS AT THE OUTER EDGE OF RADAR DISPLAY.

- This tilt setting guards against overscanning nearby weather areas and provides continuous confirmation that the radar is working. Weather targets will separate from ground returns and move towards the bottom of the display.

(Continued on next page)

RADAR OPERATION (Continued)

RANGE SETTINGS ABOVE 100 NM SHOULD BE SELECTED OCCASIONALLY FOR LONG RANGE PLANNING.

- Set tilt to produce a scattering of ground returns beyond 100 nm.

NOTE: *Nearby weather areas may not be detected due to overscanning. When returning to a shorter range, lower tilt to enroute park position.*

- Storms detected at long range will increase in displayed intensity as they are approached. Plan early deviations accordingly.

➤ **At cruise altitudes above 30,000 feet:**

USE SUFFICIENT DOWN TILT TO DIRECT THE BEAM INTO UNFROZEN AREAS OF NEARBY STORMS.

➤ **Confidence check:**

➤ **To check enroute radar performance:**

ADJUST TILT TO DISPLAY FARTHEST POSSIBLE GROUND RETURNS.

➤ **In WX and with GAIN control in AUTO:**

A PROPERLY FUNCTIONING RADAR SHOULD DETECT GROUND RETURNS TO THE FOLLOWING DISTANCES:

- 10,000 feet AGL 100 nm
- 20,000 feet AGL 140 nm
- 30,000 feet AGL 175 nm
- 40,000 feet AGL 200 nm

(Continued on next page)

RADAR OPERATION

(Continued)

DESCENT

➤ ***On descent from cruise altitude:***

RAISE TILT AS NECESSARY TO MAINTAIN GROUND RETURNS AT THE OUTER EDGE OF THE DISPLAY.

➤ ***Low altitude park:***

GENERALLY USED AT ALTITUDES BELOW 10,000 FEET AGL.

➤ ***To observe weather:***

SET TILT 1 1/2° TO 2° UP, RANGE AT SHORTEST APPROPRIATE DISTANCE.

NOTE: *If ground returns flood display, raise tilt until ground returns are removed, and weather can be displayed.*

(Continued on next page)

RADAR OPERATION (Continued)

APPROACH

➤ *Approach park:*

➤ *On final approach:*

SET TILT AT 10° UP, RANGE AT 20 NM.

- At 10° up tilt, the radar height of weather returns displayed will be above aircraft altitude by **at least** (tilt X distance X 100).
- Weather areas will be developed above aircraft altitude by **at least**:
 - 10,000 feet if displayed at 10 nm
 - 15,000 feet 15 nm
 - 20,000 feet 20 nm

STRONG RETURNS AT MID TO UPPER LEVELS INDICATES HAZARDOUS CONVECTIVE ACTIVITY.

➤➤ *In a thunderstorm environment:*

**OCCASIONALLY LOWER TILT TO PRODUCE
GROUND RETURNS AND DETECT RADAR
SHADOWS, THEN RETURN TILT TO APPROACH
PARK.**

(Continued on next page)

RADAR OPERATION

(Continued)

RADAR GUIDELINES

► Tilt formula:

NOTE: *Using ground returns as a reference provides quick and effective tilt management.*

► When more precise tilt management is desired:

THE TILT FORMULA CAN BE USED:

- $\text{Tilt} \times \text{distance} \times 100 = \text{feet (above or below) aircraft altitude.}$
- Example: With 5° down tilt, the radar beam would be centered approximately 20,000 feet below aircraft altitude 40 nm ahead.
 $-5 \times 40 \times 100 = 20,000 \text{ feet (below aircraft altitude).}$

(Continued on next page)

RADAR OPERATION (Continued)

➤ *Tilt accuracy check:*

OPTIMAL CONDITIONS FOR THIS CHECK ARE:

- Straight and level flight.
- Altitude 10,000 feet AGL or higher.
- Level terrain.
- No intervening weather.

➤ *To check the accuracy of tilt control:*

ADJUST TILT UNTIL THE YELLOW GROUND RETURN ARC STARTS AT A DISTANCE EQUAL TO (2 X AGL ALTITUDE/1000).

- Example: if at 34,000 feet AGL, yellow ground returns start at 68 nm on the display (2 X 34).

CHECK TILT SETTING.

- Tilt should be at **3 1/2° down** ± 1 1/2° (acceptable limits 2° - 5° down).

➤➤ *If tilt is not within 2° - 5° down:*

NOTE DIFFERENCE BETWEEN TILT SETTING AND 3 1/2° DOWN.

- This is the amount of tilt error present and should be applied to all tilt settings.

(Continued on next page)

RADAR OPERATION

(Continued)

GAIN CONTROL

➤ ***For proper calibration of the receiver:***

GAIN CONTROL MUST BE IN AUTO.

- Manual GAIN can be used to evaluate the relative strength of surrounding weather areas.

➤ ***While slowly reducing the GAIN:***

OBSERVE WEATHER TARGET

- The GAIN knob will provide variable GAIN control for weather returns when out of the **AUTO** position.
- A blue **CAL** appears in the upper right area of the indicator whenever variable GAIN control is active.
- Rotating the GAIN knob counter clockwise decreases gain from **MAX** to **MIN**.
- The level of selected gain is indicated by a blue readout **MAX**, 9 . . . 1 or **MIN** below **CAL**.
- Weaker targets will shrink and disappear while stronger targets persist. At minimum GAIN any weather targets still displayed contain extremely heavy rain.

➤ ***If display becomes filled with red returns:***

**CHECK TILT, RAISE IF NECESSARY TO REMOVE
GROUND RETURNS FROM THE DISPLAY.**

- Weather area being scanned may be Level 3 in strength.

**REDUCE GAIN LEVEL UNTIL ONLY HEAVIER AREAS
DISPLAY AS RED, TO DIFFERENTIATE RAIN INTENSITY
WITHIN THE WEATHER AREA.**

WARNING

At reduced levels of GAIN, some weather targets will disappear from the indicator. Targets which are displayed will understate the true strength of the weather. Return GAIN to AUTO, immediately after using manual GAIN.

(Continued on next page)

RADAR OPERATION (Continued)

ATTENUATION

NOTE: *Expect attenuation any time weather targets reach Level 3 when the radome is wet or ice covered, or when operating within precipitation.*

- ***To locate intense rain areas that may be totally attenuated:***

WATCH FOR CRESCENT SHAPED RETURNS, CONCAVE ON THE BACK SIDE.

NOTE AN ABSENCE OF RETURNS OR SHADOW BEYOND THE TARGET.

USE GROUND RETURNS TO CONFIRM RADAR PENETRATION, AND LOCATE RADAR SHADOWS.

- ***When flying through areas of moderate to heavy rain:***

SYSTEM STATUS:

- Radar range may become limited by attenuation.

SET TILT TO ATTEMPT TO PRODUCE GROUND RETURNS BEYOND THE WEATHER RETURNS.

- ***If attenuation is confirmed:***

MONITOR THE OUTER EDGE OF THE WEATHER RETURNS.

TURN AWAY FROM SHADOWS THAT DIP TOWARDS THE BOTTOM OF THE DISPLAY.

FLY TOWARDS THE AREA OF FARTHEST RETURNS (THIS IS THE AREA OF LIGHTEST PRECIPITATION).

(CONTINUED ON NEXT PAGE)

RADAR OPERATION

(Continued)

**ADVISE ATC THAT YOUR RADAR RANGE IS LIMITED
AND REQUEST VECTORS AWAY FROM KNOWN
THUNDERSTORM AREAS.**

WARNING

Radar shadows are areas of unknown weather intensity. Never penetrate a storm that produces a radar shadow.

TURBULENCE AVOIDANCE

► ***When using radar to avoid turbulence enroute:***

DEVIATE UPWIND OF STORMS WHEN POSSIBLE.

**EXPECT TURBULENCE TO BE PRESENT IN ANY
CONVECTIVE ACTIVITY REGARDLESS OF INTENSITY
LEVEL DISPLAYED ON RADAR.**

► ***When convective storms reach Level 3 (red):***

**EXPECT MODERATE TO SEVERE TURBULENCE IN ALL
AREAS OF THE STORM, INCLUDING THE LEVEL 1 AND 2
AREAS.**

***NOTE: TURB mode can be used to detect areas of horizontal
rain movement within 40 nm.***

**SET TILT TO ENSURE BEAM IS SWEEPING AT FLIGHT
ALTITUDE.**

WARNING

***An absence of indicated turbulence in TURB mode does not
mean it is safe to penetrate a weather area that by other
indications is hazardous.***

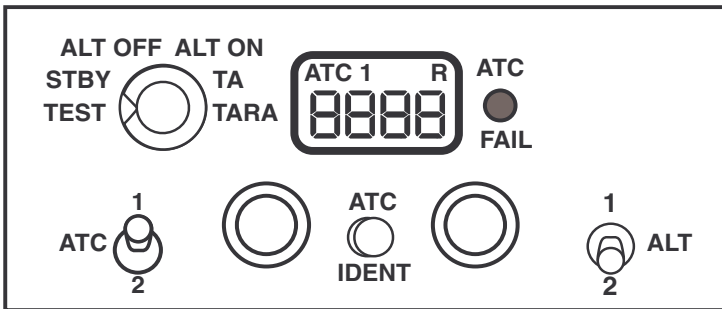
TCAS / TRANSPONDER SYSTEM TEST

CAUTION

Do not test in flight. This will cause a momentary loss of transponder and TCAS systems.

TCAS / TRANSPONDER FUNCTION SELECTOR TEST

- The TCAS/TRANSPONDER FUNCTION selector is used to test TCAS and the aircraft transponders.
- Moving the spring-loaded knob momentarily to the **TEST** position initiates a transponder self test and a TCAS processor self test.



TRANSPONDER TEST INDICATIONS

- Transponder - The code display window of the transponder control panel will display all eights (8888).
- The ATC fail light will be illuminated during the test. This display will be indicated for approximately three seconds.
- If a transponder problem exists, the ATC fail light on the transponder control panel will remain illuminated.

(Continued on next page)

TCAS / TRANSPONDER SYSTEM TEST (Continued)

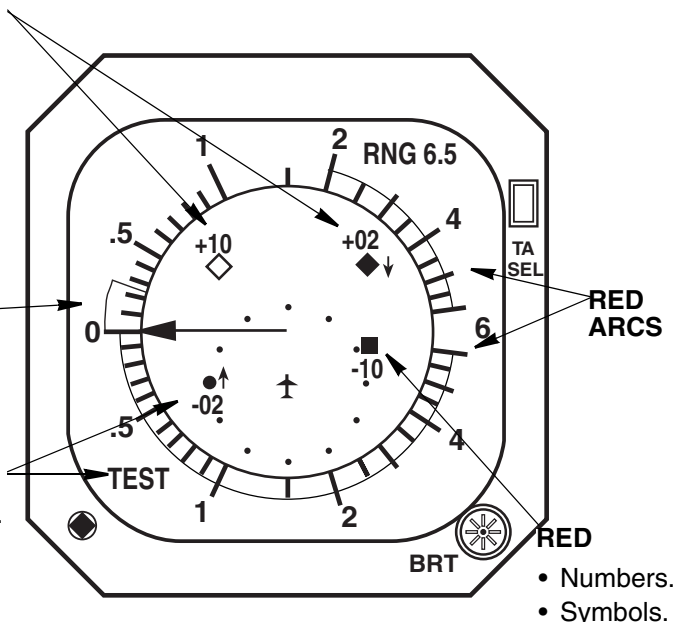
WHITE

- Number.
- Symbols.

GREEN ARC

YELLOW

- Numbers.
- Symbols.
- TEST.



TA/VS1-TCAS TEST INDICATIONS

- TA/VS1 - Each of the TCAS traffic symbols, along with portions of the green and red arcs will be displayed on the TA/VS1.
- This display will be indicated for approximately 12 seconds.
- After the self test is completed a voice message indicates system status as appropriate.
 - “TCAS SYSTEM TEST OK”.
 - “TCAS SYSTEM TEST FAIL”.

————— **END OF PROCEDURE** —————

WINDSHEAR TEST

System test required for first flight of the day.

WINDSHEAR TEST SWITCH TEST

- Hold test switch in position momentarily and release.
- Observe the following during an approximate 8 second test.
 - Amber **WINDSHR** light on glareshield illuminates 3 times followed by red **WINDSHR** light which illuminates 3 times.
 - WINDSHEAR INOP OAP message is annunciated for 2 seconds then extinguishes.
 - Aural warning should sound.
 - FD pitch bars center then indicate pitch up followed by pitch down then are biased from view.
 - Fast/slow indicator is centered, then indicates one bar up followed by one bar down, then is biased from view. Sometimes the F/S is biased from view.
 - PLI is centered, then indicates 10° pitch up followed by 10° pitch down, then is biased from view.
 - STALL IND FAILURE and GPWS FAIL OAP messages illuminate for 6 seconds then extinguish.
 - FMA displays WIND SHR, AUT W/S, HDG HLD, WIND SHR.

NOTE: Windshear test may fail if the flaps and slats have drooped sufficiently. In this case, fully retract the flaps and slats, then repeat the test.

———— **END OF PROCEDURE** ————

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
10 DEG RUD RESTRICT*	Caution	The rudder stop limiter is deployed at an airspeed below the normal retracted speed.	27 -	Flight Controls
AC EMER BUS OFF	Master Warning	AC emergency bus de-energized.	None	Electrical
ACCESS COMPT DOOR	Caution	Access compartment door not closed and latched.	33 -	N/A
AC CROSSTIE LOCKOUT	Caution	AC crosstie is locked open; automatic crosstie is inoperative.	24 -	Electrical
ACS FAULT*	Status	Clapper spring assemblies failed check.	22 -	N/A
AFT CABIN DOOR	Caution	Aft cabin door not closed and latched.	33 -	N/A
AFT CARGO DOOR	Caution	Aft cargo door not closed and latched.	33 -	Aircraft General
AFT GALLEY DOOR	Caution	Aft galley door not closed and latched.	33 -	N/A
AFT STAIRWAY DOOR	Caution	Aft stairway door not closed and latched.	33 -	Aircraft General
AIR COND LOW FLOW*	Master Caution	Low airflow condition in left or right air conditioning system.	21 -	Air Systems
AIRFL ICE PRES ABNML	Master Caution	Low or unbalanced pressure in wing ducts or low pressure in horizontal stabilizer duct.	30 -	Anti-Ice, Rain
ALL DOORS CLOSED	Status	All doors are closed and latched (press DOOR cue light to check door status).	33 -	N/A
ANTI-ICE SUPPLY HIGH	Master Caution	Excessive duct pressure.	30 -	Anti-Ice, Rain
ANTI-SKID FAULT*	Status	Fault detected which could result in a reduction in or a loss of system redundancy.	None	Landing Gear
APU AC PWR FAULT*	Master Caution and Status	Generic message indicating a potential AC power loss could occur.	24 -	Electrical
*Messages only applicable to MD-90.				

