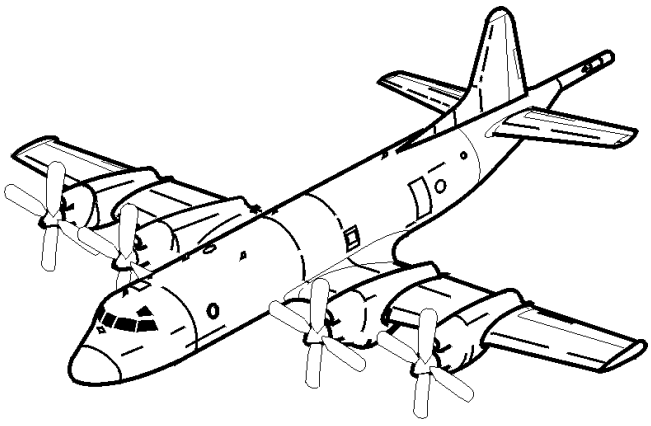
NAVAIR 01-75PAC-1

NATOPS FLIGHT MANUAL
NAVY MODEL
P-3C AIRCRAFT

THIS PUBLICATION SUPERSEDES NAVAIR 01-75PAC-1 DATED 1 JUNE 2005.

TO BE USED IN CONJUNCTION WITH NATOPS FLIGHT MANUAL NAVAIR 01-75PAC-1.1



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DEPARTMENT OF THE NAVY
NAVAL AIR SYSTEMS COMMAND
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47123 BUSE ROAD, BLDG 2272
PATUXENT RIVER, MD 20670-1547

1 August 2007

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization (NATOPS) Program is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft mishap rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the Commanding Officer in increasing the unit's combat potential without reducing command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual requirements and procedures is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, Commanding Officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAV Instruction 3710.7, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and carried for use in naval aircraft.

S. R. EASTBURG
Rear Admiral, United States Navy
By direction of
Commander, Naval Air Systems Command

INTERIM CHANGE SUMMARY

The following Interim Changes have been cancelled or previously incorporated into this manual.

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1 thru 83	Previously Incorporated

The following Interim Changes have been incorporated into this Change/Revision.

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
84	Misc. changes
85	ASW-60 Digital Autopilot System

Interim Changes Outstanding — To be maintained by the custodian of this manual.

INTERIM CHANGE NUMBER(S)	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE

Summary of Applicable Technical Directives

Information relating to the following technical directives has been incorporated in this manual.

CHANGE NUMBER	DESCRIPTION	DATE INC. IN MANUAL	VISUAL IDENTIFICATION
AFC-457	AN/ALR-66(V)3 Installation	01 May 1987	
AFC-517	Fuel Tank Foam	01 Sept 1991	
AFC-540	AN/ARN-151 Global Positioning System (GPS)	01 June 1997	
AFC-554	Install Upgraded AS-2146A/ APS-115 Radar Antenna	15 Mar 2002	
AFC-562	AN/ASH-37 Structural Data Recording System	15 Feb 1999	
AFC-563	Counter Drug Upgrades	15 Mar 2002	
AFC-568	Counter Drug Upgrades	15 Mar 2002	
AFC-589	Refrigerator Replaced/Microwave Provisions	15 Mar 2002	
AFC-597	Communications Improvement Program (CIP)	15 Mar 2002	
AFC-603	Electronic Flight Display System (EFDS)	15 Mar 2002	
AFC-611	OV-78/A IACS Removal	15 Mar 2002	
AFC-615	AN/ALR-95 Radar Signals Detecting Set	15 Mar 2002	
AFC-619	Removal of APN-187 or APN-227 Doppler Radar	15 Mar 2002	
AFC-625	A/P22P-21 Parachute (NB-8 Replacement)	15 Mar 2002	
AFC-627	Control Surface Bearing Replacement	15 Mar 2002	
AFC-628	Flight Station Oxygen System Improvements	15 Mar 2002	
AFC-632	Temperature Control Amplifier System Circuit Projection	15 Mar 2002	
AFC-637	Remove/Replace Air Flow Multiplier	15 Mar 2002	
AFC-643	ASN-179 RINU Wiring Modification	15 Mar 2002	
AFC-651	ARC-182A(V) V/UHF Radio Set Provisions	01 Jun 2005	
AFC-654	Upgrade of AN/APS-137B/C(V)5 Radar Set	01 Jun 2005	
AFC-660	5 Vac Control Pedestal Red Lighting Wiring Mod	01 Jun 2005	
AFC-661	Installation of Infrared Anti-Collision Lights	01 Jun 2005	
AFC-662	Installation of AIP SLAMER System	01 Jun 2005	

CHANGE NUMBER	DESCRIPTION	DATE INC. IN MANUAL	VISUAL IDENTIFICATION
AFC-663	AN/ARC-187(V) Line of Sight FM Mode Capability	01 Jun 2005	
AFC-667	Mod of AN/USC-42(V)3 Mini-DAMA Power Wiring	01 Jun 2005	
AFC-669	Mod of AN/ASX-4 AIMS Nose Radome Wiring	01 Jun 2005	
AFC-671	Upgrade of AN/USQ-78(V) Display-Control Set	01 Jun 2005	
AFC-672	Upgrade of AN/USQ-78B(V) Display-Control Set	01 Jun 2005	
AFC-673	Mod of Flight Station Oxygen System	01 Jun 2005	
AFC-675	Mod of AN/ALE-47(V) and AN/APS-137(V) Circuit	01 Jun 2005	
AFC-676	Mod of OASIS Mounting	01 Jun 2005	
AFC-678	Change Wing Flap Carriage Access Door Clip	01 Jun 2005	
AFC-682	Mod of Electronic Flight Display System	01 Jun 2005	
AFC-683	Relocation of Radar Navigation System AS-2146A/APS-115	01 Jun 2005	
AFC–705	AN/ASX–6 Multi–Mode Imaging System	1 Jun 2007	

P-3 Update Program

The purpose of the P-3C Update Program is to accomplish modifications to the P-3C aircraft and/or weapons systems necessary to improve its capability for performing ASW and related VP missions. The following demonstrates the evolution of the baseline P-3C.

	EQUIPMENT ADDED	EQUIPMENT DELETED	EQUIPMENT MODIFIED
UPDATE I	Logic Unit No. 4	MC-2 Altimeter	RD-319 Mag Tape Transport
159503 — 160289	ARN-99 Omega Navigation SS 1/2 ASA–66 Display	ARN-81 Loran	ASQ-114 Computer ARC-143B UHF AQA-7 Improved DIFAR
UPDATE II	AWG-19 HACLCS	ARW-77 Bullpup	AQH-4 Recorder–Reproducer
160290 — 161131	AAS-36 IRDS ARS-3 SRS	KA-74 FWD Camera AXR-13 LLLTV	
UPDATE II 1/2	APN-227 Doppler	APN-187 Doppler	Standardize Pylons
161132 — 161596	OV-78 IACS ASH-33 DMTS ARN-118 TACAN ARN-140 VOR ARC-197 VHF	RD-319 MTT ARN-84 TACAN ARN-32/ARC-87 VOR UYQ-8 SETAD KB-18 AFT Camera ARC-101 VHF	Teletype Printer
UPDATE III 161762 and subsequent	ALQ-158 ECM ARR-78 SRS UYS-1 Analyzer USQ-78 Display	ARR-72 SRS SSQ-36 BT AQA-7 DIFAR/DICASS ID-1872 Ambient Sea Meter	EDCs Exhaust Fan ECS Ducts and Outlets Air Multiplier
	SG-1156 ATSG GTC95-3 APU ASH-33A DMTS	AQA-76 Signal Generator ASH-33 DMTS GTCP95-2 APU	Cabin Pressure Schedule

	EQUIPMENT ADDED	EQUIPMENT DELETED	EQUIPMENT MODIFIED
ASUW Improvement Program (AIP)	AN/AIC-41 ICS CP-2339/ASQ-222 Computer AN/ALR-95 SEI AN/ASX-4 AIMS APS-137C(V)5 Radar AN/AAR-47 Missile Warning Set AN/ALE-47 Countermeasures Dispenser System USQ-42(V)3 Mini-DAMA System AN/0Z-72(V) MATT Oasis III TDP Maverick Missile Control System	AN/AIC-22 ICS CP-2044/ASQ-212 Computer AN/ULQ-16 Pulse Analyzer AAS-36 IRDS APS-115 Radar	ALR-66C(V)3
Block Modification Update Program (BMUP)	CP-2451/ASQ-227 Computer AN/USQ-78B Acoustic Processor AN/AQH-13 ADR EFDS	CP-901 Computer AQA-7 DIFAR/DICASS AN/AQH-4 Recorder-Reproducer	AN/ARR-78 ASCL

This list is intended to show the production effort only that caused the Update change. Equipment changes have also occurred by Airframe Changes (AFCs) and are not shown.

RECORD OF CHANGES

Change No. and Date of Change	Date of Entry	Page Count Verified by (Signature)

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NAVY MODEL P-3 AIRCRAFT

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LIST OF ABBREVIATIONS AND ACRONYMS

A

A-4. Three-Axis Accelerometer.

A/A. Air-to-Air.

A/C. Aircraft.

AC. Alternating Current.

ACP. Autopilot Control Panel.

ACR. Auxiliary Control Relay.

ADB. Acoustic Distribution Box.

ADC. Automatic Drift Control.

ADDU. Air Data Display Unit.

ADF. Automatic Direction Finder.

ADIZ. Air Defense Identification Zone.

ADRL. Automatic Distribution Requirement List.

AFC. Airframe Change.

AFCS. Automatic Flight Control System.

AFM. Airflow Multiplier.

AGL. Above Ground Level.

AIMS. Advanced Imaging Multispectral Sensor.

AIP. ASuW Improvement Program.

Alpha Range. Propeller Flight Operating Range.

AM. Amplitude-Modulation.

AME. Amplitude Modulated Equivalent.

ANDVT. Advanced Narrowband Digital Voice Terminal.

AOA. Angle-of-Attack.

AOB. Angle of Bank.

AOP. Airborne Operational Program.

APC. Autopilot Computer.

APU. Auxiliary Power Unit.

APU ESS. APU ESSENTIAL (DC BUS).

ARINC. Aeronautical Radio Incorporated.

ARO. Auxiliary Readout Display.

AS. Anti-Spoofing.

ASCL. Advanced Sonobuoy Communication Link.

ASP. Advanced Signal Processor.

ASR. Air Surveillance Radar.

ASuW. Anti-Surface Warfare.

ASW. Antisubmarine Warfare.

ATC. Air Traffic Control.

ATM. Air Training Missile.

ATSG. Acoustic Test Signal Generator.

ATT REF. Attitude Reference.

ATTD SEL. Attitude Select.

B

BAROSET. Barometric Pressure Setting.

BATT. Battery.

BBC. Backup Bus Controller.

BC. Bus Controller; Bus Coupler.

BCN. Beacon.

Beta. Propeller Blade Angle.

Beta Range. Propeller Ground Operating Range.

BFO. Beat-Frequency Oscillator.

BIT. Built-In Test (Facilities for External Test).

BITE. Built-In Test Equipment (Facilities for Self-Test).

BMUP. Block Modification Update Program.

BTRY. Battery.

BU. Battery Unit.

Bus A. MAIN AC BUS A.

Bus B. MAIN AC BUS B.

C

CAD. Cartridge-Actuated Device.

CAS. Calibrated Airspeed — Knots.

CASS. Command Active Sonobuoy System.

CB. Circuit Breaker.

CBIT. Continuous Built-In Test.

CBR. Chemical, Biological, Radiological.

CCA. Circuit Card Assembly.

CCI. Controlled Cryptographic Item.

CCU. Cockpit Control Unit.

ccw. Counterclockwise.

CDI. Course Deviation Indicator.

CDLS. Communications Data Link System.

CDNU. Control Display Navigation Unit.

CDU. Control Display Unit.

cg. Center of Gravity.

CHRD. Color High Resolution Display.

CI. Control Indicator.

CIP. Control Indicator Panel; Communications Improvement Program.

CMDS. Countermeasures Dispenser System.

CNARF. Commander, Naval Air Reserve Force.

CNS/ATM. Communications, Navigation, Surveillance/Air Traffic Management.

CNSU. Communications/Navigation Switching Unit.

COMSEC. Communications Security.

CON. Control.

CONFIG. Configuration.

CP. Computer Processor.

CPA. Closest Point of Approach.

CPRL. Commander, Patrol Reconnaissance Atlantic.

CPRP. Commander, Patrol Reconnaissance Pacific.

CRM. Crew Resource Management.

CRS. Central Repeater System.

CRT. Cathode Ray Tube.

CSC. Crew Station Control.

CSM. Crew Station Manual.

CSMM. Crew Station Maintenance Manual.

CTM. Centrifugal Twisting Moment; Counter Threat Maneuvers.

cw. Clockwise.

CW. Continuous Wave.

CWS. Control Wheel Steering.

D

DA. Drift Angle.

DAC. Digital-to-Analog Converter.

DADS. Dual Air Data Sensor.

DAI. Digital Audio Interface.

DAMA. Demand Assigned Multiple Access.

DAS. Digital Autopilot System.

dB. Decibel.

DBI. Digital Bus Interface.

DC. Direct Current.

DCI. Display Control Indicator; Digital Crew Interface.

DCP. Display Control Panel.

DCU. Display Computer Unit.

DDP. Dual Dispenser Panel.

DDS. Digital Data Set.

DDU. Digital Data Unit.

DEK. Data-Entry Keyboard.

DEP. Display Entry Panel; Data Entry Panel.

DFQS. Digital Fuel Quantity System.

DG. Directional Gyro.

DH. Decision Height.

DIS. Displays; Distance.

DME. Distance Measuring Equipment.

DMTC. Digital Magnetic Tape Control.

DMTU. Digital Magnetic Tape Unit.

DoD. Department of Defense.

DR. Dead Reckoning.

DSR TK. Desired Track Angle.

DT. Delta T.

DTM. Data Transfer Module.

DTS. Data Terminal Set.

E

EAS. Equivalent Airspeed — Knots.

ECA. Electronic Control Amplifier.

ECCM. Electronic Counter-Countermeasures.

EDC. Engine Driven Compressor.

EDDK. Emergency Data Destruction Kit.

EDP. Emergency Destruction Plan.

EEBD. Emergency Escape Breathing Device.

EFDI. Electronic Flight Director Indicator.

EFDS. Electronic Flight Display System.

EGT. Exhaust Gas Temperature.

EHSI. Electronic Horizontal Situation Indicator.

EMATT. Expendable Mobile ASW Training Target.

EMCON. Emission Control.

EMDC. Extension Main DC.

EOD. Explosive Ordnance Disposal.

EPOS. Emergency Passenger Oxygen System.

ESF. Explosive Suppressant Foam.

ESM. Electronic Support Measures.

ETA. Estimated Time of Arrival.

ETE. Estimated Time En Route.

EWO. Electronic Warfare Operator.

EWS. Electronic Warfare System.

EWSSD. EWS Status Driver.

EWSSI. EWS Status Indicator.

EXT MDC. Extension Main DC.

F

FAF. Final Approach Fix.

FCF. Functional Checkflight.

FDCI. Flight Digital Crew Interface.

FDE. Fault Detection and Exclusion.

FDI. Flight Director Indicator.

FDS. Flight Director System.

FDSC. Flight Director Steering Computer.

FEAC. Flight Essential AC.

FECB. Forward Electronic Circuit Breaker Panel.

FEDC. Flight Essential DC.

FF. Fuel Flow.

FLIR. Forward Looking Infrared.

FLT. Flight.

FM. Frequency Modulation.

FO. Foldout.

FOD. Foreign Object Damage.

FOG. Fleet Operator Guide.

FOM. Figure of Merit.

FPLN. Flight Plan Route.

FRPA. Fixed Reception Pattern Antenna.

FSK. Frequency Shift Keying.

FTE. Flight Technical Error.

FTP. Fly-to-Point.

G

GALL. Galley.

GCA. Ground Controlled Approach.

GCR. Generator Control Relay.

GOB. Ground Operation Bus (DC).

GP. General Planning.

gpm. Gallons Per Minute.

GPS. Global Positioning System.

GS. Glideslope; Groundspeed — Knots.

GTC. Gas Turbine Compressor.

gw. Gross Weight.

H

HARLID. High Angular Resolution Laser Irradiation Detector.

HARPS. Hardover Protection Systems.

Hd. Density Altitude.

HDG. Heading.

HERO. Hazard of Electromagnetic Radiation to Ordnance.

HF. High Frequency.

Hp. Density Pressure.

HRD. High Rate of Discharge.

HS. Hung Store.

HSC. Hydraulic Service Center.

HSI. Horizontal Situation Indicator.

HSP. High Speed Printer.

Hz. Hertz (Cycles/Second).

I

IACS. Integrated Acoustic Communication System.

IAS. Indicated Airspeed — Knots.

IBIT. Initiated Built-In Test.

ICAO. International Civil Aviation Organization.

ICE. Imaging and Communication Environment.

ICS. Intercommunications System.

IFA. In-Flight Alignment.

IFF. Identification Friend or Foe.

IFF/SIF. Identification Friend or Foe/Selective Identification Feature.

IFT. In-Flight Technician.

ILS. Instrument Landing System.

IMC. Instrument Meteorological Conditions.

IMN. Indicated Mach Number.

INBD. Inbound.

INC. Increase.

INS. Inertial Navigation System (Set).

INU. Inertial Navigation Unit.

I/O. Input/Output.

IOSC. Infrared Optical Sensor-Converter.

IR. Infrared.

IRDS. Infrared Detection System.

IRU. Interface Receptacle Unit.

ISAR. Inverse Synthetic Aperture Radar.

ITL. Intent to Launch.

J

JB. Junction Box; Jackbox.

K

KCAS. Knots Calibrated Speed.

kHz. Kilohertz.

KIAS. Knots Indicated Airspeed.

kVA. Kilo-Volt Amps.

L

LAT. Latitude.

LCD. Liquid Crystal Display.

LDR. Low Data Rate.

LED. Light Emitting Diode.

LEMA. Linear Electromechanical Actuator.

LF. Low Frequency.

LFA. LEMA Fails to Actuate.

LGWS. Landing Gear Warning System.

LLS. Left Line Select.

LO. Local Oscillator.

LOC. Localizer.

LONG. Longitude.

LOS. Line of Sight.

LPA. Life Preserver Assembly.

LPU. Life Preserver Unit.

LSB. Lower Side Band.

M

MAC. Mean Aerodynamic Chord.

MAD. Magnetic Anomaly Detection.

MAG. Magnetic.

MAG VAR. Magnetic Variation.

MAN. Manual (Tuning Mode).

MAP. Missile Armament Panel; Missed Approach Point.

MATT. Multi-Mission Advanced Tactical Terminal.

MBCN. Marker Beacon.

MC. Missile Controller.

MCP. Maintenance Control Panel; Missile Control Panel.

MDA. Minimum Descent Altitude.

MDC. Main DC.

MDF. Mission Data File.

MDL. Mission Data Loader.

MEAC. Monitorable Essential AC.

MEDC. Monitorable Essential DC.

MFD. Multi-Function Display.

MGRS. Military Grid Reference System.

MHRS. Magnetic Heading Reference System.

MHz. Megahertz.

MIB. Missile Interface Box.

MISP. Missile/IRDS Status Panel.

MLC. Main Load Center.

MLG. Main Landing Gear.

MLVS. Memory Loader Verifier Set.

MMR. Multimode Receiver.

MNL RLSE. Manual Release.

MO. Magneto-Optical.

MOSA. Minimum Operational Safe Altitude.

MOT. Mark On Top.

MPLR. Multi-Place Liferaft.

MPT. Motion Pickup Transducer.

MROD. Manual Reverse Osmosis Desalinator.

MSA. Minimum Safe Altitude.

MSL. Mean Sea Level.

MSU. Mode Selector Unit.

MTT. Magnetic Tape Transport.

MU. Memory Unit.

MVMS. Micro Voice Message System.

MVOL. Master Volume.

MWS. Missile Warning Set.

N

NATIP. Naval Aviation Technical Information Product.

NATOPS. Naval Air Training and Operating Procedures Standardization.

NAV/COMM. Navigator/Communicator; Navigation/Communication.

NAVAID. Navigational Aid.

NB. Narrow Band.

NDB. Navigation Database; Non-Directional Beacon.

NFO. Naval Flight Officer.

nm. Nautical Mile.

NM. Navigation Multiplexer.

NTS. Negative Torque Sensing; Negative Torque System.

NVIS. Night Vision.

NVM. Non-Volatile Memory.

O

OAD. Operational Availability Date.

OAT. Outside Air Temperature.

OBS. Observer.

OFP. Operational Flight Program.

OFT. Operational Flight Trainer.

OP. Operational Program.

OPNAV. Office of the Chief of Naval Operations.

OPORD. Operation/Operational Order.

ORD. Ordnance.

ORIDE. Override.

OSC. Optical Sensor-Converter.

OTCIXS. Officer in Tactical Command Information Exchange System.

OTPI. On-Top Position Indicator.

OUTBD. Outbound.

OVRD. Override.

P

PA. Power Amplifier; Public Address.

PAR. Precision Approach Radar.

PBD. Place, Bearing, and Place, Bearing.

PBIT. Periodic Built-In Test.

PBPB. Place, Bearing, and Distance.

PCHRD. Pilot Color High Resolution Display.

PCMCIA. Personal Computer Memory Card International Association.

PCO. Pressure Cutout Override.

PDEP. Pilot Data Entry Panel.

PDP. Power Distribution Panel.

PDTM. PCMCIA Data Transfer Module.

PEP. Programmable Entry Panel.

PERF. Performance.

PFD. Primary Flight Display; Program Functional Description.

PILS. Protected Instrument Landing System.

PIU. Power Interrupt Unit.

PLF. Parachute Landing Fall.

PMG. Permanent Magnet Generator.

POBS. Port Observer.

POS. Present Position.

PPC. Patrol Plane Commander.

PPCP. Patrol Plane Copilot.

pph. Pounds Per Hour.

ppm. Pounds Per Minute.

PPP. Patrol Plane Pilot.

PPS. Precise Positioning Service; Program Performance Specification.

PPTC. Patrol Plane Tactical Coordinator.

P-RAIM. Predictive RAIM.

PRF. Pulse Repetition Frequency.

PSH. Preselect Heading.

PSLT. Pressurized Sonobuoy Launch Tube.

PSR. Packed Snow on Runway.

PTT. Push-to-Talk.

PUBIT. Power-Up Built-In Testing.

PWR. Power.

R

RAIM. Receiver Autonomous Integrity Monitoring.

RAM. Random Access Memory.

RAWS. Radar Altimeter Warning System.

RC. Recorder Converter.

RCDR. Recorder.

RCR. Runway Condition Reading.

RCU. Remote Control Unit.

RCVR. Receiver.

RDSS. Replacement Data Storage System.

REC. Recover.

REF. Reference.

RF. Radio Frequency (Buoy Channel).

RGB. Reduction Gear Box.

RINU. Replacement Inertial Navigation Unit.

RIU. Radar Interface Unit.

RLS. Right Line Select.

RNP. Required Navigation Performance.

rpm. Revolutions Per Minute.

RSC. Runway Surface Covering; Radar Set Control.

RSCI. Radar Set Control-Interface.

RT. Receiver-Transmitter.

RTA. Receiver Transmitter Antenna; Required Time of Arrival.

RWR. Radar Warning Receiver.

S

SA. Selective Availability.

SAASM. Selective Availability/Anti-Spoofing Module.

SAD. Sub Anomaly Detection; Standard Arming Device; Safety Arming Device.

SAR. Search and Rescue; Synthetic-Aperture Radar.

SARSAT. Search and Rescue Satellite Aided Tracking.

SASP. Single Advanced Signal Processor.

SATCOM. Satellite Communications.

SBIT. Start-up BIT.

SC. Sono Command; System Controller.

SDC. Signal Data Converter.

SD/DS. Synchro-to-Digital/Digital-to-Synchro.

SDRS. Structural Data Recording System.

SEAC. Start Essential AC.

SEDC. Start Essential DC.

SEI. Specific Emitter Identification.

SFC. Specific Fuel Consumption, Lb/Hr/SHP.

shp. Shaft Horsepower.

SID. Standard Instrument Departure.

SIF. Selective Identification Feature.

SLAMER. Stand-Off Land Attack Missile Expanded Response.

SLC. Sonobuoy Launch Container.

SLR. Slush on Runway.

SLT. Sonobuoy Launch Tube.

SMCS. Systems and Mission Control Subsystem.

SOBS. Starboard Observer.

SOFRO. Safety of Flight Radar Operator.

SONO. Sonobuoys.

SPKR. Speaker.

SPS. Standard Positioning Service.

SRCH. Search.

SRS. Sonobuoy Reference System.

SS. Sensor Station.

SSRGA. Solid State Rate Gyro Assembly.

STAT. Status.

STBY. Standby.

STS. Status/Action/Malfunction Code.

SUS. Sound Underwater Signal.

SYGNOG. System GO-NO GO.

T

TAC. Tactical.

TACAN. Tactical Air Navigation.

TACCO. Tactical Coordinator.

TAMPS. Tactical Automated Mission Planning System.

TAS. True Airspeed — Knots.

TCDL. Tactical Common Data Link.

TD. Temperature Datum.

TDP. Tactical Data Processor.

TIT. Turbine Inlet Temperature.

TK. Track Angle.

TK GS. Track Groundspeed.

TKE. Track Angle Error.

TMS. Tactical Mission Software.

TO. Takeoff.

T/R. Transmit and Receive.

TR. Transformer Rectifier.

TRK. Track.

TSC. Tactical Support Center.

TTSC. Target Tracking Sight Control; Target Tracking Sight Controller.

TTY. Teletype.

U

UHF. Ultrahigh Frequency.

USB. Upper Side Band.

V

V_{50}. Airspeed at 50-Foot Height.

Vac. Volts Alternating Current.

V_{CR}. Critical Speed for Engine Failure.

VCR. Video Cassette Recorder.

VCU. Video Converter Unit.

V_D. Decision Speed.

VDC. Video Distribution Controller.

Vdc. Volts Direct Current.

V_{EF}. Engine Failure Speed.

VFR. Visual Flight Rules.

VHF. Very High Frequency.

VIMG. Video Imaging.

VLAD. Vertical Line Array DIFAR.

V_{LOF}. Liftoff Speed.

VMC. Visual Meteorological Conditions.

$V_{MC\ AIR}$. Minimum Control Speed in Air.

$V_{MC\ GRD}$. Minimum Control Speed on Ground.

V_{NE}. Never Exceed Velocity.

VOR. Very High Frequency Omnidirectional Range.

VOX. Voice Activated Switch.

V_R. Refusal Speed.

V_{RO}. Rotation Speed.

VRU. Victim Rescue Unit.

V_S. Stall Speed.

VSI. Vertical Speed Indicator.

VTR. Video Tape Recorder.

W

WHT. White.

WOW. Weight-On-Wheels.

WPT. Waypoint.

WRA. Weapons Replaceable Assembly.

WRAT. Weapons Replaceable Assembly Test.

WST. Weapons System Trainer.

X

XMTR. Transmitter.

XTK. Crosstrack Angle/Crosstrack Distance.

XTK/TKE. Crosstrack/Track Angle Error.

Z

ZFW. Zero Fuel Weight.

ZLG. Zero-Lock Laser Gyros.

PREFACE

SCOPE

NATOPS manuals are issued by the authority of the Chief of Naval Operations and under the direction of the Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) program. NATOPS publications provide the best available operating instructions for most circumstances. However, no manual can cover every situation or be a substitute for sound judgment; operational situations may require modification of the procedures contained therein. Read these publications from cover to cover. It is your responsibility to have a complete knowledge of their contents.

Note

See Chapter 1 for more information on the scope and purpose of this manual, and for any special requirements or procedures that compliment those contained in this preface.

OTHER RELEVANT PUBLICATIONS

Current versions of the following publications comprise the family of NATOPS and tactical manual publications that complement the information contained within this manual:

NAVAIR 75PAC-1.1 (NFO/Aircrew NATOPS Flight Manual)

NAVAIR 01-75PAC-1.1B (NFO/Aircrew NATOPS Pocket Checklist, P-3C Model Aircraft)

NAVAIR 01-75PAC-1.1C (P-3C Weapons Delivery Checklist)

NAVAIR 01-75PAC-1.1D (NATOPS Aircrew Pocket Checklist/AGM-84K P-3C AIP Aircraft)

NAVAIR 01-75PAC-1C (NATOPS Checklist Normal Procedures)

NAVAIR 01-75PAC-1E (NATOPS Ditching and Bailout Placards, Navy Model P-3C Aircraft)

NAVAIR 01-75PAC-1F (NATOPS Functional Checkflight Checklist)

NAVAIR 01-75PAC-11 (Series) (P-3C Inflight Handbook)

NAVAIR 01-75PAC-12 (Series) (Crew Station Maintenance Manual)

NAVAIR 01-75PAI-11 (Series) (P-3C (AIP) Inflight Handbook)

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The current versions of NATOPS publications are listed in the NATOPS Status Report which is available online at https://airworthiness.navair.navy.mil. Upon receiving a copy of a NATOPS, consult the NATOPS Status Report to determine its current configuration (through the latest revision, change, and interim change). Before using this publication, users shall ensure that they have the current version of it.

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To be effective, NATOPS publications must be kept current through an active manual change program. Corrections, additions to, deletions from, and suggestions for improvement of contents should be submitted as NATOPS change recommendations as soon as possible after discovery. Suggestions for improvement should avoid vague and generalized language and shall be worded as specifically as possible. Detailed standards for NATOPS publications are found in MIL-DTL-85025B(AS), which is available online at https://airworthiness.navair.navy.mil. Change recommendations may be submitted by anyone in accordance with OPNAVINST 3710.7-series. All users are encouraged to contribute to the currency, accuracy, and usefulness of this and other NATOPS publications by submitting timely change recommendations for these publications.

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Types of Change Recommendations

Change recommendations should be submitted as URGENT, PRIORITY or ROUTINE. Urgent and Priority change recommendations are changes that cannot be allowed to wait for implementation until after the next review conference. These usually involve safety-of-flight matters. Some priority change recommendations may be upgraded to URGENT by NATOPS Program Manager, Program Class Desk, or NAVAIR (AIR-4.0P) following receipt and initial review.

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While each type of change recommendation is processed and approved differently, the preferred means of submitting all of them is through the Airworthiness Issues Resolution System (AIRS) which may be accessed online at https://airworthiness.navair.navy.mil, or on SIPRNET at https://airworthiness.navair.navy.smil.mil for classified or otherwise sensitive change recommendations. AIRS provides the fastest and most efficient means of processing and resolving NATOPS change recommendations. It expedites distribution of the URGENT and PRIORITY change recommendations to those who need to act on them and compiles the ROUTINE change recommendations into their respective review conference agenda packages.

In the event that a worldwide web connection to AIRS is not available, PRIORITY change recommendations may be submitted via Naval message in accordance with OPNAVINST 3710.7-series. When AIRS is not accessible, ROUTINE change recommendations may be submitted on a NATOPS/Tactical Change Recommendation (Form OPNAV 3710/6), a copy of which is contained within the preface of this manual. The completed change recommendations forms for changes to this manual should be sent by U.S. Mail to the NATOPS Model Manager of this publication at:

Commanding Officer
Patrol Squadron-30
NAS Jacksonville, FL 32212-0024
Attention: P-3 Evaluator
Telephone:
Commercial (904) 542-3030
DSN 942-3030

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NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV 3710/6 (4-90) S/N 0107-LF-009-7900 **DATE** _____

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (Originator)	Unit
TO (Model Manager)	Unit

Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (Be specific.)

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

TO BE FILLED IN BY MODEL MANAGER *(Return to Originator)*

FROM	DATE
TO	

REFERENCE

(a) Your Change Recommendation Dated _____

☐ Your change recommendation dated _____ is acknowledged. It will be held for action of the review conference planned for _____ to be held at _____

☐ Your change recommendation is reclassified URGENT and forwarded for approval to _____ by my DTG _____

/S/ _____ MODEL MANAGER	_____ AIRCRAFT

Form OPNAV 3710/6

Revisions, Changes and Errata

Routine change recommendations are compiled into a conference agenda and held for review at the next NATOPS review conference for this publication. Change recommendations approved by the review conference are published by the NATOPS Model Manager in a review conference report and then incorporated into a revision or change to this manual, copies of which are mailed on paper and/or electronic media to users that have a listed requirement for it in the NATEC ADRL system database. Copies of most unclassified publications are also posted on the NATEC and Airworthiness websites. When printing errors are found in publications, errata may also be prepared and posted and/or distributed in electronic or paper form in the same manner as for revisions and changes. After incorporating a change or errata into this publication, you should page check and record its entry on the Record of Changes page within this publication.

CHANGE SYMBOLS

Revised text is indicated by a black vertical line in the outside margin of the page, like the one printed next to this paragraph. The change symbol shows where there has been a change. The change might be material added or information restated. A change symbol in the margin by the chapter number and title indicates a new or completely revised chapter. Change symbols are not normally used to mark the locations of deleted information.

SPECIAL TERMINOLOGY IN NATOPS PUBLICATIONS

The following special terminology and meanings apply to the contents of this and other NATOPS publications:

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to WARNINGS, CAUTIONS, and Notes:

WARNING

An operating procedure, practice, or condition, etc., that may result in injury or death, if not carefully observed or followed.

CAUTION

An operating procedure, practice, or condition, etc., that may result in damage to equipment if not carefully observed or followed.

Note

An operating procedure, practice, or condition, etc., that is essential to emphasize.

Requirement for compliance

"Shall" is used only when application of a procedure is mandatory.

"Should" is used only when application of a procedure is recommended.

"May" and "need not" are used only when application of a procedure is optional.

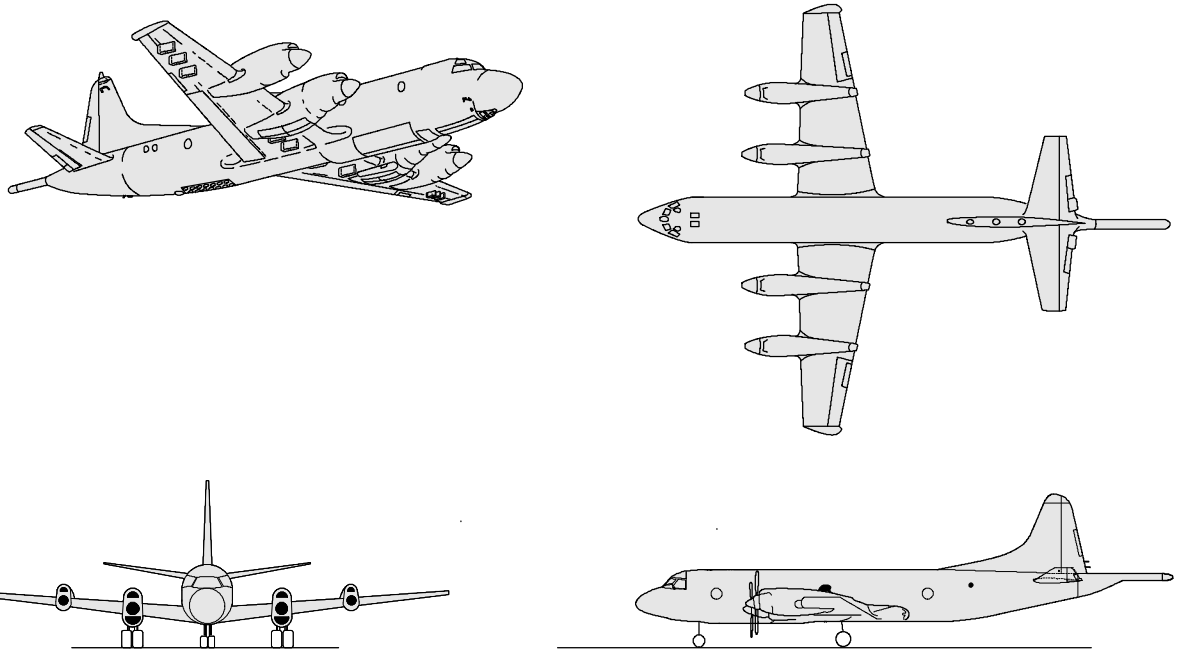
"Will" is used only to indicate futurity, and never to indicate any degree of requirement for applicability of a procedure.

Requirement for landing aircraft

Land immediately means execute a landing without delay. The primary consideration is to ensure the survival of the occupants. (Applicable to helicopters and other VTOL aircraft).

Land as soon as possible means land at the first landing site at which a safe landing may be made.

Land as soon as practical means extended flight is not recommended. The landing and duration of flight is at the discretion of the pilot in command.



PART I

The Aircraft

Chapter 1 — General Description

Chapter 2 — Systems and Equipment

Chapter 3 — Servicing

Chapter 4 — Operating Limitations

Chapter 5 — Armament Limitations

CHAPTER 1

General Description

1.1 THE AIRCRAFT

The P-3 is a four-engine, low-wing aircraft designed for patrol, antisubmarine warfare, and fleet support. It is in the 135,000-pound gross weight class and powered by four T56-A-14 turboprop engines. Each engine provides 4,600 Shaft Horsepower (SHP) (maximum rated) for takeoff. Distinguishing features of the aircraft include surface and subsurface detection gear, including computer interfacing of the detection gear, the ordnance, and armament systems. The P-3C model is readily identified by the installation of sonobuoy chutes, visible in the lower aft fuselage of the aircraft, and three additional small windows on the starboard side of the fuselage.

1.2 DIMENSIONS

The overall aircraft dimensions are as follows:

Wing span . . . . . 99 feet 8 inches.

Length . . . . . 116 feet 10 inches.

Height to top of fin (antenna) . . . . . 34 feet 3 inches.

Top of fin (antenna) to lower skin (FS 1185.5) . . . . . 24 feet 4 inches.

1.3 GENERAL ARRANGEMENT (FIGURE 1-1)

The fuselage is pressurized from the forward bulkhead of the flight station to the aft bulkhead in the cabin. Entrance to the cabin is by way of the door in the port side of the fuselage. The flight station is entered from the cabin. An electromechanical folding ladder, which stows in the cabin, can be used for personnel loading and unloading at stations where external loading ramps are not available. Emergency exit hatches are located over each wing in the sides of the fuselage, aft of the pilot side windshield panel, and in the top of the flight station. Lavatory, galley, and other convenience facilities are located in the aft fuselage.

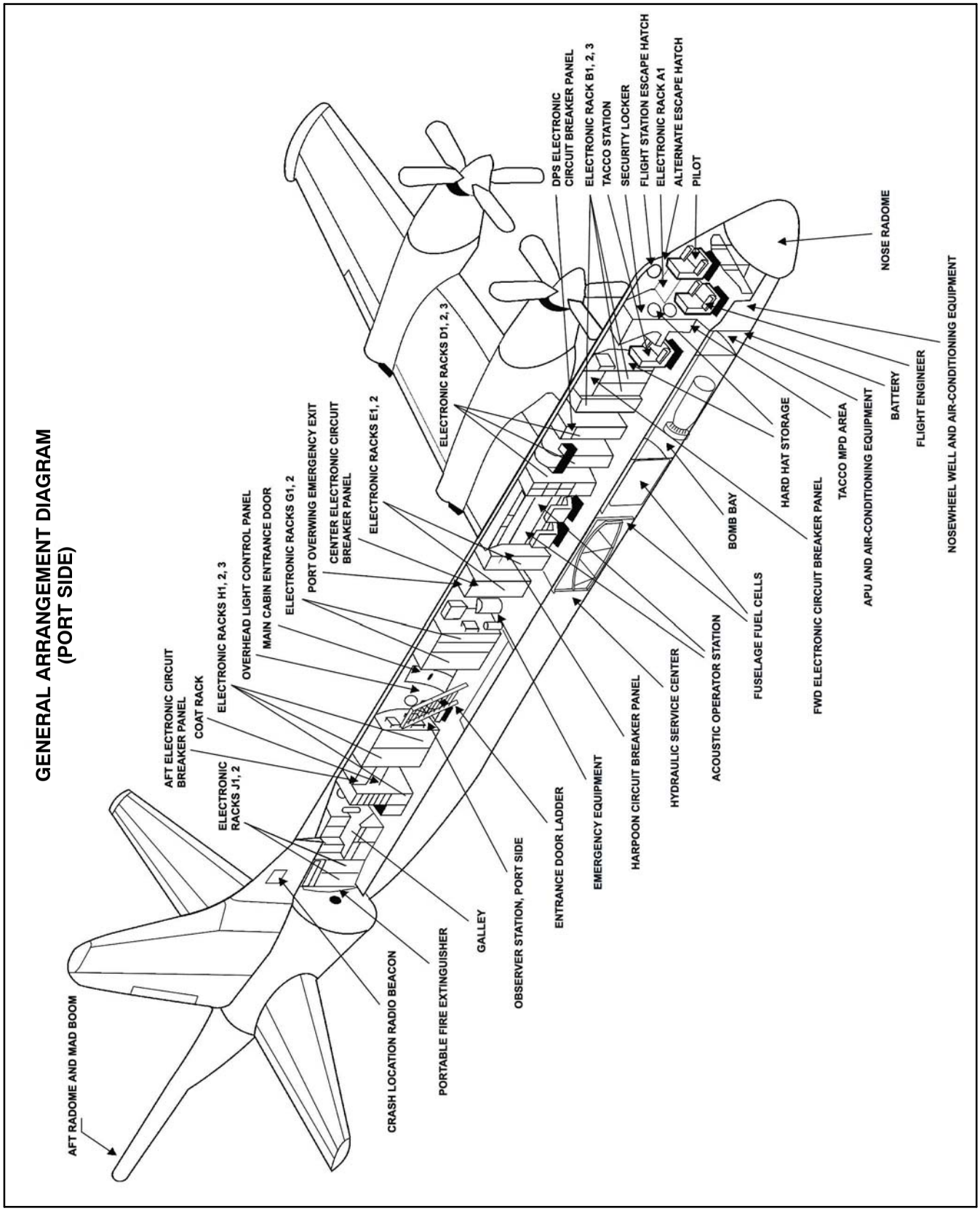


Figure 1-1. P-3 General Arrangement Diagram (Sheet 1 of 2)

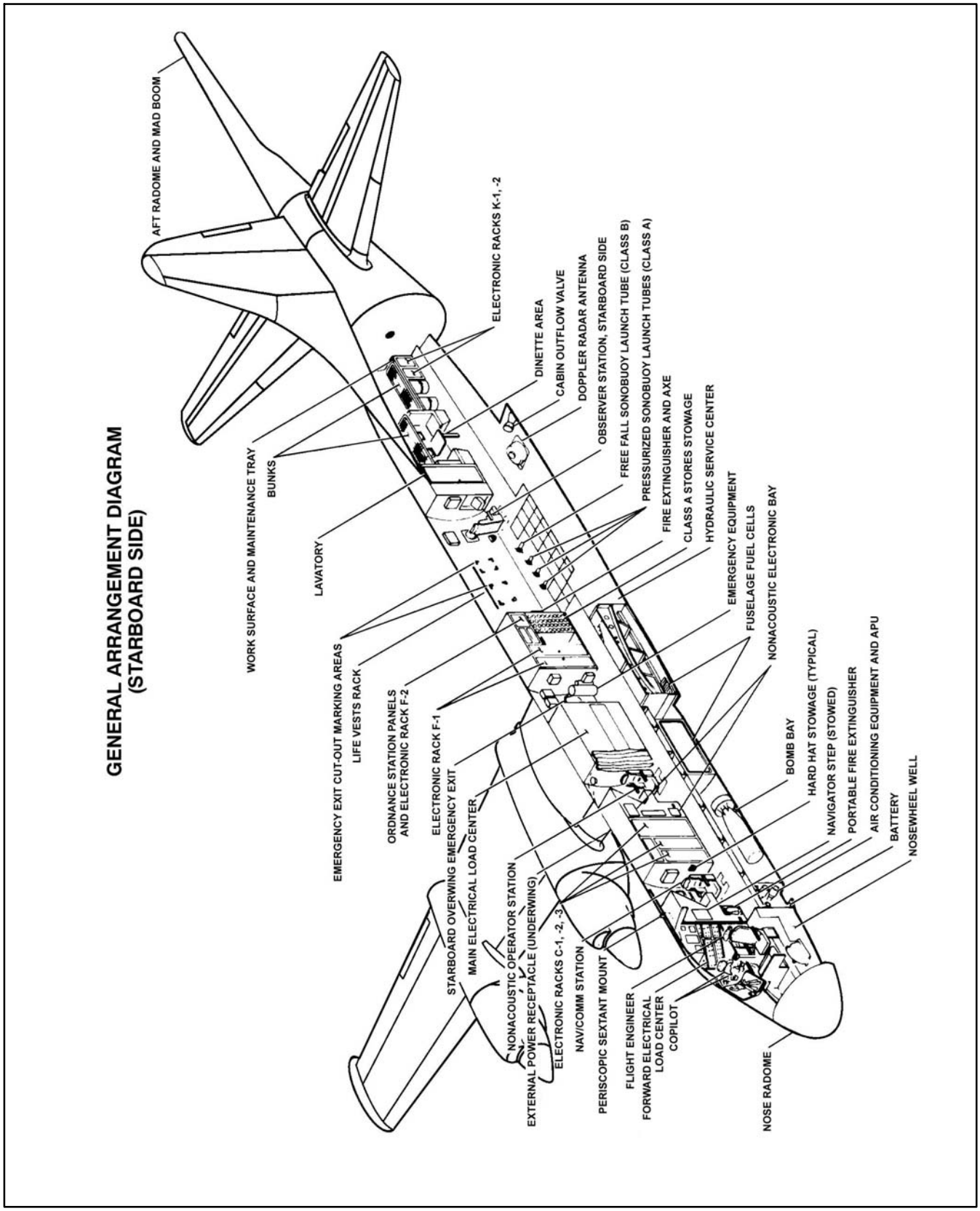


Figure 1-1. P-3 General Arrangement Diagram (Sheet 2 of 2)

CHAPTER 2

Systems and Equipment

2.1 AUXILIARY POWER UNIT (APU)

The APU is made up of a turbine compressor driving a generator that is identical to the engine-driven generators. The gas turbine compressor has a two-stage centrifugal compressor and a single-stage inward flow radial turbine. Air bled from the compressor is used for engine starting, ground air-conditioning, or for bomb bay heating. Because the power developed by the APU is somewhat limited, all of the features cannot be used simultaneously. If bleed air is demanded in sufficient quantities to jeopardize the generator output, the amount of bleed air being delivered is automatically reduced. Ground air-conditioning and engine starting air cannot be used simultaneously. It is possible, and permissible, to use ground air and bomb bay heating simultaneously. The APU can be operated in flight for electrical power use, but bleed air is not available.

The APU gas turbine engine is a self-contained power source that requires only the aircraft battery for starting. If power is available to the MONITORABLE ESSENTIAL DC BUS, the APU starter draws its power from the extension MAIN DC BUS. If no MONITORABLE ESSENTIAL DC BUS power is available, the FLIGHT ESSENTIAL DC BUS feeds power to the starter motor. Refer to Chapter 15 for emergency operation of the APU in flight.

2.1.1 Fuel System

Fuel for the APU gas turbine engine is normally supplied from the No. 2 fuel tank, although it may be supplied from any main tank through the crossfeed system. It is routed to the APU through a manual shutoff valve, a solenoid-operated fuel shutoff valve, and a fuel filter. The solenoid fuel shutoff valve is opened automatically when the APU control switch is positioned to START. The APU consumes approximately 300 Pounds Per Hour (pph) when operating a normal electrical load and the air-conditioning system.

2.1.2 Generator System

The APU generator control and protective circuits are identical to those of the three engine-driven generators. The APU generator assumes the electrical loads lost during malfunctions of the main engine-driven generators. An APU load monitoring relay drops out additional electrical loads if the aircraft is required to operate on APU generator only while in flight above 8,000 feet (refer to APU Generator-Only Operation Above 8,000 Feet [Full Load Monitoring], paragraph 2.2.5.2).

2.1.3 APU Controls and Indicators

Controls for the APU are located on the center overhead panel in the flight station. Refer to Foldout (FO) FO-16.

2.1.3.1 APU Control Switch

The guarded APU control switch, located on the APU overhead control panel, is labeled OFF, ON, and START. It is used for starting and stopping the APU. It is spring-loaded to the ON position from START. Placing the switch in the ON position (only) opens the intake and exhaust doors. In the OFF position, the APU shuts down and the intake and exhaust doors close after an approximate 1-minute time delay.

2.1.3.2 Generator Switch

The APU generator switch is identical to the engine-driven generator switch in operation. The switch is located on the electric power control panel and is labeled ON, OFF, and RESET.

2.1.3.3 INFLIGHT ARMING Switch

The guarded APU INFLIGHT ARMING switch, located on the APU control panel, has two positions: OFF and ARM. In the ARM position, the nose landing gear uplock switch is bypassed to energize the GROUND OPERATION DC BUS, the APU load control valve is disabled, and the APU scissor switch relay is bypassed to allow APU operation during in-flight emergencies. If this switch is positioned to ARM while the aircraft is on the ground, air-conditioning and engine starting are not available from the APU.

2.1.3.4 LIGHTS TEST Switch

The LIGHTS TEST switch, located on the APU control panel, can test the DOORS and ARMED lights at any time. When the APU OFF-ON-START switch is ON, it tests the APU GEN OFF light (on the electric power control panel) after the APU generator is online.

2.1.3.5 APU Fire Extinguishing Manual Release Switch

The extinguishing agent is discharged from the flight station by the manual release switch located adjacent to the APU fire detection indicator lights on the right side of the glareshield panel. This switch also shuts off the APU fuel supply and closes the compartment doors.

2.1.3.6 DOORS Signal Light

The DOORS signal light, located on the APU control panel, illuminates anytime the APU intake and/or exhaust doors are not closed.

2.1.3.7 APU Generator-Off Signal Light

The APU GEN OFF signal light, located on the electric power control panel, is similar in operation to the engine-driven generator light when the APU OFF-ON-START switch is ON and the APU is operating.

Note

If the APU generator control circuit breaker is out, the APU GEN OFF light will be on. Automatic APU load monitoring above 8,000 feet will be disabled; however, the generator will assume the load.

2.1.3.8 ARMED Signal Light

The ARMED signal light, located on the APU control panel, illuminates when the INFLIGHT ARMING switch is in the ARM position. The ARMED signal light indicates that the INFLIGHT ARMING switch has been positioned to ARM, the GROUND OPERATION DC BUS is energized, the load control valve is disabled, and the APU scissor switch relay is bypassed.

2.1.3.9 APU Tachometer

This instrument, located on the APU control panel, indicates the percent rpm of the gas turbine engine.

2.1.3.10 APU Exhaust Gas Temperature Indicator

This instrument is located on the APU control panel.

2.1.3.11 APU Fire Detector Test Switch

The APU fire detector test switch, located on the engine check portion of the overhead panel in the flight station, tests operation of the detector control unit and continuity of the detector sensing loop. The switch has a TEST and a NORMAL position. In the TEST position, the APU fire warning lights on the glareshield illuminate and the fire warning horn(s) (flight station and cabin) sound if the system is operating properly. On the ground, both horns will sound; in flight, only the flight station horn will sound. The TEST position disables the APU fire protection discharge system during the test sequence. Electrical power for the test circuit is provided through the APU essential bus.

2.1.4 Fire Protection System

A continuous-loop fire detection element is installed in the APU compartment. At a sufficient temperature, the warning lights glow, flight station and cabin warning horns sound, and the APU shuts down. When the intake and exhaust doors close, the fire extinguishing agent automatically discharges. For a detailed shutdown sequence, refer to Chapter 12.

2.1.4.1 APU and Fire Extinguisher Safety Switch

The APU safety switch, accessible through a door on the left side of the fuselage forward of the APU, is used during ground maintenance. When actuated:

1. APU intake and exhaust doors cannot be moved.
2. APU cannot be started, and, if running, shuts down.
3. Fire extinguishing system is deactivated.

2.2 ELECTRICAL POWER SUPPLY SYSTEM

The electrical power supply system provides the necessary Alternating Current (AC) and Direct Current (DC) power for aircraft requirements. Aircraft AC power is furnished by three engine-driven generators (GENs 2, 3, and 4) and one additional generator driven by the APU. AC power is furnished to five separate AC buses via a series of transfer relays (2 through 7) operating in conjunction with the runaround relays (1 and 2) and the AC monitoring relays. The six DC buses receive power from three transformer rectifier units (TR 1, 2, and 3). These units receive AC power from MAIN AC buses A and B, and the MONITORABLE ESSENTIAL AC BUS, respectively, and provide the necessary output voltage in DC form. Additionally, a 24-volt battery is provided to supply DC power to the ground operating bus, START ESSENTIAL DC BUS, and APU ESSENTIAL BUS via the FLIGHT ESSENTIAL DC BUS if required. The battery may also supply power to the START ESSENTIAL AC BUS via an inverter if necessary.

2.2.1 AC Power Supply

The P-3 utilizes AC as the primary electrical power source. The AC power requirements are supplied by four interchangeable brushless generators that supply 120-volt, three-phase power at 400 Hertz (Hz). Generators 2, 3, and 4 are mounted on the lower right section of the reduction gearbox of their respective engines. The APU generator is normally used for ground functions such as fueling and preflight/postflight inspections, but has the in-flight capability of supplying emergency electrical power if multiple generator failures should occur.

Note

Generator 4 and the APU generator cannot concurrently supply power to the aircraft electrical system. Transfer relay 7 gives generator 4 priority over the APU (refer to FO-10).

The brushless generator essentially incorporates three subgenerators to maintain its rated output. These are the permanent magnet generator, the exciter generator, and the main generator. Mounted in one common unit, these subgenerators work in unison to provide the required aircraft electrical power.

2.2.1.1 Permanent Magnet Generator (PMG)

When the engine-driven generator is on speed (engine operating at normal rpm), the PMG (Figure 2-1) generates single-phase, 39-Volts Alternating Current (Vac) power at 600 Hz and routes it to the supervisory panel located in the main load center. The supervisory panel senses the onspeed condition at the frequency sensor. Once on speed, the generator control relay in the supervisory panel is energized and allows the 39-Vac (now rectified to a lower voltage DC output) to proceed to the exciter section of the generator.

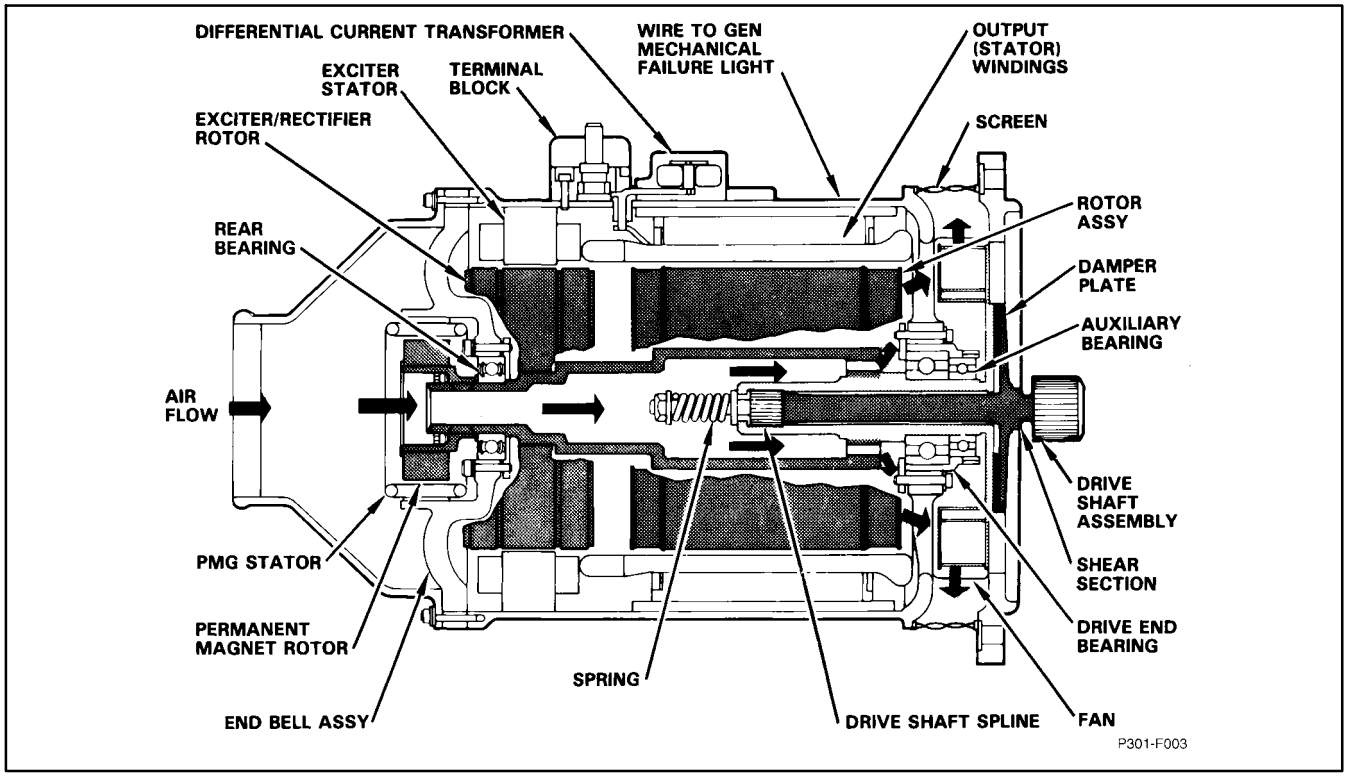


Figure 2-1. Generator Cutaway

Note

Power is supplied to a generator's respective supervisory panel by a 39-Vac PMG anytime the generator is turning (propeller rotating). It cannot be stopped by turning the respective generator switch OFF. Refer to Fuselage Fire or Electrical Fire of Unknown Origin, paragraph 12.3.

2.2.1.2 Exciter Generator

The exciter generator receives rectified DC power from the PMG via the supervisory panel. It utilizes this DC power to generate the exciter field for the main generator section. The exciter generator is the link between the PMG and the main generator via a rotating rectifier assembly.

2.2.1.3 Main Generator

The main section of the generator utilizes the excitation field of the exciter section to generate three-phase, 120-Vac power in the AC windings. Its output is checked by the supervisory panel voltage sensing unit for the proper voltage. When proper voltage is achieved, the Auxiliary Control Relay (ACR) is energized and AC power can now flow to the respective AC bus. The ACR in each supervisory panel controls bus transfer and is energized anytime the respective generator is available for load.

Note

With the No. 2 generator available for load (No. 2 supervisory panel ACR energized), the A coil of transfer relay No. 2 is energized and the No. 2 generator supplies power to the MAIN AC BUS A (FO-10).

2.2.1.4 Generator Mechanical Failure

Each generator contains two primary support bearings: the drive-end bearing and the rear bearing. In addition, an auxiliary bearing is installed adjacent to the drive-end bearing. The purpose of the auxiliary bearing is to assume the generator driveshaft load in the event the drive-end bearing should fail. If this occurs, the respective red GEN mechanical failure light on the horizontal annunciator light panel illuminates. The light illuminates anytime the auxiliary bearing is under a load.

An unresettable GEN OFF light accompanied by a GEN mechanical failure light may be indicative of various internal generator problems and requires engine shutdown. In the event of generator seizure, however, the generator driveshaft has a shear section to prevent damage to the reduction gear section. Refer to Generator Failure, paragraph 15.1.1 for a discussion of generator failure.

2.2.1.5 Supervisory Panels

Each generator has an associated supervisory panel located in the main electrical load center. As noted previously, each contains its respective Generator Control Relay (GCR), ACR, and voltage regulator. In addition, the supervisory panels provide overvoltage, undervoltage, underfrequency, and feeder-fault protection to their respective generators.

CAUTION

Due to no overfrequency protection, if rpm exceeds 109 percent, place respective GEN switch OFF.

If the supervisory panel senses incorrect voltage, underfrequency, or a feeder fault, the associated GCR and ACR are deenergized and the respective generator output is stopped. Illumination of the respective GEN OFF light in conjunction with the ELEC POWER light informs the crew of this condition. The Generator Reset Procedures, (paragraph 15.1.2) should be performed.

2.2.2 AC Power Distribution

AC power distribution is controlled by a transfer and runaround relay system. The transfer relays are located in the main electrical load center and ensure a power source is connected to MAIN AC buses A and B.

The runaround relays are located in the main electrical load center and ensure a source of power to the FLIGHT ESSENTIAL AC and MONITORABLE ESSENTIAL AC buses. The runaround relays do not require a separate source of power as they rectify available AC voltage to DC voltage for actuation.

Three AC monitoring relays, located in the forward electrical load center, function exactly like runaround relays. They allow the FLIGHT ESSENTIAL AC BUS to be powered by MAIN AC BUS A if the runaround relays fail and also allow the MONITORABLE ESSENTIAL AC BUS to be powered by the generators via the runaround relays if MAIN AC BUS A fails.

As shown in FO-10, the transfer and runaround system not only ensures a primary and backup source of power for the AC buses but actually sets a priority.

2.2.3 DC Power System

The DC power system consists of three 28-volt, 200-ampere transformer-rectifiers, six DC buses, an inverter, a 24-volt battery, and two power-blocking diodes.

The heart of the DC power system is the transformer-rectifier unit. Transformer-Rectifiers 1 and 2 (TR 1, TR 2) receive AC power directly from MAIN AC buses A and B, respectively. They in turn rectify the AC input to a 28-volt DC output for use at the MAIN DC BUS. Transformer-Rectifier 3 (TR 3) receives its AC power input from the MONITORABLE ESSENTIAL AC (MEAC) BUS and routes its 28-Volts Direct Current (Vdc) output to the MONITORABLE ESSENTIAL DC (MEDC) BUS.

DC power is distributed throughout the aircraft via the buses described in the following paragraphs.

2.2.3.1 MAIN DC (MDC) BUS

The MDC bus is powered by TR 1 and TR 2 and has no backup power sources; however, TR 1 or TR 2 alone supply sufficient power to carry the load of the MAIN DC BUS if the other TR unit should fail.

2.2.3.2 MONITORABLE ESSENTIAL DC BUS

The MEDC bus is powered by TR 3 via the MEAC bus. The backup power source is from the MDC bus via blocking diode No. 1.

2.2.3.3 FLIGHT ESSENTIAL DC (FEDC) BUS

The FEDC bus is powered directly from the MEDC bus via blocking diode No. 2. The backup power source is the aircraft battery. Blocking diode No. 2 will allow only one-way current flow from the MEDC bus to the FEDC bus.

2.2.3.4 START ESSENTIAL DC (SEDC) BUS

The SEDC bus is powered directly by the MEDC bus. The backup power source is from the FEDC bus via the inverter power relay.

2.2.3.5 GROUND OPERATION DC BUS (GOB)

The GOB is powered by the FEDC bus provided the ground operation bus relay is deenergized. This relay can be deenergized in three ways:

1. Place the nosegear uplock switch in the NOT UP position.
2. Place the APU INFLIGHT ARMING switch to the ARM position.
3. Pull the GRD OPERATION BUS RELAY circuit breaker on FEDC.

The GOB has no backup power source.

2.2.3.6 APU ESSENTIAL DC BUS

The APU ESSENTIAL (APU ESS) DC BUS is powered by the MEDC bus provided the power sensing circuit breaker on MEDC is set and MEDC is powered. The backup power source is from the GOB.

2.2.3.7 Battery

One 24-volt battery is located in the aft section of the nose wheelwell. The battery is normally used for starting the APU and is directly connected to the FEDC bus. Emergency power of 24 volts can be provided for a limited time by the battery in the event all other DC sources fail. The battery is capable of powering all DC buses (except MDC and the MEDC bus) in this case. Under normal operation, the battery receives a continuous charge from TR 3 via the MEDC and FEDC buses. Gases are vented overboard via a sump jar also located in the nose wheelwell. A quick-disconnect assembly is provided at the battery.

2.2.4 Electric Power Control Panel

All the switches and indicators required to control the electrical power supply system are located on the ELECTRIC POWER SYSTEM panel located on the flight station overhead panel. Refer to to FO-16. Each switch, control, and indicator is described individually in the following paragraphs.

2.2.4.1 GEN 2 OFF Light

The GEN 2 OFF light indicates that generator 2 is not powering bus A. The light illuminates when the A coil of transfer relay 2 is deenergized. The A coil will deenergize whenever the ACR is deenergized (e.g., overvoltage, undervoltage, underfrequency, feeder fault). MAIN AC BUS A (Bus A) will now be powered by an alternate source via the B coil of transfer relay No. 2.

2.2.4.2 GEN 3 OFF Light

The GEN 3 OFF light indicates that generator 3 is not powering MAIN AC BUS B (Bus B). The light illuminates when the A coil of transfer relay 3 is deenergized. The 3A side will deenergize whenever the ACR is deenergized (e.g., overvoltage, undervoltage, underfrequency, feeder fault). Bus B will now be powered by an alternate source via the B coil of transfer relay No. 3.

2.2.4.3 GEN 4 OFF Light

The GEN 4 OFF light indicates that generator 4 is incapable of powering any bus. The light indicates that the No. 4 supervisory panel is deenergized, and, therefore, the No. 4 generator is unavailable for load. Generator 4 can also be disabled by an open GEN 4 AUX CONT circuit breaker on the FEDC circuit breaker panel without the illumination of the GEN 4 OFF light.

2.2.4.4 Transformer-Rectifier Overheat Lights

These lights illuminate whenever the temperature of their respective transformer unit exceeds the safe value. To disconnect the appropriate transformer-rectifier, the associated circuit breaker must be pulled. The circuit breakers are:

1. The transformer-rectifier No. 1 circuit breaker is located on the MAIN AC BUS A circuit breaker panel.
2. The transformer-rectifier No. 2 circuit breaker is located on the MAIN AC BUS B circuit breaker panel.
3. The transformer-rectifier No. 3 circuit breaker is located on the MEAC circuit breaker panel.

Note

The MASTER ELEC POWER light on the vertical annunciator panel will illuminate whenever the following overhead lights illuminate:

4. GEN 2, 3, or 4 OFF.
5. TRANSFORMER RECTIFIER OVERHEAT 1, 2, or 3.

2.2.4.5 Generator Switches

The three engine-driven generator switches (labeled GEN 2, 3, and 4) and the APU GEN switch connect or disconnect their respective generators from the bus transfer system. Each switch has three positions: OFF, ON, and RESET. The ON position energizes the GCR, which energizes the generator exciter field; the generator is then available for load. The OFF position deenergizes the GCR and in turn the ACR. The generator is now incapable of powering any bus since it has no output voltage. In the OFF position, the associated GEN OFF lights illuminate. The RESET position is a momentary spring-loaded OFF position; hence, when the switch is released, it returns to the ON position.

2.2.4.6 Bus Monitoring Switches

The A BUS, B BUS, and ESS BUS monitoring switches have two positions: ON, OFF. Normally they remain on, but in the event of any emergency they can be turned off to disconnect their buses. On non-Electronic Flight Display System (EFDS) aircraft, when the ESS BUS switch is placed in the OFF position, power is routed to the pilot turn-and-bank indicator from FEDC. Normal power to the pilot turn-and-bank indicator is the MEDC bus.

2.2.4.7 External Power Available Signal Light

A neon EXTERNAL PWR AVAILABLE signal light indicates that external power is plugged in and available. This light is illuminated whether or not external power is being utilized.

2.2.4.8 External Power ON Signal Light

An external power ON signal light illuminates whenever transfer relay 4 is energized. When energized, transfer relay 4 connects all AC buses to external power, provided generators 2 and 3 are off.

2.2.4.9 EXTERNAL POWER Switch

The EXTERNAL POWER switch is a three-position switch labeled RESET, OFF, and ON. Placing the switch to the ON position energizes all AC buses via transfer relay 4 if the external power monitor senses proper frequency, phase, and voltage. DC power to energize transfer relay 4 is received from the EXT PWR CONT circuit breaker on the GOB. If this circuit breaker is out or the GOB is deenergized, the aircraft cannot accept external power.

Note

When transferring from the aircraft power system to ground power, it may be necessary to place the external power ON/OFF/RESET switch momentarily to the RESET position before the aircraft buses will accept ground power. This action resets the sensor in the external power monitor.

2.2.5 Load Monitoring

The P-3 electrical system is capable of shedding or monitoring certain electrical loads in the event of single-generator operation. This monitoring is necessary in order to avoid overloading the remaining generator and risking a complete loss of AC electrical power.

2.2.5.1 Single-Engine Generator/APU Generator Operation Below 8,000 Feet (Partial Load Monitoring)

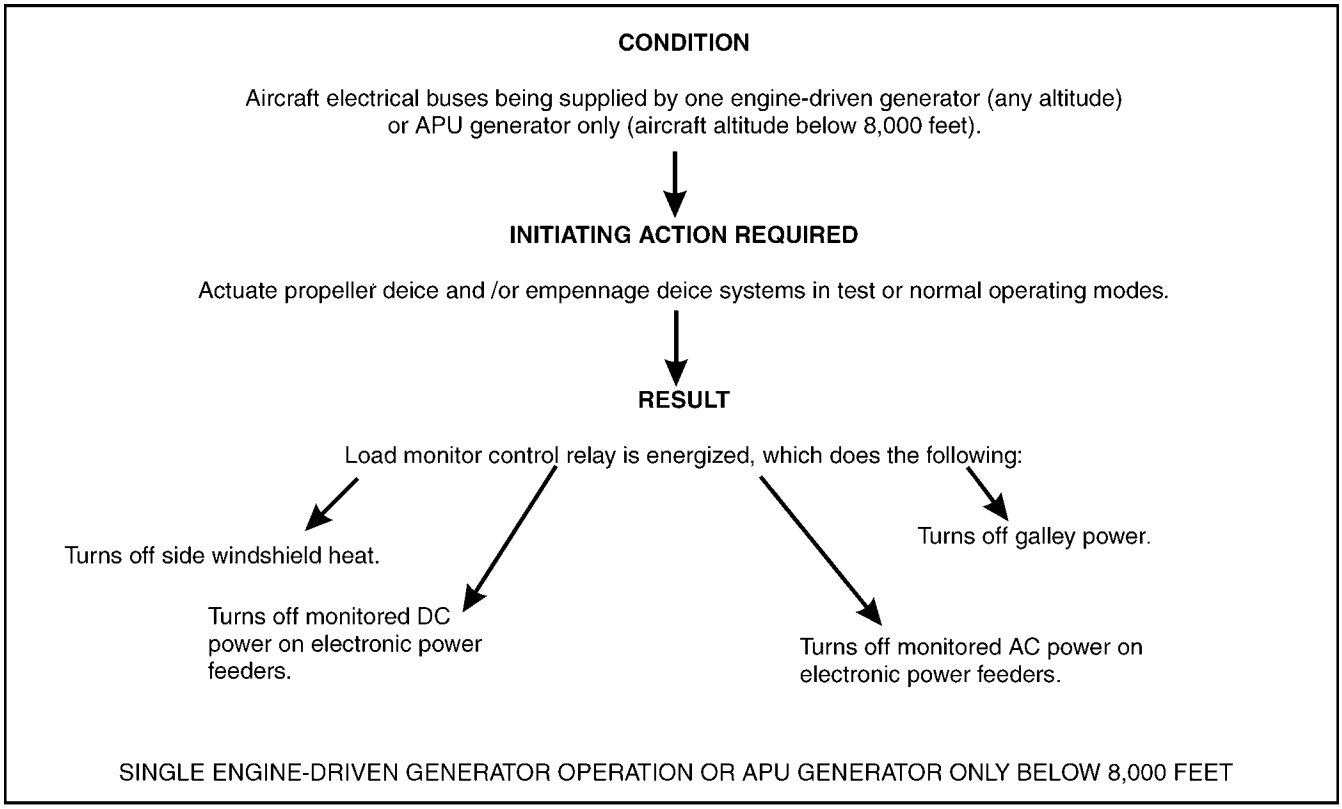
If operating in a single-engine generator configuration at any altitude, load monitoring will occur if the propeller and/or empennage ice control systems are activated. This partial load monitoring will shed the AC and DC feeders 1, 2, and 3 (Figures 2-2, 2-3, 2-4), galley power, radiant heaters, and the side windshield defogging system.

CAUTION

Manual load monitoring of AN/UYS-1 and AN/USQ-78 is required during single-generator operation to prevent generator overload.

Note

If generator 4 and the APU are the only available generators, the aircraft is in single-generator operation as generator 4 and the APU generator cannot share a load (refer to FO-10).



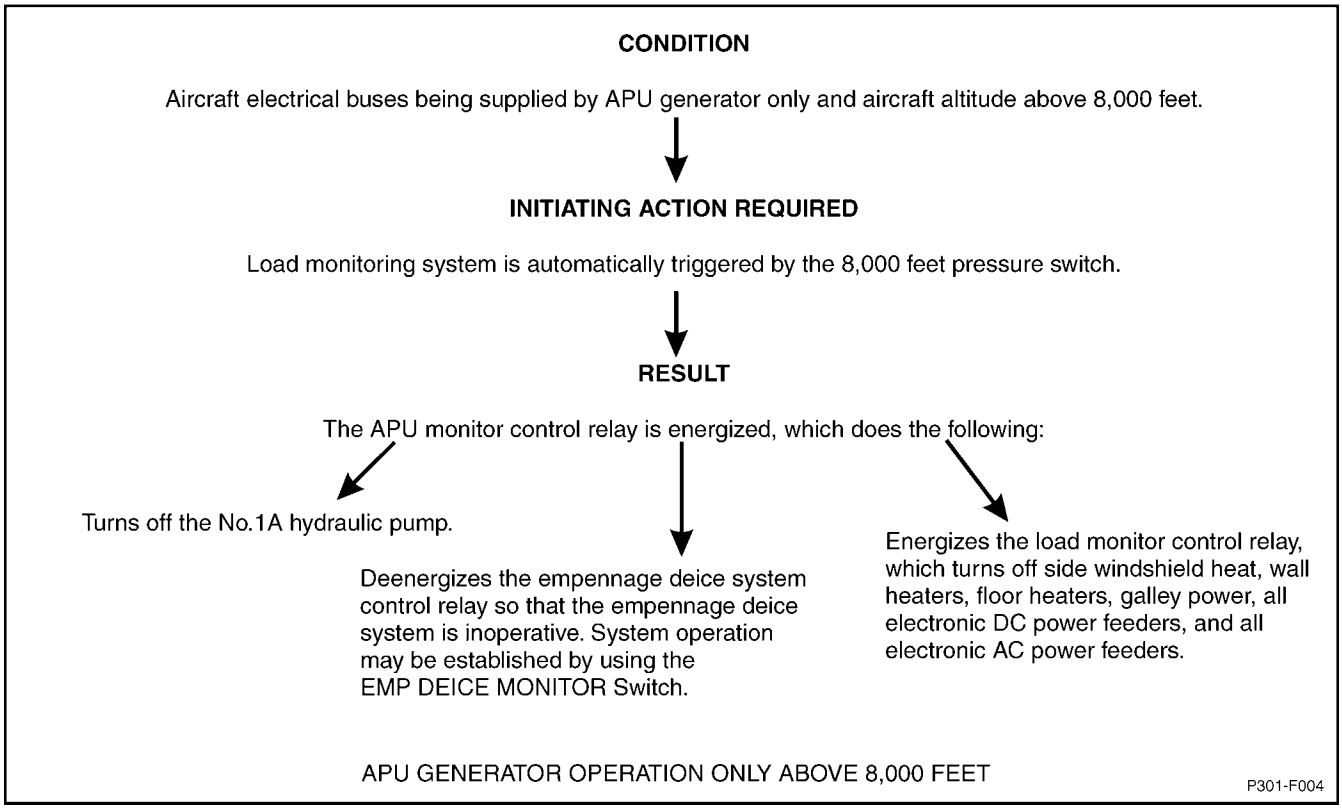


Figure 2-2. Load Monitoring System Functional Block Diagram

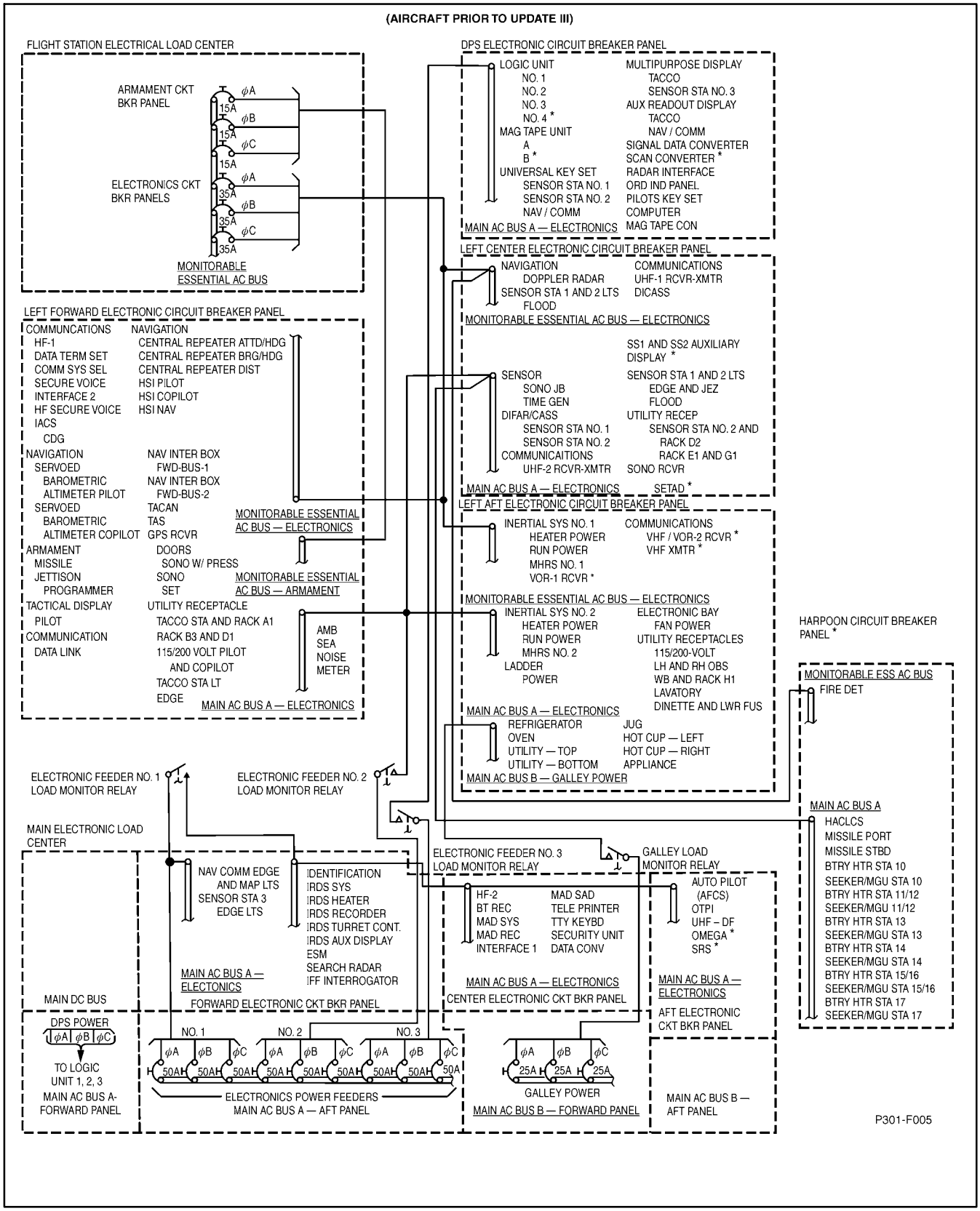


Figure 2-3. AC Power Supply for Electronic Circuit Breaker Panels (Sheet 1 of 2)

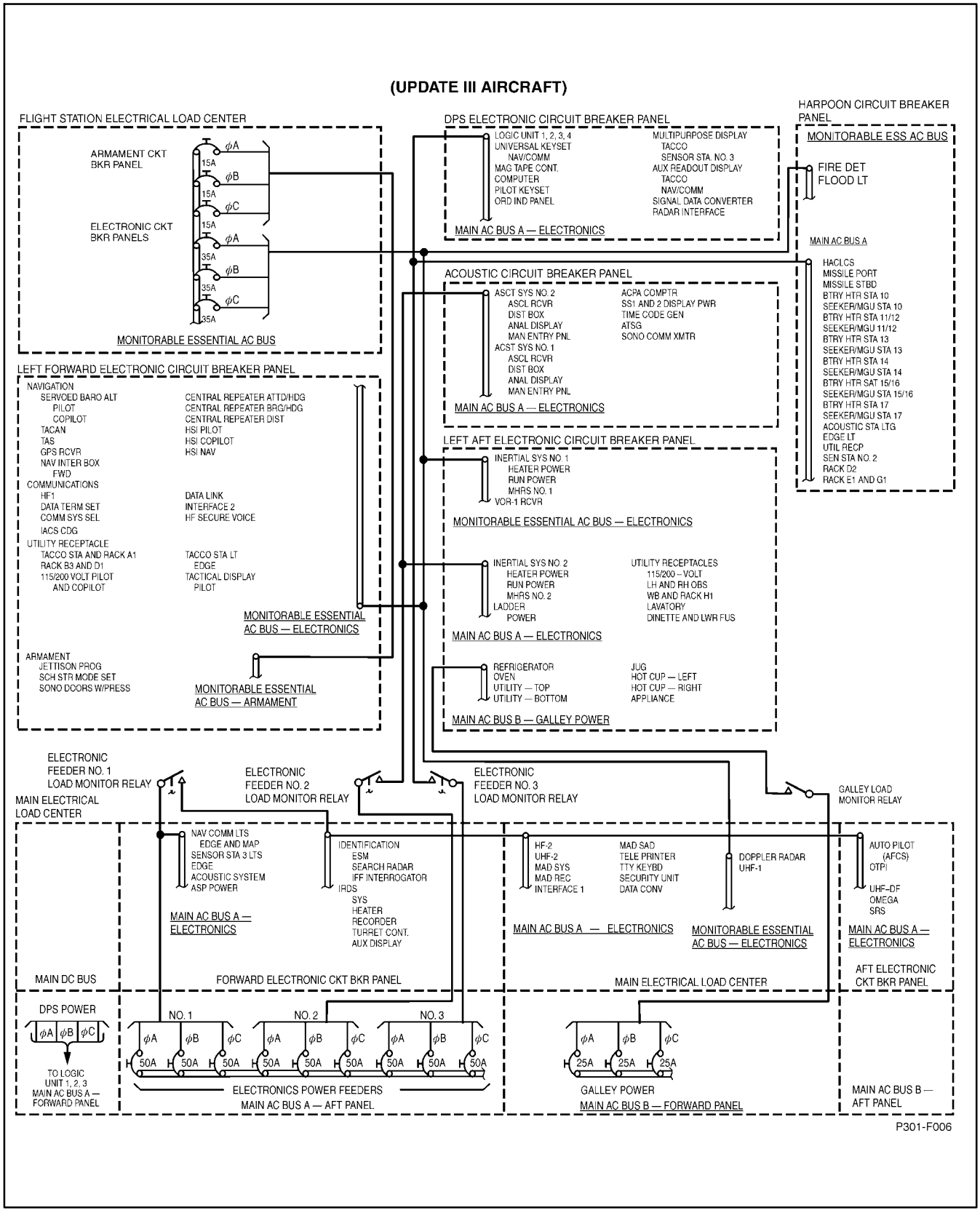


Figure 2-3. AC Power Supply for Electronic Circuit Breaker Panels (Sheet 2 of 2)

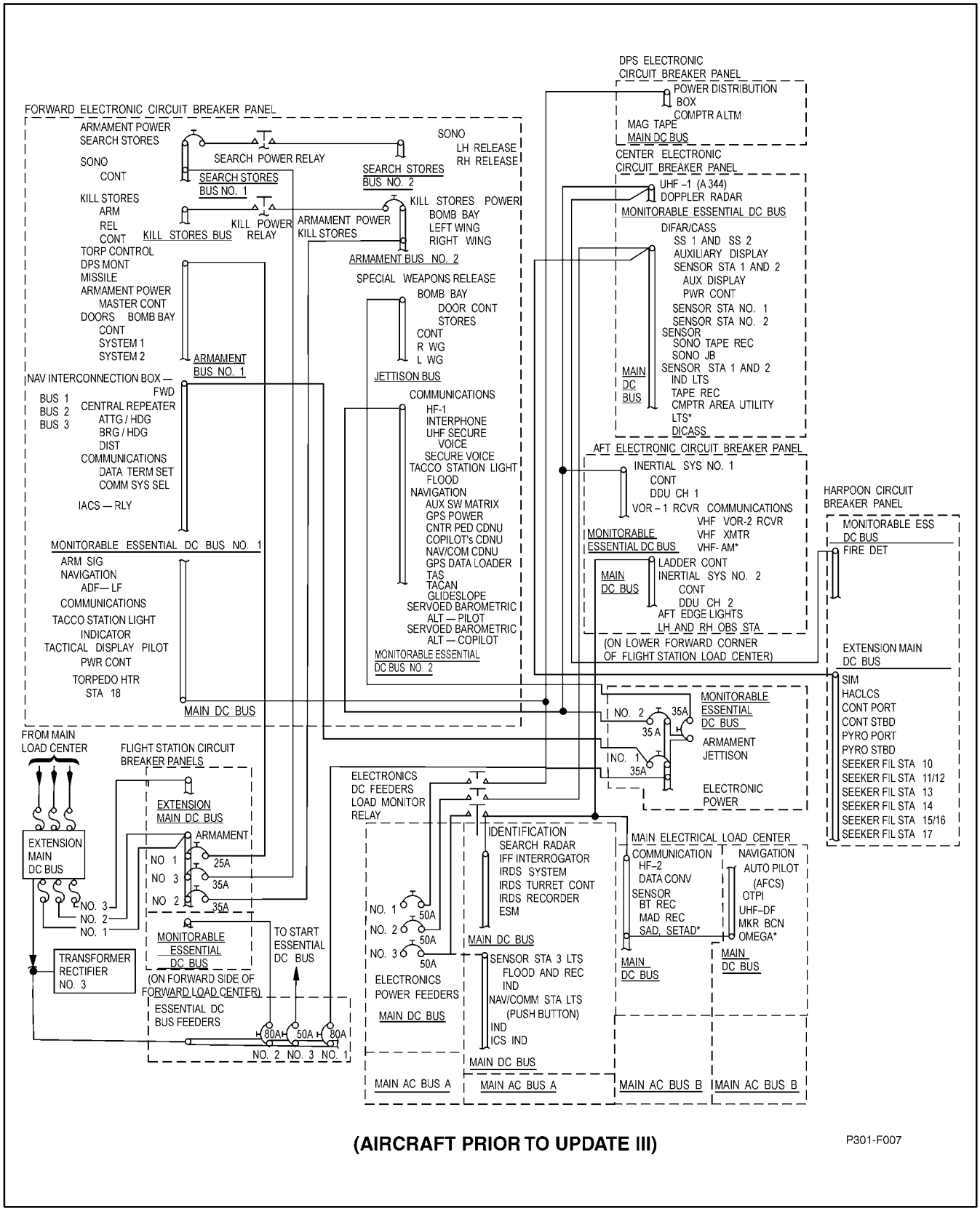


Figure 2-4. DC Power Supply for Electronic Circuit Breaker Panels (Sheet 1 of 2)

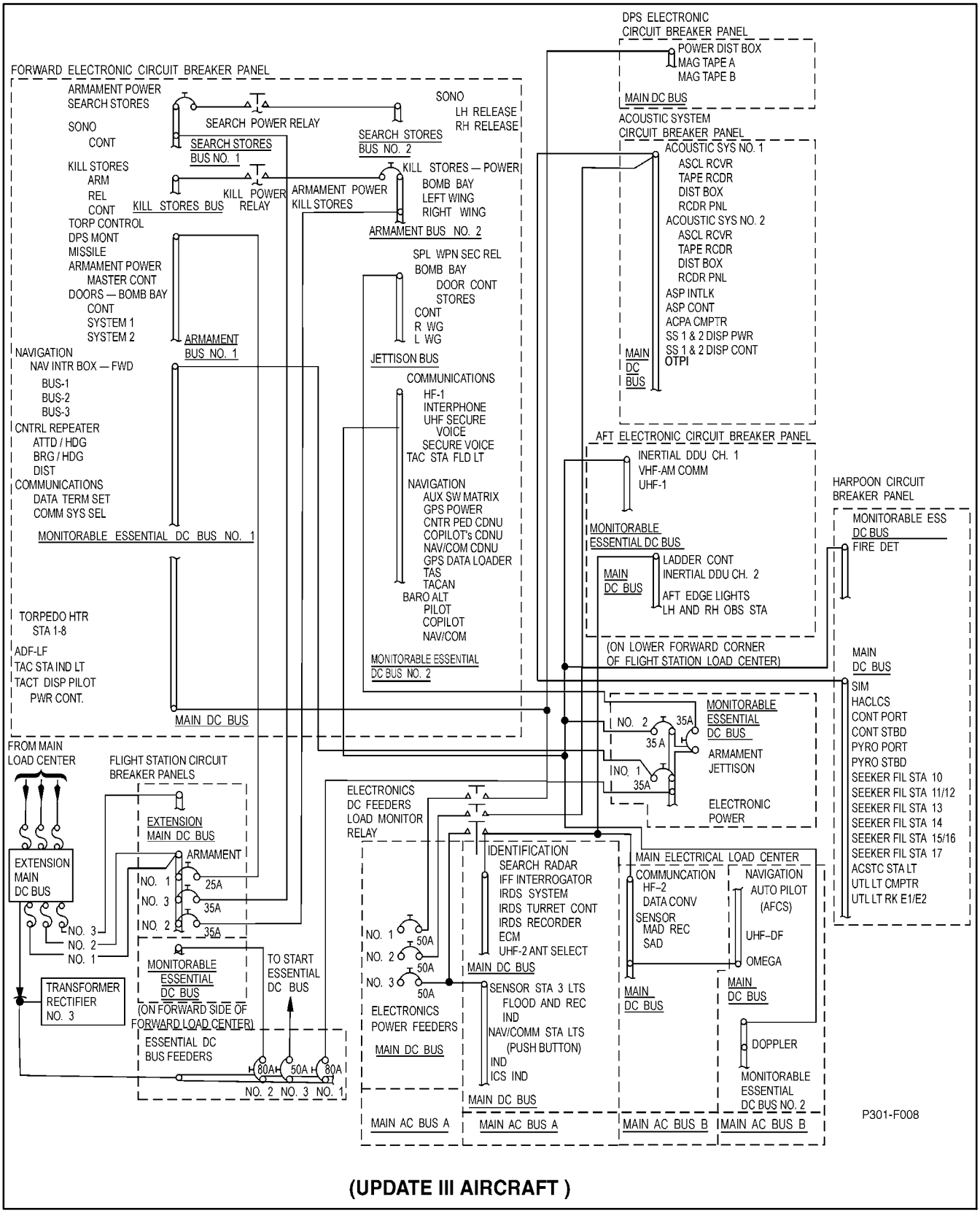


Figure 2-4. DC Power Supply for Electronic Circuit Breaker Panels (Sheet 2 of 2)

2.2.5.2 APU Generator-Only Operation Above 8,000 Feet (Full Load Monitoring)

If the APU generator is the only available generator and the aircraft altitude is above 8,000 feet, automatic full load monitoring occurs without the manual actuation of any switches (Figure 2-2).

Note

The 8,000-foot barometric switch is controlled by the GEN CONT circuit breaker located on the GOB. If tripped (out), full load monitoring will not occur.

Actuation of full load monitoring sheds all items mentioned in the partial load monitoring case as well as the following items: the No. 1A hydraulic pump and the empennage deice system feeder. The empennage deice system can be regained, if necessary, by manually monitoring an equivalent electrical load and activating the EMP DE-ICE MONITOR switch in the override position prior to turning on the empennage deice system (refer to Chapter 15). The EMP DE-ICE MONITOR switch is located on the electric power control panel.

2.2.6 Bus Distribution

AC/DC bus distributions are shown in Figures 2-5 and 2-6.

2.2.7 Circuit Breaker Locations

Circuit breaker locations, types, names, and bus designations are listed in Figure 2-7.

2.3 LIGHTING SYSTEM

2.3.1 Interior Lights (Refer to Figure 2-8 and 2-9)

2.3.1.1 Annunciator Light BRIGHT-DIM Switch

A separate solenoid-held toggle switch located adjacent to the panel signal lights test switches on the pilot overhead lighting panel provides bright/dim control for the flight station annunciator lights. In the BRIGHT position, the annunciator lights illuminate at full intensity when the individual light test switches are actuated. The switch solenoid is energized through the signal lights control circuit breaker on the MEDC bus.

2.3.2 Exterior Lights

Exterior aircraft lights include two motor-driven extendible landing lights, two taxi lights, three wheelwell lights, two anticollision lights, two wingtip position lights, and two tail position lights. Control switches for the exterior lights are located on the flight station overhead panel. Refer to FO-16.

2.3.2.1 Landing Lights

Landing lights are installed at the trailing edge of the port and starboard wings, between the inboard and outboard nacelles. The lights may be operated at any intermediate position between fully retracted and fully extended. Power for the landing lights is furnished from the MEAC bus through circuit breakers on the forward load center circuit breaker panel.

2.3.2.2 LANDING LIGHTS RETRACT-EXTEND Switch

Two LANDING LIGHTS switches (one for each light), located on the exterior lights control panel, control the position mechanism of the landing lights. The switches are placarded RETRACT, STOP, and EXTEND. The RETRACT and EXTEND positions energize the light motors to move the lights to one extreme or the other of their travel. Selecting the STOP position stops the light in any intermediate position between retracted and extended.

2.3.2.3 Landing Lights ON-OFF Switch

A landing light ON-OFF switch, located adjacent to the RETRACT-EXTEND switches on the exterior lights control panel, controls power to the landing light lamps. The lamps may be turned on or off with the landing lights in any position.

2.3.2.4 Taxi Lights

Taxi lights are installed on the left and right sides of the nosegear strut. Power for the lights is obtained from the 28-Vac forward lighting bus through the TAXI light circuit breaker on an aft circuit breaker panel in the forward load center.

2.3.2.5 TAXI Light Switch

Both taxi lights are controlled by the TAXI light switch located on the exterior lights control panel. The ON and OFF positions directly energize or deenergize the lamps.

2.3.2.6 EXTERIOR LIGHTS MASTER Switch

The MASTER switch is a part of the exterior lights circuit. It is a two-position ON-OFF switch that controls power to all of the exterior lights except the landing lights and taxi lights.

2.3.2.7 Wheelwell Lights

A wheelwell light with a clear glass lens is installed in each wheelwell. Power for the lights is obtained from the 28-Vac forward lighting bus through the WHEEL WELL lights circuit breaker located on an aft circuit breaker panel in the forward load center.

2.3.2.8 Wheelwell Lights Switch

The wheelwell lights are controlled by the EXTERIOR LIGHTS MASTER switch and WHL WELL switch on the exterior light control panel. With the MASTER switch ON, selecting the ON position of the WHL WELL light switch illuminates the wheelwell lights. Selecting the OFF position of either the MASTER or WHL WELL switch causes the wheelwell lights to extinguish.

2.3.2.9 Strobe Lights

Two high-intensity strobe lights are installed along the centerline on the aft fuselage, top and bottom, to provide anticollision warning to other aircraft. Power for the strobe lights is supplied from 115-volt MAIN AC BUS B through STROBE TOP and STROBE BOT circuit breakers located at the main load center. Strobe light system control power is supplied from the extension main DC bus through the STROBE LIGHT circuit breaker located in the forward load center.

WARNING

Do not operate the strobe lights with the glass lens removed because of ultraviolet emission. There is no hazard when the strobe lights are operating with the glass lens installed, regardless of viewing distance.

A three-position switch is provided on the exterior lights panel on the flight station overhead to select OFF, white (WHT), or RED operation.

A three-position strobe light switch is located on the forward load center circuit breaker panel for GRD TEST/NORMAL/BOT OFF operation. The strobe lights are tested while the aircraft is on the ground by placing the overhead panel switch in either the WHT or RED position and placing the strobe light switch on GRD TEST. When the switch is in the NORMAL position, ground sensing automatically precludes other than top red strobe operation. The BOT OFF position provides a means of turning off the bottom strobe light when the aircraft is in flight.

2.3.2.9.1 Infrared (IR) Anticollision Lights

AFC-661 incorporates IR Anticollision Light capability. The IR Anticollision lights are controlled by two two-position toggle switches and an intensity control potentiometer located on the Extension Main DC (EMDC) portion of the forward load center. Power is provided from the EMDC bus through two circuit breakers labeled IR ANTI-COLLISION LTS upper and lower. The IR Anticollision lights are operated independently from the standard strobe lights. To ensure IR Anticollision light illumination, the intensity potentiometer should be rotated above a setting of 2. Additionally, using intensity levels above 5 could cause washout of night-vision devices in the vicinity.

WARNING

IR Anticollision lights shall not be operated when personnel are within 2 feet of the IR Anticollision light assembly. The anticollision light assembly infrared emission may cause eye damage if viewed for an extended period of time.

2.3.2.10 Wing and Tail Lights

Wing position lights are installed in the tips of each wing. The tail position lights are located on the bottom of the aft fuselage and the top forward section of the Magnetic Anomaly Detection (MAD) boom. Power for the lights is obtained from the 28-volt forward lighting bus through a circuit breaker located on an aft circuit breaker panel in the forward load center.

2.3.2.11 Wing and Tail Light Switches

A two-position (ON, OFF) WING TAIL switch is located on the exterior lights control panel. Selecting the ON position illuminates the wing and tail lights if the EXTERIOR LIGHTS MASTER switch is ON. Turning off either the MASTER or WING TAIL switch deenergizes the wing and tail lights.

MONITORABLE ESSENTIAL AC BUS

- 26-VOLT INSTRUMENT TRANSFORMER NO 1 AND NO.2
- AIR CONDITIONING INSTRUMENTATION
- AIRFOIL IND & OVHT WARNING
- ALTM VIB NAV
- AUX VENT ACTUATOR
- CHRD
- EFDI/EHSI
- EMPENNAGE DEICING TIMER MOTOR
- ESS LTG & IND CONTROL
- [1] FDI/EFDI (PILOT AND COPILOT)
- FLT DIR PWR
- FLT STA & CABIN TEMP CONTROL & IND
- FUEL CROSSFEED CONTROL
- FUEL QUANTITY INDICATORS (FLT STA)
- FUEL TANK SHUTOFF VALVE CONTROL
- HSI MODE LIGHTS
- ICE DETECTOR
- LANDING LIGHTS
- OIL COOLER FLAP CONTROL
- PILOT DEP
- PEP
- [1] PILOT & COPILOT RED INST LTS
- RAWS (1 AND 2)
- RED EDGE AND POST LIGHTS FOR OVERHEAD, INSTRUMENT, AND PEDESTAL PANELS
- SRCH STORES INT BOX
- TEMPERATURE DATUM CONTROL
- TORQUEMETER
- VCU
- VDC
- [1] VERTICAL (STANDBY) GYRO
- WINDSHIELD WASHER PUMP
- WINDSHIELD WIPERS
- WINDSHIELD HEAT
- XMFR RECT NO. 3

28 VOLT FWD LIGHTING TRANSFORMER

- C/B PNL RED EDGE
- DOME & FLT CAPT READING
- RH PITOT HTR
- ROCKET SIGHT
- SEXTANT
- STEP LIGHT
- TAXI LIGHTS
- WHEEL WELL LIGHTS
- WING & TAIL LIGHTS

ELECTRONICS

- BARO ALTIMETERS ENCODER (PILOT & COPILOT)
- CENTRAL REPEATER SYS
- COMM INTERFACE 2
- COMM SYS SEL
- DATA LINK (DATA TERMINAL SET)
- ELECTRONIC BAY FAN POWER
- GPS RECEIVER
- HACLCS FIRE DET
- HF SECURE VOICE
- HF-1 TRANSCEIVER
- HSI CONTROL (PILOT, COPILOT & NAV/COMM
- INS-1
- NAV INTERCONNECTION BOX (BUS 1 AND 2)
- RINU (AN/ASN-179)
- SECURE VOICE (SECURE SWITCHING MATRIX)
- SS1 AND 2 FLOOD LIGHTS
- TACAN
- TAS
- UHF-1 (ARC-143)
- VHF XMTR (ARC–101)
- VOR–1 REC (ARN-87)
- VOR–2 REC (ARN-87)

ARMAMENT

- DOORS (SONO WITH PRESS)
- JETTISON PROGRAMMER
- MISSILE AN/ARW-77

26 VOLT INSTRUMENT TRANSFORMER NO. 1

- BLEED AIR MANIFOLD PRESSURE INDICATOR
- FLAP POSITION INDICATOR
- HYDRAULIC PRESSURE INDICATOR SYSTEM NO. 1
- LEFT EDC AIR PRESSURE INDICATOR
- NORMAL BRAKE PRESSURE INDICATOR
- OIL COOLER FLAP POSITION INDICATOR (ENGINE 1 AND ENGINE 4)
- OIL PRESSURE INDICATOR (ENGINE 1 AND 4)

26 VOLT INSTRUMENT TRANSFORMER NO. 2

- EMERGENCY BRAKE PRESSURE INDICATOR
- FUEL CROSSFEED MANIFOLD PRESSURE INDICATOR
- HYDRAULIC PRESSURE INDICATOR SYSTEM NO. 2
- OIL COOLER FLAP POSITION INDICATOR (ENGINE 2 AND ENGINE 3)
- OIL PRESSURE INDICATOR (ENGINE 2 AND ENGINE 3)
- RIGHT EDC AIR PRESSURE INDICATOR

START ESSENTIAL AC BUS

- TURBINE INLET TEMPERATURE

MAIN AC BUS A

- [4] ACOUSTIC PROCESSOR
- AIMS INTERFACE CONTROLLER
- ANTENNA COMBINER
- CMDS DATA INTERFACE
- EMPENNAGE DEICING (PARTING STRIPS)
- FEATHER PUMP (ENG NO. 1 AND NO. 4 ALT)
- FEATHER PUMP (ENG NO. 2 AND NO. 3)
- FORWARD FUEL TRANSFER PUMP
- FUEL BOOST PUMP NO. 1 AND NO. 3
- FUEL DUMP JETTISON PUMP
- FUEL FLOW INDICATOR
- FUEL QUANTITY INDICATOR (FUELING PANEL)
- HYDRAULIC PUMP NO. 1
- INS-2
- MATT
- MINI-DAMA MODEM R/T
- MINI-DAMA PWR AMP
- OVERHEAD LIGHTS
- PROPELLER SYNC
- [2] SIDE WSHLD HEAT POWER
- TDP/OASIS
- XMFR RECT NO. 1

[2] ELECTRONICS FEEDER NO. 1

- AUTOMATIC PILOT SYSTEM
- BT RECORDER
- CASS XMTR
- COMM INTERFACE 1
- ESM
- HCR
- HF/UHF SDC
- HF-2 TRANSCEIVER
- IFF INTERROGATOR
- IRDS
- MAD/SAD
- ON TOP POSITION INDICATOR (OTPI)
- SEARCH RADAR
- TTY CONVERTER
- TTY KEYBOARD
- TTY PRINTER
- TTY SECURITY UNIT
- UHF DF
- UTILITY OUTLETS

[2] ELECTRONICS FEEDER NO. 2

- ADB
- AMBIENT SEA NOISE METER
- CREW EDGE LIGHTING (NAV/COMM AND SS3)
- DATA LINK
- DICASS SDC
- DIFAR 1 AND 2
- EDGE LIGHTING (TACCO STATION)
- HACLCS
- IACS CDG
- LADDER
- PILOT DISPLAY
- SONO JB
- SONOBUOY RECEIVERS
- SS1 AND 2 AUX DISPLAY
- SS1 AND 2 LIGHTING
- TIME CODE GEN
- UHF-2 (ARC-143)
- UTILITY RECEPTACLES

[2] ELECTRONICS FEEDER NO. 3

- AUX READOUTS
- COMPUTER
- LOGIC UNITS (1, 2, AND 3)
- LOGIC UNIT 4
- MAG TAPE CONT
- MAG TAPE TRANSPORTS
- MULTIPURPOSE DISPLAYS
- ORD IND PANEL
- PILOT KEYSET
- RADAR INTERFACE
- SCAN CONVERTER
- SIGNAL DATA CONVERTER
- UNIVERSAL KEYSETS

FLIGHT ESSENTIAL AC BUS

- ATTD IND. GYRO HORIZON
- [1] ATTD IND. VERT GYRO
- [1] FDI/EFDI (PILOT AND COPILOT)
- GYRO HORIZON (STANDBY) NON-EFDS
- IFF TRANSPONDER PWR
- LH PITOT HEATER
- OUTFLOW VALVE OVERRIDE
- [1] PILOT AND COPILOT RED INST LTS
- RADAR ALTIMETER POWER

MAIN AC BUS B

- AFT FUEL TRANSFER PUMP
- CABIN EXHAUST FAN
- EMPENNAGE DEICING (CYCLE POWER)
- [3] FEATHER PUMPS (ENG NO. 1 AND 4)
- [2] FLOOR HEATERS
- FUEL BOOST PUMP NO. 2 AND NO. 4
- [2] GALLEY POWER
- HEAT EXCHANGER FANS
- HYDRAULIC PUMP NO. 1A AND NO. 2
- PROPELLER DEICE POWER
- SERVICE OUTLETS
- STROBE LIGHTS
- [2] WALL HEATERS
- XMFR RECT NO. 2

AFT LIGHT TRANSFORMER

- BOMB BAY, LAV AND GALLEY LIGHTS
- PROP DEICE TEST
- SERVICE AND CIRCUIT BREAKER PANEL LIGHTS

NOTES:

[1] POWERED BY FLIGHT ESSENTIAL AC BUS IF MONITORABLE AC BUS BECOMES DEENERGIZED.IF MONITORABLE ESSENTIAL DC BUS BECOMES DEENERGIZED, VERTICAL GYRO ATTITUDE INFORMATION IS DISPLAYED ON PILOT AND COPILOT FDIS REGARDLESS OF POSITION OF ATTD SELECT SWITCHES.

[2] WITH EMPENNAGE AND OR PROPELLER ICE CONTROL SYSTEMS ENERGIZED AND ONLY ONE GENERATOR OPERATING, THE MAIN AC BUS A AND MAIN DC ELECTRONIC FEEDERS, FLOOR AND WALL HEATERS, SIDE WINDSHIELD DEFOG, AND GALLEY POWER ARE AUTOMATICALLY DISCONNECTED. ABOVE 8,000 FEET ALTITUDE, ADDITIONAL MONITORING OF NO. 1A HYDRAULIC PUMP AND EMPENNAGE DEICING IS PROVIDED WHEN THE APU GENERATOR IS THE ONLY POWER SOURCE AVAILABLE.

[3] CAN BE POWERED BY MAIN AC BUS A BY POSITIONING FEATHER TRANSFER SWITCH.

[4] MUST BE SECURED DURING SINGLE-GENERATOR OPERATIONS.

Figure 2-5. AC Bus Distribution

MONITORABLE ESSENTIAL DC BUS

AAR-47 COMPUTER PROCESSOR
ADDU
AIMS CONTROL UNIT
AIMS ELECTRONIC UNIT
AIMS TURRET CONTROL
AIR-CONDITIONING BLOWER CONTROL (L AND R)
AIR MULTIPLIER VALVE
ANGLE OF ATTACK
APU ESSENTIAL BUS FEEDER
AUX VENT
BOMB RACK LOCK POWER
BUS A AND BUS B CONTROLS
CDU-7000 NAV/COMM
CDU-7000 PILOT
COMPASS LIGHT
CONSOLE (PILOT, COPILOT RED EDGE)
DAIC
DAMA MODEM
DIGITAL DATA UNIT CH1
EDC DISCONNECT L AND R
EDC DUMP L AND R
EMER ENGINE SHUTDOWN CONTROL 1, 2, 3, 4
ENGINE ICE CONTROL
FIRE DETECTORS
FIRE DETECTOR HORN
FIRE EXTINGUISHER SYSTEM
FLIGHT DIRECTOR
FLIGHT IDLE STOPS
GENERATOR 2, 3, AND 4 CONTROLS
GENERATOR 4 TRANSFER
[5] GYRO HORIZON(STANDBY) EFDS
HYDRAULIC PUMP NO. 1A CONTROL
ICS AND LIGHTS (PILOT, COPILOT)
IFF TRANSPONDER CONTROL PWR
IFF TEST SET
OIL TANK SHUTOFF VALVE CONTROL
POWER SENSING
PROP FEATHER CONTROLS NO. 1 AND NO. 4
RAWS (1 AND 2 POWER AND TEST)
RUDDER BOOST SHUTOFF VALVE
SATCOM MX-7580
SATCOM MX-11949
SEI
SIGNAL LIGHTS
[2] TURN RATE GYRO (PILOT AND COPILOT)
UHF-1 CONT
VOR 1 REC (ARN-140)
VOR 2 REC (ARN-140)
WARNING LIGHTS (RED)
WINDSHIELD HEAT CONTROL

ELECTRONIC PWR NO. 1

COMM SYS SEL
NAV INTER BOX
CENTRAL REPEATER SYS
DATA LINK (DATA TERMINAL SET)

ELECTRONIC PWR NO. 2

ALTIMETER VIB (PILOT AND COPILOT)
AUX SW MATRIX (COM-NAV SW UNIT)
BARO ALTM NAV
COPILOT CDNU
CNTR PED CDNU
DATA LOADER
DOPPLER RADAR
GPS
HACLCS FIRE DET
HF-1
ILS G S
INTERPHONE
NAV/COMM CDNU
SECURE VOICE (SECURE SWITCHING MATRIX)
TACAN
TACCO STA FLOODLIGHTS
TAS
UHF SECURE VOICE
UHF-1 (VOICE SEL PANEL)
[3] UHF-1 (ARC-187)
VHF/UHF XMTR (ARC-182)
VHF/UHF XMTR (ARC-210)
VHF XMTR (ARC-101 OR ARC-197)
VOR 1 REC (ARN-87)
VOR 2 REC (ARN-87)

ARMAMENT JETTISON

BOMB BAY DOORS CONT
BOMB BAY STORES
JETTISON CONTROL
LEFT WING JETTISON
RIGHT WING JETTISON

APU ESSENTIAL DC BUS

AUTO CONTROL
AUTO RELEASE
DOOR POS LIGHT
EXH DOOR ACT
FIRE DET HORN
FIRE EXTINGUISHER
INTAKE DOOR ACTUATOR
MANUAL CONTROL
MANUAL RELEASE

START ESSENTIAL DC BUS

BLEED AIR FIREWALL SHUTOFF VALVES
FUEL AND IGNITION CONTROL
FUEL SHUTOFF VALVES
FUSELAGE BLEED AIR ISOLATION VALVES
INVERTER POWER
PRIMER CONTROL
START CONTROL
TEMP DATUM CONTROL

GROUND OPERATION DC BUS

APU CONTROLS
EXTERNAL POWER
HYDRAULIC PUMP CONTROL NO. 1B
HYDRAULIC PUMP POWER NO. 1B
OIL QUANTITY INDICATORS

FLIGHT ESSENTIAL DC BUS

ADDU
APX-118
COMMAND BELL
CDU-7000 COPILOT
FLIGHT STATION UTILITY LIGHTS
GEN 4 AUX CON
GPS AMP
GRND OPER BUS RELAY
[5] GYRO HORIZON (STANDBY) EFDS
IFF EMERGENCY CONTROL
INS-1 & -2
INVERTER RELAY
PROPELLER PITCHLOCK RESET
[2] TURN RATE GYRO (PILOT) NON-EFDS
UHF-1 VOICE SELECTOR

MAIN DC BUS

ACOUSTIC PROCESSOR
AIMS AUXILIARY DISPLAY
AIMS POWER CONDITIONER
BOMB BAY HEAT CONTROL
CABIN EXHAUST FAN CONTROL
CMDS DATA INTERFACE
[4] COUNTING ACCEL
DICASS SDC
DIGITAL DATA UNIT CH2
DUCT OVERHEAT TEST
[1] EMPENNAGE DEICING CONTROL
FIRE EXTINGUISHER CONTROL (ALT)
FLAP BRAKE LATCH AND RELEASE L AND R
FREE AIR TEMPERATURE INDICATOR
FUEL BOOST AND TRANSFER PUMPS CONTROL
FUEL DUMP PUMP CONTROL
FUEL DUMP VALVE
FUEL INLET VALVES AND REFUEL CONTROL
FUEL QUANTITY SYS TEST
GROUND AIR SENSING
HYDRAULIC FLUID QUANTITY
HYDRAULIC PUMP CONTROL NO. 1 AND 2
LANDING GEAR CONTROL
LANDING GEAR INDICATION AND WARNING
LOAD MONITORING CONTROL
[1] LOAD MONITORING RELAYS
LOW RPM SOLENOID
NEGATIVE TORQUE SYSTEM CHECK
OIL QUANTITY AND TEMP INDICATORS
PILOTS DISPLAY CONTROL
PROPELLER AND WING ICE CONTROL
PROPELLER AUTOFEATHER
PROP FEATHER CONTROLS NO. 2 AND NO. 3
PROP SYNC CONTROL
RACK OVERHEAT
RF ANTENNA SWITCH
[1] SIDE WINDSHIELD HEAT CONTROL
SRCH STORES INT BOX
STROBE LIGHTS
UHF-2 CONT
UTILITY RECEPTACLES

ARMAMENT

ARMAMENT POWER
BOMB BAY DOORS
DPS MON
KILL STORES
KILL POWER RELAY
KILL STORES POWER (LW, RW, & BOMB BAY)
MIB/AMIB
SEARCH POWER RELAY
SEARCH STORES
SONO RELEASE LH & RH
TORPEDO

[1] MAIN DC ELECTRONIC FEEDER NO. 1

ADF
COMPUTER ALT
DPS PWR DIST BOX
IACS RLY
MAG TAPE
PILOT DISPLAY
TACCO STA LIGHT IND

MAIN DC ELECTRONIC FEEDER NO. 2

DIFAR/CASS
HACLCS
SONO JUNCTION BOX
SONO TAPE RECORDER
SS1 AND 2 LIGHTS
SS1 AND 2 AUX DISPLAY
[3] UHF-2 (ARC-187)(UD II)
UTILITY LIGHT COMPTR AREA

MAIN DC ELECTRONIC FEEDER NO.3

AUTOPILOT
BIT RECORDER
EDGE LIGHTS L & RH OBS STA
ESM
HF-2
IFF INTERROGATOR
INS-2
IRDS
LADDER CONTROL
LH & RH UTL RECEPTACLES
MAD
MKR BEACON (ARN-32)
NAV/COMM LIGHTS
OBS STA
OTPI
SAD
SEARCH RADAR
SS3 LIGHTS
TTY CONVERTER
UHF DF
[3] UHF-2 (ARC-187)(UD III)

NOTES:

[1] WITH EMPENNAGE AND OR PROPELLER ICE CONTROL SYSTEMS ENERGIZED AND ONLY ONE GENERATOR OPERATING, THE MAIN AC BUS A AND MAIN DC ELECTRONIC FEEDERS, FLOOR AND WALL HEATERS, SIDE WINDSHIELD DEFOG, AND GALLEY POWER ARE AUTOMATICALLY DISCONNECTED ABOVE 8,000 FEET ALTITUDE. ADDITIONAL MONITORING OF NO. 1A HYDRAULIC PUMP AND EMPENNAGE DEICING IS PROVIDED WHEN THE APU GENERATOR IS THE ONLY POWER SOURCE AVAILABLE.
[2] PILOT TURN RATE GYRO POWERED BY FLIGHT ESSENTIAL DC WITH THE ESSENTIAL BUS SWITCH IN THE OFF POSITION.
[3] PRC-187 UHF-1 BLOWER FAN POWERED BY MEAC. UHF-2 BLOWER FAN POWERED BY MAIN AC BUS A.
[4] ON A/C WITH SDRS CIRCUIT BREAKER LABELED “SDRS” VICE “COUNT ACCEL”
[5] ON EFDS-EQUIPPED AIRCRAFT, THE STANDBY ATTITUDE INDICATOR (GYRO HORIZON (STANDBY)) IS POWERED BY FLIGHT ESSENTIAL DC WITH THE ESSENTIAL BUS MONITORING SWITCH IN THE OFF POSITION.

Figure 2-6. DC Bus Distribution — P-3

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK A-1			
APG-66 INU	FLC UPPER C20	APG-66 INU	MEAC
APG-66 POWER DIST. UNIT	MLC 1 UPPER MLC 1 LOWER FLC UPPER C20	APG-66 APG-66 APG-66 INU	MAIN DC BUS A MEAC
APS-115 RADAR R/T (FWD)	MLC 2 UPPER	SEARCH RADAR	MAC BUS A MDC
APS-137 RECEIVER PULSE COMPRESSOR	MLC 2 UPPER	SEARCH RADAR	BUS B MDC
APS-137 SYNCHRONIZER-EXCITER	MLC 2 UPPER	SEARCH RADAR	BUS B MDC
APS-137 TRANSMITTER	MLC 2 UPPER	SEARCH RADAR	BUS A MDC
Note To remove power from the FWD R/T without removing power from the aft R/T, pull the breakers labeled FWD on the APP in rack F1.			
RACK A-1 (AIP)			
RECEIVER, EXCITER-PROCESSOR (R-2588B/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
TRANSMITTER (T-1621/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
FLIGHT STATION			
ALE-39 CMDS CONTROL	FECB	SURVIVABILITY MOD	MDC
ARN-151 GPS CDNU #1 (PILOT)	FECB	CNTR PED	MEDC
ARN-151 GPS CDNU #2 (COPILOT)	FECB	COPILOT	MEDC
AAR-47 CONTROL INDICATOR	FECB	SURVIVABILITY MOD	MDC
FDI PILOT/COPILOT	FLC UPPER NAV-J	ATTITUDE IND: PILOT/COPILOT D-1/D-2 PILOT/COPILOT	MEAC 26 VAC
HSI	FECB NAV-J	PILOT/COPILOT	MEAC
MAVERICK PILOT TACTICAL DISPLAY (ASA-66)[2]	FLC	TACTICAL (TAC) DISPLAY — PILOT	EXT. MDC
MAVERICK PILOT TACTICAL DISPLAY (CRT)[2]	FLC	AUX DISPLAY	EXT. MDC
MAVERICK PILOT TACTICAL DISPLAY (LCD)[1]	FECB	GLARESHIELD PED EDGE AND POST	MEAC
MAVERICK PILOT TACTICAL DISPLAY (LCD)[1]	FLC	TAC DISPLAY	EXT. MDC
UHF-1 VOICE SELECTOR	MLC 3 UPPER FLC LOWER	UHF-1 SECURE ZERO	MEDC FECB
FLIGHT STATION (AIP)			
CMDS DISPLAY/EWS DISPLAY LIGHT CONTROL PANEL	FLC UPPER	WARNING LIGHTS — K-24	MEDC
COUNTER MEASURES DISPENSING SYSTEM (CMDS) COCKPIT CONTROL UNIT (CCU)	FECB	CMDS — CONT.	MEDC

1. With the LCD configuration at the Flight Station, the GLARESHIELD PED EDGE and POST circuit breakers power the VIP panel, and the TAC DISPLAY powers the LCD.
2. With the CRT configuration at the Flight Station, the AUX DISPLAY powers the CRT and the TAC DISPLAY-PILOT circuit breaker powers the ASA-66 display.

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 1 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
FLIGHT STATION (AIP) (Continued)			
CREW STATION CONTROL PANEL	FECB	COMMUNICATIONS — INTERPHONE	MEDC
DATA ENTRY PANEL	DPS	PILOT DEP	MAC BUS A
ELECTRONIC WARFARE SYSTEM (EWS) STATUS INDICATOR	FLC UPPER	EWSSD — K-7	MEDC
FDCI BYPASS SWITCH (2)	NO POWER	NO POWER	
FLIGHT DIGITAL CREW INTERFACE (2)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
ICS DIGITAL BUS COUPLER (2) (CU-2570/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
MICRO VOICE MESSAGE SYSTEM	FECB	COMMUNICATIONS — INTERPHONE — MVMS	MEDC
MISSILE CONTROLLER (MC)	MISSILE CB PANEL	MIB/AMIB	MDC
MISSILE IFF RADAR PANEL (MIRP)	NO POWER	NO POWER	
MISSILE IRDS STATUS PANEL (MISP)	FLC UPPER	LIGHTING — SIGNAL LIGHTS — PED — J-18	MEDC
MISSILE WARNING SYSTEM (MWS) CONTROL INDICATOR (CI)	FECB	MWS	MEDC
PILOT COLOR HIGH RESOLUTION DISPLAY (PCHRD)	FLC UPPER	PILOT CHRD — G-20	EXT MDC
FLIGHT STATION (BMUP)			
DATA ENTRY PANEL (DEP)	DPS	PILOT DEP	MAC BUS A
PILOT COLOR HIGH RESOLUTION DISPLAY (PCHRD)	FLC UPPER G-20	PILOT CHRD	EXT MDC
FLIGHT STATION (CNS/ATM)			
CDU-7000 PILOT	FECB	CDU PILOT	MEDC
CDU-7000 COPILOT	FLC LOWER	CDU COPILOT	FEDC
RACK A-2 (TACCO STATION)			
ALE-39 CMDS PROGRAMMER	FECB	SURVIVABILITY MOD	MDC
AVX-1 OPTICAL SENSOR GROUP	MLC 1 LOWER	AVX-1 EOS	BUS A
AVX-1 OPTICAL WINDOW DEFROSTER ASSEMBLY	FECB	AVX-1 EOS	BUS A
HARPOON DECODER/ENCODER (DE)	HARPOON	HACLCS	MEAC MEDC
LIGHTING POWER RECTIFIER	FECB	TACCO STA LT-EDGE	MAC BUS A
MAP BLOWER FAN	FECB	MAP BLOWER	MEAC
MAVERICK TACTICAL COORDINATOR (TACCO) TACTICAL DISPLAY	FECB	TACTICAL DISPLAY PWR CONT	MDC
MPD POWER SUPPLY	DPS	MULTIPURPOSE DISPLAY	MAC BUS A
TACCO AUX. CONTROL PANEL	FECB	TACCO STA. LT. IND	MDC
TACCO LCD MONITOR	MLC 2 UPPER	MMIS AUX DISPLAY	MDC
TACCO POWER CONTROL PANEL	DPS FECB	COMPUTER PWR. DISTR. BOX TACCO STA. LT. IND	BUS A MDCE MDC
RACK A-2 (TACCO STATION) (AIP)			
COLOR HIGH RESOLUTION DISPLAY	DPS	TACCO — CHRD	MAC BUS A
COMM SECURITY UNIT (KG-84A) NO. 1	FECB	COMMUNICATIONS — SECURE VOICE — UHF-3 — KG-84A NO.1	MAC BUS A MDC
COMM SECURITY UNIT (KG-84A) NO. 2	FECB	COMMUNICATIONS — SECURE VOICE — UHF-3 — KG-84A NO.2	MAC BUS A MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 2 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK A-2 (TACCO STATION) (AIP) (Continued)			
DIGITAL CREW INTERFACE	FECB	COMMUNICATIONS — INTERPHONE	MEDC
ICS DIGITAL BUS COUPLER (CU-2570/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
KEYBOARD	DPS	TACCO — PEP	MAC BUS A
MISSILE/IRDS STATUS PANEL	FECB	TACCO STA LT — IND	MDC
MISSILE ARMAMENT PANEL (DEP)	MISSILE CB PNL	MAP	MDC
MISSILE CONTROLLER (MC)	MISSILE CB PNL	MIB/AMIB	MDC
PROGRAMMABLE ENTRY PANRL (PEP)	DPS	TACCO — PEP	MAC BUS A
PEP POWER SUPPLY (AS/PS-2)	DPS	TACCO — PEP	MAC BUS A
TRACKBALL	DPS	TACCO — PEP	MAC BUS A
RACK A-2 (TACCO STATION — BMUP)			
FLAT PANEL DISPLAY	DPS	TACCO — FPD	MAC BUS A
KEYBOARD	DPS	TACCO — PEP	MAC BUS A
PEP	DPS	TACCO — PEP	MAC BUS A
PEP POWER SUPPLY (AS/PS-2)	DPS	TACCO — PEP	MAC BUS A
TACCO LCD MONITOR	MLC 2 UPPER	MMIS AUX DISPLAY	MDC
TACCO POWER CONTROL PANEL	DPS FECB	COP PWR DIST BOX TACCO STA. LT. IND	MAC BUS A MDC MDC
TRACKBALL	DPS	TACCO — PEP	MAC BUS A
NAV/COMM STATION			
ACQ-5 DTS	FECB	DATA TERM SET	MEAC MEDC
ANGLE OF ATTACK TRANSMITTER	FLC UPPER H-16	ANGLE OF ATTACK INST PWR	MEDC
ANTENNA SWITCHING ASSEMBLY	FECB	SATCOM	MDC
ARN-151 GPS CDNU #3 (NAV/COMM)	FECB	NAV/COM	MEDC
HIGH SPEED PRINTER (HSP)	MLC PNL 3 UPPER	TELEPRINTER	MAC BUS A
HSI	FECB NAV J	NAV NAVIGATOR	MEAC MEAC
KEYSETS	DPS	UNIVERSAL KEYSET NAV/COMM	BUS A
KGX-40	FECB	DATA LINK	BUS A
KYV-5 REMOTE CONTROL UNIT (RCU)	FECB	COMMUNICATIONS SECURE VOICE HF	MEAC
NAV/COMM ARO POWER SUPPLY	DPS	AUX READOUT DISPLAY N/C	MAC BUS A
TACCO ARO POWER SUPPLY	DPS	AUX READOUT DISPLAY T/C	MAC BUS A
TELETYPE KEYBOARD (TTY)	MLC PNL 3 UPPER	KEYBD	MAC BUS A
NAV/COMM STATION (AIP)			
ANDVT REMOTE CONTROL (Z-ANG)	FECB	COMMUNICATIONS- SECURE VOICE — HF ANDVT	MAC BUS A
COLOR HIGH RESOLUTION DISPLAY	DPS	NAV/COM — CHRD	MAC BUS A
DIGITAL CREW INTERFACE	FECB	COMMUNICATIONS — INTERPHONE	MEDC
HARD COPY RECORDER/MILTOPE	DPS	HCR/MILTOPE	MAC BUS A
ICS DIGITAL BUS COUPLER (CU-2570/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 3 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
NAV/COMM STATION (AIP) (Continued)			
KEYBOARD	DPS	NAV/COMM — PEP	MAC BUS A
KY-58 REMOTE CONTROL UNIT (Z-ANP)	FECB	COMMUNICATIONS — SECURE VOICE — KY-58	MDC
MINI DAMA DEP (C-12226)	DPS	COMMUNICATIONS — MINI DAMA — PWR AMP	MAC BUS A
PEP	DPS	NAV/COMM — PEP	MAC BUS A
PEP POWER SUPPLY (AS/PS-2)	DPS	NAV/COMM — PEP	MAC BUS A
SECURE VOICE EQUIPMENT (KWX-13)	MLC PNL 3 UPPER	COMMUNICATIONS — TELETYPE — SECURITY UNIT	MAC BUS A
TRACKBALL	DPS	NAV/COMM — PEP	MAC BUS A
NAV/COMM STATION (BMUP)			
FLAT PANEL DISPLAY	DPS	NAV/COMM — FPD	MAC BUS A
HARD COPY RECORDER	DPS	HCR	MAC BUS A
KEYBOARD	DPS	NAV/COMM — PEP	MAC BUS A
PEP	DPS	NAV/COMM — PEP	MAC BUS A
PEP POWER SUPPLY (AS/PS-2)	DPS	NAV/COMM — PEP	MAC BUS A
TRACKBALL	DPS	NAV/COMM — PEP	MAC BUS A
NAV/COMM STATION (CNS/ATM)			
CDU-7000 NAV/COMM	FECB	CDU NAV/COMM	MEDC
DIGITAL DATA SET (DDS)	FECB	DDS	MEDC
RACK B-1 AND B-2			
ADF FILTER	FECB	ADF LF	MDC
COMM SWITCHING MATRIX	FECB FECB	COMM SYS SEL SECURE VOICE HF AND UHF	MEAC/DC MEAC/DC
DATA LINK SECURITY UNIT	FECB	DATA LINK	MAC BUS A
ELECTRONIC CONTROL AMPLIFIER #1	FECB	ATT/HDG	MEAC/DC
ELECTRONIC CONTROL AMPLIFIER #2	FECB	BRG/HDG	MEAC/DC
FLASHER CONTROL	FLC UPPER K-24	WARNING LIGHTS	MEDC
FLIGHT DIRECTOR SIGNAL DATA CONVERTER	FLC D-3/H-15 NAV-J BOX	FLT DIR PWR FDI SYS	MEAC/DC MEAC
FLIGHT DIRECTOR STEERING COMPUTER (FDSC)	FLC UPPER D-3 FLC UPPER H-15	FLT DIR PWR FLT DIR PWR	MEAC MEDC
FWD ARMAMENT INTCN BOX	FLC UPPER A-1/2/3 FLC UPPER G-1/2/3 FLC LOWER FLC LOWER	ARMAMENT CKT BRK PNL ARMAMENT 1, 2, & 3 BOMB RACK LOCK PWR STB, CTR PORT ARMAMENT JETTISON	MEAC EXT MDC MEDC MEDC
FWD NAV-J BOX	FECB FLC LOWER	NAV INTERCONNECTION BOX BUS 1, 2, & 3 DC/BUS 1 & 2 RADAR ALTM PWR	MEAC/DC FEAC
GLIDESLOPE RECEIVER	FECB	GLIDESLOPE	MEDC
GPS POWER RELAY ASSY	FECB	GPS POWER	MEDC
HACLCS DATA PROCESSOR COMPUTER	HARPOON NAV-J BOX	HACLCS MAD	MAC BUS A MEAC
KG-40A	FECB	DATA LINK	BUS A
KILL STORES POWER RELAY	FECB	ARM. PWR — MASTER CONT ARM. PWR — STORES-KILL	EXT MDC EXT MDC
RADAR ALTIMETER WARNING SET #1 (RAWS) #1	FLC UPPER D-5 FLC UPPER K-18	RAWS PWR — NO. 1 RAWS NO. 1 — PWR	MEAC MEDC
RADAR ALTIMETER WARNING SET #2 (RAWS) #2	FLC UPPER D-6 FLC UPPER K-20	RAWS PWR — NO. 1 RAWS NO. 1 — PWR	MEAC MEDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 4 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK B-1 AND B-2 (Continued)			
SEARCH STORES POWER RELAY	FECB	ARM. PWR — MASTER CONT ARM. PWR — STORES-SEARCH	EXT MDC EXT MDC
VOR-1 NAV CONVERTER	AFT C/B PANEL NAV J BOX	VOR-1 RCVR VOR-1	MEAC/DC MEAC
VOR-2 NAV CONVERTER	AFT C/B Panel NAV-J BOX	VHF/VOR-2 RCVR VOR 2	MEAC/DC MEDC
RACK B-1 AND B-2 (AIP)			
ANDVT SATELLITE COMMUNICATIONS (SATCOM) (AN/USC-43(V)3)	FECB	COMMUNICATIONS — SECURE VOICE — UHF 3 — ANDVT	MAC BUS A
ANTENNA COUPLER (NAVAIDS)	NO POWER	NO POWER	
CMDS PWR & ARM RELAYS	FECB	CMDS — PWR CMDS — CONT	MEDC MEDC
ICS POWER ISOLATOR ASSEMBLY	FECB	COMMUNICATIONS — INTERPHONE PILOT, TACCO, SS-3 DBI DATA SW COPILOT, NAV/COMM CSC/MVMS	MEDC MEDC MEDC MEDC
POWER SUPPLY (PP-8456/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
RACK B-1 AND B-2 UPDATE II AND II.5			
APS-137 POWER SUPPLY	MLC 2 UPPER	SEARCH RADAR	BUS A MDC
VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE (VOR) ANTENNA COUPLER AND ATTENUATOR	NO POWER	NO POWER	
VOR/ILS-1 MARKER BEACON RECEIVER (RCVR)	FLC UPPER K-5 NAV-J BOX	VOR ILS-1 VOR 1	MEDC MEAC
VOR/ILS-2 MARKER BEACON RCVR	FLC UPPER K-6 NAV-J BOX	VOR ILS-2 VOR 2	MEDC MEAC
RACK B-3			
COMM INTERFACE #2	FECB	INTERFACE 2	MEAC
DATA LINK CONVERTER CONTROL (MODEM)	FECB	DATA TERM SET	MEAC/DC
DATA LINK POWER SUPPLY	FECB	DATA TERM SET	MEAC/DC
HF-1 ANTENNA COUPLER AND FAN	FECB	HF-1	MEAC/DC
HF-1 POWER AMPLIFIER (PA)	FECB	HF-1	MEAC/DC
HF-1 RECEIVER TRANSMITTER (R/T)	FECB	HF-1	MEAC/DC
HF SECURE UNIT	FECB	SECURE VOICE HF	MEAC
ICS INTERCONNECTION BOX	FECB	INTERPHONE	MEDC
ICS POWER FILTER	FECB	INTERPHONE	MEDC
SECURE SWITCHING MATRIX	FECB FECB	SECURE VOICE DATA TERM SET	MEAC/DC MEDC
ULTRA HIGH FREQUENCY (UHF) SECURE UNIT	FECB	SECURE VOICE-UHF	MEDC
RACK B-3 UPDATE II AND II.5			
CABIN DUCT TEMP SENSOR	FLC UPPER A-22	CABIN TEMP CONT	MEAC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 5 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK C-1 AND C-2			
ARN-151 GPS MISSION DATA LOADER	FECB	DATA LDR	MEDC
ARN-151 GPS RECEIVER	FECB	RCVR	MEAC
ARN-151 GPS KYK-13 FILL PANEL	FECB	RCVR	MEAC
AUTO PILOT ALTITUDE CONTROL 1 AND 2	MLC PNL 4 UPPER	AFCS MAIN	MAC BUS A MDC
AUTOPILOT — PITCH, ROLL, YAW, MONITOR CONTROL AMPLIFIERS	MLC PNL 4 UPPER	AFCS MAIN	MAC BUS A MDC
COMM INTERFACE #1 (CD-40)	MLC PNL 3 UPPER	INTERFACE 1	MAC BUS A
IRDS RECORDER	MLC PNL 2 UPPER	IRDS-RECORDER	MAC BUS A MDC
NAV SIMULATOR	FECB NAV-J BOX	NAV INTCN BOX-FWD-BUS 3 NAV TEST SET	MEDC MEAC
RATE OF TURN CONTROL	FLC LOWER	VERT GYRO	MEAC
TACTICAL AIR NAVIGATION (TACAN) RECEIVER TRANSMITTER (R/T)	FECB NAV-J BOX	TACAN TACAN	MEAC/DC MEAC
TACAN RF SWITCH RELAY	FECB	TACAN	MEDC
TRUE AIRSPEED COMPUTER (**TAS**)	FECB DPS	TAS COMPUTER	MEAC/DC MAC BUS A
TTY SECURITY UNIT	MLC PNL 3 UPPER	SECURITY UNIT	MAC BUS A
TTY SIGNAL DATA CONVERTER (SDC)	MLC PNL 3 UPPER	DATA CONV	MAC BUS A MDC
VERTICAL (STANDBY) GYRO	FLC LOWER	VERT GYRO	MEAC
RACK C-1 AND C-2 (AIP)			
APS-137 GPS KYK-13 FILL PANEL	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
DIGITAL AUDIO INTERFACE CONVERTER (3) (CV-4303/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
DIGITAL BUS INTERFACE CONVERTER (CV-4304/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
HF/UHF SIGNAL DATA CONVERTER (SDC) (A-555)	MLC PNL 3 UPPER	COMMUNICATIONS — TELETYPE — DATA CONV	MAC BUS A MDC
ICS DATA SWITCH (SA-2726/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
ICS DIGITAL BUS COUPLER (4) (CU-2570/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
RACK C-1 AND C-2 (CNS/ATM)			
TRUE AIRSPEED COMPUTER (TAS)	FECB DPS	TAS SIGNAL DATA CONVERTER	MEAC/DC MAC BUS A
RACK C1 AND C2 UPDATE II AND II.5			
TRUE AIRSPEED COMPUTER (TAS)	FECB DPS	TAS SIGNAL DATA CONVERTER	MEAC/DC MAC BUS A
RACK C-3			
APS-137 RADAR SET CONTROL-INTERFACE (RSCI)	MLC 2 UPPER	SEARCH RADAR	BUS A MDC
APS-137 SIGNAL DATA CONVERTER	MLC 2 UPPER	SEARCH RADAR	BUS A MDC
EMP DE-ICER THERMAL SENSOR AND TEST SWITCH	FLC UPPER F-16	EMP DE-ICER CONT	EXT MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 6 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK C-3 (Continued)			
IRDS INTERCONNECTION BOX	MLC PNL 2 UPPER DPS	IRDS-SYS COMPUTER	MAC BUS A MAC BUS A
LEFT AND RIGHT SIDE WINDSHIELD OVERHEAT CONTROL RELAYS	MLC PNL 2 LOWER FLC UPPER F-7/8	SIDE WSHLD HT PWER L&R SIDE WSHLD HT CONT L&R	MAC BUS A EXT MDC
LEFT AND RIGHT SIDE WINDSHIELD POWER CONTROL RELAYS	MLC PNL 2 LOWER FLC UPPER F-7/8	SIDE WSHLD HT PWER L&R SIDE WSHLD HT CONT L&R	MAC BUS A EXT MDC
LEFT AND RIGHT SIDE WINDSHIELD TEMPERATURE CONTROL RELAYS	MLC PNL 2 LOWER FLC UPPER F-7/8	SIDE WSHLD HT PWER L&R SIDE WSHLD HT CONT L&R	MAC BUS A EXT MDC
MAD AMPLIFIER POWER SUPPLY	MLC PNL 3 UPPER	MAD SYSTEM	MAC BUS A
PUSH TO TALK (PIT) RELAY	MLC PNL 3 UPPER MLC PNL 3 UPPER	DATA CONV SECURITY UNIT	MDC MAC BUS A
RADAR INTERFACE UNIT (RIU)	DPS	RADAR INTERFACE	MAC BUS A
SIDE WINDSHIELD LOAD MONITOR RELAY	MLC PNL 1 UPPER FLC UPPER F-7/8	SIDE WSHLD DEFOG SIDE WSHLD HT CONT L&R	MDC EXT MDC
SYNCHROPHASER	MLC PNL 1 LOWER FLC UPPER G-22	SYNC PHASE CONTROL SYNC CONT	MAC BUS A EXT MDC
SYNCHROPHASER HF FILTER	NO POWER	NO POWER	
T414 INTERCONNECTION BOX	FLC LOWER FLC LOWER	T414 POWER 1, 2 AND 3 T414 CONTROL 1 AND 2	MEDC MEDC
WINDSHIELD DISCHARGE SUPPRESSION CAPACITORS	FLC UPPER A-25/26	L & R PNL HEAT PWR	MEAC
RACK C-3 (AIP)			
AIMS ELECTRONIC UNIT	MLC 2 UPPER	AIMS — AEU POWER	MEDC
RADAR SET CONTROL-INTERFACE (C-12434B/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
SIGNAL DATA CONVERTER (CV-4295A/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
RACK C-3 UPDATE II AND II.5			
IRDS INTERCONNECTION BOX	MLC PNL 2 UPPER DPS	IRDS SYS SIGNAL DATA CONVERTER	MAC BUS A/ MDC MAC BUS A
RACK C-4			
IRDS CONTROL SERVOMECHANISM	MLC PNL 2 UPPER DPS	IRDS SYS COMPUTER	MAC BUS A/ MDC MAC BUS A
IRDS VIDEO CONVERTER/POWER SUPPLY	MLC PNL 2 UPPER MLC PNL 2 UPPER	IRDS SYS IRDS HEATER	MAC BUS A/ MDC MAC BUS A
IRDS VIDEO INDICATOR	MLC PNL 2 UPPER	IRDS SYS	MAC BUS A/ MDC
RACK C-4 (AIP)			
AIMS INTERFACE CONTROLLER (AIC)	MLC 2 UPPER	AIMS — AIC POWER	MAC BUS A
AIMS VIDEO INDICATOR	MLC PNL 2 UPPER	AUX MON POWER	MAC BUS A
C-AUX BAY			
A-303 SELECTOR CONTROL	MLC PNL 3 UPPER NAV-J BOX	MAD-SAD MAD	MAC BUS A/ MDC MEAC
MAG VAR INDICATOR	MLC PNL 3 UPPER	MAD-SAD	MAC BUS A
SS-3 LIGHTING PWR RECTIFIER	MLC PNL 2 UPPER	SENSOR STA 3 LTS-EDGE	MAC BUS A

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 7 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK C-4 UPDATE II AND II.5			
IRDS CONTROL SERVOMECHANISM	MLC PNL2 UPPER DPS	IRDS SYS SIGNAL DATA CONVERTER	MAC BUS A/ MDC MAC BUS A
RACK C-5			
SS-3 MPD POWER SUPPLY	DPS	MULTIPURPOSE DISPLAY — SENSOR STA NO. 3	MAC BUS A
RACK C-5 (AIP)			
TACTICAL DATA PROCESSOR OASIS III (ACAC/RV18-01/MP)	DPS	COMMUNICATIONS — OASIS	MAC BUS A
NONACOUSTIC STATION			
AIRCRAFT CAMERA MASTER CONTROL (CD-223/ASX-6)	MLC 2 UPPER	MMIS — ACMC	MAC BUS A MDC
ALR-66 ICP	MLC 2 UPPER	ALR-66 ESM	MAC BUS A MDC
DETECTING SET CONTROL	MLC 2 UPPER	IRDS SYS	MAC BUS A MDC
DIGITAL TO DIGITAL CONVERTER	MLC 2 UPPER	MMIS — SYSTEM CONV	MDC MDC
FLIR TURRET CONTROL PANEL	MLC 2 UPPER	IRDS TURRET CONT	MAC BUS A MDC
INFRARED SET CONTROL (C-12723/ASX-6)	MLC 2 UPPER	PWR RELAY	MDC
IRDS TURRET CONTROL PANEL	MLC 2 UPPER	MMIS — TURRET CONT	MAC BUS A MDC
RADAR ANT. CONTROL PANEL	MLC 2 UPPER	SEARCH RADAR	MAC BUS A MDC
RADAR CONTROL PANEL	MLC 2 UPPER	SEARCH RADAR	MAC BUS A MDC
RADAR SCAN CONVERTER	DPS	SCAN CONV	MAC BUS A
RECEIVER CONVERTER	MLC 2 UPPER	IRDS SYS	MAC BUS A MDC
RO-32	MLC 3 UPPER	MAD REC	MAC BUS A
SIF AND AUX CONTROL PANEL	MLC 2 UPPER	IFF INTERROGATOR	MAC BUS A MDC
SS-3 LCD MONITOR	MLC 2 UPPER	MMIS — SYSTEM DISPLAY	MDC MDC
TARGET TRACKING SIGHT CONTROL(LER) (TTSC)	MLC 2 UPPER	IRDS SYS IRDS TURRET CONT	MAC BUS A MDC
ULQ-16	MLC 2 UPPER	ULQ-16	MAC BUS A
NONACOUSTIC STATION (AIP)			
1553 BUSS COUPLER (2 EACH)	NO POWER	NO POWER	
AIMS AUXILIARY DISPLAY	MLC 2 UPPER	AIMS	MDC
AIMS BACKUP CONTROL PANEL	MLC 2 UPPER	AIMS — TURRET POWER	MEDC
AIMS CONTROL UNIT	MLC 2 UPPER	AIMS — CONTROL	MEDC
AIMS TURRET CONTROL	MLC 2 UPPER	AIMS — TURRET PAYLOAD	MEDC
COLOR HIGH RESOLUTION DISPLAY	DPS	SENSOR STA NO. 3 — CHRD	MAC BUS A

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 8 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
NONACOUSTIC STATION (AIP) (Continued)			
CONTROL-INDICATOR (C-11584A/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
DIGITAL CREW INTERFACE (C-12450/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
DIGITAL DATA COUPLER (CU-2570/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
ICS AMPLIFIER INTERCONNECTION JACKBOX (J-6309/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
KEYBOARD	DPS	SENSOR STA NO. 3 — PEP	MAC BUS A
PEP	DPS	SENSOR STA NO. 3 — PEP	MAC BUS A
PEP POWER SUPPLY (AS/PS-2)	DPS	SENSOR STA NO. 3 — PEP	MAC BUS A
RADAR SET CONTROL (C-12433A/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
SEI	MLC 2 UPPER	SEI	MAC BUS A
SEI CONTROL DISPLAY	MLC 2 UPPER	PULSE PROCESSOR	MAC BUS A
TRACKBALL	DPS	SENSOR STA NO. 3 — PEP	MAC BUS A
VIDEO RECORDER CONTROL (VS-83F)	MLC 2 UPPER	IDENTIFICATION — VTR	MDC
VIDEO TAPE RECORDER (VTR) (V-83AB-F)	MLC 2 UPPER	IDENTIFICATION — VTR	MDC
NONACOUSTIC STATION (BMUP)			
AIRCRAFT CAMERA MASTER CONTROL (CD-223/ASX-6)	MLC 2 UPPER	MMIS — ACMC	MDC
DIGITAL TO DIGITAL CONVERTER	MLC 2 UPPER	MMIS — SYSTEM CONV	MDC MDC
FLAT PANEL DISPLAY	DPS	SENSOR STA NO.3 — FPD	MAC BUS A
INFRARED SET CONTROL (C-12723/ASX-6)	MLC 2 UPPER	PWR RELAY	MDC
IRDS TURRET CONTROL PANEL	MLC 2 UPPER	MMIS — TURRET CONT	MAC BUS A MDC
KEYBOARD	DPS	SENSOR STA NO.3 — PEP	MAC BUS A
PEP	DPS	SENSOR STA NO.3 — PEP	MAC BUS A
PEP POWER SUPPLY (AS/PS-2)	DPS	SENSOR STA NO.3 — PEP	MAC BUS A
SS-3 LCD MONITOR	MLC 2 UPPER	MMIS — SYSTEM DISPLAY	MDC MDC
TRACKBALL	DPS	SENSOR STA NO.3 — PEP	MAC BUS A
RACK D-1			
DIGITAL DATA UNIT (DDU)	AECB	DDU CH1 DDU CH2	MEDC MDC
LOGIC UNIT 2 (LU-2)	DPS	LOGIC UNIT — NO. 2	MAC BUS A
LOGIC UNIT 3 (LU-3)	DPS	LOGIC UNIT — NO. 3	MAC BUS A
POWER DISTRIBUTION BOX	MLC PNL 1 UPPER MLC PNL 2 LOWER	ELEC. PWR FEEDERS NO. 1 ELEC. PWR FEEDERS NO. 3	MDC MAC BUS A

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 9 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK D-1 (AIP)			
1553 BUS COUPLERS (2 EACH)	NO POWER	NO POWER	
CP-2339 INTERCONNECTION BOX	DPS	COMPUTER	MAC BUS A MDC
RADAR SET COMPUTER (CP-1706B/APS-137D(V))	MLC 2 UPPER	IDENTIFICATION — SEARCH RADAR	MAC BUS A MDC
VIDEO CONVERTER UNIT (VCU) (CV-4296A/APS)	DPS	RADAR VCU	MAC BUS A
RACK D-1 (CNS/ATM)			
DIGITAL DATA UNIT (DDU)	AECB	DDU CH1 DDU CH2	MEDC MDC
RACK D-2			
BULK MEMORY INTERFACE BOX (A-505) OVERHEAD BETWEEN RACK D1 AND D2	NO POWER	NO POWER	
COMPUTER MAINTENANCE CONTROL PANEL (MCP)	DPS DPS	COMPUTER PWR DISTR BOX	MAC BUS A MDC
CP-901 DIGITAL DATA COMPUTER	DPS	COMPUTER	MAC BUS A
CP-2044 DIGITAL DATA COMPUTER	DPS	COMPUTER PWR DISTR BOX	MAC BUS A MDC
ISOLATION TRANSFORMER	DPS	COMPUTER	MAC BUS A
LOGIC UNIT 1 (LU-1)	DPS	LOGIC UNIT — NO.1	MAC BUS A
UTILITY LIGHT	HARPOON/CENTER	UTIL LT-CMPTR AREA	MDC
RACK D-2 (AIP)			
COMPUTER TERMINAL CONTROL	DPS	COMPUTER	MAC BUS A
CP-2339 DIGITAL DATA COMPUTER	DPS	COMPUTER	MAC BUS A MDC
CP-2339 INTERCONNECTION BOX #1 (J-6319/ASQ-222(V))	DPS	COMPUTER	MAC BUS A MDC
RACK D-2 (BMUP)			
COMPUTER MAINTENANCE PANEL (CMP)	DPS	COP PWR DIST BOX	MAC BUS A MDC
CP-2451 DIGITAL DATA COMPUTER	DPS	DDC	MAC BUS A
RACK D-3			
AUTOPILOT RATE SENSORS	MLC PNL 4 UPPER	AFCS MAIN	MAC BUS A MDC
CABIN TEMPERATURE SENSOR	FLC UPPER A-22	CABIN TEMP CONT	MEAC
CIPHER DATA RELAY	FECB	DATA TERM SET	MEDC
COMPUTER BAROMETRIC ALTIMETER	DPS DPS	CMPTR ALTM SIGNAL DATA CONVERTER	MDC MAC BUS A
HARPOON INTERCONNECTION BOX (IB)	HARPOON	ALL 29 CIRCUIT BREAKERS ON THE HACLCS CIRCUIT BREAKER PANEL	MEAC/DC MAC BUS A MDC
REPLACEMENT DATA STORAGE SYSTEM (RDSS)	DPS	RDSS PWR DISTR BOX	MAC BUS A MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 10 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK D-3 (AIP)			
ICS INTERCONNECTION BOX (J-6309/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
MISSILE INTERFACE BOX (MIB/AMIB) (J-6315/ALQ)	MISSILE CB PNL	MIB/AMIB	MDC
REPLACEMENT DATA STORAGE SYSTEM (RDSS)	DPS	RDSS COMPUTER	MAC BUS A MDC
VIDEO DISTRIBUTION CONTROLLER (VDC) (CD-124/ASQ-222)	DPS	VDC	MAC BUS A
RACK D-3 (BMUP)			
COMPUTER BAROMETRIC ALTIMETER	DPS	BARO/ALT ENCDR	MAC BUS A
REPLACEMENT DATA STORAGE SYSTEM (RDSS)	DPS	RDSS POWER DISTR BOX	MAC BUS A MDC
VIDEO DISTRIBUTION CONTROLLER	DPS	VDC	MAC BUS A
RACK D-3 UPDATE II			
LOGIC UNIT NO. 4	DPS	LOGIC UNIT NO. 4	MAC BUS A
MAG TAPE TRANSPORT A (MTT A)	DPS	MAG TAPE A	MAC BUS A
RACK D-3 UPDATE II.5			
DIGITAL MAG TAPE CONTROL (DMTC)	DPS	MAG TAPE CONT	MAC BUS A
DIGITAL MAG TAPE UNIT (DMTU) “A”	DPS	MAG TAPE A	MDC
DIGITAL MAG TAPE UNIT (DMTU) “B”	DPS	MAG TAPE B	MDC
DMTS INTERFACE BOX (A-505) (OVERHEAD BETWEEN D2 AND D3)	NO POWER		
LOGIC UNIT NO. 4	DPS	LOGIC UNIT NO. 4	MAC BUS A
SIGNAL DATA CONVERTER (SDC)	DPS	SIGNAL DATA CONVERTER	MAC BUS A
MAIN LOAD CENTER			
APU SUPERVISORY PANEL	FLIGHT STATION	SECURE GENERATOR	APU GEN
COUNTER ACCELEROMETER	MLC PNL 1 UPPER	COUNT ACCEL	MDC
DPS TIME DELAY RELAY	MLC PNL 1 LOWER MLC PNL 1 UPPER	DPS POWER ELECTRIC FEEDERS AC	MAC BUS A MDC
EXTERNAL POWER MONITOR	FLC UPPER E-29	EXT PWR CONT	GRND OP BUS
FUEL FLOW POWER SUPPLY	MLC PNL 1 LOWER	FUEL FLOW ID	MAC BUS A
PROP DE-ICE TIMER	FLC UPPER G-13	PROP DE-ICER CONT	EXT MDC
RUNAROUND RELAY # 1	FWD 2 GANG BREAKERS ON MLC	2 AND 4 RUN AROUND FEEDERS	GEN. 2 AND 4 APU GEN. AND EXT PWR
RUNAROUND RELAY # 2	3 GANG BREAKERS ON MLC	2, 4, AND 3 RUN AROUND FEEDERS	GEN. 2, 4, 3 APU GEN. AND EXT PWR
TRANSFER RELAY 2	FLC UPPER J-1	BUS A CONT	NO.2 SUPERVISORY PANEL ACR ENERGIZED MEDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 11 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
MAIN LOAD CENTER (Continued)			
TRANSFER RELAY 3	FLC UPPER J-2	BUS B CONT	NO.3 SUPERVISORY PANEL ACR ENERGIZED MEDC
TRANSFER RELAY 4	FLC UPPER E-29	EXT PWR CONT	GOB
TRANSFER RELAY 5	FLC UPPER H-4	GEN 4 TRANS	MEDC
TRANSFER RELAY 6	FLC UPPER H-4	GEN 4 TRANS	MEDC
TRANSFER RELAY 7	FLC LOWER	GEN 4 AUX CONT	FEDC
STROBE LIGHTS FLASHER RELAY	MLC PNL 4 LOWER MLC PNL 4 LOWER FLC F-5	STROBE LIGHT-TOP STROBE LIGHT-BOTTOM STROBE LIGHT	MAC BUS B MAC BUS B
SUPERVISORY PANEL #2	FLIGHT STATION	SECURE GENERATOR #2	GEN. 2
SUPERVISORY PANEL #3	FLIGHT STATION	SECURE GENERATOR #3	GEN. 3
SUPERVISORY PANEL #4	FLIGHT STATION	SECURE GENERATOR #4	GEN. 4
TRANSFORMER RECTIFIER #1	MLC PNL 1 LOWER	XMFR RECT NO. 1	MAC BUS A
TRANSFORMER RECTIFIER #2	MLC PNL 3 LOWER	XMFR RECT NO. 2	MAC BUS B
MAIN LOAD CENTER (AIP)			
AIMS POWER CONDITIONER	MLC 2 UPPER	AIMS — AUX MON POWER	MDC
APS-137 POWER DISTRIBUTION PANEL (PDP)	MLC 2 UPPER	SEARCH RADAR	MAC BUS A
STRUCTURAL DATA RECORDING SYSTEM (SDRS)	MLC 1 UPPER	SDRS	MDC
SS-1 AND -2			
ACOUSTIC TEST SIGNAL GENERATOR	ASCB	ATSG	BUS A
AFT ARMAMENT INTERCONNECTION	FLC UPPER FLC LOWER	ARMAMENT G1 AND 2 ARMAMENT JETTISON	EXT MDC MEDC
AQH-4(V)2 REMOTE CONTROL PANEL	ASCB	ACOUSTIC SYSTEM 1 AND 2 TAPE RCDR PNL	MDC
ASCL RECEIVER CONTROL	ASCB	ACOUSTIC SYSTEM 1 AND 2 ASCL RCVR	MDC BUS A
ASCL RECEIVER INDICATOR	ASCB	ACOUSTIC SYSTEM 1 AND 2 ASCL RCVR	MDC BUS A
ADVANCED SIGNAL PROCESSOR (ASP) POWER INTERLOCK RELAY	ASCB	ASP — INTLK, ASP — CONT	MDC
HACLCS CONTROL DISTRIBUTION BOX (CDB)	HARPOON	ALL 29 CIRCUIT BREAKERS ON THE HARPOON CIRCUIT BREAKER PANEL	MEAC/DC MAC BUS A MDC
KEYSETS	DPS	UNIVERSAL KEYSETS SENSOR STATION 1 AND 2	BUS A
MEP/MPD POWER RELAY NO. 1	ASCB	ACOUSTIC SYS #1 — MEP ACOUSTIC SYS #1 — ANAL DISP ASP — CONT	MAC BUS A MAC BUS A MDC
MEP/MPD POWER RELAY NO. 2	ASCB	ACOUSTIC SYS # 2 — MEP ACOUSTIC SYS #2 — ANAL DISP ASP — CONT	MAC BUS A MAC BUS A MDC
RACK E1 AND E2 UTILITY LIGHT	HARPOON	UTIL LT-RACK E2/E1	MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 12 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
SS-1 AND -2 (Continued)			
SONOBUOYS (SONO) AUDIO SELECTOR PANELS	ASCB	ACOUSTIC SYSTEM 1 AND 2 DISTR. BOX	MDC BUS A
SS1 AND LIGHTING POWER RECTIFIER	HARPOON	SS1 AND 2 STA LTG-EDGE LT SS1 AND 2 STA LTG-IND LT	MAC BUS A MDC
TIME CODE GENERATOR	ASCB	TIME CODE GEN	BUS A
SS-1 AND -2 (AIP)			
CREW STATION CONTROL PANEL (2)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
PEP	ACOUSTIC C/B	PEP	MAC BUS A
SS-1 AND -2 (BMUP)			
AQH-13 REMOTE CNTRL BOX	ASCB	RECORDER/REPRODUCER POWER RMT CONT	MDC MDC
FLAT PANEL DISPLAY (SS-1)		SENSOR STATION 1 — DISPLAY POWER	MAC BUS A
FLAT PANEL DISPLAY (SS-2)		SENSOR STATION 2 — DISPLAY POWER	MAC BUS A
KEYBOARD (SS-1)		SENSOR STATION 1 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
KEYBOARD (SS-2)		SENSOR STATION 2 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
PEP (SS-1)		SENSOR STATION 1 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
PEP (SS-2)		SENSOR STATION 2 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
PEP POWER SUPPLY (AS/PS-2) (SS-1)		SENSOR STATION 1 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
PEP POWER SUPPLY (AS/PS-2) (SS-2)		SENSOR STATION 2 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
TRACKBALL (SS-1)		SENSOR STATION 1 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
TRACKBALL (SS-2)		SENSOR STATION 2 — PROGRAMMABLE ENTRY PANEL	MAC BUS A
RACK E-1			
ACOUSTIC DISTRIBUTION BOX #1 (ADB #1)	ASCB ASCB	ACOUSTIC SYS #1 — DIST BOX ACOUSTIC SYS #1 — DIST BOX	MAC BUS A MDC
ACOUSTIC DISTRIBUTION BOX #2 (ADB #2)	ASCB ASCB	ACOUSTIC SYS #2 — DIST BOX ACOUSTIC SYS #2 — DIST BOX	MAC BUS A MDC
ANALYZER UNIT (AU)	MLC PNL 2 LOWER	ACOUSTIC SYS ASP POWER	MAC BUS A
ASCL SELECT RELAY (OVERHEAD ABOVE RACK E1)	ASCB	OTPI	MDC
ASP POWER RELAY	MLC PNL 2 LOWER ASCB	ACOUSTIC SYS ASP POWER ASP-CONT	MAC BUS A MDC
AU POWER INTERRUPT UNIT (AU PIU)	MLC PNL 2 LOWER	ACOUSTIC SYS ASP POWER	MAC BUS A
DCU POWER INTERRUPT UNIT (DCU PIU)	MLC PNL 2 LOWER	ACOUSTIC SYS ASP POWER	MAC BUS A
DISPLAY CONTROL UNIT (DCU)	MLC PNL 2 LOWER	ACOUSTIC SYS ASP POWER	MAC BUS A
UTILITY LIGHT	HARPOON	UTIL LT-RACK E2/E1	MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 13 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK E-1C (BMUP)			
ACOUSTIC DISTRIBUTION BOX #1 (ADB #1)	ASCB ASCB	ACOUSTIC DISTR BOX NO. 1 ACOUSTIC DISTR BOX NO. 1	MAC BUS A MDC
ACOUSTIC DISTRIBUTION BOX #2 (ADB #2)	ASCB ASCB	ACOUSTIC DISTR BOX NO. 2 ACOUSTIC DISTR BOX NO. 2	MAC BUS A MDC
RACK E-2			
AQH-4 RECORDER #1	ASCB	ACOUSTIC SYS NO. 1-RCDR	MDC
AQH-4 RECORDER #2	ASCB	ACOUSTIC SYS NO. 2-RCDR	MDC
ARR-78 SONO RECEIVER #1	ASCB	ACOUSTIC SYS NO.1 ASCL SYS RCVR	MAC BUS A MDC
ARR-78 SONO RECEIVER #2	ASCB	ACOUSTIC SYS NO. 2 ASCL SYS RCVR	MAC BUS A MDC
RACK E-2 (BMUP)			
AQH-13 RECORDER	ASCB	RECORDER/REPRODUCER POWER	MDC
ARR-78 SONO RECEIVER	ASCB	ASCL RCVR	MAC BUS A MDC
RACK F-1			
ADF RECEIVER	FECB NAV-J BOX	ADF LF ADF	MDC MEAC
APS-115 ANTENNA ELEVATION PARKING CONTROL*	MLC PNL 2 UPPER	SEARCH RADAR	MAC BUS A MDC
APS-115 ANTENNA POSITION PROGRAMMER (APP)	MLC PNL 2 UPPER NAV-J BOX	SEARCH RADAR SEARCH RADAR	MAC BUS A MDC MEAC
Note *To remove from the parking control only, pull the APP DC breaker on the APP.			
APX-76 RECEIVER TRANSMITTER	MLC PNL 2 UPPER	IFF INTERROGATOR	MAC BUS MDC
APX-76 SIF SYNCHRONIZER	MLC PNL 2 UPPER	IFF INTERROGATOR	MAC BUS A MDC
ARA-50 AMPLIFIER RELAY (UHF-DF)	MLC PNL 4 UPPER	UHF DF	MAC BUS A MDC
DF/OTPI AUDIO SELECT RELAY	ASCB	OTPI	MDC
DF/OTPI AVAILABLE RELAY	MLC PNL 3 UPPER ASCB	UHF-1 RT OTPI	MEDC MDC
DOPPLER FREQUENCY TRACKER COMPUTER (FTC)	MLC PNL 3 UPPER	DOPPLER	MEAC/DC
DOPPLER FTC SHORTING PLUG	MLC PNL 3 UPPER	DOPPLER	MEAC/DC
DOPPLER INTERCONNECTION BOX	MLC PNL 2 UPPER	DOPPLER	MEAC/DC
HAVE QUICK FILL PORT UHF-1/2	NO PWR	NO PWR	
HF-2 POWER AMPLIFIER (PA)	MLC PNL 3 UPPER	HF-2	MAC BUS A MDC
HF-2 RECEIVER TRANSMITTER (R/T)	MLC PNL 3 UPPER	HF-2	MAC BUS A MDC
KIR-1A/TSEC	MLC PNL 2 UPPER	IFF INTERROGATOR	MAC BUS A MDC
MARKER BEACON RECEIVER	MLC PNL 4 UPPER	MKR BCN	MDC
MARKER BEACON RIPPLE FILTER	MLC PNL 4 UPPER	MKR BCN	MDC
MD-1324-U MODEM	MLC PNL 3 UPPER	DAMA MODEM	MEDC SEE NOTE
RADIO SET CONTROL C-12435	MLC PNL 3 UPPER	UHF-1 CONT	MEDC SEE NOTE

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 14 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK F-1 (Continued)			
RADIO SET CONTROL C-12435	MLC PNL 3 UPPER	UHF-2 CONT	MDC SEE NOTE
Note On aircraft not incorporating AFC-450, the UHF-1, UHF-2, and MD-1324/U Modem Circuit Breakers are located on the CNTR ELEC LOAD CENTER.			
UHF-1 RECEIVER TRANSMITTER (R/T)	MLC PNL 3 UPPER	UHF 1-FAN AND RT	MEAC/DC
UHF-1 RF SWITCH	MLC PNL 3 UPPER	UHF DF	MDC
UHF-2 ANTENNA SELECT	MLC PNL 3 UPPER	UHF-2 ANT SEL	BUS A
UHF-2 RECEIVER TRANSMITTER (R/T)	MLC PNL 3 UPPER	UHF-2-FAN AND RT	MAC BUS A MDC
UHF-2 RF FILTER	NO POWER		
UHF-2 RF SWITCH	MLC PNL 3 UPPER	UHF-2 ANT SEL	MDC
X-MODE ENABLE RELAY	MLC PNL 3 UPPER	UHF 1-FAN AND RT	MEAC/DC
RACK F-1 (AIP)			
1553 TEST PANEL	NO POWER	NO POWER	
MULTI-MISSION ADVANCED TACTICAL TERMINAL (MATT)	DPS	COMMUNICATIONS — MATT	MAC BUS A
RACK F-1 UPDATE II AND II.5			
DOPPLER COMPUTER (FTC)	CECB	DOPPLER	MEAC/DC
DOPPLER FTC SHORTING PLUG	CECB	DOPPLER	MEAC/DC
DOPPLER INTERCONNECTION BOX	CECB	DOPPLER	MEAC/DC
OTPI RECEIVER	MLC PNL 4 UPPER	OTPI	MAC BUS A MDC
OTPI RELAY	CECB	UHF-1 RCVR-XMTR	MDC
UHF-1 R/T	CECB	UHF-1 RCVR-XMTR	MEAC/DC
UHF-2 R/T	CECB	UHF-2 RCVR-XMTR	MAC BUS A
UHF-1 RF RELAY	MLC PNL 4 UPPER	UHF DF	MDC
RACK F-2			
ARM/ORDNANCE (ORD) TEST PANEL	DPS	LOGIC UNIT-NO. 2	MAC BUS A
HF-2 ANTENNA COUPLER AND LIGHTING ARRESTER	MLC PNL 3 UPPER	HF-2	MAC BUS A MDC
ORDNANCE PANEL (KEYSET)	DPS	ORD IND PANEL	MAC BUS A
RACK F-2 (AIP)			
CREW STATION CONTROL (CSC)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
CSC LIGHTS CONTROL SWITCH	AECB	UTILITY RECEPTACLES — AFT EDGE LTS	MDC
DATA ENTRY PANEL	DPS	ORD DEP	MAC BUS A
RACK F-2 (BMUP)			
DATA ENTRY PANEL	DPS	ORD DEP	MAC BUS A

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 15 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
HYDRAULIC SERVICE CENTER (HSC)			
AILERON BOOST PACKAGE AUTOPILOT SERVO TRANSMITTER (XMTR)	MLC PNL 4 UPPER	AFCS MAIN	MAC BUS A MDC
APX-76 SIF RF SWITCH	MLC PNL 2 UPPER	SEARCH RADAR	MAC BUS A MDC
BOTTOM STROBE LIGHT POWER SUPPLY	MLC PNL 4 LOWER FLC UPPER F-5	STROBE LIGHT-BOT STROBE LIGHT	MAC BUS B EXT MDC
EMERGENCY AIR BRAKE BOTTLE	NO POWER		
EMERGENCY LANDING RELEASE	NO POWER		
HYDRAULIC FLAP MOTOR	NO POWER		
LANDING GEAR CONTROL VALVE	FLC UPPER E-17	LANDING GEAR-CONT VAL	EXT MDC
NO. 1 HYDRAULIC PUMP	MLC PNL 2 LOWER FLC UPPER E-13	HYD PUMP NO. 1 HYD SYS PUMP CONT-1	MAC BUS A EXT MDC
NO. 1 HYDRAULIC RESERVOIR	NO POWER		
NO. 1A HYDRAULIC PUMP	MLC PNL 3 LOWER FLC UPPER K-14	HYDRAULIC PUMP-NO. 1A HYD PUMP 1A CONT	MAC BUS B MEDC
NO. 1B HYDRAULIC PUMP	FLC UPPER E-30 FLC UPPER E-31	HYD PUMP 1B-CONT HYD PUMP 1B-PWR	GOB GOB
NO. 2 HYDRAULIC PUMP	MLC PNL 3 LOWER FLC UPPER E-15	HYDRAULIC PUMP-NO. 2 HYD SYS PUMP CONT-2	MAC BUS B EXT MDC
NO. 2 HYDRAULIC RESERVOIR	NO POWER		
HYDRAULIC SERVICE CENTER (HSC) (AIP)			
BAND REJECT FILTER ASSEMBLY	MLC 2 UPPER	ESM	MAC BUS A MDC
ESM DF ANTENNA	MLC 2 UPPER	ESM	MAC BUS A MDC
RADIO FREQUENCY DISTRIBUTION (RFD) UNIT	MLC 2 UPPER	ESM	MAC BUS A MDC
RF PREAMP	MLC 2 UPPER	ESM	MAC BUS A MDC
RACK G-1 AND G-2			
ALQ-78 ESM DATA CONVERTER CONTROL (DPAC)	MLC PNL 2 UPPER	IDENTIFICATION-ECM	MAC BUS A MDC
ALQ-78 ESM POWER SUPPLY	MLC PNL 2 UPPER	IDENTIFICATION-ECM	MAC BUS A MDC
ALQ-78 ESM VIDEO-LOCAL OSCILLATOR (VID/LO)	MLC PNL 2 UPPER	IDENTIFICATION-ECM	MAC BUS A MDC
ALQ-78 RADIO FREQUENCY CONVERTER (RF/IF)	MLC PNL 2 UPPER	IDENTIFICATION-ECM	MAC BUS A MDC
ALR-66 COMPUTER CONVERTER (CC)	MLC PNL 2 UPPER	ESM	MAC BUS A MDC
ALR-66 PROCESSOR INTERFACE	MLC PNL 2 UPPER	ESM	MAC BUS A MDC
ALR-66 REMOTE SWITCHING CONTROL (RRCU)	MLC PNL 2 UPPER	ESM	MAC BUS A MDC
AAR-47 COMPUTER PROCESSOR	FECB	SURVIVABILITY MOD	MDC
CASS TRANSMITTER	ASCB	SONO-COMM XMTR	MAC BUS A
CONTINUITY LIGHT	HARPOON	ACOUS. STA LTG-IND LT	MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 16 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK G-1 AND G-2 (Continued)			
SEARCH STORES INTERCONNECTION BOX	FECB FECB FECB	ARM POWER-STORES-SRCH DOORS-SONO W/PRESS SONO-CONT (SEE NOTE.)	EXT MDC MEAC EXT MDC
SONO COMMAND POWER RELAY	ASCB ASCB	SONO-COMM XMTR ASP-CONT	MAC BUS A MDC
Note For kill stores to remain operable, ensure SEARCH POWER switch secured in flight station and pull only breakers listed. (Logic unit 2 supplies 12-Vdc logic power through the ARM/ORD test panel to the interconnection box.)			
RACK G-1 AND G-2 (AIP)			
1553 BUS COUPLERS (2 EACH)	NO POWER	NO POWER	
AAR-47 COMPUTER PROCESSOR (CP-1975/AAR-47)	FECB	MWS	MEDC
AN/ALE-47 PROGRAMMER	FECB	CMDS — PWR CMDS — CONT	MDC MDC
ANTENNA COMBINER UNIT	DPS	COMMUNICATIONS — ANT CMBNR	MAC BUS A
ANTENNA SWITCH (RS104L)	DPS	COMMUNICATIONS — MINI-DAMA — ANT SW	MDC
BLANKING COMBINER UNIT (BCU)	MLC 2 UPPER	ESM	MAC BUS A MDC
CMDS DATA INTERFACE	AECB	UTILITY RECEPTACLES — 115/200-VOLT AFT OBS/CMDS PANEL UTILITY RECEPTACLES — AFT OBS & CMDS PANEL	MAC BUS A MDC
FREQUENCY MEASUREMENT UNIT (AM-7138B/ALR-66(V))	MLC 2 UPPER	ESM	MAC BUS A
MINI-DAMA MODEM R/T (AN/USC-42(V)3)	DPS	COMMUNICATIONS — MINI-DAMA — MODEM R/T	MAC BUS A
MINI-DAMA PWR AMP (AN/USC-42(V)3)	DPS	COMMUNICATIONS — MINI-DAMA — PWR AMP	MAC BUS A
PEDESTAL ELECTRONIC UNIT (C-12475/ALR-66)	MLC 2 UPPER	ESM	MAC BUS A MDC
POWER RELAY UNIT (RE-1167/ALR-66C(V))	MLC 2 UPPER	ESM	MAC BUS A MDC
TN-613/ALR-81(V) TUNER	MLC 2 UPPER	SEI	MEDC
RACK H-1 AND H-2			
APX-72 IFF KIT-1A	FLC UPPER K-15 FLC LOWER	TRANSP IFF PWR CONT TRANSPONDER PWR IFF	MEDC FEAC
APX-72 IFF TEST SET	FLC UPPER K-16	TRANSP IFF TEST SET	MEDC
APX-72 IFF TRANSPONDER	FLC UPPER K-15 FLC LOWER	TRANSP IFF PWR CONT TRANSPONDER PWR IFF	MEDC FEAC
BATTERY UNIT #1 (BU-1)	ON UNIT		
BATTERY UNIT #2 (BU-2)	ON UNIT		
INERTIAL NAVIGATION UNIT #1 (INU#1)	AECB FECB NAV-J BOX	SYSTEM NO. 1-RUN/HTR TAS (SEE Note.) INS NO. 1	MEAC MEAC/DC MEAC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 17 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK H-1 AND H-2 (Continued)			
INERTIAL NAVIGATION UNIT #2 (INU#2)	AECB FECB NAV-J BOX	SYSTEM NO. 2-RUN/HTR TAS (SEE Note.) INS NO. 2	MAC BUS A MEAC/DC MEAC
LADDER UP AND DOWN RELAYS	AECB	LADDER-PWR AND CONT	MAC BUS A MDC
MHRS #1 COMPASS COUPLER	AECB NAV-J BOX FECB MLC PNL 4 UPPER	MHRS NO. 1 INS NO. 1 TAS AFCS ROLL	MEAC MEAC MEAC MAC BUS A
MHRS #2 COMPASS COUPLER	AECB NAV-J BOX FECB MLC PNL 4 UPPER	MHRS NO. 2 INS NO. 2 TAS AFCS ROLL	MAC BUS A MEAC MEAC MAC BUS A
(NAV PAC) POWER ALARM	AECB AND BU-1 AND 2	DDU CH1 AND CH2 CKBKs ON THE BATTERY UNITS (See Note.)	MEDC
Note • If fire persists after pulling above circuit breakers, secure both inertials at MSU in flight station. • Secure the Inertial Navigation System (INS) in the flight station and stand by to pull breakers listed. If the INS is not secured from the flight station, pull the associated INS battery unit breaker along with those listed to prevent the INS from going on battery power.			
RACK H-1 and H-2 (ASN-179-EQUIPPED AIRCRAFT)			
APX-72 IFF KIT 1A	FLC UPPER K-15 FLC LOWER	TRANSP IFF PWR CONT TRANSPONDER PWR IFF	MEDC FEAC
APX-72 IFF TEST SET	FLC UPPER K-16	TRANSP IFF TEST SET	MEDC
APX-72 IFF TRANSPONDER	FLC UPPER K-15 FLC LOWER	TRANSP IFF PWR CONT TRANSPONDER PWR IFF	MEDC FEAC
ASN-179, INERTIAL NAVIGATION UNIT #1 (INU #1)	AECB PNL FLC LOWER NAV J-BOX FECB	INS NO. 1 — RUN DDU CH1 MHRS NO. 1 INS NO. 1 INS NO. 1 TAS	MEAC MEDC MEAC FEDC MEAC MEAC & MEDC
ASN-179, INERTIAL NAVIGATION UNIT #2 (INU #2)	AECB PNL FLC LOWER NAV J-BOX FECB	INS NO. 2 — RUN DDU CH2 MHRS NO. 2 INS NO. 2 INS NO. 2 TAS	MAC BUS A MDC MEAC FEDC MEAC MEAC & MEDC
LADDER UP AND DOWN RELAYS	AECB	LADDER-PWR AND CONT	MAC BUS A MDC
MHRS #1 COMPASS COUPLER	AECB NAV-J BOX FECB MLC PNL 4 UPPER	MHRS NO. 1 INS NO. 1 TAS AFCS ROLL	MEAC MEAC MEAC MAC BUS A
MHRS #2 COMPASS COUPLER	AECB NAV-J BOX FECB MLC PNL 4 UPPER	MHRS NO. 2 INS NO. 2 TAS AFCS ROLL	MEAC MEAC MEAC MAC BUS A

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 18 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK H-1 and H-2 (ASN-179-EQUIPPED AIRCRAFT) (Continued)			
Note • If fire persists after pulling above circuit breakers, secure both INS at the MSUs in the flight station. • Although INS #1 and INS #2 receive power from different AC buses, both systems receive synchro excitation from the same source. This source is the navigation interconnection box powered by the MEAC bus, which steps the voltage down to 26 Vac. If the MEAC bus fails, in addition to losing INS #1, INS #2 will not provide heading and attitude information to peripheral navigation equipment, but will provide positional information to the CDU.			
RACK H-1 and H-2 (CNS/ATM)			
APX-118 RECEIVER TRANSMITTER	FLC LOWER FLC LOWER	IFF POWER ZERO IF	FEDC FEDC
CN-1714/ASN INERTIAL NAVIGATION UNIT #1 (INU #1) (RINU-G1)	AECB PNL FLC LOWER NAV J-BOX	INS NO. 1 — RUN INS NO. 1 INS NO. 1	MEAC FEDC MEAC
CN-1714/ASN INERTIAL NAVIGATION UNIT #2 (INU #2) (RINU-G2)	AECB PNL FLC LOWER NAV J-BOX	INS NO. 2 — RUN INS NO. 2 INS NO. 2	MAC BUS A FEDC MEAC
MHRS #1 COMPASS COUPLER	AECB NAV-J BOX	MHRS NO. 1 INS NO. 1	MEAC MEAC
MHRS #2 COMPASS COUPLER	AECB NAV-J BOX	MHRS NO. 2 INS NO. 2	MAC BUS A MEAC
CDU-7000 (PILOT)	FECB	CDU PILOT	MEDC
CDU-7000 (COPILOT)	FLC LOWER	CDU COPILOT	FEDC
CDU-7000 (NAV/COMM)	FECB	CDU NAV/COMM	MEDC
Note If fire persists after pulling above circuit breakers, secure both RINU-Gs via the POWER page on the CDU-7000.			
DOPPLER WELL			
CABIN EXHAUST FAN	MLC PNL 4 LOWER FLC UPPER E-1	CABIN EXHAUST FAN CABIN EXH FAN CONT	MAC BUS B EXT MDC
DOPPLER RECEIVER TRANSMITTER ANTENNA (RTA)	MLC PNL 3 UPPER	DOPPLER	MEAC/DC
OUTFLOW VALVE	FLC LOWER	OUT FLOW VALVE OVRD	FEAC
RADAR ALTIMETER (R/T)	FLC LOWER	RADAR ALTM PWR	FEAC
DOPPLER WELL UPDATE II AND II.5			
DOPPLER ANTENNA (RTA)	CECB	DOPPLER	MEAC/DC
RACK J-1 AND J-2			
APS-115 RADAR R/T (AFT)	MLC PNL 2 UPPER	SEARCH RADAR (See Note.)	MAC BUS A MDC
Note To remove from the aft R/T only, pull the breakers labeled AFT on the APP.			
ARC-182 VERY HIGH FREQUENCY (VHF)/UHF R/T	AECB	VHF/UHF	MEDC
ICS ISOLATION TRANSFORMER	NO POWER		
MAD COMPENSATOR ECA	MLC PNL 3 UPPER	SENSOR-MAD-SYSTEM	MAC BUS A
MAGNETIC FIELD COMPUTER	MLC PNL 3 UPPER	SENSOR-MAD-SYSTEM	MAC BUS A

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 19 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK J-1 AND J-2 (Continued)			
SA-675 TRANSFER RELAY (TRANSMISSION LINE SWITCH)	AECB	VHF XMTR	MEAC MEDC
VHF POWER ON STATUS RELAY	AECB	VHF/UHF	MEDC
VHF RF FILTER	NO POWER		
VHF RF SWITCH	AECB	VHF/UHF	MEDC
VOR 1 POWER RELAY	AECB	VOR-1 RCVR	MEAC/DC
VOR 1 RECEIVER	AECB	VOR-1 RCVR	MEAC/DC
VOR 2 POWER RELAY	AECB	VHF/VOR-2 RCVR	MEAC/DC
VOR 2 RECEIVER	AECB	VHF/VOR-2 RCVR	MEAC/DC
VOR ANTENNA COUPLER	NO POWER		
RACK J-1 AND J-2 (AIP)			
CREW STATION CONTROL (CSC) (C-12451/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
CSC LIGHT CONTROL SWITCH	AECB	UTILITY RECEPTACLES — AFT EDGE LTS	MDC
ICS INTERCONNECTION BOX (J-6309/AIC-41)	FECB	COMMUNICATIONS — INTERPHONE	MEDC
RACK J-1 AND J-2 UPDATE II			
RADIO BEACON DISPENSER BATTERY	FLC UPPER K-22	CRASH LOCATOR-PWR	MEDC
VHF/VOR ANT RELAY	AECB	VHF/VOR 2 RCVR	MEAC/DC
VHF TRANSMITTER	AECB	VHF XMTR	MEAC/DC
RACK J-1 AND J-2 UPDATE II.5			
ARN-151 GPS ANTENNA AMPLIFIER OVERHEAD SS-2	N/A	N/A	NO POWER
SS1 AND 2 FLOODLIGHT	HARPOON	FLOOD LT	MEAC
UPPER STROBE LIGHT PWR SUPPLY OVERHEAD NEAR MAIN CABIN DOOR	MLC PNL 4 LOWER FLC UPPER F-5	STROBE LIGHT-TOP STROBE LIGHT	MAC BUS B EXT MDC
VHF TRANSCEIVER	AECB	VHF AM COMM	MEDC
ADDITIONAL EQUIPMENT			
AVX-1 CONTROL INDICATOR GROUP	MLC 1 LOWER	AVX-1 EOS	BUS A
EMP DEICE RELAYS ON BULKHEAD ABOVE RACK K1 AND 2	FLC UPPER F-16 MLC PNL 1 LOWER MLC PNL 4 LOWER	EMP DEICER CONT EMP DEICING PART STRIPS EMP DEICE	EXT MDC MAC BUS A MAC BUS B
EMP DE-ICE TIMER MOTOR AND CIRCUIT BREAKER PANEL ON BULKHEAD ABOVE RACK K1 AND 2	FLC UPPER C-6 FLC UPPER F-16 MLC PNL 4 LOWER	EMP DI TIME MOTOR EMP DEICER CONT EMP DEICE	MEAC EXT MDC MAC BUS B
ICS CREW CONTROL EDGE LIGHTING (OBSERVERS, GALLEY, AND ORD STA)	AECB	AFT EDGE LTS	MDC
ICS ISOLATION BOX (A-350) OVERHEAD BETWEEN TACCO AND NAV/COMM STATION	FECB FECB FLC UPPER K-21 MLC PNL 2 UPPER	INTERPHONE TACCO STA LT-IND ICS IND LIGHTS NAV/COMM LTS-ICS IND	MEDC MDC MDC
MX-7580 DIPLEXER	FECB	SATCOM	SEE NOTE
MX-11949/ARC IDAA	FECB	SATCOM	SEE NOTE

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 20 of 21)

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
ADDITIONAL EQUIPMENT (Continued)			
Note The IDAA and Diplexer Units receive power from MON ESS DC BUS via the SATCOM circuit breaker and also receive 28-volt regulated power from UHF 1/2 on aircraft not incorporating AFC-687. On aircraft incorporating AFC-687, the IDAA and Diplexer Units receive power from the MON ESS DC via the SATCOM breaker and receive regulated 28-volt DC power from the UHF-1.			
OVERHEAD FLUORESCENT LIGHTS	MLC PNL 2 LOWER MLC PNL 2 LOWER MLC PNL 2 LOWER	OVHD FLR LTS-RST AREA OVHD FLR LTS-SONO OVHD FLR LTS-FWD COMP	MAC BUS A MAC BUS A MAC BUS A
PRESSURIZED SONOBUOY LAUNCH TUBE (PSLT) DOOR ACTUATORS	FECB	SONO DOOR W/PRESS	MEAC
RACK OVERHEAT SYSTEM	MLC PNL 1 UPPER FLC UPPER J-19	RACK OVERHEAT WARNING LIGHTING-SIG LTS INST	MDC MEDC
SATCOM PANEL AFT OF A-350 BOX	MLC PNL 3 UPPER FECB	UHF-1 VO SEL SATCOM	MEDC MDC
ADDITIONAL EQUIPMENT (AIP)			
AIMS TURRET UNIT	MLC 2 UPPER	AIMS — TURRET POWER	MDC
PREAMPLIFIER/DIPLEXER UHF/SATCOM- TOP, PORT, STBD, TAIL	DPS	DPLXR PRE AMP NO.1, NO.2, NO.3, & NO.4	
SPINNING DF ANTENNA	MLC 2 UPPER	ESM	MAC BUS A MDC
ADDITIONAL EQUIPMENT (CNS/ATM)			
GPS AMPLIFIER LOCATED IN OVERHEAD ADJACENT TO SS-2	FLC LOWER	GPS AMP	FEDC
FOUR-PIN RECEPTACLES			
PILOT AND COPILOT	FECB	115/200-VOLT PILOT AND COPILOT	MAC BUS A
PORT AND STRBD OBSERVER	AECB	115/200-VOLT LH AND RH OBS	MAC BUS A
THREE-PRONG RECEPTACLES			
DINETTE AND DOPPLER WELL	AECB	DINETTE AND LWR FUS	MAC BUS A
GALLEY COUNTER	AECB	UTILITY-TOP UTILITY-BOT	MAC BUS B MAC BUS B
GALLEY POWER PANEL	AECB	APPLIANCE	MAC BUS B
MLC AND RACK F-1	MLC PNL 4 LOWER	MLC AND RACK F1	MAC BUS B
NAV/COMM AND SS-3 STATION	MLC PNL 4 LOWER	SENSOR STA 3 AND NAV/COMM	MAC BUS B
RACK A1, TACCO STATION	FECB	TACCO, A1, AND NOSE	MAC BUS A
RACK B3 AND D1	FECB	RACK B3 AND D1	MAC BUS A
RACK D2 AND SS-2 STATION	HARPOON	SS-2 RACK D2	MEAC
RACK H1 AND WORK BENCH	AECB	WB AND RACK H1	MAC BUS A
RACKS E1 AND G1	HARPOON	RACK E1 AND G1	MEAC
28-VDC RECEPTACLES			
COPILOT AND NAV/COMM	FLC UPPER G-18	UTIL RECEP-CO-PLT AND NC	EXT MDC
PILOT AND TACCO	FLC UPPER G-17	UTIL RECEP-PLT AND TAC	EXT MDC
PORT AND STBD OBSERVER	AECB	LH AND RH OBS STA	EXT MDC

Figure 2-7. AC/DC Power Distribution Circuit Breaker List (Sheet 21 of 21)

LIGHT CONTROL	SWITCH NOMENCLATURE	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION FWD LOAD CENTER
Flight (Flt) Sta Utility		Pilot's window sills (on light assembly)	UTILITY LT PLT & COPILOT	FEDC
Inst Panel (Red)	PILOTS INSTRUMENT, (INSTRUMENTS) CENTER INSTRUMENT	Pilot overhead panel Copilot overhead panel Pilot overhead panel	FLT STA INST RED LIGHTS — PILOT EDGE & POST, COPILOT POST CENTER POST	MEAC or FEAC* MEAC
Inst Panel Flood (White and Red)	WHITE FLOOD, PILOT INSTRUMENT RED FLOOD, RED FLOOD (COPILOT)	Pilot overhead panel Copilot overhead panel	INST PANEL WHITE-PLTS, SIDE CONSOLE & INST PNL RED PILOT (COPILOT), INST PNL RED CTR.	MEAC
Overhead Panel Inst (Red)	LIGHTING CONTROL INSTRUMENTS	Copilot overhead panel	FLT STA INST RED LIGHTS OVHD POST	MEAC
Overhead Panels Red Edge	OVERHEAD LIGHTING CONTROLS, PANELS — INSTRUMENTS	Copilot overhead panel	OVHD PNLS EDGE	MEAC
Console Dome and Reading Side Console Red Edge (FLT ENG Oxygen and ICS)	DOME READING LIGHT SIDE CONSOLE	Pilot overhead panel Pilot overhead panel Copilot overhead panel	DOME & FLT CAPT READING PILOT CONSOLE RED EDGE LTS COPILOT CONSOLE RED EDGE LTS	28-Vac Fwd Lght Bus XMFR MEDC
Center Control Stand and Glareshield (Red)	PEDESTAL LIGHTS	Aft face of center control stand	GLARESHIELD & RED EDGE & POST	MEAC
Forward Load Center Circuit Breaker Panel	CKT BKR LIGHTS	Aft face of center control stand	CB PNL RED EDGE	28-Vac Fwd Lght Bus XMFR
Fuel and Hydraulic Panel	FUEL & HYD LIGHTS	Aft face of center control stand	CB PNL RED EDGE	28-Vac Fwd Lght Bus XMFR
APU Panel Instruments		Lights automatically (APU operating)	APU PANEL LTS	GOB
HSI Mode	HSI MODE	Pilot Overhead Panel	HSI MODE LIGHTS	MEAC
Sight	SIGHT	Pilot Overhead Panel	SIGHT	28-Vac Fwd Lght Bus XMFR
Compass	COMPASS	Pilot Overhead Panel	COMPASS	MEDC
AOA Indicator	APPROACH INDEX	Pilot Overhead Panel	ANGLE OF ATTACK	MEDC
*Automatic transfer when power not applied to ESSENTIAL INDICATORS AND LIGHT CONTROL circuit breaker.				

Figure 2-8. Interior Light — Flight Station

LIGHT CONTROL	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION
Cabin Overhead:	Aft face cabin overhead	OVHD FLUOR LTS:	
— Forward Compartment	TACCO station	— FWD COMP	Bus A (MLC)
Galley	Galley Light Control Panel	GALLEY & LAV	28-Vac Aft Lighting Bus (MLC)
Lavatory (Red & White)	Upper forward corner of lavatory	GALLEY & LAV	28-Vac Aft Lighting Bus (MLC)
Service:			
— Tail area	Inside and aft of entrance door	BOMB BAY & SERV AREA	28-Vac Aft Lighting Bus (MLC)
— Hydraulic Service Center	(1) Door actuated switch	BOMB BAY & SERV AREA	28-Vac Aft Lighting Bus (MLC)
	(2) Right forward center inside	BOMB BAY & SERV AREA	28-Vac Aft Lighting Bus (MLC)
	(3) Hatch switch	BOMB BAY & SERV AREA	28-Vac Aft Lighting Bus (MLC)
— Bomb Bay	Fwd left corner of bomb bay	BOMB BAY & SERV AREA	28-Vac Aft Lighting Bus (MLC)
— Bomb Bay View Window	Under cabin floor, adjacent to view window	BOMB BAY & SERV AREA	28-Vac Aft Lighting Bus (MLC)
EXIT	Flight Station, emergency exits, cabin door	Self-contained	
Circuit Breaker Panels:			
— Main Load Center	Aft face of MLC enclosure	MN LOAD CTR	28-Vac Aft Lighting Bus (MLC)
— DPS CB Panel	On panel face	SIDE FWD	28-Vac Aft Lighting Bus (MLC)
— Left CB Panel	On panel face	L SIDE FWD	28-Vac Aft Lighting Bus (MLC)
— Center CB Panel	On panel face	L SIDE CTR & AFT	28-Vac Aft Lighting Bus (MLC)
— Aft CB Panel	On panel face	L SIDE CTR & AFT	28-Vac Aft Lighting Bus (MLC)
NAV/COMM Station:		NAV COMM LTS:	
— Indicator	At station	— IND	MDC E (MLC)
— Fluorescent Map and Alt Red Edge	At station light control	— EDGE & MAP	BUS A (MLC)
— ICS	At station light control	— ICS IND	MDC E (MLC)
Nonacoustic Station:		SENSOR STA 3 LTS:	
— Floodlight	At station	— FLOOR & REC	MDC (MLC)
— Edge	At station	— EDGE	BUS A (MLC)
— MAD/RADAR	At station	— IND	MDC (MLC)

Figure 2-9. Interior Lights — Cabin (Sheet 1 of 2)

LIGHT CONTROL	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION
Nonacoustic Station:		SENSOR STA 3 LTS:	
— Floodlight	At station	— FLOOR & REC	MDC (MLC)
— Edge	At station	— EDGE	BUS A (MLC)
— MAD/RADAR	At station	— IND	MDC (MLC)
TACCO Station:		TACCO STA LT:	
— Floodlight	At station	— FLOOD	MEDC (Fwd Elect)
— Edge	At station	— EDGE	BUS A (Fwd Elect)
— Indicator	At station	— IND	MDC (Fwd Elect)
Acoustic Stations:		SENSOR STA 1 & 2 LTS:	
— Panel	At station	— IND	MDC (Center Elec)*
— Floodlight	At station	— FLOOD	MEAC (Center Elec)*
— Fluorescent	At station	— EDGE LT JEZ	BUS A (Center Elec)*
Crew (Aft Station):	At station	AFT EDGE LT	MDC E (Aft Elec)
— Galley, Observer, Ordnance			
Computer Area Utility	D2, D3 Racks	CMPTR AREA UTILITY LIGHTS	MDC (Center Elec)*
	*On Update III aircraft SENSOR STA 1 & 2 LTS and CMPTR AREA UTILITY LIGHTS circuit breakers are located on the Harpoon circuit breaker panel.		

Figure 2-9. Interior Lights — Cabin (Sheet 2 of 2)

2.4 ASW-60 DIGITAL AUTOPILOT SYSTEM (DAS)

2.4.1 System Description

The P-3 DAS provides dual-channel fail passive redundancy in all three axis. The DAS does not provide a single channel mode, but single inertial operations are possible by selecting either INS 1 or INS 2 at the inertial select panel located just below the DAS control panel. The DAS functions include pitch and roll attitude hold, heading hold, pitch and roll control wheel steering, barometric altitude hold, altitude select, indicated airspeed hold, and heading select. Individually labeled DAS circuit breakers are located on the Main Load Center (MLC) on panel 4 upper.

2.4.2 Built-In Test (BIT)

The DAS provides a comprehensive BIT capability, which identifies system failures. This BIT capability also stores faults detected during flight for later maintenance action.

Note

Removal of static plugs, pitot covers, and inertial alignment are required to pass a successful IBIT.

2.4.3 Autopilot Computer (APC)

The Autopilot Computer, located in the C rack, includes two redundant channels for controlling the three surface actuator booster packages: pitch, roll, and yaw. The Computer also includes a single Automatic Elevator Trim computation and driver with redundant monitoring. Initialization occurs automatically when power is applied.

Note

- After power is applied to the autopilot system, either by turning on the GROUND POWER switch or after takeoff, wait approximately 20 seconds before engaging the autopilot to ensure the Startup BIT (SBIT) is complete.
- If the AP ENGAGE button is selected before twenty second SBIT has passed, the DAS will generate a fail. If this occurs, the DAS circuit breakers must be recycled on the main load center.

Surface actuator boost is provided for pilot/copilot control wheel pitch and roll commands. Sensor inputs stabilize attitude, altitude, and provide yaw damping. The servo load sensors provide surface actuator effort to the Autopilot Computer for display on the 3-Axis Trim Indicator. The load sensor on the Elevator Boost Package is also used to command the Automatic Elevator Trim Drive. Power is provided to the APC via Bus A and Main DC.

2.4.4 Autopilot Control Panel (ACP)

The Autopilot Control Panel, located on the center pedestal (Figure 2-10), provides DAS engagement and operating mode selection. The DAS engage (AP ENGAGE) button and the two altitude mode select buttons (BARO ALT and RDR ALT) are emphasized by raised bars to aid in selection by tactile feel only. The modes that have been selected or engaged are indicated on the Control Panel. The AP ENGAGE button is used to engage the Autopilot, Yaw Damper, Automatic Turn Coordinator, and Automatic Elevator Trim. The ALT SEL button sets the Altitude Select mode and the Increase/Decrease (INC/DEC) buttons select the altitude used by the mode. The selected altitude is displayed on the ACP eight-character display. The remaining mode buttons are used to either engage modes or arm modes as described in Figure 2-10. The TEST button on the Control Panel is used to clear an Autopilot failure indication and initiates Initiated Built-In Test (IBIT) on the ground. This button is also used to switch between barometric reference and the desired level off altitude when the autopilot is engaged. The TEST annunciator remains lit while testing is in progress. The FAIL annunciator indicates a failure has been detected. Power is provided to the Autopilot Control Panel via BUS A and Main DC.

2.4.4.1 Attitude Select (ATTD SEL)

Attitude information from the inertials to the DAS is set through the ATTD SEL button on the Automatic Flight Control System (AFCS) subpanel on the center pedestal.

Note

Loss of one inertial, with attitude set to normal, will cause a DAS fail indication and disengagement along with a continuous tone. The working inertial must be selected using the ATT SEL button on the AFCS sub panel prior to reengagement.

2.4.5 Dual Air Data Sensor (DADS)

The DADS, located in the C rack, provides dual redundant pitot-static pressure to the Autopilot Computer. Static pressure is used for the Barometric Altitude Hold and the Altitude Select/Altitude Capture modes of operation. Pitot pressure is used for the Indicated Airspeed–Knots (IAS) Hold mode. Power is provided to the Dual Air Data Sensor via Bus A and Main DC.

2.4.6 Solid State Rate Gyro Assembly (SSRGA)

The Solid State Rate Gyro Assemblies, located in the D rack, are three-axis motion rate sensors that provide pitch, roll, and yaw motion rate data to the Autopilot Computer. Two identical Gyro Assemblies are provided for DAS redundancy. The Autopilot Computer uses the aircraft rate information supplied by the SSRGAs to provide three-axis rate damping. Power is provided to the SSRGAs via BUS A and MAIN DC.

2.4.7 Normal/Lateral Accelerometers

Dual redundant normal and lateral accelerometers, located beneath the floor panels, provide aircraft normal and lateral acceleration data to the Autopilot Computer. The normal acceleration is used by the pitch axis computations to provide damping in all modes. The lateral acceleration is used in the yaw axis for turn coordination.

2.4.8 Control Wheel Force Sensors

Control Wheel Steering (CWS) force sensors are embedded in the hub of the pilot and copilot control wheels and provide control wheel pitch and roll force data to the Autopilot Computer for the CWS modes of operation.

2.4.9 Control Wheel Autopilot Disconnect Switch

The control wheel autopilot disconnect switch is a two-force detent mechanism located on the outboard handle of each control wheel. The first detent is used during Barometric Altitude Hold or IAS Hold modes. In Barometric Altitude Hold mode, depressing to the first detent switches modes from Barometric Altitude Hold to Barometric Altitude Arm. In IAS Hold mode, depressing to the first detent switches modes from IAS Hold mode to IAS Arm mode. The second detent is used to disengage the Autopilot or to cancel the Autopilot disengagement visual and aural warning. When either yoke switch disengages the autopilot, the aural warning will be signaled by three tones in two second intervals in concert with the glareshield Autopilot/Radar Altimeter Warning System (RAWS) flashing warning lights.

2.4.10 Autopilot Controls and Indicators

The Autopilot operating controls and indicators as shown in Figure 2-10 are located on the flight station center pedestal. Figure 2-10 provides an indexed list of the ACP controls and indicators. The Autopilot power control circuitry is interconnected with the “ground-air” sensing circuit, which automatically applies DC and single phase AC power to the Autopilot at takeoff and removes power at touchdown. Consequently, the Autopilot will be available immediately after takeoff; the Yaw Damper and Elevator Automatic Trim System will become operational at the time of Autopilot engagement.

Note

Each time the power is applied, the system begins an SBIT for twenty seconds. Any attempt to engage the Autopilot or IBIT before the SBIT is complete will cause the system to fail.

2.4.11 In-Flight Automatic Operating Modes

The DAS has several operating modes that are engaged automatically when the Autopilot is engaged and no other modes have been selected. These modes are referred to as the Automatic Operating modes.

2.4.11.1 Heading Hold

The Heading Hold mode is a basic engage mode of the Autopilot and maintains the aircraft heading within 1 degree.

2.4.11.2 Roll Altitude Hold

The Roll Attitude Hold mode, the basic roll axis mode of the DAS, maintains angle of bank within 1 degree when engaged between 2 and 45 degrees with no roll force on either control wheel. When engaged at less than 2 degrees, the DAS will set and maintain wings level. When engaged at greater than 45 degrees, the DAS will reduce bank to and maintain 45 degrees.

2.4.11.3 Pitch Altitude Hold

The Pitch Attitude Hold mode, the basic pitch axis mode of the DAS, maintains pitch attitude within 1 degree when engaged at 22 degrees or less of pitch with no pitch force on either control wheel. Pitch Attitude Hold mode holds the existing pitch attitude up to 22 degrees. When engaged at greater than 22 degrees the DAS will reduce pitch and maintain 22 degrees.

Note

Due to the limited authority of the autopilot auto trim and boost package, the autopilot may not be able to maintain desired pitch at speeds approaching $1.2V_S$ in conjunction with large power applications. As speed increases above $1.52\ V_S$, the autopilot will return to the referenced attitude.

2.4.11.4 Roll Control Wheel Steering

Roll Control Wheel Steering (CWS) inputs produce an aircraft roll rate proportional to the force applied up to 45 degrees. CWS requires an increasing force to obtain and maintain the bank angle in excess of 45 degrees. Maneuvers initiated by the use of roll CWS are coordinated without the necessity of manual control in pitch and yaw.

2.4.11.5 Pitch Control Wheel Steering

Pitch CWS inputs produce aircraft pitch acceleration proportional to the force applied up to an aircraft attitude of 22 degrees. CWS requires increasing force to obtain and maintain the pitch angle in excess of 22 degrees.

2.4.11.6 Yaw Damping

The autopilot contains a dual channel Yaw Damper that provides turn coordination.

2.4.11.7 Automatic Elevator Trim

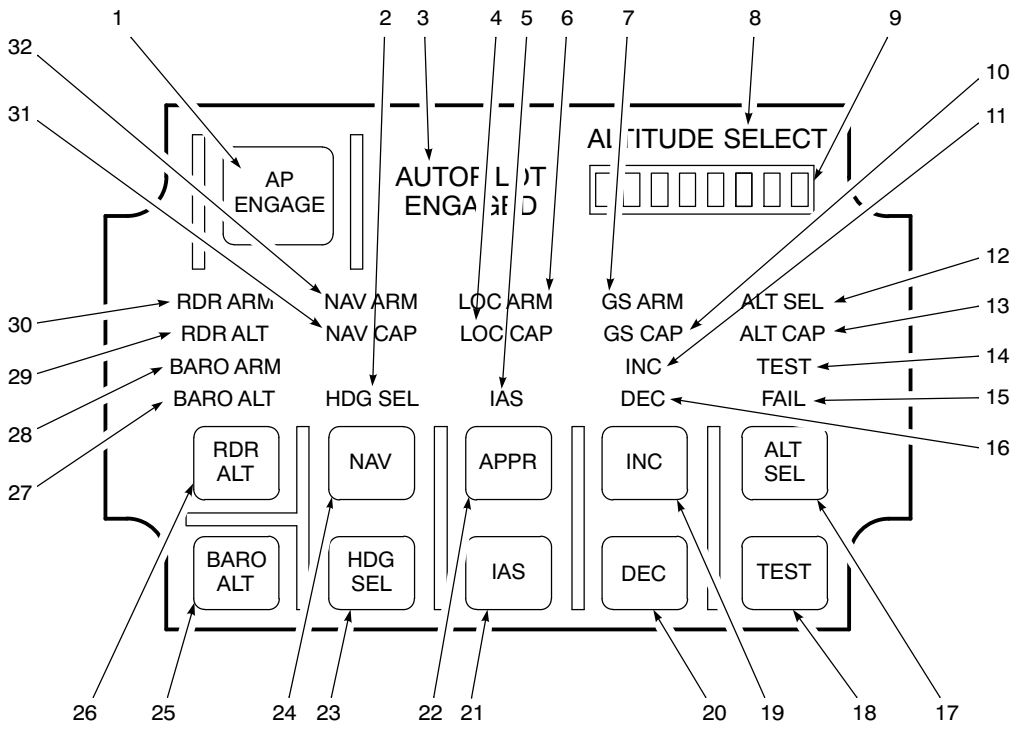
The Automatic Elevator Trim is operative when the autopilot is engaged, but is deenergized during pitch CWS maneuvers. Redundant monitors detect failures of the Elevator Load Sensor signals and Trim Drive signal. If the trim system locks out, disengaging and reengaging, the DAS can reactivate the trim system.

CAUTION

If the pilot attempts to maintain a desired pitch attitude with force exerted on the yoke during large power additions, the auto-trim will not function and excessive control force could be required to maintain desired pitch if the autopilot is suddenly disengaged prior to the trim stabilizing.

2.4.11.8 In-Flight ACP Selected Modes

Each selected mode is either engaged or armed by a push of its associated Control Panel button. Heading Select mode cannot be engaged with greater than 2 degrees angle of bank. Altitude Select mode will transition to Barometric Altitude Hold mode when the capture conditions are met. Barometric Altitude Hold mode cannot be engaged simultaneously with IAS Hold mode. Barometric Altitude Hold mode will not disengage with application of pitch control wheel force. This allows the pilot to assist DAS pitch authority at high angles of bank to aid in pitch or altitude maintenance. Any selected roll axis mode will be disengaged with application of roll control wheel force. The Selected Modes are listed in Figure 2-10.



Item	Control/Indicator	Setting	Function
1	AP ENGAGE	Press On/Press Off	Switch engages Autopilot.
2	HDG SEL	--	Annunciator illuminates when INS Heading Select Mode is engaged.
3	AUTOPILOT ENGAGED	--	Annunciator illuminates when Autopilot is engaged.
4	LOC CAP	--	Provided for future growth; disabled by software.
5	IAS	--	Annunciator illuminates when the Indicated Airspeed Mode is engaged and flashes when armed.
6	LOC ARM	--	Provided for future growth; disabled by software.
7	GS ARM	--	Provided for future growth; disabled by software.
8	ALTITUDE SELECT	--	Identifies function of the 8-character display during Autopilot operation.
9	8-Character Display	Display	Provides the display of the selected altitude or the set value of the Barometric reference when the autopilot is engaged. Provides a display for IBIT menus and status during BIT operation on the ground.
10	GS CAP	--	Provided for future growth; disabled by software.
11	INC	--	Annunciator illuminates when the Autopilot is engaged and the INC switch, item no. 19, is pressed.
12	ALT SEL	--	Annunciator illuminates when the Autopilot is engaged and the Altitude Select Mode is engaged.

Figure 2-10. Autopilot Control Panel (Sheet 1 of 2)

Item	Control/Indicator	Setting	Function
13	ALT CAP	--	Annunciator illuminates when the Altitude Select Mode has been selected and the Altitude Capture Mode is engaged.
14	TEST	--	Annunciator illuminates while IBIT is running as a result of the Test switch, item no. 18, being pressed on the ground.
15	FAIL	--	Annunciator illuminates when the Autopilot has detected a failure. The annunciator also illuminates during IBIT when a test failure has occurred.
16	DEC	--	Annunciator illuminates when the Autopilot is engaged and the DEC switch, item no. 20, is pressed.
17	ALT SEL	Press On/Press Off	Selects the Altitude Select Mode when the Autopilot is engaged.
18	TEST	Press On/Press Off	Button is used to clear the autopilot failure indication. Button also initiates IBIT on the ground. This button is also used to switch between barometric reference and the desired level off altitude when autopilot is engaged.
19	INC	Momentary	When the autopilot is engaged, button increases the selected altitude displayed in the Altitude Select window. The button is also used when autopilot is not engaged during IBIT to scroll through menus to select tests or BIT Status records.
20	DEC	DEC	When the autopilot is engaged, button decreases the selected altitude displayed in the Altitude Select window. When autopilot is not engaged the button is also used during IBIT to scroll through menus to select tests or BIT status records.
21	IAS	Momentary	Selects IAS Hold Mode when the Autopilot is engaged.
22	APPR	Press On/Press Off	Provided for future growth; disabled by software.
23	HDG SEL	Press On/Press Off	Selects preselected heading hold mode.
24	NAV	Press On/Press Off	Provided for future growth; disabled by software.
25	BARO ALT	Press On/Press Off	Selects the Barometric Altitude Hold Mode when the Autopilot is engaged.
26	RDR ALT	Press On/Press Off	RDR ALT Function currently not in use but RDR ALT button can be used to display Power On demarcations in Altitude Select Display window.
27	BARO ALT	--	Annunciator illuminates when the Barometric Altitude Hold Mode has been selected and is engaged.
28	BARO ARM	--	Annunciator illuminates when the Barometric Altitude Hold Mode and the arm condition are in effect.
29	RDR ALT	--	Provided for future growth; disabled by software.
30	RDR ARM	--	Provided for future growth; disabled by software.
31	NAV CAP	--	Provided for future growth; disabled by software.
32	NAV ARM	--	Provided for future growth; disabled by software.

Figure 2-10. Autopilot Control Panel (Sheet 2 of 2)

2.4.11.9 Barometric Altitude Hold

The Barometric Altitude Hold mode holds the aircraft at a selected barometric altitude. The mode is engaged by pressing the BARO ALT button on the Control Panel when the climb/descent rate is less than 300 fpm with no pitch force on the control wheels. Barometric Altitude Hold mode can also be armed by pressing the autopilot disconnect button to the first detent, establishing a rate of climb/descent of greater than 300 fpm, and pressing the BARO ALT button. When the mode is engaged, the Barometric Altitude annunciator is illuminated. The Barometric Altitude Hold mode is also engaged during the Altitude Select operation when the selected altitude has been acquired.

2.4.11.9.1 Changing Barometric Altitude Hold

To change the selected barometric altitude:

1. Depress and hold the Autopilot Disconnect switch to the first detent and use pitch Control Wheel Steering to set a climb/descent of greater than 300 fpm.

2. Release the Autopilot Disconnect switch and force on the control wheel. The DAS will maintain the established pitch attitude. The DAS will be in Barometric Arm mode.

To reengage the Barometric Altitude hold:

1. Use pitch Control Wheel Steering to reduce the rate of climb/descent to 300 fpm or less and release control wheel force.

2.4.11.10 Indicated Airspeed (IAS) Hold

The IAS Hold mode uses aircraft pitch to maintain a selected indicated airspeed. The mode is engaged by pressing the IAS button on the Autopilot Control Panel. When the mode is engaged, the IAS annunciator is illuminated.

2.4.11.10.1 Changing Indicated Airspeed Hold

To change the selected indicated airspeed:

1. Depress and hold the Autopilot Disconnect switch to the first detent and use pitch Control Wheel Steering or power levers to set a new airspeed. The IAS annunciator light will flash.

2. Release the Autopilot Disconnect switch. The DAS will maintain the new indicated airspeed and the IAS annunciator light will return to steady.

2.4.11.11 Altitude Select (ALT SEL)

The Altitude Select mode uses aircraft pitch to capture and maintain a desired altitude between 2,000 and 40,000 feet. The desired altitude is input by the pilot into the Altitude Select window. The mode is engaged by pressing the ALT SEL button on the Autopilot Control Panel and initiating a climb or descent toward the desired altitude. When the mode is engaged, the ALT SEL annunciator is illuminated.

WARNING

When updating the flight station altimeter settings, failure to adjust the barometric reference on the DAS Control Panel will cause a discrepancy between the actual aircraft altitude and the DAS selected altitude.

2.4.11.12 Altitude Capture

Altitude Select mode switches to Altitude Capture mode automatically when the aircraft reaches the selected altitude and provides a single one second aural tone. Altitude Capture provides a smooth pitch transition from the climb/descent attitude to level flight at the selected altitude based on input from the Autopilot Control Panel. When the aircraft has obtained level flight at the selected altitude, the Altitude Capture mode is disengaged and the Barometric Hold mode is engaged. If the selected altitude is changed at any time during the arm and capture portions of this mode, the mode will disengage and leave the pitch axis in the basic pitch attitude mode.

2.4.11.13 INC and DEC Button Operation

The INC or DEC button increases or decreases the selected altitude or barometric reference. When the INC or DEC button remains activated for greater than one second, the altitude displayed will change at a rate of approximately 300 feet per second. When the INC or DEC button remains activated for greater than three seconds, the altitude displayed will change at a rate of approximately 500 feet per second. If the INC or DEC button remains activated for greater than six seconds, the altitude displayed will change at a rate of approximately 1,000 feet per second.

2.4.11.14 Heading Select

The Heading Select mode allows the pilot's heading bug to control the steering mode and illuminates the HDG SEL annunciator. Once activated, the Heading Select mode smoothly commands up to 25 degrees Angle of Bank (AOB) to capture and maintain the selected heading.

2.4.12 Display Operation

2.4.12.1 Autopilot Engagement

The first time the autopilot is engaged following the application of autopilot power, the ALTITUDE SELECT display will show dashes (----------). When either the INC or DEC button on the Autopilot Control Panel is activated, the ALTITUDE SELECT display will be initialized at 10,000 feet. The Selected Altitude displayed is controlled by INC and DEC buttons. The display blanks out when autopilot is disengaged.

2.4.12.2 Barometric Reference

The capability for barometric altitude correction is provided. Barometric reference is controlled by the INC/DEC buttons on the Autopilot Control Panel and is displayed in the 8-character display. The pressure is adjustable from 22 to 32 inches Hg in 0.01-inch Hg increments. The TEST button is used to switch between barometric reference and the desired level off altitude. The range of the altitude selected is 2,000 to 40,000 feet.

2.4.13 Autopilot Engagement/Disengagement

The autopilot will automatically disengage if an error occurs or the autopilot computer detects failure condition. If a failure condition is detected prior to the engagement of the autopilot, engagement is inhibited.

2.4.13.1 Safety Interlock (Emergency Manual Disconnect Handle)

The DAS provides a safety interlock to ensure positive disengagement of the autopilot in the event of the failure of the normal means of autopilot disengagement. All power for autopilot engagement is interlocked through the Emergency Disconnect Handle on the center pedestal. Activation of the disconnect handle removes all engagement electrical power and also provides a physical disengagement of the autopilot at the three-actuator boost packages. A release-lock, adjacent to the disconnect handle, must be actuated to allow the spring-loaded cable to retract and permit the DAS to be reengaged.

2.4.13.2 Three-Axis Trim Indicator

A three-axis trim indicator is installed on the copilot instrument panel. With DAS disengaged, this instrument indicates the degree of synchronization existing between the control surface positions and the DAS. With the DAS engaged, this instrument shows the relative force being held on the respective surface by the DAS. A warning flag appears when the automatic trim system is not operating.

2.4.13.3 Automatic Pitch Trim Monitor

An automatic pitch trim monitor protects against an inoperative or runaway trim tab. In the event of either failure, the monitor disengages the automatic pitch trim system and energizes an amber caution light on the annunciator panel. It also causes a warning flag to be displayed in the window of the three-axis trim indicator. In order to reactivate the system, it is necessary to disengage and reengage the DAS.

2.4.13.4 Visual Indications

The DAS provides visual warnings to inform the flightcrew of various conditions occurring during the operation of the Autopilot. The DAS actuates the flashing autopilot/RAWS lights on the glareshield for the following conditions:

1. Disengagement of the autopilot for any condition other than by use of the control wheel disconnects or the Emergency Disconnect Handle.

2. When the Barometric Altitude Hold mode is engaged and the barometric altitude deviates more than 60 feet from the engaged altitude.

3. When either the pilot or copilot disconnects the autopilot via the control wheel disconnect switch (second detent) or Emergency Manual Disconnect Handle, the autopilot/RAWS lights will flash momentarily (approximately 3 seconds).

The visual warnings are canceled in the following manner:

1. By activation of either control wheel Autopilot Disconnect switch (second detent).

2. The altitude deviation warnings are canceled by either:

   a. Reducing the altitude error to less than 60 feet.

   b. Disengaging the engaged altitude hold mode, or

   c. Disengaging the autopilot.

2.4.13.4.1 Autopilot Caution

The amber Autopilot Caution Indication, located on the pilots instrument panel, is illuminated when:

1. The autopilot is disengaged by use of the ACP Engage switch, or a loss/transient of phase A of MAIN AC BUS A power.

2. The disengagement of the autopilot occurs for any detected engaged-autopilot-failure condition other than loss of DC power.

The Autopilot Caution Indication is canceled and errors are cleared by pressing the TEST button on the Autopilot Control Panel. Pressing either control wheel Autopilot Disconnect switch to the second detent will cancel the aural tone and autopilot/RAWS lights.

2.4.13.4.2 AUTOTRIM Caution

The amber AUTOTRIM Caution Indication, located on the pilots instrument panel, will illuminate when the autopilot is engaged, a failure of the Automatic Elevator Trim is detected, and the Automatic Elevator Trim has been disengaged. The AUTO TRIM LT OVERRIDE switch on the AFCS subpanel controls the illumination of the AUTOTRIM Caution Indicator. With the switch in the NORM position, the indicator will be illuminated when a trim failure is detected. When the indicator is illuminated and the wing flaps are less than 60 percent, the indicator can be canceled by placing the switch in the OVERRIDE position. The switch will remain in the OVERRIDE position and the AUTOTRIM Indicator extinguished as long as the trim failure exists, the autopilot is engaged, and the wing flaps are less than 60%. If any one of these three conditions no longer exists, the switch will return to the NORM position and, if the autopilot is engaged and the trim failure still exists, the AUTOTRIM Caution Indicator will be illuminated. If the trim system locks, it can be reactivated by disengaging and reengaging the DAS.

2.4.13.5 Aural Warnings

The aural warning horn located at the top of the forward electrical load center, is activated by the autopilot for four different conditions:

1. Automatic engagement of the Altitude Capture Mode from Altitude Select (single, one second tone).

2. When the Barometric Altitude Hold mode is engaged and the barometric altitude deviates more than 60 feet from the engaged altitude (Continuous pulses of 1/2 second on, 1/4 second off until altitude deviation is corrected or Autopilot is disengaged.)

3. Uncommanded disengagement or a disengagement using the AP ENGAGE Button on the Autopilot Control Panel. (Continuous tone until the disengagement warnings are cancelled by the activation of either Control Wheel Autopilot Disconnect Switch.)

4. Activation of the Control Wheel Autopilot Disconnect Switch or the Emergency Manual Disconnect Handle. (Three tones of 1/2 second on and 1/2 second off.)

2.5 ASW-31 AUTOMATIC FLIGHT CONTROL SYSTEM

The ASW-31 AFCS controls and stabilizes the aircraft about its three axes (pitch, roll, and yaw). This is performed throughout the aircraft speed, altitude, and maneuvering envelopes at all permissible weights, centers of gravity, aerodynamic configurations, and engine power settings. Refer to FO-17.

The ASW-31 AFCS receives input signals from various sources throughout the aircraft. These input signals are fed to the individual axis amplifiers. The amplifiers mix, modify, and amplify these signals and apply them to the aileron, rudder, and elevator boost packages.

2.5.1 Inputs

2.5.1.1 Attitude

Attitude (pitch and roll) information is supplied to the ASW-31 AFCS by INS 1 and 2 through the ATTD SEL switch on the AFCS subpanel.

2.5.1.2 Altitude

Altitude information is supplied to the ASW-31 AFCS by two barometric altitude control units. BARO ALT CONTROL No. 1 supplies information to pitch channel 1 and BARO ALT CONTROL No. 2 supplies information to pitch channel 2.

2.5.1.3 Heading

Heading information is supplied to the ASW-31 AFCS by INS 1 and 2 through the pilot Horizontal Situation Indicator (HSI) control panel. If the pilot selects INS 1 for heading information to the HSI, the ASW-31 AFCS receives heading information from INS 1. If the pilot selects INS 2 information, the ASW-31 AFCS receives INS 2 information.

2.5.1.4 Disconnects

The pilot or copilot disconnects normally by pressing the AFCS disconnect switch, located on their respective control wheels, to the second detent, or by pulling the emergency disconnect handle located on the port side of the center console. The AFCS disconnect switch disconnects the AFCS electrically. The emergency disconnect handle disconnects the AFCS both electrically and mechanically. All other disconnects are considered abnormal.

WARNING

Before disconnecting the ASW-31 AFCS, ensure the three-axis trim indicator is checked for relative force in all channels.

Note

The AFCS will disconnect if MAIN AC BUS A fails, load monitoring occurs, or No. 1 hydraulic system pressure is lost.

Pressing either AFCS disconnect switch releases a solenoid holding circuit on the engage and heading select switches and allows them to return to the OFF position.

The emergency disconnect handle, placarded AUTO-PILOT EMER. DISCONN., is a cable-type control with an IN position (engaged) and an OUT position (disengaged). This handle gives the pilots a positive mechanical and electrical disengaging method in the event of AFCS malfunction. Normally, this handle remains IN (engaged) at all times. A red release lock, adjacent to the disconnect handle, must be actuated to allow the spring-loaded cable to retract and permit the autopilot to be reengaged.

2.5.2 ASW-31 AFCS Characteristics

2.5.2.1 Dual-Channel Fail-Passive

Each axis consists of two independent functional channels that can be operated individually or simultaneously. A dual system with capability of single-channel operation provides high operational system reliability. When operating in dual channel (norm), the ASW-31 AFCS is said to be fail-passive; this means that if a malfunction is sensed by the monitor amplifier, the monitor amplifier will disengage the affected axis without resultant aircraft transients. This feature is available only when operating in dual channel. During single-channel operation, if a malfunction is detected, an aircraft transient could occur prior to axis disconnect.

2.5.2.2 Control Wheel Steering

Control wheel steering in the ASW-31 AFCS is one of its most important features. As roll or pitch force is applied to the control wheel by the pilot or copilot, a signal proportional to the applied force is sent to the roll or pitch amplifier; thus, the pilot controls the aircraft as he would manually, but with assistance from the stabilizing effects of the AFCS.

2.5.3 Controls and Indicators

2.5.3.1 Axis Engage Switch

Three axis-engaged switches (PITCH, ROLL, and YAW) are mounted across the top of the AFCS control panel. Each axis is engaged separately with a magnetically held toggle switch. An axis will engage only if all electrical and mechanical interlocks are closed.

2.5.3.2 Channel Select Switches

Below the axis engage switches are three three-position toggle switches that are the channel select switches. When the channel select switch is in the NORM position, the individual axis is in the dual-channel configuration. In this configuration, both channels 1 and 2 are operating and are being monitored by the monitor amplifier for any differences in signals. With the channel select switch in the No. 1 position, the axis is controlled by the No. 1 channel only. With the channel select switch in the No. 2 position, the axis is controlled by the No. 2 channel only. Interlocks are provided to disengage the AFCS in the affected axis in the event of operation of its channel select switch while its axis is engaged.

2.5.3.3 WARN/TEST Indicator Light/Switch

Three square indicator light/pushbutton switches are located below the channel select switches. The upper half of each indicator is labeled WARN and illuminates anytime the axis is disengaged abnormally. The bottom half is labeled TEST and illuminates when a rate gyro test is in progress. The warning light is reset by pressing the indicator/switch.

2.5.3.4 Axis TEST Switch

Each axis has an axis TEST switch located below the WARN/TEST indicator light/switches. They are momentary-contact, pushbutton-type switches used by ground maintenance personnel to aid in troubleshooting the AFCS. When pressed, these switches torque the rate gyros and illuminate the test lights. Interlocks render these switches inoperative in flight with the axis engaged.

2.5.3.5 Heading Select Switch

With the heading select switch in the HDG SEL position and the ASW-31 AFCS engaged, the AFCS will receive heading command signals from the pilot HSI heading marker.

2.5.3.6 Altitude Hold Switch

Placing the ALT HOLD switch to ALT HOLD enables operation of the automatic altitude control feature in the pitch axis of the AFCS.

2.5.3.7 AUTO TRIM LT OVERRIDE Switch

The AUTO TRIM LT OVERRIDE switch allows the flightcrew to extinguish the autotrim caution light. It is a magnetically held switch controlled by wing flap position. If the autotrim light illuminates in flight and the wing flaps are above 60 percent, the AUTO TRIM LT OVERRIDE switch can be engaged. With the AUTO TRIM LT OVERRIDE switch engaged, when flap position is moved to TAKEOFF/APPROACH or LAND positions, the AUTO TRIM LT OVERRIDE switch disengages and the autotrim caution light again illuminates provided the pitch axis is engaged.

2.5.3.8 Attitude Select

The ATTD SEL switch allows the flightcrew to connect one or both INS to the ASW-31 AFCS. With the ATTD SEL switch in the INS 1 position, both channels 1 and 2 of the pitch and roll axes receive INS 1 information. With the ATTD SEL switch in the INS 2 position, both channels 1 and 2 of the pitch and roll axes receive INS 2 information. With the ATTD SEL switch in the NORM position, channel 1 of both the pitch and roll axes receives INS 1 information and channel 2 of both the pitch and roll axes receives INS 2 information.

2.5.3.9 Ground Power Switch

The ground power switch is a solenoid-operated switch that supplies power to the AFCS for ground testing the capabilities of the AFCS. If the ground power switch is left in the GROUND POWER position after ground test procedures are completed, the switch snaps to OFF when the aircraft becomes airborne, through the action of the landing gear ground-air sensing switch.

2.5.3.10 Autotrim Ground Test Switch

The spring-loaded autotrim ground test switch provides a method of momentarily testing the autotrim system while the aircraft is on the ground. When the switch is held in the AUTOTRIM GROUND TEST position, the clutch in the elevator trim servo is energized and the trim flag on the three-axis trim indicator disappears.

2.5.3.11 Three-Axis Trim Indicator

A three-axis trim indicator is located on the copilot instrument panel. With the ASW-31 AFCS disengaged, this instrument indicates the degree of synchronization existing between the control surface position and the AFCS. With the AFCS engaged, this instrument shows the relative force being held on the respective surface by the AFCS. An OFF flag appears when the automatic trim system is not operating.

2.5.4 AFCS Status Lights

The AFCS provides status indication to both the pilot and copilot by amber caution light assemblies on their respective instrument panels. The status lights indicate an AFCS abnormal disconnect or a malfunction in the attitude reference servo booster (boost package), altitude hold, or elevator automatic trim system. The caution lights may be extinguished by operating the AFCS disconnect switch (to second detent) on the pilot or copilot control wheel or the individual axis WARN/TEST pushbutton indicator light on the AFCS control panel.

2.5.4.1 AFCS Caution Light

When an axis is disengaged by an abnormal disconnect, the AFCS caution light illuminates.

2.5.4.2 ATTD Caution Light

The ATTD caution light illuminates whenever there is a difference of more than 3° in the attitude signals from the inertial reference systems, either inertial system has failed, the associated module in the central repeater set has failed, or if the AFCS inertial select switch has been operated while AFCS is engaged. This light may be extinguished by restoring a valid attitude reference.

2.5.4.3 SERVO Caution Light

The SERVO light illuminates when the monitor amplifier detects a failure in the servo amplifier or in the boost packages. This light operates in conjunction with the flashing red warning lights, the AFCS caution light, and the respective axis indicator lights on the AFCS control panel.

2.5.4.4 ALT Caution Light

The ALT caution light illuminates when a malfunction occurs in the AFCS altitude system, or when the aircraft deviates more than 60 feet from engaged altitude (in which case this light operates in conjunction with the flashing red warning lights). It also activates when the altitude hold function has been deactivated by the pilot or copilot moving the altitude hold switch to its off position, or by operation of the attitude monitor when invalid pitch attitude is sensed. The light also illuminates if attitude failure occurs when altitude hold is engaged, in which case it operates in conjunction with the flashing red warning lights. The caution light extinguishes automatically when the desired altitude is captured or when normal operation is restored.

2.5.4.5 AUTOTRIM Caution Light

The AUTOTRIM caution light illuminates whenever the trim monitor detects a pitch autotrim malfunction.

2.5.4.6 Flashing Red Warning Lights

An AFCS malfunction is also indicated by flashing red warning lights on the glareshield. These lights also announce RAWS and radar altimeter malfunction warnings when accompanied by an audio signal in the ICS. When indicating an AFCS malfunction, no audio signal is given. The flashing red warning lights operate when there is an abnormal disconnect of the AFCS, when altitude deviates more than 60 feet from initial engagement altitude, or if attitude failure occurs when altitude hold is engaged. These lights may be extinguished by the AFCS disconnect switches on the control wheels, by the WARN/TEST pushbutton-indicator light switches on the AFCS control panel, or by the AFCS emergency disconnect handle.

2.5.5 Modes of Operation

2.5.5.1 Pitch Control Wheel Steering

When the pitch control wheel force exceeds 2 pounds, the pitch reference is automatically disengaged and the aircraft is then commanded through the AFCS to pitch to an angle dictated by the pilot and at a rate proportional to the force applied. The AFCS maintains a pitch angle between 0° to 22° ±4°, up or down. If the control force is released (2 pounds of force removed) at a pitch angle above 22° ±4°, the AFCS returns the aircraft back to 22° ±4° pitch and maintains that pitch angle.

2.5.5.2 Roll Control Wheel Steering

When the roll control wheel force signal exceeds 2 pounds, the heading reference is automatically disengaged and the aircraft is then commanded through the AFCS to roll to the bank angle the pilot desires at a rate proportional to the force applied. The AFCS maintains a bank angle between 2° and 45° ±5°. If the roll control force is released (2 pounds of force removed) below 2° bank angle, the aircraft returns to wings level. If the roll control wheel is released above 45° ±5°, the aircraft rolls to 45° ±5° and maintains the bank angle.

2.5.5.3 Altitude Hold

When in the ALT HOLD mode, the AFCS maintains altitude reference supplied by the barometric altitude control units. When the system is in ALT HOLD and the pilot wishes to descend to a new cruise altitude, the following must be accomplished: the pilot depresses the AFCS disconnect switch on the control wheel to the first detent and applies a force (pitch down); the AFCS commands the aircraft to descend from its altitude reference; and the ALT light on the AFCS status light assemblies illuminates. When the desired descent rate is established (provided the rate exceeds 300 fpm) and when the force is removed from the control wheel, the AFCS holds the aircraft at the selected pitch attitude. As the aircraft approaches the new cruise altitude, the pilot again depresses the AFCS disconnect switch to the first detent and levels off. When the rate of descent is below 300 fpm, the pilot releases the AFCS disconnect switch and the aircraft maintains the new reference altitude. If the aircraft exceeds 60 feet from the engaged altitude, the flashing red warning lights and the ALT caution light illuminate.

2.5.5.4 Heading Select Mode

Placing the heading select switch to HDG SEL with the roll and yaw axes engaged places the AFCS in the heading select mode. During this mode of operation, the AFCS receives heading inputs from the pilot HSI (heading bug). The aircraft rolls up to 25° ±5° angle of bank to the heading selected by the pilot. A force applied to the control wheel in a roll direction releases the magnetically held heading select switch and the AFCS reverts to the roll control wheel steering mode of operation.

2.5.6 MAD Maneuver Programmer Panel

A panel (Figure 2-11) on the pilot side console, in conjunction with the ASW-31, performs a series of standard maneuvers to provide a calibration reference for the MAD system. An axis selector switch applies maneuvers to the selected axis. A toggle switch, lever-locked to the OFF position, controls the operation of the programmer. The MAD maneuver programmer provides standard maneuvers as discussed in the following paragraphs.

2.5.6.1 Roll

The aircraft may be rolled ±7° to ±10° within a period of 7 to 9 seconds. Heading is maintained within 1°.

2.5.6.2 Pitch

The aircraft may be pitched ±3° within a period of 4 to 6 seconds. Altitude variations are held to a minimum and in no case will exceed 50 feet.

CAUTION

While the MAD maneuver programmer is engaged in pitch mode, pulling the AFCS emergency disconnect handle achieves only mechanical disconnect. If the handle is allowed to retract, the AFCS reengages.

2.5.6.3 Yaw

The aircraft may be yawed through heading changes of ±5° within a period of 7 to 9 seconds. A zero roll angle is maintained within 1°.

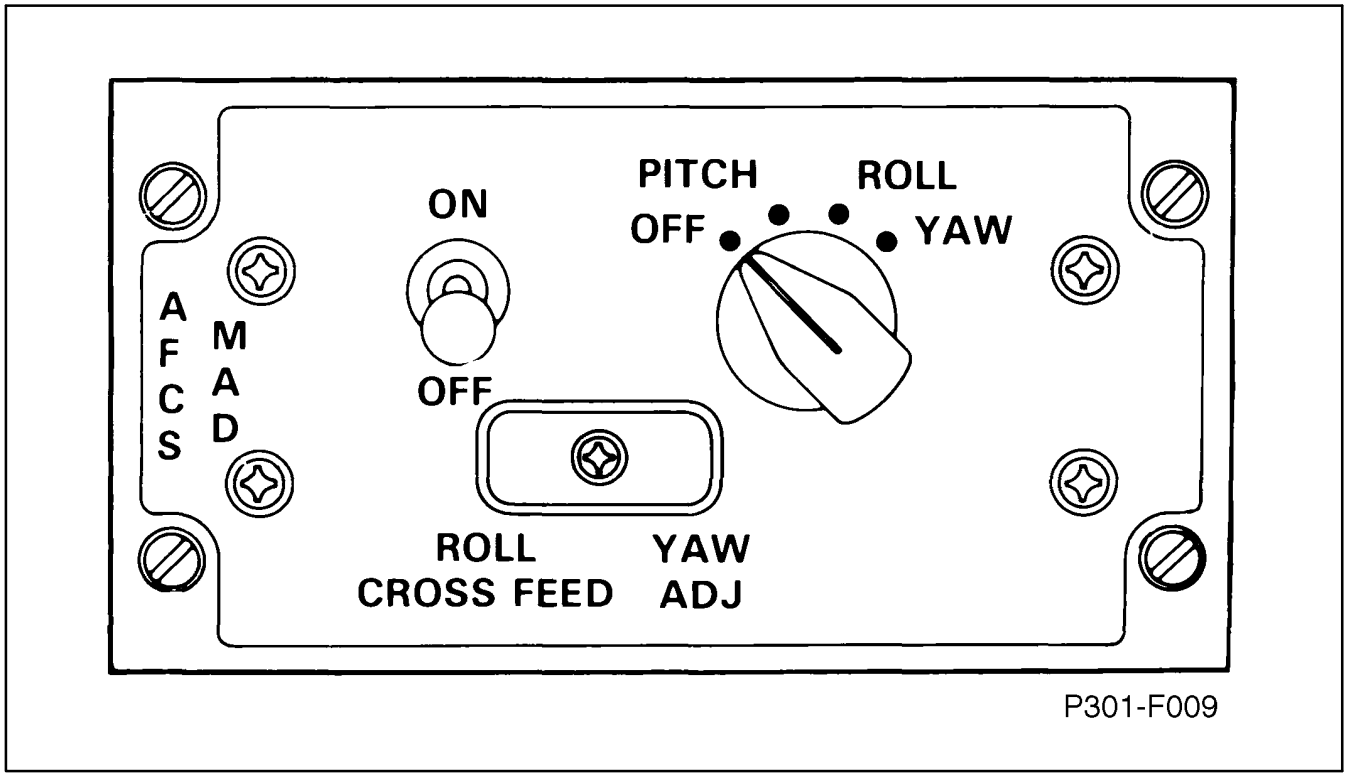


Figure 2-11. MAD Maneuver Programmer Panel

Note

- Monitoring is disabled in the axis in which the maneuver is being performed during MAD compensation.
- Three to four cycles of operation in each axis must be allowed for the maneuver to settle out to a steady-state value.

2.6 PB-20N AUTOMATIC FLIGHT CONTROL SYSTEM

The PB-20N AFCS is designed to maintain the aircraft on any selected heading while keeping it stabilized in pitch, roll, and yaw attitude. The aircraft can be made to climb, descend, or make coordinated turns by means of the pitch and turn controls on the center control stand, or by use of control wheel steering in pitch and roll. Autopilot attitude signals are received from the vertical gyro, clutched heading information is accepted from the magnetic heading source selected by the pilot, and preselected heading information is obtained from the pilot HSI. A radar altimeter and barometric altitude reference supply altitude-hold signals to the autopilot to maintain level flight at a constant selected altitude.

2.6.1 Autopilot Coupler

The autopilot coupler processes the radar altimeter information for application to the autopilot.

2.6.2 PB-20N Autopilot Controls

Most of the autopilot controls are located on the AFCS control panel and subpanel on the center control stand in the flight station.

2.6.2.1 AFCS Control Panel

The following switches and controls are located on the AFCS (autopilot) control panel (Figure 2-12).

2.6.2.1.1 ENGAGE Switch

The ENGAGE switch is a two-position, paddle-type switch used to engage or disengage the autopilot. The switch is placarded ENGAGE and OFF. A solenoid holds the switch in the ENGAGE position. The switch returns automatically to the OFF position if there is an electrical power failure (bus A power, main DC control) to the autopilot, if there is a loss of hydraulic pressure in the No. 1 system, or if the autopilot disengage button on either control wheel is depressed.

2.6.2.1.2 Preselect Heading (PSH) Switch

The preselect heading switch is a two-position, paddle-type, bar-guarded switch placarded PRE-SEL HDG and OFF. Operating the switch to the PRE-SEL HDG position provides a magnetic heading signal for the autopilot from the pilot HSI instead of from the gyro platform. Turns can be made by making a new heading selection on the HSI or by selecting a desired heading prior to engaging the PSH switch. Bank angles in this mode are limited to approximately 30°. Manual override of the autopilot by control wheel steering or turn controller operation causes the preselect heading switch to return to the OFF position automatically.

2.6.2.1.3 Altitude Hold Switch

The altitude hold switch is a three-position, paddle-type switch placarded BAR. ALT. HOLD, OFF, and RADAR ALT. HOLD that, in either hold position, signals the autopilot to maintain the aircraft at a constant altitude. In the BAR. ALT. HOLD position, the aircraft maintains a constant barometric altitude. At 5,000 feet or lower, a safer altitude hold is provided by moving the switch to RADAR ALT. HOLD. This position partly switches the functions of altitude control to the radar altimeter.

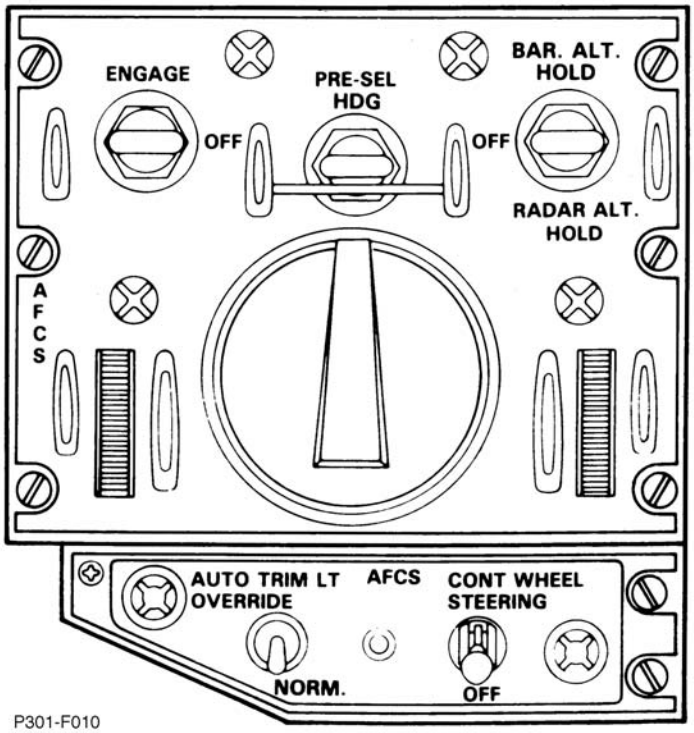


Figure 2-12. Autopilot Control Panel

2.6.2.1.4 Autopilot Turn Knob

The autopilot turn knob is the autopilot direction controller. By turning the turn knob to the left or right of the center position, coordinated turns can be made. The amount of displacement from the center position determines the angle of bank. (Bank angles are limited to 45°.) Once angle of bank is established, the autopilot holds the aircraft at the bank angle. Returning the turn knob to the detented center position returns the aircraft to level flight. The turn knob is motor driven back to the center detent whenever the aileron channel is disengaged. This occurs whenever the autopilot is disengaged or whenever control wheel steering is used and 1.5 pounds of force is applied to one of the pilot control wheels in roll.

2.6.2.1.5 Autopilot Pitch Controller

Dual pitch controllers provide climb and descent control. This control is used to vary the aircraft attitude, enabling the pilot to climb or descend without disengaging the autopilot. The change in attitude is proportionate to pitch controller wheel movement and is limited to 25°. The pitch controller is declutched whenever an altitude hold position is selected.

2.6.2.2 AFCS Subpanel

The AFCS subpanel (Figure 2-12) provides a switching function to select control wheel steering as a mode of operation for the autopilot. A switch, labeled CONT WHEEL STEERING and OFF, provides excitation to the force sensors in the control wheels when positioned to CONT WHEEL STEERING. A second, spring-loaded switch labeled AUTOTRIM LT OVERRIDE and NORM. provides a means of deenergizing the autotrim warning light. The switch, spring-loaded in the NORM. position, allows the autotrim warning light to illuminate when the autotrim system malfunctions.

Note

The override function of the autotrim light override switch is effective only when an autotrim failure exists and the flaps are up above 60 percent. When the flaps are lowered, the autotrim warning light returns to on. This function is to warn of an autotrim malfunction. The aircraft should be trimmed before disengaging the autopilot.

2.6.2.3 AFCS Ground Test Panel

The ground test panel is used to decrease the operating time of the autopilot and to provide ground test capabilities while the aircraft is on the ground. The panel, located on the pilot side panel, contains two switches, placarded GROUND POWER and AUTO TRIM GROUND TEST.

2.6.2.3.1 Ground Power Switch

The ground power switch is a solenoid-operated switch that supplies power to the autopilot for ground testing autopilot capabilities. If the ground power switch is left in the GROUND POWER position after ground test procedures are completed, the switch snaps to OFF when the aircraft is airborne through the action of the landing gear ground sensing switch.

2.6.2.3.2 Autotrim Ground Test Switch

The spring-loaded autotrim ground test switch provides a method of momentarily testing the autotrim system while the aircraft is on the ground. When the switch is held in the AUTOTRIM GROUND TEST position, the clutch in the elevator trim servo is energized and the trim flag on the three-axis trim indicator disappears. If the autotrim system is malfunctioning, the trim flag appears and the servoclutch disengages.

2.6.3 PB-20N Autopilot Characteristics

Before engaging the autopilot during flight, it should be aligned with the actual aircraft attitude. This feature is called synchronization and is accomplished by manually trimming the aircraft and observing the alignment on the three-axis trim indicator.

2.6.3.1 Roll Attitude

The system can be engaged at any angle of bank. Roll attitude is maintained at the engaged bank angle, provided this angle is more than approximately 7° and less than 45°. If the engagement angle is less than approximately 7°, the aircraft rolls smoothly to wings-level attitude, stabilizes, and holds the heading obtained at the moment of engagement. If the bank angle is greater than 45°, the aircraft rolls back smoothly to the limiting value of approximately 45°. If the system is engaged during a bank, the turn knob is ineffective.

2.6.3.2 Pitch Attitude

The system may be engaged at any pitch angle. Aircraft attitude is maintained at the engagement pitch angle, provided this angle is less than approximately 25°. If the engagement angle is greater than 25°, the aircraft smoothly pitches to the limiting value of approximately 25°.

2.6.3.3 Automatic Pitch Trim

When the Autopilot is engaged, the automatic pitch trim system continuously trims the elevator. This ensures a constantly trimmed elevator, preventing pitch transients when the autopilot is disengaged. The pilot can manually override the automatic pitch trim system. In addition, a wing flap compensator partially counteracts the nosedown pitch created by flap extension.

2.6.3.4 Altitude Hold

The autopilot incorporates barometric and radar references to maintain aircraft altitude. Because of barometric pressure changes induced by variable weather conditions, the radar altitude reference permits safer altitude-hold operation at 5,000 feet or lower.

2.6.4 PB-20N Autopilot Disengagement

The autopilot can be disengaged at the flight station by electrical and electromechanical means. Disengagement is accomplished by any of the following methods: moving the autopilot engage switch to OFF, pulling the autopilot emergency disconnect handle, or by pressing the disengaging button on either control wheel. If all the above methods fail to disengage the autopilot, disengaging a booster disconnects the autopilot in that channel; however, automatic trim still functions.

2.6.4.1 Autopilot Disengage Buttons

Disengage buttons for the autopilot are located on the outboard handle of the pilot and copilot control wheels. To disengage the autopilot, either button may be pressed; pressing a button releases a solenoid holding circuit on the engage, altitude hold, and preselect heading switches, and allows them to return to the OFF position.

2.6.4.2 Autopilot Emergency Disconnect Handle

The manual autopilot emergency disconnect handle, placarded AUTO-PILOT EMER. DISCONN., is located on the aft face of the center control stand near the base (not shown). This is a cable-type control with an IN position (engaged) and an OUT position (disengaged). This handle gives the pilots a positive mechanical and electrical disengaging method in the event of autopilot malfunction. Normally, this handle remains IN (engaged) at all times. A red release lock, adjacent to the disconnect handle, must be actuated to allow the spring-loaded cable to retract and permit the autopilot to be reengaged.

2.6.5 Safety Interlocks

Safety interlocks are included to protect against various system malfunctions. These interlocks not only monitor the system, but disengage the autopilot and illuminate a warning light whenever a malfunction occurs.

2.6.5.1 Roll Verticality Monitor

The roll verticality monitor senses abnormal roll precession, automatically disconnects the autopilot, and warns the pilots through the autopilot disconnect warning lights and, if STANDBY GYRO is selected, the malfunction flag on the attitude indicator.

2.6.5.2 Pitch Verticality Monitor

If abnormal precession in the pitch axis is detected, the autopilot automatically disengages, warning the pilots through the autopilot disconnect warning lights and, if STANDBY GYRO is selected, the malfunction flag on the attitude indicator.

2.6.5.3 Vertical Gyro Power Monitor

In the event of power failure to the vertical gyro, the vertical gyro power monitor disengages the autopilot. It also energizes the AUTOPILOT flashing red warning lights and the AUTOPILOT amber caution light.

2.6.5.4 Three-Phase Power Monitor

A three-phase power monitor disengages the autopilot and energizes the AUTOPILOT flashing red warning lights and the AUTOPILOT amber caution light in the event of any failure of any or all three phases of electrical power to the autopilot power junction box.

2.6.5.5 Filtered DC Monitor

The filtered DC monitor senses the failure of DC excitation voltage to the servoamplifiers. The monitor disengages the autopilot and energizes the autopilot flashing red warning lights and the autopilot amber caution light if DC excitation voltage fails.

2.6.5.6 Hardover Protection System (HARPS)

The HARPS, upon detection in the elevator channel of a pitch hardover, disengages the autopilot and alerts the pilot and copilot by energizing the AUTOPILOT flashing red warning lights. The system enables the pilot to assume manual control of the aircraft without need of excessive control forces.

2.6.5.7 Automatic Pitch Trim Monitor

An automatic trim monitor protects against an inoperative or runaway trim tab. In the event of either failure, the monitor disengages the automatic pitch trim system and energizes an amber caution light on the annunciator panel. It also causes a warning flag to be displayed in the window of the three-axis trim indicator.

Note

The autotrim monitor system monitors trim direction but does not indicate loss of electrical power.

2.6.5.8 Autopilot Hydraulic Low Pressure Monitor

A pressure monitor senses the No. 1 system hydraulic pressure to the control boosters. It automatically disengages the autopilot and energizes the AUTOPILOT flashing red warning lights and the AUTOPILOT amber caution lights with a loss of hydraulic pressure.

2.6.5.9 Three-Axis Trim Indicator

A three-axis trim indicator is installed on the copilot instrument panel. With the autopilot disengaged, this instrument indicates the degree of synchronization existing between the control surface positions and the autopilot. With the autopilot engaged, this instrument shows the relative force being held on the respective surface by the autopilot. A warning flag appears when the automatic trim system is not operating.

2.6.5.10 Elevator AUTOTRIM Warning Light

The elevator AUTOTRIM warning light is located on the center instrument annunciator panel. This light warns the pilot that the elevator autotrim system monitor has rendered the system inoperative because of a malfunction.

2.6.5.11 AUTOPILOT Amber Caution Light

The AUTOPILOT amber caution light is located on the center instrument annunciator panel. The amber AUTOPILOT light warns the pilots of a malfunction in the autopilot system and that the autopilot has been disengaged. When the light remains on for any reason, depressing the autopilot disengage button on either control wheel extinguishes the light.

2.6.5.12 AUTOPILOT Flashing Red Warning Lights

The AUTOPILOT flashing red warning lights are located on the pilot and copilot glareshield. When operating at low altitudes in Antisubmarine Warfare (ASW) maneuvering flight conditions, the pilots are warned by the flashing red lights if the autopilot or radar altimeter malfunctions. The AUTOPILOT flashing red lights and the AUTOPILOT amber caution light illuminate and the autopilot disengages in the event of:

1. Excessive gyro precession.
2. Autopilot or gyro power loss.
3. No. 1 hydraulic system low pressure.
4. Disengagement of autopilot by paddle switch (not normal disengagement procedure).

If using the radar altitude hold mode, the following items illuminate the flashing red warning lights only but neither altitude hold mode nor autopilot disengages:

1. Unreliable radar altimeter signal.
2. AC or DC power loss to radar altimeter.
3. Aircraft deviation of more than 75 feet from the engaged reference altitude.

The flashing red warning lights do not illuminate if the altitude hold mode is disengaged by the paddle switch on the center control stand because this is the normal disengage procedure. In addition, the red warning lights do not illuminate as a result of an unsafe deviation from engaged altitudes when the barometric altitude hold mode is in use. When the red warning lights illuminate, the pilot should actuate the control wheel autopilot disengage button.

The AUTOPILOT flashing red lights illuminate and the autopilot rapidly disengages whenever a hardover pitch is detected.

2.7 FLIGHT STATION INSTRUMENTS

Refer to FO-18 for diagrams of the flight station instruments.

2.7.1 Pitot-Static System

The pitot-static system (Figure 2-13) consists of the pitot heads and associated plumbing that supply ram air (pitot pressure) to the airspeed indicators, true airspeed transducer, and landing gear warning system airspeed sensor. The static ports and associated plumbing supply static air pressure to the airspeed indicators, barometric altitude control(s)[1] or autopilot air data sensor[2] , true airspeed transducer, altimeters, vertical speed indicators, and cabin pressure controller. Static pressure is also applied to the RAWS. Two electrically heated pitot heads are mounted symmetrically on either side of the lower forward fuselage. The left (pilot) pitot head supplies pressure for the pilot airspeed indicator only. The right (copilot) pitot head is connected to the copilot airspeed indicator, the true airspeed transducer, landing gear warning system airspeed sensor, and to the autopilot air data sensor[2]. For anti-icing purposes, the pilot pitot tube receives power (AC) from the FLIGHT ESSENTIAL AC (FEAC) bus through a circuit breaker marked PITOT HEATER-LEFT at the forward load center. The RH PITOT HTR (copilot) circuit breaker at the forward load center receives power from the 28 Vac FORWARD LIGHTING TRANSFORMER BUS powered by the MEAC bus. Power to heat the pitot head is controlled by a single two-position switch located on the lower (windshield heat) portion of the anti-icing control panel. L or R HTR OUT caution lights, adjacent to the switch, are illuminated when current to the heater is interrupted with the switch in the ON position. An in-line current flow detector may fail and illuminate the L or R HTR OUT light even though the heater head is receiving power and operating normally. Either light illuminates the master DEICING caution light.

The static system consists of two (four[1]) dual-port (or balanced) and three (two[1]) single-port systems. One dual-port system furnishes static pressure to the pilot flight instruments only (airspeed, altimeter, and vertical speed indicator). The other dual-port system furnishes static pressure to the copilot flight instruments (airspeed, altimeter, and vertical speed indicator), the navigator altimeter, the AAU-28/A transmitter altimeter, the landing gear warning system, and the true airspeed transducer. On later aircraft[1], a third dual-port system is used for the barometric altitude control that replaced the autopilot air data sensor. (Early aircraft are equipped with a single port for the air data sensor with the single-channel autopilot installation.)

Later aircraft[1] also incorporate a fourth dual-port system to serve an additional barometric altitude control and an additional APQ-107 (RAWS). One single-port static system furnishes pressure for the cabin pressure controller and cabin differential pressure gauge. The other single-port system furnishes pressure for the cabin pressure safety valve.

2.7.2 Airspeed Indicator

Two airspeed indicators are installed, one on the pilot instrument panel and one on the copilot instrument panel. The dial reads from 50 to 450 knots with an expanded scale below 200 knots. In addition to the airspeed pointer, a maximum safe airspeed pointer (Never Exceed Velocity [V_{NE}] needle) is incorporated. Needle position varies according to altitude.

2.7.3 Altimeter Encoder

Two altimeter encoders are installed, one each on the pilot and copilot instrument panel. The pilot altimeter encoder encodes altitude information in 100-foot increments for transmission on mode C. The copilot baro-altimeter provides the Global Positioning System (GPS) with baro-corrected altitudes for use as a reference.

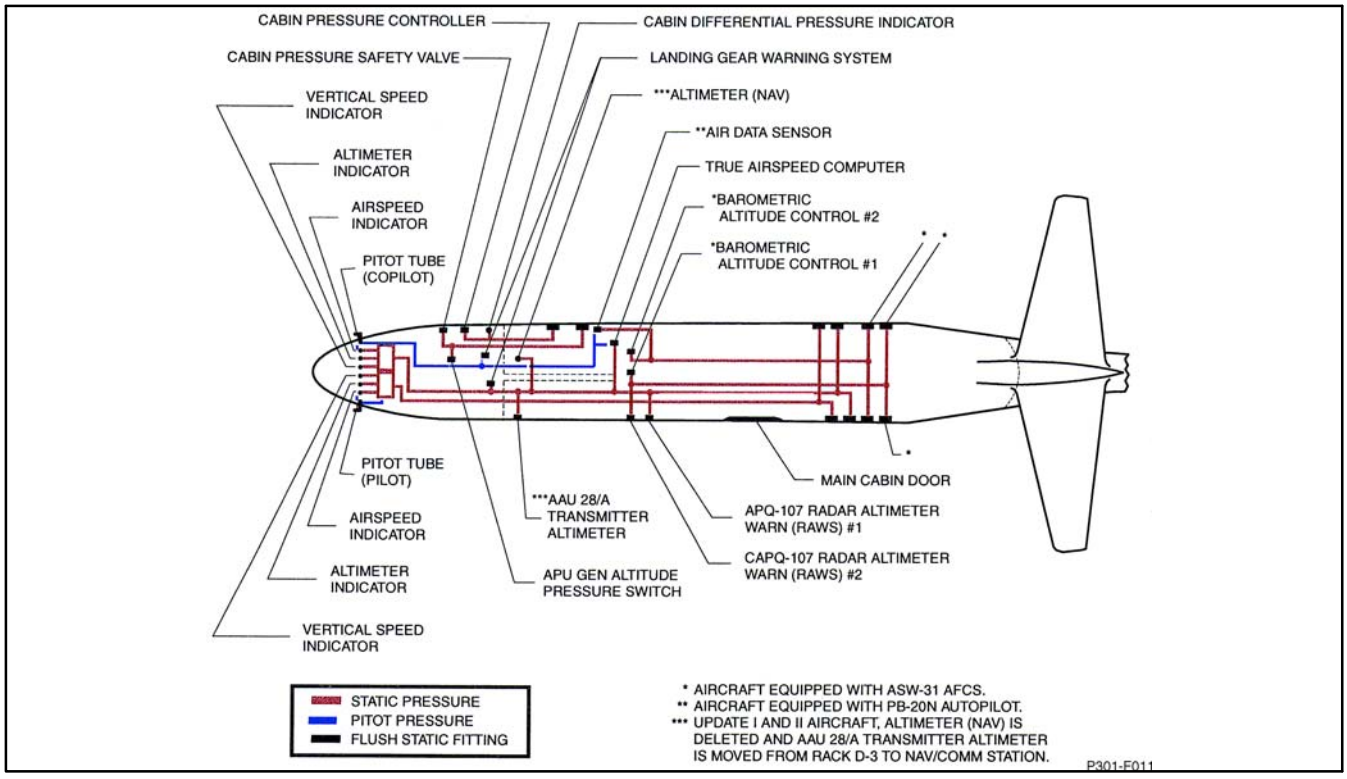


Figure 2-13. Pitot-Static System

[1] Aircraft equipped with ASW-31 AFCS.
[2] Aircraft equipped with PB-20N autopilot.

Altitude is displayed on the altimeter by a 10,000-foot counter, 1,000-foot counter, and a 100-foot drum. A single pointer indicates hundreds of feet on a circular scale with 50-foot center graduations. Below 10,000 feet, a diagonal warning symbol appears on the 10,000-foot counter. To minimize friction in the display mechanism, a DC-powered vibrator in the altimeter is energized whenever aircraft power is on. The Barometric Pressure Setting (BAROSET) knob on the altimeter face is provided to insert barometric pressure in inches of Hg. The BAROSET knob has no effect on the digital output of the encoder (mode C) that is always referenced to 29.92 inches of Hg. If AC power to the encoder is lost, the altimeter encoder continues to operate normally as a pressure altimeter but a CODE OFF flag indicates that no altitude signals are being provided to the transponder for transmission on mode C. 115 Vac and 28 Vdc are provided to the instruments through two circuit breakers located on the forward electronic circuit breaker panel, above the B-1 and B-2 electronic racks, and powered by the MEAC and MEDC buses.

2.7.3.1 Operating Characteristics of the Altimeter Encoder

The counterdrum-pointer display is designed so that the 100-foot drum and the pointer rotate continuously during altitude changes, while the 10,000-foot and 1,000-foot counters remain in fixed position. When each 1,000-foot increment is completed, the counter(s) abruptly index to the next digit; however, there may be a noticeable pause or hesitation of the pointer caused by the additional friction and inertia loads involved in indexing the counter(s) change. The pause-and-accelerate behavior occurs in the 9 to 1 sector of the scale and is more pronounced when the 10,000-foot counter changes. It is also more pronounced at high altitudes and high rates of ascent and descent. During normal rates of descent at low altitudes, the effect is minimal.

Note

If the altimeter's internal vibrator is inoperative, the pause-and-accelerate effect may be exaggerated. Check for this behavior when the minimum approach altitude lies within the 8 to 2 sector of the scale (e.g., between 800 and 1,200 feet, etc.).

2.7.3.2 Field Elevation Check

When the local barometric pressure is set into the altimeter encoder, the altimeter should agree within ±75 feet of field elevation.

Note

During normal use of the BAROSET knob, if momentary locking of the barocounter is experienced, do not force the setting. Application of force may cause internal gear disengagement and result in excessive altitude errors. If locking occurs, rotate the knob a full turn in the opposite direction and approach the setting again with caution.

2.7.3.3 AAU-28/A Barometric Altimeter Transmitter

The barometric altimeter transmitter is installed in rack D-3 on P-3C baseline and MOD aircraft and on the Navigation/Communication (NAV/COMM) console in place of the counter-pointer altimeter on update aircraft. It is an AAU-21/A altimeter encoder modified to provide a single- or dual-synchro output signal. The output is routed through the Synchro-to-Digital/Digital-to-Synchro (SD/DS) signal data converter to the ASQ-114 digital computer. This analog output is always referenced to the standard pressure altitude of 29.92 inches Hg.

2.7.4 Accelerometer

The mechanical accelerometer, mounted on the instrument panel, has three pointers mounted on concentric shafts. One pointer indicates instantaneous acceleration, and the other two retain the maximum and minimum indications until reset. The instrument is self-contained and measures vertical accelerations in g units on a dial graduated from –4g to +10g. The cumulative accelerometer, mounted in the main electrical load center, has four small windows to facilitate observation of cumulative g loads that have been exerted on the aircraft. The first window maintains a record for 2.0g, the second window for 2.5g, the third window for 3.0g, and the fourth window for 3.5g.

Note

This instrument is to be reset in a laboratory only. Since Navy specifications do not require that the instrument be zeroized after laboratory functional tests, the instrument readings for a new P-3 aircraft will appear to be unrealistically high.

The accumulative accelerometer is disarmed through the landing gear system when the landing gear handle is down.

2.7.5 Altimeter, Pressure, Air Data Display Unit (ADDU) AAU-61/A

The ADDU is designed to be a functional replacement for the existing altimeters in the aircraft. The ADDU requires electrical and pneumatic inputs from the aircraft and functions as an independent air data computer. These inputs are used to compute accurate air data information and are scaled for primary flight data displays, navigation, automatic altitude reporting, and autopilot/flight director systems. An IBIT is initiated by using a pen or small pointer to press the inset “test” button located at the bottom right corner of the display unit next to the altitude select knob.

The altimeter has an electromechanical driven pointer and a Liquid Crystal Display (LCD) with high-intensity backlighting for daytime use and low-level red lighting for nighttime viewing. Additionally, the altimeter provides altitude alert notifications using its ALT alert light. The barometric altitude display range is –1,000 to +55,000 feet. The ADDU provides air data to the CDU-7000, which sends it to the transponder and RINU-G. The barometric setting can be set via the BARO SET knob over a range of 22.00 to 31.00 inches Hg. The pilot ADDU receives a temperature input from the TAS probe for air data calculations including TAS and wind calculations. The copilot ADDU is crossfed the temperature input from the pilot ADDU. Each ADDU is powered by Mon DC via a separate circuit breaker on the Forward Electronic CB panel. The backup power source for each ADDU is Flight DC.

2.7.5.1 Alert Light

The ADDU has an altitude alerting system that includes an Altitude Select knob, selected altitude display, and an Alert light. When the aircraft altitude is within 1,000 feet of the selected altitude, the altitude alert light will illuminate. When the aircraft altitude is within 200 feet of the selected altitude, the alert light goes out. After altitude capture, if the aircraft altitude deviates by ± 200 feet from the selected altitude, the alert light will illuminate. The light may be manually extinguished by either pilot by pressing the altitude select knob.

2.7.5.2 Altimeter Setting Miscompares

If there is a difference between the pilot and copilot altimeter settings or selected scales, the altimeter setting will flash in both ADDUs. Additionally, if both pilots do not have the same scale selected (millibars and inches Hg, or feet and meters), the barometric settings will flash.

2.7.5.3 Switching Between Inches Hg/MB and Feet/Meters

The ADDUs are designed to display either inches Hg or millibars (MB) for barometric pressure and can also display either feet or meters for altitude. These selections are made using the Baro Set knob located on the lower right corner of each unit. ADDU pressure and altitude selections are independently selected between units. Refer to Figure 2-14 below and note the “ft” indication located directly above the digital altitude reading. This will indicate “M” if meters was selected.

WARNING

ADDUs are able to display meters for altitude, if desired. Both pilots shall have “ft” selected for altitude to ensure proper altitude is displayed.

1. To change inches Hg to MB: Press and hold the BARO knob for more than 4 seconds.

2. To change back to inches Hg: Press and hold the BARO knob for more than 4 seconds.

3. To change altitude reading from feet to meters: Press and hold the BARO knob for more than 8 seconds (note that the inches Hg or MB may change after 4 seconds during this procedure depending on what pressure setting was previously selected). To return to feet, press and hold the knob for another 8 seconds.

2.7.5.4 ADDU Lighting Control

The ADDU altimeter is normally backlit white during daylight operations and red for nighttime operations. Pilot and copilot instrument lighting rheostats control the red backlighting.

Note

In lower rheostat settings, the ADDU may appear unpowered under certain lighting conditions. Adjust rheostat as necessary.

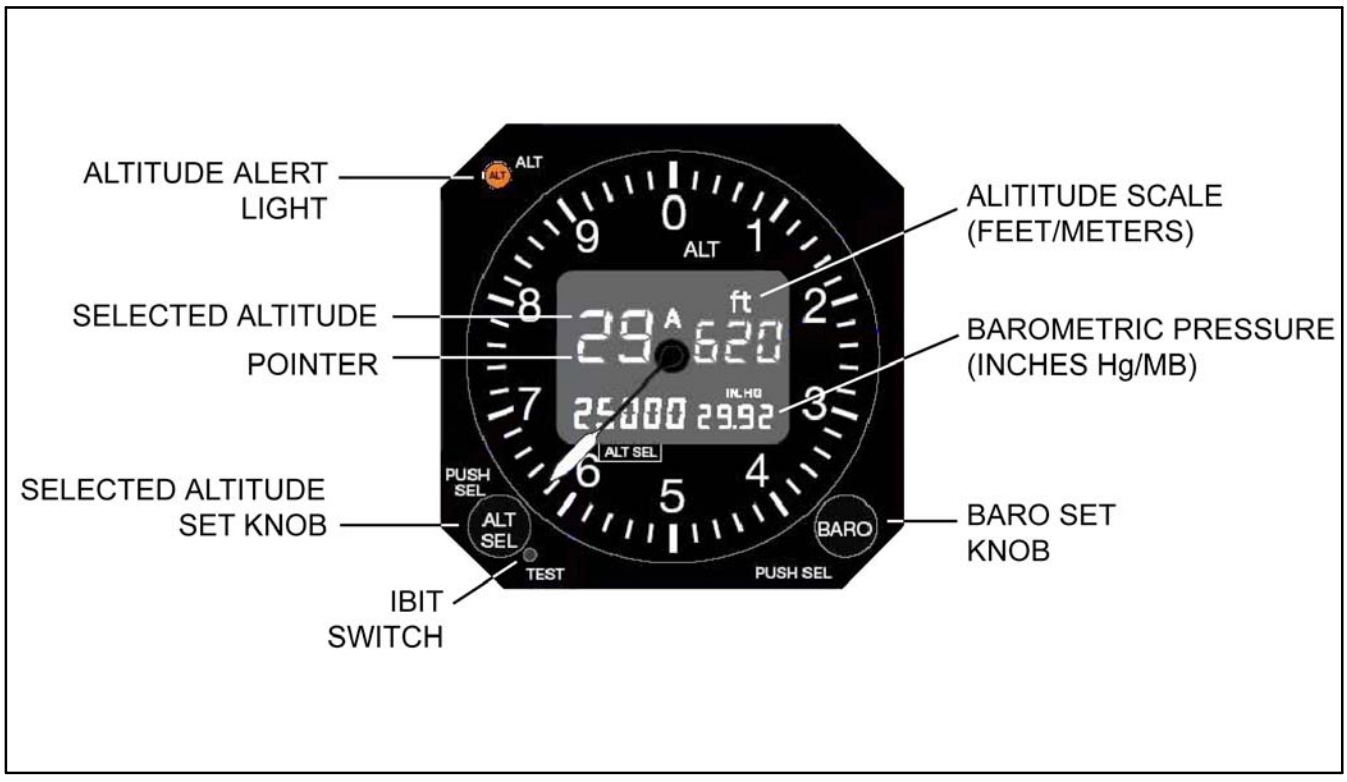


Figure 2-14. Air Data Display Unit AAU-61/A

2.7.5.5 ADDU Master and Slave Switch

The ADDU master and slave switch is located on the copilot side CDU power switch panel located on the side console. The master and slave switch selects which altimeter will be used for the altitude alerting via the alert light. A white “R” indicates the slave ADDU and white “A” indicates the active master. If the master altimeter fails, select the other ADDU as the master.

2.7.5.6 Fault Indicators

2.7.5.6.1 Standby (STBY) Indication

Fault condition will be indicated by a yellow STBY displayed on the ADDU. The fault can be verified on the CDU-7000 ADDU STATUS page. If STBY is indicated in either ADDU during preflight, ensure the static plugs are removed and then pull and reset primary and backup power circuit breakers for both units. If STBY is still displayed, further maintenance action is required prior to flight.

Note

If the static plugs remain installed for an extended period of time, a pressure differential may develop between units, causing a STBY indication.

2.7.5.6.2 Power (PWR) Indication

When the ADDU is on backup power, PWR is displayed as black text in a small yellow rectangle in the upper right corner of the applicable altimeter. Ensure that all Circuit Breakers (CBs) are set (MEDC and FEDC). Both units retain full functionality when powered by their backup power source.

2.7.6 Vertical Speed Indicator (VSI)

Two VSIs are installed, one on the pilot instrument panel and the other on the copilot instrument panel. The instrument is pressure sensitive and is connected to the static pressure line. The VSIs show rate of altitude change from 0 to 6,000 fpm.

2.7.7 Angle-Of-Attack (AOA) Indicator System

The AOA indicator system provides the pilot with a visual indication of the relationship between the aircraft wing cord line and the relative wind. It also furnishes a signal-light indication of a correct, too-low, or too-high landing approach AOA. These signal lights operate only when the aircraft is airborne, the landing gear lever is down, and the index light switch is on. The relative wind is sensed by an external probe that transmits an electrical signal to the AOA indicator.

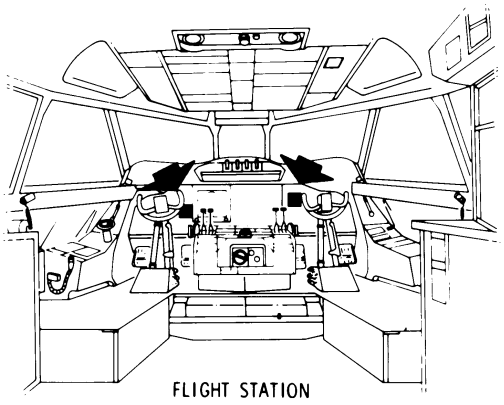
2.7.7.1 Angle-of-Attack Indicator

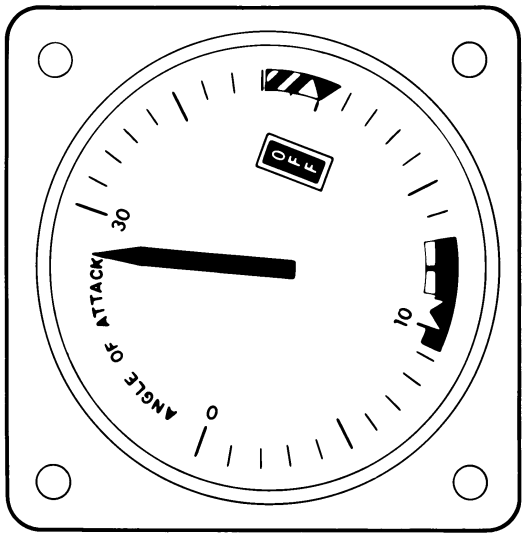
Two AOA indicators (Figure 2-15), located on the pilot and copilot instrument panels, are identically marked in 30 equal divisions. The divisions are arbitrary and do not represent degree or other standard units. Failure of the system is indicated by a red OFF flag, or by the indicator needle moving completely off scale and staying there. Fluctuations of the flag or needle are also failure warnings. The system is powered through the MEDC bus.

2.7.7.1.1 Reference Markers

Four reference markers are provided on the indicator face to help the pilot remember particular AOA references. These reference markers are shown in Figure 2-15.

	Flaps	Gear	Angle-of-Attack Indication (Units)	Reference Marker
Loiter	UP	UP	10.5	◁
Loiter	Manuv	UP	9.8	□
Stall Buffet Warning	ALL	ALL	20.0	▨
Approach for Landing	Approach	DN	12.0	◔





P301-F012

Figure 2-15. Angle-of-Attack Indicators

The loiter AOA indications do not vary appreciably with gross weight, altitude, external stores, or number of engines operating and are valid for an outside air temperature deviation from standard of +20 °C to –10 °C. A more accurate loiter speed schedule is contained in the operating tables, Chapter 33.

The stall buffet warning reference marker corresponds to a margin ranging from 0 to 15 percent above the speed for start of stall buffet. With flight idle power, the warning is approximately 0 percent during 1g stalls in the takeoff/approach and landing configurations and approximately 6 percent during 1g stalls in the maneuver and clean configurations. The addition of power increases the percent warning in all configurations. For example, in the takeoff/approach configuration with takeoff power, the warning is approximately 15 percent above the speed for start of stall buffet. The reference marker is not valid at high altitudes or for abrupt maneuvers and turning flight.

2.7.7.2 Approach Index Lights

The AOA approach index lights, one set for each pilot, are mounted on the flight station glareshield or below the edge of the flight station glareshield directly in front of each pilot. The index light consists of a top chevron, center doughnut, and bottom chevron controlled by switches in the respective AOA indicator. Power to the approach index light circuit is routed through the landing gear lever switch and ground sensor relays so that the lights operate only when the gear lever is down and the aircraft is airborne. The lights are tested by activating the instrument light switch to the TEST position.

The top chevron and bottom chevron may be displayed singly or in combination with the center doughnut, relative to 12 units AOA (Figure 2-16). At 12 units AOA, the doughnut is displayed regardless of flap setting or aircraft gross weight.

With landing flaps, the doughnut verifies a speed of 1.3 V_S. The system also displays a doughnut (12 units AOA) at 1.35 Stall Speed (V_S) with APPROACH flaps, 1.42 V_S with MANEUVER flaps, and 1.52 V_S with no flaps. These latter speeds should be considered as minimum speeds for maneuvering in the landing pattern. Use of the doughnut to establish minimum final approach speed in configurations other than landing flaps or approach flaps results in improper final approach speeds.

Note

The 12 units of AOA provide a safe margin only above stall and do not necessarily provide a safe rate of descent for landing.

2.7.7.2.1 Approach Index Light Switch

An approach index light switch, one for each pilot, is located on the pilot overhead light control panel. These switches, when in the ON position, allow the approach index lights to illuminate whenever the aircraft is airborne and the landing gear lever is down.

2.7.7.3 Angle-of-Attack Probe Heater Switch

The AOA probe heater switch, located on the flight station overhead panel above the pilot, has an ON and OFF position. When placed in the ON position, the switch allows power from the MEDC bus to energize the AOA probe heater.

2.7.7.4 Function of Angle-of-Attack System in Landing Pattern

The AOA indication of 12 units (or the center doughnut on the approach index when the gear handle is down) is used as a means of tapering landing pattern speed down to the final approach speed.

2.7.7.5 Angle of Attack/APU Exhaust Door/Airspeed Relationship

Readings on the AOA indicator, in flight, increase approximately one-half unit when the APU exhaust door is opened and an additional increase of one unit occurs when the APU is operating.

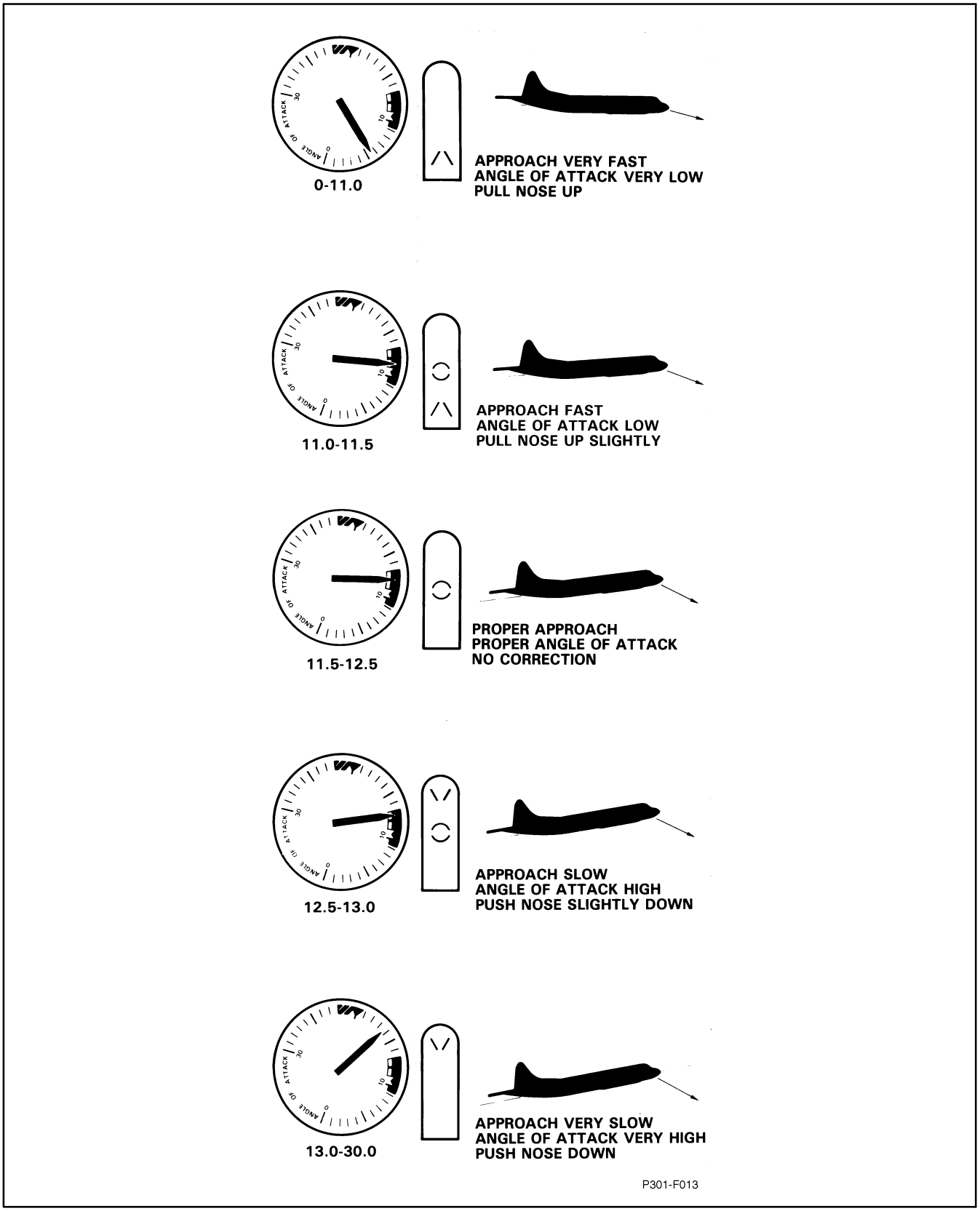


Figure 2-16. Angle-of-Attack Display

2.7.8 Radar Altimeter

The radar altimeter, APN-194, is a C-band, pulsed range tracking, special purpose radar set. The altimeter provides reliable, continuous indication of aircraft height above land or water, in the range of 10 to 5,000 feet with accuracy of ±5 feet or ±5 percent, whichever is greater. Dropout altitude is 5,000 feet. The system consists of an indicator and associated low-altitude warning lights. The system receives AC operating power from the FEAC bus.

2.7.8.1 Height Indicator

A radar altitude indicator (Figure 2-17) is provided on the pilot and copilot instrument panels. The indicator, labeled RADAR ALTITUDE, FEET on the circular face, is calibrated from 0 to slightly more than 5,000 feet in 20-foot increments up to 1,000 feet and 500-foot increments above 1,000 feet. A black mask appears at the top of the instrument face, indicating a system inoperative region. An adjustable index arrow, set by operation of the control knob, moves around the periphery of the indicator face to a desired position. A single pointer is used to indicate height above terrain. A knurled control knob is located at the lower left of the instrument case to perform these functions. Rotating the control knob in either direction moves the index arrow correspondingly to a desired position. If the control knob is rotated counterclockwise until the index arrow disappears behind the mask at the top of the instrument face, power is removed from the indicator and the system is shut off. Rotating the control knob so that the index arrow appears energizes the radar altimeter system on the ground or in flight with the gear up. Depressing the control knob (on the ground, or above 5,500 feet) provides a self-test function: a signal is generated internally that causes the instrument pointer to move to an approximate 100-foot indication and the green self-test light illuminates to verify normal operation.

Note

The APN-194 automatically energizes when the landing gear is selected down, even if system power is shut off.

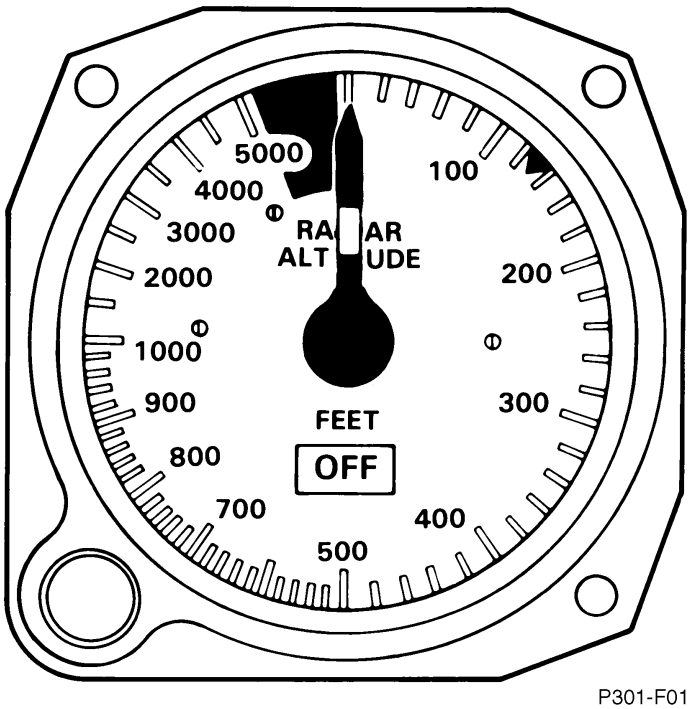


Figure 2-17. Radar Altitude Indicator (Typical)

A window in the lower part of the indicator face indicates the operational status of the radar altimeter. When the system is operating normally, the OFF legend will disappear. The OFF legend appears in the window if 115-Vac power is lost, the system is not reliable, or height above terrain exceeds 5,000 feet.

2.7.8.2 Indicator Limit Light

An annunciator light, directly above the height indicator, illuminates the legend LOW ALT when aircraft height above terrain equals or becomes less than the preset height indexed on the indicator face.

2.7.9 Radar Altimeter Warning System

The APQ-107 RAWS provides the pilot and copilot with flashing red warning lights and an intermittent tone under the following conditions:

1. Three-second warning as the aircraft descends through 380 ±20 feet.
2. Continuous warning when aircraft altitude is 170 ±10 feet or below.
3. Power interrupted to radar altimeter at any altitude.
4. Radar altimeter becomes unreliable.

Note

- All RAWS warnings are inhibited when gear is down and locked or when the flap handle is below MANEUVER.
- Radar altimeter unreliability warnings are inhibited 500 to 1,000 feet above the barometric altitude at which the RAWS PWR AC circuit breaker was set.

To ensure RAWS warning capabilities throughout altitudes below 5,000 feet, the RAWS PWR AC circuit breakers, located on the MEAC bus at the forward load center, should be pulled for approximately 10 seconds and then reset when the aircraft is at approximately 4,000-foot radar altitude. If the RAWS PWR AC circuit breakers are out, all RAWS warnings will be unavailable.

Note

Problems can result if the RAWS PWR AC circuit breakers are not cycled prior to descent below 4,000 feet. The barometric reference altitude is based on the actual barometric pressure at the departure airfield. A significant drop in atmospheric pressure between the field and on station would place the established barometric reference altitude much lower or even below sea level at the on-station location. If this should occur, the pressure change and failure to cycle the RAWS PWR AC circuit breakers cause unreliable radar altimeter warnings to be inhibited at all altitudes; however, failure to recycle the circuit breaker will not inhibit the 380-foot and 170-foot warnings.

2.8 PROPELLER SYSTEM

The four-bladed Hamilton Standard 54H60-77 propeller provides an efficient and flexible means of converting engine SHP to thrust. The propeller consists of two principal sections: the rotating section comprises the blades, hub, spinner, and the dome that houses the pitch changing mechanism; the nonrotating section contains an oil reservoir, pressure and scavenge pumps, the governor, and control mechanism. It is a constant-speed, variable-pitch, full-feathering propeller, having the added features of negative torque sensing, pitchlock (to prevent excessive overspeed), and a combination synchronizing and synchrophasing system. Refer to FO-13.

2.8.1 Mechanical Governor

Propeller operation is divided into two separate regimes: the Propeller Flight Operating Range (Alpha range), which includes the takeoff roll after the power levers are moved forward for takeoff, and the Propeller Ground Operating Range (Beta range) , in which the power levers are aft of the FLIGHT IDLE stop. As a propeller rotates, its blades are subjected to several forces as a function of rotational speed, aerodynamic loads, and frictional factors. Predominant among these forces is centrifugal twisting moment, which constantly acts to twist the blades to a flat pitch. In order to control blade angle in both the ground and flight ranges, the propeller control applies hydraulic pressure to counteract centrifugal twisting moment.

In the ground operating (Beta) range, propeller blade angle is determined directly by the power lever position through a hydromechanical system that meters oil pressure to either the increase or decrease side of the propeller dome. Propeller revolutions per minute (rpm) in the ground range is maintained by the fuel control, which schedules more or less fuel depending on power lever position.

As the power lever is moved aft from FLIGHT IDLE, blade angle and fuel supply decrease, reducing power. As blade angle decreases to the point at which the propeller is delivering negative thrust, fuel supply begins to increase. Reverse power continues to increase until the power levers reach the full aft position. During Beta operation, there is no electronic governing.

In the flight (Alpha) range of operation, when the power lever is forward of the FLIGHT IDLE stop, a flyweight governor driven by propeller rotation mechanically controls propeller speed through the pilot valve of the hydraulic governing system so that approximately 100 percent rpm is maintained.

2.8.2 Electronic Governor

When the individual SYNC SERVO switch is placed to NORMAL, power is applied to the power lever anticipation circuits to limit rpm over/undershoots caused by rapid power lever movement and to the speed derivative circuits, which dampens rpm transients. Selecting one of the inboard propellers as a master energizes the synchrophasing circuitry, which maintains a predetermined blade phase relationship (lead/lag) between the propellers and matches the slave propeller rpm to the master's.

2.8.3 Speed Bias Servo Motor

Located in the control valve housing of each propeller is a two-phase electric motor. The reference phase of this motor is powered from the MAIN AC BUS A and is energized anytime its SYNC SERVO switch is in the NORMAL position. The control phase is energized by a voltage from the synchrophaser unit. The speed bias motor is the primary means by which the propeller synchrophaser system operates. Because of built-in mechanical stops in the system, the normal operating range of the bias motor is limited from a plus 6 percent rpm to a minus 4 percent rpm, or 96 to 106 percent rpm.

Speed bias motor rpm changes are limited to ±2.5 percent. This system incorporates an authority-limiting feature that is designed to lock out all speed bias motor inputs if an rpm change signal in excess of 2.5 percent is sensed. Authority limiting lockout has occurred when individual propeller rpm does not respond when the MASTER TRIM control knob is rotated. No additional speed bias motor inputs will be received until maintenance has been performed. With the fuel governor check switch placed to the test position, a signal to increase rpm to 106 percent will be sent to the speed bias motor through alternate circuitry.

Note

Anytime electrical power is applied to the aircraft, the propeller synchronization box receives electrical power. Power to the synchronization box is secured by pulling the respective circuit breaker on MAIN AC BUS A.

2.8.4 Propeller Synchronization Control Panel

The autofeather and rpm control portion of the pilot overhead control panel contains the following synchrophasing system switches as discussed in the following paragraphs. Refer to FO-16.

2.8.4.1 SYNC MASTER Switch

Allows the selection of a desired propeller governor (No. 2 or No. 3, whichever is closest to 100 percent rpm and most stable) for use as the master engine during propeller sync operations.

2.8.4.2 SYNC SERVO Switches

Four switches, one for each engine, provide for selection of electronic (NORMAL) or mechanical (OFF) control of the propeller governor. These switches also energize the anticipator and speed derivative circuits for their respective engines.

2.8.4.3 RESYNC-NORMAL Switch

The RESYNC-NORMAL switch provides a means of recentering the biasing circuit of the speed bias motor in the synchronization system if the normal drift or normal change of rpm allows the system to deviate from center (i.e., 100 percent). The biasing circuitry is designed to allow a maximum rpm change of ±2 percent with each actuation of the RESYNC switch.

2.8.5 Synchrophaser Control Panel

2.8.5.1 MASTER TRIM Control Knob

The MASTER TRIM control knob increases or decreases the rpm of the master engine (approximately 1 percent) if the SYNC MASTER switch is positioned to either No. 2 or No. 3, and its SYNC SERVO switch is NORMAL. If the SYNC MASTER switch is OFF, and the SYNC SERVO switch NORMAL, only the No. 2 engine is affected. Refer to FO-16.

2.8.6 Propeller Components

The P-3 propeller assembly is comprised of four main subassemblies: the barrel, the dome, the blade assembly, and the control assembly. Refer to FO-13.

2.8.6.1 Barrel

The barrel is the hub of the propeller that is mounted on the propeller driveshaft at the front of the reduction gearbox. It serves as a structural foundation for the propeller blades, the dome, and the control assemblies. Mounted in the center of the hub is a pitchlock regulator that provides the oil passages needed to transmit hydraulic power from the control assembly to the dome.

2.8.6.2 Dome

The dome, mounted on the barrel shelf, incorporates a pitch control piston and a cam and gear train that convert linear travel of the piston into rotary motion of the blades. Thus, increased and decreased pitch are provided.

2.8.6.3 Control Assembly

The control assembly is mounted on the aft extension of the propeller barrel. Made up of two housings (pump housing and valve housing), it consists of the various components necessary for control of propeller blade angle.

2.8.6.4 Pump Housing

The pump housing is the lower part of the control assembly that contains the components necessary to provide a hydraulic power pumping system. There are two sumps: atmospheric and pressurized. The atmospheric sump contains the main scavenge pump (propeller-driven gear type) and the auxiliary scavenge pump (electrically driven gear type). Both scavenge pumps provide pressure to the pressurized sump. The pressurized sump contains the propeller-driven main and standby pressure pumps (along with their associated filters) and an electrically driven auxiliary pump used for feather, unfeather, and static ground operation. The main and standby pumps are of the gear-driven type. Either mechanical pump is capable of providing sufficient fluid flow to accomplish all normal propeller functions. Although the standby pump is larger in size and capacity, its flow is normally bypassed, putting this pump in standby until called upon to assist the main pump in major blade angle changes. Two flow switches give cockpit indications of each pump's output.

2.8.6.5 Valve Housing

The valve housing is the upper part of the control assembly that contains all the components that make up what is commonly referred to as the propeller governor. The pilot valve is positioned by the speeder spring at one end and flyweight force at the other. It is a metering sleeve that, through its servo spool, directs hydraulic fluid to the increase- or decrease-pitch side of the dome.

2.8.6.6 Backup Valve

The backup valve allows various propeller reference pressures to be felt at the top of the main and standby regulator valve when in the open position. When in the closed position, it blocks the reference pressure, limiting the amount of decrease pitch pressure available to the propeller system. In the flight range, the backup valve closes when blade angle is less than 24°. This prevents inadvertent retraction of the low pitch stops when in flight, thus ensuring a minimum blade angle of 13°. When the power levers are moved into the ground range (less than 28° coordinator), the backup valve opens, no longer limiting decrease pitch pressure. This allows the low pitch stops to retract and permits lower blade angles for ground operations. The backup valve in the open position also allows for maximum decrease-pitch pressure to overcome the feather latches when unfeathering a propeller.

2.8.6.7 Feather Valve

All hydraulic fluid passes through this valve on its way to the dome. This valve is spring-loaded to the neutral position. When it is in the feather position, all pump flow is directed to the increase-pitch side of the dome without going through the pilot valve.

2.8.6.8 Low Pitch Stop Assembly

A mechanical stop in the propeller dome is set to maintain a minimum desired low pitch blade angle of 13°. When the power levers are positioned below approximately 28° coordinator, a cam-operated backup valve operating in conjunction with the main and standby regulators in the propeller valve housing permits high oil pressure to retract the low pitch stop levers, allowing the blades to continue moving toward the reverse position as directed by the power lever Beta schedule.

2.8.7 Beta Follow-up

The Beta follow-up system provides a secondary variable hydraulic low pitch stop. As power is applied on takeoff, the same cams, Beta follow-up, and Beta set that provide pitch control in the Beta range start moving to set up a minimum follow-up blade angle of 11° with the power levers at FLIGHT IDLE, to a minimum of 22.5° with the power levers at 90° coordinator. The major increase occurs between 68° and 90° coordinator.

2.8.8 Pitchlock

A hydraulic, speed-sensitive pitchlock mechanism is contained in the propeller assembly to prevent excessive overspeeds. It is completely automatic and prevents further decrease in blade angle when engaged. Automatic engagement can occur in two ways: by loss of control oil pressure and when rpm exceeds approximately 103.5 percent. The pitchlock governor, sensing the overspeed, allows the pitchlock teeth to engage, preventing further decrease in blade angle. Because of the design of the teeth, the blade angle can increase if the normal governing control is restored.

2.8.8.1 Blockout Ranges

There are certain blade angles at which pitchlock does not operate. The pitchlock teeth are mechanically held apart whenever the blade angle is below 17°. This allows for rpm surges during rapid reversals. Also, pitchlock is blocked out at blade angles between 57° and 86° (full feather). This is necessary to be able to decrease blade angle for air starting. Blade angles will be less than 57° at 405 knots or limit Mach speed.

2.8.8.2 Pitchlock Reset

A reset system is incorporated to reset pitchlock up to 109 percent rpm at blade angles above 10° with the power lever below 28° coordinator. This 109 percent rpm setting of the pitchlock is momentary and necessary when the power lever is retarded very rapidly to maximum reverse. In this condition, the amount of fuel scheduled may cause engine speed to increase above 103.5 percent rpm. Refer to Propeller Malfunctions, paragraph 15.12 for procedures to follow in the event of pitchlock under various conditions.

2.8.8.3 Fuel Governor and Propeller Pitchlock Test Switch

Four two-position (TEST-NORMAL) switches, one for each propeller, are located on the engine check panel. When a switch is actuated to the TEST position with the SYNC SERVO on, the propeller speed-bias servo motor receives a continuous overriding signal that drives the mechanism full travel toward decrease pitch. This effectively resets the propeller governor to a speed of approximately 106 percent rpm to permit a ground check of the pitchlock and fuel governor functions or for certain in-flight propeller emergencies. Refer to FO-16.

WARNING

Intentionally pitchlocking the propeller in flight will result in a significant loss of power and available range. Increasing rpm from 100 percent to approximately 106 percent will result in a power loss of as much as 2,500 SHP.

2.8.9 Negative Torque System (NTS)

The NTS protects the aircraft from excess drag by limiting the negative torque from the propeller to a predetermined value range of –150 to –500 SHP for engines 1 and 4 and –100 to –500 SHP for engines 2 and 3. During a negative torque condition, the NTS will provide a mechanical signal overriding the governing action of the propeller and increasing the blade angle. When the propeller blades reach a position where the propeller no longer is developing sufficient negative torque, the propeller governor controls and maintains 100 percent rpm. In the event the negative torque condition persists, a cycling action at a reduced rpm will continue from the mechanical signal to propeller governor and vice versa until some corrective action is taken.

2.8.9.1 NTS Inoperative Warning Light

An NTS INOPR warning light, installed on the center instrument panel, illuminates when the 45° airstart blade angle circuit is energized with the feather button out. The airstart blade angle system is installed to limit negative horsepower during in-flight unfeather operations with failed NTS. The blades, upon reaching 45°, energize the feather valve solenoid, actuating the feather valve to the feather position. The blades moving toward the feather position open the circuit, deenergizing the feather solenoid valve. The result of this action is a cycling of the blades around the airstart blade angle switch. For ground unfeather operation, the airstart blade limit switch is bypassed by actuating the feather pump pressure cutout override switch to the OVERRIDE position while the propeller is unfeathering. Refer to FO-16.

2.8.10 Safety Coupling

The safety coupling is a backup for the NTS system. If the NTS system fails to function properly or fails, the safety coupling will decouple the reduction gearbox from the power section by a maximum of –1,700 SHP at 100 percent, thus automatically limiting excessive loads on aircraft structures and excessive drag on the aircraft. (Refer to FO-13.)

WARNING

If the propeller continues to rotate with the engine shut down, windmilling rotational speed of the engine will be insufficient to scavenge oil. This will cause eventual depletion of the oil tank reserve, and subsequent failure of the reduction gearbox is possible. This condition may result in a fire and/or propeller separation from the aircraft.

2.8.11 Propeller Brake

The engine has a friction-cone type propeller brake that is provided to prevent windmilling when the propeller is fully feathered in flight and when the aircraft is parked. It is incorporated in the reduction gear assembly as a part of the accessories drive gear train and acts through gears on the first-stage reduction pinion shaft. The brake also provides a means of increasing the rate of propeller deceleration on engine shutdown. It operates automatically and has three operating phases: released, applied, and locked. In the disengaged (released) position, the brake is held open by oil pressure acting on a piston. As engine speed is reduced and oil pressure drops, springs force the brake to the applied position and the braking surfaces into contact. Since the inner member of the brake operates on a helical spline, a slight reverse rotation of the feathered propeller causes the brake to be self-energized in the locked position, thus preventing further propeller rotation in reverse. The brake is always engaged when the engine is not running.

During normal ground starting, helical splines between the starter shaft and outer member cause the brake to release when starter torque is applied. The starter torque is adequate to overcome the spring force and release the brake until oil pressure builds up sufficiently to hold the brake in the released position. Conversely, when unfeathering, the starter torque is not available to release the brake; the brake remains in the applied position until rpm reaches 21 percent, when oil pressure becomes sufficient to overcome the spring force. The brake is then released and held in the disengaged (released) position. When the engine is shut down, the propeller brake application begins at approximately 21 percent rpm; therefore, it is undesirable to have the propeller rotate unnecessarily for extended periods with the electrical feather pump inoperative, as damage to the brake can result.

2.8.12 Propeller Feathering

Feathering is initiated by pulling the engine emergency shutdown handle, by autofeathering, or by depressing the feathering switch button. It is accomplished hydraulically by the feather valve directing pump Nos. 1 and 2 and auxiliary pump oil directly to increase pitch. All other control functions are bypassed.

2.8.12.1 Normal Feathering

Feathering is normally accomplished by pulling the engine emergency shutdown handle. Pulling the handle mechanically positions the feather valve to feather and electrically energizes the feather valve solenoid and feather pump. When the propeller has fully feathered, feathering oil pressure buildup will operate a pressure cutout switch, causing the feather pump and feather valve solenoid to be deenergized. The feather button light should then go out. Refer to Emergency Shutdown Handles, paragraph 2.9.10 for a more complete description of emergency handle functions.

2.8.12.2 Feather Pump Pressure Cutout Override Switch

A pushbutton-type switch is located adjacent to each feather button. Actuating the override switch bypasses the feather pump pressure cutout switch, permitting continued operation of the feather pump in the event the feather pump operation terminates before the propeller blades reach the full-feather position. Refer to FO-16.

2.8.12.3 Feather Transfer Switch

Located adjacent to the feather buttons and labeled NO. 1 & NO. 4 POWER, the guarded feather transfer switch has two positions: BUS B NORM and BUS A ALT. MAIN AC BUS B normally supplies electrical power to operate feather pump Nos. 1 and 4. In the event of a bus B failure or open PROP FEATHER PUMP circuit breaker, No. 1 and No. 4 feather pumps can be powered by MAIN AC BUS A for an in-flight restart or during performance of the Propeller Fails to Feather procedures.

2.8.12.4 Feathering Switches (Buttons)

Four guarded feathering switches (FO-16), one for each engine, are located on the pilot overhead control panel. These switches provide an alternate method for feathering the propellers. Depressing a button to feather cuts off fuel electrically, energizes the feather valve solenoid, and energizes the feather pump motor to feather the propeller. The propeller is unfeathered when the button is pulled to unfeather. The center position is for normal propeller operation. A light in the feather button illuminates when the circuit to the feather pump is energized.

2.8.12.5 Automatic Feathering

The automatic feathering system performs its function by energizing the feathering button holding coil (pulling in the feathering button). This occurs when the autofeather arming switch is in ARMED and loss of engine power results in a large decrease in propeller thrust. This system is used during takeoff only and will function above 60° ±2 coordinator setting. Only one propeller will feather automatically. The feathering priority is 4, 1, 3, 2.

2.8.12.5.1 Autofeather Arming Switch

An autofeather ARMED/OFF switch, located on the autofeather and rpm control portion of the pilot overhead control panel, provides the control for the autofeather system. During normal operations, with the switch in the ARMED position, all powerplants are protected by the autofeather system. With the switch in the ARMED position, the autofeather armed lights are illuminated and electrical power is supplied to the power lever quadrant autofeather arming switches. Both the arming switch and the power lever quadrant switch (activated at 60°) must be closed before the thrust-sensitive signal device can cause propeller autofeathering.

2.8.12.5.2 Autofeather System Indicators

Four green indicator lamps, one for each propeller, illuminate to indicate that each individual propeller autofeathering circuit is armed. They are located on the pilot overhead control panel. Also, should a propeller autofeather, its light remains illuminated and the others go out.

2.8.12.6 Static Unfeathering

On the ground, the propeller is unfeathered by holding the feathering button in the unfeather position. The airstart switch (in the propeller) limits the blade angle decrease to 45°. For further decrease in the blade angle, hold in the PRESSURE CUTOUT OVERRIDE button.

CAUTION

During static ground operation of a propeller, any selected decrease of blade angle toward low pitch shall not be interrupted in any intermediate position between full feather and the low pitch stop. Under no circumstances should an attempt be made to further decrease the blade angle toward the low pitch stop after any interruption, unless the operation is immediately preceded by increasing the blade angle to full feather in order to disengage the pitchlock ratchet teeth. Not following these instructions can cause damage to the pitchlock teeth.

For in-flight unfeathering, Refer to Engine Restart During Flight, paragraph 8.33.

Figure 2-18 shows propeller blade angle as determined by power lever position.

2.8.13 Propeller Operating Fundamentals

Propeller operation requires mechanical governing and fluid reliability to counteract Centrifugal Twisting Moment (CTM) and maintain constant rpm at 100 percent. A loss of fluid reliability or improper mechanical/electrical governing may result in some degree of off-speed or rpm fluctuation. A propeller pump light, fluid leak, or rpm fluctuation may indicate a loss of fluid reliability and preclude the ability to feather: therefore, propeller malfunction procedures address symptoms of internal mechanical failure and fluid control reliability. When fluid reliability is not questionable, procedures direct feathering the propeller. When fluid control pressure is unreliable, procedures call for continued engine operation and preparation for pitchlock. A power plant with a pitchlocked propeller can provide near normal services (electrical power, air-conditioning, bleed air, and possibly usable horsepower). If the propeller does not pitchlock, a normal four-engine transit and landing will ensue.

Propeller malfunction procedures are designed to achieve high blade angles prior to pitchlock in order to maximize range during transit and improve aircraft controllability after fuel chopping. Once a propeller pitchlocks, the primary means of determining pitchlock is to increase True Airspeed — Knots (TAS). For pitchlocked propellers, increasing TAS will increase rpm and cause SHP to decrease. When optimizing range with a pitchlocked propeller, there is only one TAS at which SHP will be zero for a given blade angle. This TAS can be flown at many combinations of altitude and indicated airspeeds. If the propeller has pitchlocked at a high blade angle, the aircraft can be flown at or near maximum range altitude and airspeed. In order to optimize range with a propeller pitchlocked at a lower blade angle, the aircraft should be flown at airspeeds approximating maximum endurance airspeed (12 units AOA or 1.52 V_S), at an altitude that results in zero SHP on the malfunctioning propeller.

In the terminal area, as TAS is reduced, SHP will increase. SHP at the time of fuel chopping is a relative indicator of the relationship between blade angle of the pitchlocked propeller and TAS. The propeller will decouple when negative torque exceeds the strength of the decoupler. TAS and blade angle combine to yield negative torque. Since blade angle is fixed due to pitchlock, reducing TAS prior to fuel chopping decreases the probability of decouple. If the propeller remains coupled after the engine is shut down, the drag associated with the coupled propeller will decrease as airspeed is reduced. That drag is always greater than a decoupled propeller at the same blade angle and TAS. If controllability is adversely affected with a coupled propeller, decouple the propeller by increasing TAS. Additionally, if the pitchlocked propeller is running at 100 percent and SHP is positive prior to fuel chopping, rpm will be less than 100 percent after the engine is secured, whether or not the propeller remains coupled or decoupled, provided blade angle and TAS remain constant.

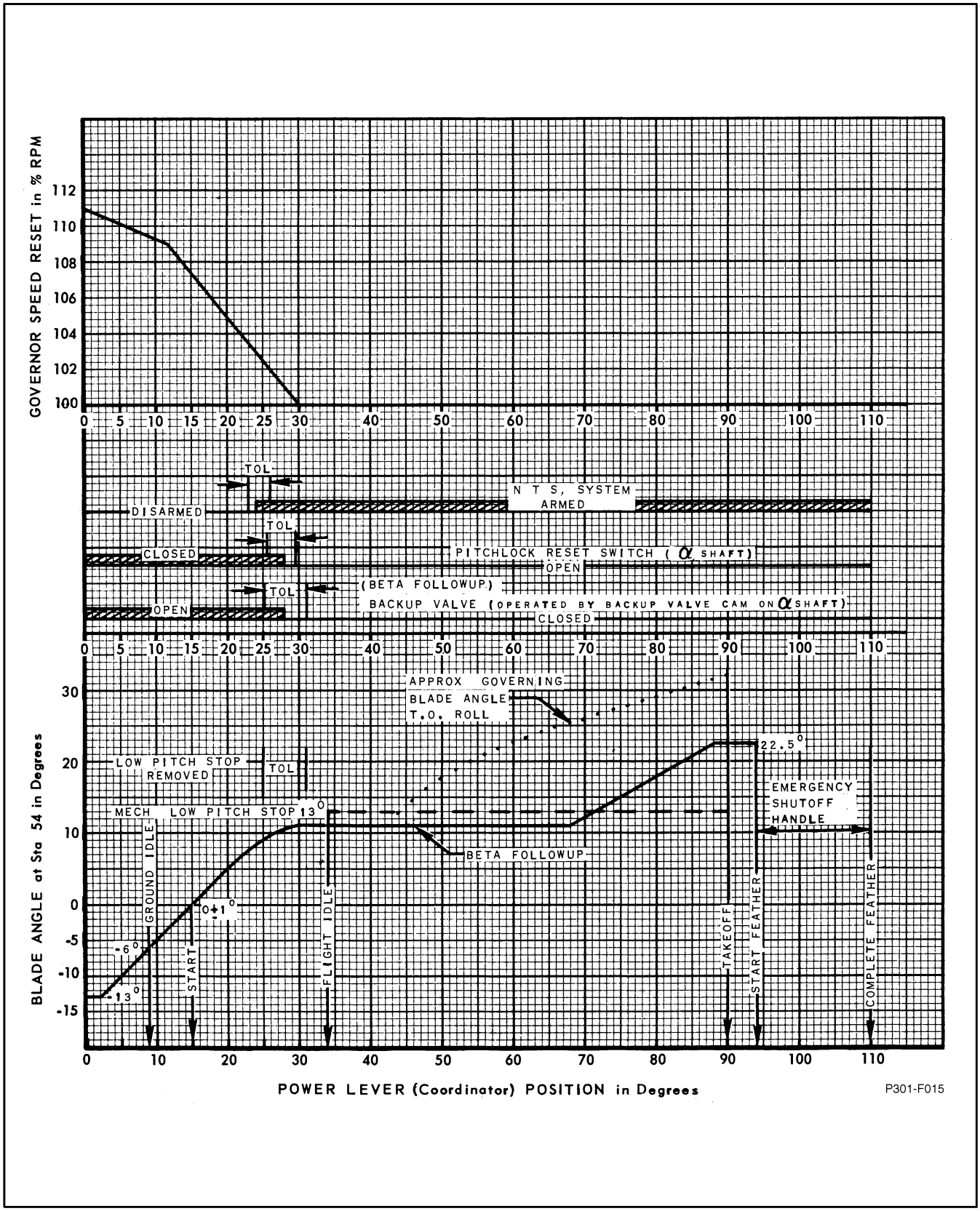


Figure 2-18. Power Lever Position vs. Blade Angle

In some cases, particularly when decoupled at extremely low blade angles, the resultant IAS at 115 percent rpm may be much lower than 1.52 V_S. In this case, range at less than 1.52 V_S must be evaluated in comparison to operation at higher rpm. If decouple occurs due to a prop malfunction and the engine is running, the engine is not secured because a windmilling decoupled propeller will eventually result in oil starvation. Oil starvation occurs due to the difference between the oil scavenge pumps and the main oil pumps. At windmilling engine speeds, oil is pumped from the oil tank to the engine components. The scavenge pumps do not build enough pressure to pump oil back into the oil tank at this rpm and oil pools in the engine. Eventually, oil is depleted from the oil tank, allowing the reduction gearbox to heat up due to a lack of lubrication.

WARNING

Operation with a windmilling decoupled engine for an extended period of time may result in reduction gearbox failure and possible propeller separation from the aircraft.

2.9 PROPULSION SYSTEM

The P-3 aircraft has four Allison T56-A-14 turboprop engines (Figure 2-19) rated at 4,600 SHP. They are single-spool, axial-flow, gas turbine engines that operate at a constant speed. Power from these engines is converted to thrust principally by four-bladed Hamilton standard propellers. Some additional jet thrust is obtained from the high velocity exhaust gases. The engine consists of a power unit attached by interconnecting structures to a reduction gearbox unit.

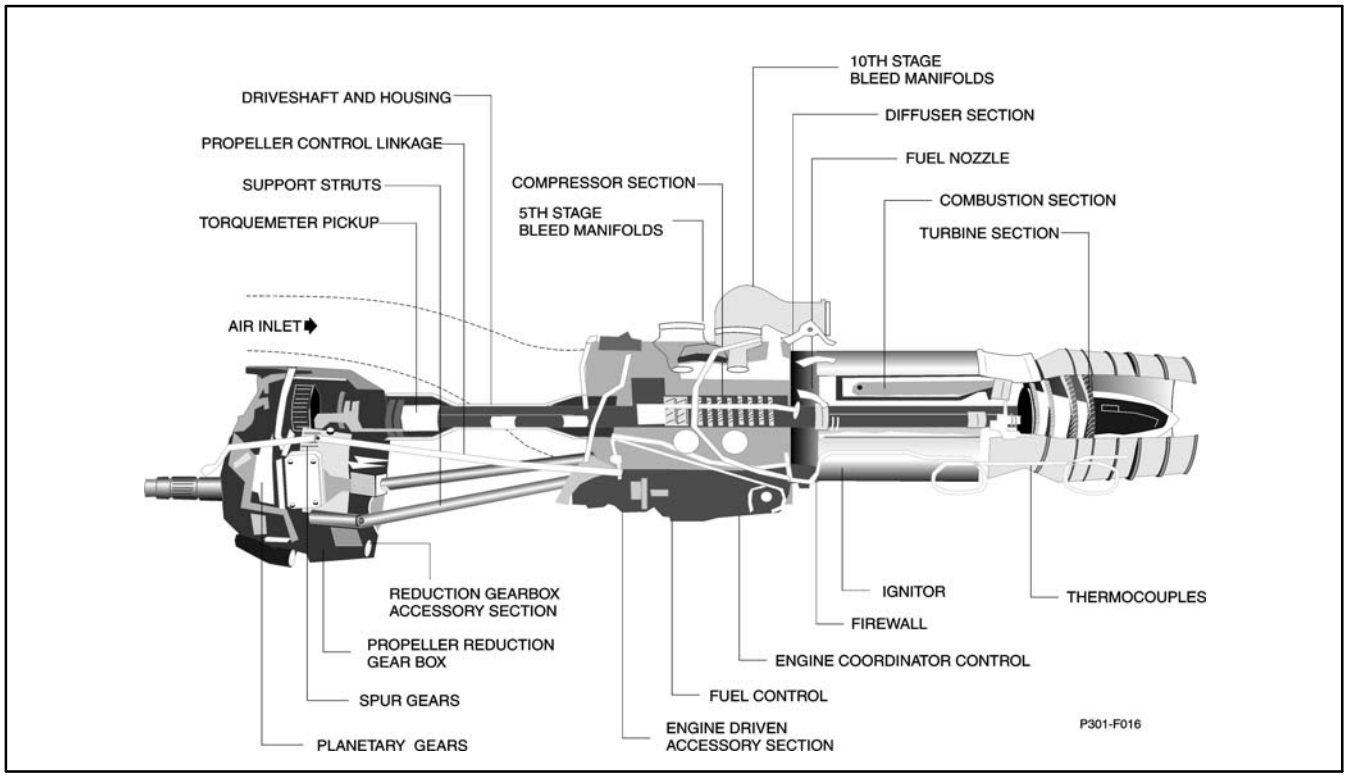


Figure 2-19. T56 Powerplant

The power unit includes an air inlet housing, a compressor section, a turbine section, and an accessory section. The reduction gearbox unit provides a speed reduction of 13.54:1 that reduces the 13,820 rpm normal operating speed to 1,020 rpm at the propeller shaft. The reduction gearbox unit also has an accessory section that drives selected equipment.

2.9.1 Power Section

The power section consists of a 14-stage, axial-flow compressor; 6 cylindrical combustion liners that comprise the combustion section; a 4-stage turbine section; an accessory drive unit; an oil system; and a fuel control unit.

2.9.2 Compressor Section

The compressor consists of a 14-stage rotor-stator assembly, a diffuser assembly (from which 14th-stage bleed air is tapped), and the compressor extension shaft and bevel gearing required to drive the accessory section of the engine. Fourteenth-stage bleed air is used to perform the following functions:

1. Engine starting.
2. Engine anti-ice.
3. Wing deice.
4. Oil cooler augmentation.
5. Close the 5th and 10th stage bleed air valves at 94 percent rpm.
6. Bomb bay heat.

2.9.3 Combustion Section

The combustion section consists of six combustion liners evenly spaced in an annular chamber. Fuel nozzles are located in the domes of each liner. An igniter plug is installed in each of two diametrically opposite liners (liners 2 and 5). Crossover tubes between the liners carry the flame to the liners that contain no igniters. Approximately 25 percent of the air passing through this section is used to support combustion; the remaining 75 percent is used for cooling and flame control.

2.9.4 Turbine Section

The turbine section consists of a four-stage, rotor-stator assembly that extracts the power required to support the operation of the propeller and the compressor. The first stage of the turbine is air cooled and the Turbine Inlet Temperature (TIT) thermocouples are located prior to this section.

2.9.5 Accessory Section — Engine

The engine accessory drive pad is mounted on the bottom of the compressor air inlet housing and is driven by a compressor extension shaft via a bevel gearing assembly (Figure 2-20). The following equipment is mounted on the accessory section:

1. Engine fuel pump.
2. Fuel control unit.
3. Speed-sensitive control.

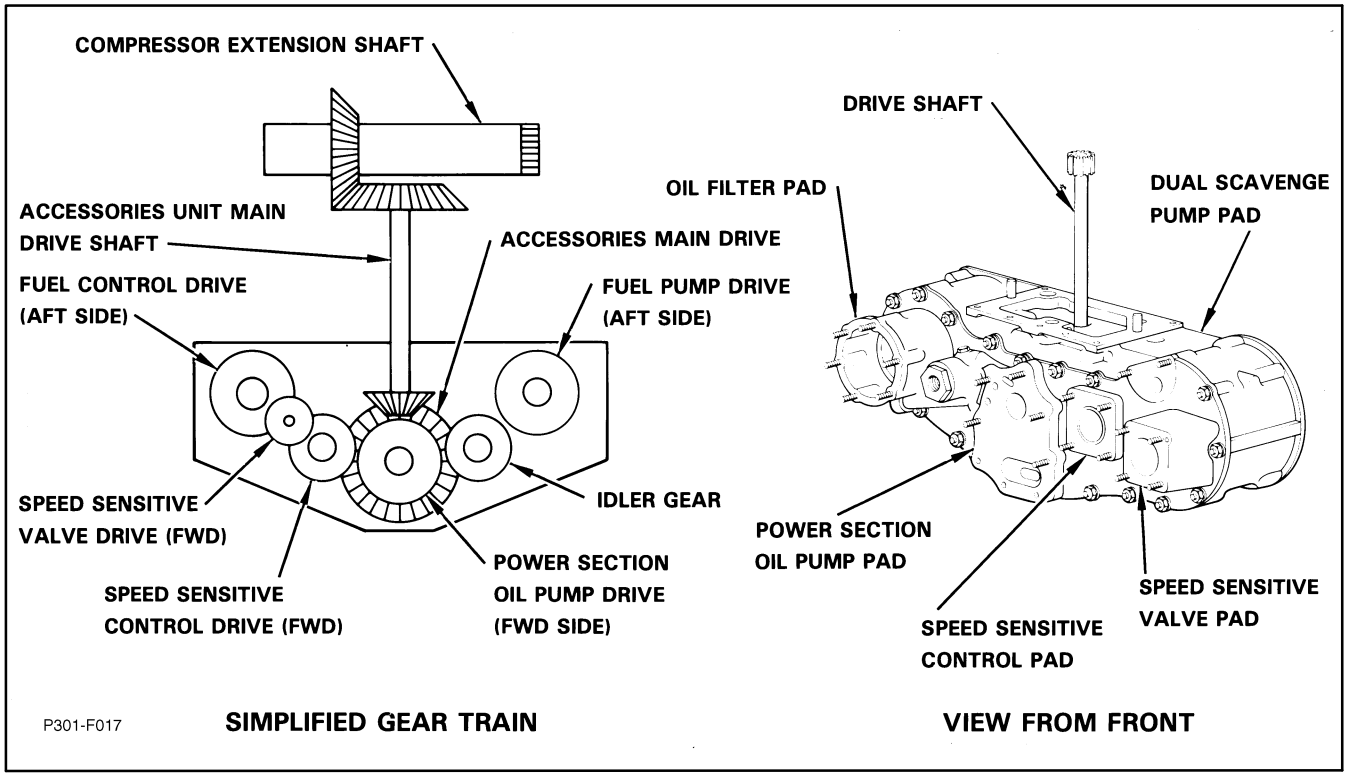


Figure 2-20. Compressor Accessory Section

4. Speed-sensitive valve.
5. Main oil pump.
6. Oil filter.
7. Scavenge oil pump.

2.9.6 Reduction Gear System

The reduction gearbox reduces the high-rpm, low-torque output of the power section to a low-rpm, high-torque output to be utilized by the propeller shaft (Figure 2-21). The reduction gearbox consists of two stages of reduction to avoid excessive gearbox size. The first stage (spur gear) has a reduction ratio of 3.125:1; the second stage (planetary type) has a reduction ratio of 4.333:1. This results in an overall reduction of 13.54:1.

2.9.6.1 Thrust Sensitive Signal System (Autofeather)

The autofeather system is a safety device that automatically feathers the propeller in the event of a large power loss during takeoff. The respective circuit breakers for this system are located on the extension MAIN DC BUS in the flight station. The autofeather system electrically pulls in the feather button to feather the propeller and shut down the engine when the following conditions exist:

1. System is armed.
2. Power lever is greater than 60° coordinator.
3. Propeller thrust is less than 500 pounds.
4. No other feather button is in the feather position.

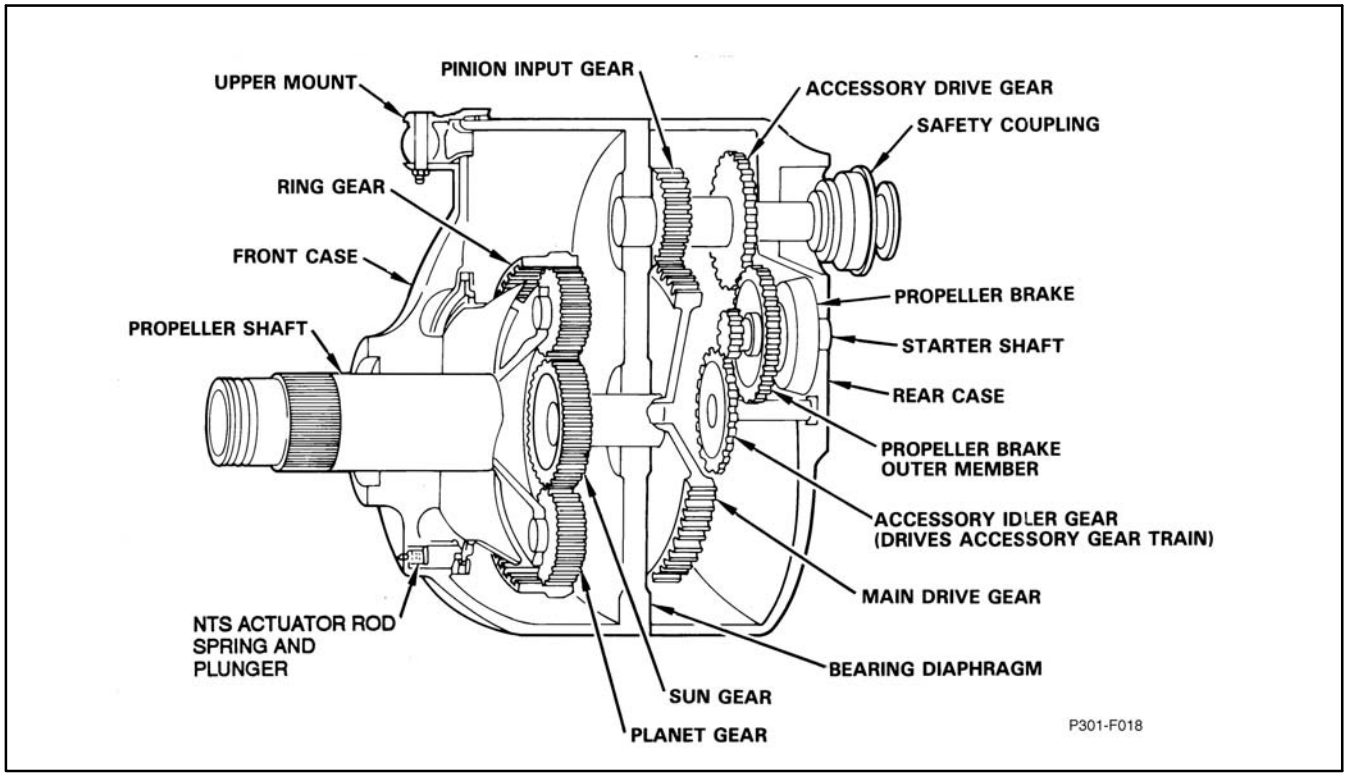


Figure 2-21. Basic Reduction Gear

Note

The autofeather system is not recommended for use in areas where high bird activity exists or during landings.

2.9.6.2 Accessory Section

The accessory section of the reduction gearbox (Figure 2-22) has the following items mounted on its aft face:

1. Generator (engines 2, 3, and 4).
2. Engine-driven compressor (engines 2 and 3).
3. Tachometer generator.
4. Engine starter.
5. Oil pump and filter.

2.9.7 Interconnecting Structure

The interconnecting structure between the reduction gear assembly and the power unit consists of the torquemeter assembly and two tie struts. The struts and the torquemeter housing rigidly connect the reduction gear and the power unit. The torquemeter transmits torque from the power unit to the reduction gear assembly and provides an accurate means of measuring this torque. The torquemeter housing is also the primary support structure between the power unit and the reduction gearbox.

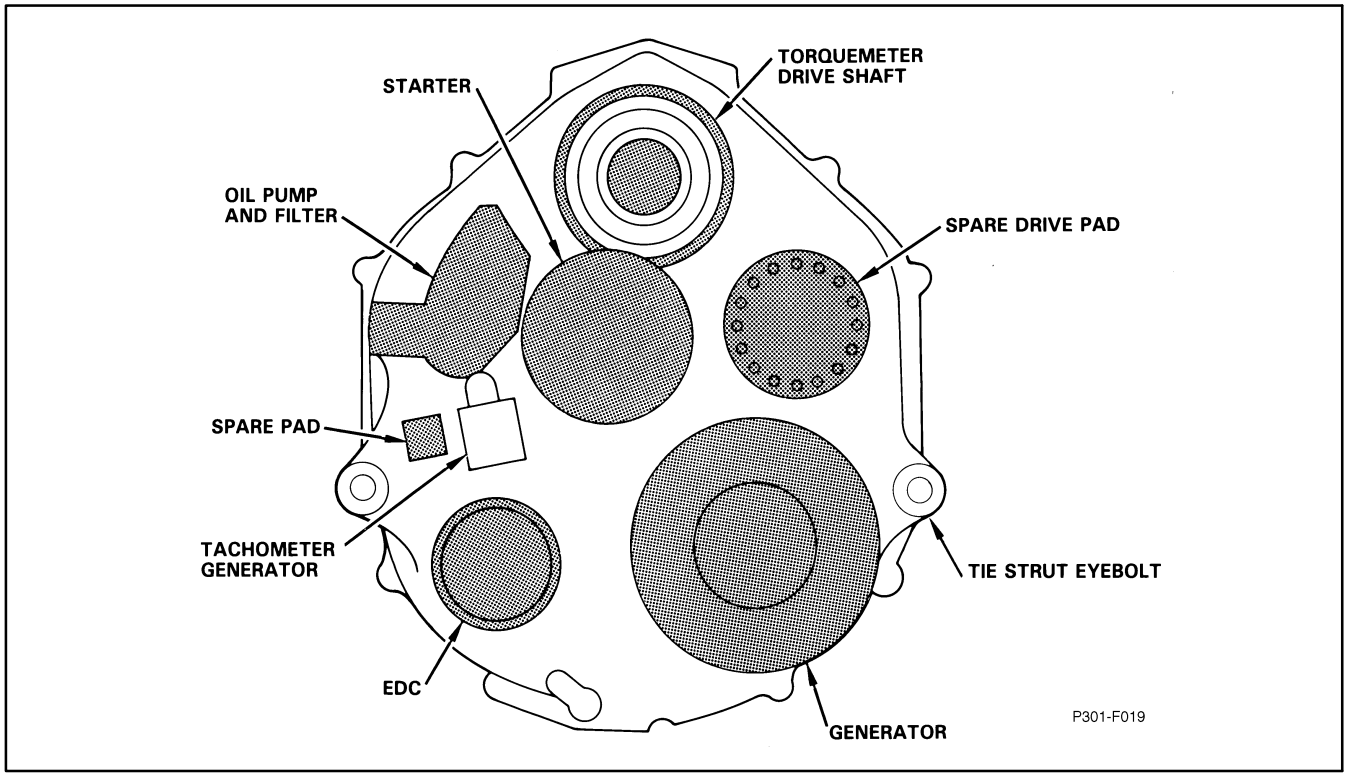


Figure 2-22. Reduction Gear Accessory Section

Two concentric shafts comprise the rotating portion of the torquemeter. Both shafts rotate as a unit within the torquemeter housing where an electromagnetic pickup assembly is mounted. The outer (reference) shaft is not torsionally loaded and provides a point of reference at the output end for measuring the torsional deflection of the inner (torque transmission) shaft. As the amount of transmitted torque increases, the torsional deflection of the inner shaft causes a displacement between the exciter teeth located on the flanges of the two shafts. This deflection is indicated in SHP at 100 percent (13,820 rpm) on an indicator at the flight station.

2.9.8 Principles of Operation

The engine operates in two distinct modes: the ground range and the flight range (Figure 2-23).

2.9.8.1 Ground Range (Taxi Range)

The ground range is that portion of the power lever quadrant from the maximum reverse to flight idle position (0° to 34° coordinator). Throughout this range, power lever position determines blade angle while the fuel control unit provides sufficient fuel flow to maintain engine speed. Two conditions of taxi are available: normal rpm and low rpm). Low rpm is selected by means of a paddle switch provided for each individual engine on the overhead panel. Selecting low rpm does not change the blade angle in any way; however, it does change the tension on the flyweights located in the fuel control unit, setting a lower rpm as onspeed. When the power levers are advanced above 36° coordinator, the engines will shift from low to normal rpm automatically to prevent an attempted takeoff in low rpm.

Engine starts are accomplished in the ground range at 15° coordinator as this power lever position will provide 0° blade angle and very little propeller loading during ground starts.

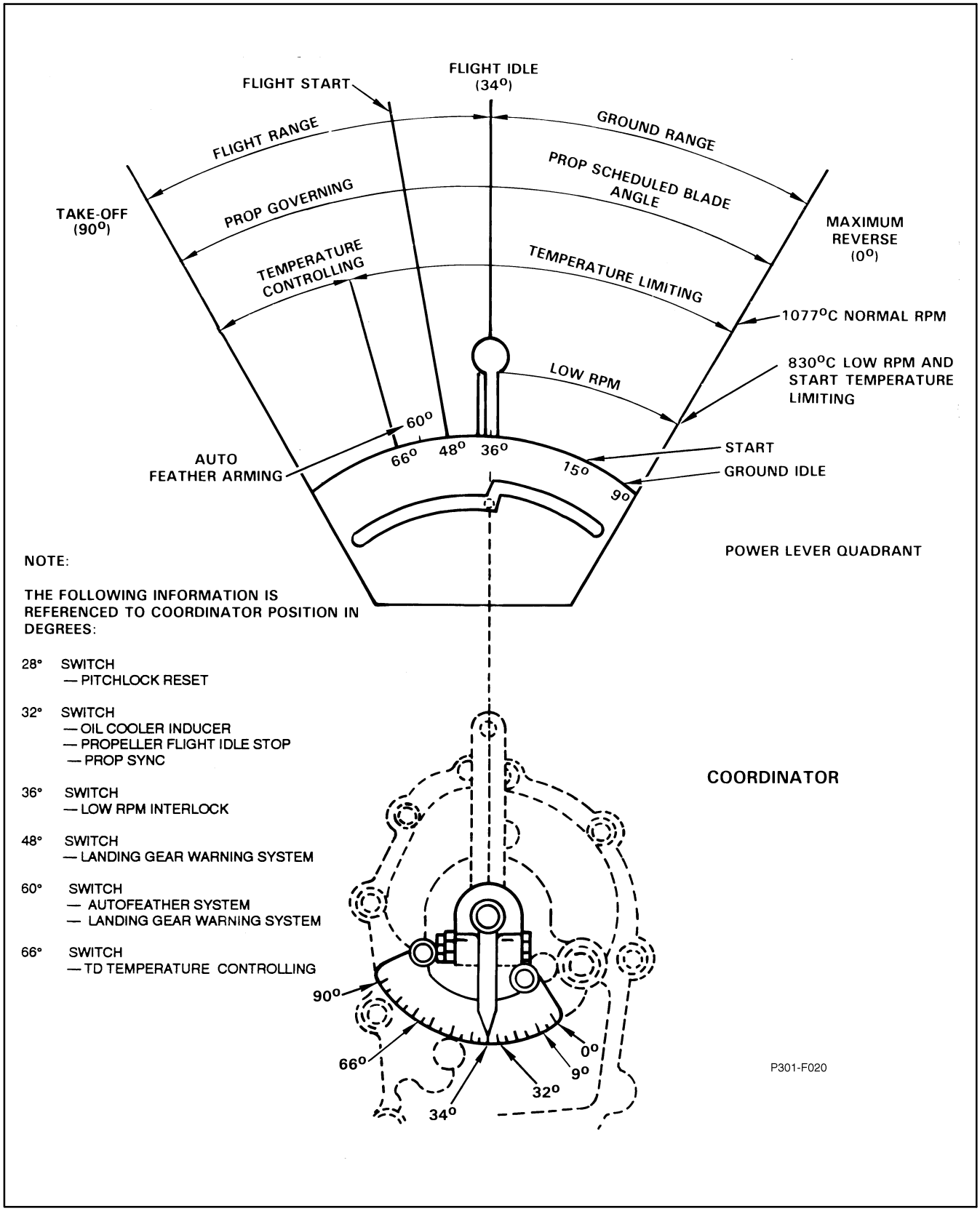


Figure 2-23. Power Lever Function

2.9.8.2 Flight Range

The flight range is the portion of the power lever quadrant from the FLIGHT IDLE position to maximum power (34° to 90° coordinator). During flight, the propeller maintains a constant speed as does the engine. This speed is known as the "100 percent rated speed" of the engine. Changes in power lever position are not related to propeller or engine speed but to the TIT via fuel flow. Advancing the power lever increases the fuel flow, which increases the TIT with a corresponding increase in the energy available at the turbine. The turbine transmits this increased energy to the propeller in the form of increased torque via the torquemeter. The propeller then increases its pitch angle to absorb this increased torque while maintaining the same speed.

2.9.9 Engine Start System

2.9.9.1 Starter

A turbine starter unit, operated by compressed air from an external Gas Turbine Compressor (GTC), the APU, or bleed air from an operating engine is used to start the engine. Refer to FO-12. The normal air source for the initial engine start is the APU, and the remaining engines are started with bleed air from the initial engine. If the APU is unavailable for engine starting, an external air source GTC may be used.

Note

The starting system requires a stabilized air source that must maintain a minimum of 25 psi at 16 percent rpm. Refer to Normal Start, paragraph 8.5.

2.9.9.2 Speed-Sensitive Control

The speed-sensitive control, located on the engine accessory section, contains three switches that actuate at approximately 16, 65, and 94 percent rpm. The switches are actuated by a self-contained flyweight assembly and perform the functions as discussed in the following paragraphs.

2.9.9.3 16 Percent Switch

The 16 percent switch opens the fuel shutoff valve through the fuel shutoff circuit breaker on SEDC provided the fuel and ignition switch is on and energizes the ignition relay through the fuel shutoff valve circuit breaker on SEDC. The ignition relay performs the following functions:

1. Energizes the igniter plugs (cans 2 and 5).
2. Energizes the paralleling valve solenoid allowing the primary and secondary pumps to operate in parallel during the starting sequence (16 to 65 percent rpm).
3. Energizes the fuel manifold drain solenoid.

If prime is selected, the enrichment valve solenoid energizes.

2.9.9.4 65 Percent Switch

The 65 percent switch deenergizes the ignition relay, which:

1. Deenergizes the igniter plugs.
2. Deenergizes the paralleling valve solenoid that puts the primary and secondary pumps in series.
3. Deenergizes the fuel manifold drain valve solenoid, but the drain valve itself remains closed because of fuel pressure.

2.9.9.5 94 Percent Switch

Above 94 percent, the temperature datum control system switches from start limiting to temperature limiting.

2.9.9.6 Speed-Sensitive Valve

The 5th and 10th stage bleed-air valves are a purely pneumatic/mechanical system controlled by the speed-sensitive valve, which reduces compressor back pressure and starter overload during engine turnup. During starts, air is bled from the 5th and 10th stages of the compressor through eight ports located on the compressor housing. These ports are held open below 94 percent rpm by compressor air pressure from their respective stage. At 94 percent, the speed-sensitive valve ports 14th-stage bleed air to close the 5th and 10th stage bleed-air ports.

2.9.10 Emergency Shutdown Handles

An emergency shutdown handle for each engine is located on the glareshield. Refer to FO-18. When a handle is pulled to the full-out position, it performs various functions electrically or mechanically (Figure 2-24).

Function	Actuation
Shuts off fuel at fuel control unit	Electrical Mechanical
Actuates feather system	Electrical
Moves propeller feather valve to feather position	Mechanical
Closes fuel tank emergency shutoff valve	Mechanical
Closes bleed air shutoff valve	Electrical
Closes generator cooling air shutoff valve	Mechanical
Dumps engine-driven compressor (2 and 3 only) and closes firewall shutoff valve	Electrical
Closes oil tank shutoff valve	Electrical

Figure 2-24. Emergency Shutdown Handles Functions

Note

The electrical functions of the emergency shutdown handle are controlled by electrical switches powered by the MEDC bus. The system is redundant, providing two switches and two circuit breakers.

2.9.11 Engine Switches

2.9.11.1 FUEL AND IGNITION Switch

Placing this switch ON arms the fuel and ignition circuits for starting. Actual power to open the fuel shutoff valve is supplied from the fuel shutoff valve circuit breaker on SEDC. Refer to FO-16. Moving this switch to the OFF position, as during a normal engine shutdown, disarms the circuit, thus routing power from the fuel shutoff valve circuit breaker to close the fuel shutoff valve.

2.9.11.2 Rpm Selector Switches

Four rpm selector switches (paddle switches) powered by extension main DC are located on the overhead panel. They each have two positions: NORMAL and LOW.

2.9.11.3 Start Selector

The engine start selector switch determines the engine to be started by connecting the starting circuits to the SEDC bus through the START CONT circuit breaker.

Note

Selecting an engine disables ground air-conditioning and oil cooler augmentation.

2.9.11.4 START Button

The push-pull START button opens the start valve of the selected engine to allow starting air to turn the starter. Refer to FO-12. The START button is held in by a solenoid that receives power from the START CONT circuit breaker on the SEDC bus. The START button should be pulled between 57 and 64 percent rpm during the start sequence, but may be pulled at any time to discontinue the start.

CAUTION

- Positive start valve closure is imperative and must be monitored closely. Any indication that the start valve did not close requires that the emergency shutdown handle be pulled. Refer to Chapter 8.
- Any delay in pulling the emergency shutdown handle with engine rpm above 64 percent and the start valve open causes the starter to overspeed and possibly disintegrate.

2.9.11.5 PRIMER Button

The PRIMER button arms the automatic fuel enrichment system in the fuel control and makes boosted fuel pressure available to the fuel nozzles. Refer to FO-12. The PRIMER button must be pressed prior to engine rpm reaching 16 percent and held there until the fuel shutoff valve opens, or enrichment will not occur. The enrichment valve closes when fuel manifold pressure reaches 50 psi. Refer to Normal Start, paragraph 8.5.

2.9.11.6 Temperature Datum Control Switches

The temperature datum control switches remove the electronic fuel trimming system from the hydromechanical fuel system. With the switch in NORMAL, power is supplied to the temperature datum control. When the switch is in NULL, power is removed from the temperature datum control, the temperature datum valve returns to the null position, and all fuel metering is accomplished by the fuel control. All electronic overtemperature protection is lost with the switch in NULL.

2.9.11.7 Feather Valve NTS Check Switch and Lights

Placing the switch in the NTS position arms the NTS test circuit. When the engine is shut down, propeller inertia produces a momentary negative torque as rpm decays. If the NTS mechanical linkage system is functioning properly, the test light illuminates and remains on until the switch is placed in the FEATHER VALVE position or the electrical power supply is interrupted. Placing the switch in the FEATHER VALVE position illuminates the advisory light each time the NTS system actuates the feather valve. The light illuminates and remains on when the emergency handle is pulled.

2.9.11.8 Horsepower Calibration Check Switch

A three-position calibration check switch is located on the lower part of the center instrument panel, labeled CAL A, NORMAL, and CAL B. This switch is spring-loaded to the center (NORMAL) position. Refer to NAVAIR 01-75PAA-2-4 for calibration procedure of the horsepower indicators.

2.9.11.9 Fire Extinguisher Discharge Button

Four fire extinguisher discharge buttons (Figure 2-25) (one for each nacelle) are located under the emergency shutdown handles. The buttons are protected from inadvertent operation by a plastic guard. Operation of a button discharges one bottle into the corresponding nacelle. When the transfer switch for the associated system is activated, the discharge button is rearmed so the alternate bottle in that system can discharge into the same nacelle.

2.9.11.10 Fire Extinguisher Transfer Switch

A two-position transfer switch for each fire extinguishing system is located on each end of the glareshield panel (Figure 2-25), adjacent to emergency shutdown handles 1 and 4. The switches are guarded in the DIRECT TO ENGINES position. When a switch is moved to the TRANSFER TO ADJACENT ENGINES position, the alternate bottle is selected so its charge may be directed to the nacelle when the discharge button is pushed.

2.9.11.11 Fire Detector Test Switches

Four fire detector test switches, located on the engine check panel, test operation of the detector control units and continuity of the detector sensing loops. Operation of the switches to the TEST position causes the fire indicator light panels on the glareshield to light and the fire warning horn(s) to sound if the system is operating properly. Each switch is designated by engine number and includes a TEST and NORMAL position. Power for the circuit is provided by the MEDC bus. The horns are silenced by a pushbutton marked FIRE DET HORN LOCKOUT.

2.9.11.12 Oil Cooler Flaps Switches

The switches for controlling the oil cooler flaps are located on the engine check panel. The switches have three positions, OPEN, close, and OFF, and are spring-loaded to OFF from the close position. The actuator receives power from the MEAC bus in the forward load center. After the flaps are fully open, the switches must be left in the OPEN position for an additional 8 seconds to allow the inducer valves to open. In closing, the flaps will not start to move until approximately 8 seconds have elapsed to permit the inducer valves to close.

2.9.11.13 Engine Airscoop and Inlet Vanes Switches

The four toggle switches labeled ENG AIR SCOOP & INLET VANES on the anti-icing control panel (refer to FO-16) control the position of the engine anti-icing shutoff valves. The two switch positions are OFF and ON.

2.9.11.14 Center Instrument Panel Test and Reset Switches

The DUCT LOOP TEST switch, located adjacent to the upper right corner of the center instrument panel (refer to FO-18), is used to test the warning circuit on the fuselage portion of the bleed-air duct. Power for the switch is provided by the WARNING LTS circuit breaker on the MEDC bus on the forward load center circuit breaker panel. The MASTER RESET switch, located adjacent to the upper right corner of the center panel, is used to extinguish the master warning lights on the center instrument panel for the deicing system, the electrical system, and the pressurization system. The lights are extinguished automatically if the discrepancy is corrected.

2.9.12 Engine Indicators

Refer to FO-18.

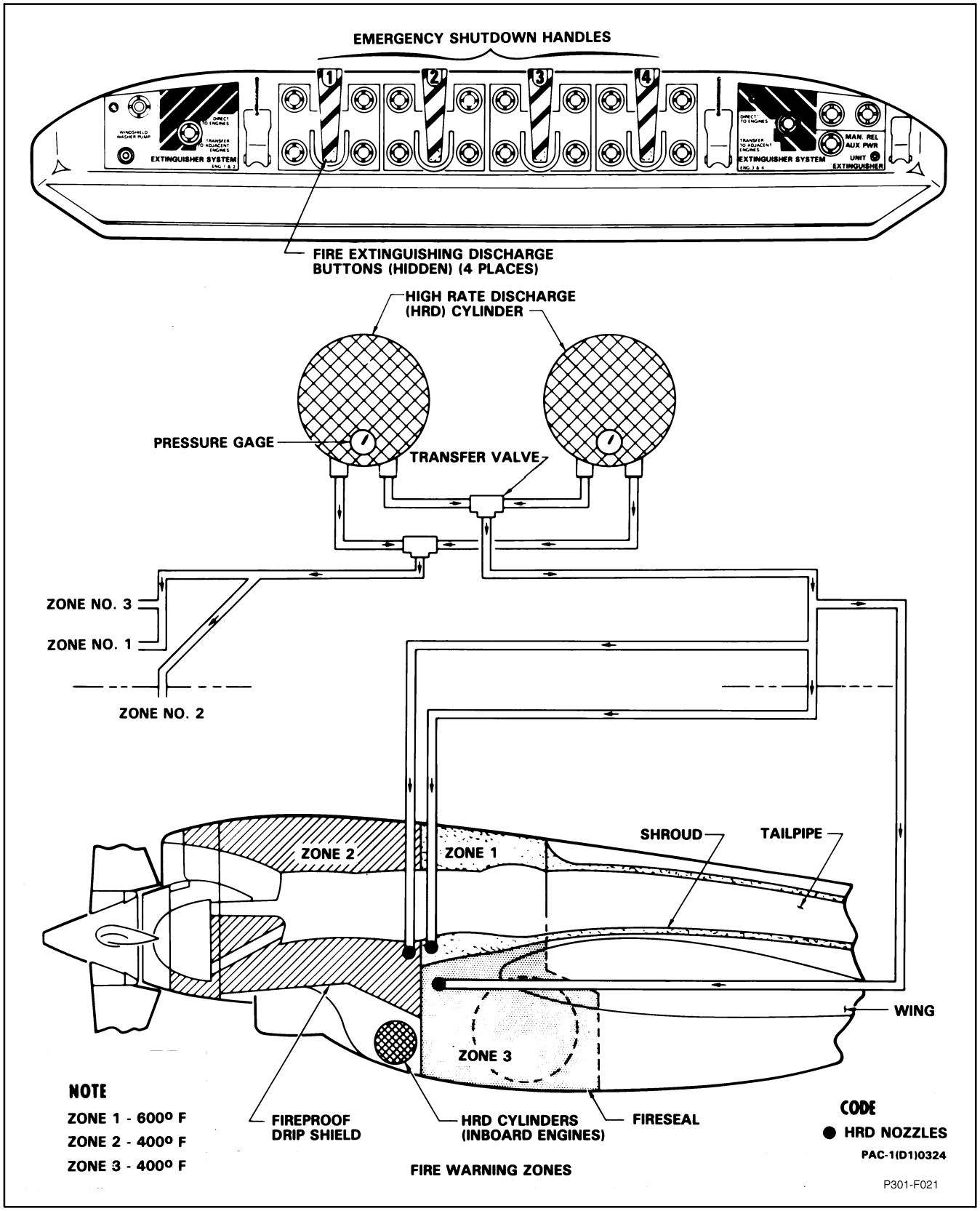


Figure 2-25. Fire Detection and Extinguishing System

2.9.12.1 Horsepower Indicators

These indicators, located on the center instrument panel, show the power output of the engine power section at 100 percent rpm. Engine torque is measured by torsional deflection of the torquemeter inner shaft. Electromagnetic pickups on the torquemeter housing furnish signals to the indicator that is calibrated in horsepower. Digital SHP indicators include a digital readout that has an automatic dimming feature. A red overtorque light illuminates when SHP exceeds 4,600.

