NATOPS FLIGHT MANUAL

NAVY MODEL

P-3A/B/C AIRCRAFT

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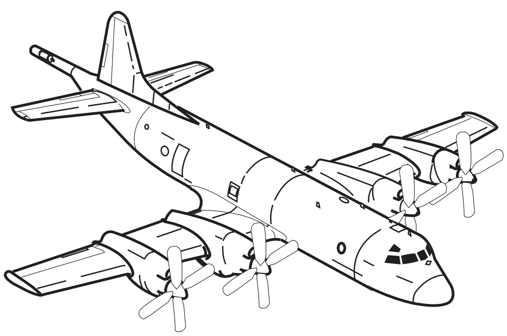
TO BE USED IN CONJUNCTION WITH
NFO/AIRCREW NATOPS FLIGHT MANUAL NAVAIR 01-75PAC-1.1



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DEPARTMENT OF THE NAVY
CHIEF OF NAVAL OPERATIONS
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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 OPNAVINST 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.

J. B. NATHMAN
Rear Admiral, U.S. Navy
Director, Air Warfare

INTERIM CHANGE SUMMARY

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

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1 thru 73	Previously Incorporated

The following Interim changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
74	Initial NATOPS Errata
75	Fueling Procedures
76	GPS Usage
77	Before Start/Takeoff Checklist, Engine Fire on the Ground
78	GPS Procedures

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

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

SUMMARY OF APPLICABLE TECHNICAL DIRECTIVES

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

TECHNICAL DIRECTIVE	TITLE	DATE INCORPORATED IN MANUAL
AFC-374	BA-1109/URT-26(V) Dry Battery Relocation	15 Dec 1981
AFC-378	Dual TACAN Antenna	15 Oct 1980
AFC-387	ASW System — 3V DIFAR/DICASS	15 Dec 1981
AFC-405	AWG-19B(V)1 HACLCS	15 Dec 1981
AFC-408	LTN-72 Inertial Navigation	01 Sept 1981
AFC-414	LTN-211 Omega Navigation	01 Aug 1982
AFC-424	Parkhill KY-75	01 Dec 1983
AFC-426	WHEELS Warning Light	15 Dec 1981
AFC-443	AQA-7A(V) DIFAR System, Modification of	01 Feb 1985
AFC-450	UD III Provisions (SUDS)	01 May 1987
AFC-456	BRU-14/A Bomb Rack	01 Feb 1985
AFC-457	DPS with MLU	01 May 1987
AFC-457	AN/ALR-66(V)3 Installation	01 May 1987
AFC-459	ASQ-81 in Lieu of ASQ-10 MAD/CGA	01 May 1987
AFC-460	Landing Gear Warning System	15 Feb 1986
AFC-472	ARC-187 in Lieu of ARC-143	15 June 1988
AFC-473	Solid-State Synchrophaser	15 Feb 1986
AFC-477	UD III MLU Installation	01 May 1987
AFC-483	Secure Voice UHF SATCOM Interim Installation	15 June 1988
AFC-484	UD III Channel Expansion	15 June 1988
AFC-485	ARC-182 in Lieu of ARC-101	15 June 1988
AFC-489	Electronic Equipment Rack Aural Overheat Warning	15 June 1988
AFC-495	Provisions for Mk-50 Torpedo	30 Jan 1990
AFC-496	Bomb Bay Door Control Design Improvements	30 July 1989
AFC-517	Fuel Tank Foam	01 Sept 1991
AFC-520	AN/APS-234 Installed in P-3A/B	01 June 1997
AFC-522	Modify SATCOM System, Install Batwing Antenna	01 June 1997
AFC-538	Installation of T56-A-14 on P-3A	01 June 1997
AFC-540	AN/ARN-151 Global Positioning System (GPS)	01 June 1997
AFC-542	AN/USC-43 Advanced Narrowband Digital Voice Terminal (ANDVT)	01 June 1997
AFC-549	ALE-39/AAR-47 Missile Warning Set	01 June 1997
AFC-551	AN/APS-234 Installed in P-3C	01 June 1997
AFC-552	Secure Voice UHF Satcom	01 June 1997
AFC-562	AN/ASH-37 Structural Data Recording System	15 Feb 1999
AFC-570	AN/AWG-32 Pre-AIP Maverick Missile System	15 Feb 1999
AFC-574	Anti-Surface Warfare Improvement Program (AIP)	15 Feb 1999
AFC-576	AN/USQ-78 Upgrade	01 June 1999
AFC-578	Sustained Readiness Program/Digital Fuel Quantity System (DFQS)	15 Feb 1999
AFC-581	AN/ASN-179 Replacement Inertial Navigation Unit (RINU)	15 Feb 1999
AFC-582	AN/AWG-19B HACLCS On-Line Wiring	15 Feb 1999
AFC-608	Removal of RO-515 IRDS Video Recorder	15 Feb 1999
AFC-609	Removal of AN/ASQ-57B SAR Buoy	15 Feb 1999
AFC-610	Removal of ARN-99/LTN-211 Omega Navigation Systems	15 Feb 1999

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

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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List of Abbreviations and Acronyms

A

A-4. Three-Axis Accelerometer.

A. BFI Trace or CIP A.

A/A. Air-to-Air.

AAC. Aircraft Armament Change.

AAI. Air-to-Air Interrogator.

A/C. Aircraft.

AC. Alternating Current.

ACC. Accuracy Check Control.

ACPA. Adaptive Control Phased Array.

ACQ. Acquisition.

ACR. Auxiliary Control Relay.

ADB. Acoustic Distribution Box.

ADC. Automatic Drift Control.

ADF. Automatic Direction Finder.

ADIZ. Air Defense Identification Zone.

ADL. Auxiliary Display Logic.

ADRL. Automatic Distribution Requirement List.

AECB. Aft Electronic Circuit Breaker Panel.

AFC. Airframe Change, Automatic Frequency Control.

AFCS. Automatic Flight Control System.

AGL. Above Ground Level.

AGM. Air-to-Ground Missile.

AHRS. Attitude Heading Reference System.

ALI. Automatic Line Integration.

ALI BRG. Automatic Line Integrated Bearing.

Alpha Range. Propeller Flight Operating Range.

AM. Amplitude-Modulation.

AMAC. Aircraft Monitor and Control System.

AME. Amplitude Modulated Equivalent.

ANT. Antenna.

AOA. Angle-of-Attack.

APU. Auxiliary Power Unit.

APU ESS. APU Essential (DC Bus).

ARM. Armament.

ARO. Auxiliary Readout Display.

ARTCC. Air Route Traffic Control Center.

AS. Anti-Spoofing.

ASCB. Acoustic System Circuit Breaker Panel.

ASCII. American Standard Code for Information Interchange.

ASCL. Advanced Sonobuoy Communication Link.

ASGN. Assign.

ASM. Aux Switching Matrix.

ASP. Advanced Signal Processor.

ASR. Air Surveillance Radar.

ASRAPS. Acoustic Sensor Range Prediction Service.

ASSG. Acoustic Sensor Signal Generator.

ASUW. Anti-Surface Warfare.

ATAC. Air Transportable Acoustic Communications.

ATSG. Acoustic Test Signal Generator.

AU. Analyzer Unit.

AUTO. Automatic.

AVC. Automatic Volume Control.

B

B. BFI Trace B or CIP B.

BATT. Battery.

BBC. Bearing Bias Correction.

BC. Bus Controller.

BDHI. Bearing-Distance-Heading Indicator.

Beta. Propeller Blade Angle.

Beta Range. Propeller Ground Operating Range.

BFC. Bearing Frequency Control.

BFI. Bearing Frequency Indicator.

BFO. Beat-Frequency Oscillator.

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

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

BOL. Bearing Only Launch.

BOT. Beginning of Tape.

BR. Blade Rate.

BT. Bathythermograph.

BU. Battery Unit.

BUS A. Main AC.

BUS B. Main AC.

C

C. BFI Trace C or CIP C.

CAD. Cartridge Actuated Device.

CAS. Calibrated Airspeed — Knots.

CASS. Command Active Sonobuoy System.

CAVANT. Cavitation.

CBIT. Continuous Built-In Test.

CDG. Control Display Generator.

CDI. Course Deviation Indicator.

CDNU. Control Display Navigation Unit.

CDU. Control Display Unit.

CECB. Center Electronic Circuit Breaker Panel.

CEP. Circular Error Probability.

CF. Confidence Factor.

CFT. Computer Frequency Tracker.

CG. Center of Gravity.

CGA. Compensator Group Adapter.

CHEX. Channel Expansion.

CIG. Control Indicator Group.

CIP. Control Indicator Panel or Communication Improvement Program.

CIU. Communications Interface Unit.

CMEP. Commandable Manual Entry Panel.

CMPUT. Compute.

CNSU. Com-Nav Switching Unit.

CNT. Contact.

COB. Center of Bracket.

COM. Communicator, Communication.

COMP LOFAR. Comparative LOFAR.

COMP OVRD. Computer Override (Tuning Mode).

CON. Control.

CONT PRDCT. Continuous Predict.

CPA. Closest Point of Approach.

CPI. Crash Position Indicator.

CPS. Cycles Per Second.

CRS. Central Repeater System.

CRT. Cathode Ray Tube.

CSMM. Crew Station Maintenance Manual.

CTGRY. Category.

CTM. Centrifugal Twisting Moment.

CURSR. Cursor.

CW. Clockwise or Continuous Wave.

CWS. Control Wheel Steering.

CYLR. Cylinder Rate.

D

D. BFI Trace D or CIP D.

DA. Drift Angle.

DAC. Digital-to-Analog Converter.

dB. Decibel.

DC. Direct Current.

DCCI. Dual Channel Control Indicator.

DCI. Display Control Indicator.

DCU. Display Computer Unit.

DDI. Digital Display Indicator.

DDS. Digital Data Set.

DDU. Digital Data Unit.

DEG. Degree.

DEK. Data-Entry Keyboard.

DELTIC. Delay Line Time Compressor.

DEMON. Demodulated Noise.

DESIG. Designate.

DF. Direction Finder.

DFQS. Digital Fuel Quantity System.

DG. Directional Gyro.

DIFAR. Directional Frequency Analysis and Recording.

DIM. Digital Input Multiplexer.

DIS. Displays or Distance.

DISCR FREQ. Discrete Frequency.

DIU. DIFAR Interface Unit.

DL. Directional Listening.

DLRP. Data Link Reference Point.

DLBRG. Directional Listening Bearing.

DMA. Direct Memory Access.

DME. Distance Measuring Equipment.

DMS. Data Multiplexer Subunit.

DMTC. Digital Magnetic Tape Control.

DMTS. Digital Magnetic Tape System.

DMTU. Digital Magnetic Tape Unit.

DNCU. Data Net Control Unit.

DNRS. Doppler Navigation Radar Set.

DOM. Digital Output Multiplexer.

DOP. Doppler.

DP. Data Processor.

DPC. Data Processor Computer.

DPS. Data Processing System.

DR. Dead Reckoning.

DRP. Data Retrieval Program.

DRT. Dead Reckoning Tracker.

DSR TK. Desired Track Angle.

DSR TK STS. Desired Track Status.

DSTY. Destroy.

DTM. Data Transfer Module.

DTS. Data Terminal Set.

DTUNE. Detune.

DVARS. Doppler Velocity Altimeter Radar Set.

E

EAS. Equivalent Airspeed — Knots.

EB. Extended Band.

ECA. Electronic Control Amplifier.

ECM. Electronic Countermeasure.

ECP. Engineering Change Proposal.

EDC. Engine Driven Compressor.

EFB. Earth Field Balance.

EGT. Exhaust Gas Temperature.

EIU. ESM Interface Unit.

EMCON. Emission Control.

EMERG. Emergency.

EOM. End-of-Message.

EOT. End-of-Tape.

ESM. Electronic Support Measures.

ETA. Estimated Time of Arrival.

ETE. Estimated Time En Route.

ETP. Equal Time Point.

EVAL. Evaluation.

EXPND. Expand.

EXTD. Extend.

EXT MDC. Extension Main DC.

EXTRN. Extraction.

EXTRT. Extract.

F

FAT. Free Air Temperature (ambient).

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.

FELC. Forward Electronic Load Center.

FFAR. Folded-Fin Aerial Rocket.

FLC. Forward Load Center Circuit Breaker Panel.

FLIR. Forward Looking Infrared.

FLT. Flight.

FM. Frequency Modulation.

FO. Foldout.

FOD. Foreign Object Damage.

FOM. Figure of Merit.

FPM. Feet Per Minute.

FREQ. Frequency.

FSK. Frequency Shift Keying.

FTP. Fly-to-Point.

FTS. Frequency Tracker Status.

FUND FREQ. Fundamental Frequency.

G

g. Gravity.

GCA. Ground Controlled Approach.

GCR. Generator Control Relay.

GEO. Geographic.

GOB. Ground Operation Bus (DC).

GPI. Ground Position Indicator.

GPM. Gallons Per Minute.

GPS. Global Positioning System.

GS. Glideslope, Groundspeed — Knots.

GTC. Gas Turbine Compressor.

GTP. Ground Track Plotter.

H

HACLCS. Harpoon Aircraft Command-Launch Control Set.

HARPs. Hardover Protection Systems.

Hd. Density Altitude.

HDG. Heading.

HDG/DA. Heading/Drift Angle.

HF. High Frequency.

HMS. Harpoon Missle Simulator.

HORIZ. Horizon.

Hp. Density Pressure.

HRD. High Rate of Discharge.

HS. Hung Store.

HSI. Horizontal Situation Indicator.

HSP. High Speed Printer.

HYFIX. Hyperbolic Fix.

Hz. Hertz (Cycles/Second).

I

IACS. Integrated Acoustic Communication System.

IAS. Indicated Airspeed — Knots.

ICAO. International Civil Aviation Organization.

ICP. Interactive Control Panel.

ICS. Intercommunications System.

IDR. Input Data Request.

IFA. In-Flight Alignment.

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

IFPM. In-Flight Performance Monitoring.

IFT. In-Flight Technician.

ILLEG. Illegal.

ILS. Instrument Landing System.

IMC. Instrument Meteorological Conditions.

IMN. Indicated Mach Number.

IMPROP. Improper.

INC. Increase.

INCMG. Incoming.

INITLZN. Initialization.

INS. Inertial Navigation System (Set).

INTCP. Intercept.

INU. Inertial Navigation Unit.

INV. Inverter.

I/O. Input/Output.

IRDS. Infrared Detection System.

IRG. Inter Record Gap.

IRU. Interface Receptacle Unit.

ITADS. Integrated Tactical Display System.

ITL. Intent to Launch.

ISAR. Inverse Synthetic Aperture RADAR.

ISD. Initial Search Depth.

J

JB. Junction Box.

K

KCAS. Knots Calibrated Speed.

KIAS. Knots Indicated Airspeed.

kVA. Kilo-Volt Amps.

KYSET. Keyset.

L

LAT. Latitude.

LBA. Limits of the Basic Aircraft without External Stores.

LDR. Low Data Rate.

LED. Light Emitting Diode.

LEMA. Linear Electromagnetic Actuator.

LFA. LEMA Fails to Actuate.

LGWS. Landing Gear Warning System.

LICT. Longitudinal Induced Compensation Trimmer.

LO or LOWER. Lower Half of BFI Presentation (DIFAR or RANGE).

LOB. Line of Bearing.

LOC. Localizer.

LOD. Light-Off Detector.

LOFAR. Low Frequency Analysis and Recording.

LONG. Longitude.

LOP. Line of Positions.

LOS. Line of Sight.

LSB. Lower Side Band.

LSO. Low Speed Oscillator.

M

MAC. Main AC; Mean Aerodynamic Chord.

MACH NOISE. Machinery Noise.

MAD. Magnetic Anomaly Detection.

MAG. Magnetic.

MAG DS. Magnetic Detecting Set.

MAG VAR. Magnetic Variation.

MAN. Manual (Tuning Mode).

MCP. Maintenance Control Panel.

MDC. Main DC.

MDC E. Main DC Electronics.

MDD. Multipurpose Data Display (TACCO).

MDL. Mission Data Loader.

MDS. Minimum Discernible (or Detectable) Signal.

MEAC. Monitorable Essential AC.

MEDC. Monitorable Essential DC.

MEDC E. Monitorable Essential DC Electronics.

MEP. Manual Entry Panel.

MHRS. Magnetic Heading Reference System.

MLA. Mean Line of Approach.

MLC. Main Load Center.

MLM. Marine Location Marker.

MM. Model Manager.

MOSA. Minimum Operational Safe Altitude.

MOT. Mark On Top.

mPA_2. Micropascal Squared.

MPD. Multipurpose Display.

MPT. Motion Pickup Transducer.

MS. Matrix Select.

MSA. Minimum Safe Altitude.

MSL. Missile.

MSU. Mode Selector Unit.

MTC. Magnetic Tape Control.

MTT. Magnetic Tape Transport.

MU. Memory Unit.

MUF. Maximum Usable Frequency.

MUSIG. Multiple Signals.

N

NATOPS. Naval Air Training and Operating Procedures Standardization.

NAV/COMM. Navigator/Communicator.

NB. Normal Band.

NDB. Nondirectional Bearing, Nondirectional Beacon.

NM. Navigation Multiplexer.

NFO. Naval Fight Officer.

NM. Navigation Multiplexer or Nautical Mile.

NTDS. Navy Tactical Data System.

NTS. Negative Torque Sensing.

NVGs. Night Vision Goggles.

NVIS. Night Vision.

O

OAT. Outside Air Temperature.

OBS. Observer.

OFOM. Operational Figure of Merit.

OMNI. Omnidirectional or Omnidirectional Range.

OP. Operational Program.

OPTNL EOM. Optional End-of-Message.

ORD. Ordnance.

OS. Omnisearch.

OTPI. On-Top Position Indicator.

P

PA. Public Address.

PADC. Passive Acoustic Detection and Classification.

PAR. Precision Approach Radar.

PCB. Printed Circuit Board.

PCM. Pulse Code Modulation.

PCO. Pressure Cutout Override.

PDC. Processing Display Channel.

PDM. Planned Depot Maintenance.

PF. Parachute Flare.

PIC. Processor Input Channel.

PIM. Position of Intended Movement.

PIU. Power Interrupt Unit.

PLE. Prudent Limit of Endurance.

PLT DIS. Pilot Display.

PMBR. Practice Multiple Bomb Rack.

PMG. Permanent Magnet Generator.

POS. Present Position.

POSIT. Position.

PPC. Patrol Plane Commander.

PPCP. Patrol Plane Copilot.

PPG. Pounds Per Gallon.

PPH. Pounds Per Hour.

PPI. Plan Position Indicator.

PPM. Pounds Per Minute.

PPP. Patrol Plane Pilot.

PPS. Precise Positioning Service.

PQS. Personnel Qualification Standards.

PRF. Pulse Repetition Frequency.

PRO. Projection Readout.

PRR. Pulse Repetition Rate.

PSH. Preselect Heading.

PSLT. Pressurized Sonobuoy Launch Tube.

PSR. Point of Safe Return.

PT. Point.

PTA. Passive Tracking Algorithm.

PU. Participating Unit.

PUTN. Participating Unit Track Number.

R

RAM. Random Access Memory.

RAWS. Radar Altimeter Warning System.

RBL. Range and Bearing Launch.

RC. Recorder Converter.

RCR. Runway Condition Reading.

REC. Recover.

RECTR. Recenter.

RECY. Recovery.

REF. Reference.

RF. Radio Frequency (Buoy Channel).

RIU. Radar Interface Unit.

RMS. Radar Monitoring System.

RO. Range Only.

RPM. Revolution Per Minute.

RSC. Runway Surface Covering.

RSG. Reference Signal Generator.

RTA. Receiver Transmitter Antenna.

S

SA. Selective Availability.

SAD. Sub Anomaly Detection.

SAR. Search and Rescue.

SASP. Single Advanced Single Processor.

SATCOM. Satellite Communications.

SC. Sono Command, System Controller.

S/C. Scan Converter.

SD. Steered DIFAR.

S-D. Synchro-to-Digital.

SDC. Signal Data Converter.

SDD. Sensor Data Display.

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

SDR. Signal Data Recorder.

SEAC. Start Essential AC.

SEDC. Start Essential DC.

SF. Sonobuoy Frequency.

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

SHP. Shaft Horsepower.

SIF. Selective Identification Feature.

SIGNAL STR. Signal Strength.

SINGLE PRDCT. Single Predict.

SLC. Sonobuoy Launch Container.

SLN. Straight and Level Noise.

SLT. Sonobuoy Launch Tube.

SM. Smoke Marker.

SNR. Signal-to-Noise Ratio.

SO. Steered OMNI.

SOM. System Operator Manual.

SONO. Sonobuoys.

SPL WPN. Special Weapon.

SPS. Standard Positioning Service.

SPV. Signal Processor Verifier.

SR. Shaft Rate.

SRA. Shop Replaceable Assembly.

SRCH. Search.

SRL. Sonobuoy Receiver Logic.

SRM. Software Reference Manual.

SRS. Sonobuoy Reference System.

SS. Sensor Station.

SSB. Single Sideband.

ST. Store.

STAT. Status.

STP. Systems Test Program.

STS. Status/Action/Malfunction Code.

SUB. Submarine.

SUS. Sound Underwater Signal.

SYGNOG. System GO-NO GO.

SYNC CONV. Synchronous Converter.

T

T. Temperature.

TAC. Tactical.

TACAN. Tactical Air Navigation.

TACCO. Tactical Coordinator.

TAS. True Airspeed — Knots.

TCG. Time Code Generator.

TD. Temperature Datum.

TGT POSIT. Target Position.

TIT. Turbine Inlet Temperature.

TK. Track Angle.

TKE. Track Angle Error.

TK/GS. Track/Groundspeed.

TO. Takeoff.

TOA. Time of Arrival.

TR. Transformer Rectifier.

T/R. Transmit and Receive.

TRAN. Transfer.

TRK. Track.

TRKR BRG. Tracker Bearing.

TSC. Tactical Support Center.

TSHP. Takeoff Shaft Horsepower.

TSS. Thrust Sensitive Signal.

TST. Test.

TTSC. Target Tracking Sight Control.

TTY. Teletype.

U

UHF. Ultrahigh Frequency.

UKL. Universal Keyset Logic.

UNKN. Unknown.

UP or UPPER. Upper Half of BFI Presentation (DIFAR or RANGE Mode).

USB. Upper Side Band.

V

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

V_{CR}. Critical Speed for Engine Failure.

V_D. Decision Speed.

VEC. Vector.

V_{EF}. Engine Failure Speed.

VEL. Velocity.

VFR. Visual Flight Rules.

VHF. Very High Frequency.

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.

V_R. Refusal Speed.

V_{RO}. Rotation Speed.

V_S. Stall Speed.

VSI. Vertical Speed Indicator.

W

WPN. Weapon.

WPT. Waypoint.

WRA. Weapons Replaceable Assembly.

WWV. Radio Call Letters for National Bureau of Standards, Fort Collins, Colo.

WWVH. Radio Call Letters for National Bureau of Standards, Maui, Hawaii.

X

XTK. Cross-Track Angle/Crosstrack Distance.

Z

ZFW. Zero Fuel Weight.

ZLG. Zero-Lock Laser Gyros

I. SDR Gram I or CIP I.

II. SDR Gram II or CIP II.

III. SDR Gram III or CIP III.

IV. SDR Gram IV or CIP IV.

ΔT. Change in Temperature.

ΔV. Change in Speed.

Σ. Air Density Ratio (Sigma).

Δ. Air Pressure Ratio (Delta).

PREFACE

SCOPE

The NATOPS flight manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the naval air training and operating procedures standardization (NATOPS) program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operations. However, it is not a substitute for sound judgment. Compound emergencies, available facilities, adverse weather or terrain, or considerations affecting the lives and property of others may require modification of the procedures contained herein. Read this manual from cover to cover. It is your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-75PAC-1.1 (NFO/Aircrew NATOPS Flight Manual)

NAVAIR 01-75PAC-1C (Checklist)

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

NAVAIR 01-75PAC-11-1 (Series) (P-3C Update System Operator Manual)

NAVAIR 01-75PAC-11-2 (Series) (P-3C Update System Operator Manual)

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

HOW TO GET COPIES

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Note

Activities not submitting an ADRL report on floppy disk for more than 12 months may be dropped from distribution of all NAVAIR technical publications.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3710.7.

CHANGE RECOMMENDATIONS

Routine change recommendations are submitted directly to the model manager on OPNAV 3710/6 (4-90) shown herein. The address of the program manager of this aircraft is:

Commanding Officer
VP-30 Attention: P-3 Evaluator
NAS Jacksonville, Florida 32212-0024

Change recommendations of an URGENT nature (safety of flight, etc.) should be submitted directly to the NATOPS advisory group member in the chain of command by priority message.

YOUR RESPONSIBILITY

NATOPS flight manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight manual interim changes are changes or corrections to the NATOPS flight manuals promulgated by CNO or NAVAIRSYSCOM. Interim changes are issued either as printed pages or as a naval message. The interim change summary page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated interim change summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

CHANGE SYMBOL

Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of either new information, a changed procedure, the correction of an error, or a rephrasing of the previous material.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to “WARNINGs,” “CAUTIONs,” and “Notes” found throughout the manual.

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 the equipment.

Note

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

WORDING

The concept of word usage and intended meaning that has been adhered to in preparing this manual is as follows:

“Shall” has been used only when application of a procedure is mandatory.

“Should” has been used only when application of a procedure is recommended.

“May” and “need not” have been used only when application of a procedure is optional.

“Will” has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

“Land Immediately” is self-explanatory.

“Land as Soon as Possible” means land at the first site at which a safe landing can 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.

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 sepcific)

☐ 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

PART I

The Aircraft

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 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. Also, provisions for carrying a streamlined ESM pod-pylon assembly on a wing station are installed.

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.

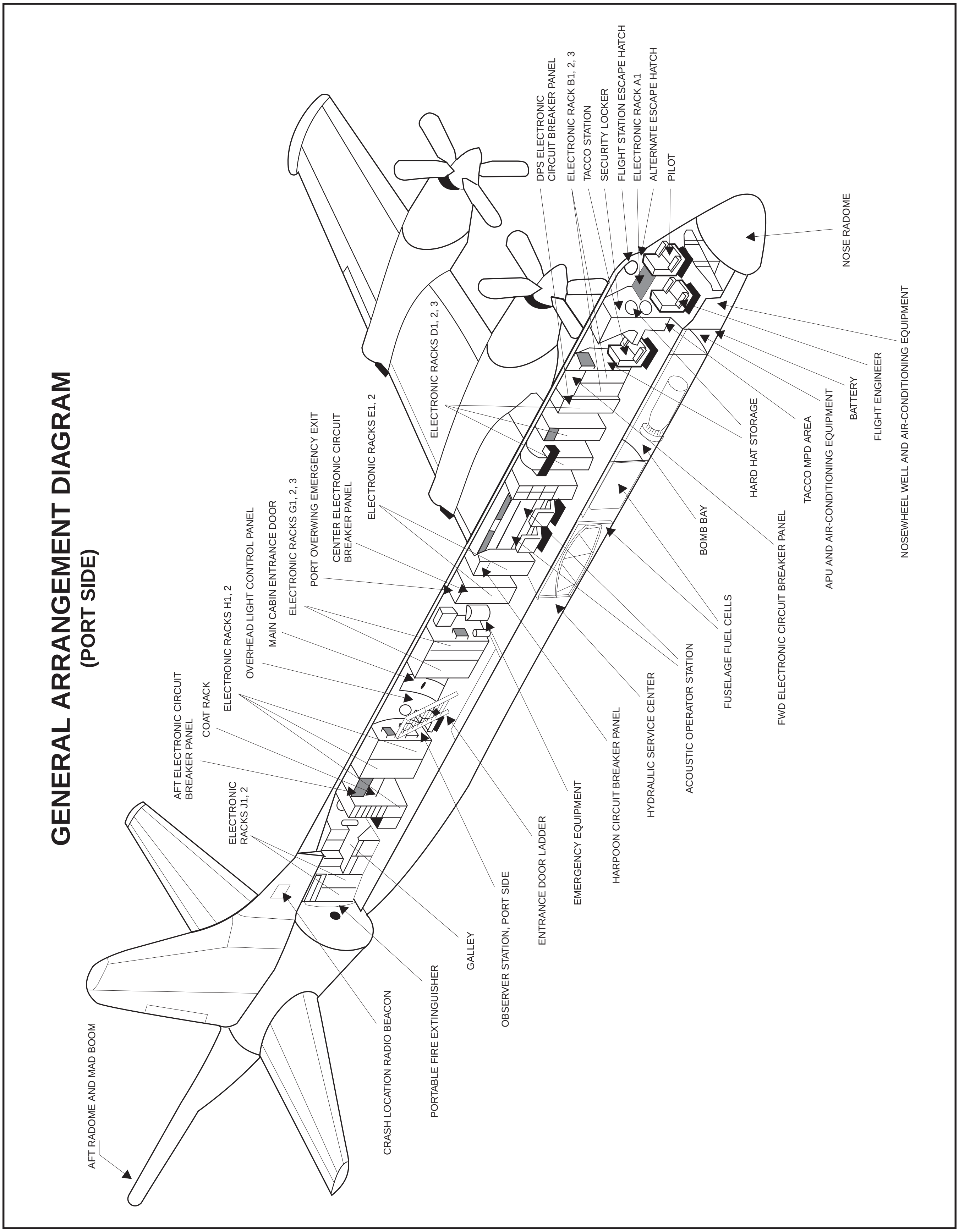


Figure 1-1. P-3C General Arrangement Diagram (Sheet 1 of 2)

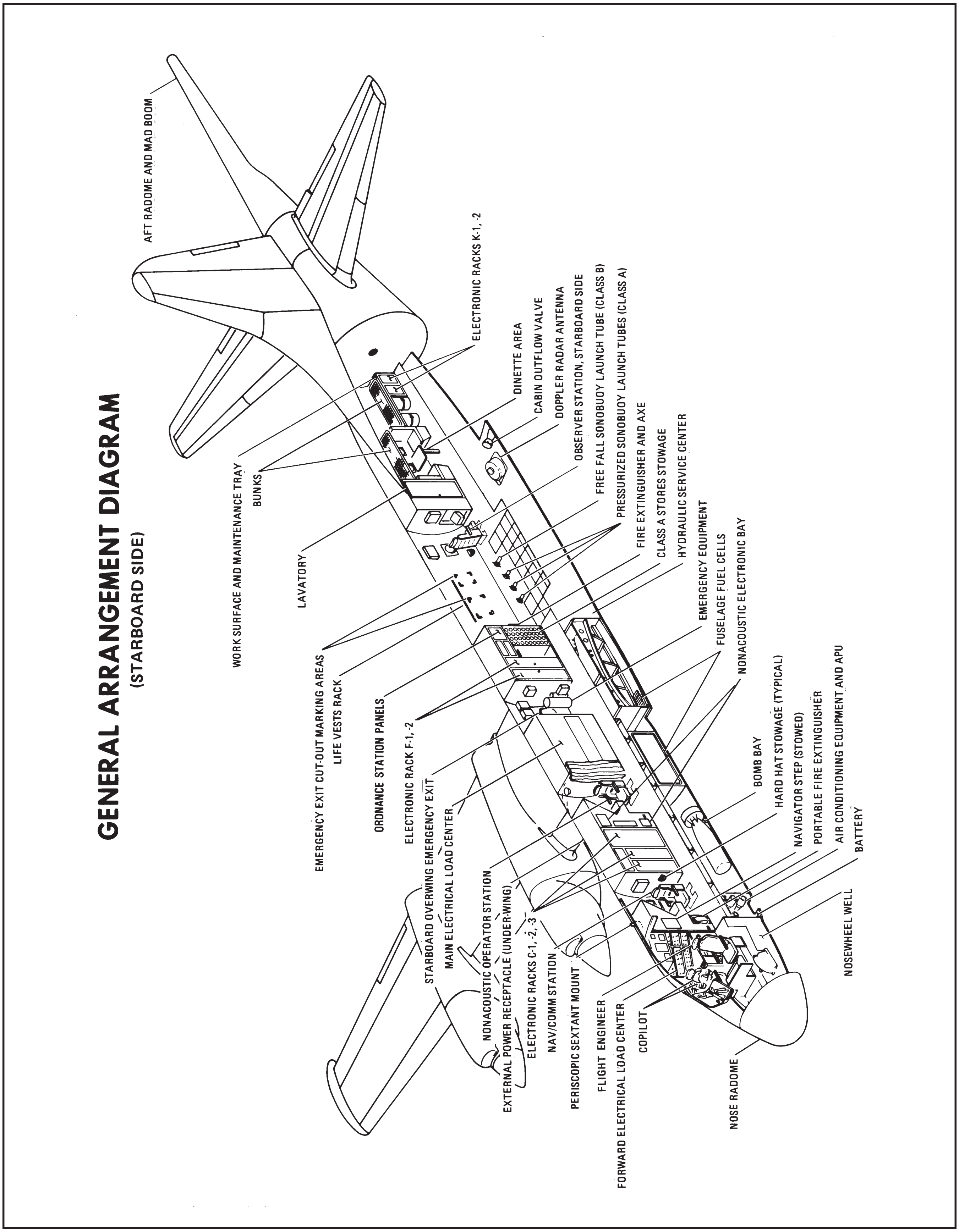


Figure 1-1. P-3C General Arrangement Diagram (Sheet 2 of 2)

CHAPTER 2

Systems and Equipment

2.1 AUXILIARY POWER UNIT

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.

On some aircraft a GTCP 95-3 APU is installed that produces an increased airflow from the GTCP 95-2 model. Though both models are interchangeable, they do not have the same EGT limitations. (Refer to Chapter 4 for operating limitations of both models.)

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 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 (see 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. (See FO-12.)

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, and, 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 on line.

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. (See Figure 2-22.)

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 main landing gear scissor switches are 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 temperature of 400 °F, 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 AC and DC power for aircraft requirements. Aircraft AC power is furnished by three engine-driven generators (GENs 2, 3, 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, 31-ampere-hour 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 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 (see FO-6).

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. When the engine-driven generator is on speed (engine operating at normal RPM), the PMG (Figure 2-1) generates single-phase, 39-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.

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. (See paragraph 12.3, Fuselage Fire or Electrical Fire of Unknown Origin.)

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 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-6).

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. (See 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 GCR, ACR, and voltage regulator. In addition, the supervisory panels provide overvoltage, undervoltage, off-frequency, and feeder-fault protection to their respective generators.

CAUTION

Solid-state supervisory panels, which are the preferred replacements, do not provide overfrequency protection. If RPM exceeds 109 percent, place the 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-6, 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 MEAC bus and routes its 28-VDC output to the MEDC bus.

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

2.2.3.1 Main DC 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 Bus. The FEDC bus is powered directly from the MEDC bus via blocking diode No. 2. The backup power source is the aircraft

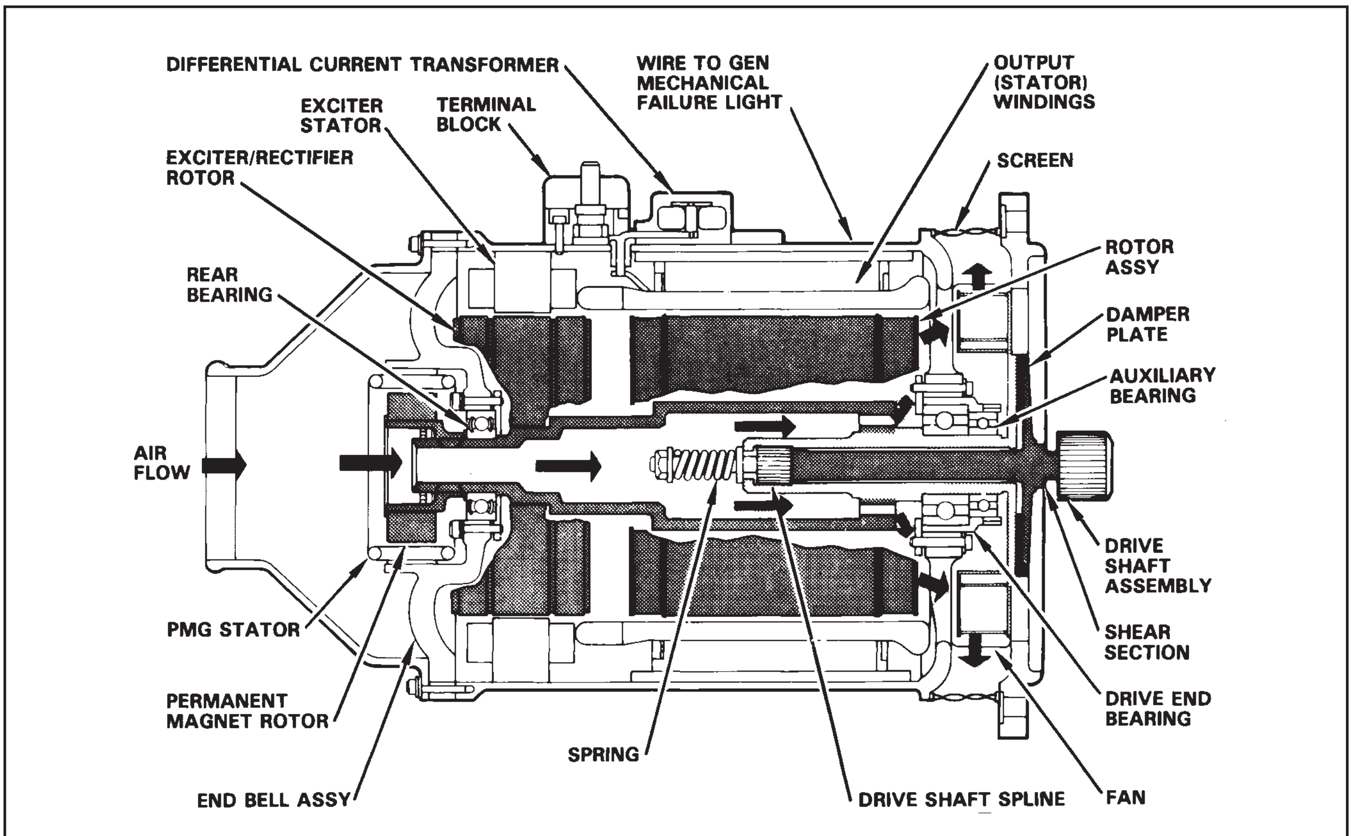


Figure 2-1. Generator Cutaway

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 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. 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 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. (See FO-12.) 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, off-frequency, feeder fault). 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 bus B. The light illuminates when the 3A side of transfer relay 3 is deenergized. The 3A side will deenergize whenever the ACR is deenergized (e.g., overvoltage, undervoltage, off-frequency, 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 ACR 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 breaker for the units are located as follows:

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:

1. GEN 2, 3, or 4 OFF
2. TRANSFORMER RECTIFIER OVER HEAT 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. (When the ESS BUS switch is placed in the OFF position, power is routed to the pilot turn-and-bank indicator from the 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 (Figures 2-2, 2-3, 2-4), galley power, radiant heaters, and the side windshield defogging system (AC feeders 2 and 3 only on P-3A/B).

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-6).

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 2-5).

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 (and the number 1 AC on P-3A/B). 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, Emergency Procedures). 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.

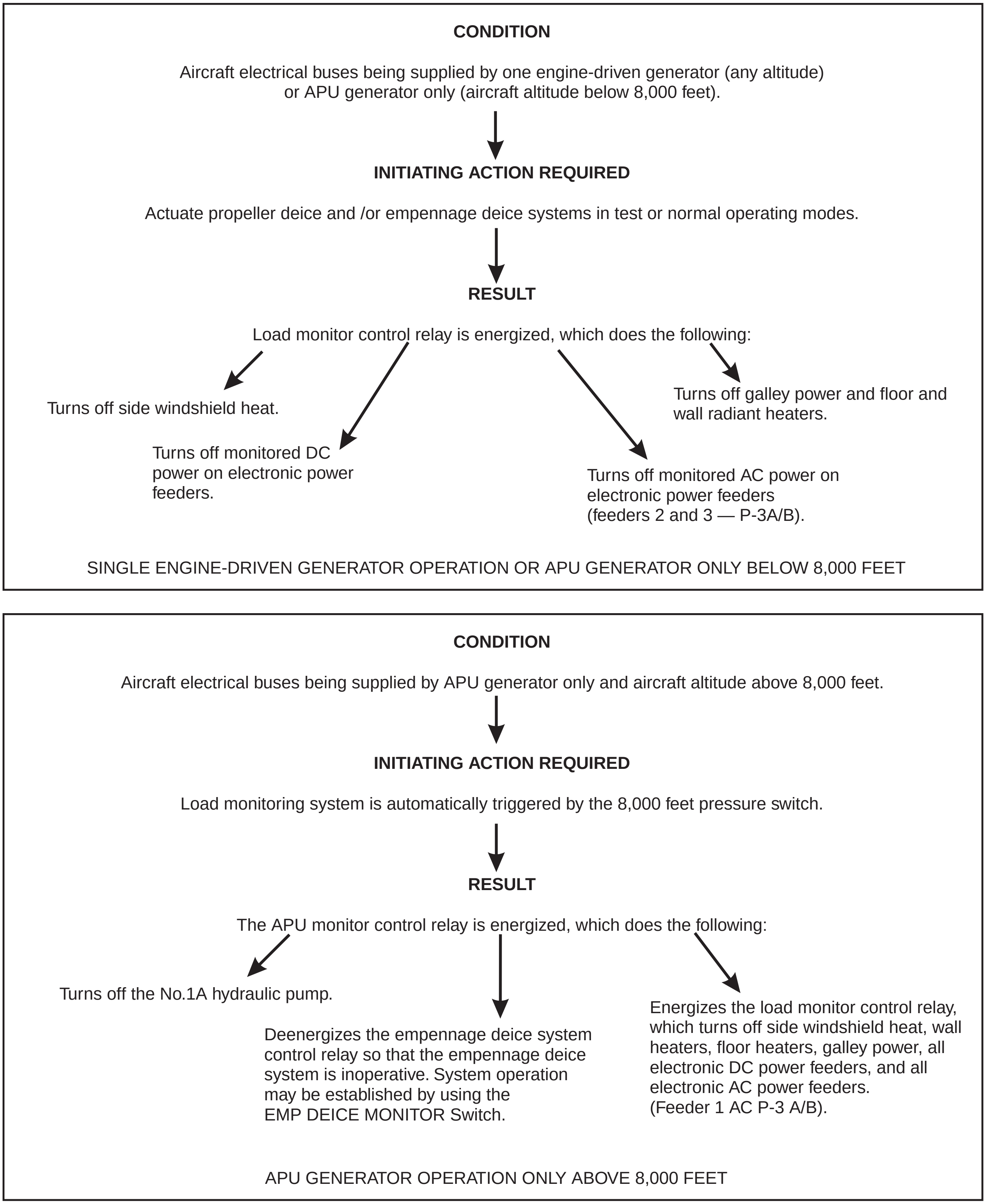


Figure 2-2. Load Monitoring System Functional Block Diagram

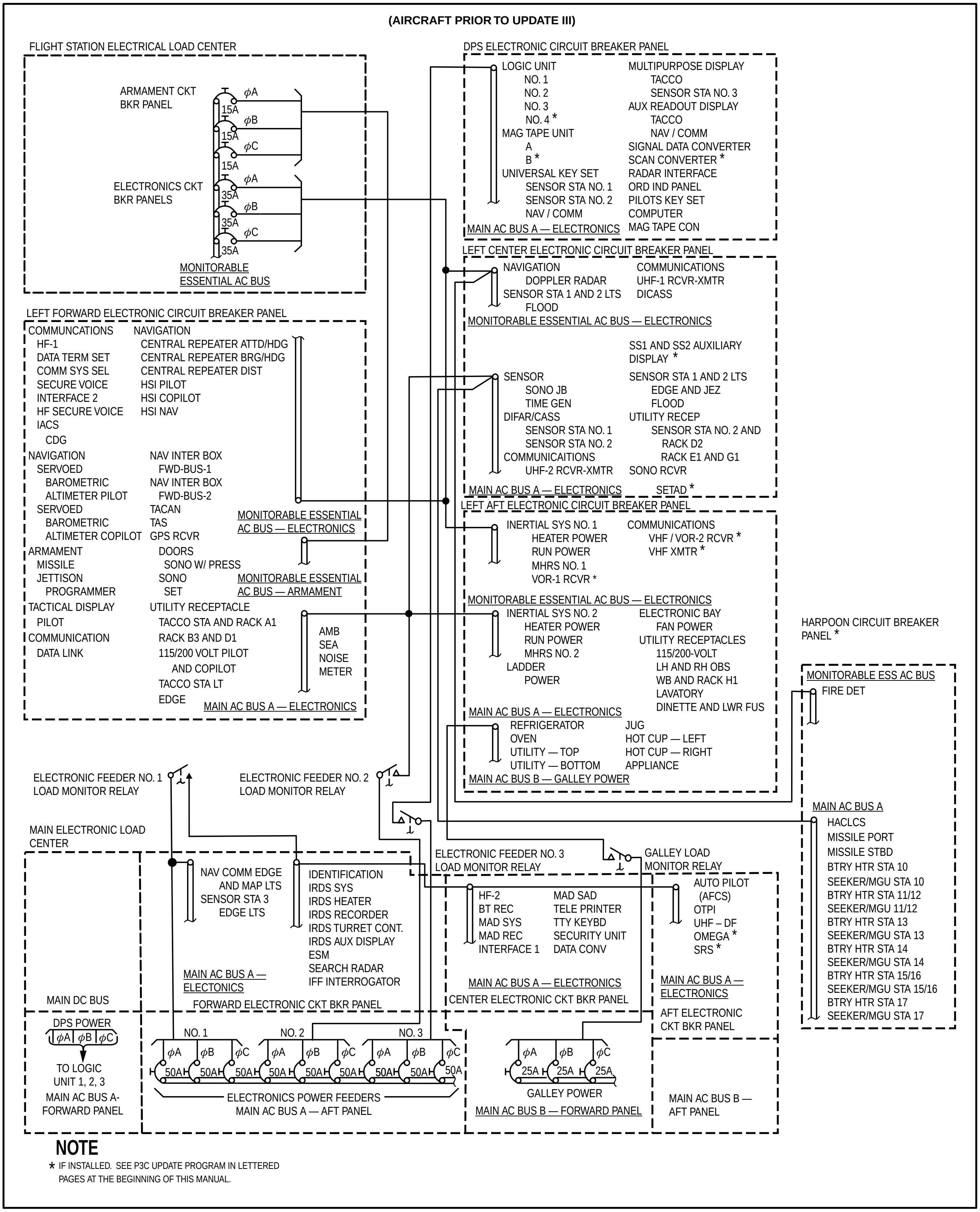


Figure 2-3. AC Power Supply for Electronic Circuit Breaker Panels (Sheet 1 of 2)

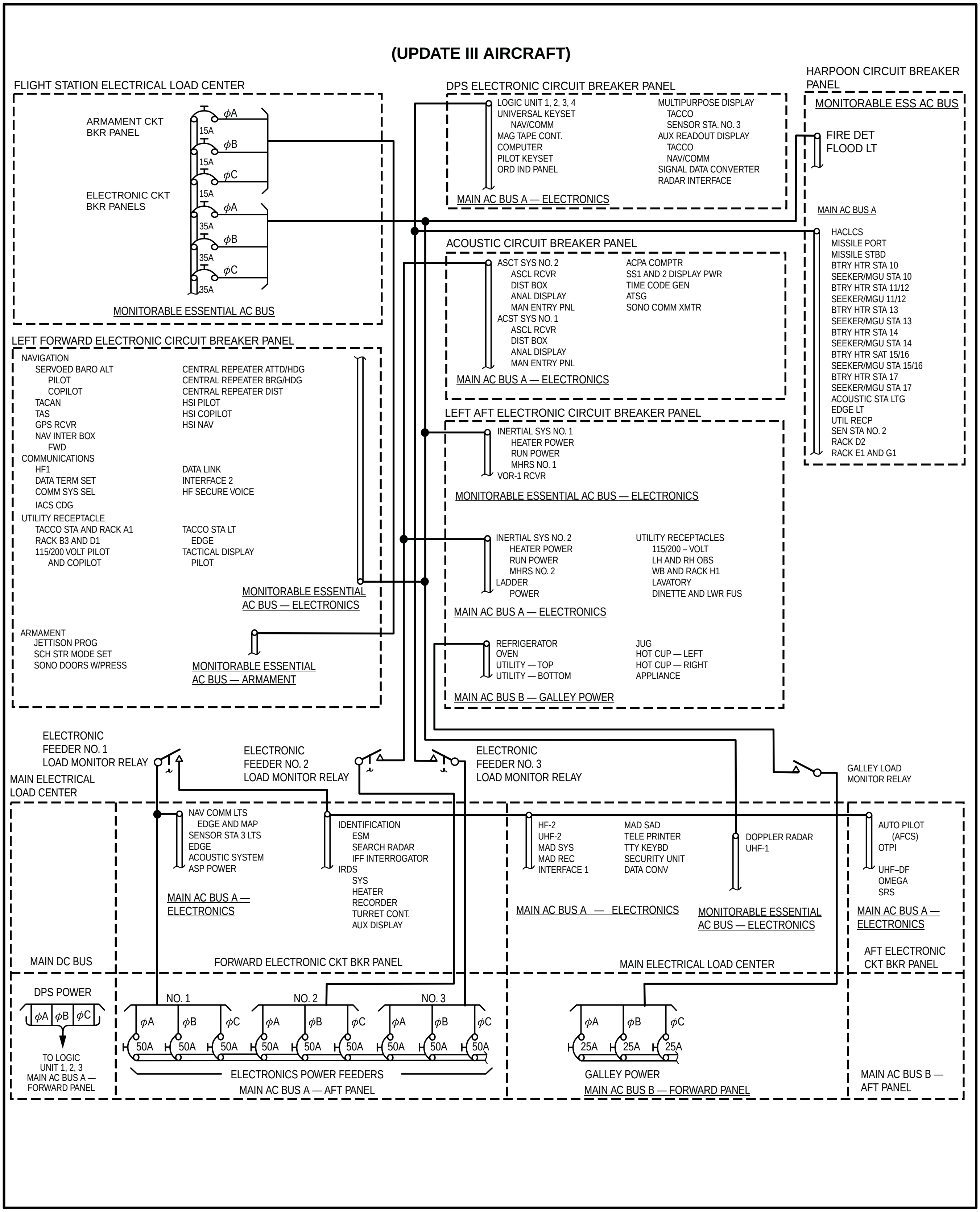
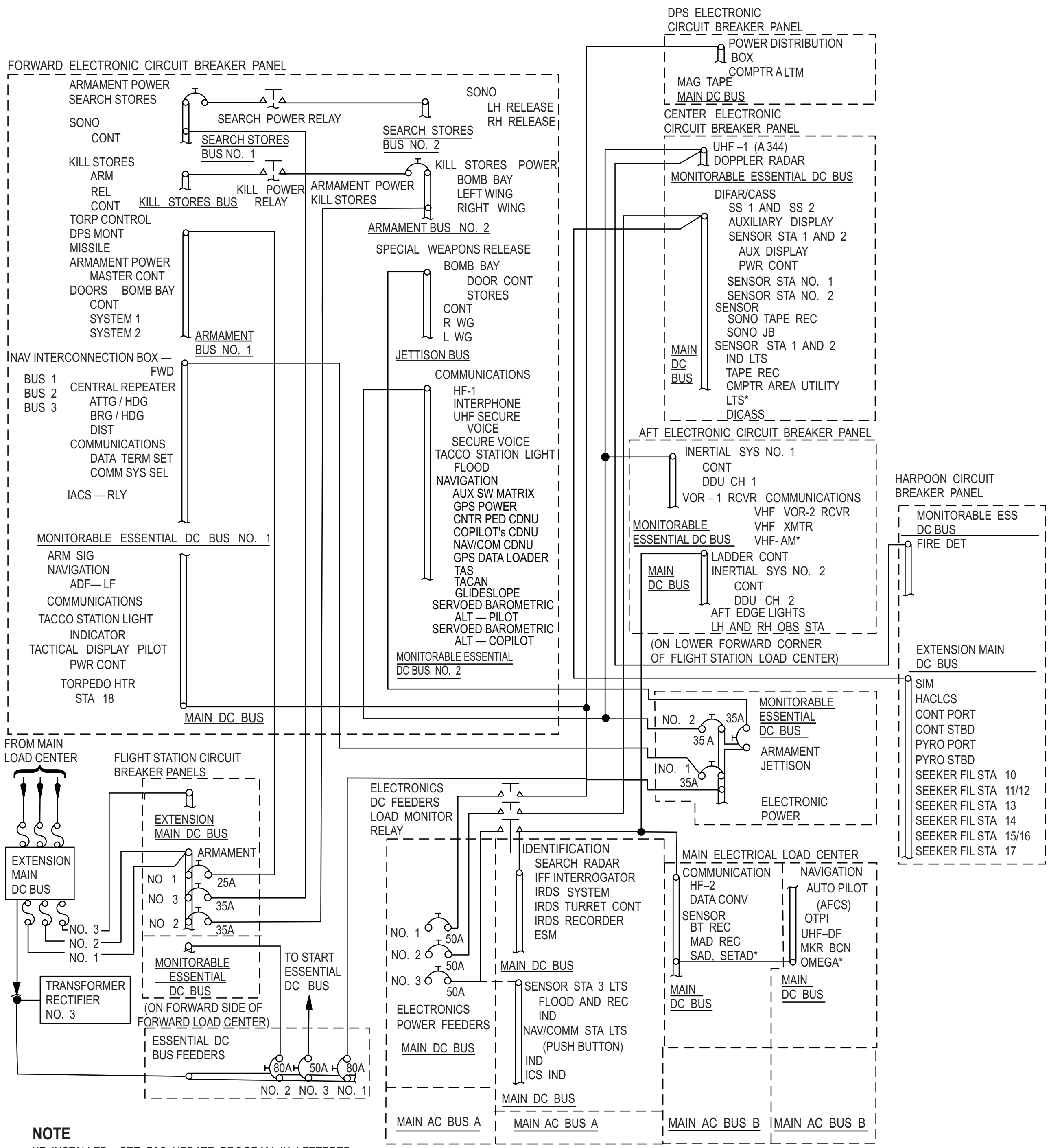


Figure 2-3. AC Power Supply for Electronic Circuit Breaker Panels (Sheet 2 of 2)



NOTE

***IF INSTALLED. SEE P3C UPDATE PROGRAM IN LETTERED PAGES AT THE BEGINNING OF THIS MANUAL.**

(AIRCRAFT PRIOR TO UPDATE III)

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

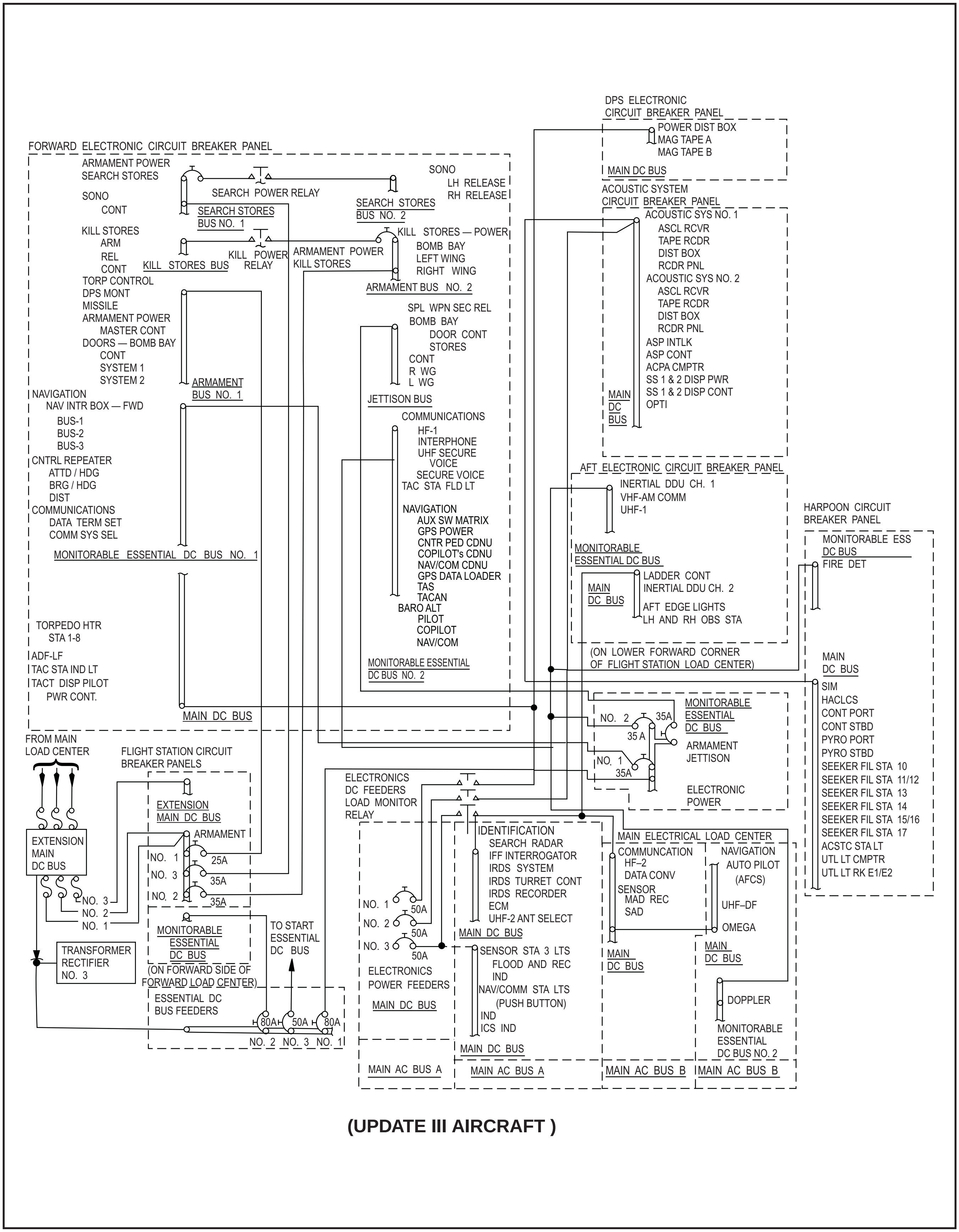


Figure 2-4. DC Power Supply for Electronic Circuit Breaker Panels (Sheet 2 of 2)

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
EMPENNAGE DEICING TIMER MOTOR
ESS LTG & IND CONTROL
(1) FDI (PILOT AND COPILOT)
FLT DIR PWR
FLT STATION AND CABIN TEMP CONTROL AND INDICATOR
FUEL CROSSFEED CONTROL
FUEL QUANTITY INDICATORS (FLIGHT STATION)
FUEL TANK SHUTOFF VALVE CONTROL
HSI MODE LIGHTS
ICE DETECTOR
LANDING LIGHTS
OIL COOLER FLAP CONTROL
(1) PILOT AND COPILOT RED INST LTS
RAWS (1 AND 2)
RED EDGE AND POST LIGHTS FOR OVERHEAD, INSTRUMENT, AND PEDESTAL PANELS
TEMPERATURE DATUM CONTROL
TORQUEMETER
(1) VERTICAL (STANDBY) GYRO
WINDSHIELD WASHER PUMP
WINDSHIELD WIPERS
WINDSHIELD HEAT
XFMR RECT NO 3

28V AC FWD LIGHT XFMR

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

ELECTRONICS

BARO ALTIMETERS ENCODER (PILOT AND COPILOT)
CENTRAL REPEATER SYS
COMM INTERFACE 2
COMM SYS SEL
DATA LINK (DATA TERMINAL SET)
DOPPLER NAVIGATION RADAR
ELECTRONIC BAY FAN POWER
*HACLCS FIRE DET
HF SECURE VOICE
HF-1 TRANSCEIVER
HSI CONTROL (PILOT, COPILOT, AND NAV/COMM)
LTN-72 NO.1
NAV INTERCONNECTION BOX (BUS 1 AND 2)
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

EMPENNAGE DEICING (PARTING STRIPS)
(3) 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 3
FUEL DUMP JETTISON PUMP
FUEL FLOW INDICATOR
FUEL QUANTITY INDICATOR (FUELING PANEL)
HYDRAULIC PUMP NO. 1
OVERHEAD LIGHTS
PROPELLER SYNC
(4) *SASP
(2) SIDE WINDSHIELD HEAT POWER
XFMR RECT NO. 1

(2) **ELECTRONICS NO. 1 FEEDER**

AUTOMATIC PILOT SYSTEM
BT RECORDER
COMM INTERFACE 1
ESM
*HF-2 TRANSCEIVER
IFF INTERROGATOR
IRDS
LTN-72 NO. 2
MAD/SAD
*OMEGA
ON TOP POSITION INDICATOR (OTPI)
SEARCH RADAR
*SONO REF SYS
TTY CONVERTER
TTY KEYBOARD
TTY PRINTER
TTY SECURITY UNIT
UHF DF
UTILITY OUTLETS

(2) **ELECTRONICS NO. 2 FEEDER**

*AMBIENT SEA NOISE METER
CREW EDGE LIGHTING (NAVCOMM AND SS3)
DATA LINK
*DICASS
DIFAR 1 AND 2
EDGE LIGHTING (TACCO STATION)
*HACLCS
IACS CDG
LADDER
PILOT'S 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 NO. 3 FEEDER**

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

(1) ATTD IND. VERT GYRO
(1) FDI (PILOT AND COPILOT)
GYRO HORIZON (STANDBY)
IFF TRANSPONDER PWR
LH PITOT HEATER
OUTFLOW VALVE OVERRIDE
PILOT AND COPILOT RED INST LTS
(1) 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 ϕB
(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 ESSENTIAL 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.

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

(3) MUST BE SECURED DURING SINGLE-GENERATOR OPERATIONS.

(4) IF INSTALLED SEE P-3C UPDATE PROGRAM IN LETTERED PAGES AT THE BEGINNING OF THIS MANUAL.

Figure 2-5. AC Bus Distribution — P-3C (Sheet 1 of 2)

MONITORABLE ESSENTIAL AC BUS

AIR CONDITIONING INSTRUMENTATION
⚠1 ⚠4 ADI (PILOT AND COPILOT)
AIRFOIL IND AND OVRHT WARNING
APN-234 WEATHER RADAR
ARA-25A AMPLIFIER
ARA-25A UHF DF ANTENNA
ARMAMENT
AUX VENT ACTUATOR
BARO ALTM ENCODERS
CONTROL PEDESTAL LIGHTS
EMPENNAGE DEICING TIMER MOTOR
FLT STATION AND CABIN TEMP CONTROL
FORWARD NAVIGATION INTERCONNECTION BOX
FUEL CROSSFEED CONTROL
FUEL QUANTITY INDICATORS (FLIGHT STATION)
HSI CONTROL
ICE DETECTOR
INSTRUMENT PANEL AND FLOODLIGHTS
LANDING LIGHTS
⚠1 ⚠4 MM-4 (PILOT AND COPILOT)
OIL COOLER FLAP CONTROL
OVERHEAD PANEL INSTRUMENT LIGHTS
⚠1 PILOT AND COPILOT RED INST LTS
TAS/INS
TEMPERATURE DATUM CONTROL
TORQUE METER
⚠1 VERTICAL (STANDBY) GYRO
WINDSHIELD HEAT
WINDSHIELD WASHER CONTROL
XMFR RECT NO. 3
26-VOLT INSTRUMENT TRANSFORMERS

28-VOLT AC FWD LIGHTING XFMR

CB PNL RED EDGE AND PLOT FLOOD
CHECKLIST RED EDGE
DOME AND FLT CAPT READING
FLT STATION AND EXTERIOR LIGHTING
RH PITOT HTR
SERV OUTLETS COPLT AND RADAR OP
SERV OUTLETS PLT AND FWD OBS
SIGHT
TAXI
WHEEL WELL
WING AND TAIL

ELECTRONICS

APN-153
APQ-107 RAWS
ARC-51 UHF-1 TRANSCEIVER
ARC-94 (618T-2) HF-1 TRANSCEIVER
ARN-87 BEARING CONVERTERS NO. 1 AND NO. 2
ASN-50 ATTITUDE HEADING REFERENCE SYSTEM (AHRS)
VOR 1 AND 2 NAVIGATION RECEIVER

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
OIL COOLER FLAP POSITION INDICATOR ENGINE 2
OIL PRESSURE INDICATOR ENGINE 1
OIL PRESSURE INDICATOR ENGINE 4

26-VOLT INSTRUMENT TRANSFORMER NO. 2

EMERGENCY BRAKE PRESSURE INDICATOR
FUEL CROSSFEED MANIFOLD PRESSURE INDICATOR
OIL COOLER FLAP POSITION INDICATOR ENGINE 2
OIL COOLER FLAP POSITION INDICATOR ENGINE 4
OIL PRESSURE INDICATOR ENGINE 2
OIL PRESSURE INDICATOR ENGINE 3
RIGHT EDC AIR PRESSURE INDICATOR

START ESSENTIAL AC BUS

TURBINE INLET TEMPERATURE

MAIN AC BUS A

ARINC 581 (LTN-72)
ASN-124 J BOX
EMPENNAGE DE-ICING (PARTING STRIPS)
⚠3 FEATHER PUMP (ENG NO. 1 AND NO. 4 ALT)
FEATHER PUMP (ENG NO. 2 AND NO. 3)
FORWARD FUEL TRANSFER PUMP
XFMR RECT NO. 1
FUEL BOOST PUMP NO. 1 AND 3
FUEL DUMP JETTISON PUMP
FUEL FLOW INDICATOR
FUEL QUANTITY INDICATOR (FUELING PANEL)
HYDRAULIC PUMP NO. 1
ITADS
OVERHEAD LIGHTS
P-3 MOD COMP ADPTR
PROPELLER SYNC
RD-461/A RECORDER REPRODUCER
SATCOM
⚠2 SIDE WINDSHIELD HEAT POWER
WATER INJECTION PUMP #1 (P-3A AIRCRAFT)

⚠2 **ELECTRONICS NO. 1 FEEDER**

AC TACTICAL CREW LIGHTING
AGC-9(V)1 TELETYPE SYSTEM
APN-70 LORAN RECEIVER
APX-78 RADAR RECOGNITION SET
AQA-7 SENSOR STA NO. 1
AQA-7 SENSOR STA NO. 2
ARC-51 UHF-2 TRANSCEIVER
ARC-94 (618R-2) HF-2 TRANSCEIVER
ARD-13 (DF-202) ADF SYSTEM
ARINC 561 (LTN-72)
ARN-83 ADF
ARN-118 TACAN
ARR-72
CU-308/U LORAN ANTENNA COUPLER
IP886/ASA-66 (PILOT)
IP886B/ASA-66 (TACCO)
ON TOP POSITION INDICATOR (OTPI)
PB20-N AUTOMATIC PILOT SYSTEM
SONO J-BOX
TAC/NAV LTS
TD-900 TIME CODE GENERATOR
ULA-2 PULSE ANALYZER
UTILITY OUTLETS

⚠2 **ELECTRONICS NO. 2 FEEDERS**

ALD-2 ECM
AMB SEA NM
APA-125/125A INDICATOR
APS-80 RADAR SET
ASQ-10 MAGNETIC ANOMALY DETECTING SET (MAD)
AQH-4
ARN-99 OMEGA
BT RECORDER
ID-499/ASA-13 POSITION INDICATOR
MX-2230/ASQ MANEUVER MONITOR
PT-396 GROUND TRACK PLOTTER
18 VDC TACTICAL CREW LIGHTING

⚠2 **ELECTRONICS NO. 3 FEEDERS**

AAS-36 (IRDS)

FLIGHT ESSENTIAL AC BUS

APN-194 RADAR ALTIMETER
APX-72 IFF TRANSPONDER
FLIGHT RECORDER LOCATOR
LH PITOT HEATER
⚠1 MM-4 (PILOT AND COPILOT)
OUTFLOW VALVE OVERRIDE
⚠1 PILOT AND COPILOT RED INST LTS
⚠1 VERTICAL (STANDBY) GRYO

MAIN AC BUS B

AFT FUEL TRANSFER PUMP
AIR COMPRESSOR
CABIN EXHAUST FAN
EMPENNAGE DEICING CYCLE ELEMENTS
FEATHER PUMP ENG NO. 1
FEATHER PUMP ENG NO. 4
⚠2 FLOOR HEATERS
FUEL BOOST PUMP NO. 2
FUEL BOOST PUMP NO. 4
⚠2 GALLEY
HYDRAULIC PUMP NO. 1A
HYDRAULIC PUMP NO. 2
PROPELLER DEICE
SERVICE OUTLETS
STROBE LIGHT TOP/BOTTOM
XMFR RECT NO. 2
28-VAC LIGHTING BUS

AFT LIGHT TRANSFORMER

B.B. LIGHT
LAV AND GALLEY LIGHTS
PROP DEICE TEST
SERVICE AND CIRCUIT BREAKER PANEL LIGHTS
SEXTANT LIGHTS
TOP AND BOTTOM BEACON LIGHTS

NOTES:

⚠1 POWERED BY FLIGHT ESSENTIAL AC BUS IF MONITORABLE ESSENTIAL 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 ELECTRONIC FEEDERS 2 AND 3, FLOOR AND WALL HEATERS, SIDE WINDSHIELD DEFOG, AND GALLEY POWER ARE AUTOMATICALLY DISCONNECTED. ADDITIONAL MONITORING OF NO. 1A HYDRAULIC PUMP AND EMPENNAGE DEICING IS PROVIDED WHEN THE APU GENERATOR IS THE ONLY POWER SOURCE AVAILABLE ABOVE 8,000 FEET ALTITUDE.

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

⚠4 A LOSS OF MONITORIBLE ESSENTIAL AC BUS WILL PREVENT THE LTN-72 FROM PROVIDING ANY PITCH, ROLL OR HEADING TO THE COPILOT BECAUSE OF THE DEENERGIZED CIRCUITRY IN THE FORWARD NAVIGATION INTERCONNECTION BOX.

Figure 2-5. AC Bus Distribution — P-3A/B (Sheet 2 of 2)

MONITORABLE ESSENTIAL DC BUS
- AMAC POWER AND CONTROL
- AIR-CONDITIONING BLOWER CONTROL (L AND R)
- ANGLE OF ATTACK
- AIR MULTIPLIER VALVE
- APU ESSENTIAL BUS FEEDER
- AUX VENT
- BOMB RACK LOCK POWER
- BUS A AND BUS B CONTROLS
- COMPASS LIGHT
- CONSOLE (PILOT, COPILOT RED EDGE)
- CRASH LOCATOR
- 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 IDLE STOPS
- GENERATOR 2, 3, AND 4 CONTROLS
- GENERATOR 4 TRANSFER
- HYDRAULIC PUMP NO. 1A CONTROL
- WINDSHIELD HEAT CONTROL
- OIL TANK SHUTOFF VALVE CONTROL
- POWER SENSING
- PROP FEATHER CONTROLS NO. 1 AND NO. 4
- RUDDER BOOST SHUTOFF VALVE
- WARNING LIGHTS (RED)
- IFF TRANSPONDER CONTROL PWR
- IFF TEST SET
- SIGNAL LIGHTS
- ⚠2 TURN RATE GYRO (PILOT AND COPILOT)
- RAWS (1 AND 2 POWER AND TEST)
- ICS AND LIGHTS (PILOT, COPILOT)
- FLIGHT DIRECTOR
- *VOR 1 REC (ARN-140)
- *VOR 2 REC (ARN-140)

ELECTRONIC PWR NO. 1
- COMM SYS SEL
- NAV INTER BOX
- CENTRAL REPEATER SYS
- DATA LINK (DATA TERMINAL SET)

ELECTRONIC PWR NO. 2
- TACCO STA FLOODLIGHTS
- TAS
- HF1
- TACAN
- *VHF XMTR (ARC-101 OR ARC-197)
- *VOR 1 REC (ARN-87)
- VOR 2 REC (ARN-87)
- INTERPHONE
- *HACLCS FIRE DET
- ILS G S
- DOPPLER RADAR
- UHF-1 (VOICE SEL PANEL)
- UHF SECURE VOICE
- UHF-1 (ARC-187)
- SECURE VOICE (SECURE SWITCHING MATRIX)
- LTN-72 NO. 1
- ALTIMETER VIB (PILOT AND COPILOT)
- BARO ALTM NAV

ARMAMENT JETTISON
- BOMB BAY DOOR CONT
- BOMB BAY STORES
- JETTISON CONTROL
- LEFT WING JETTISON
- RIGHT WING JETTISON
- SPECIAL WEAPONS RELEASE

APU ESSENTIAL DC BUS
- DOOR POS LIGHT
- EXH DOOR ACT
- FIRE DET HORN
- FIRE EXTINGUISHER
- AUTO CONTROL
- AUTO RELEASE
- MANUAL CONTROL
- MANUAL RELEASE
- INTAKE DOOR ACTUATOR

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
- COMMAND BELL
- FLIGHT STATION UTILITY LIGHTS
- GEN 4 AUX CON
- GRND OPER BUS RELAY
- IFF EMERGENCY CONTROL
- INVERTER RELAY
- PROPELLER PITCHLOCK RESET
- ⚠2 TURN RATE GYRO (PILOT)
- SECURE VOICE ZERO

MAIN DC BUS
- RACK OVERHEAT
- BOMB BAY HEAT CONTROL
- CABIN EXHAUST FAN CONTROL
- COUNTING ACCEL
- *DICASS
- 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 NO. 2
- LANDING GEAR CONTROL
- LANDING GEAR INDICATION AND WARNING
- LTN-72 NO. 2
- LOAD MONITORING CONTROL
- ⚠1 LOAD MONITORING RELAYS
- LOW RPM SOLENOID
- NEGATIVE TORQUE SYSTEM CHECK
- OIL QUANTITY AND TEMP INDICATORS
- PROPELLER AND WING ICE CONTROL
- PROPELLER AUTOFEATHER
- PROP FEATHER CONTROLS NO. 2 AND NO. 3
- PILOT'S DISPLAY CONTROL
- PROP SYNC CONTROL
- RACK OVERHEAT
- UTILITY RECEPTACLES
- *SASP
- ⚠1 SIDE WINDSHIELD HEAT CONTROL
- STROBE LIGHTS

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

⚠1 **MAIN DC ELECTRONIC FEEDER NO. 1**
- ADF
- COMPUTER ALT
- DPS PWR DIST BOX
- IACS RLY
- *MAG TAPE
- PILOT DISPLAY
- TACCO STA LIGHT IND

⚠1 **MAIN DC ELECTRONIC FEEDER NO. 2**
- *DIFAR/CASS
- *HACLCS
- SS1 AND 2 LIGHTS
- *SS1 AND 2 AUX DISPLAY
- SONO TAPE RECORDER
- SONO JUNCTION BOX
- *UTILITY LIGHT COMPTR AREA
- UHF-2 (ARC-187) UD II

⚠1 **MAIN DC ELECTRONIC FEEDER NO. 3**
- LADDER CONTROL
- INS 2
- EDGE LIGHTS LH & RH OBS STA
- SEARCH RADAR
- ESM
- IFF INTERROGATOR
- HF-2
- BIT RECORDER
- MAD
- SAD
- AUTOPILOT
- OTPI
- UHF DF
- *MKR BEACON (ARN-32)
- SS 3 LIGHTS
- NAV/COMM LIGHTS
- TTY CONVERTER
- IRDS
- *OMEGA
- LH AND RH UTIL RECEPTACLES
- OBS STA
- *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.

* IF INSTALLED SEE P-3C UPDATE PROGRAM IN LETTERED PAGES AT THE BEGINNING OF THIS MANUAL.

⚠2 PILOT'S TURN RATE GYRO POWERED BY FLIGHT ESSENTIAL DC WITH THE ESSENTIAL BUS SWITCH IN THE OFF POSITION.

Figure 2-6. DC Bus Distribution — P-3C (Sheet 1 of 2)

MONITORABLE ESSENTIAL DC BUS
- AMAC POWER AND CONTROL
- ANGLE OF ATTACK
- APN-234 WEATHER RADAR
- APU ESSENTIAL BUS FEEDER
- ARMAMENT JETTISON
- AUX VENT
- BARO ALT (PILOT & COPILOT)
- BUS A AND BUS B CONTROLS
- COMPASS AND SIGHT LIGHTS
- CONSOLE AND DOME LIGHTS
- EDC DISCONNECT
- EDC DUMP
- EMER ENGINE SHUTDOWN CONTROL
- ENGINE ICE CONTROL
- FIRE DETECTORS
- FIRE DETECTOR HORN
- FIRE EXTINGUISHER SYSTEM
- FLIGHT IDLE STOP
- FORWARD NAVIGATION INTERCONNECTION BOX
- GENERATOR 2, 3, AND CONTROLS
- GENERATOR 4 TRANSFER
- HYDRAULIC PUMP NO. 1A CONTROL
- IFF POWER CONT
- LANDING GEAR WARNING HORN
- OIL TANK SHUTOFF VALVE CONTROL
- POWER SENSING
- PROP FEATHER CONTROLS NO. 1 AND NO. 4
- RUDDER BOOST CONTROL
- ⚠2 TURN AND BANK INDICATOR (PILOT AND COPILOT)
- WARNING LIGHTS (RED)
- WINDSHIELD HEAT CONTROL

ELECTRONICS POWER
- AGC-9(V)1 TELETYPE SYSTEM
- AIC-22 INTERCOMMUNICATION SET
- APQ-107 RAWS
- ARA-25 AMPLIFIER
- ARC 51 UHF-1 TRANSCEIVER
- ARC-94 (618T-2) HF-1 AND HF-2 TRANSCEIVERS
- ARC-182 VHF/UHF SYSTEM
- ASN-50 ATTITUDE HEADING REFERENCE SYSTEM (AHRS)
- ILS RECEIVER
- UHF ANTENNA RELAY
- VOR 1, 2 NAVIGATION RECEIVER

APU ESSENTIAL DC BUS
- DOOR PQS LIGHT
- EXH DOOR ACT
- FIRE DET. HORN
- FIRE EXTINGUISHERS
  - AUTO CONTROL
  - AUTO RELEASE
  - MANUAL CONTROL
  - MANUAL RELEASE
- INTAKE DOOR ACTUATOR

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
- APX-72 IFF TRANSPONDER
- COMMAND BELL
- FLIGHT STATION UTILITY LIGHTS
- FLT RECORDER LOCATOR
- GEN 4 AUX CONT
- GRND OPER TRANSFER RELAY
- INVERTER RELAY
- PROPELLER PITCHLOCK REST
- SECURITY UNIT HF
- SECURITY UNIT UHF
- ⚠2 TURN AND BANK INDICATOR (PILOT)

MAIN DC BUS
- AIR COMPRESSOR CONTROL
- ASA-66 TAC DSPL
- BOMB BAY HEAT CONTROL
- CABIN EXHAUST FAN CONTROL
- COUNTING ACCEL
- DUCT OVERHEAT TEST
- EMPENNAGE DEICING
- EXTERIOR LIGHTS
- FIRE EXTINGUISHER SYSTEM
- FREE AIR TEMPERATURE INDICATORS
- FUEL BOOST AND TRANSFER PUMPS CONTROL
- FUEL DUMP PUMP CONTROL
- FUEL DUMP VALVE
- FUEL INLET VALVES AND REFUEL CONTROL
- GROUND AIR SENSING
- HYDRAULIC FLUID QUANTITY
- HYDRAULIC PUMP CONTROL NO. 1 AND NO. 2
- IFF TEST
- LANDING GEAR CONTROL
- LANDING GEAR INDICATION AND WARNING
- FLAP BRAKE LATCH AND RELEASE L AND R
- LOAD MONITORING CONTROL
- LOAD MONITORING RELAYS
- LOW RPM SOLENOID
- MARK ON TOP RELAY
- NEGATIVE TORQUE SYSTEM CHECK
- OIL QUANTITY AND TEMP INDICATORS
- PROPELLER AND WING DEICE CONTROL
- PROPELLER AUTOFEATHER
- PROPELLER DEICE TIMER
- PROP FEATHER CONTROLS NO. 2 AND NO. 3
- PROP SYNCH
- RATE SWITCHING GYRO
- SATCOM
- ⚠1 SIDE WINDSHIELD DEFOGGING
- STORMSCOPE

⚠1 **ELECTRONIC POWER FEEDERS NO. 1 AND NO. 2**
- AAS-36
- ALD-2, -28
- APA-125 INDICATOR
- APS-80 RADAR SET
- APX-7 RADAR RECOGNITION SET
- APX-72 IFF TEST SET
- AQA-7 SENSOR STA NO. 1
- AQA-7 SENSOR STA NO. 2
- AQH-4 TAPE RECORDER (PRE-DELTIC/DIFAR)
- ARC-51 UHF-2 TRANSCEIVER
- ARD-13 (DF-202) AUTOMATIC DIRECTION FINDING SYSTEM
- ARN-32 MARKER BEACON RECEIVER
- ARN-83 ADF
- ARN-99 OMEGA
- ARN-118 TACAN RECEIVER
- ASA-66 PWR
- ID-499/ASA-13 POSITION INDICATOR
- MX-2230/ASQ MANEUVER INDICATOR
- QA-1768 FLIGHT STATION PLOTTER
- ON TOP POSITION INDICATOR (OTP)
- P-3 MOD COMP ADPTR
- P820-N AUTOMATIC PILOT SYSTEM
- PT-398 GROUND TRACK PLOTTER
- SONO J-BOX
- STROBE LIGHTS
- TAS TRANSDUCER
- 28V DC TACTICAL CREW LIGHTING

ARMAMENT
- ARMAMENT POWER
- BOMB BAY
- INTERVALOMETER
- KILL STORES
- SEARCH STORES
- SONO DATA DISPLAY
- TORPEDO

START ESSENTIAL DC BUS
- BLEED AIR SHUTOFF VALVES
- ENGINE FUEL AND IGNITION CONTROL
- ENGINE START CONTROL
- FUEL SHUTOFF VALVES
- INVERTER POWER
- PRIME CONTROL
- TEMP DATUM CONTROL

NOTES:

⚠1 WITH EMPENNAGE AND OR PROPELLER ICE CONTROL SYSTEMS ENERGIZED AND ONLY ONE GENERATOR OPERATING, THE MAIN AC BUS A ELECTRONIC FEEDERS 2 AND 3, FLOOR AND WALL HEATERS, SIDE WINDSHIELD DEFOG, AND GALLEY POWER ARE AUTOMATICALLY DISCONNECTED. ADDITIONAL MONITORING OF NO. 1A HYDRAULIC PUMP AND EMPENNAGE DEICING IS PROVIDED WHEN THE APU GENERATOR IS THE ONLY POWER SOURCE AVAILABLE ABOVE 8,000 FEET ALTITUDE.

⚠2 PILOT TURN AND BANK INDICATOR POWERED BY FLIGHT ESSENTIAL DC BUS WITH THE ESSENTIAL BUS SWITCH IN THE OFF POSITION.

Figure 2-6. DC Bus Distribution — P-3A/B (Sheet 2 of 2)

2.2.7 Circuit Breaker Locations. Circuit breaker locations are presented in FO-3, FO-4, and FO-5.

2.3 LIGHTING SYSTEM

2.3.1 Interior Lights. Interior incandescent and fluorescent lights illuminate areas, controls, and instruments (Figures 2-7, 2-8, and FO-12). White, red, or white-and-red lighting is provided for the eyebrow-post and edge-type instrument lights and for the overhead, service, utility, crew, and other panel lights. The flight station utility lights provide emergency lighting for the pilot and copilot instrument panels if an AC electrical power disruption occurs; however, disruption of power to the MEAC bus causes an automatic power switchover to the FEAC bus to provide power for the pilot and copilot red instrument lights. Autotransformers (AC variable rheostats) and toggle, rheostat, and rocker-type switches control the lights throughout the aircraft and provide dimmer control where necessary. Autotransformers have integral fuses located behind the panels (beneath a cap) that can be changed in flight. Extra bulbs and fuses are stored in spare lamp panel boxes located in the flight station above the forward load center circuit breaker panel. An additional bulb locker is located aft of the galley above the electronic rack on the P-3C.

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 (see FO-12).

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 Lights 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

LIGHT CONTROL	SWITCH NOMENCLATURE	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION FWD LOAD CENTER
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'S 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

*Automatic transfer when power not applied to ESSENTIAL INDICATORS AND LIGHT CONTROL circuit breaker.

Figure 2-7. Interior Light — Flight Station (Sheet 1 of 2)

LIGHT CONTROL	SWITCH NOMENCLATURE	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION FWD LOAD CENTER
HSI Mode	HSI MODE (P-3C)	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

Figure 2-7. Interior Light — Flight Station (Sheet 2 of 2)

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.

2.3.2.10 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 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.

2.4 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's speed, altitude, and maneuvering envelopes at all permissible weights, centers of gravity, aerodynamic configurations, and engine power settings. (See FO-12.)

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.

2.4.1 Inputs

2.4.1.1 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.

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

LIGHT CONTROL	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION
Cabin Overhead:	Aft face cabin over-head	OVHD FLUOR LTS:	
— Sonobuoy (P-3A/B)	Aft of main cabin door	— SONO AREA	Main AC Bus A
— Rest area (P-3A/B)	Aft of main cabin door	— REST AREA	Main AC Bus A
— Forward Compartment	TACCO station	— FWD COMP	Bus A (MLC)
— Radio operator area (P-3A/B)	(2) Aft — Forward load center and above lavatory door		Main AC Bus A
— Tactical station area (P-3A/B)	Aft face — Main load center assembly		Main AC Bus A
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)
— Circuit breaker — Main Load Center (P-3A/B)	Aft face of MLC	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 win-dow	BOMB BAY & SERV AREA	28-VAC Aft Lighting Bus (MLC)
— Circuit breaker — Electronic (P-3A/B)	Above lavatory door — opposite panel		Main AC Bus B
— Tactical crew (P-3A/B) breaker panel	At station areas		Fwd left electronic circuit

Figure 2-8. Interior Lights — Cabin (Sheet 1 of 2)

LIGHT CONTROL	CONTROL LOCATION	CIRCUIT BREAKER	CIRCUIT BREAKER LOCATION
EXIT	Flight Station, emergency exits, cabin door	Self-contained	
Circuit Breaker Panels: — Main Load Center — DPS CB Panel — Left CB Panel — Center CB Panel — Aft CB Panel	 Aft face of MLC enclosure On panel face On panel face On panel face On panel face	 — MN LOAD CTR — L SIDE FWD — L SIDE FWD — L SIDE CTR & AFT — L SIDE CTR & AFT	 28-VAC Aft Lighting Bus (MLC) 28-VAC Aft Lighting Bus (MLC) 28-VAC Aft Lighting Bus (MLC) 28-VAC Aft Lighting Bus (MLC) 28-VAC Aft Lighting Bus (MLC)
NAV/COMM Station: — Indicator — Fluorescent Map and Alt Red Edge — ICS	 At station At station light control At station light control	NAV COMM LTS — IND — EDGE & MAP — ICS IND	 MDC E (MLC) BUS A (MLC) MDC E (MLC)
Nonacoustic Station: — Floodlight — Edge — MAD/RADAR	 At station At station At station	SENSOR STA 3 LTS — FLOOR & REC — EDGE — IND	 MDC (MLC) BUS A (MLC) MDC (MLC)
TACCO Station: — Floodlight — Edge — Indicator	 At station At station At station	TACCO STA LT — FLOOD — EDGE — IND	 MEDC (Fwd Elect) BUS A (Fwd Elect) MDC (Fwd Elect)
Acoustic Stations: — Panel — Floodlight — Fluorescent	 At station At station At station	SENSOR STA 1 & 2 LTS — IND — FLOOD — EDGE LT JEZ	 MDC (Center Elec)* MEAC (Center Elec)* BUS A (Center Elec)*
Crew (Aft Station): Galley, Observer, Ordnance	At station	AFT EDGE LT	MDC E (Aft Elec)
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 2-8. Interior Lights — Cabin (Sheet 2 of 2)

information to pitch channel 1 and BARO ALT CONTROL No. 2 supplies information to pitch channel 2.

2.4.1.3 Heading. Heading information is supplied to the ASW-31 AFCS by INS 1 and 2 through the pilot 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.

2.4.1.4 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 that 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.

2.4.2 ASW-31 AFCS Characteristics

2.4.2.1 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.

2.4.2.2 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.

2.4.3 Controls and Indicators

2.4.3.1 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.

2.4.3.2 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.

2.4.3.3 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.

2.4.3.4 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.

2.4.3.5 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.

2.4.3.6 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.

2.4.3.7 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.

2.4.3.8 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 receive INS 1 information and channel 2 of both the pitch and roll axes receive INS 2 information.

2.4.3.9 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.

2.4.3.10 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.

2.4.3.11 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.

2.4.4 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.

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

2.4.4.2 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.

2.4.4.3 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.

2.4.4.4 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.

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

2.4.4.6 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.

2.4.5 Modes of Operation

2.4.5.1 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.

2.4.5.2 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.

2.4.5.3 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.

2.4.5.4 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.

2.4.6 MAD Maneuver Programmer Panel. A panel (Figure 2-9) 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.

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

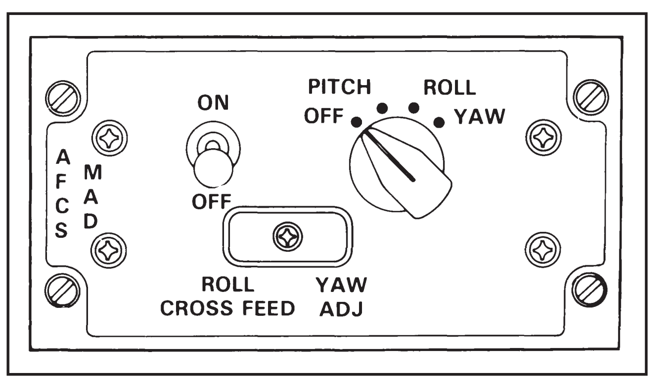


Figure 2-9. MAD Maneuver Programmer Panel

2.4.6.2 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.

2.4.6.3 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°.

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.

2.5 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.

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

2.5.2 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.

2.5.2.1 AFCS Control Panel. The following switches and controls are located on the AFCS (autopilot) control panel (Figure 2-10).

2.5.2.1.1 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.

2.5.2.1.2 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.

2.5.2.1.3 Altitude Hold Switch. The altitude hold switch is a three-position, paddle-type switch placarded BAR. ALT. HOLD, OFF and RADAR ALT. HOLD, which in either hold position, signals the autopilot to

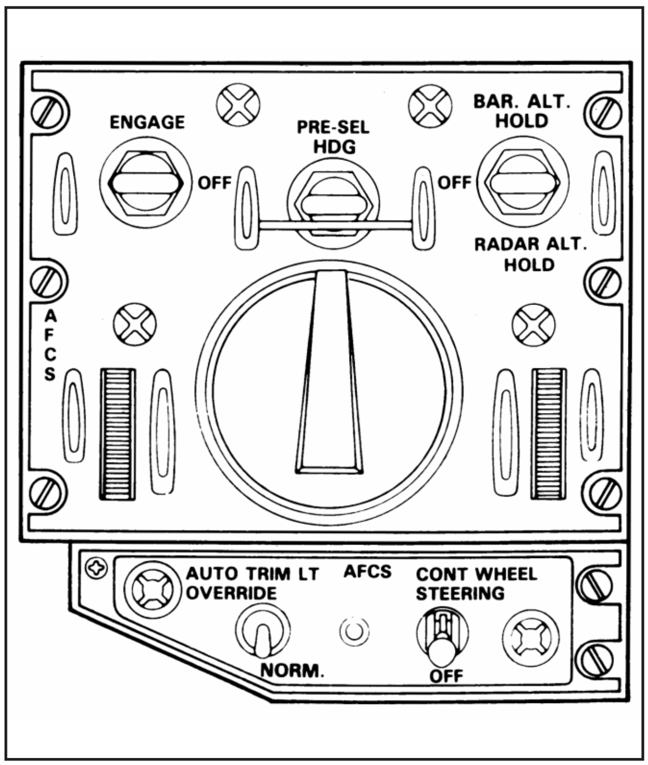


Figure 2-10. Autopilot Control Panel

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.

2.5.2.1.4 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.

2.5.2.1.5 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.

2.5.2.2 AFCS Subpanel. The AFCS subpanel (Figure 2-10) 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 OVER-RIDE 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.

2.5.2.3 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.

2.5.2.3.1 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.

2.5.2.3.2 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.

2.5.3 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.

2.5.3.1 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.

2.5.3.2 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°.

2.5.3.3 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.

2.5.3.4 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.

2.5.4 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.

2.5.4.1 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.

2.5.4.2 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.

2.5.5 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.

2.5.5.1 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.

2.5.5.2 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.

2.5.5.3 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.

2.5.5.4 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.

2.5.5.5 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.

2.5.5.6 Hardover Protection System. 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.

2.5.5.7 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.

2.5.5.8 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 if the pressure drops below approximately 1,100 psi.

2.5.5.9 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.

2.5.5.10 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.

2.5.5.11 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.

2.5.5.12 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 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.

2.6 FLIGHT STATION INSTRUMENTS

Refer to FO-12 for diagrams of the flight station instruments.

2.6.1 Pitot-Static System. The pitot-static system (Figure 2-11) 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 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 through the

1 Aircraft equipped with ASW-31 AFCS

2 Aircraft equipped with PB-20N autopilot

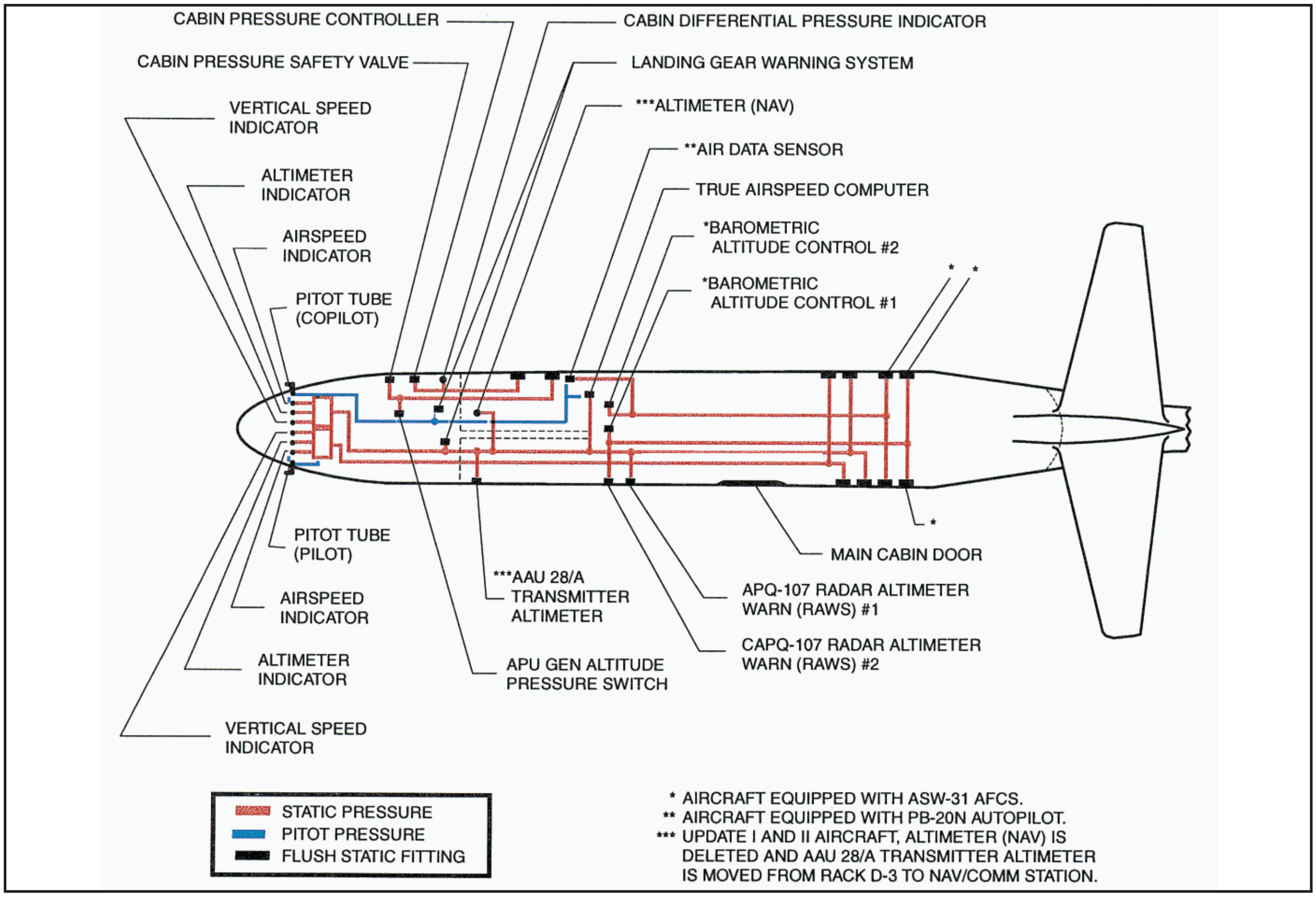


Figure 2-11. Pitot-Static System

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 to 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[2] 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.

2.6.2 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 (VNE needle) is incorporated. Needle position varies according to altitude.

[1]Aircraft equipped with ASW-31 AFCS

[2]Aircraft equipped with PB-20N autopilot

2.6.3 AAU-21/A or AAU-32/A 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's baro-altimeter provides the GPS with baro-corrected altitudes for use as a reference.

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 AAU-21/A 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.

2.6.3.1 Operating Characteristics of the AAU-21/A. 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, and so on).

2.6.3.2 Altimeter-Encoder (P-3A/B). On aircraft incorporating AFC-326, the copilot AAU-24/A is replaced by either an AAU-21/A or AAU-32/A altimeter-encoder. The AAU-32/A is functionally identical to the AAU-21/A described in this chapter, except the maximum altitude output is 50,000 feet. The altitude signal is routed to the ASN-124 computer via the signal data converter for display and tactical computations.

2.6.3.3 Field Elevation Check. When the local barometric pressure is set into the AAU-21/A, 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.

2.6.3.4 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 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 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.

2.6.4 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.

2.6.5 Standby Attitude Indicator (Pilot Miniature Attitude Indicator). The standby attitude indicator, a self-contained vertical gyroscope, is installed on the pilot instrument panel (P-3C). It provides a backup presentation of attitude reference in case of possible failure of both inertial navigation systems and the vertical (standby) gyro. The unit is powered by the FEAC bus through the GYRO HORIZON circuit breaker.

2.6.5.1 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 after indicator stabilizes.

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 attitude.

3. After takeoff, adjust miniature aircraft to desired pitch position.

Note

Do not recage gyro unless large errors (greater than 10°) are present. If recaging is necessary, ensure wings-level attitude exists at time of recaging.

4. In the event of complete electrical power failure, the OFF flag appears but the gyro presents useful attitude information for 9 minutes.

2.6.6 Vertical Speed Indicator. 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.

2.6.7 Angle-of-Attack 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.

2.6.7.1 Angle-of-Attack Indicator. Two AOA indicators (Figure 2-12), located on the pilot and copilot instrument panels (pilot only on P-3A/B), 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.

2.6.7.1.1 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 2-12.

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.

2.6.7.2 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

	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	

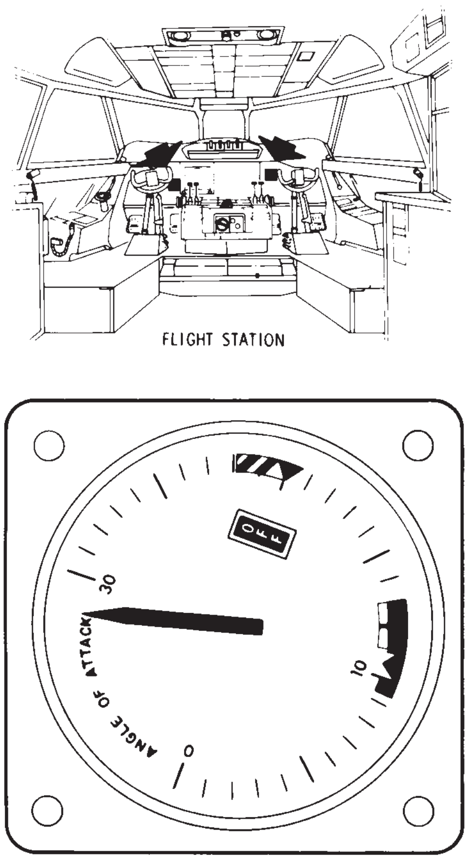


Figure 2-12. Angle-of-Attack Indicators

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 lights 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 2-13). 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 VS. The system also displays a doughnut (12 units AOA) at 1.35 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.

2.6.7.2.1 Approach Index Lights 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.

2.6.7.3 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.

2.6.7.4 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.

2.6.7.5 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.

2.6.8 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

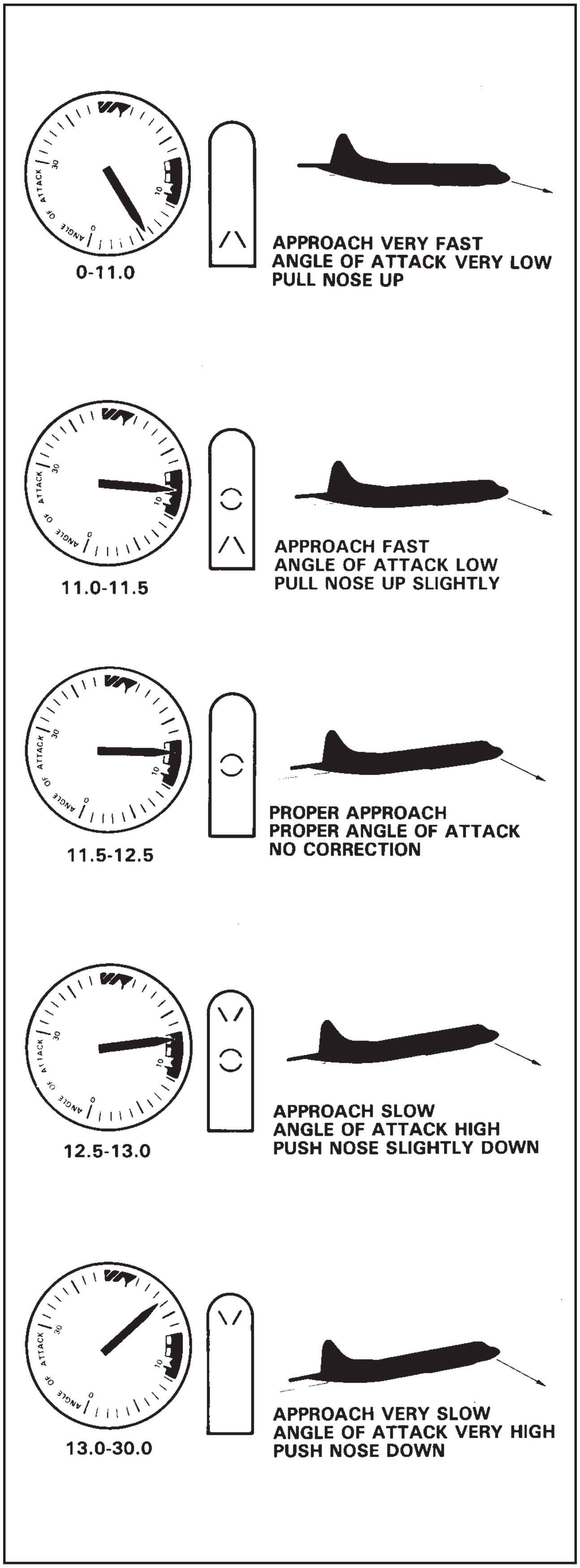


Figure 2-13. Angle-of-Attack Display

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.

2.6.8.1 Height Indicator. A radar altitude indicator (Figure 2-14) 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 counter clockwise 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.

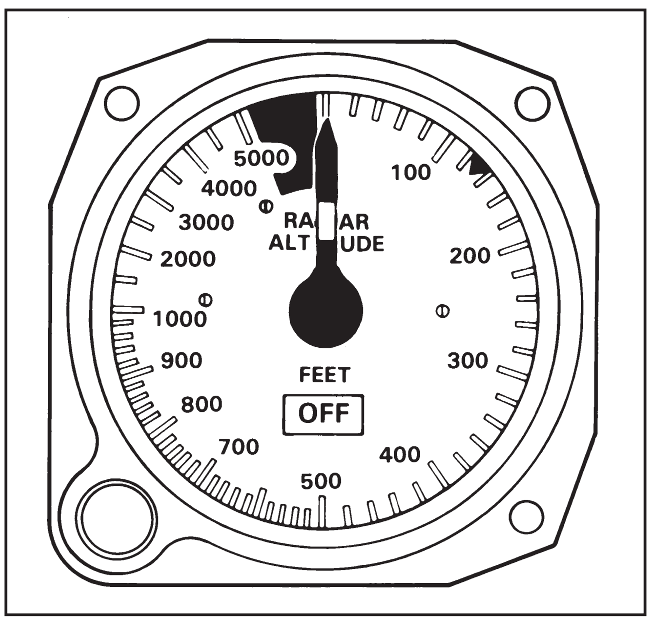


Figure 2-14. Radar Altitude Indicator (Typical)

Note

- On the P-3C, the APN-194 automatically energizes when the landing gear is selected down, even if system power is shut off.
- On the P-3A/B, power will be applied to the APN-194 system whenever the flap handle is positioned to takeoff/approach or land regardless of power switch position.

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.

2.6.8.2 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.

2.6.9 Radar Altimeter Warning System. The APQ-107 RAWS provides the pilot and copilot with flashing red warning lights and a 1000-Hz aural tone (interrupted at a 2-Hz rate) 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 assure 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.

2.7 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 (see FO-9).

2.7.1 Mechanical Governor. Propeller operation is divided into two separate regimes: the flight (Alpha) range, which includes the takeoff roll after the power levers are moved forward for takeoff, and the ground operating (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. Predominate 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 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.

2.7.2 Electronic Governor. When the individual SYNC SERVO switch is placed to NORMAL, the synchrophaser system energizes, which provides power 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.

2.7.3 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- to106-percent RPM.

With the solid-state synchronization system installed (AFC-473), 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.

2.7.4 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. (See FO-12.)

2.7.4.1 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.

2.7.4.2 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.

2.7.4.3 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. With the solid-state synchronization system (AFC 473) installed, this switch is not normally used in flight.

2.7.5 Synchrophaser Control Panel

2.7.5.1 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 (see FO-12).

2.7.6 Propeller Components. The P-3 propeller assembly is comprised of four main subassemblies: the barrel, the dome, the blade assembly, and the control assembly. (See FO-9.)

2.7.6.1 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 pitch-lock regulator that provides the oil passages needed to transmit hydraulic power from the control assembly to the dome.

2.7.6.2 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.

2.7.6.3 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.

2.7.6.4 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.

2.7.6.5 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.

2.7.6.6 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.

2.7.6.7 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.

2.7.6.8 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.

2.7.7 Beta Followup. The Beta followup system provides a secondary variable hydraulic low pitch stop. As power is applied on takeoff, the same cams, Beta followup, and Beta set that provide pitch control in the Beta range start moving to set up a minimum followup 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.

2.7.8 Pitchlock. A hydraulic, speed-sensitive pitch-lock 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 pitch-lock 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.

2.7.8.1 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 airstarting. Blade angles will be less than 57° at 405 knots or limit Mach speed.

2.7.8.2 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 Chapter 15, paragraph 15.11, PROPELLER MALFUNCTIONS, for procedures to follow in the event of pitchlock under various conditions.

2.7.8.3 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. (See FO-12.)

WARNING

Intentionally pitchlocking the propeller inflight 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.

2.7.9 Negative Torque System. 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.

2.7.9.1 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. (See FO-12.)

2.7.10 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, or as early as –500 SHP, thus automatically limiting excessive loads on aircraft structures and excessive drag on the aircraft. (See FO-9.)

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.

2.7.11 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.

2.7.12 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.

2.7.12.1 Normal Feathering. Feathering is normally accomplished by pulling the engine's 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 paragraph 2.8.10, Emergency Shutdown Handles, for a more complete description of emergency handle functions.

2.7.12.2 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. (See FO-12.)

2.7.12.3 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.

2.7.12.4 Feathering Switches (Buttons). Four guarded feathering switches (FO-12), 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.

2.7.12.5 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.

2.7.12.5.1 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.

2.7.12.5.2 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.

2.7.12.6 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, see paragraph 8.33, ENGINE RESTART DURING FLIGHT.

Figure 2-15 shows propeller blade angle as determined by power lever position.

2.7.13 Propeller Operating Fundamentals. Propeller operation requires mechanical governing and fluid reliability to counteract 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 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 $1.52V_s$), 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.

In some cases, particularly when decoupled at extremely low blade angles, the resultant IAS at 115 percent RPM may be much lower than $1.52V_s$. In this case range at less than $1.52V_s$ 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

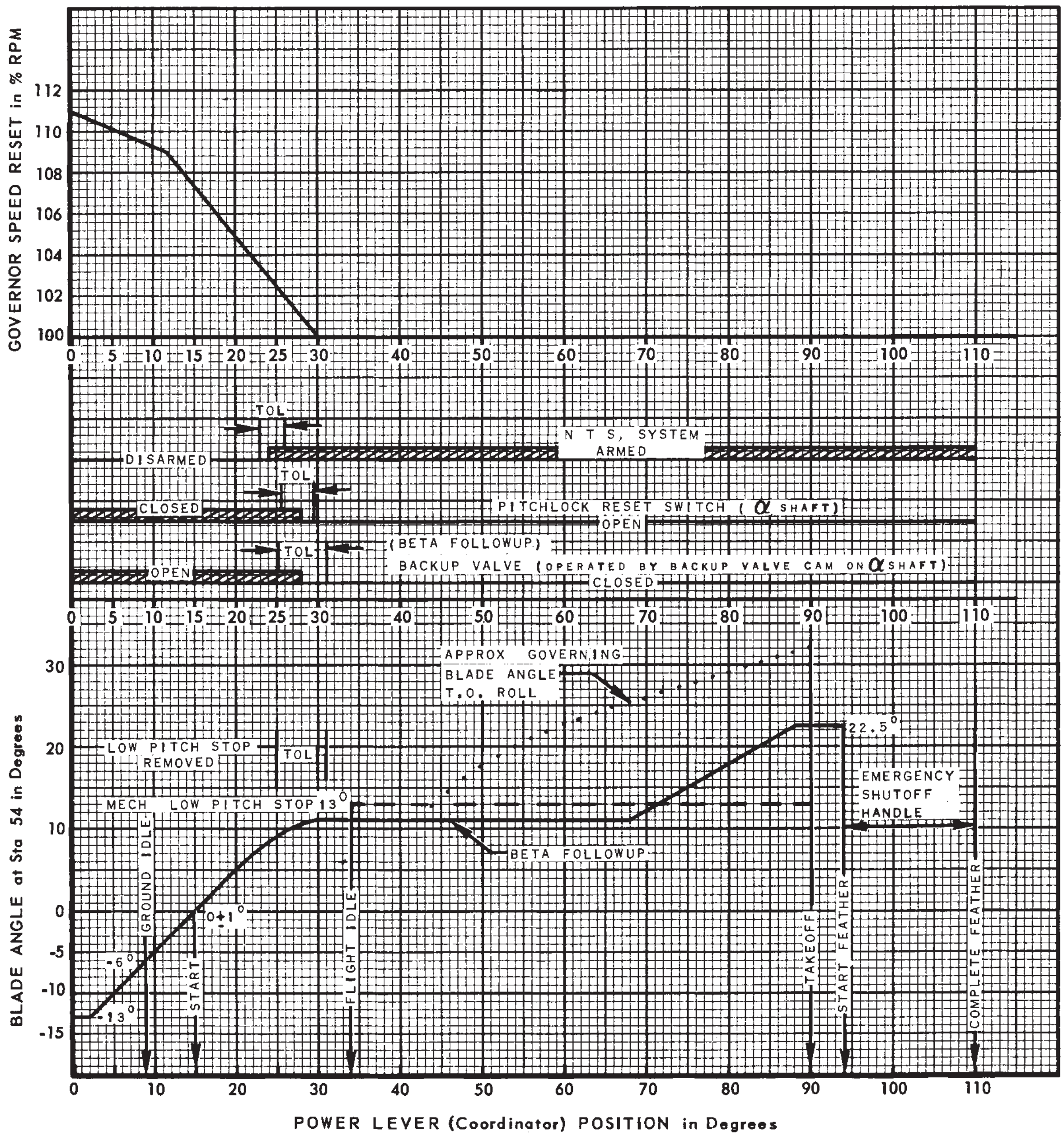


Figure 2-15. Power Lever Position vs. Blade Angle

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 gear box 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.