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MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
APU FAULT	Master Caution	APU system fault exists that could cause damage to the APU or degrade its performance.	49 -	Engines, APU
APU FIRE	Master Warning	APU fire detection system activated.	26 -	Engines, APU
APU FIRE DET FAULT*	Master Caution	Both APU fire detect loop systems inoperative.	26 -	Fire Protection
APU GEN BRG FAIL*	Status	One or both main bearings have failed in the APU generator.	24 -	N / A
APU GEN DIODE FAIL*	Status	One or more APU generator rotating rectifier diodes have failed.	24 -	N/A
APU GEN FAIL*	Status	APU generator de-energized has no output or has exceeded critical operating temperature.	24 -	N/A
APU GEN FEEDER FAULT*	Status	Feeder fault detected on APU generator feeders.	24 -	N/A
APU GEN OFF	Master Caution	APU generator power available and auxiliary power relay is open.	24 -	Electrical
APU GEN OVERHEAT*	Status	APU generator temperature exceeded maximum normal, but not critical, operating limits.	24 -	N/A
APU OIL PRESS LOW	Master Caution	APU oil pressure below normal.	49 -	Engines, APU
APU STARTER ON*	Advisory	APU starter is engaged.	49 -	N/A
ART INOP	Caution	Automatic reserve thrust is inoperative, or switch is OFF .	22 -	Engines, APU
AUTO BRAKE FAIL	Master Caution	Malfunction of auto brake system.	32 -	N/A
AUTO SLAT FAIL	Master Caution	Auto slat system malfunction.	None	Flight Controls
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
AUTO SPOILER FAIL	Caution	Malfunction in ground spoiler system or when system is armed and only one main gear senses ground contact.	27 -	Flight Controls
BATTERY BUS OFF*	Caution	Battery bus is de-energized.	None	Electrical
BKUP RUD LIM FAULT*	Caution	After landing, the rudder stop limiter was retracted at an airspeed greater than deployment speed.	27 - 22 -	N/A
CABIN ALT	Master Warning	Cabin altitude has exceeded 10,000 feet.	21 -	Air Systems
CABIN OXYGEN ON	Advisory	All cabin oxygen door latches activated.	35 -	N/A
CARGO FIRE	Master Warning	Cargo fire detection system activated	26 -	Fire Protection
CARGO COMPARTMENT FAULT LIGHT	Caution	Cargo fire loop inop.	26 -	Fire Protection
CAWS FAIL	Caution	Central aural warning system failed.	31 -	N/A
CENTER FUEL PRESS LO	Master Caution	Reduction or loss of fuel pressure across either center tank boost pump.	28 -	Fuel
DC BUS OFF	Master Caution	Left or right DC bus de-energized.	None	Electrical
DC EMER BUS OFF	Master Warning	DC emergency bus de-energized.	None	Electrical
DC XFER BUS OFF	Master Caution	DC transfer bus is de-energized.	None	Electrical
DFDR MALFUNCTION*	Status	DFDR critical failure detected.	31 -	N/A
DRAIN MAST HEAT*	Caution	One of the three drain masts is not powered.	30 -	Electrical
ELEC COMPT DOOR	Caution	Electric compartment door not closed and latched.	33 -	N/A
ELEC FAULT *	Caution	An electrical failure has occurred which does not have a discreet message.	None	N/A
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
ELEC SYS BIT FAIL*	Caution	An electrical failure has occurred which does not have a discreet message	None	N/A
ELEV CONTROLS MANUAL*	Master Caution	The elevators are in manual mode.	27 - 22 -	Flight Controls
ELEV LD FEEL INOP *	Master Caution	Both channels of the ACU are inoperative	27 - 22 -	Flight Controls
ELEVATOR AT LIMIT *	Advisory	Both elevators are at a limit stop position.	27 -	N/A
ELEVATOR POWER ON	Advisory	Hydraulic elevator augmentor activated	27 -	N/A
ELEVATOR SPLIT *	Master Caution	The left or right elevator positions differ by 5 or more.	None	Flight Controls
EMER LIGHT NOT ARMED	Caution	Emergency light switch in OFF or ON position.	33 -	N/A
EMER POWER ON *	Master Caution	Emergency power is in use.	None	Electrical
EMER PWR AUTO FAULT *	Master Caution	Emergency power switch in ARM position and EPCU unsuccessfully attempted to switch to emergency power automatically.	None	Electrical
EMER PWR SW OFF *	Caution	Emergency power switch in OFF position.	None	N/A
ENG SYNC FAULT *	Caution	Engine synchronizer actuator is in the N ₁ position and the actuator has reached the end of its travel or has failed.	76 -	Engines, APU
ENGINE SYNC ON	Caution	ENG SYNC selector is in N ₁ position with landing gear handle down.	76 -	N/A
FIRE DETECTOR LOOP	Master Caution	Illuminates when any A or B loop light illuminates.	26 -	Fire Protection
FIRE LOOP INOP*	Status	One of two fire loops for an engine or APU indicates a fault.	26 -	N/A
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
FLT RECORDER OFF	Caution	Recorder de-energized or BIT requirements not met.	31 -	N/A
FUEL LEVEL LOW	Master Caution	Fuel quantity level approximately 2,500 pounds in either main wing tank.	28 -	Fuel
FWD CABIN DOOR	Caution	Forward cabin door not closed and latched.	33 -	N/A
FWD CARGO DOOR	Caution	Forward cargo door not closed and latched.	33 -	Aircraft General
FWD GALLEY DOOR	Caution	Forward galley door not closed and latched.	33 -	N/A
FWD STAIRWAY DOOR	Caution	Forward stairway door not closed and latched.	33 -	N/A
GPWS FAIL	Caution	Ground proximity warning system inoperative.	34 -	N/A
GPWS TERRAIN FAIL	Advisory	Enhanced ground proximity warning system inoperative.	34 -	N/A
ICE FOD ALERT	Master Caution	Presence of ice buildup on wing upper surface-ground advisory only.	30 -	N/A
ICE FOD DETECT INOP*	Status	Wing ice FOD alert system inoperative.	30 -	N/A
IRS 1 ATT MODE	Advisory	Back-up attitude mode selected for IRS 1.	None	Flight Management Navigation
IRS 1 BATTERY FAIL	Caution	Battery will not support IRU 1 should normal power be lost.	None	Flight Management Navigation
IRS 1 NO AIR	Caution	Loss of cooling air to IRU 1.	None	Flight Management Navigation
IRS 1 ON BATTERY	Caution	IRU 1 on battery power.	None	Flight Management Navigation
IRS 2 ATT MODE	Advisory	Back-up attitude mode selected for IRS 2.	None	Flight Management Navigation
*Messages only applicable to MD-90.				



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MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
IRS 2 BATTERY FAIL	Caution	Battery will not support IRU 2 should normal power be lost.	None	Flight Management Navigation
IRS 2 ON BATTERY	Caution	IRU 2 on battery power.	None	Flight Management Navigation
IRS 2 NO AIR	Caution	Loss of cooling air to IRU 2.	None	Flight Management Navigation
L AC BUS OFF	Master Caution	Left generator bus de-energized.	None	Electrical
L AC PWR FAULT*	Master Caution and Status	Generic message indicating a potential left electrical system power loss could occur.	24 -	Electrical
L AIR COND TEMP HIGH	Master Caution	Left air conditioning pneumatic air supply temperature above normal.	21 -	Anti-Ice, Rain
L BUS FEEDER FAULT*	Status	Feeder fault detected on left generator bus.	24 -	N/A
L BUS TIE LOCKOUT*	Caution	Left bus tie relay locked out from closing.	None	Electrical
L CSD OIL PRESS LOW	Master Caution	Left CSD oil pressure is below limits.	24 -	Electrical
L CONV OVERHEAT*	Status	Left VSCF converter temperature above maximum normal, but not critical, operating limits.	24 -	N/A
L EEC/EDP BUS FAIL*	Caution	One left EEC channel has failed at the EDP.	73 -	N/A
L EEC FAULT*	Caution	EEC has detected a time limited left engine dispatch fault. Message/Alert associated with a Status message.	73 -	N/A
L EEC NO PERF PENALTY*	Status	EEC has detected a fault with no performance penalty.	73 -	N/A
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
L EEC PERF PENALTY*1 2 3 4 5	Status	EEC has detected a performance penalty associated fault.	73 -	N/A
L ENG ANTI-ICE ON	Advisory	Left engine anti-ice switch in the ON position.	30 -	N/A
L ENG FIRE DET FAULT*	Master Caution	Both left engine fire detect loop systems inoperative.	26 -	Fire Protection
L ENG FUEL OFF*	Caution	Left FMU fuel-on / off valve in OFF position	None	N/A
L ENG IGN ON*	Advisory	Left engine ignition system in use.	74 -	N/A
L ENG MANUAL START*	Master Caution	Communications between DFGC and EEC have failed.	80 -	Engines, APU
L ENG START ABORTED*	Caution	Left EEC detects an abnormal start.	80 -	Engines, APU
L ENG SYSTEM FAIL*	Status	EEC has detected a non-dispatch left engine fault.	None	N/A
L ENG IGN ON*	Advisory	Left engine ignition system in use.	74 -	N/A
L ENG MANUAL START*	Master Caution	Communications between DFGC and EEC have failed.	80 -	Engines, APU
L ENG START ABORTED*	Caution	Left EEC detects an abnormal start.	80 -	Engines, APU
L ENG SYSTEM FAIL*	Status	EEC has detected a non-dispatch left engine fault.	None	N/A
L ENG VALVE	Caution	Disagreement between left engine anti-ice valve and switch position.	30 -	Anti-Ice, Rain
L ENGINE OVERSPEED*	Caution	EEC detects left engine rotor speed beyond maximum limit.	None	N/A
L ENGINE SURGE*	Master Caution	EEC detects left engine compressor surge or starting stall.	None	Engines, APU
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
L FAIL (O/W Heater System)	Advisory	Fault detected with power to system.	30 -	Anti-Ice, Rain
L FUEL FIL PRES DROP	Master Caution	Differential pressure at left main engine fuel system filter.	73 -	Fuel
L GEN BRG FAIL*	Status	One or both main bearings have failed in the left VSCF generator.	24 -	N/A
L GEN DIODE FAIL*	Status	One or more left generator rotating rectifier diodes have failed.	24 -	N/A
L GEN FAIL*	Status	Left generator de-energized, has no output, or has shut down due to generator oil pressure below critical operating condition or oil temperature exceeded critical value or converter temperature exceeding critical operating limits.	24 -	N/A
L GEN FEEDER FAULT*	Status	Feeder fault detected on left generator system feeders.	24 -	N/A
L GEN OFF	Master Caution	Left generator relay de-energized.	24 -	Electrical
L GEN OIL FILTER*	Status	Left VSCF generator oil filter clogged and bypass valve has opened.	24 -	N/A
L GEN OIL PRESS*	Status	Left VSCF generator oil pressure below minimum but not critical, operating limits.	None	N/A
L GEN OVERHEAT*	Status	Left VSCF generator temperature exceeded maximum but not critical, operating limits.	24 -	N/A
L HYD PRESS LOW	Master Caution	Hydraulic pressure in left spoiler supply system below normal.	None	Hydraulics
L HYD TEMP HIGH	Master Caution	Left hydraulic reservoir fluid temperature above normal.	None	Hydraulics
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
L ICE FOD ALERT*	Master Caution	Presence of ice buildup on left wing upper surface on ground. Advisory only.	30 -	Anti-Ice, Rain
L ICE FOD SYS INOP*	Status	Left wing ice FOD alert system inoperative.	30 -	Anti-Ice, Rain
L ICE PROT TEMP HIGH	Master Caution	Left pneumatic crossfeed duct temperature is above normal.	30 -	Anti-Ice, Rain
L ICE PROT TEMP LOW	Caution	Left pneumatic crossfeed duct temperature is below normal.	30 -	Anti-Ice, Rain
L INBD ANTI- SKID	Caution	Malfunction of anti-skid protection for left inboard wheel.	32 -	Landing Gear
L INLET FUEL PRES LO	Master Caution	Fuel supply pressure at left engine is low	73 -	Fuel
L OIL PRESS LOW	Master Caution	Left engine oil pressure is low.	79 -	Engines, APU
LOIL STRAINER CLOG	Master Caution	Differential pressure across left main engine oil system filter.	79 -	Engines, APU
L OUTBD ANTI-SKID	Caution	Malfunction of anti-skid protection for left outboard wheel.	32 -	Landing Gear
L PNEU SYSTEM FAULT*	Caution	Excessive supply pressure from left pressure regulator and shutoff valve and/or high stage valve.	36 -	Air Systems
L REV PRESSURIZED*	Master Caution	EEC auto restow commanded or EEC detects left isolation valve failure.	None	Engines, APU
L REVERSER ACCUM LOW	(88) Caution (90) Status	Hydraulic pressure at left reverser accumulator is low.	78 -	(88) Engines, APU (90) N/A
L REVERSER FAULT*	Status	EEC determined left thrust reverser cannot be deployed.	78 -	N/A
L START VALVE OPEN	Caution	Left start valve not fully closed.	80 -	N/A
*Messages only applicable to MD-90.				