2.9.12.2 Turbine Inlet Temperature Indicator

TIT is measured by 18 dual-unit thermocouple assemblies installed in the turbine inlet casing. An average signal from the thermocouples is provided to the TIT indicator located on the center instrument panel and to the temperature datum control. A red light on the indicator illuminates when 1,080 ±2 °C TIT is exceeded. An OFF flag appears when start AC power is lost. On aircraft incorporating digital TIT gauges, operation is the same, but without an OFF flag. Loss of power results in loss of digital display. The digital TIT gauge also has a photo-resistor installed to automatically dim the digital display during hours of darkness.

2.9.12.3 Tachometer

The engine tachometer, located on the center instrument panel, indicates engine speed in percent of 13,820 rpm. In the event of a decoupling, the tachometer will indicate reduction gear speed only.

2.9.12.4 Fuel Flow Gauges

Four fuel flow gauges, located at the bottom of the center instrument panel, show engine fuel consumption in hundreds of pounds per hour. They receive power from the MAIN AC BUS A through a single power supply.

2.9.12.5 Oil Quantity Indicator

Two dual oil quantity indicators are located on the right overhead panel; each indicator is calibrated from empty (E) to full (F). Electrical power is supplied from the 28-volt extension MAIN DC BUS. When the check switch is pushed, 28 Vdc is supplied by the GROUND OPERATION DC BUS.

2.9.12.6 Oil Pressure Indicators

Eight oil pressure indicators are located on the right overhead instrument panel. Refer to FO-16. The four upper indicators present engine power section oil pressure; therefore, the four lower indicators show oil pressure in the reduction gear cases. These gauges receive power from the MEAC bus through the 26-Vac bus XMFRS No. 1 and No. 2.

2.9.12.7 Oil Temperature Indicators

Four oil temperature indicators, located on the right overhead instrument panel (Refer to FO-16), indicate engine oil temperature. They receive power from the forward load center extension MAIN DC BUS.

2.9.12.8 Oil Cooler Flap Position Indicators

An oil cooler flap position indicator (Refer to FO-16), one for each engine oil system, is located on the right overhead panel. The indicator is marked in percent of flap opening from 0 to 100 percent. The faired position (approximately 25 percent) is also marked. The indicators for engines 1 and 4 receive their power from the 26-Vac instrument bus No. 1, and the indicators for engines 2 and 3 receive power from the 26-Vac instrument bus No. 2.

2.9.12.9 Magnetic Chip Detector Light

Two magnetic chip detector plugs are installed in the engine. One plug is in the power section scavenge pump outlet, and the other is in the scavenge pump outlet of the reduction gear assembly. When an accumulation of metal chips adheres to a detector plug in sufficient quantities to ground the plug electrode, the circuit closes and the chip caution light on the center instrument panel illuminates. The circuit is powered from the signal light circuit breaker on the MEDC bus.

2.9.13 Engine Nacelle Fire Detection and Extinguishing System

The fire protection system consists of two closely associated subsystems, a detection system, and an electrically controlled fire extinguishing system.

2.9.13.1 Nacelle Fire Detection System

The fire detection system (one for each nacelle) incorporates cable-type sensing elements that are routed through the three fire zones (Figure 2-25) of the nacelle. If a sensing element is broken, the fire warning system is still effective up to either side of the break; however, the system will not test. The fire warning system does not identify the zone in which the fire is located. When an engine fire or excessive heat condition is sensed by a detector, the fire warning horns sound and one of the four engine fire warning panels on the glareshield in the flight station illuminates. One fire warning horn is located on the pilot overhead panel and another is located at the main electrical load center in the cabin. The latter horn is inoperative in flight when the nose landing gear is in the up and locked position.

2.9.13.2 Fire Extinguishing System

The aircraft is equipped with two independent, electrically controlled, high-rate-of-discharge fire extinguishing systems, one for each side of the aircraft. No interconnection is provided between the two systems. When activated, a fire extinguishing chemical (bromotrifluoromethane) is discharged simultaneously into all three zones of the engine selected. Two dual-position transfer switches and four fire extinguisher discharge buttons are used to operate the system (Figure 2-25). Each system includes two extinguishing agent container bottles located forward of the firewall in the inboard engine nacelles. Access to the bottles is provided through firewall doors in the forward wheelwell area. Each bottle is equipped with two discharge valves, a charging valve and safety disc, and a pressure temperature gauge. The bottle is filled with 10.5 pounds of bromotrifluoromethane and is charged to approximately 600 psi with nitrogen. (The nitrogen is used as the expelling agent.) Two discharges are available for one engine on one side, or one discharge for each engine on one side, from the two associated bottles. The discharge can be directed into an engine by depressing the discharge button under the emergency shutdown handle. The second charge can be used by moving the appropriate transfer switch, on the glareshield, to the TRANSFER TO ADJACENT ENGINES position and pressing the discharge button again. When the discharge button is depressed, an electrical circuit is completed to explode a cartridge. Expanding gases from the cartridge propel a slug through a frangible disc, allowing the agent to be forced through lines into the nacelle by the nitrogen. To ensure operational reliability, each cartridge is dual-wired and receives power from two independent sources. One source of power is the forward load center extension MAIN DC BUS, and the other is the MEDC bus.

2.9.14 Oil System

2.9.14.1 Oil Supply Tank

One common oil supply tank mounted in the nacelle of each engine supplies the power section and reduction gear oil system. Each tank has a usable oil capacity of 8.65 U.S. gallons and foaming space for 5.7 U.S. gallons. The tank is pressurized to ensure positive oil feed to the system pumps and has an oil level indicator visible at the filler cap.

A flexible inlet tube picks up oil from either the top or the bottom of the tank to prevent oil starvation during negative-g flights (Figure 2-26).

The normal oil temperature range is 60 to 90 °C and is monitored by a temperature sensing bulb located in the oil tank.

2.9.14.2 Oil Tank Shutoff Valve

Each oil tank contains an electric motor operated shutoff valve powered by the MEDC bus. Pulling the emergency shutdown handle closes the oil tank shutoff valve provided the circuit breakers are in; pushing the handle in opens the shutoff valve if the circuit breakers are in. Currently, procedures call for leaving the circuit breakers out during flight to ensure an oil supply to the power section and reduction gearbox in the event a propeller fails to feather. Refer to Oil System Failure (Engine), paragraph 15.9.

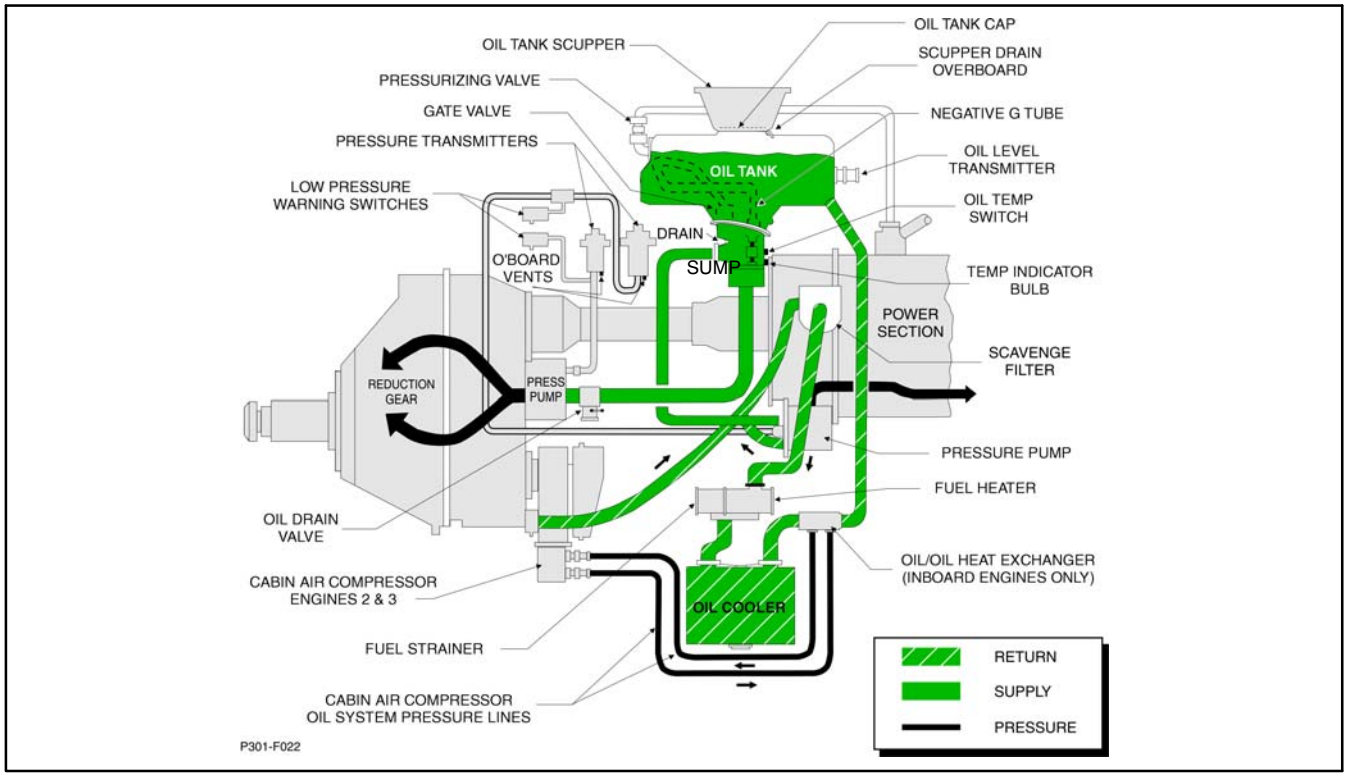


Figure 2-26. Engine Oil System

2.9.14.3 Oil Cooling System

An oil cooler is mounted in the lower cowl panel of each engine. Airflow through the cooler is controlled by a flap at the oil-cooler air exit duct. The flap position is controlled from the flight station. During ground operation, where ram air is not available, an airstream is created in the exit duct by introducing bleed air from the 14th compressor stage of the associated engine into the duct through an air inducer valve and nozzles. The velocity of the air through the nozzles creates a venturi effect inducing airflow through the oil cooler to maintain normal oil temperature. When the flap switch is in the OPEN position, the actuator opens the inducer valve fully (provided the oil-cooler flap is fully open, the power lever is retarded below 32° coordinator, and the start selector switch is off). The inducer valve must be fully closed before the oil-cooler flap will move from the full-open position. When the power lever is above 32° coordinator or during engine starting, the inducer valve remains closed.

2.9.14.4 Power Section Oil System

The power section is lubricated by an independent dry-sump oil system that includes an oil filter, a combination main pressure and scavenge oil pump, an external scavenge pump, and a turbine rear scavenge oil pump. A chip detector is located in the power section scavenge line. Refer to Magnetic Chip Detector Indication, paragraph 15.10. At 100 percent engine rpm, the oil pressure limits are 50 to 60 psi.

2.9.14.5 Reduction Gear Oil System

The reduction gear dry-sump oil system includes a main oil pump, filter, and two scavenge oil pumps. Both scavenge pumps are mounted internally.

Oil from the pressure pump passes through the filter assembly and through cored passages to a pinion oil nozzle, the propeller brake, the planetary gearing, and the main bearings. The nose scavenge pump picks up oil and delivers it to a common outlet with the main scavenge pump. The main pump scavenges the oil, which collects in the bottom of the rear casing, and returns the oil through the common outlet to the aircraft supply tank.

The pressure pump is designed to maintain positive oil pressure at all engine speeds and at all altitudes. The full-flow (unregulated) oil system produces an oil pressure of approximately 180 psi at 83 °C at normal rated speed during static sea level conditions. The oil pressure may vary from 130 to 250 psi from one reduction gear assembly to another and the oil pressure and flow will decrease somewhat with increased altitude. A relief valve limits maximum oil pressure. A chip detector is located in the scavenge line. Refer to Magnetic Chip Detector Indication, paragraph 15.10.

A common filter is located in the return line to scavenge both oil systems prior to returning to the oil tank.

2.10 AIRCRAFT AND ENGINE FUEL SYSTEM

2.10.1 Fuel Supply System

The fuel system consists of five tanks, a fueling system, a transfer system, a crossfeed system, and a dump system (FO-11). The fueling system permits conventional overwing fueling or pressure fueling and defueling under the wing. The transfer system transfers fuel as needed from tank No. 5 to the four wing tanks. The crossfeed system permits any wing tank to supply fuel to any engine. The fuel dump system provides a means for dumping fuel overboard from fuel tank No. 5 when desired. Fuel grades and specifications are shown in Figure 3-2.

2.10.1.1 Fuel Tanks

Four integral wing tanks and an auxiliary tank carry the fuel supply for the engines. The auxiliary tank, identified as tank No. 5, consists of a bladder-type fuselage tank connected to an integral center-section tank. The bladder cell is located in the unpressurized area of the lower fuselage forward of the integral tank.

A fuselage tank fuel bay drain mast/vent is provided on the lower centerline of the aircraft. The mast is hinged to facilitate weapon loading. The mast must be locked in the vertical position for flight.

All tanks are automatically protected against excessive positive and negative pressure during fueling, transfer, and defueling.

2.10.1.2 Fuel Tank Foam

Aircraft incorporating AFC-517 have explosion suppressant foam installed in the four integral wing tanks, integral center section tank, and bladder-type fuselage tank. The fuel cell foam is a fully reticulated fire screen designed to prevent fuel tank explosions caused by tracers or high explosive incendiary rounds, thereby igniting oxygen-rich fuel vapors. The foam adheres to fuel droplets in order to keep the fuel cell cavity too fuel-rich to support combustion.

2.10.1.3 Fuel Boost Pumps

Each wing tank is equipped with a fuel boost pump consisting of a scavenge section and boost section. The scavenge section discharges into a surge box while the boost section pumps fuel from the surge box to the engine-driven pump. In addition, they supply fuel flow for crossfeeding. Normal boost pump pressure is 15 to 30 psi.

The fuel tank boost pumps for engines 1 and 3 receive power from MAIN AC BUS A through individual pump-control relays. The fuel boost pumps for engines 2 and 4 receive power from MAIN AC BUS B through other pump-control relays. Each of the four pump-control relays is energized by the EXTENSION MAIN DC bus through the corresponding boost pump switch. A thermal switch opens the fuel boost pump circuit whenever the pump case temperature becomes excessive.

2.10.1.4 Fueling System

The fueling system allows pressure fueling of any tank to any desired quantity if electrical power is available. Two pressure fueling adapters are located adjacent to each other on the inboard aft section of the starboard wing. Suction at these adapters defuels the aircraft. Pressurized fuel flows to the four wing tanks through the same valves used in the transfer system; however, the two pressure fueling valves for tank No. 5 are not used in the transfer system. A conventional flush-mounted fuel tank filler is provided at the top of each wing tank. Tank No. 5 can be fueled only through the pressure fueling system.

2.10.1.5 Fuel Transfer System

The fuel transfer system controls fuel flow from tank No. 5 to the wing tanks (FO-14). A dual float-operated pilot valve, located at the full-tank level in each tank, closes a transfer valve, thereby shutting off the tank from the fuel transfer manifold. A tank may be shut off from the fuel transfer manifold at any time by closing the corresponding transfer valve switch (either on the fueling control panel or on the fuel management panel in the flight station), which closes the transfer valve. Either of the transfer pumps is capable of pumping fuel from tank No. 5 to the wing tanks, but both are normally used.

2.10.1.5.1 Fuel Transfer Pumps

The bladder cell is equipped with two transfer pumps. Each transfer pump consists of a scavenge section and a boost section. The boost section pumps fuel from the fuselage cell to any or all wing tanks. The scavenge section pumps fuel to the fuselage cell from the bottom of the center section tank. The forward transfer pump receives power from MAIN AC BUS A through a pump-control relay. The aft transfer pump receives power from MAIN AC BUS B through another pump-control relay. Each of the pump-control relays is energized by the EXTENSION MAIN DC BUS through the corresponding transfer pump switch. A thermal switch disconnects a transfer pump whenever the case temperature of the pump becomes excessive.

2.10.1.6 Fuel Crossfeed System

The crossfeed system is composed of the fuel boost pumps, fuel crossfeed valves, and the crossfeed manifold. Pressure for crossfeeding is generated by the fuel boost pumps that are capable of pumping directly to the engines or into the crossfeed manifold but not into another tank. (Check valves within the system prevent tank-to-tank transfer.)

2.10.1.7 Fuel Dump System

A fuel dump system is provided from tank 5, resulting in reduced landing weight should the need arise. Dumping fuel reduces landing weight. The system incorporates a fixed dump chute that extends over the left wing trailing edge. Fuel is dumped through the use of an electrically driven jettison pump installed in the center section tank, adjacent to the tank access panel and the tank No. 5 transfer pumps, which are simultaneously activated to augment jettison flow; therefore, if the fuel transfer valves are shut off during fuel dump, a lower landing gross weight will be effected as a result of fuel burnout from the main tanks. A check valve prevents backflow to the jettison pump during normal fuel transfer. Actuation of a single switch starts the dumping.

2.10.1.7.1 FUEL DUMP Switch

The single, guarded, two-position FUEL DUMP switch, labeled ON and OFF, is located on the pilot overhead lighting control panel. Turning it ON starts the jettison pump and transfer pumps and opens the dump valve, allowing fuel to be dumped overboard. The switch and valve are powered by the MAIN DC BUS through a circuit breaker located on the MAIN DC BUS circuit breaker panel. The three-phase jettison pump is powered through a ganged circuit breaker located on the MAIN AC BUS A panel at the main electrical load center.

2.10.1.8 Fueling Control Panel

The fueling control panel (refueling panel), located between the pressure fuel adapters, is the control center for fueling and defueling (FO-11). Also, the panel enables the pressure fueling valves to be checked before fueling begins. Service lights on the fueling control panel will illuminate whenever the fueling panel service door is opened. These lights are powered by the MAIN DC BUS through the service door switch. On aircraft not incorporating AFC-578, an inclinometer is mounted adjacent to the panel for attitude reference when using the hydrostatic fuel quantity gauge equipment. The controls and indicator lights on the fueling control panel are discussed in the following paragraphs. On aircraft incorporating AFC-578, a dual channel attitude sensor provides an attitude reading to the indicators, which then corrects the fuel quantity calculation for attitude.

2.10.1.8.1 Fueling SYSTEM POWER Switch

The solenoid-held SYSTEM POWER switch is placarded ON and OFF. When the switch is placed in the ON position, a master relay is energized that transfers control of the pressure fueling valves from the fuel management panel to the fueling control panel and prepares a test to determine if the pressure fueling valves will close when the tank is full. Also, with the SYSTEM POWER switch in the ON position, the RESET light on the fuel management panel lights to indicate fueling is in progress. The master relay is energized from the MAIN DC BUS through the SYSTEM POWER switch.

2.10.1.8.2 Fueling SYSTEM CHECK Switch

The three-position SYSTEM CHECK switch is placarded PRIMARY, OFF, and SECONDARY. When the SYSTEM CHECK switch is in the PRIMARY or SECONDARY position, the primary or secondary pilot valve test solenoid, respectively, is energized in each tank. With these solenoids energized and fuel pressure at a pressure fueling adapter, a full-tank condition is simulated. The pilot valve test solenoids are energized by the MAIN DC BUS through the SYSTEM CHECK switch and the SYSTEM POWER switch. The switch also has an OFF (center) position.

2.10.1.8.3 Fuel Valve Control Switches

Four of the six pressure fuel valve control switches are identified by tank number, except that the two center switches control tank No. 5. The two-position switches are placarded OPEN and CLOSED. When the switch is in the OPEN position, a control solenoid is energized, thereby opening the corresponding pressure fuel valve when fuel pressure is applied to the valve. The control solenoid is energized from the MAIN DC BUS through contacts of the energized master relay and the pressure fuel valve switch. When the switch is in the CLOSED position, the fuel valve is closed. The tank valves close automatically when the tank is full.

2.10.1.8.4 Fuel Valve Closed Light

A green indicator light, placarded VALVE CLOSE INDICATION, illuminates when the corresponding pressure fueling valve closes. The lights are energized from the MAIN DC BUS through the service door switch and primary or secondary valve close limit switches.

2.10.1.8.5 INDICATOR LIGHTS TEST Switch

On aircraft not incorporating AFC-578, pressing the INDICATOR LIGHTS TEST switch illuminates the serviceable VALVE CLOSE INDICATION light to discover defective lamps. The indicator lights are energized from the MAIN DC BUS through the service door switch and the INDICATOR LIGHTS TEST switch. On aircraft incorporating AFC-578, the test switch is labeled “TEST.” The test switch, when depressed, performs a Display Test and fault code display on the indicators and a lamp test on the Fuel Valve Closed lights (Figure 2-27).

2.10.1.8.6 Fuel Quantity Gauges

On aircraft not incorporating AFC-578, the gauges for the four wing tanks are marked 0 to 12 X 1,000 pounds, and the tank No. 5 gauge is marked 0 to 18 X 1,000 pounds. The gauges are powered from the MAIN AC BUS A.

On aircraft incorporating AFC-578, digital fuel quantity indicators have been installed. These indicators are repeaters of the main 1 to 5 indicators on the Fuel Management Panel in the flight station, and each is interchangeable with the other repeater tank indicators 1 to 5 by ground maintenance technicians. Each indicator is capable of displaying tank fuel quantity in digital and analog formats, lighting up an ERROR message whenever a malfunction of the Digital Fuel Quantity System (DFQS) system is detected, and providing fault codes and maintenance fault code history. The digital fuel quantity and fault codes are displayed on the indicators in a seven-segment liquid crystal display. When TANK 5 is selected on the Fueling Control Panel, the indicator will display the total fuel quantity of Tank 5. When TOTAL FUEL is selected, the Tank 5 indicator becomes a totalizer and displays the sum of the five main tanks.

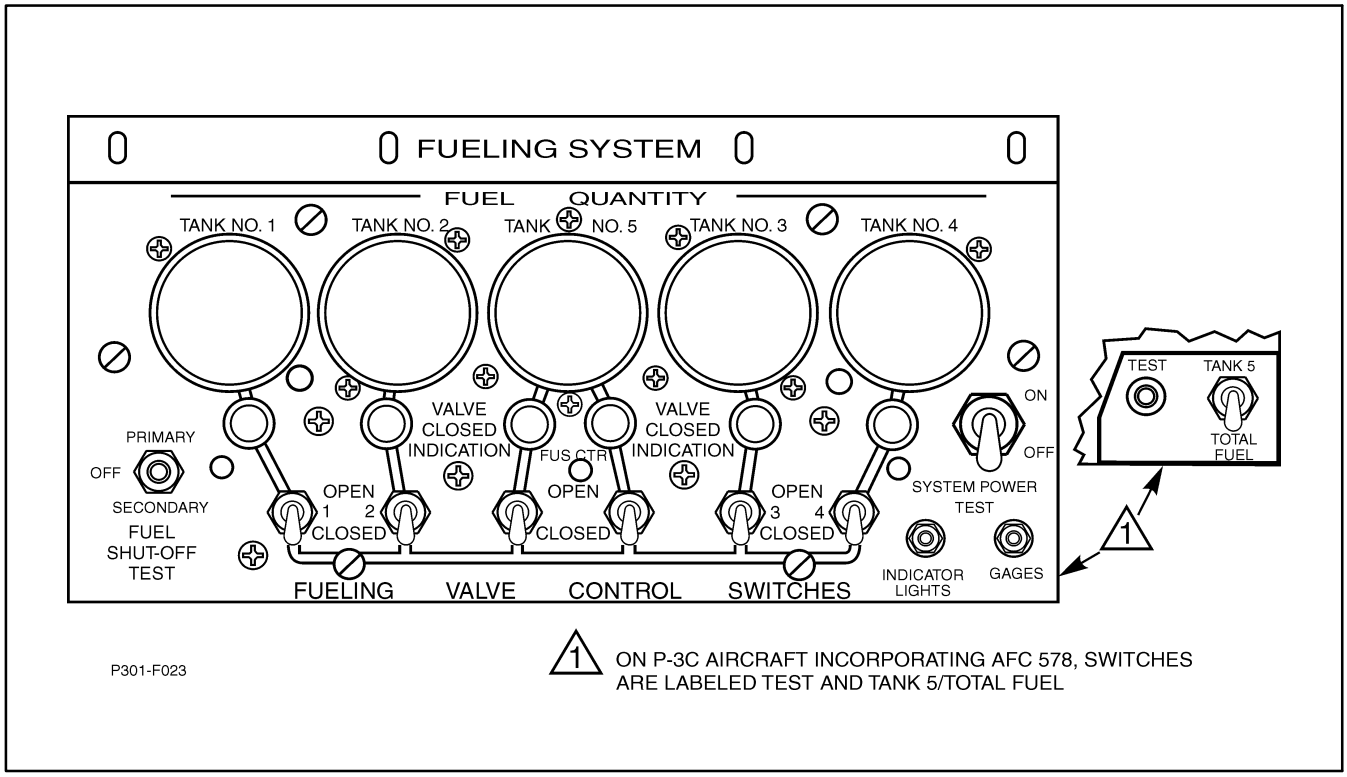


Figure 2-27. Fueling Control Panel

Each of the main Tanks 1 to 4 will display fuel quantity from 0 to 12,000 pounds, Tank 5 displays fuel quantity from 0 to 18,000 pounds, and the totalizer displays fuel quantity from 0 to 66,000 pounds. The analog display consists of segments, each of which represents 5 percent of the total fuel mass of the respective indicator. The digital readout displays tank quantity to 50-pound resolution. The DFQS indicators at the Fueling Control Panel are powered from MAIN AC BUS A.

2.10.1.8.7 Fuel Quantity Gauges Test Switch

On aircraft not incorporating AFC-578, a switch, placarded TEST GAUGE, is provided to determine the usability of the fuel gauges. Pressing the gauge test switch energizes a test relay, which drives the needles of correctly operating gauges toward zero. The test relay is energized from the extension MAIN DC BUS through the FUEL QTY SYS TEST circuit breaker.

On aircraft incorporating AFC-578, a switch placarded TEST is provided. When depressed, this switch commands the system to execute a Display Test and fault codes display. Built-In Test (BIT) of the DFQS for fault isolation of individual indicators, fuel probes, and harnesses is initiated at startup and periodically throughout power on operation. At the completion of the Display Test, the fuel quantity indicator will return to normal configuration, unless a malfunction is noted, in which case the error message will illuminate.

2.10.1.8.8 Built-In Test (BIT) Functions (Aircraft Incorporating AFC-578)

On aircraft incorporating AFC-578, a Built-In Test function has been added to run internal diagnostic test of fuel indicators, fuel probes, and wire harnesses. These tests are initiated upon: 1) initial startup when power is applied to the aircraft, and 2) periodic BIT, which is automatically performed approximately every 4 minutes. When the test switch is depressed on either the Fuel Management or Fueling Control Panels, the system executes Display Test and fault codes display.

When a commanded test is performed, all display segments will illuminate while the test switch is depressed; after a short delay, the display segments will then turn off and the indicator tank ID will display on the digital liquid crystal

display. The flight station indicator IDs with Explosive Suppressant Foam (ESF) installed in the fuel tanks will display “id1F, 2F, 3F, 4F, or 5F” for the main tanks. The totalizer will display an ID of “id6.” Tank 1 and 4 flight station indicators will then perform an in-flight/ground discreet test and display “Air” or “Gnd” on the display. Following this, all current fault codes will illuminate for approximately 4 seconds each; at the completion of this segment, the fuel indicator should return to normal configuration. If the test switch is depressed a second time during All Segment Off condition, the BIT system will enter the “history” mode, and all stored fault codes will illuminate for approximately 4 seconds each. If a Display Test is performed at the Fueling Control Panel, the same sequence will apply and the repeater IDs will display “id1r, 2r, 3r, 4r, or 5r” for the main tanks. When TOTAL FUEL is selected on the Tank 5 repeater, it will display tank “id6.”

During normal operation, if a fault is detected by BIT, a lighted ERROR message will illuminate in the upper portion of the indicator. In most cases the ERROR light will flash, and a Display Test should be performed to return the indicator to normal configuration. The ERROR legend will not flash after a Display Test has been performed, but may remain on and steady. The DFQS provides the capability to assess the functional performance and to identify failed units in order to determine operational readiness. Refer to Figure 2-28 for fault codes.

Fault Code (1)	System Fault Definition	Error Legend (10)			Effect on Quality
		Disp	Flash	Stdy	Display (2)
P1-S	Shorted Fuel Probe #1 (12)	YES	X		Degraded
P2-S	Shorted Fuel Probe #2 (12)	YES	X		Degraded
P3-S	Shorted Fuel Probe #3 (12)	YES	X		Degraded
P4-S	Shorted Fuel Probe #4 (12)	YES	X		Degraded
P5-S	Shorted Fuel Probe #5 (12)	YES	X		Degraded
P6-S	Shorted Fuel Probe #6 (12)	YES	X		Degraded
ACPr	Acft Fuel Prb Writing Multiple Short Faults (3) (12)	YES	X		Degraded
P1-O	Open Fuel Probe #1 (12)	YES	X		Degraded
P2-O	Open Fuel Probe #2 (12)	YES	X		Degraded
P3-O	Open Fuel Probe #3 (12)	YES	X		Degraded
P4-O	Open Fuel Probe #4 (12)	YES	X		Degraded
P5-O	Open Fuel Probe #5 (12)	YES	X		Degraded
P6-O	Open Fuel Probe #6 (12)	YES	X		Degraded
P1-C	Contaminated Fuel Probe #1 (11)	YES	X		Degraded
P2-C	Contaminated Fuel Probe #2 (11)	YES	X		Degraded
P3-C	Contaminated Fuel Probe #3 (11)	YES	X		Degraded
P4-C	Contaminated Fuel Probe #4 (11)	YES	X		Degraded
P5-C	Contaminated Fuel Probe #5 (11)	YES	X		Degraded
P6-C	Contaminated Fuel Probe #6 (11)	YES	X		Degraded
L1-S	Shorted Fuel Prb Lo-Z #1 (12)	YES	X		Degraded
L2-S	Shorted Fuel Lo-Z #2 (12)	YES	X		Degraded
L1-O	Open Fuel Prb Lo-Z #1 (12)	YES	X		Degraded
L2-O	Open Fuel Prb Lo-Z #2 (12)	YES	X		Degraded
H1-F	Shorted/Open Hi-Z #1 (12)	YES	X		Degraded
H2-F	Shorted/Open Hi-Z #2 (12)	YES	X		Degraded
H3-F	Shorted/Open Hi-Z #3 (12)	YES	X		Degraded

Figure 2-28. Built-In Test Fault Codes (Sheet 1 of 3)

Fault Code (1)	System Fault Definition	Error Legend (10)			Effect on Quality
		Disp	Flash	Stdy	Display (2)
LOCP	Flt Sta Ind. Has Repeater Main 1 to 5 ID Jumper Set (4)	YES	X		"—"
LOCr	Rptr Ind has FS Main 1–5 ID Jumper Set (5)	YES	X		"—"
ASP	Att. Sensor-Pitch Input – Self-Test Fail (6) – Range Check Fail – No Self-Test Performed	YES		X	None
ASr	Att. Sensor-Roll Input (12) – Self-Test Fail – Range Check Fail – No Self-Test Performed	YES		X	None
ind1	Indictr A1 Brd Fault (12) – Processor Failure – ROM Failure – RAM Failure – Watchdog Timer Failure – Internal Control Bus	YES or None (fault Dpnd)	X		"—" or Blank
ind2	Indictr A2 Brd Fault (12) – Intml Serial Bus 3 Fail – A/D Converter (8)	YES	X		00 or "—"
ind2	– Lo-Z Driver 1 or 2 (12) – Signal Conditioner 1–4	YES	X		00 or Degraded
ind3	Indictr A3 Brd Fault (12) – Analog Power Supply – LCD Heater Regulator	YES	X		00 or Blank
ind3	– Analog Power Supply (12) – LCD Heater Regulator	YES		X	None
ind4	Indicator Display Fault (12) (Fuel Quantity Xmtd to Repeater & Totalizer)	YES or None	N/A	X	Blank
FLE	Non-Volatile Memory Fault (12)	YES		X	None
id-A	ID-A Fault (12)	YES	X		"—"
id-B	ID-B Fault (12)	YES	X		"—"
id-C	ID-C Fault (12)	YES	X		"—"
id-D	ID-D Fault (12)	YES	X		"—"
id-F	FOAM ID Fault	YES	X		Degraded
id-?	Invalid ID Jumper Set (12)	YES	X		"—"
ACA	No Air/Gnd Discrete (9)	YES	X		None or Deg
ACS	Aircraft Test Switch Continually ON	YES		X	None
Sd	No Serial Data Input (12)	YES	X		Ind. — None Total "—" Reptr "—"
dL	Serial Input Missing Data (12)	YES	X		Ind. — None Total-Dgrd Reptr "—"
Pri	Primary Gauge Fault (check Flight Station Tank Indicator)	YES	X		00 or Degraded

Figure 2-28. Built-In Test Fault Codes (Sheet 2 of 3)

Fault Code (1)	System Fault Definition	Error Legend (10)			Effect on Quality
		Disp	Flash	Stdy	Display (2)
P-?	Primary and Redundant Pitch Data Disagrees by 2.0° or Both Pitch Sensors Fault (7)	YES	X		Degraded
r-?	Primary and Redundant Roll Data Disagree by 2.0° or Both Pitch Sensors Fault (7)	YES	X		Degraded

NOTES:

1. Fault codes will be displayed on the four-digit, seven-segment display of the indicator LCD after display test.
2. When the fuel quantity displayed is defined as degraded, the indicator is calculating fuel quantity based upon all remaining valid fuel probe signals. The fuel quantity associated with a failed or unreadable fuel probe will input zero.
3. This fault signifies multiple shorts of Lo-Z and/or Hi-Z fuel probe wires to ground or each other.
4. This fault code is active if a Flight Station Indicator has been placed in a Repeater Indicator position or if one of the flight station positions has an improper ID set in the aircraft wiring.
5. This fault code is active if a Repeater Indicator has been placed in a Main Tank Flight Station Indicator position on the aircraft or if one of the flight station positions has an improper ID set in the aircraft wiring.
6. This fault code applies only to Tanks 1 through 4 indicators. Fuel quantity continues to display these fault codes. Tanks 1 through 4 use the attitude information on the bus as read by the preceding indicator to correct fuel quantity.
7. This fault code applies only to Tanks 1 through 4 indicators. No attitude correction for the respective axis is applied to the fuel quantity displayed when this fault is present.
8. A/D is not applicable to the repeater and totalizer.
9. This fault applies only to Tanks 1 and 4.
10. If the ERROR light is initially flashing, the fuel quantity calculation is degraded for that indicator. If the ERROR light is steady (stdy), there is no degrade to the indicator and the fuel quantity indicated is valid.
11. Multiple contaminated probes or multiple probes in different tanks, discontinue crossfeed, monitor engine operation, land as soon as practicable.
12. Discontinue crossfeed; initiate a fuel log.

Figure 2-28. Built-In Test Fault Codes (Sheet 3 of 3)

2.10.1.9 Fuel Tank Vent System

The tanks are vented by float-type vent valves, located one in each wing tank and one in each cell of tank No. 5, that prevent overpressurization and overflow or siphoning during maneuvering. Each valve assembly contains a float-operated poppet, dual pressure relief valves, and suction relief valve. In addition, tank Nos. 1 and 4 contain a float-operated relief valve that prevents excessive tank pressure should a dual failure occur in the fuel shutoff valves. Tank Nos. 2 and 3 also incorporate a recirculation valve that vents excess fuel pressure to tank No. 5.

Vents for the valves are located inboard of the wingtips and are flush static-types with flame arrestors. A flush mounted ram airscoop, located just forward of the trailing edge of the port wing, permits air to enter the tank No. 5 vent system and pressurize the fuselage cell. A check valve is located in this line to prevent tank venting through the ram airscoop.

A fuel monitoring and overpressurization indicating system for tank No. 5 (Figure 2-29) consists of a black pointer. The area behind the pointer is divided between a green and red area. The green area covers the movement of the pointer between 0 and 7.0 psi (safe). Above 7.0 psi, the pointer will be in the red area (overpressurized) and will latch at the highest pressure sensed.

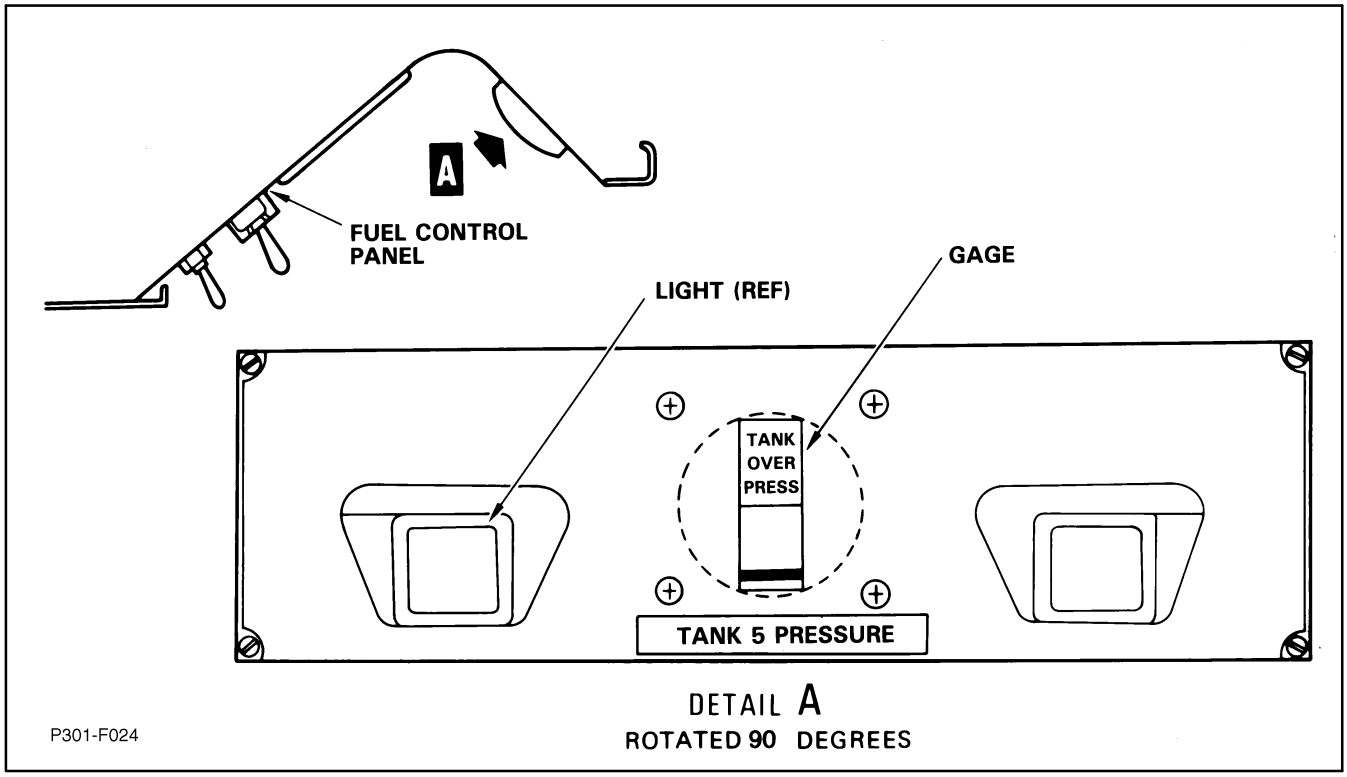


Figure 2-29. Air Vent Pressure Gauge

WARNING

If, during the pressure fueling cycle, the black pointer contacts the overpressure indication line on the tank No. 5 pressure gauge, fueling must be halted immediately and a visual inspection of tank No. 5 (center and fuselage section) shall be accomplished prior to any flight.

2.10.1.10 Fuel Management Panel

The fuel system is controlled from the fuel management panel whenever the SYSTEM POWER switch on the fueling control panel is in the OFF position (FO-11). The fuel management panel is laid out in the form of the fuel system schematic diagram. On aircraft incorporating AFC-578 on the fuel management panel, the indicators have been tilted for better visibility during low light and sun glare conditions, main tank valve switches have a guarded cover to preclude inadvertent changing of the switches during normal operation of the panel, and rheostated switches have been added at the bottom of the panel for post and indicator lighting adjustments. The panel, located on the center control stand, contains the following controls and indicators.

2.10.1.10.1 Fuel Transfer Valve Switches

There are four fuel transfer valve switches, one for each main tank. The switch positions are OPEN and CLOSED. Placing a transfer valve switch in the OPEN position energizes the corresponding control solenoid, which opens the transfer valve (if fuel pressure is available) and prepares the corresponding tank to accept fuel from tank No. 5. The control solenoid is energized by power from the MAIN DC BUS through contacts of the deenergized master relay and the transfer valve switch.

2.10.1.10.2 Fuel Boost Pump Switches

There are four boost pump switches, one for each main tank. The switch positions are ON and OFF. Placing a boost pump switch in the ON position energizes a boost pump relay, which starts the corresponding boost pump. The boost pump relays are energized by power from the extension MAIN DC BUS through the boost pump switches.

2.10.1.10.3 Fuel Boost Pump Low-Pressure Lights

Boost pump low-pressure lights indicate BOOST whenever the output pressure of the corresponding boost pump drops below a safe value. Two additional indicators are located at the bottom of the panel. These indicators serve the same function for the tank No. 5 transfer pumps. They are green and are energized from the MEDC bus through a light-dimming circuit and the pressure switches.

2.10.1.10.4 Main Fuel Tank Valve Switches

Four switches, placarded MAIN TANK VALVE, are provided to control each main tank valve. The switch positions are OPEN and CLOSED. Placing a switch in the CLOSED position closes a main tank valve and shuts off the corresponding tank fuel supply from the engine and the crossfeed manifold. The valve motor is energized from the MEAC bus, receiving power through the MAIN TANK VALVE switch and a limit switch on the motor.

2.10.1.10.5 Main Fuel Tank Valve Open Lights

Four lights that read TANK are associated with each MAIN TANK VALVE. They light green whenever the corresponding main tank valve position does not coincide with the MAIN TANK VALVE switch position. Failure of a tank valve to open or close completely causes the associated light to remain on. They are energized from the MEDC bus and receive power through a light-dimming circuit, MAIN TANK VALVE switches, and limit switches.

2.10.1.10.6 Fuel Crossfeed Valve Switches

Five switches, one labeled CROSSFEED and four labeled CROSSFEED VALVE, control the crossfeed valves. The switch labeled CROSSFEED controls the valve in the crossfeed line between the port and starboard wing tanks. The switch positions are OPEN and CLOSED. Operating a switch to a placarded position causes the corresponding crossfeed valve to open or close. The motors that operate the crossfeed valves are energized from the MEAC bus and receive power through the CROSSFEED VALVE switches and the limit switches on the motors.

2.10.1.10.7 Fuel Crossfeed Valve Lights

The crossfeed valve signal indicators are placarded XFEED and illuminate green whenever the corresponding valve position does not coincide with the CROSSFEED VALVE switch position. Failure of a crossfeed valve to open or close completely causes the associated indicator to remain on. The indicators are energized from the MEDC bus, receiving power through a light-dimming circuit, the CROSSFEED VALVE switches, and the limit switch.

2.10.1.10.8 Fuel Low Pressure Lights

Four indicators, one for each engine and placarded PRESS LOW, are provided to warn of a low differential pressure across the corresponding engine-driven boost pump. The indicators light yellow. Before starting, the light will be on but should go out during the start and remain out during all normal engine operations. The indicators are powered from the MEDC bus through a light-dimming circuit and a pressure switch.

2.10.1.10.9 Fuel Filter Bypass Lights

Four indicators, one for each engine, are placarded FILTER and, when illuminated, indicate that fuel is bypassing the low pressure filters. The indicators are powered from the MEDC bus through a light-dimming circuit and pressure switch.

2.10.1.10.10 Fuel Transfer Control Reset Light

An indicator in the center of the panel, placarded RESET, illuminates green whenever the refuel control panel has control of the pressure fueling valves and the fuel management panel does not. The indicator receives power from the MEDC bus through a light-dimming circuit and the contacts of the energized master relay.

2.10.1.10.11 Fuel Transfer Control Switch

A spring-loaded pushbutton on the panel, placarded FUEL TRANSFER CONTROL, is provided to ensure the fuel management panel has control of the pressure fueling valves. When the pushbutton is depressed, the holding coil of the master relay is deenergized, which returns control of the pressure fueling valves to the fuel management panel, extinguishing the RESET light. The holding coil is energized from the MAIN DC BUS through the SYSTEM POWER switch (on the fueling panel) and the FUEL TRANSFER CONTROL switch.

2.10.1.10.12 Fuel Crossfeed Pressure Gauge

A fuel crossfeed pressure gauge, calibrated 0 to 50 psi, is provided to indicate pressure in the fuel crossfeed manifold. This permits checking the crossfeed system for correct operation and is the only way of checking boost pump pressure. The gauge receives power from the 26-Vac instrument transformer #2. Because of thermal expansion, the gauge may indicate up to 50 psi with valves closed. Excessive pressure in the manifold relieves into tank No. 5.

2.10.1.10.13 Total Fuel Quantity Gauge

A gauge, indicating total fuel in pounds, is located in the center of the panel. This gauge receives power from the MEAC bus. On aircraft incorporating AFC-578, the totalizer indicator located on the Fuel Management Panel will display fuel quantity from 0 to 66,000 pounds and is interchangeable with the main fuel tank indicators 1 to 5 (by maintenance technicians). This indicator is equipped with BIT for the indicator and associated segment of the fuel system (Figure 2-30).

2.10.1.10.14 Fuel Tank Quantity Gauges

Five fuel quantity gauges indicate fuel quantity in the separate tanks. On aircraft not incorporating AFC-578, the gauges for the four wing tanks are marked 0 to 12,000 pounds, and the tank No. 5 gauge is marked 0 to 18,000 pounds. They are powered by the MEAC bus.

On aircraft incorporating AFC-578, digital fuel quantity indicators have been installed on the Fuel Management Panel. Each is interchangeable with the other main fuel tank indicators 1 to 5 and the fuel totalizer indicator by maintenance technicians. All quantity indicator positions must be installed for proper system operation. All indicators are capable of displaying tank fuel quantity in digital and analog formats, light up an ERROR message whenever a malfunction of the DFQS is detected, and provide BIT fault codes and maintenance fault code history. The digital fuel quantity and fault codes are displayed on the indicators in a seven-segmented liquid crystal display (Figure 2-30).

Each of the main tank indicators 1 to 4 will display fuel quantity from 0 to 12,000 pounds, Tank 5's indicator displays fuel quantity from 0 to 18,000 pounds, and the totalizer displays fuel quantity from 0 to 66,000 pounds. The analog display consists of segments, each of which represents 5 percent of the total fuel mass of the respective indicator. The digital readout displays tank quantity to 50-pound resolution. The DFQS indicators at the Fuel Management Panel are powered from the MEAC bus.

2.10.1.10.15 Fuel Quantity Gauge Test Switch

A spring-loaded pushbutton switch, placarded FUEL GAUGE TEST, is provided to test correct operation of the gauges on the panel. On aircraft not incorporating AFC-578, pressing the switch causes a test relay to be energized that drives the pointers of properly operating gauges toward zero. The test relay is energized from the extension MAIN DC BUS receiving power through the GAUGE TEST switch.

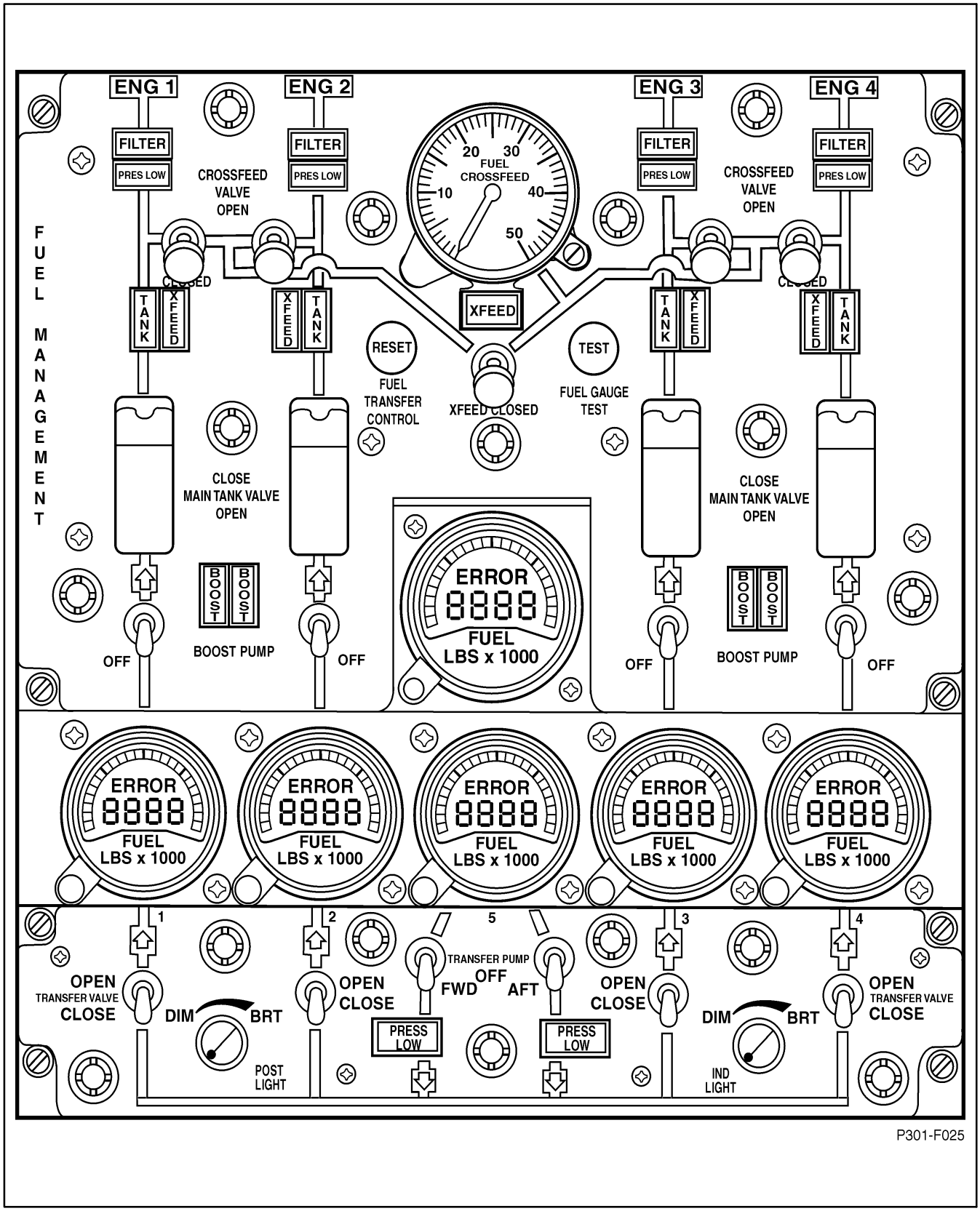


Figure 2-30. Fuel Management Panel

On aircraft incorporating AFC-578, the "FUEL GAUGE TEST" switch, when depressed, commands a Display Test and fault codes display for fault isolation of individual indicators, fuel probes, and harnesses. At the completion of the Display Test, the fuel quantity indicator will return to normal configuration, unless a malfunction was present prior to the Test, in which case the error message will again illuminate.

2.10.1.10.16 Dual Channel Attitude Sensor Unit (Aircraft Incorporating AFC-578)

On aircraft incorporating AFC-578, a Dual Channel Attitude Sensor is used to provide improved fuel gauging accuracy over the required attitude spectrum. It provides both pitch and roll information to the flight station fuel indicators. The Attitude Sensor contains two identical, electrically isolated pitch and roll sensors used individually by Main Tank indicators 1 to 4. Tank quantity indicator corrects fuel quantity information for attitude. This corrected fuel quantity is then transmitted to the totalizer and repeater indicators. The Dual Channel Attitude Sensor Unit is located in the bottom of electronics rack C1/C2 and is powered by 15 Vdc from the fuel indicator units. The No. 1 primary indicator powers channel A and the No. 2 primary indicator powers channel B of the Attitude Sensor.

2.10.1.10.17 Aircraft Air/Ground Relay (Aircraft Incorporating AFC-578)

On aircraft incorporating AFC-578, tanks 1 and 4 flight station indicators receive a discrete input through the Air/Ground Relay from the scissor switches on the main landing gear. This provides the indicators with ground or flight information that is used in conjunction with Dual Channel Attitude Sensor to correct for attitude errors in the fuel quantity system. The Air/Ground Relay is activated by a guarded switch labeled DFQS SCISSOR CKT TEST located on the MONITORABLE ESSENTIAL AC BUS circuit breaker panel. When the aircraft is on the ground and the switch is placed in the test mode (bypassing the scissor switch), simulated flight information data are provided to the indicators, which are used in conjunction with data from the Dual Channel Attitude Sensor to correct for in-flight attitude errors in the fuel quantity system. In this configuration, a Display Test at the Fuel Management Panel will show indicators 1 and 4 in the "AIR" mode.

Note

The Aircraft Air/Ground switch shall remain in the NORMAL (guarded) position for all in-flight operations.

2.10.1.11 Fuel Quantity Dipstick

The aircraft is equipped with a dipstick, normally located in the galley/rest area. It is designed to be used as a manual means of determining the amount of fuel in tank Nos. 1 through 4. The dipstick is marked in gallons. Instructions for use are on the dipstick.

2.10.1.12 Tank 5 Sight Gauge

The tank No. 5 sight gauge (Figure 2-31) is located in the center-section cell and is accessible via a hinged panel in the underside of the fuselage. The fuel level is obtained by viewing an image in a prism at the base of the sight gauge. When the sight gauge is lowered, the image in the prism changes from bull's-eye to lines converging to lines converged (dark). When the image is dark, the top of the sight gauge is at the fuel level, and the amount of fuel may be read off the calibrated scale. There are two scales on the sight gauge, one from 700 to 2,000 pounds, and one from 4,300 to 17,200 pounds. If the reading is between 700 pounds (lowest reading on sight gauge) and 2,000 pounds, only the center-section cell is being measured as the fuel level is below that of the interconnect line.

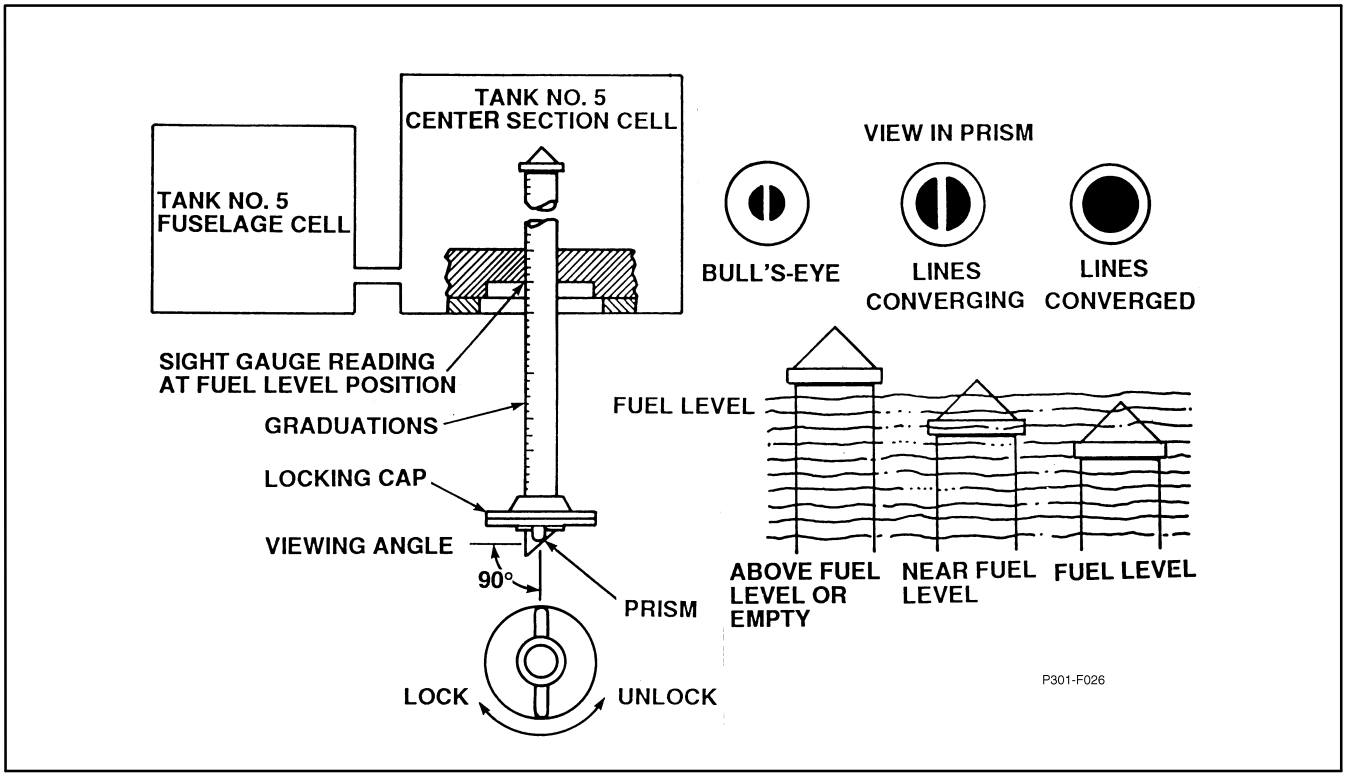


Figure 2-31. Tank No. 5 Sight Gauge

2.10.1.13 Hydrostatic Fuel Quantity Gauge and Water Drain Fixture

The hydrostatic fuel gauge (Figure 2-32) is stowed in a case normally located on the inboard side of the port wheelwell. The gauge is used to drain water from the fuel tank sumps and as a go/no-go device to check for gross malfunctions of the wing tank fuel quantity indicating system. The gauge dial is calibrated in pounds for fuel in the specific gravity range of JP-5, although it may be used with JP-4 and JP-8 fuel. Accuracy of the fuel readings is affected by level of the aircraft, with roll having a greater effect than pitch. The quantity gauge calibration is based on the aircraft being in a nominal position of 0° roll and 1° nosedown pitch. An inclinometer, oriented to indicate roll attitude, is located at the underwing fueling station. (Refer to NAVAIR 01-75PAA-2-4 for gauge operating instructions.)

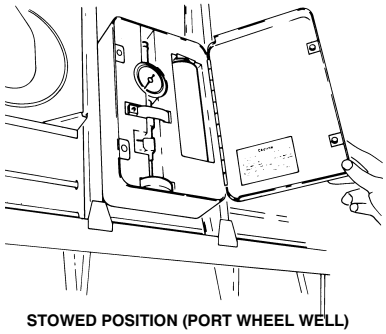
2.10.2 Engine Fuel System

The principal components of the engine fuel system are: a fuel heater/strainer, an engine-driven boost pump with a differential pressure switch, two low-pressure paper cartridge-type fuel filters, a dual-element fuel pump, a high-pressure fuel filter assembly, a hydromechanical fuel control, a fuel enrichment system, a temperature datum valve, a fuel manifold and six fuel nozzles, a manifold drain valve solenoid, and combustion chamber drain valves.

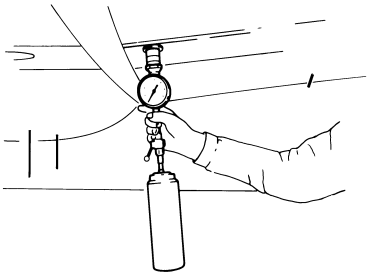
Fuel from the aircraft supply tank enters the fuel heater/strainer, then enters the engine-driven boost pump. The fuel then travels through the low-pressure filters, the primary and secondary engine-driven pumps, and through the high-pressure fuel filter to the fuel control. The fuel passes from the fuel control through the temperature datum valve, which bypasses the amount of fuel necessary to maintain a desired TIT. From the temperature datum valve, fuel passes to the fuel manifold, which distributes the fuel to six fuel nozzles. Refer to Figure 2-33.

2.10.2.1 Fuel Heater/Strainer

The fuel heater/strainer receives incoming fuel from the wing tanks. The heater uses heat from engine oil to maintain fuel temperature to remove water droplets and ice crystals from the fuel. The fuel then passes through a strainer and flows to the engine-driven fuel boost pumps.



STOWED POSITION (PORT WHEEL WELL)



OPERATION (UNDER WING)

P301-F027

Figure 2-32. Hydrostatic Fuel Quantity Gauge

2.10.2.2 Engine-Driven Fuel Boost Pump

The engine-driven fuel boost pump is an impeller-type boost pump. The pump has sufficient suction to draw fuel from the wing tank to supply the engine if the tank boost pump fails. The engine-driven boost pump inlet and discharge pressures are sensed by a differential pressure switch that, if differential pressure drops below a preset value, closes and energizes the PRESS LOW light on the fuel management panel. This indicates fuel is being bypassed around the engine-driven boost pump and low-pressure filters.

2.10.2.3 Low-Pressure Filters

Fuel passes through the low-pressure fuel filters prior to entering the secondary element of the engine-driven fuel pump. There is a differential pressure switch connected across the inlet and outlet of the filters. If pressure differential exceeds a preset value, the switch closes and energizes the FILTER light on the fuel management panel. This indicates fuel to one or both low-pressure filters is being bypassed.

2.10.2.4 Engine Fuel Pump

The engine fuel pump consists of a primary and secondary element. The capacity of the primary element is 10 percent greater than that of the secondary element. If the primary element should fail, the secondary element will provide sufficient flow to operate the engine. During engine starts, the elements operate in parallel to provide sufficient flow at low rpm; at other times they operate in series. Parallel operation occurs during starting when engine speed is between 16 and 65 percent rpm. If both elements are operating properly, the paralleling light will be on between 16 and 65 percent rpm. If the secondary element has failed, the light will not illuminate during start; and, if the primary element has failed, the light will be on above 65 percent rpm.

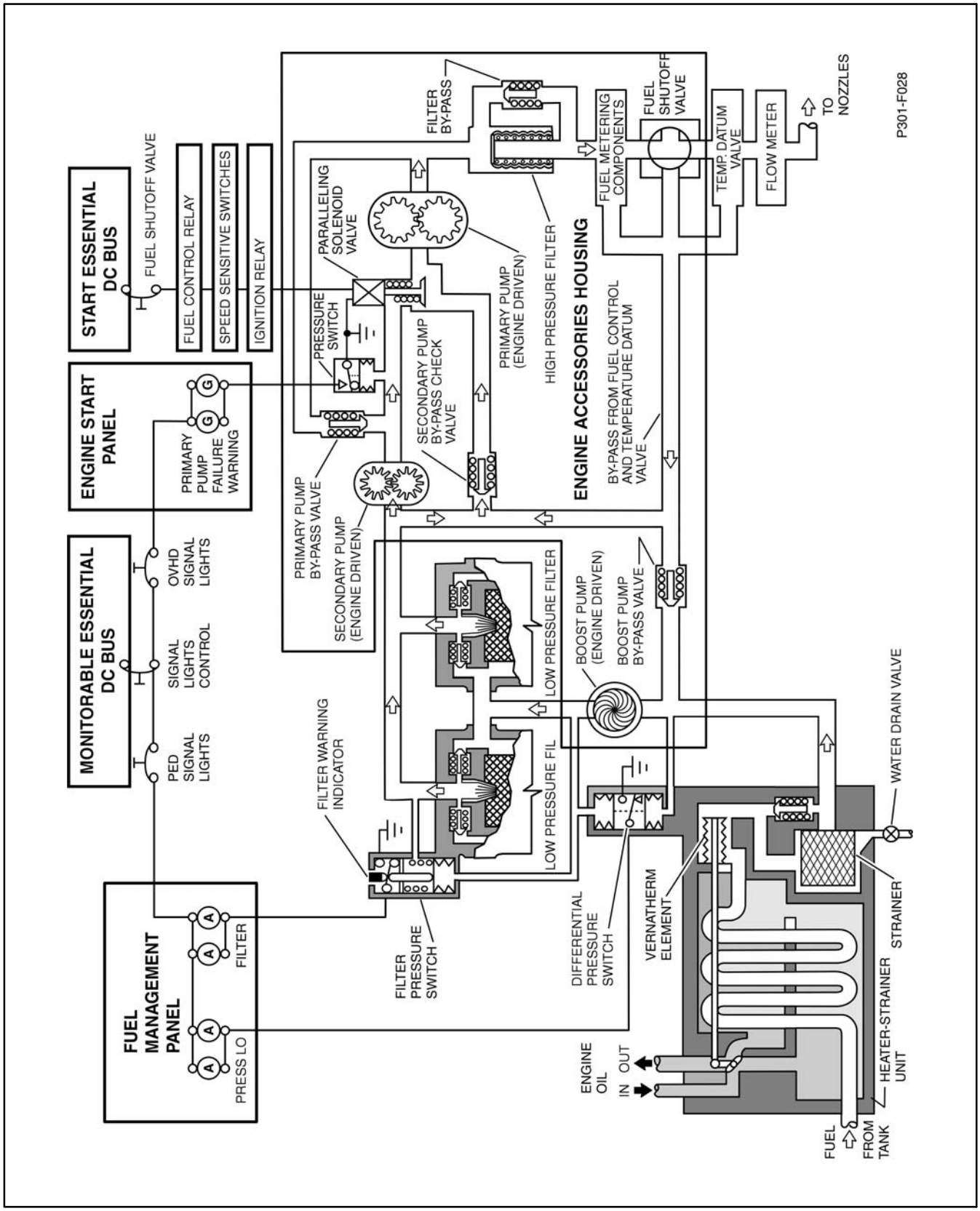


Figure 2-33. Nacelle-Mounted Fuel Pumping/Filtration

2.10.2.5 High-Pressure Fuel Filter

After passing through the primary fuel pump or primary fuel pump bypass, fuel enters the high-pressure fuel filter. This filter incorporates a bypass that allows fuel to flow directly to the fuel control if the filter clogs. Figure 2-33 shows fuel pumping and filtration flow.

2.10.2.6 Fuel Control

The fuel control is mounted on the accessories drive housing and is mechanically linked to the coordinator. The fuel control performs the following functions:

1. Varies fuel flow to coordinate power with propeller blade angle and engine speed.
2. Compensates for changes in air density caused by variations in compressor inlet air temperature and pressure.
3. Regulates rate of fuel metering during acceleration to prevent excessive TIT.
4. Controls the rate of decrease of fuel metering during deceleration to prevent flameout.
5. Controls engine and propeller speed beyond the limit of propeller governor operation, including reverse thrust, low and normal rpm conditions, and engine overspeed.
6. Provides a measure of engine protection during overspeed conditions by reducing fuel flow and TIT.
7. Provides a starting fuel flow schedule that, in conjunction with the temperature datum valve, prevents overtemperature and compressor surge.
8. Provides a means of cutting off fuel flow electrically and mechanically.
9. Adds fuel to maintain engine speed above 97 percent.

The fuel control senses compressor inlet pressure, compressor inlet temperature, and engine speed. Using these three factors and the setting of the power lever, the fuel control meters the proper amount of fuel throughout the range of engine operation. Pressure and temperature compensating systems are designed to maintain constant TIT as the compressor inlet conditions vary.

The fuel control schedules fuel output to the Temperature Datum (TD) valve at 120 percent of engine fuel requirements. Fuel received by the TD valve in excess of the requirement is bypassed back to the fuel pressure pumps inlet. This excess flow to the temperature datum valve gives it the capacity to add as well as subtract fuel to maintain the temperature scheduled by the coordinator and the temperature datum control.

The fuel control includes a cutoff valve for stopping fuel flow to the engine. It can be actuated either manually or electrically. When starting the engine, the fuel shutoff valve remains closed until the engine reaches 16 percent rpm. The speed-sensitive control then opens the cutoff valve, permitting fuel to flow to the engine.

2.10.2.7 Starting Fuel Enrichment

The engine primer system provides instantaneous fuel (at 16 percent rpm) for faster engine light-off during cold weather operation. A quicker light-off is accomplished by rapidly filling the fuel manifold, which causes fuel to spray from the nozzles sooner. The primer button operates the fuel enrichment (primer) valve. This extra fuel, along with the normal fuel flow through the fuel control, is directed to the temperature datum valve and then to the fuel manifold and nozzles. The primer button must be pressed until the fuel control cutoff valve opens at 16 percent rpm, or enrichment will not occur. The enrichment (primer) valve closes when fuel manifold pressure is sufficient.

2.10.2.8 Temperature Datum Valve

The TD valve is located between the fuel control and the fuel nozzles. It is a motor-operated bypass valve that responds to signals received from the TD control. Depending on which mode (start limiting, temperature limiting, or temperature controlling), the TD valve will position itself to maintain the desired TIT.

2.10.2.9 Temperature Datum Control

The TD control limits TIT to a maximum safe value. Between 0° and 66° coordinator position, the TD control limits only maximum temperature. Between 66° and 90°, the TD control keeps TIT on the schedule called for by the coordinator potentiometer and the temperature adjustment network. It also controls TIT by compensating for changes in fuel density and other characteristics, manufacturing tolerances in fuel controls, and variations in fuel requirements between engines.

The aircraft-mounted TD control incorporates the electrical circuits necessary for operation of the TD valve. The control is furnished an actual TIT signal from 18 paralleled thermocouples and a desired TIT signal from the potentiometer in the coordinator and the temperature adjustment network. The potentiometer signal varies with power lever position. The temperature adjustment potentiometers are contained in the TD control.

In the start limiting mode with engine speed below 94 percent rpm, the TD system maintains 830 °C TIT as an upper TIT limit and has up to 50 percent “take” capability.

In the temperature limiting mode with engine speed greater than 94 percent rpm and the power lever below 66° coordinator, the TD system maintains 1077 °C as an upper TIT limit and has up to 20 percent take capability.

In the temperature controlling mode with engine speed greater than 94 percent and power lever position greater than 66° coordinator, the TD system maintains a scheduled TIT for a given coordinator position. In this mode, the TD control can take 20 percent or put 15 percent to meet its target TIT.

If an overtemperature condition exists, the overtemperature release circuit is energized, alerting the TD control to signal the TD valve to reduce fuel flow until the temperature falls within limits.

2.10.2.10 Fuel Nozzles

The fuel output from the TD valve flows through the fuel manifold to the six fuel nozzles. Fuel flows through both the primary and secondary nozzle orifices during normal operation and through the primary orifice at low fuel flow rates.

2.10.2.11 Drain Valves

A spring-loaded, solenoid-operated manifold drain valve is located at the bottom of the fuel manifold. It drains the fuel manifold when fuel pressure drops below a preset value, minimizing the amount of fuel entering the combustion liners while the engine is shut down. Two combustion liner drain valves, located at the bottom of the combustion chamber assembly, prevent the accumulation of fuel in the burner section after an unsuccessful start or after shutting down the engine (evidenced by fuel streaming from the gang drain). These valves open during coast down and close during start.

2.11 AIRCRAFT AND ENGINE FOUL WEATHER SYSTEMS

Ice control systems on the P-3 enable the aircraft to perform its mission under various weather conditions and return home safely. Engine bleed air from the 14th stage of the compressor (diffuser assembly) is used to deice the wings and anti-ice the engine airscoop, compressor inlet, and torquemeter shroud assembly. Electrical heating circuits anti-ice and/or deice the propellers, empennage, instrument probes, windshield, and side windows.

The terms anti-icing and deicing are used in describing the various ice control systems. Anti-icing refers to a system that prevents ice formation. Deicing refers to a system that removes ice buildup. Details concerning operation of the ice control systems are found in Chapter 18.

2.11.1 Ice Detector

An ice detector probe mounted on the lower starboard side of the fuselage, just aft of the nose radome, provides an indication in the flight station that structural icing conditions exist. The probe contains a pressure switch that is

actuated by ice formation and completes a circuit that illuminates the ICING light on the flight station vertical annunciator panel. The pressure switch also completes a probe heating circuit that then melts the accumulated ice. When the ice melts, the pressure switch opens, deenergizing the signal light and probe heater circuitry. New ice accumulation repeats the cycle, causing the ICING light to blink on and off. The frequency of icing light flashes is proportional to the severity of icing conditions. Power to the ICING light is through the signal lights circuitry on the MEDC bus. The ice detector probe heater is powered by the MEAC bus.

2.11.2 Angle-of-Attack Heat

A thermostatically controlled probe heater prevents ice formation on the fuselage-mounted AOA probe. Power to the probe heater element is routed from the MEDC bus through a two-position ON/OFF switch located on the flight station overhead panel.

2.11.3 Pitot Heat

Two pitot tubes are mounted symmetrically on either side of the lower fuselage, just aft of the nose radome. Each pitot tube is anti-iced by an integral heating element. The port pitot tube, which provides airspeed information to the pilot airspeed indicator, receives heating power from the FEAC bus. The starboard pitot tube provides airspeed information to the copilot airspeed indicator and is heated by the MEAC bus through the 28-volt forward lighting bus transformer. Both circuits are controlled by a single switch on the flight station overhead panel. Each pitot tube has an individual heater-out caution light that illuminates if power to the heating elements is interrupted while the pitot heat switch is on. The L HTR OUT and R HTR OUT lights are located on the flight station overhead panel. Illumination of either light brings on the master DEICING light on the vertical annunciator panel. The caution lights are powered by the MEDC bus signal lights control circuit.

2.11.4 Engine Ice Control System

The engine anti-ice system uses 14th-stage bleed air to prevent ice formation on the engine airscoop, torquemeter shroud, and compressor inlet assembly. The system is controlled by four switches (one for each engine) labeled ENG AIR SCOOP & INLET VANES. These switches are located on the flight station overhead panel and are powered by the MEDC bus. ANTI-ICING advisory lights located adjacent to the control switches illuminate when the engine airscoops and torquemeter shroud are sufficiently heated to prevent ice formation. The ANTI-ICING lights are also powered by the MEDC bus through the signal lights circuitry. The system is designed so that the valves will fail to open with a loss of MEDC bus control power, ensuring anti-icing protection in the event of electrical system failure.

The engine anti-ice system for each engine is made up of two subsystems: one supplies bleed air to heat the engine airscoop while the other uses bleed air to heat the compressor inlet and torquemeter shroud assembly.

2.11.4.1 Airscoop Subsystem

Fourteenth-stage air is bled from a port on the diffuser and routed to the engine airscoop through a duct that contains a solenoid-operated anti-icing valve and an externally mounted thermal switch. When the valve opens, hot air enters the hollow airscoop lip, flows around its circumference, then passes into a manifold that runs down the starboard side of the airscoop. The manifold distributes air to a series of tapered passages that are built into the upper circumference of the airscoop. System air flows through the passages, heating the upper half of the airscoop, and is exhausted through exit holes in the port side of the airscoop into the nacelle.

2.11.4.2 Compressor Inlet Assembly Subsystem

Hot air to anti-ice the compressor inlet assembly and torquemeter shroud is bled from two 14th-stage ports mounted on the opposite side of the diffuser. A separate duct line incorporates an anti-icing valve. Both valves are controlled by a single solenoid-operated pilot valve that opens the anti-ice valves when the solenoid is deenergized. Hot air enters the compressor inlet housing from both sides and heats the leading edge struts, guide vanes, and the fuel control

temperature probe. Hot air is also ducted forward to the torquemeter shroud, where it enters passages in the upper half of the shroud assembly. A second thermal switch is mounted on the duct line near the shroud and is connected in series with the switch on the airscoop subsystem. The air is exhausted into the compressor inlet. The left and right anti-icing valves are connected by a balance line. If one anti-icing valve fails to open, all areas will still be anti-iced through the balance line interconnect.

2.11.4.3 Operation

Refer to Figure 2-34. Turning on engine anti-icing deenergizes the two solenoid-operated pilot valves. This causes the three pneumatically operated anti-icing valves to open, sending hot air to the engine airscoop, compressor inlet assembly, and torquemeter shroud. It is important to note that the valves open when power is removed, making the system essentially fail-safe. The two thermal switches close when the airscoop and torquemeter shroud are hot enough to prevent ice formation. When both switches are closed, the ANTI-ICING advisory light for that engine illuminates. Illumination of the ANTI-ICING light normally occurs about 90 seconds after the system is turned on.

The engine anti-icing system should be turned on prior to entering areas where structural icing is likely to exist. A SHP drop of about 9 percent occurs when the anti-icing valves open and air is bled from the diffuser. Recovering the drop in horsepower will result in a 5 percent increase in fuel flow.

2.11.5 Propeller Ice Control

Electric heating elements are used to anti-ice and deice the propellers. Continuous heat anti-icing is applied to the front spinners of all four propellers when the system is turned on. The propeller blade cuffs, aft spinner, and islands are cyclically heated (deiced), one propeller at a time, cycling through all four propellers in sequence 1 to 4. The cycle repeats as long as the system is operating and stops on the propeller being deiced when the switch is turned off. A low-voltage test circuit allows continuity checks of the AC circuitry without raising the temperature of the heated components. It also checks the operation of the timer circuit. The system is controlled by a three-position switch labeled ON, OFF, and GRD TEST. An ammeter and rotary selector switch provides a readout of current flow to the heating elements. The control switch, ammeter, and selector switch are located on the flight station overhead panel. Control power for the system is the extension MAIN DC BUS. Power to the heating elements is the MAIN AC BUS B.

2.11.5.1 Front Spinners

All four front spinners are continuously heated when the system is turned on. Bus B power is delivered at 76 to 100 amps in flight (74 to 100 amps during ground test) and achieves sufficient temperature to vaporize moisture, preventing runback.

2.11.5.2 Blade Cuffs, Aft Spinners, and Islands

These components are cyclically deiced (Figure 2-35). Starting with the No. 1 propeller, the blade cuffs receive bus B power for approximately 20 seconds. Then the No. 1 propeller aft spinner and island are powered simultaneously for another 20 seconds. The cycle then moves to the No. 2 propeller and continues in sequence. A complete cycle takes approximately 160 seconds. Bus B power is delivered to the blade cuffs at 51 to 72 amps in flight (48 to 72 amps during ground test) and to the aft spinner and island at 63 to 82 amps in flight (58 to 82 amps during ground test).

2.11.5.3 Propeller Deice Timer Motor

Power sequencing to the cuffs, aft spinner, and island is regulated by a timer motor located in the main load center. The timer motor is powered by the extension MAIN DC BUS.

2.11.5.4 Operation

Use of the propeller ice control system is recommended whenever structural icing is evident. Refer to Chapter 18. Positioning the control switch to ON routes extension main DC power to the PROP DEICE and ANTI-ICE POWER

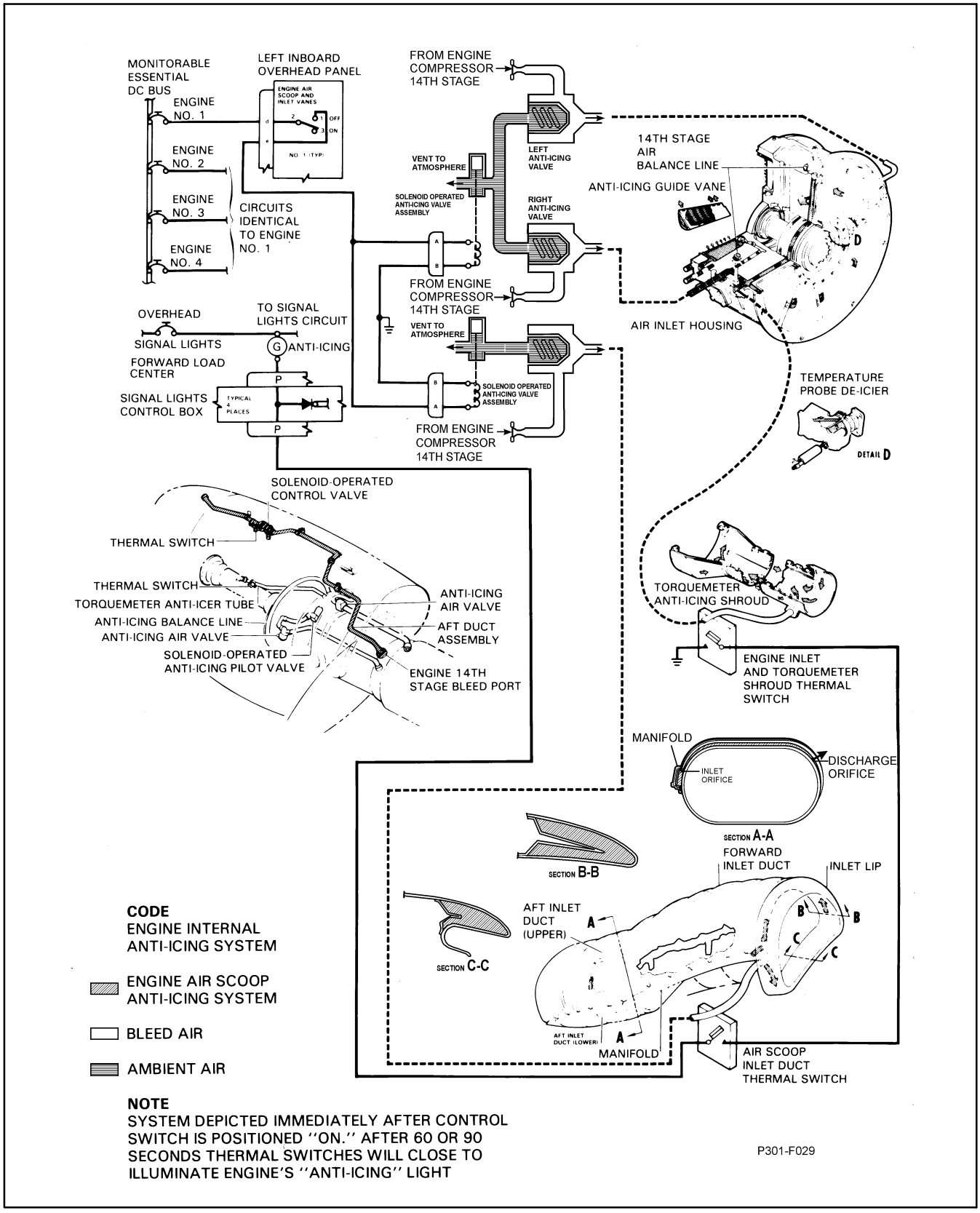


Figure 2-34. Engine Anti-Ice System Schematic

relay and to the propeller deice timer motor. DC control power is routed through contacts on a scissor switch (ground air sensing) relay that prevents system operation on the ground. When the control relay is energized, bus B power flows to the heating elements via propeller slip rings. The timer motor sequentially energizes and deenergizes a series of relays that distribute power to the deicing heating elements in the order shown in Figure 2-35.

The ammeter and its adjacent rotary selector on the propeller and engine ice control panel permit a readout of current flow to the No. 1 and 4 spinners, cuffs and islands, and the No. 2 and 3 spinners. In the 1 & 4 SPIN position, phase A current heating the No. 1 and No. 4 forward spinners is indicated, whereas the 2 & 3 SPIN position indicates phase C current to No. 2 and No. 3 forward spinners. The selector is spring-loaded to the CUFFS AND ISLANDS position where phase B current to the cyclically heated areas is indicated. The ammeter must be monitored for 160 seconds (one complete cycle) to determine proper operation of all eight cycle areas.

A reduced voltage tap on the bus B powered aft lighting bus transformer provides system continuity checks without actually raising the temperature of the heated elements. The GRD TEST position of the control switch bypasses the scissor switch. Operation is determined by observing the ammeter through one complete cycle.

Note

A contact in the control switch arms the automatic load monitoring circuitry when the switch is placed to either ON or GRD TEST. Load monitoring will occur in flight if the propeller ice control system is engaged during single-generator operation.

ALL PROPELLER FRONT SPINNERS		CONTINUALLY ANTI-ICED	FLIGHT	GROUND TEST
			76 — 100 amps	74 — 100 amps
PROPELLER NO. 1	CUFFS		51 — 72 amps	48 — 72 amps
	AFT SPINNER AND ISLANDS		63 — 82 amps	58 — 82 amps
PROPELLER NO. 2	CUFFS		51 — 72 amps	48 — 72 amps
	AFT SPINNER AND ISLANDS		63 — 82 amps	58 — 82 amps
PROPELLER NO. 3	CUFFS		51 — 72 amps	48 — 72 amps
	AFT SPINNER AND ISLANDS		63 — 82 amps	58 — 82 amps
PROPELLER NO. 4	CUFFS		51 — 72 amps	48 — 72 amps
	AFT SPINNER AND ISLANDS		63 — 82 amps	58 — 82 amps
		160 SECONDS		

Figure 2-35. Propeller Deice Cycle Control

2.11.5.5 Malfunctions

Faults in the propeller ice control system are detected by observing the ammeter for correct readings. Abnormal readings in the No. 1 & 4 SPIN or No. 2 & 3 SPIN positions can easily be isolated to the affected propeller by taking readings with the individual PROP SPINNER NOSE circuit breakers out. Since the timer motor does not drive back

to a start position when the system is turned off, isolating a faulty reading in the CUFFS AND ISLANDS position is more difficult. Refer to Chapter 18. On aircraft incorporating the solid state timer motor, placing the control switch to Off resets the deice cycle to the number 1 propeller cuffs. Refer to Chapter 18.

2.11.6 Wing Deice System (Refer to FO-19)

Fourteenth-stage engine bleed air is used to remove ice from the wing leading edges. Engine bleed air passes through a motor-driven bleed air valve to a manifold that runs parallel to the wing leading edge (Figure 2-36). The bleed air then enters one of six ejector assemblies (also called piccolo tubes) that run lengthwise inside each leading edge section. Airflow to each ejector assembly is controlled by a pneumatically operated modulating valve. From the ejector assemblies, bleed air enters a passage formed by the two layers of the wing leading edge skin. A series of jet action nozzles mounted on each ejector assembly causes the bleed air to mix with air from the plenum area as it enters the leading edges. This warm air mixture circulates aft through the leading edge upper and lower passages and is discharged back into the plenum. As plenum air is displaced by incoming air, it is exhausted overboard through louvers in the aft end of the nacelles.

The system is operated by four BLEED AIR VALVE switches, two FUS bleed-air shutoff valve switches, and three LEFT AND RIGHT WING ICE switches that provide symmetrical deicing of the outboard, center, and inboard sections of each wing. A rotating temperature selector switch and temperature gauge provide a readout of skin temperature for each of the six leading edge sections. The temperature gauge is powered by the MEAC bus. Three caution lights are associated with the system: an LE HOT light illuminates if the leading edge skin temperature of any section becomes excessive; L WING HOT or R WING HOT lights indicate excessive temperature in the left or the right wing plenum area. These lights are powered by the MEDC bus signal lights control circuitry and cause the master DEICING caution light to illuminate. Controls and indicators for the wing deice system are located on the flight station overhead panel.

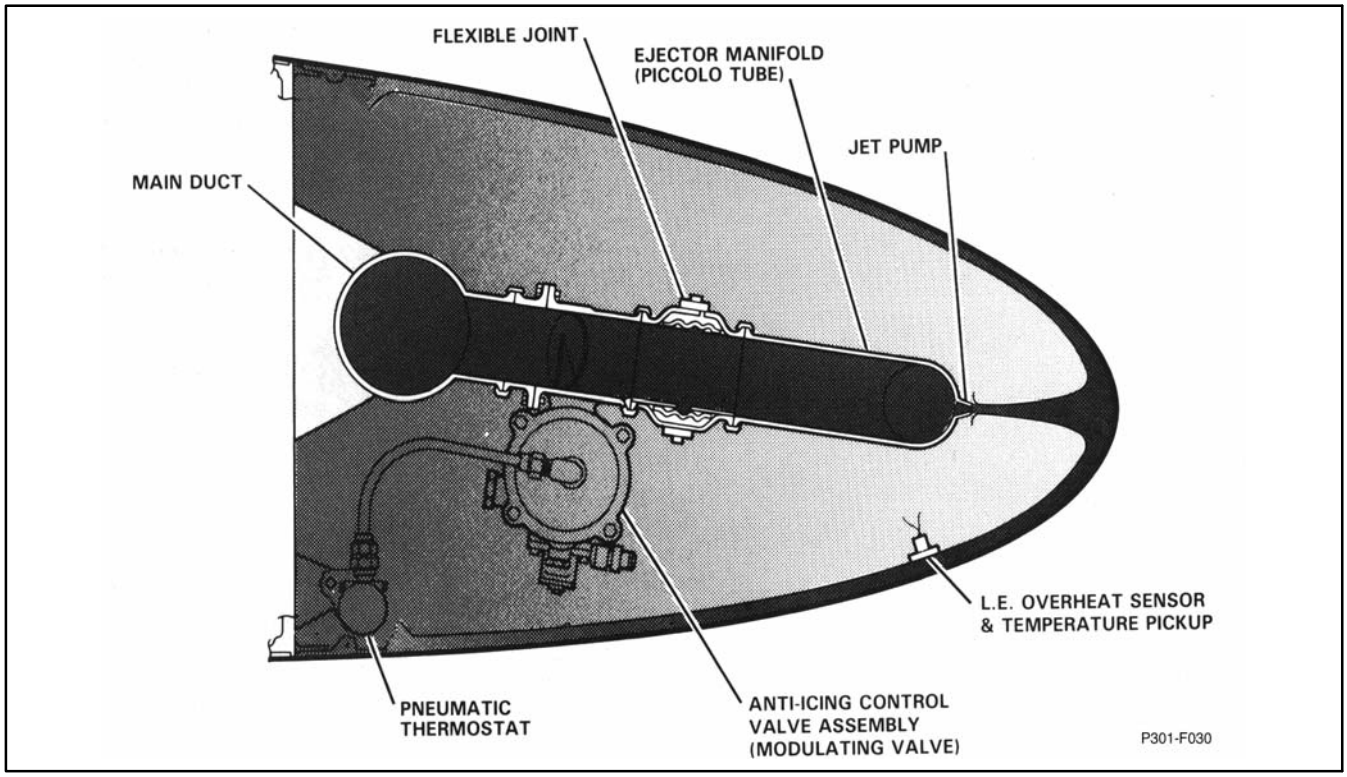


Figure 2-36. Wing Leading Edge Plenum

2.11.6.1 Bleed-Air Manifold

Fourteenth-stage bleed air from any operating engine can be routed to a duct that extends spanwise from outboard of the No. 1 engine to outboard of the No. 4 engine. Air enters the duct from each engine through an SEDC powered bleed-air valve. Airflow through the cross-ship portion of the duct is controlled by two SEDC powered fuselage bleed-air shutoff valves, one at each end of the cross-ship duct. The fuselage shutoff valves are not normally opened in flight. The six valves associated with the bleed-air system are operated by switches on the overhead bleed-air panel. An advisory light adjacent to each switch indicates OPEN when the motor-driven valve begins to open. A bleed-air manifold pressure gauge, located on the bleed-air panel, indicates pressure in the cross-ship duct. The gauge is powered by the MEAC bus from the No. 1 instrument bus.

Note

Normal leakage of the bleed-air valves may result in a buildup of pressure on the BLEED-AIR MANIFOLD pressure gauge even when the valves are closed. A slow pressure buildup is of no concern, regardless of how high the pressure goes. A rapid pressure rise may indicate a serious leak or broken duct.

In addition to wing deice, 14th-stage bleed air routed to the bleed-air manifold is used for bomb bay heat, pneumatic engine starting, and engine oil cooler augmentation.

2.11.6.2 Anti-Icing Modulating Valves

Six pneumatically operated modulating valves control the flow of bleed air from the bleed-air manifold to each of the six ejector assemblies. The valves receive control power from the extension MAIN DC BUS when the flight station switches are actuated. The three flight station switches labeled Outbound (OUTBD), CTR, and Inbound (INBD) each control two valves corresponding to that section, one in each wing. Each valve is also controlled by a pneumatic thermostat mounted in the plenum area that causes the valve to cycle when plenum air temperature reaches a preset value, hence the name modulating valve. It is important to note that although the thermostatic control feature of the valve allows it to be used as an anti-icing valve, it is operated strictly as a deicing valve in the P-3.

2.11.6.3 Ejector Assemblies

Bleed air flows through each modulating valve to an ejector assembly corresponding to that section of the wing. The ejector assembly directs air through a series of nozzles where it is mixed with plenum air and enters the double skin passage of the wing leading edge.

2.11.6.4 Leading-Edge Temperature Sensors

A temperature sensor is installed on the inner skin of each leading-edge section. These sensors provide a signal input to the flight station leading-edge temperature gauge and actuate the LE HOT light if the temperature exceeds 110 °C.

2.11.6.5 Overheat Warning Sensors

Six overheat warning sensors are located along the front spar of the wing and sense excessive temperature in the plenum area. Detection of an overheat condition results in illumination of either the L WING HOT or R WING HOT light on the flight station overhead panel. Three similar sensors are mounted adjacent to the cross-ship and APU ducting in the fuselage. These sensors cause the FUS DUCT HOT light on the vertical annunciator panel to illuminate when excessive temperature is detected in that area of the fuselage.

2.11.6.6 Operation

Use of the wing deice system is recommended when ice on the leading edges builds up to approximately one-half inch. The system should be operated periodically to remove ice rather than continuously. Operation in this manner

prevents possible runback and refreezing of melted ice. When engine anti-ice and wing deice are used in flight, the total fuel flow required to maintain the same horsepower is approximately 500 pph greater. Refer to Chapter 8 for ground checks of the wing deice system and Chapter 18 for specific operating instructions.

2.11.7 Empennage Ice Control System

Portions of the horizontal and vertical stabilizer leading edges are electrically heated in a system that simultaneously anti-ices a series of parting strips while momentary heating power is applied sequentially to deice 20 cycling strips (Figure 2-37). A two-speed timer motor controls the sequencing of power to the cycling strips. A thermal sensor relay automatically turns the system off if an overheat condition is detected. Power sources for the system are as follows:

1. Control power — EXT MDC.
2. Parting strip power — BUS A.
3. Cycling strip power — BUS B.
4. Timer motor power — MEAC.
5. EMP DE-ICE signal light — MEDC.

2.11.7.1 Parting Strips

The anti-icing parting strips are located at the extreme forward section of the stabilizer leading edges (Figure 2-38). During in-flight operation, the parting strips are heated continuously as long as the system is turned on. A ground test mode is available during which the parting strips are energized for only 2 seconds out of the 44-second test cycle.

2.11.7.2 Cycling Strips

The deicing cycling strips are arranged symmetrically just aft of the parting strips. Eight cycling strips are located on each horizontal stabilizer and four on the vertical stabilizer for a total of 20 (Figure 2-38). During normal system operation, each cycling strip is energized for 8 seconds and deenergized for 168 seconds. In the test mode, each cycling strip is energized for 2 seconds and deenergized for 42 seconds.

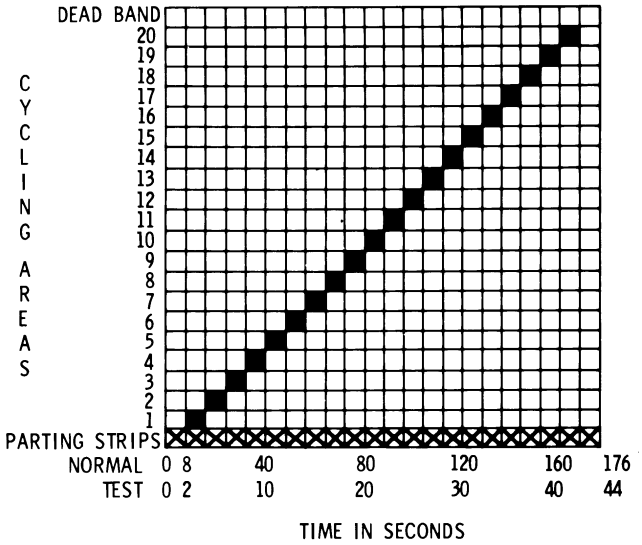
2.11.7.3 Timer Motor

An AC-powered timer motor controls the flow of power to the cycling strips during normal operation and system test. The timer motor operates at two speeds: the low-speed motor energizes each cycling strip for 8 seconds and includes a 16-second dead band for a total cycle of 176 seconds; the high-speed motor energizes each cycling strip for 2 seconds and the parting strips for 2 seconds, and includes a 2-second dead band for a total cycle of 44 seconds. The low-speed motor is used for normal operation whereas the high-speed motor is used for ground and in-flight system test. The high-speed motor also automatically repositions when the system is turned off or the control relay is deenergized. The timer motor is located in the cabin just forward of the aft pressure bulkhead.

2.11.7.4 Thermal Sensor Relay

Two overheat sensors located on the port horizontal stabilizer and a thermal sensor relay located in electronics bay C-3 provide overheat protection and warning. When an overheat condition is sensed, the thermal sensor circuitry deenergizes the system control relay. This removes power from the parting and cycling strips and illuminates the EMP DE-ICE signal light and master DEICING light. An amber light on the sensor relay box also illuminates. When the leading edge cools sufficiently, the control relay is automatically reenergized, but the EMP DE-ICE light will remain on until the control switch is cycled through the OFF position.

Test switches on the thermal sensor relay box simulate an overheat condition. Pressing either test switch during system operation will illuminate the amber overheat light, EMP DE-ICE light, and master DEICING light.



NOTE

DURING GROUND TEST, PARTING STRIPS ARE ENERGIZED FOR THE INITIAL TWO SECONDS ONLY

P301-F031

Figure 2-37. Timer Switching Schedule

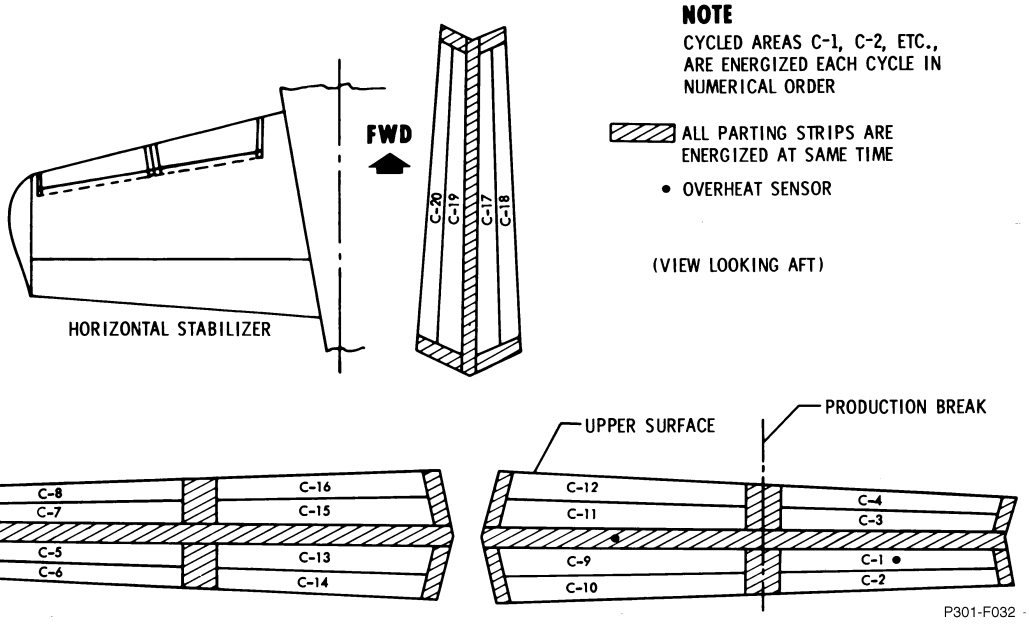


Figure 2-38. Empennage Deicer System Control Areas

2.11.7.5 Controls and Indicators

System controls and indicators are located on the flight station overhead anti-icing panel.

2.11.7.5.1 Empennage Deice Switch

The system is controlled by a three-position switch labeled TEST-OFF-ON. The switch uses power from the extension MAIN DC BUS to control the empennage deice system.

2.11.7.5.2 Empennage Deice Monitor Override Switch

A two-position (NORM-Override [OVRD]) EMP DE-ICE MONITOR switch is located on the electric power control panel. This switch overrides the automatic empennage deice cutout feature of the APU generator monitor system (above 8,000-foot altitude) and allows normal operation of the empennage deicer when necessary during emergency APU single-generator, in-flight operation. The EMPENNAGE ICE switch must be in the ON position for the EMP DEICE MONITOR switch to activate the system. When use of the override function of the empennage deicing system is required, manual monitoring of equivalent electrical loads is mandatory to avoid overloading the APU generator.

2.11.7.5.3 Empennage Deicer Gauge

The empennage deicer gauge measures the balance between the three-phase AC power routed to the parting strips and cycling strips. The gauge has two color areas: white for indications within normal operating tolerance and red/white striped to indicate system faults such as a short circuit or open circuit in one of the AC phases.

2.11.7.5.4 Empennage Deice Signal Light

The EMP DE-ICE signal light illuminates if any of the following malfunctions occur:

1. Parting strip power relay deenergizes.
2. Cycling power relays deenergize.
3. Control relay deenergizes.
4. Control power circuit breaker is opened.
5. Timer motor fails.
6. Empennage overheat conditions occur.

When the EMP DE-ICE signal light illuminates, the master DEICING signal light on the vertical panel illuminates.

2.11.7.5.5 Operation

The empennage ice control system should be turned on in flight when structural icing is evident. Refer to Chapter 18 for specific operating instructions.

When the system is turned on, DC control power energizes the control relay, which routes DC power to energize the parting strip and the cycling strip power relays. AC power is then routed via the energized relays to the parting strips, cycling strips, and timer motor. Proper system operation is verified by observing the deicer gauge and signal lights. Initially the deicer gauge needle shows zero deflection because the cycle starts and stops in the dead band. The next 8-second interval measures three-phase MAIN AC BUS A current to the parting strips. The following 160 seconds, in 8-second intervals, measures three-phase MAIN AC BUS B current to each of the 20 cycled strips in numerical order. When the deice switch is turned off, power is removed from the parting and cycling strips and the high-speed motor drives the timer back to the dead band, where it stops.

Note

- Ground-air-sensing circuitry prevents full system operation on the ground.
- Turning the system on results in automatic load monitoring if only one generator is providing electrical power.

2.11.7.5.6 Test

A test is provided for ground or in-flight checks. Holding the empennage deice control switch in the TEST position for approximately 2 seconds energizes the low-speed timer motor and starts the deicing test. After 2 seconds, the deicer switch may be released; the timer control then shifts to the high-speed motor. The system is checked by monitoring the fault gauge. During ground test, the parting strips are energized for a 2-second dead band. If the system is tested in flight, the parting strips are energized for the entire 44-second cycle vice the 2-second on-ground test.

2.11.8 Windshield Wipers

The windshield wipers are powered electrically through circuit breakers labeled WINDSHIELD WIPER PILOT and COPILOT on the MEAC bus at the forward load center. The wipers provide two-speed selection and are controlled individually by the pilot and copilot.

2.11.8.1 Windshield Wiper Control

Windshield wiper control knobs, located on the left and right sides of the exterior lights control panel, provide individual control by the pilot and copilot. The control knob positions clockwise are PARK, OFF, LOW, and HIGH. Each selector switch is spring-loaded from the PARK position to the OFF position; therefore, it is necessary to release the selector switch as soon as the blades stop in the parked position or damage to the wiper motor may result.

2.11.8.2 Windshield Washer

The windshield washer is used to remove salt encrustation and other foreign matter from the two forward windshield panels. The system uses a fluid mixture of isopropyl alcohol and water. The system comprises a 1-gallon reservoir, electrically driven pump, check valve, filter, metering valve, and spray nozzle. Power for the pump is taken from the MEAC bus through a circuit breaker located on the forward load center.

2.11.8.3 Windshield Washer Metering Valve Control

With the windshield pump energized, the metering valve control knob, located on the pilot side panel, controls the flow of fluid to the windshield panels. Turning the knob counterclockwise increases the flow of fluid; rotating it clockwise decreases the flow, but it cannot be turned completely off.

2.11.8.4 Windshield Washer Pump Switch

The windshield washer pump switch, located to the left of the emergency shutdown handles, controls electric power to the windshield washer pump.

2.11.9 Windshield Heating System

The three forward windshield panels (Figure 2-39) are electrically heated to prevent icing. The heating consists of separate pilot and copilot systems. Both systems are essentially the same, except that the pilot system heats only the port forward panel, whereas the copilot system heats the center and starboard forward panels. Power to the heating circuit is supplied through circuit breakers on the MEAC and MEDC buses. The heating circuit is cycled off when the temperature reaches a preset maximum (regardless HIGH or LOW selection) and comes on when the temperature drops to a preset minimum.

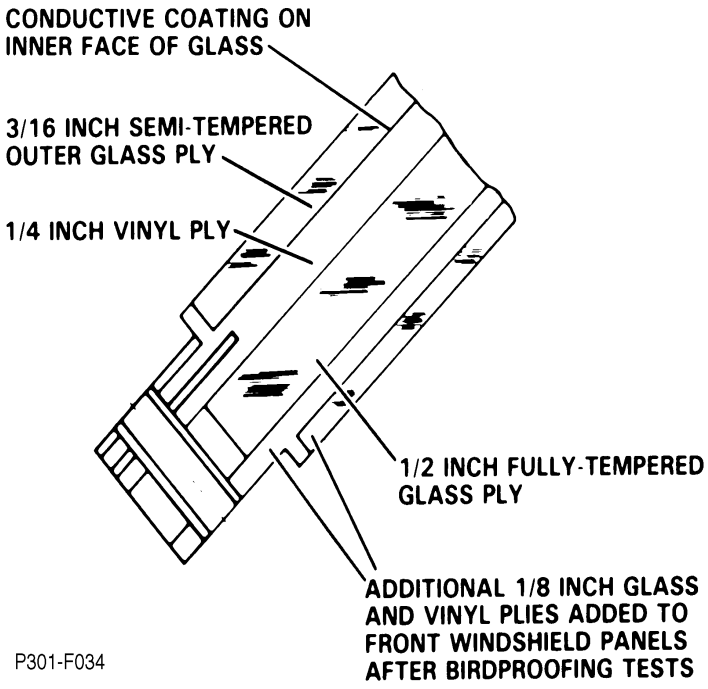


Figure 2-39. Windshield Panel Section

Normal (low) power is recommended for all operating conditions except as specified below. The following are conditions in which high power may be used, assuming prior warmup of approximately 10 minutes in low power:

1. When ice begins to form on the windshield panel.

CAUTION

If ice is allowed to build up prior to selecting high, the possibility of thermal shock exists.

2. When icing is anticipated at outside air temperatures near the low end of the icing range (0 to –25 °C).
3. At an altitude of 10,000 feet or less when descending into areas where birds are likely to be encountered and outside air temperature is below 0 °C.
4. At an altitude of 10,000 feet or less when descending into areas of high humidity, which may occur in areas of high temperatures.
5. At any time in flight for anti-fogging purposes, provided low heat has been applied for the full period required for a complete cycle.

The aircraft may be dispatched with the forward windshield electric heating system unserviceable or selected OFF, provided the following conditions are satisfied:

1. Indicated airspeed must not exceed 240 knots below an altitude of 10,000 feet. (Birds are unlikely to be encountered at higher altitudes and normal speed limitations apply above 10,000 feet.)
2. The aircraft must not be dispatched into known or anticipated icing conditions.

Refer to Chapter 18 for cold-weather operating procedures.

2.11.9.1 Windshield Heat Controls

The controls and indicators for the windshield heat system are located on the anti-icing control panel and are described in the following paragraphs.

2.11.9.2 Windshield Heat Control Switch

Two three-position windshield heat control toggle switches placarded PILOT and CO-PILOT & CTR are provided for the pilot windshield panel, the center panel, and the copilot panels. These three switch positions are HIGH, LOW, and OFF.

2.11.9.3 Windshield Heat Control OVERRIDE Switch

The windshield heat control OVERRIDE switch is located adjacent to the heat control switches and provides a means of energizing the heating circuit when the heat cycling sensor is below the control range. Automatic cycling control takes over when the windshield temperature increases to the control range. The OVERRIDE switch must be held in position until automatic cycling is established.

2.11.9.4 Windshield Heat CYCLING Signal Lights

Two windshield heat CYCLING lights illuminate when power is being supplied to the windshield panels. They are extinguished when power is interrupted.

2.11.9.5 Side Windshield Defogging System

The side windshields, one on each side of the flight station, are electrically heated to prevent or eliminate fogging. Operating similarly to the forward windshield panels, the system is independently controlled and monitored and is provided to increase side vision in flight as well as to improve ground handling conditions. The system consists of two similar subsystems, one for each side window. Each is operated by ON/OFF switches labeled PILOT and CO-PILOT on the flight station overhead control panel. Relay failure (FAIL) indicating caution lights illuminate if the windshield overheat control relays and/or windshield power relays stick in the energized position, provided the switches are in the OFF position. The systems receive 28 Vdc through left (L) and right (R) SIDE WSHLD HT CONT circuit breakers on the extension MAIN DC BUS, and 115 Vac through the left (L) and right (R) SIDE WSHLD HT PWR circuit breakers on MAIN AC BUS A.

Note

The side windshield defogging system is designed to be used when needed. It may take as long as 45 minutes for side windshield heat to become fully effective. If it is determined that it is needed, then it should be turned on and left on for the remainder of the flight.

2.12 AIR-CONDITIONING AND PRESSURIZATION SYSTEM

The air-conditioning and pressurization system provides crew environment control and electronic equipment cooling both in flight and on the ground. Bomb bay heating and the electronic equipment rack overheat warning systems are also described.

The normal mode of operation of the air-conditioning and pressurization system employs two Engine-Driven Compressors (EDCs) mounted on engine Nos. 2 and 3. Heated, compressed air from the EDCs is ducted through two air cycle cooling units in the nose wheelwell and then into the flight station and cabin. Air is drawn through the aircraft by the cabin exhaust fan and ducted overboard through the outflow valve, which controls pressurization (FO-1).

A second mode of operation employs the APU and an air multiplier package to supply the air cycle cooling units with heated, compressed air that is then cooled and distributed as described above. Not available in flight, this is the normal mode of operation for ground air-conditioning when engine Nos. 2 and 3 are not operating.

A third method of obtaining ground air-conditioning utilizes air from an external air-conditioning source connected downstream of the air cycle cooling units. This air is ducted directly into the air distribution system.

An auxiliary ventilation system supplies unpressurized ambient air on the ground. It may also be used during unpressurized flight to remove smoke or fumes from the flight station. With this system, ram air is ducted directly into the distribution system, bypassing the air cycle cooling units.

2.12.1 Cabin Air Compressors

Mounted on engine Nos. 2 and 3 are single-stage, centrifugal-type compressors coupled directly to the accessory drive train. An electrically operated disconnect mechanism enables the flightcrew to disconnect the compressor from the engine. Compressed air output is regulated by inlet flow control vanes that regulate the volume of air entering the compressor on the basis of signals received from one element of a dual pitot-static probe mounted in the compressor discharge duct. As altitude increases, the pitot-static element senses lowering pressure and causes the inlet flow vanes to admit more air for compression. The other element of the pitot-static probe senses excess output pressure and in response operates a dump valve to spill or dump the compressor output. The dump valve bleeds off excess air caused by surges in the system and protects it when excessive demands are made upon it. It also dumps compressor output automatically when the APU air multiplier package is supplying the air-conditioning system. A switch in the flight station may be operated to dump cabin air compressor output manually.

2.12.2 Firewall Shutoff Valve

Located in the inboard nacelle fillet, areas of the No. 2 and 3 engines are electrically actuated firewall shutoff valves that close whenever the APU is supplying the air-conditioning system and when the cabin air compressor output is being dumped. These valves isolate the EDCs from the air cycle cooling system.

2.12.3 APU Air Multiplier Package

The APU air multiplier package ordinarily supplies air for the air-conditioning system on the ground. The raw pneumatic output of the APU is too hot and of insufficient volume to handle air-conditioning system requirements. Therefore, APU output is routed through the air multiplier package where it drives a turbine; the turbine drives a compressor that draws in and compresses ambient air. APU air is augmented by the compressed ambient air, and both are ducted into the air cycle cooling systems.

2.12.4 Air Cycle Cooling Systems

Two two-stage air cycle cooling units are installed in the nose wheelwell. The port unit receives the output of the No. 3 engine-driven cabin air compressor (or half the APU air multiplier package output) and supplies the main cabin. The starboard unit receives the output of the cabin air compressor driven by the No. 2 engine, divided about evenly between the flight station and the cabin. On P-3 Update III aircraft, the output of the starboard unit is approximately two-thirds to the cabin and one-third to the flight station. This change was accomplished by installing an orifice in the flight station air supply ducting. Each unit routes air through a primary heat exchanger, a compressor, a secondary heat exchanger, an expansion turbine, a water separator (to control humidity), and thence into the flight station or cabin. In modified aircraft, the water recovered from the separators is used as a water coolant spray system (onto the secondary heat exchanger) to increase air-conditioning system efficiency. The heat exchanger coils are cooled by ram air in flight and by air from electrically driven fans (bus B, MEDC) on the ground (turned on by the ground air-conditioning switch). The compressor is driven by the expansion turbine.

2.12.5 Distribution and Exhaust System

Separately controlled distribution systems provide fresh, conditioned air to the flight station and the cabin (FO-1). An outlet over the entrance supplies the flight station. In addition, foot-warmers are provided for both pilots with

mechanically connected on-off controls located outboard under the respective instrument panels. An overhead longitudinal duct delivers cabin air to louvered outlets in the ceiling, and individually controllable (on/off) gaspers are provided at the various crew stations and rest areas.

The exhaust system (FO-1) draws cabin air through the electronic equipment cabinets and the electrical load center and dumps it overboard through the outflow valve. Modulation of the outflow valve controls pressurization in the flight station and cabin. Some air is also exhausted through vents provided in the lavatory and galley to expel fumes and odors. A manually operated valve, provided in the galley vent, should be closed except when cooking.

2.12.6 Temperature Control System

Two independent temperature control systems are provided, one for the flight station and one for the cabin. Both systems are completely automatic; however, manual control systems are provided for backup. Each system consists primarily of the controls on the air-conditioning panel, a programming controller in the forward electrical load center, a master temperature sensor, a duct rate sensor, and three servo-operated valves in the ducting that control the flow of air. The valves are shown in FO-1 as A, B, and C. In the automatic mode, the positions of valves A, B, and C are modulated by action of the programming controller. This controller relies upon inputs from the controls on the air-conditioning control panel, from an ice sensor in the ducting, from a differential pressure sensor on the cabin air compressor, from the cabin (or flight station) temperature sensor, and from a temperature change rate sensor (duct rate sensor) in the ducting that senses temperature and rate of temperature change of conditioned air being blown into the cabin (or flight station). In the automatic mode, the controller modulates valves A, B, and C to maintain a constant temperature between 18 and 29 °C depending on the adjustment of the selector. If ice builds up in the water separator, the controller automatically positions the A valve to remove the ice, and if excessive demands are made on the compressors, the A valve is positioned to reduce the load (pressure ratio limiting).

In the manual mode, the selector commands control valve position rather than setting a temperature. Ice-limiting protection and pressure-limiting protection are provided in the manual mode.

The three airflow control valves (A, B, C) function as a team according to the temperature control system predetermined program schedule (Figure 2-40). Note that for a full cold command, the C valve (hot air bypass) is shut, the A valve (turbine bypass) is shut, and the B valve (turbine shutoff) is open. FO-1 shows that when full cold is commanded, all of the airflow is directed through the entire air cycle cooling system. Conversely, with full hot commanded, the A and B valves are fully closed, the C valve is fully open, and all of the airflow is bypassed directly to the air distribution network.

2.12.7 Air-Conditioning Controls and Indicators

All controls and indicators for the air-conditioning and pressurization system are on a control panel on the flight station overhead panel. Refer to FO-16.

2.12.7.1 Temperature Selectors

Two temperature selectors, placarded CABIN and FLT STA, provide independent temperature control for the cabin and flight station. A push/pull knob on the dial is used to switch temperature control mode from manual to automatic, and the word AUTO or Manual (MAN) appears on the face of the dial to indicate the temperature control mode selected. The knob may be rotated to select a warmer or cooler temperature. In the automatic mode, the moving index mark on the periphery of the dial provides an indication approximately equivalent to the temperature selected. The center needle indicates the setting of valves A, B, and C being utilized to achieve or maintain the selected temperature. When the system is in automatic and the index mark is in the center of its range, a temperature of approximately 24 °C will be maintained. In the manual mode, valves A, B, and C are positioned directly as shown in Figure 2-40. It will be necessary to adjust the control knob as altitude and outside air temperature change. Both selectors are powered through circuit breakers on the MEAC bus in the forward load center.

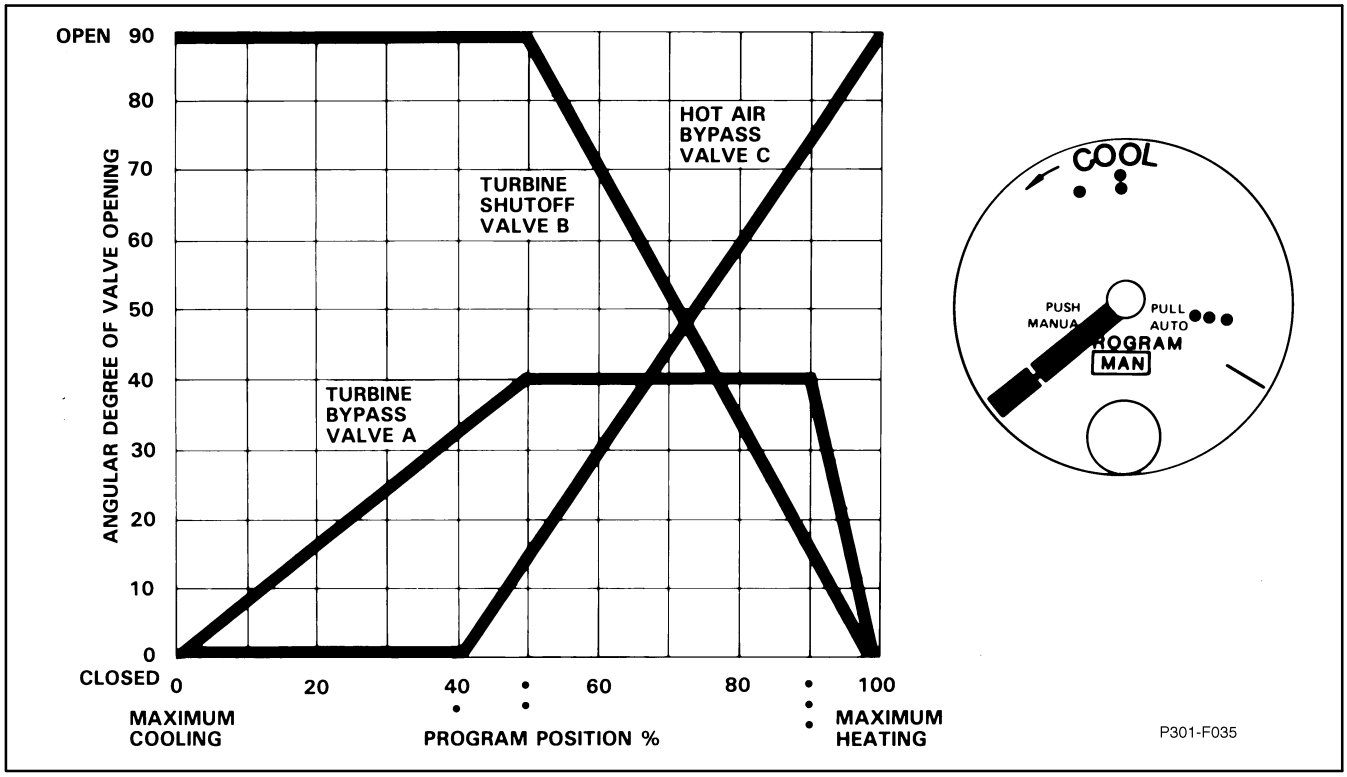


Figure 2-40. Air Cycle Cooling System Valve Operating Schedule

2.12.7.2 Temperature Selector Switch and Gauge

The air-conditioning temperature gauge is marked from 0 to 60 °C and displays any of the three temperatures selected by the TEMP SELECTOR knob located adjacent to the indicator. The three temperatures that may be monitored are flight station conditioned air temperature (FLT STA COND AIR), cabin conditioned air temperature (CABIN COND AIR), and cabin exhaust air temperature (CABIN TEMP). The flight station and cabin-conditioned air temperatures are measured at the base of their respective conditioned air ducts. Cabin temperature is measured in a duct located in electronics rack B-3 (on update III aircraft this temperature bulb has been relocated to rack D-3) and is collocated with the cabin master temperature sensor. The electrical circuit receives power from the MEAC bus in the forward load center.

2.12.7.3 Refrigeration Overheat Light

Two yellow signal lights reading REFR OVHT, one for each air cycle cooling unit, are located on the air-conditioning panel. The illuminated light indicates that a closed thermal sensor switch sensing an overheat condition at the output side of the air cycle machine compressor and that temperature in the affected duct has exceeded safe limits. During ground operation, the air-conditioning system and both EDCs will automatically dump and remain dumped until the overheat condition has been removed. Operation of the ground air-conditioning system can then be continued after cycling the GRD AIR COND switch and by selecting MAN, 2-dot position (or warmer) with the temperature selector. In flight, the appropriate REFR OVHT light will illuminate but the EDCs will not dump. A REFR OVHT light usually occurs as a result of a restriction in the heat exchanger ventilation system or a lack of cooling airflow to the heat exchangers.

2.12.7.4 Cabin Exhaust Fan Switch and Signal Light

Cabin air is drawn through the electronics compartments by the cabin exhaust fan and exhausted overboard through the outflow valve (FO-1). Power is furnished to the fan through a circuit breaker on the MAIN AC BUS B panel and to the switch through a circuit breaker on the extension MAIN DC BUS panel. Guarded to ON, the switch has an

OFF position that should not be used if the electronic equipment is operating. A light, located adjacent to the fan switch, illuminates FAN OUT to indicate exhaust fan failure or lack of airflow.

Note

Cabin exhaust fan must be operating to allow power application to the Single Advanced Signal Processor (SASP) system.

2.12.7.5 Ground Air-Conditioning Switch

The ground air-conditioning switch has multiple electrical connections that perform the following functions with the APU operating:

1. Open APU air multiplier shutoff valve and introduce APU air into the air multiplier package.
2. Dump (discharge) cabin air compressor output overboard.
3. Close firewall shutoff valves.
4. Close auxiliary vent valve.
5. Energize air cycle cooling unit blowers to cool heat exchanger coils.

If the APU is not operating (engine Nos. 2 and 3 operating), the ground air-conditioning switch energizes electrical connections to:

1. Undump (stop discharging) cabin air compressors.
2. Open firewall shutoff valves.
3. Close auxiliary vent valve.
4. Energize air cycle cooling unit blowers to cool heat exchanger coils.

The various ground air-conditioning switch functions are powered through the AUX VENT CONT circuit breaker on the MEDC bus and receive holding power from the START CONT circuit breaker on the SEDC bus.

2.12.7.6 APU Air Override Switch

This switch, in conjunction with the ground air-conditioning switch, allows the EDCs to be used for air-conditioning when the APU is operating. Labeled ON and OFF, the APU air override switch in the ON position closes the APU air multiplier valve, opens the firewall shutoff valves, and disables the ground air-conditioning switch functions that select APU air multiplier package air for air-conditioning. The switch functions are powered through circuit breakers on the MEDC bus panel.

2.12.8 Flight Operation

On takeoff, once the aircraft weight is off the wheels, scissor-switch action deenergizes the ground air-conditioning switch that secures power to the heat exchanger fans. Air-conditioning is automatically supplied by the EDCs via the normal airflow distribution system.

2.12.8.1 Pressurization Control System

Pressurization is controlled automatically by an isobaric and differential system that consists of the pressurization controller and the outflow valve in the lower rear fuselage. The isobaric system modulates the outflow valve to limit exhaust airflow and maintain cabin pressure equivalent to the altitude selected on the pressurization controller. As the aircraft climbs, the difference between cabin and outside pressure increases. When this pressure difference reaches 13.3 inches Hg (11.0 inches Hg in aircraft not incorporating AFC-341), the differential system overrides the isobaric system, modulating the outflow valve to maintain the limit pressure differential rather than the selected equivalent

cabin altitude (Figure 2-41). A pressure relief valve under the copilot seat prevents dangerous buildup of cabin pressure in the event of a malfunction of the differential system. The pressure relief valve is set at 13.9 to 14.4 inches Hg (11.7 to 12.2 inches Hg in aircraft not incorporating AFC-341).

CAUTION

Cabin differential pressure must be at or below 9 inches Hg prior to opening the pyrotechnic pistol porthole door.

2.12.8.2 Negative Pressure Safety Relief Valve

A negative pressure relief valve is located in the center of the aft pressure bulkhead. It will open if outside (ambient) pressure exceeds cabin pressure.

2.12.8.3 Pressurization Controls and Indicators

Refer to FO-16.

2.12.8.3.1 Compressor Inlet/Discharge Pressure Gauge

An inlet/discharge pressure gauge is provided for each cabin air compressor. During APU ground operation, the gauges indicate air multiplier package loading. The dial face of each indicator is graduated from 0 to 85 inches Hg. Each dial has two pointers, I and D, for inlet and discharge pressure, respectively. Maximum compressor inlet/discharge pressure ratio is shown in Figure 2-42. The instruments receive power from the 26-Vac instrument buses, the port engine compressor from bus No. 1, and the starboard from bus No. 2.

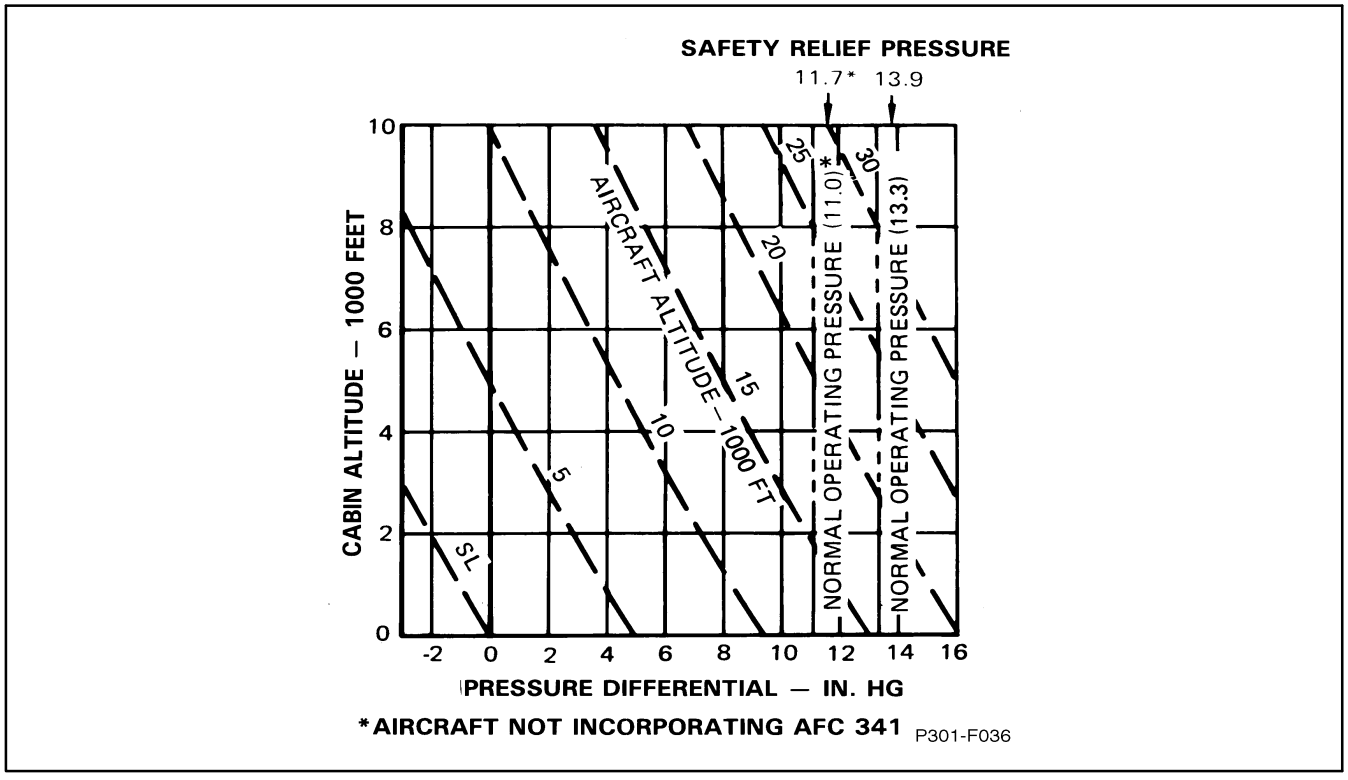


Figure 2-41. Cabin Altitude vs. Pressure Differential

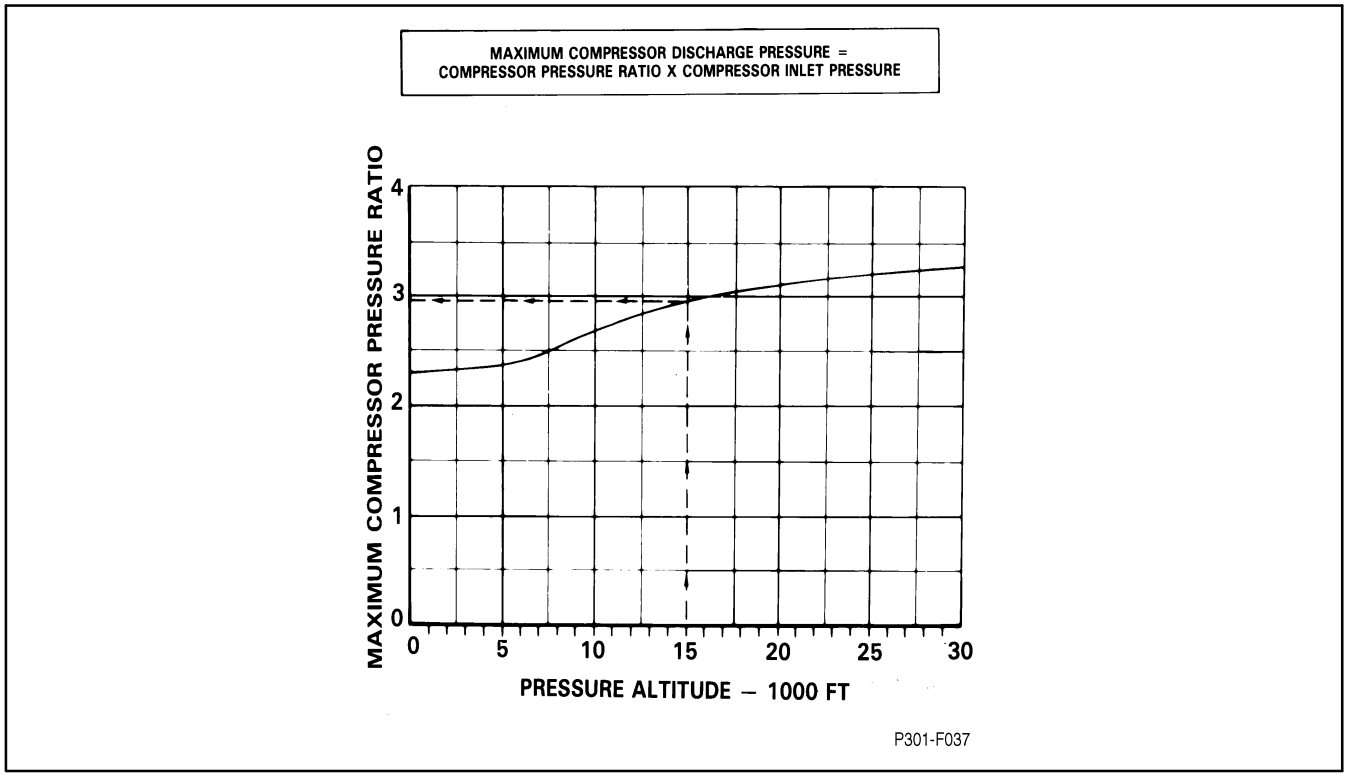


Figure 2-42. Cabin Compressor Performance

CAUTION

Excessive compressor discharge pressures may cause EDC damage. If the difference between inlet and discharge pressure reaches approximately 35 inches Hg, the maximum compressor discharge should be computed. If the maximum is exceeded, select a warmer temperature on the appropriate temperature programmer to bring discharge pressure within limits.

2.12.8.3.2 Cabin Air Compressor Signal Lights

Two dual, yellow lights, placarded LEFT and RIGHT, provide caution indication of the cabin air compressor oil temperature and pressure. The lights illuminate TEMP HIGH or PRESS LOW, as applicable, if oil temperature exceeds a safe value or if oil pressure in a compressor falls below a safe pressure. The lights are powered through the signal light circuit breaker on the MEDC bus panel.

2.12.8.3.3 Engine-Driven Compressor DUMP Switches

A dump switch, placarded DUMP and NORMAL, is provided for each engine-driven cabin air compressor. When the switch is in DUMP, the firewall shutoff valve is closed and the cabin air compressor output is dumped overboard. Power is supplied through the EDC DUMP circuit breaker on the MEDC bus panel. The EDCs are dumped and the firewall shutoff valves are closed automatically upon landing.

2.12.8.3.4 Engine-Driven Compressor Disconnect Switch

A disconnect switch is provided for each cabin air compressor. The switches are guarded in NORMAL and have a DISCONNECT position. DISCONNECT disconnects the compressor from the engine by applying power from the EDC DISCONNECT circuit breaker on the MEDC bus panel to the solenoid-operated unit. The DISCONNECT position shall be selected only when the engine is operating in normal rpm range; otherwise, the compressor will be damaged.

2.12.8.3.5 Cabin Pressurization Controller

The cabin pressure controller operates pneumatically and is connected by an air line to the outflow valve. The cabin pressure controller modulates the position of the outflow valve to hold a constant cabin altitude (isobaric), to limit differential pressure to a maximum of 13.3 inches Hg (11.0 inches Hg in aircraft not incorporating AFC-341), and to limit rate of pressure change when the cabin altitude setting is changed. To provide more comfortable cabin pressure rates of change, the system may be maintained in the isobaric range until top of the climb. To accomplish this, set the cabin pressure controller as determined by the following formula: (aircraft altitude/1,000 – 14) $\times$ 5 (–11 $\times$ 6) in aircraft not incorporating AFC-341). A knurled wheel on the left side of the controller, placarded BAR CORR, is used to apply a barometric altitude setting to the controller. The altimeter setting is revealed in the left window. The cabin altitude setting may be read in the right window. The setting may be varied by operation of a knurled wheel placarded CABIN ALT on the right side of the controller. In the lower portion of the controller is a rate selector knob that controls cabin altitude change rate during isobaric operation. Rate of change is controllable within a range of 200 to 2,000 fpm.

2.12.8.3.6 Cabin Vertical Velocity Indicator

The cabin vertical velocity indicator is graduated in fpm from 0 to 2,000 up and down. When cabin pressure is changing, the change is displayed as an equivalent vertical velocity.

2.12.8.3.7 Cabin Differential Pressure Indicator

The cabin differential pressure indicator displays the difference in pressure between cabin and outside air. Dial marking is from 0 to 20 inches Hg.

2.12.8.3.8 Cabin Altimeter

The cabin altimeter displays the existing cabin pressure in terms of pressure altitude.

2.12.8.3.9 Auxiliary Ventilation Switch

Provided as an alternate source of air on the ground and as an emergency depressurization and smoke removal system in flight, the auxiliary ventilation system is controlled by the two-position AUX VENT switch. In the OPEN position, the auxiliary ventilation valve opens fully, the EDCs are dumped, firewall shutoff valves close, and the outflow valve opens electrically. These actions also occur upon landing regardless of switch position.

2.12.8.3.10 Ground Check Switch

Placarded GRD CHECK, the ground check switch has two positions: TEST and NORMAL. In NORMAL, when the aircraft is on the ground, a circuit energized by the landing gear scissor switch drives the outflow valve to the fully open position, opens the auxiliary vent, dumps the EDCs, and closes the firewall shutoff valves. In TEST, a portion of the scissor switch is bypassed to allow the pressurization control circuit to simulate an in-flight condition by closing the auxiliary vent and putting the outflow valve into the position selected by the outflow valve switch. The ground check switch is powered through the outflow valve override circuit breaker on the FEAC bus and the auxiliary vent actuator circuit breaker on the MEAC bus.

2.12.8.3.11 OUTFLOW VALVE Switch

The OUTFLOW VALVE switch has four positions: OPEN, CLOSE, AUTO, and off (center). The switch controls the outflow valve as follows:

1. OPEN — Electrically drives the outflow valve to the full-open position, releasing cabin exhaust air and depressurizing the aircraft.
2. CLOSE — Electrically drives the outflow valve to the full-closed position, decreasing cabin altitude.
3. AUTO — Electrically drives the outflow valve to a midrange position, allowing the cabin pressure controller to pneumatically control the position of the outflow valve in either isobaric or differential range.
4. Off (center) — The cabin pressure controller will pneumatically control the position of the outflow valve provided the outflow valve is in the midrange area (pneumatic control available) at the time the switch is placed to off (center). If outside the midrange area, the outflow valve will stop and remain fixed as long as the switch is in the off position, unless the auxiliary vent switch is moved to the OPEN position. The ground-air sensing circuit opens the outflow valve electrically upon landing.

2.12.9 Radiant Heated Panels

Radiant heated deck panels are provided at the crew stations to compensate for heat loss through the cabin structure. On early P-3 aircraft, radiant heated bulkhead panels are also provided in the bunk and galley areas (deleted from BuNo 157327 and subsequent). An automatic monitoring system disables the radiant heating circuits when higher priority demands for electric power exist. Circuit breakers are provided on the MAIN AC BUS B panel in the main load center. On later P-3 aircraft, cabin exhaust air is provided through louvered grills to the dinette and ordnance areas, replacing radiant deck and bulkhead heaters in these areas.

2.12.9.1 Foot-Warmer Control

Foot-warmer control knobs, one located below each pilot instrument panel, control the flow of air from the foot-warmer outlets forward of the rudder pedals. To increase the amount of airflow through the foot warmer, push the knob placarded FOOT AIR PUSH forward. To decrease the foot-warmer airflow, pull the knob aft.

2.12.10 Galley and Lavatory Venturi

Sonic venturis are installed in the lavatory and galley to vent odors overboard. A manual shutoff valve is provided in the galley to close the venturi.

2.12.11 Gasper Control

Gasper outlets are installed at crew and rest stations throughout the aircraft. Gasper airflow is controlled by manually turning the control ring on the outer surface of the unit.

2.12.12 Bomb Bay Heating System

The bomb bay heating system utilizes 14th-stage engine bleed air. APU bleed air for ground heating of the bomb bay is also available. If the bomb bay temperature falls below approximately 0 °C, a caution indicator light on the overhead engine bleed-air panel, actuated by a low temperature sensor in the bomb bay, illuminates. This sensor also actuates the deicing master caution light on the center annunciator panel. Turning on the bomb bay heat switch on the bleed-air panel energizes a cycling thermostat that actuates a solenoid controlled pneumatic valve installed on a bleed-air line tapped into the manifold, outboard of the right fuselage valve.

This allows the hot bleed air to flow from the right crossduct manifold when the No. 3 or No. 4 engine bleed-air shutoff valve is opened. A cycling thermostat maintains the bomb bay temperature at approximately 5 °C by cycling the valve solenoid as required. When operating in very low Outside Air Temperature (OAT), the bomb bay temperature should be monitored when the system is initially turned on to ensure an increase in temperature. Failure of the cycling thermostat will be indicated by failure of the bomb bay cold light to go out and failure of the bomb bay temperature to rise. If this occurs, the bomb bay heat switch can be placed in the OVERRIDE position; this will bypass the cycling thermostat and send power directly to the valve solenoid.

A thermal switch is also installed in the bomb bay that illuminates another caution indicator light on the bleed-air panel if the operating temperature exceeds approximately 60 °C. This high-temperature switch also illuminates the deicing master caution light on the center annunciator panel. To assist in monitoring bomb bay temperature, a temperature selector switch position is provided on the bleed-air panel that indicates bomb bay temperatures on the associated temperature indicator. The APU may be used to provide bleed air for bomb bay heating for ground operation only. The right bleed air isolation valve must be in the OPEN position to allow APU airflow to the bomb bay air distribution line. During engine start, the system is not automatically monitored, and it is necessary to turn off the bomb bay heat switch to maintain proper manifold pressure. The system is powered by the extension MAIN DC BUS. A circuit breaker, labeled BOMB BAY HEAT & CONT, is located on the forward load center in the flight station.

2.12.12.1 Bomb Bay Heat Switch

A bomb bay heat switch located on the bleed-air panel in the flight station has three positions: ON, OFF, and OVERRIDE. The ON position energizes a cycling thermostat that actuates a solenoid and opens a pneumatic valve in the bleed-air lines, allowing hot bleed air from the engine or APU to enter the bomb bay for heating purposes. In the OVERRIDE position, the thermostat is bypassed and the solenoid valve is opened to allow bleed air to flow into the bomb bay area without cycling control.

2.12.12.2 Bomb Bay Temperature Selector Switch and Temperature Indicator

A bomb bay temperature selector and temperature indicator is located on the bleed-air panel in the flight station and is used in conjunction with the wing leading edge temperature indicator switch. When the rotary switch is in the BOMB BAY position, the bomb bay temperature can be monitored on the adjacent indicator (LEAD EDGE TEMP).

2.12.13 Electronic Rack Overheat Warning System

The aircraft is provided with an electronic rack overheat warning system that provides a visual (in flight) or a visual and aural (on ground) warning whenever an electronic rack attains an overtemperature condition. There are warning indicators by the various rack doors and bays and a master warning light (RACK OVHT) on the pilot vertical annunciator panel.

The appropriate warning indicator and the master warning light (RACK OVHT) will illuminate if the equipment bay temperature becomes excessive. Individual switches adjacent to the indicators extinguish the flight station RACK OVHT warning light and warning horn. The individual rack light remains illuminated and the toggle switch remains down until the sensor for that rack has cooled.

Warning horns are located in the nose wheelwell and on the bulkhead behind SS3. Both horns are powered through a landing gear scissor switch that enables a pulsing aural warning whenever an overheat condition exists. The horns will not sound while airborne. Power for the system is provided through a rack overheat warning circuit breaker at the MAIN DC BUS located at the main load center. In the event of MAIN DC BUS failure, the master (RACK OVHT) warning light illuminates on the pilot vertical annunciator panel. In addition, all power will be secured to the various rack sensors.

Note

The ASH-33 (digital magnetic tape system) will cause a rack overheat indication on pilot annunciator panel (in flight) and an aural and visual indication (on ground) for approximately 4 seconds when the system is initially turned on or continuously when a loss of airflow is detected within the digital magnetic tape system chassis.

2.12.14 Oxygen System

The oxygen system (Figure 2-43) is designed to supply a flightcrew of three members. Oxygen is supplied from three high-pressure (1,800 psi) bottles through three regulators, one for each flightcrewmember. A common manifold

allows oxygen to be evenly furnished from one or all three bottles through a pressure reducer to the oxygen regulators. Smoke masks, one for each flight station crewmember, are stored adjacent to each regulator. The system incorporates an external filler connection to which a portable oxygen cart may be attached. By this means, the bottles can be recharged to 1,800 psi without removing them from the aircraft.

The approximate amount of time available to the flightcrew can be determined using system pressure, cabin altitude, and diluter lever position (Figure 2-44). The charts can also be used to find a minimum cabin altitude necessary to meet a required flight time on oxygen. These charts should be used as a decision-making tool when presented with an emergency requiring extended oxygen use. Selecting EMERGENCY on the oxygen regulator, performing moderate work, or increased breathing rate due to anxiety will dramatically decrease the time available found on the chart.

Seven portable oxygen bottles are stowed at the tactical crew stations except stations 9 and 10, whose bottles are located at the aft end of the sonobuoy storage bins. These bottles are normally equipped with diluter-demand regulators and smoke masks. With the regulator set for 100 percent oxygen and with the user experiencing little or no physical exertion, approximately 22 minutes of oxygen are available. For the same person performing moderate work, consequently breathing at a faster rate, approximately 5 to 10 minutes of oxygen are available per bottle.

2.12.14.1 Oxygen Regulator Supply Lever

An oxygen regulator supply lever, located in the lower right corner of the regulator panel, is used to control the supply of oxygen to the regulator. The lever positions are ON and OFF.

2.12.14.2 Oxygen Regulator Diluter Lever

The oxygen diluter lever, located at the lower center of the regulator panel, has two positions, 100% OXYGEN and NORMAL OXYGEN. In the 100% OXYGEN position, the regulator delivers 100 percent oxygen on inhalation. In the NORMAL OXYGEN position, the regulator delivers air and oxygen; the oxygen content increases until approximately 30,000 feet cabin altitude, when 100 percent oxygen is delivered on inhalation.

2.12.14.3 Oxygen Regulator Emergency Pressure Lever

The oxygen regulator emergency pressure lever, located in the lower left corner of the regulator panel, has three positions: EMERGENCY, NORMAL, and TEST MASK. The EMERGENCY position delivers positive pressure at lower altitudes where positive pressure normally is not delivered. In the NORMAL position, the diluter valve is the controlling lever. The TEST MASK position supplies a higher-than-emergency pressure for testing the mask and its fit.

2.12.14.4 Oxygen Regulator Flow Indicator

An oxygen-flow blinker indicator is installed on each regulator panel. Oxygen flow is indicated by the indicator blinking during inhalation.

2.12.14.5 Oxygen Regulator Pressure Gauge

The oxygen pressure gauge, located on the regulator panel, indicates the regulator inlet pressure.

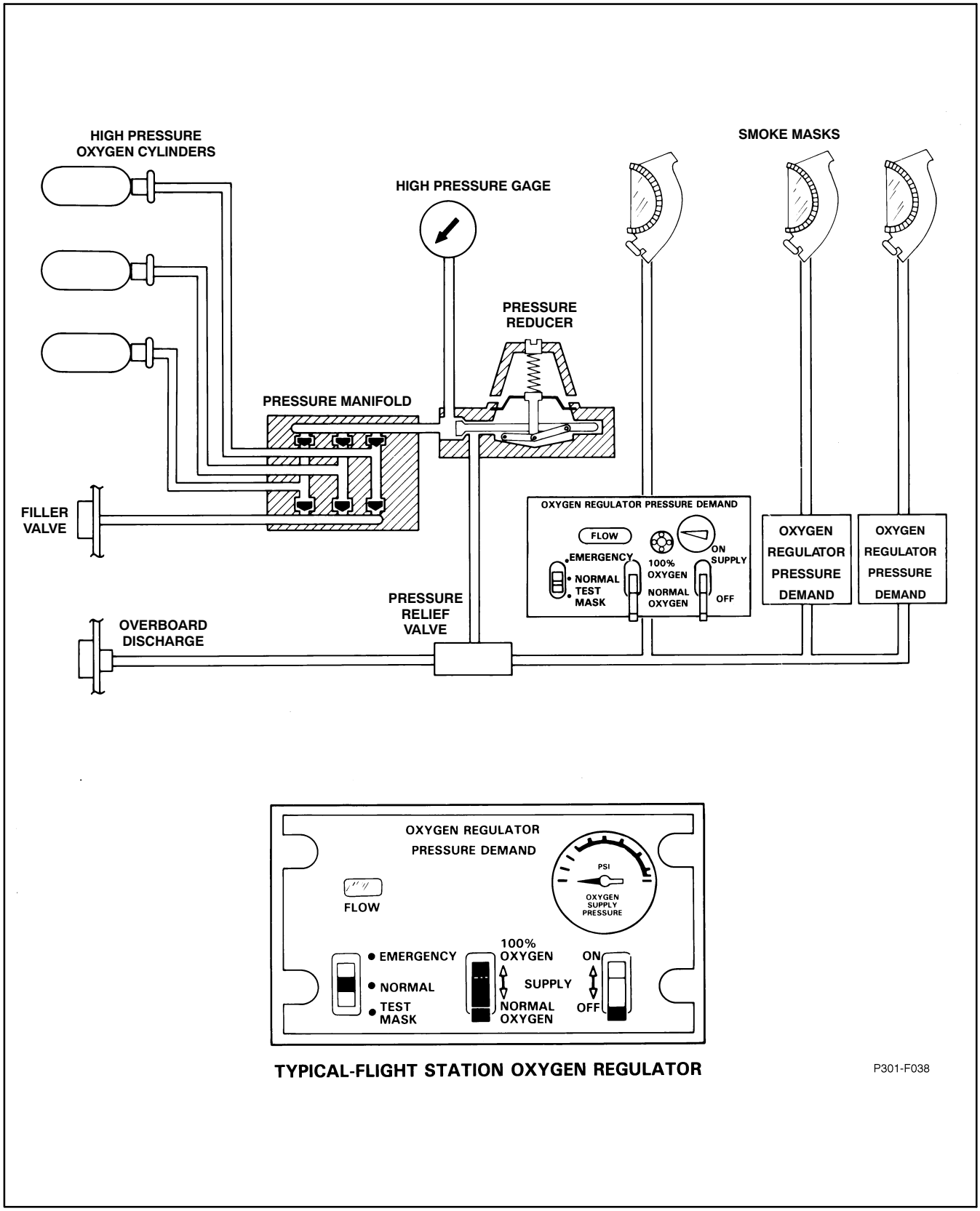
2.12.14.6 Oxygen System Pressure Gauge

An oxygen system pressure gauge is installed at the aft end of the pilot side console. This gauge is calibrated from 0 to 2,000 psi and indicates the pressure in the oxygen system.

2.13 HYDRAULIC AND FLIGHT CONTROL SYSTEM

2.13.1 Hydraulic System

Two independent, 3,000-psi hydraulic power systems operate the hydraulic equipment on the aircraft. They are designated system No. 1 and system No. 2 (FO-15).



TYPICAL-FLIGHT STATION OXYGEN REGULATOR

Figure 2-43. Oxygen System

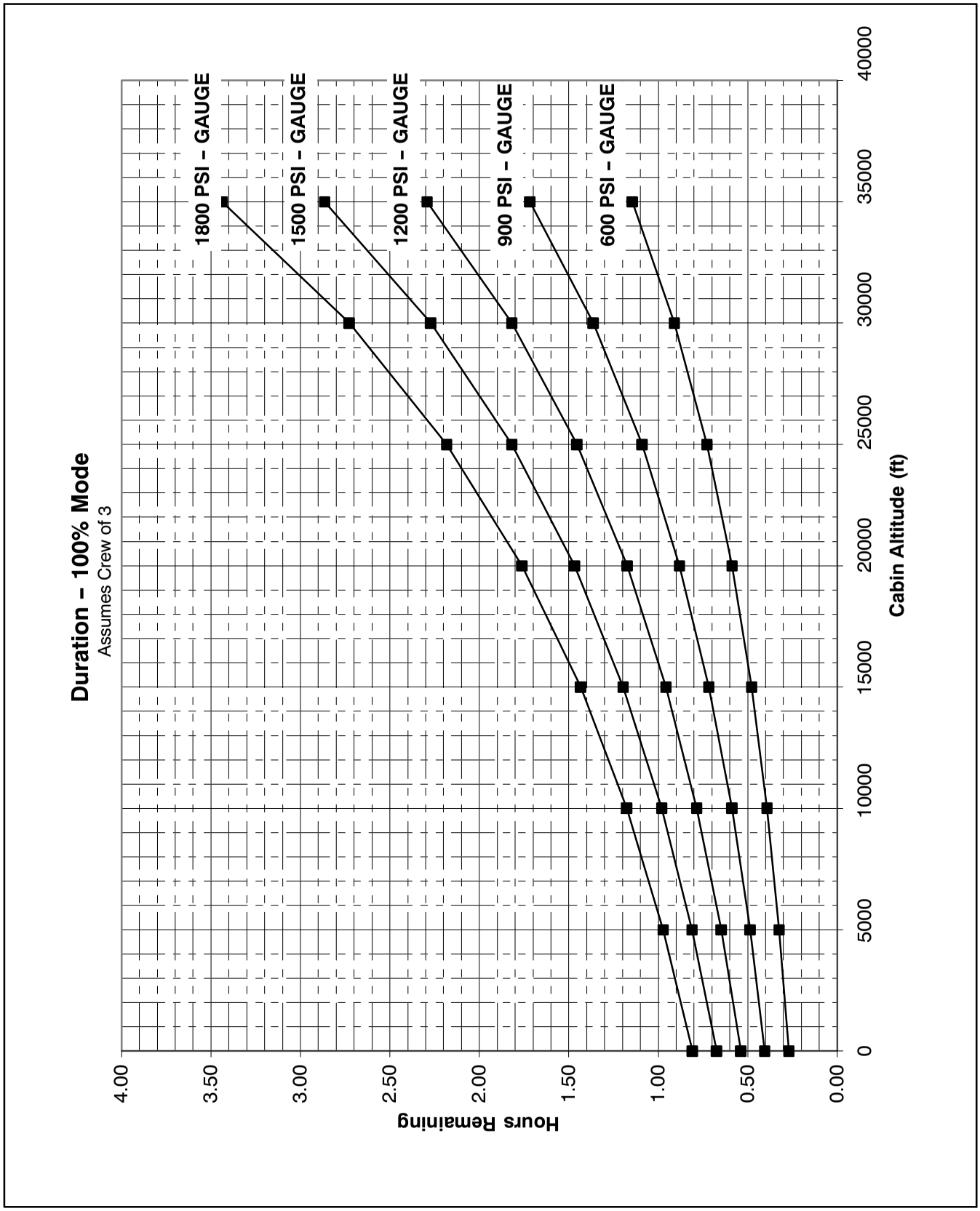


Figure 2-44. Oxygen Usage — 100% Mode (Sheet 1 of 2)

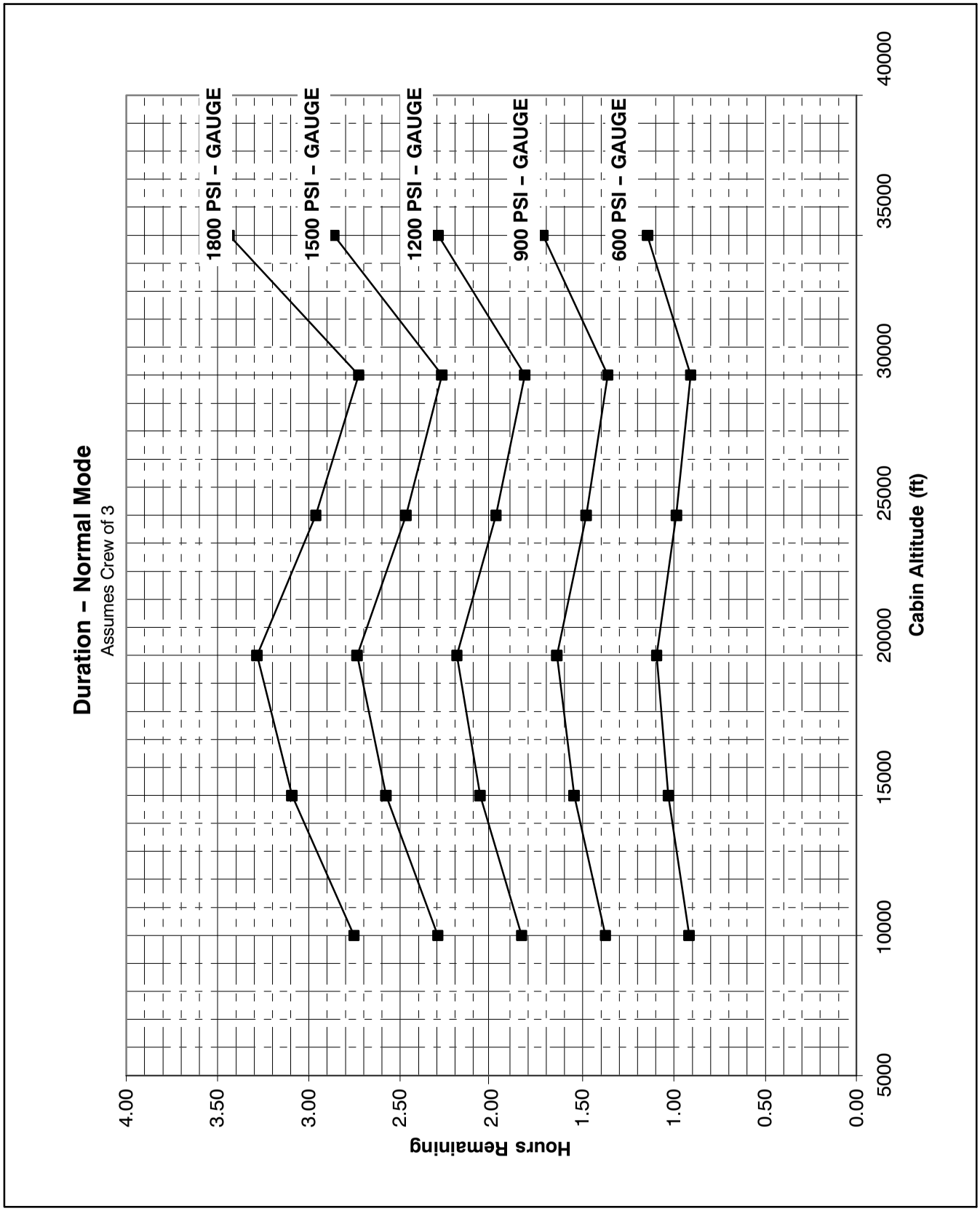


Figure 2-44. Oxygen Usage — Normal Mode (Sheet 2 of 2)

2.13.1.1 Hydraulic Electrical Power Source

Figure 2-45 shows the sources of electrical power for the hydraulic system components.

2.13.1.2 System No. 1

Hydraulic system No. 1 is powered by two AC-motor pumps, each of which is capable of operating all of the hydraulic units in the aircraft. In addition, system No. 1 includes a DC motor-operated pump (1B) that is used primarily for charging the brake accumulator. The three pumps are supplied from the No. 1 system reservoir, which has a capacity of 5.6 gallons. System No. 1 operates the main landing gear, nosewheel steering, wheelbrakes, bomb bay doors, wing flaps, aileron, rudder, and elevator boosters.

2.13.1.3 System No. 2

Hydraulic system No. 2 is powered by one AC-motor pump, and fluid is supplied from a 1-gallon reservoir. Hydraulic pressure from this pump is used to assist in operation of the wing flaps, bomb bay doors, aileron, rudder, and elevator booster units, all of which receive pressure from both systems.

Pumps	
1 motor power	BUS A
1 control	EXT MDC
1A motor power	BUS B
1A control	MEDC
1B motor power and control	GOB*
2 motor power	BUS B
2 control	EXT MDC
Quantity indicators	EXT MDC
Pressure indicators	
No. 1 system	No. 1 AC INST BUS
No. 2 system	No. 2 AC INST BUS
Normal brakes	No. 1 AC INST BUS
Emergency brakes	No. 2 AC INST BUS
Landing gear	
Control valve	EXT MDC
Position indicator	EXT MDC
Handle warning lights	EXT MDC
WHEELS light	MEDC
Wheels warning horn	MEDC
Wing flaps	
Position indicator	No. 1 AC INST BUS
Brake actuator	MDC
Latch release	MDC
Bomb bay	
Door control	EXT MDC
System 1 and 2	EXT MDC
Rudder boost shutoff valve	MEDC
All caution lights	MEDC
Service center lights	BUS B
* May be energized in flight by pulling Ground Operating Bus (GOB) circuit breaker, energizing the APU IN-FLIGHT ARM switch, or lowering nosegear.	

Figure 2-45. Hydraulic System Components

2.13.1.4 Hydraulic System Components

The hydraulic power system components are located in the hydraulic service center (Figure 2-46). The service center is accessible both from the cabin (through a hatch in the deck) and from outside the aircraft (through a door in the bottom of the fuselage). The No. 1 system components are on the port side of the compartment and the No. 2 system components are on the starboard side. In addition to the power system components, the following components are located in the service center: normal brake valve and accumulator, emergency brake modulator valves and airbrake bottle, in-flight brake pressure reducer, aileron servo, wing flap hydraulic components, and the landing gear selector valve.

2.13.1.4.1 Electrically Driven Hydraulic Pumps

There are three electrically driven, variable displacement type hydraulic pumps. The pumps are constantly monitored for pressure output, fluid and motor temperature, and electrical control. A low-pressure warning is initiated when pump output falls to 1,800 psi. Excessive fluid temperatures and pump motor case temperatures are detected by thermal switches. AC phase-to-phase faults are detected by a phase protection relay that opens the pump control circuit.

2.13.1.4.2 Filters

Filters located throughout the hydraulic system protect working portions of the system. The filters are of the disposable type and incorporate integral red pop-out indicators to show when the fluid flow is restricted.

2.13.1.5 Hydraulic Power System

The hydraulic power system is controlled from the flight station hydraulic control panel, located on the forward right portion of the center control stand. The control panel contains the ON/OFF switches for each hydraulic pump, a dual pressure gauge for the two systems, and a dual quantity gauge for the two reservoirs. Low-pressure warning and high-temperature warning lights for each pump are located on the annunciator panel. The red arcs on the dual-quantity gauge serve as a warning that the respective reservoir level is low and that operation with continued loss of fluid may result in pump cavitation. On retrofitted aircraft, the hydraulic pump is equipped with an automatic thermal protecting switch in lieu of the manual reset thermal protector.

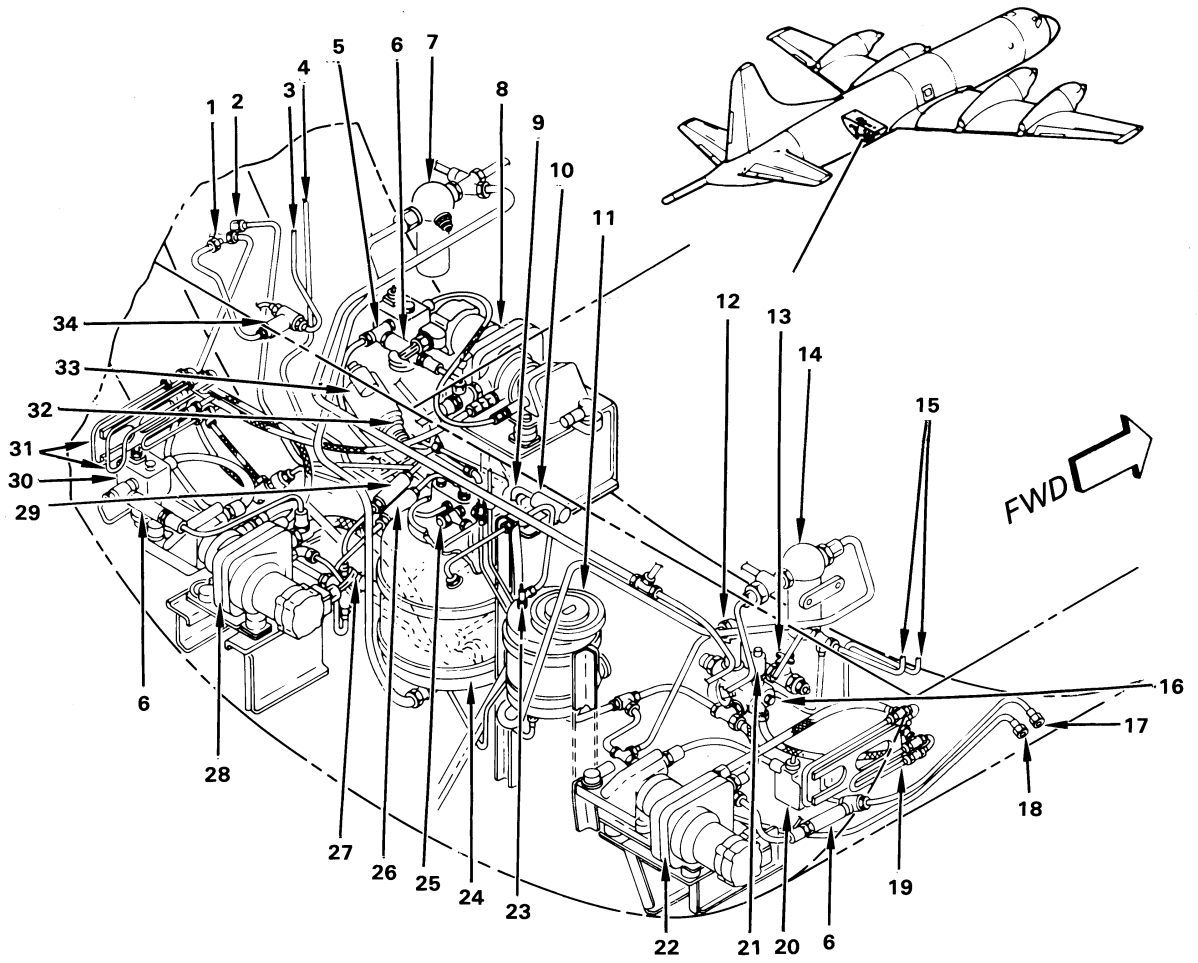
2.13.2 Flight Controls

The ailerons, elevators, and rudder are conventional except for hydraulic booster units built into the three systems to assist control movement. Cable-operated trim tabs, mechanically operated from the flight station, are located on the rudder and on each aileron and elevator.

2.13.2.1 Flight Control Boosters

Hydraulic flight control boosters operated by both hydraulic systems (Figure 2-47) are incorporated in each of the three surface control systems. The aileron booster is located in the hydraulic service area. The elevator and rudder boosters are located in the unpressurized section of the aft fuselage. Each booster assembly includes a dual, tandem hydraulic actuating cylinder and valves that regulate the flow and direction of the fluid to the actuating cylinder. Movement of the rudder pedals, control wheels, and control columns opens these valves, which in turn direct hydraulic pressure to both sections of the tandem cylinders. The units are designed so that if either the No. 1 or No. 2 hydraulic system fails, the remaining system will furnish sufficient hydraulic pressure to operate the boosters. In the event of complete hydraulic system failure, or failure of the booster units, any of the control systems can be shifted to completely mechanical operation by pulling the respective booster shift handle. Pulling the handle shuts off fluid to the booster, bypasses fluid around the actuating cylinder, and gives the pilot a mechanical advantage in the boost-off condition.

The booster system is designed so that the pilot has a normal feel of control forces when hydraulic pressure is available to the booster cylinders. Without hydraulic pressure, the controls can be moved but considerable force is required unless the booster shift handles are pulled. When the shift handles are pulled, control force is not excessive (Refer to Figure 2-48).



1 RETURN FROM OIL COOLER
2 FLOW TO OIL COOLER (NO. 2 FUEL TANK)
3 BRAKE DC HYDRAULIC PUMP PRESSURE
4 SYSTEM NO. 1 PRESSURE
5 NO. 1A SYSTEM FILTER
6 FLOW CONTROL VALVE
7 NO. 1 SYSTEM RETURN FILTER
8 AC HYDRAULIC PUMP NO. 1A
9 PRESSURE AND VACUUM RELIEF VALVE
10 DEHYDRATOR
11 RESERVOIR NO. 2
12 RELIEF VALVE (AC HYDRAULIC PUMP NO. 2)
13 MANUAL SHUTOFF VALVE (BOMB BAY DOOR SYSTEM)
14 NO. 2 SYSTEM RETURN FILTER
15 SYSTEM NO. 2 PRESSURE
16 SERVICE CENTER ASSEMBLY NO. 2
17 FLOW TO OIL COOLER (NO. 3 FUEL TANK)
18 RETURN FROM OIL COOLER
19 SURGE DAMPER (AC HYDRAULIC PUMP NO. 2)
20 NO. 2 SYSTEM COOLING HYDRAULIC FILTER
21 LOW PRESSURE WARNING SWITCH (AC HYDRAULIC PUMP NO. 2)
22 AC HYDRAULIC PUMP NO. 2
23 RESERVOIR AIR BLEED VALVE
24 RESERVOIR NO. 1
25 SERVICE CENTER ASSEMBLY NO. 1
26 RELIEF VALVE (AC HYDRAULIC PUMP NO. 1A)
27 MANUAL SHUTOFF VALVE
28 AC HYDRAULIC PUMP NO. 1
29 RELIEF VALVE (AC HYDRAULIC PUMP NO. 1)
30 NO. 1 SYSTEM HYDRAULIC FILTER
31 SURGE DAMPERS (AC HYDRAULIC PUMPS NO. 1 AND 1A)
32 DC HYDRAULIC PUMP NO. 1B PRESSURE LINE FILTER
33 DC HYDRAULIC PUMP NO. 1B
34 DC HYDRAULIC PUMP RELIEF VALVE

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Figure 2-46. Hydraulic Service Center Component Location (Typical)

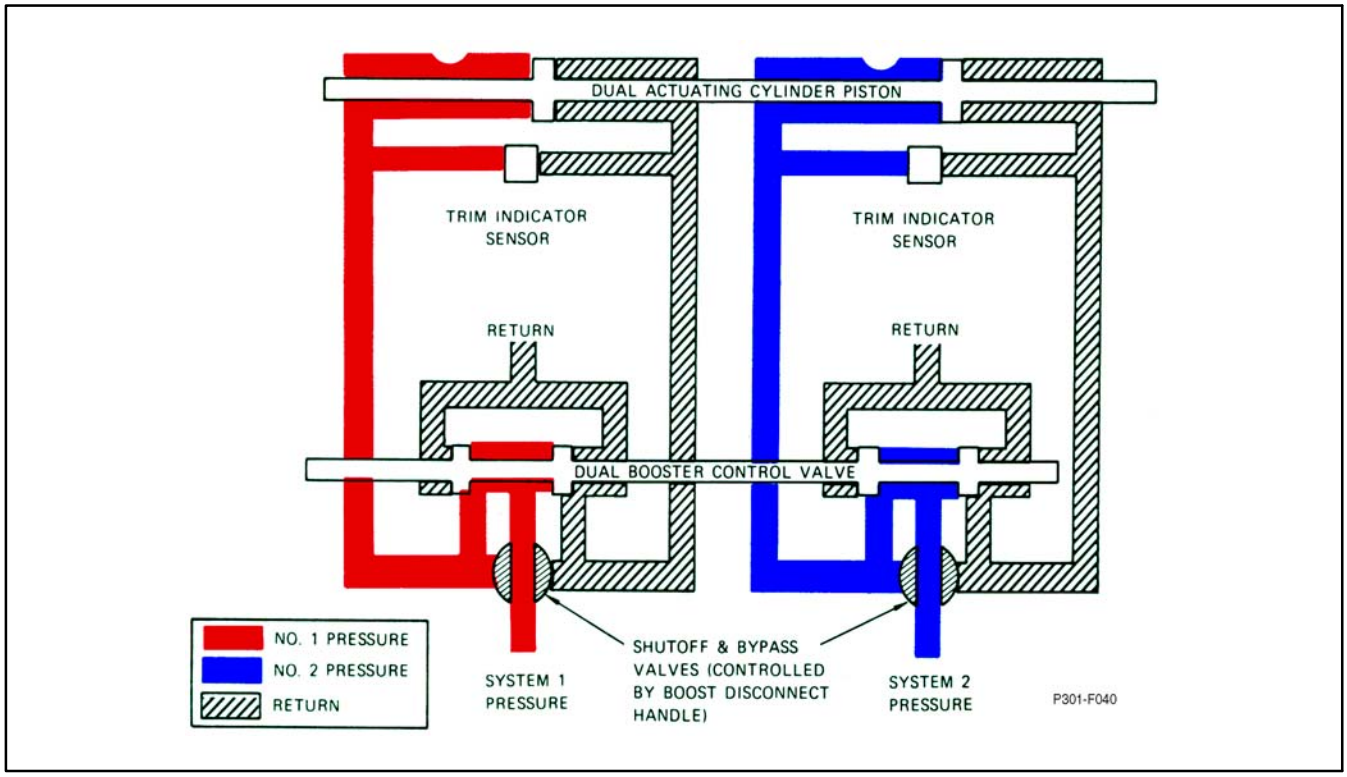


Figure 2-47. Flight Control Booster Hydraulic System

2.13.2.2 Rudder Booster Shutoff Valve

The rudder boost system is equipped with a device that shuts off No. 2 hydraulic pressure to the rudder booster when the wing flaps are retracted. The device prevents excessive structural loads that might result from maximum pilot force on the rudder at high speeds. The rudder booster shutoff valve is solenoid operated and is in the No. 2 hydraulic system pressure line to the rudder booster. The valve is actuated by a switch on the flap drive mechanism, located in the hydraulic service center.

Electrical power to this switch is taken from the No. 1 or No. 1A hydraulic pump switches (or from both). The switch closes, energizing the valve solenoid and closing the valve, when the flaps are raised to or above the 60 percent position. The valve remains closed until the flaps are again lowered to or below the 60 percent position. If the No. 1 and No. 1A hydraulic pump switches are turned off, power to the switch on the flap drive mechanism is interrupted and the shutoff valve opens, allowing No. 2 system pressure to operate the rudder booster.

2.13.2.3 Rudder Booster Servo Pressure Switch

A pressure-actuated switch is mounted in each hydraulic system line upstream of the rudder booster. The switch in the No. 1 system opens at 2,000 psi and closes at 1,500 psi. The switch in the No. 2 system opens at 200 psi and closes at 50 psi. The switches will turn on the RUDDER POWER light on the center instrument panel under the following conditions:

1. Both systems are pressurized, flaps are less than 60 percent, and the rudder booster shutoff valve opens.
2. Pressure in only one system, and flaps are extended beyond 60 percent.
3. No system pressure, regardless of flap position.
4. Both systems are pressurized, flaps are extended beyond 60 percent, and the rudder booster shutoff valve fails to open.

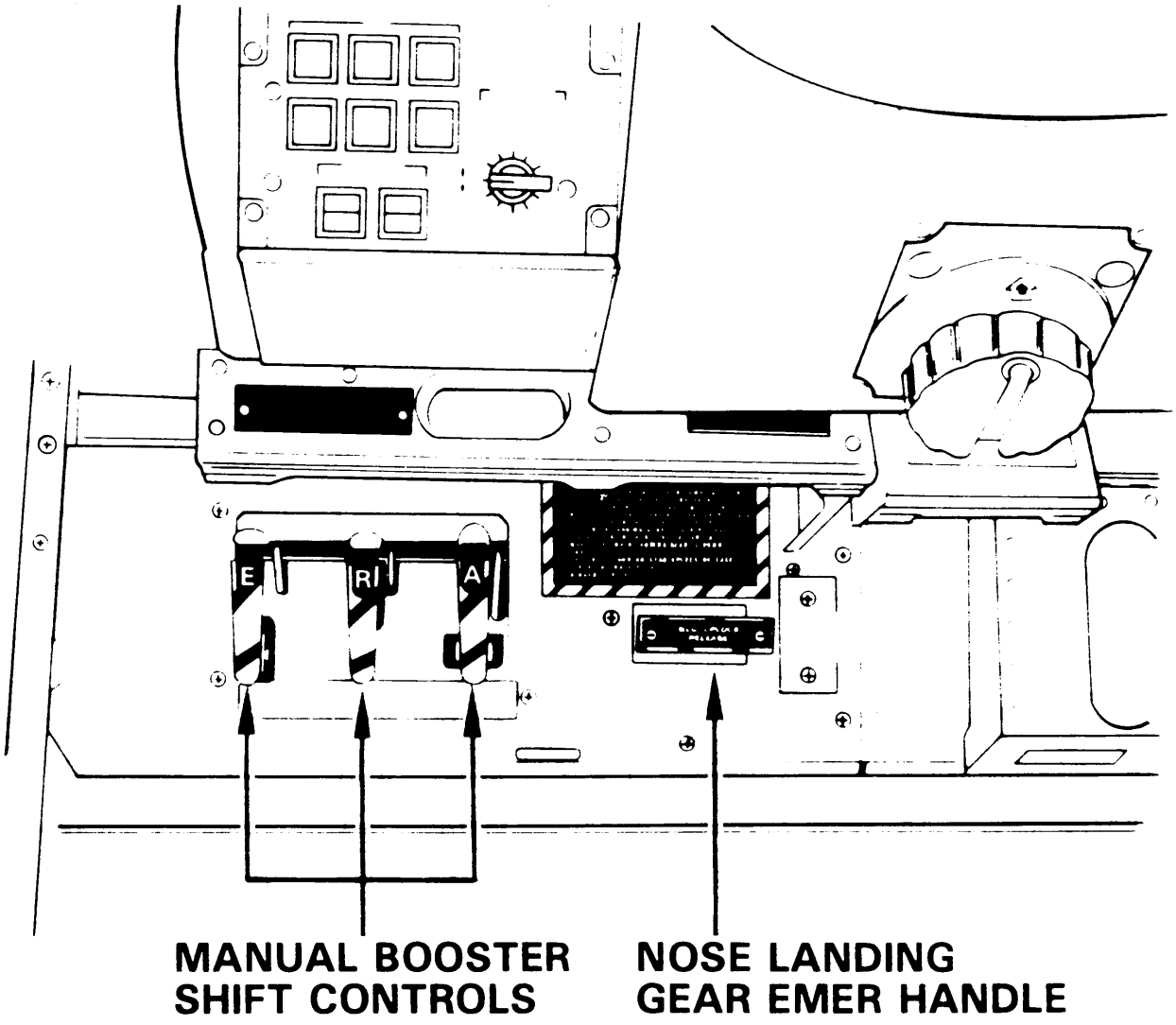


Figure 2-48. Hydraulic Emergency Manual Control Handles

2.13.2.4 Surface Control Locks

The effect of surface control locks is achieved by leaving the flight control boosters engaged when the aircraft is parked. The boosters provide sufficient resistance to absorb wind gust loads.

2.13.2.5 Aileron Control System

Movement of the control wheel operates the aileron booster unit through a system of cables. Output from the booster moves the ailerons through push-pull rods that connect the booster output lever to the aileron bellcrank assemblies.

2.13.2.6 Elevator Control System

Control column movement is transmitted to the elevator booster unit by a cable and pulley system. Booster output moves the elevators through a push-pull rod connected to the elevator torque-tube bellcrank.

2.13.2.7 Rudder Control System

A system of cables and pulleys transmits rudder pedal movement to the rudder booster unit. The output lever of the booster is linked to the rudder torque-tube bellcrank.

2.13.2.8 Rudder Pedals

Rudder pedals for the pilot and copilot are conventional in operation. A fore-and-aft adjustment knob is located between each set of pedals.

2.13.2.9 Control Wheels

The two control wheels are conventional in operation and are mechanically connected to booster assemblies that, in turn, are connected to the ailerons and elevators. Microphone switches and autopilot disconnect switches are located on the outboard side of both control wheels. Armament switches are located on the inboard side of each wheel.

2.13.2.10 Manual Booster Shift Controls

Three push-pull handles, one for each booster unit, are located under a hinged cover plate at the base of the center control stand. Pulling the handle shuts off the booster and changes the mechanical advantage. Pushing the handle back in reengages the booster.

CAUTION

If boost handles are pulled laterally or with excessive force past the mechanical stops, it may be impossible to reengage them in flight.

2.13.2.11 Aileron Trim Tab Knob and Position Indicator

The aileron trim tab control is located on the rear face of the center control stand. It is a combination knob and handcrank. An indicator above the knob shows the relative tab position.

2.13.2.12 Elevator Trim Tab Control Wheels and Position Indicators

Elevator trim tab control wheels, located on each side of the center control stand, rotate forward and aft for nosedown or noseup elevator trim. A dial in the center of each wheel indicates the relative position of the trim tabs.

2.13.2.13 Elevator Force Link Tab

A spring tab is located on the inboard portion of each elevator. Its spring load is an automatic function of the elevator trim tab setting. The function of this tab is to improve the elevator force gradient with airspeed when flying with an aft center of gravity (cg). At forward cg when operating at full noseup trim tab, the force link tab is automatically locked downward to act as a supplementary trim tab to improve forward cg minimum trim.

2.13.2.14 Rudder Trim Tab Knob and Position Indicator

A rudder trim tab control knob and handcrank is located on top of the center control stand. The relative amount of left or right trim is shown on an indicator at the base of the knob.

2.13.3 Wing Flaps

The wing flaps are of the high-lift Fowler type. This type of flap uses a combination of aft movement to increase the wing area and a drooping (downward) movement to change the airfoil section. The wing flaps are powered by the combined No. 1 and No. 2 hydraulic systems. Because of this dual system operation, no emergency method of flap operation is necessary or provided. Each hydraulic system by itself is capable of supplying sufficient power for flap operation.

During operation of the flaps, hydraulic fluid from the No. 1 and No. 2 systems flows through the asymmetry shutoff valve to the flap control manifold assembly. This manifold routes the fluid to the control valve. The control valve, when actuated by the flap lever, allows fluid to flow to two hydraulic motors, one of which is located on each side of the main flap gearbox. The hydraulic motors convert fluid pressure to rotary mechanical motion for driving the gearbox. The direction of rotation of the flap motors is dependent upon the lever position selected in the flight station. The gearbox drives the flaps through a system of torque tubes and actuator units.

To prevent the normal pitch changes during flap extension when the aircraft is on autopilot, a transmitter on the gearbox directs compensatory signals proportional to flap extension to the autopilot.

2.13.3.1 Flap Asymmetry Protection

The flaps are rigged to provide symmetrical extension and retraction of the right and left flap sections. An asymmetry switch, actuated by the flaps, prevents any asymmetrical condition between the flap sections. This asymmetry switch shuts off fluid to the flap hydraulic motors, stopping the flaps if the flaps on one side extend more than those on the other. If flap travel has been stopped by the asymmetry switch, flap brakes are applied, flaps cannot be moved, and a landing must be made in the existing extension configuration.

2.13.3.2 Flap Control Lever

The flap control lever is located on the center control stand. The flap lever quadrant is marked FLAPS UP, MANEUVER, TAKEOFF/APPROACH, and FLAPS DOWN. Pushing the flap lever release button on the side of the lever unlocks it for movement to any of the indicated flap positions; releasing the flap lever release button locks the lever in the selected position.

2.13.3.3 Wing Flap Position Indicator

A wing flap position indicator located on the upper part of the copilot instrument panel shows flap position in percent of extension (Refer to FO-18).

2.13.3.4 Wing Flap Asymmetry Indicator Light

A wing flap asymmetry indicator light, reading FLAP ASYM, is located on the center instrument panel in the indicator light group. This indicator illuminates when an asymmetrical wing flap condition occurs. The asymmetry caution light circuitry will annunciate a flap asymmetry from either the detection system or actuation of the flap asymmetry hydraulic shutoff valve.

2.13.4 Landing Gear

The landing gear comprises two main gears and the nose gear. Each gear consists of dual wheels and forward-retracting struts. The landing gear is designed so that the weight of the aircraft on the gear keeps it down and locked. A mechanical safety downlock is provided to prevent inadvertent retraction when the aircraft is on the ground. If hydraulic pressure is lost in flight, the gear uplocks can be released manually; the gear will free fall and lock down because of the combined forces of gear weight, aerodynamic load, and downlock bungee spring load (Figure 2-49). During the first part of the retraction cycle, main gear wheel rotation is stopped automatically by in-flight brakes to prevent excessive loads in the gear retraction and uplock mechanism. Mechanically operated doors enclose each gear assembly; however, the main gear doors incorporate a single-acting hydraulic cylinder to assist in door closing. Hydraulic power for normal retraction and extension and nosewheel steering is supplied by the No. 1 hydraulic system and operates as illustrated in Figure 2-50.

2.13.4.1 Landing Gear Control Lever

Two landing gear levers, one for each pilot, are located to the left and right, respectively, of the center control stand. The levers are placarded UP and DN. Moving the handle to the DN position with hydraulic pressure available provides release pressure to the uplock release cylinders of each gear and to the down side of each gear actuating cylinder. After all gears are up and locked, the selector valve automatically returns to neutral, thus removing hydraulic pressure from the landing gear system. The gear lever does not go to neutral. The nosegear uplocks can be released manually by pulling a T-handle located on the offset at the rear of the center control stand, next to the control surface booster shift handles. The main gear manual uplock release handle and the landing gear selector valve are located in the hydraulic service center and can be reached through the access hatch in the cabin deck (Refer to FO-18).

2.13.4.2 Landing Gear Warning System (LGWS)

The LGWS provides a positive aural and visual warning to the flight station crew if one or more of the landing gear are not down and locked and a set of predetermined conditions are met that indicate a landing is imminent. These conditions are based on the following variables: airspeed, flap handle position, and power lever position.

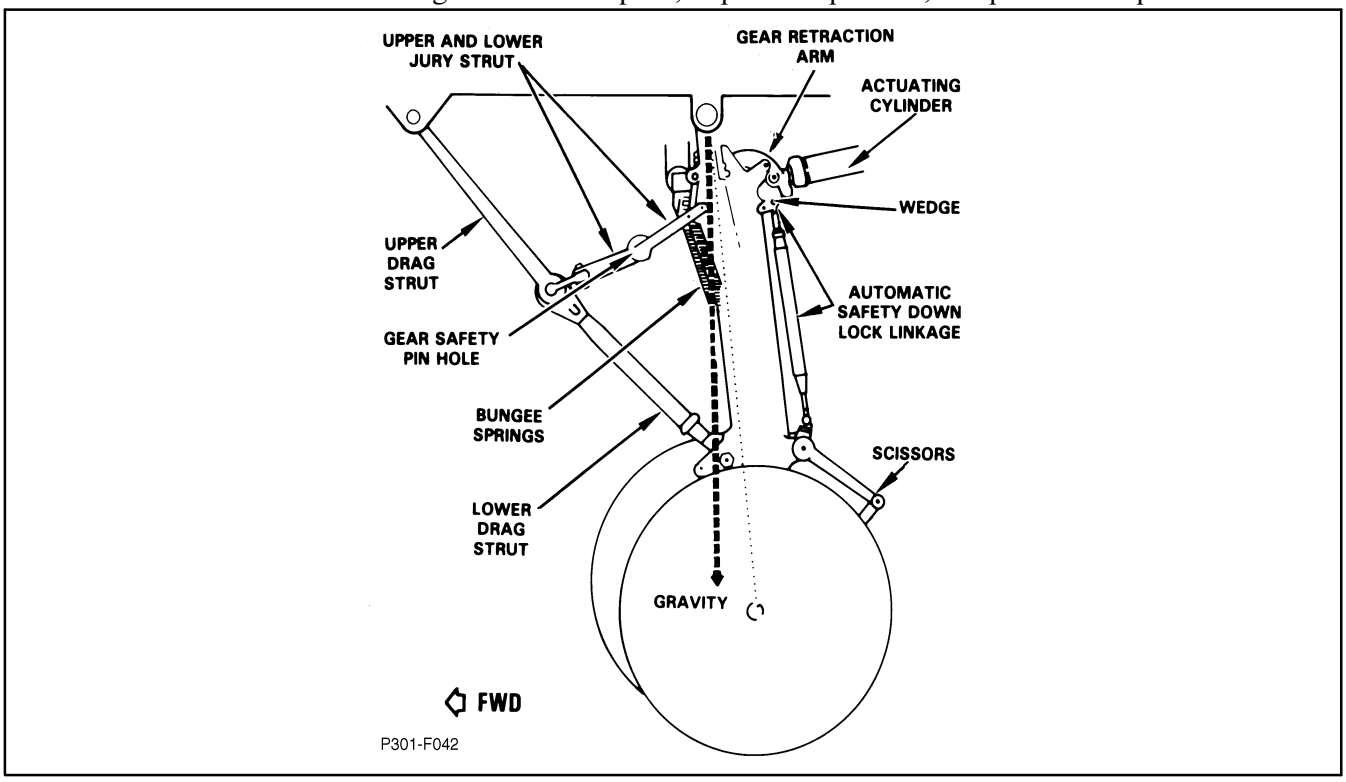


Figure 2-49. Landing Gear Downlock

The LGWS will activate the landing gear warning lights (WHEELS), located on both the pilot and copilot instrument panels, and the landing gear warning horn, located above the forward electrical load center circuit breaker panel, when any of the landing gear is not down and locked and:

1. The airspeed is below 153 ±3 Knots Indicated Speed (KIAS) and any of the power levers are below 48° coordinator.

Note

The 153 KIAS warning can be canceled with the landing gear warning override button on the right side of the center console.

2. The airspeed is below 142 ±3 KIAS and any of the power levers are below 60° coordinator.

Note

The 142 KIAS warning cannot be canceled with the override button.

3. The flap handle is moved to the landing position.

Note

The flap handle warning cannot be canceled with the override button.

The logic for the LGWS is provided by a series of switches (Figure 2-51) located throughout the aircraft. The three landing gear downlock switches are located on the landing gear downlocks. The four 48° and four 60° switches are located in the power lever quadrant within the center console. The flap handle switch and the landing gear warning override switch are also in the center console. The 153- and 142-knot switches are located in the copilot pitot-static system.

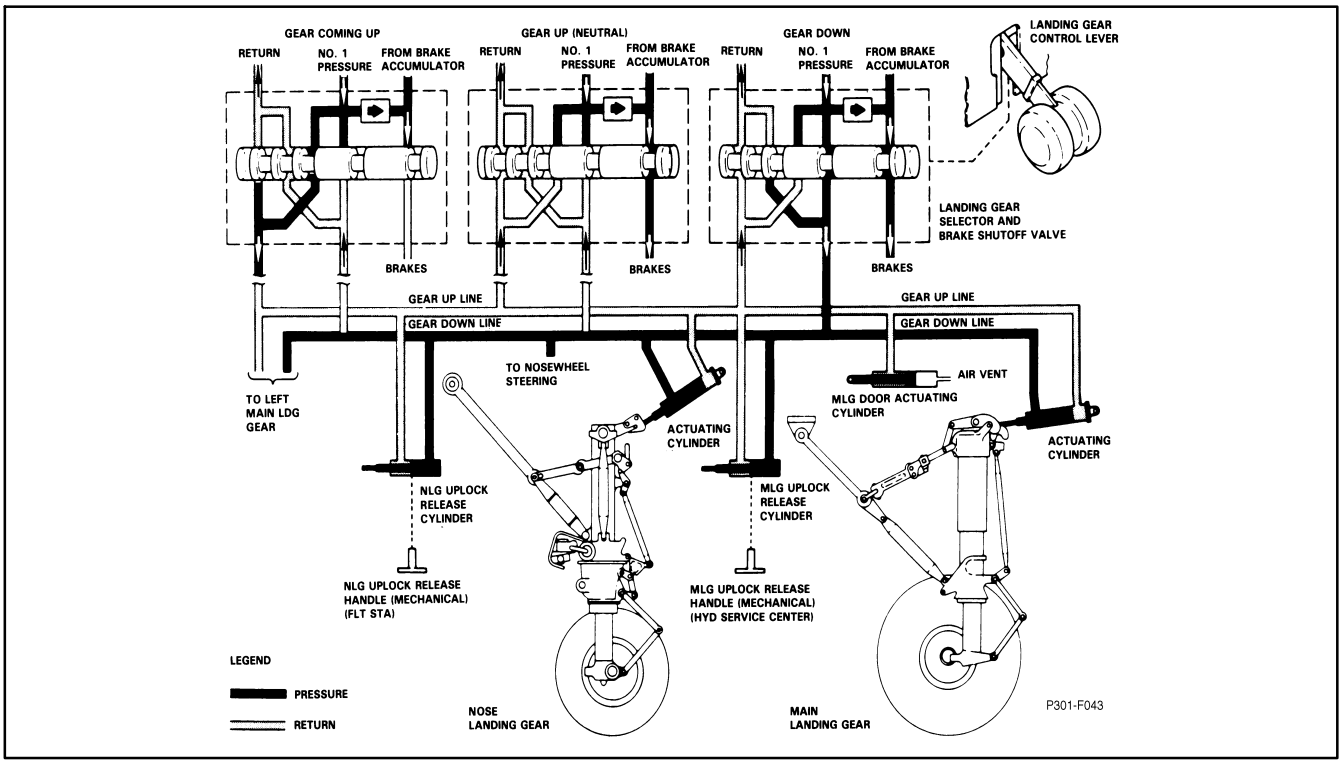


Figure 2-50. Landing Gear Hydraulic System

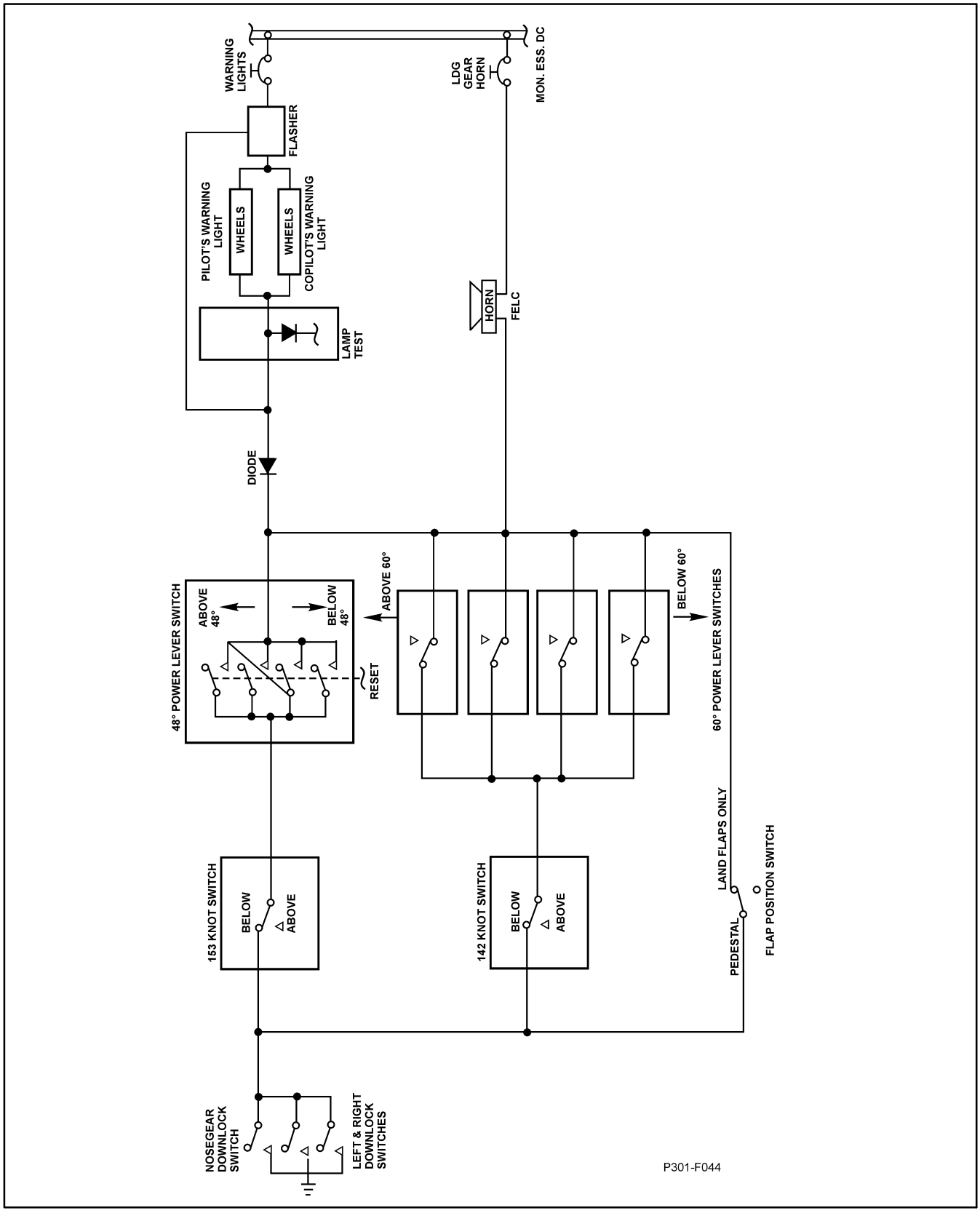


Figure 2-51. Landing Gear Warning System Electrical Schematic

The LGWS is powered by the MEDC bus through a circuit breaker located on the main circuit breaker panel on the forward electrical load center. The WHEELS lights can be tested with the PANEL SIGNAL LIGHTS TEST-INST switch located on the flight station overhead panel. The horn is prevented from operating when the TEST switch is activated through the use of a blocking diode.

2.13.4.3 Landing Gear Indicators

A red warning light in the knob of each handle illuminates when the gear is not locked in the selected position. Position indicators for each gear are located on the upper left of the copilot instrument panel. The gear handle lights and position indicators are powered from the extension MAIN DC BUS.

The annunciator lights (WHEELS) on both the pilot and copilot instrument panels and the landing gear warning horn function as described above. The WHEELS lights and landing gear warning horn are powered from the MEDC bus and are controlled by a set of contacts on the downlock switches. Refer to FO-18.

2.13.5 Nosewheel Steering System

Nosewheel steering is accomplished by applying reduced pressure from the No. 1 hydraulic system to either end of a steering cylinder mounted on the nosewheel strut. Rotating the steering wheel on the pilot side panel operates a control valve and follow-up mechanism that provides for turning the nosewheel approximately 67° left or right of straight ahead when the nosegear is extended. Travel of the steering wheel is approximately three turns from stop-to-stop; therefore, a centered indicating arrow on the nosewheel steering wheel is no guarantee that the nosewheel points straight ahead because it indicates straight ahead at three places. The pilot must check the position of the nosewheel during the preflight inspection.

2.13.6 Brake System

The engine-propeller combination on the P-3 aircraft is usually effective in stopping the aircraft and reducing the work brakes normally do. Four multiple-disc brake assemblies, one for each main gear wheel, are mounted on the strut side of each main gear axle. Brake clearance is adjusted automatically.

2.13.6.1 Normal Brakes

For normal brake operation, hydraulic pressure is supplied by the No. 1 hydraulic system. This (high) pressure is controlled and reduced by a dual valve that is mounted in the hydraulic service center. It is connected to the pilot and copilot brake pedals by a cable system. The brake system uses a cylindrical floating piston-type accumulator with an air charge of 800 psi on one side of the piston and a hydraulic charge of 3,000 psi on the fluid side. The fluid volume required to compress the 800-psi air charge to 3,000 psi is approximately 0.6 gallon. This fluid volume provides approximately eight full brake applications. Charging the brake accumulator with the No. 1 hydraulic system requires approximately 3 seconds and by the 1B hydraulic pump, 3 minutes.

2.13.6.2 Automatic In-Flight Braking System

For in-flight brake operation, pressure flows from the gear-up line through the brake selector valve to provide automatic brake application at a reduced pressure during gear retraction. In-flight brake pressure is released after the gear is up and locked and the landing gear selector valve has returned to neutral.

2.13.6.3 Emergency Airbrakes

An emergency airbrake pressure source is provided by a 3,000 psi air bottle located in the hydraulic service center. This emergency system is completely independent of the normal brake system down to the brake assembly shuttle valves. Two emergency brake control handles are located one each on the pilot and copilot side panels. They are cable connected to an air-modulating valve located in the hydraulic service center. Differential braking is not available with the emergency airbrake system.

2.13.6.4 Parking Brakes

The parking brakes are set by depressing the toe pedals and by pulling the parking handle to lock the brake control valves in the open position. The accumulator will keep the parking brakes set for approximately 30 hours without recharging.

2.13.6.4.1 Parking Brake Handle

A T-handle, located on the pilot instrument panel, is used to lock the parking brakes in the set position. The brakes can be set only from the pilot position; however, they can be released by pressing either the pilot or copilot pedals.

2.13.7 Bomb Bay Door System

The bomb bay doors are operated by the No. 1 and No. 2 hydraulic systems. Hydraulic system No. 1 actuates the left bomb bay door, and the No. 2 hydraulic system actuates the right bomb bay door. Both bomb bay door actuating cylinders are linked together so that if one hydraulic system fails, the remaining system will operate both doors. An emergency reservoir and a handpump are provided for emergency opening and closing of the bomb bay doors in the event both hydraulic systems fail. During normal operation, the bomb bay doors are opened or closed by routing No. 1 and No. 2 hydraulic system pressure through a dual-flow control valve to the door actuating cylinders. The control valve is electrically operated by the BOMB BAY OPEN-CLOSE switch located on the pilot armament control panel. The control valve can be mechanically positioned using the bomb bay safety lock lever or the TACCO bomb bay control T-handle. Once the control valve is moved to the open position, it is held in the open position by mechanical detents.

Two ground safety mechanisms are provided that prevent inadvertent closing of the bomb bay doors. These safety mechanisms are located behind the safety pin access door on the port forward side of the fuselage. The first mechanism is a switch actuated by simply opening the safety pin access door. This switch removes electrical power from the BOMB BAY OPEN/CLOSE switch and reapplies power when the access door is closed. The second mechanism is a lever and safety pin. Pulling the safety lock lever and inserting the safety pin locks the hydraulic control valve in the open position, thereby preventing closure of the bomb bay doors.

WARNING

- Ensure a lookout is posted in front of the aircraft to visually check the doors. Do not open or close bomb bay doors with personnel or equipment in the immediate vicinity of the bomb bay. Do not enter the bomb bay without first verifying all hydraulic pumps are secured, the bomb bay safety lock access door is open, the safety pin is installed, and the cable connecting the safety lock and door actuator is taut. Do not pull bomb bay circuit breakers after opening or closing the bomb bay doors.

- Structural failure of the air multiplier turbocompressor can cause extensive damage or injury to personnel in the adjacent areas. All personnel approaching the bomb bay area must be aware of the potential for air multiplier assembly damage as a result of blocking the air intake.

- If the bomb bay doors are closed with electrical and hydraulic power applied to the aircraft, shifting the bomb bay door safety lock lever to the down position will result in opening of the bomb bay doors.

2.14 MISCELLANEOUS EQUIPMENT

2.14.1 Galley

The galley is located on the port aft side of the cabin. Galley facilities include stowage cabinets with a work top and table, oven, refrigerator, liquid compartment, and hot cups. A two-place, hinged seat (with stowage space beneath for loose equipment) is provided with two seatbelts and can be used as a ditching station. The oven and the 2-gallon liquid container are equipped with plug-in electrical connectors powered by switches located on the galley control panel. Two flush-mounted outlets on the galley face, controlled by timing devices, are available for use with the hot

cups. Three additional outlets are provided. Power-on lights, located on the galley control panel, glow when the hot cups, liquid container, and oven are in operation. The galley plug-in electrical connectors are powered by switches located on the galley control panel. Current is monitored automatically when either the empennage or propeller ice control system is energized under single-generator operation.

Note

The galley exhaust should remain open when cooking unless pressurization problems require that it be closed.

2.14.2 Dinette

Dinette facilities are located in the starboard aft position of the fuselage across the cabin aisle from the galley. A table and two benches with stowage cabinets beneath the seats are provided.

There are four seatbelt assemblies installed, but only the forward outboard position is to be used for ditching.

2.14.3 Lavatory

Lavatory facilities are located in the aft cabin area and consist of a chemical toilet, a self-contained 6.5-gallon urinal, water tank, wash basin, razor outlet, mirror, light, and dispensers for paper towels and toilet paper. The 4.5-U.S. gallon water tank supplies wash water to the basin. Waste water is collected in a removable container below the basin. Red and white lights illuminate the lavatory compartment.

CAUTION

The lavatory in the P-3 aircraft was not designed to stow loose gear; therefore, loose gear stowed in that area shall be kept to a minimum to prevent damage to the lavatory.

2.14.4 Bunks

Two bunks are installed on the starboard aft side of the aircraft. The bunks are hinged to fold back so the dinette and work bench area may be used.

2.14.5 Ladder

The P-3C is equipped with a track-mounted, stowable, electromechanically operated entry ladder with collapsible handrails (for utility) and terrain compensating wheels for leveling of the ladder feet. An actuator with a chain drive mechanism deploys and retracts the ladder.

MAIN AC BUS A power is supplied to a DC controlled three-phase, reversible-type motor through a LADDER circuit breaker on the aft electronic circuit breaker panel. A ladder switch (UP, DOWN, OFF), located at the lighting console aft of the main cabin doorway, controls the motor. An interlock permits operation of the ladder only when the cabin door is open and stowed. Load limit switches, self-release plug disconnects, and a step light are incorporated as safety factors.

CAUTION

Damage to the drive, stops, or gear train will result if the actuator is overdriven during manual operation.

A handcrank is provided for manual operation if electrical power fails. The crank is stowed by clips on the forward side of the actuator assembly.

Note

Alignment of the manual drive index is required to lock the actuator and hold the ladder rigidly in flight.

The ladder has two positions on the deck tracks. It shall be outboard for deployment and inboard for in-flight stowage and cabin door operation. A foot latch allows the ladder to unlock and to be moved to an alternate position. Openings at the inboard end of each track permit the ladder to be removed from the tracks for cargo loading. The ladder should be in the outboard position on the track for deployment prior to actuation of the ladder switch.

To remove the ladder from its tracks, rotate the stop to the unlocked (horizontal) position and release the foot latch.

CAUTION

Handrails must be in the upright position with quick-release pins installed prior to unfolding from the half-tuck or tuck-under position, or raising or lowering the ladder.

2.14.6 Map Case

The aircraft is equipped with three map cases; one is located in the aft platform of the pilot side console, one is attached to the forward wall of electronic rack A-1, and one is attached to the flight station bulkhead aft of the copilot side console.

2.14.7 Approach Plate Holder

On later aircraft an approach plate holder, normally stowed in the pilot and copilot map cases, can be attached to each control wheel. The flight station utility lights can be attached to the light brackets above the side windshields to illuminate the approach plate.

2.14.8 Miscellaneous Stowage Locker

Two miscellaneous stowage lockers are located at the starboard aft fuselage area beneath the work surface aft of the dinette.

2.14.9 Publications Stowage Box

A publications stowage box is located at the starboard aft fuselage area, above the work area, just aft of the dinette.

2.14.10 Navigator Step

A navigator step required for sextant use is located on the port side of the NAV/COMM station bulkhead. It is hinged to a slide assembly to permit folding against the bulkhead when not in use. When extended, it is supported by a bracket on the TACCO station bulkhead. In use, the step actuates a switch that turns on aisle-obstruction warning lights.

2.14.11 Security Locker

A lockable security locker is located in the aisle bulkhead at the TACCO station.

2.14.12 Window Polarized Blackout Filters

Panels containing two-piece, polarized blackout filters are installed at the TACCO, NAV/COMM, and nonacoustic stations. The panels are retained by guides so they can be pushed away from the windows to allow unrestricted observation or illumination. If subdued light is desired, the panels slide over the windows. The outer piece of each filter is installed in a fixed position; the inner piece can be rotated, using an attached knob, thereby adjusting the degree of light passage. Maximum darkness is achieved by rotating the inner polarized filter counterclockwise to a limit of 90°.

WARNING

Do not look directly at the sun through the polarizing windows at the TACCO, NAV/COMM, and nonacoustic operator stations, as central retinal injury to the eye may result because of thermal burns.

2.14.13 Pilot Seats

The pilot seats consist of tubular aluminum frames covered with stretched nylon net. They are mounted on rollers that move forward and aft on rails set in the flight station deck and are locked in position by spring-loaded pins controlled by levers located under the left front seat corners. The seats are also adjustable through a vertical travel of 5 inches; height is controlled by levers located under the right front seat corners. The seats are spring-loaded in the up position, which tends to raise them as the pilots' weight is removed. Armrests that are adjustable in height stow parallel to the seatback. The seatbacks recline forward and aft by control levers located under the left edges of the seats near the back. Removable headrests are adjustable within a travel of 3 inches.

2.14.14 Flight Engineer Seat

The flight engineer seat is of the same construction as the pilot seats. The major difference is that the tracks are skewed and the forward and aft lock mechanism inserts pins into holes in the top of the rails instead of through the side. This difference precludes the necessity for wide openings in the flight station deck. The flight engineer seat is located between the pilot seats in the center of the flight station.

2.14.15 NAV/COMM, TACCO, Nonacoustic Operator Seats

The NAV/COMM, TACCO, and nonacoustic operator seat construction is similar to that of the pilot and flight engineer seats. They move laterally on tracks and lock in position by use of a step-treadle mounted on each seat base. Forward and aft movement and adjustment are incorporated in a mechanism located between the seat bottom and the mounting pedestal.

2.14.16 Crew Seats

The observer and both acoustic operator seats are similar to the pilot seats. These seats move along tracks and lock in position by use of a step-treadle mounted at each seat base. Forward and aft seatback adjustment may be made by the recline lever located under the seats. These crew seats swivel through 360° and may be locked in positions differing by 45°.

2.14.17 Seatbelts

Each seat is equipped with a safety belt. Belts are attached at designated crew ditching stations, and extra belts are installed for additional ditching stations. Refer to Figure 12-8. All personnel should fasten their seatbelt while seated at a ditching station.

2.14.18 Shoulder Harness

All forward facing seats are equipped with shoulder harnesses. All other seats on the aircraft can be rotated to face aft and therefore do not require shoulder harnesses.

2.14.19 Inertia Reel

Each pilot and flight engineer seat incorporates an inertia reel. A control location on the left side of the seat permits the inertia reel to be locked or unlocked manually. When a sudden forward inertia force is applied to the reel, it automatically locks and secures the harness.

2.14.20 Hard Hats

Stowage for hard hats is provided at each primary crew position.

2.14.21 Electrical Service Outlets

Forty-six service outlets are provided throughout the aircraft to supply power for electronic/electrical maintenance equipment and for small appliance use. All outlets are energized whenever power is supplied to the aircraft electrical system. All AC outlets are 400 cycle. Six two-prong, 28-Vdc service outlets, located at the pilot, copilot, TACCO, NAV/COMM, port aft observer, and starboard aft observer stations are provided. Four additional outlets supply 115-Vac power to four-pin receptacles for the pilot, copilot, port aft observer, and starboard aft observer. Phase A, 115-Vac power is supplied to 20 outlets throughout the aircraft including one four-pin receptacle located in the forward radar rack. The remaining outlets are three-prong. In addition, 11 three-prong outlets supply phase B AC.

The top and bottom outlets at the galley are also three-prong and appliance power is supplied from the three phases of the MAIN AC BUS B through the galley circuit breaker in the main load center to individual circuit breakers in the port aft circuit breaker panel.

Note

A load monitor relay in the DC power line provides overload protection during single-generator propeller and empennage deicing operation and shuts down the galley AC power line.

Three-prong outlets are used normally to supply power for in-flight and ground maintenance equipment.

One MAIN AC BUS A, two-prong outlet at the lavatory provides 115-Vdc power via a power supply for use with an electric razor.

2.14.22 Mk 8 Mod 8 Rocket Sight

An illuminated, collimating, reflector-type, fixed sight that contains an illuminated fixed-reticle image pattern is provided for rocket sighting. The sight is stowed at the base of the center control stand on the copilot side; for use, it is installed in front of the pilot on the instrument panel glareshield. Operate the sight by turning on the sight switch and adjusting the rheostat for proper illumination. A bracket provides for mounting to the aircraft and aligning the sight vertically and horizontally. The rocket sight light receives power from the SIGHT LIGHT circuit breaker on the forward lighting bus at the forward load center. The brilliance of the light is controlled by the SIGHT rheostat located on the flight station port outboard overhead panel. The sight illumination bulb has a dual filament, either of which may be selected on the FILAMENT 1/FILAMENT 2 control switch, located adjacent to the sight switch.

CHAPTER 3

Servicing

3.1 REFUELING

The P-3 aircraft is designed to be fueled by two methods: center-point pressure fueling and overwing gravity feed. Refer to Figures 3-1 and 3-2 for fuel quantities and specifications.

WARNING

- Any Radio Frequency (RF) transmission is a potential source of fuel ignition. Use of transmitting equipment during fueling operations should be avoided.
- Allow at least 3 minutes following refueling before using the dipstick. Failure to do so may result in static discharge.
- Aircraft incorporating AFC-517 (explosive suppressant foam) build up and retain electrostatic charges during fueling/defueling operations. Following fueling/defueling of aircraft with AFC-517 installed, allow at least 15 minutes to dissipate electrostatic charges prior to using the dipstick or hydrostatic fuel gauge. The dipstick or hydrostatic fuel gauge shall not be used when the aircraft is exposed to temperatures below –34 °C. Overwing gravity fueling operations shall not be performed on aircraft incorporating AFC-517 when outside air temperature is below –6 °C.

Note

- Because of wing dihedral, the filler wells must be located near the high outboard end of the engine feed tanks. To ensure adequate fuel levels for fuel dip quantity checks, inboard tanks should have 5,500 pounds or more and outboard tanks should have 9,500 pounds or more of fuel.
- If requirements dictate, flight without the tank 5 drain mast installed is authorized. The following limitations apply regardless of the fuel load in tank 5. If operating without the drain mast installed, do not perform practice emergency descents or unnecessary rapid descents. If mission requires deployment of sonobuoys with fuel in tank 5, ensure fuel transfer rate is normal. If excessive, sonobuoys should not be deployed using Cartridge-Actuated Devices (CADs).

3.1.1 Center-Point Pressure Fueling

The normal fueling for the P-3 aircraft will be accomplished with the center-point pressure system, which is designed to accept 600 gallons of fuel per minute from two fuel trucks pumping simultaneously. The aircraft can also be fueled by one truck but at a reduced rate of approximately 300 gallons per minute (gpm).

	U.S. GAL	IMP GAL	LITERS	POUNDS*		
FUEL (Specification JP-4, JP-5, and JP-8)				(JP-4) @ 6.5 lb/gal	(JP-5) @ 6.8 lb/gal	(JP-8) @ 6.7 lb/gal
Tank No. 5	2646	2203.32	10,015.11	17,199	17,993	17,728
Inboard Tanks (two)	1671 (ea)	1391.44	6,324.74	10,861	11,363	11,196
Outboard Tanks (two)	1606 (ea)	1337.32	6,078.71	10,439	10,921	10,760
Total	9200	7660.84	34,822.01	59,800	62,560	61,640
HYDRAULIC FLUID Specification MIL-H-83282; MIL-H-5606 (Alternate)						
Hydraulic System No. 1	16.20	13.49	61.32			
Hydraulic System No. 2	4.50	3.75	17.03			
Hydraulic System Reservoir No. 1	5.60	4.66	21.19			
Hydraulic System Reservoir No. 2	1.00	0.83	3.78			
Bomb Bay Door Emergency	0.75	0.60	2.25			
PROPELLER FLUID Specification MIL-H-83282; MIL-H-5606 (Alternate)						
Propeller Fluid System	6.20	5.16	23.47			
ENGINE OIL (Specification MIL-L-23699, MIL-L-7808)†						
Engine, Model T56 (four)	8.65 (ea)	7.20	32.88			
Cabin Air Compressor (two)	1.00 (ea)	0.83	3.78			
Auxiliary Power Unit	1.00	0.83	3.78			
Starter (Hamilton Standard)††	0.031	0.026	0.118			
	(4.0 fl oz) (ea)		(118 cc)			
Starter (AiResearch)††	0.112	0.094	0.425			
	(14.4 fl oz) (ea)		(425 cc)			
WINDSHIELD WASHER FLUID (Specification MIL-F-5566 Isopropyl Alcohol TT-1-735)						
Windshield Washer (20 percent water, 80 percent alcohol; 100 percent alcohol optional)	1.00	0.83	3.785			
OXYGEN (Specification MIL-O-27210B) 1800 psi (1500 psi minimum at 70 °F). Refer to Figure 3-3 for temperature versus pressure table.						
REFRIGERATION UNIT (Specification MIL-L-23699) — Capacity 0.7 pint (340 cc)						
AIR MULTIPLIER PACKAGE (Specification MIL-L-23699) — (Air-Conditioning) Capacity 8.45 oz.						

	Tire Pressure MLG				Tire Pressure NLG
	Takeoff Gross Weight	Inflated Tires – psi MIN	MAX		150 psi for weights up to 135,000 lb. 170 psi for weights 135,000 to 139,760 lb.
	85,000	122	190		
	90,000	130	190		
	100,000	148	190		
	110,000	156	190		
	120,000	165	190		
	135,000	190	190		
	139,760	200	200		

NOTES:

* Specific gravity of fuel varies. Hydrometer readings are required for accurate calculations.

† When start temperatures below –40 °C (–40 °F) are anticipated, MIL-L-7808 should be used in lieu of MIL-L-23699.

†† One starter per engine, four per aircraft (may be intermixed).

Figure 3-1. Servicing Quantities

	NATO CODE NO.	FUEL TYPE[1]	U.S. MILITARY		UNITED KINGDOM		ASTM COMMERCIAL	
			Code	Spec	Code	Spec	Code	Spec
Primary[2] Fuels	F-44	HIGH FLASH KEROSENE	JP-5	MIL-T-53624L	AVCAT/FSII	DSTAN 91-86 (DERD 2452)	NONE	NONE
	F-34	KEROSENE	JP-8	MIL-T-83133A	AVTUR/FSII	DSTAN 91-87 (DERD 2453)	NONE	NONE
	F-40	WIDECUT	JP-4	MIL-T-5624 L	AVTAG/FSII	DSTAN 91-88 (DERD 2454)	NONE	NONE
Alternate[3] Fuels	F-35	KEROSENE	JP-8[5]	MIL-T-83133 A	AVTUR	DSTAN 91-91 (DERD 2494)	JET A-1	ASTM D-1655
	NONE	KEROSENE	NONE	NONE	NONE	NONE	JET A[6]	ASTM D-1655
	NONE	WIDECUT	JP-4[5]	NONE	AVTAG	NONE (DERD 2486)	JET B	ASTM D-1655
Emergency Fuels[4]	F-12	GASOLINE	AVGAS 80	MIL-G-5572 F	NONE	NONE	GRADE 80	ASTM D-910
	NONE	GASOLINE	AVGAS 100	MIL-G-5572 F	NONE	NONE	GRADE 100	ASTM D-910
	F-18	GASOLINE	AVGAS 100LL	MIL-G-5572 F	NONE	NONE	GRADE 100LL	ASTM D-97

NOTES:

1. The use of gasoline (ASTM D-910) may require adjustment of fuel control governor for satisfactory pitchlock and governor check. Low-speed ground idle adjustment may also be required. Flameout is possible during speed reset operation in the taxi range.
2. Primary fuels are those fuels that the aircraft and engine were designed to use without any operational restrictions.
3. Alternate fuels are those fuels that can be used without operational restrictions, but which can impact durability if used for multiple flights. The alternate fuels listed are commercial fuels. Alternate fuels are authorized for occasional flights because they do not always contain the following additives, which are included in the Primary Fuels:

   a. Fuel System Icing Inhibitor (**FSII**). The additive prevents the formation of ice in the fuel, which can block the engine fuel filter. It also acts as a biostat to prevent the development of microbiological contamination in the aircraft during inactive periods.

   b. Corrosion Inhibitor/Lubricity Improver. The additive improves the long-term durability of the aircraft and engine fuel systems by increasing fuel lubricity.

   Multiple flights with fuels that do not contain either of these additives are authorized; however, continuous use of such fuels is not recommended since the life of fuel system components may be compromised.
4. Emergency fuels are those that impose operational restrictions on the aircraft when used.
5. The basic physical and chemical properties of these military fuels are similar to those of the listed commercial fuels; however, the commercial fuels do not usually contain the necessary additives. See note 3 above.
6. Jet A fuels may solidify if they are chilled to temperatures below –40 °C compared to –46 °C for JP-5 and –47 °C for JP-8.

Figure 3-2. Fuel Availability

TEMPERATURE		PRESSURE		TEMPERATURE		PRESSURE	
°C	°F	MAXIMUM	MINIMUM	°C	°F	MAXIMUM	MINIMUM
–45.6	–50	1,239	939	11.1	52	1,716	1,416
–44.4	–48	1,248	948	12.2	54	1,726	1,426
–43.3	–46	1,258	958	13.3	56	1,735	1,435
–42.2	–44	1,267	967	14.4	58	1,744	1,444
–41.1	–42	1,277	977	15.6	60	1,753	1,453
–40.0	–40	1,286	986	16.7	62	1,763	1,463
–38.9	–38	1,296	996	17.8	64	1,772	1,472
–37.8	–36	1,305	1,005	18.9	66	1,781	1,481
–36.7	–34	1,315	1,015	20.0	68	1,790	1,490
–35.6	–32	1,324	1,024	21.1	70	1,800	1,500
–34.4	–30	1,334	1,034	22.2	72	1,809	1,509
–33.3	–28	1,343	1,043	23.3	74	1,818	1,518
–32.1	–26	1,352	1,052	24.4	76	1,827	1,527
–31.1	–24	1,362	1,062	25.6	78	1,836	1,536
–29.9	–22	1,371	1,071	26.7	80	1,846	1,546
–28.9	–20	1,381	1,081	27.8	82	1,855	1,555
–27.7	–18	1,390	1,090	28.9	84	1,864	1,564
–26.7	–16	1,399	1099	30.0	86	1,873	1,573
–25.6	–14	1,409	1,109	31.1	88	1,882	1,582
–24.4	–12	1,418	1,118	32.2	90	1,892	1,592
–23.3	–10	1,428	1,128	33.3	92	1,901	1,601
–22.2	–8	1,437	1,137	34.4	94	1,910	1,610
–21.1	–6	1,446	1,146	35.6	96	1,919	1,619
–20.0	–4	1,456	1,156	36.7	98	1,928	1,628
–18.9	–2	1,465	1,165	37.8	100	1,938	1,638
–17.8	0	1,475	1,175	38.9	102	1,947	1,647
–16.7	2	1,484	1,184	40.0	104	1,956	1,656
–15.6	4	1,493	1,193	41.1	106	1,965	1,665
–14.4	6	1,503	1,203	42.2	108	1,974	1,674
–13.3	8	1,512	1,212	43.3	110	1,983	1,683
–12.2	10	1,521	1,221	44.4	112	1,992	1,692
–11.1	12	1,531	1,231	45.6	114	2,002	1,702
–10.0	14	1,540	1,240	46.7	116	2,011	1,711
–8.9	16	1,549	1,249	47.8	118	2,020	1,720
–7.8	18	1,559	1,259	48.9	120	2,029	1,729
–6.7	20	1,568	1,268	50.0	122	2,038	1,738
–5.6	22	1,577	1,277	51.1	124	2,047	1,747
–4.4	24	1,587	1,287	52.2	126	2,056	1,756
–3.3	26	1,596	1,296	53.3	128	2,066	1,766
–2.2	28	1,605	1,305	54.4	130	2,075	1,775
–1.1	30	1,614	1,314	55.6	132	2,084	1,784
0.0	32	1,624	1,324	56.7	134	2,093	1,793
1.1	34	1,633	1,333	57.8	136	2,102	1,802
2.2	36	1,642	1,342	58.9	138	2,111	1,811
3.3	38	1,652	1,352	60.0	140	2,120	1,820
4.4	40	1,661	1,361	61.1	142	2,129	1,829
5.6	42	1,670	1,370	62.2	144	2,138	1,838
6.7	44	1,679	1,379	63.3	146	2,147	1,847
7.8	46	1,689	1,389	64.4	148	2,157	1,857
8.9	48	1,698	1,398	65.6	150	2,166	1,866
10.0	50	1,707	1,407				

Figure 3-3. Oxygen Table

The pressure fueling connectors and control panel are located on the lower surface of the starboard wing immediately forward of the flaps and just outboard of the fuselage. Fueling with the APU operating is considered normal refueling, not hot refueling. If 4,000 pounds or less fuel is to be carried in tank 5, it shall be loaded through the No. 5 fuselage fueling valve.

WARNING

Fueling shall be halted immediately if, during the pressure fueling cycle, any of the following occurs: 1) any wing tank or tank 5 (center or fuselage section) is overfilled, 2) wing tank fuel spills from a wingtip vent, or 3) loud or unusual noise is accompanied by wing vibration or aircraft decking vibration. An inspection of the internal wing structure (WS 380 through WS 465) for structural damage shall be accomplished prior to the next flight.

CAUTION

To prevent structural damage, verify positive fuel tank venting and ensure fueling pressure does not exceed 55 psi. The pressure gauge for tank No. 5 shall be closely monitored during fueling to prevent tank overpressurization.

3.1.2 Overwing Gravity Feed

Although it is intended that the aircraft be normally refueled by pressure filling methods, it may also be fueled through the overwing gravity filler wells in each main wing tank. The center section and fuselage tank do not incorporate a gravity filler well.

3.1.3 Fuel Quantity Verification

Fuel quantity verification is required during all preflights. Four methods are available for this check (Dipsticking, Hydrostatic Testing, Tank 5 Sight Gauge, and Density Versus Quantity). Dipsticking offers the most accurate means of verifying fuel quantity when sufficient fuel is loaded, unless tanks are completely full and the density versus quantity method is used. If unable to dip tank due to fuel level, the hydrostatic gauge shall be used to determine fuel quantity. Refer to NAVAIR 01-75PAA-6-1, Turnaround Checklist, for gauge error corrections to dipstick, hydrostatic test, and Tank-5 indications.

3.1.3.1 Dipsticking

The dipstick may be used in tanks 1 through 4 for all types of fuel. Its reading is multiplied by the current fuel density, provided sufficient fuel is available in the tank.

Note

When opening fuel tank filler caps after the aircraft tanks have been fueled to within 500 pounds of the full level, fuel may spray out from the filler neck.

3.1.3.2 Density Versus Quantity

When any fuel tank is completely filled to automatic shutoff, the current fuel density can be multiplied by the tank capacities and compared to flight station indicator readings to verify their accuracy.

3.1.3.3 Hydrostatic Testing

The hydrostatic fuel gauge can be used to check fuel quantities in tanks 1 through 4 and is calibrated for JP-5; however, it may be used for other fuels. The hydrostatic fuel gauge reading is invalid when the wing tank is full or within 500 pounds of being full. Density versus quantity check is recommended. Refer to NAVAIR 01-75PAA-2-13.1.2 for gauge operating instructions and to calculate for nonstandard aircraft pitch and roll attitudes.

3.1.3.4 Tank 5 Sight Gauge

When greater than 4,300 pounds is loaded into tank 5 (forward and center tanks), the quantity can be measured by a sight gauge calibrated for JP-4. If other fuels are loaded, a correction factor must be multiplied by the sight gauge reading.

3.1.4 Fuel Density Versus Temperature

Fuel quantity indication can vary even though the aircraft is serviced with the same number of gallons of fuel. The factors that cause the fuel weight to change with a constant quantity are temperature and fuel density tolerances. Figure 3-4 shows the variation of fuel density with temperatures for nominal JP-4, JP-5, and JP-8 fuel. Fuel production specifications for JP-4 and JP-5 permit a density range of ±0.2 pound per U.S. gallon. JP-8 fuel specifications allow a density range of ±0.25 pound per U.S. gallon. For example, although JP-4 has a nominal fuel density of 6.5 pounds per U.S. gallon at 15 °C, the same fuel at a temperature of 40 °C has a density of 6.15 pounds per U.S. gallon. For an aircraft with 9,200 gallons of fuel, the load would be 56,580 pounds as compared with 58,510 pounds for nominal JP-4 at the same temperature.

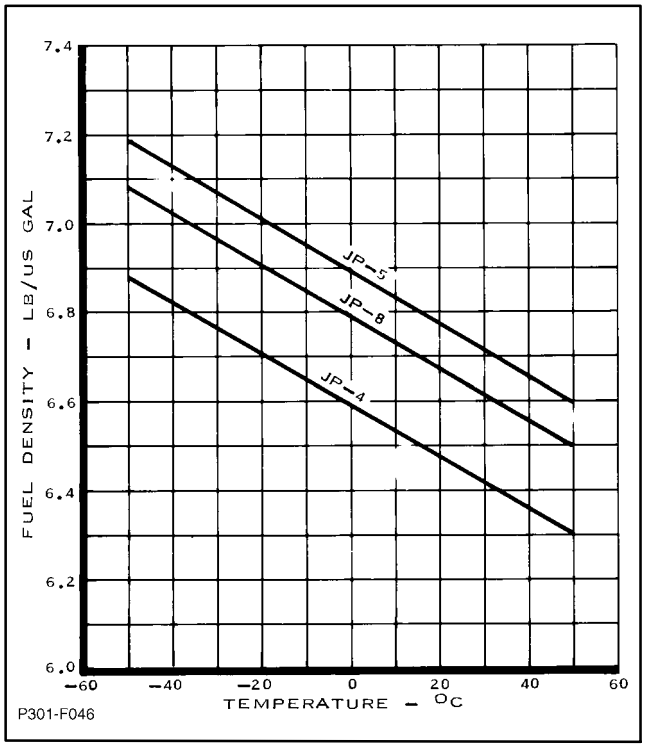


Figure 3-4. Fuel Density vs. Temperature

3.2 GROUND ENGINE AIR START UNIT

Engine ground starting may be accomplished with an air starting unit that delivers a minimum of 90 pounds per minute (ppm) airflow at 32 Pounds Per Square Inch Gauge (psig) pressure.

The ground airstart connection is located in the lower surface of the starboard wing, adjacent to the fuselage, and is accessible through an external access door. The airstart connection is a universal coupling that is used on U.S. military, NATO, and most civilian units.

Refer to Figure 3-5 for airstart units approved for use on the P-3 aircraft.

Navy	Air Force
GTC-85	A/M32-60
NCPP-105	A/M32-90
A/M47A	

Figure 3-5. Airstart Units

3.3 ELECTRICAL GROUND POWER UNIT

Electrical ground power unit requirements for full avionics support for preflight are as follows:

1. 115/200 volts.
2. 400 cycle.
3. 3-phase.
4. 75 Kilo-Volt Amps (kVA) (60 kVA for preflight without full avionics support).
5. 4-wire.

Refer to Figure 3-6 for ground power units approved for use on P-3 aircraft.

Unlimited Use	
Navy	**Air Force**
NC-10	A/M32-60
	A/M32-86
Limited Use (Minimum Avionics Support)	
NC-8A	
MMG-1A	

Figure 3-6. Ground Power Units

3.4 DANGER AREAS

WARNING

Paragraphs in this section discuss specific hazards associated with each area. These hazards or danger areas are illustrated in Figure 3-7.

3.4.1 Propeller Area

The propeller arc is considered a hazardous area. Personnel and equipment should be kept clear. When working on or in close proximity to any aircraft propellers, never walk directly through any propeller arc. The area between the fuselage and the number 2 or 3 propeller is considered a propeller arc hazard area and should always be avoided.

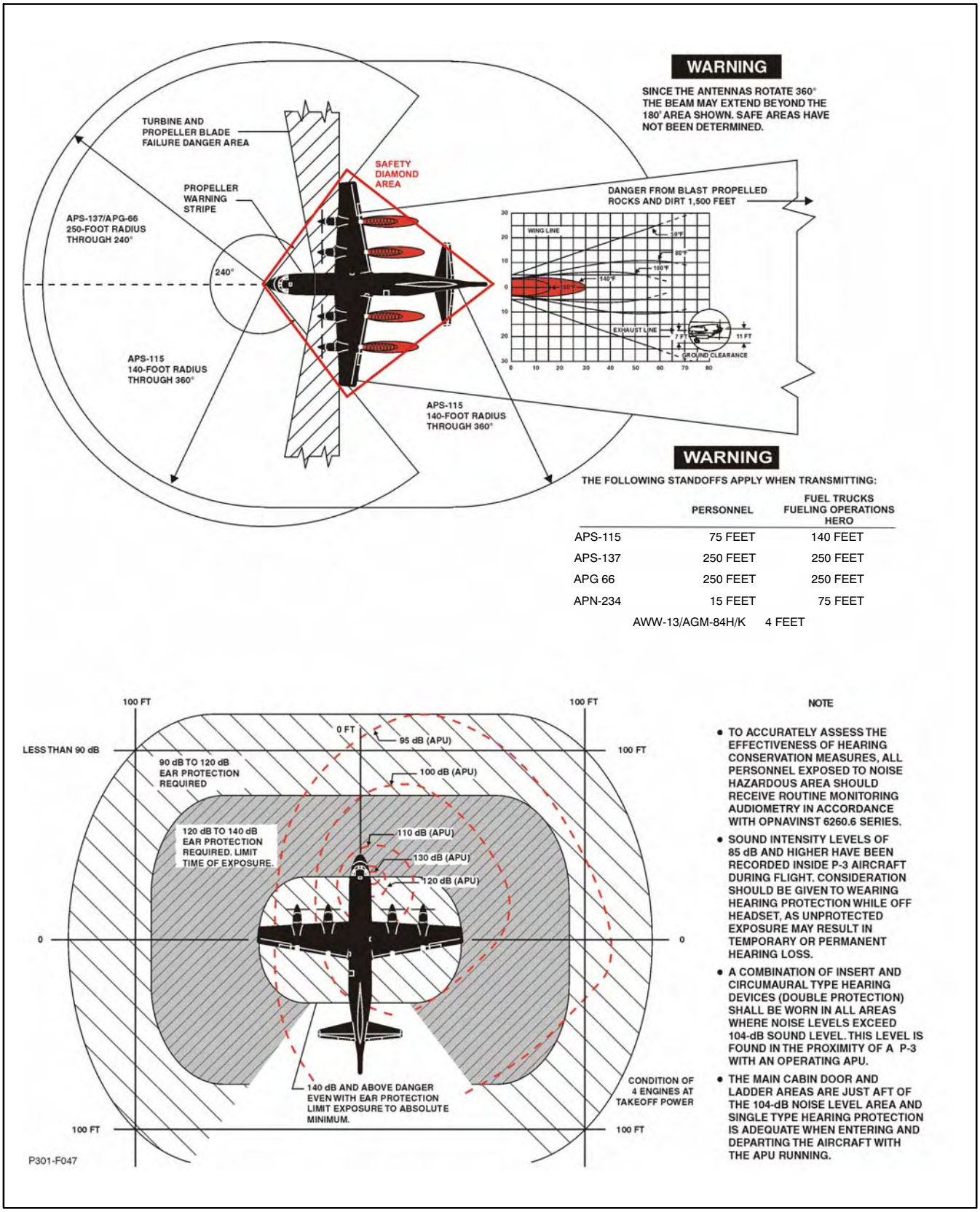


Figure 3-7. Danger Areas

3.4.2 Propeller Jet Blast Area

Structural damage to other aircraft and support equipment and personnel injuries can be incurred by blast-propelled objects and high exhaust temperatures.

3.4.3 Engine Compressor and Turbine Area

Engine failure could result in blades being thrown from the engine radially at high velocity. Keep personnel clear during engine runup.

3.4.4 Bomb Bay

Ensure a lookout is posted in front of the aircraft to visually check that the bomb bay is clear when opening or closing the doors. Do not open or close the bomb bay doors with personnel or equipment in the immediate vicinity of the bomb bay. Do not enter the bomb bay without first verifying the bomb bay safety pin access door is open, the safety pin is installed, and ensuring the cable connecting the safety pin and the door control valve is taut.

3.4.5 Radar Radiation Area

Personal physical injury, Hazard of Electromagnetic Radiation to Ordnance (HERO), or fueling hazards may result in the radiation area during ground radar operation. Radar antenna may radiate harmful rays for personnel. The possibility of fuel ignition also exists with RF radiation. Fuel trucks or fueling operations may constitute a hazard. (Refer to Figure 3-7 for specific standoffs.)

WARNING

During ground operation of the radar when high voltage is applied and antenna is selected, the taxi lights shall be turned on. The anticollision lights shall be turned on by pulling the strobe lights circuit breaker on EXTENSION MAIN DC to allow both the top and bottom red lights to operate. An exterior inspection shall be conducted to ensure the radiation hazard area is clear prior to checks. Reset the circuit breaker and turn off the taxi lights after radar checks are complete.

3.4.6 Sonobuoy Launch Area

Prior to walking under (loading, unloading, or inspecting) external Sonobuoy Launch Tubes (SLTs), ensure sono safety switch door is open, roller switch is fully extended, and sono disabled light in cockpit is illuminated. If sono safety switch door is closed, ensure an outside observer is posted to prevent personnel from entering sono launch area.

3.4.7 Engine and APU Noise Areas

High sound intensities (noise) often result in permanent damage to the ear. Noise is broadcast from the aircraft in patterns that vary in direction, distance, and intensity with changes in engine and APU speed and wind conditions. Damage to hearing occurs when the ear is exposed to high sound intensities for excessive periods of time. The higher the sound intensities, the shorter the period of exposure that produces damage. Above approximately 140 decibel (dB) intensity, any exposure without ear protection can cause damage (Figure 3-7).

Note

Sound intensity is measured in decibels (dB). A decibel is a number that relates a given sound intensity to the smallest sound ordinarily detectable to the human ear.

3.4.8 APU/Air Multiplier Area

Structural failure of the air multiplier turbocompressor can cause extensive damage or injury to personnel in the adjacent areas. All personnel approaching the bomb bay area must be aware of the potential for air multiplier assembly damage as a result of blocking the air intake.

3.4.9 Wing Flap Danger Area

The extension of flaps usually leaves insufficient clearance for personnel or ground equipment in the flap area. An observer shall ensure that there is adequate clearance and that the wing area in the vicinity of the flaps is clear of equipment and personnel prior to posting in front of aircraft to call for flap movement. The person moving the flaps shall monitor the observer throughout the duration of flap travel. Flaps shall not be lowered to an intermediate position unless clearance exists for full extension. If, during flap extension, the observer indicates a clearance danger exists, flap travel shall be stopped immediately by securing hydraulic power.

3.4.10 Safety Diamond Area

The area is defined by lines connecting extremities of the nose, wingtips, and tail extending out 5 feet.

3.4.11 Emergency Brake Overboard Discharge Port

A high-pressure air and fluid discharge port is located on the starboard fuselage just aft of the wing trailing edge. Actuation of the emergency brake handles will cause a high velocity discharge of nitrogen and hydraulic fluid to exit from this port. Personnel should remain clear of this area whenever practical.

3.5 GROUND HANDLING

In order to ensure there is no danger of collision with other aircraft or obstacles during ground handling, the following safety precautions must be observed:

1. Aircraft battery must be in place and connected.
2. Landing gear pins will be installed as required by the flight engineer postflight card.
3. A minimum of six personnel shall accompany the aircraft during all towing operations, positioned as follows:
   a. The flight engineer or other qualified individual shall position himself near the towing vehicle so that he remains in eyesight of the brakerider at all times and shall serve as aircraft director.
   b. A qualified brakerider shall be in the flight station ensuring the brake system is operative.
   c. One person shall be stationed immediately forward or aft of each wingtip, depending on the direction of movement of the aircraft, to observe for adequate clearance of all obstacles.
   d. One person shall act as tractor operator.
   e. One person shall be stationed in the vicinity of the MAD cone (tail section).
   f. Each walker shall carry a whistle ready for immediate use.

WARNING

The Search and Rescue (SAR) bar shall be installed in the main cabin doorway during all aircraft towing operations.

Note

The requirement for six people during towing operations may be waived once the aircraft is well clear of obstructions and established on the centerline of a designated taxiway or runway. Once established, a qualified brakerider, taxi director, and tractor driver may proceed with the aircraft under tow. Local conditions may exist that would make wingwalkers advisable, in which case the six-person requirement would remain in effect at the discretion of the commanding officer.

4. The aircraft director shall direct the towing operation, observing that the walkers are alert, properly positioned, and have whistles ready for use. He shall ensure the tow vehicle driver does not use excessive speeds.

5. Sounding a whistle shall be a signal for the towing vehicle to stop immediately. Aircraft brakes will not be applied without specific direction from the aircraft director.

6. When in confined areas and as necessary for sharp maneuvers, towing speed shall be limited to a normal walking speed. Refer to Figure 3-8 for turning radius distances.

3.5.1 Support Equipment Handling

Stationary non-propelled support equipment shall be chocked, brakes set with exhaust outlets pointing away from aircraft, and extensions used whenever possible. When self-propelled support equipment must be driven within the Safety Diamond, an outside observer shall be positioned to ensure separation between the aircraft and any support equipment. All self-propelled support equipment within close proximity or within the Safety Diamond shall have chocks installed and the engine secured unless a driver is required to operate equipment.

3.6 SERVICING INSTRUCTIONS

Refer to Figure 3-9 for illustrated instructions and servicing directives.

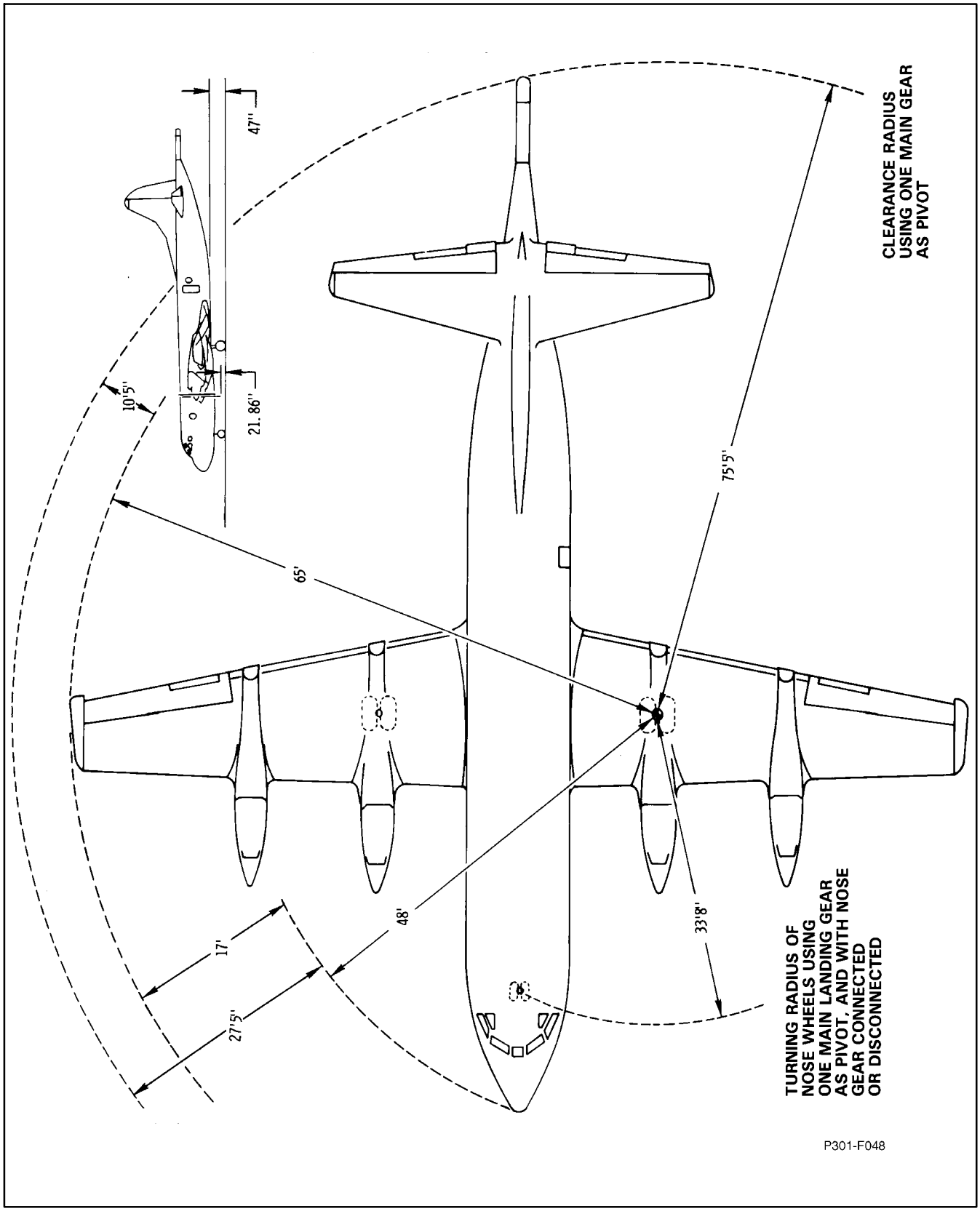
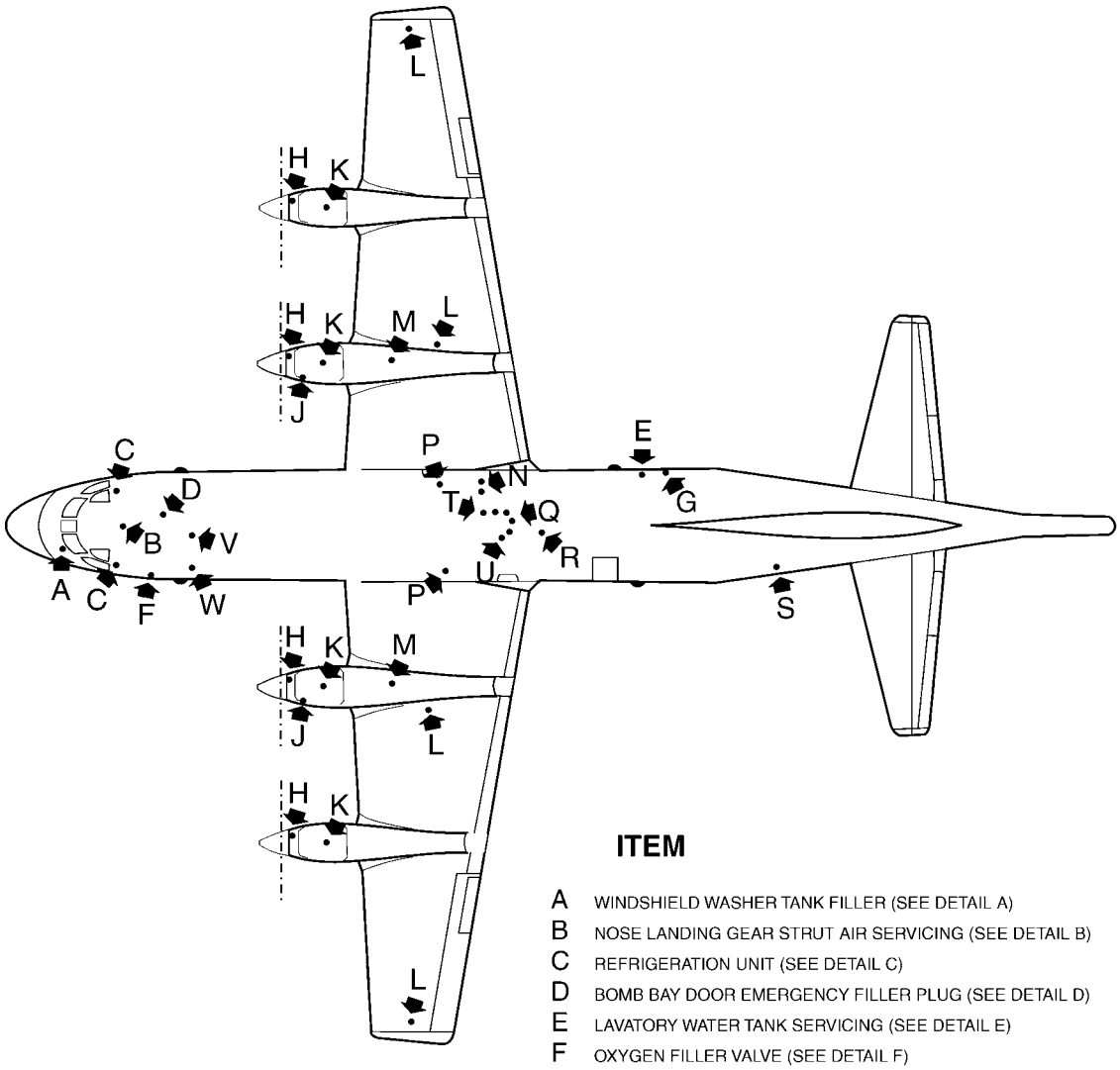


Figure 3-8. Turning Radius

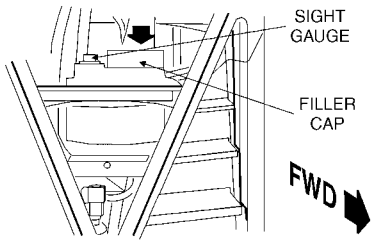


ITEM

A	WINDSHIELD WASHER TANK FILLER (SEE DETAIL A)
B	NOSE LANDING GEAR STRUT AIR SERVICING (SEE DETAIL B)
C	REFRIGERATION UNIT (SEE DETAIL C)
D	BOMB BAY DOOR EMERGENCY FILLER PLUG (SEE DETAIL D)
E	LAVATORY WATER TANK SERVICING (SEE DETAIL E)
F	OXYGEN FILLER VALVE (SEE DETAIL F)
G	CHEMICAL TOILET SERVICING (SEE DETAIL G)
H	PROPELLER FLUID RESERVOIR FILLER PROVISIONS (SEE DETAIL H)
J	CABIN AIR COMPRESSOR SUMP SERVICING (SEE DETAIL J)
K	ENGINE OIL TANK FILLER PROVISIONS (SEE DETAIL K)
L	OVERWING FUEL FILLER (SEE DETAIL L)
M	MAIN LANDING GEAR AIR SERVICING (SEE DETAIL M)
N	PRESSURE FUELING SERVICING (SEE DETAIL N)
P	EMERGENCY WATER BREAKERS (SEE DETAIL P)
Q	HYDRAULIC POWER SYSTEM RESERVOIR SERVICING (SEE DETAIL Q)
R	BRAKE ACCUMULATOR AIR FILLER VALVE (SEE DETAIL R)
S	GALLEY LIQUID COMPARTMENT SERVICING (SEE DETAIL S)
T	EMERGENCY BRAKE AIR RESERVOIR SERVICING (SEE DETAIL T)
U	HYDRAULIC AC PUMP RESERVOIRS (SEE DETAIL U)
V	AUXILIARY POWER UNIT (SEE DETAIL V)
W	AIR MULTIPLIER PACKAGE SERVICING (SEE DETAIL W)

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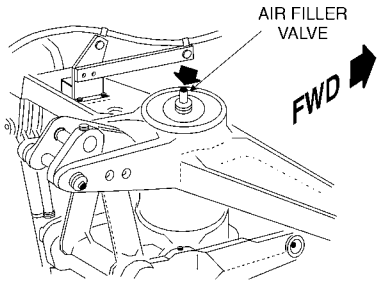
Figure 3-9. Servicing Instructions (Sheet 1 of 5)



DETAIL **A**

WINDSHIELD WASHER TANK FILLER

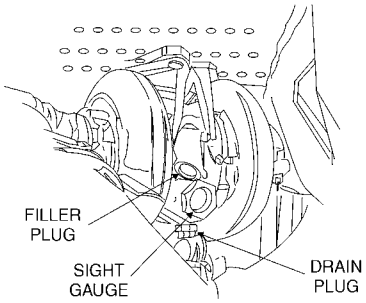
(LEFT SIDE OF NOSE WHEELWELL.) CAPACITY OF TANK—1.0 U.S. GAL. FILL WITH A MIXTURE OF 80% ISOPROPYL ALCOHOL AND 20% WATER TILL PLUNGER IS IN SIGHT. FOR COLD WEATHER AND OPTIONAL FOR NORMAL OPERATION, USE 100% ANTI-ICING FLUID, TT-I-735 (ISOPROPYL ALCOHOL).



DETAIL **B**

NOSE LANDING GEAR STRUT AIR SERVICING

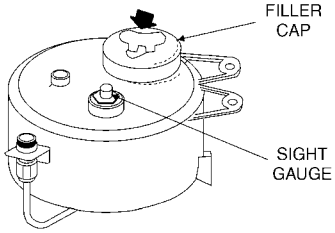
(SEE MAINTENANCE INSTRUCTIONS NAVAIR 01-75PAA-2-1.)



DETAIL **C**

REFRIGERATION UNIT (TYPICAL)

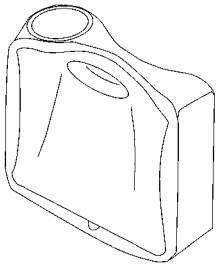
(SERVICE THROUGH ACCESS PANEL ON RIGHT AND LEFT SIDE OF AIRCRAFT OR THROUGH NOSE WHEELWELL.) ADD OIL IF LEVEL IN SIGHT GLASS IS BELOW 3/4 FULL CAPACITY OF UNIT—0.7 PINT. FILL TILL FLUID LEVEL IS 1/8 INCH FROM TOP OF SIGHT GAUGE. MIL-L-23699 LUBRICATING OIL.



DETAIL **D**

BOMB BAY DOOR EMERGENCY FILLER PLUG

(SERVICE THROUGH ACCESS PANEL IN CABIN FLOOR AT NAV STA.) CAPACITY OF TANK—0.75 U.S. GAL. FILL WITH FLUID TILL PLUNGER IS IN SIGHT. MIL-H-83282 HYDRAULIC FLUID (MIL-H-5606 ALTERNATE).



DETAIL **E**

LAVATORY WATER TANK SERVICING

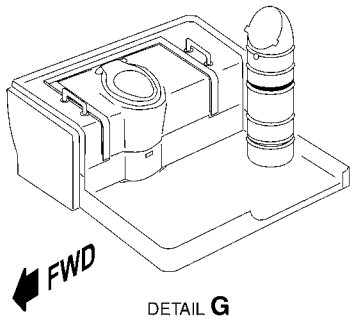
(RIGHT SIDE OF AFT CABIN AREA.) CAPACITY OF TANK—4.5 U.S. GAL. FILL WITH DRINKING WATER.



DETAIL **F**

OXYGEN FILLER VALVE

(SERVICE THROUGH ACCESS PANEL IN LEFT SIDE OF FUSELAGE AFT OF FLIGHT STATION.) SYSTEM PRESSURE 1,800 PSI (MIL-0-27210, TYPE 1 OXYGEN).



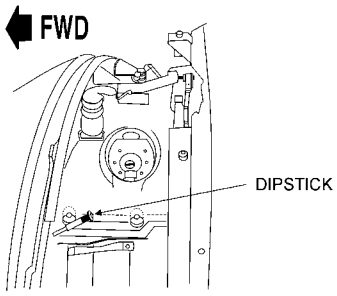
DETAIL **G**

CHEMICAL TOILET SERVICING

(RIGHT SIDE OF CABIN AREA.) CAPACITY OF TOILET—6.0 U.S. GAL. MIX 4 TO 6 OUNCES OF CHEMICALS TO 1 GALLON OF WATER.

NOTE

ANY TIME MIL-H-5606 HYDRAULIC FLUID IS MIXED WITH MIL-H-83282 FIRE RETARDANT CAPABILITIES ARE DEGRADED.



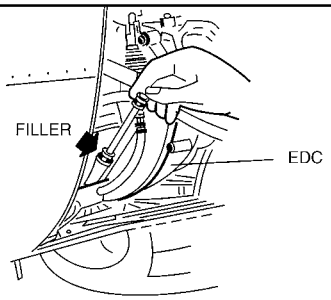
DETAIL **H**

PROPELLER FLUID RESERVOIR FILLER PROVISIONS

(SERVICE THROUGH ATMOSPHERIC ACCESS PANEL IN LEFT SECTION OF PROPELLER AFTERBODY.) CAPACITY—6.2 U.S. GAL. FILL WITH FLUID TO LOWER BAND OF THE OP LEVEL. MIL-H-83282 (MIL-H-5606 ALTERNATE).

P301-F050

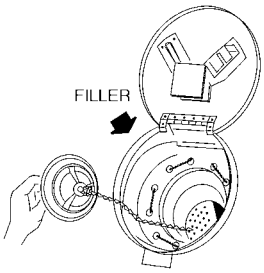
Figure 3-9. Servicing Instructions (Sheet 2 of 5)



DETAIL **J**

CABIN AIR COMPRESSOR SUMP SERVICE

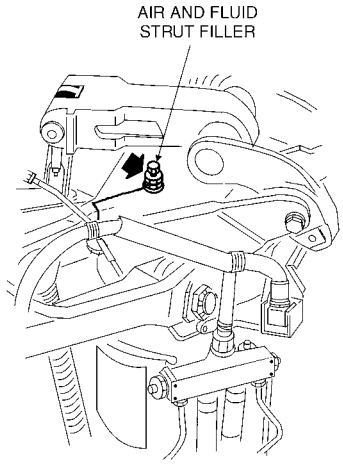
(NO. 2 AND 3 ENGINES) TO SERVICE, OPEN LEFT COWL PANEL ON ENGINE, CAPACITY OF SUMP — 0.7 U.S. GAL. (COMPRESSOR — 1.0 GAL.) FILL WITH FLUID TO FULL MARK ON DIPSTICK (MIL-L-23699 OR BELOW –40°C, MIL-L-7808).



DETAIL **K**

ENGINE OIL TANK FILLER PROVISIONS

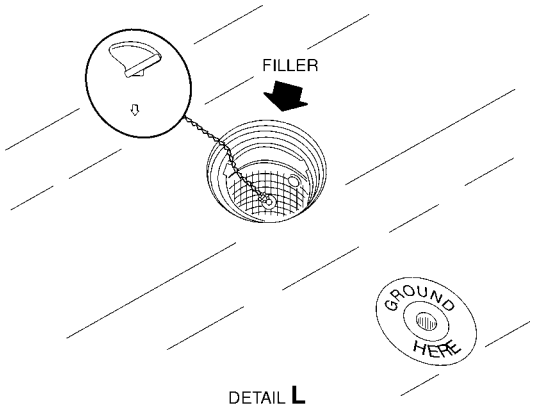
(SERVICE THROUGH ACCESS PANEL NEAR TOP OF EACH NACELLE.) CAPACITY OF TANK — 8.65 U.S. GAL. FILL TO 2 QUARTS LOW LEVEL WITHIN TANK (MIL-L- 23699 OR MIL-L-7808). CHECK WITHIN 30 MINUTES AFTER ENGINE SHUTDOWN.



DETAIL **M**

MAIN LANDING GEAR AIR SERVICING

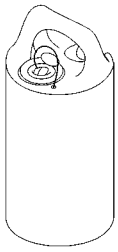
(SEE MAINTENANCE INSTRUCTIONS NAVAIR 01-75PAA-2-1.)



DETAIL **L**

OVERWING FUEL FILLER, FOUR PLACES (TYPICAL)

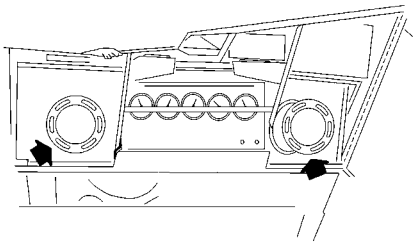
(TO SERVICE REMOVE FILLER CAP FROM WING TANK BEING FUELED) MIL-T-5624, GRADES JP-4 OR JP-5, OR MIL-T-83133A, GRADE JP-8.



DETAIL **P**

EMERGENCY WATER BREAKERS

FLUSH WITH CHLORINE SOLUTION, LET STAND FOR 4 HOURS, FLUSH WITH CLEAN WATER, REFILL WITH FRESH DRINKING WATER. CAPACITY — 2.5 U.S. GAL.



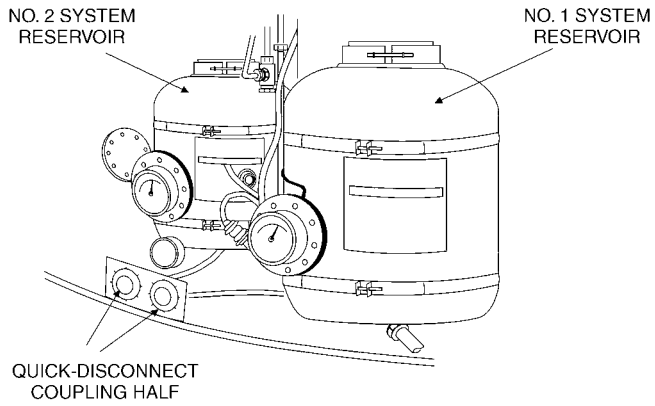
DETAIL **N**

PRESSURE FUELING SERVICING

(SERVICE THROUGH ACCESS PANEL IN BOTTOM OF RIGHT WING) MIL-T-5624, GRADES JP-4 OR JP-5, OR MIL-T-83133A, GRADE JP-8.

P301-F051

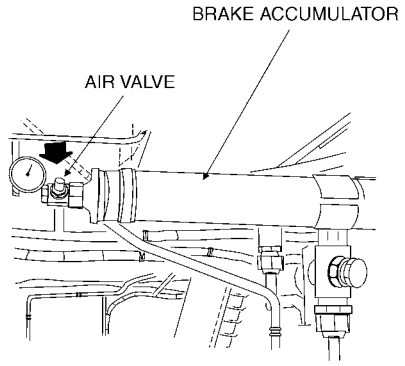
Figure 3-9. Servicing Instructions (Sheet 3 of 5)



DETAIL **Q**

HYDRAULIC POWER SYSTEM RESERVOIR SERVICING (TYPICAL)

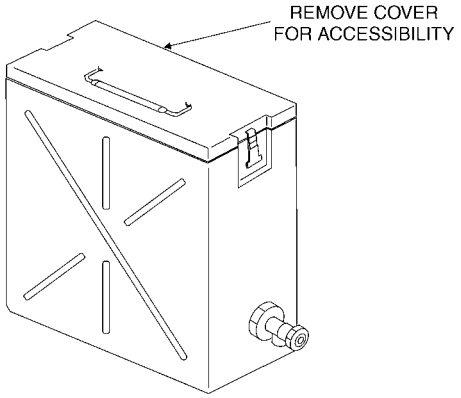
TWO RESERVOIRS IN HYDRAULIC SERVICE CENTER
TOTAL CAPACITY OF HYDRAULIC POWER SYSTEM NO. 1 ..... 16.2 U.S. GAL
CAPACITY OF HYDRAULIC POWER SYSTEM RESERVOIR NO. 1
ACCUMULATOR CHARGED ..... 5.0 U.S. GAL
TOTAL CAPACITY OF HYDRAULIC POWER SYSTEM NO. 2 ..... 4.5 U.S. GAL
CAPACITY OF HYDRAULIC POWER SYSTEM RESERVOIR NO. 2 ..... 1.0 U.S. GAL
HYDRAULIC SYSTEM MINIMUM QUANTITIES ACCEPTABLE FOR FLIGHT
CAPACITY OF RESERVOIR NO. 1:
ACCUMULATOR CHARGED ..... 4.2 U.S. GAL
ACCUMULATOR NOT CHARGED ..... 4.8 U.S. GAL
CAPACITY OF RESERVOIR 2 ..... 0.75 U.S. GAL



DETAIL **R**

BRAKE ACCUMULATOR AIR FILLER VALVE

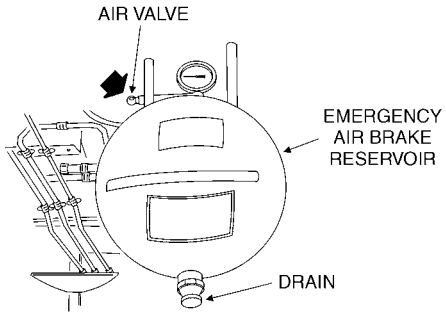
(HYDRAULIC SERVICE CENTER.)
ACCUMULATOR AIR CHARGE 800 PSI
(VIEW LOOKING AFT).



DETAIL **S**

GALLEY LIQUID COMPARTMENT SERVICING

(RIGHT SECTION OF REAR CABIN AREA.)
CAPACITY OF TANK — 2 U.S. GAL
FILL WITH DRINKING WATER.



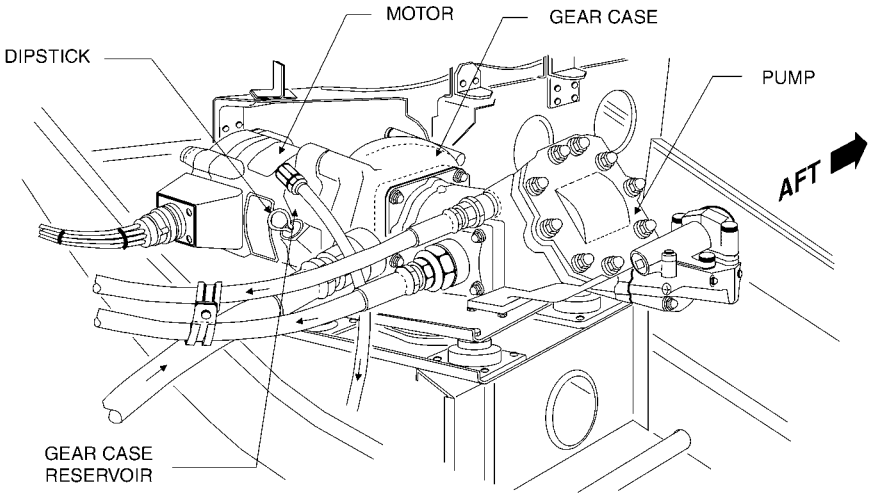
DETAIL **T**

EMERGENCY BRAKE AIR RESERVOIR SERVICING

(IN HYDRAULIC SERVICE CENTER.)
SYSTEM AIR CHARGE 1,900 PSI MINIMUM
TO 3,000 PSI MAXIMUM.

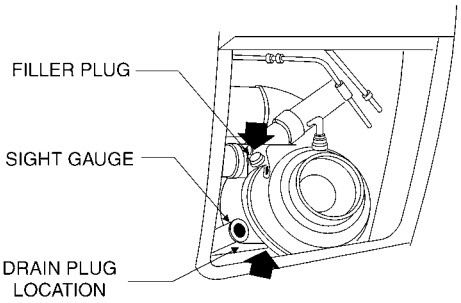
P301-F052

Figure 3-9. Servicing Instructions (Sheet 4 of 5)



DETAIL **U**

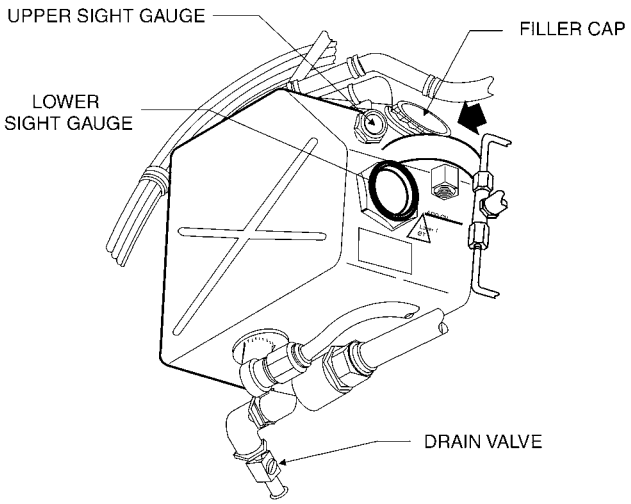
HYDRAULIC PUMP INSTALLATION (TYPICAL)



DETAIL **W**

AIR MULTIPLIER PACKAGE

CHECK FLUID LEVEL THROUGH HINGED DOOR LEFT SIDE FUSELAGE. FILL UNTIL FLUID LEVEL IS WITHIN 1/8 INCH FROM TOP OF SIGHT GAUGE. MIL-L-23699 LUBRICATING OIL. CAPACITY OF UNIT—8.45 OZ. ADD OIL IF LEVEL IS AT OR BELOW THE 1/2 MARK ON THE SIGHT GAUGE.



DETAIL **V**

AUXILIARY POWER UNIT OIL TANK

CHECK FLUID LEVEL THROUGH HINGED FIREFIGHTING ACCESS DOOR. LEFT SIDE FUSELAGE. SERVICE FROM INSIDE APU COMPARTMENT. FILL TO FULL MARK ON UPPER SIGHT GAUGE. CAPACITY OF TANK—1.0 U.S. GAL. MIL-L-23699 N10 OIL CAN SPOUT USED FOR FILLING. ADD OIL IF LEVEL IS AT OR BELOW THE 1/2 MARK ON LOWER SIGHT GAUGE.

P301-F053

Figure 3-9. Servicing Instructions (Sheet 5 of 5)

CHAPTER 4

Operating Limitations

4.1 INTRODUCTION

The limitations imposed on the aircraft must be observed during normal operations. Cognizance must be taken of the instrument markings diagram, Figure 4-1, since it illustrates operating limitations not necessarily repeated in the text. All airspeed, maneuver, acceleration, cg, and weight limitations apply to aircraft with or without external stores, provided that maximum zero fuel weight restrictions are not exceeded.

4.2 GROUND STARTER PRESSURE AND TEMPERATURE LIMITS

When using ground sources of air for starting, the following limitations should be observed:

1. 140 psi at 480 °F.
2. 110 psi at 625 °F.

4.3 ENGINE LIMITATIONS

Operating time limits, allowable observed TIT ranges, engine speed limits, and oil pressure and temperature limits are tabulated in Figure 4-2. Subsequent to application of power, it is normal to expect an overshoot in indicated SHP. The degree of overshoot depends upon the rate of power lever movement. The limit power during these transients should not exceed 4,600 SHP for 3 seconds, as read on the SHP gauge.

CAUTION

Very rapid power lever advancement should be avoided, as torquemeter "flopover" can occur. This means that at least 5,300 SHP has been momentarily exceeded and the engine(s) shall be inspected as soon as practicable.

Maximum power is used for takeoff; therefore, a 5-minute limit is imposed to prevent prolonged use of high power settings during climb; however, military power can be used for 30 minutes when mission requirements demand higher power.

Note

With digital SHP gauges incorporated, a red overtorque light will illuminate above 4,600 SHP.

4.3.1 Before Start Temperature

Maximum residual TIT for ground starting is 200 °C. Maximum residual TIT for airstarting is 150 °C.

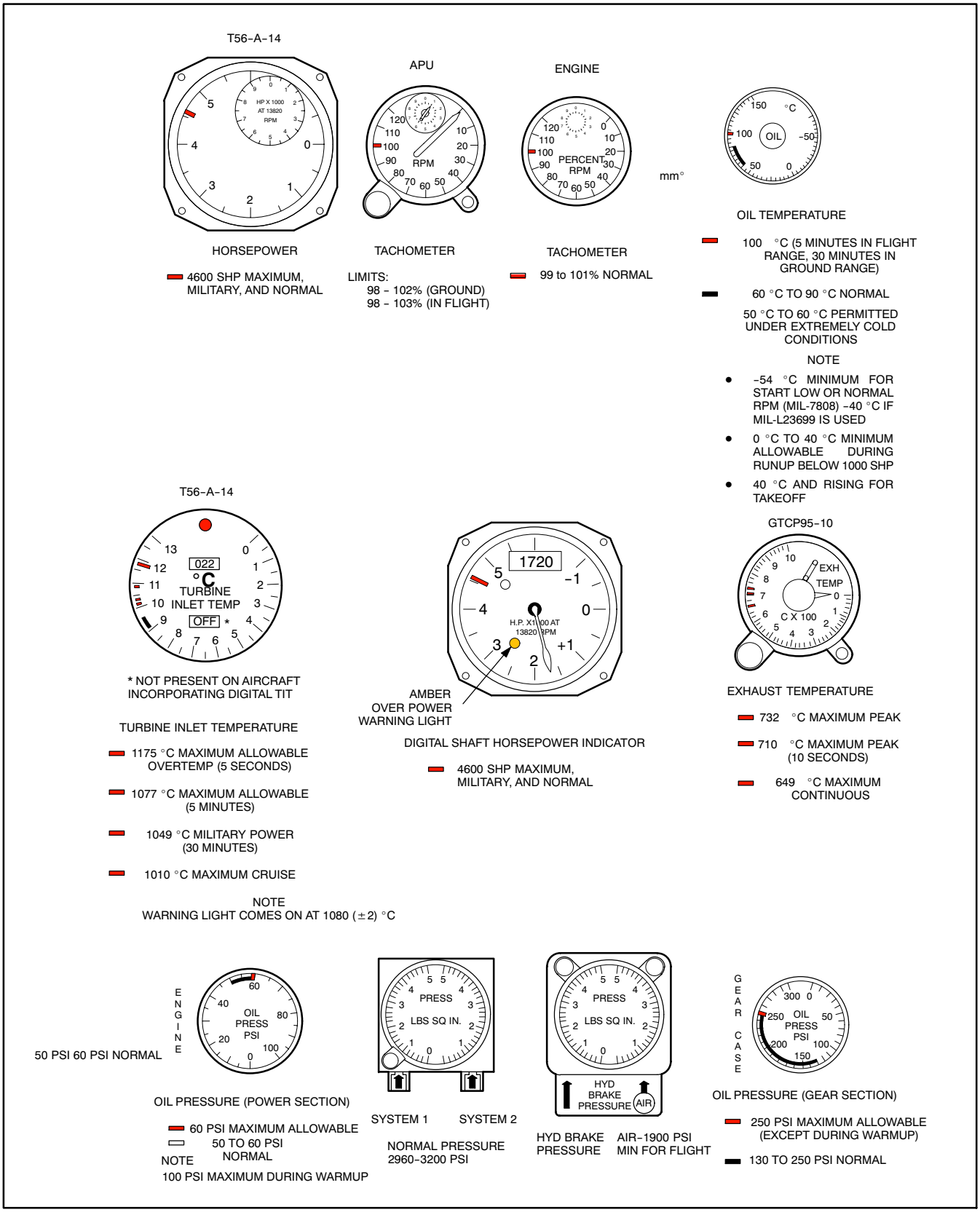


Figure 4-1. Instrument Markings

GROUND OPERATION

Note

The TIT and rpm values in ground operation are based on zero airspeed, no diffuser bleed, no accessory loading, and ambient air temperature range from –54 to +55 °C.

POWER CONDITION	TIT °C	RPM %	OIL PRESSURE (PSIG) (9) RGB	OIL PRESSURE (PSIG) (9) P/S	OIL TEMPERATURE °C	INDICATED HORSEPOWER
Start	830 750		POSITIVE OIL PRESSURE BY 35% RPM		–40(6)	
Low rpm (2)(7)	730 (12) 410	73.8 71.0	250 except start and warmup 50	100 Start and Warmup only, then 60 50(4)	90(5) 60 to 90 –40(6)	Minimum until oil temperature is above 0 °C
Normal rpm (start position)	645 445	99.1 96.3	250 except start and warmup 130(3)			1,000 maximum at oil temperature 0 to 40 °C
Maximum Reverse 0°	790 580	104.9 96.7			90(5) 60 to 90 40	
Flight idle 34°	705 430	98.4 94.5			90(5) 60 to 90 0	
TAKEOFF						
Maximum 90°	1077 (5 minutes max)	101(10) 99	250 130	60 50	90(5) 60 to 90 40(8) and increasing, then 60(8)	4,600 5,300 (engine limiting 3 seconds)
FLIGHT OPERATION						
Military	1049 30 minutes	101	250(1)	60(1)	90(5) 60 to 90 40 and increasing, then 60(8)	4,600
Normal Rated						4,600 continuous operation
Maximum Cruise	1010	99(11)	130	50		During airstart minimum until oil is above 0 °C 1,000 maximum at oil temperature of 0 to 40 °C

NOTES:

1. Ten seconds is the maximum time allowed at zero or negative-g conditions. Fluctuating oil pressure is allowed during and following zero or negative-g conditions; however, a shutdown is required if:
   a. Oil pressure fluctuations continue longer than 15 seconds after returning to positive-g flight conditions.
   b. Oil pressure remains at zero longer than during a momentary transient condition.
   c. After 1 minute, an airstart may be attempted.
2. Use of power between GROUND START and MAXIMUM REVERSE in low rpm can cause engine rpm to decay. Contributing causes are high ambient temperature, field elevation, airspeed, accessory load, and bleed air effects on the power available at low rpm. If rpm begins to decay, advance the power lever. If rpm decay continues, shut down the engine.
3. Operation below 130 psi when rpm is below 100 percent is permitted if 130 psi can be maintained at 100 percent rpm.
4. If pressure is below 50 psig at low rpm, condition is acceptable provided pressure is within limits at 100 percent rpm.
5. 100 °C oil temperature is maximum allowed for 30 minutes in beta range and 5 minutes in the alpha range, then 90 °C is maximum.
6. If MIL-L-7808 oil is used, –54 °C is the lower limit; –40 °C is the lower limit only when MIL-L-23699 oil is used. When ambient temperatures are below 0 °C, refer to Starting Engines, paragraph 18.3.2.
7. Acceleration time from start of rotation to low rpm should not exceed 60 seconds.
8. Operation with oil temperature from 50 to 60 °C is permitted under extremely cold conditions provided all oil pressure limitations are maintained.
   a. When oil temperature reaches 40 °C and the Reduction Gear Box (RGB pressure shows no fluctuation, maximum power may be applied.
9. Maximum allowable fluctuation at 100 percent rpm, provided pressure remains within limits:
   a. ±5 psi power section.
   b. ±10 psi gearbox section.
10. Takeoff rpm limits: Allowable momentary overshoot/undershoot with power lever advancement is 96 to 106 percent. An overshoot exceeding 106 percent but immediately returning to within limits must be corrected prior to the next flight. Rpm should be stabilized within 10 seconds of initial overshoot.
11. Flight operation rpm limits: Allowable overshoot/undershoot with power lever adjustment is ±1 percent sync on, ±2 percent sync off. Rpm should be stabilized within 10 seconds.
12. Maximum TIT in low rpm shall be limited to 730 °C regardless of power lever position, accessory loading, or use of diffuser bleed air to ensure adequate cooling airflow to the turbine.

Figure 4-2. Engine Operation — T56-A-14

4.3.2 Overtemperature During Power Change (Figure 4-3)

CONDITION	ACTION REQUIRED
TIT remains in the 1083 to 1175 °C range for more than 5 seconds or exceeds 1175 °C.	
1. Ground Operation	Reduce power. Shut down, record, and call for maintenance. An overtemperature inspection is required.
2. During Takeoff	Reduce power until TIT is 1077 °C or below. Record and call for maintenance prior to next flight.
3. In Flight	Reduce power until TIT is 1010 °C or below. Record and call for maintenance prior to next flight.

Figure 4-3. Power Change Overtemperature

4.4 APU LIMITS

1. Exhaust Gas Temperature (EGT) (GTCP 95-2).
   a. 715 °C maximum peak.
   b. 710 °C maximum peak (10 seconds).
   c. 688 °C maximum continuous.
2. EGT (GTCP 95-3).
   a. 704 °C maximum peak.
   b. 649 °C maximum continuous.
3. EGT (GTCP 95-10).
   a. 732 °C maximum peak.
   b. 710 °C maximum peak (10 seconds).
   c. 649 °C maximum continuous.
4. RPM.
   a. 98 to 102 percent (ground).
   b. 98 to 103 percent (in flight).

Note

The APU will automatically shut down at 106 percent rpm.

5. Altitude/airspeed.
   a. 20,000 feet maximum.

Note

The APU is capable of starting any single engine at field elevations up to 6,000 feet and at temperatures of –54 to +54 °C.

   b. 225 knots maximum.

4.5 ENGINE STARTER OPERATION LIMITS

Pull out at 64 percent rpm.

4.6 AIRSPEED LIMITATIONS

The maximum permissible indicated airspeeds in smooth or moderately turbulent air with gear and flaps retracted are shown in Figure 4-4. Limit load factors and stall buffet curves are the same for an aircraft with the Infrared Detection System (IRDS) turret extended.

Refer to Figure 4-5 for additional maximum permissible indicated airspeeds.

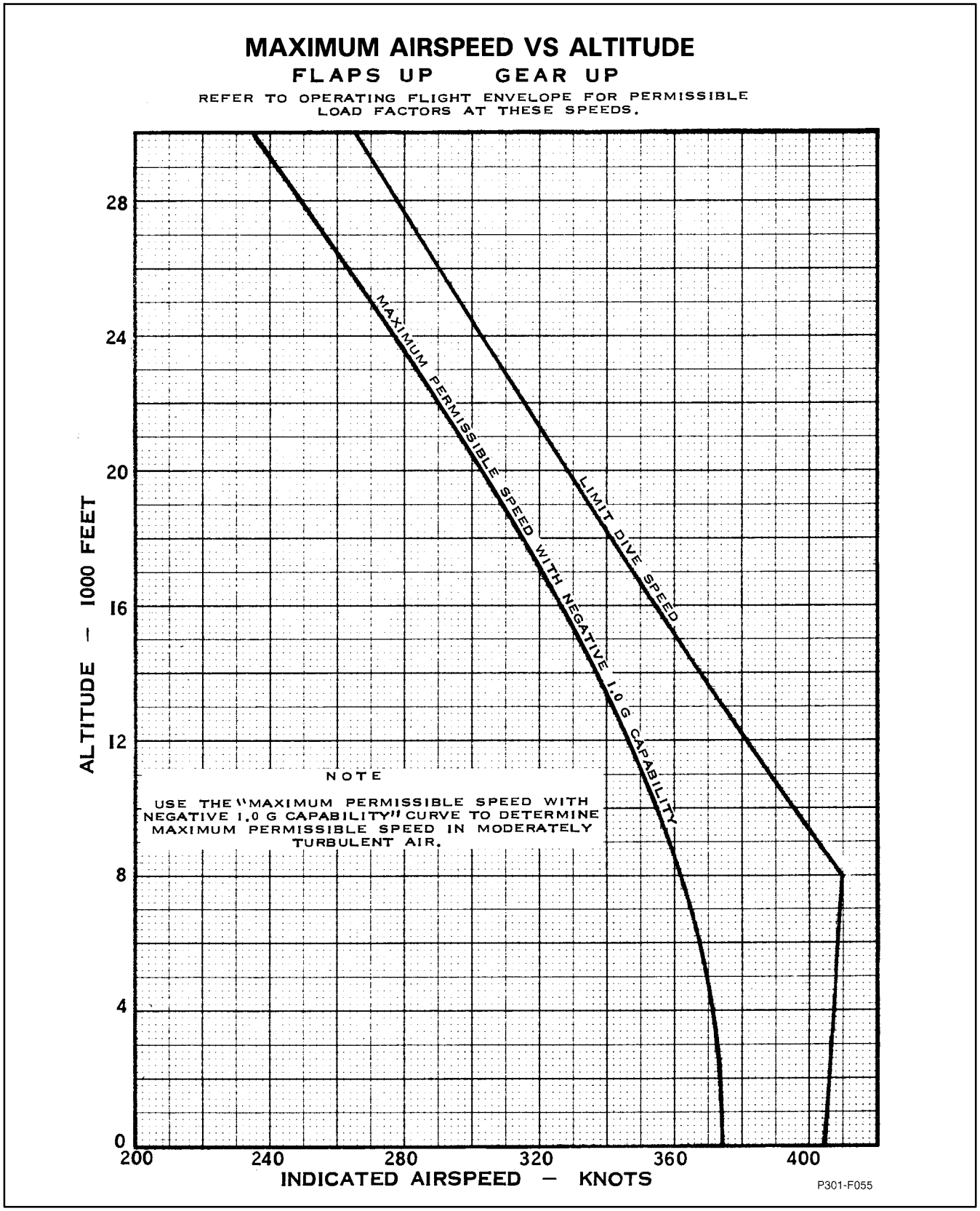


Figure 4-4. Airspeed vs. Altitude

Equipment	Condition	Maximum Speed
Flaps	Maneuver	275 KIAS
	Takeoff and approach	190 KIAS
	Land	170 KIAS
Landing gear	Flight with landing gear extended	300 KIAS
Landing gear extension	At 1.0g	300 KIAS
	Greater than 1.0g	190 KIAS
	Landing gear retraction	190 KIAS
	Landing lights extended	260 KIAS
	Bomb bay doors open	Limit dive speed
	Overwing exit	170 KIAS
	Main cabin door open	300 KIAS (maximum tested speed)
	APU door open	225 KIAS
IRDS turret:	Extended	405 KIAS (V_{NE})
	Extending/retracting	375 KIAS
AIMS turret:	Extended	405 KIAS(V_{NE})/3g
	Extending/retracting	350 KIAS/2g
Note Advanced Imaging Multispectral Sensor (AIMS) performance is degraded at airspeeds above 350 knots indicated.		
	Fuel dump operation	140 to 300 knots
Airstarts	Minimum airspeed	170 KIAS
	Minimum airspeed	210 KIAS (if range is critical)
Maximum airspeed:	Sea level	345 KIAS
	Reduce airspeed	6 knots for every 1,000 feet of altitude
Notes: The maximum altitude for air starting is 35,000 feet using JP-4 fuel and 25,000 feet using JP-5 and JP-8 fuel.		

Figure 4-5. Airspeed Limitations

4.6.1 NAVAIR P-3 Flight Restriction

As a precautionary measure taken during assessment of data from the P-3 Service Life Assessment Program (SLAP), NAVAIR has imposed flight restrictions on all P-3 aircraft (COMNAVAIRSYSCOM DTG 222000Z APR 03). These restrictions are for NAVAIR aircraft only; original limits remain in this manual. Unless an emergency exists, P-3 aircraft shall observe the more restrictive other limits in NATOPS and the following table (refer to Figure 4-6).

<table>
<tr><th colspan="2"></th><th>Gross Wt less than 125,000 lb</th><th>Gross Wt between 125,000 lb and 135,000 lb</th><th>Gross Wt between 135,000 lb and 139,760 lb</th></tr>
<tr><td rowspan="4">Altitude</td><td>Sea Level to 15K</td><td rowspan="4">300 KIAS</td><td>225 KIAS</td><td rowspan="4">215 KIAS</td></tr>
<tr><td>15K to 20K</td><td>235 KIAS</td></tr>
<tr><td>20K to 25K</td><td>245 KIAS</td></tr>
<tr><td>25K and up</td><td>255 KIAS</td></tr>
<tr><td rowspan="2">Symmetrical Flight</td><td>Min</td><td colspan="3">0.0 G</td></tr>
<tr><td>Max</td><td>2.5 G</td><td colspan="2">2.0 G</td></tr>
<tr><td rowspan="2">Roll Maneuver</td><td>Min</td><td colspan="3">1.0 G</td></tr>
<tr><td>Max</td><td>2.0 G</td><td colspan="2">1.5 G</td></tr>
<tr><td colspan="5">NOTES:
1. <u>SPEED RESTRICTIONS FOR ALL GROSS WEIGHTS</u> — May be exceeded for +1.0 g weapons release at airspeeds not to exceed 300 KIAS. Restricted airspeed should be reestablished prior to maneuvering.
2. <u>EXCEEDANCE OF RESTRICTION LIMITS</u> — Requires no additional inspection. If above restrictions are exceeded, make log book entry with type, magnitude, and number of occurrences.</td></tr>
</table>

Figure 4-6. Flight Restrictions

4.6.2 Maximum Adjusted Zero Fuel Weight (ZFW)

The maximum adjusted ZFW is defined as the ZFW plus the total weight on wing stations 12, 13, 14, and 15. Maximum adjusted ZFW shall not exceed 80,400 pounds for aircraft without AFC-517 (explosive suppressant foam) or 82,400 pounds for aircraft with AFC-517. No weight may be added to the maximum adjusted ZFW except wing stores on stations 9 to 11 and 16 to 18.

Refer to Figure 4-7 for additional zero fuel weight restrictions.

4.7 MINIMUM ALTITUDE ON STATION (FIGURE 4-8)

4.8 FLIGHT MANEUVERS

Bank angles to 60° for roll maneuvering and coordinated turns are permitted.

4.9 FUEL MANAGEMENT

Normal fuel management is based on a transfer system that replaces fuel burned from the four main wing tanks with fuel from the wing center section and fuselage tanks. This procedure provides maximum inertia relief in the wing for the maximum time. Crossfeeding should be used if necessary to maintain equal amounts of fuel in the wing tanks.

4.9.1 Zero Fuel Weight

Zero fuel weight is defined as the aircraft gross weight with zero usable fuel. The maximum allowable zero fuel weight is a critical design condition for some part of the wing. Exceeding the specific value results in exceeding the design loads on the wing. The maximum allowable zero fuel weight for the P-3C/AIP/BMUP is 80,400 pounds for aircraft not incorporating AFC-517 (explosive suppressant foam) and 82,400 pounds for aircraft incorporating AFC-517 without wing stores on stations 9, 10, 11, 16, 17, and 18. No weight may be added to the maximum allowable zero fuel weight except for stores on stations 9, 10, 11, 16, 17, and 18. For aircraft incorporating AFC-593, refer to Maximum Adjusted Zero Fuel Weight ZFW, paragraph 4.6.2, for additional zero fuel weight restrictions. All airspeed and acceleration restrictions apply regardless of zero fuel weight.

Aircraft Configuration	Maximum Weight
Note Maximum zero fuel weights with AN/APS-149 (no wing stores authorized with AN/APS-149 installed)	
With AFC-517 (explosive suppressant foam)	
With AFC-593 (Gen 1) and AN/APS-149	82,000
With AFC-593 (no Gen 1) and AN/APS-149	81,800
Without AFC-517:	
With AFC-593 (Gen 1) and AN/APS-149	80,000
With AFC-593 (no Gen 1) and AN/APS-149	79,800
Note Maximum adjusted zero fuel weights (Defined as the NATOPS defined aircraft zero fuel weight plus the total weight on wing stations 12, 13, 14, and 15)	
With AFC-517 (explosive suppressant foam)	
With AFC-593 (Gen 1)	82,600
With AFC-593 (no Gen 1)	82,400
Without AFC-517	
With AFC-593 (Gen 1)	80,600
With AFC-593 (no Gen 1)	80,400

Figure 4-7. Zero Fuel Weight Restrictions

Status	Day/VMC	Night/IMC
Aircraft with operable Radar Altimeter and RAWS	200 ft AGL	300 ft AGL
Aircraft without operable Radar Altimeter or RAWS, with updated Barometric Altimeter setting	300 ft AGL	500 ft AGL
Aircraft without operable Radar Altimeter, without updated Barometric Altimeter setting	500 ft AGL	1,000 ft AGL
Aircraft Commanders shall give due consideration to any operations below 1,000 ft Above Ground Level (AGL) at night or Instrument Meteorological Conditions (IMC) without an operable Radar Altimeter due to changes in weather conditions and variations in barometric conditions.		

Figure 4-8. Minimum Altitude on Station

The P-3 aircraft was designed for a normal fuel loading sequence of filling the wing tanks first, then filling tank 5; and a normal fuel usage sequence of transferring fuel from tank 5 to the wing tanks to maintain full wing tanks until tank 5 is empty. If the wing tanks are full, fuel in tank 5 need not be considered in determining zero fuel weight. If it is necessary to take off or fly with fuel in tank 5 but with less than full wing tanks, the weight of the fuel in tank 5 must be considered as payload and added to the predetermined zero fuel weight to ascertain that the maximum allowable zero fuel weight has not been exceeded.

CAUTION

If nonstandard fuel management results in actual zero fuel weight exceeding maximum allowable zero fuel weight, the aircraft design load factor is 2.1g.

4.9.2 Lateral Imbalance

Figure 4-9 presents the safe fuel differential between opposite pairs of tanks.

MAXIMUM DIFFERENTIAL — POUNDS			
Tanks	For Takeoff	In Flight	For Landing
1 and 4	1,400	4,389	4,389
2 and 3	5,025	No Restriction	No Restriction

Figure 4-9. Safe Fuel Differential

If there is maximum imbalance in one set of symmetrical tanks, the other set must be in balance. Asymmetric weapon loading should be taken into consideration for lateral inbalance.

4.9.3 Minimum Fuel for Flight

Refer to data in Figure 4-10.

4.9.3.1 Example

Aircraft gross weight equals 120,625 pounds (with 5 wing pylons included). Enter the chart with the aircraft gross weight (minus the weight of the 5 wing stores = 625 pounds), intersect the no wing stores line, and read 10,439 pounds (or 1,606 gallons). This is the minimum portion of the fuel load that must be in each outboard tank to provide proper load distribution to the wing. This is extremely important with increases to the maximum zero fuel weight. If ZFW (less wing stores) exceeds the applicable ZFW from Maximum Adjusted Zero Fuel Weight, paragraph 4.6.2, and gross weight (gw) is less than 120,000 pounds, laterally balancing all four wing tanks will not allow proper load distribution to the wing.

4.10 CENTER OF GRAVITY LIMITATIONS

The maximum permissible cg envelope is shown in Figure 4-11. For complete weight and balance data, refer to NAVAIR 01-1B-40.

WARNING

Installation of Sensor Station (SS) four and certain mission loading may cause the aircraft to exceed the aft cg limit. Careful consideration shall be given to ensure the cg remains within limits during all phases of flight.

MINIMUM FUEL FOR FLIGHT P-3C AIRCRAFT

NOTE:
1. THESE QUANTITIES BASED ON UNIT FUEL WEIGHT OF 6.5 LB PER GALLON.
2. QUANTITY OF FUEL SHOWN IS FOR OUTBOARD TANKS ONLY (1 AND 4).
3. WHEN WING STORES ARE INSTALLED, ENTER CHART WITH AIRCRAFT WEIGHT MINUS TOTAL STORE AND PYLON WEIGHT.

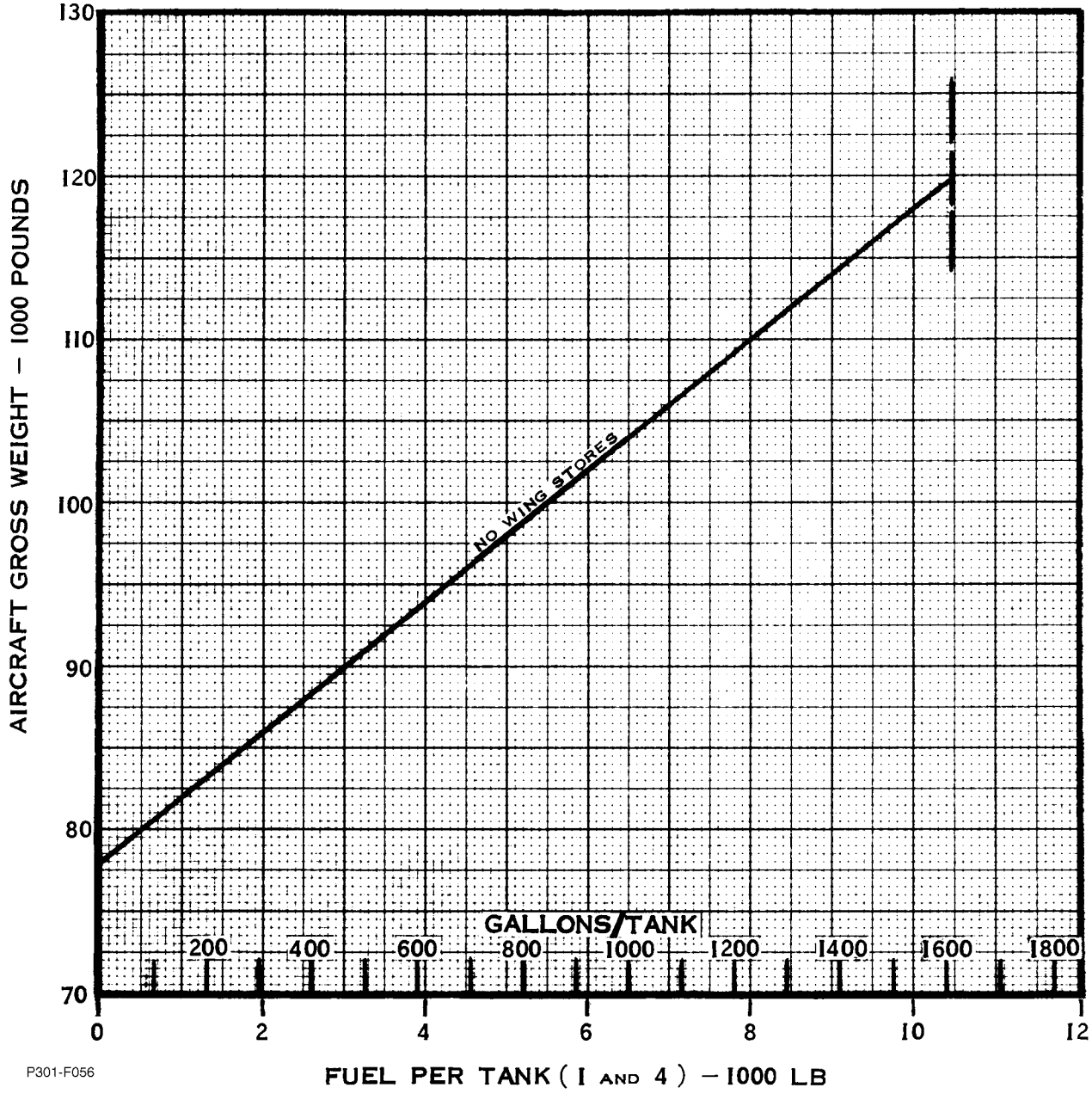


Figure 4-10. Minimum Fuel for Flight

CENTER OF GRAVITY LIMITATIONS P-3C AIRCRAFT

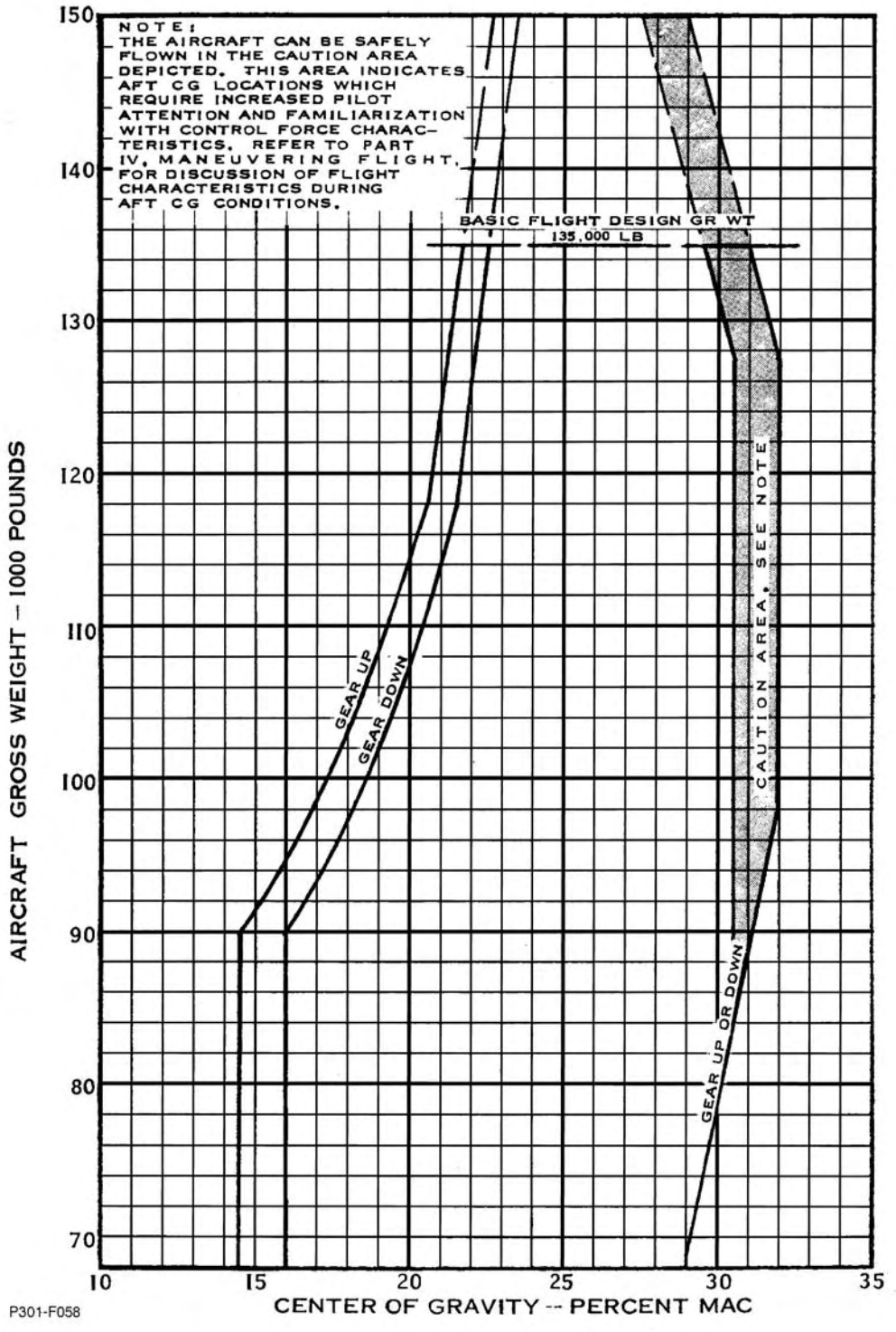


Figure 4-11. Center of Gravity Limitations

If mission loading causes the takeoff cg to be at or near the aft limit, consider increasing the bomb bay loading to shift cg forward. During flight, the number of personnel in the galley area should be minimized until tank 5 is empty to ensure cg remains within limits.

4.11 FUEL DUMPING LIMITATIONS

WARNING

Fuel dumping is prohibited with wing flaps extended beyond the TAKEOFF/APPROACH position.

Fuel dumping should be conducted with wing flaps fully retracted whenever possible. Dumping with wing flaps extended to the TAKEOFF/APPROACH position has been successfully accomplished, but any flap extension beyond FLAPS UP is not recommended.

4.12 WEIGHT LIMITATIONS

Refer to Figure 4-12 for weight limitations.

P-3C	
Recommended Takeoff	135,000 pounds
Overload Takeoff	139,760 pounds
Landing	114,000 pounds

Figure 4-12. Weight Limitations

CAUTION

- Operations at weights greater than 135,000 pounds, but not to exceed 139,760 pounds, may be undertaken only when authorized by the commanding officer. Due consideration should be given to weather, taxiway, runway, and aircraft conditions. Gross weights exceeding 135,000 pounds will result in increased airframe fatigue.
- Landing at gross weights in excess of 103,880 pounds shall be made at a minimum rate of descent. Each landing at a gross weight in excess of 103,880 pounds shall be documented. An overweight landing inspection is required after each 10 such landings are made.

Landings at gross weights in excess of 114,000 pounds should be conducted only in an emergency. An overweight landing inspection shall be performed after accumulation of 10 landings at gross weights in excess of 103,880 pounds, up to and including 114,000 pounds, and after each landing at a gross weight in excess of 114,000 pounds. An abnormal landing inspection shall be performed after each reported hard landing regardless of gross weight. Refer to Aircraft Structural Repair Instructions, NAVAIR 01-75PAA-3-1, for inspection procedures. Normal aircraft instrumentation cannot be used to accurately measure rate of descent at landing. Strut cushioning action is stiff at low gross weights and deceptively soft at high gross weights; therefore, the pilot in command must exercise sound judgment and report any landing that is considered to have been a hard landing.

4.13 CARGO LOADING

Floor panel loading is restricted to 60 pounds maximum per square foot. For further guidance, refer to NAVAIR 01-75PAA-2-1. Cargo shall not be stowed in any electronics racks/bays.

CHAPTER 5

Armament Limitations

5.1 INTRODUCTION

The limitations imposed on the aircraft must be observed during normal operations.

5.2 STORES LIMITATIONS

This chapter is provided to give the Antisubmarine Warfare (ASW) crewmember a ready reference for the type stores that may be carried aboard the P-3 aircraft. For loading information, refer to the applicable current P-3 Airborne Weapon/Store Loading Manual, NAVAIR 01-75PAC-75. For specific authorization, refer to P-3 Naval Aviation Technical Information Product (NATIP), NTRP 3-22.2. Only the internal and external stores listed in Figures 5-1, 5-2, 5-3, 5-4, and 5-5 may be carried singly or in combination to the limits shown.

WARNING

- Master arm power shall not be activated on the ground with weapons loaded on aircraft. Search power shall not be activated on the ground with search stores loaded in sonobuoy chutes.
- After each attempted release, the ordnance station shall be visually inspected to ensure against a hung store.
- Certain weapons loaded on stations 13 and 14 cannot be verified from either the aft observer stations or with the turret.
- NTRP 3-22.2 (P-3 NATIP) shall be consulted prior to carriage of weapons/stores.

Note

All BRU-14/A bomb racks are authorized for use with BDU-20 in the retarded mode.

5.3 FAIL TO RELEASE PROCEDURES

The following definitions apply to fail to release procedures:

1. LFA — Linear Electromechanical Actuator (LEMA) Fails to actuate, rack hooks remain closed, weapon is secure.
2. FTF — Fail To Fire, Harpoon missile engine fails to start, rocket/flare store fails to deploy, weapon is secure.
3. HS — Hung Store, LEMA actuates, rack hooks remain closed, weapon is not secure.

CAUTION

Positive and negative g's should not be applied to release hung stores, as aircraft damage may result.

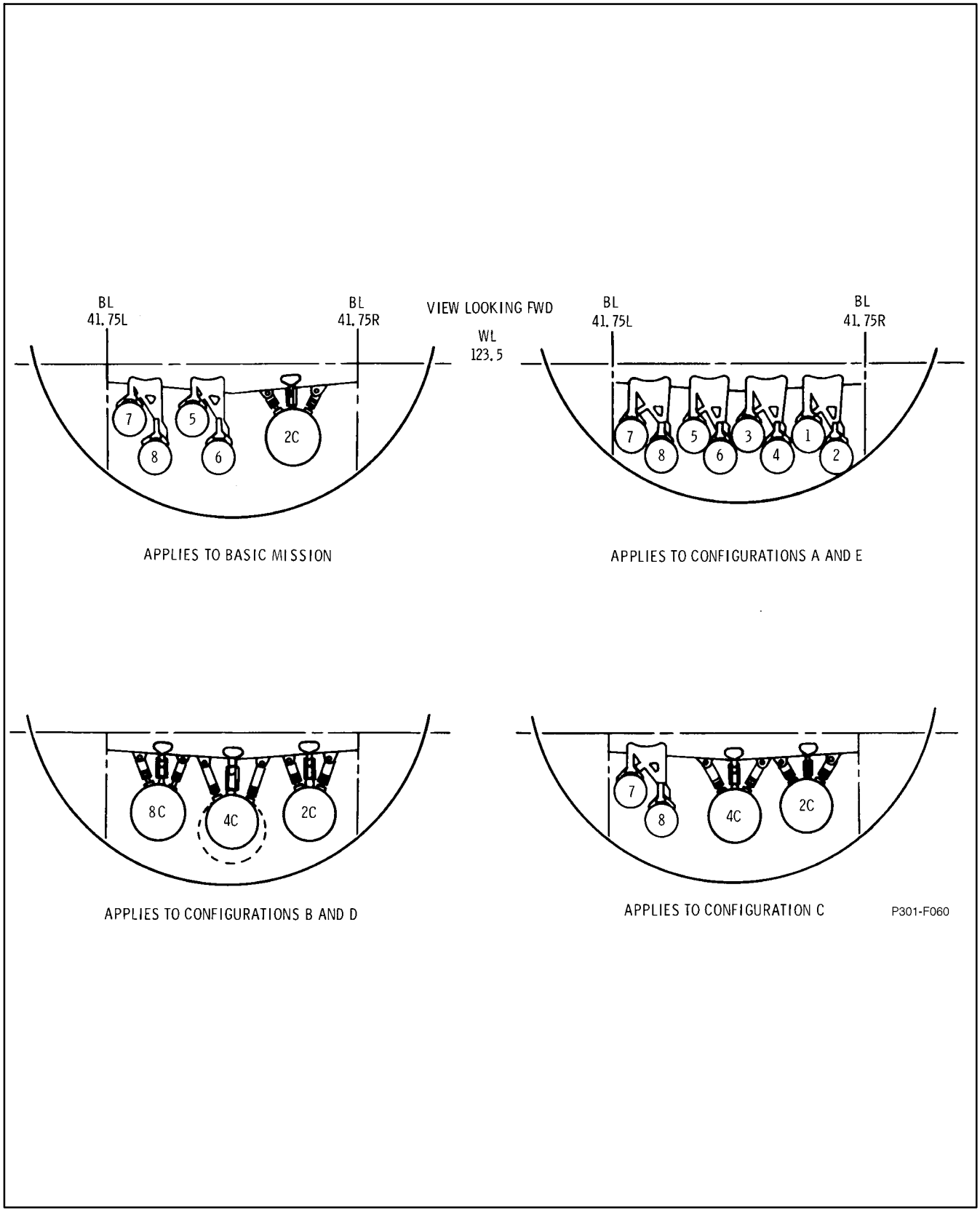


Figure 5-1. Bomb Bay Stores Loading Configuration

5.3.1 Bomb Bay Store Fails to Release Procedures

1. Select weapon on the manual armament select panel in SAFE arming mode.

   a. If the KILL READY light illuminates, an LFA condition exists. Off-line release may be attempted as appropriate using all release switches. The bomb bay doors may be closed if necessary. No further action is required.

   b. If the KILL READY light does not illuminate, an HS condition exists. If over water, consideration should be given to keeping the bomb bay doors open, as delayed release may occur.

2. Attempt NORMAL jettison when required.

WARNING

With a bomb bay hung store, bomb bay doors shall be closed prior to overflight of land, population, or friendly forces.

Note

- Bomb bay jettison pulses are routed to the same LEMA release unit used for normal launch and may not release the hung store.
- Wing stores may be saved from jettison by pulling jettison wing CBs on Forward Electronic Circuit Breaker Panel (FECB) panel prior to initiating jettison.

3. Upon return to base, secure the armament system and inform Air Traffic Controller (ATC) of the hung-store condition.

5.3.2 Wing Store Fails to Release Procedures

1. Select weapon on the manual armament select panel in SAFE arming mode.

   a. If the KILL READY light illuminates, an LFA condition exists. Off-line release may be attempted as appropriate using all release switches. No further action is required.

WARNING

A fully loaded aircraft could be asymmetrically loaded within 8 seconds. Wing stores on the opposite wing from the hung store may be saved from jettison by pulling the JETTISON WING circuit breaker on the FECB panel prior to initiating WING ONLY jettison after considering effects of asymmetrical loading.

   b. If the KILL READY light does not illuminate, an HS condition exists; attempt WING ONLY jettison when required. Upon return to base, secure the armament system and inform ATC of the hung-store situation.

5.3.3 Harpoon Fail to Release Procedures

1. If a Harpoon FTF condition exists, attempt release with all stores release switches, as appropriate.
2. If a Harpoon LFA condition exists, attempt secondary release procedures.
3. If a Harpoon FTF or LFA condition persists, or if normal Intent To Launch (ITL) indications are not noted, missile should be aborted by deselecting the station select switch securing MASTER ARM/MCP power.

WARNING

Do not disconnect umbilical from missile if missile has received ITL signal. Place missile in a safe area for 2.5 hours from ITL initiation. Remain clear of aft end of missile. Notify load team and Explosive Ordnance Disposal (EOD) personnel of ITL initiation.

4. If a Harpoon HS condition exists, attempt wing only or normal jettison (as applicable).

WARNING

- A fully loaded aircraft could be asymmetrically loaded within 8 seconds.
- If the missile is jettisoned after ITL (assuming launch is not aborted) within the release envelope (and engine is running for ENG ON REL), it will fly its programmed search mode and attempt to acquire and hit a target. If jettisoned or selectively jettisoned in the SAFE mode, the warhead will not be armed and will not explode upon contact.
- Wing stores on the opposite wing from the hung store may be saved from jettison by pulling the JETTISON WING circuit breaker on the FECB panel prior to initiating WING ONLY jettison after considering effects of asymmetrical loading.

5.4 INTERNAL KILL STORES LOADING AND JETTISONING

Refer to Figure 5-2.

5.5 INTERNAL SEARCH STORES HANDLING

Refer to Figure 5-3.

5.6 EXTERNAL KILL STORES HANDLING

Refer to Figures 5-4 and 5-5.

CONFIG	STORE	TYPE	BOMB BAY STATIONS	MAX QUANTITY	AIRSPEED (KIAS)			ACCELERATIONS (G)		REMARKS
					MAXIMUM		MINIMUM			
					IN-FLIGHT	AT RELEASE	AT RELEASE	IN-FLIGHT	AT RELEASE	
BASIC MISSION	TORPEDO	MK 46/54	5-6-7-8	4	LBA	250	180	-1.0 TO +3.0	+1.0	SEE NOTES 4, 5
	TORPEDO	MK 50	5-6-7-8	4	LBA	375	175	-1.0 TO +3.0	+1.0	SEE NOTES 4, 5
A	TORPEDO	MK 46	1-2-3-4-5-6-7-8	8	LBA	250	180	-1.0 TO +3.0	+1.0	SEE NOTES 4, 5
	TORPEDO	MK 50	5-6-7-8	6	LBA	375	175	-1.0 TO +3.0	+1.0	SEE NOTES 4, 5
	TORPEDO	MK 54	1-2-3-4-5-6-7-8	7	LBA	250	180	-1.0 TO +3.0	+1.0	SEE NOTES 4, 5
	DEPTH BOMB	MK 82 BDU-45	1-2-3-4-5-6-7-8	8	LBA	LBA	180	-1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED
	UNDERWATER MINE	MK 62 MODS 0/2/2K	1-2-3-4-5-6-7-8	8	LBA	LBA	180	-1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED
B	BOMB	MK 82 BDU-45	2C-4C-8C	3	LBA	LBA	180	-1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED
	MINE	MK 52 MODS 3B/3K/4K	2C-4C-8C	3	LBA	LBA	180	-1.0 TO +3.0	+1.0	SEE NOTE 3
	MINE	MK 62 MODS 0/2/2K	2C-4C-8C	3	LBA	LBA	180	-1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED
	MINE	MK 63 MODS 0/2/2K	2C-4C-8C	3	LBA	LBA	180	-1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED
C	TORPEDO	MK 46/54	7-8	2	LBA	250	180	-1.0 TO +3.0	+1.0	SEE NOTE 4
D	MINE	MK 56	4C	1	LBA	LBA	180	-1.0 TO +2.0	+1.0	SEE NOTE 3
E	SOUND UNDERWATER SIGNAL	MK 64/84	2-4-6-8	4	LBA	250	180	-1.0 TO +3.0	+1.0	
MOCC	FUEL TANK	N/A	2C	1	LBA	N/A	N/A	N/A	N/A	SEE NOTES 6, 7
	GENERATOR	N/A	4C	1	LBA	N/A	N/A	N/A	N/A	SEE NOTES 6, 7

Figure 5-2. P-3 Internal Kill Stores (Sheet 1 of 2)

INTERNAL KILL STORES

NOTES:

1. LBA — Maximum airspeed versus altitude without external stores (405 KIAS).
2. All bomb bay weapons shall be released at +1.0g level flight.
3. Refer to P-3 NATIP for all mine configuration information. High-speed fairing is not authorized for bomb bay use.
4. Mk 46 limitations apply to Mod 5 and to the positive buoyant exercise torpedo (PB) configuration. Maximum release altitude is 500 feet AGL.
5. The current 250 KIAS restriction is only for the Mk 46/54 torpedo with the Mk 28 MOD 2/3 air stabilizer (parapac) and remains in effect until updated guidance is received from AIR-4.3.
6. Fuel tank and generator cannot be released or jettisoned.
7. Fuel tank shall be drained and purged for safe transportation in the bomb bay.
8. Fuel tank may be transported internally provided the tank is purged.
9. For information concerning the loading of stores, refer to the Airborne Weapon/Store Loading Manual, NAVAIR 01-75PAC-75, as applicable to model type.
10. Any internal store may be safely jettisoned between 180 and 330 knots in +1.0g level flight. Individual stores may be jettisoned to their particular normal release limits.
11. Total bomb bay stores weight shall not exceed 4,800 lb.
12. Weapon data copied from P-3 NATIP. For all weapons not listed in NATOPS, refer to P-3 NATIP. If any conflict exists between the data contained in the NATOPS and the data in the NATIP, the NATIP is the final authority.

Figure 5-2. P-3 Internal Kill Stores (Sheet 2 of 2)

AN/SSQ	36B	39*	53D	53E/F	62C *	62D *	62E *	77B	86 *	101	110 *	110A *
Size	A	A	A	A	A	A	A	A	A	A	A	A
Hydrophone Depth (ft)	Thermal to 2625	N/A	90, 400, 1000	45, 90, 200, 400, 1000	90, 400, 1000, 2500	50, 150, 300 or 90, 400, 1500	90, 400, 1500	500, 1000	75, 350	66, 295, 525	N/A	N/A
Life	0.2	4 Max	1, 2, 4, 8	0.5, 1, 2, 4, 8	0.5, 3	0.5, 3	0.5, 3	1, 4, 8			4	6
RF Channels	1-99	N/A	1-99	1-99 except 57, 58, 93	1-99	1-99	1-99 except 57, 58, 93	1-99		1-47	1-31	1-99
Weight	20	25	29	29	39	39	39	29	25	39	39	36
Spd/Alt Max Launch	A	See Notes	C	C	A	A	A	C	A	A	A	A
Purpose	BT	EMATT	DIFAR	DIFAR	DICASS	DICASS	DICASS	VLAD	DLC	ADAR	EER	EER
Power	1/4	N/A	1	1	1/4	1/4	1/4	1			1/4	1/4

Note: WEIGHT SHOWN ABOVE WITH PLASTIC SLCS.

* LITHIUM BATTERY POWERED. SEE NAVAIR 28-SSQ-500 MANUAL.

SMOKE MARKERS		
TYPE	LIFE (MIN)	WEIGHT (LB)
MK58	45 TO 55	12.75
MK25	10 TO 20	3.6

TYPE	WEIGHT (LB)
PLASTIC SLC	2.0
METAL SLC	4.5
CAD JAU-22/B	0.875

SOUND UNDERWATER SIGNAL (SUS)					
TYPE	SIZE (INCHES)	WEIGHT (LB)	FIRING DEPTH (FT)	SINK RATE (FT/SEC)	PURPOSE
MK-61		6.8			BOMB BAY STATIONS 2-4-6-8
MK-64	B 3X15	6.8	60/800	22.8	TACTICAL AND PRACTICE
MK-84	B 3X15	6.8	WATER ENTRY TO 4 SEC	16.8	

CAUTION

Sonobuoys shall not be launched from the free-fall chute or internal PSLTs above 250 KIAS. Above 250 KIAS, random buoy fuselage strikes are possible.

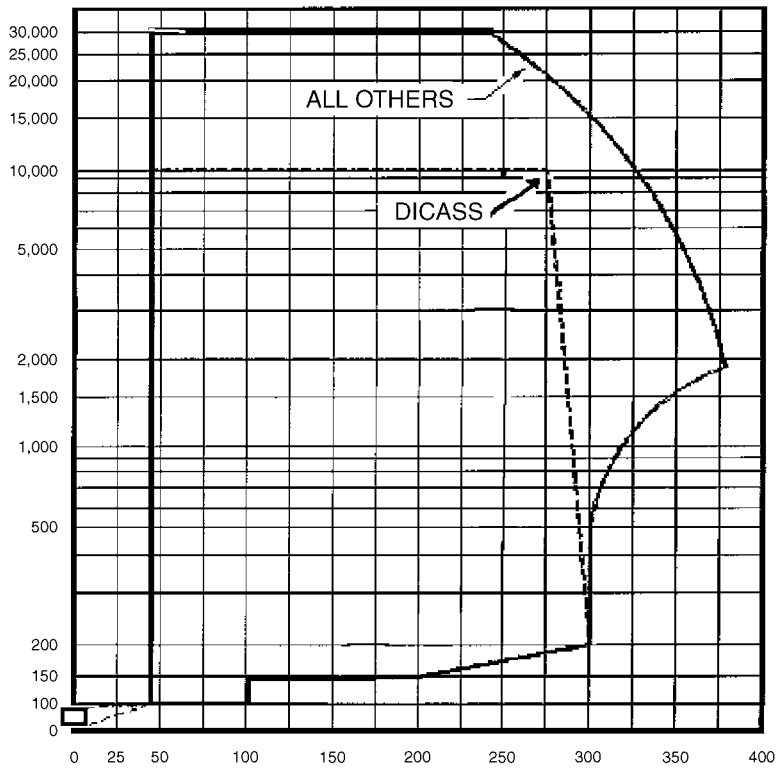


Figure 5-3. P-3 Search Stores (Sheet 1 of 2)

WARNING

- Sonobuoys that contain a lithium sulfur dioxide ($LiSO_2$) cell (SSQ-62, SSQ-86, SSQ-110, and Mk 39 Mod 0 Expendable Mobile ASW Training Target (EMATT) series sonobuoys), if abused or mishandled (risk increases when sonobuoys are over 6 years of age) may produce sulfur dioxide gas, which is potentially hazardous. SO_2 is recognized by its pungent odor and an accompanying distinctive rusty-metallic taste. Exposure at lower concentrations may cause irritation of mucous membranes. Higher concentrations for extended periods may cause irritation of the eyes with tearing, runny nose, choking, breathing difficulty, and if continued, incapacitation. If SO_2 venting is suspected, execute the smoke and fumes elimination procedure and dispose of the venting sonobuoy in a safe area through the free-fall chute without the liner. A sonobuoy in the Sonobuoy Launch Container (SLC) cannot be jettisoned with the free-fall chute liner installed. If time permits, consider slowing the aircraft toward loiter airspeed prior to emergency jettison.
- Aircraft loading/unloading of the SSQ-110 sonobuoy shall only be conducted by SSQ-110 certified personnel. Certification will be provided through the Ordnance Certification Program.
- If SSQ-10 sonobuoy is damaged in any way, do not attempt to repair, replace, realign, or reattach any part of the SSQ-110 sonobuoy. Notify the nearest U.S. Navy EOD detachment to dispose of any damaged SSQ-110 sonobuoy.
- Whenever possible, the SSQ-110 should be carried internally to prevent inadvertent launch/loss of buoys over land.
- If SSQ-110s are carried externally the PPC shall request an ordnance arrival/departure or radar vectors to minimize flight duration over populated areas.
- If SSQ-110s are carried externally, the MC shall ensure accurate track reconstruction.
- The only authorized methods for carrying SSQ-110s in flight are in the internal sonobuoy storage bin or in the external sonobuoy launch tubes.
- Deformation (e.g., melted, out-of-round) of the Mk 39 EMATT is normally caused by a battery malfunction. Dispose of the entire assembly in a safe area through the free-fall chute.
- Protective gloves shall be worn when handling the nickel-coated EMATT SLC.

Note

1. Do not attempt to launch Mk 61/64 explosive SUS from CAD-fired, pressurized, external SLCs.
2. SUS may be launched through the free-fall chute.
3. Only Mk 84 can be launched from an SLC using foam spacers.
4. Parachute flares are not to be carried internally.
5. When search stores are launched from free-fall chutes, use fiberglass liners.
6. Mk 25/58 smokes are to be launched from internal PSLTs using foam spacers or the free-fall chute.
7. Maximum release speed for smokes is 350 KIAS.
8. Lithium-powered sonobuoys shall not be carried internally unless oxygen is readily available for all personnel.
9. A 2-inch yellow band around the SLC and a yellow band on top of the SLC indicates explosive contents.
10. For information concerning the loading of stores, refer to NAVAIR 01-75PAC-75, Airborne Weapons/Stores Loading Manual Navy Model P-3 Aircraft.
11. The Mk 39 Mod 0 EMATT manufactured by the Sippican company shall not be carried internally. The Sippican model Mk 39 Mod 1 and Secchan model Mk 39 Mod 0 and 1 can be used internally or externally. Manufacturer identification can be obtained from the gray over-pack container or from line 7 of the buoy information label on the SLC.
12. Do not remove the Mk 39 Mod 0 EMATT from SLC.

Figure 5-3. P-3 Search Stores (Sheet 2 of 2)

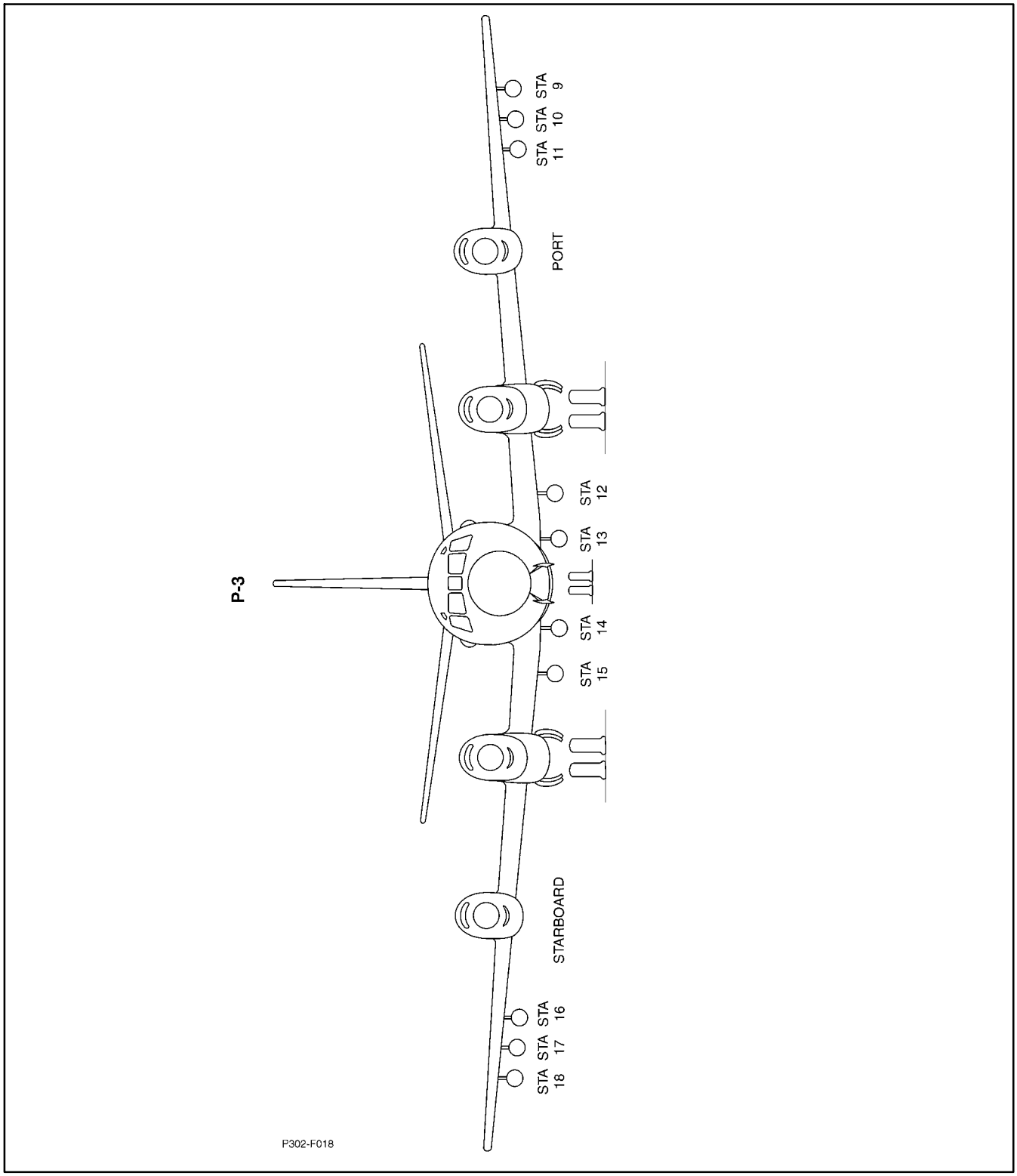


Figure 5-4. Wing Weapon Station

STORE	TYPE	WING STATIONS PORT 9 10 11 12 13	WING STATIONS STARBOARD 14 15 16 17 18	MAXIMUM QUANTITY	AIRSPEED (KIAS) MAXIMUM IN-FLIGHT	AIRSPEED (KIAS) MAXIMUM AT RELEASE	AIRSPEED (KIAS) MINIMUM AT RELEASE	ACCELERATION (G) IN-FLIGHT	ACCELERATION (G) AT RELEASE	MAXIMUM JETTISON AIRSPEED (KIAS)	REMARKS
MINE	MK-52	X X X X	X X X X	8	LBA	LBA	180	–1.0 TO +2.0	+1.0	LBA	REFER TO MINE CONFIGURATION CHART
MINE	MK-56	X X X	X X X	6							
MINE	MK-62	X X X X X	X X X X X	10				–1.0 TO +3.0		400	
MINE	MK-63	X X X X	X X X X	8						360	
MINE	MK-65	X X X	X X X	6				–1.0 TO +2.0		LBA	
BOMB	MK-82 BDU-45	X X X X X	X X X X X	10				–1.0 TO +3.0			RELEASE IN LEVEL FLIGHT. RETARDED MODE AUTHORIZED
ROCKEYE	MK-20/ CBU-99/ CBU-100	X X X X X	X X X X X	10			225	0.0 TO +2.0		340	AUTHORIZED FOR STANDARD PYLONS 9 THROUGH 18. USE 8 INCH LANYARD TO INTERFACE MK-20 TAIL FIN ARMING WIRE WITH PYLON
MAVERICK	AGM-65F	X X	X X	4			180	LBA	+.86 TO +2.0	180 TO 250	JETTISON REFERS TO JETTISON OF MISSILE LAUNCHER COMBINATION. CONFIGURATION — GEAR AND FLAPS UP
HARPOON	AGM-84D	X X X	X X X	6	350	350	200	0.0 TO +3.0	+1.0	350	REFER TO Operation/Operational Order (OPORD) OP-3594 FOR INFORMATION
SLAMER	AGM-84H/K	X X	X X	4	REFER TO EMPLOYMENT GUIDE	REFER TO EMPLOYMENT GUIDE	REFER TO EMPLOYMENT GUIDE	0.0 TO +1.0		325	REFER TO SLAMER EMPLOYMENT GUIDE
DATA LINK	AWW-13		X	1	LBA	LBA	N/A	LBA	N/A	N/A	STATION 15 FOR OPERATION. STATIONS 10 THROUGH 17 FOR LOGISTICAL CARRIAGE. POD IS PINNED.

Figure 5-5. External Stores (Sheet 1 of 2)

STORE	TYPE	WING STATIONS PORT 9 10 11 12 13	WING STATIONS STARBOARD 14 15 16 17 18	MAXIMUM QUANTITY	AIRSPEED (KIAS) MAXIMUM IN FLIGHT	AIRSPEED (KIAS) MAXIMUM AT RELEASE	AIRSPEED (KIAS) MINIMUM AT RELEASE	ACCELERATION (G) IN FLIGHT	ACCELERATION (G) AT RELEASE	MAXIMUM JETTISON AIRSPEED (KIAS)	REMARKS
ESM	AN/ALQ-78	X		1	LBA	N/A	N/A	LBA	N/A	N/A	NO RELEASE CAPABILITY
TRACKING PODS	LATR/EATS TACTS	X	X	2	LBA	N/A	N/A	LBA	N/A	N/A	PODS ARE PINNED IN FLIGHT.

P-3 EXTERNAL STORES
KILL STORES

NOTES:

1. LBA — Maximum airspeed versus altitude without external stores (405 KIAS).
2. Wing store loading should be symmetrical. Exception: P-3C, station 15 when ESM is carried on station 12.
3. For information concerning the wing stores system, refer to NAVAIR 01-75PAC-1.1, as applicable.
4. For information concerning the loading of weapons/stores, refer to P-3 Airborne Weapon/Store Loading Manual, NAVAIR 01-75PAC-75.
5. Any external store may be safely jettisoned between 180 to 200 knots in +1.0g level flight. Individual stores may be jettisoned to their particular jettison limits.
6. Stations 12 and 15 shall not be used for Harpoon carriage because the control distribution box will not provide heater power to the missile. Harpoon umbilical cable shall be installed on stations carrying Harpoon for both operational and logistic movement.
7. For information on the Maverick Missile System, refer to NAVAIR 01-75PAC-1.1.
8. Weapon data copied from P-3 NATIP. If any conflict exists between the data contained in the NATOPS and the data in the NATIP, the NATIP is the final authority.

Figure 5-5. External Stores (Sheet 2 of 2)

PART II

Indoctrination

Chapter 6 — Training and Qualifications

CHAPTER 6

Training and Qualifications

6.1 INTRODUCTION

A continuing training program shall be established that will ensure thorough training and a high degree of readiness for all flight personnel.

The following syllabus outline is intended to serve as a guide to be utilized by individual squadron flightcrews (flightcrews shall be interpreted to mean pilots and other crewmembers directly concerned with the equipment or procedures involved).

6.2 GROUND TRAINING

6.2.1 Aircraft Familiarization Lectures

Aircraft familiarization lectures shall cover the following subjects:

1. Aircraft (general).
2. Powerplants.
3. Propeller.
4. Electrical system.
5. Hydraulic system.
6. APU.
7. Flight control system.
8. AFCS.
9. Air-conditioning and pressurization.
10. Fuel system.
11. Radios and Navigational Aids (NAVAIDs).
12. All-weather systems.
13. Emergency systems and equipment.
14. Armament systems.
15. Instruments.
16. Electronic systems and equipment.

17. Weight and balance.
18. Flight characteristics.
19. Aircraft performance.
20. Normal and emergency operating procedures.
21. Servicing.

6.3 FLIGHT TRAINING

1. Takeoffs.
   a. Normal.
   b. Crosswind.
   c. Night.
   d. Engine failure before refusal speed.
   e. Engine failure before/below minimum ground control speed.
   f. Engine failure after refusal speed.
   g. Three-engine ferry.
2. Airwork.
   a. Slow flight.
   b. Approach to stalls.
   c. $V_{MC\ AIR}$, demonstration.
   d. Use of autopilot.
   e. Use of deice and anti-ice systems.
   f. Loiter shutdown and in-flight restart.
3. Landings.
   a. LAND flap landings.
   b. TAKEOFF/APPROACH flap landings.
   c. No-flap landings.
   d. Three-engine landings.
   e. Two-engine landings.
   f. Crosswind landings.
   g. Night landings.
   h. Waveoff after flare.

Note

Practice boost off landings shall not be performed.

4. Emergencies.
   a. Emergency shutdown and restart at altitude.
   b. Aircraft fire drills (on ground and in flight).
   c. Electrical system failures.
   d. Hydraulic system failures.
   e. Emergency extension of landing gear.
   f. Emergency operation of brakes.
   g. Emergency operation of bomb bay doors.
   h. Emergency operation of pressurization system.
   i. Bailout drill.
   j. Ditching drill.
5. Instruments.
   a. Basic airwork.
   b. VOR/TACAN airwork.
   c. Air Surveillance Radar (ASR), Precision Approach Radar (PAR), GPS, Instrument Landing System (ILS) with glideslope approaches.
   d. Automatic Direction Finder (ADF)/localizer approaches.
   e. Airway procedures.
   f. International Civil Aviation Organization (ICAO).
   g. Air Defense Identification Zone (ADIZ).
6. Competitive and qualification exercises required by type commander.
7. Inertial and GPS navigation systems.

6.4 FLIGHTCREW REQUIREMENTS

6.4.1 Minimum Crew

Four crewmembers, which include the pilot, copilot, flight engineer, and a crewmember qualified in observer duties, shall make up the minimum crew for operation of the P-3 aircraft.

6.4.2 Minimum Crew with Passengers Embarked

For takeoffs and landings with passengers embarked, the copilot must occupy crew station one or two and be at least a designated NATOPS-qualified copilot.

6.5 PERSONAL FLYING EQUIPMENT REQUIREMENTS

Personal equipment requirements will be in accordance with OPNAVINST 3710.7 series.

6.6 QUALIFICATION, CURRENCY, AND REQUALIFICATION REQUIREMENTS

6.6.1 Qualification Requirements

Initial qualification and requalification of all crewmembers shall be in accordance with current Office of the Chief of Naval Operations (OPNAV) and type commander training instructions.

Minimum mission commander qualification requirements shall be as follows:

1. Completion of all requirements for Patrol Plane Commander (PPC) or Patrol Plane Tactical Coordinator (PPTC).
2. Current instrument rating for all naval aviators and instrument qualification for naval flight officers.
3. Designation in writing by the squadron commanding officer.

6.6.2 Currency Requirements

Currency requirements shall be in accordance with OPNAVINST 3710.7 series.

6.7 CREW REST REQUIREMENTS

A specified period of nonduty time is considered necessary prior to most single-flight evolutions and between all multiple-flight evolutions. The following minimum crew rest criteria ensure an acceptable level of physical and mental performance during flight operations.

1. Flight personnel should not be scheduled for continuous alert and/or flight duty (required awake) in excess of 18 hours.
2. Crew rest prior to flights shall be provided as follows:
   a. For flights of less than 6 cumulative hours duration, crew rest requirements should be sufficient to allow flight personnel to eat and obtain at least 8 hours of uninterrupted rest.
   b. Scheduled flights of 6 cumulative hours duration or longer require a minimum of 12 hours crew rest prior to preflight.
   c. In the case of unplanned, short-notice flights of 6 hours duration or longer, commanding officers may waive the above requirements provided the crew has received 12 hours rest in the 24-hour period prior to preflight. When this option is exercised, the flightcrew should not be required to perform continuous duties (required awake) in excess of 18 hours.
   d. If it becomes necessary to exceed the 18-hour crew day, 15 hours of off-duty time shall be provided.
   e. Multiple flights require a minimum of 12 hours crew rest between postflight and preflight for the first three flights. After the third flight, 15 hours crew rest is required between postflight and preflight for continuing multiple flights.

Note

- Multiple flights are defined as those flights with less than 24 hours between each landing and preflight and greater than 6 cumulative hours in duration.
- Minimum preflight and postflight time is to be determined by the commanding officer based on local circumstances.

PART III

Normal Procedures

Chapter 7 — Normal Procedures (General)

Chapter 8 — Normal Procedures (Flight Station)

Chapter 9 — Functional Checkflight Procedures

CHAPTER 7

Normal Procedures (General)

7.1 INTRODUCTION

The normal procedures contained in this manual are intended to standardize operations of both training and operational units with P-3 model aircraft. This standardization should provide the ultimate in combat readiness and effectiveness as well as establish a greater degree of safety for all phases of flight, ground handling, and overwater work.

The information contained is intended to clarify, amplify, and standardize those areas where there is room for variety of interpretation by individual commands. The procedures contained cannot possibly cover every conceivable situation but are intended to govern situations most frequently met. Safety and success of any mission are of paramount importance, with precedence of actions depending upon the existing situation. The flight engineer and tactical coordinator shall ensure both NAVAIR 01-75PAC-1 and NAVAIR 01-75PAC-1.1 are aboard the aircraft. If a tactical coordinator is not assigned, individual tactical crewmembers shall ensure NAVAIR 01-75PAC-1.1 is aboard.

Note

When executing any engine shutdown or restart procedure in flight or on the runway, prior to pulling the E-handle, moving the FUEL AND IGNITION switch, or actuating the feather button, the flight engineer shall be visually checked and verbally confirmed by a pilot as to the correct engine for shutdown/restart.

7.2 BRIEFING

The mission commander (or pilot in command if no mission commander is assigned) is responsible to ensure the crew is briefed and each crewmember is acquainted with the mission and understands their duties and responsibilities. The briefing must be tailored to meet the needs of the mission and the experience of all embarking personnel. The mission commander must ensure conditions of flight are understood by non-crew personnel, all personnel have been assigned a ditching station and individual survival equipment, and they understand how to use the equipment. Each piece of survival equipment to be removed from the aircraft in the event of ditching must be assigned to an individual on flights with nonstandard personnel loadings. If the flight is to be conducted in a hazardous environment, lookout duties must be assigned.

7.3 MISSION PLANNING

The degree of planning for each mission varies with the nature of the specific task to be accomplished. Each mission must be analyzed and planned to cover its specific purpose. The following are items that must be considered:

1. Does analysis of the mission indicate special crew training is required to cope with new tactics?

2. The equipment to be utilized must be preflighted to ensure proper operation.

3. Note navigation problems and determine route; note obstacles, terrain, restricted areas, ADIZ boundaries, controlled airspaces, and the time en route.

4. Are other forces participating? Check characteristics and recognition features of other units in the area.
5. Communications frequencies, call signs, cryptographic and authentication procedures; also, note special signals established.
6. Are special publications, forms, documents, or charts required?
7. Photographic requirements.
8. Restrictions on employment of ordnance.
9. Determine type and quantity of expendable stores to be carried.
10. Determine the fuel load and suitable airfields available during the proposed flight.
11. Note requirement for special clothing and survival equipment. Ensure adequate sources of oxygen will be available for all crewmembers and passengers.
12. Flight packet with forms for obtaining services at Navy and other-services bases, including civilian fields.
13. Flight rations.
14. Weight and balance.
15. Radio aids to navigation.
16. Alternate airfields in the vicinity.
17. Terminal approach provisions.
18. Consider time of return. Will arrangements be required to alert, feed, and transport the crew?
19. Note provisions for altitude reservations and assignments.
20. Weather for departure, destination, and alternate(s):
    a. Aerology briefing for departure, en route, on station, return destination, and alternates.
    b. The weather briefing should include a forecast altimeter setting and a forecast minimum altimeter setting for the on-station area.
    c. All overwater flights shall request a horizontal weather depiction in accordance with OPNAVINST 3710.7 series.

7.4 WEIGHT AND BALANCE

For complete weight and balance data, refer to NAVAIR 01-1B-40.

7.5 AUXILIARY POWER UNIT PROCEDURES

7.5.1 Ground Operation

A qualified operator (crewmember or maintenance) shall be on board the aircraft during ground APU operations, or whenever external power is applied.

7.5.2 APU Preoperational Checks

CAUTION

Ensure a minimum of 1,000 pounds of fuel is in tank Nos. 2 and 3 to provide adequate hydraulic oil cooling.

7.5.2.1 Exterior

1. Ensure aircraft is properly grounded.
2. Check intake/exhaust door areas and air multiplier duct clear of obstructions, Foreign Object Damage (FOD), and fluid leaks, and air multiplier blades free of visible scratches or scoring.

CAUTION

If the airflow multiplier impeller is scratched, corroded, or scored, maintenance inspection of the air multiplier is required prior to use of ground air.

Note

The day signal to secure ground air will be for the operator to point at air multiplier with one hand and perform “cut throat” with the other. Night signal will be similar, using lighted wands.

3. Remove pitot, TAS, and AOA probe covers.
4. Connect battery.
5. Check APU High Rate of Discharge (HRD) bottle for proper pressure.
6. Check refrigeration turbines for proper oil level (add oil if less than three-fourths full).
7. APU and fire extinguisher safety switch (left side of fuselage forward of APU) — Normal, access door closed.
8. Check APU oil reservoir for proper level (add oil if level is at or below the halfway mark on the lower sight gauge).
9. Note position of bomb bay doors and flaps.
10. If the bomb bay is open, check safety pin is installed.
11. Check air multiplier for proper oil level (add oil if level is at or below the halfway mark on the sight gauge).
12. Remove cabin exhaust fan outflow duct plug.
13. Check sonobuoy disable door open.

7.5.2.2 Interior

1. Check Forward Looking Infrared (FLIR) turret control panel (SS-3 station) off.
2. Check TAS probe heater off.
3. Ensure the following switches and handles are in the correct position:
   a. Flight station circuit breakers — Set (except intake door circuit breaker).
   b. Inverter battery test switch — TEST (22 volts minimum).
   c. All red guard switches — Closed.
   d. Identification Friend or Foe (IFF)/Selective Identification Feature (SIF) control — OFF.
   e. Hydraulic pump Nos. 1, 1A, and 2 — OFF.
   f. Landing gear handle — Down.
   g. Wing flap lever position agrees with flap position.
   h. Bomb bay doors switch agrees with doors position.
   i. MASTER ARM/SEARCH POWER switches — OFF.
   j. Emergency shutdown handles — In.
   k. Windshield, pitot, AOA heat — OFF.
   l. Propeller and engine ice control switches — OFF.
   m. Bleed air/fuselage shutoff valves — Closed.
   n. External power — OFF.
   o. Start selector — OFF.
   p. FUEL AND IGNITION switches — OFF.
   q. Visually check feather buttons — NEUTRAL.
4. APU fire detector — Checked.
5. APU ARMING switch — OFF.

7.5.2.3 Starting the APU

1. APU control switch — ON.
2. Set the APU intake door circuit breaker.[1]
3. APU control switch — START, then release to ON. (APU generator will engage automatically.)
4. No. 2 fuel boost pump (or establish crossfeed) — On, if needed to maintain the APU within rpm limits.

[1] Refer to squadron standard operating procedures.

5. Check for a minimum of 1,000 pounds of fuel in tank Nos. 2 and 3 for hydraulic cooling.
6. Wing and tail lights — ON.
7. Ensure positive radio contact.

7.5.3 APU Automatic Shutdown

Automatic shutdown of the APU will occur with any of the following:

1. Loss of APU oil pressure.
2. Overspeed in excess of 106 percent.
3. APU compartment fire.

7.5.4 Ground Air-Conditioning

1. Set ground air-conditioning programmer to manual mode 1-Dot or warmer. Actuate ground air switch and observe increase in APU Exhaust Gas Temperature (EGT) and spread on compressor inlet/discharge pressure gauges. When compressor discharge needles stabilize, cooler temperatures may be selected in two needle width increments, one programmer at a time.

CAUTION

Activation of ground air-conditioning (using the APU/Airflow Multiplier [AFM]) at temperature selections cooler than 1-Dot position in the Manual mode may lead to compressor surge and possible AFM failure.

2. Allow the cabin temperature to stabilize prior to selecting AUTO mode.

WARNING

Personnel approaching the airflow multiplier intake when ground air conditioning is on shall ensure the air intake does not become obstructed. Structural failure of the air multiplier turbocompressor can cause extensive equipment damage or injury to personnel in the area.

CAUTION

- Avoid rapidly switching between EDC and APU air sources during ground operations. Before selecting APU air, deselect EDC air and allow the inlet/discharge needles to equalize prior to selecting GROUND AIR ON.
- Do not allow conditioned air duct temperature to decrease below 5 °C, as turbine howl caused by ice formation on blade tips and water separator icing may occur.

CAUTION

- Do not operate the air-conditioning system in the MAN mode full hot position for more than 1 minute, as system component damage may occur.

- For all operations, cabin ambient temperature should be maintained below 27 °C. If the operational requirements make it necessary to operate avionics on the ground without cooling air, or it is suspected that avionics are overheating: 1) close cabin door and hatches; 2) open doors on avionics racks involved; 3) keep cabin exhaust fan running. Opening the avionics bay doors increases cooling air to the bays. If cabin ambient temperature exceeds 27 °C, selected avionics should be turned off to avoid reduction in reliability and operational readiness.