2.8 PROPULSION SYSTEM

The P-3 aircraft has four Allison T56-14 turbo-prop engines (Figure 2-16) 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.

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.

2.8.1 Power Section. The power section consists of a 14-stage, axial-flow compressor; six 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.

2.8.2 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. Closes the 5th and 10th stage bleed air valves at 94 percent RPM
6. Bomb bay heat.

2.8.3 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.

2.8.4 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 TIT thermocouples are located prior to this section.

2.8.5 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 2-17). The following equipment is mounted on the accessory section:

1. Engine fuel pump
2. Fuel control unit
3. Speed sensitive control
4. Speed sensitive valve
5. Main oil pump
6. Oil filter
7. Scavenge oil pump.

2.8.6 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 2-18). 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.

2.8.6.1 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.

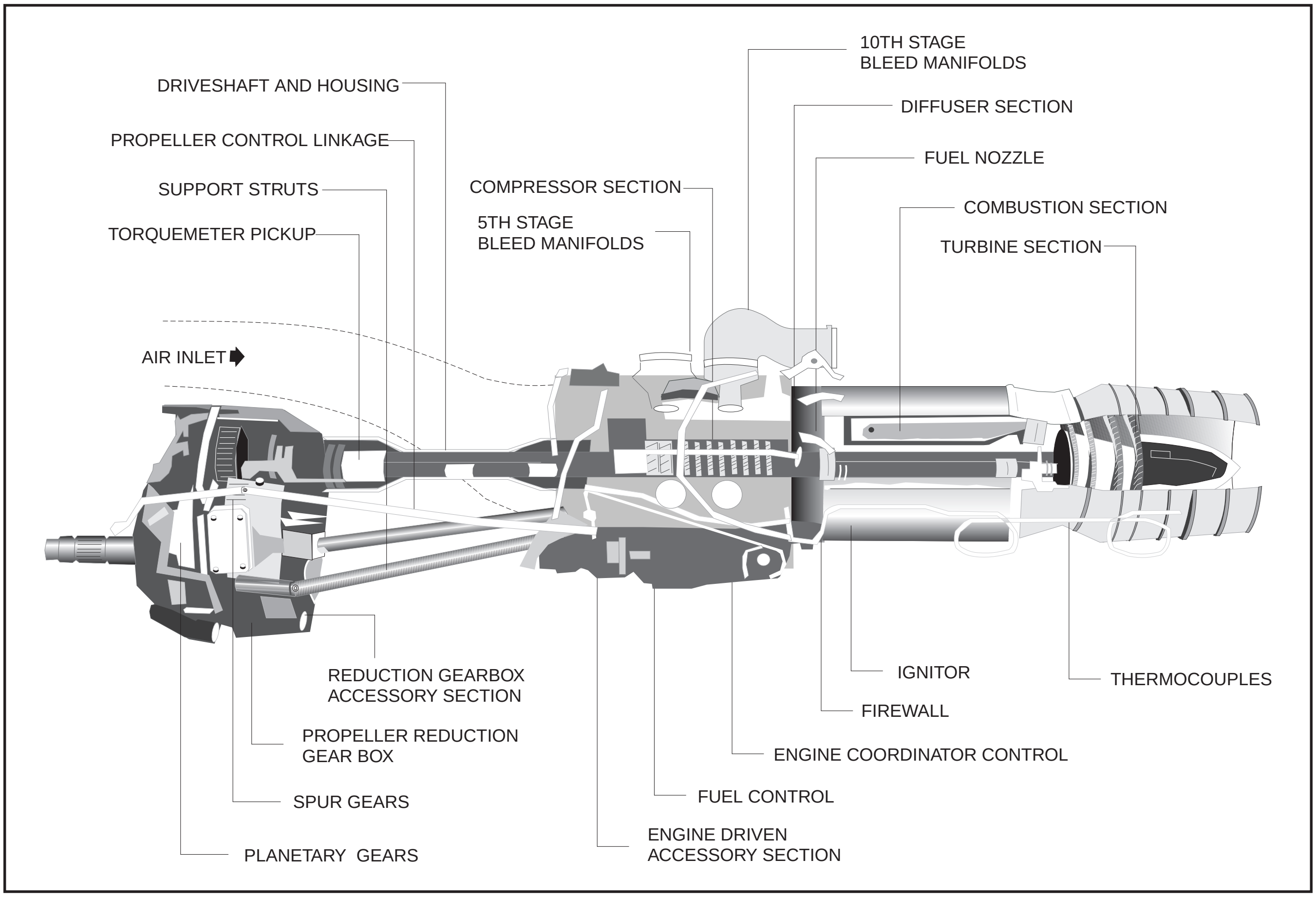


Figure 2-16. T56 Powerplant

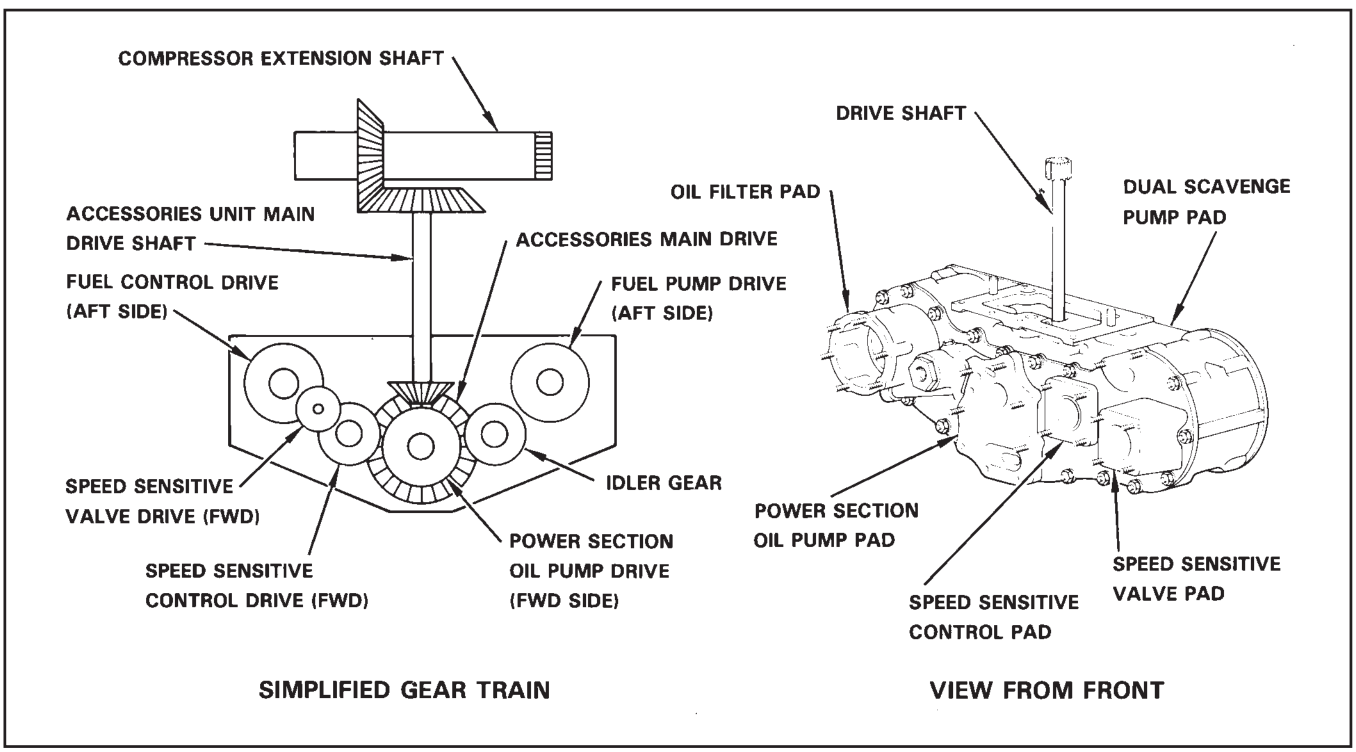


Figure 2-17. Compressor Accessory Section

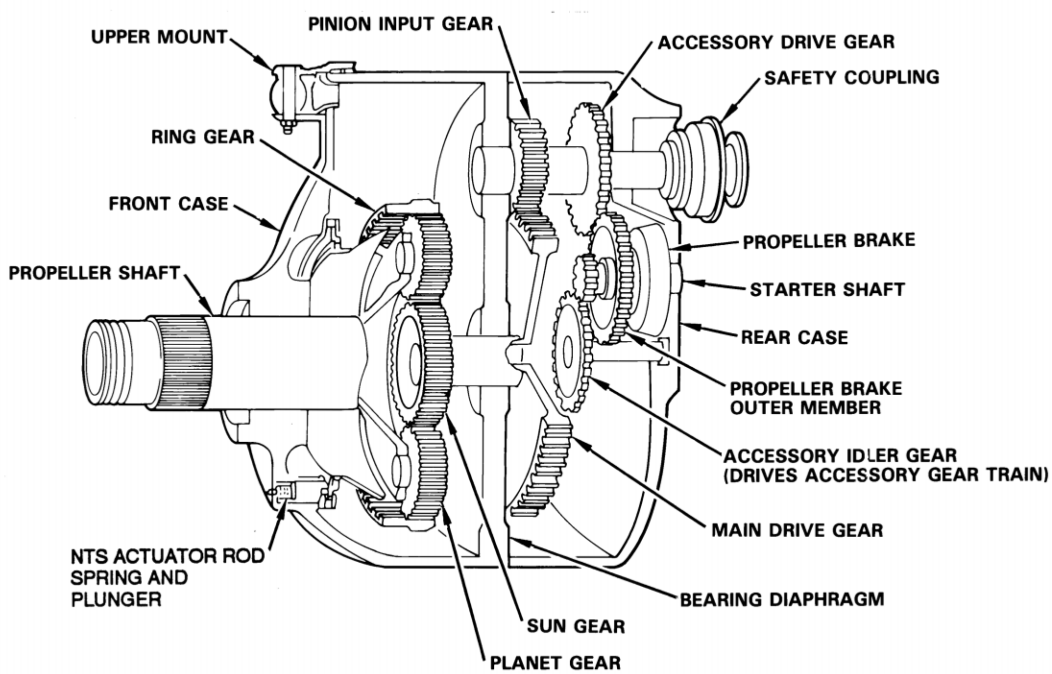


Figure 2-18. Basic Reduction Gear

4. No other feather button is in the feather position.

Note

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

2.8.6.2 Accessory Section. The accessory section of the reduction gearbox (Figure 2-19) 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.

2.8.7 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.

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.

2.8.8 Principles of Operation. The engine operates in two distinct modes, the ground range and the flight range (Figure 2-20).

2.8.8.1 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

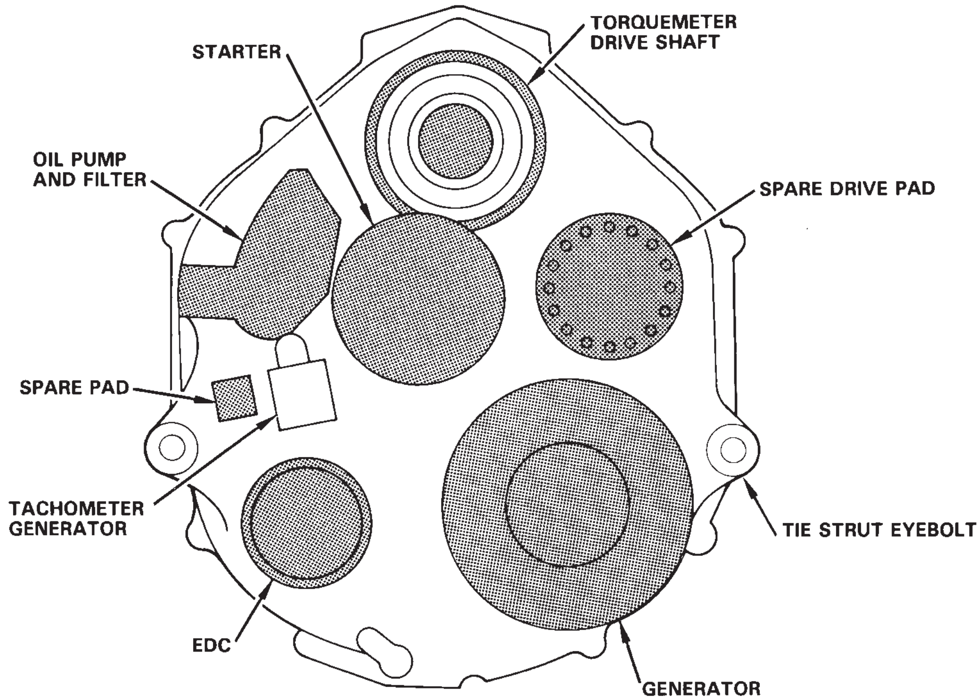


Figure 2-19. Reduction Gear Accessory Section

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; it does, however, 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.

2.8.8.2 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.

2.8.9 Engine Start System

2.8.9.1 Starter. A turbine starter unit, operated by compressed air from an external GTC, the APU, or bleed air from an operating engine is used to start the engine (see FO-8). 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. (See paragraph 8.5, NORMAL START.)

Engine starting sequence is shown in Figure 2-21.

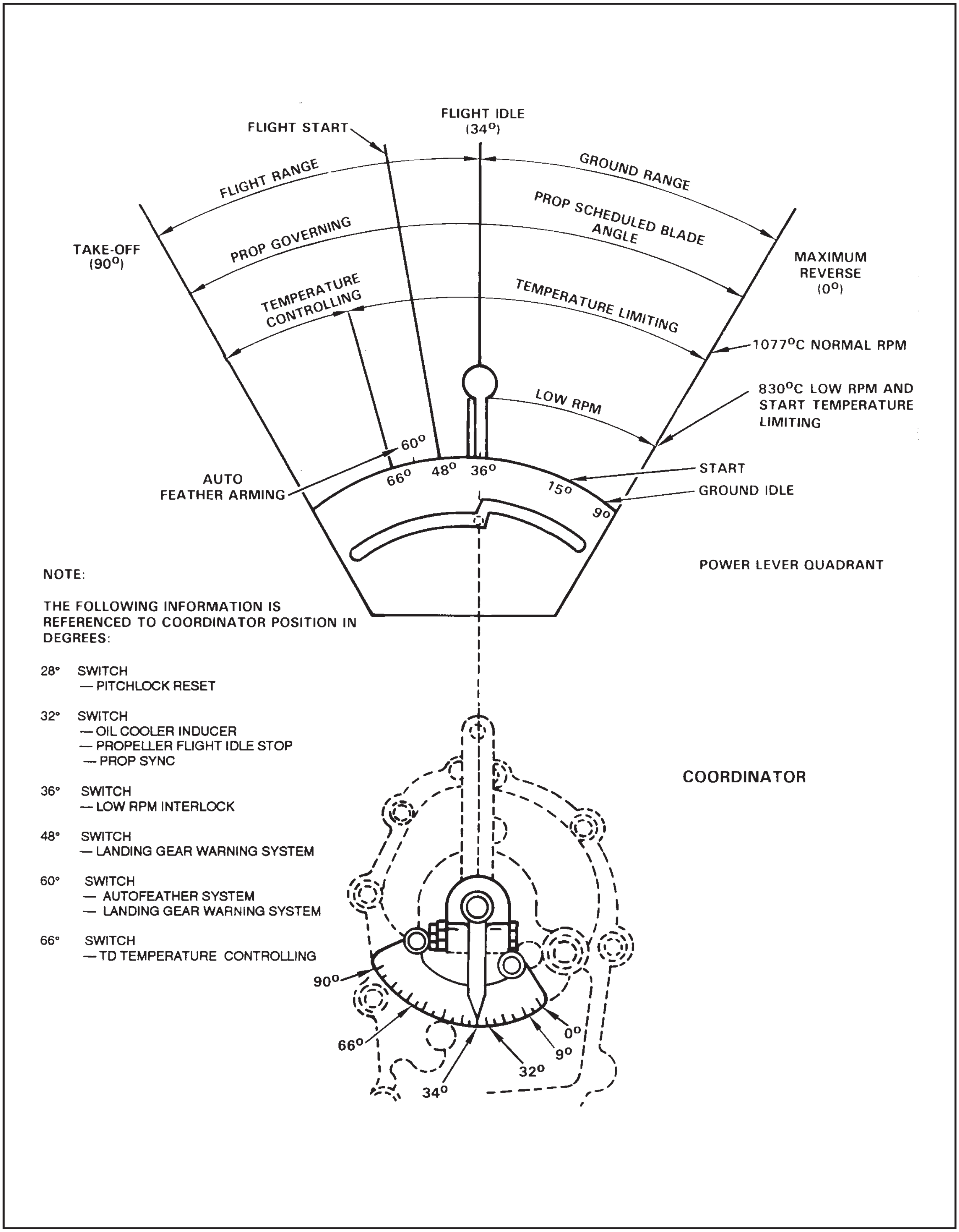


Figure 2-20. Power Lever Function

			16%					65%		94%	
ENGINE RPM	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
STARTER	CRANKING ENGINE						1 *	NOT CRANKING ENGINE			
PROPELLER BRAKE	RELEASED BY STARTER TORQUE					HELD RELEASED HYDRAULICALLY					
FUEL CONTROL CUTOFF ACTUATOR	DEENERGIZED		2 *	DEENERGIZED							
FUEL FLOW TO FUEL NOZZLES	NO		YES								
IGNITION RELAY	DEENERGIZED		ENERGIZED					DEENERGIZED			
IGNITION EXCITER	DEENERGIZED		ENERGIZED					DEENERGIZED			
MANIFOLD DRAIN VALVE SOLENOID	DEENERGIZED		ENERGIZED					DEENERGIZED			
MAINIFOLD DRAIN VALVE	OPEN		CLOSED BY SOLENOID AND HELD CLOSED BY FUEL PRESSURE								
PARALLELING VALVE SOLENOID	DEENERGIZED		ENERGIZED					DEENERGIZED			
PARALLELING VALVE	OPEN		CLOSED					OPEN			
FUEL PUMP OPERATION	SERIES		PARALLEL					SERIES			
PARALLELING LIGHT	OFF		ON, WHEN SECONDARY PRESSURE EXCEEDS 150 PSIG					OFF			
ENRICHMENT VALVE SOLENOID	DEENERGIZED		3 *	DEENERGIZED							
ENRICHMENT VALVE	CLOSED		3 *	CLOSED							
TD VALVE TAKE SOLENOID	ENERGIZED									DEENERGIZED	
% TAKE POSSIBLE	50%									20%	
TEMP. LIMIT	START LIMIT 830°									1083 °C	
5TH & 10TH STAGE BLEED AIR VALVES	OPEN									CLOSED	

1. When RPM exceeds 64 percent, a switch in starter opens circuit to starter control valve. Starter control valve closes to stop airflow to starter.
2. Fuel control cutoff actuator turns itself off when fuel shutoff valve is open.
3. Enrichment occurs only if primer button is pushed. Enrichment fuel flow is stopped when fuel manifold pressure exceeds 50 psig.

Figure 2-21. Engine Starting Sequence

2.8.9.2 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.

2.8.9.3 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.

2.8.9.4 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.

2.8.9.5 94-Percent Switch. Above 94 percent, the temperature datum control system switches from start limiting to temperature limiting.

2.8.9.6 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.

2.8.10 Emergency Shutdown Handles. An emergency shutdown handle for each engine is located on the glareshield. (See FO-12.) When a handle is pulled to the full-out position, it performs various functions electrically or mechanically as follows:

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

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.

2.8.11 Engine Switches

2.8.11.1 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 (see FO-12). 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.

2.8.11.2 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.

2.8.11.3 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.

2.8.11.4 START Button. The push-pull START button opens the start valve of the selected engine to allow starting air to turn the starter (see FO-8). The start button is held in by a solenoid that receives power from the START CONT circuit breaker on the SEDC bus. The solenoid remains energized until 57- to 64-percent engine RPM. At this time the solenoid is deenergized by a centrifugal switch, and the start button pops out. The START button can be pulled out at any time in order to discontinue a 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 (see 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.

2.8.11.5 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 (see FO-8). 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 (see paragraph 8.5, NORMAL START.)

2.8.11.6 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 over-temperature protection is lost with the switch in NULL.

2.8.11.7 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.

2.8.11.8 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.

2.8.11.9 Fire Extinguisher Discharge Button. Four fire extinguisher discharge buttons (Figure 2-22) (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.

2.8.11.10 Fire Extinguisher Transfer Switch. A two-position transfer switch for each fire extinguishing system is located on each end of the glareshield panel (Figure 2-22), 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.

2.8.11.11 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.

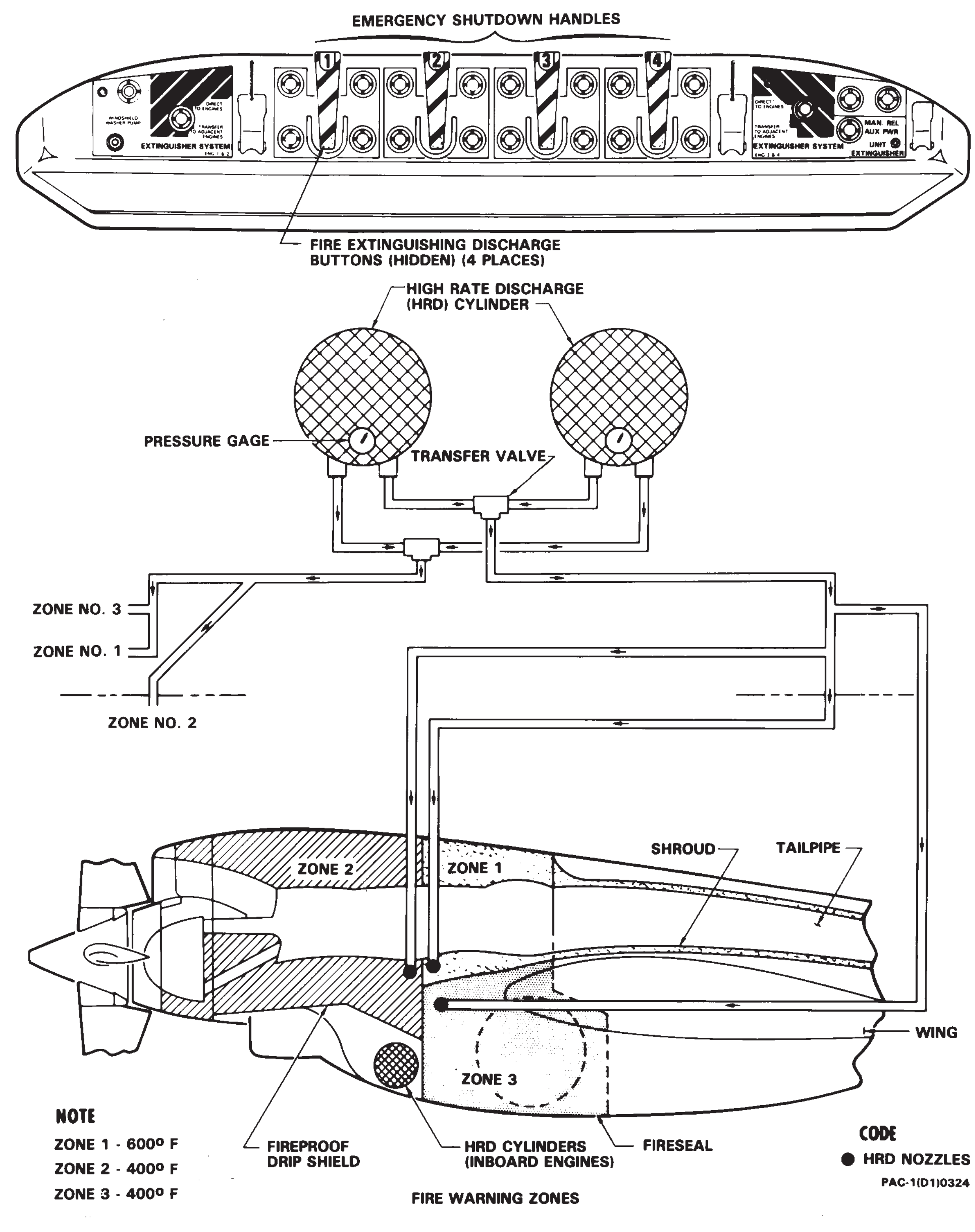


Figure 2-22. Fire Detection and Extinguishing System

2.8.11.12 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.

2.8.11.13 Engine Airscoop and Inlet Vanes Switches. The four toggle switches labeled ENG AIRSCOOP & INLET VANES on the anti-icing control panel (see FO-12) control the position of the engine anti-icing shutoff valves. The two switch positions are OFF and ON.

2.8.11.14 Center Instrument Panel Test and Reset Switches. The DUCT LOOP TEST switch, located adjacent to the upper right corner of the center instrument panel (see FO-12), 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.

2.8.12 Engine Indicators. See FO-12.

2.8.12.1 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.

2.8.12.2 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 AC power is lost.

2.8.12.3 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.

2.8.12.4 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.

2.8.12.5 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.

2.8.12.6 Oil Pressure Indicators. Eight oil pressure indicators are located on the right overhead instrument panel (see FO-12). 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.

2.8.12.7 Oil Temperature Indicators. Four oil temperature indicators, located on the right overhead instrument panel (see FO-12), indicate engine oil temperature. They receive power from the forward load center extension main DC bus.

2.8.12.8 Oil Cooler Flap Position Indicators. An oil cooler flap position indicator (see FO-12), 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.

2.8.12.9 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.

2.8.13 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.

2.8.13.1 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 2-22) 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.

2.8.13.2 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 2-22). 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.

2.8.14 Oil System

2.8.14.1 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 2-23).

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

2.8.14.2 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 (see paragraph 15.8, OIL SYSTEM FAILURE (ENGINE)).

2.8.14.3 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.

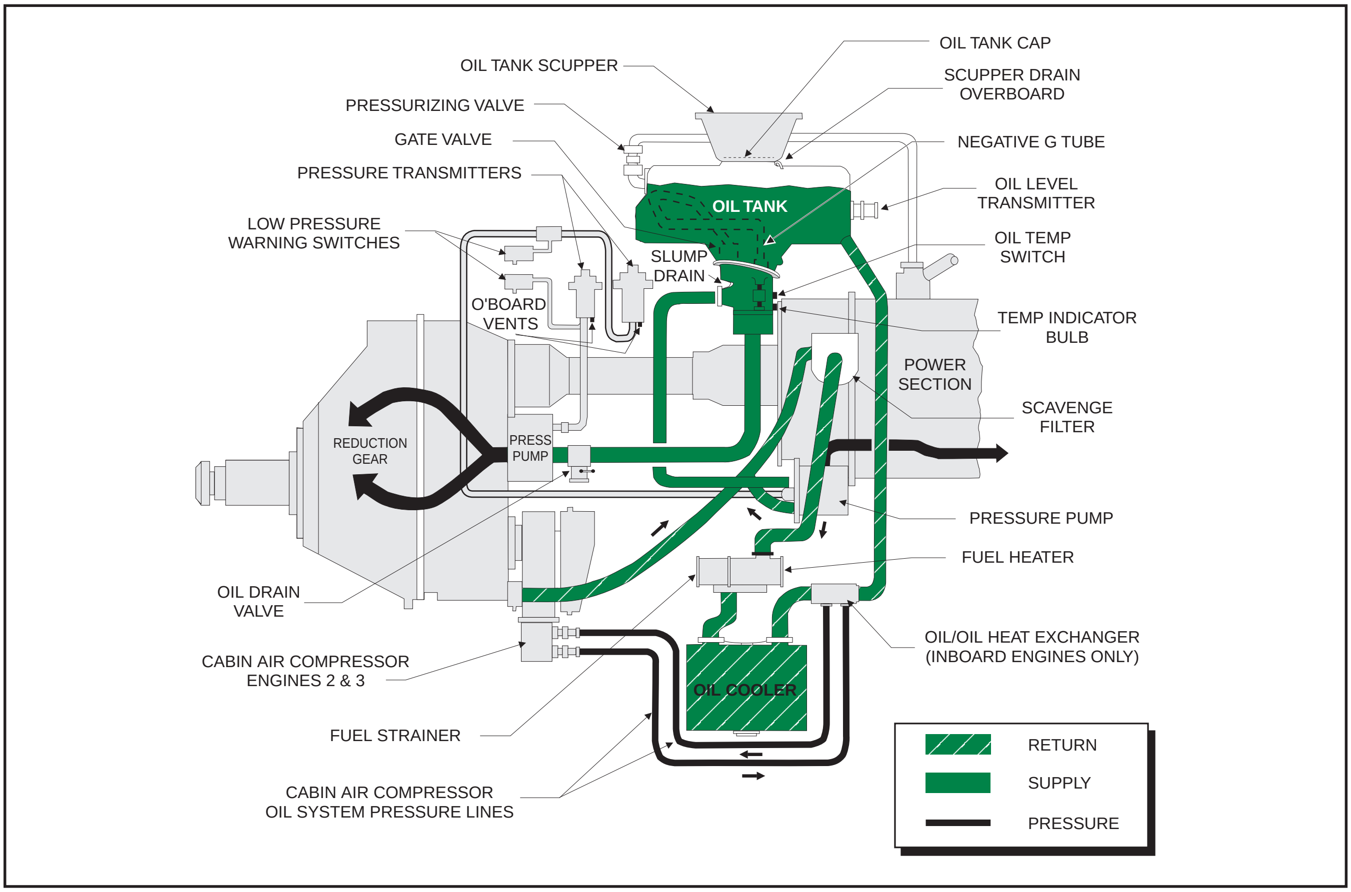


Figure 2-23. Engine Oil System

2.8.14.4 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 (see paragraph 15.9, MAGNETIC CHIP DETECTOR INDICATION). At 100-percent engine RPM the oil pressure limits are 50 to 60 psi.

2.8.14.5 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 (see paragraph 15.9, MAGNETIC CHIP DETECTOR INDICATION).

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

2.9 AIRCRAFT AND ENGINE FUEL SYSTEM

2.9.1 Fuel Supply System. The fuel system consists of five tanks, a fueling system, a transfer system, a crossfeed system, and a dump system (FO-7). 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.

2.9.1.1 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.

2.9.1.2 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.

2.9.1.3 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 main DC bus through the corresponding boost pump switch. A thermal switch opens the fuel boost pump circuit whenever the pump case temperature exceeds 400 °F.

2.9.1.4 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. The two pressure fueling valves for tank No. 5, however, 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.

2.9.1.5 Fuel Transfer System. The fuel transfer system controls fuel flow from tank No. 5 to the wing tanks (FO-10.) 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.

2.9.1.5.1 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 main DC bus through the corresponding transfer pump switch. A thermal switch disconnects a transfer pump whenever the case temperature of the pump exceeds 400 °F.

2.9.1.6 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.)

2.9.1.7 Fuel Dump System. A fuel dump system is provided from tank 5 only for P-3C and later modified P-3A/B aircraft with increased gross weight capability. 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.

2.9.1.7.1 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.

2.9.1.8 Fueling Control Panel. The fueling control panel (refueling panel), located between the pressure fuel adapters, is the control center for fueling and defueling (FO-7). 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.

2.9.1.8.1 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.

2.9.1.8.2 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.

2.9.1.8.3 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.

2.9.1.8.4 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.

2.9.1.8.5 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 2-24).

2.9.1.8.6 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 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

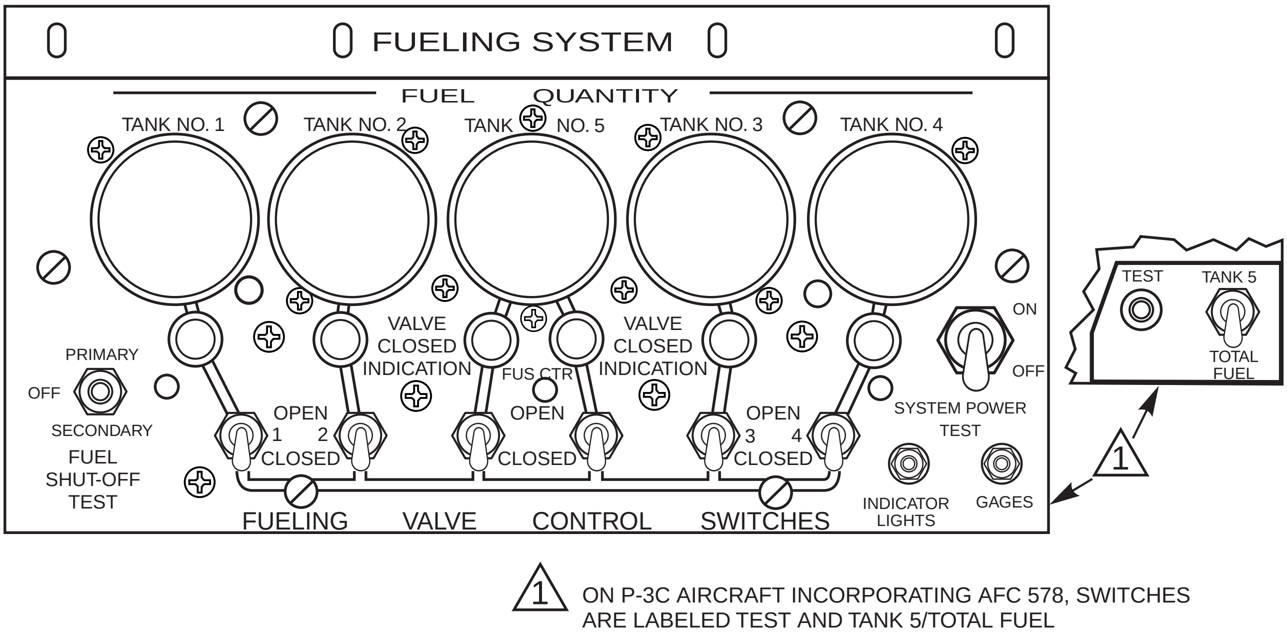


Figure 2-24. Fueling Control Panel

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.

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.

2.9.1.8.7 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 main DC bus through the TEST GAUGE switch.

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 Digital Fuel Quantity System for fault isolation of individual indicators, fuel probes, and harnesses is initiated at start-up 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.

2.9.1.8.8 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 start-up 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 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. (See Figure 2-25 for fault codes.)

2.9.1.9 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 2-26) 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.

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.

2.9.1.10 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-7). 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.

2.9.1.10.1 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.

2.9.1.10.2 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.

2.9.1.10.3 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

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)	YE S	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)	YE S	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
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

Fault Code (1)	System Fault Definition	Error Legend (10)			Effect on Quality
		Disp	Flash	Stdy	Display (2)
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 Re-peater & 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		Degra ded
id-?	Invalid ID Jumper Set(12)	YES	X		"—"
ACA	No Air/Gnd Discrete (9)	YES	X		None or Deg
ACS	Aircraft Test Switch Continu-ally 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
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.

Figure 2-25. Built-In-Test Fault Codes

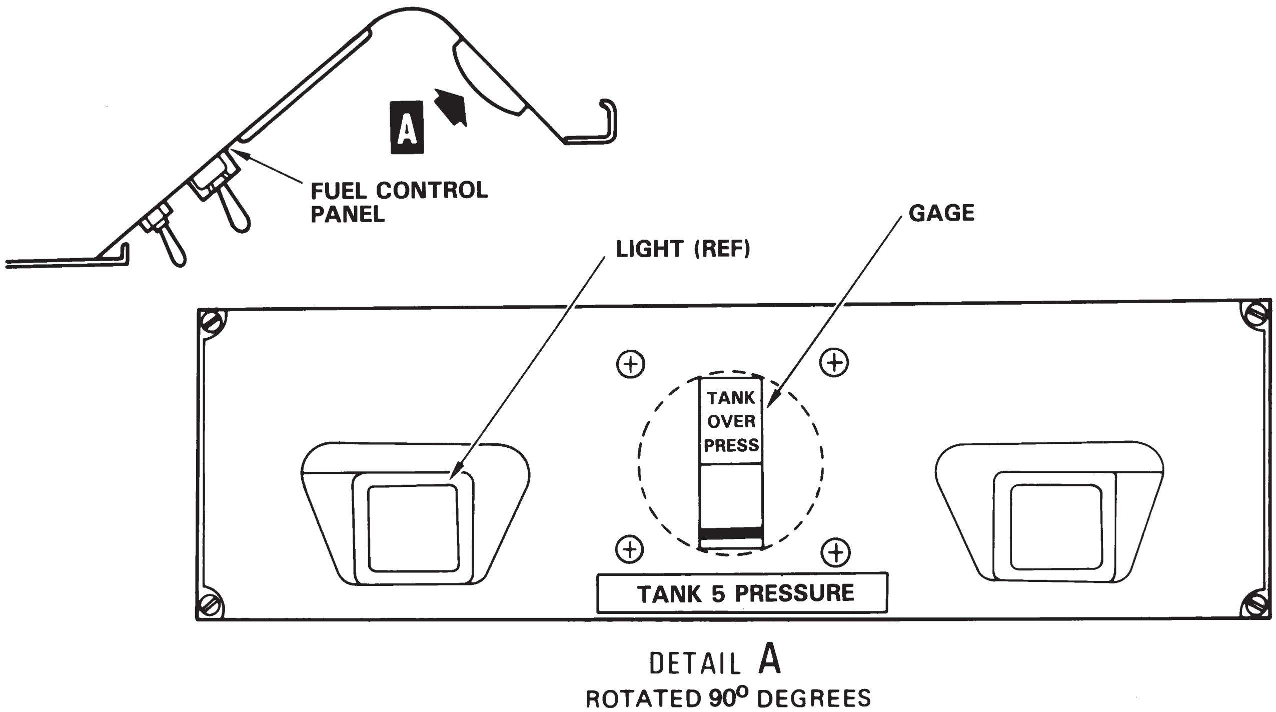


Figure 2-26. Air Vent Pressure Gauge

energized from the MEDC bus through a light-dimming circuit and the pressure switches.

2.9.1.10.4 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.

2.9.1.10.5 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.

2.9.1.10.6 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.

2.9.1.10.7 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.

2.9.1.10.8 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.

2.9.1.10.9 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.

2.9.1.10.10 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.

2.9.1.10.11 Fuel Transfer Control Switch. A spring-loaded pushbutton on the panel, placarded FUEL TRANSFER CONTROL, is provided to ensure that 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.

2.9.1.10.12 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.

2.9.1.10.13 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 2-27).

2.9.1.10.14 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 12×1,000 pounds, and the tank No. 5 gauge is marked 0 to 18 1,000 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 2-27).

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.

2.9.1.10.15 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.

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.

2.9.1.10.16 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

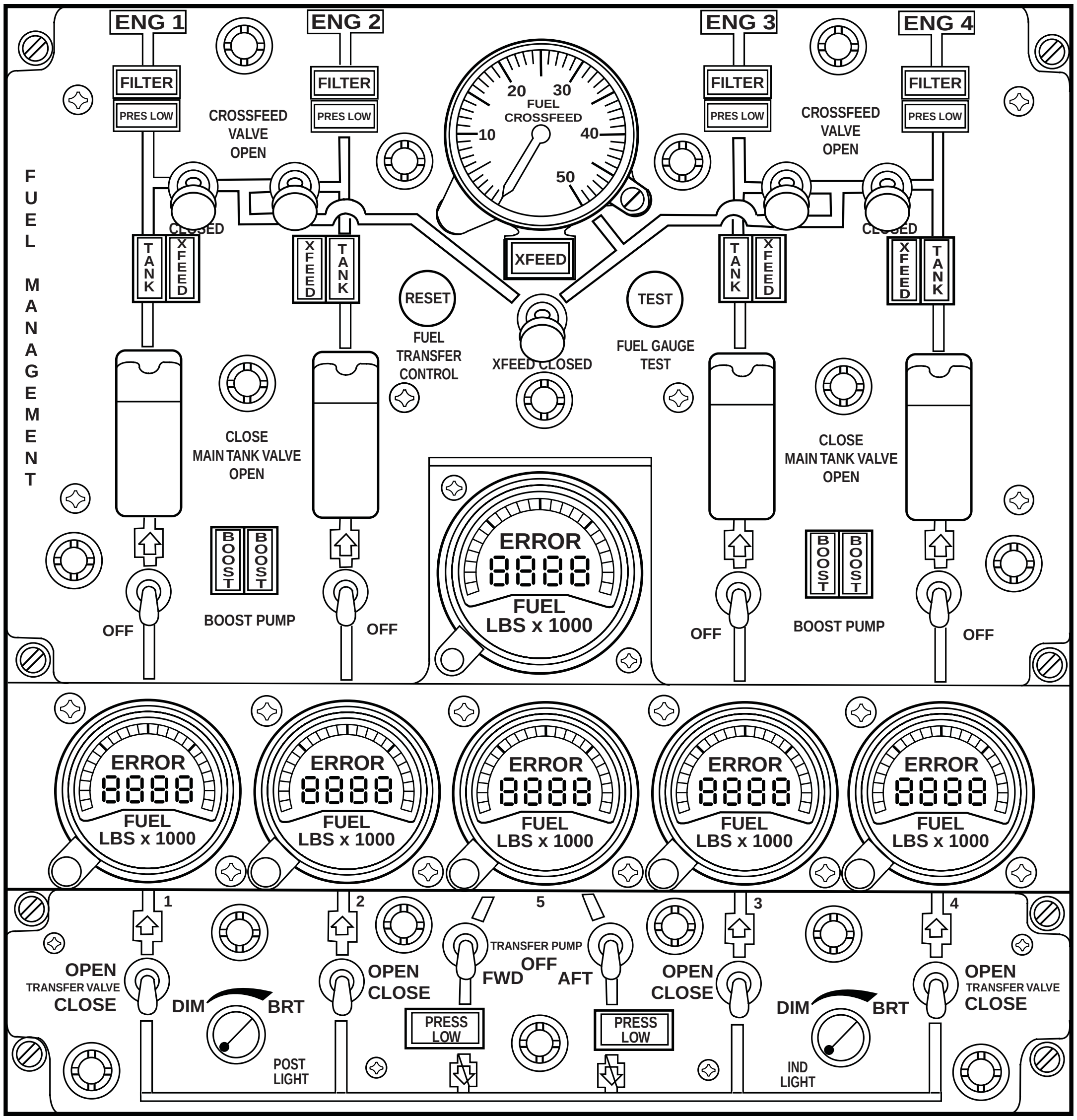


Figure 2-27. Fuel Management Panel

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.

2.9.1.10.17 Aircraft Air/Ground Relay (Aircraft Incorporating AFC-578). On aircraft incorporating AFC-578, tanks 1 and 4 Flight Stations 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.

2.9.1.11 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.

2.9.1.12 Tank 5 Sight Gauge. The tank No. 5 sight gauge (Figure 2-28) 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. (This scale is calibrated in pounds for JP-4 fuel only. Use the following correction factors for the tank 5 sight gauge when other than JP-4 fuel is used. For JP-5, multiply the reading by 1.046; for JP-8, multiply by 1.031.) 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.

2.9.1.13 Hydrostatic Fuel Quantity Gauge and Water Drain Fixture. The hydrostatic fuel gauge (Figure 2-29) 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.)

2.9.2 Engine Fuel System. The principal components of the engine fuel system are: a fuel heater/ strainer, an engine-driven boost pump with a

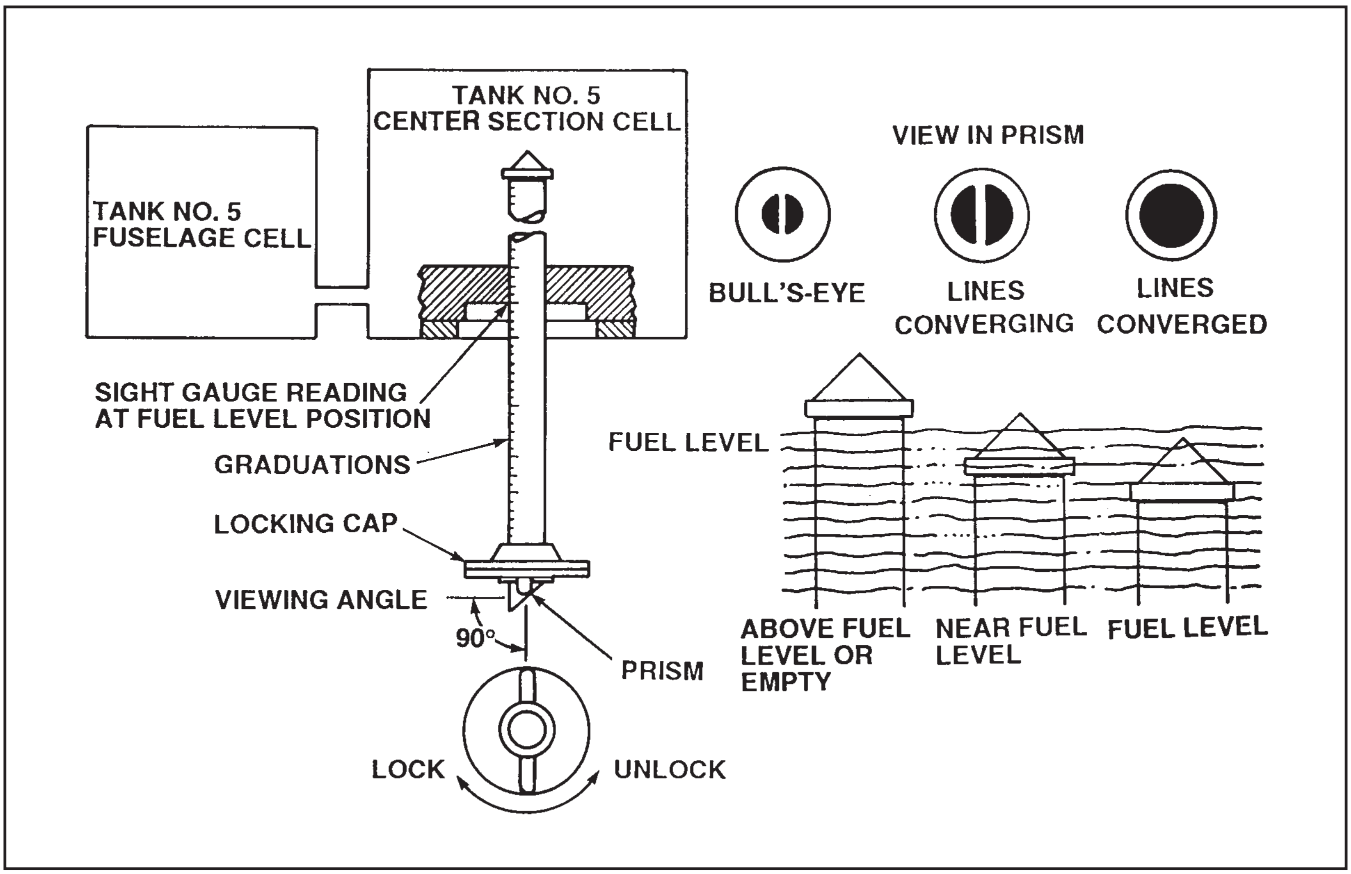


Figure 2-28. Tank No. 5 Sight Gauge

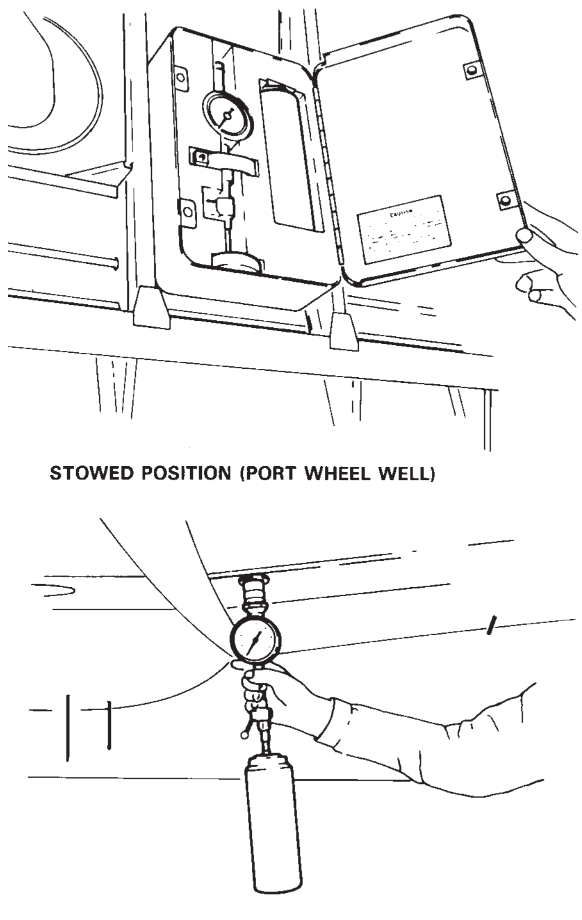


Figure 2-29. Hydrostatic Fuel Quantity Gauge

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. (See Figure 2-30.)

2.9.2.1 Fuel Heater/Strainer. The fuel heater/strainer receives incoming fuel from the wing tanks. Its purpose is to remove water droplets and ice crystals from the fuel. The heater uses heat from engine oil to maintain fuel temperature between 40 and 70 °F. The fuel then passes through a strainer and flows to the engine-driven fuel boost pumps.

2.9.2.2 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 19 psi, 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.

2.9.2.3 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 7.5 psi, the switch closes and energizes the FILTER light on the fuel management panel. This indicates fuel to the low-pressure filters is being bypassed.

2.9.2.4 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.

2.9.2.5 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 2-30 shows fuel pumping and filtration flow.

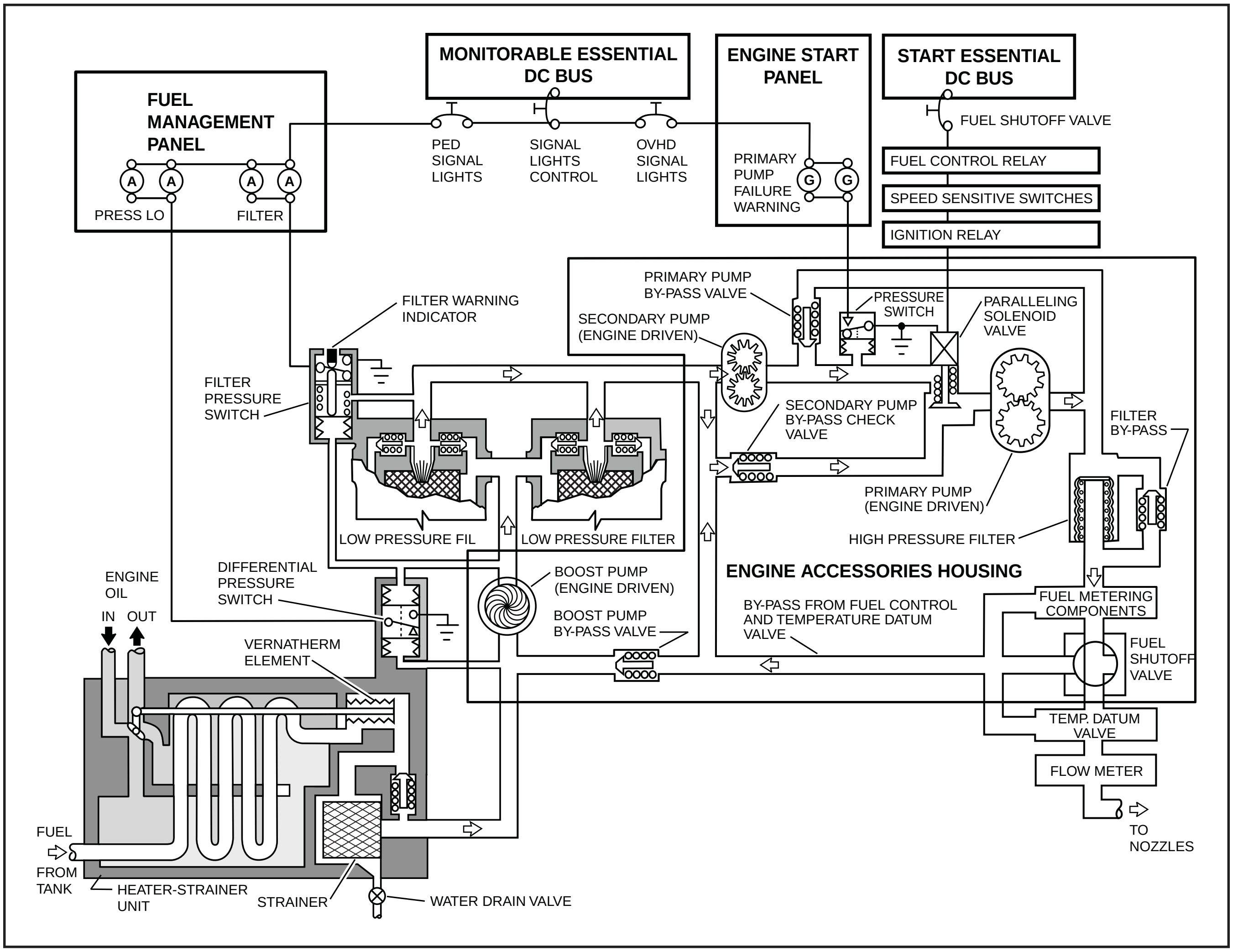


Figure 2-30. Nacelle-Mounted Fuel Pumping/Filtration

2.9.2.6 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 is scheduled 20 percent richer than the nominal engine requirements to accommodate the temperature datum valve that bypasses 20 percent of the control output when in the null position. 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.

2.9.2.7 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 that causes fuel to spray from the nozzles sooner. The primer switch 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 switch must be placed in the ON position until the fuel control cutoff valve opens at 16-percent RPM, or enrichment will not occur. The enrichment (primer) valve closes when fuel pressure in the fuel manifold reaches 50 psi. (Refer to Figure 2-21 for engine starting sequence.)

2.9.2.8 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.

2.9.2.9 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 over temperature release circuit is energized alerting the TD control to signal the TD valve to reduce fuel flow until the temperature falls within limits.

2.9.2.10 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.

2.9.2.11 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 8 to 10 psi, minimizing the amount of fuel entering the combustion liners while the engine is shutdown. 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 between 2 and 4 psi air pressure during coast down and close between 2 and 4 psi during start.

2.10 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, All-Weather Operations.

2.10.1 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.

2.10.2 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.

2.10.3 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.

2.10.4 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 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.

2.10.4.1 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.

2.10.4.2 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.

2.10.4.3 Operation. See Figure 2-31. 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.

2.10.5 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.

2.10.5.1 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.

2.10.5.2 Blade Cuffs, Aft Spinners, and Islands. These components are cyclically deiced (Figure 2-32). 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).

2.10.5.3 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.

2.10.5.4 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 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 2-32.

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, while 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 special 11-volt 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.

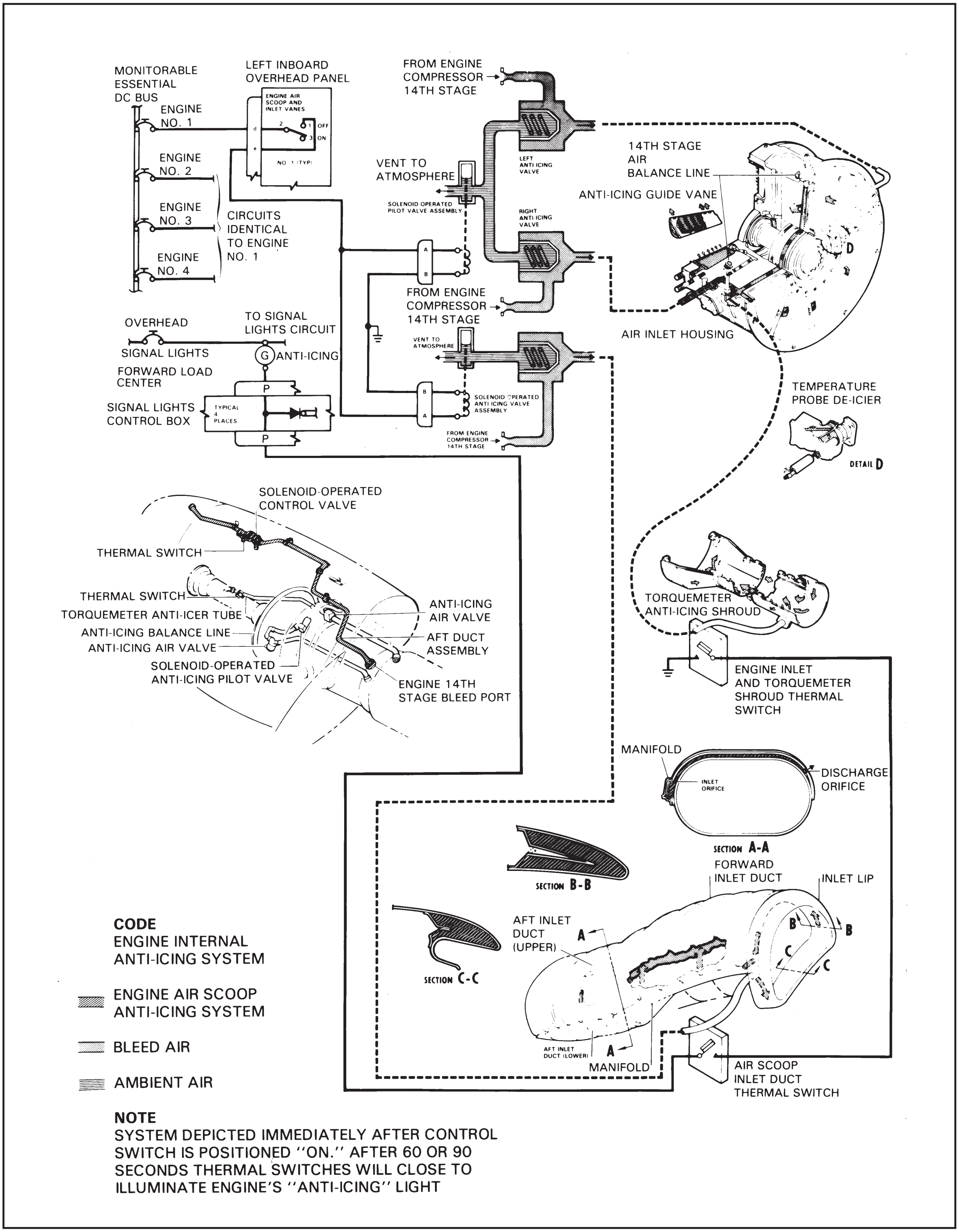


Figure 2-31. Engine Anti-Ice System Schematic

ALL PROPELLER FRONT SPINNERS		CONTINUALLY ANTI-ICED	FLIGHT 76 – 100 amps	GROUND TEST 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 – 72 amps	58 – 82 amps
		160 SECONDS		

Figure 2-32. Propeller Deice Cycle Control

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.

2.10.5.5 Malfunctions. Faults in the propeller ice control system are detected by observing the ammeter for correct readings. Abnormal readings in the No. 1 and 4 SPIN or No. 2 and 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. (See Chapter 18, All-Weather Operations.)

2.10.6 Wing Deice System. (Refer to FO-13) 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 2-33). 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; LW HOT or RW 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.

2.10.6.1 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

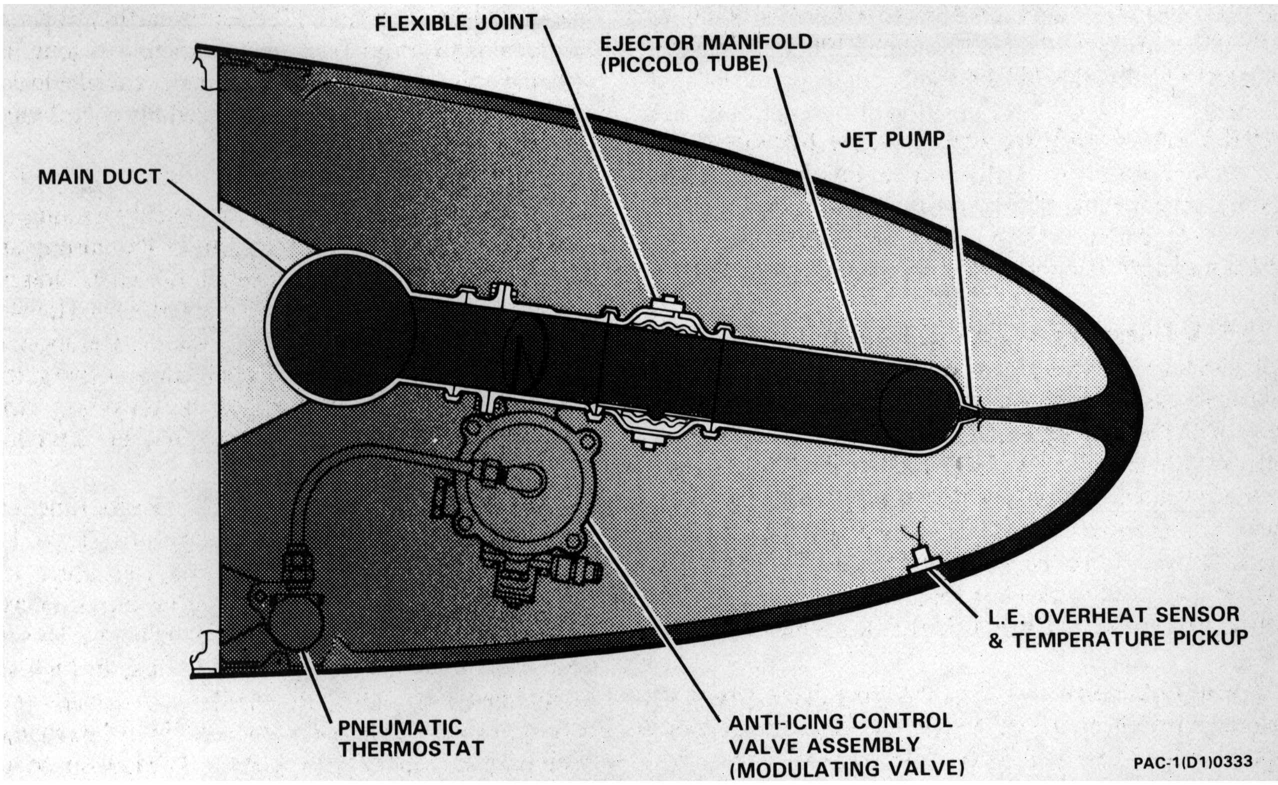


Figure 2-33. Wing Leading Edge Plenum

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.

2.10.6.2 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 OUTBD, CTR, and 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 while 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.

2.10.6.3 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.

2.10.6.4 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.

2.10.6.5 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 LW HOT or RW 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.

2.10.6.6 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.

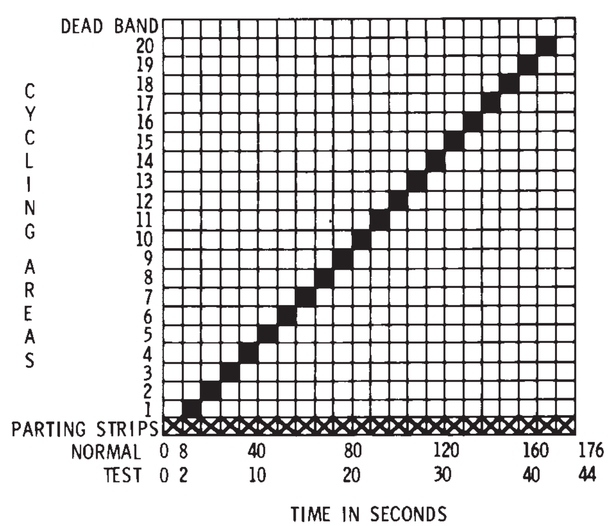
2.10.7 Empennage Ice Control System. Portions of the horizontal and vertical stabilizer leading edges are electrically heated in a system that simultaneously anti-ices a series of parting strips while momentary heating power is applied sequentially to deice 20 cycling strips (Figure 2-34). A two-speed 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 DEICE signal light — MEDC.

2.10.7.1 Parting Strips. The anti-icing parting strips are located at the extreme forward section of the stabilizer leading edges (Figure 2-35). 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.

2.10.7.2 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 2-35). 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.

2.10.7.3 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



NOTE

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

Figure 2-34. Timer Switching Schedule

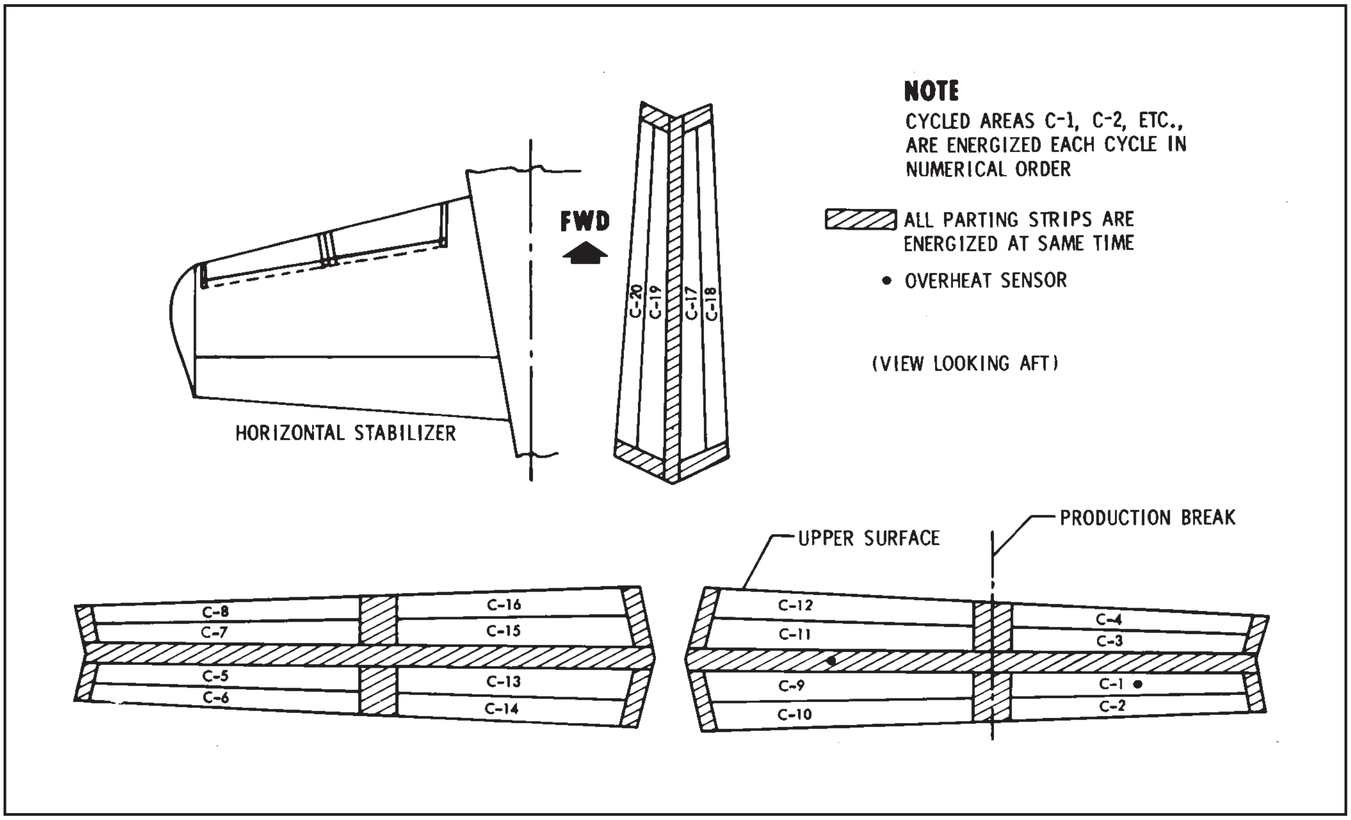


Figure 2-35. Empennage Deicer System Control Areas

low-speed motor is used for normal operation while 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.

2.10.7.4 Thermal Sensor Relay. Two overheat sensors located on the port horizontal stabilizer and a thermal sensor relay located in electronics bay C-3 (inside the electronic rack forward of the main load center P-3A/B) 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 DEICE 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 DEICE 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 DEICE light, and master DEICING light.

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

2.10.7.5.1 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.

2.10.7.5.2 Empennage Deice Monitor Override Switch. A two-position (NORM-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.

2.10.7.5.3 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.

2.10.7.5.4 Empennage Deice Signal Light. The EMP DEICE 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 DEICE signal light illuminates, the master DEICING signal light on the vertical panel illuminates.

2.10.7.5.5 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 parting strip power relay and cycling strip power relay. 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.

2.10.7.5.6 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.

2.10.8 P-3C 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.

The windshield wiper for the P-3A/B is operated by the No. 1 hydraulic system. Hydraulic flow is routed through a pressure reducer valve to the speed-control valve that starts and stops the wipers and controls their speed. From the speed-control valve, the flow is directed to the windshield wiper actuator unit.

2.10.8.1 P-3C 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.

2.10.8.2 P-3A/B Windshield Wiper Control. A windshield wiper control knob, located to the left of the glareshield panel, is connected to the speed-control valve. Rotating the knob counterclockwise (ON) regulates the speed of the wiper blades. Rotating the knob to the full clockwise position (OFF) stops the wiper action, and a spring brake secures the blades in the parked position.

2.10.8.3 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.

2.10.8.4 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.

2.10.8.5 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. Figure 2-36 is a schematic of the windshield washer system.

2.10.9 Windshield Heating System. The three forward windshield panels (Figure 2-37) 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, while 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.

Normal (low) power, which is equivalent to about 40 percent of the high-power output, 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.

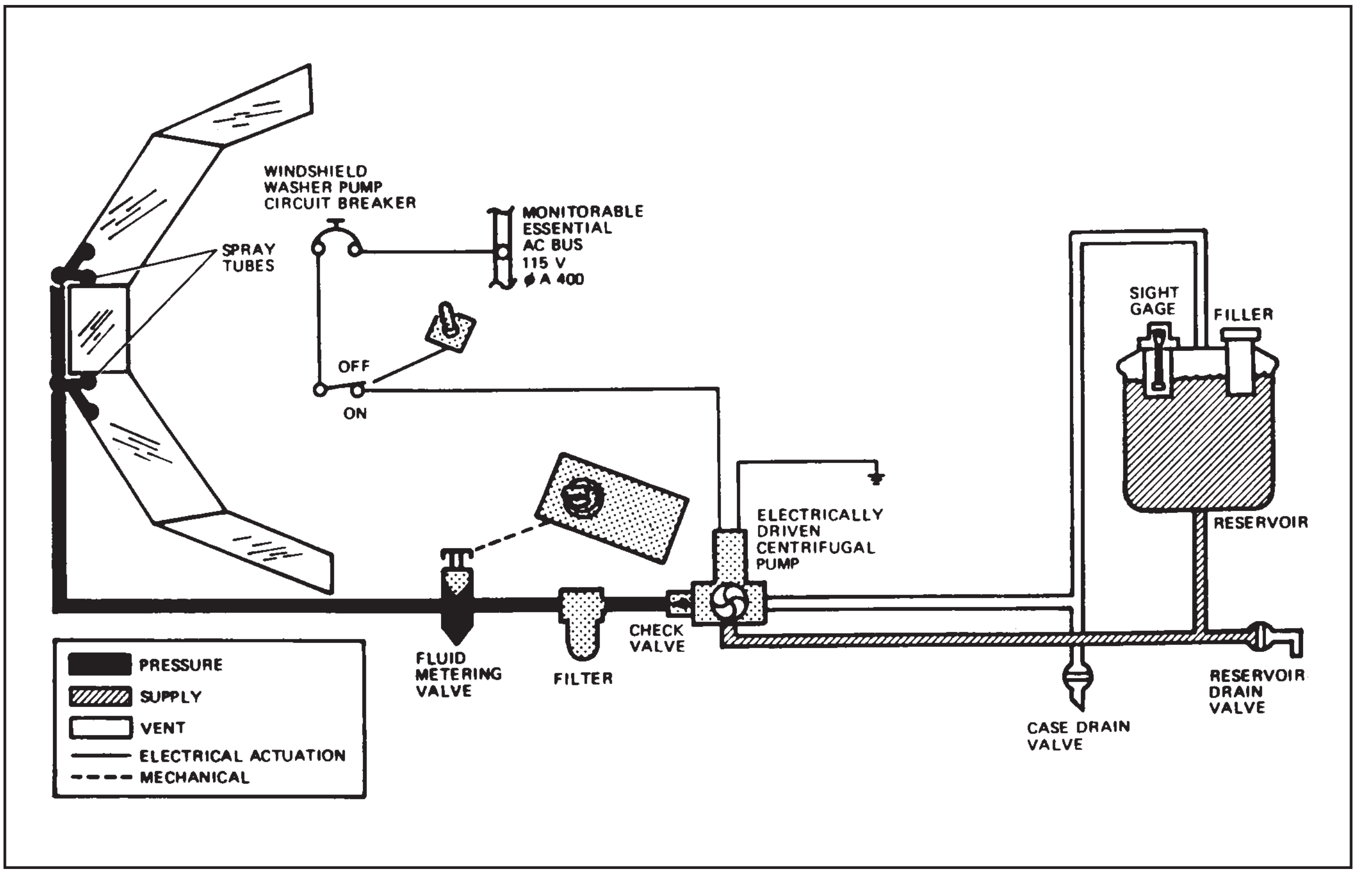


Figure 2-36. Windshield Washer System

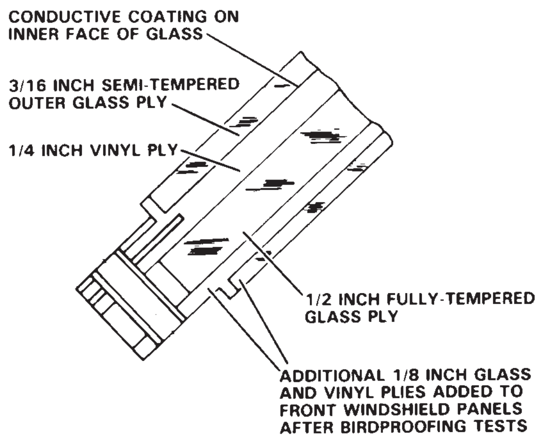


Figure 2-37. Windshield Panel Section

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 antifogging 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.

2.10.9.1 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.

2.10.9.2 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.

2.10.9.3 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.

2.10.9.4 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.

2.10.9.5 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 COPILOT 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, providing 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.

2.11 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.

2.11.1 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.

2.11.2 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.

2.11.3 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.

2.11.4 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.

2.11.5 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.

2.11.6 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, C. In the automatic mode the position of valves A, B, C are modulated by action of the programming controller. This controller is a black box with 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, with AFC-431 incorporated, 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's predetermined program schedule (Figure 2-38). 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.

2.11.7 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. (See FO-12.)

2.11.7.1 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 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 2-38. 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.

2.11.7.2 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. P-3C 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.

2.11.7.3 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: 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.

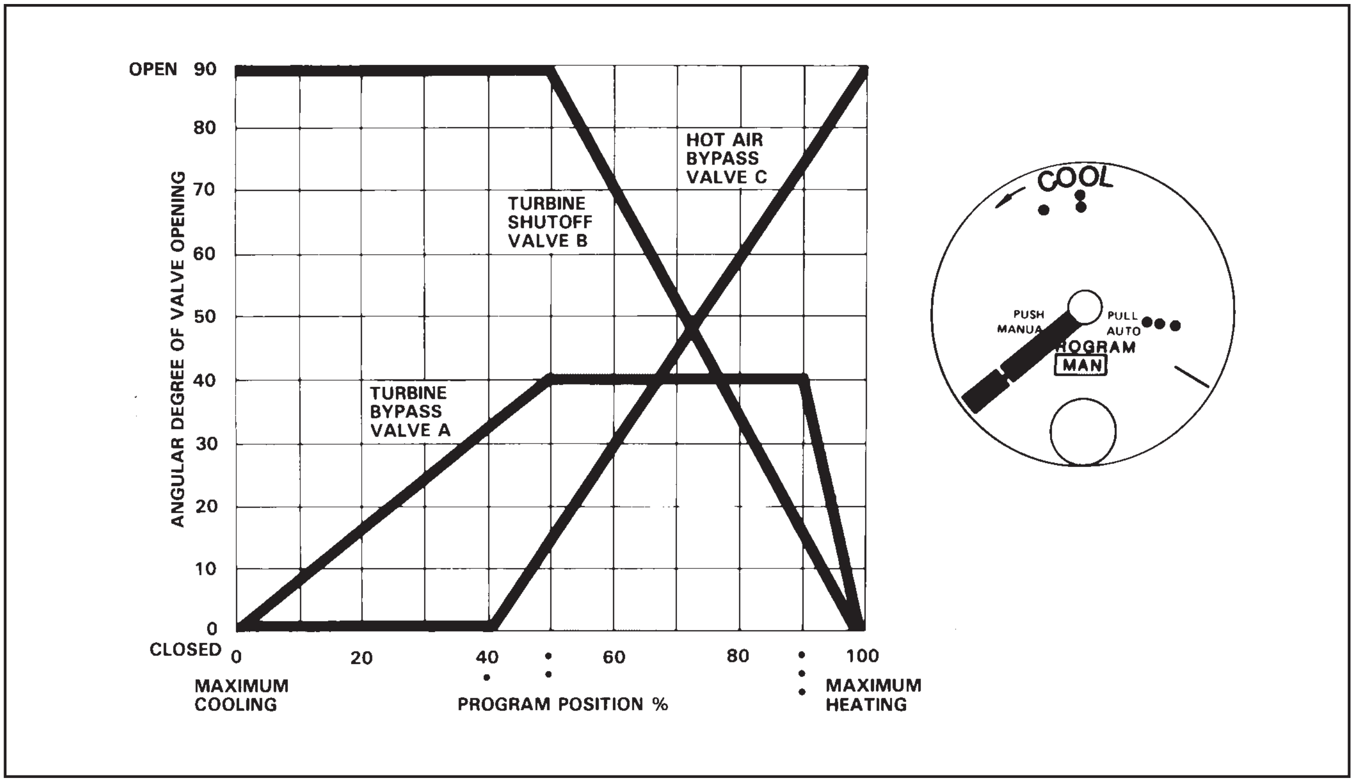


Figure 2-38. Air Cycle Cooling System Valve Operating Schedule

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.

2.11.7.4 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 indicating exhaust fan failure or lack of airflow.

Note

Cabin exhaust fan must be operating to allow power application to the SASP system.

2.11.7.5 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 heat exchanger blowers are powered through circuit breakers on the main AC bus B panel; the various ground air-conditioning switch functions are powered through circuit breakers on the MEDC bus panel.

2.11.7.6 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.

2.11.8 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.

2.11.8.1 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 2-39). 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.

2.11.8.2 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.

2.11.8.3 Pressurization Controls and Indicators. See FO-12.

2.11.8.3.1 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 2-40. The instruments receive power from the 26-VAC instrument buses, the port engine compressor from bus No. 1, the starboard from bus No. 2.

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.

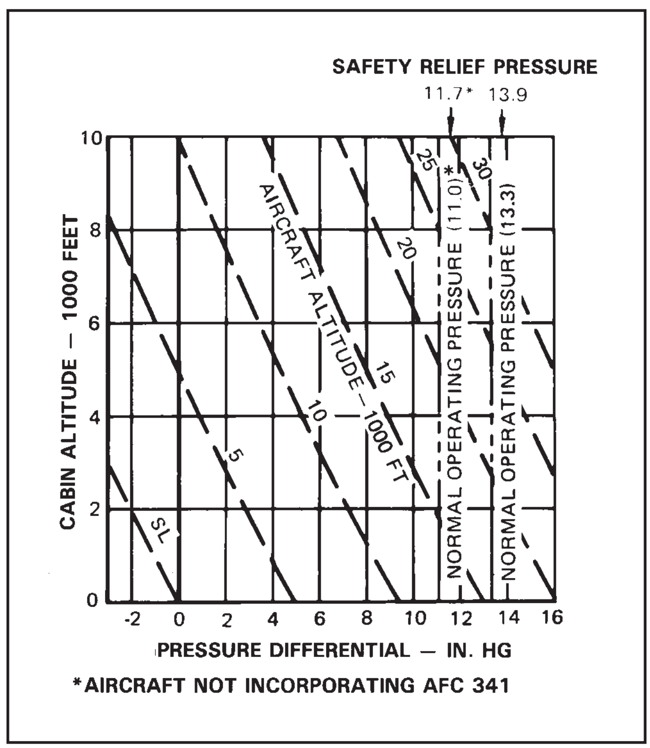


Figure 2-39. Cabin Altitude vs. Pressure Differential

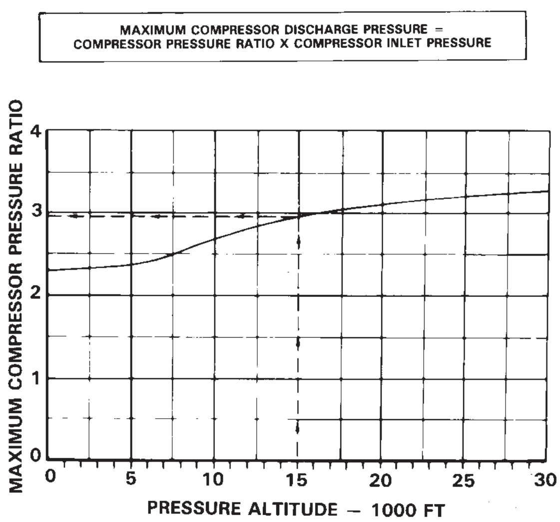


Figure 2-40. Cabin Compressor Performance

2.11.8.3.2 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.

2.11.8.3.3 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.

2.11.8.3.4 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.

2.11.8.3.5 Cabin Pressurization Controller. The cabin pressure controller operates pneumatically and is connected by an airline 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.

2.11.8.3.6 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.

2.11.8.3.7 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.

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

2.11.8.3.9 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.

2.11.8.3.10 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, 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.

2.11.8.3.11 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.

2.11.9 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-3C aircraft radiant heated bulkhead panels are also provided in the bunk and galley areas (deleted from BUNO 157327 and subsequent). Automatic switching turns on electric power to the panels when cabin temperature reduces to 69 °F and off when it rises to 80 °F. The 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-3C aircraft, cabin exhaust air is provided through louvered grills to the dinette and ordnance areas, replacing radiant deck and bulkhead heaters in these areas.

2.11.9.1 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.

2.11.10 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.

2.11.11 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.

2.11.12 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. These systems are used when carrying the Mk 46 store. If the bomb bay temperature falls below a preset level (–3 to +2 °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 between approximately +3 to +7 °C by cycling the valve solenoid as required. When operating in very low OAT, the bomb bay temperature should be monitored when the system is initially turned on to assure 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 allowable operating heat range is exceeded (+54 to 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.

2.11.12.1 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.

2.11.12.2 Bomb Bay Temperature Selector Switch and Temperature Indicator. A bomb bay temperature selector and temperature indicator are located on the bleed-air panel in the flight station and are 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).

2.11.12.3 Bomb Bay Cold Indicator Light. A bomb bay cold caution indicator light, located on the bleed-air panel in the flight station, indicates BOMB BAY COLD when the temperature in the bomb bay falls below a preset (–3 to +2 °C) low-temperature value. If it remains on after activation of the bomb bay heat system, the cycling thermostat is not operating and the system must be operated manually in the OVERRIDE switch position. Actuation of the sensor causes the deicing indicator on the center instrument panel to illuminate also.

2.11.12.4 Bomb Bay Hot Indicator Light. A bomb bay hot caution indicator light, located on the bleed-air panel in the flight station, indicates BOMB BAY HOT when the temperature exceeds the limit of the thermal switch (+54 to +60 °C) installed in the bomb bay.

2.11.13 P-3C 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 overtemperature exceeds 135 ±3 °F. 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 below 128 °F.

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.

2.11.14 Oxygen System. The oxygen system (Figure 2-41) is designed to supply an active flightcrew of three members for approximately 3.5 hours at an altitude of 25,000 feet. Oxygen is supplied from three high-pressure (1,800 psi) bottles through three regulators, one for each flight crewmember. 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.

Seven portable oxygen bottles are stowed at the tactical crew stations except station 9 and 10, whose bottles are located at the aft end of the sonobuoy storage bins. On P-3A/B, four portable oxygen bottles are stored at the bulkhead forward of the starboard forward observer, and three are stored above the aft radar rack. These bottles are normally equipped with diluter-demand regulators and smoke masks. With the regulator set for

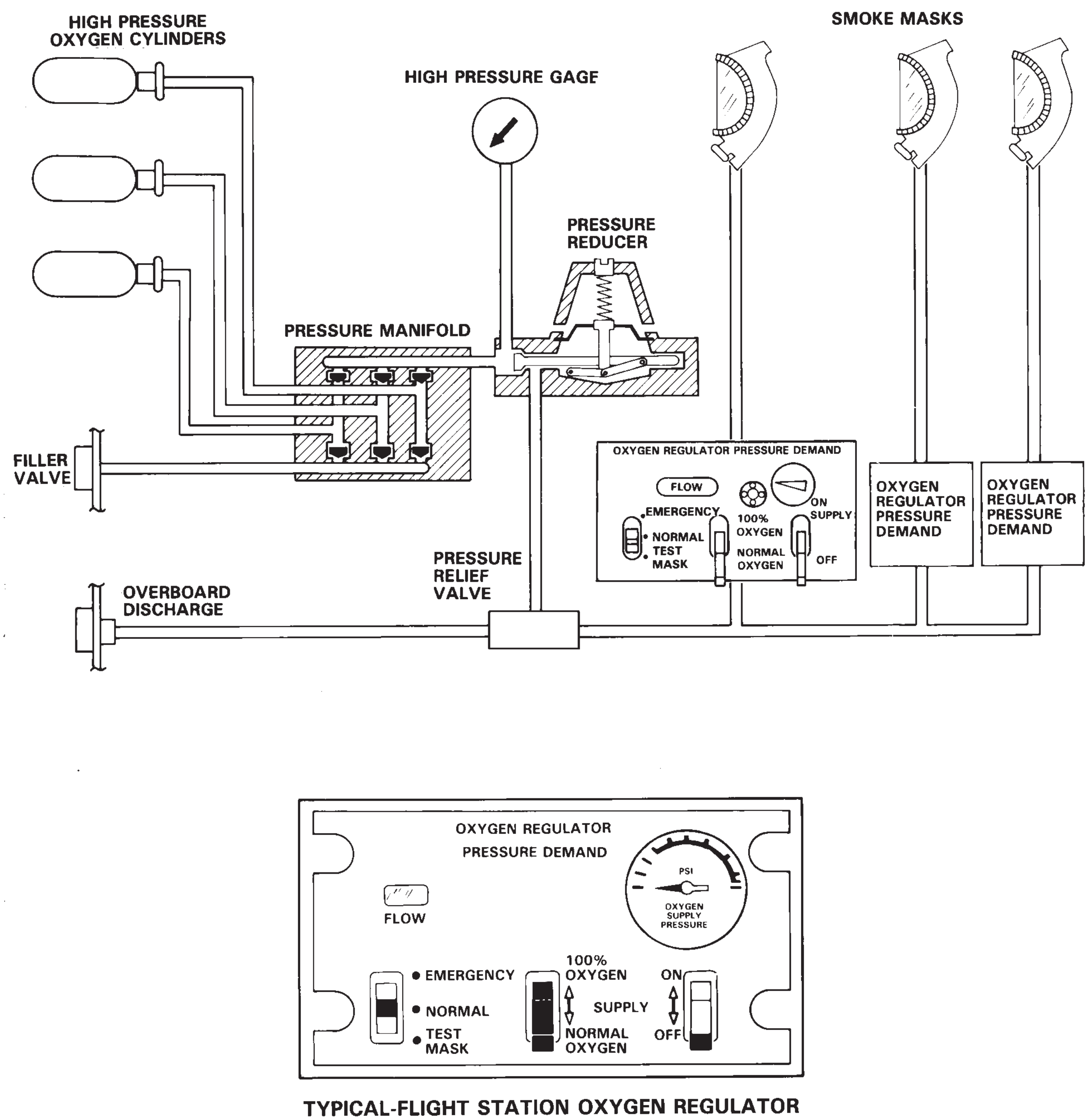


Figure 2-41. Oxygen System

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.

2.11.14.1 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.

2.11.14.2 Oxygen Regulator Diluter Lever. The oxygen diluter lever, located at the lower center of the regulator panel, has two positions, 100-percent OXYGEN and NORMAL OXYGEN. In the 100-percent 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, when 100-percent oxygen is delivered on inhalation.

2.11.14.3 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.

2.11.14.4 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.

2.11.14.5 Oxygen Regulator Pressure Gauge. The oxygen pressure gauge, located on the regulator panel, indicates the regulator inlet pressure.

2.11.14.6 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.

2.12 HYDRAULIC AND FLIGHT CONTROL SYSTEM

2.12.1 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-11).

2.12.1.1 Hydraulic Electrical Power Source. The table below shows the sources of electrical power for the hydraulic system components:

Hydraulic System Components	
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 the ground operating bus (GOB) circuit breaker, energizing the APU IN-FLIGHT ARM switch, or lowering nosegear.	

2.12.1.2 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, elevator boosters, and windshield wipers (P-3A/B).

2.12.1.3 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.

2.12.1.4 Hydraulic System Components. The hydraulic power system components are located in the hydraulic service center (Figure 2-42). 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.

2.12.1.4.1 Electrically Driven Hydraulic Pumps. There are three electrically driven, variable displacement type hydraulic pumps. Each pump has a maximum usable output of 8 gpm; 2 gpm are tapped off the pump and used for motor cooling.

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.

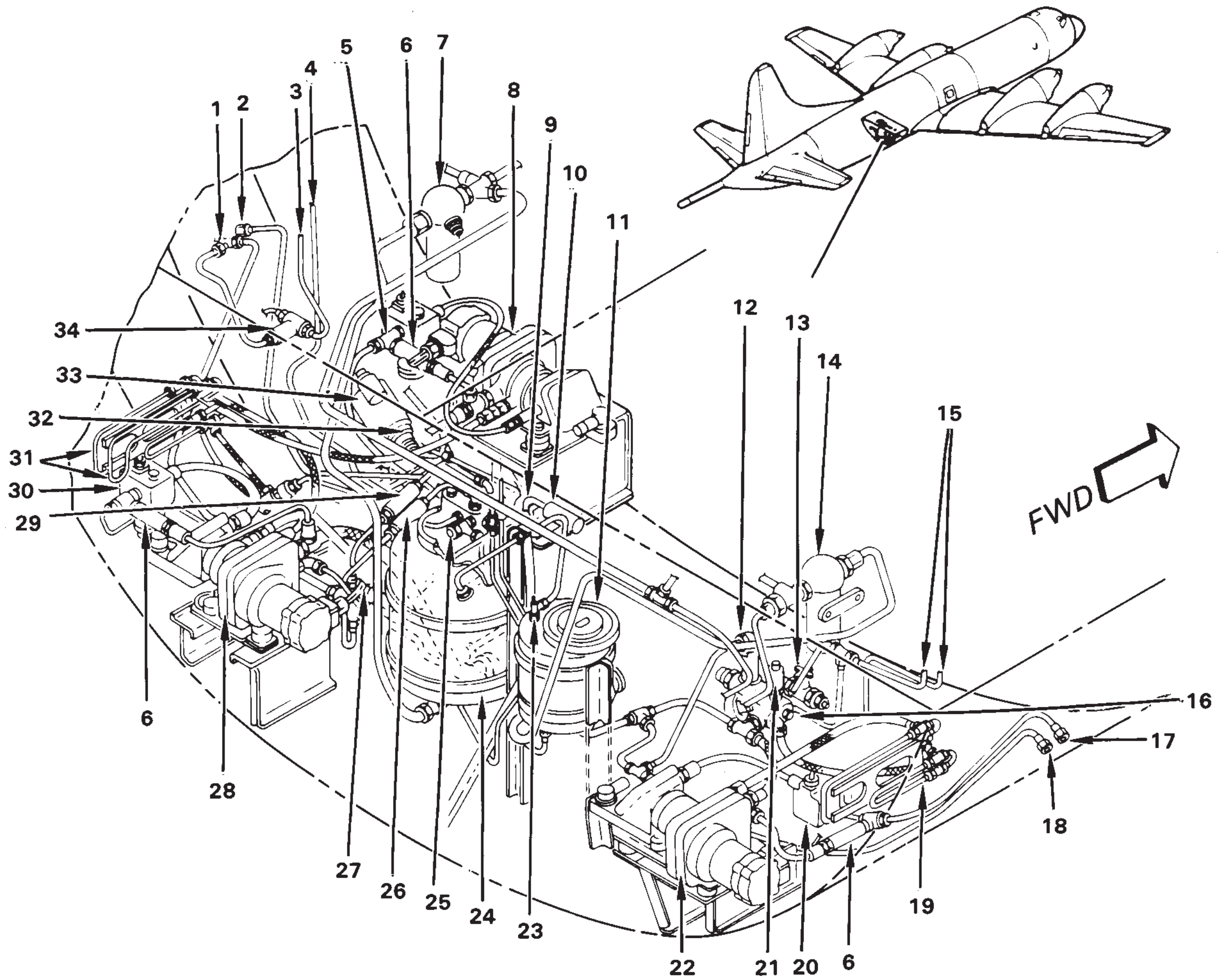
2.12.1.4.2 Filters. Filters located throughout the hydraulic system protect working portions of the system. The filters are of the disposable type and incorporate integral red pop-out indicators to show when the fluid flow is restricted.

2.12.1.5 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.

2.12.2 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.

2.12.2.1 Flight Control Boosters. Hydraulic flight control boosters operated by both hydraulic systems (Figure 2-43) 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 so 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 (see Figure 2-44).



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

Figure 2-42. Hydraulic Service Center Component Location (Typical)

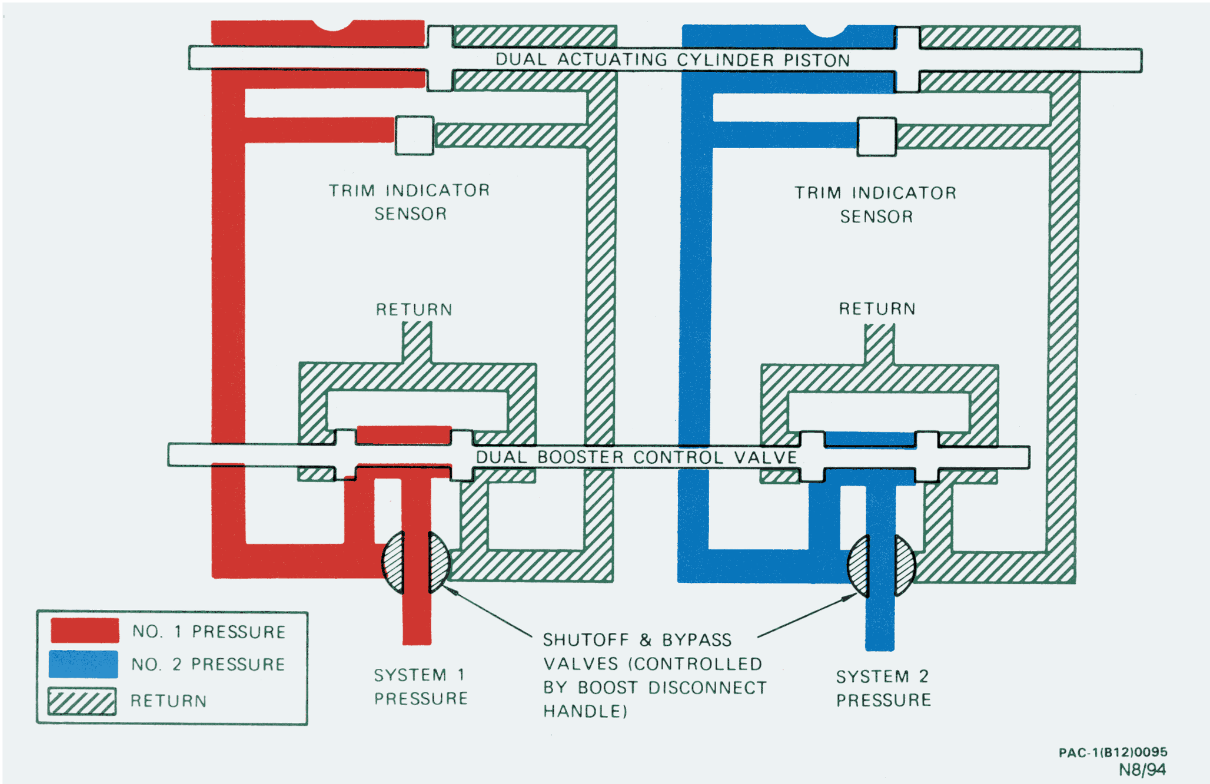


Figure 2-43. Flight Control Booster Hydraulic System

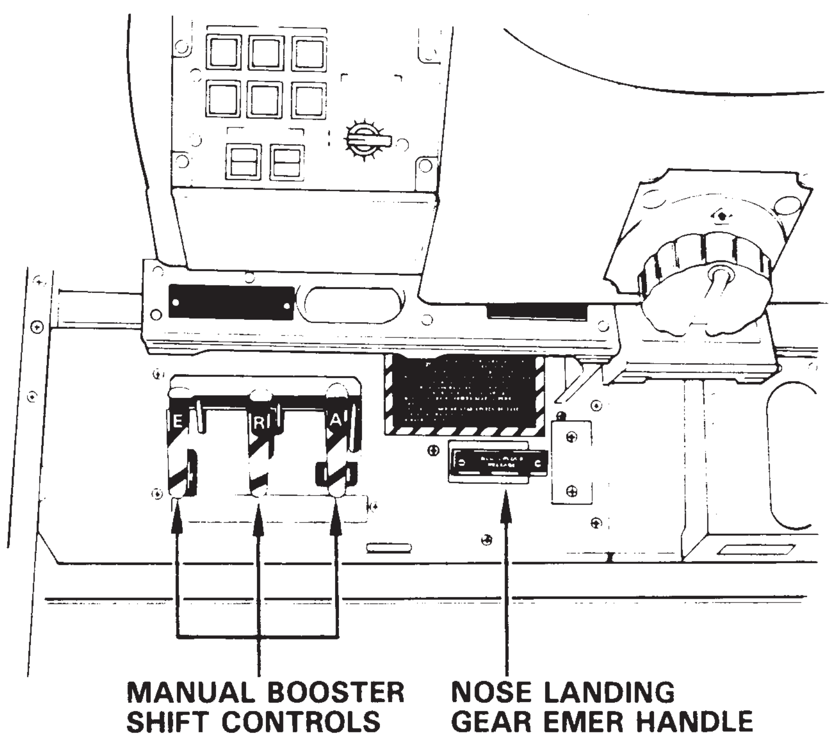


Figure 2-44. Hydraulic Emergency Manual Control Handles

2.12.2.2 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.

2.12.2.3 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.

2.12.2.4 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.

2.12.2.5 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.

2.12.2.6 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.

2.12.2.7 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.

2.12.2.8 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.

2.12.2.9 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.

2.12.2.10 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

Because of the design of the mechanical stops on the rudder and aileron boost handles, it is possible for the handles to be pulled beyond the stops if any lateral motion is applied during disengagement. When the rudder and aileron boost handles are pulled beyond the mechanical stops, it may become impossible to reengage the boost handles in flight.

2.12.2.11 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.

2.12.2.12 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.

2.12.2.13 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 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.

2.12.2.14 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.

2.12.3 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.

2.12.3.1 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.

2.12.3.2 Flap Control Lever. The flap control lever is located on the center control stand. The flap lever quadrant is marked FLAPS UP, MANEUVER, TAKE-OFF/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.

2.12.3.3 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. (See FO-12.)

2.12.3.4 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.

2.12.4 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 springload (Figure 2-45). 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. The main gear doors, however, 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 2-46.

2.12.4.1 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 DOWN. Moving the handle to the DOWN position with hydraulic pressure available provides release pressure to the uplock release

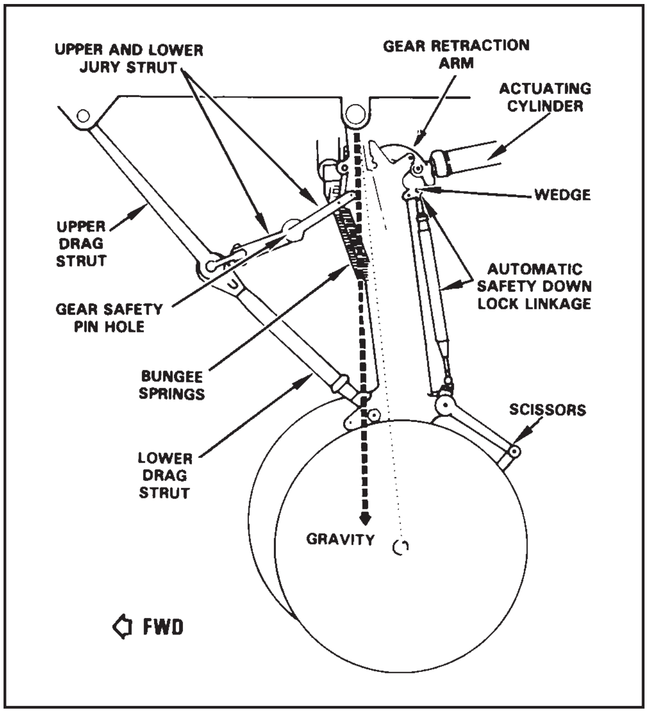


Figure 2-45. Landing Gear Downlock

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. (See FO-12.)

2.12.4.2 Landing Gear Warning System. 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 position, and power lever position.

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,

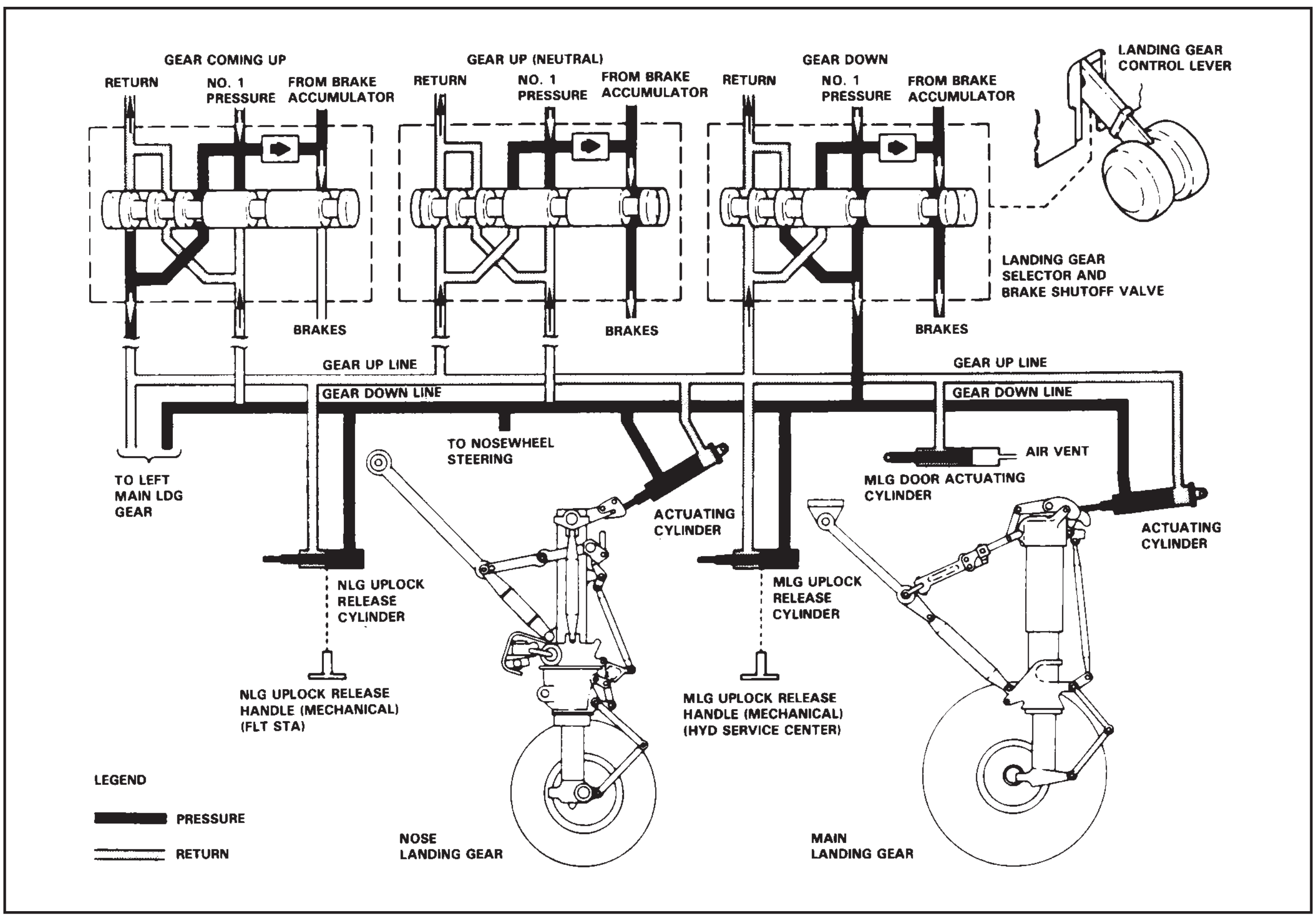


Figure 2-46. Landing Gear Hydraulic System

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 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 15 switches (Figure 2-47) located throughout the aircraft. The three landing gear downlock switches are located on the landing gear downlocks. The four 48° and the 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.

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.

2.12.4.3 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. (See FO-12.)

2.12.5 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 (Figure 2-48). Rotating the steering wheel on the pilot side panel operates a control valve and followup 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.

2.12.6 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.

2.12.6.1 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 DC hydraulic pump, 3 minutes.

2.12.6.2 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.

2.12.6.3 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

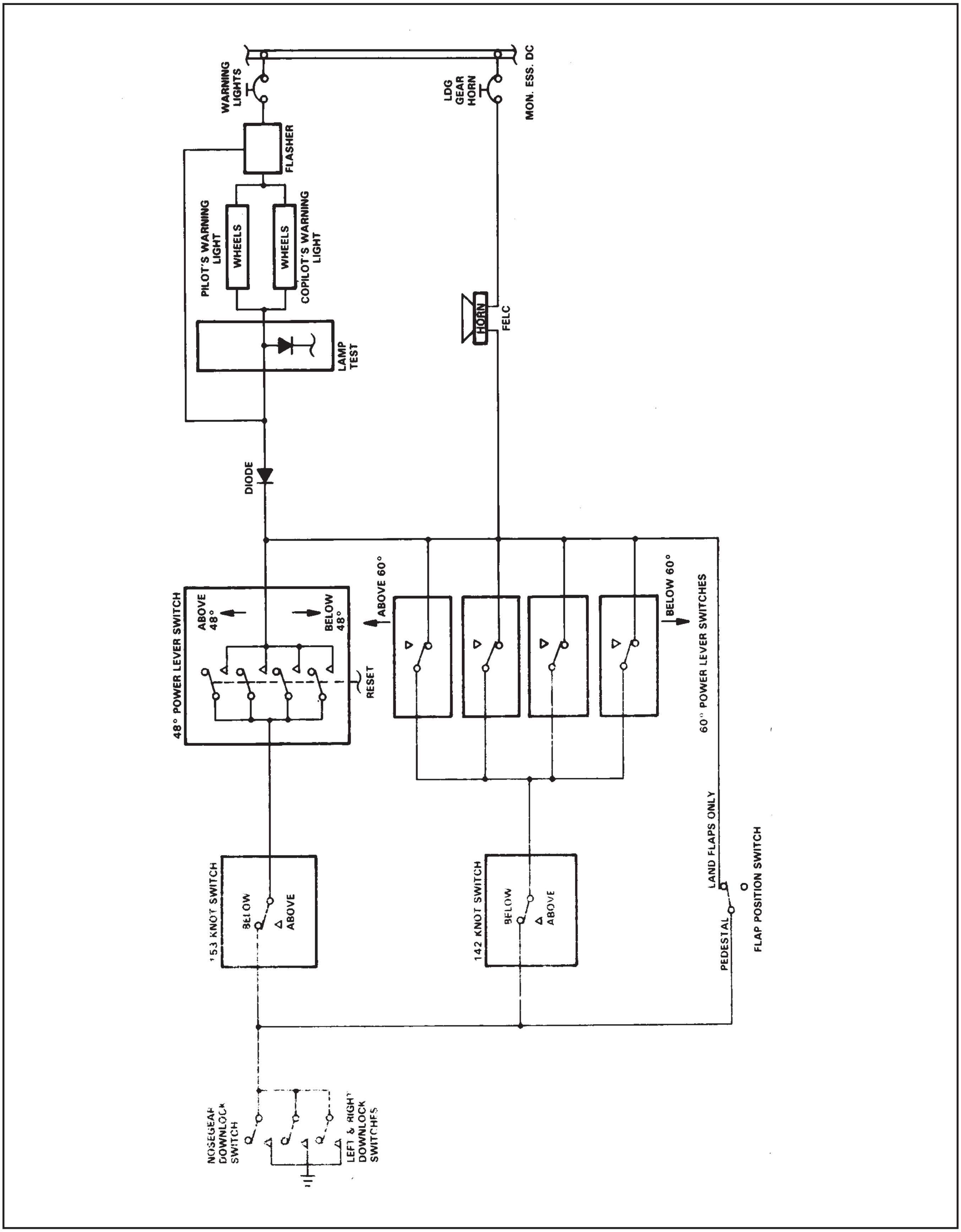


Figure 2-47. Landing Gear Warning System Electrical Schematic

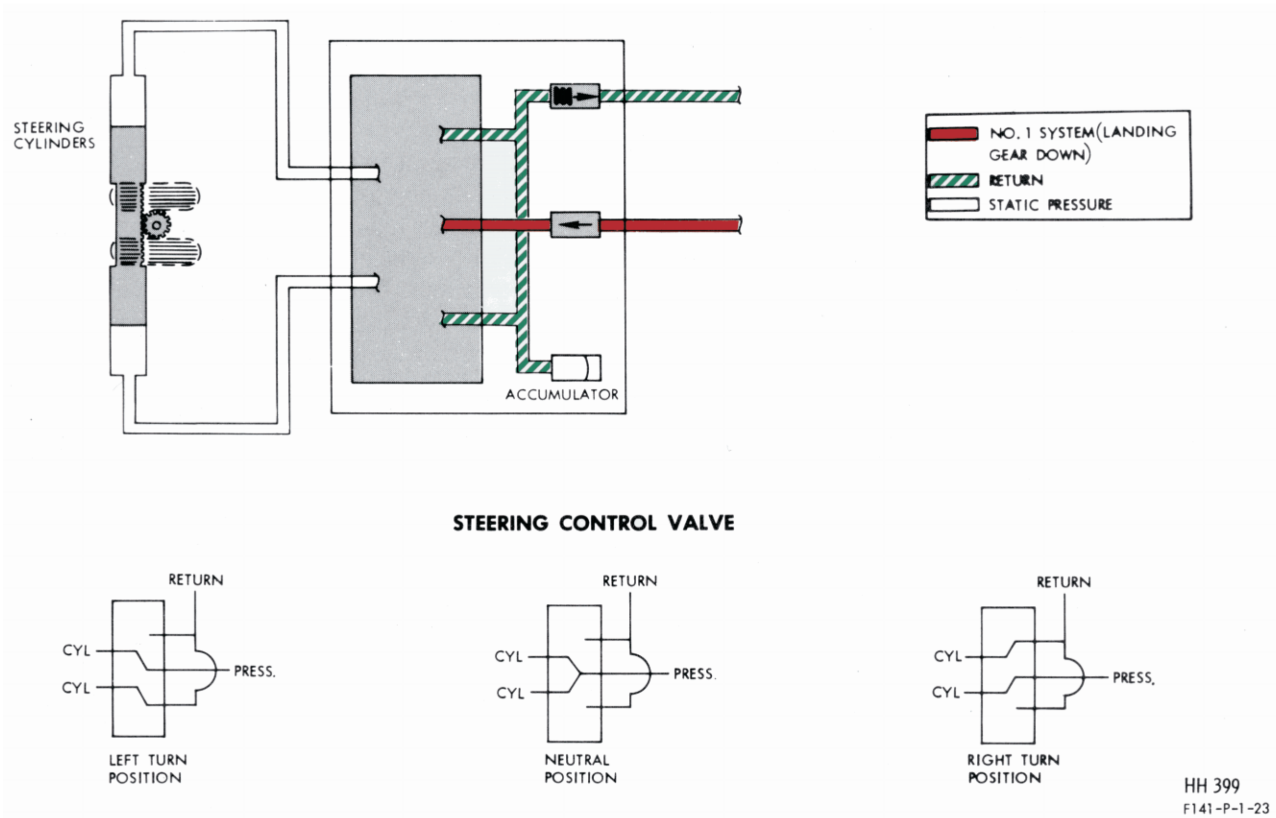


Figure 2-48. Nosewheel Steering Hydraulic System

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.