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MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
L START VALVE OPEN-A *	Caution	Left start valve not fully closed - A ignition system selected.	80 -	N/A
L START VALVE OPEN-B*	Caution	Left start valve not fully closed - B ignition system selected.	80 -	N/A
L STATOR VANE FAIL *	Master Caution	Left stator vane actuator failed- safed.	None	Engines, APU
L STRAKE FAULT*	Status	Loss of heating capability to left strake.	30 -	N/A
L TAIL TEMP HIGH*	Master Warning	Overheat condition detected in left aft accessory compartment or left pylon.	30 -	Anti-Ice, Rain
LAVATORY SMOKE *	Caution	Smoke detected in one of the lavatories.	26 -	Fire Protection
LEFT ENG BB VIB HI *	Status	Left broad based tracked vibration high.	77 -	N/A
LEFT ENG N1 VIB HI *	Status	Left N ₁ tracked vibration high.	77 -	N/A
LEFT ENG N2 VIB HI *	Status	Left N ₂ tracked vibration high.	77 -	N/A
LEFT ENG VIB HIGH *	Caution	High left engine vibration.	77 -	Engines, APU
MACH TRIM FAULT*	Caution	Mach trim system is inoperative.	22 -	Flight Controls
MACH TRIM INOP	Caution	System deactivated by system monitor or switch.	22 -	Flight Controls
MACH TRIM OFF	Caution	MACH TRIM switch is in OFF position.	22 -	N/A
MID CARGO DOOR	Caution	Mid cargo door not closed and latched.	33 -	Aircraft General
MWCC FAULT *	Caution	Overhead annunciator panel internal fault.	None	N/A
NO BKUP RUD LIM *	Caution	Backup rudder limiter failure along with failure of the primary rudder limiter.	27 -	Flight Controls
PARKING BRAKES ON	Caution	Parking brakes are set.	32 -	Landing Gear
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
PITOT / STALL HEAT OFF	Master Caution	METER SEL and HEAT selector in OFF or with selector other than OFF loss of electrical power to one or more pitot tube or stall angle of attack heaters.	30 -	Anti-Ice, Rain
PRIMARY RUD LIM FAULT*	Master Caution	A discrepancy exists between actual and programmed limit.	27 -	Flight Controls
PUSHER DUMPED*	Caution	Post stall pusher system disengaged by dump switch or G switch.	27 -	N/A
PUSHER FAIL*	Master Caution	Post stall pusher system malfunction or failure.	27 -	N/A
PWS INOP	Advisory	PWS not available.	34 -	N/A
PYLON FLAP FAULT*	Caution	Left and right pylon flap up and down switches are not in agreement or are not in correct position with respect to the elevator.	27 -	N/A
QAR MAL FUNCTION*	Status	Quick access recorder failure.	31 -	N/A
QAR TAPE LOW *	Status	Quick access recorder tape supply is low.	31 -	N/A
R AC BUS OFF	Master Caution	Right generator bus de-energized.	None	Electrical
R AC PWR FAULT*	Master Caution & Status	Generic message indicating a potential right electrical system power loss could occur.	24 -	Electrical
R AIR COND TEMP HIGH	Master Caution	Right air conditioning pneumatic air supply temperature above normal.	21 -	Anti-Ice, Rain
R BUS FEEDER FAULT*	Status	Feeder fault detected on right generator bus.	24 -	N/A
R BUS TIE LOCKOUT*	Caution	Right bus tie relay locked out from closing.	None	Electrical
R CSD OIL PRESS LOW	Master Caution	Right CSD oil pressure is below limits.	24 -	Electrical
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
R CONV OVERHEAT*	Status	Right VSCF converter temperature above maximum normal, but not critical, operating limits.	25 -	N/A
R EEC / EDP BUS FAIL*	Caution	One right EEC channel has failed at the EDP.	73 -	N/A
R EEC FAULT*	Caution	EEC has detected a time limited right engine dispatch fault.	73 -	N/A
R ENG ANTI-ICE ON	Advisory	Right engine ANTI-ICE switch in the ON position.	30 -	N/A
R ENG FIRE DET FAULT*	Master Caution	Both right engine fire detect loop systems inoperative.	26 -	Fire Protection
R ENG FUEL OFF*	Caution	Right FMU fuel-on/off valve in off position.	None	N/A
R ENG IGN ON*	Advisory	Right engine ignition system in use.	74 -	N/A
R ENG MANUAL START*	Master Caution	Communications between DFGC and EEC have failed.	80 -	Engines, APU
R ENG START ABORTED*	Caution	Right EEC detects an abnormal start.	80 -	Engines, APU
R ENG SYSTEM FAIL*	Status	EEC has detected a non-dispatch right engine fault.	None	N/A
R ENG VALVE	Caution	Disagreement between right engine anti-ice valve and switch position.	30 -	Anti-Ice, Rain
R ENGINE OVERSPEED*	Caution	EEC detects right engine rotor speed beyond maximum limit.	None	N/A
R ENGINE SURGE*	Master Caution	EEC detects right engine compressor surge or starting stall.	None	Engines, APU
R FAIL (O/W Heater System)	Advisory	Fault detected with power to system.	30 -	Anti-Ice, Rain
R FUEL FIL PRES DROP	Caution	Differential pressure at right main engine fuel system filter.	73 -	Fuel
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
R GEN BRG FAIL*	Status	One or more main bearings have failed in the right VSCF generator.	24 -	N/A
R GEN DIODE FAIL*	Status	One or more right generator rotating rectifier diodes have failed.	24 -	N/A
R GEN FAIL *	Status	Right generator de-energized, has no output or has shut down due to generator oil pressure below critical operating conditions or oil temperature exceeded critical value or converter temperature exceeded critical operating limits.	24 -	N/A
R GEN FEEDER FAULT*	Status	Feeder fault detected on right generator system feeders.	24 -	N/A
R GEN OFF	Master Caution	Right generator relay de-energized.	24 -	Electrical
R GEN OIL FILTER*	Status	Right VSCF generator oil filter clogged and bypass valve has opened.	24 -	N/A
R GEN OIL PRESS*	Status	Right VSCF generator oil pressure below minimum, but not critical, operating limits.	None	N/A
R GEN OVERHEAT*	Status	Right VSCF generator temperature exceeded maximum but not critical, operating limits.	24 -	N/A
R HYD PRESS LOW	Master Caution	Hydraulic pressure in right spoiler supply system below normal.	29 -	Hydraulics
R HYD TEMP HIGH	Master Caution	Right hydraulic reservoir fluid temperature above normal.	None	Hydraulics
R ICE FOD ALERT*	Master Caution	Presence of ice buildup on right wing upper surface on ground. Advisory only.	30 -	Anti-Ice, Rain
R ICE FOD SYS INOP*	Status	Right wing ice FOD alert system inoperative.	30 -	Anti-Ice, Rain
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
R ICE PROT TEMP HIGH	Master Caution	Right pneumatic crossfeed duct temperature is above normal.	30 -	Anti-Ice, Rain
R ICE PROT TEMP LOW	Caution	Right pneumatic crossfeed duct temperature is below normal.	30 -	Anti-Ice, Rain
R INBD ANTI-SKID	Caution	Malfunction of anti-skid protection for right inboard wheel.	32 -	Landing Gear
R INLET FUEL PRES LO	Master Caution	Fuel supply pressure at right engine is low.	73 -	Fuel
R OIL PRESS LOW	Master Caution	Right engine oil pressure is low.	79 -	Engines, APU
R OIL STRAINER CLOG	Master Caution	Differential pressure across right main engine oil system filter.	79 -	Engines, APU
R OUTBD ANTI-SKID	Caution	Malfunction of anti-skid protection for right outboard wheel.	32 -	Landing Gear
R PNEU SYSTEM FAULT*	Caution	Excessive supply pressure from right pressure regulator and shutoff valve and/or high stage valve.	36 -	Air Systems
R REV PRESSURIZED*	Master Caution	EEC auto restow commanded or EEC detects right isolation valve failure.	None	Engines, APU
R REVERSER ACCUM LOW	(88) Caution (90) Status	Hydraulic pressure at right reverser accumulator is low.	78 -	(88) Engines, APU (90) N/A
R REVERSER FAULT*	Status	EEC determined right thrust reverser cannot be deployed.	78 -	N/A
R START VALVE OPEN	Caution	Right start valve not fully closed.	80 -	N/A
R START VALVE OPEN-A *	Caution	Right start valve not fully closed - A ignition system selected.	80 -	N/A
R START VALVE OPEN-B*	Caution	Right start valve not fully closed - B ignition system selected.	80 -	N/A
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
R STATOR VANE FAIL*	Master Caution	Right stator vane actuator fail-safed.	None	Engines, APU
R STRAKE FAULT*	Status	Loss of heating capability to right strake.	30 -	N/A
R TAIL TEMP HIGH *	Master Warning	Overheat condition detected in right aft accessory compartment or right pylon.	30 -	Air Systems
RADIO FAN OFF	Caution	In flight, primary and standby fans inoperative with radio rack switch in FAN . On ground, primary fan is inoperative.	21 -	Air Systems
RAIN REPELLENT RESERVE IN USE	Advisory	Rain repellant switch has been momentarily moved to the RES position.	30 -	N/A
RIGHT ENG BB VIB HI *	Status	Right broad based tracked vibration high.	77 -	N/A
RIGHT ENG N ₁ VIB HI*	Status	Right N ₁ tracked vibration high.	77 -	N/A
RIGHT ENG N ₂ VIB HI*	Status	Right N ₂ tracked vibration high.	77 -	N/A
RIGHT ENG VIB HIGH*	Caution	High right engine vibration.	77 -	Engines, APU
RUD CONTROL MANUAL	(88) Caution (90) Master Caution	No hydraulic power to rudder.	None	Flight Controls
SNGL ELEV FEEL FAULT*	Caution	One channel of the ACU is inoperative.	27 - 22 -	Flight Controls
SPOILER DEPLOYED	Caution	Either ground spoiler extended in flight or any spoiler deployed more than 10° ± 2° on ground with spoiler/speedbrake lever stowed.	27 -	N/A
SPOILER/FLAP EXTEND	Master Caution	Speedbrakes extended with flaps extended beyond 6.	27 -	N/A
*Messages only applicable to MD-90.				

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MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
STALL IND FAILURE	Caution	Any system channel is inoperative or malfunctioning or post stall pusher system is shut off by pushing stick pusher PUSH TO INHIBIT light or by reduction in G forces.	27 -	Flight Controls
STRAKE ICE FAULT*	Caution	Generic message indicating loss of anti-icing capability to left or right strike.	30 -	Anti-Ice, Rain
TAIL DE-ICE ON	Advisory	De-icing heat selected for horizontal stabilizer leading edge.	30 -	N/A
TAIL TEMP FAULT*	Caution	Both channels of the tail temperature high controller unable to detect tail temperature is high.	30 -	Air Systems
TAIL COMP TEMP HIGH	Master Warning	Overheat condition detected in tail compartment or pylon.	None	Air Systems
TAILCONE UNSAFE	Caution	Tailcone not fully engaged or locked.	53 -	Aircraft General
TAKEOFF WARNING FAIL*	Caution	Takeoff warning not available when both throttles advanced for takeoff and FLAP/SLAT handle not in agreement with value set in flap/CG windows or HORIZ STAB not set in green band or slats not extended or spoiler handle not in RETRACT detent or parking brake is set, or autobrakes and auto spoilers not both armed or disarmed.	27 -	N/A
TIE BUS FEEDER FAULT*	Caution	Feeder fault in the tie bus.	None	Electrical
TRANSPONDER INOP*	Caution	Selected transponder has failed.	34 -	N/A
WINDSHEAR INOP	Caution	Windshear detection and guidance not available and PFD-PLI not displayed.	34 -	N/A
*Messages only applicable to MD-90.				

MD-88/90 OAP MESSAGE / WARNING LIGHT CROSS REFERENCE				
MESSAGE / WARNING LIGHT	ALERT LEVEL	DESCRIPTION	MEL CHAPTER	QRH SECTION
WINDSHIELD (88) OVERHEAT (90) OVERTEMP	Caution	One or all windshield panes are overheated.	30 -	Anti-Ice, Rain
WING ANTI-ICE ON	Advisory	Anti-ice heat selected for wing leading edge.	30 -	N/A
YAW DAMP OFF	Caution	Yaw damper is not operating.	22 -	(90)Flight Controls
*Messages only applicable to MD-90.				

Supplementary Procedures

Adverse Weather

Chapter SP

Section 16

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.

Cold Weather Operation

Considerations associated with cold weather operation are primarily concerned with low temperatures and with ice and snow on the airplane, ramps, taxiways and runways.

Before Start

Exterior Preflight

Although removal of snow, ice, or frost is a ground crew function, the flight crew must ascertain that:

- The Captain receives the notification “De/Anti-icing Check Complete” following aircraft de-icing or any upper wing surface inspection required by the ground crew.
 - Under de/anti-icing procedures, a qualified individual (other than the flight crew) may perform this inspection following de/anti-icing.
- There is no snow or ice adhering to the exterior surfaces of the airplane.
- The Captain is advised whenever there is ice or frost discovered between the front and rear wing spars on the lower wing surface (bottom of the fuel tank area).
- A coating of frost up to 1/8 inch (3.2mm) thick on the lower wing surface need not be removed provided it is caused by fuel cooling of the adjacent air. If de-icing is required on any other aircraft surface, underwing frost should also be removed.
- APU doors, air conditioning inlet and exhaust openings, landing gear doors, and control surfaces are unobstructed and free of impacted snow.
- Honeycomb panels including access doors and flight controls are checked for bulges caused by frozen moisture within the panels.
- Engine inlet protective covers are removed and engine inlets/cowlings are free of snow and ice.

- A tactile wing inspection is accomplished when conditions warrant. Tactile inspection requirements are accomplished by:
 - The flight crew at all stations, or
 - A de/anti-icing crew at any station following de/anti-icing.

(88) The following guidelines must be observed concerning tactile wing inspections of the upper wing surfaces on the MD-88:

- If the aircraft is equipped with overwing heater blankets and the WARM light is illuminated, a tactile wing inspection of the upper wing surface is not required.
- A tactile wing inspection of the upper wing surface is required anytime the aircraft has been de-iced.
- A tactile wing inspection is required if the flight deck WARM light is not illuminated, and does not illuminate within 12 minutes following a reset.
- If the aircraft is not equipped with overwing heater blankets or the blankets are inoperative, a tactile wing inspection of the upper wing surface is required when:
 - The ambient temperature is 10°C or below with:
 - Visible moisture as in rain, snow or fog (visibility 1 mile or less in fog), or
 - 3°C or less dewpoint spread, or
 - Runways and taxiways are wet.
 - Frost or ice is present on the lower surface of either main wing tank.

(90) The following guidelines must be observed concerning tactile wing inspections of the upper wing surfaces on the MD-90:

- A tactile wing inspection of the upper wing surface is required anytime the aircraft has been de-iced.
- A tactile wing inspection of the upper wing surface is required if any of the following conditions exist (except for aircraft equipped with Primary Ice Detectors):
 - Both fuel tank temperatures are below 0°C for short turnarounds (less than 4 hours), or
 - Both fuel tank temperatures are below 4°C following an overnight or long turnaround (great than 4 hours), or
 - Fuel tank temperatures are not available and either of the following two conditions exist:
 - The ambient temperature is 10°C or below with:

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- Visible moisture as in rain, snow or fog (visibility 1 mile or less in fog), or
- 3°C or less dewpoint spread, or
- Runways and taxiways are wet.
- Frost or ice is present on the lower surface of either main wing tank.
- A tactile wing inspection of the upper wing surface is required anytime the aircraft is equipped with the Primary Ice Detector system and the following conditions exist:
 - An ICE FOD ALERT or ICE FOD SYS FAIL message is illuminated,
 - AND
 - Both fuel tank temperatures are below 0°C for short turnarounds (less than 4 hours), or
 - Both fuel tank temperatures are below 4°C following an overnight or long turnaround (greater than 4 hours), or
 - Fuel tank temperatures are not available and either of the following two conditions exist:
 - The ambient temperature is 10°C or below with:
 - Visible moisture as in rain, snow or fog (visibility 1 mile or less in fog), or
 - 3°C or less dewpoint spread, or
 - Runways and taxiways are wet.
 - Frost or ice is present on the lower surface of either main wing tank.

Pushback/Start

Engine Start

Normal procedures for engine starting are applicable for cold weather operations. If taxiways are slippery, the Captain should consider starting all engines before leaving the gate to improve steering effectiveness and reduce jet blast effect.

Anticipate abnormal oil pressures, temperatures, and quantities. The oil strainer clogging light may illuminate for up to 10 minutes as a result of extremely cold oil. If the indication is due solely to cold oil, the light should extinguish before the oil temperature reaches 25°C. The engine should not be accelerated from idle until the light extinguishes.

(88) For first flight of the day engine starts, when the OAT is at or below -6°C (20°F), accomplish the following steps:

- Start the right engine to allow the full 5 minutes of warm-up, rather than the minimum 2 minutes.
- After the engine warm-up is completed, advance both throttles to 1.2 EPR and check for normal EPR increase. If the EPR indication is not approximately equal for both engines, allow two (2) additional minutes of engine warm-up time. Use engine anti-ice even if the temperature dew point spread does not require its use.
- Advance throttles again to check for normal EPR increase. If EPR indication is normal, proceed with takeoff. If EPR indication is still abnormal, contact OCC, MCC.

Note: Failure to comply with the above procedure may result in erroneous EPR indications on takeoff roll.

If OAT is -35°C (-30°F) or colder, operate the engine(s) at idle for two minutes before advancing throttle.

After Start

Engine anti-ice systems must be on after start when the ambient temperature is 6°C (42°F) or below and any of the following conditions exist.