Note

- If extended maintenance or preflight action is required in the vicinity of the airflow multiplier, a ground air-conditioning cart should be used if air-conditioning is required.

- In the AUTO mode, the program position indicator needle on cabin and flight station temperature selectors drives to full hot (90 seconds maximum) before stabilized temperature is observed.

- If the temperature control system does not stabilize in the AUTO mode within 30 minutes, maintain the conditioned air duct temperature above 5 °C in the MAN mode and report the discrepancy.

- Repeatedly changing temperature selections will increase the time required for system stabilization in the AUTO mode.

- During some conditions, hot air from the left heat exchanger fan discharge duct may enter the air multiplier inlet, causing the air multiplier duct temperature sensing switch to automatically terminate ground air-conditioning. The GRD AIR COND switch must be placed to OFF and back to ON to reactivate the ground air-conditioning system.

7.5.5 Securing the APU

1. Secure all electrical equipment.

CAUTION

- Do not allow duct temperatures to rise above 40 °C.

- When the ASN-179 Inertial Navigation Units (INUs) are not in use, the inertial system NO. 1 and inertial system NO. 2 RUN circuit breakers on the aft electronic circuit breaker panel shall be pulled.

Note

When operating APU ground air in a high humidity environment for 30 minutes or longer, dehumidification shall be performed.

a. Dehumidification — Set temperature controllers to AUTO 2-dot position, then slowly increase to 3-dot position.

b. Dehumidification — Operate the ground air-conditioning system for a minimum of 15 minutes to stabilize the cabin and flight station temperature.

2. Ground air-conditioning switch — OFF.
3. After exhaust temperature has stabilized, APU control switch — OFF.

   a. EGT should drop.

   b. Rpm should drop immediately.

4. Pull the intake door circuit breaker; exhaust door should close after 1 minute.[2]
5. Disconnect the battery and install the covers.

7.6 SURVIVAL EQUIPMENT PREFLIGHT

1. Check survival vest for minimum mandatory survival gear in accordance with Minimum Survival Gear, paragraph 17.11.1.
2. Check flotation device Life Perserver Assembly (LPA) for physical integrity.
3. Preflight parachute.

   a. Check harness for tears, cuts, and moisture.

   b. Check parachute for fit. Parachute shall be fitted over the survival vest and/or inflatable life preserver.

   c. Stow parachute in holder.

4. Check oxygen bottle and smoke mask in accordance with Oxygen System Preflight Operation, paragraph 7.7.

7.7 OXYGEN SYSTEM PREFLIGHT OPERATION

1. Crewmembers will preflight only the portable oxygen bottle assigned to their ditching station.
2. Remove bottle and mask from stowed position.
3. Ensure the smoke mask and oxygen bottle couplings are fully engaged.
4. Check mask and hose for cracks, contaminants, and exposed ICS wires.

WARNING

Ensure any smoke mask containing exposed ICS wires is not plugged into the ICS system.

[2] Refer to squadron standard operating procedures.

5. Regulator switch positions:
   a. Supply lever — ON.
   b. Diluter lever — 100% OXYGEN.
   c. Pressure lever — NORMAL.
6. Turn bottle on momentarily and then off (this is done to conserve bottle oxygen supply).
7. Check regulator for proper pressure.
8. Momentarily press the pressure lever to the TEST MASK position. Observe blinker flash on the regulator.
9. Apply smoke mask to face and test for proper fit.
10. Inhale remainder of oxygen in the regulator. Test for leaks and proper operation of the system.
11. When securing the system, leave the regulator switches in the following positions:
    a. Pressure lever — NORMAL.
    b. Diluter lever — 100% OXYGEN.
    c. Supply lever — OFF.
12. Leave smoke mask and bottle coupled for stowage.

Note

Upon stowing the portable oxygen bottle, ensure the supply valve is closed and any residual oxygen in the regulator has been bled off.

7.8 BOMB BAY DOORS OPERATING PROCEDURES

The following procedures shall be used when opening and closing the bomb bay doors. When the situation permits, a verbal briefing of all participants shall be conducted prior to commencing bomb bay door operations. The outside observer and the bomb bay operator shall communicate via ICS when available. The hand or wand signals shown in Figure 7-1 shall be utilized when ICS communication is not available.

Note

Anytime the bomb bay doors are open and hydraulic power is required, an outside observer shall be posted to ensure the bomb bay door area remains clear.

Opening the bomb bay doors:

1. Bomb bay area clear of personnel and equipment — Verified. (outside observer)
2. Bomb bay safety pin access door closed — Verified. (outside observer)

WARNING

Operation of the bomb bay doors when personnel or equipment are in the vicinity of the doors can cause death or serious injury to personnel and damage to equipment.

3. Bomb bay switch agrees with position of doors — Verified. (bomb bay operator)
4. Hydraulic pumps No. 1, or No. 1A, and No. 2 — ON. (bomb bay operator)
5. Indicate that hydraulic pumps No. 1, or No. 1A, and No. 2 are on. (bomb bay operator)
6. Request bomb bay doors open. (outside observer)
7. Bomb bay switch — OPEN. (bomb bay operator)

If the bomb bay doors fail to open:

8. Bomb bay switch — CLOSED. (bomb bay operator)

WARNING

The bomb bay switch shall be placed to match the door position before further action is taken. Failure of the switch to match the door position may result in unexpected operation of the bomb bay doors.

When the bomb bay doors are fully open:

9. Request hydraulic pumps No. 1, No. 1A, and No. 2 off. (outside observer)
10. Hydraulic pumps No. 1, No. 1A, and No. 2 — OFF. (bomb bay operator)
11. Indicate that hydraulic pumps No. 1, No. 1A, and No. 2 are off. (bomb bay operator)
12. Place hands in view of outside observer. (flight station personnel)

WARNING

Flight station personnel shall retain hands in view and the bomb bay operator shall take no action while the outside observer is out of sight.

When hands of flight station personnel are visible:

13. Request installation of safety pin. (outside observer)
14. Safety pin and cable — Installed/taut. (outside observer)
15. Indicate safety pin installed and cable taut. (outside observer)

Closing the bomb bay doors:

1. Bomb bay door area clear of personnel and equipment — Verified. (outside observer)

WARNING

Operation of the bomb bay doors when personnel or equipment are in the vicinity of the doors can cause death or serious injury to personnel and damage to equipment.

2. Bomb bay safety pin access door open/safety pin installed — Verified. (outside observer)
3. Bomb bay switch agrees with position of doors — Verified. (bomb bay operator)
4. Hydraulic pumps No. 1, No. 1A, and No. 2 — OFF. (bomb bay operator)
5. Indicate that hydraulic pumps No. 1, No. 1A, and No. 2 are off. (bomb bay operator)
6. Place hands in view of outside observer. (flight station personnel)

WARNING

Flight station personnel shall retain hands in view and the bomb bay operator shall take no action while the outside observer is out of sight.

When hands of flight station personnel are visible:

7. Request removal of bomb bay door safety pin. (outside observer)
8. Bomb bay door safety pin/access door — REMOVE/CLOSE. (outside observer)
9. Request hydraulic pumps No. 1, or No. 1A, and No. 2 on. (outside observer)
10. Hydraulic pumps No. 1, or No. 1A, and No. 2 — ON. (bomb bay operator)
11. Indicate that hydraulic pumps No. 1, or No. 1A, and No. 2 are on. (bomb bay operator)

When the bomb bay door area is confirmed clear:

12. Request bomb bay doors closed. (outside observer)
13. Bomb bay switch — CLOSED. (bomb bay operator)

If the bomb bay doors fail to close:

14. Bomb bay switch — OPEN. (bomb bay operator)

WARNING

The bomb bay switch shall be placed to match the door position before further action is taken. Failure of the switch to match the door position may result in unexpected operation of the bomb bay doors.

When the bomb bay doors are fully closed:

15. Indicate doors closed and procedure completed. (outside observer)

7.9 NORMAL AND EMERGENCY CHECKLISTS

The normal checklist is shown in Figure 7-2. When using the normal checklist, the challenge shall be read, and the appropriate crewmember shall respond as delineated on the checklist. The emergency checklist is shown in Figure 7-3. When the emergency checklist is required, the asterisked memory items shall be initiated prior to requesting that the checklist be read. When using the emergency checklist, both the challenge and response shall be read, and the appropriate crewmember shall respond as delineated by the checklist or with the appropriate action taken if the response is as required.

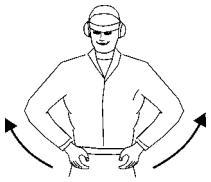
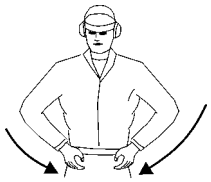
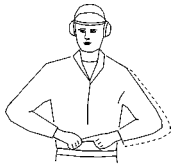
SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Outside observer: Body bent forward at the waist, hands held with fingertips touching in front of body and elbows bent at approximately 45°, then arms swing downward and outward. 	Same as day signal with addition of wands.	Bomb bay operator: Open bomb bay doors.	Bomb bay operator: Open bomb bay doors.
2. Outside observer: Body bent forward at the waist and arms extended horizontally, then arms swing downward and in until fingertips touch in front of the body with elbows bent at approximately 45°. 	Same as day signal with addition of wands.	Bomb bay operator: Close bomb bay doors.	Bomb bay operator: Close bomb bay doors.
3. Outside observer: Insert finger of one hand into clenched fist of other hand and give extracting motion. 	Touch tips of RED-banded wands in front of body, then move one wand laterally in a sweeping motion.	Outside observer: Install bomb bay door safety pin. OR Remove bomb bay door safety pin.	Bomb bay operator: Place both hands in view of the outside observer.

Figure 7-1. Hand or Wand Signals When ICS Communication Is Not Available (Sheet 1 of 3)

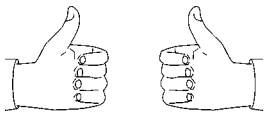
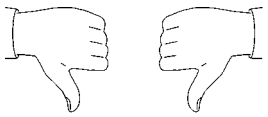
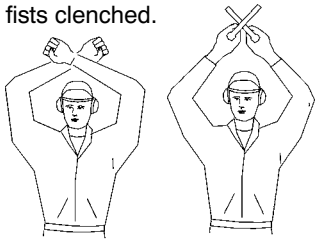
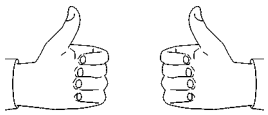
SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
4. Outside observer: Give pilot: (a) Thumbs up  (b) Thumbs down 	 (a) Vertical sweep with RED-banded wand. (b) Horizontal sweep with RED-banded wand.	Bomb bay operator: (a) Bomb bay door safety pin installed, cable taut. (b) Bomb bay door in an unsafe position.	Bomb bay operator: (a) Acknowledge with similar signal. (b) Acknowledge with similar signal.
5. Outside observer: Crossed arms over head, fists clenched.  P301-F065F	Crossed standard RED-banded wand over head.	Bomb bay operator: Suspend all bomb bay safing evolutions.	Bomb bay operator: Suspend all evolutions and await further instructors.
6. Outside observer: Give bomb bay operator: (a) A one and two signal with fingers.  (b) Thumbs up 	 (a) Flash one wand once quickly, then flash twice quickly with the other wand. (b) Hold wand vertically straight out in front with tip of wand pointing up.	Bomb bay operator: Turn on No. 1 or 1A, and No. 2 hydraulic pumps.	Bomb bay operator: Give day signal back to outside observer.

Figure 7-1. Hand or Wand Signals When ICS Communication Is Not Available (Sheet 2 of 3)

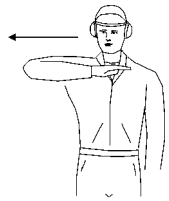
SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
7. Outside observer: Give bomb bay operator:		Bomb bay operator:	Bomb bay operator:
(a) A one and two signal with fingers. 	(a) Flash one wand once quickly, then flash twice quickly with the other wand.	Secure No. 1, No. 1A, and No. 2 hydraulic pumps.	Give day signal back to outside observer.
(b) Perform “cut throat” gesture with one hand. 	(b) Perform “cut throat” gesture with wand.		

Figure 7-1. Hand or Wand Signals When ICS Communication Is Not Available (Sheet 3 of 3)

BEFORE START

1. GEAR PINS ..... AS DESIRED (CP,FE)
2. PARKING BRAKES ..... SET (P)
3. CIRCUIT BREAKERS ..... SET (FE)
4. LIGHTS ..... CHECKED & SET (P,CP,FE)
5. BLEED AIR, ICE CONTROL PANEL ..... SET (FE)
6. WINDSHIELD, PITOT, AOA HEAT ..... LOW & ON (FE)
7. FUEL & IGNITION SWITCHES ..... AS REQUIRED (FE)
8. RPM SWITCHES ..... SET (FE)
9. FIRE DETECTORS ..... CHECKED (FE)
10. TD SWITCHES ..... AS REQUIRED (FE)
11. ATTITUDE SOURCES, HSIs ..... ACCEPTED, CHECKED (P,CP)
12. RADAR ALTIMETERS ..... ON (P,CP)
13. FUEL QUANTITY/PANEL ..... ____LB/SET (FE)
14. HYDRAULIC PUMP 1A ..... ON (FE)
15. ARM PANEL, TACTICAL DISPLAY ..... OFF, OUT, CLOSED, SECURED (P)
16. RADAR, TURRET, COMPUTER ..... OFF, RETRACTED, OFF (CABIN)
17. FLAPS ..... AS DESIRED (CP)
18. CHOCKS ..... AS DESIRED (P)
19. GROSS WEIGHT, CG, SDRS ..... ____LB/CG/LOADED & ON (FE)
20. TAC CREW CHECKLIST ..... COMPLETED (TC)
21. ANTICOLLISION LIGHT ..... ON (FE)
22. DOORS & HATCHES ..... CLOSED (FE)

AFTER START

1. ENGINE START SELECTOR SWITCH ..... OFF (FE)
2. BLEED AIR, FUSELAGE SHUTOFF VALVES ..... AS REQUIRED (FE)
3. HYDRAULIC PANEL ..... SET (FE)
4. ESM, RADAR, MISSION EQUIPMENT ..... AS REQUIRED (CP,TC)
5. IFF ..... STANDBY (CP)
6. FUEL TRANSFER ..... AS REQUIRED (FE)

TAKEOFF

1. SET CONDITION V ..... (CP)
2. BRAKES ..... CHECKED (P)
3. TURN INDICATORS, COMPASSES .. CHECKED (P,CP)
4. ALTIMETERS ..... SET (P,CP,FE,NC)
5. SYNC SYSTEM ..... NORMAL, OFF (FE)
6. FUEL GOV CHECK SWITCHES ..... NORMAL (FE)
7. OIL TANK SHUTOFF VALVE CKT BKRS ..... OUT (FE)
8. AUTOFEATHERING ..... AS DESIRED (P,FE)
9. TRIM TABS ..... SET (P,CP)
10. FLIGHT CONTROLS ..... CHECKED (P)
11. APU, DOORS LIGHT ..... OFF, OUT (FE)
12. RADIOS, HSIs, FMS ..... SET (P,CP,NC)
13. REPORT CONDITION V ..... (CABIN)
14. RPM ..... NORMAL (FE)
15. ELECTRICAL PANEL ..... CHECKED (FE)
16. HARNESS ..... SET (P,CP,FE)
17. ICE CONTROL PANEL ..... SET (FE)
18. IFF ..... SET (CP)
19. FLAPS ..... TAKEOFF (P,CP)
20. OIL COOLERS ..... SET (FE)
21. LIGHTS ..... AS REQUIRED (FE)

CLIMB

1. LANDING GEAR ..... UP (CP)
2. FLAPS ..... UP (CP)
3. AUTOFEATHERING ..... OFF (FE)
4. PRESSURIZATION ..... SET (FE)
5. SYNC SYSTEM ..... SET (FE)
6. LIGHTS ..... AS REQUIRED (FE)

LOITER SHUTDOWN

1. PERFORM NTS CHECK ..... COMPLETE (FE)
2. SYNC SERVO SWITCH ..... OFF (FE)
3. POWER LEVER ..... FLIGHT START (FE)
4. EMERGENCY SHUTDOWN HANDLE ..... PULL (FE)
5. PROPELLER/ENGINE ..... SHUT DOWN (P,CP,FE)
6. CHECK FEATHER BUTTON LIGHT ..... OUT (FE)
7. COMPLETE RESTART CHECKLIST THROUGH ITEM 9 ..... (CP)

IN-FLIGHT RESTART

1. FUEL & IGNITION SWITCH ..... OFF (FE)
2. EMERGENCY SHUTDOWN HANDLE ..... IN (FE)
3. AIRSPEED ..... AS REQUIRED (P)
4. SYNC SERVO SWITCH ..... OFF (FE)
5. FUEL BOOST PUMP SWITCH ..... ON (FE)
6. POWER LEVER ..... FLIGHT START (FE)
7. NTS/FX VALVE SWITCH ..... FEATHER VALVE (FE)
8. FEATHER BUTTON ..... IN (FE)
9. PRESSURE CUTOUT OVRD ..... PUSH (FE)
10. RESTART ..... COMPLETE (FE)
11. OIL PRESSURE ..... NORMAL (FE)
12. OIL COOLER ..... SET (FE)
13. ELECTRICAL PANEL ..... CHECKED (FE)
14. SYNC SYSTEM ..... SET (FE)
15. NTS/FX VALVE SWITCH ..... NTS (FE)

DESCENT/OFF STATION

1. CREW ALERTED ..... (CP,NC,SS3)
2. ALTIMETERS ..... SET (P,CP,FE,NC)
3. FUEL PANEL ..... SET (FE)
4. PRESSURIZATION ..... SET (FE)
5. LIGHTS ..... AS REQUIRED (FE)
6. MASTER ARM & SEARCH POWER ..... AS REQUIRED (P)
7. TURRET/MISSION EQUIPMENT ..... AS REQUIRED (CREW)
8. RAWS AC CIRCUIT BREAKERS (AT 4,000 FT) ..... AS REQUIRED (FE)
9. WHEEL WARNING CKT BREAKER ..... SET (FE)
10. SDRS ..... AS REQUIRED (FE)

APPROACH

1. LIGHTS ..... AS REQUIRED (FE)
2. SET CONDITION V ..... (CP)
3. ALTIMETERS ..... SET (P,CP,FE,NC)
4. LANDING WEIGHT & SPEEDS ..... CHECKED (FE)
5. SYNC SYSTEM ..... NORMAL, OFF (FE)
6. RADIOS, HSIs, FDS, FMS ..... SET (P,CP,NC)

LANDING

1. REPORT CONDITION V ..... (CABIN)
2. FLAPS ..... AS DESIRED (CP)
3. LANDING GEAR ..... DOWN & DETENT (P,CP,FE)
4. BRAKES ..... CHECKED (P)
5. HARNESS ..... SET (P,CP,FE)

AFTER LANDING

1. CREW (FROM DITCH STA) ..... RELEASED (CP)
2. RADAR ..... AS REQUIRED (CP)
3. LIGHTS ..... AS REQUIRED (FE)
4. IFF ..... AS REQUIRED (CP)
5. OIL COOLERS ..... SET (FE)
6. FLAPS ..... AS DESIRED (CP)
7. SYNC SYSTEM ..... OFF (FE)
8. OIL TANK SHUTOFF VALVE CKT BKRS ..... IN (FE)
9. APU ..... AS REQUIRED (FE)

SECURE

1. PARKING BRAKES ..... SET (P)
2. WINDSHIELD, PITOT, AOA HEAT ..... OFF (FE)
3. FUEL BOOST PUMPS ..... OFF (FE)
4. HYD PUMPS 1 & 2 ..... OFF (FE)
5. OIL COOLERS ..... LESS THAN 100% (FE)
6. MISSION EQUIPMENT/TAS HEAT ..... SECURED (CP,TC)
7. OXYGEN SELECTORS ..... OFF (P,CP,FE)
8. ENGINES ..... SHUT DOWN (FE)
9. HYD PUMP 1A ..... OFF (FE)
10. UTILITY LIGHTS ..... OFF (P,CP)
11. START SELECTOR ..... OFF (FE)
12. RADIOS, INERTIALS, FMS ..... AS REQUIRED (P,CP)
13. TRIM ..... ZERO (CP)
14. ANTICOLLISION LIGHT ..... AS REQUIRED (FE)
15. CHOCKS ..... AS REQUIRED (P)
16. APU ..... AS REQUIRED (FE)

** NOTE: Boxed items are abbreviated checklist items.*

Figure 7-2. Normal Procedures

EMERGENCY SHUTDOWN

*1. EMERGENCY SHUTDOWN HANDLE ..... PULL (FE)
*2. HRD (FIRE ONLY) ..... DISCHARGED (P,FE)
3. CROSSFEED & BOOST PUMPS ..... CHECKED (FE)
4. PROPELLER ..... FEATHERED (P,CP,FE)
5. OIL TANK SHUTOFF VALVE CIRCUIT BREAKER ..... AS REQUIRED (P,FE)
6. ALTERNATE HRD (CONFIRMED FIRE ONLY) ..... AS REQUIRED (P,FE)
7. FEATHER BUTTON LIGHT ..... OUT (FE)
8. TANK 5 TRANSFER VALVE (FAILED ENG) ..... CLOSED (FE)
9. POWER LEVER (FAILED ENG) ..... FULL FORWARD (FE)
10. SYNC MASTER SWITCH ..... AS DESIRED (FE)
11. SYNC SERVO SWITCH (FAILED ENG) ..... OFF (FE)
12. APU ..... AS REQUIRED (FE)

ENGINE FIRE ON THE GROUND

*1. EMERGENCY SHUTDOWN HANDLE ..... PULL (FE)
*2. HRD ..... DISCHARGED (P,FE)
3. START BUTTON ..... PULL (FE)
4. CONTROL TOWER ..... NOTIFIED (P,CP)
5. OIL TANK SHUTOFF VALVE CIRCUIT BREAKER ..... SET (FE)

CONFIRMED FIRE ONLY:

6. ALTERNATE HRD ..... DISCHARGED (P,FE)
7. COMPLETE EMERGENCY EVACUATION CHECKLIST ..... (CP)

BRAKE FIRE

*1. REQUEST GROUND FIREFIGHTING EQUIP ..... (CP)
*2. STOP AIRCRAFT ..... (P)
3. RPM SWITCH (ENG OVER BURNING WHEEL) ..... NORMAL (FE)
4. POWER (ENG OVER BURNING WHEEL) ..... APPROX 1,000 SHP (P)

ON ARRIVAL OF GROUND FIREFIGHTING EQUIPMENT:

5. COMPLETE EMERGENCY EVACUATION CHECKLIST ..... (CP)

EMERGENCY EVACUATION

1. CONTROL TOWER ..... NOTIFIED (CP)
2. FLAPS ..... TAKEOFF (CP)
3. ALERT CREW (PA/ICS OVERRIDE) .... ALERTED (CP)
4. EMERGENCY SHUTDOWN HANDLE(S) ..... PULLED (FE)
5. APU ..... SECURED (FE)
6. EXECUTE EVACUATION (COMMAND BELL) ..... (FE)

DITCHING

*1. ALERT CREW TIME TO IMPACT ..... ALERTED (CP)
2. BARO & RADAR ALTIMETERS ..... AS REQUIRED (P,CP)
3. DEPRESSURIZE ..... AS REQUIRED (FE)
4. JETTISON ..... AS REQUIRED (P)
5. DITCH HEADING ..... CHECKED (P,CP)
6. DITCHING SPEED ..... CHECKED (P,CP,FE)
7. EMERGENCY MESSAGE/IFF ..... EMERGENCY (CP)
8. FLAPS ..... AS DESIRED (CP)
9. LANDING GEAR ..... UP (CP)
10. AUX VENT/OUTFLOW VALVE ..... CLOSED (FE)
11. HARNESS ..... LOCKED (P,CP,FE)

NOTE: ASTERISKED ITEMS ARE MEMORY ITEMS.

FUSELAGE FIRE OR ELECTRICAL FIRE OF UNKNOWN ORIGIN

*1. ALERT CREW, ACTIVATE FIRE BILL ..... ALERTED (CP,TC)
*2. CABIN EXHAUST FAN ..... OFF (FE)
3. SMOKE MASKS ..... AS REQUIRED (P,CP,FE)
4. VERIFY OBSTACLE CLEARANCE ..... VERIFIED (CP,NC,SS3)
5. LOITERED ENGINES ..... RESTART (P,CP,FE)

IF FIRE SOURCE IS NOT DETERMINED:

6. BUS A ..... OFF (FE)
7. ELEVATOR, RUDDER, & AILERON BOOST LEVERS ..... PULL (FE)
8. BUS B ..... OFF (FE)
9. GENERATOR SWITCH NO. 2 & 3 ..... OFF (FE)
10. LEFT OR RIGHT EDC ..... DUMP (FE)
11. EMERGENCY DESCENT ..... AS REQUIRED (P)
12. REMAINING EDC ..... DUMP (FE)
13. EMERGENCY TRANSMISSION ..... AS REQUIRED (CP)
14. ESSENTIAL BUS SWITCH ..... OFF (FE)

IF FIRE PERSISTS:

15. GENERATOR SWITCH NO. 4 ..... OFF (FE)

SMOKE OR FUME ELIMINATION

1. CABIN EXHAUST FAN SWITCH ..... ON (FE)
2. SMOKE MASKS ..... AS REQUIRED (P,CP,FE)
3. DESCEND ..... AS NECESSARY (P)
4. DEPRESSURIZE

WITH ELECTRICAL POWER AVAILABLE:

a. AUX VENT ..... OPEN (FE)

WITHOUT ELECTRICAL POWER AVAILABLE:

a. DEPRESSURIZE PNEUMATICALLY ..... (FE)

IF SMOKE OR FUMES PERSIST:

6. FREE-FALL CHUTE/SONO CHUTE #4 .... OPEN (OBS)
7. OVERHEAD SMOKE REMOVAL DOOR ..... OPEN (FE)
8. REDUCE AIRSPEED (170 KNOTS MAX) ..... (P)
9. STARBOARD EMERGENCY EXIT ..... OPEN (OBS)

RESTORING ELECTRICAL POWER

1. OXYGEN SELECTORS ..... AS REQUIRED (P,CP,FE)
2. AFFECTED EQUIPMENT ..... DISCONNECT (FE)
3. ELECTRICAL LOAD ..... REDUCE TO MINIMUM (FE/CABIN)
4. SYNC SERVO SWITCHES ..... AS REQUIRED (FE)
5. GENERATOR SWITCHES (ONE AT A TIME) ..... ON (FE)
6. BUS MONITORING SWITCHES (ONE AT A TIME) ..... ON (FE)
7. ELECTRICAL LOAD ..... RESTORE AS REQUIRED (FE)
8. START SELECTOR ..... OFF (FE)
9. CABIN EXHAUST FAN SWITCH ..... ON (FE)
10. SYNC SYSTEM ..... SET (FE)
11. COMPLETE IN-FLIGHT RESTART CHECKLIST ..... AS REQUIRED (CP)

Figure 7-3. Emergency Procedures

CHAPTER 8

Normal Procedures (Flight Station)

8.1 INTRODUCTION

The information contained in this chapter is intended to standardize those procedures that are primarily flight station oriented. These procedures cannot possibly cover every conceivable situation, but are intended to govern situations most frequently met.

8.2 PREFLIGHT INSPECTION

The pilot in command shall ensure preflight inspections have been completed in accordance with current NAVAIR directives and NAVAIR 01-75PAC-12-1, Section II. (Propeller and empennage ice control system checks as well as infrared anticollision light checks found in current NAVAIR directives should be performed only when use of these systems is anticipated.)

WARNING

- Ensure a lookout is posted in front of the aircraft to visually check the doors. Do not open or close bomb bay doors with personnel or equipment in the immediate vicinity of the bomb bay. Do not enter the bomb bay without first verifying all hydraulic pumps are secured, the bomb bay safety lock access door is open, the safety pin is installed, and the cable connecting the safety lock and door actuator is taut. Do not pull bomb bay circuit breakers after opening or closing the bomb bay doors.

- If the bomb bay doors are closed with electrical and hydraulic power applied to the aircraft, shifting the bomb bay door safety lock lever to the down position will result in opening of the bomb bay doors.

- Personnel approaching the air flow multiplier intake when ground air conditioning is on shall ensure the air intake does not become obstructed. Structural failure of the air multiplier turbocompressor can cause extensive equipment damage or injury to personnel in the vicinity.

CAUTION

- If the airflow multiplier impeller is scratched, scored, or corroded, maintenance inspection is required prior to use of ground air.

- During autofeather checks or static propeller operation, whenever decrease blade angle operation is interrupted at blade angles above the Beta range, the propeller should be feathered prior to resuming decrease blade angle (unfeathering) operation to prevent damage to the pitchlock teeth.

Note

If extended maintenance or preflight action is required in the vicinity of the airflow multiplier, a ground air-conditioning cart should be used if air-conditioning is required.

8.3 BEFORE START

Note

Items marked with a dagger (†) are included in the abbreviated checklist. They are required items for restart following engine shutdown.

† 1. Gear pins — As desired. (CP, FE)

2. Parking brakes — Set. (P)

CAUTION

Do not rotate parking brake handle. Damage may result.

3. Circuit breakers — Set. (FE)

4. Lights — Checked and set. (P, CP, FE)

† 5. Bleed air, ice control panel — Set. (FE)

† 6. WINDSHIELD, PITOT, AOA HEAT — LOW and ON. (FE)

† 7. FUEL AND IGNITION switches — As required. (FE)

† 8. RPM switches — Set. (FE)

9. Fire detectors — Checked. (FE)

10. TD switches — As required. (FE)

11. Attitude sources, HSIs — Accepted, checked. (P, CP)

Note

MHRS headings shall be cross-checked against each other (within ±2°). RINU-G synthetic magnetic headings shall be cross-checked against each other (within ±2°). All four sources of magnetic headings (two MHRS headings and two synthetic magnetic headings) shall be cross-checked against the wet compass (within ±5°).

12. Radar altimeters — ON. (P, CP)

†13. Fuel quantity/panel — ____ LB/Set. (FE)

Note

All boost pumps shall be on for takeoff.

14. Hydraulic pump 1A — ON. (FE)

15. Armament panel, tactical display — OFF, out, closed, secured. (P)

Note

Ensure MASTER JETTISON, WING ONLY JETTISON, and ALE-47 JETTISON switches are OFF, SONO DISABLED light is out, bomb bay doors are closed, and tactical display is secured.

†16. Radar, turret, computer — OFF, retracted, OFF. (Cabin)

CAUTION

- To prevent internal damage, radar system power shall be turned off prior to power shifts that result in a change of the power source to bus A.
- Ensure turret EXTEND/RETRACT switch is OFF.
- To prevent damage, AVX-1 system power shall be turned off prior to all power shifts.

17. Flaps — As desired. (CP)

†18. Chocks — As desired. (P)

19. Gross weight, CG, SDRS — ____ LB/CG/LOADED and ON. (FE)

20. Tactical crew checklist — Completed. (TC)

†21. Anticollision light — ON. (FE)

†22. Doors and hatches — Closed. (FE)

8.4 STARTING ENGINES

Prior to starting engines when the aircraft is on the parking line, the crew shall ensure there are no loose objects behind the aircraft that might be picked up by the slipstream and cause injury to personnel or damage to other aircraft or vehicles. The aircraft brakes must be set. Only NATOPS-qualified pilots, flight engineers, and duly qualified maintenance personnel are permitted to start the engines. Use of the Before Start checklist provided for each aircraft is mandatory. If OAT is below 0 °C, refer to Starting Engines, paragraph 18.3.2.

Note

When an engine is to be turned up for maintenance, use the Maintenance Instruction Manual turnup steps in conjunction with the aircraft normal and emergency procedures checklist.

Also, a qualified person who has visual or verbal contact with the person occupying either the pilot or copilot seat shall act as ground observer. The engine is started only after this ground observer has given the all-clear signal. The aft observer shall be briefed to act as an observer on all engine starts. Both the aft observer and the ground observer shall be briefed on the following:

1. Notify the person starting the engine if significant torching (appreciable visible burning in the tailpipe) or excessive smoke is observed during the initial light-off.

2. Check that no fuel appears to be coming from the fuel manifold drip valve drain. If this does happen, it indicates that the valve failed to close at 16 percent rpm. The person starting the engine should be notified and the start discontinued.

3. It is imperative that ground personnel stand clear of all propellers during engine starting procedures; a leaking starter pressure regulator and shutoff valve can cause a propeller to rotate, even when the starter button has not been operated for that engine. Also, ground personnel should keep clear of the propeller plane because of the risk of injury from starter fragmentation.

Engine start is carried out on command of the pilot. He ensures a positive radio check is obtained with ground control/tower and ICS communications are established with the aft observer and the ground observer (if possible). In addition, he ensures visual contact is maintained with the ground observer throughout the starting sequence by one pilot while the other pilot monitors engine instruments.

8.4.1 Engine Starts Using External Power and/or External Air Source

If external power and/or external air source is used for engine starts, follow the normal start sequence. After starting the No. 2 engine, brief single generator contingencies, and ensure the fuselage and/or engine bleed-air valve(s) are closed. Turn off the external power switch prior to signaling the groundcrew to disconnect external power and/or the external air source.

8.5 NORMAL START

To start the first engine with an APU or external low-pressure system, 25 psi (as measured on the bleed air manifold pressure gauge) is the minimum pressure with the engine accelerating at approximately 16 percent rpm. Starting the first engine in NORMAL RPM provides an improved air source for subsequent engine starts.

CAUTION

- If starting bleed-air manifold pressure is less than 25 psi at approximately 16 percent rpm, secure the engine start with the FUEL AND IGNITION switch. Attempt a start on another engine observing the above limitations.
- The engine maximum allowable acceleration time limit is 60 seconds from start of rotation to low rpm (35 to 45 seconds usual start time).
- Slow starting time (i.e., slow acceleration rate) may cause flame propagation and component damage in the second and third stages of the turbine. Excessive TIT may not be sensed by the engine flight station indicator because of flame location downstream of the thermocouples.
- If TIT is above 200 °C, check that the FUEL AND IGNITION switch is OFF, then motor the engine with the starter to draw cooling air through the turbine.

CAUTION

If the motoring-over procedure is used, it is mandatory that the engine be allowed to coast to a complete stop before attempting a restart. FUEL AND IGNITION switches must not be turned on to effect a relight during the motoring-over procedure.

1. ENGINE START SELECTOR switch — Desired engine. (FE)
2. Engine START button — Push (FE). Ensure START button is being held in by solenoid.
3. Engine PRIMER button — Push if required. (FE)

CAUTION

Do not use prime if the previous start went overtemperature or if residual TIT is above 100 °C.

Note

If a successful start cannot be accomplished, attempt second start using prime.

The PRIMER button arms the fuel enrichment system, thus ensuring a fuel head to the nozzles. If no prime is required, the hand should be moved directly from the starter button to the FUEL AND IGNITION switch. The starter button must never be depressed when the engine is turning, as this may shear the starter shaft or cause a starter failure with possible subsequent starter destruction. Do not reenergize the button if it pops out prematurely. Do not attempt to select another engine when the starter button is still engaged, as the engine being started may stall with subsequent overtemperature.

CAUTION

- Do not move the power lever or rpm switch of an engine while using bleed air from that engine for starting.
- Do not use bleed air from an engine that is accelerating.

At 16 percent rpm, fuel flow rises to 700 to 1,200 pph (when primer is used), then drops to approximately 500 pph after 2 seconds.

Between 16 and 33 percent rpm, rising TIT indicates engine light-off (normally about 24 percent).

Between 16 and 65 percent rpm (normally at approximately 35 percent), the EDC PRESS LOW light extinguishes and the primary fuel pump (paralleling) light illuminates.

At 35 percent rpm, rising oil pressure indication for reduction gear and power section is essential.

Note

On aircraft incorporating Digital Shaft Horsepower gauges, the gauge initiates a bit on startup, illuminating the red overtorque indication. The gauge will indicate actual engine shaft horsepower as the engine speed increases past 43 percent rpm.

Pull START button between 57 and 64 percent rpm. If there is premature start disengagement below 57 percent, the start may be continued unless stagnation occurs. Such a malfunction may preclude any subsequent start.

CAUTION

Note the bleed-air manifold pressure immediately prior to pressing the starter button. When the button is pulled out, note start valve light extinguishes and air pressure returns immediately to original value. Failure of start valve light(s) to extinguish or bleed air manifold pressure to return to original value may indicate a failure of the start valve to close. If the start valve light fails to extinguish, check overhead panel for individual start control valve light. If start valve light fails to extinguish or air pressure does not return to original value, pull appropriate emergency shutdown handle.

At 65 percent rpm, the primary fuel pump (parallel) light should go out. The fuel PRESS LOW light should be out by low rpm. Rpm should stabilize at approximately 98 percent. Discontinue the start if:

1. Starting bleed-air manifold pressure is less than 25 psi at approximately 16 percent rpm.
2. Acceleration time from start of rotation to low rpm exceeds 60 seconds.
3. If peak TIT is between 720 and 750 °C, continue start and record discrepancy. If peak TIT is below 720 °C, discontinue start, record and attempt a second start with the respective TD in null. If subsequent restart is below 720 °C, discontinue start; maintenance action is required.

CAUTION

Cold starts below 750 °C with slow acceleration can cause turbine failure due to downstream burning.

Note

Starts in cold weather conditions may result in start TIT less than the normal range. If all engine starts are similar in TIT, consider this a normal start; no further action is required.

4. If peak TIT is between 830 and 850 °C, continue start and record overtemperature. If peak is above 850 °C, discontinue start, record, and restart. If 850 °C is exceeded a second time, discontinue start. Maintenance action is required. If 965 °C is exceeded, an overtemperature inspection is required prior to flight.
5. Engine speed stagnates or begins to decay.

6. Engine fails to light-off by 33 percent rpm or maximum starter motoring rpm, whichever occurs first.

7. There is no oil pressure indication at 35 percent rpm for either the reduction gear or the power unit.

8. There is fuel spewing from the nacelle drain.

9. Torching (visible burning in the exhaust nozzle) or excessive smoke is observed. If torching lasts longer than 3 seconds, maintenance action is required.

10. Abnormal vibration is noted.

11. On initial start, if either propeller pump light remains on after low rpm is reached.

8.6 STAGNATED AND STALLED START

A stagnated start is evident when the rpm is reluctant to accelerate above 35 to 50 percent rpm, and the TIT does not rapidly rise to the starting limit. A stagnated start frequently develops into a stalled start if no action is taken. If the engine stagnates, cut off fuel immediately, using the FUEL AND IGNITION switch, and pull the START button out. Once rotation has stopped, the motoring-over procedure should be carried out before a subsequent start is attempted.

A stalled start is evident when the rpm is reluctant to accelerate above 35 to 50 percent rpm (as in a stagnated start) and the TIT rapidly increases to the starting limit. On reaching the TIT starting limit, the fuel trim system reduces fuel flow until the maximum fuel take is reached; then TIT rises rapidly and rpm decays. The actual stall may occur at any rpm, depending on the cause and the ambient conditions. During a stalled start, the fuel flow may not rise above minimum on the indicator scale except during the priming process, depending on the rpm at which the stall occurs. Serious damage will occur if a stalled condition is allowed to persist. If a stalled start is recognized, cut off fuel immediately using the FUEL AND IGNITION switch and pull the button. Once rotation has stopped, the motoring-over procedure should then be carried out before a subsequent start is attempted.

CAUTION

If propeller rotation is not noted upon air drop, immediately terminate start, as engine starter disintegration may occur.

8.7 HOT START

A hot start has occurred when TIT exceeds the start temperature limit of 830 °C. A hot start may be caused by a poor ground air supply, faulty fuel control causing a rich fuel schedule, a stalled compressor, malfunctioning temperature trimming system, electrical fault, or incorrect propeller blade angle for starting.

If a hot start exceeding 850 °C occurs, do the following:

1. Immediately turn off the FUEL AND IGNITION switch.

2. If the START button has not popped out, continue motoring over to cool engine TIT to below 200 °C.

3. If the starter button has popped out, wait until the engine has completely stopped before using the motoring-over procedure.

4. If an overtemperature inspection is not required, restart.

8.8 AFTER START

Note

- Items with daggers (†) are included in the abbreviated checklist and are required items following engine restart.
- Engine No. 2, 3, or 4 must be in normal rpm to avoid a temporary complete electrical power loss before disconnecting the ground power or shutting down the APU.

† 1. ENGINE START SELECTOR switch — OFF. (FE)

† 2. Bleed air, fuselage shutoff valves — As required. (FE)

3. Hydraulic panel — Set. (FE)

4. Electronic Support Measures (ESM), radar, mission equipment — As required. (CP, TC)

WARNING

The ALE-47 Countermeasures Dispenser System (CMDS) shall not be armed unless takeoff is planned into a threat environment.

CAUTION

- The ALQ-78 POWER switch shall be set to STBY or ON during takeoff, flight landing, and taxi to prevent damage to the antenna pedestal (if the system is operational).
- AVX-1 gimbal pins shall be installed or AVX-1 system power shall be applied during takeoff, flight, landing, and taxi to prevent damage to the AVX-1 optical station.
- APS-137(V)2 (UIII) radar system power shall be in STBY for taxi, takeoff, and landing and shall be in STBY or ON during flight. Further, both generators 2 and 3 shall be online any time power is applied to the APS-137(V)2 (UIII).

Note

- APG-66, APS-115, AN/APN-234, and APS-137D(V)5 (AIP) radar system power may be off for taxi and all phases of flight.
- ASQ-81 power shall be left off except during compensation or tactical operation.
- Hand controller and optical system acquisition sight shall be stowed.
- When inboard engines are operating with all hatches, windows, and exits closed and with the exhaust fan on, the ground air-conditioning system shall be turned on.

5. IFF — STANDBY. (CP)

6. Fuel transfer — As required. (FE)

8.9 ENGINE GROUND OPERATION

Maintain minimum SHP until oil temperature reaches 0 °C. Up to 1,000 SHP may be used to expedite engine warmup between 0 and 40 °C oil temperature, rpm in NORMAL. Maximum power may be used if the oil temperature is 40 °C and rising and gear case oil pressure is not fluctuating.

Note

APU exhaust gases entering the scoop of the No. 3 engine will, under certain wind conditions, affect rpm, fuel flow, and TIT.

8.10 AIRCRAFT LIGHTS OPERATION

Wing and tail lights should be on any time power is applied to the aircraft. Wheelwell lights shall be on during all night ground operations. Taxi lights shall be used during the hours of darkness whenever the aircraft is in motion on the ground unless the use of taxi lights would unnecessarily blind pilots of other aircraft or ground taxi directors.

Landing and taxi (when gear is down) lights should be used for all landings, takeoffs, approaches, and all other operations below 10,000 feet, day or night, in high density areas, unless operational or meteorological conditions prohibit their use.

CAUTION

Do not use the landing lights longer than 30 seconds without cooling airflow.

The anticollision lights shall be on anytime the propellers are rotating (except that they may be turned off to eliminate distracting reflection into the flight station [cockpit] during flight through clouds).

8.11 TAXIING

The aircraft may be taxied by using the power available in the low or the normal rpm range; power in excess of the Beta range is not recommended.

Note

Whenever practicable, ground operations should be conducted in low rpm to minimize small particle FOD and/or erosion to engine internal parts and for noise abatement purposes.

Before moving the rpm selector switch from LOW to NORMAL (or from NORMAL to LOW), the following procedures should be used:

1. Discontinue use of compressor bleed air from the engine to be shifted.

2. Set power at or as near minimum torque as taxi requirements allow.

3. Do not move power levers of the engine being shifted.

4. Do not shift rpm above 50 knots.

CAUTION

Use of power between GROUND START and MAXIMUM REVERSE in low rpm can cause engine rpm to decay. Contributing causes include high ambient temperature, high field elevation, tailwind, and accessory and bleed-air effects on the power available at LOW rpm. If rpm decay occurs, advance the power lever; if rpm decay continues, shut down the engine.

Note

The propeller pump No. 1 light may come on when the engine is in low rpm. This is caused by lower rpm propeller pump output combined with the higher propeller oil operating temperatures associated with ground operation. If the propeller pump No. 1 light goes out in NORMAL rpm, no corrective action is required.

During normal taxi, turns shall be controlled primarily with the nose wheel. Power should be applied until the aircraft starts rolling before using the nose steering wheel.

Turns should be started with a slight change in direction of the nose wheel and gradually increased until the desired amount of turn is established. The same technique should be used in straightening out the turn. High taxi speeds and excessive movement of the nose wheel must be avoided. Sharp turns at high speed impose excessive forces on the nose wheel tires, strut components, and aircraft structure. Side loads may prove sufficient in high-speed turns to pull the tires off the wheels.

CAUTION

Caution should be exercised at low gross weights, as moderate to heavy braking action can result in locking the wheels with resultant damage to tires.

If it becomes necessary to stop on the taxi strip or warmup ramp, always set the parking brakes. This is necessary because taxi power control can select either positive or negative blade angle and it is very easy to roll backwards in this aircraft.

In high, gusty wind conditions, an aft cg can become critical. Severe gusts are capable of lifting the nose into the air, allowing the tail to contact the ground. The following procedures are recommended as precautionary measures:

1. Taxi in NORMAL RPM.
2. Raise flaps.
3. Position crew and passengers forward during taxi operations.
4. Reduce aft loading as much as possible.
5. Use power against brakes as necessary to provide an additional downward force on the nosegear.

8.12 FUEL GOVERNOR, PITCHLOCK, AND REVERSE HORSEPOWER CHECK

The purpose of this check is to ensure the fuel control governor limits engine speed if the propeller governor fails. It also checks that the propeller pitchlock engages to prevent the propeller from going to a lower blade angle and that reverse SHP is checked. A propeller governor indexing check at 1,500 SHP should be conducted prior to commencing this check. Turn OFF the SYNC MASTER once the propellers are indexed to 100 percent rpm and while 1,500 SHP is still set prior to retarding of the power levers to FLIGHT IDLE.

1. Position aircraft into wind.
2. Rpm switches — NORMAL.
3. TEMPERATURE DATUM CONTROL switches — NULL.
4. Propeller SYNC SERVO switches — NORMAL.
5. Propeller SYNC MASTER switch — OFF.

Note

Perform steps 6 through 13 on two engines at a time (1 and 4, 2 and 3).

6. Power levers — FLIGHT IDLE.
7. Fuel governor check switches for engines being checked — TEST.
8. Power levers — Advance to maximum power position and observe fuel governor rpm (104.2 to 106.7 percent).



Limit the time at the fuel governor setting for any one check to a maximum of 1 minute.

Note

If rpm is between 105.5 and 106 percent, investigate to determine that propeller governor is not controlling rpm. Possible indications of the prop controlling rpm vice the fuel governor are high SHP and high fuel flow.

9. Power levers — Retard to 100 percent rpm; SHP should be 1,500 minimum if Beta follow-up is set correctly.



Do not permit the rpm to drop below 95 percent or the engine bleed valves may open and an overtemperature may occur.

10. Fuel governor check switches — NORMAL.

Note

In the event of a malfunction requiring engine shutdown, excluding an actual engine fire, secure the respective engine with the fuel/ignition switch.

11. Power levers — Advance and observe a SHP increase and stable rpm.

12. Power levers — MAX REVERSE (check SHP).

The following nominal values are for sea level, standard day 15 °C (59 °F) conditions.

a. Engine Nos. 2 and 3 should be 1,250 ±150 SHP.

b. Engine Nos. 1 and 4 should be 1,150 ±150 SHP.

Note

- Increase nominal values 5 SHP for each 1 °C decrease in temperatures from 15 °C.
- Decrease nominal values 4 SHP for each 1 °C increase in temperature from 15 °C.
- Decrease nominal values 40 SHP for each 1,000-foot increase in pressure altitude from sea level.

13. Power levers — START.

14. Repeat steps 6 through 13 with the remaining two engines.

15. TEMPERATURE DATUM CONTROL switches — NORMAL.

8.13 ENGINE ANTI-ICE CHECK

The purpose of this check is to ensure the engine ice control shutoff valves will operate to prevent ice formation in the engine inlet airduct. This check may be conducted in either LOW or NORMAL RPM; however, use of NORMAL RPM results in a more rapid system check.

1. Rpm switches — As desired.

2. Note stable TIT on each engine.

3. Open engine anti-ice switches and observe a corresponding TIT increase for each engine.

4. Close engine anti-icing switch after the ANTI- ICING advisory light illuminates and observe a corresponding TIT decrease.

5. ANTI-ICING advisory lights — Out.

8.14 WING DEICE SYSTEM CHECK

The wing deice check may be conducted on the left and right wings simultaneously.

1. Check bleed-air shutoff valves are closed.

2. Shift the appropriate engine(s) to NORMAL. Note stable TIT.

3. Open the appropriate engine bleed-air valve(s). Recheck TIT for little or no change and monitor wing leading edge skin temperature gauge for no rising temperature.

4. Place outboard wing deice switch(es) to ON. Note a minimum rise on the appropriate engine(s) TIT of 10 °C and return the wing switch(es) to OFF. The rise in TIT denotes the wing deice valve has opened and therefore can be closed immediately, preventing an excessive heat rise in the outboard section of the appropriate wing(s). After the switch is moved to OFF, a rise in temperature can be read on the leading edge temperature gauge with the temperature selector switch properly positioned.

5. Repeat step 4 for the center wing deice switch and temperature selector.

6. Repeat step 4 for the inboard wing deice switch and temperature selector.

7. Close the appropriate engine bleed-air valve(s). Recheck TIT near the original value.

8. Repeat steps 1 through 7 with the opposite inboard engine if this check was not performed simultaneously on both wings.

8.15 TAKEOFF

Note

Items marked with a dagger (†) are included in the abbreviated checklist.

The pilot should brief the copilot and flight engineer on takeoff procedures.

1. Set Condition V (CP).

2. Brakes — Checked. (P)

3. Turn indicators, compasses — Checked. (P, CP)

4. Altimeters — Set. (P, CP, FE, NC)

† 5. Sync system — NORMAL, OFF. (FE)

† 6. Fuel governor check switches — NORMAL. (FE)

7. Oil tank shutoff valve circuit breakers — Out. (FE)

8. Autofeathering — As desired. (P, FE)

CAUTION

If fuel shutoff valve circuit breaker is out, do not use autofeather as severe engine damage may occur.

† 9. Trim tabs — Set. (P, CP)

Note

The normal elevator tab setting for takeoff will be approximately 10° noseup, rudder trim 3° to 4° right, and aileron trim neutral.

10. Flight controls — Checked. (P)

CAUTION

- It is advisable that controls be checked one at a time and carefully with minimum force. It is possible that structural damage could occur to control surfaces when full up elevator and full left or right rudder are applied simultaneously during the control check.
- If flight controls are jammed or restricted in movement while on the ground, do not apply force. Hold light pressure against restriction and call for immediate inspection.

11. APU, DOORS light — OFF, out. (FE)
12. Radios, HSIs, FMS — Set. (P, CP, NC)

Note

When using the FMS to navigate, both pilots and the NAV/COMM shall verify the correct entry of the FMS Flight Plan Route (FPLN page), performance data (PERF page), and the selected FMS 1 and 2 navigation selections (RNAV page). During tactical flights, the selected navigation source to the tactical computer shall be confirmed by the NAV/COMM Configuration (CONFIG page).

†13. Report Condition V (Cabin).
†14. Rpm — NORMAL. (FE)
†15. Electrical panel — Checked. (FE)
†16. Harness — Set. (P, CP, FE)
17. Ice control panel — Set. (FE)
†18. IFF — Set. (CP)
†19. Flaps — TAKEOFF. (P, CP)
†20. Oil coolers — Set. (FE)
†21. Lights — As required. (FE)

8.16 NORMAL TAKEOFF

The flight engineer shall inform the pilot in command of refusal, rotation, Airspeed at 50-foot Height (V_{50}) (four engine), and V_{50} (three engine) speeds plus the computed three-engine military power takeoff rate of climb. If the conditions for takeoff are distinctly unfavorable, a takeoff speed schedule (refer to Chapter 29) shall be presented to the pilot in command. Taxi the aircraft into position on the runway for takeoff. The pilot advances the power levers and calls for desired power. At this time the tachometers should be checked for stabilized rpm. The flight engineer follows through on the copilot power levers and sets the desired power at pilot command. The flight engineer should acknowledge all commands given. The power levers should be moved smoothly in a manner to obtain predicted SHP by the time 80 KIAS is reached.

CAUTION

Very rapid power lever movement should be avoided, as torquemeter "flopover" can occur with too rapid an application of power. This means that at least 5,300 SHP has been momentarily exceeded and the engine(s) shall be inspected as soon as practicable.

Note

With digital SHP gauges incorporated, a red overtorque light will illuminate above 4,600 SHP.

It is normally not necessary to hold the brakes while setting power. Although takeoff runway requirements are based on power application before releasing the brakes, only a small increase in predicted ground roll will result from the use of the rolling-start procedure. If field length is critical, power should be set prior to brake release.

The pilot should initiate directional control using nose wheel steering. The rudder becomes effective between 50 and 60 knots. Release the nose wheel and maintain directional control with the rudder. The pilot should keep his hand on the power levers up to refusal speed.

Visually check the instruments to note any irregularity or malfunction.

The flight engineer maintains a desired power setting and checks all engine instruments for any indication of malfunction or engine overspeed. The flight engineer calls out any malfunction and awaits command from the pilot to take appropriate action.

The copilot calls out "80 KNOTS," "REFUSAL," and "ROTATE" as dictated by the mission and the performance information.

At "ROTATE," the pilot smoothly lifts the nose wheel off the runway and establishes a positive rate of climb.

8.17 WET OR SLIPPERY RUNWAY TAKEOFF

On a wet or slippery runway, it is advisable to use a rolling takeoff, increasing power as required. This enables the pilot to use the excellent power control of the aircraft to counteract torque effect and give the directional control necessary until the rudder effectiveness speed is reached (50 to 60 knots). Under these conditions, directional control can best be maintained by use of differential power and, when effective, rudder and ailerons. Use of nose wheel steering on slippery runways may result in swerving because of high power/torque and a low tire-friction component. Additionally, if a dry spot is encountered while the nose wheel is cocked excessively, damage to nose tires and strut may occur.

8.18 CROSSWIND TAKEOFF

Crosswind takeoff technique is similar to the normal takeoff techniques except that the upwind wing should be held down with the aileron as necessary. The nose wheel should be kept on the ground until rotation speed is reached. The aircraft must then be lifted off cleanly from the ground to avoid possibly retouching in a drift.

8.19 REJECTED TAKEOFF

If, at any time prior to refusal or rotation speed (whichever comes first), the pilot, copilot, or flight engineer has any indication of a malfunction or condition affecting flight safety, he shall make this fact known and the pilot shall reject the takeoff and announce "ABORT." Refer to Chapter 14. If a takeoff is rejected because of an engine FIRE WARNING light, another takeoff shall not be attempted until the affected engine has been inspected.

The pilot in command must ensure observed takeoff performance is consistent with predicted performance as computed by the flight engineer. Factors that may cause observed and predicted performance to differ include: tire inflation pressure, engine efficiencies less than 100 percent, wing leading edge condition, and techniques used to align the aircraft on the runway and set takeoff power. Although a small effect, external stores will also increase takeoff distances.

Note

Abrupt power lever movements may result in engine rpm decay.

8.20 AFTER TAKEOFF CLIMB

When safely airborne, the pilot calls, "LANDING GEAR UP." The copilot retracts the gear and acknowledges, "GEAR COMING UP." When the gear is up, the copilot states, "GEAR UP." After a positive rate of climb is established and IAS is at least 140 knots, the pilot calls, "FLAPS TO MANEUVER." The copilot moves the flap handle to the maneuver flap position and acknowledges, "FLAPS ARE COMING TO MANEUVER." When the flaps are positioned to maneuver, the copilot reports, "FLAPS AT MANEUVER." The pilot then calls, "FLAPS UP." The copilot moves the flap handle to the up position and acknowledges, "FLAPS COMING UP." When the flaps indicate up, the copilot states "FLAPS UP." Allow the aircraft to accelerate to climb schedule airspeed.

Note

- During heavy weight, high altitude, or unusual environment including turbulence associated with windshear conditions, the flaps should be retracted to the maneuver position after attaining 160 KIAS, and then fully up after attaining 180 KIAS.

- No. 1 and 1A HYD press warning lights on center instrument panel annunciator strip may illuminate momentarily (up to 5 seconds) due to a high instantaneous demand for fluid during gear retraction.

The pilot then calls for power as desired. The flight engineer acknowledges and sets the power. The pilot sets Condition IV and calls for the Climb checklist, which should be completed as soon as convenient. When Condition IV is reported completed, the pilot or TACCO should set Conditions III and II as appropriate.

Note

Because of the possibility of encountering unexpected turbulence in flight, all personnel should fasten seatbelts while seated.

8.21 CLIMB

1. Landing gear — UP. (CP)
2. Flaps — UP. (CP)
3. Autofeathering — OFF. (FE)
4. Pressurization — Set. (FE)
5. Sync system — Set. (FE)

CAUTION

Do not operate RESYNC switch unless it is part of governor indexing procedures after component replacement or rpm deviations occur during actuation of the SYNC SERVO or SYNC MASTER switch. Inadvertent actuation of the RESYNC switch may cause propeller off-speed to occur.

Note

Select SYNC MASTER switch to whichever propeller is closest to 100 percent rpm. If governor indexing is required, refer to Governor Indexing Procedure, paragraph 8.22.

6. Lights — As required. (FE)

8.22 GOVERNOR INDEXING PROCEDURE

The solid-state synchrophaser box incorporates features such as preset internal propeller phase-angle references and more accurate phase-angle control with no circuit drift during normal operation. Therefore, no governor indexing is required following initial synchrophaser system indexing. Indexing of system components shall be conducted whenever an engine, valve housing, propeller, or propeller control is removed and replaced. Indexing is not required when the same component is removed and reinstalled.

Should governor indexing be required or should rpm variation occur after selecting a SYNC SERVO or SYNC MASTER and not stabilize within 30 seconds, proceed as follows:

1. Turn off all SYNC SERVO switches.
2. Select No. 2 as master.
3. Wait 15 to 30 seconds, then hold the RESYNC switch in the RESYNC position.
4. Continue holding the RESYNC switch and place all four SYNC SERVO switches to NORMAL; wait 15 to 30 seconds.
5. Place the SYNC MASTER switch OFF, then release the RESYNC switch.
6. Repeat steps 1 through 5 using No. 3 as master.

Note

Any deviation/interruption in the preceding steps requires starting over at step 1 with No. 2 as master.

8.23 IN-FLIGHT NEGATIVE TORQUE SENSING CHECK

When post-maintenance checkflights, training flights, or mission flight plans call for shutdown and subsequent airstart of an engine or engines, a functional test of the NTS system of those engines shall be accomplished in flight, prior to engine shutdown. If the NTS check is not successful, do not shut down the engine except in an emergency. Check as follows:

1. Recommended altitude is 8,000 feet or below at 180 ±10 knots.

Note

Consider minimum airspeed for current gross weight (1.52 V_S). The NTS check may be accomplished at climb schedule airspeed for better climb performance. It may be necessary to slightly yaw the aircraft to initiate the NTS action. Opening fuselage bleed air valves may expedite NTS checks.

2. NTS feather valve switch — FEATHER VALVE position.
3. SYNC MASTER and SYNC SERVO switches (engines being checked) — OFF.
4. Wing deicer switches — All three ON.
5. Engine anti-ice switches (engines being checked) — ON.
6. Horsepower at minimum of 800 SHP.
7. Fuselage bleed valves — As required.
8. Engine bleed-air valve switch — OPEN.
9. Power lever — Retard slowly toward FLIGHT IDLE position observing SHP indicator. NTS action should initiate between negative 150 and negative 500 SHP (100 and 500 on engine Nos. 2 and 3). A satisfactory check consists of a stabilized rpm less than the mechanical propeller governing rpm (not below 95 percent rpm) with the power lever at FLIGHT IDLE in addition to any one of the following:
   a. Initial and/or continued flashing of the feather valve light.
   b. Initial and/or continued negative SHP (as described above). Do not exceed negative 500 SHP.
   c. Noticeable aircraft yaw in synchronization with NTS operation.

WARNING

If power lever movement becomes restricted and/or propeller overspeed occurs at the FLIGHT IDLE position, discontinue use of all bleed air from the appropriate engine and attempt to advance the power lever. If unable to advance the power lever, increase true airspeed and reattempt. In all cases where binding and/or propeller overspeed occurs, a second NTS check shall not be attempted. Movement of the power lever during descent and landing should be closely monitored and caution should be exercised to maintain positive SHP at all times. If the power lever cannot be advanced, secure the engine with the emergency shutdown handle. If unable to secure the engine with the emergency shutdown handle, attempt to feather utilizing the feather button. In all of the above cases, the mission should be aborted.

Note

- It is necessary that the NTS check be completed before the wing deice valves start modulating; otherwise, insufficient bleed air may prevent reaching the required NTS negative SHP.
- If NTS action does not occur prior to attaining negative 500 SHP, advance the power lever and record. Do not shut down and attempt to restart this engine unless an emergency exists.

10. If unable to obtain NTS action because of insufficient negative SHP, repeat steps 2 through 9 with fuselage bleed air valves open.
11. Engine BLEED-AIR VALVE switch — CLOSE.
12. Repeat on other engines to be shut down.
13. Engine anti-ice switches — OFF.
14. Wing deicer switches — OFF.
15. Fuselage BLEED-AIR VALVES — CLOSE.
16. NTS feather valve — NTS.

8.24 CRUISE

Upon reaching cruising altitude, the pilot levels off the aircraft and while maintaining climb power, allows the airspeed to increase to the cruising speed indicated by the mission and performance data section. The pilot then calls for cruise power. (The use of the maximum range tables is recommended to determine the required power settings for the appropriate altitude selected for the mission.) The flight engineer acknowledges cruise power and retards the power levers to the desired setting.

No more than one flight station crewmember may be absent from his seat at any given time. The flight station shall notify all personnel upon ascending above FL 250 and shall ensure Emergency Escape Breathing Devices (EEBDs) or Victim Rescue Units (VRUs) are readily available.

8.25 ENGINE SULFIDATION

The T56-A-14 turbine life can be substantially improved by operations at temperatures less than 1,010 °C. Therefore, it is mandatory that the operator concern himself with the sulfidation factor whenever cruise power is set. Heat to the turbine blades is one factor that the operator can control. Heat is the catalyst for the entire sulfidation process. The use of the maximum range operating tables reduces the temperatures of the turbine blades by approximately 100 °C as long as an appropriate altitude is selected for initial cruise.

8.26 FUEL LOG

The flight station shall coordinate with the NAV/COMM and compute fuel requirements hourly. A fuel log shall be maintained by the flight engineer for all flights scheduled to operate in excess of 500 nautical miles (nm) from the nearest suitable landing field, or flights scheduled for more than 6 hours duration. Refer to Figure 8-1. The fuel log entries may be entered hourly or in 5,000-pound increments, whichever is more suitable to the individual maintaining the log. The use of the fuel log enables the flight engineer to detect malfunctioning fuel quantity indicators, fuel flow gauges, etc., and make allowances for errors in the system. On the reverse side of the fuel log, the takeoff performance and weight-and-balance data are included to enable a single form to be utilized. Forms of the format of Figure 8-1 shall be reproduced locally.

FUEL LOG							
MODEX		FROM		PPC		FLIGHT ENGINEER	
DATE		TO		EVENT		FLIGHT ENGINEER	
PRE-FLIGHT FUEL LOADING							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	FUEL TOTAL	
DIP						DIP	
HYDRO STATIC						FUEL GAUGES	
GAUGE						TOTALIZER	
Δ						Δ ERROR	
JP-4 JP-5	10439 10921	10861 11363	10861 11363	10439 10921	17199 17993	59800 62560	
	GROUND FUEL FOR TAXI-TAKEOFF 60 LB/MIN-NORMAL 40 LB/MIN-LOW			(APPROX 600 LB)			TIME
	TOP OF CLIMB FUEL GAUGE READING						
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							

Figure 8-1. Fuel Log (Sheet 1 of 2)

	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
	TANK 1	TANK 2	TANK 3	TANK 4	TANK 5	TOTALIZER	TIME
FF							
START TIT							

REMARKS

NORMAL TAKEOFF PERFORMANCE	WEIGHT AND BALANCE
AVAILABLE RUNWAY	BASIC WEIGHT
AMBIENT TEMPERATURE	BASIC INDEX
80 KNOTS PREDICTED SHP	OPERATING WEIGHT
REFUSAL SPEED	ZFW
ROTATE SPEED	TAKEOFF WEIGHT
LIFTOFF SPEED	TAKEOFF CG % MAC
DISTANCE TO LIFTOFF	EST LANDING CG % MAC
FOUR ENGINE CLIMBOUT SPEED	
THREE ENGINE CLIMBOUT SPEED	
THREE ENGINE ROC	

NOTE: UNDER ADVERSE RUNWAY CONDITIONS (WATER, ICE, SLUSH, SNOW, AND SO FORTH) AND/OR WHEN COMPUTED REFUSAL SPEED IS 5 KNOTS ABOVE ROTATION SPEED OR LESS, PREDICTION OF FOUR-ENGINE ACCELERATION DISTANCES TO 80 KNOTS, REFUSAL SPEED, ROTATION SPEED, AND LIFT-OFF SPEED ARE MANDATORY.

Figure 8-1. Fuel Log (Sheet 2 of 2)

8.27 ENGAGEMENT OF THE ASW-31 AFCS (AUTOPILOT) IN FLIGHT

WARNING

- No operation at less than 200-foot altitude above local surface is authorized.
- Disengage altitude hold in turbulent air.
- The autopilot is not to be used during takeoff.

1. Before landing:
   a. Disconnect altitude hold for descent and approach.
   b. Disconnect AFCS prior to approach if only single-channel operation is available.
   c. Disconnect AFCS prior to final approach.
2. Engine(s) inoperative — Approved for one engine out same as four engines operating. Approved for loiter using two engines symmetrically.

8.27.1 ASW-31 Operation

WARNING

- Do not operate ATTD-HDG or BRG-HDG central repeater system press-to-test switches in flight with the ASW-31 engaged. Operation of these switches will illuminate the appropriate AFCS warning lights and the red autopilot flashing lights. In addition, transient maneuvers and axes disconnects may occur.
- Before disconnecting the ASW-31 AFCS, ensure the three-axis trim indicator is checked for relative force in all channels.

Operate the AFCS as follows:

1. Roll, pitch, and yaw channel select switches — NORMAL.
2. Roll, pitch, and yaw axes select switches — ENGAGED.
3. Heading select switch — As desired.
4. Altitude hold switch — As desired.

8.27.1.1 Altitude Hold System

To capture altitude:

1. No force on control wheel.
2. Altitude hold/AFCS disconnect switch on control wheels not depressed.
3. Rate of climb equal to or less than 300 fpm.

To release altitude:

1. Altitude hold/AFCS disconnect switch depressed to first detent (ALT light of AFCS status panel illuminated).

To change altitude:

1. Altitude hold/AFCS disconnect switch to first detent.
2. Wheel force in pitch greater than 2 pounds.
3. For rates of climb or descent less than 300 fpm:
   a. Altitude hold/AFCS disconnect switch to first detent and manually hold.
4. For rates of climb or descent greater than 300 fpm:
   a. Need only wheel force greater than 2 pounds.

8.28 ENGAGING AUTOPILOT IN FLIGHT

WARNING

- Operation is not authorized at less than 200-foot altitude above local surface.
- Disengage altitude hold in turbulent air.
- The autopilot is not authorized during takeoff or landing. Disconnect DAS prior to final approach fix.
- Approved for one engine out same as four engines operating.
- Approved for loiter using two engines symmetrically.
- IAS HOLD shall not be used when in a descent below 2,000 feet AGL.

Perform the following procedure:

1. Three-axis trim indicator — Check for synchronized condition.
2. DAS Barometric reference — Checked, set.
3. DAS AP ENGAGE button — PRESS (AUTOPILOT ENGAGED light illuminates).

WARNING

Failure to apply aft yoke force during roll into large bank angles will result in an approximate 1,200 fpm rate of descent.

Note

- If at any time the warning lights illuminate, pressing the control wheel disconnect switch to the second detent should disconnect the DAS. If no flight control transient occurred during disengagement, consideration should be given to attempting to reengage the DAS. Troubleshooting while airborne should center on mode selections at the time of failure, input/outputs to APC, and duplication of the failure.
- Visual and aural indications are provided for loss of AC power to the DAS. Loss of DC power to the DAS causes the DAS to disengage without warning.
- When maneuvering into large bank angles of 50 to 60 degrees with altitude hold mode selected, significant aft yoke force must be applied to maintain level flight. The force required will be reduced as the automatic trim catches up to the needs of the aircraft.

4. In-flight selectable modes — As desired.
   a. Barometric Altitude Hold.
   b. Heading Select.
   c. IAS Hold.
   d. Altitude Select.
5. Disengage the selected DAS mode by deselecting the mode on the ACP or using the breakout force. Total DAS disengagement is achieved by pressing the control wheel disconnect button to the second detent. The DAS should be disengaged prior to the final approach fix.

Note

The pilot can overpower the Pitch mode; however, the BARO ALT mode will not deselect. This enables the pilot to aid the autopilot in altitude maintenance at high angles of bank due to limited autopilot trim and boost authority.

8.29 ENGAGEMENT OF THE PB-20N AUTOPILOT IN FLIGHT

WARNING

At 5,000-foot altitude or lower, a safer altitude hold is provided by moving the altitude hold switch to RADAR ALT HOLD. Safety interlocks are included to protect against various radar altimeter malfunctions. These interlocks not only monitor the system, but illuminate the autopilot flashing red warning lights whenever a malfunction occurs. Selection of BAR ALT HOLD disables autopilot radar altimeter warning functions; thus, the autopilot flashing red warning lights are not illuminated in the case of aircraft deviation from the engaged reference altitude. However, unreliable radar altimeter or descent to an unsafe altitude is annunciated through the RAWS. Refer to Chapter 23 for flight station instrument information.

The APN-141 radar altimeter and the APQ-107 RAWS installation must be considered operationally as an integral unit. When operating with an inoperative RAWS, subsequent power failure to the radar altimeter causes only the radar altimeter OFF flag to appear. The radar altimeter indicator remains frozen regardless of aircraft and barometric altitude. No glareshield flashing red lights illuminate and no low-altitude warnings occur.

WARNING

Before engaging the PB-20N AFCS, ensure the three-axis trim indicator is checked for relative force in all channels.

1. Autopilot — ENGAGE.

If at any time the flashing red light comes on, take immediate corrective action and disengage the Autopilot by using the normal wheel disengage. Caution should be exercised while determining the cause of the warning and before extended use of the autopilot.

2. For preselect heading, position the pilot's HSI cursor to the desired heading and move the preselect heading switch to PRE-SEL HDG.

3. Adjust the autopilot pitch controller as required.

4. For altitude hold, select the appropriate position on the altitude hold switch.

WARNING

The autopilot should not be used below a minimum altitude of 200 feet above the terrain.

Note

With altitude hold selected, the pitch controller will be ineffective.

5. For climb or descent, disengage the altitude hold switch and rotate the pitch trim wheel to obtain the desired pitch angle.

Note

When windshield heat is placed to the HIGH position, changes in the three-phase voltages may cause the autopilot to disengage.

8.30 CONTROL WHEEL STEERING

Note

During CWS operation, only the elevator and ailerons are affected. Whenever either barometric or radar altitude hold is selected, the elevator is blocked out and CWS is available only in the roll axis.

1. Control wheel steering switch — CONT WHEEL STEERING.

In this configuration, turns can be made by use of the control wheel with the autopilot engaged. When the control wheel is released at angles less than 7°, the aircraft rolls out on the heading at which the wheel is released. At banks of approximately 7° to 45°, the bank is maintained at the angle at which the control wheel is released. Above the 45° bank (autopilot limiting bank angle), the aircraft returns to and holds approximately a 45° bank angle.

WARNING

When the bank angle exceeds 45°, autopilot force to the elevators becomes inadequate to hold altitude; therefore, the pilot is responsible for pitch control of the aircraft.

2. If pitch attitude change is desired, turn the altitude hold switch off.

If the nose is pulled up or pushed down to the desired attitude (control limit is approximately 25°) and the control wheel released, the aircraft maintains that attitude at which the control wheel was released. If the attitude change exceeds 25° and the control wheel is released, the aircraft returns to and holds approximately 25°.

8.31 TWO- AND THREE-ENGINE LOITER PROCEDURES

Two- or three-engine operation provides a substantial reduction in the fuel flow required to maintain maximum range or loiter airspeeds at low to intermediate altitudes. Power required for loitered engine operations should be determined, and crews should ensure this power is available below limit TIT prior to engine(s) being shut down. If the engines are to be shut down and a descent is planned, the engines should be shut down before the descent.

Two- and three-engine operation is permissible within the operating envelope as shown in Part XI except that during two-engine operation, a 1,000-foot minimum altitude applies. In addition, operation below chart loiter speeds shall not be attempted during two-engine loiter.

Note

- Prior to loitering the No. 4 engine, ensure the following circuit breakers are set: GEN 4 TRANS, BUS A CONT, and BUS B CONT. Operation with one AC generator should be discussed.
- Prior to two-engine loiter operations, determine the single-engine rate of descent.

Prior to the deliberate shutdown of any engines for loiter operation, the condition of all engines and systems must be checked carefully. Certain items assume prime importance when considering two- and three-engine loiter operations; these are:

1. Generators 2 and 3 normal; all electrical buses energized.
2. The tachometer, TIT gauge, and either the SHP or fuel flow gauge must be operative on an engine prior to its being shut down for loiter.

Note

Operation of an engine with an inoperative TIT gauge can be continued; however, an engine with an inoperative TIT gauge should not be shut down intentionally if a subsequent airstart of that engine is planned. Consideration should be given to substitution of gauges from operating engines to permit intentional shutdowns and subsequent airstarts for loiter operations.

3. Two- or three-engine loiter should not be used when visible moisture is present and ambient temperature is below +10 °C because of possible ice buildup in the shutdown engine.

4. Two- or three-engine loiter operations should not be performed when the OAT is below 0 °C. If mission requirements dictate loiter operations under these conditions, the following paragraph and table are applicable. In addition, following in-flight restart, propeller blade angle movement should be minimized for a 10-minute warmup period to ensure an adequate propeller fluid temperature.

Figure 8-2 shows anticipated propeller control fluid temperature as a function of loiter time and OAT. This fluid temperature should be maintained above –26 °C by either alternating between engines 1 and 4 for three-engine loiter or restarting the loitered engine(s) as necessary. This will decrease the possibility of propeller leaks or abnormal propeller pump No. 1 light indication during restart.

OAT	Time to –26 °C
–30 °C	Greater than 4 hours
–40 °C	2 hours 20 minutes
–50 °C	1 hour 40 minutes
–60 °C	1 hour 10 minutes

Figure 8-2. Propeller Control Fluid

8.31.1 Two- and Three-Engine Loiter Shutdown Procedure

1. Perform NTS check — Complete. (FE)

2. SYNC SERVO switch — OFF. (FE)

3. Power lever — FLIGHT START. (FE)

4. Emergency shutdown handle — Pull. (FE)

5. Propeller/engine — Shut down. (P, CP, FE)

Note

If the propeller fails to feather during loiter shutdown, perform the Propeller Fails to Feather Procedure. If the propeller is successfully feathered using the first four steps of the Propeller Fails to Feather Procedure, complete the Loiter Shutdown checklist. If not, complete the entire Propeller Fails to Feather Procedure, followed by the Emergency Shutdown Procedure.

6. Check feather button light — OUT. (FE)

7. Complete Restart checklist through item 9. (CP)

Note

- If the propeller rotates backwards, momentarily pull the feather button to UNFEATHER position. When rotation stops, place the feather button to neutral position. If the feather button is held in the UNFEATHER position too long, the propeller will start to rotate forward. If this occurs, push the feather button to FEATHER and repeat the procedure as often as necessary. Continued loiter operations are permissible. Ensure the feather button is pushed in prior to conducting an in-flight restart.
- To minimize buffet of a feathered propeller during two- or three-engine loiter, position the propeller blades so they do not parallel the wing leading edge. The positioning should be accomplished by means of the feathering button. Depress pressure cutout override switch for 10 seconds prior to positioning.

8.32 CROSSFEED PROCEDURE

1. Fuel boost pumps — ON.

2. Crossfeed valve — OPEN (from supplying tank).

3. Cross-ship crossfeed valve OPEN (to read fuel pressure when tank from opposite side is supplying the fuel). Check crossfeed manifold pressure is 15 to 30 psi.

4. Crossfeed valve — OPEN (engine to be supplied).

5. Fuel boost pump — OFF (tank not being used). Monitor fuel quantity gauges for proper crossfeed. Be alert for possible transfer from tank to tank.

WARNING

The opening of crossfeed valves during low fuel quantity operations may lead to a hazardous condition and allow for the unexpected loss of power on two or more engines at the same time. Even though a tank may become empty, it is highly unlikely that its associated boost pump light will come on. In this situation, the power loss on more than one engine at a given time may occur if crossfeed valves are open and the fuel boost pump in the source tank fails. During low fuel quantity operations (less than 2,000 pounds per tank), the use of multiple crossfeed configurations should be set up only when necessitated by known empty tank conditions. If a wing tank is empty, its main tank valve shall be closed.

8.33 ENGINE RESTART DURING FLIGHT

WARNING

If a propeller has been feathered and the malfunction cannot be corrected in flight, do not attempt to unfeather the propeller or restart the engine, unless a more serious emergency arises.

Note

- In case of engine failure during two-engine loiter, restart the No. 4 engine first to provide additional generator output.
- During engine airstart, certain malfunctions may result in a propeller pitchlock. If a propeller were to pitchlock, the TAS at the time of pitchlock influences the resulting propeller blade angle (the higher the TAS, the higher the pitchlock blade angle). The pitchlock blade angle may limit the maximum cruise altitude for the return transit (the higher the blade angle, the higher the altitude). The cruise altitude for the return transit dictates the available range for the fuel remaining (the higher the altitude, the greater the available range). If range is a critical factor, it is recommended engine restarts be conducted at return cruise altitude (weather permitting). During climbs to return cruise altitude, consideration should be given to propeller control fluid temperature as a function of loiter time and OAT. It may become necessary to restart the engine at an intermediate altitude to maintain propeller control fluid temperature above –26 °C. If the engine is to be restarted at return cruise altitude, an airspeed of 210 KIAS will exceed maximum allowable restart airspeed above 22,000 feet.

1. FUEL AND IGNITION switch — OFF. (FE)
2. Emergency shutdown handle — In. (FE)

Note

If range is critical, the minimum recommended airspeed is 210 knots up to a maximum of 345 knots less 6 knots per 1,000 feet.

3. Airspeed — As required. (P)
4. SYNC SERVO switch — OFF. (FE)
5. Fuel BOOST PUMP switch — ON. (FE)
6. Power lever — FLIGHT START. (FE)
7. NTS/FEATHER VALVE switch — FEATHER VALVE. (FE)
8. Feather button — In. (FE)
9. PRESSURE CUTOUT OVERRIDE — Push. (FE)

Note

During completion of the restart checklist prior to loiter operations, the Pressure Cutout Override (PCO) switch need only be depressed momentarily to ensure proper operation of the auxiliary pump/feather valve solenoid. The pilot or copilot shall monitor the propeller for blade angle and rotation when PCO is depressed.

10. Restart — Complete. (FE)
11. Oil pressure — Normal. (FE)
12. Oil cooler — Set. (FE)
13. Electrical panel — Checked. (FE)

Note

Before turning ON the SYNC SERVO switch, select SYNC MASTER to OFF.

14. SYNC system — Set. (FE)
15. NTS/FEATHER VALVE switch — NTS. (FE)

8.33.1 In-Flight Restart Procedures

Note

The flight engineer should brief the pilot on the following steps prior to engine restart and when the engine is shut down with the intent to restart.

1. Aft observer — Alerted to monitor engine restart.
2. PRESSURE CUTOUT OVERRIDE — Depress and hold for 10 seconds.

CAUTION

- If the feather button light is on following pressure cutout override action, pull the emergency shutdown handle. If the feather button light goes out, push in the emergency shutdown handle and continue with restart procedures. If the light does not go out, pull the prop feather control circuit breaker and investigate. Incomplete cutout may be caused by a prop fluid leak, stuck PCO button, or malfunctioning PCO circuitry. After investigating, reset the prop feather control circuit breaker. If the system operates normally, continue the restart procedure. If the system does not operate normally, pull the prop feather control circuit breaker and complete the Emergency Shutdown procedure.

- If blade angle/rotation is observed after pushing PCO, execute the Emergency Shutdown procedure.

Note

Following extended engine shutdown periods below –30 °C OAT, the PROP PUMP 1 light may not extinguish during PCO and the time from selecting unfeather to propeller rotation may be longer than normal. The engine may still be restarted using normal procedures.

3. Feather button — Unfeather after release of the pressure cutout override switch and hold until rpm stabilizes and the feather valve light cycles, indicating normal operation of the NTS. (FE)

WARNING

- If a feather valve light remains on steady after rpm has stabilized, a propeller fluid leak may exist. If fluid is visible or any other abnormal indications exist, the restart should be secured by pushing in the feather button and executing the Emergency Shutdown procedure.

- If the NTS INOPR light illuminates, continue holding out on the feather button and secure engine by means of the emergency shutdown handle. Push in the feather button after the emergency shutdown handle has been pulled. Do not attempt an airstart.

Note

- If the propeller does not rotate as blades unfeather (because of the propeller brake), push the feather button in. Use the engine starter until rotation begins. Pull the starter button; note air rise. Continue with step 3.

- As rpm stabilizes, cycling of the feather valve light may cease.

- As engine rpm stabilizes, NTS action should keep actual SHP in the –100 (–150) to –500 SHP range; however, the Digital SHP gauge will erroneously indicate from +1000 to +2100 SHP. Once fuel and ignition is initiated, the Digital SHP gauge conducts a BIT illuminating the gauge's red overtorque indication. The gauge will start indicating actual engine SHP as the engine speed increases past 43 percent rpm.

- In the event of a premature light-off, continue the restart; once engine is onspeed, turn the fuel and ignition switch ON and complete the In-Flight Restart checklist prior to troubleshooting.

4. Reduction gear and power section oil pressure — Oil pressure rising. (FE)

CAUTION

If no oil pressure indicated, secure with the feather button.

5. FUEL AND IGNITION switch — ON (after rpm has stabilized). (FE)

CAUTION

If no light-off occurs within 10 seconds, push in the feather button. If desired, an additional attempt may be made to start the engine using the same procedure as outlined above. If not, execute the Emergency Shutdown procedure.

6. Feather button — Release at light-off. (FE)

Stand by to shut down engine with the E-handle if any of the following occur:

a. TIT exceeds 850 °C.

b. No oil pressure rising by 35 percent in the event of premature light-off.

c. Engine rpm stagnates or begins to decay.

CAUTION

If rpm remains in an offspeed condition, refer to emergency procedures in Chapter 15.

Note

- If the feather button is not released, the NTS INOPR light will cycle and the blade angle will remain at 45°.
- The PROP PUMP 1 light may come on momentarily when the feather button is released. If either or both PROP PUMP lights are not extinguished by 55 percent rpm, continue the restart. The mission should be aborted.

7. Continue restart checklist at item 10.

8.34 DESCENT PROCEDURES

The pilot at the controls should notify the crew prior to starting a descent. Unless prevented by flight clearance restrictions, the descent should be planned at a sufficient distance from the destination to reach the desired altitude at the proper time without use of landing gear or wing flaps. A rate of descent of approximately 2,000 fpm may be attained by placing the power levers at FLIGHT IDLE and holding the airspeed at 250 to 260 knots. A higher rate of descent may be attained by increasing the airspeed.

Adjust pressurization controls to ensure a comfortable rate of depressurization (usually 300 to 500 fpm) so that the cabin is depressurized 800 feet above the field.

Whenever practicable, 100 percent oxygen should be used at night by the pilot, copilot, and flight engineer for 15 out of the last 45 minutes prior to commencing an approach to a field or descent to an operating area when flying en route at cabin altitudes above 5,000 feet. This should be performed by flight station crewmembers one at a time.

To ensure RAWS warning capabilities throughout altitudes below 5,000 feet, it is recommended that the RAWS AC circuit breakers, located on the MEAC bus at the forward load center, be pulled for approximately 10 seconds and then reset when the aircraft is at approximately 4,000-foot radar altitude in the on-station area.

Note

Descent performance is contained in Chapter 31.

8.34.1 Descent/Off Station

1. Crew alerted — (CP, NC, SS-3).

Note

NAV/COMM shall inform the flight station of all navigation hazards/obstructions within 30 nm of the intended route of flight. The pilot will direct utilization of the radar as necessary to ensure terrain avoidance.

2. Altimeters — Set. (P, CP, FE, NC)

WARNING

On aircraft incorporating a single RAWS system, certain failures of the CU-1503 radar altimeter coupler may cause erroneous readings without causing the OFF flag to be displayed. If there is a wide variation between pressure altitude using the forecast altimeter setting and indicated radar altitude, the lower indicated altitude of the two shall be used.

3. Fuel panel — Set. (FE)
4. Pressurization — Set. (FE)
5. Lights — As required. (FE)
6. Master arm and search power — As required. (P)

Note

The pilot shall ensure the pilot radio record control switch is placed to RECORD at all times the mission tape system is operating.

7. Turret/mission equipment — As required. (CREW)
8. RAWS AC circuit breakers (at 4,000 feet) — As required. (FE)
9. Wheel warning circuit breaker — Set. (FE)
10. SDRS — As required. (FE)

Note

Update ZFW if change occurred on station.

8.35 TERRAIN AVOIDANCE

The following procedures are intended to enhance crew awareness of terrain avoidance and standoffs. It is the responsibility of all crewmembers to actively participate in the safe conduct of every mission.

8.35.1 Minimum Safe Altitude (MSA)

For definition of MSA, refer to General Planning (GP) Flight Information Publication. NAV/COMM shall brief departure, approach MSA, and MSA location at planeside.

The NAV/COMM shall make ICS updates on departure and approach. The above ICS updates may be waived if:

a. The aircraft is established on a published departure or approach.

b. The aircraft is on ATC radar vectors.

c. At the discretion of the pilot in command when, in his judgment, the safety of the aircraft can be maintained visually in Visual Metorological Conditions (VMC).

The calls shall include MSA range/bearing to closest obstruction, whether the aircraft is closing or opening the obstruction, and a suitable safe heading. The safe heading shall be coordinated between the flight station and NAV/COMM. All MSA reports shall be acknowledged by the flight station.

8.35.2 Minimum En Route Safe Altitude (MESA)

MESA is defined as 1,000 feet above the highest obstacle within 30 nm of the aircraft flight planned route. NAV/COMM shall brief MESA at planeside.

8.35.3 Territorial/Threat Standoff

Flight station, TACCO, NAV/COMM, and SS-3 shall coordinate and brief at planeside all applicable mission standoffs.

When operating in a standoff environment, ICS updates are required at 10 nm, 5 nm, and every mile inside of 5 nm.

The call shall include range/bearing to standoff, whether the aircraft is closing or opening the standoff, and a suitable safe heading.

8.35.4 Minimum Operational Safe Altitude (MOSA)

MOSA is defined as 1,000 feet above the highest obstacle within 30 nm of the aircraft.

Note

The following procedures shall be adhered to on all operational and crew training flights when the aircraft is operating within 30 nm of land.

8.35.4.1 Prior to Descending Below MOSA

Prior to penetrating MOSA, the NAV/COMM shall update the crew on minimum operational safe altitude, a suitable safe heading, and range and bearing to highest obstruction using the “Prior to descending into MOSA procedures.”

WARNING

To ensure crew safety, a Closest Point of Approach (CPA) range shall be identified prior to entering MOSA. The NAV/COMM and pilot shall consider aircraft closure speed/turn radius, navigation error, and surrounding lower terrain. If the CPA range is reached, the NAV/COMM shall announce the safe heading and MOSA and flight station shall immediately turn to safe heading and climb above MOSA.

Prior to descending into MOSA procedures:

1. Notify flight station, TACCO, and SS-3 of MOSA. (NC)
2. Verify position in INS, GPS, and central computer. (NC)
3. Clear aircraft heading and altitude for obstacles. (NC)
4. Announce established CPA range to crew. (NC)
5. Conduct ICS MOSA call. (NC/SS-3)
   a. MOSA.
   b. Range/bearing to closest land or closest obstruction.
   c. Aircraft closing or opening.
   d. Suitable safe heading.
6. Altimeter. (CP/NC)
   a. Obtain local altimeter setting.
   b. Ensure NAV altimeter setting matches radar altimeter.
7. MOSA Latitude/Longitude (LAT/LONG). (NC)
   a. Pass to TACCO.
   b. Insert as waypoints into GPS/INS1/INS2/central computer.
8. Ensure radar is ready to be used as primary tool for obstacle avoidance. (SS-3/NC)
9. Tactical Mission Software (TMS). (TC/NC)
   a. Display MOSA.
   b. Display CPA circle to flight station.

8.35.4.2 ICS Updates

When operating below MOSA, ICS calls are required at 30 nm, 25 nm, 20 nm, 15 nm, 10 nm, and every mile inside of 10 nm. If operating at a constant offset within one of the outer 5-mile regions, recommend updating MOSA information at every fix and Dead Reckoning (DR) interval.

WARNING

- The calls shall include MOSA, range/bearing to closest point of land or closest obstruction, whether the aircraft is closing or opening land or the obstruction, a suitable safe heading, and distance to standoff when applicable. The safe heading shall be coordinated between the flight station, NAV/COMM, and SS-3 prior to MOSA penetration.

- The NAV/COMM shall make all required MOSA reports with SS-3 verifying with radar. All MOSA reports shall be acknowledged by the flight station.

Note

The above ICS calls may be waived at the discretion of the pilot in command when, in his judgment, the safety of the aircraft can be maintained visually in VMC.

8.35.4.3 Crew Responsibilities

In the event of navigation system uncertainty or navigation system failure in marginal VMC, night, or IMC, the aircraft shall immediately climb to briefed MOSA on a suitable safe heading. The loss of radar should not constitute navigation system failure if an external fixing source can provide an accurate aircraft position.

During certain Emission Control (EMCON) conditions or operational missions, the use of radar may jeopardize the crew and aircraft. In these situations, the use of radar shall be at the discretion of the mission commander or pilot in command if a mission commander is not assigned.

WARNING

- Displayed information on the NAV/COMM, TACCO, pilot, and nonacoustic displays shall not be relied upon as a substitute for primary terrain avoidance and standoff procedures.

- When operating at high latitudes (predominately above 88N), computer tactical displays will become erroneous with respect to aircraft track and symbology relationships. These errors may lead to a loss of positional awareness based solely on scope symbology.

- On radar run-ins, the flight station shall ensure the radar operator conducts only offset run-ins, taking into consideration weather and visibility.

Note

NAV/COMM and TACCO shall display significant features (MSA, MESA, MOSA, standoffs, on-station areas, etc.) within 30 nm and update the pilot display accordingly.

When below MOSA and within 30 nm of land:

(1) Patrol plane pilot, NAV/COMM, and SS-3 shall use a 1:500,000, or 1:1,000,000 scale chart with suitable obstacle depiction. NAV/COMM shall plot the aircraft position DR every 15 minutes and fix the aircraft position every 30 minutes (NAV/COMM log annotation of the fix is only required hourly).

Note

Because of numerous duties assigned to the NAV/COMM below MOSA and within 30 nm of obstacles, Dead Reckoning Trackers (DRTs) and NAV/COMM log annotation except for fixing are optional.

(2) NAV/COMM and SS-3 shall update crew with MOSA ICS call as necessary in relation to closest land or the closest obstacle.

(3) Use radar as the primary aid for obstacle avoidance.

(4) As directed by the pilot in command, the NAV/COMM and SS-3 shall provide MOSA ICS updates.

8.36 LANDING PROCEDURES

Complete the Descent and Approach checklist before entering the traffic pattern. Enter the traffic pattern as specified by local course rules. The landing gear may be lowered when desired. Refer to Figure 8-3 for the landing pattern.

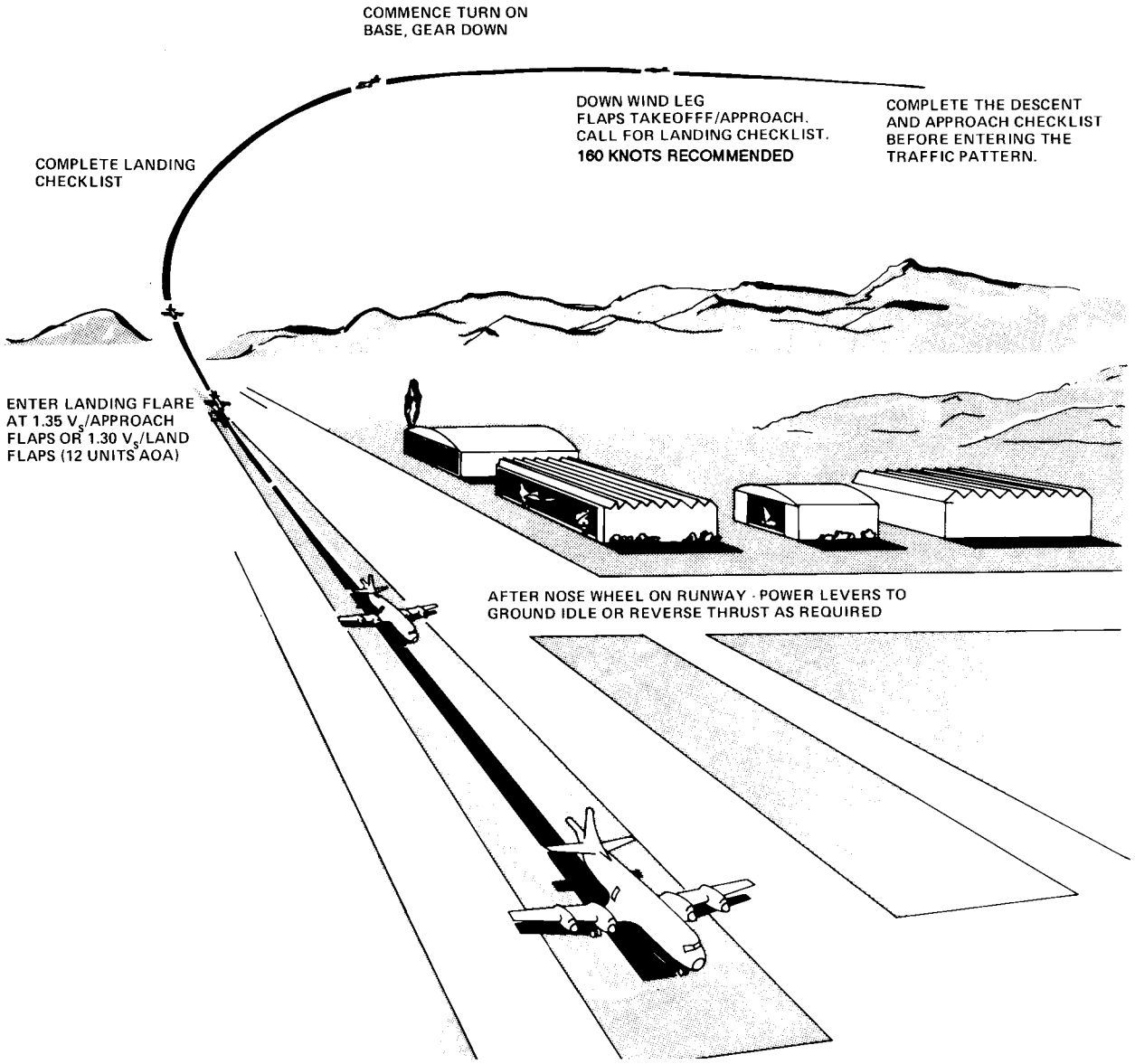
WARNING

Any landing made with the flap handle above the LAND position eliminates that portion of the landing gear warning system, AFC-460. High-speed, high-power setting approaches may negate the 153 knot/power lever switches. Ensure the Landing checklist is complete.

Note

- Canceling of the wheels warning system shall be done only at the direction of the pilot at the controls.
- During the approach and landing, pilots and flight engineers should be particularly alert for any indication of a pitchlocked condition. A pitchlocked propeller may be indicated by a higher SHP reading than is consistent with power lever position and a decrease in rpm as power is reduced.
- Flaps should be called for and selected in increments.
- When wing stores place the aircraft in configurations “D” or “E” (greater than 700 drag count), add 5 KIAS to 1.35 V_S and 1.3 V_S for approach and landing.

The recommended downwind airspeed for normal landing pattern weights is 160 knots. At the base leg position, complete the Landing checklist and commence a visual descending/decelerating approach so that the airspeed slowly tapers to 1.35 V_S (approach flaps) or 1.30 V_S (land flaps) as the flare is established. It is not desirable to arrive at these speeds early on final approach.



DATA FOR LANDING PATTERN DIAGRAM

12 UNITS AOA INDICATED AIRSPEED — KNOTS, ZERO THRUST, ZERO BANK ANGLE, GEAR UP OR DOWN																	
AIRCRAFT WEIGHT X 1000	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145
T.O./APP FLAPS 1.35 V_S	114	119	123	128	131	135	138	142	145	149	152	155	158	162	165	168	171
LAND FLAPS 1.3 V_S	103	107	111	114	118	121	124	127	131	134	137	139	142	145	148	151	154
NO FLAP (DOWN WIND) 1.52 V_S	MINIMUM 160 KTS				161	165	170	174	178	183	187	191	195	199	202	206	210
NO FLAP 1.2 V_S	MINIMUM 135 KTS							137	140	143	147	150	153	156	159	162	165
LAND FLAP DITCH*	94	97	100	103	106	108	111	114	117	119	121	124	126	129	131	134	135
*APPROACH FLAPS ADD 5 KTS. MANEUVER OR FLAPS UP ADD 20 KTS.																	

P301-F066

Figure 8-3. Landing Pattern

8.36.1 Approach

1. Lights — As required. (FE)
2. Set Condition V (CP).
3. Altimeters — Set. (P, CP, FE, NC)
4. Landing weight and speeds — Checked. (FE)
5. Sync system — NORMAL, OFF. (FE)
6. Radios, HSIs, Flight Director System (FDS), and FMS — Set. (P, CP, NC)

Note

- Flight station should brief approach and applicable information with NAV/COMM.
- If an FMS-based approach is planned, the correct entry of the approach into the CDU-7000 shall be verified by pilot, copilot, and NAV/COMM.

8.36.2 Landing

Note

- Items marked with a dagger (†) are included in the abbreviated checklist.
- Landings on runways of less than 5,000 feet require commanding officer's approval.
- Boost pumps for operating engines shall be on for landing.

1. Report Condition V — (Cabin).

† 2. Flaps — As desired. (CP)

† 3. Landing gear — DOWN and DETENT (P, CP, FE). Check that handle is in detent.

† 4. Brakes — Checked. (P)

† 5. Harness — Set. (P, CP, FE)

Ease off power as flare is established. (The pilot will normally handle the power levers during approach and landing.)

Immediately after the nose wheel touches the runway, lift up the power levers and pull back to the GROUND START position. If the flight idle solenoid should fail to operate during landing, more than the normal amount of force is required to move the power levers into the ground operation range. Reverse thrust is most effective at speeds above 80 knots and should be initiated as soon as possible after the nose wheel touches the runway. Maintain directional control, using the rudder down to 60 knots. Below 60 knots, use engine power, nose wheel steering, or both.

CAUTION

After landing, no attempt should be made to retard the power levers beyond FLIGHT IDLE until speed is less than 135 KIAS or less than 125 KIAS if without electrical power.

When the power levers are moved into the ground operating range, all four Beta lights should come on. If any Beta light fails to come on, the flight engineer calls out this fact. If the propeller blade angle does not follow the power lever position when going from flight idle to the ground operation range, that propeller remains at positive thrust while the other propellers are moving toward zero thrust. This causes the aircraft to swerve and is readily noticeable by the pilot. If this happens, pull the emergency shutdown handle on that engine. Reverse thrust may be used on the remaining engines. If, on the other hand, the aircraft continues straight down the runway when the power levers are moved into the ground operating range, the cause is most likely a malfunctioning Beta light switch or burned out bulbs. Reverse thrust in this instance is normal but should be applied with caution.

Maintain directional control, using the rudder while it is still effective. When required, as rudder becomes ineffective, use differential power, then nose wheel steering. Differential reverse thrust can be used to advantage on slippery runways in emergency situations, such as failure of the hydraulic system, and in other situations in which nose wheel steering may not be available.

Note

The PROP PUMP 1 light of any propeller may come on momentarily when the propeller is pulled into the Beta range as a result of pitchlock reset actuation.

8.36.3 Landing on Wet or Slippery Runways

When landing on wet or slippery runways, apply reverse thrust slowly, then after a substantial decrease in airspeed, use the brakes lightly and intermittently. After most of the weight is on the landing gear, more braking may be used but the applications must continue to be intermittent.

8.36.4 Crosswind Landings

The maximum crosswind component that P-3 aircraft have been flight tested is 35 knots. In making a crosswind landing, the following variables must be taken into consideration:

1. Direction and velocity of the wind.
2. Condition and length of runway.
3. Crosswind component.
4. Wind gusts.

The three methods of making a crosswind approach are:

1. Lowering the upwind wing.
2. Crabbing into the wind.
3. A combination of the first two methods.

The recommended method of landing the aircraft in a crosswind is to lower the upwind wing; however, at the discretion of the pilot, any one of the above three methods may be used. It is preferable to touch down on the upwind gear first. Lower the nose wheel to the runway and exert forward pressure on the yoke. Keep sufficient aileron in to hold the upwind wing down. Use rudder and asymmetric power for directional control. Maintain at least 130 knots airspeed until touchdown when crosswind component is above 30 knots to provide adequate directional control and allow runway lineup without exceeding 15° of sideslip.

CAUTION

Bank angles in excess of 9° at touchdown result in the outboard propeller striking the runway surface.

8.36.5 Short-Field Landing

The P-3 possesses inherent design characteristics that enable it to stop in short distances. Flight operations are normally conducted from runways in excess of 6,000 feet; therefore, the necessity to perform the short-field landing procedure is remote; however, if, after reviewing available runway and determining normal landing ground roll distance, a short-field landing is deemed necessary, the following procedure is recommended:

1. Slow to no less than 1.3 times the stalling speed with land flaps.
2. Establish a slightly less than normal glideslope.
3. Adjust aircraft flightpath to ensure touchdown in the first 500 to 1,000 feet of runway.
4. As necessary, to effect a shorter stopping distance, use reverse thrust immediately after the main gear is on the runway. Set power levers in ground operating range (Beta lights on), then pull steadily into reverse. Use elevator control to lower the nose wheel onto the runway. Do not apply reverse thrust suddenly, as this causes the nose wheel to slam heavily onto the runway.
5. To obtain maximum braking, first apply reverse thrust (this increases weight on the wheels), then apply brakes by partly depressing the brake pedals and gradually increasing brake pressure up to the maximum possible without sliding the tires. Hard braking at speeds above 120 knots should be avoided.

CAUTION

Brakes should be released immediately after stopping if hard braking has been used. Do not set parking brakes. Use brakes sparingly during subsequent taxiing to allow heat to dissipate.

Note

Landings on runways of less than 5,000 feet require commanding officer's approval.

Propeller braking is most effective at high speeds, whereas wheelbrakes are most effective at low speeds. The importance of the timely use of propeller braking may be seen by referring to Figure 8-4.

Use of the FLIGHT IDLE power lever position is not an effective means of braking. As illustrated in Figure 8-4, the variation of thrust at flight idle is such that as the aircraft decelerates through approximately 80 knots, the thrust becomes positive and further deceleration would result in increasing positive thrust. The consequences of attempting to overcome this positive thrust with the use of wheelbrakes should be self-evident. Examination of the ground idle characteristics on the example emphasizes the desirability of retarding the power levers into the ground operating range (Beta) as soon as practicable during the rollout in order to obtain the maximum braking effect of the propellers. Undue delay in the flight idle range not only affects the overall aircraft performance but may impose unnecessarily severe requirements on the wheelbrakes during the stop. For this reason, it is important to utilize the excellent braking

capability of the propellers in GROUND IDLE as soon as possible after touchdown. The additional decelerating force available with the use of full reverse is also illustrated. It can be seen that approximately 90 percent of the maximum available aerodynamic braking may be obtained with the power levers in the GROUND IDLE position. The effect of wheelbraking is also included in this chart to show that as propeller effectiveness diminishes with speed reduction, wheelbraking effectiveness increases.

8.37 OVERHEATED BRAKES/TIRES PROCEDURE

Each wheel is designed with thermal fuses that allow deflation of the tires whenever temperatures become excessive. This eliminates tire blowout (caused by excessive tire temperatures) that can cause nacelle damage. In order to avoid inadvertent deflation of tires during normal operation, it is recommended that retraction of the landing gear be delayed a minimum of 2 minutes for cooling after takeoff whenever excessive braking is utilized or when long-period intermittent braking is used during taxiing.

8.37.1 Brake Cooling Procedure During Taxiing

Effective brake cooling can be achieved while taxiing whenever the brakes are suspected to be hot. This can occur when heavy braking action is used during any part of the landing or taxi segment. Cooling is achieved by adjusting the No. 2 and No. 3 power levers forward of the GROUND START position using NORMAL RPM. This creates high airflow through the wheel assembly for a fast cooldown. Taxi speed control can be accomplished by use of reverse power on engine Nos. 1 and 4.

If excessive tailwinds are encountered, use symmetrical reverse on all four engines, maintaining as low a taxi speed as possible.

If hot brakes are suspected, continue using this procedure for at least 5 minutes. This procedure cools the brakes to a safe temperature, which avoids actuation of the thermal fuses.

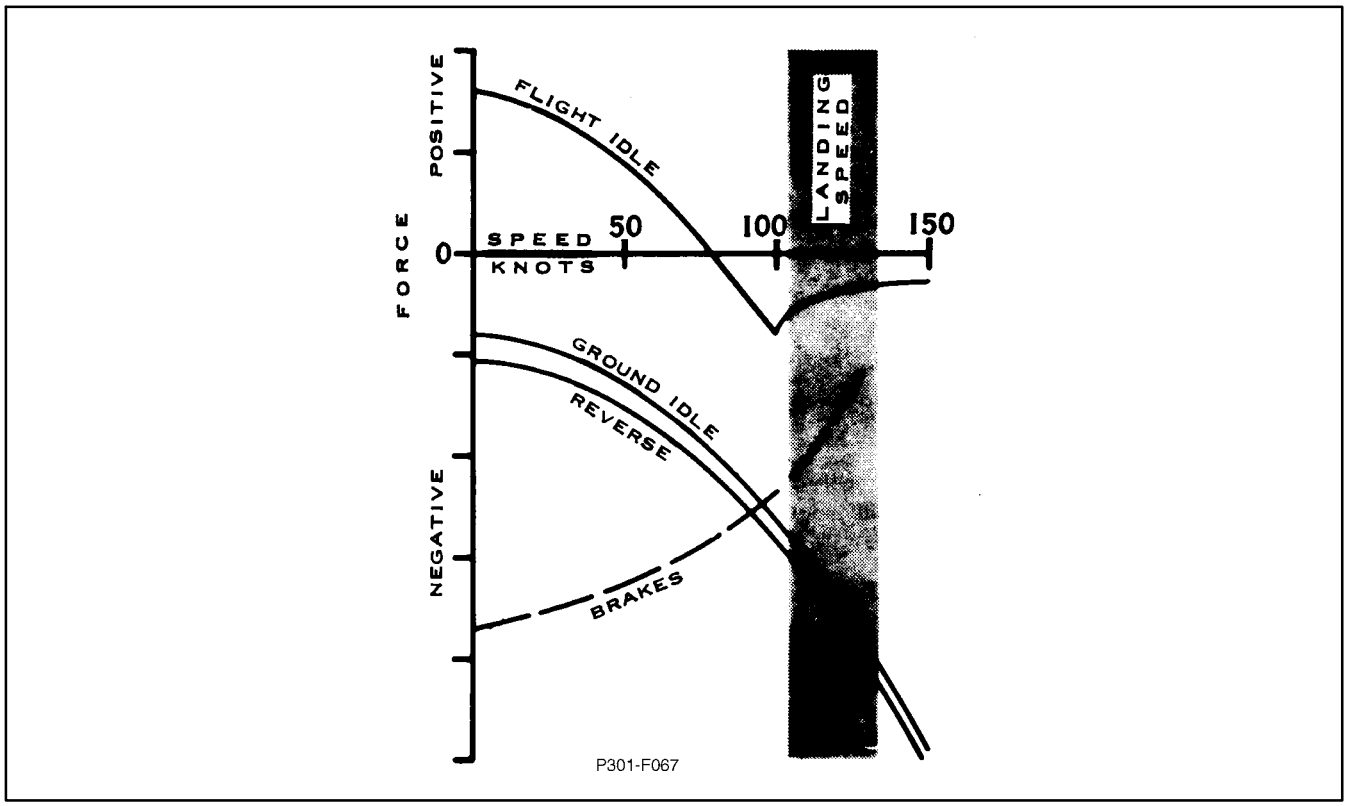


Figure 8-4. Propeller and Wheelbrake Efficiency

8.37.2 Brake Cooling While Parked

If the aircraft has been parked and wheels chocked, brakes can be cooled by use of 1,000 SHP on engine Nos. 2 and 3 with the brakes off.

8.38 TOUCH-AND-GO LANDINGS

Touch-and-go landings with land or approach flaps are permitted in this aircraft provided no emergency is being practiced; however, since many actions must be executed while rolling on the runway, a well-qualified pilot will occupy one of the pilot positions during these landings. The procedure for touch-and-go landings follows.

Note

- Touch-and-go landings shall not be performed on runways less than 6,000 feet in length.
- No-flap touch-and-go landings are permitted provided a qualified instructor pilot is occupying one of the pilot positions.

8.38.1 Before Landing

1. The pilot should brief the copilot to retract the wing flaps to the TAKEOFF position and set trim after touchdown.
2. The pilot should brief the flight engineer to monitor instruments, stand by to follow through on power levers, and set power on command.

Note

Whenever feasible, the use of reduced power is recommended for this training evolution.

3. Make the landing approach as though a full-stop landing were to be made.

8.38.2 On the Runway

1. After touchdown, lower the nose wheel to the runway in the normal manner prior to any application of power. Leave the power levers in the FLIGHT IDLE position.
2. Copilot sets flaps and trim and acknowledges.
3. Pilot advances the power levers and directs the flight engineer to set desired power.
4. Continue takeoff using normal procedures.

WARNING

Normal takeoff rejection criteria may or may not apply during a touch-and-go landing. Careful consideration should be given to aircraft speed, engines available, runway condition, and runway remaining prior to rejecting a touch-and-go takeoff.

8.39 WAVEOFF

1. Apply power and establish a positive rate of climb. Flight engineer maintains desired power.
2. Wing flap lever — APPROACH.
3. Landing gear lever — UP (after flaps are at the APPROACH position and definite climb is established).
4. Continue as outlined in normal takeoff procedures.

8.40 AFTER LANDING

After landing and when clear of the runway, complete the After Landing checklist. Do not downshift from NORMAL RPM to LOW RPM while using reverse thrust or when airspeed is above 50 knots.

CAUTION

- During downshift from NORMAL to LOW RPM, monitor TIT and rpm. Shut down the engine immediately if TIT exceeds 850 °C or rpm drops below 71 percent.
- Any movement of the flaps from the LAND position with reverse thrust applied should be avoided, as a flap asymmetry may occur.

When landing on gravel runways or runways covered with snow or ice, it is possible for rocks, gravel, snow, or ice to be carried into the APU exhaust and intake doors and into the wing flap well where it may jam. Under these conditions, the APU should not be started and the flaps should not be raised above the TAKEOFF/APPROACH position until the flap mechanism can be inspected and cleaned.

Note

Items marked with a dagger (†) are included in the abbreviated checklist.

1. Crew (from ditching stations) — Released. (CP)
2. Radar — As required. (CP)

CAUTION

APS-137(V)2 (UIII) radar system power shall be in STBY for taxi, takeoff, and landing, and shall be in STBY or ON during flight. Further, both generators 2 and 3 shall be online any time power is applied to the APS-137(V)2 (UIII).

Note

APG-66, APS-115, AN/APN-234, and APS-137D(V)5 (AIP) radar system power may be off for taxi and all phases of flight.

† 3. Lights — As required. (FE)

† 4. IFF — As required. (CP)

† 5. Oil coolers — Set. (FE)

† 6. Flaps — As desired. (CP)

7. Sync system — OFF. (FE)

8. Oil tank shutoff valve circuit breakers — In. (FE)

9. APU — As required. (FE)

8.41 SECURING THE AIRCRAFT

Note

Items marked with a dagger (†) are included in the abbreviated checklist.

† 1. Parking brakes — Set. (P)

CAUTION

Do not rotate the parking brake handle. Damage may result.

† 2. WINDSHIELD, PITOT, AOA HEAT — OFF. (FE)

† 3. Fuel boost pumps — OFF. (FE)

† 4. Hydraulic pump Nos. 1 and 2 — OFF. (FE)

† 5. Oil coolers — Less than 100 percent. (FE)

† 6. Mission equipment/TAS heat — Secured. (CP, TC)

† 7. Oxygen Selectors — OFF. (P, CP, FE)

† 8. Engines — Shut down. (FE)

a. Power levers — GROUND START.

b. Rpm switches — LOW.

Note

Allow engines to run at low rpm for a minimum of 2 minutes to facilitate turbine cooling and lessen fuel nozzle coking due to the effects of soak back temperatures.

c. FUEL AND IGNITION switch Nos. 1, 2, 3, 4 — OFF.

CAUTION

When the FUEL AND IGNITION switch has been placed to OFF, it must remain there until the rpm has decayed to zero. Closely monitor engine instruments during coastdown. If the engine fails to shut down, it may be necessary to pull the emergency shutdown handle to stop fuel flow.

d. Ground power — As desired.

Note

- When using external or battery electrical power during engine shutdown, select any engine with the start selector to provide a source of electrical power for the START ESSENTIAL AC (SEAC) and SEDC buses in the event of external power failure during coastdown.
- When transferring from the aircraft power system to ground power, it may be necessary to place the external power ON/OFF/RESET switch momentarily to the RESET position before the aircraft will accept ground power.

e. NTS lights — Checked.

Each engine NTS light should come on when its FUEL AND IGNITION switch is positioned to OFF. If a satisfactory NTS check is not obtained from low rpm, maintenance action is required.

9. Hydraulic pump 1A — OFF. (FE)
10. Utility lights — OFF. (P, CP)
11. Start selector — OFF. (FE)
12. Radios, inertials, FMS — As required. (P, CP)

CAUTION

When the ASN-179 INUs are not in use, the inertial system NO. 1 and inertial system NO. 2 RUN circuit breakers on the aft electronic circuit breaker panel shall be pulled.

13. Trim — ZERO. (CP)

†14. Anticollision light — As required. (FE)

†15. Chocks — As required. (P)

16. APU — As required. (FE)

CAUTION

Control boosters shall remain engaged at all times. This will dampen movement of the control surfaces during wind gusts. Failure to leave the boosters engaged can result in damage to the control surfaces during high wind conditions.

8.42 THREE-ENGINE FERRYING TAKEOFF

If an engine and/or propeller is inoperative and cannot be repaired or replaced locally, consideration should be given to the return of the aircraft to a maintenance base by a three-engine ferry flight. This is an abnormal operation and should only be considered when circumstances render other solutions impractical. Prior consent of the commanding officer is required for a three-engine ferry flight.

The following procedures apply to three-engine ferry operation:

1. Flights of this nature may be made only when VMC exists at the point of takeoff and landing or when alternate landing areas are reported as having VMC.
2. Operating weights for a three-engine ferry must be limited to the minimum weight necessary for the particular ferry flight being planned.
3. Only those crewmembers essential to the safe conduct of the flight should be carried.
4. The maximum recommended takeoff weight is 100,000 pounds unless further limited by climb performance, field altitude, runway length, or temperature. Refer to Chapter 29 for the necessary performance information.
5. The inoperative propeller should be feathered or removed. If the propeller is feathered, the propeller brake must be operative. If the propeller is removed, the unbalance created by the removal should be compensated for by asymmetric fuel loading. Balance should be maintained by crossfeeding to ensure adequate lateral control at low speed during approach and landing.
6. If possible, all takeoffs should be made from a dry runway surface and due regard must be given to existing crosswind and its effect on the required runway as well as directional control.
7. Prior to takeoff, determine all necessary performance information from applicable data in Chapter 29.

The following checklist items must be satisfied for the inoperative powerplant prior to takeoff:

1. Propeller — Feathered or removed.

Note

If the propeller has been removed, the engine intake must be plugged and a plate installed to prevent air damage to the engine cowling.

2. Propeller brake — Locked.

Note

If the propeller brake is inoperative, the propeller must be removed.

3. Emergency shutdown handle — In.
4. Power lever — FULL FORWARD position.
5. Fuel boost pump operation and switch — Checked, OFF.
6. Fuel crossfeed valve switch — CLOSED.
7. Generator switch — OFF.
8. Oil cooler flap — FAIRED.
9. FUEL AND IGNITION switch — OFF.
10. Fuel quantity, all tanks — Symmetrical.

Note

If the propeller has been removed, maintain approximately 1,000 pounds fuel imbalance to account for lack of propeller weight.

11. Trim tabs — Elevator and aileron control; rudder as required (at pilot discretion).

8.42.1 Takeoff Procedure

Ensure seat and rudder pedal adjustments are such that full rudder can be applied easily without inadvertently applying brakes. Line up with the runway and hold brakes while applying maximum power on symmetrical engines. Request flight engineer to maintain maximum power setting, using copilot power levers. Place the power lever of the remaining operative engine at FLIGHT IDLE and release brakes. Apply full rudder toward the asymmetric engine. The copilot should hold the control column forward and deflect the aileron toward the side with two operating engines. As the aircraft accelerates and as the rudder becomes effective, advance the power lever of the asymmetric engine slowly, maintaining initial directional control by use of mild nose wheel steering. Discontinue use of nose wheel steering as rudder effectiveness is gained, preferably at or near 50 knots. It should be noted that nose wheel steering allows a slightly more rapid application of power during the first portion of the takeoff roll; however, it is recommended that nose wheel steering should not be employed to an excessive degree since skipping may be encountered that can cause excessive wear of the nose wheel tires. As airspeed increases, less rudder is required. Application of rudder as power is increased on the asymmetric engine should be such that a reserve of rudder movement is available at all times for heading correction.

Note

As rudder control becomes effective, it is desirable to gradually reduce rudder deflection such that directional control can be maintained with approximately 25 percent less than full travel. This permits heading corrections in both directions.

No attempt should be made to apply maximum power on the asymmetric engine prior to reaching minimum control speed. When maximum power has been achieved on the asymmetric engine, the flight engineer should aid the pilot in maintaining power as directed. Improved directional control is available if the nose wheel is kept in contact with the runway until reaching rotation speed. When rotation is reached, the pilot should release the power levers and accomplish a smooth, positive liftoff. The aircraft should be banked approximately 5° toward the side with two operative engines. This reduces the amount of rudder required to maintain directional control. Climb at takeoff speed and retract the landing gear as soon as a positive rate of climb has been established.

Should engine failure occur before rotation and the takeoff is continued, $V_{MC\ GRD}$ may limit pilot ability to successfully become airborne. Once in flight, margin above $V_{MC\ AIR}$ may be critical. Abort attempts in this situation will meet with controllability problems resulting in greater-than-normal stopping distances. The following consideration should be reviewed before attempting three-engine ferry operations:

1. Total runway required could be double the computed three-engine ferry distance to liftoff if an additional engine failed near Rotation Speed (V_{RO}) because of unfavorable runway conditions, wind, or pilot technique.
2. Consider aborting the takeoff if not airborne when runway remaining equals predicted distance to liftoff.
3. With additional engine failure once airborne, obstacle clearance could become impossible because of $V_{MC\ AIR}$.

8.43 WINDMILL START PROCEDURES

With permission of the commanding officer and when circumstances warrant, either of the following procedures may be used to start an engine with an inoperative starter.

8.43.1 Ground-Run Procedure

1. Select appropriate runway, considering length, wind (use crosswind to advantage, if available), and surface. Limit to dry surface.
2. Consider exchanging starters with an inboard engine if an outboard starter is affected. Do not attempt start if any possibility of inadvertent starter engagement (of the inoperative starter) exists.

3. Reduce fuel load to minimum required for intended flight.

4. Compute realistic refusal distance considering the following examples: at 90,000 pounds, with 4,000 SHP being developed by the operating engines, it takes approximately 2,000 feet of runway to accelerate to 90 knots. This distance increases to 3,250 feet at an aircraft weight of 125,000 pounds. Total runway requirement for the 90,000-pound aircraft is 4,000 feet. Total requirement for the 125,000-pound aircraft is close to 6,000 feet (average conditions at sea level).

5. Complete the Takeoff checklist, except leave flaps UP for better acceleration. Pull the rudder booster shutoff valve circuit breaker to supply pressure to the rudder booster package from both hydraulic systems.

6. Have engine to be started in the following configuration:

   a. Propeller feathered (less drag, less swerve, better acceleration).

   b. FUEL AND IGNITION switch — ON.

   c. Power lever set at FLIGHT START position.

CAUTION

Ensure power lever is not at GROUND START position.

7. Brief copilot and flight engineer.

   a. Copilot — Call airspeed at 50 knots, 70 knots, and 90 knots. Monitor TIT/SHP on operating engines during run, as flight engineer will be engaged in starting engine.

   b. Flight engineer — Start unfeather at 50 knots, be alert for normal start sequence. Light-off should occur normally (about 24 percent; use prime for earlier start). Since pilot starts deceleration at light-off, ensure no hung start occurs; if it does, refeather with emergency shutdown handle and inform pilot. Flight engineer should announce light-off, 40 percent, and 70 percent.

8. Line up aircraft on the end of the runway using crosswind (if any) to best advantage to compensate for asymmetric power situation.

9. Hold brakes and apply maximum power to the two symmetric engines.

10. Release brakes and start applying power on the remaining engine, taking care not to move the power lever of the inoperative engine from the FLIGHT START position. Power application should be as rapid as possible to avoid a lengthy acceleration run.

11. Copilot calls 50 knots. Flight engineer pulls out on feather button of inoperative engine to initiate start.

12. Copilot calls 70 knots for acceleration check. Flight engineer observes rotation (10 to 15 percent rpm).

13. Copilot calls 90 knots (about 2,000 feet of runway used). Flight engineer observes light-off and releases feather button (may have occurred earlier). At 90 knots or light-off, whichever occurs first, pilot pulls power levers of operating engines back to FLIGHT IDLE, leaving power lever of engine being started at FLIGHT START. (Let the aircraft coast until 40 percent rpm is attained on the starting engine.) Flight engineer may use pressure cutout override. If override is not used, NTS INOPR light may flash several times with feather button held in unfeather position when the propeller blade cycles at 45°. If override is used, the light flashes once if override is released prior to releasing the feather button.

14. At 40 percent engine rpm (engine being started), pilot pulls power levers on the three normally operating engines over the ramp to approximately the GROUND START position. Some reverse thrust may be used on symmetric engines.
15. At 70 percent rpm, the power levers of the starting engine may be moved to the FLIGHT IDLE position. Commence braking and reversing on the normally operating engines.
16. Since engine acceleration from 70 to 90 percent is fairly rapid, the power lever on the engine being started may be moved to the GROUND START position shortly after 70 percent rpm is announced.

CAUTION

Speed should not be in excess of 50 knots. Avoid maximum reverse-power application on the started engine unless engine oil pressure and temperature are normal.

8.43.2 Static Start Procedure

This static start procedure is predicated on a P-3 aircraft (or equivalent) providing the airblast; however, a similar procedure should produce satisfactory results using piston engine type tricycle landing gear aircraft. Suitable on-the-spot modifications to the above, relating to a specific type, will then be necessary.

1. Position P-3 or equivalent aircraft on starting area facing into wind.
2. Using applicable current “start and run” procedures, run all engines to blast area clear.
3. Shut down all engines and visibly inspect the area in front and behind the P-3 aircraft or equivalent to ensure it is free from foreign matter and objects.
4. Position P-3 aircraft as indicated in Figure 8-5. This position provides clearance between the forward P-3 tail plane and nose of the aft P-3, should the aft P-3 swing during power application.
5. Flaps — UP (both aircraft).
6. Establish communication between operators of both aircraft.

CAUTION

To preclude the possibility of a hot start, TIT residual temperature should not exceed 100 °C before starting.

7. Prepare for P-3 aircraft engine start as detailed in current Before Start checklist, paragraph 8.3, except as follows:
   a. Feather propeller.
   b. Power lever — FLIGHT START position.
8. On request, start applicable engines on the forward P-3 (or equivalent aircraft) and establish power at 3,000 to 3,500 SHP.

Note

Brakes should be guarded and nose wheel held straight forward in the event of brake failure.

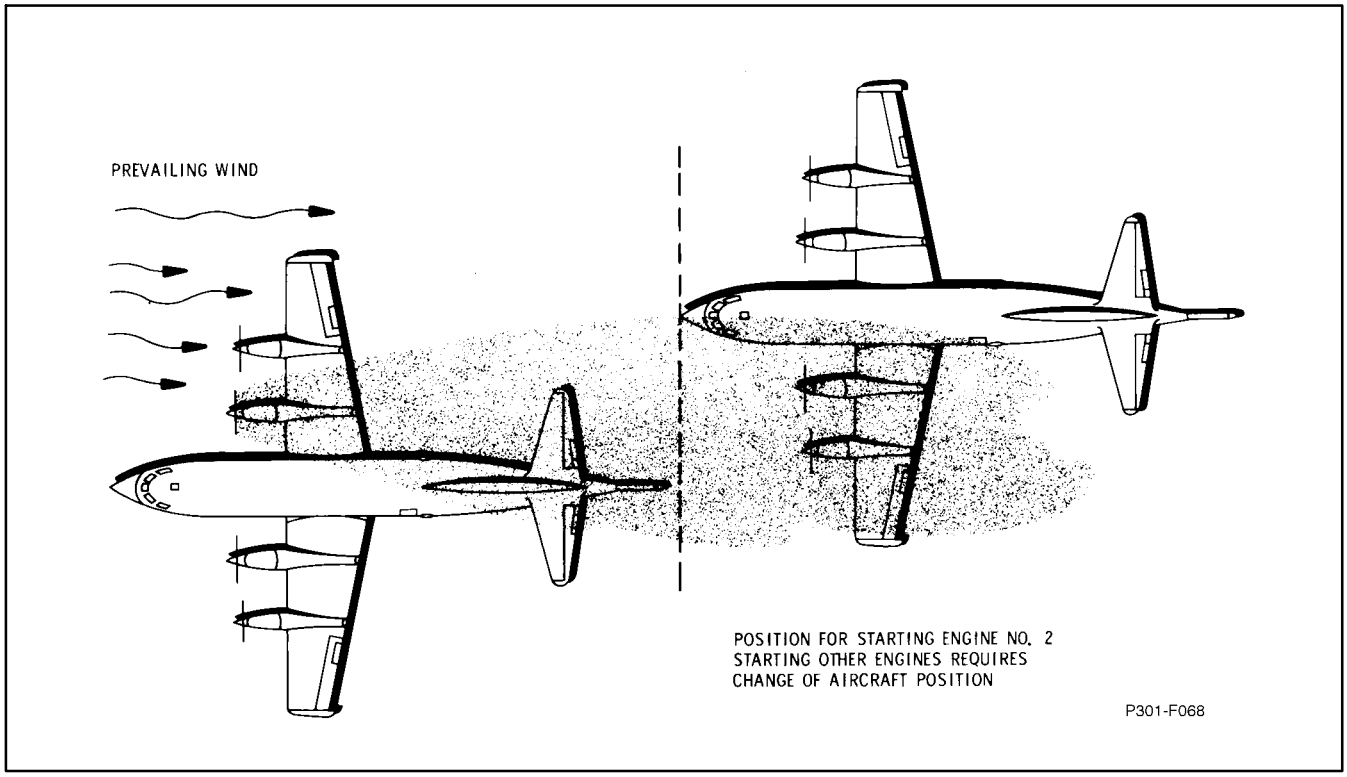


Figure 8-5. Aircraft Position for Static Start

9. Pull feather button (of engine to be started) to unfeather and hold until engine reaches 30 percent rpm, then release to neutral. Flight engineer may use pressure cutout override. If override is not used, NTS INOPR light may flash several times with the feather button held in the unfeather position when the propeller blade cycles at 45°. If override is used, the light flashes once if override is released prior to releasing the feather button.

CAUTION

- Pull the emergency shutdown handle if the engine fails to ignite or rpm stagnates or begins to decay.
- Do not use prime if the previous start went overtemperature or if residual temperature is above 100 °C.

Note

If the first attempt is unsuccessful, utilization of engine prime is recommended.

10. Closely monitor TIT for overtemperature and engine rpm.

CAUTION

Discontinue start immediately by pulling the emergency shutdown handle if the engine fails to ignite or starting limits are exceeded.

11. After rpm has stabilized, return the power lever to GROUND START position.
12. Advise the forward P-3 (or equivalent aircraft) of completed engine start.
13. Taxi or tow the forward P-3 (or equivalent aircraft) from the area.

8.44 BATTERY START

When making a battery start, the following procedure is recommended:

1. Accomplish as much of the preflight as possible without electrical power.
2. Brief the aft observer that ICS is not available, and establish communication within the aircraft by use of a runner.
3. Have a fire truck standing by the parking spot and brief the crash crew of your intentions.
4. Use the complete Before Start checklist, turning on the appropriate switches as applicable for engine No. 2.

Note

Use the No. 1B hydraulic pump to charge the brake accumulator if necessary.

5. Start the No. 2 engine using an external air source and the battery.

Note

- There will be no signal light warning, fire protection, or oil pressure indication, and the engine will assume normal rpm.
- There will be no overtemperature protection, as the TD control will not be energized.
- Since the battery is very limited in its capacity, battery voltage may drop during the start. If the engine must be secured, it may be necessary to pull the emergency shutdown handle.

6. Close bleed-air valves and disconnect ground air. Have the ground air supply removed as expeditiously as possible.
7. Review the Before Start checklist and conduct radio and ICS checks.
8. Start the No. 3 or 4 engine in normal rpm.
9. After the No. 3 or 4 engine is in normal rpm with an operating generator, shift the No. 2 engine to low rpm and secure with the FUEL AND IGNITION switch.

Note

The No. 2 engine is secured and later restarted to ensure a proper start sequence now that the aircraft has full electrical power.

10. Accomplish the After Start checklist as required.
11. Conduct the remainder of the aircraft preflight.

8.45 SEARCH AND RESCUE (SAR)

P-3 equipped units may be directed to assist in SAR operations, primarily in the search phase. The P-3 lends itself to this task with fast en route speeds and good on-station endurance capability. Effective search plans and techniques are covered in the Search and Rescue Manual, NWP 3-50.1. To assist survivors when located at sea, a SAR drop kit, consisting of two seven-man liferafts and an emergency equipment container, has been developed for use by P-3 units. All P-3 aircrew personnel concerned with the utilization of the SAR kit should be familiar with the SAR kit, deployment preparation, and deployment techniques. The patrol plane commander should designate a dropmaster (normally the TACCO) and two other aircrewmen to perform the drop duties. A thorough briefing should precede the mission covering in detail the techniques, coordination, and communications involved.

8.45.1 Deployment of SAR Kit

Upon receipt of a directive requiring an airdrop SAR mission, proceed to the location of survivors. Determine the direction of the wind, and whether wind/wave action or ocean current is the predominant factor causing the drift of the survivors. If wind/waves are predominant, drop the raft ensemble upwind of the survivors as shown in Figure 8-6. In a no-wind scenario, determine the direction of the current, then drop the kit slightly up current from the survivors. Close-aboard positioning of the rafts is essential in a no-wind scenario to ensure survivors reach the rafts.

8.45.1.1 Pilot Procedures

1. Upon arrival in the drop area, determine surface wind, approximate direction, and velocity. Attempt to ascertain condition of survivors in regard to their ability to help themselves retrieve the SAR kit and board the rafts. Carefully ascertain if there is fuel or oil on the surface of the water in the vicinity of survivors (petroleum is normally visible on the surface of the water). Slicks or streaks of iridescence on the surface may be indications of the presence of flammable fuels. Under conditions of darkness, this will be very difficult to determine. If fuels are present or suspected, do not use smoke lights or markers of a type that could ignite fuel. Alternate markers of readily available items would be dye markers or strobe lights attached to an inflated LPP-1.

2. Establish an orbit around survivors until the dropmaster signifies he is ready for the drop run.

WARNING

- All flight maneuvers conducted during the SAR drop procedure should be made with utmost consideration for the safety of the drop crew, especially during operations with the main cabin door open.
- Establish the aircraft at an altitude of 300 feet with an airspeed of 1.2 V_S (flaps up) but not below 135 knots. Maneuver flaps are recommended. Approach the survivors in a crosswind direction and enter the flightpath shown in Figure 8-6. Remind the crew to suspend ICS communications until after the drop.
- Use of approach/landing flaps will disable RAWS and may result in unacceptable range limitations in the event of flap asymmetry.

To preclude the possibility of violent aircraft movement, the autopilot should not be used with ALT HOLD during deployment of the SAR package.

3. Make a crosswind run directly over the survivors. Order the dropmaster to launch a smoke light or marker 1 to 2 seconds after passing the survivors.

4. Execute a 90° to 270° turn and align flightpath to pass 50 to 150 feet upwind of survivors. Order SAR drop when abeam the smoke light or marker.

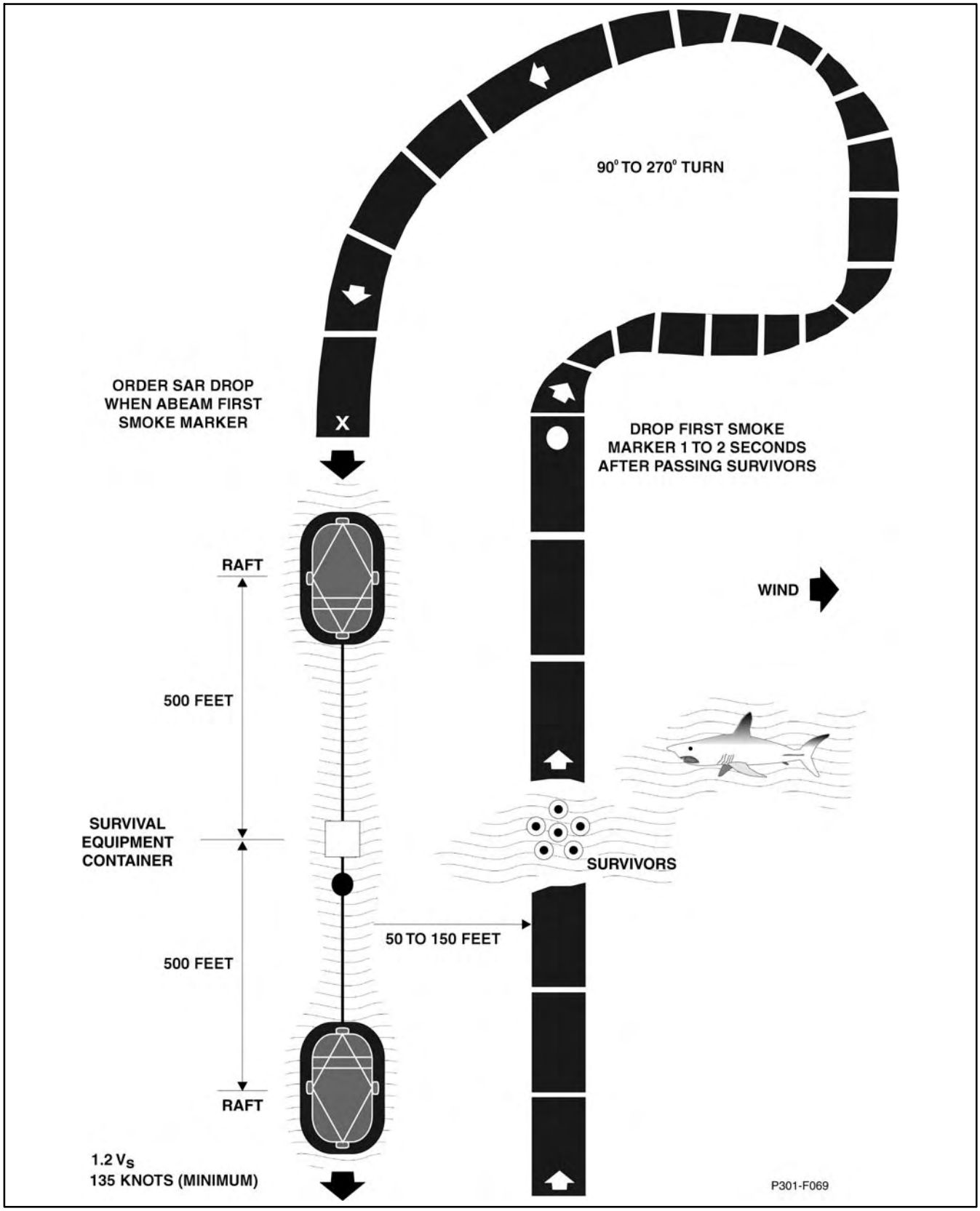


Figure 8-6. SAR Drop-Area Flightpath

8.46 PARACHUTE OPERATIONS

P-3 units may be directed to work in coordination with special units performing airborne parachute operations. Experience has proven that premeditated freefall can be safely accomplished from the aircraft for parachutists. The maximum number of jumpers that can be carried is limited only by the availability of ditching stations that can accommodate a parachutist and his gear. A parachute operations coordinator and assistant parachute operations coordinator should be designated to perform duties associated with the egress. A minimum of two NC-3 parachute harnesses (or their equivalent) and safety lines are required for the operation. The use of tactical style oxygen masks, if available, will greatly enhance communications between the flight station and the parachute operations coordination team by improving the quality of ICS transmission.

8.46.1 Parachute Evolution

Coordination between the pilot, parachute operations coordinator, jumpmaster, parachutists, crewmembers, and ground-based drop zone personnel is critical during parachute operations. The patrol plane commander and parachute operations coordinator shall receive a brief from the jumpmaster to include the following:

1. The number of parachutists.
2. The required altitude and heading at the egress point.
3. The preferred direction of turn during any maneuver.
4. Hand signals that may be required in order to effectively complete the drop sequence.
5. Any other information pertinent to the operation.

In turn, the PPC shall ensure the jumpmaster and parachutists are thoroughly briefed on any mission critical information during the planeside brief. Other crewmembers shall be briefed to remain forward of the overwing exits while the main cabin door is open. The following procedures will ensure successful parachute operations.

8.46.2 Pilot Procedures

1. The maximum recommended airspeed for discharging parachutists is 150 knots. Lower airspeeds are desirable. Because minimum safe airspeed will be based on gross weight, it is imperative that special attention is given to fuel planning in order to arrive on station at the lowest possible weight.
2. Upon arrival at the area of operation, observe winds and weather that may impact the jump. Pass any relevant information immediately to the jumpmaster via the parachute operations coordinator.

Note

Aircraft configuration for discharging jumpers will depend upon mission requirements. Unlike other platforms, the P-3 lacks a blast deflector when the main cabin door is open in flight. This makes stable exits from the aircraft slightly more difficult. Because of this, it is imperative that the aircraft is flown as slowly as safety allows. Furthermore, egress shock can be relieved by setting minimum SHP on the No. 2 engine.

3. Prior to selection of the flap configuration to be used, weigh the conflicting requirements of maintaining the lowest possible airspeed (lower flap settings) versus allowing the jumpmaster to keep an unobstructed view of the jump zone (higher flap settings). In all cases, the PPC shall consider the effect of a flap asymmetry on available range. Determine zero-thrust stall buffet and zero-thrust stall speeds for egress configuration. On

initial approach to or during maneuvering in the vicinity of the drop zone, a suitable airspeed should be selected to maintain a safe margin above stall. Once stabilized and ready to proceed with the drop, reduce power on engine No. 2 and further decrease airspeed to a minimum of 25 knots above chart zero-thrust stall speed (0° angle of bank). This minimum airspeed will allow a safe margin above stall with respect to airspeed indicator tolerances, margin above stall buffet, and aircraft maneuvering utilizing less than 20° angle of bank.

WARNING

- Crews should give special consideration to recovery techniques required in the event an engine malfunction is experienced while flying in this low-speed, asymmetrical power configuration.
- All egress shall terminate if airspeed exceeds 150 knots.

Note

Pilots must be aware that aircraft cg change during the parachute evolution may require additional attention to aircraft trim. A flap asymmetry in the land flap configuration may increase fuel requirements by over 100 percent because of increased fuel flow and reduced airspeed.

4. When signaled from the jumpmaster, notify crewmembers to prepare for premeditated bailout.
5. The copilot should operate the handheld Frequency Modulation (FM) radio if one is used to communicate with the ground safety officer and shall relay any instructions to the parachute operations coordinator.
6. When notified that the jumpmaster is ready, instruct crewmembers to remain forward of the overwing exits and suspend unnecessary ICS communication until after the drop. Depressurize the aircraft and direct the coordination team to open the main cabin door.

WARNING

- All flight maneuvers conducted during the premeditated parachute operations evolution shall be made with the utmost consideration for the safety of the parachutist and the coordination team, especially during operations with the main cabin door open.
- At cabin altitudes above 10,000 feet Mean Sea Level (MSL), the pilot at controls shall utilize oxygen. Other crewmembers should utilize oxygen as appropriate in accordance with OPNAVINST 3710.7 series.

7. The approach to the drop zone should be made with wings level, making only small heading corrections. Shallow turns will assist the jumpmaster in keeping the drop zone in sight and allow him to better gauge the release of his parachutists.

WARNING

Use of the autopilot is not permitted during jump operations.

8. No parachutist shall depart the aircraft until the pilot has given his approval. Approval to jump shall be given by the pilot prior to each pass through the drop zone and should be relayed to the jumpmaster by the parachute operations coordinator. The jumpmaster shall be told to hold all jumps prior to the pilot changing altitudes or increasing airspeed above 150 knots.

9. Between parachutist egress evolutions, left turns should be made and the aircraft flown in a racetrack pattern. This will enable the jumpmaster to keep the parachutists and drop zone in view as long as possible.

8.46.3 Parachute Operations Coordinator and Assistant Procedures

1. The duties of the parachute operations coordinator will normally be assigned to the tactical coordinator but may be otherwise assigned if mission needs require the tactical coordinator to be at his station.

2. If jump altitude is to exceed 10,000 feet MSL, ensure adequate portable oxygen bottles are available in accordance with OPNAVINST 3710.7 series.

3. Prior to arrival at the drop zone, all loose gear shall be stowed to include the port aft observer station curtain. In order to provide room for parachutists, the aircraft ladder shall be removed and securely stowed in an area that will not affect the operation.

4. The parachute operations coordinator shall ensure all remaining aircrew remain forward of the overwing exits whenever the main cabin door is open.

5. The parachute operations coordinator and his assistant shall don NC-3 parachute harnesses (or equivalent) and connect safety lines. Adjust safety lines to allow movement to within 1 foot of the door (out of the red area). The parachute operations coordinator shall connect his safety line to the cargo deck ring aft of the sonobuoy rack. The parachute operations coordinator's assistant shall connect his safety line to the cargo deck ring forward of the starboard aft observer seat.

6. The parachute operations coordinator should position himself slightly forward of the main cabin door and outboard of the PSLTs. He shall don helmet and maintain ICS communication with the pilot. Additionally, he will relay all radio communications received from the flight station to the jumpmaster.

7. The parachute operations coordinator's assistant shall remain in the starboard aft observer seat at all times until directed otherwise by the parachute operations coordinator. Helmet shall be donned and the ICS connected.

8. When the jumpmaster is ready, the parachute operations coordinator will inform the pilot to depressurize the aircraft.

WARNING

At cabin altitudes above 10,000 feet MSL, crewmembers should utilize oxygen in accordance with OPNAVINST 3710.7 series.

9. Once the aircraft is depressurized, the pilot gives the command to open the main cabin door.

Note

The noise from propeller blast is extreme. In order to relay instructions to the jumpmaster, it will be necessary to talk directly into his ear. In addition, it is necessary for the parachute operations coordinator and his assistant to talk very slowly and distinctly when communicating over the ICS system.

10. The parachute operations coordinator shall direct his assistant to open and stow the main cabin door.

Note

It may be necessary to open the free-fall chute prior to opening the main cabin door to relieve residual pressure in the cabin.

11. After stowing the main cabin door, the assistant parachute operations coordinator shall assume his position in the starboard aft observer seat.

12. The parachute operations coordinator, when directed by the pilot, shall inform the jumpmaster via hand signal that egress is approved or that all jumps shall be held.

13. The parachute operations coordinator shall relay heading corrections and requests for turns from the jumpmaster to the flight station using the ICS.

14. Once all of the parachutists have departed the aircraft, the parachute operations coordinator shall direct his assistant to close the main cabin door.

Note

- At this time, the aircraft ladder should be repositioned.
- In the event of a mission abort before all parachutists have exited the aircraft, the parachute operations coordinator shall ensure the jumpmaster resets barometric switches as necessary to prevent parachute deployments during descent.

CHAPTER 9

Functional Checkflight Procedures

Note

The information contained in the functional checkflight procedures may be used for NATOPS open-book examinations but shall not be used for NATOPS closed-book examinations or flight evaluations.

9.1 FUNCTIONAL CHECKFLIGHTS

Functional checkflights shall be performed when directed by, and in accordance with, COMNAVFORINST 4790.2 series, OPNAVINST 3710.7 series, and this manual, using the NAVAIR 01-75PAC-1F, NATOPS Functional Checkflight Checklist.

In addition, the following general regulations apply following installation of an engine, fuel control, propeller, propeller governor, or valve housing and installation or rerigging of any fixed or movable flight control surface:

1. Functional checkflights shall be flown with the minimum crew necessary to properly operate and evaluate the required equipment.
2. Aircraft shall be serviced with the minimum amount of fuel required, plus a proper reserve.
3. Flight duration shall be the minimum time necessary to check the required systems and equipment for operational use.
4. Flights shall be conducted within the local flying area.
5. Flights shall normally be conducted during daylight hours under Visual Flight Rules (VFR) conditions.
6. Flights shall be conducted with no external or bomb bay stores (live or inert).

9.2 FUNCTIONAL CHECKFLIGHT CREW

The most important factor in obtaining good checkflights on the aircraft is to pick experienced and conscientious check crews. Persons conducting the checkflights shall be qualified to perform and evaluate the checks required. Functional checkflight pilots shall be those most qualified in type and the pilot in command shall be designated as a functional checkflight pilot in writing by the commanding officer. The copilot on a functional checkflight shall be a NATOPS qualified copilot or higher rated pilot.

9.3 CONDITIONS REQUIRING FUNCTIONAL CHECKFLIGHTS

A. After installation or reinstallation of an engine(s) or reduction gear assembly change, complete items 1, 2, 3, 4, 6, 7, 11, 12, 19, 21, 37, and 41. Minimum checks required are profiled by the letter A (NAVAIR 01-75PAC-1F, Part 1).

B. After installation or reinstallation of a fuel control, coordinator, or rerigging of mechanical linkage, complete items 1, 2, 3, 4, 6, 12, 19, 21, 37, and 41. Minimum checks required are profiled by the letter B (NAVAIR 01-75PAC-1F, Part 1).

C. After installation or reinstallation of a propeller and control assembly or valve housing, complete items 1, 2, 3, 6, 11, 19, 37, and 41. Minimum checks required are profiled by the letter C (NAVAIR 01-75PAC-1F, Part 1).

D. When fixed or movable flight surfaces or flight control system components have been installed or reinstalled, adjusted, or rerigged, and improper adjustment or replacement of such components could cause an unsafe operating condition, complete items 1, 2, 13, 17, 18, and 41. Minimum checks required are profiled by the letter D (NAVAIR 01-75PAC-1F, Part 2).

E. The following items should be accomplished prior to or after completion of Phase D or ISIS C maintenance: 1, 2, 5, 14, 16, 20, 21, 35, 36, and 41. Minimum checks required are profiled by the letter E (NAVAIR 01-75PAC-1F, Part 3).

F. Upon acceptance of an aircraft from standard depot level maintenance or newly assigned aircraft, complete all 42 items. All checks required are profiled by the letter F (NAVAIR 01-75PAC-1F, Parts 1 through 4).

G. After 30 days of no-flying, complete items 1, 2, 3, 6, 7, 11, 20, and 41.

9.4 PROCEDURES

The following items provide a detailed description of the functional checks, sequenced in the order that checks should be performed. To complete the required checks in the most efficient and logical order, a flight profile (Figure 9-1), has been established for each checkflight condition, and identified by the letter corresponding to the purpose that the checkflight is being flown, that is A through G, under Conditions Requiring Functional Checkflights. The applicable letter identifying the profile prefixes each check, both in the following text and the Functional Checkflight Checklist (NAVAIR 01-75PAC-1F). Checkflight personnel shall familiarize themselves with these requirements prior to the flight. NATOPS procedures will apply during the entire checkflight.

Some items may also be used by flightcrew personnel to perform in-flight evaluations when a discrepancy arises in a particular system. When using the asterisked items in the Functional Checkflight (FCF) Checklist for in-flight evaluations, the general regulations listed in Functional Checkflights, paragraph 9.1 apply.

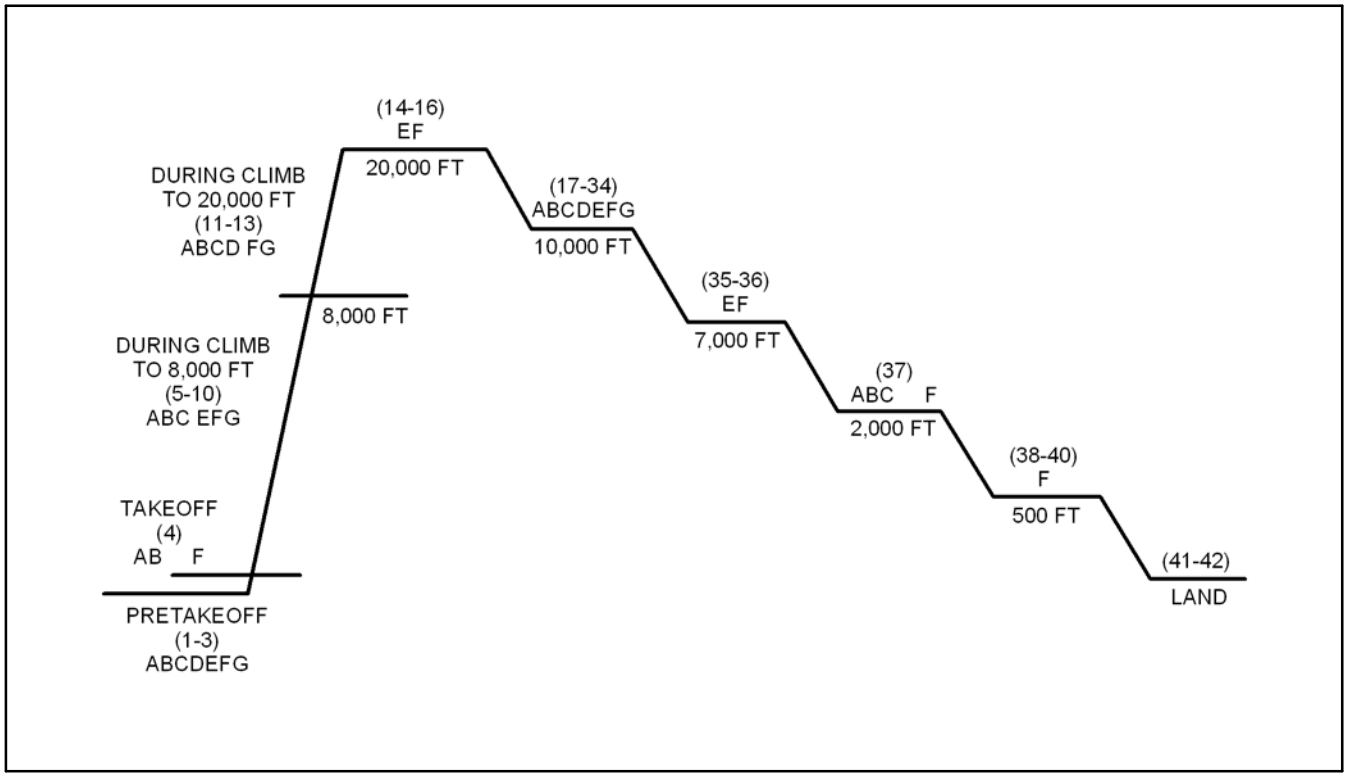


Figure 9-1. Functional Checkflight Flight Profile

PROFILE	
	9.5 CHECKFLIGHT
	9.5.1 Pretakeoff
ABCDEFG	1. Preflight and daily checks.
	a. Perform preflight and daily inspection in accordance with current NAVAIR directives.
ABCDEFG	2. Engine start. (FE)
	a. Start engines in accordance with Starting Engines, paragraph 8.4.
	b. Record start TIT.
ABC FG	3. Pretakeoff checks. (FE)
	a. Perform fuel governor, pitchlock, and reverse SHP check in accordance with Fuel Governor, Pitchlock, and Reverse Horsepower Check, paragraph 8.12.
	9.5.2 Takeoff
AB F	4. Takeoff power — As required. (FE)
	9.5.3 During Climb to 8,000 Feet
EF	5. In-flight brake check. (P,FE)
	a. Landing gear handle positioned to UP after takeoff.
	Limit: Main wheels shall stop rotating within 4 seconds after handle is positioned to UP.
ABC FG	6. NTS check. (P,FE)
	a. Perform NTS check on engines to be shut down and restarted in accordance with In-Flight Negative Torque Sensing Check, paragraph 8.23.
A FG	7. Engine anti-ice system check. (FE)
	a. Set ENG AIR SCOOP & INLET VANES switches to ON.
	Limit: Observe an approximate 9 percent SHP loss. Advisory lights on approximately 90 seconds after switches are on.
	b. Return switches to OFF.
	Limit: SHP recovers. Advisory lights extinguish.
F	8. Radar maximum altitude check. (P,CP)
	a. Increase aircraft altitude to above 5,000 feet.
	Limit: Both indicator needles shall stow behind their masks. Both indicator flags shall come in view.

PROFILE	
F	9. RAWS warning check (aircraft climbing through 6,000 feet). (P)

a. Pull the RAWS AC circuit breaker and leave it out for approximately 10 seconds, then reset.

Limit: RAWS warnings shall be activated.

b. Increase altitude.

Limit: RAWS warnings cease between 600- to 1,000-foot altitude change.

c. Pull the RADAR ALTM PWR circuit breaker.

Limit: RAWS warning No. 1 shall be activated.

d. Reset the RADAR ALTM PWR circuit breaker.

Limit: RAWS warning shall cease.

Note

Descending through the altitude at which the RAWS warnings were deactivated during climb, the RAWS warnings again activate. Pull the RAWS AC circuit breakers and reset at 5,000 feet or below when the radar altimeter indicators begin to operate normally again.

F 10. Indicated airspeed system check. (P,CP)

a. Set barometric altimeter to 29.92 inches HG.

b. Compare indicated airspeed readings of pilot and copilot airspeed indicators at 140 KIAS.

Limit: Indicators shall read within 5 KIAS.

9.5.4 During Climb to 20,000 Feet

A C FG 11. Propeller deice system check. (FE)

a. PROP DEICE switch to ON.

b. Selector to 1 and 4 SPIN.

Limit: 76 to 100 amps.

c. Selector to 2 and 3 SPIN.

Limit: 76 to 100 amps.

d. Selector to CUFFS AND ISLANDS.

Limit: (CUFFS) 51 to 72 amps, (ISLANDS) 63 to 82 amps.

e. Timer operation.

Limit: 160 ±16 seconds.

f. PROP DEICE switch to OFF.

PROFILE

AB F

12. TD system check. (FE)

a. Move power levers individually and slowly from 780 to 950 °C TIT. Observe and record TIT at crossover and change after crossover.

b. Set 950 °C TIT and set TEMP DATUM CONTROL switches to NULL. Observe TIT change and record indications.

c. Set maximum power (TD null).

Limit: 1007 °C TIT minimum.

Note

Under normal conditions, a TIT that drops at the crossover point during step (a) above increases when the switch is placed to NULL during step (b). A TIT that increases during step (a) decreases during step (b). A TIT that stays the same during step (a) may increase or decrease during step (b).

d. Set TEMP DATUM CONTROL switch to NORMAL (individually); set power lever to maximum power position.

Limit: 1,077 +6 to –10 °C TIT.

D F

13. Flap position check (170 KIAS maximum). (P)

Limit: Flap indicator must indicate within the selected white band with the handle in the detent. With flaps UP or at LAND, the needle must indicate in the selected band ± one-sixteenth inch.

a. Flaps to MANEUVER.

b. Flaps to TAKEOFF or APPROACH.

c. Flaps to LAND.

d. Flaps to TAKEOFF or APPROACH.

e. Flaps to MANEUVER.

f. Flaps to UP.

g. Flaps to LAND.

Limit: 20 seconds maximum.

h. Flaps to UP.

Limit: 20 seconds maximum.

PROFILE

9.5.5 Level at 20,000 Feet

EF

*14. Pressurization system check. (FE)

a. Set cabin altitude selector to obtain maximum differential.

Limit: 13.3 to 13.9 inches HG (11.0 to 11.7 inches HG in aircraft not incorporating AFC-341).

b. Dump EDCs one at a time; observe cabin pressure.

Limit: 13.3 to 13.9 inches HG (11.0 to 11.7 inches HG in aircraft not incorporating AFC-341).

c. Manually close outflow valve.

Limit: Maximum safety relief valve opens at pressure differential 13.9 to 14.4 inches HG (11.7 to 12.2 inches HG in aircraft not incorporating AFC-341).

d. Manually control cabin pressure. Observe normal operation of manual control of the outflow valve.

e. Altitude above 10,500 feet.

f. Set cabin pressure controller to 9,000 feet, set barometric selector to 29.92 inches HG, and set cabin altimeter to 29.92 inches HG.

Limit: 8,700- to 9,300-foot cabin altitude.

g. Check that cabin rate-of-change selector operates normally for both up and down rate change.

Limit: At minimum rate, 250 fpm or less. At maximum rate, 1,500 fpm or more.

h. Raise cabin altitude until CABIN PRESS warning light illuminates.

Limit: Light illuminates between 9,500 and 10,500 feet.

F

15. Altimeter check. (P,CP,FE)

a. During level cruise flight using pilot altitude as master, compare readings of pilot, copilot, NAV/SEVAL altimeters.

Limit: 300-foot maximum spread between all altimeters at 20,000 feet and 200-foot maximum spread at 10,000 feet.

EF

16. Fuel dump check. (P,FE)

a. 6,000-foot altitude minimum.

b. Maintain level flight, 140 to 300 KIAS, flaps UP.

c. RF emitters, VHF, and IFF interrogator to OFF. HF-1, HF-2, radar, and IFF transponder to STANDBY; TACAN to REC mode.

PROFILE

d. Fuel transfer valves to CLOSED.

e. Station aft observer.

f. FUEL DUMP switch to ON.

Limit: Monitor fuel dump chute for flow.

Note

Dump rate is approximately 1,000 PPM but may be as low as 500 PPM at low fuel levels.

g. FUEL DUMP switch to OFF.

Limit: Observe that fuel ceases to dump from the chute.

h. Radios, radar, IFF, and TACAN as required.

i. Secure aft observer.

9.5.6 Level at 10,000 Feet

D F *17. Trim Check. (P)

a. Set 225 KIAS; symmetrical SHP on all four engines.

b. Check oil cooler flaps for symmetrical fairings.

c. Hold wings level with ailerons. Trim rudder and ailerons to maintain straight-and-level flight. Check that pilot and copilot turn-and-slip balls are centered.

Limit: Elevator tab: no limit established. Rudder tab: 0 to 4° right. Aileron tab: ±2°.

d. Shift rudder, elevator, and aileron boost to off, check trim, and check control forces.

e. Note trim changes, if any (ordinarily none is required).

f. Shift rudder, elevator, and aileron boost to on.

WARNING

It is recommended that each channel be checked individually. Uncommanded maneuvers may occur when going boost out if controls are out of adjustment.

D F 18. Aileron position check. (FE)

a. Check aileron position visually.

Limit: 1/2 inch down, 1 inch up maximum (not both down).

PROFILE

ABC F

*19. Propeller normal and mechanical feather check. (P,FE)

Note

All systems functioning normally.

a. Pre-position the following:

(1) Respective SYNC MASTER and SYNC SERVO switches to OFF.

(2) Airspeed 190 to 200 KIAS.

(3) NTS/feather valve switch to FEATHER VALVE CHECK position.

Note

Check propellers individually.

(4) Respective dump switch to DUMP (engines 2 and 3 only). Ensure remaining EDC maintains pressurization.

(5) Respective GEN switch to OFF (engines 2, 3, and 4 only). Ensure all electrical buses remain powered.

b. Normal feather.

(1) Pull E-handle.

Limit: Propeller feathers within 9 seconds.

c. Restart:

(1) FUEL AND IGNITION switch to OFF.

(2) E-handle in.

(3) Power lever to FLT START.

(4) PCO 10 seconds.

(5) Pull feather button.

(6) Feather valve action.

(7) Oil pressure rising.

(8) Stabilized rpm.

(9) FUEL AND IGNITION switch to ON.

(10) Oil pressure checked.

(11) Oil coolers set.

PROFILE

d. Mechanical feather.

(1) Pull PROP AUTO FEATHER circuit breaker.

(2) Pull PROP FEATHER CONT circuit breaker.

(3) Pull E-handle.

Limit: Propeller 0 to 10 percent rpm, NTS/feather valve light on.

CAUTION

Do not allow the propeller to rotate for an extended period of time at low rpm, even after ensuring that the engine has lubrication, because of the possibility of inducing a propeller brake to freeze.

Note

- Rpm in excess of 10 percent must be reported. If the propeller stabilizes above 10 percent rpm but fully feathers with the propeller control and autofeather circuit breakers reset, a restart may be attempted after considering the negative effects of a possible propeller leak or excessive rpm.
- Step (4) shall be accomplished within 45 seconds.

(4) Set PROP FEATHER CONT circuit breaker.

Limit: Feather button light on. Propeller feathers. Feather light out.

(5) Set PROP AUTO FEATHER circuit breaker.

Limit: Feather button in.

(6) No propeller rotation.

e. For restart, refer to step c above.

f. Respective dump switch to NORMAL (engines 2 and 3 only). Ensure spread returns and normal operation of air-conditioning and pressurization systems.

g. Respective GEN switch to ON (engines 2, 3, and 4 only). Ensure normal operation of all electrical buses.

h. Repeat steps b through e above, as necessary, for remaining propellers or engines.

i. Set NTS/FEATHER VALVE switch to NTS CHECK position.

j. Governor indexing.

PROFILE	
EFG	*20. Landing gear check. (P,FE) a. Brake operation; gear UP and locked. Limit: Observe fluctuation of normal brake pressure gauge. b. Operating times. (1) Landing gear extension at 150 KIAS. Limit: 7 seconds minimum, 15 seconds maximum. (2) Landing gear retraction at 150 KIAS (straight-and-level flight). Limit: 9 seconds minimum, 11.5 seconds maximum. c. Emergency landing gear extension (free fall). (1) Pull LANDING GEAR CONT VALVE circuit breaker. (2) Place landing gear lever in DOWN position. (3) Pull main landing gear uplock release. Limit: Main landing gear extends and locks down in 60 seconds maximum. (4) Pull nose landing gear uplock release. Limit: Same as for main landing gear. (5) Reset LANDING GEAR CONT VALVE circuit breaker and retract gear.
AB EF	21. Landing gear warning system check. (P,FE) a. Airspeed switch, wheels, lights, and horn operation. (1) Initial airspeed — 190 KIAS maximum. (2) Landing gear — UP. (3) Flaps — APPROACH. (4) Power levers — Less than FLT START. Limit: WHEELS lights flash and horn sounds as airspeed decreases through 153 ± 3 KIAS. (5) LANDING GEAR WARNING OVERRIDE button — Push. Limit: WHEELS lights extinguish and horn stops sounding. (6) Decrease airspeed. Limit: WHEELS lights flash and horn sounds as airspeed decreases through 142 ± 3 KIAS.

PROFILE

(7) LANDING GEAR WARNING OVERRIDE button — Push.

Limit: WHEELS lights flash and horn cannot be canceled.

(8) Increase airspeed to at least 164 KIAS.

Limit: WHEELS lights extinguish and horn stops sounding.

b. Forty-eight degree power lever switch operation.

(1) Decrease airspeed to 150 KIAS.

(2) Landing gear — UP.

(3) Flaps — APPROACH.

(4) Power levers — Above FLT START.

(5) Retard No. 1 power lever toward FLIGHT IDLE.

Limit: WHEELS lights flash and horn sounds when lever reaches FLT START.

(6) Advance power lever 2 inches above FLT START.

Limit: WHEELS lights extinguish and horn stops sounding.

Note

A momentary sound is permissible when advancing power lever past the FLT START position.

(7) Repeat steps (5) through (7) for the No. 2, 3, and 4 power levers.

(8) Retard No. 1 power lever to FLIGHT IDLE.

Limit: WHEELS lights flash and horn sounds.

(9) Increase airspeed to 175 KIAS.

Limit: WHEELS lights extinguish and horn stops sounding.

c. Sixty-degree power lever switch operation.

(1) Airspeed — 190 KIAS.

(2) Landing gear — UP.

(3) Flaps — APPROACH.

(4) Power levers — Less than 60° and greater than 48° coordinator.

(5) Decrease airspeed to 135 KIAS.

Limit: WHEELS lights flash and horn sounds at 142 ±3 KIAS.

PROFILE

(6) LANDING GEAR WARNING OVERRIDE button — Push.

Limit: WHEELS lights and horn cannot be canceled.

(7) Leaving No. 1 between the 48° and 60° coordinator positions, momentarily advance the No. 2, 3, and 4 power levers above 75° coordinator.

Limit: WHEELS lights and horn remain on.

(8) Repeat step (7) three times leaving the No. 2, 3, and 4 power levers between the 48° and 60° coordinator positions individually while the remaining three power levers are momentarily advanced above the 75° coordinator position.

Limit: WHEELS lights and horn remain on.

(9) Advance all power levers above 75° coordinator.

Limit: WHEELS lights extinguish and horn stops sounding.

d. Land flap switch operation.

(1) Airspeed — 165 KIAS.

(2) Landing gear — UP.

(3) Flaps — LAND.

Limit: WHEELS lights flash and horn sounds.

(4) LANDING GEAR WARNING OVERRIDE button — Push.

Limit: WHEELS lights and horn cannot be canceled.

(5) Lower landing gear.

Limit: WHEELS lights extinguish and horn stops sounding after all gear are down and locked.

(6) Decrease airspeed — 130 to 135 KIAS.

Limit: WHEELS lights and horn do not operate.

F 22. Windshield heat check. (FE)

a. Front windshields:

(1) FRONT WINDSHIELD HEAT (PILOT and COPILOT & CTR) switches to LOW.

Limit: CYCLING light — CYCLING. Three forward panels are warm.

CAUTION

Operate windshield heat 10 minutes minimum in LOW before going to HIGH.

PROFILE

(2) FRONT WINDSHIELD HEAT (PILOT and COPILOT & CTR) switches to HIGH.

Limit: CYCLING lights — CYCLING.

(3) FRONT WINDSHIELD HEAT (PILOT and COPILOT & CTR) switches to LOW.

b. Side windshields:

(1) PILOT and COPILOT SIDE WINDSHIELD HEAT switches to ON.

Limit: Check side panels are warm.

(2) PILOT AND COPILOT WINDSHIELD HEAT switches to OFF.

Limit: FAIL lights not illuminated.

(3) PILOT AND COPILOT SIDE WINDSHIELD HEAT switches to ON.

F 23. Windshield washer and wiper check. (P,FE)

CAUTION

Do not operate windshield wipers on dry glass.

a. 190 KIAS.

b. Cabin pressure 5 inches HG or below.

c. Position windshield washer pump switch to ON; turn metering valve control knob full counterclockwise.

Limit: Observe spray pattern.

d. Turn windshield wiper to ON.

Limit: Observe smoothness of operation and sweep. Check that blade touches glass throughout sweep and does not contact windshield post or lift off glass.

e. Check blade parking by selecting PARK.

Limit: Blades park within 1 inch up from the edge of the frame.

CAUTION

Do not hold the wiper control in the PARK position after the blade is parked.

f. Position windshield washer pump switch to OFF.

Note

Fluid may continue to bleed from the spray nozzles after the windshield washer pump is turned off. To minimize this condition, the metering valve control knob must be turned to the full-clockwise position.

PROFILE

F 24. Empennage deice system check. (FE)

a. Position EMPENNAGE ICE switch to TEST; monitor cycling.

Limit: Meter indication in OK range. No EMP DEICE light.

b. Position EMPENNAGE ICE switch to ON; monitor cycling.

Limit: Observe complete cycle time of 176 seconds. Meter indication in OK range. No system fault light.

Note

If the EMP DEICE light illuminates, determine the cause. If the cause is due to overheat and the aircraft is not in icing conditions, the system is acceptable, providing a recheck of the TEST cycle on the ground is satisfactory.

c. Position EMPENNAGE ICE switch to OFF.

F 25. Wing deice system check. (FE)

a. Position engine BLEED AIR VALVES switches to OPEN.

Limit: Engine bleed-air valve advisory lights on.

b. Individually position the three LEFT AND RIGHT WING ICE switches to ON. Observe individual area temperature rise and stabilization. Observe no heat rise in other areas.

Limit: The system shall modulate 60 °C minimum, 110 °C maximum. Wing LE hot light shall not illuminate.

c. Position engine BLEED AIR VALVES to CLOSE; and the three LEFT and RIGHT WING ICE switches to OFF.

Limit: Engine bleed-air valve advisory lights out.

F 26. Air-conditioning system check. (FE)

a. Select MAN full hot on CABIN and FLT STA temperature programmers.

Limit: Duct temperatures must increase to 55 °C minimum.

CAUTION

Do not operate the air-conditioning systems at MAN full hot for more than 1 minute maximum or system components will be damaged.

b. Select MAN full cold on CABIN and FLT STA temperature programmers.

Limit: Duct temperatures decrease smoothly to 5 °C. Difference between left and right compressor discharge pressure, 1.5 inches HG maximum.

PROFILE

CAUTION

Do not allow duct temperature to decrease below 5 °C minimum as turbine howl (squeal) may occur because of ice formation on blade tips. Water separator icing may also occur at duct temperatures below 5 °C.

c. Select MAN one-dot temperatures on CABIN and FLT STA temperature programmers. Allow duct temperatures to stabilize prior to selecting AUTO mode.

Limit: Duct temperatures shall not fluctuate more than ±4 °C after 30 minutes in AUTO mode.

Note

Repeatedly changing temperature selections will increase the time required for the systems to stabilize in AUTO.

F 27. Auxiliary vent check. (P,FE)

a. Position AUX VENT switch to OPEN.

Limit: Auxiliary vent and outflow valve shall open. Left and right cabin compressors shall dump as evidenced by loss of discharge pressure and detectable flight station airflow.

b. Position AUX VENT switch to CLOSE.

Limit: Auxiliary vent and outflow valve shall close. Left and right cabin compressors shall undump as evidenced by discharge pressure and flight station airflow.

F 28. AOA indicator check. (P,FE)

a. In smooth air and level flight, read the indicated AOA under the following conditions:

(1) Flaps and gear UP, loiter KIAS.

Limit: AOA 10.5 ±0.50 units.

(2) Flaps MANEUVER, gear UP, loiter KIAS.

Limit: AOA 9.8 ±0.50 units.

b. If indicator error is too large, adjustment to obtain correct value may be made in flight as follows:

(1) Open trim panel at lower forward corner of NAV/COMM (STBD FORWARD OBSERVER) station. (Remove INS-2 in the lower portion of electronics rack B1 on EP-3E. Remove four self-locking nuts and special large area stopwashers on transmitter mounting studs. Loosen the four spanner nuts located under these washers. If transmitter is stuck, cabin may be depressurized to help free unit. With transmitter correctly engaged in seal ring dowel pinholes, rotate transmitter and seal ring to bring indicator to desired indication as listed in step a.)

PROFILE

(2) Recheck AOA indications after tightening spanner nuts and self-locking nuts.

(3) Record corrected transmitting orientation (that is, XX.X degrees nosedown) on decal near transmitter.

Note

If any adjustments have been made in flight to the AOA system, inspect the AOA transmitter probe from outside the aircraft to ensure the probe clears the skin of the aircraft by a minimum of one-sixteenth inch.

F 29. Approach index check. (P)

a. Check operation of approach dimmer switches on pilot and copilot overhead panel. Leave on full bright.

b. Conduct an approach at 1.3 Vs with LAND flaps and gear DOWN. Refer to Figure 9-2.

Limit: Approach index donut (O) should be on with no chevrons. AOA indicator should read 12.0 units (for reference).

c. Increase speed above 1.3 Vs.

Limit: Noseup (/\ ) chevron should appear. Refer to Figure 9-2.

d. Decrease speed below 1.3 Vs.

Limit: Nosedown (\/) chevron should appear. Refer to Figure 9-2.

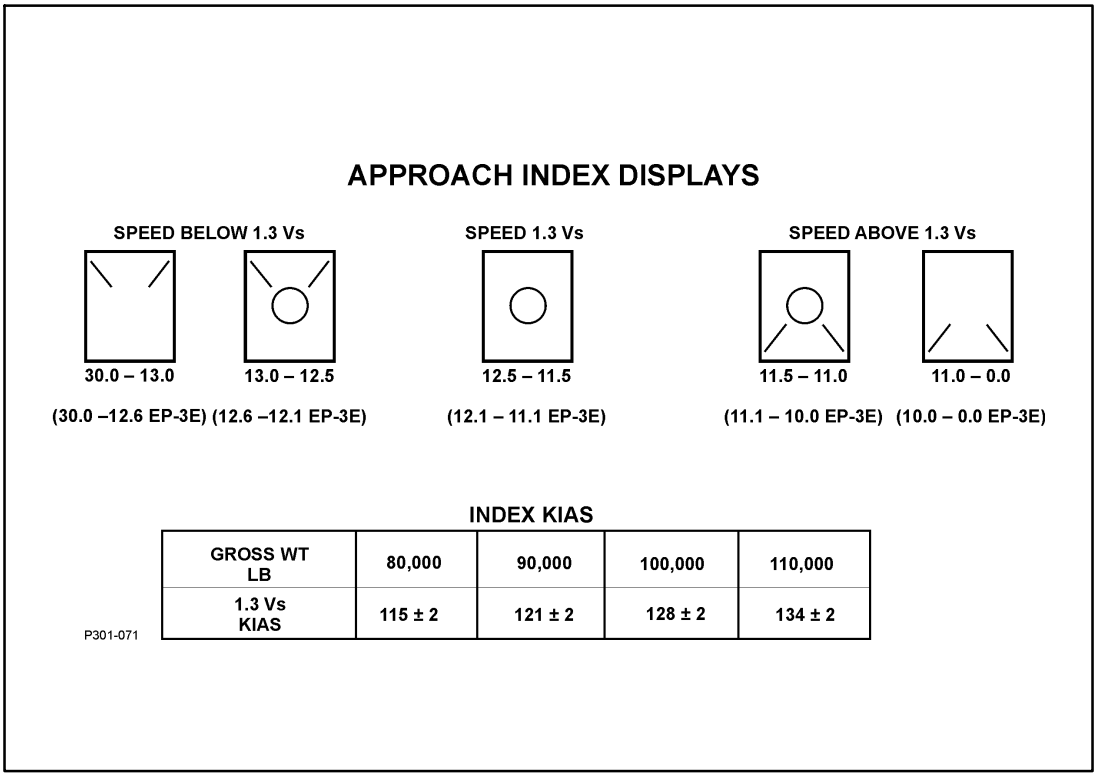


Figure 9-2. Approach Index Displays — Index KIAS

PROFILE

e. Gear UP.

Limit: Approach index lights extinguish.

F

30. Autopilot check (PB-20N). (P)

a. Disconnects.

(1) Pilot control wheel button.

(2) Copilot control wheel button.

(3) Autopilot emergency disconnect.

(4) Autopilot ENGAGE switch.

b. Overpower autopilot.

(1) BAR. ALT. HOLD and CONT WHEEL STEERING switches to OFF.

(2) Momentarily overpower controls with autopilot engaged in straight-and-level flight.

Limit: Aircraft should return to stable flight with no noticeable oscillation or overshoot.

c. Controller.

(1) Establish standard-rate turn to left and right. Note coordinations.

(2) Increase turn controller knob to maximum and note maximum bank angle.

Limit: 30 to 45° maximum.

(3) Check pitch controller for proper operation.

d. Clutched heading.

(1) With selector in manual and in straight-and-level flight on a numbered heading at a safe speed and altitude, engage autopilot. Note course for several minutes.

Limit: No course deviation and no drift or heading instability.

(2) Overpower to change heading 10° and release.

Limit: Heading recaptured. Recapture should be dead beat with little or no overshoot or oscillation.

(3) Repeat with other heading source.

e. Preselect heading.

(1) Autopilot engaged with selector in manual and heading set marker on lubber line of HSI. Engage PRE-SEL HDG switch.

PROFILE

(2) Rotate heading set marker 2 to 3° left and right.

Limit: Aircraft follows in proper direction.

(3) PRE-SEL HDG switch to OFF. Select heading 45° or more to the right and engage PRE-SEL HDG.

Limit: Bank angle 25° ±5° and rollout to within 1° of selected heading set marker. This should be smooth with little or no overshoot.

(4) Repeat step (3) to the left.

f. Autotrim operation.

(1) During all operations with autopilot engaged, aircraft should remain trimmed in pitch.

Limit: No noticeable transient in pitch attitude when autopilot is engaged.

Note

In case autotrim is inoperative, pull autopilot circuit breakers and reengage. In case this does not reengage autotrim, keep elevators trimmed with trim tab by observing trim axis indicator.

g. Barometric altitude control.

(1) CONT WHEEL STEERING switch to OFF.

(2) In a 500 fpm rate of climb, engage altitude hold switch to BAR. ALT. HOLD to establish intercept.

Limit: Aircraft levels out with no more than one overshoot.

Note

Because of altimeter lag, the altitude hold (BAR. ALT. HOLD) switch must be engaged prior to reaching the desired altitude. A good rule of thumb is to engage at 10 percent of the rate of climb. For example, if the rate of climb is 500 fpm, engage 50 feet low.

(3) Repeat operation during descent.

(4) Fly straight and level.

Limit: Altitude should not vary more than ±20 feet.

(5) Execute 20° bank turn at approximately 200 KIAS for 90°.

Limit: Altitude should not vary more than ±40 feet.

(6) Execute standard-rate turns with approach flaps set at 150 KIAS.

Limit: Altitude should not vary more than ±20 feet.

PROFILE

(7) Check coordination and time through 60 seconds for turn-needle checks (approach flaps set).

Limit: 60 ±8 seconds; balls centered (± one-sixteenth ball). Adjust in flight as necessary.

Note

If there is a difference between pilot and copilot needles, it may be necessary to time the indicators individually.

(8) Overpower the elevators in each direction 3 to 5° for not more than 3 seconds (for 50- to 80-foot altitude change) and release.

Limit: Aircraft recovers reference altitude within ±20 feet.

Note

On aircraft with AVC-1998 incorporated, the autopilot will disengage.

h. Control wheel steering.

(1) Altitude hold (BAR. ALT. HOLD) switch to OFF. CONT WHEEL STEERING switch to ON.

(a) Turn left at 4° bank angle and release.

Limit: Rollout and capture of heading at point of release.

(b) Repeat to right.

(c) Turn left at 10° bank angle or more and release.

Limit: Bank angle remains at point of release. Check for coordination of turn.

(d) Repeat to right.

(2) Pull up 5° and release.

Limit: Attitude holds.

(a) Repeat 5° down.

(3) Altitude hold switch to BAR. ALT. HOLD.

Limit: CWS (pitch) locked out (disengaged).

(4) Bank aircraft left and right to 60° and release.

Limit: Aircraft must return to 40 to 50°.

PROFILE

F

31. Autopilot check (ASW-31). (P,CP)

a. Engagement.

(1) ATTD SEL switch (INS select) to NORM.

(2) AFCS control panel:

(a) CHAN SEL switches to NORM.

(b) ALT HOLD switch to ON.

(c) HDG SEL switch to OFF.

(d) PITCH, ROLL, YAW ENGAGE switches to ENGAGE.

Limit: Status lights off. WARN-TEST lights out. Trim flag hidden.

b. Disconnects.

(1) Pilot autopilot disconnect button (second detent).

(2) Copilot autopilot disconnect button (second detent).

(3) AUTOPILOT EMER. DISCONN. (Pull 6 inches, then release).

(4) PITCH, ROLL, YAW ENGAGE switches to OFF.

Limit: Autopilot flashing red lights illuminate. AFCS status lights illuminate. PITCH, ROLL, YAW-WARN lights illuminate.

(5) Press three WARN lights switches and reengage autopilot.

Limit: All AFCS status and WARN lights extinguish.

(6) Altitude hold switch to OFF.

Limit: ALT status lights illuminate.

c. Heading select.

(1) HDG SEL switch to HDG SEL. Ensure heading set marker of pilot HSI is on lubber line.

(2) With HEADING SET knob on pilot HSI, move heading set marker to right and left of lubber line.

Limit: Controls shall follow smoothly.

(3) Move pilot HSI heading set marker 45° or more to left.

Limit: Bank angle to heading shall be 25° ±5° and rollout to heading set marker shall be within ±1° with little or no overshoot.

(4) Repeat for 45° or more to right.

PROFILE

d. Heading select disengage.

(1) With pilot control wheel, apply roll force.

Limit: HDG SEL switch shall move to OFF.

e. Heading hold.

(1) With pilot control wheel, roll aircraft to less than 2°; release wheel.

Limit: Aircraft shall roll out wings level and hold the heading at the time of release within 1°.

f. Roll attitude hold.

(1) Roll aircraft to 25° left and release control wheel.

Limit: Aircraft shall maintain roll attitude of 25° ±1°.

(a) Repeat to right.

(2) Roll aircraft to 60° left and release control wheel.

Limit: Aircraft shall return to a 40 to 50° bank angle.

(a) Repeat to right.

g. Pitch attitude control.

(1) Pull up 5° and release wheel.

Limit: Aircraft shall maintain 5° up attitude.

(2) Push down 5° and release wheel.

Limit: Aircraft shall maintain 5° down attitude.

h. Altitude hold in level flight.

(1) Altitude hold switch to ON. Check at one or more altitudes in level flight.

Limit: ALT status lights extinguish on capture of altitude. Aircraft shall hold altitude ±5 feet at altitudes up to 5,000 feet and one-tenth of 1 percent of engaged altitude above 5,000 feet.

i. Altitude hold in turns.

(1) Bank aircraft 30°; release wheel.

Limit: Aircraft shall hold engaged altitude ±20 feet up to 6,600 feet and three-tenths of 1 percent of engaged altitude above 6,600 feet.

(2) Bank aircraft 45°; release wheel.

Limit: Aircraft shall hold engaged altitude ±40 feet up to 10,000 feet and four-tenths of 1 percent of engaged altitude above 10,000 feet.

PROFILE

j. Altitude capture.

(1) Press autopilot disconnect switch to first detent and hold.

Limit: ALT status lights illuminate.

(2) Establish a rate of climb greater than 500 fpm; release wheel and disconnect switch.

Limit: Aircraft shall not capture altitude. ALT status lights remain on. Aircraft holds the attitude in pitch established at time of wheel release.

(3) Establish a rate of climb of less than 300 fpm; release wheel.

Limit: AFCS captures altitude smoothly with small overshoot. ALT status lights extinguish.

(4) Apply pitchup force of 5 to 10 pounds; release wheel.

Limit: Aircraft returns to reference altitude. ALT status lights extinguish.

Note

Overpowering the AFCS in pitch allows the aircraft to change altitude; however, upon release of forces, the aircraft returns to the reference altitude.

(5) Repeat steps (1) through (4) for descents of greater than 500 fpm and less than 300 fpm.

k. MAD maneuver (180 KIAS).

(1) AFCS/MAD control panel ON/OFF switch to OFF.

(2) Axis selector switch to PITCH.

(3) AFCS/MAD ON/OFF switch to ON.

Limit: Aircraft shall be pitched $\pm 3^\circ$ within a period of 4 to 6 seconds. Altitude variation shall not exceed 50 feet.

(4) AFCS/MAD ON/OFF switch to OFF.

(5) Axis selector switch to ROLL.

(6) AFCS/MAD ON/OFF switch to ON.

Limit: Aircraft shall be rolled $\pm 10^\circ$ within a period of 7 to 9 seconds. Heading shall be maintained within 1°.

(7) AFCS/MAD ON/OFF switch to OFF.

(8) Axis selector switch to YAW.

(9) AFCS/MAD ON/OFF switch to ON.

Limit: Aircraft shall be yawed through heading changes of 5° within a period of 7 to 9 seconds. A zero roll angle shall be maintained within 1°.

(10) AFCS/MAD ON/OFF and axis selector switches to OFF.

PROFILE

l. Ground Built-In Test Equipment (BITE).

(1) On AFCS TEST panel, select and test all positions.

Limit: Test functions inoperative.

CAUTION

A malfunction during this test procedure may result in a sudden aircraft transient or AFCS disconnect.

F 32. AUTOPILOT CHECK (DAS). (P,CP)

Note

Due to the robust IBIT capability of the DAS, procedures for an autopilot FCF should normally not be required. If IBIT fails to identify the source of an autopilot discrepancy, the following procedures may be utilized.

a. Engagement.

(1) ATTD SEL switch (INS select) to NORM.

(2) AFCS control panel:

(a) AP ENGAGE.

Limit: AUTOPILOT ENGAGE light on ACP illuminates. Trim flag hidden. Turn Coordination ball centered within ± 1/4 diameter. Autopilot smoothly engages with no objectionable transients.

b. Disconnects.

(1) Pilot autopilot disconnect button (second detent).

Limit: AP Warning light flashes for 2 seconds. AUTOPILOT ENGAGE light extinguishes.

(2) Copilot autopilot disconnect button (second detent).

Limit: AP Warning light flashes for 2 seconds. AUTOPILOT ENGAGE light extinguishes.

(3) AUTOPILOT EMERGENCY. DISCONNECT. (Pull 6 inches, then release).

Limit: AUTOPILOT ENGAGE light extinguishes. AP Warning light flashes until P or CP yoke switch is depressed to second detent.

(4) AP ENGAGE — OFF.

Limit: AUTOPILOT ENGAGE light extinguishes. AP Warning light flashes until P or CP yoke switch is depressed to second detent.

PROFILE

(5) BARO ALT switch to ON.

Limit: BARO ALT light illuminates on ACP. ALT status lights extinguish on instrument panel. Aircraft maintains altitude.

c. Heading select.

(1) HDG SEL — Select. Ensure heading set marker of pilot HSI is on lubber line.

(2) HDG SEL annunciator light illuminates.

(3) With HEADING SET knob on pilot HSI, move heading set marker to right and left of lubber line.

Limit: Controls shall follow smoothly.

(4) Move pilot HSI heading set marker 45° or more to left.

Limit: Bank angle to heading shall be 25° ±5° and rollout to heading set marker shall be within ±1° with little or no overshoot.

(5) Repeat for 45° or more to right.

d. HDG SEL DESELECT.

(1) HDG SEL annunciator light extinguishes.

e. HEADING HOLD.

(1) With pilot control wheel, roll aircraft to less than 2°; release wheel.

Limit: Aircraft shall roll out wings level and hold the heading at the time of release within 1°.

f. ROLL ATTITUDE HOLD.

(1) Roll aircraft to 25° left and release control wheel.

Limit: Aircraft shall maintain roll attitude of 25° ±1°.

(a) Repeat to right.

g. PITCH ATTITUDE CONTROL.

(1) Pull up 5° and release wheel.

Limit: Aircraft shall maintain 5° up attitude.

(2) Push down 5° and release wheel.

Limit: Aircraft shall maintain 5° down attitude.

PROFILE

h. ALTITUDE HOLD IN LEVEL FLIGHT.

(1) BARO ALT switch select. Check at one or more altitudes in level flight.

Limit: ALT status lights extinguish on capture of altitude. Aircraft shall hold altitude ±5 feet at altitudes up to 5,000 feet and one-tenth of 1 percent of engaged altitude above 5,000 feet.

i. ALTITUDE HOLD IN TURNS.

(1) Bank aircraft 30°; release wheel.

Limit: ±5 ft <5,000 ft MSL 0° AOB.

±0.1% >5,000 ft MSL 0° AOB.

±20 ft <6,600 ft MSL <30° AOB.

±0.3% >6,600 ft MSL <30° AOB.

±40 ft <10,000 ft MSL <45° AOB.

±0.4% >10,000 ft MSL <45° AOB.

(2) Bank aircraft 45°; release wheel.

Limit: Aircraft shall hold engaged altitude ±40 feet up to 10,000 feet and four-tenths of 1 percent of engaged altitude above 10,000 feet.

j. ALTITUDE CAPTURE.

(1) Press autopilot disconnect switch to first detent and hold.

Limit: BARO ALT light extinguishes, BARO ARM light illuminates on ACP. ALT status lights illuminate on instrument panel.

(2) Establish a rate of climb greater than 500 fpm; release wheel and disconnect switch.

Limit: Aircraft shall not capture altitude. ALT status lights remain on. BARO ARM light remains lit on ACP. Aircraft holds the attitude in pitch established at time of wheel release.

(3) Establish a rate of climb of less than 300 fpm; release wheel.

Limit: AFCS captures altitude smoothly with no overshoot. BARO ALT light illuminates, BARO ARM light extinguishes on ACP. ALT status lights extinguish on instrument panel.

(4) Apply pitch up force; release wheel.

Limit: Aircraft returns to reference altitude. BARO ALT light illuminates, BARO ARM light extinguishes on ACP. ALT status lights extinguish on instrument panel.

PROFILE

Note

The pilot can overpower the Pitch mode; however, the BARO ALT mode will not de-select. This enables the pilot to aid the autopilot in altitude maintenance at high angles of bank due to limited autopilot trim and boost authority.

(5) Repeat steps (1) through (4) for descents of greater than 500 fpm and less than 300 fpm.

(6) Deselect BARO ALT.

k. MAD Maneuver (180 KIAS).

(1) AFCS/MAD control panel ON/OFF switch to OFF.

(2) Axis selector switch to PITCH.

(3) AFCS/MAD ON/OFF switch to ON.

Limit: Aircraft shall be pitched ±3° within a period of 4 to 6 seconds. Altitude variation shall not exceed 50 feet.

(4) AFCS/MAD ON/OFF switch to OFF.

(5) Axis selector switch to ROLL.

(6) AFCS/MAD ON/OFF switch to ON.

Limit: Aircraft shall be rolled ±10° within a period of 7 to 9 seconds. Heading shall be maintained within 1°.

(7) AFCS/MAD ON/OFF switch to OFF.

(8) Axis selector switch to YAW.

(9) AFCS/MAD ON/OFF switch to ON.

Limit: Aircraft shall be yawed through heading changes of 5° within a period of 7 to 9 seconds. A zero roll angle shall be maintained within 1°.

(10) AFCS/MAD ON/OFF and axis selector switches to OFF.

l. ERROR CODES (Post Flight).

(1) Record NVM fault codes for CHAN 1 and CHAN 2.

PROFILE

F

33. Inertial/standby gyro/standby compass check. (P,CP)

a. Compass heading:

INS-1 to INS-2.

Limit: ±2°, true and magnetic.

INS-1/INS-2 to standby compass.

Limit: ±5°.

(1) Pilot HSI control HDG selector switch to INS-1.

(2) Copilot HSI control HDG selector switch to INS-2.

(3) Check INS-1 and INS-2 synchronization.

b. Attitude indicator:

(1) Pilot HSI control ATTD selector switch to INS-1.

(2) Copilot HSI control ATTD selector switch to STBY GYRO.

(3) Half standard-rate left turn for 2 minutes then straight and level.

Limit: ±1/2° on pilot and copilot FDIs.

(4) Pilot ATTD selector switch to STBY GYRO.

(5) Copilot ATTD selector switch to INS-2.

(6) Half standard-rate right turn for 2 minutes; then straight and level.

Limit: ±1/2° on pilot and copilot FDIs.

F

34. Inertial/standby gyro/standby compass check. (Communications, Navigation Surveillance/Air Traffic Management [CNS/ATM] modified aircraft) (P,CP)

a. MHRS Compass heading:

MHRS-1 to MHRS-2.

Limit: Within ±2°.

MHRS-1/MHRS-2 to standby compass.

Limit: Within ±5°.

(1) Pilot HSI control HDG selector switch to INS-1.

(2) Copilot HSI control HDG selector switch to INS-2.

(3) Course source to VOR-1, VOR-2, or TACAN.

(4) Check headings within limits.

PROFILE

b. RINU-G synthetic Magnetic (MAG) heading:

RINU-G1 to RINU-G2 magnetic.

Limit: Within ±2°.

RINU-G1/RINU-G2 to standby compass.

Limit: Within ±5°.

(1) Pilot HSI control HDG selector switch to INS-1.

(2) Copilot HSI control HDG selector switch to INS-2.

(3) Pilot and copilot course source to FMS-1 or FMS-2.

(4) Check headings within limits.

c. RINU-G True heading:

RINU-G1 to RINU-G2 true.

Limit: Within ±2°.

(1) Pilot HSI control HDG selector switch to INS-1.

(2) Copilot HSI control HDG selector switch to INS-2.

(3) Pilot and copilot course source to FMS-1 or FMS-2.

(4) Pilot and copilot press and hold HDG Reference (REF) minimum of 2 seconds.

(5) Check true headings within limits.

d. Attitude indicator:

(1) Pilot HSI control ATTD selector switch to INS-1.

(2) Copilot HSI control ATTD selector switch to STBY GYRO.

(3) Half standard-rate left turn for 2 minutes; then straight and level.

Limit: Within ±1/2° on pilot and copilot FDIs.

(4) Pilot ATTD selector switch to STBY GYRO.

(5) Copilot ATTD selector switch to INS-2.

(6) Half standard-rate right turn for 2 minutes; then straight and level.

Limit: Within ±1/2° on pilot and copilot FDIs.

9.5.7 Level at 7,000 Feet

EF

*35. APU in-flight check. (P,FE)

a. Maximum airspeed 225 KIAS, maximum altitude 20,000 feet.

b. APU generator switch to OFF.

c. Fuel boost pump switch to ON.

d. APU INFLIGHT ARMING switch to ARM.

Limit: ARMED light on.

PROFILE

e. APU control switch to START.

Limit: DOORS, ARMED, and GEN OFF (APU) lights on. GTCP95-2 EGT 715 °C maximum peak; 710 °C not more than 10 seconds; 688 °C maximum continuous. (GTCP95-3 EGT 704 °C maximum peak; 649 °C maximum continuous; GTCP95-10 EGT 732 °C maximum peak; 710 °C not more than 10 seconds; 649 °C maximum continuous.) Rpm 100 +3 to –2 percent stabilized.

f. APU generator switch to ON after rpm has stabilized.

g. PROP DEICE switch to ON.

h. GEN 4 and GEN 3 switches to OFF.

Limit: APU assumes Bus B load. Observe increase EGT; rpm 100 +3 to –2 percent.

i. GEN 4 switch to ON.

Limit: No. 4 generator assumes Bus B load. Observe decrease of EGT.

j. PROP DEICE switch to OFF.

k. GEN 3 switch to ON.

Proceed to item 36 if load monitoring check required.

l. APU INFLIGHT ARMING switch to OFF.

Limit: ARMED light out. APU shuts down. DOORS light extinguishes in approximately 1 minute.

m. APU control switch to OFF.

EF

*36. Load monitoring check. (P,FE)

a. Set copilot altimeter to 29.92 inches HG.

b. Altitude 7,000 feet maximum.

WARNING

Loss of the APU generator will result in a gust-locked condition. Be prepared to immediately restore engine-driven generators. Boost handles should be uncovered.

c. GEN 4, GEN 3, and GEN 2 switches to OFF.

d. PROP DEICE switch to ON.

Limit: Normal load monitoring occurs.

PROFILE

e. PROP DEICE switch to OFF.

Limit: Monitored circuits reenergized.

f. EMPENNAGE ICE switch to ON.

Limit: Normal load monitoring occurs.

g. EMPENNAGE ICE switch to OFF.

Limit: Monitored circuits reenergized.

h. PROP DEICE and EMPENNAGE ICE switches to ON.

Limit: Propeller and empennage deice systems operate. Normal load monitoring occurs.

i. Climb aircraft.

Limit: Empennage deice system and hydraulic pump 1A deenergized at 8,000 $\pm$ 500 feet.

j. PROP DEICE and EMPENNAGE ICE switches to OFF.

Limit: Automatic load monitoring still activated.

k. PROP DEICE and EMPENNAGE ICE switches to ON.

l. EMP DEICE MONITOR switch to OVRD.

Limit: Empennage deice system operates.

m. Descend aircraft below 7,000 feet.

n. EMPENNAGE ICE switch to OFF.

Limit: Hydraulic pump 1A remains off.

o. PROP DEICE switch to OFF.

Limit: Hydraulic pump 1A operates.

p. GEN 2, GEN 3, and GEN 4 switches to ON.

q. EMP DEICE MONITOR switch to NORM.

r. Secure APU (refer to item 35, steps l and m).

s. Reset copilot altimeter.

PROFILE

9.5.8 Level at 2,000 Feet

ABC F 37. Flight idle check. (P,FE)

a. Altitude 2,000 feet maximum; 130 to 140 KIAS.

b. Retard power levers one at a time or in symmetrical pairs to FLIGHT IDLE.

Limit: No NTS action should occur. Record horsepower.

Note

If NTS occurs, include in discrepancy: OAT, airspeed, SHP, Fuel Flow (FF), TIT, start TIT, 1050 power check readings, and TD control check information. After corrective action has been accomplished, a notation of this discrepancy shall be readily available to future flightcrews if the problem still exists.

9.5.9 Level at 500 Feet

F 38. Radar altimeter check. (P)

a. Fly at 500 feet as indicated on pilot baro-altimeter.

Limit: Radar altimeters read 500 ± 50 feet and within 20 feet of each other.

F *39. RAWS warning and radar low-altitude check. (P)

Note

Pull RAWS PWR NO. 2 (warning) circuit breaker.

a. Descend slowly to 380 feet.

Limit: RAWS warning shall come on for 3 seconds at 380 ± 20 feet.

b. Descend slowly to 300-foot radar altitude.

Limit: Indicators shall agree within 12 feet.

c. Rotate both indicators on limit controls to position index arrow to approximately 300 feet.

Limit: Pilot and copilot low-level (LOW ALT) lights come on when altitude reaches the index arrow setting ± 10 feet.

d. Descend to 170 feet.

Limit: Continuous RAWS warning shall start at 170 ± 10 feet.

e. Aircraft altitude 500 feet, reset RAWS PWR NO. 2 (warning) circuit breaker and pull RAWS PWR NO. 1 (warning) circuit breaker.

PROFILE

f. Descend slowly to 380 ±20-foot radar altitude.

Limit: RAWS warning on for 3 seconds.

g. Descend to 170 feet.

Limit: RAWS warning continuous at 170 ±10 feet.

h. Reset RAWS PWR NO. 1 (warning) circuit breaker.

F 40. Autopilot radar-hold check (PB-20N). (P)

a. Engage BAR. ALT. HOLD at 500-foot radar altitude.

(1) Fly straight and level until autotrim integration stops.

(2) Engage RADAR ALT. HOLD; wait 3 seconds.

(3) Execute 30° bank at 200 KIAS for 180° in both directions.

Limit: Altitude should not vary more than ±40 feet.

(4) Overpower autopilot (downward) and start a 500 fpm rate of descent.

Limit: Reading radar altimeter indicator, the warning light shall flash between 50 and 100 feet of altitude change from the engaged altitude.

b. Engage BAR. ALT. HOLD at 300-foot radar altitude.

(1) Fly straight and level until autotrim integration stops.

(2) Engage RADAR ALT. HOLD; wait 3 seconds.

(3) Overpower autopilot (upward) and start a 500 fpm rate of climb.

Limit: Reading radar altimeter indicator, the warning light shall flash between 50 and 100 feet of altitude change from the engaged altitude.

9.5.10 After Flight

ABCDEFG 41. All discrepancies recorded. (P,FE)

a. Checkflight checklist completed.

F 42. Inspection of AOA transmitter probe completed. (FE)

PART IV

Flight Characteristics

Chapter 10 — Flight Characteristics

CHAPTER 10

Flight Characteristics

10.1 INTRODUCTION

The flight characteristics of P-3 aircraft are considered satisfactory for all maneuvering within the flight envelope in all flight configurations. The most outstanding and useful characteristic is the aircraft immediate and precise response to power applications. The takeoff, landing, and waveoff performance and handling qualities are greatly enhanced by this characteristic.

10.2 FLIGHT CONTROL SYSTEM

10.2.1 Hydraulic Boost System

The P-3 has conventional rudder, aileron, and elevators with aerodynamic loads on the control surfaces fed back to the pilot control wheels and pedals. To provide manageable control forces, each axis of the system incorporates a dual-tandem, hydraulic booster package that serves to multiply the pilot force inputs. These packages receive 3,000 psi hydraulic pressure from the No. 1 and 2 hydraulic systems.

In the event of failure of one hydraulic system, normal control is retained with up to one-half of the former capacity. For example, if, with both systems operating, control was available up to 180 pounds of rudder force, then with one system operating, normal control would be available up to 90 pounds of force. If the airloads were high enough to resist the 90 pounds of force before full-rudder deflection was reached, the rudder pedal would feel bottomed-out prior to its full travel and the remainder of rudder deflection would be essentially unavailable because of very high forces. No other difference would be noticed by the pilot. With one hydraulic system operating, ample control deflections are available for normal maneuvering.

10.2.2 Rudder Boost Shutoff

The rudder axis incorporates a system that automatically shuts off the No. 2 hydraulic system pressure when the flaps are extended less than 60 percent. This protects the vertical fin from overstress by allowing airloads to limit rudder deflection at high speeds.

10.2.3 Boost-Off Backup System

In the event of a loss of all hydraulic pressure, each axis must be shifted to a mechanical backup mode by manually pulling a boost-off handle. This handle shuts off all boost inputs and reduces the throw of the control surfaces approximately 50 percent, thereby giving the pilot better mechanical advantage to move the control surfaces manually. The conventional, mechanical trim tab system in each axis is unaffected in the boost-off mode and must be used to reduce control forces during airspeed and configuration changes.

10.3 LONGITUDINAL HANDLING QUALITIES

10.3.1 Effects of Center of Gravity

Shifts in the longitudinal cg have a great effect on handling qualities in this aircraft. As the cg moves aft, airspeed control and altitude control become more difficult, whereas yoke forces to maneuver the aircraft decrease. Full flap deflection further aggravates the aft cg situation, with better stability realized with approach flaps. As the cg moves forward, airspeed and altitude control improve, whereas yoke forces required to maneuver increase. At cg near the forward limit, noseup attitude changes at slow speeds require large aft yoke deflections and stick force per g is very high.

10.3.2 Level Flight

The P-3 aircraft tends to wander off altitude and airspeed easily because it has relatively weak positive speed stability, aggravated as cg moves aft. With controls free, the aircraft will maintain prolonged oscillations in airspeed and altitude at a period of 30 to 80 seconds. During IMC or night departures, approaches, and other low-altitude maneuvers, the aircraft will require frequent pilot attention to control airspeed and altitude.

Use of autopilot altitude hold is highly recommended during prolonged night or IMC operations at low altitudes or in proximity to other aircraft. When hand flying the aircraft under these conditions, fatigue or other cockpit tasks can divert pilot attention long enough to cause significant altitude changes.

During night or IMC approaches, the lack of good speed stability is most critical inside the final approach fix when frequent reference to airspeed, rate of descent, and power setting is required. Pilot workload is higher, also, because there are no sufficient audible cues during small power lever adjustment and the SHP gauges take time to scan.

10.3.3 Maneuvering Flight

Longitudinal yoke forces during maneuvering flight are very high with forward cg and relatively low with aft cg. Yoke forces also decrease as airspeed and gross weight increase. At 18 percent Mean Aerodynamic Chord (MAC) forward cg, the yoke forces can be as high as 80 pounds per g; and at 32 percent MAC aft cg, they can be as low as 20 pounds per g. Opening the bomb bay doors reduces the stick force per g slightly. With flaps in the maneuver configuration at 180 KIAS, the effect of the bomb bay doors opening is to decrease the gradient by 10 pounds per g.

10.3.3.1 Avoid Abrupt Pitch Input at High Airspeed

The yoke forces make the aircraft resistant to overstress throughout most of the envelope; however, at high speed, and especially at aft cg and heavy gross weight, the aircraft can be overstressed if the pilot makes an abrupt pitch input. This is most likely to occur during defensive/evasive combat maneuvering, an air show, a dive recovery, pre-Harpoon launch pullup, post mining-run pullup, or other pullup or pushover. Rolling during these maneuvers further increases the chance of overstress because it puts additional loads on parts of the wing structure.

Abrupt pitch inputs at high speed, and especially at aft cg and heavy gross weight, may cause inadvertent overstress for several reasons. First, the yoke forces per g under these conditions are much lower than during typical pilot training flights. Second, because of the large moment of inertia, the pitch rate will lag significantly behind a quick pilot yoke input, resulting in a delayed aircraft response. Third, the available g feedback may not provide the pilot sufficient warning of an impending overstress.

When the yoke is moved quickly, the initial forces on the yoke to resist the pilot's input are very low. Also, the g response will lag behind a quick pitch input. Very little pitch rate and g increase occurs in the first half to three-fourths second. If the yoke input is maintained, the g will build very rapidly over the next second. Under these conditions, an unexpectedly high g overshoot beyond the aircraft limits can occur.

Seat-of-the-pants g cues are not always sufficient. This is because the human body is very insensitive to short duration g: however, the aircraft wing structure, is not. The cockpit g meter has some limitations as well. It does not indicate the g occurring at critical aircraft structure points, and it does not indicate accurately during short duration or highly dynamic g. At these conditions, the pilot must move the elevator trim slowly as well, because it too can cause large g excursions. Trim inputs also reduce the already low yoke forces.

10.3.3.2 Safe Maneuvering at High Speed

The aircraft can be safely maneuvered at high speed and aft cg if the pilot makes small, slow yoke and pitch trim inputs (2 seconds or longer to complete the input). During slow inputs, the yoke forces resisting elevator movement will remain sufficient, and the g buildup will appear to follow the pilot's inputs with no overshoots. If the pilot scans the g meter during these slow inputs, he will be able to precisely set and adjust g up to the limit.

WARNING

At speeds above 300 knots, make only slow and smooth yoke and pitch trim inputs (2 seconds or longer to complete each input). This is especially important with aft cg and at heavy gross weight. With abrupt pitch inputs, structural limits can be exceeded before the pilot has g feedback of sufficient duration to react, and aircraft structural failure could occur. During these maneuvers, the g meter shall be monitored to help prevent high positive and negative loads. During rolling pullup and pushover maneuvers, the pilot must use added care because the g limits are lower.

10.3.4 Trim Changes with Configuration

Lowering the landing gear causes a noticeable increase in drag but has a negligible effect on pitch trim. Moving flaps between UP and MANEUVER has little effect on drag or pitch trim. Moving flaps from MANEUVER to APPROACH causes a noticeable increase in drag and small nosedown pitching moment. Moving the flaps from APPROACH to LAND causes a significant increase in drag and a large nosedown pitching moment, requiring several degrees of noseup trim. For this reason, LAND flaps should not be selected under IMC inside the final approach fix.

The increase in drag from APPROACH to LAND flaps is significantly larger than that caused by extending the landing gear. In a waveoff maneuver, retracting the flaps to APPROACH before raising the gear is prudent to eliminate this large drag increment. When retracting flaps from either LAND or APPROACH, a significant settling occurs that must be countered with an increase in nose attitude and should not be initiated until power has been increased.

10.3.5 Trim Change with Power

The position of the propellers relative to the wing and horizontal stabilizer results in a mild aircraft pitchup with power addition. This is most pronounced during a no-flap waveoff. Rapidly reducing power has the opposite effect, resulting in a small nosedown pitch moment.

10.3.6 Lift from Propeller Wash

Propeller-generated airflow produces a significant increment of lift proportional to the propeller thrust. In the landing flare, moving the power levers to FLIGHT IDLE too rapidly may cause an increased sink rate and a hard landing. This settling tendency is most pronounced as stall speed is approached and can be avoided by slow power lever movement coordinated with a smooth noseup flare. Propeller wash effect on lift also is obvious during stalls where stall speeds decrease proportionally with increased symmetrical power. Refer to Stalls, paragraph 10.9.

10.3.7 Waveoff Performance

Since the propeller and engine maintain a constant 100 percent rpm in flight, there is little thrust delay after power levers are advanced. This characteristic, coupled with the wing-lift increment from propeller wash, provides outstanding waveoff capability from a low and/or slow approach.

10.4 LATERAL/DIRECTIONAL HANDLING QUALITIES

Adequate roll performance is available at all speeds and in all configurations with maximum roll rates available at approximately 265 knots. In 1g flight, smooth aileron inputs all the way to the stop can be made without overstressing the aircraft.

Roll control system friction prevents the yoke and ailerons from returning completely to the centered position when the pilot relaxes the input. This will frequently cause small undesired roll rates. Also, power changes frequently upset the lateral trim. For these reasons, setting and maintaining the desired angle of bank requires frequent pilot attention.

Rudder forces are moderate to heavy. At slow speeds, large sideslips can be generated. Sideslips in excess of 15° are not recommended because rudder force lightening occurs. With the rudder boost shutoff valve properly functioning, full rudder-pedal inputs up to 385 KIAS will not cause excessive structural loads. Above 385 KIAS, sideslip must be kept approximately zero.

CAUTION

If the RUDDER POWER caution light illuminates with flaps above 60 percent and both hydraulic systems operating, the rudder may be receiving hydraulic pressure from both systems. Under these conditions, large or abrupt rudder pedal deflections shall be avoided at high speeds or structural damage can occur.

10.5 CONTROL HARMONY

The yoke forces required to maneuver the aircraft are generally well matched throughout the envelope. The exception is flight at high speed and aft cg, when the roll forces remain relatively high but the pitch forces are reduced to relatively low values. As the pilot rolls the aircraft rapidly under these conditions, it is easy for large roll forces on the yoke to translate into undesired pitch inputs. This is especially true during a rolling pullout maneuver.

10.6 ASYMMETRICAL POWER HANDLING QUALITIES

The aircraft has good engine-out handling qualities. In all configurations, the chart one- and two-engine-out Minimum Control Speed in Air ($V_{MC\ AIR}$) for 5° angle of bank toward the operating engines is rudder limited. At all but light gross weights, the one-engine-out chart $V_{MC\ AIR}$ is below stall speed. At chart V_{MC} airspeeds and power settings, sufficient aileron is available to arrest roll rates following a sudden power change and to control angle of bank for turns. As the aircraft slows below chart $V_{MC\ AIR}$, the aileron available to stop roll rates decreases, higher than 5° favorable bank angle is required to go straight, and sideslip drag begins to increase. At more than 10 knots below chart $V_{MC\ AIR}$, there is insufficient aileron to hold the desired angle of bank and the aircraft will roll and turn uncontrollably into the failed engines.

Establishing 3° to 5° angle of bank into the operating engines for straight flight results in the best climb performance and is a compromise between providing the maximum controllable engine thrust and the minimum sideslip drag. This attitude results in approximately one-half to three-fourths ball deflection toward the operating engines. Under these conditions, a centered balance ball is not optimum and should not be utilized. If maximum climb performance is required in a turn, this same ball deflection should be maintained.

10.6.1 Two-Engine Out $V_{MC\ AIR}$

Two engines out on one side is much more hazardous than one because minimum control airspeeds are much higher, climb performance is limited, and all power changes induce large yawing and rolling moments. Airspeed becomes the most critical variable in maintaining climb performance and directional control. The 3° to 5° angle of bank, and the one-half to three-fourths ball deflection toward the operating engines, must be maintained. Do not intentionally slow below 1.52 V_S, flaps UP, or 1.35 V_S, flaps APPROACH (minimum 145 knots), or select flaps to LAND until landing is assured.

At chart $V_{MC\ AIR}$, sudden changes in asymmetric power caused by engine failures or rapid power lever movements require the pilot to react quickly with rudder and aileron inputs. If the pilot does not react quickly, unusual attitudes resulting from very high roll rates can occur, even when significantly above chart $V_{MC\ AIR}$.

10.6.2 Asymmetric Power and Heavy Gross Weight

At heavy gross weights, engine-out operations require significantly more caution primarily because of the requirement for higher power settings for all maneuvers. The limited excess power to accelerate or climb the aircraft under these conditions becomes more critical as airspeed drops below the chart $V_{MC\,AIR}$, when power available on the operating engines would have to be reduced to maintain straight flight. The heavy gross weights also result in more roll momentum. This is particularly hazardous when banked into the failed engines. There may be insufficient aileron to counter the power additions on the raised engines and a dangerously high angle of bank may result.

WARNING

With two engines out on one side and when gross weight makes acceleration and climb performance marginal, avoid turning into the failed engines. When turns into the failed engines at heavy gross weights are required, maintain airspeed above 1.52 V_S and angle of bank at 20° or less.

In the event directional control becomes critical and altitude allows, altitude can be exchanged for increasing airspeed. Also, power on the outboard engine can be reduced while full power is maintained on the inboard engine to regain control. If the flaps are up, $V_{MC\,AIR}$ speeds may be higher than published because rudder deflection may be reduced because of airloads. The rudder boost shutoff valve circuit breaker may be pulled to restore No. 2 hydraulic system pressure to the rudder boost package.

10.6.3 Practice Maneuvers with One or Two Engines Inoperative

It should be clearly understood that during practice maneuvers, the simulation of engine failures and various system failures requires thorough knowledge of resulting conditions. Therefore, a knowledge of applicable regulations and other sections of this manual is essential. Practice emergency maneuvers with one engine simulated inoperative can be accomplished by either feathering the propeller or setting zero thrust on that engine. Practice maneuvers with two engines simulated inoperative shall be accomplished by setting zero thrust on the desired engines. No actual feathering of a propeller shall be done during simulated two-engine-out emergency maneuvers. No actual feathering of a propeller shall be done during a ditching drill. Turns should not exceed 45° of bank during simulated two-engine failure because of excessive control deflection. During practice maneuvers, the simulated failure of more than two engines is prohibited. There is no restriction on combinations of simulated two-engine failures. Minimum recovery altitude for ditching drills and simulated two-engine-out emergency maneuvers (except landing pattern) is 4,000 feet above the surface. Recovery shall be effected using all four engines.

Typical simulated two-engine-inoperative procedures are as follows:

1. Simulate No. 1 and 2 engine failures by throttling to zero thrust (175 SHP).

2. Use the emergency section of the checklist during all procedures.

10.7 HYDRAULIC BOOST-OFF HANDLING QUALITIES

With loss of both hydraulic systems, the boost-off mode must be selected or a hydraulic lock will prevent flight control movement. In the boost-off mode, the aircraft can still be controlled for basic flight to a full-stop landing. Control forces are greatly increased and approximately one-half of the total flight control surface motion is available. Angles of bank should be limited to approximately 20° and all turns and descents planned early and conducted gradually. Continuous use of trim is important to minimize pilot fatigue, and in many cases trim can be used to maneuver the aircraft. Pitching moments from power changes and flap movement (if available) are much more difficult to control.

Boost-off landings, with flaps up or down, are safely flyable but allow the pilot reduced margin for error in lineup, speed, and pitch control. For all boost-off landings, a wide, long runway with little crosswind is recommended. The use of reverse thrust after landing causes significant vibration in the ailerons below 100 knots.

If a compound emergency occurs involving one or two engines out on one side and loss of one or both hydraulic systems, the minimum control speeds may be greatly increased over chart $V_{MC\,AIR}$. With a total boost loss, all power and configuration changes would have to be made only as fast as rudder, aileron, and elevator control and trim inputs could be made to keep the aircraft attitude under control. Power changes should be made with symmetric engines only, whenever possible. A boost-off waveoff with engine(s) out would be very difficult unless the aircraft was at low gross weight.

10.8 ANGLE OF ATTACK

The AOA system provides an excellent cross-check reference to optimize the performance and safety of many aspects of P-3 aircraft operations. It is extremely useful in monitoring the margin above stall speed throughout the aircraft maneuvering envelope. The system also is a quick reference for setting maximum endurance, loiter, maximum range, approach, ditching, and best climb angle airspeeds.

WARNING

The AOA gauges should be monitored for smooth operation, as the indicator in a faulty system can stick. Because there is only one AOA transmitter in the system, it should be cross-checked routinely with both the pilot and copilot airspeed indicators.

The AOA system (unlike airspeed) gives the same indication of stall margin regardless of gross weight or angle of bank. In a level turn, the aircraft apparent weight increases as a function of bank angle because of the increase in lift required to maintain both level flight and the turn. The stall speed increases in a level turn as the apparent gross weight goes up just as if there were an actual increase in gross weight. Refer to Figure 27-9. For example, in a 60° angle-of-bank, level turn, the apparent weight of the aircraft doubles and the stall speed increases accordingly; however, the stall buffet always occurs at 19 to 22 units AOA. If AOA is monitored, the pilot can have confidence a safe stall margin is being maintained. This can be very useful during low-altitude, maximum-endurance operations and no-flap approaches when the aircraft is being maneuvered well below the normal stall margins.

Minimum fuel flow always occurs at approximately 14 units in both turns and level flight.

WARNING

Although minimum fuel flow for level flight occurs at approximately 14 units, this is also the AOA where the backside of the power curve begins (airspeed will continue to decrease to stall at a constant power setting). The aircraft should not be flown near or above 14 units in loiter conditions because of this speed instability and the potential for inadvertent stall.

When maximum endurance operations are required, maintaining up to 12 units AOA will provide a stable airspeed condition and nearly minimum fuel flow. Additional power should only be required if the aircraft reaches 13 units AOA, which may happen in a steep turn, for example. Loiter airspeeds in Part XI equate to an AOA of 10.5 units, flaps UP (which provides a very comfortable stall margin).

Approximate maximum range for any condition can be reached by climbing until 9 units AOA can just be maintained at cruise power settings (925° or 1010° TIT). The aircraft will then be at approximately the best altitude and the best airspeed for maximum range. At less than optimum altitude, the AOA for maximum range is not a constant, decreasing to as low as 6 units at light weight and low altitude.

With either LAND or APPROACH flaps set, 12 units AOA is equivalent to the published 1.3 and 1.35 V_S speeds, respectively. This corresponds to the on-speed doughnut indication on the approach indexers. This on-speed indication always provides a safe stall margin regardless of weight or bank angle. During no-flap approaches, AOA should be cross-checked to ensure it does not exceed 15 units. This is most likely to occur during the turn to final.

When ditching the aircraft at night or in instrument conditions, an AOA of 15 units can be used as a minimum airspeed target regardless of flap setting, gross weight, or number of engines operating.

When excess power to climb or accelerate is limited, such as after an engine failure at maximum gross weight, approximately 14 units AOA should be flown to provide the best climb angle. This AOA is the best compromise between the increasing thrust and increasing induced drag that occurs as airspeed decreases.

Prior to use of the AOA system for any of these references, an operational check of the system after takeoff should be made. With flaps up, chart loiter airspeed should equate to 10.5 units AOA. This check can be made at any convenient time such as first arrival on station. In the landing pattern, the system can be checked with flaps at APPROACH when 1.35 V_S should equate to 12 units AOA. If the needle is correct at one reference point and is operating smoothly, it should be correct throughout its range. Refer to Figure 10-1.

CONDITION	AOA UNITS
Maximum Range (High Altitude)	9
Loiter	10.5
Maximum Endurance	12
Approach	12
Minimum Fuel Flow	14
Best Climb Angle	14
Ditching	15
Maximum AOA for No-Flap Approach	15

Figure 10-1. Reference Angle of Attack

10.9 STALLS

10.9.1 1g Stalls

The power-off stall characteristics of this aircraft with any position of wing flaps and landing gear are preceded by natural warning in the form of moderate to heavy airframe buffet. The start of airframe buffet occurs approximately 5 knots above the stall with flaps in MANEUVER, TAKEOFF/APPROACH, or LAND, and approximately 8 knots above stall with flaps UP. The power-off stall is characterized by a steady increase in buffet levels, an increase in rate of descent, a tendency for the nose to drop, and a gradual decrease in flight control responsiveness.

The published stall speeds are normally attained by noting the minimum airspeed observed during a 1 knot-per-second deceleration rate in a wings-level, 1g stall entry. A slight roll tendency may occur in some configurations at the start of stall, but rolloff can be safely countered with smooth, coordinated aileron and rudder. The ailerons, rudder, and elevator remain effective into the stall, providing adequate control. Recovery from a stall is rapid and is accomplished by relaxing back pressure on the yoke and smoothly applying power. A slight tendency for the nose to pitch up with power must be countered with forward yoke force to avoid entering a progressive stall.

10.9.2 Accelerated Stalls

Accelerated stalls (stalls at greater than 1g) are very similar to 1g stalls except that the actual stall is more abrupt with a quicker onset of heavier airframe buffet and higher g spikes. Sustained accelerated stalls produce uncomfortably heavy buffet levels and should be avoided because of the airframe loads imparted.

CAUTION

Avoid sustained accelerated stalls, as the heavy buffet conditions produced may result in the loss of the MAD boom or other structural damage to the airframe or installed equipment.

10.9.3 Power-On Stalls

The effect of increasing power on the stall is to increase the aircraft pitch attitude at stall, decrease the stall warning, and decrease the stall airspeed. With symmetric power set on all engines, each 1,000 SHP per engine (total of 4,000 SHP) will decrease both stall buffet and stall airspeeds approximately 8 knots. With very high power and at light weight, the aircraft attitude at stall buffet is uncomfortably high and airspeed very low for a large aircraft. If power is reduced to idle during a power-on stall maneuver, the aircraft will be well below the power-off stall. Any asymmetric power conditions or large rudder inputs will cause the aircraft to depart controlled flight. Power-on stalls shall not be practiced.

With asymmetric power-on stalls, a rapid and dangerous rolling tendency toward the side with reduced power will occur at stall. The potential for departure from controlled flight from this maneuver is very high.

WARNING

Power-on stalls can result in inadvertent departure from controlled flight and could lead to airframe overstress during recovery. Asymmetric power-on stalls are especially hazardous.

10.9.4 Stall Recovery Procedures

The following procedures should be used to recover from a stalled condition. To initiate the recovery, simultaneously disconnect autopilot, smoothly add symmetric power, and relax back pressure on the yoke (16 units AOA or less). Use rudder and aileron to level the wings and center the ball. Gently recover pitch attitude as airspeed builds (maintain AOA between 13 and 16 units for minimum altitude loss).

WARNING

- Avoid initiating an abrupt pullup during recovery or an accelerated stall may occur.
- Utilizing asymmetric power on stall recovery can result in dangerous rolling departure tendencies toward the reduced power side. If a stall occurs during three-engine loiter operations, increased pilot awareness is imperative to coordinate rudder input with asymmetric power addition.

Note

- Holding slight forward yoke pressure during power application should be anticipated during stall recovery, as pitchup with power advance will occur.
- Always disengage the autopilot prior to initiating stall recovery. The AFCS will continue to raise the nose to attempt to maintain altitude deep into the stall, and the pilot must override the autopilot to hold the nose down during recovery.

10.9.5 Practice Approaches to Stalls

Practice approaches to stalls should be conducted at a moderate aircraft weight, at a minimum altitude of 10,000 feet above ground level, and with power at FLIGHT IDLE. Power-on approaches to stalls shall not be practiced. The recommended procedure for practice approaches to stalls is to trim the aircraft in a particular configuration approximately 20 knots above the stall buffet speed. Refer to Figure 10-2 for stall buffet speeds. Without retrimming or changing the configuration, gradually decrease the airspeed at approximately 1 knot per second. Use recovery techniques discussed above. The possibility of inducing a departure or spin increases during power-on stalls.

1. With 4 engines operating, stall speeds will decrease approximately 8 knots for each 1,000 SHP set on all 4 engines. With less than 4 engines, use chart power off stall buffet speed.
2. Refer to Stall Speed Chart, paragraph 27.11.

10.9.6 Stall Speed Chart Data

The speed for start of stall buffet in all configurations is shown in Figure 10-2. This chart should not be confused with the stall speed data shown in Part XI.

The Part XI stall speed data are based on full stalls in which the minimum attainable airspeed is reached at 1 knot per second deceleration. The indicated airspeeds during stall will be erratic since the region about the airspeed system static ports will be turbulent. The actual airspeed in a full stall is always a few knots less than that indicated by the airspeed indicator. Deceleration into the stall at less than 1 knot per second will result in higher observed stall buffet and stall airspeeds.

10.10 OUT OF CONTROLLED FLIGHT AND SPINS

10.10.1 Out of Controlled Flight

The P-3 aircraft will depart controlled flight if a yawing motion is induced at low airspeed. The yawing motion can be caused by either rudder input or sudden asymmetric change in power (increase or decrease). The aircraft will roll in the direction of yaw. As the angle of bank increases, the nose will fall rapidly. If the wings are stalled and the yawing moment continues, the aircraft will likely enter a spin. In all cases, large altitude loss will occur before recovery can be completed. With large asymmetric power changes, the aircraft can reach unusual attitudes quickly if the pilot does not react with proper rudder inputs, even when significantly above chart $V_{MC\ AIR}$.

10.10.2 Recognition of a Spin

The P-3 aircraft has not demonstrated either spins or spin recovery. Because of its conventional design, it is likely that the aircraft would exhibit typical spin characteristics. The primary indicators that the aircraft is in a spin or about to enter a spin are: a stalled angle of attack accompanied by heavy buffet, a pegged turn needle in either direction, and a very low nose attitude. The most likely cause of a spin in a P-3 is deep 1g stall penetration combined with a large yawing moment generated either by asymmetric thrust, rudder inputs, or high bank angle.

Model P-3 *Forward CG*
Basis: P3V-1 Flight Tests, April 1961

CONFIGURATION	*STALL BUFFET SPEED KNOTS IAS*			
	0° AOB	15° AOB	30° AOB	45° AOB
142,000 LB GROSS WEIGHT				
Flaps and gear up	145	147	157	173
Maneuver flaps, gear up	139	142	149	165
Takeoff flaps, gear down	130	132	140	154
Land flaps, gear down	124	126	134	147
137,500 LB GROSS WEIGHT				
Flaps and gear up	143	146	154	170
Maneuver flaps, gear up	137	139	147	162
Takeoff flaps, gear down	128	130	137	152
Land flaps, gear down	122	124	131	145
133,500 LB GROSS WEIGHT				
Flaps and gear up	141	144	152	168
Maneuver flaps, gear up	135	137	145	160
Takeoff flaps, gear down	126	129	136	150
Land flaps, gear down	120	123	129	143
127,200 LB GROSS WEIGHT				
Flaps and gear up	138	141	149	165
Maneuver flaps, gear up	132	134	142	156
Takeoff flaps, gear down	123	125	132	147
Land flaps, gear down	118	120	126	140
100,000 LB GROSS WEIGHT				
Flaps and gear up	122	124	132	146
Maneuver flaps, gear up	116	118	125	139
Takeoff flaps, gear down	109	111	118	130
Land flaps, gear down	104	106	112	124
70,000 LB GROSS WEIGHT				
Flaps and gear up	102	104	110	122
Maneuver flaps, gear up	97	99	104	116
Takeoff flaps, gear down	91	93	98	108
Land flaps, gear down	87	89	94	104

Notes:

With 4 engines operating, stall speeds will decrease approximately 8 knots for each 1,000 SHP set on all 4 engines. With less than 4 engines, use chart power off stall buffet speed.

Refer to Section XI, Stall Speed Chart, paragraph 27.11.

When determining stall buffet speeds for gross weights and configurations other than those specified in this chart, refer to Figure 27-9, Stall Speed chart.

Figure 10-2. Airspeed for Start of Stall Buffet (Power Off)

10.10.3 Out of Controlled Flight and Spin Recovery Procedures

In the event the aircraft departs controlled flight, retard all power levers to FLIGHT IDLE and neutralize all controls. Check the turn needle. In the event the aircraft has entered a spin, the turn needle will be pegged. Apply full rudder opposite the direction of the turn needle. As soon as the yawing motion stops (turn needle centers), the rudder pedals must be recentered.

The airspeed will be building in a nose-low attitude. Recheck the power at idle, and raise the nose smoothly keeping wings level. If possible, reference the AOA gauge (15 units maximum) and the g meter (3g's maximum). The primary concern will be to recover the aircraft from the dive without entering another stall, overstressing the airframe, or exceeding the V_{NE} speed. Overspeeding of the gear or flaps, if extended, may occur. If so, do not retract the gear or move the flaps prior to landing unless required.

WARNING

If a spin is entered, significant altitude loss and structural damage are likely to occur. Intentional departures and spins are prohibited.

10.11 MAXIMUM PERMISSIBLE INDICATED AIRSPEED

The maximum permissible indicated airspeeds, as listed in Chapter 4, can be exceeded in a dive with power on. No significant drag rise prevents exceeding limit airspeed. At high altitudes, no cues other than the V_{NE} needle on the airspeed gauge are available. At lower altitudes the increase in airflow noise as the speed increases provides good cues for the pilot of the approaching V_{NE} limit.

WARNING

Exceeding V_{NE} speed can result in loss of pitch control at high altitude and overstressing of the structure at low altitude. Loss of the aircraft can result.

10.12 MANEUVERING FLIGHT LIMITS

10.12.1 Steep Turns

Practice of steep turns (i.e., in accordance with Counter Threat Maneuvers [CTM]) should be conducted at a moderate aircraft weight and at a minimum altitude of 4,000 feet AGL. Practice steep turns should never be attempted unless Condition V has been set and the practice maneuvers have been thoroughly briefed.

10.12.2 Acceleration Limitations

Operating flight envelopes for flaps UP and with MANEUVER flaps are shown in Figures 10-3 and 10-4. The load factor shown is the ratio of aircraft lift to weight and can be read on the accelerometer located on the copilot instrument panel. The indicated airspeed and altitude are directly read from cockpit instruments.

10.12.3 Maximum Load Factors

The maximum permissible acceleration for flight in smooth air or light turbulence is 3g's, provided normal fuel management is used.

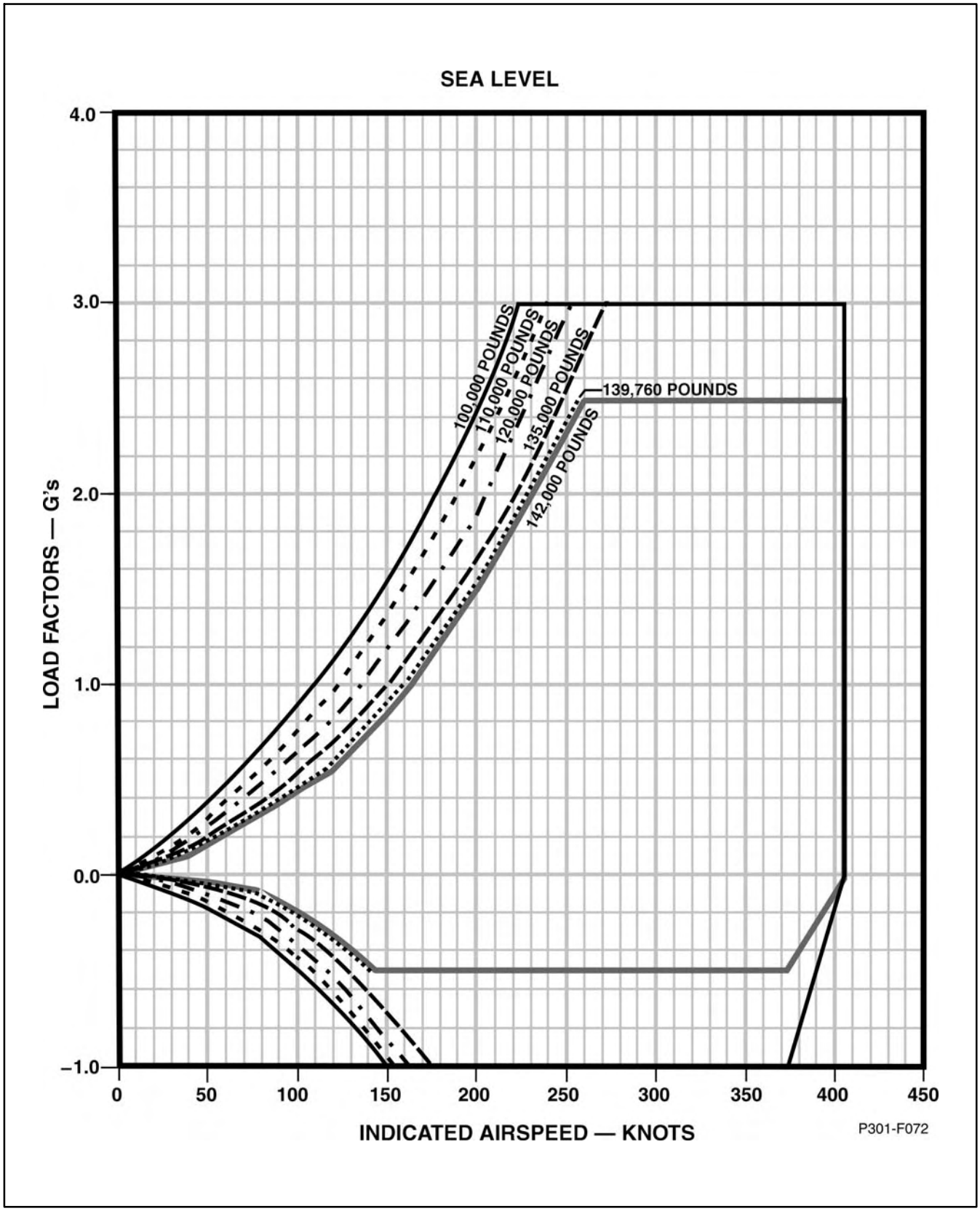


Figure 10-3. P-3 Operating Flight Envelope — Flaps Up, Gear Up

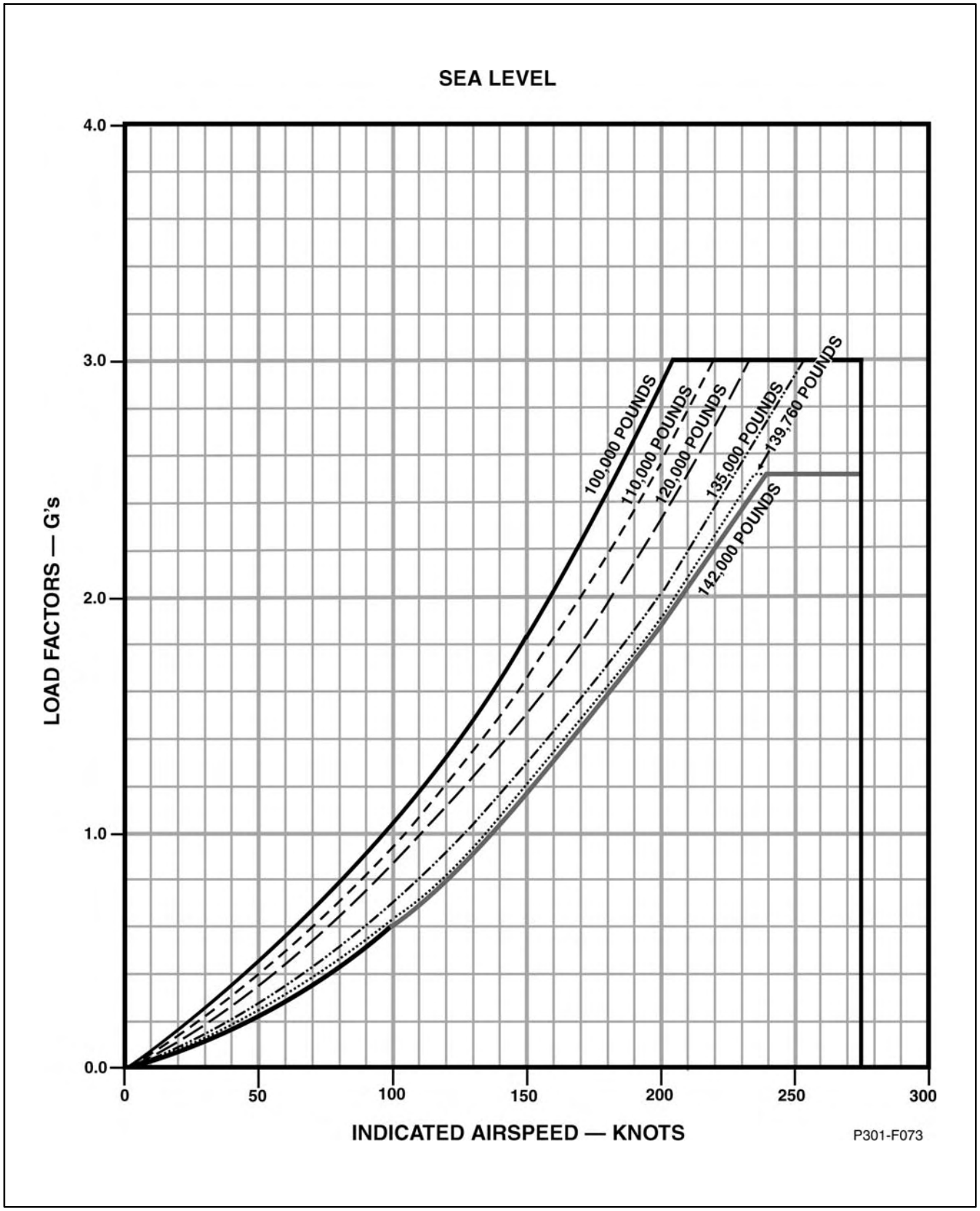


Figure 10-4. P-3 Operating Flight Envelope — MANEUVER Flaps, Gear Up

The maximum maneuver load factors vary as shown in Figure 10-5.

Configuration	Symmetric Flight		Roll Maneuver	
	Max	Min	Max	Min
(Up through 135,000 lb)				
Flaps Up	3.0	–1.0	2.4	0.0
MANEUVER Flaps	3.0	0.0	2.4	0.0
APPROACH Flaps	2.0	0.0	1.0	1.0
LAND Flaps	2.0	0.0	1.0	1.0
(135,000 to 139,760 lb)				
Flaps Up	2.5	–0.5	2.0	0.0

Figure 10-5. Maximum Maneuver Load Factors

WARNING

The aircraft structure is designed with a margin of safety above the structural loads generated at the g limits of the flight envelope. Loads generated in flight maneuvers outside the envelope increase quickly, and the exact g for failure of individual structural components is unknown. Any operation outside the g envelope is potentially hazardous.

Note

"Roll Maneuver" is defined as a pullup or pushover combined with a rolling movement around the longitudinal axis of the aircraft. The total loads on the aircraft structure include loads due to rolling and pitching. The g meter reflects only pitching loads on the fuselage and may be inaccurate for combined loads. To ensure combined rolling and pitching loads do not exceed wing limitations, the g-limits are reduced whenever the aircraft is rolling.

The limit load factors are the maximums for normal operations and include some safety factor to account for inadvertent maneuver overshoots, etc. Deliberately exceeding the permissible limits not only runs the risk of overstressing the structure, but also reduces airframe service life.

When flying in conditions of moderate turbulence, do not deliberately exceed 2 g's in maneuvers. This precaution minimizes the possibility of overstressing the aircraft as a result of the combined effects of gusts and maneuvering loads. When flying in severe turbulence, the recommendations discussed in Turbulent Air Penetration, paragraph 18.5 should be followed.

CAUTION

Prolonged flight in a sideslip condition could result in fuel starvation and flameout of the outboard engine. If a sideslip flight is required, crossfeed the outboard engines.

Note

An aircraft loading of 2g's is required for a level 60° angle-of-bank turn. An aircraft loading of 3g's is required for a level 70° angle-of-bank turn.

10.12.4 Stall Region

The stall region is defined by onset of aerodynamic buffet. Control inputs in this region should be smooth, not abrupt, to avoid deep penetration into the stall region.

10.12.5 Corner Velocity or Maneuvering Speed

The "corner velocity" is defined as the airspeed that results in the highest turn rate capability and occurs at the highest load factor attainable at the lowest airspeed. For the P-3 at 135,000 pounds and below, this means a 3g turn at buffet onset speed. The negative-g corner velocity occurs at –1g but would be usable for evasive maneuvering of short duration only. Engine flameout or propeller overspeed could occur since the engine and propeller systems are not designed for sustained zero to negative-g operation.

10.12.6 Effects of Altitude

The effect of increasing altitude is to shrink the operating flight envelope. At a given indicated airspeed, increasing altitude increases the Mach number and affects the stall region and the limit speeds.

10.13 FLIGHT WITH EXTERNAL STORES

10.13.1 ESM Pod

The ESM pod, when installed, is carried at wing store station 12. Test results indicate that pod vibration may occur as aircraft speed is increased in smooth air near Mach 0.57. Pod vibration may be stopped by either increasing or decreasing airspeed. It is recommended that continuous operation at the speed where the vibrations were encountered should be avoided.

Except for the ESM pod, no appreciable changes in flight characteristics have been noted when the aircraft is carrying external stores.

When wing stores place the aircraft in configuration D or E (greater than 700 drag count), airflow under the wing is disturbed enough to increase the stall speeds by as much as 5 knots. Due to the increase in stall speed, approach and landing speeds are increased 5 KIAS and landing distances are increased by 10 percent.

Additional information for this section will be included if warranted by data obtained in later flight and service tests.

10.13.2 Turret Extended

Stall characteristics and buffet boundary are the same with the turret extended or retracted. In full rudder sideslips with takeoff or land flaps, the extended turret may affect airspeed indications. With full left rudder, the pilot airspeed indication may oscillate. With full right rudder, the copilot indication may oscillate.

PART V

Emergency Procedures

Chapter 11 — Annunciator Lights

Chapter 12 — Emergency Procedures (General)

Chapter 13 — Ground Emergencies

Chapter 14 — Takeoff Emergencies

Chapter 15 — In-Flight Emergencies

Chapter 16 — Approach and Landing Emergencies

Chapter 17 — Emergency Equipment

CHAPTER 11

Annunciator Lights

11.1 INTRODUCTION

The following information identifies the P-3 annunciator light indications, probable causes for light illuminations, and required corrective actions.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Electrical Power Control Panel		
1. GEN 2 or GEN 3, GEN 4 or APU GEN OFF light on.	Generator failure, off frequency, over voltage, under voltage, feeder fault, supervisory panel failure, transfer relay 2 or 3 failure, or associated bus monitoring switch OFF. **Note** If the APU generator control circuit breaker is out, the APU GEN OFF light will be on. Automatic APU load monitoring above 8,000 feet will be disabled; however, the generator will assume the load.	Use reset procedure, or place associated BUS MONITORING switch ON. If an engine-driven generator light remains on steady throughout reset procedures, or goes out momentarily and comes back on, mission should be aborted. **CAUTION** Generator supervisory panels shall not be exchanged until appropriate maintenance actions are performed. **Note** Ensure GEN 4 AUX CONT and GEN 4 TRANS circuit breakers are set appropriately.
2. TRANSFORMER RECTIFIER OVERHEAT light ON.	Transformer Rectifier (TR) overheated.	Pull respective circuit breaker; No. 3 located at the flight station and No. 1 and 2 located at the main load center.
3. EXTERNAL PWR AVAILABLE light ON (neon).	Indicates electrical power is connected to the aircraft.	Light will glow whether or not external power is selected.
a. EXTERNAL PWR AVAILABLE light ON (neon), but no power into aircraft.	Wrong phase, nosegear uplock not properly positioned, battery not connected, generator No. 4 runaround feeder circuit breaker out, external power control circuit breaker out.	Move EXTERNAL POWER switch to RESET then ON. Check nose gear uplock position. Check battery condition. Check No. 4 runaround feeder circuit breaker. Check external power control circuit breaker.
b. EXTERNAL PWR AVAILABLE light ON partial power into aircraft.	Transformer-rectifier No. 3 ganged circuit breaker out. Essential DC bus feeder circuit breaker No. 2 out. Monitorable Essential AC ganged circuit breaker behind copilot out. Monitorable Essential bus switch off.	Check TR 3 circuit breaker. Check essential DC bus feeder circuit breaker No. 2. Check Monitorable Essential AC ganged circuit breaker in. Check Monitorable Essential bus switch.
4. EXTERNAL POWER light ON.	External power supplying power to aircraft system.	EXTERNAL POWER switch is on.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Center Overhead Panels		
1. PRIMARY FUEL PUMP (parallel) light.	Indicates the secondary fuel pump is functioning properly.	
a. No. 1, 2, 3, or 4 PRIMARY FUEL PUMP (parallel) light on during start (between 16 percent and 65 percent rpm).		
b. No. 1, 2, 3, or 4 PRIMARY FUEL PUMP (parallel) light off during start (between 16 percent and 65 percent rpm).	Failure of secondary pump.	Investigate.
c. No. 1, 2, 3, or 4 PRIMARY FUEL PUMP light on, or momentarily ON then OFF, above 65 percent rpm.	a. Failure of the primary pump. b. Fuel pumps are in parallel operation possibly due to a speed sense control malfunction.	Pull FUEL SHUTOFF VALVE circuit breaker on Start Essential DC bus. a. If the light remains on, reset the circuit breaker, and assume the primary pump has failed. b. If the light goes out, leave the circuit breaker out, and assume a failure of either the 65 percent switch or the speed sense control. **Note** If mission is continued: • Do not use autofeather. • Should maximum TIT be limited to approximately 830 °C with or without the parallel light, assume a failure of the 94 percent switch or speed sense control. Place the affected TD switch to NULL and pull the FUEL SHUTOFF VALVE circuit breaker on the Start Essential DC bus. • Do not shut down the affected engine with intent to restart. • Reset the circuit breaker prior to securing the engine with the FUEL AND IGNITION switch.
2. No. 1, 2, 3, and 4 AUTO FEATHER lights are all on.	The automatic feathering circuit has been armed.	
3. No. 1, 2, 3, or 4 AUTO FEATHER light on individually.	Propeller thrust has dropped to less than 500 pounds of positive thrust; propeller has automatically feathered.	Investigate.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Center Overhead Panels (Cont.)		
4. No. 1, 2, 3, or 4 engine STARTER CONTROL VALVE OPEN light on.	Engine starter control valve is open. (Valve should close and light go out when starter button is pulled out at 57 to 64 percent rpm during normal start.)	* If light remains on or comes on after start, secure engine by pulling emergency shutdown handle.
Propeller Feather Buttons		
1. No. 1, 2, 3, or 4 prop feather button light remains on.	Indicates feather pump relay is closed, supplying electrical power to the feather pump. Possible internal leakage. Incomplete pump cut-out circuit.	a. If light remains on following engine shutdown, pull respective propeller feather control circuit breaker, and execute the Emergency Shutdown procedure, paragraph 15.5.1. b. If light remains on following pressure cutout override, refer to In-Flight Restart Procedures, paragraph 8.33.1.
Air-Conditioning and Pressurization Control Panel		
1. FAN OUT light on.	Cabin exhaust fan is inoperative or lack of airflow.	Open equipment doors for additional cooling. Use minimum electronic equipment. If EDCs are inoperative (no air-conditioning available), open AUX vent.
2. EDC TEMP HIGH light on.	EDC oil temperature excessive. Low oil level in sump. High engine oil temperature.	a. Check engine oil temperature; if high, correct. b. If unable to control, disconnect, monitor for loss of spread, dump, continue operation. **CAUTION** The DISCONNECT position should be selected only when the engine is operating in the normal rpm range to prevent EDC damage. c. If spread is indicated after disconnect, execute the Emergency Shutdown procedure, paragraph 15.5.1. If the engine is allowed to operate due to a greater emergency, the EDC should be dumped. d. Refer to Air-Conditioning System Malfunction (In Flight), paragraph 15.16.

*Indicates memory item.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Air-Conditioning and Pressurization Control Panel (cont)		
3. EDC PRESS LOW light on.	EDC oil pressure is low. Low level in sump. EDC driveshaft sheared.	a. With loss of spread, disconnect and dump EDC. Continue operation. b. If spread is indicated, disconnect, monitor for loss of spread, dump. Continue operation. **CAUTION** The DISCONNECT position should be selected only when the engine is operating in the normal rpm range to prevent EDC damage. c. If spread is indicated after disconnect, execute the Emergency Shutdown procedure, paragraph 15.5.1. If the engine is allowed to operate due to a greater emergency, the EDC should be dumped. **NOTE** If on ground and mission is continued: Ensure Normal rpm selected and ground air conditioning on prior to disconnect. d. Refer to Air-Conditioning System Malfunction (In Flight), paragraph 15.16.
4. REFR OVHT (overheat) light on.	Temperature in cooling duct exceeds safe limits. On ground: inoperative heat exchanger blower fan.	In flight, dump EDC. After light is out, operation is permitted in the manual mode at the two-dot position or warmer. On deck, turn off GRD AIR COND switch; investigate by checking the HEAT EXCHANGER cbs on BUS B and BLOWER CONT cb on MEDC. If cbs are set and the light is out, operation is permitted in the manual mode two-dot position or warmer.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Engine Bleed Air and Anti-Icing Control Panels		
1. L Wing HOT or R Wing HOT light on.	Air temperature in the wing plenum area exceeds safe limits. May be caused by a leak in the bleed air manifold or EDC plumbing.	a. Secure wing deicing and get out of icing area. b. If light remains on, dump appropriate EDC.
2. LEAK TEST ACCEPT light.		Maintenance function. Refer to appropriate maintenance manuals.
3. No. 1, 2, 3, and 4 engine bleed air valve OPEN lights on.	When the valve begins to open, the light will be on. When the valve is closed, the light should be off.	
4. Left and right FUS BLEED AIR SHUT-OFF valve OPEN lights on.	When the valve begins to open, the light is on. When the valve is closed, the light should be off.	
5. LE HOT light on.	The wing leading edge skin temperature has increased in excess of 110 °C. One of the six modulating valves is either stuck open or improperly modulating.	Close all bleed air valves. Locate defective area with temperature selector. Open all modulating valves. When necessary, deice the entire wing using the bleed air valves.
6. EMP DE-ICE light on.	Parting strip power relay deenergized, cycling power relay deenergized, control relay deenergized, timer motor failure, empennage overheat condition. Open control power circuit breaker.	Turn switch OFF then ON. If light remains on, turn switch OFF, increase airspeed above 200 KIAS; vacate icing area. If light does not come back on, a temporary overheat exists. Continue operation.
7. ANTI-ICING light a. No. 1, 2, 3, or 4 engine ANTI-ICING advisory light on with control switch on.	Fourteenth stage air of sufficient temperature to melt ice has entered the torquemeter shroud and the inlet scoop.	
b. No ANTI-ICING advisory light with control switch on.	One or both areas of system may not be receiving hot air.	a. Check for horsepower drop. If normal, continue operation. b. If less than normal: (1) Check for ice buildup on air inlet scoop. If excessive, execute the Emergency Shutdown procedure, paragraph 15.5.1.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Engine Bleed Air and Anti-Icing Control Panels (cont)		
ANTI-ICING light (cont)		(2) If no ice buildup on air inlet scoop is observed, monitor SHP, TIT, and fuel flow. Initial indications may be a gradual power loss followed by erratic operations. If either of these indications is observed, execute the Emergency Shutdown procedure, paragraph 15.5.1.
c. ANTI-ICING advisory light on and control switch off.	a. Abnormal heat in the area. b. Loss of electrical power to the solenoid valve.	On deck, investigate, secure engine, and return to the line. In flight, turn on anti-ice control switch. a. If a SHP drop is observed, execute the Emergency Shutdown procedure, paragraph 15.5.1. b. If no SHP drop is observed, continue engine operation.
d. ANTI-ICING advisory light remains on after system utilization.	Failure of one or both thermal switches and/or anti-icing valves.	Allow sufficient time for thermal switch cooling prior to investigating. If no other abnormal indications exist, engine operation may be continued for the remainder of the flight.
8. Windshield heat CYCLING lights on (neon).	Indicates that electrical power is being supplied to the windshield panels. When lights are out, electrical power is cycled off.	If unable to start cycling on a cold windshield, use OVERRIDE switch.
9. Side windshield heat FAIL light on.	Windshield power relay and/or overheat control relay stuck in energized position when control switch off.	Pull side windshield heat power circuit breaker on main AC bus A.
10. L or R HTR OUT pitot heat out light on.	Indicates electrical current flow to the pitot heater element has been interrupted, or current flow detector is inoperative.	Check respective circuit breaker and bus. Monitor equipment for proper operation.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Engine Bleed Air and Anti-Icing Control Panels (cont)		
11. No. 1, 2, 3 or 4 feather valve and NTS lights on.		
a. Switch in NTS position.	NTS has occurred.	Reset by putting switch to FEATHER VALVE position and back to NTS position.
b. Switch in FEATHER VALVE position.	Feather valve is being mechanically positioned to the feather position by NTS action during an NTS check (flashing light), or by the emergency shutdown handle when pulled (steady light).	
12. BOMB BAY COLD light on.	Temperature below desired level in bomb bay.	Turn bomb bay heat switch ON (autocycling), open No. 3 or No. 4 engine bleed air valve.
13. BOMB BAY HOT light on.	Temperature above desired level, not cycling.	Turn BOMB BAY HEAT switch OFF until light goes out, then heat bomb bay with switch in OVRD position. Monitor for proper operation.
APU Control Panel		
1. DOORS light on.	Intake or exhaust door open. (Should close when APU is shut down.)	Do not exceed 225 KIAS.
2. ARMED light on.	Arming switch on.	If APU is not being used in flight, turn arming switch off.
Fuel Management Panel		
1. No. 1, 2, 3, or 4 FILTER light on.	One or both of the low pressure fuel filters are restricting flow.	If engine continues to function normally, continue engine operation.
2. No. 1, 2, 3, or 4 PRESS LOW light on.	Indicates the differential pressure across the corresponding engine driven centrifugal boost pump is low. A flickering light indicates a partial obstruction of the fuel line.	a. If fuel flow and quantity of the corresponding engine are normal and engine continues to operate normally, inspect nacelle for visible fuel. If fuel is visible, secure engine.
	Note The FUEL PRESS LOW light should be out by low rpm.	b. In flight, if no fuel visible, continue operation, observing engine closely.
	After start, possible faulty or stuck pressure switch.	c. During ground operations, if no fuel is visible, cycle respective boost pump or shift engine to normal rpm then back to low rpm. If light goes out and remains out, continue operation.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Fuel Management Panel (cont)		
3. No. 1, 2, 3, or 4 TANK shutoff valve advisory lights on.	Light will illuminate whenever the corresponding tank valve position does not coincide with the tank valve switch. Failure of the valve to open or close completely energizes the light.	Investigate.
4. No. 1, 2, 3, or 4 XFEED valve advisory lights on.	Same as No. 3 above.	Investigate.
5. Cross ship X FEED valve advisory light on.	Same as No. 3 above.	Investigate.
6. RESET advisory light on.	Light will illuminate whenever the refuel control panel has control of the transfer valves, which are also used to refuel tanks No. 1, 2, 3, 4.	Push reset button to regain control of transfer valves.
7. Tank BOOST pump low pressure advisory light on.	Light will illuminate whenever the output pressure of the corresponding boost pump is low.	Refer to Fuel Boost Pump Failure, paragraph 15.8.2.
8. Transfer pumps PRESS LOW advisory lights on.	Tank No. 5 is empty or pump output pressure is low.	Shut off respective pump; refer to Transfer Pump Failure, Tank 5, paragraph 15.8.3.
Pilot Center Instrument Panel (Horizontal)		
1. GEN mechanical failure light No. 2, 3, or 4 on (steady or intermittent).	Primary generator drive end bearing has failed.	Mission should be aborted. If the generator switch must be left in the OFF position because of a generator malfunction, execute the Emergency Shutdown procedure, paragraph 15.5.1.
2. CHIPS light No. 1, 2, 3, or 4 on (steady or intermittent).	Metal particles on magnetic plug in power section or gearbox.	Check for secondary indications. If noted, execute Emergency Shutdown procedure. If no secondary indications are present, engine operation may be continued. Refer to Magnetic Chip Detector Indication, paragraph 15.10.
3. OIL HOT light No. 1, 2, 3, or 4 engine on.	Engine oil temperature 100 °C or over.	If power levers in the ground (BETA) range, open inducers to decrease temperature. If power levers are in flight (ALPHA) range, 100 °C for 5 minutes, then 90 °C. Control with oil cooler flaps position. If unable to control, secure engine.
4. OIL PRESS light No. 1, 2, 3, or 4 engine on.	Either engine oil pressure is below 40 psi or gearbox pressure below 130 psi.	Low rpm, light normal. In flight, check oil pressure gauges; investigate. If oil pressure is within limits, continue engine operation. If out of limits, execute the Emergency Shutdown procedure.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Pilot Center Instrument Panel (Horizontal) (cont)		
5. PROP PUMP No. 1 light (1, 2, 3, or 4 engine) on.	Reduced flow and drop in pressure from prop pump 1 due to pump failure, obstruction, or low oil level.	If either or both propeller pump caution lights illuminate: Continue normal engine operation and refer to Propeller Malfunctions, paragraph 15.12.
6. PROP PUMP No. 2 light (1, 2, 3, or 4 engine) on.	Same as 5 above except No. 2 pump.	Same as 5.
7. BETA light No. 1, 2, 3, or 4 prop on.	Blade angle at 10° or less.	
Pilot Instrument Panels (Vertical)		
1. FUS DUCT HOT light on.	Leak in area around cross ship manifold, creating excessive temperature. Can be caused by a leak in the bleed air manifold, APU bleed air lines, or EDC plumbing.	*1. On ground, secure ground air-conditioning and all engine and APU bleed air, and return to the line. *2. In flight, close all engine bleed and fuselage shutoff valves. 3. If light remains on, dump EDCs one at a time. 4. If light remains on, land as soon as possible.
2. CABIN PRESS light on.	Light on at cabin altitude 10,000 (±500) feet. CABIN PRESS light out by 8,000 feet on descent.	Refer to Pressurization Loss, paragraph 12.4.
3. Master DE-ICING light on.	Alert or fault in deicing system or bomb bay heating system (L or R wing hot, LE hot, EMP deice, L or R pitot heater, or bomb bay hot or cold).	Look for cause in deicing systems on overhead anti-icing control panel. Activate system or secure if necessary. Reset for continued warning protection. Get out of icing area if system is critical and inoperative.
4. Master ELEC POWER light on.	Generator No. 2, 3, or 4 OFF light is on. Overheat of TR No. 1, 2, or 3.	Locate fault on overhead panel. Secure faulty system. Reset for continued warning protection.
5. Master PRESS SYSTEM light on.	Oil pressure low or oil temperature high on left or right EDC. Cabin exhaust fan inoperative. Refrigeration duct overheat warning.	Locate fault on overhead panel. Secure faulty system. Reset for continued warning protection.
6. Master RACK OVHT light on.	Electronic rack overheat condition exists. Also comes on during main DC bus failure. The ASH-33 (DMTS) will cause a rack overheat indication when the system is initially turned on, or will illuminate continuously when a loss of airflow is detected.	Initiate Fire of Unknown Origin checklist/procedures. Locate overheated electronic bay(s) by illuminated individual bay overheat light(s). Provide required cooling or secure equipment as necessary.

*Indicates memory item.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Pilot Instrument Panels (Vertical) (cont)		
7. IFF light on. (Operational only if KIT-C transponder computer is installed.)	Mode 4 zeroized, self-test function of computer has detected a faulty computer, transponder not replying to proper Mode 4 interrogations.	Ensure MASTER switch in NORM, Mode 4 toggle switch ON, and proper code selected. If light persists, fly selected operational procedure for inoperative tactical IFF.
8. START VALVE light on. a. During start sequence (normal). b. After start sequence or during engine operation (abnormal).	Indicates one of the four engine start control valves is open.	*1. Check overhead panel for individual engine start control valve open light.
9. AUTOPILOT light †a. AUTOPILOT amber light (on annunciator panel). Autopilot disengages.	Autopilot or vertical gyro power loss. Excessive vertical gyro precession. No. 1 hydraulic system pressure low. Disengagement by paddle switch.	Extinguish light by depressing pilot or copilot yoke button. Investigate.
†b. AUTOPILOT flashing red warning light (on glareshield). Autopilot disengages.	Hardover pitch has been detected.	Assume manual control.
10. AUTOPILOT/RAWS †a. AUTOPILOT/RAWS flashing red warning lights (glareshield).	Autopilot or vertical gyro power loss. Excessive vertical gyro precession. No. 1 hydraulic system pressure low. Disengagement by paddle switch.	Disengage autopilot. Investigate.
††b. AUTOPILOT/RAWS flashing red warning lights (glareshield).	Autopilot malfunction or certain types of normal/automatic disconnects.	Refer to status lights. May be extinguished by pushing WARN/TEST indicator light switch, by pushing (second detent) disengage button on control wheel, or by operation of the autopilot emergency manual disconnect handle.
11. AUTOPILOT/RAWS flashing red warning lights (glareshield) with synchronized tone.	RAWS warning: Loss of AC power to radar altimeter. Unreliable radar altimeter signal. Aircraft descending through 380 (±20) feet (3-second warning) or 170 (±10) feet (continuous warning). (All warnings are canceled when nose gear is down and locked or flap handle is below MANEUVER.)	If warning is abnormal, investigate.

*Indicates memory item.

†Aircraft with PB-20N Autopilot.

††Aircraft with ASW-31 AFCS.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Pilot Instrument Panels (Vertical) (cont)		
12. FLAP ASYM light on.	Flap asymmetry system has tripped. If there has been a multiple flap component failure, the flaps may still be moving or could be moved by use of the flap handle.	a. If accompanied by a change in flight characteristics, refer to Uncommanded Roll/Yaw Procedures, paragraph 16.6. b. If not, place flap handle in position best corresponding to flap position. c. Execute Uncommanded Roll/Yaw Procedures.
13. DOOR OPEN light on.	Cabin door (either section), hydraulic service center door is not locked.	Lock the door.
14. RUDDER POWER light on (flaps up).	No. 1 hydraulic system pressure failure. Shutoff valve has opened.	Actuate rudder pedals to deplete residual No. 2 hydraulic system pressure in the rudder boost package. If the light remains on: a. Check the rudder boost shutoff valve circuit breaker. b. Turn off the No. 2 hydraulic pump. If the warning light goes out, the shutoff valve is inoperative. Turn the No. 2 hydraulic pump on and make no abrupt rudder movements.
†15. AUTO TRIM light on.	Indicates the auto pitch trim system has failed. This will also cause the pitch trim off flag to appear in the 3-axis trim indicator.	Disengage autopilot. Reset auto trim system by pulling the three AC autopilot circuit breakers and resetting one time only. If failure persists, extinguish light with AUTO TRIM LT OVERRIDE switch. Light automatically resets when flaps extended. Check 3-axis trim indicator before disconnecting autopilot.
16. HYD PRESS light a. No. 1 or 1A HYD PRESS light on.	Respective pump output pressure is below 1,800 psi.	Turn off the respective pump; investigate. **Note** Gear retraction with one operable hydraulic pump may result in indication of hydraulic system failure and unsafe gear due to heavy system demand.
b. No. 2 HYD PRESS light on.	No. 2 pump output pressure is below 1,800 psi.	Check No. 2 system pressure. If low, secure No. 2 pump.

†Aircraft with PB-20N Autopilot.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Pilot Instrument Panels (Vertical) (cont)		
17. No. 1, 1A, or 2 HYD OIL HOT light on.	Hydraulic oil temperature is excessive, restricted coolant flow, not enough fuel in respective inboard fuel tank (minimum 1,000 lb).	Turn off respective pump.
18. NTS INOPR.	Inoperative NTS system.	*1. Continue holding out on feather button. (FE) *2. Emergency Shutdown handle — Pull. (FE) *3. Feather button — Push. (FE)
19. ICING light on.	Indicates the ice detector probe is accumulating ice. The frequency of the light cycling indicates the amount of ice buildup. Long "off" period indicates a slow buildup. Light may illuminate at high angles of attack.	Anticipate icing conditions.
20. ASW-31 AFCS status lights.		
a. AFCS caution light on.	AFCS malfunction.	Discontinue use of AFCS and investigate. (Check separate channel operation.)
b. ATTD caution light on.	Attitude signals divergent or erroneous or module failure. AFCS inertial select switch operated when AFCS engaged.	Reestablish valid attitude reference. Check inertial switch.
c. SERVO light on (operates in conjunction with red warning light and AFCS caution lights).	Failure in servoamplifier or AFCS hydraulic actuator.	Discontinue use of AFCS and investigate. (Check separate channel operation.)
d. ALT status light on (operates in conjunction with red warning lights if AFCS attitude system malfunction, but independently for other reasons).	Pitch is engaged but not in ALT-HOLD mode, altitude failure when in ALT-HOLD mode (operates in conjunction with flashing red warning lights), aircraft has deviated from engaged altitude in excess of 60 feet (flashing red warning lights), malfunction in AFCS altitude system.	Reestablish attitude reference and attitude. If AFCS malfunction, discontinue ALT-HOLD mode and investigate. (Check separate channel operation.)
e. AUTOTRIM caution light on.	Pitch autotrim malfunction.	Disengage and reengage pitch axis. If failure persists, extinguish light with autotrim light override switch, and trim manually. Light automatically resets when flaps extended. Check 3-axis trim indicator before disconnecting autopilot.

*Indicates memory item.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
Armament Panel		
1. BOMB BAY cue light on.	Cue to move BOMB BAY switch to opposite position.	Move BOMB BAY switch to opposite position.
2. ARM HAZARD light on.	Energized buffer relay.	Go to RESET. If light remains on, use offline mode for weapon release.
3. SONO DISABLED light on.	Sonobuoy circuit disabled.	Close sonobuoy disable door prior to taxi.

CHAPTER 12

Emergency Procedures (General)

12.1 INTRODUCTION

This chapter of the emergency procedures part describes the procedures to be used in coping with various emergencies that may be encountered during aircraft operation and may require action by crewmembers in addition to flight station occupants. Crewmembers must have a thorough knowledge of these emergency procedures. Each emergency presents a different problem that can be solved only through specific remedial action. Judgment, precision, and teamwork are essential to handling emergencies quickly and can be developed only through frequent simulated emergencies and emergency drills. The pilot is responsible for safety of flight and, in this regard, must determine that emergency procedures are properly completed. He may delegate accomplishment of certain phases of the emergency procedures to other crewmembers, but the main execution of emergency procedures is the responsibility of the pilot.

A pilot experiencing any emergency during flight shall, as soon as possible after completion of emergency checklists, notify surface craft or ground station in as much detail as possible about the following:

1. Nature of the emergency.
2. Assistance desired.
3. Pilot intentions.
4. Any other information that might be related to the incident or any other incidents encountered that might affect the safety of the flight.

It must be kept in mind that the emergency procedures are guides to action and are not a substitute for the exercise of good judgment. They apply primarily to single emergency situations and should be followed accordingly. With an engine failure prior to securing a second engine, consideration should be given to its effect on safety of flight.

Note

When executing any engine shutdown or restart procedure in flight or on the runway, prior to pulling the E-handle, moving the FUEL AND IGNITION switch, or actuating the feather button, the flight engineer shall be visually checked and verbally confirmed by a pilot as to the correct engine for shutdown/restart.

12.2 APU FIRE

WARNING

If an APU fire occurs on the ground, the aircraft shall be evacuated immediately by all personnel.

If a fire occurs in the APU compartment, the following actions take place automatically:

1. Flight station APU warning lights glow.
2. Flight station and cabin APU/engine fire warning horns sound (in flight, only the flight station horn will sound).
3. The APU solenoid fuel valve closes.
4. As the engine runs down, intake and exhaust doors close.
5. HRD fire extinguishing agent is discharged when the exhaust door is fully closed.

Note

If the exhaust door fails to close, the HRD extinguisher agent will discharge 20 seconds after the fire warning.

To operate the fire extinguishing system manually, proceed as follows:

1. Operate APU fire extinguisher manual release switch.
   a. The APU fuel valve closes.
   b. Intake and exhaust doors close.
   c. HRD extinguishing agent is discharged after exhaust door is fully closed.

Note

- If the exhaust door fails to close, the HRD extinguisher agent will discharge 20 seconds after actuation of the discharge switch.
- If an APU Fire Warning indication is received after engines are running, perform the Emergency Evacuation Checklist.

12.3 FUSELAGE FIRE OR ELECTRICAL FIRE OF UNKNOWN ORIGIN

The most likely cause of interior fire is a fault in the electrical or electronic installations. With this in mind, the flight station is arranged so that all electrical power sources can be cut off quickly and selectively by easily accessible flight station controls. The procedures suggested for combating various types of fires are intended to eliminate most likely sources first. If the fire cannot be located, the following action is required.

WARNING

- The SSQ-110 sonobuoy contains an RDX-based explosive. RDX gives off toxic fumes when burning. If fumes are suspected from an SSQ-110 sonobuoy, execute the Smoke and Fumes Elimination procedure and dispose of the sonobuoy in a safe area through the free-fall chute.
- Atomized hydraulic fluid may exhibit visual characteristics of smoke. Open hydraulic service center door to shield body. If fire or hydraulic leak is present, don oxygen mask prior to inspecting Hydraulic Service Center (HSC).

Note

- The PMG control power to the generator supervisory panel in the main load center is available at all times that the generator is rotating and can be secured only by stopping generator rotation. Fires in any of the supervisory panels should be combated by first placing the respective generator control switch to off. If fire persists, execute Emergency Shutdown procedure for the respective engine. Fires in any of these units are usually (but not always) preceded by a generator electrical failure (GCR trip) in which executing Emergency Shutdown procedure is the only alternative.
- If source of fuselage fire or electrical fire of unknown origin cannot be determined with engines running on the ground, execute the Emergency Ground Evacuation procedures.

12.3.1 Crew Responsibility for Fire of Unknown Origin

WARNING

- All crewmembers shall wear flight gloves during an electrical fire or fire of unknown origin. Refer to Figure 12-9 for specific crewmember responsibilities.
- Remove personnel overcome by smoke/fumes from the scene of the fire before administering oxygen. Keep oxygen bottles away from the scene of the fire.
- Do not enter main load center in flight except in case of extreme emergency.

*1. Alert crew, activate fire bill — Alerted. (CP, TC)

*2. Cabin exhaust fan — OFF. (FE)

Note

Securing the cabin exhaust fan reduces air circulation in the aircraft, thereby aiding in locating the source of the fire. If it can be determined quickly that the fire is in a particular piece of equipment, this equipment can be isolated by pulling the appropriate circuit breaker or securing the bus.

3. Smoke masks — As required. (P, CP, FE)
4. Verify obstacle clearance — Verified. (CP, NC, SS3)
5. Loitered engines — Restart. (P, CP, FE)

If fire source is not determined:

Note

Positional station inspection may aid in determination of fire of unknown origin source.

Note: Asterisked items are memory items.

6. Bus A — OFF. (FE)

WARNING

Copilot must select INS-1 for heading source and STBY GYRO for attitude source.

Note

Most tactical station lighting will be inoperative.

7. Elevator, rudder, and aileron boost levers — Pull. (FE)
8. Bus B — OFF. (FE)
9. Generator switch Nos. 2 and 3 — OFF. (FE)
10. Left or right EDC — DUMP. (FE)
11. Emergency descent — As required. (P)

Note

Good judgment should be exercised before deciding on an emergency descent in the case of a fuselage fire. When oxygen is provided for the entire crew, staying at high altitude and depressurizing may help to control fuselage fires.

12. Remaining EDC — DUMP. (FE)
13. Emergency transmission — As required. (CP)

Note

The aircraft commander shall ensure the emergency message is transmitted on the High Frequency (HF) radio if UHF or VHF communications are not possible.

14. Essential bus switch — OFF. (FE)

Note

- ICS will be inoperative.
- The outflow valve is available electrically.

If fire persists:

WARNING

Electrically operated flight instruments may be necessary for safe flight, and power to them must not be shut off except as a last resort.

15. Generator switch No. 4 — OFF. (FE)

12.3.2 Smoke or Fume Elimination

Attempt to locate, isolate, and extinguish the fire or source of smoke/fumes prior to initiating a smoke removal procedure.

When depressurizing, take into account the minimum safe en route altitude and crew oxygen requirements. If immediate smoke removal is thought necessary, use the following procedure:

1. Cabin exhaust fan switch — ON. (FE)
2. Smoke masks — As required. (P, CP, FE)
3. Descend — As necessary. (P)
4. Depressurize.

With electrical power available:

a. AUX VENT switch — OPEN. (FE)

Without electrical power available:

a. Depressurize pneumatically. (FE)

(1) Aircraft altitude — Not above 12,000 feet.

(2) Cabin altitude — Set 10,000 feet.

(3) BAR. CORR knob — Set 28 inches HG.

(4) Rate knob — MAXIMUM.

If smoke or fumes persist:

5. Free-fall chute/sono chute # 4 — Open. (OBS)
6. Overhead smoke removal door — Open. (FE)
7. Reduce airspeed (170 knots maximum). (P)
8. Starboard emergency exit — Open. (OBS)

WARNING

- Never open a vent or emergency exit in the flight station before there is an opening in the cabin. Pressure buildup in the cabin makes opening of a vent or door more difficult.
- Keep hands clear, as the negative pressure over the wings tends to seat/reseat the hatch prematurely.

12.3.3 Restoring Electrical Power

1. Oxygen selectors — As required. (P, CP, FE)
2. Affected equipment — Disconnect. (FE)
3. Electrical load — Reduce to minimum. (FE/CABIN)

CAUTION

To prevent equipment damage, ensure all applicable equipment is deenergized prior to energizing electrical buses.

4. SYNC SERVO switches — As required. (FE)
5. Generator switches (one at a time) — ON. (FE)
6. Bus monitoring switches (one at a time) — ON. (FE)
7. Electrical load — Restore as required. (FE)
8. START SELECTOR — OFF. (FE)
9. CABIN EXHAUST FAN switch — ON. (FE)
10. Sync system — Set. (FE)
11. Complete In-flight Restart Checklist — As required. (CP)

12.4 PRESSURIZATION LOSS

The most likely causes of a pressurization loss are mechanical or structural failures that result in a sustained loss of pressure or explosive decompression.

If cabin altitude exceeds 10,000 feet, the flight station shall:

*1. Don smoke masks.

*2. Alert crew.

Regardless of cabin altitude, continue with the following steps:

3. Verify obstacle clearance.
4. Investigate pressurization loss.

Other crewmembers should verify the condition of flight station personnel, provide assistance to other personnel as required, and be prepared to set Condition V.

Note: Asterisked items are memory items.

12.4.1 Explosive Decompression

If explosive decompression occurs, the cabin pressure changes to the outside pressure in less than 1 second. Explosive decompression causes a fog that should not be confused with smoke. An explosive decompression affects all crewmembers and can be extremely dangerous if it occurs at high altitude. Some of the effects accompanying explosive decompression are rush of air from lungs, a momentary dazed sensation that passes immediately, possible gas pains, and hypoxia if oxygen equipment is not immediately available. Maintaining a safe pressure differential and having oxygen equipment immediately available are precautions that should be observed in pressurized compartments. If an explosive decompression occurs, the pilot must try to ascertain the cause of the trouble and, if it cannot be fixed in flight, he should decide immediately whether to continue the mission or to descend to a safe altitude.

12.4.2 Rapid Decompression

Rapid aircraft decompression may commence as a result of a landing gear scissor switch malfunction and can be recognized by a loss of spread on both EDCs and the autopilot (if engaged). In the event of a scissor switch failure and loss of associated aircraft system functions, perform the following steps:

*1. Pressurization ground check switch — TEST. (FE)

*2. Ground air-conditioning switch — ON. (FE)

Note

Manual modulation of the outflow valve may be required initially to minimize cycling.

Once pressurization is regained:

3. Ground air sensing circuit breaker — Pull. (FE)

4. Pressurization ground check switch — NORMAL. (FE)

CAUTION

In the event of scissor switch failure and performance of the above procedure, the ground air sensing circuit breaker should be reset after landing rollout.

12.4.3 Emergency Depressurization Procedure

With electrical power available:

*1. AUX VENT — OPEN. (FE)

*2. OUTFLOW VALVE — OPEN. (FE)

*3. EDCs — DUMP. (FE)

*4. AUX VENT — Close at 1-inch differential. (FE)

Without electrical power available:

*5. FREE-FALL CHUTE — Open. (OBS)

Note: Asterisked items are memory items.

12.5 EMERGENCY DESCENT

Emergency descent from high altitude should be made with the landing gear extended at a maximum permissible indicated airspeed of 300 knots when below FL245 and at Mach limit dive speed above FL245. A high rate of descent can be obtained with a gear-down configuration while retaining better aircraft controllability than in a clean configuration Mach limit airspeed descent. The highest angle of descent can be achieved by descending with the landing gear and wing flaps extended; however, the rate of descent will be less because of reduced permissible airspeeds imposed by wing flap extension.

12.5.1 Emergency Descent Procedure

*1. Autopilot — Disengaged. (P)

*2. Power levers— FLIGHT IDLE. (P)

*3. Landing gear lever — As required. (CP)

*4. Airspeed — As required. (P)

*5. Pressurization — As required. (FE)

Note

Flight station shall verify obstacle clearance and altimeter setting.

12.6 EMERGENCY EXITS/ENTRANCES

The hatches shown in Figures 12-1and 12-3 are the normal means of surface emergency evacuation. The main cabin door shown in Figure 12-2 may also be used. If it is necessary to enter the aircraft to rescue trapped personnel, open the emergency exits (Figures 12-1, 12-2 and 12-3), all of which are operable from inside or outside.

Note

The overwing hatches and main door each have a phosphorus button located by the handle to aid in location in complete darkness.

12.7 DITCHING

It is essential that each crewmember be thoroughly familiar with the ditching procedures, with his duties, and the duties of all other crewmembers so that, in case of injury to one member, his duties may be assigned to or assumed by another. Responsibility for each piece of equipment to be removed from the aircraft is assigned to the specific crew positions. Periodic drills should be conducted to ensure crew proficiency in the event of an actual ditching situation.

Note

Each person is responsible for carrying out the duties of his assigned ditching station. In the event of an immediate ditch, each person shall take the nearest ditching station but carry out the duties assigned during the brief.

Note: Asterisked items are memory items.

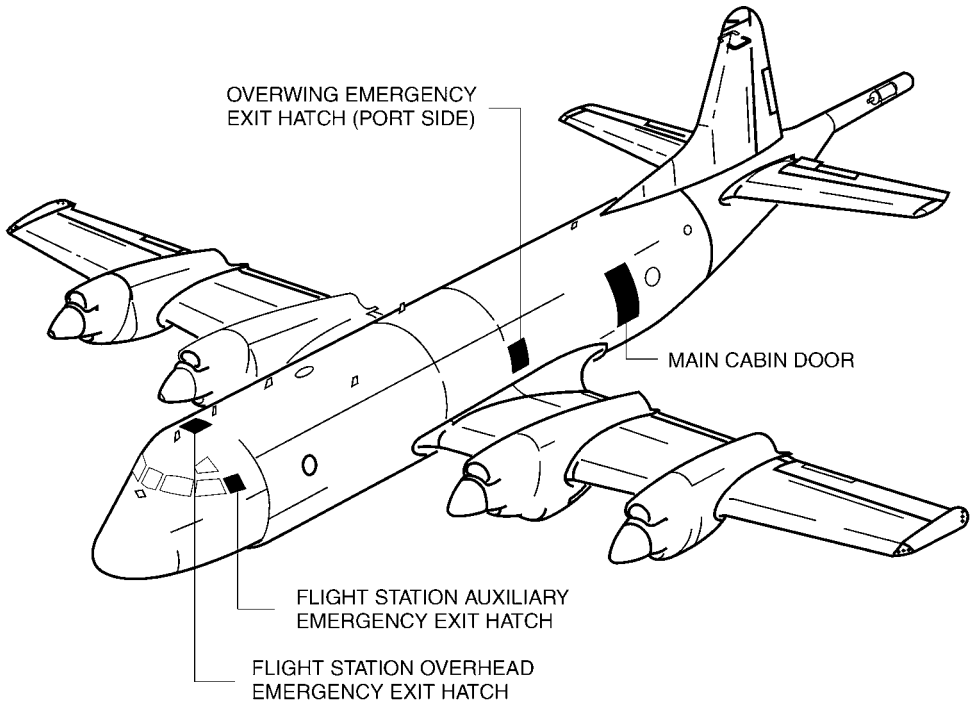
FLIGHT STATION AUXILIARY EMERGENCY EXIT

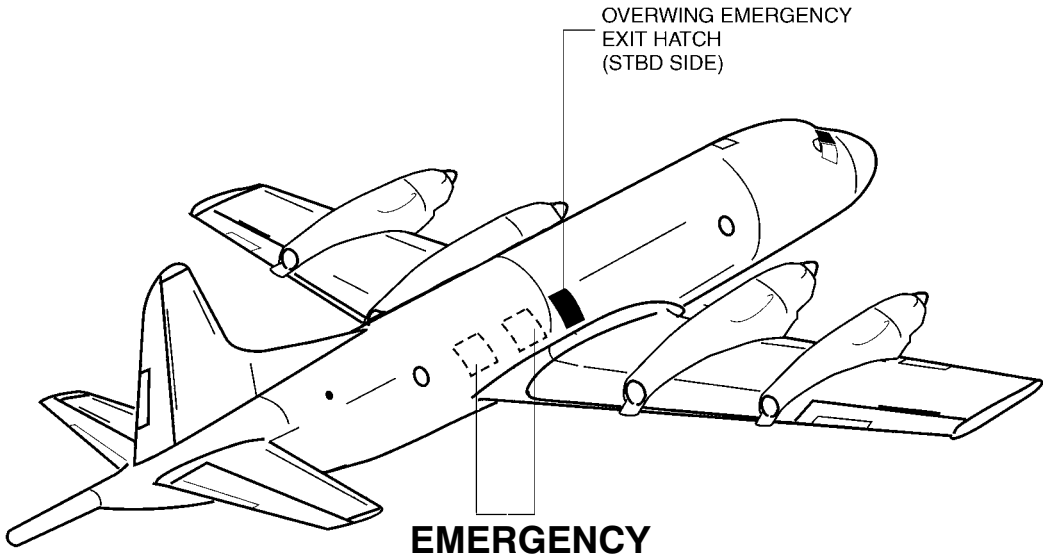


FLIGHT STATION OVERHEAD EMERGENCY EXIT AND SMOKE REMOVAL DOOR



Figure 12-1. Flight Station Alternate Emergency Exit Hatches





EMERGENCY CUTOUTS

P301-F076

Note

- All doors and hatches can be opened from inside or outside of aircraft.
- In some aircraft the cutout area is located in the lavatory area.

Figure 12-2. Emergency Entrances and Exits

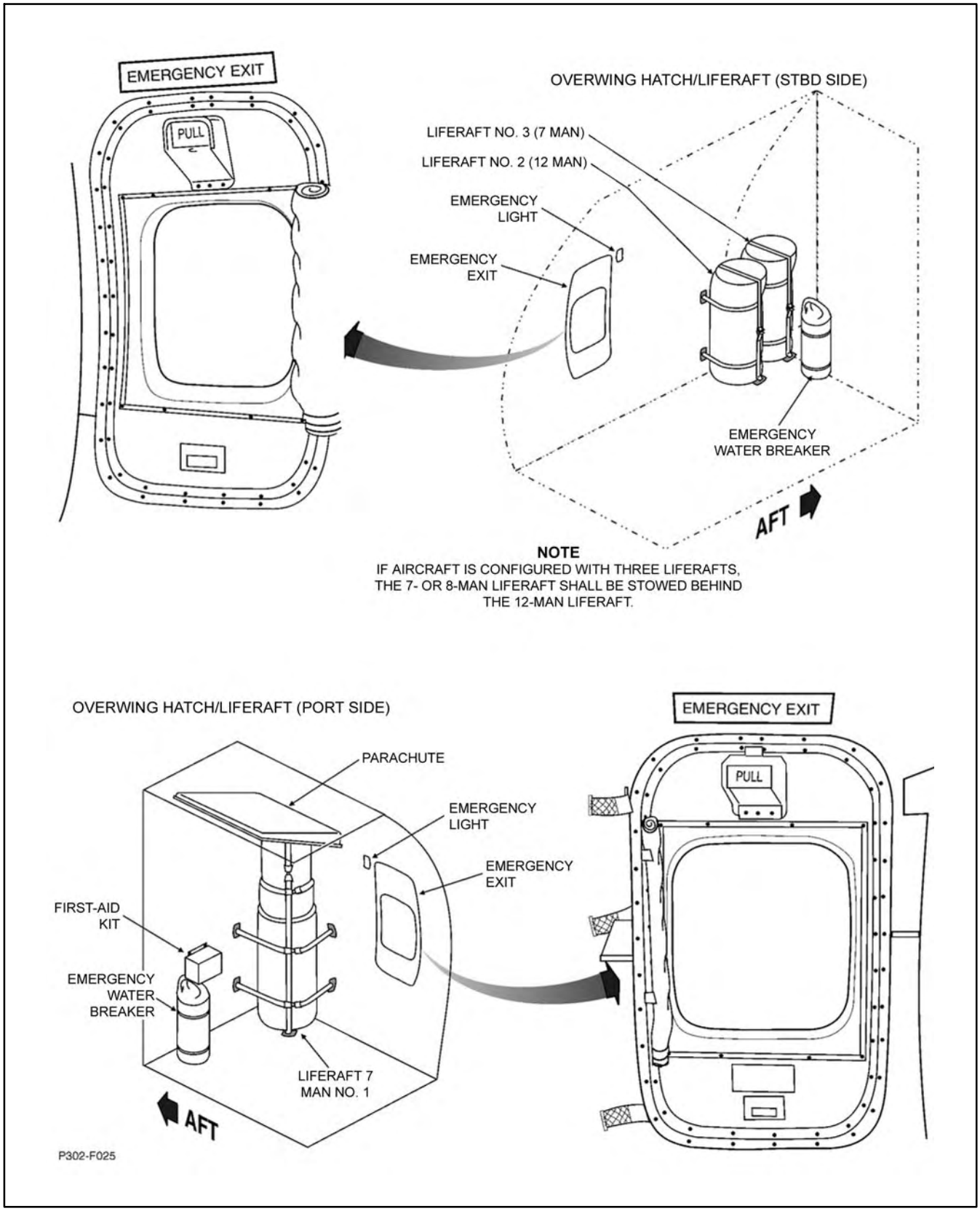


Figure 12-3. Overwing Emergency Escape Hatches and Liferaft Stowage

Any ditching situation requires the pilot to rapidly determine the best configuration for the given condition. There are aircraft configurations or conditions caused by damage or unknowns that will make a successful ditching marginal. When a catastrophic emergency arises, the following points should be assessed to determine whether ditching, bailout, or an immediate landing is the best course of action:

1. Is there sufficient time available in which the aircraft can be flown to successfully carry out the desired course of action?
2. Is the flight control system completely functional? If not, what are the restrictions for low-speed flight? Is lateral and directional control assured and not endangered because of failure of one or more engines, engine/wing fire, or boost control malfunction? If an immediate landing or ditching cannot be made, bailout procedures should be initiated immediately.
3. What are the crew survivability chances in the water without rafts for a given sea state, water temperature, and distance from possible rescue units?
4. Can a normal ditching configuration be attained? (Gear up, approach or land flaps, bomb bay and APU doors closed.)
5. A determination of the ditching technique to be utilized and the correct airspeeds to be flown should be decided on as soon as possible.

12.7.1 Ditch Heading and Sea Evaluation

Except in extremely high wind conditions, the aircraft should be ditched parallel to the primary swell system. Model tests and actual ditchings of various aircraft indicate that ditching into the wall of seawater created by a major swell is roughly analogous to flying into a mountain. Accordingly, a careful evaluation of the sea condition is essential to successful ditching. In this regard, sea conditions should be continually reviewed to determine updated ditching heading. The surface should be analyzed from as high an altitude as the surface can be seen, 2,000 feet or more if possible. The primary or basic swell can readily be distinguished from high altitude and is seen first. It may be hidden beneath another system plus a surface chop, but from altitude the largest and most dangerous system is the first one recognized. By watching the pattern for a few seconds, the direction of motion of the system can be determined. Once the basic system is found, look in different directions for other systems. Perhaps the second system may not be visible until a lower altitude is reached. Direction of swell movement does not necessarily correspond to wind direction. The wind-driven sea waves are indicative of wind direction, and the water surface conditions are indicative of windspeed. If visibility is restricted, the ditch heading may be determined from forecast data. It is possible, once a low altitude is reached, the basic system may disappear from view hidden by the second system and the local chop. It is essential, therefore, to plot the direction of the various systems as they are recognized.

Where weather or night operations preclude visual determination of sea conditions, forecast data should be utilized. In addition, ships may be used to obtain sea conditions.

Based on the foregoing discussion, the following guidelines are offered:

1. The best ditch heading is usually parallel to the major swell system. (Refer to Figure 12-4.)
2. In strong winds, it may be desirable to compromise the above by landing more into the wind and slightly across the swell system.

12.7.2 Approach Technique

The aircraft should be ditched while power is still available. Flight control boost should be operative and land or approach flaps should be used, as appropriate. Water entry should be in steady, straight flight with wings level to the surface of the water and the aircraft in a nose-high attitude at the lowest possible rate of descent. The aircraft should be flown at the lowest possible airspeed consistent with good lateral and directional control. The placard ditching speed is the absolute minimum airspeed allowable and is approximately 10 knots above land flap zero thrust stall buffet. If practicable, excess fuel should be burned or dumped and weapons jettisoned to lower the aircraft weight, the power required, the approach speed, and to provide buoyancy after impact.

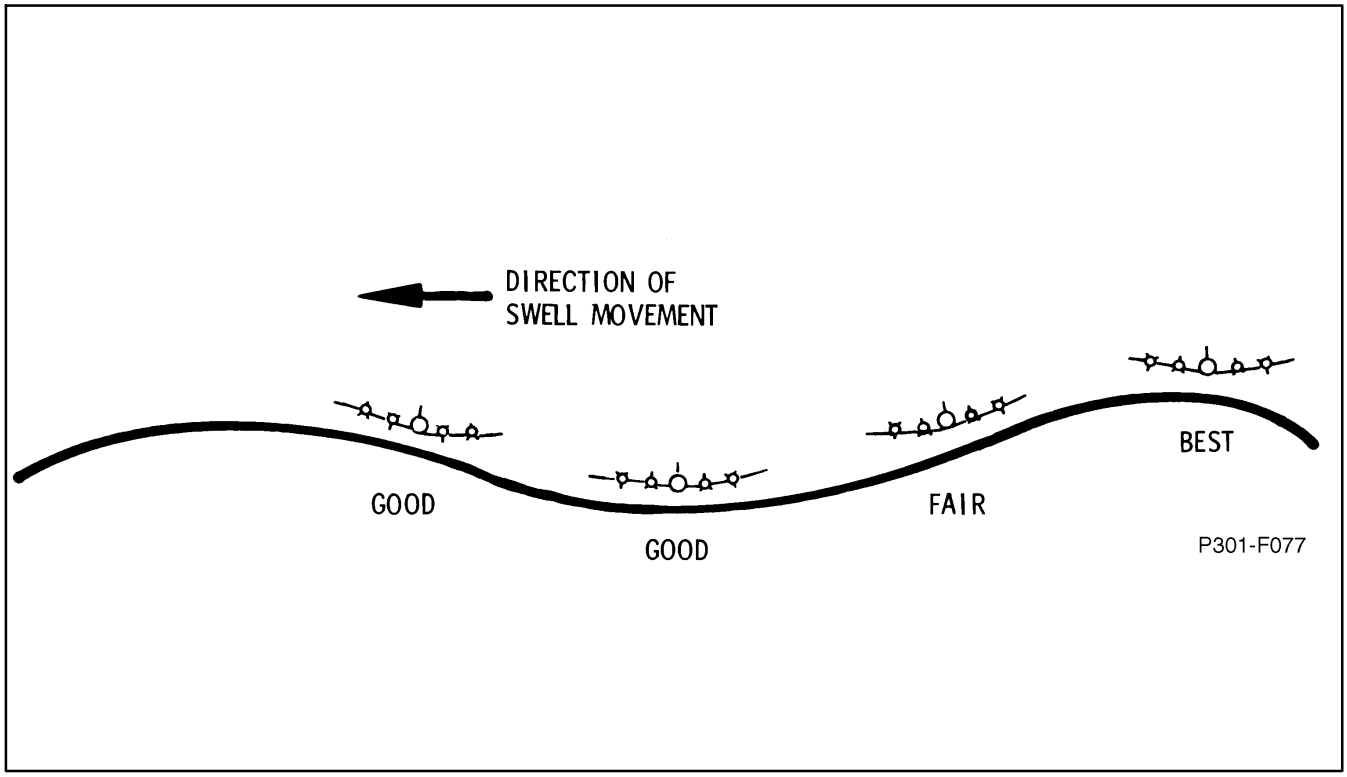


Figure 12-4. Selection of Ditching Heading by Evaluation of Sea and Wind

Figure 12-5 may be helpful in determining windspeed from the surface of the water:

SURFACE CONDITION	WINDSPEED KNOTS
Few white crests	10 to 15
Many white crests	15 to 25
Streaks of foam from crests	25 to 35
Spray blown from tops of waves	35 to 45

Figure 12-5. Water Surface Windspeed Chart

12.7.3 Partial Power Ditching

While it is not practical to cover all possible combinations of engine failure, loss of one or more engines typically precedes ditching and can significantly affect the ditching procedure utilized. Use of high asymmetric power should be avoided since this can cause the land flap ditching airspeed to be near or below $V_{MC\,AIR}$. With land flaps selected, there may also be insufficient power available to maintain the land flap ditching speed at a 100 fpm rate of descent. With only one engine failed and at lower gross weights, it is possible to attain an optimum ditching airspeed, minimum rate of descent, and directional control by reducing power on the opposite symmetric engine. With one or more engines failed, power required can be significantly reduced by using approach flaps. Directional control and rate of descent can also be improved by increasing the approach speed. If an immediate ditching is not required, the optimum approach airspeed can be determined by a slow flight check at altitude prior to the final approach to ditching.

12.7.4 Visual Ditching Technique

With reasonably good visibility, ditch the aircraft by flying a visual descending/decelerating approach so that the airspeed slowly tapers to 1.35 V_S (approach flaps) or 1.3 V_S (land flaps) as the transition to landing attitude is established. Initiate a gradual power reduction and flare as in a normal field landing. Water entry should be in steady, straight flight with the wings level to the surface of the water and the aircraft in a nose-high attitude at the lowest possible rate of descent. If the aircraft bounces on impact, attempt to keep the nose up.

12.7.5 Night or Instrument Technique

At night, during conditions of reduced visibility or over glassy smooth water, if all engines are operating, the aircraft should be flown as slow as the minimum ditching airspeed with approach or land flaps. Ditch at the lowest possible rate of descent (100 fpm optimum).

If one or more engines have failed, the initial approach speed should be 1.35 V_S or higher with approach flaps in order to maintain directional control. If sufficient time exists, the airspeed may be decreased at the pilot's discretion to no slower than the approach flap ditching airspeed with approach flaps.

If the aircraft bounces on impact, attempt to keep the nose up.

If two engines have failed on the same side, the three-engine ditch technique is effective at light to moderate gross weights. At higher gross weights, it may be necessary to increase airspeed in order to maintain directional control while maintaining minimum rate of descent.

12.7.6 Ditching Procedures

The following ditching checklist is based on the experiences of pilots who have successfully ditched four-engine aircraft:

*1. Alert crew time to impact — Alerted. (CP)

Note

- Announce intention to ditch and time until impact over Public Address (PA) system using ICS override.
- In the event of an immediate ditch, one long ring on the command bell shall be followed by an ICS PA override alert.
- The pilot, having announced his intentions to ditch, has authorized the transmission of the emergency message.
- Because of the added structural strength and the likelihood of flash fire on impact, emergency overwing exits shall not be removed until the aircraft has come to a complete stop.

2. Barometric and radar altimeters — As required. (P, CP)

3. Depressurize — As required. (FE)

4. Jettison — As required. (P)

Note: Asterisked items are memory items.

WARNING

- If external or bomb bay stores are being carried, actuate the JETTISON switch and leave in the JETTISON position.
- If the nature of the emergency indicates that hydraulic/electrical power may be lost during the jettison cycle, consideration should be given to utilizing WING ONLY JETTISON to preclude open bomb bay doors during ditching.
- Do not select WING ONLY JETTISON with the JETTISON switch actuated because the bomb bay doors will not close. The WING ONLY JETTISON switch interrupts the control of the bomb bay doors by the programmer module. The WING ONLY JETTISON cycle takes approximately 8 seconds. If the switch is not held for that length of time, all stores may not release.

5. Ditch heading — Checked. (P, CP)
6. Ditching speed — Checked. (P, CP, FE)

Note

When calling out the ditching speed, the flight engineer shall give the land flap ditch speed, 1.35 V_S or 1.3 V_S, as directed by the pilot. During a night or instrument ditch, if limited to takeoff/approach flaps, the pilot must increase the minimum ditching speed by 5 KIAS or, if forced to use maneuver/flaps up, increase the minimum ditching speed by 20 KIAS.

Representative weights and speeds:

WEIGHT	DITCHING SPEEDS (LAND FLAPS)
140,000	134 KIAS/LAND Flaps
135,000	131 KIAS/LAND Flaps
130,000	129 KIAS/LAND Flaps
125,000	126 KIAS/LAND Flaps
120,000	124 KIAS/LAND Flaps
115,000	121 KIAS/LAND Flaps
110,000	119 KIAS/LAND Flaps
105,000	117 KIAS/LAND Flaps
100,000	114 KIAS/LAND Flaps
95,000	111 KIAS/LAND Flaps
90,000	108 KIAS/LAND Flaps
85,000	106 KIAS/LAND Flaps
80,000	103 KIAS/LAND Flaps
75,000	100 KIAS/LAND Flaps
70,000	97 KIAS/LAND Flaps

7. Emergency message/IFF — EMERGENCY. (CP)
8. Flaps — As desired. (CP)

Note

With one or more engines inoperative, selection of land flaps is not recommended.

9. Landing gear — UP. (CP)
10. Auxiliary vent/outflow valve — CLOSED. (FE)
11. Harness — Locked. (P, CP, FE)

WARNING

- Remove hand from power levers because random motion of power levers after water impact may cause injury to hand.
- Water impact could cause severe head injury. If time permits, don helmets and/or anti-exposure suits.

12.7.7 Exits

The exits over the wings provide an added advantage for evacuating because the wings provide a pier from which the rafts may be boarded.

12.7.8 Liferaft Procedures

Check that the liferaft painter or Multi-Place Liferaft (MPLR) actuating/retaining line is attached to the aircraft. This line is used to keep the liferaft close to the aircraft for boarding and will release the liferaft when the aircraft sinks. With the exception of the MPLR, the person launching the raft should attach nylon-launching strap to lifevest and push or lift liferaft through exit.

WARNING

Do not remove liferaft from the carrying case. Ensure the liferaft is launched and inflated away from any sharp surfaces.

Follow launching strap (or retaining line on MPLR) to the vicinity of the inflation assembly actuation handle located under the carrying case end flap. On MPLR, the actuation handle is located in the international orange flap. Upon pulling the actuation handle, the raft will inflate and be removed from its carrying case automatically. Leave the liferaft painter attached to the aircraft. MPLR actuation is completed with one smooth pull.

Distribute emergency supplies among the rafts and tie them down in the center of the raft to prevent them from being lost in case the raft capsizes.

After all personnel have been evacuated (Figure 12-6), move rafts out from under any part of the aircraft that might strike them as it sinks. Rope the rafts together so that they will not drift apart and become separated and complicate rescue. Remain in the vicinity of the aircraft as long as it remains afloat.

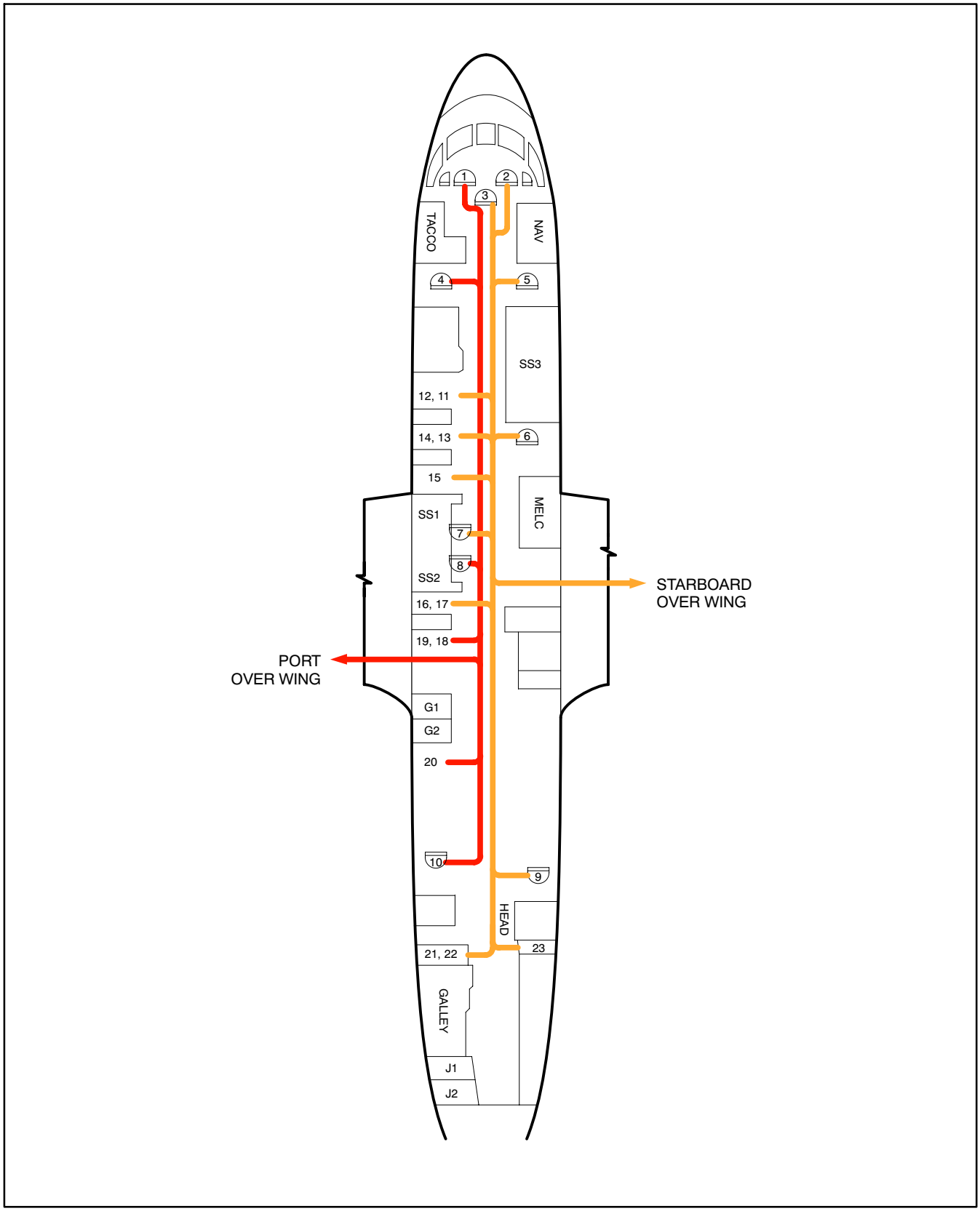


Figure 12-6. Surface Emergency Evacuation and Crew Ditching Stations

12.8 EMERGENCY JETTISONING

If the nature of the emergency permits, prior to a gear-up landing or ditching, use up as much fuel as possible, maintaining just enough reserve for power-on approach. Loose equipment should be secured or jettisoned through the main cabin door. All external and bomb bay stores should be jettisoned.

12.9 ABANDON AIRCRAFT STATIONS

Twenty-three stations (on Update III aircraft, stations 16 and 17 have been deleted) are numbered and placarded with the ditching and bailout procedures and responsibilities for the crewmember manning each particular position (Figure 12-9). Priorities for assignment of ditching stations may be obtained from Figure 12-7. All parachutes aboard the aircraft are designated with a number corresponding to an assigned station usually painted on the individual parachute stowage location.

Note

During a bailout or drill, personnel shall utilize that parachute assigned during the brief.

12.10 BAILOUT PROCEDURES

Note

- Thorough consideration should be given to the consequences of scattering flightcrewmembers over a large area of ocean without the benefit of liferafts. The command “PREPARE TO BAILOUT” (when over water and a great distance from land or surface vessels) should be issued only after it is determined that ditching cannot be safely accomplished. Bailout should be conducted with the aircraft circling to avoid widespread separation of crewmembers.

- The pilot, having announced his intention to bail out, has authorized the transmission of the emergency message.

The command “PREPARE TO BAIL OUT” is passed verbally and by four short rings on the command bell. All crewmembers shall use the main cabin door for exit (refer to Figures 12-9 and 12-8).The parachute should fit tightly, high on the back, and snug in the seat. The parachute harness should not cross the collar lobes of the Life Preserver Unit (LPU) flotation devices. The leg straps should be routed under the accessory pouches on the LPU waist lobe container (if carried). The protective helmet visor shall be down and locked. All objects protruding from pockets shall be removed and flight gloves shall be worn. Crewmembers should assemble at the sonobuoy area and inspect each other for proper donning of equipment. The minimum recommended altitude for an emergency bailout is 3,000 feet. Bailout should not be attempted below 1,000 feet. If time permits, the tactical coordinator shall ensure launching of the liferafts and other emergency equipment. The copilot shall deploy the crash locator (if installed) prior to leaving the flight station. Also, prior to sounding the command bell, the aircraft shall be depressurized by the flight engineer following emergency depressurization procedures.

WARNING

When donning the Thin Pack parachute, ensure the leg straps are tightly snug around the upper legs. Failure to properly adjust the leg straps may result in severe injury.

		DITCHING STATIONS																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16*	17*	18	19	20	21	22	23
	4C	X	X	XA						XB														
	5C	X	X	X						X	XB													
	6C	X	X	X			X			X	XB													
	7C	X	X	X			X	X		X	X													
	8	X	X	X	X		X	X		X	X													
	9	X	X	X	X	X	X	X		X	X													
CREW	10	X	X	X	X	X	X	X	X	X	X													
	11	X	X	X	X	X	X	X	X	X	X													X
	12	X	X	X	X	X	X	X	X	X	X								X					X
	13	X	X	X	X	X	X	X	X	X	X								X	X				X
ON	14	X	X	X	X	X	X	X	X	X	X	X							X	X				X
	15	X	X	X	X	X	X	X	X	X	X	X	X						X	X				X
	16	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X				X
BOARD	17	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X	X				X
	18	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X				X
	19	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X				X
	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				X
	21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
	22	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
	23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		P	C	F	T	N	S	S	S	O	F													
		I	O	E	C	C	S	S	S	B	T													
		L	P				3	1	2	S														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16*	17*	18	19	20	21	22	23
		DITCHING STATIONS																						

NOTES:

A. STBD EMERGENCY WATER BREAKER.

B. LAUNCH NO. 2 LIFERAFT.

C. ALL PERSONNEL BOARD NO. 2 LIFERAFT WITH 7 OR LESS.

***** DITCHING STATIONS 16 AND 17 HAVE BEEN DELETED FROM UPDATE III AIRCRAFT.

IF AIRCRAFT IS CONFIGURED WITH TWO 12-MAN LIFERAFTS, PERSONNEL NORMALLY ASSIGNED TO THE NO. 3 LIFERAFT WILL BOARD THE NO. 1 LIFERAFT.

Figure 12-7. Priority of Ditching Station Assignment

WARNING

Before opening cabin door, verify flight station overhead smoke removal door is closed. Stay clear of marked caution area when opening the door since it may open explosively when the air seal is broken. Aircraft must be depressurized prior to attempting to open the main cabin door.

Once the cabin door has been opened and secured, all crewmembers should stand by for the command, "EXECUTE BAILOUT" (passed verbally and by one long ring of the command bell, 10 seconds or longer). Following the command to bail out, proceed as follows:

1. Depart the aircraft in a quick, orderly fashion at 1-second intervals by grasping the door edges at waist height, placing feet together, and exiting by pulling forcefully. Passing through the door, push back and away to ensure adequate aircraft separation.

2. When clear of the aircraft, grip ripcord handle and pull ripcord the maximum length of travel to allow complete release of pins from parachute pack.

3. Immediately following opening shock of parachute, check for proper deployment and condition of the parachute canopy.

Note

If using the Thin Pack parachute, after opening shock it may be necessary to remove remnants of the vacuum seal bag in order to check the condition of the canopy.

4. Locate the beaded handles on the LPU and pull down and straight out to inflate LPU.

5. Squeeze LPU waist lobes together to help release Velcro on collar lobe.

6. Manually release Velcro on collar, if necessary, to achieve complete lobe inflation.

7. Snap LPU waist lobes together.

8. Raise and lock the helmet visor (if over land, leave visor down and locked) and remove gloves if desired.

Note

Stow gloves in a safe place to prevent loss. Removal of gloves may facilitate subsequent release of parachute release fittings.

9. Parachute.

   a. (For NB-8 only) Consider actuating the four-line release system to reduce oscillation and provide an optional method of maneuvering the parachute to an optimal landing site (adjacent liferaft or to a clear landing area). Grasp the release lanyard loops located on the inside of the rear risers and break the release ties by a sharp pull. This action will free the rear four suspension lines, allowing the canopy to form a lobe in the rear center and permit a steady escape of air reducing the oscillation and providing minimal directional control by pulling on the respective release lanyard.

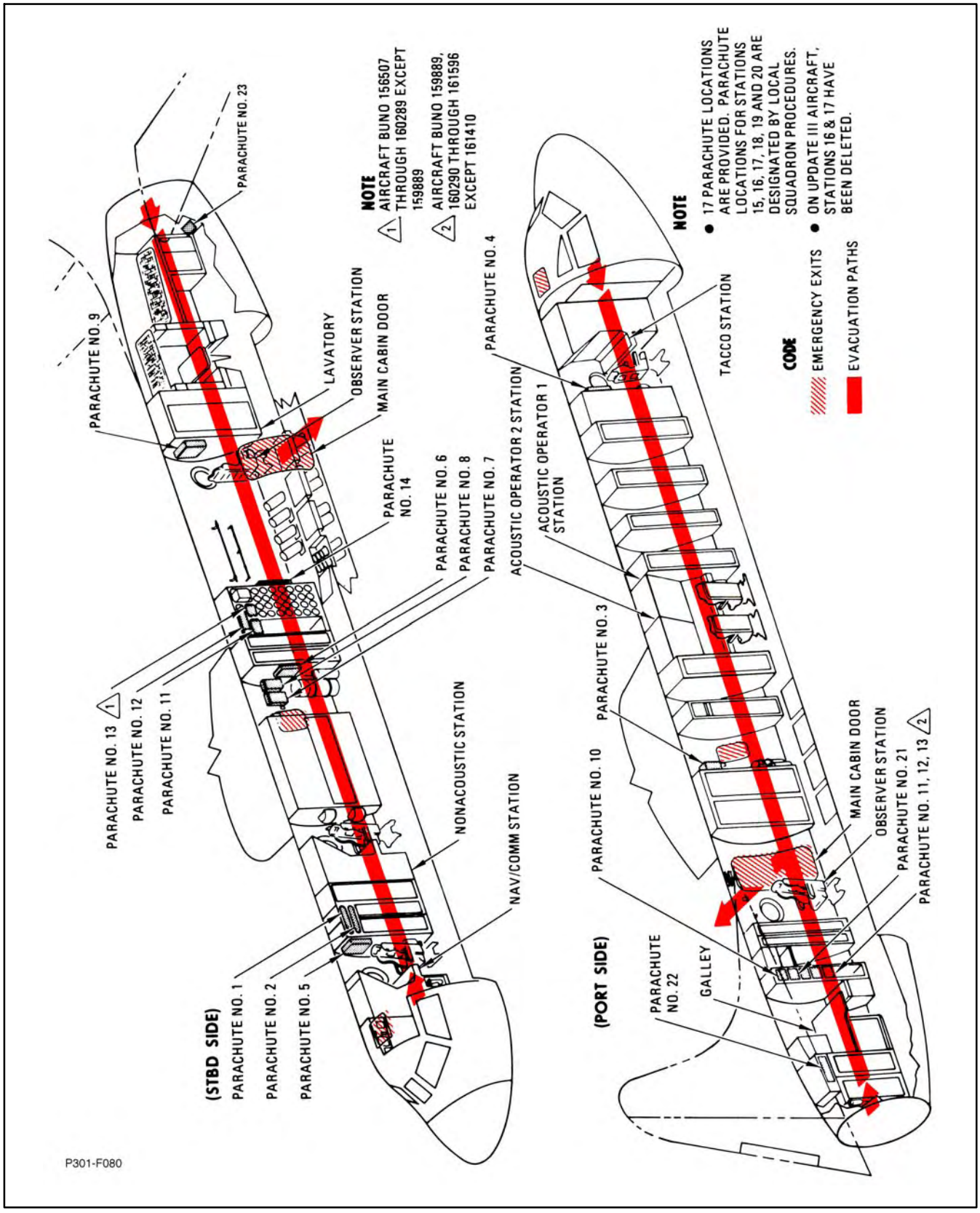


Figure 12-8. In-Flight Evacuation and Parachute Location

WARNING

The four-line release should not be activated if a damaged parachute canopy or broken suspension lines are observed.

b. (For A/P22P-21 Thin Pack only) Consider operating the steering system to provide for maneuvering the parachute to an optimal landing site (adjacent liferaft or a clear landing area). Pull down on the right loop to steer right; pull down on the left loop to steer left.

10. Attempt to turn into the wind by pulling on either four-line release lanyard, steering loop or riser to turn to avoid being caught under parachute canopy after water entry.

WARNING

The following procedures are for egress over water. If over land, do not release chest and leg straps. Position body properly and perform Parachute Landing Fall (PLF).

11. To prepare for water entry, grasp either side of the parachute shoulder harness. With the opposite hand unfasten the parachute chest strap then leg strap, reach over to opposite shoulder harness strap. Release original shoulder harness strap and place hand on the remaining leg strap.

12. Upon water entry, unfasten the remaining leg strap and roll free of the parachute harness.

13. If trapped under the parachute canopy, remove it by reaching overhead and pulling the canopy from the head toward the feet until clearing the outer edge. Do not follow the panel seams, as some seams orbit the canopy. Do not kick feet until clear of canopy and suspension lines.

12.11 IN-FLIGHT EMERGENCY DESTRUCTION PLAN (EDP)

In the event of an emergency situation on a P-3, the security of classified material and information is paramount. This in-flight EDP defines the course of action to be followed in order to deny access to such material by unauthorized personnel. This plan is for the emergency destruction of classified documents, software, Communications Security (COMSEC) material, and magnetically stored classified data and databases aboard all versions of patrol squadron aircraft. It also ensures the most rapid and thorough disposition of the materials should the situation warrant. Refer to Figure 12-9 for specific crewmember responsibilities. Additional provisions for the EDP can be referenced in the Commander, Naval Air Reserve Force (CNARF)/Commander, Patrol Reconnaissance Alantic (CPRL)/Commander, Patrol Reconnaissance Pacific (CPRP) Instruction 5510.4 and applicable theater directives.

Note

Consideration should be given to leaving select communications gear keyed until the last moment to ensure all emergency transmissions are completed.

12.12 BOMB BAY DOORS EMERGENCY OPERATION

12.12.1 Without Electrical Power

In the event of an electrical failure, the doors may be opened or closed by operating the control valve manually. A handle for positioning the valve is attached to the control valve and is accessible through a door in the fuselage floor adjacent to the TACCO seat. A two-position selector switch, placarded LOCAL and REMOTE, is located adjacent to the control valve handle. This switch must be in LOCAL during emergency operation to preclude repositioning of the valve in the event the electrical circuit is reenergized. When closing the doors, the valve handle must be held down until the doors are closed and locked, as the valve is spring-loaded to the neutral position.

The following procedures for opening and closing the bomb bay doors, in the event of bomb bay door electrical failure, are placarded on the underside of the control valve access door:

To open doors:

1. Selector switch — LOCAL.
2. Control valve handle — Pull up.

Note

The indicator light located near the selector comes on when the doors are open.

To close doors:

1. Selector switch — LOCAL.
2. Control valve handle — Push down (hold down until doors are closed, as valve is spring-loaded to the neutral position).

CAUTION

To prevent possible damage to the control valve handle, only use your hand to apply pressure until the doors are closed.

3. Return selector switch to REMOTE for normal operation.

12.12.2 Without Hydraulic Power

In the event of hydraulic failure with or without electrical power, the bomb bay doors may be opened and closed using the bomb bay door emergency hydraulic system. This system consists of a reservoir, handpump, shutoff valve, and necessary plumbing. The system is tied into the No. 1 hydraulic system. Controls for the system are accessible through a door in the fuselage floor directly across from the control valve access door. To operate the system, two crewmembers are needed: one to operate the control valve handle and selector switch and the other to operate the handpump and shutoff valve. The following procedures for opening and closing the bomb bay doors with the emergency hydraulic system are placarded on the underside of the handpump and shutoff valve access door.

To open doors:

1. Shutoff valve — OPEN.
2. Selector switch — LOCAL.
3. Control valve handle — Pull up.

4. Remove pump handle from its stowed position adjacent to the pump and insert it into the pump socket.
5. Operate handpump until the bomb bay doors are open and continue pumping to hold the doors open.

To close doors:

1. Control valve handle — Push down (hold while operating the handpump until the doors are closed).

CAUTION

To prevent possible damage to the control valve handle, only use your hand to apply pressure until the doors are closed.

2. Control valve handle — Release (handle returns to neutral).
3. Selector switch — Return to REMOTE.

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
CREW STATION 1 (PILOT)			
1. Warn Crew: "PREPARE TO DITCH," time to impact. Give signal of one long ring on command bell for immediate ditch. Jettison bomb loads. Adjust seatbelt and shoulder harness. 2. Receive acknowledgment from TACCO of crew preparedness. 3. Check crew evacuation. Exit through port overwing hatch or overhead escape hatch; board No. 1 liferaft.	1. Give signal for bailout preparation on command bell (four short rings) and on interphone using PA function. 2. Receive acknowledgment from TACCO of crew preparedness. 3. Reduce airspeed if possible. 4. Depressurize aircraft and trim slightly nose down. 5. Head aircraft toward uninhabited area and engage autopilot. If over water or uninhabited area, establish port turn and engage autopilot. 6. Give signal to bail out over interphone and sound one long ring on the command bell. 7. Put on parachute and bail out through main cabin door.		1. Descend — As required. 2. Off duty pilot report to TACCO.
CREW STATION 2 (COPILOT)			
1. Announce intention to ditch and time to impact over PA system using ICS override. 2. Set IFF to emergency. 3. Establish voice communication if possible. 4. Adjust seatbelt and shoulder harness. 5. After stop, exit through overhead hatch or starboard overwing hatch; board No. 2 liferaft.	1. Set IFF to emergency. 2. Announce altitude over PA and OVERRIDE. 3. Establish voice communication if possible. 4. Assist pilot as directed. 5. Deploy crash locator. 6. Put on parachute and bail out through main cabin door when directed.		1. Classified Material — Pass to TACCO. 2. IFF — Zeroize. 3. UHF-1 — Zeroize.

Figure 12-9. Positional Emergency Procedures (Sheet 1 of 7)

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
CREW STATION 3 (FLIGHT ENGINEER)			
1. Adjust seatbelt and shoulder harness. 2. Depressurize: Dump compressors, close aux vent and outflow valve. 3. Exit overwing hatch on starboard side; board No. 2 liferaft. (Open overhead hatch only if deemed necessary for egress.)	1. Acknowledge bailout preparation signal (given verbally and four short rings on command bell by pilot). 2. Depressurize: Dump compressors, open outflow valve, close aux vent. 3. Put on parachute and bail out through main cabin door when directed.	Inspect forward electrical load center if not otherwise assigned.	1. Depressurize — As required. 2. Off duty engineer report to TACCO.
CREW STATION 4 (TACCO)			
1. Acknowledge command, ensure crew is prepared, and notify pilot. 2. Secure classified material and loose equipment. 3. Take ditching station. Adjust seatbelt and shoulder harness. 4. After stop, direct crew exit and removal of survival gear through port overwing exit. Take port first-aid kit and port water breaker; board No. 1 liferaft.	1. Acknowledge command, put on parachute, ensure crew is prepared, and notify pilot. 2. Ensure all liferafts are launched if time permits. 3. Bail out through main cabin door when directed.	Direct crew effort in locating and fighting fire. Direct remaining crew with unassigned duties to assist as required (e.g., obtain oxygen bottles, take messages to flight station, etc.). Continuously report progress and results to flight station.	1. Initiate EDP. 2. Collect classified material. 3. Direct the destruct/ jettison process. 4. Zeroize all fill devices. 5. Destroy laptop hard drive (if applicable). 6. Smash COMSEC hardware. 7. Destroy destruction cards and inventories.

Figure 12-9. Positional Emergency Procedures (Sheet 2 of 7)

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
CREW STATION 5 (NAV/COMM)			
1. Pass heading to land to flight station. Send emergency message. 2. Secure loose equipment and classified material. 3. Adjust seatbelt and shoulder harness. 4. After stop, direct crew exit and removal of survival gear through starboard overwing hatch. Take charts and reports; board No. 2 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), pass heading to nearest land to copilot. Send abbreviated emergency message (Call sign, aircraft type, position, altitude, intentions, souls on board). 2. Put on parachute and, when prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	Remain at station. Inspect Auxiliary Readout Display (ARO) power supplies. Be prepared to pull applicable circuit breakers. Report progress to TACCO. Pass heading to nearest land and verify obstacle clearance with the copilot. Perform radio check with appropriate communications facility and be prepared to send emergency message when authorized. For AIP, if fire/smoke persists in the TACCO or NAV/COMM Color High Resolution Display (CHRD) area, be prepared to assist the In-Flight Technician (IFT) in pulling the applicable CHRD to inspect the PEP power supply.	1. Pass MOSA and heading to nearest land/divert to flight station. 2. Send emergency message. 3. Zeroize the following: a. UHF-1. b. KG-84C (Rack C). c. KY-58 (Rack B-3). d. KYV-5 (Rack B-3). e. KG-40A (Rack B-1/2). f. Clear Data Terminal Set (DTS) window (at station). g. Clear frequency from UHF-2 (at station). h. Clear the frequencies from HF-1 and HF-2 (at station). i. GPS (at station). 4. AIP ONLY a. KG-84A (x2) (TACCO station). b. UHF-3 ANDVT (Rack B-1/2). 5. Destroy charts and logs at Mission Commander discretion.
CREW STATION 6 (NONACOUSTIC OPERATOR)			
1. Give bearing and distance to nearest ship or closest point of land. 2. Secure loose equipment. 3. Take ditching station. Adjust seatbelt and shoulder harness. 4. After stop, launch No. 3 liferaft, exit over wing starboard side; board No. 3 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), give bearing and distance to nearest ship or closest point of land. 2. Put on parachute and, when prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	Give range and bearing to nearest ship or closest point of land. Check rack overheat lights and press toggle switches on assigned area. Inspect electronic racks C-1, -2, and -3; nonacoustic electronic bay and entire nonacoustic operating area. Be prepared to pull applicable circuit breakers as required. Report progress to TACCO.	1. Pass MOSA and heading to nearest land/ship to flight station. 2. Pass IRDS/ISAR/AIMS tapes to IFT. 3. Pass all classified documents to SS1. 4. If safety/time permits, destroy Inverse Synthetic Aperture Radar (ISAR) components. 5. Report completion to TACCO.

Figure 12-9. Positional Emergency Procedures (Sheet 3 of 7)

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
CREW STATION 7 (ACOUSTIC OPERATOR 1)			
1. Secure loose equipment. 2. Turn on starboard and port overwing exit light. 3. Take ditching station and adjust seatbelt. 4. After stop, jettison starboard overwing hatch. Launch No. 2 liferaft; exit over wing starboard side; board No. 2 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), turn on starboard and port overwing exit lights. 2. Put on parachute and, when prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	Turn on station floodlight. Activate starboard and port overwing exit lights. Obtain fire bottle (if required) at the end of sonobuoy stowage rack. Check rack overheat lights and press toggle switches on assigned area. Inspect entire acoustic operator area, the main load center, electronic racks F-1 (HF-2 coupler, Sonobuoy Reference System (SRS) [update aircraft]) and F-2 (ordnance indicator and test panels plus ICS and ICS lighting); E-1, -2; G-1, -2; UHF/OTPI select relay in overhead aisle by rack E-1; and hydraulic service center. Be prepared to pull applicable circuit breakers as required. Inspect GPS preamp and AIP diplexer in overhead above SS-2 operator. Report progress to TACCO.	1. Pass AQH-4/13/AVX-1/ DASD tapes and drives to IFT. 2. Set up shredder in galley. 3. Destroy classified documents in following order: a. Key tapes (in the order Top Secret, Secret, Confidential). b. Crypto booklets (In the order Top Secret, Secret, Confidential). 4. Assist IFT with destruction. 5. Report completion to TACCO.
CREW STATION 8			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit over wing port side; board No. 1 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	1. Pass all classified material to SS-1. 2. Don harness, helmet with visor down. 3. Secure harness to starboard aft observer seat. 4. When directed, begin jettison procedures.

Figure 12-9. Positional Emergency Procedures (Sheet 4 of 7)

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
CREW STATION 9 (STARBOARD OBSERVER/ORDNANCEMAN/ACOUSTIC OPERATOR 2)			
1. Secure loose equipment in aft portion of aircraft. 2. Turn on main cabin door exit light. 3. Take ditching station and adjust seatbelt. 4. After stop, take starboard water breaker and starboard first-aid kit. 5. Exit starboard overwing hatch; board No. 2 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), turn on main cabin door emergency exit light. 2. Put on parachute and, when prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	Activate main cabin door exit light. Obtain aft fire bottle (if required). Check rack overheat lights and press toggle switches on assigned area. Inspect all electronic racks aft of main cabin door, galley, deicer control panel, Doppler well, and top strobe light power supply in overhead. For AIP, inspect SS-4 and batwing diplexer in head. Be prepared to pull applicable circuit breakers as required. Report progress to TACCO.	1. Refer to station 8.
CREW STATION 10 (PORT OBSERVER/FLIGHT TECH)			
1. Secure loose equipment in aft portion of aircraft. 2. Take ditching station and adjust seatbelt. 3. After stop, jettison port overwing hatch. Launch No.1 liferaft; exit over wing port side; board No. 1 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	Obtain forward fire bottle (if required). Check rack overheat lights and press toggle switches on assigned area including the NAV/COMM area. Inspect electronic racks A-1, TACCO multi-purpose display power supply area; electronic racks B-1, -2, and -3; D-1, -2, and -3; HF-1 coupler; and A350 ICS isolation box and, if applicable, SATCOM antenna switching assembly in overhead between TACCO and NAV/COMM. If applicable, inspect DMTU interconnection box in the overhead above the computer maintenance control panel. Be prepared to pull applicable circuit breakers as required. Report progress to TACCO.	1. Purge memory on tactical computer (Rack D-2). 2. Zeroize/clear the following: a. MATT (Rack F1). b. Mini-DAMA (Rack G1&2). c. KIR-1C (Rack F-1). d. ALR-66 ESM LIBRARY MODULE (Rack G-1). e. MODE II (Rack H1). f. KIT-1C (Rack H-1). 3. Destroy and jettison the following: a. Operational Program (OP) tape/ Magneto-Optical (MO) disk or DATA EXTRACT (Rack D-3). 4. AIP only a. ODS hard drive (Rack C-5). b. Imaging and Communication Enviroment (ICE) hard drive (Rack C-5). c. AIMS hard drive (Rack C-4). d. RDSS disks (Rack D-3). 5. Report completion to TACCO.

Figure 12-9. Positional Emergency Procedures (Sheet 5 of 7)

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
STATIONS 11 and 12			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit starboard overwing hatch; board No. 2 liferaft. **Note** Station 11 take parachute.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	
STATIONS 13 and 14			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit starboard overwing hatch; board No. 2 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	
STATION 15			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, take parachute, exit starboard overwing hatch; board No. 3 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	
STATIONS 16 and 17 (DELETED ON AIRCRAFT BuNo 161410, 161762, AND SUBSEQUENT)			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit starboard overwing hatch; board No. 2 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	

Figure 12-9. Positional Emergency Procedures (Sheet 6 of 7)

P-3C			
DITCHING	**BAILOUT**	**FIRE BILL**	**EDP**
STATIONS 18 and 19			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit port overwing hatch; board No. 1 liferaft. **Note** Station 18 take parachute.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	
STATION 20			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit port overwing hatch; board No. 1 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	
STATIONS 21 and 22			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, exit starboard overwing hatch; board No. 3 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	
STATION 23			
1. Secure loose equipment. 2. Take ditching station and adjust seatbelt. 3. After stop, if time and aircraft damage permitting, take head water breaker; exit starboard overwing hatch; board No. 3 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.	

Figure 12-9. Positional Emergency Procedures (Sheet 7 of 7)

CHAPTER 13

Ground Emergencies

13.1 BRAKE FIRE

If a brake fire occurs after aborted takeoff, landing, or while taxiing, the following procedure is recommended:

*1. Request ground firefighting equipment. (CP)

*2. Stop the aircraft. (P)

Note

Stop the aircraft using reverse thrust and the good brake. In order to keep the aircraft straight, the nosewheel must be used to counteract the aircraft's tendency to turn into the applied brake. Once the aircraft is stopped, the nosewheel must be held straight ahead and the parking brake set using only the good brake.

3. Rpm switch (engine over burning wheel) — NORMAL. (FE)

4. Power (engine over burning wheel) — Approximately 1,000 SHP. (P)

Note

Increase power on the engine over the burning wheel in an attempt to extinguish the fire (1,000 SHP should be sufficient).

On arrival of ground firefighting equipment:

5. Complete Emergency Evacuation Checklist — CP.

Note

Evacuate crewmembers using the overwing exit opposite the fire. All crewmembers are to stay a safe distance away from the aircraft. It is preferable to stay well behind the aircraft. If a wheel explodes because of rapid cooling, the fragments tend to fly out sideways from the wheel. (A tire may also explode from the heat of the fire.) Do not use CO_2 directly on the wheel as this may cause it to shatter.

13.2 ENGINE FIRE ON THE GROUND

Note

- If conducting a maximum power check in accordance with applicable maintenance manuals as part of a maintenance check, the power levers shall be retarded to FLIGHT IDLE if the fire warning activates. Engine Fire on the Ground procedures shall be executed if the fire warning continues.
- During single-engine driven generator operations, both HRD bottles shall be discharged and control tower notified prior to pulling emergency shutdown handle(s).

Note: Asterisked items are memory items.

*1. Emergency shutdown handle — Pull. (FE)

*2. HRD — Discharged. (P, FE)

3. START button — Pull. (FE)

4. Control tower — Notified. (P, CP)

5. OIL TANK SHUTOFF VALVE circuit breaker — Set. (FE)

Confirmed fire only:

6. Alternate HRD — Discharged. (P, FE)

7. Complete Emergency Evacuation Checklist — CP.

13.3 EMERGENCY GROUND EVACUATION PROCEDURES

The emergency evacuation checklist should be used to facilitate orderly and safe crew egress during ground emergencies after the aircraft ladder has been raised. Such situations include, but are not limited to, APU/engine fire, brake fire, or fuselage/electrical Fire of Unknown Origin (FOUO). The Aircraft Commander should alert crew using PA/ICS OVERRIDE of the intention to evacuate aircraft and specify which exit to use (normally those on the side opposite of a fire). One long ring on the command bell shall be used to signal execution of ground egress. All crewmembers are to stay a safe distance away from the aircraft. It is preferable to stay well behind the aircraft. For example, if a wheel explodes because of rapid cooling, the fragments tend to fly out sideways from the wheel.

13.3.1 Emergency Evacuation Checklist

1. Control tower — Notified. (CP)

2. Flaps — Takeoff. (CP)

3. Alert crew (PA/ICS OVERRIDE) — Alerted. (CP)

4. Emergency shutdown handle(s) — Pulled. (FE)

5. APU — Secured. (FE)

6. Execute evacuation (command bell) — FE.

WARNING

When evacuating the aircraft over the port wing, care should be taken to avoid the fuel dump probe and the vortex generator.

Note: Asterisked items are memory items.

CHAPTER 14

Takeoff Emergencies

14.1 ENGINE FAILURES DURING TAKEOFF

The power levers shall not be retarded from the flight range when on the ground until speed drops below 135 KIAS. Beta operation on the ground at a higher speed may result in the propellers pitchlocking or decoupling from the engine. While the fuel control and integral propeller governors would prevent an uncontrolled overspeed, negative propeller thrust would not be available to assist in stopping the aircraft. If the copilot or flight engineer has any indication of a malfunction affecting flight safety, he shall advise the pilot, who shall abort the takeoff.

14.1.1 Prior to Reaching Refusal Speed (V_R)

If an engine should fail during takeoff and prior to V_R, stop the aircraft by pulling power levers into the ground operating range. When the Beta lights illuminate, use reverse thrust and brakes as necessary to decelerate to stop. To obtain maximum braking, apply the brake by partly depressing the brake pedals and gradually increase brake pressure up to the maximum possible without sliding the tires. Avoid hard wheel braking above 120 KIAS. (For maximum brake application speeds, refer to Refusal Speed, paragraph 29.3.13.) Maintain direction primarily by using the rudder. Use nose wheel steering and differential power as required. The copilot should hold the control column forward.

WARNING

A partial power loss may be the result of an undetected overspeed. If further evaluation of engine operation dictates, or control difficulties are encountered, the emergency shutdown handle should be pulled.

CAUTION

Brakes should be released immediately after stopping if hard braking has been used. Use brakes sparingly during subsequent taxi to allow heat to dissipate.

14.1.2 After Reaching V_R

If an engine should fail after reaching V_R during takeoff, continue the takeoff using the following procedure:

Note

If the automatic feathering system is operative and has been armed, the propeller should feather automatically when the power drops below 500 pounds thrust. If manual feathering is required, the flight engineer pulls the emergency shutdown handle for the failed engine at pilot command.

1. Use rudder to maintain directional control. Full aileron away from the failed engine may be necessary to maintain wings level.
2. Hold the control column slightly forward for increased directional control.

3. When the aircraft accelerates to V_{RO}, rotate to reach the three-engine climbout speed V_{50} (three engine) by 50 feet. (Refer to the V_{RO}, Liftoff Speed (V_{LOF}), V_{50} relationship in Part XI.) After liftoff, raise the wing with the inoperative engine sufficiently to optimize control and climb performance (up to a maximum of 5°, if necessary).

4. When a definite rate of climb has been established and at pilot command, the copilot will raise the landing gear.

5. After landing gear is up and obstructions cleared, accelerate to a minimum of 140 KIAS prior to repositioning flaps. Prepare for landing pattern entry or raise the flaps and accelerate to three-engine climb airspeed (190 KIAS), as desired.

6. Confirm engine/propeller indications and commence Emergency Shutdown procedure, in accordance with Emergency Shutdown Procedure, paragraph 15.5.1, as required.

7. The pilot calls for power reduction when advisable. The flight engineer sets the power as requested.

14.2 PROPELLER MALFUNCTIONS

14.2.1 Propeller Malfunction Below V_R

1. Abort the takeoff and pull the emergency shutdown handle as the power levers are retarded toward FLIGHT IDLE.

Below refusal speed, pitchlocking is the most serious propeller malfunction likely to occur. If rpm stabilizes above 103.5 percent during the takeoff roll, it may be assumed that the propeller is pitchlocked. Retarding the power lever to FLIGHT IDLE results in more than normal flight idle thrust, and this increases the stopping distance. Also, unless symmetrical propellers pitchlock simultaneously, the resulting asymmetrical thrust causes the aircraft to yaw. Retarding the power lever into the reverse range further increases the forward thrust, thus aggravating the tendency to yaw. For these reasons, when a propeller malfunction is detected below refusal speed, the emergency shutdown handle shall be pulled as the power levers are retarded toward FLIGHT IDLE, and the takeoff aborted.

WARNING

Excessive delay in retarding the power levers increases stopping distance; however, rapid retardation of the power levers into the Beta range before securing the engine may result in severe directional control problems.

14.2.2 Propeller Malfunction Above V_R

If a propeller malfunction occurs after V_R is reached, continue the takeoff. After reaching a safe altitude, take action as prescribed in the appropriate paragraph under Propeller Malfunctions, paragraph 15.12. In case of an overspeed, it must be recognized that excessive airspeed tends to aggravate the overspeed and/or the loss of torque that is always associated with overspeeds; however, insufficient airspeed decreases the effectiveness of the flight controls and has an adverse affect on the ability of the pilot to counter yawing and rolling forces caused by high windmilling drag. The best airspeed during the initial climbout with an overspeed may very well be dictated by a compromise between these two considerations.

14.3 TIRE FAILURE DURING TAKEOFF

If a tire blows out during takeoff and below V_R, stop the aircraft by moving the power levers to GROUND IDLE, maintaining directional control by using brakes and asymmetrical power. Avoid using nose wheel steering until speed drops below 50 KIAS. Use reverse thrust as necessary. If above V_R, continue the takeoff but do not retract the landing gear since the blown tire may jam the gear in the wheelwell.

CHAPTER 15

In-Flight Emergencies

15.1 ELECTRICAL SYSTEM FAILURES

15.1.1 Generator Failure

The aircraft is equipped with three engine-driven AC generators. The probability of all three engine-driven generators failing at the same time is remote; however, an APU with in-flight generator capability is provided for emergency operation. DC power for the aircraft is supplied through transformer-rectifiers; therefore, if all AC generators are lost, DC power (except flight essential, ground operating, and APU DC buses) is also lost. The battery, through the ENGINE START SELECTOR switch, can power the emergency inverter to furnish AC power for the TIT instruments.

WARNING

- If the generator switch must be left in the OFF position because of a generator malfunction and the generator mechanical failure light is on (steady or intermittent), execute the Emergency Shutdown procedure, paragraph 15.5.1.

- A tripped generator No. 4 auxiliary control circuit breaker (GEN 4 AUX CONT) located on the FEDC bus will disable generator number 4 from assuming any part of the aircraft electrical load and does not cause the generator No. 4 OFF light to illuminate. Should an emergency occur resulting in the loss of either generator No. 2 or 3 at this time, the entire electrical load will be assumed by the remaining generator and load monitoring will be activated if the propeller or empennage deice system(s) are utilized.

Note

- Disruption of power to the MEAC bus will cause an automatic power switch-over to the FEAC bus in order to provide power for the pilot and copilot red instrument lights, Flight Director Indicators (FDIs), and vertical gyro.

- With loss of the MEAC bus, information displayed on the copilot FDI, with inertial 2 selected, will be unreliable because of loss of synchro-excitation voltage. Standby gyro shall be selected by both the pilot and copilot.

- If MEAC is lost and the MEDC bus is still energized, the POWER SENSING relay circuit breaker on the MEDC bus panel must be deenergized or there will be no TIT indication when the engine start selector is operated.

15.1.1.1 Operation with One AC Generator

Electrical loads must be closely monitored if operation with one AC generator becomes necessary. Operation of either the empennage or propeller deice system automatically disconnects MAIN AC BUS A and MAIN DC BUS electronic feeders, galley power, radiant floor and wall heaters, and side windshield heat through the load monitoring relays. Electrical loading should be further reduced by securing all nonessential electrical/electronic equipment, limiting cabin lights aft of the flight station to those absolutely essential. Deice operation should be monitored; the propeller and empennage systems should be used strictly as deice systems and not simultaneously unless required by severity of icing conditions. In any case of one-generator operation, complete loss of electrical and hydraulic power should be anticipated.

CAUTION

Manual load monitoring of AN/UYS-1 and AN/USQ-78 is required during single generator operations to prevent generator overload.

Preparations should be made to adapt quickly; boost handles uncovered, pilot and copilot utility lights positioned and on, flashlights within easy grasp, and copilot briefed to place ESS BUS switch off in the event that the remaining generator fails. Flight should be continued in VMC if possible. If the destination airport is IFR, a VFR alternate should be considered.

15.1.1.2 Operation with Failure of All Generators

Boost handles must be pulled to provide control. The ESS BUS monitoring switch must be positioned to OFF to provide power to the pilot turn indicator (standby attitude indicator on EFDS equipped aircraft). The remainder of the flight will be boost out, partial panel, without electronic NAVAIDs or communications. Flaps will remain in position at the time of the power failure, and the instrument lighting will be reduced to the flight station utility lights and flashlight. TIT is provided by selecting an engine with the start selector or by placing the inverter and battery test switch in the test position. This should be done only when required to make engine power changes. Deice functions will be limited to engines only, as the engine anti-ice valves open upon loss of electrical power. Land at the nearest suitable airport as soon as possible, considering weather, runway length, and terrain clearance adequate for boost-out approach and landing. Use extreme caution approaching the destination airport. Boost-off landing, emergency landing gear extension, and emergency brake operation are covered separately in Chapter 16.

CAUTION

During landing, do not move power levers into ground operating (Beta) range until speed is less than 125 KIAS. This will eliminate the possibility of inadvertent pitchlock caused by depleted battery power.

15.1.2 Generator Reset Procedures

1. Generator switch — OFF. (FE)
2. Generator control circuit breaker for respective generator (located on MEDC bus) — Pull and reset. (FE)
3. Generator switch — ON. (FE)

If the GEN OFF light remains on steady or goes out momentarily and comes back on:

4. Generator switch — OFF. (FE)

Note

Ensure GEN 4 AUX CONT and/or GEN 4 TRANS circuit breakers are set appropriately.

5. Continue engine operation. The mission should be aborted.

15.1.3 Use of APU in Flight

The APU should be used to provide electrical power (or standby electrical power) in flight if any two engine-driven generators have failed. Its use is restricted to altitudes of 20,000 feet or below and to speeds not in excess of 225 KIAS.

Some electrical equipment should be turned off before starting the APU and loading the APU generator, since an overload could result in APU compressor surge or APU flameout. Therefore, monitor all nonessential equipment not necessary for safe operation before starting the APU. This is to preclude the possibility of losing complete electrical power if the remaining generator fails.

Note

- If an APU start is to be attempted with the MAIN DC BUS failed and the MEDC bus powered, shift flight controls to BOOST-OFF and pull the three-phase power circuit breaker for transformer-rectifier No. 3 (located on the MEAC bus circuit breaker panel) before placing the APU control switch to ON or START. This allows the flight essential bus starter relay to close when sequenced by the APU start control system. If these steps are not followed in the sequence given, the APU will not start, in which case the APU control switch must be placed to OFF, then back to START.
- Operation of the APU with an inoperative No. 2 fuel boost pump may cause the APU to flame out. To ensure positive fuel feed to the APU, set up crossfeed as necessary.

15.1.3.1 APU In-Flight Start Procedures

1. APU generator switch — OFF.
2. Fuel boost pump — ON (crossfeed, if required).
3. INFLIGHT ARM switch — ARMED.
4. APU start switch — START, release to ON.
5. After APU RPM has stabilized, turn the APU generator switch — ON.

15.1.3.2 APU in Flight with Altitude Automatic Load Monitoring

Generator No. 4 takes priority over the APU generator. During single engine-driven generator operation, MAIN AC BUS A electronic feeders, MAIN DC BUS electronic feeders, side windshield heat, galley power, and floor and wall heaters are monitored when the propeller deice or empennage deice control switches are activated. When the APU generator is the only source of electrical power available and the aircraft is below 8,000-foot pressure altitude, these loads are monitored in the same manner; however, as the aircraft ascends through 8,000-foot pressure altitude, complete automatic monitoring occurs without activation of the propeller or empennage ice control switches, dropping out the previously monitored and some additional loads. The additional loads dropped include the empennage deice system and the No. 1A hydraulic pump.

WARNING

Electrical loads equivalent to the empennage deice system loads must be manually monitored prior to actuating the empennage deice monitor switch or APU surging and overtemperature can occur, which may result in the loss of the APU generator and all electrical power except battery power. Equivalent loads will consist of the No. 1 and No. 2 hydraulic pumps (boost out), cabin exhaust fan, and three fuel boost pumps.

Note

- Monitoring continues on descent through 8,000-foot pressure altitude because of a holding relay, unless the propeller and empennage deice switches are both placed to the OFF position momentarily.
- It is recommended that the APU with altitude automatic load monitoring functions be used in the following manner:

1. Loss of any one generator — Do not start APU.
2. Loss of any two generators — Start the APU with the APU generator switch OFF. After APU RPM has stabilized, turn the APU generator switch ON. Refer to Chapter 4 for APU airspeed and altitude limitations.