2.12.6.4 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.

2.12.6.4.1 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.

2.12.7 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.

If bomb bay doors design improvements (AFC-496) have been incorporated, 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

- If AFC-496 has not been incorporated, the safety lock lever and safety pin are the only ground safety mechanisms provided. 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.
- Ensure that 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 that all hydraulic pumps are secured, the bomb bay safety lock access door is open, the safety pin is installed, and that 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.

2.13 MISCELLANEOUS EQUIPMENT

2.13.1 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 electrically powered refrigerator provides separate temperature zones for the simultaneous storage of prefrozen and prechilled food products. 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 to be closed.

2.13.2 Dinette (P-3C). 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.

2.13.3 Lavatory. Lavatory facilities are located in the aft cabin area (forward cabin in P-3A/B) 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.

2.13.4 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.

2.13.5 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.

The P-3A/B is equipped with a hinged, stowable, entry ladder with handrails and safety lines on each side of the top section. To stow the ladder, it is pulled into the aircraft, folded in the middle, and secured to an overhead attachment and receptacles in the floor. On later aircraft, the existing internal fittings for the ladder life lines are replaced by external eyebolts adjacent to the entrance door.

2.13.6 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.

2.13.7 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.

2.13.8 Miscellaneous Stowage Locker. Two miscellaneous stowage lockers are located at the starboard aft fuselage area beneath the work surface aft of the dinette.

2.13.9 Publications Stowage Box. A publications stowage box is located at the starboard aft fuselage area, above the work area, just aft of the dinette.

2.13.10 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.

2.13.11 Security Locker. A lockable security locker is located in the aisle bulkhead at the TACCO station.

2.13.12 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.

2.13.13 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.

2.13.14 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.

2.13.15 NAV/COMM, TACCO, Nonacoustic Operator, Radio Operator (P-3A/B) Seats. The NAV/COMM, TACCO (P-3C), 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.

2.13.16 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°.

2.13.17 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.

2.13.18 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.

2.13.19 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 forward inertia force of 2 to 3gs is applied to the reel, it automatically locks and secures the harness.

2.13.20 Hardhats. Stowage for hardhats is provided at each primary crew position (P-3C).

2.13.21 Aldis Lamp. Some aircraft are equipped with a portable Aldis lamp that can be used during night flights for inspecting wings and engine nacelles; for example, when oil or fuel leaks are suspected. Power receptacles for the lamp are located in the flight station and at the observer windows.

2.13.22 Electrical Service Outlets (P-3C). 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 to test the T-414 AMAC control box. 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.

CAUTION

Do not use the lavatory service outlet for purposes other than operation of the Lockheed aircraft electric shaver. Integral rectifiers and inductance units may be damaged.

2.13.23 Electrical Service Outlets (P-3A/B). All outlets are energized whenever power is supplied to the aircraft electrical system. All AC outlets are 400 cycle.

Two-prong 28-VAC service outlets located at the pilot, copilot, radio operator, and forward observer stations are provided for use of an Aldis lamp. Power for these outlets is obtained through the 28VAC FWD LIGHTING BUS XMFR located on the flight station electrical load center circuit-breaker panels. Two circuit breakers control the power; one for the pilot and forward observer outlets and one for the copilot and radio operator outlets.

CAUTION

Maximum load on any 28-VAC outlets must not exceed 210 volt-amperes.

A two-prong 115-VDC service outlet is located in the lavatory to supply power for electric razors. Power for the outlet is controlled by the SERV LAV circuit breaker on main AC bus B and integral rectifiers in the circuit.

Two three-prong 115-VAC service outlets are located in the main load center, and one is located under the floor at the forward right-hand corner of the APN-153 transmitter/receiver access door. The OUTLETS MLC & LWR FUS circuit breaker controls these outlets and is located on main AC bus B.

Three-prong 115-VAC utility outlets are at the following locations: one inside the flight station radar rack, two at the left forward electronic rack, two at the right forward electronic rack, two between the TACCO and navigator stations under the console, and two between sensor 1 and sensor 2 stations under the console. The circuit breakers for all but the right forward electronic rack outlets are located on the forward left electronic circuit-breaker panel, and the remaining breaker is on the forward right electronic circuit-breaker panel.

Three three-prong 115-VAC outlets are located in the galley and their circuit breakers are located on the aft electronic circuit-breaker panel. These outlets may be used for cooking appliances.

All three-prong outlets are to supply power for in-flight and ground maintenance equipment.

The MAIN DC VOLT TEST receptacle may be used as a 28-VDC outlet for the ARM-53. The circuit breaker is located behind a plastic panel below the rectifiers in the main load center.

2.13.24 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. See Figures 3-1 and 3-2 for fuel quantities and specifications.

WARNING

- Any 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. Consequently, dipsticking through the filler wells will yield a no-reading indication unless the inboard tanks contain 4,225 pounds (650 gallons) of fuel or more, and the outboard tanks contain 8,775 pounds (1,350 gallons) of fuel or more.

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 gpm.

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 that fueling pressure does not exceed 55 psi. The pressure gauge for tank No. 5 shall be closely monitored during fueling to prevent tank overpressurization.

	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 (4 fl oz) (ea)	0.026	0.118 (118 cc)			
Starter (AiResearch)††	0.112 (14.4 fl oz) (ea)	0.094	0.425 (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). See Figure 3-7 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.

TIRES

At 80,000-lb gross takeoff weight inflate nose tires to 150 psi and main gear tires to between 110 and 180 psi.
At 127,500-lb gross takeoff weight inflate nose tires to 150 psi and main gear tires to 180 psi.
At 135,000-lb gross takeoff weight inflate nose tires to 150 psi and main gear tires to 190 psi.
Nose Wheel — Tire size 28 x 7.7, 12-ply rating, VII Tubeless High Speed.
Main Wheels — Tire size 40 x 14, 28-ply rating, VII Tubeless High Speed.

Note

*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

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

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 (Hydrostatic Testing, Dipsticking, Tank 5 Sight Gauge, and Density Versus Quantity). Their use is dependent on the amount of fuel loaded in each tank.

3.1.3.1 Hydrostatic Testing. The hydrostatic fuel gauge can be used for all fuel quantities in tanks 1 through 4 and is calibrated for JP-5; however, it may be used for other fuels. Refer to NAVAIR 01-75PAA-2-4 for gauge operating instructions and for non-standard pitch and roll corrections.

3.1.3.2 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

Dipsticking shall be used 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.

3.1.3.3 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.

3.1.3.4 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.

3.1.4 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 3-3 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 pounds per U.S. gallon. JP-8 fuel specifications allow a density range of ±0.25 pounds 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.

3.2 GROUND ENGINE AIR START UNIT

Engine ground starting may be accomplished with an airstarting unit that delivers a minimum of 90 ppm airflow at 32 psig pressure.

The ground air start 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.

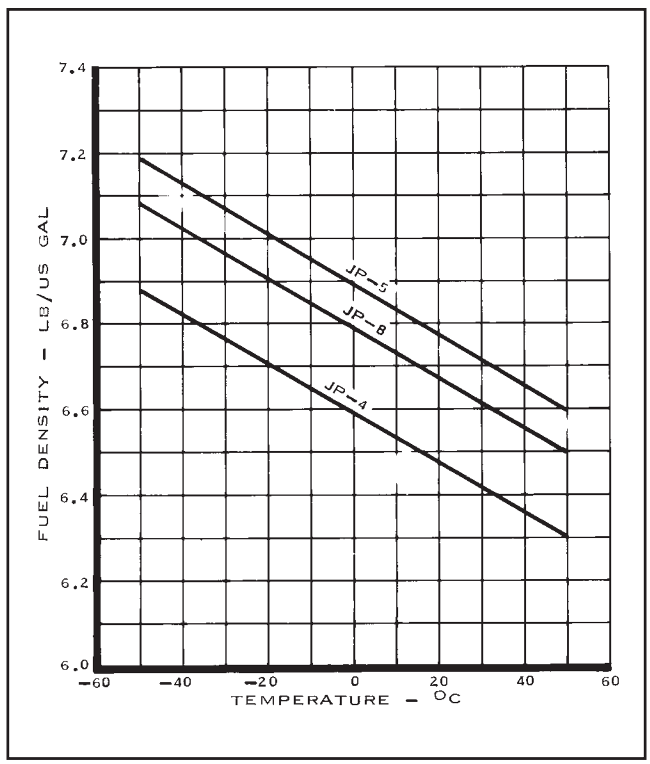


Figure 3-3. Fuel Density vs. Temperature

The following airstart units are approved for use on the P-3 aircraft:

Navy	Air Force
GTC-85	A/M32-60
NCPP-105	A/M32-90
A/M47A	

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 KVA (60 KVA for preflight without full avionics support)
5. 4-wire.

The following ground units are 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	

3.4 DANGER AREAS

WARNING

The following paragraphs, including Propeller Area, Propeller Jet Blast Area, Engine Compressor and Turbine Area, Bomb Bay, Radar Radiation Area, Sonobuoy Launch Area, Engine and APU Noise Area, APU/Air Multiplier Area, and Wing Flap Area discuss specific hazards associated with each area. These hazard or danger areas are illustrated in Figure 3-4.

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.

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 that 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 that the bomb bay safety pin access door is open, the safety pin is installed, and ensuring that the cable connecting the safety pin and the door control valve is taut.

3.4.5 Radar Radiation Area. Personal physical injury, 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. (See Figure 3-4 for specific standoffs.)

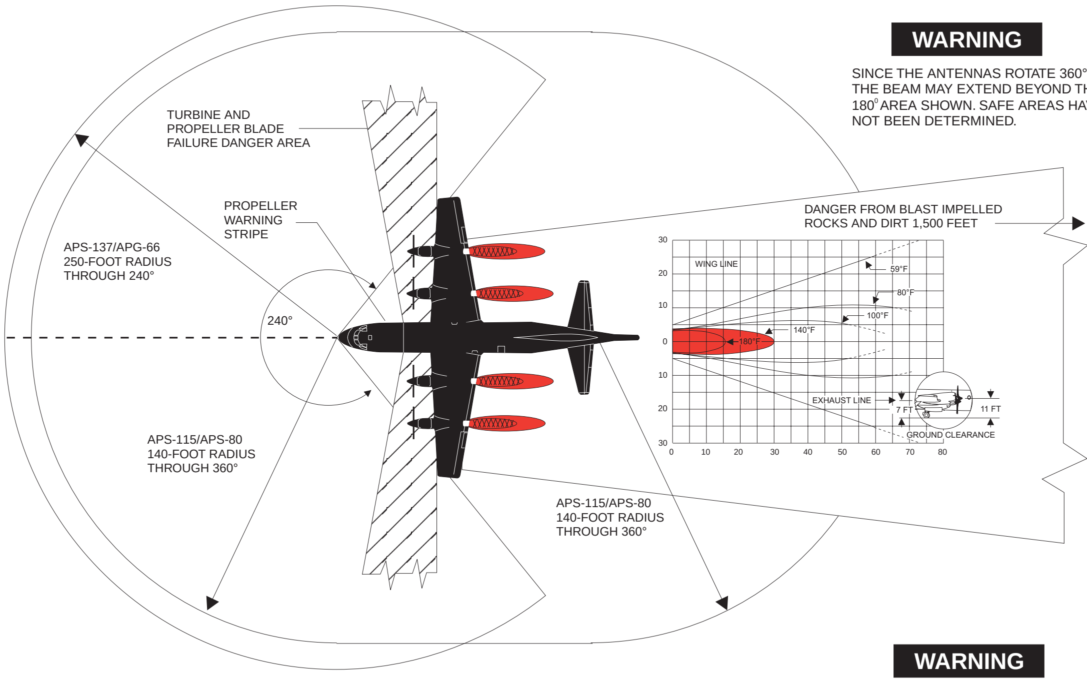
WARNING

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 P-3C Sonobuoy Launch Area. Prior to walking under (loading, unloading, or inspecting) external SLTs, ensure sono safety switch door is open, roller switch is fully extended, and sono disabled light in

WARNING

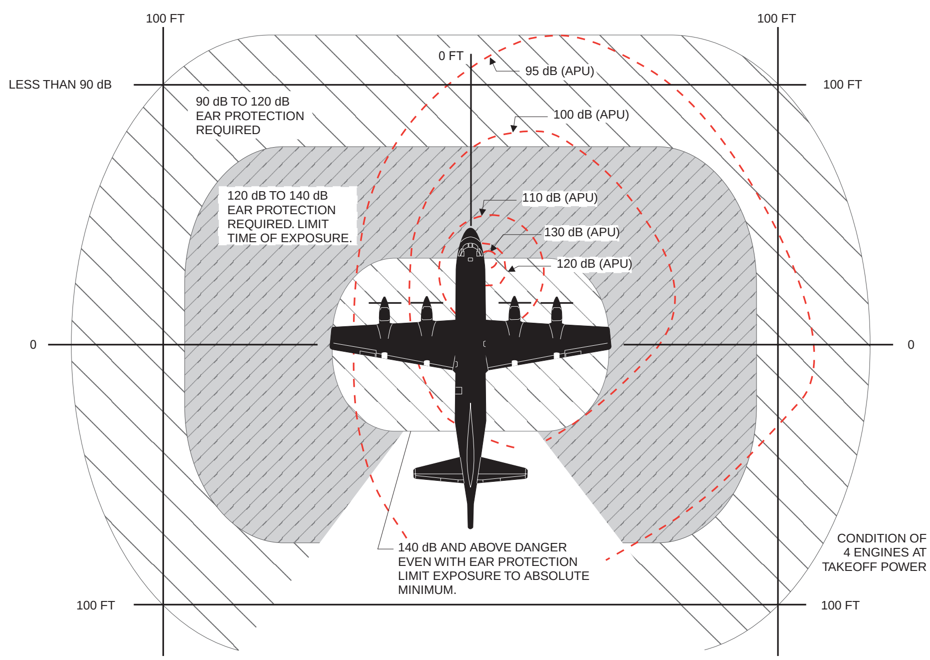
SINCE THE ANTENNAS ROTATE 360° THE BEAM MAY EXTEND BEYOND THE 180° AREA SHOWN. SAFE AREAS HAVE NOT BEEN DETERMINED.



WARNING

THE FOLLOWING STANDOFFS APPLY WHEN OPERATING THE RADAR IN ANT AND HV ON:

	PERSONNEL	FUEL TRUCKS/FUELING OPERATIONS/HERO
APS-115	75 FEET	140 FEET
APS-80	75 FEET	140 FEET
APS-137	250 FEET	250 FEET
APG-66	250 FEET	250 FEET
APN-234	15 FEET	75 FEET



NOTE

- TO ACCURATELY ASSESS THE EFFECTIVENESS OF HEARING CONSERVATION MEASURES, ALL PERSONNEL EXPOSED TO NOISE HAZARDOUS AREA SHOULD RECEIVE ROUTINE MONITORING AUDIO-METRY IN ACCORDANCE WITH OPNAVINST 6260.6 SERIES.
- SOUND INTENSITY LEVELS OF 85 dB AND HIGHER HAVE BEEN RECORDED INSIDE P-3 AIRCRAFT DURING FLIGHT. CONSIDERATION SHOULD BE GIVEN TO WEARING HEARING PROTECTION WHILE OFF HEADSET, AS UNPROTECTED EXPOSURE MAY RESULT IN TEMPORARY OR PERMANENT HEARING LOSS.
- A COMBINATION OF INSERT AND CIRCUMAURAL TYPE HEARING DEVICES (DOUBLE PROTECTION) SHALL BE WORN IN ALL AREAS WHERE NOISE LEVELS EXCEED 104-dB SOUND LEVEL. THIS LEVEL IS FOUND IN THE PROXIMITY OF A P-3 WITH AN OPERATING APU.
- THE MAIN CABIN DOOR AND LADDER AREAS ARE JUST AFT OF THE 104-dB NOISE LEVEL AREA AND SINGLE TYPE HEARING PROTECTION IS ADEQUATE WHEN ENTERING AND DEPARTING THE AIRCRAFT WITH THE APU RUNNING.

Figure 3-4. Danger Areas

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 dB intensity, any exposure without ear protection can cause damage (Figure 3-4).

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. The turbocompressor inlet duct thermoforms or melts and cannot withstand reverse airflow at high temperatures. 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 adequate clearance prior to posting in front of the 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.

3.5 GROUND HANDLING

In order to ensure that 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 that the brake system is operative.

   c. One man 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 man shall act as tractor operator.

   e. One man 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 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-man 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 that 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. See Figure 3-5 for turning radius distances.

CAUTION

P-3A/B aircraft without power should be moved within 5 minutes after power is removed. If 5 minutes have elapsed, the aircraft should remain stationary for an additional 25 minutes to enable the AHRS gyros to run down without damage.

3.6 SERVICING INSTRUCTIONS

Refer to Figure 3-6 for illustrated instructions and servicing directives.

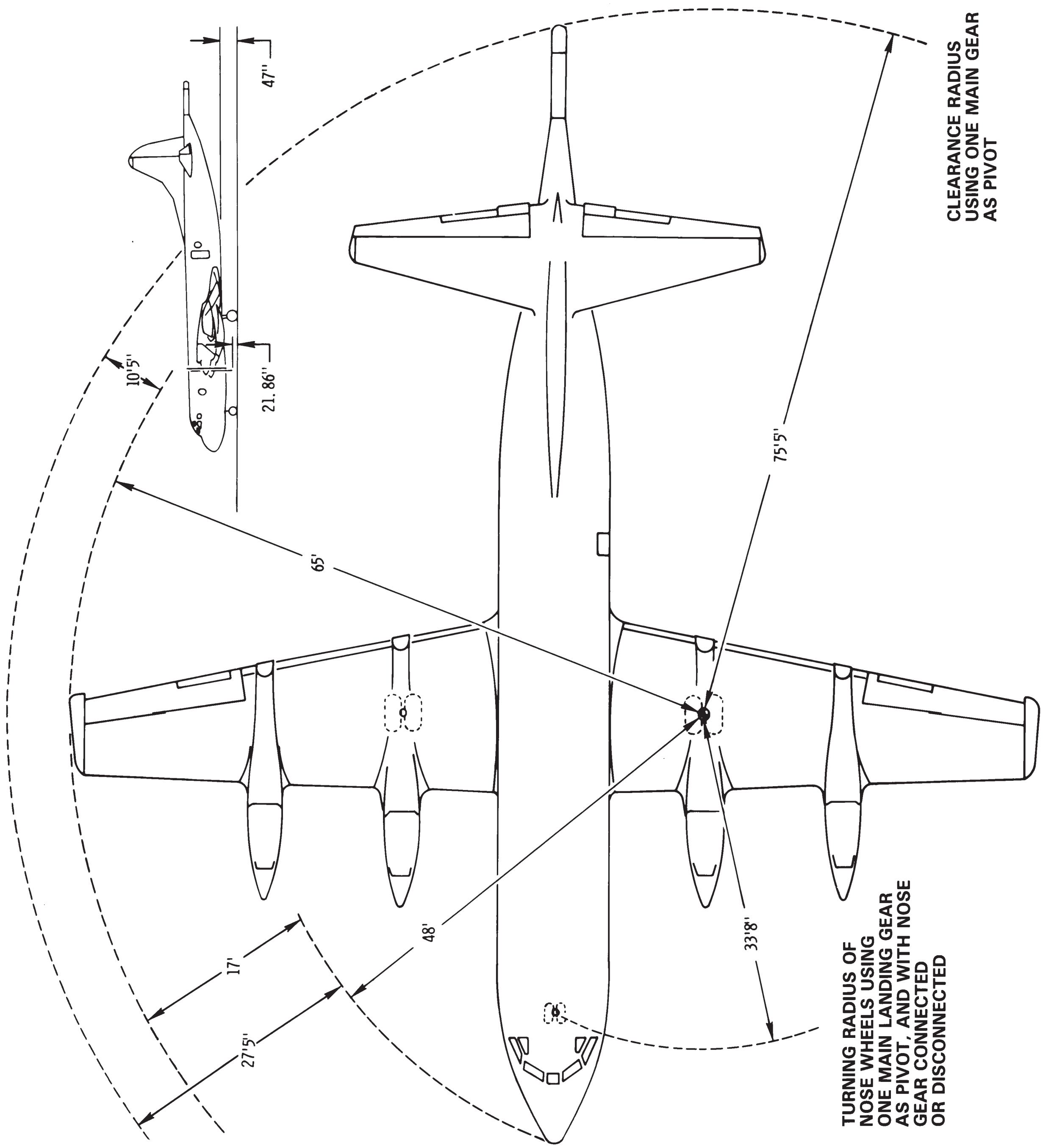
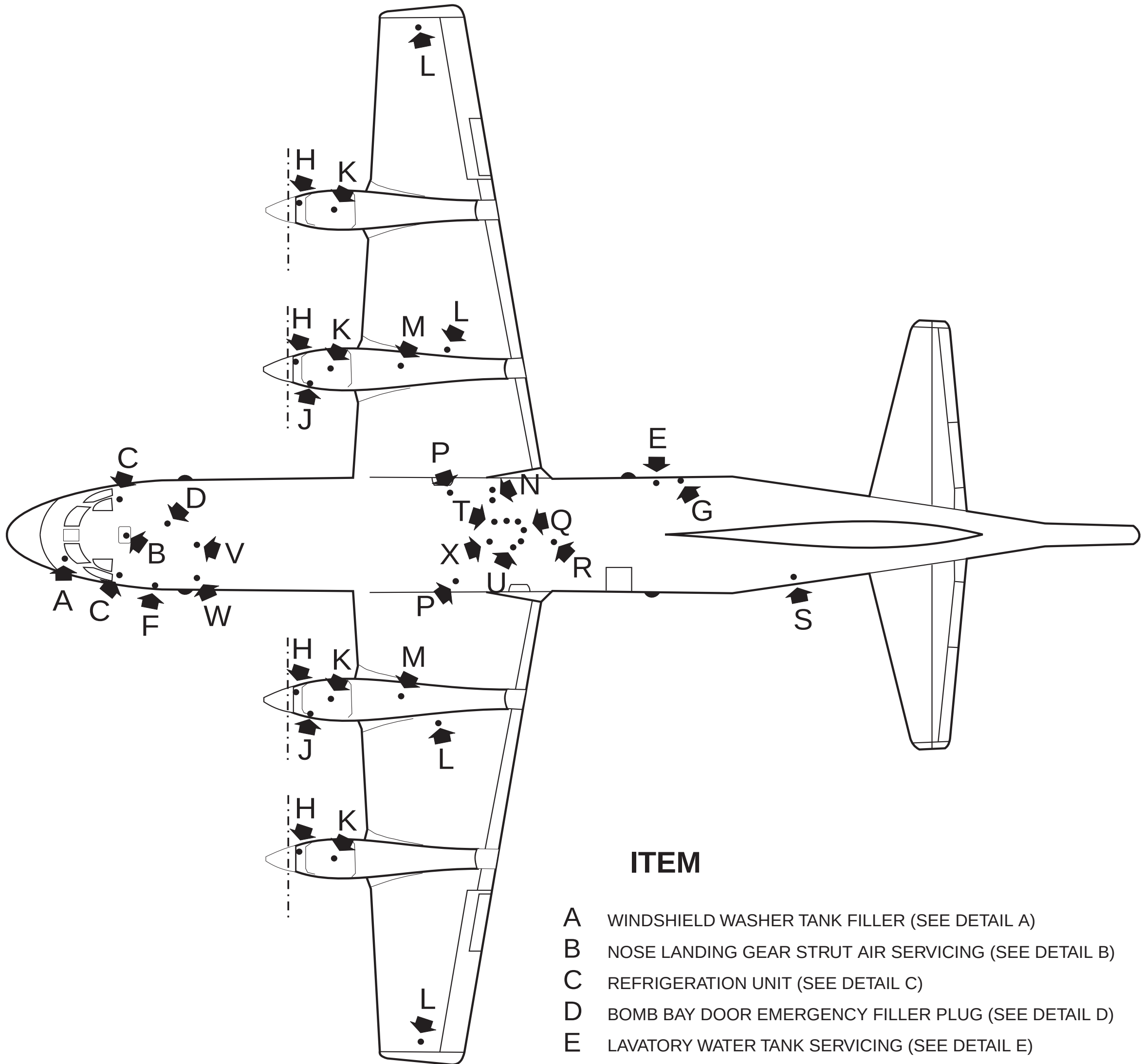


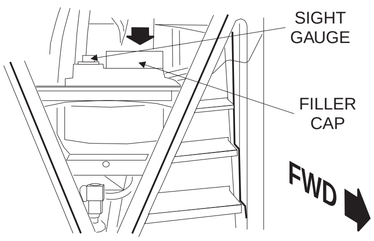
Figure 3-5. Turning Radius



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)
X SEARCH STORES PNEUMATIC SYSTEM (SEE DETAIL X)

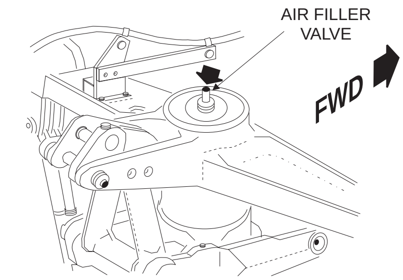
Figure 3-6. Servicing Instructions (Sheet 1 of 5)



DETAIL **A**

WINDSHIELD WASHER TANK FILLER

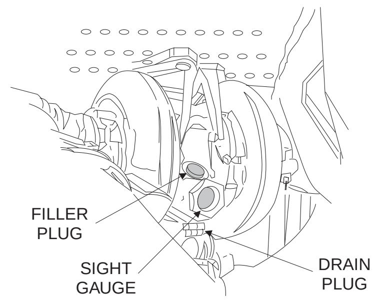
(LEFT SIDE OF NOSE WHEELWELL.) CAPACITY OF TANK—1.0 U.S. GAL. FILL WITH A MIXTURE OF 80% ISOPROPYL ALCOHOL AND 20% WATER TILL PLUNGER IS IN SIGHT. FOR COLD WEATHER AND OPTIONAL FOR NORMAL OPERATION, USE 100% ANTI-ICING FLUID, TT-I-735 (ISOPROPYL ALCOHOL).



DETAIL **B**

NOSE LANDING GEAR STRUT AIR SERVICING

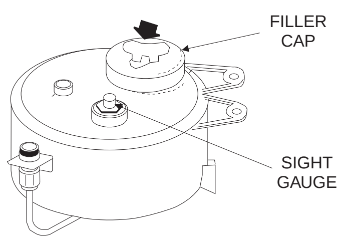
(SEE MAINTENANCE INSTRUCTIONS NAVAIR 01-75PAA-2-1.)



DETAIL **C**

REFRIGERATION UNIT (TYPICAL)

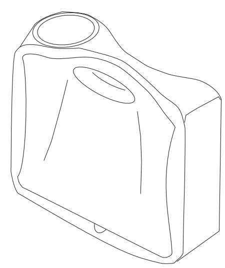
(SERVICE THROUGH ACCESS PANEL ON RIGHT AND LEFT SIDE OF AIRCRAFT OR THROUGH NOSE WHEELWELL.) ADD OIL IF LEVEL IN SIGHT GLASS IS BELOW 3/4 FULL CAPACITY OF UNIT—0.7 PINT. FILL TILL FLUID LEVEL IS 1/8 INCH FROM TOP OF SIGHT GAUGE. MIL-L-23699 LUBRICATING OIL.



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**

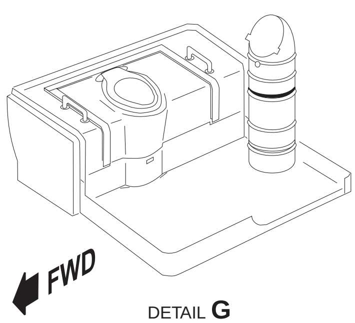
LAVATORY WATER TANK SERVICING

(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).



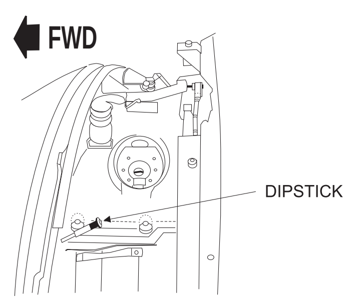
DETAIL **G**

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.

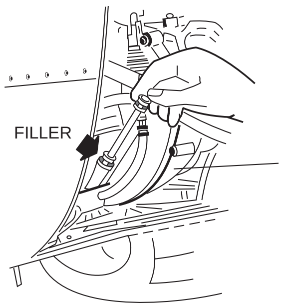


DETAIL **H**

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 TOP LEVEL BAND ON DIPSTICK. MIL-H-83282 (MIL-H-5606 ALTERNATE).

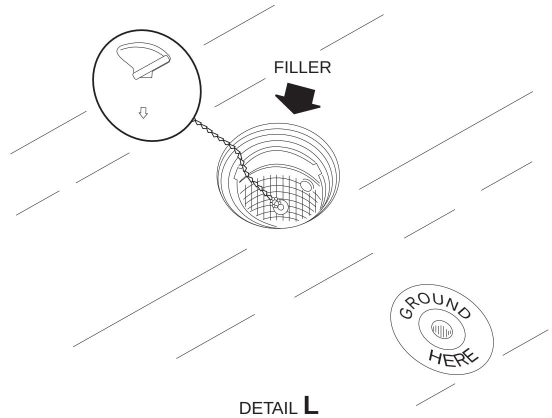
Figure 3-6. Servicing Instructions (Sheet 2 of 5)



DETAIL **J**

CABIN AIR COMPRESSOR SUMP SERVICE

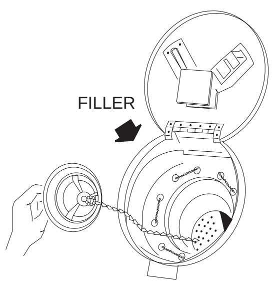
(NO. 2 AND 3 ENGINES) TO SERVICE, OPEN LEFT COWL PANEL ON ENGINE, CAPACITY OF SUMP — 0.7 U.S. GAL. (COMPRESSOR — 1.0 GAL.) FILL WITH FLUID TO FULL MARK ON DIPSTICK (MIL-L-23699 OR BELOW –40°C, MIL-L-7808).



DETAIL **L**

OVERWING FUEL FILLER, FOUR PLACES (TYPICAL)

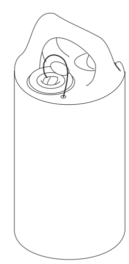
(TO SERVICE REMOVE FILLER CAP FROM WING TANK BEING FUELED) MIL-T-5624, GRADES JP-4 OR JP-5, OR MIL-T-83133A, GRADE JP-8.



DETAIL **K**

ENGINE OIL TANK FILLER PROVISIONS

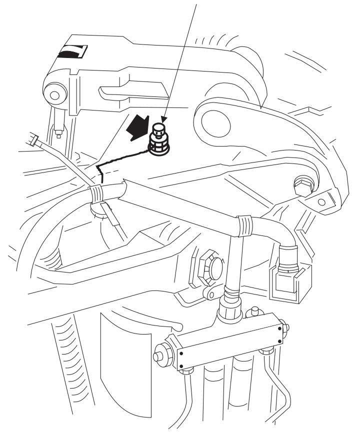
(SERVICE THROUGH ACCESS PANEL NEAR TOP OF EACH NACELLE.) CAPACITY OF TANK — 8.65 U.S. GAL. FILL TO 2 QUARTS LOW LEVEL WITHIN TANK (MIL-L- 23699 OR MIL-L-7808). CHECK WITHIN 30 MINUTES AFTER ENGINE SHUTDOWN.



DETAIL **P**

EMERGENCY WATER BREAKERS

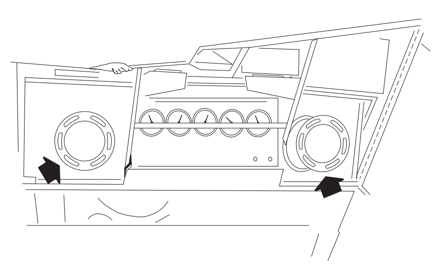
FLUSH WITH CHLORINE SOLUTION, LET STAND FOR 4 HOURS, FLUSH WITH CLEAN WATER, REFILL WITH FRESH DRINKING WATER.
CAPACITY — 2.5 U.S. GAL.



DETAIL **M**

MAIN LANDING GEAR AIR SERVICING

(SEE MAINTENANCE INSTRUCTIONS NAVAIR 01-75PAA-2-1.)

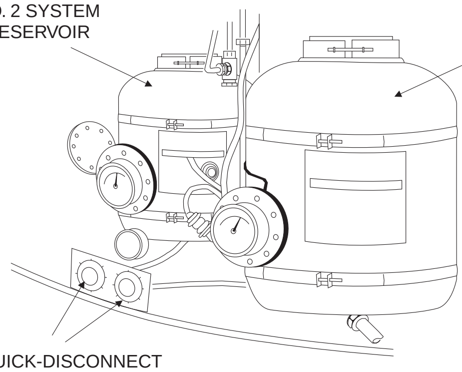


DETAIL **N**

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.

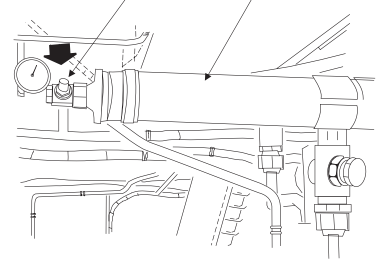
Figure 3-6. Servicing Instructions (Sheet 3 of 5)



DETAIL **Q**

HYDRAULIC POWER SYSTEM RESERVOIR SERVICING (TYPICAL)

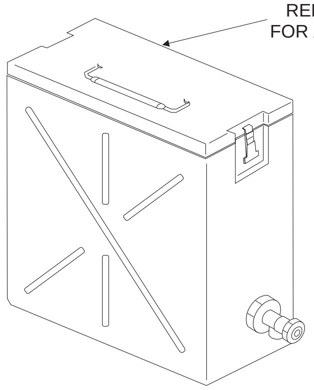
TWO RESERVOIRS IN HYDRAULIC SERVICE CENTER
TOTAL CAPACITY OF HYDRAULIC POWER SYSTEM NO. 1 .... 16.2 U.S. GAL
CAPACITY OF HYDRAULIC POWER SYSTEM RESERVOIR NO. 1
ACCUMULATOR CHARGED .... 5.0 U.S. GAL
TOTAL CAPACITY OF HYDRAULIC POWER SYSTEM NO. 2 .... 4.5 U.S. GAL
CAPACITY OF HYDRAULIC POWER SYSTEM RESERVOIR 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

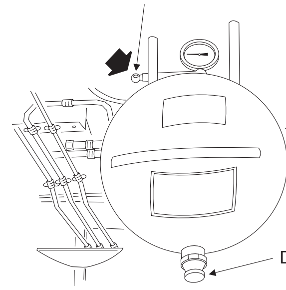
(HYDRAULIC SERVICE CENTER.)
ACCUMULATOR AIR CHARGE 800 PSI
(VIEW LOOKING AFT).



DETAIL **S**

GALLEY LIQUID COMPARTMENT SERVICING

(RIGHT SECTION OF REAR CABIN AREA.)
CAPACITY OF TANK — 2 U.S. GAL
FILL WITH DRINKING WATER.

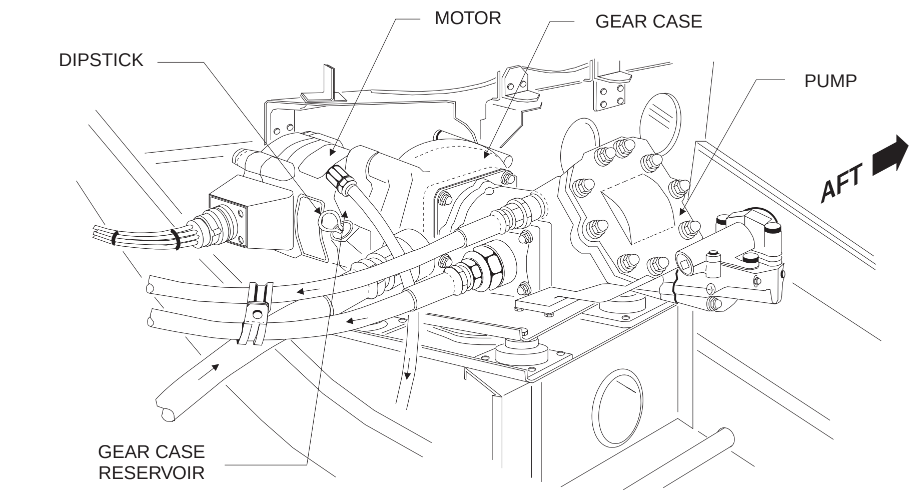


DETAIL **T**

EMERGENCY BRAKE AIR RESERVOIR SERVICING

(IN HYDRAULIC SERVICE CENTER.)
SYSTEM AIR CHARGE 1,900 PSI MINIMUM
TO 3,000 PSI MAXIMUM.

Figure 3-6. Servicing Instructions (Sheet 4 of 5)

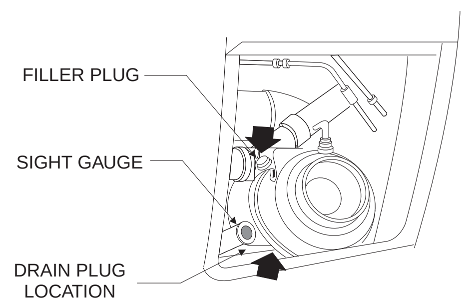


DETAIL **U**

HYDRAULIC PUMP INSTALLATION (TYPICAL)

NOTE

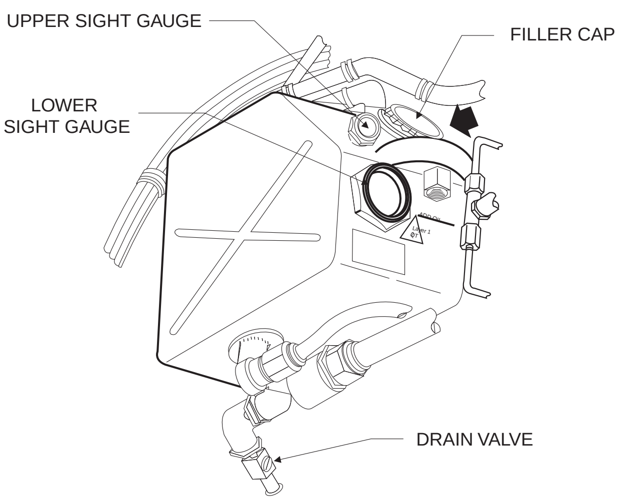
ON AIRCRAFT BUNO 159503 AND SUBSEQUENT AND ANY AIRCRAFT RETROFITTED WITH HYDRAULIC PUMP MODEL EA1320-077, THE HYDRAULIC PUMP REQUIRES NO SERVICING.



DETAIL **W**

AIR MULTIPLIER PACKAGE

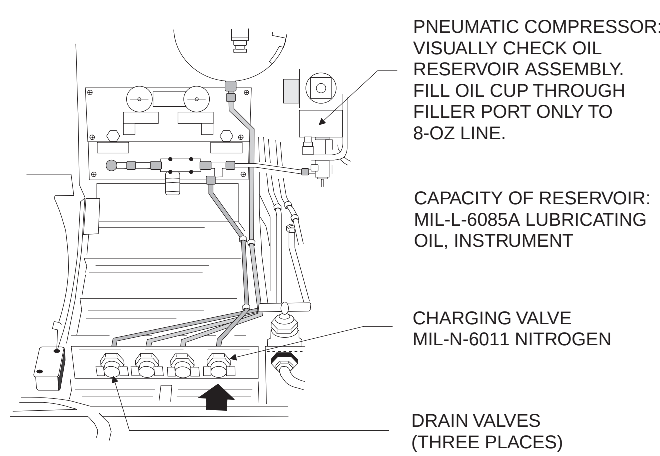
CHECK FLUID LEVEL THROUGH HINGED DOOR LEFT SIDE FUSELAGE. FILL UNTIL FLUID LEVEL IS WITHIN 1/8 INCH FROM TOP OF SIGHT GAUGE. MIL-L-23699 LUBRICATING OIL. CAPACITY OF UNIT—8.45 OZ. ADD OIL IF LEVEL IS AT OR BELOW THE 1/2 MARK ON THE SIGHT GAUGE.



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.



DETAIL **X**

SEARCH STORES PNEUMATIC SYSTEM

Figure 3-6. Servicing Instructions (Sheet 5 of 5)

TEMPERATURE °C	°F	PRESSURE MAXIMUM	MINIMUM	TEMPERATURE °C	°F	PRESSURE 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 3-7. Oxygen Table

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. 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.

4.3.1 Before Start Temperature. Maximum residual TIT for ground starting is 200 °C. Maximum residual TIT for air starting is 150 °C.

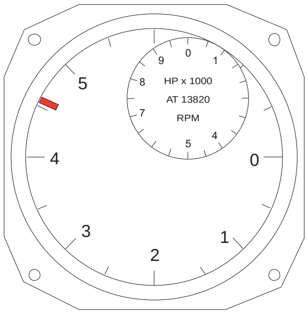
4.3.2 Overtemperature During Start

CONDITION	ACTION REQUIRED
TIT exceeds 830 °C (excluding the peak occurring at 94-percent RPM).	Continue start and record discrepancy.
TIT exceeds 850 °C (excluding the peak occurring at 94-percent RPM).	1. Ground operation — Place FUEL AND IGNITION switch OFF and record peak TIT. 2. Flight operation — Pull emergency shutdown handle and record peak TIT. 3. Cool to below 200 °C TIT if on the ground, below 150 °C if in flight. 4. If 850 °C is exceeded on next starting attempt: a. Ground operation — Place FUEL AND IGNITION switch to OFF, record, and call for maintenance. b. In flight — Pull emergency shutdown handle and record. Another start is not recommended.

CAUTION

Should TIT exceed 965 °C, record and call for maintenance. A restart attempt is not recommended.

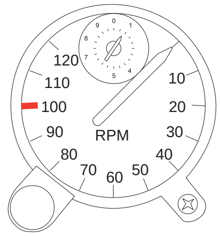
T56-A-14



HORSEPOWER

- (red) 4600 SHP MAXIMUM, MILITARY, AND NORMAL

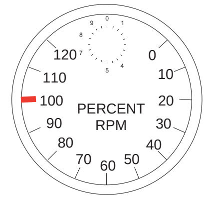
APU



TACHOMETER

LIMITS:
98–102% (GROUND)
98–103% (INFLIGHT)

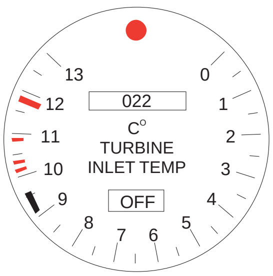
ENGINE



TACHOMETER

- (red) 99 PCT TO 101 PCT NORMAL

T56-A-14

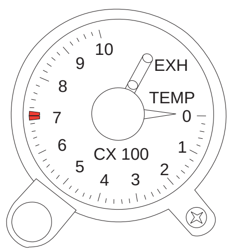


TURBINE INLET TEMPERATURE

- (red) 1175 °C MAXIMUM ALLOWABLE OVERTEMP (5 SECONDS)
- (red) 1083 °C MAXIMUM ALLOWABLE (5 MINUTES)
- (red) 1049 °C MILITARY POWER (30 MINUTES)
- (red) 1010 °C MAXIMUM CRUISE

NOTE WARNING LIGHT COMES ON AT 1080 (± 2) °C

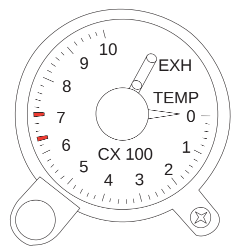
GTCP95-2



EXHAUST TEMPERATURE

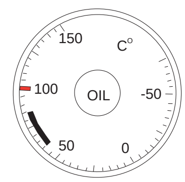
- (red) 715 °C MAXIMUM PEAK (710 °C MAXIMUM 10 SEC)
- (red) 688 °C MAXIMUM CONTINUOUS

GTCP95-3



EXHAUST TEMPERATURE

- (red) 704 °C MAXIMUM PEAK
- (red) 649 °C MAXIMUM CONTINUOUS



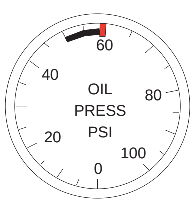
OIL TEMPERATURE

- (red) 100 °C (5 MINUTES IN FLIGHT RANGE, 30 MINUTES IN GROUND RANGE)
- (black) 60 °C TO 90 °C NORMAL
  50 °C TO 60 °C PERMITTED UNDER EXTREMELY COLD CONDITIONS

NOTE

- –54 °C MINIMUM FOR START LOW OR NORMAL RPM (MIL-7808)
  –40 °C IF MIL-L23699 IS USED
- 0 °C TO 40 °C MINIMUM ALLOWABLE DURING RUNUP BELOW 1000 SHP
- 40 °C AND RISING FOR TAKEOFF

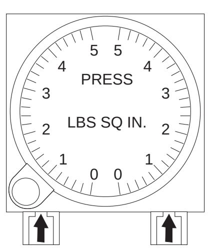
ENGINE



OIL PRESSURE (POWER SECTION)

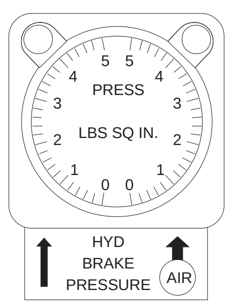
- (red) 60 PSI MAXIMUM ALLOWABLE
- (black) 50 PSI TO 60 PSI NORMAL

NOTE
100 PSI MAXIMUM DURING WARMUP



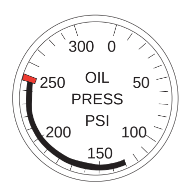
SYSTEM 1 **SYSTEM 2**

NORMAL PRESSURE
2960–3200 PSI



HYD BRAKE PRESSURE AIR—1900 PSI MIN FOR FLIGHT

GEAR CASE



OIL PRESSURE (GEAR SECTION)

- (red) 250 PSI MAXIMUM ALLOWABLE (EXCEPT DURING WARMUP)
- (black) 130 PSI TO 250 PSI NORMAL

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		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	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, the 60[8]	4,600
Normal Rated	1010					4,600 continuous operation
Maximum Cruise		99[11]	130	50		During air start minimum until oil is above 0 °C 1,000 maximum at oil temperature of 0 to 40 °C

(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 air start 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.

(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 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 106 to 96 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

CAUTION

If a torch occurs, shutdown and record. An overtemperature inspection is required.

4.3.3 Overtemperature During Power Change

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. Shutdown, 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.

4.4 APU LIMITS

1. EGT (GTCP95-2)
   a. 715 °C maximum peak.
   b. 710 °C maximum peak (10 seconds).
   c. 688 °C maximum continuous.
2. EGT (GTCP95-3)
   a. 704 °C maximum peak.
   b. 649 °C maximum continuous.
3. RPM
   a. 98 to 102 percent (ground).
   b. 98 to 103 percent (in flight).
   c. 106 percent maximum.
4. 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

1. Pop out by 64-percent RPM.
2. 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 4-3. Limit load factors and stall buffet curves are the same for an aircraft with the IRDS turret extended.

Additional maximum permissible indicated airspeeds are as follows:

Flaps:	
Maneuver	275 knots
Takeoff and approach	190 knots
Land	170 knots
Landing gear:	
Flight with landing gear extended	300 knots
Landing gear extension:	
At 1.0g	300 knots
Greater than 1.0g	190 knots
Landing gear retraction:	190 knots
Landing lights extended:	260 knots
Bomb bay doors open:	Limit dive speed
Overwing exit:	170 knots

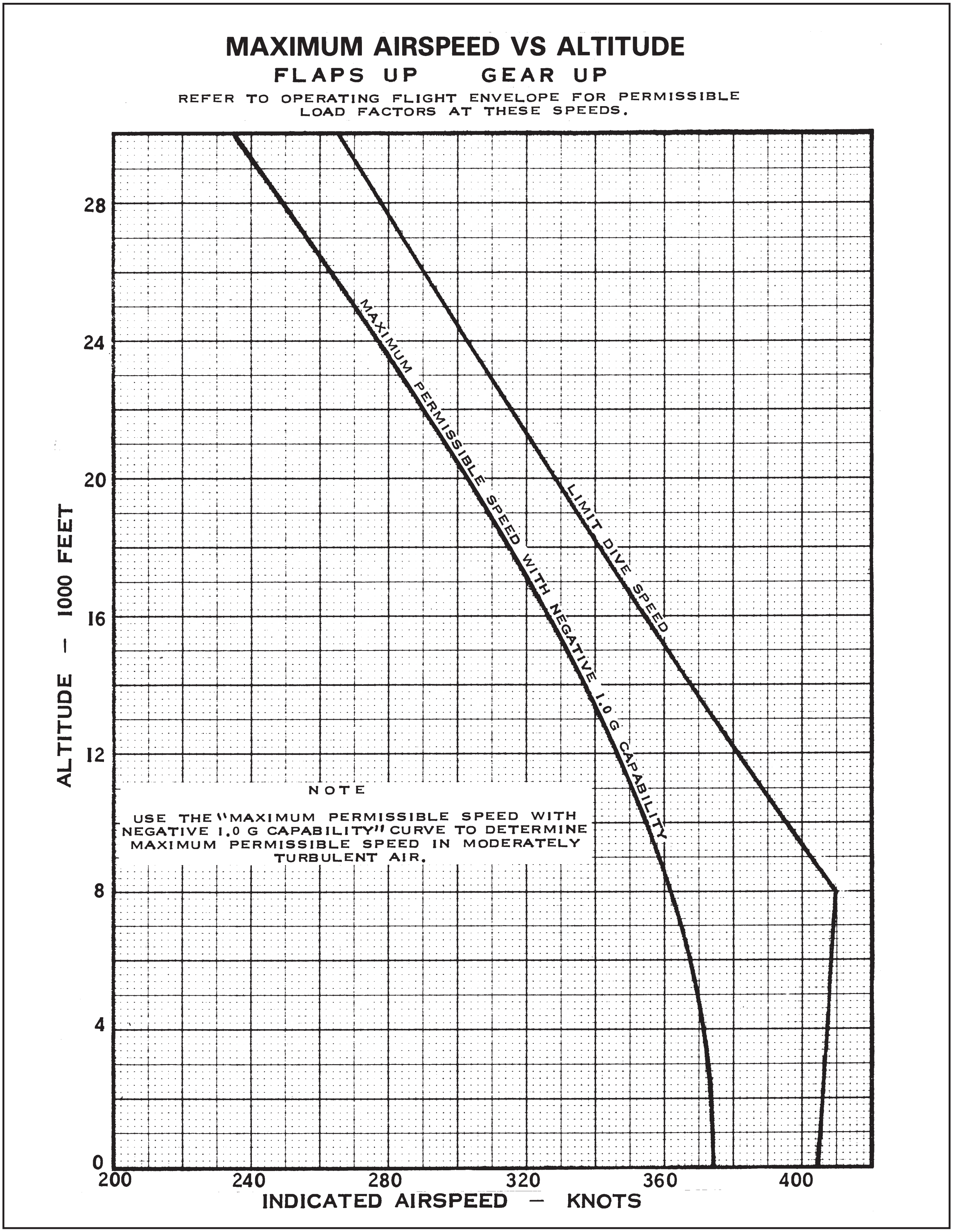


Figure 4-3. Airspeed vs. Altitude

Main cabin door open:	300 knots (maximum tested speed)
APU door open:	225 knots
IRDS turret:	
Extended	405 knots (V_{NE})
Extending/retracting	375 knots
Fuel dump operation:	140 to 300 knots
Air starts:	
Minimum Airspeed	170 knots
Minimum Airspeed (if range is critical)	210 knots
Maximum Airspeed:	
Sea level	345 knots
Reduce Airspeed	6 knots for every 1,000 feet of altitude

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.

4.7 FLIGHT MANEUVERS

Bank angles to 65° for roll maneuvering and 70° for coordinated turns are permitted.

4.8 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.

4.8.1 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 and P-3A/B increased gross weight aircraft is 77,200 pounds without wing stores or AFC-517. The maximum allowable zero fuel weight for standard P-3A/B aircraft is 71,584 pounds without wing stores. For all P-3 aircraft incorporating AFC-517, the maximum allowable zero fuel weight is 78,015 pounds. No weight may be added to the maximum allowable zero fuel weight except wing stores.

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 reduced from 3.0g to as low as 2.1g.
- For P-3A/B aircraft only, that are fitted with 10 external stations, maximum allowable zero fuel weight may not be increased by pylon and store weights in excess of 616 pounds per station on external stations 12 through 15.

Note

Flights with the Tank 5 drain mast removed are authorized, provided no fuel remains in Tank 5 at takeoff.

The P-3 pylon weights table (Figure 5-2) is included to facilitate zero fuel weight determination.

4.8.2 Lateral Unbalance. The following table 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

If there is maximum unbalance in one set of symmetrical tanks, the other set must be in balance. Asymmetric weapon loading should be taken into consideration for lateral unbalance.

4.8.3 Minimum Fuel for Flight. Refer to data in Figure 4-4.

4.8.3.1 Example. Aircraft gross weight equals 105,000 pounds (no wing stores). Enter the chart with the aircraft gross weight, intersect the no wing stores line, and read 6,750 pounds (or 1,040 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. Should wing stores be carried, enter the chart with an aircraft weight reduced by the total weight of these stores (includes pylons, launchers, and so forth).

4.9 CENTER OF GRAVITY LIMITATIONS

The maximum permissible cg envelope is shown in Figure 4-5. For complete weight and balance data, refer to NAVAIR 01-1B-40.

4.10 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.

4.11 WEIGHT LIMITATIONS

	P-3C/P-3A/B Increased Gross Weight	P-3A/B Standard Aircraft
Recommended Takeoff	135,000 pounds	127,500 pounds
Overload Takeoff	139,760 pounds	—
Landing	114,000 pounds	105,000 pounds

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, 91,320 pounds for P-3A/B standard aircraft, shall be made at a minimum rate of descent. Each landing at a gross weight in excess of 103,880 pounds, 91,320 pounds for P-3A/B standard aircraft, 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, 105,000 pounds for P-3A/B standard aircraft, 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 91,320 pounds up to 105,000 pounds for P-3A/B standard aircraft, and after each landing at a gross weight in excess of 114,000 pounds, 105,000 pounds for P-3A/B standard aircraft. An abnormal landing inspection shall be performed after each reported hard landing regardless of gross weight. Refer to Handbook — 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.

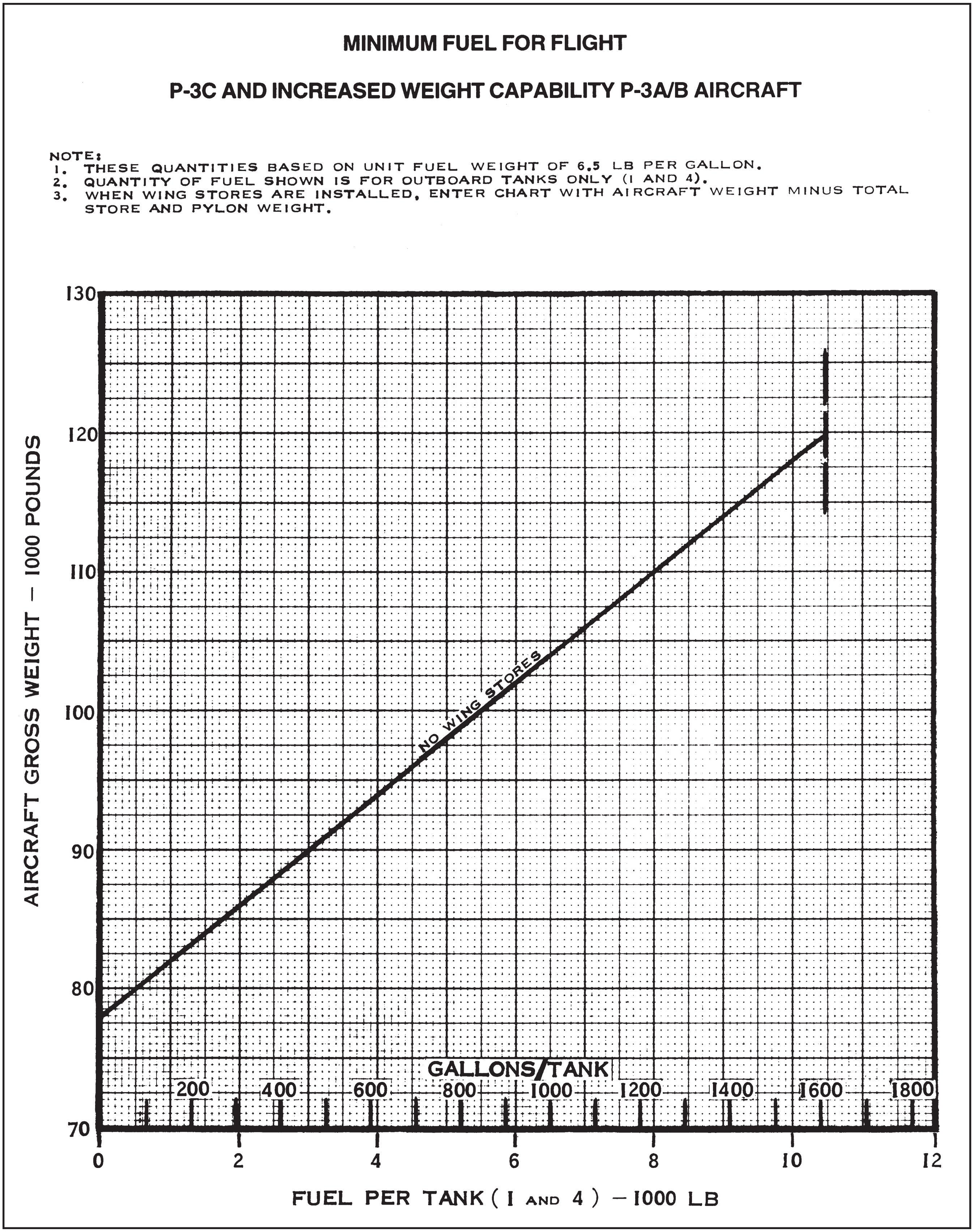


Figure 4-4. Minimum Fuel for Flight (Sheet 1 of 2)

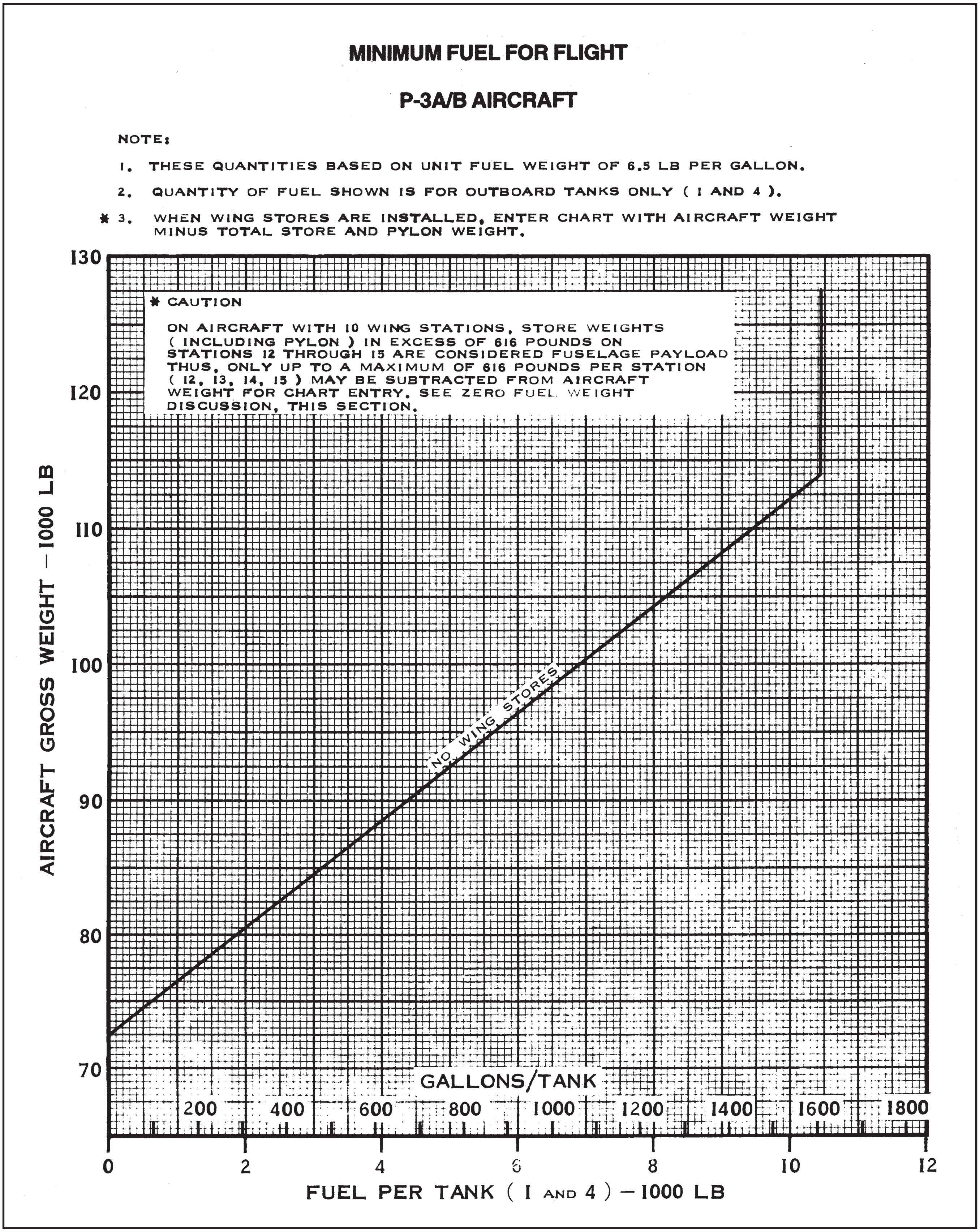


Figure 4-4. Minimum Fuel for Flight (Sheet 2 of 2)

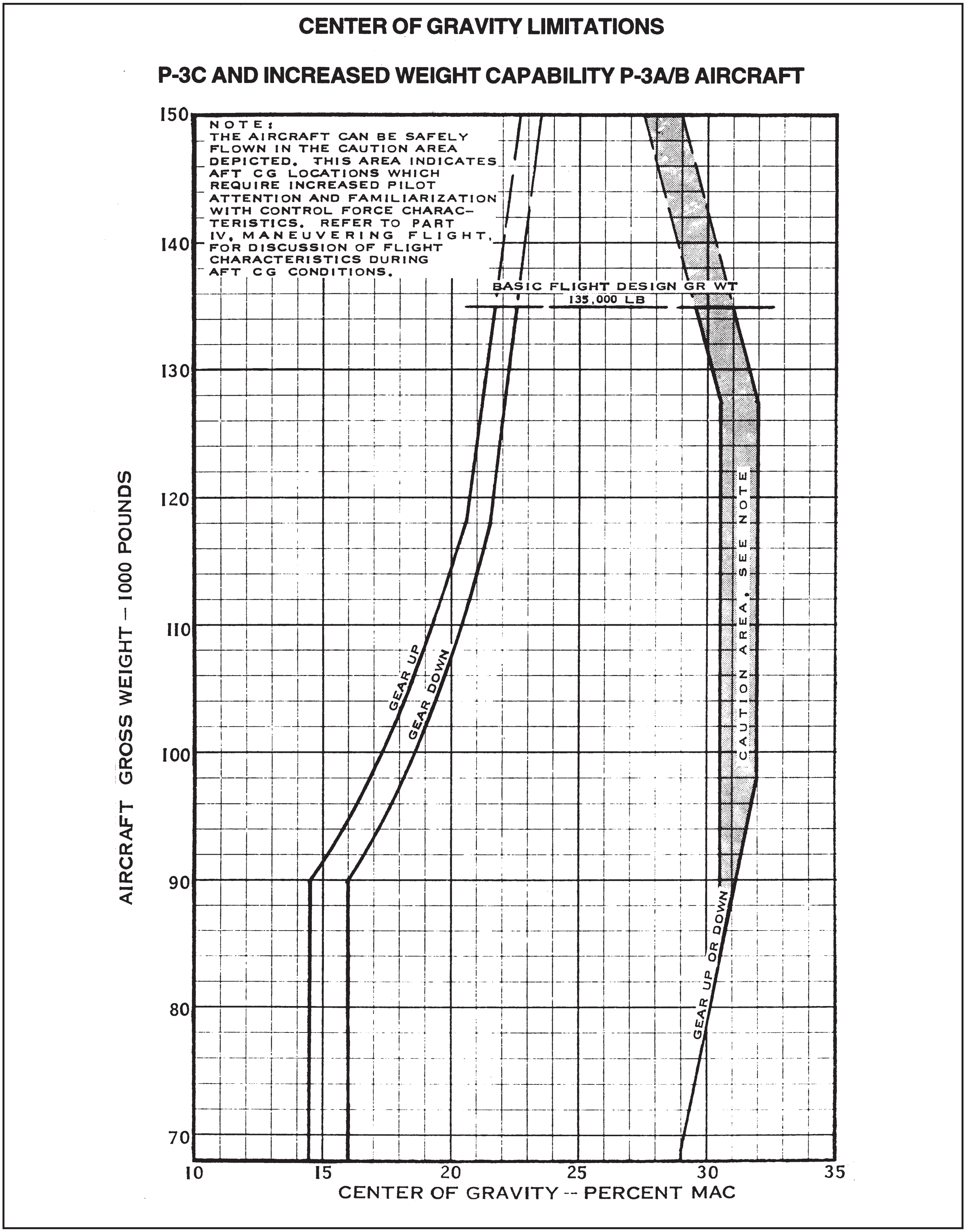


Figure 4-5. Center of Gravity Limitations (Sheet 1 of 2)

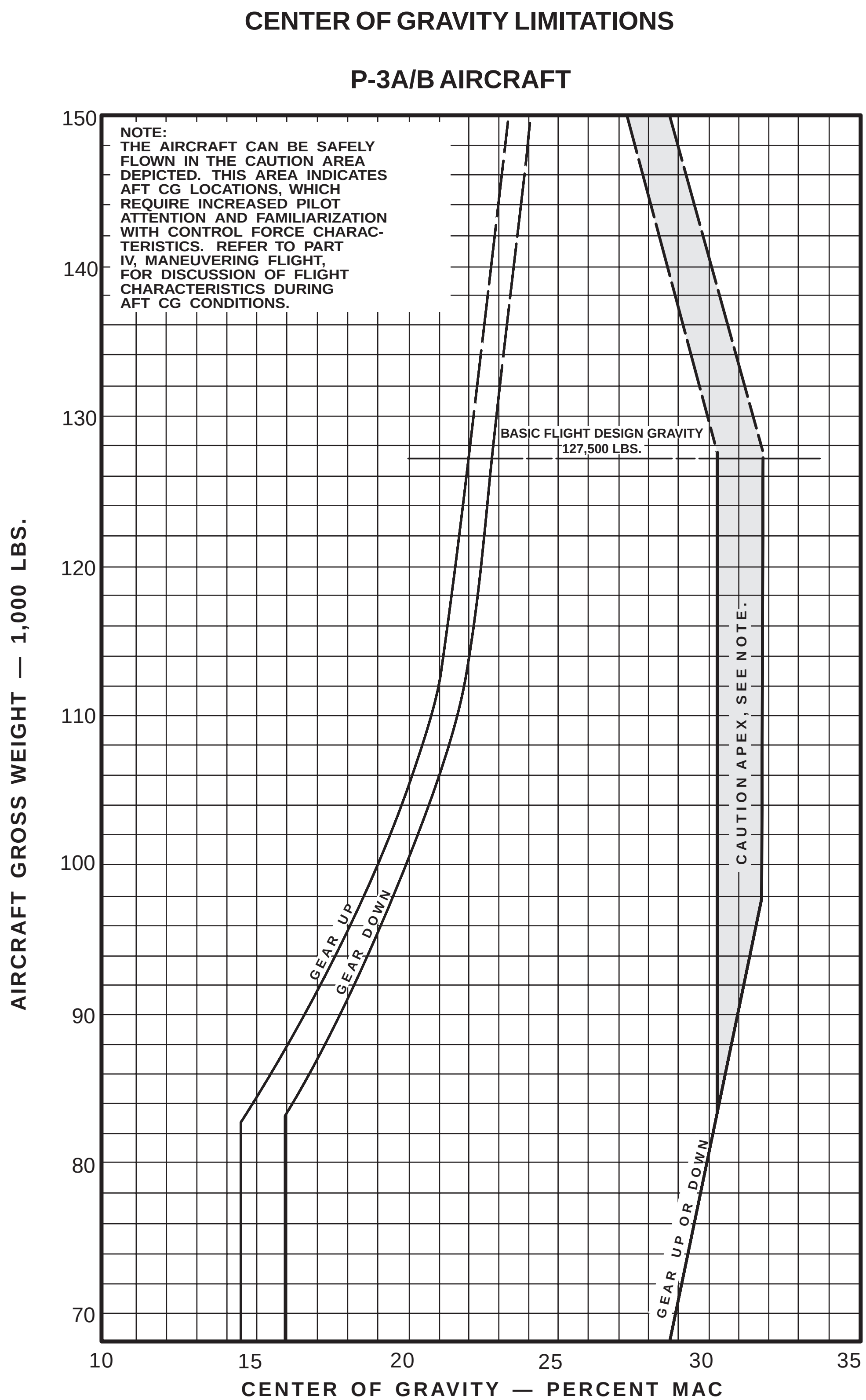


Figure 4-5. Center of Gravity Limitations (Sheet 2 of 2)

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 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 01-75PA-75. For specific authorization, refer to NWP 55-2-P3 Tactical Manual. Only the internal and external stores listed in Figures 5-1 through 5-6 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 IRDS.
- NWP 3-20.5 Tactical Manual Chapter 9 and Appendix A shall be consulted prior to carriage of weapons/stores.

Note

- BRU-12, BRU-14, and BRU-15 bomb racks must be modified in accordance with AAC 956/904/955 respectively prior to carriage of stores.
- 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 — 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.

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. Offline 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.

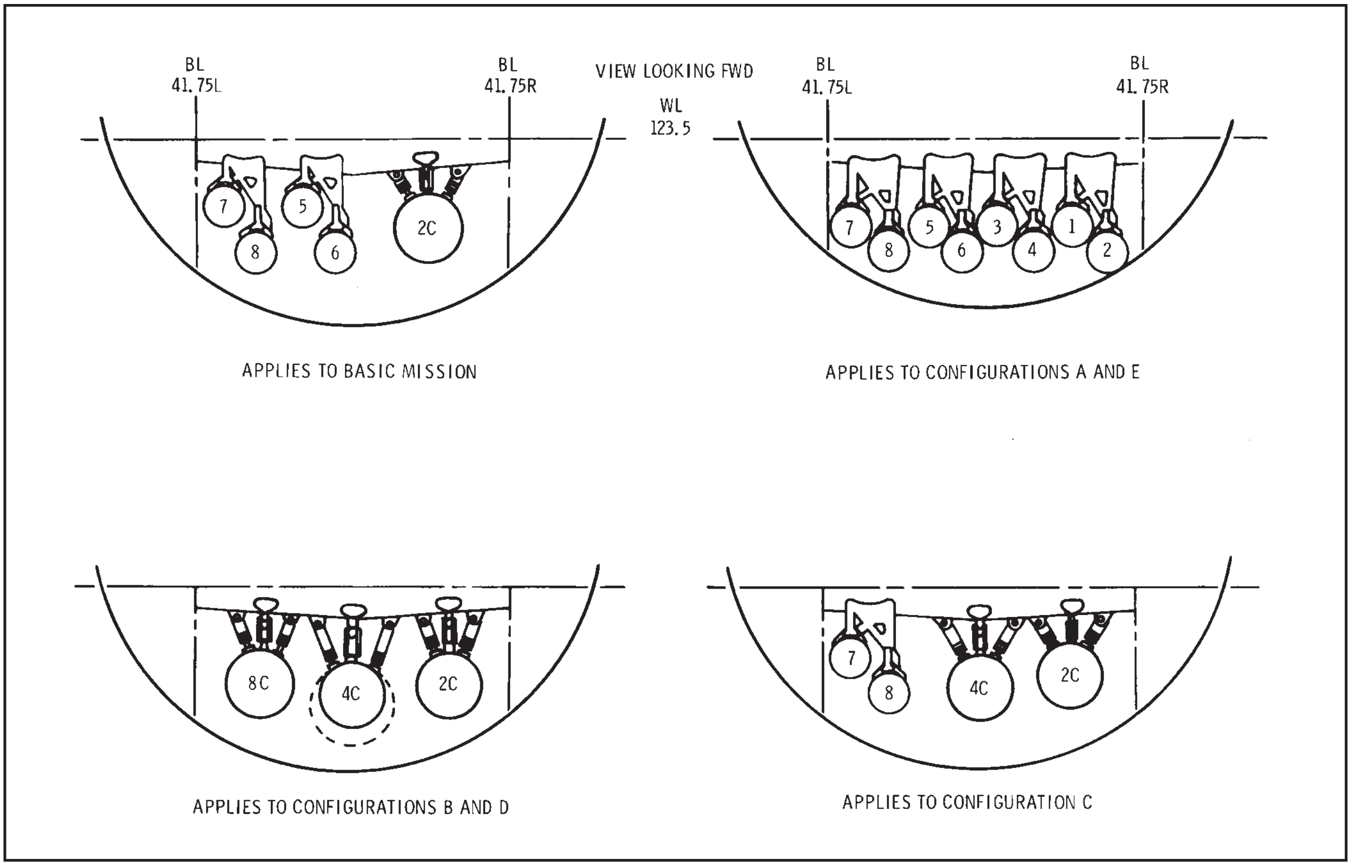


Figure 5-1. Bomb Bay Stores Loading Configuration

PYLON	WEIGHT (LB)	REMARKS
Mining	125	Wing Pylon
Primary	43	BB Pylon
1,000/2,000	39	BB Pylon
ESM	177	

Figure 5-2. P-3 Pylon Weight

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 FECB panel prior to initiating jettison.

3. Upon return to base, secure the armament system and inform 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. Offline 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. Wings 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, a 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 Harpoon FTF or LFA condition persists, or if normal 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 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 CB 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 5-3.

5.5 INTERNAL SEARCH STORES HANDLING

Refer to Figure 5-4.

5.6 EXTERNAL KILL STORES HANDLING

Refer to Figures 5-5 and 5-6.

CONFIG	STORE	TYPE	AVERAGE WEIGHT (LB)	BOMB BAY STATIONS	QUANTITY	AIRSPEED (KTAS) MAXIMUM IN FLIGHT	AIRSPEED (KTAS) MAXIMUM AT RELEASE	AIRSPEED (KTAS) MINIMUM AT RELEASE	ACCELERATIONS (G) IN FLIGHT	ACCELERATIONS (G) AT RELEASE	REMARKS
BASIC MISSION	DEPTH BOMB	B57 BDU-20/C	510	2C	1	LBA	330	180	–1.0 TO +3.0	+1.0	MAXIMUM RELEASE ALTITUDE 1,000 FT. BDUs AUTHORIZED SEE NOTE 3.
	TORPEDO	MK-46	604	5-6-7-8	4	LBA	350	180	–1.0 TO +3.0	+1.0	SEE NOTE 5.
A	TORPEDO	MK46	604	1-2-3-4-5-6-7-8	8	LBA	350	180	–1.0 TO +3.0	+1.0	SEE NOTE 5.
	TORPEDO	MK-50	798	2-3-4-5-6-7	6	LBA	375	175	–1.0 TO +3.0	+1.0	
	DEPTH BOMB	MK-82 BDU-45	SE/RET 569	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, AND 3	SE/RET 569	1-2-3-4-5-6-7-8	8	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
	DESTRUCTOR	MK-36 MOD	SE/RET 569	1-2-3-4-5-6-7-8	8	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
B	LDGP BOMB	MK-83 INERT		2C-4C-8C						+1.0	
	BOMB (INERT)	MK-82 BDU-45	SE/RET 569	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
	DESTRUCTOR	MK-36 MODS	SE/RET 572	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
	DESTRUCTOR	MK- 40 MODS 3 – 7	SE/RET 1,057	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
	MINE	MK-36	1,110	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	SEE NOTE 4.
	MINE	MK-52	1,243	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	SEE NOTE 4.
	UNDERWATER MINE	MK-62 MOD 0	SE/RET 569	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
	UNDERWATER MINE	MK- 63 MOD 0	1,069	2C-4C-8C	3	LBA	LBA	180	–1.0 TO +3.0	+1.0	DELAY ARMING LANYARD REQUIRED.
C	TORPEDO	MK-46	604	7-8	2	LBA	330	180	–1.0 TO +3.0	+1.0	SEE NOTE 5.
D	MINE	MK-25	1,997	4C	1	LBA	LBA	180	–1.0 TO +2.0	+1.0	SEE NOTE 4.
	MINE	MK-55	2,194	4C	1	LBA	LBA	180	–1.0 TO +2.0	+1.0	SEE NOTE 4.
	MINE	MK-56	2,215	4C	1	LBA	LBA	180	–1.0 TO +2.0	+1.0	SEE NOTE 4.
E	SOUND UNDER-WATER SIGNAL	MK-61 MK-64	6.8 6.0	2-4-6-8	4	LBA	340	180	–1.0 TO +2.0	+1.0	
MOCC	FUEL TANK	N/A	70	2C	1	LBA	N/A	N/A	N/A	N/A	SEE NOTES 6, 7, 8.
	GENERATOR	N/A	900	4C	1	LBA	N/A	N/A	N/A	N/A	SEE NOTES 6, 7, 8.
PRACTICE BOMB		MK-82 INERT MK-83 INERT	LD 531 SE/RET 572 LD 985	1-2-3-4-5-6-7-8 2C-4C-8C							

Figure 5-3. 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. The BDU-20/C special weapon training shape may be carried and released from P-3 aircraft incorporating ECP-814 (BRU-14 racks).
4. Refer to NWP-3-20-5 Chapter 12 Appendix A for all mine configuration information. High-speed fairing is not authorized for bomb bay use.
5. MK-46 limitations apply to Mod 1, 2, and 5 and to the positive buoyant exercise torpedo (PB) configuration. Use of safety sleeve (NSN 4T1355-01-102-8306) on suspension bands Mk-78 Mod 0/1 for the Mk-46 torpedo is authorized. Maximum release altitude is 500 feet AGL.
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 01-75PA-75, as applicable to model type.
10. Loading of weapons on BRU-12 and BRU-14 racks is not authorized unless AAC-956 and -904 respectively, have been incorporated.
11. 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.

Figure 5-3. P-3 Internal Kill Stores (Sheet 2 of 2)

SONOBUOY															
AN/SSQ	36	47B	53	53A	53B*	53D	57A	57B	62*	62A*	62B*	71	77A	77B	110
SIZE	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
HYDROPHONE DEPTH (FT)	THERMAL PROBE TO 1000	60 OR 800	90	90 OR 1000	90, 400, OR 1000	90, 400, OR 1000	60 OR 300	(8W 70) 60, 400 (8W 73) 90, 400	60 OR 1500	90–450	90, 400, OR 1500	350	1000	500 OR 1000	
LIFE (HR)	0.1	0.5	1 OR 8	1 OR 4	1, 3, OR 8	1, 2, 4, OR 8	1, 3, OR 8	1, 3, OR 8	1 MAX	30 MIN 3.5 HRS	30 MIN 3 HRS		1, 4, OR 8	1, 4, OR 8	4
RADIO CHANNELS	3	12	31	31	1-99	1-99	31	31	31	31	31	3	1–99	1–99	1–31
WEIGHT (LB)	21	25	22	25	29	28.7	20	18	41	41	41	29	29	29	39
SPEED ALTITUDE MAX LAUNCH	A	B	B	C	C	C	PARA C / ROTO A	C	(2) AMOD	B	A	C	C	C	A
PURPOSE	BT	RO	DIFAR	DIFAR	DIFAR	DIFAR	LOFAR	LOFAR	DICASS	DICASS	DICASS	ATAC	VLAD	VLAD	EER
POWER (WATTS)	1/4	1/4	1	1	1	1	1	1	1/4	1/4	1/4	1	1	1	1/4

SONOBUOY NOTES: 1. WEIGHT SHOWN ABOVE WITH PLASTICS SLCS.
* LITHIUM BATTERY POWERED, SEE NAVAIR 28-SSQ-500.

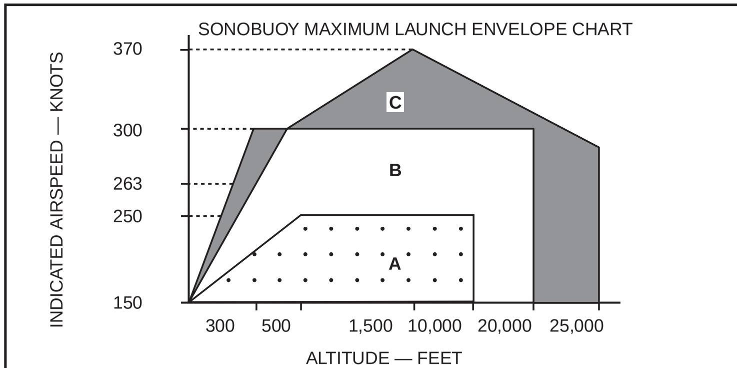
CAUTION

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.

SMOKE MARKER		
TYPE	LIFE (MINUTES)	WEIGHT (LB)
MK-58	45 TO 55	12.75
MK-25	10 TO 20	3.6

TYPE	WEIGHT (LB)
PLASTIC SLC	2.0
METAL SLC	4.5
CAD JAU-1/B	2.5
CAD JAU-22/B	0.875

SOUND UNDERWATER SIGNAL (SUS)					
TYPE	SIZE (INCHES)	WEIGHT (LB)	FIRING DEPTH/FT	SINKING RATE FT/SEC (TERM V.)	PURPOSE
MK-61		6.8			BOMB BAY STATION 2-4 – 6-8
MK-64	B 3 x 15	6.8	60/800	22.8	TACTICAL AND PRACTICE
MK-84	B 3 x 15	6.0	WATER ENTRY TO 4 SECS	16.8	



NAVAIR–developed buoys may be used with fleet P-3 aircraft for special exercises when they conform to design characteristics for “A” size (4-7/8 x 36) buoy.

Figure 5-4. P-3 Search Stores (Sheet 1 of 2)

WARNING

- Sonobuoys that contain a lithium sulfur dioxide ($LiSO_2$) cells (SSQ-62, SSQ-86, SSQ-110, and MK-39 Mod 0 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 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-110 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 should 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 should 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 01-75-PA-75 Airborne Weapon/Store Loading Manual Navy Model P-3 Aircraft.
11. Do not use the free-fall chute to launch the Mk-39 MOD 0 EMATT.
12. Do not remove the Mk-39 MOD 0 EMATT from SLC.

Figure 5-4. Search Stores (Sheet 2 of 2)

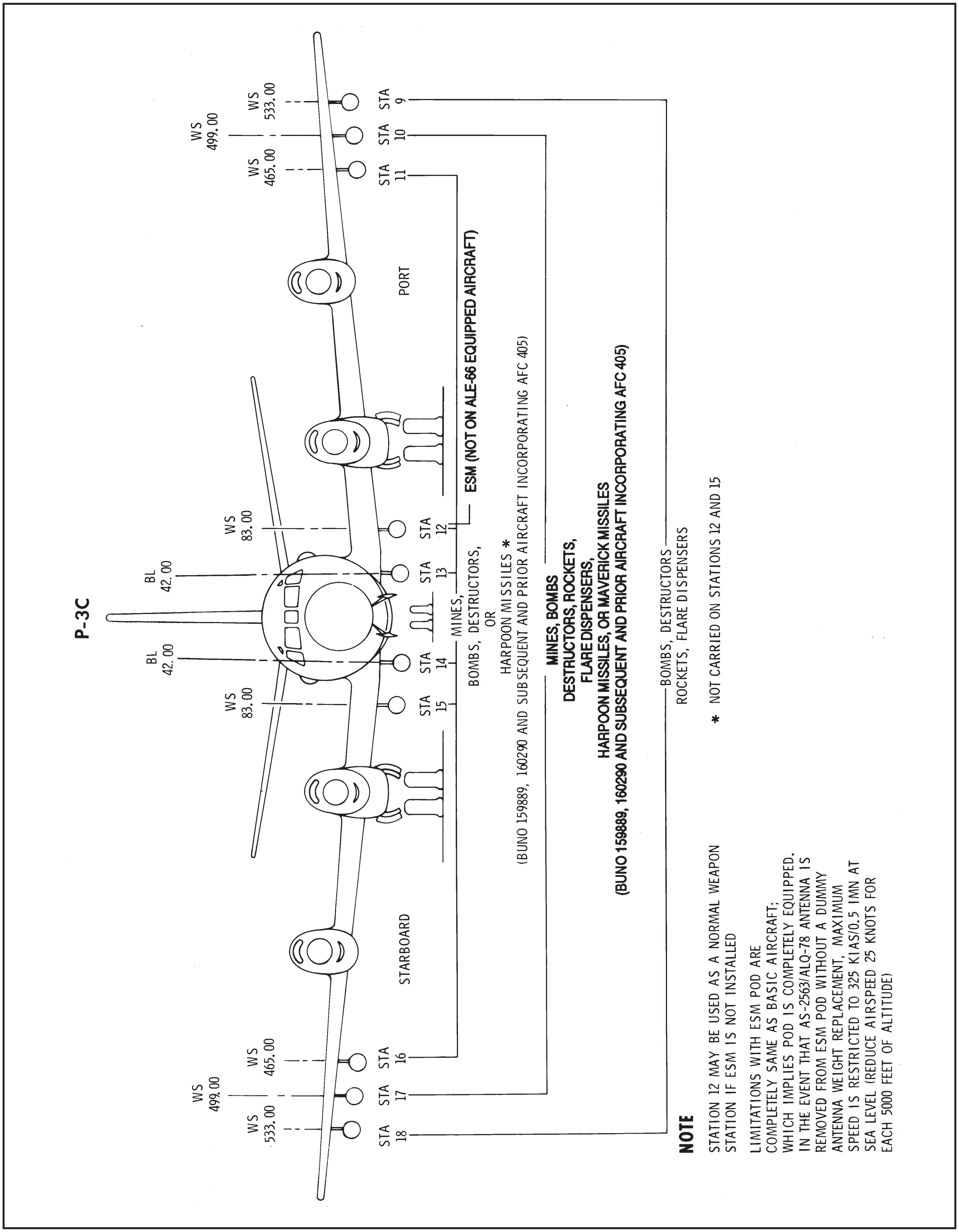


Figure 5-5. Wing Weapon Stations

LINE NO.	STORE	TYPE	AVERAGE WEIGHT (LB)	WING STATIONS PORT 9	10	11	12	13	WING STATIONS STARBOARD 14	15	16	17	18	QTY	AIRSPEED (KIAS) MAXIMUM IN FLIGHT	AIRSPEED (KIAS) MAXIMUM AT RELEASE	AIRSPEED (KIAS) MINIMUM AT RELEASE	ACCELERATIONS (G) IN FLIGHT	ACCELERATIONS (G) AT RELEASE	MAXIMUM JETTISON AIRSPEED (KIAS)	REMARKS
1	(4) 5-INCH FFAR POD	LAU-10 SERIES	593	X	X							X	X	16 RDS/ 4 PER POD	LBA	LBA	140	−1.0 TO +3.0	+1.0	200 (+1.0G) FULL PARTIAL OR EMPTY PODS	STATIONS 9 AND 18 REQUIRE SCARFED FUEL VENT FLAME ARRESTORS INSTALLED.
2	(7) 2.75-INCH FFARD POD	LAU-68 SERIES	218	X	X							X	X	28 RDS/7 PER POD							
3	(19) 2.75-INCH FFARD POD	LAU-61 LAU-69 SERIES	683 (M229)	X	X							X	X	76 RDS/ 19 PER POD							
4	MINE	MK-52	1,250		X	X	X	X	X	X	X	X		8			180	−1.0 TO +2.0		LBA	REFER TO MINE CONFIGURATION CHART.
5	MINE	MK-36	1,145		X	X	X	X	X	X	X	X									
6	MINE	MK-62	SE/RET 569	X	X	X	X	X	X	X	X	X	X	10				−1.0 TO +3.0		360	
7	MINE	MK-25	1,997			X	X	X	X	X	X							−1.0 TO +2.0		LBA	NO MINE CARRIAGE AUTHORIZED ON AERO 15 TYPE BOMB RACKS.
8	MINE	MK-65	2,390			X	X	X	X	X	X			6				−1.0 TO +3.0		360	
9	MINE	MK-55	2,197			X	X	X	X	X	X							−1.0 TO +2.0		LBA	
10	MINE	MK-63	1,069		X	X	X	X	X	X	X	X		8				−1.0 TO +3.0			
11	MINE	MK-56	2,147			X	X	X	X	X	X			6				−1.0 TO +2.0			
12	MINE	MK-60	2,370			X	X	X	X	X	X						*				REFER TO P-3 TACTICAL MANUAL, NAVAIR 01-75-PAA-1T.
13	ROCK EYE	MK-20	496	X	X	X	X	X	X	X	X	X	X	10	LBA	340	225	0.0 TO +2.0	+1.0	340	AUTHORIZED FOR STANDARD MINE PYLONS 9 THROUGH 18 AND HARPOON PYLONS 10, 11, 16, 17. USE CAPTOR 8-INCH LANYARD TO INTERFACE MK-20 TAIL FIN ARMING WIRE WITH MINE OR HARPOON PYLON.
14	DESTRUCTOR	MK-36 MOD 3 – 7	LD 531	X	X	X	X	X	X	X	X	X	X	10		LBA	*			360	RETARDED AND NONRETARDED DELIVERY MODE AUTHORIZED.
			SE/RET 572																		
15	PRACTICE BOMB	BDU-45	LD 531	X	X	X	X	X	X	X	X	X	X	10			140	−1.0 TO +3.0		400	RELEASE IN LEVEL FLIGHT.
			SE/RET 572																		REFER TO NAVORD OP-3529 FOR RELEASE LIMITATION ON DESTRUCTORS.
16	DESTRUCTOR	MK 40 MODS 3 – 7	LD 985 SE/RET 1057		X	X	X	X	X	X	X	X		8			*	0.0 TO +2.0		360	
17	DEPTH 80m B	MK-8	SE/RET 569	X	X	X	X	X	X	X	X	X	X	10	LBA	LBA	*	0.0 TO +2.0	1.0	360	

*See Remarks
LBA — Maximum airspeed versus altitude without external stores (405 KIAS)

Figure 5-6. P-3 External Stores (Sheet 1 of 3)

LINE NO.	STORE	TYPE	AVERAGE WEIGHT (LB)	WING STATIONS PORT 9 10 11 12 13	WING STATIONS STARBOARD 14 15 16 17 18	QTY	AIRSPEED (KIAS) MAXIMUM IN FLIGHT	AIRSPEED (KIAS) MAXIMUM AT RELEASE	AIRSPEED (KIAS) MINIMUM AT RELEASE	ACCELERATIONS (G) IN FLIGHT	ACCELERATIONS (G) AT RELEASE	MAXIMUM JETTISON AIRSPEED (KIAS)	REMARKS
17	PRACTICE BOMB	MK-83 INERT	LD GP 985	X X X X	X X X X	8	LBA	LBA	140	−1.0 TO +3.0	+1.0	400	RETARDED AND NONRETARDED DELIVERY MODE AUTHORIZED. RELEASE IN LEVEL FLIGHT. RELEASE LIMITATIONS ON DESTRUCTORS.
18	FLARE DISPENSER	SUU-44 WITH MK-24/25 OR LUU-2 FLARES	350	P-3C WITH AERO 65 OR BRU-15 RACKS X X	X X	32/8 PER POD			165	−1.0 TO +3.0	+1.0	200	AAC-570 MUST BE INCORPORATED. JETTISON AT +1.0G STRAIGHT AND LEVEL FLIGHT. DO NOT EXTEND FLAPS BEYOND THE MANEUVER POSITION WHEN DISPENSING FLARES.
19	FLARE DISPENSER	SUU-25 F/A WITH LUU-2 FLARES	490	X X	X X								
20	PRACTICE BOMB	MK-84 INERT	1.970	X X X	X X X	6			180	−1.0 TO +2.0	+1.0	LBA	RELEASE IN LEVEL FLIGHT.
21	DESTRUCTOR	MK-41 MODS 3 – 7	1.970	X X X	X X X								UNRETARDED DELIVERY, RELEASE IN LEVEL FLIGHT. REFER TO NAVORD OP-3529.
22	DISPENSER WITH WMU-1/B AND WMU-2	SUU-53	150	P-3C WITH AERO 65 RACKS X X	X X	4			150	−1.0 TO +3.0	+1.0	200	JETTISON AT +1.0G STRAIGHT AND LEVEL.
23	ESM POD	ALQ-78	177	X		1				LBA			NO RELEASE/JETTISON CAPABILITY IF AS-2563/ALQ-78 ANTENNA IS REMOVED FROM POD WITHOUT A DUMMY ANTENNA WEIGHT REPLACEMENT. MAXIMUM SPEED IS 325 KIAS/0.5 IMN AT SEA LEVEL (REDUCE AIRSPEED 25 KIAS FOR EACH 5,000 FEET OF ALTITUDE).
24	HARPOON	AGM-84	1.220	BUNO 159889, 160290, AND UP, AND PRIOR AIRCRAFT INCORPORATING AFC-405 X X X	X X X	6	350	350	200	0.0 TO +3.0	+1.0	350	REFER TO OPORD OP-3594 FOR INFORMATION.
25	MAVERICK WITH LAU-117 LAUNCHER	AGM-65	802	X X	X X	2	LBA	405	180	LBA	+.0.86 TO +2.0	MIN 180 TO MAX 250	JETTISON REFERS TO JETTISON OF MISSILE LAUNCHER COMBINATION. CONFIGURATION — GEAR UP AND FLAPS UP.

Figure 5-6. P-3 External Stores (Sheet 2 of 3)

P-3 EXTERNAL STORES (Cont)

KILL STORES

Notes

1. LBA — Maximum airspeed versus altitude without external stores (405 KIAS).
2. Release in straight and level flight.
3. Wing store loading should be symmetrical. Exception: P-3C, station 15 when ESM is carried on station 12.
4. Only those stores shown in this table may be carried on wing stations.
5. For information concerning the wing stores system, refer to NAVAIR 01-75PAC-1.1, as applicable.
6. For information concerning the loading of weapons/stores, refer to P-3 Airborne Weapon/ Store Loading Manual, NAVAIR 01-75PA-75.
7. Any external store may be safely jettisoned between 180 – 200 knots in +1.0g level flight. Individual stores may be jettisoned to their particular jettison limits.
8. Rocket launchers and/or flare pods should not be jettisoned from aircraft if a misfire condition exists. Deselect station for remainder of flight. Only in an emergency shall rocket launcher and/or flare pods be jettisoned from aircraft while in flight.
9. 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.
10. Loading of weapons on BRU-15 racks is not authorized unless AAC-955 has been incorporated.
11. For information on the Maverick Missile System, refer to NAVAIR 01-75PAC-1.1.

Figure 5-6. P-3 External Stores (Sheet 3 of 3)

PART II

Indoctrination

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 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. Cruise control
21. Normal and emergency operating procedures
22. 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 no-boost 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. OMNI airwork

c. ASR, PAR, ILS with glideslope approaches

d. ADF/localizer approaches

e. Airway procedures

f. ICAO

g. ADIZ.

6. Competitive and qualification exercises required by type commander

7. Navigation

a. Navigation systems

b. DR/celestial/electronic.

6.4 FLIGHT CREW 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.

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 OPNAV and type commander training instructions.

Minimum mission commander qualification requirements shall be as follows:

1. Completion of all requirements for PPC or 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.

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 shall be in accordance with OPNAVINST 3710.7.

   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. 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)

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 that 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 that 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 that 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 that conditions of flight are understood by noncrew personnel, that all personnel have been assigned a ditching station and individual survival equipment, and that 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 enroute.

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.

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, enroute, 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.

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, FOD, and fluid leaks and air multiplier blades free of visible scratches or scoring.

WARNING

All aircrew and maintenance personnel should minimize their exposure to the airflow multiplier when ground air is on. This should include performing exterior preflight inspections in the vicinity of the airflow multiplier prior to turning on ground air.

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.

3. Remove pitot, TAS, and AOA probe covers.

4. Connect battery.

5. Check APU 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 flap position.

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 (P-3C).

7.5.2.2 Interior

1. Check FLIR turret control panel (SS3 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. IFF/ 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.

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.

7.5.2.4 APU Limits

APU LIMITS		
EGT	GTCP-95-2	GTCP-92-3
Maximum Peak	715 °C	704 °C
Maximum Peak (10 seconds)	710 °C	
Maximum Continuous	688 °C	649 °C
RPM	98 to 102 percent	98 to 102 percent
RPM Maximum	106 percent	106 percent

1 Refer to squadron standard operating procedures.

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 air-conditioning programmers, located on the air-conditioning panel overhead in the flight station, to the manual mode. Actuate the ground air-conditioning switch; observe an increase in EGT and a spread on the I/D needles of the pressure gauges.

Note

The temperature controller index mark must be placed in a position closely corresponding to actual temperature to prevent temperature cycling.

2. Allow the cabin temperature to stabilize prior to selecting automode.

WARNING

All aircrew and maintenance personnel should minimize their exposure to the airflow multiplier when ground air is on. This should include performing exterior preflight inspections in the vicinity of the airflow multiplier prior to turning on ground air.

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.
- 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.
- 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.

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.[1]

5. Disconnect the battery and install the covers.

7.6 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 that the smoke mask and oxygen bottle couplings are fully engaged.

4. Check mask and hose for cracks, contaminants, and exposed ICS wires.

WARNING

Ensure that any smoke mask containing exposed ICS wires is not plugged into the ICS system.

5. Regulator switch positions:

a. Supply lever — ON.

b. Diluter lever — 100-percent 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-percent OXYGEN.

c. Supply lever — OFF.

12. Leave smoke mask and bottle coupled for stowage.

Note

Upon stowing the portable oxygen bottle, ensure that the supply valve is closed and any residual oxygen in the regulator has been bled off.

7.7 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

1 Refer to squadron standard operating procedures.

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 that the bomb bay door area remains clear.

Opening the bomb bay doors:

1. Ground air — SECURED (bomb bay operator).

2. Bomb bay area clear of personnel and equipment — VERIFIED (outside observer).

3. 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.

4. Bomb bay switch agrees with position of doors — VERIFIED (bomb bay operator).

5. Hydraulic pumps No. 1, or No. 1A, and No. 2 — ON (bomb bay operator).

6. Indicate that hydraulic pumps No. 1, or No. 1A, and No. 2 are on (bomb bay operator).

7. Request bomb bay doors open (outside observer).

8. Bomb bay switch — OPEN (bomb bay operator).

If the bomb bay doors fail to open:

9. 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:

10. Request hydraulic pumps No. 1, No. 1A, and No. 2 off (outside observer).

11. Hydraulic pumps No. 1, No. 1A, and No. 2 — OFF (bomb bay operator).

12. Indicate that hydraulic pumps No. 1, No. 1A, and No. 2 are off (bomb bay operator).

13. 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:

14. Request installation of safety pin (outside observer).

15. Safety pin and cable — INSTALLED/TAUT (outside observer).

16. Indicate safety pin installed and cable taut (outside observer).

17. Ground air — AS REQUIRED (bomb bay operator).

Closing the bomb bay doors:

1. Ground air — SECURED (bomb bay operator).

2. 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.

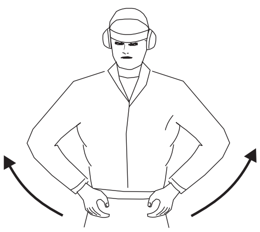
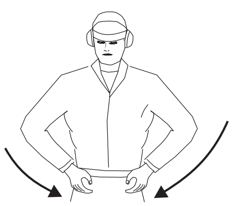
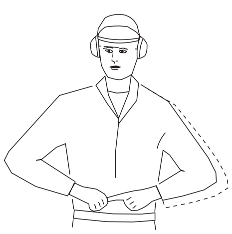
SIGNAL			
DAY	NIGHT	MEANING	RESPONSE
1. Outside observer: Body bent forward at the waist, hands held with finger-tips touching in front of body and elbows bent at approxi-mately 45°, then arms swing downward and outward. 	Same as day signal with addition of wands.	Bomb bay operator: Open bomb bay doors.	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 finger-tips touch in front of the body with elbows bent at approxi-mately 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)

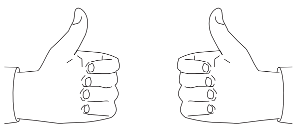
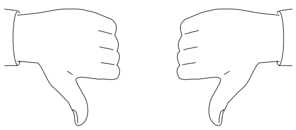
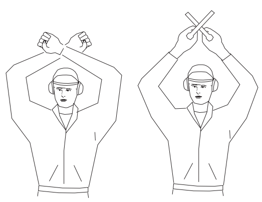
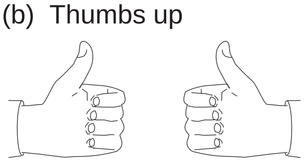
SIGNAL			
DAY	NIGHT	MEANING	RESPONSE
4. Outside observer: Give pilot: (a) Thumbs up  (b) Thumbs down 	 (a) Vertical sweep with RED-banded wand. (b) Horizontal sweep with RED-banded wand.	Bomb bay operator: (a) Bomb bay door safety pin installed, cable taut. (b) Bomb bay door in an unsafe position.	Bomb bay operator: (a) Acknowledge with similar signal. (b) Acknowledge with similar signal.
5. Outside observer: Crossed arms over head, fists clenched. 	 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)

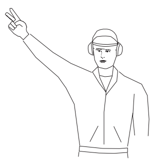
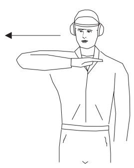
SIGNAL			
DAY	NIGHT	MEANING	RESPONSE
7. Outside observer: Give bomb bay operator:		Bomb bay operator:	Bomb bay operator:
(a) A one and two signal with fingers. 	(a) Flash one wand once quickly, then flash twice quickly with the other wand.	Secure No. 1, No. 1a, and No. 2 hydraulic pumps.	Give day signal 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)

3. Bomb bay safety pin access door open/safety pin installed — VERIFIED (outside observer).
4. Bomb bay switch agrees with position of doors — VERIFIED (bomb bay operator).
5. Hydraulic pumps No. 1, No. 1A, and No. 2 — OFF (bomb bay operator).
6. Indicate that hydraulic pumps No. 1, No. 1A, and No. 2 are off (bomb bay operator).
7. 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:

8. Request removal of bomb bay door safety pin (outside observer).
9. Bomb bay door safety pin/access door — REMOVE/CLOSE (outside observer).

10. Request hydraulic pumps No. 1, or No. 1A, and No. 2 on (outside observer).

11. Hydraulic pumps No. 1, or No. 1A, and No. 2 — ON (bomb bay operator).

12. 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:

13. Request bomb bay doors closed (outside observer).

14. Bomb bay switch — CLOSED (bomb bay operator).

If the bomb bay doors fail to close:

15. 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:

16. Indicate doors closed and procedure completed (outside observer).

17. Ground air — As required (bomb bay operator). ■

7.8 NORMAL AND EMERGENCY CHECKLISTS

The P-3C 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.

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 AND IGNITION SWITCHES . . . . AS REQUIRED (FE)
8. RPM SWITCHES . . . . SET (FE)
9. FIRE DETECTORS . . . . CHECKED (FE)
10. TD SWITCHES . . . . CYCLED (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, ASA-66 DISPLAY . . . . OFF CLOSED, SECURED (P)
16. RADAR, IRDS, COMPUTER . . . . OFF, RETRACTED OFF, OFF (CABIN)
17. FLAPS . . . . AS DESIRED (CP)
18. CHOCKS . . . . AS DESIRED (P)
19. GROSS WEIGHT & CG . . . . ____LB,CG (FE)
20. TAC CREW CHECKLIST . . . . COMPLETED (TC)
21. ANTICOLLISION LIGHT . . . . ON (FE)
22. DOORS & HATCHES . . . . CLOSED (FE)

AFTER START

1. ENGINE START SELECTOR . . . . OFF (FE)
2. BLEED AIR, FUSELAGE SHUTOFF VALVES. . . AS REQUIRED (FE)
3. HYDRAULIC PANEL . . . . SET (FE)
4. DOPPLER, ESM, RADAR, MISSION EQUIPMENT . . . . AS REQUIRED (CP, TC)
5. IFF . . . . STANDBY (CP)
6. FUEL TRANSFER . . . . AS REQUIRED (FE)
7. OIL TANK SHUTOFF VALVE CKT BKRS . . . . OUT (FE)

TAKEOFF

1. SET CONDITION V . . . . (CP)
2. BRAKES . . . . CHECKED (P)
3. TURN INDICATORS, COMPASSES . . . . CHECKED (P, CP)
4. ALTIMETERS . . . . SET (P, CP, FE)
5. SYNC SYSTEM . . . . AS REQUIRED (FE)
6. FUEL GOV CHECK SWITCHES . . . . NORMAL (FE)
7. AUTOFEATHERING . . . . AS DESIRED (P, FE)
8. TRIM TABS . . . . SET (P, CP)
9. FLIGHT CONTROLS . . . . CHECKED (P)
10. APU, DOORS LIGHT . . . . OFF, OUT (FE)
11. RADIOS, HSIs . . . . SET (P, CP)
12. REPORT CONDITION V . . . . (CABIN)
13. RPM . . . . NORMAL (FE)
14. ELECTRICAL PANEL . . . . CHECKED (FE)
15. HARNESS . . . . SET (P, CP, FE)
16. ICE CONTROL PANEL . . . . SET (FE)
17. IFF . . . . SET (CP)
18. FLAPS . . . . TAKEOFF (P, CP)
19. OIL COOLERS . . . . SET (FE)
20. 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 . . . . SHUTDOWN (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 . . . . 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/OFFSTATION

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 AND SEARCH POWER . . . . AS REQUIRED (P)
7. IRDS, MISSION EQUIPMENT . . . . AS REQUIRED (CREW)
8. RAWS AC CKT BREAKERS (4000 FT) . . . . . . AS REQUIRED (FE)
9. WHEEL WARNING CKT BREAKER . . . . SET (FE)

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 . . . . AS REQUIRED (FE)
6. RADIOS, HSIs, FDS . . . . SET (P, CP, NC)

LANDING

1. REPORT CONDITION V . . . . (CABIN)
2. FLAPS . . . . AS DESIRED (CP)
3. LANDING GEAR . . . . DOWN AND DETENT (P, CP, FE)
4. BRAKES . . . . CHECKED (P)
5. HARNESS . . . . SET (P, CP, FE)

AFTER LANDING

1. CREW (FROM DITCH STA) . . . . RELEASED (P)
2. LIGHTS . . . . AS REQUIRED (FE)
3. WX RADAR . . . . STANDBY (CP)
4. IFF . . . . AS REQUIRED (CP)
5. OIL COOLERS . . . . SET (FE)
6. FLAPS . . . . AS DESIRED (CP)
7. FUEL BOOST PUMPS . . . . OFF (FE)
8. SYNC SYSTEM . . . . OFF (FE)
9. APU . . . . AS REQUIRED (FE)

SECURE

1. PARKING BRAKES . . . . SET (P)
2. WINDSHIELD, PITOT, AOA HEAT . . . . OFF(FE)
3. HYD PUMPS 1 AND 2 . . . . OFF (FE)
4. OIL COOLERS . . . . LESS THAN 100% (FE)
5. MISSION EQUIPMENT/TAS HEAT . . . . SECURED (CP, TC)
6. ENGINES . . . . SHUT DOWN (FE)
7. HYD PUMP 1A . . . . OFF (FE)
8. UTILITY LIGHTS . . . . OFF (P, CP)
9. START SELECTOR . . . . OFF (FE)
10. RADIOS, INERTIALS . . . . AS REQUIRED (P, CP)
11. SEAC/APN141 CB . . . . OUT (FE)
12. OIL TANK SHUTOFF VALVE CKT BKRS . . . . IN (FE)
13. ANTICOLLISION LIGHT . . . . AS REQUIRED (FE)
14. CHOCKS . . . . AS REQUIRED (P)
15. APU . . . . AS REQUIRED (FE)

Note: Boxed and shaded 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 AND BOOST PUMPS . . . . . CHECKED (FE)
4. PROPELLER . . . . FEATHERED (P, CP, FE)
5. OIL TANK SHUTOFF VALVE CIRCUIT BREAKERS . . . . 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 . . . . AS DESIRED (FE)
11. SYNC SERVO (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 BREAKERS . . . . 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 BURN WHEEL) . . . . NORMAL (FE)
4. POWER (ENG OVER BURN WHEEL) . . . . APPROX 1000 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 AND 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. LOITERED ENGINES . . . . RESTART (P, CP, FE)

IF FIRE SOURCE IS NOT DETERMINED:

5. BUS A . . . . OFF (FE)
6. BOOST LEVERS . . . . PULL (FE)
7. BUS B . . . . OFF (FE)
8. GENERATORS 2 AND 3 . . . . OFF (FE)
9. LEFT OR RIGHT EDC . . . . DUMP (FE)
10. EMERGENCY DESCENT . . . . AS REQUIRED (P)
11. REMAINING EDC . . . . DUMP (FE)
12. EMERGENCY TRANSMISSION. . . . . . AS REQUIRED (CP)
13. ESS BUS . . . . OFF (FE)

IF FIRE PERSISTS:

14. GENERATOR 4 . . . . OFF (FE)

SMOKE OR FUME ELIMINATION

1. CABIN EXHAUST FAN . . . . 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:

5. FREEFALL CHUTE . . . . OPEN (OBS)
6. OVERHEAD SMOKE REMOVAL DOOR . . . . . . OPEN (FE)
7. REDUCE AIRSPEED (170 KNOTS MAX) . . . . (P)
8. STARBOARD EMERGENCY EXIT . . . . OPEN (OBS)

RESTORING ELECTRICAL POWER

1. OXYGEN SELECTORS . . . . OFF (P, CP, FE)
2. AFFECTED EQUIPMENT . . . . DISCONNECT (FE)
3. ELECTRICAL LOAD . . . . REDUCE TO MINIMUM (FE)
4. SYNC SERVOS . . . . AS REQUIRED (FE)
5. GENERATORS (ONE AT A TIME) . . . . ON (FE)
6. BUS SWITCHES (ONE AT A TIME) . . . . ON (FE)
7. ELECTRICAL LOAD . . . . . RESTORE AS REQUIRED (FE)
8. START SELECTOR . . . . OFF (FE)
9. CABIN EXHAUST FAN . . . . ON (FE)
10. SYNC SYSTEM . . . . SET (FE)

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 that 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 found in current NAVAIR directives should be performed only when the use of these systems is anticipated.)

WARNING

- If AFC-496 has not been incorporated, the safety lock lever and safety pin are the only ground safety mechanism provided. Pulling the lever and inserting the safety pin locks the hydraulic control valve, thereby preventing operation of the bomb bay doors.

- Ensure that 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 that all hydraulic pumps are secured, the bomb bay safety lock access door is open, the safety pin is installed, and that 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.

WARNING

- 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.

- All aircrew and maintenance personnel should minimize their exposure to the airflow multiplier when ground air is on. This should include performing exterior preflight inspections in the vicinity of the airflow multiplier prior to turning on ground air.

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 — CYCLE (5 seconds) (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. Armament panel, ASA-66 display — OFF, CLOSED, SECURED (P).

Note

Visually ensure the jettison switch is positioned to OFF, bomb bay doors are closed, and pilot display is secured.

16. Radar, IRDS, Computer — OFF, RETRACTED OFF, OFF (Cabin).

CAUTION

Ensure IRDS EXTEND/RETRACT switch is OFF.

17. Flaps — AS DESIRED (CP).

†18. Chocks — AS DESIRED (P).

19. Gross weight and cg — LB/CG (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 that 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.

Note

When an engine is to be turned up for maintenance, use the Maintenance Instruction Manual turn-up 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 that a positive radio check is obtained with ground control/tower and that 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 #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 ground crew 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.

- 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 that 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. Be prepared to pull out the starter button immediately if it does not automatically pop out by 64-percent RPM. 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), it 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.