- Visible moisture is present. Visible moisture may be fog, rain, or snow. Fog is considered as visible moisture when it limits visibility to one mile or less.
- A 3°C or less temperature/dewpoint spread exists.
- Runway and taxiways are wet.

Note: Even though 6°C (42°F) is above freezing, the expansion of air at the engine inlet causes a cooling process and could lower the temperature to the freezing level.

Engine Run-up Procedures

During prolonged ground operation, including taxi-in, taxi-out, and ground holding, when in icing conditions, run each engine up every 10 minutes to as high a thrust setting as practical. The following are recommended with the engine anti-ice system on for a minimum of:

- (88) 70% N1 for 15 seconds, or 60% N1 for 40 seconds.
- (90) 50% N1 momentary.

Taxi

Consideration must be given to delaying flap/slat extension when operating the aircraft in the following conditions:

- When the aircraft has been de/anti-iced and any precipitation is falling which may adhere to untreated aircraft surfaces.
- When taxiing on surfaces contaminated with wet snow and/or slush which may accumulate on critical aircraft surfaces from splashing/spraying.

Exposure of untreated surfaces for the short period of time from delayed flap extension to takeoff should not affect the performance of the wing nor jeopardize compliance with the clean aircraft concept.

Maintain a greater separation distance than normal when operating on ice, packed snow, or slush. The flaps/slats may be extended to the takeoff setting when commencing taxi as in normal established procedures. Spray and debris deflectors combined with prudent taxi speeds on contaminated taxi areas provide protection from contamination of exposed flap/slat surface areas. If the flaps/slats are left up for certain conditions during taxi, delay completion of the TAXI checklist until the flaps/slats are in the takeoff position and the flight control check is complete.

CAUTION: When operating on contaminated surfaces, taxi onto and off runways at an extremely slow speed. Nose wheel slippage may occur causing the aircraft to continue straight ahead and possibly off the paved surface.

When operating the wing flaps during low temperatures, the flap position indicators should be closely observed. If the flap indication should stop before reaching the selected position, the flap control lever should be placed immediately to the same position as indicated.

Before Takeoff

(88) When fuel temperature is 0°C or below, place FUEL HEAT switches to ON for 1 minute just prior to takeoff. FUEL HEAT ON lights must be extinguished for takeoff.

Snow (wet or dry), slush, standing water, and ice will adversely affect takeoff performance; for performance corrections, consult Aircraft Restrictions Manual, and AWABS. Precipitation in any form will affect stopping capability.

Takeoff, acceleration-stop distances, and V1 speeds are based on smooth, dry, hard-surfaced runways.

Takeoff

If the runway is contaminated, observe the following:

- Do not takeoff with standing water, slush, or wet snow in excess of 1/2 inch (1.2 cm).
- Do not takeoff in dry snow in excess of 4 inches or 10 cm depth.

Note: Snow is considered dry if OAT is less than -1°C.

- A rolling takeoff is advised when the crosswind exceeds 20 knots.

When operating in icing conditions, all takeoffs must be preceded by a static (momentary) run-up to a minimum of:

- (88) 70% N1
- (90) 50% N1

and stable engine operation observed prior to brake release.

During takeoff in icing conditions, a partially blocked PT-2 probe may cause erroneous EPR indications resulting in less than desired thrust.

Crosscheck EPR and ensure N1 is approximately:

T/O POWER	88	90
ALTERNATE	88% N1	78% N1
NORMAL	92% N1	82% N1
MAXIMUM	95% N1	85% N1

to ensure the required takeoff thrust has been obtained.

Set IGN switch to OVRD (88 only) and do not use alternate power for takeoff during moderate to heavy rain or on runways having slush, snow, or standing water. Before takeoff roll commences, make a static thrust check to ensure normal engine operation.

After takeoff power is set, check EPR against rpm, EGT, and fuel flow for the proper readings.

After 70 knots during takeoff roll, do not hold forward pressure on the control column. This will reduce the intensity of the spray from the nose wheel.

If icing conditions exist or are anticipated immediately after takeoff, the engine anti-ice system should be on. EPR loss due to use of engine anti-ice is automatically recovered during takeoff by the thrust rating computer. Normal takeoff techniques should be used when taking off from precipitation covered runways.

You may elect to use airfoil anti-ice at 400 feet AFE if OAT is 10°C or less and visible moisture exists.

Climb

Activate engine anti-ice before entering icing conditions. Turn ignition ON before turning on engine anti-ice. Wait for the engines to stabilize before turning ignition OFF. A sound practice to apply - when in doubt, use engine anti-ice.

In flight, a RAT/TAT of 10°C or below with visible moisture indicates a need for engine anti-icing.

Note: Because of the susceptibility of the engines to icing, meteorological conditions may be encountered where engine anti-ice is required but airfoil anti-ice is not. Formation of ice on the windshield bolt is one indication of the requirement for use of airfoil ice protection. Always use airfoil ice protection if there is any question of airfoil icing. When engine anti-ice is used without airfoil anti-ice, occasionally a nuisance AIR COND TEMP HIGH annunciation may occur. Follow the AIR COND TEMP HIGH procedure in such a situation.

Note: The thrust rating computer makes all EPR corrections automatically. If the TRP is inoperative, when operating at climb, max cruise or single engine max continuous power with engine anti-ice on, EPR must be reduced by .08 from applicable maximum. EPR must be reduced by an additional .03 (two engines) or .06 (one engine) when airfoil ice protection is in use.

Periodically check the FUEL TEMP indicators. If the FUEL FIL PRESS DROP message illuminates, proceed as follows:

- (MD-88) - Use fuel heat as required and refer to QRH, NNC.12, Fuel, FUEL FIL PRES DROP non-normal checklist. Turn fuel heat ON, one engine at a time, and observe the associated oil temperature rise. Do not operate fuel heat for both engines simultaneously in flight.
- (MD-90) - Monitor engine operation.

Descent

(88) Activate fuel heat, one engine at a time, for one cycle prior to final approach if fuel temperature is 0°C or below. Fuel heat operation should be completed prior to final approach.

Engines should be operated at the highest practical rpm to furnish adequate bleed air for airfoil and engine ice protection during descent.

All ice protection systems may (and should, if conditions warrant) be operated to touchdown. Initiate a tail deice cycle one minute prior to extension of landing flaps (normally just prior to gear extension) to ensure that the tail assembly is free of ice for approach and landing.

(90) Moving the flaps to 40° automatically activates both wing and tail anti-ice simultaneously.

Consider the additional weight of ice accumulation which may occur on those portions of the aircraft not subject to anti-icing. This could amount to several thousand pounds with a corresponding increase in drag. Check the ARM for Approach Climb Limit Weight corrections.

Approach

When operating into airports with contaminated runways, obtain the current runway condition and braking action report. Be wary of old reports and during rapidly changing weather conditions. Be conservative and plan your approach for the worst expected conditions. Be prepared to operate the aircraft to its maximum capability.

If it is known that a landing will be made in snow, slush, or standing water, it is recommended that the APU be started and (88) the APU BUS switches be ON prior to landing. Use engine ignition as required. Use OVRD during moderate to heavy rain or with standing water, snow, or slush on the runway.

Landing

Landing surfaces can be very treacherous when contaminated. Observe the following:

- Do not land with a braking action report of NIL in the landing or rollout portion of the runway.

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- Do not land with standing water, slush, or wet snow in excess of 1 inch (2.5 cm) depth.
- Do not land in dry snow in excess of 4 inches or 10 cm depth.

Note: Snow is considered dry if OAT is less than -1°C.

- Reduce crosswind guidelines by 5 knots with a reverser inoperative.
- Use flaps 40.

Medium autobrakes should be used on wet or slippery runways. Maximum autobrakes should be used on cluttered, snow covered or icy runways.

Braking effectiveness will be reduced. Land as early in the touchdown zone as possible. On touchdown, assure spoiler extension, monitor autobrake operation, and apply brakes manually if necessary. For optimum manual braking:

- Smoothly apply brakes and do not modulate them.
- Hold constant brake pressure until a safe taxi speed is reached.

Apply reverse thrust cautiously. Engines should be allowed to spool up at a lower power setting, then reverse thrust applied slowly and symmetrically. If a skid condition develops, release the brakes and return both reverse thrust levers toward the IDLE detent. As soon as runway track is reestablished, symmetrical reverse thrust and braking should be reapplied as necessary to stop the airplane.

- Do not select forward idle thrust until a safe taxi speed is attained.
- Do not assume the last 2,000 feet of the runway will have braking action as good as the touchdown zone.
- Be aware of the possibility of white out effect from reverse thrust use in dry snow.

If weather conditions during the approach and landing are significantly different than anticipated and such that they may affect following flights, advise the Tower, local Operations, and Flight Control immediately.

After Landing

If icing conditions existed during approach, or slush is present, do not retract flaps and slats for taxi. A visual inspection should be made to determine if flap areas are clear before retracting flaps. Consider leaving all engines operating until arrival at the gate as an aid to directional control.

During prolonged ground operation, including taxi-in and ground holding, when in icing conditions, run each engine up every 10 minutes to as high a thrust setting as practical. The following are recommended with the engine anti-ice system on for a minimum of:

- (88) 70% N1 for 15 seconds, or 60% N1 for 40 seconds.
- (90) 50% N1 momentary.

Secure

In addition to the SECURE checklist, the following items must be accomplished whenever the temperature may fall below 0°C (32°F) or the aircraft may be de/anti-iced during overnight parking.

- Release parking brakes.
 - Ensure the aircraft is chocked. On ice covered ramps, the parking brakes may remain set if doubt exists that chocks will hold the aircraft.
- Set the horizontal stabilizer trim to 0°, which is cruise neutral.
- Close the flight deck/cabin doors & windows.
 - Stations personnel may leave the passenger door partially open to prevent conditioned air from pressurizing the cabin.

Note: Additional cold weather procedures are required to be accomplished by maintenance personnel. Stations are responsible for draining the water system.

Ground De/Anti-Icing

Definitions and Concepts

Ground de/anti-icing background information and policies are described in this section and the Airway Manual, Weather - Icing. Procedures for aircraft specific de/anti-icing are located in this section.

Deicing

Deicing is the procedure of removing frost, ice, slush, or snow from the aircraft in order to provide clean surfaces. On the ground this may be accomplished by:

- Using any mechanical or pneumatic means that will not damage the aircraft.
- Using heated deicing fluid to remove all forms of frozen contamination (including environmental frost). Heated fluids penetrate the frozen contaminants and contact the aircraft skin. The high thermal conductivity of the aircraft skin causes the heat to spread, breaking the bond of the ice and snow, causing it to melt or fall off the aircraft.

Anti-icing

Anti-icing is a precautionary procedure that provides protection against the formation of frost or ice, and accumulation of snow or slush on treated surfaces of the aircraft for a limited period of time (holdover time).

Anti-icing fluid is the only protection against airfoil icing prior to getting airborne. Therefore, fluid application should be completed as close to takeoff time as possible.

De/Anti-icing

A combination of the deicing and anti-icing procedures.

Secondary De/Anti-icing

If an aircraft which has been de/anti-iced is delayed on the ground long enough that anti-icing protection is no longer effective, or if for any reason the de/anti-icing process is interrupted while freezing/frozen precipitation is falling, the ground de/anti-icing procedure must be reaccomplished in its entirety. This is referred to as secondary de/anti-icing.

When secondary de/anti-icing is necessary, the contaminated anti-icing fluid and all frozen contamination must be completely removed by deicing before making another application of anti-icing fluid. If a holdover time was previously established after completing secondary de/anti-icing, a new holdover time must be determined.

Clean Aircraft Concept

The airline industry, in concert with the FAA, is operating with a clean aircraft concept to minimize the effects of all forms of frozen contamination on aircraft surfaces.

Takeoff is prohibited when frost, ice, snow or slush is adhering to the wings, control surfaces, engine inlets, or other critical surfaces of the aircraft.

- Do not rely on air flow during takeoff roll to remove frozen precipitation that may be adhering to the aircraft.
- A coating of frost up to 1/8 inch thick on the lower wing surface, below the fuel tank area, is permissible provided it is caused by cold soaked fuel.
- A thin coating of frost is permitted on the fuselage, provided letter and paint lines are visible through the frost.

Cold soaked wings

A cold soaked wing condition can occur when an aircraft lands with a large amount of fuel remaining in the wing tanks. During cruise at high altitude, the aircraft is subjected to extremely cold temperatures for an extended period of time causing the aircraft skin and fuel to become super cooled. If enough super cooled fuel is remaining in the wing tanks to contact the upper wing surface, it will maintain the skin at a temperature below freezing. When this happens, any moisture contacting the upper wing surface may form frozen contamination, even in ambient air temperatures as high as 15°C (60°F).

For all other aircraft, a cold soaked wing should only be suspected if both of the following conditions are met.

- Frost or ice is observed on the wing's underside during the walk around, and
- A large amount of fuel was remaining in the wing tanks after landing.

If cold soaked wings are suspected, cabin windows may be used during the preflight to visually inspect the upper wing surfaces for frost or ice. The quickest way to alleviate a cold soaked wing condition is to add warm fuel to the wing tanks.

Critical Aircraft Surfaces

Critical aircraft surfaces are those surfaces which must be clear of adhering frozen contamination before beginning takeoff roll. Critical aircraft surfaces include, but may not be limited to:

- Wings, slats, flaps, ailerons, spoilers.
- Horizontal stabilizer and elevator.
- Vertical stabilizer and rudder.
- Pitot heads, static ports, ram-air intakes, engine and flight instrument probes, other kinds of instrument sensor pickups.
- Engine and APU inlets and exhausts.
- Landing gear and landing gear doors.
- Fuel vents.
- Radome

Representative Aircraft Surfaces

Representative aircraft surfaces are those which the pilot can readily observe to determine whether or not frost, ice, or snow is accumulating or forming on that surface. By using a representative surface, a pilot can make a reasoned judgement regarding whether or not frost, ice, or snow is adhering to other aircraft surfaces.

Representative aircraft surfaces visible from the flight deck are:

- Fuselage.
- Radome.

Representative aircraft surfaces visible from the best vantage point(s) in the cabin are:

- Wing area upper surfaces.
- Wing leading edges.
- Engine inlets.

Best Vantage Point(s)

The best vantage point is the location in the aircraft where a pilot can best check representative aircraft surfaces. This will normally be a passenger window in the over-wing area. It may be necessary in some circumstances to move forward a few rows to get the best view of the engines. Outside lighting conditions and glare may also affect which specific location is the best vantage point.

Holdover Time

Holdover time is the estimated time that anti-icing fluid will prevent the formation of frozen contaminants on the treated surfaces of the aircraft. Holdover time is determined by the pilot using the Holdover Time Tables.

Holdover time starts when the final application of fluid begins. The final fluid applied will be either:

- De/Anti-icing fluid in the one step procedure, or
- Anti-icing fluid in the two step procedure.

Holdover time ends when either:

- The applied fluid loses its effectiveness, or
- The time extracted from the holdover time range expires.

Ground Icing Conditions

Guidance for determining precipitation categories (type) and intensities (light, moderate, and heavy) is located in the Airway Manual, Weather, Hazardous Weather - Icing.

WARNING: Do not take off during hail, moderate or heavy freezing rain, snow pellets, or heavy ice pellets.