To ensure positive fuel feed to the APU, leave one fuel boost pump operating and set up crossfeed as necessary.

15.2 ENGINE FAILURE

The corrective action required after complete failure of a propjet engine consists of shutting down the failed engine and retrimming the aircraft for continued flight. The longer the delay between detection of a malfunction and the actual feathering or engine shutdown, the more severe the damage may be.

Execute the Emergency Shutdown procedure, paragraph 15.5.1, when advisable and when any of the following occurs:

1. Extreme or abnormal engine vibration.

WARNING

In rare cases, significant airframe vibration may be indicative of impending propeller blade failure. This vibration may be accompanied by noticeable/profound vibration of the power lever and/or E-handle.

2. Excessive or uncontrollable power loss.
3. Sudden or uncontrollable rise in oil temperature.
4. Gear case or engine oil pressure becomes low or excessive.
5. TIT increases and cannot be controlled.

6. When a magnetic chip detector light illuminates steady or intermittent accompanied by secondary indications.

7. Actuation of the fire warning system (steady or intermittent).

Note

- The flight engineer should lock out the fire warning horn prior to executing the Emergency Shutdown procedure, paragraph 15.5.1.
- Avoid operating the aircraft at high power settings, high AOA and low airspeeds, as these conditions may induce a fire warning.
- To minimize buffet of a feathered propeller, use the starter to position the blades so they do not parallel the wing leading edge.

If a propeller has been feathered and the malfunction cannot be corrected in flight, do not attempt to unfeather the propeller and restart the engine unless a more serious emergency arises.

If a feathered propeller rotates backward, push the emergency shutdown handle in and momentarily pull the feather button to the UNFEATHER position. When rotation stops, place the feather button in the neutral position, and then pull the propeller feather control circuit breaker. After the circuit breaker is out, pull the emergency shutdown handle. If the feather button is held in the UNFEATHER position too long, the propeller will start to rotate forward. If this occurs, push the feather button to FEATHER and repeat the procedure as often as necessary.

WARNING

If the engine has been secured because of engine fire or fuel leak, careful consideration should be given before pushing the emergency shutdown handle back in. Temperatures may be sufficiently high to cause reignition.

15.2.1 Engine Failure Under Specific Conditions

Flight characteristics of this aircraft with either inboard engine inoperative are not altered appreciably and rapid trim changes are not required. With either outboard engine inoperative, the aircraft yaws noticeably and corrective rudder and aileron trim is required. The engine instruments indicate which engine has failed. The aircraft can be controlled easily with the loss of any one engine, but the engine should be shut down as soon as possible.

15.2.2 Failure of Two Engines in Flight

Shut down the inoperative engines as set forth in the Emergency Shutdown procedure checklist, paragraph 15.5.1. If both inboard engines or engine-driven compressors fail, descend to a safe altitude. When the inboard engines are shut down, propeller synchrophasing is not available. Remember that when an engine is shut down, it loses its deicing capability. Failure of the selected master engine may result in an offspeed condition of the slave engines. Refer to Chapters 31 and 32 for climb and cruise performance.

15.3 TEMPERATURE DATUM SYSTEM MALFUNCTION

In case TIT, fuel flow, and SHP begin fluctuating abnormally, move the temperature datum control switch of the affected engine to NULL. If this corrects the fluctuations, continue operation in NULL. TIT must be monitored, as no temperature-limiting protection is provided with the temperature datum control switch in NULL.

15.4 SPEED SENSE CONTROL MALFUNCTION

A failure of the speed sense control may be identified by TIT limited to 830 °C. If a speed sense control malfunction is suspected, place affected TD switch to NULL. Do not shut down the engine with the intent to restart.

15.5 ENGINE SHUTDOWN

The engine shutdown procedures below are designed to allow flightcrews to handle a wide range of malfunctions. The most demanding emergency would likely be an engine fire accompanied by a propeller that failed to feather. In such an instance, flightcrews should consider the following prior to deciding whether to secure oil to a rotating propeller.

1. Confirmed fire indications and effect of HRD.
2. Indications of fire source (oil or fuel leak).
3. Indicated rpm.
4. Distance to suitable landing field.

If oil has been secured and the propeller remains in a fails-to-feather condition, aircrews must carefully consider potential hazards prior to deciding whether oil should be restored (i.e., reintroduction of a fire source versus possible gearbox failure).

WARNING

Waiting too long to restore oil to a propeller that has failed to feather may result in fire when oil is reintroduced as a result of heat buildup in the reduction gearbox. Flightcrews electing to restore oil should do so as soon as they determine the engine has cooled to the point that reintroducing the initial fire source is not likely. Such a decision requires flightcrews to weigh conflicting requirements.

Flightcrews shall use the following procedures if restoring oil is elected:

1. Pull both emergency shutdown circuit breakers (MON DC) for the affected engine.
2. After waiting a minimum of 10 seconds, pull the corresponding oil tank shutoff valve circuit breaker (MON DC).
3. Reset both emergency shutdown circuit breakers (MON DC).

15.5.1 Emergency Shutdown Procedure

*1. Emergency shutdown handle (on pilot command) — Pull. (FE)

*2. HRD (fire only) — Discharged. (P, FE)

3. Crossfeed and boost pumps — Checked. (FE)

Note: Asterisked items are memory items.

WARNING

If an engine is shut down for fire or fuel leak, the associated crossfeed valve shall be closed, the boost pump turned off, and crossfeed from the associated tank discontinued as a precautionary measure until it is determined that it will not present a fire hazard.

4. Propeller — Feathered. (P, CP, FE)

Note

If the propeller fails to feather in conjunction with an engine fire indication, only the first four items of the Propeller Fails to Feather procedure, paragraph 15.12.6, shall be completed. If the propeller does not feather, complete the remaining items of the Emergency Shutdown Checklist, paragraph 15.5.1, then complete the remaining items of the Propeller Fails to Feather procedure.

5. Oil tank shutoff valve circuit breaker — As required. (P, FE)

WARNING

The oil tank shutoff valve circuit breaker should not be reset unless the engine is secured for a fire or an oil leak. Because of potential failure of the reduction gearbox, consider maintaining oil to an engine when the propeller has failed to feather.

6. Alternate HRD bottle (confirmed fire only) — As required. (P, FE)

WARNING

- Do not release the alternate HRD until it is determined that the first charge has not extinguished the fire.
- If the fire does not extinguish after the second HRD, consider attempting to extinguish the fire by increasing airspeed.

7. Feather button light — Out. (FE)
8. Tank 5 transfer valve (failed engine) — CLOSED. (FE)
9. Power lever (failed engine) — Full forward. (FE)
10. SYNC MASTER switch — As desired. (FE)
11. SYNC SERVO switch (failed engine) — OFF. (FE)

Note

- Visually check propeller position after feathering. Position fuel crossfeed controls to equalize fuel load (if it does not add to the fire hazard).
- During shutdown or restart of engine No. 2, the autopilot disengages as MAIN AC BUS A loads are transferred from or to generator No. 2.

12. APU — As required. (FE)

Refer to Chapters 31 and 32 for three-engine climb and cruise performance data.

15.6 AUTOPILOT DISCONNECT

If the autopilot malfunctions, disengage it immediately by one of the following methods:

1. Depress either the pilot or copilot disconnect switch on the control wheel (PB-20N) to the second detent on ASW-31.
2. Check that the autopilot engage switch is OFF (PB-20N) and that pitch, roll, and yaw channel switches are OFF (ASW-31).
3. Pull the autopilot emergency disconnect handle.
4. If the autotrim fails to disconnect, pull all AFCS circuit breakers on the main load center panel.

WARNING

The autopilot emergency disconnect handle must be stowed in the horizontal position. If stowed in the vertical position, it is not possible to disconnect the surface control booster packages.

Note

The autopilot is disengaged automatically by any momentary interruption of electrical current or from low hydraulic pressure in the No. 1 hydraulic system.

15.7 FLIGHT CONTROL SYSTEM MALFUNCTIONS

If flight control system difficulty occurs, it should be recognizable by one or more of the following conditions:

1. Flight station controls seem to be immovable or require abnormally high force.
2. The aircraft starts nosing up or down, rolling or yawing, and application of pilot force on the flight station controls to correct or stop the condition is ineffective.

If either condition exists, perform the Shifting To Boost Off procedure, paragraph 15.7.1.

WARNING

In certain flight control related malfunctions, shifting to boost off will not correct the problem and may result in serious control difficulties.

Do not shift to boost off for the following flight control malfunctions:

1. If a trim system problem occurs, the aircraft will respond to pilot force on the primary flight control; however, abnormally high forces may be required depending on the position of the malfunctioning tab.

CAUTION

It is possible for high levels of moisture to collect and freeze onto trim cables and pulleys, causing the system to bind. If a frozen trim system is suspected, troubleshoot by descending below the freezing level before assuming a binding condition exists.

2. If an autopilot malfunction occurs, corrective action on the flight station controls will be effective, since malfunctions of the autopilot can be overpowered. Disconnect the autopilot using Autopilot Disconnect, paragraph 15.6 procedures.
3. If a flight control cable binds, it may exhibit the same characteristics as a boost package malfunction (e.g., flight controls become immovable or require abnormally high force). In such cases, it is likely that ability to control the aircraft will diminish as a result of selecting boost off.
4. If control of the elevator, rudder, or aileron is lost (e.g., if flight station controls move freely but have no effect on aircraft attitude), refer to Controls Move Freely But Have No Effect, paragraph 15.7.2.

15.7.1 Shifting to Boost Off

*1. Disconnect the Autopilot.

*2. Attempt to obtain a safe altitude.

*3. Set Condition V.

WARNING

If the trim tabs have been moved several degrees away from the normal trim position, the aircraft may react violently when shifting to boost off.

*4. Trim tab setting — Check for normal position.

If abnormal force is still present:

*5. Booster shift handle — Pull.

WARNING

- Be prepared to immediately return to boosted flight control operation if control of the aircraft is diminished.
- Avoid force on the affected controls while shifting to prevent a sudden change in control surface position when the boosters are turned on or off.

Note: Asterisked items are memory items

If unable to shift for any reason, do the following:

6. Shift the other two control systems to boost off.
7. Turn off all AC hydraulic pumps.
8. Pull the shift control for the malfunctioning system. If the shift is completed on the malfunctioning system, reestablish aircraft hydraulic pressure and return the other two control systems to boost on operations.
9. If the shift cannot be completed, leave hydraulic pressure off for the remainder of the flight. Refer to Boost Off Landing procedures, paragraph 16.5.1; Emergency Brake Operation procedures, paragraph 16.7; and Landing Gear Extension without Hydraulic Pressure procedures, paragraph 16.8.1.

15.7.2 Controls Move Freely But Have No Effect

If control of the elevator, rudder, or aileron is lost (e.g., if the flight station controls move freely but have no effect on aircraft attitude), attempt to control the aircraft by use of the autopilot as outlined below. If the autopilot is unsuccessful in correcting the problem, attempt to control the aircraft by use of the trim tabs.

15.7.2.1 Aircraft Equipped with PB-20N/Digital Autopilot System (DAS)

1. Autopilot — ON.
2. Land using autopilot.

WARNING

Prior to touchdown, ensure affected control is in trim by monitoring the three-axis trim indicator. At touchdown, the autopilot is automatically disengaged by the ground air sensing circuit.

15.7.2.2 Aircraft Equipped with ASW-31

Elevator control lost:

1. Flight control boosters — ON.
2. Pitch axis — ENGAGE (altitude hold on until approach).
3. Other AFCS axes — As desired.
4. For altitude changes:
   a. The copilot immobilizes control column by firmly grasping the column below the control wheel.
   b. The pilot disengages ALT HOLD and applies force as required to establish desired attitude.

Aileron control lost:

1. Flight control boosters — ON.
2. Roll and yaw axis — ENGAGE.

3. HDG SEL/OFF switch — HDG SEL.

4. Pitch axis — As desired.

Note

Heading select is not available with pilot Course Deviation Indicator (CDI) selected to TACNAV.

5. For heading changes, utilize the heading set knob on the pilot HSI.

Rudder control lost:

1. Flight control boosters — ON.

2. YAW axis — ENGAGE.

3. Other AFCS axis — As desired.

WARNING

- Ensure the altitude hold control switch on the ASW-31 control panel is selected OFF before final approach.
- Prior to touchdown, ensure the affected axis is in trim by monitoring the three-axis trim indicator. At touchdown, AFCS is automatically disengaged by the ground air sensing circuit.

15.8 FUEL SYSTEM FAILURE

15.8.1 Stuck Fuel Quantity Indicator (Aircraft Not Incorporating AFC-578)

CAUTION

When testing the fuel quantity gauges with the press-to-test switch on the fuel management panel, do not allow the gauges to drive all the way to zero, or damage to gauge calibration may result.

1. Fuel gauge test switch — TEST. (FE)

2. Lightly tap the fuel quantity indicator (FE).

WARNING

If a quantity indicator circuit breaker trips, do not reset.

3. Check fuel quantity indicator circuit breakers — (MEAC/BUS A). (FE)

WARNING

Connecting or disconnecting connector plugs may cause a 115-volt electrical arc to be generated inside the fuel tank under certain system failure conditions.

4. Start a fuel log (FE).

5. Do not conduct further troubleshooting.

15.8.1.1 Fuel Quantity Indicator Failure

On aircraft incorporating AFC-578, the individual digital fuel indicators have a BIT function that will diagnose errors within the fuel management system and provide fault codes for definition (Figure 2-28). When the BIT system detects a fault within the system, and if the ERROR light is flashing, there is some level of degradation to be expected in the fuel indicator quantity. A fuel log should be used to calculate the approximate amount of fuel remaining in the tank.

15.8.1.2 Fuel Quantity Indicator Goes Off Scale, High or Low or Fluctuates Abnormally

Note

A faulty fuel quantity gauge test switch or relay may fail energized. If all fuel quantity indicators begin to drive toward zero, pull fuel quantity system test circuit breaker EXTENSION MAIN DC (EXT MDC).

1. Both flight station and fueling panel quantity indicator circuit breakers (MEAC/BUS A) — Pull. (FE)

WARNING

Connecting or disconnecting connector plugs may cause a 115-volt electrical arc to be generated inside the fuel tank under certain system failure conditions.

2. Start a fuel log (FE).

3. Do not conduct further troubleshooting.

15.8.2 Fuel Boost Pump Failure

Fuel boost pump failures are generally mechanical in nature, which may lead to electrical or thermal protective device actuation. A normally operating fuel boost pump is capable of overriding the effects of aeration during climb. Fuel aeration alone will not disable a fuel boost pump.

Fuel aeration effect combined with an inoperative fuel boost pump has caused engine power loss to be experienced during climbout or initial phase of cruise. This combined condition causes a gradual power loss on the affected engine at approximately 13,000 feet, but may vary with the prevailing fuel temperature in the tank (the higher the fuel temperature, the lower the altitude at which the gradual power loss occurs).

Note

Complete power loss occurs if the climb is continued under these circumstances.

Once fuel tank pressure has stabilized and excess air has escaped from the fuel, loss of a fuel boost pump has no effect on engine operation with maximum power settings at altitudes up to 30,000 feet.

15.8.2.1 Fuel Boost Pump Failure — Climb

1. Verify pump failure and establish crossfeed (FE).
2. Inoperative boost pump switch — OFF. (FE)
3. Boost pump control circuit breaker — Pull. (FE)
4. Continue climb.
5. After sufficient time at cruise altitude, discontinue crossfeed and monitor engine operation.

If the engine operates satisfactorily, continue the mission. If not, continue as follows:

6. Return to crossfeed operation.
7. Wait several more minutes and repeat step 5. If repeated attempts produce unsatisfactory results, continue crossfeed operation.

Note

Adjust mission as necessary. If the mission can be accomplished at lower altitude, descend until the engine runs satisfactorily in the tank-to-engine configuration.

15.8.2.2 Fuel Boost Pump Failure — Cruise/Descent Conditions

1. Verify pump failure (FE).
2. Inoperative boost pump switch — OFF. (FE)
3. Boost pump control circuit breaker — Pull. (FE)
4. Monitor engine operation.
5. If abnormal indications are observed during tank-to-engine operation, crossfeed engine from another tank, and proceed with step 5 of Fuel Boost Pump Failure — Climb, paragraph 15.8.2.1.

Note

- When operating with low fuel quantities in the tank-to-engine position with an inoperative boost pump, avoid nosedown attitudes and excessive yawing.
- Descents from high altitude with the boost pump inoperative do not affect engine operations. When operating with low tank quantities in the tank-to-engine position with an inoperative boost pump, descent should be made with minimum nosedown attitude.

Note

If a prolonged or high rate of descent is required, select crossfeed operation, as the scavenge section of the boost pump is also inoperative.

15.8.3 Transfer Pump Failure, Tank 5

The following procedures apply to the failure of one tank 5 transfer pump. The failure is indicated by the PRESS LOW indicator light coming on and the tank 5 quantity gauge showing fuel available.

1. Inoperative transfer pump switch — OFF. (FE)
2. Transfer pump circuit breakers — Pull. (FE)
3. Reduce tank 5 fuel to 3,000-pound level with the operating pump.
4. Close transfer valves and allow fuel quantity in each wing tank to drop 250 pounds.
5. Open all transfer valves and lower the fuel level in tank 5 by 1,000 pounds.
6. Repeat steps 4 and 5 until tank 5 fuel is depleted.

Note

It is possible that some fuel may have been trapped in the center section tank. Some of this fuel can be recovered by maneuvering the aircraft to a nosedown attitude.

The following procedures apply to the failure of both tank 5 transfer pumps, indicated by illumination of both PRESS LOW lights and the tank 5 fuel quantity gauge indicating fuel available.

1. Turn both tank 5 transfer pumps off.
2. Ensure tank 5 transfer pump circuit breakers are pulled.
3. Determine zero fuel weight.
4. If maximum zero fuel weight is not exceeded, adjust mission as necessary.
5. If maximum zero fuel weight is exceeded, continue:
   a. Dump fuel until below maximum zero fuel weight.
   b. If maximum zero fuel weight is exceeded, do not exceed 2.1g's, avoid turbulent air penetration, abort mission, and land.

15.8.4 Fuel Dump Procedure

1. Maintain airspeed — 140 to 300 knots.
2. Aft observer — Posted.
3. Flaps (recommended) — UP.

WARNING

Fuel dumping is prohibited with wing flaps extended beyond the TAKEOFF/APPROACH position. Refer to Fuel Dumping Limitations in paragraph 4.11.

4. Affected equipment:
   a. VHF — OFF.
   b. HF-1 and -2 — STANDBY.
   c. TACAN — REC mode.
   d. IFF interrogator — OFF.
   e. IFF transponder — STANDBY.
   f. Radar — STANDBY.
   g. Chaff and flare dispenser — OFF.
5. Fuel transfer valves — CLOSED.

Note

If the fuel transfer valves are shut off during fuel dump, a lower landing gross weight is effected as a result of fuel burnout from the main tanks.

6. Fuel dump switch — ON.
7. Tank 5 fuel gauge — Monitor. Dump rate is approximately 1,000 ppm.
8. Fuel dump switch — OFF (when dumping is completed and prior to landing).
9. Tank 5 transfer pumps — OFF.
10. Affected equipment (in step 4) — As required.

15.9 OIL SYSTEM FAILURE (ENGINE)

The indications of an engine oil system failure that may lead to engine failure are loss of oil pressure or increase of oil temperature. Execute the Emergency Shutdown procedure, paragraph 15.5.1, if oil temperature cannot be maintained within limits.

In case of a loss of oil pressure, execute the Emergency Shutdown procedure, paragraph 15.5.1. If engine oil pressure loss was caused by a negative-g condition and reduction gear assembly and engine oil pressures fluctuate for more than 15 seconds or remain at zero longer than a momentary transient after returning to a positive-g condition, the propeller should be feathered. After 1 minute, an airstart may be attempted according to the Engine Restart procedure in paragraph 8.33.

15.10 MAGNETIC CHIP DETECTOR INDICATION

When a magnetic chip detector light illuminates, steady or intermittent, check for secondary indications. If secondary indications are present, execute the Emergency Shutdown procedure, paragraph 15.5.1. If there are no secondary indications, engine operation may be continued for the duration of the flight. The decision to continue flight should be based upon mission requirements and the potential impact of possible engine or gearbox failure. Takeoffs and practice landings shall not be performed.

15.11 ENGINE-DRIVEN COMPRESSOR FAILURE

With an EDC failure (loss of inlet/discharge needle spread), which is not accompanied by an EDC pressure low light, the EDC should be disconnected and then dumped. If the EDC fails to disconnect, indicated by the EDC pressure low light remaining off, execute the Emergency Shutdown procedure, paragraph 15.5.1. If the engine is allowed to operate due to a greater emergency, the EDC should be dumped. Refer to Air-Conditioning System Malfunction (In Flight), paragraph 15.16.

15.12 PROPELLER MALFUNCTIONS

15.12.1 Propeller Malfunctions

A propeller malfunction is a propeller pump light/fluid leak or an offspeed condition. The illumination of a single propeller pump light or a visible propeller fluid leak may prevent full feathering capability. A propeller off-speed condition exists when indicated rpm is greater than 1 percent above or below mechanical/electronic governing rpm for that engine, or if any sustained rpm oscillation occurs. In each of these cases, the offspeed condition must be detected audibly. Propeller malfunctions may be complicated; therefore, the following procedures should be referenced during execution.

If a propeller pump light/fluid leak or offspeed condition occurs, proceed as follows:

WARNING

- Significant airframe vibration combined with external propeller fluid leaks and/or propeller pump lights may be indicative of impending propeller blade failure. This vibration may be accompanied by noticeable/profound vibration of the power lever and/or E-handle. Continued operation may result in blade separation and subsequent loss of propeller and/or reduction gearbox from the aircraft. If significant airframe vibration occurs in conjunction with visible propeller fluid leaks and/or propeller pump lights, consider completing the Emergency Shutdown procedure, paragraph 15.5.1.
- If an immediate, uncontrolled overspeed above 115 percent occurs, reduce airspeed as rapidly as practical to the speed at which safe control of the aircraft and propeller can be maintained, but initially not less than 150 KIAS. Subsequent airspeed selection should be based on aircraft gross weight, controllability, and rpm. Perform Operation with a Pitchlocked Propeller procedure in paragraph 15.12.2.

*1. If rpm at or above 115 percent — Reduce airspeed (150 KIAS minimum) and perform Operation with a Pitchlocked Propeller procedure in paragraph 15.12.2. (P, FE)

*2. If rpm below 115 percent — Smoothly advance power lever(s) toward cruise conditions and increase TAS, noting engine indications (normal rated power if range is a factor). (P, FE)

CAUTION

If the propeller pitchlocked at low power settings, SHP may be or become negative. In this case, consider initially decreasing TAS to check for pitchlock to avoid inadvertent decouple or unsafe increase in rpm.

Note: Asterisked items are memory items

3. Based on engine indications, proceed as follows:

   a. If rpm was stabilized at less than 100 percent, and advancement of the power lever causes rpm to stabilize at 100 percent with a corresponding increase in SHP, the propeller is pitchlocked without overspeed. If pitchlocked without overspeed, perform Pitchlock Without Overspeed procedures in paragraph 15.12.4.

   b. If rpm remains on-speed, continue engine operation throughout the landing evolution.

   c. If propeller is off-speed, proceed as follows:

      (1) SYNC SERVO switch (affected propeller) — OFF. (FE)

      (2) SYNC MASTER switch — As required. (FE)

      (3) Generator switch, affected engine (if rpm exceeds 109 percent) — OFF. (FE)

CAUTION

Due to excessive rpm, the EDCs may produce smoke or fumes. If smoke or fumes are detected, consider dumping the respective EDC.

4. If rpm is fluctuating, TEMP DATUM CONTROL switch — NULL. (FE)

   a. If rpm is fluctuating and directional control is affected, consider performing Operation with a Pitchlocked Propeller procedures in paragraph 15.12.2.

WARNING

Operation with a pitchlocked propeller procedure is performed to improve aircraft controllability. Execution of this procedure will result in a significant loss of power and available range. Increasing rpm from near 100 percent to approximately 106 percent will result in a power loss of as much as 2,500 SHP.

   b. If flux is not corrected, continue with step 6.

5. Determine if pitchlocked by increasing TAS. With an increase in TAS, the prop is pitchlocked if any of the following occurs:

   a. Rpm increases and SHP decreases (SHP will be 0 or wandering if decoupled).

   b. Rpm stabilizes at the fuel topping governor setting (104.2 to 106.7).

If pitchlocked, perform Operation with a Pitchlocked Propeller procedures.

6. If not pitchlocked and rpm stabilizes above 95 percent, or rpm fluctuation continues, continue engine operation. Consider maintaining a high blade angle as long as practicable.

a. Attempt to correct the malfunctioning prop with the sync system if:

(1) Malfunctioning propeller was selected as master.

(2) No master was selected.

(3) Sync system was off.

(4) Off-speed condition deteriorated when SYNC SERVO switch was turned off.

CAUTION

Inadvertent actuation of the RESYNC switch may aggravate the propeller offspeed condition.

b. If rpm corrects toward normal governing, leave the respective sync servo, the sync master, and the sync master's servo on for landing. The remaining sync servos should be turned off.

7. If rpm cannot be maintained above 95 percent, E-handle — Pull. (FE)

8. Continue operation throughout the landing evolution. Power lever movement should be smooth and cautious.

15.12.2 Operation with a Pitchlocked Propeller

1. SYNC SERVO (all) and SYNC MASTER switches — OFF. (FE)

2. FUEL GOVERNOR & PROP PITCHLOCK switch (affected propeller) — TEST. (FE)

3. SYNC SERVO switch (affected propeller) — NORMAL. (FE)

4. Generator switch for affected engine (if rpm exceeds 109 percent) — OFF. (FE)

CAUTION

Due to excessive rpm, the EDCs may produce smoke or fumes. If smoke or fumes are detected, consider dumping the respective EDC.

Note

Possible indications of a pitchlocked decoupled propeller include:

- SHP near 0 or wandering.
- Fuel flow approximately 600 pounds per hour.
- Increase in Reduction Gear Box (RGB) oil pressure.
- Rpm extremely sensitive to changes in TAS.

5. If coupled, proceed to step 9. If decoupled, proceed as follows:

WARNING

- If the emergency shutdown handle has not been pulled, do not attempt to feather or fuel chop. Rpm should be reduced by decreasing TAS.
- Failure of the reduction gearbox because of oil starvation can result in a fire and/or propeller separation from the aircraft.

6. Propeller rpm — Adjust TAS to maintain 115 percent rpm or less if possible. (P)

7. Power lever (affected engine) — Full forward. (FE)

When clear of the active runway:

8. FUEL AND IGNITION switch (affected engine) — OFF. (FE)

9. If coupled:

WARNING

- Do not allow indicated SHP to become or remain negative. Reduce TAS in order to increase SHP if necessary.
- Limit the use of bleed air from the affected engine to engine anti-ice only.

Note

If forced to operate a pitchlocked propeller with an inoperative electronic synchronization system, attempt to maintain rpm in the underspeed range of 96 to 98 percent to reinforce pitchlock.

10. Power lever (affected engine) — Adjust power and/or TAS to maintain approximately 100 percent rpm.

Note

Consider undumping the EDC and turning the generator back on if required.

11. NTS/FEATHER VALVE switch — FEATHER VALVE. (FE)

WARNING

Do not allow rpm to drop below 95 percent. Increase TAS, altitude, and/or power lever to increase rpm.

Note

Consider maintaining a constant indicated airspeed during the descent.

a. The following factors should be considered prior to fuel chopping the engine:

(1) Suitable landing field has been determined (weather and three engine contingencies).

(2) Useful thrust and accessories are no longer required and oil starvation is not a factor.

(3) If pitchlock occurred at high blade angle, SHP and/or TIT may be limited during the descent when maintaining 100 percent rpm. If necessary, increasing TAS will allow the power lever to be retarded and a lower altitude to be reached before fuel chopping.

(4) Decreasing TAS prior to fuel chopping the respective engine will reduce the possibility of decouple. If decoupling the propeller is undesirable due to oil depletion, reduce airspeed based on gross weight and controllability (minimum 130 KIAS).

(5) Ensure SHP is not negative prior to fuel chopping. If SHP is negative, a higher rpm may occur.

(6) Ensure the aircraft is far enough from the runway that power and control changes can be established prior to touchdown.

b. Additionally, the crew should discuss the three possible outcomes that may occur after fuel chopping:

(1) NTS is indicated by stabilized rpm, in addition to any one of the following:

(a) Flashing feather valve light.

(b) Aircraft yaw in conjunction with NTS action.

Note

- NTS may not occur until the aircraft is sufficiently slowed. Actual rpm (normally between 30 and 45 percent) is dependent upon airspeed and the ability of NTS to control blade angle.
- A secondary NTS indication may be fluctuating negative SHP in the NTS range. With digital SHP gauges, SHP will give erroneous indications if rpm is below 43 percent.

(2) No NTS action, prop remains coupled as indicated by:

(a) Decreased rpm.

(b) Power section oil pressure near normal (commensurate with rpm and oil temperature).

(c) SHP steady in the negative range and responsive to changes in TAS.

CAUTION

If coupled, evaluate aircraft controllability. Conduct slow flight check at altitude if necessary.

(d) If controllability is difficult, decoupling the propeller may be necessary to reduce drag. Decoupling may be accomplished by increasing airspeed.

WARNING

As airspeed is increased, rpm will increase. At the point of decouple, a sharp rise in rpm will be observed. Consider the effects of excessive rpm on gearbox accessories, airframe vibration, and cockpit noise levels prior to increasing TAS. Decrease airspeed immediately after decoupling the propeller.

(e) If controllable, continue to landing without increasing airspeed. As airspeed decreases, drag from the windmilling propeller will decrease.

(3) No NTS action, prop decoupled as indicated by:

(a) Rpm extremely sensitive to changes in TAS.

(b) SHP near 0 or wandering and not responsive to changes in TAS.

(c) Power section oil pressure decreasing toward 0. Oil pressure may stabilize above 0, depending upon windmilling rotational energy of the engine.

CAUTION

If decoupled, evaluate aircraft controllability. Conduct slow flight check at altitude if necessary.

Note

Windmilling rotational speed of the engine may be insufficient to generate proper excitation signal for digital SHP gauge, resulting in erroneous indications.

12. FUEL AND IGNITION switch — OFF. (FE)

    If a stabilized NTS condition is achieved, the Emergency Shutdown procedure, paragraph 15.5.1, should be executed.

13. Power lever (affected engine) — Full forward. (FE)

15.12.3 Fuel Planning with a Pitchlocked Propeller

A pitchlocked propeller affects available range. If the propeller is pitchlocked and range is a factor, one of the following procedures should apply:

1. If the propeller is coupled with the engine running, climb at climb schedule airspeed toward optimum maximum range altitude and accelerate to maximum range airspeed. If SHP approaches 0 prior to attaining maximum range altitude and airspeed, and range is still unacceptable, decelerate toward an indicated airspeed of 1.52 V_s by climbing, ultimately stabilizing the aircraft at 1.52 V_s and 0 SHP. At 1.52 V_s and 0 SHP, determine range by calculating fuel available versus distance to destination (distance over groundspeed and total fuel flow).

Note

- The effect of wind on available range should be evaluated during the climb (distance over groundspeed and total fuel flow). A greater range may be achieved at a lower altitude if winds aloft are higher.
- As 1.52 V_S speed decreases, step climb to maintain 0 SHP.

2. If the propeller is decoupled, climb at climb scheduled airspeed toward maximum range altitude and airspeed. If rpm can be maintained at approximately 100 percent and range is acceptable, continue. If not, consider increasing rpm toward a maximum of 115 percent and slowing the aircraft to 1.52 V_S and climbing to optimize range.

WARNING

The propeller decoupled with the engine shutdown, following an unsuccessful attempt to feather, may lead to failure of the reduction gearbox due to oil starvation and can result in a fire and/or propeller separation from the aircraft. This may be the limiting factor affecting aircraft range.

CAUTION

Longer range may be obtained at higher prop speed but at a greater risk of reduction gearbox failure.

Note

- In cases with extremely low blade angles, airspeed may have to be reduced below 1.52 V_S in order to maintain rpm below 115 percent, provided available range is still acceptable.
- As 1.52 V_S speed decreases, step climb to optimize range.

3. If range appears questionable after completing the computations outlined above, consider increasing TAS. If range is unacceptable, it may be necessary to loiter an operable engine. If range is still unacceptable, the final recourse may be to attempt to feather the affected propeller. If decoupled, attempt to feather by pulling the fuel shutoff valve circuit breaker and pushing the feather button in. If the propeller feathers, complete the emergency shutdown checklist.

15.12.4 Pitchlock without Overspeed

Certain malfunctions of the pitchlock regulator can cause a propeller to pitchlock in the governing range without an overspeed condition. In this circumstance, retarding the power lever produces a decrease in rpm, but moving the power lever forward again causes rpm to increase only to 100 percent. Continued forward movement of the power lever will cause the SHP indication to increase. If this condition occurs, continued operation is permissible.

CAUTION

Do not permit rpm to drop below 95 percent.

When in the terminal area and at a sufficient distance from the field to allow for power and control changes prior to landing, execute the Emergency Shutdown procedure, paragraph 15.5.1.

15.12.5 Decoupling

Decoupling can be recognized during flight by observation of engine instrumentation.

1. If decoupling is due to fuel cutoff to the engine:
   a. SHP should indicate near zero initially and then may wander randomly.
   b. Rpm will initially surge but should stabilize at 100 percent.
   c. TIT will decrease toward ambient.
   d. Fuel flow will read zero.
   e. Power section oil pressure will be at or near zero psi.
2. If decoupling occurs due to a decoupler failure, the engine will continue to run on its fuel topping governor:
   a. SHP should read near zero initially and then may wander randomly.
   b. Rpm should stabilize at 100 percent.
   c. TIT will be approximately 550 °C.
   d. Fuel flow will be approximately 600 pounds per hour.

In each of the above cases, execute the Emergency Shutdown procedure, paragraph 15.5.1.

15.12.6 Propeller Fails to Feather

*1. Feather button — In.

WARNING

If propeller feathered at step 1, ensure emergency shutdown handle wiper switch circuit breakers are set.

*2. PCO — Press.

*3. Alternate bus (propellers 1 and 4) — Select.

*4. PROP FEATHER circuit breakers — Check in.

*5. Airspeed — Decrease toward 150 KIAS.

Note

Subsequent airspeed selection should be based on aircraft gross weight and controllability.

Note: Asterisked items are memory items

If feather button light remains on:

*6. PROP FEATHER CONT circuit breaker — Pull.

Note

If the propeller remains in an overspeed condition, refer to Operation with a Pitchlocked Propeller procedure. Refer to Operation with a Pitchlocked Propeller, paragraph 15.12.2.

15.12.7 Operation without Rpm Indication

1. SYNC SERVO switch (affected propeller) — OFF. (FE)

If erratic rpm changes are noted audibly, procedures for propeller malfunction should be followed. Consider swapping the inoperative rpm indicator with a known good indicator.

Note

- Power lever movements should be smooth and cautious.
- Practice landings shall not be performed.
- Do not shut down engine with the intent to restart.

15.13 FLIGHT WITH CRACKED WINDSHIELD

15.13.1 Flight with Cracked Front Windshield

If the windshield cracks in flight, use the following procedure:

*1. Turn off heat of affected panels.

*2. Helmets on, visors down. (P, CP, FE)

3. If possible, determine which of the glass layers is cracked (refer to Figure 2-39). Depending upon which layer is damaged, do the following:

   a. Outer layer of glass — Do not exceed 240 KIAS below 10,000 feet.

   b. Middle (structural) layer of glass — Reduce speed to 240 KIAS, reduce cabin differential pressure to 2.0 inches Hg, and make a normal descent to 10,000 feet or lower.

Note

Maintain 2.0 inches Hg pressure differential until reaching the final approach phase.

   c. Inner layer of glass — Turn windshield heat to LOW (helmets may be removed).

Note

If unable to determine which layer of glass is cracked, follow procedure (3.b).

Note: Asterisked items are memory items

15.13.2 Flight with Cracked Side Windshield

If the side windshield cracks in flight, use the following procedure:

1. Turn side windshield defogging off.
2. If crack is in one layer, normal flight profile is permitted.
3. If unable to determine if crack is in one pane only or if crack is in both panes, reduce cabin differential pressure to 2.0 inches Hg and make a normal descent to 10,000 feet or lower.

15.13.3 Flight with Cracked Skylight or Cabin Windows

If a skylight or cabin observer window cracks in flight, use the following procedure:

1. Determine if the crack is in outer or inner pane.
   a. Outer pane — Reduce cabin differential pressure to 2.0 inches Hg and make a normal descent to 10,000 feet or lower.
   b. Inner pane — No action required.
2. Evacuate crewmembers from immediate area if crack is in outer pane or if undetermined.

15.13.4 Flight with Cracked Flight Station Escape Hatch Optical Window

1. Reduce cabin differential pressure to 2.0 inches Hg and make a normal descent to 10,000 feet or lower.
2. Evacuate nonessential crewmembers from immediate area (electronic rack A1).

15.14 LOSS OF ALL AIRSPEED INDICATION

If loss of all airspeed indications is encountered, the following procedure is recommended:

*1. Check pitot heat — ON. (FE)
2. Fly known combinations of attitude and power.
3. Select groundspeed function from the INS or GPS as a reference.
4. Use AOA in cruise and descent and the approach indexer lights during landing approach to establish safe margins between stall and Mach limit speed. At FL240 and 240 KIAS, AOA will be approximately 7 to 8 units. This provides a margin of 60 knots below V_{NE} limits. During landing approach, as a function of flap position, the indexer lights (12 units AOA) provide a margin of approximately 30 to 50 knots above stall at typical landing weights.
5. Use the autopilot with altitude hold as necessary to maintain safe attitudes.
6. Notify FAA ATC controllers and/or departure/approach/tower personnel as appropriate. If possible, make radio contact with another aircraft and fly wing on this aircraft at airspeeds commensurate with those of the normal operating envelope of the P-3.

15.15 WING FIRE

Execute the Emergency Shutdown procedure, paragraph 15.5.1.

Note: Asterisked items are memory items

15.16 AIR-CONDITIONING SYSTEM MALFUNCTION (IN FLIGHT)

In the event that one EDC is inoperative and the cabin exhaust fan is operable, reduce cabin electrical load to only that used for navigation should the cabin temperature rise excessively.

Note

Climbing to altitude or opening equipment doors will decrease the efficiency of the air-conditioning system.

15.17 HF ANTENNA SEPARATION AT OR NEAR VERTICAL STABILIZER

Indications of an HF antenna separation are: 1) loss of HF unit and/or 2) audible impact of the antenna against the aircraft fuselage. Verification can be accomplished using the aft observer windows.

WARNING

- Remain clear of observer windows if the antenna is striking against them.
- Abort the flight, secure the appropriate HF unit, and pull the HF circuit breakers.

Flight capabilities with an antenna separation should be ascertained and possible damage to the aircraft must be determined, if possible.

If no immediate emergency is determined, do not attempt to recover the broken antenna. Proceed to the nearest suitable field and land. The landing rollout should be completed with the appropriate inboard power lever at GROUND START.

If the failed antenna is on the port side and structural damage, danger to engine operation, and/or flight control difficulties are encountered, proceed as follows:

1. Slow the aircraft to 170 knots maximum. Visually ensure the antenna has dropped against the fuselage overwing hatch area.

   a. If the antenna is not retrievable, proceed to the nearest suitable field and land.

2. Depressurize (descend if necessary).

3. Ensure both HFs are off and circuit breakers are pulled.

4. Ensure one crewmember dons helmet, gloves, and parachute/safety harness with connected safety lines.

WARNING

Secure and adjust safety lines to ensure the crewman has no movement outside the aircraft overwing hatch.

5. Remove the port emergency overwing exit (maximum 170 knots).

6. The HF antenna will be lying next to the open overwing exit. Pull the antenna into the aircraft and secure it by replacing the exit hatch.

WARNING

Keep hands clear, as the negative pressure over the wings tends to seat/reseat the hatch prematurely.

7. Repressurize the aircraft and proceed to the nearest suitable field and land.

WARNING

To prevent possible shock hazard, do not reset HF circuit breakers.

15.18 LIGHTNING STRIKE

If the aircraft is struck by lightning, the aircraft will act as a large conductor. High power electrical current will flow from the point of impact to the point of discharge. Lightning strikes may cause visible damage at the impact and discharge points. The high electrical current flowing through the aircraft may cause electrical equipment to malfunction, and large metal components may be magnetized, causing compass deviations. In the event of a lightning strike, flash blindness may occur. White instrument panel floodlights may be turned on to increase cockpit visibility. After landing, a detailed inspection of the aircraft is required prior to next flight.

15.18.1 Lightning Strike Procedures

If lighting strikes the aircraft during flight, proceed as follows:

1. Verify proper operation of flight controls.

2. Establish a safe altitude and heading to allow further investigation as required.

3. Set Condition IV to inspect the aircraft for damage. Check essential flight instruments, navigation, and communication equipment for proper operation.

4. Time permitting, set Condition III to perform an operational check of only those aircraft systems required for the remainder of the flight.

CAUTION

Consideration should be given to aborting the mission even if no damage is detected and all systems are functioning normally due to the possibility of undetected damage.

CHAPTER 16

Approach and Landing Emergencies

16.1 EMERGENCY LANDING BRIEF

The emergency landing brief shall be conducted prior to executing an engine-out, no-flap, or boost-off landing. Before landing, the pilot shall brief the copilot and flight engineer on all aspects of the approach and landing. As a minimum, this brief shall consist of the following:

1. Runway length, width, condition, and selection.
2. Wind velocity and crosswind component effect on aircraft during approach and when on runway.
3. Copilot assistance during landing rollout and reversal.
4. Consideration of restarting feathered engine (as applicable).
5. Waveoff.
6. Suitable alternate airfields.

16.2 SLOW FLIGHT CONTROLLABILITY CHECK

If an aircraft emergency leads to concern over aircraft controllability, a slow flight check is recommended. The purpose of the slow flight check is to confirm a safe landing configuration and speed. Once a safe landing speed has been determined, further deceleration to determine minimum control speed is unwarranted.

1. Continue transit at safe speed until within reasonable distance of landing field. During transit, estimate desired landing configuration and speed based on gross weight, runway length, winds, and aircraft condition.
2. Maintain V_{MC} above 10,000 feet if practical. The check may be performed at a lower altitude if necessary (e.g., pitchlocked propeller).
3. Set Condition V.
4. Configure and incrementally slow the aircraft toward the desired landing speed. Slow no less than normal approach speeds for the selected flap settings. Use of LAND flaps is not recommended unless further decreased landing speed is necessitated by conditions.
5. At each speed increment, evaluate aircraft handling characteristics, using no more power and/or angles of bank than anticipated for approach and waveoff.

Note

Maintain configuration throughout the approach and landing if practical.

6. Fly a straight-in approach if practicable.

16.3 LANDING WITH ONE OR MORE ENGINES INOPERATIVE

Limits imposed on the aircraft when landing with one or more engines inoperative are the same as limits with four engines operating as described in Chapter 4. The following procedures are in addition to the normal landing procedures. It is assumed that the landing area is within range and that the Emergency Shutdown procedure has been completed. The positioning of the inoperative engines with respect to wind direction will affect controllability during both the approach and landing rollout. For crosswind conditions, the landing should be planned to position the inoperative engines upwind so that reverse thrust on the operative engines counteracts the tendency of the aircraft to swerve into the wind.

Note

If an inboard engine(s) is/are inoperative, cooling airflow to the brake assembly is not available. Use of normal braking is still available. Consider having the crash crew follow the aircraft to the line in the event of hot brakes or a brake fire.

16.3.1 One Engine Inoperative

Landing with one engine inoperative does not seriously affect the normal flight characteristics of the aircraft.

1. Fly a normal traffic pattern using normal procedures as defined in Chapter 8.
2. Adjust power to maintain the desired pattern airspeed.
3. Trim rudder to compensate for power changes as necessary.
4. After nose wheel is on the runway, reverse thrust may be applied to the three operating engines.
5. Maintain directional control with the rudder and apply aileron as necessary. Copilot holds control column forward. As rudder effectiveness decreases, revert to nose wheel steering and asymmetrical power for directional control.

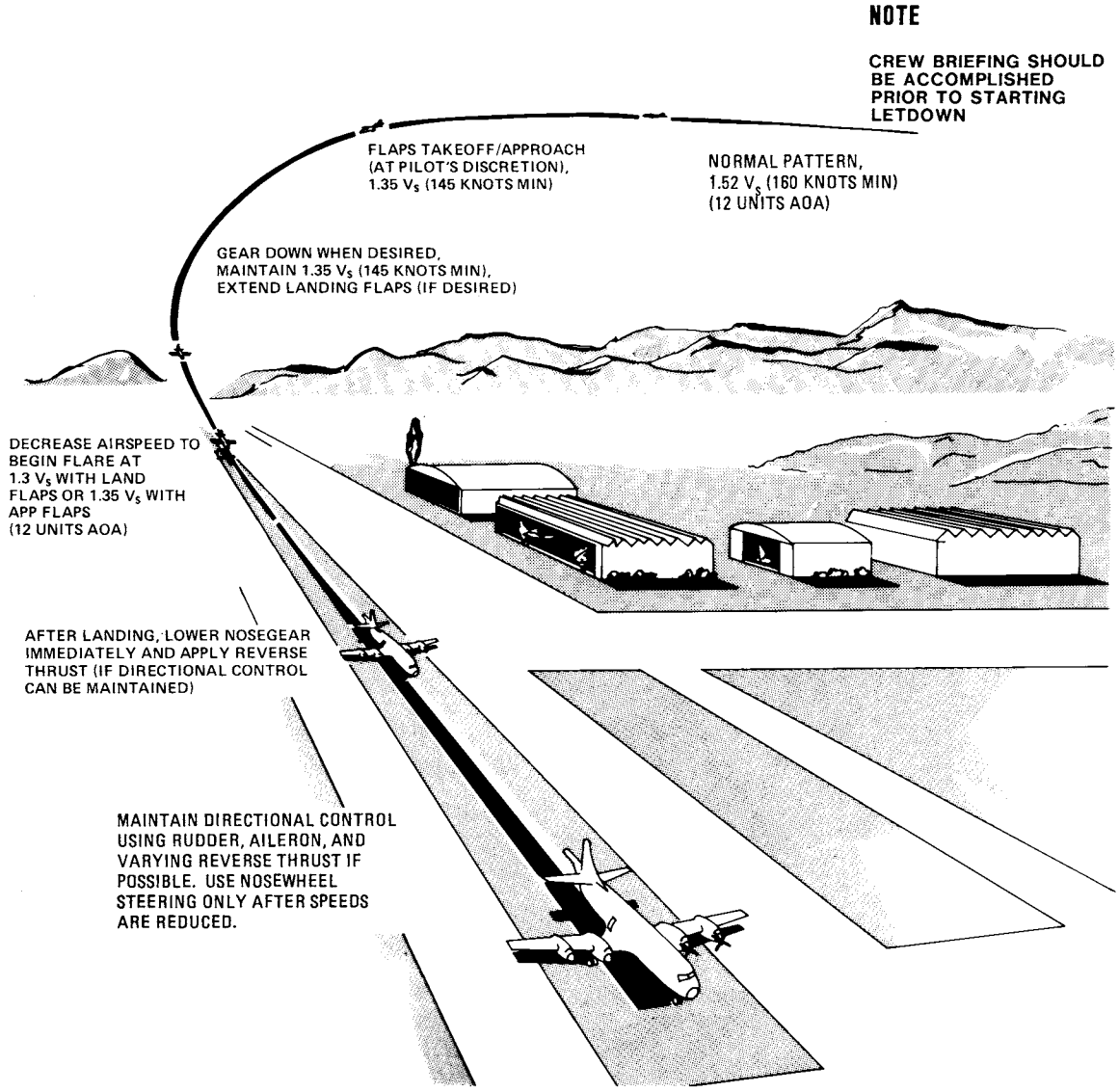
16.3.1.1 Waveoff, One Engine Inoperative

To accomplish a three-engine waveoff, use four-engine waveoff procedures as outlined in Chapter 8. A waveoff at maximum recommended landing weights can be accomplished if the airspeed is at least 1.15 times the zero-thrust stall speed (takeoff speed) for the waveoff configuration, provided flight control boosters are on. During waveoff, raise the wing with the inoperative engine sufficiently to optimize control and climb performance (up to a maximum of 5°, if necessary). Refer to Chapter 29 for initial climbout and best rate-of-climb speeds.

16.3.2 Two Engines Inoperative

The weather at the intended point of landing should be closely checked. The longest available runway should be used in landing so that a minimum of asymmetric reverse thrust can be applied. Wide variation of trim occurs with power and airspeed changes (refer to Figure 16-1).

1. The RUDDER BOOST SHUTOFF VALVE circuit breaker (K-13) shall be pulled in order to supply full pressure from both hydraulic systems in the event an asymmetric waveoff occurs.
2. Fly a normal pattern using power as required to maintain 1.52 V_S (12 units AOA) or 160 KIAS, whichever is higher, in the clean configuration.
3. Extend flaps to the approach position at pilot's discretion. Adjust power as necessary to maintain 1.35 V_S (145 KIAS minimum).
4. Retrim rudder to compensate for power changes.
5. Extend landing gear when desired. This will normally be done as in any other approach unless aircraft weight versus power available makes delaying gear extension advisable.
6. Maintain 1.35 V_S (145 KIAS minimum) in order to ensure an adequate margin above $V_{MC\ AIR}$ in the event of a waveoff. Taper airspeed when landing is assured to 1.35 V_S (approach flaps) or 1.3 V_S (landing flaps, 12 units AOA) as the flare is established. Refer to Figure 16-1 for equivalent IAS.



DATA FOR LANDING PATTERN DIAGRAM

AIRCRAFT WEIGHT X 1000	65	70	75	80	85	90	95	100	105	110	115	120	125	130	135	140	145
T.O./APP FLAPS 1.35 V_S	114	119	123	128	131	135	138	142	145	149	152	155	158	162	165	168	171
LAND FLAPS 1.3 V_S	103	107	111	114	118	121	124	127	131	134	137	139	142	145	148	151	154
NO FLAP (DOWNWIND) 1.52 V_S	MINIMUM 160 KTS				161	165	170	174	178	183	187	191	195	199	202	206	210
NO FLAP 1.2 V_S	MINIMUM 135 KTS							137	140	143	147	150	153	156	159	162	165
LAND FLAP DITCH*	94	97	100	103	106	108	111	114	117	119	121	124	126	129	131	134	135
*APPROACH FLAPS ADD 5 KTS. MANEUVER OR FLAPS UP ADD 20 KTS.																	

Figure 16-1. Landing Pattern — Two Engines Inoperative

7. After landing, lower nose wheel onto runway and then apply reverse thrust to the operating engines. Apply rudder to hold the aircraft straight. If two operating engines are on one side, it is necessary to use ailerons to assist in directional control and to reduce the amount of reversing as the speed decreases. Once aileron correction is established by the pilot, the copilot should hold the yoke, maintaining the correction. Nose wheel steering should not be used until directional control cannot be maintained with rudder, at which time reverse thrust will have been discontinued.

8. Use NORMAL rpm for taxiing.

16.3.2.1 Waveoff, Two Engines Inoperative

An asymmetric two-engine waveoff is not recommended; however, it can be accomplished at the maximum recommended landing weights if the airspeed can be maintained at 145 KIAS or higher, provided flight control boosters are on. Power can be applied fairly rapidly if the necessary rudder and aileron application is anticipated. If a waveoff is to be made, the following procedure is recommended:

1. Airspeed — 145 KIAS minimum.

2. Power levers — Advance to MAXIMUM POWER as soon as directional control is gained.

3. Raise the wing with the inoperative engines sufficiently to optimize control and climb performance (up to a maximum of 5°, if necessary).

4. Wing flap lever — APPROACH.

5. Landing gear lever — UP.

6. Wing flap lever — MANEUVER, then UP (145 KIAS minimum).

16.4 LOW-ALTITUDE WINDSHEAR

A windshear is defined as any rapid change in wind direction and/or speed that results in an airspeed change of 10 knots or more and/or a vertical speed change greater than 500 fpm. Windshear at low altitudes is a potential hazard to the P-3 during takeoff, landing, and all low-altitude operations. The principal causes of low-altitude windshear are convective activity, frontal systems, lake and sea breezes, and large temperature inversions. Most windshear incidents recorded have been associated with convective thunderstorms that have produced microbursts. These microbursts are extremely concentrated downdrafts that, when impacting the ground, cause large headwind/tailwind differentials. A windshear is an extremely dynamic event that, if severe and encountered at a low altitude, makes aircraft recovery extremely difficult, if not impossible. Windshears that exceed the performance capability of the P-3 in all configurations have been recorded.

16.4.1 Windshear Procedures

Upon encountering windshear, disregard airspeed indication, and fly known attitude and power combinations. AOA indications will not provide a suitable source of aircraft performance because of turbulence and the inherent instrument lag.

The following precautions should be considered when an encounter with a microburst or any type of low-level windshear is expected during an approach to landing:

1. Avoid thunderstorm conditions. Delay the approach, if possible.

2. Use APPROACH flaps. Do not extend flaps to LAND until runway is made.

3. If possible, use a precision approach procedure in order to more accurately monitor for unexpected glideslope deviations and greater-than-predicted rates of descent.
4. Approach speeds may be flown 5 to 10 knots faster with due consideration given to the increase in landing ground-roll distance if normal touchdown speeds are not met.
5. Attain a stabilized airspeed approach before passing 1,000 feet AGL. Minimize power lever movement beyond this point. Maintain glideslope with pitch attitude. Abrupt changes in airspeed will serve as an indication of windshear.
6. The windshear escape procedure should be initiated if unexpected, sustained deviations from target conditions in excess of the following occur:
   a. ±15 knots airspeed.
   b. ±500 fpm vertical speed.
   c. ±5° pitch attitude.
   d. ±1 dot glideslope deviation.
   e. Unusual power requirements.

During any phase of flight, it is possible to use windspeed and groundspeed information from the inertials to aid the crew in windshear recognition.

Note

Report any type of windshear to the air traffic controller.

16.4.2 Windshear Escape Procedure

Generally, successful recovery from a windshear encounter requires early recognition, adding all available power, and maintaining a recovery pitch attitude until clear of the disturbance. The escape pitch attitude of approximately 10° is applicable for any gross weight and/or engine-out combination. The following procedure should be executed if a windshear is encountered:

*1. Max Power — Set. (P, FE)

*2. Pitch attitude — 10° up. (P)

WARNING

Any attempt to recover loss of airspeed by decreasing pitch or allowing the aircraft nose to fall through is not recommended.

*3. Landing gear — UP. (P, CP)

*4. FLAPS — Do not change until out of windshear. (P)

16.5 FAILURE OF THE NO. 1 AND NO. 2 HYDRAULIC SYSTEMS

Failure of both the No. 1 and 2 hydraulic systems will result in a complete loss of pressure to the control boosters. If this occurs in flight, pull elevator, rudder, and aileron booster shift handles and then turn hydraulic pump switches off.

Note: Asterisked items are memory items.

16.5.1 Boost-Off Landing

When making a boost-off landing, fly a traffic pattern slightly wider than normal, holding the same speed schedule as during a no-flap approach. The landing can be made with the wing flaps UP, at MANEUVER, or in the APPROACH position.

WARNING

If boost-off in the elevator, the landing should be made with the flaps up or at maneuver to ensure adequate longitudinal control close to the ground as well as to maintain reasonable elevator control forces.

The final approach glidepath should be slightly flatter than normal. Land with power on in a slightly noseup attitude. After the nose wheel is on the runway, apply reverse thrust as required. Have the copilot steady the control column in the forward position. Refer to Hydraulic Boost-Off Handling Qualities, paragraph 10.7 for hydraulic boost-off handling qualities.

CAUTION

After landing, no attempt should be made to retard the power levers beyond FLIGHT IDLE until speed is less than 135 KIAS or less than 125 KIAS if without electrical power.

16.6 UNCOMMANDED ROLL/YAW

A split-flap malfunction can occur during flap retraction or extension. When a split-flap condition occurs, it will be evidenced by a yaw in one direction with an opposite roll and it will most likely be accompanied by a flap asymmetry light.

Recovery from a split-flap condition may require immediate recognition and rapid response. If this occurs on short final, continuing a safe landing is most critical. In all other situations (e.g., during climbout or following a waveoff because a safe landing cannot be made), a Slow Flight Controllability Check should be performed. Any increase or decrease in airspeed or power setting may significantly affect the controllability of the aircraft.

If a split flap occurs during flap actuation:

*1. If uncontrollable, reset the flap handle to the previous position.

*2. If controllable, land with the flap handle in the selected position.

3. If a safe landing cannot be made, climb to a sufficient altitude in order to determine minimum approach and landing airspeeds during a slow flight check.

4. Visually inspect flaps for position and damage.

Note: Asterisked items are memory items.

WARNING

During slow flight, determine the best airspeed where aileron and rudder can be used to turn the aircraft in either direction. Rapid or large power increases during slow flight will increase corrective control requirements and minimum control airspeed.

Note

Any change in slow flight airspeed versus controllability may be indicative of a further flap split. If this occurs, another slow flight check should be conducted. Flap position should be monitored visually by aft observers following the slow flight check until just prior to landing to ensure no further flap movement occurs.

5. Select a runway that offers an extended final with no lateral or vertical hazards and minimal crosswind.

WARNING

High-speed/high-power setting approaches may negate the 153 KIAS/power lever switch activation features. Ensure the Landing checklist is complete.

16.7 EMERGENCY BRAKE OPERATION

CAUTION

Brakes should be operated carefully to avoid locking the wheels.

16.7.1 Hydraulic Brakes

With the brake accumulator fully charged, approximately eight brake applications are available. Brake pressure can be maintained by turning on the 1B hydraulic pump.

16.7.2 Airbrakes

If no hydraulic brake pressure is available, the emergency airbrakes can be applied by either the pilot or copilot. Approximately three full airbrake applications or six normal airbrake applications should be available.

Note

The emergency airbrake was designed to be used in the event of complete loss of hydraulic pressure including the loss of pressure in the brake accumulator. If the air system is used, the brake system must be bled before normal operation can be assured.

16.8 LANDING GEAR SYSTEM EMERGENCIES

If damage to the landing gear is suspected, regardless of flight station indications, do not cycle the landing gear. Visually inspect the landing gear. If damage is noted that may result in collapsed landing gear upon touchdown, review the Landing Without All Gear Extended procedure, paragraph 16.8.6.

CAUTION

If structural or mechanical integrity of the landing gear is in question, with or without safe down and locked indications, the landing gear safety pins should be installed and a visual inspection performed prior to further aircraft ground movement to prevent structural damage.

16.8.1 Landing Gear Extension without Hydraulic Pressure

1. Landing gear lever — DOWN. (CP)
2. Main landing gear EMER release handle — Pull (FE) (accessible through hatch over the hydraulic service center). The main landing gear should fall free and lock in the down position.

WARNING

The nose landing gear EMER release handle should not be pulled until it is determined that the main gear is down and locked.

3. Nose landing gear EMER release handle — Pull (FE). (Located aft of the center control stand adjacent to the booster shift handles.) The nosegear should fall free and lock down.
4. Hydraulic pump switch 1B — ON. (FE)
5. Landing gear indicators — Main and nosegear DOWN AND LOCKED. (CP)

If an unsafe landing gear down position is indicated, proceed as follows:

a. After notifying the crew, make alternate pullups and pushovers to increase g forces on the gear mechanism. Increase airspeed to 300 KIAS for maximum airloads to assist in locking the gear down. Do not exceed 1g at this speed. If this procedure produces a safe landing gear indication, make a normal landing; if not, perform step b.

b. Request tower personnel or other aircraft to observe gear position. If gear appears to be down but still unlocked, proceed as outlined under the applicable portions of the landing with unsafe gear indication, Unsafe Landing Gear Down Indication, paragraphs 16.8.4 and Unlocked Gear Indication Landing, 16.8.5.

16.8.2 Landing Gear Extension or Retraction (Loss of Power in Electrical Control Circuit)

A fault in the electrical circuit between the landing gear handles and the landing gear selector valve may make it necessary to operate the gear by operating the selector valve manually. If the landing gear is selected up and power to the control circuit is lost, any unlocked gear will free fall. If this has occurred, proceed as follows:

1. LANDING GEAR CONT VALVE circuit breaker — Check. (FE)
   If breaker is out, position gear handle to previous position and set circuit breaker.
2. Landing gear handle — As desired. (CP)

CAUTION

If landing gear selector valve has deenergized to the neutral position, nosewheel steering will not be available. Selector valve must be manually positioned down.

If it is decided to operate the valve manually, proceed as follows:

1. Landing gear control circuit breaker — Pull. (FE)
2. Landing gear handle — As desired. (P)
3. If extending without MAIN DC BUS, retard one power lever below FLIGHT START and slow the aircraft to 150 KIAS, observing actuation of the landing gear warning system. (P)
4. Landing gear selector valve — Operate. (FE)

When raising the gear, this control must be held in until the gear is reported up and locked. It is accessible through the hatch over the hydraulic service center. When extending the landing gear without electrical power (main DC failure), the flashing WHEELS warning light will only extinguish when the gears are down and locked.

16.8.3 Unsafe Landing Gear Up Indication

If any of the landing gear warning devices do not indicate up and locked when the gear are retracted, proceed as follows:

1. Visually inspect the landing gear if possible.
2. Check the position of the landing gear selector valve by actuating the wheelbrakes. If a fluctuation is indicated in hydraulic brake pressure, the landing gear selector valve has returned to neutral and an indicating system problem exists.
3. If no hydraulic brake pressure fluctuation is indicated, the landing gear selector valve is still up. Pull the landing gear control valve circuit breaker. If any gear falls free, put the gear handle down and reset the circuit breaker. If a safe down-and-locked indication is obtained, leave the gear handle down.

Note

If a safe down-and-locked indication is not obtained, refer to Unsafe Landing Gear Down Indication, paragraph 16.8.4.

4. If no gear falls free, leave the circuit breaker out until the gear is to be lowered.

Note

- If the landing gear does not fall free, a factor to consider before continuing the mission is the effect inadvertent gear extension will have on safe mission completion.

- Cycling of the landing gear handle with an unsafe up indication is not recommended.

16.8.4 Unsafe Landing Gear Down Indication

If any of the landing gear warning devices does not indicate down and locked when the gear is extended, it should be considered that the gear is unsafe for landing unless definitely proven otherwise. These warnings would be the glowing of the red light in the landing gear lever, the unlocked indication of any of the landing gear down indicators, or the flashing WHEELS lights on the pilot and copilot instrument panels. If the gear is released from the uplocks and extends but an unsafe gear indication exists, proceed as follows:

WARNING

If damage to the landing gear assembly is suspected, attempts to cycle the gear may cause additional damage.

Note

The possibility of an internal actuating cylinder malfunction may result in an unsafe landing gear indication after a safe down and locked has been obtained. If this occurs, secure the No. 1 hydraulic system and accelerate to 300 KIAS. If a safe down and locked is obtained, leave the Nos. 1 and 1A pumps off and turn on the No. 1B pump. Nose wheel steering will not be available.

1. Operate the landing gear through several complete cycles. If a safe landing gear down indication is received, make a normal landing; if not, perform step 2.

2. If any one of the landing gear indicators displays an unsafe indication, remove the indicator and swap the cannon plug of the unsafe indicator with one of the gears that indicates down. If the unsafe indication transfers to this gear, assume the indicator is reliable and proceed with step 3.

3. Secure the No. 1 hydraulic system (hydraulic pumps 1 and 1A off) and increase airspeed to 300 KIAS for maximum airload to assist in locking the landing gear down. If a safe landing gear indication is obtained, restore the No. 1 hydraulic system and execute a normal landing; if not, restore the No. 1 hydraulic system and perform step 4.

4. Reduce speed and, after notifying the crew, make alternate pullups and pushovers to increase g forces on the landing gear.

5. Fly by the tower or request another aircraft observe the landing gear position. If it appears that the landing gear is down but an unsafe position indication still exists, proceed as outlined in Unlocked Gear Indication Landing, paragraph 16.8.5.

WARNING

If doubt exists about the safety of the landing gear, review the Landing Without All Gear Extended procedure, paragraph 16.8.6.

16.8.5 Unlocked Gear Indication Landing

The gear can be held in the extended position by hydraulic pressure as long as sufficient pressure is maintained in the landing gear actuating cylinder. If normal hydraulic system pressure is available, use the following procedure in the event of an unsafe gear indication.

1. Make a normal landing. If the nosegear indicates unlocked, lower the nose wheel normally and hold forward yoke pressure if the nose strut is apparently holding. The stop should be made with the power levers in the START position and with wheelbrakes. The geometry of the gear and the inertia of the aircraft being opposed by the wheelbrakes will tend to hold the gear in the down position; however, this will not be true if propeller reversing is used for braking at low speeds.

2. Do not raise the flaps.

3. Bring the aircraft to a smooth stop. After stopping, maintain positive thrust and hold position with the brakes.

WARNING

Power levers forward of the GROUND START position may generate sufficient propeller thrust to make personnel movement behind the propellers extremely hazardous. Extreme caution must be exercised regarding the power lever position as personnel are attempting to install landing gear safety pins.

4. Maintain hydraulic pressure until the landing gear safety pins are installed.

5. Do not move the aircraft until the landing gear safety pins are in place.

16.8.6 Landing without All Gear Extended

If all gear can neither be extended nor retracted, land with the aircraft level and maintain level attitude as long as possible after the extended gear contacts the runway. If the nosegear fails to extend but the main gear is down and locked, land on the main gear and gently lower the nose to the runway before elevator control is completely lost.

WARNING

If the nosegear collapses completely, the inboard propeller tips will probably strike the runway, and propeller blade fragments will be scattered at random in the propeller plane of rotation.

If the nosegear is down and locked and one or both main gear fail to extend, retract all gear as far as possible and make a wheels-up landing. The recommended procedure is as follows in any of the aforementioned situations:

1. Secure or stow loose equipment.

WARNING

Crewmembers shall evacuate stations nearest to the propeller plane.

2. Order the crew to fasten seatbelts.
3. Depressurize the cabin.
4. Assign a crewmember to open emergency exits after aircraft comes to a stop; however, do not remove an exit if there is fire in the vicinity outside.

Note

The flightcrew may elect to remove certain emergency exits prior to landing if special circumstances indicate this is clearly advisable. In this event, reduce airspeed to 170 KIAS prior to opening an exit; do not exceed this speed while an exit is open over the wing.

5. All fuel boost pumps — OFF.
6. FUEL AND IGNITION switch on engine Nos. 2 and 3 — OFF.

Note

Step 6 is an optional but recommended procedure that will reduce rotational energy of the inboard propellers and decrease exposure to damage from propeller fragments. This should be done sufficiently early during final approach to allow inboard propellers to reach a stabilized NTS windmilling condition and to permit the pilot to reestablish a smooth approach using power as required from engine Nos. 1 and 4. If landing is to be made without the nosegear extended, FUEL AND IGNITION switches should be secured after touchdown but prior to lowering the nose.

7. Wing flaps — Extend to landing position as soon as it is certain that landing area can be reached.
8. Fly an approach profile like a normal landing. When landing with all gear retracted, a flatter attitude at touchdown is advantageous. If only the nosegear is retracted, lower the nose to the runway at a speed high enough to provide elevator control.
9. Emergency shutdown handles (all four engines) — Pull.

WARNING

Remove hand from power levers because random motion of power levers after ground contact may cause injury to hand.

10. Evacuate aircraft immediately using all available exits.

16.9 FLAT TIRE LANDING

If one or both nosewheel tires are flat at time of landing, keep nosewheel off the ground as long as possible. Aft cg is generally desirable. Use a minimum of braking.

If one or both tires on one main gear are flat, lower the nosegear as quickly as possible. There is very little actual danger in landing with one flat tire on one main gear. The landing should be made smoothly and taxiing done slowly. Avoid extended taxiing with one main tire flat.

If both tires on one main gear are flat as a result of striking some object on the runway, damage in addition to the flat tires may have occurred. For example, a hydraulic hose may have been torn loose, a wheel may have been broken, or the landing gear itself may have been damaged. A forward cg will place more weight on the nose wheel and provide positive steering after touchdown. Make a normal approach and landing. After touchdown, the aircraft will tend to swerve in the direction of the blown tires; therefore, land the aircraft on the side of the runway away from the blown tires to allow space for possible swerve during deceleration. The use of aileron away from the flat tire side will ease the weight on the blown tires. When the aircraft has slowed, use asymmetrical reverse power for direction control.

Do not apply brakes to the wheels with the blown tires during the landing roll or attempt to taxi after the aircraft has stopped.

WARNING

Select the widest runway available consistent with wind conditions. Land with APPROACH flaps if landing weight is low or can be reduced prior to landing in order to minimize damage to flaps from tire fragments at maximum flap settings. Avoid use of reverse pitch past the GROUND IDLE position on the side of the blown tires. Propeller damage occurs when tire fragments are drawn through the propeller.

16.10 LANDING ON SOFT GROUND OR UNPREPARED SURFACE

WARNING

Crewmembers shall evacuate stations nearest to the propeller plane.

If it is necessary to land on soft ground or any unprepared surface, the landing can be made with the landing gear retracted or extended as appropriate to the condition of the landing gear. If a landing is to be made with the landing gear retracted, refer to Landing without All Gear Extended, paragraph 16.8.6 for additional procedures.

A propeller that contacts soft ground while pulling horsepower above FLIGHT IDLE may be expected to shear off and travel forward to the right. When landing or rollout is made anywhere except on a runway, the FUEL AND IGNITION switches should be turned off as soon as power is not required for directional control or stopping. A feathered propeller contacting soft or hard ground can cause the propeller assembly to fail in a downward and aft direction that can cause extensive wing damage and fuel tank ruptures with ensuing fire hazards.

Note

Complete loss of boosted aerodynamic controls will result from an all-engine shutdown. Nose wheel steering will not be available. Hydraulic pump No. 1B must be on to maintain brake accumulator pressure.

16.11 NO-FLAP LANDING

1. Brief Emergency Landing Brief, paragraph 16.1.
2. No-flap landings are not recommended at gross weights exceeding 103,880 pounds. When making a no-flap approach and landing, fly a traffic pattern slightly wider than normal. The airspeed downwind should be maintained at 1.52 V_S or 160 KIAS, whichever is higher. The RUDDER BOOST SHUTOFF VALVE circuit breaker (K-13) shall be pulled in order to supply full pressure from both hydraulic systems. At the desired point of the downwind leg, call for the Landing checklist. Slow to arrive at 1.2 V_S (minimum 135 KIAS) turning final using power as necessary and fly the aircraft to touchdown. The final approach glidepath should be slightly flatter than normal.

Note

When wing stores place the aircraft in configurations “D” or “E” (greater than 700 drag count), add 5 KIAS to 1.52 V_S and 1.2 V_S for approach and landing.

3. After landing, no attempt should be made to retard power levers below FLIGHT IDLE until speed is below 135 KIAS. Beta operation on the ground at a higher speed may result in the propellers pitchlocking or decoupling.
4. When applying reverse thrust at high speeds, pull the power levers into the reverse range smoothly.

Check landing ground-roll distance prior to commencing the approach phase. Use the following procedure when estimating the distance.

1. To determine the approximate no-flap landing ground-roll distance, first determine the normal landing performance ground-roll distance from Chapter 30 and then apply the moderate braking and “no-flap” factor shown in the same chapter for the approximate gross weight.

16.12 PROPELLER MALFUNCTIONS DURING LANDING

If a beta light fails to come on when power levers are moved into ground operating range (start position):

1. Flight engineer announces the fact.
2. If swerve occurs, pull the E-handle on the affected engine.
3. Use reverse thrust and brakes to stop.

CHAPTER 17

Emergency Equipment

17.1 EMERGENCY ESCAPE ROPE

An emergency escape rope is provided inside the cabin entrance above the cabin door (Figure 17-1).

17.2 SEARCH AND RESCUE BAR

The SAR bar is an expandable metal bar stowed on the underside of the port galley seat. It is designed to be inserted into the holes in the main cabin door opening that are filled by the locking bars on the door when it is closed. The SAR bar should be inserted into the middle set of holes to provide maximum safety. It may be inserted in flight with the door open or on the ground with either the ladder tucked under or raised inside the aircraft and the door open.

17.3 FIRE AX

A fire ax is attached at the aft end of the sonobuoy stowage rack. Two strap assemblies hold the ax in place. The blade of the ax should be used to make a horizontal cut in the insulation along the top boundary of the designated cutout area (refer to Figure 12-2). After tearing away the insulation, the pick end of the ax should be used to make the initial puncture through the fuselage, starting in the upper left-hand corner of the cutout area. The blade of the ax should then be used to chop through the top and two sides, forming an inverted "U." The skin of the aircraft should then be kicked outward, resulting in an emergency exit, free of a jagged edge along the bottom boundary.

17.4 EMERGENCY EXIT LIGHTS

The aircraft is equipped with four emergency exit lights that incorporate two dry cell batteries to furnish power for the lights. One light is located at each of the overwing emergency exits, the main cabin door, and near the flight station overhead emergency exit. The emergency light has a two-position ON/OFF switch with provisions for manual and automatic operation. In the ON position, the light remains illuminated. When placed in the OFF position, an inertia switch located behind the light in the mounting rack closes the circuit and causes the light to illuminate whenever a sufficient force is applied.

17.5 PORTABLE FIRE EXTINGUISHERS

Three portable fire extinguishers are provided containing either Halon 1301 or CO_2. One extinguisher is located on the aisle panel at the NAV/COMM station. This extinguisher may be obstructed when the NAV/COMM step is down. A second extinguisher is stowed at the end of the sonobuoy stowage rack. The third extinguisher is fastened to the aft portion of electronic rack J2.

WARNING

A fire extinguished by Halon 1301 may produce decomposition by-products, characterized by a sharp acrid odor, that may be harmful. If this odor is detected, utilization of oxygen or evacuation of the immediate area is recommended until proper ventilation is established.

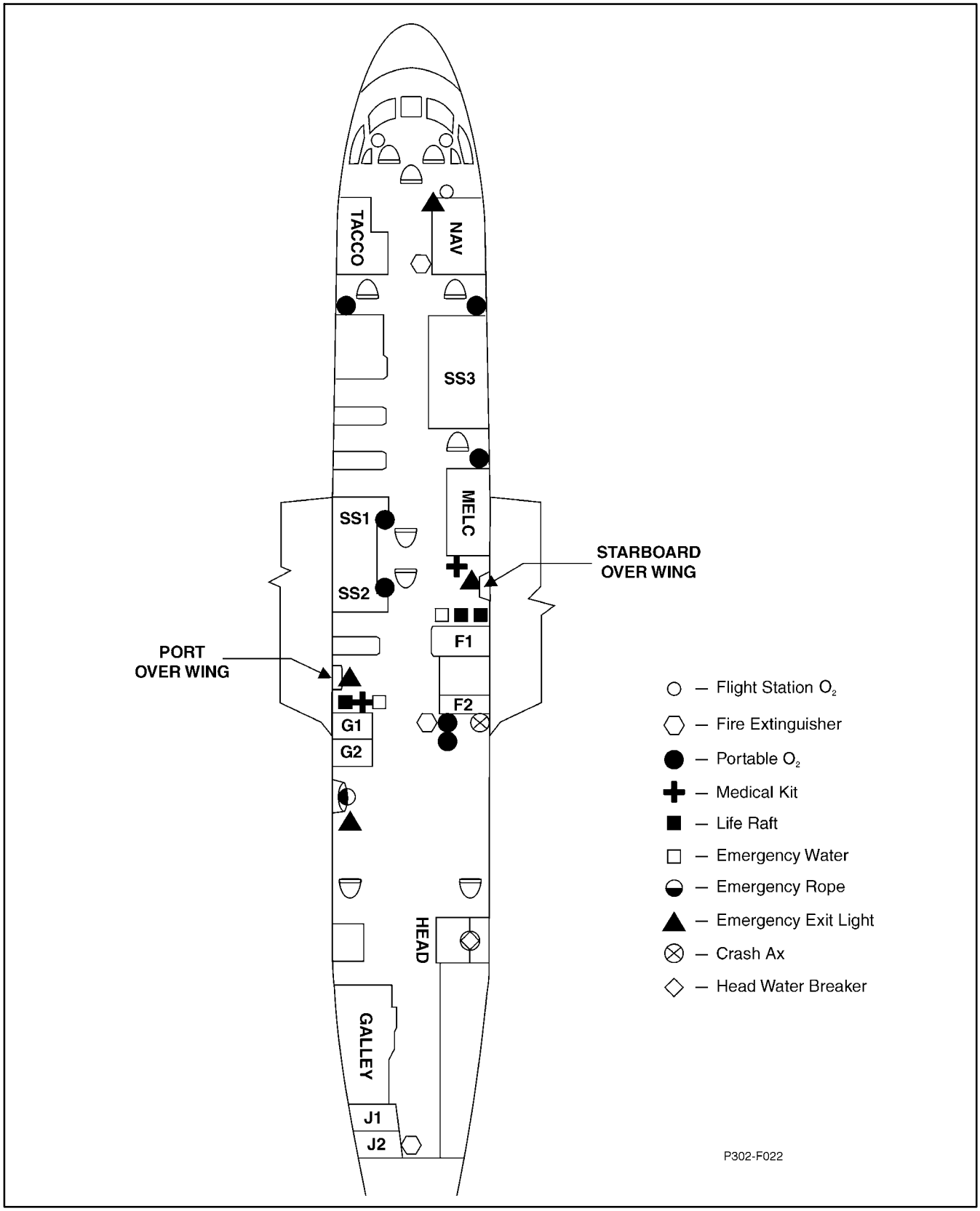


Figure 17-1. Emergency Equipment Location

17.6 LIFERAFTS

The aircraft is equipped with one 12-man raft (near the starboard overwing hatch) and one 7- or 8-man raft (near the port overwing hatch). A second 7- or 8-man raft is normally carried and shall be stowed behind the 12-man raft (near the starboard overwing hatch). Some aircraft may be equipped with two 12-man liferafts. Each raft has a survival kit containing equipment with the raft as prescribed in NAVAIR 13-1-6.1.

The 8- and 12-man Multi-Place Liferafts (MPLRs) are vacuum packaged and contain the same survival equipment as the original rafts. MPLR features include a self-erecting canopy with removable radar/light reflective strips, a rain collection system, two large boarding ramps sturdy enough to stand in, and automatic sea marker lights located in and outside the raft. MPLRs have one combination actuation/retaining line with a snaphook attached to the bitter end. The MPLR retaining line is designed to detach from the raft when the aircraft sinks. MPLRs are certified to a 50 percent overcapacity rating.

17.7 LIFEVESTS

Lifevests shall be worn during takeoff and landing when the path of flight is over water and at all times over water by flight station personnel. Crewmembers and passengers shall wear a lifevest at all times when below 1,000 feet over water or when the PPC deems it necessary. Whenever conditions of flight do not require lifevests to be worn, they should be stowed in a readily accessible place.

17.8 LPU-21/P SERIES, OR EQUIVALENT FLOTATION ASSEMBLY

The LPU-21/P or equivalent life preserver assembly is used in conjunction with the SV-2 or AIRSAVE survival vest. It consists of a two-chambered flotation assembly, a casing assembly, two CO_2 inflation assemblies, and optional survival items and pouches. Each chamber is equipped with a CO_2 inflation assembly and an oral inflation tube. The waist lobes are equipped with a snaphook and a D-ring to secure them together after inflation.

17.9 LPP-1 LIFE PRESERVER

The LPP-1 life preserver consists of a single-compartment, yoke-type flotation assembly, a pouch and belt assembly, and an inflation assembly. Survival items provided are a whistle, a dye marker, and a steady-burning, water-activated distress light.

The pouch and belt assembly consists of a rubber-coated nylon pouch and adjustable belt. The pouch contains the flotation assembly and the survival items. The belt consists of an adjustable buckle and clasp and a toggle assembly pocket. The belt attaches to the flotation assembly and pouch by means of belt loops. The toggle assembly consists of a wooden toggle and line and is used to secure survivors together while in the water. When not in use, the toggle line is wrapped around the wooden toggle and stowed in the pocket located on the belt.

The inflation assembly consists of a carbon dioxide cartridge and an inflation valve. The knurled locknut of the tube must be turned down and the nut must then be depressed for inflation. The bladder cannot otherwise be inflated with the oral inflation tube. The knurled locknut should be turned up, relocking the valve to prevent inadvertent deflation of the vest.

When the LPP-1 is worn with a helmet, the flotation assembly shall be removed from the pouch and the yoke placed over the head.

WARNING

Do not inflate the LPP-1 life preserver while wearing a parachute or parachute harness.

17.10 LPU-32/P PASSENGER LIFE PRESERVER

The LPU-32/P consists of a flotation assembly, two CO_2 inflators with backup oral inflation tubes, and a waist belt assembly with a survival pouch containing a whistle, sea dye marker, and a chemlite.

Note

The LPU-32/P may require a 12-inch locally manufactured extension belt when used by larger individuals or when used with winter clothing or survival suits to ensure proper flotation.

To don the LPU-32/P, the slider should be opened and the yoke placed over the head. The yoke will fit over a helmet, if required. After the preserver is placed around the neck, the belt should be fastened by snapping the buckle into place. The waist belt should then be adjusted for a snug fit and the slider zipped up.

The LPU-32/P is manually inflated by pulling both beaded handles down. In an emergency situation, the oral inflation tubes should be used to top-off an inflated preserver, maintain inflation of a leaky preserver, or to inflate a preserver when the CO_2 bottles fail to actuate. Should the CO_2 inflators fail, the hook and pile fasteners used to secure the casing will have to be opened to gain access to the oral inflation tubes. To use the oral inflation tubes, locate them between the bladders just below the wearer's chin and blow into the end. There are no knurled knobs on the LPU-32/P oral inflation tubes.

WARNING

Do not inflate the LPU-32/P while wearing a parachute or parachute harness.

17.11 SV-2 SERIES SURVIVAL VEST

The SV-2 series vest is constructed basically of nylon cloth. An adjustable harness, leg straps, and chest strap provide a means of securing the vest to the aircrewman. Elastic straps at the rear allow greater comfort and mobility for the wearer. Pockets are provided for stowage of survival items. The vest should be fitted to the individual crewmember. A D-ring on the chest strap is incorporated to provide a means of hoisting during helicopter recovery operations.

17.11.1 Minimum Survival Gear

1. Signal kit, personal.
2. Signal light (strobe).
3. Distress signal (day/night).
4. Survival radio.
5. Whistle.
6. Survival knife.
7. Pen light.
8. Signal mirror.

9. Shroud line cutter or hook blade knife.
10. Flashlight.
11. Two dye markers.
12. Compass.
13. 4 oz. water bottle.

17.12 CMU-33/P22P-18(V) AIRSAVE SURVIVAL VEST

The AIRSAVE survival vest is constructed of nylon mesh with an integral nylon hoisting harness built in. The hoisting harness is designed to carry the weight of the person being hoisted on their legs, with the chest strap only providing stabilization. A gated D-ring is provided on the right shoulder of the vest for attaching to the hoisting hook during recovery operations. The vest is custom fit with pocket positions for survival equipment selected by the wearer on initial issue/fitting. The position of the survival item pockets shall not be switched between left and right sides of the vest. Only the LPU-21/P flotation assembly is authorized for use with the AIRSAVE survival vest on the P-3 aircraft. Minimum survival equipment remains unchanged from the SV-2B survival vest.

17.13 ANTI-EXPOSURE SUITS

Anti-exposure suits shall be provided for all flight personnel and passengers when, in the event of a mishap, there would be a significant risk of water entry and when atmospheric conditions described in OPNAVINST 3710.7 series exist. An anti-exposure suit will be stowed either at each ditching station or reasonably nearby.

Note

Time permitting, the LPU should be worn on the outside of the anti-exposure suit.

17.14 PERSONAL DISTRESS SIGNAL KIT

WARNING

- The pencil-type projector shall be in the cocked position before loading a cartridge. Failure to follow this procedure will create a hazard to all persons in the area of loading.
- The Mk 79 Mod 0 or Mk 79 Mod 2 signal kit consists of one pencil-type projector and seven signal cartridges. The Distress Signal Kit is stowed in the flare gun pocket located on the left side of survival vest. The pencil-type projector shall be stored in the cocked position.

1. Screw launcher onto flare while keeping flare pointed in a safe direction.
2. Hold launcher from about a 45° angle to slightly overhead. Pull back on trigger and release.

17.15 MK 124 MOD 0 MARINE SMOKE AND ILLUMINATION DISTRESS SIGNAL FLARE

The signal flare is a small, one-hand operable device intended for either day or night signaling. Each end of the signal flare is provided with a protective cap. The case has two raised-beaded circles around its circumference on the night end of the flare to facilitate identification in darkness. Operating instructions and further identification of the smoke (day) end and flare (night) end appear on the outside of the flare. The signal flare emits an orange smoke or red flare for approximately 20 seconds.

To operate:

1. Slide or roll the cover cap of the end to be fired. This can be accomplished by scraping across the chest or thigh.
2. Slide the firing lever out to the extended position using either the thumb or index finger.
3. To discharge, apply steady downward pressure to the lever until the pin cocks and fires the signal.
4. Hold the signal flare with arm fully extended at a 45° angle from the horizontal plane.
5. If smoke end flames, briefly immerse in water or tap against a solid, nonflammable object.

After using one end, douse signal in water to cool. If on land, place signal flare on a noncombustible surface to cool.

17.16 DISTRESS MARKER LIGHTS

17.16.1 SDU-5/E Distress Marker Light

The SDU-5/E is actuated by pressing the button on the bottom of the light. It emits a 360° beam of light that flashes continuously for approximately 8 hours. The SDU-5/E distress marker light can be attached to the helmet by Velcro tape. This frees hands for using other signaling devices while allowing light to flash up into the sky and to reflect off the helmet.

17.16.2 SDU-39/N Distress Marker Light

The SDU-39/N is actuated by sliding the switch located on the front of the unit to the "on" position. It emits a 360° beam of light that flashes continuously until depleted. The SDU-39/N distress marker light can be attached to the helmet by Velcro tape (which allows for hands-free operation and utilizes the reflective helmet tape to enhance the lighting effect). The strobe light is equipped with blue and infrared filter lenses and two standard AA batteries.

Note

Extra batteries should be carried in the survival vest since environmental conditions can adversely affect battery shelf life.

17.17 PARACHUTES

The P-3 normally has 23 parachutes aboard that are stowed as indicated in Figure 12-8. They may be NB-8 or A/P22P-21 (Thin Pack) parachutes.

17.17.1 NB-8 Parachute

The NB-8 parachute is a backpack type parachute with a 28-foot flat canopy. The parachute and harness are integrated. The ripcord located on the left side of the harness is used to actuate the chute. When clear of the aircraft, a steady pull releases the ripcord and deploys the chute. Once the canopy is deployed, the rate of descent is about 18 feet per second.

17.17.2 A/P22P-21 (Thin Pack) Parachute

The Thin Pack parachute is a backpack-type parachute with a 26-foot round extended skirt canopy. The ripcord is located on the left side of the harness and is used to initiate main canopy deployment. A steady pull removes the ripcord pin and causes deployment of the pilot parachute, which deploys the main canopy. Once the main canopy is deployed, the rate of descent is less than 20 feet per second. The Thin Pack parachute does not have a four-line release system. Instead, it has steering loops located on the rear canopy risers.

CAUTION

The Thin Pack parachute canopy is vacuum sealed. Care should be exercised when inspecting, donning, and stowing parachute to avoid damage to the vacuum seal.

Note

A torn vacuum seal does not degrade parachute performance; however, the parachute should be replaced as soon as practical.

17.18 FIRST-AID KITS

Two first-aid kits are installed in the aircraft. One is located on the outside of the aft bulkhead of the main load center at the starboard, overwing emergency exit and the other is attached on the forward bulkhead of the electronics rack at the port overwing emergency exit. In addition to these kits, there is an additional first-aid kit in each liferaft. Refer to NAVAIR 13-1-6.5, Aviator Survival Equipment Manual, for the kit contents.

17.19 EMERGENCY WATER BREAKERS

The aircraft is equipped with two emergency portable water breakers, one installed at each overwing emergency escape hatch. The capacity of each breaker is 2.5 U.S. gallons.

17.20 MANUAL REVERSE OSMOSIS DESALINATOR (MROD)

The MROD is tethered to the accessory kit inside the liferaft. It is a hand-operated device that is designed to convert nonpotable water into potable (drinking) water. This hand-operated device draws nonpotable water into the device and forces it under high pressure through a semipermeable membrane that filters out salt molecules, viruses, and bacteria. The unit is designed for one-person operation and is capable of providing 1.4 gallons per hour of fresh water.

Note

Some liferafts may not be equipped with MROD. Rafts not equipped with MROD carry increased rations of bagged water.

To operate:

1. Remove MROD from carrying case.
2. Uncoil hoses and visually inspect for damage or obstructions in hoses. Clear any obstructions prior to proceeding. Place end of the intake/reject brine hose into the feedwater, making sure that the intake strainer is fully submerged to prevent air from getting into the hose. Never place the freshwater hose into the feedwater.
3. Use the cleanest water possible. Try to avoid using water covered by fuel. Either move to another location or disperse fuel away from strainer location.

CAUTION

Oil, fuel, or other petroleum-based products will damage the membrane.

4. Continuously pump handle as far as it will go in each direction at a comfortable speed (about 2 seconds per up/down stroke). After pumping for approximately 1 to 2 minutes, the pressure indicating rod will extend itself. Adjust pumping rate to ensure the indicator rod is always extended at least 1/4 inch. If water sprays from around the pressure indicator, reduce pumping rate.

5. Once water begins to drip from the freshwater hose, pump an additional 60 strokes while discarding the water. This process will clear the stored biocide solution or previously ingested water from the unit. Continue pumping to produce fresh water. It is normal to detect a slight salt taste in the fresh water.

Note

Because of startup requirements, the MROD should be operated for at least 30 minutes each session. During extended use, operate the unit for at least 10 minutes each day to prevent stagnation of residual water in the unit.

17.21 EMERGENCY RADIOS

A PRT-5, PRC-90, or PRC-90-2 emergency transmitter is installed in each liferaft (the PRT-5 in the accessory container; the PRC-90 or PRC-90-2 in the supply pocket). If a PRC-90 is installed, a helmet/radio speaker adapter is provided.

17.21.1 PRT-5

The transmitting set, AN/PRT-5, is a battery-operated, emergency radio that transmits on emergency guard frequencies of 8.364 Megahertz (MHz) (8364 Kilohertz [kHz]) and 243.0 MHz simultaneously. The 243.0 MHz beacon activates the Search And Rescue Satellite Aided Tracking (SARSAT) system. An inflatable float assembly (Figure 17-2) is included to allow the set to float at sea and provides a support platform for use on land. The battery pack is designed to provide rated power for at least 72 hours at 25 °C (77 °F). The transmitting set will continue to transmit at reduced power until the battery discharges completely or about 20 percent longer than the hours listed.

17.21.1.1 Characteristics

The PRT-5 is constructed in a watertight, two-part aluminum case. The top part is the electronic housing assembly. The lower part is the battery case. The float assembly can be inflated either orally or by CO_2 cartridge. Straps sewn to the float assembly permit adjustment for use on land or sea.

17.21.1.2 PRT-5 Operation

1. Remove PRT-5 from packet.

2. Attach lanyard to raft.

3. Check to see that transmitting set is secured to float assembly.

4. Inflate float assembly by CO_2 or by oral valve.

5. Release flexible antenna.

CAUTION

Damage will result if any part other than the knurled top section cap is turned.

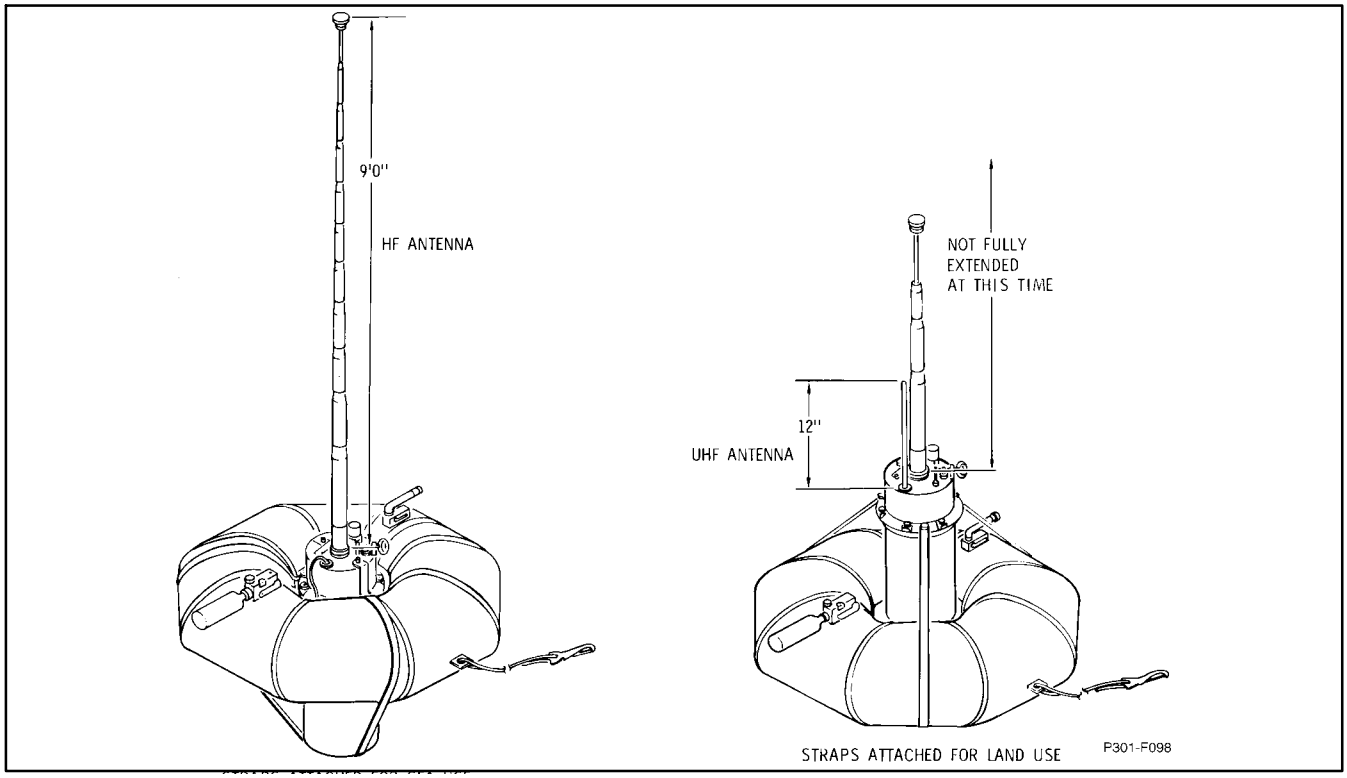


Figure 17-2. AN/PRT-5 Emergency Radio and Float Assembly

6. Unscrew the uppermost, knurled, top section cap of the antenna and pull sections to full extension. When fully raised, the antenna sections are alternate black and gray with the top section gray.
7. Pull out the switch safety pin and turn the power toggle switch on. The transmitting set is now operating.
8. When the transmitting set antennas are fully erected and the power switch turned ON, tone-modulated UHF and HF radio signals are simultaneously and automatically transmitted in all directions. It is a siren-like tone that is received in any radio receiver tuned to either of the emergency transmitted frequencies (8364 kHz or 243.0 MHz).
9. Place the entire assembly in the water and tow it behind the liferaft.
10. When operating on land, be sure the transmitting set is placed on level ground so that the antennas are vertical.

Note

Do not stand close to the transmitting set, as changes in the radiation pattern of the transmitting signals may result.

11. The safety pin can be replaced to prevent the transmitting set from being turned off accidentally.
12. The PRT-5 does not have the capability to:
    a. Activate the shipboard alarm system directly.
    b. Be used for voice or code communications or for receiving signals from search aircraft.
13. The PRT-5 has the capability to:
    a. Activate SARSAT system on the emergency frequency band of 243.0 MHz.

17.21.2 PRC-90 Dual-Channel Survival Radio

The PRC-90 is a hand-held, battery-operated emergency radio that operates on 243.0 MHz emergency guard and 282.8 MHz SAR coordination frequencies. A four-position function selector allows operation in the following modes:

1. OFF.
2. VOICE 282.8 — Voice transmit and receive (using PUSH TO TALK button).
3. VOICE/MCW 243.0 — Voice transmit and receive (using PUSH TO TALK button) or Morse code transmit and receive (using MCW button).
4. BCN 243.0 — Continuously transmits Beacon (BCN) signal. The beacon is detected by the SARSAT system.

The radio is equipped with a built-in separate microphone and speaker. The speaker will be cut out by use of the earphone included with the set.

17.21.2.1 PRC-90 Operation

1. Remove radio and extend antenna fully.

Note

For maximum signal strength when transmitting or receiving, maintain the antenna in a vertical position.

2. Select desired mode of operation using the push-to-turn indicator arrow and thumbwheel switch located on the side of the radio.
3. Adjust volume.
4. If quiet operation desired:
   a. Attach earphone to contacts (located on top of the radio) before turning on.
   b. Transmit and receive as described in step 2.

17.21.3 PRC-90-2 Survival Radio

The PRC-90-2 survival radio has the same features as the PRC-90, with one exception. The MCW key has been replaced with a high-power signal beacon key. This feature does not increase range, but is intended to transmit through foliage. Use of this feature depletes normal life from approximately 18 hours to 8.5 hours and is used only on the 243.0 MHz beacon.

17.21.4 AN/PRC-112B and -112B1 Survival Radio Set

The AN/PRC-112 radio set is designed to assist air and ground personnel engaged in combat search and rescue operations, land navigation, and tracking. It provides data and voice communication capabilities with a low RF signature by using microburst transmissions that contain a variety of identification, location, and situation information. The radio set provides two-way voice communication on five selectable frequencies of 121.5, 243.0, 282.8, and A and B. Channels A and B are programmed with a frequency between 225.000 to 299.975 MHz. The emergency locator beacon operates on 121.5 and 243.0 MHz. Additionally, Distance Measuring Equipment (DME)

information is provided to search units; the DME Light Emitting Diode (LED) will illuminate when the radio's six-digit ID is interrogated by the AN/ARS-6. In addition to all radio features, the PRC-112B series radios provide the user the following capabilities:

1. GPS position interrogation.
2. Specific ID or GLOBAL interrogation versatility.
3. Preprogrammable waypoints.
4. Canned and free format message transmission.

17.21.4.1 AN/PRC-112B and -112B1 Survival Radio Operation

Several parameters must be loaded into each radio prior to use. They include: DME/GPS ID, almanac, encryption key/encryption status, radio frequencies A and B, and GPS data. Power On procedures are controlled by two switches that turn the AN/PRC-112B series radio on and off. Radio VOL/ON/OFF supplies power to both the radio and the GPS functions. This must be in the ON position in order to establish voice communications, be interrogated, or allow GPS data transmission. The GPS PWR key turns only the GPS receiver on and off. It must be ON in order to use any GPS capabilities. The Channel/Mode selector located on the top of the AN/PRC-112B series selects the operating mode of the radio. Seven modes are available:

1. 121.5 — LOS voice communication/transponder capabilities on the 121.5 MHz International Distress Frequency.
2. 121.5 BCN — Transmits a 121.5 MHz beacon on the International Distress Frequency.
3. A — LOS voice communications/transponder capabilities on the loaded programmed frequency.

Note

Unit defaults to mute when switching between modes.

4. B — LOS voice communications/transponder capabilities on the loaded programmed frequency.
5. 243 — LOS voice communications/transponder capabilities on the 243 MHz International Distress Frequency.
6. 243 BCN — Transmits a 243 MHz beacon on the International Distress Frequency.

Note

- Using GPS with the radio set to 243 MHz may result in a failure to achieve a position. Select another channel or turn the radio off until position fix is achieved, then return to 243 MHz or turn the radio back.
- Interrogation of this radio by search aircraft for survivor ID code will be unsuccessful if radio is in one of the beacon transmission modes.

7. 282.8 — LOS voice communications.

For additional information on the AN/PRC-112B/B1 Survival Radio System, refer to NAVAIR 16-35PRC112-1-1.

The GPS has four programmable ("soft") buttons with functions that correspond to the bottom row of the display. They access Message, Position, Navigation, and Menu pages. There are also six fixed-function ("hard" AN/PRC-112B Series Performance Data) buttons:

1. QIT — Returns to previous display.
2. LIT — Illuminates display.

3. MRK — Marks current position.
4. SND — Sends position and message.
5. PWR — Turns GPS on (press for a minimum of 2 seconds).
6. DEL — Deletes all waypoints, messages, and encryption keys.

17.21.4.2 AN/PRC-112B Series Performance Data

The radio is designed to have a battery life of 24 hours in the GPS only mode (radio off) and 7 hours when using radio only, assuming a 10 percent voice duty cycle. When utilizing both the radio and GPS, the battery life is decreased to 6 hours, utilizing the same 10 percent voice duty cycle.

WARNING

Do not install dissimilar batteries. They may explode due to differences in chemical composition.

17.21.5 AN/PRC-149 Radio Set

The AN/PRC-149 radio set is a handheld emergency communications radio and a personal emergency locator beacon transmitter. The radio set provides two-way voice communication on selectable frequencies of 121.5, 243.0, and 282.8 MHz. The personal emergency locator operates in the triple frequency beacon mode. An enhanced rescue message is simultaneously transmitted on 121.5 and 243.0, while a digital message containing beacon identification is transmitted to international satellite search and rescue assets via the 406.025 MHz frequency.

17.21.5.1 AN/PRC-149 Survival Radio Operation

A five-position mode selector switch allows operation in the following modes:

1. Off.
2. GPS — Allows radio to acquire GPS satellites. Once acquired, the GPS LED will light continuously. It is now ready to transmit on triple frequency beacon mode or 406 beacon mode. If the light continues to flash after approximately 5 minutes, then the GPS receiver has failed to acquire. After initial acquisition, the unit updates every 20 minutes. If the radio is turned off, the GPS position information will be lost.

Note

Poor positioning of the GPS antenna results in wasted battery life. If possible, hold the radio in the vertical position.

3. Voice — Allows operator to transmit and receive on two-way communication frequencies. The operator must push and hold both volume buttons simultaneously in order to switch between frequencies.

Note

Unit defaults to mute when switching between modes.

4. Triple frequency beacon — When this mode is selected, the radio set combines simultaneous transmissions on channels 243.0 and 121.5 MHz with burst transmissions at 406.025 MHz every minute. All voice modes are unavailable in this mode. GPS mode is operational.

5. 406 — Transmits a SARSAT beacon message on 406.025 MHz approximately every minute. GPS mode remains operational.

Note

The operator should first acquire the satellites in GPS mode prior to transmitting on the triple frequency beacon mode or the 406 beacon mode. Doing so will ensure first 406.025 MHz signal will include position if radio is not turned off between GPS acquisition and beacon mode.

6. BIT mode — Initiates a BIT anytime the selector switch is rotated from off to any operating mode.

17.21.5.2 AN/PRC-149 Performance Data

The radio is designed to have a battery life of 48 hours in the 406.025 beacon mode and 24 hours in the triple frequency beacon mode. Utilizing a 90 percent triple-frequency beacon and 10 percent voice duty cycle reduces battery life to approximately 8 hours.

17.22 A/P22P-14(V)4 CHEMICAL, BIOLOGICAL, RADIOLOGICAL (CBR) PROTECTIVE RESPIRATOR ASSEMBLY

The A/P22P-14(V)4 Respirator Assembly (Panel Mount Regulator) is authorized to be worn for protection against the elements of CBR warfare. Initial FAILSAFE introduction/training is required prior to use of the A/P22P-14(V)4 assembly. For general information regarding the assembly, refer to Aviation Crew Systems Manual, NAVAIR 13-1-6.10, Special Mission Aircrew Equipment. For information regarding available advanced water survival training while using the CBR ensemble, refer to OPNAVINST 3710.7 series.

17.23 EMERGENCY ESCAPE BREATHING DEVICE (EEBD)

The EEBD is a self-contained, hooded, emergency breathing device that enables personnel to breathe in a smoke-filled or toxic environment.

Note

- If the humidity-sensitive indicator is clear or pink, the EEBD is unusable. The indicator must be light blue.
- The protective cover (box) for the EEBD must be sealed. If the seal is broken, the EEBD must be inspected prior to use and cover resealed.

17.23.1 Description

The life support pack consists of a solid chemical generator that produces oxygen, a chemical scrubber for the removal of carbon dioxide and water vapor from the system, and a venturi flow tube that acts as a pump to recirculate the gases through the closed-circuit loop. The system maintains a safety pressure within the hood, thereby preventing smoke and toxic gas from entering. The device provides sufficient oxygen for the user for a maximum of 15 minutes.

17.23.2 Operation

After removing the breathing device from its storage container, grasp the device in one hand and the red tear strip with the other. Pull down on the tear strip until it is separated from the remainder of the bag and remove the breathing device.

To actuate the breathing device, insert a finger into the ring with the red marker tab marked PULL TO ACTUATE. Pull hard in the direction shown. The ring must separate from the device, making a snap sound. A slight hissing will be heard, indicating the device is working.

To don the breathing device, proceed as follows:

1. Bend slightly forward from the waist, insert thumbs inside the neck seal, and exert an outward pull to spread the seal.

2. Bring the device up to the face while still bending over and place the chin into the opening of the neck seal. Pull the device up and over the head.

3. Stand upright and pull down on the hood so that the retaining straps inside the hood create a snug fit around the top of the head. Be sure the neck seal is in contact with the neck with no clothing or hair creating a gap so as to admit the outside atmosphere.

WARNING

The inner hood of pure oxygen will significantly enhance the combustibility of all materials. Every effort must be made to avoid burning areas.

CAUTION

Temperature of the canister attaching metal screws and the firing pin area can reach up to 105 ±5 °F.

Note

The EEBD is not intended as a bailout or underwater breathing device.

17.24 VICTIM RESCUE UNIT (VRU)/EMERGENCY PASSENGER OXYGEN SYSTEM (EPOS)

The VRU is a vacuum-sealed, self-contained protective breathing device typically used by aircrew and passengers in emergency situations. It provides oxygen during aircraft decompression and when smoke or toxic fumes are present to aid in exiting oxygen-deficient, smoke-filled cabins.

Note

The VRU is not intended for use in fire fighting, bailout, or underwater breathing.

17.24.1 Description

The victim rescue unit consists of a hood, oxygen cylinder, carbon dioxide controller, neck seal, and storage pouch. The system operates by emptying compressed oxygen from the cylinder into the hood and then recycling the carbon dioxide exhaled by the user through lithium hydroxide scrubber panels to provide more oxygen. Depending upon the user's size and exertion levels, the VRU will last from 12 to 60 minutes.

17.24.2 Operation

After removing the VRU from its cordura pouch, open the vacuum-sealed bag and remove the VRU. Unfold the hood far enough to reveal the oxygen cylinder. Hold the hood with neck seal (silver end) facing you. Pull red ball with one hand while holding the oxygen cylinder with the other hand. The ball, pull cord, and lever will pull free from the oxygen cylinder, indicating that oxygen is flowing.

WARNING

Failure to activate the flow of oxygen will result in suffocation and death.

To don the breathing device, proceed as follows:

1. Place both hands inside the neck seal opening, with palms facing each other. Stretch the neck seal open by spreading the hands apart enough to allow the head to enter.
2. Pull the VRU over your head. Start by placing the VRU at the base of the neck, and then pulling the VRU forward over the rest of the head, tucking in all hair, jewelry, etc.

From activation, the VRU hood will begin to inflate. After activation, the sound of oxygen can be heard flowing into the hood for approximately 5 minutes, fully inflating the hood. When the VRU is worn, it is normal for the temperature inside the hood to increase and condensation to appear. Additionally, as oxygen fills the hood, the pressure inside increases. Some wearers may initially experience lightheadedness due to the high oxygen content, but this sensation should quickly disappear.

Once the oxygen supply has been depleted, the VRU will start collapsing to the point that it touches the wearer's face. Remove the VRU when you have evacuated to a safe area, or when directed by qualified personnel.

WARNING

Complete depletion of the oxygen supply will increase CO_2 levels to such a state that the hood must be removed to avoid suffocation. To remove the breathing device, proceed as follows:

1. Open up the silicone rubber neck seal with your hands (opening up underneath the chin is the easiest method).
2. Quickly remove the VRU from your head.

17.25 IN-FLIGHT EMERGENCY DESTRUCTION PLAN (EDP)

In the event of an emergency situation on a P-3, the security of classified material and information is paramount. This in-flight EDP defines the course of action to be followed in order to deny access to such material by unauthorized personnel. This plan is for the emergency destruction of classified documents, software, Communications Security (COMSEC) material, and magnetically stored classified data and databases aboard all versions of patrol squadron aircraft. It also ensures the most rapid and thorough disposition of the materials should the situation warrant. Refer to Figure 12-9 for specific crewmember responsibilities. Additional provisions for the EDP can be referenced in the CNARF/CPRL/CPRP Instruction 5510.4 and applicable theater directives.

Note

Consideration should be given to leaving select communications gear keyed until the last moment to ensure all emergency transmissions are completed.

17.25.1 Emergency Data Destruction Kit (EDDK)

EDDK contains hand tools for emergency procedures only.

The box containing the components will be secured to the deck plate behind the sonobuoy storage rack with CGU-1B cargo straps. Refer to Figure 17-3.

In the event the EDDK is used:

1. Remove only the longitudinal strap going across the top of the component box for access. Do not remove the other two horizontal straps.

17.25.2 EDP Jettison Procedures

1. The main cabin door should be used for jettisoning during emergency data destruction.

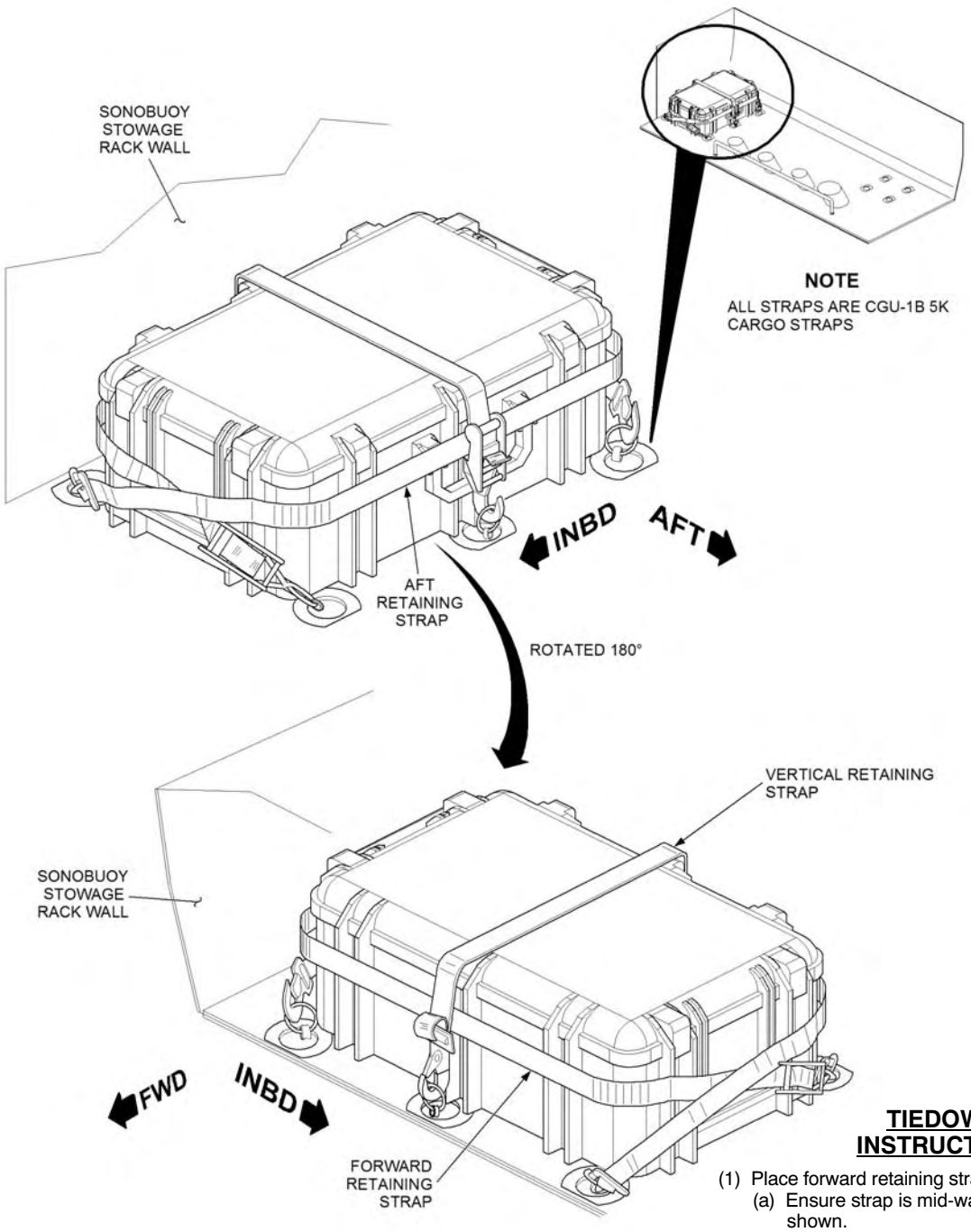
2. Crewmember executing emergency jettison shall don restraint harness, helmet with visor down, and connect safety line.

3. Starboard aft observer seat will be used as tiedown (not cargo rings) to anchor safety line. Safety line will wrap once around seat's center hub and latch back to safety line.

4. Ensure seat is locked on the rail with safety line length set to allow movement of crewmen to within 1 foot of door (out of red area).

Note

Do not jettison material in a locked box. Wide dispersal of destroyed material is preferred.



CAUTION

To open the container in flight, only remove the vertical retaining strap.

TIEDOWN INSTRUCTIONS

(1) Place forward retaining strap on first.
  (a) Ensure strap is mid-way up back side as shown.
  (b) Ratchet until container starts to move.
(2) Place aft retaining strap on next.
  (a) Place strap just above handle, hold firmly with one hand, and ratchet tight.

Note

Strap might move downward while ratcheting but will stop when it hits forward strap ratchet and hook.

(3) Place vertical retaining strap on last.

Figure 17-3. Emergency Data Destruction Kit (EDDK)

PART VI

All-Weather Operations

Chapter 18 — All-Weather Operations

CHAPTER 18

All-Weather Operations

18.1 SCOPE

This chapter contains information and procedures relative to operation and flight under instrument and all weather conditions.

18.2 TIRE HYDROPLANING

Three types of hydroplaning are possible on wet runways. Dynamic hydroplaning occurs when fluid pressures develop between the tire footprint and the pavement. There is a critical speed beyond which the tire is completely supported by fluid. To determine this speed, the square root of tire inflation pressure in psi is multiplied by nine. For this aircraft, with tires inflated to 160 psi, dynamic hydroplaning occurs at approximately 115 knots. Viscous hydroplaning is possible at a much lower groundspeed than dynamic hydroplaning, but it is possible only on very smooth runway surfaces. Rubber reversion hydroplaning is possible at speeds as low as 5 knots if a locked wheelbrake results in the generation of steam in the tire footprint. The obvious results of all forms of hydroplaning are the loss of braking action and the potential loss of ground directional stability. The effect is similar to operation on ice. Landing rollout requirements and crosswind effects should be considered during operation in these conditions.

18.3 COLD-WEATHER PROCEDURES

Special precautions must be taken during all phases of operation from ground handling to landing in temperatures near and below the freezing level. Pilots and aircrew must be fully aware of the effects of cold weather and special procedures required during these conditions.

18.3.1 Preflight

Preflight operations in cold weather will require additional time to complete and should be planned accordingly. The following paragraphs cover procedures to be utilized during conditions of cold to extreme cold temperatures with the types of precipitation that are normally associated with these conditions.

18.3.1.1 Preflight Procedures

The following items are procedures that may be employed to increase safety and aircraft reliability in cold environments. Local directives may provide additional guidelines for specific procedures required in those areas.

18.3.1.1.1 Warming of Aircraft Cabin

Warming of the aircraft cabin to moderate temperatures prior to scheduled preflight time will increase avionics reliability. This is accomplished by beginning ground air-conditioning (utilizing APU ground air-conditioning in the manual mode or a ground air-conditioning unit) 30 to 45 minutes prior to power-up of electronics equipment.

18.3.1.1.2 Exterior Inspection

1. Particular attention should be paid to the following areas during preflight inspection:

   a. Static Ports — Ensure there is no ice or snow accumulation in or around the area adjacent to the flush static ports.

   b. Landing Gear — Ensure the landing gear well and doors are free of ice and snow. Special attention should be paid to landing gear uplock mechanisms and their associated hardware on the landing gear struts, as ice on these assemblies may result in landing gear unsafe up indications after takeoff. Check all landing gear struts and tires for proper inflation. When aircraft are parked outside in slush or snow, it is possible for tires to freeze to the ramp. Ground heaters may be used to release tires.

   c. Flight Controls — Prior to movement of any flight control, including trim tabs and flaps, the control will be visually inspected to ensure ice or snow will not cause damage when actuated. Initially move controls slowly to prevent actuator or seal damage. A greater number of actuations will aid in warming of actuator fluid through increased circulation. Flaps should be lowered and inspected for ice and snow accumulation. Particular attention should be paid to accumulations on upper surface and flap track recesses, as ice or snow buildup in these areas may result in a flap asymmetry trip when flaps are raised. In conditions of freezing rain or snow, flaps should be returned to the up position upon completion of inspection.

Note

Static hydraulic leaks are more common in cold temperatures. Maintenance personnel should be called upon to inspect leaks that continue either statically or under pressure.

   d. Windshield Heat — Initial windshield heating should be accomplished through the use of ground air-conditioning and the associated cabin warming. This should allow windshield panels to reach a temperature sufficient to prevent thermal shock when windshield heat is applied. If this method of warming is unavailable or impractical, another method of heating can be obtained with little likelihood of thermal shock. This may be accomplished by switching power to low for a few seconds at a time with pauses of about a minute between power applications until the panel has become sufficiently warmed. In extremely cold temperatures, this would require the use of the override switch.

   e. Fuel Drains — The likelihood of a low-point drain sticking in the open position is higher at temperatures below freezing, as ice particle formations may prevent proper reseating of fuel drains. The presence of ice in drains may indicate that ice has formed in the sump or tank.

   f. Propeller Inspection — Propellers shall be thoroughly inspected to ensure there is no ice accumulation on blades, cuffs, or islands. Care should be taken when removing ice from blades and cuffs to avoid damaging these surfaces. Ice and snow accumulations may result in severe engine vibrations during starting, and ground personnel shall stand well clear of the propeller plane of rotation to avoid being hit by ice.

Note

External leakage may occur during static and dynamic cycling at low ambient temperatures (below 0 °C) as a result of blade seals taking a cold set. When ambient temperature is below 0 °C, unnecessary static and dynamic cycling of propeller blades should be avoided until fluid is up to normal operating temperatures. Propeller servicing checks should be conducted on postflight or after engine warmup when ambient temperatures are below freezing.

g. Engine Inlets — Inspect engine inlets and compressors for ice accumulation. The APU intake should be periodically inspected during operation for ice buildup on the intake screen. During conditions of freezing rain or snow, engine covers should remain in place after inspection until immediately prior to engine starts.

h. Deicing of Aircraft — Ice and snow can be removed rapidly and efficiently if a deicing solution is applied to the wing and horizontal stabilizers. The application of deicing solution prevents snow from freezing to aircraft surfaces. A good rule of thumb for deicing solution application is to apply a solution/water mixture that results in a solution freezing level approximately 20 °F below the ambient temperature. Continued precipitation will further dilute deicing fluid; therefore, extreme caution should be exercised if takeoff is delayed after deicing. It is normally more efficient to remove snow buildup on the wings by use of a stiff bristled broom. Extreme caution should be exercised when personnel are on wings with ice or snow accumulations, and use of a safety harness is mandatory. Deicing should be accomplished as close to time of takeoff as practical. Deicing truck positioning shall be as to ensure optimum results with minimal truck repositioning.

(1) Deicing precautions:

(a) When applying deicing solution with a sprayer, do not spray fluid into static ports or engine inlets, as the fluid can cause corrosion damage.

(b) Inform the crewmember when deicing is beginning to ensure personnel do not exit aircraft during the evolution.

(c) Ground air-conditioning should be secured to prevent fumes from being drawn into the aircraft.

Note

When deicing forward of the wing, turn ground air off. When deicing aft of the wing, turn ground air on to prevent fumes from entering the aircraft through the negative pressure relief valve.

(d) Deicing solution is extremely slippery. Exercise caution when walking around aircraft after deicing has been completed.

(e) Engine cooling plugs should be removed prior to deicing to preclude the need to walk on the wing surface after deicing solution is applied; therefore, engine nacelles and tailpipe cowlings shall not be deiced.

All snow and ice should be removed from the forward radome and windshield. Snow remaining on the radome may be blown onto the windshield during takeoff roll. Windshield ice accumulation will normally be eliminated when windshield heat is applied; however, remaining ice removal may be accomplished using full-strength isopropyl alcohol.

i. Aircraft Tiedowns — During icy and/or high-wind conditions, the nose tiedown chain(s) shall remain on until ready for engine starts. If a nose tiedown is not available in these conditions, the flightcrew brief shall be held as far forward in the cabin as possible. Consideration should be given to using ICS/PA for the brief. Flightcrewmembers should remain well forward after tiedown removal when ice or high winds are present.

18.3.1.2 High-Wind Conditions

When high-wind conditions are anticipated, certain precautions should be taken to prevent damage to equipment or personnel.

1. Tiedowns — Refer to NAVAIR 01-75PAA-2-1 for minimum tiedown requirements.

2. Radome opening — Opening of either the forward or aft radome is restricted to wind velocities of 20 knots or less.

3. Boarding ladder — In high-wind conditions, it may be necessary to secure the aircraft boarding ladder to prevent lifting from the deck during wind gusts. This may be accomplished by use of tiedowns or sand bags. If no method is available, consideration should be given to raising and stowing the ladder when securing aircraft.

4. Control boosters — To prevent damage to the control surfaces during high-wind conditions, the control boosters shall remain engaged.

18.3.2 Starting Engines

Starting engines in cold weather presents no unusual problems. Engines may be started with oil temperatures down to a minimum of –40 °C, MIL-L-23699 oil. If oil temperature is lower, preheat should be applied until the temperature reaches the minimum prescribed value. When preheat is not available and the cold start temperature is expected to be below –40 °C, MIL-L-23699 oil should be drained and the engines reserviced with MIL-L-7808 oil. A method of engine starts that is effective in temperatures below 0 °C is as follows:

1. Start engines symmetrically in low rpm.

2. After engine oil has warmed above 20 °C, engines may be shifted to normal rpm. Do not move power levers (change blade angle) for at least 10 minutes.

3. After 10 minute warmup, with oil temperature between 20 to 40 °C, the power levers may be set to 1,000 SHP to expedite warmup.

4. When oil temperature reaches 40 °C and gearbox oil pressure shows no fluctuation, maximum power may be applied.

CAUTION

- Use care in setting asymmetric power when aircraft is parked on snow or ice.

- This method prevents excessive oil pressures associated with cold oil temperatures. It also serves to reduce propeller blade seal leakage associated with propeller operation in extremely cold temperatures; however, this leakage should cease when the propeller reaches normal operating temperature.

18.3.3 Taxiing

Taxiing on packed snow, slush, or ice is hazardous, particularly in the vicinity of other aircraft, vehicles, or snowbanks, and especially so with a crosswind or tailwind component. The best general rule is to taxi very slowly, making wide rolling turns when possible. Specific guidelines are as follows:

1. The route from the chocks to the approach end of the runway should be carefully surveyed by the PPC prior to boarding the aircraft. Use the widest possible taxiways or runways if traffic permits.

2. The crewmembers should be stationed as far forward as possible for taxiing. This increases the weight component on the nosewheel.

3. Flaps should be up.

4. The APU should be shut down and doors checked closed prior to commencing taxi. This minimizes the possibility of loose ice chunks being drawn into the APU air inlet during taxi.
5. Taxi using LOW or NORMAL rpm on symmetrical engines. Abrupt power changes should be avoided. The tendency is to overcontrol.
6. The copilot should hold aileron into the wind. If a strong tailwind component is present, control may be aided by holding yoke aft, thus decreasing downward lift on the horizontal stabilizer.
7. Nosewheel steering is useless. Even on packed snow, it is possible for the nosewheel to cock in a direction quite different from the direction of movement. If this happens, the aircraft should slowly be brought to a complete stop, the nosewheel straightened out, and taxiing resumed.
8. It is often advisable for the pilot to rest his hand on the nosewheel steering control to determine the rate and direction of nosewheel movement; however, the control should not be used to steer the aircraft.
9. Ground clearance of the outboard propellers varies with strut extension, but normal clearance is slightly more than 30 inches. Care should be used in the vicinity of snowbanks. If necessary, outboard engines should be shut down and propeller blades be positioned to ensure clearance. If a snowbank or other obstruction is inadvertently contacted by a propeller tip, the engine should be secured immediately with the FUEL AND IGNITION switch and a detailed inspection performed prior to restart.
10. Braking should be checked while moving out of the chocks. On ice at near-freezing temperatures, brakes may be completely ineffective and it is possible to lock the wheels and slide. In these conditions, only reverse and differential power can be used to slow and turn the aircraft. On ice at colder temperatures and on snow or slush, brakes are generally much more effective and may be judiciously used.
11. Use of reverse power blows loose snow, slush, rocks, and gravel ahead of the aircraft, obscuring vision and possibly damaging propellers and engines.

18.3.4 Pretakeoff

Prior to flight in anticipated icing conditions, perform a complete check of all deicing systems. Check the empennage and propeller ice control systems by using the test positions of the respective switches; these switch positions bypass the ground air sensing relays and allow the system to be checked on the ground. Check the wing deicing system and monitor each wing section for proper operation.

CAUTION

Full operation of the wing deicing system on the ground is prohibited.

Check the windshield heat for proper operation. Engine anti-ice should not be used during taxi and takeoff unless icing exists at or near ground level. It is recommended for use during taxi and takeoff in conditions of high atmospheric moisture content at temperatures of +8 °C or lower.

18.3.5 Takeoff

In cold-weather operations, all factors that affect takeoff performance must be carefully considered prior to takeoff roll. Use the longest runway available considering wind, runway condition, and terrain clearance. At times it may be desirable to take off with a crosswind or a tailwind component when all other factors are considered. Prior to every takeoff, Minimum Control Speed on Ground ($V_{MC\ GRD}$), Refusal Speed (V_R), and Decision Speed (V_D) should be computed as accurately as possible, using the current runway conditions. The distance required to accelerate and stop

on an ice-covered runway may be twice that required on a dry runway. Some other factors to be considered when computing takeoff performance include:

1. Three-engine stopping performance. When power is used for directional control on icy runways, the total deceleration thrust is not the maximum for three engines. In balancing the thrust with a feathered outboard propeller, total deceleration will be approximately equal to that of two engines. With an inboard propeller, feathered thrust will be slightly higher.
2. Lack of nosewheel steering.
3. Time lost in transitioning from takeoff power to reverse. Transition time is greater than on a dry runway because of the effect of power change on directional control.
4. Propeller reverse thrust versus true airspeed.
5. Directional control using asymmetrical power.

In most conditions, decision speed will be equal to $V_{MC\ GRD}$ or approximately 100 knots. On ice-covered runways, $V_{MC\ GRD}$ may be increased to equal $V_{MC\ AIR}$ or approximately 110 knots. Under these conditions, once a decision is reached, refusal may be impossible. Snow or slush-covered runways provide better braking and stopping conditions than on ice, but takeoff distances are correspondingly increased. Increased takeoff roll to reach liftoff speed refer to Figure 18-1.

WET (DENSE) SLUSH OR WATER DEPTH	DRY SNOW DEPTH	APPROXIMATE INCREASE IN DISTANCE
1/4 inch	3 inches	6 percent
1/2 inch	4 inches	15 percent
3/4 inch	5 inches	28 percent
1 inch	——	50 percent

Figure 18-1. Covered Runways Braking and Stopping

Note

During takeoff, treat everything as wet (dense) slush or water except dry snow. With runway conditions having more than three-fourths inch of slush or standing water or snow in excess of 5 inches, takeoffs are not recommended.

Before commencing takeoff roll on a slush-covered runway, line up in the center of the runway to provide ample maneuvering room. Increased stick forces are required to break the nosewheel free of the slush. After takeoff, cycle the gear and flaps to prevent slush freezing on the gear and flaps. Make rolling takeoffs on ice and snow, maintaining directional control with power until rudder control is obtained. At this point, the flight engineer should maintain the power setting. On rough runways, maintain zero elevator angle to reduce loads on the nose strut. (When the yoke is even with the aft edge of the glareshield, the elevators should be at zero angle.) Crosswind takeoffs on ice and snow are extremely hazardous and should be conducted with extreme caution. Hold aileron into the wind and maintain directional control with differential power. When rudder control is established, call for maximum allowable power. Use normal crosswind techniques for liftoff.

If icing conditions prevail on the ground or are encountered shortly after takeoff, the engine anti-ice system should be on. Since the wing anti-ice system operates effectively as a deicer, it shall not be on during takeoff as the power loss incurred is excessive for the value gained. The propeller deice control switch should be placed ON as soon after takeoff as is practical.

As soon as possible after takeoff in icing conditions, observe the leading edge of the wings for ice buildup so that timely deicing procedures may be employed. During daylight, the wings can be observed from the flight station; at night, it may be necessary to use a light at the TACCO and NAV/COMM stations.

Water is normally not a problem on takeoff if airport runway drainage is adequate, but as with slush, a relatively shallow layer of water may cause considerable deterioration in performance and problems of controllability. This occurs as a result of the retarding force of the water action on the wheels and to the impingement drag from the nosewheel spray on the aircraft. If there are large areas of standing water or water and slush on the runway, the takeoff should be conducted as though a slush condition exists. Remember that the drag at high speeds is considerable and an increasing nosedown moment, caused by the thrust and main wheel drag couple, builds up so that the nosewheel is difficult to lift off. Lift the nosewheel early and hold just on the surface of the water during the takeoff run. Be aware that the retarding force of the snow, slush, or water acting on the wheels is proportional to the square of the forward speed; hence, it is most pronounced in the later stages of the takeoff run. Additional conditions should be considered such as field elevations above 2,000 feet, upslope runway gradients in excess of 1 percent, loss of an operating engine (i.e., loss of thrust to overcome drag), and obstacle clearance that is adversely affected by the reduced acceleration.

18.3.6 In Flight

The P-3 aircraft is equipped for flight through most icing conditions. On unmodified aircraft, no weather radar indicator is provided for the pilots; however, frontal activity or heavy precipitation can be detected by the radar equipment. In flying through areas of thunderstorm activity, care should be exercised because severe turbulence is likely to be encountered. (Refer to Airspeed Limitations, paragraph 4.6.) Instrument panel white floodlights, controlled by a rotary switch on the pilot overhead panel, can be turned on to reduce the blinding effect of nearby lightning flashes.

CAUTION

- The pilot and Electronic Warfare Operator (EWO) should ensure the turret is retracted prior to entering any area of anticipated icing or hail.

- It is possible for high levels of moisture to collect and freeze onto trim cables and pulleys, causing the system to bind. If a frozen trim system is suspected, troubleshoot by descending below the freezing level before assuming a binding condition exists.

Whenever structural icing conditions are encountered in flight, the wing and empennage ice control systems should be utilized as a combination deicing system. Ice on the leading edges of the wings should be allowed to build up to approximately one-half inch, then all operating engine bleed-air shutoff valves should be opened and the empennage deice system shall be selected ON. To remove ice from the wings in the most efficient manner, place the OUTBD wing ice control switch on, monitor temperature, and, if possible, the wings should be visually observed until the ice breaks away. Place the OUTBD wing ice control switch off. Repeat this procedure for the CTR and INBD sections. Normally a 10-degree rise on the temperature indicator is sufficient to remove ice from the wings. These procedures normally require the switches for each section to remain on for 20 to 30 seconds. When the ice has broken away from all the wing surfaces, position the wing deicing switches to OFF until ice builds up sufficiently to repeat the cycle. The empennage deice switch should be left on until the empennage ice breaks away. To ensure complete empennage deicing, leave the control switch on for a minimum of one complete cycle.

CAUTION

Prolonged use of the empennage deice system in light icing conditions may result in damage to the leading edge of the empennage.

One technique to isolate a propeller deicing system malfunction involves turning the control switch OFF as soon as the abnormal reading is observed (timer motor stops at this position), then pulling all four PROP DEICE circuit breakers. The system is turned back ON, and the circuit breakers reset one at a time until an ammeter reading is obtained, indicating the faulty propeller. On aircraft incorporating the solid state timer motor, placing the control switch to off resets the deice cycle to the number 1 propeller cuffs. Faulty areas may be isolated by timing the deice cycle (refer to Figure 2-35).

Note

Airspeeds in excess of 200 knots tend to reduce the possibility of ice buildup on the underside of the wing and empennage.

In flight, engine anti-icing heat should be on prior to entering any area where structural icing is likely to exist. This system is truly an anti-icing system even though it does have the capability of operating as a deicer. When activating or securing this system, monitor SHP closely for an indication of proper operation of the engine anti-icing valves. Operation of the propeller deicing system should be initiated when structural icing is evident.

CAUTION

Anti-ice protection is not available to engines secured for loiter operations. Two- or three-engine loiter in icing conditions may cause ice buildups in the feathered engine, leading to damage or possible engine failure upon restart. Two- or three-engine loiter should not be utilized in conditions where visible moisture is present at ambient temperatures below +10 °C because of possible ice buildup in the shut-down engine.

18.3.7 Approaches and Landings

Approaches and landings in cold weather areas can bear little resemblance to normal approaches and landings. Where icing during the approach and reduced braking effectiveness on the runway may be expected, caution must be exercised throughout the approach and landing. Descent should be made with gear and flaps up. Ice buildup on gear and flaps may cause damage on subsequent retraction. On long final, flaps can be lowered and airspeed reduced to normal approach speeds. In gusty wind conditions, speeds on final may be maintained 5 to 10 knots higher but, at the touchdown point, speed should be down to normal. Altitude on final and aircraft weight must be carefully considered, as both will affect stopping distance.

Note

Ten knots excess speed can increase stopping distance 1,000 feet.

If the final approach is made through icing conditions, cycle the wing deicers to clear the wing. Engine anti-ice may be used through completion of landing. Be alert for possible NTS action with power levers at FLIGHT IDLE.

If possible, land into the wind; for each knot of headwind or tailwind, landing distance will be decreased or increased by 1 percent. On crosswind landings, directional control must be maintained by differential thrust; do not use nosewheel steering. As a result, maximum reverse thrust is not available. Move the power levers into Beta range, establishing good directional control before applying full reverse thrust. As the aircraft slows, test the braking effectiveness by applying the brakes symmetrically. Do not lock the brakes.

Note

During the landing rollout, it is doubtful if any wheelbraking is possible in water or slush at higher speeds because of tire hydroplaning effects.

If a landing must be made to a runway with a crosswind or downwind component, refer to the Wind Component chart in Chapter 30 to determine minimum recommended Runaway Condition Reading (RCR).

Land on the centerline, allowing ample runway surface for lateral movement on rollout. Snow can obscure the end of the runway completely. Plan the approach to land slightly long on snow to ensure landing on the runway. If loose snow is present on the runway, the use of high power in reverse at low airspeeds (approximately 50 knots) may result in a cloud of snow ahead of the aircraft, tending to obscure forward vision. On all icy runways, come to a complete stop before attempting to turn off the runway. To avoid damage to the wing trailing edge and the flap retraction mechanism, it is recommended that after landing on snow or slush-covered runways, the wing flaps should not be retracted beyond the TAKEOFF/APPROACH position before shutting down the engines. This places the flaps in a position sufficiently high to protect them from flying debris and also affords adequate clearance in the wing flap well so that damage caused by accumulation of snow or slush will be avoided. (Refer to Chapter 30 for effect of runway surface condition.) Utilize taxi precautions mentioned above for all ground operations. Park the aircraft in position so that tiedown pads are easily accessible. Tiedown pads on the ramp should be free of ice before attempting tiedown. In gusty winds, keep the crewmembers stationed forward until nose tiedowns are in place.

The propellers shall be secured in the START blade angle position of approximately 0°. In extremely cold weather, remove the battery and water breakers to prevent freezing. Do not set the parking brakes in freezing weather or when brakes are overheated.

Note

It is neither necessary nor desired to feather the propeller to prevent windmilling in strong wind conditions.

18.4 HOT-WEATHER PROCEDURES

Operations in extreme heat pose unique challenges for the crewmembers and aircraft. Special precautions are necessary for operations in extreme hot weather.

18.4.1 Mission Planning

Check flight profile obstacle clearance for takeoff power selection. Expect minimal 3 and 4 engine rates of climb. If possible, the APU or external air-conditioning source should be utilized for ground air-conditioning 2 hours prior to preflight.

18.4.2 Preflight

Internal avionics will cause cabin temperature to increase when turned on. Selected avionics should be turned off after preflight is complete, if practicable. Reenergize remaining equipment during taxi. Flight station sun visors should remain in place as long as practicable. Removal may be necessary during preflight but should be reinstalled to prevent cabin temperature increase. Ensure the main cabin door remains closed to preserve cooling.

18.4.3 Engine Starts and Taxi

Slow acceleration times are common during engine starts, especially when engine is started off APU air. Isolating engine 1 for starts is recommended due to accessory loading. A combination of APU air and ground air starting equipment may be necessary to start engines. The start button should be pulled closer to 64 percent rpm to ensure adequate engine acceleration. To prevent excessive TIT during starts, engine 4 may be started and the APU secured prior to starting engine 3.

If engine anti-ice checks are conducted, engine anti-ice lights may illuminate quickly and take longer to extinguish.

During taxi, engine oil hot and EDC hot lights may illuminate. Oil cooler augmentation procedures may not be effective in extinguishing oil hot lights. If oil cooler systems are functioning normally, takeoffs are permitted with one or more oil hot lights illuminated.

18.5 TURBULENT AIR PENETRATION

Care must be taken to ensure all loose gear is stowed in a safe place, preferably lashed to the deck, at all times. Full use of the radar will assist in avoiding turbulence associated with frontal and system weather, but the flightcrew should always be alert for clear air turbulence while flying at altitude. Crewmembers should be placed in their ditching stations with hardhats on and seatbelts fastened to reduce the possibility of injury to personnel. The aircraft should always be prepared for severe turbulence. For conditions of moderate to extreme turbulence, 220 KIAS is recommended. In light to moderate conditions, crewmember comfort may be improved by reducing airspeed to a minimum of 190 KIAS (1.52 V_s above 120,000 pounds).

WARNING

Extreme turbulence and hail may extend outward as far as 20 miles from a fully developed thunderstorm cell. The pilot and EWO should attempt to avoid thunderstorm cells by at least 20 miles.

18.6 INSTRUMENT FLIGHT

To have separate inputs to the pilot and copilot attitude indicators and HSI direction indicator dials, the pilot ATTD and HDG switches should be set to INS-1 and the copilot switches to INS-2. The copilot normally handles the communications and radio NAVAIDs on airway flights. All clearances and instructions received from ATC controllers are recorded by the copilot, who ensures all clearances and instructions are understood by the pilot. During IFR departure and arrival, the copilot ensures primary and secondary transceivers are set on proper frequency and the pilot is informed of the radio setup.

18.7 HIGH-ALTITUDE PENETRATIONS

Penetrations may be made in any configuration within the aircraft operating envelope. For example, a penetration made with APPROACH flaps, gear down, and at 190 KIAS results in a descent rate of 2,000 to 3,000 fpm. Due regard for maneuver airspace, turbulence, and approach weather should be made in selecting an appropriate aircraft configuration. On teardrop penetrations, limit bank angles to those that result in standard-rate turns.

18.8 INSTRUMENT APPROACH PROCEDURES

Flightcrew coordination is of utmost importance during the execution of instrument approaches. The following general and specific duties are performed by the copilot.

Note

- Canceling of the wheels warning system shall be done only at the direction of the pilot at the controls.
- When operating at civilian fields or where other aircraft are using VHF circuits, consideration should be given to using VOR-2/VHF as a primary communications source.

18.8.1 General Duties

1. Back up the pilot during all phases of the approach, providing assistance as required. Ensure checklists are completed.
2. Ensure applicable navigation and communications receivers are tuned to correct frequencies during the approach.
3. Handle all communications during terminal procedures.
4. Record the following information when received from the controlling authority:
   a. Headings, altitudes assigned.
   b. Communications frequencies assigned.
   c. Clearances.
   d. Applicable airport information (runway, altimeter, wind, etc.).

18.8.2 Specific Duties

1. Notify pilot when 1,000 feet prior to assigned altitude.
2. Record approach/landing speeds when given on the Approach checklist.
3. When the pilot calls for landing gear extension, repeat approach/landing speeds; repeat Decision Height (DH)/Minimum Descent Altitude (MDA) (as applicable).
4. Call out anytime airspeed is slower than specified.
5. Call out “APPROACHING DH/MDA” (as applicable) when 100 feet above minimums.
6. Call contact and runway location (left/right) when runway or approach lights are in sight. Repeat approach/landing speeds.
7. Complete Landing checklist with pilot/flight engineer and review at 500 feet AGL.
8. Be prepared to assist the pilot as directed in the event a missed approach procedure must be executed.
9. Call out any rate of descent in excess of 1,000 fpm when on final approach.
10. Call “Approach Mode” during FMS approaches (FMS 1 or FMS 2 selected as course source) when RNP value sequences to RNP 0.3 (typically 2 nm from the Final Approach Fix [FAF]) and APPROACH is displayed on the CDU-7000.
11. Set the desired altitude in the ADDU and call out the altitude. The pilot shall repeat the desired altitude after verifying that the altitude is properly set.
12. Make all necessary entries into the CDU-7000. Flight plan modifications shall be verified by the pilot prior to the copilot executing the flight plan.

The pilot should be alert for any excessive difference between his and the copilot altimeters, especially during the final phase of the approach.

18.8.3 Precision Approaches

18.8.3.1 Ground Controlled Approach (GCA)

A GCA approach is normally made from a radar handoff from an ATC (Figure 18-2) facility to a precision final controller. The following is recommended for execution of this approach at normal landing weights:

1. Entry — Complete Descent checklist with gear and flaps as required.
2. Downwind — Approach checklist complete.
3. Base leg — Flaps to TAKEOFF/APPROACH. Drop landing gear on base leg, dog leg, or extended final as desired.
4. Final — Lower landing gear, if not previously lowered, and complete the Landing checklist no later than glidepath interception.
5. Glidepath — Flown with APPROACH flaps, at a recommended airspeed of 1.35 V_S +5 knots but not less than 130 KIAS. Maintain approach airspeed until visual contact is made.

Note

When weather is at or near GCA minimum, consideration should be given to landing with APPROACH flaps versus LAND flaps if length of runway permits. This procedure will minimize movement in aircraft pitch, a desired effect when the aircraft is maneuvered for landing during the critical transition period after visual contact with the runway is obtained. Consider landing ground roll distance when landing with APPROACH flaps.

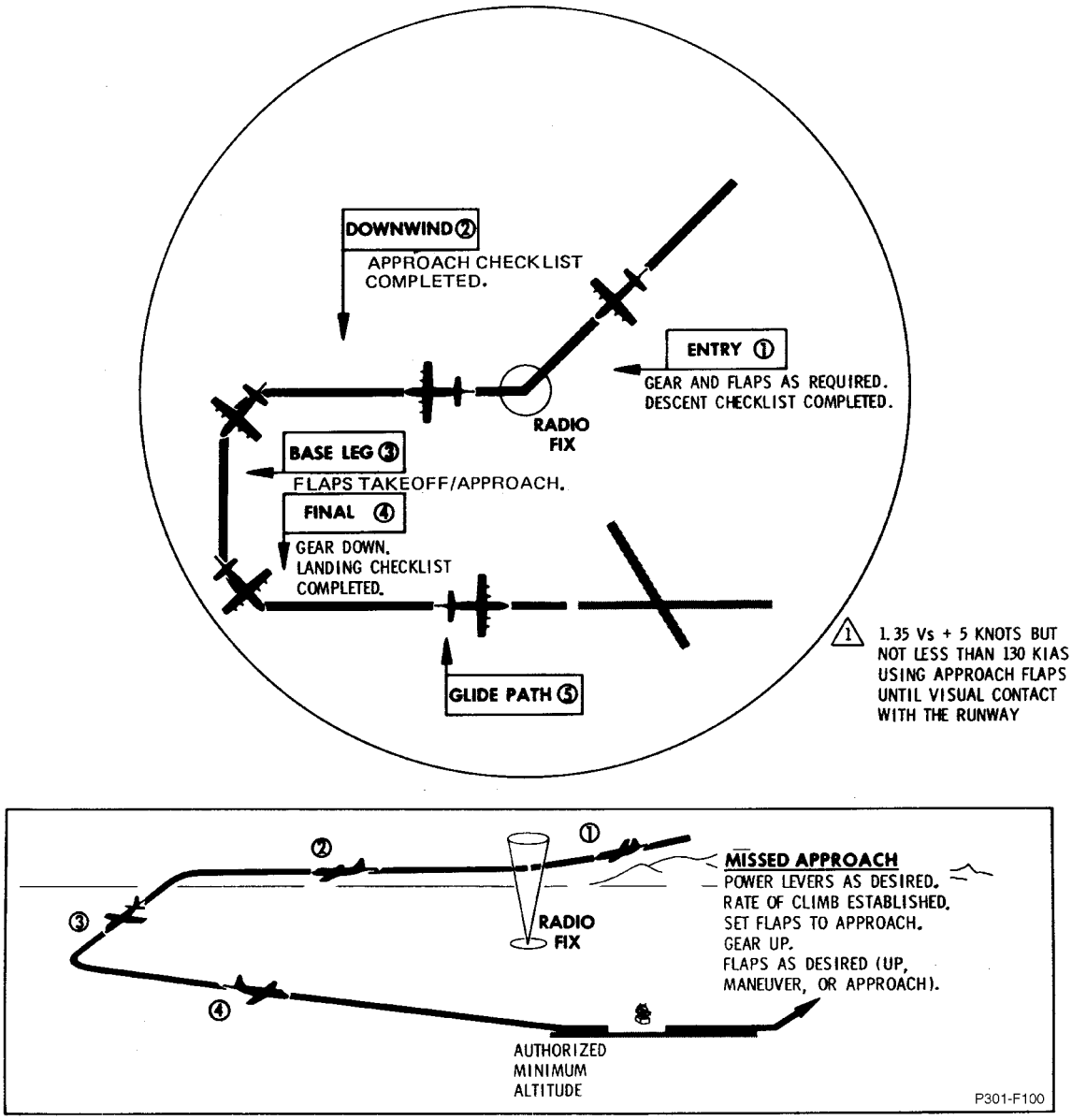
18.8.3.1.1 Recommended Equipment Setup

1. Use UHF-1/UHF-2 and VOR-2/VHF for primary and secondary communication frequencies as required.
2. Both pilots rotate HSI COURSE SET knobs so that the course needle points to the inbound course on the dial face.[1]

If localizer is to be used in conjunction with GCA instructions, continue with the following steps:

3. Pilot uses VOR-1 to provide input to his HSI course bar by selecting VOR-1 on his HSI COURSE knob.
4. Copilot uses VOR-2 (unless needed for communication) to provide input to his HSI course bar by selecting VOR-2 on his HSI COURSE knob.
5. Tune ADF to the compass locators as needed. Both pilots can receive bearing indications on the HSI by selecting ADF on the HSI BRG knob.

[1] Heading set marker can be used to set in reference headings as desired. The copilot marker is slaved to the pilot marker.



MINIMUM RECOMMENDED AIRSPEEDS

AIRSPEED-KNOTS IAS	ENTRY	DOWNWIND	BASE LEG	FINAL
THREE/FOUR ENG	AS DESIRED	AS DESIRED	APP FLAPS (1.35 V_S MIN)	1
TWO ENG	AS DESIRED	CLEAN 1.52 V_S (160 MIN)	APP FLAPS 1.35 V_S (145 MIN)	1.35 V_S + 5 (145 MIN)
NO FLAP	1.52 V_S (160 MIN)	1.52 V_S (160 MIN)	1.52 V_S (160 MIN)	1.2 V_S (135 MIN)

Figure 18-2. Typical GCA Pattern

18.8.3.2 ILS Approach

The P-3 aircraft is equipped with a glideslope receiver that is energized whenever the VOR-1 receiver is powered. The desired ILS localizer frequency must be selected manually. The published ILS front course inbound course must always be set in the COURSE window on the HSIs. The HSI is so designed that corrections are flown toward the course bar at all times, regardless of the heading or position of the aircraft (including back-course approaches).

Note

- Removal of the AJN-15 steering computer will disable the ILS system.
- Aircraft equipped with the ARN-87 VOR receiver and the 51V-4 UHF glideslope receiver will not process glideslope information with ILS frequencies containing a hundredths place digit (e.g., 110.35 MHz). Localizer information is available.

18.8.3.2.1 ILS Front-Course Manual Procedure

1. Use UHF-1/UHF-2 and VOR-2/VHF for primary and secondary communication frequencies as required.
2. Tune VOR-1 and VOR-2 receivers to the Localizer (LOC) (or ILS) frequency.
3. Set the published ILS inbound course (front course) in the COURSE window of the HSIs.
4. Set HSI COURSE knob on pilot HSI control panel to VOR-1/ILS position and to VOR-2 on the copilot HSI control panel.
5. Select BRG 1 control on pilot HSI control panel and BRG 2 control on copilot HSI control to ADF.
6. Tune in the outer compass locator on the ADF.

Note

For easiest transition to localizer course, do not exceed a 90° intercept angle.

7. Monitor outer compass locator passage by ADF reversal and marker beacon visual and audio indications.
8. The ADF may be reset to the middle marker compass locator and passage monitored in step 7.

Note

It is reemphasized that the aircraft always flies toward the HSI course bar to correct to on-course. Once the inbound course is set in the HSI COURSE windows, it should not be changed.

18.8.3.2.2 ILS Back-Course Manual Procedure

An ILS (or LOC) back-course approach is similar to a front-course approach except:

1. No glideslope is available.
2. NAVAIDs probably are different. (Refer to approach plates for NAVAIDs.)
3. Set ILS front-course inbound course into the HSI COURSE window.

Note

This mechanically inverts the center portion of the HSI display so that the aircraft must always be flown toward the course deviation bar. The head of the course arrow will point down instead of up, as in a front-course approach. The HSI will give correct sensing with the front course inbound course set; however, the FDI "Runway" will give reverse sensing.

18.8.3.2.3 AJN-15 Flight Director — ILS Mode Front-Course Procedure

1. Communications and NAVAID setup will be as described under ILS Approach paragraph 18.8.3.2.1.
2. Turn COURSE SET knob on HSI to ILS inbound course.
3. Set selected heading marker on HSI to desired ILS intercept angle.

Note

Limit intercept angle to 90° or less. Captures at an intercept angle greater than 90° can cause excessive overshoot. Optimum capture angle is 45° or less.

4. Verify PITCH COMMAND knob is set to 0 and is in detent position.
5. Engage ROLL, MAN HDG, and RADIO ARM on flight director control panel (lights illuminate amber).

Note

If the course deviation bar on the HSI indicates less than two dots, radio capture will be immediate and both MAN HDG and RADIO ARM lights will illuminate green, signifying that radio capture has occurred and the FDI command indicator will then steer to the localizer; however, best FDS performance for intercept angles of 45° or greater is obtained if the ILS mode is engaged approximately 15 miles from the runway and localizer deviation is two dots or more.

6. Fly manual heading mode until radio capture occurs (at slightly less than two dots command bar deviation). Both MAN HDG and RADIO ARM lights then change from amber to green.

Note

Do not move the COURSE SET knob on the pilot HSI once the radio mode is engaged; movement of the knob at this time can generate spurious FDS commands to the command bar. Should a change in selected course be necessary, reengage the MAN HDG mode before moving the COURSE SET knob.

7. At one or less dots of localizer deviation, press the PITCH and GLIDE SLOPE ARM pushbuttons on the flight director control panel (lights illuminate amber).
8. Glideslope capture occurs when glideslope deviation indicator is within one-fifth dot deviation. When capture occurs, GLIDE SLOPE ARM light changes to green.

Note

If glideslope capture does not occur and the GLIDE SLOPE ARM light remains illuminated amber, press the GLIDE SLOPE ARM pushbutton again. This action bypasses the normal capture and provides for glideslope capture whenever the glideslope deviation is one dot or less.

9. Follow FDI localizer and glideslope deviation commands for completion of the ILS approach.

18.8.3.2.4 AJN-15 Flight Director — ILS Back-Course Procedure

The flight director should be designated the primary procedure for flying a back-course ILS approach and the manual procedure designated the backup method. The following procedures are recommended:

1. Set communications and tune radio facilities as required.
2. Turn COURSE SET knob on HSI to ILS back course.
3. Set selected heading marker on HSI to desired ILS intercept angle.

Note

The optimum capture angle is 45° or less.

4. Engage ROLL, MAN HDG, RADIO ARM, and BACK COURSE localizer on flight director control panel.
5. Fly manual heading mode until radio capture occurs at slightly less than two dots course bar deviation. Both MAN HDG and RADIO ARM lights then change from amber to green.

Note

Do not move the COURSE SET knob on the pilot HSI once the radio mode is engaged; movement of the knob at this time can generate spurious FDS commands to the command bar. Should a change in course be necessary, reengage the manual heading mode before moving the COURSE SET knob.

6. Follow FDI localizer deviation commands for completion of the localizer approach.

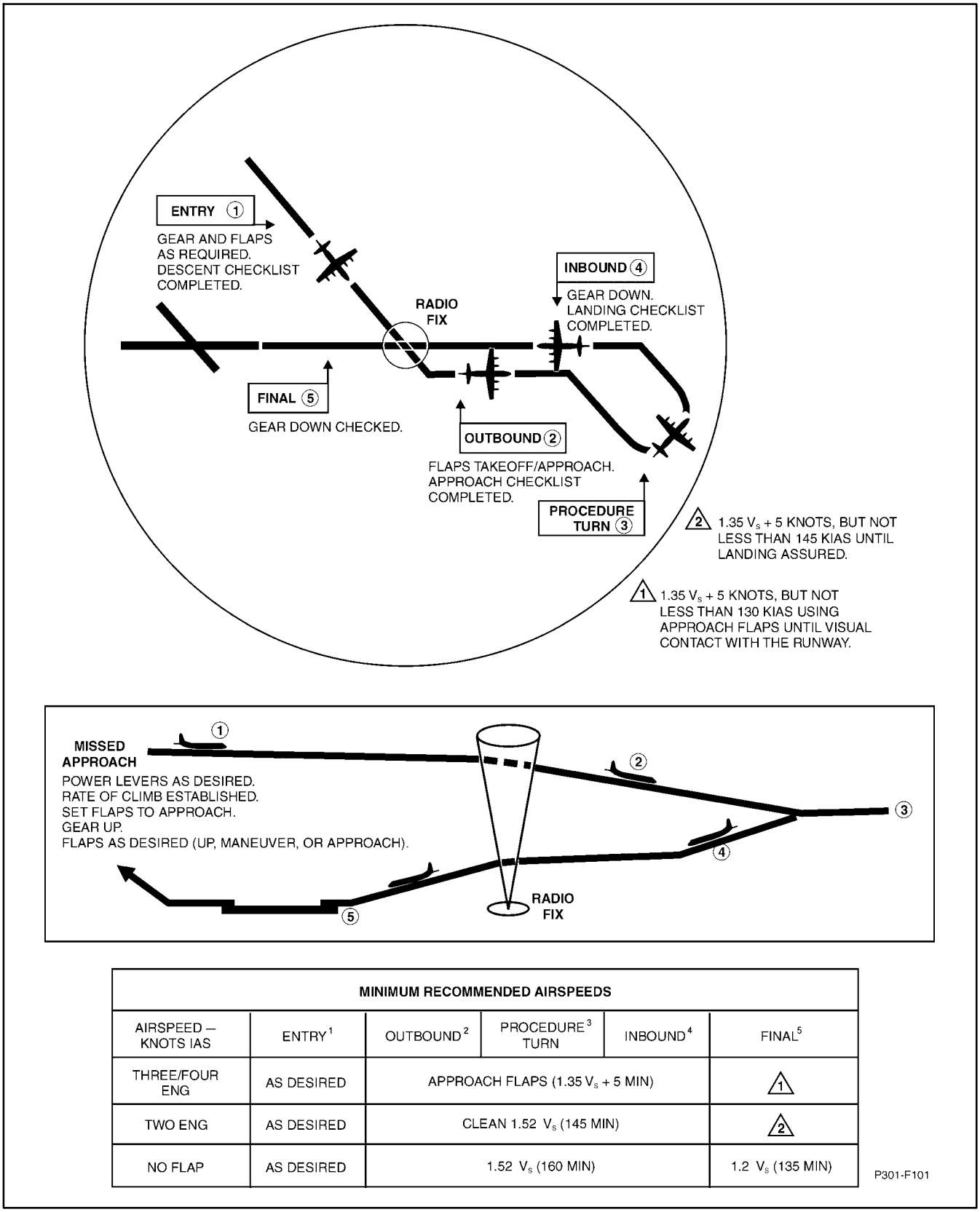
Note

If it should become necessary to terminate use of the flight director during the approach after deselecting roll on the flight director control panel, the pilot must turn the COURSE SET knob on his HSI to the ILS front-course inbound heading to avoid reverse sensing on both the HSI and FDI deviation indicators. After setting in the front-course heading, the HSI will have correct sensing while the FDI localizer deviation indicator will have reverse sensing.

18.8.4 Nonprecision Approaches

A nonprecision approach (Figure 18-3) is normally made from over the navigational facility or from a TACAN fix serving the destination airport. The following is recommended for execution of this approach at normal landing weights:

1. Entry — Complete Descent checklist with gear and flaps as required.
2. Outbound — APPROACH flaps and with the Approach checklist complete.
3. Procedure turn — Comply with standard instrument procedures.



MINIMUM RECOMMENDED AIRSPEEDS					
AIRSPEED — KNOTS IAS	ENTRY[1]	OUTBOUND[2]	PROCEDURE TURN[3]	INBOUND[4]	FINAL[5]
THREE/FOUR ENG	AS DESIRED	APPROACH FLAPS (1.35 V_S + 5 MIN)			1
TWO ENG	AS DESIRED	CLEAN 1.52 V_S (145 MIN)			2
NO FLAP	AS DESIRED	1.52 V_S (160 MIN)			1.2 V_S (135 MIN)

Figure 18-3. Typical Low-Altitude Nonprecision Procedure Turn Approach

4. Inbound — Lower the landing gear and complete the Landing checklist by the final approach fix, but no later than 3 miles from the field.

5. Final — Slow aircraft in order to arrive at the final approach fix or at least 3 miles from the field at a recommended airspeed of 1.35 V_s +5 knots, APPROACH flaps, but not less than 130 KIAS. Maintain approach airspeed until visual contact is made.

18.8.4.1 Circling Approaches

WARNING

Circling approaches are not recommended unless the aircraft can safely maneuver within 1.7 nm of the airport at approach category C minimums or within 2.3 nm of the airport at approach category D minimums. This is the area wherein the 300-foot obstruction clearance is normally provided.

When executing a circling approach, maintain final approach speed (1.35 V_s +5 knots) but not less than 140 KIAS. Turning final, execute normal landing.

18.8.4.2 TACAN Approach

1. Use UHF-1/UHF-2 and VOR-2/VHF as primary and secondary communication frequencies as required.

2. Tune appropriate channel with TACAN channel selector.

3. Set TACAN function switch to T/R. This provides distance indication on HSIs.

4. If the TACAN is the only aid to the facility, then both pilots set HSI COURSE and HSI BRG knobs to TACAN.[1]

5. Pilot rotates HSI COURSE SET knobs so that inbound course appears in COURSE window. Copilot course indication is slaved to the pilot indication.

6. Course, bearing, and distance can be read on the HSIs.

18.8.4.3 VOR Approach

1. Use UHF-1/UHF-2 and VHF as primary and secondary communication frequencies as required.

2. Pilot selects VOR-1 on HSI COURSE selector and HSI BRG 1 selector.

3. Copilot selects VOR-2 (unless needed for communication) on HSI COURSE and HSI BRG 2 selector.[1]

4. Both pilots rotate HSI COURSE SET knob until inbound course appears in HSI COURSE windows.

5. Course and bearing can be read on HSIs.

6. The heading set marker can be used for heading reference as desired.

[1] If using VORTAC facility, copilot should select alternate NAVAID.

18.8.4.4 ADF Approach

1. Use UHF-1/UHF-2 and VOR-2/VHF as primary and secondary communication frequencies as required.
2. Tune ADF receiver to the radio beacon and select ADF function switch to ADF.
3. Both pilots select ADF on HSI bearing knobs.[2]

18.8.4.5 Nondirectional Beacon Automatic Direction Finder, UHF Approach

1. Use UHF-2 and VHF as primary and secondary communication frequencies as required.
2. Tune UHF-1 to homer to be used as follows:
   a. Tune appropriate frequency.
   b. Function selector in ADF mode.
3. Both pilots select UHF/DF on HSI bearing knobs.[2]

Note

The ARA-50 UHF-DF bearing is inaccurate and oscillatory with the landing gear extended. It should be used for instrument landing approaches only when other NAVAIDs are not available, and, if used, the landing gear should remain retracted until visual contact is made with the landing area.

18.8.4.6 Localizer Approach

Localizer (LOC) approaches can be executed by departing the outer compass locator at the prescribed altitude and maintaining the recommended rate of descent and airspeed.

The HSI is so designed that the aircraft flies toward the course bar at all times regardless of the heading or position of the aircraft (including back-course approaches).

1. Use UHF-1/UHF-2 and VHF as primary and secondary communications frequencies as required.
2. Tune both VORs to the LOC (or ILS) frequency and set the published inbound course in the HSI COURSE windows. Select ROLL STEERING, MAN HDG, and RADIO ARM on flight director control panel.
3. Select the pilot HSI COURSE knob to VOR-1/ILS and the copilot to VOR-2.
4. Select pilot and copilot HSI BEARING knobs to ADF.
5. Tune in the outer compass locator on the ADF.
6. Monitor outer compass locator passage by ADF reversal and marker beacon visual and audio indications.
7. The ADF may be reset to the middle marker compass locator and passage monitored as in step 6.

It is reemphasized that the aircraft always flies toward the course bar to correct to on-course when the published inbound course is set in the HSI COURSE windows.

When using omniranges, the inbound or reciprocal course may be set in the HSI COURSE windows. In either case, on-course corrections are always made by flying toward the course bar; however, it is recommended that the inbound course be set in the HSI COURSE window.

[2] The heading set marker can be used for heading reference as desired.

18.8.5 Missed Approach

If runway environment has not been sighted at the specified distance (approach minimums) from the facility, a missed approach shall be executed. The pilot should apply sufficient power to establish a positive rate of climb, ensure approach flaps are set, and then raise the gear. At 140 KIAS or more with gear up, set the flaps as desired.

18.9 FMS PROCEDURES

The use of GPS for flight in controlled airspace requires thorough knowledge of the terms and nomenclature used to describe and depict GPS navigation processes. The FMS generated course information shall not be used as the sole source of navigation during en route navigation until aircrew have received required training and designation. When utilizing the FMS for course guidance, INU/GPS or GPS/A/H shall be selected as the navigation solution and both RINU-Gs shall be keyed. The pure INU solution is not an approved navigation source selection when using the FMS.

WARNING

The WGS-84 DATUM shall be used for all nontactical FMS procedures. Failure to use the proper datum will result in inaccurate navigation data.

Aircrew shall have current DoD FLIP publications for the intended region of operations and must actively cross-check the FMS route of flight against these publications. If discrepancies exist, the paper charts will take precedence. The FMS shall not be used for navigation if doubt exists as to the validity of the procedure in the CDU-7000. If unable to comply with the requirements of an RNAV procedure, pilots shall advise Air Traffic Control as soon as possible.

Note

Pilots may notice a slight difference between the navigation information portrayed on the chart and the course information displayed on the CDU-7000 and EFDS flight displays. Differences of 3° or less may be a result of variances in the CDU-7000's application of magnetic variation and are operationally acceptable.

For all FMS operations, a current electronic navigation database is required. If the navigation database has been superseded, the crew shall verify that the FMS route matches the current DoD FLIP publication.

Note

When using FMS as source of navigation, aircrews shall check GPS NOTAMs. GPS NOTAMs may be reviewed by entering "KGPS" as the four-letter identifier on the NOTAM website (https://www.notams.jcs.mil).

18.9.1 FMS (CDU-7000) Approach Procedures (CNS/ATM Modified Aircraft)

There are three types of approaches that may be flown using the FMS:

1. Localizer-based approaches (ILS, LOC, LOC-BC, LOC/DME, SDF, LDA) are advisory type approaches that require the necessary NAVAID information to be displayed prior to intercepting the Final Approach Course (FAC). The FMS may only be used for navigation up to that point. During the approach, the FMS may be used for situational awareness but the establishment on the final approach course must be determined by the localizer. The FMS may be used for course guidance upon executing the missed approach procedure.
2. Overlay approaches are nonprecision approaches (except localizer-based approaches) that do not contain GPS in the title. The copilot shall have raw data displayed prior to the FAF.

3. FMS GPS approaches are identified by GPS in the approach title (RNAV GPS RWY XX, or GPS RWY XX).

WARNING

Manually entered approach procedures are prohibited. Approved approach procedures shall be selected from the ARRIVAL page to ensure required RNP.

Note

- Any discrepancy between the charted approach and the database approach shall require compliance with the charted approach.
- If the FMS is providing guidance contrary to anticipated flight path, the aircrew shall disregard the FMS guidance and climb to the Minimum Safe Altitude (MSA) until proper flight path is confirmed and established.
- Manual entry of waypoints between the IAF and the Missed Approach Point (MAP) is not allowed. The IAF, the MAP, and any waypoints in between shall not be edited or altered.
- Either the Blended (INU/GPS) or Smoothed GPS (GPS/A/H) solutions shall be selected as the source of navigation.
- If the NO APPR RAIM advisory message appears, consideration should be given to conducting a non-FMS-based approach (i.e., raw data TACAN, VOR, ILS, or PAR approach).

18.9.1.1 Approach Procedure Selection

1. Select DP/AR. Observe ARRIVAL page for destination airport.

Note

Depending upon aircraft position along route of flight, DEPART page for departure airport may be displayed. Select DP/AR a second time to display the DEP/ARR INDEX page then select Right Line Select (RLS) 2 to access ARRIVAL page.

2. RLS desired instrument approach. Observe <CONF> displayed next to selected approach and full approach name is displayed in scratchpad.

Note

It may be necessary to page down on the ARRIVAL page to find the desired approach.

3. RLS desired instrument approach again: Observe <SEL> displayed next to desired instrument approach on data line 1.
4. RLS desired transition for selected instrument approach: Observe <SEL> displayed next to desired transition on data line 2.

Note

If no transition is selected, the CDU will use the default VECTORS transition that will insert a discontinuity in the flight plan after the last waypoint on the route of flight and before the final approach fix for the selected instrument approach.

5. Select EXEC to incorporate changes into active flight plan: Observe page title changes from MOD to ACT ARRIVAL.

6. Verify that the correct approach and transition appear on the LEGS and the FPLN pages.

18.9.1.2 Advisory FMS Approach (Localizer Based) Procedures

1. Select approach as outlined in Approach Procedure Selection, paragraph 18.9.1.1.

2. Tune both VORs to the LOC (or ILS) frequency.

3. Pilot shall select FMS for course guidance and bearing.

4. Copilot shall select VOR 2 for course guidance and set the published final approach course. Select bearing as required for the approach.

5. Prior to intercepting the final approach course, the pilot shall select VOR 1 for course guidance and set the published final approach course.

Note

Establishment on the final approach course must be determined by the localizer. The FMS will not enter the approach mode for localizer type approaches (RNP will not transition to 0.3 nm near the FAF).

6. The ILS glideslope information shall be used for vertical guidance.

Note

To avoid two sources of glideslope on the EFDI for ILS approaches (ILS and VNAV), both pilots should deselect VNAV vertical guidance. This is accomplished on the Pilot or Copilot Display Control 2/2 page.

7. If the published missed approach is necessary, FMS course information may be used to the missed approach holding point.

18.9.1.3 FMS Overlay Approach Procedures (VOR/TACAN/NDB Approaches)

1. Select approach as outlined in Approach Procedure Selection, paragraph 18.9.1.1.

2. Tune NAVAIDs.

3. Pilot shall select FMS for course guidance and bearing.

4. Copilot shall select required NAVAID published final approach course and bearing information prior to the FAF.

WARNING

- The copilot shall select and display all required NAVAID data information (bearing, course, DME) prior to the FAF. The copilot shall be alert for any disparities and alert the pilot flying. If disparities are noticed, consideration should be given to selecting NAVAID data if available and/or discontinuing the approach.

- If an FMS navigation caution or warning condition (as indicated by a yellow or red course label flag) or NO GPS APPR message occurs during the approach, notify ATC, utilize NAVAID data for course guidance, or proceed visually if field in sight.

5. Copilot call "Approach Mode" when RNP value sequences to RNP 0.3 (typically 2 nm from the FAF) and APPROACH is displayed on the CDU-7000.

Note

- It is the responsibility of the pilot to maintain the required approach altitude in accordance with the vertical profile defined by the published approach. Any FMS vertical guidance on approach is strictly advisory. One dot of deviation on the VNAV glideslope equates to 500 feet of altitude deviation.

- If approach mode is not entered by the FAF, ensure that required NAVAID information is utilized by both pilots. If NAVAID information is unavailable, proceed visually if field in sight or execute missed approach procedures.

18.9.1.4 FMS GPS Approach Procedures (RNAV GPS RWY XX, or GPS RWY XX)

Note

Crews shall utilize the LNAV MDA Approach Category minimums for GPS approaches.

1. Select the approach as outlined in Approach Procedure Selection, paragraph 18.9.1.1.

2. Pilot should select FMS1 as COURSE source. Select bearing information as desired for situational awareness.

3. Copilot should select FMS2 for COURSE source. Select bearing information as desired for situational awareness.

WARNING

If an FMS navigation caution or warning condition (as indicated by a yellow or red course label flag) or NO GPS APPR message occurs during the approach, notify ATC and then proceed visually if field in sight or climb to MSA.

4. Copilot call “Approach Mode” when RNP value sequences to RNP 0.3 (typically 2 nm from the FAF) and APPROACH is displayed on the CDU-7000.

Note

- It is the responsibility of the pilot to maintain the required approach altitude in accordance with the vertical profile defined by the published approach. Any FMS vertical guidance on approach is strictly advisory. One dot of deviation on the VNAV glideslope equates to 500 feet of altitude deviation.

- If approach mode is not entered by the FAF, notify ATC and proceed visually if field in sight or execute missed approach procedures.

PART VII

Communication Procedures

Chapter 19 — Communication Procedures

Chapter 20 — Communication Equipment

CHAPTER 19

Communication Procedures

19.1 COMMUNICATIONS

The P-3 aircraft has a highly refined communications system that provides for communication in voice and teletype. It is mandatory that every crewmember understand the communications system thoroughly to effectively utilize the high degree of flexibility designed into the P-3 aircraft. To operate the communications system as an integral part of the ASW weapons in coordinated operations, the pilots, tactical coordinator, and NAV/COMM must be familiar with the current communication plans. The communication plan of operation orders outlines the reports required, to whom they are to be sent, the frequencies to be used at specific times, the determination of precedence, the use of authenticators and crypto materials, and all other phases of airborne communications necessary to properly carry out the assigned mission. Specific fleet communications instructions and techniques are contained in wing communication plans and operation orders.

Note

A detailed description of all P-3 aircraft radio and navigation electronic equipment is contained in Chapter 20. Figure 19-1 shows the electronic equipment antenna locations.

19.2 MESSAGE RELEASING AUTHORITY

The responsibility for all transmissions rests with the mission commander or pilot in command if no mission commander is assigned. He should inform his NAV/COMM and other crewmembers who may be called upon to conduct external communications as to what transmissions are permissible without specific authority. He should normally sight and release messages for transmission. The message releasing authority may be delegated to other officers in the crew and is in fact encouraged when conditions require the full attention of the mission commander to safely fly the aircraft, such as during low-level tactical, night, instrument, or turbulent-weather operations; however, he should at all times be made aware of the content of outgoing messages.

19.3 RADIO COMMUNICATIONS

The P-3 aircraft has either one ARC-101 VHF, ARC-197 VHF, ARC-182 UHF/VHF, or ARC-210 UHF/VHF; two ARC-143 or ARC-187 UHF radios; and two ARC-161 HF radios. The VHF radio is only plain-voice capable. The UHF radios can be utilized for plain-voice and cipher-voice transmissions. Additionally, the UHF-2 radio allows for teletype and data link. The HF radios provide for plain-voice, cipher-voice, teletype, and data-link communications. All of the radio sets are connected to an intercommunication system to add flexibility and convenience during radio selection. For a more in-depth discussion of these systems and the procedures to operate the communication systems, refer to Chapter 20.

The AIP aircraft has an additional UHF radio that can be utilized for SATCOM voice, imagery, and Officer in Tactical Command Information Exchange System (OTCIXS) transmissions.

Note

If attempting to simultaneously transmit on both HF radios, the ICS may incorrectly give simultaneous transmit indications on the FDCIs and DCIs. This does not interfere with correct radio operation, as a hardware lockout prevents both HF radios from simultaneously being in a transmit mode.

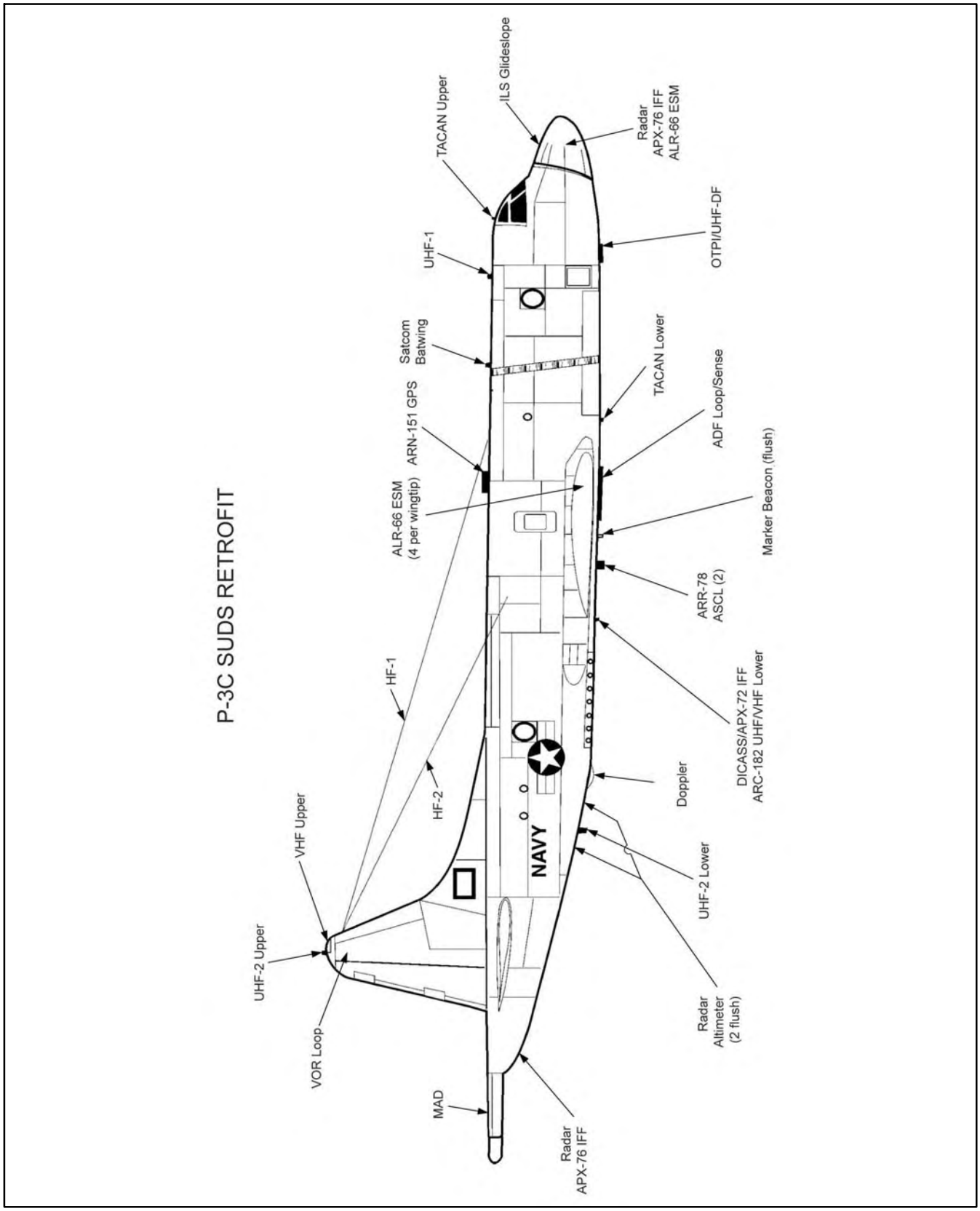


Figure 19-1. Antenna Locations (Sheet 1 of 5)

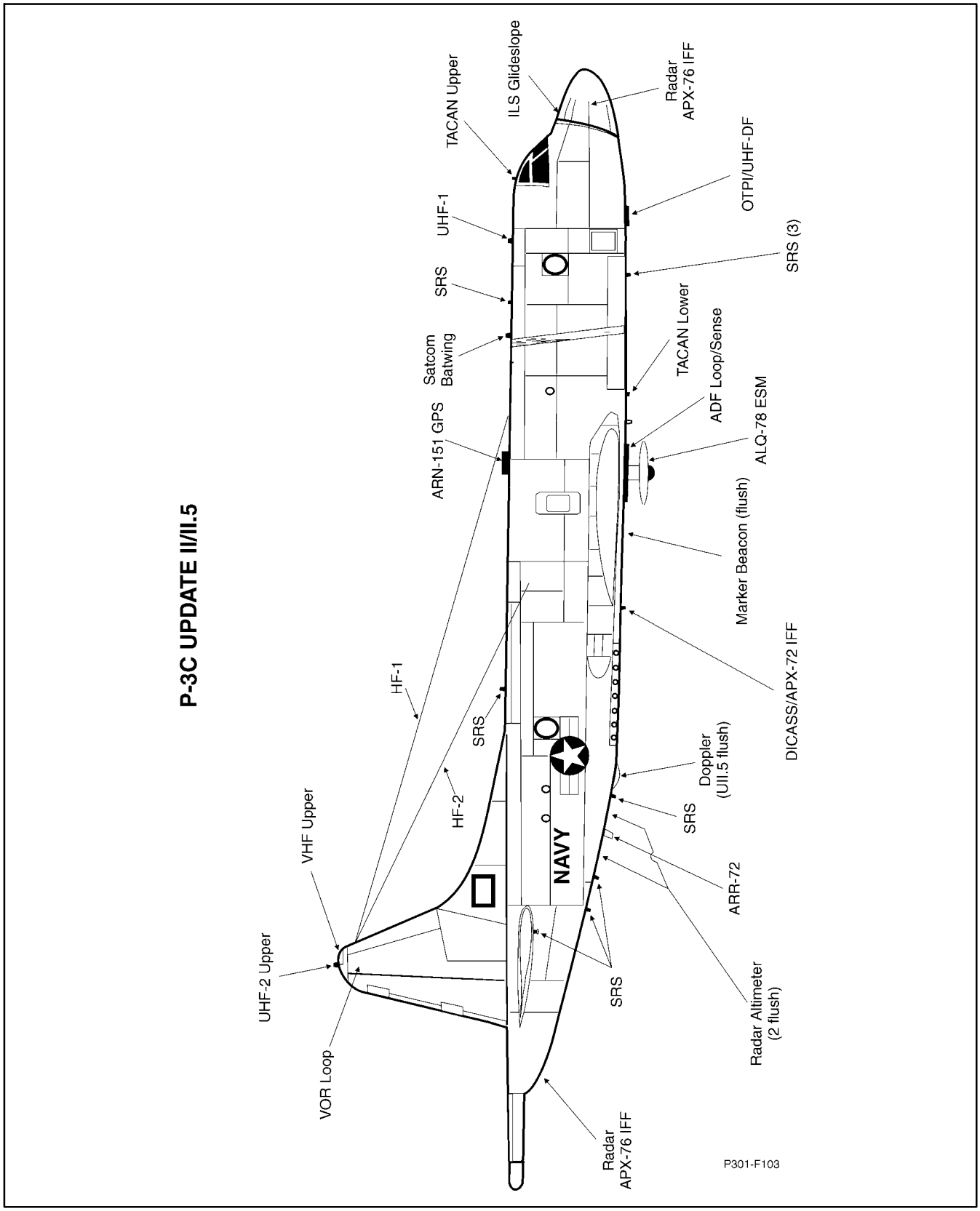


Figure 19-1. Antenna Locations (Sheet 2 of 5)

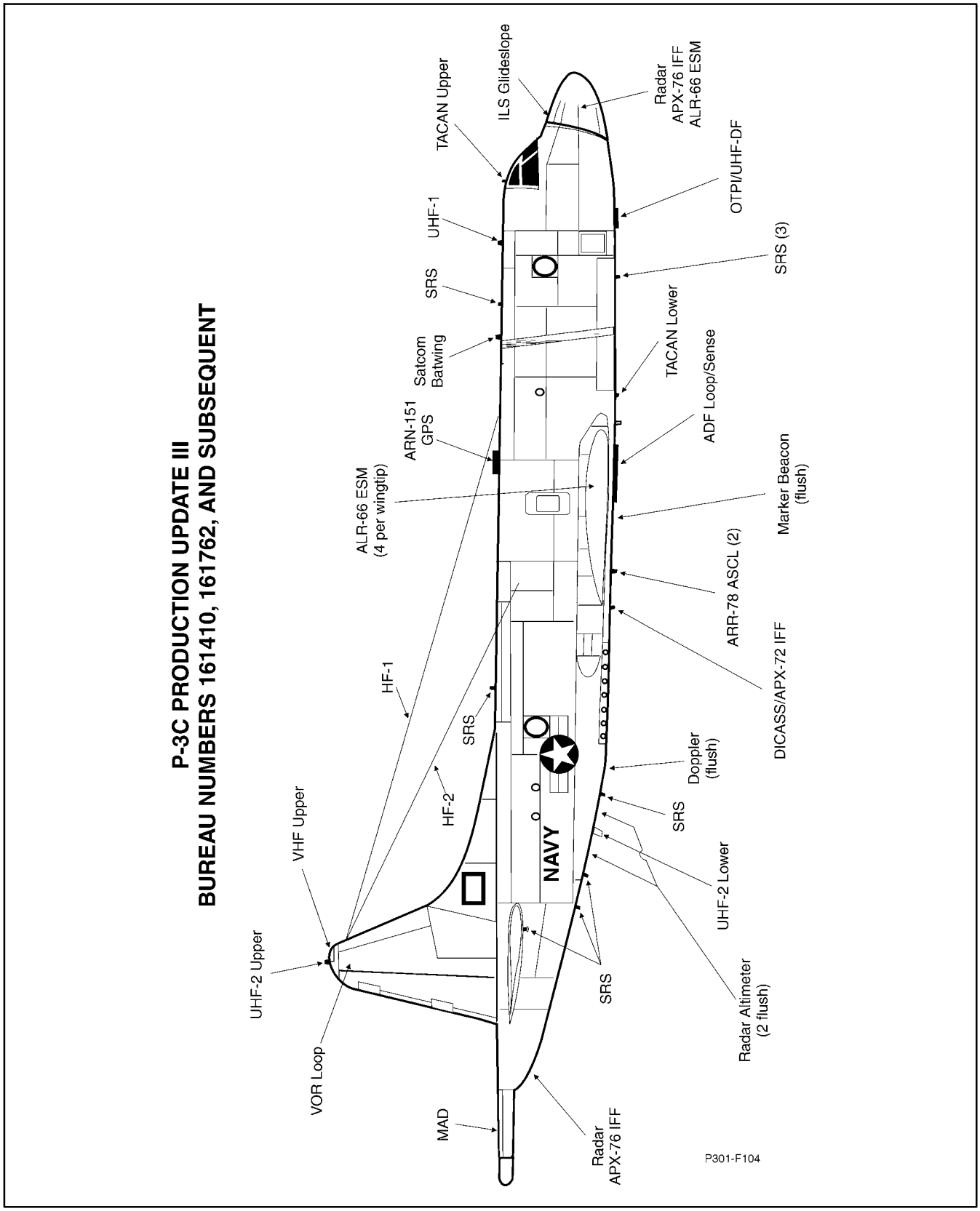


Figure 19-1. Antenna Locations (Sheet 3 of 5)

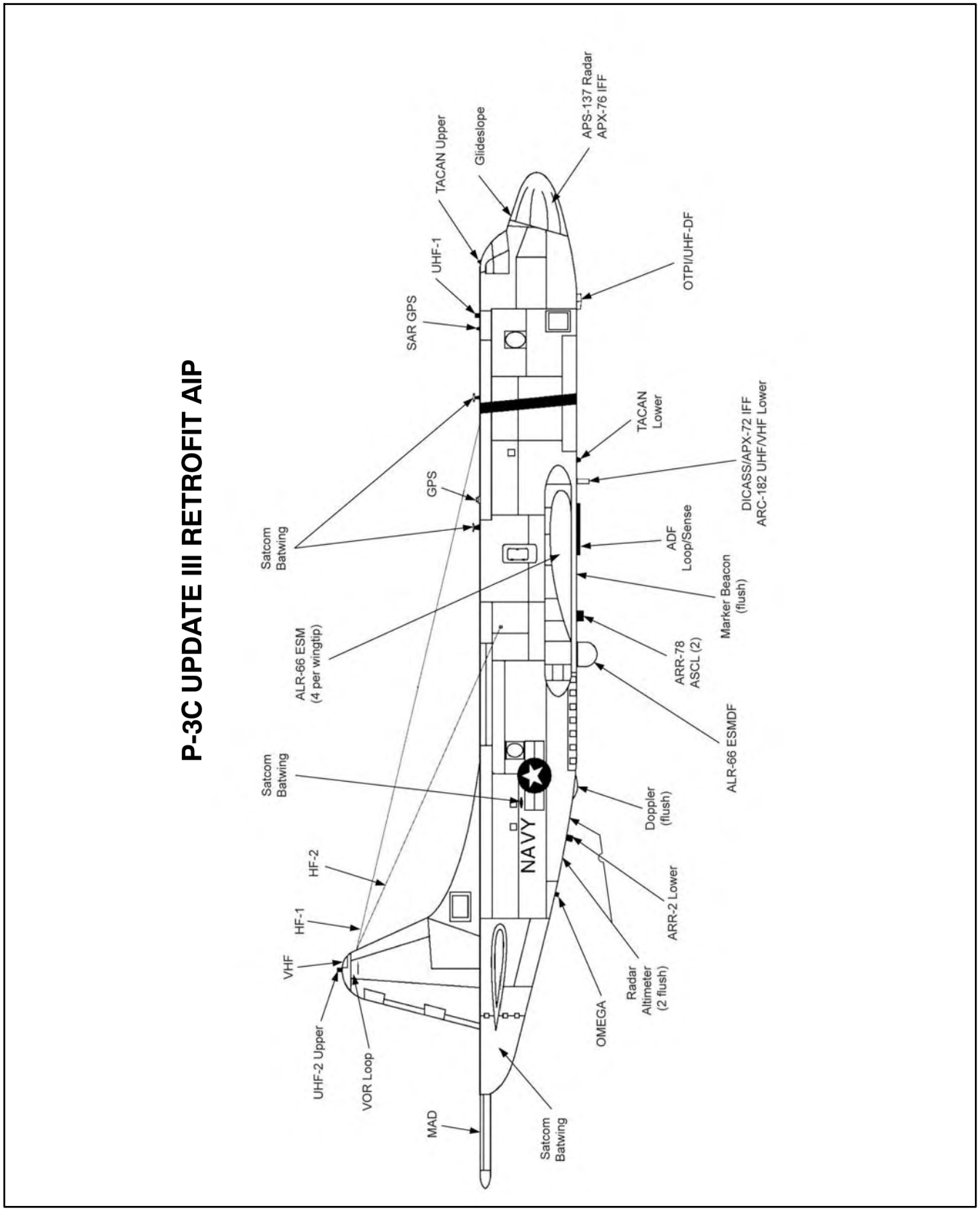


Figure 19-1. Antenna Locations (Sheet 4 of 5)

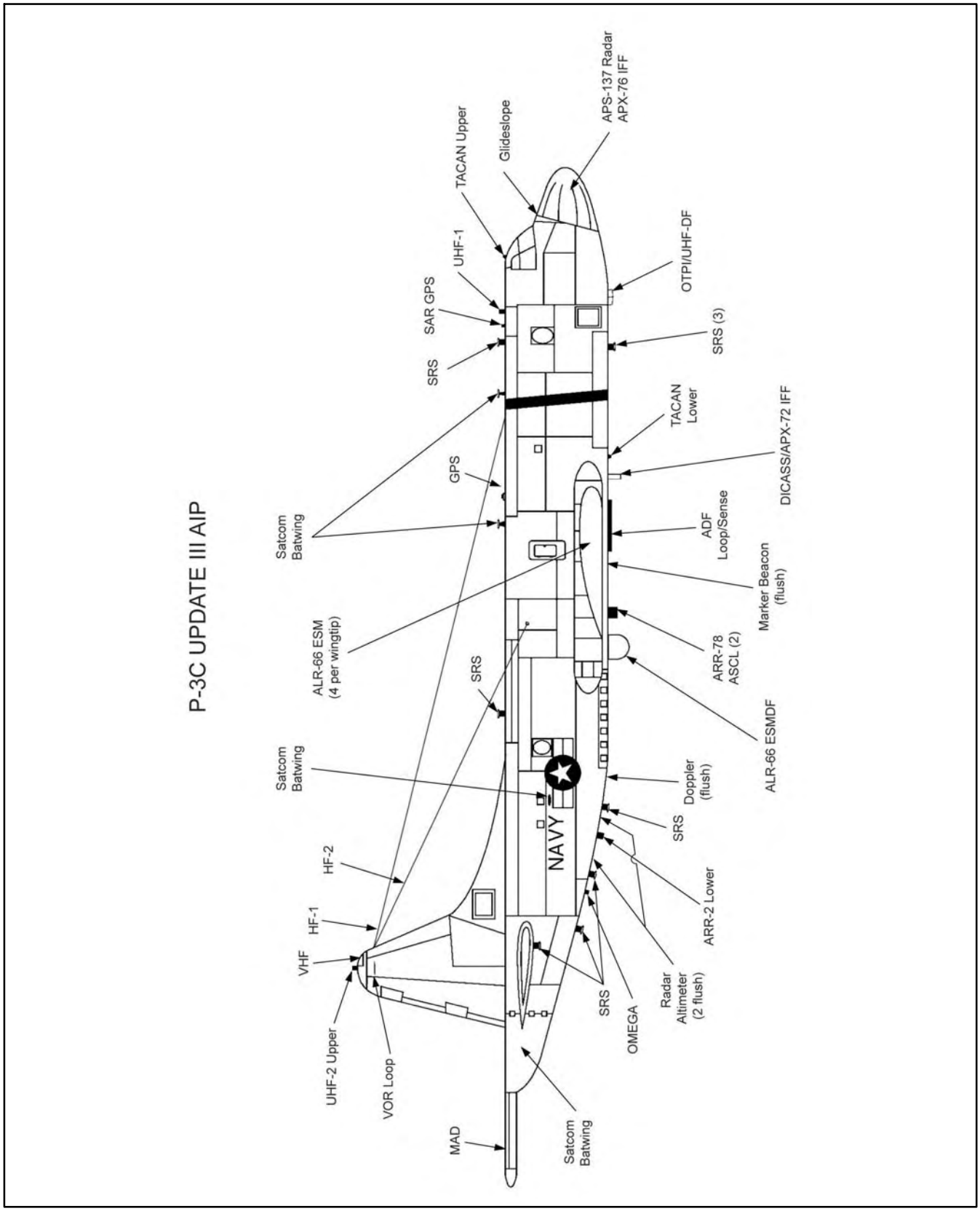


Figure 19-1. Antenna Locations (Sheet 5 of 5)

CHAPTER 20

Communication Equipment

20.1 P-3 INTERCOMMUNICATION SYSTEM

An Intercommunication System (ICS), AN/AIC-22, is installed to provide intercommunication functions for crewmembers. A pilot, copilot, and TACCO operated PA system and radio receiving facilities are provided for each crew station. In addition, radio transmitting facilities are provided for the pilot, copilot, TACCO, and NAV/COMM. Audio monitor circuits are provided for special purpose equipment. Twelve headsets with dynamic boom microphones are provided, one for each crew station, the ordnance station, and the nose wheelwell. An ICS microphone control switch is installed on the pilot and copilot control wheel, and a knee-operated ICS-disconnect switch is mounted on the side of the pilot and copilot control yokes. Five foot-controlled microphone switches are located, one each, at the TACCO, NAV/COMM, acoustic, and nonacoustic operator stations. A microphone switch for the flight engineer is located on the center pedestal in the flight station. Twelve hand-held dynamic microphones are provided, one for each crew station, the galley station, and the ordnance station. A 15-foot headset connecting cord assembly, with microphone switch attached, is located aft of rack F-2. Six-foot connecting cord assemblies, with microphone switches, are provided at the two aft observer stations. Six-foot connecting cord assemblies, without microphone switches, are provided at the pilot, copilot, flight engineer, TACCO, NAV/COMM, acoustic, and nonacoustic operator stations. A 75-foot connecting cord assembly, with microphone switch attached, is stowed in the nose wheelwell headset storage container and is provided for special use.

The communication switching matrix and secure switching matrix are controlled through the communication selector panel and operate jointly with the ICS. Both the UHF and HF radios are selected through the ICS and communication switching matrix. These systems will be discussed in more detail later in this chapter.

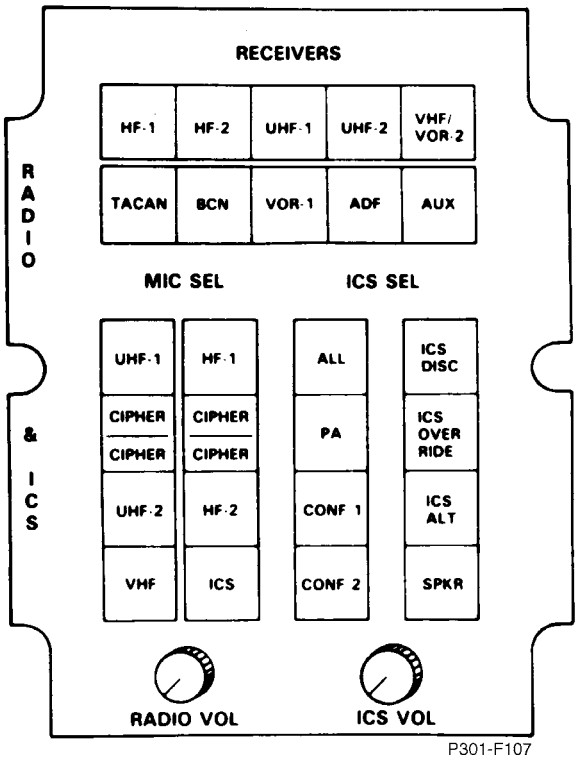
20.1.1 System Components

20.1.1.1 ICS Master Control Panel

The ICS master control panel is installed at the pilot, copilot, TACCO, and NAV/COMM stations. Each control panel contains 24 switchlights and two volume controls. The master control boxes are internally identical, and the functions differ by the connecting lines into the box. Lighting power is supplied to the ICS master control panels (Figure 20-1) through the appropriate ICS IND or IND circuit breaker at each station.

Note

To ensure radio silence, the ICS MIC SEL switch on the pilot and copilot ICS master control panel should be selected. Otherwise, a radio that is selected on the MIC SEL function of the ICS master control box may be keyed momentarily when the pilot or copilot ICS switch is keyed. This is because of relay delays in the ICS box that can result in detectable transmission of RF energy.



PANEL MARKING	FUNCTION
RECEIVERS:	
HF-1 HF-2 UHF-1 UHF-2 VHF/VOR-2* TACAN BCN* VOR-1 ADF	Respective radio receiver audio output is connected to the operator headset when the switchlight is amber. When the switchlight is green, audio is available, but not selected. Dark indicates the receiver is off, a cipher mode is selected on a MIC SEL switchlight, or the radio receiver is not in a voice mode (not selectable).
AUX*	AUX line audio is connected to the operator headset when switchlight is amber. Dark when not selected.
UPDATE III* has VHF, VOR-2, AND AUX/BCN	* AUX/BCN operates identical to all other radio receivers.
MIC SEL:	
UHF-1 HF-1 UHF-2 HF-2 VHF	Transmit-receive control of respective transceiver when switchlight is amber. When MIC SEL is amber, the associated receiver switchlight illuminates amber. When the switchlight is green, transmit-receive control is available. Dark indicates receiver-transmitter is off or not in a voice mode (not selectable). When transmitting on one of the HF radios, the other HF MIC SEL and REC switchlight will be dark.

Figure 20-1. ICS Master Control Panel (Sheet 1 of 2)

PANEL MARKING	FUNCTION
CIPHER/CIPHER	Two sets of status lights that illuminate amber when the adjacent radio is in cipher voice mode.
ICS	When switchlight is amber, operator microphone is connected to the ICS audio line selected by ICS SEL switchlights.
ICS SEL:	
ALL	Connected to the ICS ALL circuit when amber.
ICS DISC	Incoming ICS audio disconnected and transferred to the alternate control panel when switchlight is amber (pilot-copilot to TACCO-NAV/COMM). Copilot ICS DISC is dark (not selectable) when the pilot has disconnected, and TACCO ICS DISC is dark when the NAV/COMM is disconnected.
PA	Headset, microphone, and speakers are connected to the public-address circuit when the switchlight is amber. Available only at the pilot, copilot, and TACCO stations. NAV/COMM switchlight is always dark.
ICS OVERRIDE	Overrides disconnected ICS stations when switchlight is held (amber). Switchlight is green when specific stations are disconnected: pilot — if TACCO, NAV/COMM, copilot, or acoustic operators; copilot — if TACCO, NAV/COMM, pilot, or acoustic operators; TACCO — if NAV/COMM or acoustic operators; NAV/COMM — not available. Switchlight is dark when specific stations are not disconnected. On aircraft equipped with ALR-66(V)3, the nonacoustic operator will also illuminate the ICS OVERRIDE switchlight.
CONF 1 and CONF 2	Operator headset and microphone are connected to the conference (1 or 2) line when switchlight is amber.
ICS ALT	ICS audio from the alternate ICS master control panel is routed to the headset in place of normal ICS audio. Switchlight is amber (pilot-copilot or TACCO-NAV/COMM).
SPKR	All selected audio connected to the loudspeaker when amber. All of the ICS SEL switchlights become dark on a panel when a radio is selected for cipher voice mode except the MIC SEL for that radio. If Speaker (SPKR) was selected prior to selecting cipher, clear voice radios and ICS will still be heard from the speaker.
RADIO VOL	Incoming radio receiver audio level and cipher voice level controlled by knob.
ICS VOL	Incoming ICS audio level controlled by knob.

Figure 20-1. ICS Master Control Panel (Sheet 2 of 2)

20.1.1.2 ICS Crew Station Control Panel

The ICS crew station control panel is installed at the flight engineer station, acoustic operator stations 1 and 2, nonacoustic operator station, aft observers, ordnance, and galley stations. The ICS crew control panels are identical and differ only in the connected lines and panel markings of the RECEIVER SEL switch (Figure 20-2).

20.1.1.3 Pilot Record Control

Installed at the pilot side console, the RECORD position enables the pilot to select radio receiver and transmitter audio along with normal ICS audio for recording on the AQH-4 or AQH-13. A green RECORDING AVAILABLE light on the control panel advises the pilot that the AQH-4 or AQH-13 is operating and available for recording. In the OFF position, ICS ALL is recorded anytime the AQH-4 or AQH-13 is on (Figure 20-3).

Note

If the pilot has selected the RECORD function, only pilot headset audio will be recorded. If the pilot should also select ICS disconnect, no ICS will be recorded. When the pilot selects secure communications, no ICS will be recorded.

20.1.1.4 ICS Interconnection Box

Located in rack B-3, the ICS interconnection box interconnects and distributes ICS, radio receiver, and NAVAID audio. In addition, sonobuoy audio is available through an input from the ARR-78 Advanced Sonobuoy Communication Link (ASCL) receiver.

Two wafer switches on the front of the interconnection box allow selection of the input line for the AUX receiver position on the ICS crew and master control boxes. SONO audio is the only master ICS selection currently functional for the AUX channel. Various radios and NAVAID receiver audios are available for selection for the crew ICS AUX channel. Adjustable potentiometers on the front of the ICS interconnection box allow adjustment of radio and NAVAID volume (Figure 20-4).

20.1.1.5 ICS Isolation Box

Located in the overhead between the TACCO and NAV/COMM stations is the ICS isolation box. This box provides the switchlights on the four ICS master control panels with the correct lighting indications. This junction box enables switch lighting only and has no other effect on the ICS.

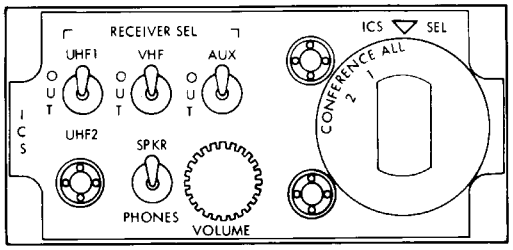
20.1.1.6 Loudspeaker

Ten speaker assemblies are installed. They are located at the pilot, copilot, TACCO, NAV/COMM, nonacoustic operator station, between acoustic operator stations 1 and 2, three in the ordnance area, and one in the galley area. Each speaker assembly consists of an isolation amplifier, muting circuitry, output level control, PA level control, and a muting control.

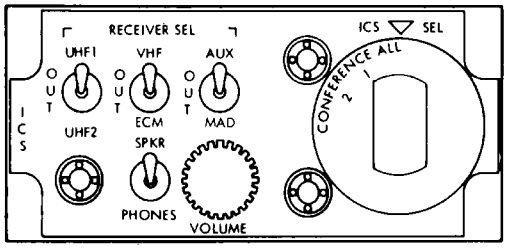
The output control adjusts normal speaker output audio when selected at the corresponding ICS station. The PA level control adjusts the speaker output when the PA function is active, and the muting control adjusts for proper attenuation of speaker volume when the microphone is keyed at the station. Access to the adjustments is gained by removing the small cover on the face of the speaker assembly.

Note

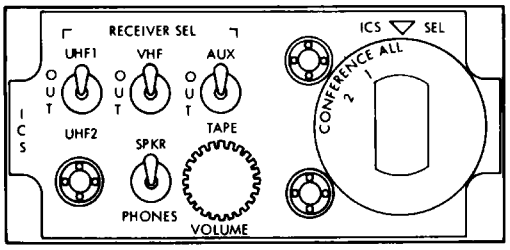
The adjustment controls inside the speaker assemblies are to be adjusted by qualified technicians only.



FLIGHT ENGINEER STA, L&R OBSERVER STA, GALLEY



NONACOUSTIC OPERATOR



P301-F108

ACOUSTIC OPERATOR

PANEL MARKING	FUNCTION
RECEIVER SEL:	
UHF1 UHF2 VHF	Selects the indicated radio audio on crew ICS control panels. UHF1 and UHF 2 cannot be monitored simultaneously.
OUT	No radio audio is heard.
AUX	Monitors the radio or NAVAID selected on the ICS Interconnection Box in rack B3.
ECM	Available only at the nonacoustic operator station.
MAD	
ICS SEL:	Connects the microphone and headset audio to the ICS
ALL	ALL,
CONFERENCE 1	CONFERENCE 1, or
CONFERENCE 2	CONFERENCE 2 circuit.
	Note • ICS ALL will always be heard in the headset in addition to the line selected on the ICS select switch. • On aircraft incorporating ALR-66, the ICS disconnect switch, located above the ICS control panel, enables the nonacoustic operator to disconnect from the intercommunication system. This enhances the operator's ability to detect weak ESM audio.
TAPE	Available only at the acoustic operator stations.
Volume	Adjusts headset audio level for incoming ICS and radio selections.
	Note When an incoming call is received on ICS, the radio audio volume is automatically decreased.
PHONES	Incoming audio is connected to the headset.
SPKR	Incoming audio is connected to the loudspeaker and the headset.

Figure 20-2. ICS Crew Station Control Panel

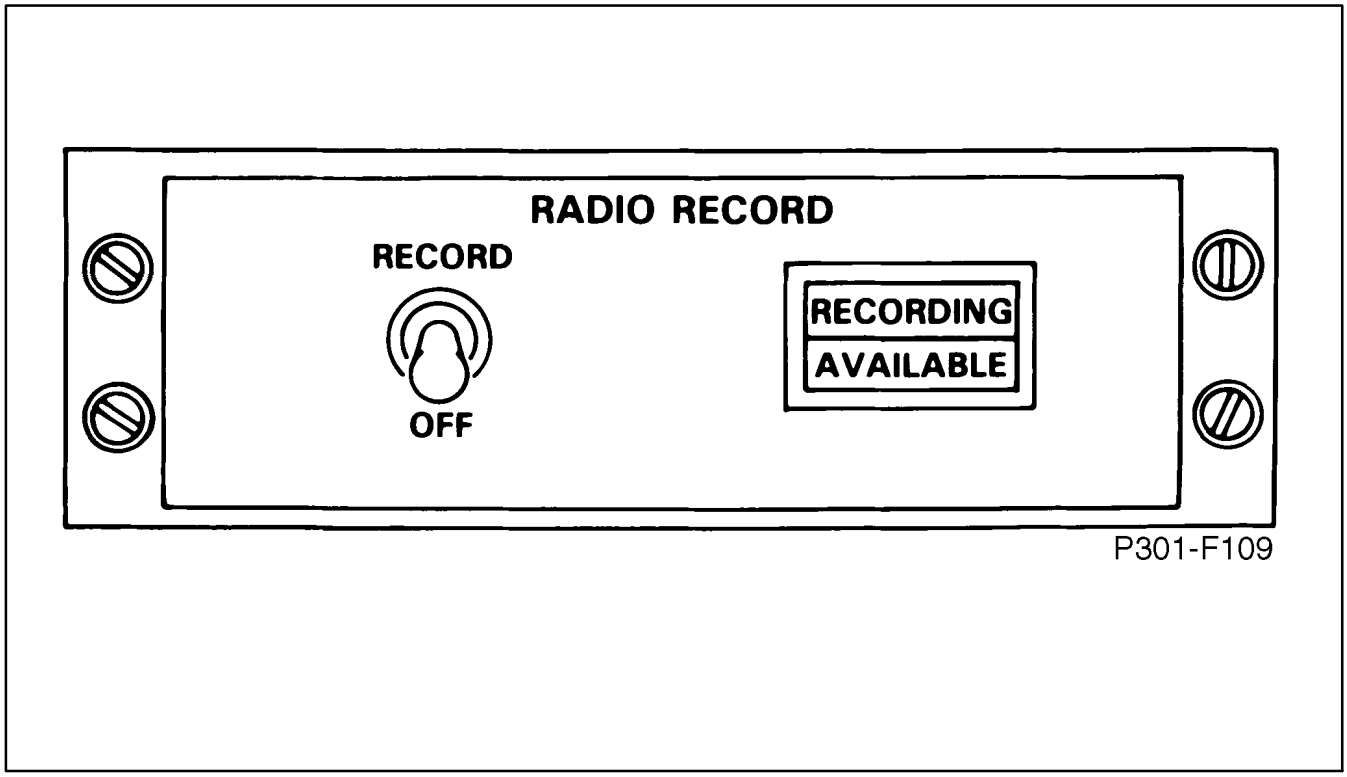


Figure 20-3. Pilot Radio Record Control

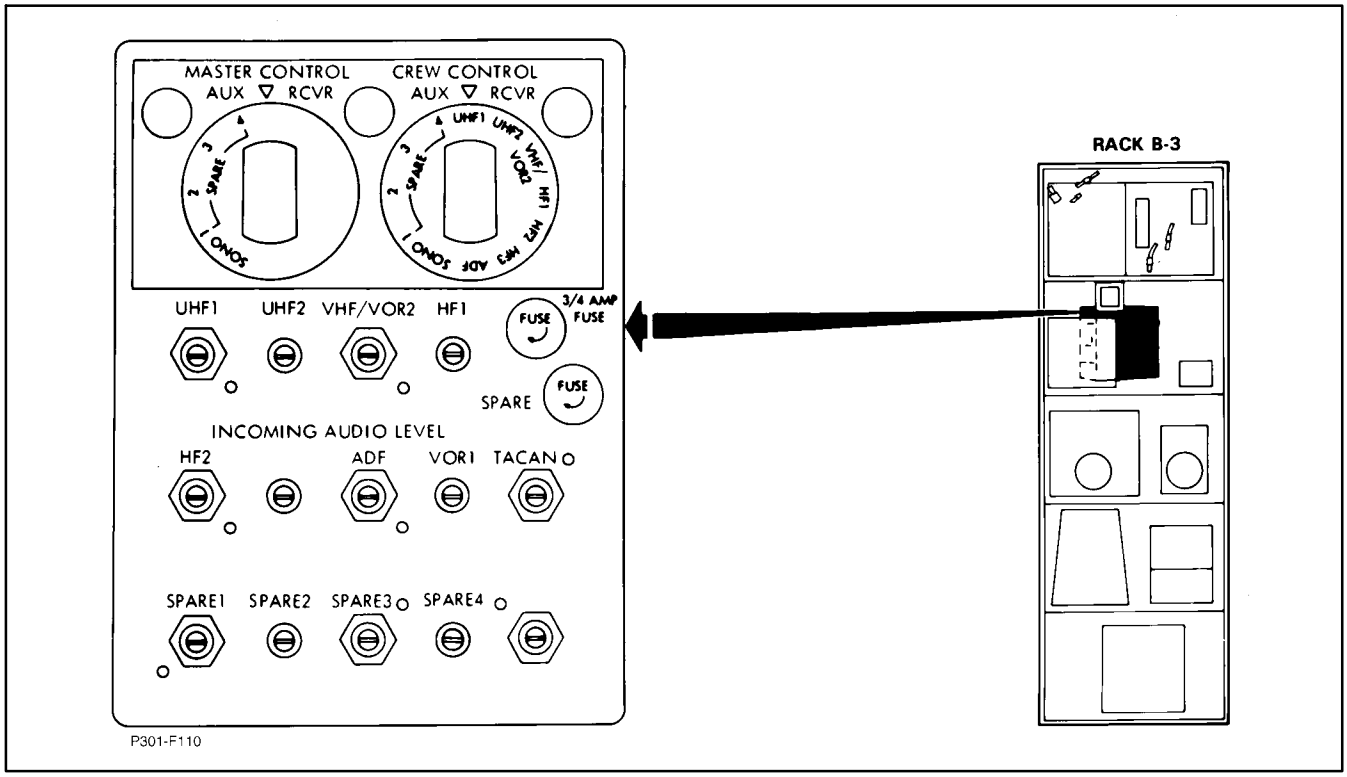


Figure 20-4. ICS Interconnection Box

20.1.1.7 Control Wheel Microphone Switch

The control wheel microphone switch is located outboard on both the pilot and copilot control wheels. The three-position tab switch labeled ICS forward and XMTR aft is spring-loaded to the center (OFF) position.

20.1.1.8 Flightcrew Smoke Mask Microphone

The flightcrew smoke mask microphone is a dynamic microphone with an audio frequency amplifier built into the mask. It is used by the flightcrew in case of a smoke or fumes hazard in the flight station. Smoke masks are installed as loose equipment in the storage areas at the pilot, copilot, and flight engineer stations. The microphone in the mask is energized by the external push-to-talk button.

20.1.1.9 Pilot and Copilot Smoke Mask Microphone Switch

Two intercommunication smoke mask microphone control switches labeled ICS MIKE are provided on the forward part of the pilot side console for the pilot smoke mask microphone and on the forward part of the copilot side console for the copilot smoke mask microphone. With the ICS MIKE smoke mask/normal switch in the SMOKE MASK for the copilot smoke mask microphone. With the ICS MIKE smoke mask/normal switch in the SMOKE MASK position, the smoke mask is connected to the ICS system. With the switch in the NORMAL position, the smoke mask microphone is not connected.

20.1.1.10 Flight Engineer Smoke Mask Microphone Switch

The flight engineer smoke mask ICS control panel located on the console below the flight station forward load center is provided for the flight engineer to operate the microphone and headset when wearing a smoke mask. The panel contains a two-position toggle switch and a pushbutton labeled MIKE. When the toggle switch is in the NORMAL position, the flight engineer communicates on the intercom normally using his boom microphone or hand-held microphone for speaking. When the switch is in the SMOKE MASK position, the microphone in the smoke mask is connected to the intercom circuit, and the flight engineer must depress the MIKE pushbutton on the panel each time he wishes to speak.

20.1.1.11 ICS Amplifier Interconnection Box

The ICS amplifier interconnection box is located at each ICS location in the aircraft. There are three receptacles that allow connection of a hand-held microphone, a headset, and a standard Navy headset or helmet with a boom mike. The pilot, copilot, TACCO, and NAV/COMM differ from the other jackboxes only by a secure/unsecure capability.

20.1.1.12 VHF ICS Isolation Transformer

Located in rack J-2, the VHF ICS isolation transformer provides impedance matching and ICS isolation for the ICS system. This transformer is not required if the Collins VOR/VHF (ARC-140) is installed.

20.1.1.13 Communication Switching Matrix

The communication switching matrix provides interface between the HF/UHF radios and other equipment in the aircraft that requires its use. The control and selection of the communication switching matrix is accomplished through the communication selector panel and the UHF-1 voice selector panel. The communication switching matrix is located in rack B-1/B-2 (Figure 20-5).

20.1.1.14 Communication Selector Panel

Located at the NAV/COMM station, the communication selector panel controls and selects modes of HF-1, HF-2, and UHF-2 radio sets. The communication selector panel enables circuitry in the communication switching matrix to select the desired mode on the HF-1, HF-2, or UHF-2 radio. Illuminated switchlights provide manual control of interlocking functions of the associated equipment. Availability of a function is indicated by green illumination of the appropriate switchlight. Amber illumination signifies that a function has been activated. A dark switchlight indicates that the function is not available (Figure 20-6).

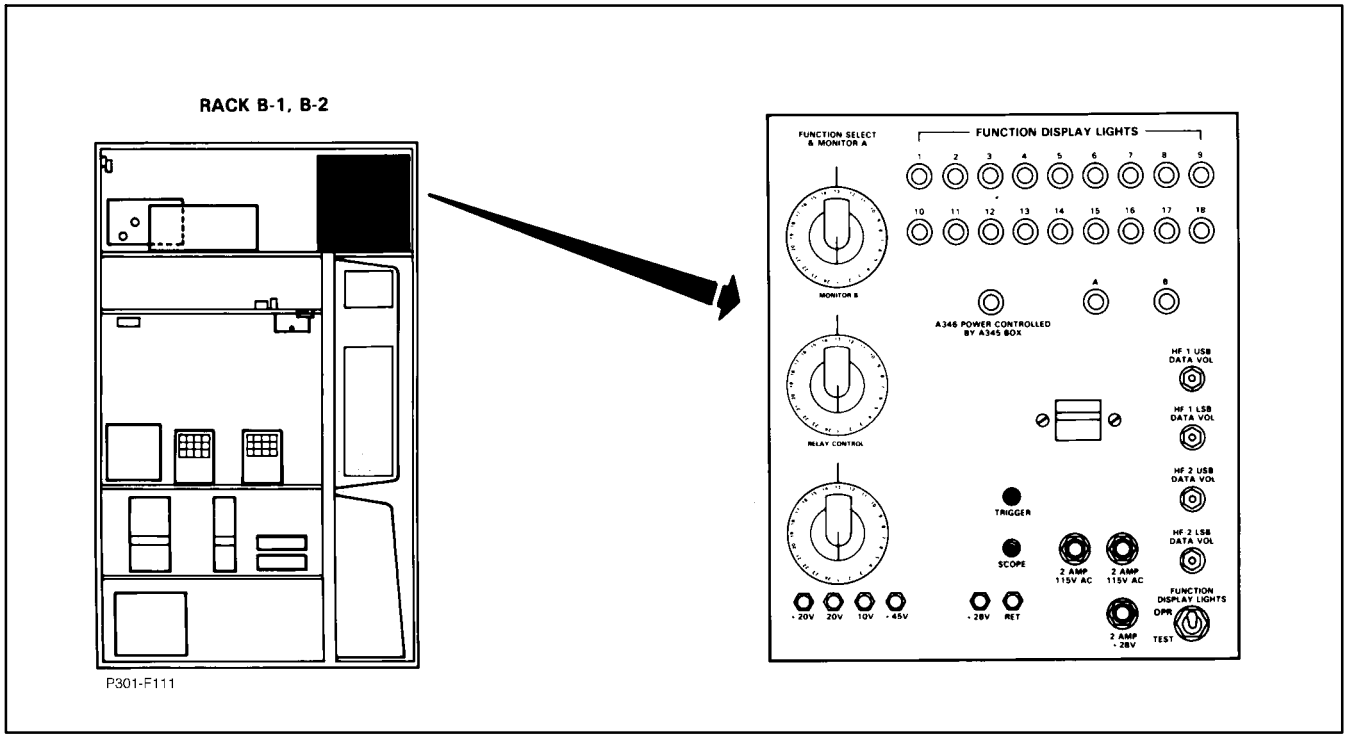


Figure 20-5. Communication Switching Matrix

20.1.1.15 UHF-1 Cipher-Voice Select Panel

Located in the flight station, the UHF-1 cipher-voice select panel allows for switching of UHF-1 from plain to cipher voice. Light indications are the same as the communication selector panel (Figure 20-7).

20.1.1.16 Secure Switching Matrix

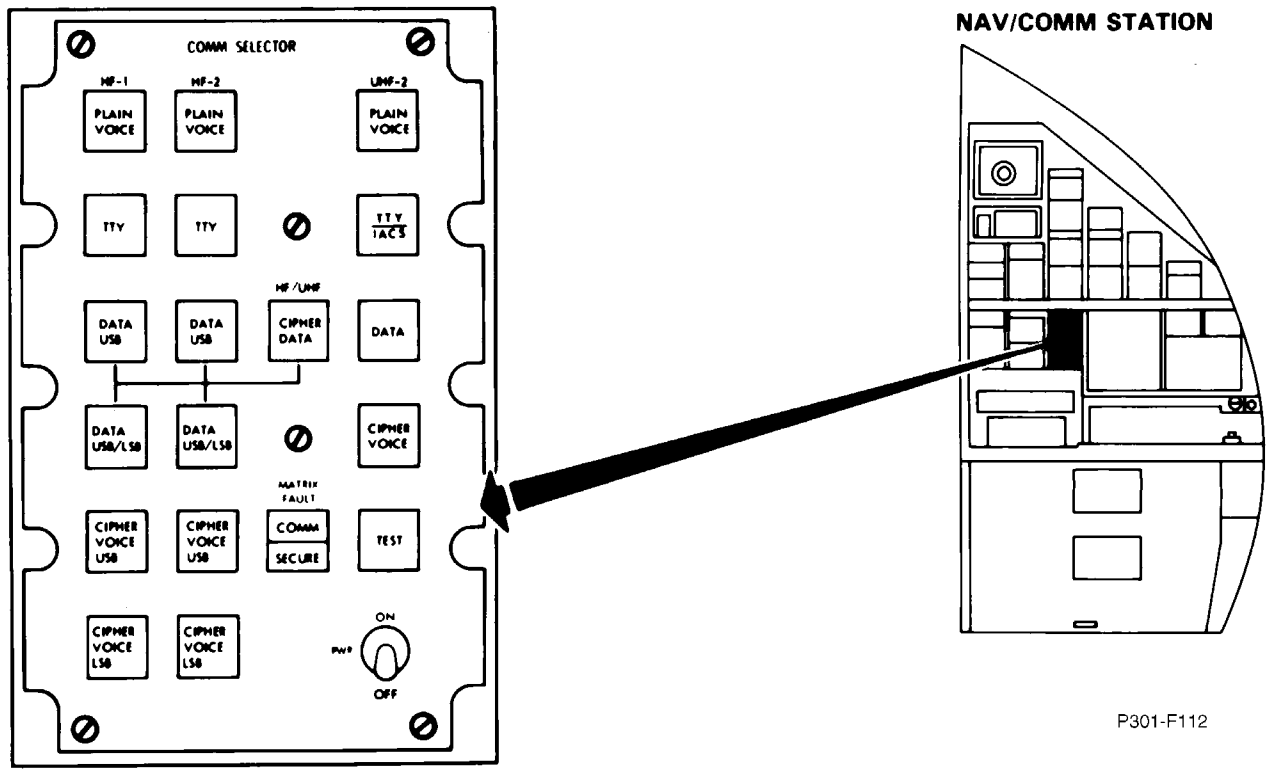
Located in rack B-3, the secure switching matrix is a junction box that routes signals to encryption devices in the aircraft. Binary data-link information is routed to the KG-40A if selected by the NAV/COMM. Voice data are switched between clear voice and encrypted voice lines for Vincent and Parkhill. The secure switching matrix also provides all radio audio transmission and reception connections with the ICS system.

20.1.1.17 Circuit Breakers

Circuit breakers for the ICS interconnection box, ICS isolation box, communication switching matrix, communication selector panel, UHF-1 voice selector panel, and secure switching matrix are listed in Figure 20-8.

20.1.2 System Description

The ICS system provides the aircrew with a means to communicate within the aircraft and, through the secure switching matrix and communication switching matrix, with outside stations. There are three independent communication lines provided for inter-aircraft communications (ALL, CONF-1, and CONF-2). The ICS also provides the tie-in between the radio and radio NAVAID systems for audio monitoring at any ICS station and for two-way communications from any ICS master control box. Secure communications are only available to the four master ICS stations.



SELECTOR	CONDITIONS			
	DARK (not available for selection)	**GREEN (available for selection)**	**AMBER (selection made)**	**CONNECTIONS MADE (when amber)**
HF PLAIN VOICE	OFF, TEST, or Continuous Wave (CW) is selected at HF radio control panel.	HF TTY, DATA, or CIPHER VOICE is selected at COMM selector panel.	HF radio set and COMM selector panel are turned on (initial condition); or AME is selected on HF radio control panel; or HF PLAIN VOICE, at COMM selector panel, is pressed when green; or no other HF selections are made at COMM selector panel.	ICS HF audio and keyline to HF radio set Upper Side Band (USB) audio and keyline.
HF TTY	OFF, TEST, AME, or CW is selected at HF radio control panel.	HF PLAIN VOICE, DATA, or CIPHER VOICE; or other HF or UHF TTY is selected at a COMM selector panel.	HF TTY at COMM selector panel is pressed when green.	TTY signal data converter audio and keyline to HF radio set USB audio and keyline.

Figure 20-6. Communication Selector Panel (Sheet 1 of 5)

SELECTOR	CONDITIONS			
	DARK (not available for selection)	GREEN (available for selection)	AMBER (selection made)	CONNECTIONS MADE (when amber)
HF DATA USB	OFF, TEST, AME, or CW is selected at HF radio control panel; or HF DATA and RADIO SILENCE not selected on the other HF; or OFF or TEST is selected at DTS monitor control panel.	HF PLAIN VOICE, TTY, DATA USB/LSB, or CIPHER VOICE; or HF DATA and RADIO SILENCE selected on the other HF; or UHF DATA is selected at COMM selector panel.	HF DATA USB at COMM selector panel is pressed when green.	Data terminal set primary (receive) and composite (transmit) audio and keyline to HF radio set USB audio and keyline.
HF DATA USB/LSB	Same as HF DATA USB.	HF PLAIN VOICE, TTY, DATA USB, or CIPHER VOICE; or DATA or CIPHER VOICE selected on other HF; or UHF DATA is selected at COMM selector panel.	HF DATA USB/Lower Side Band (LSB) at COMM selector panel is pressed when green.	Data terminal set primary and secondary audio to HF USB and LSB receive audio respectively, DTS composite audio to HF USB and LSB transmit audio (parallel), DTS keyline to HF keyline.
HF CIPHER VOICE USB	HF, TEST, AME, or CW is off.	HF PLAIN VOICE, TTY, DATA, or CIPHER VOICE USB/LSB; or other HF DATA or CIPHER VOICE USB/LSB; or UHF DATA is selected at COMM selector panel.	HF CIPHER VOICE USB at COMM selector panel is pressed when green.	ICS HF audio and keyline to HF radio set USB cipher audio and keyline.

Figure 20-6. Communication Selector Panel (Sheet 2 of 5)

SELECTOR	CONDITIONS			
	DARK (not available for selection)	GREEN (available for selection)	AMBER (selection made)	CONNECTIONS MADE (when amber)
HF CIPHER VOICE LSB	HF, TEST, AME, or CW is off.	HF PLAIN VOICE, TTY, DATA, or CIPHER VOICE USB; or other HF DATA or CIPHER VOICE; or UHF DATA is selected at COMM selector panel.	HF CIPHER VOICE LSB at COMM selector panel is pressed when green.	ICS HF audio and keyline to HF radio set USB cipher audio and keyline.
UHF-2 PLAIN VOICE	OFF, TEST, or SC is selected at UHF-2 radio control panel.	UHF-2 TTY, DATA, or CIPHER VOICE is selected at COMM selector panel.	UHF-2 radio set and/or COMM selector panel is turned on (initial condition); or G (guard transmission) is selected at UHF-2 radio control panel; or UHF-2 PLAIN VOICE at COMM selector panel pressed when green; or no other UHF-2 selections are made at COMM selector panel.	ICS UHF-2 audio and keyline to UHF-2 radio set Amplitude-Modulation (AM) audio and keyline.
UHF-2 TTY/IACS	ARC-143: OFF, TEST, SC, or G is selected at UHF-2 radio control panel.	UHF-2 PLAIN VOICE, DATA, or CIPHER VOICE; or	UHF-2 TTY pressed when green.	TTY signal data converter audio and keyline to UHF-2 radio set AM audio and keyline. UHF/HF radio select line grounded to SDC. IACS audio and keyline to UHF-2.
	ARC-187: OFF, TONE, SC, or GRD is selected at UHF-2 radio control panel.	HF-1 or HF-2 TTY selected at COMM selector panel.		

Figure 20-6. Communication Selector Panel (Sheet 3 of 5)

SELECTOR	CONDITIONS			
	DARK (not available for selection)	GREEN (available for selection)	AMBER (selection made)	CONNECTIONS MADE (when amber)
UHF-2 TTY/IACS (cont)	ARC-143: OFF, TEST, SC, or G is selected at UHF-2 radio control panel. ARC-187: OFF, TONE, SC, or GRD is selected at UHF-2 radio control panel.	UHF-2 PLAIN VOICE, DATA, or CIPHER VOICE; or HF-1 or HF-2 TTY selected at COMM selector panel.	UHF-2 TTY pressed when green.	TTY signal data converter audio and keyline to UHF-2 radio set AM audio and keyline. UHF/HF radio select line grounded to SDC. IACS audio and keyline to UHF-2.
UHF-2 DATA	Same as UHF-2 TTY/IACS; or OFF or TEST is selected at DTS monitor-control panel.	UHF-2 PLAIN VOICE, TTY, or CIPHER VOICE; or HF-1 or HF-2 DATA or CIPHER VOICE selected at COMM selector panel.	UHF-2 DATA pressed when green.	Data terminal set primary (receive) and composite (transmit) audio and keyline to UHF-2 radio set FM audio and keyline.
UHF-2 CIPHER VOICE	Same as UHF-2 PLAIN VOICE; or CIPHER VOICE amber or KY-58 power is off at UHF-1 voice selector panel.	UHF-2 PLAIN VOICE, TTY, or DATA selected at COMM selector panel.	UHF-2 CIPHER VOICE pressed when green.	KY-58 voice lines to UHF-2 radio set wideband audio. ICS UHF-2 keyline to KY-58 and UHF-2 radio set keylines.
CIPHER DATA	None of the following COMM selector panel indicators are amber: HF-1 DATA USB HF-1 DATA USB/LSB HF-2 DATA USB HF-2 DATA USB/LSB UHF-2 DATA.	CIPHER DATA pressed when amber (alternate action, mechanically latching).	CIPHER DATA pressed when green (alternate action, mechanically latching).	KG-40 placed in cipher mode.

Figure 20-6. Communication Selector Panel (Sheet 4 of 5)

SELECTOR	CONDITIONS			
	DARK (not available for selection)	GREEN (available for selection)	AMBER (selection made)	CONNECTIONS MADE (when amber)
MATRIX FAULT COMM indicator	Normally dark.	N/A	Automatically illuminates.	Illuminates to indicate a fault in the communication switching matrix.
MATRIX FAULT SECURE indicator	Normally dark.	N/A	Automatically illuminates.	Illuminates to indicate a fault in the secure switching matrix. Indicator illuminates during data link operation to indicate fault in KG-40.

Figure 20-6. Communication Selector Panel (Sheet 5 of 5)

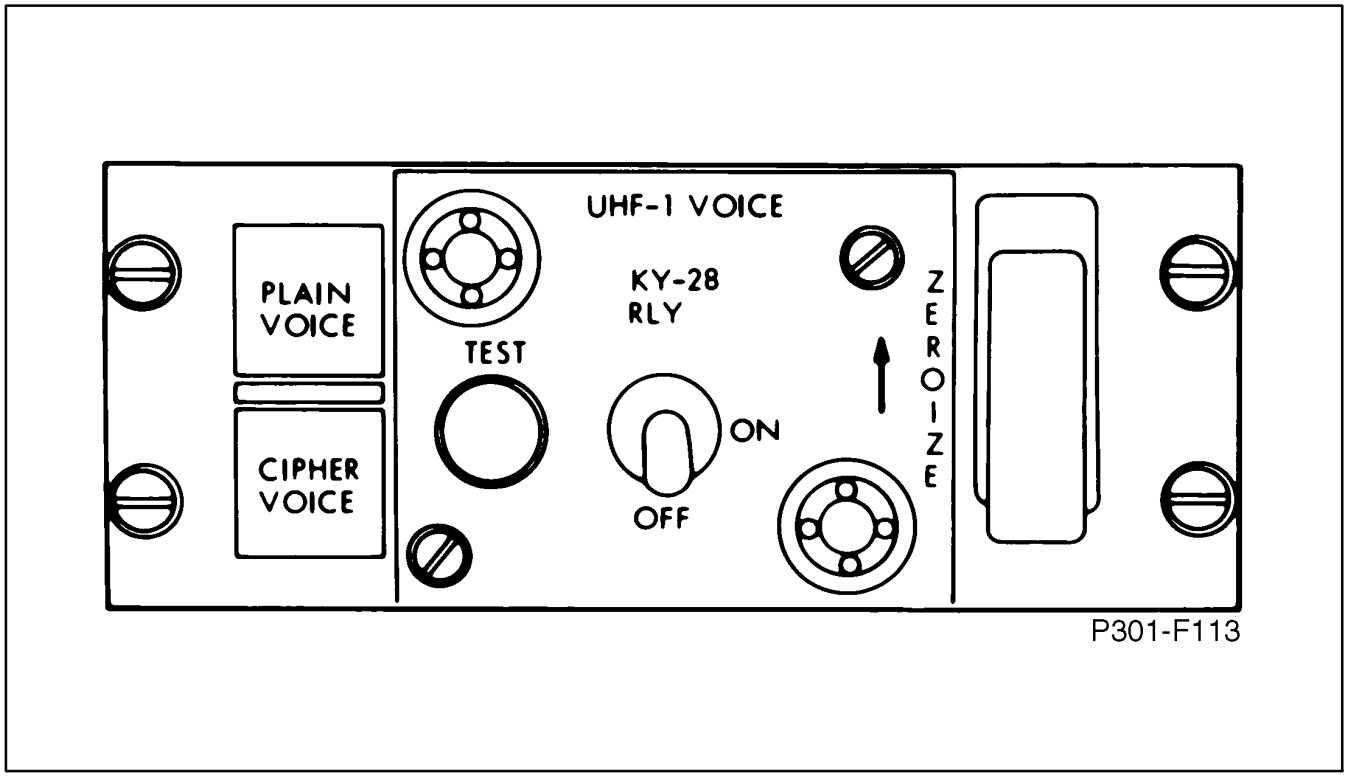


Figure 20-7. UHF-1 Cipher-Voice Select Panel

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
ICS Interconnection Box	Forward Electronic	COMMUNICATIONS INTERPHONE	MEDC
ICS Isolation Box	Forward Electronic Forward Load Center Forward Electronic Main Load Center	INTERPHONE ICS IND TACCO STA LT-IND NAV/COMM LTS-ICS IND	MEDC MEDC MDC MDC
Communications Switching Matrix	Forward Electronic	COMM SYS SEL	MEAC MEDC
Communications Selector Panel	Forward Electronic	COMM SYS SEL	MEAC MEDC
UHF-1 Voice Selector	Center Electronic	UHF-1	MEDC
	Note On Update III aircraft, breaker is moved to Main Load Center Panel 3 Upper.		
Secure Switching Matrix	Forward Electronic	SECURE VOICE	MEAC MEDC

Figure 20-8. Circuit Breaker Locations and Power Sources

The communication switching matrix allows the HF and UHF radio sets to be automatically selected through the communication selector panel and UHF-1 voice selector panel. The mode switch functions on the HF and UHF radios are replaced by switchlights on the communication selector panel. This rewiring of the mode switches is called forced moding. The UHF-1 voice selector panel only allows selection of cipher voice and plain voice on UHF-1. The UHF-1 mode selector switch on the UHF-1 control panel has not been disabled (Refer to UHF Radio System, paragraph 20.7.3.2) and is not subject to forced moding.

The communication selector panel forces all modes for the UHF-2 radio set and both HF sets (except Amplitude Modulated Equivalent [AME]). There must be power to the communication switching matrix and communication selector panel in order to select modes for the radios. If the power switch on the communication selector panel is off, plain voice is available only on the UHF-2 and HF radio sets, although no light indications will be seen on any ICS master control box.

Note

If the communication selector panel power at the NAV/COMM station is off, UHF-1, UHF-2, HF-1, and HF-2 MIC SEL and RECEIVE switchlights on all of the ICS master control panels will not illuminate. The radios may be selected and operated; however, there will be no green or amber indications for the selected switchlight.

The VHF radio operates independently of the communication selector and is controlled directly through ICS master control panels via chassis-mounted relays in the communication switching matrix.

20.1.3 Operating Procedures

The ICS is energized whenever power is applied to the aircraft. Operation of the various functions of the ICS at stations equipped with master control panels is initiated by operating lighted switchlights on the respective master control panel. To operate, proceed as follows:

1. MIC SEL ICS switchlight at station initiating call — Press. Switchlight must light green before pressing. When switchlight illuminates amber, continue with next step.
2. ICS SEL switchlight for ALL, PA, CONF-1, or CONF-2 — Press. When switchlight illuminates amber, continue with next step. Adjust ICS volume control for desired audio signal level.
3. Monitor selected ICS line, prior to initiating call, to prevent interrupting calls on the line.
4. Press microphone push-to-talk switch or microphone foot switch and speak. Release when transmission is complete.

Note

ICS SEL switchlights are not available for selection when UHF-1, UHF-2, HF-1, or HF-2 CIPHER VOICE is selected on MIC SEL switchlights.

5. For radio transmission, press appropriate MIC SEL switchlight. Selected switchlight and associated RECEIVERS switchlight will light amber.
6. Monitor selected radio channel, prior to transmitting, to prevent interference with other stations.
7. Press microphone push-to-talk switch or microphone foot switch and speak. Release when transmission is complete.
8. For receiver monitoring, press desired RECEIVERS switchlight until it changes amber.
9. Adjust radio volume control for desired audio signal level.

Note

RECEIVERS lighted switchlights are not available for selection when UHF-1, UHF-2, HF-1, or HF-2 CIPHER VOICE is selected on the MIC SEL switchlight except for the associated receiver.

At stations with ICS crew control panels:

1. ICS SEL switch at station initiating call — Set to desired line (ALL, CONF-1, CONF-2).
2. Monitor selected ICS line, prior to initiating call, to prevent interrupting calls on the line.
3. Press microphone push-to-talk switch or microphone foot switch and speak. Release switch when transmission is complete.
4. For receiver monitoring, place RECEIVER SEL switch of desired receiver to the indicated position.

Note

The CREW CONTROL AUX RCVR selector switch on the ICS interconnection box must be set to the appropriate position to receive desired auxiliary (AUX) receiver audio.

5. Adjust volume control for desired radio and ICS audio signal level in headset.

20.1.4 Emergency Turnoff Procedures[1]

Electrical power to the ICS is supplied through the closed COMMUNICATION INTERPHONE DC circuit breaker on the forward electronic circuit breaker panel. Normal and emergency deenergizing of the ICS consists of opening this circuit breaker. No other controls are required to deenergize the system.

20.2 ARC-197 VHF RADIO SYSTEM

VHF capability is provided for voice communication with commercial airfields and airways stations in the 116.0 to 151.975 MHz range. The VHF communication is controlled from the flight station but may be utilized at any of the four ICS master control panels. The flight station control panel is located on the copilot side of the center control pedestal. The radio is utilized for plain-voice communication only. The following paragraphs discuss general operating procedures of the VHF portions of the ARC-197. For further discussions on these particular systems, refer to Chapter 22.

20.2.1 ARC-197 Operating Procedures

1. Position power control switch to PWR.
2. Turn the megahertz control unit until the first three digits of the desired operating frequency appear in the indicating window.
3. Turn the kilohertz control until the last three digits of the desired operating frequency appear in the indicating window.
4. Adjust volume control until desired audio level is obtained.

20.2.2 ARC-197 Emergency Operation

In the event of ICS failure, the microphone and headset can be plugged into the transceiver for communications purposes.

Note

A phone-type jack plug (PJ-055B) is required for receiver operation.

20.3 ARC-182 VHF/UHF RADIO SYSTEM

The ARC-182 VHF/UHF radio system is installed in aircraft incorporating AFC-485 to allow communication with civilian and military agencies in the VHF-AM and UHF bands, civilian maritime units in the high VHF-FM band, and tactical military units in the low VHF-FM band. The control panel is located in the flight station on the copilot side of the center control pedestal. The radio is utilized for plain voice communication only.

Unlike earlier VHF radio system installations, this radio system is independent of either VOR radio navigation system; however, this VHF/UHF radio system does share the bottom VHF/UHF antenna with the IFF system and also with the Command Active Sonobuoy System (CASS) via an antenna switch located at the acoustic operator station. The radio is powered by the MEDC circuit breaker on the aft electronic circuit breaker panel.

20.3.1 System Components

20.3.1.1 C-10319A VHF/UHF Radio Set Control

The radio set control (Figure 20-9) controls the frequency and frequency mode, power, squelch, and volume level of the receiver-transmitter. The radio set control can store and retrieve 30 preset channel frequencies.

1 Aircraft BuNo 161122, 161132, and subsequent.

20.3.1.2 RT-1250A Receiver-Transmitter

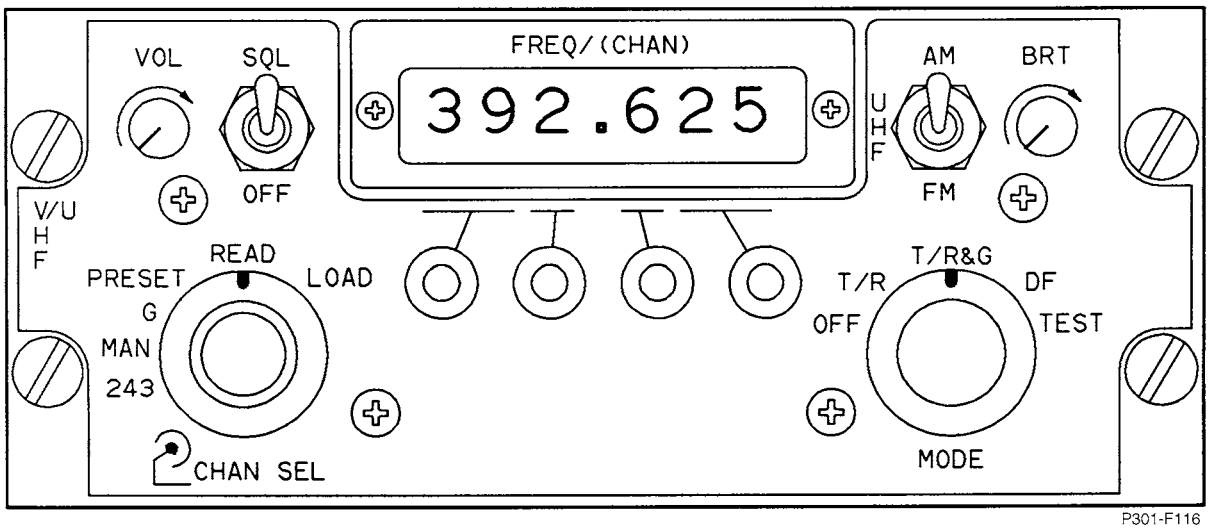
The receiver-transmitter, located in rack J-2 (Figure 20-10), provides two-way voice communications. It will receive and transmit AM or FM signals over the frequency range of 30.000 to 399.975 MHz, in 25-kHz increments, within the frequency bands shown in Figure 20-11. Power output of the transmitter in AM modes is 10 watts and in FM modes 15 watts.

Four guard frequencies are available and selected automatically by the main receiver operating band. Selecting G on the mode selector allows guard operation on the currently selected frequency band guard frequency. Selecting 243 on the mode selector automatically selects 243.000 MHz as guard frequency for transmit and receive.

20.3.1.3 Antennas

Two antennas are used with the VHF/UHF radio system: a wideband VHF/UHF antenna and a VHF antenna. The VHF/UHF antenna, which is capable of carrying VHF and UHF frequencies, is mounted on the bottom of the fuselage adjacent to the hydraulic service center. The top VHF antenna, located in the tail cap, is only VHF capable.

The VHF/UHF antenna is also shared with the IFF system and can be used with the CASS via an antenna switch located at the acoustic operator station.



PANEL MARKING	FUNCTION
VOL	Used to adjust audio level.
SQL/OFF	Enables main receiver squelch in SQL position. Disables squelch in OFF position.
FREQ/(CHAN) indicator	Displays frequency in manual mode of operation, channel in preset mode of operation, and BIT results when in TEST mode or if BIT detects a system fault.
Frequency switches	Momentary contact switch used to set operating frequency.

Figure 20-9. VHF/UHF Radio Set Control Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
UHF AM/FM	Selects either AM or FM operating mode when the system is tuned to a frequency in the UHF band.
BRT	Varies intensity of FREQ/(CHAN) display.
MODE selector:	Used to select system operating mode.
OFF	Turns off power to radio set.
T/R	Enables main receiver and transmitter.
T/R + G	Enables main receiver and transmitter in addition to the guard receiver. The guard receiver is tuned to proper frequency automatically for selected operating band of main receiver.
DF	Not operable.
TEST	Initiates built-in test of receiver-transmitter. Results of test are displayed on FREQ/(CHAN) indicator.
CHAN SEL	Permits selection of preset frequency (channel) when operational mode is set to PRESET.
Frequency mode selector:	
243	Turns on radio and causes main receiver and transmitter to tune to 243.000 MHz (UHF AM) guard frequency. All front panel controls except VOL/SQL and BRT are disabled.
MAN	Permits manual change in operating frequency by using frequency control switches.
G (Guard)	Tunes receiver-transmitter to the guard frequency of the band to which the radio was last tuned.
PRESET	Allows selection of any one of 30 preset operating frequencies. Used in conjunction with the CHAN SEL switch.
READ	Displays frequency of preset channel operating frequency instead of channel number. Displayed frequency may be altered by use of frequency control switches, but stored frequency will not change (unless LOAD is selected).
LOAD	Loads frequency selected in READ mode into memory to alter preset channel frequency. **Note** If the frequency mode selector is set to PRESET or READ and then to GUARD, the guard frequency displayed will be the one appropriate for the frequency band of the preset channel. If the frequency mode selector is then set to MAN and then back to GUARD, the guard frequency displayed will be one appropriate for the frequency band of the manually selected frequency.

Figure 20-9. VHF/UHF Radio Set Control Panel Markings and Functions (Sheet 2 of 2)

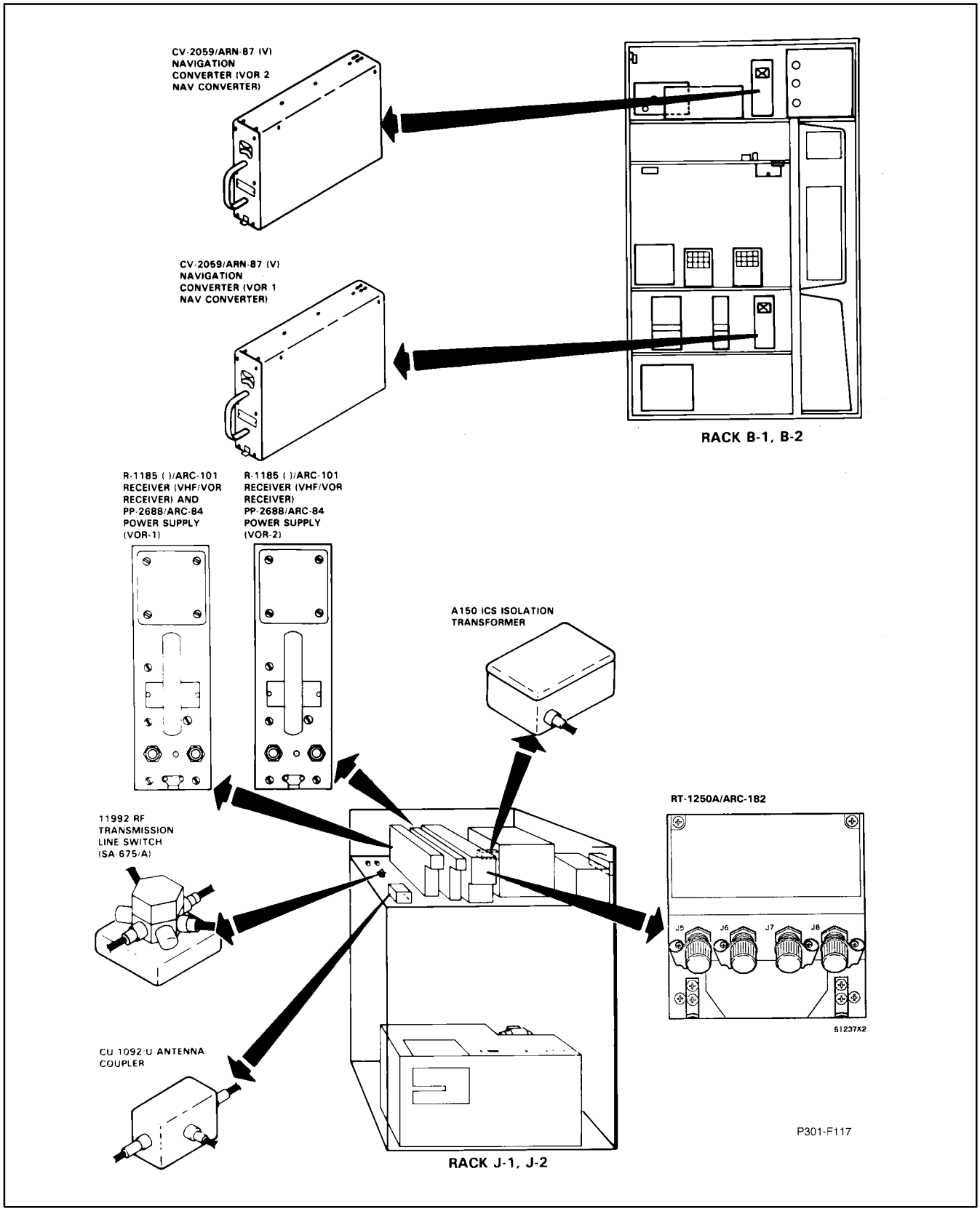


Figure 20-10. ARC-182 VHF/UHF Radio System Component Locations

20.3.1.4 Antenna Select Panel

Located on the flight station center pedestal, the antenna select panel allows selection of the top or bottom antenna for VHF communications. UHF communication is limited to the bottom antenna because of an in-line RF filter placed between the receiver-transmitter and the upper antenna.

CAUTION

Selection of the top VHF antenna, when using a UHF frequency, may cause damage to the radio due to reflected energy. Communications in the UHF frequency band will not be transmitted by the VHF antenna.

Note

A notch filter is installed on the receive line external to the receiver-transmitter to prevent interference from high power FM radio stations when operating in the 108.000 to 136.995 MHz range. Reception of frequencies below 108.000 is not possible unless the filter is bypassed.

20.3.1.5 Radio/CASS Selector

Located at the acoustic operator station, this switch allows CASS transmissions using the lower VHF/UHF antenna. When CASS is selected, no UHF voice communications are possible; however, VHF transmissions are possible using the top VHF tail cap antenna.

Note

Selecting the bottom VHF/UHF antenna for CASS transmissions prohibits UHF radio transmissions using the ARC-182 VHF/UHF radio system.

20.3.2 System Description

Refer to Figure 20-11 for the ARC-182 radio system frequency ranges.

The VHF/UHF radio is selectable for transmission at any of the master ICS control panels by selecting VHF. All crew ICS control panels are capable of monitoring ARC-182 communications by selecting VHF with the audio selector switches. Selectable SQL-OFF (squelch ON-OFF) automatic level adjustment squelch is provided to reduce or eliminate receiver background noise. The radio set also incorporates a continuous Built-In Test (BIT) and a selectable TEST mode for fault isolation.

The ARC-182 provides the capability to monitor four internationally recognized guard channels while communicating on a separate frequency. Frequency selection on the radio set control determines which of the four guard frequencies is received. The four frequencies that are available and selected automatically by the main receiver operating band are: 40.5 MHz FM, 121.5 MHz AM, 156.80 MHz FM, and 243.0 MHz AM.

BIT is conducted each time power is applied and when the TEST function is selected. Also, the radio set control continuously monitors system performance. When a fault is detected, either during BIT or continuous monitoring, a corresponding indication is displayed on the FREQ/(CHAN) display.

Note

When using the ARC-182 radio system in the UHF frequency band, transmissions are inhibited by an in-line UHF filter installed between the receiver-transmitter and the top VHF tail cap antenna. UHF transmissions are only possible when using the lower UHF antenna.

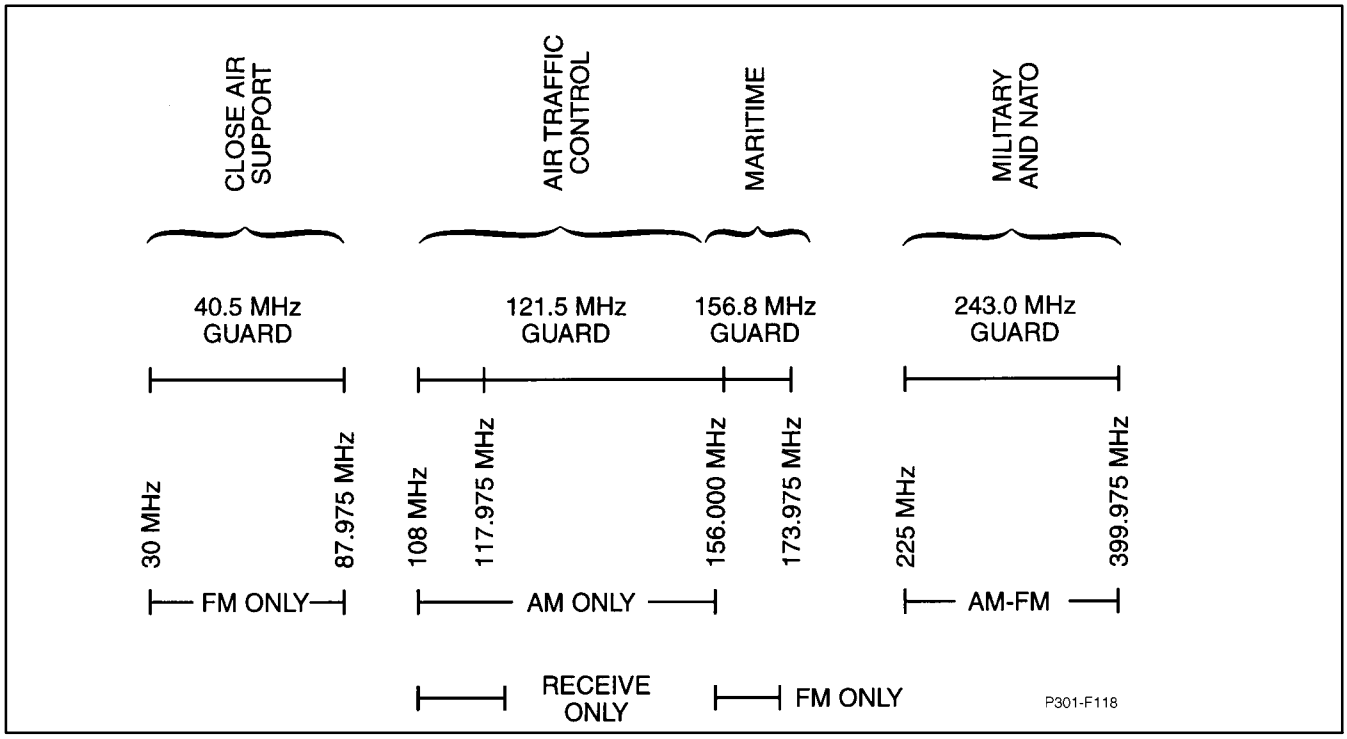


Figure 20-11. ARC-182 VHF/UHF Operating Frequency Bands

20.3.3 Operating Procedures

Note

Selection of frequencies outside the authorized ranges (below 30 MHz, 88 through 107.975 MHz, and 174.000 through 224.975 MHz) will result in automatic rejection of the selected frequency. The last two digits of the FREQ/(CHAN) readout will blank, and the radio will remain tuned to the last authorized frequency displayed.

20.3.3.1 Channel Presetting Operation

1. Select T/R or T/R&G.
2. Set frequency mode selector to PRESET and rotate CHAN SEL control to display desired channel in FREQ/(CHAN) display.
3. Set frequency mode selector to READ and toggle frequency switches to display desired frequency in FREQ/(CHAN) display.
4. Set frequency mode selector to LOAD.
5. Set frequency mode to READ and verify the desired frequency is displayed in the FREQ/(CHAN) display.

20.3.3.2 Plain-Voice Operation

1. MODE selector — T/R or T/R&G.
2. BRT selector — Adjust as desired.

3. UHF AM/FM selector — As desired.
4. VOL selector — Adjust as desired.
5. SQL/OFF selector — As desired.
6. Frequency mode selector — MAN or PRESET.

Note

If MAN is selected, toggle the frequency switches until the desired frequency is displayed in the FREQ/(CHAN) display. If PRESET is selected, rotate the CHAN SEL knob until the desired preset channel is displayed in the FREQ/(CHAN) display.

7. ICS master control panel, MIC SEL — VHF.
8. Key the microphone for transmission.

20.3.3.3 Guard Operation

1. MODE selector — T/R or T/R&G.
2. BRT selector — Adjust as desired.
3. Frequency selector — Select appropriate guard frequency, or:
4. CHAN SEL — G — Automatically selects the guard frequency for the frequency band in the FREQ/(CHAN) display according to Figure 20-11.
5. CHAN SEL — 243 — Automatically selects 243.000 MHz for guard transmission reception.
6. VOL selector — Adjust as desired.
7. SQL/OFF selector — As desired.
8. ICS master control panel, MIC SEL — VHF.
9. Key the microphone for transmission.

20.3.4 Built-In Test

The Built-In Test (BIT) circuitry continuously monitors the ARC-182 to determine operational status. If a fault is detected, the FREQ/(CHAN) display will blank except for the decimal point. Setting the MODE selector to TEST initiates the sequence. The results of BIT are shown in the FREQ/(CHAN) display (Figure 20-12).

MODE	DISPLAY	FAULT	INTERPRETATION
RCV	.	RT LOL OR RMT CONT	SELECT TEST MODE
XMT	.	REDUCED PWR HIGH VSWR	SELECT TEST MODE
TEST	000.000 888.888	NONE	RT AND CONTROL OK
TEST	0 6 1 0 6 1	VSWR	RT OR ANTENNA SYSTEM
TEST	6 5 1 6 5 1	FWD PWR	MODULES A6, A5, OR A1 FAULT
TEST	2 2 1 2 2 1	LOL	MODULES A2 OR A1 FAULT
TEST	1 5 7 1 5 7	RT	MODULE A1, A5, OR FUSE FAULT
TEST	3 3 3 3 3 3	RT	MODULE A3 FAULT
TEST	3 3 2 3 3 2	RT	MODULE A3 OR A2 FAULT
TEST	3 2 4 3 2 4	RT	MODULE A3, A2, OR A4 FAULT
TEST	1 5 7 1 5 7	INTFCE OR RT	NO RESPONSE
TEST	.	RMT CONT	DEFECTIVE CONTROL

Figure 20-12. ARC-182 Radio Set Control Built-In Test Indications

20.4 ARC-210 VHF/UHF RADIO SYSTEM

The ARC-210 VHF/UHF radio system may be installed in place of the ARC-182 VHF/UHF radio system (refer to Figure 20-13) for aircraft operating in areas where 8.33 kHz VHF channel spacing is required. Like the ARC-182, the ARC-210 allows communications with civilian and military agencies in the VHF-AM and UHF bands, civilian maritime units in the high VHF-FM band, and tactical military units in the low VHF-FM band. The control panel is located in the flight station on the copilot side of the center control pedestal. The radio is used for plain voice communication only.

When installed in place of the ARC-182 system, only the receiver/transmitter and radio set control are changed. All other elements of the ARC-182 system are retained.

20.4.1 System Components

20.4.1.1 C-11898A VHF/UHF Radio Set Control

The radio set control (Figure 20-14) controls the frequency mode, power, squelch, and volume level of the receiver-transmitter. The radio set control can store, transmit, and receive on 30 preset channel frequencies.

Note

The C-11898A radio set control is not installed when AFC-597 is incorporated. Control of the ARC-210 is performed via the Control Display Navigation Unit (CDNU). Additionally, an On/Off switch is installed on the copilot's side console as part of AFC-597.

20.4.1.2 RT-1556B Receiver-Transmitter

The receiver-transmitter, located in rack J-2 (Figure 20-10), provides two-way voice communications. It will receive and/or transmit AM or FM signals as depicted in Figure 20-15. The receiver-transmitter is capable of receiving and transmitting in 25-kHz increments in the 30 to 87.975 MHz band, 108 to 173.975 MHz band, and the 225 to 399.975 MHz band. The receiver-transmitter can also transmit and receive in 8.33-kHz increments in the 108 to 136.995 MHz band. The receiver-transmitter will receive navigational information in 25-kHz increments from 108 to 117.975 MHz band.

Two guard frequencies are available to be selected automatically by the main receiver operating band. Selecting G on the mode selector allows guard operation on 121.500 MHz when operating in the 108 to 136.995 MHz band and 243.000 MHz when in all other frequency bands. Selecting 243 on the mode selector automatically selects 243.000 MHz as guard frequency for transmit and receive.

Note

A notch filter is installed on the receive line external to the receiver-transmitter to prevent interference from high power FM radio stations when operating in the 108.000 to 136.995 MHz range. Reception of frequencies below 108.000 MHz is not possible unless the filter is bypassed.

20.4.1.3 Antennas

Refer to Antennas, paragraph 20.3.1.3.

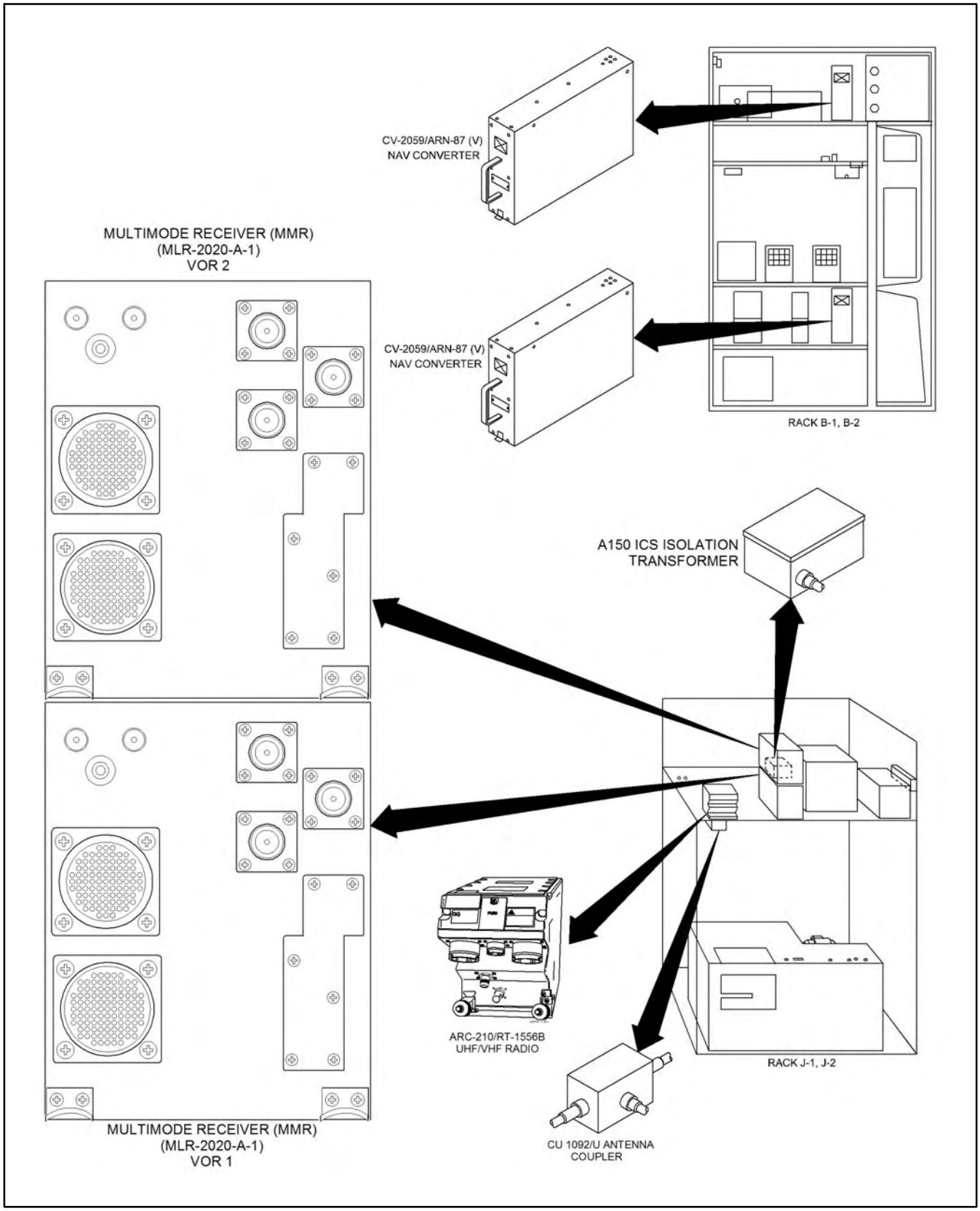


Figure 20-13. RT-1556B Receiver-Transmitter

20.4.1.4 Antenna Select Panel

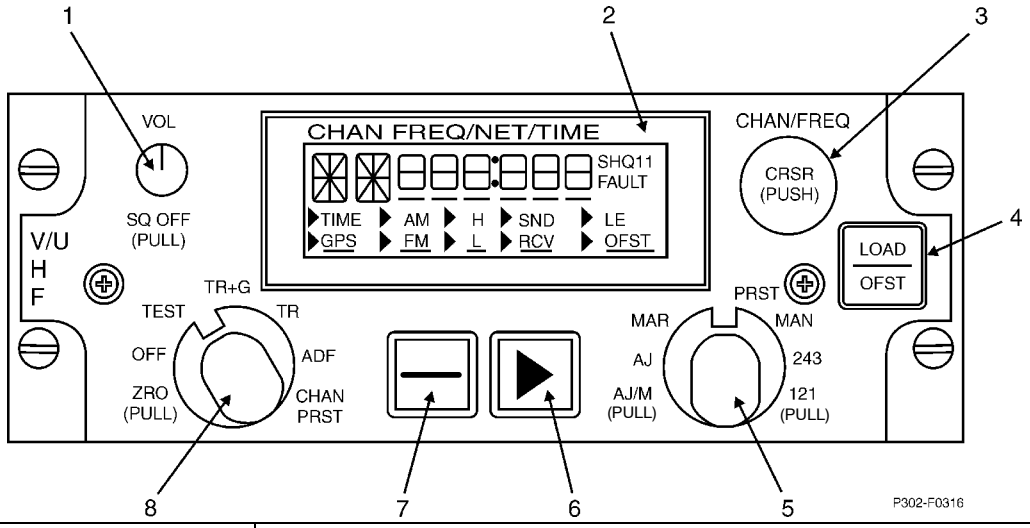
Refer to Antenna Select Panel, paragraph 20.3.1.4.

CAUTION

Selection of the top VHF antenna, when using a UHF frequency, may cause damage to the radio due to reflected energy. Communications in the UHF frequency band will not be transmitted by the VHF antenna.

Note

The antenna select panel is removed on aircraft incorporating AFC-597. Selection of the antenna is performed via the Control Display Navigation Unit.



#	PANEL MARKING	FUNCTION
1	VOL/SQ OFF (PULL)	VOL. Turning clockwise increases volume. SQ OFF (PULL). Push-pull switch disables main receiver squelch when pulled out and enables main receiver squelch when pushed in.
2	CHAN/FREQ/NET/TIME Display	Liquid crystal module display. Displays channel, frequency, net, time, mode, or built-in test results.
3	CHAN/FREQ CRSR (PUSH) Selector	Channel/frequency cursor pushbutton rotary switch. Used to dial in frequencies and/or preset/maritime channels. When dialing in a frequency, each time the switch is pressed, the cursor position moves from underneath one digit to another. The digit that the cursor is under is the one that is adjusted when rotating the knob; however, that last two digits will be adjusted simultaneously at multiples of 25.
4	LOAD/OFST	Pushbutton switch. When pressed, enables the loading of various data and operating frequencies depending upon mode selected.

Figure 20-14. ARC-210 Radio Set Control Panel Markings and Functions (Sheet 1 of 3)

#	PANEL MARKING	FUNCTION
5	Frequency Mode Selector:	Isolated position rotary switch (knob must be pulled out to enter or exit positions marked ([PULL]). Select the following frequency modes:
	121(PULL)	With the switch pulled and placed in the 121 position (pull-to-turn), the VHF guard mode is selected. The transmitter and main receiver are tuned to 121.500 MHz (AM). The preset and manual frequency selector controls become inoperative.
	243	With the switch placed in the 243 position, UHF guard mode is selected. The transmitter and main receiver are tuned to 243.000 MHz (AM). The preset and manual frequency selector controls become inoperative. Selection of this mode also turns on the radio with the operational mode selector in the OFF position with primary power present.
	MAN	Selects manual frequency select mode. Operator may select any of the radio operating frequencies. The ancillary modes are also available.
	PRST	Preset mode. Using the CHAN/FREQ switch, the operator may select up to 25 preset channels (1 thru 25) for simplex operation, channels 25 thru 30 with dual frequencies for half duplex. The selected channel, frequency, and modulation type (AM/FM) is displayed. Scan mode is enabled when SCAN is displayed. Preset channels 22 thru 25 are scan channels. When a signal is detected on a scan channel, the channel number and frequency are displayed. Press LOAD/OFST to return the radio receiver-transmitter to the last active channel (scanning ceases). The radio receiver-transmitter is ready to communicate on the selected frequency. Pressing the LOAD/OFST a second and/or third time tunes the radio receiver to the second and/or third channel that was last active. Pressing LOAD/OFST a fourth time causes the ARC-210 to resume scanning. Ancillary modes are also available.
	MAR	Maritime mode. The operator may select any one of the 57 present maritime channels (channels 1 thru 28 and 60 thru 68). Maritime channel and transmit frequency are displayed. Alternately pressing the LOAD/OFST pushbutton while in the MAR mode changes transmit frequency and station operation from shore to ship station and back.
	AJ	Electronic Protection (EP) AJ (Anti-Jam) mode. Not used by P-3.
	AJ/M (PULL)	Not used by P-3.
6	▶	Pointer pushbutton switch. Positions pointer to select or deselect ancillary mode option identified by cursor position by ancillary mode pushbutton switch (7).
7	▬	Ancillary mode pushbutton switch. Positions the cursor under various ancillary mode options. Used with pointer pushbutton switch (6) to select and deselect ancillary modes.

Figure 20-14. ARC-210 Radio Set Control Panel Markings and Functions (Sheet 2 of 3)

#	PANEL MARKING	FUNCTION
8	Operational Mode Selector:	Push-pull rotary switch selects the following operational modes:
	ZRO (PULL)	Not used by P-3.
	OFF	Selects OFF mode. Turns off power to the radio set.
	TEST	Selects TEST mode. Initiates BIT of the radio set control, radio receiver-transmitter, digital converter, and antenna. Display is blanked except for a momentary side pointer followed by the decimal point with the test in progress. Faults detected are displayed (refer to Figure 20-16). With no faults detected the display illuminates all function indicators. Test mode takes precedence over all operations except 243 MHz Guard. When using the A version of the radio set control, TEST also tests the diplexer and checks the radio frequency amplifier fault line if present.
	TR+G	Selects the main radio receiver-transmitter mode plus guard mode. The main receiver, transmitter, and guard receiver are on and able to perform all functions.
	TR	Selects the main radio receiver-transmitter mode. The main communications receiver and transmitter are on. Guard receiver is off.
	ADF	Not used by P-3.
	CHAN PRST	Select change presets mode.
	NOTE To select ancillary modes, the ancillary mode pushbutton switch (7) is used to position the cursor under the desired mode. The pointer pushbutton switch (6) is used to select or deselect the modes.	
	Ancillary Modes:	
	TIME	Not used by P-3.
	GPS	Not used by P-3.
	AM/FM	AM/FM mode selection. Identifies modulation in the VHF band 136 to 155.975 MHz and the UHF band 225 to 399.975 MHz.
	H/L	Not used by P-3.
	SND/RCV	Not used by P-3.
	LE	Not used by P-3.
	OFST	Offset mode. Enable the selection of any frequency in the valid operating bands (refer to Figure 20-15) in 5-kHz steps when using a radio set control. Offsets of 0 kHz, ±5 kHz, and ±10 kHz can be selected after the pointer is placed in front of the OFST menu selection, and pressing the LOAD/OFST pushbutton switch to increment in 5-kHz steps. When in 118.000 to 135.995 MHz band, selection of the 8.33 kHz channel spacing for air traffic control (European) is enabled (refer to Figure 20-18). The radio receiver-transmitter may be tuned in 2.5-kHz increments when using a MIL-STD-1553B control display unit.

Figure 20-14. ARC-210 Radio Set Control Panel Markings and Functions (Sheet 3 of 3)

20.4.1.5 Radio/CASS Selector

Refer to Radio/CASS Selector, paragraph 20.3.1.5.

20.4.2 System Description

Refer to Figure 20-15 for the ARC-210 frequency ranges.

The VHF/UHF radio is selectable for a transmission at any of the master ICS control panels by selecting VHF. All crew ICS control panels are capable of monitoring ARC-210 communications by selecting VHF with the audio selector switches. Selectable SQL-OFF (squelch ON-OFF) automatic level adjustment is provided to reduce or eliminate receiver background noise. The radio set also incorporates a continuous Built-In Test (BIT) and a selectable TEST mode for fault isolation.

The ARC-210 provides the capability to monitor two internationally recognized guard channels while communicating on a separate frequency. Frequency selection on the radio set control or Control Display Navigation Unit determines which of the guard frequencies is received. The frequencies that are available and selected automatically by the main receiver operating band are 121.5 MHz AM and 243.0 MHz AM.

BIT is conducted each time power is applied and when the TEST function is selected. Also, the radio set control continuously monitors system performance. When a fault is detected, either during BIT or continuous monitoring, a corresponding indication is displayed on the FREQ/(CHAN) display.

Note

The Control Display Navigation Unit is used to initiate TEST and report BIT on aircraft incorporating AFC-597.

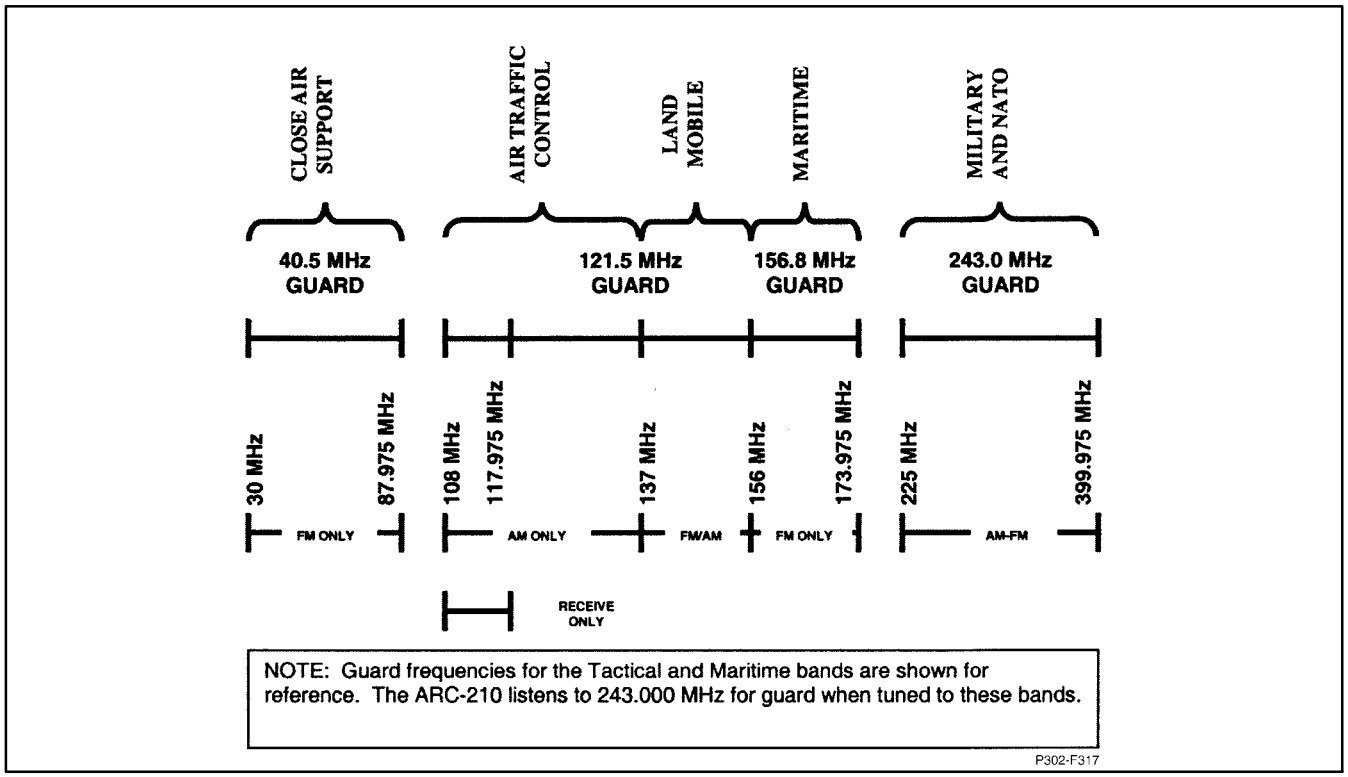


Figure 20-15. ARC-210 Operating Frequency Bands

DISPLAY INDICATION		FAULT
Left Side	Right Side	
All function indicators lit		Good System (Any missing segments indicate faulty control)
Blank	Blank	Radio Set Control Fault
CU	Fault	Digital Converter Fault
AM	Fault	Radio Frequency Amplifier Fault
MX	Fault	Diplexer Fault
AT	Fault	Antenna Fault
AP	Blank	Receiver-Transmitter A8 Module Fault
Blank	Fault	System Fault (normal display with Fault indicator lit)
RT	Fault	Receiver Transmitter Fault (Press LOAD/OFST pushbutton)
RT 136	Blank	With LOAD/OFST pushbutton pressed, gives actual failure code for depot maintenance.

Figure 20-16. BIT Readouts

20.4.3 Operating Procedures

Note

Selection of frequencies outside the authorized ranges (below 30 MHz, 88 through 117.975 MHz, and 174.000 through 224.975 MHz) will result in automatic rejection of the selected frequency. The last two digits of the FREQ/(CHAN) readout will blank, and the radio will remain tuned to the last authorized frequency displayed.

20.4.3.1 Channel Presetting Operation

1. Operation Mode selector — CHNG PRST.
2. Frequency Mode selector — PRST.
3. Load presets by pushing the CHAN/FREQ CRSR (PUSH) switch until cursor is below the desired frequency digit on the CHAN FREQ/NET/TIME display. Rotate until desired value is obtained. Repeat for each digit until desired operating frequency is obtained. Use ancillary mode cursor and pointer to select the desired modulation. When desired frequency and modulation are set, press the LOAD/OFST pushbutton switch. The desired frequency should be displayed on the CHAN FREQ/NET/TIME display. Repeat for each desired preset.
4. Rotate CHAN/FREQ CRSR selector to obtain desired channel indication on CHAN FREQ/NET/TIME display.

20.4.3.2 Plain-Voice Operation

1. Operational Mode selector — T/R or T/R&G.
2. Frequency Mode selector — MAN or PRST.
3. Frequency/Channel — Set as required.

Note

If MAN is selected, push the CHAN/FREQ CRSR (PUSH) switch until cursor is below desired frequency digit on the CHAN FREQ/NET/TIME display. Rotate until desired value is obtained. Repeat for each digit until desired operating frequency is obtained.

4. AM/FM — As desired.
5. VOL selector — Adjust as desired.
6. SQL/OFF selector — As desired.

Note

If MAN is selected, push the CHAN/FREQ CRSR (PUSH) switch until cursor is below desired frequency digit on the CHAN FREQ/NET/TIME display. Rotate until desired value is obtained. Repeat for each digit until desired operating frequency is obtained.

7. ICS master control panel, MIC SEL — VHF.
8. Key the microphone for transmission.

20.4.3.3 Guard Operation

1. Operational Mode selector — TR.
2. Frequency Mode selector — 243. CHAN FREQ/NET/TIME display indicates 243.000 and the receiver-transmitter tunes to 243.000 MHz. All control unit panel controls (except VOL/SQ OFF) are disabled.
3. Frequency Mode selector — 121. CHAN FREQ/NET/TIME display indicates 121.500 and the receiver-transmitter tunes to 121.500 MHz. All control unit panel controls (except VOL/SQ OFF) are disabled.

20.5 ARC-210 VHF/UHF RADIO SYSTEM (AIRCRAFT INCORPORATING CNS/ATM)

The ARC-210 VHF/UHF radio system may be installed in place of the ARC-182 VHF/UHF radio system for aircraft operating in areas where 8.33 kHz VHF channel spacing is required. Like the ARC-182, the ARC-210 allows communications with civilian and military agencies in the VHF-AM and UHF bands, civilian maritime units in the high VHF-FM band, and tactical military units in the low VHF-FM band. The radio is used for plain voice communication only.

20.5.1 System Components

20.5.1.1 RT-1556B Receiver-Transmitter

The receiver-transmitter, located in rack J-2 (Figure 20-10), provides two-way voice communications. It will receive and/or transmit AM or FM signals as depicted in Figure 20-15. The receiver-transmitter is capable of receiving and transmitting in 25-kHz increments in the 30 to 87.975 MHz band, 108 to 173.975 MHz band, and the 225 to 399.975 MHz band. The receiver-transmitter can also transmit and receive in 8.33-kHz increments in the 108 to 136.995 MHz band. The receiver-transmitter will receive navigational information in 25-kHz increments from 108 to 117.975 MHz band.

Two guard frequencies are available to be selected automatically by the main receiver operating band. Selecting the Guard mode on the CDU-7000 allows guard operation on 121.500 MHz when operating in the 108 to 136.995 MHz band and 243.000 MHz when in all other frequency bands. Selecting 243 on the mode selector automatically selects 243.000 MHz as guard frequency for transmit and receive.

Note

A notch filter is installed on the receive line external to the receiver-transmitter to prevent interference from high power FM radio stations when operating in the 108.000 to 136.995 MHz range. Reception of frequencies below 108.000 is not possible unless the filter is bypassed.

20.5.1.2 CDU-7000

The CDU-7000 powers and tunes the ARC-210 VHF/UHF radio. Refer to System Description, paragraph 23.17.2, for a system description of the CDU-7000.

20.5.1.3 Antennas

Refer to Antennas, paragraph 20.3.1.3.

20.5.1.4 Antenna Select Panel

Refer to Antenna Select Panel, paragraph 20.3.1.4.

CAUTION

Selection of the top VHF antenna, when using a UHF frequency, may cause damage to the radio due to reflected energy. Communications in the UHF frequency band will not be transmitted by the VHF antenna.

20.5.1.5 Radio/CASS Selector

Refer to Radio/CASS Selector, paragraph 20.3.1.5.

20.5.2 System Description

Refer to Figure 20-17 for the ARC-210 frequency ranges.

The VHF/UHF radio is selectable for a transmission at any of the master ICS control panels by selecting VHF. All crew ICS control panels are capable of monitoring ARC-210 communications by selecting VHF with the audio selector switches. Selectable SQL-OFF (squelch ON-OFF) automatic level adjustment is provided to reduce or eliminate receiver background noise. The CDU-7000 also incorporates a continuous Built-In Test (BIT) and a selectable TEST mode for fault isolation.

The ARC-210 provides the capability to monitor two internationally recognized guard channels while communicating on a separate frequency. Frequency selection on the Control Display Unit determines which of the guard frequencies is received. The frequencies that are available and selected automatically by the main receiver operating band are 121.5 MHz AM and 243.0 MHz AM.

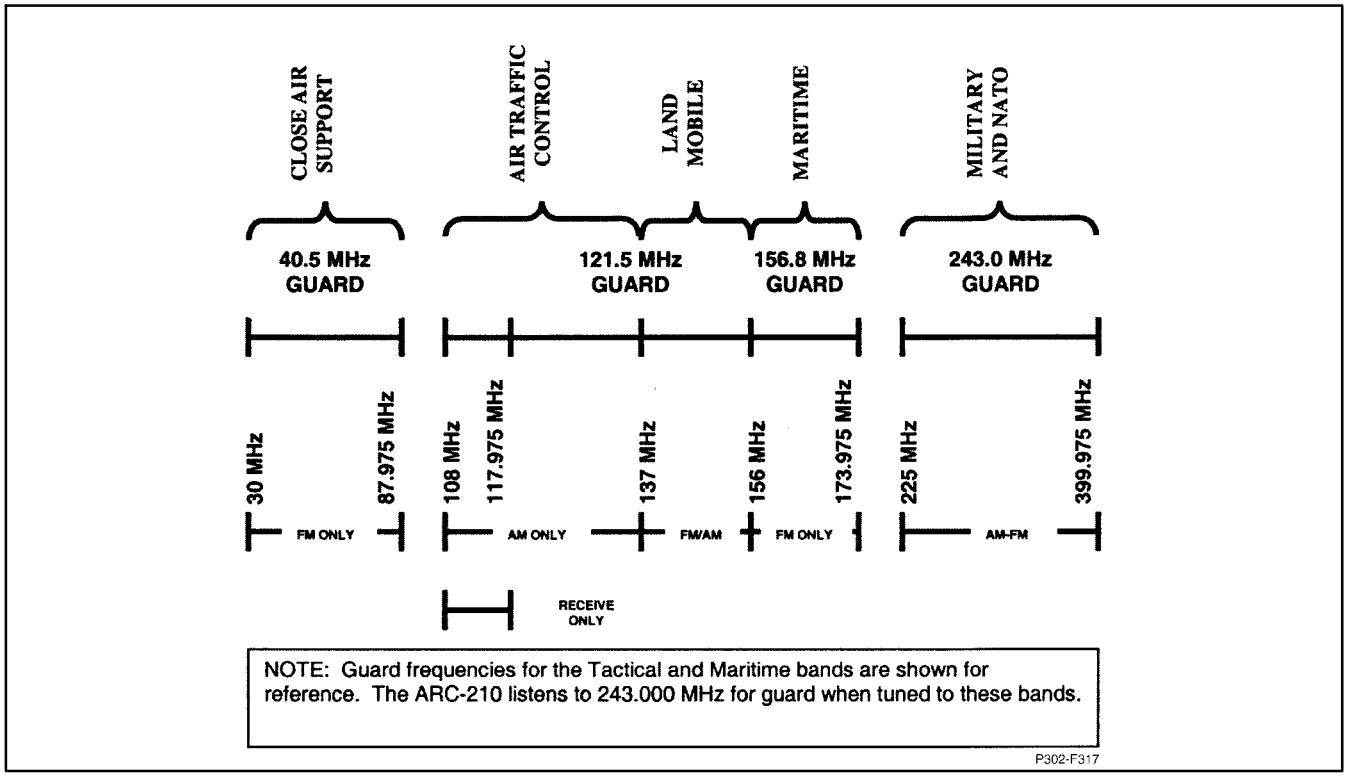


Figure 20-17. ARC-210 Operating Frequency Bands

BIT is conducted each time power is applied and when the TEST function is selected. Also, the radio set control continuously monitors system performance. When a fault is detected, either during BIT or continuous monitoring, a corresponding indication is displayed on the FREQ/(CHAN) display.

20.5.3 Operating Procedures

Note

Selection of frequencies outside the authorized ranges (below 30 MHz, 88 through 117.975 MHz, and 174.000 through 224.975 MHz) will result in automatic rejection of the selected frequency. INVALID ENTRY is displayed in the scratchpad, and the radio will remain tuned to the last authorized frequency displayed.

20.5.3.1 Power On

1. Select IDX.
2. Left Line Select (LLS2) <START INIT>.
3. RLS6 (Right Line Select) <POWER>.
4. LLS3 <VHF> to ON.

ATC Freq. (Entered via CDNU)	Bandwidth (kHz)	EATC Freq. (Interpreted in ARC-210)
118.000	25	118.0000
118.005	8.33	118.0000
118.010	8.33	118.0083
118.015	8.33	118.0617
118.020*	25	118.0250
118.025	25	118.0250
118.030	8.33	118.0250
118.035	8.33	118.0333
118.040	8.33	118.0417
118.045*	25	118.0450
118.050	25	118.0500
118.055	8.33	118.0500
118.060	8.33	118.0583
118.065	8.33	118.0667
118.070*	25	118.0750
118.075	25	118.0750
118.080	8.33	118.0750
118.085	8.33	118.0833
118.090	8.33	118.0917
118.095*	25	118.0950
Sequence repeats…		

NOTE

All frequencies given are in MHz.

*These channel names are not listed in the ICAO table but are shown to illustrate how the radio receiver transmitter will perform if tuned to one of these channels.

Figure 20-18. ICAO Automatic Frequency Translation

20.5.3.2 Preflight

1. Select COM.
2. T/R or T/R&G — LLS2 as desired.
3. SQL/OFF selector — LLS3 as desired.

20.5.3.3 Frequency Changes

1. Type in new frequency to scratchpad.
2. Press COM.
3. LLS next to VHF radio to change the frequency.

Note

Enter 0 and LLS next to radio to return to previous frequency.

20.5.3.4 Power Off

1. Select IDX.
2. LLS2 <START INIT>.
3. RLS6 <POWER>.
4. LLS3 <VHF> to OFF (must press again to confirm off).

20.6 ARC-143 UHF RADIO SYSTEM

Two identical ARC-143 UHF transceivers are installed in the P-3 aircraft. These radios are functionally identical; however, they have different capabilities because of aircraft wiring differences between the NAV/COMM station and the flight station. The UHF-1 control box is mounted in the flight station. It can be utilized for plain voice, cipher voice (Vinson), and UHF-DF in conjunction with the ARA-50 amplifier and a DF loop antenna. For aircraft incorporating AFC-483, UHF-1 secure-voice SATCOM has been added. The UHF-2 control box is mounted at the NAV/COMM station and is capable of plain voice, cipher voice, teletype, data link, and sonobuoy command.

Externally, three antennas are utilized by the UHF system. UHF-1 has a top antenna mounted behind the cockpit windows on the upper fuselage and a DF loop antenna mounted aft of the nose landing gear. Switching between these antennas is automatic. When ADF is selected on UHF-1, the receiver-transmitter is connected to the lower DF loop and direction to any UHF transmission is available on any HSI by selecting the DF position. When T/R or T/R+G is selected on the function selector, G is selected on the mode selector, or the microphone is keyed in the ADF mode, the output of UHF-1 is switched to the upper blade antenna.

UHF-2 is always connected to the blade antenna on top of the vertical stabilizer on aircraft prior to Update III. On Update III aircraft, a second blade antenna is mounted on the lower fuselage forward of the sonobuoy tubes and the NAV/COMM is provided with an antenna select switch. The switch allows selection of either antenna for UHF-2 transmission and reception. The deselected antenna may be used to provide the input for end-to-end BITE testing for the advanced sonobuoy communication link. This lower antenna is primarily installed to reduce shadowing when conducting on-station swaps in the high-boy role.

20.6.1 System Components

Figure 20-19 shows component locations, panel markings, and functions of the UHF radio system components and a simplified block diagram. Figure 20-20 shows circuit breaker locations and power sources.

20.6.2 System Description

The ARC-143 radio system operates in the frequency range of 225.000 to 399.975 MHz (399.950 MHz in earlier sets). The UHF radio is capable of continuous transmission for 5 minutes under all conditions. In temperatures up to 55 °C, 30 minutes of continuous transmission is possible. Warmup time is less than 1 minute in most service conditions. Under adverse conditions, approximately 2 minutes warmup time can be expected. Operating power is 10 watts in SC; 30 watts in voice and TTY; and 100 watts in data link (FM).

Either UHF radio is selectable for transmission at any of the ICS master control boxes. Additionally, any crew ICS control box may select UHF-1 or UHF-2 for reception only. Mode selection on a radio is determined by a procedure called mode forcing. This involves leaving the radio in a voice mode (T/R or T/R+G) and forcing the radio into a data transmission mode through the communication switching matrix. There are no forced modes on UHF-1. UHF-2 can be forced into FM for data link or Frequency Shift Key (FSK) for teletype and Integrated Acoustic Communication System (IACS). Discussion on mode forcing is contained in System Description, paragraph 20.1.2. Both radios can be selected for cipher voice, switching the voice line from the secure switching matrix to the cipher voice line through the KY-58 for encryption.

Secure voice SATCOM, used only with the UHF-1 system in conjunction with the KY-58 and the antenna switching assembly, can be used by any crew position with a master ICS control (Refer to Operating Procedures, paragraph 20.1.3). The SATCOM installation prohibits secure-voice communications from UHF-2. The KY-58 provides encryption and decryption, and the antenna switching assembly, located in the overhead near the top UHF antenna, provides the required filters and preamplifier to receive low-level satellite signals.

When the UHF-2 mode selector is placed in Sonobuoy Command (SC), the radio is automatically tuned to 291.4 MHz and transmission power is reduced to 10 watts and connected to the output of the CASS reference signal generator. This function is not available on Update III aircraft. The NAV/COMM loses all radio capabilities except guard reception. Guard is available for monitoring if the function selector is selected to T/R or T/R+G in the SC mode.

When primary power is lost to the communication selector panel (with all equipment installed), the radios are forced into a plain-voice mode. Primary control remains throughout the ICS system, although no lighting indications will be received. When primary power is lost to the secure switching matrix, ICS, UHF, and HF plain voice will remain available.

When the ICS system is inoperative, either UHF radio may be monitored with a standard headset by plugging into the front of the receiver-transmitter unit in rack F-1. If an RT-932B transceiver is installed, transmission is also possible utilizing an ordnance type ICS cord with an in-line keying device and a headset with a boom mike.

20.6.3 Operating Procedures

20.6.3.1 Plain Voice

1. Close circuit breakers at center electronic circuit breaker panel or main load center (Update III).
2. Frequency — Rotate selectors to display desired frequency.
3. Mode selector — MAN.
4. Function selector — R TEST. Observe illuminated GO indicator.
5. Function selector — T TEST. Observe illuminated GO indicator.

Note

These self-tests perform overall receiver-transmitter checks. Fault isolation tests can be conducted from the front panel of the UHF R/T unit if either self-test fails.

6. Function selector — T/R+G. May be set to the T/R position if guard reception is not desired.
7. SQUELCH, M and G — As desired.
8. UHF-2 (on communication selector panel) or UHF-1 (on voice selector panel) PLAIN VOICE — Press. Pushbutton indicator illuminates amber.
9. MIC SEL UHF-2 (or UHF-1) on ICS master control panel — Press. Pushbutton indicator illuminates amber.
10. Press microphone push-to-talk switch or microphone foot switch to key transmitter. For teletype and data-link operation (with UHF-2 only), perform the preceding steps, except in step 7 select UHF-2 TTY or DATA on the communication selector panel. Refer to NAVAIR 01-75PAC-1.1, for additional procedures involving teletype and data-link operation.

20.6.3.2 UHF-2 (UHF-1) Cipher Voice

1. Perform plain voice setup.
2. UHF-2 (on communication selector panel) or UHF-1 (on voice selector panel) CIPHER VOICE — Press. Pushbutton indicator illuminates amber. For UHF-2 setup only, flight station must have UHF-1 voice selector panel power ON and PLAIN VOICE pushbutton indicator illuminated amber.
3. UHF-2 (UHF-1) CIPHER (on ICS master control panel) — Illuminated amber.
4. MIC SEL UHF-1 (UHF-2) (on ICS master control panel) — Press. Pushbutton indicator illuminates amber.
5. Press microphone push-to-talk switch or microphone foot switch to key transmitter. Wait for tone to cease, indicating system is synchronized, before commencing transmission.

Note

During cipher-voice transmissions, if an ICS master control panel loses headset audio, cycle the forward DC circuit breaker under the COMMUNICATION SECURE VOICE group on the forward electronic circuit breaker panel.

20.6.3.3 UHF-1 Secure SATCOM

1. Perform plain voice setup steps 1 through 5.
2. Function selector — FM.
3. Cipher voice panel — Select UHF-1 amber.
4. Master ICS control panel — MIC SEL switch UHF-1 amber.
5. Press microphone push-to-talk switch or microphone foot switch to key transmitter.

20.6.3.4 UHF-2 (UHF-1) Guard

1. Perform plain voice setup.
2. Mode selector — G. UHF-2 (UHF-1) PLAIN VOICE indicator selection on the communication selector (or voice selector) panel is forced and illumination changes to amber; all other UHF-2 (CIPHER VOICE on UHF-1 voice selector panel) pushbutton indicators extinguish.
3. MIC SEL UHF-2 (UHF-1) (on ICS master control panel) — Press. Pushbutton indicator illuminates amber.

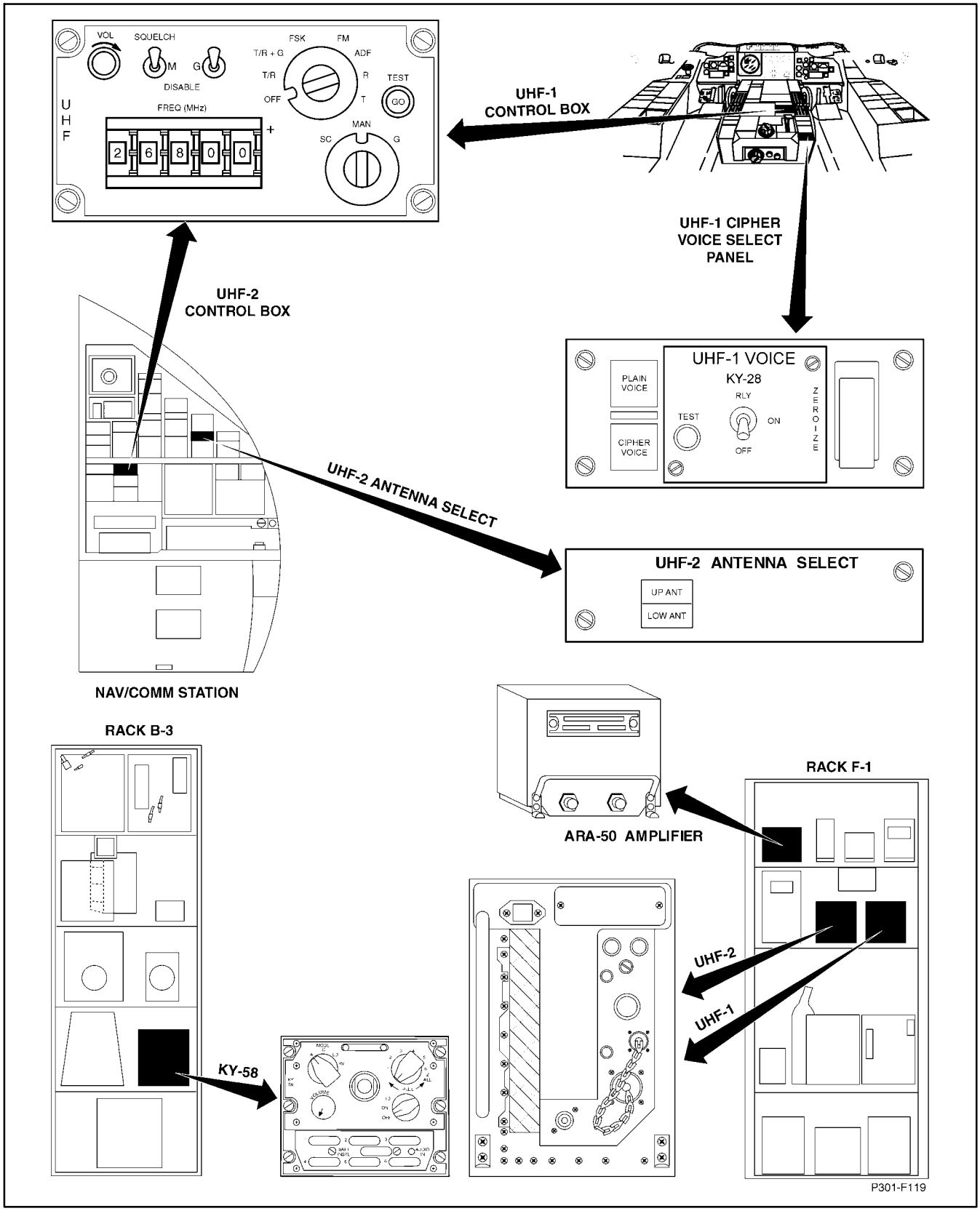


Figure 20-19. ARC-143 UHF Radio System (Sheet 1 of 2)

UHF CONTROL PANEL MARKING AND FUNCTIONS	
PANEL MARKING	**FUNCTION**
VOL	Inoperative.
M/G	Manual or guard receiver squelch.
SQUELCH	Selects normal preset receiver squelch.
DISABLE	No squelch action performed.
TEST GO Light	Indicates successful R/T BIT.
Function Selector:	
ADF	Selects UHF-DF on UHF-1. Inoperative on UHF-2.
FM	Selects SATCOM communications on UHF-1 (for aircraft incorporating AFC-483). Otherwise inoperative. For UHF-2, FM is mode forced by the communications selector panel for data link.
FSK	Inoperative — Mode forced by communication selector panel for TTY on UHF-2.
TR+G	AM T/R on the selected frequency plus simultaneous guard (243.0 MHz) reception. Enables mode forcing on UHF-2.
T/R	AM T/R on the selected frequency. Enables mode forcing on UHF-2.
Mode Select:	
SC	Selects sono command mode on UHF-2. Inoperative on UHF-1. **Note** This function is not available on Update III aircraft.
MAN	Enables the function selector.
G	Selects 243.0 MHz for transmission and reception regardless of set window frequency.
UHF-1 CIPHER VOICE SELECT PANEL MARKING AND FUNCTIONS	
ON/OFF/RLY	Applies primary power to the KY-58. RLY enables longer sync signal when keying the KY-58.
ZEROIZE	Red guarded switch clears the code set in the KY-58.

Figure 20-19. ARC-143 UHF Radio System (Sheet 2 of 2)

COMPONENT NAME	CIRCUIT BREAKER LOCATION		CIRCUIT BREAKER NAME	POWER SOURCE
	(PRIOR TO UPDATE III)	(UPDATE III)		
UHF-1	Center Electronic	Main Load Center Panel 3 Upper	UHF-1	MEAC
UHF-2	Center Electronic	Main Load Center Panel 3 Upper	UHF-2	BUS A
UHF-DF	Main Load Center Panel 4 Upper	Main Load Center Panel 4 Upper	UHF-DF	BUS A MDC
UHF-2 ANTENNA SELECT	Not Installed	Main Load Center Panel 3 Upper	UHF-2 ANT SEL	BUS A
KY-58	Forward Electronic	Forward Electronic	COMMUNICATIONS SECURE UHF VOICE	MEDC
ANTENNA SWITCHING ASSEMBLY	Forward Electronic	Forward Electronic	SATCOM	MDC

Figure 20-20. Circuit Breaker Locations and Power Sources

20.6.3.5 UHF-2 Sonobuoy Command

1. Perform plain voice setup.
2. Mode selector — SC. This causes the UHF-2 indicators to extinguish on the communication selector panel.

20.6.3.6 UHF-1 ADF

1. Perform plain voice setup.
2. Function selector — ADF. The UHF-1 PLAIN VOICE pushbutton indicator illuminates amber on the voice selector panel, and the CIPHER VOICE pushbutton indicator extinguishes.

On pilot HSI control panel:

3. BRG 1 switch — DF. Relative bearing to tuned-in UHF station is indicated by pointer 1 of all three HSIs.

Note

The ARA-50 UHF-DF bearing is inaccurate and oscillatory with the landing gear extended. It should be used for instrument landing approaches only when other NAVAIDs are not available, and, if used, the landing gear should remain retracted until visual contact is made with the landing area.

20.6.4 UHF Emergency Operation

In the event of ICS failure, UHF radios utilizing an RT-932B have microphone/headset connectors on the front of the receiver-transmitter units that permit voice communication independent of the intercom system. Ordnance type headsets with boom mikes and in-line keying devices (CX-11754/AIC-22(V)) are required. Earlier UHF receiver-transmitters have the capability of reception only.

20.7 COMMUNICATIONS IMPROVEMENT PROGRAM (CIP)

20.7.1 Introduction

The P-3 CIP was initiated to develop, modify, and integrate hardware and software required to provide secure UHF SATCOM capability for the P-3 that meets the Joint Chiefs of Staff (JCS) UHF SATCOM Demand Assigned Multiple Access (DAMA) requirement.

Software and hardware developed for the P-3 CIP coupled with the installation of a common communication architecture provides the following to all P-3 aircraft:

1. Secure UHF-1 Narrowband Satellite Communication (NBSAT).
2. Design growth features to allow for future incorporation of digital secure data communication.
3. A common P-3 V/UHF and UHF radio configuration that consists of one AN/ARC-182 or AN/ARC-210 V/UHF and two AN/ARC-187(V) UHF radio sets.
4. Integration with Control Display Navigation Units (CDNUs), installed aboard the P-3 to provide interface for CDNU control and selection of all radio functions and UHF-1 secure SATCOM.
5. Universal Timing Signal (UTS) from the GPS for utilization of the HAVE QUICK features of the AN/ARC-187(V) radio sets.
6. Growth provisions in the architecture design to allow for future incorporation of a DAMA SATCOM Secure TTY Mode.

In general, the baseline architecture expands the SATCOM capabilities of UHF-1 to include Narrowband 25K/5K DAMA and Narrowband Dedicated SATCOM. Frequency control and management of the V/UHF and UHF radios is available to all stations with a CDNU (pilot, copilot, and NAV/COMM). Selection of cipher and other forced modes is still done through either the UHF-1 Cipher Select Panel in the flight station or the Comm Selector Panel at the NAV/COMM station. CIP added components are shown in Figure 20-21.

Although the normal means of control will be online via the CDNU and supporting CIP software, offline control of the UHF radios is still possible by manually taking the radio out of REMOTE and selecting the frequency on the Radio Set Controls located in rack F-1. Offline control of the V/UHF radio is not possible since the control head is no longer in the aircraft. Off-line the V/UHF radio will remain tuned to the last frequency selected online, but transmission and reception are still possible.

20.7.2 System Components

Components of the Communication Improvement Program and their integration with the existing P-3 communication architecture are shown in Figure 20-21.

QUANTITY	NOMENCLATURE	DESIGNATION	LOCATION
1	V/UHF Power Switch	401MS08B/001	Copilot Side Console
2	Radio Set Control	C-12435/ARC-187(V) (Version 01.98)	RACK F1
2	Crypto Fill Panel	C-12094/AR	RACK F1
1	Diplexer	MX-7580/U	FS 359 O/H
1	Interface Device Adapter Assembly	MX-11949/ARC	FS 359 O/H
1	X-Mode Relay	M83536/9-024M	RACK F1
1	Modem	MD-1324(c) U DAMA SATCOM Interface	RACK F1
1	Modem Mount	26745-1	RACK F1
1	ANDVT	USC-43(V)3	RACK B3
1	ANDVT Mount	Z-AKM	RACK B3
4	Data Bus Coupler	5008309-002	Overhead FS 694, 677, 961, 973
1 (lot)	CDNU Software	CDNU Communication Control Software	P, CP, NC CDNUs

Figure 20-21. CIP Equipment Changes

20.7.2.1 V/UHF Power Switch

The V/UHF POWER switch (Figure 20-22), installed on the copilot side console just forward of the CDNU, routes power to the ARC-182 VHF/UHF Radio Subsystem when selected amber. Power to the light for the V/UHF POWER switch is wired through the copilot side console rheostat for dimming capability. All V/UHF radio controls previously performed by the V/UHF Radio Set Control are now available from the pilot, copilot, and NAV/COMM CDNUs.

20.7.2.2 UHF Receiver-Transmitter

The UHF Receiver-Transmitter (RT) located in rack F-1/F-2 provides for multi-mode Line Of Sight (LOS), SATCOM, and data link receive and transmit applications. The existing P-3 onboard RT-1571/ARC-187 UHF RT has been modified to incorporate operation in 5/25 kHz DAMA SATCOM modes. The CIP installation requires two ARC-187(V) RTs modified for baseband VINSON and DAMA. The modified receiver-transmitters are identified as RT-1571A/ARC-187(V). All other features of the ARC-187 RTs are unmodified.

20.7.2.3 C-12435/ARC-187(V) Radio Set Control (RSC)

Two digital RSCs located in rack F-1/F-2 replace existing analog RSCs for the UHF-1 and UHF-2 radio systems. The digital RSC (Figures 20-23 and 20-24) provides the necessary control circuitry to operate the ARC-187(V) RT to provide two-way AM voice, FM data, and 70 MHz Input/Output (I/O) communications. The RSC provides LOS or SATCOM configurations of FM data and 70 MHz I/O modes. AM voice is LOS only. The RSC can operate a HAVE QUICK II RT in AM voice and FM Data Link modes. Included in the FM data mode are the capability for SATCOM (VINSON) transmit and receive, Link 11 transmit and receive, and receive only for Link 4A. Sonobuoy Command (SC) and Automatic Direction Finding (ADF) selection controls are also provided by the RSC interface to enable wideband audio use by other onboard equipment.

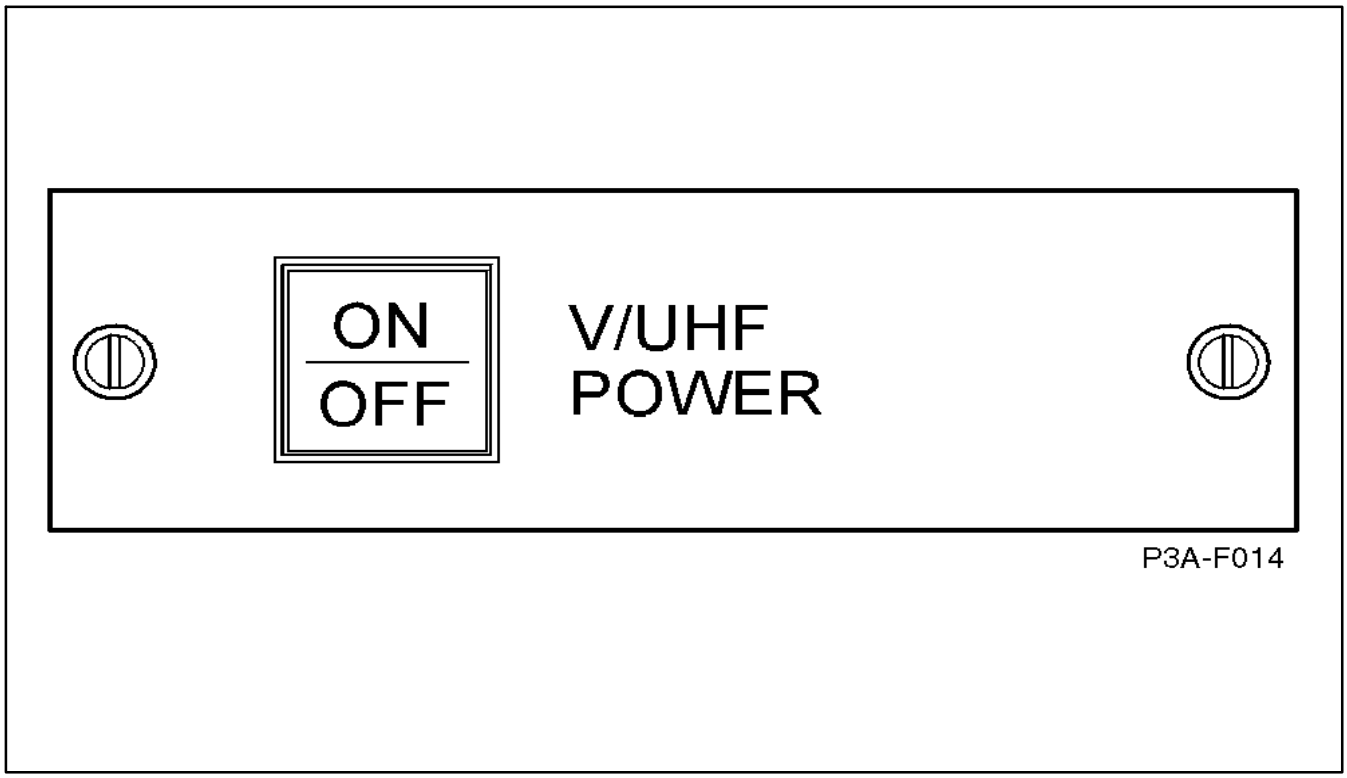


Figure 20-22. V/UHF Power Switch

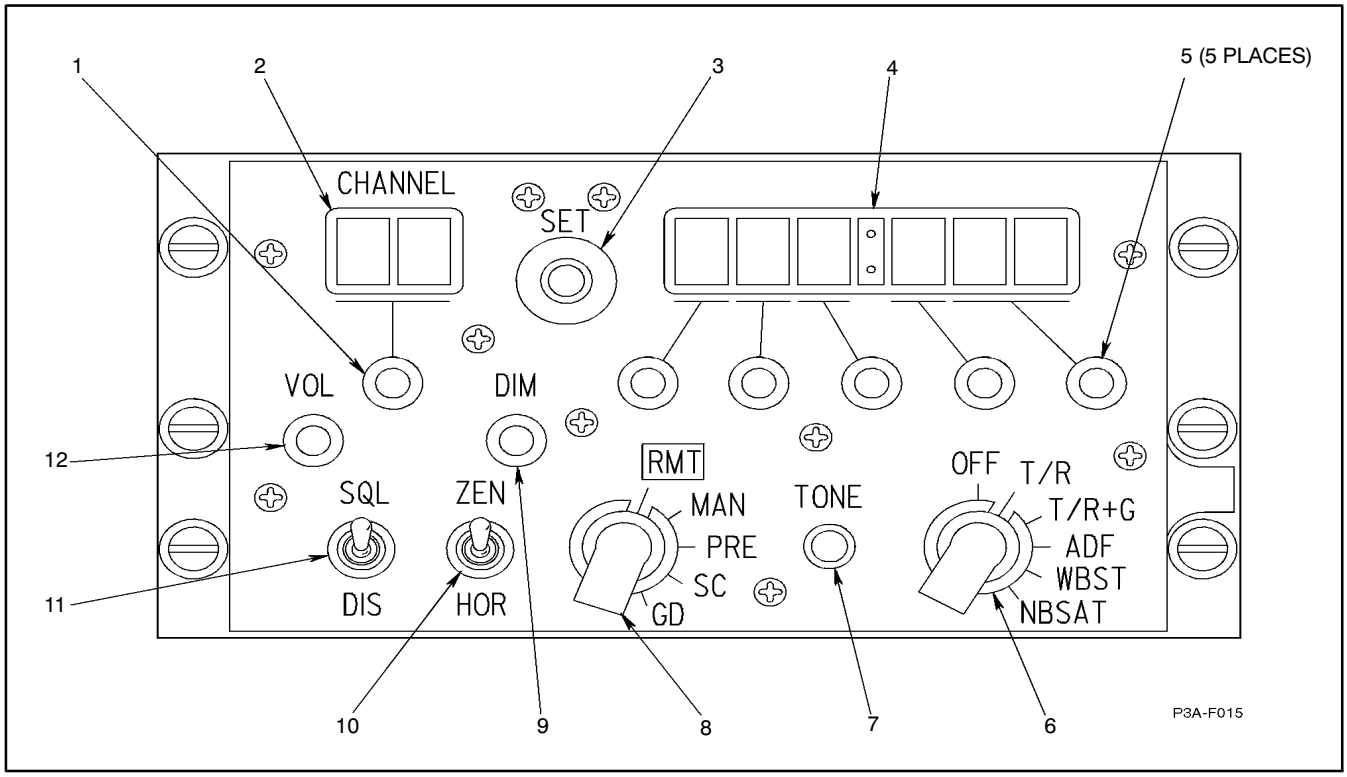


Figure 20-23. AN/ARC-187(V) Radio Set Control Head (RSC)

ID	CONTROL/INDICATOR	FUNCTION
1	Channel selector	Selects preset channel or SATCOM offset. Slew rate is approximately two values per second.
2	Channel display	Displays selected preset channel (1-20 FOR LOS, 21-40 for SATCOM) or SATCOM OFFSET (S1-S8).
3	SET switch	Presets the displayed normal mode frequency or the HAVE QUICK active mode word of the day into memory.
4	Frequency display	Displays selected frequency, Anti-Jamming (AJ) mode, the time of day, fault indications, or bit codes. An A in the leftmost location indicates AJ mode is active, and the remaining digits represent the net number. **Note** A question mark in the 100 MHz digit position of the frequency display is the fault indication for an operator error.
5	Manual frequency select toggle switches	Selects operating frequency. The first (leftmost) switch is electronically stopped at “T” (TIME OF DAY READOUT) at the lower limit and “A” (indicating the anti-jamming mode is active) at the upper limit. The other four switches slew through the values without stopping at maximum or minimum values.

Figure 20-24. AN/ARC-187(V) Radio Set Control Head (RSC) Functions (Sheet 1 of 2)

ID	CONTROL/INDICATOR	FUNCTION
6	Function selector switch:	Selects the following functions:
	OFF	Removes power from the system.
	T/R	Sets radio to an 'AM' operation, enabling HQ, plain, and cipher voice.
	T/R+G	Operates similar to T/R with additional guard functions. Enables dedicated guard receiver on 243.0 and combines guard audio with main receiver audio.
	ADF	Enables DF operation (UHF-1 only).
	WBSAT	Enables 25 kHz wideband SATCOM operation (UHF-1 only).
	NBSAT	Enables narrowband SATCOM operation requiring external modem. Not currently active on P-3C.
7	TONE switch	Performs the following functions in accordance with the selected mode: AM mode — Transmits a 1020 MHz and displays time of day. HAVE QUICK II load mode — Enters Word of the Day (WOD), day, or FMT net segment load key. Preset SAT mode — Displays the SATCOM offset associated with the displayed channel/offset number.
8	Mode selector switch:	Selects the following modes:
	RMT	Places radio in the MIL-STD-1553B (online) mode. Commands issued by the 1553B Bus have priority.
	MAN	OP freq is set by the manual frequency select toggle switches.
	PRE	Preset operating frequency channel is set by the PREST channel selector toggle switch. In SATCOM mode, receive frequency is read directly from preset memory, and transmit frequency is receive FREQ plus the assigned SATCOM OFFSET (S1-S8).
	SC	Tunes the radio to 291.400 MHz.
	GD	Activates the guard mode. Tunes the main receiver to 243.0 MHz, disables guard receiver to avoid interference, and forces radio into LOS AM voice configuration.
9	DIM switch	Controls brightness of channel and frequency displays.
10	ZEN/HOR switch	Controls selection of the Zenith/Horizon (Batwing/blade) antenna selection.
11	SQL/DIS switch	Enables/disables normal main receiver squelch function.
12	VOL switch	Control plain audio level. Not active on P-3 aircraft.
13	WB/NB selector switch (not shown)	Mounted on back panel of RSC. Controls wideband/narrowband (WB/NB) selection for fixed frequency operation.

Figure 20-24. AN/ARC-187(V) Radio Set Control Head (RSC) Functions (Sheet 2 of 2)

20.7.2.4 CDNU Communication Control Software

The CIP integrates existing communication and navigation equipment with new and modified communication equipment. CDNUs located at the pilot, copilot, and NAV/COMM stations provide control of the UHF-1, UHF-2, and VHF/UHF radio subsystems while displaying operational and system status information. Each CDNU is capable of operating as the MIL-STD-1553B data bus controller; however, only one may operate as the bus controller at any given time. Communication Control Software developed under CIP, for the CDNU Operational Flight Program (OFP), provides control, display, processing, and interface capabilities necessary to control two AN/ARC-187 UHF radios, one AN/ARC-182 VHF/UHF radio, and one MD-1324(c)/U Modem.

20.7.3 System Description

20.7.3.1 Communication Control Software (CCS)

The software for the Control Display Navigation Units (CDNUs) located at the pilot, copilot, and NAV/COMM stations was developed for the P-3 Communications Improvement Program (CIP) to provide control of CIP components via MIL-STD-1553B interface and display CIP operational and system status information. The System Functional Description focuses on the CDNU CCS software controls and functions implemented for the P-3 CIP UHF-1, UHF-2, VHF/UHF, and Demand Assigned Multiple Access (DAMA) Satellite Communication (SATCOM) Modem. For actual software manipulation procedures, refer to CDNU Users Aid.

The CDNU contains a display, an alphanumeric keypad, and function keys used to display and manipulate data. The CDNU contains two software programs: the Operational Flight Program (OFP) and the fixed program. The CDNU OFP provides control, display, processing, and interface capabilities necessary to control two AN/ARC-187 UHF radios, one AN/ARC-182 VHF/UHF radio, one MD-1324(c)/U Modem, a Digital Data Set (DDS), and a Global Positioning System (GPS) receiver. The fixed program performs Built-In Test (BIT) and loading of the OFP. Each CDNU is capable of operating as the MIL-STD-1553B data Bus Controller (BC) or Backup Bus Controller (BBC). Only one may operate as the BC at any given time.

The CDNU display presents various pages of communication and system data in a format consisting of 8 lines of 22 characters each. The bottom line of the display is a buffer, called a scratchpad, which holds all keystrokes before executing the input. Incorrect scratchpad entries may be cleared with the CLR key. A single press of the CLR key clears the last character entered. Pressing and holding the CLR key will delete the scratchpad characters in a reverse order.

The CDNU alerts the crew of communication failures, degraded operations, and operator entry errors. Methods used to display alerts are:

1. System annunciations.
2. Scratchpad messages.
3. Master CDNU alert discretes.

System annunciations appear on line 6 of the CDNUs simultaneously. The annunciation line is divided into two fields, left and right justified, that have independent display queues and priorities. Higher-priority annunciations preempt the display of lower-priority annunciations. Pressing the CLR key on the CDNU clears the highest priority annunciation from each field and displays the next lower-priority annunciations. Some annunciations (such as NAV FAIL or mode-indicating annunciations) are not clearable and are placed on the bottom of the display queue when the CLR key is pressed. Refer to the CDNU Job Aid for a complete listing of error messages and status alerts displayed by the CDNUs for the P-3 CIP.

The CDNUs are powered by +28 Vdc from the MONITORABLE ESSENTIAL DC bus. If the CDNU power supply falls below the absolute steady state limits for less than 500 milliseconds, Random Access Memory (RAM) will be maintained through this period and the CDNU will resume normal operation when steady state voltage levels are restored.

20.7.3.1.1 MIL-STD-1553B Interface

For the P-3 CIP configuration, three CDNUs provide controls and receive system status from the UHF-1, UHF-2, and VHF/UHF radio subsystems, and MD-1324(c)/U Modem via a dual redundant MIL-STD-1553B data bus.

The first CDNU to complete initialization will become the BC. Each CDNU is capable of becoming the BC in the event of a BC failure. If the CDNU is functioning as the BC fails, the BBC will take over as BC within 500 milliseconds. All pertinent data is retained in each CDNU Non-Volatile Memory (NVM) and will be resident on the new BC. The UHF-1, UHF-2, VHF/UHF, radio subsystems, and MD-1324(c)/U Modem are designated as remote terminals on the P-3 CIP 1553B data bus.

20.7.3.2 UHF Radio System

20.7.3.2.1 Plain Voice Communication—LOS

Operator selection of the T/R or T/R+G functions from the CDNUs provides for selection and control of Frequency, Squelch, Guard, and HAVE QUICK features for LOS plain voice communication. Plain voice selections performed with existing communication system equipment (UHF-1 Voice Selector, COMM Selector [A-516], ICS) will force the UHF-1 or -2 R/T to the AM mode and raise the keyline required for transmission. The CDNUs will notify the operator when plain voice communication has been selected from existing equipment.

20.7.3.2.2 Secure Voice Communication KY-58, LOS

Operator selection of the T/R or T/R+G functions from the CDNUs provides for selection and control of Frequency, Squelch, Guard, and HAVE QUICK features when LOS secure voice communication using KY-58 security equipment are enabled. Secure voice communication is enabled when selected from existing communication system equipment (UHF-1 Voice Selector, COMM Selector). The CDNUs will notify the operator when cipher voice communication capability has been selected.

The Communications/Navigation Switching Unit (CNSU) routes secure voice signals from the Secure Switching Matrix (A-552) or secure data from the RS-422 Auxiliary Port to the KY-58 encryption unit when CIPHER is selected and T/R or T/R+G has been selected on the CDNU UHF Control page or on the UHF RSC.

20.7.3.2.3 Automatic Direction Finding LOS (UHF-1 Only)

Operator selection of the ADF function from the CDNUs will cause the UHF-1 RSC to force the RT into a receive state for wideband AM audio and disable the guard receiver. The CDNUs do not display nor allow selection of the ADF function when CIPHER has been selected at the UHF-1 Voice Selector.

20.7.3.2.4 Sono Command

Operator selection of the SC mode from the CDNUs will cause the UHF-2 RSC to force the main RT to tune to the preprogrammed sonobuoy command frequency supplied by the CDNU. While in the SC mode, Guard cannot be monitored from the UHF-2 radio.

20.7.3.2.5 Guard

Operator selection of the Guard mode from the CDNUs will cause the UHF-1 RSC to force the main RT to tune to the preset emergency guard receiver frequency of 243.000 MHz. Selection of the Guard mode will cancel any current mode currently selected and lockout selection of other modes at the CDNUs until GUARD is deselected.

20.7.3.3 VHF/UHF Radio System

20.7.3.3.1 Plain Voice Communication-LOS

Operator selection of the T/R or T/R+G functions from the CDNUs provides for selection and control from the CDNUs of frequency, squelch, and Guard features for LOS plain voice communication. AM or FM modulation is operator selectable from the CDNUs for the VHF/UHF radio UHF operating frequency range.

20.7.3.3.2 ADF

ADF, while displayed as a selectable function on the CDNU for the V/UHF radio, is not used in the P-3 due to aircraft configuration wiring.

20.7.3.3.3 Guard

When the Guard mode is selected at any CDNU, the guard receiver selected is the one that is in the frequency band of the main receiver frequency selected. Selection of the Guard mode locks out selection of other modes at the CDNUs until deselected.

20.7.4 Operating Procedures

20.7.4.1 CIP

CIP (Figure 20-25) is a software-driven upgrade to the existing communication architecture of the P-3. As such, detailed operating procedures are beyond the scope of this document. Consult the NAV/COMM Checklist, Software Users Manual, Operator and Maintenance Manual, or CDNU Users Guide for detailed operating procedures. The following are procedures for basic operation and loading of the gear.

20.7.4.2 Quickstart Checklist

1. CDNU — ON.
2. V/UHF Power Panel — ON.
3. UHF-RSC.
   a. Mode switch — MAN.
   b. Function Selector — T/R.
   c. Observe.

      Operating frequency displayed.
      No flashing bit fail codes.

   d. Mode switch — RMT.
4. CDNU — Enter desired frequency.
5. Select Function key for desired radio.

   F1 = UHF-1.
   F2 = UHF-2.
   F2 = V/UHF.
6. Select the radio on the ICS Master Control Box.
7. Comms are now possible.

CIP QUICKSTART CHECKLIST

CAUTION

PRIOR TO APPLYING OR REMOVING AIRCRAFT POWER, ENSURE THE RADIO SET CONTROLLER (RSC), LOCATED IN F-RACK FOR UHF-1 AND UHF-2, AND THE V/UHF POWER SWITCH, LOCATED IN THE FLIGHT STATION FORWARD OF THE COPILOT CDNU, ARE IN THE OFF POSITION.

TO ENABLE CDNU (ONLINE) CONTROL

1. PILOT, COPILOT, AND/OR NAV CDNU: ON
2. V/UHF POWER PANEL: ON
3. UHF-1/2 RSC: FUNCTION SWITCH: T/R+G;
   MODE SWITCH: RMT

CIP COMMUNICATIONS

F1: UHF-1 CONTROL PAGE. INDICATES STATUS OF UHF-1. AN ASTERISK NEXT TO AN ITEM INDICATES THAT IT IS SELECTED/ACTIVE. MOST ITEMS (SQUELCH, GUARD, ETC.) CAN BE TOGGLED BY PRESSING THE LINE SELECT KEY ADJACENT TO THE DESIRED FUNCTION.

F2: UHF-2 CONTROL PAGE. INDICATES STATUS OF UHF-2. FUNCTIONALITY IDENTICAL TO F1.

F3: MASTER COMM PAGE. INDICATES FREQUENCIES SET IN UHF-1, UHF-2, AND V/UHF.

F4: V/UHF CONTROL PAGE. INDICATES STATUS OF V/UHF RADIO. FUNCTIONALITY IDENTICAL TO F1.

SETTING & CHANGING RADIO FREQUENCIES

1. USING GPS NAVIGATION PAGE:

   TYPE IN THE DESIRED FREQUENCY (INCLUDING THE DECIMAL POINT) ON THE CDNU SCRATCHPAD. PRESS THE FUNCTION KEY (F1, F2, OR F4) CORRESPONDING TO THE DESIRED RADIO. THE RADIO WILL NOW BE TUNED TO THAT FREQUENCY.

2. USING ONE OF THE RADIO CONTROL PAGES OR MASTER COMMUNICATION PAGE:

   TYPE IN THE DESIRED FREQUENCY (INCLUDING THE DECIMAL POINT) ON THE CDNU SCRATCHPAD. PRESS THE LINE SELECT KEY (ARROW) ADJACENT TO CURRENTLY TUNED FREQUENCY. THE TUNED FREQUENCY WILL THEN CHANGE TO WHAT WAS ENTERED ON THE SCRATCHPAD.

LOST COMMUNICATIONS

1. IN RACK F-1, PLACE THE UHF-1 AND UHF-2 RSC MODE SWITCHES IN MANUAL; VERIFY THE UHF-1 AND UHF-2 RADIO FREQUENCIES ARE STEADILY DISPLAYED. IF THE FREQUENCY IS ALTERNATING WITH A TWO-DIGIT CODE, AN ERROR EXISTS. SEE THE CIP MAINTENANCE MANUAL. IF NO ERRORS ARE DISPLAYED, PLACE MODE SWITCH IN RMT.
2. IF CDNU TUNING FUNCTIONALITY IS LOST DUE TO FAILURE OF BOTH BUSES OR CORRUPTED SOFTWARE, THE FOLLOWING CONDITIONS WILL EXIST:
   a. VHF WILL REMAIN TUNED TO THE LAST ASSIGNED FREQUENCY AND CANNOT BE CHANGED. TRANSMISSION AND RECEPTION IS AVAILABLE ON THIS FREQUENCY THROUGH THE ICS CONTROL BOXES.
   b. UHF CAN BE USED OFF-LINE BY SETTING EACH UHF RSC (RACK F-1) TO MANUAL. ALL CONTROLS FOR THE RADIOS (MODE, FREQUENCY, SQUELCH, ETC.) WILL NOW BE MADE AT THE RSC. FREQUENCY AND MODE SELECTIONS WILL BE DISPLAYED ON THE CDNUs; HOWEVER, CDNU CONTROL IS NOT AVAILABLE. TRANSMISSION AND RECEPTION IS AVAILABLE THROUGH THE ICS CONTROL BOXES. IF ICS IS INOPERATIVE, A HEADSET WITH INLINE KEYING DEVICE MAY BE PLUGGED DIRECTLY INTO THE FRONT OF THE UHF-1/2 RT FOR TRANSMISSION AND RECEPTION.
3. TO RETURN THE RADIOS TO CDNU CONTROL, THE FOLLOWING PROCEDURES SHOULD BE USED:
   a. DETERMINE WHICH CDNU IS THE BUS CONTROLLER (WILL BE INDICATED BY BC ON LINE 7 OF STATUS PAGE OF CORRESPONDING CDNU). THE BC CDNU SHOULD BE SECURED IN AN ATTEMPT TO ALLEVIATE THE POSSIBLE SOFTWARE CORRUPTION.
   b. CHECK THE STATUS PAGES OF THE CDNU TO DETERMINE IF A BUS FAILURE HAS OCCURRED. IF 'BUS NO/GO-T' IS DISPLAYED, A HARD FAILURE OF BOTH BUSES HAS OCCURRED AND ONLINE CONTROL OF THE RADIOS WILL NOT BE POSSIBLE.
   c. IF POSSIBLE, CYCLE POWER TO ALL THE CDNUs AND RADIOS.
   d. CHECK THE STATUS PAGES FOR THE AFFECTED RADIOS TO DETERMINE/RECORD ANY BIT FAULTS THAT MAY BE DISPLAYED. THIS INFORMATION WILL HELP IN TROUBLESHOOTING AFTER LANDING.

FIRE IN THE DIPLEXER SET PROCEDURES

IF AN ELECTRICAL FIRE IN THE DIPLEXER SET (OVERHEAD BETWEEN THE TACCO AND NAV/COMM STATIONS) OCCURS, THE FOLLOWING PROCEDURES ARE RECOMMENDED:

1. SECURE ALL POWER TO THE DIPLEXER SET BY PULLING THE CIRCUIT BREAKERS FOR THE DIPLEXER AND ALL CIRCUIT BREAKERS FOR UHF-1 AND UHF-2. ONCE THESE CIRCUIT BREAKERS ARE PULLED, UHF-1/2 COMMUNICATIONS WILL BE INHIBITED; HOWEVER, V/UHF WILL REMAIN FUNCTIONAL.

Figure 20-25. CIP Quickstart Procedures

20.8 COMMUNICATIONS IMPROVEMENT PROGRAM (CIP) ON AIRCRAFT INCORPORATING CNS/ATM

20.8.1 Introduction

The P-3 CIP fundamentally remains the same with the exception of the integration of the CDU-7000. Software and hardware developed for the P-3 CIP and P-3 CNS/ATM coupled with the installation of common communication architecture provides the following:

1. Secure UHF-1 Satellite Communication (NBSAT).

2. A common P-3 V/UHF and UHF radio configuration that consists of one AN/ARC-210 V/UHF and two AN/ARC-187(V) UHF radio sets.

3. The CDU-7000 provides an interface for control and selection of all radio functions and UHF-1 secure SATCOM.

4. All other functions are the same as CDNU CIP. Refer to paragraph 20.6.

20.8.2 System Components

All components remain the same except that the VHF/UHF power switch has been removed, and the CDU-7000 and its respective software replace the CDNU and its software.

20.8.3 System Description

20.8.3.1 Communication Control Software (CCS)

The software for the Control Display Units (CDUs) located at the pilot, copilot, and NAV/COMM stations was developed to interface with the Communications Improvement Program (CIP) to provide control of CIP components via MIL-STD-1553B interface and display CIP operational and system status information. The System Functional Description focuses on the CDU CCS and functions implemented for the CIP UHF 1, UHF 2, VHF/UHF, and Demand Assigned Multiple Access (DAMA) Satellite Communication (SATCOM) Modem. For actual software manipulation procedures, refer to CDNU and CDU-7000 Users Aids.

The CDU contains a display, an alphanumeric keypad, and a COM function key used to display and manipulate data. The CDU provides control, display, processing, and interface capabilities necessary to control two AN/ARC-187 UHF radios, one AN/ARC-210 VHF/UHF radio, one MD-1324(c)/(U) Modem, and a Digital Data Set (DDS). The CDU display presents various pages of communication and system data. The bottom line of the display is a buffer, called a scratchpad, which holds all keystrokes before executing the input. Incorrect scratchpad entries may be cleared with the CLR key. A single press of the CLR key clears the last character entered. Pressing and holding the CLR key will delete all the scratchpad characters.

Note

The CDU alerts the crew of communication failures, degraded operations, and operator entry errors via annunciations and scratchpad messages.

The annunciation line is at the bottom of the CDU display. If multiple annunciations or messages occur simultaneously, the highest priority annunciation appears on the annunciation line. The remaining messages are accessed by the MSG function key, which accesses the message page. Refer to the CDU-7000 Users Manual Job Aid for a complete listing of error messages and status alerts displayed by the CDUs for the CIP.

20.8.4 UHF Radio System

20.8.4.1 Plain Voice Communication-LOS

Operator selection of the T/R or T/R+G functions from the CDUs provides for selection and control of Frequency, Squelch, Guard, and HAVE QUICK features for LOS plain voice communication. Plain voice selections performed with existing communication system equipment (UHF-1 Voice Selector, COMM Selector [A-516], ICS) will force the UHF-1 or -2 RT to the AM mode and raise the keyline required for transmission. The CDUs will notify the operator when plain voice communication has been selected from existing equipment.

20.8.4.1.1 Secure Voice Communication KY-58, LOS

Operator selection of the T/R or T/R+G functions from the CDUs provides for selection and control of Frequency, Squelch, Guard, and HAVE QUICK features when LOS secure voice communication using KY-58 security equipment is enabled. Secure voice communication is enabled when selected from existing communication system equipment (UHF-1 Voice Selector, COMM Selector). The CDUs will notify the operator when cipher voice communication capability has been selected.

The CNSU routes secure voice signals from the Secure Switching Matrix (A-552) or secure data from the RS-422 Auxiliary Port to the KY-58 encryption unit when CIPHER is selected and T/R or T/R+G has been selected on the CDU UHF Control page or on the UHF RSC.

20.8.4.1.2 Automatic Direction Finding LOS (UHF-1 Only)

Operator selection of the ADF function from the CDUs will cause the UHF-1 RSC to force the RT into a receive state for wideband AM audio and disable the guard receiver. The CDUs do not display nor allow selection of the ADF function when CIPHER has been selected at the UHF-1 Voice Selector.

20.8.4.1.3 Sono Command

Operator selection of the SC mode from the CDUs will cause the UHF-2 RSC to force the main RT to tune to the preprogrammed sonobuoy command frequency supplied by the CDNU. While in the SC mode, Guard cannot be monitored from the UHF-2 radio.

20.8.4.1.4 Guard

Operator selection of the Guard mode from the CDUs will cause the UHF-1 RSC to force the main RT to tune to the preset emergency guard receiver frequency of 243.000 MHz. Selection of the Guard mode will cancel any current mode currently selected and lockout selection of other modes at the CDUs until GUARD is deselected.

20.8.4.2 VHF/UHF Radio System

20.8.4.2.1 Plain Voice Communication-LOS

Operator selection of the T/R or T/R+G functions from the CDUs provides for selection and control from the CDUs of frequency, squelch, and Guard features for LOS plain voice communication. AM or FM modulation is operator selectable from the CDUs for the VHF/UHF radio UHF operating frequency range.

20.8.4.2.2 Guard

When the Guard mode is selected at any CDU, the guard receiver selected is the one that is in the frequency band of the main receiver frequency selected. Selection of the Guard mode locks out selection of other modes at the CDUs until deselected.

20.8.5 Operating Procedures

20.8.5.1 CIP

CDU-7000 controlled CIP is software driven similar to the existing CIP functionality. Detailed operating procedures can be found in the CDU-7000 user's manual. The following are procedures that differ from the previous CIP version.

20.8.5.2 Quickstart Checklist

1. CDU-7000 — ON.
2. V/UHF Power — ON.
   a. Select IDX.
   b. LLS2 (Left Line Select) <START INIT>.
   c. RLS6 (Right Line Select) <POWER>.
   d. LLS3 <VHF> power to ON.
3. UHF-RSC.
   a. Mode switch — MAN.
   b. Function Selector — T/R.
   c. Observe:
      (1) Operating frequency displayed.
      (2) No flashing BIT fail codes.
   d. Mode switch — RMT.
4. CDU-7000 — Enter desired frequency.
   a. Type in new frequency to scratchpad.
   b. Press COM.
   c. LLS next to VHF radio to change the frequency.

Note

Enter 0 and LLS next to radio to return to previous frequency.

5. Select the radio on the ICS Master Control Box.
6. Comms are now possible.

20.9 ARC-187 UHF RADIO SYSTEM

Two ARC-187 UHF radio systems are installed in the aircraft (Figure 20-26). One radio set control is located on the flight station center pedestal and the other at the NAV/COMM station. The ARC-187 radio system has the capability to communicate in plain or cipher voice, teletype, or data-link mode. It is also capable of secure FM imagery, and DF. Additionally, the ARC-187 UHF system has built-in provisions for SATCOM and HAVE QUICK Electronic Counter-Countermeasures (ECCM).

The flight station radio set operates the UHF-1 system. UHF-1 is capable of plain- or cipher-voice communication or DF operation when used with the ARA-50 UHF-DF system. For aircraft incorporating AFC-483, UHF-1 secure satellite communication capabilities have been added by the incorporation of an antenna switching assembly and simple modifications to the receiver-transmitter.

The radio set control located at the NAV/COMM station controls the UHF-2 system. UHF-2 is capable of plain or cipher voice, teletype, data-link operation, or secure FM imagery. For aircraft incorporating AFC-663, UHF-2 secure FM imagery LOS transmission capabilities have been added by the incorporation of a UHF-2 relay panel assembly in rack F-1.

20.9.1 System Components

20.9.1.1 RT-1571 Receiver-Transmitter

The receiver-transmitters (UHF-1 and UHF-2) are mounted in rack F-1. This rack also has an audio interface module and a fan cooler assembly mounted on the aft portion of the rack.

A separate guard (243.000 MHz) receiver is incorporated in each receiver-transmitter. This guard receiver allows guard channel monitoring, in addition to the preset or manually set frequency, when T/R+G is selected.

The receiver-transmitters incorporate HAVE QUICK ECCM, which is a frequency-agile mode of operation, and SATCOM capabilities; however, the HAVE QUICK ECCM mode is not currently available for use. SATCOM capabilities are only available with aircraft incorporating an antenna switching assembly and AFC-483.

20.9.1.2 C-1190 Radio Set Control

The UHF-1 RSC is located in the flight station and the UHF-2 RSC is located at the NAV/COMM station.

The radio set control (Figure 20-27) is capable of storing 20 preset channels, one guard channel, and one sonobuoy command channel; however, sonobuoy command is not available for use. Five manual control knobs permit selection of any one of 7,000 available channels. Four system operating modes are selectable: sonobuoy command, manual, preset, and guard. The radio set control also incorporates selections for T/R, T/R+G, ADF, and SAT. Other controls and indicators are provided to set and select frequencies, read selected frequency, control squelch operation, initiate transmission of a 1020 Hz tone, and indicate system faults when detected.

20.9.1.3 UHF-2 Relay Panel Assembly

Located in rack F-1, the UHF-2 relay panel assembly (refer to Figure 20-28) allows UHF-2 to be capable of secure FM imagery LOS transmissions.

20.9.1.4 AM-7373 Audio Interface Module

The audio interface module provides signal processing and distribution. The unit interfaces the UHF system with the ICS system, the communication switching matrix, and the secure switching matrix.

20.9.1.5 Antenna Switching Assembly

The antenna switching assembly is located in the overhead near the UHF-1 antenna. The antenna switching assembly contains the preamplifier and bandpass filters required for receiving low-level satellite signals.

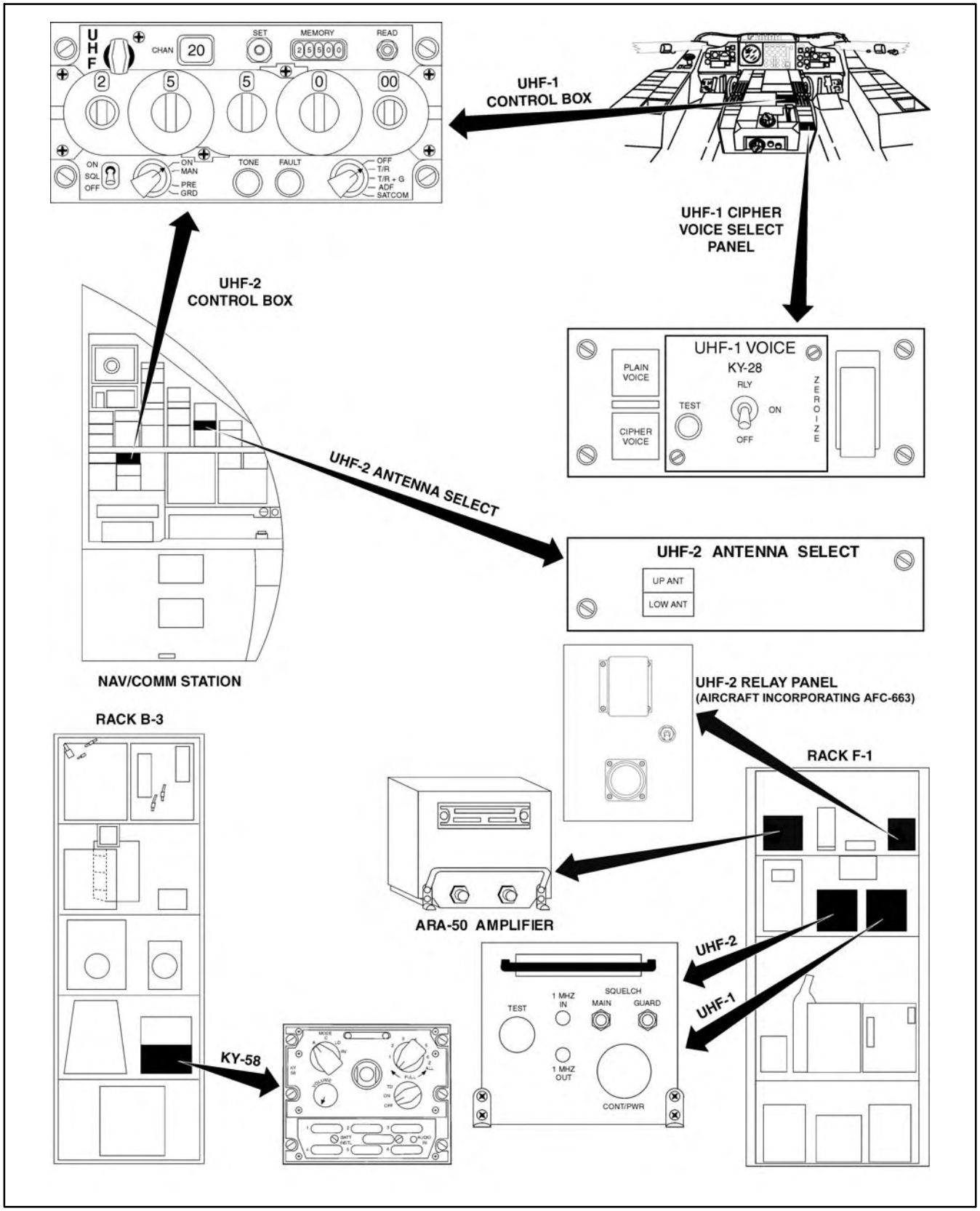
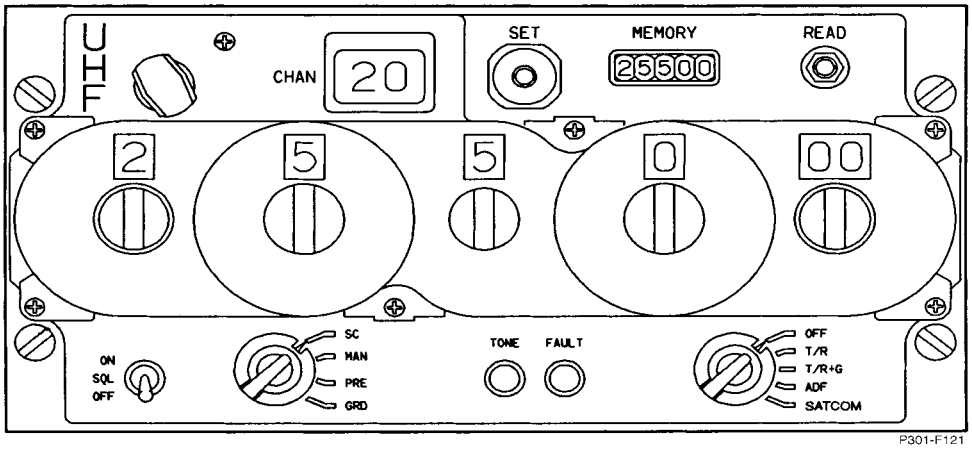


Figure 20-26. ARC-187 Radio System

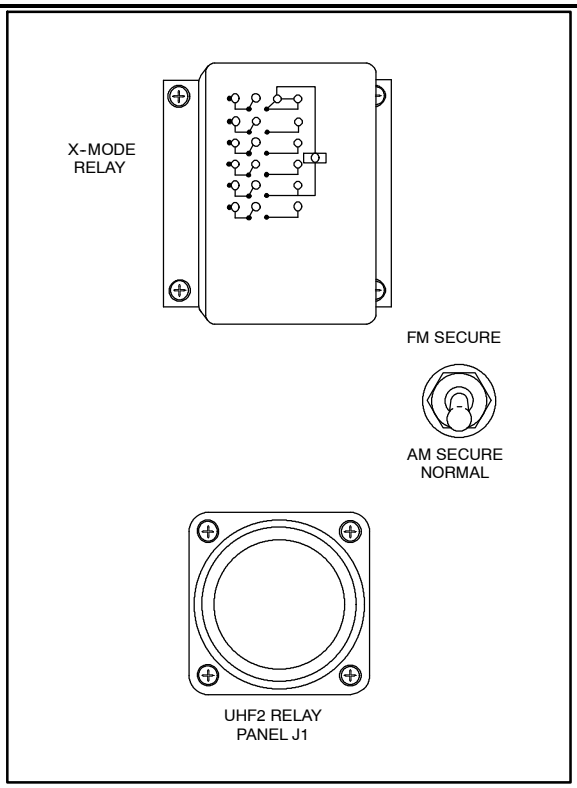


PANEL MARKING	FUNCTION
CHAN selector	Allows selection of 1 of 20 preset frequency channels.
CHAN display	Displays selected preset channel number.
SET pushbutton	When pressed, stores selected frequency in selected preset channel.
MEMORY window	LEDs display selected preset channel frequency when READ is pressed.
READ pushbutton	Illuminates MEMORY window LEDs displaying selected preset frequency.
Manual frequency selector switches	Allows frequency selection for transmission or reception and to select frequency for the channel presets.
Mode selector SC MAN PRE GRD	Selects system mode of operation. Tunes radio to 291.400 MHz. Allows manual frequency selection using the 5 manual frequency selector switches. Allows frequency selection using the preset frequency channels. This position is also used in setting the preset channel frequency. The transmitter and main receiver are tuned to the guard frequency of 243.000 MHz.
FAULT indicator	Illuminates to indicate a fault has been detected in the radio system. Steady illumination of the indicator indicates an R/T fault. A slow flash (approximately 1 flash per second) indicates a fault in the audio interface unit. A fast flash (approximately 4 flashes per second) indicates a fault with the radio set control panel.
TONE pushbutton	Transmits a 1020-Hz tone on the selected frequency.