Between 57 and 64 percent RPM, the starter button pops out; if not, pull it out. If the starter button pops out below 57 percent, the start may be continued unless stagnation occurs. The first-time occurrence of premature starter disengagement may indicate a starter engagement mechanism malfunction. Such a malfunction may preclude any subsequent starts.

CAUTION

Note the bleed-air manifold pressure immediately prior to pressing the starter button. When the button pops out between 57 and 64 percent RPM, 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. 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. On initial start, if peak TIT is below 750 °C, discontinue start and call for maintenance. If peak TIT is between 750 °C and 760 °C, continue start and record (maintenance action is required prior to next flight). If peak TIT is between 830 and 850 °C, continue start but record overtemperature. If peak is above 850 °C, discontinue start, record, and restart. If this happens a second time, discontinue start and call maintenance personnel. If 965 °C is exceeded, an overtemperature inspection is required prior to flight.

CAUTION

Cold starts below 750 °C can cause excess start time and turbine failure due to downstream burning.

4. Engine speed stagnates or begins to decay.
5. Engine fails to light-off by 33-percent RPM or maximum starter motoring RPM, whichever occurs first.

6. There is no oil pressure indication at 35-percent RPM for either the reduction gear or the power unit.

7. There is fuel spewing from the nacelle drain.

8. Torching (visible burning in the exhaust nozzle) or excessive smoke is observed. If torching lasts longer than 3 seconds, maintenance action is required.

9. Abnormal vibration is noted.

10. 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. The motoring-over procedure should then 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.

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. Doppler, ESM, radar, mission equipment — AS REQUIRED (CP, TC).

WARNING

ALE-39 CMD SAFE/ARM switch should remain SAFE unless takeoff is planned into a threat environment.

CAUTION

- The APN-187 DVARS system must be on anytime the aircraft is taxiing or flying.

- 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).

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.
- ISAR system power shall be on or in standby anytime the aircraft is flying. For all taxi, takeoff, and landing evolutions, the system power shall be in standby.

Note

- Power to the APN-227 DVARS system need not be applied prior to aircraft taxi or while flying.
- ASQ-10 (P-3A/B) power must be on whether or not the equipment has been preflighted or is to be used on the mission.
- ASQ-81 power shall be left off except during compensation or tactical operation.
- Maverick missile control joystick 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).
7. Oil tank shutoff valve circuit breakers — OUT (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.

Full power (within limits of TIT and SHP) 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

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, taxi (when gear is down), and wing and tail 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 engines are running (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 idle 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 that 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.

Note

For aircraft incorporating the solid-state synchrophaser (AFC-473), a governor indexing check at 1,500 SHP is not required.

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).

CAUTION

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 followup is set correctly.

CAUTION

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 that 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).

†5. Sync system — AS REQUIRED (FE).

Note

The SYNC MASTER and SYNC SERVO switches shall be off for takeoff for those aircraft without solid-state sync incorporated (AFC-473). The SYNC MASTER shall be selected OFF and SYNC SERVO switches should be selected to NORMAL for those aircraft with solid-state sync incorporated (AFC-473).

†6. Fuel governor check switches — NORMAL (FE).

7. Autofeathering — AS DESIRED (P, FE).

†8. 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.

9. 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.

10. APU/doors light — OFF/OUT (FE).

11. Radios, HSIs — SET (P, CP).

†12. Report Condition V — (Cabin).

†13. RPM switches — NORMAL (FE).

†14. Electrical panel — CHECKED (FE).

†15. Harness — SET (P, CP, FE).

Note

Harnesses of flight station personnel shall be locked provided all controls can be reached. The inertia reel is designed to lock the harness in a stationary position automatically as a result of inertia forces acting against the reel.

16. Ice control panel — SET (FE).

†17. IFF — SET (CP).

†18. Flaps — TAKEOFF (P, CP).

†19. Oil coolers — SET (FE).

†20. Lights — AS REQUIRED (FE).

8.16 NORMAL TAKEOFF

The flight engineer shall inform the pilot in command of refusal, rotation, V50 (four engine), and V50 (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 (see 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.

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, Emergency Procedures.) 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 that 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 — AS REQUIRED (FE).

CAUTION

If solid-state synchrophaser (AFC-473) is installed, do not operate RESYNC switch unless it is part of governor indexing procedures after component replacement or RPM variations 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

For aircraft with AFC-473 select the SYNC MASTER switch to whichever propeller is closest to 100 percent RPM. If governor indexing is required, refer to paragraph 8.22 for the correct indexing procedure.

6. Lights — AS REQUIRED (FE).

8.22 GOVERNOR INDEXING PROCEDURE

Aircraft may have either the solid-state (AFC-473) or vacuum-tube type synchrophaser incorporated. Each system design necessitates separate operating procedures.

8.22.1 Aircraft without AFC-473. Should governing indexing be required, proceed as follows:

1. SYNC SERVO/SYNC MASTER switches — OFF.
2. SYNC MASTER — SELECT (engine closest to 100 percent).
3. RESYNC switch — Hold to RESYNC.
4. SYNC SERVO switches — Select the three slaves to NORMAL while RESYNC is engaged.

Note

Maintain RESYNC switch at RESYNC approximately 4 seconds after SYNC SERVO switches are positioned at NORMAL.

5. RESYNC — Release to NORMAL.

Note

If the inboard slave is not governing properly at this time, terminate the indexing procedure. Carrying out the remaining steps of this procedure could result in misindexing of all propellers.

6. RESYNC switch — Hold to RESYNC.

7. SYNC MASTER switch — Select other engine as MASTER.

8. SYNC SERVO switch of inboard slave — NORMAL.

Note

Hold RESYNC switch at RESYNC approximately 4 seconds to ensure indexing is complete.

9. RESYNC switch — Release to NORMAL.

10. RESYNC switch — RESYNC and release to NORMAL.

8.22.2 Aircraft with AFC-473. 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 air start 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 Vs). 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. If the power lever can then be advanced, 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 that EEBDs are readily available.

8.25 ENGINE SULFIDATION

The T56-A-14 turbine life can be substantially improved by operations at temperatures less than 1010 °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 MISSION FUEL PLANNING

Mission fuel planning is ultimately the responsibility of the pilot in command. The flight station shall coordinate with the NAVCOMM and compute fuel requirements hourly.

8.27 FUEL LOG

A fuel log shall be maintained by the flight engineer for all flights scheduled to operate in excess of 500 nm from the nearest suitable landing field, or flights scheduled for more than 6 hours duration (see 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.

8.28 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.
- Before landing:
    1. Disconnect altitude hold for descent and approach.
    2. Disconnect AFCS prior to approach if only single-channel operation is available.
    3. Disconnect AFCS prior to final approach.
- Engine(s) inoperative — Approved for one engine out same as four engines operating. Approved for loiter using two engines symmetrically.

8.28.1 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 that 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.

8.28.1.1 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.

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	
△						△ 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)

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.

8.29 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 that 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.

Note

P-3A/B automatic pilot heading hold will be unstable if the AHRS mode selector is in COMPASS position and the pilot HSI is in AHRS. The heading hold is also unstable if the pilot HSI is in INERTIAL and the inertial mode selector is in the COMPASS position.

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 automatic pilot 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 two-engine loiter operations, single-engine/generator contingencies should be discussed. Determine the single-engine rate of descent from Chapter 31. Brief crewmembers to immediately secure all nonessential equipment in the event of an engine failure. Ensure GEN 4 AUX CONTROL, GEN 4 TRANS CONTROL, BUS A AND BUS B CONTROL circuit breakers are set.

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 busses 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 air start 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 inflight restart, propeller blade angle movement should be minimized for a 10-minute warmup period to ensure an adequate propeller fluid temperature.

The following table 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 one and four 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

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 — SHUTDOWN (P, CP, FE).

Note

If the propeller fails to feather during loiter shutdown, perform the Propeller Fails to Feather Procedures, paragraph 15.11.6. If the propeller is successfully feathered, complete the Loiter Shutdown checklist. If not, complete the Emergency Shutdown Procedure, paragraph 15.4.1.

6. Check feather button light — OUT (FE).
7. Complete Restart checklist through item 9 (CP).

Note

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 landing, takeoff, and 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 air start, 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 that 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 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. If the system operates normally after investigating, continue the restart procedure. If the system does not operate normally, leave prop feather control circuit breaker out, and complete the Emergency Shutdown procedure.

CAUTION

If blade angle/rotation is observed after pushing PCO, pull the E-handle.

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 the feather valve light remains on steady after RPM has stabilized during air start, a propeller fluid leakage may exist. However, if all other indications are normal, a light-off should be attempted. Special attention should be given to possible malfunctions occurring after light-off, and applicable NATOPS procedures should be followed.

- 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 air start.

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.

- 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).

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 and secure the engine. If desired, an additional attempt may be made to start the engine using the same procedure as outlined above.

6. Feather button — Release at light-off (FE).

Standby to shutdown engine if any of the following occurs:

a. No oil pressure indication prior to reaching 35-percent RPM.

b. TIT exceeds 850°.

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 in 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 assure 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, NAV/COMM, 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. IRDS/Mission equipment — AS REQUIRED (CREW). Mission equipment includes Maverick, optical systems, and survivability modifications.
8. RAWS AC circuit breakers (at 4,000 feet) — AS REQUIRED (FE).
9. Wheel warning circuit breaker — SET (FE).

8.35 TERRAIN AVOIDANCE

The following procedures are intended to enhance crew awareness of terrain avoidance. It is the responsibility of all crewmembers to actively participate in the safe conduct of every mission. The following procedures shall be adhered to on all operational and crew training flights when the aircraft is within 30 nm of land.

1. The patrol plane pilot, NAV/COMM, and radar operator shall obtain 1:500,000 or 1:1,000,000 scale charts with suitable obstacle depiction and FLIP en route charts for use by the flight station and radar operator.
2. The patrol plane pilot, NAV/COMM, and radar operator shall coordinate and plot suitable ADF, VOR, TACAN, and radar fixing sites or features.

3. On radar run-ins, the flight station shall ensure that the radar operator conducts only offset run-ins, taking into consideration weather and visibility.

Note

MOSA is defined as 1,000 feet above the highest obstacle within 30 nm of the aircraft.

4. When the aircraft is operating within 30 nm of land and below MOSA, the NAV/COMM shall plot aircraft DR every 15 minutes and fix aircraft position every 30 minutes. The radar shall become the primary aid for obstacle avoidance. As directed by the pilot, the NAV/COMM and radar operator shall brief the flight station on the aircraft position in relation to closest obstacles and suitable safe headings. Radar fixing shall be performed on all hazards by the radar operator.

   a. When operating below MOSA, ICS MOSA updates 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 DR interval.

WARNING

- To ensure crew safety, a 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. The flight station shall immediately turn to the safe heading and climb above MOSA.

- The calls shall include MOSA altitude, range/bearing to 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, NAV/COMM, and SS3 prior to MOSA penetration. All MOSA reports shall be acknowledged by the flight station.

- The NAV/COMM shall make all required MOSA reports with SS3 verifying with radar.

Note

- The above procedures may be modified at the discretion of the pilot in command when, in his judgment, the safety of the aircraft can be maintained visually in daylight VMC conditions.

- In the event of navigation system uncertainty or navigation system failure in marginal VMC, night, or IMC conditions, 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 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 aircraft commander if a mission commander is not assigned.

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. See Figure 8-2 for the landing pattern.

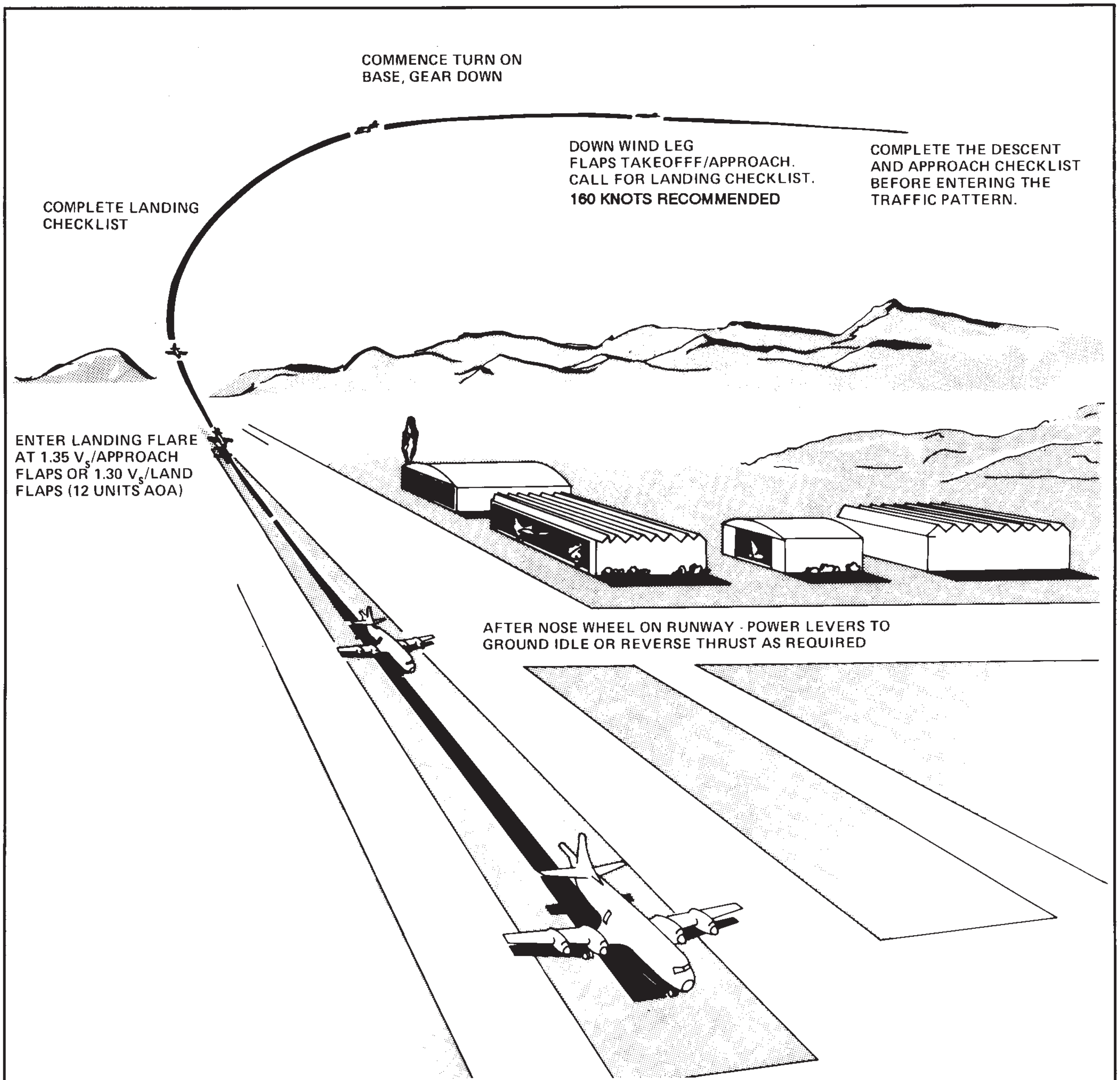
WARNING

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 that 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.



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.																	

Figure 8-2. Landing Pattern

Note

- 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.

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 — AS REQUIRED (FE).

Note

The SYNC MASTER and SYNC SERVO switches shall be OFF for approach and landing for those aircraft without solid-state SYNC incorporated (AFC-473). The SYNC MASTER shall be selected OFF, and SYNC SERVO switches should remain in NORMAL for those aircraft with solid-state SYNC incorporated (AFC-473).

6. Radios, HSIs, and FDS — SET (P, CP, NC).

8.36.2 Landing

Note

Items marked with a dagger (†) are included in the abbreviated checklist.

1. Report Condition V — (Cabin).

†2. Flaps — AS DESIRED (CP).

Note

Monitor AOA after flap selection. Failure of the flap drive gearbox and/or flap extension to less than the desired position will result in abnormally high AOA readings and reduced stall margin during approach to landing.

†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).

Note

Flight station personnel harnesses shall be locked provided all controls can be reached. The inertia reel is designed to lock the harness in a stationary position automatically as a result of inertia forces acting against the reel.

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. Do not move power levers past FLIGHT IDLE until below 135 knots. Reverse thrust is most effective at speeds above 80 knots and should, therefore, 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.

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 Landing on Snow-Covered Runways. Since brakes are relatively ineffective on slippery runways, it is recommended that reverse thrust be used during landings under such conditions. Differential reverse thrust can be used to an advantage. If loose snow is present on the runway, the use of high power in reverse at low speeds (approximately 50 knots) may result in a cloud of snow ahead of the aircraft, tending to obscure forward vision.

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.)

8.36.5 Crosswind Landings. The maximum cross- wind 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.

8.36.6 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.

Propeller braking is most effective at high speeds, while wheelbrakes are most effective at low speeds. The importance of the timely use of propeller braking may be seen by referring to Figure 8-3.

Use of the FLIGHT IDLE power lever position is not an effective means of braking. As illustrated in Figure 8-3, 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.

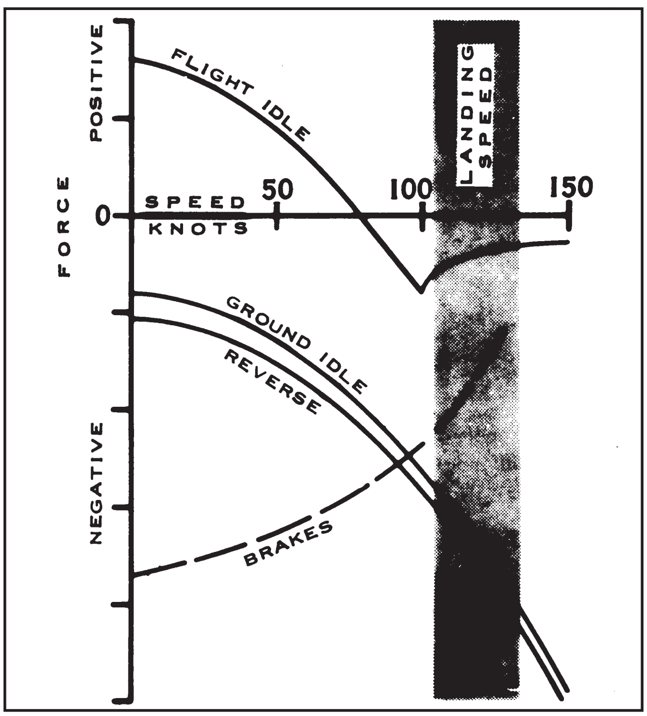


Figure 8-3. Propeller and Wheelbrake Efficiency

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 cool-down. 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.

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 landing 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.

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 down shift 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 (P).
†2. Lights — AS REQUIRED (FE).
3. Weather Radar — STANDBY (CP).
†4. IFF — AS REQUIRED (CP).
†5. Oil coolers — SET (FE).
†6. Flaps — AS DESIRED (CP).
7. Fuel boost pumps — OFF (FE).
8. Sync system — OFF (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. Hydraulic pumps Nos. 1 and 2 — OFF (FE).
†4. Oil coolers — LESS THAN 100 PERCENT (FE).
5. Mission equipment/TAS heat — SECURED (CP, TC).

Note

- MAD, ISAR, and Doppler power should be turned off prior to placing the No. 2 engine in LOW RPM prior to shutdown.
- Ensure ALE-39 CMD SAFE/ARM switch is SAFE.

†6. 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 shutdown, 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 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.

7. Hydraulic pump 1A — OFF (FE).
8. Utility lights — OFF (P, CP).

9. Start selector — OFF (FE).

10. Radios, inertials — AS REQUIRED (P, CP).

11. SEAC/APN-141 CBs — OUT (FE).

12. Oil tank shutoff valve CBs — IN (FE).

†13. Anticollision lights — AS REQUIRED (FE).

†14. Chocks — AS REQUIRED (P).

15. APU — AS REQUIRED (FE).

CAUTION

AHRS-equipped aircraft should be moved within 5 minutes after power is removed. If 5 minutes have elapsed, the aircraft should remain stationary for an additional 25 minutes to enable the AHRS gyros to run down without damage.

Leave the control boosters on. This will dampen movement of the surfaces during wind gusts.

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 VFR conditions exist at the point of takeoff and landing or when alternate landing areas are reported as having VFR conditions.

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. See 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 assure 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 that 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 lift-off. 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 lift-off if an additional engine failed near 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 lift-off.

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 in

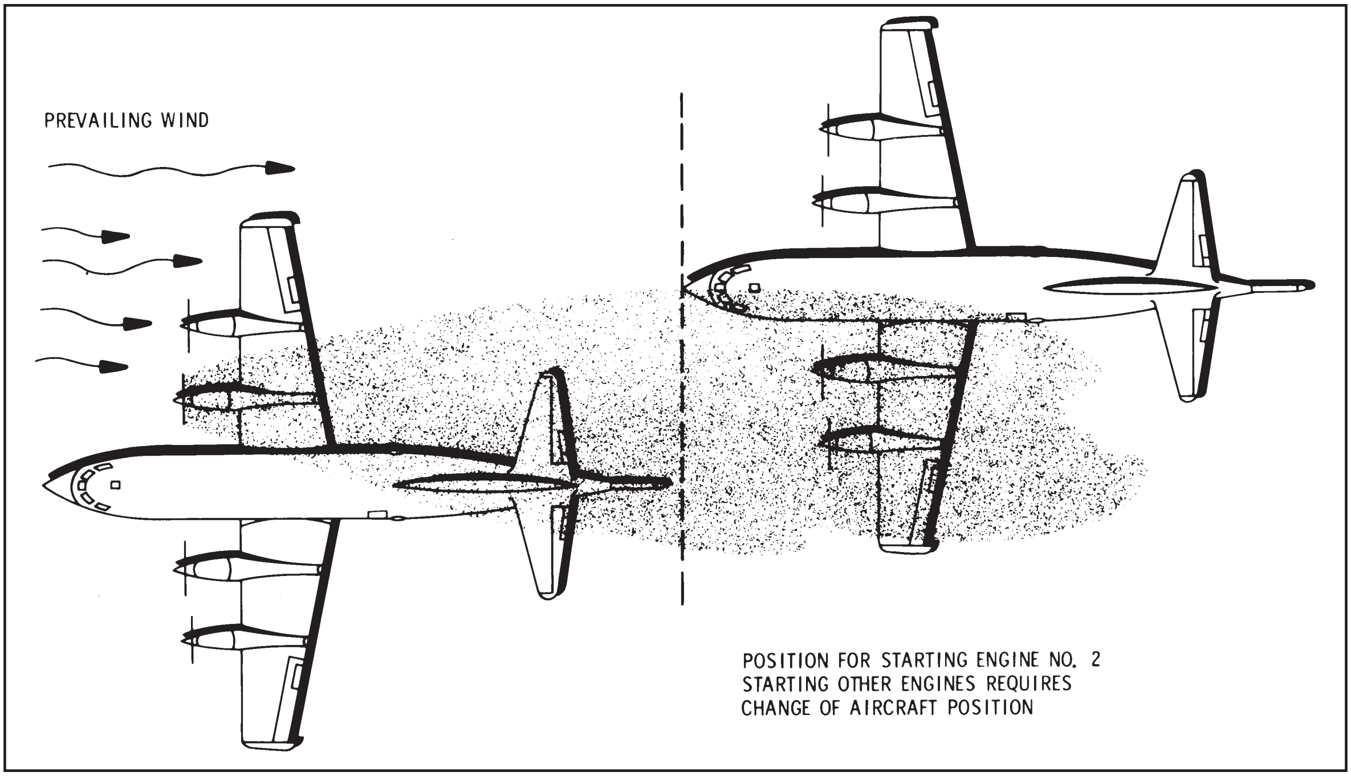


Figure 8-4. Aircraft Position for Static Start

most respects, 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 8-4. 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-3C 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.

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 firetruck 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

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 19-1. 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. These kits should be fabricated in accordance with Aircrew Systems Change No. 92 of February 1967 and subsequent changes. 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 air crewmen 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 and determine the direction of the surface wind. Depressurize the aircraft and order preparation for the SAR drop. Coordination between the pilot, dropmaster, and crewmembers dropping the SAR kit is critical. The following procedures will ensure successful SAR kit deployment.

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 8-5. 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.

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 free fall 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.

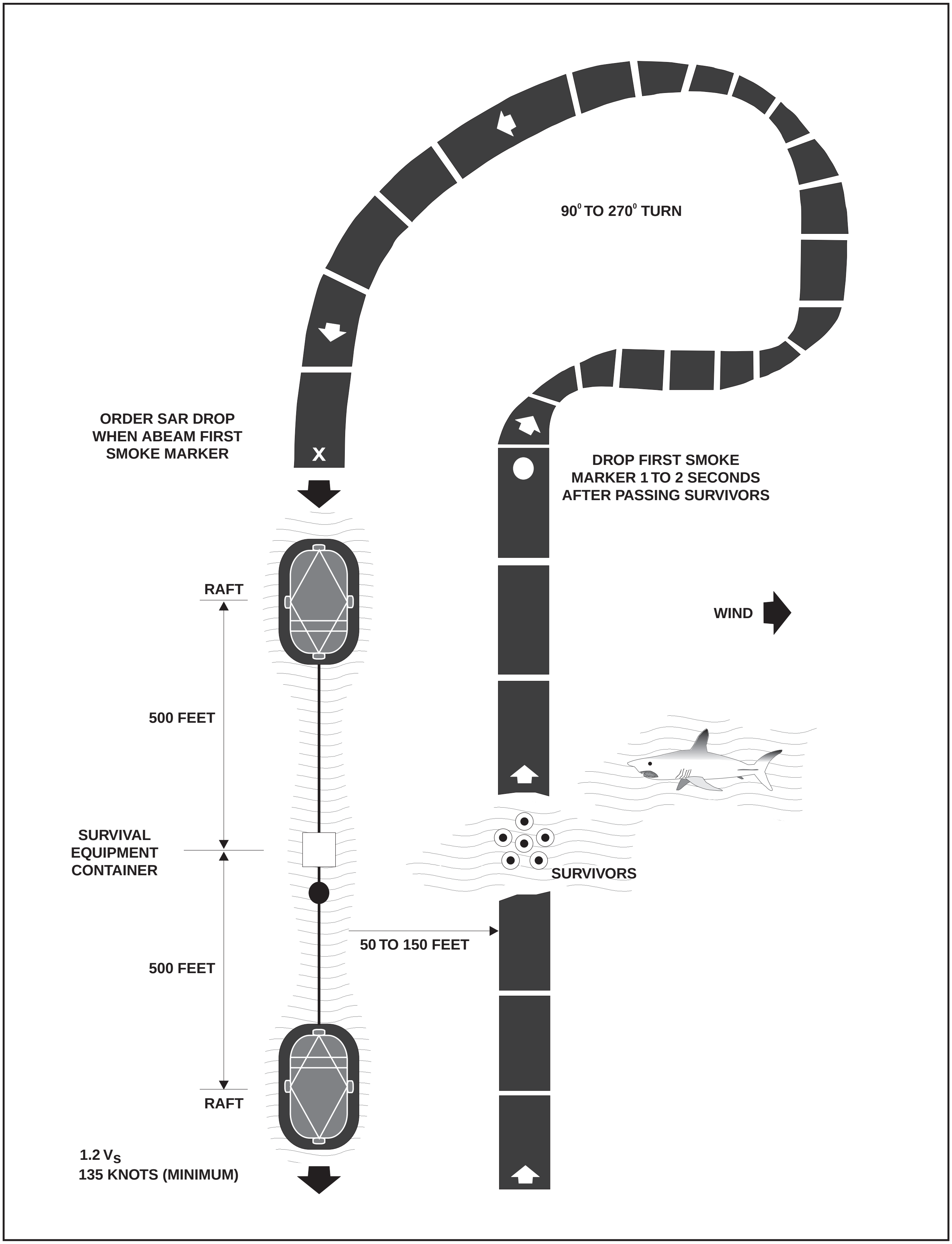


Figure 8-5. SAR Drop-Area Flightpath

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 plane-side 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 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 MSL, the pilot at controls shall utilize oxygen. Other crewmembers should utilize oxygen as appropriate in accordance with OPNAVINST 3710.

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.

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.

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 (P-3C) or chute 4 (P-3A/B) 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 that 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, OPNAVINST 4790.2 (series), 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 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, 5, 7, 8, 12, 13, 19, 21, 22, 23, and 38. Minimum checks required are profiled by the letter A (NAVAIR 01-75PAC- 1F, Part 1).

Note

Steps 22 and 23 are not applicable when an AFC-473 solid-state synchrophaser system is installed and ground checks have been completed using approved test set, or the same engine is removed then reinstalled.

B. After installation or reinstallation of a fuel control, coordinator, or rerigging of mechanical linkage, complete items 1, 3, 4, 5, 7, 13, 19, 21, and 38. 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, 4, 7, 12, 19, 22, 23, and 38. Minimum checks required are profiled by the letter C (NAVAIR 01-75PAC-1F, Part 1).

Note

Steps 22 and 23 are not applicable when an AFC-473 solid-state synchrophaser system is installed and ground checks have been completed using approved test set, or the same propeller and or valve housing is removed then reinstalled.

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, 3, 14, 17, and 18. 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 maintenance: 1, 3, 6, 15, 20, 21, 29, 36, and 37. 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 41 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, 3, 4, 7, 8, 12, and 20.

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 S, 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.

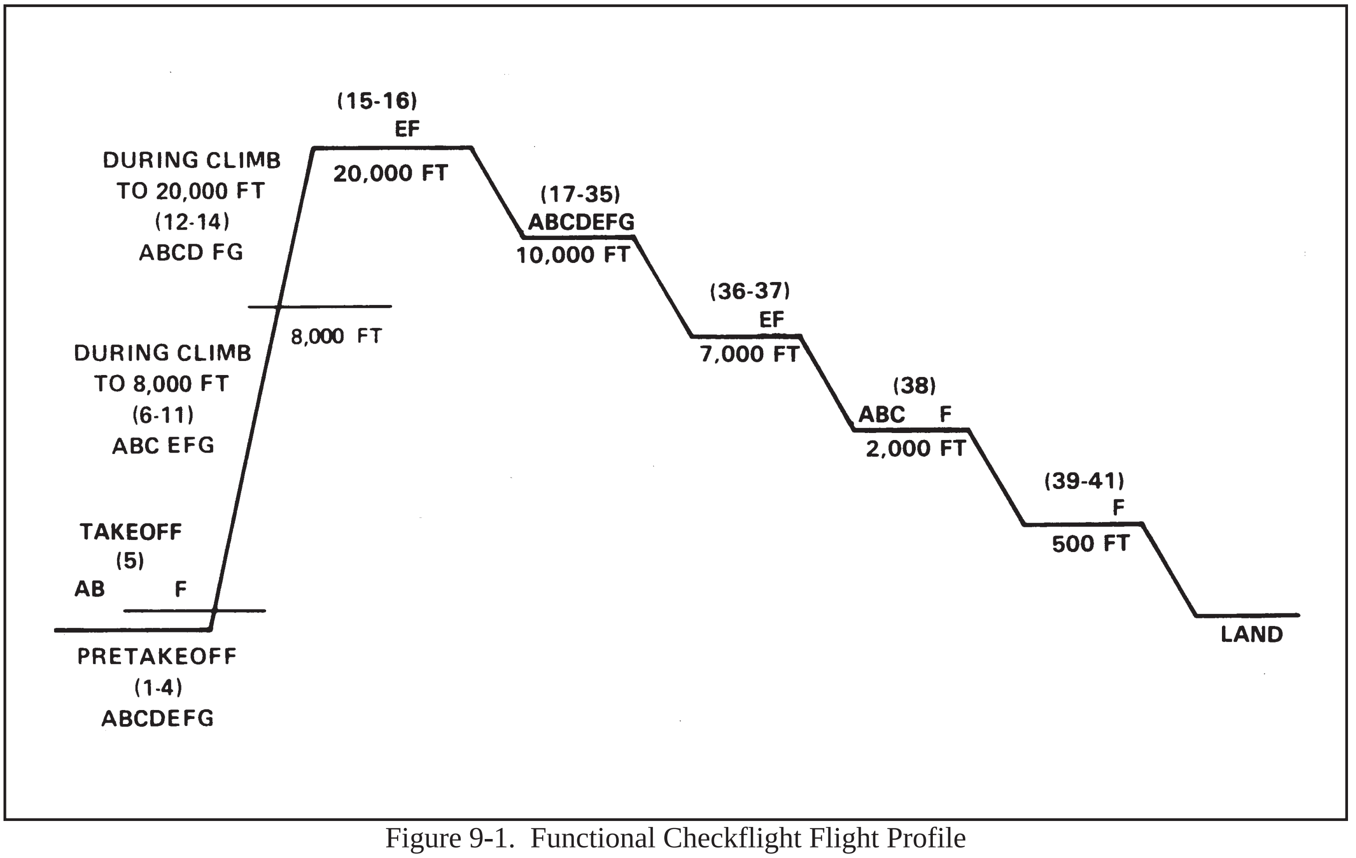


Figure 9-1. Functional Checkflight Flight Profile

F

9.5 CHECKFLIGHT

ABCDEFG

9.5.1 Pretakeoff

1. Preflight and daily checks.

   a. Perform preflight and daily inspection in accordance with current NAVAIR directives.

A C F

2. RPM and phase indicator test set and harness installed (P, FE).

WARNING

The RPM and phase indicator set must be properly installed and securely stored prior to takeoff.

CAUTION

Ensure that the sync box circuit breakers are pulled anytime the sync box is being removed or installed.

Note

- If the required test equipment is not available, RPM governor and phase angle checks may be omitted until the test set becomes available.

- Preferred test equipment to conduct RPM governor and phase angle checks for aircraft with the solid-state synchrophaser (AFC-473), is the Hamilton Standard AD33480. Vacuum tube type test set (GS3940) may give incorrect readings during these checks. For specific procedures and limits, refer to operating instructions for use of the P-3 synchrophaser test set (AD33480).

ABCDEFG

3. Engine start (FE).

   a. Start engines in accordance with paragraph 8.4.

   b. Record start TIT.

ABC FG

4. Pretakeoff checks (FE).

   a. Perform fuel governor, pitchlock, and reverse SHP check in accordance with paragraph 8.12.

F

Note

The phase angle test set shall not be turned on for takeoffs or landings.

9.5.2 Takeoff

Note

Anytime a propeller overspeed occurs with the RPM and phase indicator test set installed, turn off the power switch prior to taking any corrective action.

AB F — 5. Takeoff power — AS REQUIRED (FE).

9.5.3 During Climb to 8,000 Feet

EF — 6. 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 — 7. NTS check (P, FE).

a. Perform NTS check on engines to be shut down and restarted in accordance with paragraph 8.23.

A FG — 8. 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 — 9. 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.

F — 10. 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.

F

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 11. Indicated airspeed system check (P, CP, NAV).

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 12. 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 +8 seconds.

f. PROP DEICE switch to OFF.

AB F 13. 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.

F

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: 1,007 °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.M

D F 14. 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.

9.5.5 Level at 20,000 Feet

EF 15. 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).

F

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 16. Altimeter check (P, CP).

a. During level cruise flight using pilot altitude as master, compare readings of all altimeters.

LIMIT: 300-foot maximum spread between all altimeters at 20,000 feet and 200-foot maximum spread at 10,000 feet.

9.5.6 Level at 10,000 Feet

D F 17. Trim check (P).

a. Set 250 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.

F

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: one-half inch down, 1 inch up maximum (not both down).

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.

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.

F

(8) Stabilized RPM.

(9) FUEL AND IGNITION switch to ON.

(10) Oil pressure checked.

(11) Oil coolers set.

d. Mechanical feather.

(1) Pull PROP AUTO FEATHER circuit breaker.

(2) Pull PROP FEATHER CONT circuit breaker.

(3) Pull E-handle.

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.

LIMIT: Propeller 0- to 10-percent RPM. NTS/feather valve light on.

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, see step c above.

f. Repeat steps b through e above, as necessary, for remaining propellers or engines.

PROFILE

g. Set NTS/feather valve switch to NTS CHECK position.

h. Governor indexing.

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.

F

LIMIT: WHEELS lights flash and horn sounds as airspeed decreases through 142 ±3 KIAS.

(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.

F

(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 gears are down and locked.

(6) Decrease airspeed — 130 to 135 KIAS.

LIMIT: WHEELS lights and horn do not operate.

A C F 22. Rpm governor check (P, FE).

Note

Propeller SYNC MASTER switch must be in either the No. 2 or 3 position to provide power to the test set. SYNC SERVO switches must be off when checking the mechanical governing RPM. Allow a minimum of 30 minutes in this condition for test before proceeding with check.

a. SYNC SERVO switches to OFF.

b. SYNC MASTER switch to the No. 2 or 3 position.

F

c. Select No. 1 on RPM and phase indicator test set auxiliary selector box.

d. Null tachometer on test set.

e. Note indicated RPM in percent.

f. Note test set indicator RPM in percent.

Note

Mechanical RPM limits are 99.8 to 100.2 but have been expanded in flight because of test set limitations to 99.6 and 100.4, respectively.

g. Repeat steps c, d, e, and f for engine No. 2, 3, and 4.

A C F 23. Phase angle check (P, FE).

a. Aircraft must be flown in a steady state and under nonturbulent conditions.

b. RPM and phase indicator test set to ON.

c. MASTER TRIM knob to 0 (zero).

d. Governor indexing set, with No. 3 as master.

Note

The solid-state lead/lag values are preset and can only be verified. If the values are incorrect, the synchrophaser assembly must be changed.

e. Adjust phase angles for the No. 1, 2, and 4 propellers on phase indicators.

LIMIT: Phase angles — No. 3 master.

Propeller No. 1 — Lag 43°
Propeller No. 2 — Lead 18°
Propeller No. 4 — Lead 12°

f. SYNC MASTER switch to No. 2.

g. Operate RESYNC switch until all RPMs are synchronized.

h. Adjust phase angles for the No. 1, 3, and 4 propellers on phase indicators.

LIMIT: Phase angles — No. 2 master.

Propeller No. 1 — Lead 29°
Propeller No. 3 — Lag 18°
Propeller No. 4 — Lag 6°

F

Note

Hold the RESYNC switch on for 2 seconds and allow phase angle stabilization if any adjustments are made and recheck.

F 24. Windshield heat check (FE).

a. Front windshields:

(1) FRONT WINDSHIELD HEAT (PILOT, 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.

(2) FRONT WINDSHIELD HEAT (PILOT, COPILOT, and CTR) switches to HIGH.

LIMIT: CYCLING lights — CYCLING.

(3) FRONT WINDSHIELD HEAT (PILOT, COPILOT, and 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 25. 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.

F

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 (P-3C).

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.

F 26. Empennage deice system check (FE).

a. Position EMPENNAGE ICE switch to TEST; monitor cycling.

LIMIT: Meter indication in O.K. range. No system fault 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 DE-ICE 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. EMPENNAGE ICE switch to OFF.

F 27. 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 LEFT AND RIGHT WING ICE switches to ON. Observe individual area temperature rise and stabilization. Observe no heat rise in other areas.

F

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; LEFT and RIGHT WING ICE switches to OFF.

LIMIT: Engine bleed-air valve advisory lights out.

F 28. 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.

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.

Note

Repeatedly changing temperature selections will increase the time required for the systems to stabilize in AUTO.

LIMIT: Duct temperatures shall not fluctuate more than ±4 °C after 30 minutes in AUTO mode.

EF 29. Fuel dump check (P, FE).

a. 6,000-foot altitude minimum.

b. Maintain level flight, 140 to 300 KIAS, flaps UP.

F

c. RF emitters, VHF, and IFF interrogator to OFF. HF-1 , HF-2, radar, and IFF transponder to STANDBY; TACAN to REC mode.

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.

F 30. 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 31. 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 (FORWARD OBSERVER) station. 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

F

engaged in seal ring dowel pinholes, rotate transmitter and seal ring to bring indicator to desired indication as listed in step a.

(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 32. Approach index check (P).

a. Check operation of approach dimmer switches on pilot and copilot overhead panel. Leave on full bright.

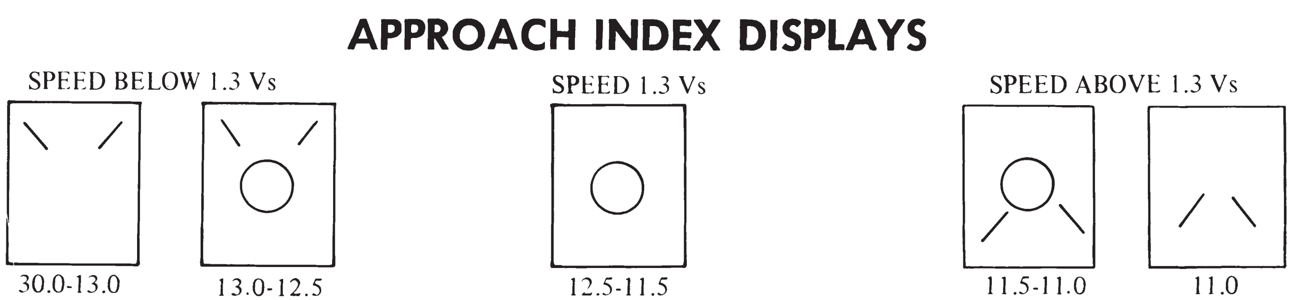
b. Conduct an approach at 1.3 Vs with LAND flaps and gear DOWN (see Figure 9-2).

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 (see Figure 9-2).

d. Decrease speed below 1.3 Vs.



INDEX KIAS

GROSS WT LB	*80,000*	*90,000*	*100,000*	*110,000*
1.3 Vs KIAS	115 ±2	121 ±2	128 ±2	134 ±2

Figure 9-2. Approach Index Displays — Index KIAS

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LIMIT: Nosedown (V) chevron should appear (see Figure 9-2).

e. Gear UP.

LIMIT: Approach index lights extinguish.

F 33. 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.

F

(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.

F

LIMIT: Altitude should not vary more than ±20 feet.

(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.

Note

On aircraft with AVC 1998 incorporated, the autopilot will disengage.

LIMIT: Aircraft recovers reference altitude within ±20 feet.

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°.

F 34. Autopilot check (ASW 31) (P, CP).

F

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.

d. Heading select disengage.

PROFILE

(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.

j. Altitude capture.

(1) Press autopilot disconnect switch to first detent and hold.

F

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 light remains 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 ±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.

F

l. Ground 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 35. Inertial/standby gyro/standby compass check (P, CP).

a. Compass heading (P-3A/B)

AHRS to INERTIAL

LIMIT: ±3°

AHRS/INERTIAL to standby compass

LIMIT: ±5°

(1) Pilot HSI control HDG selector switch to AHRS

(2) Copilot HSI control HDG selector switch to INERTIAL

(3) Check AHRS and INERTIAL sync.

b. Compass heading (P-3C)

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 (MM-4s on P-3A/B).

c. 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.

F

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 (MM-4s on P-3A/B).

9.5.7 Level at 7,000 Feet

EF 36. 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 IN-FLIGHT ARMING switch to ARM.

LIMIT: ARMED light on.

e. APU control switch to START.

LIMIT: DOORS, ARMED, and GEN OFF (APU) lights on. 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.) RPM 100 +3 to –2 percent stabilized, 106 maximum.

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 37 if load monitoring check required.

1. APU INFLIGHT ARMING switch to OFF.

LIMIT: ARMED light out. APU shuts down. DOORS light extinguishes in approximately 1 minute.

F

m. APU control switch to OFF.

EF 37. 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.

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 ±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.

F

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 36, steps l and m).

s. Reset copilot altimeter.

9.5.8 Level at 2,000 Feet

ABC F 38. 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.

Note

If NTS occurs, include in discrepancy: OAT, airspeed, SHP, FF, TIT, start TIT, 1,050 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 39. Radar altimeter/DVARS 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 40. 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.

F

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.

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 41. 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 1. All discrepancies recorded (P, FE).

a. Checkflight checklist completed.

F	
A C F	2. Rpm and phase indicator test set and harness removed (FE).
A C F	3. Reinstall sync box and perform fuel governor, pitchlock, and reverse SHP check in accordance with Chapter 8 of this manual (FE).
F	4. Inspection of AOA transmitter probe completed (FE).

PART IV

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's 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's 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, while 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, while 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 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 airshow, 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. The aircraft wing structure, however, 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. (See paragraph 10.9, Stalls).

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, provide 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 pull-out 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-air ($V_{MC\ AIR}$) for 5° angle of bank toward the operating engines are 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's 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's 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 27-8). For example, in a 60° angle-of-bank, level turn, the apparent weight of the aircraft doubles and the stall speed increases accordingly. The stall buffet, however, 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.

Reference Angle of Attack

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

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 (see Figure 10-1 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 Part XI, Chapter 27, Stall Speed chart text.

10.9.6 Stall Speed Chart Data. The speed for start of stall buffet in all configurations is shown in Figure 10-1. 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.

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

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	17
Maneuver flaps, gear up	1 9	14	149	1 5
Takeoff flaps, gear down	1 0	1	140	154
Land flaps, gear down	1 4	1	1 4	147
137,500 LB GROSS WEIGHT				
Flaps and gear up	14	14	154	170
Maneuver flaps, gear up	1 7	1 9	147	1
Takeoff flaps, gear down	1 8	1 0	1 7	15
Land flaps, gear down	1	1 4	1 1	145
133,500 LB GROSS WEIGHT				
Flaps and gear up	141	144	15	1 8
Maneuver flaps, gear up	1 5	1 7	145	1 0
Takeoff flaps, gear down	1	1 9	1	150
Land flaps, gear down	1 0	1	1 9	14
127,200 LB GROSS WEIGHT				
Flaps and gear up	1 8	141	149	1 5
Maneuver flaps, gear up	1	1 4	14	15
Takeoff flaps, gear down	1	1 5	1	147
Land flaps, gear down	118	1 0	1	140
100,000 LB GROSS WEIGHT				
Flaps and gear up	1	1 4	1	14
Maneuver flaps, gear up	11	118	1 5	1 9
Takeoff flaps, gear down	109	111	118	1 0
Land flaps, gear down	104	10	11	1 4
70,000 LB GROSS WEIGHT				
Flaps and gear up	10	104	110	1
Maneuver flaps, gear up	97	99	104	11
Takeoff flaps, gear down	91	9	98	108
Land flaps, gear down	87	89	94	104

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, Chapter 27, Stall Speed Chart text.

Figure - . irspeed for tart of tall uffet Power ff 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, however, 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 DACM procedures) should be conducted at a moderate aircraft weight and at a normal altitude of 5,000 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 10-2 and 10-3. 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.

The maximum maneuver load factors vary as follows:

Configuration	Symmetric Flight		Roll Maneuver	
	Max	Min	Max	Min
(Up through 135,000 lbs)				
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 lbs)				
Flaps Up	2.5	–0.5	2.0	0.0

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 pull-up or push-over 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

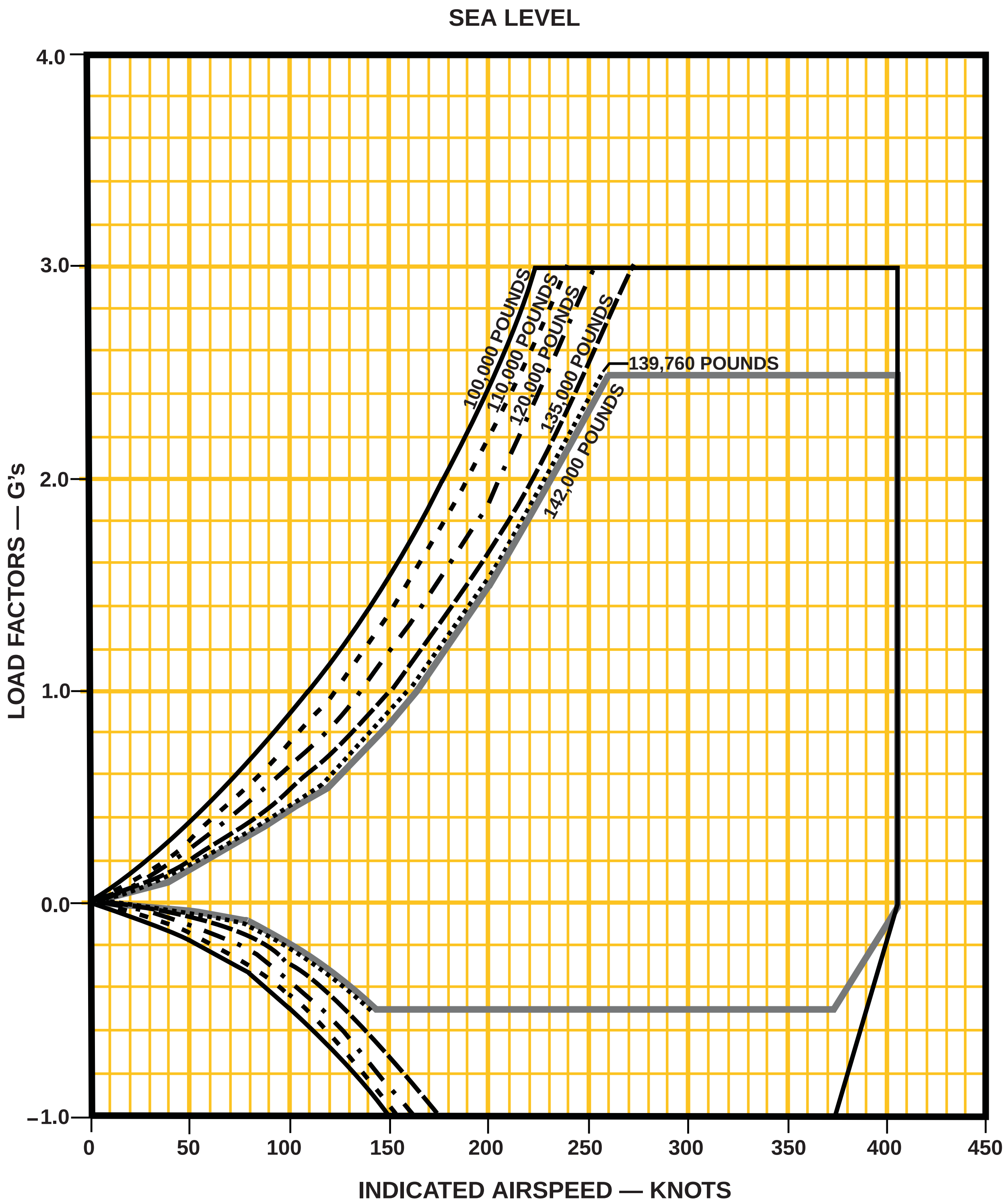


Figure -2. P-3 C perating Flight n elope Flaps p, ear p

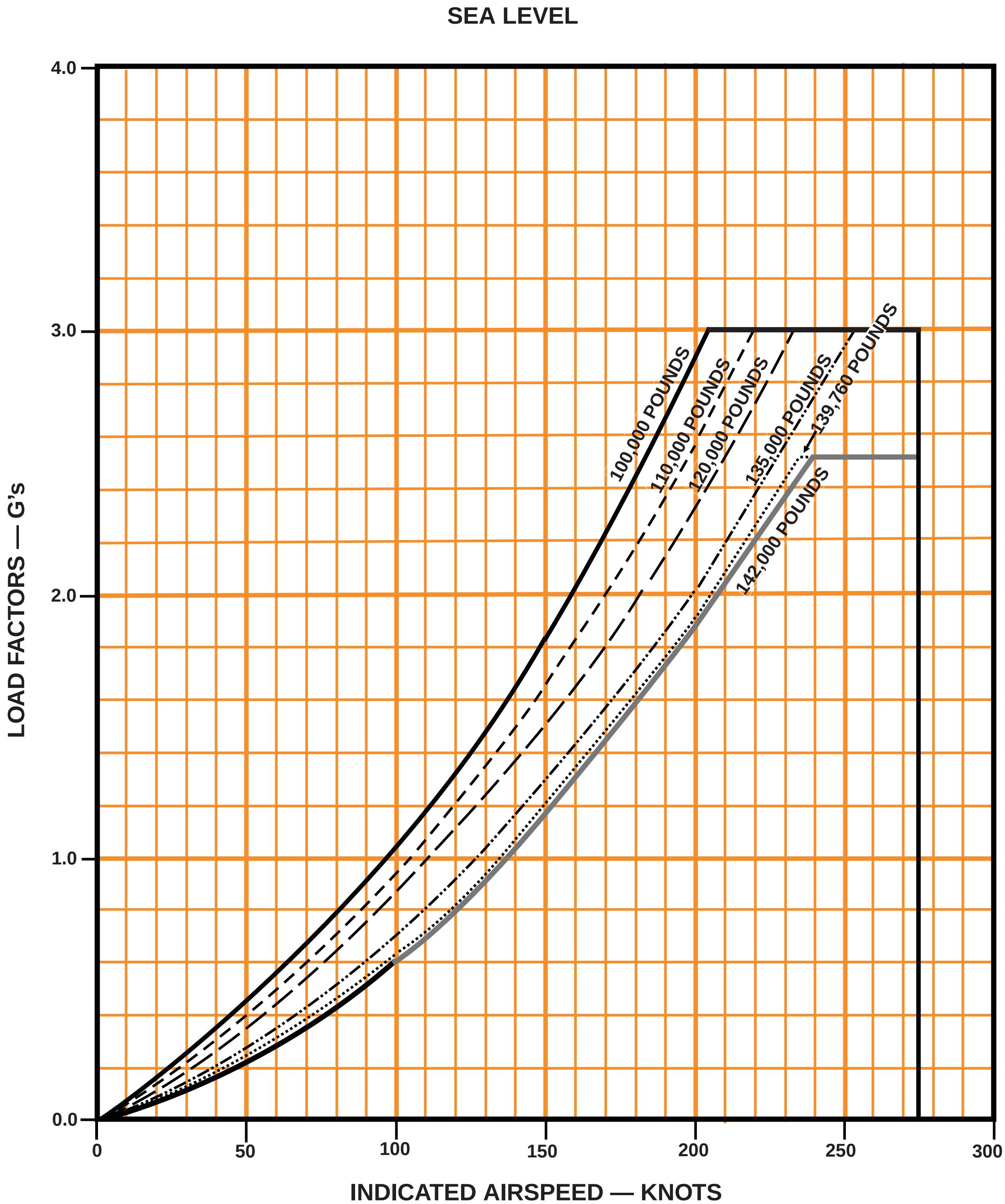


Figure -3. P-3C perating Flight n elope Flaps, ear p the fuselage and may be inaccurate for combined loads. To ensure that combined rolling and pitching loads do not exceed wing limitations, the g-limits are reduced whenever the aircraft is rolling.

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 under the turbulent air penetration paragraphs 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 IRDS Turret Extended. Stall characteristics and buffet boundary are the same with the IRDS 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

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 (150 °C).	Pull respective circuit breaker; No. 3 located at flight station and No. 1 and 2 located at 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 Power 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.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
b. External Power 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.
Center Overhead Panels		
1. a. No. 1, 2, 3, or 4 primary fuel pump (parallel) light on during start (between 16 percent and 65 percent RPM).	Indicates the secondary fuel pump is functioning properly.	
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. • 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
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 pops out at 57 to 64 percent RPM during normal start.)	Secure engine by pulling emergency shutdown handle, if light remains on or comes on after start.
Propeller Feather Buttons 1. No. 1, 2, 3, or 4 props 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. b. If light remains on following pressure cutout override, refer to Chapter 8, In-Flight Restart Procedures.
Air-Conditioning and Pressurization Control Panel 1. FAN OUT light on.	Cabin exhaust fan is inoperative or lack of air flow.	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. c. If loss of spread is not indicated after disconnect, execute the Emergency Shutdown Procedure. If the engine is allowed to operate due to a greater emergency, the EDC should be dumped.
3. EDC PRESS LOW light on.	EDC oil pressure is low. Low level in sump. EDC driveshaft sheared.	a. If loss of spread is already indicated, disconnect and dump EDC. Continue operation. b. If loss of spread is not already indicated, disconnect, monitor for loss of spread, dump. Continue operation. c. If loss of spread is not indicated after disconnect, execute the Emergency Shutdown Procedure. If the engine is allowed to operate due to a greater emergency, the EDC should be dumped.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
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; after light is out, operation is permitted in the manual mode at the two-dot position or warmer; investigate.
Engine Bleed Air and Anti-Icing Control Panels		
1. LW HOT or RW 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 shutoff 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. 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 torque-meter shroud and the inlet scoop.	

LIGHT INDICATION	PROBABLE CAUSE	ACTION
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. (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.
c. ANTI-ICING advisory light on and control switch off.	a. Abnormal heat in the area.	On deck, investigate, secure engine and return to the line.
	b. Loss of electrical power to the solenoid valve.	In flight, turn on anti-ice control switch. a. If a SHP drop is observed, execute the Emergency Shut-down Procedure. 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 over-heat 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 inter-rupted, or current flow detector is inoperative.	Check respective circuit breaker and bus. Monitor equipment for proper operation.
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).	

LIGHT INDICATION	PROBABLE CAUSE	ACTION
12. BOMB BAY COLD light on.	Temperature below desired level in bomb bay.	Turn bomb bay heat switch ON (auto-cycling), 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 OVERRIDE 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. 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.
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 XFEED 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 drops below 2 psi.	Refer to Chapter 15, Fuel Boost Pump Failure Procedures.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
8. Transfer pumps PRESS LOW advisory lights on.	Tank No. 5 is empty or pump output below 4 psi.	Shut off respective pump; refer to Chapter 15, Transfer Pump Failure.
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.
2. CHIPS light No. 1, 2, 3, or 4 on (steady or intermittent).	Metal particles on magnetic plug in power section or gear box.	Execute the Emergency Shutdown Procedure unless emergency requiring power exists.
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 gear box 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.
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 Chapter 15, Propeller Malfunctions.
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.	a. Close all engine bleed and fuselage shutoff valves. b. In flight, if light remains on, dump EDCs one at a time. c. On ground, secure ground air-conditioning and all engine and APU bleed air, and return to the line.
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 Chapter 12, Pressurization Loss.

LIGHT INDICATION	PROBABLE CAUSE	ACTION
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 illumininate 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.
7. IFF light on. (Operational only if KIT-1A 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.	Engine starter control valve is not closed.	If the light remains on after the start sequence (57 percent to 64 percent) or comes on during flight, check overhead panel for individual engine starter control valve open light and pull appropriate emergency shutdown handle.
9. 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. 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.

*Aircraft with PB-20N Autopilot
**Aircraft with ASW-31 AFCS

LIGHT INDICATION	PROBABLE CAUSE	ACTION
11. AUTOPILOT/RAWS flashing red warning lights (glareshield) with 1000-cycle 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.
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.	If accompanied by a change in flight characteristics, refer to Split Flap Procedures. If not, place flap handle in position best corresponding to flap position.
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. 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 resut 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.
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 lbs).	Turn off respective pump.
18. NTS INOPR.	Inoperative NTS system	Refeather propeller.

*Aircraft with PB-20N Autopilot

LIGHT INDICATION	PROBABLE CAUSE	ACTION
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.
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, essential to handling emergencies quickly, 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 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, consider performing Engine Fire on the Ground 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.
- If a hydraulic leak is suspected, don helmet with visor down when inspecting the 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. The PMG power directly controls operation of the GCR in the generator supervisory panels and the generator exciter control field current in the generator exciter and cannot be secured by placing the bus switches off. These units, both the GCR and exciter control field, can be deenergized by: 1) placing the respective generator control switch OFF, or 2) feathering the respective propeller (securing the APU if its respective generator control panel malfunctions), thus stopping generator rotation. Fires in any of these units are usually (but not always) preceded by a generator electrical failure (GCR trip) in which feathering 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.
- Atomized hydraulic fluid may exhibit visual characteristics of smoke.

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 12-8 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).

Note

The copilot shall verify obstacle clearance with NAV/COMM.

*2. Cabin exhaust fan — OFF (FE).

Note: Asterisked items are memory items.

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. 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.

5. 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.

6. Elevator, rudder, and aileron boost levers — Pull (FE).

7. Bus B — OFF (FE).

8. Generator switch Nos. 2 and 3 — OFF (FE).

9. Left or right EDC — DUMP (FE).

10. 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.

11. Remaining EDC — DUMP (FE).

12. Emergency transmission — AS REQUIRED (CP).

Note

The aircraft commander shall ensure the emergency message is transmitted on the HF radio, if UHF or VHF communications are not possible.

13. Essential bus switch — OFF (FE).

Note

- ICS will be inoperative.
- The outflow valve is available electrically.

If fire persists:

Note

Electrically operated flight instruments may be necessary for safe flight, and power to them must not be shut off except as a last resort.

14. 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 enroute 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).

Note

The outer door (P-3A/B) must be opened first. This will require pulling the SONO W/PRESS ganged circuit breaker on the armament circuit breaker panel if monitorable essential power is available.

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 (approximately 1-1/2-inches HG) 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 — OFF (P, CP, FE).
2. Affected equipment — Disconnect (FE).
3. Electrical load — Reduce to minimum (FE).
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).

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.

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).

Note: Asterisked items are memory items.

*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 switch — OPEN (FE).

*2. Outflow valve switch — OPEN (FE).

*3. EDCs — DUMP (FE).

*4. AUX VENT switch — Close at 1-inch differential (FE).

Without electrical power available:

*5. Free-fall chute/P-3A/B aircraft sono chute #4 — OPEN (OBS).

Note

The outer door (P-3A/B) must be opened first. This will require pulling the SONO W/PRESS ganged circuit breaker on the armament circuit breaker panel if monitorable essential power is available.

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 12-1 and 12-2 are the normal means of surface emergency evacuation. The main cabin door shown in Figure 12-3 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: Asterisked items are memory items.

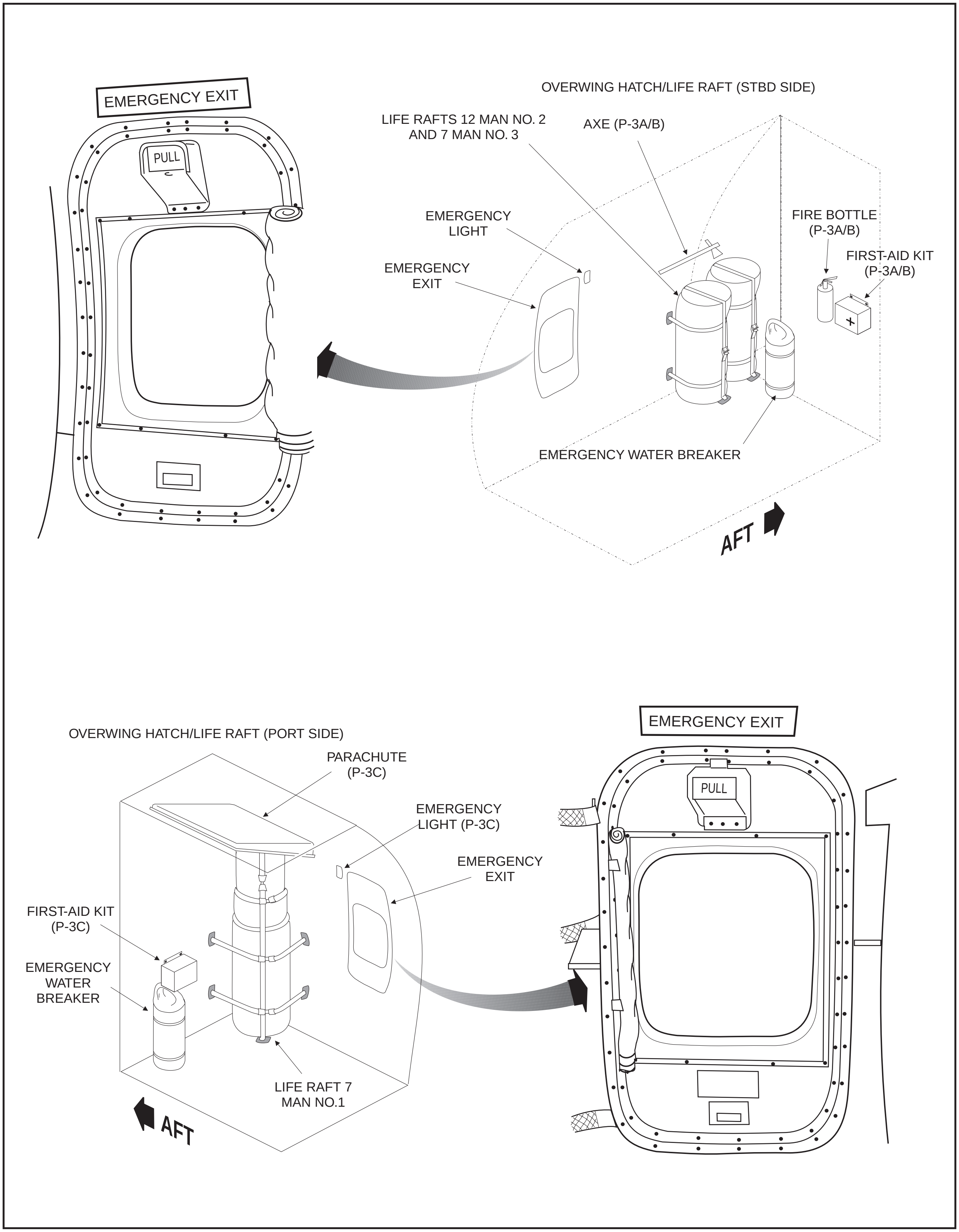
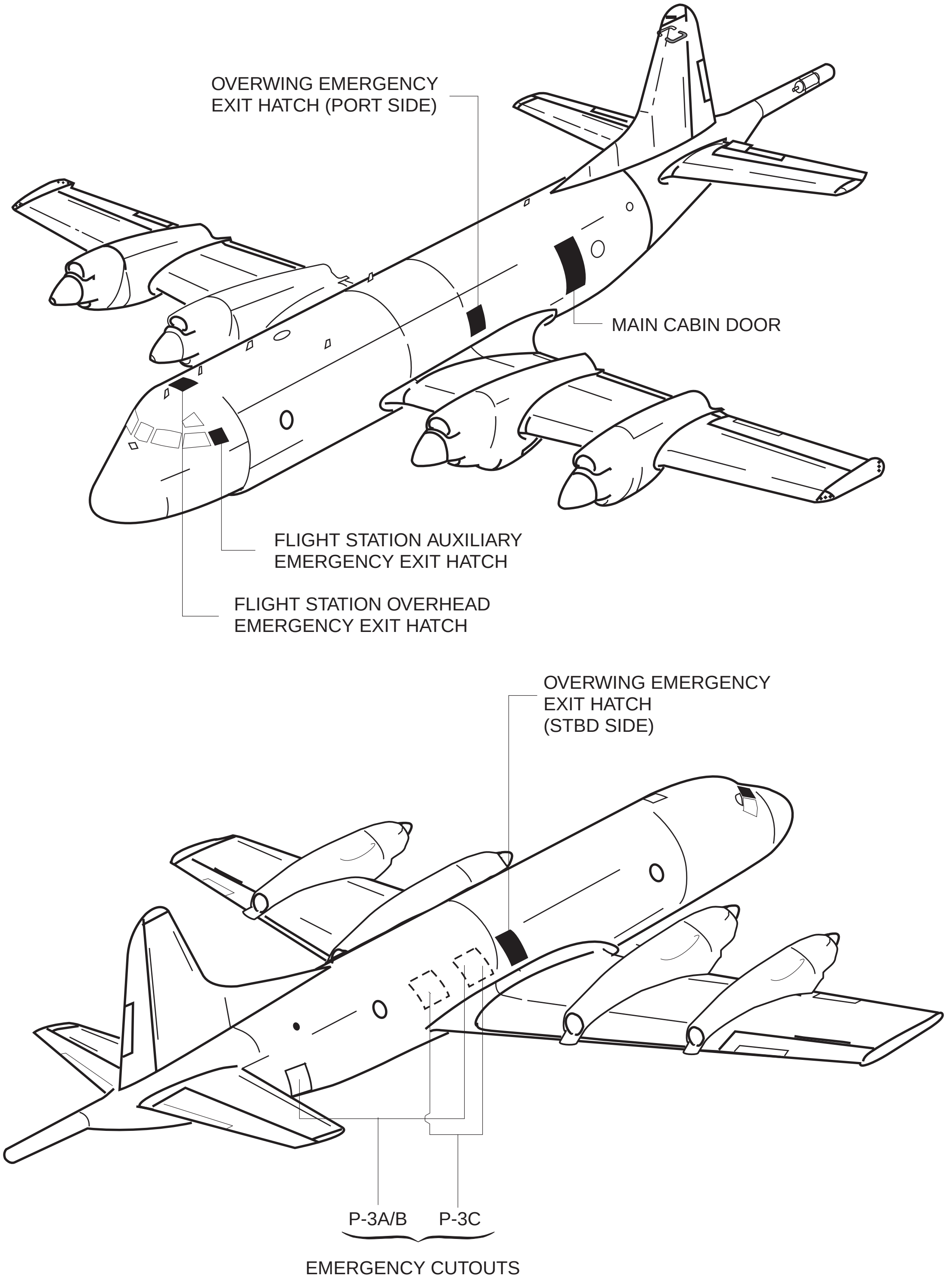


Figure 12-1. Overwing Emergency Escape Hatches and Liferaft Stowage

FLIGHT STATION AUXILIARY EMERGENCY EXIT

FLIGHT STATION OVERHEAD EMERGENCY EXIT AND SMOKE REMOVAL DOOR

Figure 12-2. Flight Station Alternate Emergency Exit Hatches



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 12-3. Emergency Entrances and Exits

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.

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. (See 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.

The following 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

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

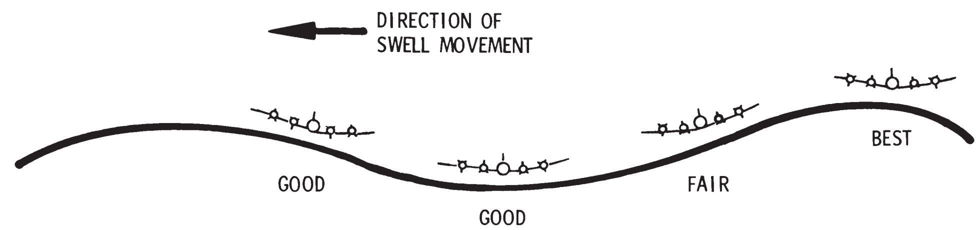


Figure 12-4. Selection of Ditching Heading by Evaluation of Sea and Wind

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.

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 VMC 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 Vs (approach flaps) or l.3 Vs (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 Vs 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 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).

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.

Note

If time permits, pilot, copilot, and engineer 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 Liferafts. Check that the liferaft painter (60 feet in length) is attached to the aircraft. This line is used to keep the liferaft close to the aircraft for boarding and will break, releasing the liferaft when the aircraft sinks. Persons launching the raft should attach the nylon launching strap to the lifevest and push or lift the liferaft through the exit.

WARNING

Do not remove the liferaft from its carrying case. Ensure the liferaft is launched and inflated away from any sharp surfaces.

Follow the launching strap to the vicinity of the inflation assembly actuating handle located under the carrying case end flap. Upon pulling the actuation handle, the raft will inflate and be removed from its carrying case automatically. Leave the painter attached to the aircraft.

Disperse personnel equally among exits selected for evacuation to minimize congestion.

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 12-5), move rafts out from under any part of the aircraft that might strike them as it sinks. Rope the rafts together so that they do not drift apart and become separated and complicate rescue. Remain in the vicinity of the aircraft as long as it remains afloat.

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 P-3C aircraft (on Update III aircraft, stations 16 and 17 have been deleted), and 18 stations on P-3A/B aircraft are numbered and placarded with the ditching and bailout procedures and responsibilities for the crewmember manning each particular position (Figure 12-8). 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 flight crewmembers over a large area of ocean without the benefit of liferafts. The command "PREPARE TO BAIL OUT" (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 bailout, 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 (see Figures 12-6 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 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

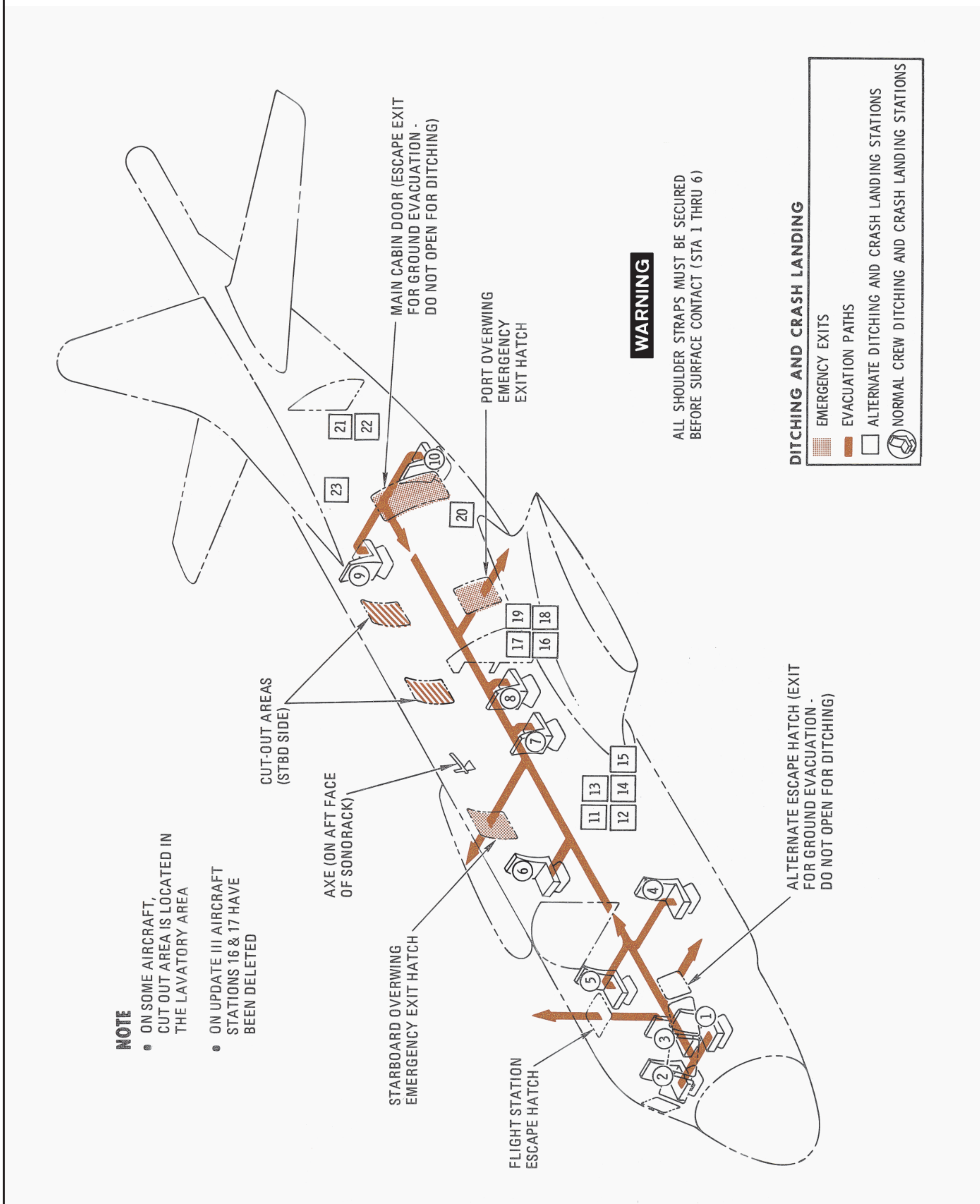


Figure 12-5. Surface Emergency Evacuation and Crew Ditching Stations — P-3C (Sheet 1 of 2)

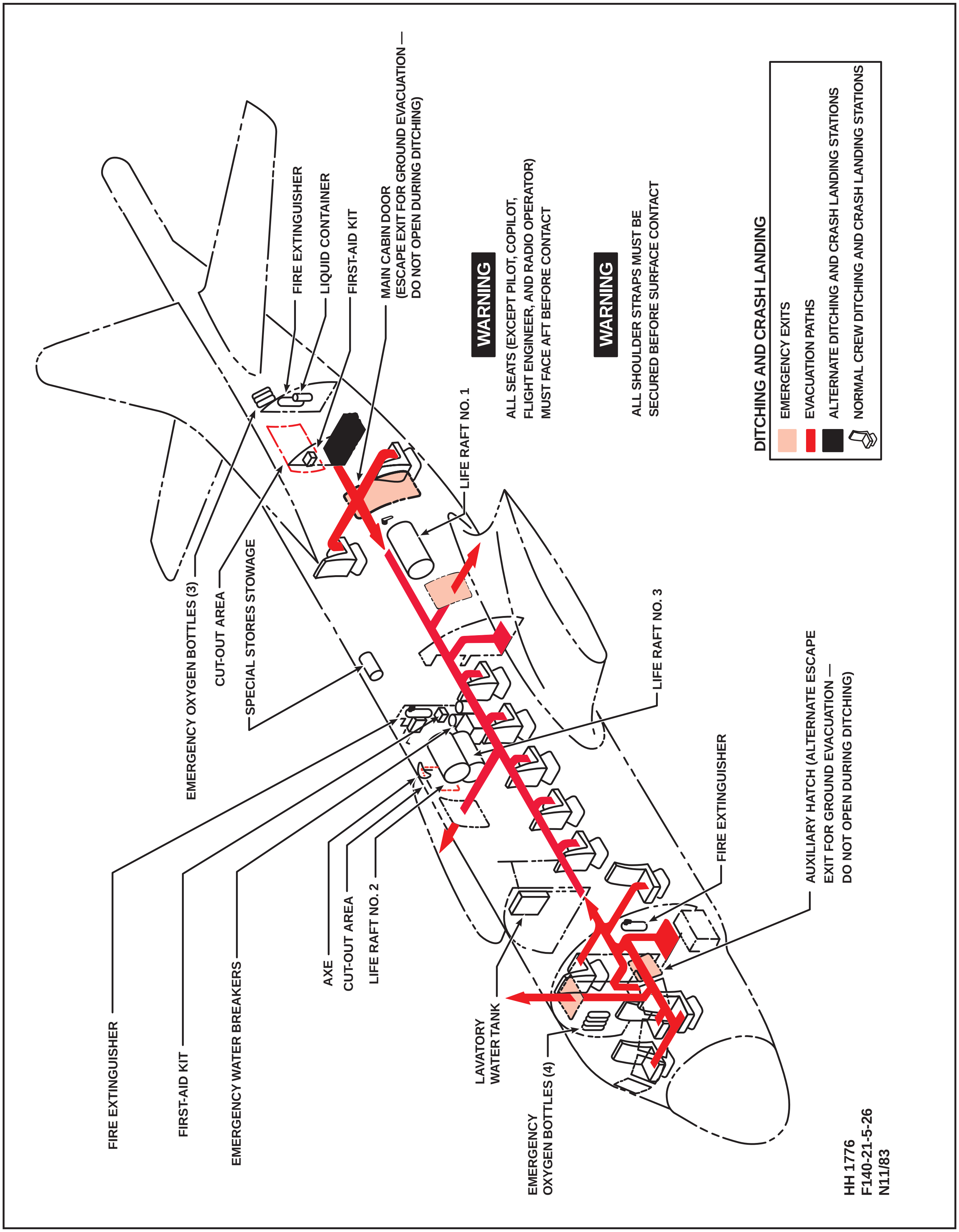


Figure 12-5. Surface Emergency Evacuation and Crew Ditching Stations — P-3A/B (Sheet 2 of 2)

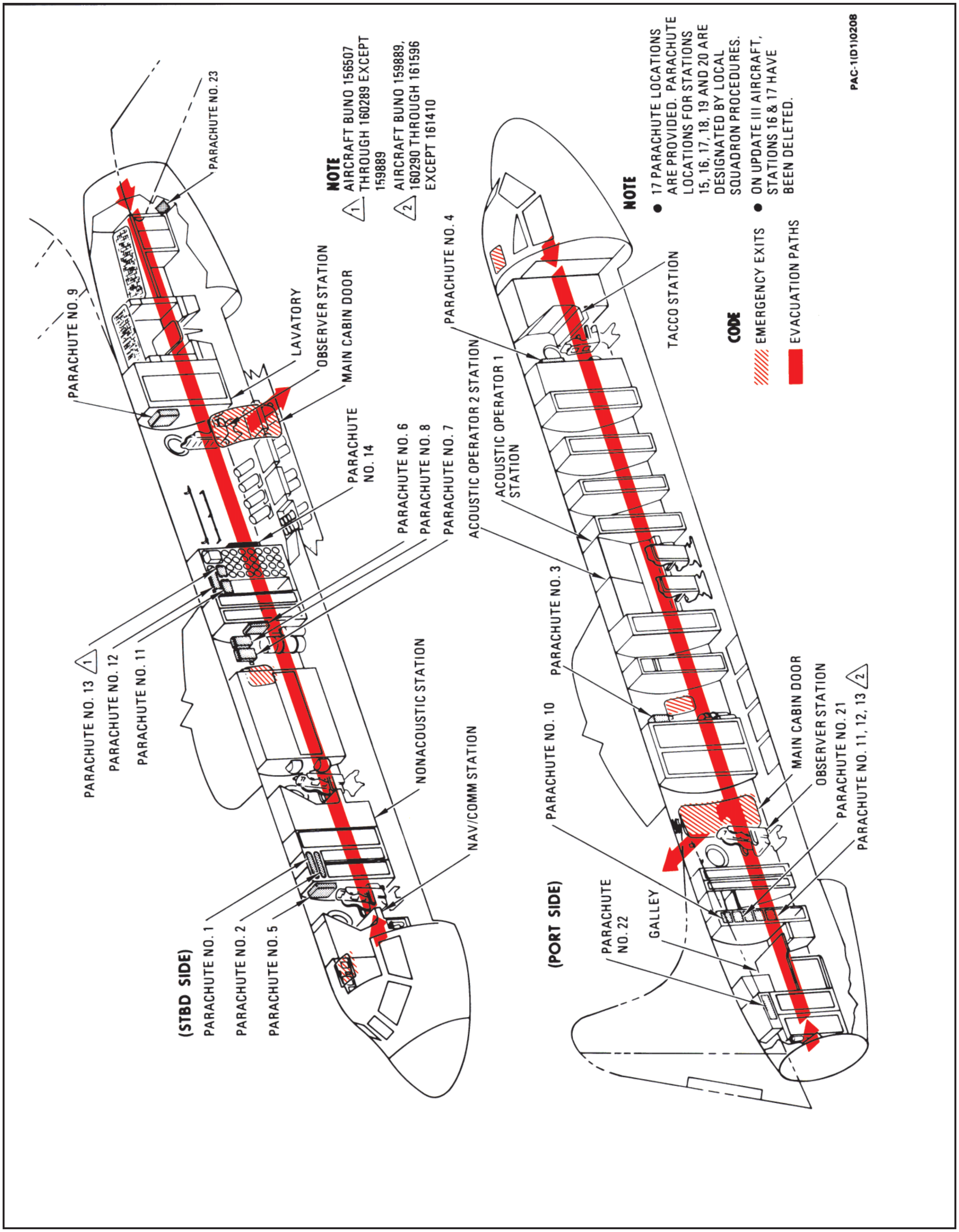


Figure 12-6. In-Flight Evacuation and Parachute Location — P-3C (Sheet 1 of 2)

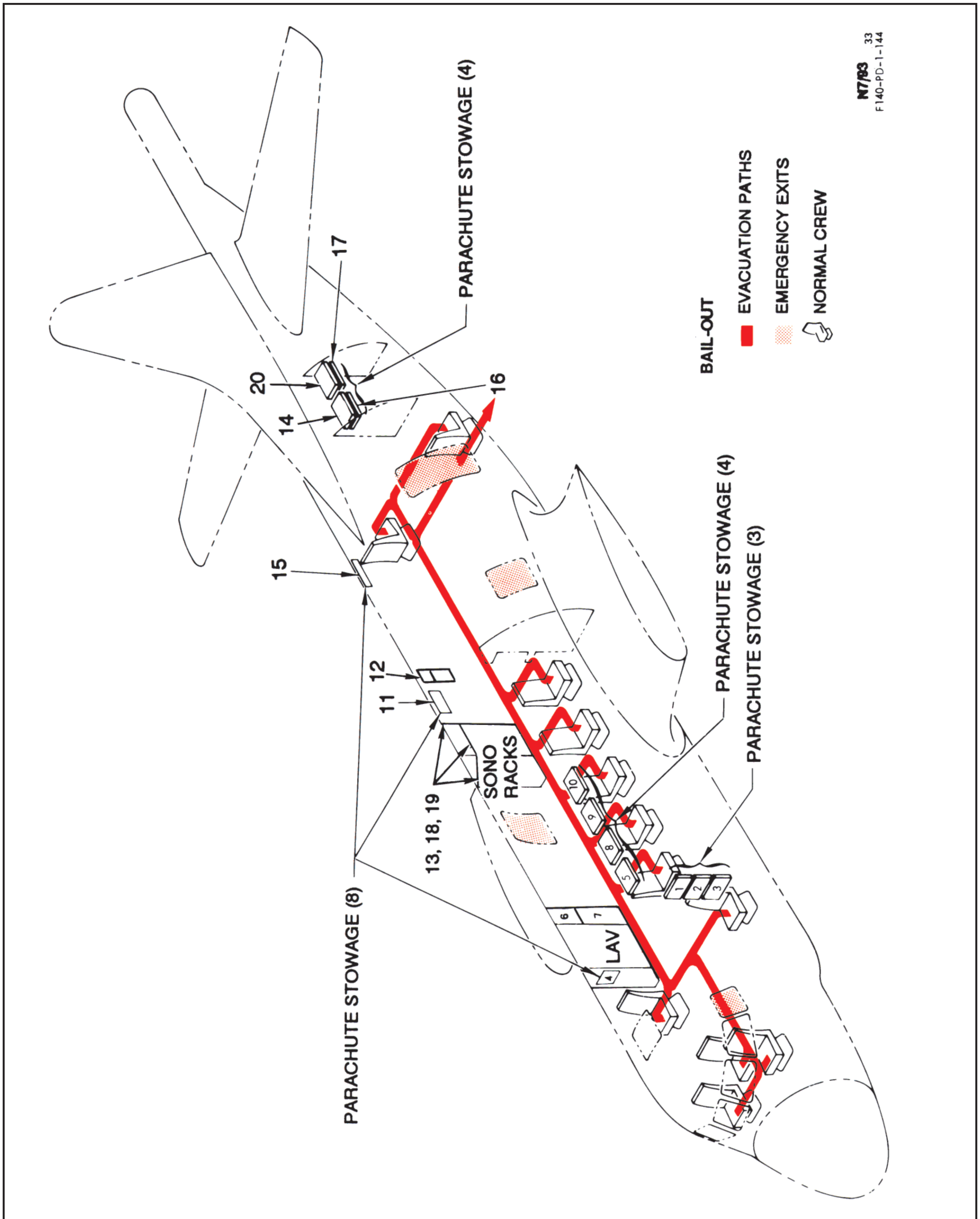


Figure 12-6. In-Flight Evacuation and Parachute Location — P-3A/B (Sheet 2 of 2)

PRIORITY OF DITCHING STATION ASSIGNMENT

DITCHING STATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16*	17*	18	19	20	21	22	23
NUMBER OF	P	C	F	T	N	S	S	S	O	F													
CREWMEMBERS	I	O	E	C	C	S	S	S	B	T													
ABOARD	L	P				3	1	2	S														
C { 4	X	X	X[A]						X[B]														
C { 5	X	X	X						X[A]	X[B]													
C { 6	X	X	X			X			X[A]	X[B]													
C { 7	X	X	X			X	X		X[A]	X[B]													
8	X	X	X	X		X	X		X	X													
9	X	X	X	X	X	X	X		X	X													
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
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
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
DITCHING STATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16*	17*	18	19	20	21	22	23

Notes:

A. TAKE WATER BREAKER.

B. LAUNCH LIFERAFT NO. 2

C. ALL PERSONNEL BOARD NO. 2 LIFERAFT WITH 7 OR LESS.

* DITCHING STATIONS 16 AND 17 HAVE BEEN DELETED FROM THE UPDATE III AIRCRAFT.

IF AIRCRAFT IS CONFIGURED WITH TWO 12-MAN LIFERAFTS, PERSONNEL NORMALLY ASSIGNED

Figure 12-7. Priority of Ditching Station Assignment — P-3C (Sheet 1 of 2)

PRIORITY OF DITCHING STATION ASSIGNMENT

DITCHING STATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
NUMBER OF CREW ON BOARD																		
4	X	X	①												X			
5	X	X	①											②	X			
6	X	X	①							X				②	X			
7	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			
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			
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
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
DITCHING STATION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16*	17*	18

Notes:

- ALL PERSONNEL BOARD NO. 2 LIFERAFT WITH 7 OR LESS.
- ALL PERSONNEL ASSIGNED BY PLACARD TO BOARD NO.3 LIFERAFT WILL BOARD NO. 2 LIFERAFT WITH 10 OR LESS.
- OFF-DUTY PILOT/FLIGHT ENGINEER SHALL HAVE READILY AVAILABLE DITCHING STATION.
- IF THE AIRCRAFT IS CONFIGURED WITH TWO 12-MAN LIFERAFTS, PERSONNEL NORMALLY ASSIGNED TO THE NO. 3 LIFERAFT WILL BOARD THE NO. 2 LIFERAFT.
- IF AUTHORIZED TO CARRY 19 OR 20 TOTAL PERSONNEL, PASSENGERS #19 AND #20 SHALL BE DOUBLED UP AT STATIONS #18 AND #6. PASSENGERS #19 AND #20 SHALL BOARD LIFERAFT NO. 3 IN THE EVENT OF A DITCH. IN THE EVENT OF A BAILOUT, THEY SHALL UTILIZE PARACHUTES #19 AND #20. IN THE EVENT OF A FIRE OF UNKNOWN ORIGIN, THEY SHALL ASSIST AS DIRECTED.

① TAKE WATER BREAKER BY SONO STORAGE RACK.

② SHALL CARRY OUT SS3's DUTIES.

X CARRIES OUT NORMAL RESPONSIBILITIES

Figure 12-7. Priority of Ditching Station Assignment — P-3A/B (Sheet 2 of 2)

P-3C		
DITCHING	**BAILOUT**	**FIRE BILL**
CREW STATION 1 (PILOT)		
1. Warn Crew: "PREPARE TO DITCH," time to impact. Give signal of one long ring on command bell for immediate ditches. 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.	
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.	
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.

Figure 12-8. Ditching and Bailout Procedures (Sheet 1 of 11)

P-3C		
DITCHING	BAILOUT	FIRE BILL
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 seat-belt 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 pre-pared, and notify pilot. 2. Ensure all liferafts are launched if time permits. 3. Put on parachute and 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.
CREW STATION 5 (NAV/COMM)		
1. Pass heading to nearest land to copilot. Send emergency message. Select TTY on communications selector panel and DIR/SEND on teletypewriter keyboard transmitter on the appropriate radio. 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 com-mand (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). Select TTY on com-munications selector panel and DIR/SEND on teletypewriter key-board transmitter on the appropri-ate radio. 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 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. Draft emergency message. Perform radio check with appropriate communications facility and be prepared to send emergency message when authorized.
CREW STATION 6 (NONACOUSTIC OPERATOR)		
1. Give bearing and distance to near-est ship or closest point of land. 2. Secure loose equipment. 3. Take ditching station. Adjust seat-belt and shoulder harness. 4. After stop, launch No. 3 liferaft, exit over wing starboard side; board No. 3 liferaft.	1. Upon receipt of preparatory com-mand (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.

Figure 12-8. Ditching and Bailout Procedures (Sheet 2 of 11)

P-3C		
DITCHING	**BAILOUT**	**FIRE BILL**
CREW STATION 7 (ACOUSTIC OPERATOR 1)		
1. Secure loose equipment. 2. Turn on starboard and port over-wing exit light. 3. Take ditching station and adjust seatbelt. 4. After stop, jettison starboard over-wing hatch. Launch No. 2 liferaft; exit over wing starboard side; board No. 2 liferaft.	1. Upon receipt of preparatory com-mand (verbal and/or four short rings), turn on starboard and port over wing exit lights. 2. Put on parachute and when pre-pared to bail out, assemble in front of main cabin door. 3. Bail out through main cabin door when directed.	Turn on station floodlight. Activate star-board and port overwing exit lights. Obtain fire bottle at the end of son-obuoy stowage rack. Check rack over-heat lights and press toggle switches on assigned area. Inspect entire acous-tic operator area, the main load center, electronic racks F-1 (HF-2 coupler, SRS (update aircraft)) and F-2 (ord-nance indicator and test panels plus ICS and ICS lighting); E-1, -2; G-1, -2; UHF/OTPI select relay (update III only) in overhead aisle by Rack E-1; and hydraulic service center. Be prepared to pull applicable circuit breakers as required. Report progress 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 com-mand (verbal and/or four short rings), put on parachute. 2. When prepared to bail out, assem-ble in front of main cabin door. 3. Bail out through main cabin door when directed.	As assigned or directed by TACCO.
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 water breaker from head and starboard first-aid kit. 5. Exit starboard overwing hatch; board No. 2 liferaft.	1. Upon receipt of preparatory com-mand (verbal and/or four short rings), turn on main cabin door emergency exit light. 2. Put on parachute and, when pre-pared 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. Check rack over-heat 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 over-head. Be prepared to pull applicable cir-cuit breakers as required. Report progress to TACCO.

Figure 12-8. Ditching and Bailout Procedures (Sheet 3 of 11)

P-3C		
DITCHING	**BAILOUT**	**FIRE BILL**
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. Check rack overheat lights and press toggle switches on assigned area including the NAV/COMM area. Inspect electronic racks A-1, TACCO's multipurpose 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.
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 action 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 12-8. Ditching and Bailout Procedures (Sheet 4 of 11)

P-3C		
DITCHING	**BAILOUT**	**FIRE BILL**
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.
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.

Figure 12-8. Ditching and Bailout Procedures (Sheet 5 of 11)

P-3C		
DITCHING	**BAILOUT**	**FIRE BILL**
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, take starboard emergency water breaker and 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 12-8. Ditching and Bailout Procedures (Sheet 6 of 11)

P-3A/B		
DITCHING	**BAILOUT**	**FIRE BILL**
PILOT — STATION 1		
1. Warn Crew: "Prepare to Ditch," time to impact; jettison bomb load; turn search power off; adjust seatbelt and shoulder harness. 2. Check crew evacuation: Exit through overhead hatch or over wing on port side; board No. 1 liferaft.	1. Give signal for bailout preparation verbally and by four short rings on the command bell. 2. Receive acknowledgment from assigned jump master. 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 verbally and by one long ring on the command bell. 7. Deploy crash recorder/locator prior to leaving flight station. 8. Put on parachute and bail out through main cabin door.	
COPILOT — STATION 2		
1. Announce intention to ditch and time to impact over PA system using ICS override. 2. Set IFF to emergency; establish voice communication if possible; secure loose equipment; and adjust seatbelt and shoulder harness. 3. Exit through overhead hatch or over wing on starboard side; board No. 2 liferaft.	1. Set IFF to emergency; establish voice communication if possible. 2. Assist pilot as directed. 3. Put on parachute and bail out through main cabin door when directed.	
FLIGHT ENGINEER — STATION 3		
1. Adjust seatbelt and shoulder harness. 2. Depressurize: Dump compressors, close aux vent and outflow valve. 3. Open overhead hatch (if not submerged.) Exit over wing on starboard side, or through overhead hatch; board No. 2 liferaft.	1. Acknowledge bailout preparation signal (verbal or four short rings on command bell). 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. Be prepared to pull applicable circuit breakers as required; report progress to pilot.

Figure 12-8. Ditching and Bailout Procedures (Sheet 7 of 11)

P-3A/B		
DITCHING	**BAILOUT**	**FIRE BILL**
RADIO OPERATOR — STATION 4		
1. Send position reports and distress signals; lock key down on command of pilot; time permitting, purge or destroy AGC-9 bubble memory. 2. Adjust seatbelt and shoulder harness. 3. After impact, assist in passing gear out hatch; take any accessible parachute; exit over wing on port side; board No. 1 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), send position reports and distress signals. Time permitting, purge or destroy AGC-9 bubble memory. 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; check behind dust cover above radio operator and forward armament interconnection box via access door; be prepared to transmit emergency message and aircraft position when directed by pilot.
FORWARD OBSERVER — STATION 5		
1. Secure loose equipment, take ditching station, and adjust seatbelt and shoulder harness. 2. After impact, take water breaker from head; exit over wing on starboard side; 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.	Assist as directed.
STARBOARD FORWARD OBSERVER DECK STATION — STATIONS 6 and 20		
1. Secure loose equipment, take ditching station, and adjust seatbelt. 2. Station 6: Assist in launching No. 2 liferaft; exit over wing starboard side; board No. 2 liferaft. 3. Station 20: Assist in launching No. 3 liferaft; exit over wing on starboard side; 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 PPC/ mission commander.
PORT FORWARD OBSERVER DECK STATION — STATION 7		
1. Secure loose equipment, take ditching station, and adjust seatbelt. 2. Assist as required; exit over wing on 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 PPC/ mission commander.

Figure 12-8. Ditching and Bailout Procedures (Sheet 8 of 11)

P-3A/B		
DITCHING	**BAILOUT**	**FIRE BILL**
SENSOR 3 — STATION 8		
1. Over water, give bearing and distance to nearest ship or closest point of land. 2. Secure loose equipment, take ditching station, and adjust seatbelt and shoulder harness. 3. After impact take port water breaker and first aid kit; exit over wing on port side; board No. 1 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), when over water, 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.	If possible, give bearing and distance to nearest ship or closest point of land. Inspect all forward left electrical bays, head, and forward radar cabinet, and be prepared to pull circuit breakers on applicable circuit breaker panel as required. Obtain the forward fire bottle. Report progress to flight station.
NAVIGATOR — STATION 9		
1. Check position and give to radio operator and copilot on paper. Take ditching station, and adjust seatbelt and shoulder harness. 2. Assist TACCO as required. Take maps, reports, and channel 15 sonobuoy exit over wing on starboard side; board No. 2 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), check position and give to radio operator and copilot on paper. 2. Put on parachute and when prepared to bail out, assemble in front of main cabin door. Assist as required. 3. Bail out through main cabin door when directed.	Remain at station. Obtain aircraft position, draft emergency message on paper and pass to radio operator and copilot. Assist as required.
TACTICAL COORDINATOR — STATION 10		
1. Secure loose equipment. Take ditching station and adjust seatbelt and shoulder harness. 2. Direct evacuation of crew and survival equipment. Take starboard water breaker, exit over wing on starboard side; board No. 3 liferaft.	1. Acknowledge command, put on parachute, ensure crew is prepared, and notify pilot. 2. Ensure all life rafts are launched if time permits. 3. Bail out through main cabin door when directed.	Direct crew efforts in locating and fighting fire; direct remaining crew with unassigned duties to assist as required (obtain oxygen bottles; take messages to flight station; ensure sono package is up, etc.); continuously report progress to flight station.
SENSOR 1 — STATION 11		
1. Secure loose equipment. 2. Turn on starboard overwing exit light. 3. Take ditching station, and adjust seatbelt and shoulder harness. 4. After stop, jettison starboard overwing hatch; launch No. 3 liferaft; exit over wing on starboard side; board No. 3 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), turn on starboard overwing 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 starboard overwing exit light. Inspect all forward right electronics bays, main electrical load center, areas behind pull-away dust covers beneath tactical stations, and areas behind cover panels located below sensor stations 1 and 2. Be prepared to pull circuit breakers on applicable circuit breaker panels as required. Report progress to flight station.

Figure 12-8. Ditching and Bailout Procedures (Sheet 9 of 11)

P-3A/B		
DITCHING	**BAILOUT**	**FIRE BILL**
SENSOR 2 — STATION 12		
1. Secure loose equipment. 2. Turn on port overwing exit light. 3. Take ditching station, and adjust seatbelt and shoulder harness. 4. After stop, jettison port overwing hatch; launch No.1 liferaft; exit over wing on port side; board No. 1 liferaft.	1. Upon receipt of preparatory command (verbal and/or four short rings), turn on port overwing emergency 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 port overwing exit light. Obtain fire extinguisher at the sonobuoy stowage rack; inspect electronics bays 17, 18, and 19 and the hydraulic service center; be prepared to pull circuit breakers on applicable circuit breaker panels as required. Report progress to flight station.
STATIONS 13, 18, and 19		
1. Secure loose equipment. Take ditching station and adjust seatbelt. 2. Stations 13 and 18: Assist in launching No. 1 liferaft; exit over wing on port side; board No. 1 liferaft. 3. Station 19: Assist in launching No. 3 liferaft; exit over wing on starboard side; 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 PPC/ mission commander.
FLIGHT TECHNICIAN/PORT AFT OBSERVER STATION 14		
1. Secure loose equipment. Take ditching station and adjust seatbelt and shoulder harness. 2. Take galley liquid container and AFT first aid kit; exit overwing on the starboard side; 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.	Assist as directed.
STARBOARD AFT OBSERVER — STATION 15		
1. Secure loose equipment, turn on main cabin door emergency exit light, take ditching station, and adjust seatbelt and shoulder harness. 2. Launch No. 2 liferaft; exit overwing on starboard side; 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. Inspect aft left electronic bays, deicer control panel, ASH-20 (if installed), top strobe power supply, and Doppler well. Be prepared to pull circuit breakers on applicable circuit breaker panel. Obtain aft fire bottle. Report progress to flight station.

Figure 12-8. Ditching and Bailout Procedures (Sheet 10 of 11)

P-3A/B		
DITCHING	**BAILOUT**	**FIRE BILL**
INBOARD GALLEY SEAT — STATION 16		
1. Secure loose equipment, take ditching station, and adjust seatbelt. 2. Assist as required; exit over wing on starboard side; 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 PPC/ mission commander.
OUTBOARD GALLEY — STATION 17		
1. Secure loose equipment, take ditching station, and adjust seatbelt. 2. Exit over wing on starboard side; 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 PPC/ mission commander.

Figure 12-8. Ditching and Bailout Procedures (Sheet 11 of 11)

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

> Before opening the cabin door, verify that the flight station overhead smoke door is closed. Stay clear of the marked caution area when opening the door as it may open explosively when the air seal is broken. The aircraft must be depressurized prior to attempting to open the main cabin door.

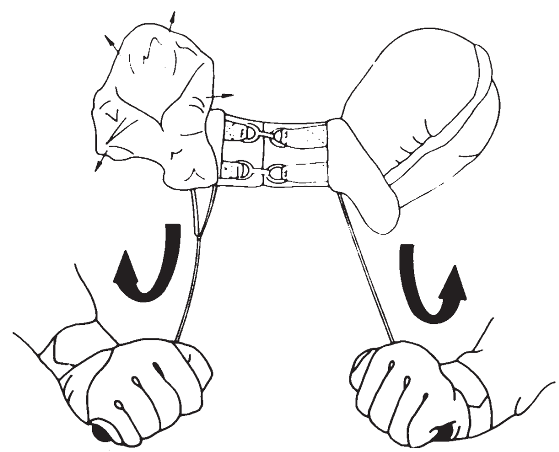
Once the cabin door has been opened and secured, all crewmembers should stand by for the command, “EXECUTE BAILOUT” (passed verbally and by one long ring of the command bell, 10 seconds or longer). Following the command to bailout, proceed as follows:

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.

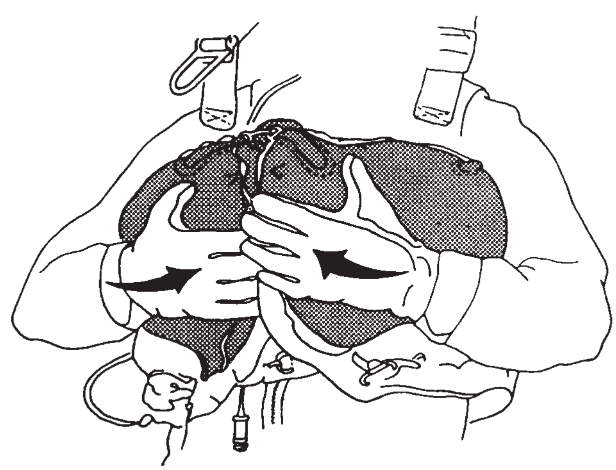
2. When clear of the aircraft, grip ripcord handle and pull ripcord the maximum length of travel to allow complete release of pins from parachute pack.

3. Immediately following opening shock of parachute, check for proper deployment and condition of the parachute canopy.

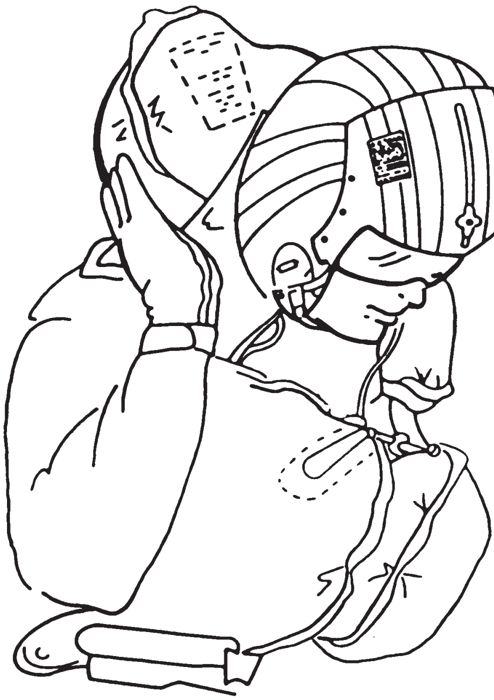
4. Locate the beaded handles on the LPU and pull down and straight out to inflate LPU.



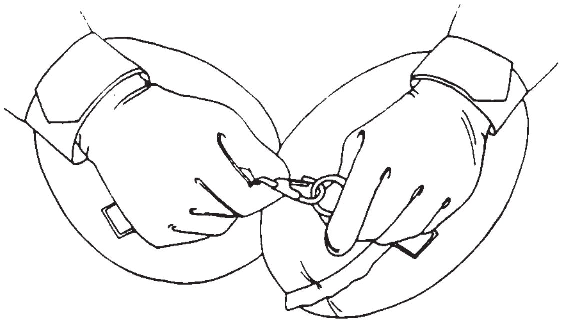
5. Squeeze LPU waist lobes together to help release velcro on collar lobe.



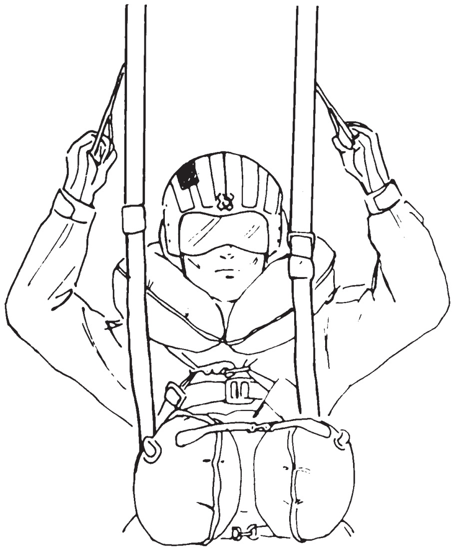
6. Manually release velcro on collar, if necessary, to achieve complete lobe inflation.

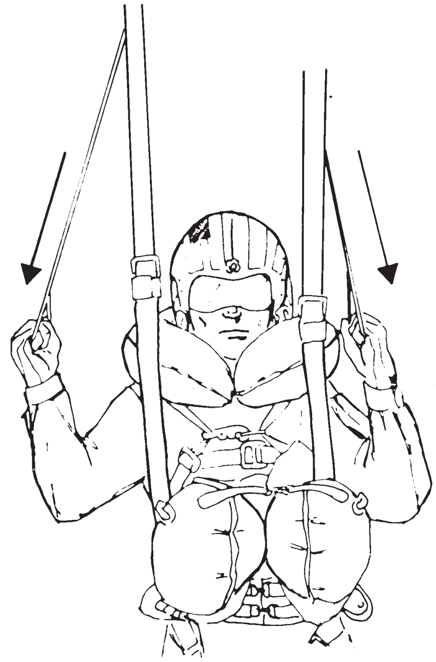


7. Snap LPU waist lobes together.



8. 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.

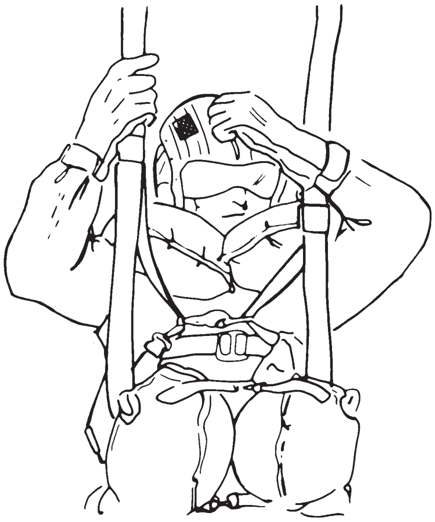




WARNING

The four-line release should not be activated if a damaged parachute canopy or broken suspension lines are observed.

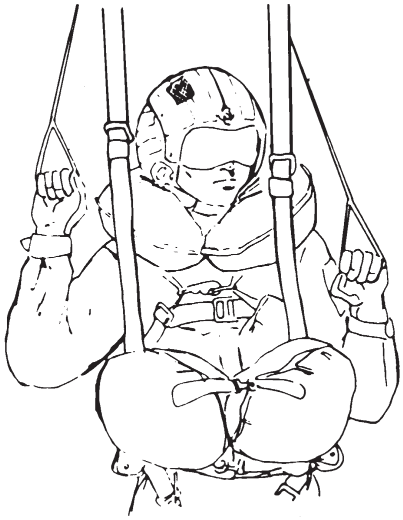
9. Raise and lock the helmet visor (if over land, leave visor down and locked) and remove gloves if desired.



Note

Stow gloves in a safe place to prevent loss. Removal of gloves may facilitate subsequent release of parachute release fittings.

10. Attempt to turn into the wind by pulling on the left riser to turn left or the right riser to turn right 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 the left side of the parachute harness with right hand. Unfasten the parachute chest strap and left leg strap with the left hand. With the left hand, grasp the right side of harness and place right hand on right leg strap.

12. Upon water entry, unfasten the right leg strap with the right hand 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 BOMB BAY DOORS EMERGENCY OPERATION

12.11.1 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 (radio operator seat on P-3A/B). 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).

Return selector switch to REMOTE for normal operation.

12.11.2 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.)

2. Control valve handle — Release (handle returns to neutral).

3. Selector switch — Return to REMOTE.

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).

*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).

Note: Asterisked items are memory items.

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 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).

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 V_R (Refusal Speed). 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 see the Refusal Speed discussion in Chapter 29.) 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}, V_{LOF}, V_{50} relationship in Part XI). After lift-off, 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 paragraph 15.4, 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 15.11. 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.

- 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 switchover to the FEAC bus in order to provide power for the pilot and copilot red instrument lights, FDIs, MM4s (P-3A/B) and vertical gyro.

- With loss of the MEAC bus, information displayed on the copilot FDI, MM4s (P-3A/B), 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, P-3A/B AC 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 VFR conditions 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. 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 this chapter.

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).

WARNING

A generator light that remains on steady may be indicative of a feeder fault, supervisory panel malfunction, generator flywheel diode malfunction, or generator bearing failure.

Note

If the generator light goes out momentarily and comes back on, the generator has a recurring malfunction.

If the GEN OFF light remains on steady or goes out momentarily and comes back on:

4. Generator switch — OFF (FE).
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 flameout. 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. In-flight 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, the No. 1A hydraulic pump, and electronics feeder #1 on P-3A/B.

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 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 (unless an emergency requiring power exists).

7. Actuation of the fire warning system.

Note

- The flight engineer should lock out the fire warning horn prior to executing the emergency shutdown procedure.
- Operating at high power settings, high AOA, and low airspeeds may induce a valid engine 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 shutdown handle in and momentarily pull the feather button to the UNFEATHER position; rotation should stop. 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. When rotation has been stopped, pull the propeller feather circuit breaker, then pull the shutdown handle.

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 15.4.1. 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 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).

15.4.1 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).

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 procedures, paragraph 15.11.6, shall be completed. If the propeller does not feather, complete the remaining items of the Emergency Shutdown Checklist, 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.)

15.5 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.

15.6 FLIGHT CONTROL SYSTEM MALFUNCTIONS

15.6.1 Shifting to Boost Off in Flight. If flight control system difficulty should ever occur, 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.

WARNING

If this is a trim system problem, 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. If a trim tab malfunction occurs, do not shift to boost off as this will not correct the problem. Shifting to boost off with a malfunctioning trim tab may result in serious control difficulties because of the fact that control surface travel is reduced by one-half.