Operational Effects of Frozen Contamination

Frost, ice, and/or snow adhering to airfoils, engine inlets, flight controls and flight instrument sensors, even in small amounts, can have a critical effect on aircraft performance. For example, ice formations on the wing's leading edges and upper surfaces creating texture roughness of medium to coarse sandpaper can reduce lift as much as 30 percent and increase drag by 40 percent. Therefore, frozen contamination on the aircraft in any form poses a serious threat to flight safety due to degraded operational performance.

Degraded aerodynamic performance such as:

- Lift decreases - Frozen contamination may destroy the lifting ability of an airfoil, including leading edge devices. The aircraft may not lift off at a normal pitch attitude. Required gaps in leading edge devices may be blocked and further reduce lift on one or both wings.
- Drag/weight increases - An aircraft may fail to reach takeoff speed in the calculated distance.
- Stall speed increases - Buffet or stall may occur before activation of stall warning systems.
- Controllability decreases - Caused by changing the aerodynamic properties of the control surface due to ice. For example, ice on the leading edge of the horizontal stabilizer can affect pitch control, especially during rotation.

Reduction in available engine power caused by:

- Icing of engine inlets, guide vanes or compressor blades.
- Ingestion of ice shedding from other parts of the aircraft.

Impairment of flight and engine performance indicators resulting in:

- Incorrect power settings due to EPR probe icing.
- Incorrect airspeed indication caused by pitot/static probe icing.
- Erroneous stall warning caused by ice on the AOA probe.

Degraded flight control response as ice may interfere with the free movement of the flight controls.

Delta De/Anti-icing Program

Delta Air Lines' Ground De/Anti-icing Program is coordinated among Airport Customer Service, Maintenance, Flight Control, Flight Operations, Fleet Management and Reliability, and Flight Safety. Each Delta deicing station will have designated trained personnel on duty to determine when to initiate ground de/anti-icing operations. At airports where no Delta personnel are permanently assigned, the Captain may declare the de/anti-icing program in effect. In this case, the Captain shares responsibility for the effectiveness of the effort with the ground crew. The procedures outlined in this section will help guide the Captain through this decision making process.

There are several components to Delta's De/Anti-icing Program. Pilots need to be aware of how key components play an integral part in ensuring safe winter flight operations.

De/Anti-icing Alert Plan

A Deicing Alert Chart will be issued daily by Delta Meteorology to the OCC Duty Director. This chart reflects forecasted freezing/frozen precipitation for specific geographic regions for the next day's flying (24 - 48 hours in advance). Affected stations will be notified, and plans will be made to initiate local de/anti-icing operations. Flight Control will work in conjunction with individual stations to determine possible changes to the flight schedule based on any anticipated decrease in airport air traffic capacity.

Station De/Anti-icing Plans

Each Delta station that conducts de/anti-icing operations is required to have a detailed de/anti-icing plan on file. This plan contains, but is not limited to the following information:

- Persons responsible for implementing/terminating the de/anti-icing plan.
- Deicing equipment and fluids.
- Location of de/anti-icing areas.
- Local procedures including communication with the flight crew and coordination with local ATC.

ATC will be notified whenever the local de/anti-icing plan is in effect. Departure runway queues will be managed by ATC in order to minimize the amount of time an aircraft spends on the ground after being de/anti-iced.

Special procedures for the pilots will be contained in the Airway Manual, 10-0 Delta Special Pages (green pages), or noted in the Airport Remarks section of the flight plan.

Responsibility for De/Anti-icing of Aircraft

The Captain has the ultimate responsibility for ensuring the aircraft's critical surfaces are free of frozen contamination and the flight can be operated safely. The ground deicing crew shares in this responsibility by providing an aircraft that complies with the clean aircraft concept.

Normally, aircraft de/anti-icing will be performed by:

- Delta Maintenance.
- Airport Customer Service (ACS).
- Business partner (contractor).
- Any combination of the above.

ACS and/or contractors accomplish the majority of aircraft de/anti-icing. As always, pilot vigilance is paramount during any de/anti-icing procedure. If possible, the pilots should evaluate the operation from the flight deck as it is being conducted and:

- If deicing or anti-icing is not being performed properly and safety is jeopardized, stop the operation and attempt to have the problem corrected.
- When possible, provide timely feedback on individual station de/anti-icing performance to the Dispatcher. A telephone report is preferred.
- Document all de/anti-icing problems or kudos on a COR.

Depending on the circumstances and local station procedures, aircraft de/anti-icing may be accomplished:

- Whenever requested by the Captain.
- Prior to taxiing into the gate (to prevent accumulation).
- During overnight parking (prior to pilots' arrival).
- At the gate - prior to pushback.
- After pushback - clear of the gate.
- During taxi operations, i.e., car wash.

Deicing at Offline Stations

If de/anti-icing is required at an offline station, consult with Flight Control.

In unusual circumstances, such as when operating at an offline station, the pilots may be required to supervise the de/anti-icing operation. In this case, the pilots must ensure the aircraft is free of frozen contamination in accordance with the clean aircraft concept. If the Captain determines that the pilots are unable to effectively supervise the de/anti-icing procedure, the flight will not operate.

Note: Contact the Dispatcher if a noncertified fluid must be used.
Refer to Noncertified Fluids section in this chapter.

De/Anti-icing Fluids

Type I Fluid

Type I fluid is a deicing and anti-icing fluid with low viscosity and is considered an unthickened fluid. It forms a very thin wetting film on aircraft surfaces and has excellent deicing properties. Type I fluid can be orange-colored or colorless. Due to its low viscosity, it provides minimal anti-icing protection. Type I fluid is always diluted because adding water ensures fluid freeze point protection and ensures proper aerodynamic flow-off characteristics. Type I fluid is never applied 100 percent. Different dilution ratios of Type I fluids affect the freeze point of the fluid, but do not alter its holdover time significantly. Consequently, there are no ratio break outs on the Type I Holdover Time Table. The Type I Holdover Table will apply when this fluid is used.

Type II Fluid

Type II fluid is a deicing and anti-icing fluid of high viscosity and is considered a thickened fluid. It adheres to the aircraft surfaces to provide a protective film. It creates a thicker layer than Type I fluid and thus has improved anti-icing capability. Type II fluid can be straw-colored or colorless. Airflow during takeoff roll causes the fluid to shed so that by rotation the surfaces are aerodynamically clean. Varying concentration levels of Type II fluid affect its holdover time. Delta prefers to use 100 percent concentration of Type II fluid, but other concentration levels may be used at contract or overseas facilities. Not all stations will have Type II available. The Type II Holdover Table will apply when this fluid is used.

Type III Fluid

Type III fluid is a deicing and anti-icing fluid with longer [holdover] times than Type I fluid, but lower viscosity than Type IV fluids. It was primarily designed for use on aircraft with slower rotation speeds to ease shedding of the fluid during takeoff, but it is fully approved for use on Delta aircraft. Type III fluid is bright yellow in color. Few stations are expected to have Type III fluid available. The Type III Holdover Table will apply when this fluid is used.

Type III fluid or fluid/water mixtures are normally applied heated when used for deicing (contamination removal), but may be heated or unheated for anti-icing (surface protection).

Type IV Fluid

Type IV fluid is an enhanced performance deicing and anti-icing fluid with characteristics similar to Type II. Type IV fluid is green colored, except in Japan, where it is colorless. Its anti-icing effectiveness is superior to Type II fluid and holdover time is increased by a significant factor under most conditions. There is a separate Holdover Time Table for Type IV which reflects this improved performance. Additionally, Type IV fluid has some unique visual characteristics. It is pale green in color and considerably thicker than Type II fluid. When applied to the wings, the extra thickness may cause the fluid to appear wavy or bumpy. Varying concentration levels of Type IV fluid affect its holdover time. Delta prefers to use 100 percent concentration of Type IV, but other concentration levels may be used at contract or overseas facilities. Not all stations will have Type IV available. The Type IV Holdover Table will apply when this fluid is used.

Some contract deicing ground crews may communicate a specific brand of Type IV fluid during the Post De/Anti-icing Report, for example, "Type IV, Octagon, Max-Flight." Flight crews should disregard the fluid brand information and utilize the Type IV Holdover Time Table.

Noncertified Fluids

A de/anti-icing fluid that does not meet SAE/ISO certification requirements (including military fluids) is classified as noncertified, Type I, Type II, Type III, or Type IV fluid. These fluids may be encountered at certain international stations, or during offline operations at military bases. The use of noncertified Type I fluid is not authorized for takeoff during active icing conditions. Contact the Dispatcher if a noncertified Type I fluid is used. Noncertified Type II, Type III, or Type IV fluids are not authorized under any circumstances.

Fluid Standards

Deicing fluids are:

- Heated water when OAT is above or equal to -3°C (27°F).
- Heated water mixed with Type I fluid.
- Heated water mixed with one of the following SAE/ISO fluids:
 - Type II, or
 - Type III, or
 - Type IV.

Anti-icing fluids must be certified by the:

- Society of Automotive Engineers (SAE).
- International Standards Organization (ISO).

Anti-icing fluids are:

- Heated or unheated water mixed with one of the following SAE/ISO fluids:
 - Type I,
 - Type II,
 - Type III, or
 - Type IV.
- Undiluted SAE/ISO Type II fluid.
- Undiluted SAE Type III fluid
- Undiluted SAE/ISO Type IV fluid

All de/anti-icing fluids have a limit to their low operational temperature use. Ground deicing crews and Dispatchers have access to this information in the Technical Operations Policies and Procedures (TOPP) 20-30-05.

The following is an approximate low temperature limit of the fluids:

- Type I has the lowest temperature use, approximately -30°C (-22°F)
- Type II and IV are approximately -25°C (-13°F)
- Type III is approximately -29°C (-20°F)

Under extremely low temperature conditions consider using alternate means of deicing, such as brooms or nonheated forced air.

Fluid Effects on Braking and Steering

Generally, Type I, Type II, Type III, and Type IV fluids are considered to have the same affect on braking and steering as water.

CAUTION: A slippery condition may exist in and around the de/anti-icing ramp and taxi ways, particularly during dry weather conditions or light precipitation.

De/Anti-icing Fluid vs. Hydraulic Fluid

It is very difficult to distinguish between de/anti-icing fluids and hydraulic fluid. In small quantities and thin coatings, both fluids will have similar coloring and feel slippery to the touch. During the exterior inspection, if residual fluids on aircraft surfaces cannot be identified, contact local Maintenance or call the MCC through the Dispatcher for guidance.

Fluid Application Methods

De/anti-icing can be performed using a one or two step procedure.

- One step procedure - This procedure is a combination of deicing and anti-icing performed at the same time with the same fluid (de/anti-icing). The fluid used to deice the aircraft is always heated and remains on the surface to provide anti-icing protection. This procedure can be repeated so as to minimize the time required to complete the final application of fluid.
- Two step procedure - This procedure consists of two distinct fluid applications. The first step, deicing with a heated fluid, is followed by the second step, anti-icing, as a separate fluid application. Normally, Type II or Type IV fluid is used during the second step; however, Type I or Type III fluid may be used.

Note: Areas in front of the most forward passenger door are normally treated only with Type I or Type III fluid. International stations may use a thin mixture of Type II or Type IV fluid when Type I or Type III fluid is not available.

Note: Holdover time starts when the final application begins in either the one step or two step procedure.

Forced Air Deicing

At some stations, forced air deicing equipment is used to facilitate contamination removal. Forced air deicing utilizes an air stream to help remove frozen accumulations from an aircraft with or without deicing fluid. Forced air deicing has the advantage of reducing the total amount of glycol needed for deicing, providing economic and environmental benefits. Forced air only (without fluid) may be especially helpful for removing frozen accumulations from RON aircraft surfaces.

Forced air applications (with or without fluid) may not eliminate the need for conventional de/anti-icing procedures. After a forced air application has occurred, conventional deicing (using fluid only) may be needed to ensure complete contamination removal.

Holdover times are not associated with forced air deicing. To use Type I holdover time tables, anti-icing using heated Type I fluid without forced air must occur. To use Type II, Type III, or Type IV holdover time tables, anti-icing using Type II, Type III, or Type IV fluid without forced air must occur.

The post-de/anti-icing check and report (below) should still occur even if forced-air deicing is the only task performed.

De-/Anti-icing Checks

There are four types of de/anti-icing checks: Post De/Anti-icing Check, Flight Deck Check, Cabin Check, and External Check.

Post De/Anti-icing Check

This check is an integral part of the de/anti-icing process. After aircraft de/anti-icing is complete, the deicing ground crew performs a Post De/Anti-icing Check to confirm that the critical surfaces are free of any contamination. Confirmation that the Post De/Anti-icing Check has been successfully completed will be communicated to the pilots during the Post De/Anti-icing Report by stating: “POST DE/ANTI-ICING CHECK COMPLETE” and “TACTILE CHECK COMPLETE.”

Flight Deck Check

This check is an integral part of the holdover time and is performed by the pilots. Because of the limitations and cautions associated with the use of the Holdover Time Tables, the pilots must not rely on the use of holdover times as the sole determinant that the aircraft is free of contamination. They must continually assess the current weather, environmental conditions, and the aircraft’s condition. Several Flight Deck Checks are required during the holdover time period to maintain awareness of the aircraft’s condition.

The Flight Deck Check is performed by the pilots just prior to takeoff and is required anytime:

- Ground icing conditions exist, and
- The holdover time is still valid.

The Flight Deck Check consists of:

- A check of representative aircraft surfaces which are visible from the flight deck.
- If desired or if any doubt exists, conduct a Cabin Check.

When circumstances do not permit a satisfactory visual check from inside the aircraft, return to the designated area and:

- Have ground de-icing crew perform an External Check, or
- If any doubt exists as to the condition of the aircraft, repeat the Ground De/Anti-icing procedure.

Cabin Check

This check is performed by the pilots and is required:

- Any time the aircraft has been de/anti-iced, and holdover time is exceeded during conditions of frost, freezing fog, or snow, or
- Within 5 minutes of takeoff any time a pilot-assessed change in intensity is to be used, or
- When doubt exists after conducting the Flight Deck Check, or
- During conditions of heavy snow (provided Type IV fluid has been used for anti-icing).

Since clear ice formation cannot be detected visually from inside the aircraft, the Cabin Check is not authorized when:

- Type I fluid has been applied during freezing drizzle.
- Type II, Type III, or Type IV fluid has been applied during freezing drizzle, light freezing rain, or rain on cold soaked wings and holdover time has expired. Secondary de/anti-icing or an External check must be accomplished prior to takeoff.
- Ice pellets have fallen.

The Cabin Check consists of a visual inspection of all representative aircraft surfaces which are visible from the best vantage point(s) in the cabin. Normally, de/anti-icing fluid failure will first occur on the leading or trailing edges of the wing rather than the mid-chord. Therefore, the leading edges and upper surfaces of both wings must be visually checked for evidence of fluid failure. Additionally, engine inlets must be inspected for contamination. Takeoff must occur within five minutes of the most recent check.

The ability to adequately perform this check from inside the aircraft is highly dependent upon several factors. Lighting conditions, cleanliness of cabin/flight deck windows, and outside visibility may severely hinder or prevent the pilot's ability to satisfactorily assess aircraft surfaces for contamination. When circumstances do not permit a satisfactory visual check from inside the aircraft, return to the designated area and:

- Have ground de-icing crew perform the External Check.
- If any doubt exists as to the condition of the aircraft, repeat the ground de/anti-icing procedure.