Figure 20-27. ARC-187 UHF Radio Set Control, Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
Function selector:	Selects the system function.
OFF	Removes system operating power.
T/R	Enables the main receiver and transmitter.
T/R+G	Enables the main receiver, transmitter, and guard receiver.
ADF	Enables the UHF-1 system to be used in conjunction with the UHF-DF system. The bearing to the selected station is selectable at any of the HSIs. This selection is not available with the UHF-2 system.
SATCOM	Available on aircraft incorporating AFC-483. Permits secure satellite communications using UHF-1 only.
SQL ON/OFF	Enables or disables receiver squelch.

Figure 20-27. ARC-187 UHF Radio Set Control, Panel Markings and Functions (Sheet 2 of 2)



PANEL MARKING	FUNCTION
FM SECURE	Allows transmission of secure FM imagery.
AM SECURE NORMAL	Allows normal transmission.

Figure 20-28. UHF-2 Relay Panel Assembly, Panel Markings and Functions

20.9.1.6 Circuit Breakers

Circuit breaker location and power sources for the two ARC-187 UHF radio systems are listed in Figure 20-29.

20.9.2 System Description

The ARC-187 UHF radio system provides 30 watts of power in the AM voice and teletype modes and 100 watts in FM data link. The frequency range of the UHF radio system is 225.000 to 399.975 MHz.

Either UHF system can be selected for cipher voice, using the communication selector panel for UHF-2 or cipher-voice panel for UHF-1, utilizing the KY-58 for encryption; however, only stations with a master ICS control panel may transmit and receive cipher communications. Any crew station may monitor plain-voice UHF communications using the appropriate switch on the ICS crew control panel.

Teletype and data-link communications are enabled by selecting the respective UHF-2 function located on the communication selector panel. The radio is then mode forced to the selected function.

Secure voice SATCOM, used only with the UHF-1 system, in conjunction with the KY-58 and the antenna switching assembly, can be operated by any crew position with a master ICS control (refer to Operating Procedures, paragraph 20.6.3). The SATCOM installation prohibits secure-voice communications from UHF-2. The KY-58 provides encryption and decryption and the antenna switching assembly provides the required filters and preamplifier to receive low-level satellite signals.

Three or four antennas, depending on the aircraft type, are utilized by the two UHF systems. UHF-1 has one communication antenna located forward of the smoke removal door on the upper fuselage and a DF loop antenna mounted aft of the nose landing gear. Switching between these antennas is automatic. When ADF is selected on the UHF-1 radio set control, the receiver-transmitter is connected to the lower DF loop, and direction to any UHF transmission is available on any HSI by selecting the DF position on the respective HSI control. When T/R, T/R+G, or G is selected on the UHF-1 control or the microphone is keyed while in the ADF mode, the output of the UHF-1 transmitter is switched to the upper blade antenna.

COMPONENT NAME	LOCATION	NAME	POWER SOURCE
UHF-1	MLC MLC	UHF-1 UHF-1	MEAC MEDC
UHF-2	MLC MLC	UHF-2 UHF-2	BUS A MDC
Antenna switching assembly	FECB	SATCOM	MDC

Figure 20-29. ARC-187 UHF-1 and UHF-2 System Circuit Breaker Location and Power Source

UHF-2 is connected to the blade antenna on top of the vertical stabilizer on aircraft prior to Update III. On Update III aircraft, a second blade antenna is mounted on the lower fuselage forward of the sonobuoy tubes and the NAV/COMM is provided with an antenna select switch. This switch allows selection of either antenna for UHF-2 transmission and reception. The deselected antenna may be used to provide the Acoustic Test Signal Generator (ATSG) a signal output for end-to-end BITE testing for the advanced sonobuoy communication link receiver. This lower antenna is primarily installed to reduce shadowing when conducting on-station swaps in the high-boy role.

20.9.3 Operating Procedures

The following procedures describe UHF system operation to set preset frequencies or to communicate in the plain or cipher-voice mode. For data-link or teletype operation, refer to System Description, paragraph 20.9.2. UHF-DF operation is covered in UHF-1 ADF, paragraph 20.6.3.6.

20.9.3.1 Channel Presetting Operation

1. Function selector — T/R or T/R+G.
2. Mode selector — PRE.
3. Set the desired frequency with the manual frequency selector switches.
4. CHAN selector — Set to desired preset channel number.
5. SET button — Press.
6. READ button — Press. Verify the selected frequency is displayed in the memory display.

20.9.3.2 Plain-Voice Operation

1. Function selector — Select T/R+G. T/R may be selected if guard reception is not desired.
2. Squelch — SQL ON/OFF, as desired.
3. Mode selector — MAN, PRE, or GRD, as desired.
4. Frequency controls — As desired.
5. UHF-2 (on communication selector panel) or UHF-1 (on voice selector panel) PLAIN VOICE — Press. Verify PLAIN VOICE is illuminated amber.
6. MIC SEL UHF-2 (or UHF-1) on ICS master control panel — Press. Pushbutton indicator illuminates amber.
7. Press microphone push-to-talk switch or microphone foot switch to key transmitter.

20.9.3.3 Cipher-Voice Operation

1. Function selector — Select T/R or T/R+G.
2. Squelch — SQL ON/OFF, as desired.
3. Mode selector — MAN or PRE, as desired.
4. Frequency controls — As desired.
5. UHF-2 (on communication selector panel) or UHF-1 (on voice selector panel) CIPHER VOICE — Press. CIPHER VOICE illuminates amber.
6. MIC SEL UHF-2 (or UHF-1) on ICS master control panel — Press. Pushbutton indicator illuminates amber.
7. Press microphone push-to-talk switch or microphone foot switch to key transmitter.

20.9.3.4 UHF-1 Secure SATCOM (Aircraft Incorporating AFC-483)

1. Function selector — FM.
2. Cipher voice panel — Select UHF-1 amber.
3. Master ICS control panel — MIC SEL switch UHF-1 amber.
4. Press microphone push-to-talk switch or microphone foot switch to key transmitters.

20.9.4 Operating Procedures For Use With AIC-41

The following procedures describe UHF system operation to set preset frequencies or to communicate in plain- or cipher-voice mode. UHF-DF operation is covered in UHF–DF Direction Finder, paragraph 23.13.

20.9.4.1 Channel Presetting Operation

1. Function selector — T/R or T/R+G.
2. Mode selector — PRE.
3. Set the desired frequency with the manual frequency selector switches.
4. CHAN selector — Set to desired preset channel number.
5. SET button — Press.
6. READ button — Press and verify the selected frequency is displayed in the memory display.

20.9.4.2 Plain-Voice Operation

1. Function selector — Select T/R+G. T/R may be selected if guard reception is not desired.
2. Squelch — SQL ON/OFF, as desired.
3. Mode selector — MAN, PRE, or GRD, as desired.
4. Frequency controls — As desired.
5. Pilot or copilot Flight Digital Crew Interface (FDCI) panel.
   a. XMIT UHF2 (or UHF1) switch-indicator — Press and verify XMIT UHF2 (or UHF1) switch-indicator is illuminated amber.
   b. XMIT C/S (Clear/Secure) switch-indicator — Press to toggle selected radio for clear voice (red LED on selected radio is dark).
   c. Verify XMIT ICS switch-indicator is illuminated green.
6. Press microphone push-to-talk switch or microphone foot switch to key transmitter.
7. TACCO or NAV/COMM Digital Crew Interface (DCI) panel.
   a. XMIT UHF2 (or UHF1) switch-indicator — Press and verify XMIT UHF2 (or UHF1) switch-indicator is illuminated amber.
   b. XMIT C/S (Clear/Secure) switch-indicator — Press to toggle selected radio for clear voice (red LED on selected radio is dark).
   c. Verify XMIT ICS switch-indicator is illuminated green.
8. Press microphone push-to-talk switch or microphone foot switch to key transmitter.

20.10 HF RADIO SYSTEM

20.10.1 ARC-161 Radio Sets

For a complete description of the ARC-161 HF radio, refer to NAVAIR 01-75PAC-1.1.

PART VIII

Mission Systems

Chapter 21 — Mission Systems Overview

Chapter 22 — Mission Equipment

Chapter 23 — Flight Station Systems

CHAPTER 21

Mission Systems Overview

21.1 INTRODUCTION

Mission Systems provides an overview of those systems contained in the P-3 aircraft. It is organized by specific systems and, as much as possible, separated by the various models of the P-3 aircraft; however, with the constant ongoing retrofit process, care should be taken in studying the systems currently installed in each aircraft.

This part contains only hardware systems but is by no means a complete discussion of these aircraft systems. For more in-depth information, many other sources are available. These include (but are not limited to) maintenance instruction manuals, Lockheed digests, and crew station maintenance manuals.

For information on software, the primary reference is the Systems Operator Manual (NAVAIR 01-75PAC-11-1) for the nondrum operational program or the System Reference Manual (NAVAIR 01-75PAC-11-2) for the drum operational program. Additional information can be found in the Fleet Operators Guides (FOGs), Program Performance Specifications (PPS), and Program Functional Descriptions (PFDs).

The following mission systems are not a direct responsibility of the flight station personnel and, as such, are not discussed in this section; however, they are an integral part of the P-3 ASW system, and their system discussion can be found in the Naval Flight Officer (NFO)/Aircrew NATOPS Manual (NAVAIR 01-75PAC-1.1).

21.1.1 Systems

1. Data processing system.
2. Ordnance system.
3. Acoustic audio system.
4. Radar.
5. IFF.
6. Magnetic Detecting system (MAD).
7. Radar Warning Receiver (RWR)/Specific Emitter Identification (SEI) system.
8. Infrared (IR)/Electro-Optical (EO) Imagery system.
9. Electronic Warfare System (EWS).
10. Tactical Data Processor (TDP) system.

Each part is arranged in the following format:

1. Introduction — Contains a general description of the ASW system and how it is utilized in a tactical environment.
2. System components — Lists the elements within each system and the nomenclature, if appropriate. This part also contains specific switch functions, power sources, and the function of each component.

3. System description — Discusses the normal operation of the system from an operator viewpoint. Also included are simplified signal flow diagrams, if appropriate.

4. Operating procedures — Provides checklist, if appropriate, along with normal turn-on, operating, and shutdown procedures.

5. Technical data — Provides technical operating data not contained in previous parts. This can be used by technicians or operators desiring more thorough and complete information on system operating theory.

CHAPTER 22

Mission Equipment

22.1 VHF/VOR RADIO NAVIGATION (ARN-87, ARN-140, AND ILS)

The VHF navigation and communication system consists of dual AN/ARN-87 VOR receivers. The VHF/VOR system provides a means of airway radio navigation, en route communications, and instrument landing system approaches. The VOR receivers operate in the VHF frequency range and work in conjunction with the VHF transmitter for two-way voice communication. The two VORs are labeled VOR-1 and VOR-2. Each VOR can be operated simultaneously to receive signals from VOR stations in the 108.00 to 117.95 MHz range.

The ILS receiving equipment enables the pilot to make approaches during low-visibility conditions to airfields having ground ILS equipment. The aircraft equipment comprises a standard 329.3 to 335.0 MHz UHF glideslope receiver, 51V-4, with an antenna located in the nose radome. A marker beacon receiving set, ARN-32, is installed with an antenna on the lower center fuselage and indicator lights on the pilot and copilot instrument panels. The marker beacon receiver output causes the indicator lights to illuminate whenever the aircraft passes over a ground facility transmitting on 75 MHz.

22.1.1 System Components

System components are shown in Figure 22-1.

22.1.1.1 AN/ARN-87 VOR Radio Receiver

The AN/ARN-87 VOR radio receiver is located in rack J-2 and provides for VHF reception of radio navigation signals and plain-voice audio for VHF communication.

There are two identical receivers labeled VOR-1 and VOR-2 that operate in the 108.00 to 151.95 MHz frequency range.

22.1.1.2 MLR-2020A-1 Multimode Receiver

Two MLR-2020A-1 Multimode Receivers (MMRs) are located (when installed in place of the ARN-87 VOR receivers) in rack J-2. These two MMRs are identical and provide FM-immune (also known as Protected Instrument Landing System [PILS]) VHF reception in the 108.00 to 117.95 MHz frequency range. The MMR receivers are replacements for the existing VOR/Glideslope and Marker Beacon receivers. The MMR receivers have the capability to receive the following navigation signals: Localizer, Glideslope, Marker Beacon, and VOR, which provides precision approach and en route navigation capabilities. Using these guidance transmissions, the MMRs compute guidance information for display on the existing guidance instruments (HSI, FDI, or EFDS, EFDI). The VHF radio communication capability will be lost and may be provided by the AN/ARC-210(V) VHF/UHF Communication System on aircraft configured with ECP-827. Refer to Figure 22-2.

22.1.1.3 C-6842/ARN-87 VOR-2 Receiver-Transmitter Control Panel

The C-6842/ARN-87 VOR receiver-transmitter control panel is located on the center pedestal in the flight station and provides for frequency selection, squelch control, and power to the VOR-2 receiver and VHF transmitter (AN/ARN-87, refer to Figures 22-3 and 22-4; MMR, refer to Figure 22-5).

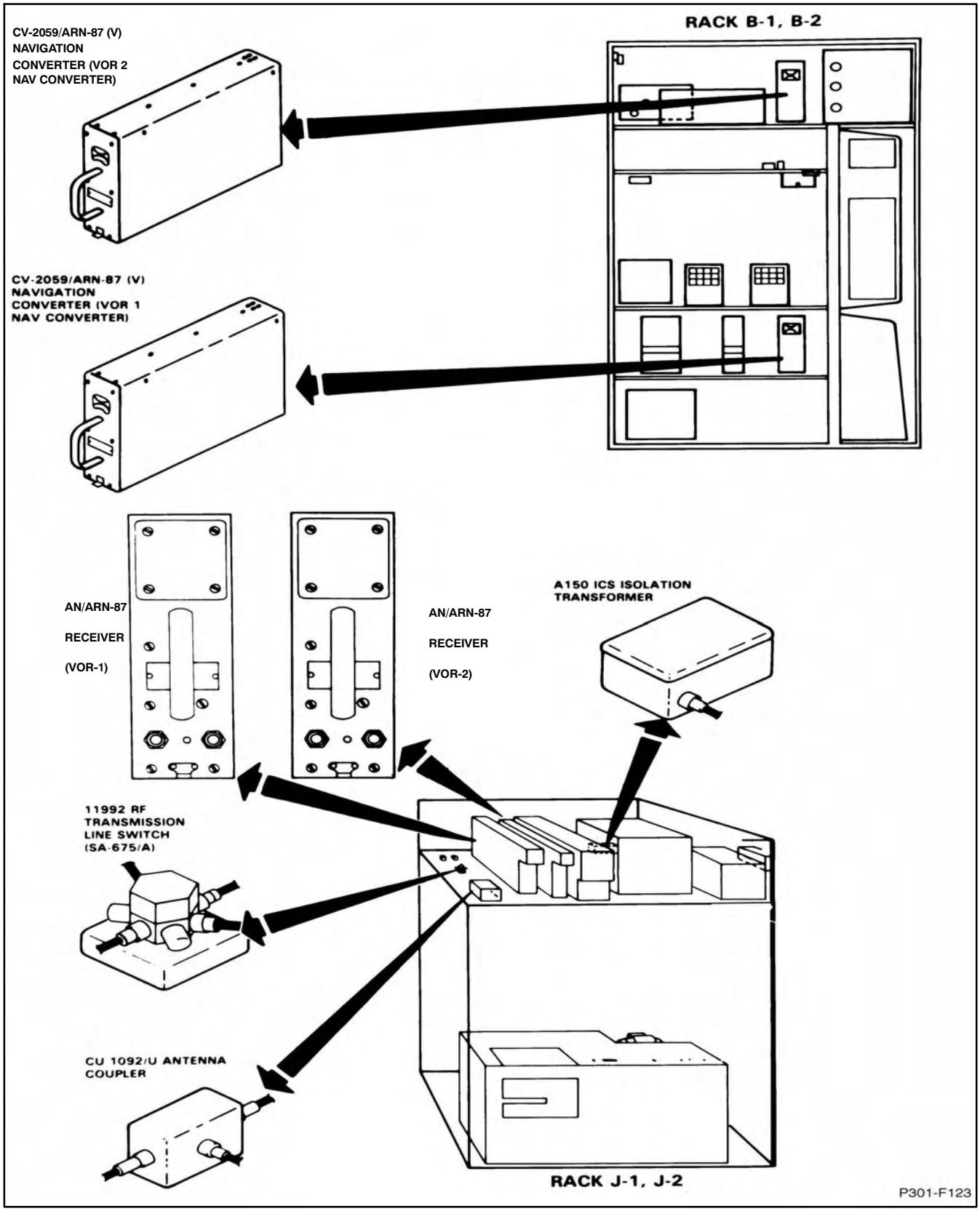


Figure 22-1. Radio Navigation System Components (Prior to Update II.5)

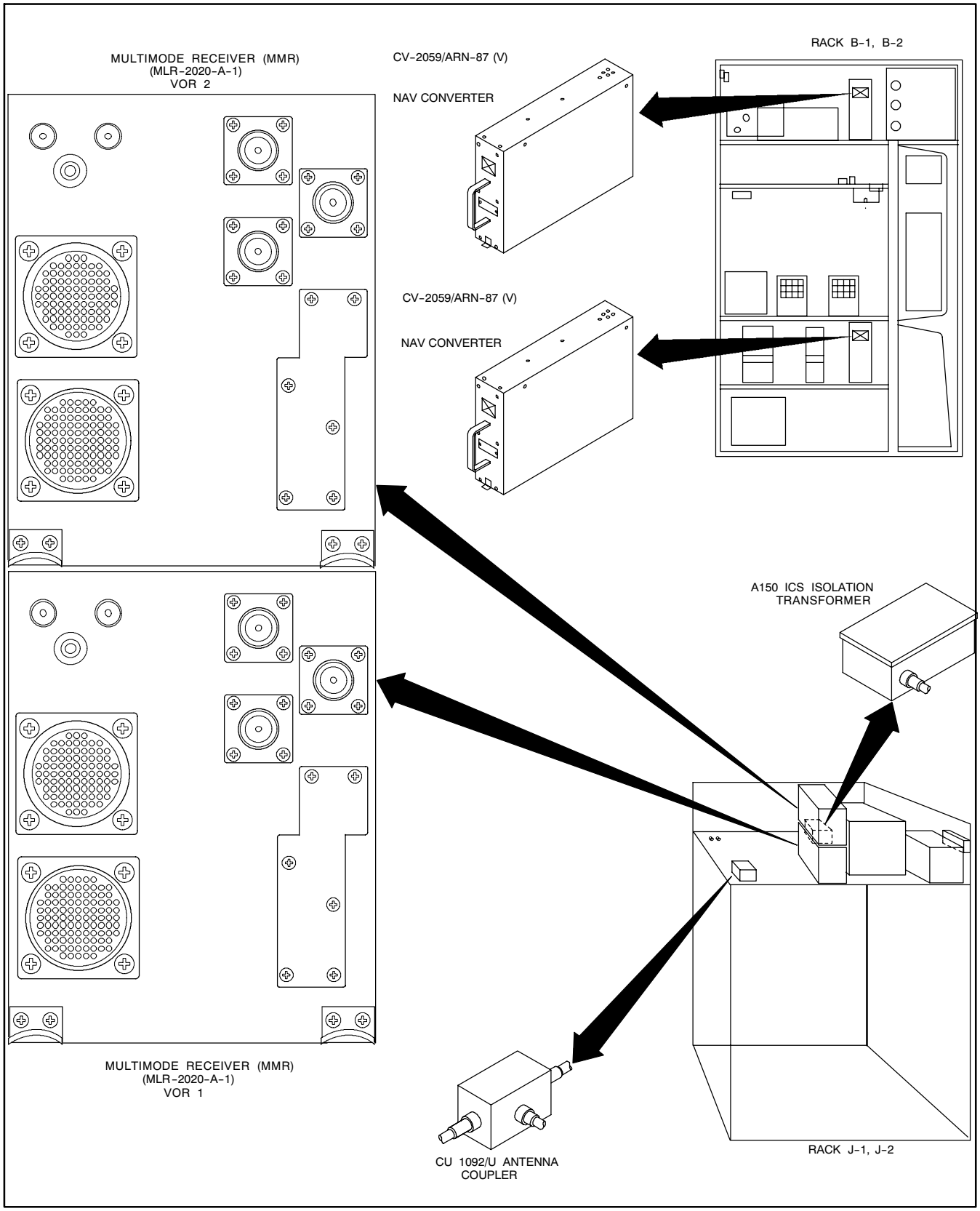


Figure 22-2. MMR Radio Navigation System Components (Prior to Update II.5)

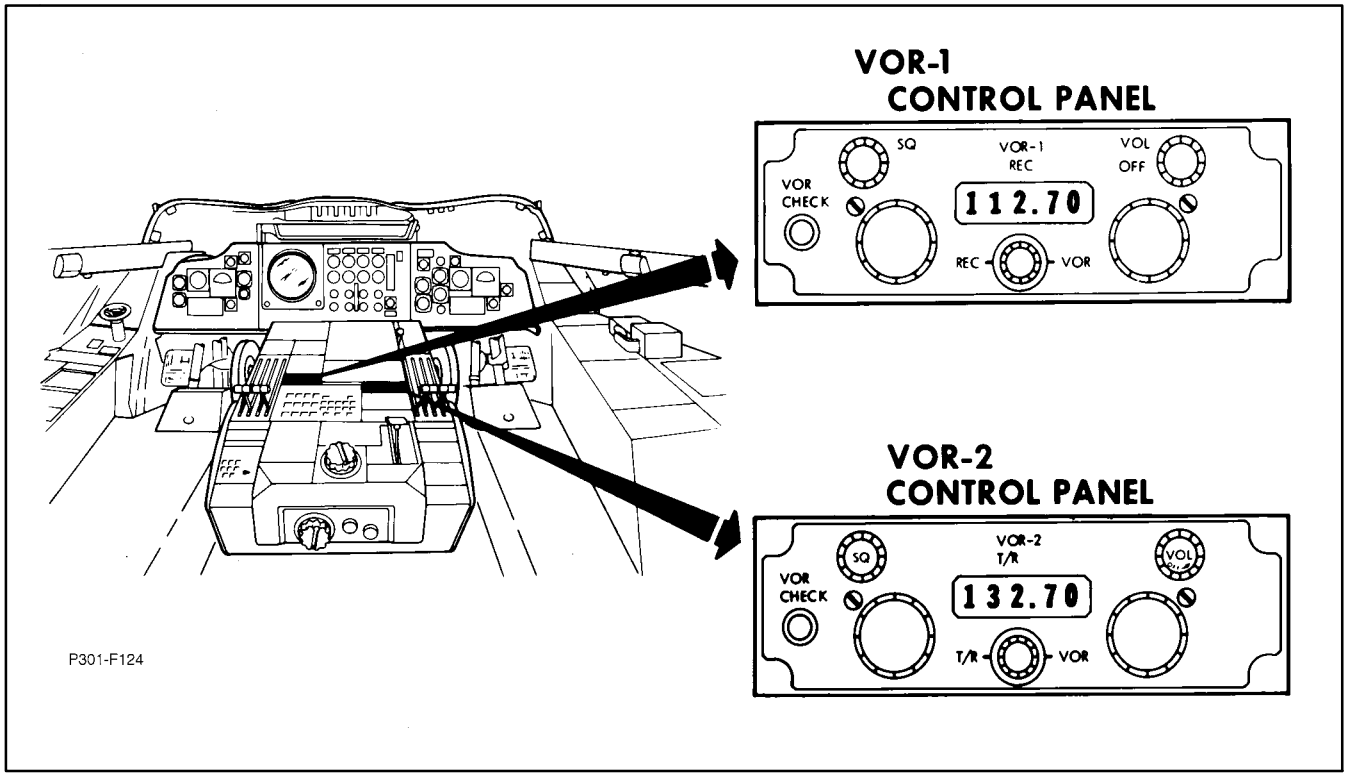


Figure 22-3. VOR-1 and VOR-2 Control Panels

PANEL MARKING	FUNCTION
SQ	Set threshold of the receiver squelch circuit (VHF/VOR-2 receiver only).
VOL	Extreme ccw rotation turns off VHF/VOR-2.
T/R	Resets the normal lower limit for communications from 118.00 to 116.00 MHz and disables VOR navigation in this range.
VOR	Enables VOR-2 receiver for navigation up to a limit of 117.95 MHz.
VOR CHECK	Provides a check of critical VOR circuits. HSI pointer indication goes to 003° and NAV flag appears, if circuits are intact.

Figure 22-4. VOR-2 Control Panel Markings and Functions

PANEL MARKING	FUNCTION
SQ	Squelch control knob inoperative.
VOL	Vol control knob turns VHF/VOR-2 group on and off.
T/R /VOR	T/R/VOR switch inoperative.
VOR CHECK	VOR CHECK pushbutton inoperative.

Figure 22-5. MMR VOR-2 Control Panel Markings and Functions

22.1.1.4 C-6843/ARN-87 VOR-1 Receiver-Transmitter Control Panel

The C-6843/ARN-87 VOR-1 receiver-transmitter control panel is located on the center pedestal in the flight station and provides for frequency selection, squelch control, and power to the VOR-1 receiver (AN/ARN-87, refer to Figures 22-3 and 22-6; MMR, refer to Figure 22-7).

22.1.1.5 CV-2059/ARN-87 Navigation Converter

The CV-2059/ARN-87 navigation converter converts received VOR signals into a synchronized signal for display on the HSIs. There are two identical converters, one for each VOR, located in rack B-1.

22.1.1.6 CU-1092 Antenna Coupler

The CU-1092 antenna coupler provides impedance matching and is a junction for incoming VOR signals from a single loop antenna that serves both VORs. The coupler is located in rack J-2.

22.1.1.7 RF Transmission Line Switch

The RF transmission line switch changes the VOR-2 receiver from the VOR antenna to the VHF tail cap antenna for VHF communications. The line switch is located in rack J-2.

22.1.1.8 51V-4 UHF Glideslope Receiver

The 51V-4 UHF glideslope receiver is located in rack B-2 and provides glideslope indications on the FDIs when the VOR-1 control panel is tuned to 108.1 to 111.9 MHz in odd tenths (localizer frequencies). The glideslope receiver is connected to the glideslope antenna in the nose radome.

PANEL MARKING	FUNCTION
SQ	Squelch control knob inoperative.
VOL	Extreme ccw rotation turns off VOR-1.
REC	Resets the normal lower limit for voice reception from 118.00 to 116.00 MHz and disables VOR navigation in this range.
VOR	Enables VOR-1 receiver for navigation up to a limit of 117.95 MHz.
VOR CHECK	Provides a check of critical VOR circuits. HSI pointer indication goes to 003° and NAV flag appears, if circuits are intact.

Figure 22-6. VOR-1 Control Panel Markings and Functions

PANEL MARKING	FUNCTION
SQ	Squelch control knob inoperative.
VOL	Vol control knob turns VOR-1 group on and off.
REC/VOR	REC/VOR switch inoperative.
VOR CHECK	VOR CHECK pushbutton inoperative.

Figure 22-7. MMR VOR-1 Control Panel Markings and Functions

Note

- If the VOR-1 receiver is not installed or inoperative, it is not possible to channelize the glideslope receiver.
- Aircraft equipped with the 51V-4 UHF glideslope receiver will not process glideslope information with ILS frequencies containing a hundredths place digit (e.g., 110.35 MHz).

22.1.1.9 R-666/ARN-32 Marker Beacon Receiver

The R-666/ARN-32 marker beacon receiver is located in rack F-1 and provides indications to the flight station for ILS approaches. The receiver is always powered when extension main DC is energized. The marker beacon light will illuminate on the pilot and copilot instrument panel when the proper signal is received. There is an aural tone associated with a received frequency that can be monitored by selecting the BCN switchlight on any ICS master control panel.

22.1.1.10 Circuit Breakers

Circuit breakers and power sources for all VHF/VOR radio navigation system components are listed in Figures 22-8 and 22-9.

22.1.2 System Description

The dual VORs simultaneously receive incoming RF signals by the loop antenna on the vertical stabilizer; the signals then pass through the coupler for impedance matching and splitting. The signal is then routed to the VOR-1 and VOR-2 receivers. The RF signal is processed into directional information (bearing, to-from, and right-left course deviation) by the navigation converters and is then made available for display on the HSIs/EHSIs.

The navigation information received by either VOR is determined by the frequency selected on the control panel. The VOR control panels enable selection of frequencies between 108.00 and 151.95 MHz. The received signal is monitored by selecting the appropriate RECEIVE switchlight on the ICS master control panel. To process radio navigation data on the HSI/EHSI, VOR mode must be selected on the HSI/EHSI control panel and a frequency from 108.00 to 117.95 MHz set in the frequency window.

To utilize VHF communications, a frequency of 118.00 to 151.95 MHz must be set in the control panel. The transmission line switch switches the VOR receiver to the VHF cap antenna to receive VHF signals. Selection is made for transmission on any ICS master control panel by selecting VHF on the MIC SEL switchlight. (Not applicable for MMR-equipped aircraft.)

The T/R position on the VOR-2 control panel and the REC position on the VOR-1 control panel enables two-way voice communication on frequencies that are normally utilized for VOR reception. Once either switch is selected to this position, VOR navigation data are disabled for frequencies 116.00 to 117.95 MHz. (Not applicable for MMR-equipped aircraft.)

For an approach to landing using the ILS glideslope and localizer, the VOR-1 control panel must be set to a frequency between 108.1 and 111.9 MHz (odd tenths). This couples VOR-1 to the loop antenna for localizer information and enables the glideslope receiver. Received data are automatically displayed on the FDI/EFDI. To display course information on the HSI/EHSI, VOR-1 must be selected on the appropriate flight station HSI/EHSI control panel.

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
VOR-1 Receiver	Aft Electronic	VOR-1 RCVR	MEAC
VOR-2 Receiver	Aft Electronic	VHF/VOR-2 RCVR	MEAC
VOR-1 Navigation Converter	Aft Electronic Navigation Interconnection Box	VOR-1 RCVR VOR-2	MEAC MEDC 26-Vac Sync Excitation
VOR-1 Navigation Converter	Aft Electronic Navigation Interconnection Box	VHF/VOR-1 RCVR VOR-2	MEAC MEDC 26-Vac Sync Excitation
SA-675 Transfer Relay (Transmission Line Switch)	Aft Electronic	VHF XMTR	MEAC MEDC

Figure 22-8. Radio Navigation System Circuit Breaker Locations and Power Source for MMR-Equipped Aircraft (Prior to Update II.5)

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
VOR-1 Receiver	Aft Electronic	VOR-1 RCVR	MEAC MEDC
VOR-2 Receiver	Aft Electronic	VHF/VOR-2 RCVR	MEAC MEDC
VHF Transmitter	Aft Electronic	VHF XMTR	MEAC MEDC
VOR-1 Navigation Converter	Aft Electronic Navigation Interconnection Box	VOR-1 RCVR VOR-2	MEAC MEDC 26-Vac Sync Excitation
VOR-2 Navigation Converter	Aft Electronic Navigation Interconnection Box	VHF/VOR-2 RCVR VOR-2	MEAC MEDC 26-Vac Sync Excitation
SA-675 Transfer Relay (Transmission Line Switch)	Aft Electronic	VHF XMTR	MEAC MEDC
VHF Glideslope Receiver	Forward Electronic	GLIDESLOPE	MEDC
Marker Beacon Receiver	Main Load Center	MKR BCN	MDC E

Figure 22-9. Radio Navigation System Circuit Breaker Locations and Power Source (Prior to Update II.5)

22.1.3 Operating Procedures

The operating procedures are identical for each VOR.

1. Function selector — VOR.

Note

The VOR control panel should be left in the VOR position for both VOR reception and VHF communication. Selection of REC (VOR-1) or T/R (VOR-2) should be done only if communication is desired in the 116.00 to 117.95 MHz range.

2. SQ control — Fully counterclockwise.
3. Volume control — Rotate clockwise out of OFF position to turn the set on.
4. Tune receiver to desired VOR frequency.
5. Select the appropriate HSI control panel and REC switchlight on the ICS master control panel.
6. SQ control — Set to desired threshold.

For VOR and ILS approach procedures, refer to Chapter 18.

22.1.4 MMR Operating Procedures

The operating procedures are identical for each VOR.

1. SQ control — Inoperative.
2. Function selector — T/R/VOR or REC/VOR are inoperative.
3. Volume control — Rotate clockwise out of OFF position to turn on the set.
4. Tune receiver to desired VOR frequency.
5. Select the appropriate HSI control panel and REC switchlight on the ICS master control panel.

For VOR and ILS approach procedures, refer to Chapter 18.

22.2 VHF/VOR RADIO NAVIGATION (ARN-140, ARN-87, AND ILS) UPDATE II.5 AND SUBSEQUENT

The VHF navigation and communication system consists of dual ARN-140 VHF omnirange and instrument landing system receivers and an ARC-197 VHF transceiver. The dual VOR/ILS systems provide a means of airway radio navigation and receiving instrument landing information. The VOR/ILS receivers operate in the VHF frequency range. The two systems (VOR/ILS-1 and VOR/ILS-2) can be operated simultaneously to receive signals from VOR stations in the 108.00 to 117.95 MHz range.

An ARC-197 VHF transceiver is provided for voice communication with commercial airfields and airway stations in the 116.0 to 151.975 MHz range. The VHF communication is controlled from the flight station but may be utilized at any of the four ICS master control panels. It has a REC and MIC SEL switchlight on the ICS master control panel and is independent of the VOR system.

The ILS receiving equipment enables the pilot to make approaches during low-visibility conditions to airfields having ground ILS equipment. Incorporated within each VOR/ILS receiver is an ILS localizer, ILS glideslope, and marker beacon receiver. The ILS glideslope receiver operates between 329.15 and 335.0 MHz with an antenna located in the nose radome. A marker beacon receiver is installed with an antenna on the lower center fuselage and indicator lights on the pilot and copilot instrument panels. The marker beacon receiver output causes the indicator lights to illuminate whenever the aircraft passes over a ground facility transmitting on 75 MHz.

22.2.1 System Components

System components are presented in Figure 22-10.

22.2.1.1 VIR-31A/ARN-140 VOR/ILS Receiver

The VIR-31A/ARN-140 VOR/ILS receiver is located in rack B-1 and provides for VHF reception of radio navigation signals, ILS localizer/glideslope deviation, and marker beacon information. There are two identical receivers labeled VOR/ILS-1 and VOR/ILS-2. If modified, these receivers can provide FM-immune (also known as Protected Instrument Landing System [PILS]) VHF reception in the 108.00 to 117.95 MHz frequency range.

22.2.1.2 RT-1397/ARC-197 VHF Transceiver

The RT-1397/ARC-197 VHF transceiver is located in rack J-2 and provides VHF transmission and reception capability. The front panel of the transceiver has a headphone jack, microphone jack, squelch disable switch, and a power output indicator.

22.2.1.3 313N-48/ARN-140 VOR/ILS Receiver Control Panel

The 313N-48/ARN-140 VOR/ILS receiver control panel is located on the center pedestal in the flight station and provides for frequency selection, squelch control, and power. Both receiver control panels function identically (refer to Figures 22-11 and 22-12).

22.2.1.4 C-11067/ARC-197 VHF Control Panel

The C-11067/ARC-197 VHF control panel is located on the center pedestal in the flight station and provides for frequency selection, volume control, and power to the VHF transceiver (refer to Figures 22-11 and 22-13).

22.2.1.5 CU-1092 Antenna Coupler

The CU-1092 antenna coupler provides impedance matching and is a junction for incoming VOR signals from a single loop antenna on the vertical stabilizer that serves both VOR/ILS receivers. The coupler is located in rack B-1/2.

22.2.1.6 VHF Bandpass Filter

The VHF bandpass filter is located in rack J-2 and reduces crosstalk between the VHF transceiver and UHF radio system.

22.2.1.7 Marker Beacon Indicators

Marker beacon indicators are located at both the pilot and copilot instrument panels and illuminate to signal passage of the inner, middle, or outer marker during an ILS approach. The three different colored lights are labeled INNER, MIDDLE, and OUTER. An associated aural tone can be monitored if the BCN/AUX switchlight on any of the ICS master control panels is illuminated amber (refer to Figure 22-11).

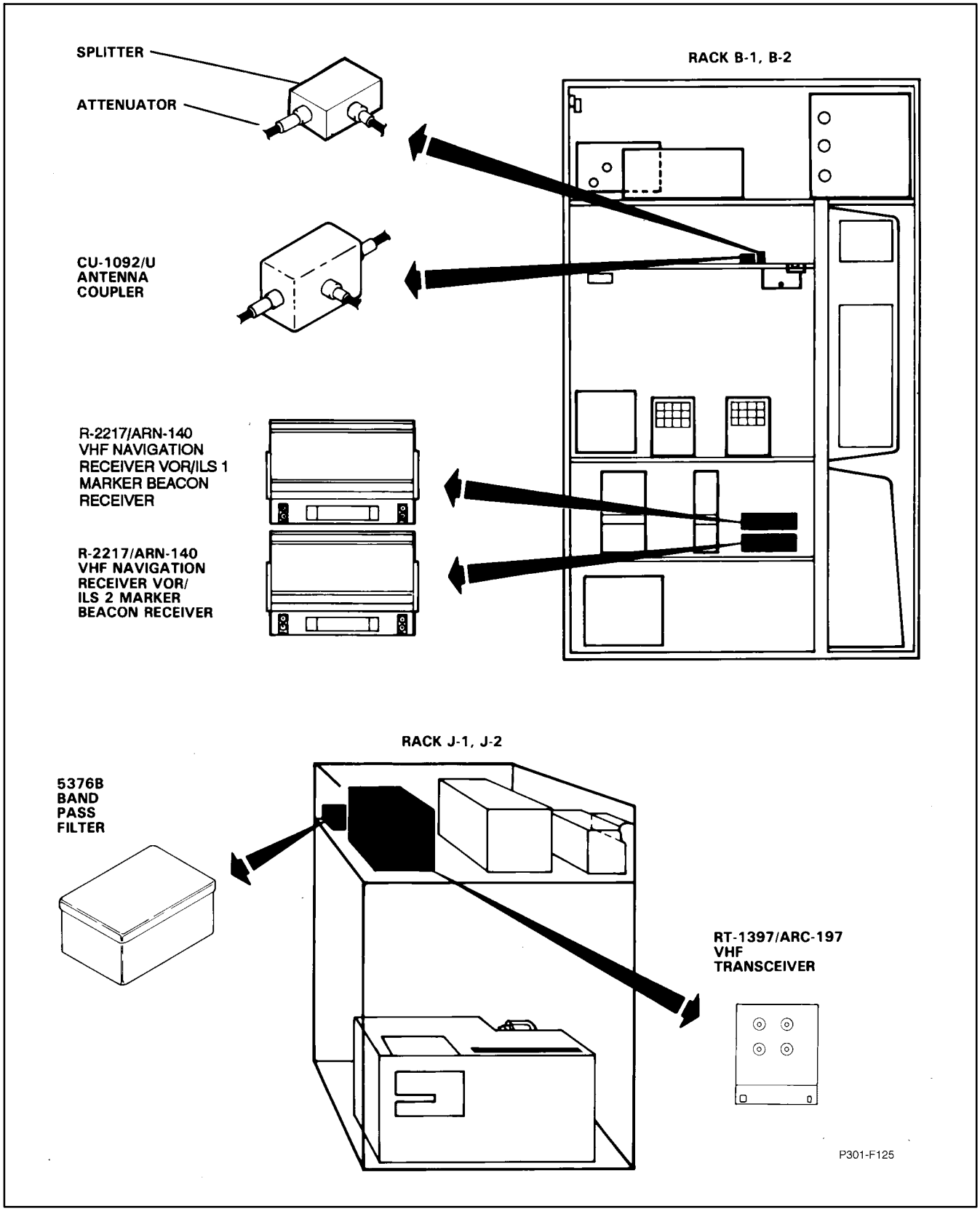


Figure 22-10. Radio Navigation System Components (Update II.5 and Later)

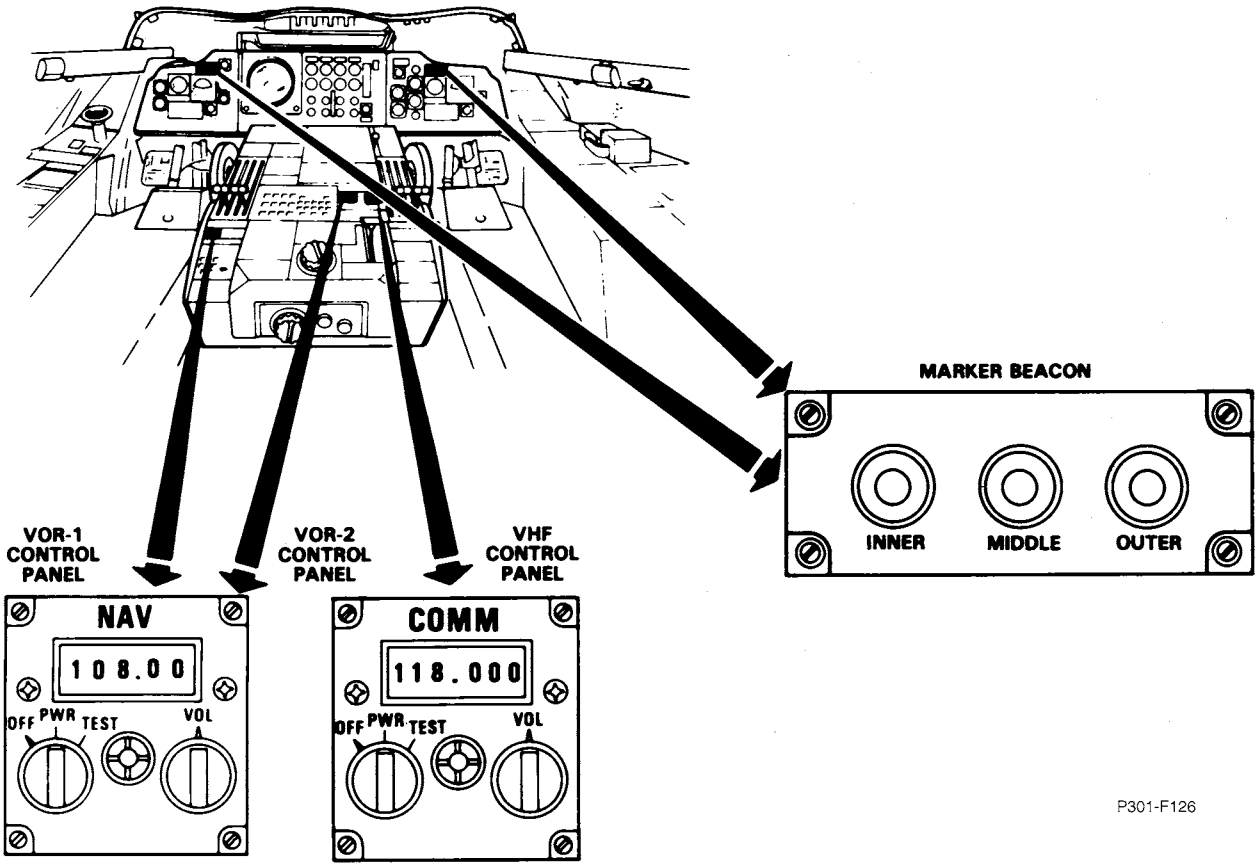


Figure 22-11. VOR/ILS/VHS Receiver Control Panels and Marker Beacon Lights

PANEL MARKING	FUNCTION
MHz Selector	Inside knob of the OFF/PWR/TEST switch changes the frequency by single-MHz increments.
kHz Selector	Inside knob of the VOL control changes the frequency by 50-kHz increments.
VOL Control	Not presently connected.
OFF/PWR/TEST Switch	Controls the power and test functions to the transceiver.

Figure 22-12. VOR/ILS Receiver Control Panel Markings and Functions

PANEL MARKING	FUNCTION
MHz Selector	Inside knob of the OFF/PWR/TEST switch changes the frequency by single-MHz increments.
kHz Selector	Inside knob of the VOL control changes the frequency by 25-kHz increments.
VOL Control	Not presently connected.
OFF/PWR/TEST Switch	Controls the power and test functions to the transceiver.

Figure 22-13. VHF Control Panel Markings and Functions

22.2.1.8 Antenna Power Attenuator/Splitter

The antenna power attenuator/splitter matches the impedance between the antenna and the marker beacon power splitter. The antenna power splitter is a junction for a single signal that serves both marker beacon receivers.

22.2.1.9 Circuit Breakers

Circuit breakers and power sources for the radio navigation system components are listed in Figure 22-14.

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
VOR/ILS-1 Receiver	Forward Load Center Navigation Interconnection Box	VOR/ILS-1 VOR-1	MEDC 26-Vac Sync Excitation
VOR/ILS-2 Receiver	Forward Load Center Navigation Interconnection Box	VOR/ILS-2 RCVR VOR-2	MEDC 26-Vac Sync Excitation
VHF Transceiver	Aft Electronic	VHF-AM	MEDC

Figure 22-14. Radio Navigation System Circuit Breaker Locations and Power Sources

22.2.2 System Description

The dual VOR/ILS systems simultaneously receive incoming RF signals by means of the loop antenna on the vertical stabilizer, passed through the coupler for impedance matching and splitting. The signal is then routed to the VOR/ILS-1 and VOR/ILS-2 receivers. The RF signal is processed into directional information (bearing, to-from, and right-left course deviation) in the converter section of the receiver that is then made available for display on the HSIs.

The navigation information received by either VOR/ILS is determined by the frequency selected on the control panel. The VOR control panels can select frequencies between 108.00 and 117.95 MHz. To monitor the received signal, select the appropriate RECEIVER switchlight on the ICS master control panel.

To utilize VHF communications, set a frequency between 118.00 and 151.975 MHz in the control panel. The transmitter is then connected to the VHF tail cap antenna, through the VHF bandpass filter. Make selection for transmission and reception on any ICS master control panel by selecting VHF on the MIC SEL switchlight or monitor by switching to VHF on any ICS crew station control panel.

For an approach to landing using the ILS glideslope and localizer, set the VOR/ILS-1 control panel to a frequency between 108.00 and 111.95 MHz (odd tenths). ILS localizer information is received through the loop antenna and the glideslope receiver is enabled. Received data are automatically displayed on the FDI. In order to display course information on the HSI, select VOR-1 on the appropriate flight station HSI control panel. An ARN-140 receiver must be located in the VOR-1/ILS rack position to enable glideslope information to be displayed to the flight station FDIs.

The marker beacon is always enabled through the antenna on the underside of the aircraft. The signal passes through an antenna power splitter/attenuator that routes marker beacon information to both VOR/ILS-1 and VOR/ILS-2. To monitor the marker beacon, select the BCN/AUX switchlight on the ICS master control panel. When the BCN/AUX switchlight is amber, the marker beacon and the AUX channel of the ICS will be received simultaneously. Normally, these two audio lines are not active at the same time.

22.2.3 Operating Procedures — ARN-140 VOR/ILS Receiver

1. Turn OFF/PWR/TEST switch to PWR.
2. Set desired frequency on the VOR/ILS receiver No. 1 control panel.
3. Adjust the volume control on the ICS master control panel to desired level.
4. To test the VOR-1 receiver, select VOR-1 for bearing 1 and course on the pilot HSI control panel. Slew the course arrow to 003 using the course set knob on the pilot HSI (the course indicator window on the pilot HSI should read 003). Set the OFF/PWR/TEST switch to TEST and observe the following: bearing pointer 1 arrow points to 003, course deviation bar is centered, and to-from arrow indicates Takeoff (TO). If course 183 is selected with the course set knob, the to-from arrow indicates FROM. The VOR-1 receiver can be tested on the copilot HSI by selecting VOR-1 for bearing 2 and course on the copilot HSI control panel and observing the bearing pointer 2 arrow.
5. To test the VOR-2 receiver, set the desired frequency on the VOR/ILS receiver No. 2 control panel; select VOR 2 for bearing 1 and course on the pilot HSI control panel. Slew the course arrow to 003 using the course set knob on the pilot HSI (the course indicator window on the pilot HSI should read 003). Set the OFF/PWR/TEST switch to TEST and observe the following: bearing pointer 1 arrow points to 003, course deviation bar is centered, and to-from arrow indicates TO. If course 183 is selected with the course set knob, the to-from arrow indicates FROM. The VOR-2 receiver can be tested on the copilot HSI by selecting VOR-2 for bearing 2 and course on the copilot HSI control panel and observing the bearing pointer 2 arrow.

For VOR and ILS approach procedures, refer to Chapter 18.

22.3 AN/ASN-179 INERTIAL NAVIGATION SYSTEM

22.3.1 Introduction

The P-3 AN/ASN-179 Inertial Navigation System (INS) is a self-contained, all-weather, worldwide navigation system that is independent of ground-based NAVAIDs. The aircraft contains two independent ASN-179 inertial systems. Both are capable of providing the same data to the operator and aircraft.

Note

The INS (ASN-179) is the primary navigation source for oceanic en route and due regard operations.

The ASN-179 Inertial Navigation Unit (INU) interfaces with the existing Mode Selector Units (MSUs), Control Display Units (CDUs), and the aircraft computer system. Each ASN-179 INS independently computes the navigation solution to include present position (latitude and longitude), and the results are displayed on the CDUs.

INS-1 is designated as primary and INS-2 is designated as secondary. Either the primary or secondary INS may be designated to provide navigation input data to the aircraft computer system. External inputs to the system include:

1. TAS from the true airspeed system or by operator entry at the CDU.

2. Initial aircraft position (latitude and longitude) from the Global Positioning System (GPS) or by operator entry at the CDU.

22.3.2 System Components

22.3.2.1 Mode Selector Unit

Located at the pilot (INS-1) and the copilot (INS-2) side consoles, each MSU controls the application of power and selects the STBY (standby), ALIGN, NAV (navigation), and Attitude Reference (ATT REF) modes of operation. Each MSU has two annunciators that provide status information. Figure 22-15 shows the locations and front panel of the MSU, and Figure 22-16 describes the functions of the mode switch and the two annunciators.

22.3.2.2 Control Display Unit

Located at the NAV/COMM station (Figure 22-15), the CDUs provide a means for entry, control, and display of navigation data. A list of CDU panel functions is provided in Figure 22-17.

22.3.2.3 Inertial Navigation Unit

Located in rack H-1/H-2 (Figure 22-18), the INU houses the inertial platform, digital computer, inertial power supply, and digital subsystem modules. The platform is an all-attitude, strap down (no moving parts), self-contained platform that contains three orthogonal Zero-lock Laser Gyros (ZLGs) to measure vehicle angular rates and uses a three-axis accelerometer (A-4) triad package to measure vehicle linear acceleration. The INU inertial sensor assembly senses aircraft motions in terms of angular rates (delta theta) and linear acceleration (delta velocity) about the aircraft axes. These three axes are designated X, Y, and Z. The outputs of the INU include pitch and roll, velocity, and true heading.

The INU is the navigation component that provides information for other aircraft systems to support navigation, weapons delivery, attitude, and flight control requirements. Navigation and attitude information include acceleration, velocity, position, true heading, magnetic heading, waypoint bearing, digital and analog attitude (roll, pitch, and yaw), and attitude rates.

The INU internal power supply converts 115 Vac, 400 Hz, single-phase power into various regulated and unregulated DC voltages required by the system and is capable of operating from a 28 Vdc supply in the event 115 Vac power is lost.

CAUTION

The cooling for the two INUs is controlled by a two-position (NORMAL/EMERGENCY) butterfly valve located in the lower part of rack H-1/H-2. The NORMAL position allows cooling by means of the cabin exhaust fan.

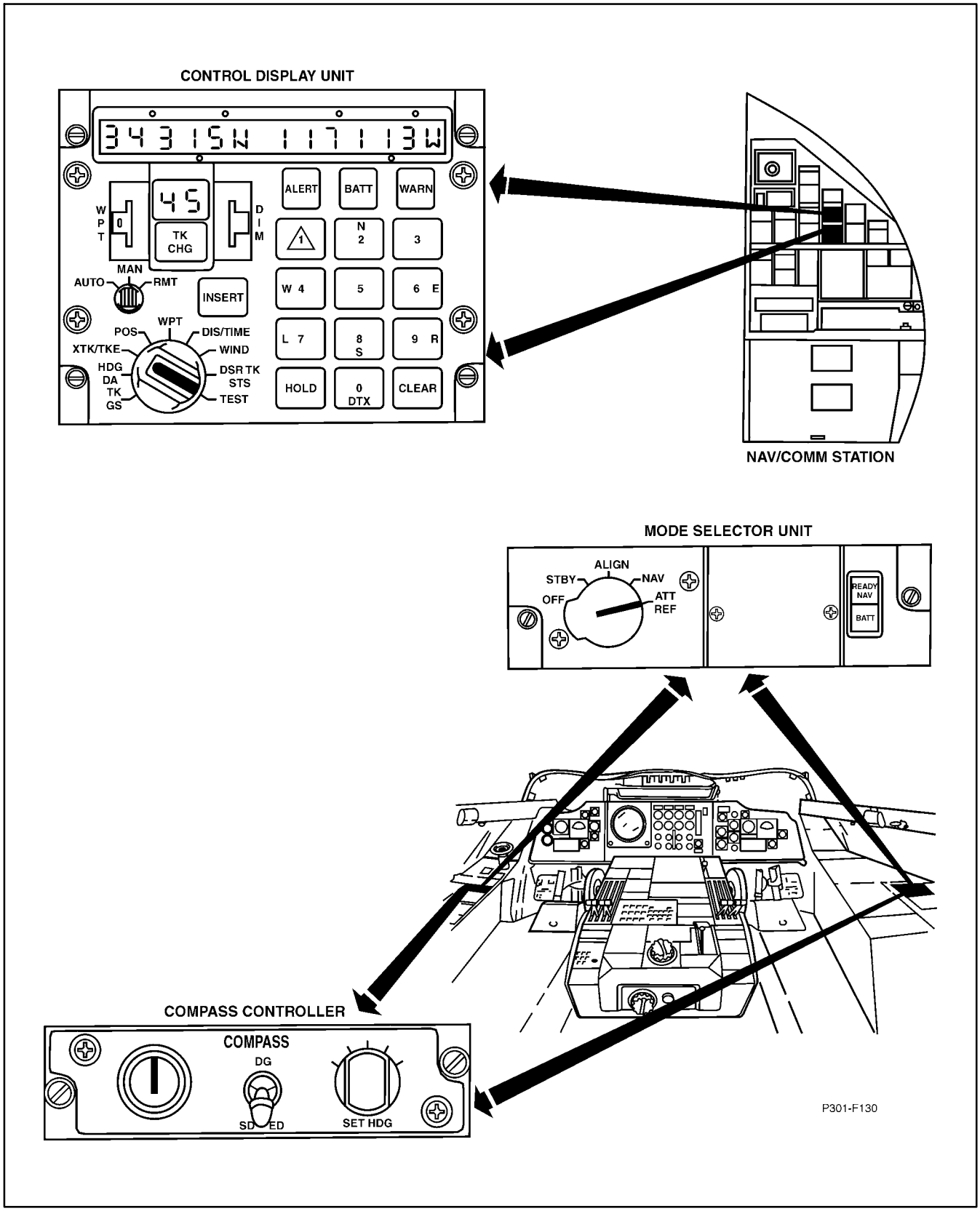


Figure 22-15. AN/ASN-179 System Control Component Locations

PANEL MARKING	FUNCTION
Mode Selector Switch:	
STBY	Allows CDU display of present position coordinates and allows display test to be performed. Power is supplied to all units. Built-In Test (BIT) is performed. System alignment begins.
ALIGN	Aligns the system.
NAV	Normal operation mode. The knob must be pulled away from the panel before the mode selector switch can be moved from the NAV position.
ATT REF	Attitude reference is normally selected when navigation capability is lost. In this mode, the system only provides platform heading, pitch and roll attitude signals. **Note** ● If the system detects a computer failure during NAV mode, it will automatically revert to the ATT REF mode. ● Once deselected, NAV mode cannot be used unless a new ground alignment (normal or rapid) or an in-flight alignment is completed.
READY NAV (Green)	Illuminates to indicate that the system alignment is completed and the system is ready for the NAV mode of operation. **Note** The READY NAV light will illuminate only if the mode switch is in ALIGN position. The light extinguishes when NAV is selected.
BATT (Red)	Illuminates to indicate that the backup DC voltage (FEDC bus) is in use. **Note** If DC voltage is below preset value, the INS will shut down.

Figure 22-16. MSU Panel Markings and Functions

PANEL MARKING	FUNCTION
Display Switch TK GS (Track — Groundspeed)	Displays aircraft track angle in the left display with respect to true north, from 0° to 360°, and groundspeed in the right display, from 0 to 3,999 nautical miles per hour.
HDG DA (Heading — Drift Angle)	Displays aircraft true heading in the left display from 0° to 360° and the aircraft drift angle (L or R) in the right display from 0° to 180°.
XTK/TKE (Crosstrack Distance/Track Angle Error)	Displays crosstrack distance (L or R) in the left display from 0 to 399.9 nautical miles, and the track angle error (L or R) in the right display from 0° to 180°. **Note** If the AUTO/MAN/RMT switch is in the RMT position, the left display shows the inserted crosstrack offset distance from 0 to 400 nm. The right display shows the track angle error and the From-To display flashes.
POS (Present Position)	Displays the latitude of the aircraft in the left display and the longitude in the right display.
WPT (Waypoint)	Displays the latitude in the left display and longitude in the right display of up to nine stored waypoints corresponding to the digit selected on the waypoint selector.
DIS/TIME (Distance/Time)	Displays distance to go in the left display from 0 to 9999 nautical miles to the waypoint currently selected and time to go in the right display from 0 to 19 hours 59.9 minutes. **Note** • Time to go will read 0 at groundspeeds below 10 knots. • Distance to go and time to go will read 0 until a track leg is inserted in the From-To waypoint display.
WIND	Displays wind direction in the left display from 0° to 360° and wind speed in the right display from 0 to 999 knots. **Note** • Wind direction and speed will be blank until true airspeed is greater than the manually entered wind blanking value. • In RMT, left display will be TAS. • During Wind On Nose/Tail procedures, the left display indicates N (nose wind) or S (tail wind), and the right display indicates wind component.
DSR TK STS (Desired Track Status)	Displays the computed desired track angle in the left display between selected waypoints from 0° to 360°. **Note** • Desired track reads 0 until a track leg is inserted. • In RMT, right display will be MAG VAR. • Also used to monitor alignment progress.
TEST	Used to test the CDU. All segments of the numerical and From-To displays illuminate. 1. With the AUTO/MAN/RMT switch in AUTO: the ALERT, BATT, and WARN indicators; the degree, decimal, and minute displays; and the TK CHG, INSERT, and HOLD pushbuttons illuminate. 2. With the AUTO/MAN/RMT switch in RMT: the TK CHG, INSERT, and HOLD pushbuttons are extinguished. **Note** • Test may be performed during STBY, ALIGN, and NAV without affecting INS operation. • In MAN, system altitude will be displayed in left display. • In RMT, Grey Code altitude will be displayed in left display. • If HSI COURSE is set to TAC/NAV and BEARING is set to DA during display test when the system is in STBY or ALIGN, the HSI heading will rotate to 120°.

Figure 22-17. CDU Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
AUTO/MAN/RMT Switch	Controls the method of waypoint sequencing and data entry.
AUTO	Track leg changes are automatically sequenced in order by the system at the appropriate time.
MAN	Track leg changes are manually initiated by the operator.
RMT	Permits semiautomatic autofill operation. Data entry from one system is automatically transferred to the other systems. Remote is also used to call up DIST/TIME and DSR TK STS between waypoints other than the active track leg and to observe inserted crosstrack offsets.
WPT	Selects waypoint (1 through 9) for latitude and longitude insertion or selects waypoint (0 through 9) for presentation of waypoint coordinates.
TK CHG	Allows manual track changes to be made with the data keyboard.
INSERT	Used to enter keyboard entries into the computer. At startup, the initial position of the aircraft is stored and the operator may accept the initial latitude and longitude by depressing the INSERT pushbutton or may enter a new latitude/longitude.
From-To Display	Provides a visual indication of the from and to waypoint numbers representing the active track leg.
DIM	Dimmer control to vary intensity of From-To and numerical displays.
ALERT	Illuminates steady amber in the automatic mode when the aircraft is 2 minutes from the next waypoint. When 30 seconds from the next waypoint, the track leg is automatically sequenced and the ALERT light extinguishes. Illuminates steady amber in the manual mode 2 minutes from the next waypoint and flashes 30 seconds from the next waypoint. It will continue to flash until the operator enters the next track leg. **Note** ALERT light will not illuminate when groundspeed is below 125 knots.
BATT (Battery)	Illuminates amber to indicate the primary AC power is not within specified limits and the system has reverted to the backup DC power source (the FEDC bus, which in some conditions may be powered by the aircraft battery).
WARN (Warning)	Illuminates red to indicate the system self-test and monitoring circuits have detected a malfunction and the navigation data are no longer available. **Note** A flashing WARN light indicates system degradation.
Data Pushbuttons	Used to manually enter data into displays. The INSERT pushbutton is used to enter data into the computer.
CLEAR	Used to clear keyboard entries before they are inserted into the computer.
HOLD	Freezes the present position, but does not stop position computations within the system. This provides a convenient means for position reporting and manual position updating.

Figure 22-17. CDU Panel Markings and Functions (Sheet 2 of 2)

CAUTION

The EMERGENCY position allows for a greater airflow over the INUs. Ensure this valve is in the NORMAL position when preflighting the aircraft.

The INU performs the following primary functions:

1. Determines the angular orientation and horizontal velocity of the aircraft.
2. Determines the groundspeed and drift angle of the aircraft.
3. Determines the geographic position of the aircraft.
4. Serves as the bus controller for the Aeronautical Radio Incorporated (ARINC) navigation data buses.

22.3.2.4 28 Vdc Backup

In the event that primary 115 Vac power is momentarily interrupted or lost, the flight essential 28 Vdc bus provides operating power to the inertial system.

Note

Initial power-on requires 115 Vac power.

The emergency backup power source for the flight essential 28 Vdc bus is the aircraft battery located in the nose wheelwell. In an emergency, the INS will operate from the aircraft battery.

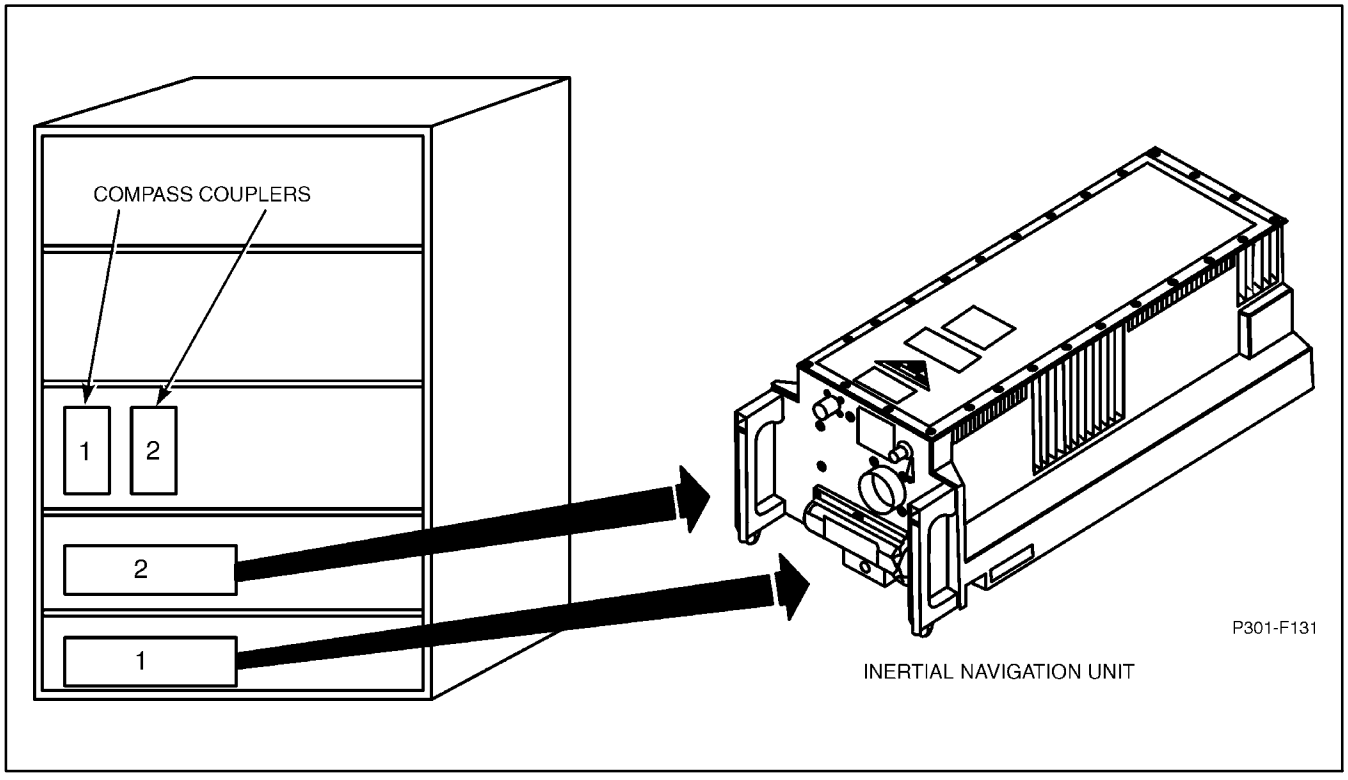


Figure 22-18. AN/ASN-179 Components Located in Rack H-1/H-2

22.3.2.5 Magnetic Heading Reference System (MHRS)

The MHRS supplies analog (synchro) outputs representing either the stabilized magnetic heading of the aircraft or the slewed Directional Gyro (DG) heading. The compass controller, located in the flight station (Figure 22-15), selects either the SLAVED or DG mode for the MHRS. Selecting SLAVED on the compass controller enables the compass coupler, located in rack H-1/H-2, to stabilize signals supplied by the flux valve, located in the starboard horizontal stabilizer, with the platform heading output from the INU. Selecting DG on the compass controller references all outputs to the platform heading that takes the place of a directional gyro signal. For grid navigation operations, the output signal heading can be slewed clockwise or counterclockwise with the SET HDG spring-loaded, center-OFF rotary switch on the compass controller.

Note

The TAS input is used to compute wind speed and direction in the INU. Reference voltage for magnetic variation is supplied by the TAS and is required for Magnetic Variation (MAG VAR) functionality.

22.3.2.6 Digital Data Unit

Located in rack D-1, this unit translates the ASN-179 INS data into a format capable of being processed by the central computer.

22.3.2.7 True Airspeed Computer

Located in rack C-2 (Figure 22-19), this computer utilizes the copilot pitot-static system and the TAS temperature probe to calculate speeds from 70 to 450 knots.

22.3.2.8 True Airspeed Control Panel

Located at the NAV/COMM station (Figure 22-19), this panel has two toggle switches: POWER/OFF and PROBE HEATER/OFF. The POWER/OFF switch in the POWER position energizes the TAS computer and enables the ASN-179 INS to calculate magnetic variation and wind velocities.

The PROBE HEATER/OFF switch in the PROBE HEATER position energizes the TAS temperature probe deicing heater. This switch should be OFF except during icing conditions.

WARNING

Use the probe heater only during flight.

22.3.2.9 Circuit Breakers

Circuit breakers and power sources for the AN/ASN-179 INS components are listed in Figure 22-20.

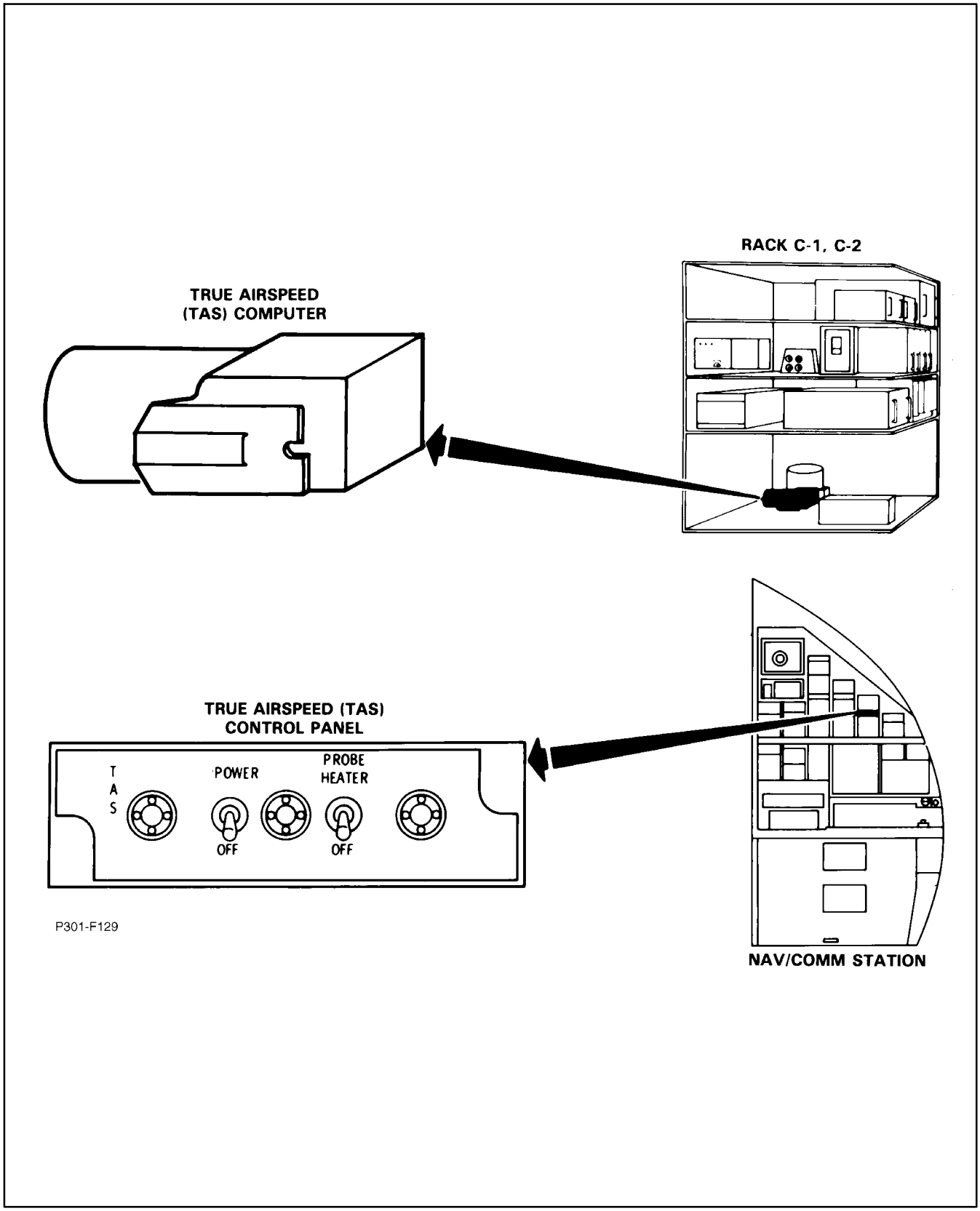


Figure 22-19. TAS Computer and Control Panel

EQUIPMENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
RACK C-1 AND C-2			
TRUE AIRSPEED COMPUTER (TAS)	FECB DPS	TAS SIGNAL DATA CONVERTER	MEAC/DC BUS A
RACK D-1			
DIGITAL DATA UNIT (DDU)	AECB	DDU CH 1 DDU CH 2	MEDC MDC
RACK H-1 AND H-2			
AN/ASN-179, INERTIAL NAVIGATION UNIT #1 (INU #1)	AECB FLC LOWER NAV J-BOX	INERTIAL SYSTEM NO. 1 — RUN INS-1 INS NO. 1	MEAC FEDC MEAC
AN/ASN-179, INERTIAL NAVIGATION UNIT #2 (INU #2)	AECB FLC LOWER NAV J-BOX	INERTIAL SYSTEM NO. 2 — RUN INS-2 INS NO. 2	BUS A FEDC MEAC
MHRS #1 COMPASS COUPLER	AECB NAV J-BOX FECB	MHRS NO. 1 INS NO. 1 TAS	MEAC MEAC MEAC
MHRS #2 COMPASS COUPLER	AECB NAV J-BOX FECB	MHRS NO. 2 INS NO. 2 TAS	BUS A MEAC MEAC

Note

- If a fire persists after pulling above circuit breakers, secure both INS at the MSUs in the flight station.
- Although INS-1 and INS-2 receive power from different AC buses, both systems receive synchro excitation from the same source. This source is the navigation interconnection box powered by the MEAC bus, which steps the voltage down to 26 Vac. If the MEAC bus fails, in addition to losing INS-1, INS-2 will not provide heading and attitude information to peripheral navigation equipment, but will provide positional information to the CDU.

Figure 22-20. AN/ASN-179 INS Circuit Breaker Locations and Power Sources

22.3.3 System Description

The AN/ASN-179 INS is a precision, self-contained, all-weather, worldwide inertial navigation system that is independent of ground-based NAVAIDs. It supplies extremely accurate navigation and guidance data. The system has no moving parts and operates by using three ZLGs and an A-4 triad accelerometer to sense aircraft tilt and accelerations. Measured aircraft accelerations are integrated by a programmable general-purpose digital computer that performs all the navigation and guidance computations. Output functions of the system include accurate present position and selected navigation data between nine waypoints, pitch, roll, and platform heading information.

Unrestricted worldwide navigation is provided by the wander azimuth angle technique following initial alignment. Except for verification or corrected entry of initial position latitude and longitude, system alignment is a highly reliable, accurate, and completely automatic process accomplished without the use of external references. During this sequence, the accelerometer triad is referenced to local vertical. This determines their true north orientation and computes gyro bias prior to each flight. The AN/ASN-179 process of determining gyro bias calculations is unique since these corrections can be based on each gyro, depending on the aircraft true heading during alignment or upon selective rotation of the platform.

The TAS system supplies airspeed values to the AN/ASN-179 inertials and the aircraft computer system. The AN/ASN-179 inertials use the TAS information to calculate wind. The aircraft computer system receives the TAS data via the synchro-to-digital and digital-to-synchro converter. The TAS values are used for calculating winds in the inertial and Doppler navigation modes. In the aircraft computer system air data navigation mode, TAS is used with the entered wind value to determine the track/groundspeed vector. TAS values are displayed on the auxiliary readouts.

The AN/ASN-179 may be used as a directional gyro by the compass coupler and as an attitude reference by the flight director system, without further alignment procedures, by selecting ATT REF on the MSU.

The system can be operated in either the navigate or attitude reference modes. The NAV mode is the normal operating mode in which the system is employed to its fullest capability. The ATT REF mode is the alternate operating mode that is used when only inertial attitude and magnetic heading reference are required or when the NAV mode fails in flight. Integrity-monitoring and warning routines are incorporated within the system to detect malfunctions and to alert the NAV/COMM to their existence.

Note

Although INS-1 and INS-2 receive power from different AC buses, both systems receive synchro excitation from the same source. The navigation interconnection box is powered by the MONITORABLE ESSENTIAL AC BUS, which steps the voltage down to 26 Vac. If the MONITORABLE ESSENTIAL AC BUS fails, in addition to losing INS-1, INS-2 will not provide heading and attitude information to peripheral navigation equipment, but will provide positional information to the CDU.

22.3.3.1 GPS-Aided Operation

When interfaced with the AN/ARN-151 GPS receiver, the AN/ASN-179 INS can be aligned during flight and/or updated in NAV mode. GPS aiding requires that the GPS receiver attain a Figure Of Merit (FOM) of at least 5.

Note

CNO policy is to operate all crypto-capable GPS systems in the keyed mode. The GPS system has been tested and approved for use in the keyed (Precise Positioning Service [PPS]) mode of operation only.

GPS-aided alignments can only be performed in a closed loop mode where GPS data are used to update position and velocity. Navigation updates may be performed in either the open loop or closed loop mode where INS inertial solutions are maintained in the computer separate from the GPS updated equivalents. With the INS in NAV mode, either open or closed loop GPS updates can be enabled, terminated, or flushed, as required. Upon flushing of either mode, the INS will revert to inertial navigation.

The AN/ASN-179 INS may be aligned with the AN/ARN-151 GPS using one of three methods:

1. Normal ground alignment. INS will automatically enter closed loop update at STS 70 if the GPS (AN/ARN-151) is installed and turned on.
2. In-flight alignment. The alignment is initiated and completed during flight.
3. Hybrid alignment. The alignment is started on the ground with the aircraft stationary and completed during taxi or flight.

Note

Normal alignment is the recommended method for aligning the INS on the ground.

During in-flight alignment, the Kalman filter will be initialized in the in-flight alignment mode and will remain coupled to the free inertial navigation solution until alignment is complete and NAV is selected on the MSU. If NAV is not selected after the READY NAV light illuminates, the INS remains in the closed loop update condition and continues to align the system based on GPS inputs until NAV is selected.

When GPS-aided alignment is complete and NAV is selected, the Kalman filter will be decoupled from the free inertial solution. The system will transition to the NAV mode and will separate the hybrid INS/GPS and free inertial solutions. The hybrid INS/GPS position will be the top-level position normally presented to the operator on the CDU. The free inertial solution will be unaffected by GPS updates while in closed or open loop, aiding in the NAV mode.

22.3.4 Modes of Operation

The MSU is used to select the AN/ASN-179 INS operating mode as described in the following paragraphs.

22.3.4.1 Standby Mode

Selecting STBY on the pilot/copilot MSU starts the alignment procedure for INS-1/INS-2, respectively. In STBY, the BIT routines are run, the ZLG lasers are fired, and the instruments begin the leveling process. During this time, it is necessary for the operator to accept the stored present position latitude/longitude or enter a corrected latitude and longitude at the CDU.

22.3.4.2 Align Mode

Selecting ALIGN on each MSU enables each INS to complete the alignment procedure. For aircraft not equipped with the AN/ARN-151 GPS, there are two alignment methods: Normal and Rapid. For aircraft equipped with the AN/ARN-151 GPS, there are two additional alignment methods: Hybrid and In-Flight.

Note

Normal alignment is the recommended method for aligning the INS on the ground.

a. Normal Alignment. Normal alignment is accomplished on the ground, with the aircraft stationary, an operator-entered corrected latitude and longitude at the CDU, and does not require an operational AN/ARN-151 GPS. The INU logically determines that the aircraft is on the ground. Alignment completion is normally less than 4 minutes. At completion of alignment, the READY NAV light on the MSU illuminates. Until the READY NAV light illuminates, the aircraft should not be moved/relocated; however, minor movement that might be caused by wind or personnel moving about the aircraft will not interfere with the alignment process.

Note

INS will automatically enter closed loop update at STS 70 if the GPS (AN/ARN-151) is installed and turned on.

b. Rapid Alignment. Rapid alignment, a variation of normal alignment, is accomplished on the ground, with the aircraft stationary, and does not require an operational AN/ARN-151 GPS. If the aircraft position and heading has not changed since the last shutdown and the operator accepts the stored present position latitude/longitude at the CDU, alignment completion is approximately 30 seconds. At completion of alignment, the READY NAV light illuminates. Until the READY NAV light illuminates, the aircraft should not be moved/relocated; however, minor movement that might be caused by wind or personnel moving about the aircraft will not interfere with the alignment process.

Note

Present position latitude/longitude or enter a corrected latitude and longitude at the CDU. For a rapid alignment to function, a normal alignment must have been accomplished prior to STS 02 and not accepted.

c. Hybrid Alignment. The normal alignment process, with the AN/ARN-151 GPS aiding, becomes a hybrid alignment when the alignment is started on the ground with the aircraft stationary and is completed during taxi or flight. The INU automatically switches to align hold when motion is detected, switches to hybrid align at 20 knots, and switches to in-flight alignment at 80 knots. If motion stops prior to READY NAV light illumination, the INU continues with normal ground alignment. With the MSU set to ALIGN, the INU can logically determine whether the aircraft is on the ground or in the air.

d. In-Flight Alignment. In-flight alignment is available only on aircraft with an operating AN/ARN-151 GPS. Prior to attempting an in-flight alignment, the INS shall have been operating normally (in NAV mode). Selecting OFF, STBY, then ALIGN on the MSU enables the INU to logically determine that the aircraft is in the air and initiate alignment. The present position input for alignment is automatically obtained from the GPS system. Upon completion of the alignment, normally less than 85 seconds, the READY NAV light illuminates. After the READY NAV light illuminates, the NAV mode shall be selected.

22.3.4.3 Navigation Mode

Selecting NAV (a detented switch position) on the pilot and copilot MSUs enables the INUs to provide suitable reference data for the aircraft navigation systems. When AN/ARN-151 GPS aiding is not available, NAV shall be selected prior to taxi. Normal operations call for NAV to be selected after the NAV READY light is illuminated and while the aircraft is stationary just prior to flight operations.

An in-flight alignment procedure, which uses AN/ARN-151 GPS aiding, specifies the MSU selector switch is to be moved from the ALIGN position to the NAV position after the NAV READY light illuminates.

22.3.4.4 Attitude Reference Mode

Selecting ATT REF on the MSU disables the navigation capability of the INU for the remainder of the flight, or until an in-flight alignment procedure is initiated. The INU continues to provide INS heading for use as a directional gyro to the MHRS and pitch and roll for use as attitude references.

Note

If the selected INS is in ATT REF, the radar must be in HEADING STAB and OFF-LINE mode.

22.3.5 Operating Procedures

22.3.5.1 Alignment Procedures

22.3.5.1.1 Normal Alignment and Present Position Entry

Alignment of each of the two AN/ASN-179 INSs is accomplished prior to aircraft taxi operations and takes approximately 4 minutes to complete using the following procedure:

1. MSU mode selector switch — STBY.
2. Appropriate NAVCOM CDU INSERT pushbutton — Illuminate.
   a. CDU display switch — POS.
   b. Present position (latitude and longitude) display — Verify.

c. If present position is correct:

(1) CDU INSERT pushbutton — Press.

(2) Proceed to step 5.

d. If present position is incorrect:

(1) Continue with steps 3 and 4.

3. Enter present position (latitude) — Press the appropriate CDU data pushbuttons.

a. CDU INSERT pushbutton — Press.

4. Enter present position (longitude) — Press the appropriate CDU data pushbuttons.

a. CDU INSERT pushbutton — Press.

Note

Any errors made when entering the latitude or longitude can be corrected by pressing the CLEAR pushbutton and reinserting the correct data.

5. MSU mode selector switch — ALIGN.

a. To monitor alignment progress:

(1) CDU display selector — DSR TK STS.

Note

In the DSR TK STS mode, the align status is shown on the right display as a status number (90, 80, 70, 60, 50, 40, 10, and 02). At STS 70, the system automatically enters closed loop update if the GPS (AN/ARN-151) is installed and turned on. At STS 60, an automatic test of system alignment is made. If the test is passed, alignment continues. If the alignment test fails, the WARN indicator flashes.

b. If the CDU WARN indicator flashes, proceed as follows:

(1) Note the action code and status number in the right display.

Note

More than one malfunction may exist, but only the lowest numerical action code will be displayed at any one time.

(2) A malfunction code will replace the action code if the HOLD pushbutton is pressed. Repeat pressing the HOLD pushbutton to sequentially step from one code number to the next for each detected system malfunction.

(3) Record type of warning indication, action/malfunction codes, and status number. This information will be used by maintenance personnel to fault isolate system malfunctions.

(4) Perform action indicated by action codes.

(5) If the directed action does not correct the malfunction, notify Maintenance Control.

6. After status 02 is displayed:

a. MSU mode selector switch — NAV.

Note

- It is recommended that the MSU mode selector switch be set to the NAV position prior to taxi, while the aircraft is stationary and the READY NAV light is illuminated.
- If the INS is in NAV mode (STS 01) and the GPS (AN/ARN-151) is installed and turned on, the system will automatically enter closed loop update.

22.3.5.1.2 Rapid Alignment

Alignment of each of the two AN/ASN-179 INS is accomplished prior to taxi operations in approximately 30 seconds using the following procedure:

Note

- A normal alignment must have been previously performed and the MSU selector switch positioned to OFF (with STS 02 achieved and the system not accepted to NAV mode). Aircraft position and heading must not have changed during the interim between normal alignment and rapid alignment.
- Navigation performance may be degraded by up to 4 miles per hour following a rapid alignment.

1. MSU mode selector switch — STBY.
2. CDU display switch — POS.
   a. CDU HOLD pushbutton — Press.
   b. CDU 9 data pushbutton — Press.
   c. CDU INSERT pushbutton — Press.
3. Verify present position from reference alignment is displayed on the CDU.
4. MSU mode selector switch — ALIGN.
5. READY NAV annunciator — Illuminates (after approximately 30 seconds).
6. MSU mode selector switch — NAV.

22.3.5.1.3 In-Flight Alignment

In-flight alignment of the AN/ASN-179 INS can be accomplished using the following procedure:

Note

- An operable AN/ARN-151 GPS must be installed for the in-flight alignment procedure to function.
- Alignment with the aircraft moving is a hybrid alignment. In-flight alignment can be enabled during any portion of a ground alignment if it becomes necessary to complete the alignment with the aircraft moving.

Note

- For an in-flight alignment initiated at status 70, the system will enter air align hold until groundspeed exceeds 20 knots. For an in-flight alignment initiated after status 70, the 20-knot limitation does not apply.
- If an in-flight alignment is terminated prior to selecting NAV mode, the align status will reset to status 80 and the Action/Malfunction Code 3/22 (enter present position) will be displayed until the MSU is switched to STBY.

1. Affected system MSU mode selector switch — OFF, then STBY.

Note

No position entry is required. The GPS will initialize the system position.

2. CDU display switch — DSR TK STS.
   a. CDU 1 data pushbutton — Press.
   b. Left display blank — Verify.
   c. CDU INSERT pushbutton — Illuminate.
3. CDU 2 data pushbutton — Press.
   a. 2 is displayed — Verify.
4. CDU INSERT pushbutton — Press.
   a. Display reverts to standard DSR TK STS with either status 90 or 80 displayed — Verify.
5. MSU mode selector switch — ALIGN.
   a. The system will remain in air align hold in status 80 with no ⊏ displayed until:
      (1) GPS groundspeed exceeds 20 knots.
      (2) Alignment exceeds 85 seconds.
      (3) When the above conditions are met, the system will exit air align hold, sequence to ⊏ 70 and initialize position and velocity from the GPS inputs.
   b. If ⊏ does not appear, updates are being rejected.

Note

- Aircraft maneuvers should be restricted to straight-and-level flight until approximately 1 minute after status 70 has been reached. Aircraft maneuvering thereafter is desirable and will speed the alignment process.
- During a maneuver that exceeds acceleration and heading rate limits, GPS updating will not be accepted by the INS for approximately 15 seconds after completion of the excessive maneuvers.

6. After status 02 is displayed:
   a. MSU mode selector switch — NAV.

22.3.5.2 Attitude Reference Operation

In the attitude reference mode of operation, the INS provides only pitch, roll, and platform heading information.

The ATT REF mode may be selected at any time. When ATT REF is selected, the navigational capability of the INS is canceled until another alignment is performed on the ground or an in-flight alignment is initiated.

If the WARN indicator illuminates while operating in the NAV mode during flight, it signifies a loss of INS navigational capability. The INS may automatically enter the attitude reference mode. If this occurs, ATT REF should be selected manually.

If preflight selection of the ATT REF mode is made, valid attitude reference output data are available:

1. Approximately 30 seconds after turning the MSU mode switch from OFF to STBY if the system has been on and the INS is still warm.

2. Approximately 1 minute after turning the MSU mode switch from OFF to STBY if the system has not been on.

Note

Do not use the system attitude outputs until the warmup times specified have elapsed, since possible erroneous outputs may occur.

Select attitude reference operations by performing the following steps:

1. MSU mode switch knob — Pull away from panel and select ATT REF.

2. If CDU WARN indicator is illuminated or if attitude flags are present:

   a. MSU mode switch knob — Pull away from panel and select OFF.

22.3.5.3 Initial Track Selection

The initial track is the direct route between aircraft present position and initial en route waypoint.

The operator must select and insert the initial track leg. Subsequent track legs can be manually inserted by the operator or automatically sequenced by the INS.

The desired initial track leg is inserted using the following procedures:

1. CDU AUTO/MAN/RMT switch — AUTO or MAN.

2. CDU TK CHG pushbutton — Press.

   a. CDU TK CHG pushbutton — Illuminate.

   b. CDU INSERT pushbutton — Illuminate.

3. CDU data pushbuttons:

   a. Enter the number representing the desired track leg start en route waypoint — Press.

   b. Enter the number representing the desired track leg stop en route waypoint — Press.

4. CDU INSERT pushbutton — Press.

   a. CDU INSERT pushbutton — Extinguish.

   b. CDU TK CHG pushbutton — Extinguish.

   c. From-To display displays the numbers inserted in step 3 — Verify.

Note

Crosstrack distance and track angle error (XTK/TKE), distance and time to next waypoint (DIS/TIME), and desired track angle (DSR TK STS) data are not available until a track leg is initiated.

22.3.5.4 Manual Waypoint Coordinates Entry

Coordinates for up to nine waypoints can be entered into the INS. These waypoints may be entered during the alignment sequence while the aircraft is still on the ground, or they may be entered after takeoff, but they should not be entered until after present position coordinates have been entered. Once entered, waypoints will remain in the INS until new waypoints are entered or the system is turned off. Waypoint coordinates are entered using the following procedures:

1. CDU AUTO/MAN/RMT switch — MAN.

2. CDU display switch — WPT.

Note

- Waypoint 0 is reserved for the computer to establish a track from the aircraft present position and cannot be used to enter waypoint coordinates.

- If return to point of departure capability is being used, the point of departure coordinates should be entered as waypoint 1.

3. CDU WPT switch — 1.

4. Enter waypoint 1 latitude and longitude coordinates using the data pushbuttons in the same manner that present position coordinates were entered.

Note

INSERT light extinguishes after each coordinate is entered and INSERT is pressed.

5. CDU WPT switch — 2. Enter waypoint coordinates in the same manner as WPT1 coordinates.

6. CDU WPT switch — Sequential positions. Enter waypoints in the same manner as WPT2 coordinates.

22.3.5.5 In-Flight Procedures

The NAV mode is the normal in-flight operating mode in which the INS is used to navigate a flight plan. Sequential track changes at each waypoint along the flight plan can be made automatically by the INS or manually by the operator. In the NAV mode, the NAV/COMM can:

1. Initiate a change to the next sequential track leg at any waypoint (track leg change at waypoint).
2. Initiate a track from the aircraft present position to any waypoint (track leg change from present position).
3. Bypass a waypoint starting from an en route waypoint or from present position (waypoint bypassing).
4. Change the flight plan to use a different waypoint location from that originally chosen (waypoint position change).
5. Use past waypoint storage locations for entering future waypoints (waypoint position change).
6. Compare present position display with an accurate position fix and update present position. Later, compare the positions for accuracy and then, if desired, drop updated coordinates and revert back to the original ones (position updating and checks).
7. Display an offset track parallel to the present track (desired crosstrack offset mode).

While operating in the NAV mode, the CDU permits a display of the following navigational data:

1. Track angle (TK) and Groundspeed (GS).
2. True Heading (HDG) and Drift Angle (DA).
3. Crosstrack angle (XTK) and Track Angle Error (TKE).
4. Present Position (POS) updated and/or nonupdated.
5. Waypoint (WPT) position.
6. Distance (DIS) and time to next waypoint.
7. Remote direct ranging between waypoints.
8. Remote ranging along flight plan.
9. Remote direct ranging from present position.
10. Wind direction and velocity.
11. Desired Track angle (DSR TK) and Status/Action/Malfunction code (STS).
12. CDU display test.
13. Magnetic Variation (MAG VAR).
14. True Airspeed (TAS).
15. Headwind and tailwind calculations.
16. System altitude and Grey Code altitude.

In the ATT REF mode of operation, the INS provides only pitch, roll, and platform heading outputs. The CDU does not display any information. This mode is used only in the event of loss of INS navigational capability or when navigation data are not required.

22.3.5.5.1 Track Leg Change at Waypoint

The operator can initiate a change to the next sequential track leg at any waypoint. Perform track leg change at waypoint as follows:

1. CDU AUTO/MAN/RMT switch — MAN.
2. CDU TK CHG pushbutton — Press.
    a. CDU TK CHG pushbutton — Illuminate.
    b. CDU INSERT pushbutton — Illuminate.
3. Desired numbers on CDU data pushbuttons — Press.
4. CDU INSERT pushbutton — Press.
    a. CDU INSERT pushbutton — Extinguish.
    b. CDU TK CHG pushbutton — Extinguish.
    c. From-To display displays track numbers inserted in step 3 — Verify.
5. CDU display switch — DSR TK STS.
    a. New track — Check.

22.3.5.5.2 Track Leg Change from Present Position

The operator can initiate a track change from the aircraft present position to any waypoint (0X track change). Perform track change from present position to desired waypoint using the following procedures:

1. CDU AUTO/MAN/RMT switch — MAN or AUTO.
2. CDU TK CHG pushbutton — Press.
    a. CDU TK CHG pushbutton — Illuminate.
    b. CDU INSERT pushbutton — Illuminate.
3. CDU 0 DTX data pushbutton — Press.
    a. Desired waypoint number on CDU data pushbuttons — Press.
4. CDU INSERT pushbutton — Press.
    a. CDU INSERT pushbutton — Extinguish.
    b. CDU TK CHG pushbutton — Extinguish.
    c. From-To display displays track numbers inserted in step 3 — Verify.
5. CDU display switch — DSR TK STS.
    a. New track — Check.

22.3.5.5.3 Waypoint Bypassing

The operator can bypass waypoints in one of two ways: by initiating either a track leg change at waypoint or a track leg change from present position.

22.3.5.5.4 Waypoint Position Change

The operator can change the coordinates of waypoints or use waypoint storage locations for entering future waypoints. Enter waypoints as described in Manual Waypoint Coordinates Entry, paragraph 22.3.5.4. If past waypoint storage locations are to be used for future waypoints, enter future waypoints sequentially starting with waypoint 1 storage location and continuing through the last waypoint storage location used; automatic track leg switching sequences from WPT 9 back to WPT 1.

22.3.5.5.5 Automatic Route Selection

In automatic operation, the change to the next sequential track leg at each waypoint is initiated automatically by the INS. Two minutes before reaching each waypoint, the ALERT indicator illuminates. It extinguishes when the track leg change is made. The From-To display automatically changes to show the new track. Place the system in automatic operation by setting the AUTO/MAN/RMT switch to AUTO. As track leg changes are made, verify new desired track for reasonableness.

Note

- The time that the ALERT indicator illuminates is a function of the new desired track turn angle and the aircraft speed as well as the type of INS steering selected for the specific aircraft configuration.
- If groundspeed is below 125 knots, the ALERT indicator will not illuminate.

22.3.5.5.6 Remote Direct Ranging Between Waypoints

Distance, time, and desired track angle between any two waypoints can be displayed at any time when STBY, ALIGN, or NAV is selected using the following procedures:

Note

- Normal track calculations continue uninterrupted during displays.
- Time is based on a fixed velocity of 300 knots when groundspeed is less than 100 knots and is based on actual groundspeed when speed is more than 100 knots.

1. CDU display switch — DIS/TIME.
2. CDU AUTO/MAN/RMT switch — RMT.
   a. From-To display flashes — Verify.
3. CDU TK CHG pushbutton — Press.
   a. CDU TK CHG pushbutton — Illuminate.
   b. CDU INSERT pushbutton — Illuminate.

4. Press data pushbuttons corresponding to the desired waypoints. Verify selections are displayed.
5. CDU INSERT pushbutton — Press.
   a. CDU INSERT pushbutton — Extinguish.
   b. CDU TK CHG pushbutton — Extinguish.
   c. Left display indicates distance — Verify.
   d. Right display indicates time — Verify.
6. CDU display switch — DSR TK STS.
   a. Right display indicates track angle — Verify.

22.3.5.5.7 Remote Ranging Along Flight Plan

Distance, time, and track angle along the flight plan from present position to any waypoint can be displayed at any time when STBY, ALIGN, or NAV is selected using the following procedures:

Note

Normal track calculations continue uninterrupted during the displays.

1. Verify a track leg has been established.
2. CDU display switch — DIS/TIME.
3. CDU AUTO/MAN/RMT switch — RMT.
   a. From-To display flashes — Verify.
4. CDU TK CHG pushbutton — Press.
   a. CDU TK CHG pushbutton — Illuminate.
   b. CDU INSERT pushbutton — Illuminate.
5. CDU 0 DTX pushbutton — Press.
   a. Desired waypoints — Press. Verify selections.

Note

- Desired waypoint must be ahead of flight plan.
- Time is based on a fixed velocity of 300 knots when groundspeed is less than 100 knots and is based on actual groundspeed when speed is more than 100 knots.

6. CDU INSERT pushbutton — Press.
   a. CDU INSERT pushbutton — Extinguish.
   b. CDU TK CHG pushbutton — Extinguish.

7. Total distance and time along the flight plan between present position and the selected waypoint are displayed in the left and right displays, respectively.

8. CDU display switch — DSR TK STS.

   a. Left display indicates the track angle — Verify.

22.4 TACAN AND ADF RADIO NAVIGATION SYSTEMS

22.4.1 Introduction

The TACAN radio set is an airborne interrogator-responder designed to operate in conjunction with an appropriate surface beacon for navigation purposes. The airborne and surface equipment form a radio navigation system that enables the aircraft to obtain continuous indications of bearing and distance from the selected surface beacon within 300 nm (390 nm for ARN-118) or line of sight (whichever is less) from the aircraft. There is an air-to-air capability to allow distance information with another aircraft with the same capability.

Presently, there are two TACAN systems: ARN-84 (some P-3C, Update I and II), and ARN-118 (Update II.5 and Update III).

The ARN-83 low-frequency ADF is used for routine point-to-point radio navigation. The ADF receiver operates on AM signals, in the 190 to 1750 kHz frequency range. This system is installed on all P-3C aircraft.

22.4.2 System Components

TACAN and radio navigation system components are presented in Figure 22-21.

22.4.2.1 RT-1022/ARN-84(V) TACAN Receiver-Transmitter

The RT-1022/ARN-84(V) TACAN receiver-transmitter is located in rack C-2 and provides for signal transmission and reception to calculate distance and bearing to a tuned surface station or distance to an air-to-air capable aircraft.

22.4.2.2 CV-2837/ARN-84(V) TACAN Signal Data Converter

The CV-2837/ARN-84(V) TACAN signal data converter is mounted behind the TACAN receiver-transmitter and converts digital information to analog signals for the HSI displays.

22.4.2.3 C-8734/ARN-84(V) TACAN Control Panel

The C-8734/ARN-84(V) TACAN control panel is located on the flight station center pedestal. Its functions are listed in Figure 22-22.

22.4.2.4 RT-1159A/ARN-118(V) TACAN Receiver-Transmitter

The RT-1159A/ARN-118(V) TACAN receiver-transmitter is located in rack C-2 and provides for signal transmission and reception to calculate bearing and distance to a tuned surface station or to an air-to-air capable aircraft.

22.4.2.5 MX-9577A/ARN-118(V) TACAN Signal Data Converter

The MX-9577A/ARN-118(V) TACAN signal data converter is mounted beside the TACAN receiver-transmitter and converts digital information to analog signals for the HSI displays.

22.4.2.6 C-10060A/ARN-118(V) TACAN Radio Set Control

The C-10060A/ARN-118(V) TACAN radio set control is located on the flight station center pedestal. Its functions are listed in Figure 22-23.

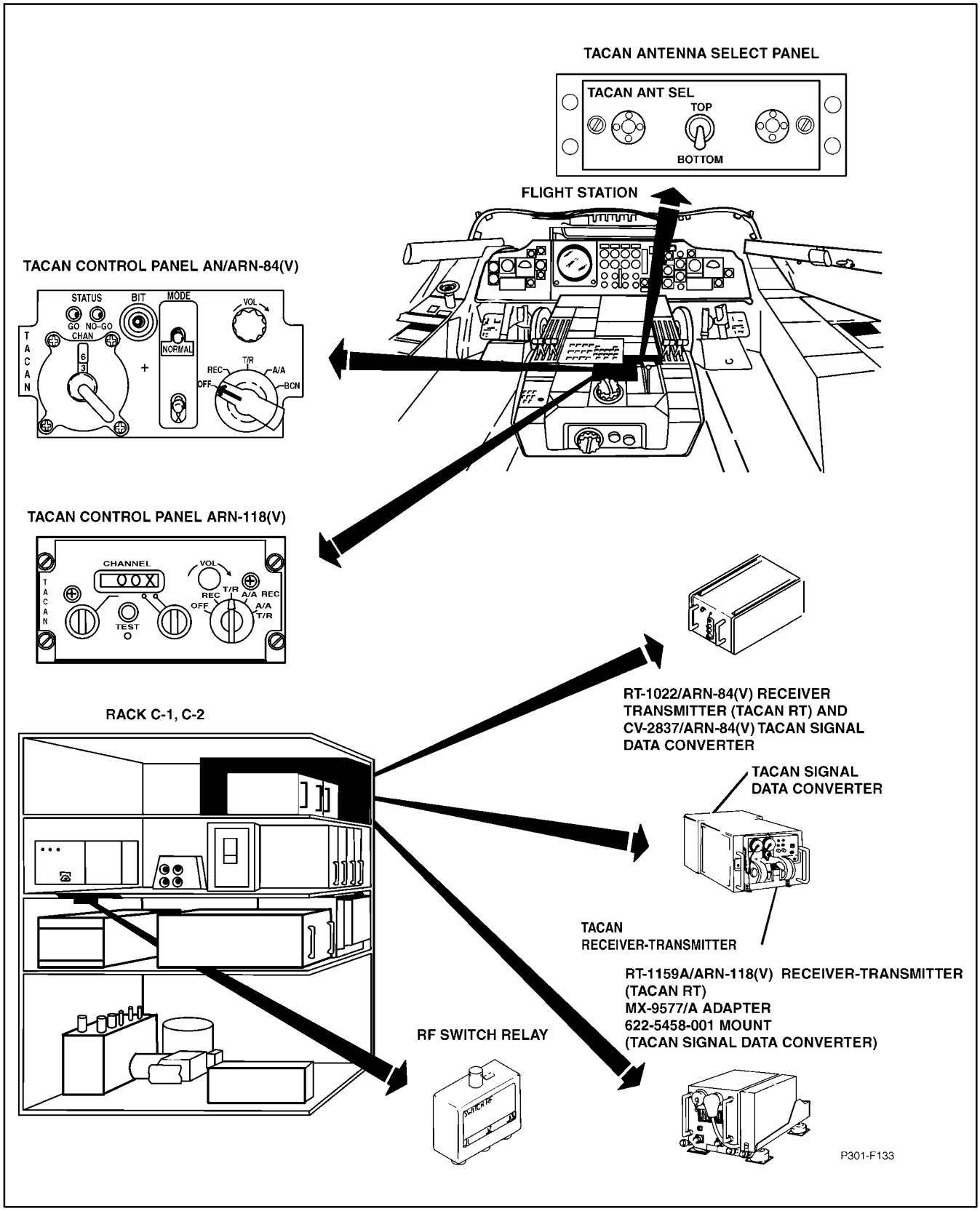


Figure 22-21. TACAN/ADF RNS Component Location (Sheet 1 of 2)

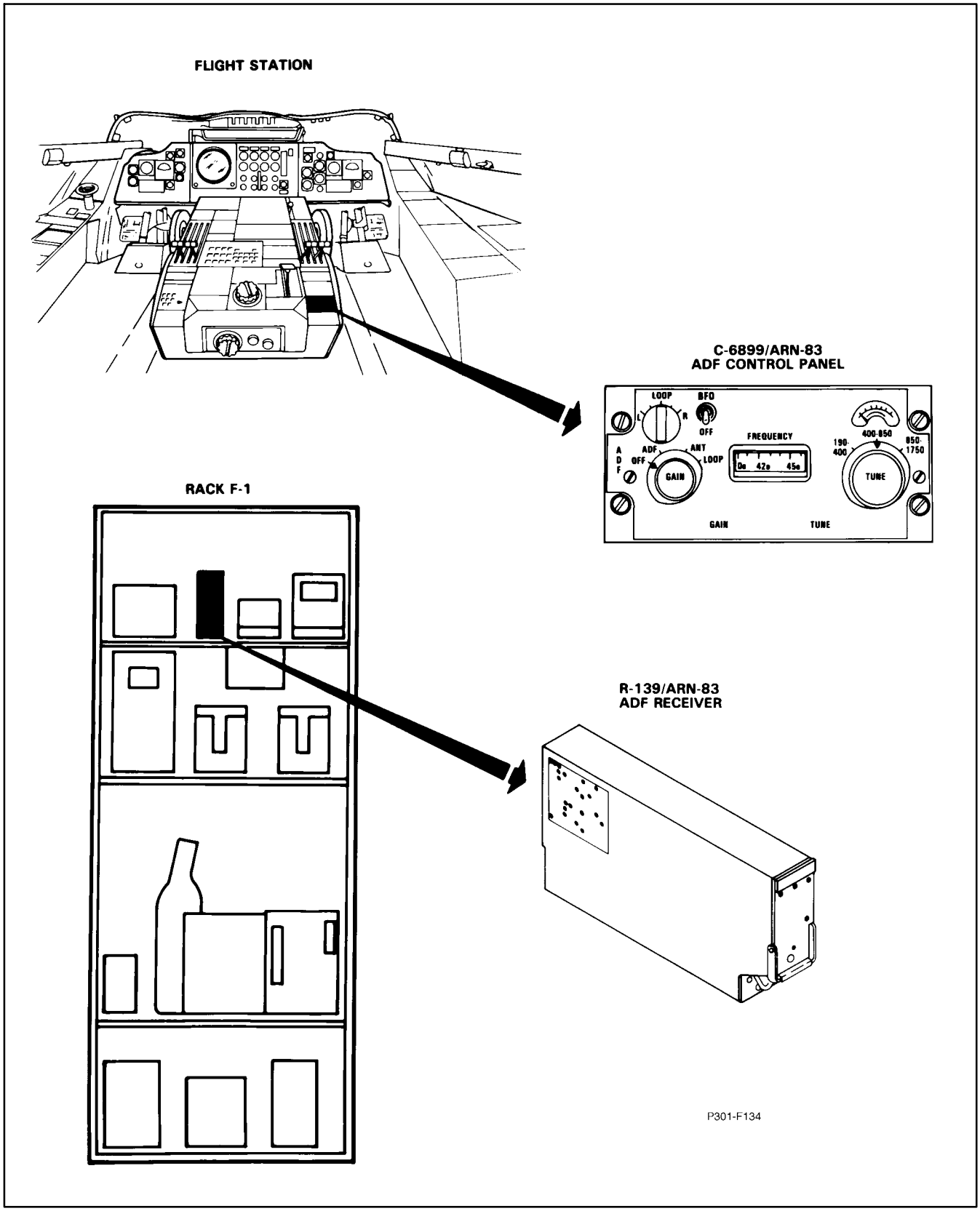


Figure 22-21. TACAN/ADF RNS Component Location (Sheet 2 of 2)

22.4.2.7 RF Switch Relay

The RF switch relay is located in rack C-2 and is installed on all P-3C aircraft. It provides for switching between the TACAN antennas on the top and the bottom of the aircraft fuselage.

22.4.2.8 Antenna Selector Panel

The antenna selector panel is located on the flight station center pedestal and is installed on most P-3 aircraft. There is one switch to select between the top or bottom TACAN antenna.

22.4.2.9 ARN-83 ADF Receiver

The ARN-83 ADF receiver is located in rack F-1 and converts ground radio beacons or commercial broadcast signals into bearings for the HSI displays.

PANEL MARKING	FUNCTION
CHAN	Provides for selection of 126 TACAN channels.
BIT	Initiates the system self-test, a GO or NO GO indicator light to display results.
MODE	Inoperative.
VOL	Controls TACAN receiver audio level.
Mode Switch: OFF REC T/R A/A BCN	Enables reception, transmission-reception, or air-to-air capability. BCN position is not used.

Figure 22-22. ARN-84(V) TACAN Control Panel Markings and Functions

PANEL MARKING	FUNCTION
CHANNEL	Provides for selection and display of 252 channels in two different bands, X and Y.
TEST	Initiates system self-test and indicator will flash at the start. Indicator will remain illuminated if a malfunction occurs during the self-test.
VOL	Controls incoming TACAN audio level.
Mode Switch: OFF REC T/R A/A REC A/A T/R	A five-position switch that enables power, reception, transmission-reception, or two different air-to-air (A/A) capabilities. A/A REC provides bearing to an air-to-air capable aircraft. A/A T/R can provide bearing and distance from an air-to-air capable aircraft.

Figure 22-23. ARN-118(V) TACAN Radio Set Control Panel Markings and Functions

22.4.2.10 ADF Sense Antenna and A-51863/ARN-83 Fixed Loop Antenna

These antennas are mounted on the underside of the fuselage and provide for ADF radio navigation. The ADF sense antenna is connected to a lightning arrestor.

22.4.2.11 ARN-83 ADF Control Panel

The ARN-83 ADF control panel is located on the flight station center pedestal station. Its functions are listed in Figure 22-24.

22.4.2.12 Circuit Breakers

Circuit breakers and power sources for the ARN-84, ARN-118 TACAN systems and the ARN-83 ADF receiver are listed in Figure 22-25.

22.4.3 System Description

The TACAN system enables the pilot, copilot, and NAV/COMM to navigate by using radio signals received from surface-equipped stations. When power is applied to the TACAN system and a surface station selected in the TACAN control panel, the system will receive a reference bearing signal and a variable bearing signal. The TACAN receiver measures the phase difference and converts it into a bearing azimuth. When TR is selected, the transmitter transmits a radio pulse and measures the elapsed time of the signal travel to determine distance information.

PANEL MARKING	FUNCTION
BFO/OFF	In Beat-Frequency Oscillator (BFO), energizes the local oscillator to beat with the incoming beacon or broadcast station signal to produce an audio tone to aid in tuning to the desired station.
TUNE Switch, TUNE Meter	The outer tune knob selects 190 to 400 kHz, 400 to 850 kHz, or 850 to 1750 kHz band. When one of the three bands is selected, the appropriate frequency band is displayed in frequency window. When a station is tuned using the inner tune knob, the tune meter indicates received signal strength.
GAIN	Rotation cw of the inner knob increases the ADF audio level. The outer knob selects OFF, ADF (connected to fixed antenna and the loop antenna), ANT, or LOOP (connected to the loop antenna).
OFF	Removes operating power from the ADF system.
ADF	Enables automatic direction finding utilizing both sense and loop antennas.
ANT	Enables only a receive mode (sense antenna only); no DF information is displayed.
LOOP	Enables the loop antenna to be rotated left or right to manually detect the bearing to a surface station.

Figure 22-24. ARN-83 ADF Control Panel Markings and Functions

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
TACAN SYSTEM: ARN-84, or ARN-118	Forward Electronic	TACAN	MEAC MEDC
	Navigation Interconnection Box	TACAN	26-Vac Sync Excitation
ARN-83 ADF RECEIVER	Forward Electronic	ADF-LF	MDC
	Navigation Interconnection Box	ADF	26-Vac Sync Excitation

Figure 22-25. TACAN-ADF Circuit Breaker Locations and Power Sources

To utilize the air-to-air mode, select a TACAN station 63 channels apart from another air-to-air capable aircraft. The transmitter operates similarly to the TR mode by sending a radio pulse measuring the time elapsed to determine distance. The ARN-84 TACAN can determine distance only in the air-to-air mode.

On aircraft equipped with ARN-118, the TACAN receiver-transmitter can determine bearing (A/A REC) or distance and bearing (A/A TR) with another suitably equipped aircraft. The P-3 does not have the capability to transmit a bearing signal.

The bearing information can be displayed on the HSI when the associated HSI control panel is selected to TACAN. The only air-to-air mode available between P-3s is A/A TR with only DME being displayed. In REC, TR, and A/A TR, the distance information, when available, is always displayed in the DME window on all of the HSIs. The pilot, copilot, NAV/COMM, or TACCO can aurally identify a TACAN ground station by selecting the TACAN REC switchlight on the ICS master control panel. The pilot and copilot have the added flexibility of adjusting the volume on the TACAN control to increase the audio level.

The ADF system control panel enables the pilot or copilot to select a radio beacon or commercial broadcast station for azimuth bearing information. When the ADF mode is selected, the ADF system utilizes the fixed reference antenna and the loop antenna to receive signals that are converted into bearing information by the receiver. The LOOP mode enables the pilot or copilot to manually slew the loop antenna until a null is heard in his headset. The position of the antenna at the aural null is converted into an azimuth bearing for display on the HSIs. The ANT mode disables the automatic circuits and enables clear reception of radio beacon or commercial broadcast stations. There is no bearing information available in the ANT mode. The ADF audio can be monitored by selecting the ADF REC switchlight on any of the four ICS master control panels.

22.4.4 Operating Procedures

22.4.4.1 ARN-84 TACAN Surface Station Operation

1. On the TACAN control panel, turn mode selector to REC and press the BIT switch during preflight (observe a GO status).
2. Select a surface station and aurally identify the station by selecting the TACAN REC switchlight on the ICS master control panel.
3. Select TACAN on the HSI control panel and observe the magnetic bearing.
4. If distance information is desired, select the TR mode.

22.4.4.2 ARN-84 TACAN Air-to-Air Operation

1. On the TACAN control panel, select the A/A mode.
2. Set a station 63 channels apart from the other airborne station.

Note

When the TACAN is utilized in the air-to-air mode of operation with channels 1 to 10 and 116 to 126 selected, an interrogation of the IFF may cause tumbling of the HSI DME window.

3. Observe distance information in the DME window of the HSI.

For TACAN approach procedures, refer to Chapter 18.

22.4.4.3 ARN-118 TACAN Surface Station Operation

1. On the TACAN control panel, select REC on the mode selector and perform the self-test during preflight.
2. Select a channel surface station and aurally identify the station by selecting the TACAN REC switchlight on the ICS master control panel.
3. Select TACAN on the HSI control panel and observe the magnetic bearing.
4. If distance information is desired, select the TR mode.

22.4.4.4 ARN-118 TACAN Air-to-Air Operation

1. On the TACAN control panel, turn the mode selector to A/A TR.
2. Select a station 63 channels apart from the other airborne station.

Note

When TACAN is utilized in the air-to-air mode of operation with channels 1 to 10 and 116 to 126 selected, an interrogation of the IFF may cause tumbling of the DME readout.

3. Observe distance information in the DME window of the HSI.

For TACAN approach procedures, refer to Chapter 18.

22.5 APX-72 IFF

22.5.1 Introduction

The air traffic control radar beacon system/IFF/Mark XII identification system transponder system automatically reports coded identification and altitude signals in response to interrogations from surface (or airborne) stations so stations can identify aircraft control air traffic and maintain vertical separation. The system has five operating modes: 1, 2, 3/A, C, and 4. Modes 1 and 2 are IFF modes, mode 3 (civil mode A) and mode C (automatic altitude reporting) are primarily air traffic control modes, and mode 4 is the secure (encrypted) IFF mode. (Mode 4 is not operational unless the system includes a KIT-1C/TSEC transponder computer.) In addition, the aircraft is equipped with an IFF interrogator set that provides the capability to challenge the identity of objects detected by the radar system.

22.5.2 System Components

The APX-72 IFF system consists of the following equipment:

1. C-6280/APX-72 transponder control (copilot side console).
2. RT-859A/APX-72 receiver-transmitter (rack H-1).
3. TS-1843/APX-72 test set (rack H-2).
4. KIT-1C/TSEC computer.
5. AT-741A antenna.
6. IFF battery power switch (copilot side console).
7. AAU-22/A encoder altimeter.
8. System components and locations are shown in Figure 22-26.

22.5.2.1 C-6280 Transponder Control

Most of the controls for the AIMS transponder system are included on the transponder control panel. The REPLY light and the controls on the left side of the transponder control are used with IFF mode 4. The TEST light and the remaining controls are associated with IFF modes 1, 2, 3/A, and C, except that the MASTER switch controls all modes of operation. Transponder control functions are listed in Figure 22-27.

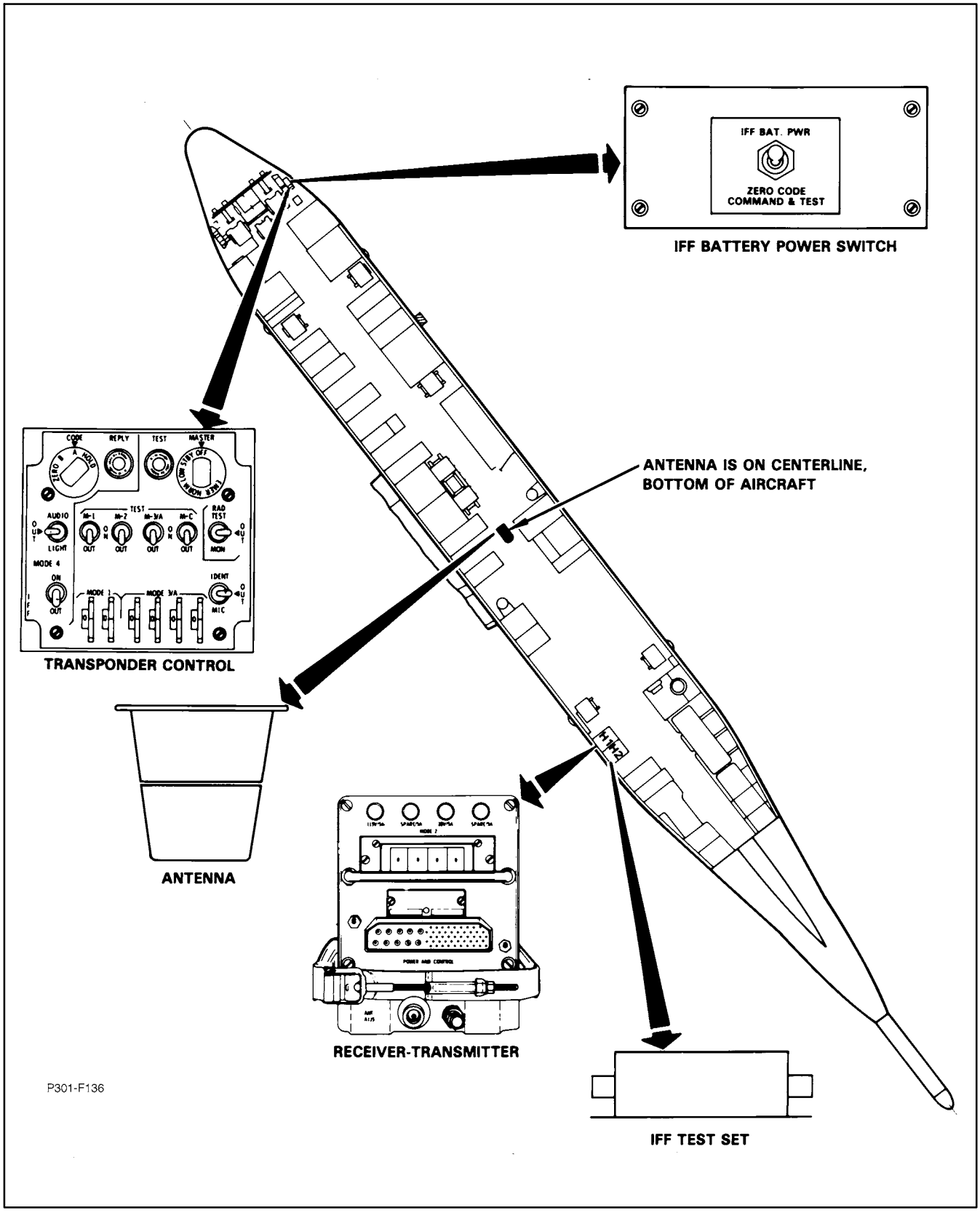


Figure 22-26. APX-72 System Component Locations

PANEL MARKING	FUNCTION
CODE:	
ZERO	Cancels (zeroizes) the mode 4 code settings in transponder and interrogator computers (if installed) when pulled outward and rotated.
B or A	Provides for selection of proper mode 4 code.
HOLD	Spring-loaded position, which allows the automatic zeroize function to be overridden.
REPLY	Illuminates to indicate the generation of valid replies to mode 4 interrogations.
AUDIO-OUT-LIGHT:	
AUDIO	Enables monitoring of both audio and light indications of valid mode 4 interrogations and replies.
OUT	Monitoring of audio and light indications of mode 4 interrogations and replies disabled.
LIGHT	Enables monitoring of only the light indication of valid mode 4 replies.
MODE 4-ON OUT:	
ON	Enables the transponder to reply to mode 4 interrogations.
OUT	Disables mode 4 reply functions.
TEST light	Illuminates when the transponder set correctly responds to mode 1, 2, 3/A, or C test.
MASTER:	
OFF	Turns transponder off.
STBY	Places transponder set in standby (warmup) condition.
LOW	Applies power to transponder set with reduced receiver sensitivity.
NORM	Applies power to transponder set with normal receiver sensitivity.
EMER	Enables automatic transmission of emergency reply signals in all modes. **Note** MASTER switch must be pulled and rotated to effect emergency operation.
TEST	Enables TS-1843/APX test set to locally interrogate the transponder while enabling the transponder to reply. The test set will then measure the characteristics of the reply and illuminate the TEST light when the characteristics of the reply are satisfactory. **Note** • The TEST light may flash once as each mode switch is released from the TEST position, and as the RAD TEST-OUT-MON switch is moved. This is a characteristic of the TS-1843 transponder test set and is meaningless. • The MASTER switch must be set to NORM and the mode switches of the modes not being tested should be out for a proper test.
ON	Enables the transponder set to reply to modes 1, 2, 3/A, and C interrogations.
OUT	Disables reply to modes 1, 2, 3/A, and C interrogations.
RAD TEST-OUT-MON:	
RAD TEST	When interrogated in test mode by external test equipment, the mode 3/A reply must be enabled with this switch for test response. To enable a reply, press the toggle upward and hold as long as is necessary for testing. Normal position is out or centered.
OUT	Disables rad test and monitor functions.
MON	Enables the monitor circuits of TS-1843/APX test set. The TEST light illuminates when replies are transmitted in response to interrogations in any SIF mode.
MODE 1	Selects and indicates the mode 1 two-digit reply code number.
MODE 3/A	Selects and indicates the mode 3/A four-digit reply code number.
IDENT-OUT-MIC:	
IDENT	Initiates identification of position reply for approximately 30 seconds.
OUT	Displays identification of position reply.
MIC	Enables identification of position reply for 30 seconds each time the microphone switch is actuated for a UHF or VHF communication.

Figure 22-27. Transponder Control Panel Markings and Functions

22.5.2.2 RT-859A/APX-72 Receiver-Transmitter

The mode 2 selector switches located on the receiver-transmitter allow selection of 4,096 mode 2 codes.

22.5.2.3 TS-1843 Transponder Test Set

The transponder test set provides the self-test and monitor functions for modes 1, 2, 3/A, and C. The test set accomplishes the self-test functions, when actuated using the TEST switches, by interrogating the transponder and monitoring the replies. The monitor (MON) function, when selected, monitors the replies to external interrogations. The controls for the TS-1843 are included on the transponder control.

22.5.2.4 IFF Caution Light

The IFF caution light is located on the center instrument (vertical annunciator) panel and illuminates to indicate that mode 4 is not operative. The light is operative whenever aircraft power is on and the MASTER switch is not OFF; however, the light will not operate if the KIT-1C/TSEC computer is not physically installed in the aircraft. The IFF caution light illuminates for 3 to 6 seconds each time the transponder is turned on, indicating proper keying and acceptance of mode 4 codes.

Subsequent illumination of the IFF caution light indicates that: 1) the mode 4 codes have zeroized, 2) the self-test function of the KIT-1C/TSEC computer has detected a faulty computer, or 3) the transponder is not replying to proper mode 4 interrogations.

If the IFF caution light illuminates, switch the MASTER switch to NORM (if in STBY) and ensure the mode 4 ON/OUT toggle switch is ON. If illumination continues, employ operationally directed flight procedures for an inoperative mode 4 condition.

22.5.2.5 IFF Battery Power Switch

A small panel containing one spring-loaded toggle switch (placarded IFF BAT. PWR ZERO CODE COMMAND & TEST) is located in the flight station adjacent to the transponder control panel on the copilot side console. This switch, when activated, provides dc control power through a 5-ampere circuit breaker on the FEDC bus to allow for emergency operation of the APX-72 transponder, without MEDC, as long as FEAC is available.

22.5.2.6 Circuit Breakers

Circuit breakers and power sources for APX-72 system components are listed in Figure 22-28.

22.5.3 System Description

22.5.3.1 Mode 4 Operation

Mode 4 operation is selected by placing the MODE 4 ON/OUT toggle switch on the transponder control to ON, provided that the MASTER switch is set to NORM or LOW. Placing the MODE 4 ON/OUT switch to OUT disables mode 4.

The mode 4 CODE switch is placarded ZERO, B, A, and HOLD. The switch must be lifted over a detent to switch to ZERO. It is spring-loaded to return from HOLD to the A position. Position A selects the mode 4 code for the present code period, and position B selects the mode 4 code for the succeeding code period. Both codes are mechanically inserted into the KIT-1C/TSEC transponder computer by a single insertion of the KIK-18/TSEC code changing key. The codes are mechanically held in the KIT-1C/TSEC, regardless of the position of the MASTER switch or the status of the position of the MASTER switch or the status of aircraft power, until the first time the weight is off the wheels. Thereafter, the mode 4 codes automatically zeroize anytime the MASTER switch or the aircraft power is turned off. The code settings can be mechanically retained after the aircraft has landed by turning the CODE switch to HOLD and releasing it at least 15 seconds before the MASTER switch or aircraft power is turned off. The codes again will be held, regardless of the status of the aircraft power or the MASTER switch, until the next time the aircraft is airborne.

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
Transponder Control	Forward Load Center (Upper) Forward Load Center (Lower)	TRANSPONDER IFF PWR CONT TRANSPONDER PWR IFF	MEDC FEAC
Receiver-Transmitter	Forward Load Center (Upper) Forward Load Center (Lower)	TRANSPONDER IFF PWR CONT TRANSPONDER PWR IFF	MEDC FEAC
Test Set	Forward Load Center (Upper)	TRANSPONDER IFF TEST SET	MEDC
KIT-1C/TSEC Computer	Forward Load Center (Upper) Forward Load Center (Lower)	TRANSPONDER IFF PWR CONT TRANSPONDER PWR IFF ZERO IFF	MEDC FEAC FEDC
IFF Battery Power Switch	Forward Load Center (Lower)	TRANSPONDER PWR IFF	FEAC
AAU-2(A) Encoder-Altimeter	Forward Electronic	SERVOED BAROMETRIC ALTIMETER PILOT	MEAC MEDC

Figure 22-28. APX-72 Component Circuit Breaker Locations and Power Switches

The mode 4 codes can be zeroized anytime the aircraft power is on and the MASTER switch is not OFF by turning the CODE switch to ZERO. Mode 4 can be zeroized anytime, with or without electrical power, by pushing the KIT-1C/TSEC zeroized pushbutton.

An audio signal, the C-6280 REPLY light, and the IFF caution light on the vertical pilot annunciator panel are used to monitor mode 4 operation. The AUDIO- OUT-LIGHT switch controls the audio signal and the REPLY light, but not the IFF caution light. In the LIGHT position, the REPLY light illuminates as mode 4 replies are transmitted. In the AUDIO position, an audio tone in the pilot headset indicates that valid mode 4 interrogations are being received and the REPLY light illuminates if mode 4 replies are transmitted. In the OUT position, the audio indications and REPLY light are inoperative and the REPLY light will not press-to-test.

22.6 AN/APX-118 DIGITAL IFF TRANSPONDER SYSTEM (AIRCRAFT INCORPORATING CNS/ATM)

22.6.1 Introduction

The AN/APX-118 IFF (Identification Friend or Foe) transponder system provides all of the Mark XII IFF capabilities of Modes 1, 2, 3/A, C, and 4. In addition, the transponder incorporates Mode S capability. Modes 1 and 2 are military identification modes. Mode 3 (civil Mode A), Mode C (automatic altitude reporting), and Mode S (selective interrogation) are primary Air Traffic Control (ATC) modes. Mode 4 is the secure (encrypted) IFF mode.

The system consists of the following components:

1. AN/APX-118 Receiver-transmitter (rack H-1).
2. CDU-7000 Transponder Control (pilot, copilot, NAV/COMM).
3. Upper and Lower IFF Antenna.

4. IFF Mode 4 Code Hold/Zeroize switch and RAD Test switch (copilot side console).
5. Air Data Display Unit (ADDU) (pilot and copilot).
6. ADDU Master/Slave switch (pilot side console).

22.6.2 System Components

22.6.2.1 AN/APX-118 Receiver-Transmitter (Rack H-1)

The transponder provides identification, altitude, and surveillance reporting in response to challenges from airborne and ground-based interrogators. The transponder obtains pressure altitude data from the Air Data Display Unit (ADDU) for use in the Mode C and Mode S replies. The transponder is considered a Controlled Cryptographic Item (CCI) contains embedded crypto; it is located in the H-1 rack. The KIT-1C is not installed with the APX-118 and performs KIT-1C functions internally to the RT. The APX-118 works in conjunction with the already installed APX-76 interrogation system.

22.6.2.1.1 GO Status LED (Green)

Steady illumination of this LED indicates the IFF transponder is fully operational. The LED is not illuminated: a) during Power-Up Built-In Testing (PUBIT), b) Initiated Built-In Testing (IBIT), c) following a catastrophic power supply fault, d) SBC fault, or e) a bootstrap failure that stalls the program. The LED flashes at predetermined rates to indicate other bootstrap faults, an invalid or missing Operational Flight Program (OFP), and failures detected in an individual Circuit Card Assembly (CCA) during IBIT, Periodic Built-In Test (PBIT), PUBIT, or performance monitoring operations.

22.6.2.1.2 LOW BTRY Fault LED (Red)

Illumination of this LED indicates that the internal crypto backup Battery (BTRY) voltage is low and that batteries should be replaced. This LED can be activated only with primary power applied to the transponder.

CAUTION

Lithium batteries are used in the IFF transponder for the Mode 4 crypto backup power function. Observe all precautions specified by the manufacturer concerning the shipping, handling, storage, and disposal of lithium batteries.

22.6.2.1.3 KEY LOADED LED (Green)

This LED flashes momentarily upon completion of a successful Key fill, regardless of whether primary power is applied to the transponder. This LED indicates that both A and B crypto codes have been loaded.

22.6.2.1.4 APX-118 RT ZEROIZE Switch

Activation of this switch zeroizes the codes stored in the Mode 4 crypto CCA, regardless of whether primary power is applied to the transponder.

22.6.2.2 IFF Control (CDU-7000)

The CDU-7000 is the control panel for the IFF transponder system. The CDU-7000 provides access to the three IFF pages for the selection of the operating modes, data entry, and system status display. Three CDU-7000s are located at the pilot center console, copilot side console, and NAV/COMM station. All three CDU-7000 stations have complete control and access to the IFF functions. Pressing the IFF function button on the CDU-7000 accesses the IFF pages. When accessed, the IFF 1/3 page is displayed. Access to the IFF 2/3 and 3/3 pages is obtained by pressing the Up and Down arrow buttons.

The IFF pages of the CDU-7000 provide control of the Identification Friend or Foe (IFF) transponder. The IFF pages are used to:

1. Enable/disable Modes 1, 2, 3A, C, 4, and S replies.
2. Select IFF STANDBY or NORMAL power.
3. Set Mode 1, Mode 2, Mode 3A, Mode C, and Mode S codes.
4. Select antenna.
5. Set Mode S flight ID (identifier).
6. Select Mode 4 code and reply indication.

22.6.2.2.1 IFF 1/3 Page

The IFF 1/3 page (refer to Figure 22-29) is used to control the operating mode of the APX-118 IFF transceiver. In addition to mode selection, the page allows the following:

1. Entry of mode codes.
2. Selection of antennas.
3. Microphone IDENT enable.
4. Emergency mode enable.
5. Identification selection.



CDU DISPLAY MARKING	FUNCTION
POWER: STBY NORM	 Places transponder set in standby condition. Applies power to transponder and enables the selected modes to function as selected below.
MODE 1,2,3A,C: ON OFF [ ]	 Enables the transponder to reply to Modes 1, 2, 3A, and C interrogations. (Individually selectable) Disables reply to Modes 1, 2, 3A, and C interrogations. Location for entry and display of Mode 1, 2, and 3A codes.
ANTENNA: TOP BOT DIV	 Selects top only antenna for 10 seconds. Selects bottom only antenna for 10 seconds. Selects a diversity mode in which either upper or lower antenna is used. **Note** If TOP or BOT is selected, this selection will persist for approximately 10 seconds and then automatically return to the Diversity mode.
MIC: ON OFF	 Enables identification of position reply for 30 seconds each time the microphone switch is actuated for a UHF or VHF communication. Disables MIC identification function.
EMERGENCY	Enables automatic transmission of emergency reply signals in all modes.
IDENT	Initiates identification of position reply for approximately 30 seconds.

Figure 22-29. IFF 1/3 Page

22.6.2.2.2 IFF 2/3 Page (MODE 4)

The IFF 2/3 page (refer to Figure 22-30) is used to control Mode 4 operation of the APX-118 IFF transceiver. In addition to Mode 4 operation, the page provides the following:

1. Reply selection.
2. RAD TEST selection.
3. Code A/B selection.



CDU DISPLAY MARKING	FUNCTION
MODE 4: ON OFF	 Enables the transponder to reply to Mode 4 interrogations. Disables reply to Mode 4 interrogations.
REPLY: AUD ANN OFF	 Enables monitoring of both audio and light indications of valid Mode 4 interrogations and replies. Enables monitoring of only the “MODE 4 REPLY” CDU annunciation. Monitoring of audio and CDU annunciations disabled.
RAD TEST: ENABLE DISABLE	 Allows the transponder to reply normally when interrogated in Mode 4 by a system with Verify Bit 1 enabled and will not reply to normal valid Mode 4 interrogations. Disables RAD test function.
CODE A / B	 Provides for selection of proper Mode 4 code.

Figure 22-30. IFF 2/3 Page

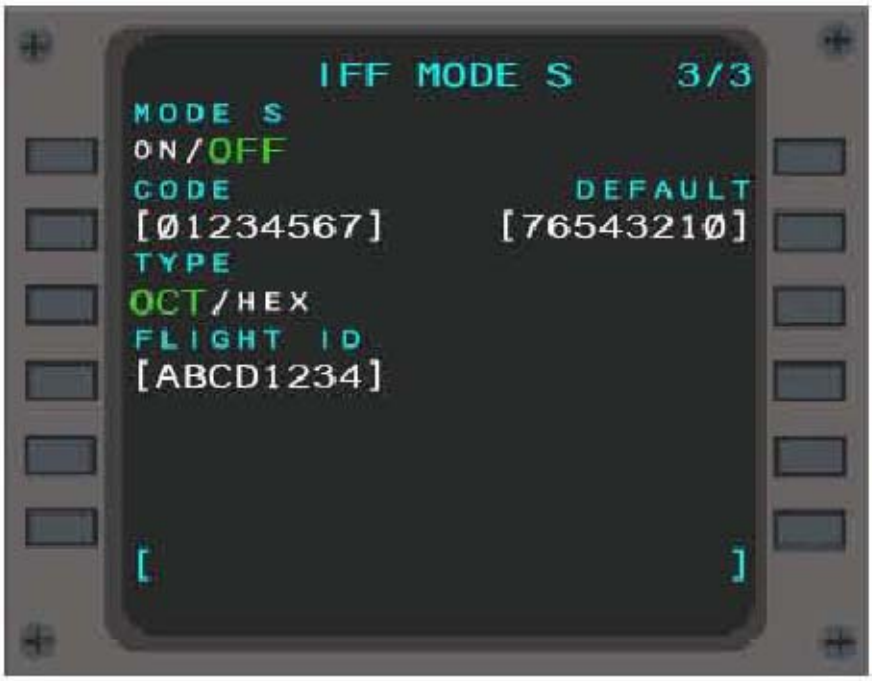
Note

When RAD TEST is set to ENABLED, the transponder will reply normally when interrogated in Mode 4 by a system with Verify Bit 1 enabled and will not reply to normal valid Mode 4 interrogations.

22.6.2.2.3 IFF 3/3 Page (MODE S)

The IFF MODE S 3/3 page (refer to Figure 22-31) is used to control Mode S operation of the APX-118 IFF transceiver. In addition to mode selection, the page allows the entry of the following:

1. Mode codes.
2. Mode code configuration.
3. Flight identification entry.



CDU DISPLAY MARKING	FUNCTION
MODE S: ON OFF	 Enables the transponder to reply to Mode S interrogations. Disables reply to Mode S interrogations.
CODE: [ ]	 Location for entry and display of Mode S code or default Mode S code.
TYPE: OCT HEX	 Allows for operator Mode S code entry in octal format (default). Allows for operator Mode S code entry in Hexadecimal format.
FLIGHT ID: [ ]	 Location for entry and display of the Mode S Flight ID/ Call sign (i.e., VV LL30).

Note

The option highlighted in green on the CDU is the active selection. Unselected options appear in white.

Figure 22-31. IFF MODE S 3/3 Page

The IFF MODE S 3/3 page allows entry of the Mode S Code in either Octal (OCT) or Hexadecimal (HEX). The value can be entered in one of two ways:

1. Toggle the Type to either OCT or HEX and then enter the code as 00000001 to 77777776 (must be eight characters) for OCT or 1 to FFFFFE (leading zeros are optional) for HEX.

2. If the Type is set to OCT, selection of Code with a valid HEX entry followed by an H (e.g.; 2ADF19H) in the scratchpad would change the Type to HEX and enter the Mode S Code.

OCT is the default selection, with Code and Type being stored in short-term nonvolatile memory. The IFF MODE S 3/3 page, with Weight-On-Wheels (WOW) set to ground, has a hidden entry for the default Mode S Code (8-character OCT entry). If WOW is set to air, the hidden entry is not accessible.

To access the hidden default entry, enter “DEFAULT” in the scratchpad and select the right side line key for DEFAULT. Set the default value and remove the hidden entry, type “SET” in the scratchpad, and select the right side line key for DEFAULT.

22.6.2.3 Upper and Lower Antenna

There is both an upper and lower IFF antenna. Accessed through the CDU-7000 IFF 1/3 page, there are three antenna selections available.

1. DIV — Both upper and lower.

2. TOP — Top only.

3. BOT — Bottom only.

The signal processor compares the strength of the received interrogations from the top and bottom receiver channels and makes a Diversity Decision. This decision determines which antenna port should be used to transmit the reply, and a reply modulation signal is generated.

Note

If TOP or BOT is selected, this selection will persist for approximately 10 seconds and then automatically return to the Diversity mode.

22.6.2.4 IFF Mode 4 Code Hold/Zeroize Switch and RAD TEST Switch

On the copilot side console CDU-7000 power panel, there are two additional IFF-related switches. The center switch, Mode 4 Code Hold/Zeroize switch, is a three-position switch. The three positions of the switch are OFF (middle), Mode 4 Zeroize (left), and Mode 4 Code Hold (right). The IFF RAD TEST switch is on the right of the CDU-7000 power panel. This RAD TEST switch is a two-position switch that is spring loaded to OFF. When the RAD TEST switch is held in the ON or enabled position, the switch enables Verify Bit 1 on the APX-76 Interrogator. When this function is enabled and the APX-76 is interrogating in Mode 4, only transponders with RAD TEST enabled will reply.

22.6.2.5 Air Data Display Unit (ADDU) (Pilot and Copilot)

The pilot or the copilot ADDU provides the pressure altitude data and other air data information to the same-side CDU-7000. Whatever CDU-7000 is the bus controller then provides the altitude and air data to the transponder.

22.6.2.6 IFF Caution Light

The IFF caution light is located on the center instrument (vertical annunciator) panel and illuminates to indicate that mode 4 is not operative. The light is operative whenever aircraft power is on and the POWER switch is not OFF. The

IFF caution light illuminates for 3 to 6 seconds each time the transponder is turned on, indicating proper keying and acceptance of mode 4 codes. Subsequent illumination of the IFF caution light indicates that: 1) the mode 4 codes have zeroized, 2) the self-test function of the embedded crypto computer has detected a faulty computer, or 3) the transponder is not replying to proper mode 4 interrogations. If the IFF caution light illuminates, switch the POWER switch to NORM (if in STBY) and ensure that the mode 4 ON/OFF toggle switch is ON. If illumination continues, employ operationally directed flight procedures for an inoperative mode 4 condition.

22.6.2.7 Circuit Breakers

Circuit breakers and power sources for APX-118 systems components are listed in Figure 22-32.

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
CDU-7000 Copilot	Forward Load Center (Lower)	CDU-7000 Pilot	MEDC
CDU-7000 Pilot	Forward Electronic	CDU-7000 Copilot	FEDC
CDU-7000 NAV/COMM	Forward Electronic	CDU-7000 NAV/COMM	MEDC
Receiver-Transmitter	Forward Load Center (Lower)	IFF Power	FEDC
	Forward Load Center (Lower)	Zero IFF	FEDC

Figure 22-32. APX-118 Component Circuit Breaker Locations and Power Switches

22.6.3 System Description

22.6.3.1 Mode 1 Operation

Mode 1 is a non-secure method of identification used exclusively by the military. This four-digit code has the following restrictions for data entry:

1. The first digit must be a number from 0 to 7.
2. The second digit must be a number from 0 to 3.
3. The last two digits are both automatically set to zero.

22.6.3.2 Mode 2 Operation

Mode 2 is used exclusively by the military for tracking. Each digit within the four-digit code may have a value from 0 to 7.

22.6.3.3 Mode 3/A Operation

Mode 3/A is the standard system used by commercial and military aircraft to relay their position to air and ground controllers throughout the world. Each digit within the four-digit code may have any value from 0 to 7.

22.6.3.4 Mode C Operation

The AN/APX-118 transponder has the capability of transmitting altitude information in reply to an interrogation from an input provided by the CDU-7000 via an input from the ADDU. The ADDU converts pitot-static information to an altitude referenced to 29.92 inches Hg. The altitude, in the form of a digital signal, is sent to the transponder for transmission when interrogated.

22.6.3.5 Mode 4 Operation

Mode 4 is for military use only and allows for secure identification of friendly aircraft. The AN/APX-118 automatically generates a reply code in response to a valid Mode 4 interrogation when Mode 4 is enabled and the crypto keys are loaded.

22.6.3.6 Mode S Operation

The Mode S (Selective interrogation) is a civil ATC system that reduces the number of unwanted IFF replies. Each aircraft is assigned a permanent, unique 24-bit default Mode S address, which allows ATC to direct interrogations and data messages to the desired aircraft. This platform is capable of Mode S level II Elementary and Enhanced mode responses, which allows the transponder to reply to interrogations including information such as the aircraft Mode S address, Mode C altitude, aircraft ID (call sign), and flight status. The following parameters need to be verified/entered prior to flight for valid Mode S operation:

1. Mode S address.

Note

Each aircraft has a specific Mode S code.

2. Aircraft ID (call sign) is inputted.

The transponder transmits the following Mode S parameters:

1. Magnetic heading.
2. Indicated airspeed.
3. Mach number.
4. Vertical rate.
5. Roll angle.
6. Track angle rate.
7. True track angle.
8. Groundspeed.
9. Selected altitude.

22.6.3.7 APX-118 Power Up

1. Press IDX button.
2. LLS1 (Left Line Select) <START INIT>.
3. RLS5 (Right Line Select) <POWER>.
4. LLS2 <IFF> to ON.

22.6.3.8 Preflight

1. Press IFF button.
2. On the IFF 1/3 page, enter codes for Modes 1, 2, 3A.
3. Turn ON or OFF Modes as desired.

4. Page down to the IFF 2/3 page.
5. Turn Mode 4 ON or OFF as desired.
6. Page down to the IFF 3/3 page.
7. Set Mode S ON or OFF as desired.
8. Verify BuNo specific Mode S code is correct; if incorrect, maintenance action is required.
9. If required, enter mission-specific Mode S code.
10. Enter ATC call sign (i.e., VVLL30) in the “flight ID” line.

22.6.3.9 Normal Operations

1. Press IFF.
2. Verify proper codes.
3. Select STBY or NORM (as required).

22.6.3.10 IDENT

1. Press IFF.
2. RLS5 <IDENT>.

Note

There is no IFF Reply light; however, Mode 4 interrogation is indicated by MODE 4 REPLY annunciation on the CDU-7000 scratchpad.

22.6.3.11 Power Off/Zeroize

1. Zeroize Mode 4 if loaded.
   a. On the copilot CDU-7000 power panel, move the Code Hold/Zeroize switch to the Zeroize position.
2. Power OFF IFF.
   a. Press IDX button.
   b. LLS1 <START INIT>.
   c. RLS6 <POWER>.
   d. LLS2 <IFF> Toggle IFF to OFF (press again to confirm).

22.6.3.12 Loading MODE 4

Cryptographic codes are loaded into the transponder set Mode 4 crypto computer via the J5 front panel connector using an approved loading device. A green light will blink on the RT when the codes are loaded. On the IFF status page, the KIT status will display GO when Mode 4 is turned on and Mode 4 keys are loaded.

22.7 AN/ARN-151(V) GLOBAL POSITIONING SYSTEM

22.7.1 Introduction

The AN/ARN-151(V) Global Positioning System (GPS) is a space-based radio positioning navigation and time-transfer system designed to provide users with worldwide, all-weather precise position, velocity, and time information. The GPS provides two levels of positioning accuracy: the Standard Positioning Service (SPS) and the Precise Positioning Service (PPS). The SPS is available to any GPS user, military or civilian, by means of any GPS receiver. The PPS is available only to U.S. military users, NATO military users, and other military and civilian users as determined by the Department of Defense (DoD). The PPS is implemented with Selective Availability (SA) and Anti-Spoofing (AS) features. SA denies the unauthorized real-time use of the PPS accuracy, whereas AS prevents hostile spoofing of the PPS signals. Cryptographic measures are integral to SA/AS; therefore, users of the PPS require the cryptographic key (referred to as the Precision "P" code or "SA/AS" code) to access the PPS. The PPS can provide extremely accurate three-dimensional positioning to within 16 meters, horizontal positioning within 5 to 8 meters, and coordinated universal system time to better than 100 nanoseconds.

Note

Per OPNAVINST 3710.7 series, the ARN-151 GPS is a suitable external fixing source in VMC only. The ARN-151 GPS does not have integrity monitoring capability and therefore shall be considered a supplemental navigational fixing source to be used for tactical positioning and as an aid to monitor the primary navigation sources during VMC only. Refer to squadron/wing standard operating procedures and site-specific directives for further minimum navigational requirements.

The AN/ARN-151 GPS only interfaces with the AN/ASN-179 INS, providing two-way communication between both systems. The GPS uses INS position, velocity, heading, and attitude to speed initialization, reduce satellite loss of lock-time after turns, and improve jamming resistance. The INS, under operator control, may use the GPS to perform an In-Flight Alignment (IFA) or for automatic position, velocity, and bias updating in the NAV mode.

22.7.2 System Components

22.7.2.1 Control Display Navigation Unit (CDNU)

Refer to Figure 22-33, Sheet 1 of 2, and Figure 22-34. Located at the NAV/COMM, pilot, and copilot stations, these units provide the control, display, processing, and operator interface capabilities of the GPS. All three CDNUs are identical and provide the means of applying primary power to the system. The CDNU performs the navigational computations, builds the page displays, and provides subsystem communication, control, and background Built-In Test (BIT). All data and solutions are shared among the CDNUs via a digital data bus. The first CDNU to be powered "on" is designated as the "Bus Controller"; however, all functions and orders may be performed on any of the CDNUs.

22.7.2.2 GPS Receiver

Refer to Figure 22-33. Located in rack C-2, this unit routes the received GPS timing signals from the antenna to the CDNUs for processing.

22.7.2.3 Mission Data Loader (MDL)

Located in rack C-2, this unit provides storage of several databases for use by the CDNUs and insertion of updated information to the CDNUs' memory from the Data Transfer Module (DTM). The MDL contains a Flight Plan database of up to 50 waypoints. A Primary Identifier database with a maximum of 20,004 waypoints may be loaded from a Tactical Automated Mission Planning System (TAMPS) terminal. A Reversionary Identifier database with up to 200 predefined waypoints may be operator-loaded into the CDNUs' non-volatile memories.

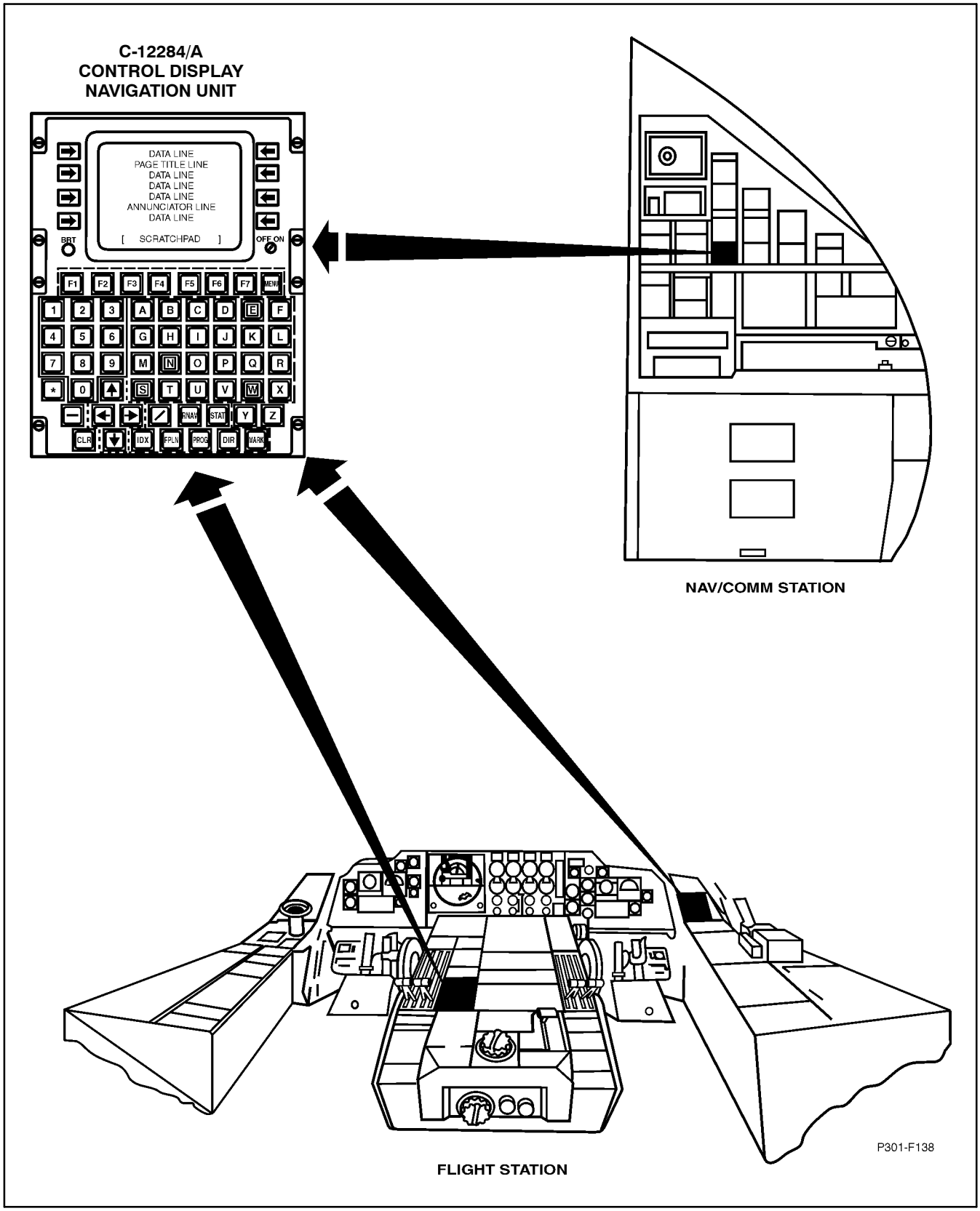


Figure 22-33. GPS System Components (Sheet 1 of 2)

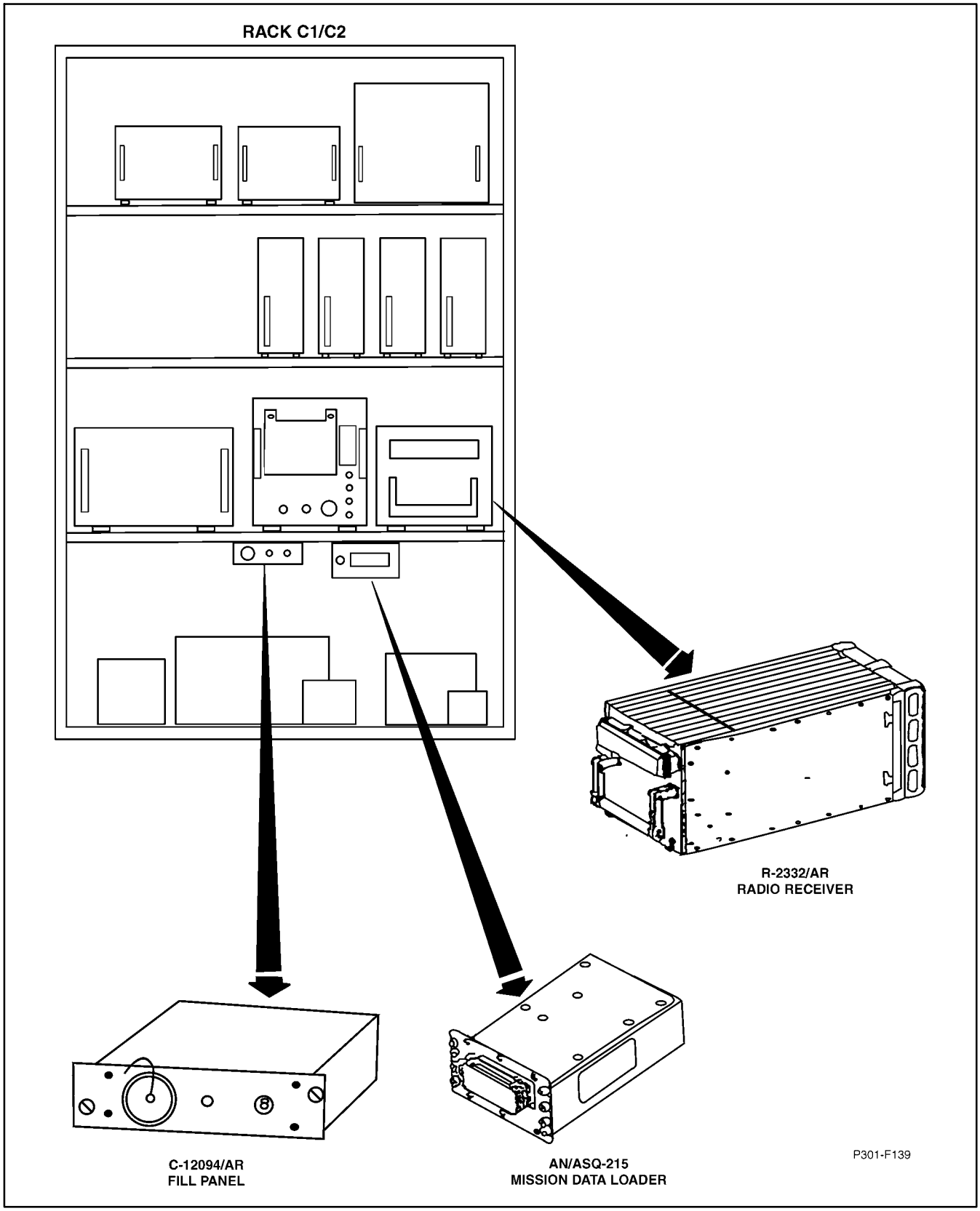


Figure 22-33. GPS System Components (Sheet 2 of 2)

(This information can be stored if power is secured and the DTM is removed.) A Magnetic Variation database is transferred automatically from the DTM to the CDNUs if it is more recent than the existing database. The MDL also contains an Air Almanac database, which automatically updates the various satellite positions and tracks for use by the GPS receiver. Future upgrades will allow for a 12 separate Flight Plan capability of up to 50 waypoints each.

22.7.2.4 Data Transfer Module

This unit facilitates the temporary storage and transfer of Flight Plan data, Primary Identifier waypoints, Reversionary Identifier waypoints, Magnetic Variation, and Air Almanac data from a TAMPS terminal to the GPS via the Mission Data Loader.

22.7.2.5 GPS KYK-13 Fill Panel

Located in rack C-2, this unit facilitates loading of the "P" code via a KYK-13 in order to access the SA/AS capabilities and improved accuracy of the PPS.

22.7.2.6 GPS Antenna

Located on the upper fuselage centerline of the aircraft between the HF radio long-wire antennas, the GPS antenna receives the various satellite timing signals and routes them via the antenna preamplifier to the receiver. Since positioning is based on signal reception timing, the position displayed on the CDNUs is the position of the antenna, not that of the receiver or respective CDNU.

22.7.2.6.1 Antenna Preamplifier

Located in the overhead adjacent to Sensor Station-2, this unit amplifies the signals received by the antenna and routes them to the receiver for processing.

22.7.3 System Initialization and Operating Procedures

For detailed GPS operating procedures, refer to the AN/ARN-151(V) Satellite Signals Navigation Set GPS Job Aid.

22.7.4 System Preflight

WARNING

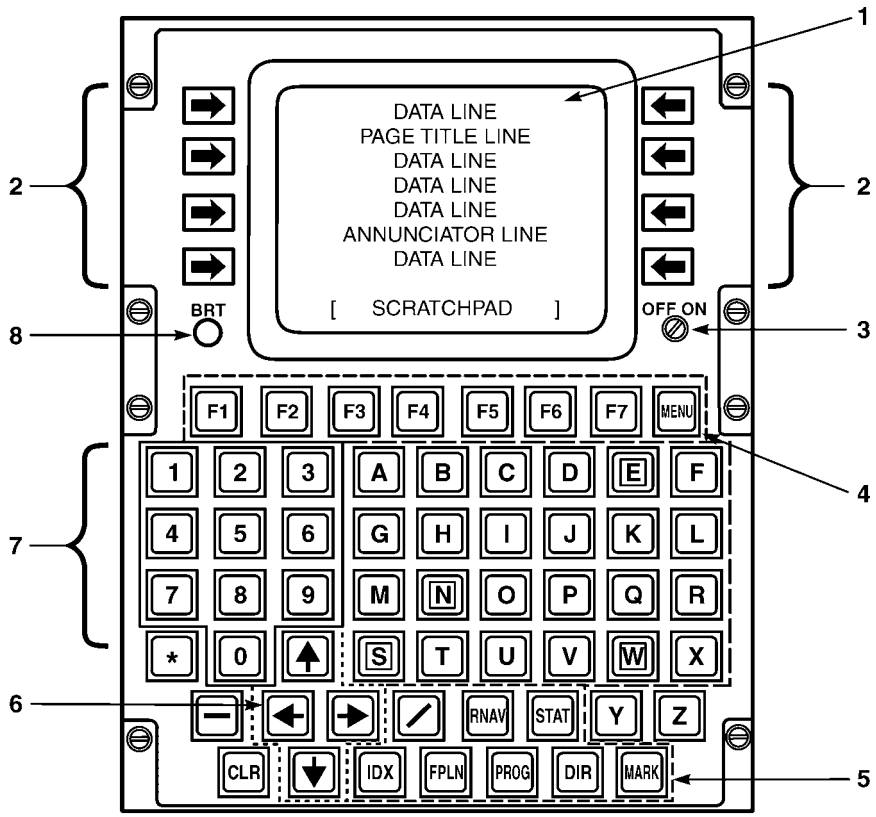
Applying power to the AN/ARN-151 GPS system in a hangar or in any other manner that may prevent signal reception may result in corruption of GPS receiver data in the Non-Volatile Memory (NVM), possibly causing navigational errors. These errors are typically indicated by discontinuous jumps in position displayed in the navigational display unit.

If the receiver data are corrupted, the system retains the corruption until the battery is removed. If a suspect receiver is corrupted, the following procedures are recommended to clear its non-volatile memory.

1. Remove the AN/ARN-151 receiver battery for at least 60 seconds using appropriate procedures from the receiver and aircraft maintenance manuals.
2. Position aircraft to ensure signal reception when power is reapplied to the receiver.
3. Load GPS almanac data with the data loader or allow the receiver to download the almanac data from GPS satellites, which may take up to 2 hours, depending on location.

Note

The first CDNU to be turned on will be the Bus Controller (BC) CDNU, and the others will be Remote Terminal (RT) CDNUs.



INDEX NO.	NAME	FUNCTION
1	CRT DISPLAY	Displays data, status, and fault information on seven lines. Line eight (SCRATCHPAD) is used to display instructions being entered by operator.
2	LINE SELECT KEYS	Initiates function displayed adjacent to key and displays new data associated with selected function.
3	ON-OFF CONTROL	Turns unit on and off. Also turns on backlighting behind keys when external 0 to 5 volts is available.
4	SPECIAL FUNCTION KEYS	Keys can be preprogrammed to permit initiating infrequently used operations.
5	STANDARD FUNCTION KEYS	Preprogrammed to provide access to frequently used functions.
6	ARROW KEYS	Allows operator to scroll lines or pages of data on CRT display.
7	DATA INPUT KEYS	Alphanumeric keys that allow operator to enter data or instructions into the CDNU.
8	BRIGHTNESS CONTROL	Controls intensity of data displayed on the CRT.

Figure 22-34. CDNU Operating Controls and Indicators

Power up GPS as follows:

1. CDNU1 (pilot), 2 (copilot), 3 (NAV/COMM).
   a. Turn knob to ON (approximately 20-second automatic BIT initiated, screen blank during BIT). Then "SELF TEST" Pages displayed. Once self-test is complete, CDNU will default to last page displayed prior to securing power in the CDNU.
   b. Adjust display intensity as required.
2. Continuous BIT Check.
   a. Depress Status (STAT) key on any CDNU; verify GO displayed for all applicable systems and there are no "STATUS" indications for any system.

Note

Nonapplicable systems will have a NOGO status. Nonapplicable systems are Signal Data Converter (SDC), Digital-to-Analog Converter (DAC), and Automatic Drift Control (ADC).

   b. If there is a "STATUS" indication, press the Line Select Key adjacent to that system.
      (1) If a NOGO-A or NOGO-B is displayed, refer to 1553 Bus Coupler Fault Isolation Procedures (NAV/COMM CSMM-GPS, [AFC-597 incorporated]).
      (2) NOGO-T displayed indicates that the Weapons Replaceable Assembly (WRA) is not communicating on either Bus. Check connections to that WRA, and ensure WRA is properly powered/wired.

The GPS is automatically initialized once power is applied to any one of the three CDNUs and START is selected on the index page. A minimum of four satellites is required in order to provide a valid three-dimensional "NAV" solution. If less than four satellites are available, the GPS will DR using INS position, velocity, heading, and attitude until satellite reacquisition occurs. If no INS data are available, the GPS will DR using operator-entered heading, airspeed, and wind estimates. In this case, significant errors can accumulate as time progresses.

Note

Satellite acquisition that results in a valid "NAV" solution (i.e., no "FAIL" alert on the "STATUS" line of the CDNU) should occur within 5 minutes; however, if the batteries were replaced and valid Air Almanac data were not reloaded, acquisition could take longer than 20 minutes.

22.7.4.1 GPS Crypto "P" Code Loading

Access to the SA/AS capabilities and improved accuracy of the PPS is accomplished only by loading of the "P" code via a KYK-13.

Note

- Current OPNAVINST 3710.7 series policy is to operate all crypto-capable GPS receivers in the PPS only. The AN/ARN-151 GPS has been tested and approved for operation in the PPS mode of operation only.
- AN/ARN-151 GPS is not authorized for use as the primary, supplemental, or sole means of air navigation for instrument flight in controlled airspace.

1. Connect KYK-13 to the GPS KYK-13 Fill Panel.
2. Select proper register and turn the KYK-13 to ON.
3. Lift the Fill Panel toggle switch to the LOAD position and release. Both the red light on the Fill Panel and the KYK-13 will flash.

4. Turn the KYK-13 to OFF and remove from the Fill Panel.
5. Verify the status of the "P" code via the SA/AS page of the ZEROIZE page on the CDNU.
   a. Depress IDX key on CDNU.
   b. Depress Line Select key #2 — ZEROIZE.
   c. Depress Line Select key #7 — GPS.

The following should be present on the SA/AS Page: DAYS [001]. [ZERO KEYS] is displayed on line #5. [STORAGE CODES] is displayed on line #7. This may take several minutes.

Note

Absence of any of the above indicates the "P" code is not properly loaded. Perform reload.

6. On the RNAV page #2, the FOM will drop below "4" (usually drops to "1"), and the EHE could drop as low as 5 to 8 meters. This may take several minutes.
   a. Depress RNAV key on CDNU.
   b. Depress Lateral Scroll key (→) to page #2.

WARNING

Due to an internal software programming error, failure to reinitialize the GPS after loading/reloading the "P" code may result in significant navigation error. This GPS navigation solution, if not reinitialized after loading the "P" code, has been observed to drift in excess of 40 nm while still indicating a FOM of "1."

7. Reinitialize GPS.
   a. Select IDX key on CDNU.
   b. Access GPS Start Page with Line Select key 1.
   c. Press Line Select key 1.

22.7.4.2 GPS Crypto "P" Code Zeroizing

Securing power to the CDNU will not zeroize the "P" code. Erase the "P" code as follows:

1. Depress IDX key on CDNU.
2. Depress Line Select key #2 — ZEROIZE.
3. Depress Line Select key #7 — GPS.
4. Depress Line Select key #7 — ZERO KEYS. Observe [CONFIRM ZERO KEYS] on "Scratchpad."
5. Depress Line Select key #7 again. Verify DAYS [000] on line #5 and SAFE KEYS on left side of line #6. If NO KEYS ZERO is displayed on line #6, code has not been erased. Perform zeroize procedures again.

22.7.4.3 Error Detection

The GPS includes a Continuous Built-In Test (CBIT). In the event the operator either uses an improper procedure for data entry or inputs unreasonable data, an Annunciation/Error message appears in the Scratchpad, line #8. If the system detects a failure of one or more of the WRAs, an Annunciation/Error message will appear in the Annunciation/Error Line, line #6. Figure 22-35 indicates the meaning and proper action for each Annunciation/Error message.

22.7.5 Portable GPS Units

In addition to the ARN-151 GPS, Portable Global Positioning Systems cleared for use aboard the P-3 include the Trimble Trimpak, PSN-11, and ARNAV 5000. Portable GPS units shall be considered a supplemental navigational source to be used for tactical positioning and as an aid to monitor the primary navigational sources during VMC only. Operators of portable systems should be thoroughly familiar with the associated user manuals.

WARNING

- During PSN-11 operation, when the receiver is connected to an external power source, the internal BA-5800/U lithium battery shall not be installed.
- Lithium batteries may explode with external power applied, possibly causing injury to personnel.

CAUTION

To minimize the possibility of battery failure, PSN-11s containing alkaline batteries shall not be connected to external power.

22.8 MISSION SYSTEMS (AIP/BMUP)

This section provides an overview of the systems that have been installed as new systems or modified and installed as a part of the P-3 ASuW Improvement Program (AIP) and Block Modification Upgrade Program (BMUP).

22.9 INTERCOMMUNICATION SYSTEM

22.9.1 Introduction

The AN/AIC-41 Intercommunication System (ICS) is installed in AIP aircraft to provide intercommunications functions for crewmembers. The pilot, copilot, and TACCO-operated Public Address (PA) line and radio receiving facilities are provided at each crew station. In addition, radio transmitting facilities are provided for the pilot, copilot, TACCO, and NAV/COMM. Audio monitor circuits are provided for special purpose equipment.

Communication switching is controlled by a data switch and a digital bus interface.

Key						
LOC: Location	**BLK: Blinking**	**NC: Not Correctable**	**MA: Master Alert**			
S = Scratchpad L = Left half Annun. Ln R = Right half Annun. Ln	B = Blinks N = Not blinking A = Alternates with entry data	✓if not correctable	✓if Master Alert			
Annunciation	**Meaning**	**Correction**	**LO**	**BL**	**NC**	**MA**
✓ALTITUDE	Barometric altitude from MADC is no longer valid.	Clear key.	L	B		
✓GPS POWER	Attempt to operate GPS with power disabled on Power Page.	Clear key.	S	A		
✓GPS STATUS	Attempt to operation of GPS when GPS indicates it has identified an internal failure.	Clear key.	S	A		
✓MDL STATUS	Attempted display or operation cannot be performed due to failure of MDL.	Clear key.	S	A		
✓STATUS	Deselected failure of a WRA or its interface.	Clear key or STAT key. **Note** Can be disabled on WRA detailed status page.	R	B		✓
✓WIND	Computed wind is no longer valid due to loss of sensors.	Clear key.	L	B		
CONFIRM ERASE FPLN	Request to erase flight plan.	Clear key, reselect function.	S	B		
CONFIRM ERASE WPTS	Request to zeroize CDNU waypoints.	Clear key, reselect function.	S	B		
CONFIRM LOAD ALM	Request to load GPS almanac data.	Clear key, reselect function.	S	B		
CONFIRM LOAD FPLN	Request to load flight plan.	Clear key, reselect function.	S	B		
CONFIRM LOAD OFP	Request to load Operation Flight Program (OFP).	Clear key, reselect function.	S	B		
CONFIRM LOAD WPTS	Request to load CDNU local waypoint database.	Clear key, reselect function.	S	B		
CONFIRM ZERO ALL	Request to zeroize all CDNUs, GPS, and MDL.	Clear key, reselect function.	S	B		
CONFIRM ZERO CDNU	Request to zeroize CDNU total RAM and NVM.	Clear key, reselect function.	S	B		
CONFIRM ZERO MDL	Request to zeroize MDL cartridge data.	Clear key, reselect function.	S	B		
CONFIRM ZERO KEYS	Request to zeroize GPS keys.	Clear key, reselect function.	S	B		
COPY WHAT?	Request to copy waypoint data.	Clear key.	S	N		
DATA FOR?	Request to access Waypoint Data page.	Clear key.	S	N		
ENTER MDL ADDRESS	Attempt to operate MDL before bus terminal address is entered.	Clear key.	S	N		
ENTER TIME	On power up if GPS time is not available and crew has not entered, also if bus control switch with GPS time not valid.	Clear key, entry of time, or return to valid GPS time.	L	N		
Error	Attempt to insert scratchpad data that do not pass format or range tests, attempt to make an invalid insert or select function when insufficient data have been entered.	Clear key or selecting a line key for which entry is allowed.	S	A		
ERROR CRS CHG>90	Attempt to apply course edit greater than 90° from the current inbound course.	Clear key.	S	A		

Figure 22-35. Annunciation/Error Messages (Sheet 1 of 2)

Key						
LOC: Location	**BLK: Blinking**	**NC: Not Correctable**	**MA: Master Alert**			
S = Scratchpad L = Left half Annun. Ln R = Right half Annun. Ln	B = Blinks N = Not blinking A = Alternates with entry data	✓if not correctable	✓if Master Alert			
Annunciation	**Meaning**	**Correction**	**LO**	**BL**	**NC**	**MA**
FLIGHT PLAN FULL	Attempt to insert more than 50 points into flight plan.	Clear key.	S	A		
FREEZE	Freeze mode engaged.	Deselecting freeze function.	L	B	✓	
GROUND TEST ONLY	Attempt to initiate prohibited tests while in flight.	Clear key.	S	B		
hh:mm:ss	System clock time.	Deselect clock display.	R	N	✓	
HOLD AT?	Holding pattern has been selected for insert into flight plan.	Clear key or valid insert.	S	N		
INSERT INTERCEPT #	Intercept number # has been selected for insert into flight plan.	Clear key or valid insert.	S	N		
INTERCEPT IS ACTIVE	Attempt to delete intercept that is active waypoint from the flight plan.	Clear key.	S	B		
INVLD APP	EHE greater than allowable levels while in en route flight mode.	Clear key or decrease of EHE below threshold.	R	B		✓
INVLD ENR	EHE greater than allowable levels while in approach flight mode.	Clear key or decrease of EHE below threshold.	R	B		✓
INVLD TRM	EHE greater than allowable levels while in terminal flight mode.	Clear key or decrease of EHE below threshold.	R	B		✓
KEY ALERT	GPS SA/AS keys will expire in 2 hours.	Clear key or entry of new keys passing time test.	R	B		
LOAD FAIL	Failure to successfully pass data from the MDL.	Clear key.	R	N		
MDL IN USE	Attempting to access MDL while being used by another CDNU.	Clear key.	S	A		
NAME IN USE	Attempt to attach user-defined label whose name is already in use in the flight plan or in the mark list.	Clear key.	S	A		
NAV FAIL	No valid navigation mode.	Upgrade to valid nav mode.	L	N	✓	✓
NEED KEY	Insufficient GPS SA/AS keys for mission duration.	Clear key or entry of keys sufficient for mission duration or shortening mission duration to fit keys available.	R	B		
NO INTERCEPT SOLN	Attempt to insert intercept when no solution can be computed.	Clear key or valid intercept solution.	S	B		
NO KEYS ZERO	Failure to zeroize GPS SA/AS keys.	Clear key or subsequent successful clear of keys.	L	B		
NOT IN DATABASE	Entry is not found in database.	Clear key.	S	A		
OFFSET	Parallel offset is applied.	Offset canceled.	L	N	✓	
OFFSET CNCLD	Parallel offset canceled automatically by CDNU.	Clear key.	L	B		✓
SAFE KEYS	GPS SA/AS keys zeroized.	Clear key.	L	N		
VERSION ERR	Detected CSCI incompatibility.	Resets only when all versions are identical.	L	N	✓	✓
WRONG KEY	Incorrect SA/AS key received.	Clear key or entry of correct key.	R	B		

Figure 22-35. Annunciation/Error Messages (Sheet 2 of 2)

22.9.2 System Components

22.9.2.1 C-12452/AIC-41 Flight Digital Crew Interface (FDCI) Panel

Note

The NAV/COMM Tactical Common Data Link (TCDL) switch panel TCDL CLEAR-SECURE switch determines the clear/secure indication and status of the Communications Data Link System (CDLS). Pressing the FDCI C/S pushbutton does not change the clear/secure indication or status of the CDLS.

Each panel contains switch-indicators, two dual-purpose volume controls, and one volume indicator. Refer to Figures 22-36 and 22-37.

WARNING

A maximum of one Digital Crew Interface (DCI) shall be installed in the flight station for any flight. Additionally, if the DCI replacement results in the loss of ICS at the TACCO, NAV/COMM, or SS-3 position (i.e., swap conducted in flight or during single aircraft DET OPS), consideration shall be given to the impact of a loss of ICS at the operator station affected by the removal of a DCI. Alternative communication means shall be established for MOSA reporting and emergency procedures execution.

Note

The DCI located at the TACCO, NAV/COMM, or SS-3 position may be installed in the flight station as a replacement for a nonfunctioning FDCI. This abnormal operation of the ICS system should only be considered when a functioning FDCI is not available locally and shall only be conducted with the permission of the commanding officer. With a DCI installed as a replacement for an FDCI, the affected station loses backlighting, single switch PA/override capability, and, if installed on the pilot side, record capability.

22.9.2.1.1 FDCI Bypass Switches

Two red guarded switches are located forward of the pilot and copilot FDCI Panels. The pilot's bypass switch will bypass the FDCI, Data Switch, Digital Bus, and Digital Audio Interface (DAI) Converter and directly connect the pilot jackbox to the UHF-1 Radio. The copilot's bypass switch performs the same functions except connects the copilot jackbox to the VHF Radio.

22.9.2.1.2 Pilot Record Capability

The pilot can select radio receiver and transmitter audio along with normal ICS audio to be recorded on the acoustic recorder. A green Light Emitting Diode (LED) on the Recorder (RCDR) switch-indicator advises the pilot that the acoustic recorder is operating, recording ICS ALL, and is available for recording pilot headset audio. An amber LED advises the pilot that the acoustic recorder is operating and is recording pilot headset audio. The copilot FDCI panel RCDR switch-indicator is nonfunctional.

Note

- If the pilot has selected the RCDR LED amber, only the pilot headset audio will be recorded. If the pilot should also select ICS disconnect, no ICS will be recorded. In addition, when the pilot selects secure communications (red LED on a radio XMIT switch-indicator) and keys the microphone, no ICS will be recorded for the duration of the transmission.
- The pilot shall ensure the RCDR LED is selected amber at all times the mission tape system is operating.

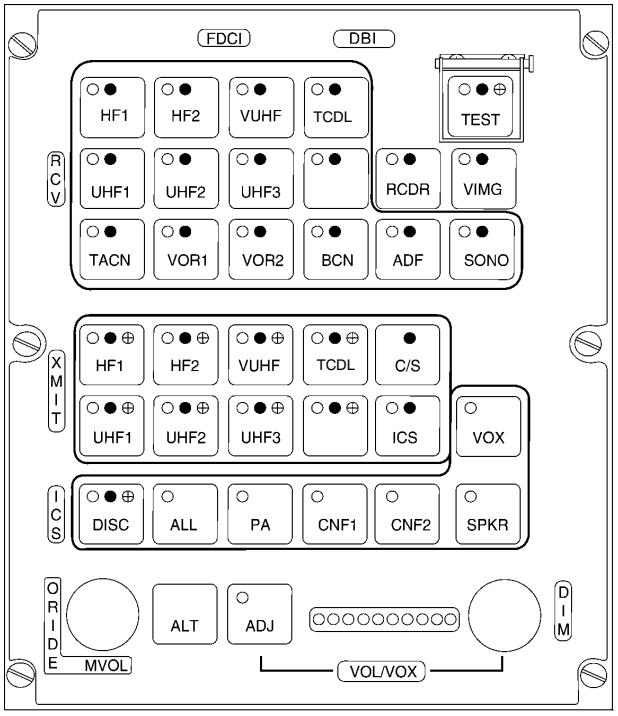


Figure 22-36. C-12452/AIC-41 Pilot/Copilot FDCI Panel

PANEL MARKING	FDCI PANEL PUSHBUTTON FUNCTIONS
RCV: HF1, HF2, VUHF, TCDL, UHF1, UHF2, UHF3, TACN, VOR1, VOR2, BCN, ADF, SONO	Receiver (RCV) group pushbuttons provide receive only audio selection. Press to select radio. 1. Any combination of radios can be selected. 2. GREEN LED = Power is ON and receiver is available for selection. 3. AMBER LED = Receiver selected. 4. ALL LEDs dark = Source is OFF or unavailable.
DBI	Illuminated RED = FDCI self-test (initial power up), USR BIT test, or FDCI failure (NO-GO). DBI indicator dark = FDCI GO.
TEST	Provides visual GO/NO-GO status. Guarded pushbutton prevents accidental activation. When pressed, initiates FDCI self-test. FDCI self-test locks out the unit. **WARNING** FDCI self-test lasts approximately 1 minute. No radio communications are possible from this station during the test with the exception of UHF-1 and VHF by using the pilot and copilot bypass switches. 1. AMBER LED = Self-test selected. 2. GREEN LED = GO (no failures detected). 3. RED LED = NO-GO (failure detected).
RCDR	Recorder (RCDR) permits the pilot to select headset audio for recording on the acoustic recorder. 1. GREEN LED = Acoustic recorder available for recording headset audio — ICS ALL being recorded. 2. AMBER LED = Pilot headset audio is being recorded.
VIMG	Video Imaging (VIMG) pushbutton activates video imaging mode of UHF1. 1. GREEN LED = UHF1 video imaging is available (secure voice or SATCOM is selected on the UHF1 control panel). 2. AMBER LED = UHF1 video imaging selected.
XMIT: HF1 HF2 VUHF TCDL UHF1 UHF2 UHF3 C/S	Transmitter (XMIT) group pushbuttons provide Transmit/Receive (T/R) audio selection. 1. Only one radio can be selected for T/R at a time. 2. Any radio in T/R, when another is selected for T/R, reverts to the previous mode selected (R or available). 3. When transmitting on a secure radio, all clear and intercom audio will be blocked from monitoring for the duration of the transmission. 4. GREEN LED = available for T/R selection. 5. GREEN LED dark = radio not available. 6. AMBER LED = selected for T/R. 7. RED LED illuminated = in secure mode. 8. RED LED dark = in clear mode.
C/S	C/S pushbutton: 1. GREEN LED = radio (which has the capability for clear and secure voice) is selected for T/R. 2. When pushed, radio currently in transmit toggles its clear/secure status. **Note** The NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch determines the clear/secure indication and status of the Communications Data Link System (CDLS). Pressing the FDCI C/S pushbutton does not change the clear/secure indication or status of the CDLS.

Figure 22-37. C-12452/AIC-41 Pilot/Copilot FDCI, Panel Markings and Functions (Sheet 1 of 3)

PANEL MARKING	FDCI PANEL PUSHBUTTON FUNCTIONS
ICS	ICS pushbutton selects between radio and intercom when using the hand-held microphone Push-to-Talk (PTT). 1. AMBER LED = hand-held microphone and control wheel microphone switch (XMTR or ICS) are intercom transmit only. 2. GREEN LED = hand-held microphone and control wheel microphone switch (XMTR) are radio transmit.
ICS:	ICS group pushbuttons select intercom networks and activate/deactivate the disconnect and speaker functions.
DISC	Disconnect (DISC) allows pilot/copilot to stop receiving audio from intercom networks. 1. Can be overridden by selecting the Override (ORIDE) function. 2. Disconnect interlock provided so pilot and copilot cannot disconnect at the same time. Pilot has DISC priority. Pilot selects DISC, copilot amber and green LEDs are off. 3. GREEN LED = available. 4. AMBER LED = selected. 5. RED LED illuminated = a crewmember has selected DISC. 6. RED LED dark = no crewmember has selected DISC. **Note** If pilot or copilot selects DISC and paired station selects ALT, no ICS will be heard in either headset.
ALL PA CNF1 CNF2 SPKR VOX	1. When selected, the LED on the following pushbuttons illuminates amber. Provides talk and listen capability between all stations. When deselected, ALL always reverts to a listen only mode. 2. Public Address (PA) provides transmission to aircraft speakers and all station headsets (independent of other selections including ICS DISC). PA audio requires PTT. 3. Conference 1 (CNF1) provides talk and listen capability among those stations that have selected CNF1. This selection also provides a listen only capability to the ALL channel. 4. Conference 2 (CNF2) provides talk and listen capability among those stations that have selected CNF2. This selection also provides a listen only capability to the ALL channel. 5. Speaker (SPKR) allows headset audio to be heard over the local speaker at the selecting station. When selected, speaker audio is inhibited if any secure radio audio is being monitored in that operator's headset or if VOX is selected. 6. Voice Activated Switch (VOX) is used for intercom only (ALL, CNF1, CNF2).
ALT	Allows pilot to monitor copilot headset audio in the event of a pilot FDCI failure, or the copilot to monitor pilot headset audio in the event of a copilot FDCI failure. Selection of ALT mode inhibits radio transmissions from the selected station. ICS transmission while in ALT mode is accomplished through the use of the pilot/copilot yoke switch, the hand-held microphone, or VOX. **Note** The ALT switch does not illuminate in either state. ALT mode selection is indicated by a lack of illuminated RCV indicators on the FDCI. XMIT indicators will remain illuminated.

Figure 22-37. C-12452/AIC-41 Pilot/Copilot FDCI, Panel Markings and Functions (Sheet 2 of 3)

PANEL MARKING	FDCI PANEL PUSHBUTTON FUNCTIONS
VOL/VOX	The Volume/Voice Activated Switch (VOL/VOX) adjustment group consists of the adjust (ADJ) pushbutton, the RCV and ICS pushbuttons, and the VOL/VOX/DIM knob. This group allows individual asset volume adjustment, VOX sensitivity adjustment, and LED intensity adjustment. Adjustments made as follows: 1. Press ADJ (LED illuminates amber, all other LEDs go dark). 2. Select asset to adjust and press pushbutton (e.g., HF1 receiver — LED illuminates amber). 3. Rotate VOL/VOX knob to desired setting (as knob turns clockwise, LEDs to the right of the ADJ pushbutton illuminate, indicating audio level). 4. Select asset to adjust and press pushbutton (e.g., VOX — HF1 LED goes dark, VOX LED illuminates amber). 5. Rotate VOL/VOX knob to desired setting (as knob turns clockwise, LEDs to the right of the ADJ pushbutton illuminate, indicating audio level). 6. Select and adjust additional assets as required. To terminate adjustments: 1. Press ADJ (LED goes dark, all other LEDs on the panel revert to their previous state). 2. LEDs to the right of the ADJ pushbutton represent the volume associated with the asset last selected. LED lighting adjustment is made by pulling the VOL/VOX/DIM knob and rotating the knob. Lighting level is indicated by the LEDs to the right of the ADJ pushbutton.
MVOL/ORIDE	Master Volume (MVOL) knob provides volume control of all incoming audio. When the MVOL knob is pulled and held, the Override (ORIDE) function is enabled. This places the unit in a hot microphone condition, which allows the crewmember to communicate with other crewmembers on the currently selected override net, even if other crewmembers have DISC selected. The message is received at a high fixed volume by all crewmembers in the system. When the MVOL knob is released, the circuit returns to the normal (not override) position.
Pushbutton indicator lights: ● (GREEN LED) = Available. ○ (AMBER LED) = Selected. ⊕ (RED LED dark) = Clear. ⊕ (RED LED illuminated) = Secure. All LEDs dark = Source not available for selection. Test Switch Failure Status: ○ (AMBER LED) = Self-test selected. ● (GREEN LED) = GO (no failure detected). ⊕ (RED LED) = NO-GO (failure detected).	

Figure 22-37. C-12452/AIC-41 Pilot/Copilot FDCI, Panel Markings and Functions (Sheet 3 of 3)

22.9.2.2 C-12450/AIC-41 Liquid Crystal Display (LCD) Digital Crew Interface (DCI) Panel

This panel is installed at the TACCO, NAV/COMM, and SS-3 stations. Each panel contains four three-position toggle switches, a master volume control, and two display readout areas with five multifunction control knobs for each display readout area. Refer to Figures 22-38, 22-39, 22-40, 22-41, 22-42, 22-43, 22-44, 22-45, 22-46, 22-47, 22-48, 22-49, 22-50, and 22-51.

22.9.2.3 C-12451/AIC-41 Crew Station Control (CSC) Panel

This panel is installed at the flight engineer station, acoustic operator stations 1 and 2, aft observers, ordnance, and galley stations. The CSC panels are identical. Refer to Figure 22-52.

22.9.2.4 SA-2726/AIC-41 Data Switch

This box is located in rack C-1/C-2. It provides switching between communications peripherals as controlled by the DCIs.

22.9.2.5 CV-4304/AIC-41 Digital Bus Interface (DBI) Converter

This box is located in rack C-1/C-2. It provides an interface between the DCIs via the 1553 data bus to the data switch for digital-to-digital conversion.

22.9.2.6 CV-4303/AIC-41 Digital Audio Interface (DAI) Converter

There are three DAIs located in rack C-1/C-2. They provide an interface between incoming radio signals and the 1553 data bus, and between the digital signals and the DCIs for analog-to-digital and digital-to-analog conversion.

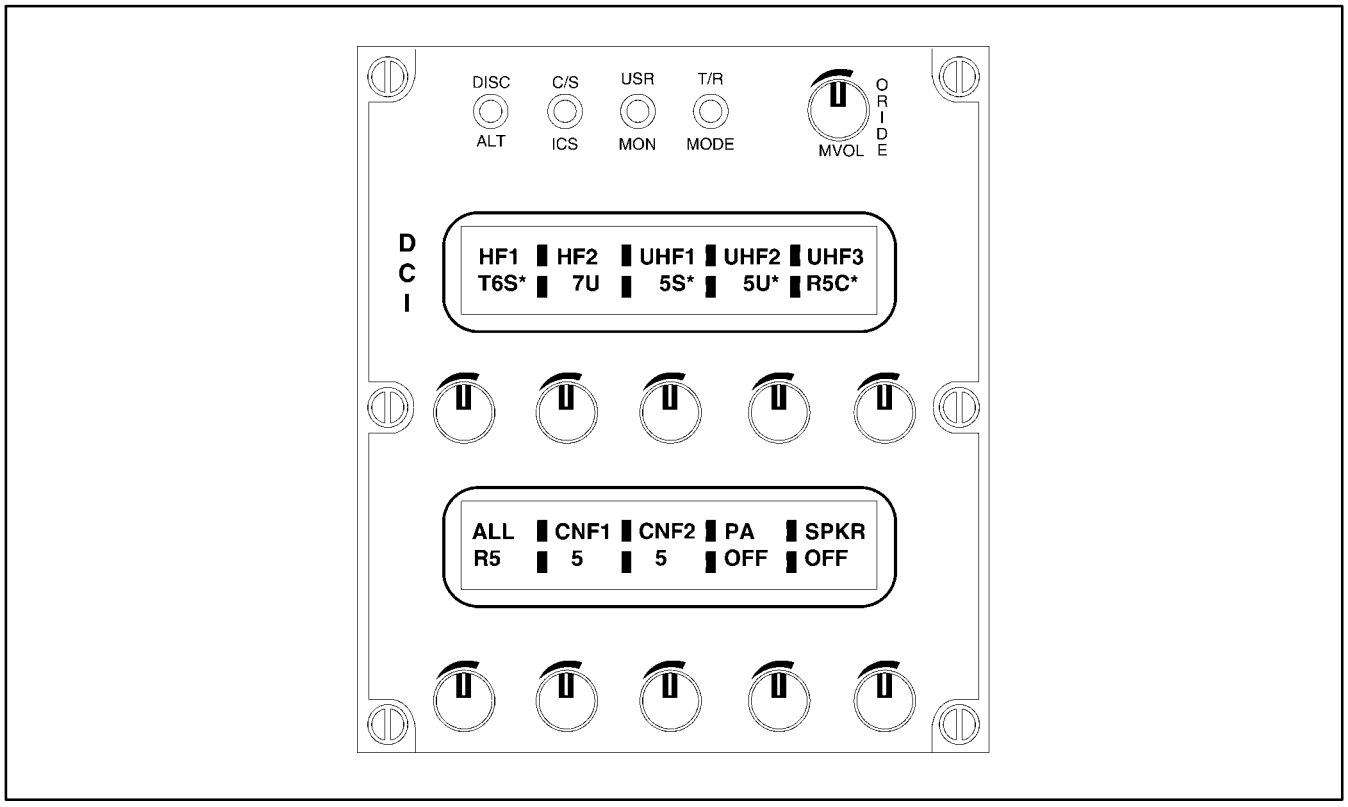


Figure 22-38. C-12450/AIC-41 TACCO, NAV/COMM, SS-3 LCD DCI Panel

22.9.2.7 CU-2570/AIC-41 Bus Coupler (BC)

There are nine BCs in the system. Four are located in rack C-1/C-2: three for the DAI, one for the DBI. Two are located under the copilot's seat: one for the pilot DCI panel and one for the copilot DCI panel. The remaining three are in the TACCO, NAV/COMM, and SS-3 electronics bays for the appropriate DCI panel. The BCs couple the DCIs, DBI, and DAIs to the 1553 data bus.

22.9.2.8 AM-7534/AIC-41 Amplifier-Loudspeaker

There are ten loudspeaker assemblies installed. They are located at the pilot, copilot, TACCO, NAV/COMM, nonacoustic operator station, between acoustic operator stations, three in the ordnance area, and one in the galley. The output volume control adjusts speaker and PA volume.

22.9.2.9 J-6309/AIC-41 ICS Amplifier Interconnection Jackbox (JB)

This box is located at each ICS station in the aircraft. There are three receptacles that allow connection of (1) a hand-held microphone, (2) a headset, and (3) a standard Navy headset with a boom mike. Use of either the hand-held microphone or headset receptacles will inhibit transmission from the boom mike attached to the standard Navy headset of that jackbox. All internal JBs are identical. Their purpose is to connect the operator to the ICS for both audio output to a headset and audio input by either a hand-held or boom mike.

22.9.2.10 J-6310/AIC-41 Auxiliary (Aux) ICS Amplifier Interconnection Jackbox (JB)

This box is located at the two external ICS stations (nose wheelwell and aft radome). The Aux JB allows communication on the ICS ALL circuit only.

22.9.3 System Description

The ICS provides the aircrew with a means to communicate within the aircraft and, through selections on the DCI panels, with outside stations. There are four independent ICS lines provided for interaircraft communications: ICS ALL, Conference 1 (CNF1), Conference 2 (CNF2), and Public Address (PA).

Note

Communication over the ICS PA line is only available at the pilot, copilot, and TACCO stations. ICS PA audio is sent to the headsets and loudspeakers at the remaining stations. TACCO station PA audio is not provided to the pilot or copilot speakers. Pilot and copilot stations can send to all other stations.

The ICS also provides the tie-in between the radio and radio navigation systems for audio monitoring at any ICS station and for two-way communications from the pilot, copilot, TACCO, or NAV/COMM DCI panel. Switch selections on the pilot, copilot, TACCO, and NAV/COMM DCI panels allow secure communications.

22.9.4 Operating Procedures

The ICS is energized whenever power is applied to the aircraft.

Note

Due to an impedance mismatch, the selection of VOX may damage the microphones of any headset other than the standard Navy headset.

Failure of either the Data Switch, Digital Bus Interface, or Digital Audio Interface (DAI) Converter can render the FDCI and/or DCI inoperative, and the pilot and copilot will be unable to select any radio for communications. If normal communications are lost for any reason, the pilot and copilot should select FDCI bypass and reattempt radio communications.

Use of either the hand-held microphone or headset receptacles of an ICS Jackbox disables transmission from a standard Navy headset and boom mike connected to that ICS Jackbox. Provided the smoke mask switch is enabled, the smoke mask will work normally with the hand-held or headset receptacles in use.

WARNING

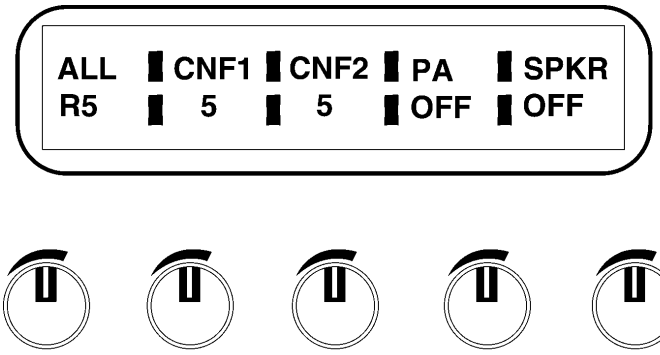
When transmission from a standard Navy headset or flightcrew helmet is required, the crewmember shall remove the plugs from the other two receptacles.

PANEL MARKING	TOGGLE SWITCHES AND SWITCH-KNOB FUNCTIONS
DISC-ALT	Disconnect (DISC): up (locked) position disconnects crewmember from receiving audio from internal intercom networks, except PA and OVERRIDE. Disconnect interlock provided so TACCO and NAV/COMM cannot disconnect at the same time. NAV/COMM has DISC priority. Center position returns all audio reception paths to their previous state. Alternate (ALT): down (locked) position provides TACCO and NAV/COMM the ability to hear the other's headset audio in the event that his LCD DCI has failed (SS-3 ALT switch is nonfunctional). **Note** If TACCO or NAV/COMM selects DISC and paired station selects ALT, no ICS will be heard in either headset.
C/S-ICS	Clear/Secure (C/S): up (momentary) position toggles the clear/secure status of a radio currently selected for transmit. If a secure radio is being keyed, a "secure" to "clear" radio change command is ignored. **Note** The NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch determines the clear/secure indication and status of the CDLS. Toggling the DCI C/S-ICS switch to C/S does not change the clear/secure indication or status of the CDLS. Spring-loaded to center position. ICS: down (momentary) position displays ICS menu on lower display (Figure 22-40). This function enables the operator to select intercom networks and to activate or deactivate the PA and speaker functions.
USR-MON	User (USR): up (momentary) position accesses special functions of the system. USR menu is displayed on both the upper and lower displays (Figures 22-42 and 22-44). Spring-loaded to center position. Monitor (MON): down (momentary) position displays MON menu on lower display (Figure 22-46).
T/R-MODE	Transmit/Receive (T/R): up (momentary) position displays T/R menu on upper display (Figure 22-48) and mode menu on lower display (Figure 22-50). Spring-loaded to center position. MODE: down (momentary) position displays MODE menu on lower display (Figure 22-50).

Figure 22-39. C-12450/AIC-41 TACCO, NAV/COMM, SS-3 LCD DCI, Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	TOGGLE SWITCHES AND SWITCH-KNOB FUNCTIONS
MVOL/ORIDE	Master Volume (MVOL) provides volume control of all incoming audio. When MVOL knob is pulled and held, Override (ORIDE) function is enabled, which allows the crewmembers to communicate with other crewmembers on the currently selected override net without using Push-To-Talk (PTT). The message is received at a high fixed volume by all crewmembers in the system. When the MVOL knob is released, the circuit returns to normal (not override).
Switch-Knobs	Functions for each window are controlled by the switch-knob located directly below each window. These knobs (depending on the window) are used to obtain transmit/receive, receive only, off, on, mode selection, or volume control capability by pulling, pushing, or turning the knob.
Upper row: T/R USR	For the upper row of knobs: 1. Pull for transmit/receive selection, pull a second time to deselect. 2. Rotate for individual volume control. 3. Push for receive only selection, push a second time to deselect. 4. Pull to initiate test.
Lower row: ICS MON MODE USR	For the lower row of knobs: 1. Pull for transmit/receive or ON selection, pull a second time to deselect or OFF. 2. Rotate for individual volume control. 3. Push for receive only selection, push a second time to deselect. 4. Rotate for individual volume control. (Provides mode selection for radio asset in associated upper window.) 1. Turn for mode selection. A new mode is displayed for 3 seconds. Pull within 3 seconds to set the new mode. 2. Rotate for CSC auxiliary selection. 3. Pull to select an audio source ON, pull a second time to deselect or OFF.

Figure 22-39. C-12450/AIC-41 TACCO, NAV/COMM, SS-3 LCD DCI, Panel Markings and Functions (Sheet 2 of 2)

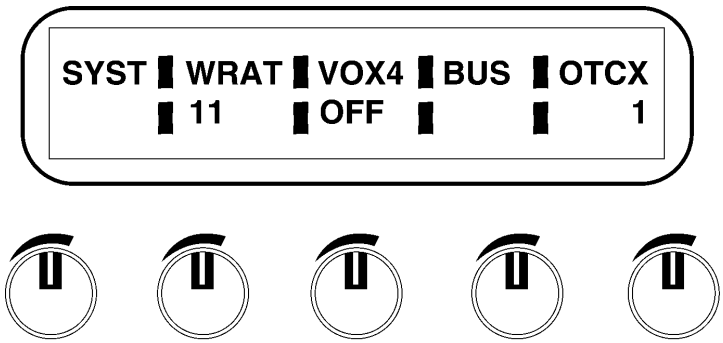


SWITCH-KNOB	LOWER DISPLAY SWITCH-KNOB FUNCTIONS
ICS network switch-knobs	Each ICS network (ALL, CNF1, CNF2) is controlled by the switch-knob directly below the window and is used to obtain transmit/receive, off, or volume control capability for intercom communication. 1. Pull for transmit/receive selection. Rotate for individual volume control. **Note** Whether ALL, CNF1, or CNF2 is selected for transmit or receive, receive for the ALL network cannot be deselected. Even if all three networks are deselected, the ALL network will still be received. Like the radios, only one network at a time can be selected for transmit.
PA	Public Address (PA) allows the pilot, copilot, and TACCO to transmit to the aircraft speakers and all user station headsets (independent of other selections including ICS disconnect). 1. Pull to turn PA ON. To talk, depress PTT on microphone. Pull to turn PA OFF.
SPKR	Speaker (SPKR) enables headset audio to be heard over the selecting station loudspeaker. 1. Pull to turn SPKR ON, pull again to turn SPKR OFF. **Note** If speaker is selected ON, speaker audio is inhibited if any secure radio is being monitored in the headset or if VOX is selected.

Figure 22-40. ICS Page Lower Display Switch-Knob Functions

ICS Page Window Numbers	Window Format	Alpha Designation	Description
6-ALL 7-CNF1 8-CNF2	AAAA BCDE	AAAA	4 character ICS network nomenclature. ALL CNF1 CNF2
		B	Transmit/Receive Status. T = Transmit/Receive selected. R = Receive selected. Blank = not selected.
		C	Received volume level. 0…9 for individual volume level.
		D	A “D” in this position in the ALL window indicates to the TACCO that the NAV/COMM is in the ICS disconnect mode. This position is not used in other ICS windows.
		E	An “X” in this position in the ALL window indicates that any crewmember is in the intercom disconnect mode. This position is not used in other ICS windows.
9-PA 10-SPKR	AAAA BBBC	AAAA	PA in window 9, SPKR in window 10. **Note** PA is at TACCO position only. NAV/COMM and SS-3 window 9 is SPKR, window 10 is blank.
		BBB	Displays OFF or ON.
		C	Always blank.

Figure 22-41. ICS Page Lower Display Menu Options

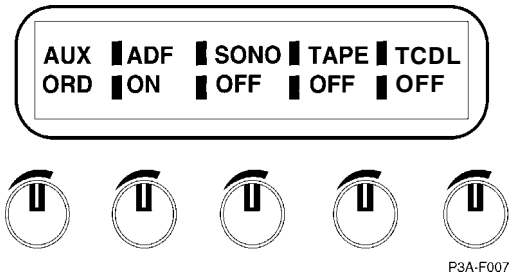


SWITCH-KNOB	UPPER DISPLAY SWITCH-KNOB FUNCTIONS
USR switch-knobs	Upper display used for Built-In Test (BIT) (Refer to Crew Station Manual (CSM) Part 2) and VOX selection. Each window selection, Windows 1, 2, 3, 4, and 5, is controlled by the switch-knob directly below the window. Window 1 selects system test and indicates test results. Window 2 indicates test selection or test results. Window 3 displays the VOX noise ambient level control setting and status or indicates test results. Window 4 selects BUS test or indicates test results. Window 5 selects between Officer in Tactical Command Information Exchange System (OTCIXS) 1 and 2 or indicates test results. 1. Rotate for volume control (Window 3). 2. Pull to initiate test, select between buses or systems, or to turn ON/OFF.
SYST	System Test (SYST) provides the capability of testing the entire ICS system. **WARNING** System Test lasts approximately 2 to 5 minutes. No radio communications are possible during the test with the exception of UHF-1 and VHF by using the pilot and copilot bypass switches. 1. Pull to initiate test. Tests results will be indicated in Windows 1 through 5.
WRAT	Weapons Replaceable Assembly Self Test (WRAT) provides the capability to test individual assemblies. 1. Pull to initiate test. Test results will be indicated in Windows 2 through 5.
VOX	VOX is a voice-activated hot microphone with an adjustable threshold. A setting of 1 is the most sensitive to voice activation and a setting of 10 is the least sensitive to voice activation. 1. Rotate to adjust for noise ambient. 2. Pull to turn ON/OFF.
BUS	BUS provides the capability of testing BUS 1 and BUS 2. 1. Pull to initiate test. Test results will be indicated in Windows 1 and 2.
OTCX	OTCX (OTCIXS) provides the capability of selecting between system 1 and 2. 1. Pull to toggle between OTCX 1 and 2. **Note** Selection of OTCX 2 will inhibit OTCIXS transmission and reception.

Figure 22-42. USR Page Upper Display Switch-Knob Functions

USR Page Window Numbers	Window Format	Alpha Designation	Description
1-SYST	AAAA BBBC	AAAA	Four character system selection: SYST
		BBB	Three character test result: OK or 001…999
		C	Always blank
2-WRAT	ABCD EEFF	ABCD	Test selection: WRAT
		ABC	Test result: BUS
		ABCD	Test result: A = "T" — 1553 BUS Tap B = "1…2" — Tap # CD = "1…35" — WRA #
		EEFF	Test result: 0001…0128
		EE	Test result/WRA # OK or 1…35
		FF	WRA #/BUS #: 1…35 1 or 2
3-VOX	AAAB CCCD	AAA	Function selection: VOX
		B	Volume indication: 0…9
		CCC	Displays ON or OFF
		D	Always blank
4-BUS	AAAB CCCC	AAA	Test selection/test result: BUS/CRC
		B	Always blank
		CCCC	Test results: 0001…0128
5-OTCX	ABCD BBBC	ABCD	OTCIXS selection: OTCX
		ABC	Test result: ACT
		CD	Test result (WRA #): 1…35
		BBBC	Test result: 0001…0128
		C	System selection: 1…2

Figure 22-43. USR Page Upper Display Menu Options

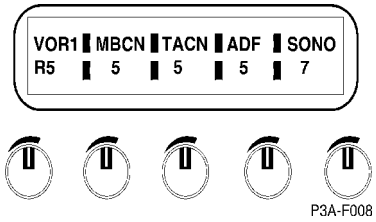


SWITCH-KNOB	LOWER DISPLAY SWITCH-KNOB FUNCTIONS
USR switch-knobs	Window 6 indicates the CSC station selected. Windows 7, 8, 9, and 10 indicate the auxiliary audio selection for the Window 6 CSC station. Each audio selection is controlled by the switch-knob located directly below the window and is used to select the CSC and turn selections ON/OFF. 1. Rotate for CSC station. 2. Pull to turn ON. 3. Pull a second time for OFF.
CSC select	Provides capability to select CSC station. 1. Rotate knob for CSC station.
ADF	Automatic Direction Finder (ADF) provides the capability to monitor the ADF audio at the selected CSC. 1. Pull to turn audio ON. 2. Pull to turn audio OFF.
SONO	Sonobuoy (SONO) provides the capability to monitor sonobuoy audio at the selected CSC. 1. Pull to turn audio ON. 2. Pull to turn audio OFF.
TAPE	TAPE provides the capability to monitor taped sonobuoy audio at the SS-1 and SS-2 stations. Monitor of VTR replay audio unavailable at Starboard Observer (SOBS) station. 1. Pull to turn audio ON. 2. Pull to turn audio OFF.
TCDL	Tactical Common Data Link (TCDL) provides the capability to monitor CDLS audio at the selected CSC. 1. Pull to turn audio ON. 2. Pull to turn audio OFF. **Note** If the NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch is in the SECURE position, no CDLS audio (speaker/headset) will be heard at the CSC stations.

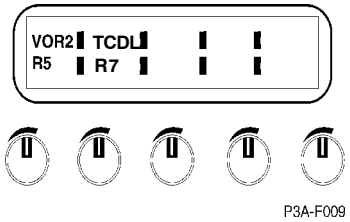
Figure 22-44. USR Page Lower Display Switch-Knob Functions

USR Page Window Numbers	Window Format	Alpha Designation	Description
6-AUX	AAAB CCCC	AAA	Three character CSC selection: AUX
		B	Always blank
		CCCC	Four character CSC station: ORD SS-1 SS-2 FE POBS (Port Observer) SOBS (Starboard Observer) GALL (Galley)
7-ADF 8-SONO 9-TAPE 10–TCDL	AAAA BBBC	AAAA	Window 7 = ADF Window 8 = SONO Window 9 = TAPE (SS-1, SS-2, & SOBS only) Window 10 = TCDL
		BBB	Displays OFF or ON.
		C	Always blank

Figure 22-45. USR Page Lower Display Menu Options



MON 1st Page Lower Display



MON 2nd Page Lower Display

SWITCH-KNOB	LOWER DISPLAY SWITCH-KNOB FUNCTIONS
MON switch-knobs	Each monitor (MON) asset is controlled by the switch-knob located directly below its window and is used to obtain receive only, off, or volume control capability. 1. Push for receive only selection. 2. Rotate for individual volume control. 3. Push a second time to deselect.

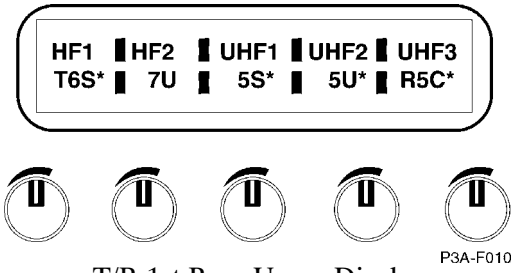
Note

Since more than five assets are involved (VOR2, TCDL), momentarily placing the MON toggle switch in the down position obtains the undisplayed assets.

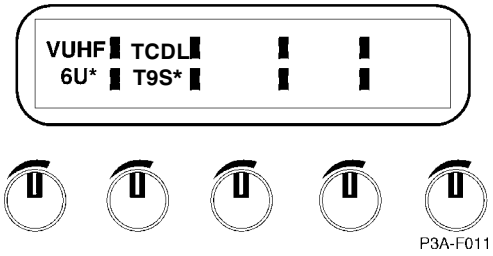
Figure 22-46. MON Page Lower Display Switch-Knob Functions

MON Page Window Numbers	MON Page Window Format	Alpha Designation	Description
6 thru 10	AAAB CDEE	AAA	MON Asset Name: VOR: VHF Omnidirectional Range MBCN: Marker Beacon TACN: TACAN ADF: Automatic Direction Finding SONO: Sonobuoy ESM: Electronic Support Measures MAD: Magnetic Anomaly Detector TCDL: Tactical Common Data Link **Note** • TACCO and NAV/COMM — Window 6 is VOR1, window 7 is MBCN, window 8 is TACN, window 9 is ADF, window 10 is SONO. Toggle MON switch down: window 6 is VOR2, window 7 is TCDL, windows 8 thru 10 are blank. • SS-3 — Window 6 is ADF, window 7 is SONO, window 8 is ESM, window 9 is MAD, window 10 is TCDL. Toggle MON switch down: windows 6 thru 10 are blank.
		B	Asset Number
		C	R = Receive Blank = off
		D	Received volume level. 0…9 for individual volume level
		EE	Always blank when asset is powered on.
		CDEE	When asset is powered off, this field will show “OFF.”

Figure 22-47. MON Page Lower Display Menu Options



T/R 1st Page Upper Display



T/R 2nd Page Upper Display

SWITCH-KNOB	UPPER DISPLAY SWITCH-KNOB FUNCTIONS
T/R switch-knobs	Each T/R asset assigned to a window is controlled by the switch-knob located directly below its window and is used to obtain transmit/receive, receive only, or volume control capability for radio communication. 1. Pull for transmit/receive selection. 2. Rotate for individual volume control. 3. Push for receive only selection. 4. Rotate for individual volume control. 5. Push a second time to deselect.

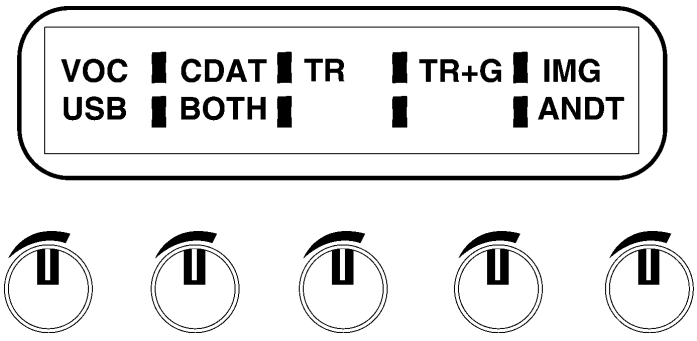
Note

Since more than five assets are involved (VUHF, TCDL), momentarily placing the T/R toggle switch in the up position obtains the undisplayed assets.

Figure 22-48. T/R Page Upper Display Switch-Knob Functions

T/R Page Window Numbers	T/R Page Window Format	Alpha Designation	Description
1 thru 5	AAAA BCDE	AAAA	Four character radio name: HF1 HF2 UHF1 UHF2 UHF3 VUHF TCDL
		B	Transmit/Receive Status: T = Transmit/Receive R = Receive only Blank = No selection
		C	Received volume level. 0…9 for individual level
		D	Asset Status: S = Secure C = Clear U = Unavailable for voice transmission
		E	* = Received audio is present on that channel on any radio selected for T/R or receive only. Blank = No received audio present.
		BCDE	If radio is powered off, this field will show “OFF.”

Figure 22-49. T/R Page Upper Display Menu Options



SWITCH-KNOB	LOWER DISPLAY SWITCH-KNOB FUNCTIONS
MODE switch-knobs	Mode selection for each T/R asset in the upper display window is controlled by the switch-knob located directly below its corresponding lower display window and is used to select the desired mode for radio communication. 1. Turn for new mode. New mode is displayed for 3 seconds. 2. Pull within 3 seconds to set the new mode.

Figure 22-50. MODE Page Lower Display Switch-Knob Functions

HF1/HF2	UHF1*	UHF2	UHF3	VUHF	TCDL**
VOC USB (CLR/SEC)	TR (CLR/SEC)	TR (CLR/SEC)	SEC VOC	CLR VOC	TR (CLR/SEC)
VOC LSB (CLR/SEC)	TR+G (CLR/SEC)	TR+G (CLR/SEC)	IMG ANDT		
VOC AME	ADF	TTY/IACS	SVOC IM84		
CW	SAT COM	DATA			
TTY/IACS	DIG IMG	SONO CMD			
SDAT USB	GRD	DIG IMG			
CDAT USB		GRD			
SDAT BOTH					
CDAT BOTH					
DIG IMG					

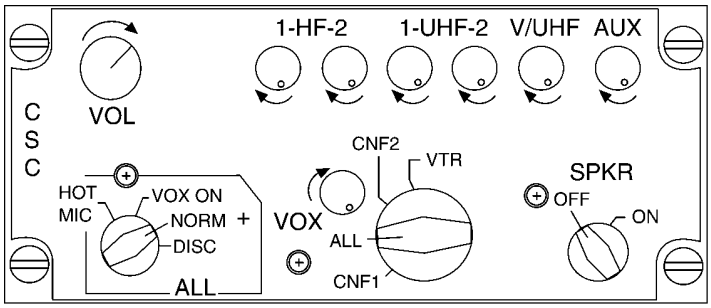
Note

If radio mode change is requested during secure transmission, the radio mode change takes priority and the secure radio audio transmission is interrupted.

* Not selectable from the DCI. Selections are made from the UHF-1 control panel or the pilot/copilot FDCI for video imagery and are displayed (DIG IMG) on the DCI for informational purposes only. Clear/Secure is selectable from any DCI.

** Clear/secure is not selectable from the DCI. Clear/secure selection is made by the NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch.

Figure 22-51. MODE Page Lower Display Menu Options



PANEL MARKING	SWITCH FUNCTIONS
VOL	Master volume knob increases the volume of the summed headset audio. When VOL knob is pulled and held, override function is enabled. This allows the crewmember to communicate with other crewmembers on the currently selected override net without using PTT. The message is received at a high fixed volume by all crewmembers in the system. When the VOL knob is released, the switch returns to the normal (not override) position.
Receiver Select: 1-HF-2 1-UHF-2 V/UHF AUX	Push control knob to select radio. Rotate knob clockwise to increase volume of selected radio. Any combination of radios can be selected. **Note** If the NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch is in the SECURE position, no CDLS audio (speaker/headset) will be heard at the CSC stations.
SPKR	ON — Incoming headset audio is sent to the loudspeaker. OFF — No headset audio is routed to the loudspeaker.
Function Select: CNF1 ALL CNF2 VTR	 Connects microphone and headset audio to CONFERENCE 1, ICS ALL, or CONFERENCE 2 circuit. ICS ALL will always be heard in the headset in addition to the line selected on the function switch. Not used.
VOX	Adjusts noise ambient input level that will activate the microphone. Only functional with ALL Select switch set to VOX ON.
ALL Select: HOT MIC VOX ON NORM DISC	 Microphone is continuously keyed, which enables the operator to speak on the intercom without using PTT. Enables VOX control knob. Permits voice-activated intercom with threshold adjusted by the VOX control knob. Normal operation. Allows operator to key the microphone using PTT. Disconnects station from listening to intercom audio. OVERRIDE or PA audio will be heard.

Figure 22-52. C-12451/AIC-41 CSC, Panel Markings and Functions

22.9.4.1 Pilot/Copilot Procedures

Operation of the various functions of the ICS at the pilot or copilot stations is initiated by operating the switch-indicators on the respective FDCI. To communicate on the ICS, proceed as follows:

1. XMIT ICS switch-indicator — Press. LED indicates amber.
2. ICS switch-indicator for ALL, PA, CNF1, or CNF2 — Press. LED indicates amber.
3. If necessary, adjust the ICS audio for the desired audio signal level by pressing adjust (ADJ) switch-indicator LED amber. Press the ICS switch-indicator selected in the previous step and then rotate the VOL/VOX knob to the desired setting. Press ADJ. The previous settings are restored with the new VOL/VOX setting.
4. Press the hand-held microphone push-to-talk switch or control wheel microphone switch and speak. Release when transmission is completed.

For radio transmission, proceed as follows:

1. Press the appropriate transmit (XMIT) switch-indicator (HF1, HF2, VUHF, TCDL, UHF1, UHF2, or UHF3). Selected switch-indicator LED and associated receiver (RCV) switch-indicator LED will light amber and XMIT ICS switch-indicator LED will light green.
2. Prior to transmitting, monitor selected radio channel to prevent interference with other stations.
3. Press the hand-held microphone push-to-talk switch or control wheel microphone switch and speak. Release when transmission is completed.

Note

If attempting to simultaneously transmit on both HF radios, the ICS may incorrectly give simultaneous transmit indications on the FDCI and DCIs. A hardware lockout prevents both HF radios from simultaneously being in a transmit mode.

For receiver monitoring, proceed as follows:

1. Press the desired receiver switch-indicator until the LED lights amber.
2. If necessary, adjust the receiver audio for the desired audio signal level by pressing the ADJ switch-indicator (LED illuminates amber). Press the RCVR switch-indicator selected in the previous step and then rotate the VOL/VOX knob to the desired setting. Press ADJ switch-indicator (ADJ LED goes dark). The previous settings are restored with the new VOL/VOX setting.
3. Monitor the selected radio(s).

22.9.4.2 TACCO, NAV/COMM, or SS-3 Procedures

Operation of the various functions of the ICS at the TACCO, NAV/COMM, or nonacoustic stations is initiated by operating switches and knobs on the respective LCD DCI. The nonacoustic operator LCD DCI does not have radio transmit capability. To communicate on the ICS, proceed as follows:

1. Clear/Secure (C/S)-ICS toggle switch — Momentarily select ICS (lower display switches to ICS mode).
2. Determine which ICS line is to be used (ALL, PA, CNF1, or CNF2) — Pull the knob below the desired ICS line to select that line. Turn knob to adjust volume. PA is not available at the NAV/COMM or nonacoustic operator stations.

3. Prior to initiating call, monitor selected ICS line to prevent interrupting calls on the line.
4. Press the hand-held microphone push-to-talk switch or foot-controlled microphone switch and speak. Release when transmission is completed. Or select VOX to ON, adjust the level, and speak.

Note

If VOX is ON and a radio is selected for transmission, VOX will be used for ICS and PTT will function for the radio.

For radio transmission, proceed as follows:

1. Transmit/Receive-Mode ((T/R)-MODE) toggle switch — Momentarily select T/R (top display shows radio selections, lower display shows operating modes).
2. From the upper readouts, determine the radio to be used (HF1, HF2, UHF1, UHF2, UHF3, VUHF, or TCDL). To select the transmitter/receiver, pull and release the knob below the desired radio. A "T" in the first position under the radio type indicates it is selected for transmit. Turn knob below the desired radio to adjust receiver volume. A number (0 to 9) in the second position indicates the volume level. The letter in the third position indicates the Clear/Secure/Unavailable (C/S/U) status of the radio. An asterisk (*) in the fourth position indicates receiver audio is present.
3. Turn knob below the lower display readouts to select the desired mode of operation (each new mode will display for 3 seconds). To set the new mode — Pull and release the knob within the 3 seconds it is displayed.
4. To change the clear/secure mode, if needed, momentarily toggle the C/S-ICS switch to the C/S position.

Note

The NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch determines the clear/secure indication and status of the CDLS. Toggling the DCI C/S-ICS switch to C/S does not change the clear/secure indication or status of the CDLS.

5. Prior to transmitting, monitor selected radio channel to prevent interference with other stations.
6. Press the hand-held microphone push-to-talk switch or foot-controlled microphone switch and speak. Release when transmission is completed.

Note

If attempting to simultaneously transmit on both HF radios, the ICS may incorrectly give simultaneous transmit indications on the FDCI and DCIs. A hardware lockout prevents both HF radios from simultaneously being in a transmit mode.

For receiver monitoring, proceed as follows:

1. Transmit/Receive-Mode ((T/R)-MODE) toggle switch — Momentarily select T/R (top display shows radio selections, lower display shows operating modes).
2. From the upper readouts, determine which radio is to be used (HF1, HF2, UHF1, UHF2, UHF3, VUHF or TCDL). To select the receiver, push and release the knob below the desired radio. An "R" in the first position under the radio type indicates it is selected for receive. Turn knob below the desired radio to adjust receiver volume. A number (0 to 9) in the second position indicates volume level. The letter in the third position indicates the Clear/Secure/Unavailable (C/S/U) status of the radio. An asterisk (*) in the fourth position indicates there is receiver audio present.

3. Turn knob below the lower display readouts to select the desired mode of operation (each new mode will display for 3 seconds). To set the new mode — Pull and release the knob.

4. To change the clear/secure mode, if needed, momentarily toggle the C/S-ICS switch to the C/S position.

Note

The NAV/COMM TCDL switch panel TCDL CLEAR-SECURE switch determines the clear/secure indication and status of the CDLS. Toggling the DCI C/S-ICS switch to C/S does not change the clear/secure indication or status of the CDLS.

5. Monitor the selected radio(s).

22.9.4.3 FE, SS-1 and -2, Ordnance, Observer, and Galley Procedures

Operation of the various functions of the ICS at the flight engineer station, acoustic operator stations 1 and 2, aft observers, ordnance, and galley stations is initiated by operating switches and knobs on the respective CSC panel. To communicate on the ICS, proceed as follows:

1. On the mode selector switch, select the Normal (NORM) mode.

2. On the function selector switch, select the desired ICS line (ALL, CNF1, or CNF2).

3. Turn the volume (VOL) knob to adjust volume.

4. Prior to initiating call, monitor selected ICS line to prevent interrupting calls on the line.

5. Press the hand-held microphone push-to-talk switch or foot-controlled microphone switch and speak. Release when transmission is completed.

For receiver monitoring, proceed as follows:

1. From the six radio control knobs (HF1, HF2, UHF1, UHF2, V/UHF, and AUX), select the desired radio to monitor — Push the selected knob.

2. Rotate the radio control knob to adjust the received radio audio.

3. Monitor the selected radio(s).

22.10 ELECTRONIC FLIGHT DISPLAY SYSTEM (EFDS) (BMUP)

22.10.1 Introduction

BMUP aircraft use the exact same EFDS components as other EFDS configured aircraft; however, the signal flow between the tactical mission computer and the EFDS is different for BMUP aircraft than it is for other aircraft. On non-BMUP aircraft, tactical data is routed from the mission computer to the AJN-15 Flight Director System, and then supplied to the EFDS in analog format. On BMUP aircraft, tactical data is routed from the mission computer directly to the EFDS in digital format. Because of this fundamental difference, non-BMUP and BMUP EFDS systems operate differently if either CPTR or FMS2 is selected as the EFDS course mode. For all other course mode selections, the systems operate identically. A summary of high-level differences between non-BMUP EFDS and BMUP EFDS is presented in Figure 22-53.

Non-BMUP EFDS	BMUP EFDS
Tactical data is routed from the mission computer to the AJN-15 Flight Director Steering Computer and then supplied to the EFDS in analog format.	Tactical data is routed from the mission computer directly to the EFDS in digital format.
Tactical data is viewed by selecting CPTR course mode on the EFDS control panel.	Tactical data is viewed by selecting FMS2 course mode on the EFDS control panel.
In CPTR course mode, control of the EHSI course arrow and EFDI command bars is accomplished using the AJN-15 FDS control panel.	In FMS2 course mode, control of the EHSI course arrow and EFDI command bars is accomplished using the Pilot Data Entry Panel (PDEP).

Figure 22-53. EFDS Difference Data

The following description contains notes and procedures applicable to the BMUP EFDS installation. For additional information on software deficiencies that impact BMUP EFDS, operators should consult the current BMUP software Operational Availability Date (OAD).

22.10.2 System Components

The BMUP EFDS consists of the following components:

1. Three C-12616/AYN Multi-Function Display Control Panels (DCPs).
2. Two ID-2551/AYN Multi-Function Displays configured as Electronic Flight Director Indicators (EFDIs).
3. Three ID-2551/AYN Multi-Function Displays configured as Electronic Horizontal Situation Indicators (EHSIs).

These are the same components that comprise the EFDS on non-BMUP aircraft. Additionally, BMUP EFDS is controlled by and receives data from the following components in the FMS2 Course Mode:

1. ASQ-227 Mission Computer.
2. Pilot Data Entry Panel (PDEP).

The components listed above interface with one another and with other aircraft navigation and attitude subsystems.

22.10.2.1 ASQ-227 Mission Computer

Most of the information displayed by EFDS in FMS2 course mode is provided by the ASQ-227 Mission Computer via an ARINC 429 digital data bus; however, the following data is provided via separate analog inputs for display in FMS2 course mode:

1. Attitude data displayed on EFDIs.
2. True Heading data displayed on EHSI compass cards and EFDIs.
3. Any of the following bearing needle selections:

   VOR1, VOR2, TCN, ADF, DF.

All of the above data remains valid in FMS2 course mode, even if the mission computer is turned off or the mission computer software malfunctions.

All other data displayed in the FMS2 course mode is provided by the mission computer via the ARINC 429 input. The digital messages that contain this data are often referred to by label number. The digital data currently provided to the FMS2 course mode by the mission computer is listed below.

Label	Definition
114	Desired Track
115	Waypoint Bearing
121	Roll Command
147	Magnetic Variation
251	Distance to Go
313	Ground Track

The digital data will be either unavailable or invalid if the mission computer is turned off or the mission computer software malfunctions.

Note

- If the mission computer is turned off or loses communications with EFDS while FMS2 is selected, the following red validity flags will appear on the EFDIs and EHSIs:

  — SPD flag.

  — ALT flag.

  — FD flag.

  — FMS2 flag.

- If this occurs, the Attitude data and True Heading data displayed in FMS2 course mode will still be valid. The flags can be removed by deselecting the FMS2 course mode or by restarting the mission computer.

22.10.2.2 Pilot Data Entry Panel (PDEP)

The PDEP does not interface directly with the EFDS. Instead, the PDEP controls the FMS2 display by controlling the digital messages that are sent to EFDS by the mission computer.

The PDEP includes two switches that control the display of tactical data in the FMS2 course mode. The switches are labeled FMS2 COMPTRK CONT and FMS2 COMMAND BAR. The switches are shown in Figure 22-54. The switches are normally present any time the ASQ-227 mission computer is on and the tactical mission software is loaded.

If a function that requires the use of the pilot numeric keypad is activated (such as a Pilot Mark On Top [MOT]), the keypad temporarily replaces the FMS2 control switches on the PDEP, as shown in Figure 22-55. When the function is completed or terminated, the FMS2 control switches are again displayed.

Display of the EHSI course arrow (described in Electronic Horizontal Situation Indicator, paragraph 22.10.2.5) and the EFDI roll command bars (described in Electronic Flight Director Indicator, paragraph 22.10.2.4) is dependent on the status of the PDEP FMS2 switches and on the presence of at least one Fly-to-Point (FTP) in the ASQ-227 mission computer. If no FTPs have been entered in the mission computer, the course arrow and roll command bars will be removed from all FMS2 EFDS displays, regardless of the status of the PDEP switches. If an FTP is currently present in the mission computer, then display of the course arrow and command bars will occur as indicated in Figure 22-56.

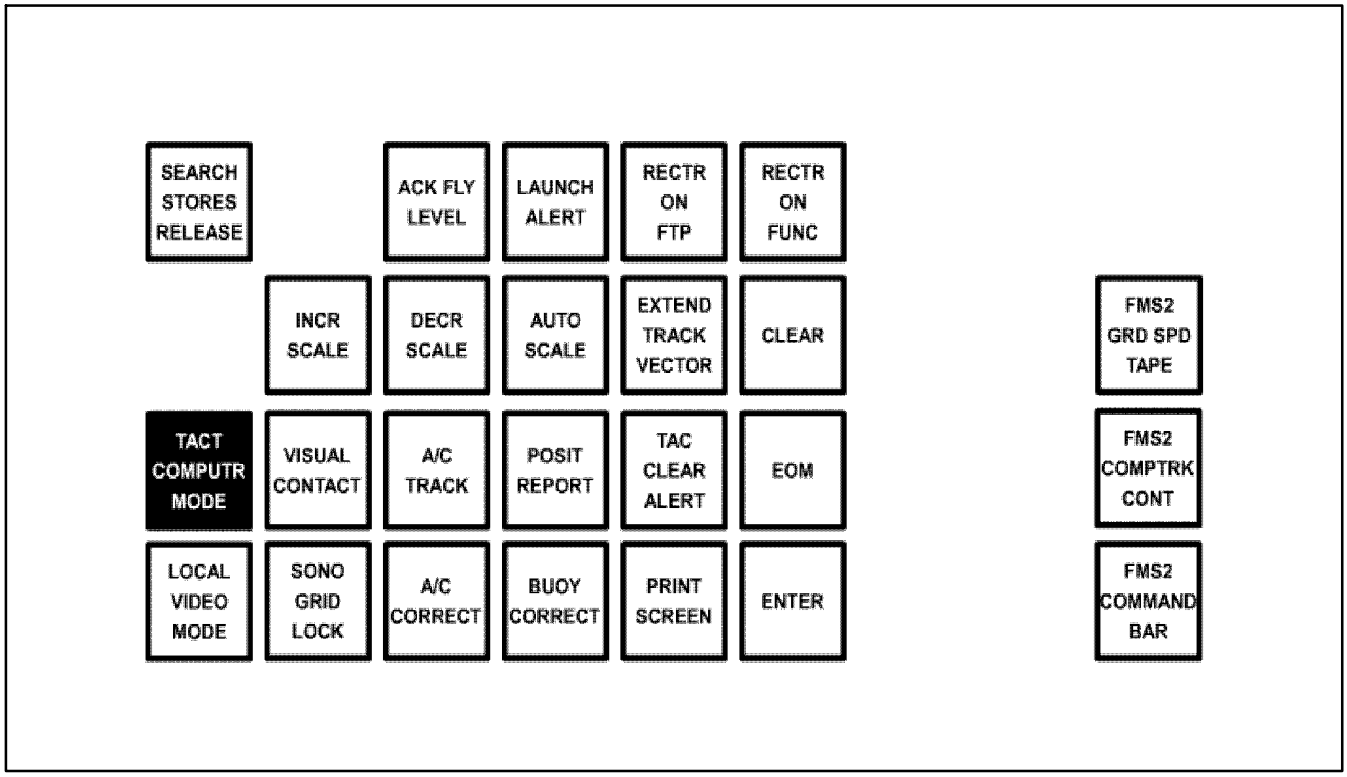


Figure 22-54. PDEP FMS2 Control Switches

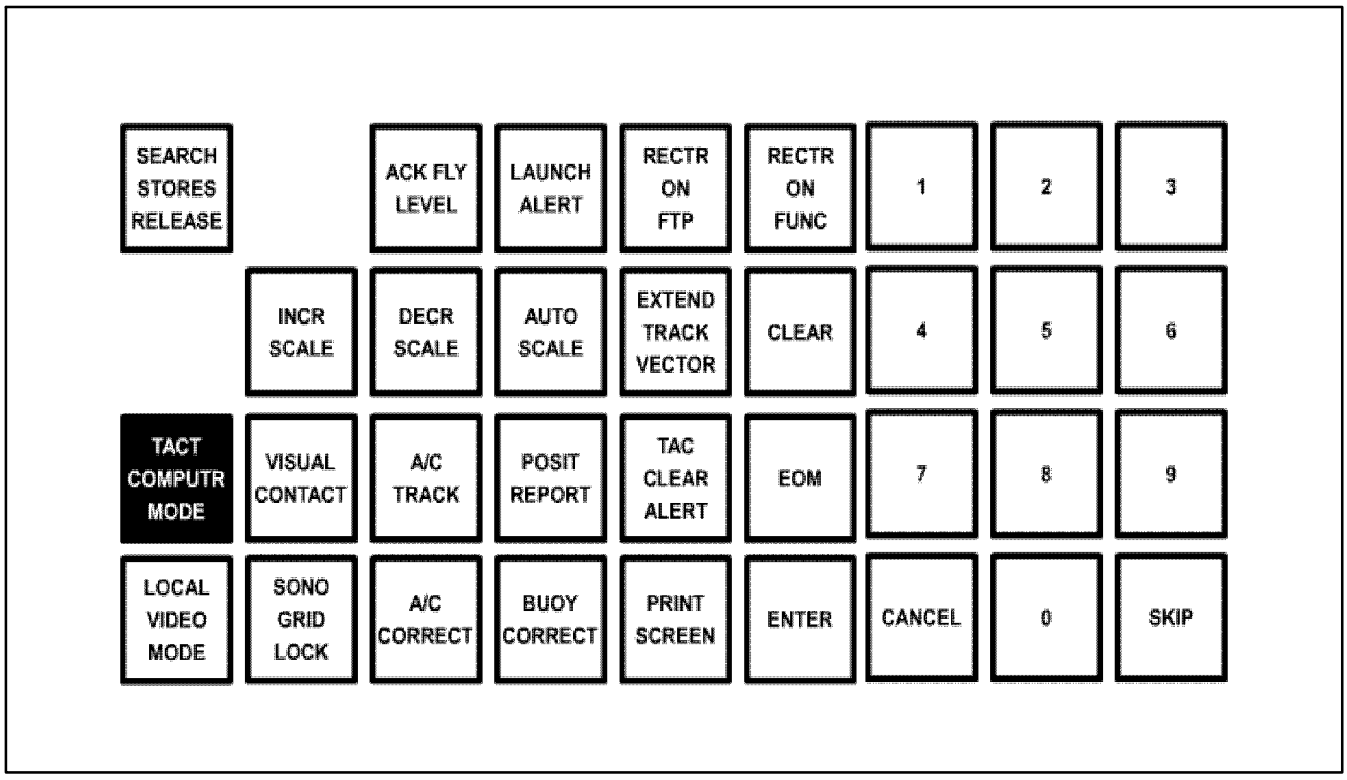


Figure 22-55. PDEP Pilot Keypad

		FMS2 COMP TRK CONT	
		On	Off
FMS2 COMMAND BAR	On	EHSI Course Arrow Displayed EFDI Roll Bars Displayed	EHSI Course Arrow and EFDI Roll Bars Both Removed
	Off	EHSI Course Arrow Displayed EFDI Roll Bars Removed	EHSI Course Arrow and EFDI Roll Bars Both Removed

Figure 22-56. FMS2 Electronic Horizontal Situation Indications

Note

- The ASQ-227 mission computer monitors the status of the pilot DCP course switch in order to determine whether the Tactical Mode has been selected. It is not possible for the copilot to access full Tactical Mode functionality unless the pilot has selected FMS2 course mode. If the pilot selects TCN, VOR1, VOR2, or FMS1 course mode, the copilot Course Arrow and Roll Bars will be removed, even if all switches listed are on.

- The FMS2 COMP Track (TRK) CONT switch also affects the computation and display of Dist-to-Go data, Estimated Time En Route (ETE) data, and Estimated Time of Arrival (ETA) data by the mission computer. If the Tactical Mode has been selected on the pilot DCP and the FMS2 COMP TRK CONT switch is active, these values will all reflect distance along the ASQ-227 computed optimal path to waypoint intercept. If either of these switches are deselected, then ASQ-227 Dist-to-Go, ETE, and ETA will reflect the current straight-line distance to the active FTP.

22.10.2.3 C-12616/AYN Multi-Function Display Control Panel (DCP)

The DCPs are used to select the inputs for the EFDI and the EHSI displays. BMUP uses the same DCPs described in C–12616/AYN, Multi–Function Display, paragraph 23.4.2.1. All of the non-tactical switch positions continue to function as described in Figure 23-5; however, BMUP uses FMS2 course mode as the Tactical Mode, and there are some differences and some new features in this mode. Figure 22-57 summarizes the differences between non-BMUP and BMUP DCP switch settings. Figure 22-57 should be used in conjunction with Figure 23-5 to gain a complete understanding of BMUP DCP switch settings.

22.10.2.4 Electronic Flight Director Indicator

Figure 22-58 depicts a typical EFDI display when operating in the FMS2 course mode. Except where otherwise noted, EFDI indications are the same in FMS2 course mode as they are in all other course modes.

In FMS2 course mode, the EFDI provides:

1. Pitch and Roll Attitude — The FMS2 course mode has the capability to receive digital pitch and roll data via ARINC 429 labels. If this data were provided, it would automatically take priority over synchro inputs from INS-1, INS-2, and the Standby Gyro; however, these labels are not currently provided to the EFDS by the mission computer. Since digital data is unavailable, FMS2 automatically reverts to the same synchro inputs used by all other course modes. Therefore, pitch and roll attitude data will be identical in all course modes (VOR2, VOR1, TCN, FMS1, CPTR, and FMS2). Pitch and roll attitude data will remain valid in FMS2 even if the mission computer is shut down or fails.



PANEL MARKING	FUNCTION
BRT control: L (OUTER) R (INNER)	Unchanged in FMS2 course mode.
HDG REF (Pushbutton)	HDG REF (MAG/TRUE heading reference) is a pushbutton switch that toggles the MFD between magnetic and true heading references. Visual feedback is provided via the words MAG or TRUE next to the heading index on the EHSI MFD. The switch must be pressed for a minimum of 2 seconds to change the reference. When the course mode is FMS2, the base heading reference is true (TRU). The heading reference can be switched to magnetic (MAG) if the ASQ-227 mission computer is on and a magnetic variance is present in the NAV PARAMETERS tableau. Mag heading supplied in FMS2 is the inertial true heading adjusted by the ASQ-227 mission computer magnetic variance. **Note** FMS2 is the only course mode that uses mission computer MAG VAR. If the mission computer MAG VAR is in error, FMS2 magnetic headings will be in error. True headings will still be correct in FMS2 course mode. Magnetic headings will still be correct in all other course modes.
ATTD SRC switch: PRI ALT	Unchanged in FMS2 course mode.
HDG SRC switch:	Selects heading source of the controlled EFDI/EHSI (pilot/copilot). If the EHSI fails, the switch will still work for the EFDI in Primary Flight Display (PFD) mode.
PRI	COURSE switch selected to FMS2: Pilot control — INS 1. Copilot control — INS 2. NAV/COMM control — INS 1.
ALT	COURSE switch selected to FMS2: Pilot control — INS 2. Copilot control — INS 1. NAV/COMM control — INS 2.

Figure 22-57. C-12616/AYN Control Panel — Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
COURSE switch:	Two concentric rotary switches control the course selection as follows:
CRS (Outer knob)	Six-position rotary switch that selects the navigation source displayed on the EHSI. The pilot and copilot selections are (clockwise): VOR2, VOR1, TCN, FMS1, CPTR (No Longer Supported), and FMS2. The NAV/COMM selections are (clockwise): SPARE, SPARE, FMS1, Repeat Pilot, CPTR (No Longer Supported), and FMS2.
CRS (Inner knob)	Inoperative in FMS2 course mode.
CRS PUSH DIRECT	Unchanged in FMS2 course mode.
MODE/RNG: PUSH TEST switch MODE (Outer knob)	Switch operation is unchanged in FMS2 course mode; however, if MAP is selected with FMS2 active, the information displayed on the EHSI will differ from all other course modes, as described in Electronic Horizontal Situation Indicator, paragraph 22.10.2.5.
RNG (Inner knob)	Unchanged in FMS2 course mode.
PUSH TEST	Unchanged in FMS2 course mode.
BEARING switch	Two concentric rotary switches control the bearing source selection on the on-side (pilot or copilot) EHSI. The controls function as follows:
Outer rotary switch	Seven-position rotary switch selects the bearing input from the following sources (left to right): VOR2, VOR1, TCN, ADF, DF (UHFDF or OTPI are valid submodes), FMS, and Spare (none selected). The pilot BEARING knob selects the Bearing Pointer #1 source for the pilot, copilot, and NAV/COMM EHSIs. The copilot BEARING knob selects the Bearing Pointer #2 source for the copilot and pilot EHSIs. The NAV/COMM BEARING knob selects the Bearing Pointer #2 source for the NAV/COMM EHSI only. There are not separate positions for FMS1 bearing and FMS2 bearing. If the FMS position is selected while the corresponding EHSI is in VOR2, VOR1, TCN, FMS1, or CPTR (No Longer Supported) course mode, then the controlled bearing needle will provide an FMS1 waypoint bearing. If the FMS position is selected while the corresponding EHSI is in FMS2 course mode, then the controlled bearing needle will provide an FMS2 waypoint bearing.
PUSH HDG SYNC	Unchanged in FMS2 course mode.
HDG (Inner knob)	HDG is a rotary knob that positions the heading marker (bug) on the EHSI. The HDG knob on the pilot and copilot Control Panel allows the flightcrew to independently rotate and set the Heading Bug on the respective EHSI compass cards. The pilot EHSI computes heading error as the difference of the Heading Command (entered by the pilot HDG control) and aircraft heading (from the INS input). The heading error is an output of the pilot EHSI. **Note** Due to a problem with the current EFDS installation, the ASW-31 Autopilot Heading Select switch will not engage in FMS2 unless the pilot selects the ALT HDG source on the PPC DCP.

Figure 22-57. C-12616/AYN Control Panel — Markings and Functions (Sheet 2 of 2)



Figure 22-58. Typical EFDI Display in FMS2 Course Mode

2. Heading Tape and Rate-of-Turn Indicator — The FMS2 course mode also has the capability to receive digital heading data via an ARINC 429 label. This label is not currently provided to the EFDS by the mission computer, so FMS2 automatically reverts to the synchro heading inputs listed in Figure 22-57. Therefore, the heading tape and rate-of-turn indicator function identically in all course modes.

3. Command Bars — In FMS2 course mode, the command bars display roll commands, which are computed by the ASQ-227 mission computer and provided via an ARINC 429 label. In FMS2, the command bars are not affected by AJN-15 control panel settings and do not receive or display data computed by the Flight Director Steering Computer (FDSC). Pitch steering is not functional in FMS2 course mode. Pitch commands are set to zero any time the command bars are displayed. The command bars are designed to steer the aircraft along the ASQ-227 computed optimal flight path in order to achieve FTP capture.

Note

For non-BMUP aircraft, the FDSC limits commanded bank angle to 45 degrees in the Tactical Submode. For BMUP aircraft, the ASQ-227 mission computer software limits commanded bank angle to 45 degrees in FMS2 course mode.

4. Course Source — Repeat of the course source displayed on the EHSI and as selected on the DCP.

5. Course Submode — Blank if no fly-to-points are present in the ASQ-227 mission computer. Displays either ENRT, TERM, or APPH if a fly-to-point is active in the ASQ-227 and if the system has been set to display the course arrow, per Pilot Data Entry Panel (PDEP), paragraph 22.10.2.2.

Note

The ENRT, TERM, and APPH labels have no meaning in FMS2 course mode, since the Deviation Bar is not currently implemented in this mode. The label that appears will match the submode that was active when FMS1 was last selected.

22.10.2.5 Electronic Horizontal Situation Indicator

Figures 22-59 and 22-60 depict typical EHSI displays when operating in the FMS2 course mode. Figure 22-59 is the pilot/copilot EHSI display. Figure 22-60 is the NAV/COMM EHSI display. Except where otherwise noted, EHSI indications are the same in FMS2 course mode as they are in all other course modes.

22.10.2.5.1 Pilot/Copilot EHSI

In FMS2 course mode, the pilot/copilot EHSI provides:

1. TACAN DME — The TACAN DME data displayed in FMS2 course mode is identical to the data displayed in all other course modes.
2. Heading Index Readout — Presents heading data from the currently selected inertial heading source in FMS2 course mode. The Heading Index Readout and the EHSI compass card default to a true heading reference upon initial selection of FMS2. The readout can be switched to a “synthetic” magnetic heading using the HDG REF switch if mission computer is on. The synthetic magnetic heading is computed by adding (or subtracting) the magnetic variation provided by the ASQ-227 mission computer to the true heading provided by the currently selected inertial.

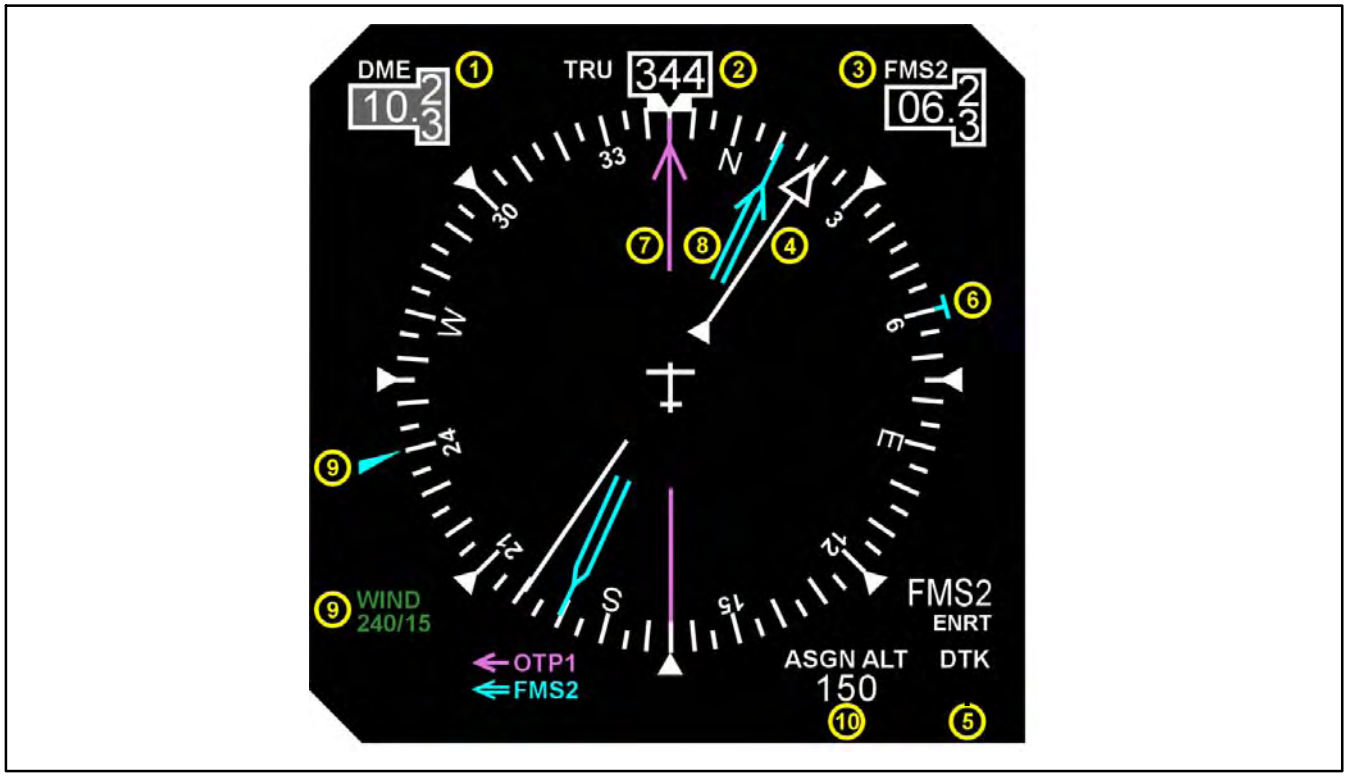


Figure 22-59. Typical Pilot/Copilot EHSI Display in FMS2 Course Mode

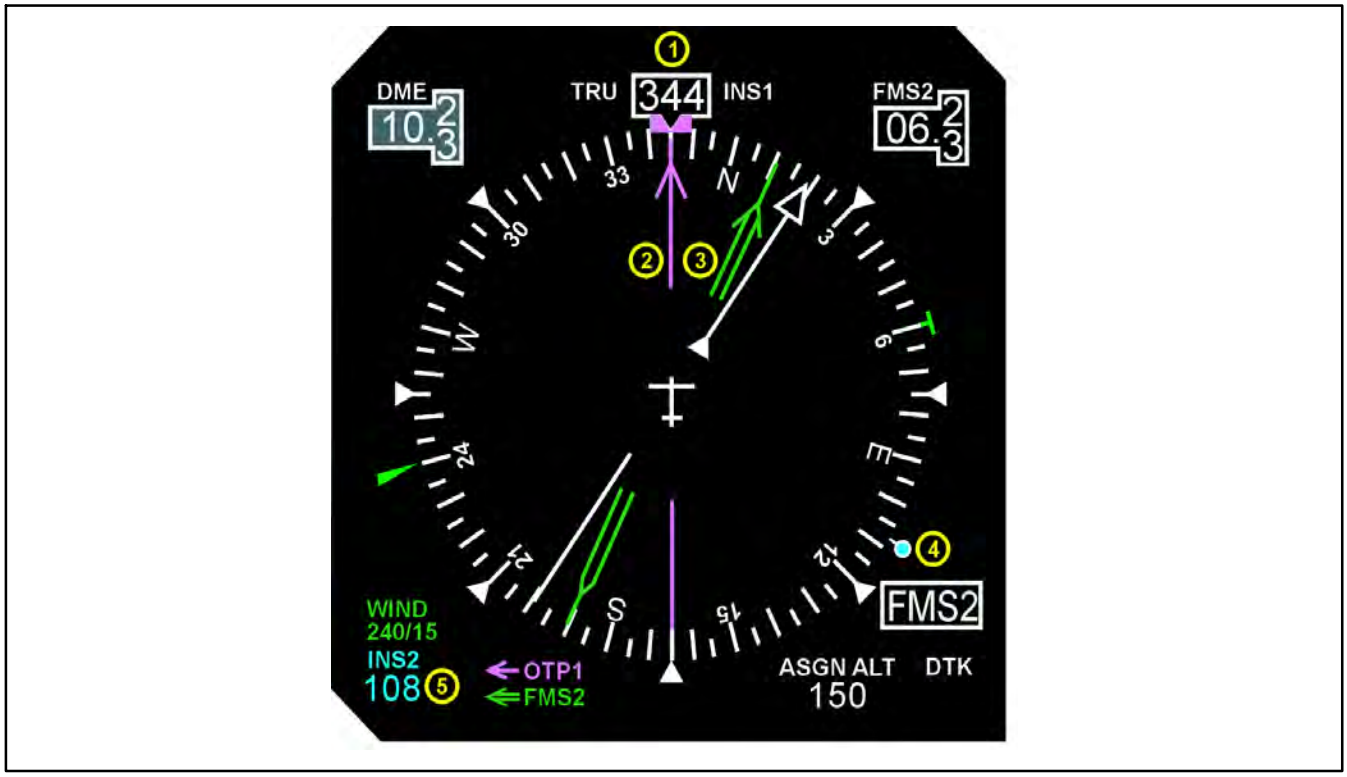


Figure 22-60. Typical NAV/COMM EHSI Display in FMS2 Course Mode

3. FMS2 Waypoint Distance — The GPS waypoint distance window displayed in all other course modes is replaced by an FMS2 waypoint distance window. This window provides the current straight-line distance from the aircraft to the highest priority fly-to-point in the ASQ-227 mission computer. The window contains three white dashes if the mission computer is on, but no FTPs are active. The window contains three red dashes if the mission computer is off or if the waypoint distance data becomes invalid.

Note

The FMS2 waypoint distance shown on the EHSI is not always the same as the Dist To Go value displayed on the Pilot Color High Resolution Display (PCHRD). The EHSI always displays a straight-line distance to the current FTP. The PCHRD displays a flight path distance determined by the roll command steering algorithm if COMP TRK CONT is selected on the PDEP and FMS2 is selected on the pilot DCP. The PCHRD reverts to straight-line distance if either of these switches are deselected.

4. Course Arrow — Appears only when selected for display as described in Pilot Data Entry Panel (PDEP), paragraph 22.10.2.2. When displayed, the course arrow indicates the course that the roll command steering algorithms are currently recommending to achieve FTP intercept.

5. DTK Numeric Readout — Provides a numeric readout of the course currently indicated by the course arrow. The DTK Numeric Readout is replaced by three white dashes if the Course Arrow is not currently displayed. The DTK Numeric Readout is replaced by three red dashes if the mission computer is off or the computed course data becomes invalid.

6. Track Indicator — Indicates current ground track, but is derived from a different source in FMS2 course mode than in other course modes. Instead of being derived from GPS ground track (as in non-FMS2 course modes), the Track Indicator repeats True Track data from the ASQ-227 mission computer in the FMS2 course mode. Mission computer True Track is also visible on PCHRD and in NAV PARAMETERS tableau.

7. Bearing Pointer #1 — If the recommended tactical mode setup described in Tactical Mode Operation, paragraph 22.10.3.2 is followed, Bearing Pointer #1 will provide the pilot and copilot with an OTPI point that can be used to MOT the currently tuned buoy. If UHF-1 is subsequently placed in the DF mode, then UHF-DF will take priority, and the Bearing Pointer label will change accordingly.

8. Bearing Pointer #2 — If the recommended tactical mode setup described in Tactical Mode Operation, paragraph 22.10.3.2 is followed, Bearing Pointer #2 will provide the pilot and copilot with a direct point to the highest priority mission computer fly-to-point. This direct point will usually differ from the recommended course data provided by the course arrow. If no fly-to-point is currently entered in the mission computer, then the bearing needle will be removed from the display; however, the bearing source label will continue to be displayed. If the mission computer is off or the FMS2 bearing data becomes invalid, the bearing source label will be presented in black over a solid red box.

9. Wind readout and wind arrow — Display wind data that has been manually entered in the Progress page of any of the three CDNUs.

10. Assigned altitude — Displays assigned altitude data that has been manually entered in the EFDS Start page of any of the three CDNUs.

Note

Wind readout, wind arrow, and assigned altitude are the only data supplied by the FMS1 ARINC 429 bus that are available for display in FMS2 course mode. For the most part, FMS1 data and FMS2 data are not displayed simultaneously on any EFDS display. This is the reason that FMS1 waypoint and flight plan data are unavailable in FMS2 MAP mode.

22.10.2.5.2 NAV/COMM EHSI

In a tactical environment, it is recommended that the NAV/COMM EHSI be placed in the Repeat Pilot course mode. If this is done, a typical NAV/COMM EHSI will appear as shown in Figure 22-60. It is also possible to place the NAV/COMM EHSI in the FMS2 course mode; however, this is not recommended, since display of the following data will then vary depending upon pilot DCP and PDEP selections that cannot be monitored by the NAV/COMM:

1. Course Arrow.

2. DTK Numeric Readout.

3. Course Submode.

If the NAV/COMM EHSI is placed in the Repeat Pilot Course mode, and the recommended tactical setup described in Tactical Mode Operation, paragraph 22.10.3.2 is followed, the NAV/COMM EHSI provides the same data described in Pilot/Copilot EHSI, paragraph 22.10.2.5.1, with the following exceptions and additions:

1. Heading Index Readout — Presents heading data from the currently selected inertial.

Note

The NAV/COMM heading index readout is often in error by as much as 1 to 2 degrees. This is most easily seen by comparing the heading index readout in FMS2 course mode to the true headings presented by the Replacement Inertial Navigation Unit (RINU) CDUs and the pilot/copilot EHSIs. The problem affects the NAV/COMM EHSI in all course modes. Due to differences in signal flow, the pilot/copilot EHSIs are believed to be immune to this problem.

2. Bearing Pointer #1 — Repeats the bearing selection made on the pilot DCP.
3. Bearing Pointer #2 — Displays the FMS2 bearing, which provides a direct point to the highest priority mission computer fly-to-point.
4. Alternate Heading Bug — Provides a numerical readout of the heading data currently being provided by the inertial that is presently not selected on the NAV/COMM DCP.
5. Alternate Heading Readout — Displayed at the perimeter of the EHSI compass card. The alternate heading readout also shows heading data provided by the unselected inertial. The alternate heading readout is designed to permit NAV/COMM monitoring of the heading split between the two available heading sources.

Note

EFDS software version “OFP 612-0248-004” contains an error that causes incorrect alternate heading data to be displayed in FMS2 course mode. When the ASQ-227 mission computer is on, both the alternate heading marker and the alternate heading readout will be in error by the amount of the mission computer magnetic variation.

22.10.2.5.3 EHSI in MAP Mode

Both the pilot/copilot and NAV/COMM EHSIs can be placed in MAP mode when FMS2 is selected. The procedures for selecting MAP mode are unchanged in FMS2; however, the displayed data is different. Most of the MAP mode data that is displayed in non-FMS2 course modes will be absent from the display in FMS2 course mode. There will be no CDNU waypoint data and no flight plan display.

22.10.2.6 Multi-Function Displays in Diagnostic Mode

The diagnostic mode operates the same way for BMUP EFDS as it does for non-BMUP EFDS. The one change to displayed data is that the FMS2 input on the System Status page is white (instead of red) when the ASQ-227 mission computer is on and the Tactical Mission Software is loaded. A white indication means that the mission computer is properly interfacing with the FMS2 course mode.

22.10.3 System Operation

22.10.3.1 Non-Tactical Mode Operation

The functions and operating procedures for BMUP EFDS and non-BMUP EFDS are identical in all respects for the following non-tactical course modes: VOR2, VOR1, TCN, and FMS1.

22.10.3.2 Tactical Mode Operation

The functions and operating procedures for BMUP EFDS and non-BMUP EFDS differ in the Tactical mode. Non-BMUP EFDS uses CPTR Course mode as the Tactical mode. BMUP EFDS uses FMS2 Course mode as the Tactical mode.

Note

On BMUP aircraft, CPTR Course mode is still selectable and still receives a damped UHF-DF or OTPI heading signal from the Flight Director Signal Data Converter; however, CPTR Course mode no longer receives any input from the mission computer. Because CPTR Course mode is no longer fully supported, confusing display indications can result. Use of CPTR Course mode is not recommended.

The following steps define the recommend Tactical mode setup:

1. COURSE switch.
   a. FMS2 on pilot and copilot DCP.
   b. Repeat Pilot on NAV/COMM DCP.

Note

If the pilot selects FMS2 course mode, it is recommended that the copilot also select FMS2 course mode. If the copilot selects a non-tactical course mode (VOR2, VOR1, TCN, or FMS1) while the pilot is in FMS2, an FD flag will appear on the copilot EFDI.

2. BEARING switch.
   a. DF on pilot DCP.
   b. FMS on copilot DCP.
   c. FMS on NAV/COMM DCP.
3. OTPI — On.
   a. Select a channel.
4. Verify following display indications at all stations:
   a. OTPI label next to bearing pointer #1.
   b. FMS2 label next to bearing pointer #2.
   c. Displayed headings are referenced to true north.
   d. FMS2 bearing needle points at highest priority FTP (if one has been entered in the mission computer).
   e. EHSI waypoint distance indicator gives distance to highest priority FTP (if one has been entered in mission computer).
   f. OTPI bearing needle points at currently tuned buoy (if a valid RF signal is present).

Note

If desired, the pilot or copilot can set his bearing needle to VOR2, VOR1, or TCN to monitor the position of the associated NAVAID. If this is done while the compass card is referenced to TRUE, the dashed bearing needle will display the current true bearing to the NAVAID. It will not display the correct magnetic radial. If the correct magnetic radial is required, the compass card HDG REF must be switched to MAG.

5. PDEP FMS2 COMPTRK CONT switch.
   a. On if mission computer steering advisories are desired via EHSI course arrow.
   b. Observe that course arrow indicates current recommended course to highest priority FTP (if one has been entered in the mission computer).
6. PDEP FMS2 CMD BAR switch.
   a. On if roll steering advisories are desired via EFDI command bars.
   b. Observe that roll steering commands attempt to intercept the course currently indicated by the EHSI course arrow (if the course arrow is currently displayed).

22.11 ELECTRONIC WARFARE SYSTEM

22.11.1 Introduction

The AIP Electronic Warfare System (EWS) provides the capability for detection of surface-to-air and air-to-air missiles and deployment of countermeasure expendables.

22.11.2 System Components

The EWS consists of the following three subsystems and components (refer to Figure 22-61 for component locations):

1. AN/AAR-47 Missile Warning Set (MWS).
   a. ID-2464/AAR-47 Control Indicator (CI).
   b. CP-1975/AAR-47 Computer Processor (CP).
   c. SU-164/AAR-47 Optical Sensor-Converter (OSC) (4).
2. AN/ALE-47 Countermeasures Dispenser System (CMDS).
   a. C-12170/ALE-47(V) Cockpit Control Unit (CCU).
   b. CD-45(V)1/ALE-47(V) Programmer.
   c. SA-2669/ALE-47(V) Sequencer (3).
   d. Dispenser assembly (6).
      (1) D-56/ALE-47(V) Dispenser Housing (6).
      (2) MX-11599/ALE-47 Magazine and Backing Plate (6).

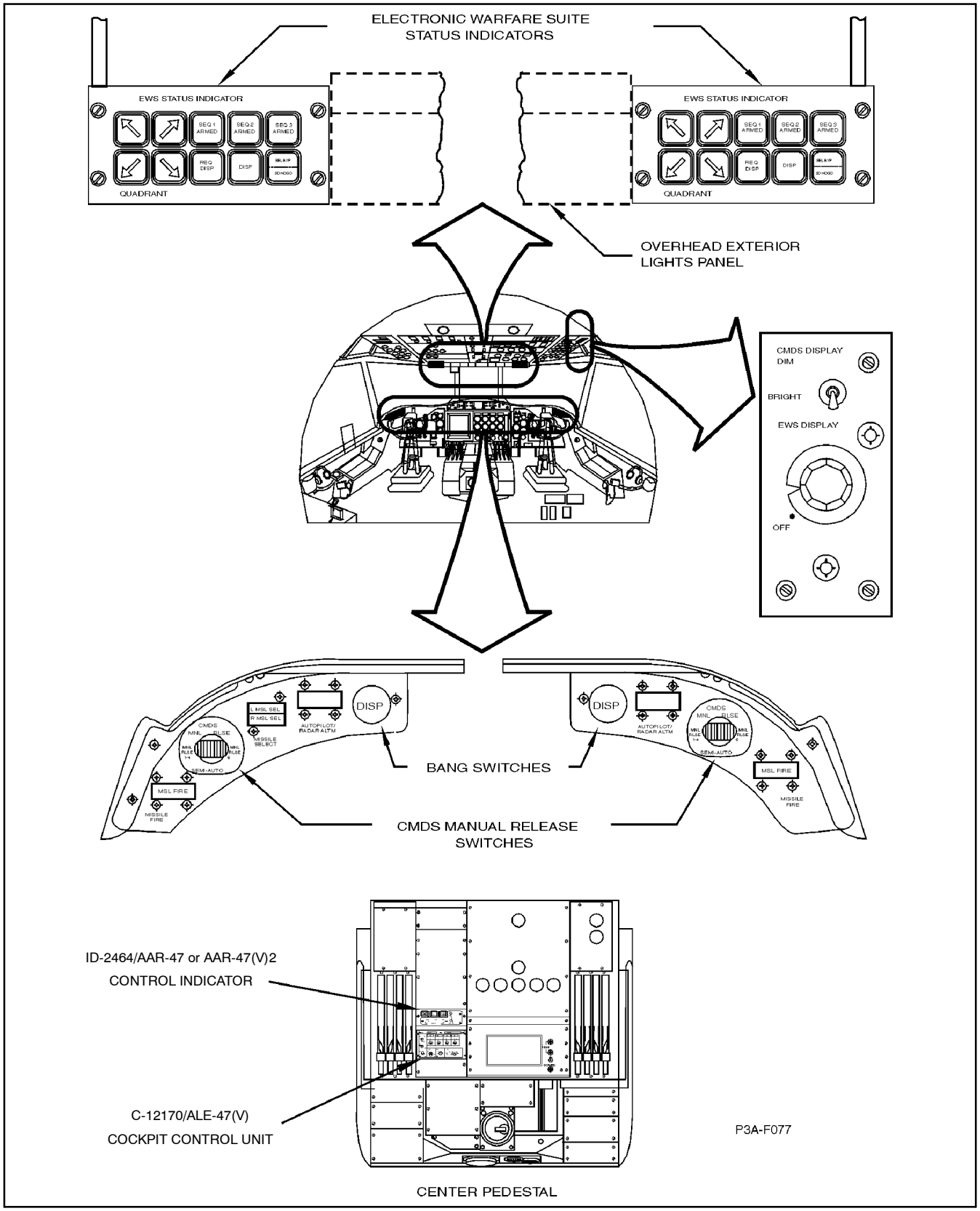


Figure 22-61. EWS Component Locations (Sheet 1 of 2)

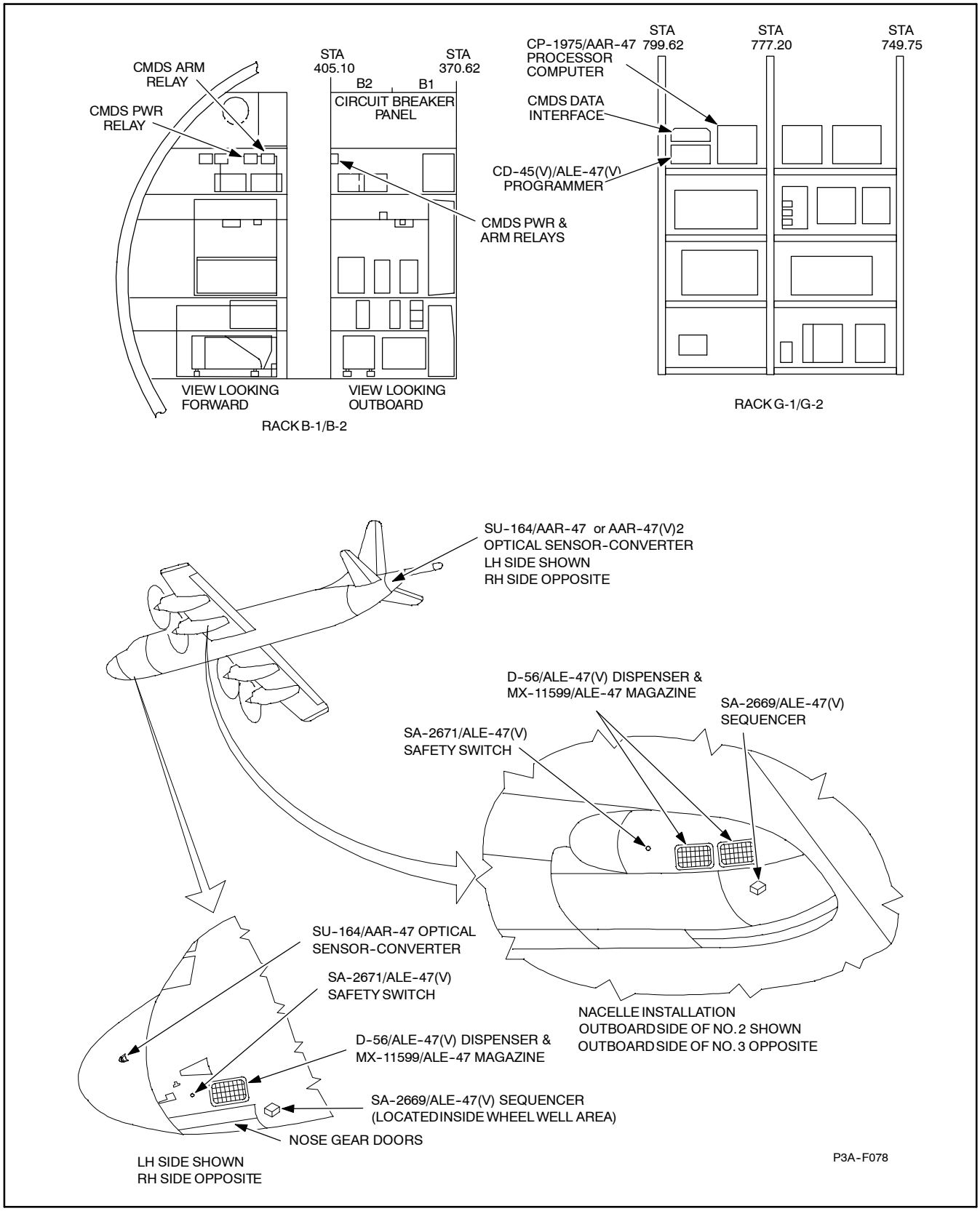


Figure 22-61. EWS Component Locations (Sheet 2 of 2)

e. CMDS Power (PWR) relay.

f. CMDS ARM relay.

g. SA-2671/ALE-47(V) Safety Switch (3).

h. Bang switch (2).

i. CMDS Manual Release switch (2).

3. EWS Display and Control.

a. EWS Status Driver (EWSSD).

b. EWS Status Indicator (EWSSI) (2).

c. AN/ASH-503 Micro Voice Message System (MVMS).

d. Weight-On-Wheels (WOW) safety circuit.

Components associated with, but not part of, the EWS are:

1. AN/AIC-41 Intercommunication System (ICS).

2. AN/USQ-131 Memory Loader Verifier Set (MLVS).

22.11.2.1 AN/AAR-47 Missile Warning Set (MWS)

The MWS is a passive electro-optical system designed to detect surface-to-air and air-to-air missiles fired at the aircraft. On MWS detection and declaration of an incoming missile, a dispense request created by the MWS is sent to the CMDS.

22.11.2.1.1 ID-2464/AAR-47 Control Indicator

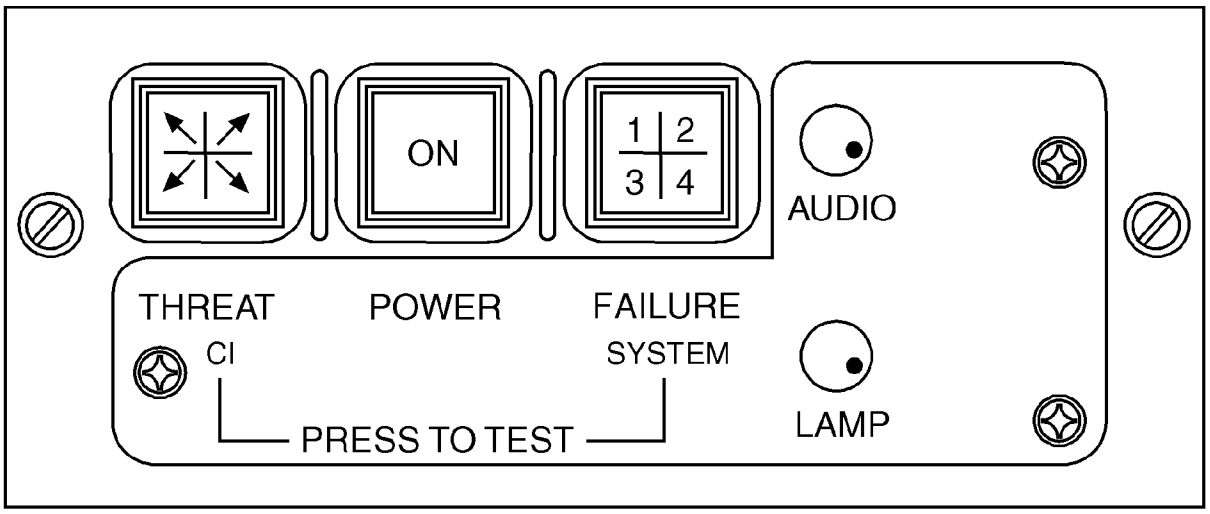
The CI (Figure 22-62) is located on the flight station center pedestal. The CI provides on and off control and BIT and threat warning indications in addition to the signal used by the MVMS for the "MISSILE THREAT, MISSILE THREAT" voice warning alert that is sent to the pilot, copilot, and flight engineer.

22.11.2.1.2 CP-1975/AAR-47 Computer Processor

The CP is located in rack G-2. The CP processes the signals received from the OSCs, outputs MWS status and threat alerts to the CI, and sends a dispense request signal to the CMDS. The CP operational software differentiates threats from non-threats, performs system Built-In Test (BIT), and system mode control. Upon threat declaration, the CP sends a dispense request command to the CMDS programmer in addition to a signal to illuminate the appropriate quadrant indicator on the CI THREAT indicator and the appropriate quadrant indicator on both EWSSIs for 3 seconds.

22.11.2.1.3 SU-164/AAR-47 Optical Sensor-Converter

There are four OSCs on the aircraft. Two are installed on the forward radome and two are installed on the aft radome. The OSCs are wide field-of-view staring devices that sense in-band optical energy.



P3A-F079

PANEL MARKING	FUNCTION
THREAT indicator/CI test switch	Dual purpose switch/indicator. Illuminated to indicate threat or test status. When pressed, initiates CI self-test.
Upper Left Arrow	When illuminated, indicates missile threat detected by forward port OSC.
Upper Right Arrow	When illuminated, indicates missile threat detected by forward starboard OSC.
Lower Left Arrow	When illuminated, indicates missile threat detected by aft port OSC.
Lower Right Arrow	When illuminated, indicates missile threat detected by aft starboard OSC.
All Four Arrows	Illuminated during CI self-test.
	Note A separate pushbutton for the MVMS is provided adjacent to the MVMS circuit breaker on the forward load center.
POWER switch/indicator	When pressed, turns power on or off. On initial power on, CI BIT is initiated.
Illuminated	Indicates power is applied.
FAILURE indicator/SYSTEM test switch	Dual purpose switch/indicator. Illuminated to indicate failure or system test status. When pressed, initiates system BIT.
1	When illuminated, indicates forward port optical sensor has failed.
2	When illuminated, indicates forward starboard optical sensor has failed.
3	When illuminated, indicates aft port quadrant optical sensor has failed.
4	When illuminated, indicates aft starboard quadrant optical sensor has failed.
All Four Numbers	Illuminated during system test and to indicate failure of the computer processor.
AUDIO	Nonfunctional.
LAMP	Adjusts the display illumination level.

Figure 22-62. ID-2464/AAR-47 Control Indicator

22.11.2.2 AN/AAR-47(V)2 Missile Warning Set (MWS)

The AAR-47(V)2 MWS incorporates the same surface-to-air passive electro-optical features of the AAR-47. Additionally it provides for 360° laser threat recognition. On MWS detection, a declaration of an incoming missile is provided via the CI, EWSSI and aurally to the pilot, copilot, and FE, and a dispense request is sent to the CMDS (MW only, not laser). For a laser threat, visual indications are provided on the CI panel and an aural cue is sent to the pilot, copilot, and flight engineer.

Note

Currently, laser threat alerts to the two front quadrants of the AAR-47(V)2 are deactivated pending further testing.

22.11.2.2.1 AAR-47(V)2 Control Indicator

The CI is located on the flight station center pedestal. The CI provides on and off control, BIT, and missile and laser threat warning indications. For laser warning threats, the CI displays angle of arrival and threat classification. Aural cues for missile and laser threats are sent to the pilot, copilot, and flight engineer (Figure 22-63).

Note

Currently, a generic “MISSILE THREAT, MISSILE THREAT” message is sent to the pilot, copilot, and flight engineer instead of the individual aural tones that distinguish between missile and laser threats. “Request dispense” is also sent if in CMDS Semi Auto for MW.

22.11.2.2.2 AAR-47(V)2 Computer Processor

In addition to the functions provided for by the AAR-47 CP, the AAR-47(V)2 CP sends a signal to the CI to display laser threat direction and laser type.

22.11.2.2.3 AAR-47(V)2 Optical Sensor-Converter

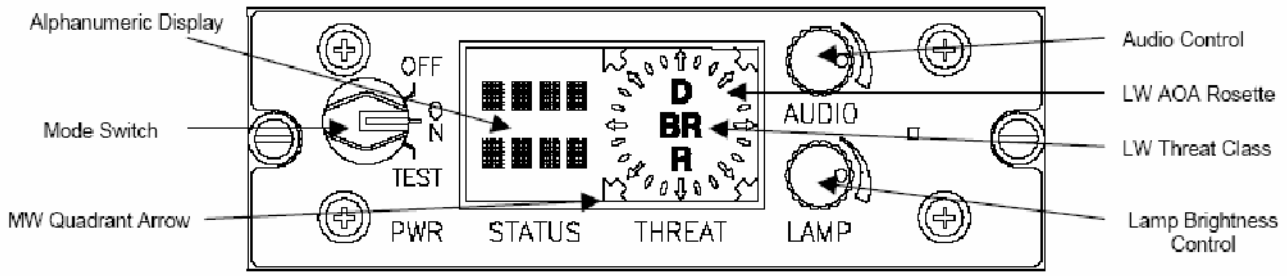
In addition to the functions provided for by the AAR-47 OSCs, AAR-47(V)2 OSCs provide for laser threat detection and angle of arrival.

WARNING

Prior to flight in a hostile environment, clean the Optical Sensor-Converter lenses and inspect for damage. The presence of a film caused by the aircraft exhaust has been proven to significantly reduce the effectiveness of the system. To clean the sensor, flood the sensor lens with a nonabrasive soap containing cleaning solutions. For hard-to-remove dirt, isopropyl alcohol may be used. Using a lens tissue or a lint-free cloth, gently wipe sensor filter until there are no streaks on the filter. Digs, scratches, or small chips located in the area of the High Angular Resolution Laser Irradiation Detector (HARLID) detector of the Infrared Optical Sensor-Converter (IOSC) will degrade the LW performance. Any OSC exhibiting cracks should not be considered serviceable.

Note

OSC alignment errors from vertical will cause corresponding errors in LW angle of arrival.



PANEL MARKING	FUNCTION
PWR	Turns power off, on, or initiates a system test.
STATUS	Indicates MW for missile threat or LW for laser threat. Also gives relative bearing of laser threat. Also indicates system degradation and failures.
THREAT	Upper left arrow indicates missile threat detected by forward port OSC. Upper right arrow indicates missile threat detected by forward starboard OSC. Lower left arrow indicates missile threat detected by aft port OSC. Lower right arrow indicates missile threat detected by aft starboard OSC. Small, interior arrows and compass rosette indicate direction of laser threat. D indicates laser designator indication. BR indicates laser beam-rider indication. R indicates laser range-finder indication.
AUDIO	Nonfunctional.
LAMP	Adjusts the display illumination level.

Figure 22-63. AAR-47(V)2 Control Indicator

22.11.2.3 AN/ALE-47 Countermeasures Dispenser System (CMDS)

The CMDS is a reprogrammable, computer-controlled, countermeasures dispenser system that provides the dispensing capability for all current types of Navy expendable countermeasures. The CMDS is capable of executing six manual and one automatic/semi-automatic (missile warning) dispense programs. The CMDS is capable of carrying and dispensing up to 16 different payload types of expendables within its inventory. Each type is allocated to one of four payload categories, which are designated as: FL (Flare), CH (Chaff), O1 (Other1), and O2 (Other2). Initial payload inventories are defined in the Mission Data File (MDF). The MDF contains definitions of up to 16 magazine loadout configurations. The CMDS consists of a Cockpit Control Unit (CCU), a programmer, three sequencers, six dispenser assemblies, a CMDS power relay, a CMDS ARM relay, three safety switches, two Bang (DISP) switches, and two CMDS Manual Release (MNL RLSE) switches.

22.11.2.3.1 C-12170/ALE-47(V) Cockpit Control Unit

The CCU (Figure 22-64) is located on the flight station center pedestal. The CCU provides the primary means for operator interface functions with the CMDS. It provides the controls to allow the operator to turn power on and off, select the mode of operation, select a manual program, initiate the jettison dispense program, selectively inhibit dispense of payload categories, inhibit the MWS interface, and initiate BIT. The CCU also provides an alphanumeric display area and annunciators for communicating CMDS status to the operator.

22.11.2.3.2 CD-45(V)1/ALE-47(V) Programmer

The programmer, located in rack G-2, is the central processing, controlling, and communications unit of the CMDS. It is designed to provide automatic threat-adaptive countermeasures dispense programs. The programmer receives dispense requests and CMDS status, determines the appropriate actions to be taken based on these inputs, and commands the sequencers (via the CCU) to execute the dispense program.

The functionality allocated to the programmer is implemented within the Operational Flight Program (OFP). The definitions of mission-specific values are provided in a MDF resident in non-volatile memory.

The AN/USQ-131 Memory Loader Verifier Set (MLVS) is used to download the OFP and MDF into the programmer via the CMDS data interface connector located adjacent to the programmer in electronic rack G2.

22.11.2.3.3 SA-2669/ALE-47(V) Sequencer

There are three sequencers in the system. One is located in the port side of the bulkhead adjacent to the forward radome in the nose wheelwell, one is located in the lower outboard area of the No. 2 engine nacelle, and one is located in the lower outboard area of the No. 3 engine nacelle. The sequencer determines the location for each requested expendable, provides squib power for that expendable, conducts BIT, determines and routes magazine identification, and monitors stores inventory based on data and dispense programs received from the programmer.

22.11.2.3.4 Dispenser Assembly

There are six dispenser assemblies, each consisting of a dispenser housing and a magazine and backing plate.

a D-56/ALE-47(V) Dispenser Housing

One dispenser housing is installed on each side of the fuselage adjacent to the nose wheelwell. Two dispenser housings are installed in a Dual Dispenser Panel (DDP) in the lower outboard side of the No. 2 and No. 3 engine nacelles.

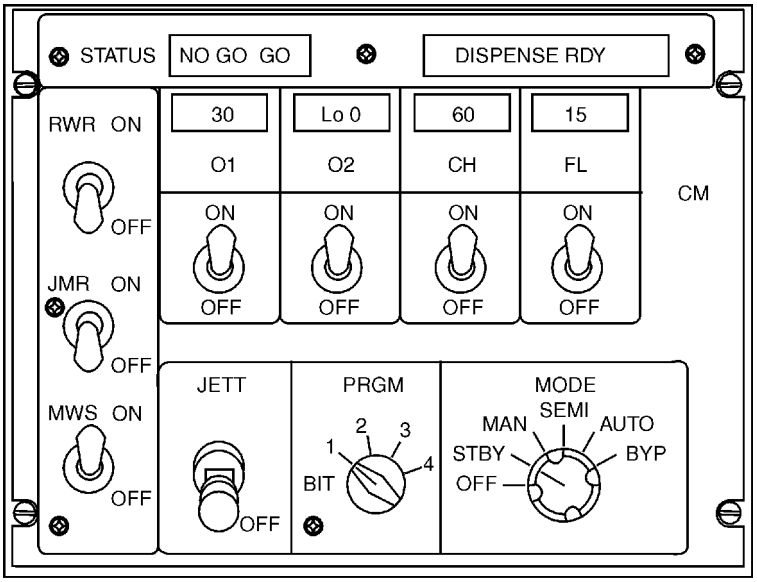
b MX-11599/ALE-47 Magazine and Backing Plate

There are two types of magazines, standard and extended. The standard magazine holds 30 standard-length, 1-inch-diameter expendables. The extended magazine holds 30 extended length (10.5 inches), 1-inch-diameter expendables. The magazines allow expendables and impulse cartridges to be stored separately and loaded in a mission ready configuration. They carry the expendable payloads and incorporate the provision for sensing magazine load configuration via loading switches. All magazine types have a rotary-switch Magazine Identification (MAG ID) code that is set before loading into the aircraft. The MAG ID code is used by the sequencer to identify one of 16 unique payload mix configurations for correlation with the MDF payload mix description. This way the payload inventory levels and pin-by-pin locations of each payload are downloaded to the sequencer during power-up.

WARNING

Magazine load plans specify decoy placement within the magazine block. Failure to load decoys into the correct holes within each magazine, properly set MAG ID switches, or load magazines into correct dispenser locations may result in unsafe decoy separation, foreign object damage to the aircraft, or ineffective countermeasures. Magazine load plans shall be verified by the aircrew prior to flight.

Safety retainers are provided as a backup to the forward dispenser magazine locking bolts. These retainers were provided for the forward dispensers only since considerable damage to the aircraft could result if a magazine were to fall out of a forward dispenser housing during takeoffs or landings.



PANEL MARKING	FUNCTION
STATUS NO GO/GO annunciators	Indicates system status.
NO GO	Illuminated when BIT has detected a failure in the system.
GO	Illuminated when system is operating as required and capable of performing all operations.
DISPENSE RDY annunciator	Illuminated when programmer has received a threat declaration from the MWS, the CCU MWS switch is ON, and the CMDS is in semi-automatic mode. Execution of the CMDS dispense program requires operator intervention. Stays illuminated for the semi-automatic hold time defined in the MDF or until the operator executes the program.
O1, O2, CH, FL inventory displays	"Lo" with any number indicates the inventory of the payload category indicated in the display has fallen to or below the Low Stores level preset in the MDF. The number "0" or any other number is the inventory quantity.
O1, O2, CH, FL enable switches	Payload category (O1 [Other1], O2 [Other2], CH [Chaff], FL [Flare]) shown above each switch.
ON	Enables the payload category identified above the switch.
OFF	Disables the payload category indicated above the switch.
	WARNING Selecting JETT overrides this setting if the payload category is programmed by the MDF for jettison. Only those expendables designated in the MDF for jettison will be released.

Figure 22-64. C-12170/ALE-47(V) Cockpit Control Unit (Sheet 1 of 2)

PANEL MARKING	FUNCTION
MODE switch	
OFF	Removes power from CMDS. All functions except JETT are disabled.
STBY	Power is applied. Inventory displays indicate the correct number of payloads loaded on all dispensers. Dispense program selection and payload dispensing is inhibited.
MAN	Enables manual dispensing of payloads.
SEMI	Enables semi-automatic dispensing of payloads.
AUTO	Enables automatic dispensing of payloads. **WARNING** Do not use the AUTO mode if payload uncommanded payload dispense is unacceptable due to safety, payload inventory, or counter detection.
BYP	Used in case of programmer or CCU failure. Press knob at AUTO and turn to select. Enables CMDS manual release switch (programs 1-4 only). Press and turn to deselect.
PRGM switch	
BIT	Spring-loaded to return to “1” when released. Initiates BIT when the MODE switch is in any position except OFF and BYP.
1-4	Selects the manual program number when MODE switch is in MAN.
JETT switch	Pull-to-unlock to change positions.
JETT	Rapidly jettisons all remaining programmed payloads. **WARNING** JETT overrides all modes (including OFF) if selected in flight. External safety interfaces (WOW and Safety switches) prevent dispensing of payload expendables in all modes. Only those expendables designated in the MDF for jettison will be released.
OFF	Disables jettison functions.
MWS enable switch	
ON	Enables the MWS input to the programmer. In AUTO mode, a MWS threat input signal automatically executes the MWS dispense program. In SEMI mode, a MWS input will alert the aircrew (“REQUEST DISPENSE, REQUEST DISPENSE, MISSILE THREAT, MISSILE THREAT”) that a response is required to execute the dispense program.
OFF	Disables the MWS input to the programmer.
JMR enable switch	Not implemented for AIP aircraft. Switch should be left in the OFF position.
RWR enable switch	Not implemented for AIP aircraft. Switch should be left in the OFF position.

Figure 22-64. C-12170/ALE-47(V) Cockpit Control Unit (Sheet 2 of 2)

22.11.2.3.5 CMDS Power Relay

When the aircraft is on the ground, the WOW circuit applies a ground that energizes the CMDS Power (PWR) relay, removing squib firing power. When deenergized, the CMDS PWR relay provides power to the squibs. The CMDS PWR relay may be bypassed (deenergized) for ground testing, troubleshooting, and WOW switch failure by actuating the red-guarded CMDS WOW OVERRIDE switch located on the forward electronic circuit breaker panel directly below the armament safety circuit disable switch. The CMDS PWR relay is located on the left bulkhead of electronic rack B2.

22.11.2.3.6 CMDS ARM Relay

The CMDS ARM relay provides logic power to the sequencers. The CMDS ARM relay is energized when the CCU MODE switch is in any position except OFF. The CMDS ARM relay is located on the left bulkhead of electronic rack B2.

22.11.2.3.7 SA-2671/ALE-47(V) Safety Switch

There are three safety switches, one located adjacent to each sequencer. It consists of an internal surface-mounted switch and an external quick-release pin with a “REMOVE WHEN ARMING” flag. With the quick-release pin installed, squib firing power to the sequencer is removed.

22.11.2.3.8 Bang Switch

There are two Bang (DISP) switches, one for the pilot and one for the copilot, located on the outboard side of the glareshield panel. When pressed, it executes manual program 5 and is designed to be readily accessible for immediate reaction situations.

22.11.2.3.9 CMDS Manual Release Switch

There are two CMDS Manual Release (MNL RLSE) switches, one for the pilot and one for the copilot, located on the outboard side of the glareshield panel. The switch is designed to allow operator intervention for semi-automatic or manual dispensing of payloads. The four-way CMDS MNL RLSE switch is a spring-loaded toggle/pushbutton switch. The switch is spring-loaded in the off position and is operational in MAN, SEMI, and AUTO modes. When toggled to the left position (MNL RLSE 1-4), the manual program selected on the CCU PRGM selector is executed. When toggled to the right position (MNL RLSE 6), manual program 6 is executed. When the CCU MODE selector is in BYP, only the left portion (MNL RLSE 1-4) is active.

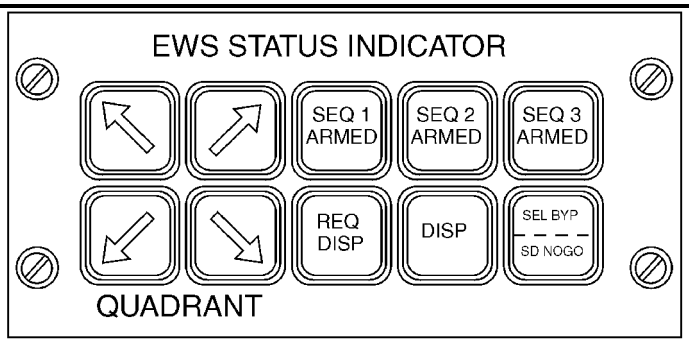
When pushed in (MNL RLSE SEMI-AUTO), the automatic/semi-automatic program is executed if the CCU MODE selector is in SEMI, the CCU MWS switch is ON, the MWS has declared a threat, and the semi-automatic dispense program preset time delay has not elapsed. The semi-automatic mode is intended to be used in an area where false alarms are likely to be encountered and payloads are limited.

22.11.2.4 EWS Status Driver

The EWSSD interfaces with the CMDS programmer and the MWS CI and outputs various EWS conditions to the EWSSIs for display. The EWSSD is located under the copilot seat.

22.11.2.5 EWS Status Indicator

There are two EWSSIs (Figure 22-65) located on either side of the exterior lighting control panel in the flight station. They provide a heads-up display of the EWS system status to the pilot and copilot. Dimmer control is provided in the overhead lighting control panel. Lamp test on the overhead control panel provides power for testing the lamps.



P3A-F081

PANEL MARKING	FUNCTION
QUADRANT indicator	Illuminated to indicate threat or MWS status.
Upper Left Arrow	When illuminated, indicates MWS has declared a missile threat in forward port quadrant relative to the aircraft.
Upper Right Arrow	When illuminated, indicates MWS has declared a missile threat in forward starboard quadrant relative to the aircraft.
Lower Left Arrow	When illuminated, indicates MWS has declared a missile threat in aft port quadrant relative to the aircraft.
Lower Right Arrow	When illuminated, indicates MWS has declared a missile threat in aft starboard quadrant relative to the aircraft.
All Four Arrows	When illuminated, AAR-47 Control Indicator (CI) is powered OFF and CMDS is powered ON.
SEQ 1 ARMED indicator	Indicates port sequencer status.
Illuminated	Indicates sequencer is hot (CMDS is in MAN, SEMI, or AUTO mode, squib power is applied, the sequencer is not reporting any faults, the CMDS PWR relay is closed, and the safety pin is removed).
Extinguished	One or more of the above conditions is not satisfied.
SEQ 2 ARMED indicator	Indicates nose sequencer status.
Illuminated	Indicates sequencer is hot.
Extinguished	One or more of the above conditions is not satisfied.
SEQ 3 ARMED indicator	Indicates starboard sequencer.
Illuminated	Indicates sequencer is hot.
Extinguished	One or more of the above conditions is not satisfied.
REQ DISP indicator	Indicates operator action is required (semi-automatic mode) to dispense payload.
Illuminated	Indicates CMDS has received a threat declaration from the MWS while in the SEMI mode. Stays illuminated for the semi-automatic hold time defined in the MDF or until the operator executes the program.
Extinguished	Implies either the operator has executed the CMDS dispense program or the request has timed out.
DISP indicator	When illuminated, indicates a dispense command has been sent by the programmer to a sequencer within the last second (4 seconds when performing jettison).
SEL BYP indicator	When illuminated, indicates a Programmer or CCU failure has been detected.
SD NOGO indicator	Indicates EWSSD status.
Illuminated	During startup, indicates EWSSD is performing Power-up BIT (PBIT). During CMDS operations, indicates a Continuous BIT (CBIT) detected fault within the EWSSD or a loss of communication with the CCU or sequencer.
Extinguished	Indicates EWSSD has recovered or operator has powered off the CMDS.

Figure 22-65. EWS Status Indicator

22.11.2.6 AN/ASH-503 Micro Voice Message System

The MVMS is located in the flight station under the copilot seat. The MVMS provides voice message warnings to the pilot, copilot, and flight engineer on a non-deselectable ICS channel. The voice messages are "MISSILE THREAT, MISSILE THREAT" and "REQUEST DISPENSE, REQUEST DISPENSE." The MISSILE THREAT inputs come from the MWS CI and are independent of EWSSD status, CMDS BIT status, or CMDS mode. The REQUEST DISPENSE input comes from the CMDS programmer.

In semi-automatic mode, the "REQUEST DISPENSE — REQUEST DISPENSE" voice warning will be heard before the "MISSILE THREAT — MISSILE THREAT" voice warning. For MVMS testing, a BIT initiate pushbutton and BIT indicator are located adjacent to the MVMS circuit breaker on the forward electrical load center.

22.11.2.7 Weight-On-Wheels Circuit

The Weight-On-Wheels (WOW) circuit, in conjunction with the CMDS PWR relay, prevents squib power from being routed to the system safety switches when the weight-on-wheels switches are energized (aircraft on the ground). A WOW signal is also routed to the programmer and CCU to further prevent inadvertent countermeasures release while the aircraft is on the ground.

22.11.3 System Description

Refer to Figure 22-66. The OSCs continuously sense in-band optical energy, convert this energy to digital signals, and pass the signals to the CP. The CP contains software that differentiates threats from non-threats. After processing, the CP outputs the MWS status and any threat alerts to the CI. Upon threat declaration, the CP sends a single dispense request command that is encoded and output over four discrete lines interfaced to the CMDS programmer. The CP also sends a signal to light the appropriate quadrant indicator on the CI THREAT indicator and on both EWSSIs for 3 seconds. This CI THREAT indicator signal is used by the MVMS to activate the "MISSILE THREAT, MISSILE THREAT" voice warning alert on a non-deselectable ICS channel to the pilot, copilot, and flight engineer.

When the CMDS programmer receives a dispense request command from the CP, further action will depend on the CCU mode selected.

If in AUTO and CCU MWS is selected ON, the dispense signal is automatically sent to the sequencers, via the CCU, to execute the automatic/semi-automatic dispense program.

If in SEMI and CCU MWS is selected ON, the programmer prepares the automatic/semi-automatic dispense program commands and retains the commands until the pilot or copilot presses the CMDS MNL RLSE button in for program execution or the preset time delay, defined in the MDF, has elapsed.

WARNING

The MDF Programmer will not begin an AUTO or SEMI release if the inventory of a category of expendables falls below low store limits (six expendables).

If in MAN, the CMDS ignores threat indications from the MWS. The pilot or copilot must select a manual program for payload release.

The Manual Dispense programs (1-6) are available in the AUTO, SEMI, and MAN modes. Manual program 5 is executed when a Bang (DISP) switch is pressed. Manual programs 1 to 4 are executed by selecting the desired program on the CCU and toggling a CMDS MNL RLSE switch to the left position. Manual program 6 is executed when a CMDS MNL RLSE switch is toggled to the right position.

When commanded to execute a dispense program, the CMDS generates the appropriate dispense command defined by the MDF which will determine the number of expenditure/burst, the number of burst/salvo, and the number of salvos for each payload category. Bursts are spread between sequencers based on magazine loadout and dispenser program definitions.

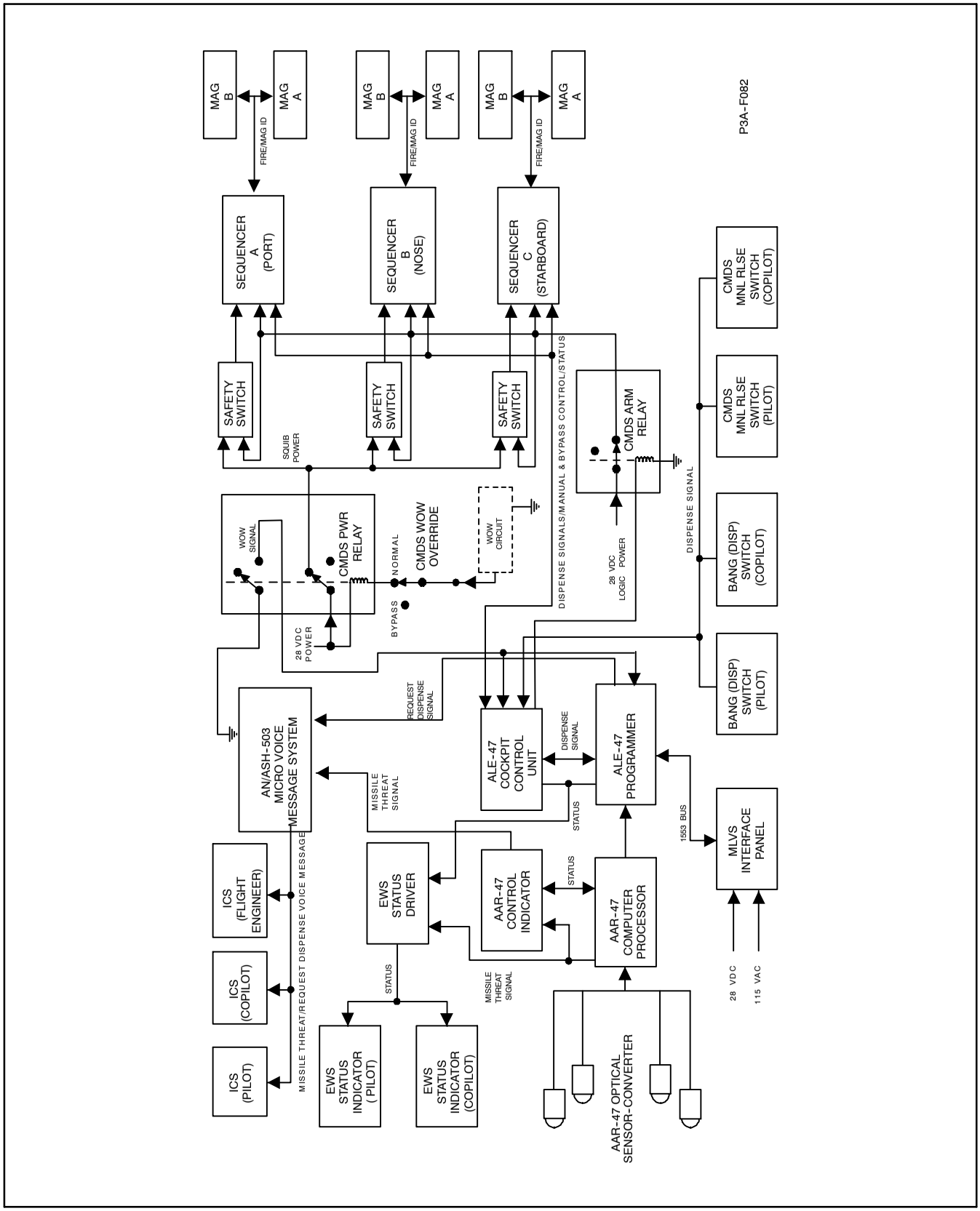


Figure 22-66. EWS Block Diagram

CHAPTER 23

Flight Station Systems

23.1 INTRODUCTION

This chapter covers that equipment under the cognizance of flight station personnel and includes discussions of the attitude/heading displays as well as the armament/jettison systems.

The display systems used to navigate and maintain the attitude of the aircraft are: the flight director system, horizontal situation indicator system, vertical gyroscope, and wet compass. The central repeater system and navigation interconnection (NAV-J) box are integral parts of these displays. The navigation simulator that assists the aircrew in preflight and troubleshooting of navigation and attitude displays will also be discussed.

To fully understand and grasp the functions of large systems, study of the illustrated diagrams in the Crew Station Maintenance Manuals, NAVAIR 01-75PAC-12, is of much value. A copy of the pertinent crew station manual is a part of each crew station equipment and is in the aircraft at all times.

23.2 FLIGHT DIRECTOR SYSTEM (FDS)

The FDS, AJN-15, is a navigational and attitude aid to the pilot and provides him with the visual cues and commands necessary to fly a prescribed pattern or approach. It consists of the flight director steering computer, a signal data converter, two flight director indicators, and the FDS control panel. Auxiliary equipment includes the HSIs, HSI control panels, and the navigational availability advisory lights. The FDS receives input data from the navigational and tactical systems, processes this data, and displays continuous roll (and in one case, pitch) commands to the pilot. Other displays of pitch and roll attitude, glideslope and localizer deviation, skid-slip, and rate of turn are also provided. The FDS receives display and status signals from other navigational equipment as follows:

1. TACAN — Course deviation.
2. VORs — Course (or localizer) deviation and localizer warning flag signal.
3. INS-1, INS-2, and vertical gyro pitch, roll, and gyro valid signals.
4. VHF navigation system, VIR-31A.
5. UHF-DF — Relative bearing signals, when used in conjunction with the OTPI or UHF 1 receiver.

The system processes and displays information from many sources depending on the mode and submode selected. There are three modes: manual, radio navigation, and tactical. The radio navigation mode may be divided into submodes of TACAN, VOR, or ILS. The tactical mode provides submodes of Direction Finding (DF) or computer track (COMP TRK CONT).

Power to the system, except the FDI, is provided by the MEAC bus through a circuit breaker on the forward load center. FDS relay control power is from the MEDC bus through a circuit breaker on the forward load center. The FDIs are normally powered by the MEAC bus but, being considered essential to flight, will be powered by the FEAC bus if the former fails (automatic transfer).

23.2.1 Flight Director System Components

23.2.1.1 Flight Director Steering Computer (FDSC)

The FDSC is located in rack B-2 (Figure 23-1) and is an analog computer used to generate ILS glideslope and localizer information for display on the command bar of the FDI. Fly-to-point steering from the central computer is input to the FDSC for display on the command bar and on the HSI course deviation bar (flight station only).

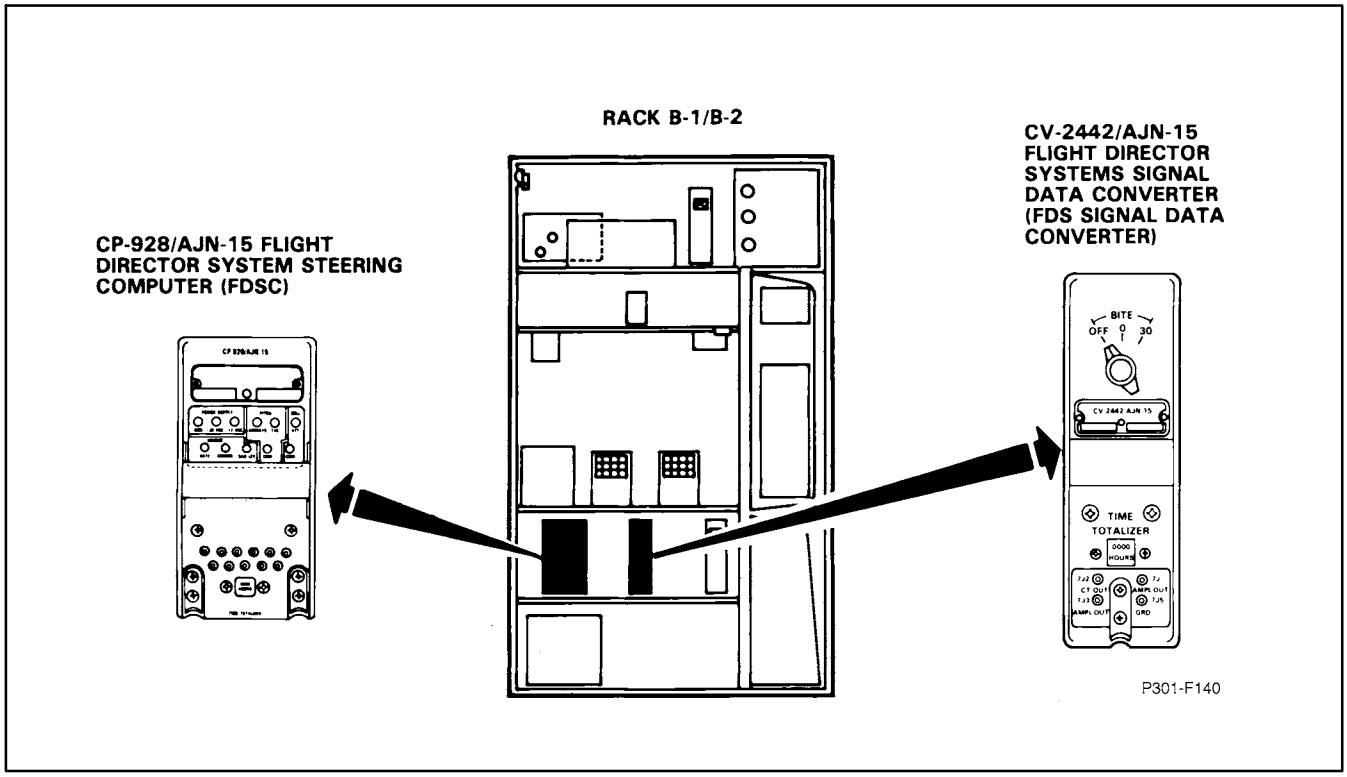


Figure 23-1. Flight Director Steering Computer and Signal Data Converter

23.2.1.2 Flight Director Signal Data Converter

The flight director signal data converter is located in rack B-2 and generates a damped UHF-DF or OTPI heading signal for display on the HSI course deviation bar and course arrow (refer to Figure 23-1).

23.2.1.3 Flight Director Indicators (FDIs)

Figure 23-2 shows the pilot and copilot instrument panels. The indicators are identical and serve as an aircraft attitude display and visual indication for flight direction. The following information is displayed:

1. Pitch and roll attitude is read as a displacement of the pitch and roll sphere. (INS-1 is the normal source of the pilot attitude information, and INS-2 is the normal source of the copilot attitude information. If either INS fails, attitude information from a standby vertical gyro may be selected manually at the respective HSI control panel.)

WARNING

Standby gyro should never be selected by both pilots unless both INS sources are completely unusable.

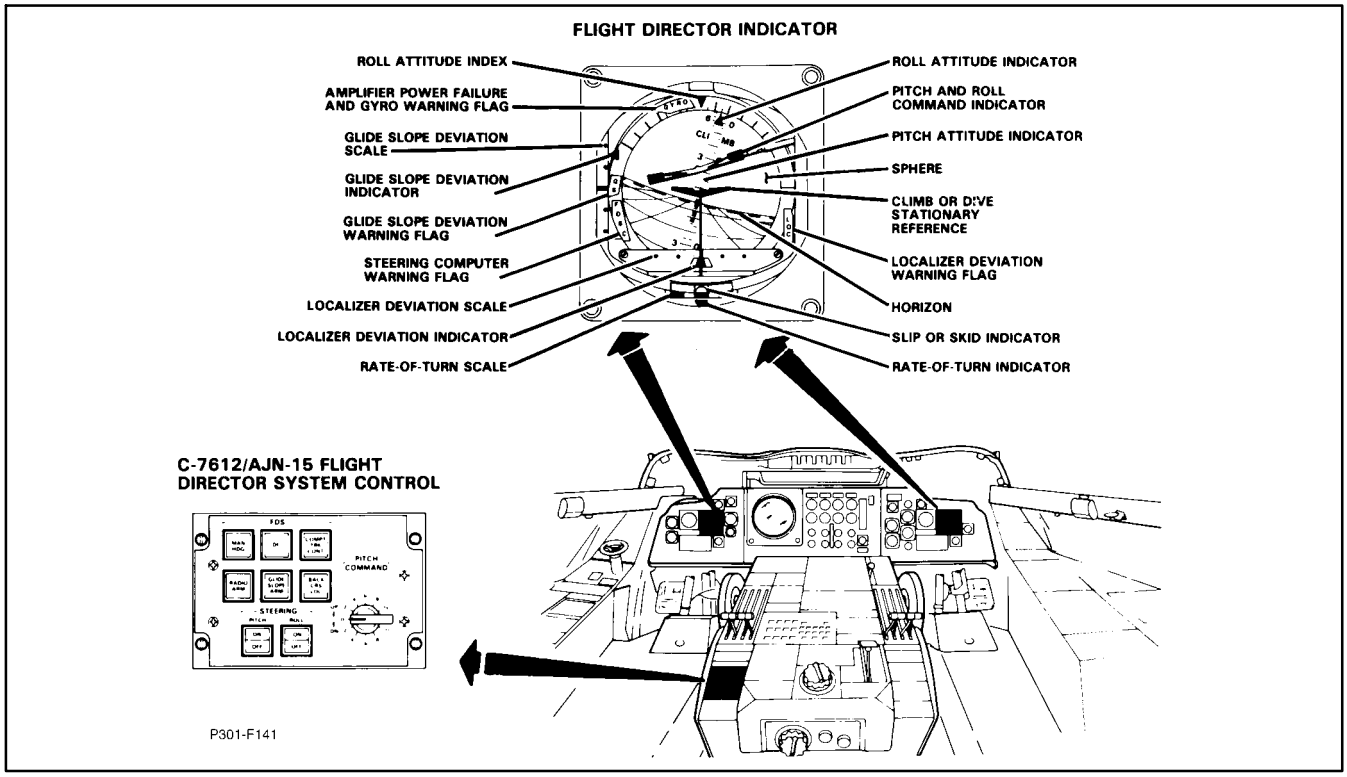


Figure 23-2. FDS Components Located at the Flight Station

Note

- With loss of the MEAC bus, information displayed on the copilot FDI with Inertial 2 selected will be unreliable because of loss of synchro-excitation voltage. Standby gyro shall be selected by both the pilot and copilot.

- The amount of aircraft pitch (in degrees) can be determined by comparing the graduated scale on the sphere with the miniature aircraft symbol on the face of the instrument. Pitch (climb or dive) attitude is read in 1° increments up to 10°, 5° increments to 60°, and 10° increments to 90°. Roll attitude is read in 5° increments up to 30°, 10° increments to 60°, and 30° increments to 90°. The amount of roll is determined by comparing the roll (bank) angle pointer against the fixed bank angle scale.

2. Command information is displayed on the command bar of each FDI instrument, although the pilot has control. Input signals are received from the FDSC to cause command-bar displacement, thus providing the pilot with a visual indication of the steering command required to achieve a desired flightpath. The command bank angle is limited to 30° in the manual and radio submodes and 45° in the tactical submodes. The roll steering function of the bar is achieved through operation of the ROLL STEERING pushbutton-indicator on the FDS control panel, and the pitch function is achieved through use of the PITCH STEERING pushbutton-indicator. When PITCH STEERING is ON in addition to ROLL STEERING, and not in the glideslope submode, the center of the command bar is positioned to indicate the actual pitch of the aircraft. If ROLL STEERING is OFF and PITCH STEERING is ON, the bar is positioned parallel to the face of the FDI. The command bar swings down and out of view when neither button is pressed.

3. Deviation from the glideslope is shown in respect to a fixed vertical scale by the glideslope pointer, which is displaced up or down in response to the glideslope deviation input signal. When the input signal goes to zero, as it does when the aircraft is on the glideslope beam, the pointer lines up with the center horizontal bar of the scale. Each dot above and below the center bar on the glideslope scale represents 1/4° displacement from the center of the glideslope beam.

4. Deviation from the localizer is read in respect to a fixed horizontal scale as a displacement of localizer pointer from center. The signal is obtained from the selected VOR receiver. Each dot on either side of centerline represents a 1 1/4° displacement from the center of the localizer beam.

5. Rate-of-turn indications are provided by the rate-of-turn pointer that moves right or left in response to a signal from the rate-of-turn gyro. Separate rate-of-turn gyros are provided for the pilot and copilot. The gyros are powered by the MEDC bus with the pilot having an alternate source from the FEDC bus if the essential bus monitoring switch is placed in the off position. The rate-of-turn scale is a series of alternate white and black bars. The rate-of-turn pointer tip is a white bar corresponding to the center white bar of the scale. When the white bar of the pointer is aligned with the black bar of the scale on either side, a standard 2-minute turn is being executed. When the pointer is aligned with the white bar on either side of the scale, a double-rate, 1-minute turn is being executed.

6. Slip or skid indications are provided by an inclinometer, which consists of a curved tube and ball, located at the bottom of the instrument.

7. Warning flags are provided on each FDI instrument and come into view in case a malfunction, unreliable signal, or power failure occurs. Each flag is driven by motor movements in response to DC signal inputs when the required normal signal is applied. The warning flags and their functions are as follows:

   a. GS — The GS flag monitors the signal intensity input from the glideslope receiver only when VOR-1 is operating on a LOC frequency (odd tenths: 108.1 to 111.9 MHz). The glideslope signal is routed through the FDSC to the FDI. The GS flag swings out of view when the glideslope signal is valid and reliable and is biased out of view when an LOC frequency has not been selected. The routing of the GS flag signal to both FDIs is controlled by the setting of the pilot HSI course selector switch.

   b. LOC — The LOC flag monitors the built-in test circuitry of the localizer receiver and the validity of the localizer signal. Failure of the localizer signal may affect the validity of the command bar display on both FDI instruments. The LOC flag swings out of view when the localizer deviation signal is valid and reliable and is biased out of view when an LOC frequency has not been selected. The routing of the LOC flag signal to both FDIs is controlled by the setting of the pilot HSI course selector switch.

   c. GYRO — The GYRO flag is kept out of view by the system valid signal provided by the selected source of attitude (INS-1, INS-2, or STBY GYRO) and appears if the selected source fails. The GYRO flag appears when a failure occurs in primary attitude, auxiliary attitude, true heading, MHRS, or Digital Data Unit (DDU) power analog circuits. The GYRO flag circuits also monitor the four servoamplifiers in each FDI. A failure of any one servo will display the GYRO flag. When STBY GYRO is selected, the GYRO flag is controlled only by the standby gyro validity and the FDI servos validity. When STBY GYRO is selected, the HSI heading should be closely monitored since there will be no annunciation of heading failure.

   d. FDSC — The FDSC flag monitors the BITE circuits of the FDS computer and comes into view if a malfunction or unreliable signal output occurs. It swings out of view when the FDSC is functioning and command signals supplied by the FDSC are valid. A failure in one mode does not necessarily prevent satisfactory operation in another mode.

23.2.1.4 FDS Control Panel

The FDS control panel is located at the aft port position of the center control stand in the flight station. The control panel contains eight self-illuminated pushbutton switches and a rotary potentiometer. The function of the FDS control panel is to provide the pilot with priority control of the inputs to the FDI command bars and, in the tactical mode, course information to the HSI.

23.2.2 System Operation

(Refer also to NAVAIR 01-75PAC-11-2 series System Operator Manuals [SOMs].) The system is in operation whenever power is applied to the aircraft buses. As stated previously, the FDI receives all display signals, except for the command bars, directly from the equipment providing the basic signals; however, those signals pass through the FDS subunits so that inputs to the status and command bar circuits can be extracted. Numerous interlocks are present in the command bar system. ROLL or PITCH STEERING must be selected prior to selecting a mode or submode requiring information from that axis. The selection of MAN HDG is a normal operation but not a prerequisite for conversion to the radio navigation mode. The tactical mode does not operate unless the pilot has selected DA/TAC NAV on his HSI control panel. When RADIO ARM is selected, the FDS will automatically switch to the radio submode selected on the pilot HSI course selector when radio course deviation is less than two dots. GLIDESLOPE ARM may be selected when the VOR-1/ILS radio navigation mode has been selected and is operable. The FDS automatically switches when the glideslope deviation is less than one-fifth dot. When the switching above occurs, the FDS is referencing the localizer/glideslope radio beam in the case of ILS approaches and the radio beam whose center has been determined by the setting of the COURSE SET control knob for other approaches.

Note

- Sequencing requirements for mode/submode selection necessitate a distinct order of switch engagement on the FDS and HSI control panels.
- Improper switch engagement during selection of any mode or submode may cause a failure warning flag on the FDI.
- Switch positions and operation in the following operating procedures refer to the pilot instruments and panels.
- The angle of intercept calculated by the FDSC varies from 30° to 45° dependent on the mode/submode selected. The pilot may elect to adjust his flightpath as the situation dictates.

23.2.2.1 Manual Heading Mode Operation

The operating procedures for the manual mode follow:

1. ROLL STEERING pushbutton indicator on the FDS control panel — Depress to illuminate amber. Command bar appears; FDSC flag retracts.
2. MAN HDG pushbutton indicator on the FDS control panel — Depress to illuminate amber.

Note

Selection of MAN HDG overrides any previously selected mode or submode.

3. The roll command bar indicates the roll recommended to intercept the heading selected by the HSI HEADING SET knob.

23.2.2.2 Radio Navigation Mode Operation

The operating procedures for the submodes of TACAN, VOR-1, VOR-2, and VOR-1/ILS (localizer only) follow:

1. TACAN, VOR-1, or VOR-2 — Energized and set to desired channel.
2. BRG-1 switch on HSI control panel — TACAN, VOR-1, or VOR-2, as required. Verify the MAG and TCN, VR1, or VR2 red mode lights illuminate on HSI. Verify bearing on HSI bearing pointer 1 indicates correct bearing and, if applicable, correct TACAN distance.

Note

VOR bearings are not valid when an ILS frequency is selected.

   a. If the use of Low Frequency (LF) radio beacon is part of the approach, energize the LF ADF receiver and set to the prescribed frequency. Select ADF on the HSI BRG-1 control and verify the MAG and ADF red mode lights illuminate on the HSI. Verify HSI bearing pointer 1 indicates the correct bearing.

3. Course switch on HSI control panel — TACAN, VOR-1/ILS, or VOR-2.
4. COURSE SET knob on HSI — Set to orient course arrow to desired radial, approach course, or ILS inbound heading. The HSI course deviation bar indicates the position of the desired course relative to the course arrow. When a localizer approach is being executed, this same information is displayed on the FDI localizer deviation indicator. Fly the approach plate or as directed by approach control.
5. FDS ROLL STEERING pushbutton indicator — Depress to illuminate amber. Command bar appears. FDSC flag retracts.
6. MAN HDG pushbutton indicator — Depress to illuminate amber.
7. RADIO ARM pushbutton indicator on FDS control panel — Depress to illuminate amber.

Note

If course deviation bar on the HSI indicates less than two dots, radio beam capture will be immediate and completion of step 7 will not result in a light change, but the MAN HDG light will change to green and the roll command bar will indicate the bank required to maintain the aircraft on the radio beam whose centerline corresponds to the selected course or localizer beam.

8. If a back course localizer approach is being executed: BACK CRS LOC pushbutton indicator — Depress to illuminate amber. This action reverses the sense of the deviation signal input to the HSI course deviation bar and FDI localizer indicator so that course corrections will always be made to the needle.
9. The roll command bar indicates the bank required to steer to the course selected by the COURSE SET knob. When radio beam capture occurs (less than two dots of course deviation), both MAN HDG and RADIO ARM lights change from amber to green and the roll command bar indicates the bank necessary to steer to the radio beam.

Note

Do not move the COURSE SET knob on the HSI once radio beam capture has occurred; movement of the knob can generate spurious FDS commands to the command bar. If a change is necessary, depress the MAN HDG switch before changing the COURSE SET knob. This note also applies to station passage if the FDS has been used for airway navigation.

10. Fly the aircraft symbol into command bar.

23.2.2.2.1 ILS Approach Submode Operation

1. Proceed as in steps 1 through 10 above except VOR-1 must be selected to a valid ILS channel and the glideslope receiver must be operating.

2. If applicable, the LF ADF should be tuned to the outer marker and the HSI BRG-1 needle selected to ADF. Verify the ADF red mode light is illuminated on the HSI. Verify HSI bearing pointer 1 indicates the correct bearing.

3. Verify the PITCH COMMAND knob on the FDS control panel is set to 0 (detent position).

4. Fly the prescribed approach plate or as directed by approach control. The glideslope deviation indicator displays the position of the glideslope relative to the aircraft (center scale).

5. Depress PITCH and GLIDE SLOPE ARM pushbutton indicator of the FDS control panel when within one dot or less of localizer deviation. (Both pushbutton indicators illuminate amber.)

6. Glideslope capture occurs when glideslope deviation indication is within one-fifth dot. When capture occurs, GLIDE SLOPE ARM light changes to green.

Note

If glideslope capture does not occur, depress and repress GLIDE SLOPE ARM. This action bypasses the normal capture whenever the glideslope deviation is one dot or less.

7. Fly the aircraft symbol into the command bar.

Note

Glideslope information is not valid on a back course approach.

23.2.2.3 Tactical Mode Operation

The following steps are common to all submodes of tactical mode operation:

1. Central computer operational.

2. COURSE switch on HSI control panel — TACNAV.

3. BRG-1 switch on HSI control panel — DA. Verify red TRU mode light on HSI and green TRUE HEADING light above the HSI are illuminated.

4. ROLL STEERING pushbutton indicator on FDS control panel — Depress to illuminate amber. Command bar appears. The FDSC flag may retract at this time but must retract following step 7.

5. MAN HDG pushbutton indicator on the FDSC control panel — Off (green) or the light changes to green upon completion of step 7.

23.2.2.3.1 Computer Track Submode

1. The green COMPUTER TRACK AVAIL light on the navigational availability panel should be illuminated, indicating TACCO or NAV/COMM has inserted a fly-to point.
2. COMPT TRK CONT pushbutton indicator on the FDS control panel — Depress to illuminate amber. Verify a red FTP mode light on the HSI.
3. The great circle course to the fly-to point is available on the HSI course arrow and course counters. The FDSC processes drift angle to output a roll steering command.
4. If the green TACTICAL STEERING light on the navigational availability advisory panel is also illuminated, the FDSC processes central-computer-generated course error, crosstrack deviation, and command bank angle to output an indicated roll steering command to maintain a rhumb line track.

23.2.2.3.2 DF Submode (UHF-DF)

1. UHF-1 — Select frequency and set to DF. Verify a green TAC UHF DF AVL light on the navigational availability advisory panel is illuminated.
2. DF pushbutton indicator on the FDS control panel — Depress to illuminate amber. Verify a red UDF mode light on the HSI is illuminated.
3. The damped true UHF-DF course is available on the HSI course arrow and course counters and the roll command bar indicates the bank angle necessary to intercept and fly the DF course.

23.2.2.3.3 DF Submode (OTPI)

1. UHF-1 DF not selected OTPI — ON. Verify a green OTPI DF AVAIL light on the navigational availability advisory panel is illuminated. Select channel.
2. DF pushbutton indicator on the FDS control panel — Depress to illuminate amber. Verify a red UDF mode light on the HSI is illuminated.
3. The damped true OTPI-DF course is available on the HSI course arrow and course counters and the FDI roll command bar indicates the bank angle required to intercept and fly the OTPI course. The reliability of the course indicated may be questionable if the SIGNAL light on the OTPI control panel is not illuminated.

23.3 HORIZONTAL SITUATION INDICATION SYSTEM

The HSI system provides azimuth display information to the pilot, copilot, and navigator with panel indicators (HSI) located at the respective locations. The pilot has control of the primary operating modes of all three indicators, whereas the copilot and navigator can implement certain other display modes to permit them to assist the pilot or to monitor his HSI display. The system receives inputs from INS systems 1 and 2, VOR, TACAN, ADF receivers, UHF-DF, and the central computer. Outputs are supplied to the AFCS and FDS. Magnetic bearing, relative to the pilot indicated aircraft heading, is displayed when in the radio navigation submodes of VOR-1, VOR-2, TACAN, ADF, and DF. In the DF submode, bearing information is derived from either the OTPI or UHF-1/ADF.

23.3.1 System Components

23.3.1.1 Horizontal Situation Indicator (HSI)

An HSI, ID-1540/A, is provided for the pilot, copilot, and navigator (Figure 23-3). The indicators are externally identical but operate differently in some operational modes. The following information is displayed:

1. TACAN distance data are displayed as a digital readout on all three instruments.
2. A distance shutter on all three HSIs indicates the validity of the source.
3. Bearing pointer No. 1 on all three HSIs indicates drift angle or magnetic bearing as selected by the pilot.

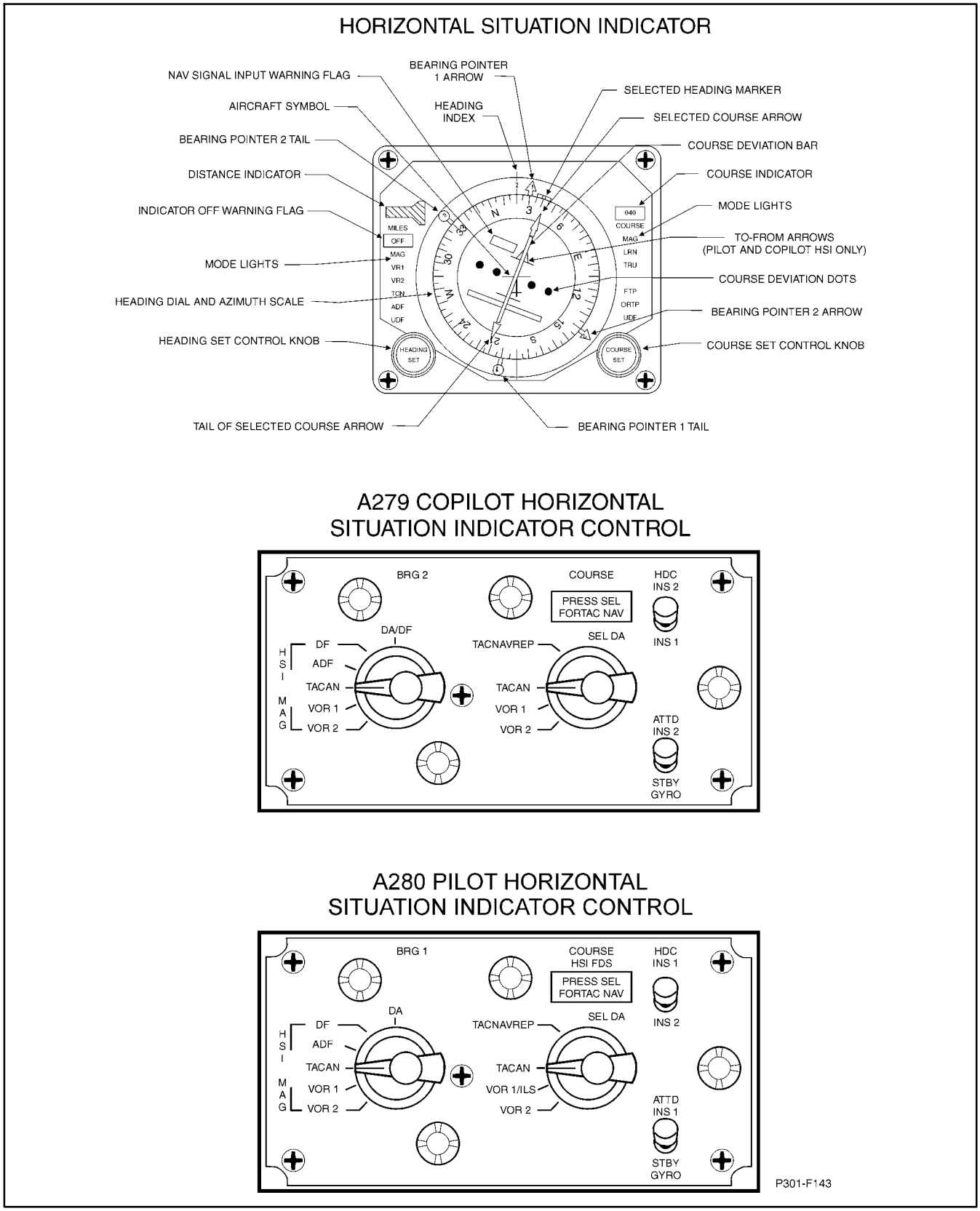


Figure 23-3. HSI System Components Located at the Flight Stations

4. Bearing pointer No. 2 on the pilot and copilot HSIs indicates either drift angle or magnetic bearing as selected by the copilot. Bearing pointer No. 2 on the NAV/COMM HSI indicates the magnetic bearing as selected by NAV/COMM.

5. Heading is displayed on the compass card (heading dial) of all three HSIs. INS-1 is the normal source for the pilot whereas INS-2 is the normal source for the copilot.

6. Selected heading is displayed on the selected heading marker of the pilot and copilot HSI. Selected heading is used as a reference mark or as an input to the AFCS and/or FDS. The HEADING SET knob on the pilot HSI is used to vary the selected heading marker with respect to the compass card. The copilot selected heading marker is slaved to the pilot selected heading marker. The NAV/COMM heading marker shows any mismatch angle between the INS-1 and INS-2 heading references by using the selected INS for compass card heading and the alternate INS for the heading marker.

7. The information shown on the course arrow on each HSI is dependent on the mode selected. In the radio navigation mode, the arrow shows the course selected by the COURSE SET knob. In the tactical navigation mode, the arrow displays a computer-generated command course (FDS computer track submode) or a damped true course (FDS DF submode). In all cases, the course indicated is also displayed as a digital readout on the course indicator.

8. Course deviation is shown on the pilot and copilot HSIs by a displacement of the course deviation bar from its center position. The signal source is the VOR or TACAN selection on the HSI control panel COURSE switch. For VOR or TACAN signals, the indicated deviation is relative to the setting of the course arrow. For localizer signals, the indicated deviation is relative to the localizer beam and independent of the course arrow setting; however, the course arrow setting is used as an input to the FDS command bar circuits and should be properly positioned. Indicated deviation is approximately 5° per dot for VOR and TACAN inputs and 1-1/4° per dot for localizer signals. In the tactical mode, the bar is aligned with the course arrow. The course deviation bar on the NAV/COMM HSI is not used.

9. To-from indication is shown on the pilot and copilot HSIs by means of a to-from arrow. The signal source is the VOR or TACAN selected to provide course information. The arrow is retracted in the localizer submode and tactical mode and is not used on the NAV/COMM HSI.

10. The COURSE SET knob on the pilot and copilot HSIs is used to select the reference course for course deviation information supplied by the particular VOR or TACAN each is using. The selected course is shown by the position of the course arrow relative to the compass card and by a course counter, as a digital readout. When the copilot selects the same VOR or TACAN as the pilot, the copilot course arrow is slaved to the pilot's and the copilot COURSE SET knob is not usable. The COURSE SET knob on both instruments is also not usable in the tactical mode.

Note

COURSE SET and HEADING SET control knobs are not operable at the NAV/COMM station.

11. The NAV flag on the pilot and copilot HSIs provides status information related to course mode selection. In all cases, it appears if a failure occurs in the repeater heading amplifier that each is using. In the radio navigation mode, the flag also appears if the course signal input from the selected VOR or TACAN becomes unreliable. In the special case that the pilot selects a VOR that is tuned to an ILS frequency, the pilot flag is masked out of view and signal reliability is indicated by the LOC/GS flags in both FDIs. The copilot flag is also masked out of view when the copilot selects the same VOR as the pilot. In the tactical mode, the flag is normally masked out of view; however, it will appear to the pilot if TACNAV or DA is deselected, provided the course signal input for the selected VOR or TACAN is unreliable. The same interlocks exist for the copilot except TACNAV must also be selected by the pilot. The NAV flag in the NAV/COMM HSI monitors only the status of the repeater heading amplifier being used for that instrument.

12. Mode lights on all three HSIs are illuminated red to show that information related to the mode displayed is available on the respective instrument. The lights in the cockpit HSIs are controlled by a rheostat on the pilot overhead panel.

13. Course error (the angle between the selected course arrow and the indicated heading) is derived from the pilot HSI for use by the flight director steering computer.

14. Heading error (the angle between the selected heading marker and the indicated heading) is derived from the pilot HSI for use by the flight director steering computer and AFCS.

23.3.1.2 HSI Test Panel

A panel labeled HSI TEST is located on the forward navigation interconnection box in rack B-1 to test the HSI and FDI indicators for correct operation. The panel contains three pushbuttons, labeled PILOT, COPILOT, and NAVIGATOR.

23.3.1.3 HSI Control Panels

A control panel to select input signal source for the HSI indicators is provided for the pilot, copilot, and navigator/communications operator. The pilot HSI control panel is located on the lower left of the pilot instrument panel. The copilot HSI control panel is located on the lower right of the copilot instrument panel (refer to Figure 23-3). Each HSI control panel provides selection of inputs to the respective HSI, except when the same operating mode has been selected on both the pilot and copilot HSI control panels, the display elements on the copilot HSI are slaved to the pilot HSI.

Note

The magnetic reference source for the NAVAID driving the copilot bearing pointer is controlled by the pilot HSI HDG select switch. Thus, if the pilot and copilot have different selections for HSI HDG and there is a heading error between the two systems, the copilot bearing pointer will disagree with his centered CDI by the amount of that error. This provides an opportunity for the copilot to monitor the heading systems for safety.

23.3.1.4 Navigation Availability Advisory Lights

Two identical navigation advisory light panels are provided for pilot and copilot use on their respective instrument panels. When illuminated green, their meaning is as listed in Figure 23-4.

23.4 ELECTRONIC FLIGHT DISPLAY SYSTEM (EFDS) (NON-BMUP)

23.4.1 Introduction

The Electronic Flight Display System (EFDS) is used to provide heading, course, and attitude information to the pilot and copilot via identical Multi-Function Displays (MFDs). Heading and course information is also provided to the NAV/COMM via the MFD located at that station. The MFDs utilize standard International Civil Aviation Organization (ICAO) symbology and associated identifiers in the generation of the standard navigational and tactical data. Additional display information available on the pilot and copilot MFDs consists of the following:

1. Dual heading bugs.

2. Bearing and heading source data.

LIGHT MARKING	FUNCTION
OTPI-DF AVAIL	All switches have been properly positioned for use of the FDS DF (OTPI) submode. Selection illuminates the HSI OTP mode lights.
TAC UHF DF AVAIL	All switches have been properly positioned for use of the FDS DF (UHF) submode. Selection illuminates the HSI UDF mode lights.
TACTICAL STEERING	The command course shown on the HSI represents a rhumb line track. This light is preceded or accompanied by the COMPUTER TRACK AVAIL light. The maximum tactical steering distance is a function of the software program.
DRIFT ANGLE INVALID	Computer drift angle is invalid.
COMPUTER DRIFT ANGLE	Indicates drift is being supplied by the central computer. DRIFT ANGLE INVALID light should be extinguished.
COMPUTER TRACK AVAIL	Pilot first selects TAC NAV. Green illumination indicates fly-to-point is available in the central computer. The pilot may select the FDS COMPT TRK CONT submode. Upon activation, the HSI FTP mode lights illuminate and fly-to-point data will be presented on the HSI and FDI.
SAD INHIBIT	Indicates one of the following conditions exists: 1. Steady light — Inhibit switch on the ASA-65 control panel at the nonacoustic station is on. 2. Three to 4 seconds — Indicates roll rates of 10° per second or greater. 3. Nine to 10 seconds — Indicates a valid MAD has been recognized.
TRUE HDG	A true heading light located above the pilot HSI illuminates green when the pilot selects TAC NAV and DA. This light is essentially connected in parallel to the TRU mode light in the pilot HSI.

Figure 23-4. Navigation Advisory Light Panel Markings and Meanings

3. A graphic depiction of the flight plan route displaying the aircraft position relative to the next three (and one previous) waypoints.
4. Great circle routing depicted between waypoints.
5. Marker beacon information.
6. Glideslope and localizer scales and indicators.
7. A turn needle depiction based on computed turn rates.
8. Manually entered wind data.
9. Desired altitude information.
10. GPS waypoint distance.
11. TACAN DME information.

An inclinometer that provides slip or skid indications is externally mounted on the bezel of the MFD display. The system components described in the following paragraphs are provided to develop a better understanding of overall system interface.

23.4.2 System Components

The EFDS consists of the following components that interface with other aircraft navigational and attitude subsystems:

1. C-12616/AYN, Multi-Function Display Control Panel (DCP) (3).

2. ID-2551/AYN, Multi-Function Display (MFD) (5).

23.4.2.1 C-12616/AYN Multi-Function Display Control Panel

The Control Panels are used to select the inputs for the Electronic Flight Director Indicator (EFDI) and the Electronic Horizontal Situation Indicator (EHSI) displays. There are three EFDS Display Control Panels located as follows (Figure 23-5):

1. Flight station center pedestal (pilot).

2. Copilot side console.

3. NAV/COMM station.

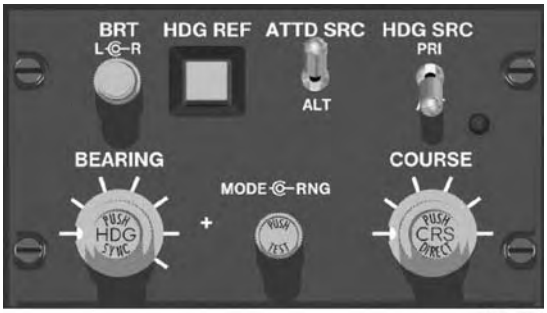
Figure 23-5 illustrates the Control Panel and describes the panel markings and functions. The NAV/COMM Display Control Panel (physical appearance is the same as the pilot and copilot control panel) does not provide the same functionality available to the pilot or copilot because of its physical location, the strapping of the unit, and the external inputs routed to the unit. All switches and controls are described to provide an understanding of the control panel capabilities. Controls that are nonfunctional for a given flightcrew position are identified in Figure 23-5.

23.4.2.2 Multi-Function Display

There are five identical, interchangeable Multi-Function Displays (MFDs) installed in the aircraft. Each unit uses color and symbol shapes to distinguish significant or abnormal situations from normal display functions. The MFD continuously monitors navigation parameters and creates alerts when an abnormal flight situation is detected. The alerts are displayed as flags/removal of related navigation data. The operating mode of each MFD is software-configured at power-up based upon its physical location in the aircraft. Four MFDs are in the flight station, two on the pilot instrument panel, and two on the copilot instrument panel. The fifth MFD is located at the NAV/COMM station (Figure 23-7). At power-up, the pilot and copilot right MFDs are configured to function as the EFDIs and the left MFDs functions as the EHSIs. The NAV/COMM MFD is always configured as an EHSI.

23.4.2.2.1 Electronic Flight Director Indicator

The right MFD functioning as the EFDI serves as an aircraft attitude display and visual indicator of flight director guidance information. It provides the pilot and copilot with a display screen as shown in Figure 23-6. Pilot and copilot EFDIs are normally powered by the MONITORABLE ESSENTIAL AC BUS. Backup power for these EFDIs comes from the FLIGHT ESSENTIAL AC BUS Figure 23-7.



PANEL MARKING	FUNCTION
BRT control	Two concentric potentiometers that control the display brightness of the EFDS display as follows:
L (OUTER)	Rotating the BRT (Brightness) L knob changes the intensity of the EFDI MFD. NAV/COMM — Nonfunctional.
R (INNER)	Rotating the BRT R knob changes the EHSI MFD intensity.
HDG REF (Pushbutton)	HDG REF (MAG/TRUE heading reference) is a pushbutton switch that toggles the MFD between magnetic and true heading references. Visual feedback is provided via the words MAG or TRUE next to the heading index on the EHSI MFD. The switch must be pressed for a minimum of 2 seconds to change the reference. When the source is FMS1, the base heading reference is magnetic (MAG) and can be switched to TRUE. The base heading reference for VOR1, VOR2, and TACAN is MAG and cannot be changed. True heading supplied in FMS1 is the MHRS magnetic heading adjusted by the Flight Management System (FMS) magnetic variance.
ATTD SRC switch	Selects attitude source to control the EFDI display. If the EFDI fails, the switch will work for the EHSI in PFD mode.
PRI	Pilot EFDI — INS 1. Copilot EFDI — INS 2. NAV/COMM — Nonfunctional.
ALT	Pilot EFDI — STBY GYRO. Copilot EFDI — STBY GYRO. NAV/COMM — Nonfunctional.
HDG SRC switch	Selects heading source of the controlled EFDI/EHSI (pilot/copilot). If the EHSI fails, the switch will still work for the EFDI in PFD mode.
PRI	COURSE switch selected to CPTR: Pilot control — INS 1. Copilot control — INS 2. NAV/COMM control — INS 1. COURSE switch selected to VOR1, VOR2, TCN, or FMS1: Pilot control — MHRS 1. Copilot control — MHRS 2. NAV/COMM control — INS 1.