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 the changing attitude is being caused by an autopilot malfunction, corrective action on the flight station controls will be effective since malfunctions of the autopilot can be overpowered.)

Use the following procedures to shift to boost off:

1. Autopilot — OFF.

2. Autopilot emergency disconnect handle — As required.

3. Trim tab setting — Check for normal position.

If abnormal force is still present:

4. Booster shift handle — Pull.

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. Time permitting, notify crewmembers to set Condition V prior to shifting to boost off.

WARNING

It is possible for a binding flight control cable to exhibit the same characteristics as a boost package malfunction (i.e., 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 out. For this reason, flightcrews should attempt to obtain a safe altitude prior to shifting to boost out and should be prepared to immediately return to boosted flight control operation.

If unable to shift for any reason, do the following:

1. Shift the other two control systems to boost off.

2. Shut off all AC hydraulic pumps.

3. Pull the shift control for the malfunctioning system. If the shift cannot be completed, leave hydraulic pressure off for the remainder of the flight.

4. If the shift is completed, on the malfunctioning system, reestablish aircraft hydraulic pressure and return the other two control systems to boost-on operations.

15.6.2 Special Case for Not Shifting Boost Off. If control of the elevator, rudder, or aileron is lost (i.e., if 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.

15.6.2.1 Aircraft Equipped with PB-20N

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.

15.6.2.2 Aircraft Equipped with ASW-31

Elevator control lost:

1. Pitch axis — ENGAGE (altitude hold on until approach).

2. Other AFCS axes — As desired.

3. 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.

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 that 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.

15.6.3 Turning Booster On or Off in Flight. If the boosters are to be turned on or off in flight, trim aircraft to fly hands-off and move the booster shift controls individually to ON or OFF.

Do not apply any force to the rudders, elevators, or ailerons. The application of pressure to any of the controls opens the booster control valve and may cause a sudden change in control surface position when the boosters are turned on or off.

15.7 FUEL SYSTEM FAILURE

15.7.1 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.

15.7.1.1 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 2-25). 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.

15.7.1.2 Fuel Quantity Indicator Goes Off Scale, High or Low or Fluctuates Abnormally

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.

15.7.2 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 climb-out 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.

15.7.2.1 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.

15.7.2.2 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 paragraph 15.7.2.1, Fuel Boost Pump Failure — Climb.

Note

- When operating with low fuel quantities in the tank to engine position with an inoperative boost pump, avoid nose-down 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 nose-down attitude.

- If a prolonged or high rate of descent is required, select crossfeed operation, as the scavenge section of the boost pump is also inoperative.

15.7.3 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 pressure 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.

15.7.4 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 Chapter 4.

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. Radios, radar — AS REQUIRED.

15.8 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. The engine should be shut down if oil temperature cannot be maintained within limits.

In case of a loss of oil pressure, the propeller should be feathered. 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 air-start may be attempted according to the engine restart procedure in Chapter 8.

15.9 MAGNETIC CHIP DETECTOR INDICATION

When a magnetic chip detector light illuminates, steady or intermittent, execute the Emergency Shutdown Procedure unless an emergency requiring power exists.

15.10 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, the respective engine should be secured. If the engine is allowed to operate due to a greater emergency, the EDC should be dumped. Refer to paragraph 15.15, Air-Conditioning System Malfunction (In Flight).

15.11 PROPELLER MALFUNCTIONS

15.11.1 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.

1. Smoothly advance power levers toward cruise conditions and increase TAS, noting engine indications (normal rated power if range is a factor).

   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 Pitchlocked Without Overspeed procedures, in 15.11.4.

   b. If RPM remains on-speed, continue engine operation throughout the landing evolution.

   c. If propeller is off-speed, proceed as follows:

2. SYNC SERVO switch (affected propeller) — OFF (FE).

3. SYNC MASTER switch — AS REQUIRED (FE).

4. 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.

5. 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 15.11.2.

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 2500 SHP.

   b. If flux is not corrected continue with step 7.

6. Determine if pitchlocked by increasing TAS. With an increase in TAS, the prop is pitchlocked if any of the following occur:

   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 – 106.7).

If pitchlocked, perform Operation with a Pitchlocked Propeller procedures.

7. 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

On aircraft incorporating the solid-state synchrophaser (AFC-473), if RPM has been corrected toward normal governing by selection of the SYNC SERVO and SYNC MASTER switches, do not attempt further correction by performing the governor indexing procedure. 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.

8. If RPM cannot be maintained above 95 percent E-HANDLE — PULL (FE).

9. Continue operation throughout the landing evolution. Power lever movement should be smooth and cautious.

15.11.2 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).

Note

Possible indications of a pitchlocked decoupled propeller include:

- SHP near 0 or wandering
- Fuel flow approximately 600 lbs/hr
- Increase in RGB oil pressure
- RPM extremely sensitive to changes in TAS.

4. If not decoupled, 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.

5. Propeller RPM — Adjust TAS to maintain 115 percent RPM or less if possible (P).

6. 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.

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 not decoupled:

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.

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) Stabilized NTS, as indicated by one or more of the following:

(a) RPM stabilized between 30 to 45 percent (primary indicator).

(b) Fluctuating negative SHP in the NTS range.

(c) Possible aircraft yaw in conjunction with NTS action.

(d) Flashing feather valve light.

(2) No NTS action, prop remains coupled as indicated by:

(a) Decreased RPM.

(b) Power section oil pressure near normal.

(c) SHP steady in the negative range.

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.

(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) SHP near 0 or wandering.

(b) Power section oil pressure near 0.

(c) RPM extremely sensitive to changes in TAS.

12. FUEL and IGNITION switch — OFF (FE).

If the propeller/engine goes to a stabilized NTS condition, the emergency shutdown handle should be pulled.

13. Power lever (affected engine) — Full forward (FE).

15.11.3 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 max 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.

15.11.4 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, pull the emergency shutdown handle.

15.11.5 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 lbs/hr.

In each of the above cases, execute the Emergency Shutdown Procedure.

15.11.6 Propeller Fails to Feather

1. Ensure feather button in (FE).

2. Push feather pump pressure cutout override (FE).

3. Select alternate bus for propeller Nos. 1 and 4 (FE).

4. Check propeller feather circuit breakers in (FE).

5. Decrease airspeed initially toward a minimum of 150 knots (P).

Note

Subsequent airspeed selection should be based on aircraft gross weight and controllability.

6. If feather button light remains on, pull propeller feather circuit breakers (FE).

Note

If the propeller remains in an overspeed condition, refer to Operation with a Pitchlocked Propeller Procedures. (See para 15.11.2).

15.11.7 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.

15.12 FLIGHT WITH CRACKED WINDSHIELD

15.12.1 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 2-37). 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 (3b).

15.12.2 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.

15.12.3 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.

15.12.4 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).

15.13 LOSS OF ALL AIRSPEED INDICATION

If loss of all airspeed indications are encountered, the following procedure is recommended:

1. Check pitot heat — ON (FE).

2. Fly known combinations of attitude and power.

3. 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.

4. Use the autopilot with altitude hold as necessary to maintain safe attitudes.

5. 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.

15.14 WING FIRE

Execute the Emergency Shutdown Procedure.

15.15 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.

15.16 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 sextant or 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 (P-3C) 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 that 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 appropriate 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.

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 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 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 feather procedure has been completed. 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.

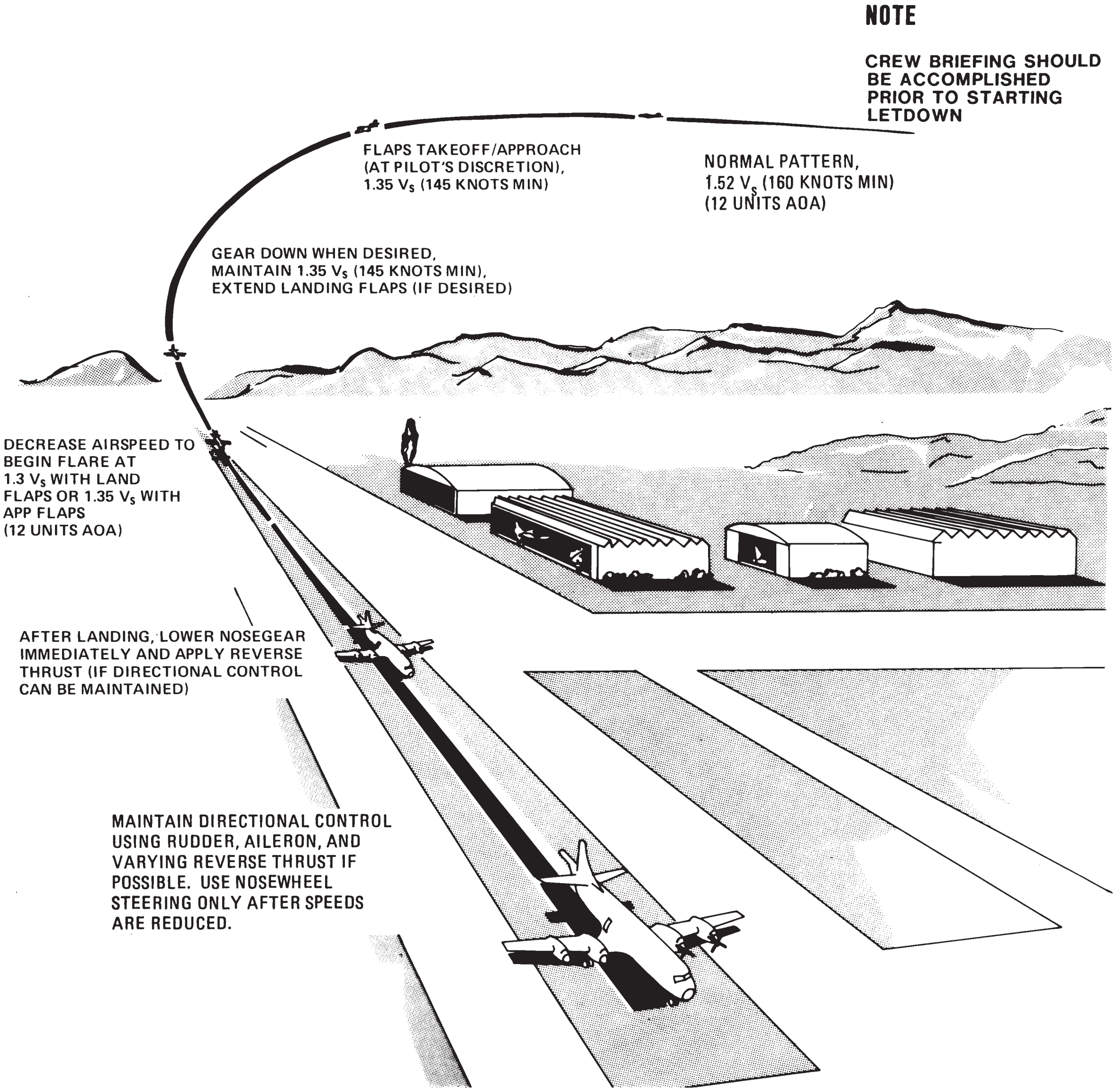
16.2.1 One Engine Inoperative. Landing with one engine inoperative does not seriously affect the normal flight characteristics of the aircraft.

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.

16.2.1.1 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). The pilot can use asymmetrical power during a three-engine go-around for better controllability. See Chapter 29, Takeoff, for initial climbout and best rate-of-climb speeds.

16.2.2 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 (see 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.



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 (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

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 TAKEOFF position at pilot 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. See Figure 16-1 for equivalent IAS.

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.

16.2.2.1 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).

16.3 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.

16.3.1 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.

16.3.2 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. Apply maximum power.

*2. Set and maintain approximately 10° of noseup pitch on the attitude indicator.

WARNING

Any attempt to recover loss of airspeed by decreasing pitch or allowing the aircraft nose to fall through is not recommended.

*3. Select landing gear up.

*4. Do not change the flap position until the aircraft has exited the windshear.

16.4 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.

16.4.1 Boost-Off Landing

1. 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 the cg is forward of 25 percent, the landing should be made with the flaps UP or at MANEUVER to assure 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.

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.

16.5 SPLIT-FLAP MALFUNCTION

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.

Note: Asterisked items are memory items.

Recovery from a split-flap condition will 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 check of slow flight characteristics is appropriate. 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. Reestablish controlled flight.

*2. If the aircraft is controllable, land with the flap handle in the selected position. If the aircraft is uncontrollable, reset the flap handle to the previous selected position.

*3. If a safe landing cannot be made, execute a waveoff.

*4. Climb to a sufficient altitude in order to determine minimum approach and landing airspeeds during a slow flight check.

*5. Visually inspect flaps for position and damage.

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 that no further flap movement occurs.

6. Select a runway that offers an extended final with no lateral and vertical hazard and minimal crosswind.

Note: Asterisked items are memory items.

WARNING

High-speed/high-power setting approaches may negate the 153 KIAS/power lever switch activation features. Ensure that the Landing checklist is complete.

16.6 EMERGENCY BRAKE OPERATION

CAUTION

Brakes should be operated carefully to avoid locking the wheels.

16.6.1 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.

16.6.2 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.

16.7 LANDING GEAR SYSTEM EMERGENCIES

16.7.1 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, paragraphs 16.7.4 and 16.7.5.

16.7.2 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 handle — Down (CP). Landing gear handle warning light should extinguish.

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. Retard one power lever below FLIGHT START and slow the aircraft to 150 KIAS, observing actuation of the landing gear warning system if extending without main DC bus (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.

16.7.3 Unsafe Landing Gear Up Indication. If any of the landing gear warning devices does 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 paragraph 16.7.4.

4. If no gear falls free, leave the circuit breaker out until the gear is to be lowered.

Note

- If the landing gear do 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.

16.7.4 Unsafe Landing Gear Down Indication.

If any of the landing gear warning devices indicates an unsafe condition of the gear when it 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 red 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:

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 paragraph 16.7.5.

WARNING

If doubt exists about the safety of the landing gear, review the Landing Without All Gear Extended procedures, paragraph 16.7.6.

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.

16.7.5 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. This will not be true, however, 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.

16.7.6 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. Do not, however, 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.

16.8 FLAT TIRE LANDING

If the nosewheel tire is flat at time of landing, keep this wheel 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.

16.9 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 paragraph 16.7.6 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.

16.10 NO-FLAP LANDING

1. Brief 16.1.

2. No-flap landings are not recommended at gross weights exceeding 103,880 pounds, 91,320 pounds for P-3A/B standard aircraft. 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 pitch-locking 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.

16.11 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

On P-3C aircraft a fire ax is attached at the aft end of the sonobuoy stowage rack, on P-3A/B the ax is attached to the cabin wall at the center of the marked cutout area near the emergency exit on the right side of the aircraft. 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 (see Figure 12-5). 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 force of 1.5g's is applied.

17.5 PORTABLE FIRE EXTINGUISHERS

Three portable fire extinguishers are provided. Each has a useful continuous discharge time of approximately 15 seconds. For the P-3C, 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 electronics rack J2. For the P-3A/B, one extinguisher is located on the left aft side of the flight station bulkhead. A second extinguisher is stowed at the forward end of the sonobuoy stowage rack. The third extinguisher is fastened to the cabin wall above the aft radar rack.

WARNING

Extinguishment of fire by HALON 1301 may produce decomposition by-products, characterized by 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.

17.6 LIFERAFTS

The P-3C is equipped with one 12-man raft (near the starboard overwing hatch) and one 7-man raft (near the port overwing hatch). A second 7-man raft is normally carried and shall be stowed behind the 12-man raft (near the starboard overwing hatch). The P-3A/B aircraft is equipped with three inflatable 7-man liferafts strapped in position against the cabin wall near the emergency

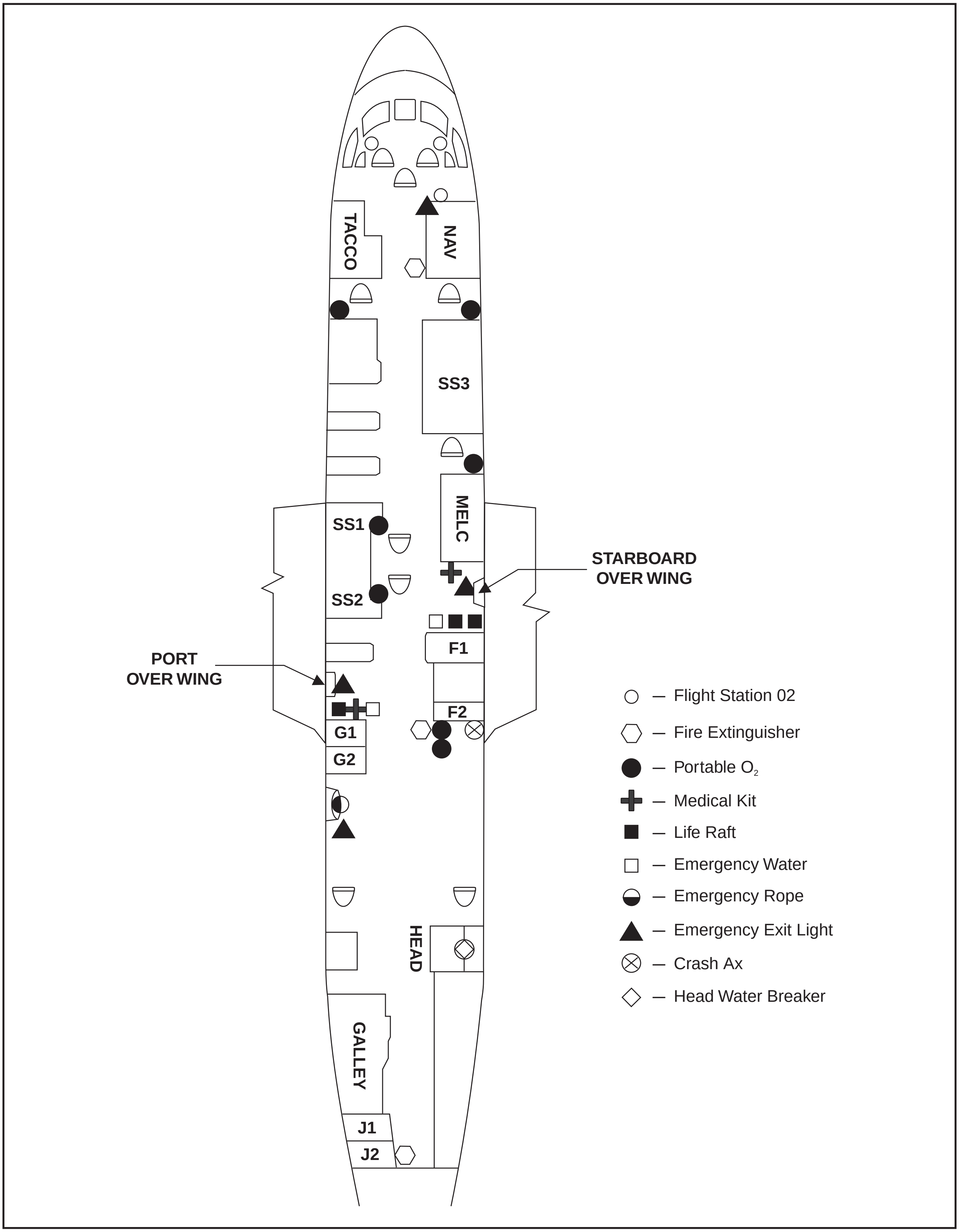


Figure 17-1. Emergency Equipment Location

exits. Some aircraft may be equipped with 12-man liferafts. Each raft has a survival kit containing equipment with the raft as prescribed in NAVAIR 13-1-6.1.

17.7 LIFE VESTS

Life vests 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 OR EQUIVALENT FLOTATION ASSEMBLY

The LPU or equivalent is designed as a constant wear item for use with the survival vest (SV-2A) and will not interfere with the removal of the non-integrated parachute harness (parachute risers are routed outside of the collar lobes). The LPU or equivalent life preserver assembly consists of a two-chambered flotation assembly, a casing assembly, two CO_2 inflation assemblies, and optional survival items and pouches. One chamber consists of the left waist lobe and right collar lobe. The right waist lobe and left collar lobe form a second chamber. Each chamber is equipped with a CO_2 inflation assembly and an oral inflation tube. 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. The waist lobes are equipped with a snaphook and a D-ring to secure them together after inflation.

17.9 SV-2A/B 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.

17.9.1 Minimum Survival Gear

1. Signal kit, personnel Mk 79 Mod 0
2. Signal light (strobe) SDU-5/E
3. Distress signal (day/night) Mk 124 Mod 0
4. Survival radio
5. Whistle
6. Survival knife
7. Pen light
8. Signal mirror
9. Shroud line cutter or hook blade knife
10. Flashlight (night)
11. Dye marker.

17.10 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 hard hat, 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.

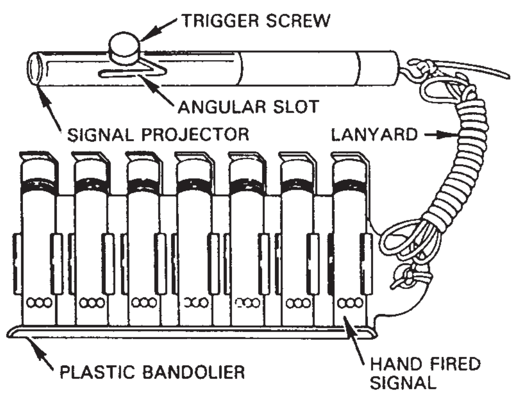
17.11 ANTI-EXPOSURE SUITS

Anti-exposure suits shall be provided for all flight personnel and passengers flying aboard P-3C aircraft 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 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 antiexposure suit.

17.12 PENCIL FLARE GUN

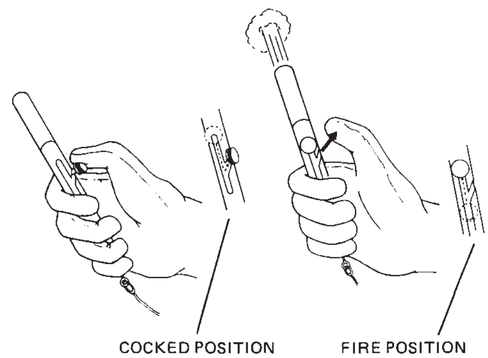


WARNING

- The pencil flare projector shall be loaded in the cocked position. Failure to follow this procedure will create a hazard to all persons in the area of loading.

- The Mk 79 Mod 0 signal kit consists of one pencil flare projector and seven signal cartridges. It is normally stored on the left side of the SV-2A/B survival vest adjacent to the centerline zipper. When the SV-2A/B is worn by a crewmember, the pencil flare 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 45º angle to slightly overhead. Pull back on trigger and release.



17.13 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 45º 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 non-combustible surface to cool.

17.14 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 at a rate of 40 to 60 flashes per minute 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.

17.15 PARACHUTE NB-8

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.

The P-3C normally has 23 parachutes aboard that are stowed as indicated in Figure 12-6.

17.16 FIRST-AID KITS

Two first-aid kits are installed in the aircraft. On P-3C 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. On P-3A/B aircraft, one is located on the outside of the aft bulkhead of the electronic bay 24, and the other is attached on the forward bulkhead of the sonobuoy storage rack. 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.

17.17 EMERGENCY WATER BREAKER

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.

17.18 EMERGENCY RADIOS

A PRT-5 or PRC-90 emergency transmitter is installed in each liferaft (the PRT-5 in the accessory container; the PRC-90 in the supply pocket). If a PRC-90 is installed, a helmet/radio speaker adapter is provided.

17.18.1 PRT-5. The transmitting set, AN/PRT-5, is a battery-operated, emergency radio that transmits on emergency guard frequencies of 8.364 MHz (8364 kHz) and 243.0 MHz, simultaneously. The 243.0 MHz Beacon activates the 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.

17.18.1.1 Characteristics

1. Range

    a. UHF — 160 nm with search aircraft at 30,000 feet using military ADF receiver.

    b. HF — varies with time of day and propagation characteristics of area.

2. Operating temperature — –40 to +131 °F.

3. Altitude — sea level to 40,000 feet.

4. Net weight — 15 pounds.

5. Antenna height

    a. UHF — 12 inches.

    b. HF — 9 feet.

6. Size (packed) — 6 inches in diameter by 16 inches long.

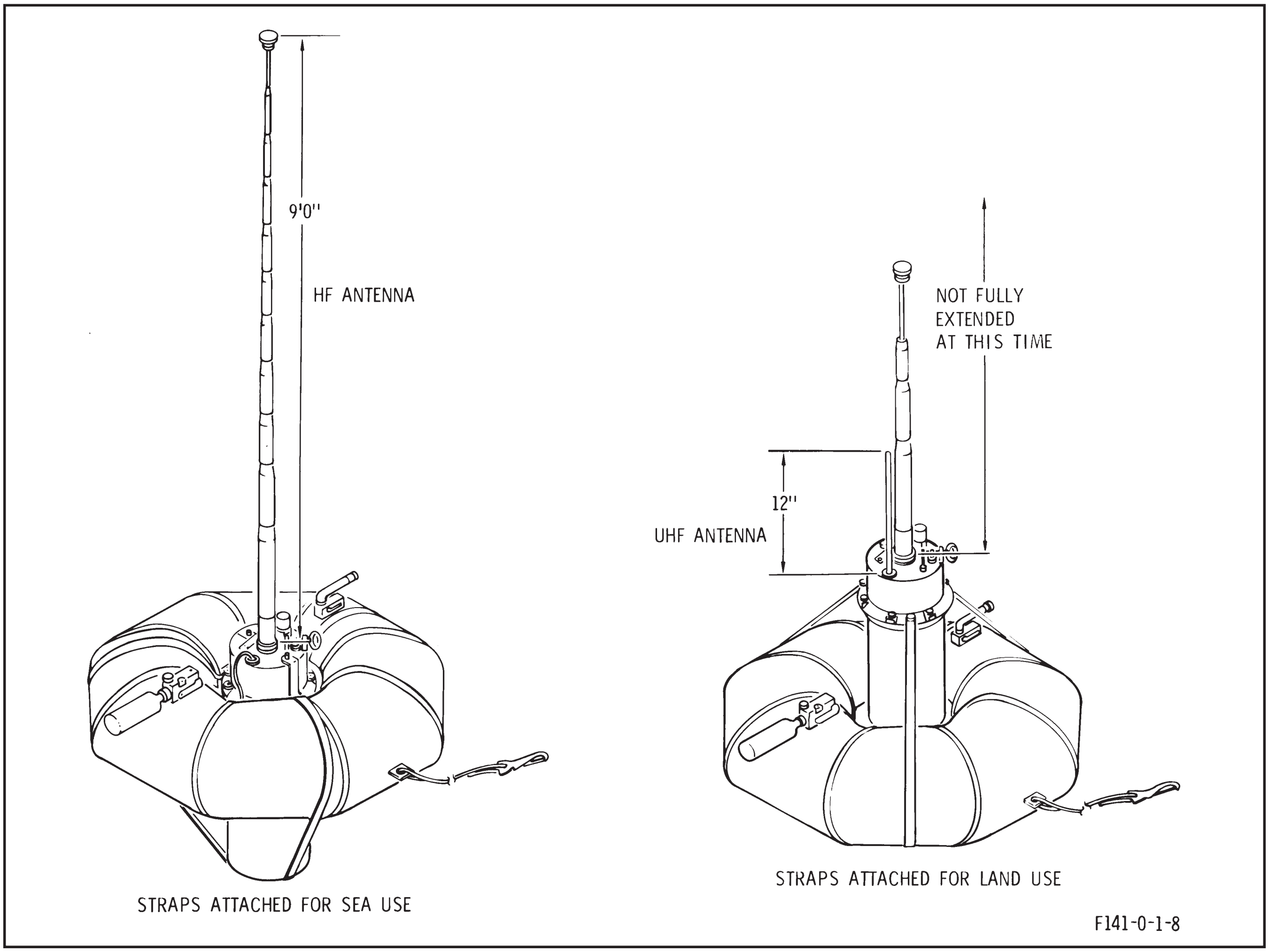


Figure 17-2. AN/PRT-5 Emergency Radio and Float Assembly

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.

17.18.1.2 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.

6. Unscrew the uppermost, knurled, top section cap of the antenna and pull each of 10 sections to full extension. When fully raised, the antenna sections are alternate black and gray with the top section gray. The antenna full length is 9 feet.

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 (varies in pitch from

1000 to 3000 Hz swept at a 2-1/2 Hz rate) 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.

17.18.2 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 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.

17.18.2.1 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.

17.18.3 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.

17.19 CRASH LOCATOR SYSTEM

The URT-26(V) crash locator system is a deployable crash-position indicator system utilizing an airfoil package containing a 243.0 MHz transmitter (radio beacon), an antenna, and a rechargeable battery pack. The radio beacon aids air-sea-land search operations by activating the SARSAT system. The airfoil package is an aerodynamically designed, plastic foam, fiberglass-encased envelope that withstands high-impact shock on release and landing and floats on water indefinitely. Sensors automatically initiate deployment of the airfoil package from the aircraft. The airfoil package then carries its payload in a predetermined, speed-reducing trajectory to the Earth’s surface outside the periphery of the aircraft impact area. The radio beacon begins operation automatically when the airfoil package is deployed and emits an emergency distress signal that can be received at a distance of 80 miles by search aircraft flying at an altitude of 10,000 feet.

Note

On aircraft incorporating AFC-374, if the crash locator becomes a screamer, it can be silenced by plugging the muting battery into the muting battery base assembly located in electronics rack J1. The battery is normally stowed in the galley stowage bag.

17.20 EMERGENCY ESCAPE BREATHING DEVICE

The EEBD is a self-contained, hooded, emergency breathing device that enables personnel to breath 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.

17.20.1 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 (see Figure 17-3). 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 to conduct medium to heavy work for a maximum of 15 minutes.

17.20.2 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.

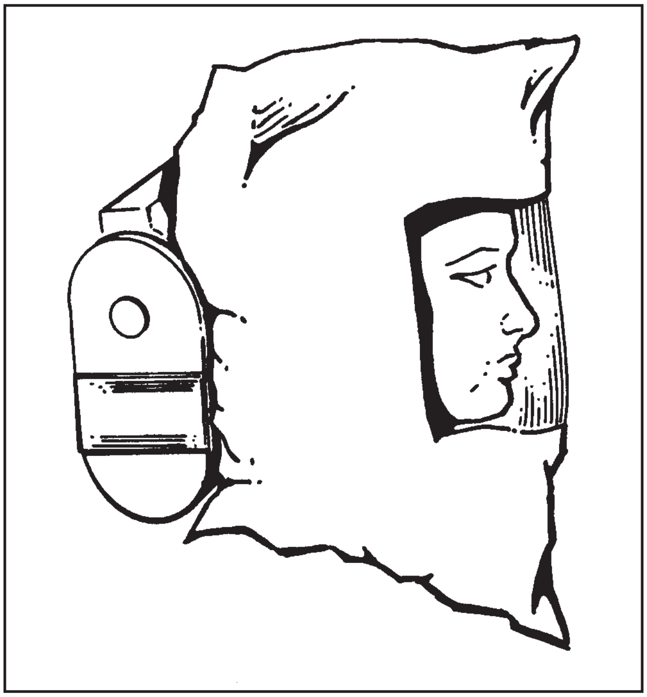


Figure 17-3. Emergency Escape Breathing Device

PART VI

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 cold 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 HOLDING PATTERNS

See the current FAA instructions for details on holding, including dimensions of the airspace reserved for holding patterns and holding pattern entry instructions.

18.4 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.

18.4.1 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.

18.4.1.1 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.

18.4.1.1.1 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.

18.4.1.1.2 Exterior Inspection. 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 that 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 that 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.

Deicing precautions:

1. When applying deicing solution with a sprayer, do not spray fluid into static ports or engine inlets as the fluid can cause corrosion damage.
2. Inform the crew when deicing is beginning to ensure personnel do not exit aircraft during the evolution.
3. 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.

4. Deicing solution is extremely slippery. Exercise caution when walking around aircraft after deicing has been completed.

5. 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 crew brief shall be held as far forward in the cabin as possible. Consideration should be given to using ICS/PA for the brief. Flight crewmembers should remain well forward after tiedown removal when ice or high winds are present.

18.4.1.2 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 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.

18.4.2 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. After engine oil has warmed above 20 °C, engines may be shifted to normal rpm. This method prevents excessive oil pressures associated with cold oil temperatures. The total recommended warmup time prior to power lever movement (blade angle change) after start is 10 minutes. This 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.

2. After engine start, leave the power levers in the start (minimum torque) position until the oil temperature reaches 0 °C. With oil temperature between 0 to 40 °C, the power levers may be set to 1,000 SHP to expedite warmup. When the oil temperature reaches 40 °C and the gearbox oil pressure shows no fluctuation, maximum power may be applied.

18.4.3 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 crew 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. The control should not be used, however, 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.

18.4.4 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.

18.4.5 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 $V_{MC\ GRD}$, V_R, and 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 lift-off speed is as follows:

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

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 lift-off.

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.

18.4.6 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 Chapter 4, Aircraft Operating Limitations, for airspeed limitations.) 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 EWO should ensure that the IRDS turret is retracted prior to entering any area of anticipated icing or hail.

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's 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.

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.

18.4.7 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 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. 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 crew 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.

18.5 TURBULENT AIR PENETRATION

Care must be taken to ensure that 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, crew comfort may be improved by reducing airspeed to a minimum of 190 KIAS (1.52 V_s above 120,000 pounds).

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 for the P-3C; for the P-3A/B, the pilot switches to AHRS and copilot switches to the inertial. 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 that all clearances and instructions are understood by the pilot. During IFR departure and arrival, the copilot ensures that primary and secondary transceivers are set on proper frequency and that 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 that checklists are completed.

2. Ensure that 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, and so forth).

18.8.2 Specific Duties

1. During descent for the approach, call out "Approaching assigned altitude" when 1,000 feet above 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 DH/ 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.

The pilot should be alert for any excessive difference between his and the copilot's altimeters, especially during the final phase of the approach.

18.8.3 Precision Approaches

18.8.3.1 Ground Controlled Approach. A GCA approach is normally made from a radar handoff from an ATC (Figure 18-1) 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

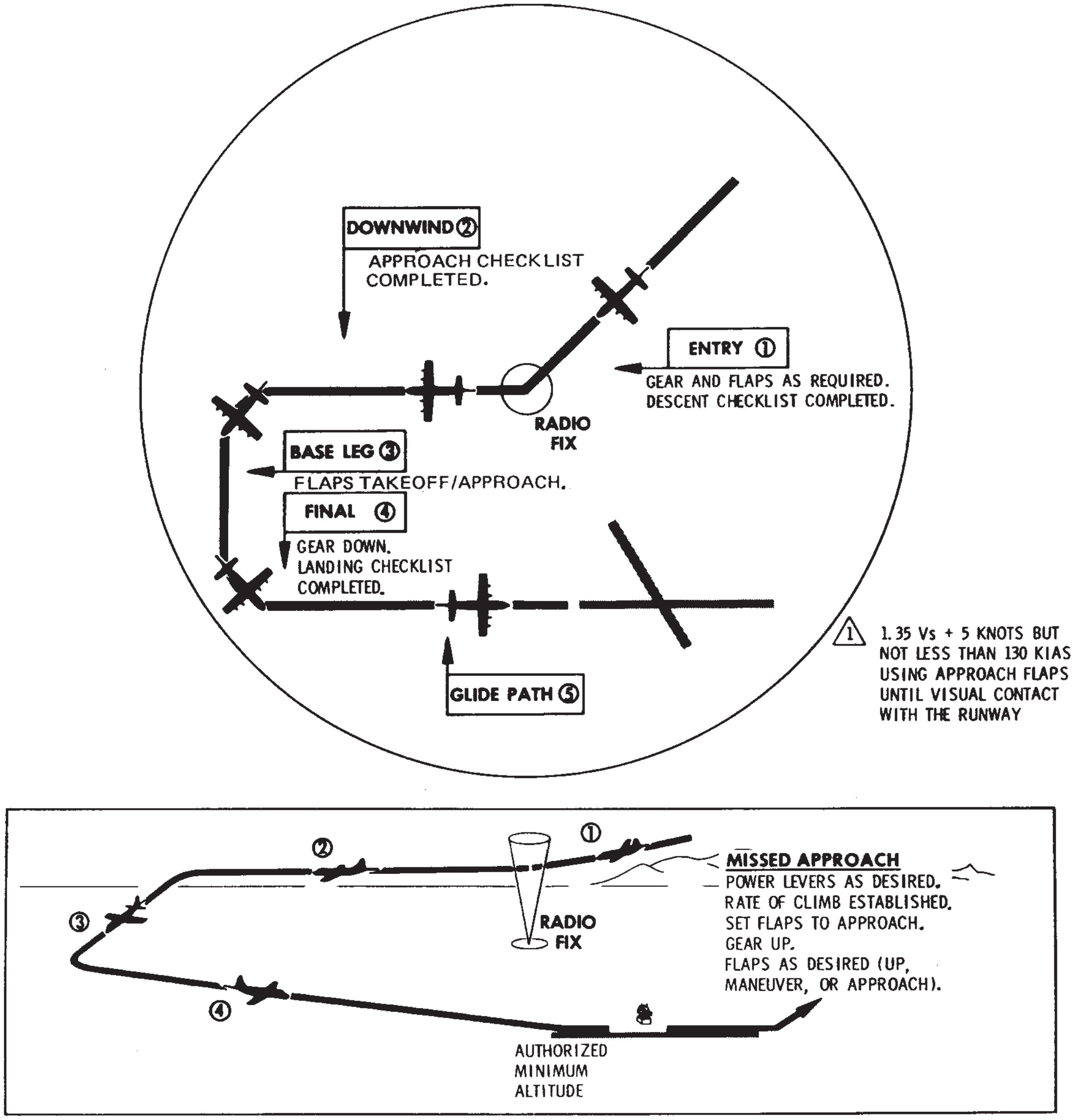
When weather is at or near GCA minimum, consideration should be given to landing with APPROACH flaps versus LAND flaps if length of runway permits. This procedure will minimize movement in aircraft pitch, a desired effect when the aircraft is maneuvered for landing during the critical transition period 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]

[1] Heading set marker can be used to set in reference headings as desired. The copilot's marker is slaved to the pilot's 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. 5 s 5 (145 MIN)
NO FLAP	1.52 V_s (160 MIN)	1.52 V_s (160 MIN)	1.5 s (160 MIN)	1. s (135 MIN)

Figure - . Typical C Pattern

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.

18.8.3.2 ILS Approach. The P-3C 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 hundredth's 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 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 fly 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-Front Course Manual Procedure.

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 that 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 18-2) 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.
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

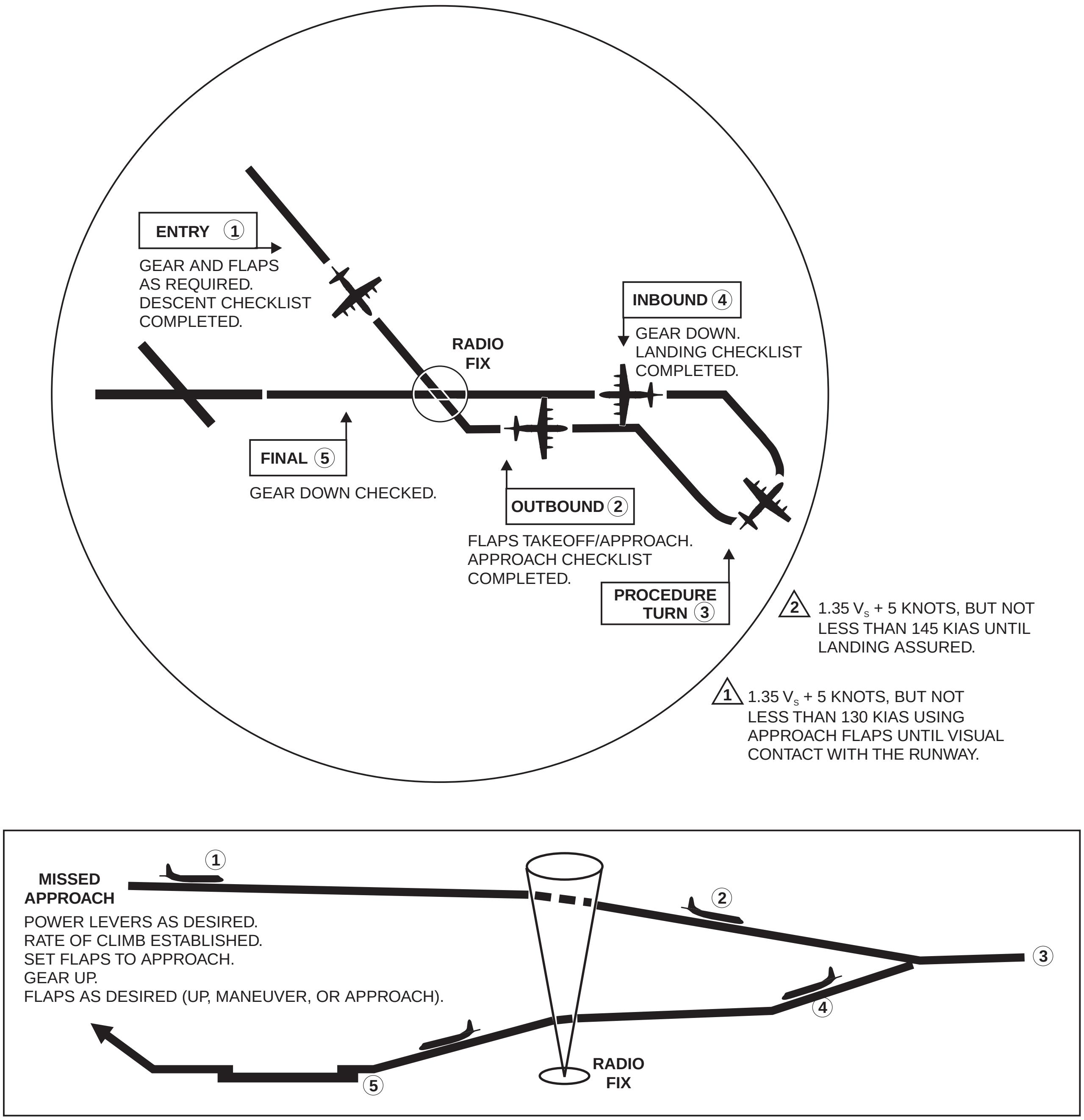
1. Use UHF-1/UHF-2 and VOR-2/VHF as primary and secondary communication frequencies as required.
2. Tune appropriate channel with TACAN channel selector.
3. Set TACAN function switch to T/R. This provides distance indication on HSIs.
4. If the TACAN is the only aid to the facility, then both pilots set 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 in the P-3C. For the P-3A/B, the heading set marker can be used for heading reference as desired.[2]

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.

[2]The heading set marker can be used for heading reference as desired.



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 -2. Typical ow- ltitude onprecision Procedure Turn pproach

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.[1]

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.[1]

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.

- UHF/DF will be degraded with AERO-65 pylons installed on the inboard stations.

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 fly 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 (P-3C).

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 fly 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.

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 that approach flaps are set, and then raise the gear. At 140 KIAS or more with gear up, set the flaps as desired.

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[1]The heading set marker can be used for heading reference as desired.

PART VII

Communication Procedures

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 (radio operator on P-3A/B) 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 (radio operator on P-3A/B) 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. He should at all times be made aware of the content of outgoing messages, however.

19.3 RADIO COMMUNICATIONS

The P-3C aircraft has either one ARC-101, ARC-197, or ARC-182 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, data link, and uplink/downlink subsurface communications (IACS). 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.

On P-3A/B aircraft, two ARC-51A transceivers, an ARC-182 VHF/UHF receiver-transmitter, two VOR receivers, and two ARC-94 SSB-HF transceivers are available for radio communications. Some aircraft have replaced UHF-2 with a SATCOM-capable ARC-187 UHF radio. Should all master control boxes become inoperative because of complete failure of the AIC-22 intercom, both HFs can be operated by plugging in a microphone and earphones directly.

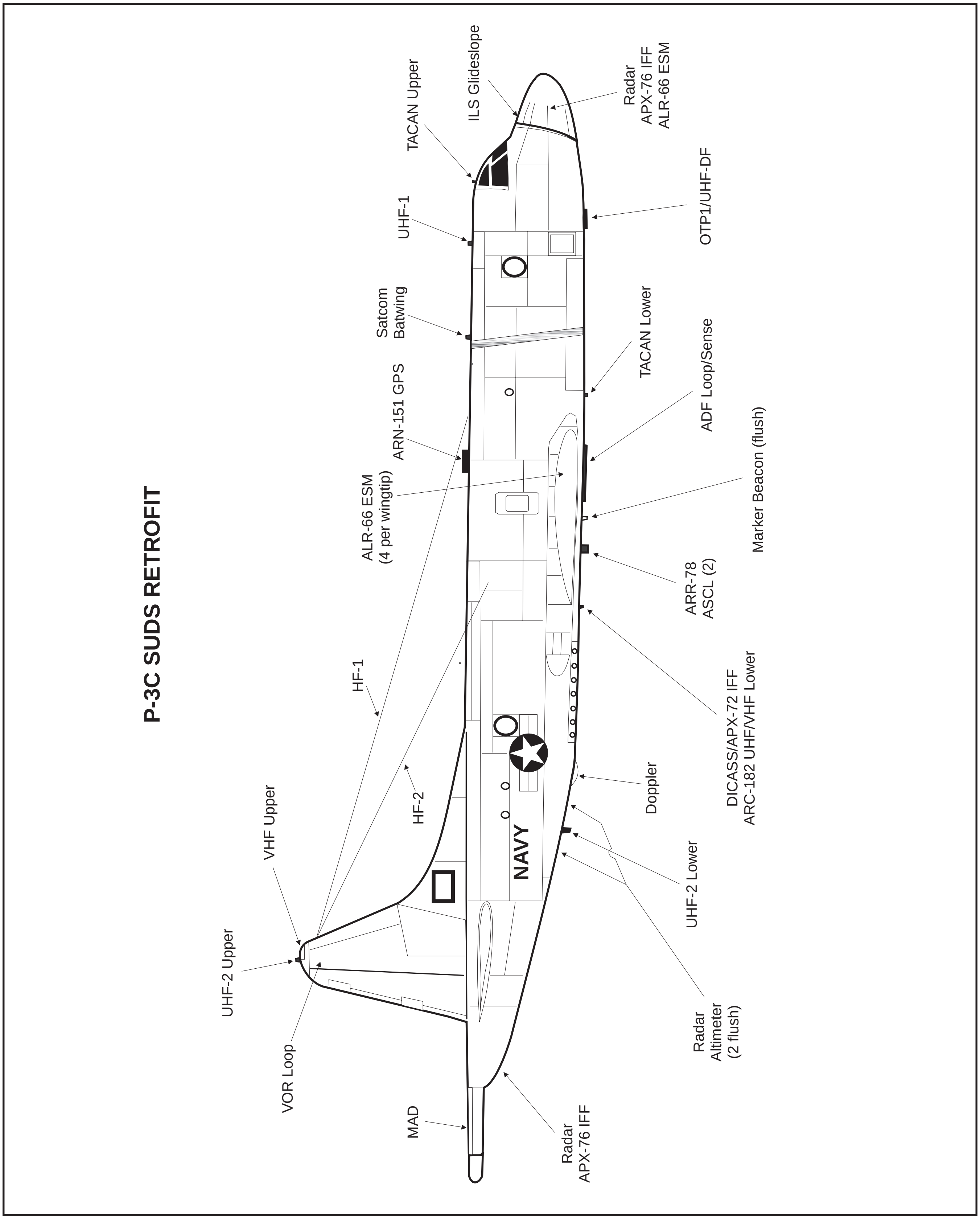


Figure 19-1. Antenna Locations — P-3C (Sheet 1 of 5)

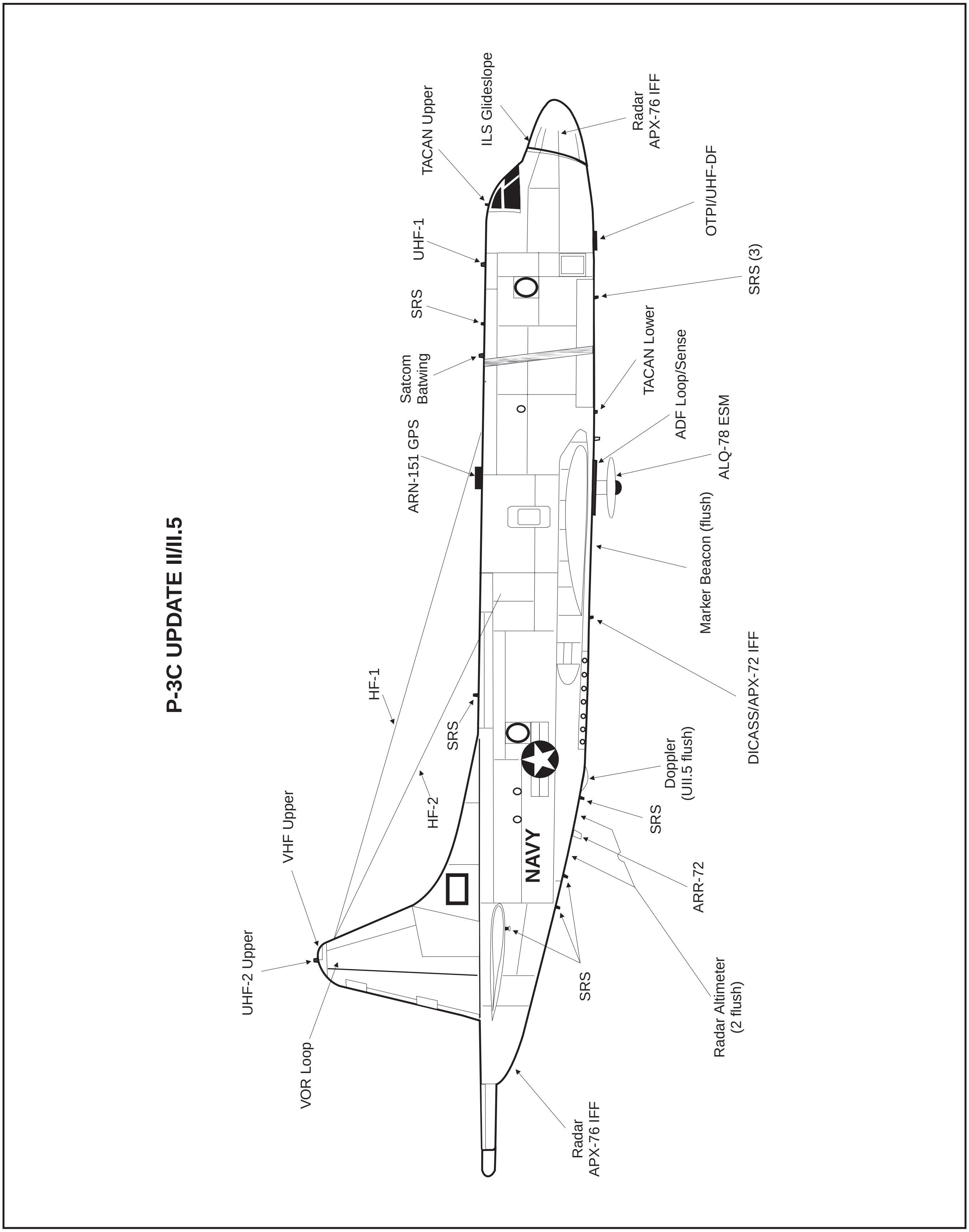


Figure 19-1. Antenna Locations — P-3C (Sheet 2 of 5)

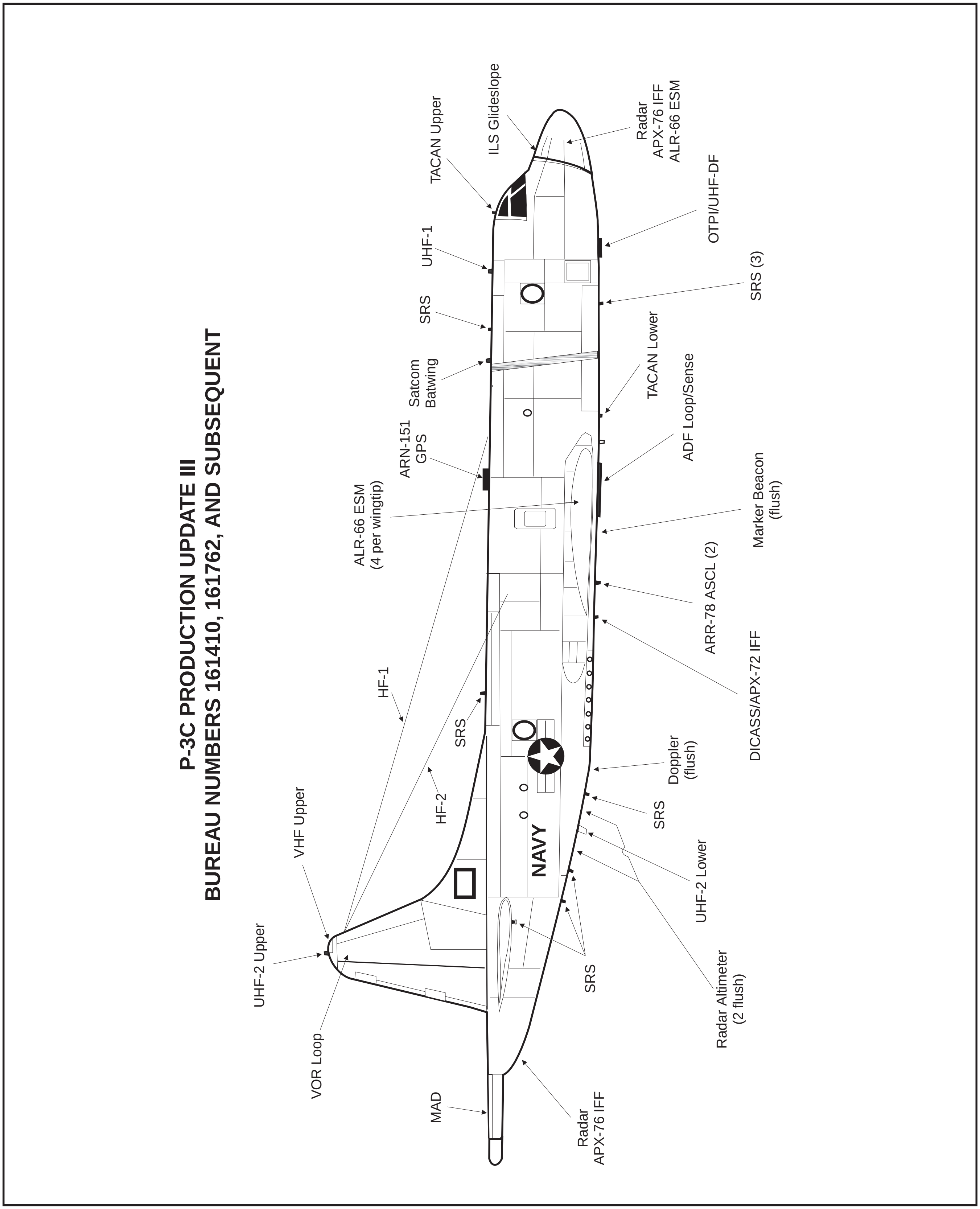


Figure 19-1. Antenna Locations — P-3C (Sheet 3 of 5)

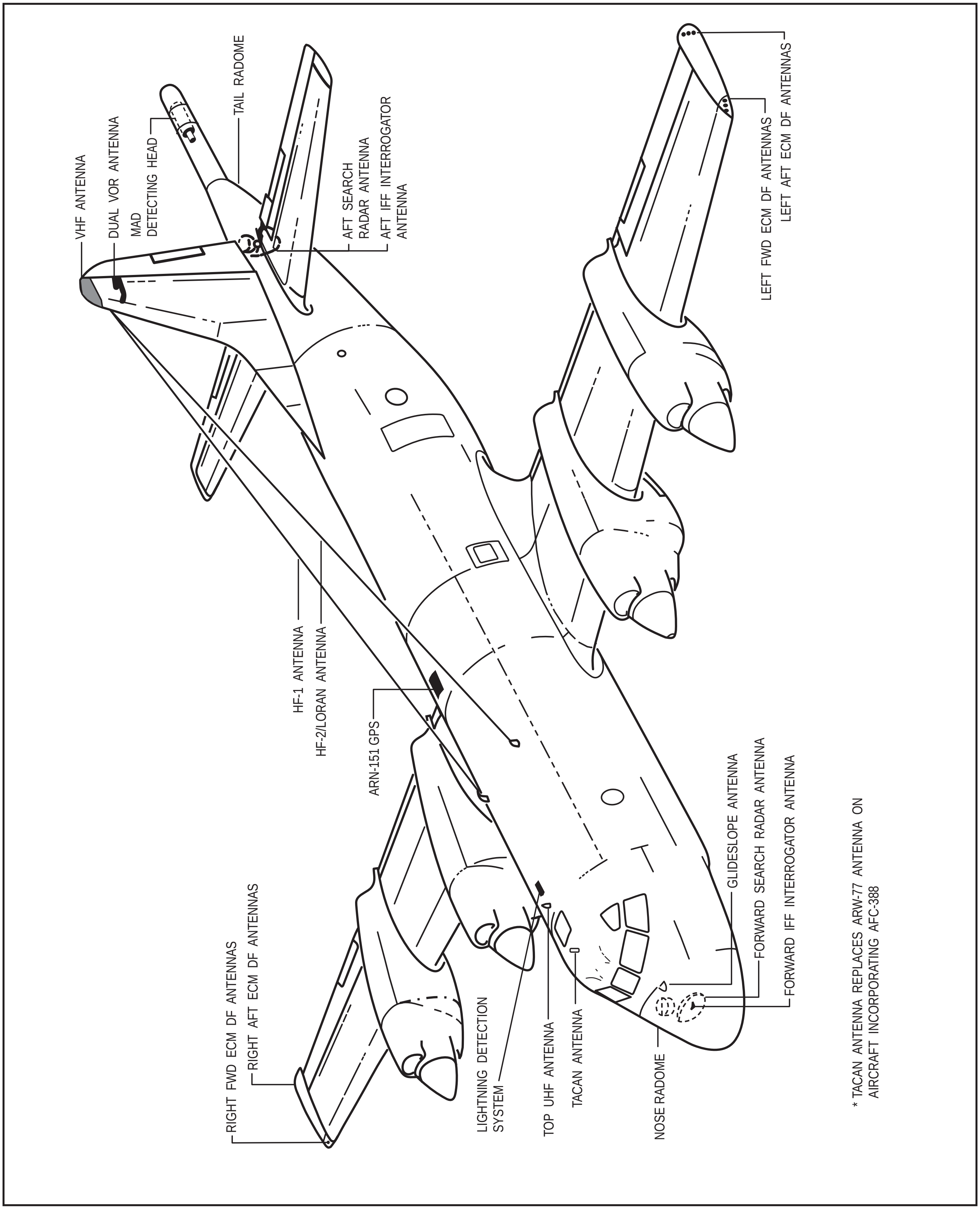


Figure 19-1. Antenna Locations — P-3A/B (Sheet 4 of 5)

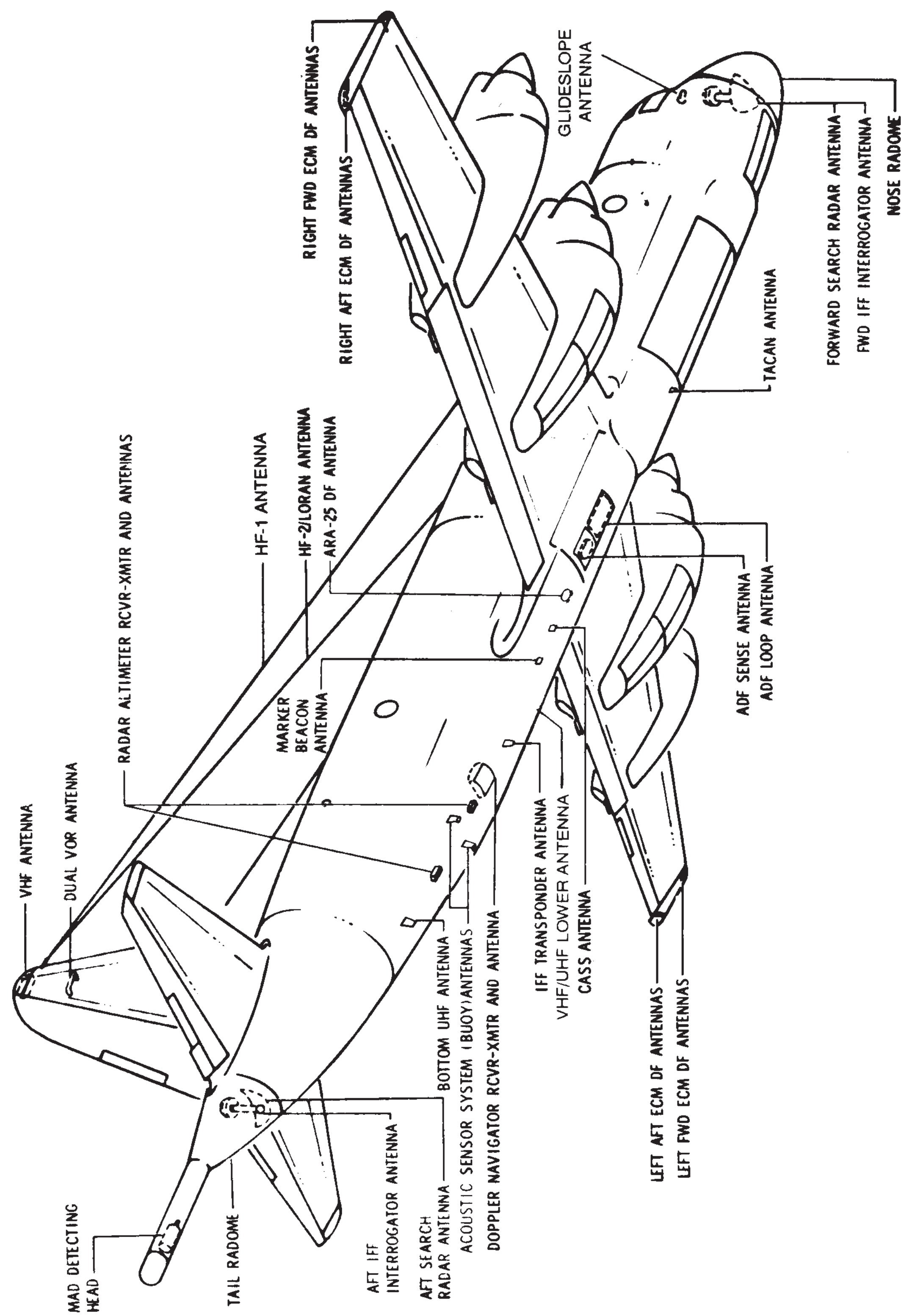


Figure 19-1. Antenna Locations — P-3A/B (Sheet 5 of 5)

CHAPTER 20

Communication Equipment

20.1 P-3C 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 non-acoustic 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 the F-2 rack. 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, and 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

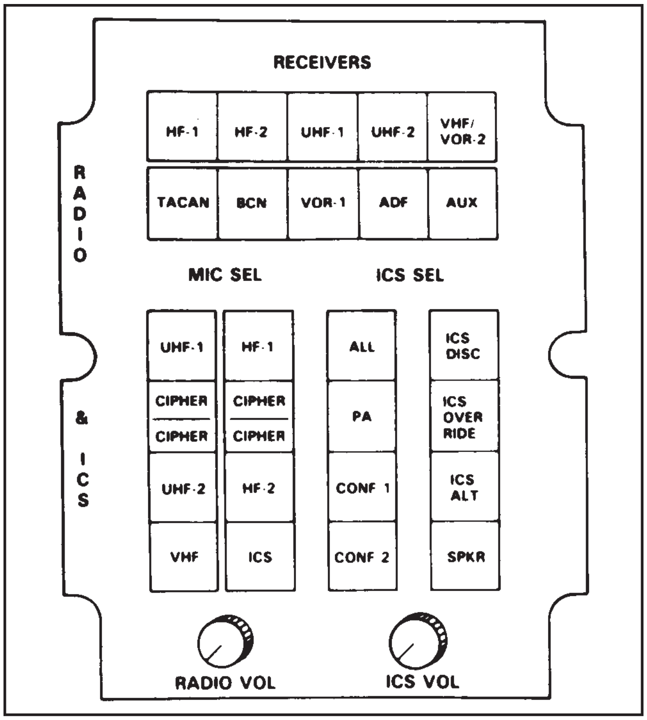
20.1.1.1 ICS Master Control Panel. The ICS master control panel is installed at the pilot, copilot, TACCO, and NAV/COMM stations. Each control panel contains 24 switchlights and two volume controls. The master control boxes are internally identical, and the functions differ by the connecting lines into 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 for approximately 5 milliseconds 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.

20.1.1.2 ICS Crew Station Control Panel. The ICS crew station control panel is installed at the flight engineer station, acoustic operator station Nos. 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. A green RECORDING AVAILABLE light on the control panel advises the pilot that the AQH-4 is operating and available for recording. In the OFF position, ICS ALL is recorded anytime the AQH-4 is on (Figure 20-3).



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 switch-light 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

PANEL MARKING	FUNCTION
MIC SEL (cont.)	mode (not selectable). When transmitting on one of the HF radios, the other HF MIC SEL and REC switchlight will be dark.
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).

Figure 20-1. ICS Master Control Panel (Sheet 1 of 2)

PANEL MARKING	FUNCTION
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 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)

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-72 sonobuoy receiver system or the ARR-78 ASCL receiver (Update III aircraft).

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 station nos. 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

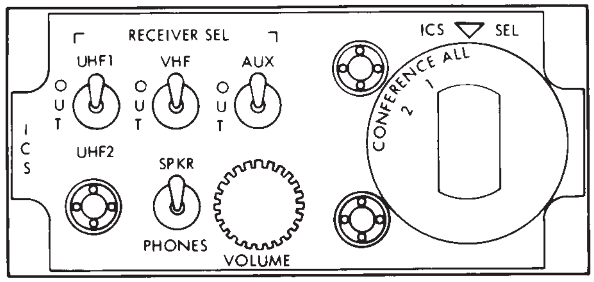
The adjustment controls inside the speaker assemblies are to be adjusted by qualified technicians only.

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.

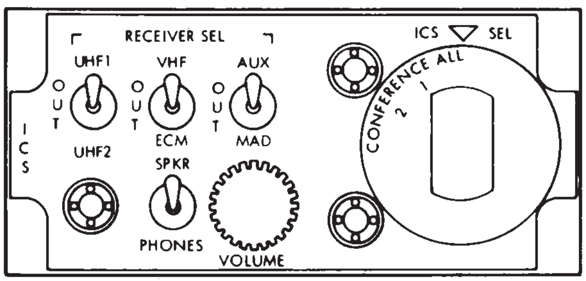
20.1.1.8 Flightcrew Smoke Mask Microphone. The flightcrew smoke mask microphone is a dynamic microphone with an audio frequency amplifier built into the mask. It is used by the flightcrew in case of a smoke or fumes hazard in the flight station. Smoke masks are installed as loose equipment in the storage 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 position, the smoke mask is connected to the ICS system. With the switch in the NORMAL position, the smoke mask microphone is not connected.

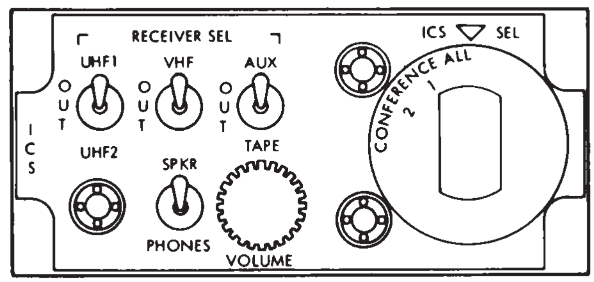
20.1.1.10 Flight Engineer Smoke Mask Microphone Switch. The flight engineer smoke mask ICS control panel located on the console below the flight station forward load center, is provided for the



FLIGHT ENGINEER STA, L&R OBSERVER STA, GALLEY



NONACOUSTIC OPERATOR



ACOUSTIC OPERATOR

PANEL MARKING	FUNCTION
RECEIVER SEL:	
UHF-1 UHF-2 VHF	Selects the indicated radio audio on crew ICS control panels. UHF-1 and UHF-2 cannot be monitored simultaneously.
OUT	No radio audio is heard.
AUX	Monitors the radio or NAV AID selected on the ICS Interconnection Box in rack B-3.
ECM MAD	Available only at the nonacoustic operator station. **Note** 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.

PANEL MARKING	FUNCTION
ICS SEL:	
ALL CONFERENCE 1 CONFERENCE 2	Connects the microphone and headset audio to the ICS ALL, CONFERENCE 1, or CONFERENCE 2 circuit. **Note** ICS ALL will always be heard in the headset in addition to the line selected on the ICS select switch.
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 by 10 dB.
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

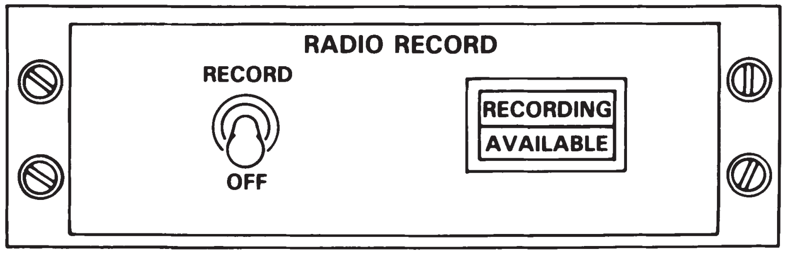


Figure 20-3. Pilot Radio Record Control

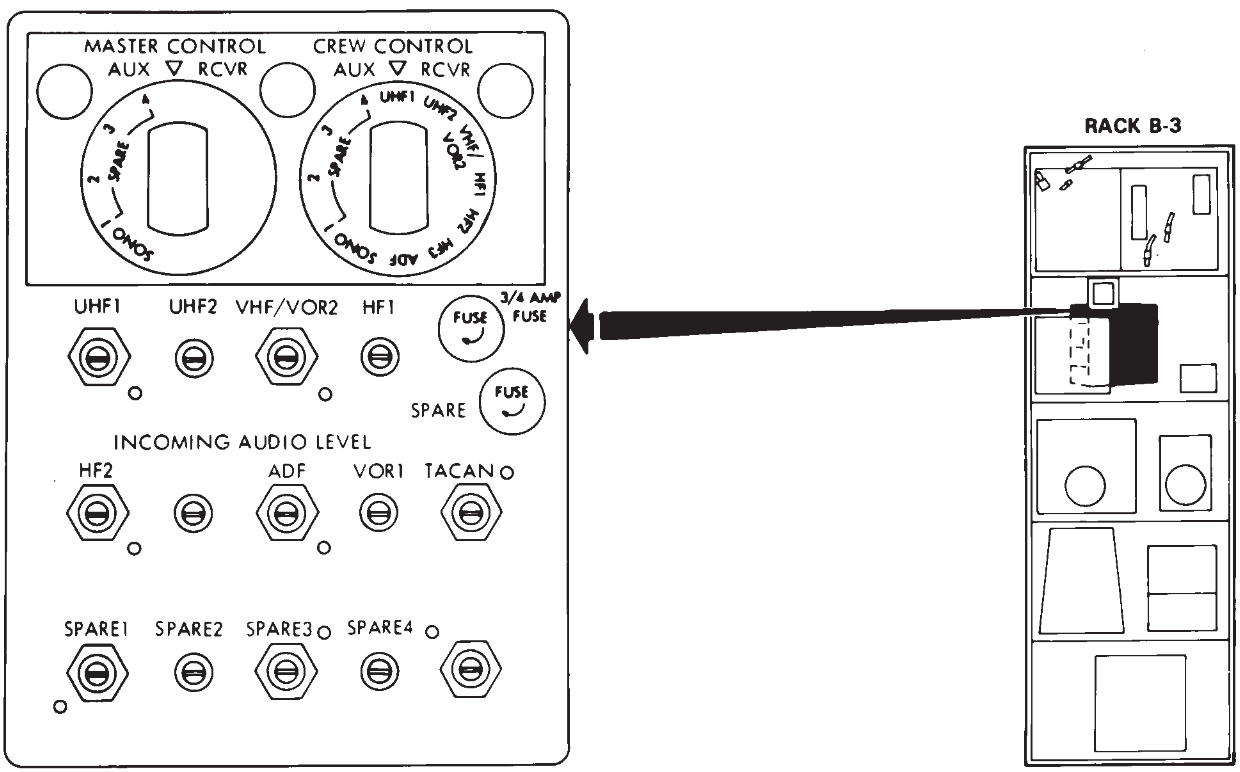


Figure 20-4. ICS Interconnection Box

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).

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).

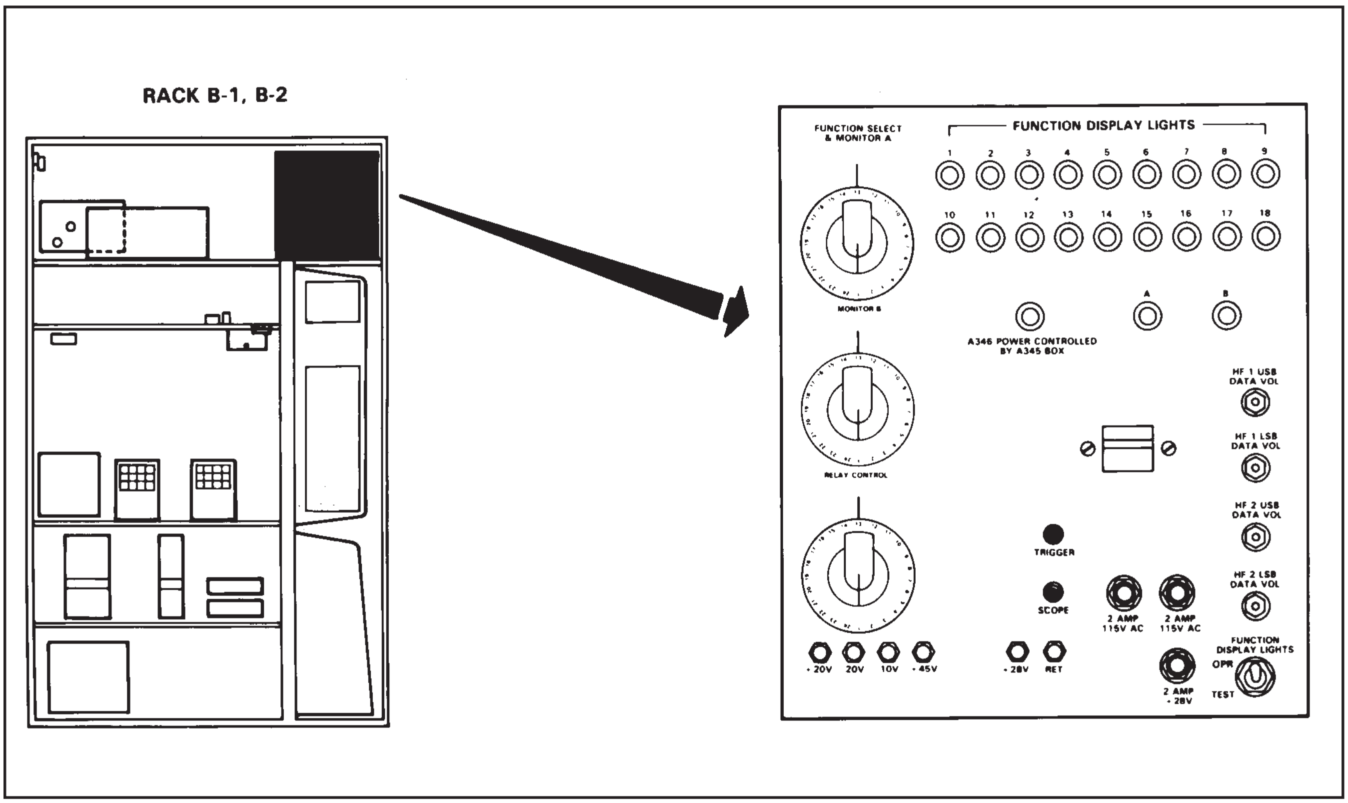
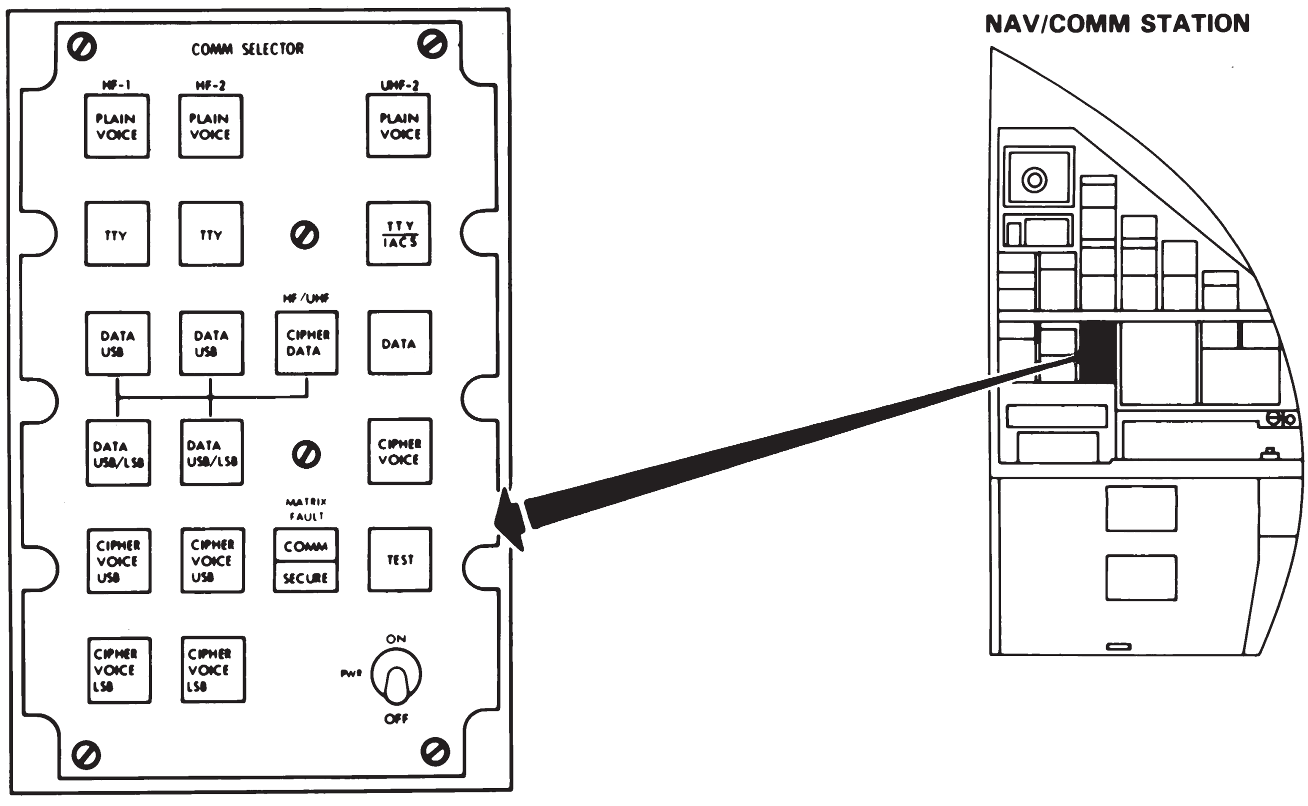


Figure 20-5. Communication Switching Matrix



SELECTOR	CONDITIONS			
	DARK (not available for selection)	**GREEN (available for selection)**	**AMBER (selection made)**	**CONNECTIONS MADE (when amber)**
HF PLAIN VOICE	OFF, TEST, or 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 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 3)

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 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 are selected at COMM selector panel.	HF DATA USB/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 are 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.
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 are 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 AM audio and keyline.

Figure 20-6. Communication Selector Panel (Sheet 2 of 3)

SELECTOR	CONDITIONS			
	DARK (not available for selection)	GREEN (available for selection)	AMBER (selection made)	CONNECTIONS MADE (when amber)
UHF-2 TTY/IACS	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.
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 3 of 3)

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 interaircraft 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.

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

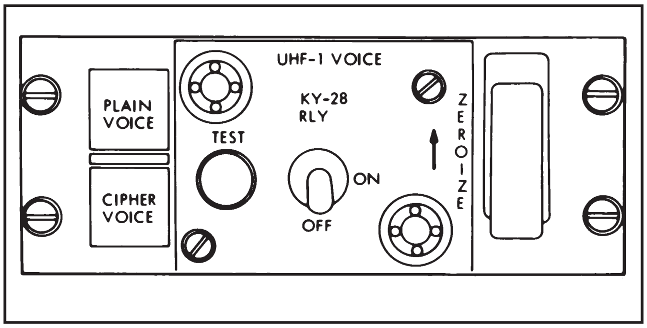


Figure 20-7. UHF-1 Cipher-Voice Select Panel

disabled (see paragraph 20.5, UHF Radio System) 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 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

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 **Note** On Update III aircraft breaker is moved to Main Load Center Panel 3 Upper.	UHF-1	MEDC
Secure Switching Matrix	Forward Electronic	SECURE VOICE	MEAC MEDC

Figure 20-8. Circuit Breaker Locations and Power Sources

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. 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 P-3A/B INTERCOMMUNICATION SYSTEMS

20.2.1 Intercommunication System (ICS) AIC-22 Components and Controls. The interphone system, through several levels of control, provides flexible, convenient intercommunications, radio monitoring, and where applicable, transmitter control to 14 flightcrew stations and 2 groundcrew stations. DC electrical power for ICS is supplied from monitorable essential DC bus through the AIC-22 circuit breaker on the forward left electronic circuit-breaker panel. The various interphone components and functions are described in the following paragraphs. Refer to Part VII for additional information.

20.2.1.1 Mike Smoke Mask-Normal Switch Panels. Three ICS MIKE SMOKE MASK-NORMAL switches are provided in the flight station. One each is located on the pilot and copilot side consoles and the third below the flight engineer ICS control box. These switches control microphones installed in the smoke masks. With the ICS MIKE SMOKE MASK position, the smoke mask microphone is connected to the associated jackbox and, in the case of the pilot and copilot positions, it is connected to the ICS master control panel and the selected interphone or radio transceiver circuit.

20.2.1.2Master Control Panel. Master control panels are located at the pilot, copilot, radio operator, navigator, and tactical coordinator stations. Each of these boxes provides a multiplicity of control functions as described below (see Figure 20-9).

20.2.1.2.1Microphone Selector Switch. The MIC SEL switch connects the station microphone, keying device, and headset to the selected interphone or radio transmitter-receiver circuit.

Note

- When the MIC SEL switch is placed in either HF position on any master ICS control, keying the microphone will not key the transmitter unless VO is selected for that transmitter on the C11176/AGC-9 HF switch selector panel. The radio operator, who has primary control, should be consulted prior to using HF-1 or HF-2.

- The pilot and copilot have direct control over frequency selection and operation of VHF and UHF-1 transmitters. When using the UHF-2 transmitter, the pilot or copilot should advise the tactical coordinator of desired frequency and type of operation.

20.2.1.2.2 ICS Selector Switch. The ICS SEL switch connects the station to the desired ICS line. The switching selections available to the various stations are determined by the individual station tactical and operational requirements. Therefore, the master control boxes are interchangeable except for the ICS SEL control knob and panel markings.

20.2.1.2.3 Speaker-Phone Switch. The SPEAKER PHONES toggle switch in the SPEAKER position parallels the station loudspeaker with the headset. The exception to this is the navigator station. Because there is no loudspeaker assigned to the navigator, the SPEAKER-PHONES switch is inoperative.

20.2.1.2.4 Alternate Switch. The alternate switch (placarded ALT) is provided to supply a source of audio in the event of a headset amplifier failure. The pilot switch, when placed in the ALT position, connects the pilot headset to the copilot headset amplifier. Similarly, when the copilot switch is placed in the ALT position, it connects his headset to the pilot headset amplifier. All audio selected on the ICS panel of the headset amplifier being utilized is heard in both headsets. The TACCO and navigator, radio operator and STBD FWD observer are also respective alternate stations.

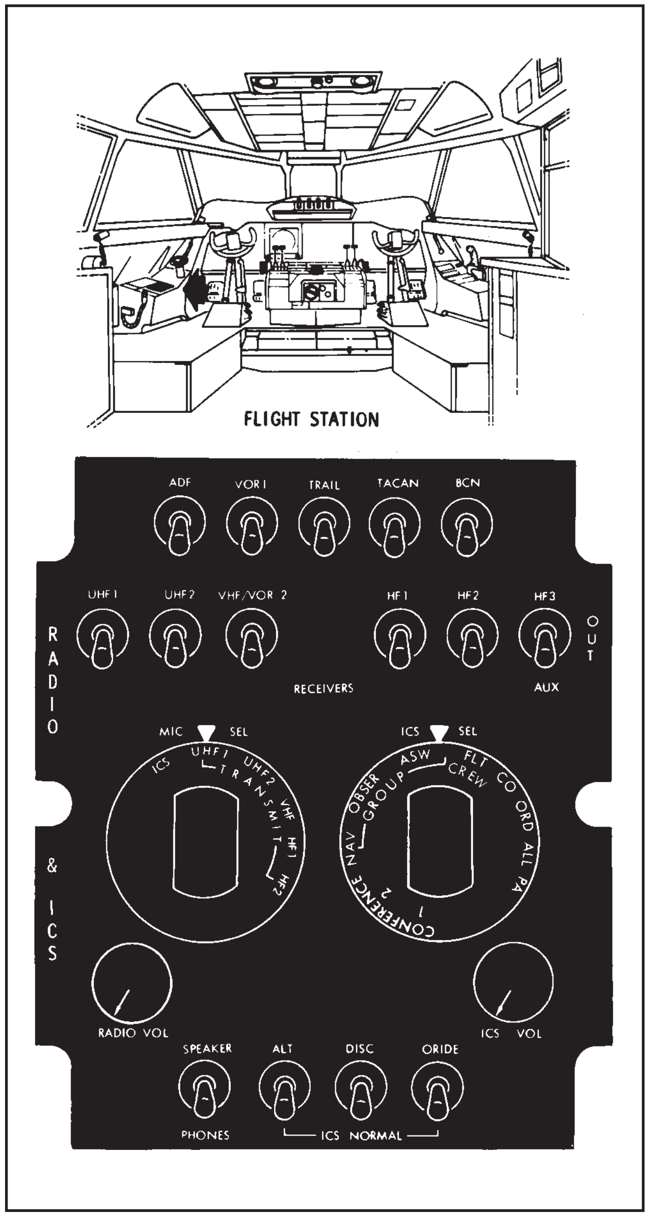


Figure 20-9. Pilot ICS Control Panel (P-3A/B)

Note

When ALT has been selected on one pilot ICS panel, care should be taken to prevent the selection of DISC at the other pilot panel. If this situation exists, no incoming ICS calls can be heard by either pilot.

20.2.1.2.5 Disconnect Switch. The disconnect switch in the DISC position disconnects the station from ICS to allow uninterrupted radio communications.

Override operation of sufficient priority by another station will bypass this function (see notes at bottom of Figure 20-10).

20.2.1.2.6 ORIDE Switch. The ORIDE switch at the pilot or copilot station may be used to contact all stations in the aircraft except wheelwells and MAD boom. The tactical coordinator ORIDE switch may be used to override any disconnects except pilot or copilot. The override function is not operable from any other station.

20.2.1.2.7 Radio Monitor Switches. Eleven toggle switches on the master control panels are used to monitor the various radio and audio circuits in the aircraft. One of the switches is three-position, center OUT, to make it possible to monitor a total of 12 circuits with the 11 switches. The AUX position of the three-position switch connects it to the audio circuit selected by the master control AUX RCVR selector at the ICS interconnection box. The 10 remaining receiver or audio circuits are the ADF, VOR-1, TACAN, BCN (marker beacon), UHF-1, UHF-2, VHF/VOR-2, HF-1, HF-2, and HF-3 (if installed).

20.2.1.2.8 ICS Volume Control. The ICS VOLUME control provides ICS audio level control.

20.2.1.2.9 Radio Volume Control. The RADIO VOLUME control provides audio level control for incoming receiver audio.

20.2.1.3 Control Wheel ICS/Transmission Switch. This allows the pilot to select ICS or radio transmission.

20.2.1.4 Knee Switch Disconnect. The pilot and copilot each have knee-operated disconnect switches located on their respective control yokes. The knee switches may be used in lieu of, and in the same manner as, the toggle switch disconnect (see notes at bottom of Figure 20-10).

20.2.1.5 Crew Control Panel. Crew control panels are located at the following crew stations: flight engineer, right forward observer, sensor 3, sensor 1 and sensor 2, ordnanceman, right aft observer, left aft observer, and galley. Functions provided by these panels are described in the following paragraphs.

20.2.1.5.1 ICS Selector Switch. The ICS SEL switch connects the station to the desired ICS line. The switch selections available to the various stations are determined by the individual station's tactical and operational requirements. Therefore, the crew control boxes are interchangeable except for the ICS SEL control knobs and panel markings. The TAPE REC position on the ICS SEL switch at sensor station 1 and 2 is deactivated and has no function.

20.2.1.5.2 Receiver SEL Switches. The RECEIVER SEL switches allow crew monitoring of the various receivers in the aircraft. A three-position switch connects the station to either UHF-1 or UHF-2. The center switch is connected to the VHF receiver line with two exceptions: the center switch on the sensor 3 control panel connects to the ECM receiver, and the center switch on the sensor 1 and 2 control panel connects to the tape recorder. The AUX toggle connects the station to the radio circuit selected by the crew control switch at the ICS interconnection box. Eight receivers are available through this auxiliary switching method.

Note

- The tape receiver select switch at sensor stations 1 or 2 must be selected in order to monitor ICS or pilot's headset audio recording by the tape recorder.
- On aircraft incorporating ALR-66, the ICS disconnect switch located above the ICS control panel enables the sensor 3 operator to disconnect from the ICS. This enhances the operator's ability to detect weak ESM audio.
- An ICS DISC-NORMAL switch, located on the sono audio selector panel at sensor stations 1 and 2, is provided to disconnect all normal incoming intercom calls and permits uninterrupted tape recorder or sonobuoy audio monitoring. The NORMAL position allows all ICS calls to be received.

20.2.1.5.3 Volume Control. The VOLUME control, using two ganged potentiometers, provides simultaneous radio level control for ICS and radio reception. Operating the volume control determines the volume of incoming intercom calls and receiver signals. The radio volume is automatically reduced approximately 10 dB when an intercom call is directed to or from the respective station. The volume level is automatically restored upon completion of the intercom call.

20.2.1.6 ICS Interconnection Box. The ICS interconnection box (Figure 20-11), located in the forward left electronic rack, provides interconnection between the radio receiver outputs and the various ICS stations. Two rotary selector switches are provided to allow optional selection of the various receivers for

	ICS LINE	ALL	PILOT-COORD. LINE	FLIGHT CREW GROUP	NAV LINE	ASW GROUP	OBSER GROUP	CONF # 1	CONF # 2	OVERRIDE CONTROL	ICS DISCONNECT*	PUBLIC ADDRESS (HDSTS & SPKRS)
NOSE WHEELWELL		X										
PILOT		X	X	X	X	O	O	O	O	E	D	CXS
COPILOT		X		X	X	O	O	O	O	E	D	CXS
FLIGHT ENGINEER		X		X				O	O			X
RADIO OBSERVER		X		O	X	O	O	O	O		D	XS
RIGHT FWD OBSERVER		X		O		O	X	O	O			X
SENSOR 3**		X		O		X		O	O			X
SENSOR 1		X				X		O	O		D	X
NAVIGATOR		X		O	X	X	O	O	O		D	X
TACTICAL COORDINATOR		X	X	O	X	X	O	O	O	E	D	XS (2)
SENSOR 2		X				X		O	O		D	X
ARMAMENT LOADER		X				X		O	O			XS (3)
RIGHT AFT OBSERVER		X		O		O	X	O	O			X
LEFT AFT OBSERVER		X		O		O	X	O	O			X
GALLEY		X		O		O	X	O	O			XS
TAIL BOOM		X										

Note

- Pilot and copilot can override a disconnect at any station; tactical coordinator can override a disconnect at any station except pilot and copilot.
- If pilot and copilot simultaneously operate control column disconnect switches, only the pilot is disconnected.
- If pilot and copilot disconnect toggle switches are both in DISCONNECT position, neither station is disconnected; pilot ICS audio is transferred to the copilot and vice versa.
- In order to ensure radio silence, all radio MIC SEL switches on the pilot and copilot ICS master control panel must be deselected. When the pilot or copilot ICS switch is keyed, the radio that is selected on the MIC SEL function of the ICS master control box may be key for approximately 5 milliseconds. This is due to relay delays in the ICS box that can result in detectable transmission of RF energy.

LEGEND

X	Incoming call connected at all times regardless of selection of that station
O	Incoming call connected when selected at that station
C	Control of PA
D	Ability to disconnect ICS
S	Loudspeaker installed
E	Override control of disconnected stations

* ICS audio transfer is affected when ICS DISCONNECT is selected as follows: pilot to copilot, copilot to pilot, radio to forward right observer, navigator to tactical coordinator, tactical coordinator to navigator, sensor 1 to sensor 2, sensor 2 to sensor 1.

** There are two sensor 3 ICS crew control panels in aircraft incorporating AFC-373.

Figure 20-10. Intercommunication Line Grouping (P-3A/B)

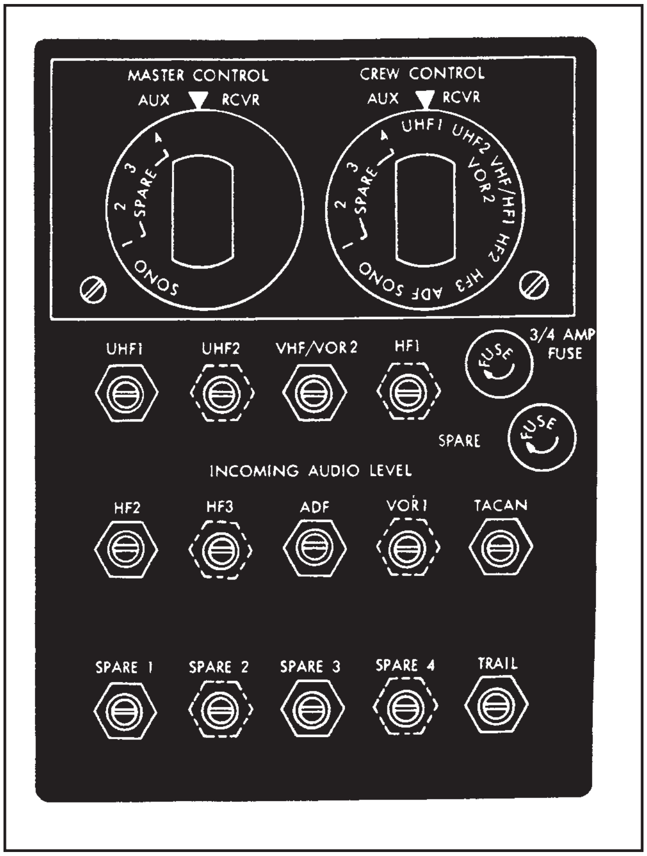


Figure 20-11. ICS Interconnection Box — P-3A/B

connection to the AUX line for selection with the AUX toggle switches of the ICS stations. The master control connects the audio from the TACCO left DCCI control to the master ICS control stations when SONO is selected. The crew control can connect any one of eight different receivers to the AUX line for the crew ICS control stations.

Also provided by the ICS interconnection box are screwdriver-adjustable, audio-level potentiometers for controlling the level of receiver audio from each of the several audio sources.

SPARE positions on the selector switches and SPARE level adjust potentiometer are unused.

20.2.1.7 Universal Jackbox. Each ICS station is provided with a universal jackbox to adapt the ICS system to the use of 99-U headsets and dynamic boom microphones or standard headsets and M-92/U handheld microphones. Two additional universal jackboxes are provided. One, controlled by the TACCO's master control box, is located on the main electrical load center. The other, controlled by the ordnance station (sono chute loading panel) is located immediately forward of the bunk in the rear of the aircraft.

20.2.1.8 Service Jackbox. Service jackboxes are installed at the groundcrew positions, nose wheelwell, and the tail boom.

20.2.1.9 Loudspeakers. One speaker is installed at the pilot, copilot, and radio station; two at the TACCO station, three in the ordnance area, and one in the galley. Each speaker assembly consists of an isolation amplifier, muting circuitry, output level control, PA level control, and the associated speaker. Access to the three adjustments is gained by removing the small cover on the face of the assembly.

Note

Three potentiometers are used to control volume level in each loudspeaker. They are adjusted by maintenance personnel and should not be adjusted by the flightcrew except when absolutely necessary. The speaker volume control is used to adjust for normal speaker volume with the PHONES-SPEAKER switch in the SPEAKER position. PA volume is used to adjust for normal speaker volume when using the speakers as a PA system. Muted volume is used to adjust for proper attenuation of speaker volume when the microphone is keyed at that station. Adjustments are made for use of a dynamic microphone; use of a carbon microphone will necessitate readjustment.

20.2.1.10 ICS Extensions. A universal jackbox located on the main electrical load center is connected in parallel with the TACCO station and is equipped with a 15-foot cord and preamplifier. The ordnance station has a parallel-connected universal jackbox located just forward of the lower bunk in the galley area. These remote positions are controlled by their respective ICS control panels.

20.2.1.11 Intercommunication Functions

20.2.1.11.1 Fixed Group Lines. Seven of the intercommunication groups are interconnected so that all stations in a group will receive calls addressed to that group regardless of the receiving circuits selected at the stations (see Figure 20-10). Individual stations can defeat this feature by selecting the DISC position of the ICS disconnect switch on the master ICS control panel (Figure 20-9). The ICS SEL switch on master ICS control panel is used to select the group desired. The groups and stations selected by the ICS SEL switch positions are as follows:

1. PA (all stations except wheelwells and MAD boom) — The PA line is available to either the

pilot or copilot and permits the pilot or copilot to call every speaker and every headset in the aircraft regardless of local station switch selection. However, the pilot cannot call the nose wheelwell or MAD boom stations.

2. ALL (all stations) — The ALL line is available to all ICS stations, including the groundcrew stations. Any call addressed to this line will be received by every station except those using the disconnect function. The pilot or copilot can call every station by selecting ALL and ORIDE simultaneously regardless of any receiving station disconnect switch setting. Groundcrew stations are always on the ALL line.

3. ASW — Sensor 3, navigator, TACCO, sensor 1, sensor 2, ordnanceman.

4. FLT CREW — Pilot, copilot, flight engineer.

5. OBSER GROUP — Forward right observer, aft right observer, aft left observer, galley.

6. NAV — Pilot, copilot, navigator, TACCO, radio operator.

7. COORD — Pilot, TACCO. (This line is available only to the pilot and TACCO.)

20.2.1.11.2 Conference Lines. Two conference lines, CONFERENCE 1 and 2, are available to all flightcrew stations to permit optional grouping of any desired stations.

20.3 ARC-101/ARC-197 VHF RADIO SYSTEM

VHF capability is provided for voice communication with commercial airfields and airways stations in the 116.0 to 149.95 MHz range (ARC-101 and ARC-197). 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-101 and ARC-197. For further discussions on these particular systems, refer to Chapter 22, Mission Equipment.

20.3.1 ARC-101 Operating Procedures

1. Close circuit breakers at the aft electronic circuit breaker panel.

2. VOL switch — Rotate CW from OFF position.

3. Mode selector switch — VOR.

Note

Use in the T/R position only when frequencies 116.00 to 118.00 are to be used for communication.

4. Frequency — Rotate tuning knobs until desired frequency is visible in center window.

5. SQ control — As desired (operative only in reception mode). Check operation of SQ control on control panel. Maximum squelch is obtained when the control is fully counterclockwise.

6. RECEIVERS VHF/VOR-2 pushbutton-indicator (on ICS master control panel) — Press. Pushbutton indicator illumination changes from green to amber. Equipment is now adjusted for operation as a receiver. (Equipment operation is simplex; although, the second receiver may be used for multiplex operation.) To transmit, continue with step 7.

7. MIC SEL VHF pushbutton indicator (on ICS master control panel) — Press. Pushbutton indicator changes from green to amber. Microphone circuit is now connected to the transmitter.

8. Press microphone push-to-talk switch to key transmitter and transmit.

20.3.2 ARC-197 Operating Procedures[1]

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.

[1]Aircraft BUNO 161122,161132, and subsequent

20.3.3 ARC-197 and ARC-101 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.

20.4 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. This VHF/UHF radio system does, however, share the bottom VHF/UHF antenna with the IFF system and also with the 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.

20.4.1System Components

20.4.1.1 C-10319A VHF/UHF Radio Set Control. The radio set control (Figure 20-12) 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.

20.4.1.2 RT-1250A Receiver-Transmitter. The receiver-transmitter, located in electronics rack J-2 (Figure 20-13), 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 20-14. 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.

20.4.1.3 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.

20.4.1.4 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.

Note

Selection of the top VHF antenna, when using a UHF frequency, will effectively cancel the transmission because of the in-line UHF RF filter. The UHF filter is installed to prevent reflected RF energy, caused by the VHF antenna characteristics from being returned to the receiver.

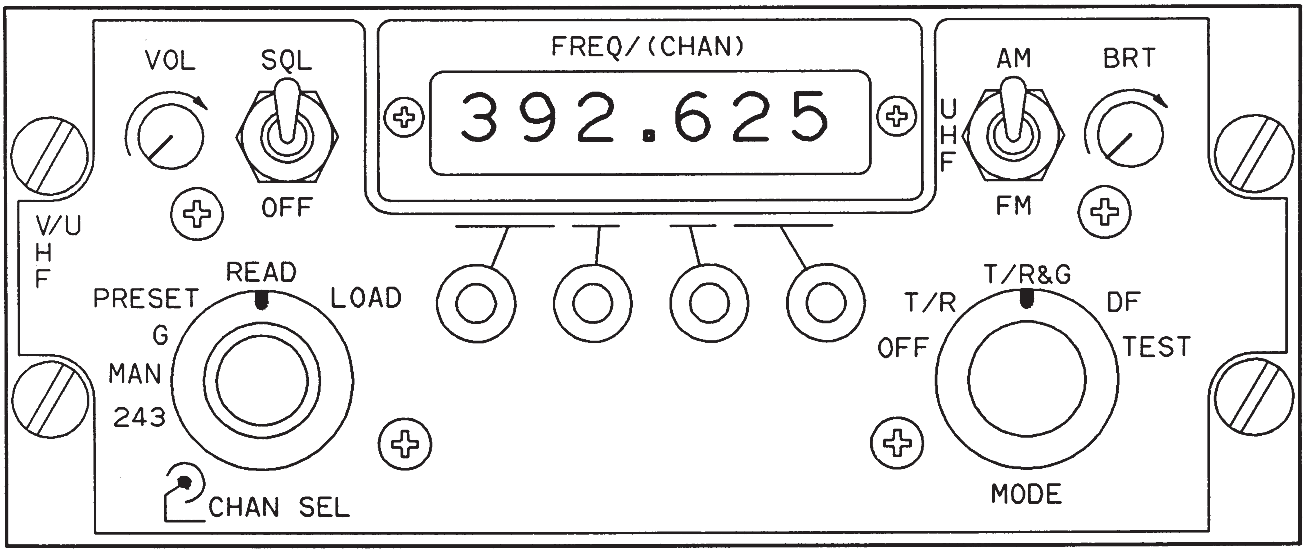
20.4.1.5 Radio/CASS Selector. Located at the acoustic operator station, this switch allows CASS transmissions using the lower VHF/UHF antenna. When CASS is selected, no UHF voice communications are possible; however, VHF transmissions are possible using the top VHF tailcap antenna.

Note

Selecting the bottom VHF/UHF antenna for CASS transmissions prohibits UHF radio transmissions using the ARC-182 VHF/UHF radio system.

20.4.2 System Description. Refer to Figure 20-14 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.



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.
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 + 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.

Figure 20-12. VHF/UHF Radio Set Control Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
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.
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).
PRESET	Allows selection of any one of 30 preset operating frequencies. Used in conjunction with the CHAN SEL switch.
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 20-12. VHF/UHF Radio Set Control Panel Markings and Functions (Sheet 2 of 2)

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 tailcap antenna. UHF transmissions are only possible when using the lower UHF antenna.

20.4.3 Operating Procedures

Note

Selection of frequencies outside the authorized ranges (below 30 MHz, 88 through 107.975 MHz, and 174.000 through 224.975

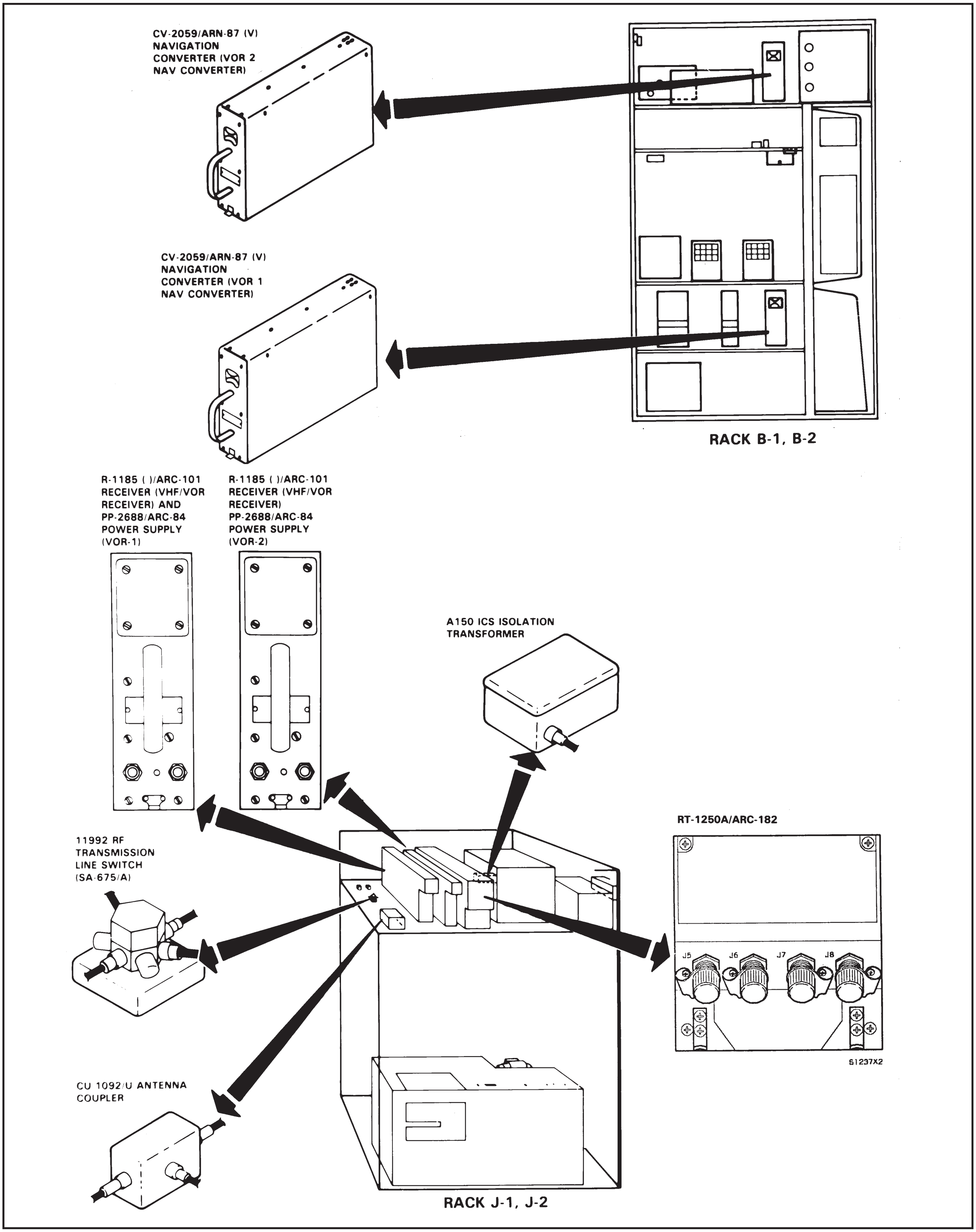


Figure 20-13. ARC-182 VHF/UHF Radio System Component Locations

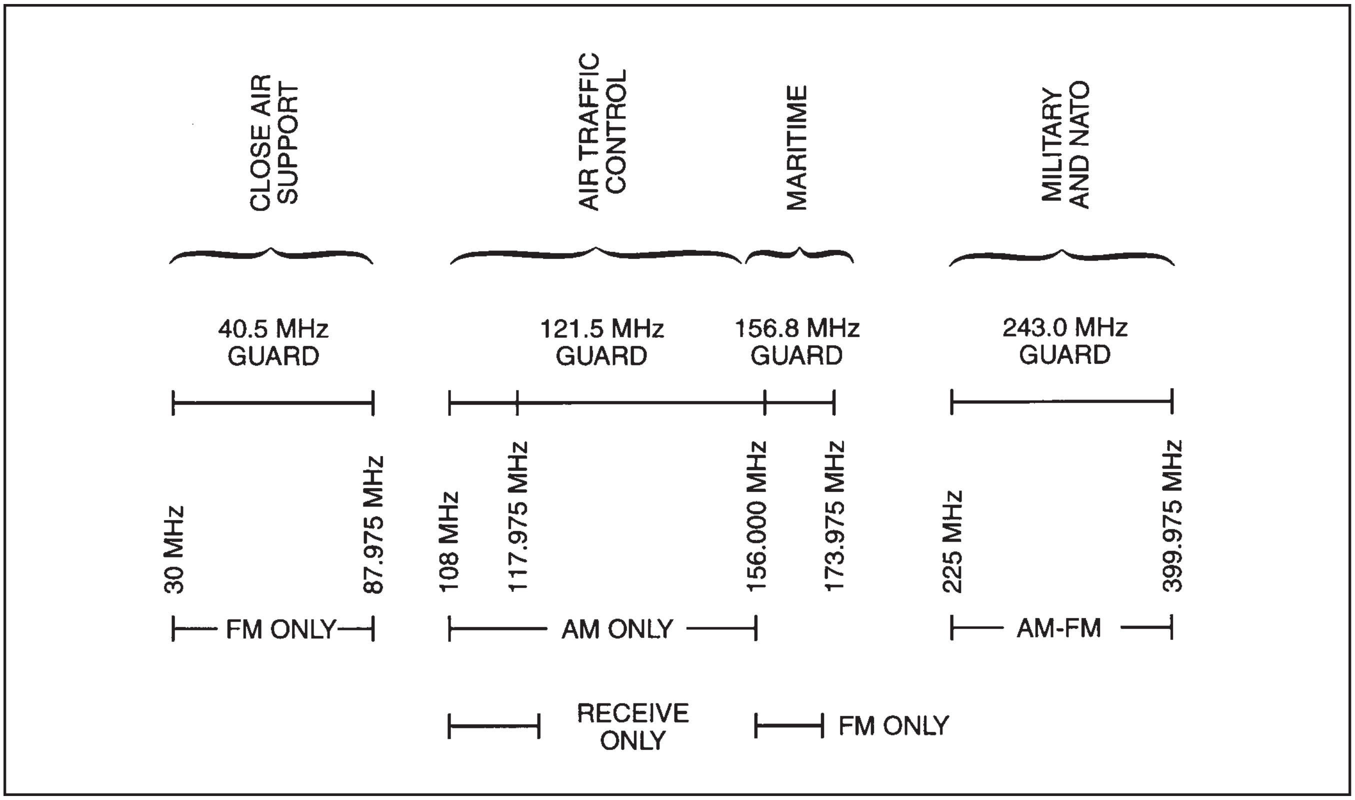


Figure 20-14. ARC-182 VHF/UHF Operating Frequency Bands

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. 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.

20.4.3.2 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.

20.4.3.3 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 20-14.

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.