External Check

This check is performed by the de/anti-icing ground crew and is required anytime:

- Doubt exists after conducting a Cabin Check, or
- The aircraft has been anti-iced with Type II, Type III, or Type IV fluid, and holdover time is exceeded during freezing drizzle, light freezing rain, or rain on cold soaked wings.

This check consists of a close visual inspection of the aircraft's upper wing surfaces and leading edges for frozen contamination. Takeoff must occur within five minutes of the External Check.

If the External Check cannot be accomplished, return for secondary de/anti-icing.

CAUTION: An External Check is not authorized during freezing drizzle when Type I fluid is used.

Contact local operations for specific locations on the airfield to accomplish the External Check. Be aware that some stations may conduct secondary de/anti-icing as an alternative to the External Check.

Visual Indications of Loss of Fluid Effectiveness

It is difficult to determine when anti-icing fluid is beginning to fail, however, when any ice or snow can be seen accumulating on treated surfaces, the fluid has lost its effectiveness. Any ice, frost, or snow on top of deicing or anti-icing fluids must be considered as adhering to the aircraft, and secondary de/anti-icing must be accomplished prior to takeoff.

- Normally, de/anti-icing fluid failure will first occur on the leading or trailing edges of the wing rather than the mid-chord. However, when the aircraft is pointing downwind the mid-chord will fail first.
- The leading edges and upper surfaces of both wings must be visually checked for evidence of fluid failure.
- If the leading edges and upper surfaces of both wings cannot be inspected from the cabin, return for an External Check or secondary de/anti-icing.

Type I Fluid

When Type I fluid has lost its effectiveness, frozen precipitation will begin to accumulate on the aircraft surface in much the same manner as it would on a nontreated surface.

Type II, Type III, and Type IV Fluid

When Type II, Type III, or Type IV fluid has lost its effectiveness and is no longer able to absorb the freezing moisture, look for the following visual indications.

- Gray or white appearance and buildup of ice crystals in or on top of the fluid.
- Progressive surface freezing.
- Snow accumulation.
- Dulling of surface reflectiveness caused by the gradual deterioration of the fluid to slush (loss of gloss or orange peel appearance).
- Ice buildup on the wing life raft attach points (if installed), adjacent to the over-wing exits.

Types of De/Anti-icing Checks

TYPES OF DE/ANTI-ICING CHECKS

Type of Check	Post De/Anti-icing Check	Flight Deck Check	Cabin Check	External Check*
Performed by:	Deicing Ground Crew	Pilots	Pilots	Deicing Ground Crew
Required when:	The final fluid coating is applied to determine critical surfaces are free of frozen contamination.	Holdover time is still valid.	Doubt exists after the Flight Deck Check, or heavy snow is falling (provided Type IV fluid has been used for anti-icing), or holdover time is exceeded during conditions of frost, freezing fog, or snow, or snow grains.	Doubt exists after the Cabin Check, or Type II, Type III, or Type IV fluid has been used and holdover time is exceeded during conditions of freezing drizzle, light freezing rain, or rain on cold soaked wings.
Time limit to accomplish the check:	During/after the de/anti-icing and prior to pushback or taxi.	During the holdover time and just prior to takeoff.	Must be within five minutes of takeoff. Repeated as necessary.	Must be within five minutes of takeoff. Repeated as necessary.
Location to perform the check:	Outside the aircraft.	The flight deck (may also include the best vantage point(s) in the cabin).	The best vantage point(s) in the cabin.	Outside the aircraft.
Areas to check are:	Aircraft critical surfaces.	Representative surfaces visible from the flight deck (and cabin if desired).	All representative aircraft surfaces visible from the cabin.	Upper wing surface and leading edge.

* In lieu of external check, deicing ground crew may elect to de/anti-ice aircraft.

Communication Procedures

Any airport specific deicing procedures will be contained in the Airway Manual, 10-0 Delta Special Pages (green pages), or noted in the Airport Remarks section of the flight plan.

It is critical to establish communications with the ground crew prior to commencing de/anti-icing. Once the deicing operation commences, any aircraft movement or changes in configuration must be coordinated with the ground crew.

Post De/Anti-icing Report

After the aircraft has been de/anti-iced, a Post De/Anti-icing Report must be directly communicated to the Captain using the format specified on the GROUND DE/ANTI-ICING procedure card. The pilot is required to read back this information to verify accuracy.

Note: A report is not required when the aircraft is deiced due to frost, prior to the pilot's arrival, and no active frost is forming.

Holdover Times

Use of Holdover Time Tables

Holdover times provide an operational guideline for departure planning. They must be used in conjunction with the Flight Deck Check. Holdover Time Tables are located in this section.

Holdover times published in the tables are only approximate and must be adjusted after considering all variables. The source of the Holdover Time Tables is the Aerospace Division of the Society of Automotive Engineers (SAE). Time data is derived from an analysis of testing conducted in field and laboratory conditions, as well as airline operational experience. Numerous factors affect the actual time that anti-icing fluid will provide protection against frozen contamination.

The times specified in the tables represent the approximate holdover times for seven categories of active precipitation.

- Frost.
- Freezing fog.
- Snow.
- Freezing drizzle.
- Freezing rain (light).

- Ice pellets
- Rain on cold soaked wings.

Three precipitation categories specify a time range (snow, freezing drizzle, and rain on cold soaked wings), and four categories specify a single time (freezing fog, frost, light freezing rain and ice pellets).

Whenever a time range is given, the lower time in the range is for moderate precipitation conditions and the upper time is for light conditions.

When a single time is specified in the table, it represents the approximate holdover time limit for that weather condition. However, it may be necessary to adjust the holdover time downward after considering other environmental factors.

Establishing Holdover Time

A holdover time is established using the following five steps.

- (1) Obtain the Post De/Anti-icing Report from the ground crew and read back the information. The following data from the report is used to establish a holdover time:
 - Fluid type: Type I, Type II, Type III, or Type IV.
 - Fluid concentration: Mixture information is only required for Type II, Type III, or Type IV fluid. There are no fluid mixture break outs on the Type I Holdover Time Table because dilution ratios do not significantly affect holdover time for Type I fluids.
 - Local time that the final (anti-icing) fluid application began.
This is the point at which the holdover timing starts.
- (2) Determine the current weather conditions (OAT, type of precipitation, and intensity of precipitation).
 - OAT is determined by the most current weather report or ATIS.
 - The Holdover tables allow pilots to determine holdover times based partly upon the type and intensity of the frozen precipitation that is falling.
 - The type and intensity of frozen precipitation (light, moderate, or heavy) is officially determined by the most current official weather report (e.g., from National Weather Service [NWS], NWS-approved automated system, or other agent approved by the NWS).
 - If at any time a pilot assesses intensity **greater** than that being reported, he/she shall use the heavier precipitation when entering the holdover tables for holdover time.

- If, in the pilot's judgement, the intensity is **less** than that being reported, the pilot shall request (e.g., to the tower or trained weather observer) a new observation be taken and reported or shall wait long enough for an update to an automated meteorological observation to be taken and reported as applicable.
 - A pilot may act on their own assessment of **lesser** precipitation intensity only in those cases concerning snowfall or ice pellets where the officially reported (e.g., from NWS, NWS-approved automated system, or other agent approved by the NWS) meteorological precipitation intensity is grossly different from that which is obviously occurring. (For example: precipitation is reported when there is no actual precipitation occurring.)
 - If an adjustment to intensity is pilot-assessed, the pilots shall communicate the newly assessed intensity to flight control via ACARS.
 - If a pilot acts based upon their own assessment that precipitation intensity levels are LOWER than the official reported intensity level, a Cabin Check is required within the 5 minutes preceding takeoff.
- Pilot assessment of precipitation intensity levels may only be used when there is enough natural sunlight or artificial lighting available to provide adequate exterior visibility. All windows through which the assessment is made must be adequately transparent so as to not restrict the pilot's visibility under the lighting conditions present.
- The Snowfall Intensities as a Function of Prevailing Visibility chart in the Flight Crew Operations Manual, Volume 1, is based on prevailing visibility and allowances are made for the effects of night light conditions.
- Ice pellet intensity shall be assessed using the following criteria:
 - Light - scattered pellets that do not completely cover exposed surfaces regardless of duration
 - Moderate - slow accumulation on the ground
 - Heavy - rapid accumulation on the ground
- Pilots are not permitted to self-assess intensity in the case of reported freezing drizzle or freezing rain unless no precipitation is actually falling. Freezing drizzle and freezing rain quickly adhere to cold surfaces and can be difficult to see; for this reason, if conditions are reported or anticipated the aircraft shall be de-iced and/or treated with anti-icing fluid as a precaution against encountering these conditions during taxi-out.

- (3) Based on all the information obtained in steps 1 and 2, reference the appropriate Holdover Time Table and determine:
 - A single time from the frost, freezing fog, light freezing rain or ice pellets column, or
 - A time range from the snow, freezing drizzle, or rain on cold soaked wings column.
- (4) If a single time was extracted from the table, go to step 5. If a time range was extracted, determine a specific holdover time from this range by assessing:
 - Intensity of precipitation. As a general rule, holdover time ranges should be interpreted as follows:
 - Light conditions = Upper end of time range.
 - Moderate conditions = Lower end of time range.
 - Heavy conditions = Less than the lower time value.
 - When determining intensity, the pilots must consider the rate, density, and moisture content of the precipitation. For example, wet snow is considered more intense than dry/powdery snow and will have a lower holdover time. Wet snow occurs at or near freezing temperatures of -1°C (30°F) or above.
- (5) Further refine the determined holdover time after considering the following additional factors:
 - Environmental factors - Jet blast, high wind velocity, and wind direction may cause anti-icing fluid to flow off aircraft surfaces thus reducing holdover time. Blowing snow due to wind or jet blast could decrease holdover time by increasing the amount of precipitation contacting aircraft surfaces and diluting the fluid. Solar radiation from direct sunlight may increase holdover time by warming aircraft surfaces.
 - Aircraft skin temperature - Although this is difficult to determine, pilots need to be aware that aircraft skin temperature lower than OAT may decrease holdover time. One of the best ways to assess wing skin temperature is by referencing the fuel temperature, if available. Fuel temperature significantly lower than OAT may decrease holdover time.
 - Operational experience of the pilots - For example, pilots who rarely fly in ground icing conditions may feel more comfortable using more conservative holdover times. Additionally, any background knowledge or experiences can be applied by the pilots.

Adjusting Holdover Time

A continuous assessment of weather and environmental conditions in conjunction with the Flight Deck Check is required during the holdover time period. Changing conditions may increase or decrease fluid effectiveness, necessitating a holdover time adjustment.

- A change in OAT.
- A change in type or intensity (rate or density) of precipitation. Snow changing to light freezing rain, or light snow changing to heavy snow will decrease holdover time. Conversely, moderate snow changing to light snow may increase holdover time. Presence of ice pellets precipitation may necessitate similar adjustment.
- Jet blast, an increase in wind velocity, or a change in wind direction will decrease holdover time.

Exceeding Holdover Time

The Captain is responsible for monitoring the status of the aircraft exterior for frozen contamination. The pilot performs periodic Flight Deck Checks to ensure the aircraft is free of contamination during the time between anti-icing and takeoff, whenever the holdover time is still valid.

When holdover time is exceeded, the required course of action will depend upon the type of active precipitation and the type of fluid used to anti-ice. Refer to the foldout card in this section for additional specific guidance.

Required Action When Holdover Time is Exceeded

Fluid Used to Anti-Ice	Active Precipitation					
	Frost	Freezing Fog	Snow, Snow Grains	Freezing Drizzle	Light Freezing Rain	Rain on Cold Soaked Wings
Type I	Accomplish one of the following actions: A Cabin Check, An External Check, or Secondary De/Anti-Icing			Takeoff Not Authorized		
Type II, Type III, or Type IV				Accomplish one of the following actions: An External Check, or Secondary De/Anti-Icing		

Configuring the Aircraft for De/Anti-icing

It is the responsibility of the pilots to ensure the aircraft is properly configured prior to commencing de/anti-icing operations.

Note: Whenever de/anti-icing will occur during overnight parking, the pilots must ensure the aircraft is properly configured prior to leaving for the night. Refer to the Securing for Cold Weather procedure contained in this section.

Ground De-Icing/Anti-Icing

Before de/anti-icing:

Parking brake.Set

Establish communications with ground personnel.

Operate engines as directed by ground personnel or 10-0 pages.

Flaps/slats. UP/RETRACT
Prevents ice and slush from accumulating in the flap cavities.

APU or external power. As required

AIR COND SUPPLY switches OFF

Outflow valve Close

Manually position the outflow valve position indicator to abeam the 15 flap position.

(88) OVERWING HEATER switch. ARM

WARNING: Once the deicing operation begins, any aircraft movement or changes in configuration must be coordinated with the ground crew.

After deicing and before anti-icing:

Deice crew reports that tactile check is complete (and on MD-88 asks if WARM light is illuminated).

(88) If WARM light is illuminated (may take up to 12 minutes after arming):

De-ice crew will proceed with anti-icing as required.

(88) If WARM light is not illuminated:

When asked by the de-ice crew if WARM light is illuminated:

Press switchlight to initiate a reset of the WARM light.

If WARM light is now illuminated,

De-ice crew will proceed with anti-icing as required.

If WARM light does not illuminate immediately after reset, inform deice crew.

Ground crew will deice the entire aircraft again.

After second deicing is complete, deice crew accomplishes tactile check and proceeds with anti-icing as required.

Note: If WARM light fails to illuminate following a WARM light system reset attempt, consider the overwing heater blanket system inoperative and comply with MEL.

After de/anti-icing:

Obtain and read back post de/anti-icing report.

Fluid type.

Concentration (for Type II, Type III, and Type IV only).

Local time final (anti-icing) fluid application began and current local time.

Verbal confirmation: "POST DE/ANTI-ICING CHECK COMPLETE,"
"TACTILE CHECK COMPLETE."

Reconfigure aircraft:

APU As required

Outflow valve AUTO

Engine(s) (if required) Restart

AIR COND SUPPLY switches As required
Allow approximately 1 minute for residual fluid to drain prior to using packs.

Determine holdover time

Use HOLDOVER TIME GUIDELINES table.

Holdover time starts when the final application of fluid begins.

Actual weather conditions could be different from reported conditions. The Captain makes the final determination using the most accurate of METAR, ATIS, or pilot observation. Refer to Icing in the Airway Manual, Weather chapter, Hazardous Weather section and the Snowfall Intensities as a Function of Visibility chart for additional information.

During taxi, complete normal checklists

Consider delaying flap/slat extension when freezing precipitation or slush may accumulate on untreated surfaces, or when slush may accumulate in flap areas. Delay accomplishment of the Taxi checklist until flaps/slats and stabilizer are positioned for takeoff.