Figure 23-5. C-12616/AYN Control Panel — Markings and Functions (Sheet 1 of 4)

<table>
<tr><th>PANEL MARKING</th><th colspan="3">FUNCTION</th></tr>
<tr><td>HDG SRC switch (cont)

ALT</td><td colspan="3">COURSE switch selected to CPTR:
Pilot control — INS 2.
Copilot control — INS 1.
NAV/COMM control — INS 2.
COURSE switch selected to VOR1, VOR2, TCN, or FMS1:
Pilot control — MHRS 2.
Copilot control — MHRS 1.
NAV/COMM control — INS 2.
COURSE switch selected to CPTR:
Pilot control — INS 2.
Copilot control — INS 1.
NAV/COMM control — INS 2.</td></tr>
<tr><td>COURSE switch</td><td colspan="3">Two concentric rotary switches control the course selection as follows:</td></tr>
<tr><td>CRS
(Outer knob)</td><td colspan="3">Six-position rotary switch that selects the navigation source displayed on the EHSI MFD.
The pilot and copilot selections are (clockwise): VOR 2, VOR 1, TCN, FMS1, CPTR (Tactical), and Spare.
The NAV/COMM selections are (clockwise): SPARE, SPARE, FMS1, Repeat Pilot, CPTR (Tactical), and Spare.</td></tr>
<tr><td>CRS
(Inner knob)</td><td colspan="3">The CRS (inner) knob sets the commanded course when the associated course arrow is not slaved to FMS or CPTR data. As the CRS knob rotates, the course arrow on the EHSI rotates in the same direction. A digital readout of the course setting is displayed on the EHSI MFD.
Pilot/copilot — Active in all radio modes.
NAV/COMM — Nonfunctional.</td></tr>
<tr><td>CRS PUSH DIRECT</td><td colspan="3">When the CRS knob is pressed and VOR1, VOR2, or TCN is selected as the navigation source, the MFD aligns the course arrow with the bearing of the navigation source and nulls out any course deviation.
Pressing the CRS knob for 2 seconds in conjunction with the PUSH TEST knob initiates the diagnostic mode display on the EHSI.</td></tr>
<tr><td>MODE/RNG
PUSH TEST switch</td><td colspan="3">Two concentric rotary switches (360° turn in both directions) control mode and range selection as follows:</td></tr>
<tr><td>MODE
(Outer knob)</td><td colspan="3">The MODE knob has no physical stops. As the MODE knob is rotated, the EFDI or EHSI display changes. The FDI — HSI mode pairs (FDI-HSI, FDI-MAP, or PFD-MAP) are selected in repeating sequence. Counterclockwise (ccw) rotation selects the prior mode. The order of the display for each of the MFDs as the MODE control is rotated is as follows:</td></tr>
<tr><td></td><td>MODE SEQ</td><td>EFDI DISPLAY</td><td>EHSI DISPLAY</td></tr>
<tr><td></td><td>1</td><td>FDI</td><td>HSI</td></tr>
<tr><td></td><td>2</td><td>FDI</td><td>MAP</td></tr>
<tr><td></td><td>3</td><td>PFD</td><td>MAP</td></tr>
</table>

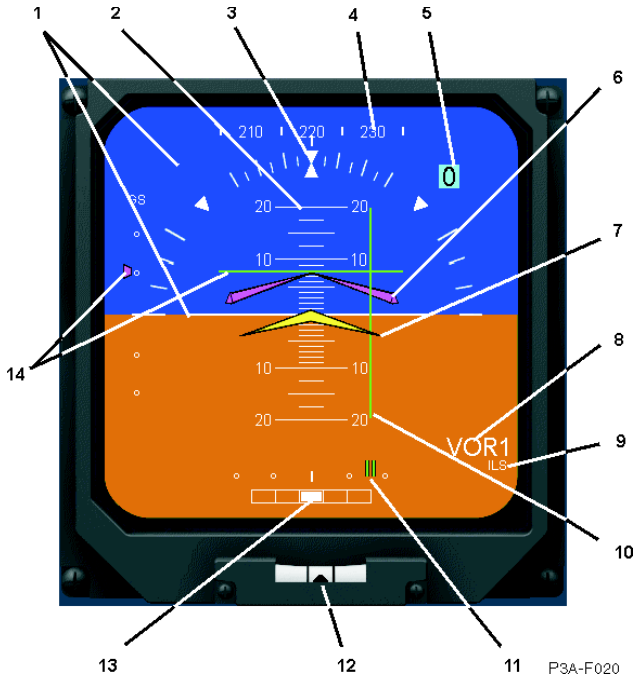
Figure 23-5. C-12616/AYN Control Panel — Markings and Functions (Sheet 2 of 4)

PANEL MARKING	FUNCTION
MODE (Outer knob) (cont)	If for some reason (fault, diagnostics mode, etc.) one of the displays at a location is inoperable, then the remaining MFD will display the PFD mode. If in test mode, rotation of MODE switch terminates the test mode.
RNG (Inner knob)	The RNG inner knob sets the map range display of the EHSI display when the unit is in the MAP mode. It is also used in the diagnostic mode to page through the status pages (SYSTEM STATUS and MFD STATUS). Rotating the switch enables the operator to select 10, 25, 50, 250, 500, or 1,000 nm range when in map mode. Also used when in test mode to view ranges.
PUSH TEST	The PUSH TEST knob is used in conjunction with the CRS or HDG controls to place the EFDI or EHSI into the diagnostic mode. To enter the diagnostic mode for the EHSI position, the EFDI must be valid and vice versa. If the other on-side display is not valid, the MFD will not enter the diagnostic mode. When an MFD enters the diagnostic mode, the other on-side MFD switches to the PFD display. In the diagnostic mode, the selected MFD displays the SYSTEM STATUS or MFD STATUS page. These diagnostic pages help the operator understand the cause of an MFD failure indication. The SYSTEM STATUS page displays first and indicates the status of the aircraft system that interfaces with the MFD. The MFD STATUS page indicates the operational status of the MFD itself. To enter the diagnostic mode and display the SYSTEM STATUS page, press and hold the PUSH TEST knob for 2 seconds and then within 5 seconds: 1. Press the HDG knob for 2 seconds to place the EFDI in a diagnostic mode. OR 2. Press the CRS knob for 2 seconds to place the EHSI in a diagnostic mode. While in the diagnostic mode, rotating the RNG knob toggles between the SYSTEM STATUS page and the MFD STATUS page. Rotating the MODE knob will exit the diagnostic mode. 3. Press the CRS knob for 2 seconds to place the EHSI in a diagnostic mode. While in the diagnostic mode, rotating the RNG knob toggles between the SYSTEM STATUS page and the MFD STATUS page. Rotating the MODE knob will exit the diagnostic mode. When in the diagnostic mode and the aircraft on the ground, Weight-On-Wheels (WOW); an Initiated Built-in Test (IBIT) can be initiated for the MFD displaying the STATUS page. The IBIT tests the functional condition of the MFD and the status (valid/invalid) of the MFD interfaces. To initiate the IBIT: 1. Press the PUSH TEST knob for 2 seconds. A confirmation message is displayed. Within 5 seconds, press the PUSH TEST again for 2 seconds to start the IBIT. Upon completion of the IBIT, the MFD STATUS page displays with any faults displayed in magenta text.

Figure 23-5. C-12616/AYN Control Panel — Markings and Functions (Sheet 3 of 4)

PANEL MARKING	FUNCTION
BEARING switch	Two concentric rotary switches control the bearing source selection on the on-side (pilot or copilot) EHSI. The controls function as follows:
Outer rotary switch	Seven-position rotary switch selects the bearing input from the following sources (left to right): VOR1, VOR2, TCN, ADF, DF (UHFDF or OTPI are valid submodes), FMS1, and Spare (none selected). The pilot BEARING knob selects the Bearing Pointer #1 source. The copilot BEARING knob selects the Bearing Pointer #2 source. Pilot bearing (pointer #1) displays on the pilot, copilot, and NAV/COMM EHSIs. Copilot bearing (pointer #2) displays on the pilot and copilot EHSIs only. During normal operation, the pilot EHSI receives the copilot bearing pointer source selection from the copilot EHSI. Conversely, the input to the copilot EHSI may be received from the cross-side bearing pointer source selected for the pilot EHSI. In the event of an MFD failure, in the reversionary (default — PFD) mode, the bearing valid selections are limited to VOR1, VOR2, TCN, or FMS1.
HDG (Inner knob)	HDG is a rotary knob that positions the heading marker (bug) on the EHSI. The HDG knob on the pilot and copilot Control Panel allows the flightcrew to independently rotate and set the Heading Bug on their respective EHSI compass cards. The Pilot EHSI computes heading error as the difference of the Heading Command (entered by the pilot HDG control) and aircraft heading (from the INS input). The heading error is an output of the pilot EHSI.
PUSH HDG SYNC	Pressing the HDG knob aligns the heading marker (bug) with the heading index. This control is used in conjunction with the MODE/RNG PUSH TEST switch to initiate the diagnostics mode display on the EFDI. When initiating the diagnostic mode, the control must be pushed and held for a minimum of 2 seconds. This control is nonfunctional on the NAV/COMM Control Panel.

Figure 23-5. C-12616/AYN Control Panel — Markings and Functions (Sheet 4 of 4)



PANEL MARKING	FUNCTION
1	Pitch and roll attitude — Displayed as displacement of a pitch and roll horizon relative to a fixed aircraft symbol. INS-1 is the primary source of pilot attitude information and INS-2 is the primary source of the copilot attitude information. If either INS fails, attitude information from the Standby Gyro may be selected manually at the respective DCP. **WARNING** Standby Gyro should never be selected by both pilot and copilot unless both INS sources are completely unusable. **Note** With loss of the MEAC bus, all EHSIs fail and the EFDIs will revert to the PFD mode. With INS-2 selected, information displayed on the copilot EFDI will be unavailable because of loss of synchro-excitation voltage. The copilot shall select Standby Gyro.
2	Pitch Tape — The amount of aircraft pitch can be determined by comparing the graduated scale with the nose of the aircraft symbol. Read in 1° increments from 0° to 10°, 5° increments between 10° and 30°, 15° increments between 30° and 60°, and a 30° increment between 60° and 90°.
3	Angle-of-Bank Scale — The amount of roll is determined by comparing the roll (bank) angle indicator against the fixed bank angle scale. Roll attitude is read in 5° increments up to 30°, 15° increments between 30°and 60°, and 10° increments between 60° and 90°. **Note** Regardless of the display mode, if pitch attitudes exceed +30° or if the bank attitude exceeds +70° all information except the aircraft symbol, turn rate, attitude, and course label will be shown in an ‘excessive’ attitude display. Some portion of the blue sky and brown ground will remain in view. All EFDI information will be restored at +25° of pitch or +65° roll.

Figure 23-6. Right MFD in EFDI Format (Sheet 1 of 3)

PANEL MARKING	FUNCTION
4	Heading Tape — A display of heading across the top. This is a display of +15° each side of center. **Note** Upon loss of heading input, the heading tape will also be lost. The alternate heading source should be selected.
5	Marker Beacon Indicator — The outer, middle, and inner markers appear in the top right area of the display whenever the respective valid signals are received from the Marker Beacon receiver. The outer marker is a blue square with a black 'O,' the middle is yellow with a black 'M,' and inner is white with a black 'I.'
6	Command bar information — Magenta command bars on each EFDI are driven by input signals received from the FDSC. The command bars provide the pilot with an indication of the steering required to achieve a desired flight path. The command bank angle is limited to 30° in manual and radio submodes and 45° in tactical submodes. The roll steering function of the bar is achieved through operation of the ROLL STEERING pushbutton-indicator on the FDS control panel, and the pitch function is achieved through use of the PITCH STEERING pushbutton-indicator. When PITCH STEERING and ROLL STEERING are ON and the glideslope submode has not been selected, the center of the command bar is positioned to indicate the actual pitch of the aircraft. If ROLL STEERING is OFF and PITCH STEERING is ON, the command bars remain horizontal on the face of the EFDI.
7	Aircraft Symbol (yellow triangular) — Nose of the aircraft symbol indicates pitch as read off the vertical pitch scale.
8	Course Source — Repeat of the course source displayed on the EHSI and as selected on the DCP. Shown here to amplify what is depicted on the deviation bar.
9	Submode — Repeat of the submode for the course source and which is displayed on the EHSI. Submodes are: VOR1-LOC, ILS, B/C, FMS — En Route (ENRT), Terminal (TERM), Approach (APPR), Computer (CPTR) — Fly to point (FTP), OTPI, and UHF-DF. **WARNING** The pilot shall ensure his course is selected to VOR-1 during ILS approaches. Otherwise, erroneous course information will be displayed to the copilot with no fault indications.
10	Localizer Deviation Vertical Extension Bar — Displayed when VOR1 is tuned to a Localizer frequency. Shown over the deviation bar when VOR1 is in a LOC or ILS submode. **Note** Localizer deviation is not available from VOR2.
11	Deviation Bar — Active in all course source modes. Represents deviation from course in radio source modes, LOC deviation when in LOC, ILS or B/C, and crosstrack deviation when in FMS mode. Scaling is dependent upon course source mode as follows: a. Radio modes (VOR, TCN) — 5° per dot. b. LOC, B/C — Each dot on either side of centerline represents a 1 1/4° displacement from the center of the beam. c. FMS — Dependent upon waypoint mode: ENRT: 2 nm per dot, TERM: 0.5 nm per dot and APPR: 0.15 nm per dot.

Figure 23-6. Right MFD in EFDI Format (Sheet 2 of 3)

PANEL MARKING	FUNCTION
12	Slip or skid indications — Provided by an externally mounted inclinometer on the front bezel of the right MFD. Aircraft slip/skid movement is shown by the displacement of a weighted black ball in a liquid-filled, curved glass tube that has a white phosphorescent painted background.
13	Rate-of-Turn Indicator — Displayed as a white rectangle that moves right or left in response to the MFD computed rate-of-change of heading. The rate-of-turn is calculated as a function of the heading input and elapsed time. The scale is a series of boxes over which the indicator moves. When the rate-of-turn indicator is in the center box, a zero turn rate is indicated. When the rate-of-turn indicator is in the first box (left or right of center), a standard rate (three degrees per second) turn is being executed. When the indicator is in the second box (left or right of center), a double standard rate (six degrees per second) turn is being executed. **Note** • Upon loss of heading input, rate of turn will also be lost. The alternate heading source should be selected. • The rate-of-turn indicator will deflect momentarily when the heading is changed between Mag and True based input as selected on the course select knob. It will not deflect during operation of the Heading Reference function.
14	Glideslope deviation (bug and extension bar) — Displayed with respect to a fixed vertical scale by the glideslope deviation indicator and accompanied by a horizontal extension bar (not displayed in PFD mode). Both the bug and the bar come into view only when valid glideslope begins to be received. The indicator is displaced up or down in response to the glideslope deviation input signal. When the aircraft is on the glideslope beam, the indicators line up with the center horizontal bar of the scale. Each dot above and below the center scale represents 1/4° displacement from the center of the beam.

Figure 23-6. Right MFD in EFDI Format (Sheet 3 of 3)

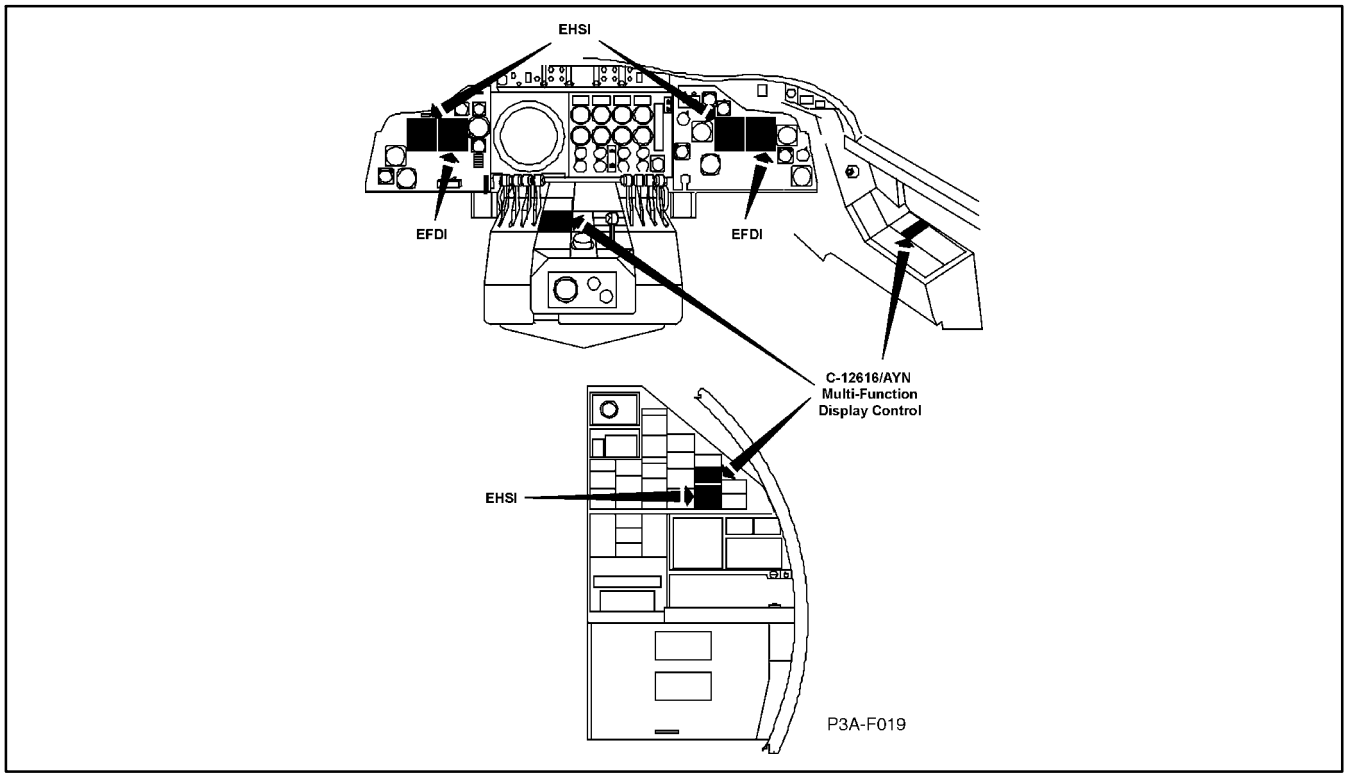


Figure 23-7. Flight Station and NAV/COMM Station MFD Locations

a EFDI in PFD Mode

Refer to Figure 23-8. The primary flight display is a reversionary mode that is automatically displayed on the pilot or copilot EFDI when the respective EHSI has failed or is in diagnostic mode. It also is selectable during normal modes in the MAP/PFD display combination intended to facilitate situational awareness and also to enable future growth of display combinations. It combines a modified EHSI display under a modified EFDI display. The basic formats of each are retained except for the following:

1. The Course Deviation Indication (CDI) is removed from the FDI display area as it is shown on the HSI deviation bar.
2. The horizontal extension of glideslope indicator and the vertical extension of localizer are not available for an ILS approach.
3. Heading is not digitally displayed.
4. Only 200° of the compass card is displayed.
5. Bearing labels are side by side.

Note

If PFD mode is forced due to a loss of an EHSI, the bearing select for that station will not have ADF or the DF sources available. Also, the cross-side MFDs will not have a display of the failed EHSI bearing or heading bug data.

6. Wind label and numeric readout are removed.



Figure 23-8. Right MFD in PFD Format

7. Assigned Altitude label and readout are removed.

8. Digital readout of the heading bug location will be constantly shown.

b EFDI in Diagnostic Mode

The EFDI diagnostic mode is available to the pilot or copilot by pressing the RNG PUSH TEST switch (for 2 seconds) and then (within 10 seconds) pressing the PUSH HDG SYNC switch (for 2 seconds) on the respective DCP. Only one display at the pilot or copilot station may be in the diagnostic mode at any given time. Rotating the MODE switch on the pilot/copilot DCP will terminate the diagnostic mode. When the diagnostic mode is terminated, the MFDs will revert to the last selected display mode combination. Rotation of the RANGE switch in either direction allows access between the MFD and System Status pages.

c EFDI Diagnostic Mode — System Status Page

The first page of the diagnostic mode is a graphic depiction of the associated system. It shows attitude, heading, FMS1, DCP, and EHSI blocks as providing inputs. It also shows the status of the selected bearing and course needles.

d EFDI in Diagnostic Mode — MFD Status

The second page of diagnostic mode is the same for all five displays. It shows in tabular format the status of internal as well as external interfaces. Most flags or faults displayed in one of the normal operating modes can be troubleshot down to the interface with the MFD by analyzing this page. A detailed fault matrix can be found in the crew station maintenance manual listing potential problems that produce the associated fault indication.

23.4.2.2.2 Electronic Horizontal Situation Indicator

When the MFD is configured as an Electronic Horizontal Situation Indicator (EHSI), it operates in one of three selectable display formats: HSI mode, MAP mode, and Diagnostic mode. When the EFDI is in the diagnostic mode or has failed, the Primary Flight Display (PFD) mode is displayed on the EHSI at the pilot or copilot station. The PFD mode cannot be displayed on the NAV/COMM EHSI. EHSIs are powered by the MONITORABLE ESSENTIAL AC BUS via circuit breakers located on the forward electronic circuit breaker panel.

The HSI mode display provides:

1. GPS distance — Displayed with scrolling tape and waypoint identifier.

2. TACAN distance data — Displayed on all three EHSIs. With digital TACAN (i.e., AN/ARN-118) installed, the selected TACAN station identifier is displayed below the window.

3. Bearing pointer #1 — Displayed on all three EHSIs. Indicates the bearing to the source selected by the pilot control panel BEARING switch.

4. Bearing pointer #2 — On the pilot and copilot EHSIs, indicates the bearing as selected by the copilot control panel BEARING switch. On the NAV/COMM EHSI, indicates the bearing as selected by the NAV/COMM control panel BEARING switch.

5. Heading bug — On the pilot and copilot EHSIs, the heading bug is used as a reference mark or as an input (pilot) to the AFCS and/or FDS. Rotating the PUSH HDG SYNC knob on the pilot/copilot control panel varies the selected heading bug with respect to the compass card. Pressing the PUSH HDG SYNC knob on the pilot/copilot control panel repositions the selected heading bug to the current aircraft heading. On the NAV/COMM EHSI, the alternate heading bug is displayed. It shows any mismatch between the heading references by comparing the selected heading as shown on the compass card heading and the alternate source as shown on the heading bug.

6. Course arrow — The information displayed on each EHSI is dependent on the source as selected on the control panel COURSE switch. In the radio navigation mode (VOR1/2 or TCN), the arrow shows the course selected by the respective PUSH CRS DIRECT switch. In the tactical navigation mode (CPTR), the arrow displays a computer-generated bearing to the highest FTP (FDS computer track submode) or a damped true bearing of the OTPI or UHF DF (FDS DF submode). In all cases, the course indicated is also displayed as a digital readout (CRS/DTK indicator).

7. Course deviation — Displayed on the pilot and copilot EHSIs by a displacement of the course deviation bar from its center position. The signal source is VOR, TACAN, or FMS1, selected by the control panel COURSE switch. For VOR or TACAN signals, the indicated deviation is relative to the setting of the course arrow. For FMS1 signals, the indicated deviation is relative to the GPS track. For localizer signals, the indicated deviation is relative to the localizer beam and independent of the course arrow setting; however, the course arrow setting is used as an input to the FDS command bar circuits to define front or back course and should be properly positioned. Indicated deviation is 5° per dot for VOR and TACAN and 1-1/4° per dot for localizer. In the tactical mode, the course deviation bar and dots are not displayed.

8. To-From indication — Displayed on the EHSIs by means of a small To-From arrow along the course arrow. The signal source is VOR or TACAN selected on the course arrow. The To-From arrow is not displayed in the tactical mode or the localizer or back course submodes.

9. The PUSH CRS DIRECT switch on the pilot and copilot control panel is used to select the reference course for course deviation supplied by the particular VOR or TACAN. The selected course is shown by the position of the course arrow relative to the compass card and by the CRS/DTK indicator readout. The PUSH CRS DIRECT switch for both the pilot and copilot EHSIs is not used in the tactical mode or FMS1. The NAV/COMM PUSH CRS DIRECT switch is only usable in conjunction with the RNG PUSH TEST switch for diagnostic mode.

10. Course error — Defined as the angle between the selected course arrow and the indicated heading. It is derived from data provided to the pilot EHSI and the developed output is also used by the FDSC.

11. Heading error — Defined as the angle between the selected heading marker and the indicated heading. It is derived from data inputs to the pilot EHSI and the error output is used by the FDSC and AFCS.

12. Failure flags — Displayed on the EHSI when a malfunction, unreliable signal, or power failure occurs.

13. The EHSI formats display information associated with the Flight Management System (FMS1) navigation mode. The FMS provides a means to display GPS navigation information on aircraft equipped with the AN/ARN-151 GPS.

a HSI Mode

The HSI mode is automatically set on the pilot and copilot left MFDs and on the NAV/COMM MFD (Figure 23-9) on power-up. The HSI mode can also be selected by rotating the MODE rotary switch until the HSI mode display appears on the EHSI.

b EHSI Display Failure

Refer to Figure 23-10. When an EHSI fails or loses electrical power at either the pilot or copilot station, the respective EFDI is automatically placed in the PFD mode. Functional sharing of navigational data between the pilot, copilot, and NAV/COMM MFDs enables the same navigational data to be presented at three stations in slightly different formats. This also provides a reliable backup system should input signals to the EHSI be lost or a unit failure occur. The loss of valid bearing information at the pilot station will result in the display of a failure flag and the removal of the pilot heading bug and #1 bearing needle on the NAV/COMM EHSI. A loss of valid navigational or steering

data at the NAV/COMM station will result in the removal of specific navigational data from the display (based on what signal is lost or has become unreliable) and replacement of the symbol/digital data with an alert/failure flag. The signal isolation (between the three stations) provided by the data bus system limits the impact an MFD failure at one station has on the remaining operational display units.

Figure 23-10 illustrates the type of failures that may occur and provides a description of each failure flag.



INDEX #	INDICATION/ INDICATOR	FUNCTION
1	Selected Heading Source Label	Indicates the heading source (INS1/INS2) selected by the NAV/COMM control panel.
2	Alternate Heading Bug	The alternate heading bug (cyan pinhead) is displayed only on the NAV/COMM EHSI. It is a visual indication of the computed heading of the alternate inertial selected by the NAV/COMM control panel. If the alternate inertial heading is invalid or failed, it will not be displayed.
3	Bearing Pointer #2 Source	Green arrow symbol and legend indicate bearing pointer #2 source as selected by the NAV/COMM control panel. **Note** The bearing pointer becomes dashed if the heading source changes to TRUE and the bearing source is radial based (TACAN, VOR1, or VOR2).
4	Alternate HDG SRC Label/Readout	On the NAV/COMM EHSI, a cyan legend and digital readout indicate the alternate heading bug source and bearing.
5	Compass Card	A 3-inch full 360° compass with N, E, S, and W designating the cardinal points and numerics at 30° marks. Fixed inter-cardinal markings are displayed every 45° around the perimeter of the compass card (45°, 135°, 225°, and 315°) and include ±90° and 180° marks, which aid in maneuvers such as holding and procedure turns.

Figure 23-9. NAV/COMM EHSI Display — HSI Mode Indications/Indicators (Sheet 1 of 2)

INDEX #	INDICATION/ INDICATOR	FUNCTION
6	Bearing Pointer #1 Source	Magenta arrow symbol and legend indicate bearing pointer #1 source as selected by the pilot. **Note** The bearing pointer becomes dashed if the heading source changes to TRUE and the bearing source is radial based (TCN or VOR).
7	Pilot Heading Bug	The pilot heading bug (magenta) is displayed on the NAV/COMM EHSI to indicate the pilot heading bug is selected. It is controlled from the pilot DCP. If the pilot heading bug fails, it will not be displayed at the NAV/COMM station.
8	TACAN Channel	Indicates the TACAN station identifier when using digital TACAN (i.e., ARN-118).
9	TACAN DME	The MFD displays TACAN DME, when available, independent of the navigation (bearing or course) selection. The label DME is displayed above the numeric readout. The TACAN distance resolution is 0.1 nautical mile below 100 nautical miles and 1.0 nautical mile between 100 and 999 nautical miles. The leading zeros on the distance are always suppressed. When distance to the active TACAN station is less than 100.0 miles, the tenths digit is displayed as a rolling wheel to emulate the scrolling of the mechanical indicator and provide rate information. If a DME failure is detected or it becomes unavailable, the numeric digits are removed and replaced with red or white dashes respectively.

Notes:

1. The remaining symbology displayed on the NAV/COMM EHSI is functionally the same as those described for the pilot and copilot indicators.
2. To indicate degraded capability, the normal display colors are changed to yellow.

Figure 23-9. NAV/COMM EHSI Display — HSI Mode Indications/Indicators (Sheet 2 of 2)



FAILURE FLAG	WHEN DISPLAYED
DME — — —	White dashes are displayed to indicate data unavailable. Red dashes are displayed to indicate invalid data.
MFD	Black MFD over a solid red box is displayed when the EHSI detects an internal failure.
DCP	Black DCP over a solid red box is displayed when the Display Control Panel or interface has failed.
HDG	Black HDG over a solid red box is displayed if heading data from FMS is invalid.
Distance to Waypoint	White dashes are displayed if the distance to the GPS waypoint is unavailable. Red dashes are displayed if the Waypoint data is invalid.
Navigation Source Flag	If the selected course source or submode is invalid or has failed, displays (boxed in red) the selected course/submode as follows: NAV SOURCE FMS1, VOR1, VOR2, TCN, or CPTR Submode LOC, B/C, ILS, ENRT, TERM, APPR, FTP, OTPI, or UHFDF
DTK — — —	Displayed if course is invalid or not computed: a. The CRS/DTK numeric readout is replaced with red dashes. b. Course arrow, course deviation bar, and To/From indicator are removed.
ASGN ALT — — —	Displayed if assigned altitude was valid and became invalid or the ARINC data bus failed. Dashes replace the numeric readout.
Bearing #1 Flag	Bearing source (black over a solid red box) is displayed if pilot selected bearing source is invalid or failed: a. Indicates failed source selected: VOR2, VOR1, TCN, ADF, DF, UHFDF, OTPI, or FMS1. b. Bearing pointer #1 is removed and the bearing annunciator is drawn black over a solid red box.

Figure 23-10. HSI Mode — Failure Flags (Sheet 1 of 2)

FAILURE FLAG	WHEN DISPLAYED
Bearing #2 Flag	Bearing source (black over a solid red box) is displayed if copilot/NAV/COMM selected bearing source is invalid or failed: a. Indicates failed source selected: VOR2, VOR1, TCN, ADF, DF, UHFDF, OTPI, or FMS1. b. Bearing pointer #2 is removed and the bearing annunciator is drawn black over a solid red box.
HDG — — —	The numeric readout is replaced with dashes and the heading bug is removed.
WIND	Wind digital readout is removed if wind was entered and data bus then fails. Wind indicator is removed.
ECA (NAV/COMM only)	Displayed if there is a fault in either Electronic Control Assembly (ECA). Displays only on the NAV/COMM indicator.

Figure 23-10. HSI Mode — Failure Flags (Sheet 2 of 2)

c Map Mode

Selection of the MAP mode enables the EHSI MFD to display an expanded arc presentation. The data normally presented on the EHSI is duplicated for the MAP mode with the following differences (Figure 23-11):

Range rings are added.

Compass card displays the forward 90° sector relative to the nose of the aircraft.

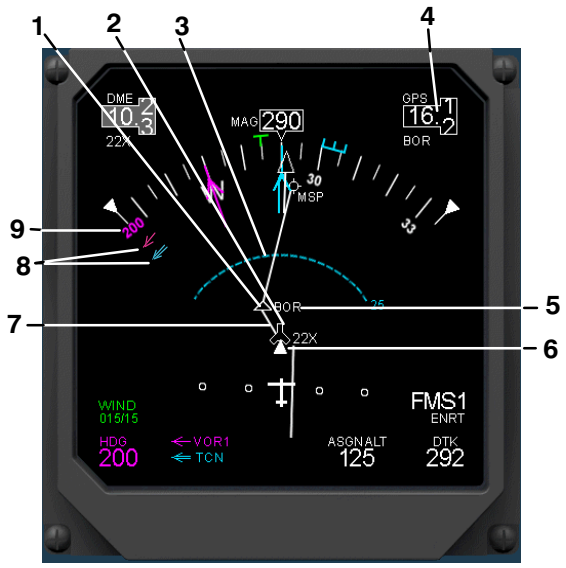
Map data is displayed, including To-To, Direct-To, and To-From flight plan data.

Out-of-view pointer information is displayed elsewhere on the display.

1. The range display is selected using the RNG knob on the Control Panel and is displayed as an arc, halfway between the compass card sector and the aircraft symbol. The arc provides pilot, copilot, or NAV/COMM with an estimate of their position with respect to the flight plan. One-half of the full-scale range is annunciated at the right hand end of the range arc. Selectable full-scale ranges are 10, 25, 50, 250, 500, and 1,000 nautical miles. The respective range arc values are 5, 12.5, 25, 125, 250, and 500.

2. Waypoint information is received from the FMS system via one of the digital inputs. The pilot, copilot, NAV/COMM MFDs display GPS flight plan waypoints to provide the flightcrew with situational awareness. The display is made up of a fixed aircraft symbol, flight plan waypoints, and flight plan tracks shown relative to the aircraft symbol in a heading-up format. This provides visual steering cues to acquire and maintain the flight plan to the active waypoint. Three submodes (To-To, Direct-To, and To-From) are supported.

3. The previous waypoint and the next three waypoints are displayed if they are within the displayed range, using the GPS data received via the ARINC 429 bus. Each waypoint is depicted using standard symbols to uniquely identify the different types. When data is provided by the CDNU, the symbols are labeled with the ICAO identifier. The symbols are shown in white. Symbols are displayed relative to the aircraft symbol. FMS1 data is used to determine the relative position and range of the displayed symbol and the current aircraft heading. Routes between waypoints are displayed as the corresponding great circle course. For waypoints beyond the range of the display, only the great circle course to the waypoint is shown.



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INDEX #	INDICATION/ INDICATOR	FUNCTION
1	Waypoint symbols	Indicates previous FROM waypoint and up to next three waypoints as entered into the CDNU Flight Plan page. Waypoint symbol types are shown in Figure 23-14.
2	TACAN Symbol	Indicates the TACAN location. When an analog TACAN is used, the MFD computes the screen coordinates of the TACAN symbol using the bearing and distance synchro inputs. The current map scale and heading are used to properly locate the symbol. The MFD performs the same computations for a digital TACAN using ARINC 582 bearing and distance labels. Additionally, the channel number frequency is displayed next to the symbol.
3	Range Arc and Distance	The range arc is a cyan arc and label halfway between the aircraft symbol and the edge of the compass card. The range label for the arc is one half of the full range value.
4	Distance to Waypoint	Indicates the distance to go to the next waypoint as entered into the CDNU flight plan page.
5	Active Waypoint ID	Indicates the next waypoint ID (if available and entered into the CDNU).
6	To-From Arrow	The To-From arrow (solid white arrowhead) is attached to and rotates with the course arrow. For a To indication, the arrow is attached to the pointer side of the arrow and points toward the course arrowhead. For a From indication, the arrow is attached to the tail side of the arrow and points toward the course arrow tail. The To-From indicator is not displayed if the selected course source is Tactical or VOR, or the submode is back course or localizer.

Figure 23-11. EHSI Display, Map Mode — Indications/Indicators and Functions (Sheet 1 of 2)

INDEX #	INDICATION/ INDICATOR	FUNCTION
7	Flight Plan Display	Graphic representation of the flight plan route showing the next three waypoints entered in the flight plan. The preprogrammed flight plan as shown in the graphic above reflects the following: a TACAN symbol with station identifier (22X) at approximately 10.25 nm, a waypoint symbol with an identifier (BOR) at approximately 16.15 nm, an airport symbol with an identifier (MSP) at approximately 40 nm, and the desired aircraft route is displayed by a line connecting each of the symbols.
8	Bearing Pointer Off-Scale Indication	Indicates associated bearing (Bearing Pointer #1 or #2) is off the compass arc on the side shown. The symbol is to the side of the arc closest to the position of the off-scale pointer.
9	On-side Heading Bug Off-Scale Indication	The heading of the on-side off-scale heading bug is displayed as a numeric readout the same color as the on-side heading bug. The readout is on the right if the heading bug is to the right, and the readout is on the left if the heading bug is to the left. The cross-side heading bug is visible when it is within the displayed 90° arc segment but is removed when it moves beyond the visible 90° arc segment. No numeric readout for the cross-side heading bug is displayed

Figure 23-11. EHSI Display, Map Mode — Indications/Indicators and Functions (Sheet 2 of 2)

4. Waypoint symbols are located to provide an accurate relative presentation. If magnetic heading is selected, the MFD will adjust the presentation to place the waypoints in the proper position relative to the magnetic heading. Lat/Long coordinates are used for position calculations.

5. A TACAN symbol is displayed when both distance and bearing are available. The TACAN symbol identifier is not available unless a digital TACAN is utilized. If TCN is the selected course source, a separate track leg is displayed from the aircraft symbol to the TCN symbol.

6. To-To Flight Plan Display (Automatic Transition of Waypoints in Flight Plan) — To-To displays when FMS is flying the flight plan in automatic waypoint transition mode. In To-To, the MFD takes the waypoint positions from the FMS and displays the From waypoint, active To waypoint, and the next two waypoints past the active To waypoint, as long as they are within the displayed range. The ground tracks connecting the waypoints are also displayed on the MFD.

7. Direct-To and To-From Flight Plan Display — Direct-To data is displayed when the FMS is flying the flight plan in the manual mode and the pilot has enabled the Direct-To function. In Direct-To, the MFD takes the waypoint positions from the FMS and displays the active To waypoint and the next two waypoints past the active To waypoint, as long as the waypoints are within the displayed range. The From waypoint is not displayed. The ground tracks connecting the waypoints are also displayed by the MFD. Additionally, a line from the active To waypoint back to the aircraft position is displayed through the aircraft symbol to the edge of the display. A dashed line on the command heading that extends from the active To waypoint to the edge of the display indicates that the system is set up for manual waypoint transition and the pilot must act to transition to the next waypoint.

d MAP Mode Display Failure

Validity flags or warning indications provided on the MFD in MAP mode in case of a malfunction, unreliable navigation signal, or power failure are the same as for HSI mode. Pilot, copilot, and NAV/COMM MAP mode failures are the same except for the ECA failure that is displayed only on the NAV/COMM MFD. Map mode failure flag display is illustrated and described in Figure 23-12.

e Diagnostic Mode

The EHSI diagnostic mode is selected by pressing the RNG PUSH TEST switch (2 seconds) and then (within 10 seconds) pressing the PUSH CRS DIRECT switch (2 seconds) on the NAV/COMM Control Panel. The NAV/COMM EHSI will remain in the diagnostic mode until terminated by the operator. The diagnostic mode is terminated by rotating the DCP MODE switch. On diagnostic mode termination, the EHSI display is automatically reset to the last selected display mode.

23.4.2.3 HSI Test Panel

A panel labeled HSI TEST is located on the FWD NAV J-BOX in electronic rack B1. The panel contains three pushbuttons labeled PILOT, COPILOT, and NAVIGATOR. These pushbuttons are nonfunctional on aircraft with the EFDS installed.

23.4.2.4 Standby Attitude Indicator Power

Power to the standby attitude indicator is provided by the MONITORABLE ESSENTIAL DC BUS with a flight essential DC backup through the essential bus monitoring switch.

23.4.3 System Description

Refer to Figure 23-13. The EFDS provides accurate and reliable navigation and aircraft attitude information to the flightcrew. The Control Panel switch and control settings determine the signal routing through the Forward Navigation Interconnection Box to the appropriate MFD. The Control Panel settings are also routed to the appropriate MFD to determine the display mode. Standard ICAO symbology is generated within the MFDs for development of the detailed displays (Figure 23-14).

23.5 WET COMPASS

The wet compass, on the left side of the cockpit, is a fluid-based magnetic compass. The ASA-66 display must be turned off to get accurate headings on the wet compass.

23.6 STANDBY ATTITUDE INDICATOR

The standby attitude indicator, a self-contained vertical gyroscope, is installed on the pilot instrument panel. It provides a backup presentation of attitude reference in case of possible failure of both inertial navigation systems. The unit is powered from the FEAC bus. On EFDS-equipped aircraft, the unit is powered by the MEDC bus through the GYRO HORIZON circuit breaker with a backup power source of FEDC when the ESS BUS monitoring switch is placed in the OFF position.

23.6.1 System Operation

1. After application of electrical power (OFF flag will go out of view), pull PULL-TO-CAGE knob out fully (OFF flag will come in view) to permit initial erection stabilizing of the horizon. Release PULL-TO-CAGE knob.

Note

The lock position is used for shipping only.

2. Within 2 minutes after gyro erection (caging), the gyro erects to true vertical. Adjust miniature aircraft to desired pitch position by rotating PULL-TO-CAGE knob. Amount of pitch trim required varies with aircraft loading.

3. After takeoff, adjust miniature aircraft to desired pitch position.



FAILURE FLAG	WHEN DISPLAYED
DME — — —	White dashes are displayed to indicate data unavailable. Red dashes are displayed to indicate invalid data.
MFD	Black MFD over a solid red box is displayed when the EHSI detects an internal failure.
DCP	Black DCP over a solid red box is displayed when the Control Panel or interface has failed.
HDG	Black HDG over a solid red box is displayed if heading data from FMS is invalid.
Distance to Waypoint	White dashes are displayed if the distance to the GPS waypoint is unavailable. Red dashes are displayed if the Waypoint data is invalid.
Navigation Source Flag	If the selected course source or submode is invalid or has failed, displays (boxed in red) the selected course/submode as follows: <u>NAV SOURCE</u> FMS1, VOR1, VOR2, TCN, or CPTR <u>Submode</u> LOC, B/C, ILS, ENRT, TERM, APPR, FTP, OTPI, or UHFDF
DTK — — —	Displayed if course is invalid or not computed: a. The CRS/DTK numeric readout is replaced with red dashes. b. Course arrow, course deviation bar, and To/From indicator are removed.

Figure 23-12. EHSI Map Mode — Failure Flags (Sheet 1 of 2)

FAILURE FLAG	WHEN DISPLAYED
Bearing #1 Flag	Bearing source (black over a solid red box) is displayed if pilot selected bearing source is invalid or failed: a. Indicates failed source selected: VOR2, VOR1, TCN, ADF, DF, UHFDF, OTPI, or FMS1. b. Bearing pointer #1 is removed and the bearing annunciator is drawn black over a solid red box.
Bearing #2 Flag	Bearing source (black over a solid red box) is displayed if copilot/NAV/COMM selected bearing source is invalid or failed: a. Indicates failed source selected: VOR2, VOR1, TCN, ADF, DF, UHFDF, OTPI, or FMS1. b. Bearing pointer #2 is removed and the bearing annunciator is drawn black over a solid red box.
ECA (NAV/COMM only)	Displayed if there is a fault in either Electronic Control Assembly (ECA). Displays only on the NAV/COMM indicator.

Figure 23-12. EHSI Map Mode — Failure Flags (Sheet 2 of 2)

Note

- Do not recage the gyro unless large errors (greater than 10°) are present. If recaging is necessary, ensure wings-level attitude exists at time of recaging.
- In the event of complete electrical power failure, the OFF flag appears but the gyro presents useful attitude information for 9 minutes.

23.7 ON-TOP POSITION INDICATOR (OTPI)

The OTPI system is utilized for tactical sonobuoy, field-plot stabilization. When over a sonobuoy, the HSI course arrow will reverse direction and either the pilot or copilot presses the control wheel mark-on-top switch to allow the central computer to utilize that position for plot stabilization computations.

The OTPI receiver utilizes the ARA-50 sensing antenna and the relay amplifier of the UHF-DF direction finder group. True bearing information to a selected sonobuoy channel frequency set on the UHF radio set control is processed identically to the UHF-DF. The UHF-DF is a backup for marking on top sonobuoys when the OTPI system fails.

Note

- Because of the common antenna, the OTPI receiver/ASCL receiver and UHF-DF equipment cannot be used simultaneously. DF use overrides the OTPI system.
- UHF-DF reception is degraded with the landing gear down.

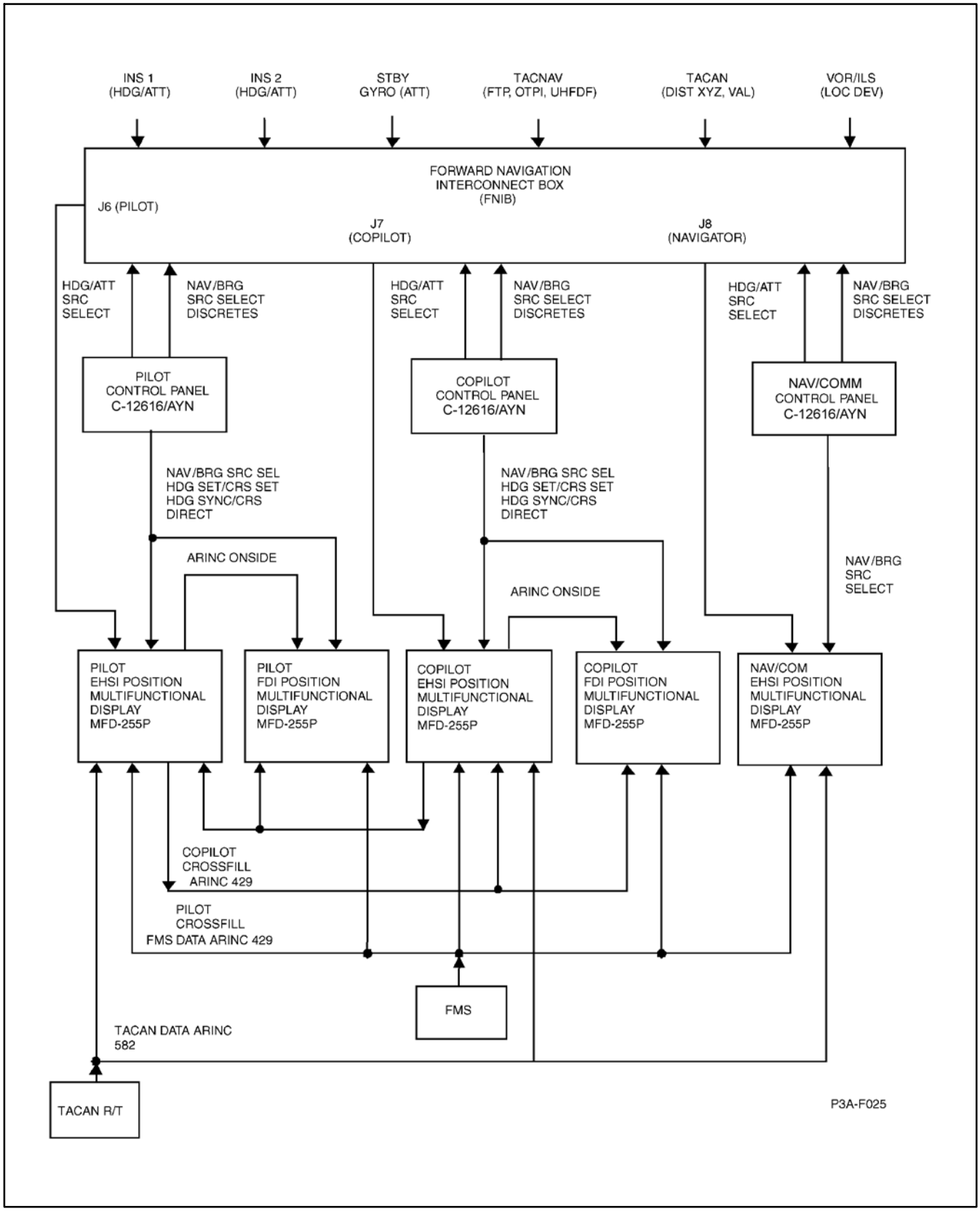


Figure 23-13. EFDS Simplified Block Diagram

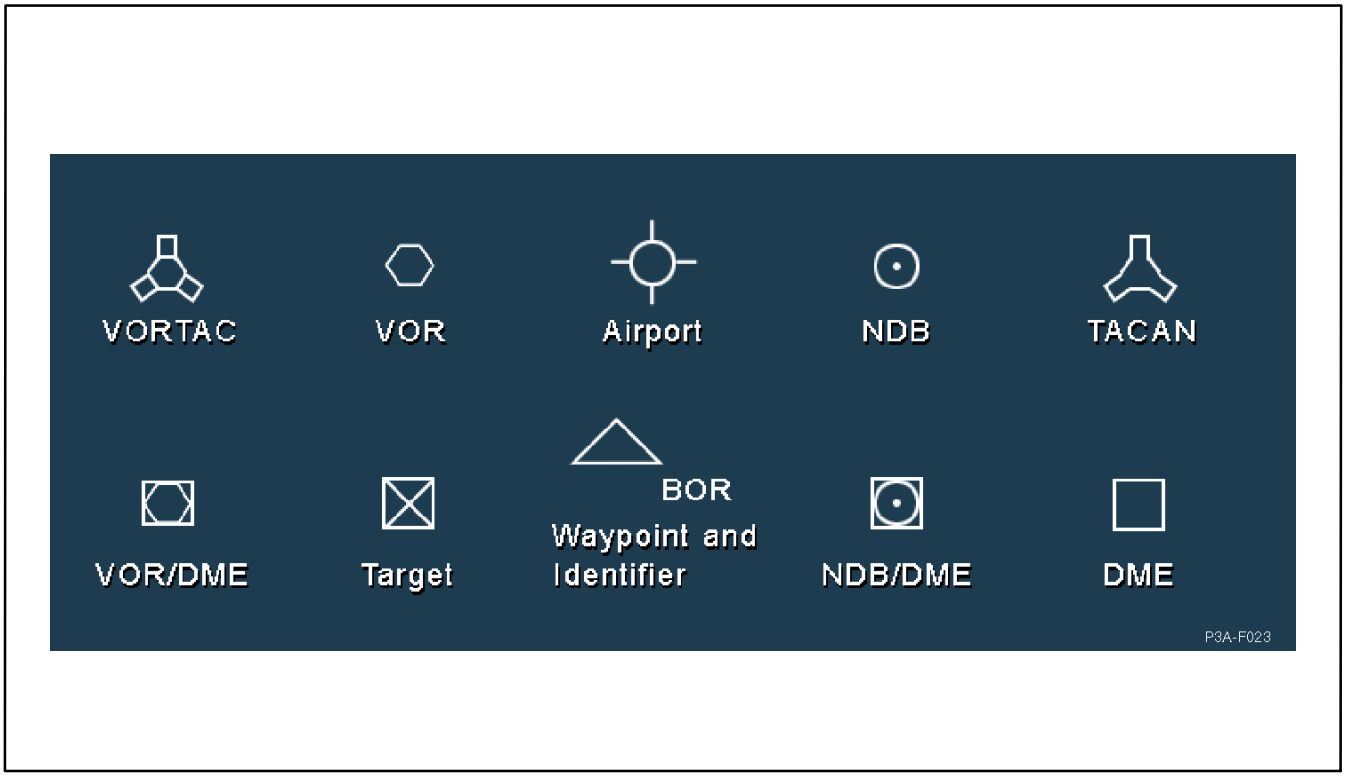


Figure 23-14. EHSI Map Mode Symbology

23.7.1 OTPI System Components

23.7.1.1 ARA-50 Relay Amplifier

The relay amplifier, located in rack F-1, is utilized by both the UHF-DF and OTPI systems. The bearing information received from the ARA-50 sensing antenna is amplified in the relay amplifier then sent to the UHF-1 or the OTPI receiver (Figure 23-15).

23.7.1.2 On-Top Position Indicator Receiver

The OTPI receiver, located in rack F-1, is installed in aircraft with the AQA-7 acoustic system. The receiver processes VHF sonobuoy signals to provide heading information for selection on the HSIs (Figure 23-15).

23.7.1.3 OTPI Receiver Control Panel

The OTPI receiver control panel, located on the center pedestal of the flight station (Figure 23-16), enables the OTPI receiver to provide bearings to a selected sonobuoy channel. Control functions are listed in Figure 23-17.

23.8 ADVANCED SONOBUOY COMMUNICATION LINK (ASCL)

The ASCL receiver replaces the OTPI receiver on SASP equipped aircraft. The ASCL receiver processes the bearing signal from the relay amplifier the same as the OTPI receiver on AQA-7 equipped aircraft. The ASCL receiver sends received signals to the FDS to be damped and available for display.

Note

Because of the common antenna, the OTPI receiver/ASCL receiver and UHF-DF equipment cannot be used simultaneously. DF use overrides the OTPI system.

23.8.1 ARR-78 System Components

23.8.1.1 ARR-78 ASCL Receiver

The ASCL receiver, located in rack E-2, is installed on aircraft equipped with the SASP acoustic system. Receiver channel 20 of the ASCL receiver processes VHF signals (OTPI) from the sonobuoy channel selected on the receiver control panel (refer to Figures 23-15 and 23-16).

23.8.1.2 ARR-78 Receiver Control Panel

The receiver control panel, located on the center pedestal in the flight station, tunes receiver channel 20 to the desired sonobuoy channel. Figure 23-18 shows control panel functions.

23.9 CENTRAL REPEATER SYSTEM (CRS)

The CRS allows inputs from the NAVAIDs or inertials to be amplified for display on the FDI and HSI. This system (located in rack B-1/B-2) consists of provisions for up to three Electronic Control Amplifiers (ECAs), although only two are currently installed (ATTD/HDG and BRG/HDG). The ECA receives synchronized information and amplifies it to a sufficient power to be displayed on multiple devices, such as the HSIs or FDS.

A push-to-test button on the front of each ECA initiates a test of the fault detection system of the ECA by removing operating voltage from the power supply (refer to Figure 23-19). This simulates a module failure and results in the illumination of all applicable fault lights on the ECA and both CRS advisory lights at the NAV/COMM station.

WARNING

Do not activate the push-to-test switches in flight with the ASW-31 autopilot engaged.

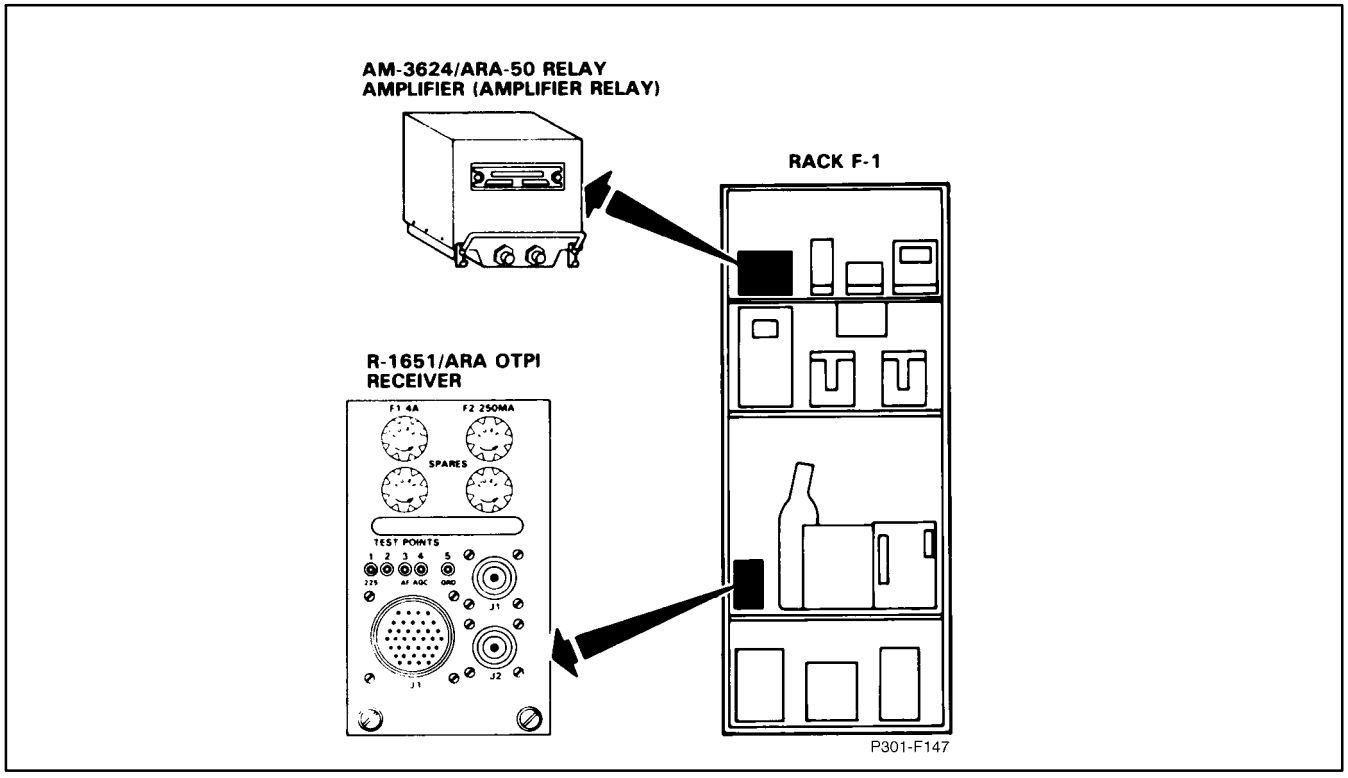
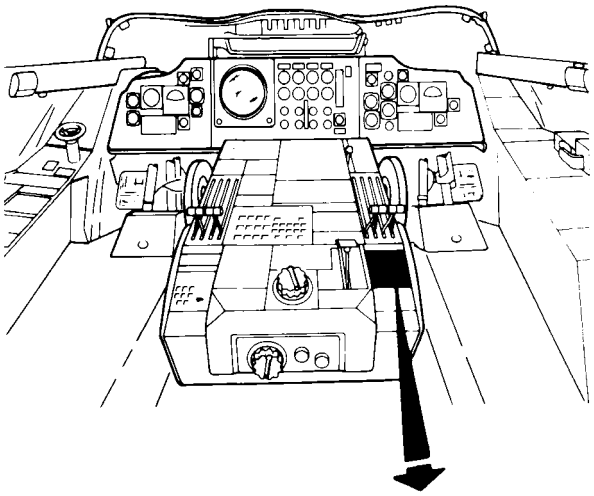
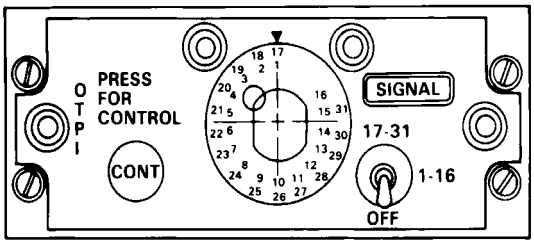


Figure 23-15. ARA-50 Relay Amplifier and OTPI Receiver

FLIGHT STATION

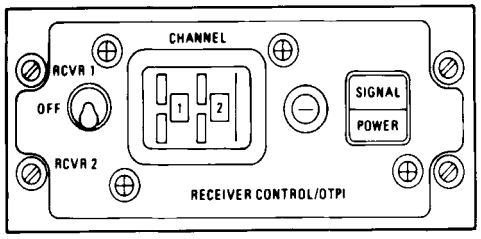


OTPI CONTROL PANEL



OR

C-10127/ARR-78(V)1
RECEIVER CONTROL/OTPI



P301-F148

Figure 23-16. OTPI Control Panels

Illumination of a fault advisory light indicates a fault in the corresponding module (numbered 1 through 12). Refer to the flight station/crew station maintenance manual for equipment served by each ECU card.

23.10 NAVIGATION INTERCONNECTION BOX

The NAV-J box, located in rack B-1, provides routing, switching, and excitation voltages for selected navigation system (Figure 23-19). Power is supplied from the MEDC bus through three circuit breakers labeled BUS 1, BUS 2, and BUS 3 and from the MEAC bus through two circuit breakers labeled BUS 1 and BUS 2. The NAV-J box also receives power from the radar altimeter via the RAD ALTM PWR circuit breaker on the FEAC bus. In the event of a MEDC bus failure, the relays in the NAV-J box go to the deenergized position. The deenergized positions are as follows:

1. The pilot HSI receives INS-1 heading and VOR-1 bearings as a result of an open BUS 1 circuit breaker on the FECB.

2. The copilot HSI receives INS-2 heading and TACAN bearings as a result of an open BUS 2 circuit breaker on the FECB.

3. Both FDIs receive attitude information from the vertical gyro as a result of an open BUS 3 circuit breaker on the FECB.

The NAV-J box generates 26-Vac synchro-excitation voltage for all equipment in the aircraft that generates analog signal outputs. Synchro excitation voltage is an analog reference signal that is required by equipment such as the TACAN and VORs to properly convert the incoming signal into an analog bearing. Loss of this excitation voltage means that the affected system will be unable to properly output any analog information.

PANEL MARKING	FUNCTION
1 - 31 Rotary Selector	Determines which of the 31 OTPI receiver channel frequencies is to be selected.
SIGNAL Light	Illuminates to indicate the aircraft is within close proximity of the selected OTPI channel.
PRESS FOR CONTROL	Inoperative.
Power Switch:	
OFF	Secures power.
1 - 16	Enables the 1 to 16 channel frequency range on the rotary selector.
17 - 31	Enables the 17 to 31 channel frequency range on the rotary selector.

Figure 23-17. OTPI Receiver Control Panel Markings and Functions

PANEL MARKING	FUNCTION
CHANNEL Thumbwheels	Selects the RF channel (1 to 99) bearing information is desired.
SIGNAL Light	Illuminates to indicate the aircraft is within close proximity of the selected sonobuoy channel.
POWER Light	Illuminates green when power is applied. The receiver selector switch must be in RCVR 1 or RCVR 2, and the corresponding ASCL receiver must be on before light illuminates.
Receiver Selector Switch:	
RCVR 1	Allows control of the OTPI receiver channel 20 in the ASCL receiver 1.
RCVR 2	Allows control of the OTPI receiver channel 20 in the ASCL receiver 2 (if installed).
OFF	Allows manual or computer control of ASCL receiver channel 20.

Figure 23-18. Advanced Sonobuoy Communication Link (ASCL) Receiver

Note

Although INS-1 and INS-2 receive power from different AC buses, both systems receive synchro-excitation from the same source. If the MEAC bus fails, the NAV-J box will not be powered and in addition to losing INS-1, INS-2 will not develop analog outputs. Therefore, there will be no INERTIAL heading and attitude information available on the HSIs and FDIs. The standby gyro will be the only reliable source of attitude information available for the FDIs.

23.11 NAVIGATION SIMULATOR

The navigation simulator (located in rack C-1) provides simulated heading, attitude, and test command signals to the CRS for on-ground testing. After power amplification, heading and attitude signals may be used to exercise heading and/or attitude systems of the radar, MAD, and HSIs. In addition, the navigation simulator provides simulated heading and TAS to the digital computer via the synchro-to-digital converter.

23.12 CIRCUIT BREAKERS

Circuit breakers and power sources for the navigation/attitude display system components are listed in Figure 23-20.

23.13 UHF-DF DIRECTION FINDER

The UHF-DF direction finder is used in conjunction with the UHF-1 radio set. The direction finder provides either navigational (magnetic) heading or tactical (true) heading. When utilizing the true headings, the FDS signal data converter receives a relative bearing signal from the relay amplifier and converts it into a damped true heading. The bearing information is then available to the HSI course arrow when DF is selected on the FDS control panel.

Note

When in the UHF-DF mode, keying the UHF-1 transmitter automatically transfers the UHF-1 set from the ARA-50 sensing antenna to the UHF-1 blade antenna before transmission starts. When keying is terminated, the UHF-1 radio set returns to the receive mode, connected to the ARA-50 sensing antenna.

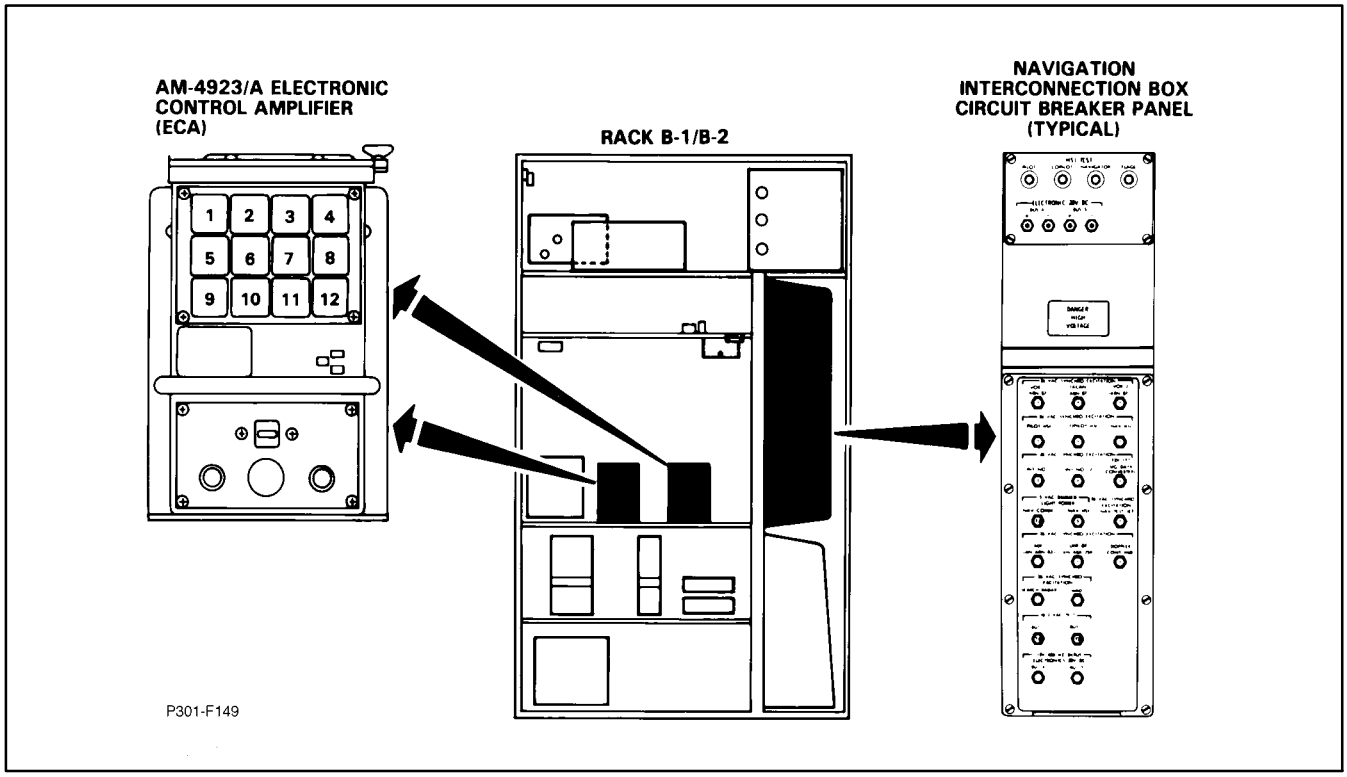


Figure 23-19. Electronic Control Amplifier and NAV-J Box

23.14 ARMAMENT SYSTEM COMPONENTS

23.14.1 Armament Safety Circuit Disable Switch

The ARMT SAFETY CKT DISABLE switch, located on the forward electronics circuit breaker panel, is a momentary contact switch used to bypass the landing gear lever switch that permits operation of the kill stores systems when the gear handle is selected DOWN. The MASTER ARM switch must be turned on before actuation of the DISABLE switch. Positioning the switch to DISABLE supplies power to the kill stores systems. Holding power for the relay is supplied through the MASTER ARM switch.

Note

The jettison function is rendered inoperative by the landing gear scissor switches when the aircraft weight is on both main landing gear mounts, regardless of the position of the ARMT SAFETY CKT DISABLE switch.

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
Flight Director Steering Computer	Forward Load Center	FLT DIR PWR	MEAC MEDC
Flight Director Signal Data Converter	Forward Load Center	FLT DIR PWR	MEAC MEDC
	Navigation Interconnection Box	FDI SYS	26-Vac Sync Excitation
Flight Director Indicator	Forward Load Center	ATTITUDE IND.: PILOT	MEAC
		COPILOT	MEAC
	Navigation Interconnection Box	FDI SYS	26-Vac Sync Excitation
Horizontal Situation Indicator	Forward Electronic	PILOT	MEAC
		COPILOT	MEAC
		NAV	MEAC
	Navigation Interconnection Box	PILOT	MEAC
		COPILOT	MEAC
		NAVIGATOR	MEAC
Vertical Gyro	Forward Load Center	ATTITUDE IND. COPILOT V. GYRO	MEAC
		VERT GYRO	MEAC
	Note Powered by FLIGHT ESSENTIAL AC BUS if MONITORABLE ESSENTIAL AC BUS becomes deenergized. If MONITORABLE ESSENTIAL DC BUS becomes deenergized, the vertical gyro attitude information is displayed on the pilot and copilot FDIs regardless of the position of the ATTD select switch on the HSI control panel.		
Bearing-Heading Electronic Control Amplifier	Forward Electronic	BRG/HDG	MEAC MEDC
Attitude-Heading Electronic Control Amplifier	Forward Electronic	ATTD/HDG	MEAC MEDC
Navigation Interconnection Box	Forward Electronic	NAV INTERCONNECTION BOX-FWD BUS 1, BUS 2, BUS 3	MEDC
		BUS 1, BUS 2	MEAC

Figure 23-20. Navigation/Attitude Display System Circuit Breaker Locations and Power Sources (Sheet 1 of 2)

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
Navigation Simulator	Forward Electronic Navigation Interconnection Box	NAV INTERCONNECTION BOX-FWD BUS 3 NAV TEST SET	 MEDC 26-Vac Sync Excitation
ARA-50 Relay Amplifier	Main Load Center Navigation Interconnection Box	UHF-DF UHF-DF	BUS A MDC E MEAC
OTPI (AQA-7 Configured)	Main Load Center	OTPI	BUS A MDC E
ASCL Receiver (SASP Configured)	Acoustic System	ASCL RCVR	BUS A MDC E

Figure 23-20. Navigation/Attitude Display System Circuit Breaker Locations and Power Sources (Sheet 2 of 2)

23.14.2 Armament Stores Jettison

WARNING

Do not activate WING ONLY JETTISON after activating JETTISON because the bomb bay doors will not close.

In an emergency situation, the pilot initiates the jettison function to accomplish an unarmed release of kill stores. The pilot has the option of either releasing only the stores on the wings or both bomb bay and wing stores. The PEU-196/A Armament Control Box (Figure 23-21), located on the center control stand, combines the necessary switches for these functions.

Operating the WING ONLY JETTISON switch to the spring-loaded forward position and holding initiates a sequence in the programmer module to jettison all wing stores in an unarmed condition in approximately 8 seconds. The wing stores are jettisoned in pairs, one from each side of the aircraft from outboard to inboard at 2-second intervals. Placing the JETTISON toggle switch to the jettison position initiates the jettison of all kill stores automatically from the aircraft in approximately 20 seconds. The jettison function can be initiated at any time, regardless of whether or not a store selection is in progress, and takes precedence over any other weapon functions in the on line or off-line mode.

23.14.2.1 Armament Jettison Circuit

Power to operate the armament jettison circuit is supplied by six circuit breakers located on the forward electronic circuit breaker panel. Five of these circuit breakers supply 28 Vdc and are placarded: LWG, RWG, CONT, BOMB BAY DOOR CONT, and BOMB BAY STORES. These five circuit breakers receive power from the ARMAMENT JETTISON circuit breaker on the MEDC bus section, on the forward electronic load center lower circuit breaker panel. The remaining circuit breaker, placarded JETTISON PROGRAMMER ⊘ A, supplies 115 Vac to operate the programmer module (2A8). This circuit breaker receives its power through a circuit breaker placarded ARMAMENT CKT BKR PNL ⊘ A located on the MEAC bus section of the forward load center circuit breaker panel.

The jettison release pulses are generated in the programmer module located in the forward armament interconnection box. A complete cycle of operation occurs in approximately 20 seconds. At the completion of a time cycle, the unit returns to the normal starting position and will remain there to prevent recycling until power is interrupted.

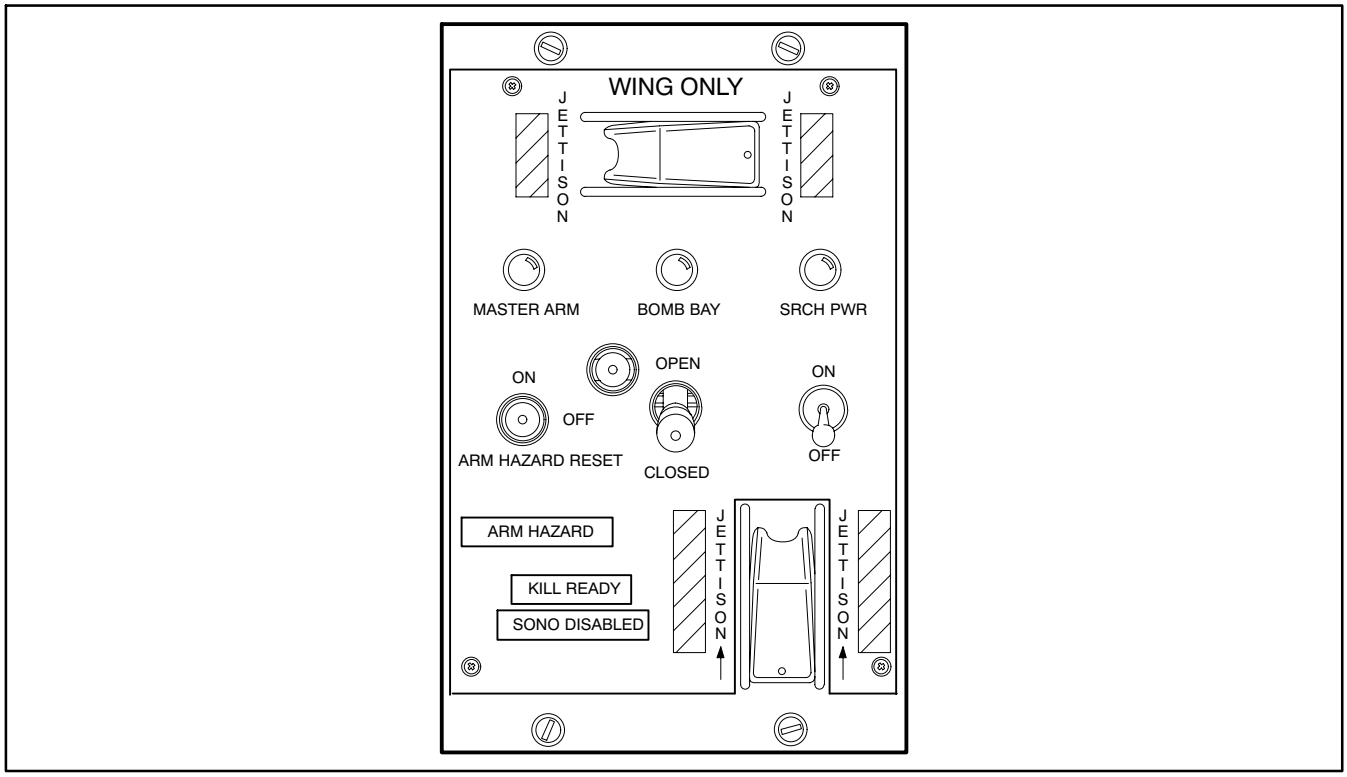


Figure 23-21. PEU-196/A Armament Control Box

The JETTISON switch, when actuated, applies power to the programmer module, which then executes its full cycle. Wing-only jettison is accomplished by actuating the WING ONLY JETTISON switch for approximately 8 seconds. The WING ONLY JETTISON switch, when actuated, applies power to the programmer and interrupts control of both the bomb bay stores and the bomb bay doors by the programmer module.

When power is applied to the programmer module, the jettison operation commences in the following order: the bomb bay doors open; at the same time, the wing stores start jettisoning in pairs, one from each wing in a symmetrical sequence, beginning with the outboard stations (9 and 18) and continuing through the inboard stations. Provided the bomb bay doors are open, power from the programmer will send three release impulses to all bomb bay stations. Store sensing switches at stations 2, 4, 6, and 8 prevent the release of an upper store until the lower store blocking it is released. For this reason, if a lower store does not release until the third bomb bay pulse, the upper store will not leave the aircraft. The jettison switch must be cycled to OFF, then back to ON. This will restart the jettison programmer and release the upper store. The programmer pulse is fed through energized station 2C, 4C, and 8C relays for station C release.

The jettison function is rendered inoperative by the landing gear scissor switches when aircraft weight is on both main landing gear mounts.

Note

The energized jettison control relay open contacts interrupt the kill store 28-Vdc arming power. This prevents the arming of stores during jettisoning.

The jettisoning cycle can be terminated at any point during the cycle by turning the JETTISON switch to off, which will return the programmer module to the start position.

23.15 AN/APN-234 WEATHER RADAR

23.15.1 Description

The AN/APN-234 color radar system employs a multi-color digital indicator to provide continuous en route weather information relative to cloud formation, rainfall rate, thunderstorms, and icing conditions. The indicator provides a three-color map display, showing three separate levels of rainfall intensity in green, yellow, and red. Blue-segmented range circles, blue alphanumerics, a 0° azimuth line, and a yellow track cursor are also provided. In addition to its primary weather mapping function, the system can be used for ground mapping and surface search.

23.15.2 System Components

The system consists of three units: a receiver-transmitter; a line-of-sight stabilized antenna; and a panel-mounted, rectangular screen indicator. The radar indicator (Figure 23-22) is mounted in the copilot instrument panel and contains all controls used to operate the radar. The antenna and the receiver/transmitter are located in the nose radome. Power is provided from three circuit breakers on the flight station MON ESS AC circuit breaker panel. One is labeled MON ESS AC, one MON ESS DC, and one MAIN AC BUS A.

23.15.2.1 Radar Antenna

Using the tilt control on the radar control panel, the operator can adjust the antenna to any position between ±15° from the horizon. Stabilization is provided by pitch and roll signals from either INS system. This stabilization signal depends on the selected position of the weather radar switch located on the copilot's instrument panel.

23.15.2.2 Radar Control Indicator

The radar control indicator (Figure 23-22) is a multifunctional digital color radar indicator that provides a continuous three-color display of weather or ground mapping targets within the area scanned by the radar antenna on a rectangular Cathode Ray Tube (CRT). All controls for the operation of the radar are arranged around the CRT. The radar information is presented in a 60° or 120° pie-shaped area originating at the bottom of the CRT.

A blue segmented line representing aircraft heading appears in the center of the display, and blue segmented arcs of concentric circles provide range indications.

The area of the CRT outside the radar display is used for the display of alphanumeric readouts such as mode status and range line values. The alphanumerics are displayed in blue. When selected, a yellow track cursor controlled by the TRACK button is displayed. While the track cursor is displayed, its differential heading is also displayed in yellow in the upper left corner of the CRT.

The radar display can be frozen by selecting the hold function. When hold is selected, the antenna continues to scan and the memory is updated, but the display remains as it was until normal operation is selected. In addition to the normal radar displays, an information list display is provided anytime a mode button is pressed. The information list (Figure 23-23) shows a list of modes, the mode in use available range selection, the range in use, a chart providing a color code for radar interpretation, and system status.

23.15.2.3 APS-115 In-Use Light

The APS-115 in-use light is located next to the indicator on the copilot instrument panel. This light alerts the copilot that the APS-115 has high voltage applied. An inhibit switch located in rack B-2 illuminates this light and prevents power-up of the Color Weather Radar System.

CAUTION

Power-up of the AN/APN-234 should not be attempted with the APS-115 in-use light illuminated.

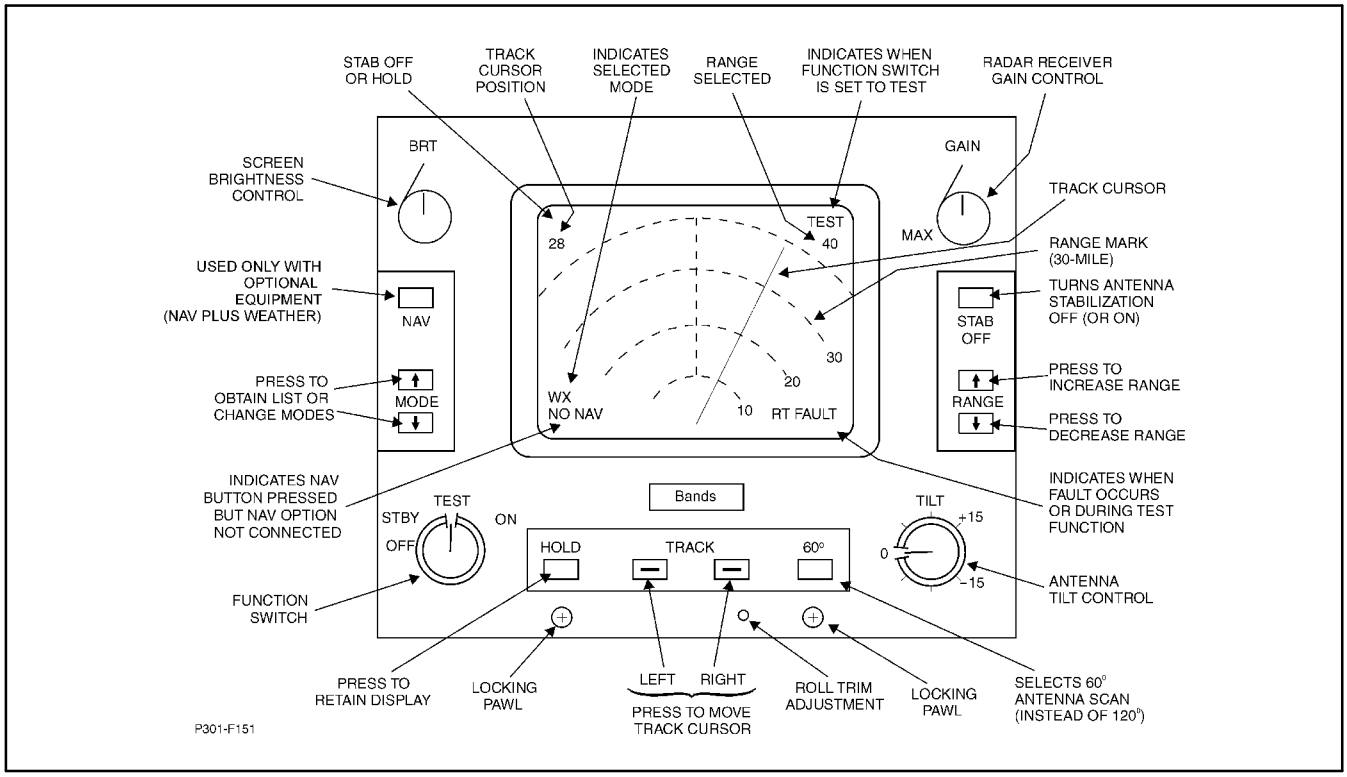


Figure 23-22. Radar Control Indicator

CONTROL/DISPLAY	FUNCTION
Function switch	1. OFF — Removes primary power from the radar system. 2. STBY — Places radar set in standby condition during warmup period (100 seconds) and when system is not in use. Display is turned off. 3. TEST — Selects the test function to determine operability of the radar system. A test pattern is displayed. No transmission exists in TEST condition, and an RT FAULT indication is present on the display. 4. On — Selects condition for normal operation.
BRT control	Adjusts brightness of display.
UP MODE button	Pressing momentarily produces information list on display. Pressing again, while information display is still present, advances indicator display to next higher mode shown on list. The list disappears after a few seconds, and mode does not change if the button is not pressed again. The following standard modes are available in the order shown. SRCH — Sea search. MAP — Ground mapping. WXA — Weather mapping with alert. The red area flashes. WX — Weather mapping. **Note** When top mode is reached, this button does not change mode.

Figure 23-23. Radar Control Indicator Functions (Sheet 1 of 2)

CONTROL/DISPLAY	FUNCTION
TRACK button	When pressed, yellow track cursor line appears and moves to right (in 10 steps) while button is held depressed. The track cursor stops when button is released and remains for about 10 to 20 seconds, then disappears. The differential heading is indicated in yellow numerals in upper left corner of display and disappears simultaneously with track cursor. When pressed, yellow track cursor appears and moves to left when held depressed.
GAIN control	Varies radar receiver gain when in MAP or SRCH mode. GAIN and STC are preset in TEST function and in WX and WXA modes.
HOLD pushbutton (push-on/push-off)	Retains display when button is actuated (push-on). The word HOLD flashes in upper left corner of display. The weather or ground-mapping image last presented is retained (frozen) on indicator display in order to evaluate the significance of storm cell movement. Switching back to normal operation (pressing HOLD pushbutton a second time) reveals direction and distance of target movement during HOLD period. In HOLD, antenna continues to scan, and a non-updated display continues to be presented as long as power is supplied to system. A change in range selection with indicator in HOLD results in a blank screen.
RT FAULT display	Appears in lower right-hand corner of display when an R/T fault occurs. Also appears during normal TEST function.
Roll Trim (screwdriver adjustment)	In-flight maintenance adjustment for antenna roll stabilization.
On MODE button	Moves indicator display to next lower mode each time button is pressed while list is being displayed. The sequence is as listed. **Note** When bottom mode (WX) is reached, button does not change mode.
NAV button (not used)	Operation only when a NAV interface unit is connected; the words NO NAV are displayed in lower left corner when NAV button is pressed.
STAB OFF button	Turns off antenna stabilization when activated. The words STAB OFF appear in upper left corner of display. Press again to turn on stabilization.
Up RANGE button	Clears display and advances indicator to next higher range each time button is pressed (e.g., 20 to 40, 80 to 160, etc.) until 240 mile range is reached. The range selected is displayed in upper right-hand corner (on last range mark), and distance to each of the other range circles is displayed along right edge of the circles (arcs).
Down RANGE button	Clears display and places indicator in next lower range each time button is pressed (e.g., 40 to 20) until minimum range is reached.
TILT control	Electrically adjusts antenna to move radar beam up to ±15° above horizontal or to a maximum of –15° below horizontal position. The horizontal position is indicated at 0° on control.
60° button	Clears display and changes antenna scan (and display) to 60° when pressed. Pressing button again returns scan to 120°. Range mark alphanumeric move inward from edge of scan in 60° position.

Figure 23-23. Radar Control Indicator Functions (Sheet 2 of 2)

23.15.3 Modes of Operation

The radar has two weather mapping modes, a ground mapping mode, a surface search mode, and a selectable built-in TEST function.

23.15.3.1 Weather Mapping Modes (WX and WXA)

Weather mapping modes provide storm detection and severe weather alerts up to a distance of 240 miles. In the weather mode (WX on the display), the radar operates in low Pulse Repetition Frequency (PRF) and automatic gain control. The radar scans a pie-shaped area 120° or 60°, as selected, either side of the aircraft heading. Cloud formations return radar energy in relation to their level of moisture content. The higher the moisture content or rainfall intensity, the more energy returned. The radar divides weather information into four categories of intensity and displays the weather ahead of the aircraft in a map-like presentation, relating range and azimuth from the aircraft. The areas of most moisture are colored red; the next most intense are yellow, followed by the least intense areas, which are green. Clouds with little or no moisture are looked through by the radar and not displayed, allowing the pilot to determine areas of relative calm. Since the amount of energy returned by a cloud is affected by range as well as moisture content, it can be expected that as range to a cloud decreases, its indicated intensity may move up the scale from green toward red. In the weather alert mode (WXA on the display), the radar operates in the same manner as the weather mode. Also, areas colored red flash, thereby alerting the pilot to areas of intense rainfall. Refer to Figure 23-24.

23.15.3.2 Ground Mapping Mode

In the ground mapping mode (MAP on the display), the radar operates at low PRF for ranges over 20 miles and at high PRF at 10 or 20 miles. The manual gain control functions in this mode.

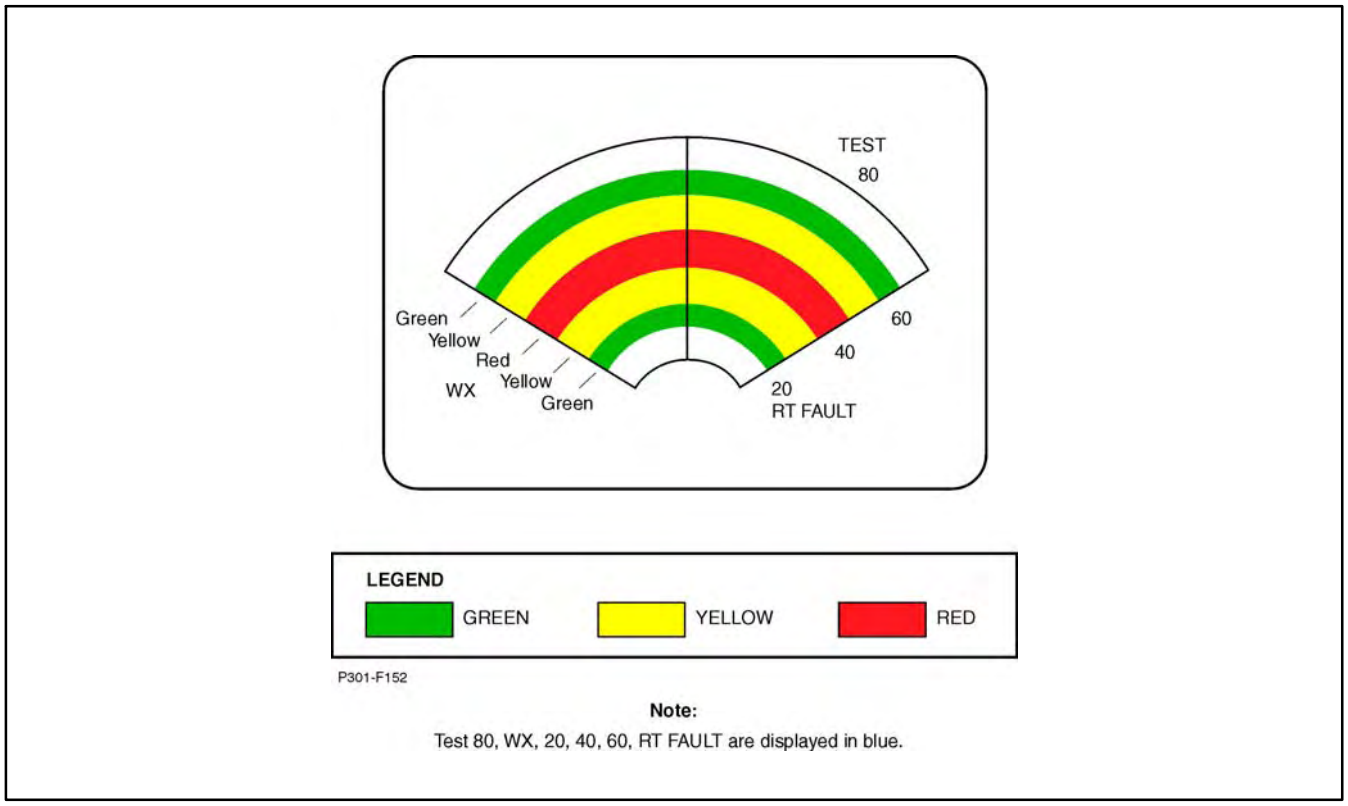


Figure 23-24. Weather Radar Typical Test Pattern

The ground mapping mode displays a pie-shaped plan view of the terrain and cultural features ahead of the aircraft in a map-like presentation. As in the weather modes, the strength of the signal returned to the radar is indicated by the color on the display. Strong returns, such as cities or prominent terrain features, are displayed red, whereas targets or terrain giving less intense reflections appear yellow or green. Calm water, which provides no return, is shown as a blank area on the display, whereas rougher water, which does return some energy, generally appears green.

23.15.3.3 Surface Search Mode (SRCH)

The search mode is used for tracking surface targets over water. In this mode, the RT uses special clutter rejection (fast time constant) circuitry and is designed primarily for short range (20 nm and below) searching for targets in a sea-clutter environment.

23.15.4 Turn-On Procedures

1. Function switch — STBY (approximately 100 seconds is required for warmup).
2. Function switch — TEST.
3. Indicator display — CHECK.
   a. RANGE — Set to 80.
   b. Observe that the test pattern (Figure 23-24) is displayed approximately 100 seconds after the system is turned on and that the 4 range marks are marked 20, 40, 60, and 80. The scan should be 120, RT FAULT should be displayed in the lower right, and TEST should be in the upper right.

Note

In the test mode, the transmitter is turned off, and simulated target return signals produce a test pattern on the indicator-control CRT. The antenna assembly is not tested in the test mode.

4. BRT control — As required.
5. Function switch — ON.

WARNING

Do not select ON within 15 feet of personnel or 75 feet of fueling operations.

6. Scan known topographical features, or if feasible, weather formations to ensure antenna assembly is operable.

Note

If cabin pressurization is lost above 19,000 feet MSL, the weather radar will automatically shut off. It will turn back on when the cabin altitude is below 15,000 feet.

23.16 AN/ASH-37 STRUCTURAL DATA RECORDING SYSTEM (SDRS)

23.16.1 System Description

The ASH-37 consists of a Recorder Converter (RC), Memory Unit (MU), Motion Pickup Transducer (MPT), and Data-Entry Keyboard (DEK). The ASH-37 SDRS provides the P-3 with more accurate measurements and recording of structural loads, thus enabling more reliable data recording of fatigue life tracking and service life predictions for the P-3 airframe. The SDRS collects data from areas in the aircraft and stores in the memory unit during flight.

The RC and MU located in the main load center receive inputs from various aircraft systems automatically. The MPT, also located in the main load center, measures aircraft g-forces and sends this information to the RC. The DEK is located in the flight station above the circuit breaker panel along with a placard defining the ranges for valid DEK entries. A high-g indicator is provided as part of the DEK, which trips to white whenever normal acceleration forces exceed 3 gs. The MAIN DC BUS supplies SDRS system power.

23.16.2 System Operation

Operation of the SDRS is automatic. Except for manually entering data into the system, no operator action is required. The DEK provides an interface for the entry of the following data parameters:

1. Date.
2. Local time.
3. Weight of wing stores station 9 through 18.
4. Fuel weight.
5. Aircraft gross weight.
6. Center of gravity.
7. Mission code.

The DEK has 16 keys and an eight-position alphanumeric, night vision compatible display. The DEK power switch is located adjacent to the keyboard. The switch is a lighted pushbutton on/off switch. Keyboard functions include:

1. CLEAR key can be used to erase invalid data, allowing the user to enter correct data.
2. CLOSED/LOAD key does not have a function in the P-3 aircraft.
3. ENTER key validates the data and stores the data in the DEK memory.
4. SEND key transmits the data in the memory buffer to the recorder/converter.
5. SCROLL key allows the user to step through the data entry fields to determine if the information has been entered correctly. This should be done prior to pressing SEND.

Note

Loss or interruption of electrical power during data entry may result in the loss or corruption of the data in the DEK. If this occurs, scroll through data parameters and ensure correct information is stored. If data are lost or corruption has occurred, reenter all data.

Upon initial power-up, the DEK is in the Night Vision (NVIS) mode. A four-pixel dot is displayed in the left corner of the LED panel as the DEK performs a self-test. To activate the normal mode, press the DIM key on the keypad when the Date is displayed in NVIS mode. The BIT status and "Memory Full" messages should be checked after every flight.

The following procedures outline the steps necessary to enter the required data parameters:

1. Press the DEK power switch.
2. The display *READY* will indicate that the DEK passed the BIT.
3. The display P3C verifies the aircraft type.

Note

If the message NO MU is displayed at this time, secure the system power and install the memory unit on the receiver recorder.

The DEK display will be in night vision mode at this time. To exit this mode, press the DIM key.

4. The display DATE#### indicates that the DEK is ready to receive data from the keypad. If the date displayed is correct, press the SCROLL key. If incorrect, enter the Julian date, then press ENTER.
5. The display TIME#### will appear. If the time is correct, press the SCROLL key. If incorrect, enter the local military time, then press ENTER.

Note

The data entries for all wing stations are identical. Therefore, only a single example will be given.

6. The display STA9WT will appear. Enter the sum of the wing store weight to the nearest pound, and then press ENTER.

Note

The valid range (in pounds) for wing stations 9 and 18 is 0 to 900; for wing stations 10 and 17 is 0 to 1,600; and for wing stations 11 through 16 is 0 to 2,600 pounds.

7. The display FW K will appear. Enter the total aircraft fuel weight to the nearest thousand pounds, then press ENTER.
8. The display GW K will appear. Enter the aircraft gross weight to the nearest thousand pounds, then press ENTER.
9. The display C.G. will appear. Enter the center of gravity in percent to the nearest 1/10 percent, then press ENTER.
10. The display MSN will appear. Type the mission code, then press ENTER. The mission code corresponds to the following:

    a. 0 — Training.

    b. 1 — Instrument checkflight.

    c. 2 — Patrol flight/Drug interdiction/Surf Surv.

d. 3 — Transport flight.

e. 4 — Functional checkflight.

f. 5 — ASW flight (with or without wing stores).

g. 6 — Training, composite flight.

h. 7 — Search and long-range flight.

i. 8 — Utility/mine laying and medium-range flight.

j. 9 — Other.

11. The display BIT PASS will appear. This indicates that the recorder/converter BIT has been completed and there are no failures. If a failure is detected, the display will indicate BIT FAIL. Press ENTER or SCROLL to continue.

12. The display MU READY will appear. This indicates the memory unit is ready to receive data from the DEK. If the memory unit is full, the display MU > 80% will appear. In this case, the memory unit should be removed from the aircraft and downloaded.

13. Press the SCROLL key to verify all data. If all the data are correct, press the SEND key.

14. The display SENDING and then COMPLETE will appear. All data entry and transmission are complete. The DEK should be left on and will automatically time-out to the low power mode.

Note

If a transmission failure occurs, wait 10 seconds and press the SEND key again. If the FAILURE message reappears, the system must be repaired.

23.17 FLIGHT MANAGEMENT SYSTEM (FMS)

The P-3 Flight Management System (FMS) allows the aircrew to use GPS as the primary means of navigation for Required Navigation Performance (RNP) Area Navigation (RNAV) operations during all phases of flight, including approach (RNP 0.3). The major components of the FMS are the CDU-7000 (referred to as the CDU), RINU-G, and Electronic Flight Display System (EFDS). The CDU, the heart of the system, allows the operator to enter data, performs required navigational calculations, presents textual display of data, and provides steering guidance to the EFDS. The RINU-G provides positioning data and GPS integrity functionality. Steering guidance, a pictorial representation of the flight path, other information that enhances situational awareness, and alerts are displayed on the EFDS. Aircraft systems that provided data to the FMS include Air Data Display Units (ADDU) and the Digital Data Set (DDS). The navigation database stored in the CDU is created off-aircraft using the Joint User Mission Planning System (JMPS) incorporating NAVSTAR. NAVSTAR is a P-3 specific software program that takes digital aeronautical data and formats it in the proper format for loading in the CDU.

WARNING

FMS generated guidance information shall not be used as the sole source of navigation until aircrew have received required training and designation in accordance with OPNAVINST 3710.7 series.

23.17.1 System Components

23.17.1.1 CDU-7000 (C-12378/A Control-Indicator)

Refer to Figure 23-25. Located at the pilot, copilot, and NAV/COMM stations, these units provide the control, display, processing, and operator interface capabilities of the FMS. The CDU performs the navigational computations, provides steering information, builds the page displays, provides subsystem communication, control and background Built-In-Test (BIT). Sufficient memory is available to store a worldwide navigational database and is stored in each CDU. All three CDUs are identical. Data are shared among the CDUs via digital data buses. The first flight station CDU to be powered on is designated as the “Bus Controller”; however, all functions and orders may be performed on any of the CDUs.

23.17.1.2 Control Panel Assembly

CDU ON/OFF switches are located on control panel assemblies. The pilot and copilot control panel assemblies are located on the respective side console. The NAV/COMM assembly is located on the panel above the station.



INDEX NO.	NAME	FUNCTION
1	EXECUTE KEY	Incorporates changes made to flight plan data into the active flight plan.
2	DATA INPUT KEYS	Keys that allow operator to enter data into the scratchpad.
3	PAGE SCROLL KEYS	Allow operator to scroll pages up or down on LCD display.
4	CLEAR KEY	Erases data entered into the scratchpad or enters DELETE mode if scratchpad is empty.
5	BRIGHTNESS CONTROLS	Control intensity of data displayed on the LCD display.

Figure 23-25. CDU Face Plate and Panel Functions (Sheet 1 of 2)

INDEX NO.	NAME	FUNCTION
6	PAGE ACCESS KEYS	Allow operator to access following pages: MENU — menu page COM — communication pages IFF — IFF pages MSN — mission pattern pages MARK — mark point pages IDX — index pages DIR — direct intercept page FPLN — flight plan pages LEGS — legs pages DP/AR — departure and arrival pages PERF — performance pages PROG — progress pages MSG — message page, unless on message page then page displayed prior to initial press of MSG key.
7	LINE SELECT KEYS	Enter data from scratchpad into field adjacent to key; copy data from field adjacent to key to empty scratchpad; initiate function displayed adjacent to key; select next choice if more than one choice is displayed; or provide access to indicated page.
8	LCD DISPLAY	Displays data, status, fault information on 15 lines. Line 1 is normally used to display the page title; line 14 (SCRATCHPAD) is used to display instructions entered by the operator or system-generated alerts; and line 15 (ANNUNCIATION) is used to display system-generated messages.

Figure 23-25. CDU Face Plate and Panel Functions (Sheet 2 of 2)

23.17.2 System Description

The CDU-7000, a replacement for the CDNU-800, contains a full alphanumeric keyboard, line select keys, function keys, a color flat panel Active Matrix Liquid Crystal Display, and a microprocessor subsystem. The Operational Flight Program (OFP) is field-loadable and consists of two independent software programs. The CDU performs the navigational computations and generates the steering guidance required for RNAV operations. The CDU controls operation of the RINU-G, IFF, V/UHF radio, and, in CIP aircraft, the satellite Modem and UHF radios and receives data from the ADDU and DDS. The pilot CDU is connected to RINU-G1 and the pilot ADDU; the copilot CDU is connected to RINU-G2 and copilot ADDU. Each CDU provides air data to the on-side RINU-G. The CDU is interfaced with the EFDS to provide steering, route-of-flight, and situational awareness information. Unlike the CDNU-800, the CDU is capable of storing a worldwide NDB. Besides navigation aid and airport data, the NDB contains airways, instrument departure procedures, instrument arrival procedures, and instrument approach procedures.

23.17.2.1 CDU Conventions

The CDU uses font size, color, and symbols to convey information to the operator. Figure 23-26 displays the common conventions utilized by the CDU.

23.17.2.2 LEGS Page

The CDU LEGS page displays the navigational data for the entered route of flight. Figure 23-27 provides an explanation of data displayed on the LEGS page.

CONVENTION	MEANING
> (inward pointing)	Performs operation indicated on line
< (outward pointing)	Accesses page indicated on line
Asterisk "*"	Operation in progress
□□□□□	Data entry field
[ ]	Data entry field
Colon ":"	Additional choices available for selection (Pressing LSKK will toggle through choices)
Dashed "-----"	Invalid data
Large font	Operator entered value Database defined value
Small font	System computed
Magenta font	Active waypoint
Cyan font	From waypoint Page titles Line Labels
Green font	Active selection, if more than 1 selection displayed Airspeed, altitude, and vertical profile data on LEGS page
Amber font	Advisory condition

Figure 23-26. CDU Conventions

23.17.3 Operations

23.17.3.1 Designated Pilot

Although all CDUs contain the same data, a master CDU is necessary to control waypoint sequencing and generation of integrity alerts. The Designated Pilot refers to the CDU that is the master CDU and is determined by the course source selected on the pilot EFDS Display Control Panel (DCP). When FMS1 is selected, the pilot CDU is the master; conversely, when FMS2 is selected, the copilot CDU is the master. The navigation solution being used by the pilot and copilot CDU is selected on the PILOT and COPILOT CDU RNAV RNP page, respectively.

23.17.3.2 Operating Modes

The CDU has two operating modes: civil and military. The civil mode is the default mode and is required to be used when operating in civil controlled airspace. In the civil mode, WGS-84 is the reference DATUM as mandated by civil requirements. The military mode may be used when not in controlled airspace, permits selection of different reference datums, affects calculation and display of Actual Navigation Performance (ANP), and suppresses the navigation alert when using the pure INS navigation solution or degraded GPS solution.

WARNING

The WGS-84 DATUM shall be used for all non-tactical FMS procedures. Failure to use the proper datum may result in inaccurate navigation data.



INDEX	PARAMETER	MEANING
1	WAYPOINT AIRSPEED	Indicated Airspeed in knots Large font — operator or database entered Small font — system assigned
2	CLIMB/DESCENT INDICATOR	↑ — Climb ↓ — Descent
3	WAYPOINT ALTITUDE	Feet or Flight Level Large font — operator or database entered A — Above B — Below 3000 — cross at 3,000 ft 5000A — cross at or above 5,000 ft FL190B — cross at or below flight level 190 1000A3000B — cross at or above 1,000 ft and at or below 3,000 ft C — Climb D — Descent FL200D — cross at FL200 while descending 7000C — cross at 7,000 ft while climbing Yellow font — altitude constraint that system unable to achieve Small font — system assigned
4	WAYPOINT ATTRIBUTE	A — initial approach fix F — final approach fix I — intercept waypoint M — missed approach point P — closed random pattern attached R — racetrack pattern attached C — circle pattern attached 8 — figure eight pattern attached T — required time of arrival entered for waypoint

Figure 23-27. LEGS Page (Sheet 1 of 2)

INDEX	PARAMETER	MEANING
5	VERTICAL PATH	Descent path between waypoints in degrees Large font — operator or database entered Small font — system assigned
6	DISTANCE	Distance between waypoints in nm
7	DESIRED TRACK	Desired track between waypoints in degrees
8	WAYPOINT	Cyan — from waypoint Magenta — TO waypoint White — other waypoints @ to right of waypoint name — operator designated fly-over waypoint

Figure 23-27. LEGS Page (Sheet 2 of 2)

23.17.3.3 Containment

In order to determine the aircraft ability to continue operation using GPS as the primary means of navigation, the CDU continuously compares Required Navigation Performance (RNP) to Actual Navigation Performance (ANP). When the ANP value exceeds the RNP value, the CDU generates a Containment Alert. A containment alert is indicated by a "√ PLT ANP" or "√ CPLT ANP" CDU annunciation and navigation caution or navigation warning condition on the EFDS.

Note

If a navigation caution or warning condition (as indicated by a yellow or red course label flag, respectively) occurs, notify ATC and discontinue use of FMS as a source of navigation. Consideration may be given to selecting alternate FMS. If alert condition is no longer present, operations may be continued using alternate FMS as means of navigation.

ANP is a measure of the overall navigation performance of the aircraft and includes the accuracy of the navigation solution, as well as an estimate of the ability of the pilot to precisely follow steering guidance, which is known as Flight Technical Error (FTE). The fixed FTE values used by the CDU in calculating ANP are shown in Figure 23-28.

RNP Value	FTE
0.01 - 0.3 nm	0.25 nm
0.31 - 1.00 nm	0.8 nm
1.01 - 2.00 nm	1.0 nm
2.01 - 99.0 nm	2.0 nm

Figure 23-28. Flight Technical Error

23.17.3.4 RNP Scaling

RNP defines the minimum navigation system performance needed to operate within a specified airspace. The active RNP value is displayed on the CDU PILOT RNAV RNP page, COPILOT RNAV RNP page, and the EFDS. On the EFDS, the RNP value determines the magnitude of the Course Deviation Indicator (CDI) full-scale deflection. When the CDI is at 2 dot deviation, the aircraft is left or right of track by the amount of the RNP value. Automatic RNP scaling will occur throughout the flight. The hierarchy for automatic RNP scaling is navigation database assigned,

then phase of flight. The navigation database assigned RNP value is displayed on the LEG INFO page. RNP value for each phase of flight is shown in Figure 23-29. The operator can override the automatic scaling by manually entering an RNP value on the PILOT RNAV RNP page or COPILOT RNAV RNP page. A manually entered RNP value is displayed in large font on the CDU and with an asterisk "*" in front of the RNP value on the EFDS. If the manually entered value exceeds the Base RNP value shown on the PILOT RNAV RNP or COPILOT RNAV RNP pages, the RNP value on the CDU and EFDS are displayed in yellow.

WARNING

A manually entered RNP value will inhibit automatic RNP scaling. This will prevent the CDI from providing proper deflection in all subsequent phases of flight. Navigational errors outside of safe parameters may occur.

RNP VALUE	PHASE OF FLIGHT	DEFINITION
4.00 nm	Oceanic	Within region bounded by N27 W010, N27 W060, N67 W060, and N67 W010. May be selected by operator in other locations if system is not in terminal or approach phase.
2.00 nm	En Route	All other locations
1.00 nm	Terminal	Within 30 nm of origin or destination airport and not in approach phase
0.30 nm	Approach	From 2 nm prior to final approach fix until missed approach point on non-precision instrument approach

Figure 23-29. Required Navigation Performance for Phase of Flight

23.17.3.5 Receiver Autonomous Integrity Monitoring (RAIM)

RAIM is the ability of the receiver to determine if the integrity of the navigation solution meets the integrity requirements for the phase of flight and requires the receiver to be tracking a minimum of five satellites. The CDU and RINU-G provide continuous RAIM and Predictive RAIM (P-RAIM) processing. P-RAIM is the ability to determine satellite coverage for a future time and position in order to predict the integrity of the navigation solution at that point and time. P-RAIM includes automatic approach P-RAIM, manual approach P-RAIM, and secondary flight plan P-RAIM.

23.17.3.5.1 Continuous RAIM

Continuous RAIM is based upon the phase of flight and requires no operator action. RAIM status is continuously displayed on the CDU INAV pages for the INS/GPS and GPS/A/H solutions. RAIM alerts are displayed on the EFDS and the CDU annunciation line. RAIM conditions are described in Figure 23-30. A RAIM WRN and NO RAIM condition will also result in either a navigation caution or navigation warning alert, depending upon the phase of flight. Refer to EFDS section for further description of EFDS alerting.

Note

If a navigation caution or warning condition (as indicated by a yellow or red course label flag, respectively) or NO RAIM annunciation occurs, notify ATC and discontinue use of FMS as means of navigation.

CONDITION	CDU RAIM STATUS	CDU RAIM ALERTS	EFDS INDICATION
RAIM is active and no alerts are present	“RAIM ACT”	None	None
Integrity of the navigation solution is insufficient for the phase of flight	“RAIM WRN”	None	Yellow “RAIM” flag
Integrity of the navigation solution cannot be determined	“NO RAIM”	“NO RAIM”	White “RAIM” flag

Figure 23-30. RAIM Conditions

23.17.3.5.2 Automatic Approach P-RAIM

Automatic approach P-RAIM is intended to predict if the integrity of the navigation solution will be suitable for approach. An alert, NO APPR RAIM, is only provided if the system determines that the integrity requirements are not met. No alert is provided if it is determined that integrity requirements are met.

Note

If the NO APPR RAIM advisory message appears, consideration should be given to conducting a non-FMS-based approach (i.e., TACAN, VOR, ILS, or PAR approach).

Automatic approach P-RAIM is initiated by the system approximately 30 nm from the destination airfield when the aircraft transitions from en route (RNP 2.0) to terminal (RNP 1.0) operations, provided an approach has been loaded in the flight plan. This function only occurs if the navigation solution includes GPS (INU/GPS, GPS/A/H, or GPS/-/H). If the pilot has selected FMS1 as the course source, the prediction is performed by RINU-G1; if the pilot has selected FMS2, the prediction is performed by RINU-G2.

23.17.3.5.3 Manual Approach P-RAIM

Manual approach P-RAIM is intended to predict if the integrity of the navigation solution will be suitable for approach at the operator-specified location and arrival time. The manual approach P-RAIM function is controlled from the APPROACH P-RAIM page. Results of the prediction are displayed on the CDU APPROACH P-RAIM page on the line above LLS6 and RLS6.

23.17.3.5.4 Secondary Flight Plan P-RAIM

Secondary flight plan P-RAIM is intended to predict if the integrity of the navigation solution will be suitable for an entire route of flight. This function is initiated on the CDU SEC PREDICTIVE RAIM page and can only be performed when the aircraft is on the ground. The prediction is performed on the route of flight entered in the secondary flight plan. Results of the prediction are displayed on the CDU SEC PREDICTIVE RAIM page on the line above LLS6 and RLS6.

23.17.3.6 Waypoint Sequencing

The CDU normally sequences waypoints automatically. If sequencing is inhibited, by either the system or the operator, the CDU will provide steering guidance to the active waypoint. Steering beyond the active waypoint is along the direction of travel into the active waypoint and continues in that direction until automatic sequencing is reselected. When sequencing waypoints, the CDU will provide steering guidance that results in a waypoint fly-by or fly-over. In a fly-by transition, the aircraft may turn prior to the waypoint in order to intercept the course to the next waypoint. The fly-over transition requires that the aircraft not turn early, but fly directly over the waypoint. Fly-by is the default transition. A fly-over transition occurs when required by procedure, when the track change between waypoints exceeds 120 degrees, or when designated by the operator. The operator designates a fly-over transition by entering an along-track distance of zero nm as discussed in Waypoint Entry, paragraph 23.17.4.1.

23.17.4 Operating Procedures

For detailed CDU-7000 operating procedures, refer to the in-flight handbook or CDU-7000 Users Manual.

23.17.4.1 Waypoint Entry

Waypoints can be manually entered in the CDU by any of the following methods. With the exception of waypoints retrieved from the navigation database, waypoint names may be changed by the operator by typing a "/" followed by the new name (up to five characters) and pressing the LLS adjacent to the waypoint.

1. Two to five character identifier for NAVAIDs (e.g., PXT), airports (e.g., KNHK), or waypoints (e.g., HELEM) contained in navigation database.
2. Latitude and longitude using in any of the following formats or combinations thereof. Waypoints entered by latitude and longitude are automatically named LLddd by the CDU, where ddd is 001 to 240.
   a. Degrees and minutes: NddmmWdddmm.
   b. Degrees, minutes, and tenths/hundredths/thousandths of minutes.
      (1) Nddmm.mWdddmm.m.
      (2) Nddmm.mmWdddmm.mm.
      (3) Nddmm.mmmWdddmm.mmm.
   c. Degrees, minutes, and seconds: NddmmssWdddmmss.
   d. Degrees, minutes, seconds, and tenths of seconds: Nddmmss.sWdddmmss.s.
3. Latitude and longitude using short-hand notation. Short-hand notation may only be used for entry of whole degrees of latitude and longitude. Positions on the earth are denoted by the letters N, E, S, or W. N is used for north latitude and west longitude; E for north latitude and east longitude; S for south latitude and east longitude; and W for south latitude and west longitude. Only two characters are used to enter longitude; placement of the letter N, E, S, or W determines whether the longitude is greater than or less than 99 degrees. Examples are shown in Figure 23-31. When the position is entered, the CDU-7000 uses the short-hand notation for the waypoint name.

LATITUDE	LONGITUDE	SHORT-HAND FORMAT
50 N	025 W	5025N
40 N	135 E	40E35
11 S	176 E	11S76
82 S	050 W	8250W

Figure 23-31. Short-Hand Format

4. Positions entered in the Military Grid Reference System (MGRS). Waypoints entered in the MGRS are automatically named GRddd by the CDU, where ddd is 001 to 240.
5. Place, Bearing, and Distance (PBD) waypoints entered as a valid identifier, followed by a "/", a bearing, another "/", and then a valid distance e.g., PXT/180/50. Bearing entries require three digits optionally followed by tenths of degrees. A T for true north reference or M for magnetic reference may also be entered. If T or M is not entered, the system will automatically use the azimuth reference indicated on the CONFIG page. Valid distance entries are between 0.1 and 199 nm. PBD waypoints are automatically named by the CDU IDddd, where ID is the first three characters of the Identifier and ddd is 001 to 240 (e.g., PXT001).

6. Place, Bearing and Place, Bearing (PBPB) waypoints entered as a valid identifier, followed by a "/", a bearing, a "/", a valid identifier, a "/", and then a bearing (e.g., PXT/180/SBY/270). Bearing entries require three digits optionally followed by tenths of degrees. A T for true north reference or M for magnetic reference may also be entered. If T or M is not entered, the system will automatically use the azimuth reference indicated on the CONFIG page. PBPB waypoints are automatically named by the CDU IDddd, where ID is the first three characters of the first identifier and ddd is 001 to 240.

7. Along Track waypoint entered as a valid identifier and followed by a distance (e.g., PXT/-10). An along track waypoint can only be entered on the active or secondary flight plan using a waypoint contained in that flight plan. Valid distances may be entered in tenths of nm as positive or negative numbers, but must be less than the distance between the waypoint and the next waypoint on the flight plan. If the distance is a negative value, the waypoint is inserted prior to the waypoint; if the value is positive, it is inserted after the waypoint in the direction of travel.

23.17.4.2 Flight Plan Entry

1. Select IDX. Observe INDEX 1/2 page.
2. LLS1 (Left Line Select) <START INIT>. Observe START INIT 1/3 page.
3. Verify current date falls within period of active database (adjacent to LLS2). If necessary, load database.
4. Select FPLN. Observe ACT FPLN 1/1 page.
5. Enter departure airport ICAO identifier into LLS1.
6. Enter destination airport ICAO identifier into RLS2.
7. RLS6 (Right Line Select). Observe DEP/ARR INDEX page.
8. LLS1. Observe DEPART page for departure airport.
9. Select necessary LLS for desired departure procedure. Observe <SEL> displayed next to desired departure on data line 1.
10. Select necessary LLS for desired transition for departure procedure. Observe <SEL> displayed next to desired transition on data line 2.
11. Select necessary RLS for desired departure runway. Observe <SEL> displayed next to desired runway on data line 1.
12. Select FPLN then down arrow. Observe ACT FPLN 2/2 page.
13. Enter waypoint identifiers into RLSs or airway identifiers (e.g., J142, V14) into LLSs as necessary to enter route of flight.

Note

If airways are not entered, route of flight will be shown as DIRECT between waypoints.

14. Select EXEC to activate active flight plan. Observe that page title changes from MOD FPLN to ACT FPLN.

23.17.4.3 Performance Initialization

1. Select PERF. Observe ACT FPLN PERF INIT page.
2. Enter desired cruise altitude into LLS1. Observe page title changes from ACT to MOD.

Note

Altitude may be entered as altitude (e.g., 24000) or flight level (e.g., FL240). Cruise altitudes below the transition altitude will be displayed in feet, regardless of format used for data entry. Conversely, cruise altitudes above the transition level will be displayed in FL, regardless of format used for data entry.

3. If desired, enter values into LLSs 2, 3, 4, or 5.
4. Select EXEC to incorporate changes into active flight plan. Observe page title changes from MOD to ACT FPLN PERF INIT.

23.17.4.4 Instrument Approach Selection

1. Select DP/AR. Observe ARRIVAL page for destination airport.

Note

- Manually entered approach procedures are prohibited. Approved approach procedures shall be selected from the ARRIVAL page.
- Depending upon aircraft position along route of flight, DEPART page for departure airport may be displayed. Select DP/AR a second time to display the DEP/ARR INDEX page then select RLS 2 to access ARRIVAL page.

2. Select necessary LLS for desired departure procedure. Observe <SEL> displayed next to desired departure on data line 1.
3. Select necessary LLS for desired transition for arrival procedure. Observe <SEL> displayed next to desired transition on data line 2.
4. Select necessary RLS for desired instrument approach. Observe <CONF> displayed next to selected approach and full approach name is displayed in scratchpad.
5. Select RLS for desired instrument approach again. Observe <SEL> displayed next to desired instrument approach on data line 1.
6. Select necessary RLS for desired transition for selected instrument approach. Observe <SEL> displayed next to desired transition on data line 2.

Note

If no transition is selected, the CDU will use the default VECTORS transition that will insert a discontinuity in the flight plan after the last waypoint on the route of flight and before the final approach fix for the selected instrument approach.

7. Select EXEC to incorporate changes into active flight plan. Observe page title changes from MOD to ACT ARRIVAL.

23.17.4.5 Visual Approach Selection

1. Select DP/AR. Observe ARRIVAL page for destination airport.

Note

Depending upon aircraft position along route of flight, DEPART page for departure airport may be displayed. Select DP/AR a second time to display the DEP/ARR INDEX page then select RLS2 to access ARRIVAL page.

2. Select necessary RLS for desired landing runway. Observe <SEL> displayed next to desired departure on data line 1.

Note

It may be necessary to page down to find the desired runway.

3. Enter desired distance (0.1 to 25.0 nm) for runway extension waypoint in RLS2.
4. Select EXEC to incorporate changes into active flight plan. Observe page title changes from MOD to ACT ARRIVAL.

23.17.4.6 Holding Pattern Creation

1. Select IDX. Observe INDEX 1/2 page.
2. LLS4. Observe HOLD LIST page.
3. LLS6 to create new holding pattern. Observe MOD LEGS page displayed.
4. LLS adjacent to desired holding location or select RLS6 to hold at present position. Observe MOD FPLN HLD page displayed.
5. Enter and/or modify holding pattern parameters as necessary.
6. Select EXEC to incorporate changes into active flight plan. Observe page title changes from MOD to ACT FPLN HLD.
7. Select LEGS. Observe that HOLD AT is displayed immediately above desired holding waypoint.

23.17.4.7 Present Position Hold

1. Select IDX. Observe INDEX 1/2 page.
2. LLS4. Observe HOLD LIST page.
3. LLS6 to create new holding pattern. Observe ACT LEGS page displayed.
4. RLS6 to select Present Position (PPOS). Observe MOD FPLN HLD page displayed and PPOS listed under FIX on LLS1.
5. Enter and/or modify holding pattern parameters as necessary.
6. Select EXEC to incorporate changes into active flight plan. Observe page title changes from MOD to ACT FPLN HLD.
7. Select LEGS. Observe that HOLD AT is displayed immediately above desired holding waypoint.

Note

The CDU only provides steering guidance on the inbound course to the holding fix.

23.17.4.8 Exiting Holding

There are several methods that may be used to exit holding, including deleting the holding waypoint and performing direct-to another waypoint. The following steps should be used when it is desired to exit holding by sequencing the holding waypoint:

1. Select LEGS. Observe LEGS page.
2. LLS6. Observe MOD LEGS page displayed and EXIT ARMED is displayed above LLS6 and RLS6.
3. Select EXEC. Observe ACT LEGS page displayed and EXIT SEL replaces EXIT ARMED.
4. Upon reaching holding fix, observe that waypoint sequencing occurs and guidance is being provided to the next waypoint.

Note

Since the CDU only provides steering guidance on the inbound course to the holding fix, when exiting holding the pilot is responsible for determining when to turn back toward the holding fix.

23.17.4.9 Direct-To

1. Select DIR. Observe ACT DIRECT-TO page is displayed.
2. LLS adjacent to desired waypoint (page up or down as necessary). Observe selected waypoint is displayed in magenta and page title changes to MOD DIRECT-TO.

Note

If the selected waypoint is a history waypoint, all waypoints along the route of flight from the selected waypoint to the aircraft present position will be incorporated in the modified flight plan.

3. Select EXEC to incorporate changes into active flight plan. Observe page title changes from MOD to ACT LEGS.

23.17.4.10 Direct-Intercept

The direct-intercept function allows the aircraft to intercept a user-defined course into the active waypoint.

1. Select DIR. Observe ACT DIRECT-TO page is displayed.
2. LLS adjacent to desired waypoint (page up or down as necessary). Observe selected waypoint is displayed in magenta and page title changes to MOD DIRECT-TO.

Note

If the selected waypoint is a history waypoint, all waypoints along the route of flight from the selected waypoint to the aircraft present position will be incorporated in the modified flight plan.

3. Enter desired inbound course into RLS6. Observe that the entered value is displayed in large font.
4. Select EXEC to incorporate changes into active flight plan and observe page title changes from MOD to ACT LEGS.

Note

The displayed desired track into the active waypoint may be different than the course entered in step 3 above. This occurs because the CDU applies the local magnetic variation when calculating the desired track. This situation occurs when the active waypoint is a NAVAID and the NAVAIDs station declination is different than the local magnetic variation.

23.17.4.11 Discontinuities

A Discontinuity is a "break" in the flight plan, which occurs because the route of flights between the two waypoints has not been specified. A discontinuity will prevent automatic waypoint sequencing. On the CDU LEGS page, a discontinuity is depicted by "□□□□□DISCONTINUITY –" adjacent to an LSK. On the FPLN page, "□□□□□" is displayed adjacent to an RLS followed by "----DISCONTINUITY-----" on the following line. The operator can enter a Discontinuity in the flight plan by entering "D" in the scratchpad and then pressing the LLS adjacent to waypoint that the operator wants to follow the discontinuity. The following procedures will remove a discontinuity:

1. Select LEGS. Observe ACT LEGS page is displayed.
2. LLS adjacent to waypoint directly below discontinuity. Observe waypoint displayed in scratchpad.
3. LLS adjacent to discontinuity. Observe MOD LEGS page displayed and discontinuity replaced by waypoint name that had been in scratchpad.
4. Select EXEC. Observe ACT LEGS page displayed and discontinuity has been removed.

23.17.4.12 Flight Plan Offsets

Flight plan offsets provide the capability for the CDU to provide steering to a path parallel to the route of flight. Offsets may be entered from 0.1 to 99.9 nm by increments of 0.1 nm. An offset will automatically terminate when the course change between waypoints exceeds 100 degrees or beyond a waypoint that has a military flight pattern, going into discontinuity is the active waypoint, or at the waypoint prior to the initial approach fix. Use the following procedures to enter a flight plan offset:

1. Select FPLN. Observe ACT FPLN page displayed.

Note

Offsets cannot be entered on the ground.

2. Enter direction of offset (L or R) and size of offset (0.1 to 99.9) in the scratchpad. Observe entry displayed in scratchpad.
3. RLS6 and observe MOD FPLN page displayed and scratchpad entry is displayed adjacent to RLS6.
4. On the EFDS, observe dashed white line is displayed parallel to route of flight corresponding to entry in step 2.
5. Select EXEC. Observe ACT FPLN displayed.
6. On the EFDS, observe dashed white line replaced by dashed magenta line, course deviation indicator deflected in the direction of the offset, and OFST flag displayed.

The following steps will remove an offset from the flight plan:

1. Select FPLN. Observe ACT FPLN page displayed.
2. Select CLR. Observe DELETE displayed in scratchpad.

3. Select RLS6. Observe MOD FPLN page displayed and offset replaced by dashes.

4. Select EXEC. Observe ACT FPLN page displayed.

5. On EFDS, observe dashed magenta line removed, course deviation indicator deflected in the direction of the route of flight, and OFST flag removed.

23.17.4.13 Loading Navigation Database

Each CDU is capable of storing a worldwide Navigation Database (NDB) in nonvolatile memory. The effective period of the database is 28 days. Loading of the database can only be controlled through the pilot or copilot CDU. The amount of time required to load an NDB depends upon its size; a worldwide NDB typically requires about 12 to 13 minutes. The database is loaded using the following procedures:

1. At the NAV/COMM station, insert Personal Computer Memory Card International Association (PCMCIA) Card with properly formatted NDB into the desired PDTM slot and reinsert PDTM into IRU.

2. Select IDX, LLS1 and RLS6. Observe POWER page displayed.

3. Ensure power is off to RINU1, RINU2, IFF, and V/UHF.

Note

On CIP aircraft, UHF1 and UHF2 may be controlled manually via the Radio Set Controls (RSC) in the F-1/F-2 racks. Mode selector switch must be placed to MANUAL to control from the RSC.

4. Turn OFF all CDUs except the CDU being loaded. If the NAV/COMM CDU is being loaded, turn off the NAV/COMM unit and turn on either the pilot or copilot CDU.

5. Select IDX. Observe IDX page.

6. Select page down, RLS3, and RLS6. Observe COMMON Low Data Rate (LDR) page.

Note

The COMMON LDR page is only accessible on the ground.

7. If loading NAV/COMM CDU, turn ON power to the NAV/COMM unit.

Note

It is normal for “DATA UNAVAILABLE” to be displayed on the NAV/COMM CDU.

8. RLS3, if necessary to select either A or B. Observe that desired card displayed in green font. It is normal for “DATA UNAVAILABLE” to appear on NAV/COMM CDU.

Note

Cards loaded in Slot 0 and Slot 1 in the PDTM are labeled CARD A and CARD B, respectively, by the CDU.

9. LLS6 (CATALOG) and observe CATALOG page displayed.

10. RLS1 to select the CDU being loaded. Observe that desired CDU displayed in green font.

Note

Pilot CDU is 1, copilot CDU is 2, NAV/COMM CDU is 3, and 4 is unused.

11. LLS adjacent to desired NDB file. Observe COMMON LDR page displayed and correct file name displayed adjacent to RLS1.

12. LLS1 and observe CONFIRM LOAD annunciation.

13. Reselect LLS1 to begin loading. Verify ">" replaced by "*" adjacent to LLS1.

Note

- Loading status may be monitored by observing messages displayed on line above LLS6 and "% COMPLETE" adjacent to LLS3.
- There is no direct correlation between values displayed for "% COMPLETE" or "MB LOADED" and time to complete the load.
- If "-----LOAD FAILED------" message appears on line above, LLS6 and reattempt loading from step 9 ensuring that the correct CDU was selected.

14. At the completion of the load, observe that CDU returns to START 1/3 page.

Note

- After the CDU returns to the START 1/3 page, an additional 2 to 3 minutes may elapse before the NDB effective period is displayed.
- Other than moving the NAV/COMM CDU to either of the flight station positions, the only indication of the NAV/COMM CDU being successfully loaded is the "-----LOAD COMPLETE------" message that appears on line above LLS6.

23.17.5 System Messages

The CDU-7000 provides alerts to the aircrew through messages displayed on the annunciation line (Figure 23-32) and displayed in the messages scratchpad (Figure 23-33). Messages displayed in the scratchpad are cleared by depressing the CLR key for 3 seconds. Messages displayed on the annunciation line are also displayed on the MESSAGES page. When the MESSAGES page is accessed, messages that were previously viewed are listed under OLD MESSAGES; all other messages are listed under NEW MESSAGES.

MESSAGE NAME	MEANING	CLEARABLE	COLOR	MSG CUE
APPROACH	System has entered approach mode.	No	W	NO
ATTD RDY 1(2)	RINU-G1(2) are providing valid attitude information.	No	W	NO
CDU1(2) ZERO COMPLETE	CDU 1(2) data has been successfully zeroized.	Yes, access MESSAGES page	W	NO
CDU1(2) ZERO FAIL	Attempt to zeroize CDU 1(2) data was unsuccessful.	Yes, reinitiate CDU data zeroize	A	NO
CIR ACTIVE	Steering is being provided for a circle pattern.	No	W	NO
CPA INTERCEPT	Intercept solution will result in closest point of approach.	No	W	NO
CRP ACTIVE	Steering is being provided to a closed random pattern.	No	W	NO
DB EXPIRED	Current date is beyond end date of primary navigation database.	No	W	YES
DB MISMATCH	Navigation databases loaded in pilot and copilot units are different, preventing either database from being displayed.	No	W	NO
DISCONTINUITY	Active waypoint is a discontinuity.	No	W	YES
DLDR ZERO COMPLETE	Data cards contained in the ASQ-215 have been successfully zeroized.	Yes, access MESSAGES page	W	NO
DLDR ZERO FAIL	Attempt to zeroize data cards was unsuccessful.	Yes, reinitiate DLDR zeroize	A	NO
DP/MSTR DISAGREE	System unable to determine which is the master CDU-7000.	No	W	NO
EXEC MOD FPLN	Modified flight plan has not been executed. Occurs 60 seconds after last edit to modified flight plan.	No	A	YES
FG8 ACTIVE	Steering is being provided for a figure 8 pattern.	No	W	NO
GPS KEY ALERT	Cryptographic keys loaded in RINU-G1(2) will expire in 2 hours.	No	A	NO
GPS NEED KEY	Mission duration entered on SA/AS page exceeds effective period of cryptographic keys loaded.	No	A	NO
GPS1(2) ZERO COMPLETE	Cryptographic keys loaded in GPS1(2) have been successfully zeroized.	Yes, access MESSAGES page	W	NO
GPS WRONG KEY	Attempt to load incorrect cryptographic keys in RINU-G1(2).	No	A	NO
GPS1(2) ZERO FAIL	Attempt to zeroize GPS1(2) cryptographic keys was unsuccessful.	Yes, reinitiate GPS key zeroize	A	NO

Figure 23-32. CDU-7000 Messages (Sheet 1 of 3)

MESSAGE NAME	MEANING	CLEARABLE	COLOR	MSG CUE
HOLD ACTIVE	Active waypoint is a holding pattern.	HOLD ACTIVE	W	NO
HOLD EFC EXPIRED	Current time has exceeded expected further clearance time displayed on ACT HOLD page.	HOLD EFC EXPIRED	W	NO
INTR ACTIVE	Steering is being provided to intercept.	No	W	NO
LAST WAYPOINT	Active waypoint is the last waypoint in the flight plan.	No	A	YES
LOAD FAIL	Attempt to load information from data cards was unsuccessful.	Yes, access MESSAGES page	W	NO
MODEM ZERO COMPLETE	Cryptographic keys loaded in Modem have been successfully zeroized.	Yes, access MESSAGES page	W	NO
MODEM ZERO FAIL	Attempt to zeroize Modem cryptographic keys was unsuccessful.	Yes, reinitiate Modem zeroize	A	NO
NAV READY 1(2)	RINU-G1(2) have completed alignment process.	No	W	NO
NO APPR RAIM	Predictive RAIM has determined that RAIM will not be available at destination airport at time of arrival.	No	W	YES
NO FPLN	No flight plan has been entered.	No	W	NO
NO GPS APPR	Conditions have not been met to conduct or continue approach using FMS1 or FMS2.	No	A	YES
NO INTR SOLUTION	The active waypoint is an intercept, but an intercept solution cannot be computed.	No	W	YES
NO NAV DB	Navigation database is not loaded or not accessible.	No	W	YES
NO RAIM	RAIM integrity monitoring is not available.	No	W	NO
OFFSET TERMINATED	Offset to flight plan has been terminated.	Yes, access MESSAGES page	W	YES
OFFSET WILL END	Offset will be terminated within 2 minutes.	No	W	YES
PLT (CPLT) NAV FAIL	Pilot (Copilot) selected navigation solution is invalid.	No	A	YES
RTK ACTIVE	Steering is being provided for a racetrack pattern.	No	W	NO
SAVE FAIL	Attempt to save information to data cards was unsuccessful.	Yes, access MESSAGES page	W	NO
SEQ INHIBITED	Automatic sequencing has been inhibited.	No	W	YES
UNABLE CRUISE ALT	System determines that aircraft cannot meet cruise altitude due to aircraft performance limitations or due to overlapping climb and descent profiles.	No	W	YES
UNABLE FPLN ALT	System determines that aircraft cannot meet climb or descent constraint altitude.	No	W	YES

Figure 23-32. CDU-7000 Messages (Sheet 2 of 3)

MESSAGE NAME	MEANING	CLEARABLE	COLOR	MSG CUE
UNABLE FPLN SEQ	System has automatically inhibited waypoint sequencing.	No	W	YES
UNABLE NEXT ALT	System determines that next altitude constraint cannot be met due to aircraft performance.	No	W	YES
UNABLE RTA	Unable to meet required-time-of-arrival for specified waypoint.	No	W	YES
VERY DATUM	System is in CIVIL mode and WGS-84 is not the selected DATUM.	Yes, access MESSAGES page	A	YES
√ APPR DATUM	System is in terminal or approach mode and WGS-84 is not the selected datum.	No	W	YES
√ BANK LIMIT	System computed bank angle has exceeded bank limit entered on CONFIG page.	No	A	YES
√ CDU VERSION	Pilot, Copilot or NAV/COMM units have different versions of operating software loaded.	No	A	YES
√ FPLN ALT	Cruise altitude entered on PERF INIT page is below a waypoint altitude constraint, climb constraint follows descent constraint, climb constraints are not smooth increasing, or descent constraints are not decreasing.	No	W	YES
√ PLT (CPLT) ANP	Pilot (Copilot) actual navigation performance has exceeded required navigation performance or is invalid.	No	A	YES
√ PLT-CPLT POS	Difference between pilot and copilot navigation solution exceeds RNP value.	No	W	YES
√ PLT (CPLT) GPS	Navigation solution is INU/GPS or GPS/A/H and GPS is not available.	No	W	YES
√ RNP VALUE	Manually entered RNP value exceeds default RNP for airspace.	No	W	YES
√ SPEED	With RTA active IAS has exceeded commanded IAS by amount entered on PROG 4/4 page Within 2 minutes of holding pattern, or while in holding, IAS exceeds holding speed displayed on LEGS page by more than 20 KIAS.	No	A	YES
√ STATUS	Change has occurred in status of systems monitored by CDU-7000.	Yes, access MESSAGES page	W	YES
Note: W=white, A=amber				

Figure 23-32. CDU-7000 Messages (Sheet 3 of 3)

MESSAGE	MEANING
ALONG TRACK WPT N/A	Unable to enter along track waypoint.
APPROACH DEFINED	Attempt to modify parameter of instrument or visual approach that is not allowed to be modified.
ATTACH (CIR, CRP, F8, HOLD, or RTK) AT?	A circle, closed random pattern, figure 8, hold, or racetrack pattern without a defined fix has been selected for insertion into a flight plan.
BRG/DIST OFFST N/A	Attempt to enter PBD using flight plan waypoint that is not allowed.
CIVIL MODE ACTIVE	Attempt to change datum when system in CIVIL mode.
CLIMB (or DESCENT) DEFINED	Attempt to enter or delete leg wind or ISA deviation on a climb leg (or descent leg).
CONFIRM LOAD XXXXX	Confirm request to load route XXXXX from data card by depressing corresponding line select key.
CONFIRM CANCEL	Confirm request to cancel secondary flight plan P-RAIM calculation by depressing corresponding line select key.
CONFIRM CANCEL EXIT	Confirm request to cancel holding pattern exit by depressing corresponding line select key.
CONFIRM (RINU-G1, RINU-G2, IFF, V/UHF) OFF	Confirm request to power off selected device by depressing corresponding line select key.
CONFIRM LOAD	Confirm request to begin software loading.
COPY N/A	Attempt to copy data when not allowed.
DATA CARD IN USE	Attempt to access data card when card is in use.
DELETE N/A	Attempt to delete desired parameter is not permitted.
DISCONTINUITY	Attempt to enter data that is not permitted to be entered on discontinuity.
DISTANCE TO LARGE	Attempt to enter an along track waypoint and distance entered exceeds distance to next waypoint.
DUPLICATE PILOT WPT	Attempt to store waypoint in pilot waypoint list when list contains waypoint with the same name.
ENTER PARAMETERS	Attempt to insert or store waypoint without providing all required parameters to define waypoint.
FPLN FULL	Attempt to enter more than 200 waypoints into flight plan.
GROUND ONLY	Attempting to perform an operation in flight that can only be performed when the aircraft is on the ground.
HOLD DEFINED	Attempt to attached a hold, circle, racetrack, figure 8, or closed random pattern to waypoint that already has a hold pattern attached.
HOLD IS ACTIVE	Attempt to make unallowed flight plan edit to hold pattern.
INSERT (CIR, CRP, F8, HOLD, or RTK) BEFORE	A circle, closed random pattern, figure 8, hold, or racetrack pattern with a defined fix has been selected for insertion into a flight plan.
INSERT INTR BEFORE	An intercept has been selected for insertion into a flight plan.
INVALID DELETE	Attempt to delete parameter or field that cannot be deleted.
INVALID DIRECT-TO	Attempt to perform direct-to when not permitted.
INVALID ENTRY	Attempt to enter scratchpad data that does not meet format requirements.
INVALID WAYPOINT	Attempt to rename runway extension waypoint.
LIST FULL	Attempt to enter 4th satellite on satellite deselect list on APPROACH P-RAIM page.

Figure 23-33. CDU-7000 Scratchpad Messages (Sheet 1 of 2)

MESSAGE	MEANING
LOAD (or SAVE) IN PROGRESS	Attempt to perform data card operation when already loading (or saving) information from (to) the data card.
MAX DISK ROUTES	Attempt to save more than 60 routes on data card.
MAX HOLDS IN FPLN (of SEC)	Attempt to enter more than hold in active (or secondary) flight plan when flight plan contains maximum number of holds allowed.
MAX INTRS IN FPLN	Attempt to enter more than 5 intercepts in either active or secondary flight plan.
MAX PTRNS IN FPLN	Attempt to enter more than 10 patterns (circle, closed random pattern, figure 8, or racetrack) in either active or primary flight plan.
N/A IN POLAR REGION	Attempt to perform operation not permitted when operating in polar region.
NO DATA CARD	Attempt to perform operation requiring data card and no data card loaded in ASQ-215.
NO DATABASE	Attempt to access navigation database and no database loaded.
NO ENTRY ALLOWED	Attempt to enter data in field in which data entry is not permitted.
NO INTR SOLUTION	Attempt to insert intercept into flight plan when no intercept solution exists.
NO INTERSECTION	Bearings entered in PBPB waypoint do not intersect.
NOT IN AIR	Attempt to perform RINU-G AIR alignment with aircraft on the ground.
NOT IN NORTH MAP	Attempt to recenter map center when EHSI is not in North Up mode.
NOT ALLOWED	Operation not permitted.
NOT AVAILABLE	Attempt to select a non-functioning CDU key.
NOT IN DATABASE	Identifier entered in scratchpad is not stored in navigation database.
NOT ON AIRWAY	Airway exit waypoint entered on flight plan page is not on specified airway.
NOT ON GROUND	Attempt to perform operation while in flight that can only be performed while on the ground.
NOT STORED	Attempt to load data that is not found on data card.
P-RAIM IN PROGRESS	Attempt to edit satellite deselect list of APPROACH P-RAIM page when P-RAIM is being performed.
PLT WPT LIST FULL	Attempt to enter more than 200 waypoints into pilot waypoint list.
SEARCH IN PROGRESS	Attempt to access navigation database while system is performing database search.
WPT NOT MATCHED	Attempt to insert along track waypoint to different waypoint than used in the entry.
√ FMS SOURCE	Attempt to select an invalid FMS source.
√ FLIGHT PLAN EDIT	Attempt to change to flight plan was unsuccessful.
√ INU MODE	Attempt to perform RINU-G inertial operation when inertial is aligning.
√ POWER	Attempt to control mode of IFF, V/UHF, RINU-G1, or RINU-G2 and device is powered off.
√ STATUS	Attempt to control or display device and device has failed or is undergoing operator initiated built-in-test.

Figure 23-33. CDU-7000 Scratchpad Messages (Sheet 2 of 2)

23.18 ELECTRONIC FLIGHT DISPLAY SYSTEM (EFDS) (AIRCRAFT INCORPORATING CNS/ATM)

23.18.1 Introduction

The Electronic Flight Display System (EFDS) is used to provide heading, course, and attitude information to the pilot and copilot via identical Multi-Function Displays (MFDs). Heading and course information is also provided to the NAV/COMM via the MFD located at that station. The MFDs utilize standard International Civil Aeronautical Organization (ICAO) symbology and associated identifiers in the generation of the standard navigational and tactical data. Additional display information available on the pilot and copilot MFDs consists of the following:

1. Dual heading bugs.
2. Bearing and heading source data.
3. A graphical depiction of the great circle flight plan route displaying the aircraft position relative to the waypoints.
4. Marker beacon information.
5. Glideslope and localizer scales and indicators.
6. A turn needle depiction based on computed turn rates.
7. Selectable real time wind readout.
8. FMS waypoint distance.
9. TACAN DME information.
10. RAIM annunciations.
11. Selectable background data (airports, NAVAIDs, intersections, NDBs).
12. Origin and destination airports.
13. FMS vertical navigation advisory information (VNAV pipper).
14. Selectable display of progress information.
15. Selectable display of secondary flight plan.
16. Display of modified flight plan and offset route.
17. Message alerts.

An inclinometer that provides slip or skid indications is externally mounted on the bezel of the MFD display.

The system components described in the following paragraphs are provided to develop a better understanding of overall system interface.

23.18.1.1 BMUP EFDS Introduction

BMUP aircraft use the exact same EFDS components as other EFDS configured aircraft; however, the signal flow between the tactical mission computer and the EFDS is different for BMUP aircraft than it is for other aircraft. On non-BMUP aircraft, tactical data is routed from the mission computer to the AJN-15 Flight Director System, and then supplied to the EFDS in analog format. On BMUP aircraft, tactical data is routed from the mission computer directly to the EFDS in digital format. Because of this fundamental difference, non-BMUP and BMUP EFDS systems operate differently when CPTR is selected as the EFDS course mode. For all other course mode selections, the systems operate identically. A summary of high-level differences between non-BMUP EFDS and BMUP EFDS is presented in Figure 23-34.

Non-BMUP EFDS	BMUP EFDS
Tactical data is routed from the mission computer to the AJN-15 Flight Director Steering Computer and then supplied to the EFDS in analog format.	Tactical data is routed from the mission computer directly to the EFDS in digital format.
In CPTR course mode, control of the EHSI course arrow and EFDI command bars is accomplished using the AJN-15 FDS control panel.	In CPTR course mode, control of the EHSI course arrow and EFDI command bars is accomplished using the Pilot Data Entry Panel (PEP).

Figure 23-34. EFDS Difference Data

23.18.2 System Components

The EFDS consists of the following components that interface with other aircraft navigational and attitude subsystems:

1. C-12616/AYN, Multi-Function Display Control Panel (DCP) (3).

2. ID-2551/AYN, Multi-Function Display (MFD) (5).

23.18.2.1 C-12616/AYN Multi-Function Display Control Panel

The Control Panels are used to select the inputs for the Electronic Flight Director Indicator (EFDI) and the Electronic Horizontal Situation Indicator (EHSI) displays. There are three EFDS Display Control Panels located as follows (Figure 23-35):

1. Flight station center pedestal (pilot).

2. Copilot side console.

3. NAV/COMM station.

Figure 23-36 illustrates the Control Panel and describes the panel markings and functions. The NAV/COMM Display Control Panel (physical appearance is the same as the pilot and copilot control panel) does not provide the same functionality available to the pilot or copilot because of its physical location, the strapping of the unit, and the external inputs routed to the unit. All switches and controls are described to provide an understanding of the control panel capabilities. Controls that are non-functional for a given flightcrew position are identified in Figure 23-36.

23.18.2.2 Multi-Function Display (MFD)

There are five identical, interchangeable MFDs installed in the aircraft. Each unit uses color and symbol shapes to distinguish significant or abnormal situations from normal display functions. The MFD continuously monitors navigation parameters and creates alerts when an abnormal flight situation is detected. The alerts are displayed as flags/removal of related navigation data. The operating mode of each MFD is software-configured at power-up based upon its physical location in the aircraft. Four MFDs are in the flight station, two on the pilot instrument panel, and two on the copilot instrument panel. The fifth MFD is located at the NAV/COMM station (Figure 23-35). At power-up, the pilot and copilot right MFDs are configured to function as the EFDIs and the left MFDs functions as the EHSIs. The NAV/COMM MFD is always configured as an EHSI.

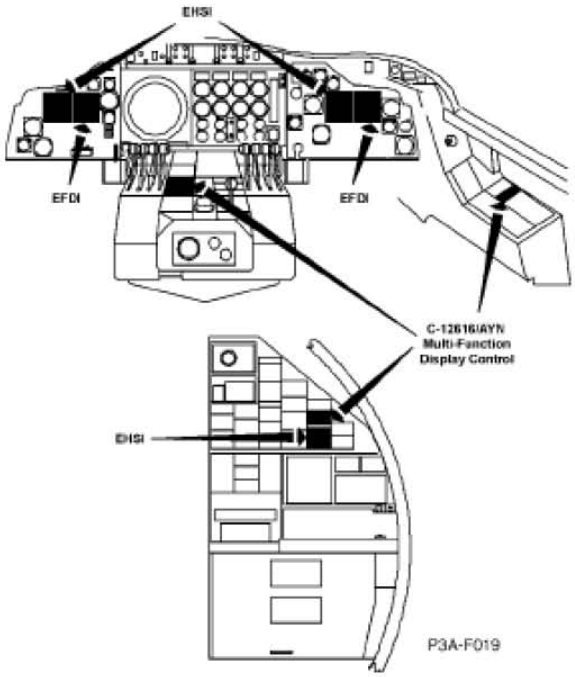
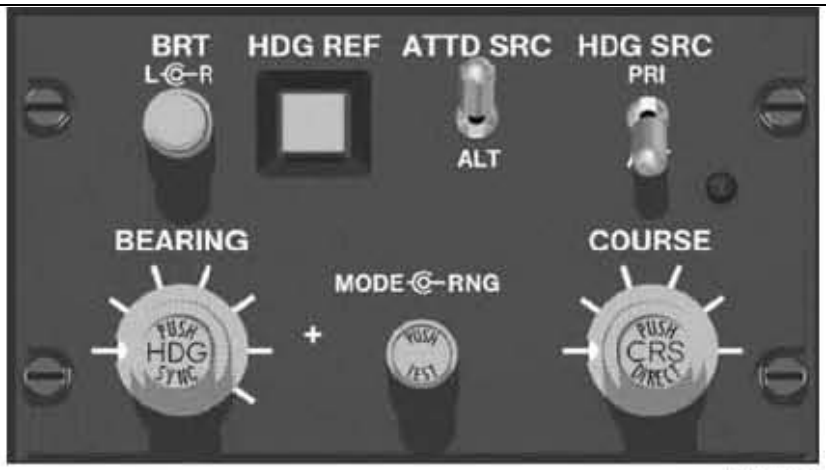


Figure 23-35. Flight Station and NAV/COMM Station MFD Locations



PANEL MARKING	FUNCTION
BRT control	Two concentric potentiometers that control the display brightness of the EFDS display as follows:
L (OUTER)	Rotating the BRT (Brightness) L knob changes the intensity of the EFDI MFD. NAV/COMM — Non-functional.
R (INNER)	Rotating the BRT R knob changes the EHSI MFD intensity.

Figure 23-36. C-12616/AYN Control Panel — Markings and Functions (Sheet 1 of 4)

PANEL MARKING	FUNCTION
HDG REF (Pushbutton)	HDG REF (MAG/TRUE heading reference) is a pushbutton switch that toggles the MFD between magnetic and true heading references. Visual feedback is provided via the words MAG or TRUE next to the heading index on the EHSI MFD. The switch must be pressed for a minimum of 2 seconds to change the reference. When the source is FMS1/FMS2, the base heading reference is magnetic (MAG) and can be switched to TRUE (TRU). The base heading reference for VOR1, VOR2, and TACAN is MAG and cannot be changed. Magnetic heading supplied in FMS1/FMS2 is RINU-G True Heading adjusted with Magnetic Variation provided by the CDU-7000. ASQ-227: When the course mode is CPTR, the base heading reference is True. The heading reference can be switched to Magnetic if the mission computer is on and a magnetic variation is present in the NAV PARAMETERS tableau. Mag heading supplied in CPTR is the inertial true heading adjusted by mission computer magnetic variation. Non ASQ-227: When the course mode is CPTR, the base heading reference is True and can be switched to Magnetic. True Heading is provided by the RINU-G. The Magnetic heading is computed by using the Magnetic Variation provided by the CDU-7000.
ATTD SRC switch PRI	Selects attitude source to control the EFDI display. If the EFDI fails, the switch will work for the EHSI in PFD mode. Pilot EFDI — INS 1. Copilot EFDI — INS 2. NAV/COMM — Non-functional.
ALT	Pilot EFDI — STBY GYRO. Copilot EFDI — STBY GYRO. NAV/COMM — Non-functional.
HDG SRC switch PRI	Selects heading source of the controlled EFDI/EHSI (pilot/copilot). If the EHSI fails, the switch will still work for the EFDI in PFD mode. COURSE switch selected to CPTR, FMS 1, FMS 2: Pilot control — INS 1. Copilot control — INS 2. NAV/COMM control — INS 1.
	COURSE switch selected to VOR1, VOR2, TCN: Pilot control — MHRS 1. Copilot control — MHRS 2. NAV/COMM control — MHRS 1.
	COURSE switch selected to CPTR, FMS1, FMS2: Pilot control — INS 2. Copilot control — INS 1. NAV/COMM control — INS 2.
ALT	COURSE switch selected to VOR1, VOR2, TCN: Pilot control — MHRS 2. Copilot control — MHRS 1. NAV/COMM control — MHRS 2.

Figure 23-36. C-12616/AYN Control Panel — Markings and Functions (Sheet 2 of 4)

PANEL MARKING	FUNCTION
COURSE switch	Two concentric rotary switches control the course selection as follows:
CRS (Outer knob)	Six-position rotary switch that selects the navigation source displayed on the EHSI MFD. The pilot and copilot selections are (clockwise): VOR 2, VOR 1, TCN, FMS1, FMS2, and CPTR (Tactical). The NAV/COMM selections are (clockwise): SPARE, SPARE, FMS1, FMS2, Repeat Pilot, and CPTR (Tactical).
CRS (Inner knob)	The CRS (inner) knob sets the commanded course when the associated course arrow is not slaved to FMS or CPTR data. As the CRS knob rotates, the course arrow on the EHSI rotates in the same direction. A digital readout of the course setting is displayed on the EHSI MFD. Pilot/copilot — Active in VOR 1, VOR 2, and TACAN. NAV/COMM — Nonfunctional.
CRS PUSH DIRECT	When the CRS knob is pressed and VOR1, VOR2, or TCN is selected as the navigation source, the MFD aligns the course arrow with the bearing of the navigation source and nulls out any course deviation. Pressing the CRS knob for 2 seconds in conjunction with the PUSH TEST knob initiates the diagnostic mode display on the EHSI.
MODE/RNG	Two concentric rotary switches (360° turn in both directions) control mode and range selection as follows: The MODE knob has no physical stops. As the MODE knob is rotated, the EFDI or EHSI display changes. Counterclockwise (ccw) rotation selects the prior mode.
PUSH TEST switch MODE (Outer knob)	Pilot/Copilot: The FDI -HSI mode pairs: FDI-ARC MAP, PFD-ARC MAP, FDI-HSI, PFD-North Up MAP, and PFD-HDG Up MAP. NAV/COMM: ARC MAP, HSI, North Up MAP, and HDG Up MAP.
	If for some reason (fault, diagnostics mode, etc.) one of the displays at a location is inoperable, then the remaining MFD will display the PFD mode. If in test mode, rotation of MODE switch terminates the test mode.
RNG (Inner knob)	The RNG inner knob sets the map range display of the EHSI display when the unit is in the MAP mode. It is also used in the diagnostic mode to page through the status pages (System Status, MFD Status, Digital Input Monitor, Analog I/O Monitor, and Discrete I/O Monitor). Rotating the switch enables the operator to select 2.5, 5, 10, 20, 40, 80, 160, 320, and 640 nm range when in map mode.
PUSH TEST	The PUSH TEST knob is used in conjunction with the CRS or HDG controls to place the EFDI or EHSI into the diagnostic mode. To enter the diagnostic mode for the EHSI position, the EFDI must be valid and vice versa. If the other on-side display is not valid, the MFD will not enter the diagnostic mode. When an MFD enters the diagnostic mode, the other on-side MFD switches to the PFD display.
	In the diagnostic mode, the selected MFD displays the System Status, MFD Status, Digital Input Monitor, Analog I/O Monitor, or Discrete I/O Monitor page. These diagnostic pages help the operator understand the cause of an MFD failure indication. The System Status page displays first and indicates the status of the aircraft system that interfaces with the MFD.

Figure 23-36. C-12616/AYN Control Panel — Markings and Functions (Sheet 3 of 4)

PANEL MARKING	FUNCTION
PUSH TEST (cont)	The MFD Status page indicates the operational status of the MFD itself. To enter the diagnostic mode and display the SYSTEM STATUS page, press and hold the PUSH TEST knob for 2 seconds and then within 5 seconds: 1. Press the HDG knob for 2 seconds to place the EFDI in a diagnostic mode. OR 2. Press the CRS knob for 2 seconds to place the EHSI in a diagnostic mode. While in the diagnostic mode, rotating the RNG knob toggles between the System Status, the MFD Status, Digital Input Monitor, Analog I/O Monitor, and Discrete I/O Monitor pages. Rotating the MODE knob will exit the diagnostic mode. 3. Press the CRS knob for 2 seconds to place the EHSI in a diagnostic mode. While in the diagnostic mode, rotating the RNG knob toggles between the System Status page and the MFD Status page. Rotating the MODE knob will exit the diagnostic mode. When in the diagnostic mode and the aircraft on the ground, Weight-on-Wheels (WOW), an Initiated Built-in Test (IBIT) can be initiated for the MFD displaying the Status page. The IBIT tests the functional condition of the MFD and the status (valid/invalid) of the MFD interfaces. To initiate the IBIT: 4. Press the PUSH TEST knob for 2 seconds. A confirmation message is displayed. Within 5 seconds, press the PUSH TEST again for 2 seconds to start the IBIT. Upon completion of the IBIT, the MFD Status page displays with any faults displayed in magenta text.
BEARING switch	Two concentric rotary switches control the bearing source selection on the on-side (pilot or copilot) EHSI. The controls function as follows:
Outer rotary switch	Seven-position rotary switch selects the bearing input from the following sources (left to right): VOR2, VOR1, TCN, ADF, DF (UHFDF or OTPI), FMS1 or FMS2, and CPTR. The pilot BEARING knob selects the Bearing Pointer #1 source. The copilot BEARING knob selects the Bearing Pointer #2 source. Pilot bearing (pointer #1) displays on the pilot, copilot, and NAV/COMM EHSIs. Copilot bearing (pointer #2) displays on the pilot and copilot EHSIs only. During normal operation, the pilot EHSI receives the copilot bearing pointer source selection from the copilot EHSI. Conversely, the input to the copilot EHSI may be received from the cross-side bearing pointer source selected for the pilot EHSI. In the event of an MFD failure, in the reversionary (default — PFD) mode, the bearing valid selections are limited to VOR1, VOR2, TCN, or FMS1/FMS2.
HDG (Inner knob)	HDG is a rotary knob that positions the heading marker (bug) on the EHSI. The HDG knob on the pilot and copilot Control Panel allows the flightcrew to independently rotate and set the Heading Bug on their respective EHSI compass cards. The Pilot EHSI computes heading error as the difference of the Heading Command (entered by the pilot HDG control) and aircraft heading (from the INS input). The heading error is an output of the pilot EHSI.
PUSH HDG SYNC	Pressing the HDG knob aligns the heading marker (bug) with the heading index. This control is used in conjunction with the MODE/RNG PUSH TEST switch to initiate the diagnostics mode display on the EFDI. When initiating the diagnostic mode, the control must be pushed and held for a minimum of 2 seconds. This control is non-functional on the NAV/COMM Control Panel.

Figure 23-36. C-12616/AYN Control Panel — Markings and Functions (Sheet 4 of 4)

23.18.2.2.1 Electronic Flight Director Indicator (EFDI)

The right MFD functioning as the EFDI serves as an aircraft attitude display and visual indicator of flight director guidance information. It provides the pilot and copilot with a display screen as shown in Figure 23-37. Pilot and copilot EFDIs are normally powered by the MONITORABLE ESSENTIAL AC BUS. Backup power for these EFDIs comes from the FLIGHT ESSENTIAL AC BUS. The functions the EFDI mode provides are listed in Figure 23-37.

a EFDI in PFD Mode

Refer to Figure 23-38. The primary flight display is a reversionary mode that is automatically displayed on the pilot or copilot EFDI when the respective EHSI has failed or is in diagnostic mode. It also is selectable during normal modes in the ARC MAP/PFD, HDG UP/ PFD, and NORTH UP/ PFD display combinations intended to facilitate situational awareness and also to enable future growth of display combinations. It combines a modified EHSI display under a modified EFDI display. The basic formats of each are retained except for the following:

1. The Course Deviation Indication (CDI) is removed from the FDI display area as it is shown on the HSI deviation bar.
2. The horizontal extension of glideslope indicator and the vertical extension of localizer are not available for an ILS approach.
3. Heading is not digitally displayed.
4. Only 200° of the compass card is displayed.
5. Bearing labels are side by side.

Note

If PFD mode is forced due to a loss of an EHSI, the bearing select for that station will not have ADF or the DF sources available. Also, the cross-side MFDs will not have a display of the failed EHSI bearing or heading bug data.

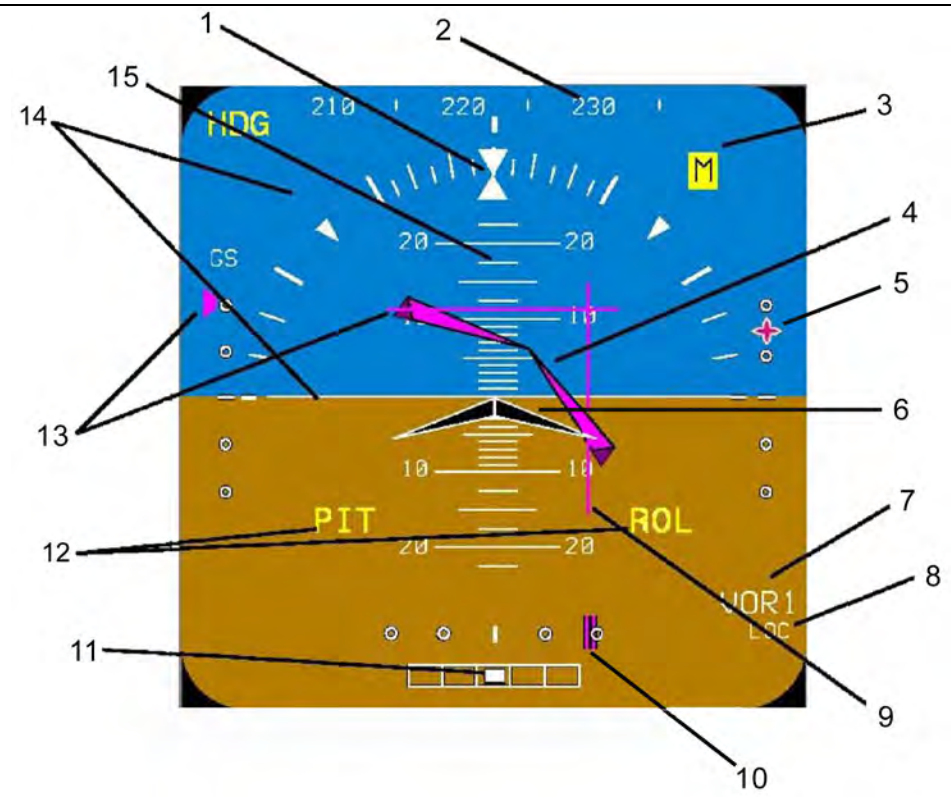
6. Wind label and numeric readout are removed.
7. Digital readout of the heading bug location will be constantly shown.

b EFDI in Diagnostic Mode

The EFDI diagnostic mode is available to the pilot or copilot by pressing the RNG PUSH TEST switch (for two seconds) and then (within 10 seconds) pressing the PUSH HDG SYNC switch (for 2 seconds) on the respective DCP. Refer to the Flight Station Crew Station Maintenance Manual (CSMM) for further troubleshooting.

23.18.2.2.2 Electronic Horizontal Situation Indicator (EHSI)

When the MFD is configured as an EHSI, it operates in one of five selectable display formats: HSI mode, ARC MAP mode, North Up MAP mode, Heading Up MAP mode, and Diagnostic mode. When the EFDI is in the diagnostic mode or has failed, the Primary Flight Display (PFD) mode is displayed on the EHSI at the pilot or copilot station. The PFD mode cannot be displayed on the NAV/COMM EHSI. EHSIs are powered by the MONITORABLE ESSENTIAL AC BUS via circuit breakers located on the forward electronic circuit breaker panel.



Index	Functions
1	The amount of roll is determined by comparing the roll (bank) angle indicator against the fixed bank angle scale. Roll attitude is read in 5° increments up to 30°, 15° increments between 30° and 60°, and 10° increments between 60° and 90°. **Note** Regardless of the display mode, if pitch attitudes exceed ±30° or if the bank attitude exceeds ±70° all information except the aircraft symbol, turn rate, attitude and course label will be shown in an "excessive attitude" display. Some portion of the blue sky and brown ground will remain in view. All EFDI information will be restored at ±25° of pitch or ±65° roll.
2	Heading Tape — A display of heading across the top. This is a display of ±15° each side of center. **Note** Upon loss of heading input, the heading tape will also be lost. The alternate heading source should be selected
3	Marker Beacon Indicator — The outer, middle and inner markers appear in the top right area of the display whenever the respective valid signals are received from the Marker Beacon receiver. The outer marker is a blue square with a black "O", the middle is yellow with a black "M" and inner is white with a black "I".

Figure 23-37. Right MFD in EFDI Format (CNS/ATM) (Sheet 1 of 3)

Index	Functions
4	Command bar information — Magenta command bars on each EFDI are driven by input signals received from the Flight Director Steering Computer (FDSC). The Command bars provide the pilot with an indication of the steering required to achieve a desired flight path. The command bank angle is limited to 30° in manual and radio submodes and 45° in tactical submodes. The roll steering function of the bar is achieved through operation of the ROLL STEERING pushbutton-indicator on the FDS control panel, and the pitch function is achieved through use of the PITCH STEERING pushbutton-indicator. When PITCH STEERING and ROLL STEERING are ON and the glideslope submode has not been selected, the center of the command bar is positioned to indicate the actual pitch of the aircraft. If ROLL STEERING is OFF and PITCH STEERING is ON, the command bars remain horizontal on the face of the EFDI.
5	FMS vertical navigation deviation (VNAV pipper) — Displayed with respect to a fixed vertical scale by the FMS computed vertical path deviation. The indicator is displaced up or down in response to the FMS computed VNAV path deviation input. When the aircraft is on the vertical path, the indicator lines up with the center horizontal bar on the scale. Each dot above and below the center scale represents 500 feet displacement from the center of the VNAV path. The scale and the pipper appear when approaching the FMS vertical path.
6	Aircraft Symbol (black triangular) — Nose of the aircraft symbol indicates pitch as read off the vertical pitch scale.
7	Course Source — Repeat of the course source displayed on the EHSI and as selected on the DCP. Shown here to amplify what is depicted on the deviation bar.
8	Course Source Submode — Repeat of the submode for the course source and which is displayed on the EHSI. Submodes are: VOR1-LOC, ILS, B/C, and FMS — Required Navigation Performance (RNP) value (e.g., 01.00), ASQ-227 computer (CPTR) — none, Non ASQ-227 computer -Fly to point (FTP), OTPI and UHF-DF. **WARNING** The pilot shall ensure that his course is selected to VOR-1 during ILS approaches. Otherwise, erroneous course information will be displayed to the copilot with no fault indications.
9	Localizer Deviation Vertical Extension Bar — Displayed when VOR1 is tuned to a Localizer frequency. Shown over the deviation bar when VOR 1 is in a LOC or ILS submode. **Note** Localizer deviation is not available from VOR2.
10	Deviation Bar — Active in all course source modes. Represents deviation from course in radio source modes, LOC deviation when in LOC, ILS or B/C, and cross track deviation when in FMS mode. Scaling is dependent upon course source mode as follows: 1. Radio modes (VOR, TCN) — 5° per dot. 2. LOC, B/C — Each dot on either side of centerline represents a 1-1/4° displacement from the center of the beam. 3. FMS — Each dot on either side of centerline represents a lateral displacement of one-half the displayed RNP value from the desired track.
11	Rate-of-Turn Indicator — Displayed as a white rectangle that moves right or left in response to the MFD computed rate-of-change of heading. The rate-of-turn is calculated as a function of the heading input and elapsed time. The scale is a series of boxes over which the indicator moves. When the rate-of-turn indicator is in the center box, a zero turn rate is indicated. When the rate-of-turn indicator is in the first box (left or right of center), a standard rate (three degrees per second) turn is being executed. When the indicator is in the second box (left or right of center), a double standard rate or six degrees per second turn is being executed.

Figure 23-37. Right MFD in EFDI Format (CNS/ATM) (Sheet 2 of 3)

Index	Functions
11 (Cont)	**Note** • Upon loss of heading input, rate-of-turn will also be lost. The alternate heading source should be selected. • The rate-of-turn indicator will deflect momentarily when the heading is changed between Mag and True based input as selected on the course select knob. It will not deflect during operation of the Heading Reference function.
12	Heading, pitch, and roll miscompare indications — Displayed in yellow when difference between pilot and copilot values exceed limit or displayed in white when comparison cannot be performed. Limits: Heading 4°, Pitch-4°, and Roll-6°.
13	ILS Glideslope deviation (bug and extension bar) — Displayed with respect to a fixed vertical scale by the glideslope deviation indicator and accompanied by a horizontal extension bar (not displayed in PFD mode). Both the bug and the bar come into view only when valid glideslope begins to be received. The indicator is displaced up or down in response to the glideslope deviation input signal. When the aircraft is on the glideslope beam, the indicators line up with the center horizontal bar of the scale. Each dot above and below the center scale represents 1/4° displacement from the center of the beam.
14	Pitch and roll attitude – Displayed as displacement of a pitch and roll horizon relative to a fixed aircraft symbol. INS-1 is the primary source of pilot attitude information and INS-2 is the primary source of the copilot attitude information. If either INS fails, attitude information from the Standby Gyro may be selected manually at the respective DCP. **WARNING** Standby Gyro should never be selected by both pilot and copilot unless both INS sources are completely unusable. **Note** With loss of the MEAC bus, all EHSIs fail and the EFDIs will revert to the PFD mode. With INS-2 selected, information displayed on the copilot EFDI will be unavailable because of loss of synchro-excitation voltage. The copilot shall select Standby Gyro.
15	Pitch Tape — The amount of aircraft pitch can be determined by comparing the graduated scale with the nose of the aircraft symbol. Read in 1° increments from 0° to 10°, 5°increments between 10° and 30°, 15° increments between 30° and 60°, and a 30° increment between 60° and 90°.
16	Slip or skid indications (not shown) — Provided by an externally mounted inclinometer on the front bezel of the right MFD. Aircraft slip/skid movement is shown by the displacement of a weighted black ball in a liquid filled, curved glass tube that has a white phosphorescent painted background.

Figure 23-37. Right MFD in EFDI Format (CNS/ATM) (Sheet 3 of 3)



Figure 23-38. Right MFD in PFD Format

a HSI Mode

The HSI mode is automatically set on the pilot and copilot left MFDs and on the NAV/COMM MFD (Figure 23-39) on power-up. The HSI mode can also be selected by rotating the MODE rotary switch until the HSI mode display appears on the EHSI.

The HSI mode display provides:

1. FMS distance — When FMS1, FMS2, or CPTR (ASQ-227) distance to the next waypoint is displayed at the upper right portion of the display. The distance is displayed as a three-digit readout. The distance represents the onside FMS unless CPTR mode, FMS1, or FMS2 is selected, in which case the distance displayed is the selected source. The navigation source and waypoint identification are also displayed. When in any course selection other than CPTR, the navigation source shall be the selected solution displayed on the CDU RNAV RNP page for the selected FMS course source. In CPTR, the navigation source shall be System and Mission Control Subsystem (SMCS), DDC, or blank.

2. TACAN distance data — Displayed on all three EHSIs. With digital TACAN (i.e., AN/ARN-118) installed, the selected TACAN station identifier is displayed below the window.

3. Bearing pointer #1 — Displayed on all three EHSIs. Indicates the bearing to the source selected by the pilot control panel BEARING switch.

4. Bearing pointer #2 — On the pilot and copilot EHSIs, indicates the bearing as selected by the copilot control panel BEARING switch. On the NAV/COMM EHSI, indicates the bearing as selected by the NAV/COMM control panel BEARING switch.

5. Heading bug — On the pilot and copilot EHSIs, the heading bug is used as a reference mark or as an input (pilot) to the AFCS and/or FDS. Rotating the PUSH HDG SYNC knob on the pilot/copilot control panel varies the selected heading bug with respect to the compass card.

6. Course arrow — The information displayed on each EHSI is dependent on the source as selected on the control panel COURSE switch. In the radio navigation mode (VOR1/2 or TCN), the arrow shows the course selected by the respective PUSH CRS DIRECT switch. In the CPTR mode (non ASQ-227), the arrow displays a computer-generated bearing to the highest FTP (FDS computer track submode) or a damped true bearing of the OTPI or UHF DF (FDS DF submode). In the CPTR mode (ASQ-227), the arrow indicates the course to achieve FTP intercept. In FMS 1 or FMS 2, the course arrow represents the desired track. In all cases, the course indicated is also displayed as a digital readout (CRS/DTK indicator).

7. Course deviation — Displayed on the pilot and copilot EHSIs by a displacement of the course deviation bar from its center position. The signal source is VOR, TACAN, or FMS, selected by the control panel COURSE switch. For VOR or TACAN signals, the indicated deviation is relative to the setting of the course arrow. For FMS signals, the indicated deviation is relative to the FMS track. For localizer signals, the indicated deviation is relative to the localizer beam and independent of the course arrow setting; however, the course arrow setting is used as an input to the FDS command bar circuits to define front or back course and should be properly positioned. Indicated deviation is 5° per dot for VOR and TACAN and 1 1/4° per dot for localizer. In the CPTR mode, the course deviation bar and dots are not displayed. In the FMS 1 or FMS 2 mode, each dot on either side of centerline represents a lateral displacement of one-half the displayed RNP value from the desired course.

8. To-From indication — Displayed on the EHSIs by means of a small To-From arrow along the course arrow. To-From indication is available in VOR, TACAN, CPTR (ASQ-227), FMS 1, or FMS 2 modes.

9. The PUSH CRS DIRECT switch on the pilot and copilot control panel is used to select the reference course for course deviation supplied by the particular VOR or TACAN. The selected course is shown by the position of the course arrow relative to the compass card and by the CRS/DTK indicator readout. The PUSH CRS DIRECT switch for both the pilot and copilot EHSIs is not used in the tactical mode or FMS mode. The NAV/COMM PUSH CRS DIRECT switch is only usable in conjunction with the RNG PUSH TEST switch for diagnostic mode.

10. Course error — Defined as the angle between the selected course arrow and the indicated heading. It is derived from data provided to the pilot EHSI and the developed output is also used by the FDSC.

11. Heading error — Defined as the angle between the selected heading marker and the indicated heading. It is derived from data inputs to the pilot EHSI and the error output is used by the FDSC and AFCS.

12. Failure flags — Displayed on the EHSI when a malfunction, unreliable signal, or power failure occurs.

13. The EHSI formats display navigation information associated with the pilot and copilot Flight Management Systems, FMS1 and FMS 2 respectively.



INDEX #	INDICATION/ INDICATOR	FUNCTION
1	Selected Heading Source Label	Indicates the heading source (INS1/INS2) selected by the NAV/COMM control panel.
2	Alternate Heading Bug	The alternate heading bug (cyan pinhead) is displayed only on the NAV/COMM EHSI. It is a visual indication of the computed heading of the alternate inertial selected by the NAV/COMM control panel. If the alternate inertial heading is invalid or failed, it will not be displayed.
3	Bearing Pointer #2 Source	Green arrow symbol and legend indicate bearing pointer #2 source as selected by the NAV/COMM control panel. Note the bearing pointer becomes dashed if the heading source changes to TRUE and the bearing source is radial based (TACAN, VOR1, or VOR2).
4	Alternate HDG SRC Label/Readout	On the NAV/COMM EHSI, a cyan legend and digital readout indicate the alternate heading bug source and bearing.
5	Compass Card	A 3-inch full 360° compass with N, E, S, and W designating the cardinal points and numerics at 30° marks. Fixed inter-cardinal markings are displayed every 45° around the perimeter of the compass card (45°, 135°, 225°, and 315°) and include ±90° and 180° marks, which aid in maneuvers such as holding and procedure turns.
6	Bearing Pointer #1 Source	Magenta arrow symbol and legend indicate bearing pointer #1 source as selected by the pilot. **Note** The bearing pointer becomes dashed if the heading source changes to TRUE and the bearing source is radial based (TCN or VOR).
7	Pilot Heading Bug	The pilot heading bug (magenta) is displayed on the NAV/COMM EHSI to indicate the pilot heading bug is selected. It is controlled from the pilot DCP. If the pilot heading bug fails, it will not be displayed at the NAV/COMM station.

Figure 23-39. NAV/COMM EHSI Display — HSI Mode Indications/Indicators (Sheet 1 of 2)

INDEX #	INDICATION/ INDICATOR	FUNCTION
8	TACAN Channel	Indicates the TACAN station identifier when using digital TACAN (i.e., ARN-118).
9	TACAN DME	The MFD displays TACAN DME, when available, independent of the navigation (bearing or course) selection. The label DME is displayed above the numeric readout. The TACAN distance resolution is 0.1 nm below 100 nm and 1.0 nm between 100 and 999 nm. The leading zeros on the distance are always suppressed. When distance to the active TACAN station is less than 100.0 nm, the tenths digit is displayed as a rolling wheel to emulate the scrolling of the mechanical indicator and provide rate information. If a DME failure is detected or it becomes unavailable, the numeric digits are removed and replaced with red or white dashes respectively.

Notes:

1. The remaining symbology displayed on the NAV/COMM EHSI is functionally the same as those described for the pilot and copilot indicators.
2. To indicate degraded capability, the normal display colors are changed to yellow.

Figure 23-39. NAV/COMM EHSI Display — HSI Mode Indications/Indicators (Sheet 2 of 2)

b Map Modes

Three map modes may be displayed on the EHSI: ARC MAP, Heading Up MAP, and North Up MAP. The map modes are selected by rotating the MODE rotary switch until the desired mode is displayed. The map modes display a graphical representation of the FMS route of flight as well as selectable background data enhancing situational awareness. The route of flight displayed includes up to 15 waypoints and the ground tracks connecting these waypoints, including curved paths. Each waypoint is depicted using the symbols shown in standard symbology and its identifier. If entered on the FPLN page of the CDU, the origin and destination airports are also displayed, if in range. The flight plan is displayed using the symbols shown in Figure 23-40. The active waypoint and leg to that waypoint are shown in magenta; all other waypoints and legs are displayed in white. Modifications to the route of flight are represented by a white dashed line until such time as the modification has been accepted by pressing the EXEC key on the CDU. An offset to the flight plan is depicted by a dashed magenta line. If selected, the secondary flight plan is displayed by a dashed cyan line. If waypoint sequencing has been inhibited, a dashed white line is extended indefinitely from the active waypoint along the direction of travel into that waypoint.

The following background data may be displayed using the symbols shown in Figure 23-40:

High NAVAIDs — Within 320 nm of map center.

Low NAVAIDs — Within 80 nm of map center.

Intersections — Within 40 nm of map center.

Airports — Within 320 nm of map center.

Non-Directional Beacons (NDB) — Within 40 nm of map center.

A maximum of 35 background objects may be displayed at one time. When more than 35 objects are available for the selected range, the closest 35 will be displayed along with the EXCESS DATA flag. If the secondary flight plan is displayed, background data cannot be shown. The operator selects background data for display on the respective PLT, CPLT, or NAV DISPLAY CTRL page. Even though low NAVAIDs may be selected, none will be displayed if the selected range is greater than 80 nm. Likewise for intersections and NDBs, no data will be displayed when the selected range exceeds 40 nm. Although high NAVAIDs and airports will be displayed in all map ranges, none will

be displayed beyond 320 nm of the map center. Although not necessarily background data, display of altitude and time of arrival information (ALT ETA) can be selected on the respective DISPLAY CTRL page. The estimated time of arrival is displayed in white; however, if a Required Time of Arrival (RTA) has been assigned for the active waypoint, the RTA is shown in magenta.

If the aircraft is equipped with a digital TACAN, a TACAN symbol is displayed when both distance and bearing are available. If TCS is the selected course source, a separate track leg is displayed from the aircraft symbol to the TCN symbol.

The map modes have selectable range settings. Available range settings are 2.5, 5, 10, 20, 40, 80, 160, 320, and 640 nautical miles, which are selected on the DCP.

c ARC MAP Mode

Selection of the ARC MAP mode enables the EHSI MFD to display an expanded arc presentation. The data normally presented on the HSI is duplicated in the ARC MAP mode with the following differences (Figure 23-41):

1. Aircraft symbol — The aircraft symbol is positioned at the bottom of the display.

2. Compass card — The compass card displays a 90° sector, 45° either side of the aircraft heading, along with the 45° benchmarks.

3. Heading marker bug — If the on-side heading marker bug is positioned on a portion of the compass rose not visible, a digital readout of its position will be displayed at all times. No readout is provided for the off-side heading marker bug.

4. Out-of-view bearing pointer — When the bearing pointer is positioned on the compass rose so that neither the head nor tail of the bearing pointer is visible, an out-of-view bearing pointer will be displayed around the edge of the compass rose on the side of the arc nearest to the head of the needle. The small bearing pointer icon shall be similar to the bearing icon. The #1 bearing pointer shall be magenta and the #2 bearing pointer shall be cyan. The on-side bearing pointer will also have a digital readout next to the pointer. No digital readout is provided for the off-side bearing pointer.

5. Range ring — A range ring shall be displayed as an arc, halfway between the compass card sector and the aircraft symbol that defines the range setting selected on the DCP. The displayed range values are 1.25, 2.5, 5, 10, 20, 40, 80, 160, and 320, which represent half the selected range.

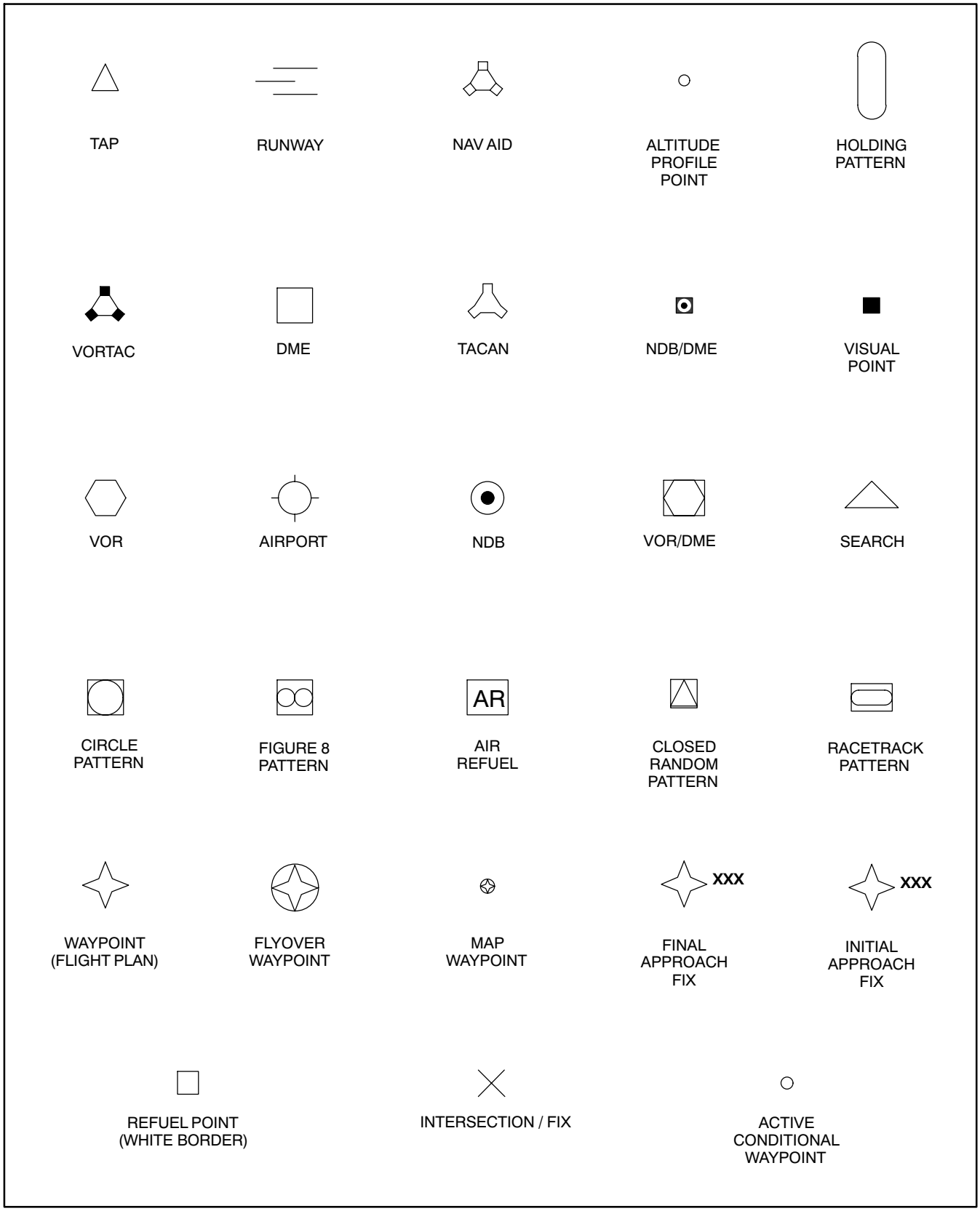


Figure 23-40. FMS Waypoints and Background Symbols



INDEX #	INDICATION/INDICATOR	FUNCTION
1	Distance to Waypoint	Indicates the distance to go to the next waypoint as entered into the CDU flight plan page.
2	Active Waypoint ID	Indicates the next waypoint ID (if available and entered into the CDU).
3	Range Arc and Distance	The range arc is a cyan arc and label halfway between the aircraft symbol and the edge of the compass card. The range label for the arc is one half of the full range value.
4	TACAN Symbol	Indicates the TACAN location. When an analog TACAN is used, the MFD computes the screen coordinates of the TACAN symbol using the bearing and distance synchro inputs. The current map scale and heading are used to properly locate the symbol. The MFD performs the same computations for a digital TACAN using ARINC 582 bearing and distance labels. Additionally, the channel number frequency is displayed next to the symbol.
5	To-From Arrow	The To-From arrow (solid white arrowhead) is attached to and rotates with the course arrow. For a To indication, the arrow is attached to the pointer side of the arrow and points toward the course arrowhead. For a From indication, the arrow is attached to the tail side of the arrow and points toward the course arrow tail. The To-From indicator is not displayed if the selected course source is Tactical or VOR, or the submode is back course or localizer.
6	Flight Plan Display	With FMS 1 or FMS2 displayed, all waypoints supplied by the map source are displayed (if within the viewable area). If the previous waypoint and/or any of the next waypoints are not displayable within the selected range, then the MFD will show the course line to or from the waypoint leaving the display's viewing area.
7	Waypoint symbols	All waypoints supplied by the map source are displayed (if within the viewable area). Waypoint symbol types are shown in Figure 23-40.

Figure 23-41. EHSI Display, ARC Map Mode — Indications/Indicators and Functions (Sheet 1 of 2)

INDEX #	INDICATION/INDICATOR	FUNCTION
8	Bearing Pointer Off-Scale Indication (Not Shown)	Indicates associated bearing (Bearing Pointer #1 or #2) is off the compass arc on the side shown. The symbol is to the side of the arc closest to the position of the off-scale pointer.
9	On-side Heading Bug Off-Scale Indication (Not Shown)	The heading of the on-side off-scale heading bug is displayed as a numeric readout the same color as the on-side heading bug. The readout is on the right if the heading bug is to the right, and the readout is on the left if the heading bug is to the left. The cross-side heading bug is visible when it is within the displayed 90° arc segment but is removed when it moves beyond the visible 90° arc segment. No numeric readout for the cross-side heading bug is displayed.

Figure 23-41. EHSI Display, ARC Map Mode — Indications/Indicators and Functions (Sheet 2 of 2)

d North Up MAP Mode

Selection of the North Up mode enables the EHSI MFD to display a map oriented to North. The data normally presented on the EHSI is duplicated for the North Up mode (refer to Figure 23-42).

e Heading Up MAP Mode

Selection of the Heading Up mode enables the EHSI MFD to be oriented to the aircraft heading. The data normally presented on the EHSI is duplicated for the Heading Up mode (refer to Figure 23-43).

f EHSI Display Failure

Refer to Figure 23-44. When an EHSI fails or loses electrical power at either the pilot or copilot station, the respective EFDI is automatically placed in the PFD mode. Functional sharing of navigational data between the pilot, copilot, and NAV/COMM MFDs enables the same navigational data to be presented at three stations in slightly different formats. This also provides a reliable backup system should input signals to the EHSI be lost or a unit failure occur. The loss of valid bearing information at the pilot station will result in the display of a failure flag and the removal of the pilot heading bug and #1 bearing needle on the NAV/COMM EHSI. A loss of valid navigational or steering data at the NAV/COMM station will result in the removal of specific navigational data from the display (based on what signal is lost or has become unreliable) and replacement of the symbol/digital data with an alert/failure flag. The signal isolation (between the three stations) provided by the data bus system limits the impact a MFD failure at one station has on the remaining operational display units. Figure 23-44 illustrates the type of failures that may occur and provides a description of each failure flag.

g EHSI in Diagnostic Mode — Diagnostic Mode

The EHSI diagnostic mode is available to the pilot and copilot by pressing the RNG PUSH TEST switch (for 2 seconds) and then (within 10 seconds) pressing the PUSH CRS DIRECT switch (for 2 seconds) on the respective DCP. Refer to the Flight Station CSMM for further troubleshooting.

23.18.2.3 HSI Test Panel

A panel labeled HSI TEST is located on the FWD NAV J-BOX in electronic rack B1. The panel contains three pushbuttons labeled PILOT, COPILOT, and NAVIGATOR. These pushbuttons are nonfunctional on aircraft with the EFDS installed.

23.18.2.4 Standby Attitude Indicator Power

Power to the standby attitude indicator is provided by the MONITORABLE ESSENTIAL DC BUS with a flight essential DC backup through the essential bus monitoring switch.



INDEX #	INDICATION/INDICATOR	FUNCTION
1	Aircraft symbol	The aircraft symbol is located in the center of the display oriented in accordance with the aircraft ground track. The flight plan and background data are positioned relative to North. The aircraft symbol rotates in place as the aircraft heading track changes.
2	Heading Reference Indicator	In the North Up mode when heading reference is MAG, the heading reference indicator is not displayed. If the heading reference is TRUE, the heading reference indicator is displayed in white as a “T” just to the left of the north cardinal point.
3	North Cardinal Point	The North Cardinal point is displayed as a character “N” in cyan.
4	Range ring	The range ring is a complete ring centered on the map center. The displayed range value is the selected range.
5	Selected Heading readout	The selected heading readout is always displayed.
6	Compass card (Not Shown)	No compass card or heading readout is provided. The display is always oriented to North. All information displayed is positioned relative to North.
7	FMS Distance (Not Shown)	The FMS distance, navigation source, and waypoint identifier displayed at the upper right of HSI and ARC Map are not displayed.
8	TACAN DME (Not Shown)	TACAN DME is not displayed.
9	Course arrow (Not Shown)	The course arrow is not displayed.
10	Bearing pointers (Not Shown)	Bearing pointers and labels are not displayed.
11	CDI and TO/FROM pointer (Not Shown)	The CDI and TO/FROM pointer are not displayed.
12	Heading marker bugs (Not Shown)	The heading marker bugs are not displayed.
13	Map Recenter Function (Not Shown)	The CDU DISPLAY CTRL pages provide the capability for the operator to change the map center. When AIRCRAFT is selected, the map center is set to the aircraft present position. When TO WPT is selected, the map center is set to the position of the TO waypoint. The PREV WPT and NEXT WPT choice moves the map center to the position of the next or previous flight plan waypoint, respectively.
Note		
When display is recentered on waypoints, the aircraft symbol is not displayed if its position is outside of the displayable area.		
14	North Up Failure flags (Not Shown)	The following failure flags do not apply to North Up Mode: Heading Flag, FMS distance, and DME distance Flags.

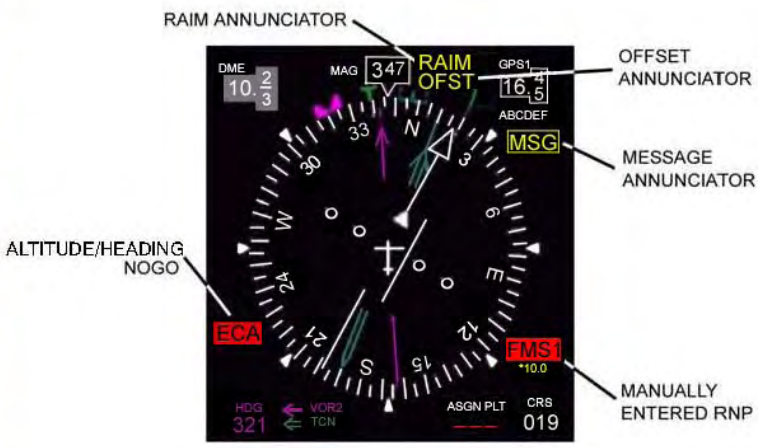
Figure 23-42. North Up MAP Mode



INDEX #	INDICATION/INDICATOR	FUNCTION
	Progress Text	When the progress text overlay is activated, the following information will be displayed:
1		Progress text and labels associated with the active flight plan TO waypoint are magenta, and the progress text associated with all other waypoints is white.
2		Waypoint identifiers for the active flight plan including previous, active (TO), TO + 1, TO + 2, and destination.
3		Desired course for the TO, TO + 1, and TO + 2 waypoints.
4		Cumulative leg distance for the TO, TO + 1, TO + 2 waypoints, and destination.
5		The Actual Time of Arrival (ATA) for the previous waypoint.
6		The Estimated Time of Arrival (ETA) for the TO, TO + 1, TO + 2 waypoints, and destination.
7	Aircraft symbol	The Aircraft symbol is located at the bottom center of the display with the aircraft oriented toward the top of the display. The flight plan and background data are positioned relative to the aircraft heading.
8	Range Rings	An inner and outer range ring are displayed with the position and appearance of an arc. The range label is positioned on the inner ring and has a value of half the selected range.
9	Selected Heading readout	The selected heading readout is always displayed.
10	FMS Distance	The FMS distance, navigation source, and waypoint identifier displayed at the upper right of HSI and ARC Map are not displayed.
11	TACAN DME	TACAN DME is not displayed.
12	Course arrow	The course arrow is not displayed.
13	Bearing pointers	Bearing pointers and labels are not displayed.
14	CDI and TO/FROM pointer	The CDI and TO/FROM pointer are not displayed.
15	Heading marker bugs	The heading marker bugs are not displayed.
16	Heading UP Mode	The following failure flags do not apply to North Up MAP Mode: FMS distance and DME distance.

Figure 23-43. Heading Up MAP Mode





FAILURE FLAG	WHEN DISPLAYED
DME — — —	White dashes are displayed to indicate data unavailable. Red dashes are displayed to indicate invalid data.
MFD	Black MFD over a solid red box is displayed when the EHSI detects an internal failure.
DCP	Black DCP over a solid red box is displayed when the Display Control Panel or interface has failed.
HDG	Black HDG over a solid red box is displayed if heading data from FMS is invalid.
Distance to Waypoint	White dashes are displayed if the distance to the data is invalid.
Navigation Source Flag	If the selected course source waypoint is unavailable or an active waypoint has not been defined, red dashes are displayed. If the Waypoint or submode is invalid or has failed, it displays the flag in red for a warning condition and boxed in yellow for a caution condition. NAV SOURCE VOR1, VOR2, TCN, CPTR, FMS1, or FMS2 Submode LOC, B/C, ILS, FTP, OTPI, or UHFDF
DTK — — —	Displayed if course is invalid or not computed: a. The CRS/DTK numeric readout is replaced with red dashes. b. Course arrow, course deviation bar, and To/From indicator are removed.
ASGN ALT — — —	Not available in CNS/ATM mode.
Bearing #1 Flag	Bearing source (black over a solid red box) is displayed if pilot selected bearing source is invalid or failed: a. Indicates failed source selected: VOR2, VOR1, TCN, ADF, DF, FMS1, FMS2, CPTR. b. Bearing pointer #1 is removed and the bearing annunciator is drawn black over a solid red box.

Figure 23-44. HSI/MAP/HDG UP/North Up MODE — Failure Flags (Sheet 1 of 2)

FAILURE FLAG	WHEN DISPLAYED
Bearing # 2 Flag	Bearing source (black over a solid red box) is displayed if copilot/NAV/COMM selected bearing source is invalid or failed: a. Indicates failed source selected: VOR2, VOR1, TCN, ADF, DF, FMS1, FMS2, CPTR. b. Bearing pointer #2 is removed and the bearing annunciation is drawn black over a solid red box.
HDG — — —	The numeric readout is replaced with red dashes and the heading bug is removed.
WIND	Wind digital readout is removed if wind was entered and data bus then fails. Wind indicator is removed.
ECA (NAV/COMM only)	Displayed if there is a fault in either Electronic Control Assembly (ECA). Displays only on the NAV/COMM indicator.
RAIM	The Receiver Autonomous Integrity Monitoring (RAIM) annunciation is displayed when the “monitoring unavailable” condition is detected by the FMS and transmitted to the display. The RAIM Annunciation is displayed white for a “no RAIM” condition, and yellow for “RAIM warn.”
OFST	The Offset (OFST) annunciation appears if the crew selects a parallel offset course via the Flight Management System. The lateral deviation scale in the center of the compass rose will be perpendicular to the parallel offset course.
MSG	The Message Alert (MSG) annunciation is generated by the Control Display Unit (CDU) and signals to the crew that they should look at the CDU for a message.
RNP	The Required Navigation Performance (RNP) value is normally displayed in white if no alert condition exists. The RNP value is displayed in yellow text if the value has been manually entered from the CDU and the entered value is greater than the base RNP value. An asterisk designates a manually entered value and will appear in yellow under an alert condition or in white if no alert exists.

Figure 23-44. HSI/MAP/HDG UP/North Up MODE — Failure Flags (Sheet 2 of 2)

23.18.2.5 ASQ-227 Mission Computer

Most of the information displayed by EFDS in CPTR course mode is digital data provided by the ASQ-227 Mission Computer; however, the following data is provided via separate analog inputs for display in CPTR course mode:

1. Attitude data displayed on EFDIs.

2. True Heading data displayed on EHSI compass cards and EFDIs.

3. Any of the following bearing needle selections: VOR1, VOR2, TCN, ADF, DF.

All of the above data remains valid in CPTR course mode, even if the mission computer is turned off or the mission computer software malfunctions.

The digital data will be either unavailable or invalid if the mission computer is turned off or the mission computer software malfunctions.

Note

If the mission computer is turned off or loses communications with EFDS while CPTR is selected, the following red validity flags will appear on the EFDIs and EHSIs: SPD, ALT, FD, and CPTR. If this occurs, the Attitude data and True Heading data displayed in CPTR course mode will still be valid. The flags can be removed by deselecting the CPTR course mode or by restarting the mission computer.

23.18.2.6 Pilot Data Entry Panel (PDEP)

The PDEP does not interface directly with the EFDS. Instead, the PDEP controls the CPTR display by controlling the digital messages that are sent to EFDS by the mission computer. The PDEP includes two switches that control the display of tactical data in the CPTR course mode. The switches are labeled "FMS2 COMPTRK CONT" and "FMS2 COMMAND BAR." The switches are shown in Figure 23-45. The switches are normally present any time the ASQ-227 mission computer is on and the tactical mission software is loaded. If a function that requires the use of the pilot numeric keypad is activated (such as a Pilot MOT), the keypad temporarily replaces the CPTR control switches on the PDEP. When the function is completed or terminated, the CPTR control switches are again displayed.

Display of the EHSI course arrow (described in Electronic Horizontal Situation Indicator, paragraph 22.10.2.5) and the EFDI roll command bars (described in Electronic Flight Director Indicator, paragraph 22.10.2.4) is dependent on the status of the PDEP FMS2 switches and on the presence of at least one FTP in the ASQ-227 mission computer. If no FTPs have been entered in the mission computer, the course arrow and roll command bars will be removed from all CPTR EFDS displays, regardless of the status of the PDEP switches. If an FTP is currently present in the mission computer, then display of the course arrow and command bars will occur as indicated in Figure 23-46.

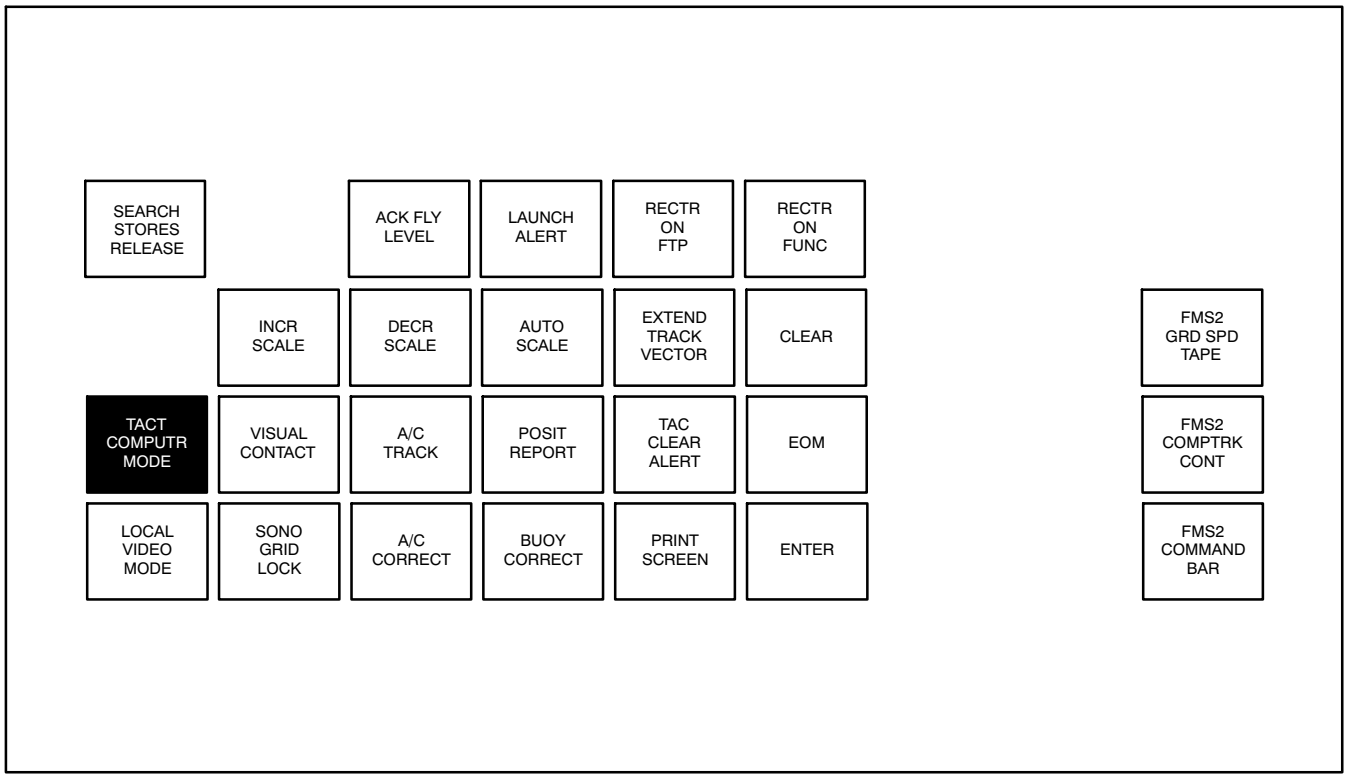


Figure 23-45. PDEP CPTR Control Switches

		FMS2 COMP TRK CONT	
		On	Off
CPTR Mode	ON	EHSI Course Arrow Displayed EFDI Roll Bars Displayed	EHSI Course Arrow and EFDI Roll Bars Both Removed
	OFF	EHSI Course Arrow Displayed EFDI Roll Bars Removed	EHSI Course Arrow and EFDI Roll Bars Both Removed

Figure 23-46. FMS2 Course Arrow and Command Bar Indications

Note

- The ASQ-227 mission computer monitors the status of the pilot DCP course switch in order to determine whether the Tactical Mode has been selected. It is not possible for the copilot to access full Tactical Mode functionality unless the pilot has selected CPTR course mode. If the pilot selects TCN, VOR1, VOR2, FMS1, or FMS2 course mode, the copilot Course Arrow and Roll Bars will be removed, even if all switches listed are on.
- The FMS2 COMPTRK CONT switch also affects the computation and display of Dist-to-Go data, ETE data, and ETA data by the mission computer. If the Tactical Mode has been selected on the pilot DCP and the FMS2 COMPTRK CONT switch is active, these values will all reflect distance along the ASQ-227 computed optimal path to waypoint intercept. If either of these switches is deselected, then ASQ-227 Dist-to-Go, ETE, and ETA will reflect the current straight-line distance to the active FTP.

23.18.3 System Description

The EFDS provides accurate and reliable navigation and aircraft attitude information to the flightcrew. The Control Panel switch and control settings determine the signal routing through the Forward Navigation Interconnection Box to the appropriate MFD. The Control Panel settings are also routed to the appropriate MFD to determine the display mode. Standard ICAO symbology is generated within the MFDs for development of the detailed displays.

23.19 CN-1714/ASN REPLACEMENT INERTIAL NAVIGATION UNIT-GPS EMBEDDED MODULE V (RINU-G) NAVIGATION SYSTEM (AIRCRAFT INCORPORATING CNS/ATM)

23.19.1 Introduction

The P-3 RINU-G system is a self-contained, all-weather, worldwide navigation system that is independent of ground-based NAVAIDs. The aircraft contains two independent CN-1714/ASN inertial systems with separate and independent GPS embedded modules (GEM V). Both are capable of providing the same data to the operator and aircraft.

23.19.2 System Components

23.19.2.1 Control Display Unit

Located at the pilot, copilot, and NAV/COMM stations, each CDU-7000 allows mode selection of the RINU-Gs and entry, control, selection, and display of navigation data. The pilot and copilot CDU-7000 control the ON/OFF mode of both RINU-G1 and RINU-G2. Control of RINU-G using the NAV/COMM CDU-7000 requires that either the pilot or copilot CDU-7000 be powered.

23.19.2.2 Replacement Inertial Navigation Unit-GPS Embedded Module V

Located in rack H-1/H-2 (Figure 23-47), the RINU-G houses the inertial platform, digital computer, inertial power supply, digital subsystem modules, and the GEM V module. The outputs of the RINU-G include pitch and roll, velocity, and true heading. The RINU-G is the component that provides navigation and attitude information to other aircraft systems. The RINU-G internal power supply converts 115 Vac, 400 Hz, single-phase power into various regulated and unregulated dc voltages required by the system and is capable of operating from the 24 Vdc aircraft battery in the event 115 Vac power is lost. RINU-G will perform an orderly shutdown when aircraft battery voltage falls below 17.5 Vdc.

The RINU-G performs the following primary functions:

1. Determines the attitude and horizontal velocities of the aircraft.
2. Determines the groundspeed and drift angle of the aircraft.
3. Determines the geographic position of the aircraft.

23.19.2.2.1 GPS Embedded Module (GEM V Module)

The GEM V is a 12-channel, all-in-view, Selective Availability/Anti-Spoofing Module (SAASM) unit that computes position, velocity, and time, and formats data for output. The GEM V provides Receiver Autonomous Integrity Monitoring (RAIM) and Fault Detection and Exclusion (FDE).

Note

The CDU will currently only display data for 5 satellites, even though the receiver may be using up to 12.

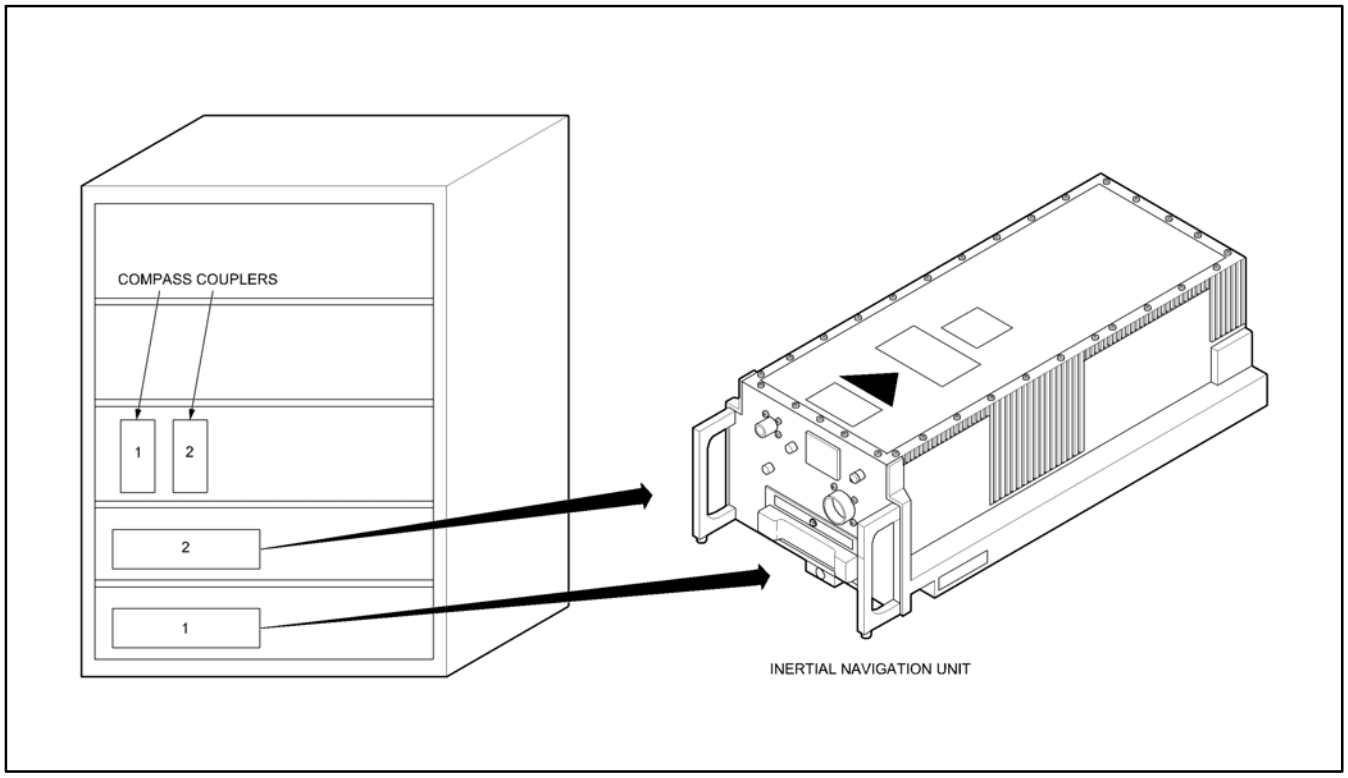


Figure 23-47. AN/CN-1714/ASN Components Located in Rack H-1/H-2

a Receiver Autonomous Integrity Monitoring (RAIM)

RAIM is the ability of the receiver to determine if the integrity of the navigation solution meets the integrity requirements for the phase of flight and requires the receiver to be tracking a minimum of five satellites. The RAIM processing includes continuous RAIM and Predictive RAIM (P-RAIM).

b Fault Detection and Exclusion (FDE)

FDE is the ability of the receiver to detect and exclude a bad satellite from the navigation solution. FDE requires the receiver to be tracking a minimum of six satellites. The satellites are periodically reevaluated for reinstatement into the navigation solution.

c GPS SA/AS Modes

d Y ONLY Mode

The Y only mode uses the crypto enabled Precise Positioning Service (PPS) encrypted military source data. Tactical considerations may dictate the selection of the Y-code only mode. If the GEM is unkeyed, the "Y ONLY" mode cannot be selected.

e Mixed Mode

The Mixed mode is the default mode of operation when keyed. When commanded, the GEM V provides a GPS solution based on any combination of available C/A or P(Y) measurement data.

f SPS Mode (C/A Code Only)

The Standard Positioning Service (SPS), C/A Code only mode is entered automatically when the GEM V is in an unkeyed state. When unkeyed, only the L1 frequency and C/A Code are utilized. In this mode, only modeled ionospheric corrections are available to the GEM V.

g GPS SA/AS Status

The status of the GPS keying state is determined on the CDU GPS SA/AS page. With keys loaded, the keying state will indicate "KEYS LOADED." When unkeyed, the CDU will indicate "NO KEYS." When Black keys are loaded, the GPS days will indicate the number of days remaining.

Note

- When Red keys are loaded, the GPS Days will always indicate 1 day.
- The CDU GPS KEY ALERT will annunciate when the GPS Keys will expire in 2 hours. The GPS NEED KEY alert will annunciate when mission duration is expected to exceed the GPS Keys duration.

h Estimated Position Uncertainty (EPU)

An Estimated Position Uncertainty will be maintained that represents an estimate of the horizontal position accuracy of the receiver such that the probability of being within a circle centered at the solution best estimate of position is 0.95.

i GPS Figure of Merit

A Figure of Merit (FOM) will be maintained that represents an estimate of the position error of the receiver. Refer to Figure 23-48.

FOM Value	Estimated Position Error (Meters)
1	less than or equal to 25
2	greater than 25 up to 50
3	greater than 50 up to 75
4	greater than 75 up to 100
5	greater than 100 up to 200
6	greater than 200 up to 500
7	greater than 500 up to 1000
8	greater than 1000 up to 5000
9	greater than 5000

Figure 23-48. FOM Positional Error Estimates

23.19.2.3 GPS Crypto Fill Panel

Loading of crypto keys is accomplished via the fill port interface. The fill ports are routed directly to a GEM, which stores the crypto keys for use in acquiring and maintaining track of the P(Y) signal. The GEM has the capability to be programmed with keys while either powered ON or OFF.

Note

Due to the security aspects of the GEM SAASM hardware architecture, the RINU-G remains unclassified even when keyed.

23.19.2.4 GPS Antenna

Located on the upper fuselage centerline of the aircraft between the HF radio longwire antennas, the Fixed Reception Pattern Antenna (FRPA 3) GPS antenna receives L1 and L2 RF. The antenna preamplifier amplifies the received RF and routes it through the GPS Splitter to each RINU-G GEM V. There is one common FRPA 3 antenna that receives the GPS signal for both GEM V modules.

Note

The loss of the antenna, amplifier, or splitter will result in a loss of GPS signal to both RINU-Gs.

23.19.2.5 GPS Amplifier

Located in the overhead adjacent to Sensor Station-2, this unit amplifies the L1/L2 RF signals received by the antenna and routes them to the GPS RF Splitter. The GPS Amplifier has a separate circuit breaker that is powered by FEDC bus.

23.19.2.6 GPS RF Splitter

The GPS Splitter is used to split the GPS signal from the amplifier to both GEM V modules located inside each RINU-G.

23.19.2.7 Magnetic Heading Reference System (MHRS)

The MHRS supplies analog (synchro) outputs representing either the stabilized aircraft magnetic heading or the slewed Directional Gyro (DG) heading. In CNS/ATM modified aircraft, MHRS magnetic heading is only available in VOR1, VOR 2, or TACAN course modes. The compass controller, located in the flight station, selects either the SLAVED or DG mode for the MHRS. Selecting SLAVED on the compass controller enables the compass coupler, located in rack H-1/H-2, to stabilize signals supplied by the Magnetic flux valve, located in the starboard horizontal stabilizer, with the platform heading output from the INU. Selecting DG on the compass controller references all outputs to the platform heading and takes the place of a directional gyro signal. For grid navigation operations, the output signal heading can be slewed clockwise or counterclockwise with the SET HDG spring-loaded-center-OFF rotary switch on the compass controller.

23.19.2.8 Digital Data Unit (DDU)

Located in rack D-1, this unit translates the RINU-G ARINC-561 data into a format capable of being processed by the mission computer. ASQ-222 and later model mission computers receive positional data directly from the RINU-G ARINC-575 output.

23.19.2.9 True Airspeed (TAS) Computer

In CNS/ATM modified aircraft, the TAS computer provides air data information to the Tactical Mission Computer. Located in rack C-2, this computer utilizes the copilot pitot-static system and the Dual element TAS temperature probe to calculate speeds from 70 to 450 knots.

Note

The TAS input is used to compute wind speed and direction in the INU. Reference voltage for magnetic variation is supplied by the TAS and is required for MAG VAR functionality.

23.19.2.10 True Airspeed Control Panel

Located at the NAV/COMM station, this panel has two toggle switches: POWER/OFF and PROBE HEATER/OFF. The POWER/OFF switch in the POWER position energizes the TAS computer to calculate wind velocities. The PROBE HEATER/OFF switch in the PROBE HEATER position energizes the TAS temperature probe deicing heater. This switch should be OFF except during icing conditions. Use the probe heater only during flight.

WARNING

Use the probe heater only during flight.

23.19.2.11 Dual Element TAS Temperature Probe

The single element TAS temperature probe has been replaced by a dual element TAS temperature probe in the same location. One element provides the temperature input to the TAS computer. Power to this element is controlled via the switch on the TAS control panel. The second element provides the temperature input to the pilot ADDU for Air Data computations. This element is always energized.

Note

Only the pilot ADDU receives an outside air temperature input from the temperature probe. When fully functional, the pilot ADDU cross-feeds the temperature value to the copilot ADDU.

23.19.3 System Description

The RINU-G provides position, heading, attitude, and velocity information for use with flight instrument and mission equipment. The RINU-G is a functional replacement for the existing CN-1701 RINU and the R-2332 (3A) GPS receiver. RINU-G is a RINU with an embedded GEM V GPS module. The GEM V module is a Selective Availability/Anti-Spoofing Module (SAASM) -compliant, 12-channel, all-in-view, Precise Positioning Service (PPS) -capable GPS receiver that computes position, velocity, and time. The GEM V receiver performs the Receiver Autonomous Integrity Monitoring (RAIM) and Fault Detection and Exclusion (FDE) functions. The RINU-G installation uses the Fixed Reception Pattern Antenna (FRPA 3) antenna, GPS amplifier, and an antenna splitter, and provides separate GPS crypto fill ports for loading required keying material. The RINU-G computes three independent navigation solutions: free Inertial Navigation Unit (INU), GPS, and blended INU and GPS (INU/GPS). The CDU-7000 refines the GPS solution by applying airspeed and heading (A/H) data to produce a smooth solution (GPS/A/H). Any of the six navigation solutions (INU1, INU2, INU1/GPS, INU2/GPS, GPS1/A/H, or GPS2/A/H) is selectable for navigation purposes.

The TAS system supplies airspeed values to the aircraft tactical computer system. The RINU-Gs use the TAS information from the on-side ADDU to calculate wind. The TMS computer receives the TAS data via the synchro-to-digital and digital-to-synchro converter. TAS values are displayed on the auxiliary readouts.

Note

- In the event that primary 115 Vac power is momentarily interrupted or lost, the flight essential 28 Vdc bus provides operating power to the inertial system.
- In an emergency, the INS will operate from the aircraft battery until battery voltage drops below 17.5 Vdc.

The RINU-G batteries provide a power source to the GEM V nonvolatile memory for data storage of loaded codes and GPS almanac data. The two C-size lithium batteries, for the GPS receiver cold load requirement and nonvolatile data storage support, are located in the compartment behind the GPS battery cover on the front of the INU.

The system can be operated in either the Navigate or Attitude Reference modes. The NAVIGATE mode is the normal operating mode in which the system is employed to its fullest capability. The ATT REF mode is the alternate operating mode that is used when only inertial attitude and MHRS magnetic heading reference are required or when the NAV mode fails in flight. GPS navigation outputs are available in ATT REF mode.

CAUTION

Although RINU-G1 and RINU-G2 receive prime power from different AC buses, both systems receive synchro excitation from the same source. The navigation interconnection box is powered by monitorable essential AC, which steps the voltage down to 26 Vac for synchro excitation. Thus, if the MONITORABLE ESSENTIAL AC BUS fails, both RINU-Gs will not provide heading and attitude information to the MFDs; however, positional data will be provided and displayed by the copilot CDU.

Note

When in attitude reference mode and either FMS 1, FMS 2, or CPTR course sources selected, the primary heading source is not available. Select alternate heading source on DCP.

1. Gyro Compass (GC) Alignment. GC Alignment is accomplished on the ground, with the aircraft stationary, and utilizes the FMS position at last shutdown, an operator-entered position, or GPS position (if selected), but does not require an operational GPS input from the GEM V receiver. The GC alignment mode is augmented by GEM V data whenever a satellite signal is processed. Alignment completion is normally 4.1 minutes. At completion of alignment, the READY NAV annunciation is displayed on the CDU-7000. If AUTO NAV is selected, the INS will transition to NAVIGATE mode at the completion of the alignment. Until the READY NAV annunciation appears or the INS transitions to the NAVIGATE mode, the aircraft should not be moved/relocated; however, minor movement that might be caused by wind or personnel moving about the aircraft will not interfere with the alignment process.

2. Stored Heading (SH) Alignment. The SH alignment, a variation of GC alignment, is accomplished on the ground, with the aircraft stationary, and does not require an operational GEM V GPS input. If the aircraft position and heading has not changed since the last shutdown and the operator accepts the stored present position latitude/longitude at the CDU, alignment completion is approximately 1 minute. At completion of alignment, the READY NAV annunciation appears on the CDU-7000 scratchpad. If AUTO NAV is selected, the INS will transition to the NAVIGATE mode upon completion of the alignment process. Until READY NAV message is received or the NAVIGATE mode is entered, the aircraft should not be moved/relocated; however, minor movement that might be caused by wind or personnel moving about the aircraft will not interfere with the alignment process.

Note

For a rapid alignment to function, a GC alignment must have been accomplished prior to STS 02 (NAV READY) and not accepted.

3. In-Flight (AIR) Alignment (IFA). Prior to attempting an in-flight alignment, the INS must have been operating normally (in NAVIGATE mode). The present position input for alignment is automatically obtained from the GPS system. Upon completion of the alignment, approximately 10 minutes, the READY NAV light illuminates. After the READY NAV light illuminates, the NAV mode shall be selected. If AUTO NAV was selected, the INS will transition to NAVIGATE mode at the completion of the alignment.

Note

GPS is required for a successful IFA.

23.19.4.4 Navigation Mode

Selecting ENAB NAV on the INAV 5/6 page (INU 1) and on the INAV 6/6 page (INU2) enables the INUs to provide suitable reference data for the aircraft navigation systems. Normal operations call for ENAB NAV to be selected after the NAV READY annunciation while the aircraft is stationary during the Before Start Checklist. In addition, AUTO NAV may be selected on the START INIT 3/3 page, which enables the INU to transition to the NAVIGATE mode once the alignment process is completed. During an in-flight alignment procedure, that uses GEM V GPS aiding, GEM V GPS aiding specifies either selecting ENAB NAV when a NAV READY CDU-7000 annunciation is received, or selecting AUTO NAV which automatically transitions the INU to NAVIGATE mode when the IFA is complete.

23.19.4.5 Attitude Reference Mode

Selecting ATT REF on the CDU-7000 START INIT 3/3 page disables the navigation capability of the INU for the remainder of the flight, or until an in-flight alignment procedure is completed. The INU continues to provide INS platform heading for use as a directional gyro to the MHRS and pitch and roll for use as attitude references. GPS outputs are still available in ATT REF mode.

23.19.3.1 RINU-G Navigation Solutions

Each RINU-G provides the following selectable navigation solutions for guidance determination along the active flight plan.

1. INU/GPS (Blended Inertial and GPS) Solution. The RINU-G processes and computes a highly accurate solution by blending inertial, GPS, and air data information (from the onside ADDU).

2. INU (Free Inertial) Solution. The RINU-G provides a free inertial solution independent of the Smooth GPS and Blended INU/GPS solutions.

3. (GPS/A/H) (Smooth GPS) Solution. The CDU applies airspeed from the onside ADDU and heading data to the GPS position to produce a Smooth GPS solution for guidance and flight instrument displays.

Note

- On the ground below 40 KIAS, the airspeed input is unavailable from the ADDU and the Smooth GPS solution will be degraded.

- The RINU-G blended and smooth navigation solutions are certified for utilizing the GPS as the primary means of navigation for oceanic, en route, terminal, and approach (RNP 0.3) operations, and as an external fixing source.

23.19.4 RINU-G Modes of Operation

The START INIT 3/3 page of the CDU-7000 is used to select the RINU-G operating mode as described in the following paragraphs.

23.19.4.1 OFF Mode

Power control of the RINU-G is via the Power page on the CDU-7000. OFF may be selected from any other mode of operation. When turned off, the RINU-G contains NVM to hold codes and GPS Almanac data. The RINU-G stores in memory the necessary data to protect parameters necessary for restart.

23.19.4.2 Standby Mode

The GEM V is initialized upon transition from the OFF to STBY modes using data from any or all of the following sources: Nonvolatile memory, internally generated data, and defaults. If GEM V data is valid, the inertial navigation function will accept GEM V present position, velocity, time, and altitude data.

23.19.4.3 Align Mode

Selecting ALN INIT on the CDU-7000 START INIT 3/3 page enables each INS to complete the alignment procedure. The three alignment modes available are Gyro Compass (GC), Stored Heading (SH), and in-flight alignment (AIR).

Note

The Gyro compass ground alignment is the preferred method for aligning the RINU-G on the ground.

Note

- When in attitude reference mode and either the FMS 1 or FMS 2 course source selected, the primary heading source (synthetic magnetic heading from RINU-G) will not be available. With CPTR source selected, primary heading (true heading from the RINU-G) will not be available. Select alternate heading source if available.

- If the selected INS is in ATT REF, the radar must be in HEADING STAB and OFF-LINE mode.

23.19.5 RINU-G Operating Procedures

23.19.5.1 Gyro Compass (GC) Alignment Procedures

1. Access the POWER page (IDX, LLS1 "<START INIT", RLS6 "POWER>") and toggle all required equipment power to ON (RINU-Gs, IFF, V/UHF).

2. Press IDX, LLS1 "<START INIT" to access the START INIT 1/3 page. On the START INIT 1/3 page, wait until the current UTC and DATE appear on line 4. These values will typically populate approximately 2 minutes after the RINU-Gs are powered up.

Note

If FMS date and time do not update automatically, it will be necessary to load GPS keys.

3. Press ↓ once on the CDU-7000 to access the START INIT 2/3 page. Verify that initialization position (INIT POS) is correct. If the INIT POS is incorrect, it can be manually typed and entered by pressing RLS5.

4. Press ↓ once on the CDU-7000 to access the START INIT 3/3 page (can also push ↑ once to go from the START INIT 1/3 page to the START INIT 3/3 page).

5. Verify the Alignment Type (ALGN TYPE) is "GC" (gyro compass) for each INU (LLS4 and RLS4).

6. Toggle AUTO NAV to ON for each INU (LLS6 and RLS6) if desired. This will automatically command each INU to NAVIGATE mode upon alignment completion.

7. Select "<INITIATE" (LLS5) under INU1 and "INITIATE>" (RLS5) under INU2. An "*INITIATE" under INU1 and "INITIATE*" under INU2 will indicate alignment confirmation while the RINU-G initializes the GPS and begins the alignment.

Note

Attitude Reference (ATT MODE) mode is selected from this page and can be selected at any time a RINU-G has power applied. Select ATT Ref by pushing the line select (LLS3 or RLS3) for the applicable RINU-G.

8. On the CDU-7000, press IDX, RLS3 "INAV>", then press ↓ until INAV 5/6 page or INAV 6/6 page. These two pages show INU1 and INU2 status respectively and can be used to monitor alignment progress and INU performance. Note that the INAV 1/6 page and INAV 2/6 page will allow monitoring of Blended (INU/GPS) solutions and the INAV 3/6 page and INAV 4/6 page allow monitoring of Free (GPS/A/H) solutions.

9. Alignment status will count down (80, 70, ...02), ALN CEP will count down toward 0.8NM, and ALN TIME will count up toward 4.1 minutes as each INU aligns. The INU MODE will change to NAVIGATE indicating that the INU has been aligned and accepted. This will happen automatically if AUTO NAV was selected ON previously. If AUTO NAV was OFF, a successful alignment will be indicated by a "NAV READY 1" or "NAV READY 2" indication on the CDU-7000 message page. Press "ENABLE NAV" (RLS1) to accept the INU. Make sure to check both INUs (INAV 5/6 page and INAV 6/6 page) to ensure NAVIGATE mode is set prior to taxiing.

10. After NAVIGATE mode is indicated for each INU, access the PILOT RNAV RNP page (IDX, "RNAV RNP>") and ensure INU1/GPS is selected under NAV SOLUTION. Use "COPILOT RNAV RNP>" (RLS6) to access the COPILOT RNAV RNP page and ensure INU2/GPS is selected under NAV SOLUTION.

23.19.5.2 In-Flight Alignment (IFA) Procedures

Note

In-flight Air Alignments will take approximately 10.1 minutes.

1. Access the POWER page via IDX, "START INIT>" (LLS1), "POWER>" (RLS6). Turn RINU1 or RINU2 OFF. After the RINU-G has completely powered down, turn the RINU1 or RINU2 ON.

2. Select IDX, "INAV>", and toggle up or down to the INAV 5/6 page for INU1 or INAV 6/6 page for INU2 and verify that "STANDBY" is present under MODE.

3. Select IDX, "<START INIT", and toggle up or down to START INIT 3/3 page. Toggle ALN TYPE to AIR (LLS5) for INU1 or to AIR (RLS5) for INU2.

4. Initiate alignment by pressing "<INITIATE" (LLS5) under ALN INIT for INU1 or "INITIATE>" (RLS5) for INU2.

Note

If a √ INU Mode message is displayed in the scratchpad or the RINU-G transitions to ATTITUDE mode, return to step 1 and reattempt another IFA.

5. Select ON under AUTO NAV (LLS6 for INU1 or RLS6 for INU2).

6. Select IDX, "INAV>", and toggle up or down to the INAV 5/6 page for INU1 or INAV 6/6 page for INU2 and verify that the INU transitions to "AIR ALIGN" under MODE. "GC ALIGN" may initially be displayed as the INU MODE.

7. A successful alignment is indicated by a "NAV READY 1" or "NAV READY 2" indication on the CDU-7000 message page and the alignment time is blank on the INAV 5/6 or INAV 6/6 page.

8. If AUTO NAV was not selected ON in step 5, select "ENAB NAV" and ensure INU MODE goes to "NAVIGATE" on the INAV 5/6 or INAV 6/6 page.

23.19.5.3 Stored Heading (SH) Alignment Procedures

Alignment of each of the two RINU-Gs is accomplished prior to taxi operations in approximately 1 minute using the following procedure:

Note

A normal alignment must have been previously performed and the RINU-G turned off (with STS 02 achieved and the system not accepted to NAVIGATE mode). Aircraft position and heading must not have changed during the interim between normal alignment and stored heading alignment.

1. Access the POWER page via IDX, “START INIT>” (LLS1), “POWER>” (RLS6). Turn RINU1 or RINU2 ON.
2. Press IDX, LLS1 “<START INIT” to access the START INIT 1/3 page. On the START INIT 1/3 page, wait until the current UTC and DATE appear on line 4. These values will typically populate approximately 2 minutes after the RINU-Gs are powered up.

Note

If FMS date and time do not update automatically, it will be necessary to load GPS keys.

3. Press ↓ once on the CDU-7000 to access the START INIT 2/3 page. Verify that initialization position (INIT POS) is correct. If the INIT POS is incorrect, it can be manually typed and entered by pressing RLS5.
4. Press ↓ once on the CDU-7000 to access the START INIT 3/3 page (can also push ↑ once to go from the START INIT 1/3 page to the START INIT 3/3 page).
5. Verify the Alignment Type (ALN TYPE) is “SH” (gyro compass) for each INU (LLS4 and RLS4).
6. Toggle AUTO NAV to ON for each INU (LLS6 and RLS6) if desired. This will automatically command each INU to NAVIGATE mode upon alignment completion.
7. Select “<INITIATE” (LLS5) under INU1 and “INITIATE>” (RLS5) under INU2. An “*INITIATE” under INU1 and “INITIATE*” under INU2 will indicate alignment confirmation while the RINU-G initializes the GPS and begins the alignment.
8. On the CDU-7000, press IDX, RLS3 “INAV>”, then press ↓ until INAV 5/6 page or INAV 6/6 page. These two pages show INU1 and INU2 status respectively and can be used to monitor alignment progress and INU performance. Note that the INAV 1/6 page and INAV 2/6 page will allow monitoring of Blended (INU/GPS) solutions and the INAV 3/6 page and INAV4/6 page allow monitoring of Free (GPS/A/H) solutions.
9. Alignment status will count down (80, 70,...02), ALN CEP will count down toward 0.8NM, and ALN TIME will count up toward approximately 1 minute as each INU aligns. The INU MODE will change to NAVIGATE indicating that the INU has been aligned and accepted. This will happen automatically if AUTO NAV was selected ON previously. If AUTO NAV was OFF, a successful alignment will be indicated by a “NAV READY 1” or “NAV READY 2” indication on the CDU-7000 message page. Make sure to check both INUs (INAV 5/6 page and INAV 6/6 page) to ensure NAVIGATE mode is set prior to taxiing.
10. After NAVIGATE mode is indicated for each INU, access the PILOT RNAV RNP page (IDX, “RNAV RNP>”) and ensure INU1/GPS is selected under NAV SOLUTION. Use “COPILOT RNAV RNP>” (RLS6) to access the COPILOT RNAV RNP page and ensure INU2/GPS is selected under NAV SOLUTION.

23.19.5.4 Attitude Reference Mode Selection Procedures

1. Access the POWER page via IDX, “START INIT>” (LLS1), “POWER>” (RLS6). Verify respective RINU1 or RINU2 ON.
2. Press ↑ once on the CDU-7000 to access the START INIT 3/3 page (can also push ↓ twice to go from the START INIT 1/3 page to the START INIT 3/3 page).
3. Select “>COMMAND” (LLS3) for INU1 ATT MODE or “COMMAND<” or (RLS3) for INU2 ATT MODE.

Note

Attitude Reference mode can be selected at any time a RINU-G has power applied from any other RINU-G mode.

4. On the CDU-7000, press IDX, RLS3 “INAV>”, then press ↓ until INAV 5/6 page or INAV 6/6 page. These two pages show INU1 and INU2 status respectively. Verify that the INU MODE displays ATTITUDE mode.
5. Entry into Attitude Reference mode can also be verified by an “ATTD READY 1” or “ATTD READY 2” indication on the CDU-7000 message page.

23.19.5.5 RINU-G Loading Procedures (CYZ-10)

1. Ensure in KYK-13 mode.
2. Select XMIT.
3. Page down and select key(s) to transmit.
4. CYZ-10 cable — Connect to station.
5. Clear button — Press.
6. Send button — Press.
7. Fill panel — Observe red light flashes.
8. Repeat steps 5 to 7 for update parameters.
9. CYZ-10 window — Observe 2 keys transferred.
10. CYZ-10 cable — Disconnect.
11. Repeat for both RINU-Gs.
12. Verify that RINU-G has accepted GPS KEYS on any CDU-7000.
    a. Press the IDX key.
    b. Arrow down to INDEX 2/2 page and the following information should be present:
        (1) GPS DAYS “001” is displayed on Line 1.
        (a) GPS STAT “KEYS LOADED” is displayed on Line 3.

23.19.5.6 RINU-G Zeroization Procedures

The RINU-G can be zeroized via the ZEROIZE page of any of the three CDUs.

1. Access ZEROIZE page (IDX, Down Arrow, and RLS5).

2. Press LLS2 to initiate zeroization of GPS1 (RINU-G1) cryptographic keys. Select LLS6 when CONFIRM GPS1 ZERO displayed. GPS ZERO COMPLETE message will be displayed at successful completion of zeroization.

3. Press LLS2 to initiate zeroization of GPS2 (RINU-G2) cryptographic keys. Select LLS6 when CONFIRM GPS1 ZERO displayed. GPS ZERO COMPLETE message will be displayed at successful completion of zeroization.

4. Verify zeroization by accessing the GPS SA/AS page (IDX, Down Arrow, and RLS1) and verify GPS Days is 0 (adjacent to LLS1 and RLS1) and NO KEYS is displayed (adjacent to LLS3 and RLS3).

23.19.6 Tactical Mission System (TMS) Computer Input Selection

The NAV/COMM Heading select switch determines which RINU-G is providing the input to the Tactical Computer. RINU-G1 is designated as primary and RINU-G2 is designated as the alternate heading and navigation source. Either the primary or alternate RINU-G may be designated to provide navigation input data to the TMS computer.

Note

Only the Blended or Free INU position from each RINU-G may be sent to the TMS computer. This selection is made on the CONFIG page of the CDU-7000.

23.19.6.1 TMS Computer Navigation Source Selection Procedures

The RINU-G interfaces with the CDU-7000, ADDU, and the aircraft computer system. Each RINU-G independently computes the navigation solution to include present position (latitude and longitude), and the results are displayed on each of the CDU-7000s. The following procedures outline which RINU-G and specific navigation solution is sent the TMS computer.

1. Use the NAV/COMM Heading Select Knob that selects either RINU-G1 (primary) or RINU-G2 (Alternate) to select which RINU-G is the source of navigation to the TMS computer.

2. Access the CONFIG page (IDX, Select “>CONFIG”).

3. Left line select 5 to select the RINU-G1 SOL, Left line select 6 to select the RINU-G2 SOL. Only the Blended (INU/GPS) or Free inertial (INU) position from each RINU-G is available for selection.

23.19.6.2 Inertial Solution Position Update Procedures

The pure inertial solution (INU1 and INU2) generated from both RINU-Gs can be updated either via a manually entered position or via the blended solution (INU1/GPS or INU2/GPS).

23.19.6.3 Manual Inertial Solution Position Update Procedure

To use a manually entered position to update the Inertial solution position:

1. Access the INAV 5/6 page (to update the INU1 position) or the INAV 6/6 page (to update the INU2 position) (IDX, RLS3 “INAV>”), and either arrow up or down to either the INAV 5/6 or INAV 6/6 page as desired.
2. Access the UPDATE feature via RLS “UPDATE>”.
3. On the UPDATE page, select the MANUAL (highlighted in green) via LLS2.
4. Type in a manually entered update position in the scratchpad and insert position in the UPDATE POSITION via LLS3.
5. Command the Update of the INU position by RLS4 “FREEZE<” and LLS6 “>ACCEPT”.
6. Access the SOLUTION SUMMARY page to verify that the selected INU position has been updated properly (IDX, ↓ to the INDEX 2/2 page, and RLS1 “SOL SUMMARY>”).

23.19.6.4 Inertial Position Update Procedure using the Blended Solution

Access the INAV 5/6 page (to update the INU1 position) or the INAV 6/6 page (to update the INU2 position) (IDX, Right line select 3 “INAV>”), and either arrow up or down to either the INAV 5/6 or INAV 6/6 page as desired.

1. Access the UPDATE feature via RLS “UPDATE>”.
2. On the UPDATE page, select either the INU1/GPS solution to update INU1 or the INU2/GPS position to update INU2 (highlighted in green).
3. Command the Update of the INU position by RLS4 “FREEZE<” and LLS6 “>ACCEPT”.
4. Access the SOLUTION SUMMARY page to verify that the selected INU position has been updated properly (IDX, ↓ to the INDEX 2/2 page, and RLS1 “SOL SUMMARY>”).

23.19.7 RINU-G Failure/Fault Indications

23.19.7.1 RINU-G Status Page Failure Explanations

Figure 23-49 provides a failure explanation of the RINU-G located on the RINU-G STATUS page of the CDU.

RINU-G STATUS	Failure Explanation
RPU	Failure of the GPS receiver processor unit bit test
SEN REF	Inertial source data has failed and no navigation or attitude data is available
BATT	RINU-G Battery Low. Loss of NVM to include GPS keys and GPS almanac data
NAV	INU digital navigation and attitude data is invalid
DGT ATT	Digital attitude data is invalid
AE	GPS Antenna Electronics fails BIT test

Figure 23-49. RINU-G STATUS Failure Explanations

23.19.7.2 RINU-G Shop Replaceable Assembly (SRA) Failure Indications

SRA failure indications are available on the respective RINU-G STATUS page. None of these components is serviceable at Operation Level Maintenance. Refer to Figure 23-50 for further description of the different SRA failures and operator impact.

SRA Failure	Description	Operator Impact
SA (Sensor Assembly)	Gyros and Accelerometers	INU Inoperative. GPS may still be working
SE (Sensor Electronics)	Electronics associated with the SA	INU Inoperative. GPS may still be working
SP (System Processor)	The computer processor module	INU Inoperative. GPS may still be working
HVPS (High Voltage Power Supply)	Provides HV for the Ring Laser Gyros	INU Inoperative. GPS may still be working
INTRCNT (Rear Interconnect)	The internal connection to the external connectors at the back of RINU-G	INU Inoperative. GPS may still be working
EGR (Embedded GPS Receiver)	The Embedded GEM V Module	GPS is lost
LVPS (Low Voltage Power Supply)	Provides dc operating voltage to internal RINU-G components	INU Inoperative
RMS 1, 2, 3 (RINU Synchro Modules)	Convert digital attitude and heading to Synchro outputs for flight instruments. RSM 3 not on USN P-3C RINU-G	Synchro outputs may fail
ADIO (ARINC Discrete Input/Output)	ARINC 575, 561, 429 outputs and inputs, 28 Vdc and Ground discrete output and input	Outputs and discrete input/output may fail
ACPM (AC Power Module)	Ac to dc for LVPS and HVPS	INU Inoperative

Figure 23-50. SRA Failure Indications and Explanations

23.19.7.3 RINU-G Fault History Action Malfunction Codes

There are RINU-G Code failures that may cause a Flight display MSG light, a CDU-7000 √ STATUS annunciation, and a RINU-G degradation (DGR) or NO GO. The RINU-G CODES Status is listed under CODES on the RINU-G STATUS page. If the RINU-G is either Degraded or NOGO for CODES, refer to the RINU-G FAULT History page for further description of the malfunction. Refer to Figure 23-51 (Action/Malfunction Table) for more detailed description of the action and malfunctions. Refer to Figure 23-52 for System Block Diagram.

Action Code	Malf Code	Fault History Text	Fault Description	Operator Action	Maintainer Action	Included in Malfunction Code Status and Overall RINU Status	Degraded or Failed Overall RINU Status
1	12	X ACELRMTR	X Accelerometer Fail	Power down the system	After three successive failures, replace system	√	FAIL
1	14	Y ACELRMTR	Y Accelerometer Fail			√	FAIL
1	16	ALL INSTRU	All Instrument Fail			√	FAIL
1	17	PROCESSOR	Processor Fail			√	FAIL
1	18	GRND SPEED	Ground speed >1000 knots			√	FAIL
2	11	CHECKSUM	Program Check sum Failure	Cycle system power	After three successive power cycles with the same failure, replace system	√	DEGRADE
2	19	ALIGNMENT	Alignment Failure			√	DEGRADE
2	20	ANGLE GC	Wide Angle Gyro Compass Failure			√	DEGRADE
2	21	GC XY BIAS	Excessive X/Y estimated gyro bias (GBX/GBY> 0.05°/Hr	Cycle system power. Verify correct position entry.		√	DEGRADE
2	23	ATTITUDE	Attitude Valid NOT TRUE in 30 sec	Cycle system power		√	DEGRADE
3	22	PPOS ENTRY	Present Position Not Entered	Turn System Off and back to On and enter present position	None	√	DEGRADE
4	4	DA4 WRAP	D/A #4 wrap-around Failure	Check all associated 26 Vac, 400 Hz circuit breakers.	Check all associated 26 Vac, 400 Hz circuit breakers. After three successive power cycles with the same failure, replace system	Recorded in Fault History Only	
4	5	DA3 WRAP	D/A #3 wrap-around Failure				
4	6	DA2 WRAP	D/A #2 wrap-around Failure				
4	7	STEER WRAP	Steering wrap-around Failure	Do not use INS as a source of heading.			
4	8	DC XTK	DC XTK Failure				
4	10	SYNC REF	Synchro Reference Failure	Check all associated 26 Vac, 400 Hz circuit breakers.			

Figure 23-51. RINU-G Fault History Action Malfunction Codes (Sheet 1 of 2)

Action Code	Malf Code	Fault History Text	Fault Description	Operator Action	Maintainer Action	Included in Malfunction Code Status and Overall RINU Status	Degraded or Failed Overall RINU Status
5	3	GC Z BIAS	Excessive Z estimated gyro bias	Record INU Radial Position Error and NAV Time at mission termination	If INU radial drift rate greater than 1.2 nm/hr for last 10 flights, replace system.	Recorded in Fault History Only	
8	1	DDU	DDU Invalid	Check DDU Circuit Breaker and Power	Check DDU Circuit Breaker and Power		DEGRADE
8	9	MHRS	MHRS Invalid	Check MHRS Circuit Breaker. Select alternate INU	Check MHRS Circuit Breaker		DEGRADE
8	24	GREY CODE	Grey Code Failure	None	None	Recorded in Fault History Only	
8	25	DISC WRAP	Discrete wrap-around Failure	None	Perform maintenance as determined by BIT Status table		DEGRADE
8	26	ARINC	ARINC Failure	Check Circuit breakers for all ARINC Equipment	Check Circuit breakers for all ARINC Equipment. If all ARINC equipment is operational, perform maintenance as determined by BIT Status table.		DEGRADE
8	27	MAG COMP	Magnetic Compass Failure	Do not use the Magnetic Compass Indicator	Check Magnetic Compass indicator		DEGRADE
8	28	LEVER ARM	Lever Arms are zero **Note** CDU-7000 contains default lever arms. Fault code a legacy issue only.	Enter Lever Arms Measurements	Enter Lever Arms Measurements		DEGRADE

Figure 23-51. RINU-G Fault History Action Malfunction Codes (Sheet 2 of 2)

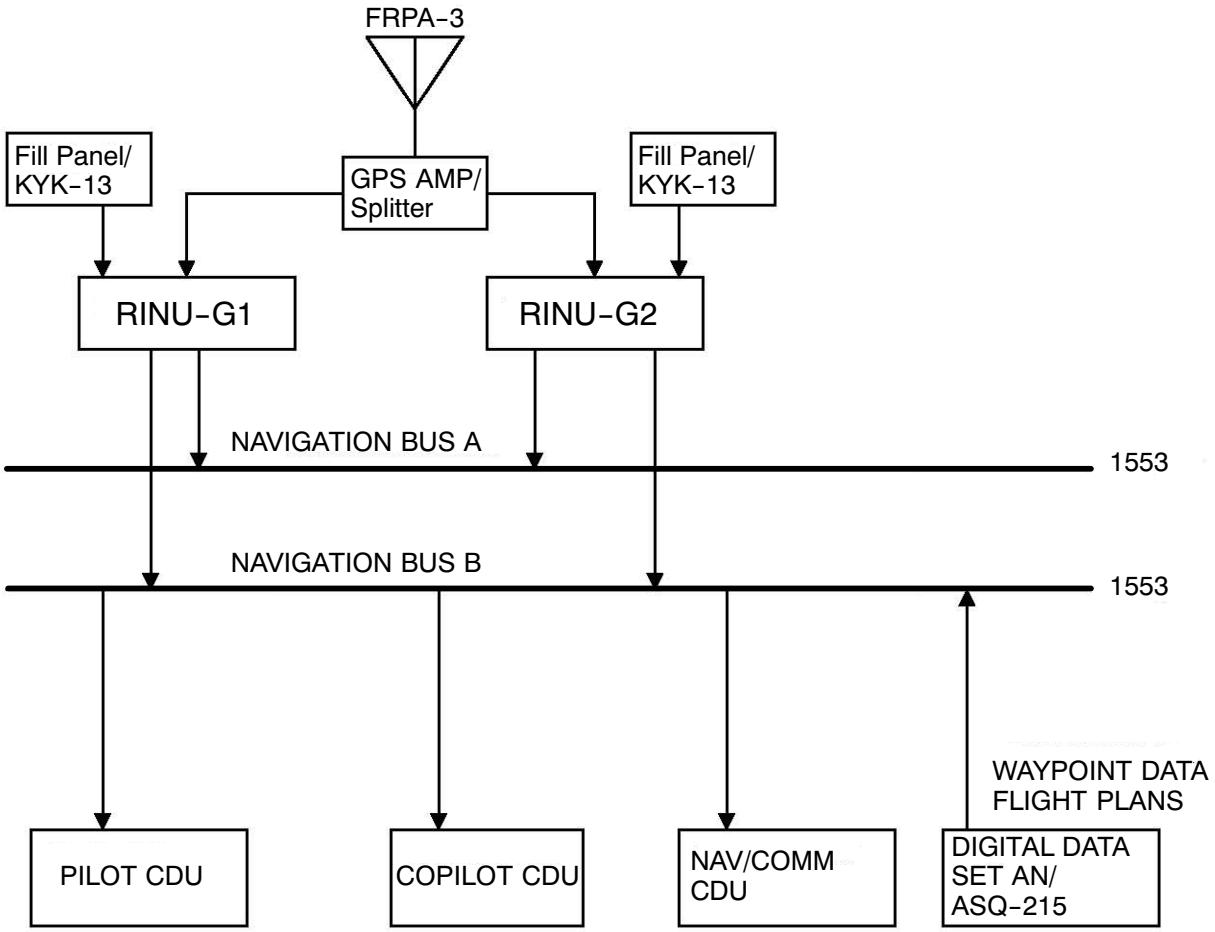


Figure 23-52. RINU-G Block Diagram (Sheet 1 of 2)

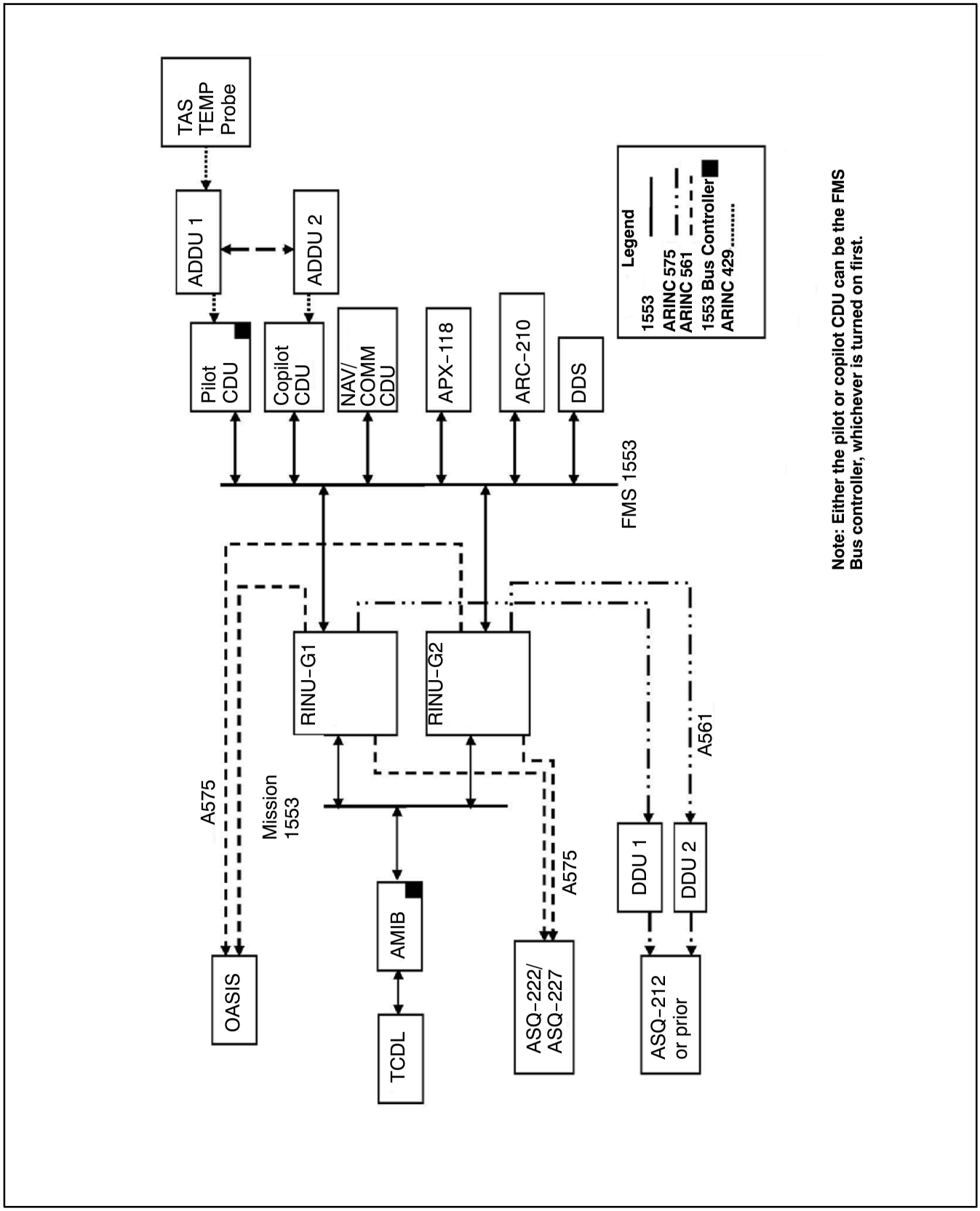


Figure 23-52. RINU-G Block Diagram (Sheet 2 of 2)

23.20 DIGITAL DATA SET (DDS)

The Digital Data Set (DDS), (AN/ASQ-215), is Navy common equipment that was developed to transfer digital navigation data from mission planning stations into the aircraft. The DDS (formerly known as the Mission Data Loader [MDL]) provides the physical interface to the MIL-STD-1553B data bus for bulk memory storage and has been modified to operate in a CNS/ATM system that uses the CDU-7000.

23.20.1 Data Files

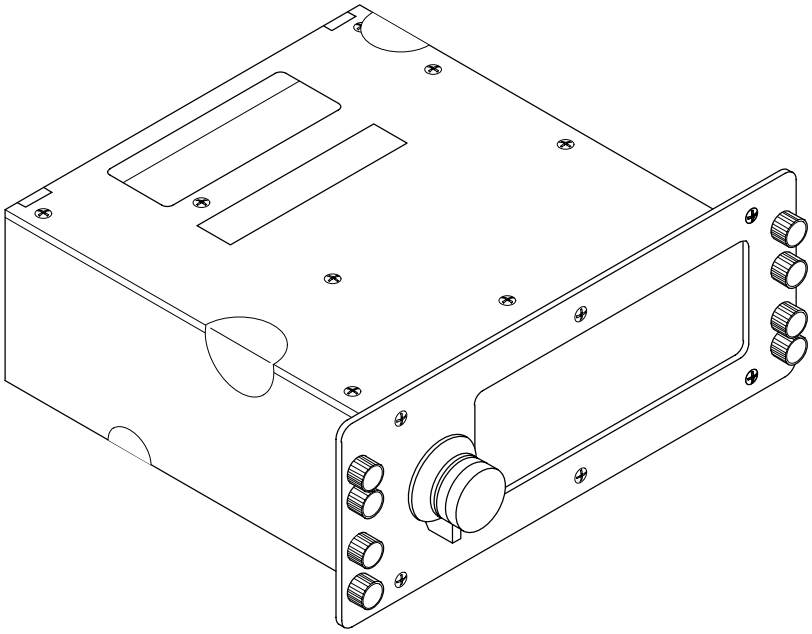
The DDS provides nonvolatile bulk memory storage for the following data, which may be loaded into the CDU-7000 over the MIL-STD-1553B data bus:

1. CDU-7000 Operational Flight Program (OFP).
2. AN/ASQ-215 Operational Flight Program (OFP).
3. 60 flight plans of up to 200 waypoints each.
4. Primary navigation database consisting of worldwide:
    a. Airports (Standard Instrument Departures [SID], Standard Terminal Arrival Routes [STAR], Instrument Approach Procedures [IAP], airport communications information).
    b. Navigation Aids (NAVAIDs).
    c. En route waypoints.
    d. Airways.
    e. Version and effectivity dates.
    f. User-defined waypoint database of up to 200 waypoints.
    g. Magnetic variation database.
    h. GPS almanac.
    i. Communications preset information.

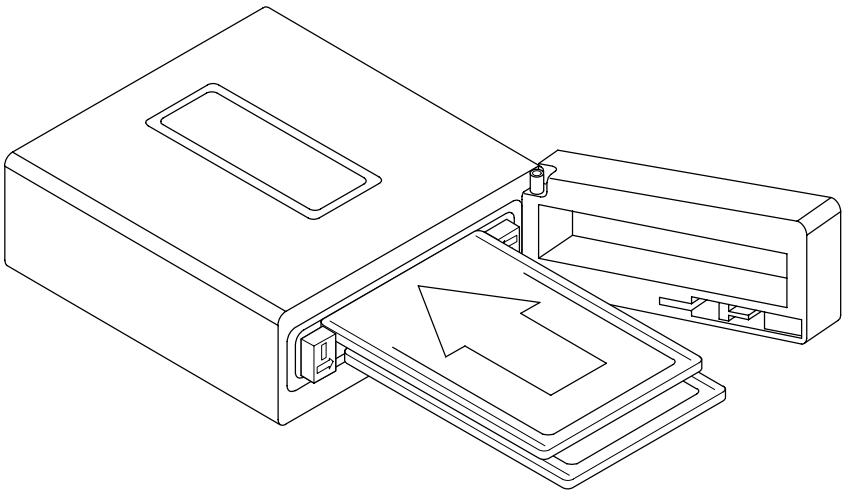
23.20.2 DDS Components

The DDS, as shown in Figure 23-53, consists of the following elements and is located at the NAV/COMM station:

1. Interface Receptacle Unit (IRU).
2. PCMCIA Data Transfer Module (PDTM).
3. TUFFCard™ Series II (1 GByte or 256 MByte) ATA Flash Type II PCMCIA cards.



INTERFACE RECEPTACLE UNIT



PDTM WITH TUFFCARD™ MISSION CARDS

Figure 23-53. AN/ASQ-215 Digital Data Set (DDS)

23.20.2.1 Interface Receptacle Unit (IRU)

The IRU located at the NAV/COMM station is an aircraft-mounted Weapons Replaceable Assembly (WRA) that manages and controls the data exchange between the PDTM and the CDU-7000. It is comprised of power control, processing, memory, and interfaces necessary to operate in the CNS/ATM system. The IRU operates as a Remote Terminal (RT) on the MIL-STD-1553B data bus and provides a self-test/Built-In-Test (BIT) function for all circuitry, including the PDTM.

23.20.2.2 PCMCIA Data Transfer Module (PDTM)

The PDTM serves as the transportable housing for two Type II PCMCIA cards that provide storage and exchange of preflight information between the Mission Planning System and the navigation system avionics. Only one card slot may be selected for use at a time, and all commands sent to the DDS will be directed to the currently selected (active) card slot. The active card slot can be changed via a selection in the CDU-7000. The PDTM is designed such that it is impossible to insert or remove a PCMCIA card while the PDTM is installed in an IRU. This feature eliminates hot insertion of the PCMCIA cards.

Note

When using the PDTM data card eject button, the PCMCIA card can be rapidly ejected from the PDTM.

23.20.2.3 TUFFCard™ PCMCIA cards

The TUFFCard™ is a PCMCIA PC Card Standard, ATA Type II Flash memory card.

The DDS, in conjunction with the TUFFCard™, provides protection of secure data in three different ways: files can be erased, files can be deleted, and the entire TUFFCard™ can be purged (or zeroized).

Declassification of data is provided as a ZEROIZE command from the CDU-7000. All memory on the card is declassified, including the remapped data that is not accessible by the user, and allows all data to be destroyed without damage to the card. The card can be reformatted and reused after a declassification event occurs. The ZEROIZE operation, once initiated, will resume on all subsequent power cycles to the TUFFCard™ until the entire memory has been purged.

CAUTION

The TUFFCard™ can be inserted into the PDTM upside down, resulting in damage to the TUFFCard™. Do not force the TUFFCard™ past the detent in the PDTM. Forcefully inserting the PDTM upside down past the detent in the PDTM will damage the TUFFCard™.

PART IX

Flightcrew Coordination

Chapter 24 — Flightcrew Coordination (General)

Chapter 25 — Aircrew Responsibilities

CHAPTER 24

Flightcrew Coordination (General)

24.1 INTRODUCTION

The primary mission of the P-3 aircraft is detection, localization, surveillance, and attack of targets that pose a potential military threat. Satisfactory pursuit of this mission is realized through the two phases of contact development and contact refinement. Each crewmember plays a vital role in support of this mission, and the P-3 aircraft is designed and built to be operated as an integrated team effort. P-3 crews fly throughout the world performing surveillance missions, routine patrols, special ASW patrols, and training flights.

The TACCO shall be responsible for the tactical portion of the flight mission and shall coordinate the functions of the entire flightcrew. The pilot in command shall be responsible for the flightcrew being in their assigned positions for takeoff and landing (including ditching in an emergency). Each crewmember shall have individual responsibilities and duties as described in the following paragraphs and in Chapter 8. Additional duties and responsibilities may be assigned by the pilot and TACCO as necessary.

Each crewmember shall possess a thorough knowledge of the equipment at his station, plus have a familiarity with equipment used by other crewmen so that he can assume other duties in an emergency and facilitate normal crew coordination. Each crewmember is expected to be thoroughly familiar with safety and survival equipment in the aircraft and to be completely knowledgeable in the use and wearing of his personal equipment.

24.1.1 Crew Resource Management

The Crew Resource Management (CRM) program is described in OPNAVINST 3710.7 series and OPNAVINST 1542.7. CRM is intended to improve the mission effectiveness of all aviation communities by enhancing crew coordination through increased awareness of associated behavioral skills.

The seven behavioral skills of CRM are:

1. Decision-making — Ability to use logical and sound judgment based on the information available.
2. Assertiveness — Willingness to actively participate and the ability to state and maintain your position, until convinced by the facts (not the authority or personality of another) that your position is wrong.
3. Mission analysis — Ability to make long-term and contingency plans and to coordinate, allocate, and monitor crew and aircraft resources.
4. Communication — Ability to clearly and accurately send and acknowledge information, instructions, or commands and provide useful feedback.
5. Leadership — Ability to direct and coordinate the activities of other crewmembers and to encourage the crew to act together as a team.
6. Adaptability/flexibility — Ability to alter a course of action to meet situational demands, to maintain constructive behavior under pressure, and to interact constructively with other crewmembers.
7. Situation awareness — Cognizance of what is happening in the cockpit and in the mission, and knowledge of how that compares with what is supposed to be happening.

Practicing CRM principles will improve mission effectiveness and reduce mishaps that result from poor crew coordination.

24.2 CONDITIONS OF FLIGHT

Five basic conditions of readiness are encountered during flight, as follows:

1. Battle.
2. Surveillance/transit.
3. Operational check.
4. Aircraft inspection.
5. Takeoff and landing.

The readiness conditions are discussed in the following paragraphs.

Note

Because of the possibility of encountering unexpected turbulence in flight, all personnel should fasten seatbelts while seated.

24.2.1 Condition I — Battle

All stations manned for low-altitude ASW localization, mining, attack, or rigging. For example, at the command "CREW, SET BATTLE CONDITION I FOR MK 46 ATTACK," each crewmember should proceed immediately to the predesignated station. Headsets shall be worn during this condition.

24.2.2 Condition II — Surveillance/High-Altitude ASW Operations/Transit

All stations shall be manned as necessary for routine search, patrol, high-altitude ASW operations, and overwater or overland flight. Observer stations shall be manned as necessary and observers periodically rotated. Continuous wearing of headsets is not required.

24.2.3 Condition III — Operational Check

All stations shall be manned by primary operators. Perform ICS check; obtain equipment status. Make equipment status report to TACCO. TACCO report status (summary) to the pilot in command. The pilot should then set Condition II if all other conditions are normal.

WARNING

At no time during the Condition III checks shall the MASTER ARM or SRCH PWR switches be turned on.

Note

- Condition III is set by the pilot after takeoff and signifies that personnel are free to leave their takeoff (ditching) station. Tactical crewmembers are directed to perform in-flight performance checks. Caution should be exercised prior to setting Condition III in high-density traffic areas.
- Condition III should be set by the TACCO prior to engaging in ASW action.

24.2.4 Condition IV — Aircraft Inspection

Crewmember(s), designated by the aircraft commander during crew briefing, leaves ditching station and inspects the following:

1. Doppler well, main load center, and hydraulic service center for loose equipment, leaks, smoke, fumes, and obvious discrepancies.
2. Visible external surfaces of aircraft.
3. By use of the bomb bay viewing window, visually check the weapons in the bomb bay for security.

When a sufficient number of crewmembers are aboard, this inspection should be done by personnel other than window observers to allow observers to monitor other airborne aircraft that may be in the vicinity of the airfield.

Note

Crewmember(s) reports inspection results to the pilot and flight engineer in the flight station in person. Pilot normally sets Condition III at this time if otherwise safe to do so.

The crewmember setting Condition IV shall don a hardhat.

24.2.5 Condition V — Takeoff/Landing

All crewmembers and passengers shall take assigned ditching (takeoff/landing) stations. Each crewmember, as appropriate, shall position the seat to face aft and shall do the following:

1. Properly rig assigned station. Safely stow or secure all loose equipment.

Note

Two additional crewmembers may remain in the flight station during takeoffs and landings at the discretion of the pilot in command so as to increase safety of flight. These crewmembers shall have immediate ditching stations available.

2. Don gloves and hardhats with visor down when deemed necessary by the PPC/MC.
3. Adjust headrest.
4. Take assigned seat, fasten seatbelt (shoulder harness), and stand by for instructions.
5. All crewmembers and passengers shall remain in assigned ditching stations until specifically released by the pilot.

Note

The aircraft interior should be maintained reasonably dark at night.

24.3 MISSION COMMANDER

The mission commander shall be a properly qualified naval aviator or naval flight officer designated by appropriate authority. He shall be responsible for all phases of the assigned mission except those aspects of flight safety that are

related to the physical control of the aircraft and are considered beyond the qualifications of the mission commander's designator. The mission commander shall direct a coordinated plan of action and shall be responsible for the effectiveness of the flight. He shall be responsible for the crew preparation for takeoff and ensuring takeoff is at the scheduled time. He shall gather and evaluate reports on the aircraft and equipment and direct preparation for flight as necessary. He shall direct the boarding of the aircraft and verify the presence of the crewmembers in their assigned stations. Further, the mission commander shall sanction armament selection and release. The mission commander shall ensure the proper EMCON condition is maintained.

All references to terrain avoidance are made in order to provide a standard crew procedure for safety of flight.

24.4 PATROL PLANE COMMANDER (PPC)

In cases where a mission commander is not assigned, the responsibilities and duties of the mission commander shall be assumed by the pilot in command.

As patrol plane commander, the pilot is responsible for the effectiveness of the aircraft and crew for all matters affecting flight safety. The PPC is responsible for calling for the appropriate checklist to be read by the copilot and shall respond as necessary. As aircraft commander, he shall coordinate ASW tactics with the TACCO and position the aircraft to effectively accomplish the mission. The PPC fulfills the requirements for aircraft commander in accordance with OPNAVINST 3710.7 series.

24.5 PATROL PLANE PILOT (PPP)

The patrol plane pilot shall assist the PPC in preparing the crew for flight and in ascertaining readiness for flight of the aircraft and aircraft systems. He shall read the checklist, as required by the flight mission. He will pilot the aircraft at all times the PPC is away from his station. The PPP function is specifically patterned as a safety backup for the PPC throughout the entire flight. In this capacity, he shall offer constructive comments and recommendations as necessary throughout the mission in order to maintain the safest and most effective possible flight environment. During the times the PPP is in control of the aircraft, his coordination of crew duties shall be the same as for the pilot. The PPP fulfills the requirements for second pilot in accordance with OPNAVINST 3710.7 series.

24.6 PATROL PLANE COPILOT (PPCP)

The patrol plane copilot shall act as a relief for the PPC or PPP during extended flight operations. In training for the position of PPP, he shall assist the PPC in mission preparation and be assigned duties consistent with his training requirements and experience level. When occupying either the pilot or copilot positions, he shall execute the described duties. The PPCP fulfills the requirements for third pilot in accordance with OPNAVINST 3710.7 series.

24.7 FLIGHT ENGINEER

The Flight Engineer (FE) is directly responsible to the pilot in command. The FE shall perform exterior and interior checks in accordance with current NAVAIR publications and maintenance requirement cards. During flight, the FE shall continually monitor engine and system flight station controls and indicators. The FE should monitor ATC radio transmissions, backup pilots on altitude assignments, and include a watch for conflicting air traffic in his instrument scan. He shall maintain an awareness of MOSA (where applicable) as well as current aircraft position. He shall not be assigned duties requiring him to observe surface objects (ships, runways on low-visibility approaches,etc. outside the aircraft. He shall perform such other duties throughout the aircraft as the pilot in command may direct. He shall be thoroughly familiar with all systems and equipment under his control and with their operation during normal and emergency operating conditions.

Note

When executing any engine shutdown or restart procedure in flight or on the runway, prior to pulling the E-handle, moving the FUEL AND IGNITION switch, or actuating the feather button, the flight engineer shall be visually checked and verbally confirmed by a pilot as to the correct engine for shutdown/restart.

The flight engineer shall conduct a preflight in accordance with current NAVAIR directives. He shall submit a completed weight and balance form (DD 365-F) to the pilot in command if no appropriate completed weight and balance form is on file in the squadron for the aircraft mission and fuel load. The flight engineer shall compute takeoff data as described in the takeoff planning procedure and the performance data section and present the data to the pilot in command. He shall ensure one complete copy of NAVAIR 01-75PAC-1 is on board prior to takeoff.

The flight engineer shall conduct in-flight duties in accordance with Chapters 4 and 8 of this manual and postflight duties in accordance with current NAVAIR directives. He shall operate equipment as listed in Chapters 22 and 23.

24.8 SECOND FLIGHT ENGINEER

The second flight engineer shall act as relief for the flight engineer during extended flight operations. In training for the position of flight engineer, he shall assist the pilot in command in mission preparation and be assigned duties consistent with training requirements and experience level. When occupying the flight engineer position, he shall execute the described duties.

24.9 TACTICAL COORDINATOR

The TACCO function is to employ appropriate tactics and procedures to most effectively carry out the mission of the aircraft and its crew. He will initiate a coordinated plan of action for all tactical crewmembers and continuously monitor, review, and revise the plan as the situation dictates. He shall make recommendations regarding search and kill store utilization to the mission commander. He shall ensure the accurate completion, collection, and disposition of required magnetic tapes, logs, and records. As senior navigator on board, he is also responsible for ensuring the safe and accurate navigation of the aircraft.

24.10 NAVIGATION/COMMUNICATIONS OFFICER

The NAV/COMM function is to maintain an accurate record of present and past positions, insert navigation fly-to points, update the geographic position, transmit position reports, and maintain an accurate record of the flight. The NAV/COMM shall inform the pilot and TACCO of station system failures. During a tactical mission, the NAV/COMM is responsible for navigating the aircraft to and from the specified area, monitoring aircraft position and navigation systems, conducting required tactical communications including authentication, and maintaining tactical records. The NAV/COMM shall provide assistance to the TACCO as directed. The NAV/COMM should be familiar with all ASW and Anti-Surface Warefare (ASuW) sensors and be prepared to direct the tactical crew should the situation arise.

24.11 ACOUSTIC OPERATORS

It is the responsibility of the acoustic operators to detect, classify, and report contact data. The acoustic operators shall ensure audio information is recorded for subsequent mission reconstruction.

24.12 ELECTRONIC WARFARE OPERATOR

The electronic warfare operator is to support the mission by utilizing radar, ESM, MAD/Sub Anomaly Detection (SAD), IRDS, and IFF systems and subsystems as directed by the TACCO; to detect and analyze targets of operational significance; and to provide radar intercept and navigation information to the TACCO and NAV/COMM.

24.13 SAFETY OF FLIGHT RADAR OPERATOR (SOFRO)

The responsibility of the SOFRO is to provide weather, terrain, and aircraft avoidance using radar and IFF systems. The SOFRO crewmember is not qualified to perform tactical duties.

Note

SOFRO is a secondary position. The crewmember shall maintain a current checkride in a primary position for the SOFRO checkride to remain valid.

24.14 ORDNANCE-QUALIFIED CREWMEMBER

The responsibility of the ordnance-qualified crewmember shall be to obtain the mission search stores required by the TACCO and ensure they are properly loaded. He shall perform a systems check in accordance with NAVAIR 01-75PAC-12-6. In flight, the ordnance-qualified crewman shall perform the loading and unloading of the three PSLTs as required.

24.15 ASSISTANT ORDNANCE-QUALIFIED CREWMEMBER

The assistant ordnance-qualified crewmember will assist the primary ordnance-qualified crewmember with in-flight duties as required.

24.16 IN-FLIGHT TECHNICIAN/ORDNANCE-QUALIFIED CREWMEMBER

The IFT/Ord Qual crewmember is responsible for preflight checks on the data processing system and for in-flight repair of all equipment as listed in NAVAIR 01-75PAC-12 series. The IFT/Ord Qual crewmember shall ensure the mission search stores required by the TACCO are properly loaded. A systems check shall be performed in accordance with NAVAIR 01-75PAC-12-6. In flight, an ordnance-qualified crewmember shall perform the loading and unloading of the three PSLTs as required by the TACCO and provide the TACCO with a list of all types of stores aboard the aircraft. Additional in-flight duties shall include acting as visual observer and such other duties as may be required.

24.17 IN-FLIGHT TECHNICIAN

The IFT is responsible for preflight checks on the data processing system and for in-flight repair on all equipment as listed in NAVAIR 01-75PAC-12 series, acting as visual observer and such other duties as may be required.

24.18 OBSERVER

A P-3 observer is an in-flight crewmember qualified to perform basic safety-of-flight duties. An observer is not qualified to fill a primary tactical position. All tactical positions maintaining currency qualifications and meeting annual NATOPS qualifications for their respective crew positions are concurrently observer qualified.

CHAPTER 25

Aircrew Responsibilities

25.1 INTRODUCTION

Aircrew responsibilities are separated into the following phases of flight:

1. Flight planning.
2. Mission planning.
3. Preflight.
4. Start/taxi.
5. Takeoff/departure.
6. En route.
7. Mission.
8. Return.
9. Descent/approach.
10. Postlanding/taxi/shutdown.
11. Postflight.
12. Debrief.

The PPC, PPP/PPCP, flight engineer/second flight engineer, and observer responsibilities are defined in the following paragraphs. The responsibilities for the TACCO, NAV/COMM, acoustic, nonacoustic, ordnance-qualified crewmember, and in-flight technician can be found in the NFO/Aircrew NATOPS Manual, NAVAIR 01-75PAC-1.1.

25.2 PATROL PLANE COMMANDER

25.2.1 Flight Planning

1. Review navigation planning and coordinate with TACCO, NAV/COMM, and EWO for desired routes and any deviations.
2. Review fuel planning with flight engineer, copilot, and NAV/COMM.

25.2.2 Mission Planning

1. Coordinate with TACCO regarding mission objective.
2. Obtain information regarding target threat and status of forces.
3. Coordinate with TACCO search and kill store requirements.
4. Coordinate with TACCO emergency destruct plan requirements and specific responsibilities for each crewmember.

25.2.3 Preflight

1. Coordinate, with TACCO and flight engineer, to ensure proper loading and inspection of required survival equipment. Ensure adequate sources of oxygen will be available for all crewmembers and passengers.
2. Preflight personal survival equipment:
   a. LPU/SV2/helmet.
   b. Parachute.
   c. Oxygen system.
3. Ensure flight station System GO-NO GO (SYGNOG) is completed in accordance with NAVAIR 01-75PAC-12-1 and other directives.
4. Conduct aircraft interior and exterior inspections.
5. Conduct a brief prior to engine start including route of flight, emergency procedures, and applicable crew coordination items.

25.2.4 Start/Taxi

1. Prior to engine starts, ensure ordnance-qualified crewmember pulls and accounts for all bomb bay and wing store safety pins.
2. Ensure weapons arrive at designated arming area.

25.2.5 Takeoff/Departure

1. Inform NAV/COMM when the aircraft is positioned on the runway and numbers for geo-correct.
2. Ensure proper conditions of flight are set. Caution should be exercised in setting Condition III prior to exiting high-density traffic areas.

25.2.6 En Route

1. Coordinate with TACCO and NAV/COMM and ensure proper status report is transmitted to Tactical Support Center (TSC).
2. Ensure navigation systems accuracy check is performed.
3. Coordinate with the TACCO the setting of proper EMCON.
4. Direct the use of radar as required for terrain and weather avoidance.
5. Refer to Terrain Avoidance, paragraph 8.35.

25.2.7 Mission

1. Coordinate with TACCO the establishment and maintenance of plot stabilization.
2. Coordinate with TACCO the employment of search stores and equipment.

3. Ensure safe and accurate navigation is maintained.
4. Coordinate with TACCO, copilot, and NAV/COMM proper radio monitoring techniques in the operational environment.
5. Coordinate with TACCO and in-flight technician for all troubleshooting and in-flight maintenance.
6. Coordinate with TACCO execution of the emergency destruct plan when required.

25.2.8 Return

1. Ensure all off-station navigational requirements are completed.

25.2.9 Postlanding/Taxi/Shutdown

1. Ensure nonexpended stores are saved and downloaded.

25.2.10 Postflight

1. Ensure all equipment discrepancies are properly recorded.

25.3 PATROL PLANE PILOT/PATROL PLANE COPILOT

25.3.1 Flight Planning

1. Coordinate with the PPC and NAV/COMM for desired routes in order to file a proper flight plan for the mission.
2. Obtain navigation charts of sufficient scale to provide minimum terrain depiction and fixing accuracy. These charts shall cover areas of intended aircraft operations where significant navigation features affect safety of flight.

Note

Charts shall be of either 1:500,000 or 1:1,000,000 scale.

3. Obtain horizontal weather depiction (if required) and weather brief.

25.3.2 Preflight

1. Conduct flight station SYGNOG in accordance with NAVAIR 01-75PAC-12-1 and other directives.
2. Preflight personal survival equipment:
   a. LPU/SV2/helmet.
   b. Parachute.
   c. Oxygen system.
3. Conduct aircraft interior/exterior inspection.

25.3.3 Start/Taxi

1. Read applicable checklist and responses.
2. Clear engine starts on engine Nos. 3 and 4 and perform all communications as directed by the pilot.

25.3.4 Takeoff/Departure

1. Perform initial radio requirements with departure agencies.
2. Maintain lookout doctrine for conflicting traffic.
3. Ensure proper conditions of flight are set.
4. Perform cockpit Condition III checks.

25.3.5 En Route/Mission/Return

1. Call out all altitudes, airspeeds, and bank angles as directed by the pilot.
2. Perform all radio duties as directed by the pilot.
3. Provide ship rigging information as required.
4. Ensure compliance with all MOSA procedures.
5. Provide navigation assistance to pilot and/or NAV/COMM.
6. Coordinate with the PPC/TACCO execution of the emergency destruct plan when required.

25.3.6 Approach/Landing

1. Perform all duties outlined in Chapter 18.

25.3.7 Postlanding/Taxi/Shutdown

1. Perform communication duties and read checklists.
2. Back up pilot with clearances and obstruction avoidance.

25.3.8 Postflight

1. Ensure all equipment discrepancies are properly recorded.

25.4 FLIGHT ENGINEER

25.4.1 Flight Planning

1. Coordinate with the pilot in command on the fuel load requirement for the flight. If mission warrants, obtain a flight packet containing forms for procuring services at other field locations. If a second flight engineer is assigned, he will assist the flight engineer in the performance of these duties.

25.4.2 Preflight

1. Review the aircraft discrepancy book and make a list of all applicable discrepancies and noteworthy information.
2. Perform inspection of aircraft interior/exterior in accordance with NAVAIR directives and any local requirements.

3. Preflight personal survival equipment:

   a. LPU/SV2/helmet.

   b. Parachute.

   c. Oxygen system.

4. Coordinate with the TACCO on search and kill stores loaded in order to compile data for weight and balance computations.

5. Compute aircraft takeoff performance data in accordance with Chapter 29.

6. Submit to the pilot in command a completed weight and balance form for the planned takeoff configuration and fuel load. Submit a completed manifest and aircraft release form.

7. Coordinate with the pilot in command on any special requirements for safety/survival equipment.

25.4.3 Start/Taxi

1. Monitor ICS and carry out engine start procedures on pilot command.

2. Coordinate any systems checks required prior to takeoff.

25.4.4 Takeoff/Climb

1. Set and maintain required engine power settings on pilot command. Back up pilots on all ATC radio transmissions.

25.4.5 En Route

1. Set and maintain required engine power settings for cruise flight and maintain a fuel log if required by the mission profile.

25.4.6 Mission

1. Coordinate with the pilot in command on loiter operation and back up pilots on minimum altitudes and airspeeds.

2. Maintain an awareness of MOSA (where applicable), as well as current position.

25.4.7 Return

1. Set and maintain required engine power settings for cruise flight and maintain a fuel log if required by mission profile.

25.4.8 Descent/Approach

1. Back up pilots on all ATC radio transmissions.

25.4.9 Postlanding/Taxi/Shutdown

1. Coordinate with the pilot in command on requirement for aircraft freshwater rinse and postflight fuel loading.

25.4.10 Postflight

1. Perform inspection and comply with requirements of NAVAIR directives and any local requirements.

25.5 OBSERVER

25.5.1 Flight Planning

1. Review all equipment discrepancies in the aircraft discrepancy book.

25.5.2 Preflight

1. Perform visual inspection of all racks and equipment for security and installation.
2. Preflight personal survival equipment:
   a. LPU/SV2/helmet.
   b. Parachute.
   c. Portable oxygen system.
3. Preflight all aircraft survival equipment.
4. Assist as required.
5. Report equipment status to mission commander/PPC.

25.5.3 Start

1. Monitor engine starts.

25.5.4 Taxi

1. Energize equipment as required.
2. When directed, set Condition V.

25.5.5 In Flight

1. Monitor UHF and VHF radios. Act as a visual observer.
2. Perform conditions of flight as directed.
3. Monitor engine shutdowns and restarts.

25.5.6 Postflight

1. Assist as required.

PART X

NATOPS Evaluation

Chapter 26 — NATOPS Evaluation

CHAPTER 26

NATOPS Evaluation

26.1 CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating P-3 aircraft. The NATOPS evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS evaluation program is to assist the unit commanding officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS evaluation program is achieved only through the vigorous support of the program by commanding officers as well as the flightcrewmembers.

26.2 IMPLEMENTATION

The NATOPS evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flightcrewmembers desiring to attain or retain qualification in the P-3 shall be evaluated in accordance with the following.

An initial positional NATOPS qualification shall be completed within 18 months of a crewmember reporting to his final command after training under flight orders. Crewmembers previously qualified in the same position and same series aircraft shall have 6 months to complete an initial NATOPS qualification. If an individual has a lapse of qualification of more than 2 years, an initial NATOPS qualification shall be completed within 12 months. Pilots and flight engineers previously qualified in the P-3 model shall have 6 months to complete an initial NATOPS qualification.

An annual NATOPS evaluation shall be conducted in accordance with OPNAVINST 3710.7 series.

Individual and unit NATOPS evaluations shall be conducted periodically; however, instruction in and adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS coordinators, evaluators, and instructors shall administer the program as outlined in OPNAVINST 3710.7 series. Evaluees who receive a grade of unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a reevaluation. NATOPS-qualified evaluees who receive a grade of unqualified on a ground or flight evaluation shall not fly as a crewmember except under the instruction of a qualified crewmember of that respective position until they have successfully completed a reevaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the evaluation flight is satisfactorily completed.

26.3 DEFINITIONS

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

1. NATOPS evaluation — A periodic evaluation of individual flightcrewmember standardization consisting of an open-book examination, a closed-book examination, an oral examination, and a flight evaluation.

2. NATOPS reevaluation — A partial NATOPS evaluation administered to a flightcrewmember who has been placed in an unqualified status by receiving a grade of unqualified for any ground examinations or the evaluation flight. Only those areas or subareas in which an unsatisfactory level was noted need be observed during a reevaluation.

3. Qualified — That degree of standardization demonstrated by a very reliable flightcrewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

4. Conditionally Qualified — That degree of standardization demonstrated by a flightcrewmember who meets the minimum acceptable standards. Crewmember is considered safe enough to fly as a pilot in command or to perform normal duties without supervision, but more practice is needed to become qualified.

5. Unqualified — That degree of standardization demonstrated by a flightcrewmember who fails to meet minimum acceptable criteria. Crewmember shall receive supervised instruction from a qualified crewmember of the respective position until he has achieved a grade of Qualified or Conditionally Qualified on a reevaluation.

6. Area — A routine of preflight, flight, or postflight.

7. Subarea — A performance subdivision within an area that is observed and evaluated during an evaluation flight.

8. Critical area/critical subarea — Any area or subarea that covers items of significant importance to the overall mission requirements or the marginal performance of which would jeopardize safe conduct of the flight.

9. Emergency — An aircraft component or system failure or condition that requires expedient recognition, analysis, and proper action.

10. Malfunction — An aircraft component or system failure or condition that requires recognition and analysis but that permits more deliberate action than that required for an emergency.

26.4 GROUND EVALUATION

Prior to commencing the evaluation flight, an evaluee must achieve a minimum grade of Qualified on the open-book and closed-book examinations. The oral examination is also a part of the ground evaluation but may be conducted as part of the flight evaluation. To ensure a degree of standardization between units, the model manager maintains the recommended question breakdown for use by NATOPS instructors in preparing the written examinations.

26.4.1 Open-Book Examination

The number of questions on the examination shall consist of 30 questions for the in-flight technician and IFT/ORD-qualified crewmember, and 24 questions for all other flightcrewmembers. The maximum time for this examination shall be 3 hours for the in-flight technician and IFT/ORD-qualified crewmember, 2.5 hours for the pilot/flight engineer, 1 hour for the ORD-qualified crewmember, and 2 hours for all other crewmembers.

26.4.2 Closed-Book Examination

The number of questions on the examination shall consist of 80 questions for the flight engineer, 24 questions for the in-flight technician, 20 questions for the ORD-qualified crewmember and observer-qualified crewmember, and 40 questions for the IFT/ORD-qualified crewmember and all other crewmembers. The maximum time for this examination shall be 2.5 hours for the flight engineer, 0.75 hour for the in-flight technician and ORD-qualified crewmember, and 1.5 hours for the IFT/ORD-qualified crewmember and all other crewmembers.

26.4.3 Oral Examination

The questions may be taken from this manual and drawn from the experience of the instructor/evaluator. Such questions should be direct and positive and should in no way be opinionated.

26.4.4 Operational Flight Trainer/Weapon System Trainer (OFT/WST) Procedures Evaluation

An OFT/WST may be used to assist in measuring the crewmember's proficiency in the execution of normal operating procedures and reaction to emergencies and malfunctions. In areas not served by the OFT/WST facilities, this may be done by placing the crewman in his station and administering appropriate questions.

26.4.5 Grading Instructions

Examination grades shall be computed on a 4.0 scale.

26.4.5.1 Open-Book Examination

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5, 3.2 for ordnance-qualified crewmember and safety of flight radar operator crewmember.

26.4.5.2 Closed-Book Examination

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3, 3.2 for ordnance-qualified crewmember and safety of flight radar operator crewmember.

26.4.5.3 Oral Examination and OFT/WST Procedure Check

A grade of Qualified or Unqualified shall be assigned by the instructor/evaluator if this exam is conducted.

26.5 FLIGHT EVALUATION

The number of flights required to complete the evaluation flight should be kept to a minimum, normally one flight. The areas and subareas to be observed and graded on an evaluation flight are outlined in the grading criteria with critical areas/subareas marked by an asterisk (*). Subarea grades will be assigned in accordance with the grading criteria. These subareas shall be combined to arrive at the overall grade for the flight. Area grades, if desired, shall also be determined in this manner.

26.5.1 Flight Evaluation Grading Criteria

Only those subareas provided or required will be graded. The grades assigned for a subarea shall be determined by comparing the degree of adherence to standard operating procedures with the adjectival ratings listed below. Momentary deviations from standard operating procedures should not be considered as unqualifying, provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action.

26.5.2 Grading Instructions

26.5.2.1 Oral Examination Grading Criteria

The oral examination will be based upon selected general areas outlined in the oral examination paragraph. The evaluator/instructor will determine the assigned grade, as outlined in the following paragraphs.

26.5.2.1.1 Qualified

Demonstrated thorough understanding of all phases of aircraft operation and performance. Reflected thorough knowledge of all governing publications, particularly the NATOPS flight manual.

26.5.2.1.2 Unqualified

Indicated obvious lack of understanding; misinterpreting important phases of aircraft operation and performance. Demonstrated a lack of understanding of and appreciation for NATOPS flight manual procedures and purposes. Revealed weaknesses that could result in unsuccessful or unsafe utilization and operation of the aircraft.

26.5.3 Flight Evaluation Grade Determination

The evaluation flight grade is the adjective grade as computed on the worksheet. Grades shall be determined by assigning the following numerical equivalents to the adjective grade for each subarea. Only the numerals 0, 2, or 4 will be assigned in subareas. No interpolation is allowed.

Unqualified — 0.0.

Conditionally Qualified — 2.0.

Qualified — 4.0.

The grade for each area is computed by totaling the points from all subareas graded in that area and dividing by the number of subareas graded. The evaluation flight grade is the adjective grade that is based on the numerical figure obtained by totaling the points from all subareas graded in all areas and dividing by the total number of subareas graded; however, a grade of Unqualified in any critical area or subarea shall result in an adjective grade of Unqualified for the flight regardless of the numerical value. An adjective grade for the area is based upon the area numerical grade on the basis of the following scale:

0.0 to 2.19 — Unqualified.

2.2 to 2.99 — Conditionally Qualified.

3.0 to 4.00 — Qualified.

26.6 OVERALL FINAL GRADE DETERMINATION

The overall final NATOPS evaluation grade shall be the same adjective grade as assigned to the evaluation flight. An evaluee who receives an unqualified flight evaluation shall be placed in an unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a reevaluation. If the crewman is prepared, competent, and qualified except in one or two critical subareas, the evaluator/instructor may recheck later in the flight. If the unqualified subareas are rechecked on the same flight, the NATOPS evaluation report will reflect a refly covering those subareas. If the refly is satisfactory, the overall final adjective grade will be determined by the original evaluation numerical flight grade (Figure 26-1).

26.7 RECORDS AND REPORTS

A NATOPS Evaluation Report (OPNAV Form 3710/7) shall be completed for each evaluation and forwarded to the evaluee's commanding officer (Figure 26-1). The expiration date shall be logged in the lower right-hand corner of "Remarks of Unit Commander."

All NATOPS reports shall be filed and maintained in the NATOPS Flight Personnel Training/Qualification Jacket (OPNAV Form 3760/32). In addition, an entry shall be made in the pilot/NFO/enlisted aircrew flight log book under "Qualifications and Achievements."

Initial NATOPS qualification in model expires on the last day of the twelfth month from the flight evaluation date. Renewal evaluations are valid for 12 months from the last day of the month of the expiration date of the current evaluation if accomplished within 60 days preceding expiration. If a NATOPS qualification expires, the requalification shall be conducted as an initial qualification.

26.8 NATOPS EVALUATION WORKSHEETS

In addition to the NATOPS Evaluation Report, NATOPS Flight Evaluation Worksheets are provided for use by the evaluator/instructor during the evaluation flight. All of the flight areas and subareas are listed on the worksheet with space allowed for related notes.

NATOPS EVALUATION REPORT

NAME *(Last, first, initial)*		GRADE	SSN
SQUADRON/UNIT	AIRCRAFT MODEL	CREW POSITION	
TOTAL PILOT/FLIGHT HOURS	TOTAL HOURS IN MODEL	DATE OF LAST EVALUATION	

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
EVALUATION FLIGHT				
FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE		

REMARKS OF EVALUATOR/INSTRUCTOR

EXPIRES: _____

☐ CHECK IF CONTINUED ON REVERSE SIDE

GRADE, NAME OF EVALUATOR/INSTRUCTOR	SIGNATURE	DATE
GRADE, NAME OF EVALUEE	SIGNATURE	DATE

REMARKS OF UNIT COMMANDER

GRADE, NAME OF UNIT COMMANDER	SIGNATURE	DATE

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Figure 26-1. NATOPS Evaluation Report (Sheet 1 of 2)



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Figure 26-1. NATOPS Evaluation Report (Sheet 2 of 2)

26.9 PILOT NATOPS EVALUATION GRADING CRITERIA (FIGURE 26-2)

AREA A: Preflight

1. Flight Planning.

   Qualified — Properly prepared for assigned flight. Familiar with all aspects pertinent to flight proposed, including en route hazards, MOSA, and instrument publications. Ensured weather brief obtained and all appropriate navigation charts onboard aircraft. Prepared all necessary flight logs, forms, etc., to ensure successful completion of the flight.

   Conditionally Qualified — Limited preparation made for assigned flight. Certain important aspects lacking to ensure the total success of the proposed flight. Flight planning, however, would not jeopardize the safe conduct of the flight.

   Unqualified — Failed to meet the minimum standards of conditionally qualified.

2. Briefing.

   Qualified — Performed thorough briefing. Reviewed selected emergency procedures and covered all aspects of the flight mission.

   Conditionally Qualified — Major omission in briefing.

   Unqualified — Failed to brief crew.

3. Aircraft Inspection/Basic Equipment Location.

   Qualified — Ensured thorough interior and exterior aircraft inspection. Demonstrated thorough knowledge of basic equipment location and power sources. Inspected data sheets of previous discrepancies and preflight inspection form.

   Conditionally Qualified — Completed aircraft inspection with omissions in minor areas that did not affect the safety of the proposed flight. Minor lack of knowledge of basic equipment. Did not check previous discrepancy sheets or preflight inspection form.

   Unqualified — Failed to conduct aircraft inspection properly and omitted important items that would affect the safety of the proposed flight. Overlooked equipment adrift in the aircraft. Lack of knowledge of basic equipment affecting safety of flight.

4. Knowledge of APU.

   Qualified —Demonstrated a thorough knowledge of the APU visual inspection, system operation, and system operating limitations.

   Conditionally Qualified — Minor omissions or deviations from above.

   Unqualified — Lacked significant knowledge of APU.

*5. Emergency/Survival Equipment and Aircraft Safety Procedures.

   Qualified — Safety and survival equipment complete, properly fitted, and worn. Demonstrated thorough knowledge and utilization of required equipment. Demonstrated thorough knowledge of Aircraft (A/C) ground safety procedures.

   Conditionally Qualified — Minor omissions noted or minor lack of knowledge of fire extinguisher, oxygen equipment, aircraft exits, liferafts, or other pertinent survival equipment.

   Unqualified — Any omission of safety or survival equipment that would preclude a successful ditching or bailout or jeopardize safety or survival. Unfamiliar with the use of required equipment.

*Critical area/Subarea

6. General Systems and Procedures Knowledge.

   Qualified — Demonstrated thorough knowledge of systems, limitations, and procedures.

   Conditionally Qualified — Minor lack of knowledge or understanding of systems, limitations, procedures.

   Unqualified — Major lack of knowledge of systems, limitations, and procedures affecting safety of flight.

Area B: Pretakeoff

1. Before Start.

   Qualified — Knew limitations and ensured execution of proper procedure.

   Conditionally Qualified — Completed checklist satisfactorily. Minor omissions that did not jeopardize flight or system operation. Adequate knowledge of limitations and procedures.

   Unqualified — Did not know limitations or did not follow standard start procedure.

2. Start.

   Qualified — Knew limitations and ensured execution of proper procedure for malfunctions.

   Conditionally Qualified — Adequate knowledge of limitations and procedures or slow to recognize a start malfunction.

   Unqualified — Did not know limitations or procedures for malfunctions.

3. Taxi Procedures.

   Qualified — Complied with procedures required by the NATOPS flight manual. Taxi signalmen were utilized, power and speeds regulated closely, watches were properly posted when required, all lights and taxi aids were utilized as necessary. Checklists were accomplished without omission or discrepancy. Judicious use of power levers.

   Conditionally Qualified — Procedures required by the NATOPS flight manual accomplished with omissions, deviations, or discrepancies that did not adversely affect successful completion of the mission, jeopardize safety, or cause undue delay.

   Unqualified — Any omission or discrepancy that precluded successful completion of the mission, jeopardized safety, or caused excessive delay. Excessive use of reverse in areas of loose dirt or stones.

4. Before Takeoff.

   Qualified — Executed checklists properly. If icing anticipated, ensured deicing and anti-icing and engine checks completed without omission and in proper sequence. Conducted proper briefing for takeoff and ensured receipt of all crew reports.

   Conditionally Qualified — Completed all of above but with minor discrepancies or omissions, or not in proper sequence.

   Unqualified — Failure to satisfy conditionally qualified, or any item jeopardizing safe operation.

*Area C: Takeoff, Climb, and Cruise

*1. Normal Takeoff.

Qualified — Effectively scanned flight station instrumentation while taking runway. Aircraft aligned with runway. Initial power application smooth. Directional control maintained with nosewheel until rudder effective and then with rudder.

Conditionally Qualified — Aircraft not aligned with runway. Discrepancies in power applications. Abrupt or excessive usage of nosewheel steering. Discrepancies in any of the foregoing to an extent not jeopardizing safe operations.

Unqualified — Failure to satisfy requirements for conditionally qualified, or any item jeopardizing safe operation.

*2. Normal Transition.

Qualified — Flew aircraft smoothly into air within 0 to +5 knots of takeoff schedule. Maintained balanced flight and correct takeoff nose attitude until power reduction. Gear retracted without delay after establishing positive rate of climb. Flap retraction made at 140 knots or greater with gear up.

Conditionally Qualified — Nosewheel skip or nose-high takeoff. Takeoff airspeed within 0 to +10 knots of takeoff schedule. Aircraft in unbalanced flight. Did not maintain takeoff attitude until power reduction. Flaps retracted before gear up.

Unqualified — Poor handling technique after liftoff. Positive rate of climb not established or maintained. Gear retracted prematurely. Any other failure to satisfy conditionally qualified, or any item jeopardizing safe operation.

*3. Malfunctions Before Refusal.

Qualified — Announced intentions to abort the takeoff. Used proper abort procedures. Maintained directional control and minimized swerve of aircraft.

Conditionally Qualified — Did not announce intentions to abort. Slow in initiating correct abort procedures. Minor difficulty maintaining directional control of aircraft but not sufficient to jeopardize safety.

Unqualified — Did not use proper abort procedures. Serious difficulty maintaining directional control of aircraft after executing abort.

*4. Malfunctions After Refusal.

Qualified — Continued the takeoff roll. Utilized correct directional control procedures to minimize swerve caused by engine failure.

Conditionally Qualified — Insufficient or late application of proper directional control procedures. Allowed aircraft to swerve, but not to an extent to jeopardize safe operations.

Unqualified — Aborted takeoff. Incorrect directional control procedures utilized to an extent that jeopardized safe operations.

*Critical area/Subarea

*5. Three-Engine Transition.

Qualified — Flew aircraft smoothly into air within 0 to +5 knots of takeoff schedule. Correct nose attitude until power reduction. Maintained directional control with rudder and aileron. Landing gear retracted without delay after establishing positive rate of climb. Flap retraction made at 140 knots or greater with landing gear up. Ensured engine secured.

Conditionally Qualified — Allowed aircraft to skid because of nose-low attitude on takeoff. Takeoff speed within 0 to +10 knots of takeoff speed schedule. Did not use proper rudder and aileron directional control. Flaps retracted before landing gear up. Unnecessary delay before securing failed engine.

Unqualified — Rotated aircraft below speed schedule. Poor handling techniques after liftoff. Landing gear retracted prematurely. Did not secure failed engine. Any other failure to satisfy conditionally qualified, or jeopardize safe operation.

6. Climb and Departure.

Qualified — Proper use of climb checklist. Maintained correct climb power setting. Climb airspeed maintained within ±5 knots. Prescribed headings within ±5°. Performed a proper NTS check below 8,000 feet. Did not exceed the limits of assigned departure altitudes and proper execution of the SID (when applicable).

Conditionally Qualified — Established but did not maintain correct climb setting. Climb airspeed maintained within ±10 knots. Prescribed headings within ±10°. Exceeded ±10 knots of prescribed airspeed during NTS check.

Unqualified — Failed to complete climb checklist. Did not establish correct climb power. Failure to satisfy requirements listed under conditionally qualified.

7. Level-Off and Cruise.

Qualified — Appropriate power selection for weight and altitude. Demonstrated knowledge of proper operation of anti-icing and deicing systems. Adequate knowledge of engine and airframe operating limitations and fuel management procedures. Leveled off and maintained assigned altitude within +100 feet. Prompt, correct altitude changes as required.

Conditionally Qualified — Leveled off and maintained assigned altitude within ±150 feet. Incorrect procedures or questionable knowledge not considered to be of sufficient magnitude to jeopardize safe operation.

Unqualified — Failure to satisfy above requirements, or any action or omission jeopardizing safety of flight. Excessive delay in executing assigned altitude changes.

*Area D: Landings

1. Normal Landing Pattern.

Qualified — Entered and flew traffic pattern in accordance with the appropriate governing directives. Proper execution of descent and approach checklists. Flew the traffic pattern within ±100 feet of altitude and ±5 knots of airspeed range.

Conditionally Qualified — Entered and flew traffic pattern in accordance with appropriate directives, but with deviations that did not interfere with traffic or jeopardize safety. Late calling for or completing checklist. Flew traffic pattern within ±150 feet of altitude and ±10 knots of airspeed range.

Unqualified — Deviated from prescribed pattern and interfered with other traffic or jeopardized safety. Failed to call for or complete descent checklist. Exceeded limitations for conditionally qualified.

*Critical area/Subarea

*2. Normal Approach.

Qualified — Established and executed pattern in accordance with NATOPS flight manual. Proper use of power. Landing checklist completed. Airspeed ±5 knots for weight.

Conditionally Qualified — Deviation in approach not sufficient to jeopardize safety. Excessive power changes or rough use. Held airspeeds within ±10 knots. Landing checklist completed.

Unqualified — Deviation in approach that interfered with normal traffic or other deviations that jeopardized flight safety. Airspeed not held within above limits. Safe completion of approach was questionable, and pilot did not attempt waveoff. Failed to complete landing checklist.

*3. Normal Landing.

Qualified — Maintained positive control of speed, power, and rate of descent. Aircraft aligned within runway limits throughout final approach. Maintained aircraft in trim. Nose-high touchdown in first third of runway. Maintained directional control during rollout. Positive control of reverse. Smooth, effective use of brakes and nosewheel steering.

Conditionally Qualified — Had minor difficulty with transition. Handled aircraft roughly and used poor technique in flare, landing, or rollout. Flat touchdown in first third of runway.

Unqualified — Had serious difficulty with transition. Failed to maintain positive control of aircraft during flare, landing, or rollout. Did not touchdown in first third of runway. Hard landing. Jeopardized safety.

*4. Three-Engine Approach.

Qualified — Satisfied normal approach criteria. Maintained balanced flight.

Conditionally Qualified — Deviation in approach not sufficient to jeopardize safety. Excessive power changes or rough use of power levers. Held airspeeds within ±10 knots. Landing checklist completed.

Unqualified — Failure to satisfy above, or performance that would result in an unqualified mark for a normal approach.

*5. Three-Engine Landing.

Qualified — Maintained positive control of speed, power, and rate of descent to touchdown. Nose-high touchdown in first third of runway. Maintained directional control through rollout. Proper use of reverse thrust. Smooth, effective use of brakes and nosewheel steering.

Conditionally Qualified — Had minor difficulty with transition. Handled aircraft roughly and used poor technique in flare, landing, or rollout. Hard or flat touchdown in first third of runway. Swerved on rollout with three-engine reverse.

Unqualified — Had serious difficulty with transition. Failed to maintain positive control of aircraft during flare, landing, or rollout. Did not touch down in first third of runway. Jeopardized safety.

*6. Two-Engine Approach.

Qualified — Normal airspeeds within ±5 knots (maintained 1.35 v_s minimum (145 knots) until landing assured). Maintained trim and balanced flight. Checklists properly utilized and copilot briefed.

Conditionally Qualified — Deviations in approach in excess of above that did not jeopardize safe completion. Airspeed within ±10 knots. Landing checklist completed.

Unqualified — Deviation in approach that interfered with normal traffic, or other deviations that jeopardized flight safety. Airspeed not held within above limits. Safe completion of approach was questionable and pilot did not attempt waveoff. Failed to complete landing checklist.

*Critical area/Subarea

*7. Two-Engine Landing.

Qualified — Maintained positive control of speed, power, and rate of descent to touchdown. Nose-high touchdown in first third of runway. Maintained directional control through rollout. Proper use of reverse thrust. Smooth, effective use of brakes and nosewheel steering.

Conditionally Qualified — Had minor difficulty with transition. Handled aircraft roughly and used poor technique in flare, landing, or rollout. Hard or flat touchdown in first third of runway.

Unqualified — Had serious difficulty with transition. Failed to maintain positive control of aircraft during flare, landing, or rollout. Did not touch down in first third of runway. Jeopardized safety or otherwise failed to satisfy requirements of conditionally qualified.

*8. No-Flap Approach.

Qualified — Pattern over the ground slightly wider and flatter than for normal approach. Airspeed within ±5 knots of prescribed. Landing checklist completed. Slowed aircraft to 1.2 V_S (135 knots minimum) on final, prior to touchdown.

Conditionally Qualified — Failed to correct back toward prescribed airspeed. Deviations in approach in excess of above, but did not jeopardize approach. Landing checklist completed.

Unqualified — Deviation in approach that interfered with normal traffic, or other deviations that jeopardized flight safety. Safe completion of approach was questionable, and pilot did not attempt waveoff. Failed to complete landing checklist.

9. No-Flap Landing.

Qualified — Well-controlled, gradual, power-on descent to landing. Proper trim. Touchdown in first third of runway. Well-controlled and proper use of reversing and brakes on rollout. Checked airspeed below 135 knots before coming into beta range.

Conditionally Qualified — Excessive rate of descent or excessive flare on landing. Hard or flat touchdown in first third of runway. Rough usage or poor technique that did not jeopardize safety. Failed to check airspeed below 135 knots.

Unqualified — Failure to satisfy requirements of conditionally qualified.

*10. Waveoff.

Qualified — Executed waveoff with proper use of power. Maintained directional control. Executed smooth transition to climb attitude. Stopped descent, established positive rate of climb, raised flaps to approach, and retracted gear. After gear fully retracted, and with at least 140 knots airspeed, raised flaps. Maintained smooth acceleration to climb airspeed.

Conditionally Qualified — Raised gear prior to raising flaps from landing to approach configuration, or initiated complete flap retraction prior to completion of gear retraction.

Unqualified — Slow or incomplete power application, failed to achieve positive rate of climb before flaps to approach, raised flaps to up position below 140 knots, incorrect sequence, or other unsafe acts.

*Critical area/Subarea

Area E: Instrument Approach

1. Approach Setup and Brief.

   Qualified — Obtained weather, airport, and runway information in a timely manner. Properly briefed required approach, hazards to flight, and MOSA. Ensured NAVAIDs and radios tuned.

   Conditionally Qualified — Not adequately prepared for approach. Did not jeopardize safety of flight.

   Unqualified — Failed to brief approach or obtain required information to the extent safety of flight jeopardized.

2. Holding Procedures.

   Qualified — Entered holding in accordance with existing FAA requirements and used correct voice procedure. Obtained weather, altimeter setting, runway in use, and expected approach clearance time information. Maintained assigned holding pattern and altitude within +100 feet.

   Conditionally Qualified — Entered holding pattern erratically. Minor omissions in weather, altimeter setting, runway, and approach clearance requests. Varied pattern in excess of 30 seconds, altitude ±150 feet.

   Unqualified — Exceeded any requirement set forth under conditionally qualified.

3. Bearing Interception.

   Qualified — Demonstrated effective interception procedures by the most direct and acceptable methods. Understood the use of bearing equipment in establishing interception.

   Conditionally Qualified — Effected bearing interception with some delay. Unsure of procedures and equipment, but performed interception without exceeding clearance limits.

   Unqualified — Became disoriented. Experienced decided amount of difficulty in effecting interception. Failed to understand equipment and clearance limits.

4. Approach Airspeed Control.

   Qualified — Maintained prescribed speed ranges and ±5 knots of specific airspeeds as published in NATOPS flight manual (Chapter 18).

   Conditionally Qualified — Maintained airspeeds within ±5 knots of prescribed speed ranges and ±10 knots of specific airspeeds as published in NATOPS flight manual (Chapter 18).

   Unqualified — Exceeded the preceding limits.

5. TACAN Arc.

   Qualified — Maintained specified distance from station within ±l mile.

   Conditionally Qualified — Maintained specified distance within ±2 miles.

   Unqualified — Failed to meet the requirements for conditionally qualified.

6. ILS Glideslope.

   Qualified — Intercepted glidepath. Remained within one dot of glidepath on FDI until reaching decision height.

   Conditionally Qualified — Intercepted glidepath. Remained within two dots of glidepath on FDI until reaching decision height.

   Unqualified — Failed to intercept glidepath or exceeded the preceding limits.

*7. Approach Altitude Control.

Qualified — Did not exceed limits of assigned or published altitudes. Maintained positive control of aircraft and situation during climbs and descents.

Conditionally Qualified — Did not exceed limits of assigned or published altitudes. Had minor difficulty maintaining positive control of aircraft and situation during climbs and descents. Did not jeopardize safety of flight.

Unqualified — Exceeded the limits of assigned or published altitudes. Handled aircraft poorly. Did not maintain positive control of situation.

8. Approach Course Control.

Qualified — Maintained course within ±5°, effectively correcting for drift.

Conditionally Qualified — Maintained course within ±10°. Had difficulty correcting for drift.

Unqualified — Failed to maintain course within ±10°. Did not hold correction for drift.

9. Approach Engine Operation.

Qualified — Considered restarting a shutdown engine and its effect on safety of flight when faced with a greater emergency requiring shutdown of a second engine. Did not exceed maximum TIT or SHP.

Conditionally Qualified — Slow to consider the effects of engine-out operation and its effect on safety of flight.

Unqualified — Failed to consider the effects on safety of flight when faced with engine-out operations. Failed to observe TIT or SHP limits.

10. Use of Checklists.

Qualified — Properly utilized checklists with no omissions or incorrect responses.

Conditionally Qualified — Late in calling for checklists with no serious omissions or incorrect responses.

Unqualified — Failed to utilize checklists with serious omissions or incorrect responses.

*11. Missed Approach.

Qualified — Prepared for missed approach. Timely and correct power application. Recognized windshear and complied with proper windshear escape procedures. Raised gear and flaps in accordance with waveoff procedure following power application. Did not descend below minimums. No deviations from published procedures.

Conditionally Qualified — Not adequately prepared for missed approach. Incorrect power application. Improper sequence of power, gear, and flaps. Slow to recognize windshear indications and comply with adequate windshear escape procedures. Did not descend below minimums. Satisfactorily carried out published procedure.

Unqualified — Raised flaps to the up position below 140 knots. Descended below minimums. Unsafe use of power. Unsatisfactory completion of published approach or windshear escape procedures.

*Critical area/Subarea

12. GCA — Airspeed Control.

    Qualified — Maintained airspeeds within ±5 knots of approach airspeeds.

    Conditionally Qualified — Maintained airspeeds within ±10 knots of approach airspeeds.

    Unqualified — Failure to remain within limits of conditionally qualified.

*13. GCA — Altitude Control.

    Qualified — Leveled off and maintained assigned altitudes within ±100 feet. Prompt, correct altitude changes.

    Conditionally Qualified — Leveled off and maintained assigned altitudes within ±150 feet. Delay in altitude changes.

    Unqualified — Failed to remain within limits of conditionally qualified.

14. GCA — Heading Control.

    Qualified — Prompt response to heading instructions; maintained assigned headings prior to final within ±5°, and on final within ±3°; balanced flight and standard-rate turns except during small heading changes.

    Conditionally Qualified — Heading changes late; maintained assigned headings prior to final within ±8°, and on final within ±5°; unbalanced flight; turning rates excessively fast or slow.

    Unqualified — Heading control not meeting requirements of conditionally qualified or resulting in waveoff or no gyro instructions.

15. GCA — Glideslope.

    Qualified — Prompt and adequate power adjustments. Carried out instructions of controller in a timely and effective manner.

    Conditionally Qualified — Power adjustments late or excessive, but sufficient to prevent waveoff.

    Unqualified — Glideslope control inadequate and resulted in waveoff.

16. GCA — Use of Checklists.

    Qualified — Prompt and timely completion of required checklists.

    Conditionally Qualified — Delay or omissions in execution of checklists that did not affect safety of flight.

    Unqualified — Delays or omissions in execution of checklist that affected safety of flight.

*17. GCA — Missed Approach.

    Qualified — Properly carried out missed approach instructions. Power application, flaps, gear, climb in accordance with NATOPS waveoff procedure.

    Conditionally Qualified — Minor discrepancies in above, not affecting safety of flight.

    Unqualified — Not in conformance with the above.

*Critical area/Subarea

18. FMS— Approach Course Control.

    Qualified — Maintained FMS course within 1 Dot Deviation, effectively correcting for drift.

    Conditionally Qualified — Maintained course within 2 Dot Deviation. Had difficulty correcting for drift.

    Unqualified — Failed to maintain course within 2 Dot Deviation. Did not hold correction for drift.

19. FMS — Approach Setup and Brief.

    Qualified — Knowledgeable of FMS approach procedures. Properly briefed required approach, hazards to flight, and MOSA. Ensured CDU-7000 FMS was properly set up and loaded.

    Conditionally Qualified — Not adequately prepared for approach. Lacked knowledge of FMS approach procedures. Did not jeopardize safety of flight.

    Unqualified — Failed to brief approach, set up CDU-7000 FMS properly, or obtain required information to the extent safety of flight jeopardized. Unfamiliar with FMS approach procedures.

20. FMS — Terminal and En Route Procedures.

    Qualified — Familiar with FMS terminal and en route navigation procedures and CDU-7000 FMS setup including executing airways navigation SIDs, STARS, and holding. Prompt use of FMS and EFDS including setup and procedure execution.

    Conditionally Qualified — Minor discrepancies in above. Able to maintain navigation and situation awareness using conventional NAVAID setup and procedures. Did not jeopardize safety of flight.

    Unqualified — Inadequate knowledge of FMS terminal and en route procedures utilizing the CDU-7000 and EFDS that compromised safety of flight.

*Area F: Emergencies

*1. Aircraft Handling.

    Qualified — Maintained or established desired heading within ±10°, altitude within ±150 feet. Minimal airspeed loss. Raised gear and flaps, if down. Restarted loitered engine in a timely manner.

    Conditionally Qualified — Maintained or established desired heading within ±20°, altitude within ±250 feet. Excessive airspeed loss. Delayed gear and flap retraction or restarting loitered engine. Did not jeopardize flight safety.

    Unqualified — Failure to satisfy criteria for conditionally qualified, loss of control or orientation, unsafe airspeed loss, or other unsafe acts. Failed to raise gear or flaps, if extended.

*2. Engine Fire.

    Qualified — Initiated first steps of checklist immediately and ensured remainder of checklist was accomplished. Called for use of transfer switch on fire extinguisher and discharged second HRD when definite determination made that first charge did not extinguish the fire.

    Conditionally Qualified — Followed initial steps immediately but did not follow up on remainder of checklist.

    Unqualified — Did not initiate checklist. Performed any action detrimental to safety of flight.

*Critical area/Subarea

*3. Propeller Fails to Feather.

Qualified — Immediately initiated correct procedures.

Conditionally Qualified — Slow to initiate correct procedures. Weak understanding of procedures.

Unqualified — Failed to positively slow aircraft, failed to initiate procedures, or performed any action detrimental to safety of flight.

*4. Landing Gear Emergencies.

Qualified — Correctly demonstrated emergency landing gear extension, showed knowledge that procedure is intended for use when main system pressure is lost, and had an understanding of significance of pulling landing gear circuit breaker in connection with certain gear malfunctions; demonstrated knowledge of method of gear extension with electrical failure; had a knowledge of landing gear and airspeed limitations.

Conditionally Qualified — Weak in knowledge of procedures.

Unqualified — Failed to execute proper procedures.

*5. Hydraulic System Failure.

Qualified — Demonstrated correct procedures to be followed in event of loss of main system hydraulic pressure with regard to use of flaps, bomb bay doors, brakes, and nosewheel steering.

Conditionally Qualified — Showed minor lack of knowledge of hydraulic system components and functions.

Unqualified — Lack of knowledge, incorrect procedures, or other failure to satisfy requirements of conditionally qualified.

*6. Brake Fire.

Qualified — Promptly executed proper procedures and maintained positive control of the emergency situation and the crew.

Conditionally Qualified — Minor omissions in procedures that did not affect the safety of the crew or the aircraft.

Unqualified — Any procedural omission or lack of positive control that would endanger the crew or the aircraft.

*7. Loss of AC or DC Power Source.

Qualified — Demonstrated a thorough knowledge of the AC or DC power systems and had no difficulty in associating equipment failure with proper electrical system.

Conditionally Qualified — Showed a minor lack of knowledge of the AC or DC power systems. Had some difficulty associating equipment failure with proper electrical system.

Unqualified — Showed considerable lack of knowledge of AC or DC power systems. Could not associate equipment failure with proper electrical system.

*Critical area/Subarea

*8. Fire of Unknown Origin.

Qualified — Initiated first step of checklist immediately and ensured remainder of checklist was accomplished. Ensured donning of oxygen masks initiated. Demonstrated knowledge of correct procedure, including securing electrical power sources and utilization of essential buses while determining source of fire.

Conditionally Qualified — Showed minor lack of understanding of procedures or hastily executed steps without determining their effectiveness.

Unqualified — Failure to satisfy requirements for conditionally qualified.

*9. Smoke and Fume Elimination.

Qualified — Initiated checklist, demonstrated knowledge of smoke removal limits, and executed correct procedures.

Conditionally Qualified — Showed minor lack of understanding of smoke removal procedures and related aircraft systems.

Unqualified — Failed to execute checklist. Inadequate knowledge of procedures to the extent that safe operating procedures are jeopardized.

*10. Emergency Descent.

Qualified — Demonstrated knowledge and executed correct procedures.

Conditionally Qualified — Excessive delay in accomplishing emergency descent.

Unqualified — Inadequate knowledge of procedures. Other acts that resulted in unsafe operation.

11. Ordnance Jettison System.

Qualified — Demonstrated a thorough knowledge of the ordnance jettison system and its limitations as it affects the safety of the crew and aircraft.

Conditionally Qualified — Minor lack of understanding of ordnance jettison system.

Unqualified — Inadequate knowledge of the jettison system that could jeopardize crew safety.

*12. Ditching Drill (Night or Instrument Technique).

Qualified — Demonstrated knowledge of ditching technique. Airspeed ±5 knots of specified airspeed, rate of descent less than 300 fpm, and heading control ±5°.

Conditionally Qualified — Executed pilot section of ditching bill. Initiated drill but did not complete pilot section of ditching bill. Airspeed ±10 knots of, or failed to correct back toward, specified airspeed. Rate of descent maximum 500 fpm; heading control ±10°.

Unqualified — Inadequate knowledge of ditching procedures. Ditching bill not complied with. Airspeed in excess of 10 knots of specified airspeed, rate of descent in excess of 500 fpm, and heading in excess of ±20° of ditch heading. Simulated water entry made in a turn or wing down.

*Critical area/Subarea

*13. Propeller Malfunctions.

Qualified — Demonstrated knowledge of one or more of the following procedures: pump light on, rpm flux, overspeeding propeller, pitchlocked propeller, and decoupled propeller. Knowledge of protective devices in propeller: NTS, autofeather, beta follow-up, pitchlock, and pitchlock reset.

Conditionally Qualified — Minor discrepancies in procedures. Knowledge of backup systems weak.

Unqualified — Knowledge of procedures and protective devices limited to extent that safe operating procedures are jeopardized.

*14. Airstart Procedures.

Qualified — Verified verbally prior to start that all instruments were being monitored. Knew limitations on TIT, rpm, etc., and procedures to follow if limits exceeded.

Conditionally Qualified — Did not scan all instruments during start. Knew procedures for malfunction but did not know limits sufficiently well.

Unqualified — Any procedure causing a safety hazard.

*15. Bailout Drill.

Qualified — Familiar with bailout signal(s) and complied with bailout bill. Had knowledge of parachute location and bailout exit location. Properly donned parachute and other personal survival equipment. Preparations were timely.

Conditionally Qualified — Minor deviations from items required for qualified.

Unqualified — Demonstrated actions or omissions jeopardizing safety of flight or personal safety.

*Area G: Crew Resource Management

*1. Crew Coordination.

Qualified — Clearly and accurately sent and acknowledged information, instructions, or commands and provided useful feedback. Properly utilized aircrew in all normal and emergency situations; stimulated crew to work together as a team. Effectively managed resources and accomplished mission without putting the crew in jeopardy.

Conditionally Qualified — Allowed crew coordination to break down. Did not properly utilize aircrew during normal or emergency situations, resulting in minor deviations from NATOPS procedures.

Unqualified — Attempted to handle normal and emergency situations without the assistance of the aircrew. Failed to inform crew of aircraft emergencies. Demonstrated ineffective crew management that jeopardized safety of flight or personal safety as evidenced by application of incorrect NATOPS procedures.

*Critical area/Subarea

*2. Decision-Making/Mission Analysis.

Qualified — Willingly and actively organized and planned mission requirements, including determining proper fuel load and weapon limitations. Utilized sound judgment to effectively coordinate, allocate, and monitor crew and aircraft resources. Demonstrated an ability to alter a course of action to meet situational demands and informed crew of changes to flight concept. Conducted post-mission review.

Conditionally Qualified — Adequate knowledge of mission requirements. Did not properly monitor and update in-flight information or conduct post-mission review.

Unqualified — Failed to adequately plan the mission. Demonstrated actions that jeopardized safety of flight or personal safety.

*3. Positional/Situational/MOSA Awareness.

Qualified — Effectively coordinated aircraft positioning with the navigator and radar operator. Ensured MOSA procedures utilized throughout flight. Demonstrated proficiency in plotting aircraft position. Effectively monitored aircrew and aircraft status to evaluate mission progress. Acknowledged potential problems to completing mission.

Conditionally Qualified — Minor discrepancies in monitoring aircraft and aircrew status. Adequate coordination with navigator and radar operator. Adequate knowledge of MOSA procedures.

Unqualified — Not familiar with definition of MOSA or procedural requirements. Failed to coordinate MOSA procedures with navigator or radar operator. Demonstrated actions that jeopardized safety of flight or personal safety.

4. Conditions of Flight.

Qualified — Coordinated the proper setting of conditions of flight.

Conditionally Qualified — Did not set conditions of flight in a timely manner.

Unqualified — Failed to set flight conditions.

Area H: Postflight Procedures

Qualified — Handled aircraft safely. Executed checklists. Taxied and parked aircraft in a safe manner. Completed postflight inspection and properly completed OPNAV form 3760 or appropriate data sheets, as applicable.

Conditionally Qualified — Poor handling technique, failed to complete checklists, and allowed minor omissions in securing aircraft. Completed all safety items without omissions.

Unqualified — Handled aircraft in a hazardous manner, failed to request checklists. Any act, performance, or omission that could result in an unsafe condition.

*Critical area/Subarea

OPNAV 3510/23					Asterisk (*) denotes critical area/subarea.				
P-3 PILOT NATOPS EVALUATION WORKSHEET									
NAME	RATE/RANK			TOTAL PILOT HOURS					
SQUADRON/UNIT				TOTAL HOURS IN MODEL					
DATE OF LAST EVALUATION				DATE OF EXPIRATION					
NATOPS EVALUATION									
REQUIREMENT				**DATE COMPLETED**	**GRADE**				
					Q	CQ	U		
OPEN BOOK EXAMINATION									
CLOSED BOOK EXAMINATION									
ORAL EXAMINATION									
FLIGHT EVALUATION									
FLIGHT DURATION	AIRCRAFT BUNO			OVERALL FINAL GRADE					
EVALUATOR/INSTRUCTOR				GRADE, NAME OF UNIT COMMANDER					

A. PREFLIGHT	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. FLIGHT PLANNING				
2. BRIEFING				
3. AIRCRAFT INSPECTION/BASIC EQUIPMENT LOCATION				
4. KNOWLEDGE OF APU				
*5. EMERGENCY/SURVIVAL EQUIPMENT AND AIRCRAFT SAFETY PROCEDURES				
6. GENERAL SYSTEMS AND PROCEDURES KNOWLEDGE				
NUMERICAL AREA GRADE	TOTAL POINTS			

B. PRETAKEOFF	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. BEFORE START				
2. START				
3. TAXI PROCEDURES				
4. BEFORE TAKEOFF				
NUMERICAL AREA GRADE	TOTAL POINTS			

***C. TAKEOFF, CLIMB, CRUISE**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. NORMAL TAKEOFF				
*2. NORMAL TRANSITION				
*3. MALFUNCTIONS BEFORE REFUSAL				
*4. MALFUNCTIONS AFTER REFUSAL				
*5. THREE-ENGINE TRANSITION				
6. CLIMB & DEPARTURE				
7. LEVEL-OFF AND CRUISE				
NUMERICAL AREA GRADE	TOTAL POINTS			

***D. LANDINGS**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. NORMAL LANDING PATTERN				
*2. NORMAL APPROACH				
*3. NORMAL LANDING				
*4. THREE-ENGINE APPROACH				
*5. THREE-ENGINE LANDING				
*6. TWO-ENGINE APPROACH				
*7. TWO-ENGINE LANDING				
*8. NO-FLAP APPROACH				
9. NO-FLAP LANDING				
*10. WAVEOFF				
NUMERICAL AREA GRADE	TOTAL POINTS			

E. INSTRUMENT APPROACH	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. APPROACH SETUP AND BRIEF				
2. HOLDING PROCEDURES				
3. BEARING INTERCEPTION				
4. APPROACH AIRSPEED CONTROL				
5. TACAN ARC				
6. ILS GLIDESLOPE				
*7. APPROACH ALTITUDE CONTROL				
8. APPROACH COURSE CONTROL				
9. APPROACH ENGINE OPERATION				
10. USE OF CHECKLISTS				
*11. MISSED APPROACH				
12. GCA-AIRSPEED CONTROL				

REMARKS

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 1 of 2)

OPNAV 3510/23

Asterisk (*) denotes critical area/subarea.

P-3 PILOT NATOPS EVALUATION WORKSHEET

E. INSTRUMENT APPROACH cont.	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*13. GCA-ALTITUDE CONTROL				
14. GCA-HEADING CONTROL				
15. GCA-GLIDESLOPE				
16. GCA-USE OF CHECKLISTS				
*17. GCA-MISSED APPROACH				
18. FMS-APPROACH COURSE CONTROL				
19. FMS-APPROACH SETUP BRIEF				
20. FMS-TERMINAL AND EN ROUTE PROCEDURES				
NUMERICAL AREA GRADE	TOTAL POINTS			

***F. EMERGENCIES** (ENGINE FIRE, DITCHING DRILL, AIRSTART, PROPELLER MALFUNCTIONS, PLUS MINIMUM OF ONE OTHER)	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. AIRCRAFT HANDLING				
*2. ENGINE FIRE				
*3. PROPELLER FAILS TO FEATHER				
*4. LANDING GEAR EMERGENCIES				
*5. HYDRAULIC SYSTEM FAILURE				
*6. BRAKE FIRE				
*7. LOSS OF AC OR DC POWER SOURCE				
*8. FIRE OF UNKNOWN ORIGIN				
*9. SMOKE AND FUME ELIMINATION				
*10. EMERGENCY DESCENT				
11. ORDNANCE JETTISON SYSTEM				
*12. DITCHING DRILL				
*13. PROPELLER MALFUNCTIONS				
*14. AIRSTART PROCEDURES				
*15. BAILOUT DRILL				
NUMERICAL AREA GRADE	TOTAL POINTS			

***G. CREW RESOURCE MANAGEMENT**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. CREW COORDINATION				
*2. DECISION-MAKING/ MISSION ANALYSIS				
*3. POSITIONAL/SITUATIONAL/ MOSA AWARENESS				
4. CONDITIONS OF FLIGHT				
NUMERICAL AREA GRADE	TOTAL POINTS			

H. POSTFLIGHT	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. POSTFLIGHT PROCEDURES				
NUMERICAL AREA GRADE	TOTAL POINTS			

A. TOTAL ALL SUBAREA POINTS	
B. TOTAL NUMBER SUBAREAS GRADED	
C. EVALUATION NUMERICAL GRADE A÷B	
**EVALUATION ADJECTIVE GRADE	

**SEE OPNAVINST 3710.7

REMARKS

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 2 of 2)

26.10 COPILOT NATOPS EVALUATION GRADING CRITERIA (FIGURE 26-3)

Area A: Preflight

1. Flight Planning.

   Qualified — Properly prepared for assigned flight. Familiar with all aspects pertinent to proposed flight, including en route hazards, MOSA, and instrument publications. Ensured weather brief obtained and all appropriate navigation charts onboard aircraft. Prepared all necessary flight logs, forms, etc., to ensure successful completion of flight.

   Conditionally Qualified — Limited preparation made for assigned flight. Certain important aspects lacking to ensure the total success of the proposed flight. Flight planning, however, would not jeopardize the safe conduct of the flight.

   Unqualified — Failed to meet the minimum standards of conditionally qualified.

2. Briefing.

   Qualified — Performed thorough briefing. Reviewed selected emergency procedures and covered all aspects of the flight mission.

   Conditional Qualified — Minor omissions in briefing.

   Unqualified — Failed to brief crew.

3. Knowledge of APU.

   Qualified —Demonstrated a thorough knowledge of the APU visual inspection, system operation, and system operating limitations.

   Conditionally Qualified — Minor omissions or deviations from above.

   Unqualified — Lacked significant knowledge of APU.

4. Aircraft Inspection.

   Qualified — Ensured thorough interior and exterior aircraft inspection. Demonstrated thorough knowledge of basic equipment location and power sources. Inspected data sheets of previous discrepancies and preflight inspection form.

   Conditionally Qualified — Completed aircraft inspection with omissions in minor areas that did not affect the safety of the proposed flight. Minor lack of knowledge of basic equipment. Did not check previous discrepancy sheets or preflight inspection form.

   Unqualified — Failed to conduct aircraft inspection properly and omitted important items that would affect the safety of the proposed flight. Overlooked equipment adrift in the aircraft. Lack of knowledge of basic equipment affecting safety of flight.

*5. Emergency/Survival Equipment and Aircraft Safety Procedures.

Qualified — Safety and survival equipment complete, properly fitted, and worn. Demonstrated thorough knowledge and utilization of required equipment.

Conditionally Qualified — Minor omissions noted or minor lack of knowledge of fire extinguisher, oxygen equipment, aircraft exits, liferafts, or other pertinent survival equipment.

Unqualified — Any omission of safety or survival equipment that would preclude successful ditching, bailout, or jeopardize safety of survival. Unfamiliar with the use of required equipment.

*6. Equipment Knowledge/Circuit Breaker Location.

Qualified — Demonstrated thorough knowledge of systems, limitations, and procedures.

Conditionally Qualified — Minor lack of knowledge or understanding of systems, limitations, procedures.

Unqualified — Major lack of knowledge of systems, limitations, and procedures affecting safety of flight.

Area B: Pretakeoff

1. Before Start.

Qualified — Knew limitations and ensured execution of proper procedures.

Conditionally Qualified — Completed checklists satisfactorily. Minor omissions that did not jeopardize flight system operation. Adequate knowledge of limitations and procedures.

Unqualified — Did not know limitations or did not follow standard start procedure.

2. Start.

Qualified — Knew limitations and ensured execution of proper procedure for malfunctions.

Conditionally Qualified — Minor difficulties with limitations or slow to recognize a start malfunction.

Unqualified — Did not know limitations or procedures for malfunctions.

3. Taxi Procedures.

Qualified — Complied with procedures required by the NATOPS flight manual. Taxi signalmen were utilized, power and speeds regulated closely, watches were properly posted when required, and all lights were utilized as necessary. Checklists were accomplished without omission or discrepancy.

Conditionally Qualified — Procedures accomplished with minor omissions, deviations, or discrepancies that did not adversely affect successful completion of the mission, jeopardize safety, or cause undue delay.

Unqualified — Any omission or discrepancy that precluded successful completion of the mission, jeopardized safety, or caused excessive delay. Excessive use of reverse in areas of loose dirt, stones, or snow.

*Critical area/Subarea

4. Before Takeoff.

   Qualified — Executed checklist properly. If icing anticipated, ensured deicing, anti-icing, and engine checks completed without omission and in proper sequence. Conducted proper briefing for takeoff and ensured receipt of all crew reports.

   Conditionally Qualified — Minor omission or nonstandard responses to checklists. Failed to ensure complete deicing or anti-icing checks. Conducted incomplete takeoff brief and failed to receive all crew reports.

   Unqualified — Failure to satisfy conditionally qualified, or any item jeopardizing safe operation.

*Area C: Takeoff, Climb, and Cruise

*1. Normal Takeoff.

   Qualified — Effectively scanned flight station instrumentation while taking runway. Aircraft aligned with runway centerline. Initial power application smooth. Directional control maintained with nosewheel until rudder effective and then with rudder.

   Conditionally Qualified — Aircraft not aligned with runway centerline. Discrepancies in power applications. Abrupt or excessive usage of nosewheel steering. Discrepancies in any of the foregoing to an extent not jeopardizing safe operations.

   Unqualified — Failure to satisfy requirements for conditionally qualified, or any item jeopardizing safe operation.

*2. Normal Transition.

   Qualified — Flew aircraft smoothly into air within 0 to +5 knots of takeoff schedule. Maintained balanced flight and correct nose attitude until power reduction. Gear retracted without delay after establishing positive rate of climb. Flap retraction made at 140 knots or greater with gear up.

   Conditionally Qualified — Nosewheel skip or nose-high takeoff. Takeoff airspeed within 0 to +10 knots of takeoff schedule. Aircraft in unbalanced flight. Did not maintain takeoff attitude until power reduction. Flaps retracted before gear up.

   Unqualified — Poor handling technique after liftoff. Positive rate of climb not established or maintained. Gear retracted prematurely. Any other failure to satisfy conditionally qualified, or any item jeopardizing safe operation.

*3. Malfunctions Before Refusal.

   Qualified — Announced intentions to abort the takeoff. Used proper abort procedures. Maintained directional control and minimized swerve of aircraft.

   Conditionally Qualified — Announced intentions to abort. Slow in initiating correct abort procedures. Minor difficulty maintaining directional control of aircraft but not sufficient to jeopardize safety. Did not announce intentions to abort.

   Unqualified — Did not use proper abort procedures. Serious difficulty maintaining directional control of aircraft after executing abort.

*Critical area/Subarea

*4. Malfunctions After Refusal.

Qualified — Continued the takeoff roll. Utilized correct directional control procedures to minimize swerve caused by engine failure.

Conditionally Qualified — Insufficient or late application of proper control surface inputs. Allowed aircraft to swerve, but not to an extent to jeopardize safe operations.

Unqualified — Aborted takeoff or improper control surface inputs to an extent that jeopardized safe operations.

*5. Three-Engine Transition.

Qualified — Flew aircraft smoothly into air within 0 to +5 knots of takeoff schedule. Correct nose attitude until power reduction. Maintained directional control with control surfaces. Landing gear retracted without delay after establishing positive rate of climb. Flap retraction made at 140 knots or greater with landing gear up. Ensured engine secured.

Conditionally Qualified — Allowed aircraft to skid because of nose-low attitude on takeoff. Takeoff speed within 0 to +10 knots of takeoff speed schedule. Minor difficulty in maintaining directional control. Flaps retracted before landing gear up. Unnecessary delay before securing failed engine.

Unqualified — Rotated aircraft below speed schedule or poor handling techniques after liftoff. Landing gear retracted prematurely. Did not secure failed engine. Any other failure to satisfy conditionally qualified. Jeopardized safe operation.

6. Climb and Departure.

Qualified — Proper use of climb checklist. Maintained correct climb power setting. Climb airspeed maintained within ±5 knots. Prescribed headings within ±5°. Performed a proper NTS check below 8,000 feet. Did not exceed the limits of assigned departure altitudes and proper execution of the Standard Instrument Departure (SID) (when applicable).

Conditionally Qualified — Established but did not maintain correct climb setting. Climb airspeed maintained within ±10 knots. Prescribed headings within ±10°. Exceeded ±10 knots of prescribed airspeed during NTS check.

Unqualified — Failed to complete climb checklist. Did not establish correct climb power. Failure to satisfy requirements listed under conditionally qualified.

7. Level-Off and Cruise.

Qualified — Appropriate power selection for weight and altitude. Demonstrated knowledge of proper operation of anti-icing and deicing systems. Adequate knowledge of engine and airframe operating limitations and fuel management procedures. Leveled off and maintained assigned altitude within ±100 feet. Prompt, correct altitude changes as required.

Conditionally Qualified — Incorrect procedures or inadequate knowledge not considered to be of sufficient magnitude to jeopardize safe operation. Leveled off and maintained assigned altitude within ±150 feet.

Unqualified — Failure to satisfy above requirements, or any action or omission jeopardizing safety of flight. Excessive delay in executing assigned altitude changes.

*Critical area/Subarea

*Area D: Landing Pattern

1. Normal Landing Pattern.

   Qualified — Entered and flew traffic pattern in accordance with the appropriate governing directives. Proper execution of checklists. Flew the traffic pattern within ±100 feet of altitude and within ±5 knots of airspeed range.

   Conditionally Qualified — Entered and flew traffic pattern in accordance with appropriate directives, but with deviations that did not interfere with traffic or jeopardize safety. Late calling for or completing checklists. Flew traffic pattern within ±150 feet of altitude and ±10 knots of airspeed range.

   Unqualified — Deviated from prescribed pattern entry and interfered with other traffic or jeopardized safety. Failed to call for or complete checklists. Exceeded limitations for conditionally qualified.

*2. Normal Approach.

   Qualified — Established and executed pattern in accordance with NATOPS flight manual. Proper use of power. Landing checklist completed. Airspeed ±5 knots for weight.

   Conditionally Qualified — Deviation in approach not sufficient to jeopardize safety. Excessive power changes or rough use. Held airspeeds within ±10 knots. Landing checklist completed.

   Unqualified — Deviation in approach that interfered with normal traffic or other deviations that jeopardized flight safety. Airspeed not held within above limits. Safe completion of approach was questionable, and pilot did not attempt waveoff. Failed to complete landing checklist.

*3. Normal Landing.

   Qualified — Maintained positive control of speed, power, and rate of descent. Aircraft aligned within runway limits throughout final approach. Maintained aircraft in trim. Nose-high touchdown in first third of runway. Maintained directional control during rollout. Positive control of reverse. Smooth, effective use of brakes and nosewheel steering.

   Conditionally Qualified — Had minor difficulty with transition. Handled aircraft roughly and used poor technique in flare, landing, or rollout. Flat touchdown in first third of runway.

   Unqualified — Had serious difficulty with transition. Failed to maintain positive control of aircraft during flare, landing, or rollout. Did not touch down in first third of runway.

*4. Waveoff.

   Qualified — Executed waveoff with proper use of power. Maintained directional control. Executed smooth transition to climb attitude. Stopped descent, established positive rate of climb, raised flaps to approach, and retracted gear. After gear fully retracted, and with at least 140 knots airspeed, raised flaps. Maintained smooth acceleration to climb airspeed.

   Conditionally Qualified — Raised gear prior to raising flaps from landing to approach configuration, or initiated complete flap retraction prior to completion of gear retraction.

   Unqualified — Slow or incomplete power application, failed to achieve positive rate of climb before flaps to approach, raised flaps to up position below 140 knots, incorrect sequence, or other unsafe acts.

*Critical area/Subarea

Area E: Instrument Procedures

1. Approach Setup and Brief.

   Qualified — Obtained weather, airport, and runway information in a timely manner. Properly briefed required approach, hazards to flight, and MOSA. Ensured NAVAIDs and radios tuned.

   Conditionally Qualified — Not adequately prepared for approach. Did not jeopardize safety of flight.

   Unqualified — Failed to brief approach or obtain required information to the extent safety of flight jeopardized.

2. Use of Checklists.

   Qualified — Properly utilized checklists and/or ensured checklists completed with no omissions or incorrect responses.

   Conditionally Qualified — Late in calling for and/or ensuring checklists were completed with no serious omissions or incorrect responses.

   Unqualified — Failed to call for and/or ensure checklists were completed with serious omissions or incorrect responses.

3. Holding Procedures.

   Qualified — Entered holding in accordance with existing FAA requirements and used correct voice procedures. Obtained weather, altimeter setting, runway in use, and expected further approach clearance time information. Maintained specified altitude within ±100 feet.

   Conditionally Qualified — Entered holding pattern erratically. Minor omissions in weather, altimeter setting, runway, and approach clearance requests. Varied pattern in excess of 30 seconds and altitude within ±150 feet.

   Unqualified — Exceeded any requirement set forth under conditionally qualified.

4. Bearing Interception.

   Qualified — Demonstrated effective interception procedures by the most direct and acceptable methods; understood the use of bearing equipment in establishing interception.

   Conditionally Qualified — Effective bearing interception with some delay. Unsure of procedures and equipment, but performed interception without exceeding clearance limits.

   Unqualified — Became disoriented. Experienced excessive amount of difficulty in effecting interception. Failed to understand equipment and clearance limits.

5. Pilot-Monitored Approach.

   Qualified — Familiar with, and prepared for, execution of pilot-monitored approach. Briefed all aspects of the approach in a timely and orderly fashion with no omissions.

   Conditionally Qualified — Familiar with and prepared for execution of pilot-monitored approach. Briefed all aspects of the approach with only minor omissions.

   Unqualified — Unfamiliar with and unprepared for execution of pilot-monitored approach with omissions affecting safety of flight.

*6. IFR En Route Navigation.

Qualified — Accurately complied with all IFR en route navigation procedures in accordance with existing FAA requirements.

Conditionally Qualified — Minor discrepancies in the above not affecting safety of flight.

Unqualified — Major discrepancies with IFR en route navigation affecting safety of flight.

7. Approach Airspeed Control.

Qualified — Maintained prescribed speed ranges and ±5 knots of specific airspeeds as published in NATOPS flight manual (Chapter 18).

Conditionally Qualified — Maintained airspeeds within ±5 knots of prescribed speed ranges and ±10 knots of specific airspeeds as published in NATOPS flight manual (Chapter 18).

Unqualified — Exceeded the preceding limits.

8. TACAN Arc.

Qualified — Maintained specified distance from station within ±1 mile.

Conditionally Qualified — Maintained specified distance within ±2 miles.

Unqualified — Failed to meet the requirements for conditionally qualified.

9. ILS Glideslope.

Qualified — Intercepted glidepath. Remained within one dot of glidepath on FDI until reaching decision height.

Conditionally Qualified — Intercepted glidepath. Remained within two dots of glidepath on FDI until reaching decision height.

Unqualified — Failed to intercept glidepath or exceeded the preceding limits.

*10. Approach Altitude Control.

Qualified — Did not exceed limits of assigned or published altitudes. Maintained positive control of aircraft and situation during climbs and descents.

Conditionally Qualified — Did not exceed limits of assigned or published altitudes. Had minor difficulty maintaining positive control of aircraft and situation during climbs and descents. Did not jeopardize safety of flight.

Unqualified — Exceeded the limits of assigned or published altitudes. Handled aircraft poorly. Did not maintain positive control of situation.

*Critical area/Subarea

11. Approach Course Control.

    Qualified — Maintained course within ±5°, effectively correcting for drift.

    Conditionally Qualified — Maintained course within ±10°. Had difficulty correcting for drift.

    Unqualified — Failed to maintain course within ±10°. Did not hold correction for drift.

12. Approach Engine Operation.

    Qualified — Considered restarting a shutdown engine and its effect on safety of flight when faced with a greater emergency requiring shutdown of a second engine. Did not exceed maximum TIT or SHP.

    Conditionally Qualified — Slow to consider the effects of engine-out operation and its effect on safety of flight.

    Unqualified — Failed to consider the effects on safety of flight when faced with engine-out operations. Failed to observe TIT or SHP limits.

*13. Missed Approach.

    Qualified — Prepared for missed approach. Timely and correct power application. Recognized windshear and complied with proper windshear escape procedures. Raised gear and flaps in accordance with waveoff procedures following power application. Did not descend below minimums. No deviations from published procedures.

    Conditionally Qualified — Not adequately prepared for missed approach. Incorrect power application. Improper sequence of power, gear, and flaps. Slow to recognize windshear indications and comply with adequate windshear escape procedures. Did not descend below minimums. Satisfactorily carried out published procedure.

    Unqualified — Raised flaps to the up position below 140 knots. Descended below minimums. Unsafe use of power. Unsatisfactory completion of published approach or windshear escape procedures.

14. GCA — Airspeed Control.

    Qualified — Maintained airspeeds within ±5 knots of approach airspeeds.

    Conditionally Qualified — Maintained airspeeds within ±10 knots of approach airspeeds.

    Unqualified — Failure to remain within limits of conditionally qualified.

*15. GCA — Altitude Control.

    Qualified — Leveled off and maintained assigned altitudes within ±100 feet. Prompt, correct altitude changes.

    Conditionally Qualified — Leveled off and maintained assigned altitudes within ±150 feet. Delay in altitude changes.

    Unqualified — Failed to remain within limits of conditionally qualified.

*Critical area/Subarea

16. GCA — Heading Control.

    Qualified — Prompt response to heading instructions; maintained assigned headings prior to final within ±5°, and on final within ±3°, balanced flight, and standard-rate turns, except during small heading changes.