20.4.4 Built-In Test. The 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 20-15).

20.5 UHF RADIO SYSTEM

20.5.1 UHF-1 Normal Operation

1. Close circuit breakers at forward right electronic circuit breaker panel. (P-3 A/B only.)

2. Connect headset microphone and make sure AIC-22 is operational.

3. Select UHF on interphone MIC SEL.

4. Using channel preset procedure previously described, set up all desired channels on preset drum.

5. Set function switch to T/R. Allow 2 minutes minimum warmup for ARC-51A system.

6. CHAN selector to desired channel. System should now operate normally.

7. If manual frequency selection is desired, turn left side function switch to MAN for ARC-51A system.

MODE	DISPLAY	FAULT	INTERPRETATION
RCV	•	RT LOL OR RMT CONT	SELECT TEST MODE
XMT	•	REDUCED PWR HIGH VSWR	SELECT TEST MODE
TEST	888.888	NONE	RT AND CONTROL. OK
TEST	0 6 1	VSWR	RT OR ANTENNA SYSTEM
TEST	6 5 1	FWD PWR	MODULES A6, A5, OR A1 FAULT
TEST	2 2 1	LOL	MODULES A2 OR A1 FAULT
TEST	1 5 7	RT	MODULES A1, A5, OR FUSE FAULT
TEST	3 3 3	RT	MODULE A3 FAULT
TEST	3 3 2	RT	MODULE A3 or A2 FAULT
TEST	3 2 4	RT	MODULE A3, A2, OR A4 FAULT
TEST	1 5 7	INTFCE OR RT	NO RESPONSE
TEST	•	RMT CONT	DEFECTIVE CONTROL

Figure 20-15. Radio Set Control Built-In Test Indications

8. To automatically tune the main receiver and the transmitter to 243.0 MHz, turn the left-side function switch to GD XMIT for ARC-51A system.

9. To operate the guard receiver in addition to any selected main receiver and transmitter frequencies, turn function switch to T/R + G.

10. Select desired antenna with flight deck antenna selector switch.

11. To activate AN/ARA-25 for direction finding, turn function switch to ADF position. ADF readout will be subject to flight deck HSI bearing selector operation. Operation of UHF-1 to ADF will automatically place UHF-2 on top antenna when transmitting on UHF-2 regardless of antenna selector position.

20.5.2 UHF-2 Normal Operation

1. Same as for UHF-1 except control panel is located at the tactical coordinator station, and ADF function is not usable.

20.6 ARC-143 UHF RADIO SYSTEM

Two identical ARC-143 UHF transceivers are installed in the P-3C 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, sonobuoy command, and IACS.

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 20-16 shows component locations, panel markings, and functions of the UHF radio system components and a simplified block diagram. Figure 20-17 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, TTY, or IACS; 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 FSK for teletype and IACS. Discussion on mode forcing is contained in paragraph 20.1.2, P-3C Intercommunication System. 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 (see paragraph 20.1.3, Operating Procedures description). 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.

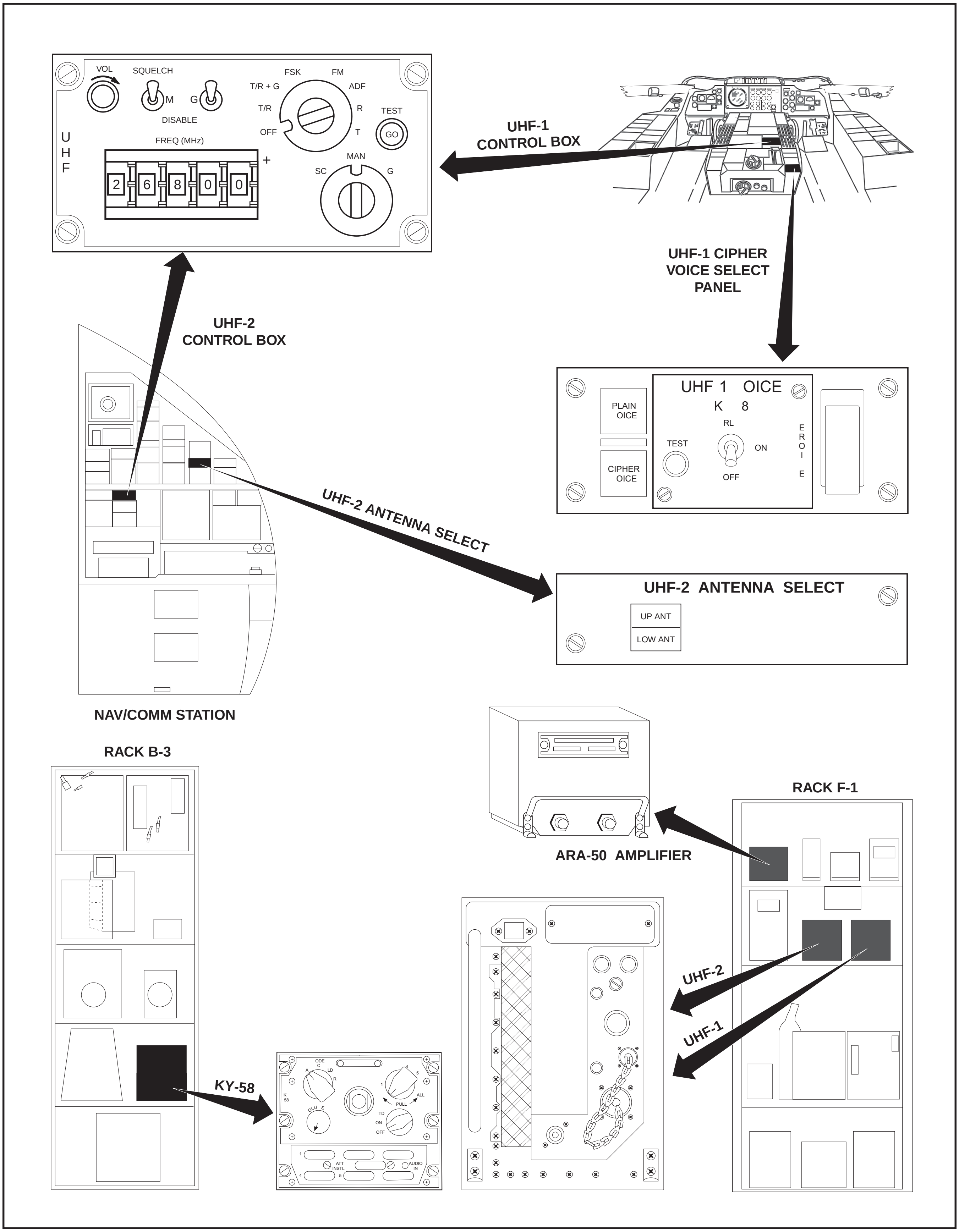


Figure 20-16. UHF Radio System (Sheet 1 of 2)

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.
T/R	AM T/R on the selected frequency. Enables mode forcing 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.
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 20-16. 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 20-17. Circuit Breaker Locations and Power Sources

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, Chapter 10, 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.

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 ARC-187 UHF RADIO SYSTEM

Two ARC-187 UHF radio systems are installed in the aircraft (Figure 20-18). 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 voice, teletype, or data-link mode, in plain or cipher operation, and has a DF function. Additionally, the ARC-187 UHF system has built-in provisions for SATCOM and HAVE QUICK 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, or data-link operation.

20.7.1 System Components

20.7.1.1 RT-1571 Receiver-Transmitter. The receiver-transmitters (UHF-1 and UHF-2) are mounted in electronics 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.

20.7.1.2 C-1190 Radio Set Control. The UHF-1 radio set control is located in the flight station and the UHF-2 control is located at the NAV/COMM station.

The radio set control (Figure 20-19) 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.

20.7.1.3 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.

20.7.1.4 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.

20.7.1.5 Circuit Breakers. Circuit breaker location and power sources for the two ARC-187 UHF radio systems are listed in Figure 20-20.

20.7.2 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

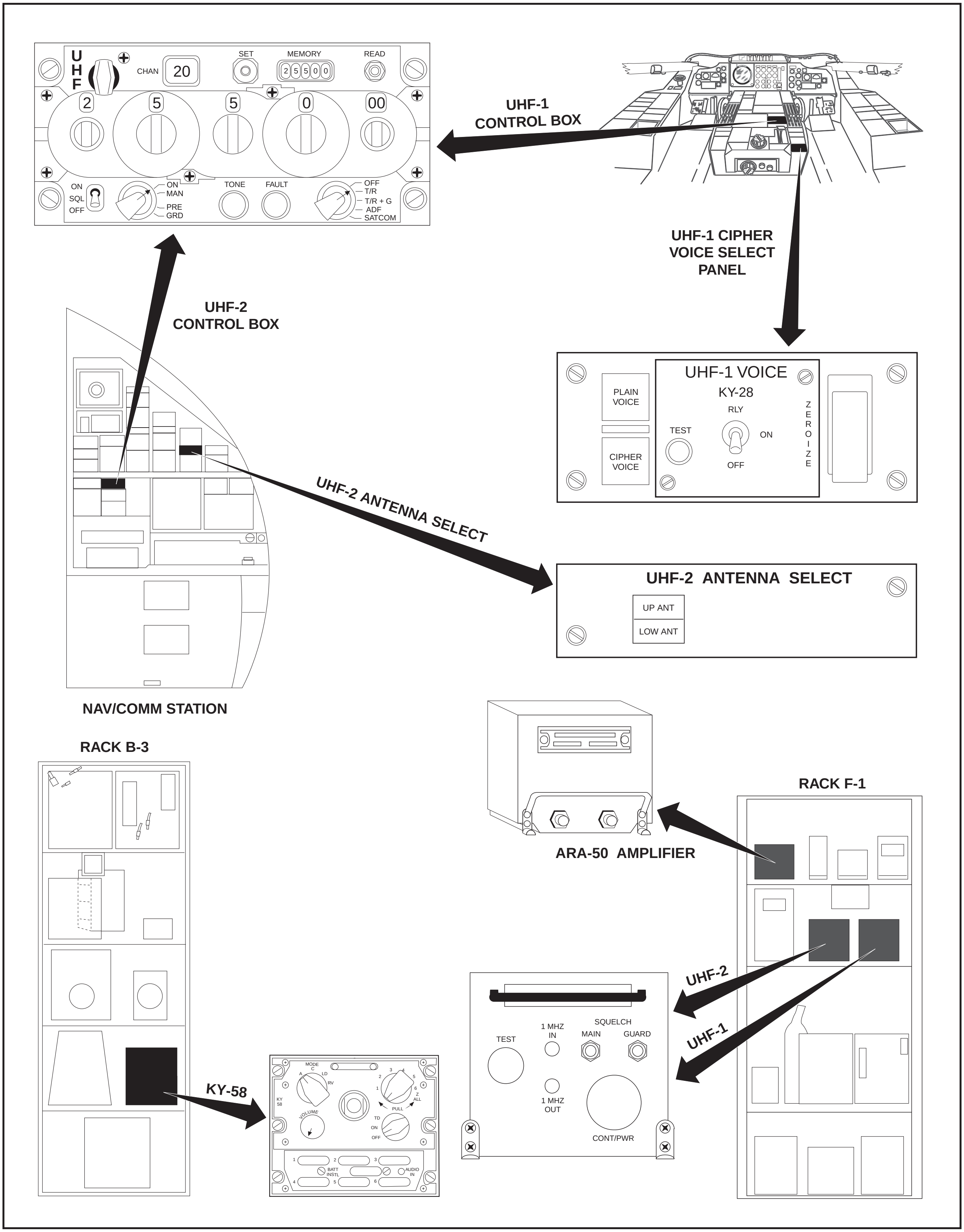
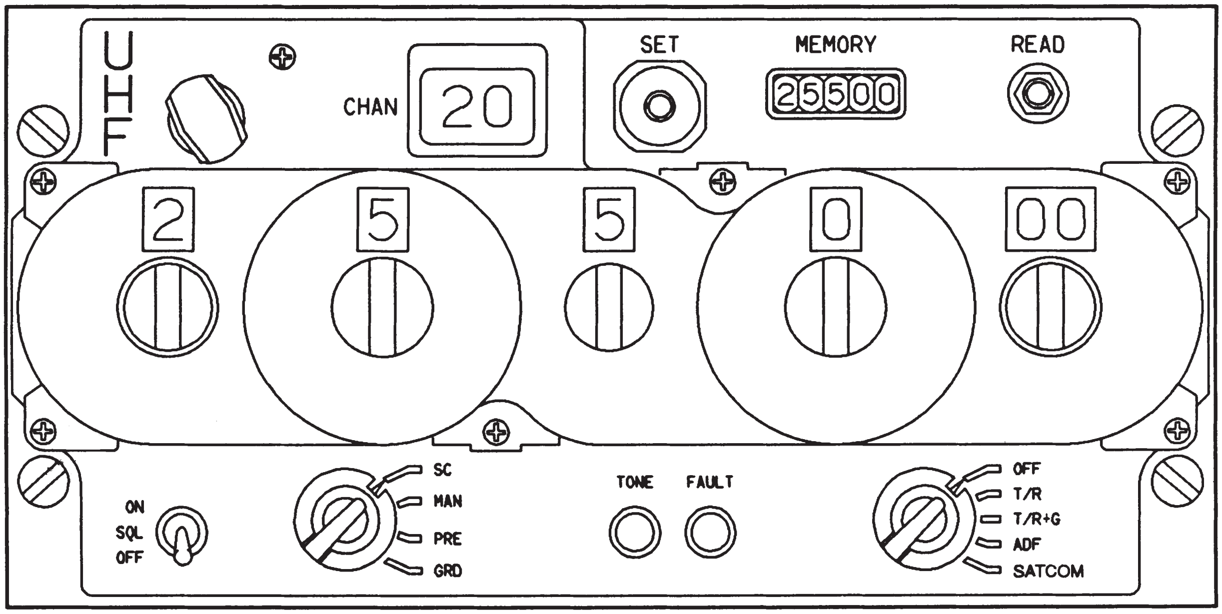


Figure 20-18. ARC-187 Radio System



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	Selects system mode of operation.
SC	Tunes radio to 291.400 MHz.
MAN	Allows manual frequency selection using the 5 manual frequency selector switches.
PRE	Allows frequency selection using the preset frequency channels. This position is also used in setting the preset channel frequency.
GRD	The transmitter and main receiver are tuned to the guard frequency of 243.000 MHz.

Figure 20-19. ARC-187 UHF Radio Set Control, Panel Markings, and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
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.
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 20-19. ARC-187 UHF Radio Set Control, Panel Markings, and Functions (Sheet 2 of 2)

COMPONENT NAME	LOCATION	NAME	POWER SOURCE
UHF-1	MLC	UHF-1	MEAC
UHF-2	MLC	UHF-2	BUS A
	MLC	UHF-2	MDC
Antenna switching assembly	FECB	SATCOM	MDC

Figure 20-20. ARC-187 UHF-1 and UHF-2 System Circuit Breaker Location and Power Source

switching assembly, can be operated by any crew position with a master ICS control (see paragraph 20.6.3, Operating Procedures). 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.

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 ATSG a signal output for end-to-end bite testing for the advanced sono- buoy communication link receiver. This lower antenna is primarily installed to reduce shadowing when conducting on-station swaps in the highboy role.

20.7.3 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 paragraph 20.7.2. UHF-DF operation is covered in paragraph 20.6.3.6.

20.7.3.1 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.

20.7.3.2 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.

20.7.3.3 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.

20.7.3.4 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.

20.8 ARC-52/51A UHF SYSTEM

The UHF-1 and UHF-2 communication systems provide two-way, AM radio telephone communication among aircraft in flight, shore, and surface vessels. The UHF radio sets transmit and receive AM signals on 1,750 channels spaced at 100-kHz intervals in the 225.0 to 399.9 MHz band on the AN/ARC-52 or on 3,500 channels spaced at 50-kHz intervals in the 225.00 to 399.95 MHz band on the AN/ARC-51A. Eighteen (AN/ARC-52) or twenty (AN/ARC-51A) preset channels plus a guard channel may be remotely selected by the radio set controls, C-6746/ARC-51A, located at the flight station (UHF-1) and tactical coordinator station (UHF-2). In addition, manual controls on each radio set control permit selection of any one of 1,750 or 3,500 channels. The guard channel assigned to this frequency range is at 243.00 MHz.

See Figure 20-21 for the UHF radio communication system components.

20.8.1 ARC-51A Control Functions. The UHF control box provides the following controls and functions.

20.8.1.1 Left Side Function Switch. The function switch on the left side of the panel has three positions: PRESET CHAN, MAN, and GD XMIT. The PRESET CHAN position permits selection of any 1 of 20 preset channels as displayed in the window above the control. The MAN position permits manual selection of transmit-receive frequency as displayed in the window at the right of the control. The GD XMIT position selects guard frequency for transmit-receive operation.

20.8.1.2 Right Side Function Switch. The function switch on the right side of the panel has four positions: OFF, T/R, T/R + G, and ADF. Placing the switch to OFF position removes all power from the transceiver. The T/R position permits operation of transmitter and main receiver. Positioning the switch to T/R + G permits operation of the transmitter, main receiver, and fixed tuned guard receiver. The ADF position is functional for the pilot UHF-1 only. This position provides power from the ARC-51A to the AS-578A/ARA-25A. This position also energizes a relay that enables the AS-578A/ARA-25A to provide DF information to the pilot and copilot HSI. OTPI operation is not possible when DF is selected.

20.8.1.3 Preset Channel Knob. The PRESET CHAN knob is manually connected to the preset tuning drum. Rotating the knob tunes the transceiver to the preset channel indicated in the window above the knob, provided that the left side function switch is in the PRESET CHAN position.

20.8.1.4 Squelch Disable Switch. The SQ DISABLE switch has two positions: ON and OFF. With the switch in the ON position, receiver squelch operation is disabled. The OFF position permits normal squelch operation.

Nomenclature	Qty	Description
RT-743B/ARC-51A	2	UHF transceiver; frequency range 225.0 to 395.95 MHz. Transmitter power output 20 watts; 3,500 channels spread at 50-kHz intervals are available. Twenty preset channels, plus guard (243.00 MHz) may be selected with the preset channel knobs.
C-6476/ARC-51A	2	Control box.
RT-743/ARC-51A*	2	UHF transceiver; frequency range 225.0 to 399.95 MHz. Transmitter power output is 20 watts; 3,500 channels spread at 0.05-MHz intervals, are available. Twenty preset channels plus guard (243.0 MHz) may be selected with the preset channel knobs.
C-6476/ARC-51A*	2	Control box.
RE-219/ARR-40	2	Antenna relay; permits switching of UHF systems between upper and lower antennae, and coupling of ARA-25 antenna system to UHF-1.
LAC 921818-1	1	Antenna selector, located on the cockpit center console; permits switching the two UHF transceivers between upper and lower antennae. UHF-1 is connected to the selected antenna. When UHF-1 ADF function is selected, UHF-2 is switched to the upper antenna regardless of antenna switch position when transmitting on UHF-2.
AT-256/ARC	2	Antenna; mounted on top and bottom of fuselage.
AS-578A/ARA-25	1	UHF direction finder antenna system; used with UHF-1 and with the OTPI receiver to determine bearing of received station.
*On some aircraft.		

Figure 20-21. UHF Radio Communication System

20.8.1.5 Volume Control. The VOL control is inoperative.

20.8.1.6 Manual Tuning Knobs. The manual tuning knobs control the transceiver frequency when the left side function switch is in the MAN position. The three knobs permit selection of 3,500 separate channels. The knob on the left selects hundreds and tens, the center knob selects units, and the right knob selects tenths and hundredths.

20.8.2 ARC-51A Channel Preset Procedure

1. Raise the preset channel select cover to expose the selector pins.

2. Remove the preset tool from the retaining bracket to use in positioning selector pins.

3. At extreme right end of preset channel drum, the number of the channel to be preset is indicated. Disregard the number at the extreme left end of the drum. Rotate the PRESET CHAN knob until the desired channel number appears at the extreme right.

4. Position the first pin at the left end of the drum to select either a 2 or a 3 for the hundreds digit.

5. Position the two pins located above the letters ABCDE at the left as prescribed in the chart on the visible inner face of the raised cover to select the tens digit. For example, if the pins are placed over the letters A and B, they represent the number 10 as indicated on the chart. If the pins are placed over the letters A and D, they represent the number 80 and so forth.

6. Position the two pins located above the letters ABCDE at the center as prescribed in the chart to select the units digit.

7. Position the two pins located above the letters ABCDE at the right of the decimal point as prescribed in the chart to select the tenths digit.

8. Position the pin at the right end of the drum over the 0 or the 5 as necessary to select the hundredths digit.

9. Replace the preset tool — Close the cover.

20.8.3 UHF-1 Security Unit. The UHF-1 security unit (KY-58) (Figure 20-22) control panel is installed on the pilot side panel. This panel is used by the pilot to choose between plain voice and cipher voice modes of communication with the UHF-1 radio set. Panel controls and their functions are as follows.

20.8.3.1 Function Switch. ON or RLY position supplies normal KY-58 power. Selection of RLY increases the length of the sync signal. It is designed for use when transmitting to a middleman, but it can also be useful when transmitting to a distant station.

20.8.3.2 Zeroize/Zero Power Pushbuttons. The ZEROIZE button by itself will destroy the KY-58 code setting if monitorable essential DC is available. If monitorable essential DC is not available, the ZERO PWR and ZEROIZE buttons together will provide flight essential DC to destroy the KY-58 code setting. Do not activate unless in-flight reset capability is available.

20.8.3.3 Cipher/Plain Voice Switch. In C position, the switch facilitates cipher voice transmissions on UHF-1 from the ICS system. In P position, the switch facilitates normal plain voice operation of UHF-1.

20.8.3.4 Volume Control. The VOL control adjusts incoming audio level to the ICS system.

20.8.3.5 Speaker Select Switch. The SPKR SEL switch allows either normal ICS or incoming cipher transmissions as selected to be heard on the pilot ICS speaker.

20.9 HF RADIO SYSTEM

20.9.1 ARC-161 Radio Sets. For a complete description of the ARC-161 HF radio refer to NAVAIR 01-75PAC-1.1.

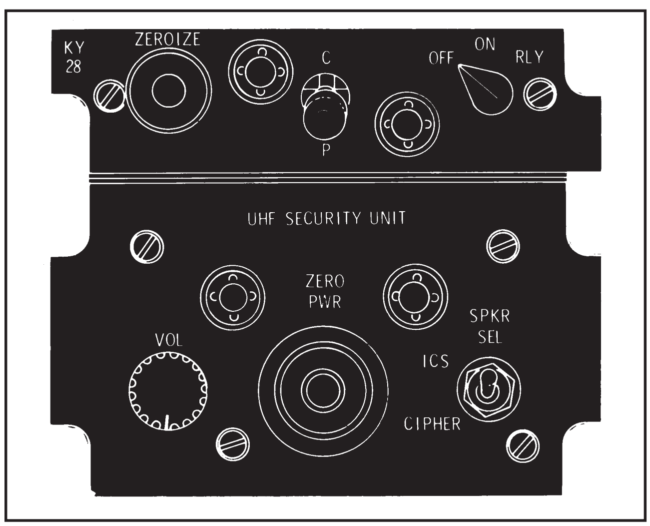


Figure 20-22. UHF-1 Security Unit

20.9.2 ARC-94 (P-3A/B) HF System. Two ARC-94 transceivers permit transmission and reception of radio signals in the frequency range of 2 to 29.999 MHz. The associated coupler tunes to the antenna impedance to provide full output power. The coupler loading coils are not utilized for reception. Therefore, the coupler need not be tuned when receive functions only are desired.

The ARC-94 can be operated in any one of the following modes: AM (transmission of carrier plus upper sideband only), USB (upper sideband), LSB, DATA (teletype operation), and CW.

20.9.3 ARC-94 Transceivers

1. Close circuit breakers at the forward left electronic circuit breaker panel and at the forward right electronic circuit breaker panel. Also, the CU-308, APN-70 HF/LORAN coupler, and AN/AIC-22 circuit breakers at the forward left electronic circuit breaker panel must be closed.

2. Connect the appropriate headset and microphone to the interphone jackbox.

3. Turn the control switches on the C-3940 control boxes to AM.

4. Allow short warmup period, and adjust RF SENS to desired level.

5. Select desired HF system (HF-1, BOTH, HF-2) with HF selector switch.

6. Using megacycle and kilocycle selectors, channel transceiver to desired frequency.

7. Position AN/AIC-22 MIC SEL control to desired HF position.

8. Key selected transmitter momentarily and allow to load. While the antenna coupler is loading, the TUNING indicator on the radio operator control panel will light and tone will be heard in the headset. When the light goes out and the tone stops, the transmitter is ready to use.

9. Transceiver can now be used on mode as selected by control panel.

   a. For voice communication use AM, USB, or LSB mode.

   b. For CW, use CW mode. This is upper sideband, 1 kHz above selected frequency. Select a frequency 1 kHz below the assigned operating frequency.

   c. For use with the teletype, select DATA mode. Select a frequency 2 kHz below the assigned operating frequency.

CAUTION

- Select 29 MHz prior to securing ARC-94 system to prevent inadvertent damage by RF radiation from nearby transmitters. Do not load antenna.

- When one or both HF transceivers are connected with voice mode selected, pulling the KY-75 control circuit breaker (flight essential DC bus) will result in continuous HF transmission. Continuous transmission in excess of 5 minutes will damage the HF transceiver.

Note

- All stations using HF are subject to transmitter selection made by the radio operator.

- To listen to the HF receiver not selected by the interphone MIC SEL control, place respective radio monitor toggle switch to the UP position.

PART VIII

Mission Systems

CHAPTER 21

Mission Systems Overview

21.1 INTRODUCTION

Mission Systems, provides an overview of those systems contained in the P-3 A/B/C 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 (FOG), Program Performance Specifications (PPS), and Program Functional Descriptions (PFD).

The following mission systems are not a direct responsibility of the flight station personnel and, as such, are not discussed in this section. They are, however, an integral part of the P-3 ASW system, and their system discussion can be found in the NFO/Aircrew NATOPS Manual (NAVAIR 01-75PAC-1.1).

21.1.1 P-3C Systems

1. Data processing system
2. Data processing system (incorporating modernized logic units)
3. Ordnance system
4. Acoustic audio system
5. Sonobuoy Reference System (SRS)
6. OV-78A Integrated Acoustic Communication System (IACS)
7. APS-115 radar
8. APX-76 IFF
9. ASQ-81 Magnetic Detecting System (MAD)
10. Auxiliary MAD systems
11. ALQ-78 Electronic Support Measures
12. ALR-66(V)3 Radar Warning Receiver
13. AAS-36 Infrared Detecting System (IRDS).

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.

21.1.2 P-3A/B Systems

1. HF system (ARC-94) operating procedures
2. Search radar (APS-80) system
3. Armament system
4. Sonobuoy control system
5. Doppler navigation (APN-153(V)) system
6. True airspeed system
7. PT-396 ground track plotter
8. Periscope sextant
9. IFF interrogator (APX-7)
10. Infrared Detecting System (IRDS)
11. Radar warning receiver (ALR-66(V)3)
12. OD-620 APX control indicator group
13. Teletypewriter system AN/AGC-9(V)1
14. Color Weather Radar (AN/APN-234).

CHAPTER 22

Mission Equipment

22.1 VHF/VOR RADIO NAVIGATION (ARC-101, ARN-87, AND ILS) PRIOR TO UPDATE II.5

The VHF navigation and communication system consists of dual AN/ARN-87 VOR receivers and an ARC-101 VHF transmitter. The VHF/VOR system provides a means of airway radio navigation, enroute 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 to 117.95 MHz range.

VHF capability is provided for voice communication with commercial airfields and airway stations in the 116.0 to 149.95 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 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, 51 V-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 T-907A/ARC-101 VHF Transmitter. The T-907A/ARC-101 VHF transmitter is located in rack J-2 and provides VHF transmission capability. The transmitter works in conjunction with VOR-2 to allow two-way VHF communications and provides transmitting capability in the 116.00 to 149.95 MHz frequency range.

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 (see Figures 22-2 and 22-3).

22.1.1.4 C-6843/ARN-87 VOR-1 Receiver 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 (Figures 22-2 and 22-4).

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.

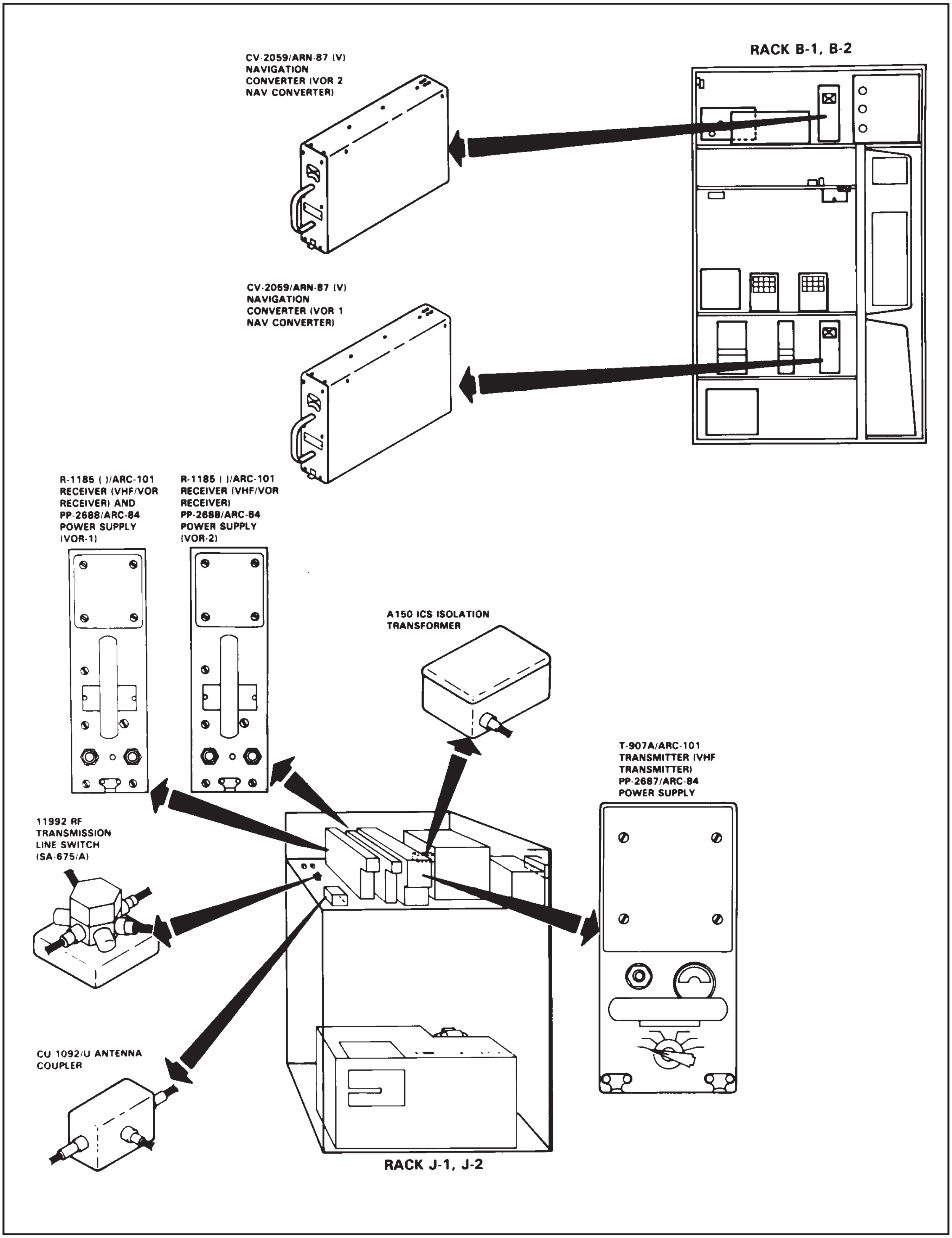


Figure 22-1. Radio Navigation System Components (Prior to Update II.5)

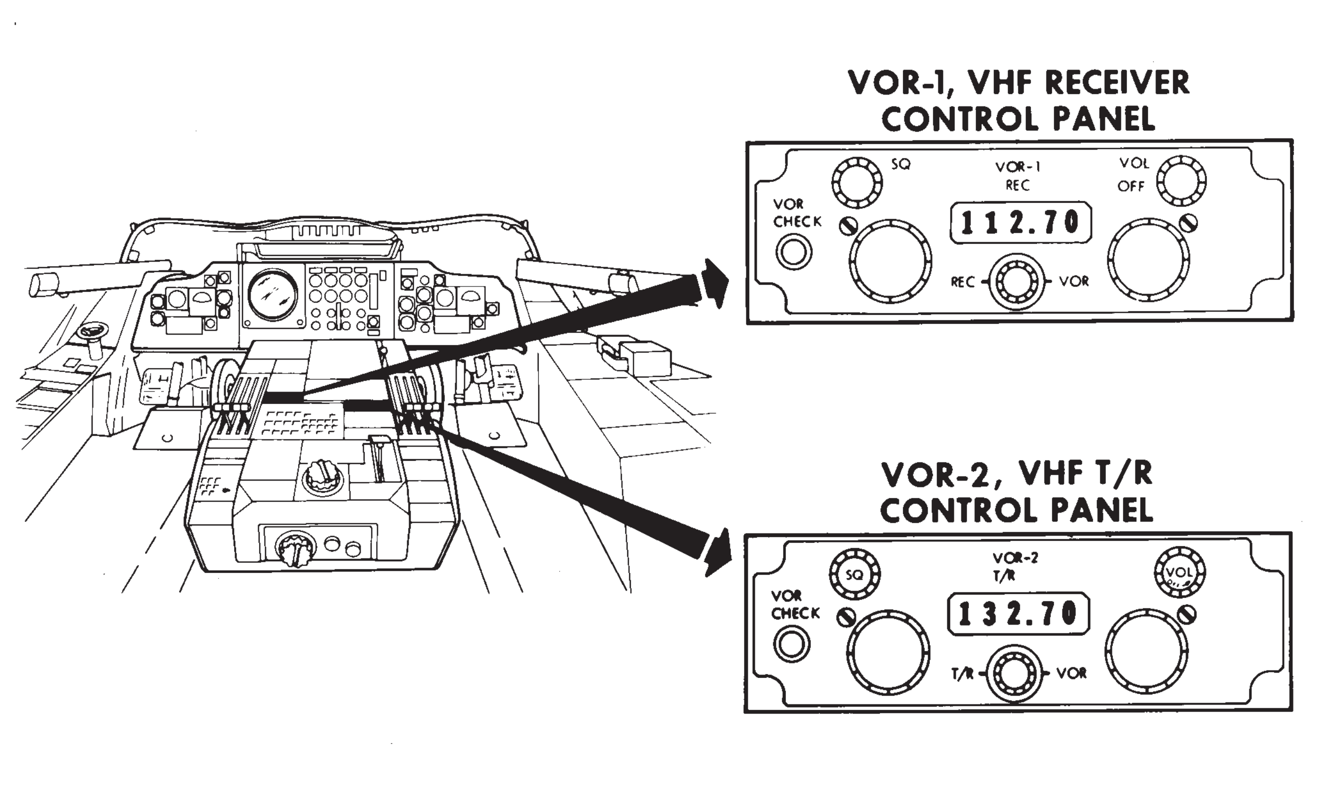


Figure 22-2. VOR-1 and VOR-2 Control Panels

PANEL MARKING	FUNCTION
SQ	Sets threshold of the receiver squelch circuit (VHF/VOR-2 receiver only).
VOL	Extreme CCW rotation turns off VHF/VOR-2. Audio volume function not operative.
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 000° and NAV flag appears, if circuits are intact.

Figure 22-3. VOR-2 Receiver-Transmitter Control Panel Markings and Functions

PANEL MARKING	FUNCTION
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 000° and NAV flag appears, if circuits are intact.

Figure 22-4. VOR-1 Receiver Control Panel Markings and Functions

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.

The 51V-4 glideslope receiver set (AFC-494) provides the P-3A/B with full ILS capability. System components include a glideslope receiver (bay 13), an antenna (in the forward radome), and ADI on both pilot and copilot instrument panels. (Some aircraft utilize the MM-4 and ID-351 combination in place of the ADI.)

WARNING

The ILS circuit breaker should be pulled prior to commencing a backcourse localizer approach to eliminate reverse localizer sensing and erroneous glideslope information. The HSI will continue to function normally (P-3A/B only).

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 hundredth's 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 Figure 22-5.

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.

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, VOR mode must be selected on the HSI 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.

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.

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. To display course information on the HSI, VOR-1 must be selected on the appropriate flight station HSI control panel.

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.

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 Glidescope Receiver	Forward Electronic	GLIDESCOPE	MEDC
Marker Beacon Receiver	Main Load Center	MKR BCN	MDC E

Figure 22-5. Radio Navigation System Circuit Breaker Locations and Power Source (Prior to Update II.5)

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, All Weather Operations.

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 22-6.

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.

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 (see Figures 22-7 and 22-8).

22.2.1.4 C11067/ARC-197 VHF Control Panel. The C11067/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 (see Figures 22-7 and 22-9).

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 Band-Pass Filter. The VHF band-pass 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 (see Figure 22-7).

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 22-10.

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 band-pass 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 glidescope 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

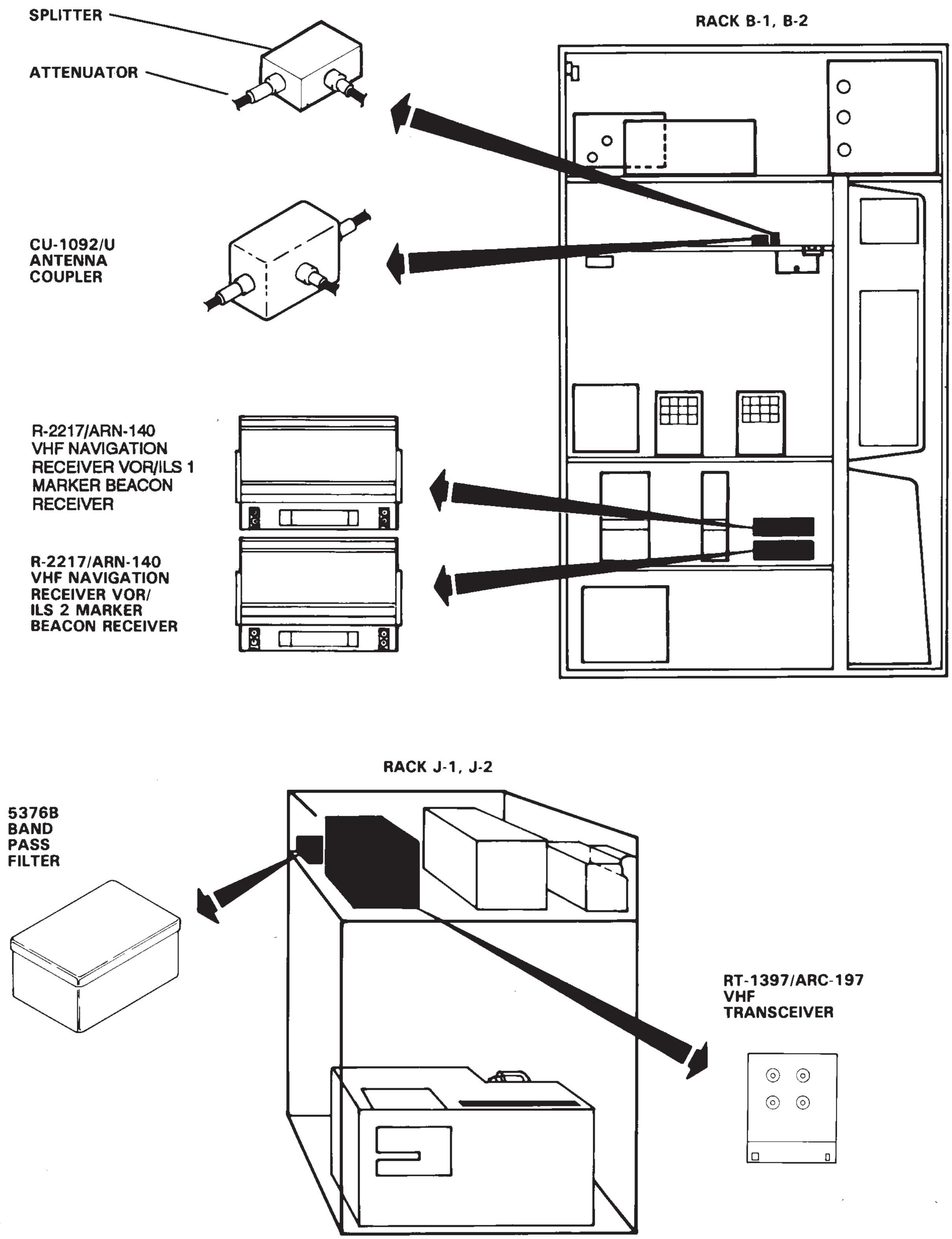


Figure 22-6. Radio Navigation System Components (Update II.5 and Later)

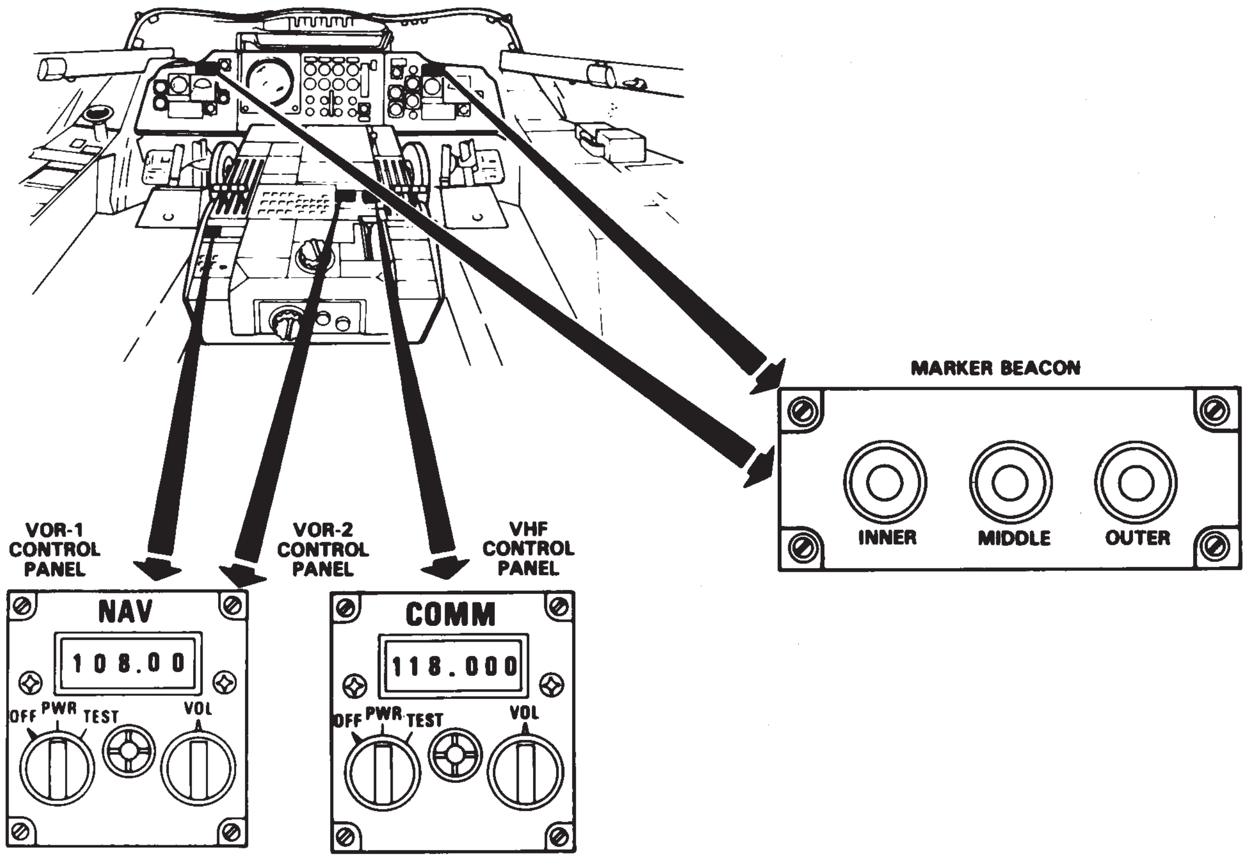


Figure 22-7. VOR/ILS/VHS Receiver Control Panels and Marker Beacon Lights

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 22-8. 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 22-9. VHF Control Panel Markings and Functions

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
VOR/ILS-1 Receiver	Forward Load Center	VOR/ILS-1	MEDC
	Navigation Interconnection Box	VOR-1	26-VAC Sync Excitation
VOR/ILS-2 Receiver	Forward Load Center	VOR/ILS-2 RCVR	MEDC
	Navigation Interconnection Box	VOR-2	26-VAC Sync Excitation
VHF Transceiver	Aft Electronic	VHF-AM	MEDC

Figure 22-10. Radio Navigation System Circuit Breaker Locations and Power Sources

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 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, All-Weather Operations.

22.3 NAVIGATION SYSTEM

22.3.1 LTN-72. The LTN-72 inertial navigation system is a self-contained, all-weather worldwide navigation system that is independent of ground-based navigation aids. It supplies continuous, accurate navigation and guidance data as well as an accurate reference from which attitude (pitch and roll) and true heading are determined. External inputs to the system include TAS from the TAS system or operator, initial position (operator entered), and magnetic heading from the MHRS.

The aircraft contains two independent LTN-72 inertial systems. Both systems provide the same information to the operator and aircraft.

Note

- The LTN-72 is the primary navigation source for oceanic enroute and due regard operations.

- When the inertials are connected to a compatible GPS receiver and an INS with the 72-09-21 program installed, GPS data inputs can be used to update inertial position, velocity, platform tilts, and gyro biases.

22.3.1.1 System Components

22.3.1.1.1 Control Display Unit. The CDU is located at the NAV/COMM station and facilitates control of displayed navigation data. The CDU (Figure 22-11) also controls the automatic, manual, and remote modes of operation. CDU panel functions are listed in Figure 22-12.

22.3.1.1.2 Mode Selector Unit. The MSU is located at the pilot (INS-1) and copilot (INS-2) side consoles and energizes and aligns the system before flight. It also controls the application of power to the INS, and controls the standby (STBY), ALIGN, navigation (NAV), and attitude reference (ATT REF) modes of operation (Figures 22-11 and 22-13).

22.3.1.1.3 Inertial Navigation Unit. The INU is located in rack H-1/H-2 (Figure 22-14) and houses the gyro-stabilized inertial platform, the digital computer, inertial power supply and digital subsystem modules. The platform is an all-attitude, two-degree-of-freedom, gyro-stabilized platform that uses accelerometers as its sensing elements. The basic outputs of the INU platform include pitch and roll, velocity, and azimuth. The INU power supply converts 115-VAC, 400-Hz, single-phase primary power into various regulated and unregulated DC voltages required by the system and is capable of operating from a DC battery supply in the event 115-volt power is lost.

CAUTION

The cooling for the two LTN-72 INUs is controlled by a two-position butterfly valve. The normal position allows cooling by means of the cabin exhaust fan. The emergency position allows for a greater airflow over the INU and is only to be used when the navigation power alarm (NAV PAC) is activated. Ensure this valve is in the normal position at the time of preflighting the aircraft. The valve is located in the lower part of rack H-1/H-2.

22.3.1.1.4 Battery Unit. The battery unit is located in rack H-1/H-2 (Figure 22-14), the BU is a backup DC power source to the system. In the event that primary 115-VAC power is lost, the BU provides operating power to the INS for 15 minutes or until the battery discharges below a predetermined level of 17.5 VDC.

Note

The battery must be installed for initial turnup of the INS.

22.3.1.1.5 Navigation Power Alarm (NAV PAC). The navigation power alarm is located in rack H-1/H-2 (Figure 22-14) and transmits warnings visually and aurally for each INS system. The NAV PAC warning lights and horn located in rack H-1 indicate that damage to the INU for that system is probable since there is not sufficient air to cool the INU. The warning lights illuminate and the horn sounds if aircraft power is secured with the INS system left in any position other than OFF.

22.3.1.1.6 Magnetic Heading Reference System. 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 22-11), 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. The output signal heading can be slewed clockwise or counterclockwise with the SET HDG spring-loaded, center-off rotary switch on the compass controller for grid navigation.

Note

- The MHRS supplies a gyro-stabilized MAG HDG to the INU to derive MAG VAR for external systems.
- The TAS input is used to compute windspeed and direction in the INU. Reference voltage for magnetic variation is supplied by TAS. No MAG VAR output is supplied unless power is applied to the TAS system.

22.3.1.1.7 Digital Data Unit. The digital data unit is located in rack D-1 (see Figure 22-15) and translates the LTN-72 data into a format capable of being processed by logic unit 1 (status) and logic unit 2 (true heading and velocities N/S and E/W).

22.3.1.1.8 True Airspeed Computer. The TAS computer is located in rack C-2 (Figure 22-15) and utilizes the copilot pitot-static system and the TAS temperature probe to calculate speeds from 70 to 450 knots.

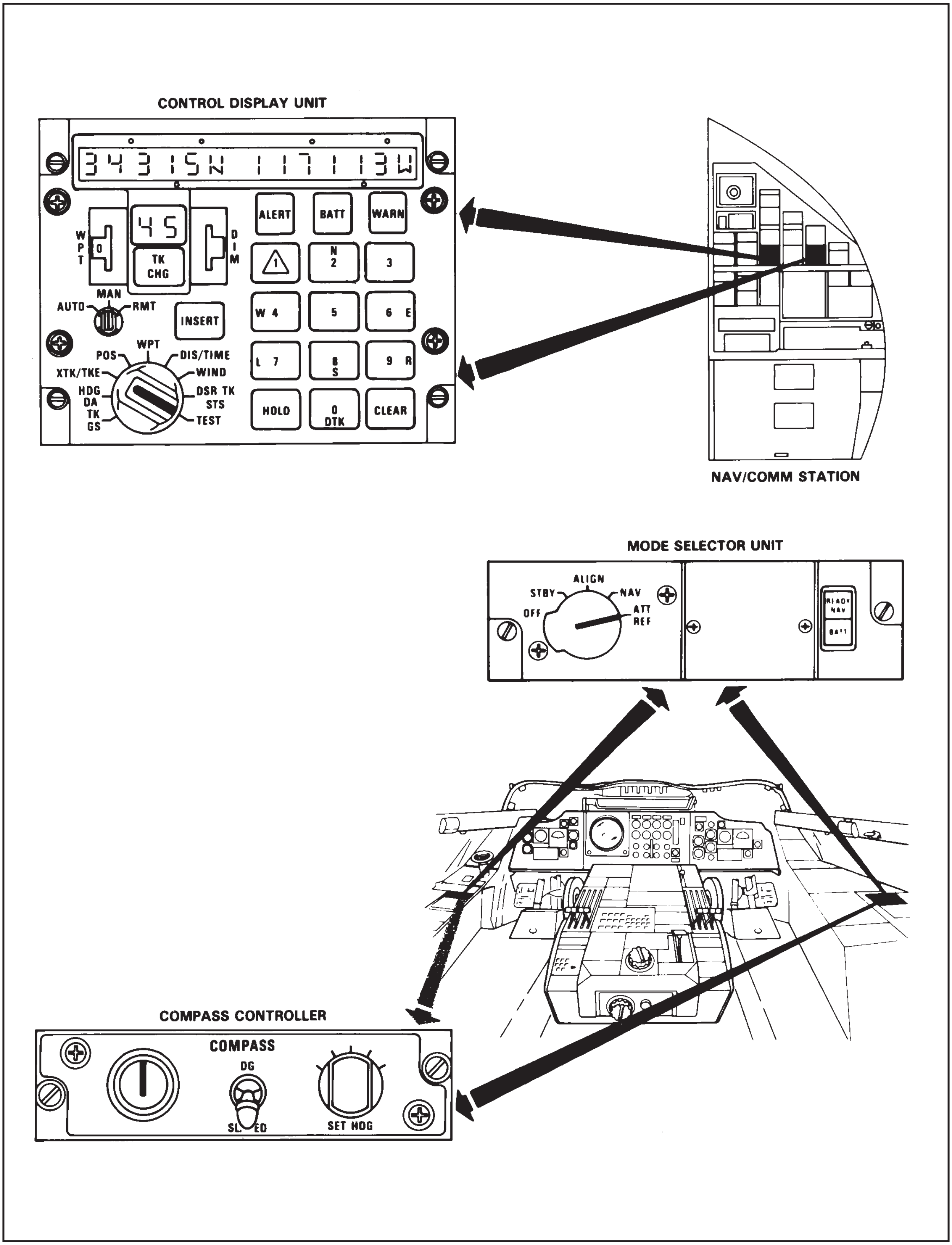


Figure 22-11. LTN-72 Control Component Locations

PANEL MARKING	FUNCTION
Display Switch	
TK GS (Track-Ground Speed)	Displays aircraft track angle in the left display with respect to true north, from 0° to 360°, and ground speed in the right display, from 0 to 3999 nautical miles per hour.
HDG DA (Heading-Drift Angle)	Displays aircraft 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 (Cross-Track Distance/Track Angle Error)	Displays cross track 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 nmi. 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 (left) and longitude (right) of up to nine stored waypoints corresponding to the digit on the waypoint selector.
DIS/TIME (Distance/Time)	Displays distance to go (left) from 0 to 999 nautical miles to the waypoint currently selected, and time to go (right) from 0 to 19 hours 59.9 minutes. **Note** • Time to go will read 0 at ground-speeds 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 (left) from 0° to 360°, and windspeed (right) 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.
WIND (Cont)	• In RMT left display will be TAS. • During wind on nose/tail procedures, left display indicates N (nosewind) — or S (tailwind) and right display indicates wind component.
DSR TK STS (Desired Track Status)	Displays the computed desired track angle (left) 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. The ALERT, BATT, WARN, degree, decimal, and minute displays illuminate; TK CHG, INSERT and HOLD pushbuttons illuminate. **Note** • Test may be performed during STBY, ALIGN, and NAV without affecting LTN-72 operation; however, the NAV Simulator must be turned off. • During display test in STBY and ALIGN, HSI heading will rotate to 120° if HSI COURSE is set to TAC/NAV and BEARING is set to DA.
AUTO/MAN/RMT	Controls the method of waypoint sequencing and data entry.
AUTO	Track leg changes are automatically sequenced in order by the system.
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.

Figure 22-12. CDU Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
WPT	Selects waypoint (1 thru 9) for latitude and longitude insertion or selects waypoint (0 thru 9) for presentation of waypoint coordinates.
TK CHG	Allows manual track change to be made with the data keyboard.
INSERT From-To Display	Used to insert keyboard entries into the computer. Provides a visual indication of the from-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 ALR goes out. 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 manually enters the next track leg.

PANEL MARKING	FUNCTION
ALERT (Cont)	**Note** ALERT light will not illuminate when groundspeed is below 125 knots.
BATT (Battery)	Indicates (amber) the primary AC power has failed and the system has reverted to the backup DC power source.
WARN (Warning)	Indicates (red) the system self-test and monitoring circuits have detected a malfunction and that the navigation data are no longer available. **Note** A flashing warning light indicates system degradation.
Data Pushbuttons	Used to manually enter data into displays.
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 facilitates convenient position reporting and manual position updating.

Figure 22-12. CDU Panel Markings and Functions (Sheet 2 of 2)

22.3.1.1.9 True Airspeed Control Panel. The TAS control panel is located at the NAV/COMM station (Figure 22-15) and 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 LTN-72 to calculate magnetic variation and wind.

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.

CAUTION

Use the probe heater during flight only.

22.3.1.1.10 Circuit Breakers. Circuit breakers and power sources for the inertial navigation system components are listed in Figure 22-16.

22.3.1.2 System Description. The LTN-72 with a 72-09-20/21 software program 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 operates by sensing aircraft accelerations using a gyro-stabilized platform. These 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, selected navigation data among nine waypoints, pitch, roll, and platform heading information.

Unrestricted worldwide navigation is provided by the wander azimuth angle technique following initial alignment. System alignment is a highly reliable, accurate, and completely automatic process accomplished without the use of external references (except for entry of initial position). During this sequence, the platform level axes accelerometers are leveled to local vertical. This determines their true north orientation and computes gyro bias calculations for each flight. The LTN-72 process of determining gyro bias calculations is unique since these corrections can be based upon either gyro, depending on the aircraft's true heading during alignment or upon selective rotation of the platform.

PANEL MARKING	FUNCTION
Mode Selector Switch:	
STBY	Inserts present position coordinates and allows display test to be performed. Power is supplied to all units. System alignment begins. **Note** The system is not affected by aircraft movement while in the STBY mode.
ALIGN	Aligns the system. **Note** The aircraft should not be relocated when the system is in ALIGN mode.
NAV	Normal operation mode. **Note** • NAV mode shall be selected prior to starting engines or moving aircraft. • The knob must be pulled away from the panel before the mode selector switch can be set out of the NAV position.
ATT REF	Attitude reference is normally selected in the event of the loss of navigation capability. In this mode, the system provides platform heading, pitch, and roll attitude signals only.
ATT REF (Cont.)	**Note** • If the system detects a computer failure during NAV mode, it will automatically revert to the attitude reference mode. • Once deselected, NAV mode cannot be used unless a new ground alignment procedure has been completed. If the inertial is modified with the software progam 72-09-21, and a compatible GPS receiver is installed, a In-Flight Alignment (IFA) or a Hybrid Alignment may be attempted.
READY NAV (Green)	Indicates that the system alignment is completed and the system is ready for the navigation 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)	Provides a visual indication that the backup DC voltage has been used, and is depleted below 17.5 VDC. **Note** INS will turn off.

Figure 22-13. MSU Panel Markings and Functions

In aircraft incorporating a compatible GPS receiver and a INS with the software program 72-09-21, GPS-aided alignments can be performed in a closed loop mode of operation. In the closed loop mode, the GPS data are used to update present position, velocity, platform tilts, and gyro biases. Navigation updates may be performed in either the closed loop mode or in the open loop mode, where the inertial solutions are maintained in the computer separate from the GPS updated equivalents. With the INS in the NAV mode, either open or closed loop GPS updates can be enabled and terminated as required. On termination of either mode, the INS will revert to inertial navigation. However, only open loop mode GPS updates can be removed by the operator using a flush procedure. Any updates to the inertial solution while in the closed loop mode are permanent and are not removable by the operator. The INS may be aligned by one of the three following methods:

1. Normal ground alignment.
2. In-Flight Alignment (IFA) — where the alignment is initiated and completed during flight.
3. Hybrid Alignment — where the alignment is started on the ground with the aircraft stationary and completed during taxi or in flight.

Note

The preferred operational procedure is to perform a normal ground alignment, allow the system to enter the NAV mode, then enable GPS open loop update.

The system can be operated in either the navigate or attitude reference modes. The NAV mode is the normal

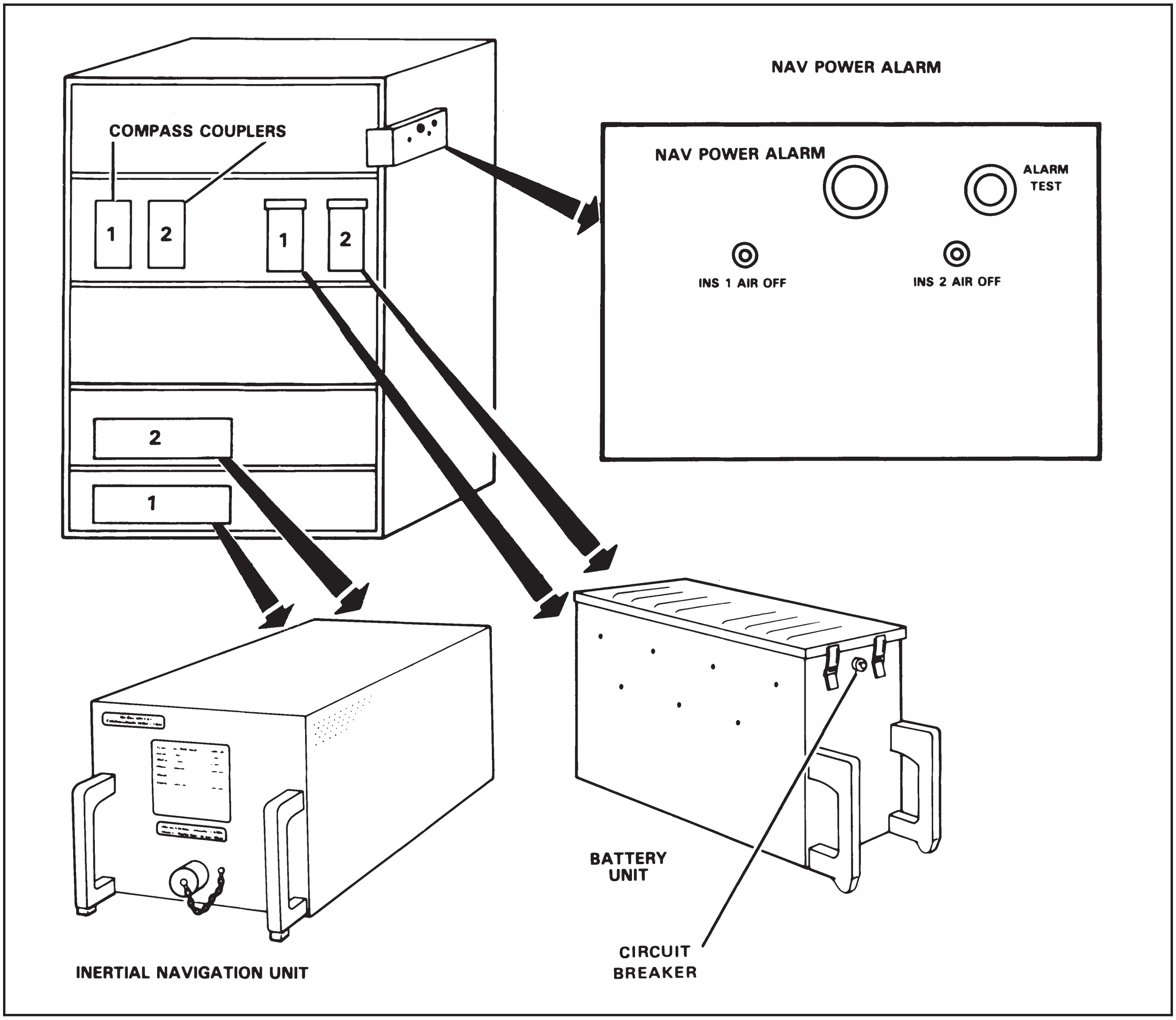


Figure 22-14. LTN-72 Components Located in Rack H-1/H-2

operating mode in which the system is employed to its fullest capability. The ATT REF mode is the alternative operating mode that is used when only inertial attitude and magnetic heading reference are required or when the NAV mode fails in flight and an In-Flight Alignment (IFA) or Hybrid Alignment is unsuccessful. Furthermore, integrity monitoring and warning routines are incorporated within the system to detect malfunctions and to alert the NAV/COMM to their existence.

All GPS-aided operations are under CDU control, and several status and advisory displays are available to the operator. Both control and display are performed with the CDU display switch in the DSR TK/STS position. The STS display on the right side of the CDU is the same with either version of software installed in the inertial (72-09-20 or the 72-09-21). The action malfunction code displays are exactly the same for both program versions with the exception of the addition of Action Code 9 (GPS) with the 72-09-21 program.

Basic GPS-mode data are provided in the space between the action malfunction code and the system status, with ⊔ indicating open loop mode and ⊏ indicating closed loop operation.

The TAS system supplies airspeed values to the LTN-72 inertials and central computer. The LTN-72 inertials utilize the TAS information to calculate inertial winds. The CP-901 computer receives the TAS data via the SD/DS converter. The TAS values are utilized for calculating winds in the inertial and Doppler navigation modes. In the CP-901 air data navigation mode, TAS is used with the entered wind value to determine the

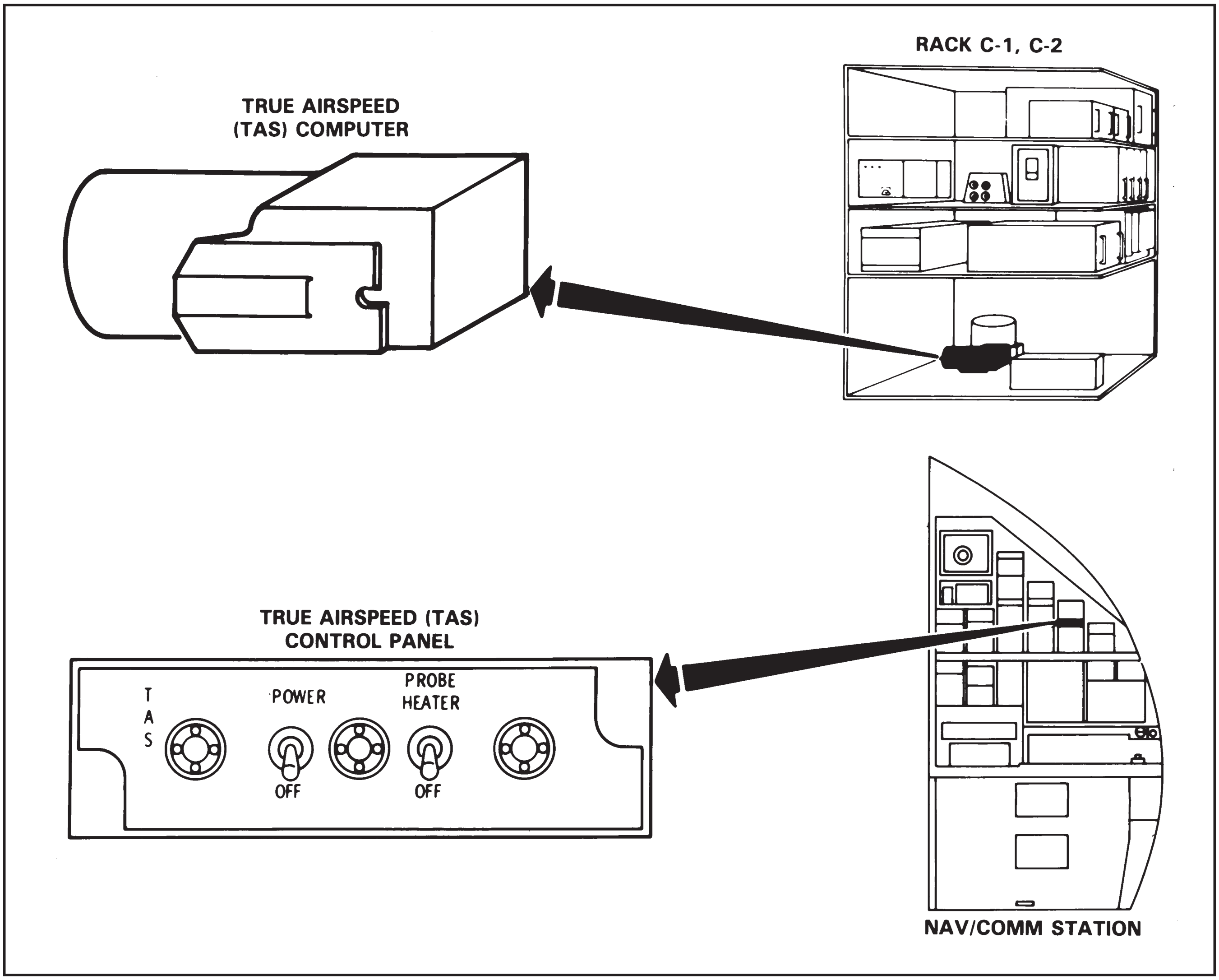


Figure 22-15. TAS Computer and Control Panel

track/groundspeed vector. TAS values are displayed on the auxiliary readouts.

22.3.1.3 Modes of Operation. The LTN-72 is instrumented to function in several basic modes. The MSU enables selection of the operating mode. The modes are described in the following paragraphs.

22.3.1.3.1 Standby Mode. Selecting STBY on the MSU enables the INU to begin alignment procedures. In STBY, the gimbals are caged, the gyros are brought up to speed, INU heaters are turned on, and platform leveling is begun. During this time it is necessary to enter present position in latitude and longitude through the CDU. When temperatures reach the desired level, the INU 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.

22.3.1.3.2 Align Mode. Selecting ALIGN on the MSU enables the INU to complete the alignment procedure. Upon completion of the alignment, the READY NAV light illuminates.

22.3.1.3.3 Navigation Mode. Selecting NAV on the MSU enables the INU to provide suitable reference data for the aircraft navigation systems.

22.3.1.3.4 Attitude Reference Mode. Selecting ATT REF on the MSU disables the navigation capability of the INU for the remainder of the flight. The INU continues to provide platform heading for use as a directional gyro to the MHRS and pitch and roll for use as attitude references.

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
Inertial Navigation Unit 1 (INU-1)	Aft Electronic	RUN	MEAC
		HTR	
	Navigation Interconnection Box	INS No. 1	26-VAC Sync Excitation
Inertial Navigation Unit 2 (INU-2)	Aft Electronic	RUN	MEAC
		HTR	BUS A
	Navigation Interconnection Box	INS NO. 2	26-VAC Sync Excitation
Battery Unit 1 (BU-1)	Circuit breaker is located on the front of the BU.		
Battery Unit 2 (BU-2)	Circuit breaker is located on the front of the BU.		
Navigation Power Alarm (NAV PAC)	Aft Electronic	RUN (INS-1)	MEAC
		DDU CH1	MEDC
		RUN (INS-2)	BUS A
		DDU CH 2	MDC
	Battery Unit 1		
	Battery Unit 2		
Compass Coupler 1	Forward Electronic	TAS	MEAC
	Aft Electronic	MHRS NO. 1	MEAC
	Navigation Interconnection Box	INS NO. 1	26-VAC Sync Excitation
Compass Coupler 2	Forward Electronic	TAS	MEAC
	Aft Electronic	MHRS NO. 2	BUS A
	Navigation Interconnection Box	INS NO. 2	26-VAC Sync Excitation
Digital Data Unit (DDU)	Aft Electronic	DDU CH1	MEDC
		DDU CH2	MDC
True Airspeed (TAS)	Forward Electronic	TAS	MEAC
			MEDC

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.

Figure 22-16. LTN-72 INS Circuit Breaker Locations and Power Sources

Note

- If the inertial is modified with the software program 72-09-21 and a compatible GPS receiver is installed, an In-Flight Alignment (IFA) or a Hybrid Alignment may be attempted before committing the unit to the ATT REF mode.
- If the selected INS is in the ATT REF mode, the radar must be in the HEADING STAB and OFF-LINE mode.

22.3.1.4 Operating Procedures

22.3.1.4.1 Alignment and Present Position Entry. Alignment of the LTN-72 system is necessary before starting the engines and is accomplished using the following procedures:

1. Set the MSU mode selector switch to STBY.
2. Set CDU display switch to POS.

Note

Verify that the left display is 00000 N, from-to display is 00, and right display is 72.9.

3. Press the appropriate data keyboard buttons to enter present position (latitude).
4. Press INSERT pushbutton.
5. Press the appropriate data keyboard buttons to enter present position (longitude).
6. Press INSERT pushbutton.

Note

Any errors made when entering the latitude or longitude can be corrected by pressing the CLEAR button and reloading the data.

7. Set the MSU mode selector switch to ALIGN.

   a. To monitor alignment progress, set the display selector to DSR TK STS.

   Note

   The align status is shown on the right display as a status number (90, 80, 70, 60, 50, 40, 10, and 02). At status 60, an automatic test of system alignment is made. If the test is passed, alignment continues. If the test fails, the WARN indicator flashes. Check the action code in the right display.

   b. If the CDU WARN indicator flashes, proceeds as follows:

      (1) Note action code and status number of right display.

      Note

      More than one malfunction may exist, but only the lowest numerical action code will be displayed.

      (2) A malfunction code will replace the action code if the HOLD pushbutton is pressed. Repeated pressing of the HOLD pushbutton will cause a sequential display of code numbers for all malfunctions.

      (3) Record type of warn indication, action/malfunction codes, and status number for use by maintenance personnel.

      (4) Perform action indicated by action codes.

      (5) If action does not correct malfunction, notify maintenance.

8. Set the MSU mode selector switch to NAV at status 02.

Note

Nav mode shall be selected prior to starting engines or moving the aircraft.

a. In-Flight Alignment (IFA). If the operator desires to realign the system during flight, an IFA is enabled by the following procedure:

1. Turn MSU to OFF and then to STBY.
2. Set display switch to DSR TK/STS.
3. Press 1 and verify left display blanks and INSERT illuminates.
4. Press 2 and verify a 2 is displayed.
5. Press INSERT. The display reverts to standard DSR TK/STS with either align status 90 or 80 displayed.
6. Set MSU to ALIGN.

7. Turn MSU to NAV once status C02 is obtained. INS will automatically enter OPEN-LOOP mode.

Note

When IFA is initiated, the system will remain in Air Align Hold mode with the CDU displaying status 80 (analog level), with no ⊏ present until both of the following conditions are met:

1. GPS groundspeed is greater than 20 KTS.

2. Analog leveling time is greater than 2 minutes.

When these conditions are met, the system will exit Air Align Hold mode, sequence to align status ⊏70, and initialize position and velocity from the GPS values. ⊏70 indicates that GPS closed loop updating is enabled and proceeding. If the ⊏ does not appear, updates are being rejected.

When the alignment is complete, STS displays ⊏02 and the READY NAV light is on at the MSU. When the system is switched from ALIGN to NAV on the MSU, the INS automatically enters the open loop update mode in which two separate navigation solutions are maintained in the INS computer. One solution is from the INU, and the other from the kalman filter best estimate based on INS and GPS measurements.

b. Hybrid In-Flight Alignment. An IFA can be enabled during any part of the ground alignment if it is necessary to complete the alignment with the aircraft moving. This procedure is called a Hybrid IFA. A Hybrid IFA is enabled by the following procedure.

Note

A Hybrid IFA must be initiated after STS 70 is maintained during a normal ground alignment. This enables the system to align without the presence of the GPS groundspeed being in excess of 20 KTS.

1. Press 1 and verify left display blank and INSERT illuminates.

2. Press 2 and verify a 2 is displayed.

3. Press INSERT. The display reverts to status ⊏70 or lower.

4. Turn MSU to NAV once status ⊏02 is obtained. INS will automatically enter the OPEN-LOOP mode.

22.3.1.4.2 Attitude Reference Operation.

In the attitude reference mode of operation, the INS provides pitch, roll, and platform heading outputs.

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 or Hybrid Alignment is successfully completed.

If the WARN annunciator illuminates while operating in the NAV mode during flight signifying 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 as follows:

1. About 3 minutes after turning the INS power back on if the INS has been on and is still warm.

2. About 5 minutes after turning the INS power on if the INS has not been on.

Note

Do not use the INS attitude outputs until the warmup times specified have elapsed, or possible erroneous INS outputs may occur.

Select attitude reference operations as follows:

1. Pull MSU mode switch knob away from panel and set to ATT REF.

2. If CDU WARN annunciator is illuminated or attitude flags are present, pull MSU mode switch knob away from panel and set to OFF.

22.3.1.4.3 Initial Track Selection.

The initial track is the direct route between the aircraft present position and the initial enroute 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 as follows:

1. Set AUTO/MAN/RMT switch to AUTO or MAN.

2. Press TK CHG pushbutton. TK CHG and INSERT lights illuminate.

3. Press 0 DTK on data pushbuttons and enter the number representing the initial enroute waypoint.

4. Press INSERT pushbutton. INSERT and TK CHG lights extinguish. From-to display should read the number inserted in step 3.

Note

Cross-track 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.

22.3.1.4.4 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. To enter waypoint coordinates, proceed as follows:

1. Set CDU AUTO/MAN/RMT switch to MAN.

2. Set CDU display switch to 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 into waypoint 1.

3. Set CDU WPT switch to 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. Set CDU WPT switch to 2 and enter waypoint coordinates in the same manner as WPT 1 coordinates.

6. Set CDU WPT switch to sequential positions and enter waypoints in the same manner as WPT 2 coordinates.

22.3.1.4.5 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 enroute 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 them again for accuracy and then, if desired, drop updated coordinates and revert back to original ones (position updating and checks).

7. Display an offset track parallel to the present track (desired cross-track 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. Cross-track angle (XTK) and track angle error (TKE)

4. Present position (POS) updated and/or nonupdated

5. Waypoint position (WPT)

6. Distance (DIS) and time (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 (WIND)
11. Desired track angle (DSR TK) and status/action/malfunction code (STS)
12. CDU display test (TEST)
13. Magnetic variation (MAG VAR)
14. True airspeed
15. Headwind and tailwind calculations.

In the ATT REF mode of operation the INS provides only pitch, roll, and platform heading outputs. The CDU does not display that information. This mode is used only in the event of loss of INS navigational capability or when NAV data are not required.

22.3.1.4.6 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. Set AUTO/MAN/RMT switch to MAN.
2. Press TK CHG. TK CHG and INSERT lights illuminate.
3. Press desired numbers on data pushbuttons.
4. Press INSERT. INSERT and TK CHG lights extinguish. From-to displays track numbers inserted in step 3.
5. Set display switch to DSR TK STS and check new track.

22.3.1.4.7 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 leg change from present position to desired waypoint as follows:

1. Set AUTO/MAN/RMT switch to MAN or AUTO.
2. Press TK CHG. TK CHG and INSERT lights illuminate.
3. Press 0 DTK and enter the desired waypoint number on data pushbuttons.
4. Press INSERT. INSERT and TK CHG lights extinguish. From-to displays track numbers inserted in step 3.
5. Set display switch to DSR TK STS and check new track.

22.3.1.4.8 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.

22.3.1.4.9 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 procedure, paragraph 22.3.1.4.4. If past waypoint storage locations are to be used for future waypoints, enter future waypoints sequentially starting with the 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.

22.3.1.4.10 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 annunciator illuminates and 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 light 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 light will not illuminate.

22.3.1.4.11 Remote Direct Ranging Between Waypoints. Distance, time, and desired track angle between any two waypoints can be displayed at any time during STBY, ALIGN, or NAV as follows:

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. Set display switch on CDU to DIS/TIME.

2. Set AUTO/MAN/RMT switch on CDU to RMT; from-to display flashes.

3. Press TK CHG. TK CHG and INSERT lights illuminate.

4. Press data pushbuttons corresponding to the desired waypoints. Verify selections are displayed.

5. Press INSERT. INSERT and TK CHG lights extinguish.

6. Distance is displayed on the left display. Time is displayed on the right display.

7. Set display switch on CDU to DSR TK STS. Track angle is displayed on the right display.

22.3.1.4.12 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 during STBY, ALIGN, or NAV as follows:

Note

Normal track calculations continue uninterrupted during the displays.

1. Verify that a track leg has been established.

2. Set display switch on CDU to DIS/TIME.

3. Set AUTO/MAN/RMT switch on CDU to RMT; from-to display flashes.

4. Press TK CHG pushbutton. TK CHG and INSERT lights illuminate.

5. Press 0 DTK pushbutton and the desired waypoints. Verify selections.

Note

The desired waypoint must be ahead of the 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. Press INSERT pushbutton. INSERT and TK CHG lights extinguish.

7. Total distance along the flight plan between present position and the selected waypoint is displayed on the left display. The time from present position to the selected waypoint is displayed on the right display.

8. Set display switch on CDU to DSR TK STS. The track angle is displayed on the left display.

22.3.1.4.13 Wind on Nose/Tail. Wind may be displayed by the following procedure:

1. Set display switch to WIND.

2. Press 1; left display blanks and INSERT comes on.

3. Press 1 again.

4. Press INSERT; left display blanks except for N (nosewind) or S (tailwind) and right display shows wind component (in knots) along aircraft axis.

5. To terminate wind on nose/tail, press 1; left display blanks and INSERT comes on.

6. Press 0 DTK.

7. Press INSERT.

8. Display returns to normal wind.

22.3.2 AN/ASN-179 Inertial Navigation System

22.3.2.1 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 (LTN-72/ASN-179) is the primary navigation source for oceanic enroute and due regard operations.

The ASN-179 Inertial Navigation Unit (INU) replaces the LTN-72 INU and 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. True airspeed (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.

22.3.2.2 System Components

22.3.2.2.1 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 ATT REF (attitude reference) modes of operation. Each MSU has two annunciators that provide status information. Figure 22-17 shows the locations and front panel of the MSU, and Figure 22-18 describes the functions of the mode switch and the two annunciators.

22.3.2.2.2 Control Display Unit. Located at the NAVCOM station (Figure 22-17), the CDUs provide a means for entry, control, and display of navigation data. A list of CDU panel functions is provided in Figure 22-19.

22.3.2.2.3 Inertial Navigation Unit. Located in rack H-1/H-2 (Figure 22-20), 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.

- The EMERGENCY position allows for a greater air flow 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 ARINC navigation data buses.

22.3.2.2.4 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.

22.3.2.2.5 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 22-17), selects either the SLAVED or DG mode for the MHRS. Selecting SLAVED on the compass controller enables the

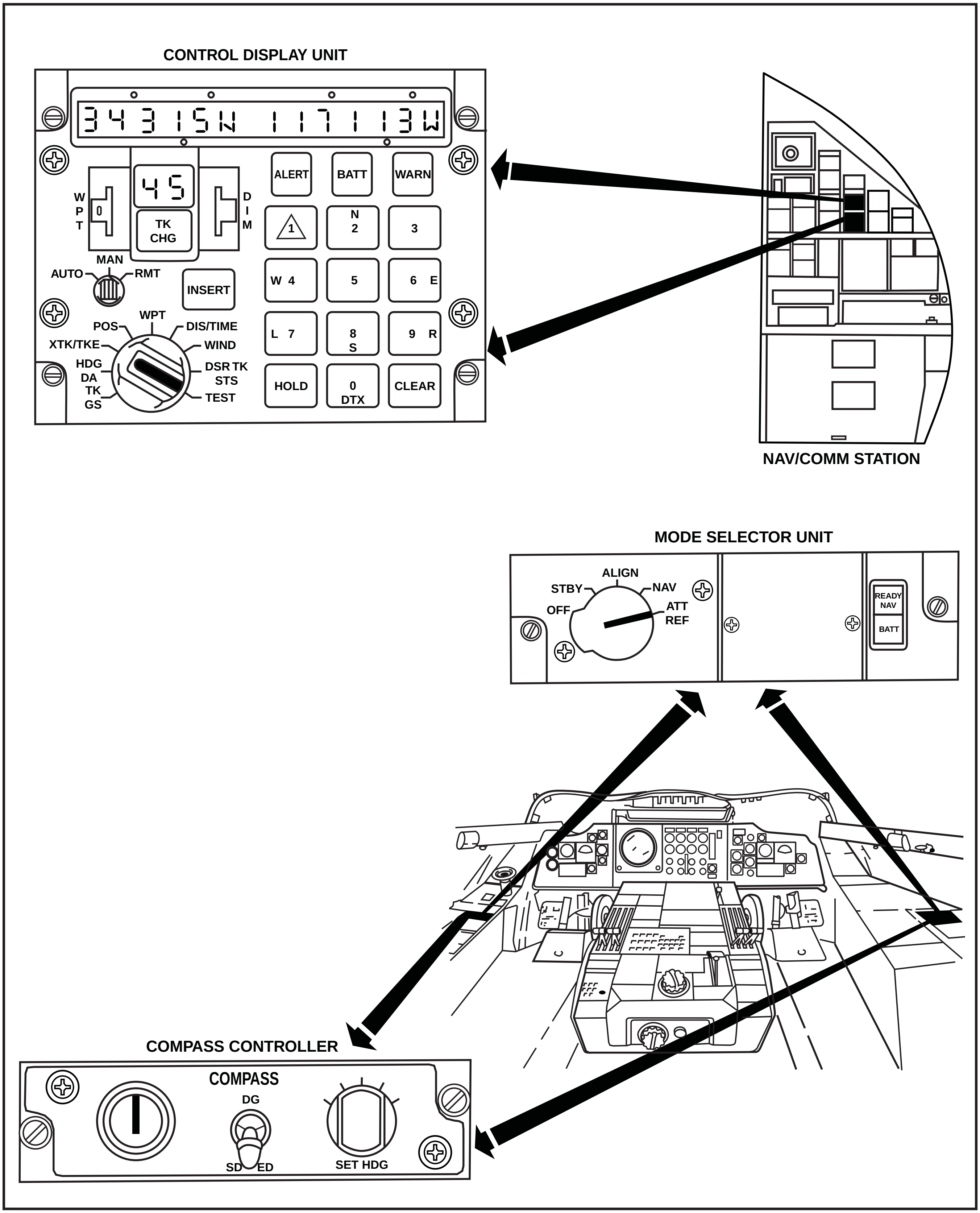


Figure 22-17. AN/ASN-179 System Control Component Locations

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.
ATT REF (cont.)	**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 17.5 VDC, the INS will shut down.

Figure 22-18. MSU Panel Markings and Functions

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 MAG VAR functionality.

22.3.2.2.6 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.

22.3.2.2.7 True Airspeed Computer. Located in rack C-2 (Figure 22-15), this computer utilizes the copilot pitot-static system and the TAS temperature probe to calculate speeds from 70 to 450 knots.

22.3.2.2.8 True Airspeed Control Panel. Located at the NAVCOM station (Figure 22-15), 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.

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 (Cross-Track Distance/Track Angle Error)	Displays cross-track 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 cross-track 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.

PANEL MARKING	FUNCTION
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°.
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 cross-track offsets.
WPT	Selects waypoint (1 through 9) for latitude and longitude insertion or selects waypoint (0 through 9) for presentation of waypoint coordinates.

Figure 22-19. CDU Panel Markings and Functions (Sheet 1 of 2)

PANEL MARKING	FUNCTION
TK CHG	Allows manual track changes to be made with the data keyboard.
INSERT	Used to enter keyboard entries into the computer. At start-up, 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 that the navigation data are no longer available. **Note** A flashing WARN light indicates system degradation.
Data Push-buttons	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 22-19. CDU Panel Markings and Functions (Sheet 2 of 2)

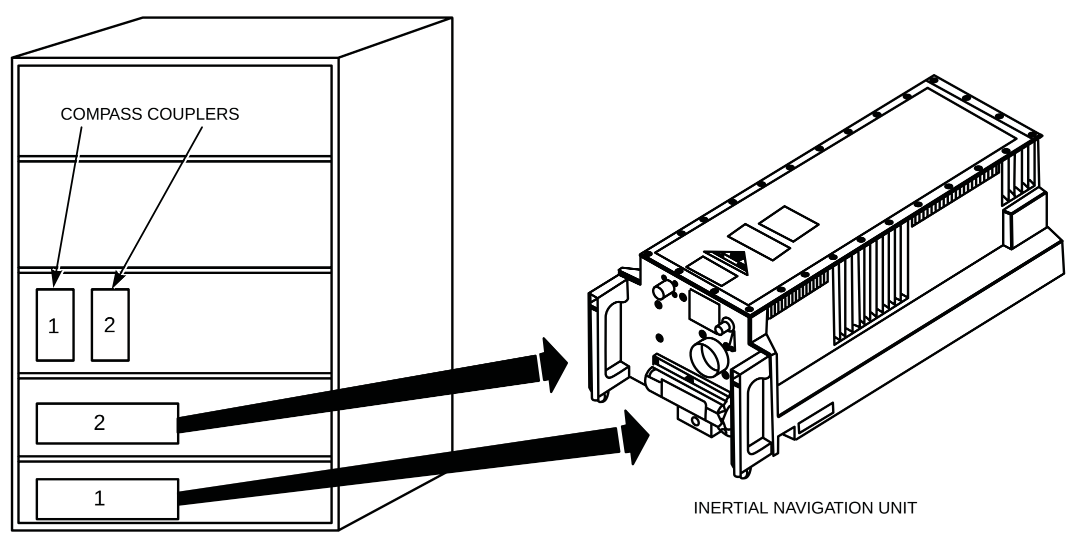


Figure 22-20. AN/ASN-179 Components Located in Rack H-1/H-2

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.

22.3.2.2.9 Circuit Breakers. Circuit breakers and power sources for the AN/ASN-179 INS components are listed in Figure 22-21.

22.3.2.3 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 read-outs.

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 NAVCOM 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.

22.3.2.3.1 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 (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.

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 22-21. AN/ASN-179 INS Circuit Breaker Locations and Power Sources

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.

22.3.2.4 Modes of Operation. The MSU is used to select the AN/ASN-179 INS operating mode as described in the following paragraphs.

22.3.2.4.1 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.

22.3.2.4.2 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

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.

22.3.2.4.3 Navigation Mode. Selecting NAV (a detented switch position) on the pilot and copilot MSUs enable 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.

22.3.2.4.4 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.

22.3.2.5 Operating Procedures

22.3.2.5.1 Alignment Procedures

a. 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.

b. 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 — Illuminate (after approximately 30 seconds).

6. MSU mode selector switch — NAV.

c. 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.

- For an in-flight alignment initiated at status 70, the system will enter air align hold until ground speed 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.

22.3.2.5.2 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.

22.3.2.5.3 Initial Track Selection. The initial track is the direct route between aircraft present position and initial enroute 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 enroute waypoint — Press.

   b. Enter the number representing the desired track leg stop enroute 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

Cross-track 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.

22.3.2.5.4 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 WPT 1 coordinates.
6. CDU WPT switch — sequential positions. Enter waypoints in the same manner as WPT 2 coordinates.

22.3.2.5.5 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 NAVCOM 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 enroute 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 cross-track 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. Cross-track 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.

a. 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.

b. 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 DTK 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.

c. 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.

d. 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 paragraph 22.3.2.5.4. 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.

e. 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.

f. 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.

g. 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 that 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 DTK 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.

22.3.3 Attitude Heading Reference System (AHRS), ASN-50. The AHRS provides roll, pitch, and magnetic heading information for various aircraft systems and instruments. Pitch and roll information is supplied by the AHRS vertical gyro; heading information is furnished by the directional gyro or ML-1 fluxgate magnetic compass located in the right horizontal stabilizer. The system may be operated in any one of three heading modes: slave, compass, or free. Normal operation uses the slave mode. In this mode, the directional gyro azimuth output signal is corrected according to the magnetic fluxgate signal at the rate of 0.75° to 1.5° per minute. This correction rate is sufficient under normal conditions. The compass mode is used in the event of directional gyro failure. In this mode, the system functions as a direct compass repeater with no gyro stabilization. The free mode may be selected when local magnetic conditions or operation in high latitudes make the magnetic compass information erratic or unreliable. During operation in the free mode, no magnetic correction is applied to the directional gyro, and the system must be given latitude information manually to correct for precession. The free mode is subject to greater error accumulation than the slave mode.

22.3.3.1 AHRS Control Panel. The AHRS control panel (Figure 22-22), located on the pilot side of the center control stand, contains all the controls and indicators necessary to operate the AHRS. The controls include the mode selector switch, manual heading selector switch, latitude selector knob with digital indicator, hemisphere switch, and synchronizing button with synchronize indicator.

22.3.3.1.1 Mode Selector Switch. The mode selector switch, placarded COMP, SLAVE, and FREE, permits selection of the compass, slave, or free modes of operation.

22.3.3.1.2 Manual Heading Selector Switch. The manual heading selector switch, placarded L, R, and PUSH TO TURN, is used to establish any desired reference heading in the free mode. The direction of knob rotation determines the direction of heading change, and the amount of knob rotation determines the speed of heading change.

22.3.3.1.3 Latitude Selector Knob. The latitude selector knob permits changing the latitude setting to correspond with the position of the aircraft during operation in free or slave modes. The selected latitude is displayed in the window (placarded LATITUDE and degrees) of the digital indicator.

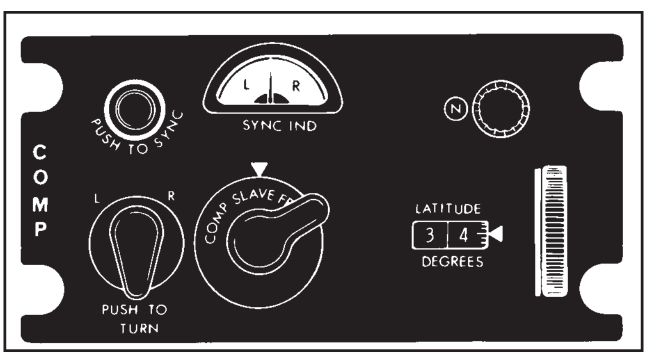


Figure 22-22. AHRS Control Panel

22.3.3.1.4 Hemisphere Selector Switch. The hemisphere selector switch permits selection of either north latitude or south latitude. The selected hemisphere is displayed, as the letter N or S, in the window adjacent to the selector switch.

22.3.3.1.5 Synchronization Button. The synchronization button, placarded PUSH TO SYNC, when depressed, increases the slaving rate of the directional gyro to bring the gyro into synchronization with the flux valve. This control is used only when operating in the slave mode.

22.3.3.1.6 Synchronism Indicator. A synchronism indicator, placarded SYNC IND, is located adjacent to the synchronization button, displaying the direction and amount that the directional gyro deviates from the flux valve.

22.3.3.2 System Operation. When power is applied to the aircraft, the AHRS is energized unless the circuit breakers are disengaged.

22.3.3.2.1 Free Mode. Local latitude must be preset and kept set as accurately as possible, particularly in high latitudes, to cancel the effects of the rate of Earth rotation. Desired grid heading is set by the L-R SLEW controller.

22.3.3.2.2 Slave Mode. The system goes into fast synchronism each time the slave mode is selected or when the system is first turned on. The SYNC IND needle should be centered. The fast synchronism function can be initiated at any time by pressing the PUSH TO SYNC button.

22.3.3.2.3 Compass Mode. The compass mode is strictly an emergency mode to be used only when the directional gyro is disabled. Only raw flux valve information is used. Because of the oscillatory nature of the flux valve signal, the autopilot should not be operated in this mode. Compass cards are not as steady as in stabilized modes.

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 three TACAN systems: ARN-52 (P-3A/B and early production P-3C baseline), ARN-84 (some P-3C, Update I and II), and ARN-118 (Update 2.5 or II.5 and Update III and modified P-3A/Bs).

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 22-23.

22.4.2.1 RT-384/ARN-52(V) TACAN Receiver-Transmitter. The RT-384/ARN-52(V) TACAN receiver-transmitter is located in rack C-2 and provides for signal reception and transmission to calculate bearing and distance to a surface station or distance to aircraft with air-to-air equipment.

22.4.2.2 C-2010/ARN-52 TACAN Control Panel. The C-2010/ARN-52 TACAN control panel is located on the flight station center pedestal and provides for channel selection, mode selection, or volume control. The mode switch enables the receive, transmit-receive, or air-to-air operation.

CAUTION

When changing stations, select REC on the TACAN control panel to prevent damage to the receiver-transmitter during station channelization.

22.4.2.3 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.

22.4.2.4 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.

22.4.2.5 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 22-24.

22.4.2.6 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.

22.4.2.7 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.

22.4.2.8 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 22-25.

22.4.2.9 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.

22.4.2.10 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.

22.4.2.11 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.

22.4.2.12 ADF Sense Antenna and A51863/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.

22.4.2.13 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 22-26.

22.4.2.14 Circuit Breakers. Circuit breakers and power sources for the ARN-52, ARN-84, ARN-118 TACAN systems and the ARN-83 ADF receiver are listed in Figure 22-27.

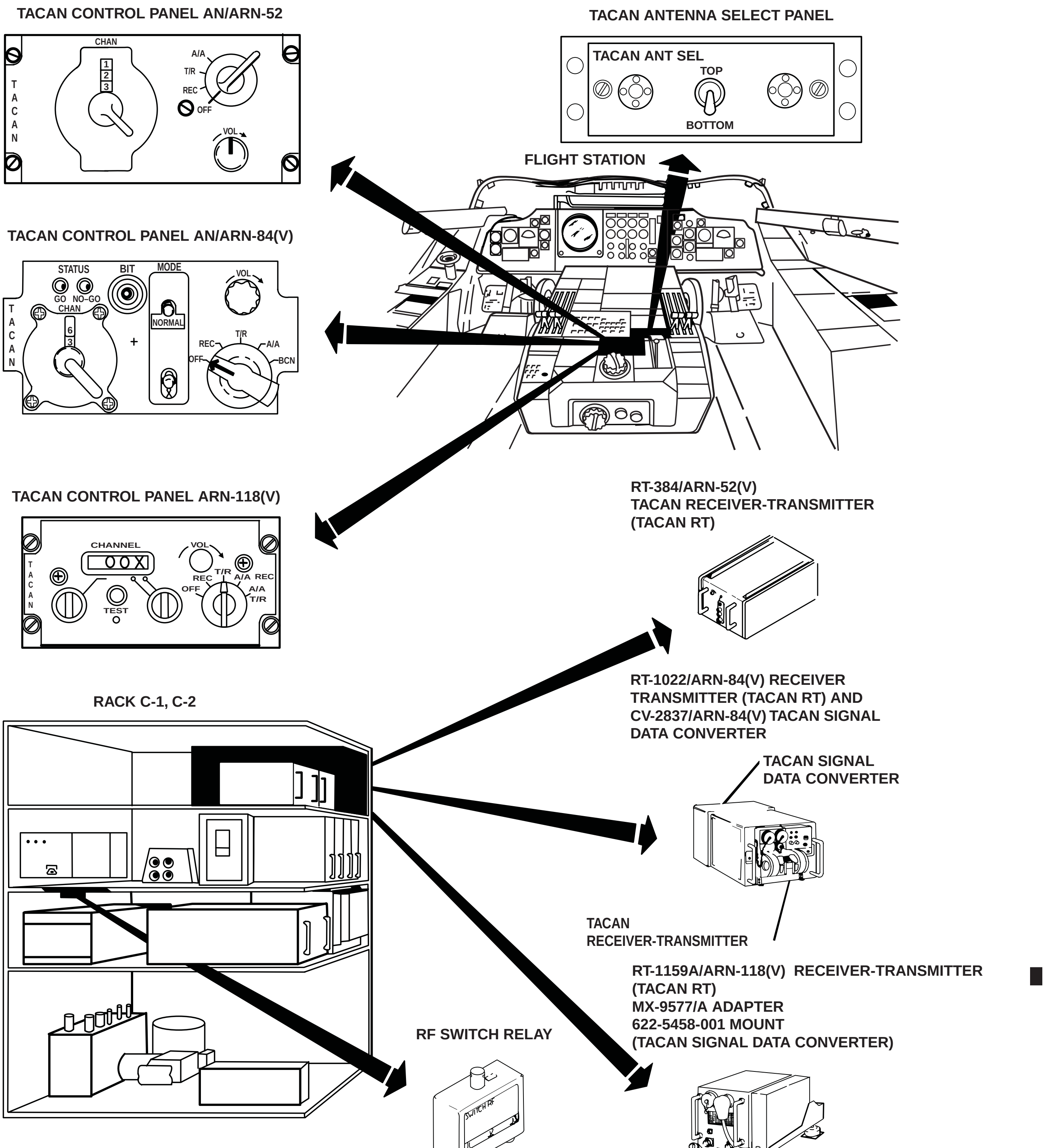


Figure 22-23. TACAN/ADF RNS Component Location (Sheet 1 of 2)

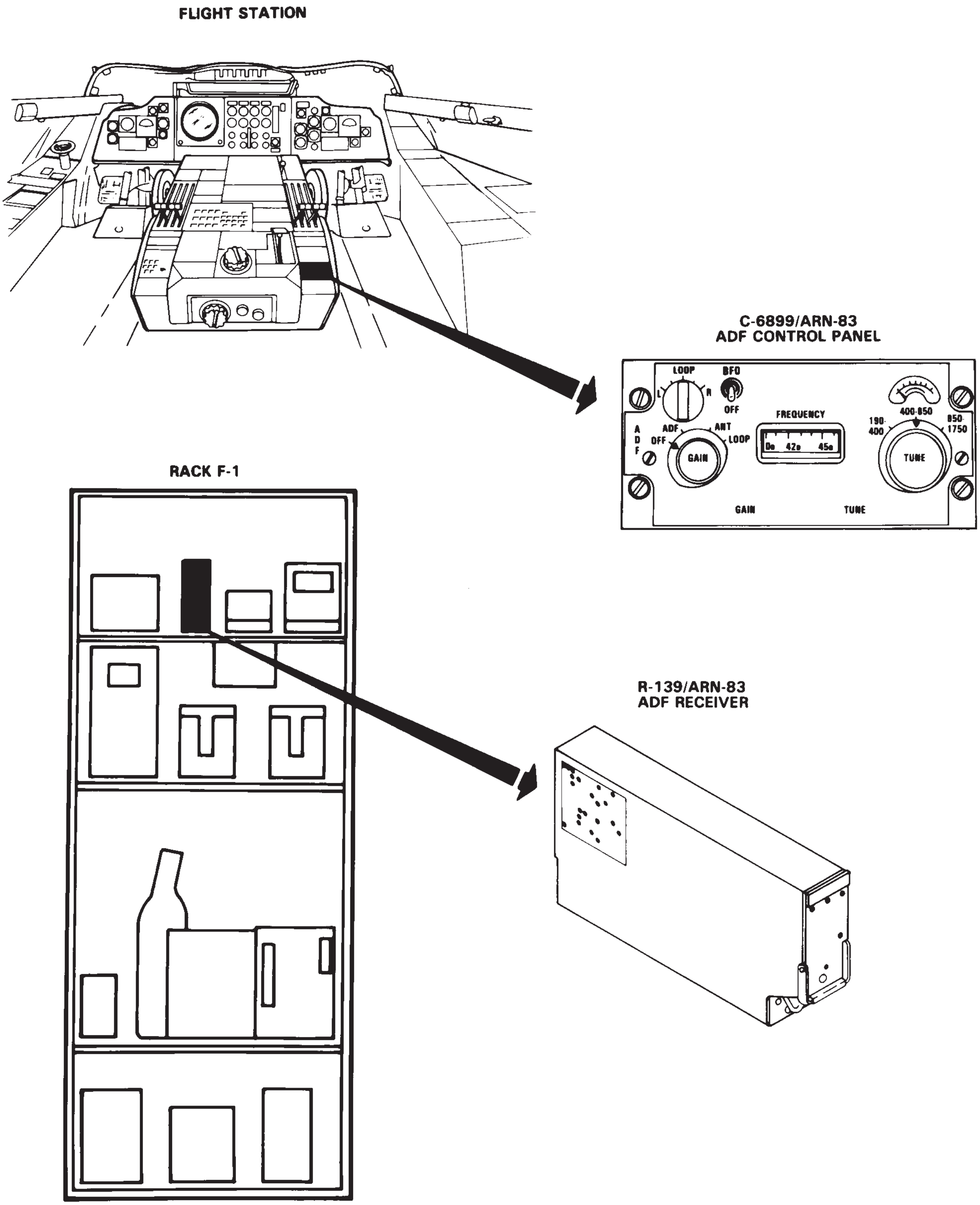


Figure 22-23. TACAN/ADF RNS Component Location (Sheet 2 of 2)

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 22-24. 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 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 22-25. ARN-118(V) TACAN Radio Set Control Panel Marking and Functions

22.4.3 ARD-13 ADF System. The ARD-13 ADF system is a navigational aid that provides ADF and radio range reception in the frequency range of 90 to 1800 kHz. The frequency range is covered in four bands. Band selections as well as tuning within each band are conducted at the pilot center control stand or at the navigator station; however, the pilot has prime control of the system. Activation of the control at the navigator station when the pilot selector is in the OFF position automatically switches control to the navigator station. Both automatic and manual direction finding are provided through use of the loop antenna principle. In the automatic mode, when the receiver is tuned to a transmitting station, the loop is rotated automatically with no ambiguity so that the plane of the loop is perpendicular to the direction of the arriving radio signals. Loop position is transmitted by a synchromechanism to provide a remote indication of the direction of the signal source. This direction is displayed on the pilot HSI and on the navigator BDHI. During operation in the loop mode, the loop is rotated electrically by operating the manual loop rotation control. In this mode, 180° ambiguity exists. A visual presentation of the bearing of the aircraft is displayed on the pilot HSIs and on the navigator BDHI. The pilot has control of the system whenever the cockpit selector, located on the pilot center control stand, is turned ON. If the navigator desires control of the ADF, the pilot must turn his control off before a transfer can be performed. Activation of the control at the navigator station automatically switches control to this station. Operating the switch again in the cockpit automatically returns control to the pilot.

PANEL MARKING	FUNCTION
BFO/OFF	In 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 – 400 kHz, 400 – 850 kHz, or 850 – 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 22-26. ARN-83 ADF Control Panel Markings and Functions

COMPONENT NAME	CIRCUIT BREAKER LOCATION	CIRCUIT BREAKER NAME	POWER SOURCE
TACAN SYSTEM: ARN-52, 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 22-27. TACAN-ADF Circuit Breaker Locations and Power Sources

22.4.3.1 Power Application. Power is supplied through the AC and DC circuit breakers, labeled DF-202 ADF, located on the forward right circuit breaker panel and an AC circuit breaker on the navigation forward interconnection box.

22.4.3.2 ARD-13 Controls and Indicators. One ADF control panel (see Figure 22-28) is located on the pilot center control stand and the other is located in the navigator station. The following controls are located on the two identical ADF control panels.

22.4.3.2.1 Function Selector Switch. The function selector switch turns the ADF system on and off and controls the mode of operation. Operating modes are ADF, ANT, and LOOP. In the ADF mode, the system operates as an automatic direction finder. The system automatically finds the null of the received station and indicates the bearing to the station on the pilot HSIs and the navigator BDHI. In the antenna mode, the ADF is used for reception only, and the direction-finding feature is defeated. The AVC operates in this position to keep the audio volume at a constant level when the signal strength from the station varies. During operation in the loop mode, the set may be used manually to find a null. In this mode the loop antenna is rotated with the loop control and the null determined aurally.

22.4.3.2.2 Loop Control. The loop control is used to rotate the loop antenna to find the aural null in the loop mode. The loop control has two rate-of-rotation positions in each direction. When the control is in the first position, the loop antenna rotates at a slow rate for accurate null finding; when in second position, the loop rotates at a fast rate to locate the general area of the null. The loop control may also be used in the ADF mode to check the operation of the ADF circuits. When the loop antenna is rotated away from the null with the loop control, the ADF circuits should swing the loop antenna back to the original null, giving the same bearing on the instrument.

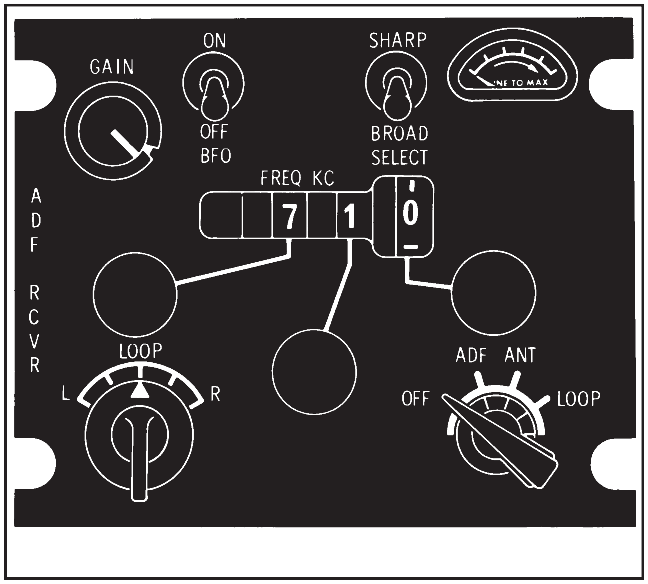


Figure 22-28. ADF Receiver Control Panel

22.4.3.2.3 Gain Control. The gain control is an RF gain control in the antenna and loop modes and controls the sensitivity of the set. During operation in the ADF mode, the gain control is an audio gain control that governs only the audio output of the set and has no effect on the RF sensitivity.

22.4.4 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.

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-52 and 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-3C 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-3Cs 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 or 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.

22.4.5 Operating Procedures

22.4.5.1 ARN-52 TACAN Surface Station Operation

1. Turn the mode selector to REC and wait 3 to 5 minutes for the system to warm up. Selecting the TR or A/A modes before the TACAN has channelized may damage the receiver-transmitter.

2. Select desired station.

CAUTION

When changing stations, select REC on the TACAN control-panel to prevent damage to the receiver-transmitter during station channelization.

3. Select the TACAN REC switchlight on the ICS and aurally identify the station.

4. After selecting TACAN on the HSI control panel and observing the HSI pointer stabilize to the magnetic bearing, select TR to read magnetic bearing and range information.

22.4.5.2 ARN-52 TACAN Air-to-Air Operations

1. Turn the mode selector to REC and wait 3 to 5 minutes for warmup, if not already done.

CAUTION

Selecting the TR or A/A modes before the TACAN has channelized may damage the receiver-transmitter.

2. Select a station 63 channels apart from the other airborne selected 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 IFF may cause tumbling of the HSI range indicator.

3. Select A/A mode on the TACAN control panel and observe DME window.

For TACAN approach procedures, refer to Chapter 18, All-Weather Operations.

22.4.5.3 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.

22.4.5.4 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, All-Weather Operations.

22.4.5.5 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.

22.4.5.6 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, All-Weather Operations.

22.5 APX-72 IFF

22.5.1 Introduction. The air traffic control radar beacon system/IFF/Mark XII identification system (AIMS) 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 22-29.

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 22-30.

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) of 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 that 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 22-31.

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 is 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.

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

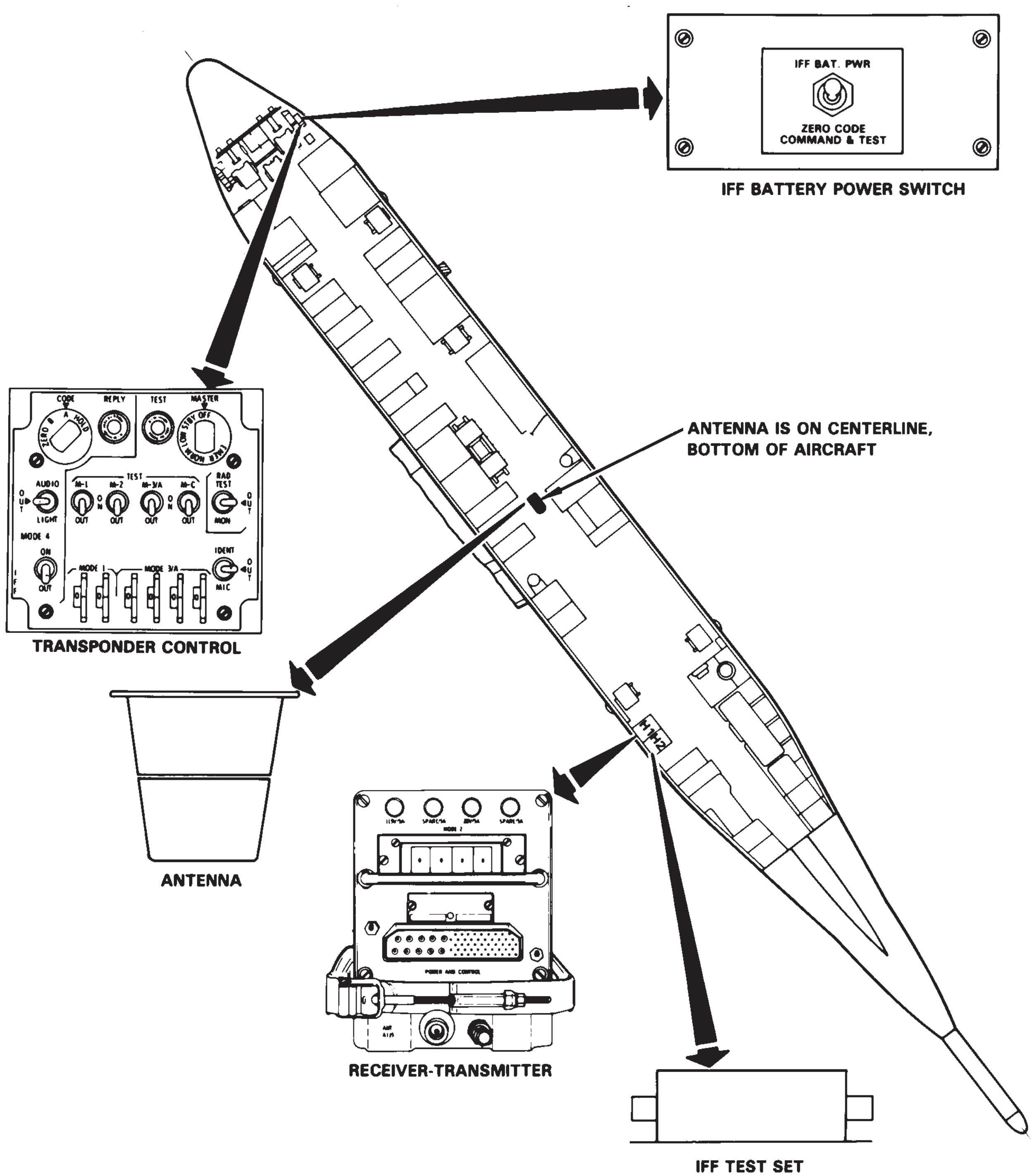


Figure 22-29. APX-72 System Component Locations (P-3C)

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.

PANEL MARKING	FUNCTION
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.