Perform engine run-up as required in the following table:

Aircraft	Interval	Min. N1	Duration
MD-88	10 Minutes	70 %	15 seconds
		60 %	40 seconds
MD-90	Prior to T/O	50 %	Momentary
MD-88		70 %	Momentary
MD-90		50 %	Momentary

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◆ **Special Considerations for Ice Pellets**

Ice pellets generally remain in the frozen state, imbedded in anti-icing fluid, and are not absorbed by fluid in the same manner as other forms of frozen precipitation. In the past, presence of a contaminant not absorbed by the fluid would be an indication of a failed fluid. Ice pellets imbedded in anti-icing fluid are difficult to detect using a cabin check. Therefore, a cabin check during ice pellet conditions may not be of value and is not required.

Use of Holdover Time Tables for Ice Pellets and Ice Pellet Mixtures

After proper deicing and anti-icing, takeoff is allowed under conditions of light ice pellets, moderate ice pellets, and ice pellets mixed with other forms of precipitation by using the "Ice Pellet Holdover Times" table and accompanying footnotes. If the holdover time has been exceeded, the aircraft must be completely deiced, and if precipitation is still present, anti-iced again prior to a subsequent takeoff. The ice pellet holdover time cannot be extended by a cabin check or an external check of the aircraft critical surfaces.

✳ **Special Considerations for Heavy Snow**

Takeoffs are allowed in heavy snow provided:

- The aircraft has been anti-iced with 100% concentration Type IV fluid following deicing, and
- A Cabin Check is accomplished within the 5 minutes preceding takeoff

If a definitive fluid failure determination cannot be made using this check due to snowfall, lighting conditions, or any other reason, the aircraft must be completely deiced and anti-iced (if precipitation is still present) prior to takeoff.

Ice Pellet Holdover Times (100% Type IV Fluid Only)					
HOLDOVER TIMES (MINUTES)					
°C	°F	LIGHT ICE PELLETS ONLY	ICE PELLETS ONLY	MODERATE ICE PELLETS ONLY	
				LT-MOD SNOW	LT-MOD FREEZING DRIZZLE
≥ 0	≥ 32	50	25	25	25
< 0 to -5	< 32 to 23	50	25	25	25
< -5 to -10	< 23 to 14	30	10	10	10
< -10	< 14	30	10	NOT AUTHORIZED	

Holdover times begin at the start of the anti-icing application.
Ice pellet holdover times are valid provided:

- Undiluted (100%) Type IV fluid is used for anti-icing.
 - Critical surfaces are free of contamination before applying Type IV anti-icing fluid (i.e., ice pellets cannot be falling during either the deice or anti-ice steps).
 - The table's precipitation intensity and temperature limits are not exceeded.
- Type IV anti-icing fluid is considered effective for 90 minutes after the start of application, under the following conditions:
- If precipitation stops falling at any time during the holdover period, and
 - the holdover time has not been exceeded, and
 - the OAT has not decreased.
- If precipitation resumes, the original holdover time must not be exceeded.
- If the temperature decreases, or conditions degrade to a point where a different holdover time must not be exceeded (from the start of the anti-icing step).

Snowfall Intensities as a Function of Prevailing Visibility									
Visibility (Statute Mile)									
Time of Day	Day		Night		OAT	°C	°F	> 2½	< 2½ - 2
	Day	Night	Day	Night					
RVR Feet	6000	5000	4000	2400					
RVR Meters	2000	1600	1200	800					
Statute Miles	1-1/4	1	3/4	1/2					

Conversions				
RVR Feet	6000	5000	4000	2400
RVR Meters	2000	1600	1200	800
Statute Miles	1-1/4	1	3/4	1/2

TYPE I									
APPROXIMATE HOLDOVER TIMES (MINUTES)									
°C	°F	ACTIVE FROST	FREEZING FOG	VERY LIGHT	LIGHT	SNOW/SNOW GRAINS *		MODERATE	TAKEOFF NOT AUTHORIZED
						FREEZING DRIZZLE	RAIN		
≥ -3	≥ 27	45	11	18 - 22 ♦♦	11 - 18 ♦♦	6 - 11 ♦♦	5 - 8 ♦♦	4 - 6 ♦♦	
< -3 to -6	< 27 to 21	45	8	14 - 17 ♦♦	8 - 14 ♦♦	6 - 11 ♦♦	5 - 8 ♦♦	4 - 6 ♦♦	
< -6 to -10	< 21 to 14	45	6	11 - 13 ♦♦	6 - 11 ♦♦	4 - 7 ♦♦			
< -10	< 14	45	5	7 - 8 ♦♦	4 - 7 ♦♦				

♦♦ To use these times the fluid must be heated to a minimum temperature of 60°C (120°F) at the nozzle and at least 1 liter per square meter (2 gallons per 100 square feet) must be applied to de-ice surfaces.

* Refer to "Snowfall Intensities as a function of Prevailing Visibility" chart if no other environmental factors inhibiting visibility, i. e., smoke or fog, are present.

Holdover times DO NOT exist for conditions of ice pellets, snow pellets, heavy snow, freezing drizzle, freezing rain, or hail, and takeoff is NOT authorized under these conditions.

TYPE IV									
APPROXIMATE HOLDOVER TIMES (MINUTES)									
°C	°F	Fluid Concentration (Fluid/Water)	ACTIVE FROST	FREEZING FOG	SNOW/SNOW GRAINS*	ICE PELLETS ♦	See Ice Pellets Table	TAKEOFF NOT AUTHORIZED	
								MOD - LGT	MOD - LGT
≥ -3	≥ 27	100/0	12 hrs	75	35-75	*		40-70	25
< -3 to -10	< 27 to 14	75/25	5 hrs	65	20-55			35-50	15
		100/0	12 hrs	20	20-40	*		10-20	
		75/25	5 hrs	25	15-35			20-45	10
		100/0	12 hrs	20	20-40	*		15-30	10
< -10 to -14	< 14 to 7	75/25	5 hrs	25	15-35				
< -14 to -25	< 7 to -13	100/0	12 hrs	15	15-30	*			
< -25	< -13								

‡ Use only for 0° C (32° F) or above.

* Refer to "Snowfall Intensities as a function of Prevailing Visibility" chart if no other environmental factors inhibiting visibility, i. e., smoke or fog, are present.

** If positive identification of freezing drizzle is not possible, use light freezing rain holdover times.

† Takeoffs are allowed in heavy snow provided:

(1) the aircraft has been anti-iced with 100/0 concentration Type IV fluid following deicing, and

(2) a pre-takeoff contamination (cabin) check is accomplished within the 5 minutes preceding takeoff.

and anti-iced (if precipitation is still present) prior to takeoff.

♦ Refer to Ice Pellets Holdover Times table in this section.

Type II and Type III Fluid Holdover Times Tables

TYPE II

OAT		FLUID CONCENTRATION (FLUID/WATER)	ACTIVE FROST	APPROXIMATE HOLDOVER TIME (MINUTES)					
°C	°F			FREEZING FOG	SNOW/ SNOW GRAINS*	FREEZING DRIZZLE**	LIGHT FREEZING RAIN	RAIN ON COLD SOAKED WING†	
									MOD - LGT
≥ -3	≥ 27	100/0	8 hrs	35	20 - 45	30 - 55	15	5 - 40	
		75/25	5 hrs	25	15 - 30	20 - 45	10	5 - 25	
		50/50	3 hrs	15	5 - 15	5 - 15			
< -3 to -10	< 27 to 14	100/0	8 hrs	20	15 - 30	15 - 45	10		
		75/25	5 hrs	20	10 - 20	15 - 30			
< -10 to -14	< 14 to 7	100/0	8 hrs	20	15 - 30		TAKEOFF NOT AUTHORIZED		
		75/25	5 hrs	20	10 - 20				
< -14 to -25	< 7 to -13	100/0	8 hrs	15	15 - 30				
< -25	< -13				USE TYPE I FLUID				

* Refer to "Snowfall Intensities as a function of Prevailing Visibility" chart if no other environmental factors inhibiting visibility, i. e., smoke or fog, are present.

** If positive identification of freezing drizzle is not possible, use light freezing rain holdover times.

† Use only for 0°C (32°F) or above.

Holdover times DO NOT exist for conditions of ice pellets, snow pellets, heavy snow, moderate to heavy freezing rain, or hail, and takeoff is NOT authorized under these conditions.



TYPE III										
OAT		APPROXIMATE HOLDOVER TIMES (MINUTES)								
°C	°F	FLUID CONCENTRATION (WATER/FLUID)	ACTIVE FROST	FREEZING FOG	SNOW/SNOW GRAINS *			FREEZING DRIZZLE **	LIGHT FREEZING RAIN	RAIN ON COLD SOAKED WING†
					VERY LIGHT	LIGHT	MODERATE			
≥ -3	≥ 27	100/0	120	20	35 - 40	20 - 35	10 - 20	10 - 20	8	6 - 20
		75/25	60	15	25 - 35	15 - 25	8 - 15	8 - 15	6	
		50/50	30	10	15 - 20	8 - 15	4 - 8	5 - 9		
< -3 to -10	< 27 to 14	100/0	120	20	30 - 35	15 - 30	9 - 15	10 - 20	8	
		75/25	60	15	25 - 30	10 - 25	7 - 10	9 - 12	6	
< -10 to -29	< 14 to -20	100/0	120	20	30 - 35	15 - 30	8 - 15	TAKEOFF NOT AUTHORIZED		
< -29	< -20	USE TYPE I FLUID								
† Use only for 0° C (32° F) or above.										
* Refer to "Snowfall Intensities as a function of Prevailing Visibility" chart if no other environmental factors inhibiting visibility, i. e., smoke or fog, are present.										
** If positive identification of freezing drizzle is not possible, use light freezing rain holdover times.										

Hot Weather Operation

During ground operation the following considerations will help keep the airplane as cool as possible:

- If a ground source of conditioned air is available, the supply should be plugged in immediately after engine shutdown and should not be removed until either the APU or the engines are started.
- If a ground source of conditioned air is not available, use both air conditioning packs.
- 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 in use.
- Open all passenger cabin gasper outlets (as installed) and close all window shades on the sun-exposed side of the passenger cabin.
- Open all flight deck air outlets.

Turbulent Air Penetration Procedures

- Limit speed to 280 ± 5 knots/ $.77 \pm .02$ Mach.
- Ignition on.
- Avoid making large pitch, roll, thrust or trim changes.
- For severe turbulence:
- Avoid severe turbulence if at all possible.
- Leave AP engaged if conditions permit.
- A/T should be off.
- Use TURB mode if desired.
- If severe turbulence cannot be avoided, buffet margin may be increased by descending approximately 4,000 feet below FMS optimum altitude.

Windshear

Windshear is a change of wind speed and/or direction over a short distance along the flight path. Severe windshear is that which produces airspeed changes greater than 15 knots or vertical speed changes greater than 500 feet per minute.

Avoidance

The flight crew should search for any clues to the presence of windshear along the intended flight path. Stay clear of thunderstorm cells and heavy precipitation and areas of known windshear. If windshear is indicated, delay takeoff or do not continue an approach.

The presence of windshear may be indicated by:

- Thunderstorm activity
- Virga (rain that evaporates before reaching the ground)
- PIREPS
- Low level windshear alerting system (LLWAS) warnings

Precautions

If windshear is suspected, takeoffs, approaches, and landings are not recommended. In the vicinity of unstable weather, 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:

Takeoff

- Use normal takeoff thrust instead of reduced thrust.
- Use the Flap setting selected by AWABS for the runway in use.
- Adjust V speeds per the Windshear procedure in the QRH Non-Normal Maneuvers chapter.
- Use the longest suitable runway, provided it is clear of areas of known windshear.
- 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 PM 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.
 - If windshear should be encountered near VR, and airspeed suddenly decreases, there may not be sufficient runway left to accelerate back to the normal VR. If there is insufficient runway left to stop, initiate a normal rotation at least 2000 feet before the end of the runway even if airspeed is low. Higher than normal attitudes may be required to lift-off in the remaining runway.

Approach and Landing

- Use the most suitable runway that avoids the areas of suspected windshear and is compatible with crosswind or tailwind limitations.
- Select the minimum landing flap position consistent with field length.
- Add an appropriate airspeed correction (correction applied in the same manner as gust), the maximum command speed should not exceed the lower of $V_{ref} + 20$ knots or landing flap placard speed minus 5 knots.
- Avoid large thrust reductions or trim changes in response to sudden airspeed increases as these may be followed by airspeed decreases.
- Crosscheck flight director commands using vertical flight path instruments.
- Crew coordination and awareness are very important, particularly at night or in marginal weather conditions. Closely monitor the vertical flight path instruments such as vertical speed, altimeters, and glideslope displacement (refer to the Windshear procedure in QRH, Non-Normal Maneuvers chapter for windshear indications information). The pilot monitoring should call out any deviations from normal. Use of the autopilot and autothrottle for the approach may provide more monitoring and recognition time.

Recovery

Refer to the Windshear Escape Maneuver in the Non-Normal Maneuvers chapter of the Quick Reference Handbook.

Guidelines for Contaminated Runways

When there is contamination on the runway or the braking action is less than good, The Captain must evaluate crew, aircraft, and environmental conditions in determining the safety of operating the flight.

For takeoff, refer to the Flight Operations Manual (FOM), Chapter 5, Flight Planning, Weight Data Record (WDR), Contaminated Runways, for additional guidance.

For landings, refer to the Airway Manual, Chapter 4, Weather Braking Action for additional guidance.

Procedure Guidance

General

- Consider crew capability.
- Consider current Maintenance Carry Overs (reversers, anti-skid, etc).
- Consider type and amount of contaminant.
- Consider source and age of reported braking action.
- Consider usable runways and taxiways (NOTAMS, ATIS, etc.).

Taxi

- Be aware that ramps and taxiways may be very slippery.
- Be cautious of jet blast effect on ground personnel and equipment.
- Taxi onto and off runways at an extremely slow speed. Nose wheel slipping may allow the aircraft to move in an unintended direction and possibly off the paved surface.

Crosswind

On slippery runways, crosswind guidelines are a function of runway surface condition, airplane loading, and proper pilot technique.

The following crosswind guidelines are applicable to all Delta aircraft for takeoff and landing.

Braking Action	Crosswind - knots*	Tailwind - knots
Good	Aircraft Limits	10*
Fair**	20	5
Poor**	10	0
Nil	Do Not Operate	

* Unless the aircraft and airport are authorized for 15 knots.

****Takeoff** on untreated ice or snow should only be attempted when no melting is present.

Note: Crosswind guidelines are not considered limitations. Refer to the Limitations chapter for crosswind limits.

Note: For landing, reduce crosswind guidelines by 5 knots with an inoperative thrust reverser.

Note: When multiple reports are present, e.g. “Braking Action Fair to Good”, use the lower crosswind value.

Takeoff

- Do not takeoff with braking action report of NIL by any air carrier aircraft or airport operator.
- A rolling takeoff is strongly advised when the crosswind exceeds 20 knots.
- Do not takeoff with a standing water, slush, or wet snow in excess of 1/2 inch (1.2 cm) depth.
- Do not takeoff in dry snow in excess of 4 inches (10 cm) depth.

Landing

- Do not land with braking action report of NIL by any air carrier aircraft or airport operator in the landing or rollout portion of the runway.
- Do not land with a standing water, slush, or wet snow in excess of 1 inch (2.5 cm) depth.
- Do not land in dry snow in excess of 4 inches (10 cm) depth.
- Land as early in the touchdown zone as possible.
- Ensure the ground spoilers are extended at touchdown.
- Use autobrakes, if available.
- Use reverse thrust judiciously.
- Do not assume the last 2,000 feet of the runway will have similar braking action as the touchdown zone.
- Be aware of possible white-out effects from reverse thrust usage in dry snow conditions.