    Conditionally Qualified — Heading changes late, maintained assigned headings prior to final within ±8° degrees, and on final within ±5°, unbalanced flight, and turning rates excessively fast or slow.

    Unqualified — Heading control not meeting requirements of conditionally qualified, or resulting in waveoff or no gyro instructions.

17. GCA — Glideslope.

    Qualified — Prompt and adequate power adjustments. Carried out instructions of controller in a timely and effective manner.

    Conditionally Qualified — Power adjustments late or excessive, but sufficient to prevent waveoff.

    Unqualified — Glideslope control inadequate and resulted in waveoff.

18. GCA — Use of Checklists.

    Qualified — Prompt and timely completion of required checklists. Minor delays or omissions in execution of checklists that did not affect safety of flight.

    Conditionally Qualified — Delays or omissions in execution of checklists that did not affect safety of flight.

    Unqualified — Delays or omissions in execution of checklist that affected safety of flight.

*19. GCA — Missed Approach.

    Qualified — Properly carried out missed approach instructions. Power application, flaps, gear, climb in accordance with NATOPS waveoff procedure.

    Conditionally Qualified — Minor discrepancies in above, not affecting safety of flight.

    Unqualified — Not in conformance with the above.

Area F: Copilot Procedures

*1. Pilot Backup.

    Qualified — Demonstrated proper pilot backup skills during all phases of flight providing assistance as required.

    Conditionally Qualified — Demonstrated pilot backup during all phases of flight with minor omissions not affecting safety of flight.

    Unqualified — Demonstrated minimal pilot backup during flight with omissions affecting safety of flight.

*Critical area/Subarea

*2. Terminal Area Procedures.

Qualified — Ensured all navigation and communication receivers were tuned and all aspects of flight were properly briefed prior to commencing terminal area navigation.

Conditionally Qualified — Ensured all navigation and communication receivers were tuned and all aspects of flight were properly briefed with minor omissions not affecting safety of flight.

Unqualified — Failed to ensure navigation and communication receivers were properly tuned and all aspects of flight were properly briefed, affecting safety of flight.

*3. Communications Procedures.

Qualified — Accurately responded to and recorded pertinent information from the controlling authority in a timely and effective manner.

Conditionally Qualified — Minor discrepancies noted in responding or recording information not affecting safety of flight.

Unqualified — Major discrepancies in responding or recording pertinent information affecting safety of flight.

*4. Specific Copilot Duties.

Qualified — Demonstrated thorough knowledge of, as well as executed, all specific copilot duties listed in Chapter 18.

Conditionally Qualified — Minor omissions in specific copilot duties not affecting safety of flight.

Unqualified — Major omissions in specific copilot duties affecting safety of flight.

5. Flight Instrument Backup.

Qualified — Maintained a thorough scan of all flight station instrumentation and promptly identified and informed the pilot of any discrepancies.

Conditionally Qualified — Slow to identify and inform the pilot of any flight station instrumentation discrepancies.

Unqualified — Failed to identify and inform the pilot of any flight station instrumentation discrepancies.

*Area G: Emergencies

*1. Aircraft Handling.

Qualified — Maintained or established desired heading within ±10°, altitude within ±150 feet. Restarted loitered engine in a timely matter. Minimal airspeed loss. Raised gear and flaps, if down.

Conditionally Qualified — Maintained or established desired heading within 20° and altitude within ±250 feet. Excessive airspeed loss. Delayed gear and flap retraction or restarting loitered engine. Did not jeopardize flight safety.

Unqualified — Failure to satisfy criteria for conditionally qualified, loss of control or orientation, unsafe airspeed loss, or other unsafe acts. Failed to raise gear or flaps, if extended.

*Critical area/Subarea

*2. Engine Fire.

Qualified — Initiated first steps of checklist immediately and ensured remainder of checklist was accomplished. Called for use of transfer switch on fire extinguisher and discharged second HRD when definite determination made that first charge did not extinguish the fire.

Conditionally Qualified — Followed initial steps immediately but did not follow up on remainder of checklist.

Unqualified — Did not initiate checklist. Performed any action detrimental to safety of flight.

*3. Propeller Fails to Feather.

Qualified — Immediately initiated correct procedures.

Conditionally Qualified — Slow to initiate correct procedures. Weak understanding of procedures.

Unqualified — Failed to positively slow aircraft, failed to initiate procedures, or performed any action detrimental to safety of flight.

*4. Landing Gear Emergencies.

Qualified — Demonstrated correct emergency landing gear extension, showed knowledge of procedures intended for use when main system pressure is lost, and had an understanding of significance of pulling landing gear circuit breaker in connection with certain gear malfunctions; demonstrated knowledge of method of gear extension with electrical failure; had a knowledge of landing gear and airspeed limitations.

Conditionally Qualified — Weak in knowledge of procedures.

Unqualified — Failed to execute proper procedures.

*5. Hydraulic System Failure.

Qualified — Demonstrated correct procedures to be followed in event of loss of main system hydraulic pressure, with regard to use of flaps, bomb bay doors, brake flight controls, and nosewheel steering.

Conditionally Qualified — Showed minor lack of knowledge of hydraulic system components and functions.

Unqualified — Lack of knowledge, incorrect procedures, or other failure to satisfy requirements of conditionally qualified.

*6. Brake Fire.

Qualified — Promptly executed proper procedures and maintained positive control of the emergency situation and the crew.

Conditionally Qualified — Minor omissions in procedures that did not affect the safety of the crew or the aircraft.

Unqualified — Any procedural omission or lack of positive control that would endanger the crew or the aircraft.

*Critical area/Subarea

*7. Loss of AC or DC Power Source.

Qualified — Demonstrated a thorough knowledge of the AC or DC power system and had no difficulty in associating equipment failure with proper electrical system.

Conditionally Qualified — Showed a minor lack of knowledge of the AC or DC power system. Had some difficulty associating equipment failure with proper electrical system.

Unqualified — Showed considerable lack of knowledge of the AC or DC power system. Could not associate equipment failure with proper electrical system.

*8. Fire of Unknown Origin.

Qualified — Initiated first steps of checklist immediately and ensured remainder of checklist was accomplished. Demonstrated knowledge of correct procedure, including securing electrical power sources and utilization of essential buses while determining source of fire.

Conditionally Qualified — Showed minor lack of understanding of procedures or hastily executed steps without determining their effectiveness.

Unqualified — Failure to satisfy requirements for conditionally qualified.

*9. Smoke and Fume Elimination.

Qualified — Initiated checklist, demonstrated knowledge of smoke removal limits, and executed correct procedures.

Conditionally Qualified — Showed minor lack of understanding of smoke removal procedures and related aircraft systems.

Unqualified — Failed to execute checklist. Inadequate knowledge of procedures to the extent that safe operating procedures were jeopardized.

*10. Emergency Descent.

Qualified — Demonstrated knowledge and executed correct procedures.

Conditionally Qualified — Excessive delay in accomplishing emergency descent.

Unqualified — Inadequate knowledge of procedures. Other acts that resulted in unsafe operation.

11. Ordnance Jettison System.

Qualified — Demonstrated a thorough knowledge of the ordnance jettison system and its limitations as it affects the safety of the crew and aircraft.

Conditionally Qualified — Minor lack of understanding of ordnance jettison system.

Unqualified — Inadequate knowledge of the jettison system that could jeopardize crew safety.

*Critical area/Subarea

*12. Ditching Drill (Night Or Instrument Technique).

Qualified — Demonstrated thorough knowledge of ditching procedures and completed ditching checklist in a timely manner with no omissions. Provided proper pilot backup throughout descent to simulated water impact.

Conditionally Qualified — Demonstrated minor lack of knowledge of ditching procedures with minor omissions in completing the ditching checklist in a timely fashion not affecting safety of flight. Provided adequate pilot backup throughout descent to simulated water impact.

Unqualified — Demonstrated a significant lack of knowledge of ditching procedures with major omissions in completing the ditching checklist affecting safety of flight. Failed to provide adequate pilot backup throughout descent to simulated water impact.

*13. Propeller Malfunctions.

Qualified — Demonstrated knowledge of the following procedures: Propeller pump light, rpm flux, underspeeding or overspeeding propeller, pitchlocked propeller, and decoupled propeller. Knowledge of protective devices in propeller: NTS, autofeather, beta follow-up, pitchlock, and pitchlock reset.

Conditionally Qualified — Minor discrepancies in procedures. Knowledge of protection systems weak.

Unqualified — Did not know procedures for propeller malfunctions.

*14. Airstart Procedures.

Qualified — Verified verbally prior to start that all instruments and engines were being monitored. Knew limitations on TIT, rpm, etc., and procedures to follow if limits exceeded.

Conditionally Qualified — Did not scan all instruments during start. Knew procedures for malfunction but did not know limits sufficiently well.

Unqualified — Any procedures causing a safety hazard.

*15. Bailout Drill.

Qualified — Familiar with bailout signal(s) and complied with bailout bill. Had knowledge of parachute location and bailout exit location. Properly donned parachute and other personal survival equipment. Preparations were timely.

Conditionally Qualified — Minor deviations from items required for qualified.

Unqualified — Demonstrated actions or omissions jeopardizing safety of flight or personal safety.

*Area H: Crew Resource Management

*1. Crew Coordination.

Qualified — Clearly and accurately sent and acknowledged information, instructions, or commands and provided useful feedback. Properly utilized aircrew in all normal and emergency situations; stimulated crew to work together as a team. Effectively managed resources and accomplished mission without putting the crew in jeopardy.

Conditionally Qualified — Allowed crew coordination to break down. Did not properly utilize aircrew during normal or emergency situations, resulting in minor deviations from NATOPS procedures.

Unqualified — Attempted to handle normal and emergency situations without the assistance of the aircrew. Failed to inform crew of aircraft emergencies. Demonstrated ineffective crew management that jeopardized safety of flight or personal safety as evidenced by application of incorrect NATOPS procedures.

*Critical area/Subarea

*2. Decision-Making/Mission Analysis.

Qualified — Willingly and actively organized and planned mission requirements, including determining proper fuel load and weapon limitations. Utilized sound judgment to effectively coordinate, allocate, and monitor crew and aircraft resources. Demonstrated an ability to alter a course of action to meet situational demands and informed crew of changes to flight concept. Conducted post-mission review.

Conditionally Qualified — Adequate knowledge of mission requirements. Did not properly monitor and update in-flight information or conduct post-mission review.

Unqualified — Failed to adequately plan the mission. Demonstrated actions that jeopardized safety of flight or personal safety.

*3. Positional/Situational/MOSA Awareness.

Qualified — Effectively coordinated aircraft positioning with the navigator and radar operator. Ensured MOSA procedures utilized throughout flight. Demonstrated proficiency in plotting aircraft position. Effectively monitored aircrew and aircraft status to evaluate mission progress. Acknowledged potential problems to completing mission.

Conditionally Qualified — Minor discrepancies in monitoring aircraft and aircrew status. Adequate coordination with navigator and radar operator. Adequate knowledge of MOSA procedures.

Unqualified — Not familiar with definition of MOSA or procedural requirements. Failed to coordinate MOSA procedures with navigator or radar operator. Demonstrated actions that jeopardized safety of flight or personal safety.

4. Conditions of Flight.

Qualified — Coordinated the proper setting of conditions of flight.

Conditionally Qualified — Did not set conditions of flight in a timely manner.

Unqualified — Failed to set flight conditions.

Area I: Postflight Procedures

Qualified — Handled aircraft safely. Executed checklist. Taxied and parked aircraft in a safe manner. Completed postflight inspection and properly completed OPNAV form 3760 or appropriate data sheets, as applicable.

Conditionally Qualified — Poor handling technique, failed to complete checklists, and allowed minor omissions in securing aircraft. Completed all safety items without omissions.

Unqualified — Handled aircraft in a hazardous manner; failed to request checklists. Any act, performance, or omission that could result in an unsafe condition.

*Critical area/Subarea

OPNAV 3510/23	Asterisk (*) denotes critical area/subarea.

P-3 COPILOT NATOPS EVALUATION WORKSHEET

NAME	RATE/RANK	TOTAL PILOT HOURS
SQUADRON/UNIT		TOTAL HOURS IN MODEL
DATE OF LAST EVALUATION	DATE OF EXPIRATION	

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
FLIGHT EVALUATION				

FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE
EVALUATOR/INSTRUCTOR	GRADE, NAME OF UNIT COMMANDER	

A. PREFLIGHT	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. FLIGHT PLANNING				
2. BRIEFING				
3. KNOWLEDGE OF APU				
4. AIRCRAFT INSPECTION				
*5. EMERGENCY/SURVIVAL EQUIPMENT AND AIRCRAFT SAFETY PROCEDURES				
*6. EQUIPMENT KNOWLEDGE/ CIRCUIT BREAKER LOCATION				
NUMERICAL AREA GRADE	TOTAL POINTS			

B. PRETAKEOFF	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. BEFORE START				
2. START				
3. TAXI PROCEDURES				
4. BEFORE TAKEOFF				
NUMERICAL AREA GRADE	TOTAL POINTS			

***C. TAKEOFF, CLIMB, CRUISE**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. NORMAL TAKEOFF				
*2. NORMAL TRANSITION				
*3. MALFUNCTIONS BEFORE REFUSAL				
*4. MALFUNCTIONS AFTER REFUSAL				
*5. THREE-ENGINE TRANSITION				
6. CLIMB AND DEPARTURE				
7. LEVEL-OFF AND CRUISE				
NUMERICAL AREA GRADE	TOTAL POINTS			

***D. LANDING PATTERN**	**ADJECTIVE AREA GRADE**			
SUBAREAS	Q	CQ	U	POINTS
1. NORMAL LANDING PATTERN				
*2. NORMAL APPROACH				
*3. NORMAL LANDING				
*4. WAVEOFF				
NUMERICAL AREA GRADE	TOTAL POINTS			

E. INSTRUMENT PROCEDURES	**ADJECTIVE AREA GRADE**			
SUBAREAS	Q	CQ	U	POINTS
1. APPROACH SETUP AND BRIEF				
2. USE OF CHECKLISTS				
3. HOLDING PROCEDURES				
4. BEARING INTERCEPTION				
5. PILOT-MONITORED APPROACH				
*6. IFR EN ROUTE NAVIGATION				
7. APPROACH AIRSPEED CONTROL				
8. TACAN ARC				
9. ILS GLIDESLOPE				
*10. APPROACH ALTITUDE CONTROL				
11. APPROACH COURSE CONTROL				
12. APPROACH ENGINE OPERATION				
*13. MISSED APPROACH				
14. GCA-AIRSPEED CONTROL				
*15. GCA-ALTITUDE CONTROL				
16. GCA-HEADING CONTROL				
17. GCA-GLIDESLOPE				

Figure 26-3. Copilot NATOPS Evaluation Worksheet (Sheet 1 of 2)

OPNAV 3510/23 — Asterisk (*) denotes critical area/subarea.

P-3 COPILOT NATOPS EVALUATION WORKSHEET

E. INSTRUMENT PROCEDURES cont.	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
18. GCA-USE OF CHECKLISTS				
*19. GCA-MISSED APPROACH				
NUMERICAL AREA GRADE	TOTAL POINTS			

F. COPILOT PROCEDURES	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. PILOT BACKUP				
*2. TERMINAL AREA PROCEDURES				
*3. COMMUNICATIONS PROCEDURES				
*4. SPECIFIC COPILOT DUTIES				
5. FLIGHT INSTRUMENT BACKUP				
NUMERICAL AREA GRADE	TOTAL POINTS			

***G. EMERGENCIES** (ENGINE FIRE, DITCHING DRILL, AIRSTART, PROPELLER MALFUNCTIONS, PLUS MINIMUM OF ONE OTHER)	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. AIRCRAFT HANDLING				
*2. ENGINE FIRE				
*3. PROPELLER FAILS TO FEATHER				
*4. LANDING GEAR EMERGENCIES				
*5. HYDRAULIC SYSTEM FAILURE				
*6. BRAKE FIRE				
*7. LOSS OF AC OR DC POWER SOURCE				
*8. FIRE OF UNKNOWN ORIGIN				
*9. SMOKE AND FUME ELIMINATION				
*10. EMERGENCY DESCENT				
11. ORDNANCE JETTISON SYSTEM				
*12. DITCHING DRILL				
*13. PROPELLER MALFUNCTIONS				
*14. AIRSTART PROCEDURES				
*15. BAILOUT DRILL				
NUMERICAL AREA GRADE	TOTAL POINTS			

***H. CREW RESOURCE MANAGEMENT**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. CREW COORDINATION				
*2.DECISION-MAKING/MISSION ANALYSIS				
*3.POSITIONAL/SITUATIONAL /MOSA AWARENESS				
4. CONDITIONS OF FLIGHT				
NUMERICAL AREA GRADE	TOTAL POINTS			

I. POSTFLIGHT	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. POSTFLIGHT PROCEDURES				
NUMERICAL AREA GRADE	TOTAL POINTS			

A. TOTAL ALL SUBAREA POINTS	
B. TOTAL NUMBER SUBAREAS GRADED	
C. EVALUATION NUMERICAL GRADE A÷B	
**EVALUATION ADJECTIVE GRADE	

**SEE OPNAVINST 3710.7

REMARKS

Figure 26-3. Copilot NATOPS Evaluation Worksheet (Sheet 2 of 2)

26.11 FLIGHT ENGINEER NATOPS EVALUATION GRADING CRITERIA (FIGURE 26-4)

*Area A: Preflight

*1. Knowledge of APU.

Qualified — Demonstrated thorough knowledge of the APU and subsystems. Complete understanding of pre/postoperational requirements and limitations.

Conditionally Qualified — Minor deviations or omissions of any items required under qualified.

Unqualified — Lacked detailed knowledge of APU operating procedures and/or limitations. Failed to comply with current NAVAIR turnaround checklist directives.

*2. Required Logs and Forms.

Qualified — Properly completed weight and balance and all required forms for type flight. Current NATOPS flight/aircrew manuals, as required, and NAVAIR turnaround checklist onboard.

Conditionally Qualified — Minor omissions or errors in weight and balance computations and/or other required forms not affecting safety of flight.

Unqualified — Safety of flight jeopardized by improper computations of aircraft weight and balance. Failed to properly list personnel embarked or complete aircraft release form. NATOPS flight manual or NAVAIR turnaround checklist not up to date or missing pages.

*3. Performance Computations.

Qualified — All required performance computations correctly provided to the pilot. Thorough knowledge of aircraft performance charts for all phases of flight.

Conditionally Qualified — Minor errors and/or omissions in required computations not affecting safety of flight.

Unqualified — Errors or omissions in computations that could jeopardize safety of flight. Lacked a thorough knowledge of the aircraft performance charts.

*4. Aircraft Inspection.

Qualified — Completed thorough aircraft inspection. Reviewed aircraft discrepancy book for last 10 flights. Ensured ditching stations assigned for all crew embarked on flight.

Conditionally Qualified — Completed aircraft inspection in accordance with current NAVAIR directives, but failed to notice minor discrepancies that would not affect safety of flight. Loose equipment not properly stowed.

Unqualified — Failed to properly inspect aircraft or omitted items that adversely affected safety of flight.

Area B: Pretakeoff

1. Before Start.

Qualified — Executed NATOPS checklists properly. Demonstrated a thorough knowledge of all items.

Conditionally Qualified — Completed checklist satisfactorily. Minor omissions that did not jeopardize flight or system operations. Adequate understanding of all items.

Unqualified — Failed to satisfactorily complete checklist, affecting safe flight operations. Knowledge of items not adequate to ensure safe and successful operation.

*Critical area/Subarea

*2. Normal Starts.

Qualified — Thoroughly familiar with starting sequence and procedures. Monitored required instruments and lights during start. Thorough knowledge of limitations.

Conditionally Qualified — Minor lack of understanding of start procedures and/or limitations.

Unqualified — Not familiar with limitations or procedures for malfunctions. Any action that could result in damage to equipment.

*3. Start Malfunctions.

Qualified — Thorough procedural knowledge and system understanding of start malfunctions. Properly identified, informed pilot of, and promptly took corrective action for a discrepancy during start.

Conditionally Qualified — Minor lack of knowledge of start malfunctions. Slow to identify, inform the pilot of, or take corrective action for a discrepancy during start.

Unqualified — Failed to identify, inform the pilot of, or take corrective action for a start malfunction.

4. After Start.

Qualified — Properly completed checklist. Monitored engine and airframe systems for normal indications and limitations.

Conditionally Qualified — Minor omissions of checklist items. Slow to identify, inform pilot of, or take corrective action for abnormal engine or airframe indications.

Unqualified — Failed to comply with or complete the checklist. Failed to identify, inform the pilot of, or take corrective action for abnormal engine or airframe indications.

5. Taxi Procedures.

Qualified — Maintained all engine and airframe systems within limits. Accomplished required icing systems checks in accordance with the NATOPS manual.

Conditionally Qualified — Slow to identify or maintain engine or airframe systems within limits. Minor errors or omissions that would not adversely affect the successful completion of the mission, jeopardize safety, or cause undue delay.

Unqualified — Any omissions or discrepancy that precluded successful completion of the flight, jeopardized safety, or caused excessive delay.

*6. Before Takeoff.

Qualified — Properly completed checklist. Verified all engine and airframe systems operating within limits for takeoff. Computed or verified forecast SHP requirements.

Conditionally Qualified — Minor omissions or discrepancies performing the checklist. Slow to identify engine or airframe systems operating out of limits.

Unqualified — Omissions or discrepancies in completion of the checklist that would adversely affect flight safety. Failed to identify or inform the pilot of a discrepancy. Did not properly compute or verify forecast SHP for takeoff.

*Critical area/Subarea

*Area C: Takeoff and Climb

1. Power Application.

   Qualified — Properly set predicted TIT required for takeoff. Maintained TIT through power checks. Thoroughly familiar with takeoff engine and rpm under/overshoot limitations.

   Conditionally Qualified — Slow to set predicted TIT. Minor lack of knowledge of engine or rpm limits for takeoff.

   Unqualified — Failed to set minimum required TIT for takeoff. Unfamiliar with engine or rpm under or overshoot limits.

*2. Malfunctions During Takeoff.

   Qualified — Properly called out malfunctions clearly and correctly. Executed instructions from pilot in the same manner.

   Conditionally Qualified — Slow to call out malfunction. Slow to execute instructions from pilot, but followed correctly. Any discrepancy that would not jeopardize safe operations.

   Unqualified — Failed to carry out pilot's instructions or did not carry them out correctly. Any discrepancy affecting safe operations.

*3. Pattern Procedures.

   Qualified — Set requested SHP on pilot command and updated pilots on changes in landing weights and speeds. Monitored all engine instruments and systems continuously to provide expedient warning of any malfunctions.

   Conditionally Qualified — Slow to set requested SHP on pilot command. Slow to recognize discrepancies or malfunctions during pattern operations.

   Unqualified — Failed to properly set requested SHP on pilot command. Computed or informed pilots of the wrong landing weights and speeds. Failed to turn fuel boost pumps on for landing or takeoffs. Failed to monitor ATC or ICS transmissions.

4. Climb.

   Qualified — Proper climb power set and maintained. Proper use of checklist. Maintained pressurization control.

   Conditionally Qualified — Slow or uncertain completion of climb checklist. Established but did not maintain climb power or pressurization control.

   Unqualified — Failed to complete climb checklist. Did not establish correct climb power. Major errors in pressurization control during climb.

*Critical area/Subarea

5. NTS Check.

   Qualified — Demonstrated thorough knowledge of NTS check procedures and limitations. Familiar with all indications and corrective action required for malfunction that may occur during an NTS check. Properly cleaned up from NTS check.

   Conditionally Qualified — Slow to take corrective action or uncertain of procedures or limitations. Did not clean up from NTS check.

   Unqualified — Failed to properly identify or take corrective action for any malfunction during the NTS check. Did not know proper indications or limitations for NTS checks.

Area D: Cruise

1. Loiter Procedures.

   Qualified — Demonstrated knowledge of loiter shutdown procedure and limitations. Computed correct airspeed and power settings. Used correct restart procedures with engine failure. Completed loiter shutdown checklist.

   Conditionally Qualified — Minor errors in airspeed and power setting computations. Slow executing proper restart procedures. Omissions in shutdown checklist.

   Unqualified — Failure to leave the engine in ready-to-start configuration. Not familiar with limitations or shutdown procedure. Did not use proper restart procedure.

*2. Anti-Icing Procedures.

   Qualified — Demonstrated knowledge of anti-icing/deicing procedures. Used correct NATOPS flight manual procedures.

   Conditionally Qualified — Failed to observe SHP drop when turning on engine anti-ice. Failure to monitor propeller/empennage cycles for proper operation. Slow to diagnose malfunctions and take corrective action.

   Unqualified — Lack of understanding of deice/anti-ice systems to an extent it would jeopardize safe operations.

*3. Fuel Management.

   Qualified — Demonstrated a thorough knowledge of fuel dump, crossfeed, and fuel transfer system operating procedures and limitations. Familiar with all aspects of fuel planning for flight in accordance with the NATOPS flight manual.

   Conditionally Qualified — Displayed a minor lack of knowledge or understanding of fuel dump, crossfeed, or fuel transfer systems or limitations. Unfamiliar with NATOPS flight planning requirements.

   Unqualified — Failed to satisfy requirements of conditionally qualified. Any item affecting safety of flight.

*Critical area/Subarea

*4. Pressurization Control.

Qualified — Operated pressurization system manually and automatically in optimum manner to avoid uncomfortable pressure and temperature changes for crew. Thorough understanding of system limitations and operation.

Conditionally Qualified — Operated system with minor crew discomfort. Slow to identify or inform pilot of system malfunction. Minor lack of system limitations or operation.

Unqualified — Failed to maintain control of pressurization. Caused major crew discomfort or allowed safety relief valve to open. Any action causing possible damage to equipment or jeopardizing safety of flight.

*Area E: Emergencies

*1. Engine Fire.

Qualified — Promptly called out fire and stood by emergency shutdown handle. Familiar with recall items of checklist and executed pilot commands smoothly and correctly. Ensured completion of checklist.

Conditionally Qualified — Not familiar with recall items of checklist. Slow to execute pilot commands and execute checklist. Discrepancies minor and did not affect safety of flight.

Unqualified — Failed to satisfy requirements for conditionally qualified. Any item affecting safety of flight.

*2. Propeller Fails to Feather.

Qualified — Properly announced and executed procedures upon command of pilot.

Conditionally Qualified — Slow to execute NATOPS procedures.

Unqualified — Failure to satisfy requirements for conditionally qualified. Any item affecting safety of flight.

*3. Engine Restart.

Qualified — Ensured checklist completed. Provided pilots with required restart brief. Thorough knowledge of normal and malfunctioning restart procedures and limitations.

Conditionally Qualified — Minor errors or omissions in restart brief. Slow to identify or execute procedures on pilot command. Minor lack of limitation knowledge.

Unqualified — Failed to complete all checklist items. Omitted required checklist items in restart brief. Failed to identify or execute NATOPS procedures during restart. Any item that might affect safety of flight.

*4. Loss of Electrical Power.

Qualified — Demonstrated thorough knowledge of both AC and DC power distribution systems. Completely familiar with electrical power loss indications. Displayed proper and thorough troubleshooting procedures.

Conditionally Qualified — Minor lack of knowledge of AC and DC power distribution systems. Slow to properly troubleshoot electrical power loss. Demonstrated some difficulty finding circuit breakers.

Unqualified — Reported warning lights but did not have sufficient knowledge of systems to troubleshoot malfunctions. Did not know which circuit breakers to check or their location.

*Critical area/Subarea

*5. Fire of Unknown Origin.

Qualified — Demonstrated knowledge of correct procedures. Used checklist to guide actions.

Conditionally Qualified — Weak knowledge of procedures. Slow to follow pilot command.

Unqualified — Failure to satisfy requirements for conditionally qualified. Failed to utilize checklist and skipped essential item in combating fire.

*6. Smoke or Fume Elimination.

Qualified — Thorough knowledge and proper execution of the checklist. Complete understanding of depressurization, both with and without electrical power. Well versed in limitations and operation of the main oxygen system.

Conditionally Qualified — Minor lack of understanding or operation of checklist items. Displayed difficulty in depressurization or repressurization of the aircraft.

Unqualified — Failed to properly comply with checklist items. Incorrectly depressurized aircraft. Did not operate oxygen system satisfactorily.

*7. Ditching or Bailout Drill.

Qualified — Properly computed weight and speeds for ditch. Correctly depressurized aircraft. Prepared both flight station and self for impact. Complied with ditch and bailout bill.

Conditionally Qualified — Slow complying with checklist and ditching and bailout bill. Failed to clean up the flight station or properly prepare harness for impact.

Unqualified — Failure to satisfy requirements or any action or omissions jeopardizing safety of flight.

*8. Hydraulic System Failure.

Qualified — Demonstrated thorough knowledge of hydraulic system components and functions. Displayed troubleshooting capabilities to isolate leaks and restore system operations.

Conditionally Qualified — Showed minor lack of knowledge of hydraulic system components and functions. Slow to troubleshoot or isolate leaks and restore system operations.

Unqualified — Lacked satisfactory knowledge of hydraulic systems components and functions. Incorrect or unsafe procedures.

*9. Propeller Malfunctions.

Qualified — Demonstrated thorough systems and procedural knowledge of propeller malfunctions. Completely familiar with symptoms and procedures for pitchlocked or decoupled propellers.

Conditionally Qualified — Minor errors or lack of understanding of systems or procedures not affecting safe operation. Slow to identify or inform the pilot of propeller malfunction, pitchlock, or decoupled propeller.

Unqualified — Failed to identify or inform the pilot of propeller malfunction, pitchlock, or windmilling decoupled propeller. Knowledge of protecting systems limited to the extent that safe operating procedures are jeopardized.

*Critical area/Subarea

*10. Engine/Fuel System Malfunction.

Qualified — Demonstrated thorough knowledge of engine/fuel system components and functions. Thoroughly familiar with procedures associated with those systems.

Conditionally Qualified — Showed minor lack of knowledge of engine/fuel system. Minor deviations from procedures not affecting safety of flight.

Unqualified — Lacked satisfactory knowledge of engine/fuel system. Incorrect or unsafe procedures used. Did not secure fuel boost pump with fuel leak.

*Area F: Landings

*1. Normal Landings.

Qualified — Set power as required by pilot. Monitored engine instruments and systems continuously to provide expedient warning of any malfunction. Alert for execution of waveoff.

Conditionally Qualified — Had difficulty setting or maintaining required power for pilot. Slow to recognize or inform the pilot of any discrepancy. Slow to identify or inform the pilot of the lack of a beta light with power levers in the ground range.

Unqualified — Failed to recognize or inform the pilot of the lack of a beta light with power levers in the ground range. Any discrepancy or condition that would affect safety of flight.

*2. Abnormal Landings.

Qualified — Demonstrated thorough knowledge and understanding of procedures for waveoff, one- and two-engine-out, and no-flap landings.

Conditionally Qualified — Minor lack of understanding or execution of procedures for waveoff, one- and two-engine-out, and no-flap landings.

Unqualified — Failed to properly execute procedures for waveoff, one and two engine out, or no flap landings. Did not start APU when single generator operations, or improperly computed landing ground roll distance for no-flap landing.

*3. Landing Gear Emergencies.

Qualified — Demonstrated a thorough knowledge and understanding of landing gear extension and retraction malfunctions.

Conditionally Qualified — Minor lack of knowledge or understanding of the NATOPS procedures. Minor deviation in the execution of procedures that would not adversely affect safety of flight.

Unqualified — Any action or condition that would directly affect safety of flight.

4. Air-Conditioning Control.

Qualified — Demonstrated thorough knowledge of air-conditioning system limitations and operation. Frequently monitored flight and cabin temperatures and operated system in accordance with the NATOPS Flight manual.

Conditionally Qualified — Minor lack of understanding of the air-conditioning system or operation. Slow to properly monitor temperature or correct discrepancies.

Unqualified — Failed to demonstrate adequate understanding of system limitations or operations. Did not take proper corrective action for discrepancies.

*Critical area/Subarea

5. Postflight.

   Qualified — Properly completed postflight inspection in accordance with current NAVAIR directives. Debriefed maintenance control on all discrepancies and completed all required forms.

   Conditionally Qualified — Minor errors in completion of postflight inspection or the debrief with maintenance control. Did not complete required postflight forms.

   Unqualified — Failed to perform or complete a postflight inspection. Did not debrief maintenance control or fill out required forms.

Area G: Aircraft General Operations

*1. Safety and Survival Equipment.

   Qualified — Demonstrated thorough knowledge and utilization of required equipment. Properly fitted and worn.

   Conditionally Qualified — Minor omissions noted or minor lack of knowledge of required equipment.

   Unqualified — Any omission of safety or survival equipment that would preclude a successful ditch or bailout or jeopardize safety or survival.

2. Systems Knowledge.

   Qualified — Demonstrated thorough knowledge of all propeller, engine, and other airframe related systems limitations and procedures. Properly demonstrated the use and operation of NATOPS propeller, engine, or other related schematics.

   Conditionally Qualified — Minor lack of knowledge or understanding of any propeller, engine, or other related systems limitations, procedures, or schematics.

   Unqualified — Major lack of knowledge of any propeller, engine, or other related systems. Unable to operate or completely understand system related schematics.

*3. Instrument Scan.

   Qualified — Maintained a thorough scan of all flight station instrumentation and related systems. Promptly identified and informed pilots of any discrepancy.

   Conditionally Qualified — Slow to identify or inform pilots of any flight station instrumentation or related system discrepancy.

   Unqualified — Failure to identify or inform pilots of any flight station instrumentation or related system discrepancy.

*4. Equipment Knowledge/Circuit Breaker Location.

   Qualified — Demonstrated a thorough knowledge of aircraft avionics, antennas, circuit breakers, and their locations.

   Conditionally Qualified — Minor lack of knowledge or understanding of the aircraft avionics, antennas, circuit breakers, or their locations.

   Unqualified — Major lack of knowledge or understanding of the aircraft avionics, antennas, circuit breakers, or their locations.

*Critical area/Subarea

5. Crew Supervision.

   Qualified — Fully understood duties and responsibilities and was acquainted with all aspects of the flight. Coordinated the efforts of all other enlisted crewmembers embarked to complete the preflight and postflight requirements in a timely manner.

   Conditionally Qualified — Minor lack of understanding of duties or responsibilities for flight. Slow to coordinate other enlisted crewmembers during preflight and postflight.

   Unqualified — Major lack of understanding of duties or responsibilities for flight. Failed to coordinate the other enlisted crewmembers during preflight and postflight.

*6. Checklist Utilization.

   Qualified — Complete understanding and proper responses to all normal and emergency checklists.

   Conditionally Qualified — Minor discrepancies in checklist operation or understanding that would not directly affect safety of flight.

   Unqualified — Major discrepancies in checklist operation or understanding that would directly affect safety of flight.

*Area H: Crew Resource Management

*1. Crew Coordination.

   Qualified — Maintained and promoted crew coordination. Verbally acknowledged and carried out all commands given by the pilots. Kept pilots informed of all deficiencies discovered in any flight-related system.

   Conditionally Qualified — Errors noted in crew coordination not adversely affecting flight safety. Slow to carry out or failed to verbally acknowledge commands given by the pilots.

   Unqualified — Failed to demonstrate satisfactory crew coordination. Promoted lack of communication or understanding within the flight station that adversely affected safety of flight.

*2. Positional/Situational/MOSA Awareness.

   Qualified — Maintained an effective awareness of aircraft position and crew situation. Was familiar with current MOSA.

   Conditionally Qualified — Minor lack of awareness of aircraft position or crew situation.

   Unqualified — No knowledge of aircraft position or crew situation. Did not know current MOSA.

*3. Conditions of Flight.

   Qualified — Knowledge of conditions of flight under crew supervision.

   Conditionally Qualified — Did not properly coordinate setting of conditions of flight.

   Unqualified — Failed to set flight conditions.

*Critical area/Subarea

Asterisk (*) denotes critical area/subarea.

P-3 FLIGHT ENGINEER EVALUATION WORKSHEET

NAME	RATE/RANK	TOTAL PILOT HOURS
SQUADRON/UNIT		TOTAL HOURS IN MODEL
DATE OF LAST EVALUATION	DATE OF EXPIRATION	

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
FLIGHT EVALUATION				

FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE
EVALUATOR/INSTRUCTOR		DATE

***A. PREFLIGHT**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. KNOWLEDGE OF APU				
*2. REQUIRED LOGS AND FORMS				
*3. PERFORMANCE COMPUTATIONS				
*4. AIRCRAFT INSPECTION				
NUMERICAL AREA GRADE	TOTAL POINTS			

B. PRETAKEOFF	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. BEFORE START				
*2. NORMAL STARTS				
*3. START MALFUNCTIONS				
4. AFTER START				
5. TAXI PROCEDURES				
*6. BEFORE TAKEOFF				
NUMERICAL AREA GRADE	TOTAL POINTS			

***C. TAKEOFF AND CLIMB**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. POWER APPLICATION				
*2. MALFUNCTIONS DURING TAKEOFF				

***C. TAKEOFF, CLIMB, CRUISE** cont.	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*3. PATTERN PROCEDURES				
4. CLIMB				
5. NTS CHECK				
NUMERICAL AREA GRADE	TOTAL POINTS			

D. CRUISE	**ADJECTIVE AREA GRADE**			
SUBAREAS	Q	CQ	U	POINTS
1. LOITER PROCEDURES				
*2. ANTI-ICING PROCEDURES				
*3. FUEL MANAGEMENT				
*4. PRESSURIZATION CONTROL				
NUMERICAL AREA GRADE	TOTAL POINTS			

REMARKS

Figure 26-4. Flight Engineer Evaluation Worksheet (Sheet 1 of 2)

Asterisk (*) denotes critical area/subarea.

P-3 FLIGHT ENGINEER EVALUATION WORKSHEET

*E. EMERGENCIES	ADJECTIVE AREA GRADE			
SUBAREA	Q	CQ	U	POINTS
*1. ENGINE FIRE				
*2. PROPELLER FAILS TO FEATHER				
*3. ENGINE RESTART				
*4. LOSS OF ELECTRICAL POWER				
*5. FIRE OF UNKNOWN ORIGIN				
*6. SMOKE OR FUME ELIMINATION				
*7. DITCHING OR BAILOUT DRILL				
*8. HYDRAULIC SYSTEM FAILURE				
*9. PROPELLER MALFUNCTIONS				
*10. ENGINE/FUEL SYSTEM MALFUNCTION				
NUMERICAL AREA GRADE	TOTAL POINTS			

*F. LANDINGS	ADJECTIVE AREA GRADE			
SUBAREA	Q	CQ	U	POINTS
*1. NORMAL LANDINGS				
*2. ABNORMAL LANDINGS				
*3. LANDING GEAR EMERGENCIES				
4. AIR-CONDITIONING CONTROL				
5. POSTFLIGHT				
NUMERICAL AREA GRADE	TOTAL POINTS			

G. AIRCRAFT GENERAL OPERATIONS	ADJECTIVE AREA GRADE			
SUBAREA	Q	CQ	U	POINTS
*1. SAFETY AND SURVIVAL EQUIPMENT				
2. SYSTEMS KNOWLEDGE				
*3. INSTRUMENT SCAN				
*4. EQUIPMENT KNOWLEDGE/ CIRCUIT BREAKER LOCATION				
5. CREW SUPERVISION				
*6. CHECKLIST UTILIZATION				
NUMERICAL AREA GRADE	TOTAL POINTS			

*H. CREW RESOURCE MANAGEMENT	ADJECTIVE AREA GRADE			
SUBAREA	Q	CQ	U	POINTS
*1. CREW COORDINATION				
*2. POSITIONAL/SITUATIONAL/ MOSA AWARENESS				
*3. CONDITIONS OF FLIGHT				
NUMERICAL AREA GRADE	TOTAL POINTS			

A. TOTAL ALL SUBAREA POINTS	
B. TOTAL NUMBER SUBAREAS GRADED	
C. EVALUATION NUMERICAL GRADE A/B	
**EVALUATION ADJECTIVE GRADE	

**SEE OPNAVINST 3710.7

REMARKS

Figure 26-4. Flight Engineer Evaluation Worksheet (Sheet 2 of 2)

PART XI

Performance Data

Chapter 27 — Performance Data Introduction

Chapter 28 — Engine Performance Data

Chapter 29 — Takeoff

Chapter 30 — Approach and Landing

Chapter 31 — Climb and Descent

Chapter 32 — Flight Planning

Chapter 33 — Operating Tables

CHAPTER 27

Performance Data Introduction

27.1 PURPOSE, SCOPE, AND ARRANGEMENT

This performance data chart provides information to be used as a guide for safe and efficient operation of the aircraft. The material intended for use by the flightcrew prior to and during flight has been considered of paramount importance; consequently, the charts and tables concerned have been arranged to yield direct solutions wherever possible.

A chapter type arrangement groups the data so that general information, engine characteristics, field length requirements, flight planning information, and operating tables can be located quickly. Refer to Figure 27-1 for general symbols and definitions.

27.2 PERFORMANCE DATA BASIS

Performance data included in this part are based on the results of flight tests of P-3B aircraft when using JP-4 fuel. Flight tests with the P-3C aircraft produced the same results.

ΔV	Speed Difference
IAS	Indicated Airspeed — Knots
CAS	Calibrated Airspeed — Knots
EAS	Equivalent Airspeed — Knots
TAS	True Airspeed — Knots
GS	Ground speed — Knots
$V_{MC\ GRD}$	Minimum Control Speed on Ground
$V_{MC\ AIR}$	Minimum Control Speed in Air
V_R	Refusal Speed
V_D	Decision Speed
V_{RO}	Takeoff Rotation Speed
V_{LOF}	Liftoff Speed
V_{50}	Airspeed at 50-ft. height
V_{EF}	Engine Failure Speed
IMN	Ind. Mach Number
Hp	Pressure Altitude
Hd	Density Altitude
FAT	Ambient Air Temperature
σ	Air Density Ratio — Sigma
δ	Air Pressure Ratio — Delta
SHP	Shaft Horsepower as indicated by cockpit gauge for 13,820 rpm
rpm	Engine Speed, revolutions per minute
TIT	Turbine Inlet Temperature
SFC	Specific Fuel Consumption, Lb/Hr/SHP
T	Temperature
Δ	Temperature Difference

Figure 27-1. Symbols and Definitions

27.3 STANDARD OPERATING CONFIGURATIONS

Separate flight planning data and operating tables are provided for flight without external stores and for various wing store combinations. The applicable drag count configuration is noted on the charts. Wing stores do not affect field length requirements materially; although, takeoff and climb out distances will be slightly longer because of the increase in drag.

27.4 DRAG COUNT

The external stores carrying capabilities of the P-3 dictate the need for a method whereby adequate accounting is made for the effects of these stores on aircraft performance. A drag count format has been selected to fill this need. To predict aircraft performance when external stores are carried, it is necessary to determine the total drag of the stores prior to selecting the series of charts to be used for performance prediction. This is done by use of Figure 27-2, which lists incremental drag for a variety of external stores.

WEAPON WEIGHT AND DRAG COUNT			
STORE (FOR ANY APPROVED EXTERNAL CARRIAGE)	**USE**	**WEIGHT**	**DRAG COUNT (PER STORE INCLUDING PYLON)**
Mk 46	Warshot	558	
Mk 46	Rextorp, w/ pinger, ballasted	544	
Mk 46	Rextorp, w/ pinger, unballasted	363	
Mk 46	Rextorp, w/o pinger, ballasted	528	
Mk 46	Rextorp, w/o pinger, unballasted	348	
Mk 46	Extorp, w/ pinger	528	
Mk 46	Extorp, w/o pinger	513	
Mk 50	Warshot or Extorp	798	
Mk 50	Rextorp, w/ pinger	491	
Mk 50	Rextorp, w/o pinger	476	
Mk 54	Warshot	587	
No external stores or pylons			0
Pylon and Rack			20
SUU-25	Flare Dispenser, empty	262	45
SUU-25	Flare Dispenser, loaded	502	45
LAU-10	Rocket Launcher, unfaired	136	90
LAU-10	Rocket Launcher, faired	684	45
LAU-61	Rocket Launcher, unfaired	160	64
LAU-61	Rocket Launcher, faired	698	43
LAU-68	Rocket Launcher, unfaired	78	45
LAU-68	Rocket Launcher, faired	276	31
Mk 20 Mod 9 CBU-99AB/BB	Rockeye	509	53
Mk 20 Mods 6/11 CBU-99B	Rockeye	506	53
Mk 20 Mods 3/12	Rockeye	490	53
CBU-100/B	Rockeye	490	53
CBU-100AB/BB	Rockeye	493	53
AGM/CATM-84 H/K	SLAMER/captive training SLAMER	1487	135
XATM-84 H/K	Exercise telemetry SLAMER	1491	135

Figure 27-2. External Stores Weight/Drag Count (Sheet 1 of 3)

WEAPON WEIGHT AND DRAG COUNT			
STORE (FOR ANY APPROVED EXTERNAL CARRIAGE)	**USE**	**WEIGHT**	**DRAG COUNT (PER STORE INCLUDING PYLON)**
XATM/AGM–84 H/K	Partially fueled SLAMER/exercise telemetry SLAMER	1428	135
AWW-13	SLAM Data Link Pod	707	50
AGM-65F, CATM, ATM	Maverick	669	90
LAU-117	Maverick Rail Launcher	135	60
AGM-84D (Grey)	Harpoon	1221	120
AGM-84D (White)	Harpoon	1169	120
ATM-84D (Grey)	Harpoon Telemetry	1213	120
Note Weapon data copied from P-3 NATIP. If any conflict exists between the data contained in the NATOPS and the data in the NATIP, the NATIP is the final authority.			
ATM-84D (White)	Harpoon Telemetry	1161	120
ATM-84D (Grey)	Harpoon (Inert)	1221	120
ATM-84D (White)	Harpoon (Inert)	1169	120
CATM-84D	Harpoon Captive Training	1151	120
HCATM-84D	Harpoon Live Captive Training	1160	120
Mk 52 3B or 3K	Mine faired/unfaired	1018	89/142
Mk 52 4K	Mine faired/unfaired	1024	89/142
Mk 52 5K or 6B	Mine faired/unfaired	1063	89/142
Mk 56 Mod 0, OA12	Mine (moored) faired/unfaired	2210	153/268
Mk 56 Mod 0, OA11	Mine (moored, bomb bay)	2147	
Mk 62 Mod 1	Quickstrike Mine	552	40
Mk 62 Mod 2	Quickstrike Mine	561	40
Mk 62 (BLU-111)	Quickstrike Mine	554	40
Mk 63 Mod 4	Quickstrike mine w/ MAU-91 Fin	1056	54
Mk 63 Mod 4	Quickstrike mine w/ Mk 12 Fin	1003	54
Mk 63 Mod 5	Quickstrike mine w/ MAU-91 Fin	1075	54
Mk 63 Mod 5	Quickstrike mine w/ Mk 12 Fin	1022	54
Mk 63 BLU-110	Quickstrike mine w/ MAU-91 Fin	1065	54
Mk 63 BLU-110	Quickstrike mine w/ Mk 12 Fin	1012	54
Mk 65 OA01K/02K	Quickstrike mine	2446	100
Mk 65 Mod 0	Quickstrike mine	2402	100
Mk 65 Mod 1	Quickstrike mine	2314	100
Mk 82 Mod 1	Bomb	539	40
Mk 82 Mod 2	Bomb	548	40
Mk 82 (BLU-111)	Bomb	541	40
BDU-45	Inert Bomb	537	40
AN/ALQ-78	ESM Pod	177	60
AN/ALQ-167-70	ECM Pod	286	53
AN/ALQ-167-71	ECM Pod	279	62

Figure 27-2. External Stores Weight/Drag Count (Sheet 2 of 3)

WEAPON WEIGHT AND DRAG COUNT			
STORE (FOR ANY APPROVED EXTERNAL CARRIAGE)	**USE**	**WEIGHT**	**DRAG COUNT (PER STORE INCLUDING PYLON)**
LAU-7 w/ ADU-299 adapter	Rail for Tracking Pods	114	20
LATR/TACTS	Range Tracking Pods w/o ballast	124	20
Note Weapon data copied from P-3 NATIP. If any conflict exists between the data contained in the NATOPS and the data in the NATIP, the NATIP is the final authority.			
LATR/TACTS	Range Tracking Pods w/ ballast	190	20
EATS POD	Range Tracking Pod	152	20
AN/ALE-37A	Dispensing Pod (Empty)	172	58
AN/ALE-37A	Dispensing Pod (Full)	378	58
ALR-66C(V)3	ESM Pod (AIP AIRCRAFT)	-	90
GTC-18-15	Generator	-	50
IRDS Turret (extended)	Turret	-	40
Mk 64/84 SUS	Signaling Device	7	-

Figure 27-2. External Stores Weight/Drag Count (Sheet 3 of 3)

Once the aircraft external stores configuration has been established, the incremental drag count values for each store as obtained from the table should be added together to obtain a total drag count.

Determine the applicable performance information by referring to Figure 27-3.

FOR TOTAL DRAG COUNTS FROM	USE CONFIGURATION
0 to 50	A
51 to 260	B
261 to 480	C
700 to 1,050	D
1,051 to 1,500	E

Figure 27-3. External Stores Drag Count

For drag counts between 480 and 700, interpolate between charts C and D.

27.4.1 Example

The aircraft is configured with 5 pylons on wing stations 10, 11, 15, 16, and 17.

Two AGM-65F Maverick Missiles are loaded on stations 10 and 17.

Drag count is computed as follows:

Stations 11, 15, and 16 (3 pylons at 20 each)	60
Stations 10 and 17 (2 Maverick Missiles at 90 each)	180
Total	240

Note

The AGM-65F Maverick Missile drag count value includes the LAU-117 Launcher. If the AGM-65F is fired in flight, the launcher drag count is to be used to recompute total drag count.

27.5 FUEL AND FUEL DENSITY

The standard fuels for operation of the P-3 aircraft are JP-4, JP-5, and JP-8, with nominal densities of 6.5, 6.8, and 6.7 ppg, respectively. Since JP-5 weighs approximately 4.5 percent more than JP-4 for an equal volume, range with the same number of gallons will be 4.5 percent greater with JP-5 fuel. Similarly, range will be 3 percent greater with JP-8. In order to stay within the allowable loading of the aircraft, the weight of the fuel rather than the volume must be considered.

27.6 AIRSPEED-MACH NUMBER CONVERSION

A direct conversion from calibrated airspeed to true Mach number can be made by using Figure 27-4. True airspeed can also be obtained, when indicated air temperature is known, by using the sea-level baseline and the indicated air temperature grid.

27.6.1 Example 1

Calibrated airspeed is 210 knots at 10,000-foot pressure altitude. Figure 27-4 shows that the true Mach number is 0.38 for this combination. The chart also shows that true airspeed is 241 knots under these conditions if indicated air temperature is 0 °C.

27.6.2 Example 2

The desired true Mach number is 0.60 for flight at 20,000-foot pressure altitude. Figure 27-4 shows that the calibrated airspeed required is 275 knots.

27.7 TEMPERATURE COMPRESSIBILITY CORRECTION CHART

Indicated outside air temperature is always higher than the actual ambient value in flight because of the temperature rise associated with ram effects on the indicating system. Figure 27-5 provides a direct means of finding the ambient flight value. Enter the chart at the side with calibrated airspeed and find a point directly opposite, corresponding to the flight pressure altitude. Proceed vertically to the Mach scale and continue vertically to the intersection of this line and a horizontal column corresponding to the indicated temperature; read the ambient temperature directly. Compare this ambient temperature with the standard temperature for the flight pressure altitude shown in the right-hand table and determine the temperature difference, ΔT. Should flight conditions result in temperature/speed combinations that do not fall directly on the table, interpolate.

27.7.1 Example

Calibrated airspeed is 220 knots at 10,000-foot pressure altitude and indicated outside air temperature is 15 °C. Figure 27-5 shows that the correct ambient air temperature is 6 °C. Standard ambient temperature at this altitude is –5 °C; therefore, the ΔT is +11 °C (11 °C above standard).

Since the effect of temperature on engine power available is quite large (approximately 1 percent change in power for each 1 °C change ambient air temperature), it is important to accurately determine ambient air temperatures when predicting or checking aircraft performances. Many aircrewmembers use various types of navigational computers to determine the temperature rise because of the ram effect. The temperature sensing system of the P-3 indicates the total temperature associated with full (100 percent) adiabatic compression. Most computers show the temperature rise associated with 80 percent adiabatic compression; if this is the case, multiply the temperature rise from the computer by 1.25 to get the correct increment to apply to the indicated temperature to find true ambient temperature. To check the computer, set 200 Knots Callibrated Speed (KCAS) opposite 25,000-foot hp. If the reading indicates a temperature rise of 10 °C opposite an indicated temperature 0 °C, the computer has a temperature correction factor of 0.8 and the answer must be multiplied by 1.25 to get the correct increment to apply to the P-3 system. If the reading indicates a temperature rise of 12.5 °C opposite 0 °C OAT, the computer is set for a 100 percent rise and additional corrections need not be applied.

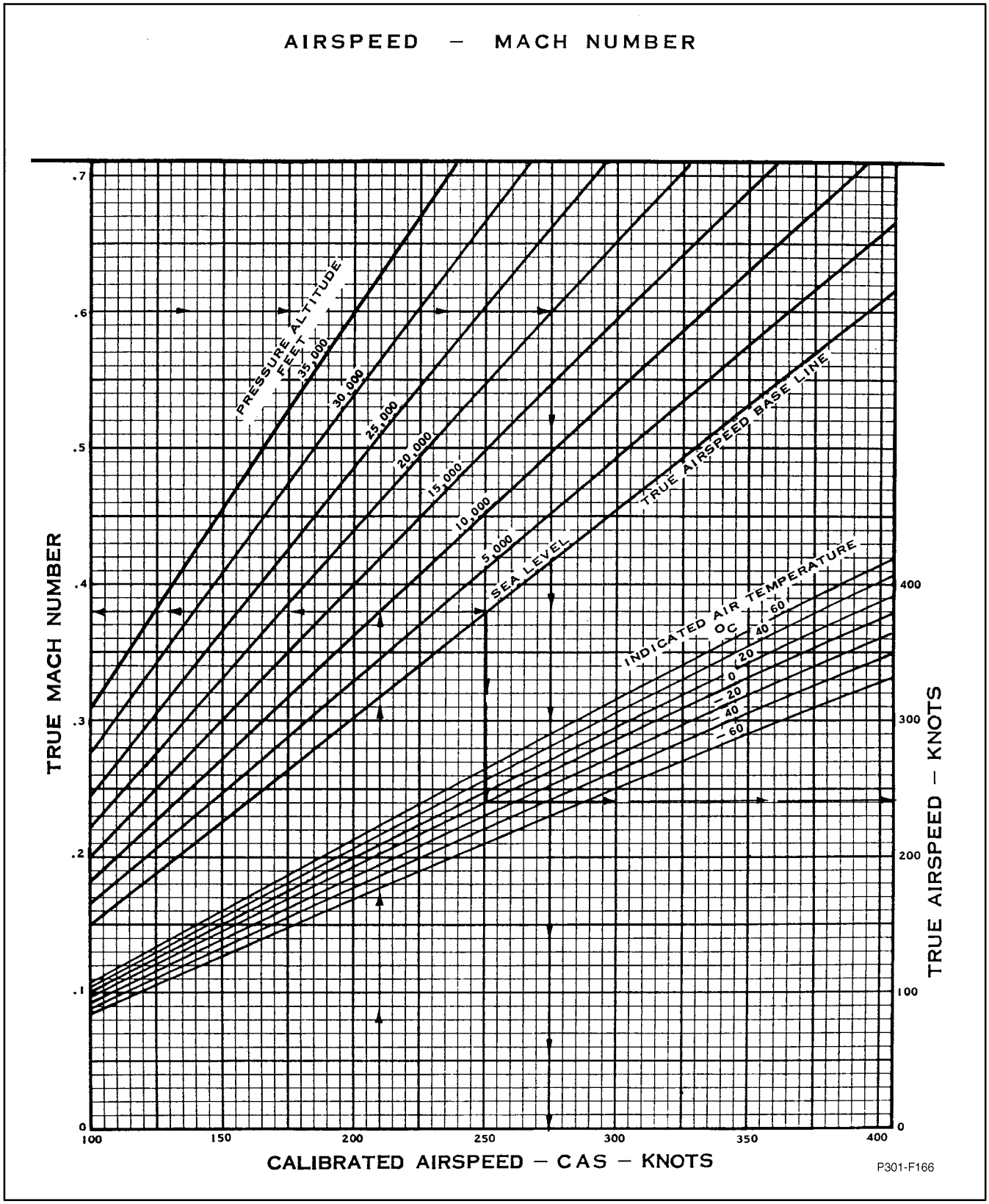
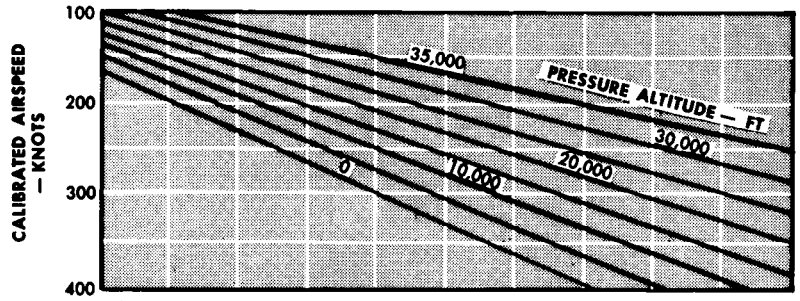


Figure 27-4. Airspeed — Mach Number

NOTE: TEMPERATURE CORRECTION BASED ON 100% ADIABATIC RISE



Indicated Air Temperature — °C	Mach Number .25	.30	.35	.40	.45	.50	.55	.60	.65	.70	.75
-45	−47	−49	−51	−52	−54	−56	−59	−61	−63	−65	−67
-40	−42	−44	−46	−47	−49	−51	−53	−56	−58	−61	−64
-35	−37	−40	−41	−42	−44	−46	−49	−51	−54	−56	−59
-30	−32	−34	−36	−38	−40	−42	−44	−46	−49	−52	−55
-25	−28	−29	−31	−33	−35	−37	−39	−42	−44	−47	−51
-20	−23	−25	−26	−28	−30	−32	−35	−37	−40	−43	−46
-15	−18	−20	−21	−23	−25	−27	−30	−32	−35	−38	−41
-10	−13	−15	−16	−18	−20	−23	−25	−28	−31	−34	−37
-5	− 8	−10	−12	−13	−16	−18	−20	−23	−26	−29	−32
0	− 3	− 5	− 7	− 9	−11	−13	−16	−18	−21	−24	−28
+5	+ 2	0	− 2	− 4	− 6	− 8	−11	−14	−17	−20	−23
10	7	+ 5	+ 3	+ 1	− 1	− 4	− 6	− 9	−12	−15	−19
15	12	10	8	6	+ 4	+ 1	− 2	− 4	− 8	−11	−14
20	16	15	13	11	8	6	+ 3	0	− 3	− 6	−10
25	21	20	18	16	13	11	8	+ 5	+ 2	− 2	− 5
30	26	25	23	21	18	16	13	10	6	+ 3	− 1
35	31	30	28	25	23	20	17	14	11	8	+ 3
40	36	35	32	30	28	25	22	19	16	12	7
45	41	39	37	35	33	30	27	24	20	17	12
50	46	44	42	40	37	35	31	28	25	21	16

AMBIENT AIR TEMPERATURE — °C

Press Altitude (1000 ft)	Std Temp (°C)
0	15
2	11
4	7
6	+3
8	-1
10	-5
12	-9
14	-13
16	-17
18	-21
20	-25
22	-29
24	-33
26	-37
28	-41
30	-44
32	-48
34	-52
35	-84

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Figure 27-5. Temperature Compressibility Correction

27.8 DENSITY ALTITUDE CHART

Figure 27-6 shows the relationship of ambient air temperature, pressure altitude, and density altitude. A line showing the standard-day variation of temperature with altitude is included for reference, as is a scale of 1/square root sigma. To determine density altitude, locate the intersection of the pressure altitude and ambient air temperature lines and read density altitude on the left-hand scale.

Note

Pressure altitude should be read from an instrument set to 29.92 inches Hg when the reading is to be used in determining density altitude.

27.9 STANDARD ATMOSPHERE

Refer to Figure 27-7 for standard atmospheric conditions at a given altitude.

27.10 TEMPERATURE CONVERSION TABLE

Figure 27-8 is a table for converting degrees Fahrenheit to degrees Centigrade and vice versa. To use the table, find the reference temperature in the center column of one of the tables and read the temperature for the desired conversion in the appropriate column.

27.10.1 Example

The reference temperature is 0 °C. Figure 27-8 shows that the corresponding temperature on the Fahrenheit scale is 32 °F.

27.11 STALL SPEED CHART

The relationship of stall speed to gross weight for various wing flap settings is shown in Figure 27-9 in terms of Equivalent Airspeed (EAS). (These speeds are used in the determination of the takeoff and landing speed schedules.) The values given are based on flight tests with the following conditions: zero thrust at airspeeds within 110 percent of the actual stall speeds, forward cg, steady deceleration of 1 knot per second during approach to stall, wings level, and a special airspeed system to minimize position error at stall.

Bank angle increases the apparent weight of the aircraft by the load factor or g force developed. Variation of load factor with bank angle is included in Figure 27-9. To find stall speed, multiply actual weight by load factor and read stall speed from Figure 27-9 for the corresponding apparent weight.

The effect of power is to decrease stall speed approximately 2 knots with an increase of 1,000 SHP on each engine when all four engines are operating. If appropriate, this correction should be applied (following bank angle correction).

27.11.1 Example

Stall speed at 111,000-pound aircraft gross weights, zero thrust maneuver flaps, and wing level is 117 KEAS.

In a 15° banked coordinated turn, the apparent gross weight is 111,000 × 1.035 or 114,885 pounds and the corresponding stall speed is 119 KEAS.

With four engines operating at 1,500 SHP each, the stall speed is decreased by (8 × (1,500/1,000)) or 12 knots.

Note

A tabulation of indicated airspeeds where initial stall buffet is felt is contained in Chapter 10. Data are provided for a variety of gross weights, aircraft configurations, and bank angles.

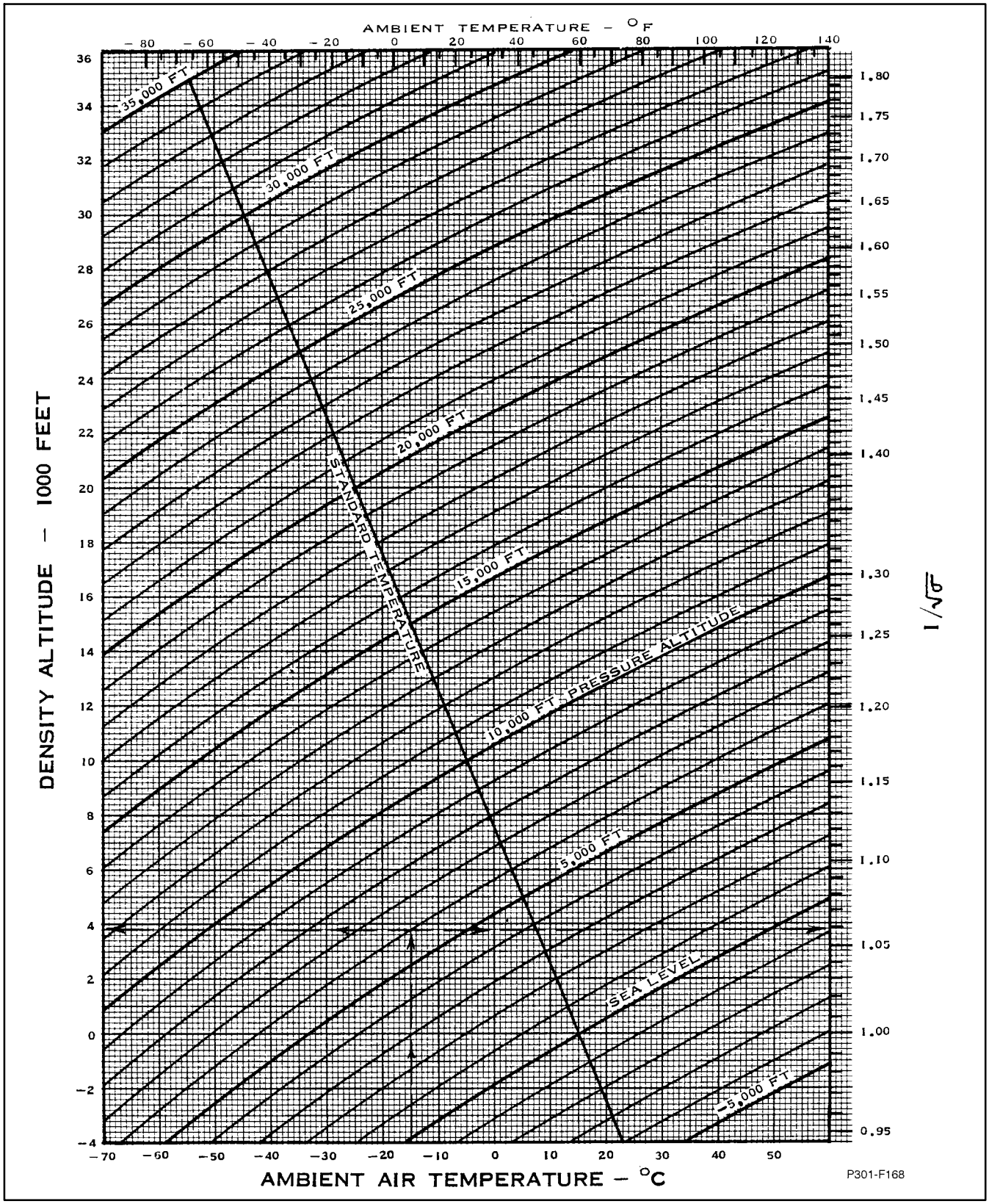


Figure 27-6. Density Altitude

Standard S L Conditions:	Conversion Factors
Temperature 15 °C (59 °F)	1 in HG = 70.727 lb/sq. ft.
Pressure 29.921 in HG 2116.216 lb/sq. ft.	1 in HG = 0.49116 lb/sq. in.
Density 0.0023769 slugs/cu. ft.	1 knot = 1.151 mph
Speed of Sound 1116.39 ft./sec. 661.7 knots	1 knot = 1,688 ft./sec.

Altitude (Feet)	Density Ratio (σ)	$\frac{1}{\sqrt{\sigma}}$	Temperature		Speed of Sound (knots)	Pressure	
			(Deg C)	(Deg F)		Inches of HG	Ratio (δ)
–4000	1.1224	0.94390	22.925	73.265	670.8	34.5072	1.15327
–3000	1.0908	0.95748	20.943	69.698	668.6	33.3107	1.11328
–2000	1.0598	0.97136	18.962	66.132	666.3	32.1481	1.07442
–1000	1.0296	0.98522	16.981	62.566	664.1	31.0185	1.03667
0	1.00000	1.00000	15.000	59.000	661.7	29.9213	1.00000
1000	0.97106	1.01480	13.019	55.434	659.5	28.8557	0.96439
2000	0.94277	1.02990	11.038	51.868	657.2	27.8210	0.92981
3000	0.91512	1.04540	9.056	48.302	654.9	26.8167	0.89624
4000	0.88808	1.06110	7.075	44.735	652.6	25.8418	0.86366
5000	0.86167	1.0773	5.094	41.169	650.3	24.8959	0.83205
6000	0.83586	1.0938	3.113	37.603	648.0	23.9782	0.80138
7000	0.81064	1.1107	1.132	34.037	645.6	23.0881	0.77163
8000	0.78601	1.1279	–0.850	30.471	643.3	22.2249	0.74278
9000	0.76196	1.1456	–2.831	26.905	641.1	21.3881	0.71481
10,000	0.73848	1.1637	–4.812	23.338	638.6	20.5769	0.68770
11,000	0.71555	1.1822	–6.793	19.772	636.2	19.7909	0.66143
12,000	0.69317	1.2011	–8.774	16.206	633.9	19.0293	0.63598
13,000	0.67133	1.2205	–10.756	12.640	631.5	18.2917	0.61133
14,000	0.65002	1.2403	–12.737	9.074	629.1	17.5773	0.58745
15,000	0.62923	1.2606	–14.718	5.508	626.7	16.8858	0.56434
16,000	0.60896	1.2815	–16.699	1.941	624.3	16.2614	0.54197
17,000	0.58919	1.3028	–18.680	–1.625	621.9	15.5687	0.52032
18,000	0.56991	1.3246	–20.662	–5.191	619.5	14.9421	0.49938
19,000	0.55112	1.3470	–22.643	–8.757	617.0	14.3360	0.47913
20,000	0.53281	1.3700	–24.624	–12.323	614.6	13.7501	0.45954
21,000	0.51496	1.3935	–26.605	–15.889	612.1	13.1386	0.44061
22,000	0.49758	1.4176	–28.586	–19.456	609.7	12.6363	0.42232
23,000	0.48065	1.4424	–30.568	–23.022	607.2	12.1074	0.40464
24,000	0.46416	1.4678	–32.549	–26.588	604.7	11.5967	0.38757
25,000	0.44811	1.4938	–34.530	–30.154	602.2	11.1035	0.37109
26,000	0.43249	1.5206	–36.511	–33.720	599.7	10.6274	0.35518
27,000	0.41729	1.5480	–38.493	–37.286	597.2	10.1681	0.33983
28,000	0.40250	1.5762	–40.474	–40.852	594.6	9.7249	0.32502
29,000	0.38812	1.6052	–42.455	–44.419	592.1	9.2975	0.31073
30,000	0.37413	1.6349	–44.436	–47.985	589.6	8.8854	0.29696
31,000	0.36053	1.6654	–46.417	–51.551	587.0	8.4883	0.28369
32,000	0.34731	1.6968	–48.398	–55.117	584.4	8.1056	0.27090
33,000	0.33447	1.7291	–50.397	–58.683	581.8	7.7371	0.25858
34,000	0.32199	1.7623	–52.361	–62.249	579.3	7.3822	0.24672
35,000	0.30987	1.7964	–54.342	–65.816	576.7	7.0406	0.23530
36,000	0.29810	1.8315	–56.323	–69.382	574.1	6.7119	0.22432
37,000	0.28435	1.8753	–56.500	–69.700	573.8	6.3970	0.21379
38,000	0.27100	1.9209	–56.500	–69.700	573.8	6.0968	0.20376
39,000	0.25829	1.9677	–56.500	–69.700	573.8	5.8107	0.19420

Figure 27-7. Standard Atmosphere

°C	°F/°C	°F	°C	°F/°C	°F	°C	°F/°C	°F	°C	°F/°C	°F
–40.0	–40	–40.0	–17.8	0	32.0	4.4	40	104.0	26.7	80	176.0
–39.4	–39	–38.2	–17.2	1	33.8	5.0	41	105.8	27.2	81	177.8
–38.9	–38	–36.4	–16.7	2	35.6	5.6	42	107.6	27.7	82	179.6
–38.3	–37	–34.6	–16.1	3	37.4	6.1	43	109.4	28.3	83	181.4
–37.8	–36	–32.8	–15.6	4	39.2	6.7	44	111.2	28.9	84	183.2
–37.2	–35	–31.0	–15.0	5	41.0	7.2	45	113.0	29.4	85	185.0
–36.7	–34	–29.2	–14.4	6	42.8	7.8	46	114.8	30.0	86	186.8
–36.1	–33	–27.4	–13.9	7	44.6	8.3	47	116.6	30.6	87	188.6
–35.6	–32	–25.6	–13.3	8	46.4	8.9	48	118.4	31.1	88	190.4
–35.0	–31	–23.8	–12.8	9	48.2	9.4	49	120.2	31.7	89	192.2
–34.4	–30	–22.0	–12.2	10	50.0	10.0	50	122.0	32.2	90	194.0
–33.9	–29	–20.2	–11.7	11	51.8	10.6	51	123.8	32.8	91	195.8
–33.3	–28	–18.4	–11.1	12	53.6	11.1	52	125.6	33.3	92	197.6
–32.8	–27	–16.6	–10.6	13	55.4	11.7	53	127.4	33.9	93	199.4
–32.2	–26	–14.8	–10.0	14	57.2	12.2	54	129.2	34.4	94	201.2
–31.7	–25	–13.0	–9.4	15	59.0	12.8	55	131.0	35.0	95	203.0
–31.1	–24	–11.2	–8.9	16	60.8	13.3	56	132.8	35.6	96	204.8
–30.6	–23	–9.4	–8.3	17	62.6	13.9	57	134.6	36.1	97	206.6
–30.0	–22	–7.6	–7.8	18	64.4	14.4	58	136.4	36.7	98	208.4
–29.4	–21	–5.8	–7.2	19	66.2	15.0	59	138.2	37.2	99	210.2
–28.9	–20	–4.0	–6.7	20	68.0	15.6	60	140.0	37.8	100	212.0
–28.3	–19	–2.2	–6.1	21	69.8	16.1	61	141.8	38.3	101	213.8
–27.8	–18	–0.4	–5.6	22	71.6	16.7	62	143.6	38.9	102	215.6
–27.2	–17	1.4	–5.0	23	73.4	17.2	63	145.4	39.4	103	217.4
–26.7	–16	3.2	–4.4	24	75.2	17.8	64	147.2	40.0	104	219.2
–26.1	–15	5.0	–3.9	25	77.0	18.3	65	149.0	40.6	105	221.0
–25.6	–14	6.8	–3.3	26	78.8	18.9	66	150.8	41.1	106	222.8
–25.0	–13	8.6	–2.8	27	80.6	19.4	67	152.6	41.7	107	224.6
–24.4	–12	10.4	–2.2	28	82.4	20.0	68	154.4	42.2	108	226.4
–23.9	–11	12.2	–1.7	29	84.2	20.6	69	156.2	42.8	109	228.2
–23.3	–10	14.0	–1.1	30	86.0	21.1	70	158.0	43.3	110	230.0
–22.8	–9	15.8	–0.6	31	87.8	21.7	71	159.8	43.9	111	231.8
–22.2	–8	17.6	0.0	32	89.6	22.2	72	161.6	44.4	112	233.6
–21.7	–7	19.4	0.6	33	91.4	22.8	73	163.4	45.0	113	235.4
–21.1	–6	21.2	1.1	34	93.2	23.3	74	165.2	45.6	114	237.2
–20.6	–5	23.0	1.7	35	95.0	23.9	75	167.0	46.1	115	239.0
–20.0	–4	24.8	2.2	36	96.8	24.4	76	168.8	46.7	116	240.8
–19.4	–3	26.6	2.8	37	98.6	25.0	77	170.6	47.2	117	242.6
–18.9	–2	28.4	3.3	38	100.4	25.6	78	172.4	47.8	118	244.4
–18.3	–1	30.2	3.9	39	102.2	26.1	79	174.2	48.3	119	246.2

HOW TO USE THE TABLE: Use shaded column to find value of temperature to be converted; if in degrees Centigrade, read Fahrenheit equivalent in right-hand column; if in degrees Fahrenheit, read Centigrade equivalent in left-hand column.

Figure 27-8. Temperature Conversion

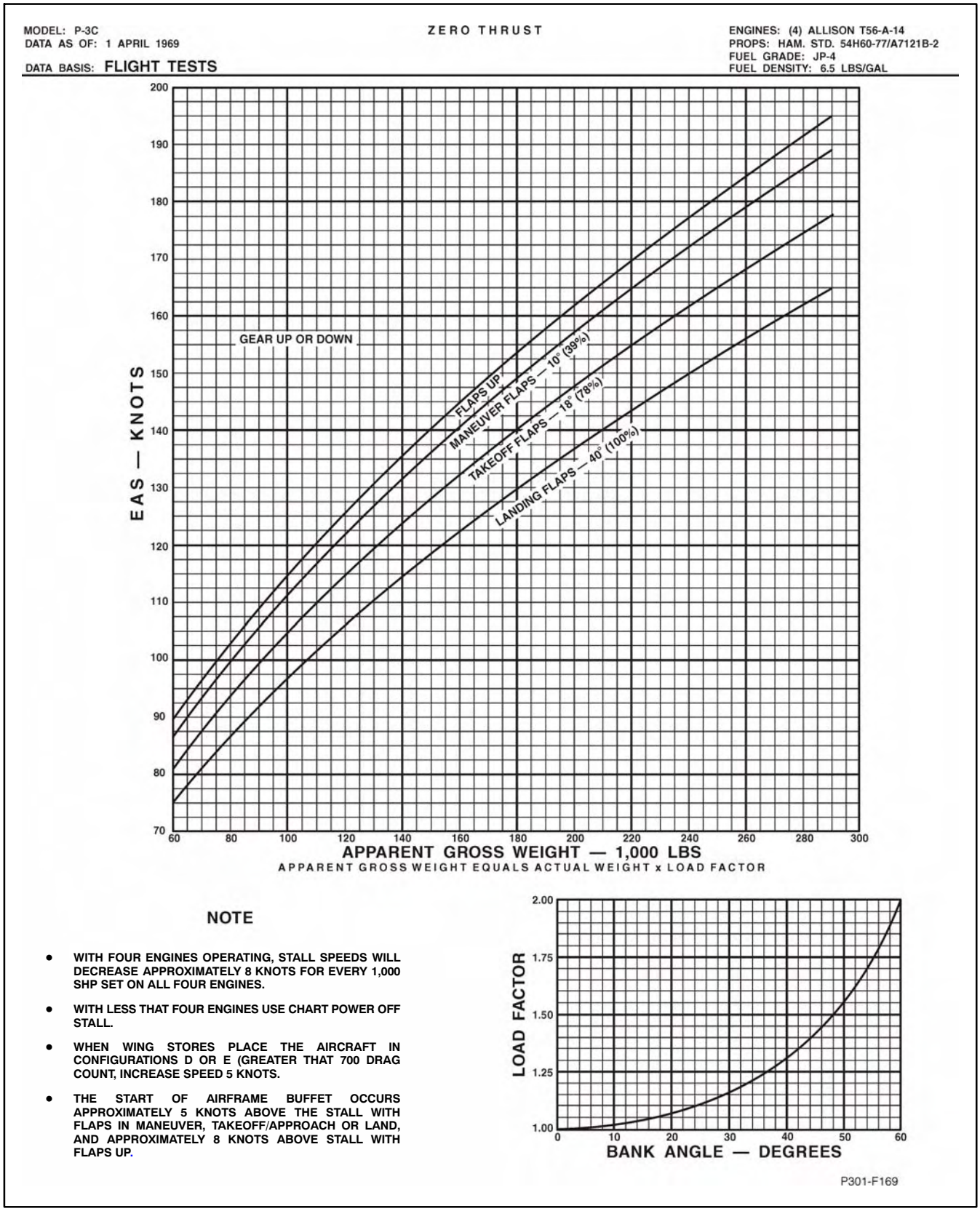


Figure 27-9. Stall Speed

CHAPTER 28

Engine Performance Data

28.1 SCOPE

Aircraft performance data presented in this chapter are based on operation with "standard" engines delivering specification power for the appropriate TIT. Performance of individual engines will vary and their characteristics will change with operating time. The information shown here is intended for reference use in forecasting the minimum engine performance that should be expected and for comparing actual engine performance with the standard. Deviations from standard should be noted, as significant nonstandard performances can be considered cause for inspection.

28.2 STANDARD ENGINE CHARACTERISTICS

The power characteristics shown here represent performance to be expected after operating conditions have stabilized. Power delivered immediately after setting TIT tends to change slightly as the engine temperature conditions stabilize; this characteristic should be recognized when comparing observed standard engine performance. After setting maximum power during the takeoff run, allow a period of at least 10 to 15 seconds so as to reach an airspeed of approximately 80 knots before comparing power with the forecast standard.

28.2.1 Allowances for Power Extraction

Power developed by the engines at 13,820 rpm is indicated directly by the torquemeter system. Not all of this power is available for propulsion since the accessories are mounted on or driven by the gear assembly power extraction pads. Although the loads on individual engines may vary because of differences in equipment loads, the average allowances used here are shown in Figure 28-1.

ENGINES OPERATING	AVERAGE SHP/ENGINE
4	75
3	100
No. 2 & No. 3	150
No. 3 & No. 4	110

Figure 28-1. Equipment SHP Modes

The reduction gearing of each engine absorbs an additional 31 SHP plus one-half percent of the power being transmitted.

28.2.2 Engine Performance with Bleed

Extraction of engine anti-icing bleed air from the engine compressor section changes the engine operating characteristics. Fuel flow increases approximately 5 percent if SHP is maintained at the previous level while the system is operating. Appropriate increases in flight plan climb or cruise-power fuel allowances should be made if use of engine anti-icing bleed is anticipated during portions of a flight. If wing deicing is to be used as well, a nominal allowance of a total of 500 pounds additional fuel should be provided for each hour of anticipated operation in these conditions. Takeoffs should not be attempted with the wing deicing system in use because of the excessive loss of power experienced in this case.

28.2.3 Fuel Flow

Fuel flow values in this section are based on the engine manufacturer's specification as verified by flight tests. New or low-time engines have been found to exhibit better fuel specifics (i.e., lower- fuel flow for a given SHP than engines approaching overhaul time). For this reason, it may be desirable to include some compensation in flight planning for individual aircraft whose engines are known to exhibit better characteristics than those shown by these data. This is done by using a performance index correction factor.

28.2.4 Engine Performance Index Correction Factor

The efficiency of any cruise power setting can be judged by noting the ratio of fuel flow to SHP. This ratio also provides an index by which to judge actual engine operation when it seems to deviate from standard. To determine the ratio, set the engines at a desired cruise power and note the resulting fuel flow. The ratio of actual fuel flow to SHP is actual specific fuel consumption (actual SFC). The value obtained from the engine characteristic charts for the same airspeed, ambient temperature, altitude, and SHP (but not necessarily the same TIT) is chart fuel flow/SHP or chart SFC. The difference between these values is the amount that an engine is deviating from normal, and that the ratio of chart SFC to actual SFC is an index of actual engine performance. It is also the performance index correction factor. This is the factor that can be used to modify chart range and endurance data to establish actual aircraft performance available if it is known that the aircraft performance is in agreement with other charted values.

28.2.4.1 Example

Assume that actual average fuel flow is 1,000 pph at 15,000-foot pressure altitude, 160 KCAS, 10 °C ambient temperature, and 1,780 SHP. For the same conditions of pressure altitude, airspeed, ambient temperature, and power, Figures 28-2 and 28-3 show that chart TIT is 830 °C and fuel flow is 1,050 pph. Chart SFC is (1,050 pph)/(1,780 SHP), or 0.590. Actual SFC is (1,000 pph)/(1,780 SHP), or 0.562. The performance index is the ratio of chart SFC to actual SFC or 1.050. Forecast range and endurance data can be increased by the 5 percent factor.

If there is no interest in determining SFCs, the performance index may be determined by taking the ratio of chart fuel flow to actual fuel flow (1,050 pph chart value)/(1,000 pph actual value) to obtain the correction factor of 1.050.

28.2.5 In-Flight Engine Trending (BELDING) Data Acquisition

Engine trending data acquired in flight shall be used to assist maintenance personnel in the evaluation of engine performance. A P-3 In-Flight Engine Data Record (Figure 28-4) should be completed for each flight.

Note

- Use 2000 SHP on each engine for a more accurate reading. If this SHP is unavailable, use round number settings (e.g., 1800, 1500 SHP).
- If turbulent air is encountered, discontinue the recording procedures until the air is smooth.

Readings are recorded during level flight at any altitude. Allow SHP to stabilize prior to recording data. Do not use bleed air from engines being checked.

Completed in-flight engine data records are to be turned in to the maintenance department upon completion of flight.

28.3 POWER VERSUS TURBINE INLET TEMPERATURE — ZERO AIRSPEED

The power versus TIT chart (Figure 28-5) may be used to forecast power for reduced power or SHP-limited takeoffs. One example shows SHP that should be expected at 900° TIT, 2,000-foot pressure altitude, and 15 °C ambient temperature. The other example shows TIT to be expected when 3,950 SHP is read on the SHP gauges at 2,000-foot pressure altitude and 0 °C ambient temperature.

28.4 POWER AVAILABLE

Power available from the T56-A-14 engine throughout the usable range of TIT may be found in Figure 28-2. The significant power settings on this curve are defined in the following paragraphs.

28.4.1 Reduced Power

Recommended for takeoffs when aircraft gross weight, atmospheric conditions, or runway length indicate no actual refusal speed.

28.4.2 Takeoff Power

Maximum stabilized power is available at a TIT of 1,077 °C. Operation at this temperature is limited to a maximum time of 5 minutes during takeoff. Under some conditions of ambient atmosphere and airspeed, indicated power values can exceed the 4,600 torquemeter SHP limit at 1,077 °C. In this event, TIT must be reduced by retarding the power lever such that 4,600 SHP is not exceeded.

28.4.3 Military Power

Power is available at a TIT of 1,049 °C. Its use is limited to a maximum time of 30 minutes. It is intended for use only during that portion of a mission that demands the ultimate or military effort. A torque meter limit of 4,600 SHP must be observed.

28.4.4 Normal Power

Power is available at a TIT of 1,010 °C. Normal power may be used for continuous operation provided that the limit of 4,600 SHP is not exceeded.

28.4.5 Cruise Power

Power is available at TITs of 1,010 °C or less. Cruise power is limited to a maximum of 4,600 SHP.

28.4.5.1 Example

Use the chart in Figure 28-2 to determine that cruise power available at 15,000-foot pressure altitude, 160 KCAS, and 10 °C ambient air temperature is 1,780 SHP at 830°TIT.

28.5 FUEL FLOW

Figure 28-3 shows the fuel flows corresponding to the power available throughout the range of TIT.

28.5.1 Example

Figure 28-4 shows the fuel flow required at 830°TIT is 1,050 pph/engine at 15,000-foot pressure altitude, 160 KCAS, and 10 °C ambient air temperature.

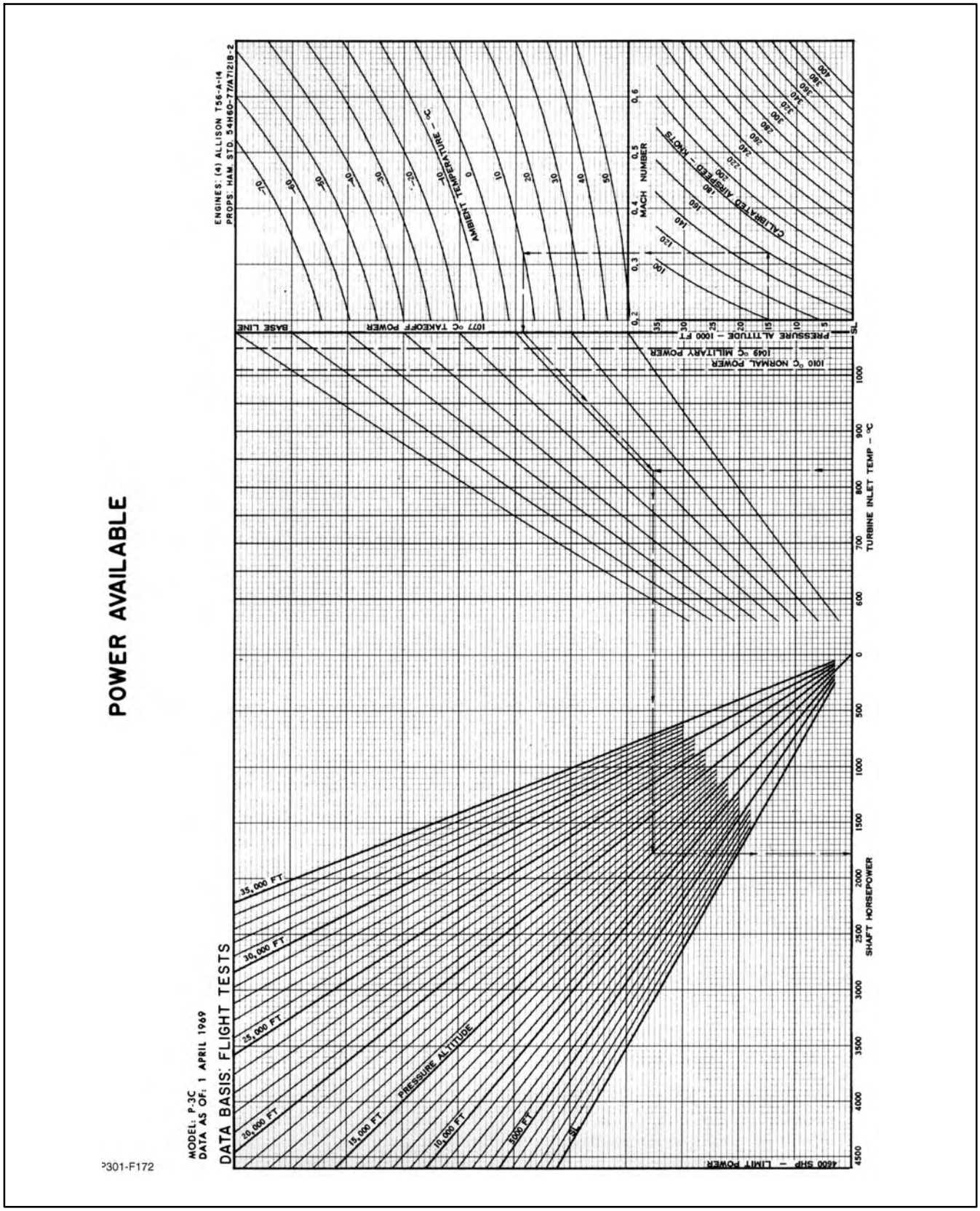


Figure 28-2. Power Available

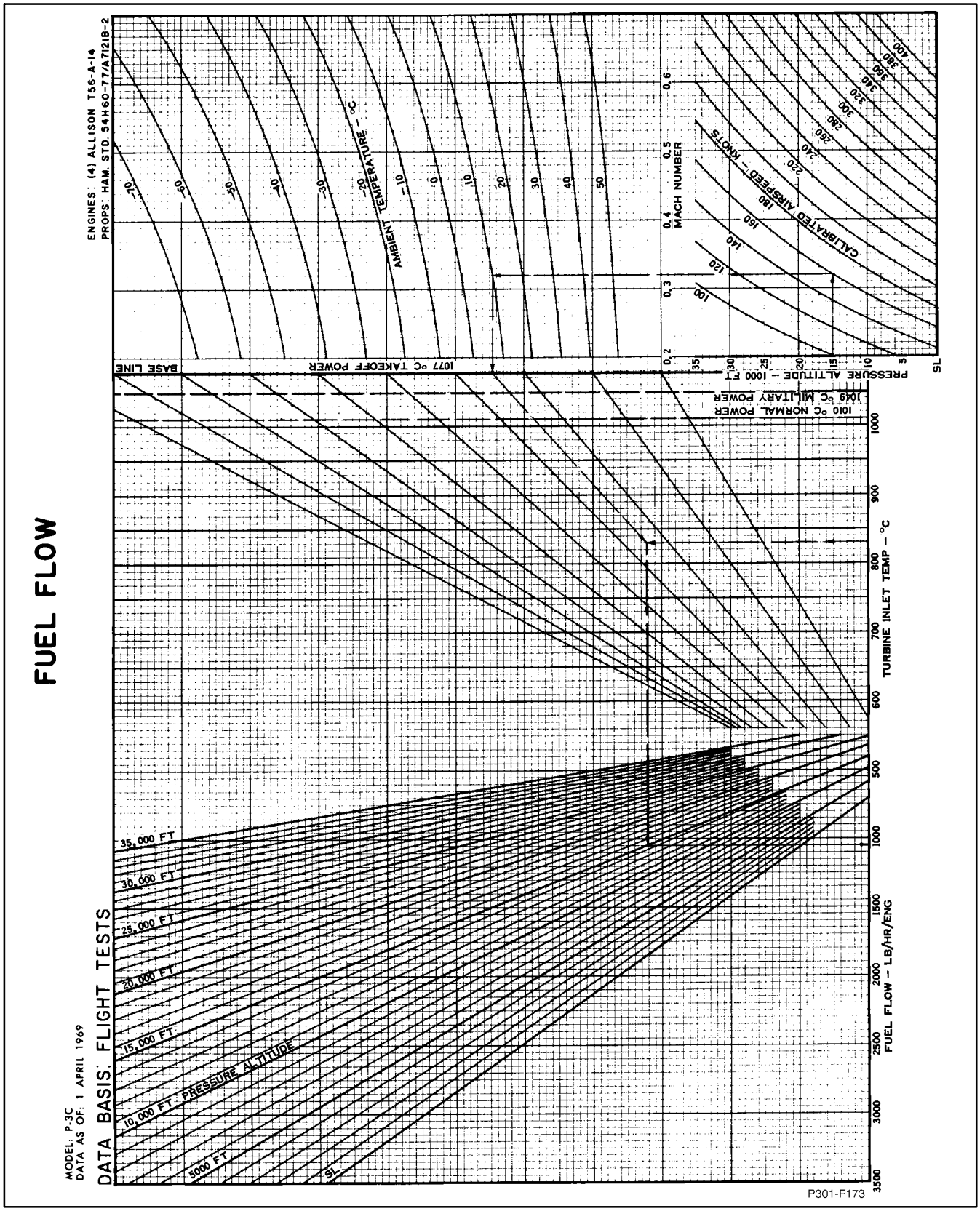


Figure 28-3. Fuel Flow

P-3 In-Flight Engine Data Record
(BELDING)

PROCEDURE:

1. ENGINE ANTI-ICE — OFF.
2. BLEED AIR VALVES — CLOSED.
3. STRAIGHT AND LEVEL FLIGHT.
4. SHP — SET SYMMETRICAL SHP ON ALL FOUR ENGINES.
5. AIRSPEED — ALLOW TO COMPLETELY STABILIZE.
6. ALLOW AT LEAST 3 MINUTES AFTER POWER LEVERS WERE LAST MOVED AND/OR AIRSPEED WAS LAST CHANGED.

DATA

BUNO	**DATE**	**FLIGHT ENGINEER (AD1 PETERMAN)**		
ENGINE	1	2	3	4
SHP (±10)				
TIT (±1°)				
F/F (±10 pph)				

Figure 28-4. P-3 In-Flight Engine Performance Data Table

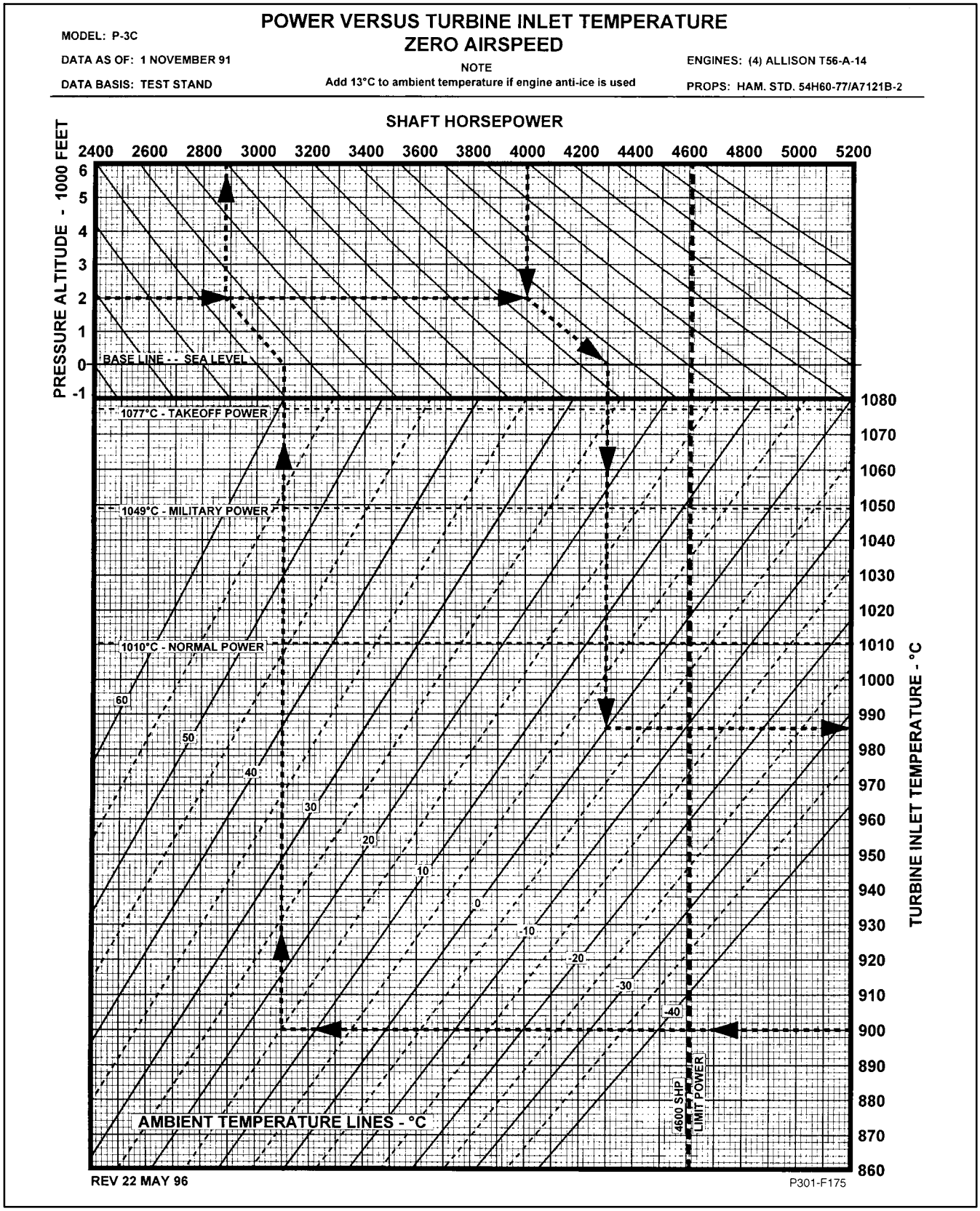


Figure 28-5. Turbine Inlet Temperature Zero Airspeed

CHAPTER 29

Takeoff

29.1 SCOPE

The material presented here permits an effective takeoff plan to be developed that allows a considered sequence of actions to be put into effect without delay if an emergency should arise. Forecasts of normal performance can be made by use of the four-engine acceleration, takeoff, and climbout data. The results of engine failure during various phases of a takeoff (and the performance that remains) can be predicted by use of the refusal- and decision-speed charts and by examination of the three-engine flightpath curves. Proper use of the material allows a decision point and a simple operating procedure to be selected for each takeoff situation.

29.2 STANDARD TERMS

1. Engine failure speed (V_{EF}) — The airspeed at which an engine is assumed to fail completely and instantaneously; or, the airspeed that an emergency occurs at that results in complete loss of power of one engine.

2. Minimum control speed (V_{MC}) — The minimum airspeed at which directional control and heading can be maintained on the ground or in the air with the critical engine inoperative and the other engines delivering maximum power for the existing altitude and temperature conditions.

3. Rotation speed (V_{RO}) — The airspeed at which the transition from ground run attitude to climbout attitude is begun.

4. Liftoff speed (V_{LOF}) — The airspeed at which the aircraft leaves the ground as a result of rotation.

5. Climbout speed (V_{50}) — The target airspeed for proper climbout attitude that is reached at the end of the transition from ground-run attitude. The aircraft is assumed to have reached a nominal height of 50 feet at this point.

6. Refusal speed (V_R) — The maximum airspeed from which the aircraft can abort a takeoff run and stop within the runway length remaining.

7. Refusal distance — The distance at which the aircraft would normally reach refusal speed.

8. Decision speed (V_D) — The minimum engine failure speed from which a safe takeoff can be completed within the runway length remaining.

Note

The aircraft is overweight for the takeoff conditions when decision speed is greater than refusal speed. Decision speed cannot be less than $V_{MC\,GRD}$ for normal takeoff planning when the aircraft is not overweight. The refusal speed will always be equal to or greater than the decision speed and should be used as both refusal and decision speed.

9. Critical field length — The greater of the total ground run distances required to either reach a critical airspeed for engine failure with all engines operating and then stop, or to continue from the engine failure speed and takeoff with one engine inoperative.

10. Critical speed for engine failure (V_{CR}) — The airspeed at which power failure will result in the critical field length described above.

Note

Refusal speed is equal to decision speed if critical field length has been optimized (balanced) for a specified takeoff condition; however, it may not always be possible to optimize the critical field length situation, since V_D cannot be less than $V_{MC\ GRD}$ and V_R should not be greater than rotation speed.

11. Available runway length — The hard-surfaced runway distance available when the aircraft is in position and ready to start the takeoff run, or the length available for landing. (Overrun areas are not usually included.)

29.3 TAKEOFF PERFORMANCE

Takeoff performance available is almost entirely dependent upon gross weight, power available, and the speed schedule used. Gross weight is usually determined by mission requirements. Maximum power is usually restricted by engine limits or by ambient conditions. Therefore, airspeed schedule becomes the major variable that is under control of the pilot. Even here, there are definite recommendations available that should be used for various purposes. An examination and understanding of available schedules is in order.

29.3.1 Normal Performance Airspeeds

Recommended speeds for normal operation have been designed to help the pilot cope with emergency situations as far as possible. They provide as much margin of control and performance as is reasonable in the following manner:

1. All “go-ahead” data are based on speeds at which the pilot can be expected to control the aircraft on the ground in the event of engine failure. Decision speed is always equal to or greater than the minimum ground control speed.

2. All rotation speeds are above the minimum air control speed by a margin of at least 5 percent. Rotation speeds are also well above the stall speeds.

3. All minimum climb speeds are at least 15 percent faster than the zero-thrust stall speeds.

29.3.2 Minimum Control Speed — Ground ($V_{MC\ GRD}$)

$V_{MC\ GRD}$ is the minimum speed that the aircraft can be controlled if one engine becomes inoperative during the takeoff run. It is equal to 102 KIAS with 4,600 SHP per operating engine, and reduces 5 KIAS per 1,000 SHP decrease. (That is,$V_{MC\ GRD}$ reduces to 97 KIAS at 3,600 SHP per engine.) These values are based on tests run on a hard-surfaced runway, using rudder and aileron to maintain directional control after power loss. Nosewheel steering was not used; although, it would assist in maintaining the direction of roll.

29.3.3 Minimum Control Speed — Air ($V_{MC\ AIR}$)

$V_{MC\ AIR}$ is the minimum speed that directional control can be maintained in the air with the most critical engine(s) inoperative. Minimum control speed varies with the number and position of the inoperative engines, altitude, power being developed by the operating engines, and the bank angle.

The effects on air minimum control speed of inoperative engine(s), altitude, and power are shown in Figure 29-1. These values are based on the use of a favorable bank angle (5° away from dead engine), the most critical engine(s) inoperative, takeoff flaps, takeoff or maximum power, and the aircraft trimmed for takeoff.

Note

- Any bank angle deviation from optimum toward the dead engine(s) increases minimum control speed at the rate of approximately 2.6 knots per degree. For example, if the aircraft were banked 5° toward the dead engine(s), the minimum control airspeed would be increased by 26 knots from the values shown.
- $V_{MC\ AIR}$ at heavy weights may be equal to, or less than, the aircraft stall speed. Flight should only be conducted with the higher of the two speeds as the governing factor.
- It is suggested that the pilot always maintain a speed margin above $V_{MC\ AIR}$ rather than operate at the critical value.

29.3.3.1 One Engine Inoperative

Because of the combined effects of torque and asymmetric thrust, the most critical engine is the left outboard (No. 1). Optimum bank angle is 5° away from the failed engine.

29.3.3.1.1 Example

At 3,000-foot density altitude with 4,000 SHP, $V_{MC\ AIR}$ is 105 KIAS with takeoff flaps. Add 13 knots if wings are level.

29.3.3.2 Two Engines Inoperative

Minimum air control speed is substantially higher with two engines on the same side inoperative. At lesser speeds, maintenance of directional control becomes increasingly difficult and it may be impossible to maintain a straight flightpath.

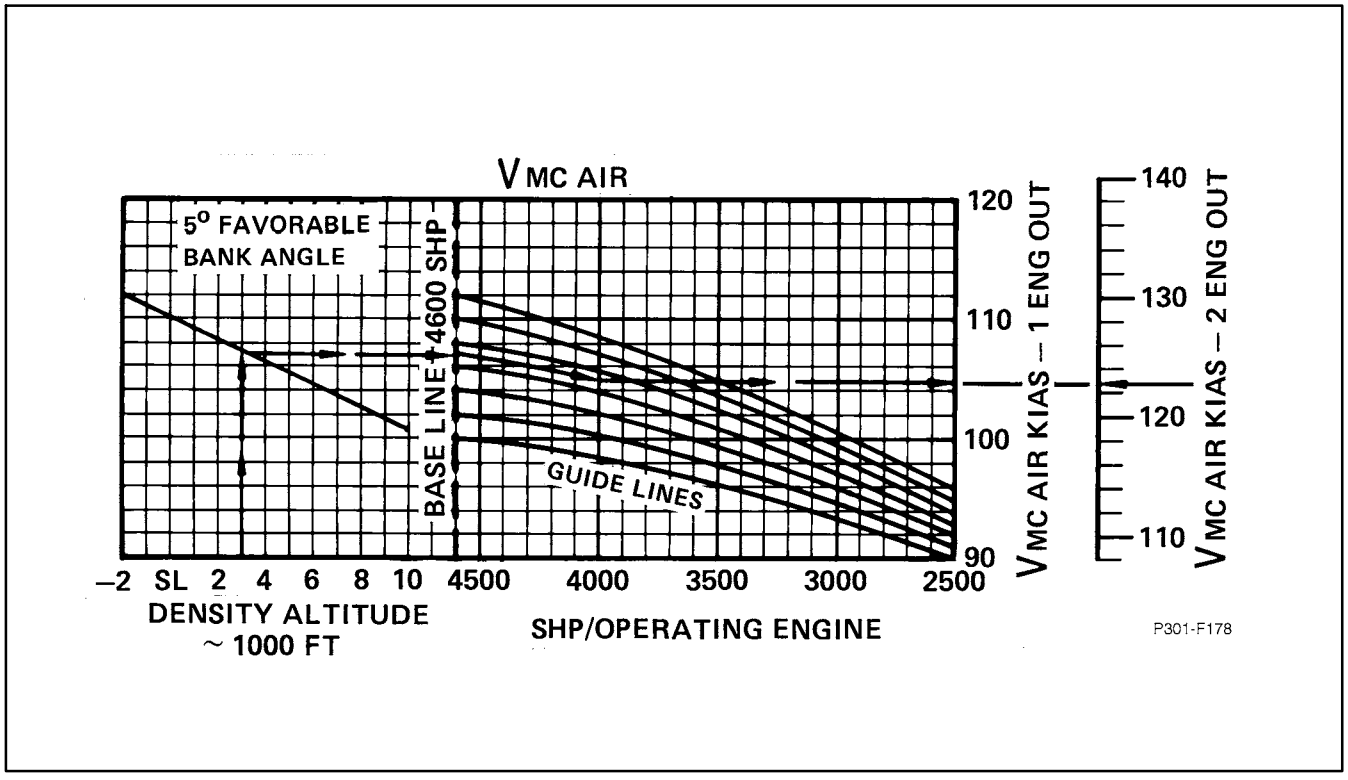


Figure 29-1. Minimum Control Speed — Air

The effect of bank angle on minimum control speed remains unchanged. It is mandatory that a favorable bank angle be maintained. Use of rudder trim will provide additional assistance in maintaining a straight flightpath, as normal pilot effort will not be sufficient to drive the rudder to its full throw.

The least desirable means of maintaining directional control in the case of multiple engine failure on the same side is reduction of asymmetrical power. Since the outboard engine provides the greatest turning moment on the aircraft, directional control can be regained with the least possible overall power reduction by reducing power on the outboard operative engine only, leaving the inboard at full power.

29.3.3.2.1 Example

At 3,000-foot density altitude, with 4,000 SHP, $V_{MC\ AIR}$ is 123 KIAS with takeoff flaps, 5° favorable bank angle, and two engines inoperative.

29.3.4 V_{RO}, V_{LOF}, V_{50} Relationship

There is a distinct relationship between rotation lift-off and climb out speeds. It involves consideration of the thrust-to-weight ratio (acceleration characteristic), rate of response to control (rotation characteristic), and pilot reaction time. A rapidly accelerating aircraft will continue to accelerate throughout the period of rotation to climbout attitude. It will stop accelerating at the point where the pilot can hold a stable climbout flightpath, when power available equals the power required for climbing flight. Therefore, if a target climb speed is selected, an initial rotation speed must also be selected that allows for pilot reaction and aircraft acceleration during the transition. If a target rotation speed is selected, lift-off speed and climbout speed must reflect the characteristic acceleration response during transition. This is the reason for the four- and three-engine V_{50} schedule. The normal takeoff speed schedules shown in Figure 29-9 allow for these transition acceleration characteristics.

29.3.5 Abnormal Performance Speed Schedules

Unusual conditions may require that normal speed schedules be modified to suit special requirements. These conditions might include three-engine ferry takeoffs, minimum distance takeoffs to clear obstacles, and minimum distance ground runs. In general, higher than normal takeoff speeds improve the ability to maintain directional control with an engine inoperative and improve takeoff climb capability, but high speeds also increase the strain on the landing gear system and may result in excessive field length requirements. Lower takeoff speeds reduce the ground-run requirement. A balance between ground-run requirements and climbout capability determines the best speed for obstacle clearance.

Maximum performance takeoffs are usually made under conditions of some urgency, where the results of engine failure cannot be considered. The takeoff planning is based strictly on four-engine performance. Power-on stall speeds and climb capability, not minimum control speeds, form the basis for these takeoff schedules. Minimum ground run is obtained by lifting off at speeds where moderate buffet is felt, with an immediate acceleration to normal speeds being made as soon as the gear is off the ground.

Ferry takeoffs at light weight are normally made at speeds higher than normal for that takeoff weight. Distances are not excessive, and good directional control and climbout capability are maintained. Ferry takeoffs are usually made with favorable operating conditions.

29.3.6 Takeoff Planning Procedure

All takeoffs should be planned to determine:

1. The airspeed at which to reject or continue the takeoff in the event of engine failure.

2. The rotation airspeed and the appropriate airspeeds for four- and three-engine climbout.

3. The amount by which the aircraft performance available exceeds the minimum performance required for safety. Under adverse conditions provide a means for checking progress during the takeoff run. The following steps outline the recommended takeoff planning procedure to be used:

   a. (Mandatory) Determine length of runway available for ground run, runway slope, location of critical obstacle(s), probable condition of runway surface, airport altitude, wind, ambient temperature, and the aircraft gross weight.

   b. (Mandatory) Determine the headwind or tailwind component along the active runway, using Figure 30-3. Decide if the magnitude of crosswind component is critical. Maximum recommended crosswind component for takeoff is 35 knots.

   c. (Mandatory) Determine TIT to set for power check at 80 KIAS, using Figures 28-5, 29-5, 29-6, 29-7, or 29-8 as desired. Base the succeeding steps on this forecast SHP. Determine abort (95 percent) SHP for takeoff.

   d. (Mandatory) Determine the rotation speed and target airspeeds for four- and three-engine climbout, using Figure 29-9. Lift-off will occur at the speed shown if rotation is started at the correct speed. Climbout should be conducted at the recommended 50-foot speed until clear of obstacles.

   e. (Mandatory) Determine refusal speed from Figure 29-11. This is the maximum speed from which the aircraft can be stopped for the existing takeoff conditions. If the chart refusal speed is equal to or greater than the rotation speed, then rotation speed will be used for both.

Note

Reduced power settings shall not result in refusal speed within 5 knots of rotate speed.

   f. (Mandatory) Determine three-engine rate of climb, military power from Figure 29-13.

   g. (Optional) To monitor progress during the takeoff run, predict four-engine acceleration distances to 80 KIAS, refusal speed, rotation speed, and lift-off speed from Figure 29-10.

Note

Step g is mandatory under adverse runway conditions (water, ice, slush, snow) and/or when runway length is near critical (i.e., computed V_R is 5 knots above V_{RO} or less).

The following steps apply if refusal speed is less than rotation speed and/or there is a critical obstacle(s) that must be cleared:

   h. Enter the Decision Speed Chart, Figure 29-12, (total distance to accelerate and takeoff with an engine failure at V_{EF}) with refusal speed to determine the distance to lift-off with an engine failure at refusal speed.

Note

If the distance to lift-off with an engine failure at refusal speed is greater than the available runway, the aircraft is overweight for the existing takeoff conditions.

i. Determine the distance from the three-engine lift-off point (assuming an engine failure at V_R) to the critical obstacle(s) by means of the given airfield and the obstacle(s) geometric data.

j. Determine the height by which the critical obstacle(s) will be cleared if an engine fails at refusal speed, using Figure 29-15, sheets 1 and 2. If desired, the clearance on four engines can be determined by using lift-off distance as determined from Figure 29-10 and the four-engine flightpath of Figure 29-15, sheets 1 and 3.

Note

If the critical obstacle(s) cannot be cleared on three engines, the aircraft is overweight for the existing take off conditions.

29.3.7 Takeoff Planning Problem

The following is proposed as typical for service operations. The solution is given as follows:

Takeoff conditions:

1. Field elevation — 1,400 feet.
2. Ambient temperature — 65 °F.
3. Wind — 15 knots with gusts to 25 knots.
4. Runway length available — 6,000 feet after allowing 200 feet for lineup.
5. Runway slope — 1 percent downhill.
6. Critical obstacle — 75 feet high and 300 feet from end of runway.
7. Tentative gross weight — 118,000 pounds.
8. Military power to be used — Aircraft configuration, four Mk 36 destructors, drag count Configuration B.

29.3.8 Wind Component Chart

Figure 30-3 provides a means for converting reported wind direction and speed to runway and crosswind components. Since windspeeds reported from remote or elevated locations may not represent runway conditions accurately, multiply reported winds by three-fourths when the anemometer is more than 50 feet above runway elevation.

29.3.9 Takeoff Power Forecast — 80 Knots

Figures 28-5, 29-5, 29-6, 29-7, or 29-8 shall be used in forecasting takeoff power. A power check shall be performed at approximately 80 KIAS, which involves determining and setting a known TIT value. Selection of this TIT value should be based on the lowest possible setting for given conditions (e.g., aircraft weight, OAT, altitude, and runway length).

Note

Since specific engine performance is not normally checked on touch-and-go landings, a uniform SHP setting may be used (e.g., 3,500, 3,000, etc.).

It will be necessary to determine as accurately as possible the runway air temperature and pressure altitude at the time of takeoff. Takeoff power can normally be forecast utilizing Figures 29-5, 29-6, 29-7, or 29-8 when runway air temperatures/pressure altitudes permit. To forecast takeoff power when encountering low runway air temperatures or when conducting reduced-power takeoffs, Figure 28-5 or 29-5 should be used. After selecting a TIT value for takeoff, utilize Figures 28-5 or 29-5 to determine the forecast SHP. Takeoffs shall be discontinued if the SHP value at 80 KIAS does not meet at least 95 percent of the forecast value.

CAUTION

- Excessive SHP at 80 knots may be indicative of a TIT indicating system problem or high-performance engine. If a TIT indicating problem is suspected, SHP should be reduced to forecast. It may also be desirable to reduce power on a high-performing engine because of wind, runway conditions, or differences in power.
- If reduced power settings result in SHP falling below the 95 percent forecast value, a subsequent takeoff may be attempted utilizing normal-rated power.

29.3.10 Reduced Power Takeoff

Reduced power takeoffs should be performed whenever possible to preserve turbine life and should be based on gross weight, runway length, and environmental conditions (Figure 29-2). Takeoff power setting should be no lower than that required during climbout. TIT should be reduced as gross weight permits to produce a minimum of 3000 SHP while not exceeding 1010 TIT, provided aircraft performance does not result in runway length or climb performance becoming critical.

Takeoff performance can be predicted by use of the standard takeoff table contained in this chapter, together with the power available at 1,010 °C.

Presentation of the reduced turbine temperature data is in no manner intended to discourage the use of maximum power when aircraft weight, temperature, altitude, or runway length indicate it is desirable. Figure 29-5 presents information for these reduced settings.

TAKEOFF REDUCED POWER SETTING TABLE 950° TIT							
°C	100%	95%	°F	°C	100%	95%	°F
5	3,820	3,629	41	37	2,910	2,765	99
6	3,790	3,601	43	38	2,890	2,746	100
7	3,760	3,572	45	39	2,865	2,722	102
8	3,730	3,544	46	40	2,830	2,689	104
9	3,700	3,515	48	41	2,800	2,660	106

Figure 29-2. Takeoff Reduced Power Setting

29.3.10.1 Example 1 (Figure 29-5)

Takeoff reduced-power setting tables (Figure 29-5) are provided for two TIT values and two SHP values: 925° and 950° and 3,000 and 3,500, respectively. These tables are based on a pressure altitude of sea level. Enter Figure 29-5 with ambient temperature and read 100- and 95 percent values.

Note

For increases in pressure altitudes above sea level, correct as follows:

1. For the 950/925° TIT tables, subtract 12 SHP per 100 feet of altitude increase.
2. For the 3,500/3,000 SHP tables, add 2 °C to predicted TIT per 100 feet of altitude increase.

Note

- Add 13 °C to ambient temperature if engine anti-ice is used.
- In some cases, the power lever position required for operation at reduced power settings is not sufficiently advanced to arm the automatic feathering system. If an engine fails under this condition, the NTS system will limit torque and drag.

29.3.11 Normal Rotation and Climbout Airspeeds

The simplified takeoff schedule shown in Figure 29-9 may be used to determine rotation speed and target speeds for four- and three-engine climbouts if use of the alternate takeoff speed schedule is not specifically recommended. These are plotted versus takeoff weight. Lift-off will occur at the speeds shown if a normal rotation is begun at the scheduled value. Lift-off speed is used only for prediction of takeoff distance.

29.3.11.1 Example

At 118,000 pounds, rotation speed is 121 KIAS; three-engine climbout speed is 130 KIAS; and four-engine climbout speed is 134 KIAS.

The alternate speed schedule may be used if desired. Its use is specifically recommended when operating at airport elevations above 3,000 feet if runway length is marginal and gross weight is less than 108,000 pounds. Its use is also recommended at airport elevations above 3,000 feet if high ambient temperature results in low forecast power regardless of runway length or gross weight.

The alternate schedule results in lower speeds for gross weights less than 108,000 pounds if $V_{MC\,AIR}$ has been reduced as a result of high-density altitude and/or low forecast power. Under these conditions, takeoff distance will be less than for the simplified schedule. The alternate schedule is also more complex because it considers acceleration characteristics that change as density altitude increases or power forecast decreases.

29.3.12 Four-Engine Acceleration Check Distance, Distance to V_{RO}

Figure 29-10, the four-engine acceleration performance chart, should be used to predict the distance to reach 80 KIAS and can be used to find the distances to the rotation and lift-off points. The chart can also be used to predict the distance to reach any other intermediate speed. To correct the zero wind ground-run distance for the effects of wind, subtract 1-1/4 percent per knot of headwind component at the runway or add 2 percent per knot of tailwind. Uphill slopes increase the ground run 8 percent for each 1 percent runway slope, and downhill runs decrease the ground run 6 percent for each percent slope.

29.3.12.1 Example

Zero wind ground-run distance to reach 80 KIAS at 118,000 pounds with a level runway would be 1,300 feet. The correction for wind is 1-1/4 percent of 13 X 1,300 feet, or minus 211 feet. The correction for slope is 6 percent of 1 X 1,300 feet, or minus 78 feet. The corrected distance is 1,300 – 211 – 78, or 1,011 feet. The distance to rotation speed corrects in a similar manner from 3,400 feet for zero slope and wind, to 2,645 feet for the takeoff conditions.

Figure 29-10 may also be used to determine distance required to accelerate to rotation speed and liftoff speed. Enter the chart with the appropriate speed (V_{RO} or V_{LOF}) and read corresponding distance.

29.3.13 Refusal Speed

The refusal speed is the speed of most interest for normal operations, since this is the maximum speed from which the aircraft can be stopped in the event of trouble.

The performance shown by Figure 29-11 is based on ground-idle thrust on three operating engines, and the following maximum true ground speeds for brake application (Figure 29-3).

Gross Weight (Pounds)	Speed (TGS) knots
up to 127,500	120
130,000	118
135,000	113
140,000	109
145,000	105

Figure 29-3. Gross Weight Refusal Speed

Ground-idle thrust provides very effective braking at high airspeeds. It also spoils a great deal of wing lift, making the wheelbrakes much more effective when they are applied below 120 knots; however, airflow over that portion of the wing behind a feathered propeller is not as greatly disturbed, so aileron and rudder control toward the dead engine should be used to reduce lift and counteract asymmetric drag.

29.3.13.1 Example (Dry Runway, RCR = 23)

Refusal speed for 118,000 pounds, 1,400-foot pressure altitude, 65 °F ambient temperature, 6,000-foot runway, and with 4,110 forecast SHP is 117 KIAS with zero wind and slope. Corrected for wind and slope, this becomes higher than rotation speed, and the takeoff may be rejected from the rotation speed.

29.3.14 Effect of Runway Surface Conditions

Stopping distance depends upon a tire-to runway coefficient of friction that will vary with the condition of the runway surface. The condition of the runway surface will be reported as an RCR. The RCR is a measure of the coefficient of friction between the tire and the runway surface, as determined by some decelerometer device. Charts involving stopping distance are generally based on dry concrete or asphalt friction coefficients corresponding to an RCR of 23. Slippery runway surfaces will increase stopping distance and are accounted for by auxiliary scales as a function of RCR.

Many airfields report braking action in accordance with ICAO documents. This is the “good,” “medium,” “poor” categorization of braking action on unusual runway surface condition. In order to relate this categorization to an RCR or when RCR values are not available, the following relationship will be used (Figure 29-4).

Runway Condition	ICAO Report	RCR
Dry	Good	23
Wet	Medium	12
Icy	Poor	05

Figure 29-4. Runway Surface Conditions Index

Also reported will be the RSC that will be the average RSC given in depth and type, such as slush, water, or snow. The depth of this covering can cause a significant increase in the takeoff run because of the retarding effect of the tires displacing the covering plus the additional drag effect of this material being sprayed on the aircraft. Refer to Chapter 18 for approximate distance increases.

The retarding effect of slush and water increases with increasing speed and varies considerably with the varying slush and water depths. The retarding effect of slush and water decreases when the aircraft reaches hydroplaning speed. Hydroplaning occurs because the pressure between the fluid on the runway and the tires increases as speed increases until the tires are entirely supported on top of the fluid. Therefore, an acceleration check, takeoff and/or stopping distances may not be valid when measurable depths of RSC are present and caution should be exercised in flight planning.

29.3.15 Runway Surface Covering

RSC is the average surface covering and is determined in depth to one-tenth inch and type, as listed below:

1. P — Patchy.
2. WR — Wet runway.
3. SLR — Slush on runway.
4. LSR — Loose snow on runway.
5. PSR — Packed snow on runway.
6. IR — Ice on runway.

A typical report of runway condition could be SLR 05P, which would indicate slush on runway with an RCR of 05 and patchy condition.

29.3.15.1 Example (RCR Less Than 23)

Determine refusal speed for the given takeoff conditions (118,000 pounds, 1,400-foot pressure altitude, 65 °F runway temperature, 6,000-foot runway length, 4,110 forecast SHP, 13-knot headwind component, and 1 percent downhill runway slope) and an RCR of 18 (rain, 62 percent braking effectiveness).

The zero wind and slope refusal speed is 109 KIAS. Corrected for wind (+13 X 1) and slope (+2 X 1), the refusal speed for the given takeoff conditions is 124 KIAS.

Since chart refusal speed (124 KIAS) is greater than rotation speed (121 KIAS), rotation speed is used for both.

29.3.15.2 Runway Bearing Strength

Runway bearing strength may be reported as runway bearing capacity (T-twin wheel type landing gear) or by the Aircraft Classification Number/Pavement Classification Number (ACN/PCN) system (ICAO standard). For detailed explanation refer to Section A of the applicable DOD Flight Information Publication (en route) IFR-Supplement.

DOD Flight Information Publication (en route) Flight Information Handbook should be used to calculate ACN. P-3 tire pressure category is always X.

29.3.16 Decision Speed

Decision speed is the minimum engine failure speed from which a safe takeoff can be completed from the runway length remaining. If decision speed is greater than refusal speed, the aircraft is overweight for takeoff. This means there would be a region during the takeoff roll between V_R and V_D should an engine fail, from which the aircraft could neither stop nor accelerate to V_{LOF} within the runway remaining. If V_R is less than V_{RO} or obstacles are present, enter the Decision Speed Chart, Figure 29-12, with refusal speed and determine the total distance to accelerate and takeoff with an engine failure at V_R. If the total distance to accelerate and takeoff is greater than the runway length available, the aircraft is overweight for takeoff. The total distance to accelerate and takeoff is the lift-off point used in the climbout flightpath charts.

29.3.16.1 Example

Decision speed would be less than 99 KIAS ($V_{MC\,GRD}$) for the takeoff conditions. For the takeoff, 4,600 feet would be required with no wind and zero slope for 99 KIAS engine-failure speed. Takeoff distance would be 3,950 feet with engine failure at refusal speed.

29.3.17 Climbout Flightpath Charts

The flightpath charts, Figure 29-15, provide a means for checking obstacle clearance performance when climbout is conducted at the recommended 50-foot airspeed predicted by use of the normal rotation and climbout airspeeds chart, Figure 29-5. They are based on distance from the point of lift-off, so the takeoff distance must be known if the flightpath charts are to be used accurately; however, as an initial check, determine whether the obstacle can be cleared if the aircraft takeoff point is at the end of the runway. If three-engine clearance is predicted, further steps are not required. The flightpaths are based on the use of a climb performance factor to represent aircraft gross weight. To determine this factor, enter the first sheet with ambient temperature and pressure altitude to locate a horizontal reference line. Reenter the chart from the bottom with actual takeoff weight and follow the power guidelines to forecast power, then move vertically to the baseline. The guidelines in the upper portion of the chart are then used to locate an intersection with the horizontal line found first. From this intersection, continue vertically to the baseline. Then follow the guidelines to the aircraft configuration. The climb performance factor is read on the scale directly above this intersection; this factor is applicable to the four- and three-engine flightpath charts.

Enter sheet 2 or 3 with the climb performance factor to establish the climbout height-distance relationship.

29.3.18 Takeoff Rate of Climb — Military Power

Figures 29-13 and 29-14 shows the three- and four-engine rates of climb available with military power at climbout airspeeds. Correction for nonstandard temperature is shown at the bottom. The data are applicable when climbs are conducted at the airspeed schedules noted on the charts.

29.3.18.1 Example

For Configuration B the four-engine takeoff rate of climb is 1,670 fpm with military power at 118,000 pounds, climb speed of 133 KIAS, 1,400-foot pressure altitude, and 18 °C ambient temperature from standard equals +6 °C. For the same conditions with three engines operating and the three-engine climb speed of 130 KIAS, the takeoff rate of climb is 670 fpm.

For temperatures that exceed +20° delta T, work chart as outlined above until baseline is reached. Follow guidelines up to the +20° delta T line, then down to baseline. Follow guideline up again until the remainder of the delta T is reached. Remainder of chart is computed as above.

WARNING

Above +20° delta T, rate of climb calculations are approximations and may be in error by as much as 100 fpm.

29.4 ABNORMAL TAKEOFF PLANNING

29.4.1 Minimum Distance Takeoff

Minimum distance takeoff performance is shown on sheets 1 and 2 of Figure 29-16. The ground run is initiated from a maximum-power, brakes-locked condition. Aircraft rotation should be at the chart V_{RO} speed. This will result in the aircraft leaving the ground at the scheduled V_{LOF} speed. Only adherence to the speed schedules noted will result in the minimum distance takeoff.

WARNING

To meet the scheduled speed at 50 feet, V_{50}, light buffet will be encountered during the climbout. Application of abnormally high g forces may result in a power-on stall at low altitude.

Note

Refer to Chapter 18 for approximate distance increases for water, slush, or snow on the runway.

29.4.1.1 Example

Sample charts are presented for the following conditions: 65 °F ambient temperature, 1,400-foot pressure altitude, 118,000-pound gross weight, forecast SHP of 4,110, 10-knot headwind and a 1 percent uphill runway slope. These conditions result in a minimum takeoff distance of 2,360 feet and a climbout distance of 1,820 feet (total distance to clear 50 feet equals 4,180 feet from brake release). The speed schedule at 118,000 pounds is 102, 109, and 122 KIAS for V_{RO}, $V_{LOF,}$ and V_{50} respectively.

29.4.2 Three-Engine Ferry Takeoff

Figure 29-17 is used to predict three-engine ferry takeoff performance. One propeller is feathered or removed.

The ground distance is based on maximum power with two symmetrical engines, gradual power application to the third during the takeoff run, with maximum power on all three engines at 115 KIAS.

The speed schedule for the ferry takeoff was selected to be 15 knots in excess of the corresponding speeds shown for the normal takeoff condition to provide an additional margin of safety.

Note

The following speed schedule remains constant throughout the range of recommended weights:

Rotation speed	= 130 KIAS
Lift-off speed	= 136 KIAS
50-foot height speed	= 140 KIAS

The wind correction was omitted for additional conservatism.

29.4.2.1 Example

Determine the distance required to takeoff and reach a 50-foot height for the following conditions: 65 °F ambient temperature, 1,400-foot pressure altitude, 90,000-pound gross weight, forecast SHP of 4,110, and a 1 percent uphill runway slope. These conditions result in a distance to lift-off of 6,130 feet and a climbout distance of 960 feet (total distance to clear 50 feet equals 6,130 + 960, or 7,090 feet).

925 °C TIT at Sea Level

Note
Add 13 °C to ambient temperature if engine anti-ice is used.

°C	100%	95%	°F	°C	100%	95%	°F
–18	4,210	4,000	0	14	3,340	3,173	57
–17	4,190	3,981	1	15	3,320	3,154	59
–16	4,160	3,952	3	16	3,290	3,126	61
–15	4,130	3,924	5	17	3,260	3,097	63
–14	4,100	3,895	7	18	3,240	3,078	64
–13	4,070	3,867	9	19	3,210	3,050	66
–12	4,040	3,838	10	20	3,190	3,031	68
–11	4,020	3,819	12	21	3,150	2,993	70
–10	3,990	3,791	14	22	3,120	2,964	72
–9	3,970	3,772	16	23	3,100	2,945	73
–8	3,940	3,743	18	24	3,070	2,917	75
–7	3,910	3,715	19	25	3,040	2,888	77
–6	3,890	3,696	21	26	3,010	2,860	79
–5	3,860	3,667	23	27	2,990	2,841	81
–4	3,830	3,639	25	28	2,960	2,812	82
–3	3,800	3,610	27	29	2,940	2,793	84
–2	3,780	3,591	28	30	2,910	2,765	86
–1	3,740	3,553	30	31	2,880	2,736	88
0	3,720	3,534	32	32	2,850	2,708	90
1	3,700	3,515	34	33	2,830	2,689	91
2	3,670	3,487	36	34	2,800	2,660	93
3	3,640	3,458	37	35	2,780	2,641	95
4	3,610	3,430	39	36	2,750	2,613	97
5	3,590	3,411	41	37	2,720	2,584	99
6	3,560	3,382	43	38	2,690	2,556	100
7	3,530	3,354	45	39	2,660	2,527	102
8	3,500	3,325	46	40	2,640	2,508	104
9	3,480	3,306	48	41	2,610	2,480	106
10	3,450	3,276	50	42	2,590	2,461	108
11	3,430	3,254	52	43	2,560	2,432	109
12	3,400	3,230	54	44	2,520	2,394	111
13	3,370	3,202	55	45	2,490	2,366	113

Note

To correct for increases in pressure altitude above sea level, decrease 12 SHP per 100 feet of altitude change. Do not correct for pressure altitudes below sea level.

Figure 29-5. Takeoff Reduced-Power Setting (Sheet 1 of 4)

950 °C TIT at Sea Level

Note
Add 13 °C to ambient temperature if engine anti-ice is used.

°C	100%	95%	°F	°C	100%	95%	°F
–18	4,450	4,228	0	14	3,560	3,382	57
–17	4,420	4,199	1	15	3,540	3,363	59
–16	4,400	4,180	3	16	3,510	3,335	61
–15	4,380	4,161	5	17	3,480	3,306	63
–14	4,350	4,133	7	18	3,460	3,287	64
–13	4,320	4,104	9	19	3,430	3,259	66
–12	4,290	4,076	10	20	3,400	3,230	68
–11	4,270	4,057	12	21	3,370	3,202	70
–10	4,240	4,028	14	22	3,340	3,173	72
–9	4,210	4,000	16	23	3,310	3,145	73
–8	4,180	3,971	18	24	3,280	3,116	75
–7	4,160	3,952	19	25	3,250	3,088	77
–6	4,130	3,924	21	26	3,220	3,059	79
–5	4,100	3,895	23	27	3,190	3,031	81
–4	4,070	3,867	25	28	3,160	3,002	82
–3	4,040	3,838	27	29	3,140	2,983	84
–2	4,010	3,810	28	30	3,110	2,955	86
–1	3,980	3,781	30	31	3,080	2,926	88
0	3,950	3,753	32	32	3,050	2,898	90
1	3,930	3,734	34	33	3,030	2,880	91
2	3,900	3,705	36	34	3,000	2,850	93
3	3,870	3,677	37	35	2,970	2,822	95
4	3,850	3,658	39	36	2,940	2,793	97
5	3,820	3,629	41	37	2,910	2,765	99
6	3,790	3,601	43	38	2,890	2,746	100
7	3,760	3,572	45	39	2,865	2,722	102
8	3,730	3,544	46	40	2,830	2,689	104
9	3,700	3,515	48	41	2,800	2,660	106
10	3,670	3,487	50	42	2,770	2,632	108
11	3,650	3,468	52	43	2,740	2,603	109
12	3,620	3,439	54	44	2,710	2,575	111
13	3,590	3,411	55	45	2,680	2,546	113

Note

To correct for increases in pressure altitude above sea level, decrease 12 SHP per 100 feet of altitude change. Do not correct for pressure altitudes below sea level.

Figure 29-5. Takeoff Reduced-Power Setting (Sheet 2 of 4)

3,000 SHP = 100 Percent
2,850 SHP = 95 Percent
Based at Sea Level

Note
Add 13 °C to ambient temperature if engine anti-ice is used.

°C	TIT	°F	°C	TIT	°F
–18	807	0	16	892	61
–17	809	1	17	894	63
–16	811	3	18	897	64
–15	813	5	19	900	66
–14	816	7	20	903	68
–13	818	9	21	906	70
–12	820	10	22	909	72
–11	822	12	23	912	73
–10	825	14	24	915	75
–9	827	16	25	919	77
–8	830	18	26	924	79
–7	832	19	27	927	81
–6	834	21	28	930	82
–5	837	23	29	932	84
–4	840	25	30	936	86
–3	842	27	31	940	88
–2	844	28	32	944	90
–1	846	30	33	947	91
0	849	32	34	951	93
1	852	34	35	954	95
2	854	36	36	957	97
3	856	37	37	961	99
4	859	39	38	965	100
5	861	41	39	968	102
6	864	43	40	971	104
7	866	45	41	976	106
8	869	46	42	981	108
9	872	48	43	985	109
10	875	50	44	989	111
11	878	52	45	993	113
12	880	54	46	998	115
13	882	56	47	1,002	117
14	885	57	48	1,006	118
15	889	59	49	1,010	120

Note

To correct for increases in pressure altitude above sea level, add 2 °C to predicted TIT per 100 feet of altitude change. Do not correct for pressure altitudes below sea level.

Figure 29-5. Takeoff Reduced-Power Setting (Sheet 3 of 4)

3,500 SHP = 100 Percent
3,325 SHP = 95 Percent
Based at Sea Level

Note
Add 13 °C to ambient temperature if engine anti-ice is used.

°C	TIT	°F	°C	TIT	°F
–18	856	0	8	923	46
–17	858	1	9	927	48
–16	860	3	10	930	50
–15	863	5	11	932	52
–14	865	7	12	935	54
–13	867	9	13	937	55
–12	869	10	14	941	57
–11	872	12	15	945	59
–10	875	14	16	949	61
–9	877	16	17	952	63
–8	879	18	18	956	64
–7	881	19	19	959	66
–6	884	21	20	961	68
–5	888	23	21	966	70
–4	890	25	22	970	72
–3	892	27	23	973	73
–2	895	28	24	976	75
–1	898	30	25	979	77
0	901	32	26	983	79
1	904	34	27	987	81
2	906	36	28	990	82
3	909	37	29	993	84
4	912	39	30	996	86
5	915	41	31	1,001	88
6	917	43	32	1,006	90
7	920	45	33	1,010	91

Note

To correct for increases in pressure altitude above sea level, add 2 °C to predicted TIT per 100 feet of altitude change. Do not correct for pressure altitudes below sea level.

Figure 29-5. Takeoff Reduced-Power Setting (Sheet 4 of 4)

4,600 Shaft Horsepower					
C°	TIT	F°	C°	TIT	F°
–40	908	–40	–9	989	16
–39	910	–38	–8	992	18
–38	913	–36	–7	995	19
–37	915	–35	–6	998	21
–36	918	–33	–5	1001	23
–35	920	–31	–4	1006	25
–34	923	–29	–3	1008	27
–33	925	–27	–2	1010	28
–32	928	–26	–1	1014	30
–31	930	–24	0	1017	32
–30	932	–22	1	1020	34
–29	936	–20	2	1024	36
–28	938	–18	3	1027	37
–27	940	–17	4	1030	39
–26	943	–15	5	1033	41
–25	946	–13	6	1035	43
–24	948	–11	7	1040	45
–23	950	–9	8	1046	46
–22	953	–8	9	1049	48
–21	955	–6	10	1052	50
–20	958	–4	11	1056	52
–19	961	–2	12	1059	54
–18	964	0	13	1063	55
–17	966	1	14	1066	57
–16	969	3	15	1069	59
–15	972	5	16	1073	61
–14	975	7	17	1077	63
–13	978	9			
–12	980	10			
–11	983	12			
–10	986	14			

Note

- 4600 SHP = 100 percent
- 4370 SHP = 95 percent (based at sea level)
- Add 13 °C to ambient temperature if engine anti-ice is used.
- To correct for increases in pressure altitude above sea level, add 2 °C to predicted TIT per 100 feet of altitude change. Do not correct for pressure altitude below sea level.

Figure 29-6. 4,600 Shaft Horsepower

1,077° TIT at Sea Level							
C°	100%	95%	F°	C°	100%	95%	F°
17	4600	4370	63	33	4040	3840	91
18	4560	4332	64	34	4010	3810	93
19	4530	4300	66	35	3970	3770	95
20	4490	4265	68	36	3940	3740	97
21	4450	4230	70	37	3910	3710	99
22	4420	4200	72	38	3870	3680	100
23	4390	4170	73	39	3840	3650	102
24	4360	4140	75	40	3810	3620	104
25	4320	4100	77	41	3770	3580	106
26	4290	4075	79	42	3740	3550	108
27	4260	4050	81	43	3700	3515	109
28	4220	4000	82	44	3660	3480	111
29	4185	3975	84	45	3630	3450	113
30	4150	3940	86				
31	4120	3910	88				
32	4080	3880	90				

Note

- Add 13 °C to ambient temperature if engine anti-ice is used.
- To correct for increases in pressure altitude above sea level, decrease 12 SHP per 100 feet of altitude change. Do not correct for pressure altitude below sea level.

Figure 29-7. 1,077° TIT

1,010° TIT at Sea Level							
C°	**100%**	**95%**	**F°**	**C°**	**100%**	**95%**	**F°**
–2	4600	4370	28	22	3850	3658	72
–1	4560	4332	30	23	3820	3629	73
0	4525	4298	32	24	3790	3601	75
1	4500	4275	34	25	3760	3572	77
2	4465	4242	36	26	3730	3544	79
3	4435	4213	37	27	3700	3515	81
4	4400	4180	39	28	3665	3482	82
5	4380	4161	41	29	3640	3458	84
6	4355	4137	43	30	3610	3430	86
7	4320	4104	45	31	3580	3401	88
8	4290	4076	46	32	3545	3368	90
9	4260	4047	48	33	3510	3335	91
10	4220	4009	50	34	3480	3306	93
11	4195	3985	52	35	3440	3268	95
12	4160	3952	54	36	3410	3240	97
13	4130	3924	56	37	3380	3211	99
14	4100	3895	57	38	3360	3192	100
15	4080	3876	59	39	3330	3164	102
16	4040	3838	61	40	3300	3135	104
17	4010	3810	63	41	3260	3097	106
18	3980	3781	64	42	3230	3069	108
19	3950	3753	66	43	3200	3040	109
20	3910	3715	68	44	3160	3002	111
21	3880	3686	70	45	3130	2974	113

Note

- Add 13 °C to ambient temperature if engine anti-ice is used.
- To correct for increases in pressure altitude above sea level, decrease 12 SHP per 100 feet of altitude change. Do not correct for pressure altitude below sea level.

Figure 29-8. 1,010° TIT

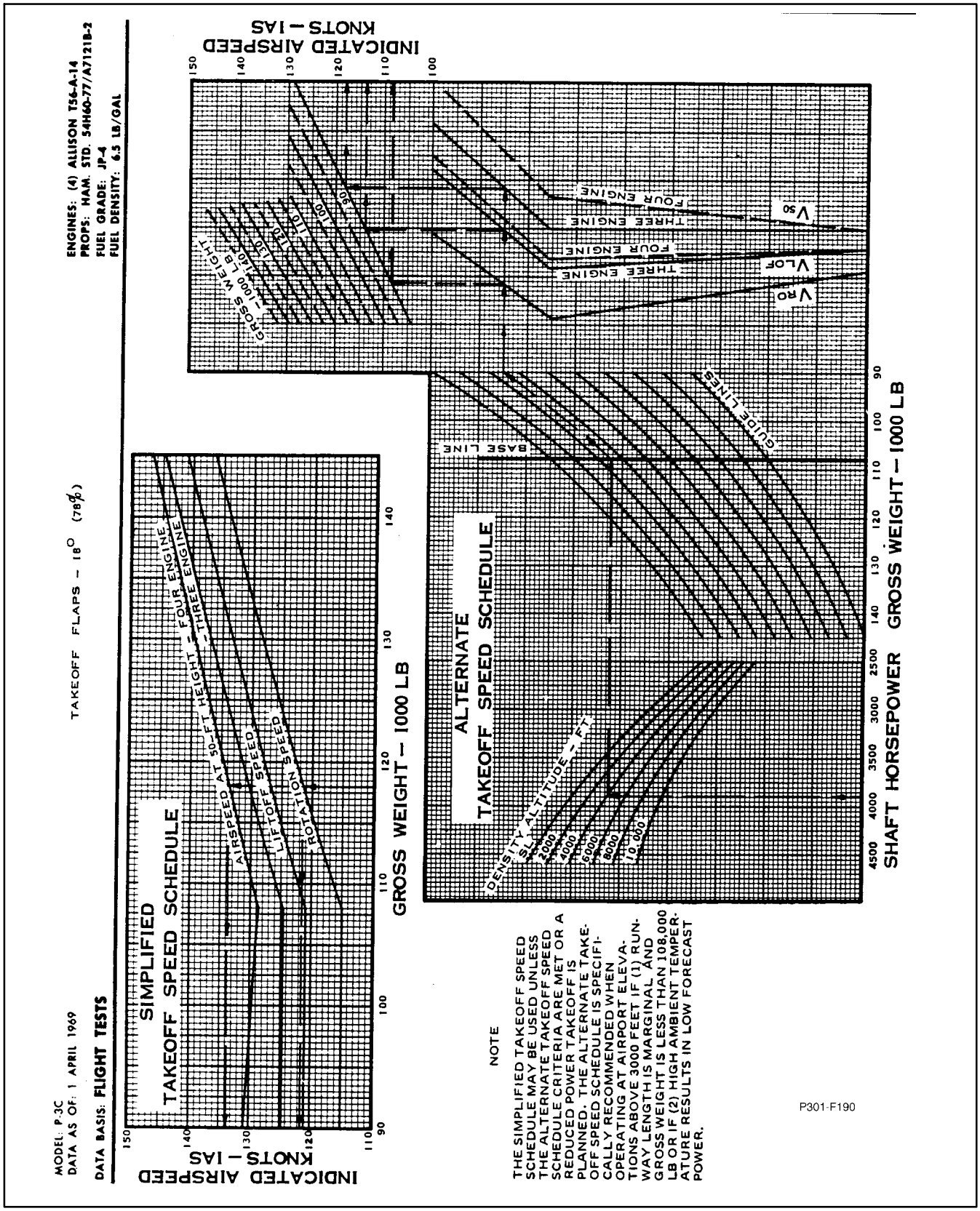


Figure 29-9. Normal Rotation and Climbout Airspeeds (Sheet 1 of 2)

GROSS WEIGHT 1000 Lb	V_{ro}	V_{lof}	$V_{50(3)}$	$V_{50(4)}$	GROSS WEIGHT 1000 Lb	V_{ro}	V_{lof}	$V_{50(3)}$	$V_{50(4)}$
90	115	121	125	131	116	120	126	129	133
91	115	121	125	131	117	121	126	130	133
92	115	121	125	131	118	122	127	130	134
93	115	121	125	131	119	122	128	131	134
94	115	121	125	130	120	123	128	132	135
95	115	121	125	130	121	123	129	132	135
96	115	121	125	130	122	124	129	133	136
97	115	121	125	130	123	124	130	133	136
98	115	121	125	130	124	125	130	134	137
99	115	121	125	130	125	126	131	134	137
100	115	121	125	130	126	126	131	135	138
101	115	121	125	130	127	127	132	135	138
102	115	121	125	130	128	127	132	136	139
103	115	121	125	130	129	128	133	136	139
104	115	121	125	129	130	128	133	137	140
105	115	121	125	129	131	129	134	137	140
106	115	121	125	129	132	129	134	138	140
107	115	121	125	129	133	130	135	139	141
108	115	121	125	129	134	131	135	139	141
109	116	122	126	129	135	131	136	140	142
110	116	122	126	130	136	132	137	140	143
111	117	123	126	130	137	132	137	141	143
112	118	123	127	131	138	133	138	141	143
113	118	124	128	131	139	133	138	142	143
114	119	125	128	132	140	134	139	142	145
115	120	125	129	132	141	134	139	143	145

Figure 29-9. Normal Rotation and Climbout Airspeeds (Sheet 2 of 2)

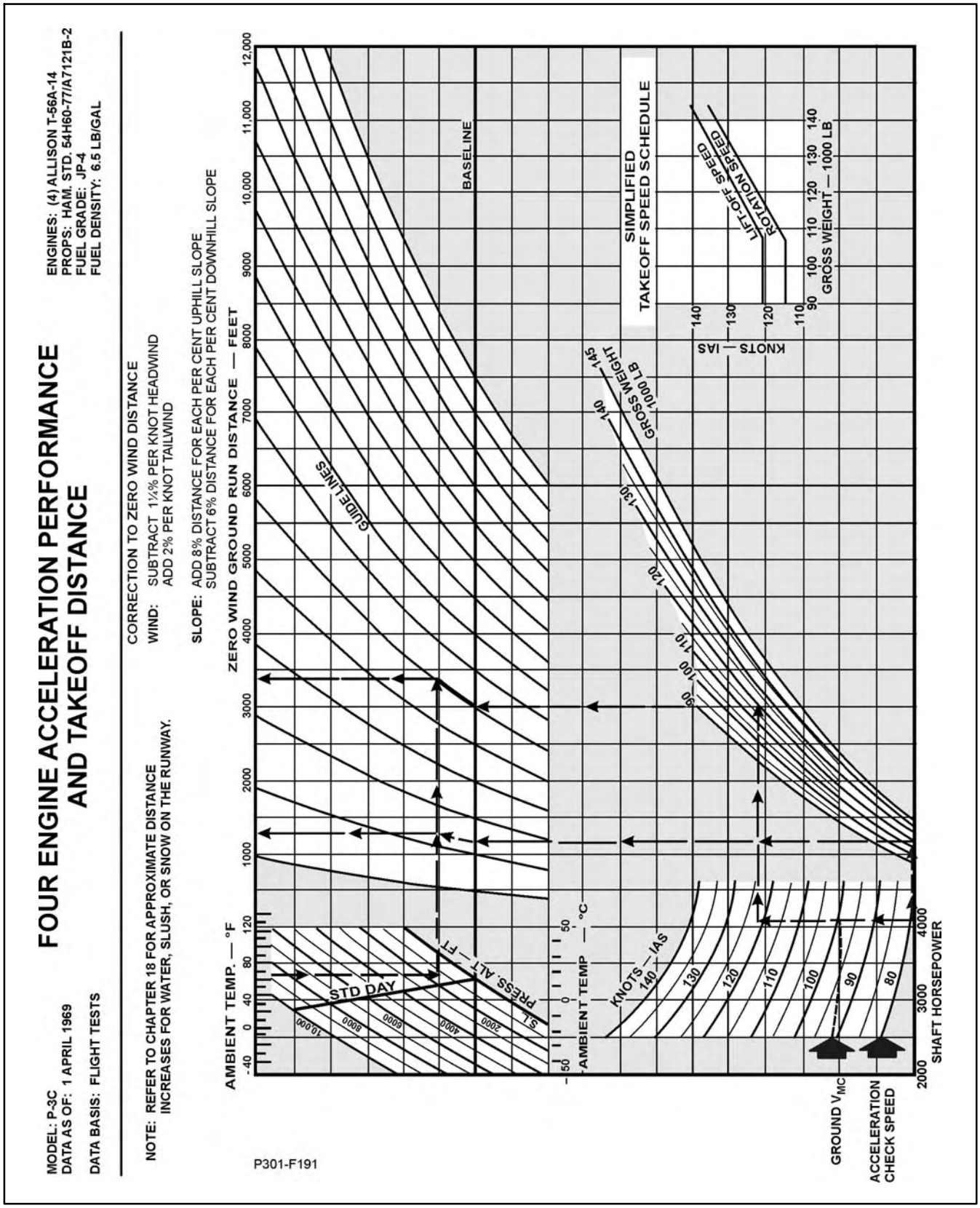


Figure 29-10. Four-Engine Acceleration Performance

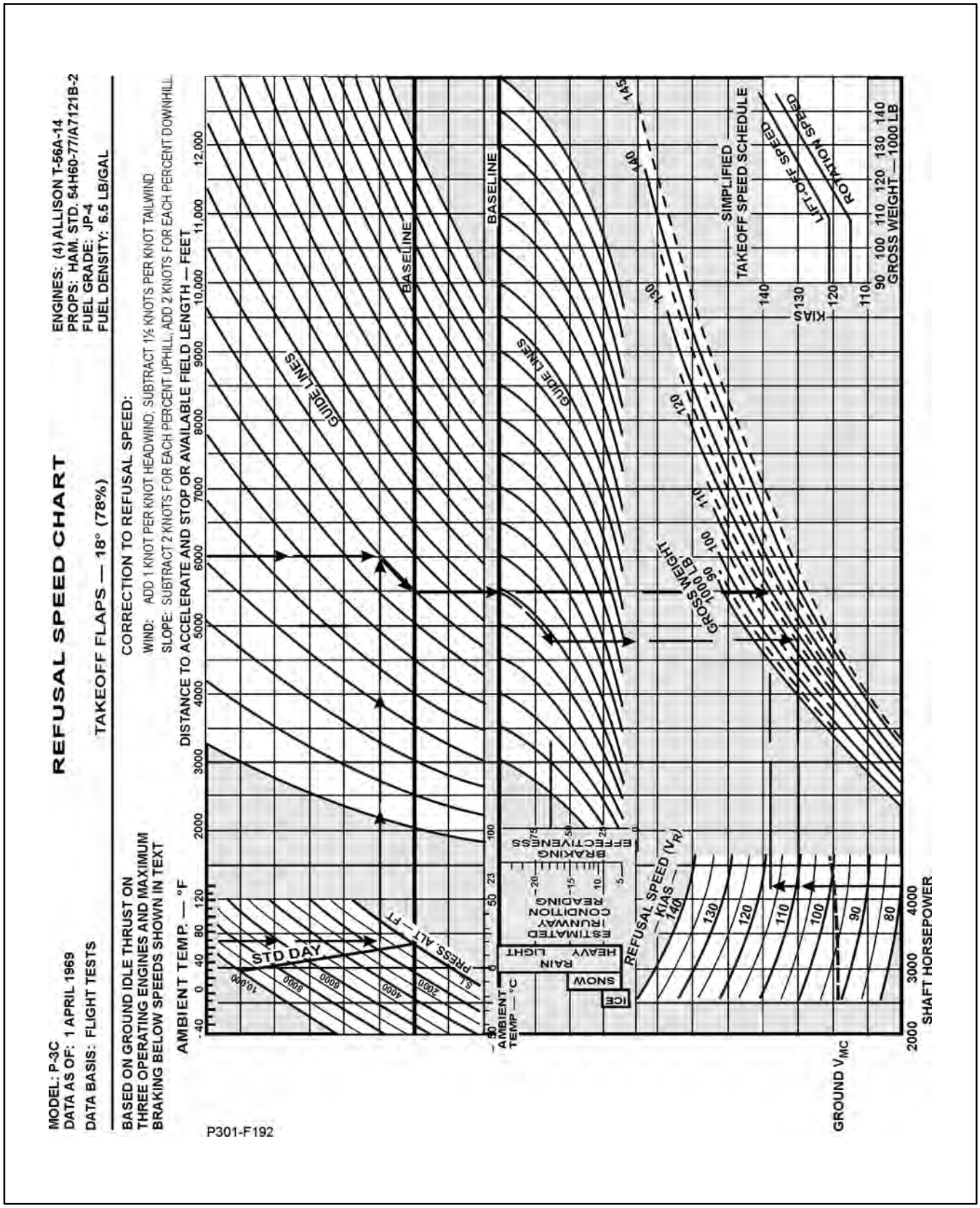


Figure 29-11. Refusal Speed Chart

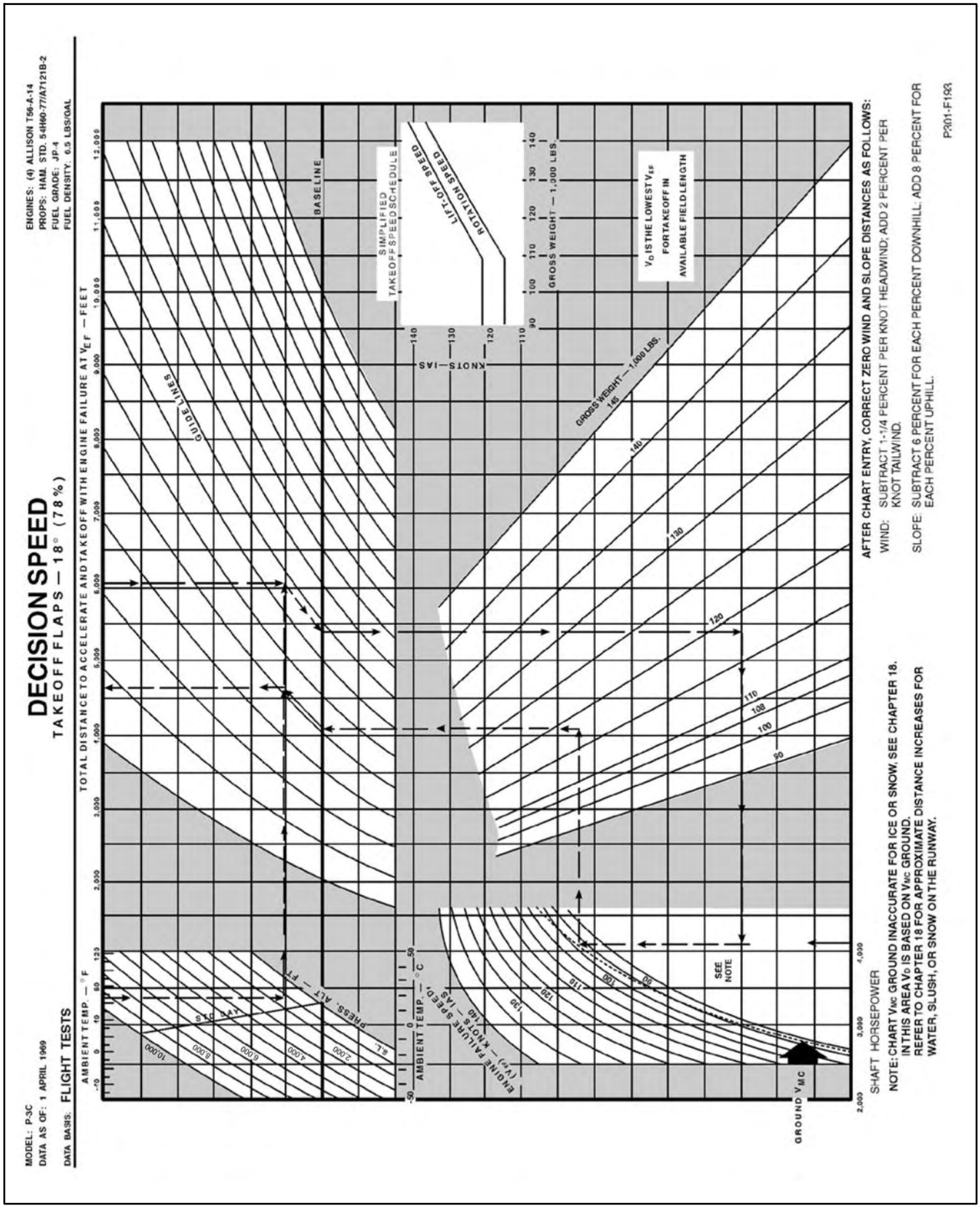


Figure 29-12. Decision Speed Chart

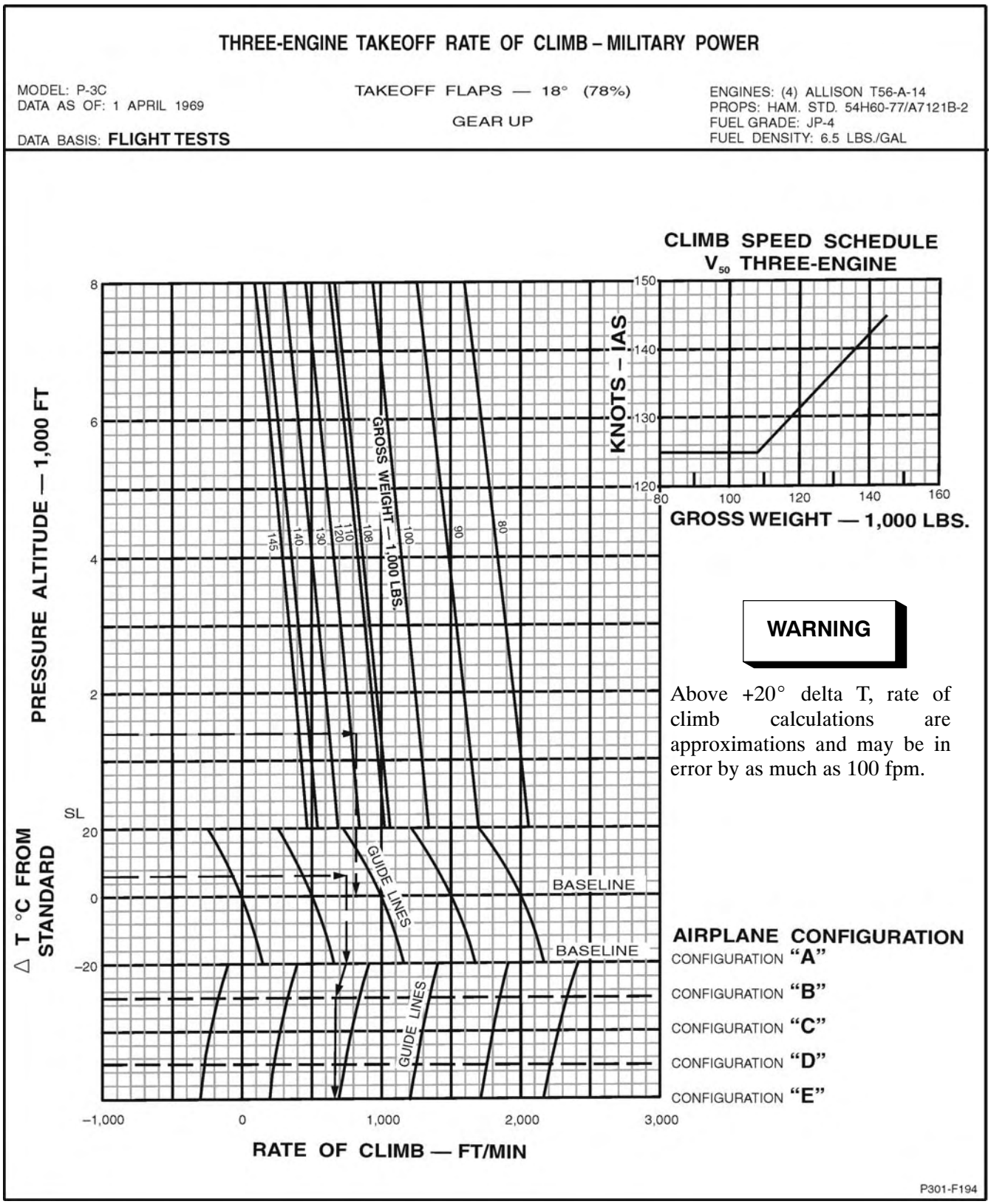


Figure 29-13. Three-Engine Takeoff Rate of Climb — Military Power

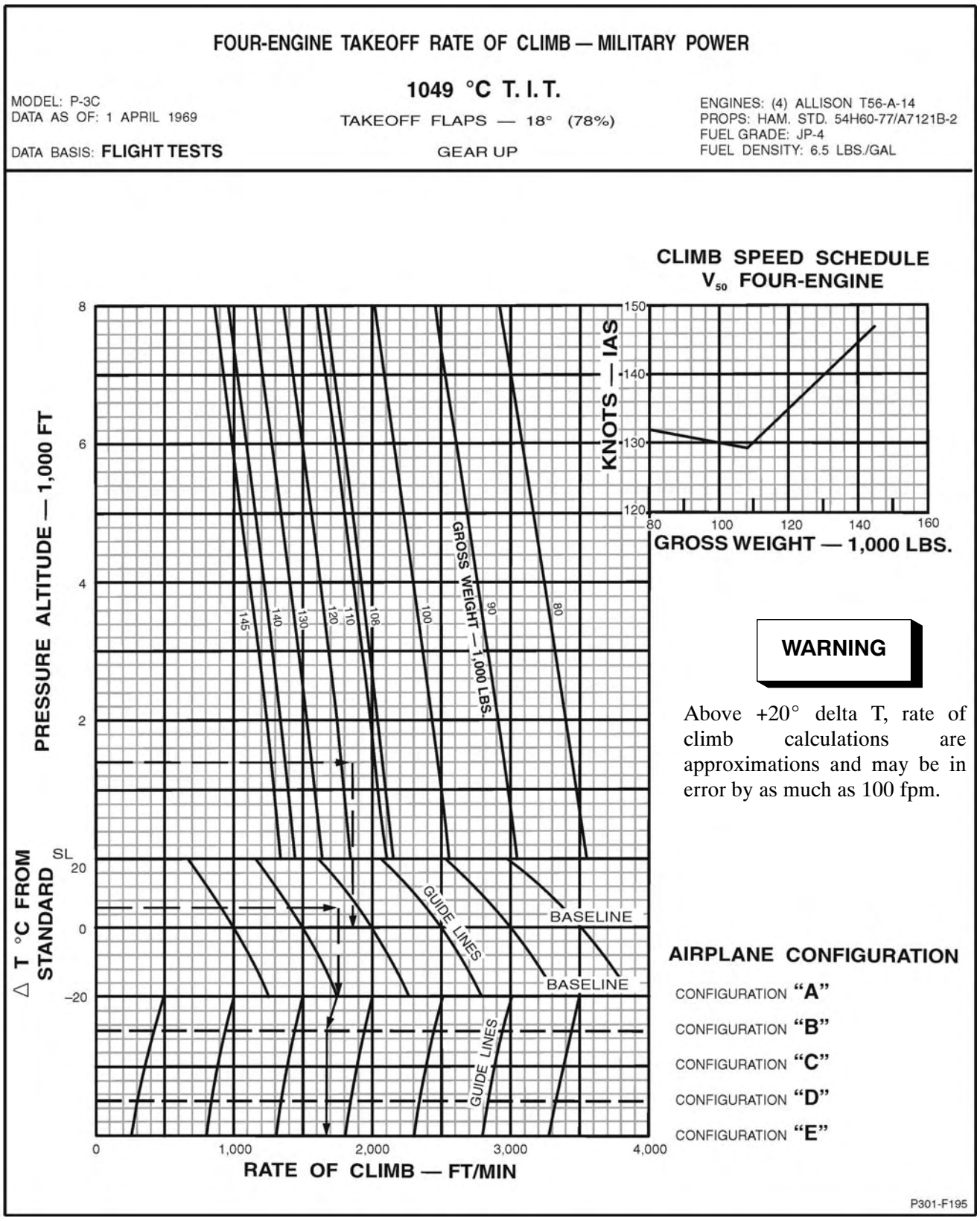


Figure 29-14. Four-Engine Takeoff Rate of Climb — Military Power

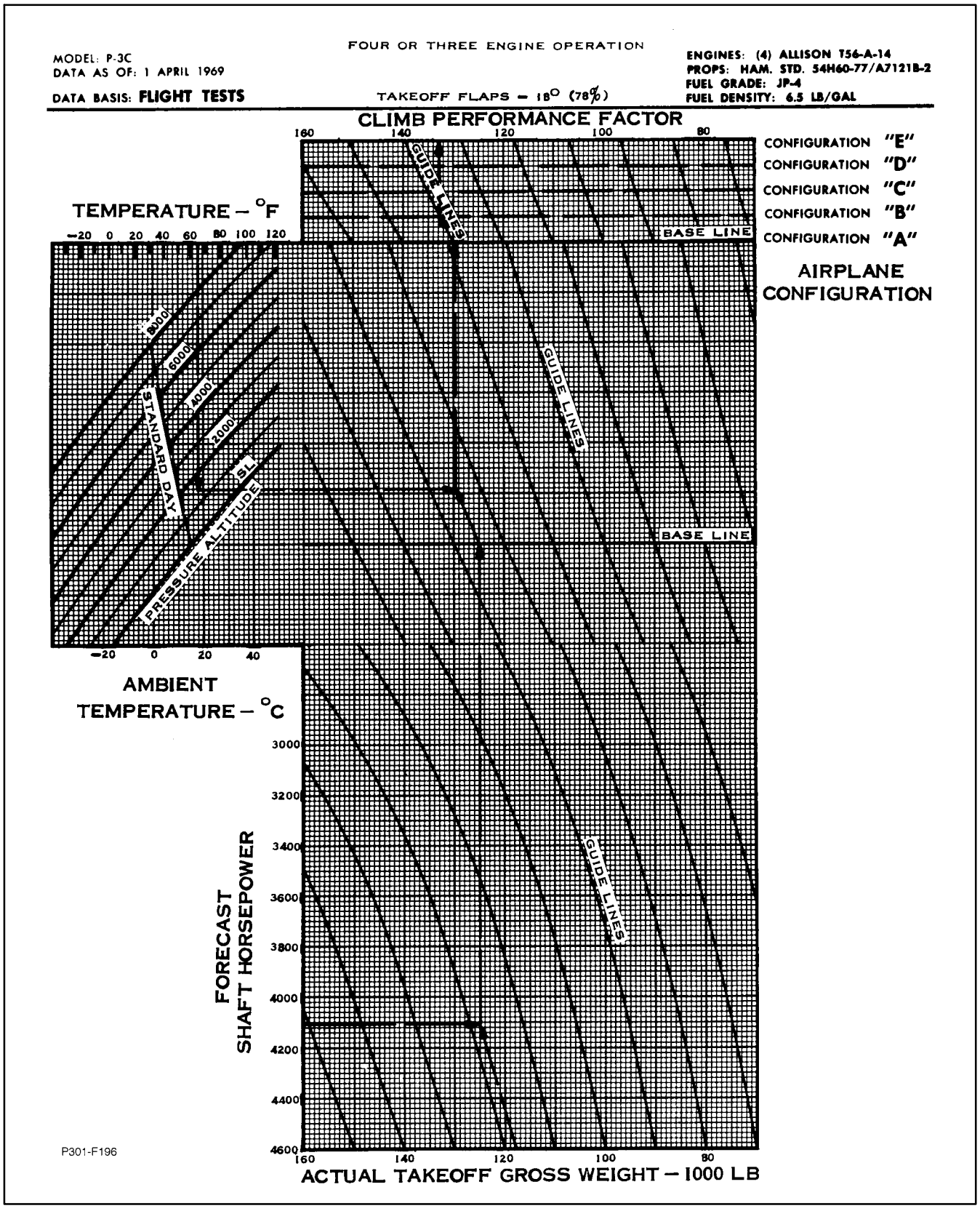


Figure 29-15. Climbout Flightpath (Sheet 1 of 3)

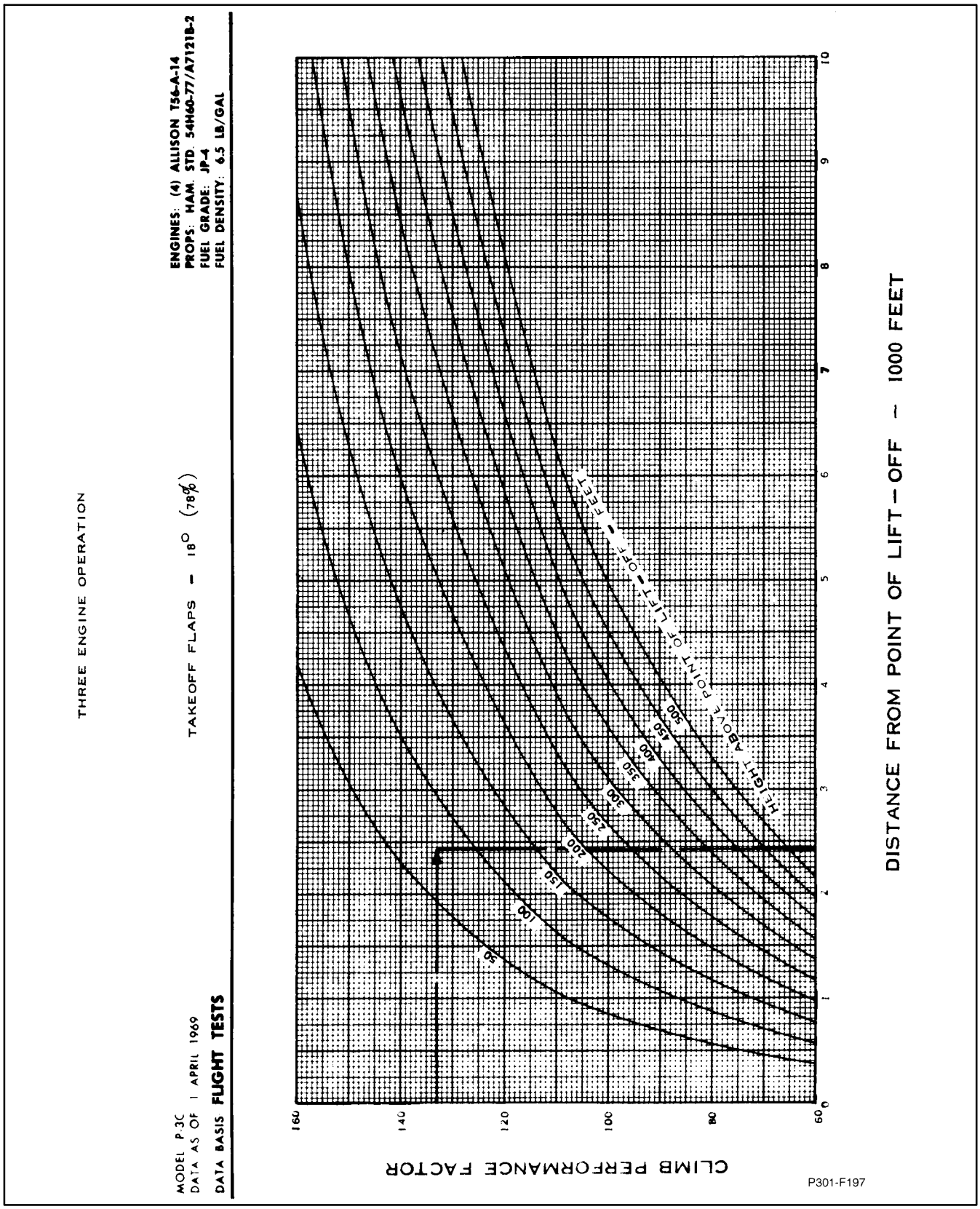


Figure 29-15. Climbout Flightpath (Sheet 2 of 3)

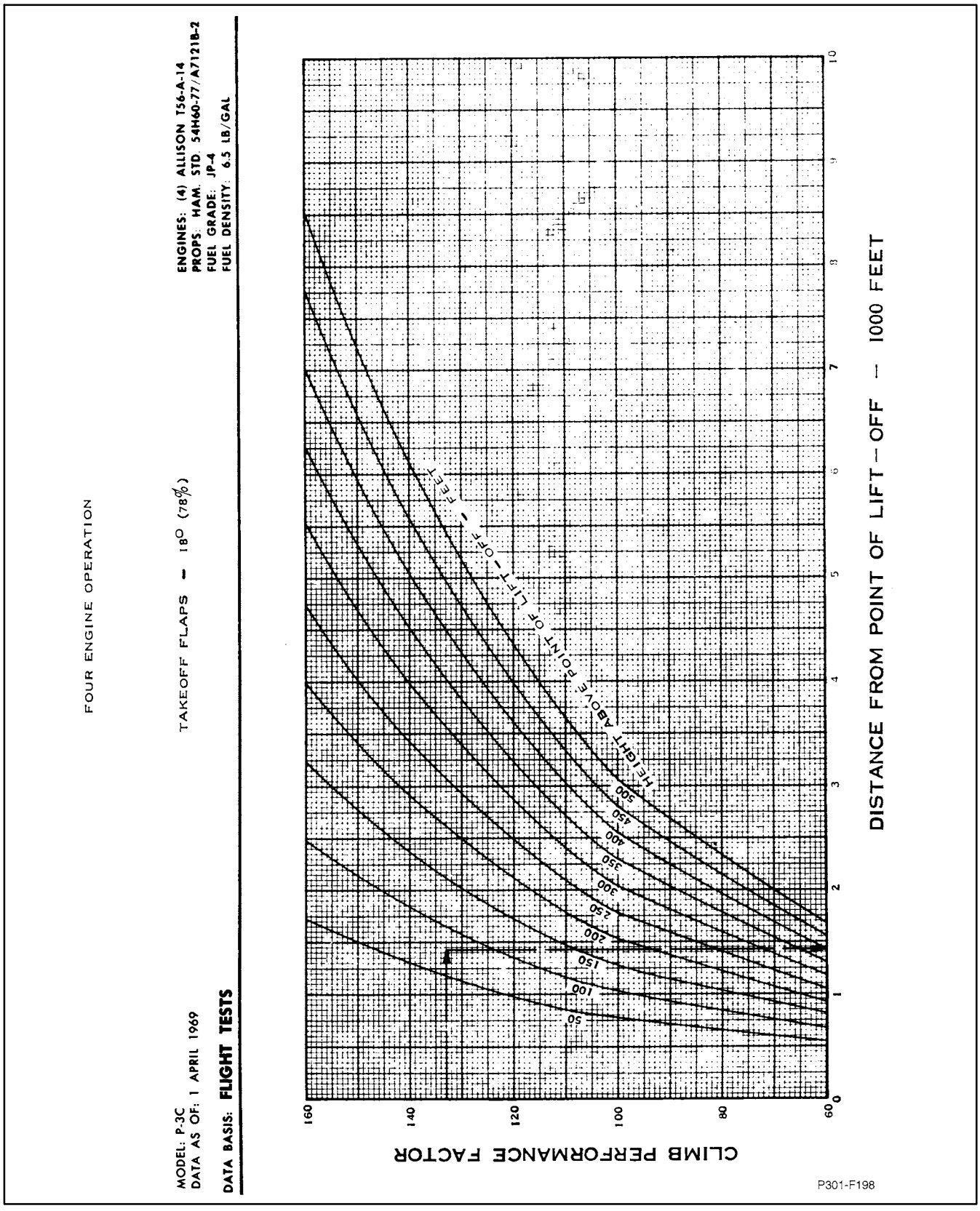


Figure 29-15. Climbout Flightpath (Sheet 3 of 3)

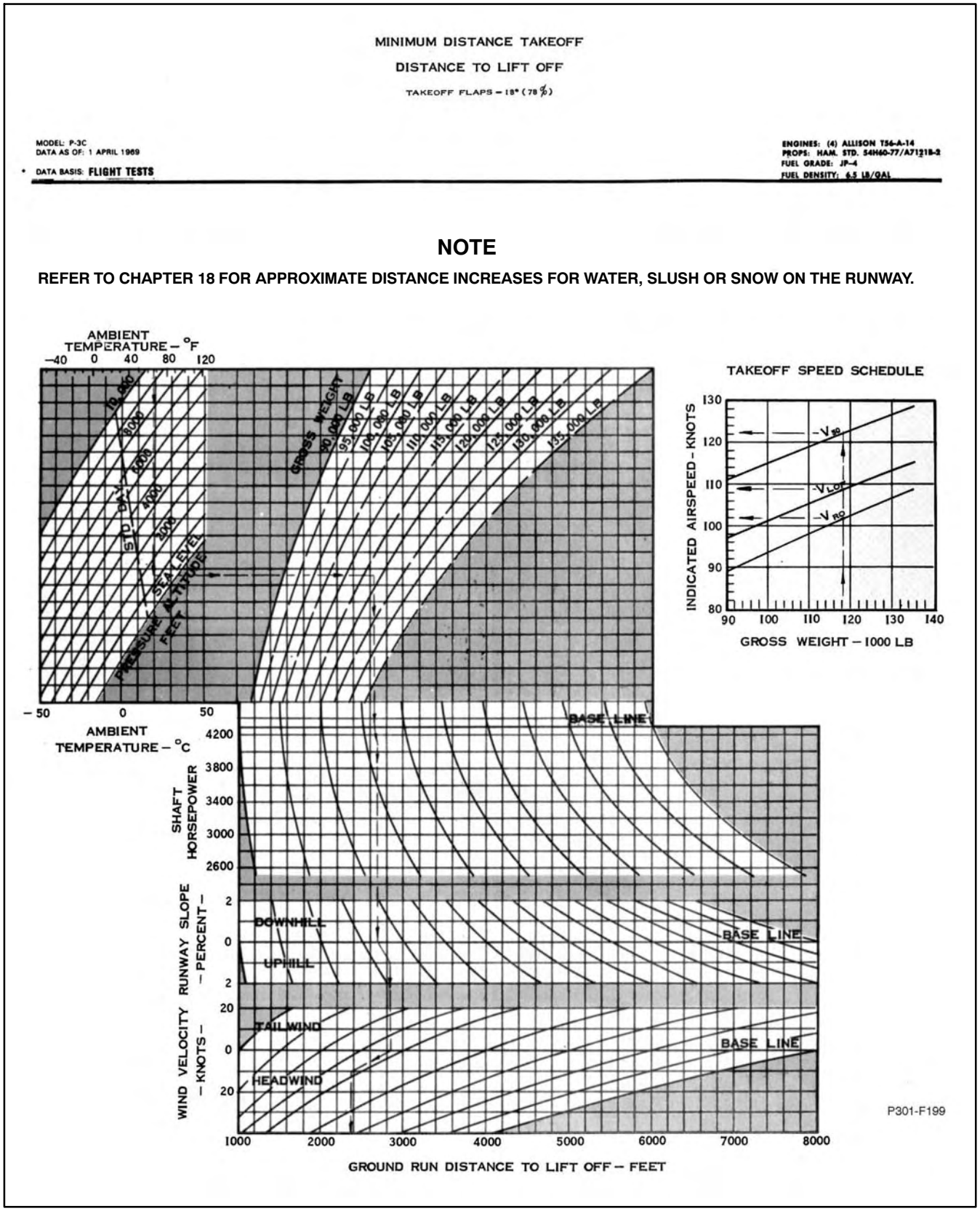


Figure 29-16. Minimum Distance to Takeoff (Sheet 1 of 2)

MINIMUM DISTANCE TAKEOFF

DISTANCE FROM LIFT-OFF TO 50 FOOT HEIGHT

TAKEOFF FLAPS – 18° (78%)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

NOTE

REFER TO CHAPTER 18 FOR APPROXIMATE DISTANCE INCREASES FOR WATER, SLUSH OR SNOW ON THE RUNWAY.

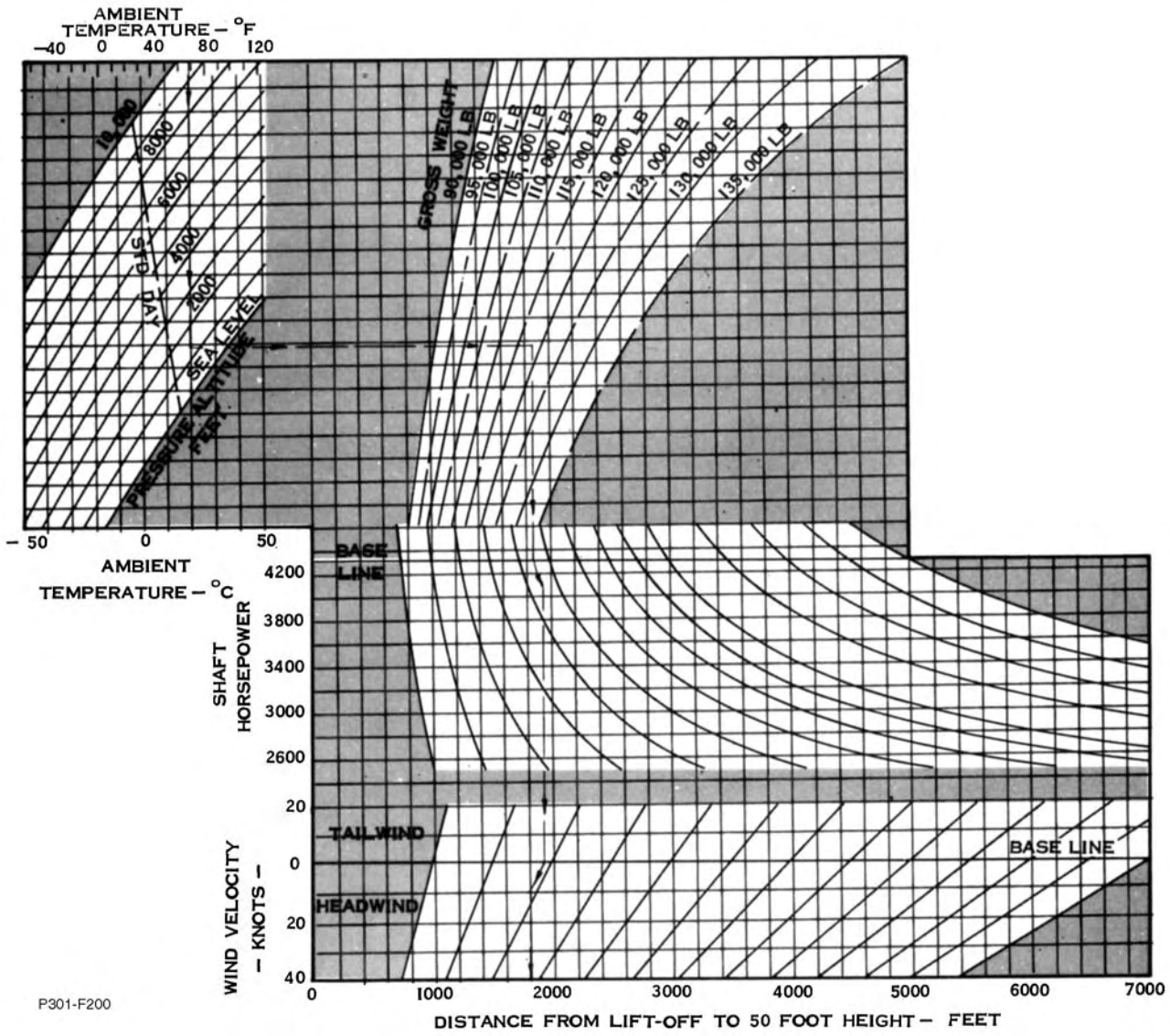


Figure 29-16. Minimum Distance to Takeoff (Sheet 2 of 2)

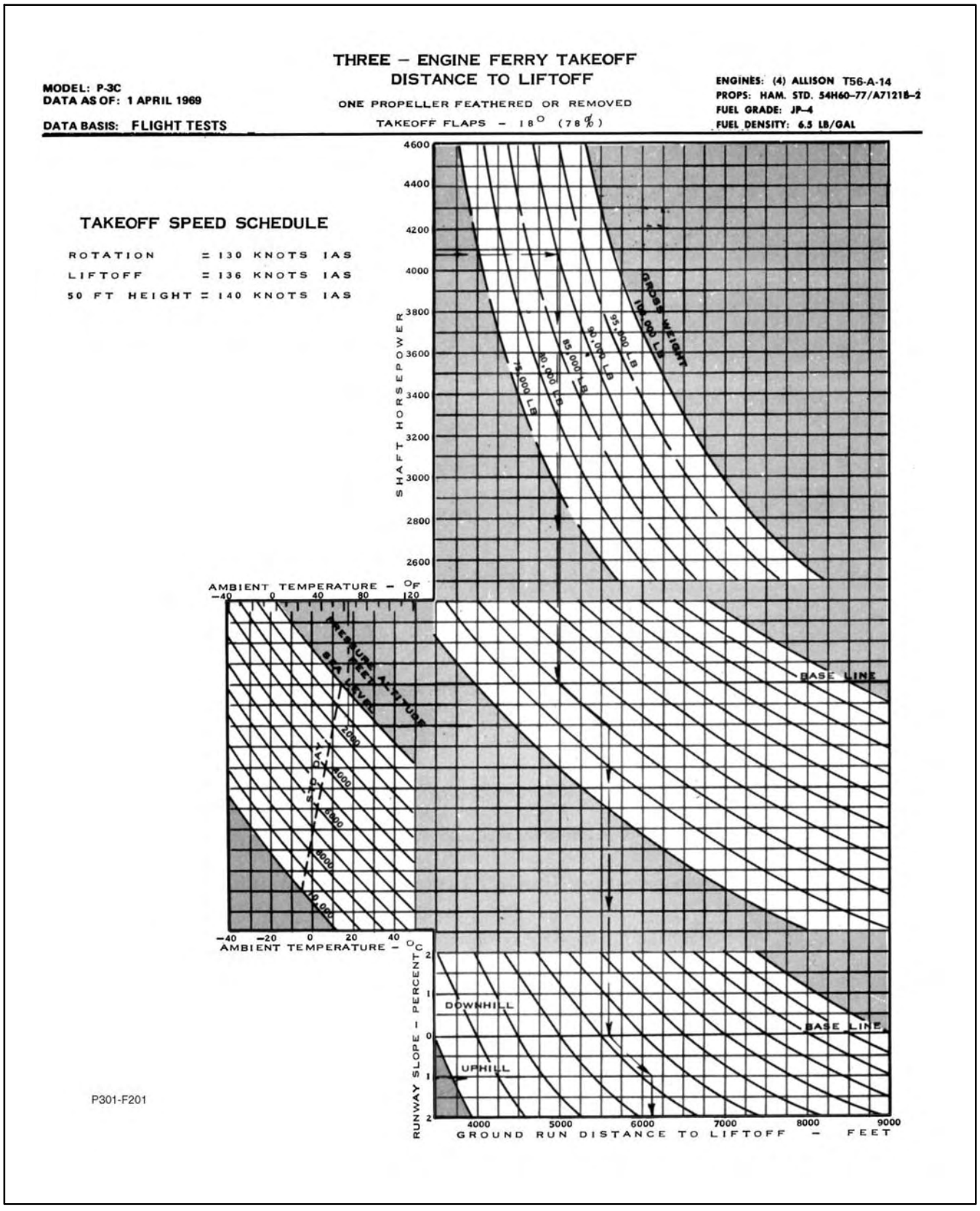


Figure 29-17. Three-Engine Ferry Takeoff (Sheet 1 of 2)

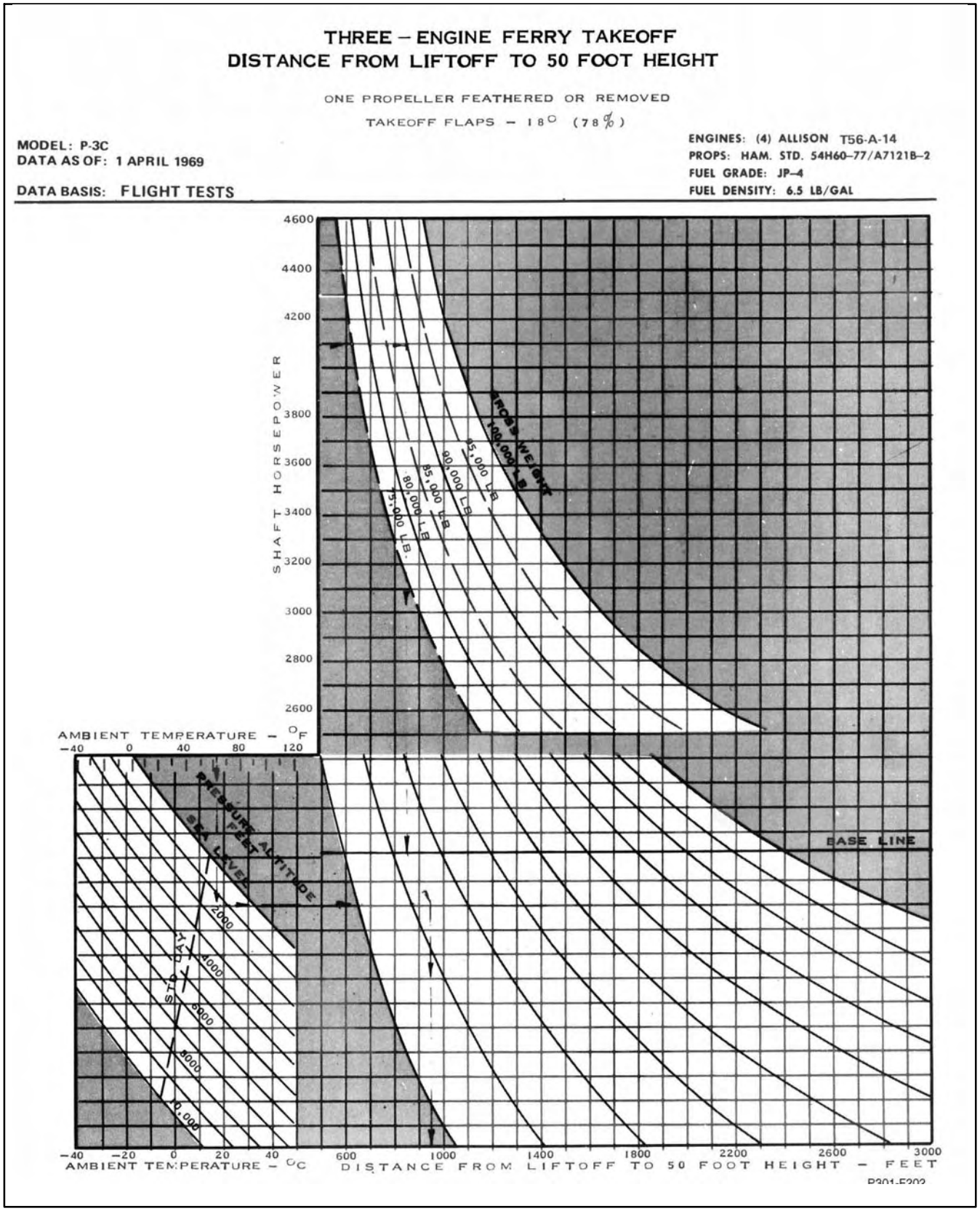


Figure 29-17. Three-Engine Ferry Takeoff (Sheet 2 of 2)

CHAPTER 30

Approach and Landing

30.1 APPROACH AND LANDING DATA

Approach and landing performance is not critical under normal conditions because field lengths usually are governed by takeoff and climbout requirements; however, landing distances should be planned in advance as a normal part of the flight planning procedure.

30.2 WIND COMPONENT CORRECTIONS

Corrections for the effects of headwind and tailwind components on landing distances are included in the landing distance charts, Figures 30-1 and 30-2. The corrections apply to wind speeds measured at the runway at elevations of 6 to 8 feet above the surface. It is normal to consider that winds at these elevations are three-quarters of the speed that would be measured by a tower anemometer more than 50 feet above the surface. It is also good practice to use the steady wind speed rather than gust velocity in determining headwind component and to use gust velocity in determining all crosswind and tailwind components. The wind component chart, Figure 30-3, is provided for calculating the runway and crosswind components for various wind conditions and the recommended minimum RCR. To find the maximum wind speed for a given RCR, enter wind component chart with RCR and go up to offset of winds from runway heading. Read wind speed.

30.2.1 Example

Winds at the runway are reported as being from 210°, 15 knots, with gusts to 25 knots. The landing runway is 18. The wind is offset at 30° from the runway heading (210° to 180°). Figure 30-3 shows that the headwind component is 13 knots for the 15-knot steady speed. The crosswind component is 12-1/2 knots for the 25-knot gust velocity. The recommended minimum RCR is 8.5. A takeoff or landing with a lower RCR could result in uncontrollable drift and yaw.

30.2.2 Sample Problem

Sample problem for finding the maximum wind speed for a given RCR: RCR reading 11, winds 30° offset from runway heading. Enter at 11 RCR, then go up to 30° offset. Maximum wind speed is 40 knots.

30.3 LANDING DISTANCES

Landing ground roll distances and total distances to land from a 50-foot height and stop are given by Figures 30-1 and 30-2, respectively. The data are based on P-3 flight tests with ideal conditions, normal airspeed schedules, minimum distance technique for approach and landing, and ground idle power with hard wheel braking beginning at 120 knots or less for the stop. (For maximum brake application speeds refer to the Refusal Speed discussion in Chapter 29.) Corrections for wind, runway surface condition, and slope are provided. Slightly shorter ground roll distances may be obtained by using full reverse power. Lower than normal landing speeds have approximately the same effect on ground roll as an equal increase in headwind; however, such technique should not be needed unless particularly adverse runway surface conditions exist or extremely short runways must be used. Normally, it should be possible to land and stop in 167 percent of the hard-stop distances shown when dry runway conditions exist and light to moderate wheel braking is used. This stopping technique conserves tires and brakes and therefore should be used when examination of the landing distance charts shows that field length is adequate. It is recommended that operational landing distances be predicted by increasing chart values by 67 percent.

30.3.1 Sample Problem

Landing weight, 85,000 pounds; field pressure altitude 1,600 feet; air temperature –5 °C; headwind component 13 knots at runway height; 33 percent of hard braking force available because of snow on the runway; downhill slope of one-half percent.

Find — Ground roll distance, distance to land and stop from 50-foot height, airspeed at 50 feet, and landing speed.

Solution — Landing ground roll is shown by Figure 30-1 as 1,910 feet for the conditions given. The roll would have been 1,525 feet for a dry, level runway with zero wind and hard braking. Figure 30-2 shows that the total distance is 2,520 feet with a 13 knot headwind component for final approach speed of 118 KIAS and landing speed of 110 KIAS.

30.4 NO-FLAP LANDING

To estimate the no-flap landing ground-roll distance, first determine the normal ground-roll distance applying corrections for the use of moderate braking (67 percent distance increase) from Figure 30-1, then apply the no-flap factor shown in Figure 30-4.

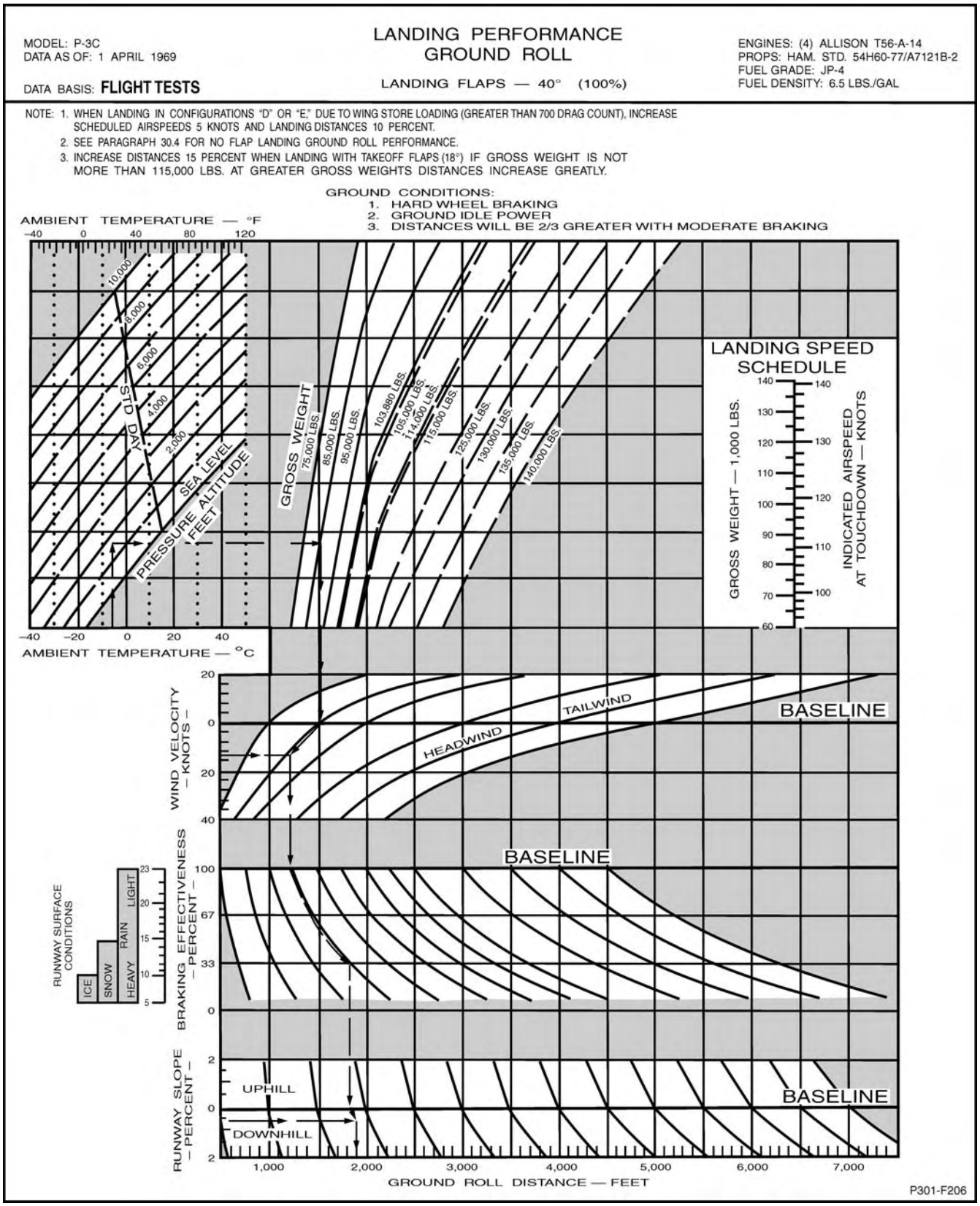


Figure 30-1. Landing Performance — Ground Roll

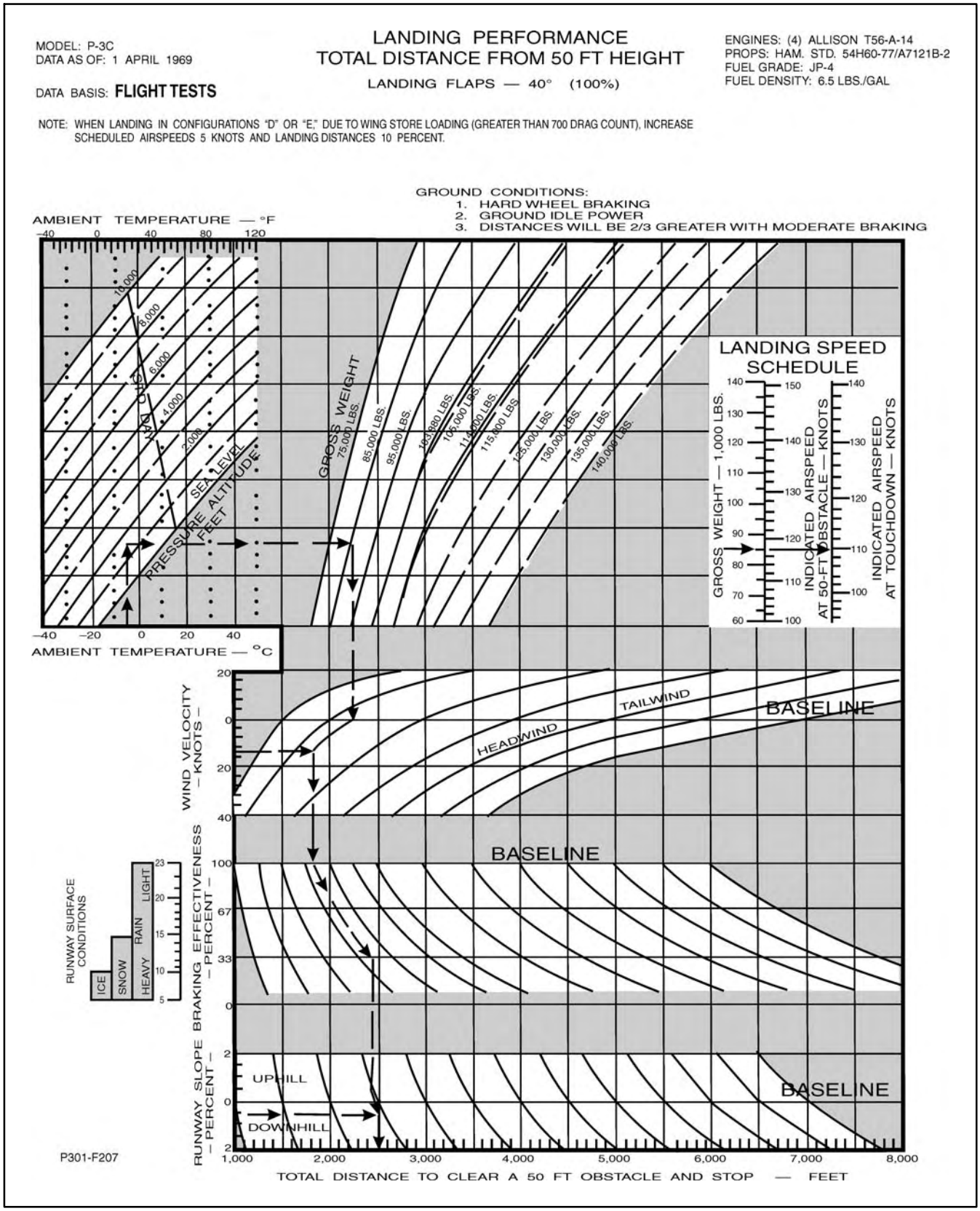


Figure 30-2. Landing Performance — Total Distance from 50-Foot Height

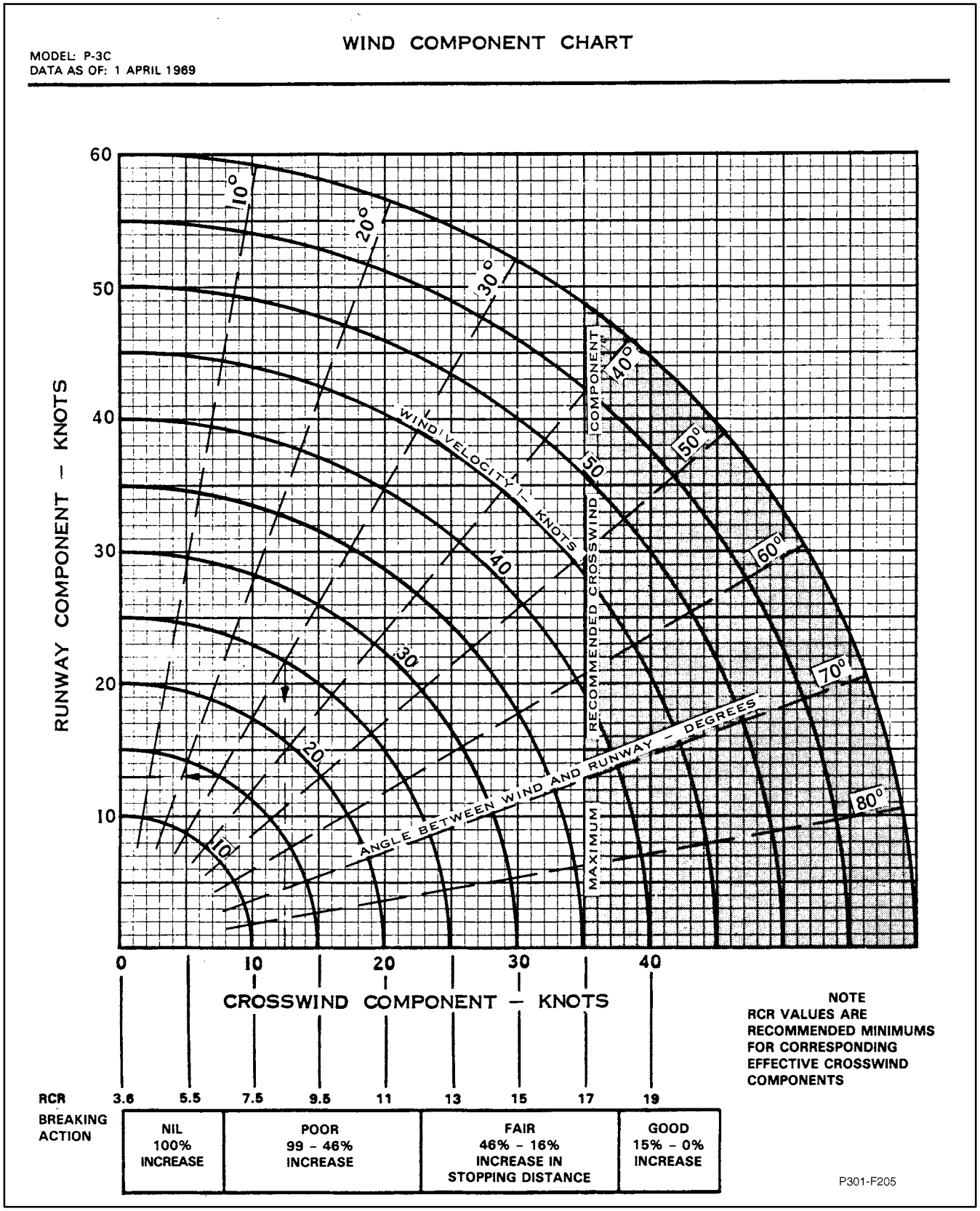


Figure 30-3. Wind Component

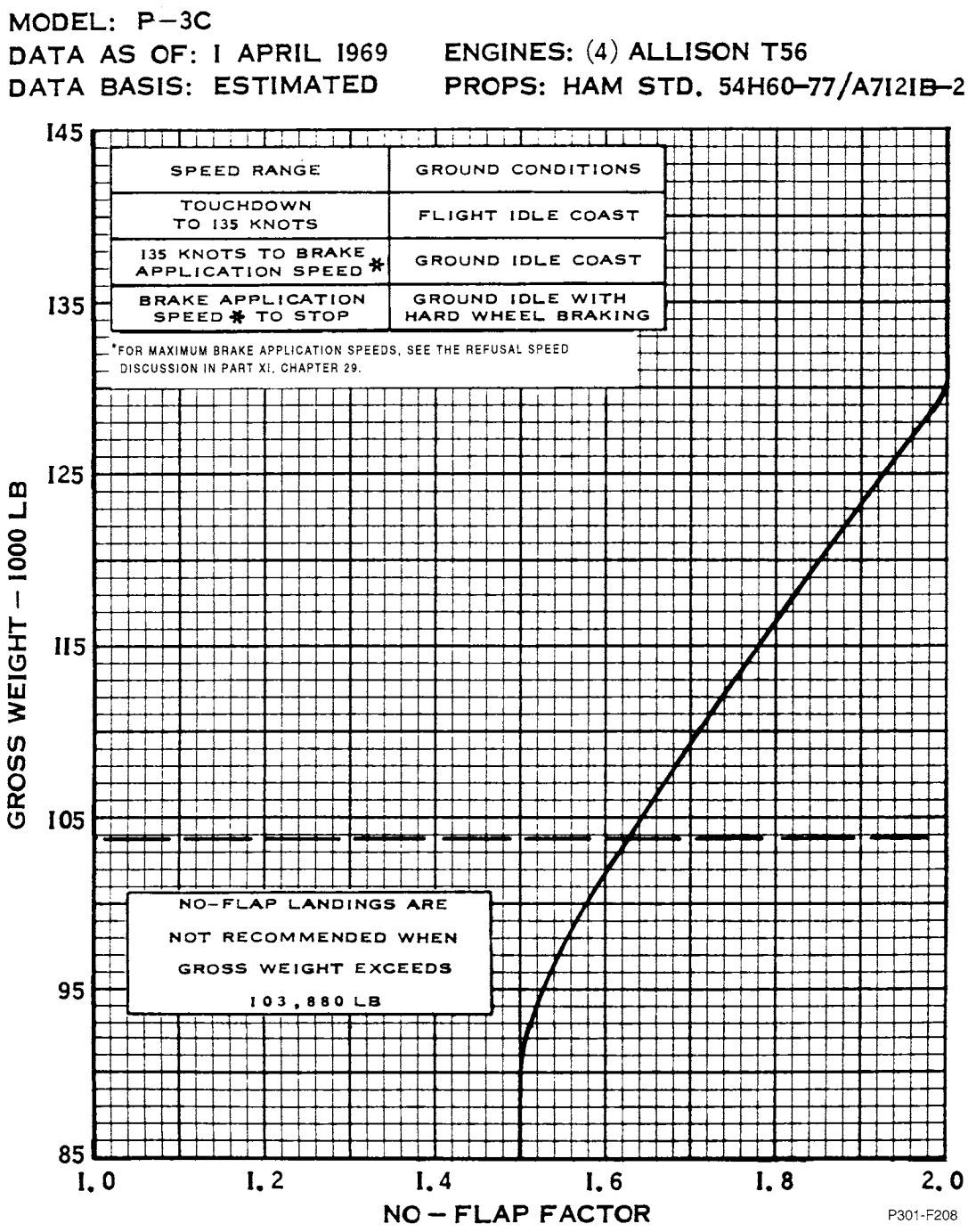


Figure 30-4. Gross Weight vs. No-Flap Factor (Emergency Procedure)

CHAPTER 31

Climb and Descent

31.1 CLIMB CONTROL CHARTS

The charts (Figures 31-1, 31-2, 31-3, 31-4, 31-5, 31-6, 31-7, 31-8, 31-9, 31-10, 31-11, and 31-12) show climb performance with four, three, and two engines operating at normal rated power. The performance is shown in terms of distance, time, and fuel to climb and provides the airspeed schedule that must be used to realize the performance shown. The weight lines are based on climbs from sea level at the listed initial climb weights. The curves include allowances for fuel burnout during climb; that is, a curve labeled 120,000 pounds actually represents the performance at a weight equal to 120,000 pounds minus the fuel consumed in reaching the altitude at which the curve is read. Each distance, time, and fuel-used curve includes corrections that should be used to account for nonstandard air temperature conditions.

31.1.1 Use of Climb Control Charts

The climb charts can be read directly for climbs started from altitudes near sea level. Enter each “fan chart” at the desired final altitude and read distance, time, and fuel below the intersection with the applicable initial weight line. The climb speed schedule, the correction for temperature variation from standard, and drag count configuration are noted on the charts. In the event that the climb is started from an intermediate altitude, use the charts on an incremental basis.

31.2 DESCENT PERFORMANCE

Figure 31-13 shows performance for descent at Flight Idle Power (sheet 1); Descent at Limit Speed at Flight Idle Power (sheet 2); Operational Descent at 275 Knots (sheet 3); and Gear Down, Limit Speed at Flight Idle Power (sheet 4). Low rate-of-descent letdowns at loiter airspeed are economical unless it may be necessary to hold at low altitude before landing, or unless an immediate return to high altitude is probable. (Letdowns at high rates of descent allow the greatest delay before making the decision to descend, if there is uncertainty as to the ability to make a prompt landing.) Low rate-of-descent letdowns should be initiated approximately 2-1/2 miles out for each 1,000 feet above the final altitude. If low-altitude, engine-out operation is planned (for example, loiter or search), additional fuel will be conserved if these engines are shut down prior to initiating the descent.

High rates of descent at limit speeds result in the least time required to reduce altitude. Note that the greatest rates of descent are obtained at light weights. Also note that terminal airspeeds up to 405 KIAS are obtained, and that allowances for time and distance to decelerate may be required if an immediate landing is to be made. Descent profiles at limit dive speed, 405 KIAS, are terminated at 8,000 feet since reduction in speed must be initiated near this altitude in order to effect a normal recovery.

Distances from the destination at which the descent may be initiated may be determined by reference to Figure 31-13. Also included in this chart are data showing predicted rates of descent, fuel, and time required for the descent.

The descent at 275 KIAS is based on the following recommended schedule:

ALTITUDE	SPEED	POWER	DESCENT RATE
Cruise ceiling to 20,000	275	As req.	Set 550 fpm
20,000 to 10,000	275	800 SHP	As results
10,000 to 3,000	275	0 SHP	As results
3,000 to 300	275 to 150	Flight Idle	Approx. 1,200 fpm

31.3 SINGLE-ENGINE FLIGHT CAPABILITY

The necessity of continuing single-engine flight in a four-engine aircraft is very remote. There is a situation, however, that would require a brief period of single-engine operation such as the loss of an engine while conducting two-engine search and loiter operations. Although engine starting can be accomplished promptly and altitude loss kept at a minimum, Figure 31-14 has been prepared to describe the single-engine performance capabilities. It is a plot of rate of descent versus gross weight and is based on the speed schedule shown. The analysis has assumed the application of normal rated power on the single operative engine at an altitude of 1,000 feet. Knowing the nominal time required to restore power to an intentionally secured engine, approximate altitude losses that might result from this type of operation can be estimated. Although these losses are quite small, situations may arise where no altitude loss whatsoever can be tolerated. In such a case, an effective decrease in rate of descent (or increase in rate of climb) amounting to approximately 600 fpm can be realized by reducing speed at the rate of 1 knot per second. This procedure converts kinetic energy into rate of climb. Obviously, speed can be reduced only so far without introducing further difficulties; however, the stall margin at the normal loiter speeds is ample to permit using this procedure for enough time to assure availability of additional engines to continue the flight.

31.4 TWO-ENGINE FLIGHT CAPABILITY

Refer to Figure 31-15 for two-engine performance with MANEUVER flaps. Refer to single engine flight capability discussion for additional information.

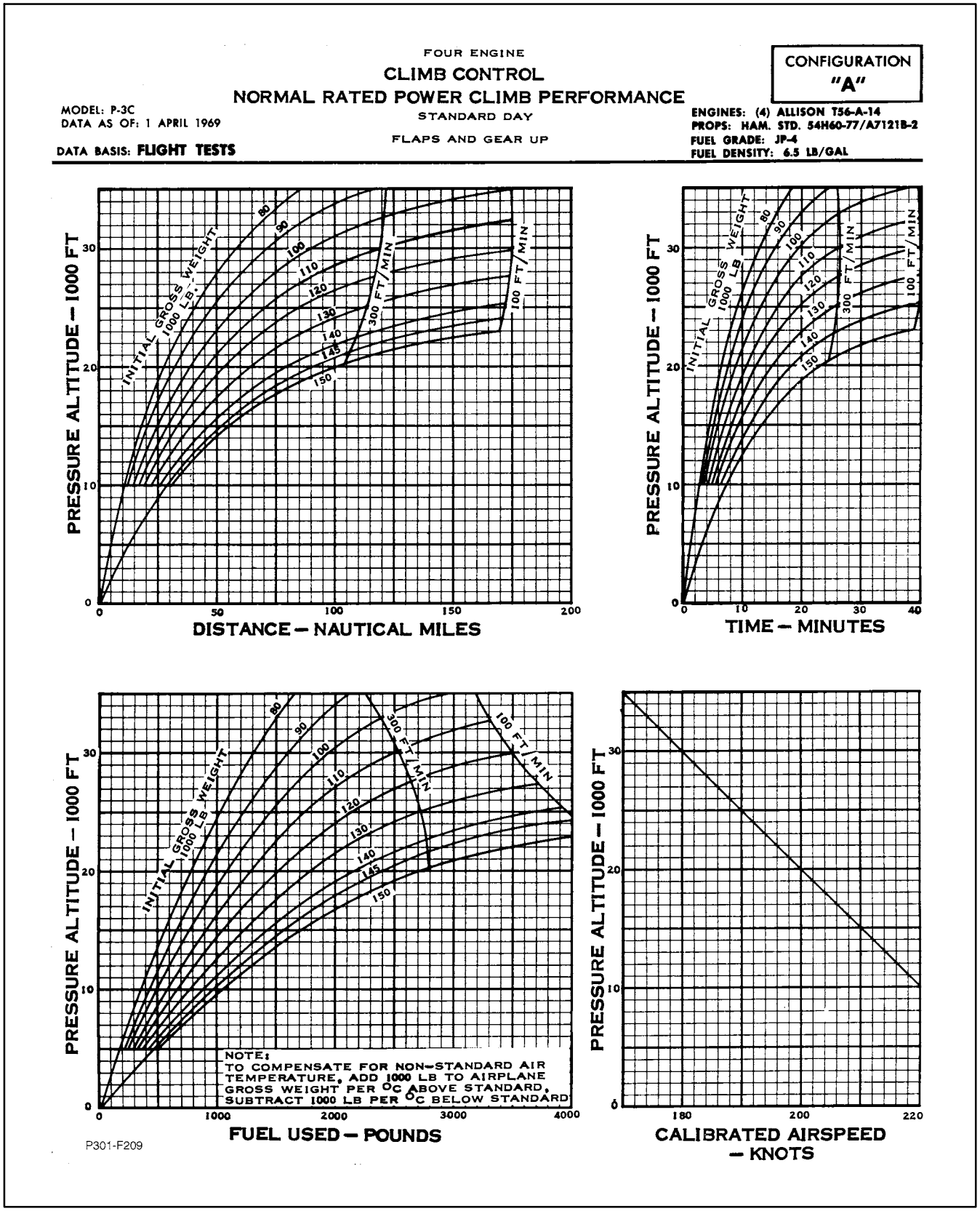


Figure 31-1. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration A

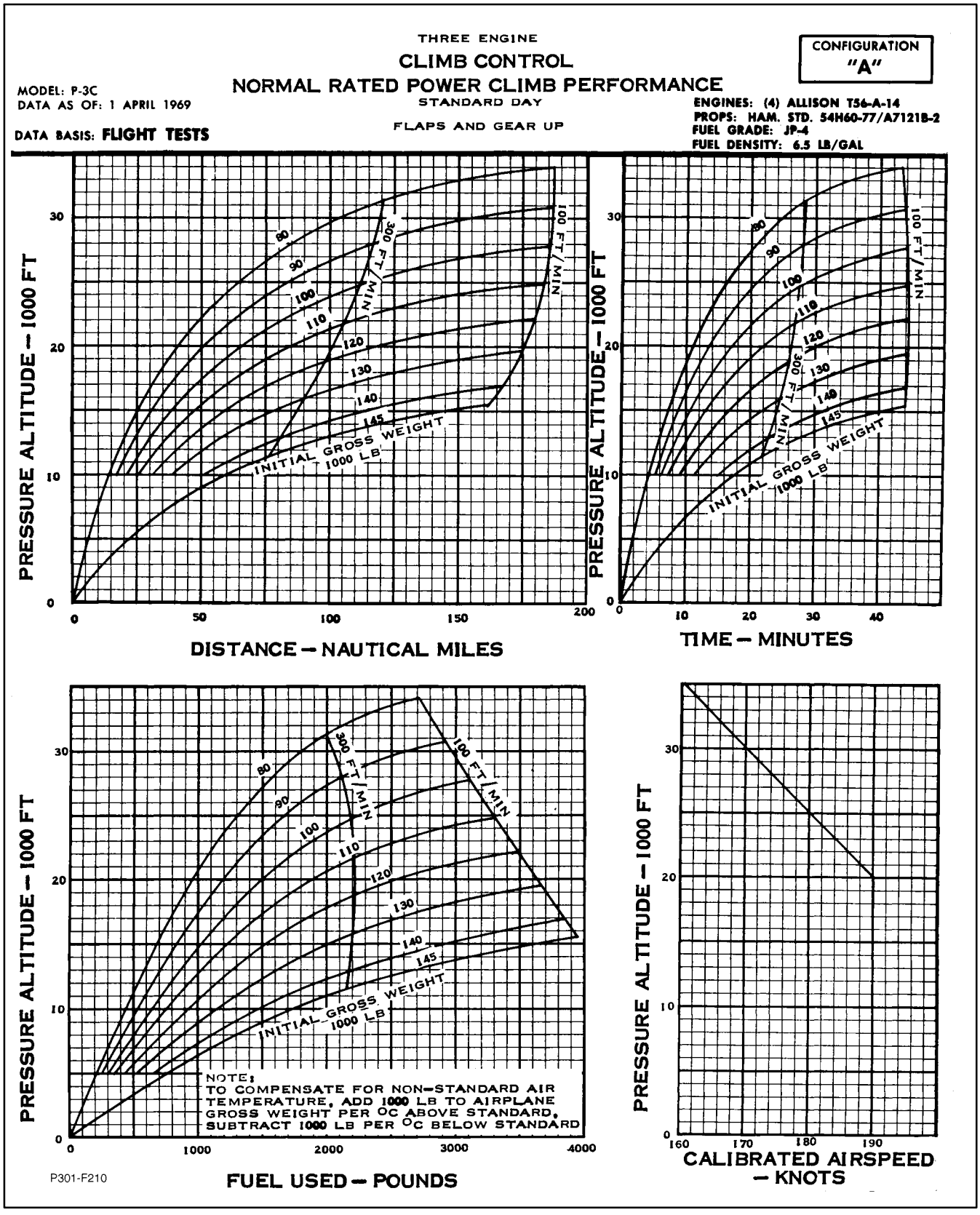


Figure 31-2. Three-Engine Climb Control — Normal Rated Climb Performance — Configuration A

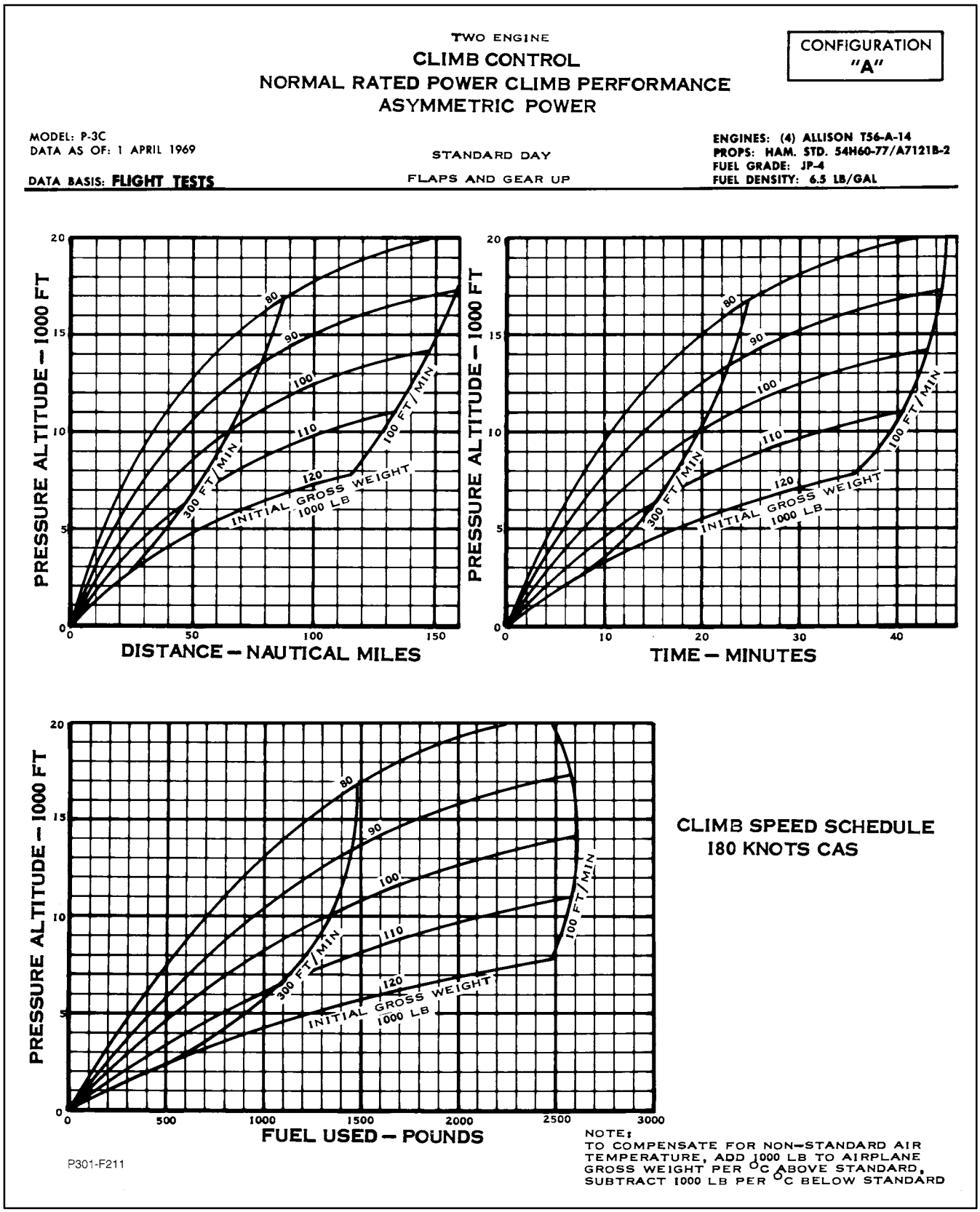


Figure 31-3. Two-Engine Climb Control — Normal Rated Power Climb — Asymmetric Power Performance — Configuration A

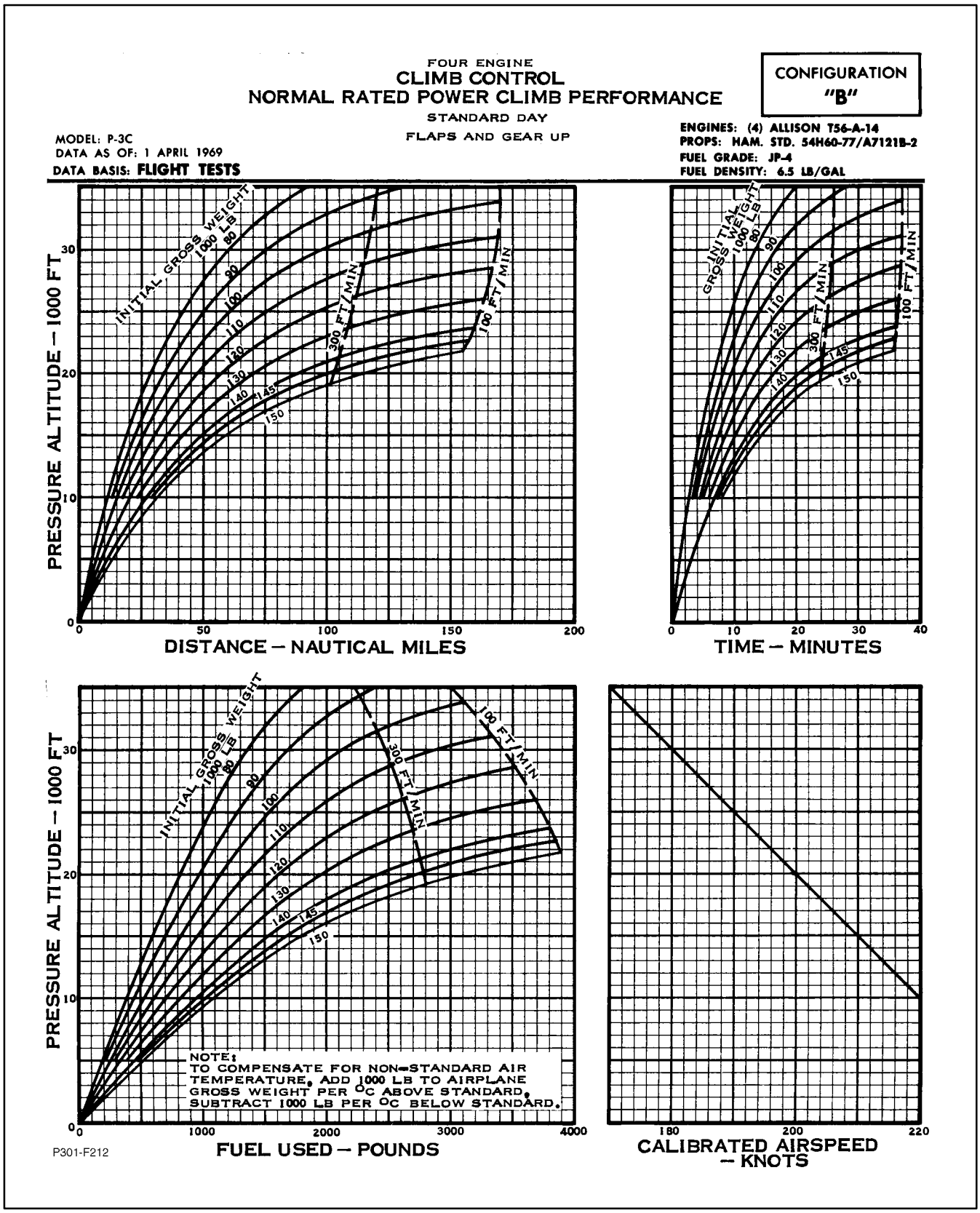


Figure 31-4. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration B

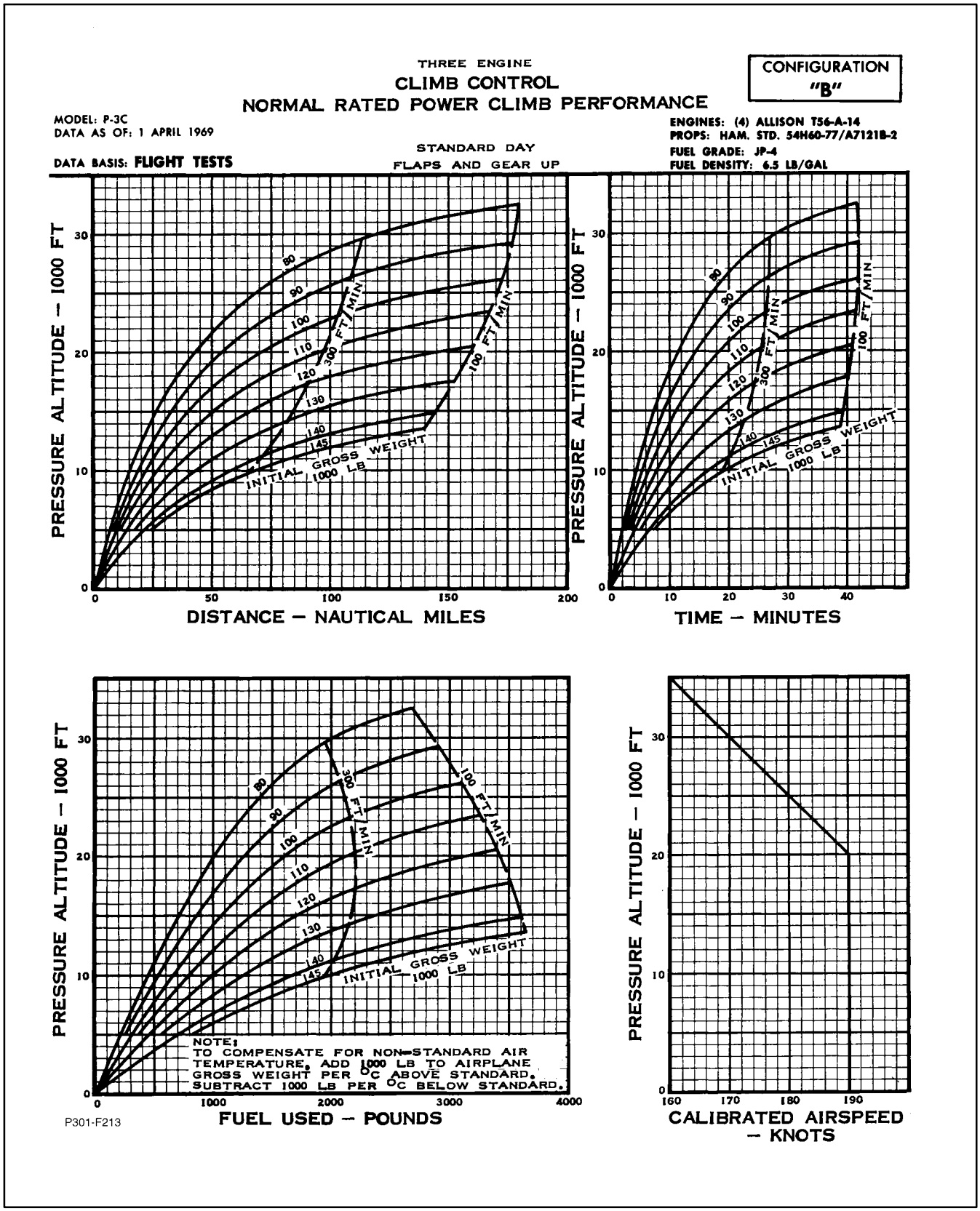


Figure 31-5. Three-Engine Climb Control — Normal Rated Power Climb Performance — Configuration B

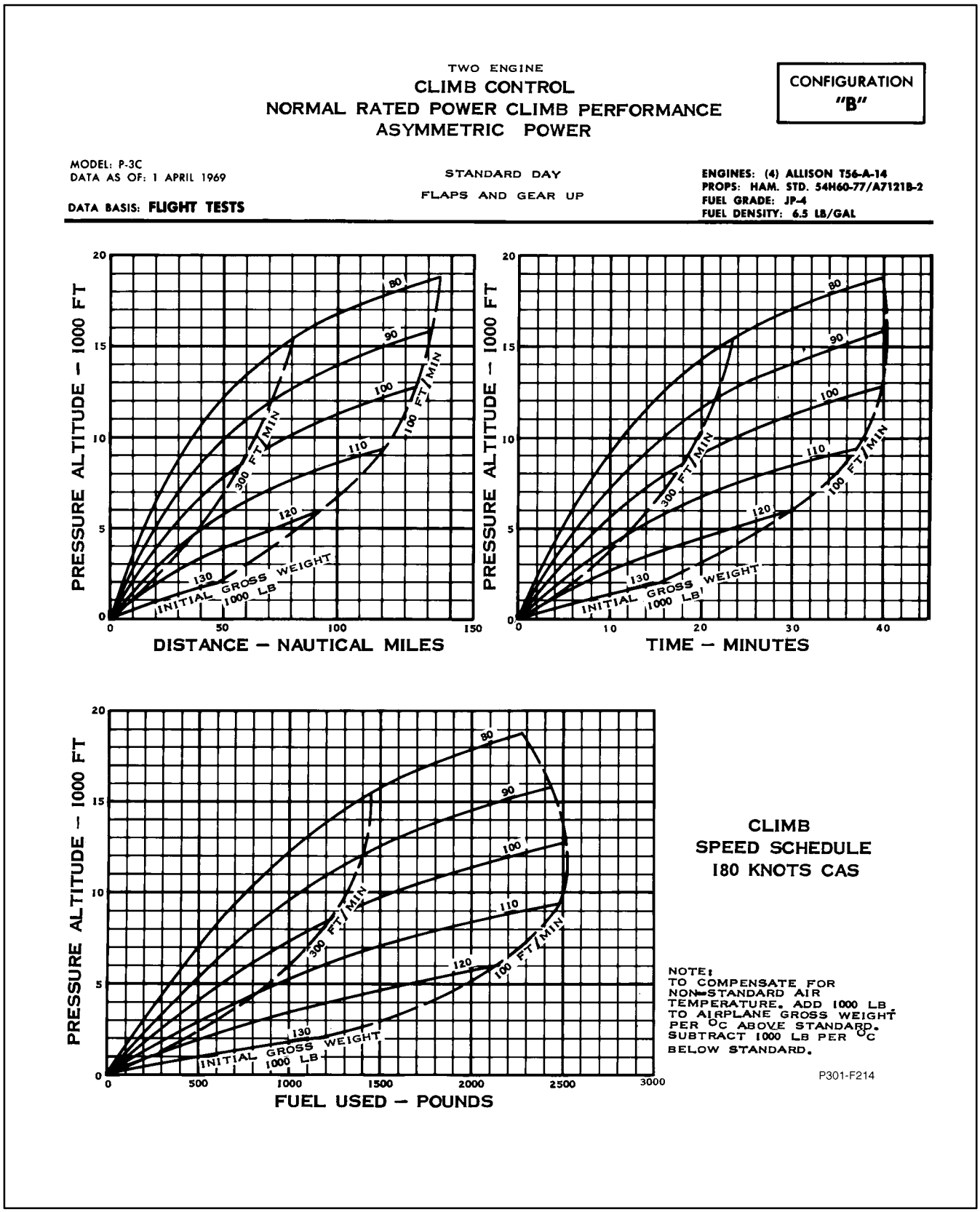


Figure 31-6. Two-Engine Climb Control — Normal Rated Power Climb — Asymmetric Power Performance — Configuration B

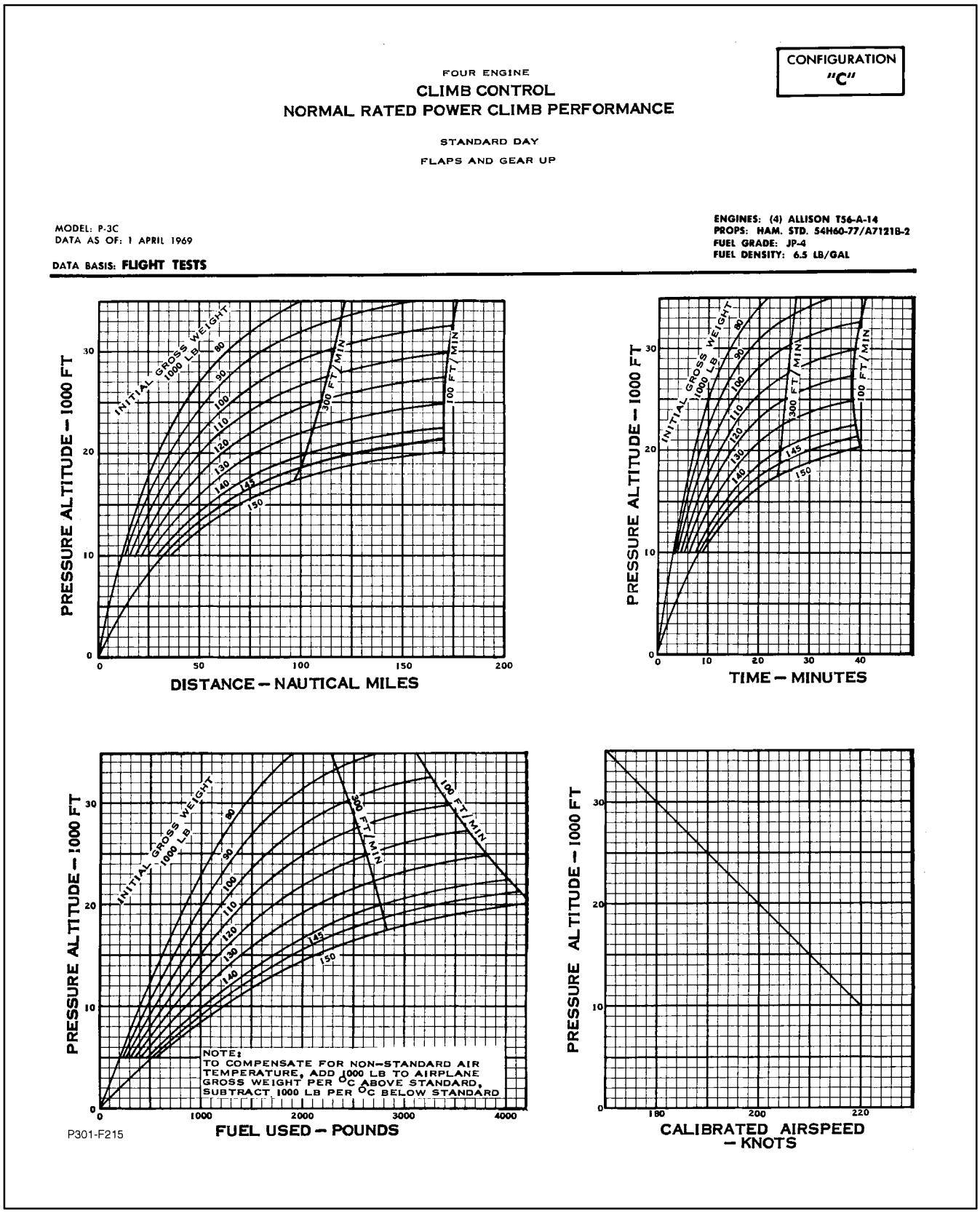


Figure 31-7. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration C

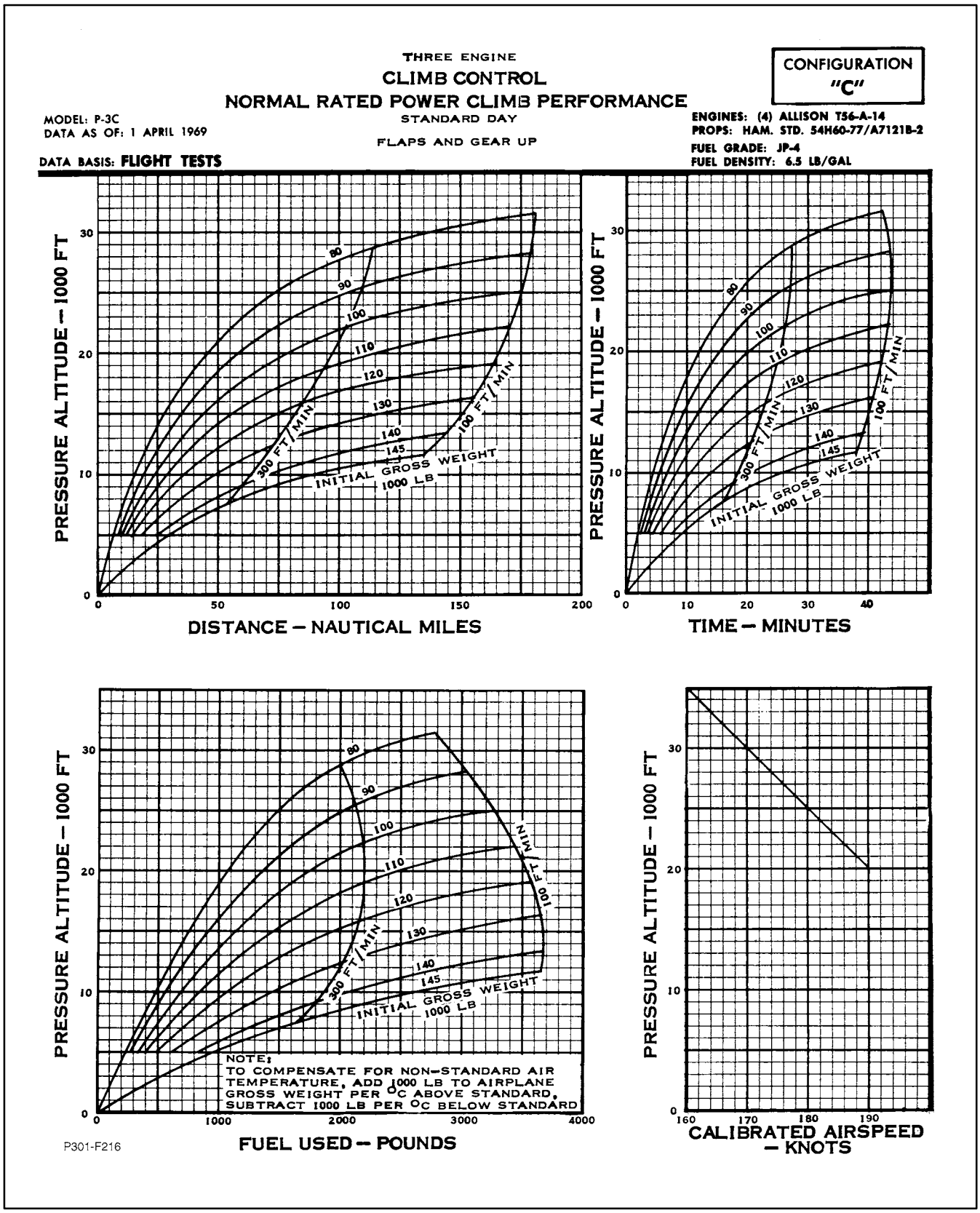


Figure 31-8. Three-Engine Climb Control — Normal Rated Power Climb Performance — Configuration C

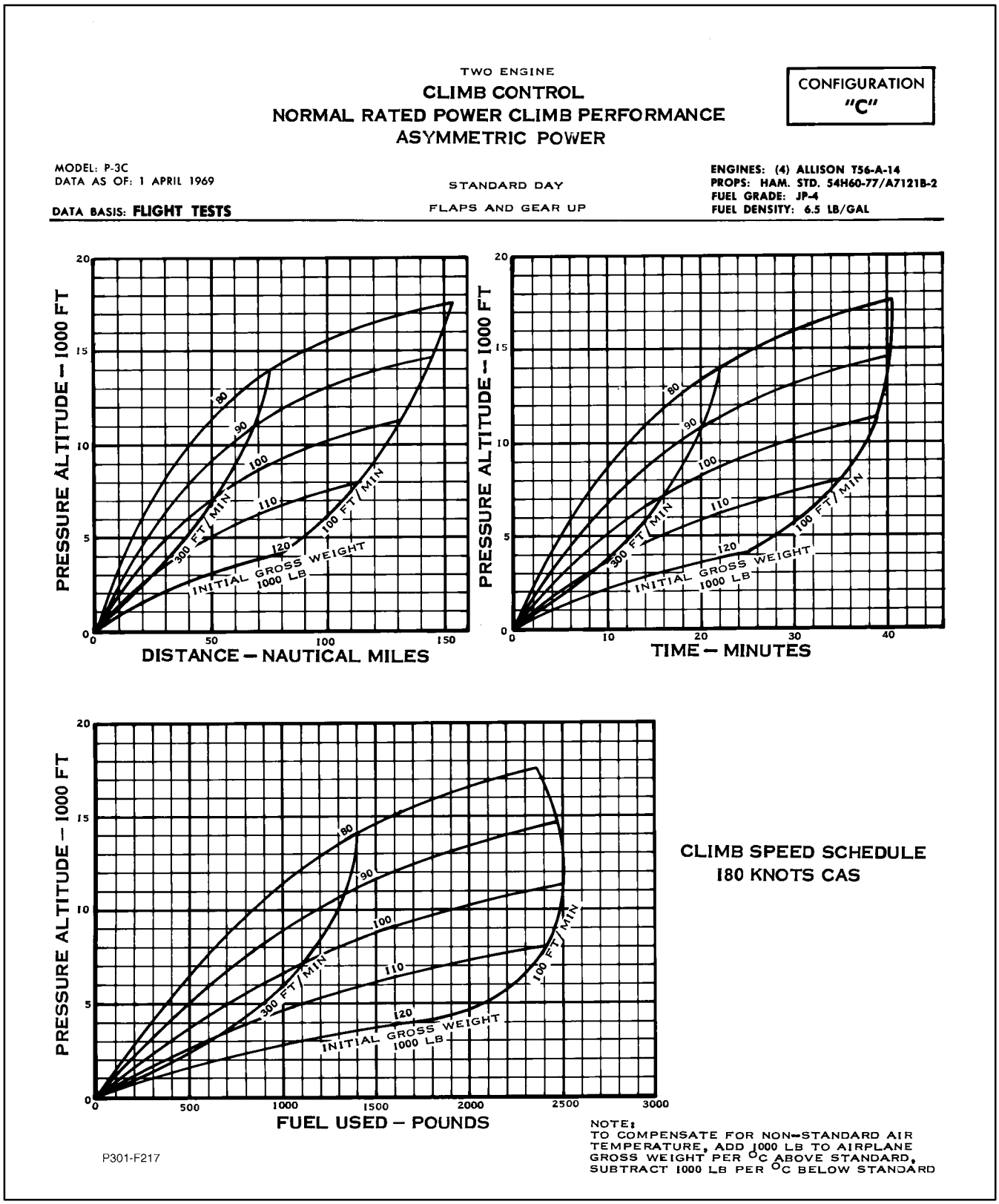


Figure 31-9. Two-Engine Climb Control — Normal Rated Power Climb Performance — Asymmetric Power — Configuration C

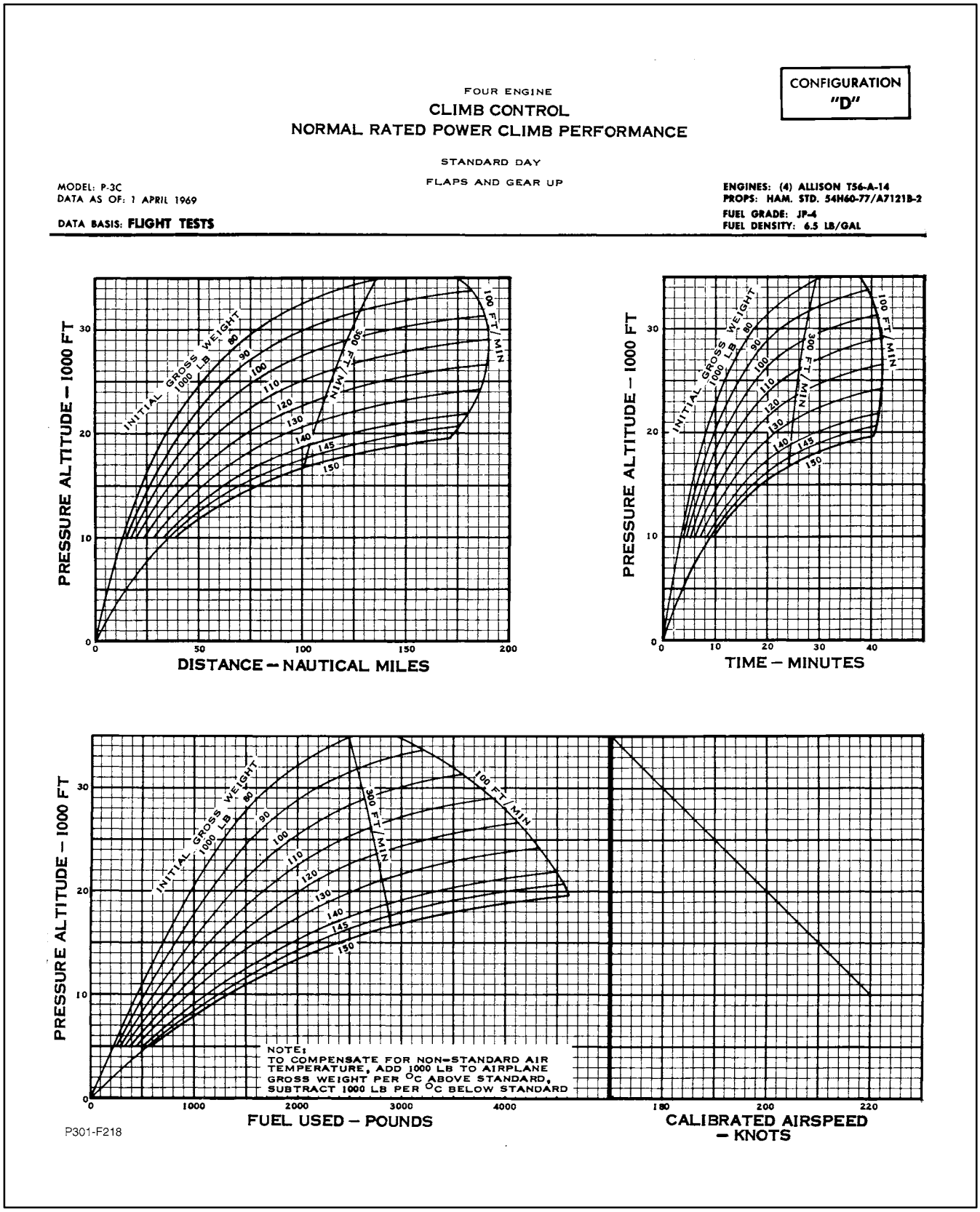


Figure 31-10. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration D

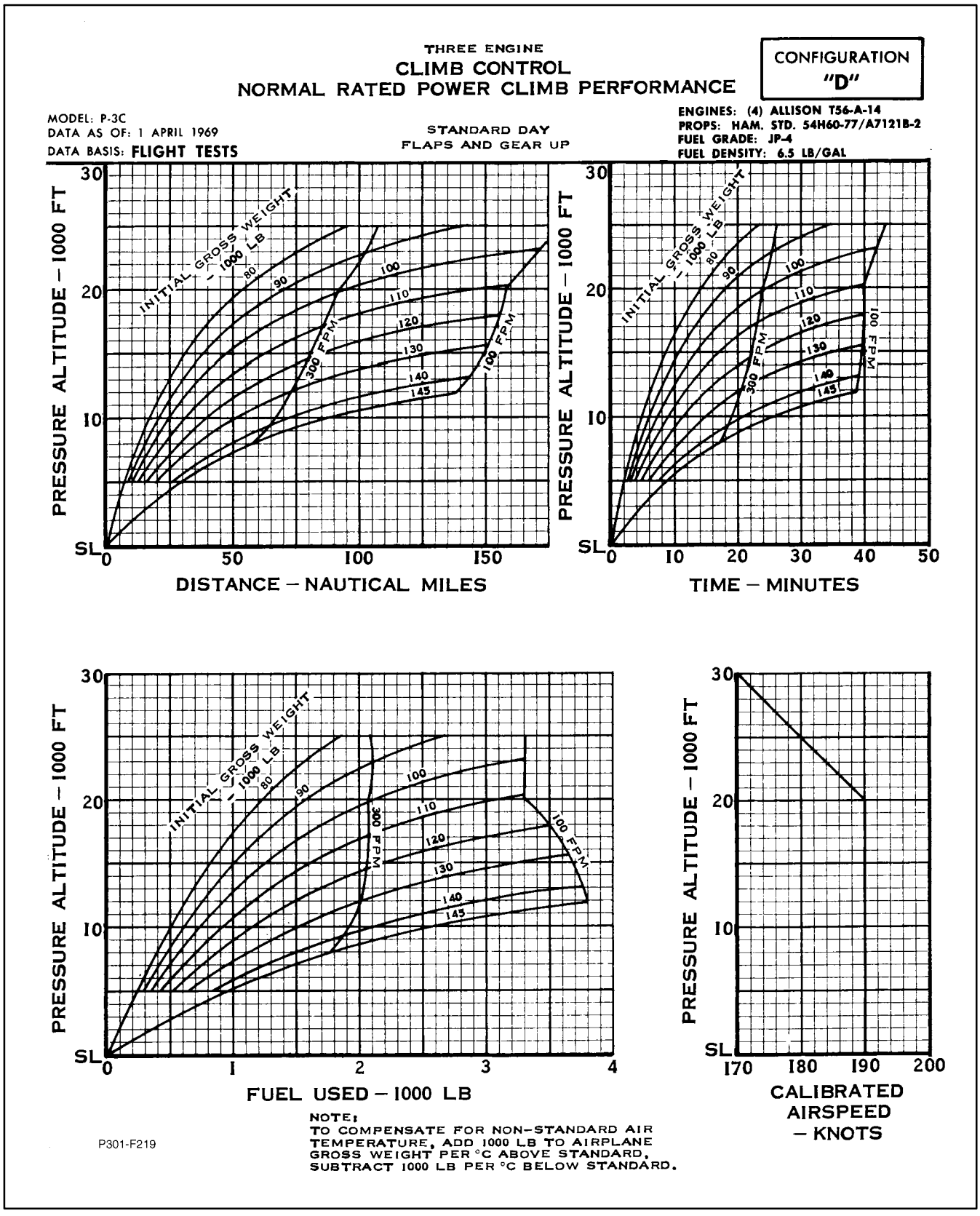


Figure 31-11. Three-Engine Climb Control — Normal Rated Power Climb Performance — Configuration D

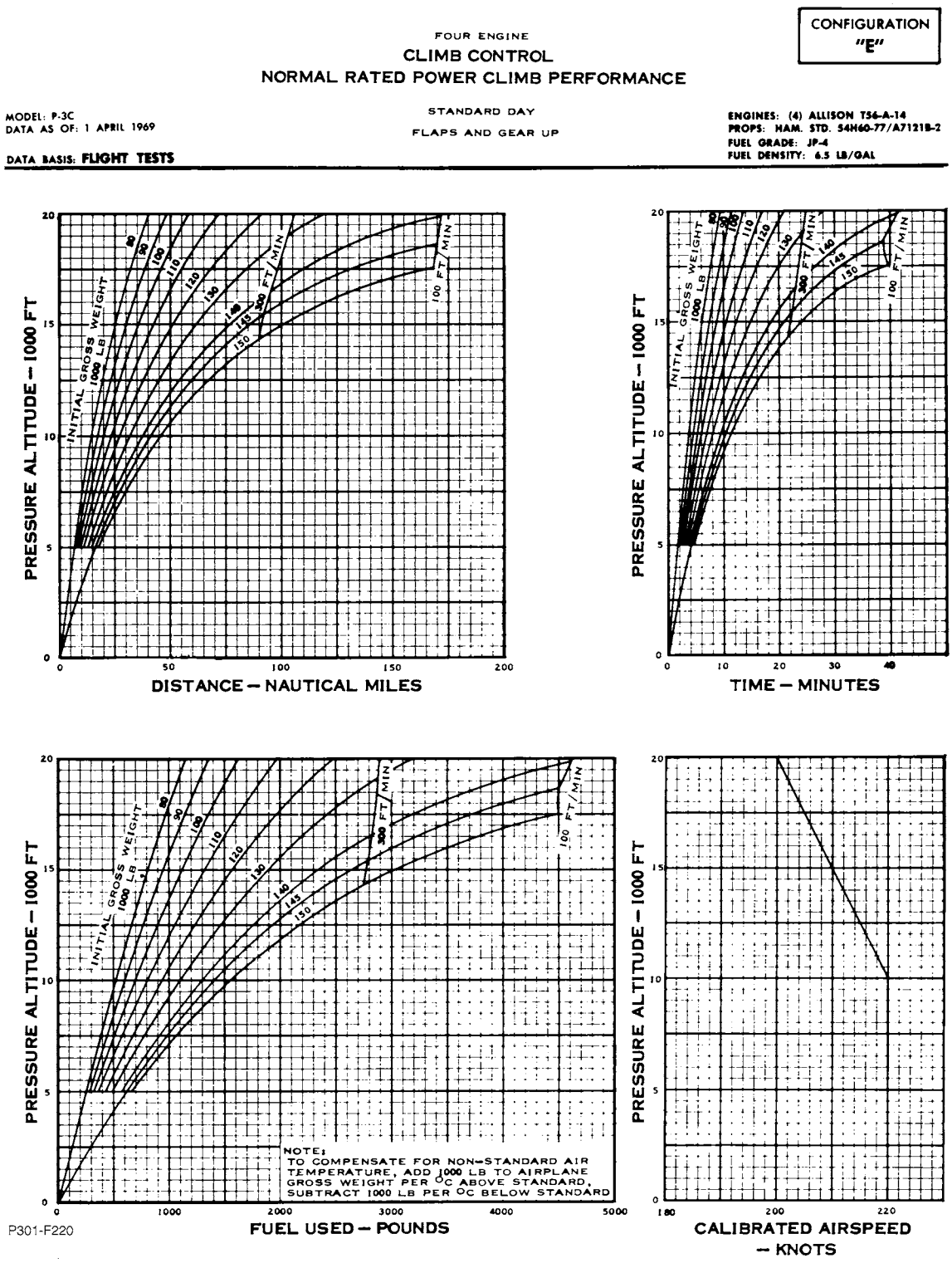


Figure 31-12. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration E

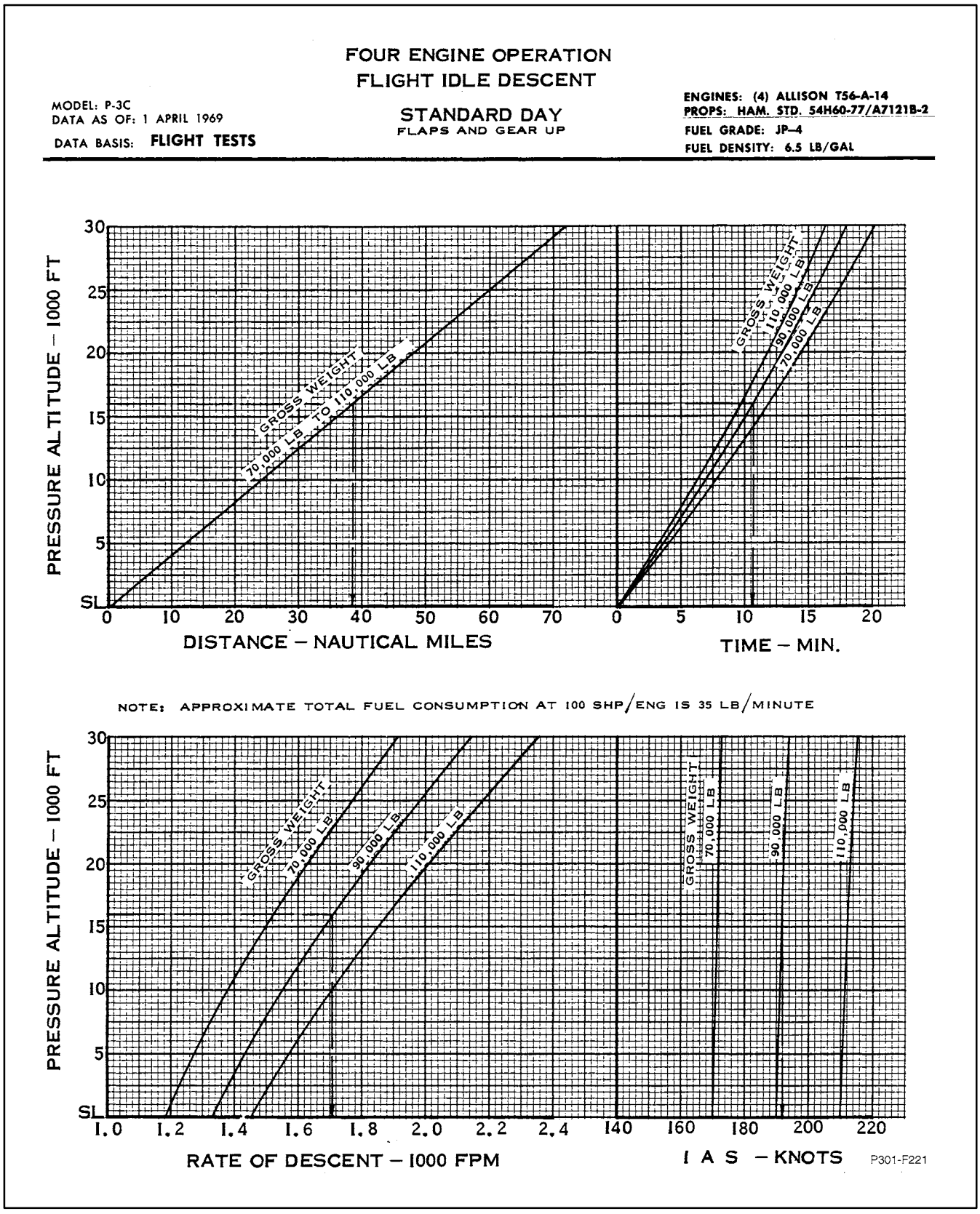


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 1 of 4)

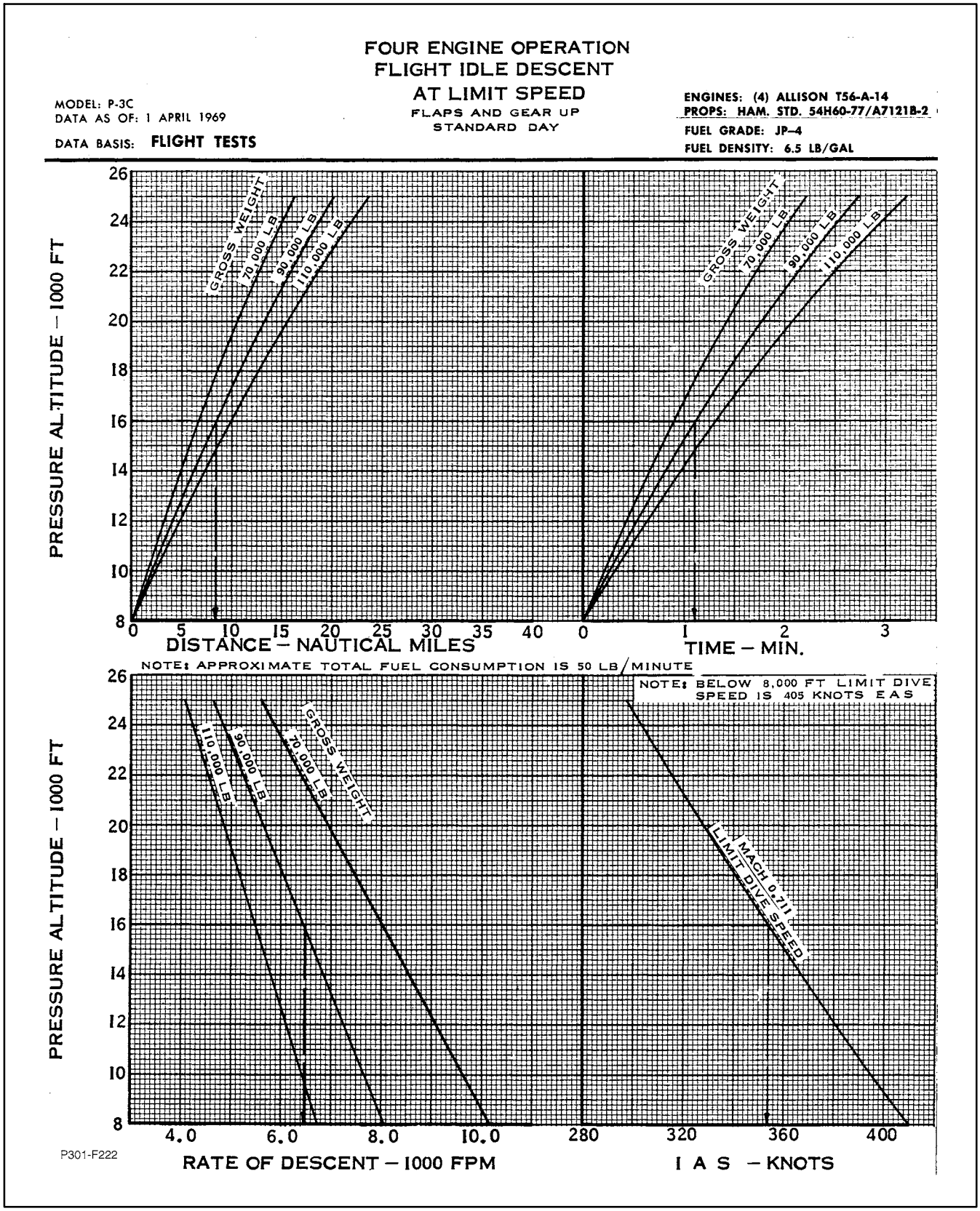


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 2 of 4)

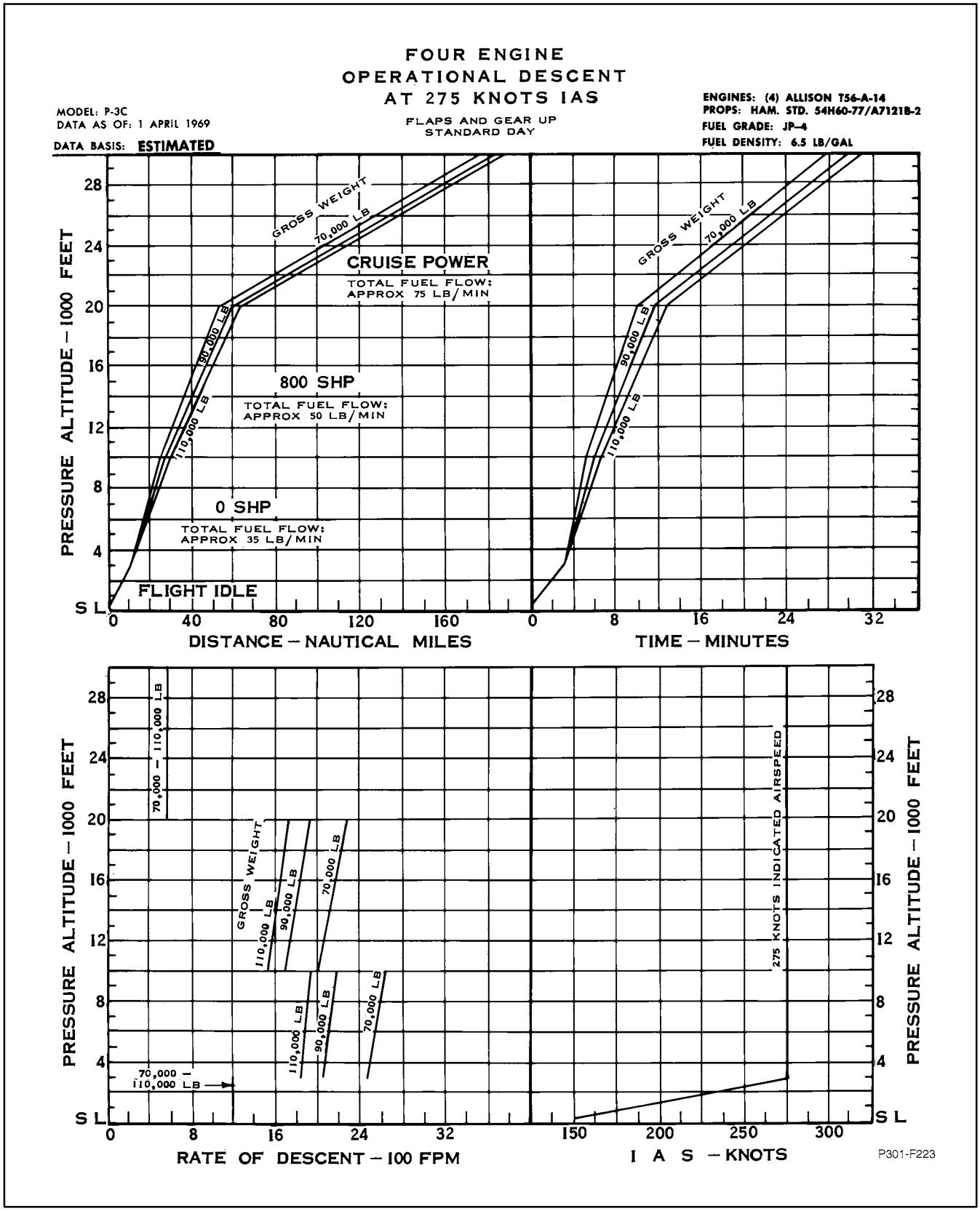


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 3 of 4)

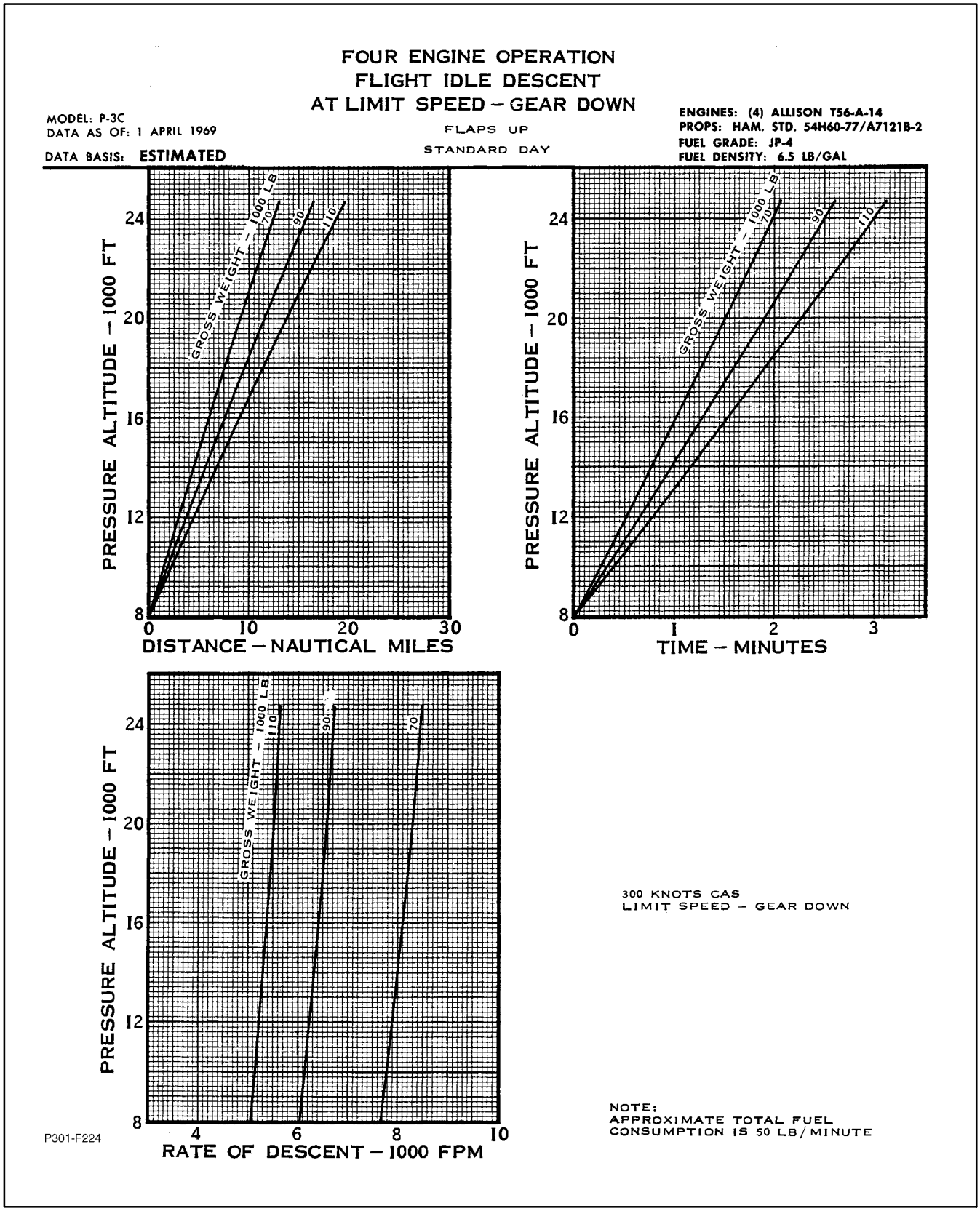


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 4 of 4)

ESTIMATED SINGLE ENGINE PERFORMANCE AT LOITER SPEEDS

1000 FEET PRESSURE ALTITUDE

CONFIGURATION "B"

STANDARD DAY

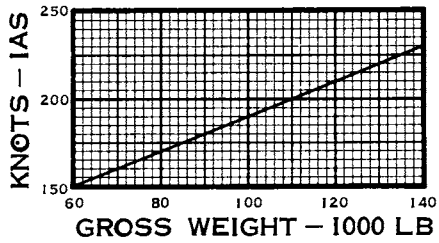
NORMAL RATED POWER

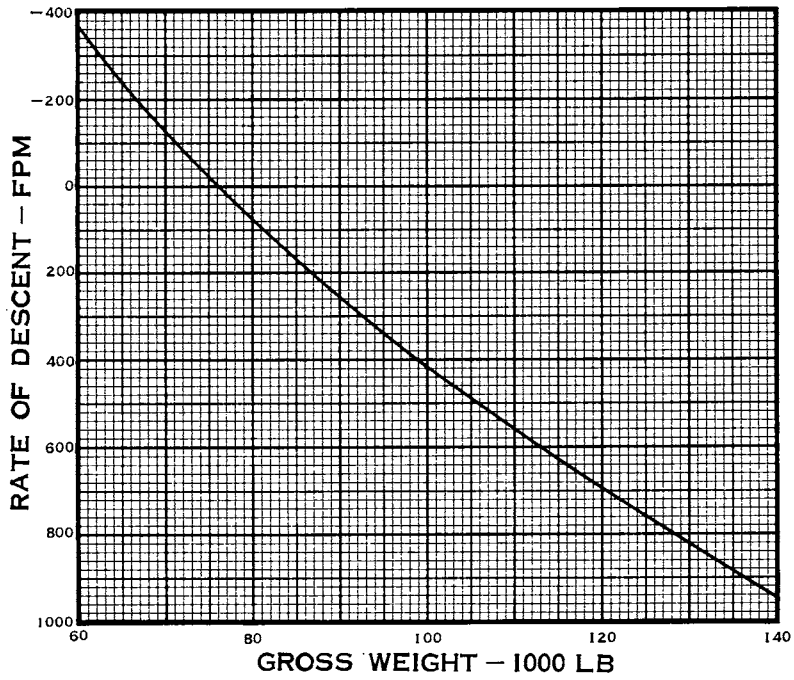
THREE PROPELLERS FEATHERED

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **ESTIMATED**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





P301-F225

Figure 31-14. Estimated Single-Engine Performance at Loiter Speeds — 1,000-Foot Pressure Altitude — Configuration B

ESTIMATED TWO ENGINE PERFORMANCE
AT LOITER SPEEDS
1000 FEET PRESSURE ALTITUDE

MANEUVER FLAPS

CONFIGURATION "B"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: ESTIMATED

NORMAL RATED POWER
TWO PROPELLERS FEATHERED ON THE SAME SIDE

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

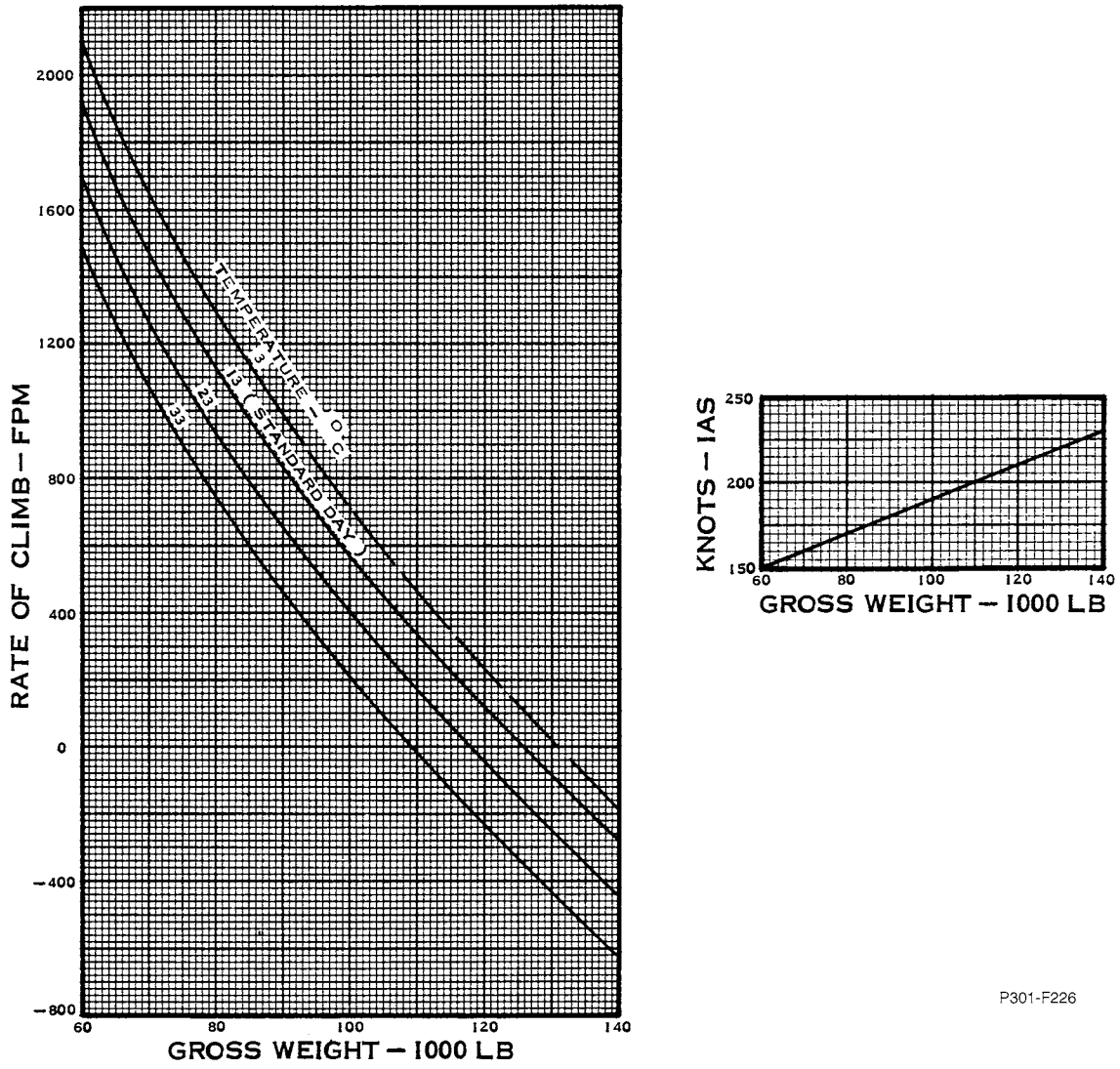


Figure 31-15. Estimated Two-Engine Performance at Loiter Speeds — 1,000-Foot Pressure Altitude — Configuration B (Sheet 1 of 2)

CONFIGURATION "C"

ESTIMATED TWO ENGINE PERFORMANCE AT LOITER SPEEDS 1000 FEET PRESSURE ALTITUDE

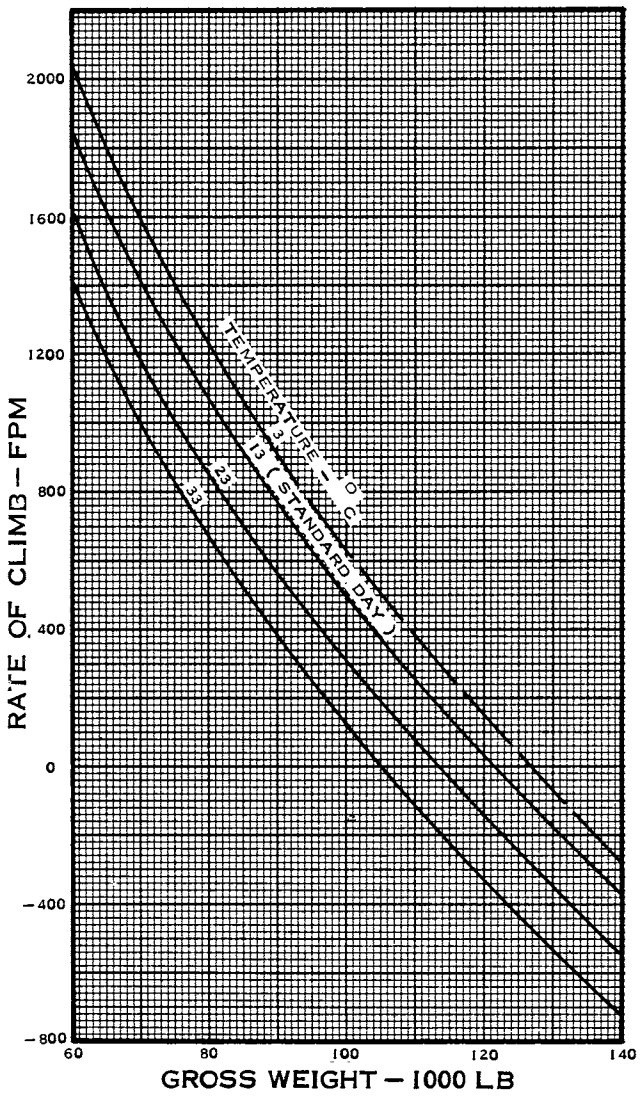
MANEUVER FLAPS

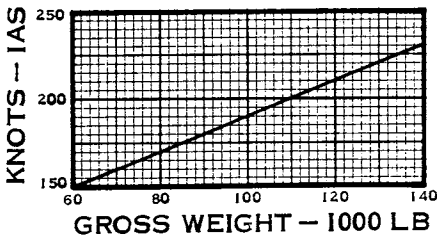
NORMAL RATED POWER

TWO PROPELLERS FEATHERED ON THE SAME SIDE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: ESTIMATED

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





P301-F227

Figure 31-15. Estimated Two-Engine Performance at Loiter Speeds — 1,000-Foot Pressure Altitude — Configuration C (Sheet 2 of 2)

CHAPTER 32

Flight Planning

32.1 SCOPE

The material in this chapter supplies information needed for planning normal missions. The data consist of maximum range and loiter speed schedules, maximum range fuel planning charts, loiter speed performance summaries, and composite power required charts. A graphical form of presentation provides the flexibility needed to cover the variety of operating conditions that will be met in normal operation. Tabular data presented in the operating tables information are consistent with this material and supply the information needed to convert flight plans into operating schedules.

Flight planning should be based on a minimum of 6,000 pounds of reserve fuel on top of destination, or if one is required by OPNAVINST 3710.7 series, on top of the alternate.

WARNING

The fuel quantity indicating system is subject to error. The above minimum reserve should be considered adequate only when a preflight fuel dip is obtained and a fuel log maintained.

Note

With AFC-517 incorporated, actual usable fuel quantity is 5 percent less than indicated. This factor should be considered when planning mission fuel requirements. Correction is not required with AFC-578 incorporated.

Without a fuel dip and fuel log, flight planning should be based on a minimum of 8,000 pounds of reserve fuel. Planning a higher reserve will result in a significant penalty in operating economy and time on station and is discouraged as a standard operating procedure.

32.2 MAXIMUM RANGE AND LOITER SPEED SCHEDULE

The loiter indicated airspeed schedule can be determined by adding 90 knots to the aircraft gross weight in thousands of pounds and does not change with altitude. There is a margin of power for turns, and maneuvers and airspeed can be allowed to decay from 15 to 20 knots while maneuvering. On a mission requiring infrequent and gentle maneuvers, fuel usage can be substantially reduced by maintaining a loiter speed 15 to 20 knots below the loiter speed schedule. The use of maneuver flaps during loiter increases fuel flow.

No wind, maximum-range cruise indicated airspeeds are determined by adjusting a basic IAS for the effects of drag loading, gross weight, altitude, and the number of operating engines. The formula for four-engine maximum-range cruise IAS, in drag configurations A, B, and C, is 205 knots plus one-half of the aircraft gross weight in thousands minus the altitude in thousands. This basic formula is modified for drag configurations D and E in that the basic IAS is 180 knots plus one-half of the aircraft gross weight in thousands minus twice the altitude in thousands. For three-engine operation, subtract 10 knots from the unmodified basic formula; for two-engine, subtract 20 knots. Three- and two-engine IAS may be limited by the power available.

These are easily remembered formulas and give the exact loiter and maximum range cruise indicated airspeeds for all conditions of weight, altitude, drag configuration, and number of operating engines whereas the operating tables normally require some type of interpolation.

These speeds are generally 0.99 of the maximum nm per pound in order to provide a 20- to 30-knot faster transit speed for drag configurations A, B, and C. The speeds for configurations D and E are closer to the maximum nm per pound. To compensate for wind in any configuration, adjust TAS as follows:

1. Increase TAS by 30 percent of a headwind component.
2. Decrease TAS by 25 percent of a tailwind component.

32.3 MAXIMUM RANGE FUEL PLANNING CHARTS

The fuel planning charts (FO-20, FO-21, FO-22, FO-23, FO-24, FO-25, FO-26, FO-27, FO-28, FO-29, FO-30, and FO-31) provide trip fuel-requirement data for maximum-range flights at constant altitude. The charts assume that the flight plan calls for level-flight operation at the recommended maximum-range cruise speed schedule to destination. Allowances for pretakeoff ground maneuver, takeoff, and acceleration to climb speed (normally 600 pounds) must be made to determine initial cruising weight. Allowances for terminal maneuvering and necessary reserve should also be added to the forecast fuel load if required. If operational conditions require extended periods of ground operation or excessive taxi distances, a standard fuel requirement rate may be determined by use of Figure 32-1 (assume all four engines operating):

POWER CONDITION	IAS KNOTS	LB/MIN.
Low Taxi	—	40
Normal Ground	—	60
Takeoff	0	150
Takeoff	140	155
APU		5

Figure 32-1. Extended Ground Operation Fuel Planning

Charts for three- and two-engine operation are also based on a level-flight profile. The charts may be used directly if destination weight is 90,000 pounds; however, they may be used for any proposed landing weight by using the distance scales and flight time lines on an incremental basis.

A level-flight transit is less economical than a transit in which step climbs are performed as aircraft gross weight decreases. A step climb is economical provided approximately 1 hour of transit remains. For aircraft drag configurations A, B, and C, climb 2,000 feet when engine TIT is decreased to:

1. 900 °C with a tailwind.
2. 890 °C with no wind.
3. 880 °C with a headwind.

32.3.1 Cruise Power

Flight planning shall be based on 925° TIT cruise ceiling performance. Cruise power setting should be based on power required to achieve maximum range airspeed at the appropriate 925° TIT altitude. These limitations are not intended to restrict higher power settings if necessary to meet operational requirements.

32.3.2 Wind Effect on Cruise Altitude

Since winds aloft have a marked effect on aircraft range, a change from the current cruise altitude to one where reported winds are different (i.e., greater headwinds at a higher altitude) may result in increased aircraft range. Calculations show that to take advantage of such conditions, the relative magnitude of the winds at both altitudes must be in effect for approximately 1,000 nautical air miles. Refer to Figure 32-2.

A rule of thumb that results in equal or greater range at the higher cruise altitude is:

1. One knot/1,000-foot maximum wind increase near the 1,010 °C TIT cruise ceiling.

2. Four knots/1,000-foot maximum wind increase near the 925 °C TIT cruise ceiling.

WIND FACTOR TABLE		
WIND SPEED	**HEADWIND**	**TAILWIND**
10	1.03	0.97
20	1.06	0.94
30	1.10	0.92
40	1.14	0.89
50	1.18	0.87
60	1.22	0.85

Figure 32-2. Wind Factor Table

32.3.3 Use of Fuel Planning Charts

If landing gross weight is known, add an allowance for terminal maneuvering. Find the equivalent pressure altitude that will give the same cruise performance as for the actual flight altitude and forecast temperature condition. This is done by using the conversion chart below. To find initial cruise altitude when delta T (DT) and level-off gross weight are known, find intersection of gross weight and cruise ceiling DT lines. Proceed left and locate the intersection of DT and pressure altitude on the pressure altitude chart. For example, with drag count configuration A, four-engine operation, 925 °C TIT cruise ceiling; at DT = +10 °C, and 120,000-pound level-off gross weight, the initial cruise altitude is 22,000-foot pressure altitude. Next, locate the intersection of this altitude line with the line representing terminal weight and note the corresponding chart time and air distance values. Then, determine the chart air distance corresponding to the distance to be flown. Read weight and flight time at the point on the chart where this distance intersects the flight altitude line. The difference in weights is the level-flight fuel load and the flight time for zero wind. Addition of climb time and fuel factors results in trip fuel and time. Ground maneuver, takeoff, and acceleration fuel and time allowances should be added to determine total fuel load and trip time. Forecast winds may be accounted for by correcting the air distance to be flown. Since the aircraft must fly through the air a greater distance with headwind and a lesser distance with tailwind to cover an equivalent ground distance, chart entry is made with an air distance corrected for wind effect to determine the correct gross weight increment. This is accomplished by correcting the zero wind air distance by the ratio of average true airspeed to average groundspeed. Thus: air distance to be flown with wind = zero wind distance $\times$ average true airspeed/average ground speed.

32.3.4 Climb Fuel and Time Factors

The climb fuel factor is the difference between climb fuel required to reach cruise altitude and the cruise fuel required to cover the same distance at altitude. Climb fuel is determined from a study of the climb performance charts, as are time and distance required to climb. Cruise fuel equals climb distance divided by cruise fuel economy (miles per pound). For example, assume 2,000 pounds of fuel and 100 air miles are required to reach cruise altitude, and cruise fuel economy is 0.080 miles per pound at the climb weight. Cruise fuel required to fly the 100 miles would be 100/0.080, or 1,250 pounds. The climb fuel factor is 2,000 – 1,250 pounds, or 750 pounds. If the fuel planning chart shows that 10,000 pounds of fuel is required for a trip distance at altitude, adding 750 pounds to the 10,000 pounds results in 10,750 pounds fuel required to climb to cruise altitude and fly the given trip distance.

Climb time factors are found in a similar manner, since the time factor is the difference between time required to climb to cruise altitude and time to cruise the same distance at altitude. For example, assume that the time to climb is 25 minutes, the distance required is 100 nautical air miles, and the cruising TAS at altitude for the climb weight is 300 knots, or 5 nm per minute. The time, therefore, to cruise 100 miles would be 20 minutes, and the climb time factor would be the difference between 25 minutes actually required and the 20 minutes cruise time for the same distance, or 5 minutes. If the fuel-planning chart shows 2.80 hours required for a trip distance and the climb time factor is found to be 5 minutes (0.08 hour), the trip time from start of climb is 2.88 hours (2.80 + 0.08).

32.3.5 Fuel Planning Example

Find trip fuel and time required for a 2,200 nm flight at maximum-range speeds and drag count configuration B. Flight altitude is 18,000 feet; standard temperatures and zero wind are anticipated. Zero fuel weight is 69,000 pounds. Assume terminal maneuvering and reserve allowances require 6,000 pounds fuel, making the weight at destination 75,000 pounds. Ground maneuver and takeoff acceleration allowance is 600 pounds of fuel.

Enter FO-23 at 18,000 feet and proceed to the 75,000-pound line. Read a time of 3.95 hours and distance of 1,170 nautical air miles. This represents time and distance from a gross weight of 90,000 pounds. The additional time, distance, and weight are also found in FO-23. Enter FO-23 with the remaining distance to be flown, 1,030 nautical air miles (2,200 – 1,170), and move vertically to 18,000 feet. Read a time of 3.40 hours and a weight of 104,100 pounds.

Chart time is 3.95 plus 3.40 hours, or 7.35 hours (7:21) and chart fuel is 104,100 minus 75,000, or 29,100 pounds; however, these values must be adjusted for greater time and fuel required during climb. The time and climb fuel factors for climb to 18,000 feet at an approximate takeoff weight of 105,000 pounds are 1.8 minutes and 575 pounds, respectively. Adding 1.0 minute for takeoff run and acceleration to climb speed, total trip time is 7.4 hours (7:21 + 0:02 + 0:01). Including fuel allowance for start, taxi, and takeoff (600 pounds), the total trip fuel is 30,275 pounds (29,100 + 575 + 600). Total ramp weight is 105,275 pounds, which includes 69,000 pounds aircraft zero fuel weight, 6,000 pounds terminal allowance, and 30,275 pounds trip fuel.

Note

With explosive suppressant foam installed (AFC-517), actual usable fuel quantity is 5 percent less than indicated. This factor should be considered when planning mission fuel requirements.

Example: Mission fuel requirement is 40,000 pounds in order to land with on top requirement of 8,000 pounds. Aircraft should be fueled with an additional 5 percent (42,000 pounds) as read on totalizer. If an additional 5 percent is not included, actual usable fuel is less by 5 percent (38,096 pounds) even though 40,000 is shown on totalizer. This factor should be included with “go home” fuel computations.

Example: “Go home” fuel requirements. If maximum range cruise planning chart determines total “go home” fuel is 20,000 pounds, add 5 percent and return when totalizer reading is 21,000 pounds. This 5 percent addition is negligible at lower fuel states.

32.3.6 Return Fuel Planning

Aircraft malfunctions such as failure to pressurize, airframe damage, or engine failure may limit return cruise altitude. Crews should plan return fuel accordingly. When operating over water, away from land, consider departing from the operating area based on three engines operating at 10,000 feet. This provides sufficient fuel for a safe return to home base or nearest suitable field in the event that a malfunction preventing cabin pressurization should occur. Substantial fuel savings may be realized by loitering an engine and flying three-engine maximum range.

Note

If freezing level is below 10,000 feet and atmospheric moisture is encountered, loiter is not recommended. Return fuel computations should take this into consideration.

32.3.6.1 Return Fuel Planning Example

Find return fuel required for an 1,100 nm return at maximum range speed, a configuration B drag count using three engines at 10,000 feet. Standard temperature and zero wind anticipated. Zero fuel weight is 72,000 pounds. The on-top fuel requirement is 8,000 pounds, making destination weight 80,000 pounds.

Enter FO-24 at 10,000 feet intersecting the 80,000-pound line, read Distance to Destination-Nautical Air Miles at bottom of chart as 690 miles. Subtract this from 1,100 miles and reenter chart 1,100 miles to left at Distance to Destination-Nautical Air Miles of 410 nm. Note the gross weight at the intersection with the distance projected up to the 10,000-foot altitude line as 96,000 pounds departure gross weight. Subtract the zero fuel weight from the departure gross weight to arrive at the return fuel totalizer reading of 26,000 pounds.

Note

Dipsticking offers the most accurate means of verifying fuel quantity when sufficient fuel is loaded unless tanks are completely full and the density versus quantity method is used. Hydrostatic testing should be used only when tank quantities preclude other verification methods.

32.4 LOITER PERFORMANCE

32.4.1 Bank Angle Correction

The loiter performance data are based on the assumption that power will remain constant except for reductions as gross weight decreases. Engine power and the resultant fuel flow must be increased if a considerable amount of maneuvering is planned. Refer to Figures 32-3 and 32-4 for AOA readings and gross weight versus indicated airspeed at a constant AOA.

32.4.1.1 Example

Using the four-engine loiter table, Figure 33-10, find the maneuvering power, fuel flow, and predicted time for a sea-level pressure altitude, DT of +10 °C, with initial and final weights of 92,500 pounds and 87,500 pounds, respectively. The tabulated loiter SHP, fuel flow, and time are 1,030, 1,055, and 1:11, respectively. Then apply the power correction factor, 2.0 per °C, (1,030 + 2.0 x 10 °C) = 1,050 SHP.

32.4.2 Loiter Speed Performance Summary and Time Prediction

The associated time prediction versus gross weight curves are provided in Figure 32-5 and Figure 32-6. These data are consistent with the loiter speed operating tables. No data are included for drag count configuration E.

32.4.2.1 Example

For four-engine operation using Figure 32-7, sheet 1, find loiter time available at 10,000 feet for initial and final weights of 113,000 and 104,000 pounds, respectively. Chart initial time at 113,000 pounds is 4.28 hours (4 hours, 17 minutes). Chart final time is 6.43 hours (6 hours, 26 minutes). Loiter time is 6:26 minus 4:17 hours, or 2 hours, 9 minutes. If forecast ambient temperature is 10° below standard, use Figure 32-8, sheet 1, to find that average true airspeed is 226 knots for the loiter period, using average weight of 108,500 pounds.

32.5 COMPOSITE POWER-REQUIRED CHARTS

The composite power-required charts (Figures 32-9, 32-10, 32-11, 32-12, and 32-13) show the power requirements for the complete range of speeds from maximum endurance through loiter to long-range and high-speed conditions. They describe the entire capability of the aircraft when used in conjunction with the power available data in Part XI.

Maximum-range and loiter speed schedules are superimposed on each chart.

Using the four-engine composite cruising flight chart, for drag count configuration B, Figure 32-10, sheet 1, find the power required to fly at 11,000-foot pressure altitude with an ambient temperature of –10 °C at the maximum-range speed schedule and gross weight of 120,000 pounds.

Enter the lower right chart at a pressure altitude of 11,000 feet and proceed to the line defining the maximum-range speed schedule at 120,000 pounds. From this point, proceed vertically to the intersection with the 120,000-pound line and then horizontally to intersect a line determined as follows. Enter the lower left portion of the curve with the ambient temperature and pressure altitude. Proceed vertically to the intersection with the previously determined horizontal line. The intersection is the power required to fly at the desired speed. This is read as 2,310 SHP.