PANEL MARKING	FUNCTION
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.
INDENT-OUT-MIC:	
INDENT	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 22-30. Transponder Control Panel Markings and Functions

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 22-31. APX-72 Component Circuit Breaker Locations and Power Switches

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/ARN-151(V) GLOBAL POSITIONING SYSTEM

22.6.1 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, while 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.

WARNING

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. Refer to squadron/wing standard operating procedures and site-specific directives for further minimum navigational requirements.

WARNING

GPS shall not be used as a primary navigation source. No P-3 GPS system meets FAA standards to fly enroute, terminal, or precision/nonprecision approaches under VMC or IMC conditions.

Note

The ARN-151 GPS is a suitable external fixing source.

Currently the only interface with other aircraft systems is with the LTN-72 Inertial Navigation System (INS) incorporated with the 72-09-21 software program and AN/ASN-179 Inertial Navigation System, which provides two-way communication between the GPS and INS. 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. For a detailed description of INS-GPS aided procedures, refer to the LTN-72 Inertial Navigation System section of this publication.

22.6.2 System Components

22.6.2.1 Control Display Navigation Unit (CDNU). See Figure 22-32 and Figure 22-33, Sheet 1of 2. 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 and 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.

22.6.2.2 GPS Receiver. See Figure 22-34, Sheet 2 of 2. Located in rack C-2, this unit routes the received GPS timing signals from the antenna to the CDNUs for processing.

22.6.2.3 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 over 45,000 waypoints may be loaded from a TAMPS terminal. A Reversionary Identifier database with up to 200 predefined waypoints may be operator-loaded into the CDNUs' non-volatile memories. (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.

22.6.2.4 Data Transfer Module (DTM). 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.

22.6.2.5 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.

22.6.2.6 GPS Antenna. Located on the upper fuselage centerline of the aircraft between the HF radio longwire 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.

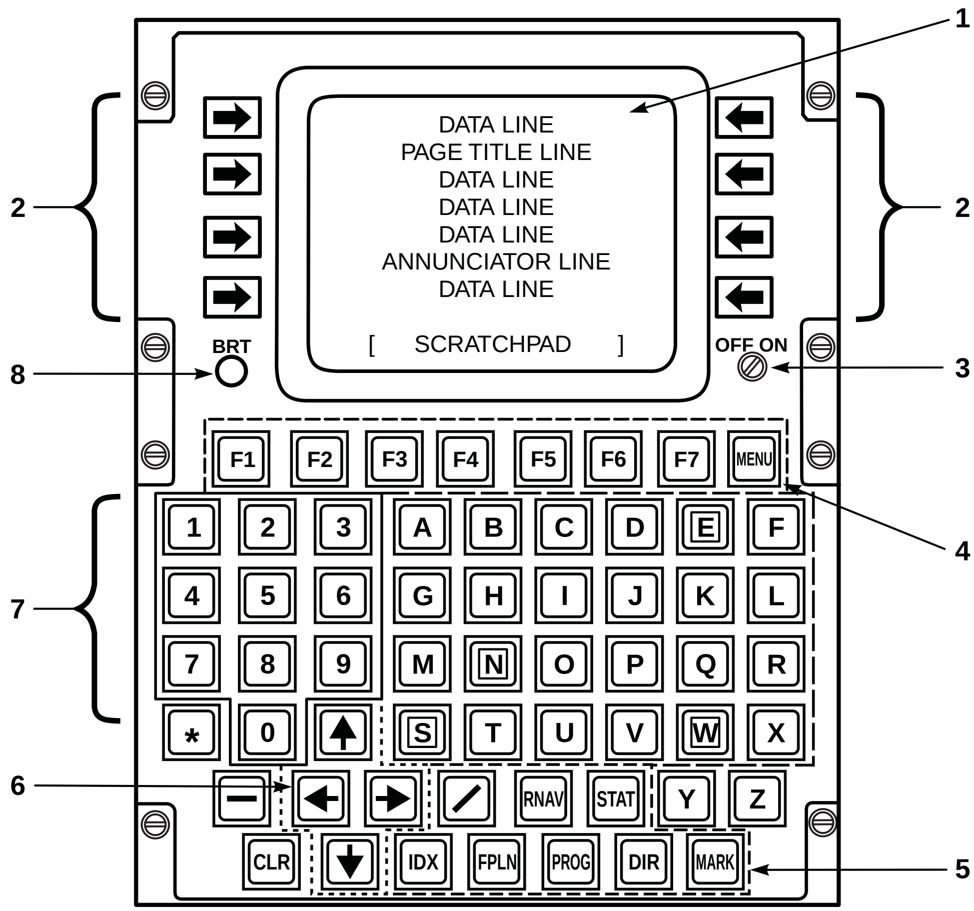
22.6.2.6.1 Antenna Pre-Amplifier. Located in the overhead adjacent to Sensor Station-2, this unit amplifies the signals received by the antenna and routes them to the receiver for processing.

22.6.3 System Initialization and Operating Procedures. For detailed GPS operating procedures, refer to the AN/ARN-151(V) Satellite Signals Navigation Set GPS JOB AID.

22.6.4 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.



INDEX NO.	NAME	FUNCTION
1	CRT DISPLAY	Displays data, status, and fault information on seven lines. Line eight (SCRATCH PAD) 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 – 5 volts is available.
4	SPECIAL FUNCTION KEYS	Keys can be pre-programmed to permit initiating infrequently used operations.
5	STANDARD FUNCTION KEYS	Pre-programmed 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 22-32. CDNU Operating Controls and Indicators

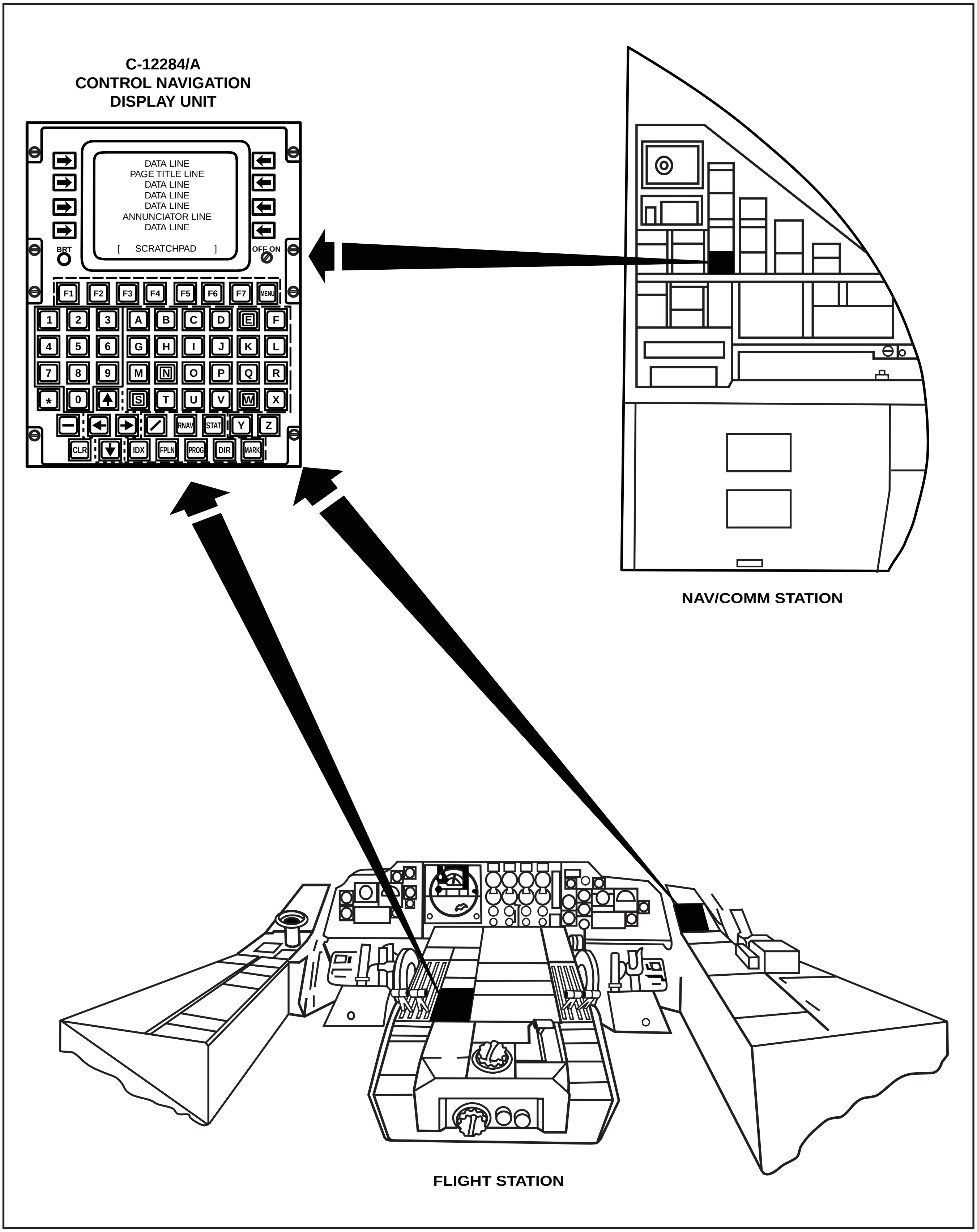


Figure 22-33. GPS System Components (Sheet 1 of 2)

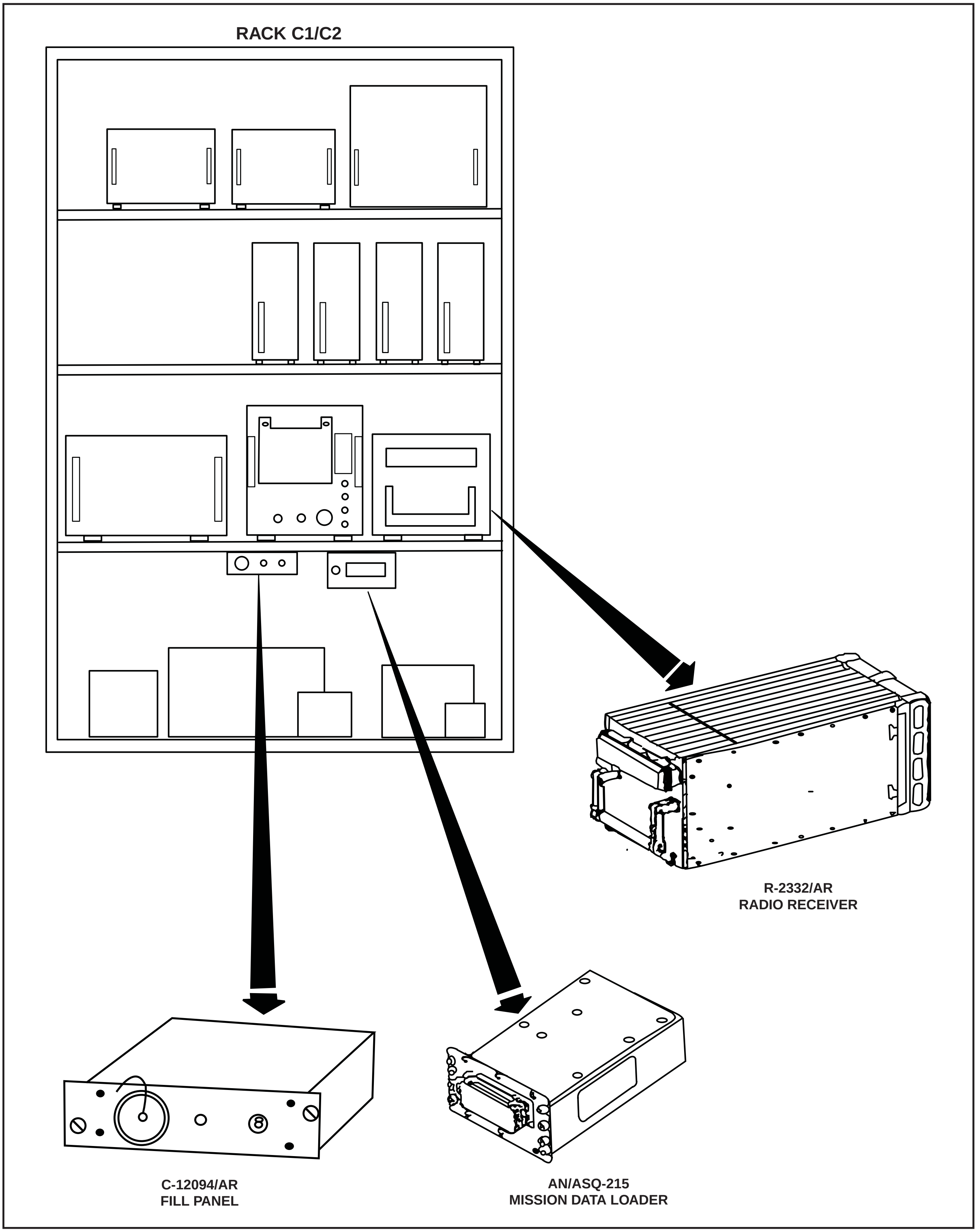


Figure 22-33. GPS System Components (Sheet 2 of 2)

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
✓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		
FLIGHT PLAN FULL	Attempt to insert more than 50 points into flight plan.	Clear key.	S	A		

Figure 22-34. 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
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 enroute 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 22-34. Annunciation/Error Messages (Sheet 2 of 2)

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.

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 STAT Key on any CDNU; verify GO displayed for all applicable systems, and that there are no “STATUS” indications for any system.

Note

Non-applicable systems will have a NOGO status. Non-applicable systems are SDC, DAC, AHRS, and 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 Bus Coupler Fault Isolation Procedures. (NAV/COMM CSMM-GPS, Figure 4-4).

      (2) NOGO-T displayed indicates that the 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.

22.6.4.1 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 CNO 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.

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's 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.

22.6.4.2 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.

22.6.4.3 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 22-34 indicates the meaning and proper action for each Annunciation/Error message.

22.6.5 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. 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.

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. Doppler radar — drift angle and drift angle valid signal.
5. VHF navigation system, VIR-31A.
6. 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).

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 (see Figure 23-1).

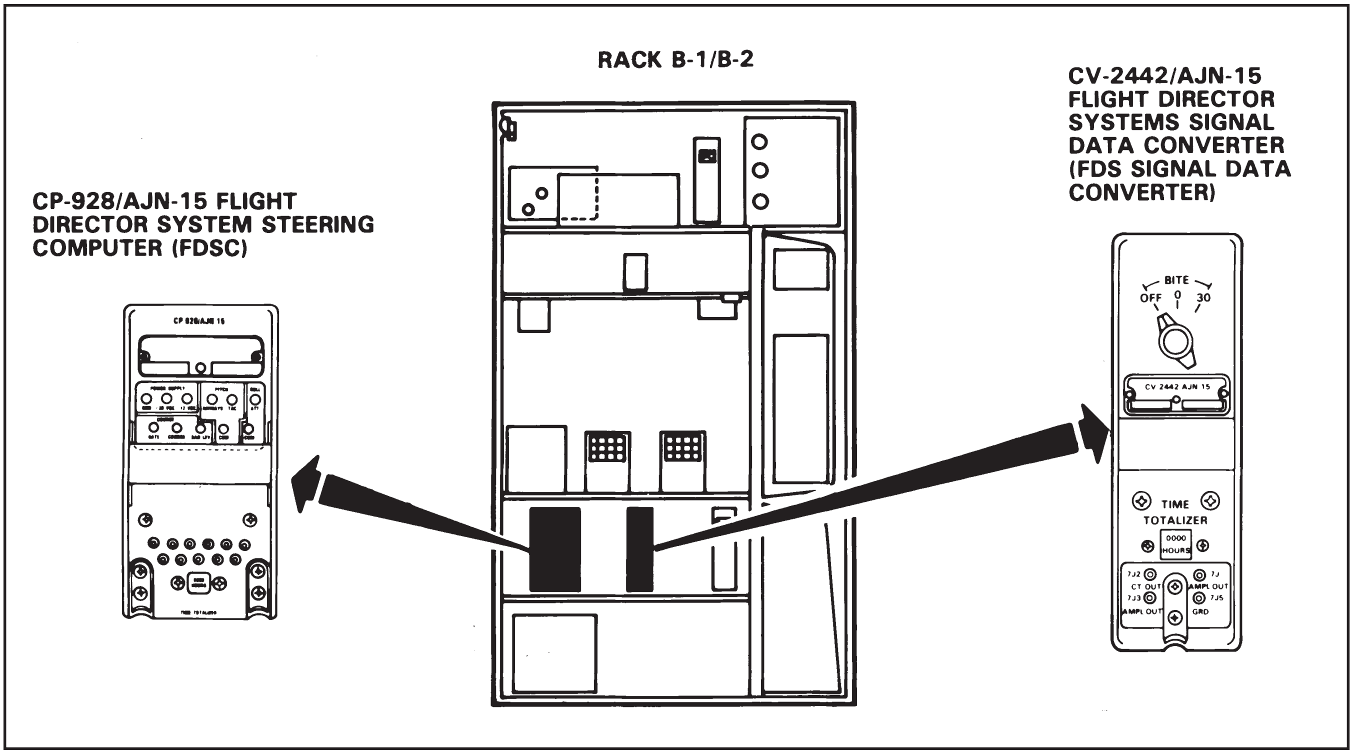


Figure 23-1. Flight Director Steering Computer and Signal Data Converter

23.2.1.3 Flight Director Indicators (FDI). 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.

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 push-button-indicator on the FDS control panel, and the pitch function is achieved through use of the PITCH STEERING push-button-indicator. When PITCH STEERING is ON in addition to ROLL STEERING, and not in the glideslope submode, the center of the

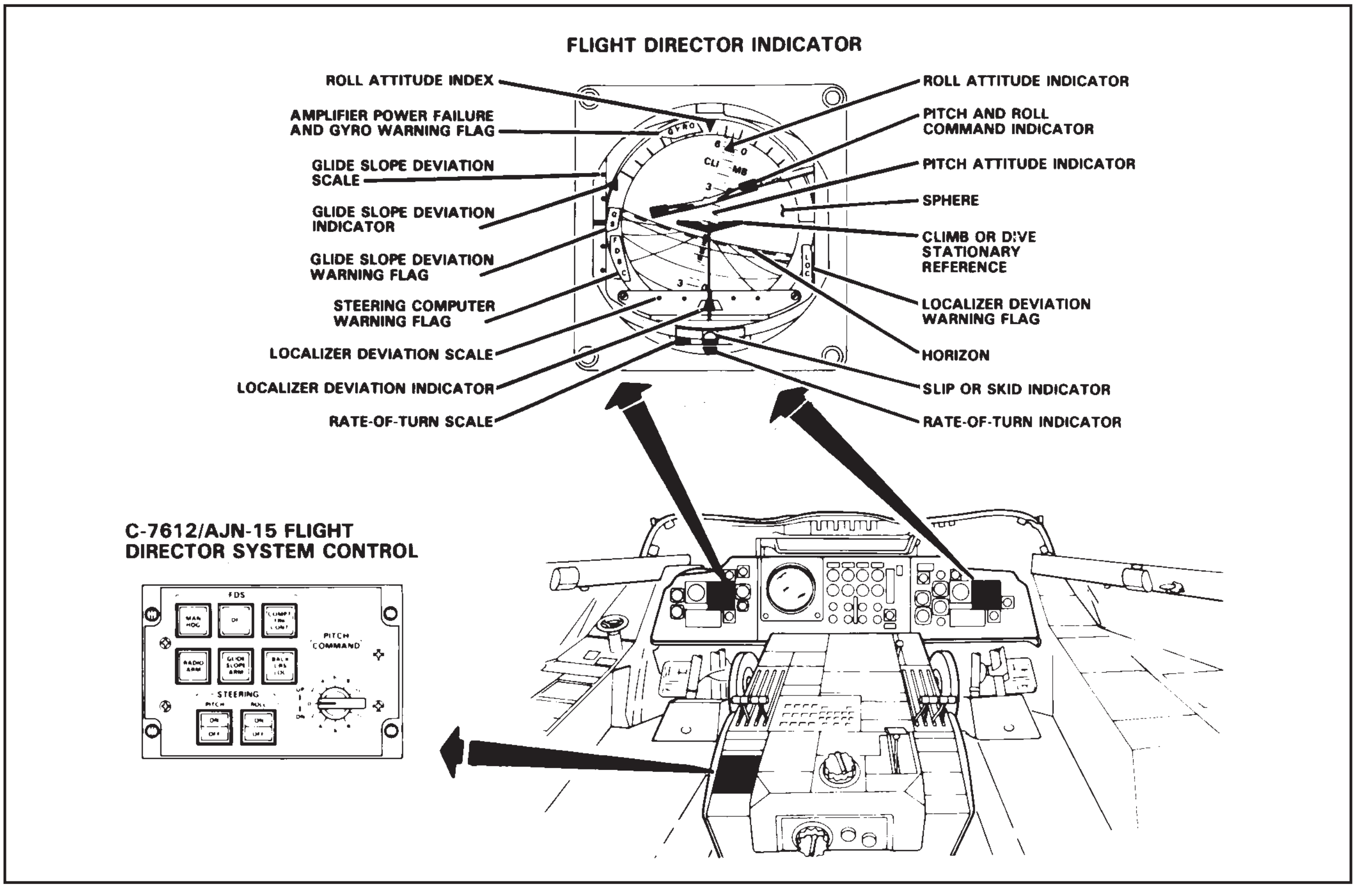


Figure 23-2. FDS Components Located at the Flight Station

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. On ASN-84 equipped aircraft, the GYRO flag appears when a failure occurs in the power supply, computer, inertial measurement unit, or gyro assembly control. On LTN-72 equipped aircraft, the GYRO flag appears when a failure occurs in primary attitude, auxiliary attitude, true heading, MHRS, or DDU power analog circuits. The GYRO flag circuits also monitor the four servo amplifiers 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 push-button 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. (See also NAVAIR 01-75PAC-11-2 series 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 signal. Those signals, however, 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 push-button indicator on the FDS control panel — Depress to illuminate amber. Command bar appears; FDSC flag retracts.

2. MAN HDG push-button 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, the TACAN distance is correct.

Note

VOR bearings are not valid when an ILS frequency is selected.

   a. If the use of 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 push-button indicator — Depress to illuminate amber. Command bar appears. FDSC flag retracts.

6. MAN HDG push-button indicator — Depress to illuminate amber.

7. RADIO ARM push-button 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 push-button 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 push-button indicator of the FDS control panel when within one dot or less of localizer deviation. (Both push-button indicators illuminate amber).

6. Glide slope 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

Glide slope 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 push-button 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 push-button 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. COMPETE TRK CONT. push-button 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, cross-track 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 push-button 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 push-button 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.

23.2.3 Attitude Director Indicator (ADI) (Aircraft Incorporating AFC-534). The ID-1329 ADI is a 360 degree, three-axis, non-limited attitude indicator that includes a turn needle, slip/skid indicator, and precision approach course bars. This combination of attitude and precision approach course information on a single flight instrument permits rapid and reliable interpretation of aircraft performance, compared to older installations. Power for the indicators is provided through the respective Pilot or Copilot/Vert Gyro circuit breaker on the flight station MON. ESS AC BUS. Components that interrelate with the ADI are three aircraft system gyros, remote turn rate gyros, VOR-1 and VOR-2, and the UHF glideslope receiver.

23.2.3.1 Indicator. Figure 23-3 depicts the pilot's and copilot's ADI. Both indicators are identical and display aircraft pitch, roll, and heading information. AHRS is the normal source for pilot attitude information, and the LTN-72 is the normal source for copilot attitude information. If either AHRS or the LTN-72 gyro fails, attitude information from the STBY gyro may be manually selected through the respective navigation control panel ATTITUDE select switch. Heading source information for the ADI is selected through the respective navigation control panel HEADING select switch.

WARNING

STBY gyro should never be selected by both pilot and copilot, unless both AHRS and the LTN-72 gyros are unusable.

The amount of aircraft pitch and roll is determined by comparing the miniature airplane with the graduated pitch and roll scale on the attitude sphere. Pitch attitude is read in 1° increments up to 10°, 5° increments to 60°, and 30° increments to 90°. Bank angle is read off the fixed bank angle index on the bottom of the indicator.

23.2.3.2 Turn Needle. Rate-of-turn is provided by the rate-of-turn indicator that moves left and right in response to the remote-mounted turn rate gyros. Separate rate-of-turn gyros are provided for the pilot and copilot. The gyros are powered by the MON. ESS DC BUS with the pilot having an alternate source from the FLT ESS DC 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. When the pointer is aligned with the black bar, a standard 3° per second turn is being flown. When the pointer is aligned with the white bar, a 6° per second (double standard rate) turn is being flown.

23.2.3.3 Slip/Skid Indicator. Balanced flight is indicated by the inclinometer, which consists of a curved tube and ball located at the bottom of the instrument.

23.2.3.4 Warning Flags. Several warning flags are provided on each ADI and will appear when malfunction, unreliable signal, or power failure occurs. Warning flags and their functions are as follows:

1. OFF flag — indicates power failure, indicator failure, or unreliable input signal.

2. LOC alarm flag — indicates unreliable localizer signal. Biased out of view when localizer frequencies are not in VOR-1.

3. Glideslope alarm flag — indicates unreliable glideslope signal. Biased out of view when localizer frequencies are not in VOR-1.

4. Displacement pointer alarm flag — indicates unreliable glideslope signal. Biased out of view when localizer frequencies are not in VOR-1.

23.2.3.5 LOC Course Bar. This bar displays localizer course deviation. Signal is selectable from either VOR-1 or VOR-2 through the navigation control panel. Full-scale deflection of the localizer course bar occurs at 2-1/2° displacement from the center of the localizer beam.

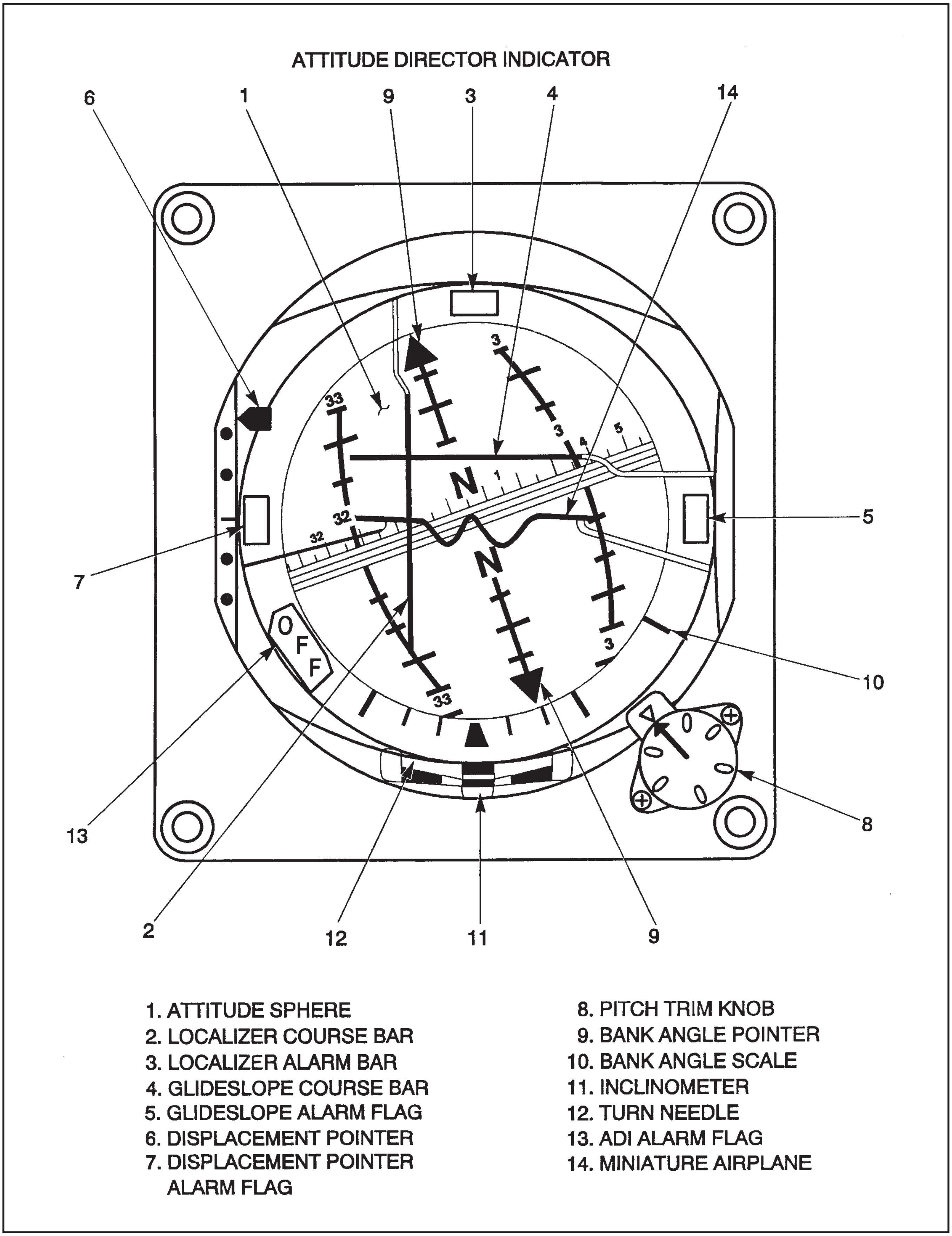


Figure 23-3. Attitude Director Indicator

WARNING

The ILS/GS circuit breaker shall be pulled prior to commencing a backcourse localizer approach to eliminate reverse localizer sensing and erroneous glideslope information to the ADI.

Note

The HSI localizer course bar will always display positive sensing, with the front course dialed in the HSI course set window.

23.2.3.6 Glideslope Course Bar. This bar displays glideslope deviation. Signal is from the 51V-4 glideslope receiver. Each dot of deviation represents a 1/4° displacement from the center of the glideslope beam.

Note

- If VOR-1 is not installed or is inoperative, it is not possible to turn on and channelize the 51V-4 glideslope receiver.
- Only localizer frequencies between 108.10 MHz and 111.95 MHz, selected in VOR-1, will energize and channelize the 51V-4 glideslope receiver.

23.2.3.7 Glideslope Indicator. This indicator works in conjunction with the glideslope course bar.

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, while 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; and ADF receivers; UHF-DF; Doppler radar; 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 (P-3C)

23.3.1.1 Horizontal Situation Indicator (HSI). An HSI, ID-1540/A, is provided for the pilot, copilot, and navigator (Figure 23-4.) 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.
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 while 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

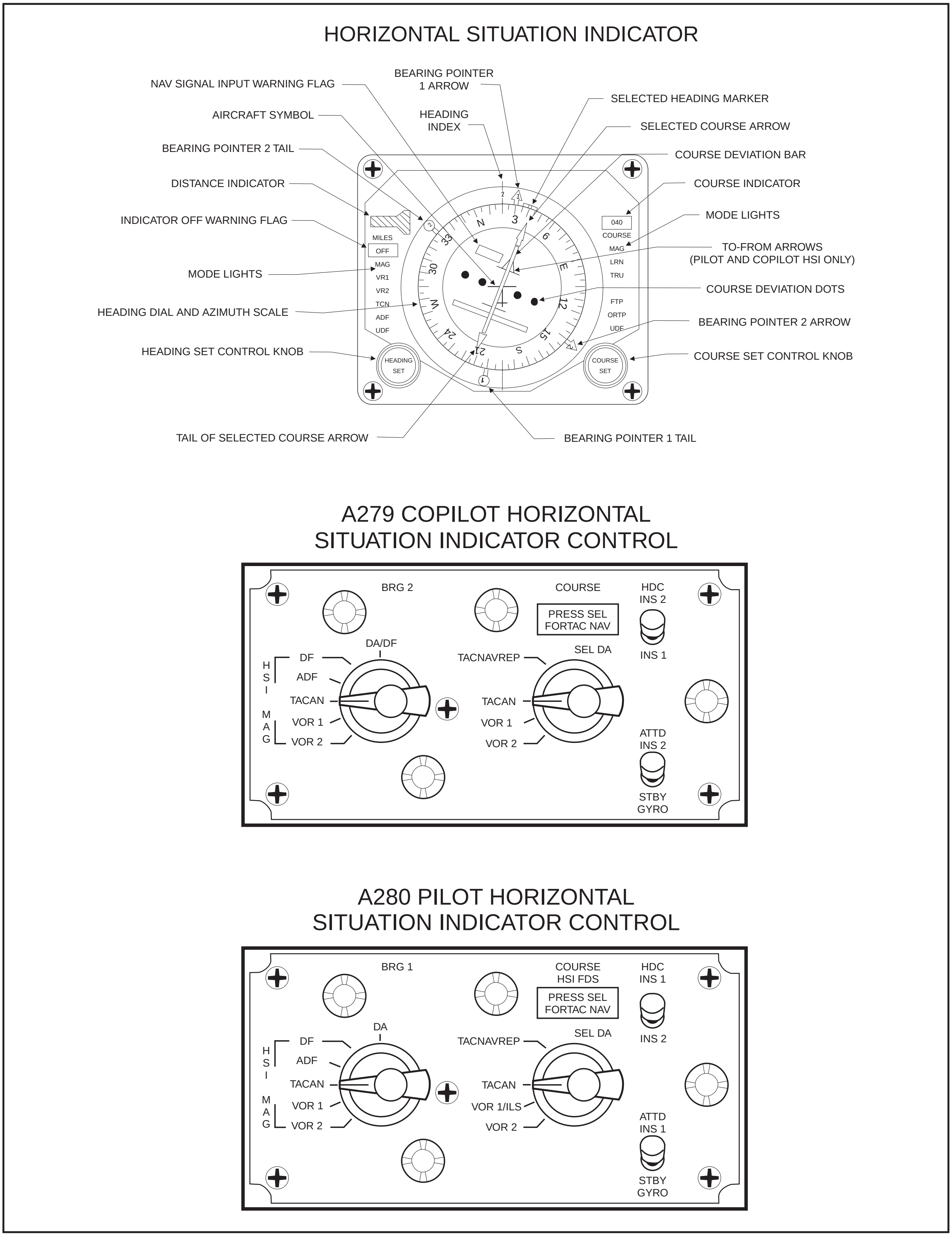


Figure 23-4. P-3C HSI System Components Located at the Flight Stations

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 equipment rack B1 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 (see Figure 23-4). 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 is 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 23-5.

23.3.2 System Components (P-3A/B)

23.3.2.1 Horizontal Situation Indicator (HSI). For ASN-124 equipped aircraft, description and operation of the navigation-display set is as follows.

An HSI is installed on each pilot instrument panel (see Figure 23-6). The HSIs are used for heading references during all phases of flight except those specifically related to ASW tactics that require use of the Bearing Distance Heading Indicators (BDHIs).

The HSI receives input information from the following sources: magnetic heading information from either the inertial or AHRS; distance information from the TACAN; bearing-to-station information from the TACAN, VOR-1 and VOR-2, ADF, or UHF DF; to-from and left-right course indications from VOR and TACAN. The HSIs provide the pilots with a plan view of the aircraft with respect to the navigation situation. They provide a combination display of course, approach, distance, and bearing information. The HSI includes a servo-driven azimuth card that displays the aircraft magnetic heading. A bearing pointer shows bearing information to the selected radio facility. The selected VOR or TACAN course is presented pictorially with respect to the stationary miniature aircraft at the center of the display. The course bar indicates the aircraft deviation from this course. A to-from pointer shows the direction along the selected course in relation to the radio facility. The selected heading appears under the heading set marker and illustrates the heading error angle by its displacement from the lubber line. The course arrow and heading set marker may be set manually by means of the COURSE SET and HEADING SET knobs. Course indications on the copilot HSI are slaved to the pilot indicator when both pilots select VOR-1 or TACAN. When both pilots select VOR-2, course indications are slaved to the copilot HSI. The pilot manually selects the heading marker and course arrow positions to line up with the bearing pointer. Once selected, they operate in unison with the compass card.

The course arrow has a center deviation bar that shows whether the aircraft is on, to the left, or to the right of course. The distance from the station to the aircraft in nautical miles is indicated by a three-digit display window in the indicator face. If the TACAN system is not operating or is in the search mode, the display window will be covered by an OFF flag. When the

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	Doppler and computer drift angle are invalid.
DOPPLER DRIFT ANGLE/	Doppler drift angle is valid. DRIFT ANGLE INVALID light should be extinguished.
COMPUTER DRIFT ANGLE	Doppler drift angle is invalid and 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 COMP 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 23-5. Navigation Advisory Light Panel Markings and Meanings

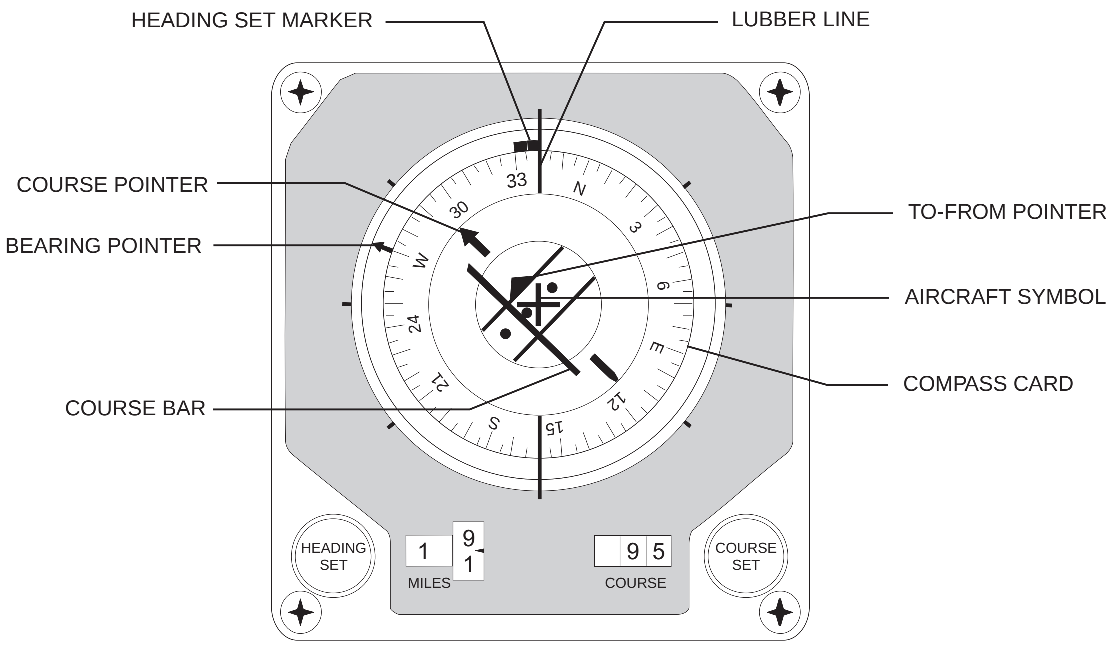


Figure 23-6. Pilot Navigation Control Panel and HSI

system is interrogating and locked on, the flag disappears, revealing the distance counters. The indicators are supplied 26-VAC power from a transformer located in the navigation forward junction box.

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.

23.3.2.2 Navigation-Display Set, AN/ASN-124 (If AFC-326 Installed)

23.3.2.2.1 Horizontal Situation Indicator System. The HSI system provides azimuth display information to the pilot and copilot with HSI indicators located at the respective stations. HSI functions are dependent on the HSI control-indicator selection. When RADIO is selected and the TRUE HDG light is extinguished, HSI functions are identical to those in aircraft not modified by AFC-326. When COMPUTER is selected and the TRUE HDG light is illuminated, the HSI indicates true heading and functions differ as shown in Figure 23-7. The pilot and copilot navigation control panels, located on the pilot instrument panels, are shown in Figures 23-8 and 23-9 respectively. The functions of the panel controls, dependent on the HSI control-indicator switch position, are provided in Figure 23-6.

23.3.2.2.2 Pilot Navigation Control Panel. A pilot navigation control panel is provided for each pilot for selection of the HSI heading, bearing, and course.

1. HSI Heading Selector Switch. An HSI HDG selector switch, one for each pilot, is located on each respective instrument panel. The switches have two positions, INERTIAL and AHRS, and are used to select the desired HSI heading source.

INDICATOR/ CONTROL	FUNCTION (for both HSI Control-Indicator positions)	
	RADIO	COMPUTER
Compass Card	Oriented to Magnetic North or grid, as selected by respective HSI HDG switch.	Oriented to True North.
Bearing Pointer	Points to the station selected by the HSI BEARING switch.	Indicates aircraft track/drift angle or OTPI bearing as selected by COMPUTER DRIFT ANGLE/OTPI switch.
Course Pointer	Points to the selected course.	Points to active fly-to-point when keyer control STEER switch set to TACCO or NAV M. Points to track between way points when KC STEER switch set to NAV A.
Course Bar	Indicates deviation from selected or localizer course. Indicated deviation is 5° per dot for VOR or TACAN and 1 1/4° per dot for localizer signals.	Indicates deviation from computer track to fly-to-point (5 nautical miles per dot) or from orbit path (1000 yards per dot).
To-From Pointer	Indicates whether the selected course will direct the aircraft to or from the selected station.	Inoperative.
COURSE SET Knob	Sets course pointer to desired course.	Inoperative.
COURSE Indicator	Indicates set course.	Indicates course to active fly-to-point.
MILES Indicator	Indicates distance to selected TACAN station.	Indicates distance to active fly-to-point.
HEADING SET Knob	Pilot set knob sets position of heading set marker on both HSIs. Copilot set knob inoperative.	

Figure 23-7. Horizontal Situation Indicator Functions

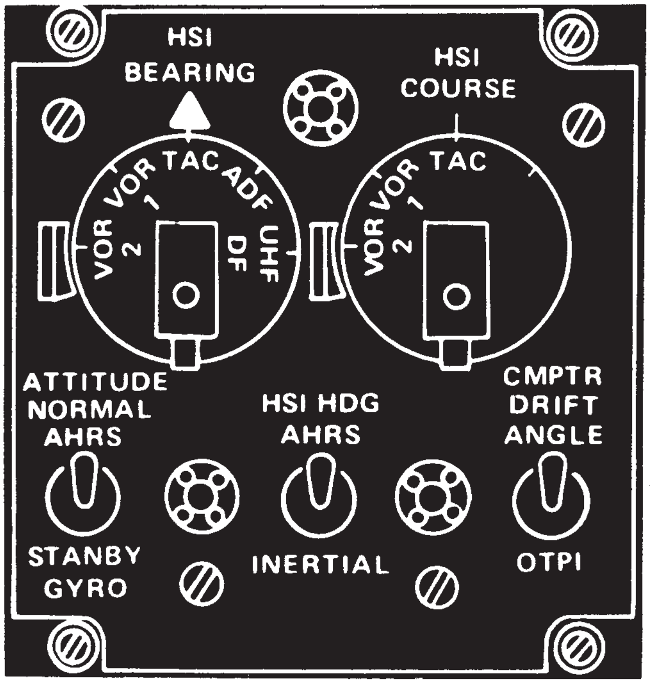


Figure 23-8. P-3 A/B Pilot Navigation Control Panel

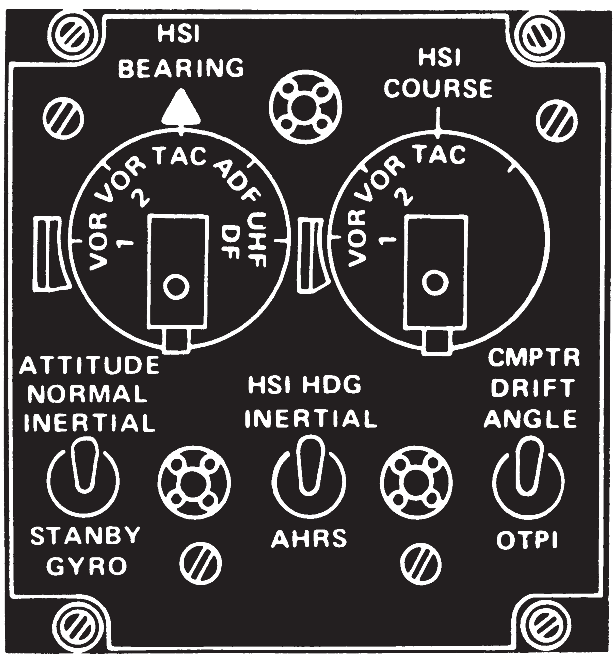


Figure 23-9. P-3A/B Copilot Navigation Control Panel

2. HSI Bearing Selector Switch. An HSI BEARING selector switch is located on each pilot instrument panel. The rotary-type switch has five placarded positions: VOR-1, VOR-2, TAC, ADF, and UHF DF. This switch is used to select the desired source of bearing information.

3. HSI Course Selector Switch. An HSI COURSE selector switch is located on each pilot instrument panel. The switch has three positions: VOR-2, VOR-1, and TAC. This switch provides source selection for course information.

23.4 WET COMPASS

The wet compass, on the left side of the cockpit, is a fluid based magnetic compass. The pilot tactical display must be turned off to get accurate headings on the wet compass.

23.5 STANDBY ATTITUDE INDICATOR (PEANUT GYRO)

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.

23.5.1 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.

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.

23.6 ON-TOP POSITION INDICATOR

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.

23.6.1 OTPI System Components

23.6.1.1 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 23-10).

23.6.1.2 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 23-10).

23.6.1.3 OTPI Receiver Control Panel. The OTPI receiver control panel, located on the center pedestal of the flight station (Figure 23-11), enables the OTPI receiver to provide bearings to a selected sonobuoy channel. Control functions are listed in Figure 23-12.

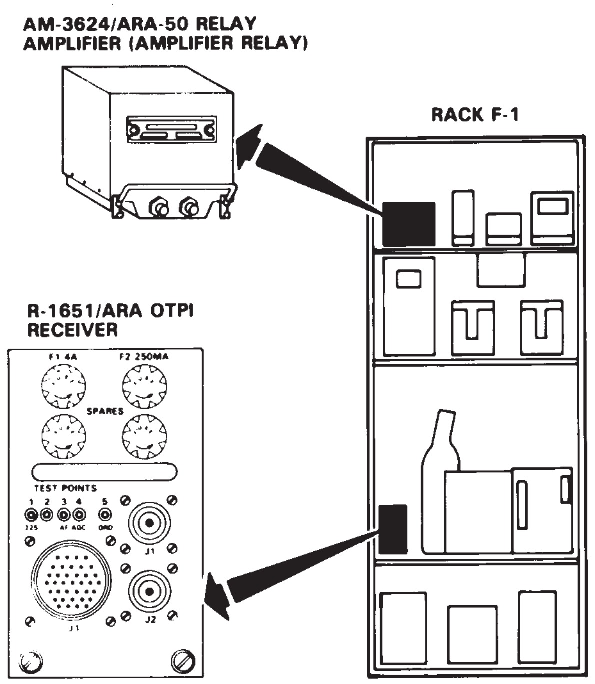


Figure 23-10. ARA-50 Relay Amplifier and OTPI Receiver

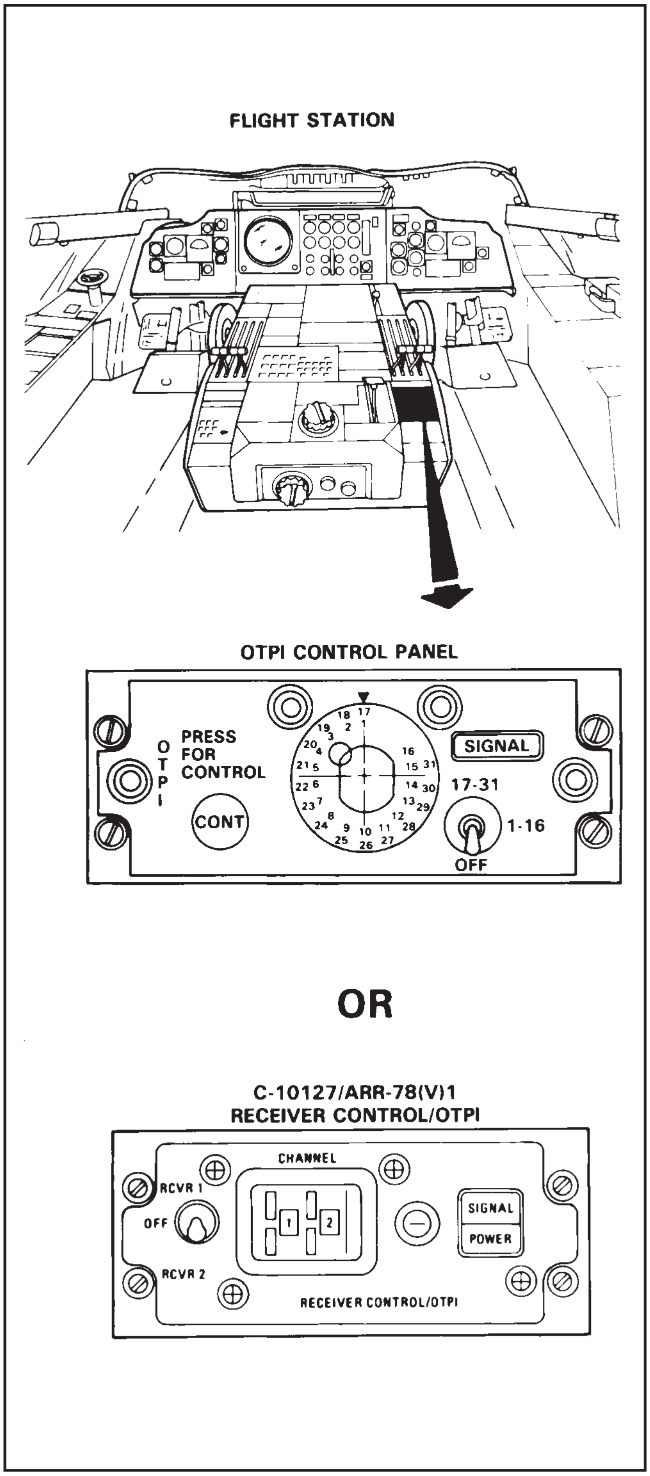


Figure 23-11. OTPI Control Panels

23.7 ADVANCED SONOBUOY COMMUNICATION LINK

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.

PANEL MARKING	FUNCTION
1 to 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 to 16	Enables the 1 to 16 channel frequency range on the rotary selector.
17 to 31	Enables the 17 to 31 channel frequency range on the rotary selector.

Figure 23-12. OTPI Receiver Control Panel Markings and Functions

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.

23.7.1 ARR-78 System Components

23.7.1.1 ARR-78 Advanced Sonobuoy Communication Link 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 (Figures 23-11 and 23-12).

23.7.1.2 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 23-13 shows control panel functions.

PANEL MARKING	FUNCTION
CHANNEL Thumbwheels	Selects the RF channel (1 to 99) that 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 23-13. ARR-78 OTPI Receiver Control Panel Markings and Functions

23.8 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/BRG and HDG/BRG). 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 (see Figure 23-14). 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.

Illumination of a fault advisory light indicates a fault in the corresponding module (numbered 1 through 12).

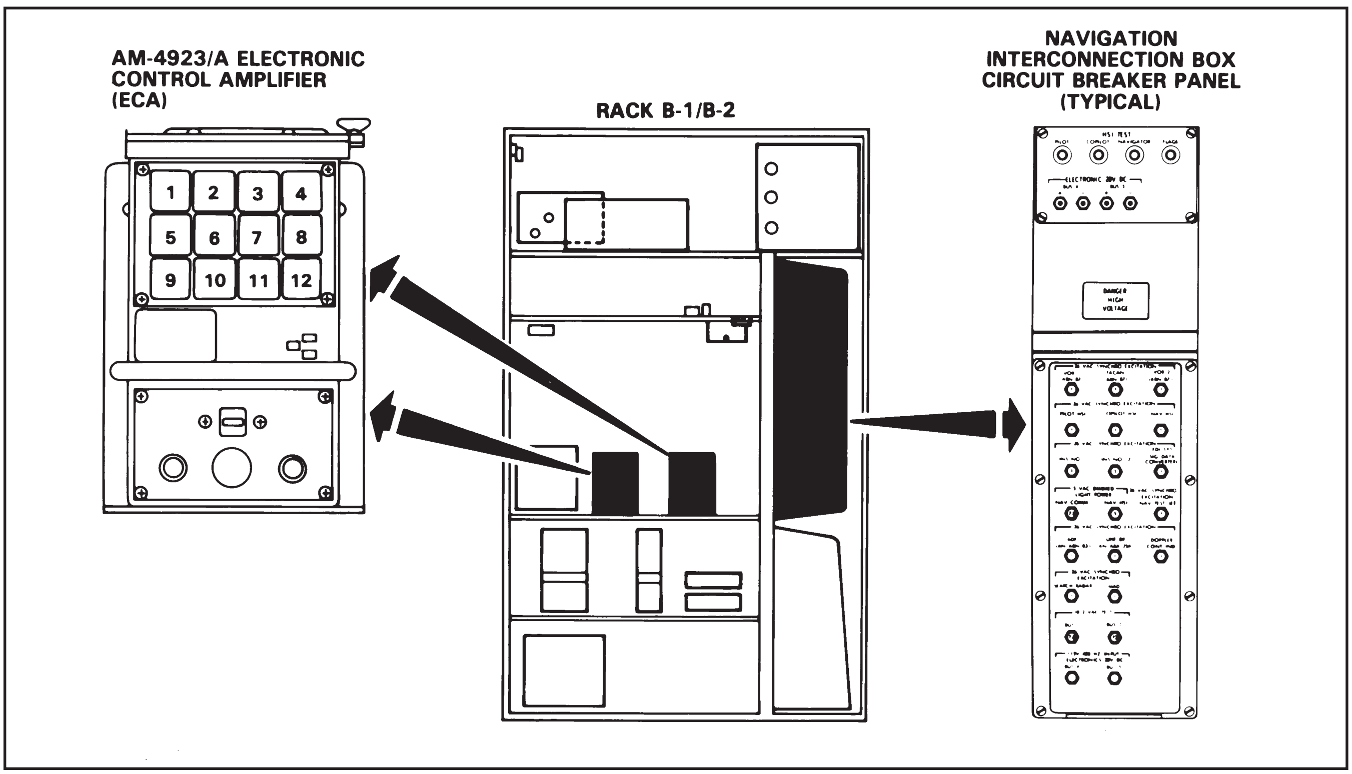


Figure 23-14. Electronic Control Amplifier and NAV-J Box

Refer to the flight station/crew station maintenance manual for equipment served by each ECU card.

23.9 NAVIGATION INTERCONNECTION BOX

The NAV-J box, located in rack B-1, provides routing, switching, and excitation voltages for selected navigation systems (Figure 23-14). 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. In the event of a MEDC bus failure, the relays in the NAV-J box go to the deenergized position. These 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 FDls receive attitude information from the vertical gyro as a result of an open BUS 3 circuit breaker on the FECB.

The P-3C 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.

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 altitude information available for the FDIs.

23.10 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, HSIs, and DVARS. In addition, the navigation simulator provides simulated heading and TAS to the digital computer via the synchro-to-digital converter.

23.11 CIRCUIT BREAKERS

Circuit breakers and power sources for the navigation/attitude display system components are listed in Figure 23-15.

23.12 NAVIGATION FORWARD INTERCONNECTION BOX (P-3A/B)

The navigation forward interconnection box (Figure 23-16), located in the forward left electronic rack, provides interconnection and switching functions among aircraft navigation systems, navigation instruments, and equipment using navigation information (FO-3). It contains circuit breakers and testing circuits operated by front panel switches for some of the navigation instruments.

Each of the four test switches — BDHI & MW-2, HSI & ATTD PILOT, HSI & ATTD COPILOT, and VOR FLAGS, is spring-loaded and must be held when in the TEST position. When in the OFF position, the switches have no effect on the operation of the respective instruments. The TACAN must be turned on or the miles-counter readings may differ from those given in the following position indications outline:

1. HSI & ATTD PILOT TEST position indications:

   a. HSI bearing pointer — At lubber line.

   b. HSI compass card — 180°.

   c. HSI course bar — Full right deflection with 180° selected in the COURSE SET window.

   d. HSI to/from pointer — TO.

   e. HSI miles counter — 555.

   f. MM-4 attitude indicator — 30° pitch (nose up) and 30° right roll.

2. HSI & ATTD COPILOT TEST position indications. Same as for pilot instruments except:

   a. MM-4 attitude indicator — 30° pitch (nose down) and 30° right roll.

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 COPILOT	 MEAC MEAC
	Navigation Interconnection Box	FDI SYS	26-VAC Sync Excitation
Horizontal Situation Indicator	Forward Electronic	PILOT COPILOT NAV	MEAC MEAC MEAC
	Navigation Interconnection Box	PILOT COPILOT NAVIGATOR	MEAC MEAC MEAC
Vertical Gyro	Forward Load Center	ATTITUDE IND. COPILOT V. GYRO VERT GYRO	 MEAC MEAC
	Note Powered by flight essential AC bus if monitorable essential AC bus becomes deenergized. If monitor able 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 BUS 1, BUS 2	 MEDC MEAC

Figure 23-15. 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	NAV INTERCONNECTION BOX-FWD	
		BUS 3	MEDC
	Navigation Interconnection Box	NAV TEST SET	26-VAC Sync Excitation
ARA-50 Relay Amplifier	Main Load Center	UHF-DF	BUS A MDC E
	Navigation Interconnection Box	UHF-DF	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 23-15. Navigation/Attitude Display System Circuit Breaker Locations and Power Sources (Sheet 2 of 2)

3. BDHI & MW-2 TEST position indications:

   a. BDHI compass card — 180°.

   b. BDHI No. 1 needle — At lubber line.

   c. BDHI No. 2 needle — At lubber line. If a placard at the navigator station advises that the TACAN information has been disconnected, the navigator BDHI No. 2 pointer and miles counters will not operate for this check.

   d. BDHI 3 miles counter — 1555.

CAUTION

Do not use lavatory service outlet for any purpose other than operation of electric razors. Integral rectifiers and inductance units may be damaged.

Note

The MW-2 is tested using the ASN-124 NAV Computer System.

4. VOR FLAGS TEST position indications:

   a. The pilot and copilot VOR 1 and VOR 2 OFF flags are retracted.

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.

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

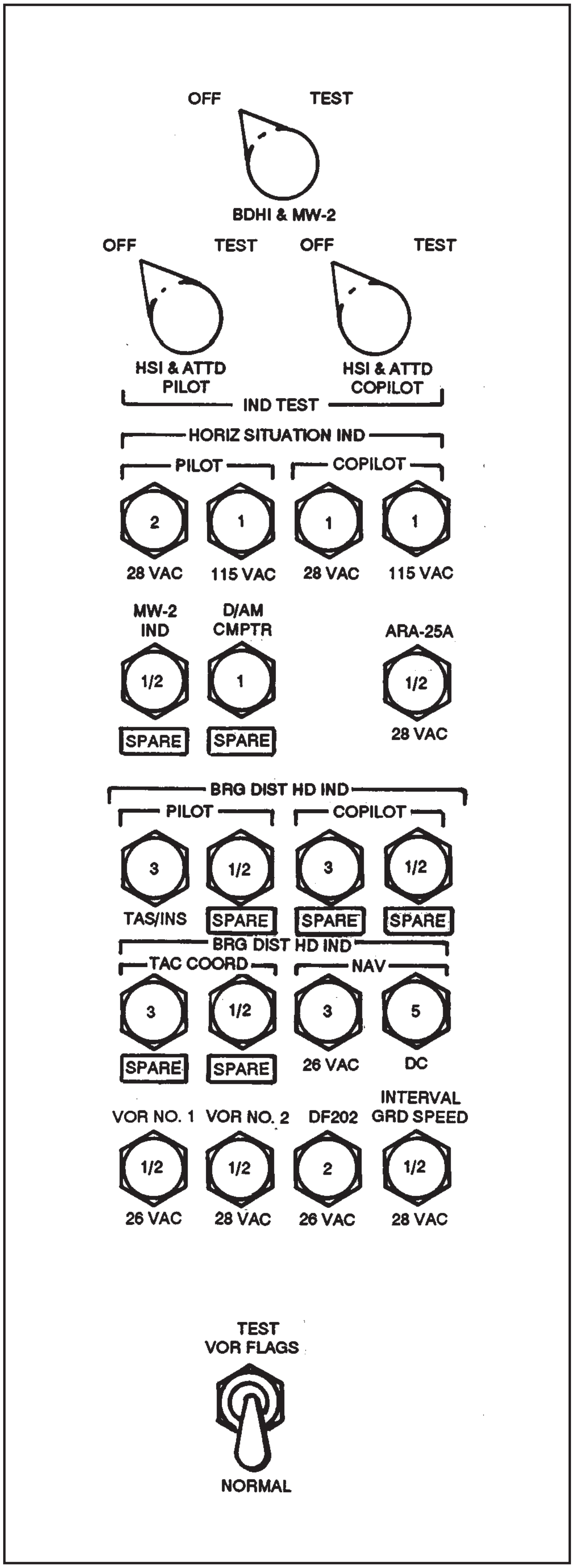


Figure 23-16. Navigation Forward Interconnection Box

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.

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 panel on the center control stand just forward of the power levers, labeled ARMAMENT and WING-ONLY, contains one guarded, two-position momentary action, toggle switch labeled JETTISON. 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.

The panel on the center control stand just forward and to the right of the power levers labeled ARMAMENT CONTROL, contains one guarded, two-position, alternate action, toggle switch labeled JETTISON. 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 phase 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 phase A located on the MEAC bus section of the forward load center circuit breaker panel. Additionally, if special weapons are to be jettisoned, it is necessary that the three circuit breakers placarded BOMB RACK LOCK PWER — STBD, CTR, and PORT, located on the MEDC bus section of the forward load center lower circuit breaker panel, be closed. The SPL WPN SECONDARY RELEASE CONT PWER DC circuit breaker, located on the forward electronic circuit breaker panel, must also be closed. This circuit breaker supplies power to operate the bomb rack lock actuators.

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.

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. Providing the bomb bay doors are open, power from the programmer will send three impulses to release the bomb bay stations. The first impulse releases the lower stations (2, 4, 6, and 8), the second releases the upper stations (1, 3, 5, and 7), and a third impulse clears any hung stores; the last step is the bomb bay doors close. The store sensing switches at stations 2, 4, 6, and 8 prevent the release of an upper store until the lower store blocking it has been released. 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 conventional 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.

23.14.3 Special Weapons Jettison. Refer to NAVAIR 01-75PAC-1.1

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 enroute 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 23-17) 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.

23.15.3 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.

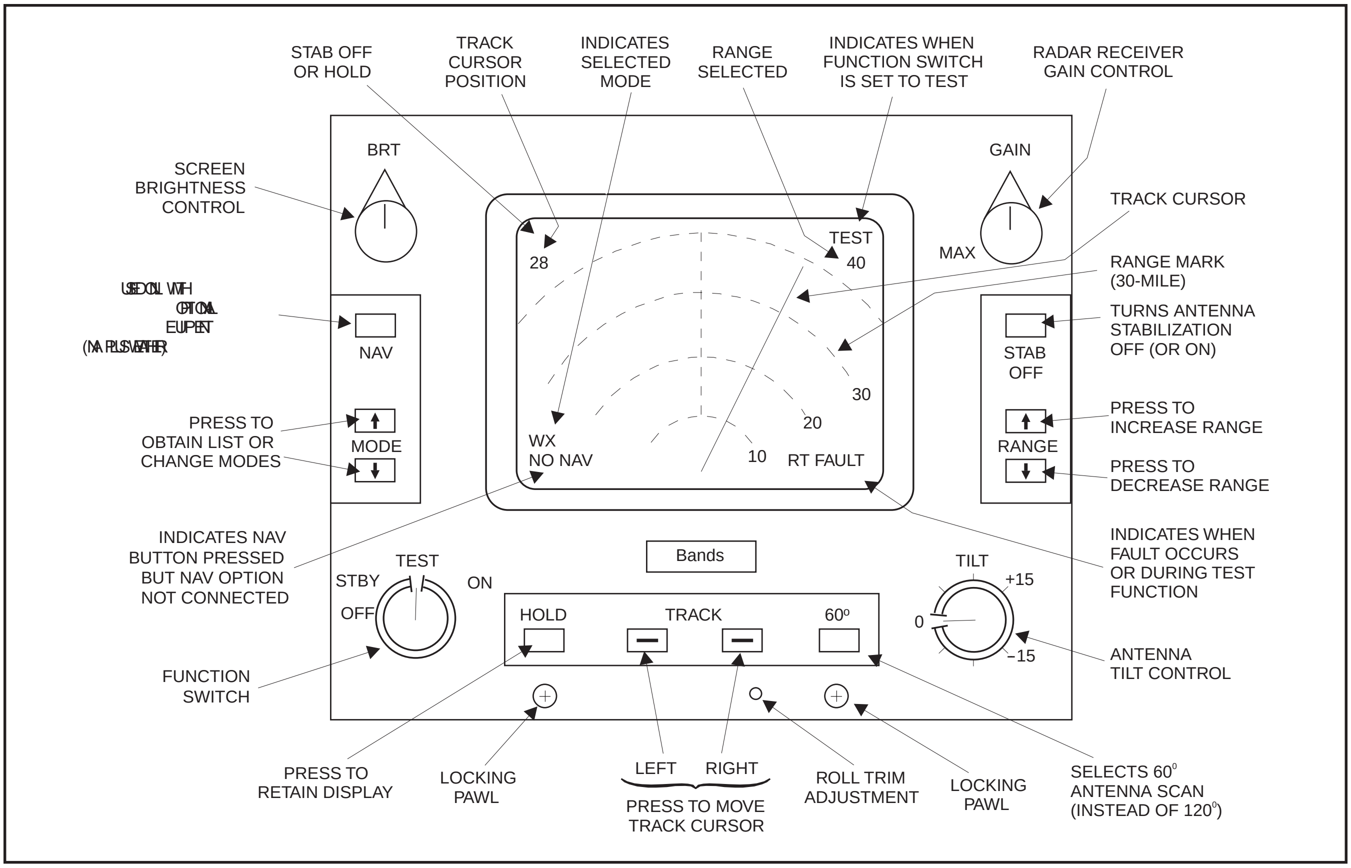


Figure 23-17. Radar Control Indicator

Stabilization is provided by pitch and roll signals from either LTN-72 system. This stabilization signal depends on the selected position of the weather radar switch located on the copilot's instrument panel.

23.15.4 Radar Control Indicator. The radar control indicator (Figure 23-17) 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 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 23-18) 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.

23.15.5 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.

23.15.6 APS-115 In-Use Light. The APS-115 in-use light is located next to the indicator on the copilot's instrument panel. This light alerts the copilot that the APS-115 has high voltage applied. An inhibit switch located in bay B-2 illuminates this light and prevents power up of the Color Weather Radar System.

CONTROL/DISPLAY	FUNCTION
FUNCTION	1. OFF — Removes primary power from the radar system. 2. STBY — Places radar set in standby condition during warm-up 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, advance 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.
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 a R/T fault occurs. Also appears during normal TEST function.
ROLL TRIM (screwdriver adjustment)	In-flight maintenance adjustment for antenna roll stabilization.

Figure 23-18. Radar Control Indicator Functions (Sheet 1 of 2)

CONTROL/DISPLAY	FUNCTION
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).
DN. 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 or –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 23-18. Radar Control Indicator Functions (Sheet 2 of 2)

CAUTION

Power up of the AN/APN-234 should not be attempted with the “APS-115 in-use light” illuminated.

23.15.7 Weathermapping Modes (WX and WXA). Weathermapping 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 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. (See Figure 23-19.)

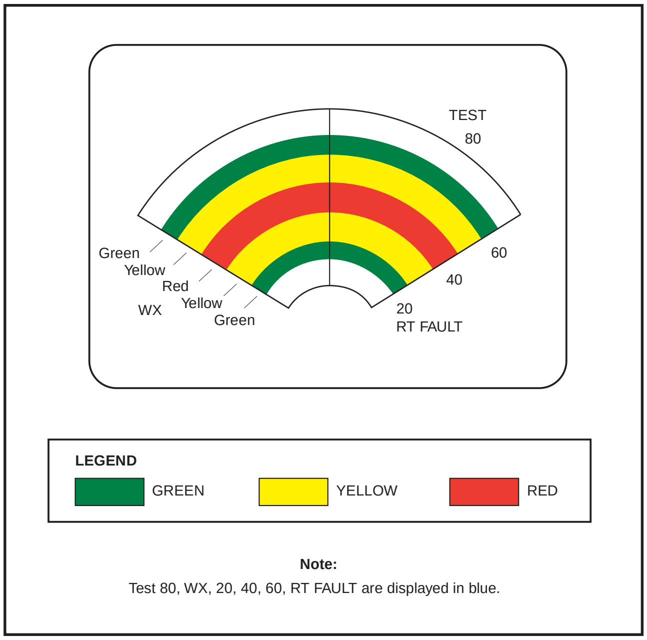


Figure 23-19. Weather Radar Typical Test Pattern

23.15.8 Groundmapping Mode. In the groundmapping 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.

The groundmapping 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, while 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, while rougher water, which does return some energy, generally appears green.

23.15.9 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.

23.15.10 Turn-On Procedures

1. Function switch — STBY (approximately 100 seconds is required for warm-up).
2. Function switch — TEST.
3. Indicator display — CHECK.
   a. RANGE — SET TO 80.
   b. Observe that the test pattern (Figure 23-19) 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 electrical load center receive inputs from various aircraft systems automatically. The MPT, also located in the main electrical 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. The purpose of the DEK is to provide an interface for entry of data parameters. 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 re-enter 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 check flight

    c. 2 — Patrol flight/Drug interdiction/Surf Surv

    d. 3 — Transport flight

    e. 4 — Functional check flight

    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 switch may now be turned off. If DEK power remains on, the DEK will automatically time-out and go 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.

PART IX

Flightcrew Coordination

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, Normal Procedures. 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 Aircrew Coordination Training. The Aircrew Coordination Training (ACT) program is described in OPNAV 3710.7 series and OPNAVINST 1542.7 series. ACT 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 ACT 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 ACT 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 standby 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 that 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. The use of radar is only mandatory when the aircraft is within 30 nm of land and below MOSA. Above MOSA, the radar is not required. The intent of these procedures is to ensure adequate crew awareness and backup for the pilot when operating in close proximity to land.

Note

During certain 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.

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 OPNAV 3710.7.

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 OPNAV 3710.7.

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 OPNAV 3710.7.

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, and so forth) 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 that one complete copy of NAVAIR 01-75PAC-1 is onboard 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. He may assist the pilots with computer entries.

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 onboard, 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 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 that 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/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 Safety of Flight Radar Operator (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 ORDNANCEMAN (IF ASSIGNED)

The responsibility of the ordnanceman shall be to obtain the mission search and kill stores required by the TACCO and ensure they are properly loaded. The ordnanceman shall perform a systems check in accordance with NAVAIR 01-75PAC-12-6. Inflight, the ordnanceman shall perform the loading and unloading of the three PSLTs and free-fall launch procedures as required by the TACCO. Additional inflight duties shall include acting as visual observer and other similar duties as required. The ordnanceman shall provide the TACCO with a list of all types of stores aboard the aircraft.

24.15 ORDNANCE-QUALIFIED CREWMEMBER

The responsibility of the ordnance-qualified crewmember shall be to ensure 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.

24.16 ASSISTANT ORDNANCE-QUALIFIED CREWMEMBER

The assistant ordnance-qualified crewmember will assist the primary ordnance-qualified crewmember with inflight duties as 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.

24.18 OBSERVER

A P-3 observer is an inflight crewmember qualified to perform basic safety-of-flight duties. An observer is not qualified to fill a primary tactical position.

24.19 RADIO OPERATOR

The radio operator is responsible for the proper preflight and operation of all equipment assigned in Part IX of this manual.

The radio operator function in flight is to maintain HF communications as directed by the mission commander (or pilot in command when no mission commander is assigned). The radio operator will request the position report 10 minutes prior to the time the report is due, authenticate/challenge messages, maintain radio logs as directed by the communication doctrine/controlling activity, and act as an observer as directed. Additionally, he shall be prepared to transmit emergency messages at any time.

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. Enroute
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 responsibilites 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.

25.2.3 Preflight

1. Coordinate, with TACCO and flight engineer, to ensure proper loading and inspection of required survival equipment.
2. Preflight personal survival equipment:
   a. LPU/SV2/helmet
   b. Parachute
   c. Oxygen system.
3. Ensure flight station 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 crew member 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 Enroute

1. Coordinate with TACCO and NAV/COMM and ensure proper status report is transmitted to 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.

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.

MOSA is defined as 1,000 feet above the highest obstacle within 30 nm of the aircraft.

When the aircraft is operating within 30 nm of land and below MOSA, the radar shall become the primary aid for obstacle avoidance. The pilot shall coordinate with the NAV/COMM and radar operator to update the flight station on the aircraft position. Radar fixing shall be performed and the NAV/COMM or radar operator shall update the flight station on the aircraft position in relation to the closest obstacles, and a suitable safe heading. On radar run-ins, the flight station shall ensure that the radar operator conducts offset run-ins, taking into consideration weather and visibility.

Note

- The above procedures may be modified at the discretion of the pilot in command when, in his judgment, the safety of the aircraft can be maintained visually in daylight VMC conditions.

- In the event of navigation system uncertainty or navigation system failure in marginal VMC, night, or IMC conditions, 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 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.

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.

25.2.8 Return

1. Ensure that all offstation navigational requirements are completed.

25.2.9 Postlanding/Taxi/Shutdown

1. Ensure nonexpended stores are safed 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 Enroute/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.

25.3.6 Approach/Landing

1. Perform all duties outlined in Part VI, 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. Backup pilots on all ATC radio transmissions.

25.4.5 Enroute

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 backup 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

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 flight crewmembers.

26.2 IMPLEMENTATION

The NATOPS evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flight crewmembers 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 12 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.

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. 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 crewman 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 flight crewmember 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 flight crewmember 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 that an unsatisfactory level was noted need be observed during a reevaluation.
3. Qualified — that degree of standardization demonstrated by a very reliable flight crewmember 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 flight crewmember 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 flight crewmember who fails to meet minimum acceptable criteria. Crew-member 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 post-flight.

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 that 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 assure 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, 10 questions for the ORD-qualified crewmember and safety of flight radar operator, and 24 questions for all other flight crewmembers. The maximum time for this examination shall be 3 hours for the in-flight technician, 2.5 hours for the pilot/flight engineer, 1 hour for the ORD-qualified crewmember and safety of flight radar operator, 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 safety of flight radar operator, 10 questions for the assistant ORD qualified crewmember, and 40 questions for 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, ORD-qualified crewmember, assistant ORD qualified crewmember, and safety of flight radar operator, and 1.5 hours for 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 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 numerical 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 a 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
OPNAV 3710/7 (4-90) S/N 0107-LF-009-8000 **REPORT SYMBOL OPNAV 3710-21**

NAME (Last, first, initial)		GRADE	SERVICE NUMBER
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

❑ CHECK IF CONTINUED ON REVERSE SIDE

GRADE, NAME OF EVALUATOR/INSTRUCTOR	SIGNATURE	DATE
GRADE, NAME OF EVALUEE	SIGNATURE	DATE

REMARKS OF UNIT COMMANDER

RANK, NAME OF UNIT COMMANDER	SIGNATURE	DATE

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3710.7 (effective edition)

Figure 26-1. NATOPS Evaluation Report

26.9 PILOT NATOPS EVALUATION GRADING CRITERIA

AREA A: PREFLIGHT

1. Flight Planning

   Qualified — Properly prepared for assigned flight. Familiar with all aspects pertinent to flight proposed, including enroute 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. Safety and Survival Equipment

   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 a successful ditching or bailout or jeopardize safety or survival. Unfamiliar with the use of required equipment.

5. 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.

*Critical area/Subarea

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.

*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.

*Critical area/Subarea

*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.

*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

*Critical area/Subarea

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 — Delays or minor deviations in establishing directional control and climb rate. 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 bringing 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, All-Weather Operations).

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, All-Weather Operation).

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.

*Critical area/Subarea

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.

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.

*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.

*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 — 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.

*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.

*Critical area/Subarea

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.

*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 followup, 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.

*Critical area/Subarea

*AREA G: CREW COORDINATION

*1. Aircrew 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.

*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

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				
PERFORMANCE COMPUTATION *PREFLIGHT INSPECTION FORM* *REQUIRED INSTRUMENT PUBS* *REQUIRED LOGS AND FORMS* *CURRENT NATOPS MANUAL*				
2. BRIEFING				
FLIGHT MISSION *EMERGENCY PROCEDURES*				

3. AIRCRAFT INSPECTION				
PREVIOUS "B" SHEETS *PREFLIGHT INSPECTION* *FORM "A" SHEET* *EXTERIOR INSPECTION* *INTERIOR INSPECTION*				
*4. SAFETY AND SURVIVAL EQUIPMENT				
PERSONAL EQUIPMENT *KNOWLEDGE OF EQUIPMENT*				
5. GENERAL SYSTEMS AND PROCEDURES KNOWLEDGE				
SYSTEMS KNOWLEDGE *PROCEDURE KNOWLEDGE* *AIRCRAFT AND SYSTEM LIMITATIONS*				
NUMERICAL AREA GRADE		TOTAL POINTS		

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 1 of 5)

OPNAV 3510/23 (3-84) *Asterisk (*) denotes critical area/subarea.*

P-3 PILOT NATOPS EVALUATION WORKSHEET

B. PRE-TAKEOFF	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. BEFORE START				
CHECKLIST				
2. START				
LIMITATIONS *MALFUNCTIONS*				
3. TAXI PROCEDURES				
CHECKLIST *USE OF REVERSE PITCH* *USE OF BRAKES* *SPEED & SMOOTHNESS*				
4. BEFORE TAKEOFF				
WARMUP *DEICING & ANTI-ICING CHECK* *FUEL GOVERNOR & PITCHLOCK CHECK* *MAXIMUM REVERSE CHECK* *CHECKLIST* *COPILOT'S BRIEFING* *CREW REPORT*				
NUMERICAL AREA GRADE		TOTAL POINTS		

***C. TAKEOFF, CLIMB, CRUISE**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. NORMAL TAKEOFF				
RUNWAY ALIGNMENT *POWER APPLICATION* *NOSEWHEEL STEERING* *RUDDER CONTROL*				
*2. NORMAL TRANSITION				
ROTATION SPEED *TAKEOFF SPEED* *TAKEOFF NOSE ATTITUDE* *GEAR RETRACTION* *FLAP RETRACTION* *POWER REDUCTION*				
*3. MALFUNCTIONS BEFORE REFUSAL				
ANNOUNCED INTENTIONS *POWER CONTROL* *USE OF RUDDERS* *USE OF NOSEWHEEL STEERING* *USE OF BRAKES*				
*4. MALFUNCTIONS AFTER REFUSAL				
DIRECTIONAL CONTROL *AILERON CONTROL* *NOSEWHEEL PRESSURE*				
*5. THREE-ENGINE TRANSITION				
ROTATION SPEED *TAKEOFF SPEED* *TAKEOFF NOSE ATTITUDE* *DIRECTIONAL CONTROL* *GEAR RETRACTION* *FLAP RETRACTION* *POWER REDUCTION*				
6. CLIMB & DEPARTURE				
CHECKLIST *CLIMB AIRSPEED* *POWER CONTROL* *HEADING CONTROL* *NTS CHECK*				

REMARKS

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 2 of 5)

OPNAV 3510/23 (3-84) *Asterisk (*) denotes critical area/subarea.*

P-3 PILOT NATOPS EVALUATION WORKSHEET

7. LEVEL OFF AND CRUISE				
POWER SELECTION KNOWLEDGE OF ENGINE & AIRFRAME LIMITS ANTI-ICING PROCEDURES FUEL MANAGEMENT				
NUMERICAL AREA GRADE		TOTAL POINTS		
*D. LANDINGS	ADJECTIVE AREA GRADE			
SUBAREA	Q	CQ	U	POINTS
1. NORMAL LANDING PATTERN				
ENTRY ALTITUDE DOWNWIND CHECKLIST AIRSPEED DOWNWIND				
*2. NORMAL APPROACH				
USE OF POWER ALTITUDE AT 90° AIRSPEED AT 90° USE OF FLAPS CHECKLIST AIRSPEED ON FINAL AIRSPEED OVER END OF RUNWAY				
*3. NORMAL LANDING				
TOUCHDOWN POINT TOUCHDOWN ATTITUDE POWER AT TOUCHDOWN DIRECTIONAL CONTROL USE OF REVERSE USE OF STEERING USE OF BRAKES				
*4. THREE-ENGINE APPROACH				
USE OF POWER AIRCRAFT HANDLING PATTERN CHECKLIST BASE LEG AIRSPEED AND ALTITUDE AT 90° USE OF FLAPS CHECKLIST AIRSPEED ON FINAL AIRSPEED OVER END OF RUNWAY				
*5. THREE-ENGINE LANDING				
TOUCHDOWN POINT TOUCHDOWN ATTITUDE POWER AT TOUCHDOWN RUDDER CONTROL THREE-ENGINE REVERSE DIRECTIONAL CONTROL USE OF STEERING USE OF BRAKES				
*6. TWO-ENGINE APPROACH				
USE OF POWER AIRCRAFT HANDLING PATTERN CHECKLIST BASE LEG AIRSPEED AND ALTITUDE AT 90° USE OF FLAPS AIRSPEED ON FINAL AIRSPEED OVER END OF RUNWAY RUDDER TRIM				

REMARKS

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 3 of 5)

OPNAV 3510/23 (3-84)

Asterisk (*) denotes critical area/subarea.

P-3 PILOT NATOPS EVALUATION WORKSHEET

SUBAREA	Q	CQ	U	POINTS
*7. TWO-ENGINE LANDING				
TOUCHDOWN POINT *TOUCHDOWN ATTITUDE* *POWER AT TOUCHDOWN* *RUDDER CONTROL* *TWO-ENGINE REVERSE* *DIRECTIONAL CONTROL* *USE OF STEERING* *USE OF BRAKES*				
*8. NO-FLAP APPROACH				
FLIGHT PATH *CHECKLIST* *AIRSPEED TURNING FINAL* *ALTITUDE* *AIRSPEED ON FINAL* *RATE OF DESCENT* *POWER CONTROL*				
*9. NO-FLAP LANDING				
TOUCHDOWN POINT *TOUCHDOWN ATTITUDE* *AIRSPEED PRIOR TO ENTERING BETA RANGE* *USE OF RUDDER* *USE OF REVERSE* *USE OF STEERING* *USE OF BRAKES*				
*10. WAVEOFF				
POWER APPLICATION *TRANSITION TO CLIMB* *GEAR & FLAP RETRACTION* *ACCELERATION* *SEQUENCE*				
NUMERICAL AREA GRADE		TOTAL POINTS		

REMARKS

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 CHECKLIST				
*11. MISSED APPROACH				
12. GCA — AIRSPEED CONTROL				
*13. GCA — ALTITUDE CONTROL				
14. GCA — HEADING CONTROL				
15. GCA — GLIDESLOPE				
16. GCA — USE OF CHECKLISTS				
*17. GCA — MISSED APPROACH				
NUMERICAL AREA GRADE		TOTAL POINTS		

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 4 of 5)

OPNAV 3510/23 (3-84) *Asterisk (*) denotes critical area/subarea.*

P-3 PILOT NATOPS EVALUATION WORKSHEET

***F. EMERGENCIES** *(ENGINE FIRE, DITCHING DRILL, AIR START, 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. AIR START PROCEDURES				
*15. BAILOUT DRILL				
NUMERICAL AREA GRADE		TOTAL POINTS		

***G. CREW COORDINATION**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. AIRCREW 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		
** EVALUATION ADJECTIVE GRADE		

*** SEE OPNAVINST 3710.7*

REMARKS

Figure 26-2. Pilot NATOPS Evaluation Worksheet (Sheet 5 of 5)

26.10 COPILOT NATOPS EVALUATION GRADING CRITERIA

AREA A: PREFLIGHT

1. Flight Planning

Qualified — Properly prepared for assigned flight. Familiar with all aspects pertinent to proposed flight, including enroute 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. 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.

*4. Safety and Survival Equipment

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.

5. 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.

*Critical area/Subarea

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.

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 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.

*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.

*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.

*4. Waveoff

Qualified — Executed waveoff with proper use of power. Executed smooth transition to climb attitude. Stopped descent, established positive rate of climb, raised flaps to APPROACH, retracted gear, 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.

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.

*Critical area/Subarea

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 Enroute Navigation

Qualified — Accurately complied with all IFR enroute 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 enroute 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, All-Weather Operations).

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, All-Weather Operation).

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.

11. Approach Course Control

Qualified — Maintained course within ±5°, effectively correcting for drift.

Conditionally Qualified — Maintained course within ±10°. Had difficulty correcting for drift.

*Critical area/Subarea

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.

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.

*Critical area/Subarea

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.

*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 NATOPS Flight Manual, Part VI, 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.

*Critical area/Subarea

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.

*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 nose-wheel 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 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.

*Critical area/Subarea

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.

*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 followup, 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.

*Critical area/Subarea

Conditionally Qualified — Minor deviations from items required for Qualified.

Unqualified — Demonstrated actions or omissions jeopardizing safety of flight or personal safety.

AREA H: CREW COORDINATION

*1. Aircrew 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.

*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

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				
PERFORMANCE COMPUTATION *PREFLIGHT INSPECTION FORM* *REQUIRED INSTRUMENT PUBS* *REQUIRED LOGS AND FORMS* *CURRENT NATOPS MANUAL*				
2. BRIEFING				
FLIGHT MISSION *EMERGENCY PROCEDURES*				
3. AIRCRAFT INSPECTION				
PREVIOUS "B" SHEETS *PREFLIGHT INSPECTION* *FORM "A" SHEET* *EXTERIOR INSPECTION* *INTERIOR INSPECTION*				
*4. SAFETY & SURVIVAL EQUIPMENT				
PERSONAL EQUIPMENT *KNOWLEDGE OF EQUIPMENT*				
5. EQUIPMENT KNOWLEDGE				
CIRCUIT BREAKER LOCATION				
NUMERICAL AREA GRADE		TOTAL POINTS		

REMARKS

Figure 26-3. Copilot NATOPS Evaluation Worksheet (1 of 5)

OPNAV 3510/23 (3-84) — *Asterisk (*) denotes critical area/subarea.*

P-3 COPILOT NATOPS EVALUATION WORKSHEET

B. PRE-TAKEOFF	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. BEFORE START				
CHECKLIST				
2. START				
LIMITATIONS *MALFUNCTIONS*				
3. TAXI PROCEDURES				
CHECKLIST *USE OF REVERSE PITCH* *USE OF BRAKES* *SPEED & SMOOTHNESS*				
4. BEFORE TAKEOFF				
WARMUP *DEICING & ANTI-ICING CHECK* *FUEL GOVENOR & PITCHLOCK CHECK* *MAXIMUM REVERSE CHECK* *CHECKLIST* *COPILOT'S BRIEFING* *CREW REPORT*				
NUMERICAL AREA GRADE		TOTAL POINTS		

***C. TAKEOFF, CLIMB, CRUISE**	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. NORMAL TAKEOFF				
RUNWAY ALIGNMENT *POWER APPLICATION* *NOSEWHEEL STEERING* *RUDDER CONTROL*				
*2. NORMAL TRANSITION				
ROTATION SPEED *TAKEOFF SPEED* *TAKEOFF NOSE ATTITUDE* *GEAR RETRACTION* *FLAP RETRACTION* *POWER REDUCTION*				
*3. MALFUNCTIONS BEFORE REFUSAL				
ANNOUNCED INTENTIONS *POWER CONTROL* *USE OF RUDDERS* *USE OF NOSEWHEEL STEERING* *USE OF BRAKES*				
*4. MALFUNCTIONS AFTER REFUSAL				
DIRECTIONAL CONTROL *AILERON CONTROL* *NOSEWHEEL PRESSURE*				
*5. THREE-ENGINE TRANSITION				
ROTATION SPEED *TAKEOFF SPEED* *TAKEOFF NOSE ATTITUDE* *DIRECTIONAL CONTROL* *GEAR RETRACTION* *FLAP RETRACTION* *POWER REDUCTION*				
6. CLIMB & DEPARTURE				
CHECKLIST *CLIMB AIRSPEED* *POWER CONTROL* *HEADING CONTROL* *NTS CHECK*				

REMARKS

Figure 26-3. Copilot NATOPS Evaluation Worksheet (2 of 5)

OPNAV 3510/23 (3-84)					*Asterisk (*) denotes critical area/subarea.*

P-3 COPILOT NATOPS EVALUATION WORKSHEET

7. LEVEL OFF AND CRUISE				
POWER SELECTION *KNOWLEDGE OF ENGINE & AIRFRAME LIMITS* *ANTI-ICING PROCEDURES* *FUEL MANAGEMENT*				
NUMERICAL AREA GRADE		TOTAL POINTS		

D. LANDINGS	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
1. NORMAL LANDING PATTERN				
ENTRY *ALTITUDE DOWNWIND* *CHECKLIST* *AIRSPEED DOWNWIND*				
*2. NORMAL APPROACH				
USE OF POWER *ALTITUDE AT 90°* *AIRSPEED AT 90°* *USE OF FLAPS* *CHECKLIST* *AIRSPEED ON FINAL* *AIRSPEED OVER END OF RUNWAY*				
*3. NORMAL LANDING				
TOUCHDOWN POINT *TOUCHDOWN ATTITUDE* *POWER AT TOUCHDOWN* *RUDDER CONTROL* *USE OF REVERSE* *BRAKES* *NOSEWHEEL STEERING*				
*4. WAVEOFF				
POWER APPLICATION *TRANSITION TO CLIMB* *GEAR & FLAP RETRACTION* *ACCELERATION* *SEQUENCE*				
NUMERICAL AREA GRADE		TOTAL POINTS		

REMARKS

Figure 26-3. Copilot NATOPS Evaluation Worksheet (3 of 5)

OPNAV 3510/23 (3-84) — *Asterisk (*) denotes critical area/subarea.*

P-3 COPILOT NATOPS EVALUATION WORKSHEET

E. INSTRUMENT APPROACH PROCEDURES	ADJECTIVE AREA GRADE			
SUBAREA	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 — GLIDESCOPE				
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		

REMARKS

Figure 26-3. Copilot NATOPS Evaluation Worksheet (4 of 5)

OPNAV 3510/23 (3-84)

Asterisk (*) denotes critical area/subarea.

P-3 COPILOT NATOPS EVALUATION WORKSHEET

***G. EMERGENCIES** *(ENGINE FIRE, DITCHING DRILL, AIR START, 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. AIR START PROCEDURES				
*15. BAILOUT DRILL				
NUMERICAL AREA GRADE		TOTAL POINTS		

H. CREW COORDINATION	**ADJECTIVE AREA GRADE**			
SUBAREA	Q	CQ	U	POINTS
*1. AIRCREW 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 $\frac{A}{B}$		
**EVALUATION ADJECTIVE GRADE		

*** See OPNAVINST 3710.7*

REMARKS

Figure 26-3. Copilot NATOPS Evaluation Worksheet (5 of 5)

26.11 FLIGHT ENGINEER NATOPS EVALUATION GRADING CRITERIA

*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. Failed to stow loose equipment.

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.

*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

*Critical area/Subarea

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

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.

*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.

*Critical area/Subarea

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.

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.

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.

*Critical area/Subarea

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.

*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.

*Critical area/Subarea

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.

*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 landing.

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.

*Critical area/Subarea

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.

*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.

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.

*Critical area/Subarea

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 COORDINATION

*1. Aircrew 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	DATE OF LAST EVALUATION
SQUADRON/UNIT	TOTAL FLIGHT HOURS	TOTAL HOURS IN MODEL

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**			
SUBAREAS	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**			
SUBAREAS	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**			
SUBAREAS	Q	CQ	U	POINTS
1. POWER APPLICATION				
*2. MALFUNCTIONS DURING TAKEOFF				
*3. PATTERN PROCEDURES				
4. CLIMB PROCEDURES				
5. NTS CHECKS				
NUMERICAL AREA GRADE		TOTAL POINTS		

D. CRUISE	**ADJECTIVE AREA GRADE**			
SUBAREAS	Q	CQ	U	POINTS
1. LOITER PROCEDURE				
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. DITCH 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/SURVIVAL EQUIPMENT				
2. SYSTEM KNOWLEDGE				
3. INSTRUMENT SCAN				
*4. EQUIPMENT KNOWLEDGE/ CIRCUIT BREAKER LOCATION				
5. CREW SUPERVISION				
*6. CHECKLIST UTILIZATION				
NUMERICAL AREA GRADE		TOTAL POINTS		

*H. CREW COORDINATION	ADJECTIVE AREA GRADE			
SUBAREA	Q	CQ	U	POINTS
*1. AIRCREW 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 $\frac{A}{B}$		
**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

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. See Figure 27-2 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.

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 27-1, which lists incremental drag for a variety of external stores.

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 reference to the following table:

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

For drag counts between 480 and 700, interpolate between charts C and D.

27.4.1 Example

Two LAU-10 rocket pods with nose fairing at 45 each:	90
Four Mk 36 destructors (low drag) at 30 each:	120
Total:	210

Configuration B includes drag count values between 51 and 260. Determine performance information from configuration B.

27.5 FUEL AND FUEL DENSITY

The standard fuels for operation of the P-3C 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

STORE — INCLUDING PYLON (For any approved external carriage)	DRAG COUNT (per store)
No external Stores or Pylons	0
Pylon and Rack	20
LAU-10 Rocket Pod (faired)	45
LAU-10 Rocket Pod (unfaired)	90
LAU-61 Rocket Pod (faired)	43
LAU-61 Rocket Pod (unfaired)	64
LAU-68 Rocket Pod (faired)	31
LAU-68 Rocket Pod (unfaired)	45
LAU-69 Rocket Pod (faired)	43
LAU-69 Rocket Pod (unfaired)	64
LAU-117 Launcher	60
Mk-20 Rockeye	53
Mk-25 Mine (faired)	130
Mk-25 Mine (unfaired)	213
Mk-36 Mine (faired)	89
Mk-36 Mine (faired)	142
Mk-36 Destructor (low drag)	30
Mk-36 Destructor (retarded)	40
Mk-40 Destructor (low drag)	37
Mk-40 Destructor (retarded)	54
Mk-41 Destructor (low drag)	43
Mk-41 Destructor (retarded)	59
Mk-52 Mine (faired)	89
Mk-52 Mine (unfaired)	142
Mk-55 Mine (faired)	144
Mk-55 Mine (unfaired)	245
Mk-56 Mine (faired)	153
Mk-56 Mine (unfaired)	268
Mk-60 Captor	220
Mk-62 Mine (retarded)	40
Mk-63 Mine (retarded)	54
Mk-65 Mine	100
Mk-65 Mine (Quickstrike)	90
Mk-82 Bomb (low drag)	30
Mk-82 Bomb (retarded)	40
Mk-83 Bomb (low drag)	37
Mk-83 Bomb (retarded)	54
AGM-65F Maverick	90
AGM-84 Harpoon	120
SUU-40 Flare Dispenser	45
SUU-44 Flare Dispenser	45
SUU-53 Flare Dispenser	57
PMBR (A/A37B-3)	40
PMBR with (3) Mk-24 Para Flares	49
PMBR with (6) Mk-24 Para Flares	58
PMBR with (3) Mk-76 Practice Bombs	60
PMBR with (6) Mk-76 Practice Bombs	80
PMBR with (3) Mk-106 Practice Bombs	70
PMBR with (6) Mk-106 Proactive Bombs	100
ALQ-78 ESM Wing Pod	60
ALQ-167B Band (antennas forward and aft)	53
ALQ-167 Standard (antennas forward only)	62
ALR-66C(V)3 ESM Antenna	90
GTC 85-15	50
IRDS Turret (extended)	40

Figure 27-1. External Stores Drag Count

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 27-2. Symbols and Definitions

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 27-3. 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 27-3 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 27-3 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 27-4 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 27-4 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 aircrew members use various types of navigational computers to determine the temperature rise because of the ram effect. The temperature sensing system of the P-3C 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 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-3C 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.

27.8 DENSITY ALTITUDE CHART

Figure 27-5 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 27-6 for standard atmospheric conditions at a given altitude.

27.10 TEMPERATURE CONVERSION TABLE

Figure 27-7 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 27-7 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 27-8 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 27-8. To find stall speed, multiply actual weight by load factor and read stall speed from Figure 27-8 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.

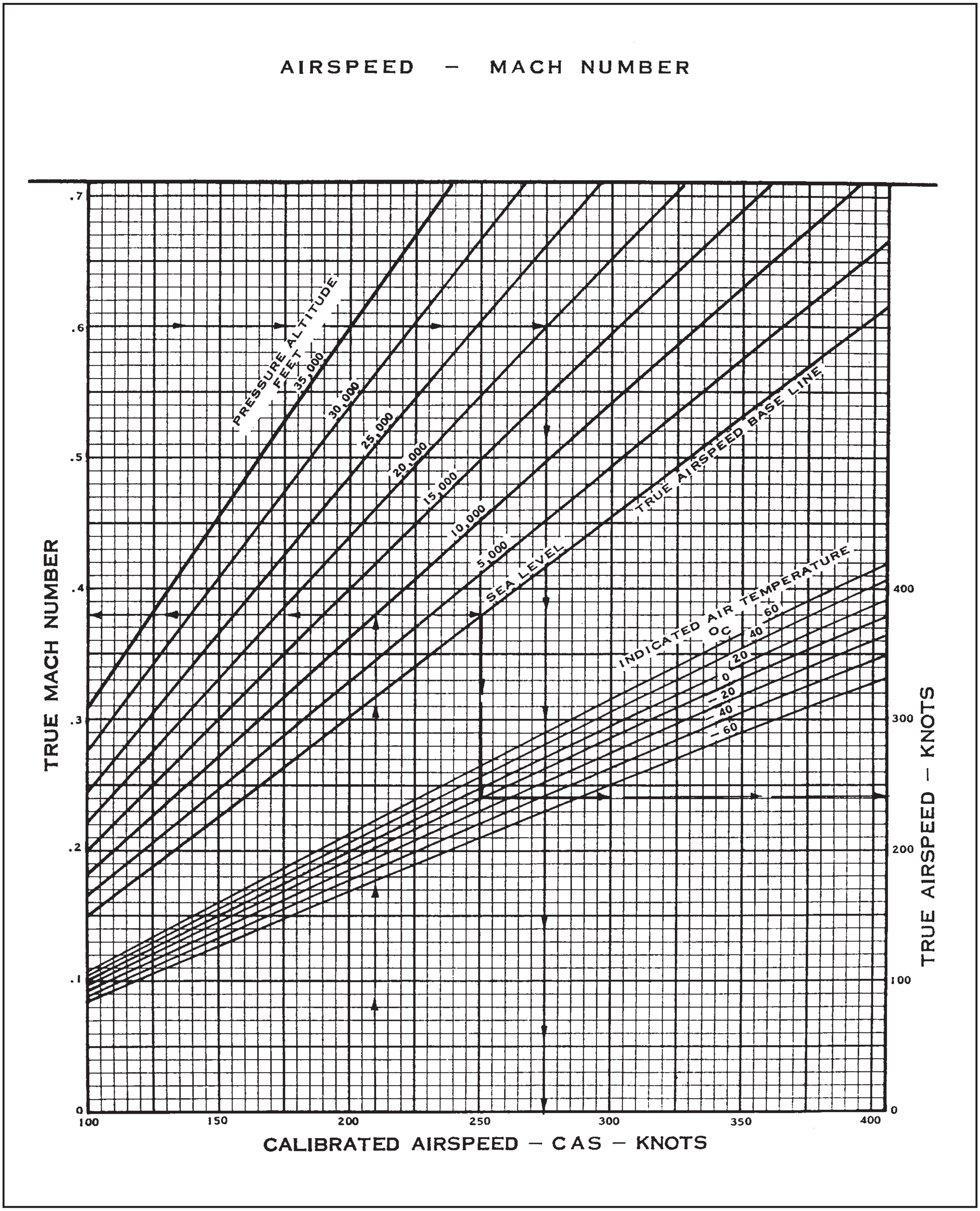
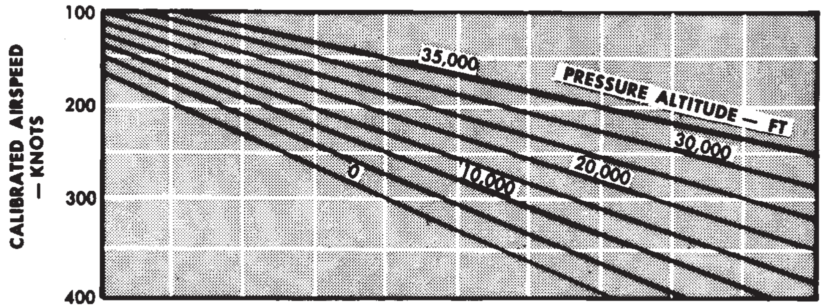


Figure 27-3. Airspeed — Mach Number

NOTE: TEMPERATURE CORRECTION BASED ON 100% ADIABATIC RISE



Indicated Air Temperature — °C	Mach .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

Figure 27-4. Temperature Compressibility Correction

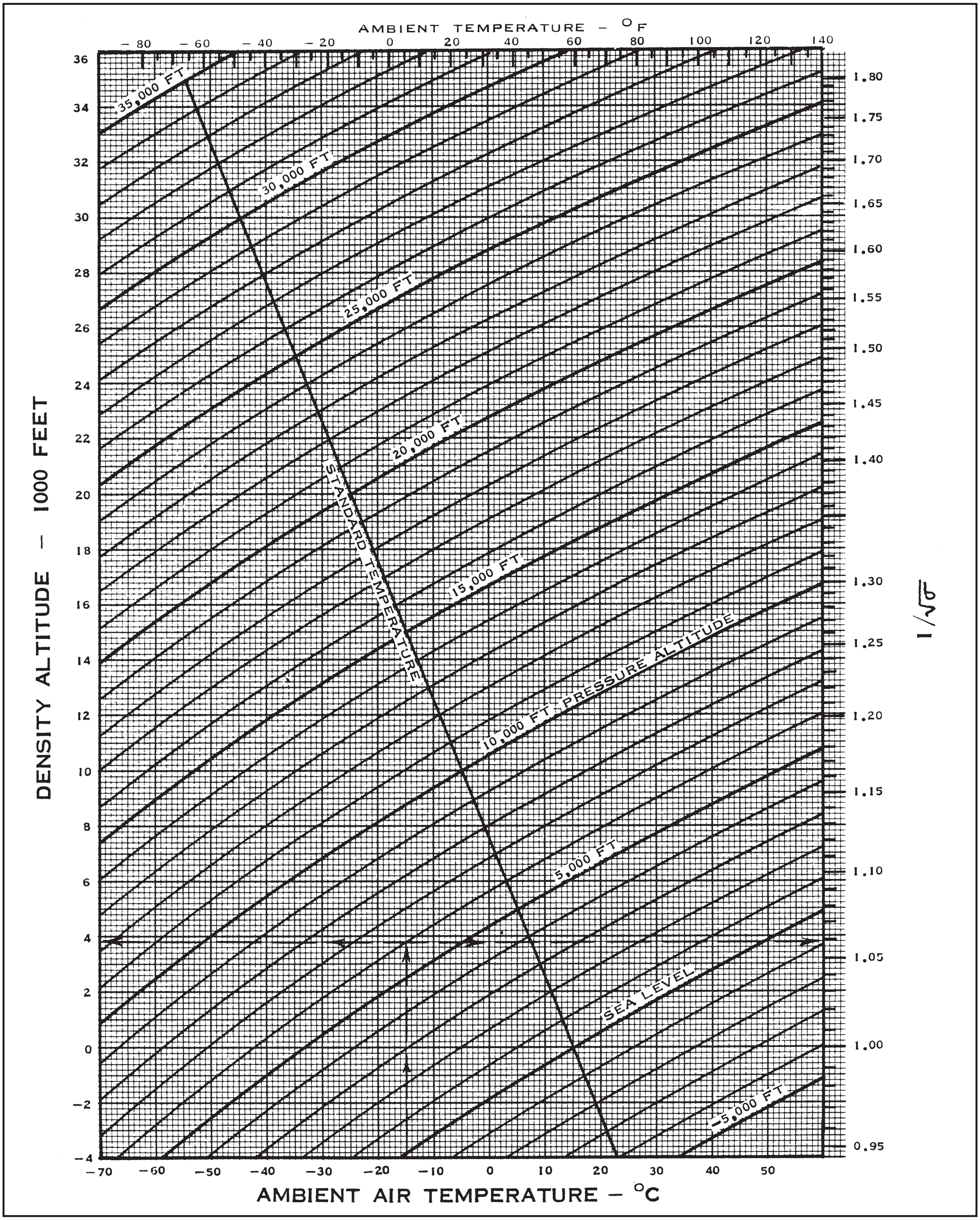


Figure 27-5. Density Altitude

Standard S L Conditions:
Temperature 15 °C (59 °F)
Pressure 29.921 in HG 2116.216 lb/sq. ft.
Density 0.0023769 slugs/cu. ft.
Speed of Sound 1116.39 ft./sec. 661.7 knots

Conversion Factors
1 in HG = 70.727 lb/sq. ft.
1 in HG = 0.49116 lb/sq. in.
1 knot = 1.151 mph
1 knot = 1,688 ft./sec.

Altitude (Feet)	Density Ratio ( )	$\frac{1}{\sqrt{s}}$	Temperature (Deg C)	Temperature (Deg F)	Speed of Sound (knots)	Pressure Inches of HG	Pressure Ratio ( )
– 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 27-6. 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

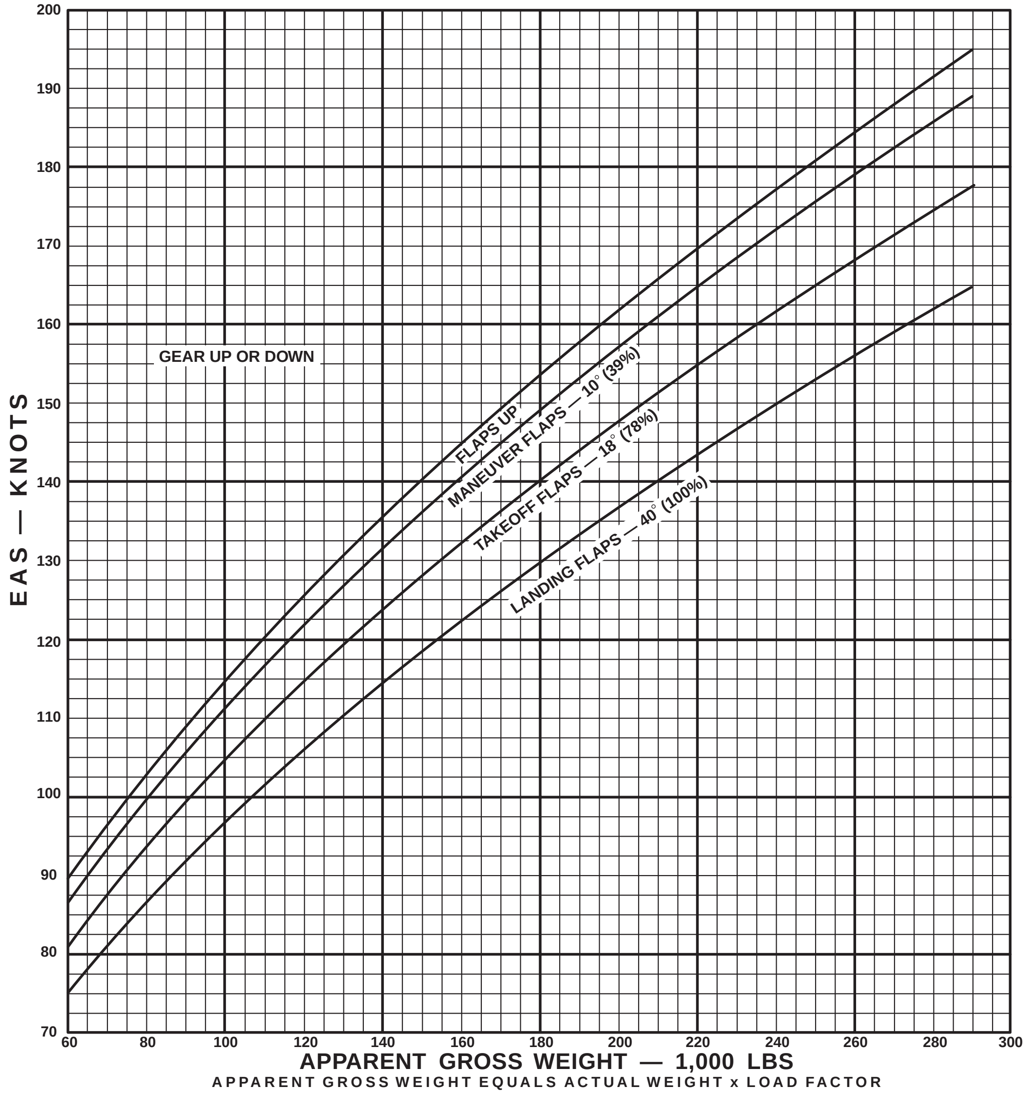
HOW TO USE THE TABLE: Use shaded column to find value of temperature to be converted; if in degrees Centigrade, read Fahrenheit equivalent in right-hand column; if in degrees Fahrenheit, read Centigrade equivalent in left-hand column.

Figure 27-7. Temperature Conversion

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

ZERO THRUST

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LBS/GAL



NOTE

- WITH FOUR ENGINES OPERATING, STALL SPEEDS WILL DECREASE APPROXIMATELY 8 KNOTS FOR EVERY 1,000 SHP SET ON ALL FOUR ENGINES.
- WITH LESS THAN FOUR ENGINES, USE CHART POWER OF STALL.
- WHEN WING STORES PLACE THE AIRCRAFT IN CONFIGURATIONS D OR E (GREATER THAN 700 DRAG COUNT), INCREASE SPEED 5 KNOTS.

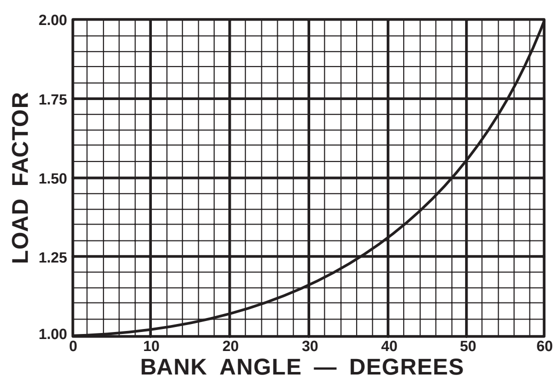


Figure 27-8. Stall Speed

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 as follows:

ENGINES OPERATING	AVERAGE SHP/ENGINE
4	75
3	100
No. 2 & No. 3	150
N o. 3 & No. 4	110

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 28-1 and 28-2 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 Performance Trending Data Acquisition. Engine performance trending data acquired in flight will be used to assist in the calculation of overall engine performance. A P-3 In-Flight Engine Performance Data Record (Figure 28-3) should be completed for all flights of more than 4 hours duration that operate at altitudes between 8,000 and 25,000 feet.

During operation between 8,000 and 25,000 foot pressure altitude, allow airspeed to completely stabilize in level flight. Prior to recording required data, allow at least 3 minutes after power levers were last moved and airspeed last changed.

Note

If turbulent air is encountered, discontinue the recording procedure until such time that air is smooth.

Record required data in accordance with Figure 28-3 provided that SHP is greater than 2,000 SHP for altitudes less than 18,000 feet, or that TIT is greater than 875 °C for altitudes greater than 18,000 feet.

Note

It is not required to be on even altitudes or airspeeds nor to have engine SHPs, TITs, or fuel flows match.

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 28-4) may be used to forecast power for reduced power or SHP-limited takeoffs since there is minimal difference between this chart and the maximum, military, or normal-rated power charts. 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 28-1. 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.