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Differences

Chapter DF

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Supplementary Procedures
MD-88/90 Differences**Chapter DF**
Section 10

Introduction

Review of this section is one method of maintaining recency on both aircraft types if you have only flown one type during the past 90 days.

Air Systems

Item	MD-90	MD-88
Cabin Air Recirculation System	Recirculation fan operates on ground under certain circumstances to help maintain cabin ventilation.	Recirculation fan operates in flight only.
Air Conditioning Indicators	Flow gauges indicate air conditioning pack discharge flow.	Pressure gauges indicate supply pressure for each air conditioning pack.
Pneumatics	Pneumatic overheat detection system determines source (L or R) of TAIL TEMP HIGH.	TAIL COMPT TEMP HIGH warning light does not differentiate between left and right sides.

Anti-Ice, Rain

Item	MD-90	MD-88
Engine Anti-Ice	Engine anti-ice is cowlings only (7th stage bleed air).	Engine anti-ice provides heat to cowlings, bullet nose, inlet guide vanes and EPR probe.
Engine Anti-Ice (Bullet Nose)	Bullet nose is rubber coated and vibration eliminates ice buildup.	N/A
Airfoil Ice Protection	With airfoil ice selected, wing/tail anti-icing alternates every 15/2.5 minutes. Moving flaps to 40° will cause both the wing and tail to be antiiced until on the ground or flaps are repositioned to less than 40°.	With airfoil ice selected, wing/tail anti-icing alternates every 15/2.5 minutes regardless of flap setting.
Airfoil Ice Protection (Forward Strakes)	Electrical heating elements are installed in the forward strakes.	Forward strakes are anti-iced with pneumatic air.

Electrical

Item	MD-90	MD-88
System Operation	Engine driven generators are variable speed constant frequency (VSCF). Converters maintain constant voltage output.	Engine driven generators are driven through constant-speed drives which convert the variable speed output of the engine to a constant speed. The CSDs maintain a constant voltage and frequency output regardless of varying engine speed and electrical loads.
Controls and Indicators	Two bus tie relays perform function of APU bus switches, external power switches and AC crosstie relay (automatic operation).	APU bus switches, external power switches and an AC crosstie relay are used to connect the right and left AC buses to an appropriate electrical power source.
Battery	Will power all equipment listed on overhead emergency circuit breaker panel and DC transfer bus for approximately 45 minutes.	Will power all equipment listed on emergency circuit breaker panel and DC transfer bus for approximately 30 minutes.

Engines, APU

Item	MD-90	MD-88
APU ECU	APU controlled by an ECU to maximize fuel efficiency by modulating airflow.	ECU not available for automatic control.
APU Duct Pressurization	Automatic APU pneumatic duct depressurization on L/R TAIL TEMP HIGH light.	No automatic duct depressurization on TAIL COMPT TEMP HIGH light.
APU Warm-Up	No warm-up needed prior to using pneumatic air.	60-second warm-up required prior to using pneumatic air.
APU as Pneumatic Air Supply	Can be used for pneumatic air supply up to 20,000 feet.	Cannot be used for pneumatic supply in flight.
APU Maximum Altitude	Maximum altitude for start: FL 350.	Maximum altitude for start: FL 370.
APU Air Switch ON	Provides pneumatic air and opens ram inlet door to maximize APU performance.	Opens APU load control valve to provide APU air to aircraft pneumatic system.
APU Air Switch OFF	Turns off pneumatic air and closes ram inlet door to prevent runway contact on takeoff and landing.	Turns off pneumatic air by closing APU load control valve.
APU DOORS Switch	No APU doors switch - automatic operation of doors.	APU DOORS Switch used to control APU doors automatically or manually.

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Item	MD-90	MD-88
APU Ram Air Door	During ground operation, moving the APU AIR Switch to ON will open the ram door. When open, the ram door extends even with the tail skid. Moving the APU AIR Switch to OFF will retract the ram door, thus eliminating the possibility of ram door damage in the event of a tail skid strike during takeoff rotation or landing flare.	In AUTO position, APU ram air door opens automatically at the beginning of the start cycle and closes when the APU reaches 95%.
Engine Type	International Aero V2500 engines.	Pratt & Whitney JT8D-219 engines.
Static Thrust	Static thrust of 28,000 pounds.	Static thrust of 21,750 pounds.
N1 Mode	N1 mode - an EEC mode initiated automatically when EEC can no longer calculate a valid EPR (DEFAULT light on overhead panel illuminates). Also initiated when throttle advanced beyond the frangible gate.	N1 mode is not installed.
N2	N2 displayed in digital form only.	N2 displayed in analog as well as digital form.
N2 Idle RPM	55 to 60%	50 to 60%
Thrust Rating Window	Thrust rating window (formerly EPR Limit Readout on MD-88) displays engine rating selected with 28K or 25K buttons on TRP.	EPR limit readout is installed instead of thrust rating window. Individual CMD EPR readout windows are installed.
Thrust Mode Window	Thrust mode window displays current thrust mode selected with TRP.	Thrust mode window is not installed.

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Item	MD-90	MD-88
Engine Vibration Display	Engine vibration display shows vibration level from 0 to 9.9 (normal range is approximately 0.0 to 4.0).	Engine vibration display is not installed.
Flashing EGT	Flashing EGT much more accurate; indicates impending HOT start.	Same, but not as accurate.
Ignition Switch	Two-position switch, AUTO and ON.	Five-position ignition switch is installed. OFF, A, B, BOTH, and OVERRIDE.
Ignition Rating	Ignition rated for continuous operation.	Ignition is rated for operation of 10 minutes ON and 10 minutes OFF for cooling.
Automatic Ignition	AUTO position automatically alternates between the A and B systems for normal engine starts or provides dual ignition for T/O, approach, engine anti-ice ON, sub-idle (N2) conditions, engine surge and throttle past frangible gate).	Automatic ignition is not installed.
Ignition System	ON powers both ignitors continuously when fuel switch is on.	Ignition is provided when selector switch is in the A, B, or BOTH position when the FUEL lever is ON. Ignition is provided continuously when the selector switch is in OVERRIDE regardless of the fuel lever position.
Engine Starting (Modes)	Normal and manual modes.	Manual starting mode only.
Engine Starting (Normal Mode)	Normal mode uses ignition in AUTO. Normal mode controls start valve, fuel metering and ignitors.	N/A

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Item	MD-90	MD-88
Engine Starting (Normal Mode AUTO ABORT)	Normal mode performs AUTO ABORT for hot start, hung start, locked N1 rotor, ignition failure, electronic control lost, engine stall and EGT failure. Once N2 reaches 50%, the AUTO-ABORT feature is inhibited.	No AUTO ABORT capability.
Engine Starting (Manual Mode)	Normal mode uses ignition in ON.	N/A
Engine Starting (Manual Mode Auto Abort)	For manual start, auto abort is not available.	All starts are manual.
Engine Starting (START Switch)	START switch automatically goes in by 43% or should be manually pushed in by 45%.	START switch must be held in the ON position from start initiation until N2 reaches 40%.
Engine Starting (Stabilized Idle)	Stabilized idle N2 is 55 - 60%.	Stabilized idle is 50 - 60%.
Synchronizer System	Two position switch. Synchronizes N1 (N1 position) or EPR (OFF position) only.	Three position switch. Synchronizes N1, N2, or EPR (OFF position).

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Item	MD-90	MD-88
Thrust Rating Panel	Only 25K thrust rating may be derated. TO/GA - Selects takeoff and go around thrust. 1 - Selects Takeoff Derate 1 and Climb Derate 1 in combination with TO or CL selection (provides 12% derate). 2 - Selects Takeoff Derate 2 and Climb Derate 2 in combination with TO or CL selection (provides 18% derate). FLEX can be selected with 25 k thrust and setting the appropriate assumed temperature.	Only derate is flex power with assumed temperature. TO selects normal takeoff power. Derate 1 and Derate 2 not available. TO FLEX selects alternate takeoff power (must also turn ART switch OFF and set assumed temperature).
Engine Oil System	Both air-cooled and fuel-cooled oil cooler. Unregulated oil pressures are higher.	Only fuel-cooled oil cooler is installed. Regulated oil pressures are lower.
Oil Pressure (PSI)		
Min for Engine Start	Indicated by 20% N2	Indication
Amber light ON	80	40
Red light ON	60	35
Oil Temperature (°C)		
Min before advancing throttle above idle	-10	N/A
Min for Takeoff	50	N/A
Amber light ON	155	135
Red light ON	165	165

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**Supplementary Procedures -
MD-88/90 Differences**

Item	MD-90	MD-88
Oil Quantity (QTS)		
Max Capacity	28	16
Min dispatch from maintenance station	16	12
Min dispatch from non-maintenance station	12	8
Min after start	8	N/A
Thrust Reversers	Cascade-type reversers are installed. Activation above 60 knots provides a maximum of 1.30 EPR (past/overrated thrust gate increases reverse thrust an additional 10%); below 60 knots, provides a maximum of 1.07 EPR.	Clamshell-type reversers are installed.

Fire Protection

Item	MD-90	MD-88
FIRE TEST	Single FIRE TEST switch tests both A and B systems on left and right engines and APU. Test indications are: 2 engine fire handles, 2 aural warnings, 2 engine bells, 2 master warning lights and 1 APU fire light. Single FAULT TEST switch tests both loop systems and fire detection components for faults.	Two fire test LOOP buttons are installed. FIRE TEST is accomplished by pressing LOOP A and LOOP B buttons simultaneously.
Test Indications (Illuminated)	Test indications are: 6 loop lights, 2 master caution lights and 4 messages (L/R/APU FIRE DETECT FAULT and FIRE LOOP INOP).	Test indications are: 2 engine fire handles illuminated, 2 aural warnings, 2 fire bells, 2 master warning lights, 2 master caution lights, 1 APU fire light, a fire detector loop message, and 6 loop lights.
Test Indications (Not Illuminated)	Agent low lights and fuel switch lights do not illuminate during test.	Agent low lights do not illuminate during test.
FAULT TEST	FAULT TEST is for maintenance use only.	FAULT TEST switch is not installed.
Loop Operation	Loop operation is same, only management is different.	Loop operation is same, only management is different.
Automatic Loop Test	Automatic loop test for short circuits or if falsely energized.	Automatic loop tests are not installed.
Fuel Switch	Fuel switch, if ON, illuminates with respective fire warning handle.	Fuel switch lights are not installed.
Engine Fire Handle	Pulling L/R engine fire handle will shut off fuel at the fuel metering unit and at the wing.	Pulling L/R engine fire handle shuts off fuel only at the wing.

Flight Controls

Item	MD-90	MD-88
Elevator	Elevator is normally hydraulically powered.	Elevator is not normally hydraulically powered.
Flight Control Check	Includes an up and down limit check of the elevator via illumination of the blue ELEVATOR AT LIMIT light on the annunciator panel.	Produces ELEVATOR POWER ON light when the elevator power augmentor system activates. Occurs when the elevator control tabs have been displaced approximately 10° nose down with respect to the elevator surface.
HYD CONT ELEV Switch	HYD CONT ELEV Switch is used to bypass powered elevator (OFF light illuminates).	HYD CONT ELEV Switch is not installed.
Loss of Hydraulic Pressure	If hydraulic pressure is lost, reverts to manual elevator (ELEVATOR CONTROLS MANUAL message illuminates).	N/A
Control Columns	The left and right control columns are connected by means of a split torque tube. Should any part of the system become jammed between the control columns and control tabs, a pre-locked detent-type mechanism will allow the pilots to override the jam by using approximately 150 lbs of force.	N/A

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Item	MD-90	MD-88
Rudder Throw Limiter	Rudder throw is 3° (restricted) to 23° (unrestricted).	Rudder throw is 2.5° (restricted) to 22° (unrestricted).
Unrestricted Rudder	Rudder Throw is constantly monitored by a Rudder Hook Monitor (RHM) System. No blue RUDDER UNRESTRICTED light.	Blue light advises of unrestricted rudder.
Backup Rudder Limiter	A backup rudder limiter limits rudder deflection to 10°. If both hydraulic systems fail, the backup rudder limiter is inoperative.	There is no backup rudder limiter.

Flight Instruments, Displays

Item	MD-90	MD-88
System Display Panel	System display panel indicates TAT.	System display panel indicates RAT.
EVENT Pushbutton	EVENT pushbutton installed to mark an event on the flight data recorder.	EVENT pushbutton is not installed.

Flight Management, Navigation

Item	MD-90	MD-88
FMS	When DES NOW is executed on the DESCENT Page, the VNAV button does not have to be pressed to initiate the descent.	When DES NOW is executed on the DESCENT Page, the VNAV button must be pressed to initiate the descent.

Fuel

Item	MD-90	MD-88
Alternate Fuel Burn	Center tank to approximately 3,000 pounds, then main tanks to approximately 4,000 pounds, then center tank to empty, then back to main tanks.	Center tank to approximately 10,000 pounds, then main tanks to approximately 4,000 pounds, then center tank to empty, then back to main tanks.
Return to Tank System	Return to tank (RTT) system recycles fuel heated by the fuel-oil heat exchanger to the main fuel tanks.	Return to tank (RTT) system not installed.
Fuel Tank Vent System	Fuel tank vent system permits overflow into the center tank so that heated, recycled fuel can return to the main tanks even when center tank is feeding and main tanks are full.	N/A
Fuel Heat	Fuel heat is not installed.	Manual fuel heat installed.

Hydraulics

Item	MD-90	MD-88
Hydraulic Quantity (QTS)	Left Minimum - 9 Right Minimum - 10	Left Minimum - 8 Right Minimum - 9

Landing Gear

Item	MD-90	MD-88
Brakes	Brakes are carbon brakes with different temperature limits.	Brakes are conventional steel brakes with different temperature limits.
Autobrakes	Below 90 knots, 25% pedal deflection is required to disengage autobrakes. Above 90 knots, 90% pedal deflection is required to disengage autobrakes.	Autobrakes are disarmed at any speed by depressing brake pedals beyond 25% travel.
Autobrakes (RTO)	Autobrakes in RTO mode use both hydraulic systems at all speeds.	Autobrakes in RTO mode use only the right hydraulic system at speeds less than 70 knots; at speeds greater than 70 knots, both hydraulic systems are used.
Autobrakes (Delay)	All autobrake modes apply with one (1) second time delay.	Max brakes apply with one (1) second time delay. Min. & Med. autobrakes apply with three (3) second time delay.
Brakes Temperatures		
OVHT Light ON	540	305
OVHT Light OFF	425	260
Set brakes	500 max	300 max
Takeoff	440 max for 11° flaps or greater and elevations of 1100' or less and OAT 100°F or less. Subtract 15°C for each knot of tailwind and/or 2°C for each 1°F above 100°F. See Delta Airways Manual special pages or ODM for other conditions.	300 max

Warning Systems

Item	MD-90	MD-88
OAP	Status light below OAP screens. Replaces MONITOR light. Advises 2nd level discrepancies or system information requiring no procedural action by the flight crew.	Monitor light advises of fault in OAP.

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