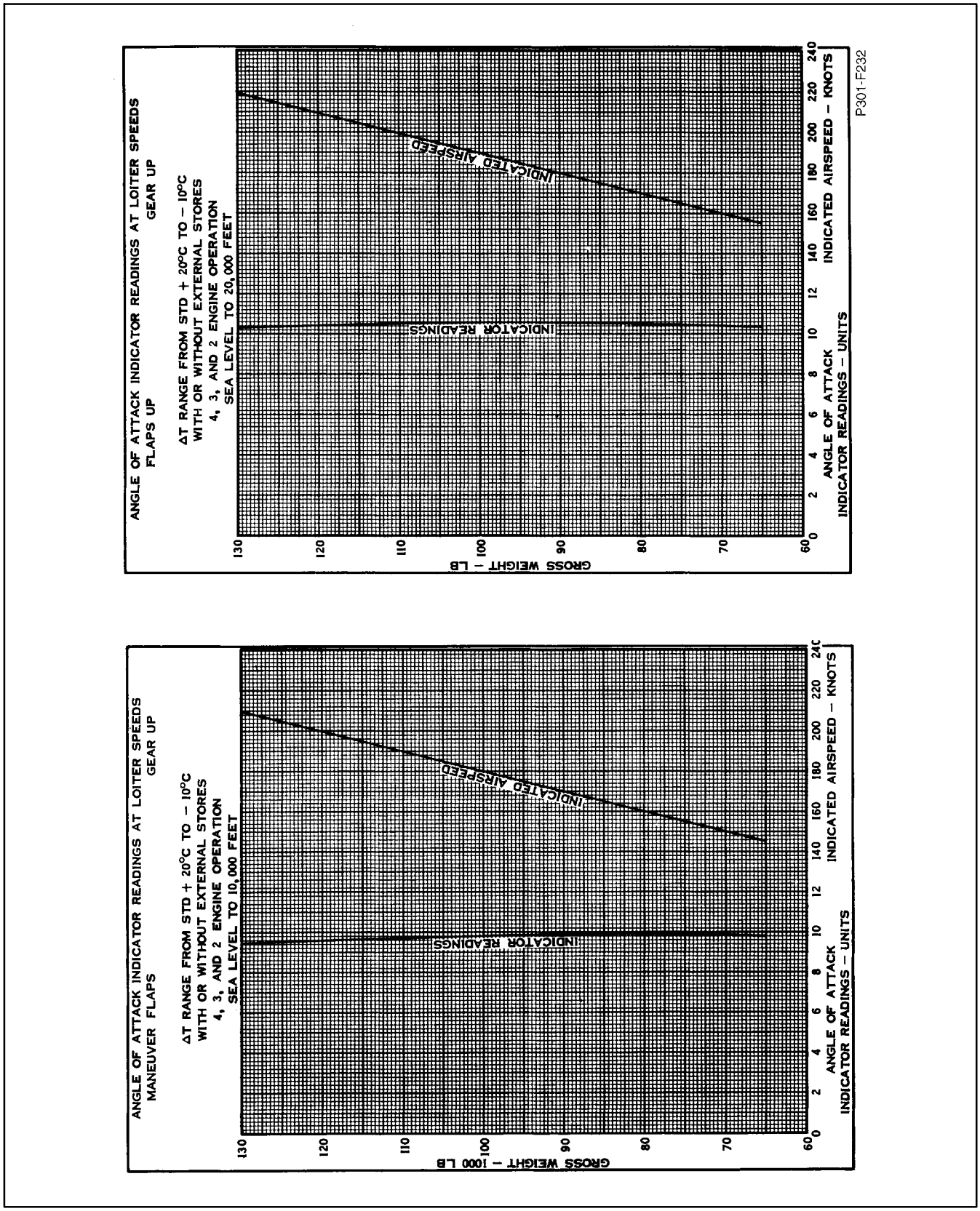


Figure 32-3. Angle-of-Attack Indicator Readings at Loiter Speeds

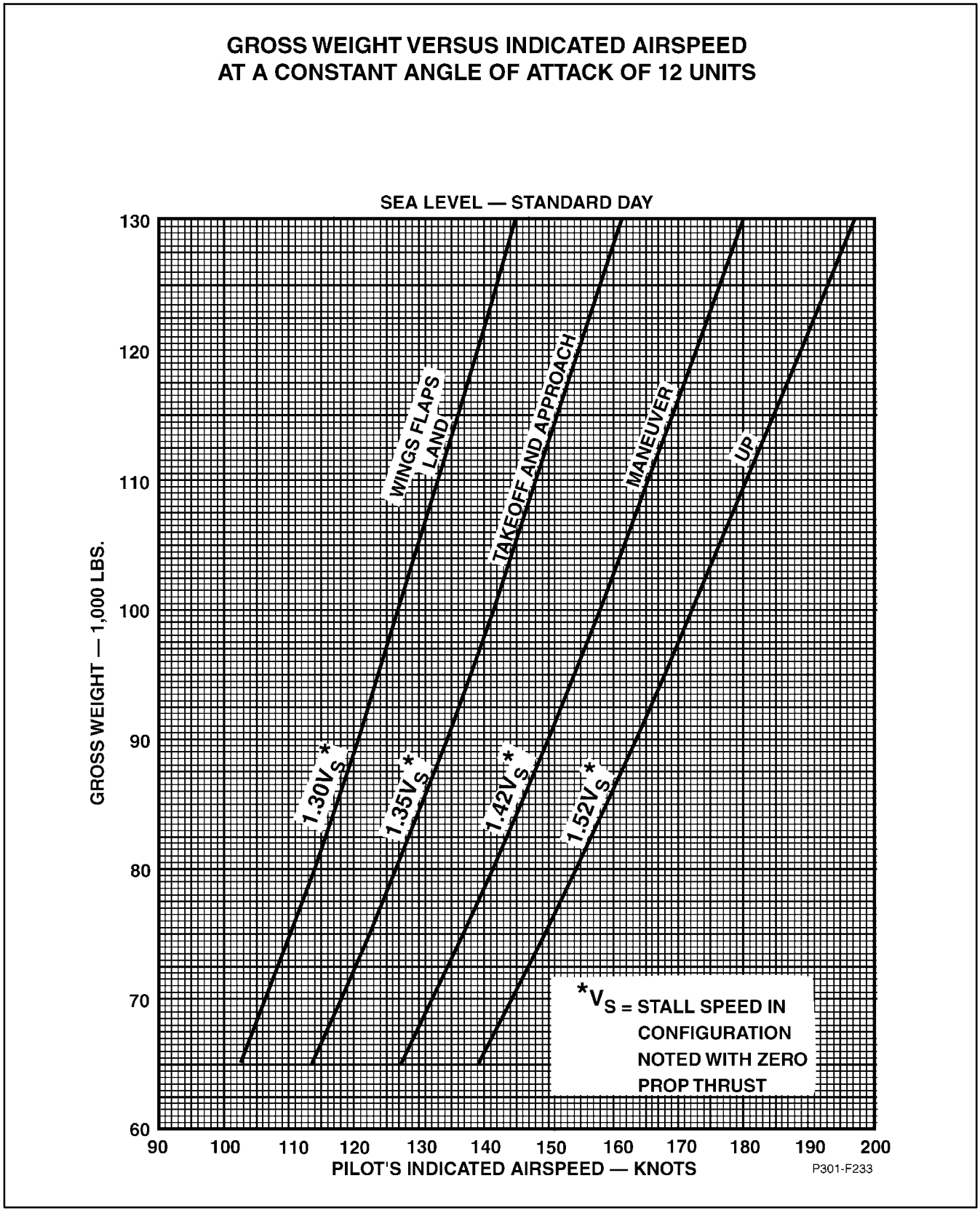


Figure 32-4. Gross Weight vs. Indicated Airspeed at a Constant Angle-of-Attack of 12 Units

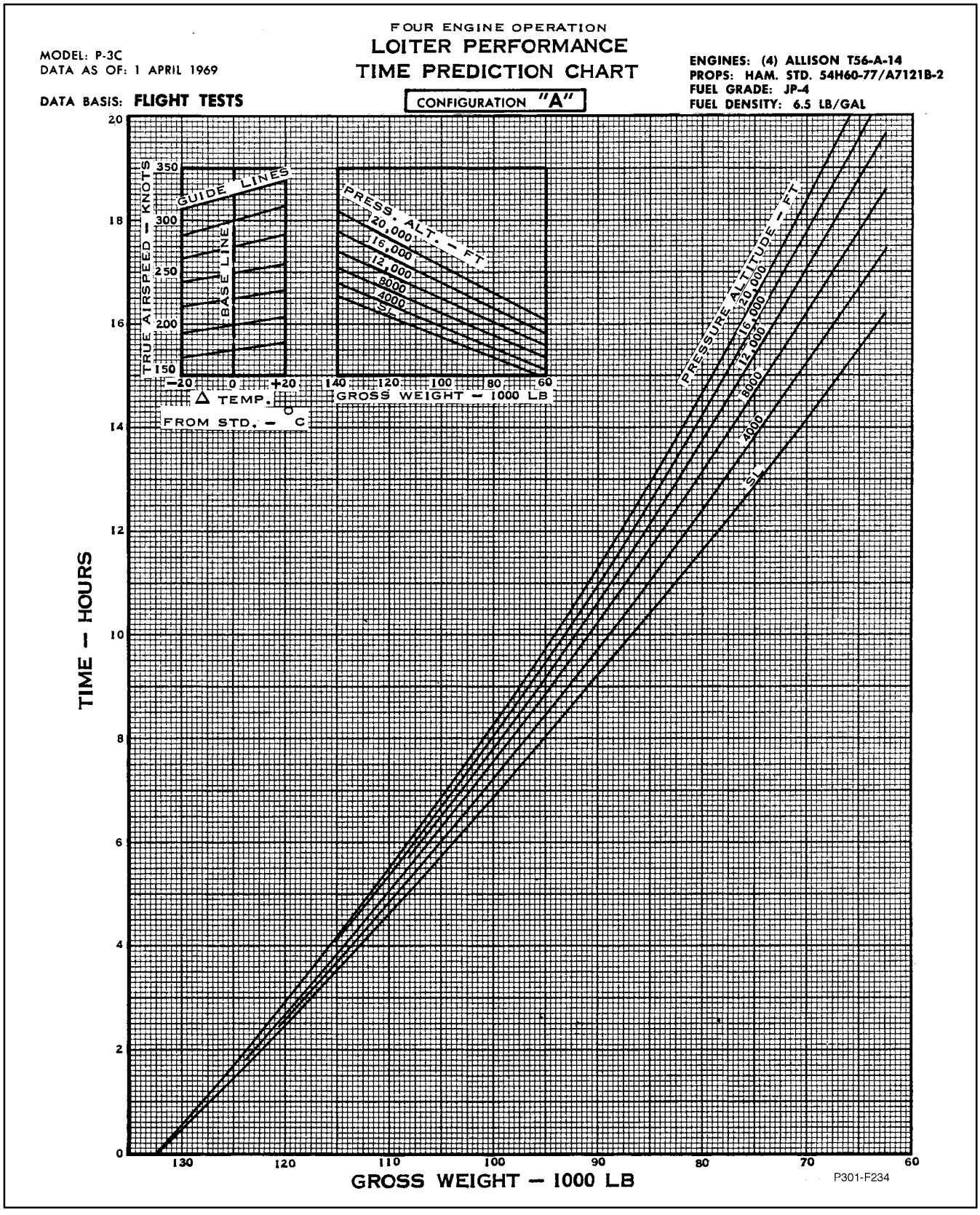


Figure 32-5. Loiter Performance Time Prediction — Configuration A (Sheet 1 of 3)

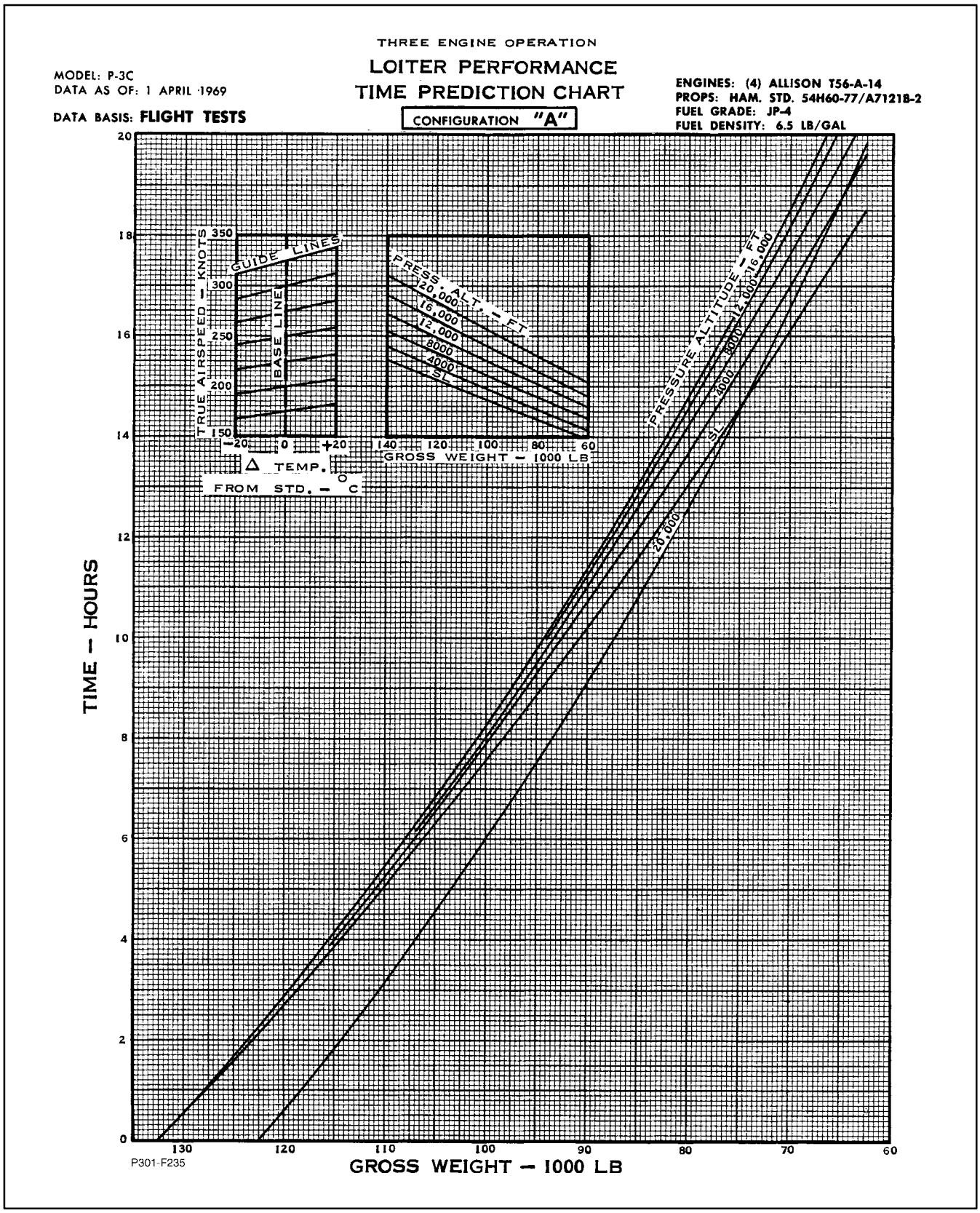


Figure 32-5. Loiter Performance Time Prediction — Configuration A (Sheet 2 of 3)

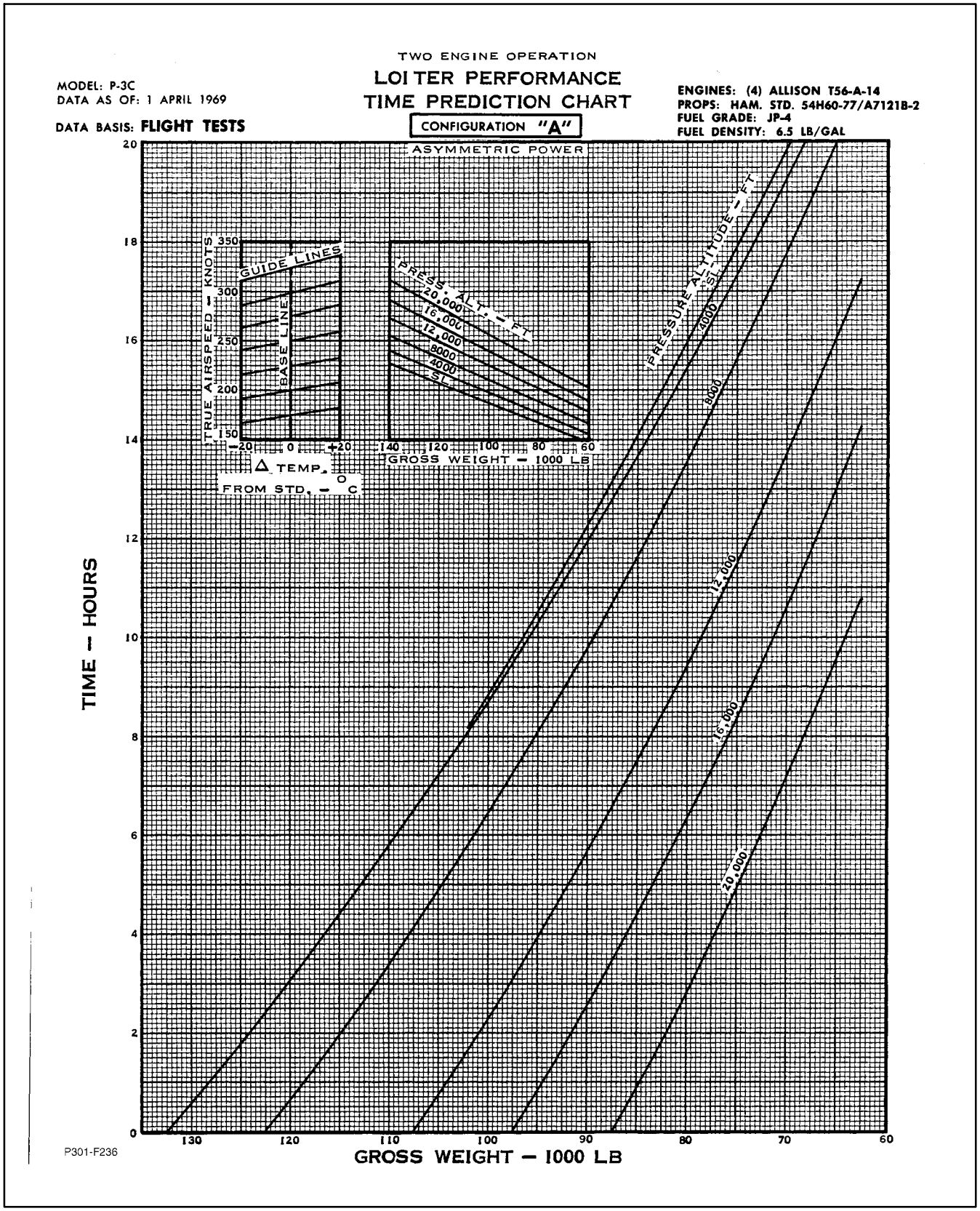


Figure 32-5. Loiter Performance Time Prediction — Configuration A (Sheet 3 of 3)

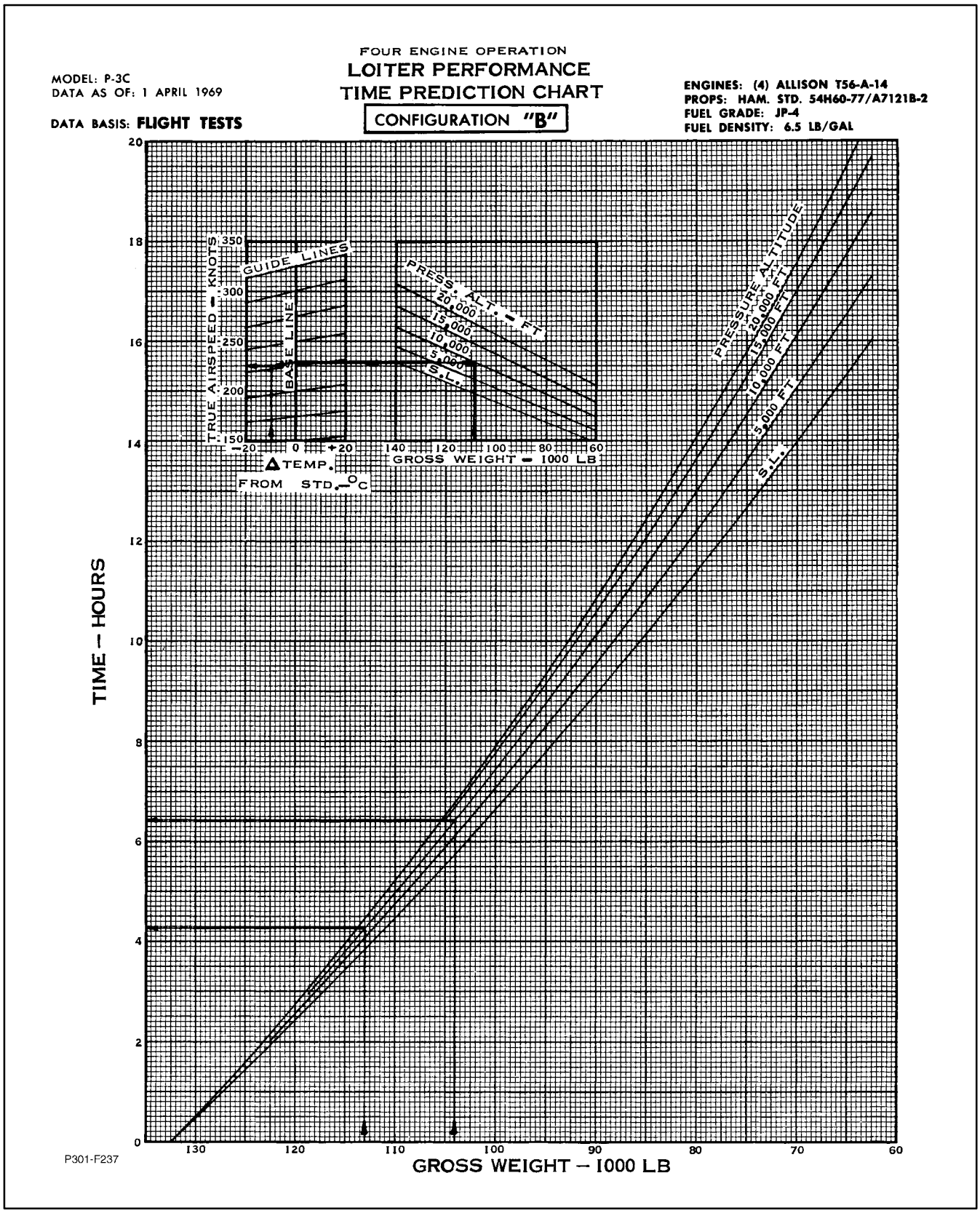


Figure 32-6. Loiter Performance Time Prediction — Configuration B (Sheet 1 of 3)

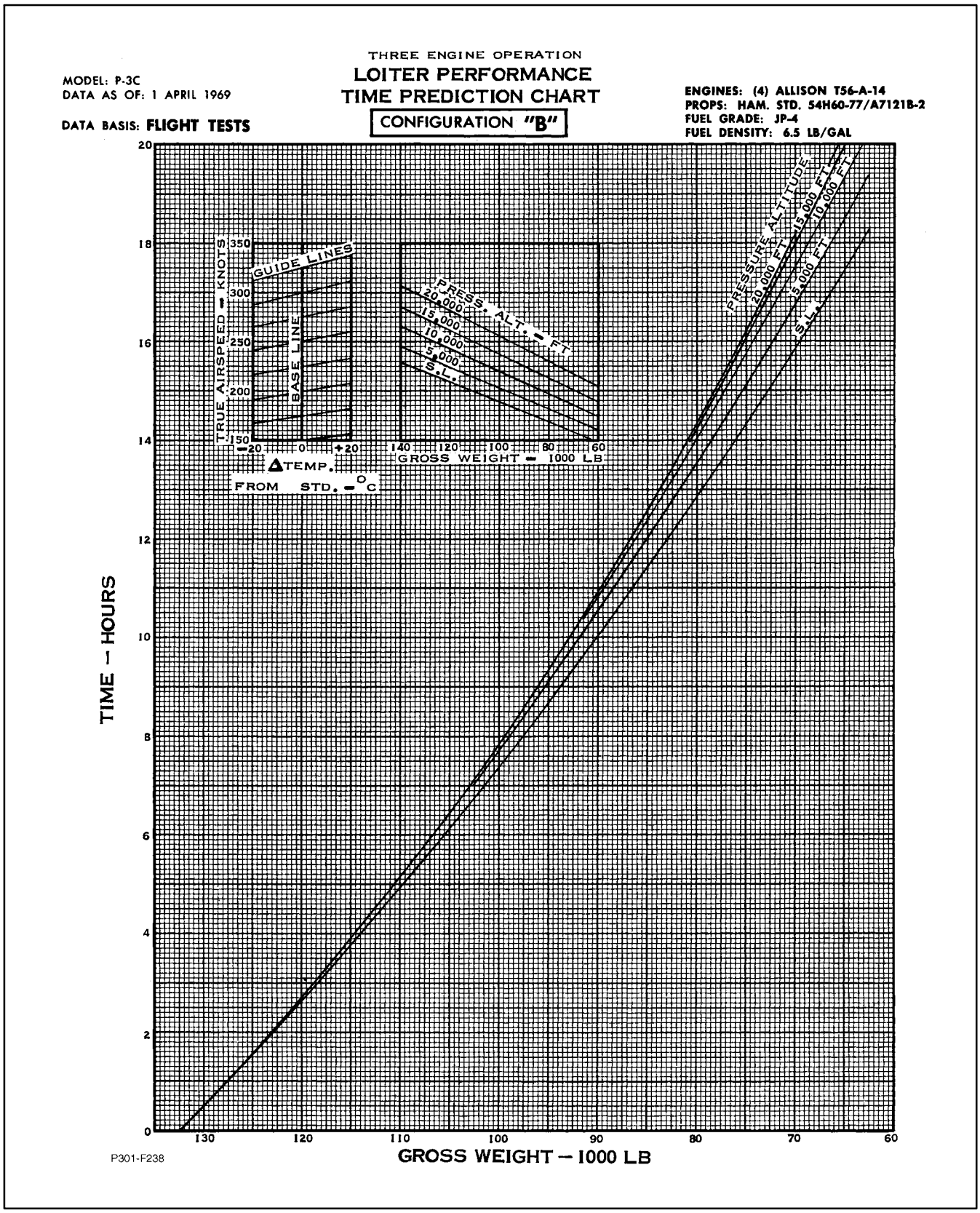


Figure 32-6. Loiter Performance Time Prediction — Configuration B (Sheet 2 of 3)

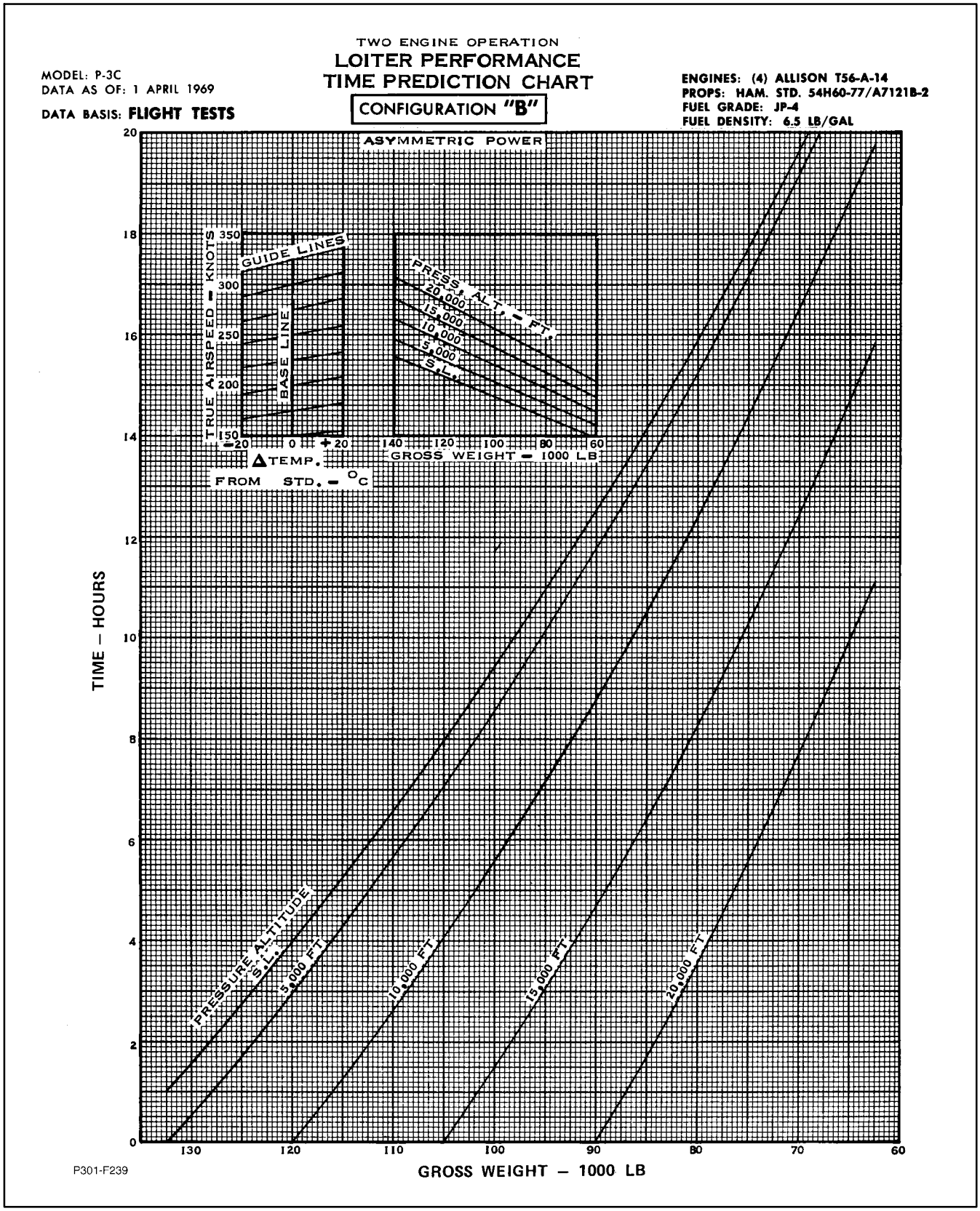


Figure 32-6. Loiter Performance Time Prediction — Configuration B (Sheet 3 of 3)

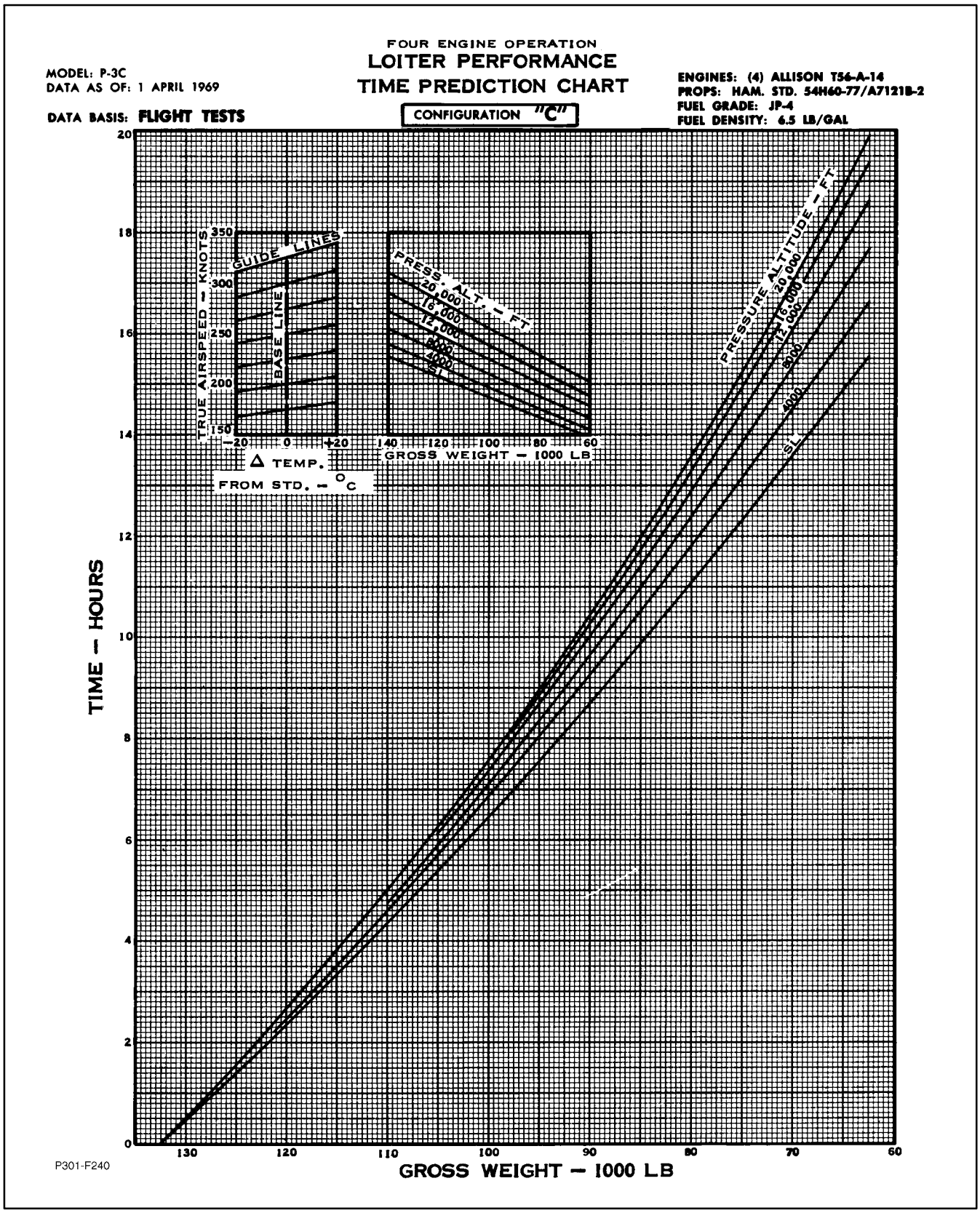


Figure 32-7. Loiter Performance Time Prediction — Configuration C (Sheet 1 of 3)

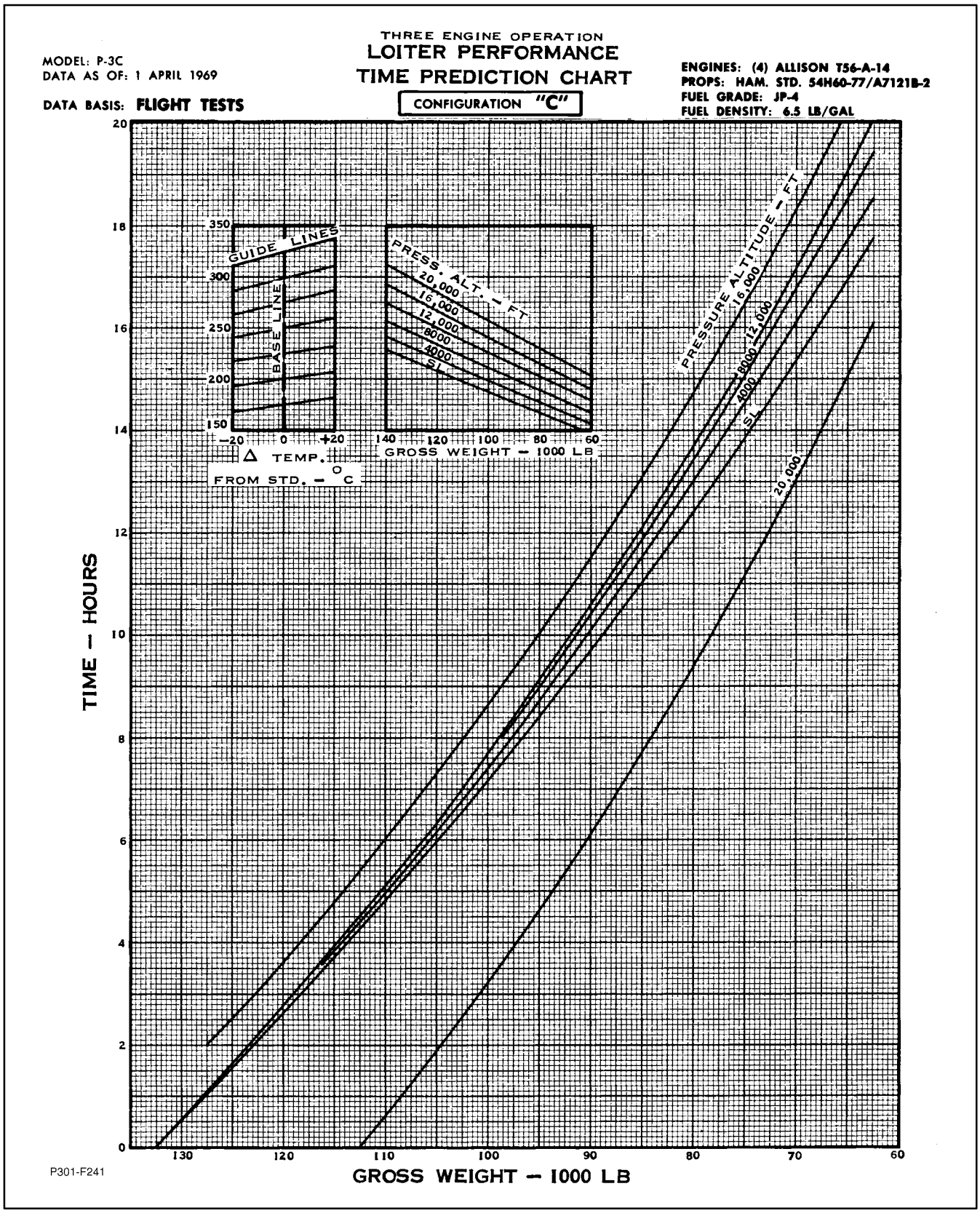


Figure 32-7. Loiter Performance Time Prediction — Configuration C (Sheet 2 of 3)

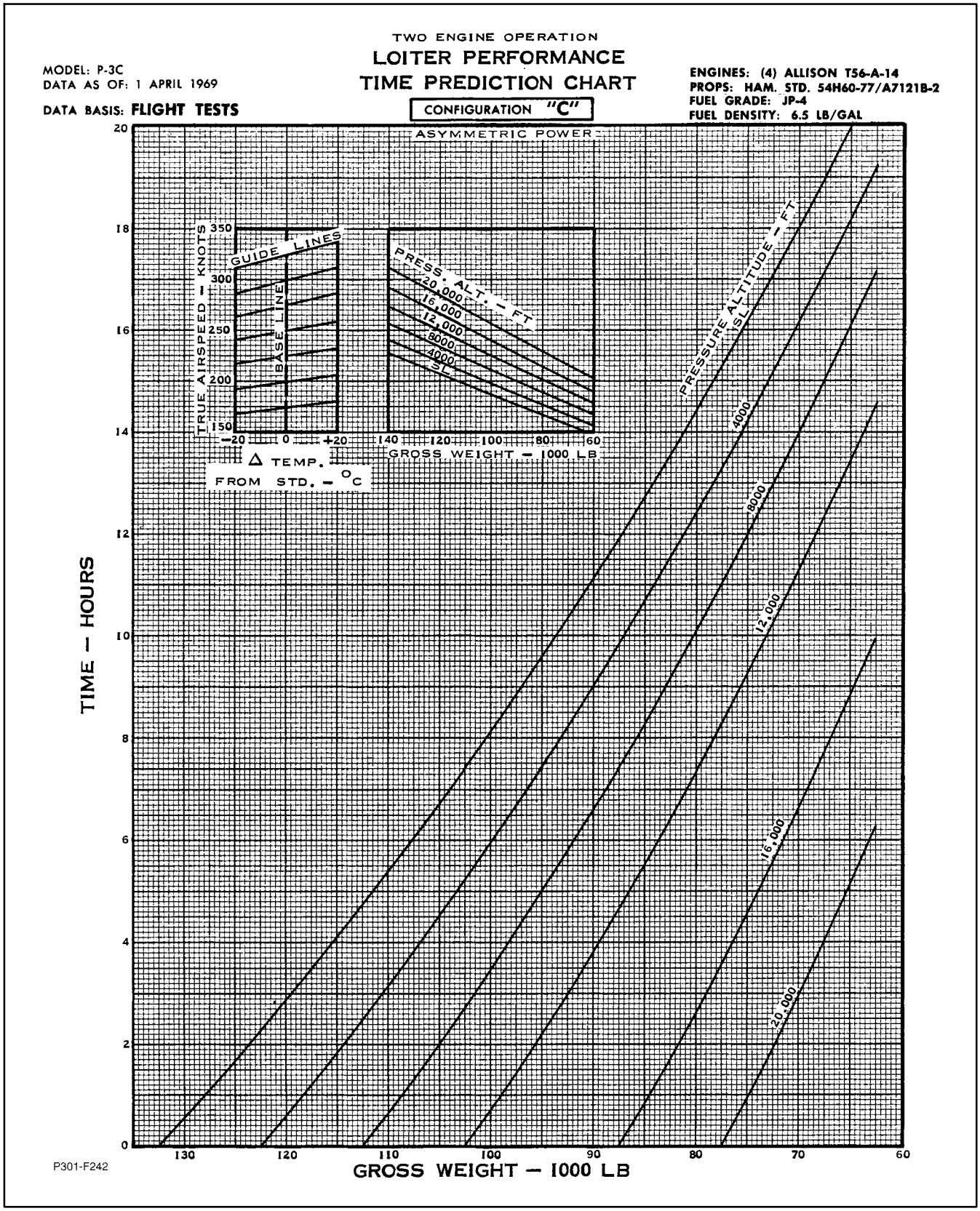


Figure 32-7. Loiter Performance Time Prediction — Configuration C (Sheet 3 of 3)

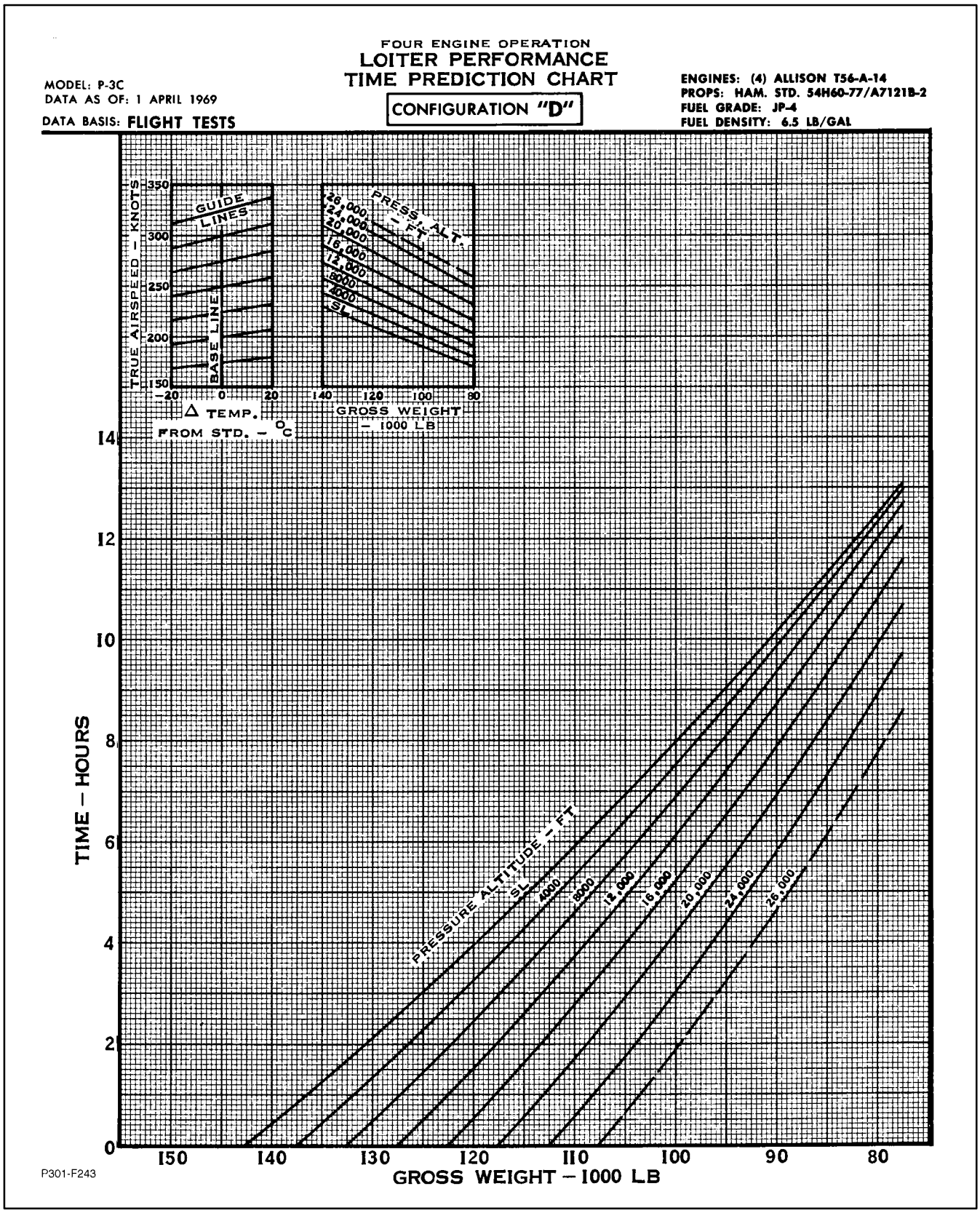


Figure 32-8. Loiter Performance Time Prediction — Configuration D (Sheet 1 of 2)

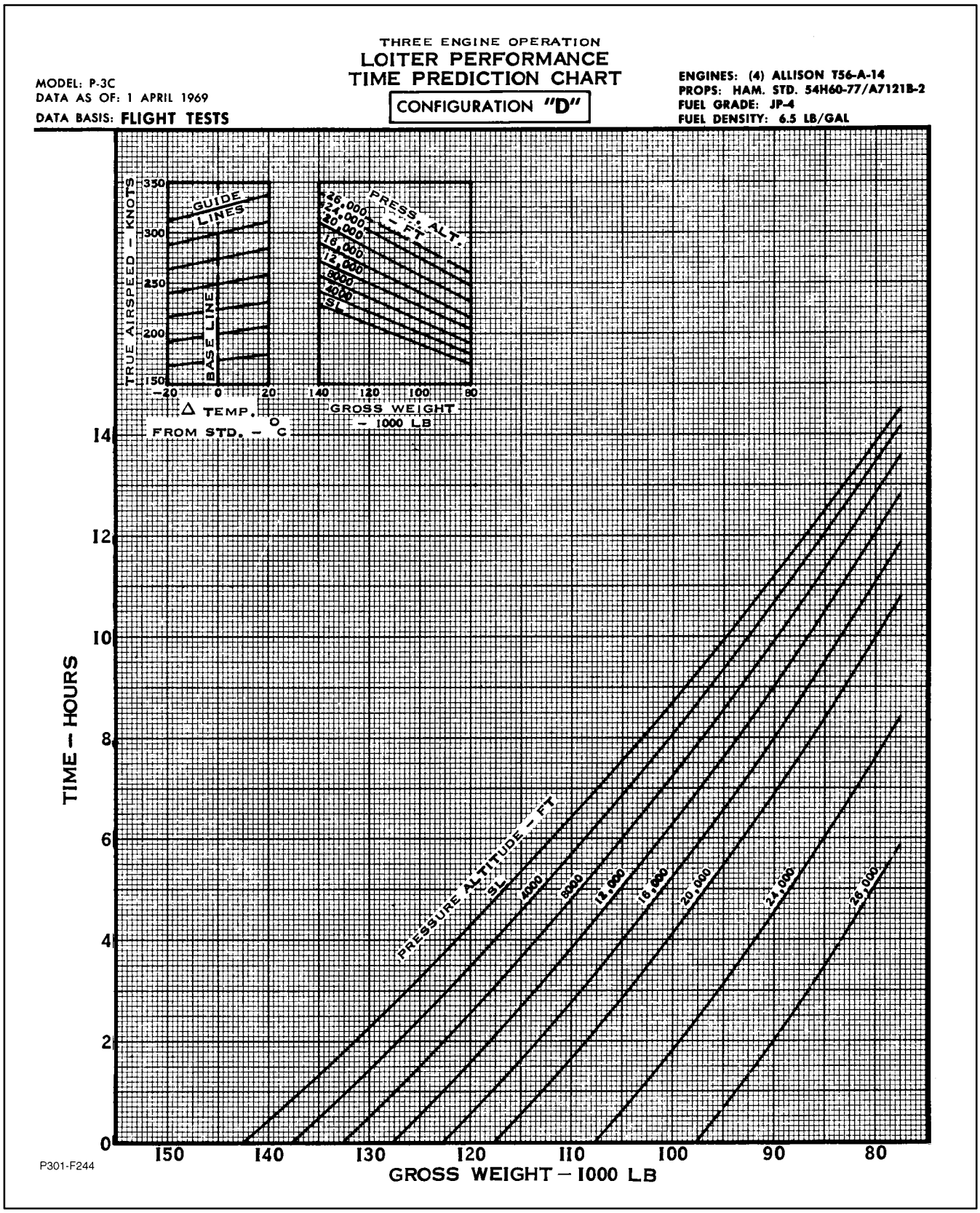


Figure 32-8. Loiter Performance Time Prediction — Configuration D (Sheet 2 of 2)

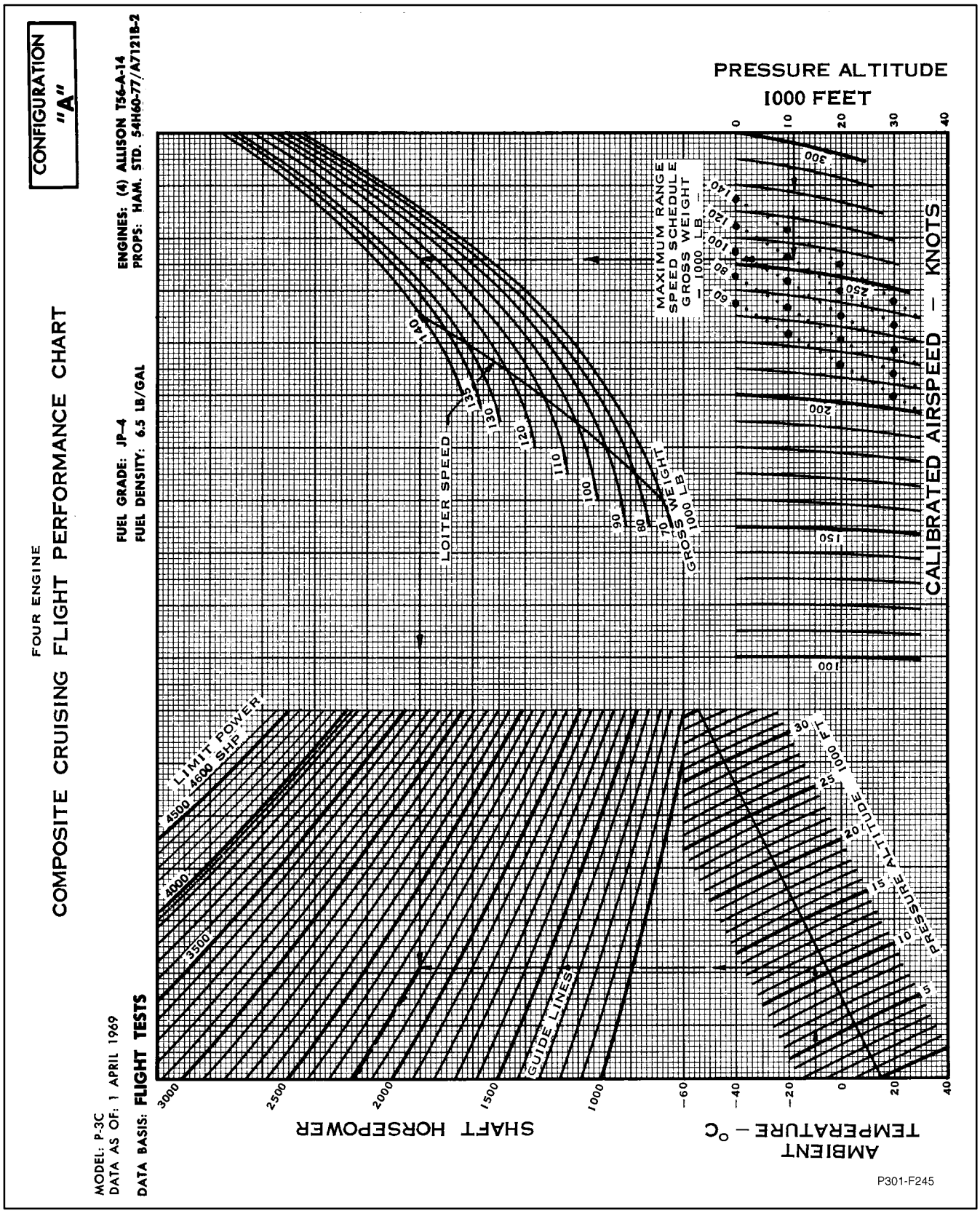


Figure 32-9. Composite Cruising Flight Performance — Configuration A (Sheet 1 of 3)

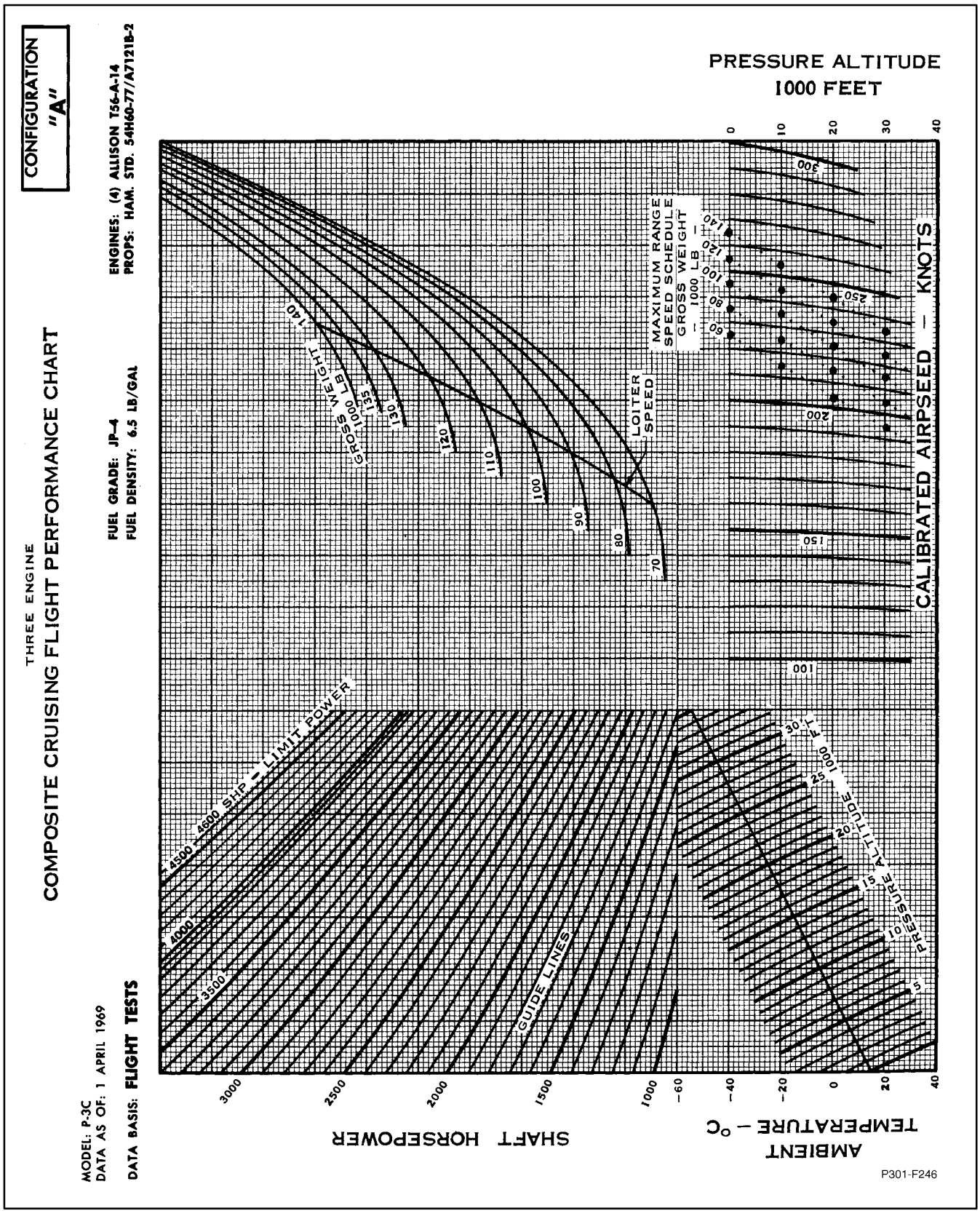


Figure 32-9. Composite Cruising Flight Performance — Configuration A (Sheet 2 of 3)

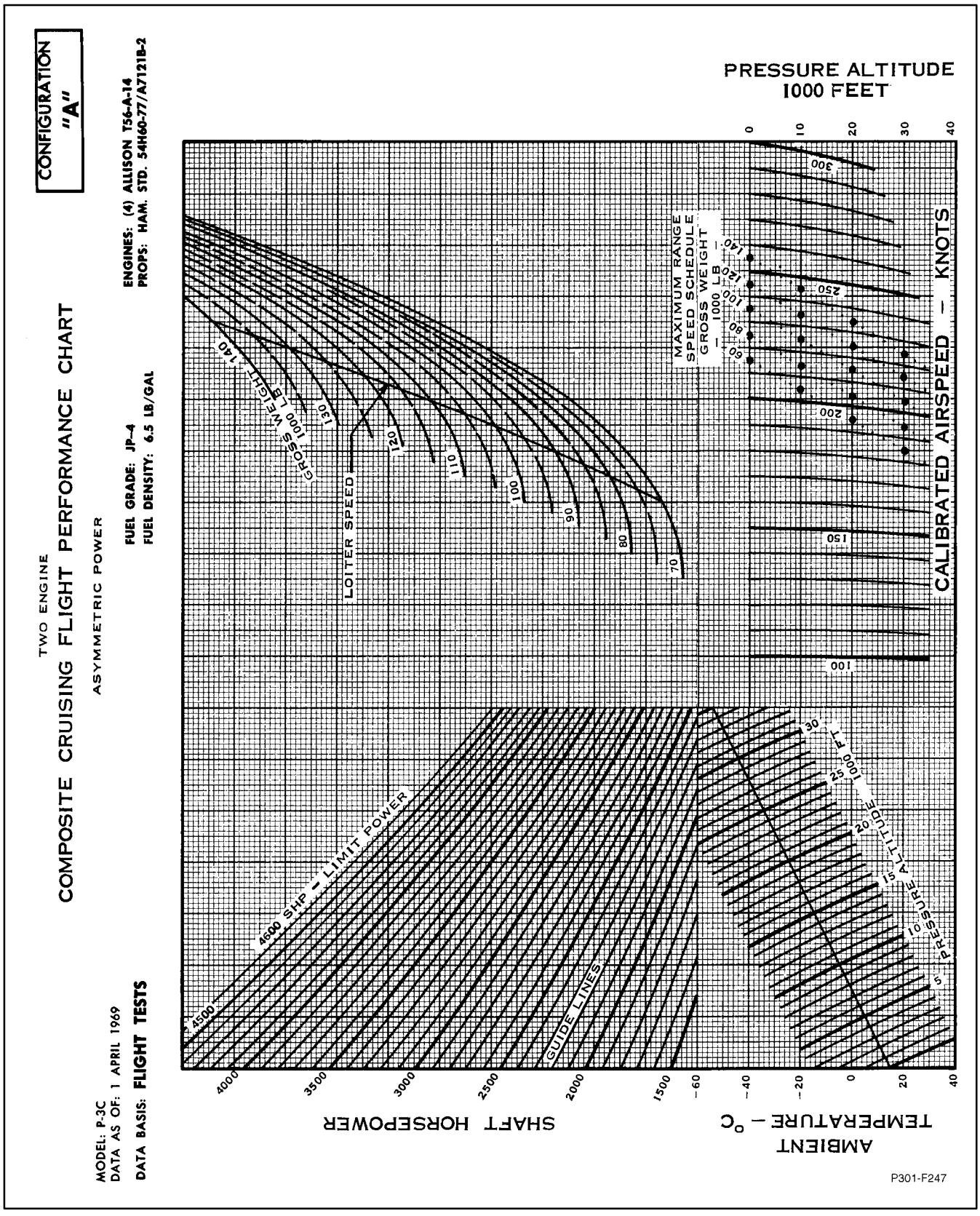


Figure 32-9. Composite Cruising Flight Performance — Configuration A (Sheet 3 of 3)

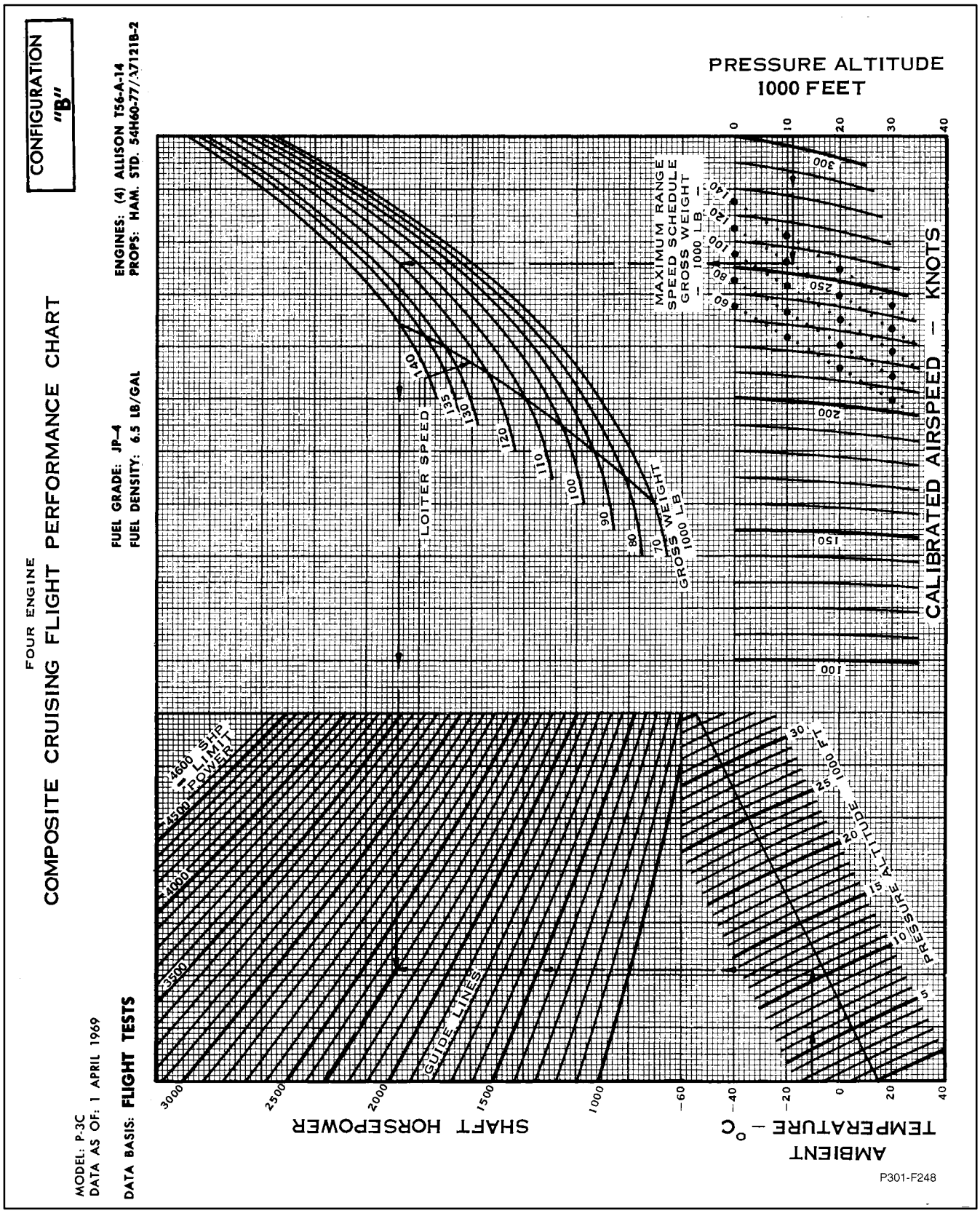


Figure 32-10. Composite Cruising Flight Performance — Configuration B (Sheet 1 of 3)

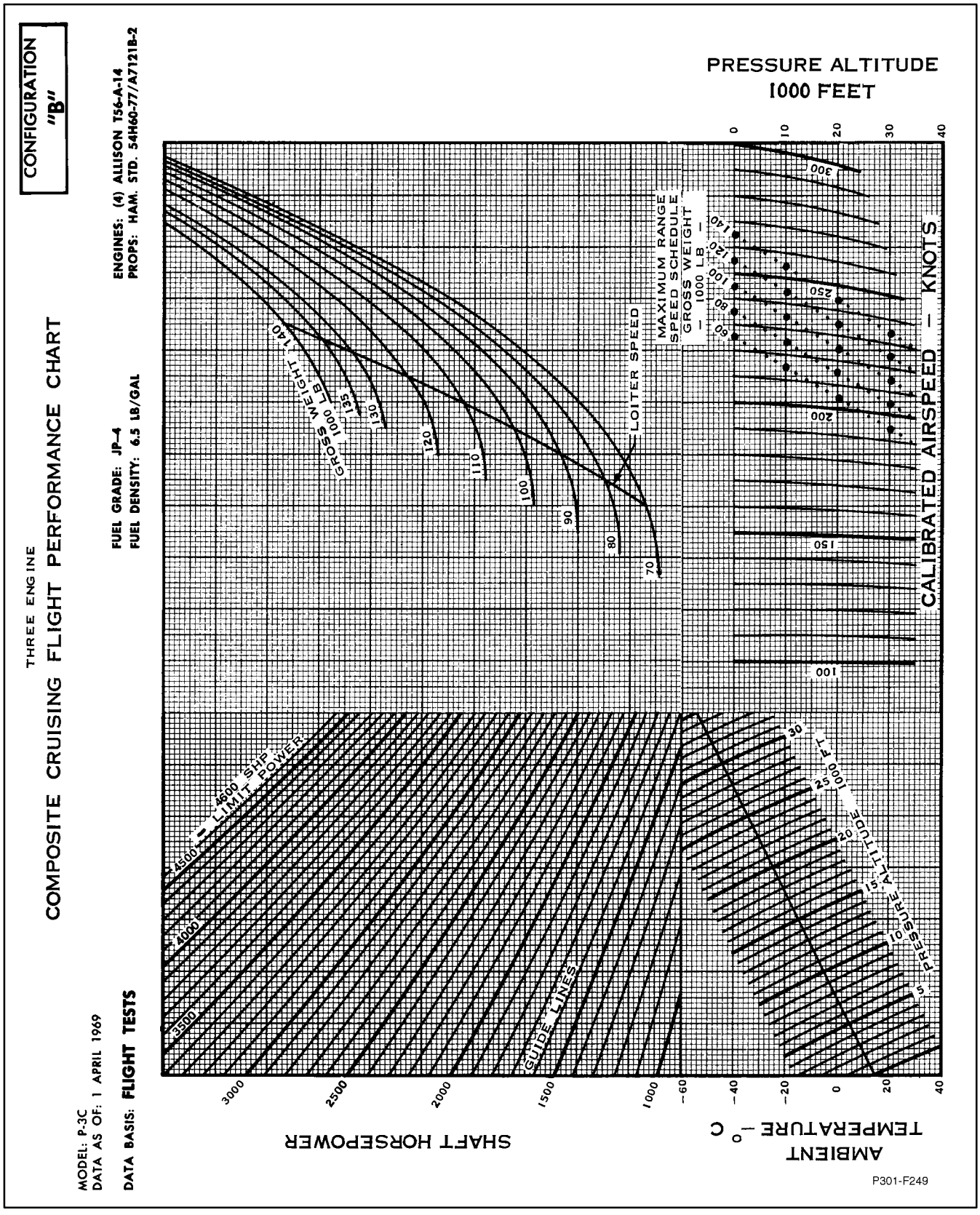


Figure 32-10. Composite Cruising Flight Performance — Configuration B (Sheet 2 of 3)

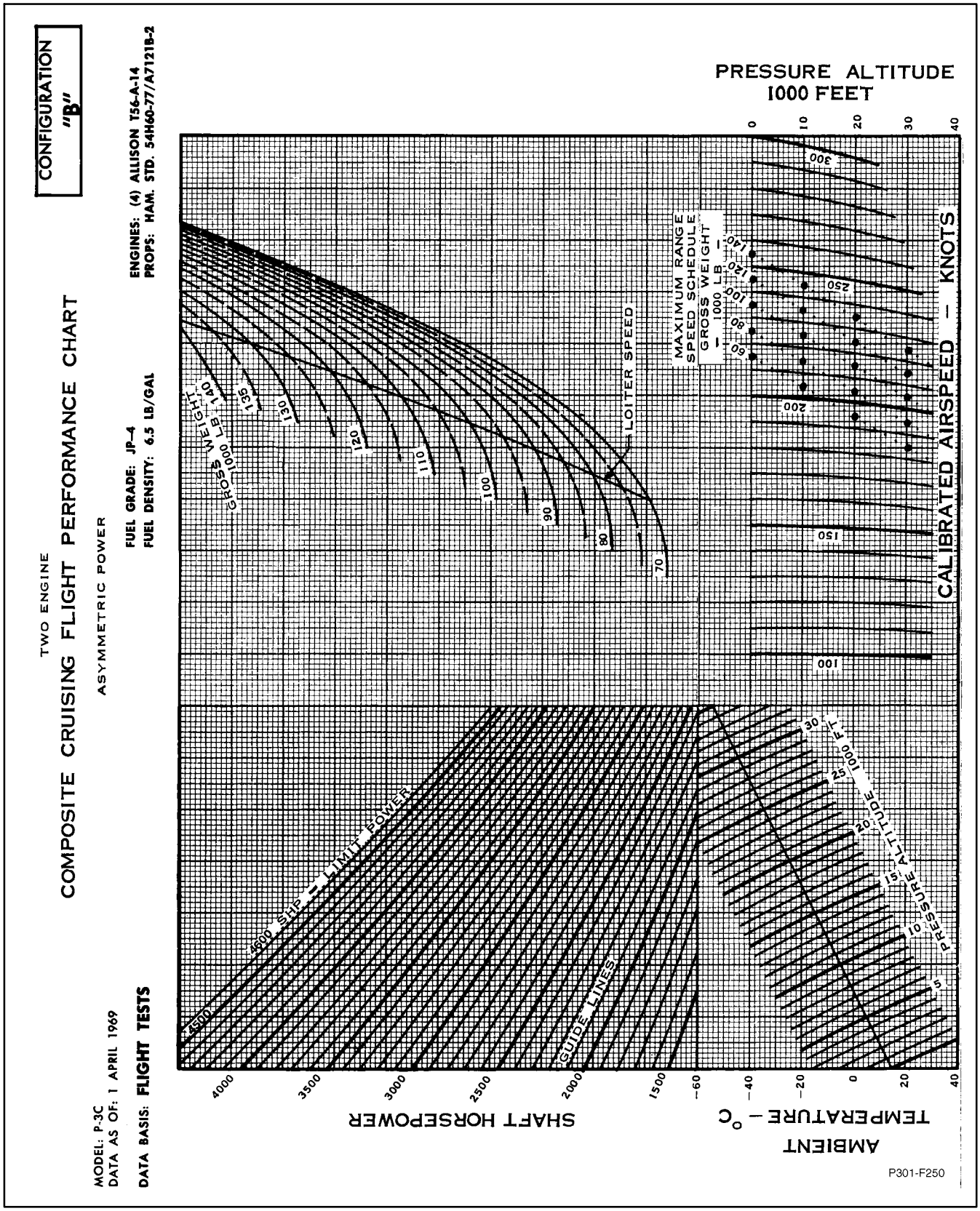


Figure 32-10. Composite Cruising Flight Performance — Configuration B (Sheet 3 of 3)

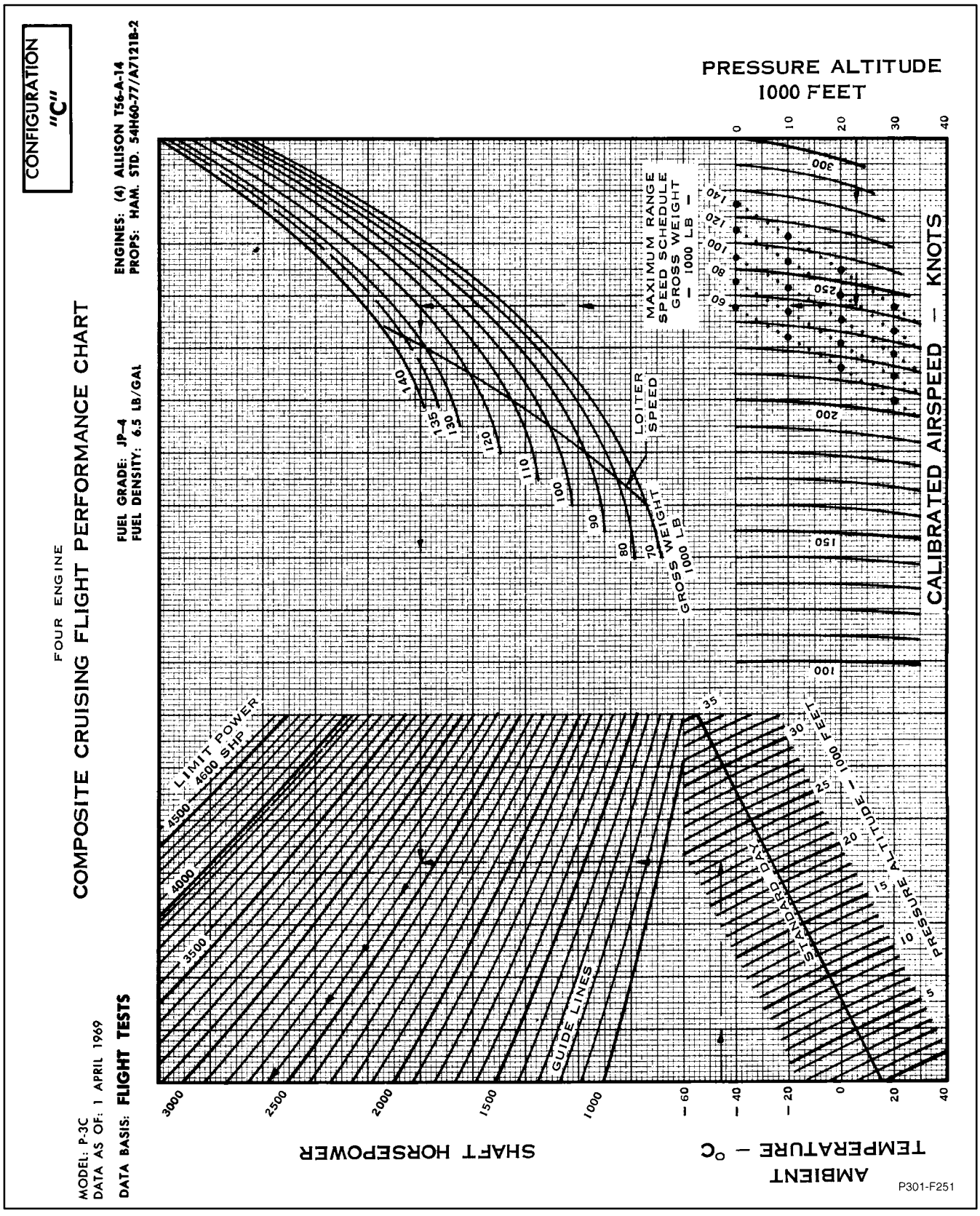


Figure 32-11. Composite Cruising Flight Performance — Configuration C (Sheet 1 of 3)

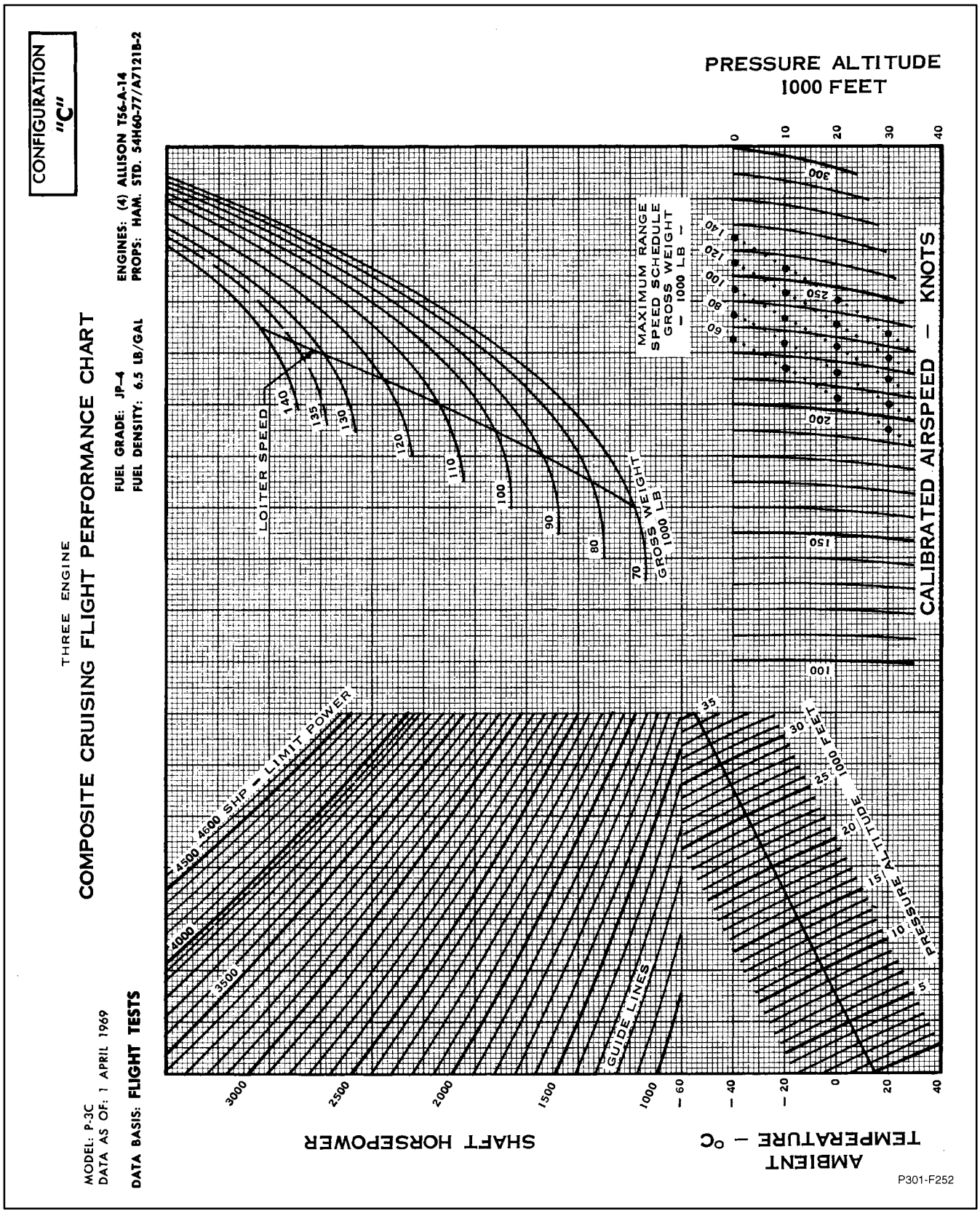


Figure 32-11. Composite Cruising Flight Performance — Configuration C (Sheet 2 of 3)

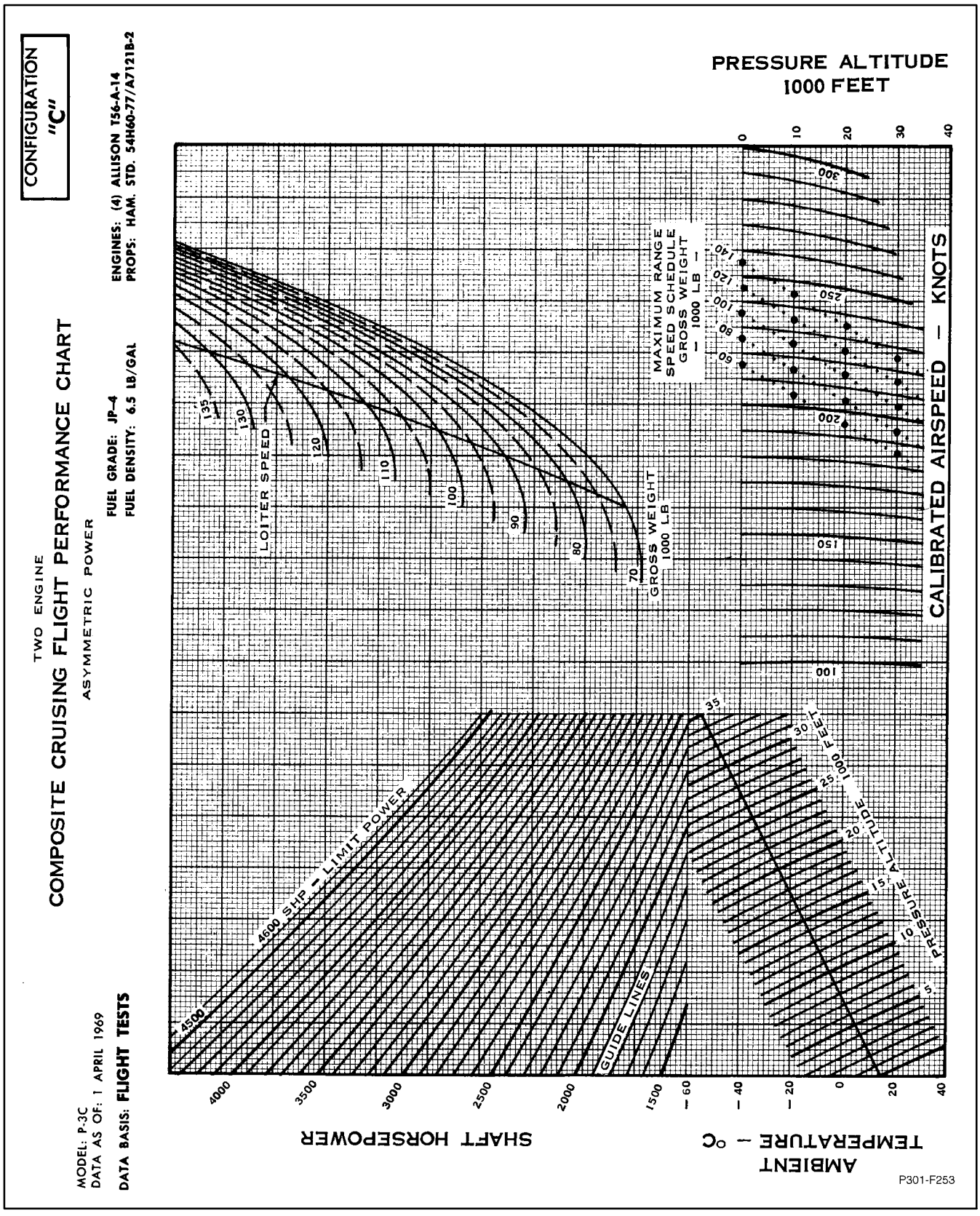


Figure 32-11. Composite Cruising Flight Performance — Configuration C (Sheet 3 of 3)

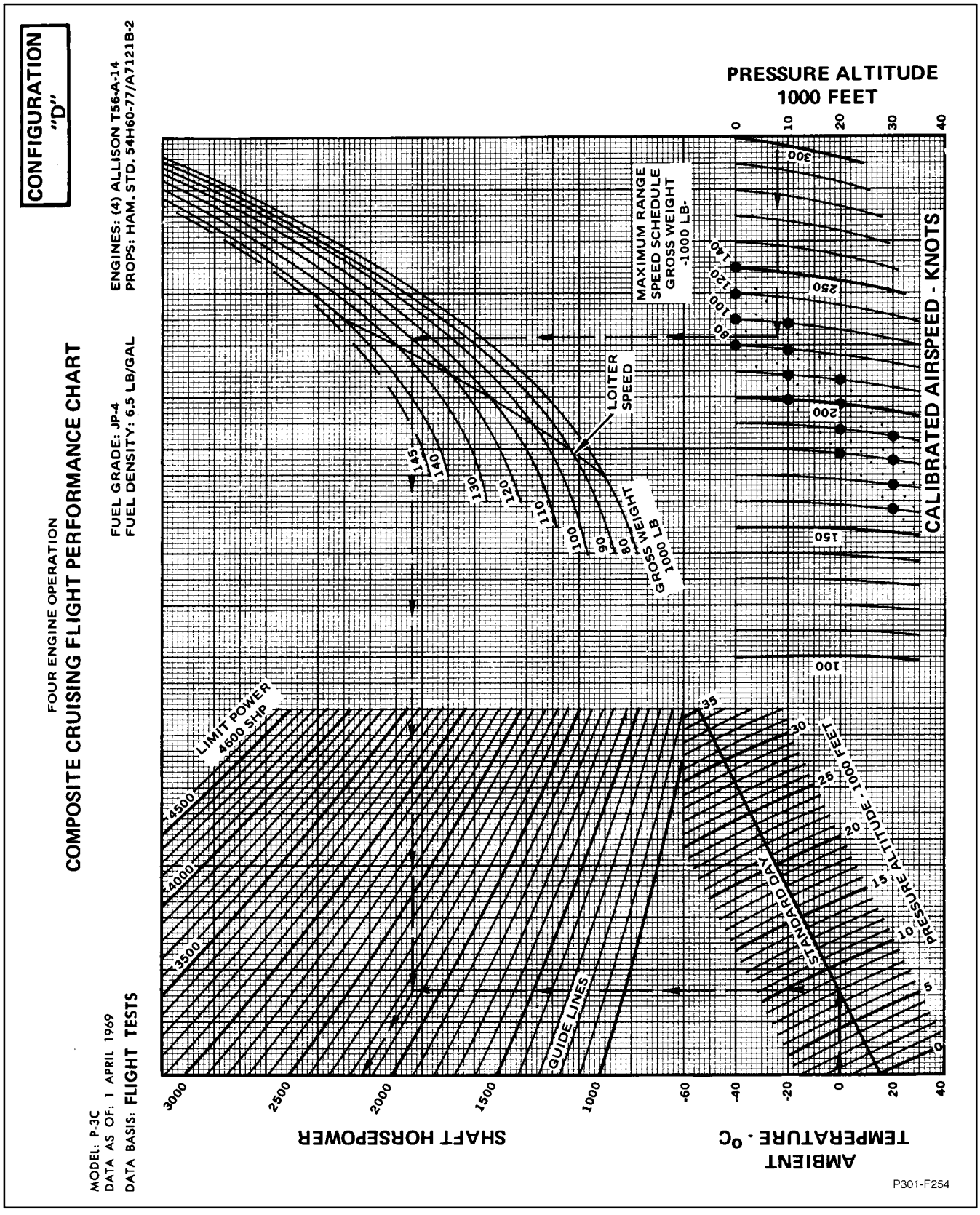


Figure 32-12. Composite Cruising Flight Performance — Configuration D (Sheet 1 of 2)

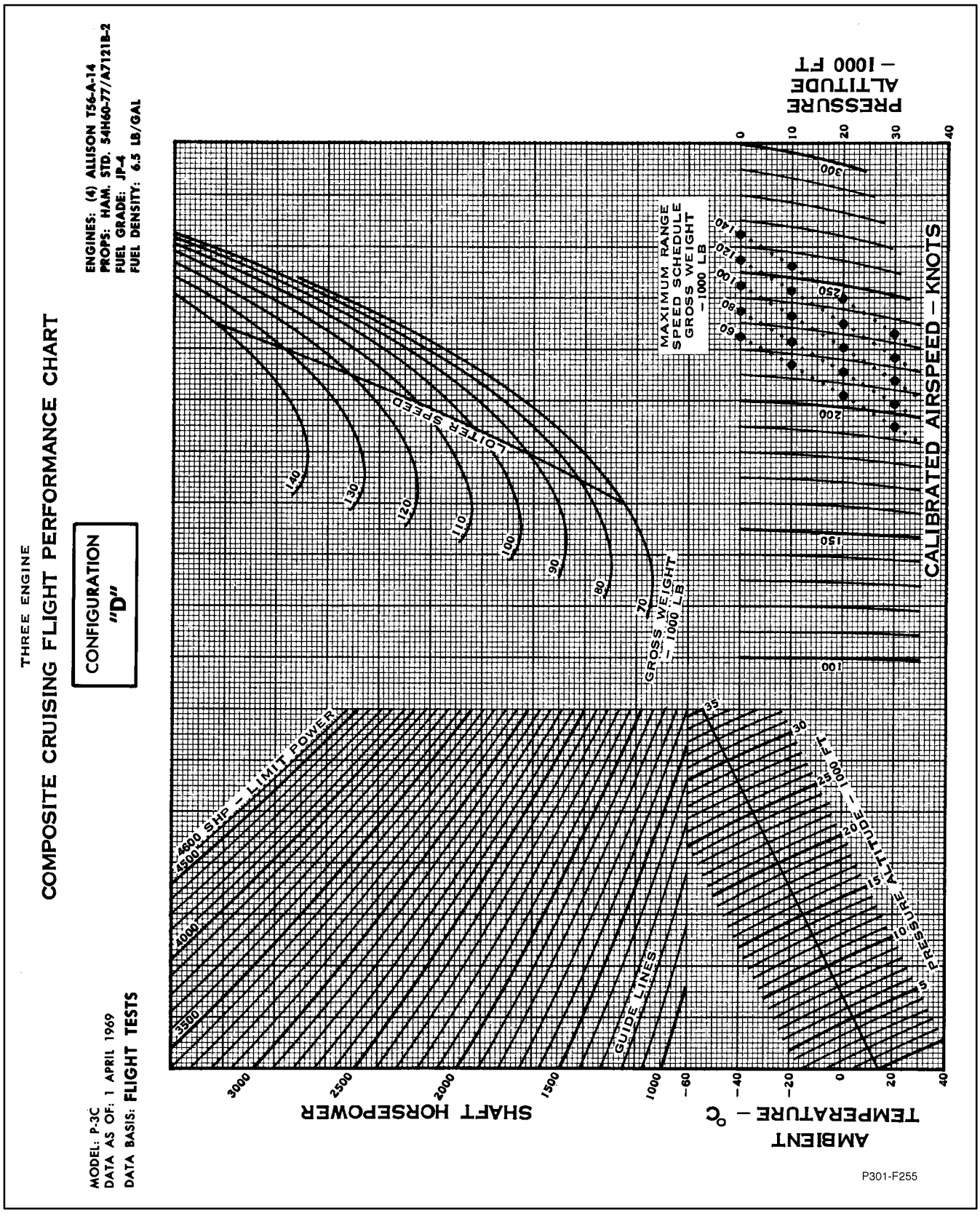


Figure 32-12. Composite Cruising Flight Performance — Configuration D (Sheet 2 of 2)

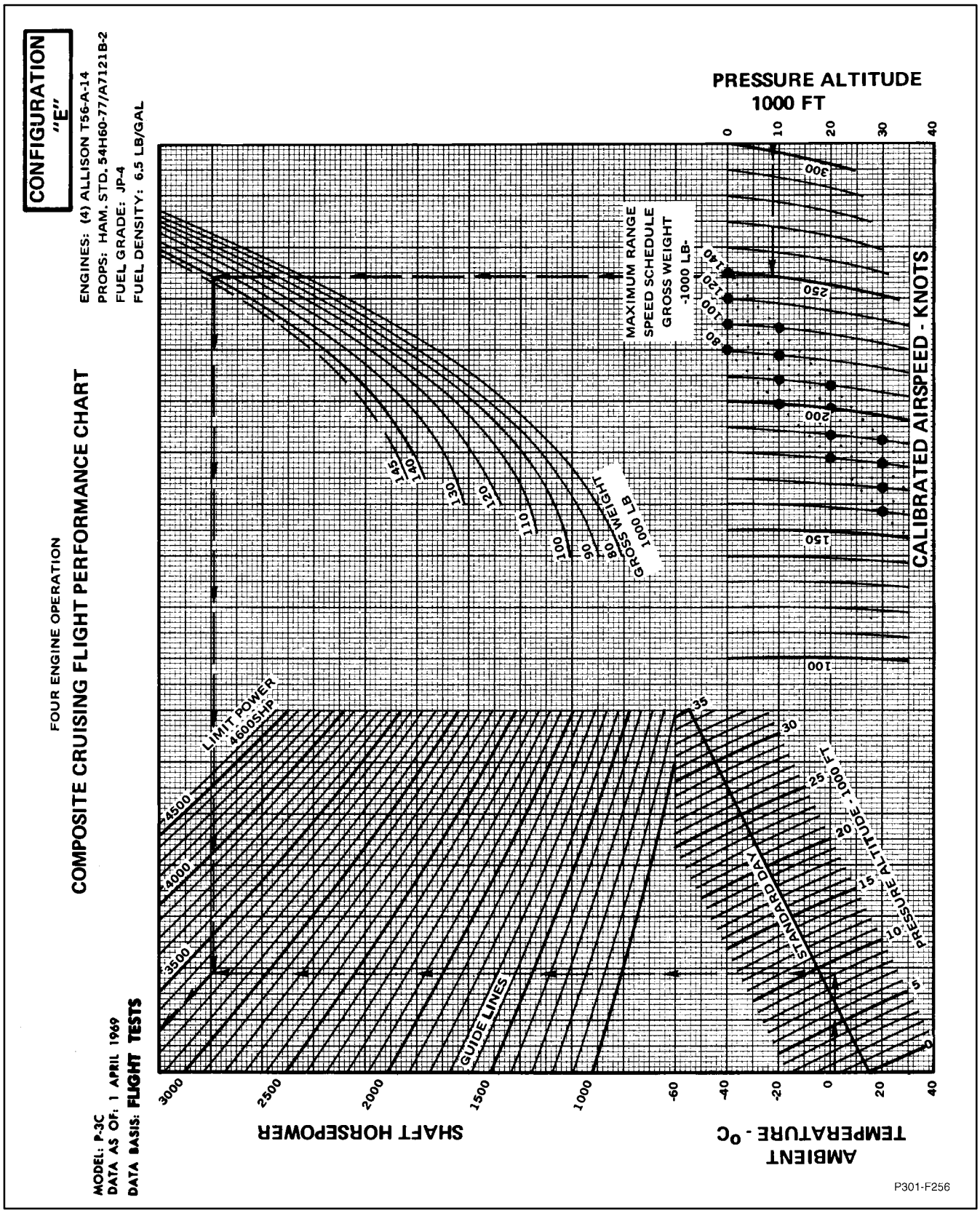


Figure 32-13. Four-Engine Composite Cruising Flight Performance — Configuration E

CHAPTER 33

Operating Tables

33.1 MAXIMUM-RANGE OPERATING TABLES

The maximum-range operating tables provide information pertaining to maximum-range flight on four, three, or two engines. Each type operation is grouped together according to drag count configurations A through E.

The following pages contain operating data at standard temperature for pressure altitudes ranging from sea level to 30,000 feet in 2,000-foot increments. Correction factors for SHP and TAS are provided for deviations from standard temperature; fuel flow and IAS remain constant regardless of temperature variation. Segment range, discussed in detail under Use of Operating Tables, paragraph 33.3 is also included.

Note

Recommended TIT may limit operation at high altitudes and/or temperatures. The heaviest weight bracket entries listed at any given altitude are included for interpolation and may be attainable only when colder than standard conditions exist. A check of power available should be made and a lower altitude selected.

The composite cruise charts in Chapter 32 can be used as an aid in determining power settings for intermediate altitudes, using the maximum-range speed schedule on the charts as a guide. This schedule provides nearly maximum miles per pound at the heavier weights, and a speed that is slightly higher than optimum for the lighter weights. The three-engine schedule is reduced 10 knots from the corresponding four-engine schedule, and a further reduction of 10 knots, total of 20 knots reduction, provides the schedule for operating with two engines out on the same side.

33.2 LOITER SPEED OPERATING TABLES

Tabulated data are provided for operation at loiter airspeed on four, three, or two engines for drag count configurations A, B, C, and D. Loiter tables are not included for drag count configuration E.

Loiter performance at standard temperature is provided on a pair of facing pages for various pressure altitudes from sea level to 20,000 feet. Time, fuel flow, and IAS remain constant for all temperature conditions; correction factors for SHP and TAS are provided for deviations from standard temperature.

A simplified airspeed schedule was selected for convenience. Loiter speeds can be determined by adding or subtracting 1 knot per 1,000-pound deviation from 200 KIAS at 110,000 pounds (heavier weight, faster speed). There is no change in IAS schedule for variations in pressure altitude or operation with four, three, or two engines. Power settings are listed for the midpoints of each weight bracket.

33.3 USE OF OPERATING TABLES

The operating tables (Figures 33-1, 33-2, 33-3, 33-4, 33-5, 33-6, 33-7, 33-8, 33-9, 33-10, 33-11, 33-12, 33-13, 33-14, 33-15, 33-16, 33-17, 33-18, 33-19, 33-20, 33-21, 33-22, and 33-23) are designed primarily for use in flight to accomplish flight plans developed from material in Chapter 10.

To use the tables, select the appropriate figure. Read IAS and fuel flow directly. It is recommended that the table value for fuel flow be set since the power settings listed are for the midpoints of each weight bracket. After determining the ambient temperature, minor adjustments may be made to achieve the listed IAS as the pilot desires. To obtain TAS, apply the correction factor listed for the altitude. To obtain SHP, apply the correction factor listed for that weight bracket.

Included for reference is segment range. It is the distance that will be flown while consuming 5,000 pounds (weight bracket) of fuel at standard temperature conditions. Segment range will increase approximately 1 percent per 5 °C increase above standard temperature and decrease 1 percent per 5 °C decrease below standard temperature.

33.3.1 Example

Four-engine maximum range:

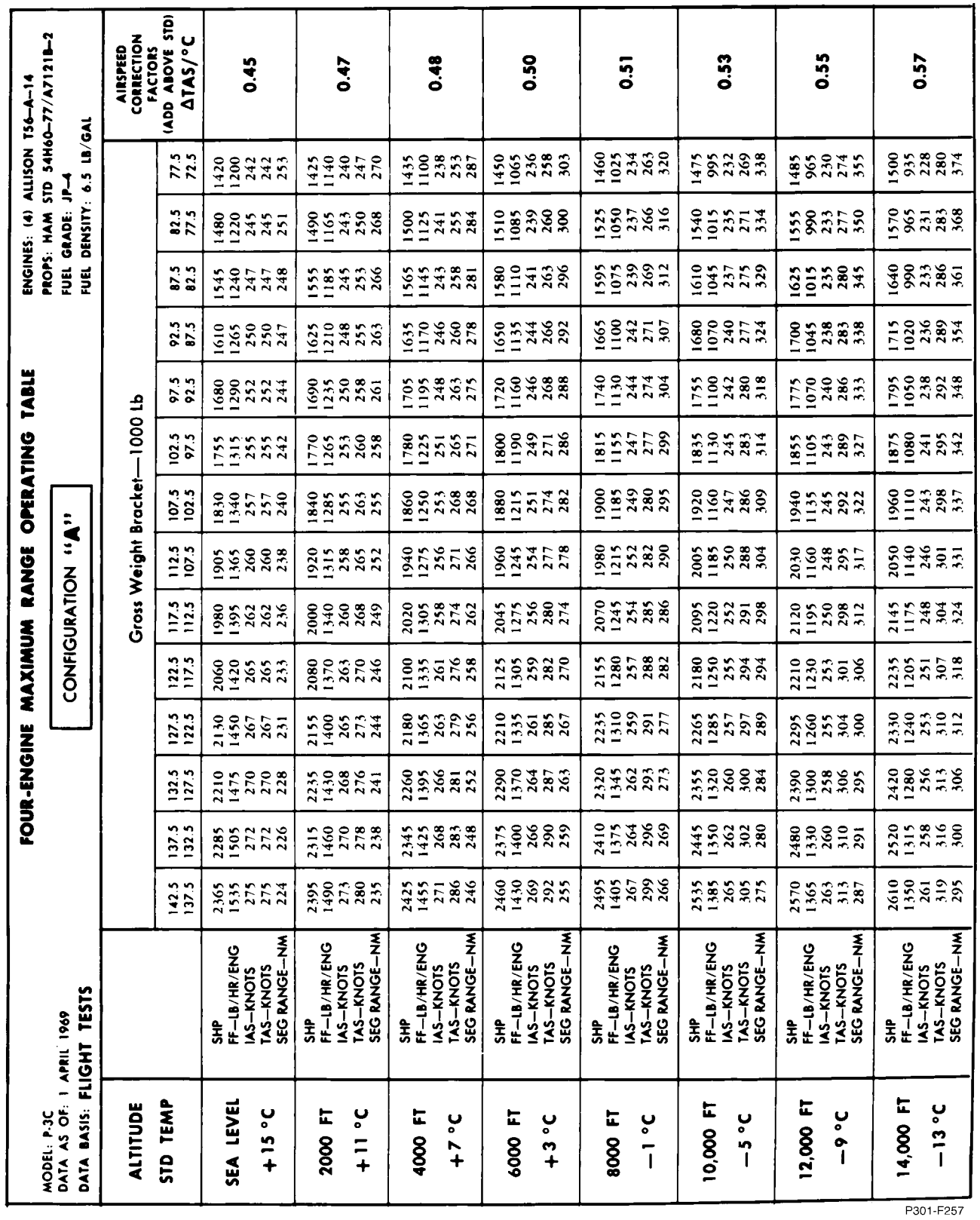
1. Drag count configuration A.
2. Gross weight — 100,000 pounds.
3. Pressure altitude — 16,000 feet.
4. Ambient temperature — –7 °C.
5. Standard temperature — –17 °C.

Solution:

1. Read directly from appropriate Figure 33-1.
    a. SHP — 1,895.
    b. Fuel flow — 1,055 PPH/engine.
    c. IAS — 239 knots.
    d. TAS — 302 knots.
    e. Segment range — 357 nm.
2. Correct for temperature deviation of +10 °C.
    a. 1,895 + (10 × 3.4) = 1,929 SHP.
    b. 302 + (10 × 0.59) = 307.9 KTAS.
3. Time in weight bracket may be calculated as follows:
    a. (5,000)/(FF. × No. of engines) = hour.
    b. (5,000)/(1,055 × 4) = 1.18 hour or 1 hour 11 minutes.
4. Segment range may be calculated for the nonstandard condition using the following equation:
    a. TAS time = segment range.
    b. 307.9 × 1.18 = 363 nm.

As indicated above, segment range increases 2 percent per 10 °C above standard.

1. 357 × 1.02 = 364 nm.



FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

CONFIGURATION "A"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM STD 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL	SHP	2365	2285	2210	2130	2060	1980	1905	1830	1755	1680	1610	1545	1480	1420	0.45
	FF—LB/HR/ENG	1535	1505	1475	1450	1420	1395	1365	1340	1315	1290	1265	1240	1220	1200	
	IAS—KNOTS	275	272	270	267	265	262	260	257	255	252	250	247	245	242	
+15 °C	TAS—KNOTS	275	272	270	267	265	262	260	257	255	252	250	247	245	242	
	SEG RANGE—NM	224	226	228	231	233	236	238	240	242	244	247	248	251	253	
2000 FT	SHP	2395	2315	2235	2155	2080	2000	1920	1840	1770	1690	1625	1555	1490	1425	0.47
	FF—LB/HR/ENG	1490	1460	1430	1400	1370	1340	1315	1285	1265	1235	1210	1185	1165	1140	
	IAS—KNOTS	273	270	268	265	263	260	258	255	253	250	248	245	243	240	
+11 °C	TAS—KNOTS	280	278	276	273	270	268	265	263	260	258	255	253	250	247	
	SEG RANGE—NM	235	238	241	244	246	249	252	255	258	261	263	266	268	270	
4000 FT	SHP	2425	2345	2260	2180	2100	2020	1940	1860	1780	1705	1635	1565	1500	1435	0.48
	FF—LB/HR/ENG	1455	1425	1395	1365	1335	1305	1275	1250	1225	1195	1170	1145	1125	1100	
	IAS—KNOTS	271	268	266	263	261	258	256	253	251	248	246	243	241	238	
+7 °C	TAS—KNOTS	286	283	281	279	276	274	271	268	265	263	260	258	255	253	
	SEG RANGE—NM	246	248	252	256	258	262	266	268	271	275	278	281	284	287	
6000 FT	SHP	2460	2375	2290	2210	2125	2045	1960	1880	1800	1720	1650	1580	1510	1450	0.50
	FF—LB/HR/ENG	1430	1400	1370	1335	1305	1275	1245	1215	1190	1160	1135	1110	1085	1065	
	IAS—KNOTS	269	266	264	261	259	256	254	251	249	246	244	241	239	236	
+3 °C	TAS—KNOTS	292	290	287	285	282	280	277	274	271	268	266	263	260	258	
	SEG RANGE—NM	255	259	263	267	270	274	278	282	286	288	292	296	300	303	
8000 FT	SHP	2495	2410	2320	2235	2155	2070	1980	1900	1815	1740	1665	1595	1525	1460	0.51
	FF—LB/HR/ENG	1405	1375	1345	1310	1280	1245	1215	1185	1155	1130	1100	1075	1050	1025	
	IAS—KNOTS	267	264	262	259	257	254	252	249	247	244	242	239	237	234	
−1 °C	TAS—KNOTS	299	296	293	291	288	285	282	280	277	274	271	269	266	263	
	SEG RANGE—NM	266	269	273	277	282	286	290	295	299	304	307	312	316	320	
10,000 FT	SHP	2535	2445	2355	2265	2180	2095	2005	1920	1835	1755	1680	1610	1540	1475	0.53
	FF—LB/HR/ENG	1385	1350	1320	1285	1250	1220	1185	1160	1130	1100	1070	1045	1015	995	
	IAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
−5 °C	TAS—KNOTS	305	302	300	297	294	291	288	286	283	280	277	275	271	269	
	SEG RANGE—NM	275	280	284	289	294	298	304	309	314	318	324	329	334	338	
12,000 FT	SHP	2570	2480	2390	2295	2210	2120	2030	1940	1855	1775	1700	1625	1555	1485	0.55
	FF—LB/HR/ENG	1365	1330	1300	1260	1230	1195	1160	1135	1105	1070	1045	1015	990	965	
	IAS—KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	233	230	
−9 °C	TAS—KNOTS	313	310	306	304	301	298	295	292	289	286	283	280	277	274	
	SEG RANGE—NM	287	291	295	300	306	312	317	322	327	333	338	345	350	355	
14,000 FT	SHP	2610	2520	2420	2330	2235	2145	2050	1960	1875	1795	1715	1640	1570	1500	0.57
	FF—LB/HR/ENG	1350	1315	1280	1240	1205	1175	1140	1110	1080	1050	1020	990	965	935	
	IAS—KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	231	228	
−13 °C	TAS—KNOTS	319	316	313	310	307	304	301	298	295	292	289	286	283	280	
	SEG RANGE—NM	295	300	306	312	318	324	331	337	342	348	354	361	368	374	

P301-F257

Figure 33-1. Four-Engine Maximum Range Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb														AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP	2650	2555	2460	2360	2265	2170	2075	1980	1895	1810	1735	1660	1585	1515	0.59
	FF—LB/HR/ENG	1335	1295	1260	1220	1185	1150	1120	1085	1055	1025	995	965	935	910	
	IAS—KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	229	226	
	TAS—KNOTS	327	323	320	317	314	311	308	305	302	299	296	293	290	287	
	SEG RANGE—NM	306	312	318	324	332	337	344	351	357	364	372	378	386	294	
18,000 FT —21 °C	SHP	2695	2595	2495	2395	2295	2195	2100	2000	1915	1830	1755	1675	1600	1530	0.61
	FF—LB/HR/ENG	1320	1280	1245	1205	1170	1135	1100	1065	1035	1005	970	940	910	885	
	IAS—KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	227	224	
	TAS—KNOTS	333	330	328	324	321	318	315	312	309	305	303	299	296	293	
	SEG RANGE—NM	315	322	329	336	344	351	358	366	373	381	390	398	406	414	
20,000 FT —25 °C	SHP	2735	2635	2530	2425	2325	2225	2125	2025	1935	1855	1770	1695	1620	1545	0.63
	FF—LB/HR/ENG	1305	1265	1230	1190	1155	1120	1085	1050	1015	985	950	920	890	860	
	IAS—KNOTS	255	252	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS	342	338	335	332	329	326	322	319	316	313	310	306	303	300	
	SEG RANGE—NM	328	334	341	348	356	364	372	381	389	398	407	416	426	435	
22,000 FT —29 °C	SHP	2780	2675	2570	2465	2365	2260	2155	2050	1955	1875	1795	1715	1635	1560	0.65
	FF—LB/HR/ENG	1305	1265	1225	1185	1145	1110	1075	1035	1000	965	930	900	870	840	
	IAS—KNOTS	253	250	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS	349	346	344	340	337	334	330	327	324	320	317	314	310	307	
	SEG RANGE—NM	334	342	350	359	368	376	385	395	406	415	426	435	445	457	
24,000 FT —33 °C	SHP	2835	2730	2620	2515	2405	2300	2190	2085	1985	1900	1815	1730	1655	1575	0.68
	FF—LB/HR/ENG	1315	1270	1230	1185	1145	1105	1065	1025	990	955	920	885	855	825	
	IAS—KNOTS	251	248	246	243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS	359	355	352	349	345	342	338	335	331	328	325	321	318	314	
	SEG RANGE—NM	341	349	358	368	377	387	397	408	419	431	442	453	464	477	
26,000 FT —37 °C	SHP		2785	2670	2560	2450	2340	2225	2120	2015	1925	1840	1755	1675	1590	0.70
	FF—LB/HR/ENG		1285	1240	1195	1150	1105	1065	1025	985	945	910	875	840	810	
	IAS—KNOTS		246	244	241	239	236	234	231	229	226	224	221	219	216	
	TAS—KNOTS		363	361	357	354	350	347	343	339	336	332	329	325	322	
	SEG RANGE—NM		353	364	374	384	396	407	419	431	444	457	469	483	498	
28,000 FT —41°C	SHP			2725	2610	2490	2375	2265	2155	2055	1955	1865	1775	1695	1610	0.72
	FF—LB/HR/ENG			1260	1210	1165	1115	1070	1025	985	945	905	870	830	800	
	IAS—KNOTS			242	239	237	234	232	229	227	224	222	219	217	214	
	TAS—KNOTS			369	366	362	359	355	352	348	344	340	337	333	330	
	SEG RANGE—NM			367	378	389	403	415	428	442	456	470	484	500	516	
30,000 FT —44 °C	SHP					2535	2420	2305	2195	2090	1990	1890	1800	1715	1635	0.75
	FF—LB/HR/ENG					1185	1130	1080	1035	990	950	905	865	830	790	
	IAS—KNOTS					235	232	230	227	225	222	220	217	215	212	
	TAS—KNOTS					371	368	364	360	356	353	349	345	342	338	
	SEG RANGE—NM					396	408	422	436	450	465	481	498	515	533	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.2	4.8	4.5	4.2	4.0	3.8	3.7	3.5	3.4	3.2	3.1	3.0	2.9	2.8	

MODEL P-3C — FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "A"

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Figure 33-1. Four-Engine Maximum Range Operating Table — Configuration A (Sheet 2 of 2)

THREE-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION "A"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	3175	3050	2925	2805	2690	2580	2475	2375	2280	2185	2090	2005	1920	1835	0.42
	FF—LB/HR/ENG	1840	1795	1745	1700	1660	1620	1585	1550	1515	1480	1445	1410	1380	1350	
	IAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	TAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	SEG RANGE—NM	238	243	248	252	256	259	263	266	270	274	277	280	284	287	
2000 FT +11 °C	SHP	3220	3095	2965	2840	2725	2615	2510	2405	2305	2205	2110	2020	1930	1845	0.44
	FF—LB/HR/ENG	1800	1755	1705	1665	1620	1580	1540	1505	1470	1435	1400	1370	1335	1305	
	IAS—KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	233	230	
	TAS—KNOTS	270	268	265	263	260	258	255	253	250	247	245	242	240	237	
	SEG RANGE—NM	250	254	259	263	268	272	276	280	284	287	291	295	299	303	
4000 FT +7 °C	SHP	3270	3149	3010	2880	2765	2650	2540	2430	2325	2225	2130	2035	1945	1855	0.45
	FF—LB/HR/ENG	1765	1720	1675	1630	1585	1545	1505	1465	1430	1395	1360	1325	1295	1260	
	IAS—KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	231	228	
	TAS—KNOTS	276	273	271	268	265	263	260	258	255	253	250	247	245	242	
	SEG RANGE—NM	260	264	270	274	279	284	288	293	297	301	306	311	315	319	
6000 FT +3 °C	SHP	3325	3190	3055	2925	2800	2685	2570	2460	2350	2250	2150	2050	1960	1870	0.47
	FF—LB/HR/ENG	1745	1700	1650	1605	1560	1515	1470	1435	1395	1360	1325	1290	1255	1220	
	IAS—KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	229	226	
	TAS—KNOTS	282	279	277	274	271	268	266	263	260	258	255	252	250	247	
	SEG RANGE—NM	269	273	279	284	290	295	301	306	311	316	321	327	332	339	
8000 FT −1 °C	SHP	3380	3240	3100	2970	2840	2720	2605	2490	2380	2275	2170	2070	1975	1885	0.48
	FF—LB/HR/ENG	1730	1680	1635	1585	1535	1490	1445	1405	1365	1330	1290	1255	1220	1185	
	IAS—KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	227	224	
	TAS—KNOTS	288	285	282	280	277	274	271	269	266	263	260	257	255	252	
	SEG RANGE—NM	277	283	288	294	300	307	313	319	325	330	337	342	348	354	
10,000 FT −5 °C	SHP	3435	3290	3150	3015	2885	2760	2640	2525	2410	2300	2195	2090	1995	1900	0.50
	FF—LB/HR/ENG	1725	1670	1620	1570	1520	1470	1425	1380	1340	1300	1260	1225	1190	1155	
	IAS—KNOTS	255	252	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS	294	291	288	286	283	280	277	275	271	269	266	263	260	257	
	SEG RANGE—NM	284	290	297	304	311	318	324	332	338	344	350	358	364	372	
12,000 FT −9 °C	SHP	3500	3350	3205	3065	2930	2800	2680	2560	2440	2330	2220	2115	2015	1915	0.52
	FF—LB/HR/ENG	1725	1665	1610	1555	1505	1455	1405	1360	1315	1275	1235	1200	1165	1130	
	IAS—KNOTS	253	250	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS	301	298	295	292	289	286	283	280	277	274	271	268	266	262	
	SEG RANGE—NM	291	298	305	313	320	328	335	343	352	358	366	372	380	388	
14,000 FT −13 °C	SHP	3570	3420	3260	3120	2980	2850	2720	2595	2475	2360	2245	2135	2035	1935	0.54
	FF—LB/HR/ENG	1730	1665	1605	1550	1495	1440	1395	1345	1300	1260	1215	1180	1140	1105	
	IAS—KNOTS	251	248	246	243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS	308	305	301	298	295	292	289	286	283	280	277	274	271	268	
	SEG RANGE—NM	297	305	313	321	329	337	346	354	364	372	381	388	397	406	

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Figure 33-2. Three-Engine Maximum Range Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM		3480 1670 246 311 310	3325 1605 244 308 319	3180 1550 241 305 328	3035 1490 239 302 337	2900 1435 236 299 347	2770 1385 234 296 356	2640 1335 231 293 366	2515 1285 229 290 376	2395 1240 226 287 385	2275 1195 224 284 395	2165 1155 221 280 404	2060 1115 219 278 415	1955 1080 216 274 424	0.55
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM			3390 1610 242 315 326	3240 1550 239 312 336	3095 1490 237 309 346	2955 1430 234 305 356	2815 1375 232 303 367	2685 1325 229 299 377	2550 1270 227 296 388	2430 1225 224 293 398	2305 1180 222 290 410	2190 1140 219 287 420	2080 1095 217 284 432	1980 1060 214 280 442	0.57
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM						3010 1430 232 313 366	2865 1370 230 310 376	2730 1315 227 306 388	2595 1265 225 303 400	2465 1215 222 300 412	2345 1170 220 297 424	2220 1125 217 293 435	2105 1080 215 290 448	2000 1040 212 287 460	0.59
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM						3065 1440 230 320 370	2920 1375 228 317 384	2775 1315 225 314 397	2640 1260 223 310 410	2505 1210 220 307 424	2380 1160 218 304 437	2250 1115 215 300 450	2135 1065 213 297 465	2025 1025 210 294 477	0.61
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM								2830 1325 223 321 404	2685 1265 221 318 418	2550 1210 218 314 434	2415 1155 216 311 448	2285 1105 213 307 464	2165 1055 211 304 480	2050 1015 208 300 494	0.63
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM									2735 1280 219 325 424	2595 1215 216 322 442	2455 1160 214 318 457	2320 1105 211 315 475	2195 1055 209 311 491	2075 1010 206 308 507	0.66
28,000 FT —41°C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM											2500 1175 212 326 462	2360 1115 209 322 482	2230 1060 207 318 501	2105 1010 204 315 518	0.68
30,000 FT —44°C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM												2405 1135 207 330 486	2270 1075 205 326 505	2140 1020 202 322 526	0.70
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		6.0	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.3	4.1	3.9	3.7	3.6	3.4	

MODEL P-3C — THREE-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "A"

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Figure 33-2. Three-Engine Maximum Range Operating Table — Configuration A (Sheet 2 of 2)

TWO-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

CONFIGURATION "A"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	4390	4210	4040	3875	3710	3550	3390	3245	3105	2960	2825	2700	0.40
	FF—LB/HR/ENG	2315	2250	2185	2120	2060	1995	1940	1885	1830	1780	1730	1680	
	IAS—KNOTS	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS	250	247	245	242	240	237	235	232	230	227	225	222	
	SEG RANGE—NM	270	275	282	286	292	297	303	308	315	319	325	331	
2000 FT +11 °C	SHP	4440	4260	4080	3915	3755	3590	3425	3275	3130	2985	2845	2715	0.41
	FF—LB/HR/ENG	2285	2220	2150	2085	2020	1960	1900	1845	1790	1735	1680	1635	
	IAS—KNOTS	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS	255	253	250	247	245	242	240	237	234	232	230	227	
	SEG RANGE—NM	278	285	291	296	300	309	315	321	328	335	341	347	
4000 FT +7 °C	SHP	4505	4315	4135	3965	3800	3625	3460	3305	3160	3010	2865	2735	0.42
	FF—LB/HR/ENG	2265	2195	2125	2055	1990	1925	1865	1810	1750	1695	1640	1590	
	IAS—KNOTS	246	243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS	260	258	255	253	250	247	245	242	239	237	234	231	
	SEG RANGE—NM	287	294	300	307	314	321	328	335	341	349	357	363	
6000 FT +3 °C	SHP	4575	4380	4190	4020	3850	3680	3495	3340	3190	3035	2890	2755	0.44
	FF—LB/HR/ENG	2250	2175	2105	2035	1965	1900	1832	1774	1717	1665	1605	1555	
	IAS—KNOTS	244	241	239	236	234	231	229	226	224	221	219	216	
	TAS—KNOTS	266	263	260	258	255	252	250	247	244	241	239	236	
	SEG RANGE—NM	295	302	309	316	324	332	340	348	355	362	372	380	
8000 FT −1 °C	SHP		4450	4255	4075	3900	3715	3535	3375	3220	3065	2920	2775	0.45
	FF—LB/HR/ENG		2165	2090	2015	1945	1880	1805	1745	1690	1635	1580	1525	
	IAS—KNOTS		239	237	234	232	229	227	224	222	219	217	214	
	TAS—KNOTS		269	266	263	260	257	255	252	249	246	244	241	
	SEG RANGE—NM		310	318	324	335	342	352	361	369	377	386	394	
10,000 FT −5 °C	SHP			4325	4135	3955	3765	3580	3415	3250	3095	2945	2800	0.47
	FF—LB/HR/ENG			2080	2005	1935	1865	1790	1730	1665	1610	1550	1500	
	IAS—KNOTS			235	232	230	227	225	222	220	217	215	212	
	TAS—KNOTS			271	269	266	263	260	257	254	251	249	246	
	SEG RANGE—NM			326	335	343	352	363	372	382	391	400	410	
12,000 FT −9 °C	SHP					4010	3820	3630	3455	3285	3125	2975	2820	0.49
	FF—LB/HR/ENG					1935	1865	1785	1715	1650	1590	1530	1465	
	IAS—KNOTS					228	225	223	220	218	215	213	210	
	TAS—KNOTS					271	268	266	262	260	257	254	251	
	SEG RANGE—NM					350	360	372	383	393	404	415	428	
14,000 FT −13 °C	SHP						3875	3680	3495	3320	3160	3005	2845	0.51
	FF—LB/HR/ENG						1870	1785	1710	1635	1575	1515	1455	
	IAS—KNOTS						223	221	218	216	213	211	208	
	TAS—KNOTS						274	271	268	265	262	259	256	
	SEG RANGE—NM						366	380	393	405	416	428	440	

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Figure 33-3. Two-Engine Maximum Range Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM								3545 1710 216 274 401	3360 1630 214 271 416	3195 1565 211 268 427	3035 1500 209 265 441	2870 1440 206 262 455	0.53
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM									3405 1630 212 277 424	3235 1565 209 274 438	3070 1495 207 271 454	2900 1425 204 267 468	0.55
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM										3275 1565 207 280 448	3105 1490 205 277 464	2935 1420 202 274 482	0.57
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		7.7	7.4	7.1	6.8	6.5	6.3	6.0	5.8	5.5	5.3	5.1	4.9	

MODEL P-3C — TWO-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "A"

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Figure 33-3. Two-Engine Maximum Range Operating Table — Configuration A (Sheet 2 of 2)

FOUR-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION **"A"**

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP	1645	1545	1455	1365	1280	1200	1125	1045	975	905	835	770	**0.33**
	FF—LB/HR/ENG	1285	1245	1215	1180	1155	1125	1100	1075	1045	1020	995	975	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	0:58	1:00	1:02	1:03	1:05	1:07	1:08	1:10	1:12	1:13	1:15	1:17	
2000 FT **+11 °C**	SHP	1685	1590	1495	1405	1315	1235	1155	1075	1000	930	860	790	**0.35**
	FF—LB/HR/ENG	1245	1210	1175	1145	1115	1090	1060	1035	1005	980	955	930	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	1:00	1:02	1:04	1:05	1:07	1:09	1:11	1:13	1:15	1:16	1:18	1:21	
4000 FT **+7 °C**	SHP	1735	1635	1535	1440	1355	1270	1185	1105	1030	955	880	810	**0.36**
	FF—LB/HR/ENG	1215	1175	1145	1110	1080	1055	1025	995	970	945	920	890	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	1:02	1:04	1:06	1:07	1:09	1:11	1:13	1:15	1:17	1:19	1:22	1:24	
6000 FT **+3 °C**	SHP	1785	1680	1580	1485	1390	1305	1220	1135	1055	980	905	830	**0.38**
	FF—LB/HR/ENG	1190	1150	1115	1080	1050	1020	990	965	935	910	880	855	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	1:03	1:05	1:07	1:09	1:11	1:13	1:16	1:18	1:20	1:23	1:25	1:28	
8000 FT **−1 °C**	SHP	1835	1725	1625	1525	1430	1340	1255	1170	1085	1005	930	855	**0.40**
	FF—LB/HR/ENG	1165	1125	1090	1055	1025	995	965	935	905	875	850	820	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	247	241	236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN	1:04	1:07	1:09	1:11	1:13	1:16	1:18	1:20	1:23	1:26	1:28	1:31	

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Figure 33-4. Four-Engine Loiter Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT −5 °C	SHP	1895	1775	1670	1570	1470	1380	1290	1205	1115	1035	955	875	0.41
	FF—LB/HR/ENG	1150	1105	1065	1030	1000	970	940	910	880	850	820	790	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	254	249	243	237	232	226	220	214	208	203	197	191	
	TIME—HR:MIN	1:05	1:08	1:10	1:13	1:15	1:17	1:20	1:23	1:25	1:28	1:31	1:35	
12,000 FT −9 °C	SHP	1950	1830	1725	1620	1515	1425	1330	1240	1150	1065	985	900	0.43
	FF—LB/HR/ENG	1140	1095	1055	1020	985	950	920	885	855	825	795	765	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	262	256	250	244	239	233	227	221	215	209	203	197	
	TIME—HR:MIN	1:06	1:08	1:11	1:14	1:16	1:19	1:22	1:25	1:28	1:31	1:35	1:38	
14,000 FT −13 °C	SHP	2010	1890	1775	1670	1565	1465	1370	1275	1185	1095	1015	925	0.45
	FF—LB/HR/ENG	1130	1085	1045	1005	970	935	900	870	835	805	770	740	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	270	264	258	252	246	240	234	228	222	216	210	203	
	TIME—HR:MIN	1:06	1:09	1:12	1:15	1:17	1:20	1:23	1:26	1:30	1:33	1:37	1:41	
16,000 FT −17 °C	SHP	2075	1950	1830	1725	1610	1510	1410	1315	1220	1130	1040	955	0.47
	FF—LB/HR/ENG	1125	1075	1035	995	955	920	885	850	815	785	750	720	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	278	272	266	260	254	248	241	235	229	222	216	210	
	TIME—HR:MIN	1:07	1:10	1:13	1:16	1:18	1:22	1:25	1:28	1:32	1:36	1:40	1:44	
18,000 FT −21 °C	SHP	2140	2010	1890	1775	1660	1555	1455	1355	1255	1165	1075	980	0.49
	FF—LB/HR/ENG	1120	1070	1025	985	945	905	870	835	800	765	730	695	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	287	281	275	268	262	255	249	243	236	230	223	217	
	TIME—HR:MIN	1:07	1:10	1:13	1:16	1:19	1:23	1:26	1:30	1:34	1:38	1:43	1:48	
20,000 FT −25 °C	SHP	2210	2070	1950	1830	1715	1605	1500	1395	1295	1200	1105	1015	0.51
	FF—LB/HR/ENG	1115	1065	1015	975	935	895	855	820	780	745	710	680	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	297	290	284	277	271	264	257	251	244	237	231	224	
	TIME—HR:MIN	1:07	1:10	1:14	1:17	1:20	1:24	1:28	1:32	1:36	1:40	1:45	1:51	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		3.3	3.1	2.9	2.7	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.4	

MODEL P-3C — FOUR-ENGINE LOITER OPERATING TABLE — CONFIGURATION "A"

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Figure 33-4. Four-Engine Loiter Operating Table — Configuration A (Sheet 2 of 2)

THREE-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION **"A"**

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2385 1570 220 220 1:04	2250 1515 215 215 1:06	2120 1465 210 210 1:08	1990 1420 205 205 1:11	1860 1375 200 200 1:13	1745 1335 195 195 1:15	1630 1290 190 190 1:17	1520 1255 185 185 1:20	1410 1215 180 180 1:22	1310 1175 175 175 1:25	1205 1135 170 170 1:28	1105 1100 165 165 1:31	**0.33**
2000 FT **+11 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2450 1535 220 226 1:05	2315 1485 215 221 1:07	2175 1435 210 216 1:10	2045 1385 205 211 1:12	1910 1335 200 206 1:15	1790 1295 195 201 1:17	1675 1255 190 195 1:20	1560 1215 185 190 1:22	1450 1175 180 185 1:24	1345 1135 175 180 1:28	1235 1100 170 175 1:31	1135 1060 165 170 1:34	**0.35**
4000 FT **+7 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2520 1510 220 233 1:06	2380 1460 215 228 1:09	2235 1410 210 222 1:11	2100 1355 205 217 1:14	1965 1310 200 212 1:16	1840 1265 195 206 1:19	1725 1225 190 201 1:22	1605 1185 185 196 1:24	1490 1145 180 190 1:29	1380 1105 175 185 1:31	1270 1065 170 180 1:34	1165 1025 165 175 1:37	**0.36**
6000 FT **+3 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2600 1495 220 240 1:07	2450 1440 215 234 1:09	2305 1390 210 229 1:12	2160 1340 205 223 1:15	2025 1290 200 218 1:17	1895 1245 195 213 1:20	1770 1195 190 207 1:23	1650 1155 185 202 1:26	1530 1110 180 196 1:30	1420 1070 175 191 1:33	1310 1035 170 185 1:37	1200 995 165 180 1:40	**0.38**
8000 FT **−1 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2675 1480 220 247 1:07	2525 1430 215 241 1:10	2375 1375 210 236 1:13	2225 1325 205 230 1:16	2080 1275 200 225 1:18	1950 1225 195 219 1:22	1825 1175 190 214 1:25	1700 1130 185 208 1:29	1575 1085 180 202 1:32	1460 1045 175 197 1:36	1345 1005 170 191 1:40	1230 960 165 186 1:44	**0.40**

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Figure 33-5. Three-Engine Loiter Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT −5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2755 1475 220 254 1:08	2600 1420 215 249 1:10	2445 1365 210 243 1:13	2290 1315 205 237 1:16	2145 1260 200 232 1:19	2010 1210 195 226 1:23	1875 1155 190 220 1:26	1750 1110 185 214 1:30	1620 1065 180 208 1:34	1500 1020 175 203 1:38	1380 975 170 197 1:42	1265 935 165 191 1:47	0.41
12,000 FT −9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2840 1475 220 262 1:08	2680 1420 215 256 1:10	2520 1365 210 250 1:13	2365 1305 205 244 1:17	2210 1250 200 239 1:20	2070 1200 195 233 1:23	1935 1145 190 227 1:27	1800 1095 185 221 1:31	1670 1050 180 215 1:35	1545 1000 175 209 1:40	1425 960 170 203 1:44	1305 915 165 197 1:50	0.43
14,000 FT −13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2930 1480 220 270 1:08	2765 1420 215 264 1:10	2600 1360 210 258 1:14	2440 1300 205 252 1:17	2275 1245 200 246 1:20	2135 1190 195 240 1:24	1995 1135 190 234 1:28	1855 1085 185 228 1:32	1720 1035 180 222 1:37	1590 985 175 216 1:41	1465 940 170 210 1:46	1345 895 165 203 1:52	0.45
16,000 FT −17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3020 1490 220 278 1:07	2850 1425 215 272 1:10	2680 1360 210 266 1:14	2515 1300 205 260 1:17	2350 1240 200 254 1:21	2200 1185 195 248 1:24	2055 1130 190 241 1:29	1910 1075 185 235 1:33	1775 1025 180 229 1:38	1640 975 175 222 1:43	1510 925 170 216 1:48	1385 880 165 210 1:54	0.47
18,000 FT −21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3115 1505 220 287 1:06	2940 1435 215 281 1:10	2765 1365 210 275 1:13	2590 1300 205 268 1:17	2420 1235 200 262 1:21	2270 1180 195 255 1:25	2120 1125 190 249 1:29	1970 1070 185 243 1:34	1830 1015 180 236 1:38	1690 965 175 230 1:44	1555 910 170 223 1:50	1425 865 165 217 1:56	0.49
20,000 FT −25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN		3035 1450 215 290 1:09	2860 1375 210 284 1:13	2680 1305 205 277 1:17	2500 1240 200 271 1:21	2340 1180 195 264 1:25	2185 1120 190 257 1:29	2035 1060 185 251 1:34	1885 1005 180 244 1:39	1740 950 175 237 1:45	1605 900 170 231 1:51	1470 850 165 224 1:58	0.51
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		4.9	4.6	4.3	4.0	3.8	3.5	3.3	3.0	2.8	2.5	2.3	2.2	

MODEL P-3C — THREE-ENGINE LOITER OPERATING TABLE — CONFIGURATION "A"

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Figure 33-5. Three-Engine Loiter Operating Table — Configuration A (Sheet 2 of 2)

TWO-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

CONFIGURATION "A"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	3735	3530	3320	3115	2910	2720	2535	2360	2185	2015	1850	1700	0.33
	FF—LB/HR/ENG	2080	2000	1925	1845	1770	1700	1630	1565	1500	1435	1375	1320	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	1:12	1:15	1:18	1:21	1:25	1:28	1:32	1:36	1:40	1:44	1:49	1:54	
2000 FT +11 °C	SHP	3840	3625	3410	3200	2995	2800	2605	2425	2245	2070	1900	1740	0.35
	FF—LB/HR/ENG	2070	1985	1905	1825	1750	1675	1605	1535	1470	1405	1345	1290	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	1:12	1:16	1:19	1:22	1:26	1:30	1:34	1:38	1:42	1:47	1:52	1:56	
4000 FT +7 °C	SHP	3955	3735	3510	3295	3080	2880	2680	2490	2310	2130	1955	1790	0.36
	FF—LB/HR/ENG	2060	1980	1895	1815	1735	1660	1585	1515	1445	1380	1320	1260	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	1:13	1:16	1:19	1:23	1:26	1:30	1:35	1:39	1:44	1:49	1:54	1:59	
6000 FT +3 °C	SHP	4075	3845	3615	3390	3170	2965	2760	2565	2375	2190	2010	1840	0.38
	FF—LB/HR/ENG	2065	1975	1890	1805	1720	1645	1570	1500	1425	1360	1295	1235	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	1:13	1:16	1:19	1:23	1:27	1:31	1:36	1:40	1:45	1:50	1:56	2:01	
8000 FT −1 °C	SHP		3965	3725	3495	3265	3050	2845	2640	2445	2255	2070	1895	0.40
	FF—LB/HR/ENG		1975	1890	1805	1715	1640	1560	1485	1415	1345	1275	1210	
	IAS—KNOTS		215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS		241	236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN		1:16	1:19	1:23	1:27	1:32	1:36	1:41	1:46	1:52	1:58	2:04	

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Figure 33-6. Two-Engine Loiter Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT —5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN			3835 1895 210 243 1:19	3605 1805 205 237 1:23	3365 1720 200 232 1:27	3140 1635 195 226 1:32	2925 1555 190 220 1:36	2720 1480 185 214 1:41	2520 1405 180 208 1:47	2320 1330 175 203 1:53	2130 1260 170 197 1:59	1950 1190 165 191 2:06	0.41
12,000 FT —9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN				3715 1815 205 244 1:23	3470 1725 200 239 1:27	3240 1640 195 233 1:31	3020 1560 190 227 1:36	2805 1480 185 221 1:41	2595 1400 180 215 1:47	2390 1325 175 209 1:53	2195 1250 170 203 2:00	2010 1180 165 197 2:07	0.43
14,000 FT —13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN						3340 1655 195 240 1:31	3115 1565 190 234 1:36	2890 1480 185 228 1:41	2675 1400 180 222 1:47	2465 1320 175 216 1:53	2265 1245 170 210 2:01	2070 1170 165 203 2:08	0.45
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN							3210 1580 190 241 1:35	2985 1490 185 235 1:41	2760 1405 180 229 1:47	2540 1325 175 222 1:53	2335 1245 170 216 2:01	2140 1165 165 210 2:09	0.47
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN								3075 1505 185 243 1:39	2845 1415 180 236 1:46	2620 1330 175 230 1:53	2405 1245 170 223 2:01	2205 1165 165 217 2:09	0.49
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN									2940 1430 180 244 1:45	2710 1335 175 237 1:52	2485 1250 170 231 2:02	2270 1165 165 224 2:09	0.51
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		6.8	6.5	6.2	5.9	5.6	5.3	5.0	4.8	4.5	4.2	4.0	3.7	

MODEL P-3C — TWO-ENGINE LOITER OPERATING TABLE — CONFIGURATION "A"

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Figure 33-6. Two-Engine Loiter Operating Table — Configuration A (Sheet 2 of 2)

FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION "B"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	2515	2425	2335	2250	2160	2080	1990	1915	1840	1765	1695	1630	1565	1500	**0.45**
	FF—LB/HR/ENG	1595	1555	1525	1495	1470	1435	1405	1380	1350	1325	1300	1275	1250	1230	
	IAS—KNOTS	275	272	270	267	265	262	260	257	255	252	250	247	245	242	
	TAS—KNOTS	275	272	270	267	265	262	260	257	255	252	250	247	245	242	
	SEG RANGE—NM	215	219	221	223	225	228	231	235	236	238	241	243	245	247	
2000 FT +11 °C	SHP	2545	2455	2365	2270	2185	2095	2010	1930	1855	1775	1705	1640	1570	1510	**0.47**
	FF—LB/HR/ENG	1555	1520	1485	1455	1425	1395	1365	1335	1310	1285	1255	1230	1205	1185	
	IAS—KNOTS	273	270	268	265	263	260	258	255	253	250	248	245	243	240	
	TAS—KNOTS	280	278	276	273	270	268	265	263	260	258	255	253	250	247	
	SEG RANGE—NM	225	228	231	235	237	240	243	246	248	251	254	257	259	261	
4000 FT +7 °C	SHP	2580	2485	2395	2300	2210	2125	2035	1950	1875	1795	1725	1650	1580	1520	**0.48**
	FF—LB/HR/ENG	1520	1485	1450	1415	1385	1355	1325	1295	1270	1245	1215	1190	1165	1140	
	IAS—KNOTS	271	268	266	263	261	258	256	253	251	248	246	243	241	238	
	TAS—KNOTS	286	283	281	279	276	274	271	268	265	263	260	258	255	253	
	SEG RANGE—NM	235	238	242	246	249	253	256	259	261	264	267	270	274	276	
6000 FT +3 °C	SHP	2615	2515	2425	2330	2240	2150	2060	1970	1890	1815	1740	1660	1590	1530	**0.50**
	FF—LB/HR/ENG	1490	1455	1415	1385	1350	1320	1285	1255	1230	1205	1175	1150	1125	1100	
	IAS—KNOTS	269	266	264	261	259	256	254	251	249	246	244	241	239	236	
	TAS—KNOTS	292	290	287	285	282	280	277	274	271	268	266	263	260	258	
	SEG RANGE—NM	245	249	253	257	261	265	269	272	275	278	282	287	290	293	
8000 FT −1 °C	SHP	2655	2550	2460	2360	2265	2175	2085	1995	1910	1835	1755	1680	1600	1540	**0.51**
	FF—LB/HR/ENG	1460	1425	1390	1350	1315	1285	1255	1220	1195	1165	1135	1110	1085	1060	
	IAS—KNOTS	267	264	262	259	257	254	252	249	247	244	242	239	237	234	
	TAS—KNOTS	299	296	293	291	288	285	282	280	277	274	271	269	266	263	
	SEG RANGE—NM	256	260	264	269	273	277	281	286	289	294	298	302	306	311	
10,000 FT −5 °C	SHP	2690	2590	2490	2395	2300	2200	2110	2020	1930	1850	1770	1690	1615	1550	**0.53**
	FF—LB/HR/ENG	1435	1395	1360	1325	1290	1255	1225	1190	1160	1130	1100	1075	1045	1020	
	IAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	TAS—KNOTS	305	302	300	297	294	291	288	286	283	280	277	275	271	269	
	SEG RANGE—NM	266	270	276	280	285	290	294	300	306	310	315	319	325	329	
12,000 FT −9 °C	SHP	2735	2625	2525	2425	2325	2230	2135	2045	1955	1870	1790	1710	1630	1560	**0.55**
	FF—LB/HR/ENG	1415	1375	1340	1300	1265	1230	1195	1165	1130	1100	1070	1045	1015	990	
	IAS—KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	233	230	
	TAS—KNOTS	313	310	306	304	301	298	295	292	289	286	283	280	277	274	
	SEG RANGE—NM	276	282	286	291	297	302	308	314	320	324	330	335	341	347	
14,000 FT −13 °C	SHP	2780	2670	2565	2460	2355	2260	2160	2065	1975	1890	1805	1725	1645	1570	**0.57**
	FF—LB/HR/ENG	1405	1360	1320	1280	1240	1210	1175	1140	1105	1075	1045	1015	990	960	
	IAS—KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	231	228	
	TAS—KNOTS	323	317	313	310	307	304	301	298	295	292	289	286	283	280	
	SEG RANGE—NM	287	291	296	302	309	315	321	327	334	340	346	352	358	365	

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Figure 33-7. Four-Engine Maximum Range Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT −17 °C	SHP	2825	2715	2600	2500	2395	2290	2190	2095	1990	1910	1825	1740	1665	1590	0.59
	FF—LB/HR/ENG	1395	1350	1305	1265	1225	1190	1155	1120	1080	1050	1020	990	960	935	
	IAS—KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	229	226	
	TAS—KNOTS	327	323	320	317	314	311	308	305	302	299	296	293	290	287	
	SEG RANGE—NM	293	299	306	313	321	327	334	340	348	356	363	369	376	384	
18,000 FT −21 °C	SHP	2880	2760	2650	2535	2430	2325	2225	2125	2015	1935	1845	1760	1680	1605	0.61
	FF—LB/HR/ENG	1390	1340	1295	1255	1210	1175	1130	1105	1065	1030	1000	970	940	910	
	IAS—KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	227	224	
	TAS—KNOTS	333	330	328	324	321	318	315	312	309	305	303	299	296	293	
	SEG RANGE—NM	299	308	316	323	332	338	346	353	362	370	379	386	394	402	
20,000 FT −25 °C	SHP	2930	2815	2695	2580	2470	2365	2260	2155	2040	1960	1870	1785	1700	1620	0.63
	FF—LB/HR/ENG	1385	1340	1290	1250	1205	1165	1130	1090	1050	1010	980	950	920	890	
	IAS—KNOTS	255	252	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS	342	338	335	332	329	326	322	319	316	313	310	306	303	300	
	SEG RANGE—NM	309	315	325	333	341	350	357	367	377	387	396	403	412	422	
22,000 FT −29 °C	SHP	2980	2865	2750	2625	2505	2390	2290	2180	2070	1980	1885	1805	1715	1630	0.65
	FF—LB/HR/ENG	1390	1340	1295	1245	1200	1160	1120	1080	1035	1000	965	935	900	870	
	IAS—KNOTS	253	250	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS	349	346	344	340	337	334	330	327	324	320	317	314	310	307	
	SEG RANGE—NM	314	323	332	341	350	359	370	380	391	401	411	420	430	440	
24,000 FT −33 °C	SHP	3035	2920	2800	2670	2550	2435	2320	2215	2100	2005	1915	1820	1735	1650	0.68
	FF—LB/HR/ENG	1405	1350	1305	1250	1200	1160	1115	1070	1030	990	955	920	885	855	
	IAS—KNOTS	251	248	246	243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS	359	355	352	349	345	342	338	335	331	328	325	321	318	314	
	SEG RANGE—NM	320	328	337	348	358	369	380	390	403	414	426	437	448	458	
26,000 FT −37 °C	SHP			2860	2710	2590	2480	2365	2250	2135	2040	1940	1845	1755	1675	0.70
	FF—LB/HR/ENG			1320	1265	1210	1160	1115	1070	1025	985	945	910	875	845	
	IAS—KNOTS			244	241	239	236	234	231	229	226	224	221	219	216	
	TAS—KNOTS			361	357	354	350	347	343	339	336	332	329	325	322	
	SEG RANGE—NM			341	353	367	377	388	400	414	426	438	450	464	474	
28,000 FT −41 °C	SHP					2635	2515	2400	2295	2175	2070	1970	1870	1775	1695	0.72
	FF—LB/HR/ENG					1225	1175	1125	1075	1030	985	945	910	870	840	
	IAS—KNOTS					237	234	232	229	227	224	222	219	217	214	
	TAS—KNOTS					362	359	355	352	348	344	340	337	333	330	
	SEG RANGE—NM					370	382	394	408	423	436	450	464	477	491	
30,000 FT −44 °C	SHP						2555	2435	2325	2220	2105	2000	1900	1805	1715	0.75
	FF—LB/HR/ENG						1195	1140	1090	1040	990	950	905	870	835	
	IAS—KNOTS						232	230	227	225	222	220	217	215	212	
	TAS—KNOTS						368	364	360	356	353	349	345	342	338	
	SEG RANGE—NM						384	398	412	429	446	462	476	492	505	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.4	5.0	4.7	4.4	4.2	4.1	3.9	3.7	3.6	3.4	3.3	3.2	3.0	2.9	

MODEL P-3C — FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "B"

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Figure 33-7. Four-Engine Maximum Range Operating Table — Configuration B (Sheet 2 of 2)

THREE-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION "B"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	3320	3185	3055	2930	2815	2700	2590	2490	2385	2285	2180	2090	1995	1915	0.42
	FF–LB/HR/ENG	1885	1845	1800	1755	1715	1675	1635	1595	1560	1515	1480	1450	1415	1385	
	IAS–KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	TAS–KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	SEG RANGE–NM	234	237	241	244	248	252	255	258	262	267	270	274	277	280	
2000 FT +11 °C	SHP	3370	3230	3095	2970	2855	2730	2615	2505	2400	2300	2195	2100	2010	1925	0.44
	FF–LB/HR/ENG	1855	1810	1760	1720	1675	1635	1595	1555	1520	1475	1440	1405	1370	1340	
	IAS–KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	233	230	
	TAS–KNOTS	270	268	265	263	260	258	255	253	250	247	245	242	240	237	
	SEG RANGE–NM	242	247	251	255	259	262	266	270	275	280	284	287	291	295	
4000 FT +7 °C	SHP	3420	3280	3140	3015	2885	2765	2650	2535	2425	2320	2225	2120	2025	1935	0.45
	FF–LB/HR/ENG	1830	1780	1730	1685	1640	1600	1560	1520	1480	1440	1400	1365	1330	1295	
	IAS–KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	231	228	
	TAS–KNOTS	276	273	271	268	265	263	260	258	255	253	250	247	245	242	
	SEG RANGE–NM	251	256	260	265	270	274	278	283	287	292	298	302	306	311	
6000 FT +3 °C	SHP	3475	3335	3190	3060	2935	2800	2680	2565	2450	2350	2240	2140	2045	1955	0.47
	FF–LB/HR/ENG	1810	1755	1705	1660	1610	1570	1525	1485	1445	1405	1365	1330	1295	1260	
	IAS–KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	229	226	
	TAS–KNOTS	282	279	277	274	271	268	266	263	260	258	255	252	250	247	
	SEG RANGE–NM	260	265	270	276	280	286	290	296	300	306	312	317	322	327	
8000 FT −1 °C	SHP	3535	3385	3235	3100	2970	2845	2715	2590	2480	2375	2265	2160	2070	1965	0.48
	FF–LB/HR/ENG	1795	1740	1685	1635	1585	1540	1495	1455	1410	1370	1330	1295	1255	1220	
	IAS–KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	227	224	
	TAS–KNOTS	288	285	282	280	277	274	271	269	266	263	260	257	255	252	
	SEG RANGE–NM	267	273	279	285	290	296	302	308	314	320	326	332	338	344	
10,000 FT −5 °C	SHP	3595	3445	3295	3150	3020	2880	2750	2630	2510	2405	2295	2185	2090	1990	0.50
	FF–LB/HR/ENG	1785	1730	1670	1620	1570	1515	1470	1425	1380	1340	1305	1265	1225	1190	
	IAS–KNOTS	255	252	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS–KNOTS	294	291	288	286	283	280	277	275	271	269	266	263	260	257	
	SEG RANGE–NM	274	280	288	294	301	308	314	321	328	334	340	347	354	361	
12,000 FT −9 °C	SHP	3665	3510	3355	3210	3065	2920	2790	2660	2545	2430	2315	2205	2105	2000	0.52
	FF–LB/HR/ENG	1780	1720	1665	1610	1555	1500	1450	1405	1355	1315	1280	1235	1195	1160	
	IAS–KNOTS	253	250	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS–KNOTS	301	298	295	292	289	286	283	280	277	274	271	268	266	262	
	SEG RANGE–NM	282	289	295	303	310	318	324	332	341	348	354	362	370	376	
14,000 FT −13 °C	SHP	3735	3580	3410	3260	3120	2975	2840	2700	2580	2455	2345	2230	2125	2020	0.54
	FF–LB/HR/ENG	1780	1720	1660	1605	1550	1490	1440	1390	1340	1300	1255	1215	1170	1140	
	IAS–KNOTS	253	248	246	243	241	238	236	233	231	228	226	223	221	218	
	TAS–KNOTS	308	305	301	298	295	292	289	286	283	280	277	274	271	268	
	SEG RANGE–NM	289	295	302	310	317	326	335	343	353	360	368	376	386	394	

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Figure 33-8. Three-Engine Maximum Range Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM		3655 1725 246 311 301	3480 1665 244 308 308	3320 1605 241 305 317	3170 1545 239 302 325	3030 1490 236 299 334	2885 1430 234 296 345	2745 1380 231 293 354	2610 1325 229 290 364	2490 1285 226 287 372	2380 1240 224 284 382	2260 1195 221 280 391	2150 1150 219 278 404	2040 1115 216 274 411	0.55
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM				3385 1615 239 312 322	3230 1550 237 309 332	3080 1495 234 305 340	2935 1430 232 303 353	2800 1375 229 299 363	2650 1315 227 296 376	2525 1270 224 293 385	2410 1220 222 290 397	2290 1175 219 287 407	2170 1130 217 284 419	2060 1090 214 280 428	0.57
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM						3135 1500 232 313 248	2990 1435 230 310 360	2840 1370 227 306 372	2700 1319 225 303 386	2565 1260 222 300 398	2440 1205 220 297 410	2315 1160 217 293 422	2195 1115 215 290 435	2080 1070 212 287 447	0.59
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM							3040 1450 228 317 364	2890 1380 225 314 380	2750 1315 223 310 393	2610 1260 220 307 406	2480 1205 218 304 420	2350 1155 215 300 434	2225 1105 213 297 448	2100 1060 210 294 462	0.61
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM									2795 1330 221 318 398	2655 1270 218 314 413	2520 1210 216 311 428	2380 1155 213 307 444	2250 1100 211 304 461	2135 1050 208 300 476	0.63
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM										2700 1280 216 322 418	2560 1215 214 318 436	2420 1160 211 315 453	2290 1100 209 311 471	2160 1050 206 308 490	0.66
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM											2600 1220 212 326 444	2460 1160 209 322 462	2325 1105 207 318 481	2190 1050 204 315 500	0.68
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													2355 1110 205 326 491	2220 1050 202 322 511	0.70
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		6.2	5.9	5.7	5.4	5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.9	3.7	3.6	

MODEL P-3C — THREE-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "B"

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Figure 33-8. Three-Engine Maximum Range Operating Table — Configuration B (Sheet 2 of 2)

TWO-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION **"B"**

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM		4440 2330 247 247 265	4250 2260 245 245 271	4070 2190 242 242 278	3900 2115 240 240 284	3735 2060 237 237 287	3575 2005 235 235 292	3420 1950 232 232 298	3270 1895 230 230 305	3125 1840 227 227 309	2985 1785 225 225 315	2855 1740 222 222 320	**0.40**
2000 FT **+11 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM		4490 2310 245 253 274	4300 2230 243 250 280	4120 2160 240 247 286	3945 2095 238 245 292	3780 2030 235 242 298	3610 1970 233 240 304	3450 1915 230 237 310	3300 1855 228 234 316	3155 1800 225 232 322	3000 1745 223 230 329	2865 1695 220 227 334	**0.41**
4000 FT **+7 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM		4545 2290 243 258 281	4350 2205 241 255 289	4175 2135 238 253 296	3995 2070 236 250 302	3820 2005 233 247 308	3650 1940 231 245 315	3490 1880 228 242 322	3330 1820 226 239 328	3180 1765 223 237 336	3025 1705 221 234 344	2880 1650 218 231 350	**0.42**
6000 FT **+3 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM		4600 2275 241 263 290	4415 2185 239 260 298	4230 2120 236 258 304	4045 2050 234 255 310	3860 1980 231 252 318	3685 1915 229 250 326	3525 1850 226 247 333	3360 1790 224 244 341	3205 1730 221 241 349	3050 1670 219 239 357	2905 1615 216 236 365	**0.44**
8000 FT **−1 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM			4490 2175 237 266 305	4285 2110 234 263 312	4095 2035 232 260 320	3905 1960 229 257 328	3730 1890 227 255 337	3560 1825 224 252 345	3390 1760 222 249 353	3235 1700 219 246 362	3070 1640 217 244 371	2920 1585 214 241 380	**0.45**
10,000 FT **−5 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM					4155 2020 230 266 328	3955 1945 227 263 338	3765 1870 225 260 348	3600 1805 222 257 356	3425 1735 220 254 366	3260 1675 217 251 375	3100 1615 215 249 385	2940 1555 212 246 395	**0.47**
12,000 FT **−9 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM						4020 1935 225 268 347	3815 1855 223 266 358	3640 1790 220 262 367	3465 1720 218 260 377	3295 1655 215 257 388	3125 1595 213 254 399	2965 1535 210 251 409	**0.49**
14,000 FT **−13 °C**	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM							3875 1845 221 271 368	3685 1780 218 268 378	3505 1715 216 265 386	3330 1645 213 262 396	3155 1575 211 259 412	2990 1515 208 256 422	**0.51**

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Figure 33-9. Two-Engine Maximum Range Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM									3545 1710 214 271 395	3370 1640 211 268 408	3190 1565 209 265 423	3020 1500 206 262 436	0.53
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM										3410 1635 209 274 420	3225 1560 207 271 432	3055 1485 204 267 450	0.55
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM											3270 1555 205 277 445	3090 1480 202 274 462	0.57
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		8.0	7.7	7.4	7.1	6.8	6.6	6.3	6.0	5.8	5.5	5.2	5.0	

MODEL P-3C — TWO-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "B"

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Figure 33-9. Two-Engine Maximum Range Operating Table — Configuration B (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

FOUR-ENGINE LOITER OPERATING TABLE

CONFIGURATION "B"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP	1740	1640	1545	1450	1355	1270	1185	1105	1030	955	880	810	**0.33**
	FF—LB/HR/ENG	1320	1285	1250	1215	1180	1150	1115	1085	1055	1025	995	970	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	0:57	0:58	1:00	1:02	1:04	1:05	1:07	1:09	1:11	1:13	1:15	1:17	
2000 FT **+11 °C**	SHP	1790	1690	1590	1485	1390	1305	1215	1135	1060	980	905	830	**0.35**
	FF—LB/HR/ENG	1290	1255	1220	1185	1150	1115	1080	1055	1020	990	965	930	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	0:58	1:00	1:02	1:04	1:05	1:07	1:09	1:11	1:13	1:16	1:18	1:20	
4000 FT **+7 °C**	SHP	1840	1740	1635	1530	1430	1340	1250	1170	1085	1010	930	855	**0.36**
	FF—LB/HR/ENG	1265	1230	1190	1155	1115	1085	1050	1025	990	960	930	900	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	0:59	1:01	1:03	1:05	1:07	1:09	1:11	1:13	1:16	1:18	1:20	1:23	
6000 FT **+3 °C**	SHP	1895	1790	1680	1570	1470	1380	1285	1200	1115	1035	955	875	**0.38**
	FF—LB/HR/ENG	1240	1205	1165	1130	1085	1060	1025	995	955	930	900	865	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	1:01	1:02	1:04	1:07	1:09	1:11	1:13	1:16	1:19	1:21	1:23	1:26	
8000 FT **−1 °C**	SHP	1950	1840	1730	1615	1510	1420	1320	1235	1145	1065	980	900	**0.40**
	FF—LB/HR/ENG	1220	1180	1140	1105	1060	1030	995	965	925	900	870	835	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	247	241	236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN	1:02	1:04	1:06	1:08	1:11	1:13	1:15	1:18	1:21	1:23	1:26	1:30	

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Figure 33-10. Four-Engine Loiter Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT −5 °C	SHP	2010	1890	1780	1665	1555	1460	1365	1270	1180	1090	1005	925	0.41
	FF—LB/HR/ENG	1200	1160	1120	1080	1040	1005	970	940	900	870	840	805	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	254	249	243	237	232	226	220	214	208	203	197	191	
	TIME—HR:MIN	1:02	1:05	1:07	1:10	1:12	1:14	1:17	1:20	1:23	1:26	1:29	1:33	
12,000 FT −9 °C	SHP	2070	1955	1835	1715	1605	1505	1405	1310	1215	1125	1035	950	0.43
	FF—LB/HR/ENG	1185	1145	1105	1060	1020	985	950	915	875	845	815	780	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	262	256	250	244	239	233	227	221	215	209	203	197	
	TIME—HR:MIN	1:03	1:05	1:08	1:11	1:14	1:16	1:19	1:22	1:26	1:29	1:32	1:36	
14,000 FT −13 °C	SHP	2135	2015	1890	1770	1655	1550	1445	1350	1250	1160	1065	980	0.45
	FF—LB/HR/ENG	1180	1135	1090	1045	1005	970	930	895	855	825	795	755	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	270	264	258	252	246	240	234	228	222	216	210	203	
	TIME—HR:MIN	1:04	1:06	1:09	1:12	1:15	1:17	1:20	1:24	1:28	1:31	1:35	1:39	
16,000 FT −17 °C	SHP	2200	2075	1950	1825	1705	1600	1490	1390	1290	1195	1100	1010	0.47
	FF—LB/HR/ENG	1175	1130	1080	1035	990	955	915	875	835	805	775	735	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	278	272	266	260	254	248	241	235	229	222	216	210	
	TIME—HR:MIN	1:04	1:07	1:10	1:13	1:16	1:19	1:22	1:26	1:30	1:33	1:37	1:40	
18,000 FT −21 °C	SHP	2270	2140	2010	1880	1760	1645	1535	1430	1330	1230	1135	1040	0.49
	FF—LB/HR/ENG	1170	1120	1070	1025	980	940	900	860	820	790	755	720	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	287	281	275	268	262	255	249	243	236	230	223	217	
	TIME—HR:MIN	1:04	1:07	1:10	1:13	1:17	1:20	1:23	1:27	1:31	1:35	1:39	1:44	
20,000 FT −25 °C	SHP	2350	2210	2080	1940	1815	1695	1585	1475	1370	1270	1165	1070	0.51
	FF—LB/HR/ENG	1170	1120	1065	1020	970	930	890	850	810	775	740	705	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	297	290	284	277	271	264	257	251	244	237	231	224	
	TIME—HR:MIN	1:04	1:07	1:10	1:14	1:17	1:20	1:25	1:28	1:32	1:37	1:41	1:46	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		3.6	3.3	3.1	2.9	2.7	2.5	2.3	2.2	2.0	1.8	1.7	1.5	

MODEL P-3C — FOUR-ENGINE LOITER OPERATING TABLE — CONFIGURATION "B"

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Figure 33-10. Four-Engine Loiter Operating Table — Configuration B (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

THREE-ENGINE LOITER OPERATING TABLE

CONFIGURATION "B"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–?
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb											AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	2495	2350	2215	2075	1945	1825	1705	1590	1475	1365	1260	1160	0.33
	FF—LB/HR/ENG	1605	1550	1500	1450	1400	1355	1310	1265	1225	1185	1145	1105	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	1:02	1:05	1:07	1:09	1:11	1:14	1:16	1:19	1:22	1:25	1:28	1:31	
2000 FT +11 °C	SHP	2570	2415	2275	2135	2000	1875	1750	1630	1510	1405	1290	1190	0.35
	FF—LB/HR/ENG	1580	1525	1470	1420	1370	1325	1280	1235	1195	1155	1115	1070	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	1:04	1:05	1:08	1:10	1:13	1:16	1:18	1:21	1:23	1:26	1:29	1:33	
4000 FT +7 °C	SHP	2640	2485	2340	2195	2055	1925	1800	1675	1555	1440	1325	1220	0.36
	FF—LB/HR/ENG	1560	1500	1445	1395	1350	1300	1255	1210	1165	1125	1085	1040	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	1:04	1:07	1:09	1:11	1:14	1:17	1:20	1:23	1:26	1:29	1:32	1:36	
6000 FT +3 °C	SHP	2720	2560	2410	2260	2115	1980	1850	1725	1600	1480	1365	1255	0.38
	FF—LB/HR/ENG	1545	1485	1430	1375	1330	1280	1230	1185	1140	1095	1055	1010	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	1:05	1:07	1:10	1:13	1:16	1:18	1:21	1:25	1:28	1:31	1:35	1:39	
8000 FT −1 °C	SHP	2800	2635	2480	2325	2175	2040	1905	1775	1645	1525	1405	1290	0.40
	FF—LB/HR/ENG	1535	1475	1415	1360	1310	1260	1210	1160	1115	1070	1025	985	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	247	241	236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN	1:05	1:08	1:11	1:13	1:16	1:19	1:23	1:26	1:29	1:33	1:37	1:41	

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Figure 33-11. Three-Engine Loiter Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb											AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT −5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2885 1530 220 254 1:05	2715 1465 215 249 1:08	2555 1410 210 243 1:11	2395 1350 205 237 1:14	2240 1300 200 232 1:17	2100 1245 195 226 1:20	1960 1195 190 220 1:24	1825 1140 185 214 1:28	1695 1095 180 208 1:31	1565 1050 175 203 1:35	1445 1005 170 197 1:40	1325 960 165 191 1:44	0.41
12,000 FT −9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2970 1530 220 262 1:05	2800 1465 215 256 1:08	2630 1405 210 250 1:11	2465 1340 205 244 1:14	2310 1285 200 239 1:18	2165 1230 195 233 1:21	2020 1180 190 227 1:25	1880 1125 185 221 1:29	1745 1075 180 215 1:33	1610 1030 175 209 1:37	1485 985 170 203 1:42	1365 940 165 197 1:46	0.43
14,000 FT −13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3065 1540 220 270 1:05	2885 1465 215 264 1:08	2715 1405 210 258 1:11	2545 1340 205 252 1:15	2380 1280 200 246 1:18	2225 1225 195 240 1:22	2080 1170 190 234 1:25	1935 1115 185 228 1:30	1800 1060 180 222 1:34	1660 1015 175 216 1:38	1530 965 170 210 1:44	1405 920 165 203 1:49	0.45
16,000 FT −17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3160 1550 220 278 1:04	2975 1475 215 272 1:08	2800 1405 210 266 1:11	2625 1340 205 260 1:15	2455 1280 200 254 1:19	2295 1220 195 248 1:23	2145 1165 190 241 1:26	1995 1105 185 235 1:31	1855 1050 180 229 1:35	1710 1000 175 222 1:40	1575 950 170 216 1:46	1445 905 165 210 1:51	0.47
18,000 FT −21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3260 1570 220 287 1:04	3070 1495 215 281 1:07	2890 1415 210 275 1:11	2710 1345 205 268 1:14	2535 1280 200 262 1:18	2370 1215 195 255 1:23	2215 1160 190 249 1:26	2060 1095 185 243 1:31	1910 1035 180 236 1:37	1760 985 175 230 1:41	1620 935 170 223 1:47	1490 885 165 217 1:53	0.49
20,000 FT −25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN			2980 1440 210 284 1:10	2795 1365 205 277 1:13	2615 1290 200 271 1:17	2445 1220 195 264 1:22	2285 1155 190 257 1:26	2125 1090 185 251 1:32	1970 1030 180 244 1:37	1820 975 175 237 1:42	1675 925 170 231 1:48	1540 875 165 224 1:55	0.51
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.1	4.8	4.5	4.2	3.9	3.7	3.4	3.2	2.9	2.7	2.5	2.3	

MODEL P-3C — THREE-ENGINE LOITER OPERATING TABLE — CONFIGURATION "B"

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Figure 33-11. Three-Engine Loiter Operating Table — Configuration B (Sheet 2 of 2)

TWO-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

CONFIGURATION "B"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	3960	3730	3510	3290	3085	2880	2685	2495	2310	2135	1960	1795	0.33
	FF—LB/HR/ENG	2160	2080	2000	1915	1835	1755	1685	1615	1540	1475	1410	1335	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	1:10	1:12	1:15	1:18	1:22	1:25	1:29	1:33	1:37	1:42	1:47	1:52	
2000 FT +11 °C	SHP	4075	3835	3610	3380	3180	2965	2760	2565	2380	2195	2015	1845	0.35
	FF—LB/HR/ENG	2145	2065	1985	1900	1815	1740	1660	1585	1515	1445	1380	1315	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	1:10	1:12	1:16	1:19	1:23	1:26	1:30	1:35	1:39	1:44	1:49	1:54	
4000 FT +7 °C	SHP	4195	3950	3715	3480	3265	3045	2840	2640	2445	2255	2070	1900	0.36
	FF—LB/HR/ENG	2140	2060	1980	1890	1805	1725	1645	1565	1495	1425	1355	1295	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	1:10	1:13	1:16	1:19	1:23	1:27	1:31	1:36	1:40	1:45	1:51	1:56	
6000 FT +3 °C	SHP	4320	4065	3825	3580	3360	3135	2920	2715	2515	2320	2130	1955	0.38
	FF—LB/HR/ENG	2140	2055	1975	1885	1800	1715	1630	1555	1480	1405	1335	1275	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	1:10	1:13	1:16	1:20	1:24	1:28	1:32	1:37	1:42	1:47	1:52	1:58	
8000 FT −1 °C	SHP			3940	3690	3465	3230	3010	2795	2590	2385	2195	2010	0.40
	FF—LB/HR/ENG			1975	1885	1795	1715	1625	1545	1475	1395	1320	1255	
	IAS—KNOTS			210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS			236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN			1:16	1:20	1:24	1:28	1:32	1:37	1:42	1:48	1:53	2:00	

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Figure 33-12. Two-Engine Loiter Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT −5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN				3800 1895 205 237 1:19	3570 1805 200 232 1:23	3330 1715 195 226 1:28	3100 1625 190 220 1:32	2880 1545 185 214 1:37	2670 1470 180 208 1:42	2455 1385 175 203 1:48	2260 1310 170 197 1:55	2070 1235 165 191 2:02	0.41
12,000 FT −9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN					3680 1820 200 239 1:23	3430 1725 195 233 1:27	3195 1630 190 227 1:32	2970 1550 185 221 1:37	2750 1470 180 215 1:42	2530 1380 175 209 1:48	2325 1300 170 203 1:55	2130 1225 165 197 2:03	0.43
14,000 FT −13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN						3540 1740 195 240 1:26	3295 1645 190 234 1:31	3060 1555 185 228 1:36	2835 1470 180 222 1:42	2615 1385 175 216 1:48	2395 1300 170 210 1:56	2195 1220 165 203 2:03	0.45
16,000 FT −17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN								3155 1570 185 235 1:36	2920 1475 180 229 1:42	2695 1390 175 222 1:48	2470 1300 170 216 1:56	2265 1215 165 210 2:03	0.47
18,000 FT −21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN									3015 1485 180 236 1:41	2780 1395 175 230 1:48	2545 1300 170 223 1:55	2335 1215 165 217 2:03	0.49
20,000 FT −25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN										2870 1400 175 237 1:47	2635 1305 170 231 1:55	2410 1215 165 224 2:03	0.51
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		7.1	6.8	6.5	6.2	5.9	5.6	5.4	5.1	4.9	4.6	4.4	4.1	

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MODEL P-3C — TWO-ENGINE LOITER OPERATING TABLE — CONFIGURATION "B"

Figure 33-12. Two-Engine Loiter Operating Table — Configuration B (Sheet 2 of 2)

FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION "C"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb														AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	2650	2555	2460	2370	2280	2195	2110	2025	1940	1860	1780	1710	1640	1570	0.45
	FF–LB/HR/ENG	1640	1605	1570	1535	1500	1470	1440	1410	1380	1355	1325	1300	1275	1250	
	IAS–KNOTS	275	272	270	267	265	262	260	257	255	252	250	247	245	242	
	TAS–KNOTS	275	272	270	267	265	262	260	257	255	252	250	247	245	242	
	SEG RANGE–NM	210	212	215	218	220	223	226	228	230	233	236	238	240	242	
2000 FT +11 °C	SHP	2685	2585	2490	2395	2305	2220	2125	2045	1960	1875	1800	1720	1655	1580	0.47
	FF–LB/HR/ENG	1595	1560	1525	1490	1460	1425	1395	1365	1340	1310	1280	1255	1230	1205	
	IAS–KNOTS	273	270	268	265	263	260	258	255	253	250	248	245	243	240	
	TAS–KNOTS	280	278	276	273	270	268	265	263	260	258	255	253	250	247	
	SEG RANGE–NM	219	223	226	229	232	235	238	240	243	246	248	252	254	256	
4000 FT +7 °C	SHP	2720	2620	2525	2430	2335	2245	2145	2070	1980	1895	1815	1735	1660	1595	0.48
	FF–LB/HR/ENG	1560	1525	1490	1455	1420	1385	1355	1325	1300	1270	1240	1215	1185	1160	
	IAS–KNOTS	271	268	266	263	261	258	256	253	251	248	246	243	241	238	
	TAS–KNOTS	286	283	281	279	276	274	271	268	265	263	260	258	255	253	
	SEG RANGE–NM	229	232	236	240	243	247	250	253	256	259	262	265	269	272	
6000 FT +3 °C	SHP	2760	2660	2565	2460	2360	2265	2170	2085	2000	1910	1825	1745	1670	1595	0.50
	FF–LB/HR/ENG	1530	1495	1460	1425	1390	1355	1320	1290	1260	1235	1205	1175	1150	1120	
	IAS–KNOTS	269	266	264	261	259	256	254	251	249	246	244	241	239	236	
	TAS–KNOTS	292	290	287	285	282	280	277	274	271	268	266	263	260	258	
	SEG RANGE–NM	238	242	246	250	254	258	261	264	268	272	276	280	284	287	
8000 FT −1 °C	SHP	2800	2695	2590	2490	2395	2300	2200	2105	2020	1930	1845	1760	1685	1610	0.51
	FF–LB/HR/ENG	1510	1470	1435	1395	1360	1325	1295	1260	1230	1200	1170	1140	1115	1085	
	IAS–KNOTS	267	264	262	259	257	254	252	249	247	244	242	239	237	234	
	TAS–KNOTS	299	296	293	291	288	285	282	280	277	274	271	269	266	263	
	SEG RANGE–NM	247	252	256	260	264	269	272	277	281	286	290	294	298	303	
10,000 FT −5 °C	SHP	2840	2735	2625	2530	2425	2320	2220	2130	2040	1950	1870	1785	1695	1620	0.53
	FF–LB/HR/ENG	1490	1450	1415	1375	1340	1300	1265	1235	1200	1170	1140	1110	1080	1050	
	IAS–KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	TAS–KNOTS	305	302	300	297	294	291	288	286	283	280	277	275	271	269	
	SEG RANGE–NM	256	260	265	270	275	280	285	289	294	300	304	310	314	319	
12,000 FT −9 °C	SHP	2890	2780	2660	2555	2455	2350	2250	2150	2060	1965	1880	1795	1710	1630	0.55
	FF–LB/HR/ENG	1475	1435	1395	1355	1320	1280	1245	1210	1175	1140	1110	1080	1050	1020	
	IAS–KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	233	230	
	TAS–KNOTS	313	310	306	304	301	298	295	292	289	286	283	280	277	274	
	SEG RANGE–NM	265	270	274	280	285	290	296	302	307	313	318	324	330	336	
14,000 FT −13 °C	SHP	2940	2825	2700	2595	2490	2385	2280	2180	2080	1990	1900	1815	1725	1640	0.57
	FF–LB/HR/ENG	1465	1425	1385	1340	1300	1260	1225	1185	1150	1115	1085	1050	1020	995	
	IAS–KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	231	228	
	TAS–KNOTS	323	317	313	310	307	304	301	298	295	292	289	286	283	280	
	SEG RANGE–NM	275	278	283	289	295	302	208	314	321	328	334	340	348	354	

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Figure 33-13. Four-Engine Maximum Range Operating Table — Configuration C (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP	2995	2875	2750	2635	2525	2420	2310	2205	2105	2010	1920	1825	1740	1660	0.59
	FF—LB/HR/ENG	1460	1415	1370	1325	1285	1245	1205	1165	1125	1095	1060	1025	995	965	
	IAS—KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	229	226	
	TAS—KNOTS	327	323	320	317	314	311	308	305	302	299	296	293	290	287	
	SEG RANGE—NM	280	285	292	299	306	312	320	327	335	341	350	357	365	370	
18,000 FT —21 °C	SHP	3050	2925	2795	2680	2560	2455	2340	2235	2135	2035	1940	1845	1755	1670	0.61
	FF—LB/HR/ENG	1455	1405	1360	1315	1270	1225	1185	1145	1105	1070	1035	1000	970	940	
	IAS—KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	227	224	
	TAS—KNOTS	333	330	328	324	321	318	315	312	309	305	303	299	296	293	
	SEG RANGE—NM	286	293	300	308	316	324	332	340	350	357	366	374	382	388	
20,000 FT —25 °C	SHP	3105	2975	2845	2720	2600	2485	2380	2265	2165	2060	1960	1865	1770	1690	0.63
	FF—LB/HR/ENG	1445	1400	1355	1305	1255	1215	1170	1130	1090	1050	1015	980	950	920	
	IAS—KNOTS	255	252	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS	342	338	335	332	329	326	322	319	316	313	310	306	303	300	
	SEG RANGE—NM	296	302	310	318	328	335	345	354	363	373	382	390	400	408	
22,000 FT —29 °C	SHP	3165	3030	2895	2765	2640	2525	2415	2300	2195	2085	1980	1890	1800	1705	0.65
	FF—LB/HR/ENG	1460	1410	1355	1305	1255	1205	1160	1115	1075	1035	995	965	930	900	
	IAS—KNOTS	253	250	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS	350	347	344	340	337	334	330	327	324	320	317	314	310	307	
	SEG RANGE—NM	300	308	317	326	335	346	355	367	377	387	397	406	416	426	
24,000 FT —33 °C	SHP			2950	2810	2685	2570	2455	2335	2225	2115	2010	1910	1815	1735	0.68
	FF—LB/HR/ENG			1365	1310	1260	1210	1160	1115	1070	1030	990	955	920	885	
	IAS—KNOTS			246	243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS			352	349	345	342	338	335	331	328	325	321	318	314	
	SEG RANGE—NM			322	332	342	352	364	376	388	400	410	422	432	444	
26,000 FT —37 °C	SHP				2865	2735	2615	2495	2375	2250	2145	2040	1935	1840	1750	0.70
	FF—LB/HR/ENG				1325	1270	1215	1165	1115	1070	1030	990	950	910	875	
	IAS—KNOTS				241	239	236	234	231	229	226	224	221	219	216	
	TAS—KNOTS				357	354	350	347	343	339	336	332	329	325	322	
	SEG RANGE—NM				337	349	360	372	385	397	408	420	433	447	460	
28,000 FT —41 °C	SHP						2660	2540	2415	2290	2175	2070	1965	1870	1780	0.72
	FF—LB/HR/ENG						1235	1180	1125	1075	1035	990	950	910	870	
	IAS—KNOTS						234	232	229	227	224	222	219	217	214	
	TAS—KNOTS						359	355	352	348	344	340	337	333	330	
	SEG RANGE—NM						363	375	390	404	416	429	443	458	474	
30,000 FT —44 °C	SHP								2450	2325	2215	2100	1995	1895	1805	0.75
	FF—LB/HR/ENG								1145	1095	1045	1000	950	910	870	
	IAS—KNOTS								227	225	222	220	217	215	212	
	TAS—KNOTS								360	356	353	349	345	342	338	
	SEG RANGE—NM								394	406	422	437	452	470	486	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.5	5.2	4.9	4.7	4.5	4.4	4.2	4.0	3.8	3.7	3.5	3.4	3.2	3.1	

MODEL P-3C — FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "C"

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Figure 33-13. Four-Engine Maximum Range Operating Table — Configuration C (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

THREE-ENGINE MAXIMUM RANGE OPERATING TABLE

CONFIGURATION "C"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb													AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP	3475	3340	3210	3090	2960	2845	2720	2610	2500	2390	2290	2195	2100	2005	0.42
	FF—LB/HR/ENG	1945	1900	1850	1805	1760	1720	1675	1635	1595	1555	1520	1485	1450	1415	
	IAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	TAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	235	232	
	SEG RANGE—NM	227	230	234	238	241	245	249	252	256	260	264	266	270	274	
2000 FT +11 °C	SHP	3520	3385	3250	3120	2995	2880	2760	2640	2530	2415	2310	2205	2110	2020	0.44
	FF—LB/HR/ENG	1920	1870	1820	1770	1725	1680	1635	1595	1550	1510	1475	1435	1400	1370	
	IAS—KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	233	230	
	TAS—KNOTS	270	268	265	263	260	258	255	253	250	247	245	242	240	237	
	SEG RANGE—NM	234	239	243	246	251	256	260	264	268	272	276	281	185	289	
4000 FT +7 °C	SHP	3570	3435	3300	3165	3040	2915	2790	2670	2550	2440	2330	2225	2125	2030	0.45
	FF—LB/HR/ENG	1895	1845	1790	1745	1690	1645	1600	1555	1515	1475	1435	1395	1360	1325	
	IAS—KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	231	228	
	TAS—KNOTS	276	273	271	268	265	263	260	258	255	253	250	247	245	242	
	SEG RANGE—NM	243	246	252	256	262	267	272	276	280	284	290	296	300	304	
6000 FT +3 °C	SHP	3625	3485	3345	3210	3085	2950	2820	2700	2580	2465	2355	2245	2145	2050	0.47
	FF—LB/HR/ENG	1875	1820	1770	1715	1665	1615	1570	1525	1485	1440	1400	1360	1320	1285	
	IAS—KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	229	226	
	TAS—KNOTS	282	279	277	274	271	268	266	263	260	258	255	252	250	247	
	SEG RANGE—NM	250	255	261	266	272	277	282	288	292	298	304	309	315	320	
8000 FT −1 °C	SHP	3685	3540	3400	3265	3125	2990	2860	2735	2610	2490	2380	2270	2160	2065	0.48
	FF—LB/HR/ENG	1860	1805	1750	1695	1640	1590	1545	1495	1455	1410	1370	1330	1290	1250	
	IAS—KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	227	224	
	TAS—KNOTS	288	285	282	280	277	274	271	269	266	263	260	257	255	252	
	SEG RANGE—NM	258	263	270	275	281	287	292	300	304	311	316	323	330	335	
10,000 FT −5 °C	SHP	3745	3600	3450	3310	3170	3030	2905	2770	2640	2525	2410	2295	2180	2080	0.50
	FF—LB/HR/ENG	1850	1790	1735	1675	1625	1570	1525	1475	1430	1385	1345	1305	1265	1225	
	IAS—KNOTS	255	252	250	247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS	294	291	288	286	283	280	277	275	271	269	266	263	260	257	
	SEG RANGE—NM	265	271	277	284	290	297	303	310	316	324	329	336	342	350	
12,000 FT −9 °C	SHP	3810	3665	3510	3365	3215	3075	2945	2810	2675	2550	2430	2315	2205	2100	0.52
	FF—LB/HR/ENG	1845	1785	1725	1665	1610	1560	1510	1460	1410	1365	1320	1275	1235	1200	
	IAS—KNOTS	253	250	248	245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS	301	298	295	292	289	286	283	280	277	274	271	268	266	262	
	SEG RANGE—NM	272	278	285	292	299	306	313	320	328	335	342	350	358	366	
14,000 FT −13 °C	SHP		3730	3575	3420	3270	3125	2985	2850	2715	2585	2460	2340	2225	2120	0.54
	FF—LB/HR/ENG		1780	1720	1660	1605	1550	1500	1445	1395	1345	1300	1255	1215	1175	
	IAS—KNOTS		248	246	243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS		304	301	298	295	292	289	286	283	280	277	274	271	268	
	SEG RANGE—NM		284	292	299	306	314	322	330	339	347	356	364	372	381	

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Figure 33-14. Three-Engine Maximum Range Operating Table — Configuration C (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb														AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT −17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM				3485 1665 241 305 305	3330 1610 239 302 313	3180 1550 236 299 322	3030 1495 234 296 330	2890 1440 231 293 340	2750 1385 229 290 349	2620 1330 226 287 359	2490 1280 224 284 368	2370 1235 221 280 378	2250 1190 219 278 388	2140 1150 216 274 398	0.55
18,000 FT −21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM					3390 1610 237 309 319	3235 1550 234 305 328	3080 1490 232 303 339	2935 1430 229 299 348	2795 1370 227 296 360	2655 1315 224 293 371	2525 1265 222 290 382	2400 1220 219 287 393	2275 1170 217 284 403	2165 1130 214 280 414	0.57
20,000 FT −25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM							3130 1485 230 310 348	2980 1425 227 306 359	2840 1365 225 303 370	2700 1305 222 300 383	2560 1255 220 297 394	2430 1205 217 293 406	2305 1155 215 290 419	2185 1105 212 287 432	0.59
22,000 FT −29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM								3035 1430 225 314 366	2885 1365 223 310 378	2740 1305 220 307 392	2600 1250 218 304 405	2465 1195 215 300 420	2335 1145 213 297 433	2215 1095 210 294 447	0.61
24,000 FT −33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM										2785 1315 218 314 398	2640 1255 216 311 413	2500 1195 213 307 429	2365 1135 211 304 446	2235 1085 208 300 462	0.63
26,000 FT −37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM											2685 1265 214 318 419	2540 1200 211 315 437	2400 1140 209 311 456	2265 1085 206 308 472	0.66
28,000 FT −41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM												2580 1210 209 322 444	2435 1150 207 318 463	2295 1095 204 315 480	0.68
30,000 FT −44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM														2330 1105 202 322 487	0.70
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		6.3	6.0	5.8	5.5	5.3	5.1	4.8	4.6	4.4	4.3	4.1	3.9	3.8	3.7	

MODEL P-3C — THREE-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "C"

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Figure 33-14. Three-Engine Maximum Range Operating Table — Configuration C (Sheet 2 of 2)

TWO-ENGINE MAXIMUM RANGE OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

CONFIGURATION "C"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL +15 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM			4475 2345 245 245 260	4290 2275 242 242 267	4100 2210 240 240 272	3925 2145 237 237 276	3755 2080 235 235 283	3590 2015 232 232 288	3435 1955 230 230 294	3280 1900 227 227 299	3125 1845 225 225 305	2990 1790 222 222 310	0.40
2000 FT +11 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM			4530 2320 243 250 270	4335 2245 240 247 275	4145 2170 238 245 282	3965 2105 235 242 288	3790 2040 233 240 294	3625 1975 230 237 300	3465 1915 228 234 306	3305 1860 225 232 312	3155 1800 223 230 318	3010 1750 220 227 325	0.41
4000 FT +7 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM			4590 2300 241 255 278	4390 2220 238 253 284	4190 2145 236 250 290	4005 2075 233 247 298	3830 2005 231 245 305	3660 1945 228 242 312	3495 1880 226 239 318	3335 1820 223 237 325	3180 1765 221 234 332	3030 1710 218 231 338	0.42
6000 FT +3 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM				4440 2205 236 258 292	4245 2120 234 255 300	4055 2050 231 252 308	3870 1980 229 250 314	3695 1915 226 247 322	3525 1850 224 244 330	3360 1790 221 241 337	3205 1730 219 239 346	3055 1670 216 236 353	0.44
8000 FT −1 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM					4300 2100 232 260 309	4105 2030 229 257 317	3915 1955 227 255 326	3735 1890 224 252 334	3555 1820 222 249 342	3390 1760 219 246 351	3230 1700 217 244 358	3075 1640 214 241 367	0.45
10,000 FT −5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM						4160 2015 227 263 326	3965 1940 225 260 335	3775 1870 222 257 344	3590 1795 220 254 354	3410 1735 217 251 362	3255 1670 215 249 372	3095 1610 212 246 380	0.47
12,000 FT −9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM							4010 1935 223 266 343	3815 1855 220 262 354	3630 1780 218 260 365	3455 1715 215 257 374	3285 1655 213 254 384	3120 1590 210 251 394	0.49
14,000 FT −13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM								3865 1855 218 268 362	3675 1770 216 265 375	3495 1705 213 262 384	3320 1640 211 259 396	3145 1575 208 256 407	0.51

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Figure 33-15. Two-Engine Maximum Range Operating Table — Configuration C (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM										3535 1700 211 268 394	3355 1630 209 265 407	3180 1560 206 262 419	0.53
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM											3390 1620 207 271 418	3210 1550 204 267 430	0.55
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM												3245 1545 202 274 443	0.57
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		8.2	8.0	7.7	7.4	7.1	6.8	6.6	6.3	6.0	5.7	5.4	5.1	

MODEL P-3C — TWO-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "C"

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Figure 33-15. Two-Engine Maximum Range Operating Table — Configuration C (Sheet 2 of 2)

FOUR-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION **"C"**

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP	1840	1730	1625	1525	1430	1335	1245	1160	1075	995	920	845	**0.33**
	FF—LB/HR/ENG	1360	1320	1280	1245	1215	1180	1145	1115	1085	1055	1030	1000	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	0:56	0:57	0:58	1:00	1:02	1:04	1:05	1:07	1:09	1:11	1:13	1:15	
2000 FT **+11 °C**	SHP	1890	1780	1670	1570	1470	1370	1285	1190	1110	1025	945	870	**0.35**
	FF—LB/HR/ENG	1325	1285	1250	1210	1170	1140	1105	1075	1045	1020	990	960	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	0:57	0:58	1:00	1:02	1:04	1:06	1:08	1:10	1:12	1:14	1:16	1:18	
4000 FT **+7 °C**	SHP	1950	1830	1720	1610	1505	1415	1315	1225	1140	1050	970	890	**0.36**
	FF—LB/HR/ENG	1295	1255	1220	1180	1140	1105	1070	1040	1010	980	950	925	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	0:58	1:00	1:02	1:04	1:06	1:08	1:10	1:12	1:14	1:16	1:19	1:21	
6000 FT **+3 °C**	SHP	2000	1885	1770	1660	1550	1455	1355	1260	1170	1085	1000	915	**0.38**
	FF—LB/HR/ENG	1270	1230	1190	1150	1110	1075	1040	1010	975	945	920	890	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	0:59	1:01	1:03	1:05	1:08	1:10	1:12	1:14	1:17	1:19	1:22	1:24	
8000 FT **−1 °C**	SHP	2060	1940	1820	1705	1595	1495	1390	1295	1200	1110	1025	945	**0.40**
	FF—LB/HR/ENG	1250	1210	1170	1125	1085	1050	1015	980	945	915	885	855	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	247	241	236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN	1:00	1:02	1:04	1:07	1:09	1:11	1:14	1:17	1:19	1:22	1:24	1:28	

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Figure 33-16. Four-Engine Loiter Operating Table — Configuration C (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT −5 °C	SHP	2120	1995	1870	1755	1645	1535	1430	1330	1240	1145	1055	970	0.41
	FF—LB/HR/ENG	1235	1190	1150	1105	1065	1030	990	955	920	890	860	825	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	254	249	243	237	232	226	220	214	208	203	197	191	
	TIME—HR:MIN	1:01	1:03	1:05	1:08	1:10	1:13	1:16	1:18	1:21	1:24	1:27	1:31	
12,000 FT −9 °C	SHP	2190	2060	1930	1810	1690	1585	1470	1370	1270	1175	1085	995	0.43
	FF—LB/HR/ENG	1225	1180	1135	1090	1050	1010	975	935	900	865	835	800	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	262	256	250	244	239	233	227	221	215	209	203	197	
	TIME—HR:MIN	1:01	1:04	1:06	1:09	1:11	1:14	1:17	1:20	1:23	1:27	1:30	1:34	
14,000 FT −13 °C	SHP	2255	2115	1990	1860	1740	1625	1515	1410	1310	1210	1115	1020	0.45
	FF—LB/HR/ENG	1220	1175	1130	1080	1040	995	955	915	880	845	810	775	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	270	264	258	252	246	240	234	228	222	216	210	203	
	TIME—HR:MIN	1:01	1:04	1:06	1:09	1:12	1:15	1:19	1:22	1:25	1:29	1:33	1:37	
16,000 FT −17 °C	SHP	2325	2185	2055	1925	1790	1680	1565	1450	1350	1250	1150	1055	0.47
	FF—LB/HR/ENG	1220	1170	1120	1075	1025	980	940	900	865	825	790	755	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	278	272	266	260	254	248	241	235	229	222	216	210	
	TIME—HR:MIN	1:01	1:04	1:07	1:10	1:13	1:16	1:20	1:23	1:27	1:31	1:35	1:40	
18,000 FT −21 °C	SHP	2400	2255	2115	1980	1850	1730	1615	1500	1390	1290	1185	1090	0.49
	FF—LB/HR/ENG	1220	1165	1115	1065	1020	970	930	885	850	810	770	735	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	287	281	275	268	262	255	249	243	236	230	223	217	
	TIME—HR:MIN	1:02	1:04	1:07	1:10	1:14	1:17	1:21	1:25	1:28	1:33	1:37	1:42	
20,000 FT −25 °C	SHP	2480	2330	2185	2045	1915	1785	1665	1550	1440	1330	1225	1125	0.51
	FF—LB/HR/ENG	1220	1165	1110	1060	1010	965	920	875	840	800	760	720	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	297	290	284	277	271	264	257	251	244	237	231	224	
	TIME—HR:MIN	1:02	1:04	1:07	1:11	1:14	1:18	1:22	1:26	1:29	1:34	1:39	1:44	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		3.8	3.5	3.3	3.1	2.8	2.7	2.5	2.3	2.1	1.9	1.8	1.6	

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MODEL P-3C — FOUR-ENGINE LOITER OPERATING TABLE — CONFIGURATION "C"

Figure 33-16. Four-Engine Loiter Operating Table — Configuration C (Sheet 2 of 2)

THREE-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION **"C"**

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP	2630	2485	2340	2200	2060	1930	1800	1675	1555	1435	1320	1210	**0.33**
	FF—LB/HR/ENG	1655	1600	1550	1495	1445	1400	1350	1305	1265	1220	1180	1140	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	1:00	1:02	1:05	1:07	1:09	1:12	1:14	1:17	1:19	1:22	1:25	1:28	
2000 FT **+11 °C**	SHP	2710	2550	2405	2255	2115	1985	1850	1715	1595	1480	1355	1245	**0.35**
	FF—LB/HR/ENG	1625	1570	1520	1465	1415	1365	1320	1275	1230	1185	1145	1105	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	1:02	1:04	1:06	1:08	1:11	1:13	1:16	1:19	1:21	1:24	1:27	1:30	
4000 FT **+7 °C**	SHP	2780	2625	2470	2320	2175	2035	1900	1765	1645	1520	1395	1280	**0.36**
	FF—LB/HR/ENG	1605	1550	1500	1445	1390	1340	1290	1245	1200	1155	1110	1070	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	1:02	1:04	1:07	1:09	1:12	1:14	1:17	1:20	1:23	1:26	1:30	1:33	
6000 FT **+3 °C**	SHP	2870	2700	2550	2390	2240	2100	1950	1820	1695	1560	1435	1315	**0.38**
	FF—LB/HR/ENG	1590	1535	1480	1425	1370	1315	1265	1215	1170	1125	1080	1035	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	240	234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN	1:03	1:05	1:07	1:10	1:13	1:16	1:19	1:22	1:25	1:29	1:32	1:36	
8000 FT **−1 °C**	SHP	2950	2785	2620	2465	2305	2155	2010	1870	1740	1605	1475	1355	**0.40**
	FF—LB/HR/ENG	1585	1525	1465	1410	1350	1300	1245	1195	1145	1100	1050	1010	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	247	241	236	230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN	1:03	1:06	1:08	1:11	1:14	1:17	1:20	1:24	1:27	1:31	1:35	1:39	

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Figure 33-17. Three-Engine Loiter Operating Table — Configuration C (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb											AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
10,000 FT —5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3035 1585 220 254 1:03	2865 1520 215 249 1:06	2705 1455 210 243 1:09	2540 1400 205 237 1:11	2380 1340 200 232 1:15	2225 1285 195 226 1:18	2075 1230 190 220 1:21	1930 1175 185 214 1:25	1785 1125 180 208 1:29	1650 1075 175 203 1:33	1520 1025 170 197 1:37	1390 980 165 191 1:42	0.41
12,000 FT —9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3130 1585 220 262 1:03	2945 1525 215 256 1:06	2780 1455 210 250 1:09	2610 1395 205 244 1:12	2450 1335 200 239 1:15	2285 1275 195 233 1:18	2135 1220 190 227 1:22	1980 1165 185 221 1:26	1840 1115 180 215 1:30	1700 1060 175 209 1:34	1560 1010 170 203 1:39	1435 960 165 197 1:44	0.43
14,000 FT —13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3230 1600 220 270 1:03	3045 1530 215 264 1:05	2865 1465 210 258 1:08	2690 1400 205 252 1:12	2520 1335 200 246 1:15	2360 1275 195 240 1:19	2200 1215 190 234 1:22	2045 1155 185 228 1:27	1895 1105 180 222 1:30	1750 1050 175 216 1:35	1610 995 170 210 1:41	1475 945 165 203 1:46	0.45
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3330 1615 220 278 1:02	3145 1545 215 272 1:05	2960 1475 210 266 1:08	2775 1405 205 260 1:11	2595 1340 200 254 1:15	2430 1275 195 248 1:19	2270 1210 190 241 1:23	2110 1150 185 235 1:27	1955 1095 180 229 1:31	1800 1040 175 222 1:36	1660 985 170 216 1:42	1520 930 165 210 1:48	0.47
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN		3245 1560 215 281 1:04	3055 1485 210 275 1:07	2865 1415 205 268 1:11	2685 1345 200 262 1:14	2505 1275 195 255 1:18	2340 1210 190 249 1:23	2175 1150 185 243 1:27	2010 1090 180 236 1:32	1860 1030 175 230 1:37	1710 975 170 223 1:43	1560 920 165 217 1:49	0.49
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN				2960 1425 205 277 1:10	2770 1350 200 271 1:14	2590 1280 195 264 1:18	2415 1210 190 257 1:23	2250 1145 185 251 1:27	2080 1085 180 244 1:32	1920 1025 175 237 1:38	1765 965 170 231 1:44	1610 910 165 224 1:50	0.51
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.7	5.3	4.9	4.6	4.2	4.0	3.7	3.4	3.2	2.9	2.7	2.5	

MODEL P-3C — THREE-ENGINE LOITER OPERATING TABLE — CONFIGURATION "C"

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Figure 33-17. Three-Engine Loiter Operating Table — Configuration C (Sheet 2 of 2)

TWO-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

CONFIGURATION "C"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	82.5 77.5	77.5 72.5	
SEA LEVEL **+15 °C**	SHP	4165	3925	3685	3465	3240	3025	2815	2630	2425	2245	2055	1885	**0.33**
	FF—LB/HR/ENG	2250	2155	2065	1980	1895	1820	1740	1665	1590	1520	1455	1390	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TIME—HR:MIN	1:07	1:10	1:13	1:16	1:19	1:22	1:26	1:30	1:34	1:39	1:43	1:48	
2000 FT **+11 °C**	SHP	4285	4035	3790	3560	3330	3115	2900	2700	2490	2305	2120	1940	**0.35**
	FF—LB/HR/ENG	2240	2145	2055	1965	1875	1795	1720	1640	1565	1495	1425	1360	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	226	221	216	211	206	201	195	190	185	180	175	170	
	TIME—HR:MIN	1:07	1:10	1:13	1:16	1:20	1:23	1:27	1:31	1:36	1:40	1:45	1:50	
4000 FT **+7 °C**	SHP	4415	4155	3905	3665	3425	3200	2980	2775	2565	2370	2180	1995	**0.36**
	FF—LB/HR/ENG	2235	2140	2045	1955	1865	1780	1705	1620	1545	1470	1400	1335	
	IAS—KNOTS	220	215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS	233	228	222	217	212	206	201	196	190	185	180	175	
	TIME—HR:MIN	1:07	1:10	1:13	1:17	1:21	1:24	1:28	1:33	1:37	1:42	1:47	1:52	
6000 FT **+3 °C**	SHP		4280	4020	3775	3530	3300	3075	2855	2640	2435	2235	2045	**0.38**
	FF—LB/HR/ENG		2145	2045	1950	1860	1775	1690	1605	1530	1455	1380	1310	
	IAS—KNOTS		215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS		234	229	223	218	213	207	202	196	191	185	180	
	TIME—HR:MIN		1:10	1:13	1:17	1:21	1:25	1:29	1:33	1:38	1:43	1:49	1:55	
8000 FT **−1 °C**	SHP				3890	3635	3400	3165	2940	2720	2505	2300	2105	**0.40**
	FF—LB/HR/ENG				1955	1860	1770	1685	1600	1520	1440	1365	1290	
	IAS—KNOTS				205	200	195	190	185	180	175	170	165	
	TAS—KNOTS				230	225	219	214	208	202	197	191	186	
	TIME—HR:MIN				1:17	1:21	1:25	1:29	1:34	1:39	1:44	1:50	1:56	

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Figure 33-18. Two-Engine Loiter Operating Table — Configuration C (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb 132.5 127.5	 127.5 122.5	 122.5 117.5	 117.5 112.5	 112.5 107.5	 107.5 102.5	 102.5 97.5	 97.5 92.5	 92.5 87.5	 87.5 82.5	 82.5 77.5	 77.5 72.5	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
10,000 FT —5 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN					3745 1865 200 232 1:20	3505 1775 195 226 1:24	3260 1685 190 220 1:29	3030 1595 185 214 1:34	2805 1515 180 208 1:39	2585 1430 175 203 1:45	2370 1350 170 197 1:51	2170 1275 165 191 1:57	0.41
12,000 FT —9 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN						3610 1785 195 233 1:24	3360 1690 190 227 1:29	3120 1600 185 221 1:34	2890 1510 180 215 1:39	2665 1425 175 209 1:45	2445 1345 170 203 1:51	2240 1265 165 197 1:58	0.43
14,000 FT —13 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN							3465 1700 190 234 1:28	3220 1610 185 228 1:33	2980 1515 180 222 1:39	2750 1430 175 216 1:45	2515 1345 170 210 1:51	2305 1265 165 203 1:59	0.45
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN								3380 1620 185 235 1:33	3075 1525 180 229 1:38	2835 1435 175 222 1:45	2600 1350 170 216 1:51	2380 1260 165 210 1:59	0.47
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN										2930 1445 175 230 1:44	2685 1355 170 223 1:51	2455 1260 165 217 1:59	0.49
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN											2770 1365 170 231 1:50	2530 1265 165 224 1:58	0.51
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		7.5	7.2	6.8	6.6	6.3	6.0	5.7	5.4	5.2	4.9	4.6	4.4	

MODEL P-3C — TWO-ENGINE LOITER OPERATING TABLE — CONFIGURATION "C"

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Figure 33-18. Two-Engine Loiter Operating Table — Configuration C (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 15 FEBRUARY 1971
DATA BASIS: **FLIGHT TESTS**

FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

CONFIGURATION "D"

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM STD 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
SEA LEVEL **+15°C**	SHP	2550	2450	2345	2260	2170	2080	1995	1915	1835	1755	1675	1600	**0.41**
	FF—LB/HR/ENG	1610	1575	1540	1505	1470	1440	1410	1380	1350	1325	1295	1260	
	IAS—KNOTS	250	248	245	243	240	238	235	233	230	228	225	223	
	TAS—KNOTS	250	248	245	243	240	238	235	233	230	228	225	223	
	SEG RANGE—NM	195	197	199	202	204	206	208	210	213	215	218	220	
2000 FT **+11°C**	SHP	2550	2450	2345	2255	2160	2070	1980	1900	1815	1735	1655	1580	**0.42**
	FF—LB/HR/ENG	1560	1525	1490	1455	1420	1390	1360	1325	1295	1265	1235	1205	
	IAS—KNOTS	246	244	241	239	236	234	231	229	226	224	221	219	
	TAS—KNOTS	253	251	248	246	243	240	238	235	233	230	227	225	
	SEG RANGE—NM	203	206	209	211	214	216	219	222	225	227	231	233	
4000 FT **+7°C**	SHP	2555	2450	2345	2250	2150	2060	1970	1885	1800	1720	1640	1560	**0.43**
	FF—LB/HR/ENG	1515	1480	1445	1405	1375	1340	1310	1275	1245	1215	1185	1150	
	IAS—KNOTS	242	240	237	235	232	230	227	225	222	220	217	215	
	TAS—KNOTS	256	254	251	248	246	243	241	238	235	233	230	227	
	SEG RANGE—NM	212	215	218	221	224	227	230	233	237	240	244	245	
6000 FT **+3°C**	SHP	2555	2450	2345	2245	2145	2050	1960	1875	1785	1705	1620	1545	**0.44**
	FF—LB/HR/ENG	1475	1435	1400	1365	1325	1295	1260	1230	1195	1160	1130	1100	
	IAS—KNOTS	238	236	233	231	228	226	223	221	218	216	213	211	
	TAS—KNOTS	260	257	254	251	249	246	243	241	238	235	232	230	
	SEG RANGE—NM	221	224	227	232	235	238	242	245	249	252	257	260	
8000 FT **−1°C**	SHP	2560	2450	2345	2245	2140	2045	1950	1860	1770	1690	1605	1530	**0.46**
	FF—LB/HR/ENG	1435	1395	1360	1320	1285	1250	1220	1185	1150	1115	1085	1050	
	IAS—KNOTS	234	232	229	227	224	222	219	217	214	212	209	207	
	TAS—KNOTS	263	260	257	255	252	249	246	243	241	238	235	232	
	SEG RANGE—NM	230	233	237	241	245	249	253	257	261	265	270	274	
10,000 FT **−5°C**	SHP	2565	2455	2350	2245	2140	2040	1945	1850	1760	1680	1595	1515	**0.47**
	FF—LB/HR/ENG	1400	1360	1320	1285	1245	1210	1180	1140	1105	1075	1040	1005	
	IAS—KNOTS	230	228	225	223	220	218	215	213	210	208	205	203	
	TAS—KNOTS	266	263	260	258	255	252	249	246	243	240	238	235	
	SEG RANGE—NM	238	242	246	251	256	260	265	270	275	279	284	289	
12,000 FT **−9°C**	SHP	2580	2465	2355	2245	2140	2035	1940	1845	1750	1670	1580	1500	**0.48**
	FF—LB/HR/ENG	1370	1325	1285	1250	1215	1180	1145	1105	1070	1035	1000	970	
	IAS—KNOTS	226	224	221	219	216	214	211	209	206	204	201	199	
	TAS—KNOTS	269	266	263	260	258	255	252	249	246	243	240	237	
	SEG RANGE—NM	245	250	255	261	265	270	275	281	286	291	297	303	
14,000 FT **−13°C**	SHP	2595	2475	2360	2255	2145	2040	1940	1840	1745	1660	1575	1490	**0.49**
	FF—LB/HR/ENG	1345	1300	1255	1220	1185	1145	1110	1075	1035	1000	965	930	
	IAS—KNOTS	222	220	217	215	212	210	207	205	202	200	197	195	
	TAS—KNOTS	272	269	266	263	260	257	254	251	249	246	243	240	
	SEG RANGE—NM	253	258	264	270	275	281	286	293	299	304	311	317	

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Figure 33-19. Four-Engine Maximum Range Operating Table — Configuration D (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
16,000 FT **−17°C**	SHP	2615	2495	2375	2260	2150	2040	1940	1840	1740	1655	1565	1480	**0.50**
	FF−LB/HR/ENG	1320	1275	1230	1195	1155	1120	1080	1045	1005	970	935	900	
	IAS−KNOTS	218	216	213	211	208	206	203	201	198	196	193	191	
	TAS−KNOTS	276	273	270	267	264	261	258	254	252	248	245	242	
	SEG RANGE−NM	260	266	272	279	285	292	298	306	312	318	326	333	
18,000 FT **−21°C**	SHP	2640	2515	2390	2275	2160	2050	1945	1845	1740	1655	1565	1480	**0.51**
	FF−LB/HR/ENG	1305	1255	1215	1175	1135	1095	1055	1020	980	945	905	870	
	IAS−KNOTS	214	212	209	207	204	202	199	197	194	192	189	187	
	TAS−KNOTS	280	277	274	270	267	264	261	258	254	251	248	245	
	SEG RANGE−NM	266	273	280	288	295	303	310	318	324	332	340	348	
20,000 FT **−25°C**	SHP	2670	2540	2415	2295	2175	2060	1955	1855	1750	1655	1565	1480	**0.52**
	FF−LB/HR/ENG	1300	1250	1200	1155	1115	1075	1035	990	955	920	880	845	
	IAS−KNOTS	210	208	205	203	200	193	195	193	190	188	185	183	
	TAS−KNOTS	284	280	277	274	271	267	264	261	257	254	251	247	
	SEG RANGE−NM	272	280	288	296	304	312	321	329	337	346	355	364	
22,000 FT **−29°C**	SHP	2710	2575	2440	2315	2200	2080	1970	1865	1760	1665	1570	1480	**0.53**
	FF−LB/HR/ENG	1295	1245	1190	1145	1100	1060	1015	975	935	900	855	820	
	IAS−KNOTS	206	204	201	199	196	194	191	189	186	184	181	179	
	TAS−KNOTS	288	284	281	277	274	270	267	264	260	257	253	250	
	SEG RANGE−NM	277	285	294	303	312	321	331	341	350	360	370	381	
24,000 FT **−33°C**	SHP	2750	2615	2475	2350	2225	2105	1990	1885	1770	1675	1580	1485	**0.55**
	FF−LB/HR/ENG	1300	1245	1190	1140	1090	1050	1000	960	915	875	835	800	
	IAS−KNOTS	202	200	197	195	192	190	187	185	182	180	177	175	
	TAS−KNOTS	291	288	284	281	277	274	270	267	263	260	256	253	
	SEG RANGE−NM	280	290	299	309	318	329	340	350	361	372	384	397	
26,000 FT **−37°C**	SHP	2795	2655	2515	2380	2255	2135	2015	1905	1790	1690	1590	1490	**0.56**
	FF−LB/HR/ENG	1310	1250	1190	1140	1090	1045	995	950	905	860	815	780	
	IAS−KNOTS	198	196	193	191	188	186	183	181	178	176	173	171	
	TAS−KNOTS	295	292	288	284	281	277	274	270	266	263	259	255	
	SEG RANGE−NM	282	292	302	313	323	334	346	358	369	382	395	410	
28,000 FT **−41°C**	SHP			2560	2420	2290	2165	2045	1930	1810	1710	1605	1500	**0.57**
	FF−LB/HR/ENG			1200	1150	1095	1045	995	945	900	850	805	765	
	IAS−KNOTS			189	187	184	182	179	177	174	172	169	167	
	TAS−KNOTS			292	288	284	281	277	273	269	266	262	258	
	SEG RANGE−NM			303	315	325	337	350	361	375	388	403	419	
30,000 FT **−44°C**	SHP					2330	2200	2075	1955	1835	1725	1620	1515	**0.58**
	FF−LB/HR/ENG					1110	1055	1000	950	900	850	795	750	
	IAS−KNOTS					180	178	175	173	170	168	165	163	
	TAS−KNOTS					288	284	280	276	272	268	265	261	
	SEG RANGE−NM					326	338	351	364	378	392	407	425	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		**4.7**	**4.5**	**4.4**	**4.2**	**4.0**	**3.8**	**3.6**	**3.4**	**3.3**	**3.1**	**2.9**	**2.7**	

MODEL P-3C — FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "D"

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Figure 33-19. Four-Engine Maximum Range Operating Table — Configuration D (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 15 FEBRUARY 1971
DATA BASIS: **FLIGHT TESTS**

THREE-ENGINE MAXIMUM RANGE OPERATING TABLE

CONFIGURATION "D"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
SEA LEVEL **+15 °C**	SHP	3980	3840	3700	3565	3435	3300	3170	3055	2935	2820	2710	2605	**0.42**
	FF—LB/HR/ENG	2150	2095	2045	1995	1945	1900	1850	1805	1760	1715	1675	1640	
	IAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	
	TAS—KNOTS	265	262	260	257	255	252	250	247	245	242	240	237	
	SEG RANGE—NM	205	208	212	215	218	221	225	229	232	235	239	242	
2000 FT **+11 °C**	SHP	4030	3880	3735	3600	3470	3335	3200	3080	2960	2840	2730	2620	**0.44**
	FF—LB/HR/ENG	2120	2065	2005	1955	1905	1850	1805	1755	1710	1670	1625	1585	
	IAS—KNOTS	263	260	258	255	253	250	248	245	243	240	238	235	
	TAS—KNOTS	270	268	265	263	260	258	255	253	250	247	245	242	
	SEG RANGE—NM	212	216	220	224	228	232	236	240	244	247	251	254	
4000 FT **+7 °C**	SHP	4080	3925	3775	3640	3505	3370	3235	3105	2980	2865	2750	2635	**0.45**
	FF—LB/HR/ENG	2095	2035	1975	1925	1865	1815	1765	1720	1675	1630	1585	1545	
	IAS—KNOTS	261	258	256	253	251	248	246	243	241	238	236	233	
	TAS—KNOTS	276	274	271	268	265	263	260	258	255	253	250	247	
	SEG RANGE—NM	220	224	229	233	237	241	245	250	254	258	262	267	
6000 FT **+3 °C**	SHP	4135	3975	3825	3680	3545	3405	3265	3130	3005	2885	2770	2655	**0.47**
	FF—LB/HR/ENG	2060	2010	1950	1895	1840	1785	1735	1685	1640	1595	1550	1510	
	IAS—KNOTS	259	256	254	251	249	246	244	241	239	236	234	231	
	TAS—KNOTS	282	280	277	274	271	268	266	263	260	258	255	252	
	SEG RANGE—NM	227	231	236	241	245	250	255	260	265	269	274	279	
8000 FT **−1 °C**	SHP	4190	4025	3875	3730	3585	3440	3300	3160	3035	2910	2790	2670	**0.48**
	FF—LB/HR/ENG	2055	1990	1930	1875	1815	1760	1710	1660	1610	1565	1520	1475	
	IAS—KNOTS	257	254	252	249	247	244	242	239	237	234	232	229	
	TAS—KNOTS	288	285	282	280	277	274	271	269	266	263	260	257	
	SEG RANGE—NM	234	238	243	249	254	259	264	270	275	280	285	291	
10,000 FT **−5 °C**	SHP		4080	3925	3775	3630	3480	3335	3195	3055	2935	2810	2690	**0.50**
	FF—LB/HR/ENG		1980	1920	1860	1800	1745	1690	1640	1585	1540	1495	1450	
	IAS—KNOTS		252	250	247	245	242	240	237	235	232	230	227	
	TAS—KNOTS		291	288	286	283	280	277	275	271	269	266	263	
	SEG RANGE—NM		246	251	256	262	267	273	279	285	291	297	303	
12,000 FT **−9 °C**	SHP				3825	3675	3520	3375	3230	3095	2960	2830	2710	**0.52**
	FF—LB/HR/ENG				1850	1790	1730	1675	1620	1570	1520	1475	1425	
	IAS—KNOTS				245	243	240	238	235	233	230	228	225	
	TAS—KNOTS				292	289	286	283	280	277	274	271	268	
	SEG RANGE—NM				263	269	275	282	288	295	301	307	314	
14,000 FT **−13 °C**	SHP					3720	3565	3415	3270	3125	2990	2855	2730	**0.54**
	FF—LB/HR/ENG					1780	1720	1665	1610	1555	1505	1450	1405	
	IAS—KNOTS					241	238	236	233	231	228	226	223	
	TAS—KNOTS					295	292	289	286	283	280	277	274	
	SEG RANGE—NM					276	282	289	296	303	310	318	325	

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Figure 33-20. Three-Engine Maximum Range Operating Table — Configuration D (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM							3455 1660 234 296 297	3310 1600 231 293 305	3165 1545 229 290 313	3020 1490 226 287 321	2885 1440 224 284 329	2750 1390 221 280 337	0.55
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM								3350 1595 229 299 313	3205 1535 227 296 321	3055 1480 224 293 330	2910 1425 222 290 339	2775 1370 219 287 348	0.57
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM										3090 1475 222 300 339	2945 1415 220 297 350	2800 1360 217 293 360	0.59
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM											2980 1410 218 304 358	2830 1355 215 300 369	0.61
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM												2870 1355 213 307 378	0.63
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS SEG RANGE—NM													
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		8.0	7.7	7.3	7.0	6.8	6.5	6.2	5.9	5.7	5.4	5.2	4.9	

MODEL P-3C — THREE-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "D"

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Figure 33-20. Three-Engine Maximum Range Operating Table — Configuration D (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

FOUR-ENGINE LOITER OPERATING TABLE

CONFIGURATION "D"

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
SEA LEVEL **+15 °C**	SHP	2235	2110	1985	1865	1745	1640	1530	1430	1330	1235	1145	1065	**0.35**
	FF—LB/HR/ENG	1500	1455	1410	1370	1330	1285	1245	1210	1175	1140	1110	1080	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TIME—HR:MIN	0:50	0:52	0:53	0:55	0:56	0:58	1:00	1:02	1:03	1:06	1:08	1:09	
2000 FT **+11 °C**	SHP	2295	2170	2040	1915	1795	1685	1570	1465	1365	1265	1180	1090	**0.36**
	FF—LB/HR/ENG	1470	1425	1380	1335	1295	1250	1215	1175	1140	1105	1075	1040	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	237	232	226	221	216	211	206	201	195	190	185	180	
	TIME—HR:MIN	0:51	0:53	0:54	0:56	0:58	1:00	1:02	1:04	1:06	1:08	1:10	1:12	
4000 FT **+7 °C**	SHP	2365	2230	2095	1970	1845	1730	1615	1505	1400	1305	1210	1120	**0.38**
	FF—LB/HR/ENG	1445	1400	1355	1310	1265	1220	1180	1145	1105	1075	1040	1010	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	244	239	233	228	222	217	212	206	201	196	190	185	
	TIME—HR:MIN	0:51	0:54	0:55	0:57	0:59	1:01	1:03	1:06	1:08	1:10	1:12	1:14	
6000 FT **+3 °C**	SHP	2435	2295	2160	2025	1900	1780	1665	1550	1440	1340	1245	1155	**0.40**
	FF—LB/HR/ENG	1430	1380	1330	1285	1240	1195	1155	1115	1075	1040	1005	975	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	251	246	240	234	229	223	218	213	207	202	196	191	
	TIME—HR:MIN	0:53	0:54	0:56	0:58	1:01	1:03	1:05	1:07	1:10	1:12	1:14	1:17	
8000 FT **−1 °C**	SHP	2505	2365	2225	2085	1955	1835	1715	1595	1485	1380	1285	1190	**0.41**
	FF—LB/HR/ENG	1415	1365	1315	1265	1220	1170	1130	1090	1050	1010	975	945	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	258	253	247	241	236	230	225	219	214	208	202	197	
	TIME—HR:MIN	0:53	0:55	0:57	0:59	1:02	1:04	1:06	1:09	1:11	1:14	1:17	1:19	
10,000 FT **−5 °C**	SHP	2580	2440	2290	2150	2015	1890	1765	1645	1530	1420	1320	1220	**0.44**
	FF—LB/HR/ENG	1405	1350	1300	1250	1200	1150	1110	1065	1025	985	950	915	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	266	260	254	249	243	237	232	226	220	214	208	203	
	TIME—HR:MIN	0:53	0:56	0:58	1:00	1:02	1:05	1:08	1:10	1:13	1:16	1:19	1:22	
12,000 FT **−9 °C**	SHP	2660	2510	2360	2215	2075	1945	1820	1695	1575	1465	1360	1260	**0.46**
	FF—LB/HR/ENG	1405	1345	1290	1240	1190	1140	1090	1050	1005	965	930	890	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	273	267	262	256	250	244	239	233	227	221	215	209	
	TIME—HR:MIN	0:53	0:56	0:58	1:01	1:03	1:06	1:08	1:11	1:14	1:18	1:21	1:24	
14,000 FT **−13 °C**	SHP	2745	2595	2435	2285	2140	2005	1875	1745	1620	1505	1400	1295	**0.48**
	FF—LB/HR/ENG	1405	1345	1290	1235	1180	1130	1080	1035	995	950	910	875	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	282	276	270	264	258	252	246	240	234	228	222	216	
	TIME—HR:MIN	0:53	0:56	0:58	1:01	1:03	1:06	1:09	1:12	1:15	1:19	1:22	1:26	

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Figure 33-21. Four-Engine Loiter Operating Table — Configuration D (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2830 1415 230 290 0:53	2675 1350 225 284 0:56	2510 1290 220 278 0:58	2355 1230 215 272 1:01	2210 1175 210 266 1:04	2070 1125 205 260 1:06	1930 1070 200 254 1:10	1795 1030 195 248 1:13	1670 985 190 241 1:16	1550 940 185 235 1:20	1440 895 180 229 1:23	1335 860 175 222 1:27	0.51
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2925 1420 230 299 0:53	2760 1355 225 293 0:55	2595 1295 220 287 0:58	2435 1230 215 281 1:01	2280 1170 210 275 1:04	2135 1115 205 268 1:07	1995 1065 200 262 1:10	1855 1020 195 255 1:13	1725 975 190 249 1:17	1600 930 185 243 1:20	1485 885 180 236 1:24	1375 845 175 230 1:28	0.53
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	3020 1435 230 310 0:52	2855 1365 225 303 0:55	2680 1295 220 297 0:58	2515 1230 215 290 1:01	2350 1170 210 284 1:04	2205 1115 205 277 1:07	2060 1065 200 271 1:10	1915 1015 195 264 1:14	1780 965 190 257 1:17	1650 920 185 251 1:21	1535 875 180 244 1:25	1420 835 175 237 1:30	0.55
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN		2950 1380 225 313 0:54	2770 1310 220 306 0:57	2595 1240 215 299 1:00	2430 1175 210 293 1:04	2280 1120 205 286 1:07	2125 1065 200 279 1:10	1980 1015 195 273 1:14	1840 965 190 266 1:18	1710 915 185 259 1:22	1585 870 180 253 1:26	1465 820 175 246 1:31	0.57
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN			2860 1340 220 316 0:56	2680 1265 215 310 0:59	2510 1195 210 303 1:03	2355 1130 205 296 1:06	2200 1070 200 289 1:10	2045 1015 195 282 1:14	1900 960 190 275 1:18	1765 910 185 268 1:23	1635 860 180 262 1:27	1515 810 175 255 1:32	0.60
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN					2600 1230 210 313 1:01	2435 1155 205 306 1:05	2270 1085 200 299 1:09	2115 1020 195 293 1:13	1965 965 190 286 1:18	1825 905 185 279 1:23	1690 855 180 273 1:28	1565 800 175 266 1:33	0.62
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN													
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN													
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.0	4.7	4.4	4.1	3.8	3.6	3.3	3.1	2.8	2.6	2.5	2.3	

MODEL P-3C — FOUR-ENGINE LOITER OPERATING TABLE — CONFIGURATION "D"

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Figure 33-21. Four-Engine Loiter Operating Table — Configuration D (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

THREE-ENGINE LOITER OPERATING TABLE

CONFIGURATION **"D"**

ENGINES: (4) ALLISON T56–A–14
PROPS: HAM STD 54H60–77/A7121B–2
FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
SEA LEVEL **+15 °C**	SHP	3205	3030	2860	2690	2530	2375	2225	2080	1940	1800	1670	1545	**0.35**
	FF—LB/HR/ENG	1875	1800	1740	1680	1625	1565	1510	1455	1405	1355	1310	1260	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TIME—HR:MIN	0:53	0:56	0:58	1:00	1:02	1:04	1:06	1:09	1:11	1:14	1:16	1:19	
2000 FT **+11 °C**	SHP	3290	3115	2935	2765	2600	2440	2285	2135	1990	1850	1715	1590	**0.36**
	FF—LB/HR/ENG	1850	1780	1720	1655	1595	1535	1480	1425	1370	1325	1275	1230	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	237	232	226	221	216	211	206	201	195	190	185	180	
	TIME—HR:MIN	0:54	0:56	0:58	1:00	1:03	1:05	1:08	1:10	1:13	1;16	1:18	1:21	
4000 FT **+7 °C**	SHP	3390	3205	3025	2845	2675	2510	2350	2195	2050	1905	1765	1635	**0.38**
	FF—LB/HR/ENG	1835	1770	1705	1635	1575	1515	1455	1400	1345	1295	1245	1195	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	244	239	233	228	222	217	212	206	201	196	190	185	
	TIME—HR:MIN	0:54	0:57	0:59	1:01	1:04	1:06	1:09	1:12	1:14	1:17	1:20	1:24	
6000 FT **+3 °C**	SHP	3490	3300	3115	2935	2755	2585	2420	2260	2105	1960	1815	1680	**0.40**
	FF—LB/HR/ENG	1830	1760	1695	1625	1560	1500	1440	1380	1325	1270	1220	1170	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	251	246	240	234	229	223	218	213	207	202	196	191	
	TIME—HR:MIN	0:55	0:57	0:59	1:02	1:04	1:07	1:09	1:13	1:16	1:19	1:22	1:26	
8000 FT **−1 °C**	SHP	3595	3400	3210	3020	2840	2660	2490	2325	2170	2015	1870	1725	**0.41**
	FF—LB/HR/ENG	1835	1760	1690	1615	1550	1485	1425	1365	1310	1250	1200	1145	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	258	253	247	241	236	230	225	219	214	208	202	197	
	TIME—HR:MIN	0:55	0:57	0:59	1:02	1:05	1:07	1:10	1:13	1:16	1:20	1:23	1:27	
10,000 FT **−5 °C**	SHP	3705	3505	3305	3110	2925	2740	2565	2395	2230	2075	1925	1775	**0.44**
	FF—LB/HR/ENG	1840	1765	1690	1615	1545	1480	1420	1355	1295	1235	1180	1120	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	266	260	254	249	243	237	232	226	220	214	208	203	
	TIME—HR:MIN	0:54	0:57	0:59	1:02	1:05	1:08	1:11	1:14	1:17	1:21	1:25	1:29	
12,000 FT **−9 °C**	SHP	3820	3605	3405	3205	3015	2825	2645	2470	2300	2135	1980	1830	**0.46**
	FF—LB/HR/ENG	1850	1770	1695	1620	1550	1480	1415	1350	1285	1225	1165	1105	
	IAS—KNOTS	230	225	220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS	273	267	262	256	250	244	239	233	227	221	215	209	
	TIME—HR:MIN	0:54	0:56	0:59	1:02	1:05	1:08	1:11	1:14	1:18	1:22	1:26	1:30	
14,000 FT **−13 °C**	SHP			3515	3305	3105	2910	2725	2545	2370	2200	2040	1885	**0.48**
	FF—LB/HR/ENG			1705	1635	1560	1485	1415	1350	1280	1215	1155	1095	
	IAS—KNOTS			220	215	210	205	200	195	190	185	180	175	
	TAS—KNOTS			270	264	258	252	246	240	234	228	222	216	
	TIME—HR:MIN			0:59	1:01	1:04	1:07	1:11	1:14	1:18	1:22	1:26	1:31	

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Figure 33-22. Three-Engine Loiter Operating Table — Configuration D (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb												AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
16,000 FT —17 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN				3415 1645 215 272 1:01	3205 1570 210 266 1:04	3005 1495 205 260 1:07	2810 1420 200 254 1:10	2625 1350 195 248 1:14	2445 1280 190 241 1:18	2270 1215 185 235 1:22	2105 1150 180 229 1:27	1945 1085 175 222 1:32	0.51
18,000 FT —21 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN					3305 1580 210 275 1:03	3105 1510 205 268 1:06	2905 1430 200 262 1:10	2710 1355 195 255 1:14	2525 1280 190 249 1:18	2345 1210 185 243 1:23	2170 1145 180 236 1:27	2005 1080 175 230 1:33	0.53
20,000 FT —25 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN							2995 1445 200 271 1:09	2800 1360 195 264 1:13	2605 1285 190 257 1:18	2420 1210 185 251 1:23	2240 1140 180 244 1:28	2070 1080 175 237 1:33	0.55
22,000 FT —29 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN								2885 1375 195 273 1:13	2685 1295 190 266 1:17	2500 1220 185 259 1:22	2315 1145 180 253 1:27	2135 1080 175 246 1:33	0.57
24,000 FT —33 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN									2770 1310 190 275 1:16	2585 1235 185 268 1:21	2390 1160 180 262 1:26	2210 1085 175 255 1:32	0.60
26,000 FT —37 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN											2470 1180 180 271 1:25	2280 1100 175 264 1:31	0.62
28,000 FT —41 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN													
30,000 FT —44 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN													
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		7.2	6.8	6.4	6.0	5.6	5.2	4.9	4.6	4.2	3.9	3.6	3.3	

MODEL P-3C — THREE-ENGINE LOITER OPERATING TABLE — CONFIGURATION "D"

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Figure 33-22. Three-Engine Loiter Operating Table — Configuration D (Sheet 2 of 2)

FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

CONFIGURATION "E"

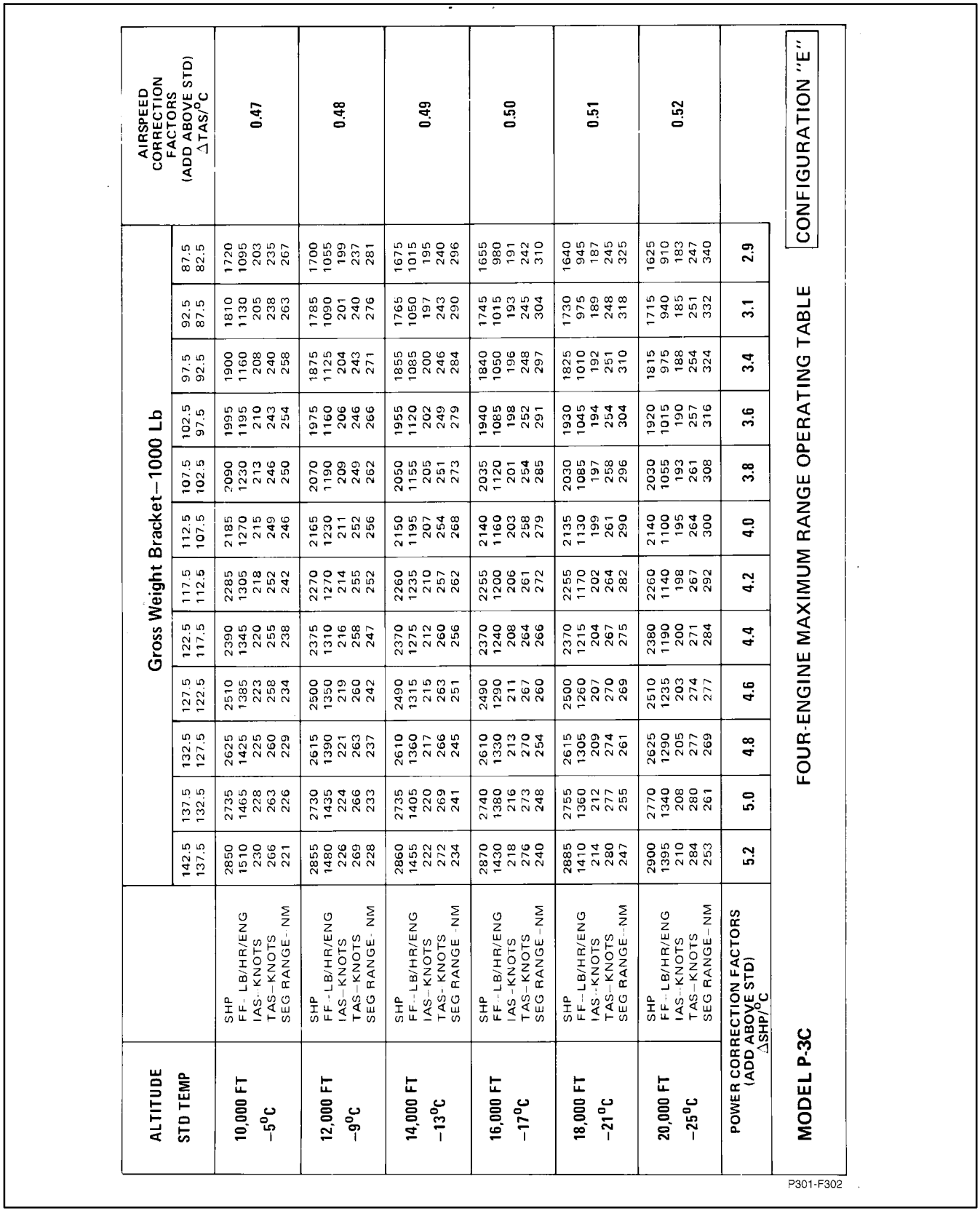
MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM STD 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb											AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
SEA LEVEL	SHP	2900	2795	2690	2590	2490	2390	2295	2205	2115	2025	1945	1855	**0.41**
	FF—LB/HR/ENG	1740	1700	1660	1625	1590	1555	1525	1490	1460	1425	1395	1365	
+15°C	IAS—KNOTS	250	248	245	243	240	238	235	233	230	228	225	223	
	TAS—KNOTS	250	248	245	243	240	238	235	233	230	228	225	223	
	SEG RANGE—NM	180	182	184	186	188	190	193	195	198	200	202	204	
2000 FT	SHP	2885	2780	2675	2570	2470	2370	2270	2180	2090	1995	1910	1830	**0.42**
	FF—LB/HR/ENG	1685	1645	1605	1570	1530	1490	1460	1425	1395	1360	1330	1305	
+11°C	IAS—KNOTS	246	244	241	239	236	234	231	229	226	224	221	219	
	TAS—KNOTS	253	251	248	246	243	240	238	235	233	230	227	225	
	SEG RANGE—NM	188	190	192	196	198	200	204	206	209	210	214	216	
4000 FT	SHP	2870	2770	2660	2555	2450	2350	2250	2155	2065	1970	1880	1800	**0.43**
	FF—LB/HR/ENG	1635	1595	1555	1520	1475	1435	1400	1370	1335	1305	1275	1245	
+7°C	IAS—KNOTS	242	240	237	235	232	230	227	225	222	220	217	215	
	TAS—KNOTS	256	254	251	248	246	243	241	238	235	233	230	227	
	SEG RANGE—NM	197	199	202	205	208	211	214	216	220	222	226	228	
6000 FT	SHP	2860	2755	2650	2535	2430	2330	2225	2135	2040	1945	1855	1775	**0.44**
	FF—LB/HR/ENG	1585	1545	1505	1470	1425	1385	1355	1320	1285	1255	1220	1190	
+3°C	IAS—KNOTS	238	236	233	231	228	226	223	221	218	216	213	211	
	TAS—KNOTS	260	257	254	251	249	246	243	241	238	235	232	230	
	SEG RANGE—NM	205	208	211	215	218	221	224	228	231	234	238	241	
8000 FT	SHP	2855	2745	2635	2520	2410	2310	2205	2110	2015	1920	1830	1745	**0.46**
	FF—LB/HR/ENG	1545	1505	1465	1425	1385	1345	1310	1275	1240	1205	1175	1140	
–1°C	IAS—KNOTS	234	232	229	227	224	222	219	217	214	212	209	207	
	TAS—KNOTS	263	260	257	255	252	249	246	243	241	238	235	232	
	SEG RANGE—NM	213	217	220	224	228	232	235	238	243	246	250	254	

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Figure 33-23. Four-Engine Maximum Range Operating Table — Configuration E (Sheet 1 of 2)



ALTITUDE / STD TEMP		Gross Weight Bracket—1000 Lb											AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		142.5 137.5	137.5 132.5	132.5 127.5	127.5 122.5	122.5 117.5	117.5 112.5	112.5 107.5	107.5 102.5	102.5 97.5	97.5 92.5	92.5 87.5	87.5 82.5	
10,000 FT −5°C	SHP	2850	2735	2625	2510	2390	2285	2185	2090	1995	1900	1810	1720	0.47
	FF−LB/HR/ENG	1510	1465	1425	1385	1345	1305	1270	1230	1195	1160	1130	1095	
	IAS−KNOTS	230	228	225	223	220	218	215	213	210	208	205	203	
	TAS−KNOTS	266	263	260	258	255	252	249	246	243	240	238	235	
	SEG RANGE−NM	221	226	229	234	238	242	246	250	254	258	263	267	
12,000 FT −9°C	SHP	2855	2730	2615	2500	2375	2270	2165	2070	1975	1875	1785	1700	0.48
	FF−LB/HR/ENG	1480	1435	1390	1350	1310	1270	1230	1190	1160	1125	1090	1055	
	IAS−KNOTS	226	224	221	219	216	214	211	209	206	204	201	199	
	TAS−KNOTS	269	266	263	260	258	255	252	249	246	243	240	237	
	SEG RANGE−NM	228	233	237	242	247	252	256	262	266	271	276	281	
14,000 FT −13°C	SHP	2860	2735	2610	2490	2370	2260	2150	2050	1955	1855	1765	1675	0.49
	FF−LB/HR/ENG	1455	1405	1360	1315	1275	1235	1195	1155	1120	1085	1050	1015	
	IAS−KNOTS	222	220	217	215	212	210	207	205	202	200	197	195	
	TAS−KNOTS	272	269	266	263	260	257	254	251	249	246	243	240	
	SEG RANGE−NM	234	241	245	251	256	262	268	273	279	284	290	296	
16,000 FT −17°C	SHP	2870	2740	2610	2490	2370	2255	2140	2035	1940	1840	1745	1655	0.50
	FF−LB/HR/ENG	1430	1380	1330	1290	1240	1200	1160	1120	1085	1050	1015	980	
	IAS−KNOTS	218	216	213	211	208	206	203	201	198	196	193	191	
	TAS−KNOTS	276	273	270	267	264	261	258	254	252	248	245	242	
	SEG RANGE−NM	240	248	254	260	266	272	279	285	291	297	304	310	
18,000 FT −21°C	SHP	2885	2755	2615	2500	2370	2255	2135	2030	1930	1825	1730	1640	0.51
	FF−LB/HR/ENG	1410	1360	1305	1260	1215	1170	1130	1085	1045	1010	975	945	
	IAS−KNOTS	214	212	209	207	204	202	199	197	194	192	189	187	
	TAS−KNOTS	280	277	274	270	267	264	261	258	254	251	248	245	
	SEG RANGE−NM	247	255	261	269	275	282	290	296	304	310	318	325	
20,000 FT −25°C	SHP	2900	2770	2625	2510	2380	2260	2140	2030	1920	1815	1715	1625	0.52
	FF−LB/HR/ENG	1395	1340	1290	1235	1190	1140	1100	1055	1015	975	940	910	
	IAS−KNOTS	210	208	205	203	200	198	195	193	190	188	185	183	
	TAS−KNOTS	284	280	277	274	271	267	264	261	257	254	251	247	
	SEG RANGE−NM	253	261	269	277	284	292	300	308	316	324	332	340	
POWER CORRECTION FACTORS (ADD ABOVE STD) ΔSHP/°C		5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.8	3.6	3.4	3.1	2.9	

MODEL P-3C — FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE — CONFIGURATION "E"

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Figure 33-23. Four-Engine Maximum Range Operating Table — Configuration E (Sheet 2 of 2)

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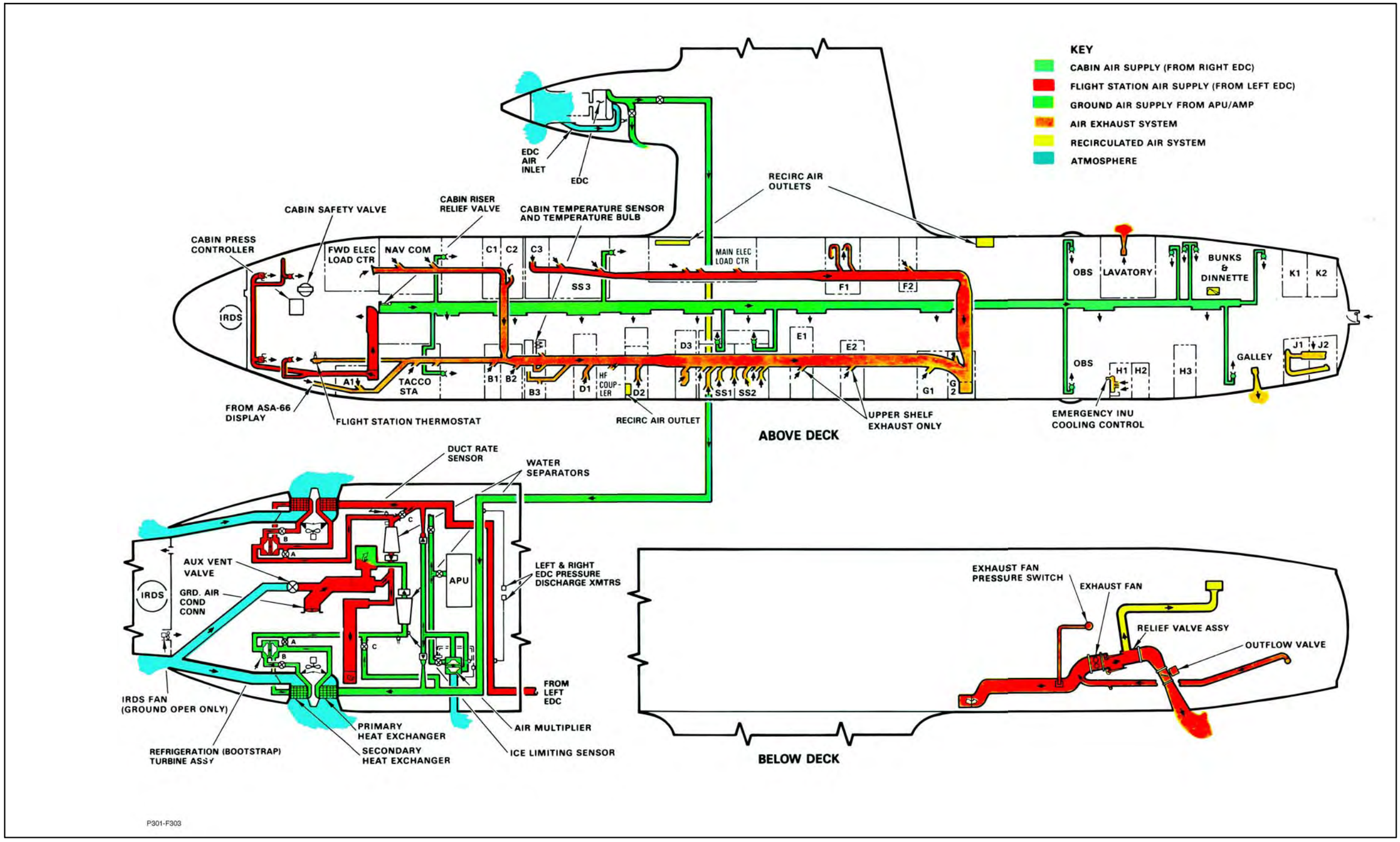
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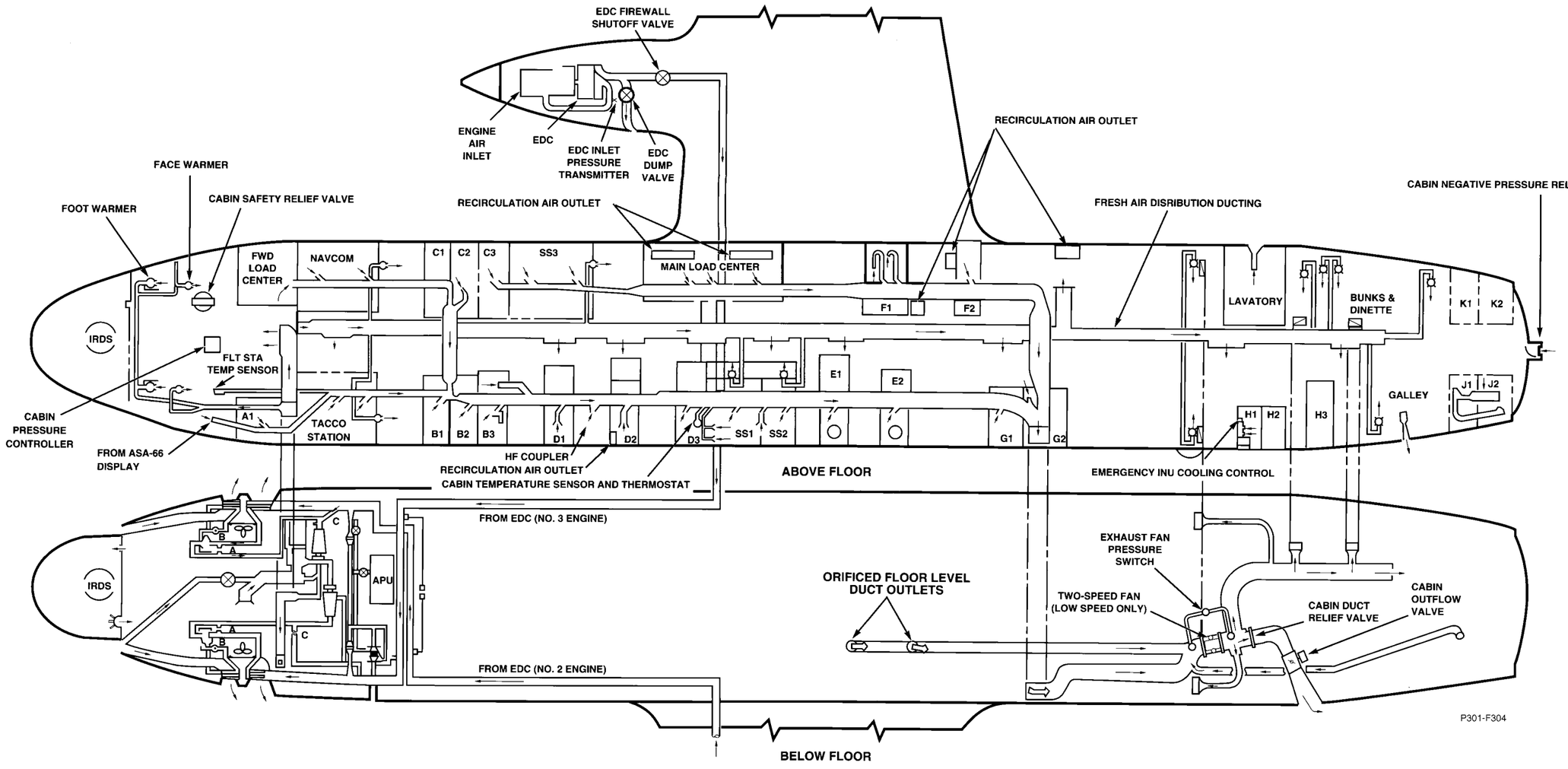
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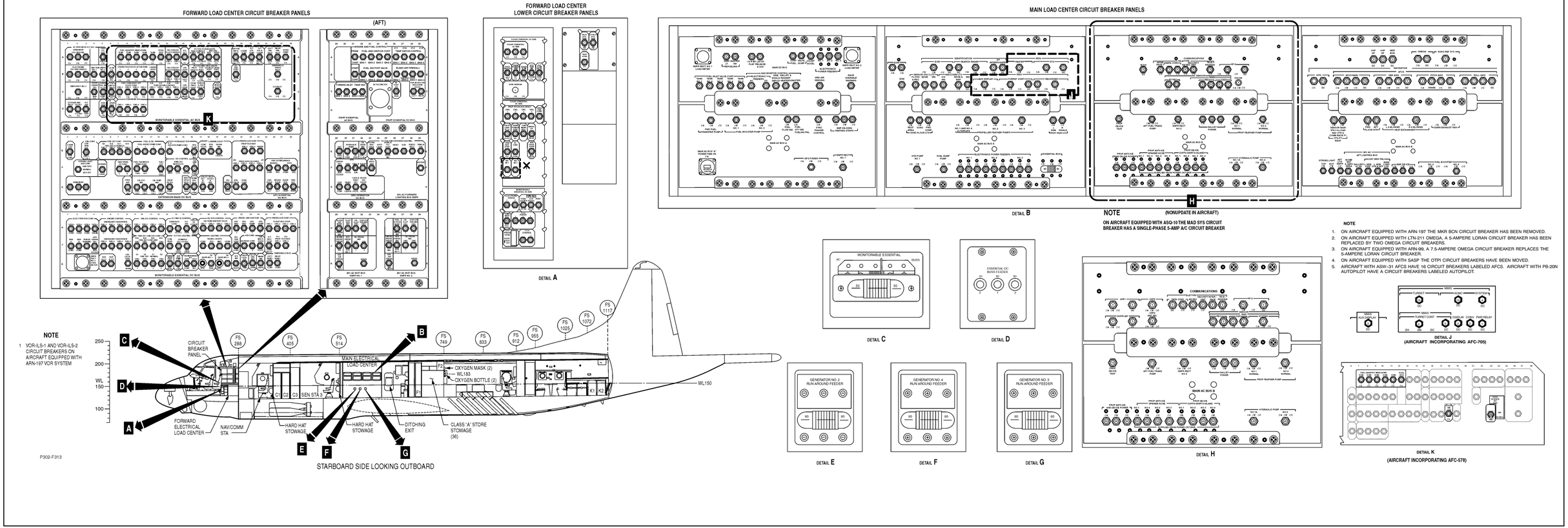
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KEY
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C2
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SS3
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F2
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K1
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B2
B3
D1
HF COUP-LER
D2
SS1
SS2
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ABOVE DECK
DUCT RATE SENSOR
WATER SEPARATORS
AUX VENT VALVE
IRDS
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APU
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FROM LEFT EDC
IRDS FAN (GROUND OPER ONLY)
PRIMARY HEAT EXCHANGER
AIR MULTIPLIER
REFRIGERATION (BOOTSTRAP) TURBINE ASSY
SECONDARY HEAT EXCHANGER
ICE LIMITING SENSOR
EXHAUST FAN PRESSURE SWITCH
EXHAUST FAN
RELIEF VALVE ASSY
OUTFLOW VALVE
BELOW DECK
P301-F303



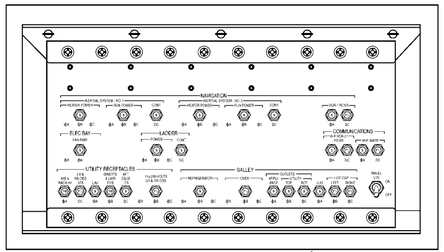
Air Distribution System, Exhaust System, and Related Components — Aircraft BuNo 161410 and Subsequent and Aircraft Incorporating AFC-450



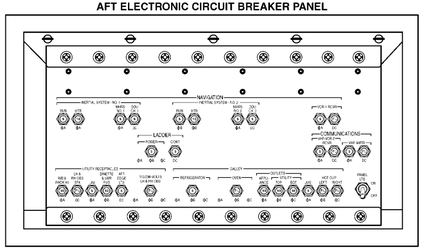
Power Distribution Circuit Breaker Panels (Aircraft Prior to Update III)
(Sheet 1 of 2)
FO-3 (Reverse Blank)

ORIGINAL

AFT ELECTRONIC CIRCUIT BREAKER PANEL



AFT ELECTRONIC CIRCUIT BREAKER PANEL



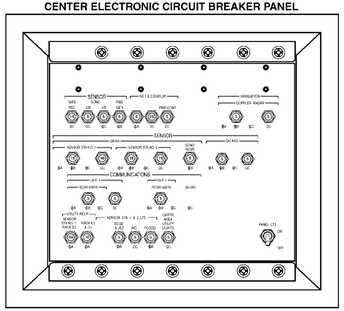
AIRCRAFT EQUIPPED WITH LTN-72 INERTIAL NAVIGATION SYSTEMS

NOTE:

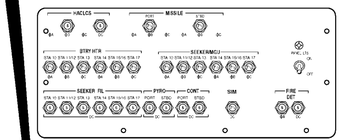
ON AIRCRAFT EQUIPPED WITH ARC-140 VHF SYSTEM THE VOR-1/RCVR AND COMM VHF/VOR-2 RCVR AND VHF XMTR ARE REPLACED WITH A VHF-AM 10 AMP CIRCUIT BREAKER

ON AIRCRAFT EQUIPPED WITH ASN-179 RINU THE 10AMP HTR CIRCUIT BREAKER IS REMOVED

CENTER ELECTRONIC CIRCUIT BREAKER PANEL



HARPOON CIRCUIT BREAKER PANEL (H)

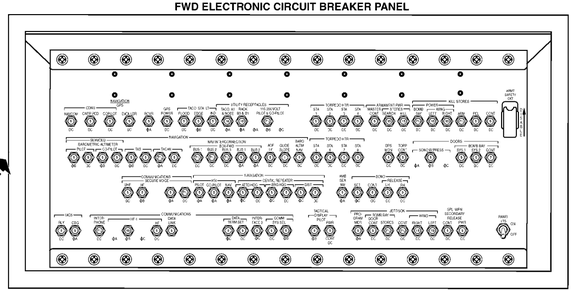


AIRCRAFT EQUIPPED WITH HACLCS SYSTEM

NOTE

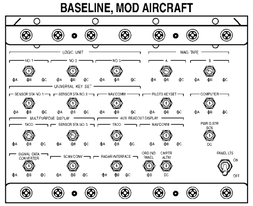
1. SPL WPN SECONDARY RELEASE AND BARO ALTM NAV CIRCUIT BREAKERS INSTALLED ON NUD AIRCRAFT
2. MISSILE ϕB AND MISSILE DC CIRCUIT BREAKERS ARE INCLUDED ON NUD AIRCRAFT

FWD ELECTRONIC CIRCUIT BREAKER PANEL

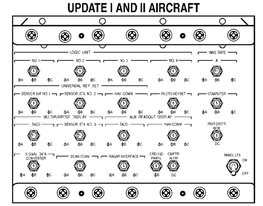


DPS ELECTRONIC CIRCUIT BREAKER PANELS

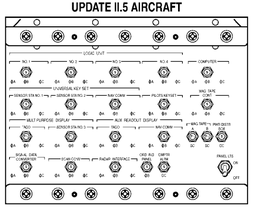
BASELINE, MOD AIRCRAFT

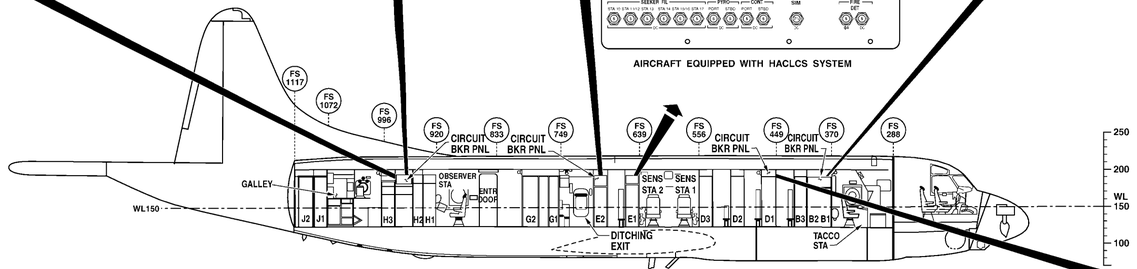


UPDATE I AND II AIRCRAFT



UPDATE II.5 AIRCRAFT





PORT SIDE LOOKING OUTBOARD

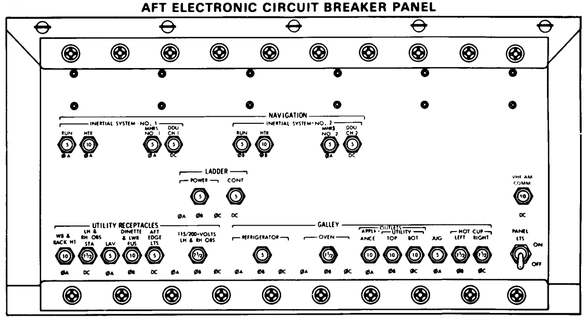
P301-F334

Power Distribution Circuit Breaker Panels (Aircraft Prior to Update III)
(Sheet 2 of 2)
FO-4 (Reverse Blank)

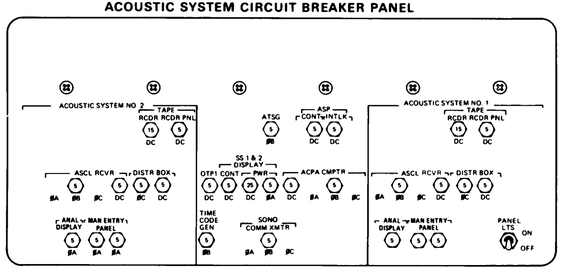
ORIGINAL

AIRCRAFT EQUIPPED WITH THE DMTU AND SASP SYSTEM

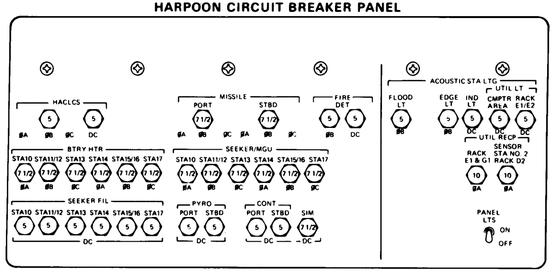
AFT ELECTRONIC CIRCUIT BREAKER PANEL



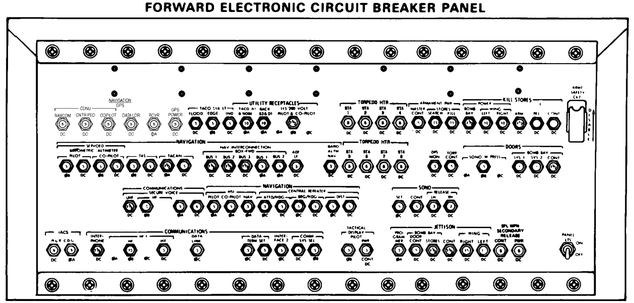
ACOUSTIC SYSTEM CIRCUIT BREAKER PANEL



HARPOON CIRCUIT BREAKER PANEL

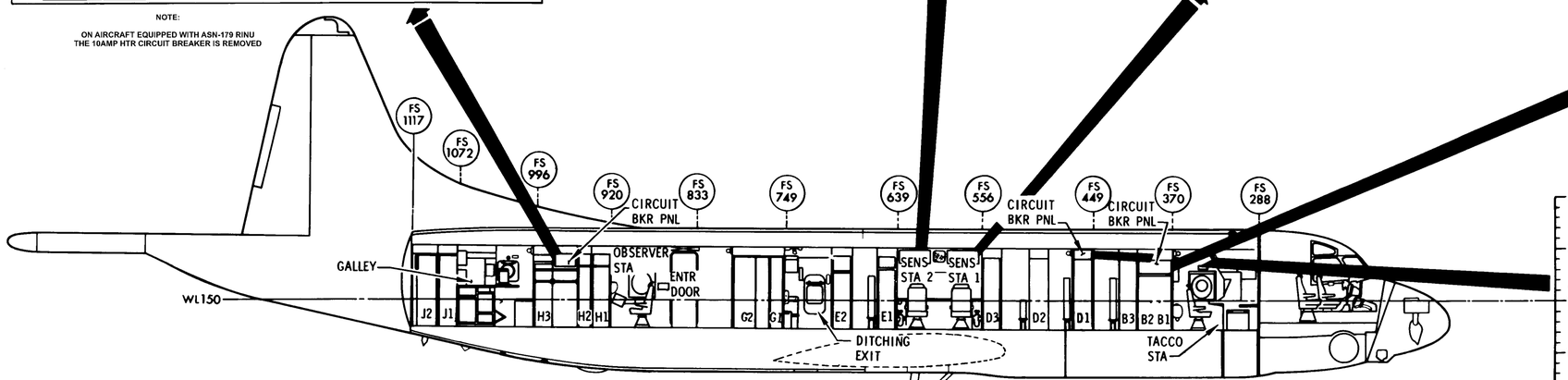


FORWARD ELECTRONIC CIRCUIT BREAKER PANEL



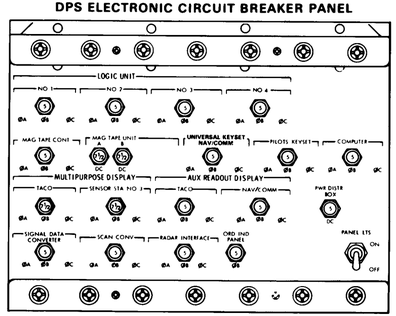
NOTE:

ON AIRCRAFT EQUIPPED WITH ASN-179 RINU THE 10AMP HTR CIRCUIT BREAKER IS REMOVED



PORT SIDE LOOKING OUTBOARD

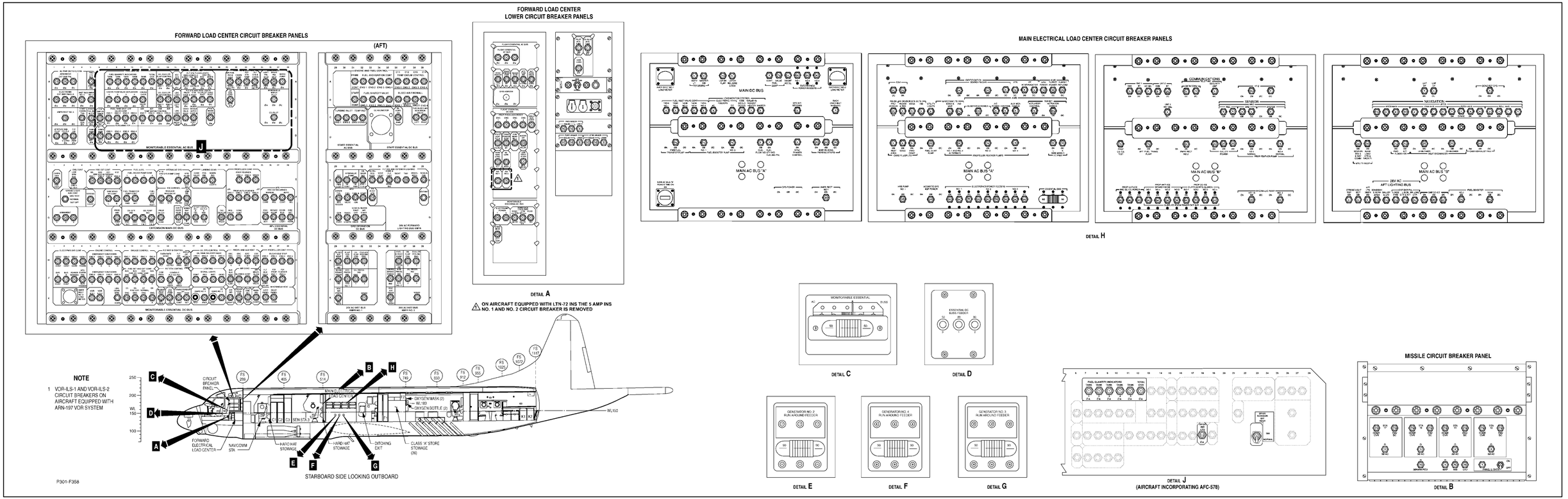
DPS ELECTRONIC CIRCUIT BREAKER PANEL



P302-F327

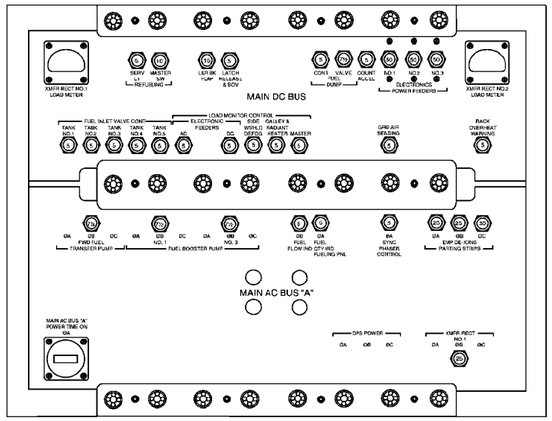
NOTE

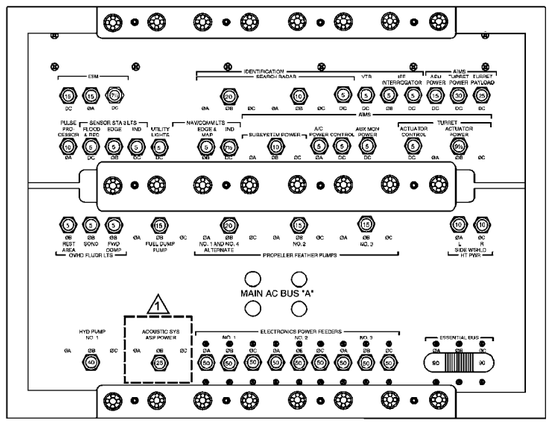
1. LOGIC UNIT NO. 4 CIRCUIT BREAKER HAS BEEN REMOVED ON UPDATE III AIRCRAFT INCORPORATING MODERNIZED LOGIC UNITS.

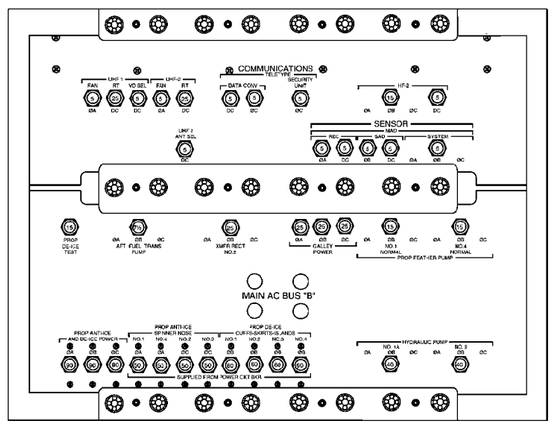


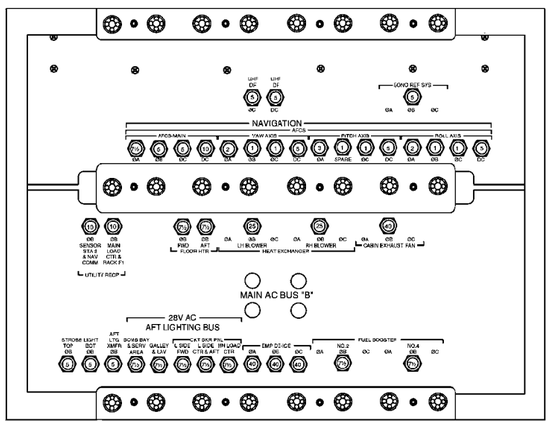
Power Distribution Circuit Breaker Panels (AIP Aircraft) (Sheet 1 of 3)

MAIN ELECTRICAL LOAD CENTER CIRCUIT BREAKER PANELS

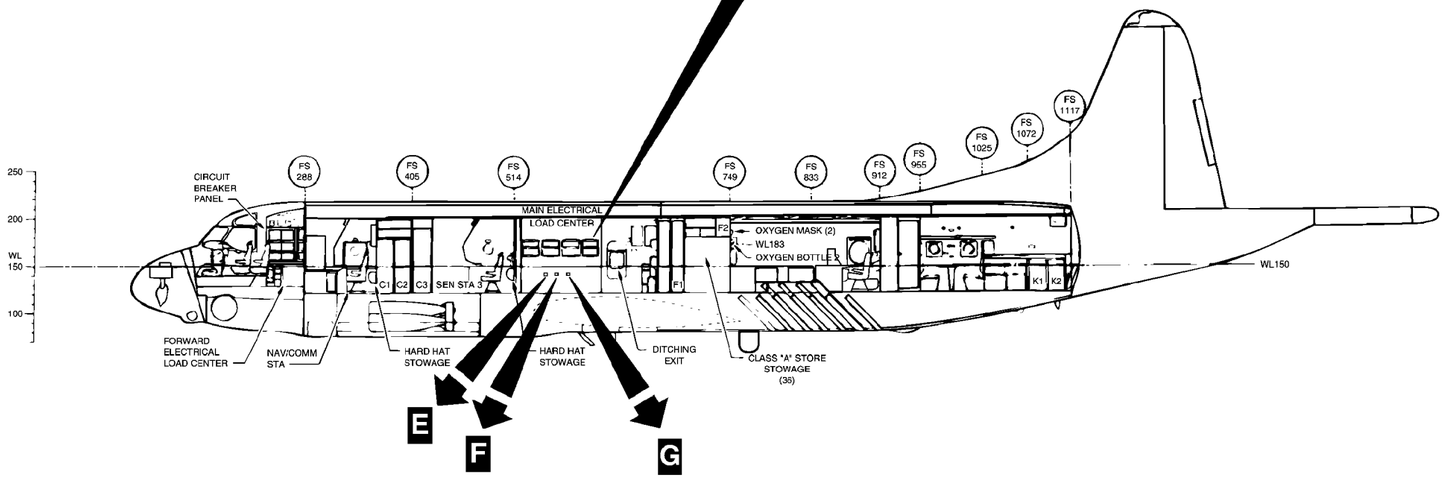


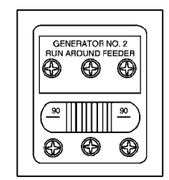




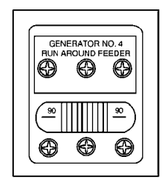


⚠1 NOT PRESENT ON USQ-78 A/B AIRCRAFT.

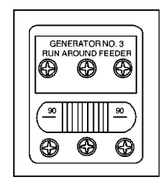




DETAIL E



DETAIL F

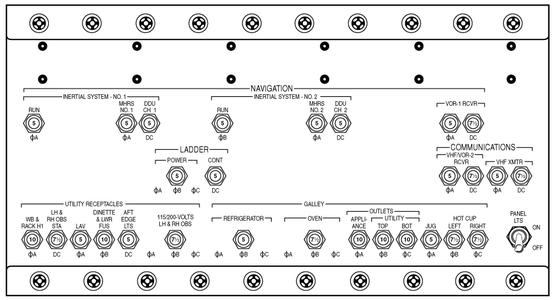


DETAIL G

P301-F359

STARBOARD SIDE LOOKING OUTBOARD

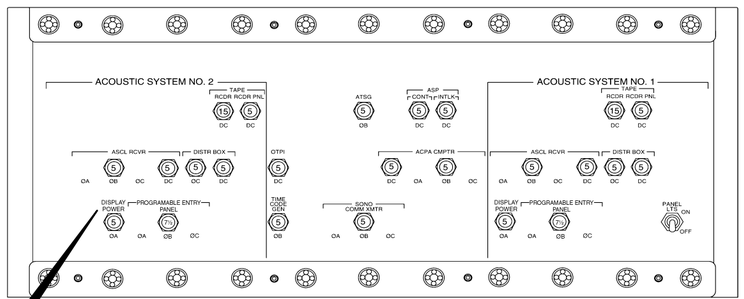
AFT ELECTRONIC CIRCUIT BREAKER PANEL



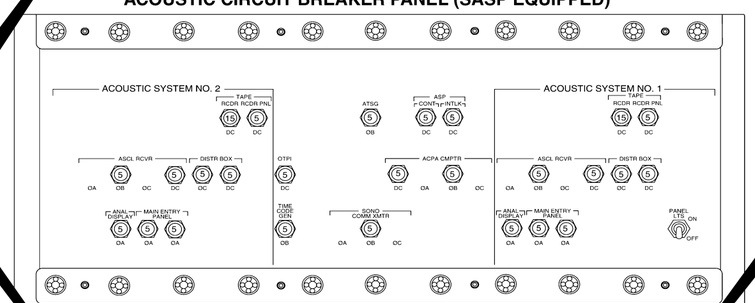
NOTE:

ON AIRCRAFT EQUIPPED WITH ARC-140 VHF SYSTEM THE VOR-1/RCVR AND COMM VHF/VOR-2 RCVR AND VHF XMTR ARE REPLACED WITH A VHF-AM 10 AMP CIRCUIT BREAKER

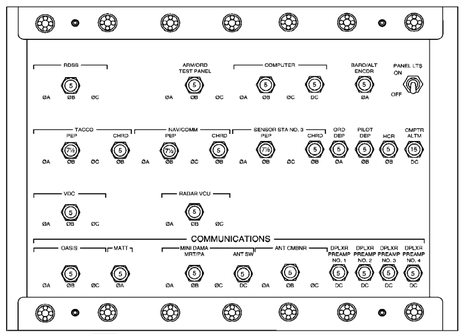
ACOUSTIC CIRCUIT BREAKER PANEL (USQ-78A EQUIPPED)



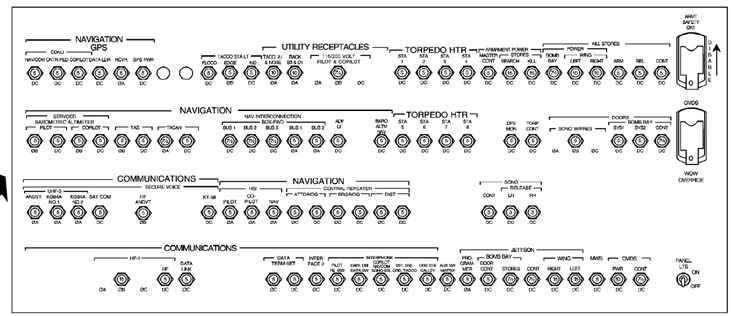
ACOUSTIC CIRCUIT BREAKER PANEL (SASP EQUIPPED)



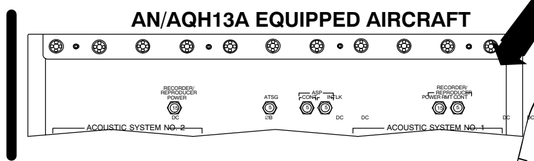
DPS CIRCUIT BREAKER PANEL

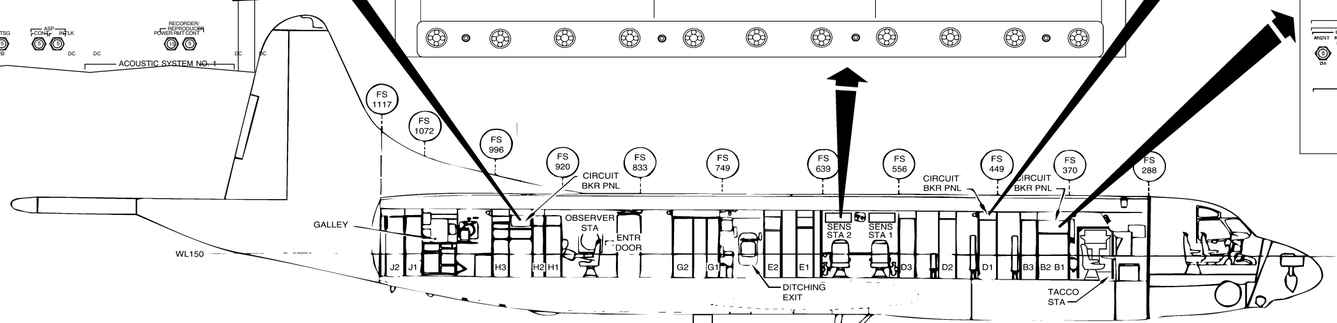


FWD ELECTRONIC CIRCUIT BREAKER PANEL



AN/AQH13A EQUIPPED AIRCRAFT



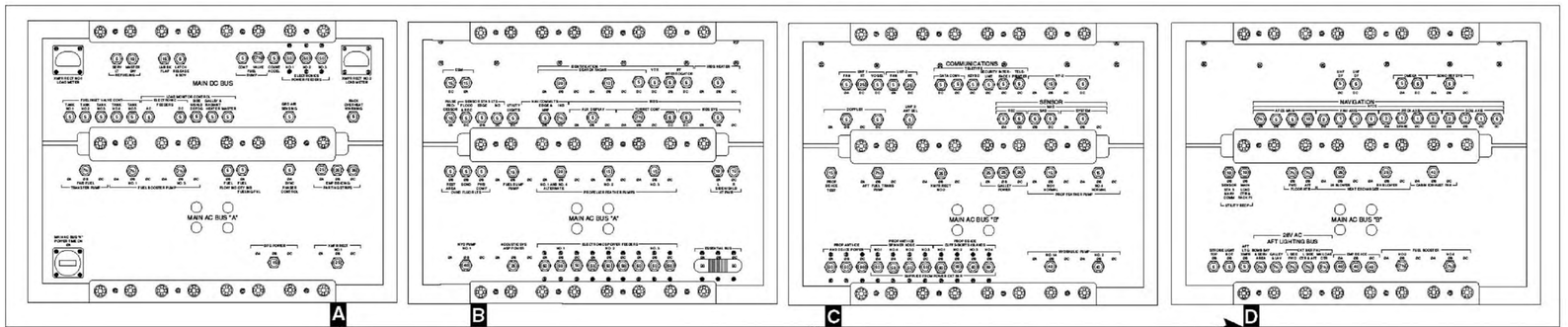


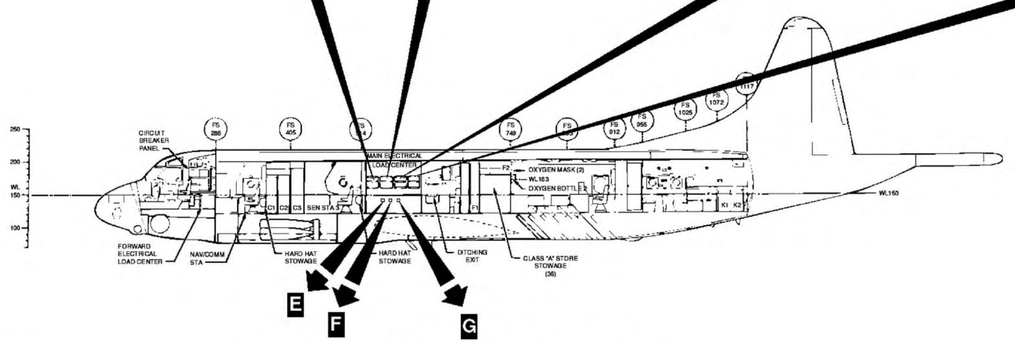
P301-F360

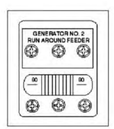
PORT SIDE LOOKING OUTBOARD

Power Distribution Circuit Breaker Panels (AIP Aircraft) (Sheet 3 of 3)

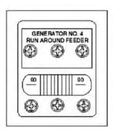
MAIN ELECTRICAL LOAD CENTER CIRCUIT BREAKER PANELS



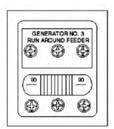




DETAIL E

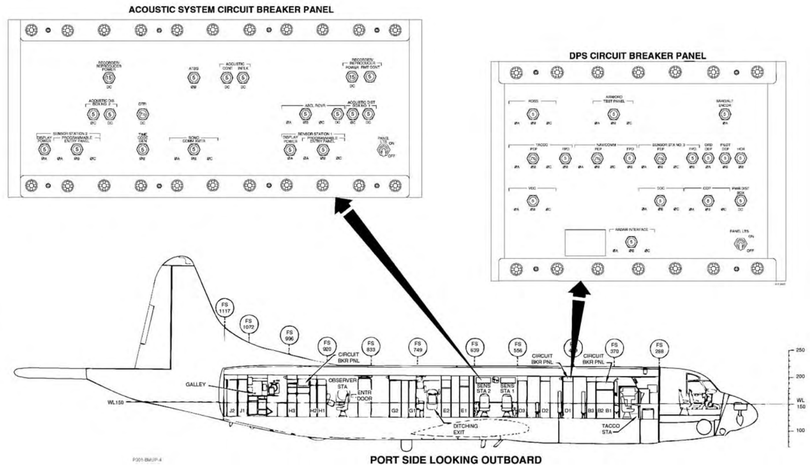


DETAIL F



DETAIL G

STARBOARD SIDE LOOKING OUTBOARD



PORT SIDE LOOKING OUTBOARD

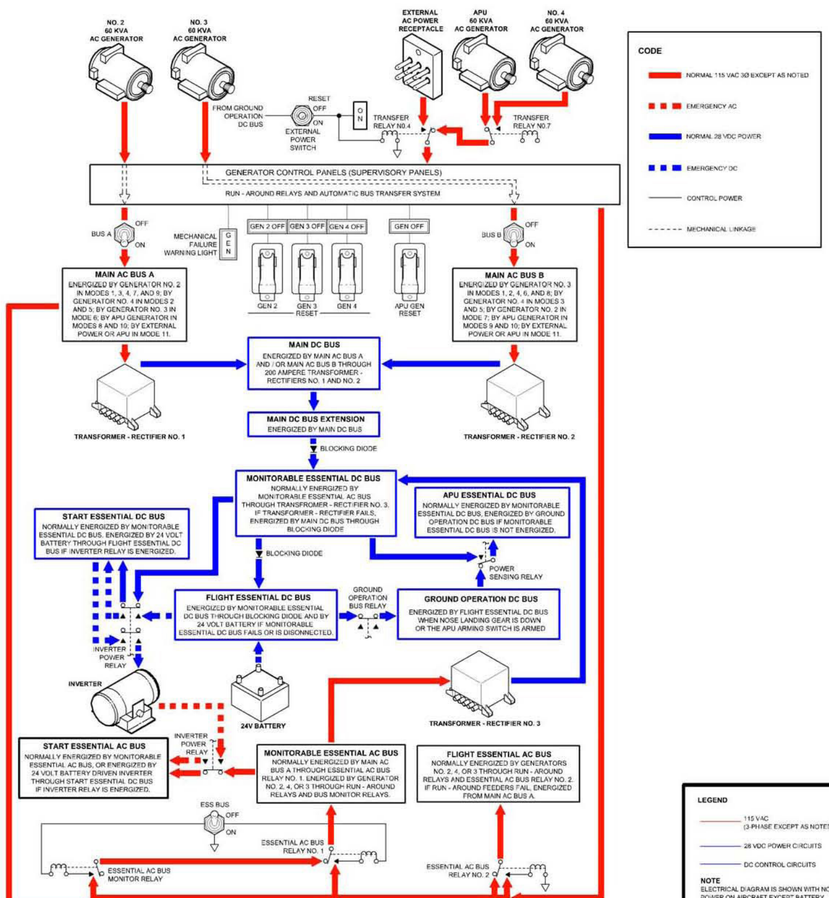
TRANSFER/RUNAROUND SYSTEM PRIORITY

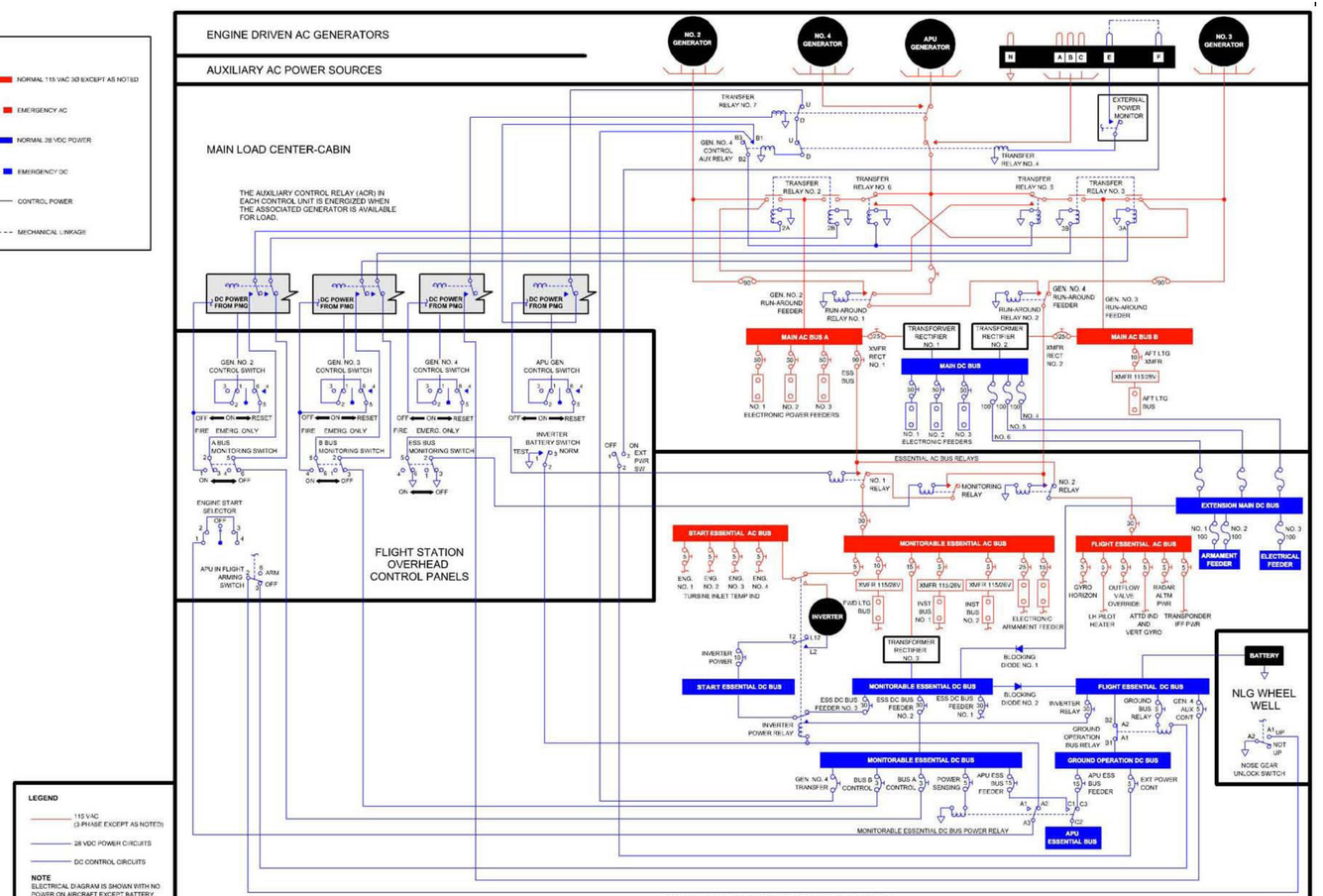
BUS A	BUS B	MEAC	FEAC	SEAC
GENERATOR NO. 2	GENERATOR NO. 3	BUS A	GENERATOR NO. 2	MEAC
EXTERNAL POWER	EXTERNAL POWER	GENERATOR NO. 2	EXTERNAL POWER	SEOC via INVERTER
GENERATOR NO. 4	GENERATOR NO. 4	EXTERNAL POWER	GENERATOR NO. 4	
APU GENERATOR	APU GENERATOR	GENERATOR NO. 4	APU GENERATOR	
GENERATOR NO. 3	GENERATOR NO. 2	APU GENERATOR	GENERATOR NO. 3	
		GENERATOR NO. 3	BUS A	

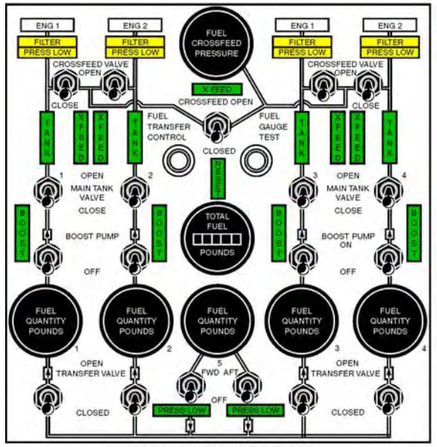
TRANSFER RELAY PURPOSES AND POWER SOURCES

TRANSFER RELAY	PURPOSE	POWER SOURCE
2A	CONNECTS GENERATOR NO. 2 TO BUS A.	NO. 2 SUPERVISORY PANEL ACR ENERGIZED.
2B	CONNECTS ALTERNATE GENERATOR TO BUS A.	MEDC via BUS A CONT CIRCUIT BREAKER.
3A	CONNECTS GENERATOR NO. 3 TO BUS B.	NO. 3 SUPERVISORY PANEL ACR ENERGIZED.
3B	CONNECTS ALTERNATE GENERATOR TO BUS B.	MEDC via BUS B CONT CIRCUIT BREAKER.
4	GIVES EXTERNAL POWER PRIORITY OVER GENERATOR NO. 4.	GOE via EXT PWR CONT CIRCUIT BREAKER.
5	CONNECTS GENERATOR NO. 2 TO BUS B.	MEDC via GEN 4 TRANS CIRCUIT BREAKER.
6	CONNECTS GENERATOR NO. 3 TO BUS A.	MEDC via GEN 4 TRANS CIRCUIT BREAKER.
7	GIVES GENERATOR NO. 4 PRIORITY OVER THE APU.	FEDC via GENERATOR NO. 4 AUX CONT CIRCUIT BREAKER.

MODE	GENERATORS	OPERATION
1	2 3 4	NO. 2 GENERATOR ENERGIZES MAIN AC BUS A NO. 3 GENERATOR ENERGIZES MAIN AC BUS B NO. 4 GENERATOR - SPARE
2	2 3 4	NO. 3 GENERATOR ENERGIZES MAIN AC BUS B NO. 4 GENERATOR ENERGIZES MAIN AC BUS A
3	2 3 4	NO. 2 GENERATOR ENERGIZES MAIN AC BUS A NO. 4 GENERATOR ENERGIZES MAIN AC BUS B
4	2 3 4	NO. 2 GENERATOR ENERGIZES MAIN AC BUS A NO. 3 GENERATOR ENERGIZES MAIN AC BUS B
5	2 3 4	NO. 4 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
6	2 3 4	NO. 3 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
7	2 3 4	NO. 2 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
8	2 3 APU	NO. 3 GENERATOR ENERGIZES MAIN AC BUS B APU GENERATOR ENERGIZES MAIN AC BUS A
9	2 3 APU	NO. 2 GENERATOR ENERGIZES MAIN AC BUS A APU GENERATOR ENERGIZES MAIN AC BUS B
10	2 3 APU	APU GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
11	GROUND OPERATION APU EXTERNAL POWER	APU GENERATOR OR EXTERNAL POWER ENERGIZES MAIN AC BUS A AND MAIN AC BUS B



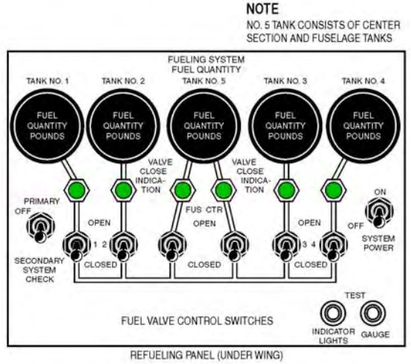




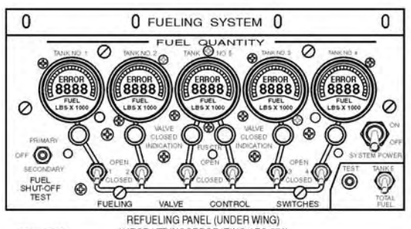
FUEL MANAGEMENT PANEL (FLIGHT STATION)

NOTE

NO. 5 TANK CONSISTS OF CENTER SECTION AND FUSELAGE TANKS

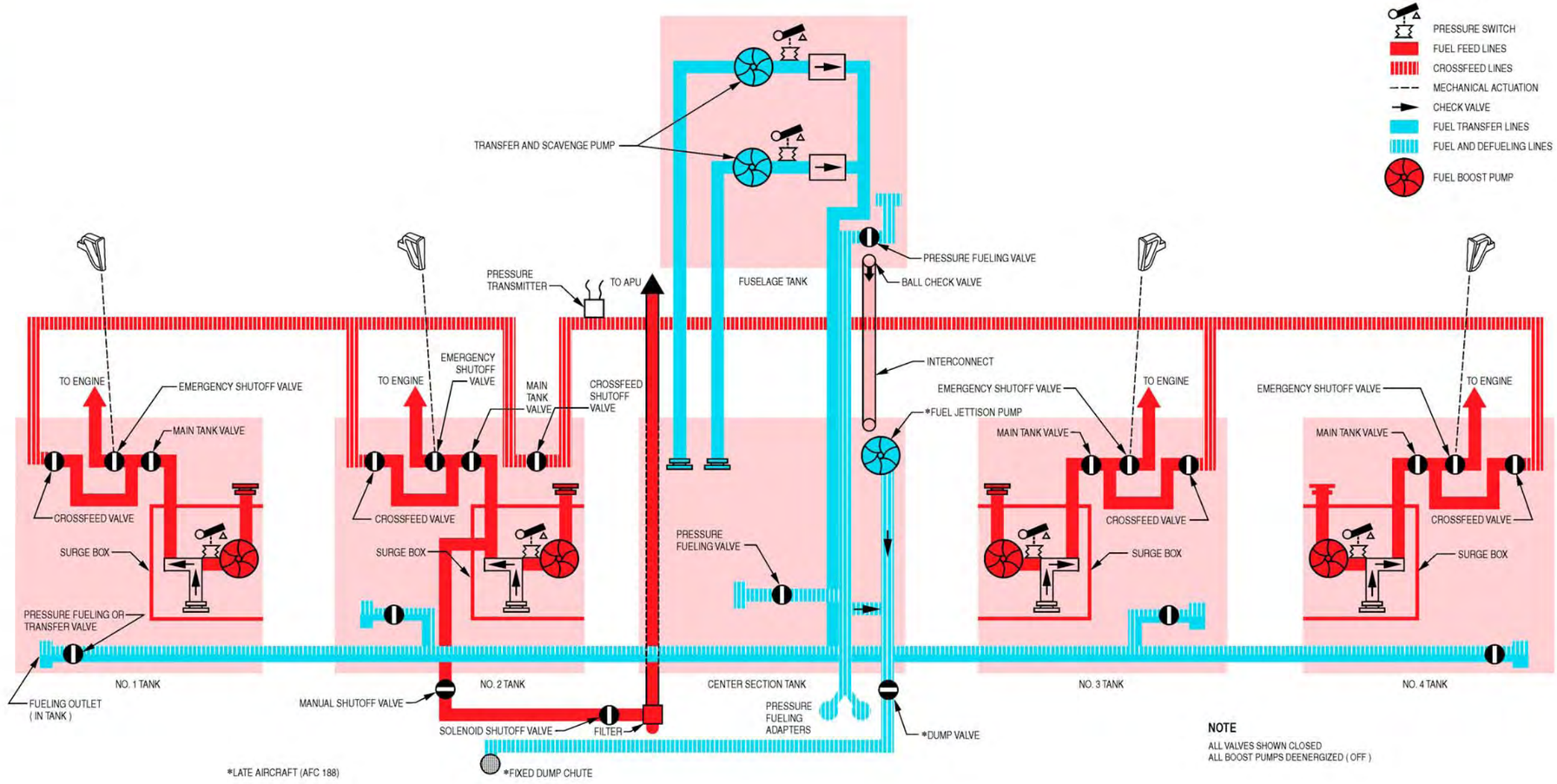


REFUELING PANEL (UNDER WING)

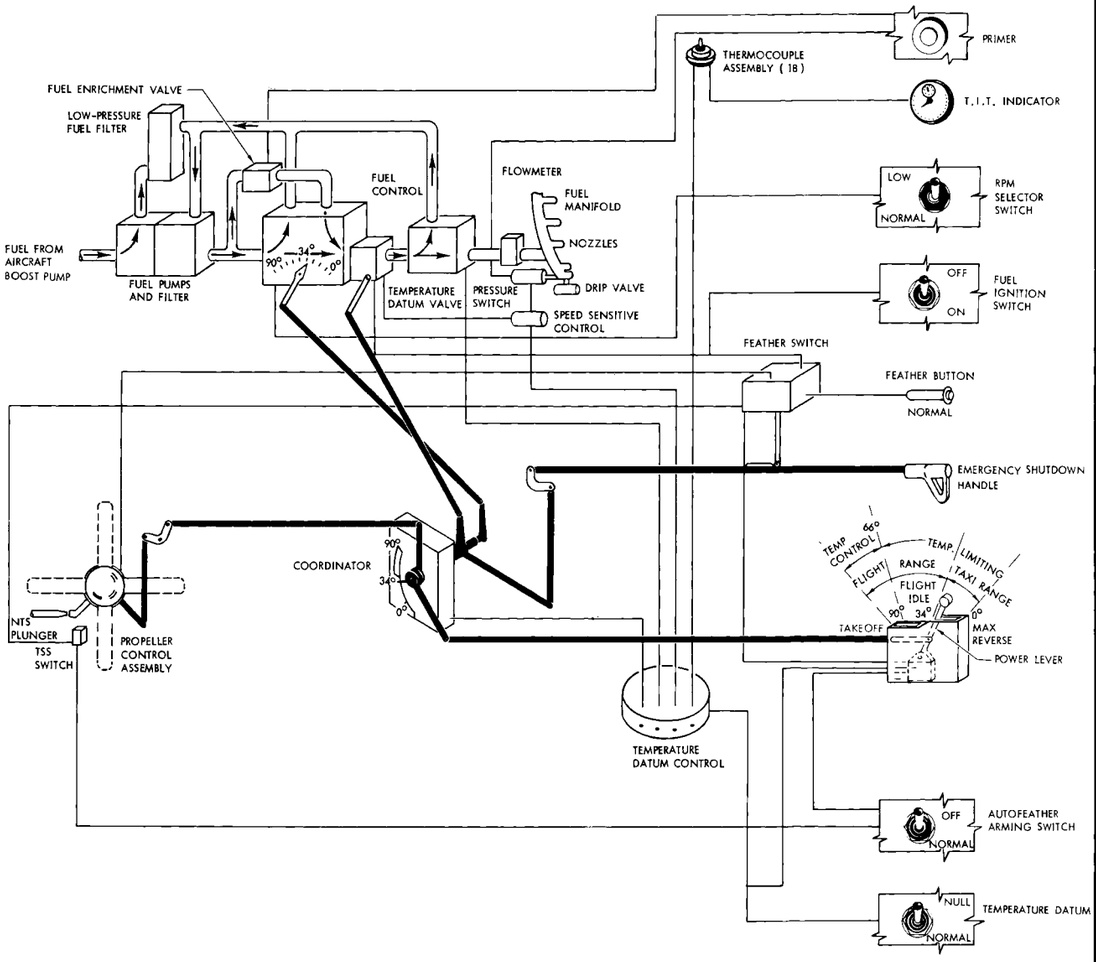


REFUELING PANEL (UNDER WING)
(AIRCRAFT INCORPORATING AFC-578)

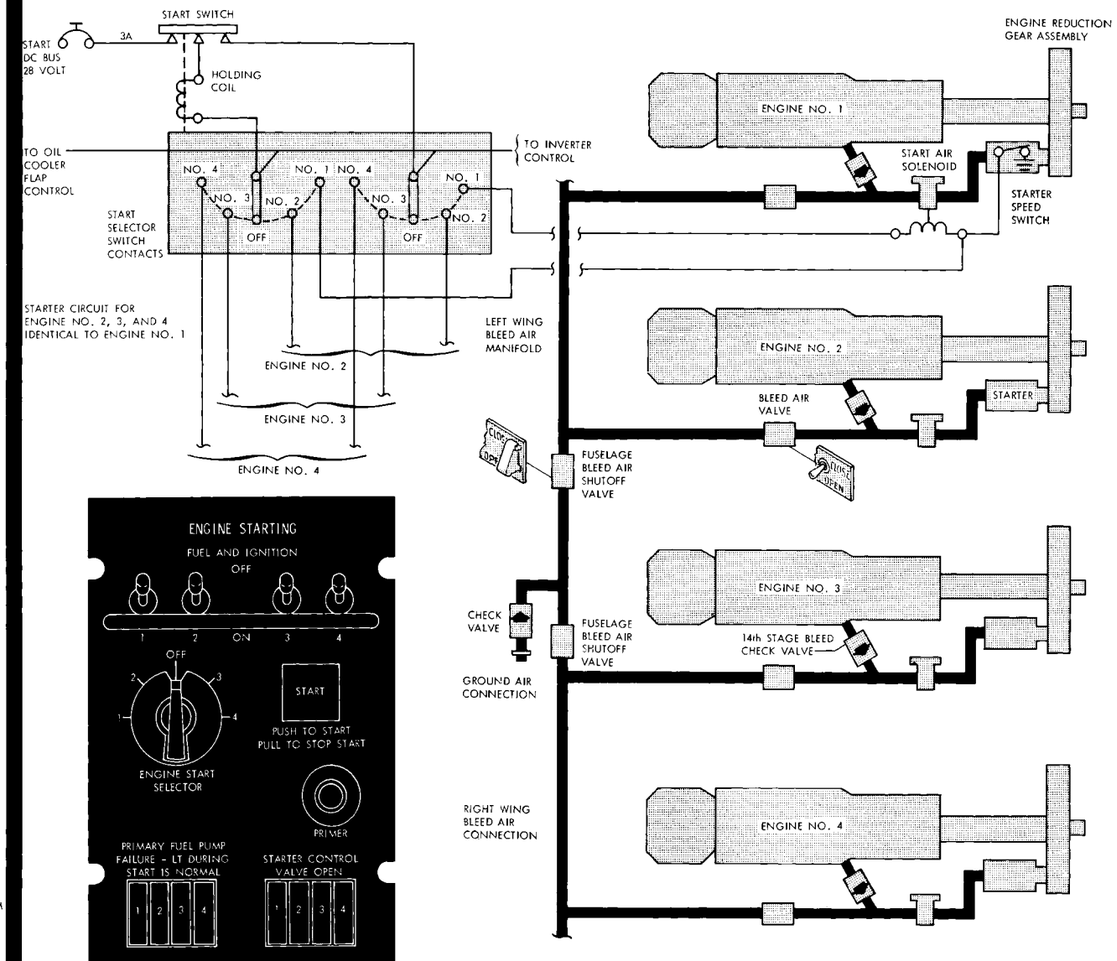
P301-F309



POWER UNIT CONTROLS



ENGINE PNEUMATIC STARTING SYSTEM

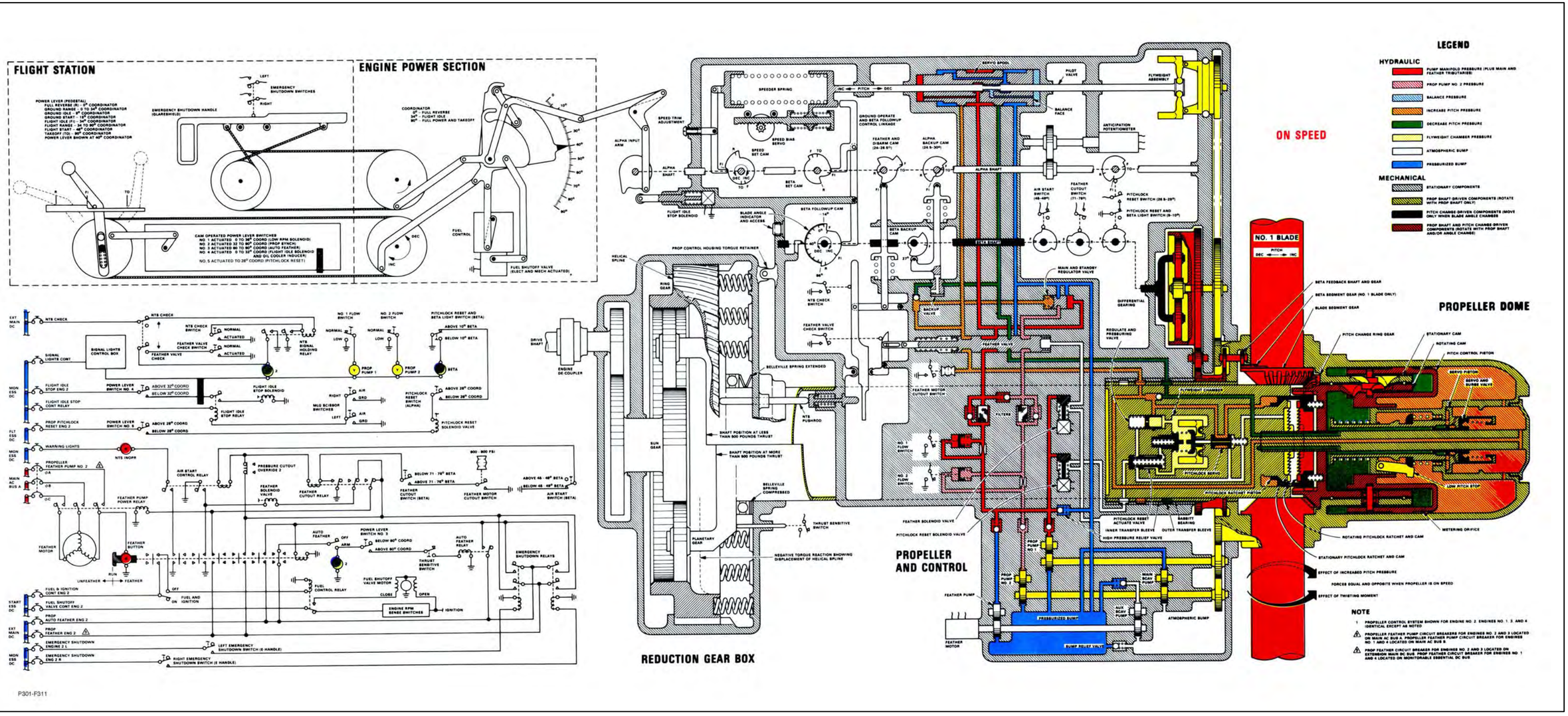


(TYPICAL)

NOTE

STARTER VALVE LIGHTS INSTALLED IF AFC 255 INCORPORATED

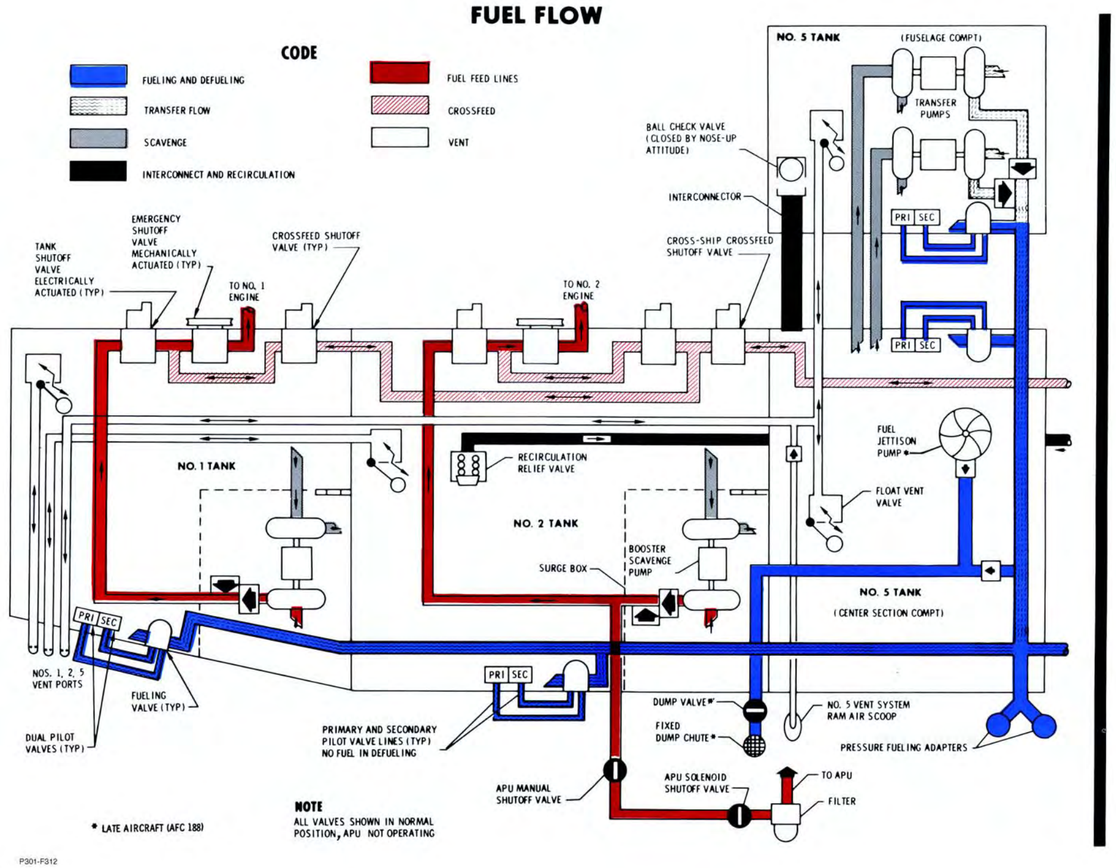
P301-F310

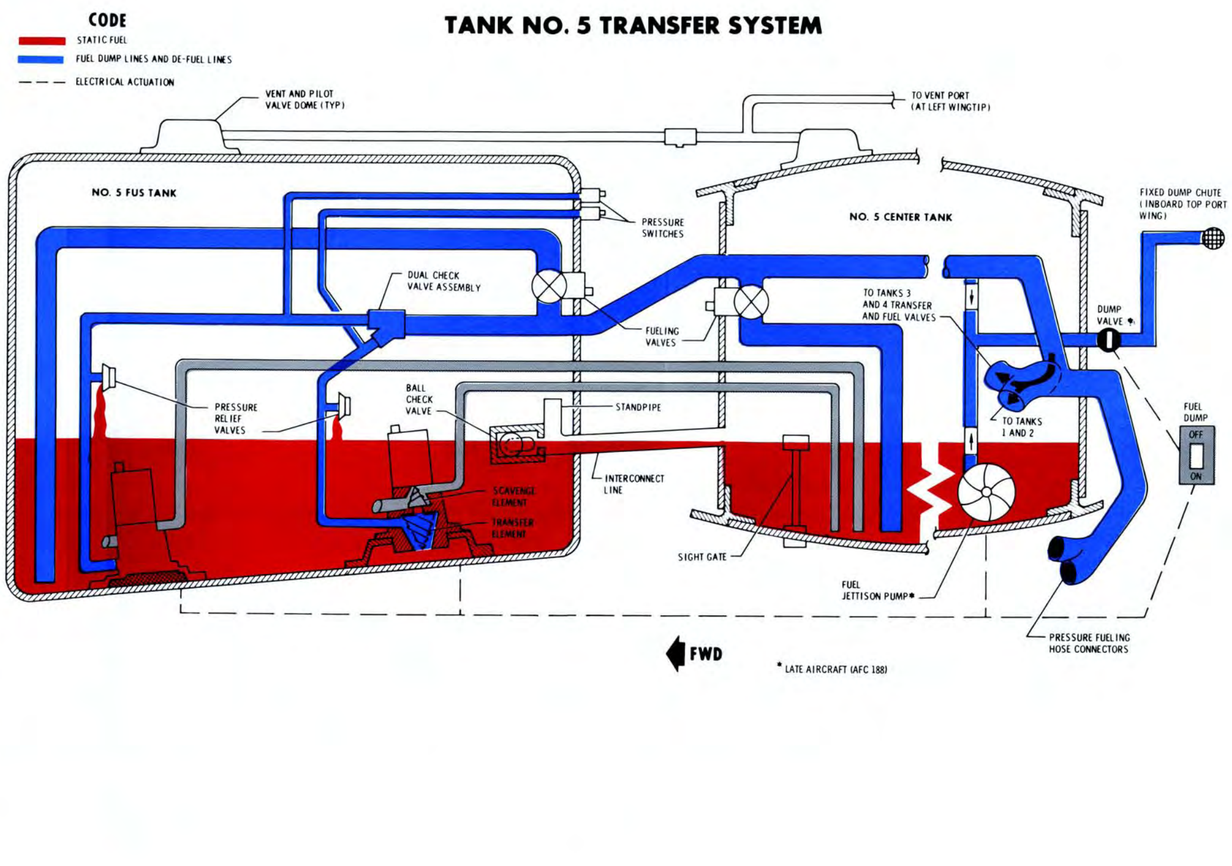


Propeller Control Master Schematic

FO-13 (Reverse Blank)

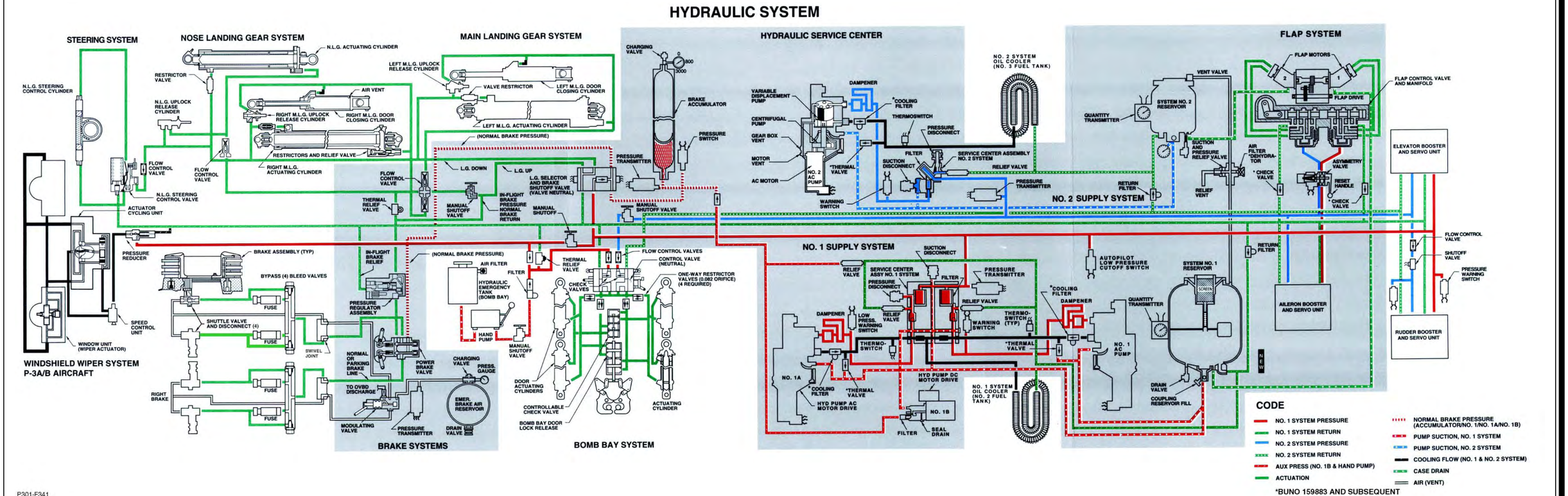
ORIGINAL





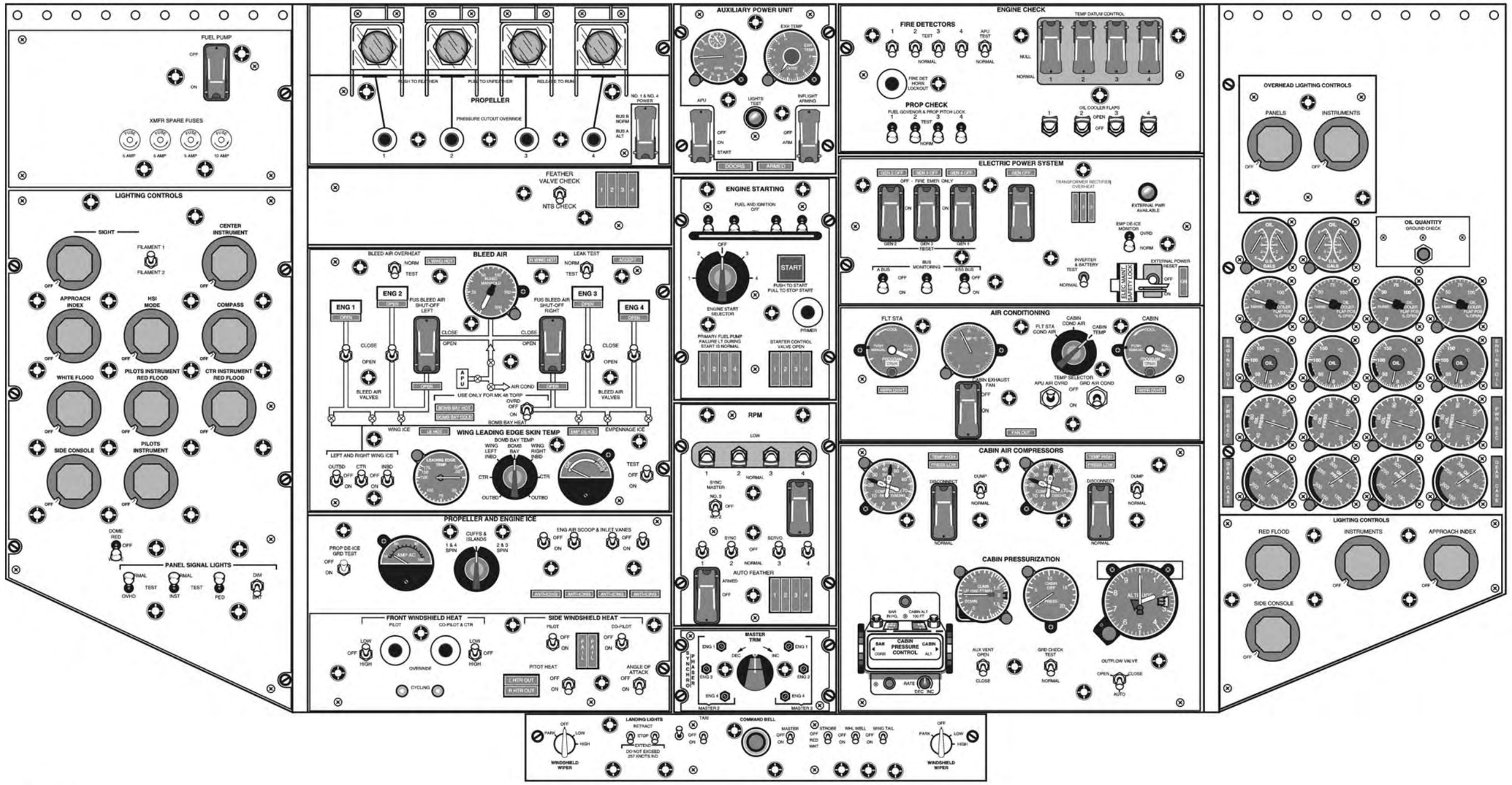
Fuel Flow/Tank No. 5 Transfer System

HYDRAULIC SYSTEM



P301-F341

Hydraulic System — Aircraft BuNo 156507 to 159875

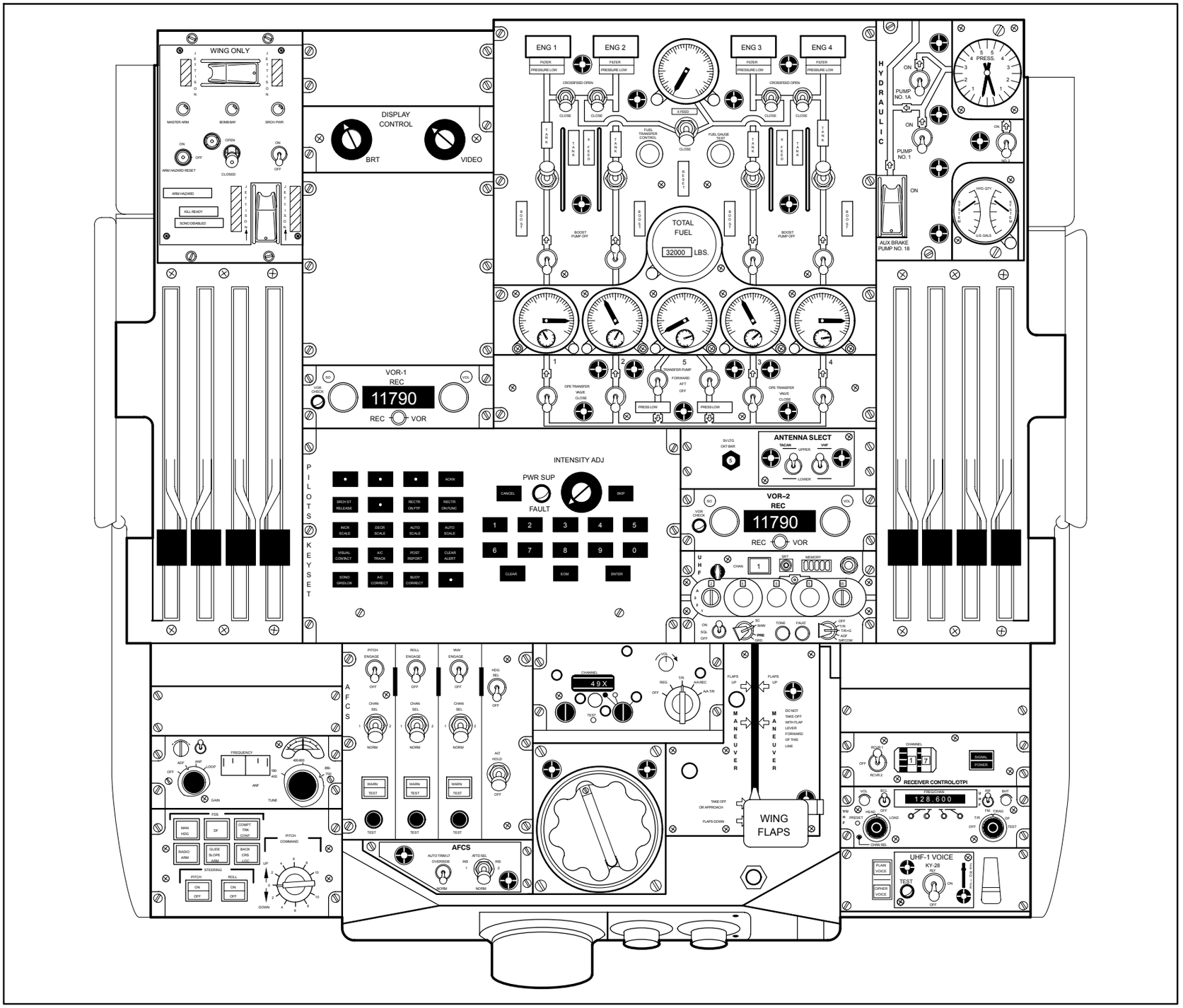


P301-F314

P-3 Flight Station (Sheet 1 of 3)

FO-16 (Reverse Blank)

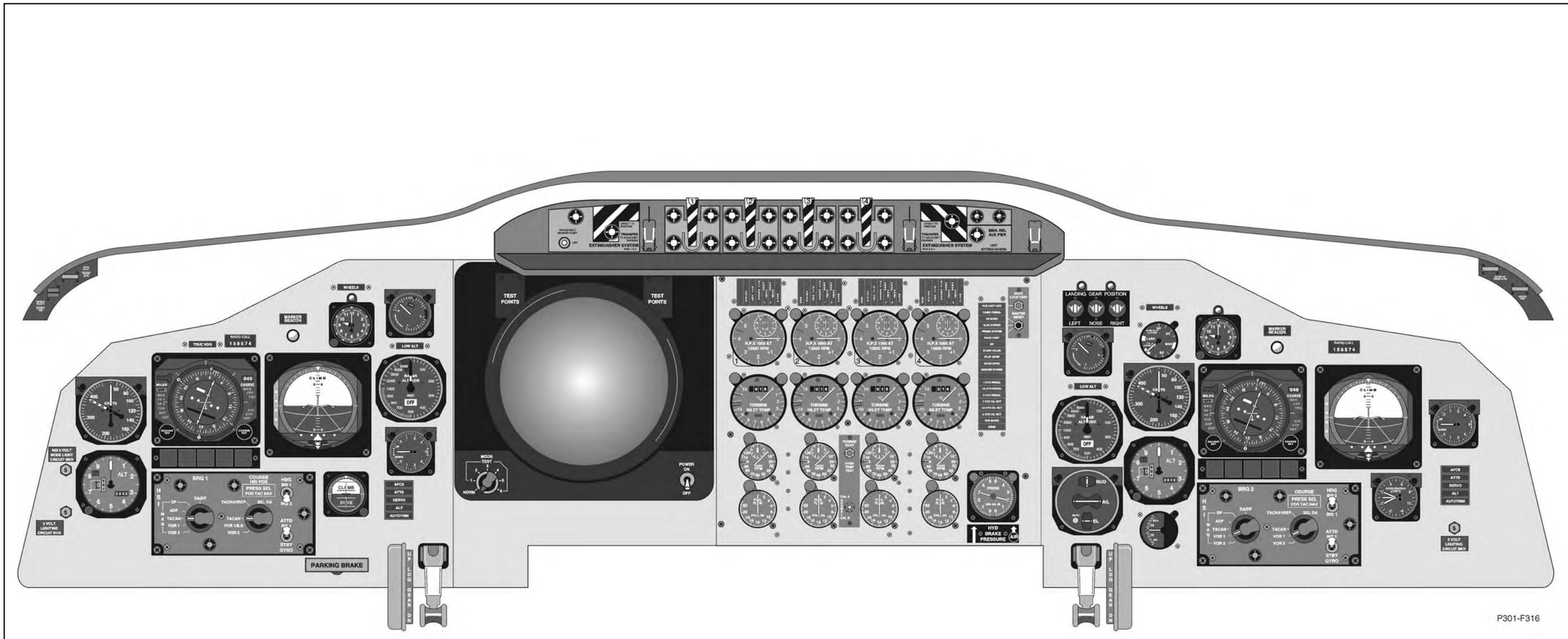
ORIGINAL



P-3 Flight Station (Sheet 2 of 3)

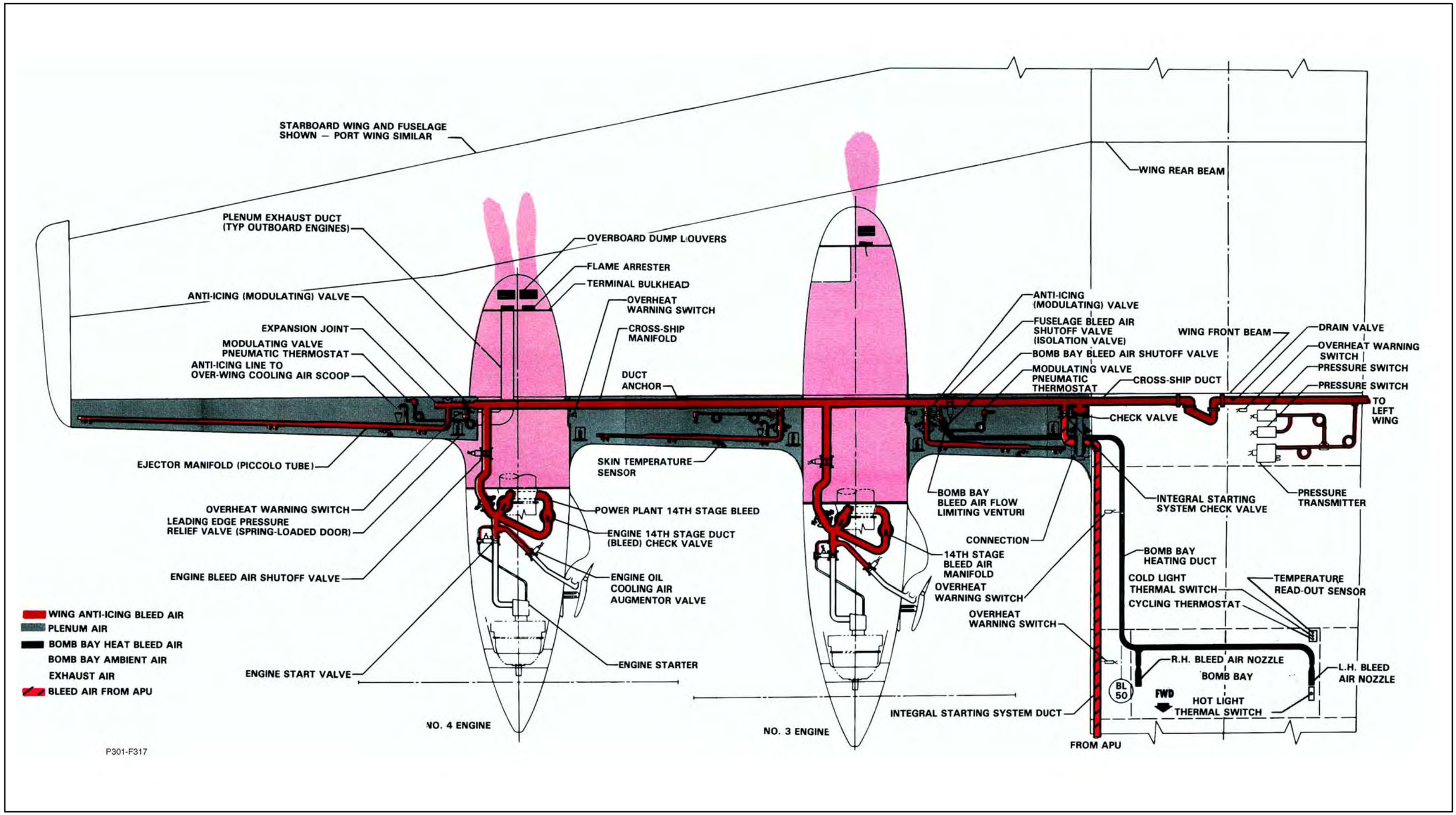
FO-17 (Reverse Blank)

ORIGINAL



P301-F316

P-3 Flight Station (Sheet 3 of 3)



Bleed Air System

FOUR ENGINE
FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

CONFIGURATION
"A"

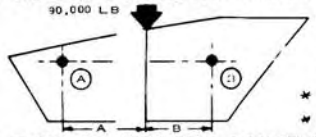
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

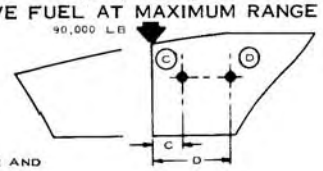
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (R)
TRIP DISTANCE A + R
* TRIP FUEL (A) − (R)
* TRIP TIME (A) + (R)
* ADD CLIMB TIME AND FUEL FACTORS.

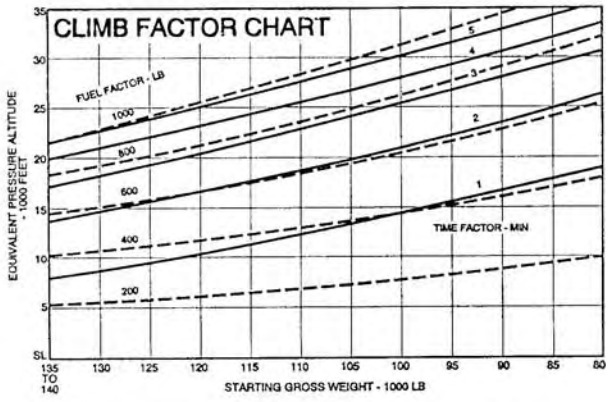
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 90,000 LB DESTINATION WEIGHT.

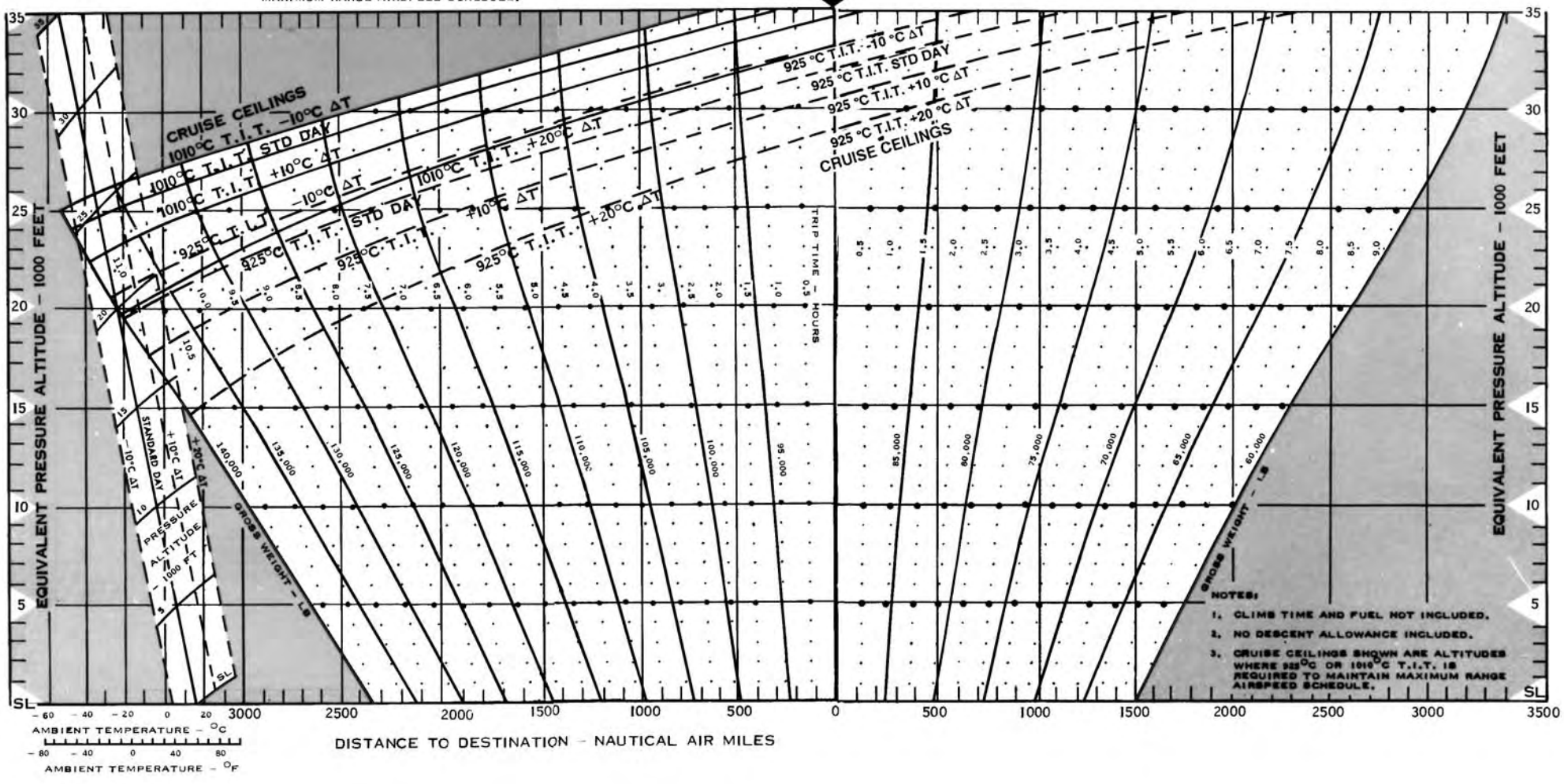


FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D − C
RESERVE TIME (D) − (C)
RESERVE FUEL (C) − (D)

NOTES:
1. CLIMB TIME AND FUEL NOT INCLUDED.
2. ADD FUEL ALLOWANCE FOR START, TAXI AND TAKEOFF (600 LB).
3. ADD TIME ALLOWANCE FOR TAKEOFF RUN AND ACCELERATION TO CLIMB SPEED (1 MIN).
4. CLIMB TIME AND FUEL ALLOWANCES OBTAINED FROM CLIMB FACTOR CHART.
5. CRUISE CEILINGS SHOWN ARE ALTITUDES WHERE 925 °C OR 1010 °C T.I.T. IS REQUIRED TO MAINTAIN MAXIMUM RANGE AIRSPEED SCHEDULE.



90,000 LB
NOMINAL WEIGHT AT DESTINATION



P301-F318

Fuel Planning — 4-Engine Maximum-Range Cruise — Configuration A (Sheet 1 of 3)

THREE ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

CONFIGURATION
"A"

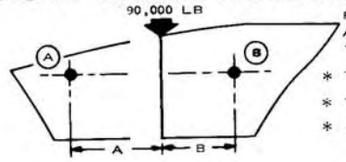
ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

TRIP FUEL AT MAXIMUM RANGE SPEEDS

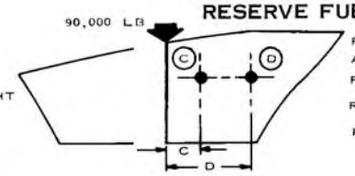
READ TRIP TIME AND FUEL FOR
90,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



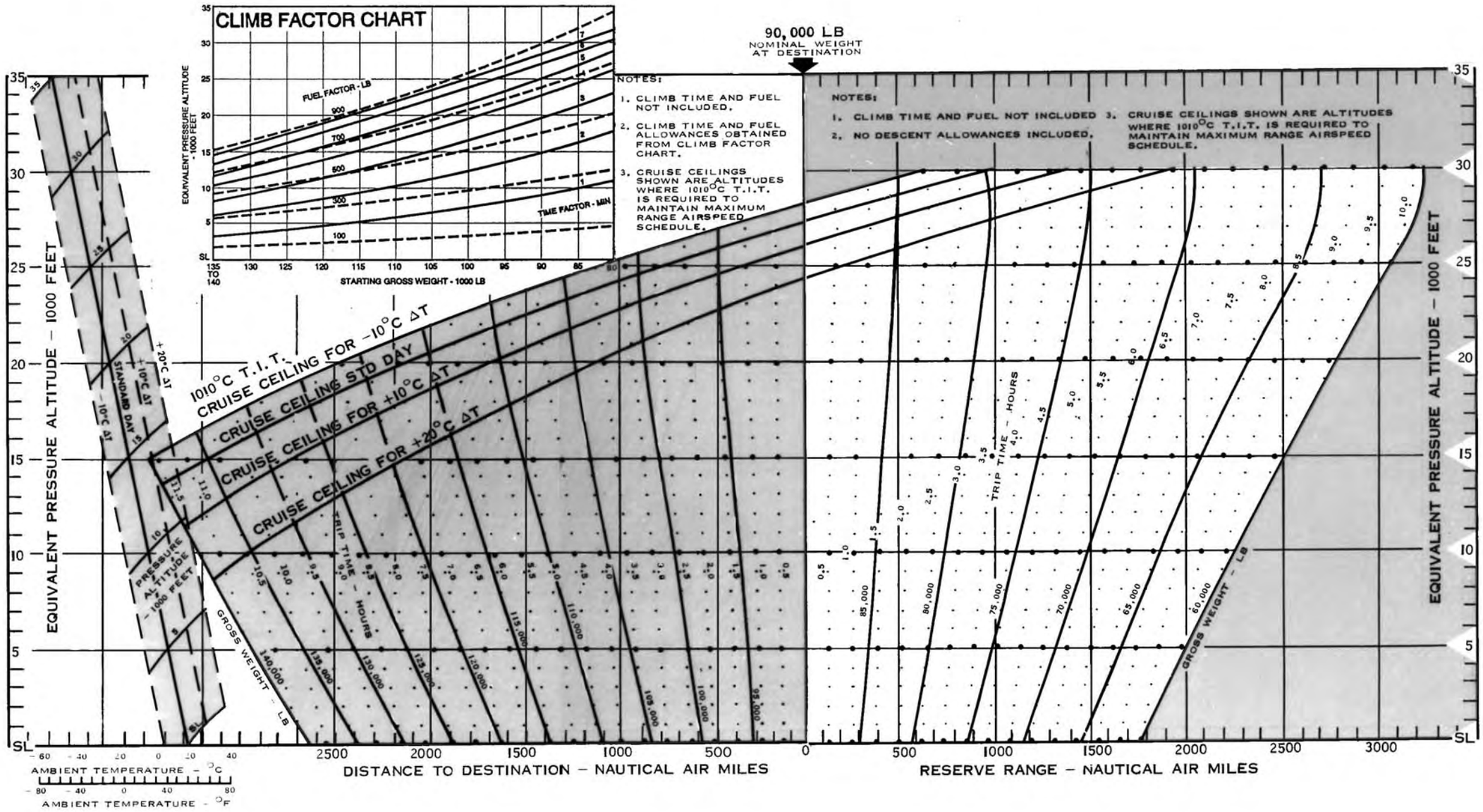
FOR OTHER DESTINATION WEIGHTS
AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A+B
* TRIP FUEL (A) − (B)
* TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS.

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 90,000 LB DESTINATION WEIGHT



FOR OTHER DESTINATION WEIGHTS
AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D − C
RESERVE TIME (D) − (C)
RESERVE FUEL (C) − (D)



P301-F319

Fuel Planning — 3-Engine Maximum-Range Cruise — Configuration A (Sheet 2 of 3)

TWO ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE ASYMMETRIC POWER

CONFIGURATION "A"

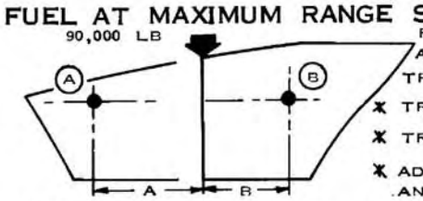
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

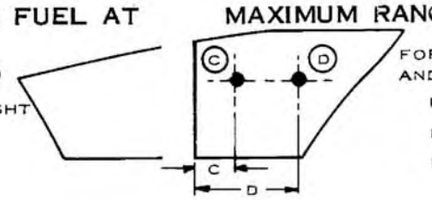
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A + B
✕ TRIP FUEL (A) − (B)
✕ TRIP TIME (A) + (B)
✕ ADD CLIMB TIME AND FUEL FACTORS

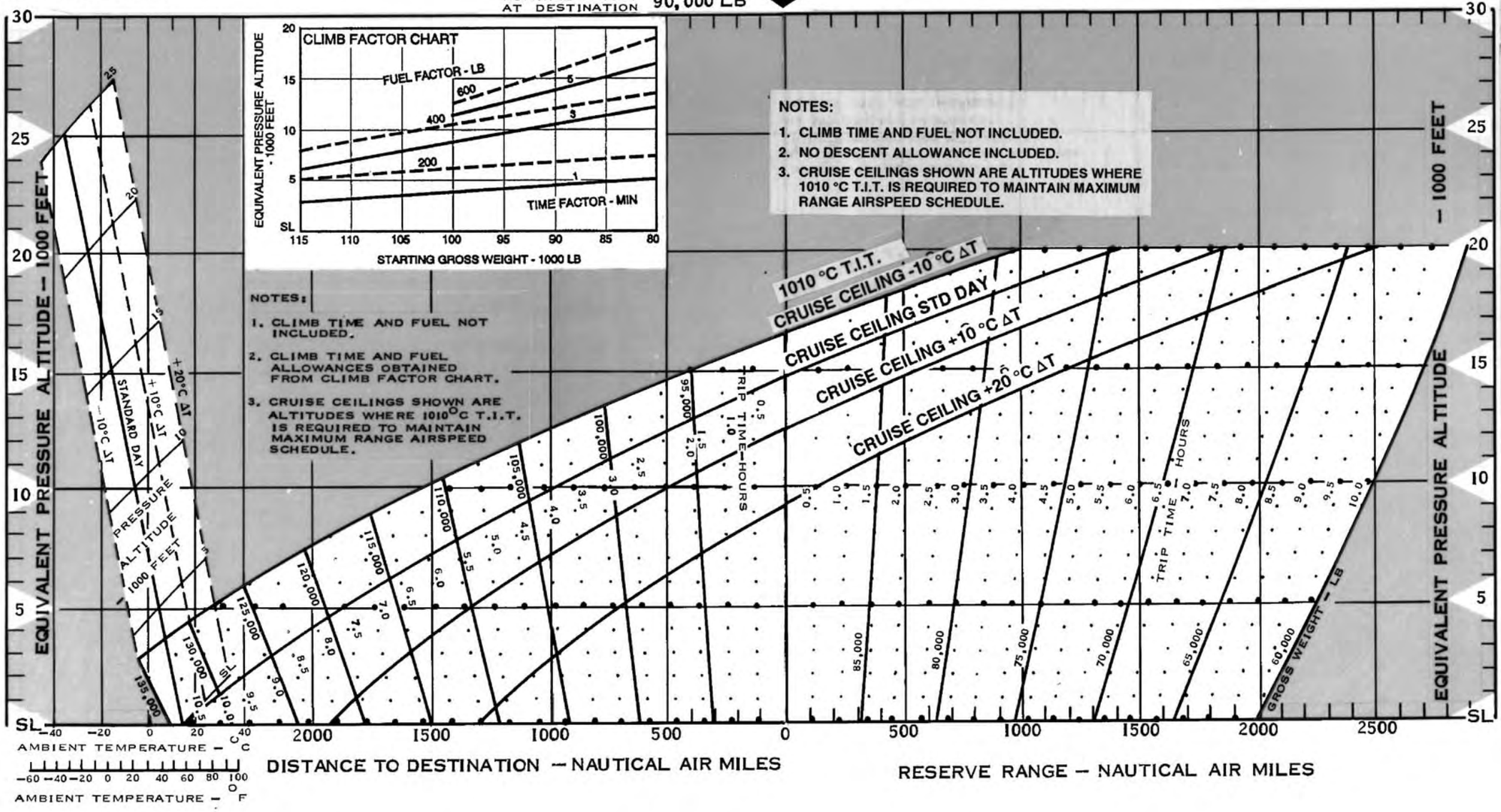
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 90,000 LB DESTINATION WEIGHT



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D − C
RESERVE TIME (D) − (C)
RESERVE FUEL (C) − (D)

NOMINAL WEIGHT AT DESTINATION **90,000 LB**



P301-F320

Fuel Planning — 2-Engine Maximum-Range Cruise — Configuration A (Sheet 3 of 3)

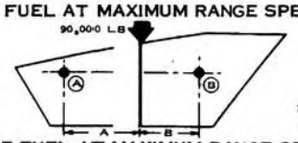
FOUR-ENGINE
FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

CONFIGURATION "B"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**
ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

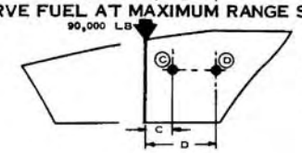


READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A). ADD CLIMB TIME AND FUEL FACTORS.

FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B).

TRIP DISTANCE A + B
*TRIP FUEL (A) − (B)
*TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS.

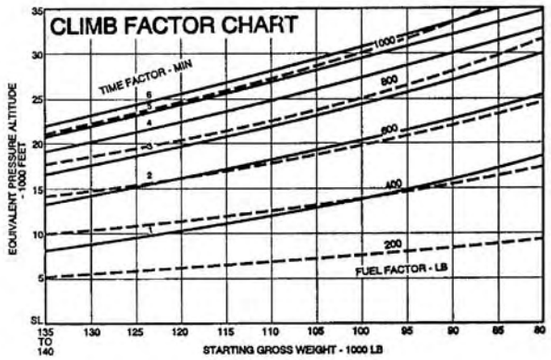
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

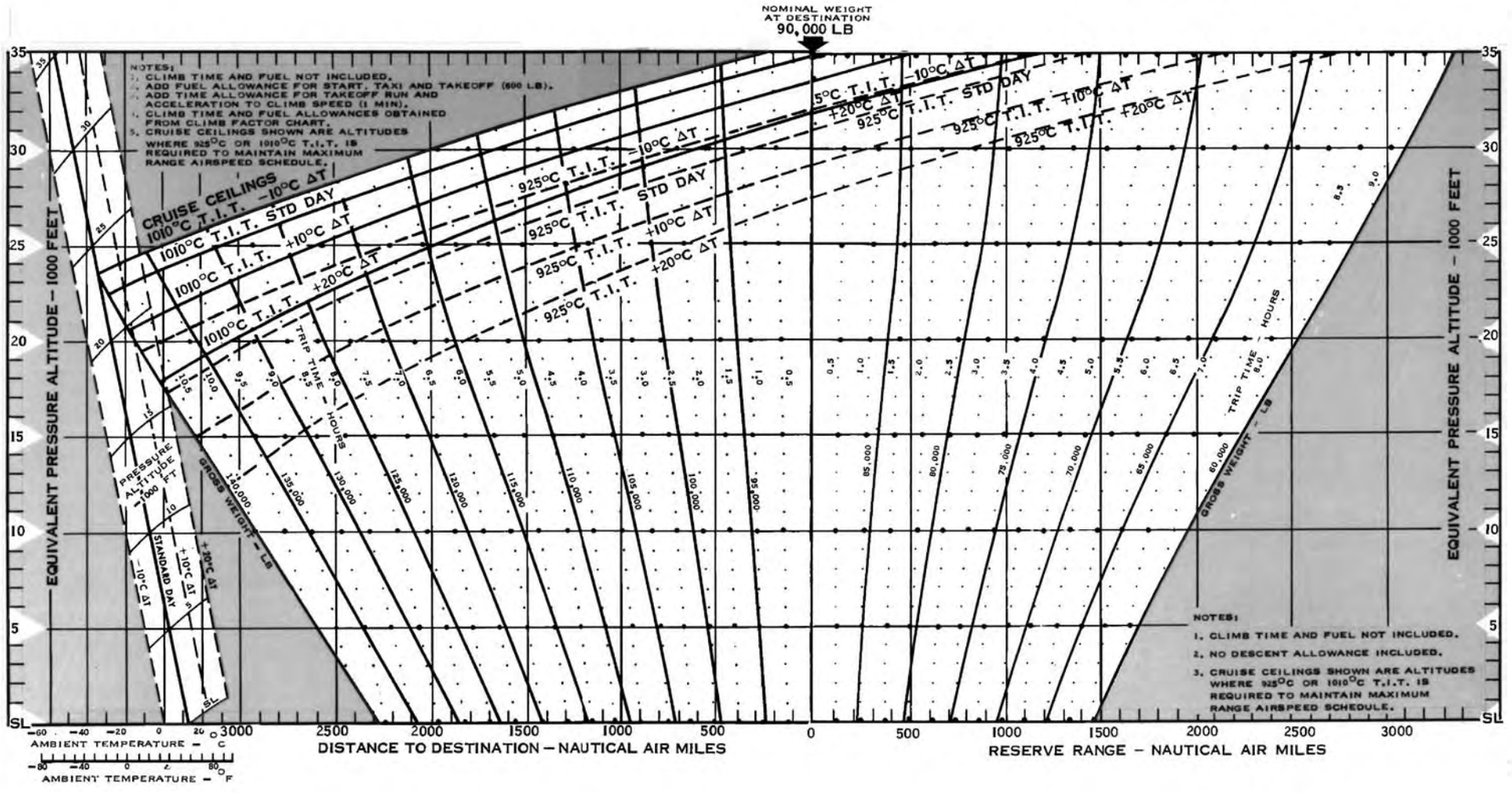


RESERVE RANGE AND TIME; READ AT ZERO FUEL WEIGHT (C) FOR 90,000 LB DESTINATION WEIGHT.

FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D).
RESERVE RANGE D − C
RESERVE TIME (D) − (C)
RESERVE FUEL (C) − (B)

CLIMB FACTOR CHART





P301-F321

Fuel Planning — 4-Engine Maximum-Range Cruise — Configuration B (Sheet 1 of 3)

THREE-ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

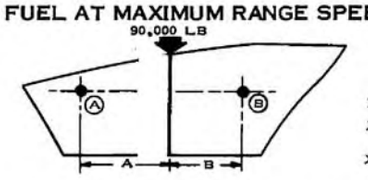
CONFIGURATION "B"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A71218-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A). ADD CLIMB TIME AND FUEL FACTORS.



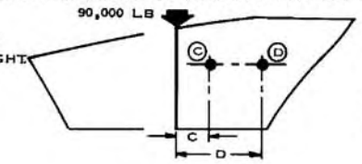
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B).

TRIP DISTANCE	A + B
* TRIP FUEL	(A) − (B)
* TRIP TIME	(A) + (B)

* ADD CLIMB TIME AND FUEL FACTORS.

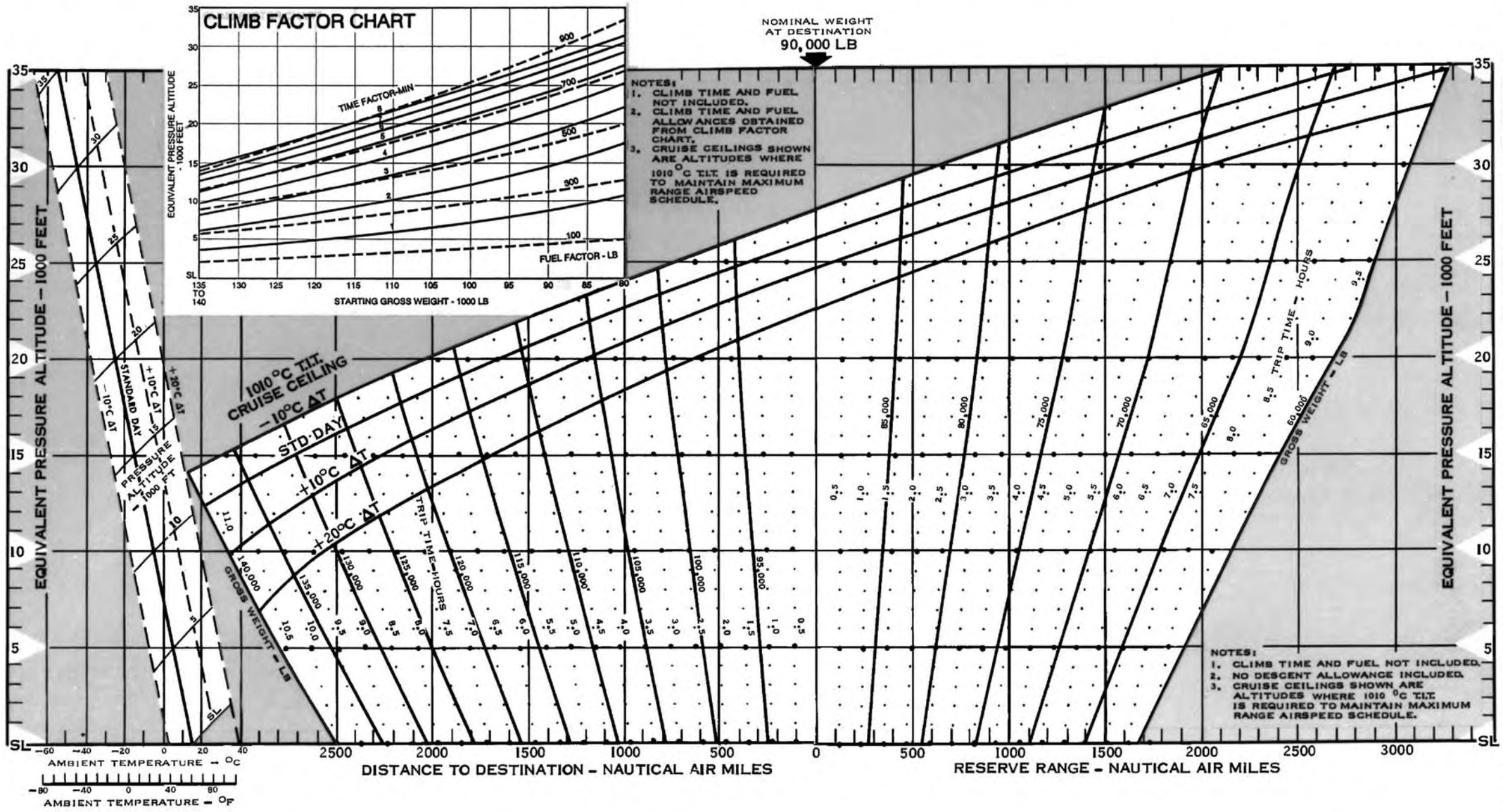
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME: READ AT ZERO FUEL WEIGHT (C) FOR 90,000 LB DESTINATION WEIGHT.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D).

RESERVE RANGE	D − C
RESERVE TIME	(D) − (C)
RESERVE FUEL	(C) − (D)



P301-F322

Fuel Planning — 3-Engine Maximum-Range Cruise — Configuration B (Sheet 2 of 3)

TWO-ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE
ASYMMETRIC POWER

CONFIGURATION "B"

MODEL: P-3C

DATA AS OF: 1 APRIL 1969

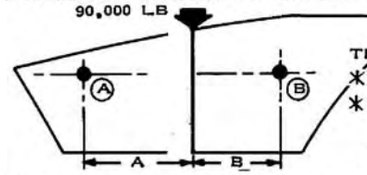
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A).

ADD CLIMB TIME AND FUEL FACTORS.



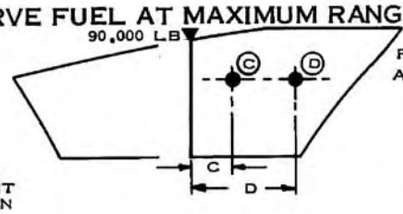
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B),

TRIP DISTANCE A + B
* TRIP FUEL (A) − (B)
* TRIP TIME (A) + (B)

* ADD CLIMB TIME AND FUEL FACTORS

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

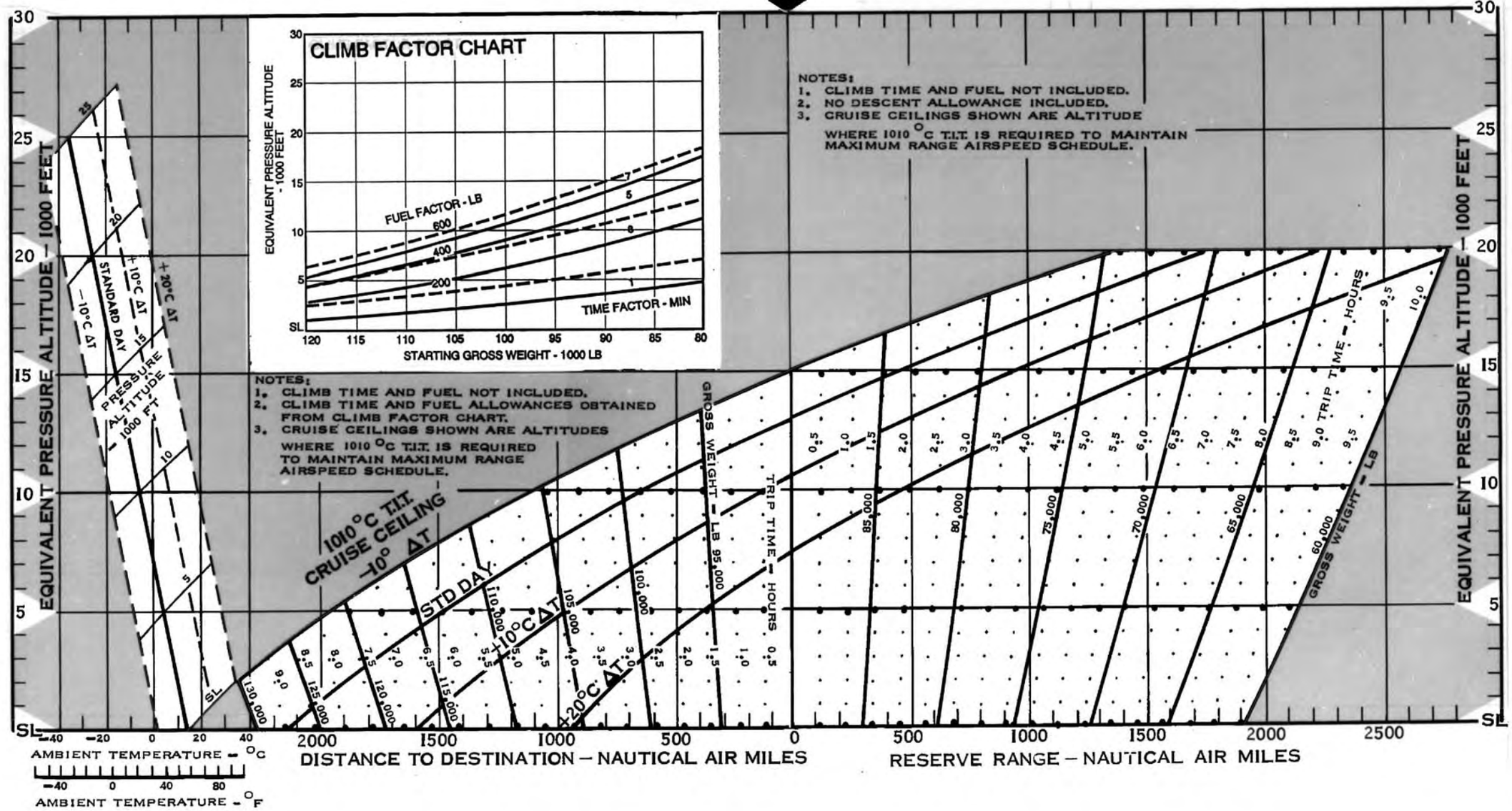
RESERVE RANGE AND TIME: READ AT ZERO FUEL WEIGHT FOR 90,000 LB DESTINATION WEIGHT (C).



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D).

RESERVE RANGE D — C
RESERVE TIME (D)−(C)
RESERVE FUEL (C)−(D)

NOMINAL WEIGHT AT DESTINATION 90,000 LB



P301-F323

Fuel Planning — 2-Engine Maximum-Range Cruise — Configuration B (Sheet 3 of 3)

FOUR ENGINE
FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

CONFIGURATION "C"

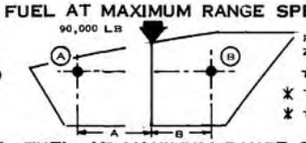
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

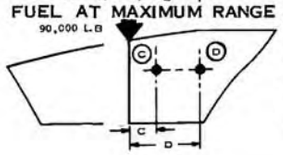
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS



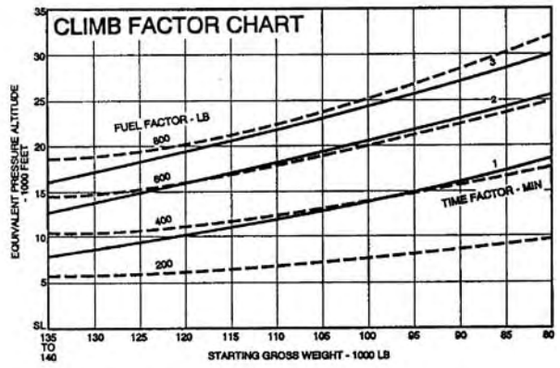
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A + B
* TRIP FUEL (A) − (B)
* TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS.

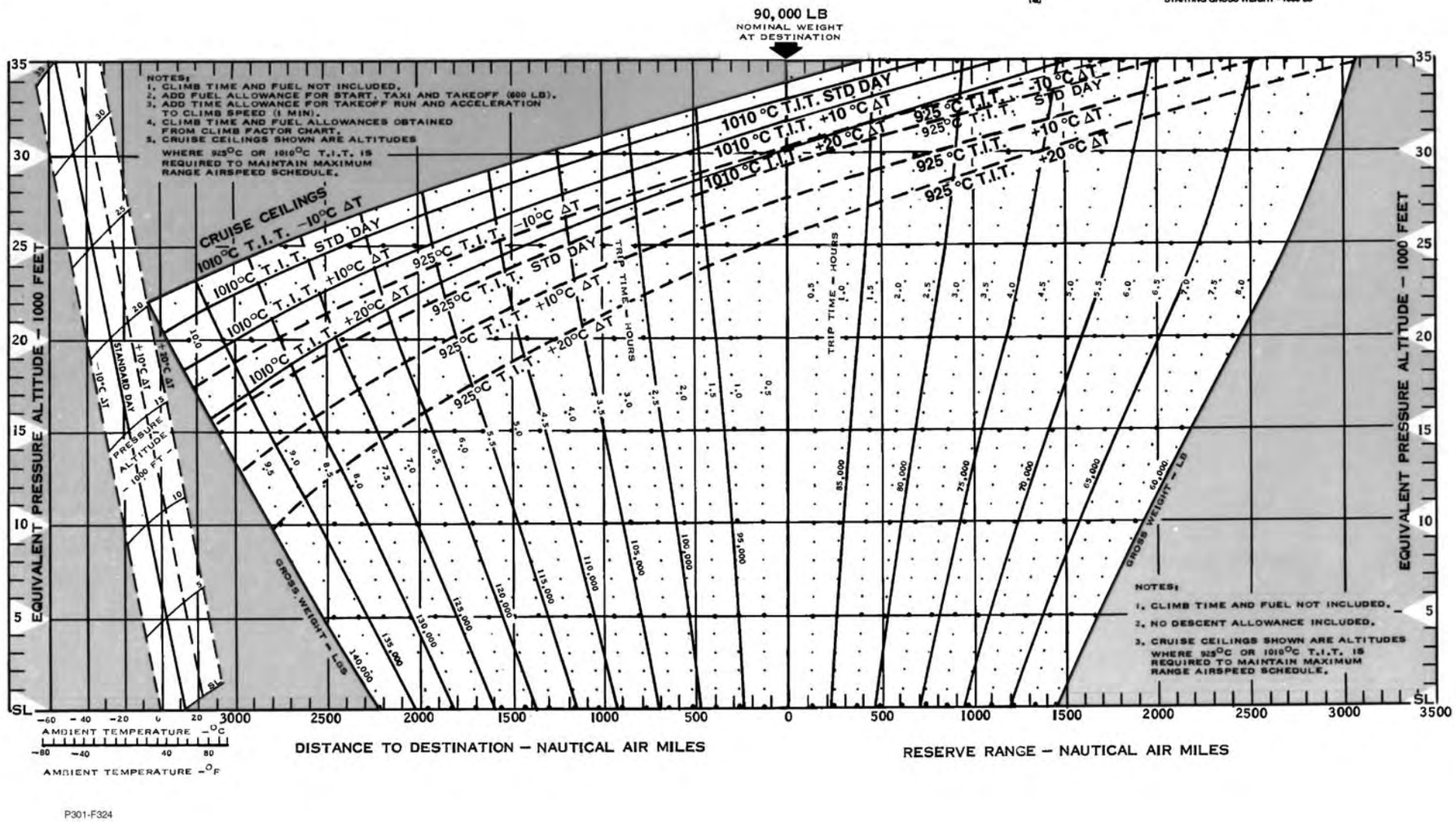
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 90,000 LB DESTINATION WEIGHT.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D − C
RESERVE TIME (D) − (C)
RESERVE FUEL (C) − (D)





P301-F324

Fuel Planning — 4-Engine Maximum-Range Cruise — Configuration C (Sheet 1 of 3)

THREE ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

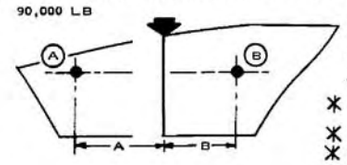
CONFIGURATION "C"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

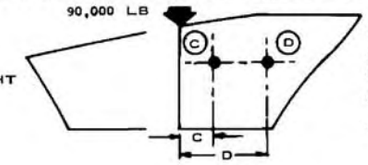
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



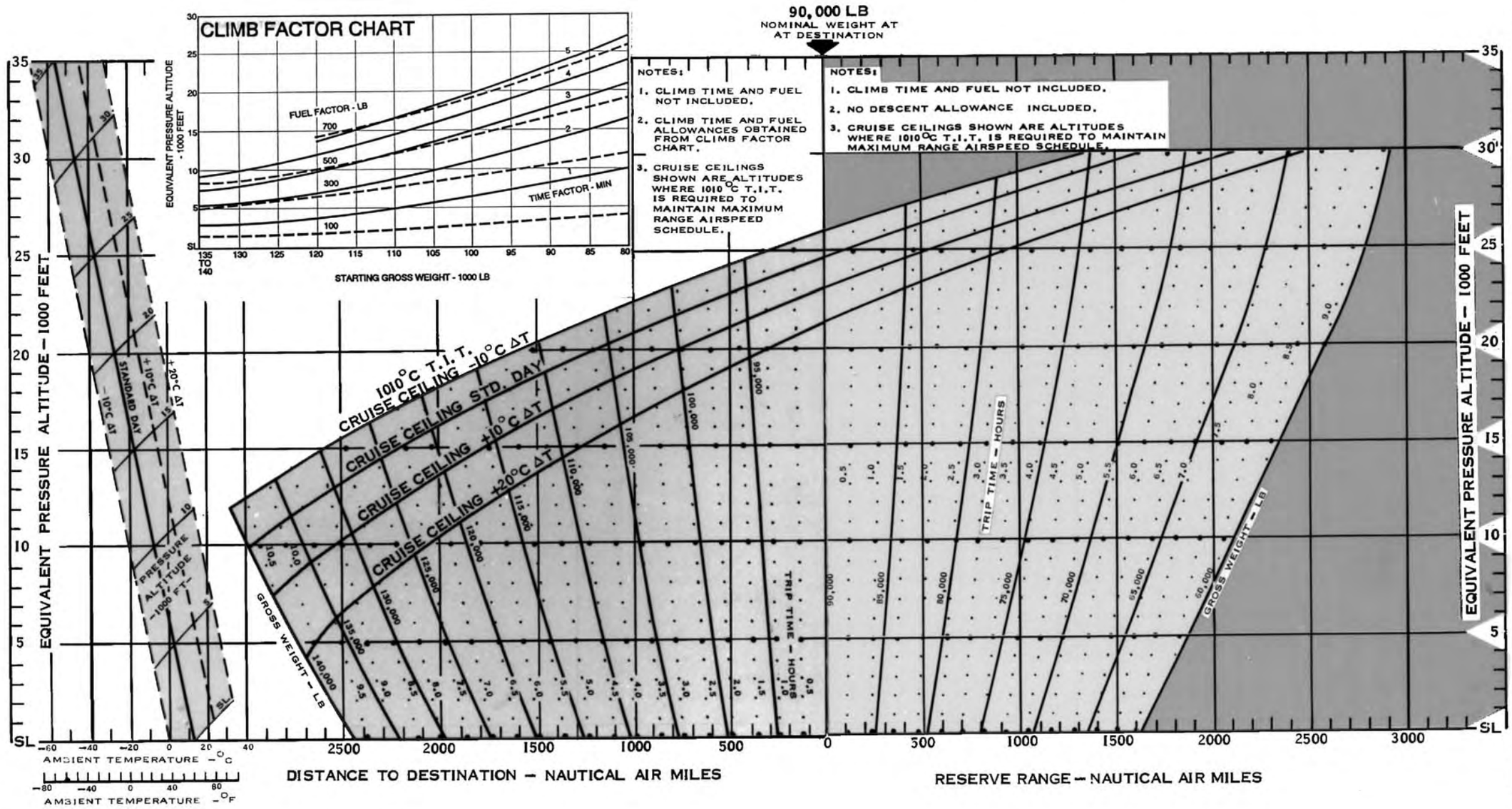
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A+B
* TRIP FUEL (A) − (B)
* TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS.

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 90,000 LB DESTINATION WEIGHT



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D − C
RESERVE TIME (D) − (C)
RESERVE FUEL (C) − (D)



P301-F325

Fuel Planning — 3-Engine Maximum-Range Cruise — Configuration C (Sheet 2 of 3)

TWO ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

ASYMMETRIC POWER

CONFIGURATION "C"

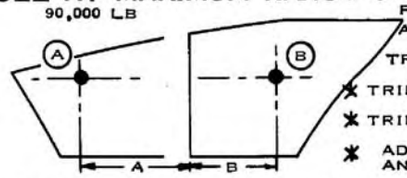
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

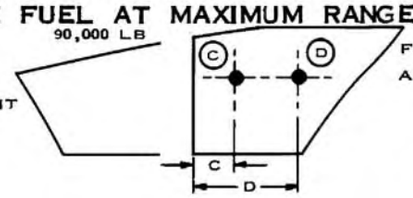
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A + B
* TRIP FUEL (A) - (B)
* TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS.

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

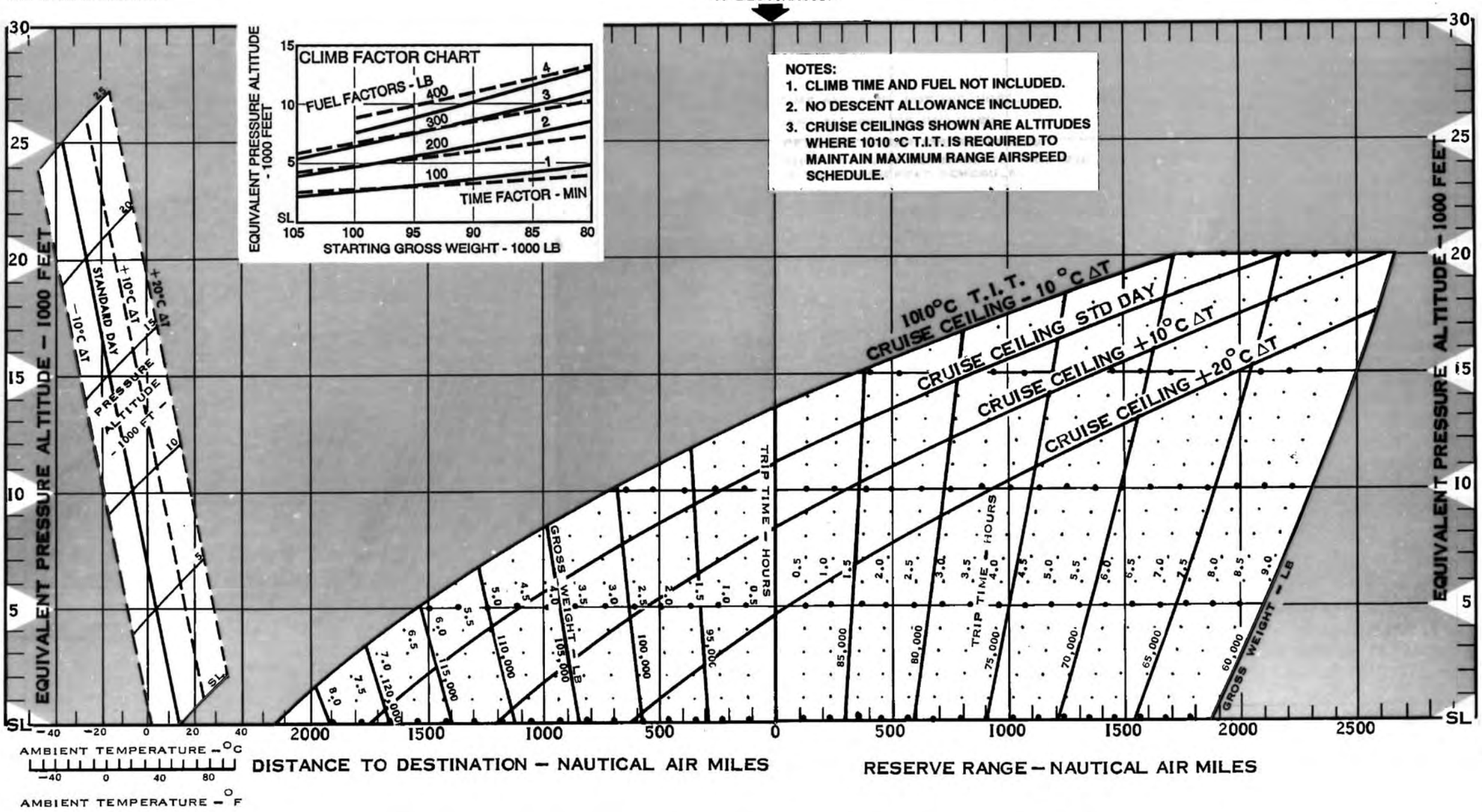
RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 90,000 LB DESTINATION WEIGHT



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D - C
RESERVE TIME (D) - (C)
RESERVE FUEL (C) - (D)

90,000 LB
NOMINAL WEIGHT AT DESTINATION

NOTES:
1. **CLIMB TIME AND FUEL NOT INCLUDED.**
2. **NO DESCENT ALLOWANCE INCLUDED.**
3. **CRUISE CEILINGS SHOWN ARE ALTITUDES WHERE 1010 °C T.I.T. IS REQUIRED TO MAINTAIN MAXIMUM RANGE AIRSPEED SCHEDULE.**



P301-F326

Fuel Planning — 2-Engine Maximum-Range Cruise — Configuration C (Sheet 3 of 3)

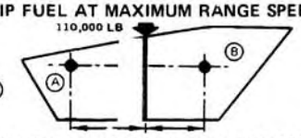
FOUR ENGINE
FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

CONFIGURATION "D"

MODEL:
P-3C
DATA AS OF:
1 APRIL 1969
DATA BASIS:
FLIGHT TESTS

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

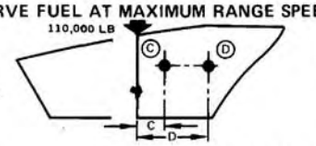
TRIP FUEL AT MAXIMUM RANGE SPEEDS



READ TRIP TIME AND FUEL FOR 110,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.

FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A + B
*TRIP FUEL (A) – (B)
*TRIP TIME (A) + (B)
*ADD CLIMB TIME AND FUEL FACTORS.

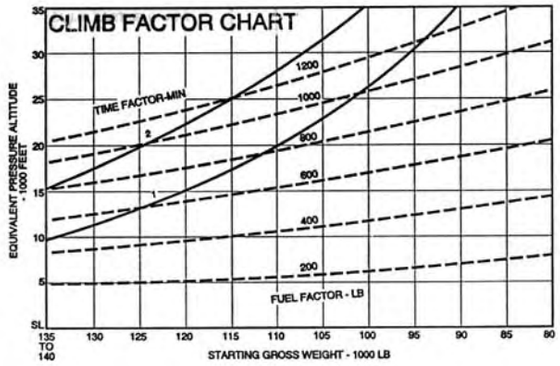
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

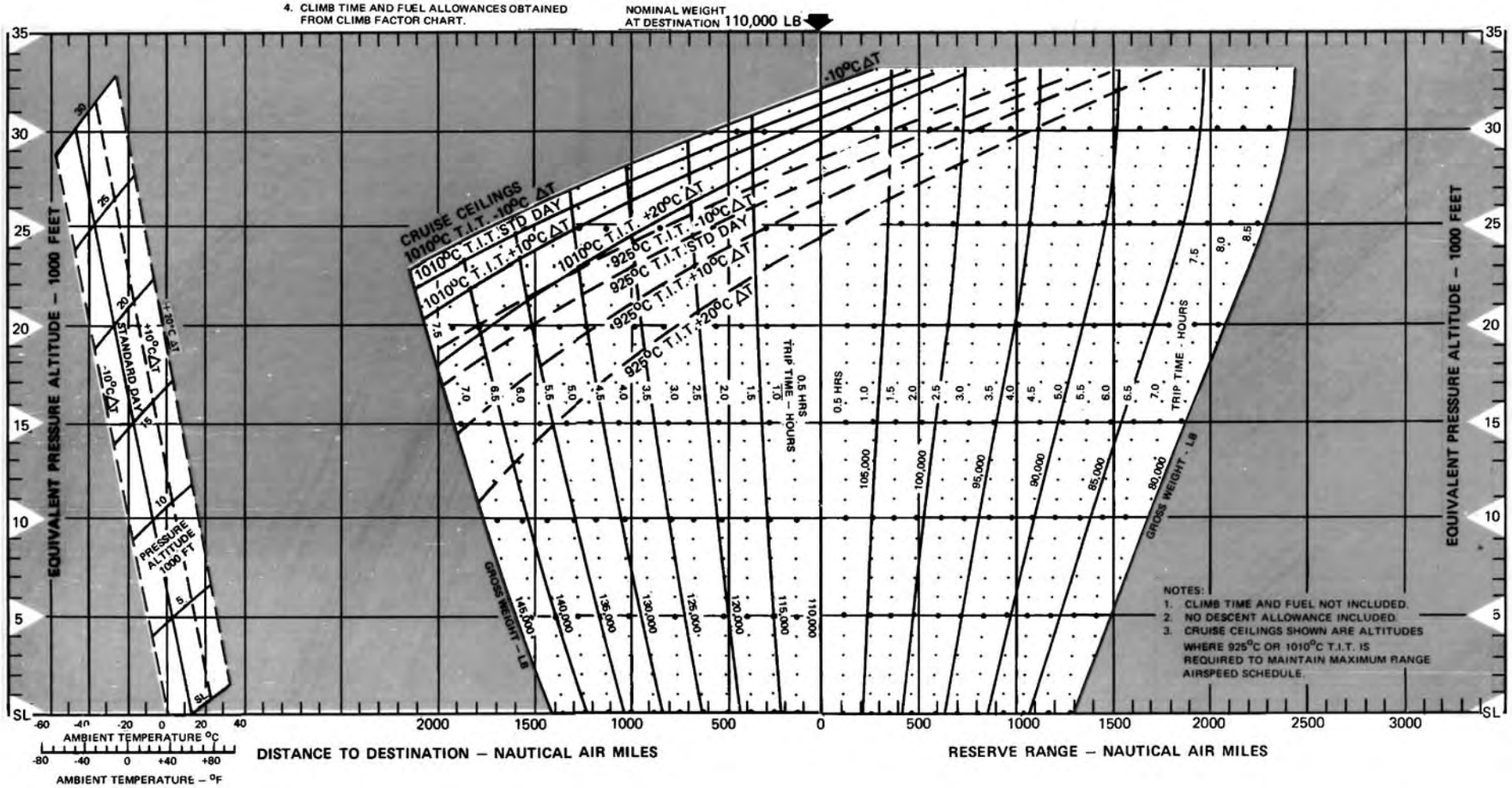


RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 110,000 LB DESTINATION WEIGHT.

FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D – C
RESERVE TIME (D) – (C)
RESERVE FUEL (C) – (D)

NOTES:
1. CLIMB TIME AND FUEL NOT INCLUDED.
2. ADD FUEL ALLOWANCE FOR START, TAXI AND TAKEOFF (600 LB).
3. ADD TIME ALLOWANCE FOR TAKEOFF RUN AND ACCELERATION TO CLIMB SPEED (1 MIN).
4. CLIMB TIME AND FUEL ALLOWANCES OBTAINED FROM CLIMB FACTOR CHART.
5. CRUISE CEILINGS SHOWN ARE ALTITUDES WHERE 925°C OR 1010°C T.I.T. IS REQUIRED TO MAINTAIN MAXIMUM RANGE AIRSPEED SCHEDULE.





P301-F327

Fuel Planning — 4-Engine Maximum-Range Cruise — Configuration D (Sheet 1 of 2)

THREE ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

CONFIGURATION "D"

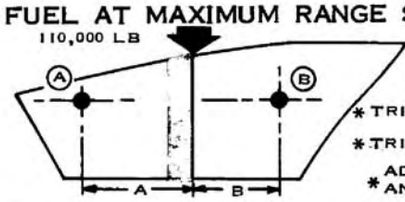
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

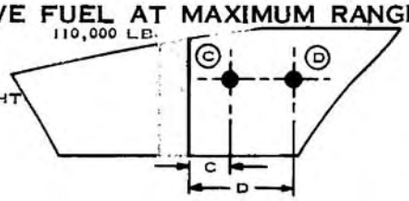
READ TRIP TIME AND FUEL FOR 110,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP TIME A + B
*TRIP FUEL (A) – (B)
*TRIP TIME (A) + (B)
*ADD CLIMB TIME AND FUEL FACTORS.

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

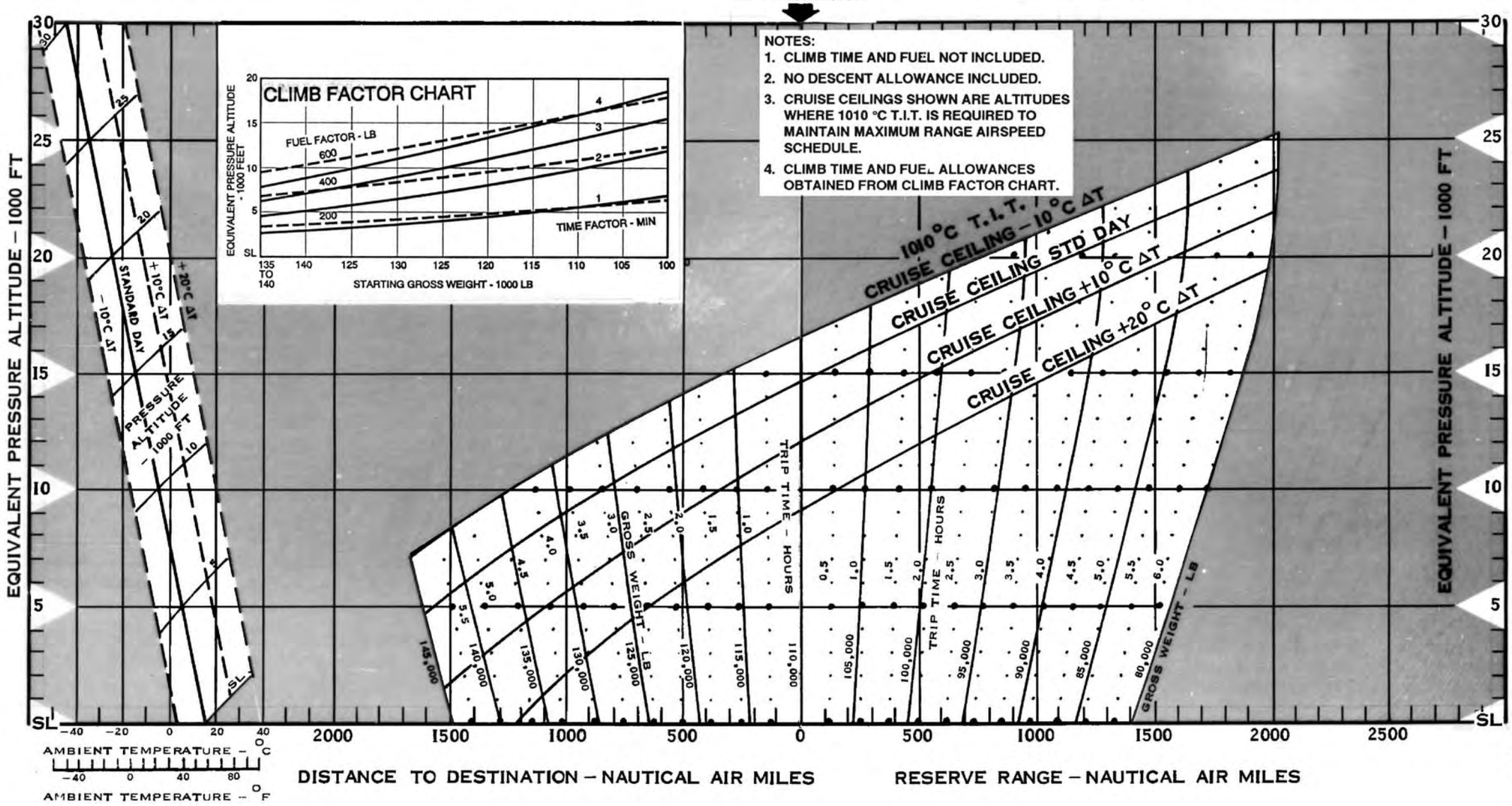
RESERVE RANGE AND TIME: READ AT ZERO FUEL WEIGHT (C) FOR 110,000 LB DESTINATION WEIGHT



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D – C
RESERVE TIME (D) – (C)
RESERVE FUEL (C) – (D)

110,000 LB
NOMINAL WEIGHT AT DESTINATION

NOTES:
1. CLIMB TIME AND FUEL NOT INCLUDED.
2. NO DESCENT ALLOWANCE INCLUDED.
3. CRUISE CEILINGS SHOWN ARE ALTITUDES WHERE 1010 °C T.I.T. IS REQUIRED TO MAINTAIN MAXIMUM RANGE AIRSPEED SCHEDULE.
4. CLIMB TIME AND FUEL ALLOWANCES OBTAINED FROM CLIMB FACTOR CHART.



P301-F328

Fuel Planning — 3-Engine Maximum-Range Cruise — Configuration D (Sheet 2 of 2)

FOUR ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

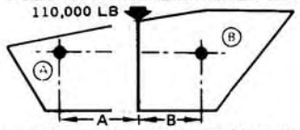
CONFIGURATION "E"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

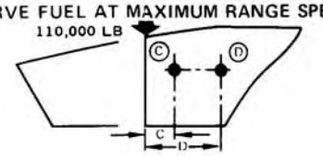
READ TRIP TIME AND FUEL FOR
110,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS



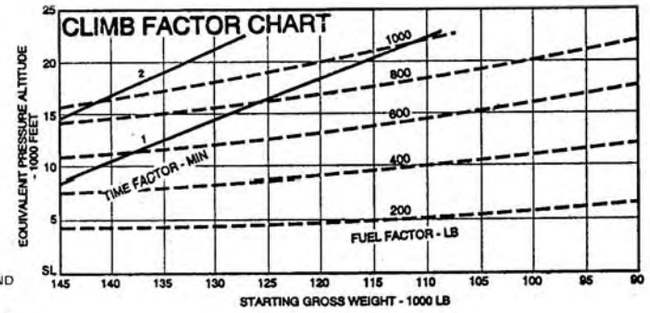
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP DISTANCE A - B
-TRIP FUEL (A) (B)
-TRIP TIME (A) (B)
ADD CLIMB TIME AND FUEL FACTORS

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT (C)
FOR 110,000 LB DESTINATION WEIGHT



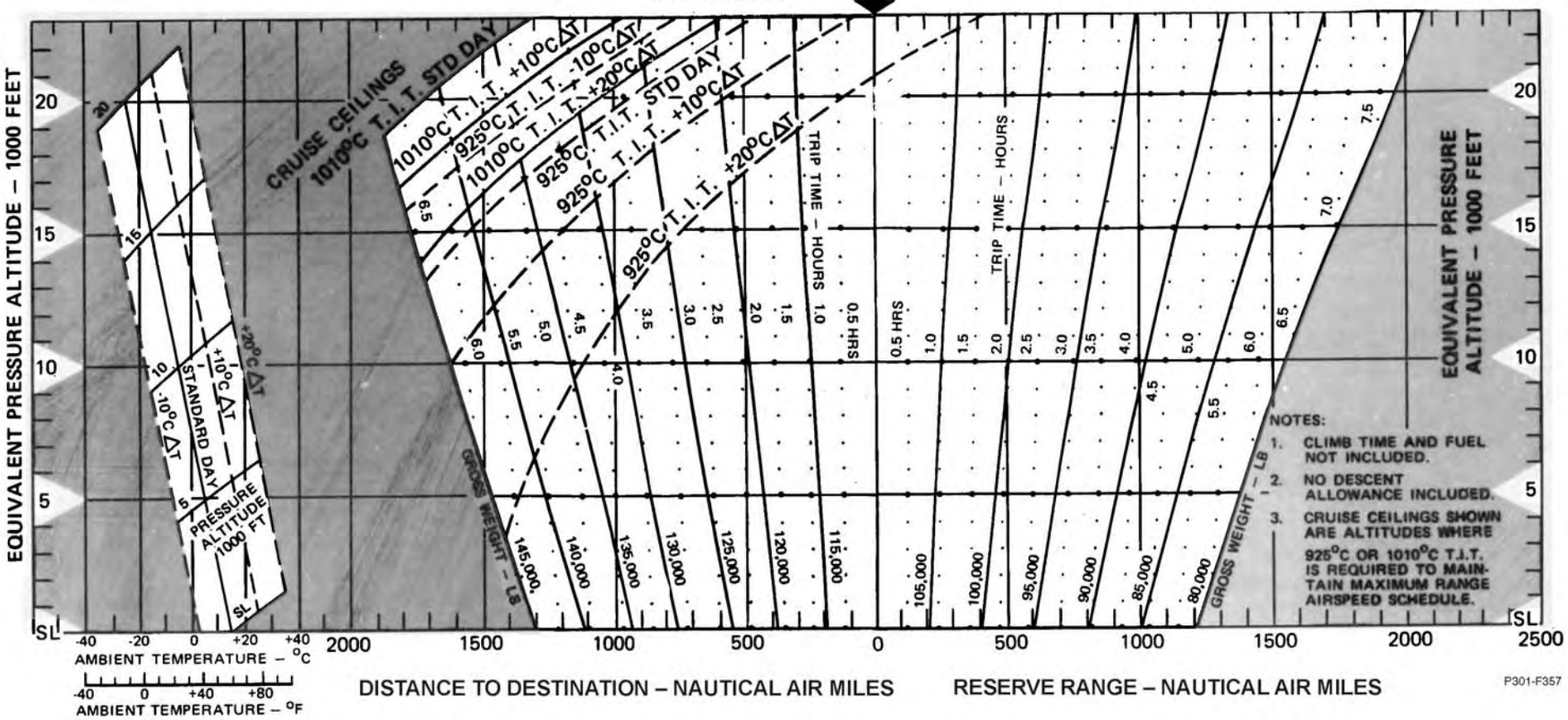
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)
RESERVE RANGE D - C
RESERVE TIME (D) (C)
RESERVE FUEL (C) (D)



NOTES:

1. CLIMB TIME AND FUEL NOT INCLUDED.
2. ADD FUEL ALLOWANCE FOR START, TAXI AND TAKEOFF (600 LB).
3. ADD TIME ALLOWANCE FOR TAKEOFF RUN AND ACCELERATION TO CLIMB SPEED (1 MIN).
4. CLIMB TIME AND FUEL ALLOWANCES OBTAINED FROM CLIMB FACTOR CHART.
5. CRUISE CEILINGS SHOWN ARE ALTITUDES WHERE 925°C OR 1010°C T.I.T. IS REQUIRED TO MAINTAIN MAXIMUM RANGE AIRSPEED SCHEDULE.

NOMINAL WEIGHT AT DESTINATION 110,000 LB



P301-F357

LIST OF EFFECTIVE PAGES

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Original	1 (Reverse Blank)
Original	3 (Reverse Blank)
Original	5 (Reverse Blank)
Original	7 thru 11 (Reverse Blank)
Original	13 thru 51 (Reverse Blank)
Original	53 thru 69 (Reverse Blank)
Original	71 (Reverse Blank)
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Original	2-1 thru 2-152
Original	3-1 thru 3-17 (Reverse Blank)
Original	4-1 thru 4-12
Original	5-1 thru 5-11 (Reverse Blank)
Original	73 (Reverse Blank)
Original	6-1 thru 6-4
Original	75 (Reverse Blank)
Original	7-1 thru 7-13 (Reverse Blank)
Original	7-15 thru 7-16
Original	8-1 thru 8-58
Original	9-1 thru 9-32
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Original	12-1 thru 12-31 (Reverse Blank)
Original	13-1 thru 13-2
Original	14-1 thru 14-2
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Original	16-1 thru 16-14
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Original	18-1 thru 18-24
Original	83 (Reverse Blank)
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Original	20-1 thru 20-58
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Original	21-1 thru 21-2
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Original	23-1 thru 23-115 (Reverse Blank)
Original	87 (Reverse Blank)
Original	24-1 thru 24-6
Original	25-1 thru 25-6
Original	89 (Reverse Blank)
Original	26-1 thru 26-49 (Reverse Blank)

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Original	29-1 thru 29-33 (Reverse Blank)
Original	30-1 thru 30-6
Original	31-1 thru 31-21 (Reverse Blank)
Original	32-1 thru 32-31 (Reverse Blank)
Original	33-1 thru 33-2
Original	33-4 (Obverse Blank)
Original	33-5 thru 33-49 (Reverse Blank)
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