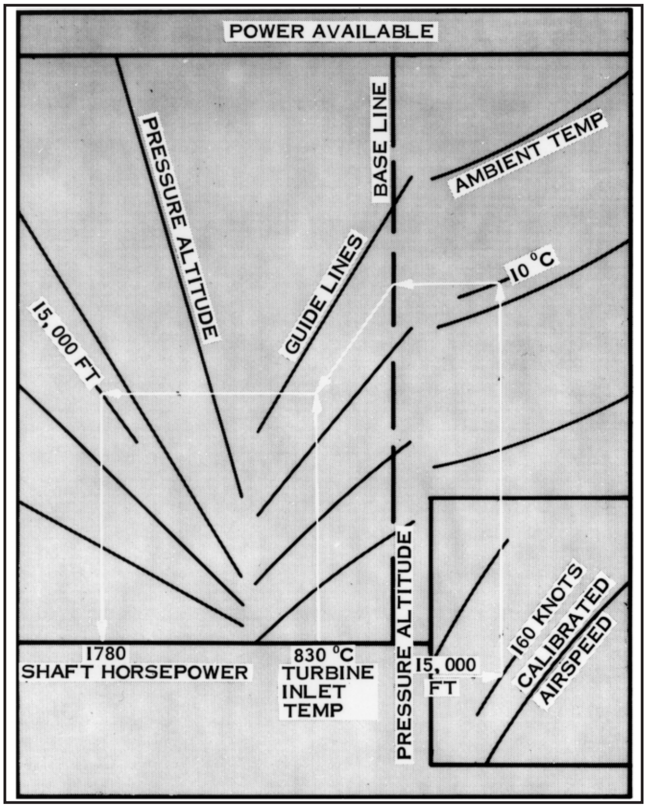
28.4.5 Cruise Power. Power is available at TITs of 1,010 °C or less. Cruise power is limited to a maximum of 4,600 SHP.

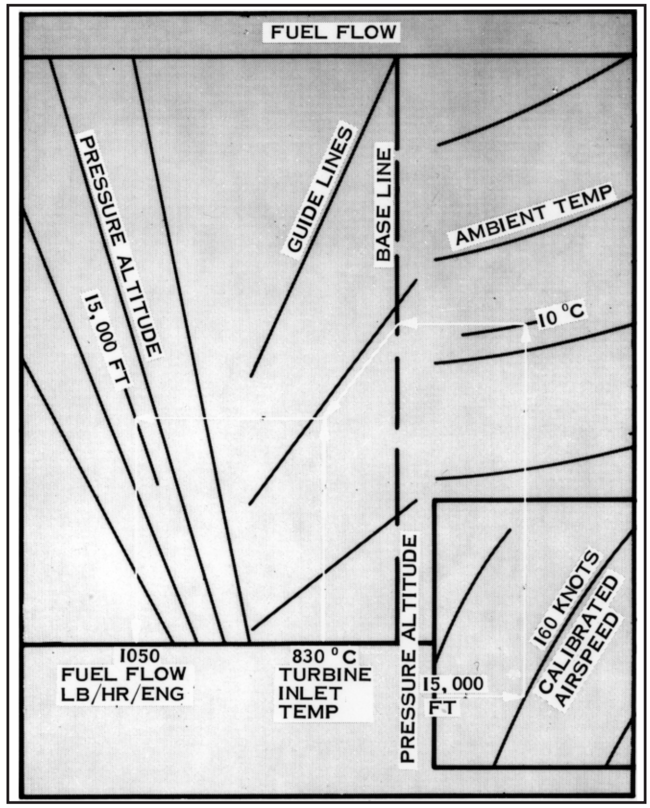
28.4.5.1 Example. Use the chart in Figure 28-1 to determine that cruise power available at 15,000-foot pressure altitude, 160 KCAS, and 10 °C ambient air temperature is 1,780 SHP at 830° TIT.

28.5 FUEL FLOW

Figure 28-2 shows the fuel flows corresponding to the power available throughout the range of TIT.

28.5.1 Example. Figure 28-2 shows the fuel flow required at 830°TIT is 1,050 PPH/engines at 15,000-foot pressure altitude, 160 KCAS, and 10 °C ambient air temperature.





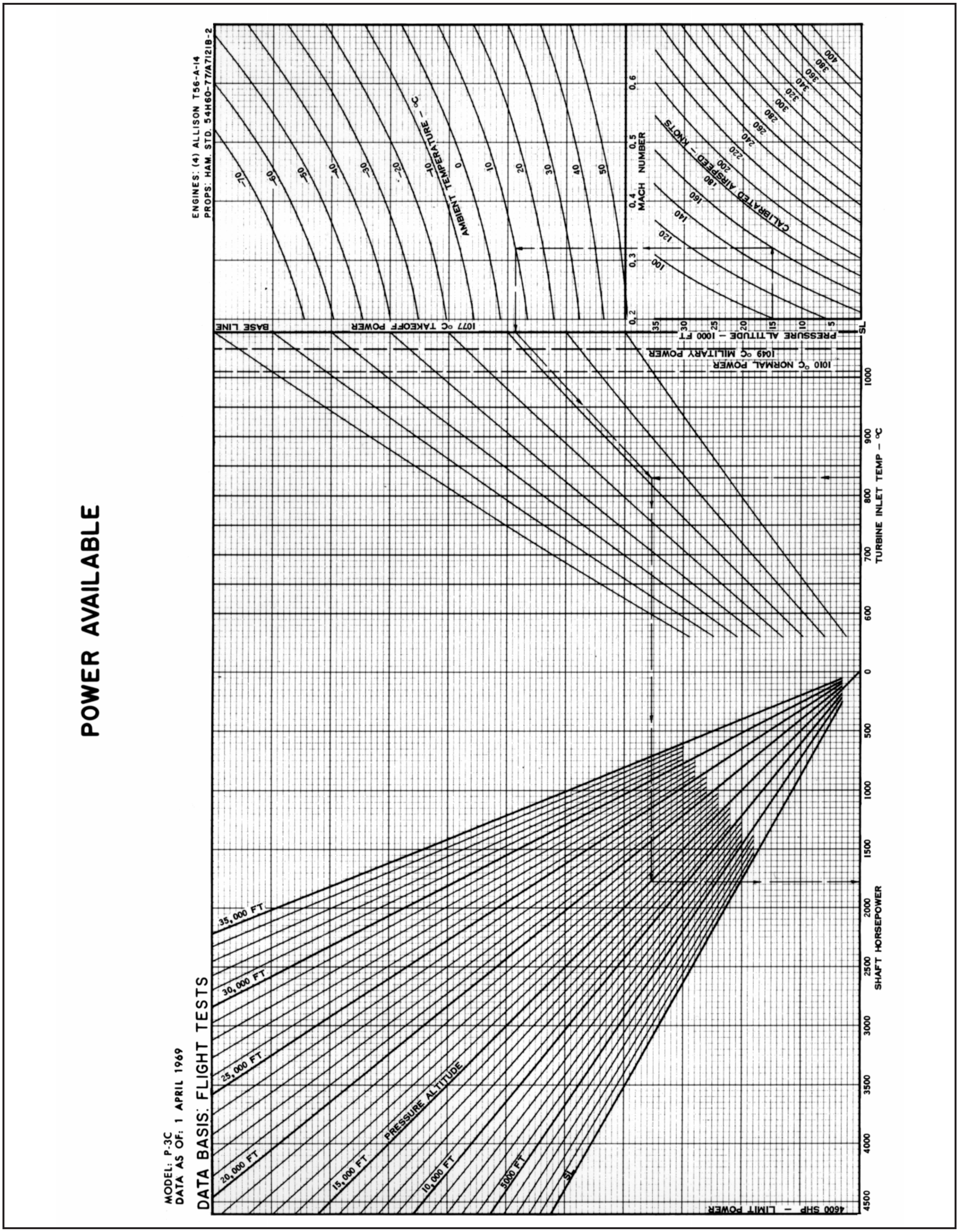


Figure 28-1. Power Available

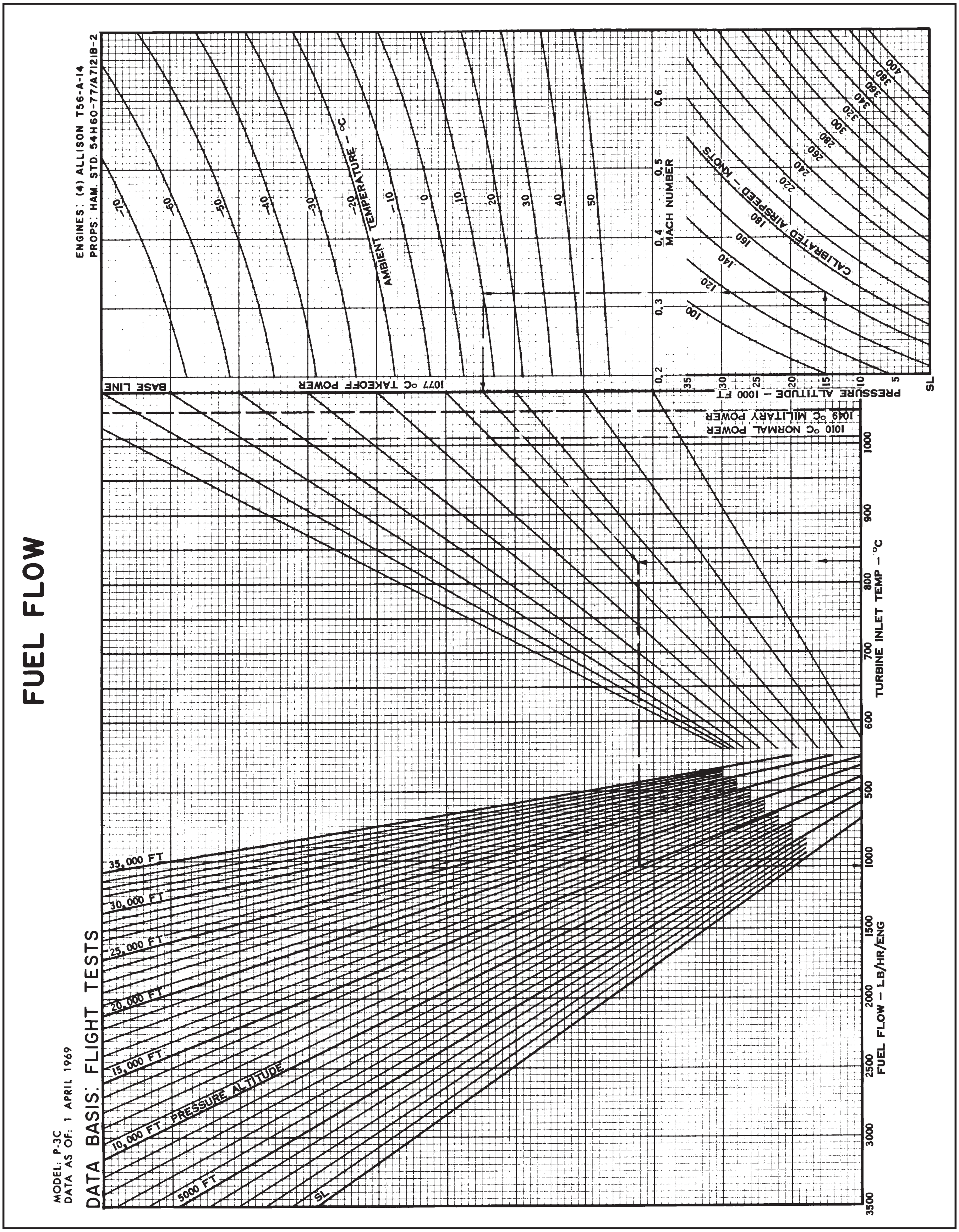


Figure 28-2. Fuel Flow

P-3 INFLIGHT ENGINE PERFORMANCE DATA

FOR 8,000– TO 25,000–FT ALTITUDES

Julian Date: ____________ BUNO: ____________

Pilot: ____________ Flt Eng: ____________

PROCEDURES:

1. SYNC SERVOS, SYNC MASTER — ON.
2. Engine anti-ice — OFF.
3. Bleed air valves — CLOSED.
4. Pressure altitude (29.92) — 8,000 to 25,000 feet.
5. ALTITUDE HOLD — ENGAGED.

Note

If turbulent air is encountered, discontinue recording procedure until such time that air is smooth.

6. Airspeed — allow to completely stabilize in level flight.
7. Record data at least 3 minutes after power levers were last moved and airspeed last changed provide that:
   a. SHP is greater than 2,000 for altitudes less than 18,000 feet.
   b. TIT is greater than 875 °C for altitudes greater than 18,000 feet.

Note

It is not required to be on even altitudes or airspeeds nor to have engine SHPs, TITs, or Fuel Flows match.

DATA REQUIRED					RECORDING ACCURACY
PRESSURE ALTUTUDE (Copilot)				FT	10 ft
OBSERVED AIRSPEED (Copilot)				KTS	1 kt
OBSERVED OAT				°C	1°C
ENGINE NO.	1	2	3	4	
SHP					10 SHP
TIT					1 °C
FUEL FLOW					10 lb/hr

Remarks:

Figure 28-3. P-3 In-Flight Engine Performance Data Table

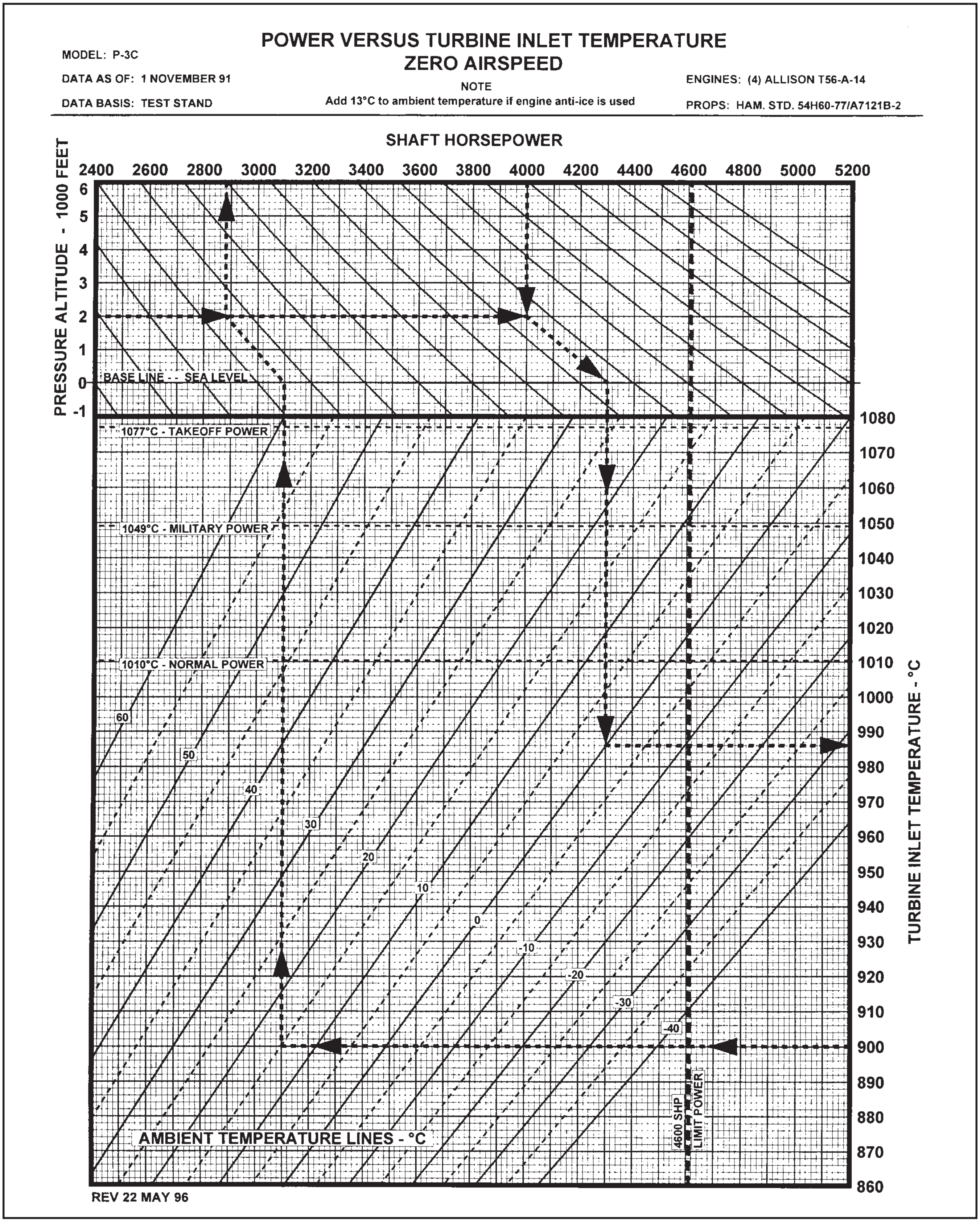


Figure 28-4. Turbine Inlet Temperature Zero Airspeed

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 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. Lift-off 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.

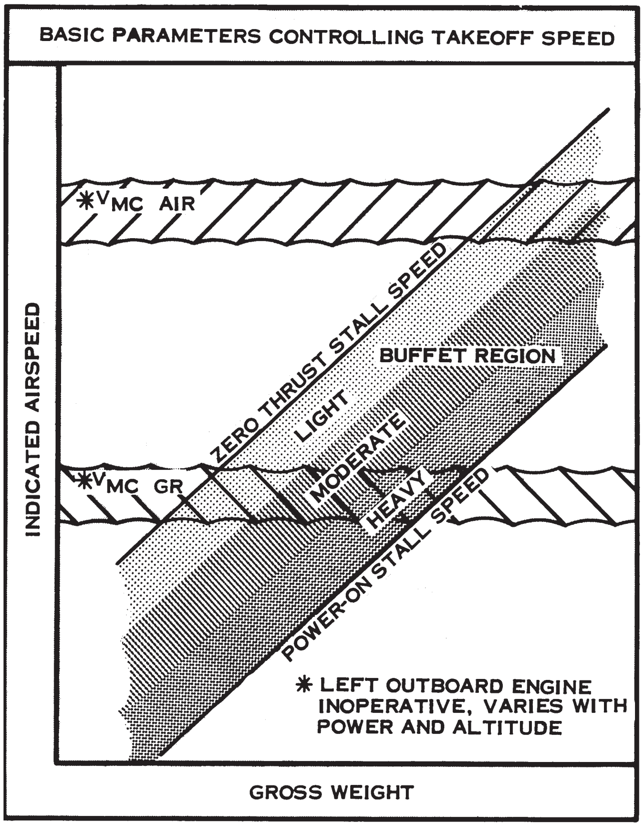
Note

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.

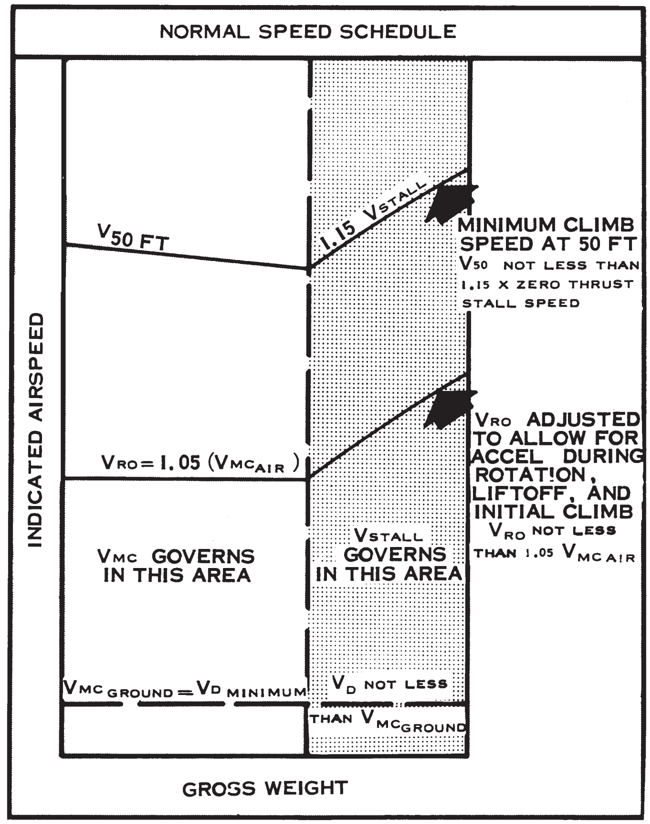


29.3.1 Normal Performance Airspeeds. Recommended speeds for normal operation have been designed to help the pilot cope with emergency situations as far as possible. They provide as much margin of control and performance as is reasonable in the following manner:

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.

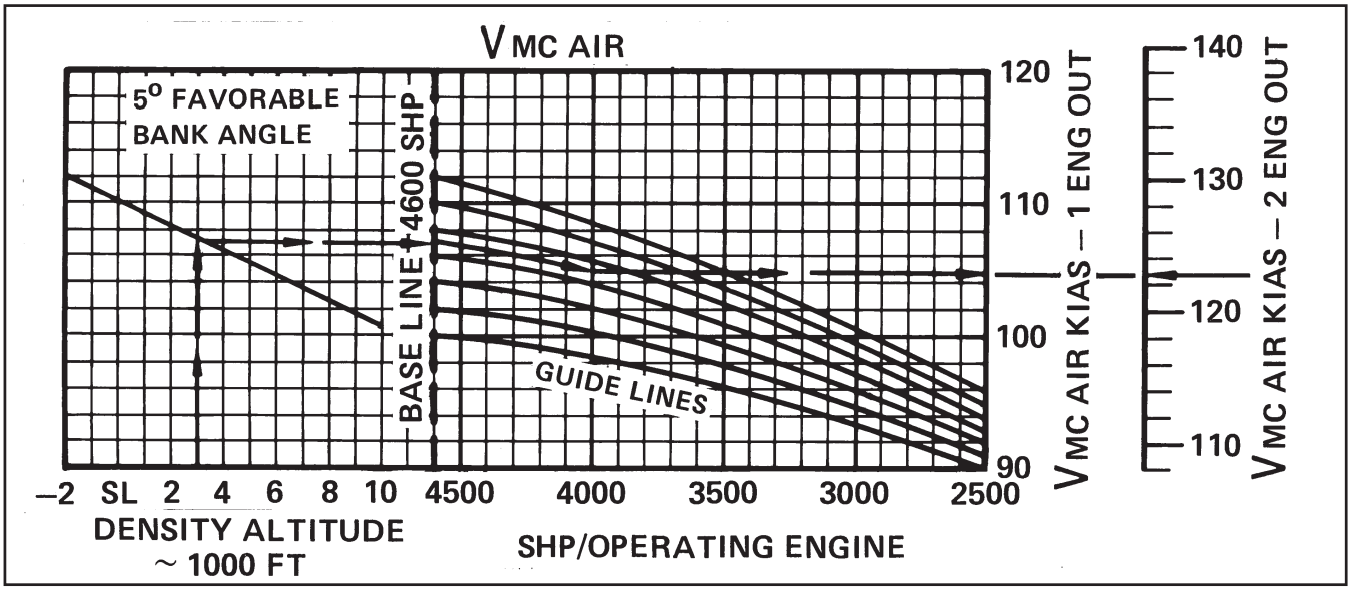


Figure 29-1. Minimum Control Speed — Air

Note

- Any bank angle deviation from optimum to wings level increases minimum control speed by 2.6 knots per degree. For example, if the aircraft wings are level, chart minimum control speed would increase by 13 knots.
- $V_{MC\ AIR}$ 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 toward 5° away from the dead engine to assist in controls.

29.3.3.1.1 Example. At 3,000-foot density altitude with 4,000 SHP, $V_{MC\ AIR}$ is 105 KIAS with take off flaps.

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.

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 29-6 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 take off 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 30-1. 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 28-4, 29-2, 29-3, 29-4, or 29-5 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 29-6. Lift-off will occur at the speed shown if rotation is started at the correct speed. Climbout should be conducted at the recommended 50-footspeed until clear of obstacles.

   e. (Mandatory) Determine refusal speed from Figure 29-8. 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.

   f. (Mandatory) Determine three-engine rate of climb, military power from Figure 29-10.

   g. (Optional) To monitor progress during the take-off run, predict four-engine acceleration distances to 80 KIAS, refusal speed, rotation speed, and lift off speed from Figure 29-7.

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 29-9, (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 take off 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 29-12, sheets 1 and 2. If desired, the clearance on four engines can be determined by using lift-off distance as determined from Figure 29-7 and the four-engine flight path of Figure 29-12, 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 30-1 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 28-4, 29-2, 29-3, 29-4, and 29-5 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 29-2, 29-3, 29-4 and 29-5 when runway air temperatures/pressure altitudes permit. To forecast takeoff power when encountering low runway air temperatures or when conducting reduced-power takeoffs, Figure 28-4 or 29-2 should be used. After selecting a TIT value for takeoff, utilize Figures 28-4 or 29-2 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. T56-A-14 turbine life can be substantially improved by use of reduced power settings during takeoff whenever possible. If it is desired to operate at reduced turbine temperature, the takeoff reduced-power setting tables (Figure 29-2) should be used to determine forecast and abort SHP.

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 are in no manner intended to discourage the use of maximum power when aircraft weight, temperature, altitude, or runway length indicate it is desirable. Figure 29-2 presents information for these reduced settings.

TAKEOFF REDUCED POWER SETTING TABLE 950° TIT							
°C	100%	95%	°F	°C	100%	95%	°F
5	3,820	3,624	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

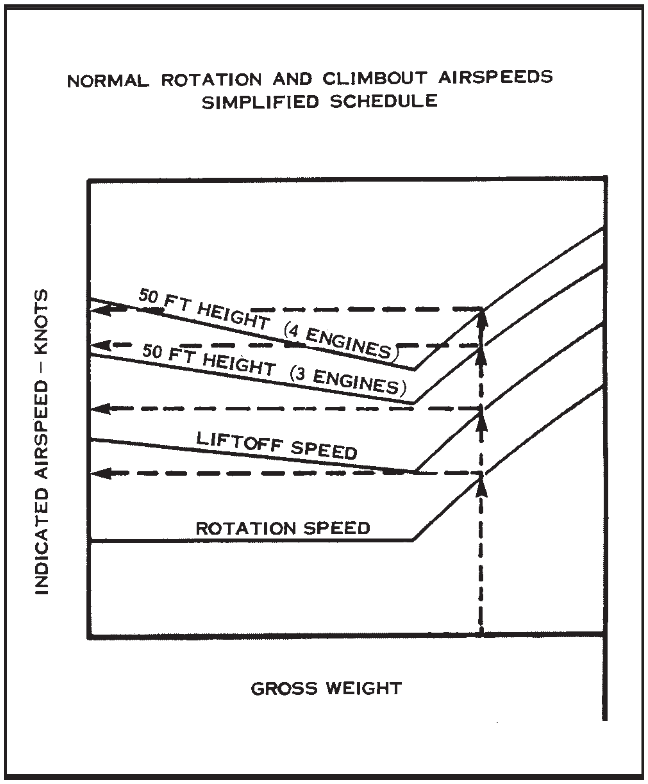
29.3.10.1 Example 1 (Figure 29-2). Takeoff reduced-power setting tables (Figure 29-2) are provided for two TIT values and two SHP values: 925° and 950° and 3,000 and 3,500, respectively. These tables are based on a pressure altitude of sea level. Enter Figure 29-2 with ambient temperature and read 100- 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.
- 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 29-6 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 29-7, 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 29-7 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.

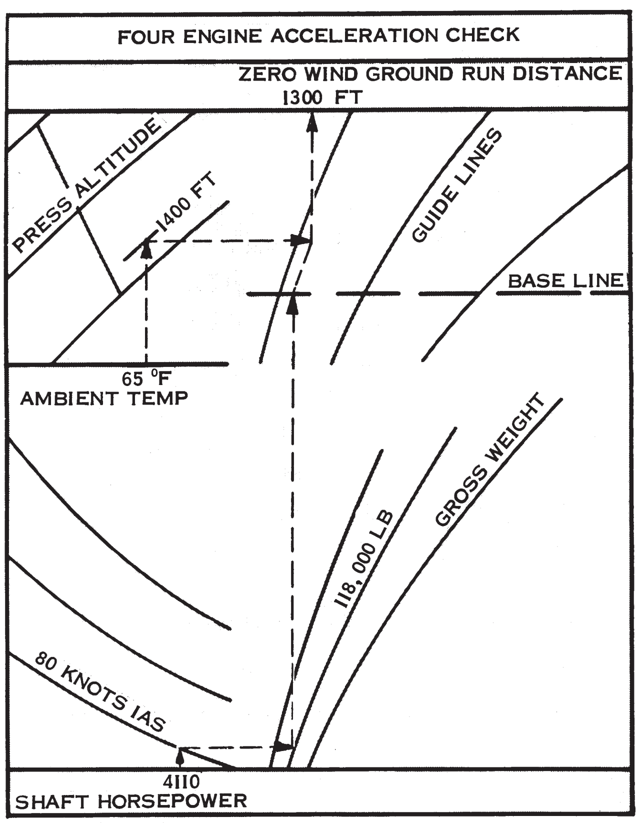
29.3.13 Refusal Speed. The refusal speed is the speed of most interest for normal operations, since this is the maximum speed from which the aircraft can be stopped in the event of trouble.

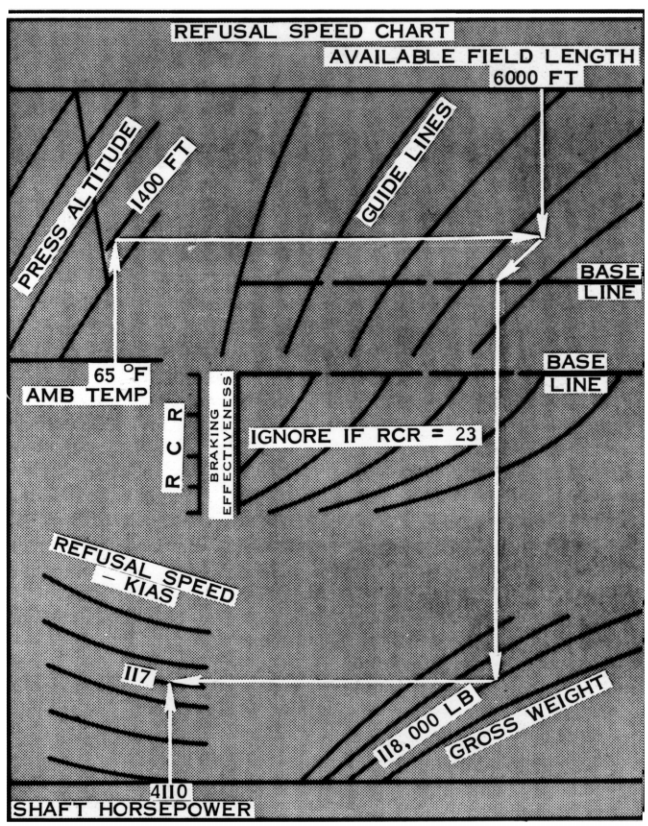
The performance shown by Figure 29-8 is based on ground-idle thrust on three operating engines, and the following maximum true groundspeeds for brake application:

Gross Weight (Pounds)	Speed (TGS) knots
up to 127,500	120
130,000	118
135,000	113
140,000	109
145,000	105

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 a 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:

Runway Condition	ICAO Report	RCR
Dry	Good	23
Wet	Medium	12
Icy	Poor	05

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.

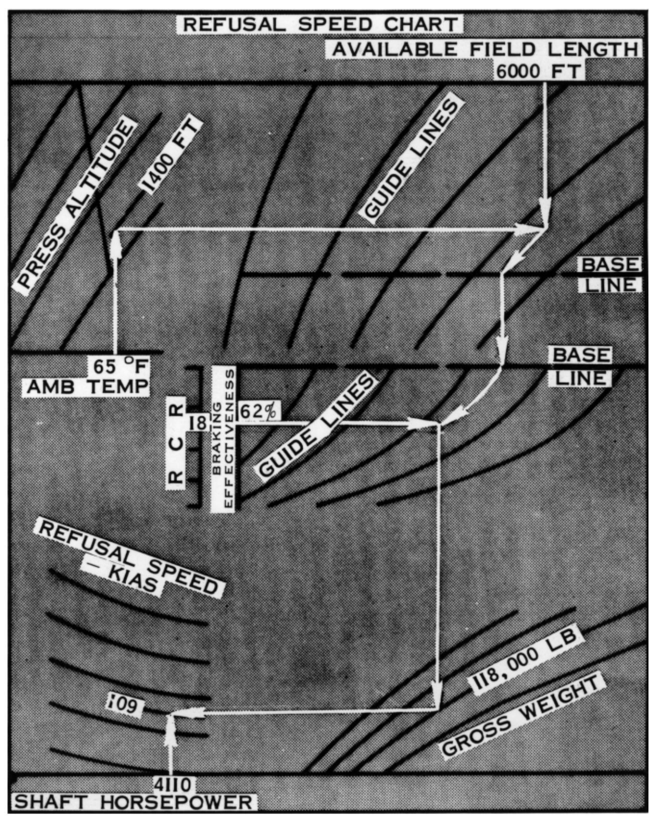
The retarding effect of slush and water increases with increasing speed and varies considerably with the varying slush and water depths. The retarding effect of slush and water decreases when the aircraft reaches hydroplaning speed. Hydroplaning occurs because the pressure between the fluid on the runway 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, that 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.

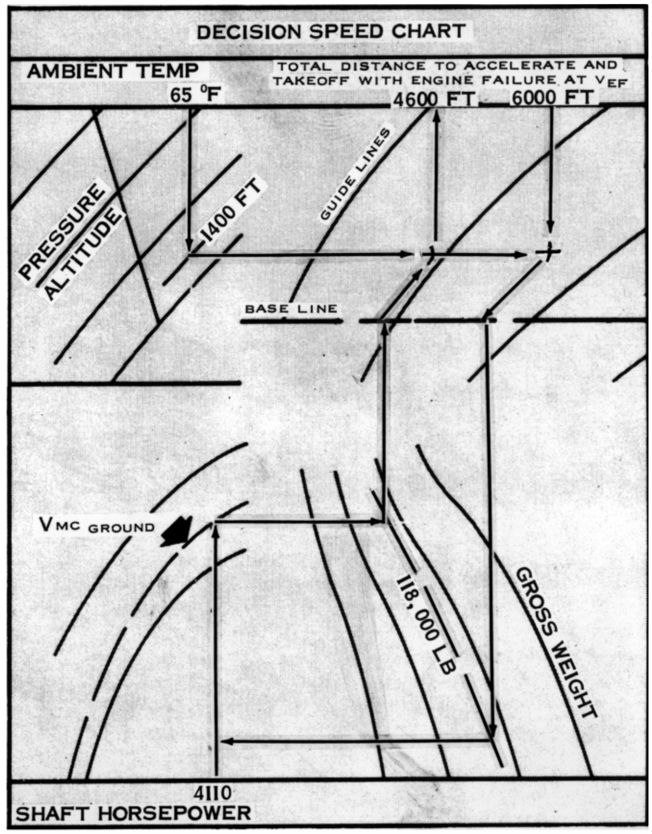
29.3.15.2 Runway Bearing Strength. Runway bearing strength may be reported as runway bearing capacity (T-twin wheel type landing gear) or by the Aircraft Classification Number/Pavement Classification Number (ACN/PCN) system (ICAO standard). For detailed explanation see Section A of the applicable DOD Flight Information Publication (Enroute) IFR-Supplement.

DOD Flight Information Publication (Enroute) 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 29-9, 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.

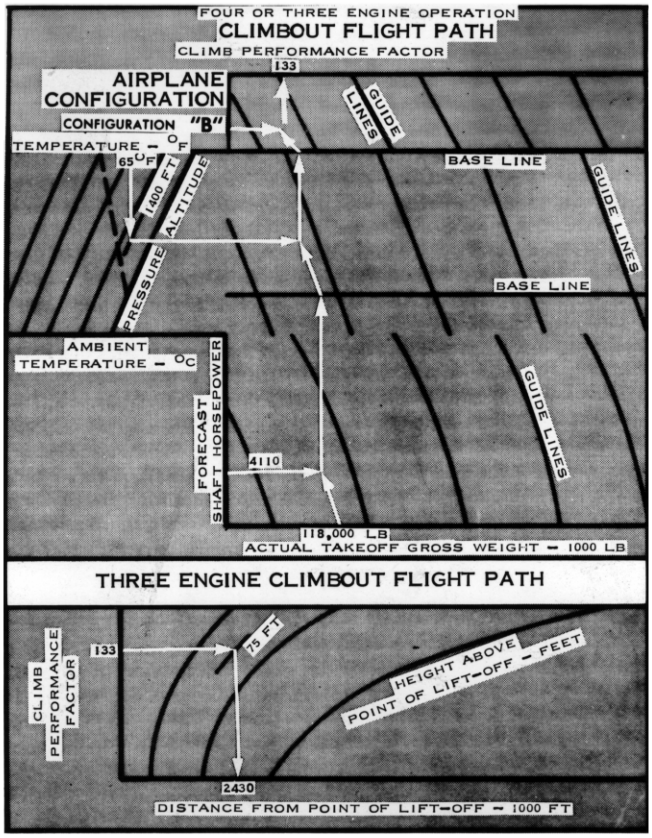
29.3.16.1 Example. Decision speed would be less than 99 KIAS ($V_{MC\ GRD}$) for the takeoff conditions. For the takeoff, 4,600 feet would be required with no wind and zero slope for 99 KIAS engine-failure speed. Takeoff distance would be 3,950 feet with engine failure at refusal speed.

29.3.17 Climbout Flightpath Charts. The flightpath charts, Figure 29-12 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 29-2. 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.

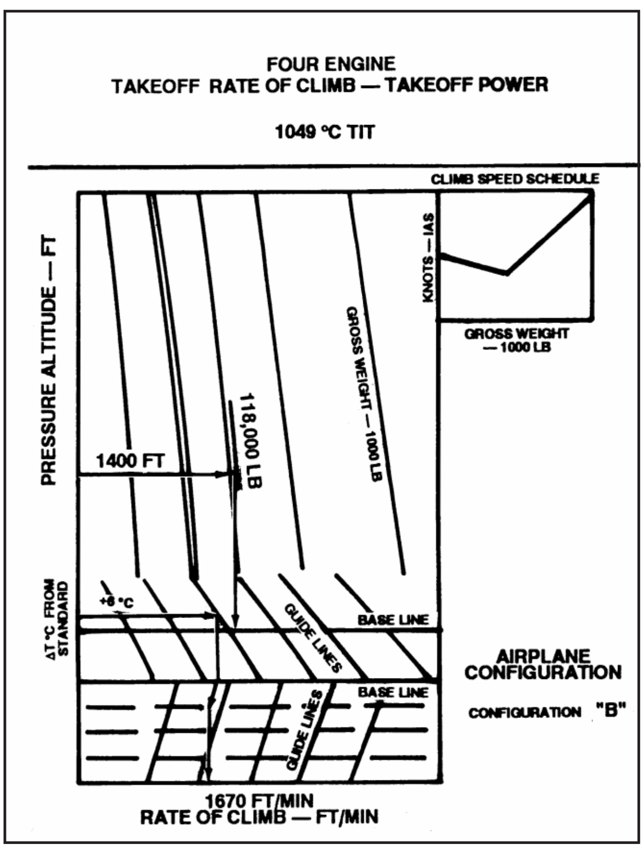


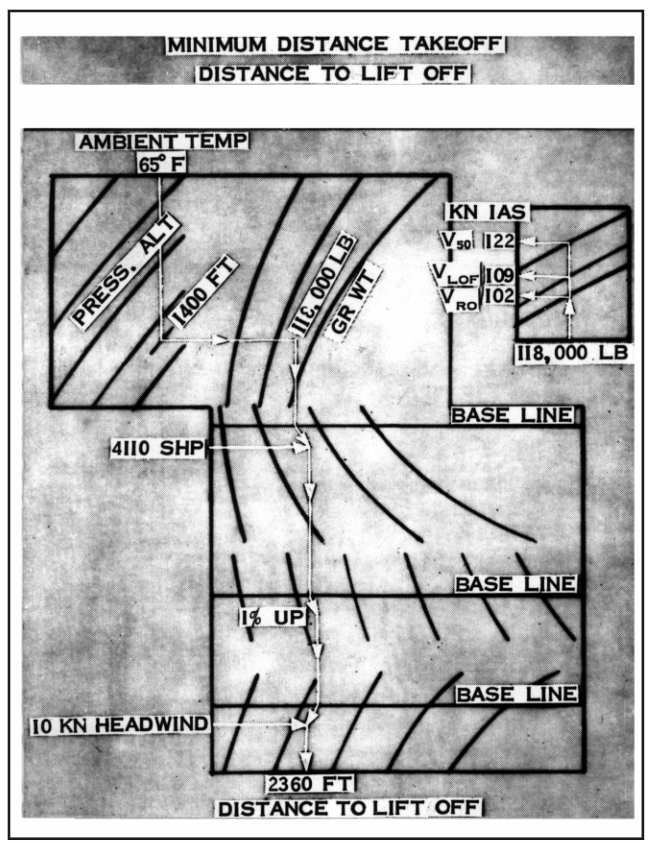
29.3.18 **Takeoff Rate of Climb — Military Power.** Figures 29-10 and 29-11 shows the three- and four-engine rates of climb available with military power at climbout airspeeds. Correction for nonstandard temperature is shown at the bottom. The data are applicable when climbs are conducted at the airspeed schedules noted on the charts.

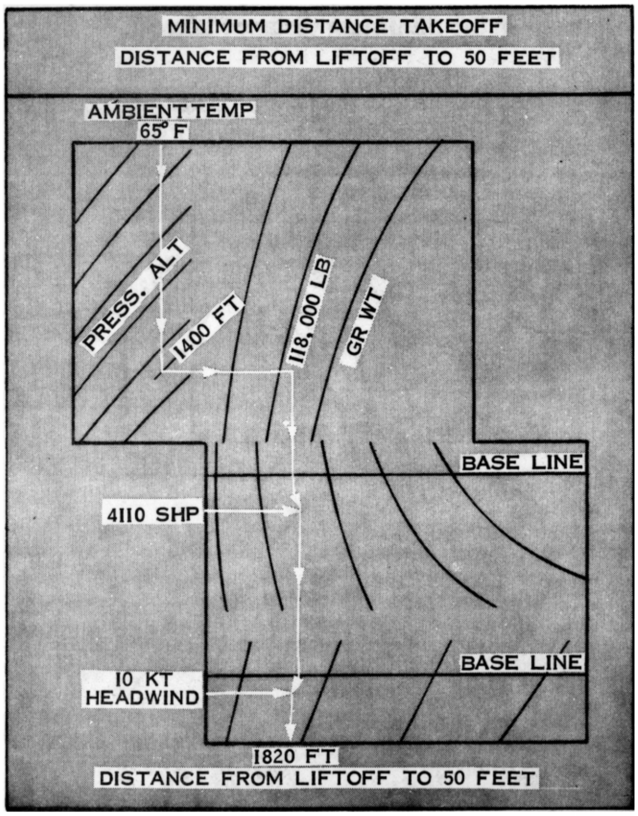
29.3.18.1 **Example.** For Configuration B the four-engine takeoff rate of climb is 1,670 fpm with military power at 118,000 pounds, climb speed of 133 KIAS, 1,400-foot pressure altitude, and 18 °C ambient temperature from standard equals +6 °C. For the same conditions with three engines operating and the three-engine climb speed of 130 KIAS, the takeoff rate of climb is 670 fpm.

29.4 ABNORMAL TAKEOFF PLANNING

29.4.1 **Minimum Distance Takeoff.** Minimum distance takeoff performance is shown on sheets 1 and 2 of Figure 29-13. 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.

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 29-14 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.

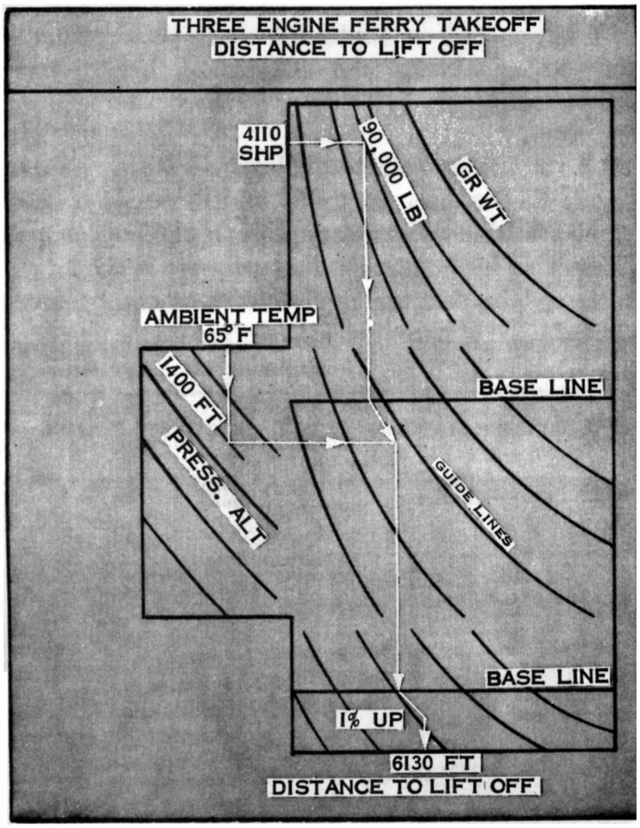
The speed schedule for the ferry takeoff was selected to be 15 knots in excess of the corresponding speeds shown for the normal takeoff condition to provide an additional margin of safety.

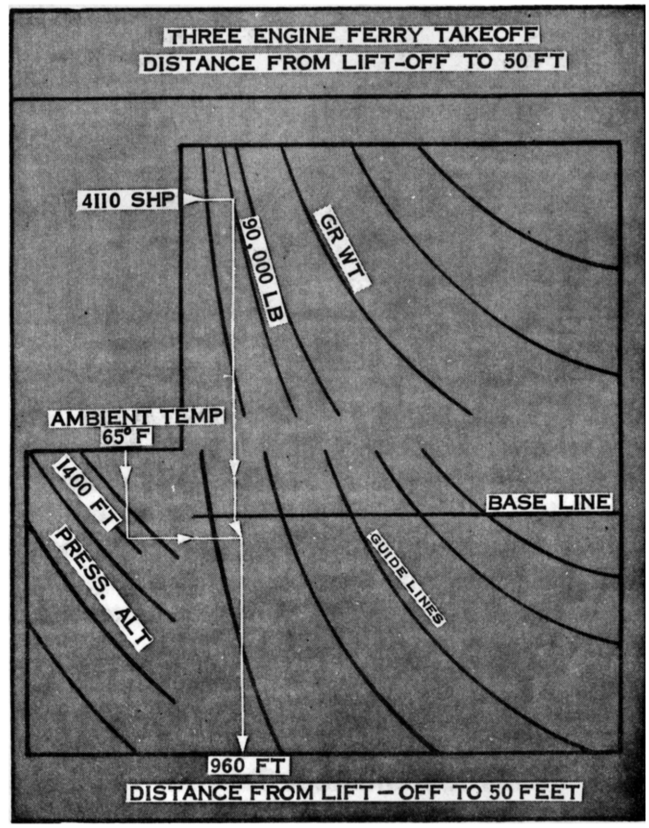
Note

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 29-2. Takeoff Reduced-Power Setting — 925 °C (Sheet 1 of 4)

950 °C TIT at Sea Level

Note

Add 13 °C to ambient temperature if engine anti-ice is used.

			F				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 29-2. Takeoff Reduced-Power Setting — 950 °C (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 29-2. Takeoff Reduced-Power Setting — 3,000/2,850 SHP (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 29-2. Takeoff Reduced-Power Setting — 3,500/3,325 SHP (Sheet 4 of 4)

4,600 Shaft Horsepower

C°		F°	C°		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 29-3. 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 29-4. 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 29-5. 1,010° TIT

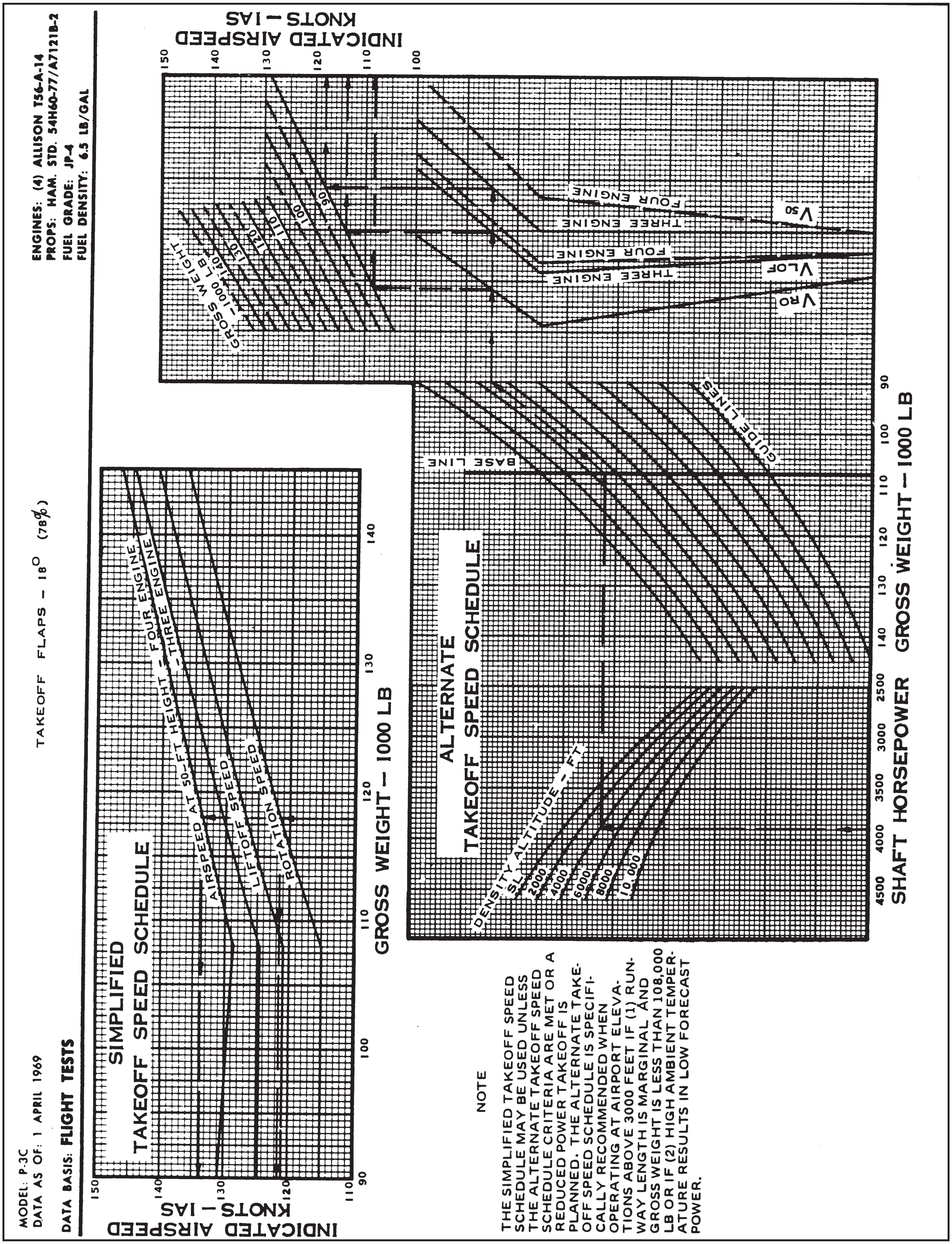


Figure 29-6. Normal Rotation and Climbout Airspeeds

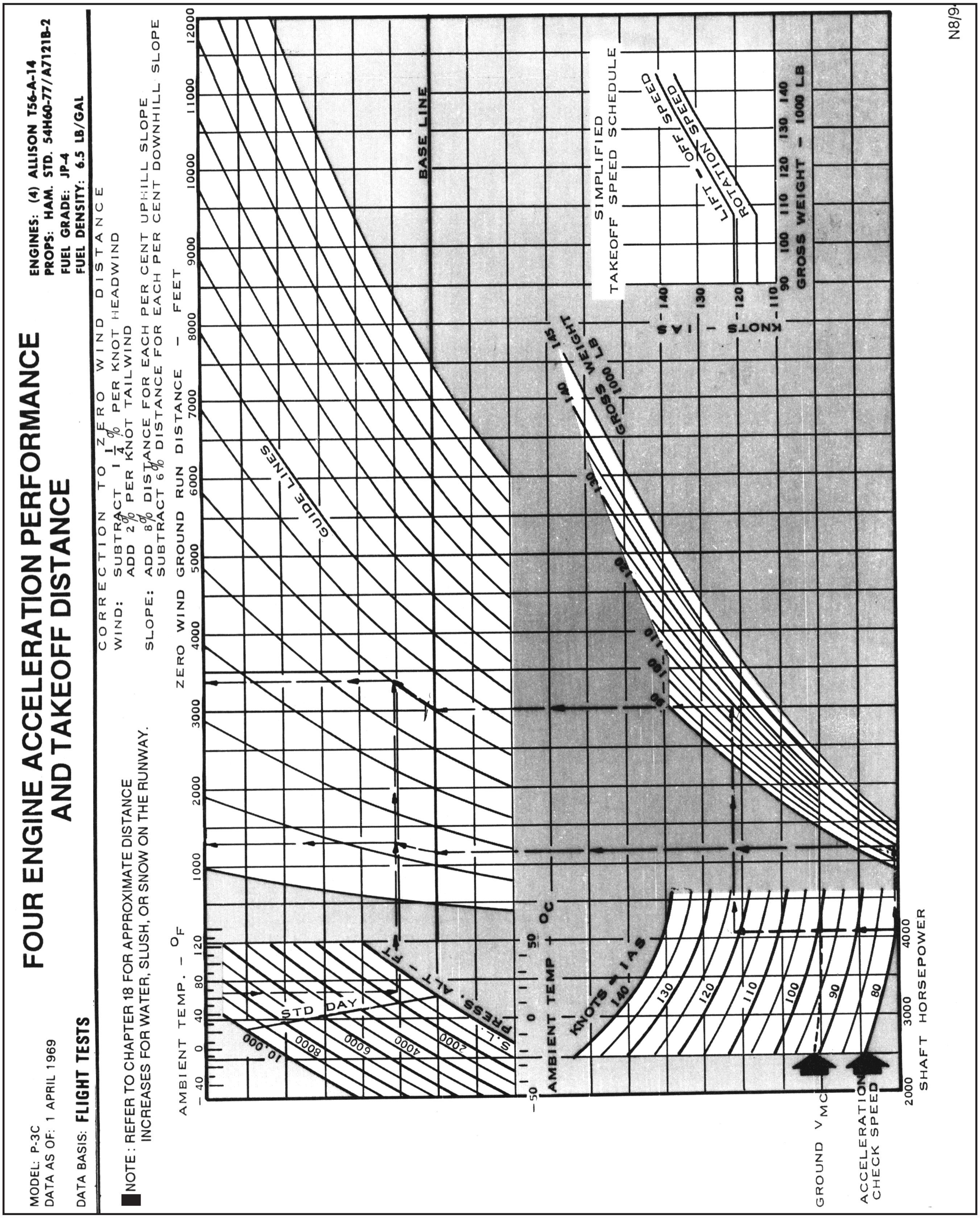


Figure 29-7. Four-Engine Acceleration Performance

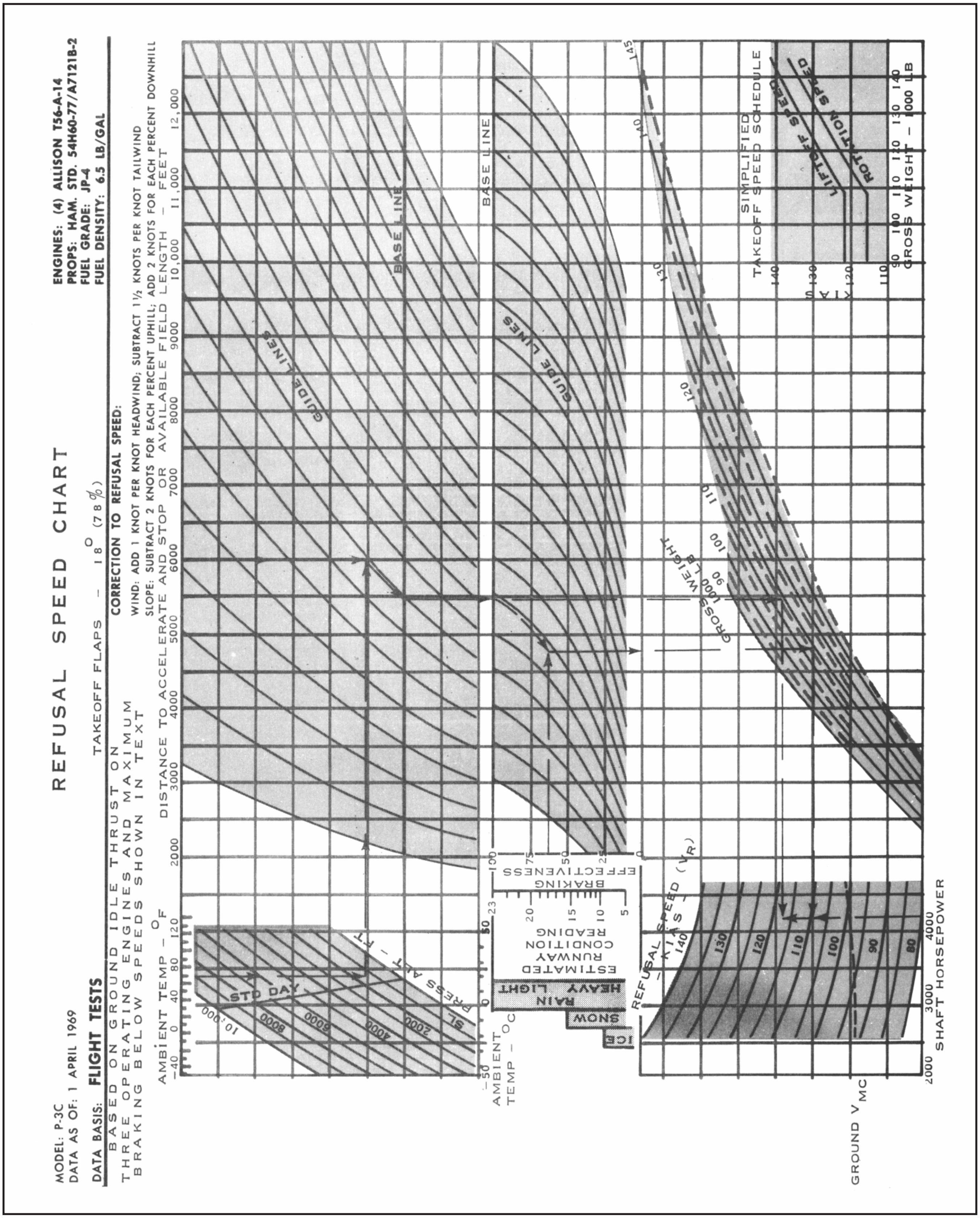


Figure 29-8. Refusal Speed Chart

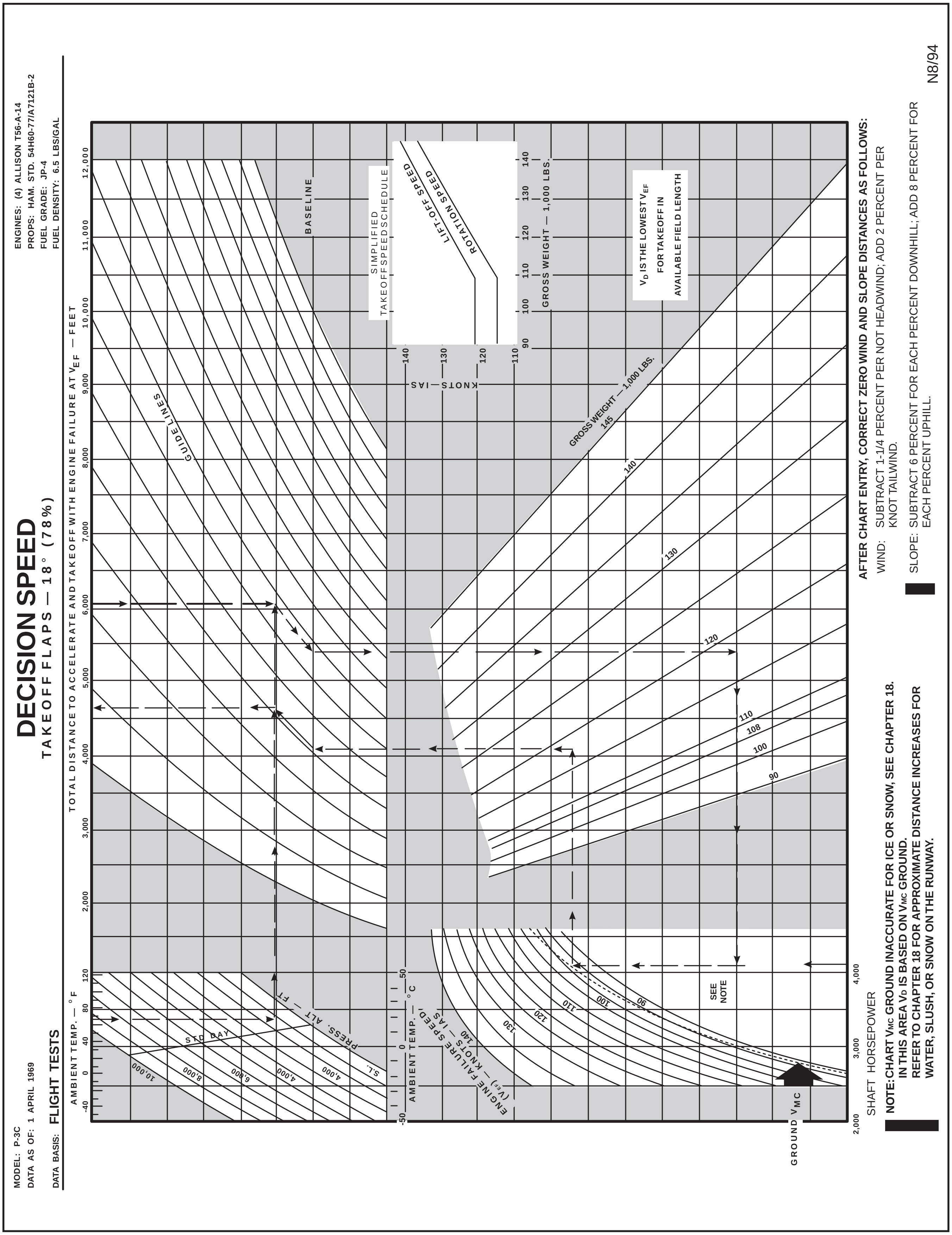


Figure 29-9. Decision Speed Chart

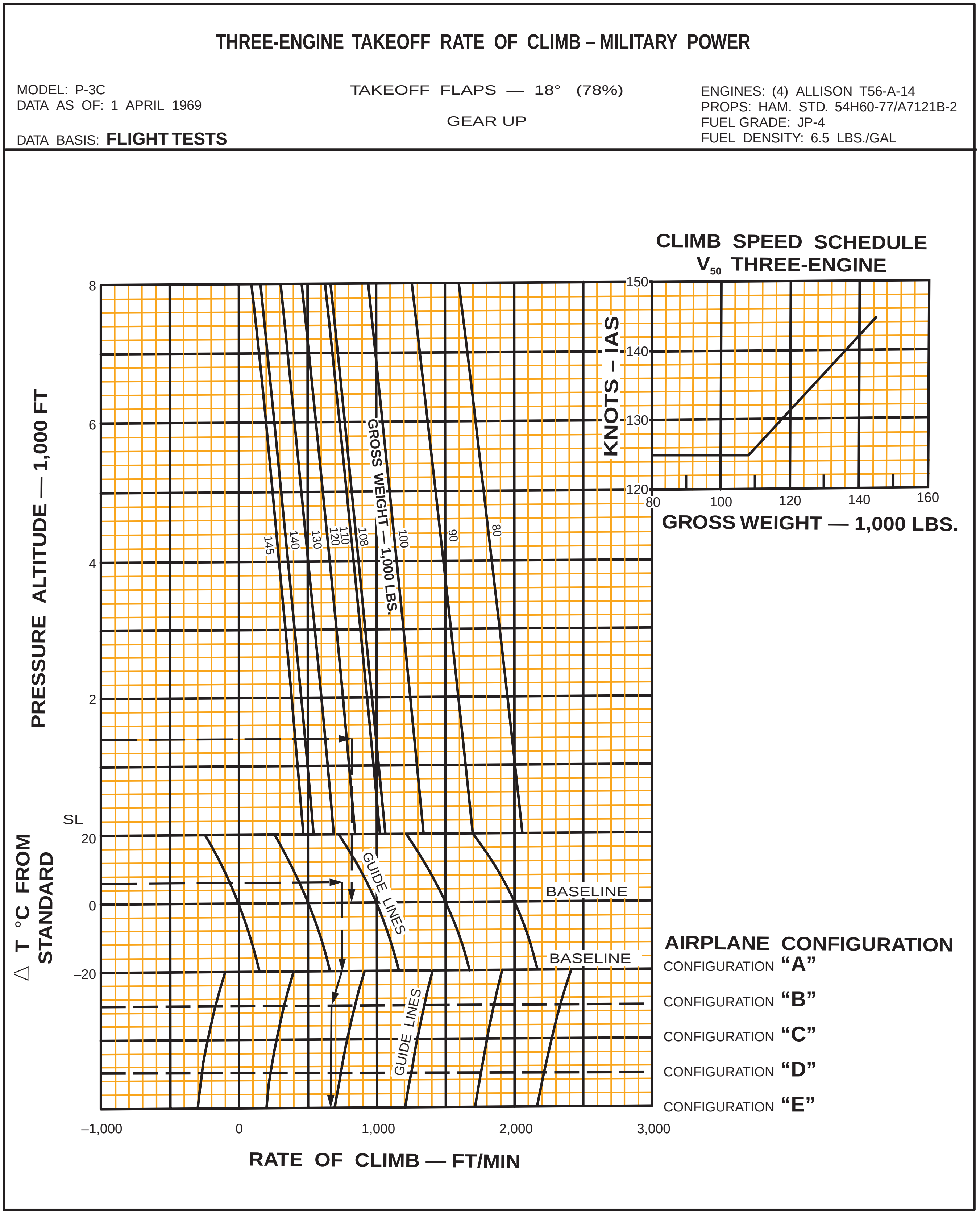


Figure 29-10. Three-Engine Takeoff Rate of Climb — Military Power

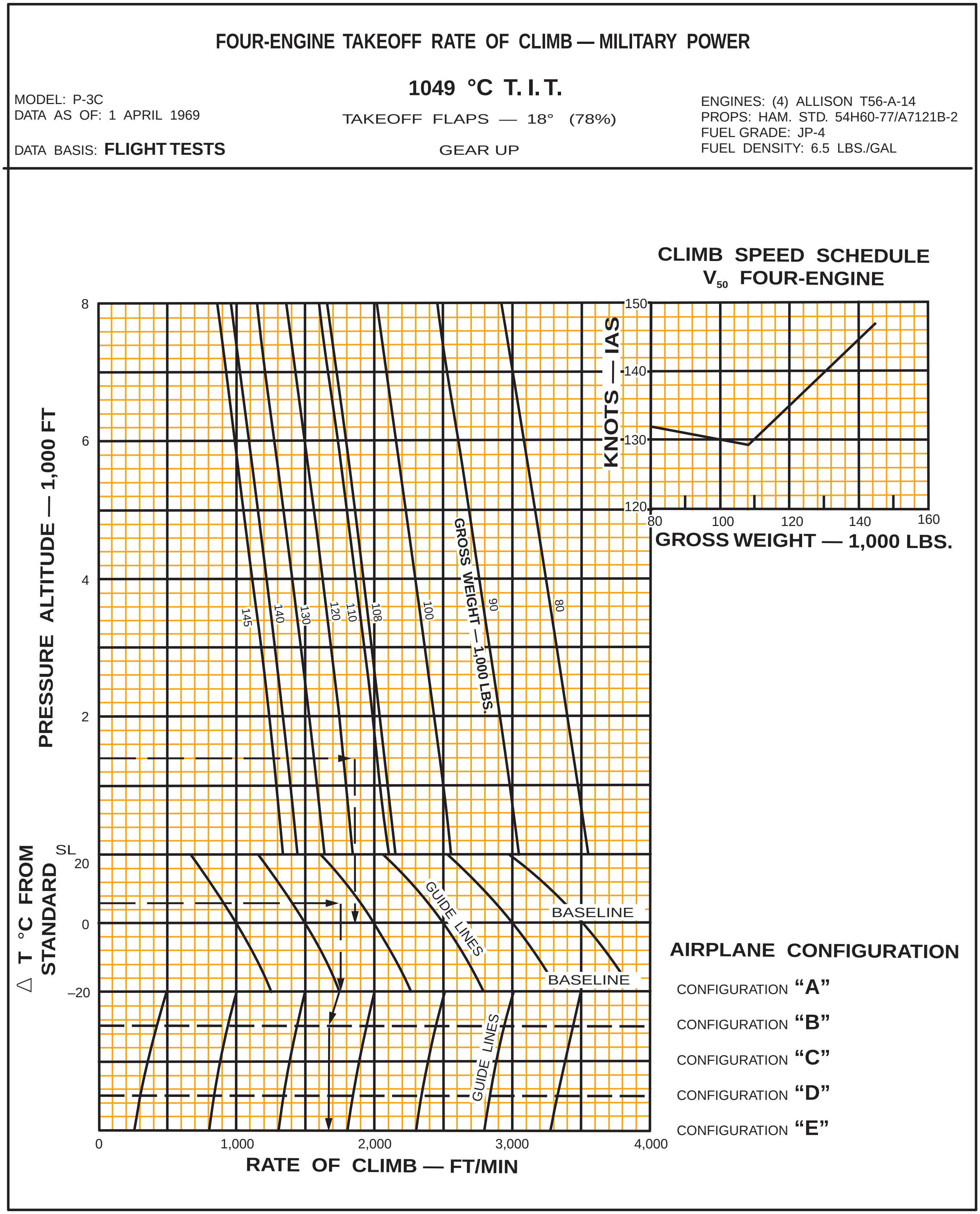


Figure 29-11. Four-Engine Takeoff Rate of Climb — Military Power

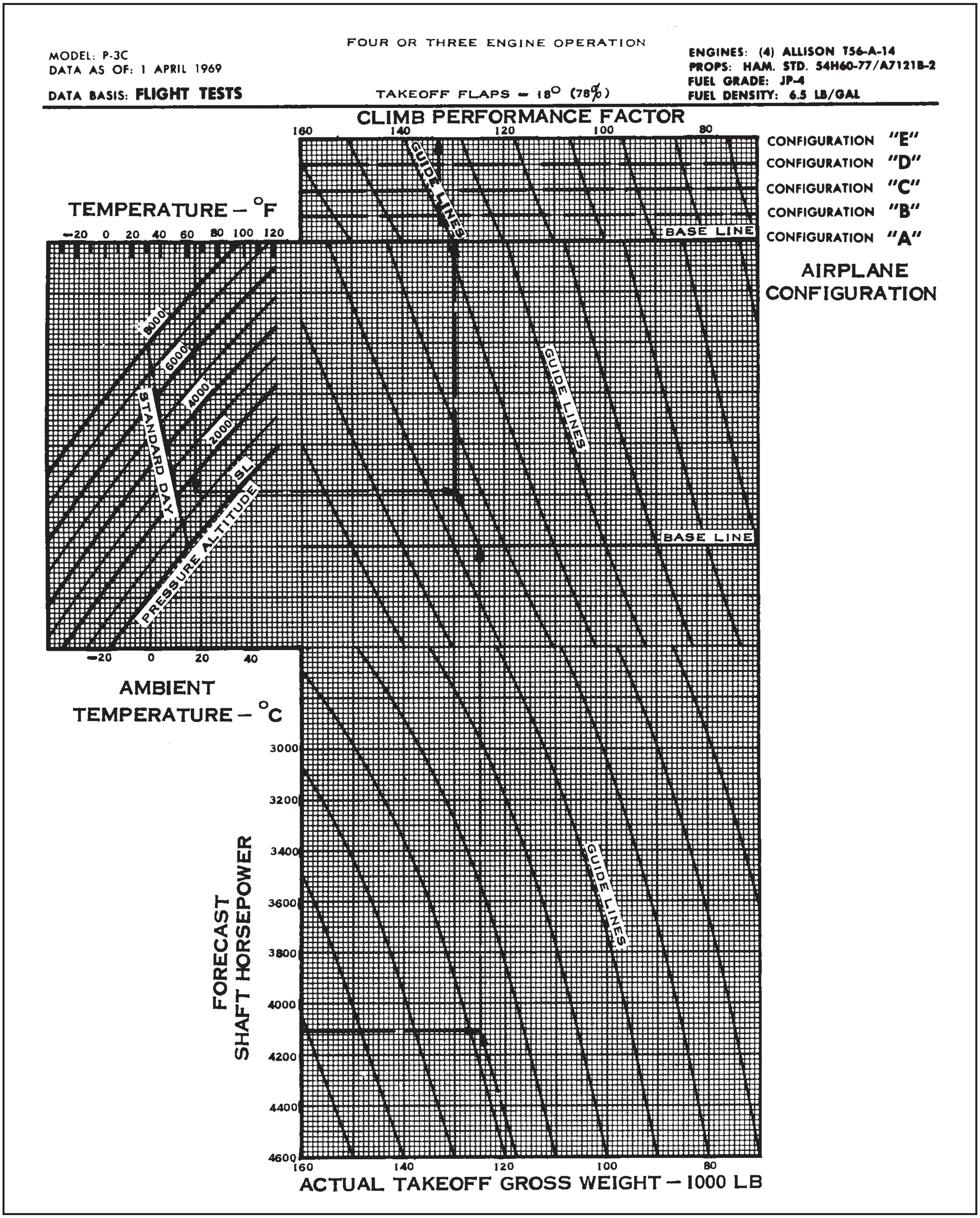


Figure 29-12. Climbout Flightpath (Sheet 1 of 3)

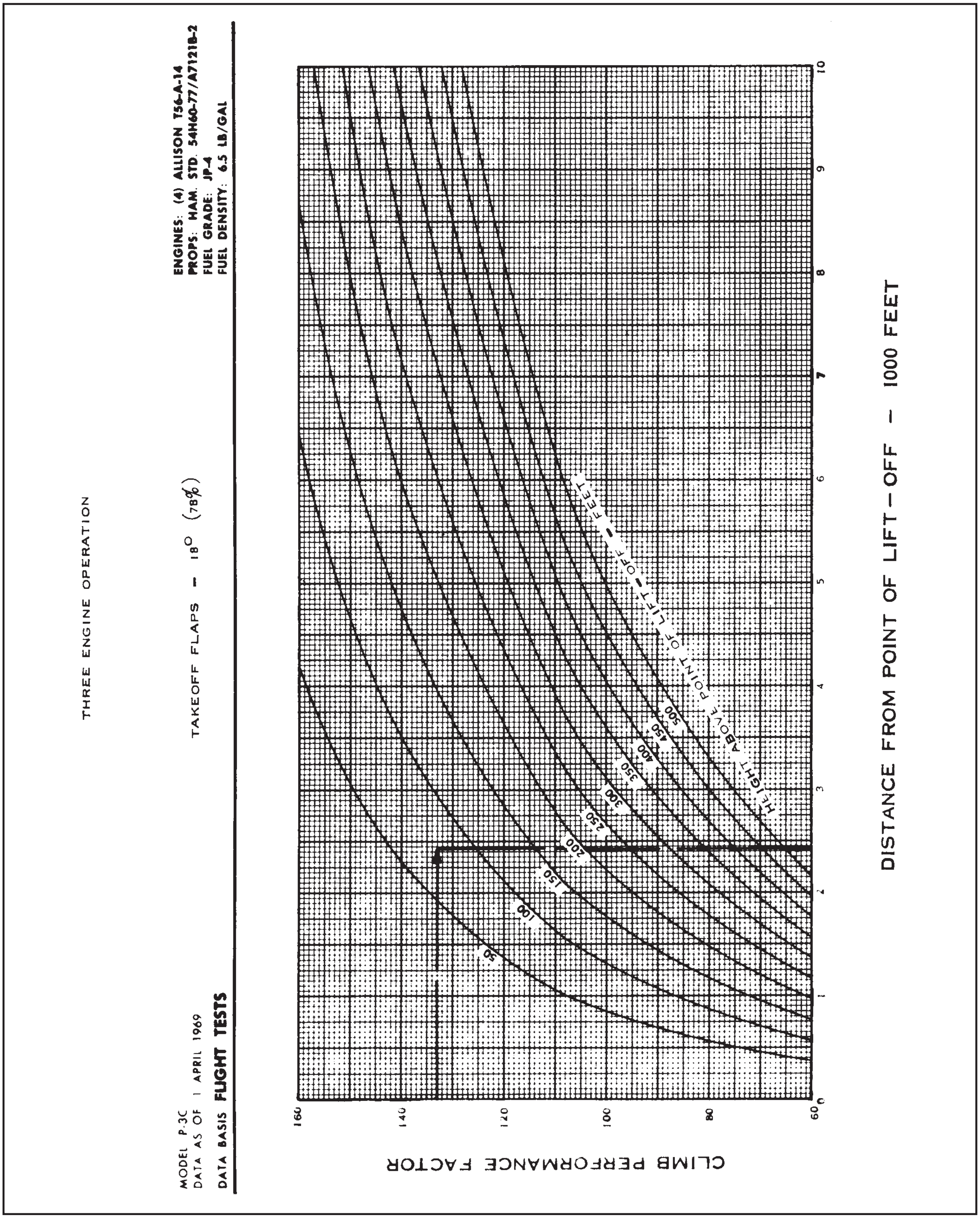


Figure 29-12. Climbout Flightpath (Sheet 2 of 3)

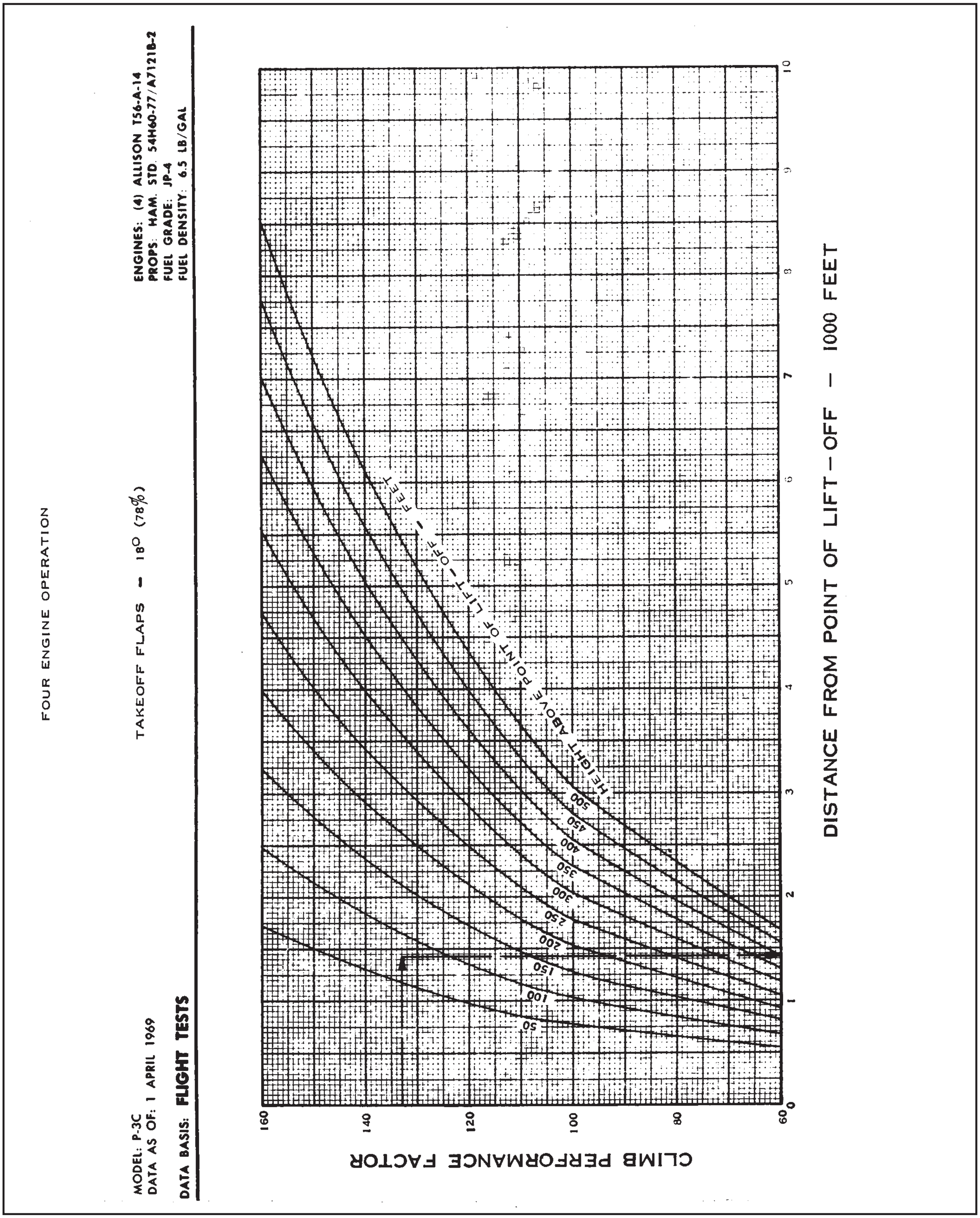


Figure 29-12. Climbout Flightpath (Sheet 3 of 3)

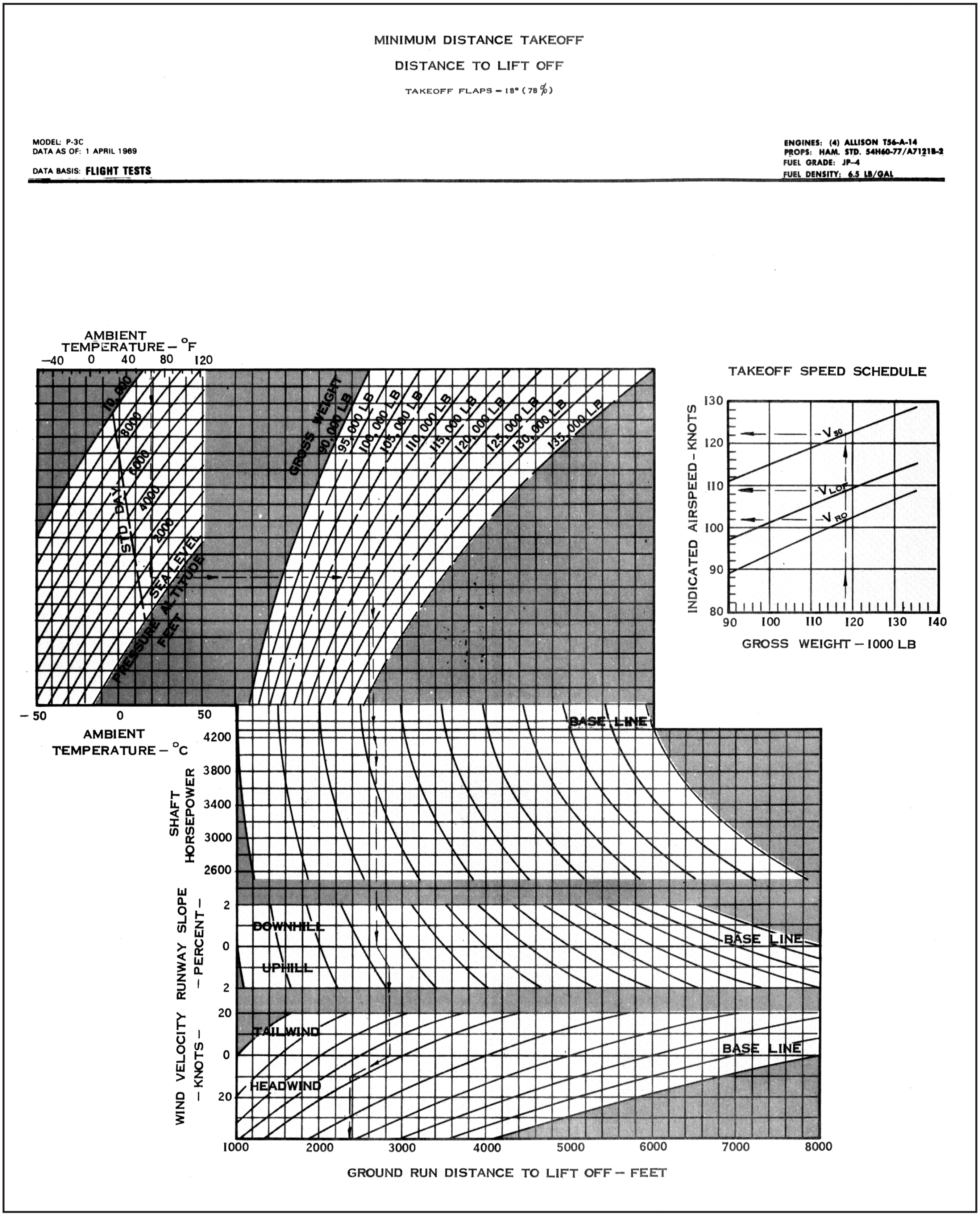


Figure 29-13. Minimum Distance to Takeoff (Sheet 1 of 2)

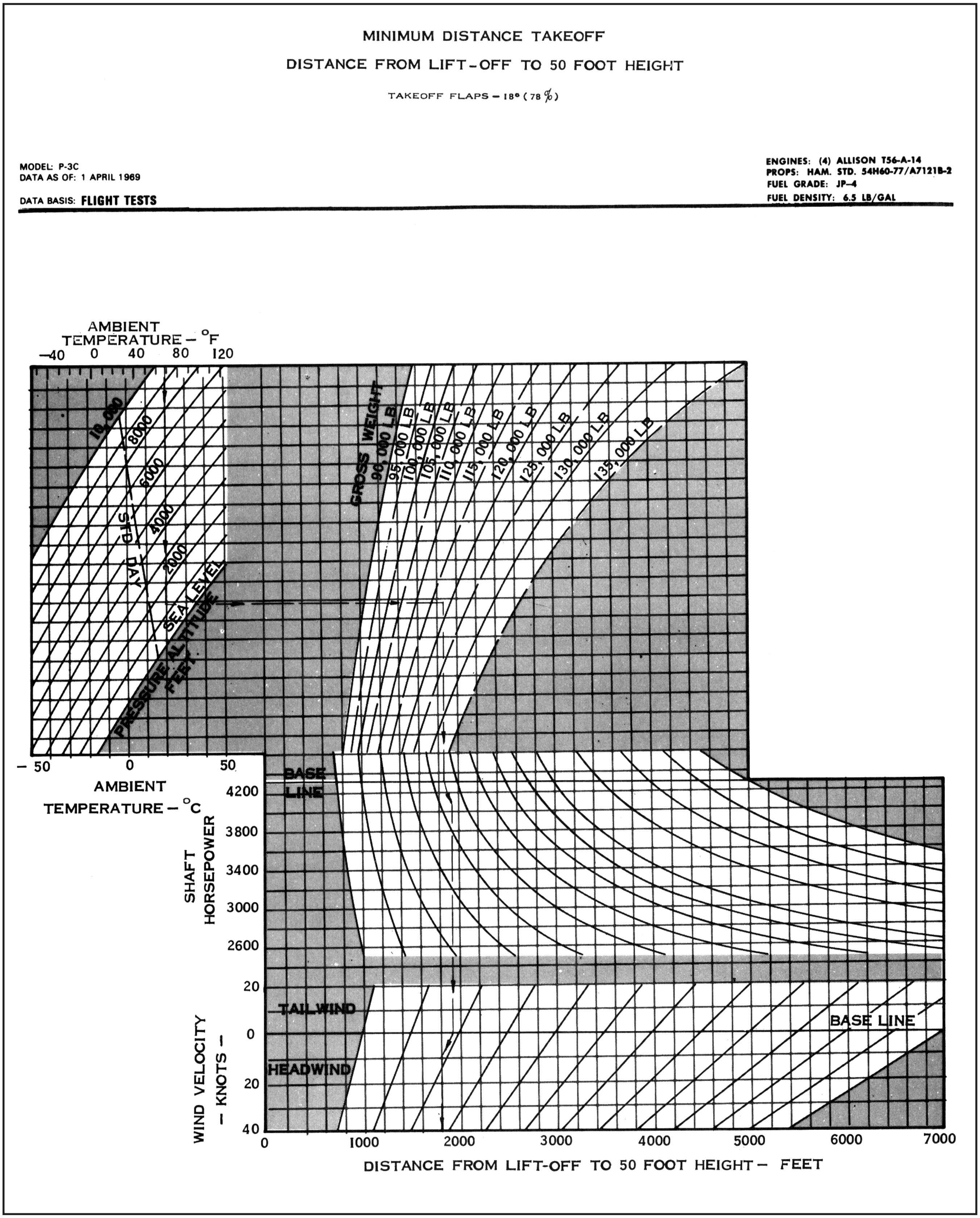


Figure 29-13. Mimimum Distance to Takeoff (Sheet 2 of 2)

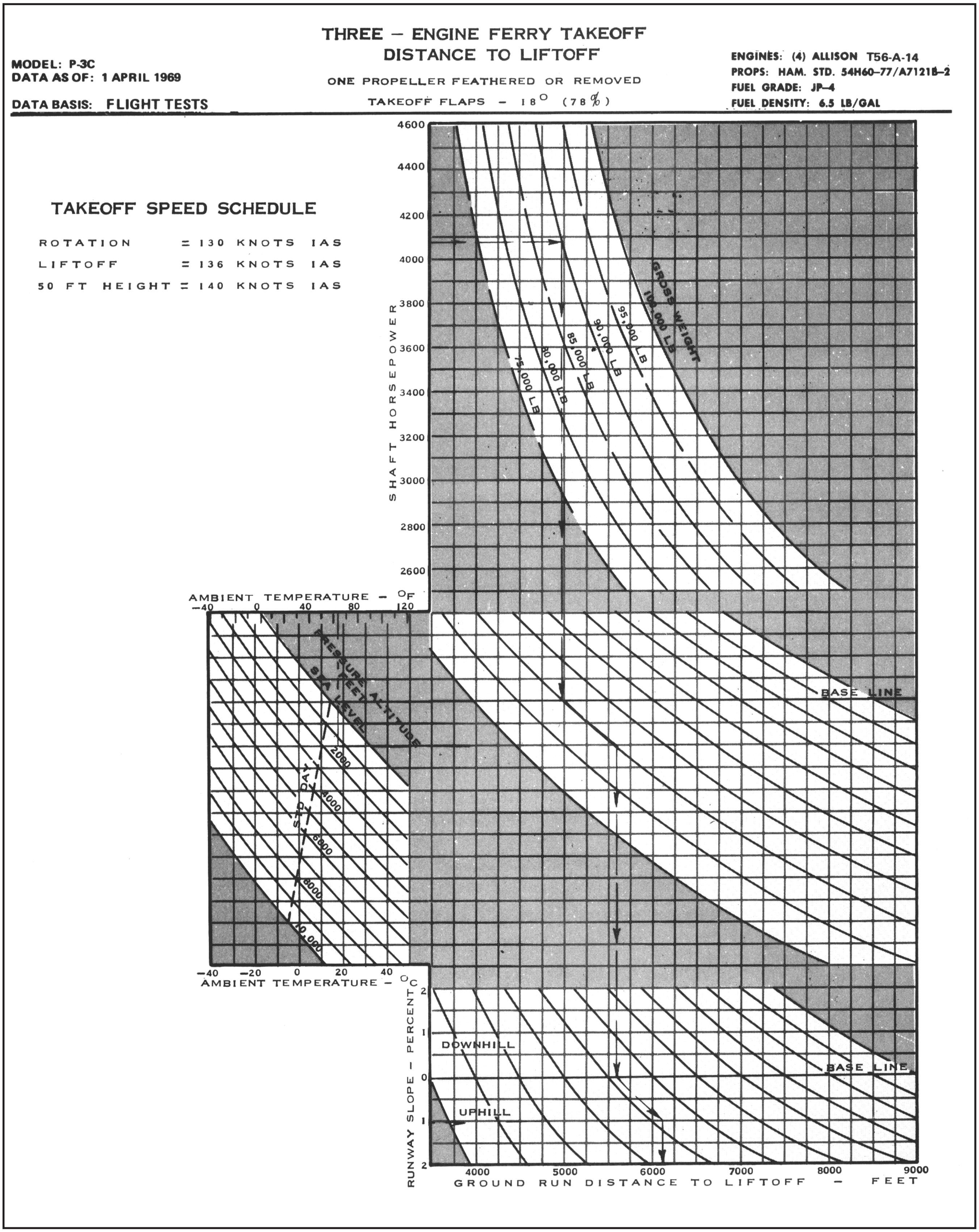


Figure 29-14. Three-Engine Ferry Takeoff (Sheet 1 of 2)

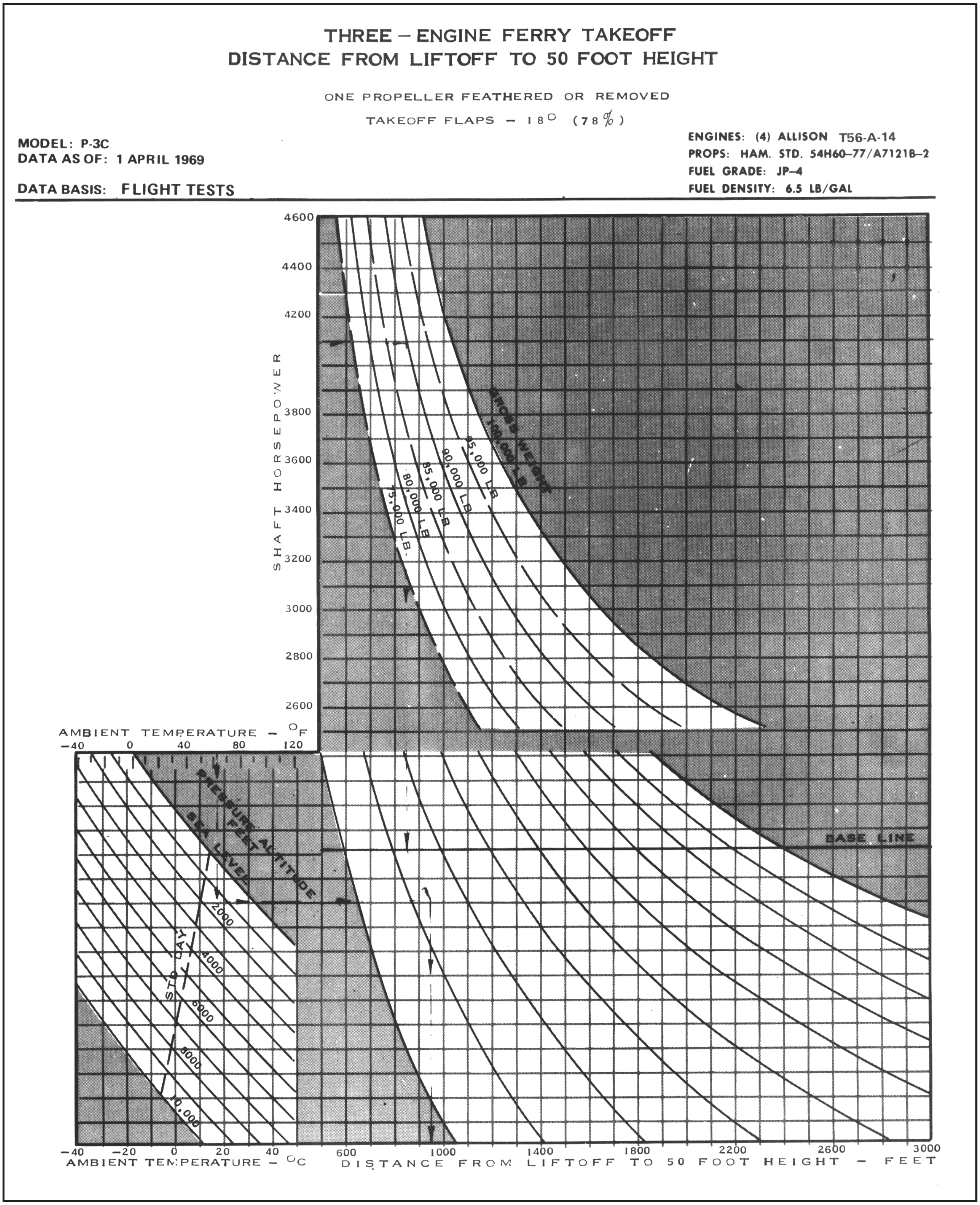


Figure 29-14. Three-Engine Ferry Takeoff (Sheet 2 of 2)

CHAPTER 30

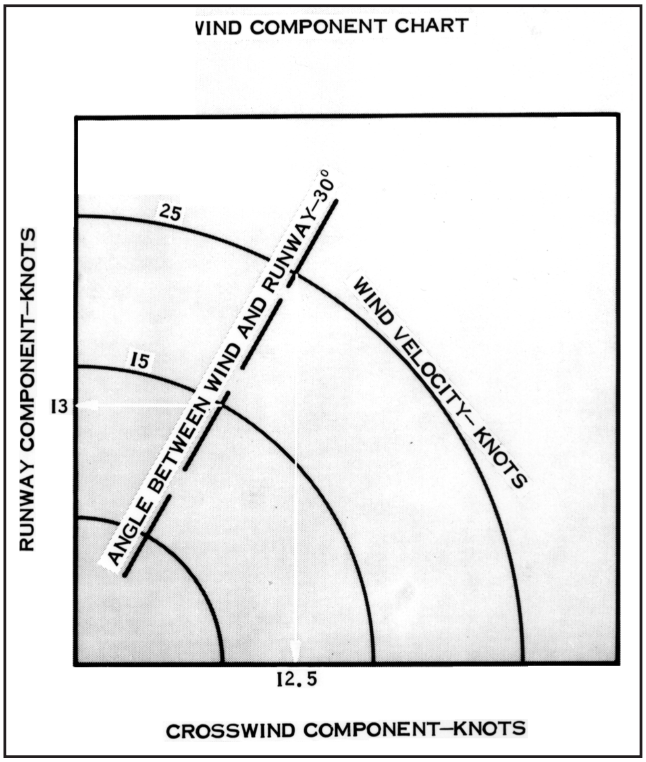
Approach and Landing

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

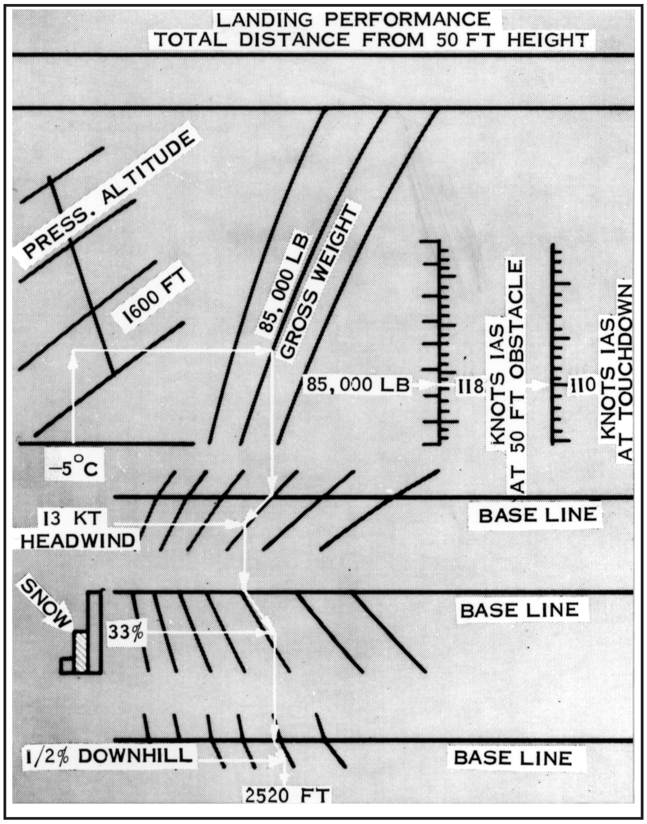
Corrections for the effects of headwind and tailwind components on landing distances are included in the landing distance charts, Figures 30-2 and 30-3. The corrections apply to wind speeds measured at the runway at elevations of 6 to 8 feet above the surface. It is normal to consider that winds at these 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 30-1, is provided for calculating the runway and crosswind components for various wind conditions and the recommended minimum RCR.



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 30-1 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.

30.3 LANDING DISTANCES

Landing ground roll distances and total distances to land from a 50-foot height and stop are given by Figures 30-2 and 30-3, 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 see 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 30-2 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 30-3 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 30-2, then apply the no-flap factor shown in Figure 30-4.

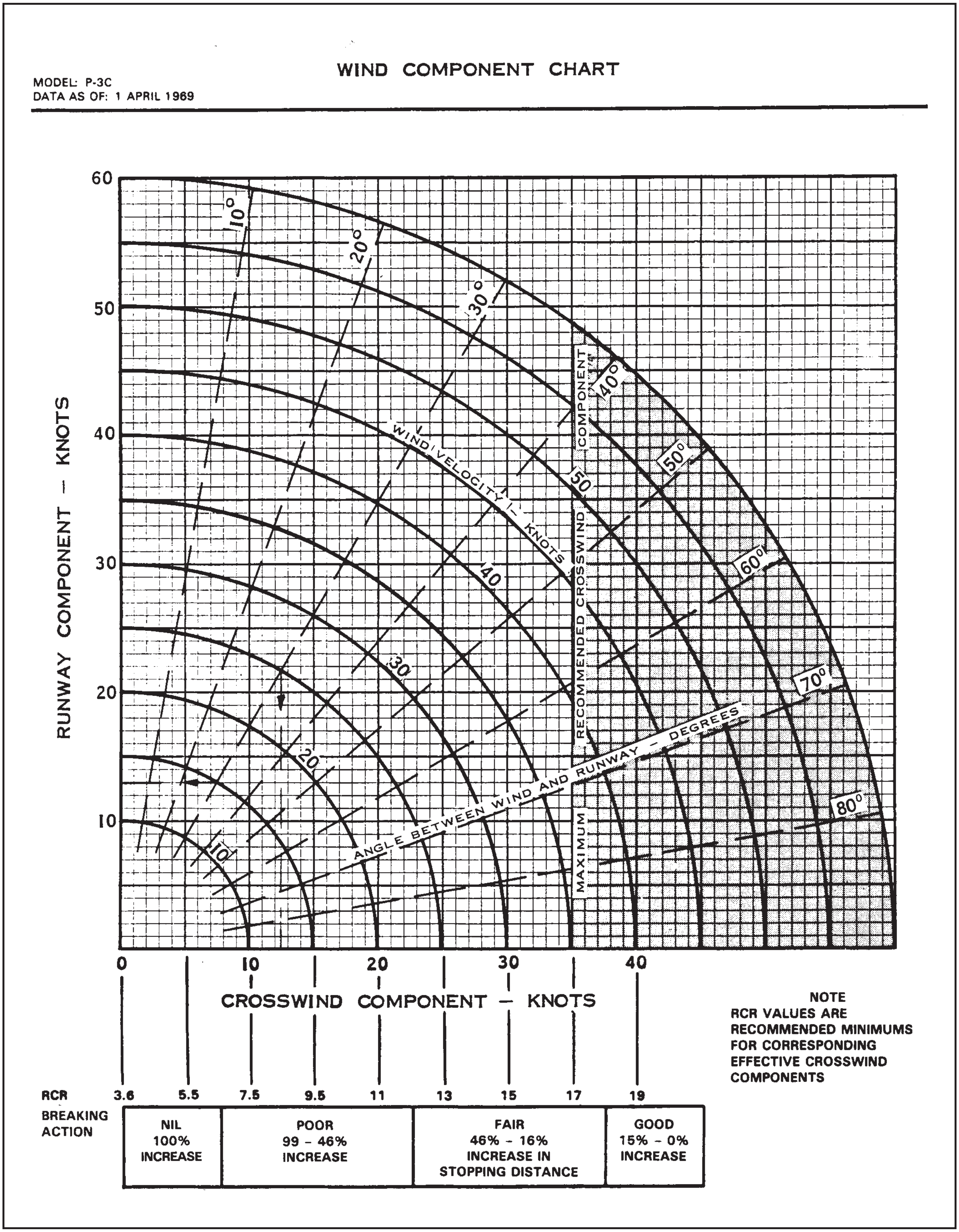


Figure 30-1. Wind Component

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

DATA BASIS: **FLIGHT TESTS**

LANDING PERFORMANCE
GROUND ROLL

LANDING FLAPS — 40° (100%)

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LBS./GAL

NOTE:
1. WHEN LANDING IN CONFIGURATIONS "D" OR "E," DUE TO WING STORE LOADING (GREATER THAN 700 DRAG COUNT), INCREASE SCHEDULED AIRSPEEDS 5 KNOTS AND LANDING DISTANCES 10 PERCENT.
2. SEE PARAGRAPH 30.4 FOR NO FLAP LANDING GROUND ROLL PERFORMANCE.
3. INCREASE DISTANCES 15 PERCENT WHEN LANDING WITH TAKEOFF FLAPS (18°) IF GROSS WEIGHT IS NOT MORE THAN 115,000 LBS. AT GREATER GROSS WEIGHTS DISTANCES INCREASE GREATLY.

GROUND CONDITIONS:
1. HARD WHEEL BRAKING
2. GROUND IDLE POWER
3. DISTANCES WILL BE 2/3 GREATER WITH MODERATE BRAKING

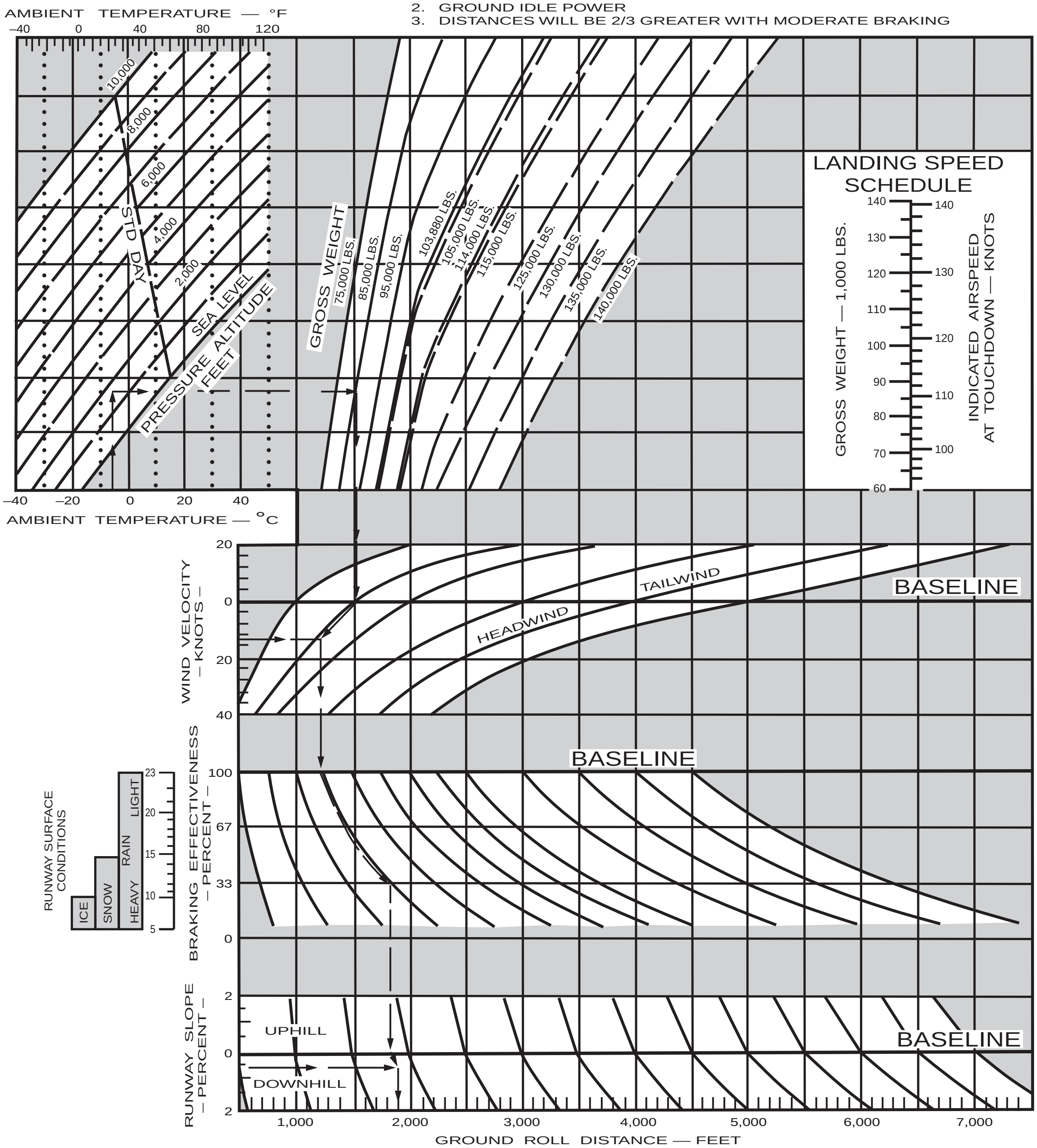


Figure 30-2. Landing Performance — Ground Roll

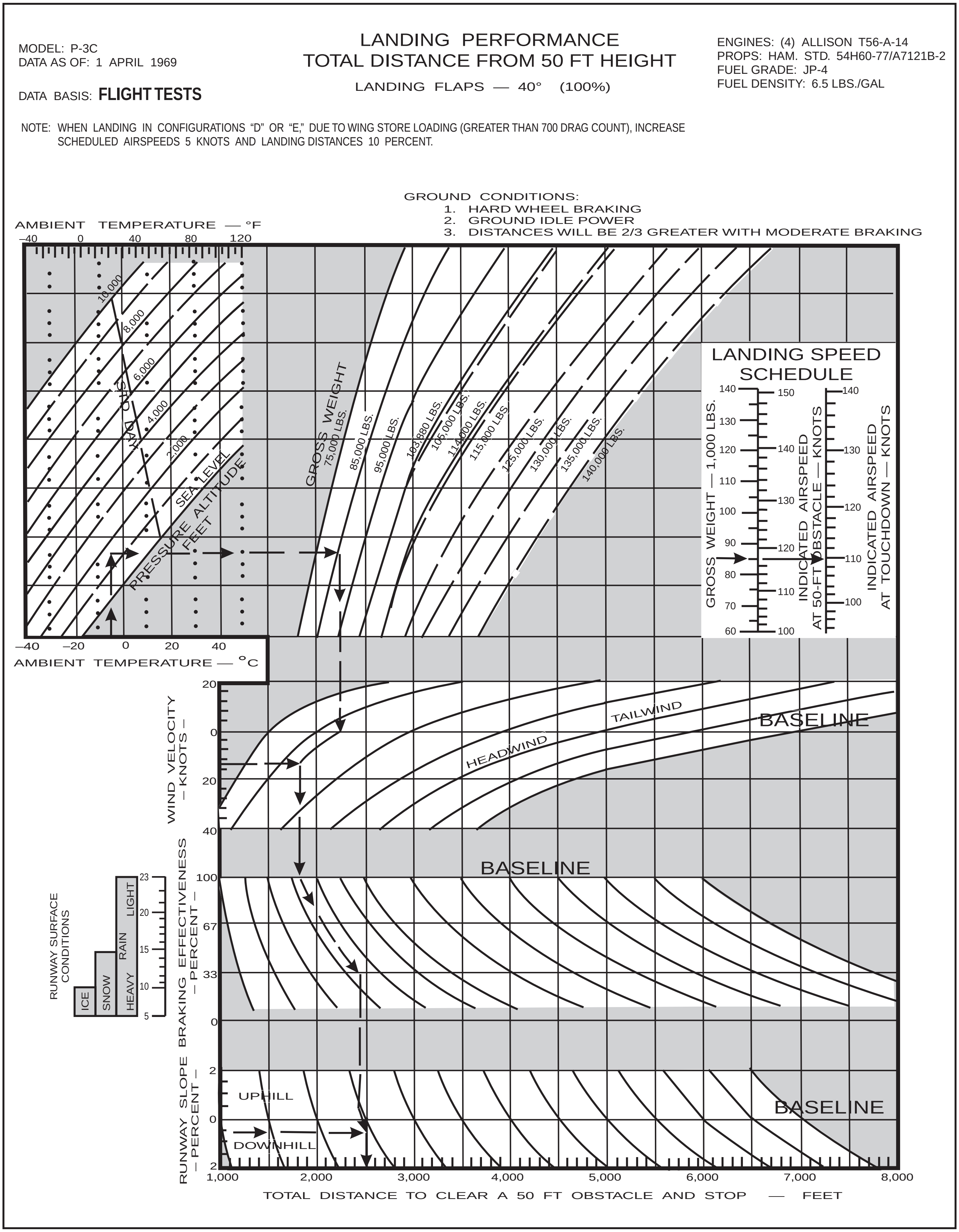


Figure 30-3. Landing Performance — Total Distance from 50-Foot Height

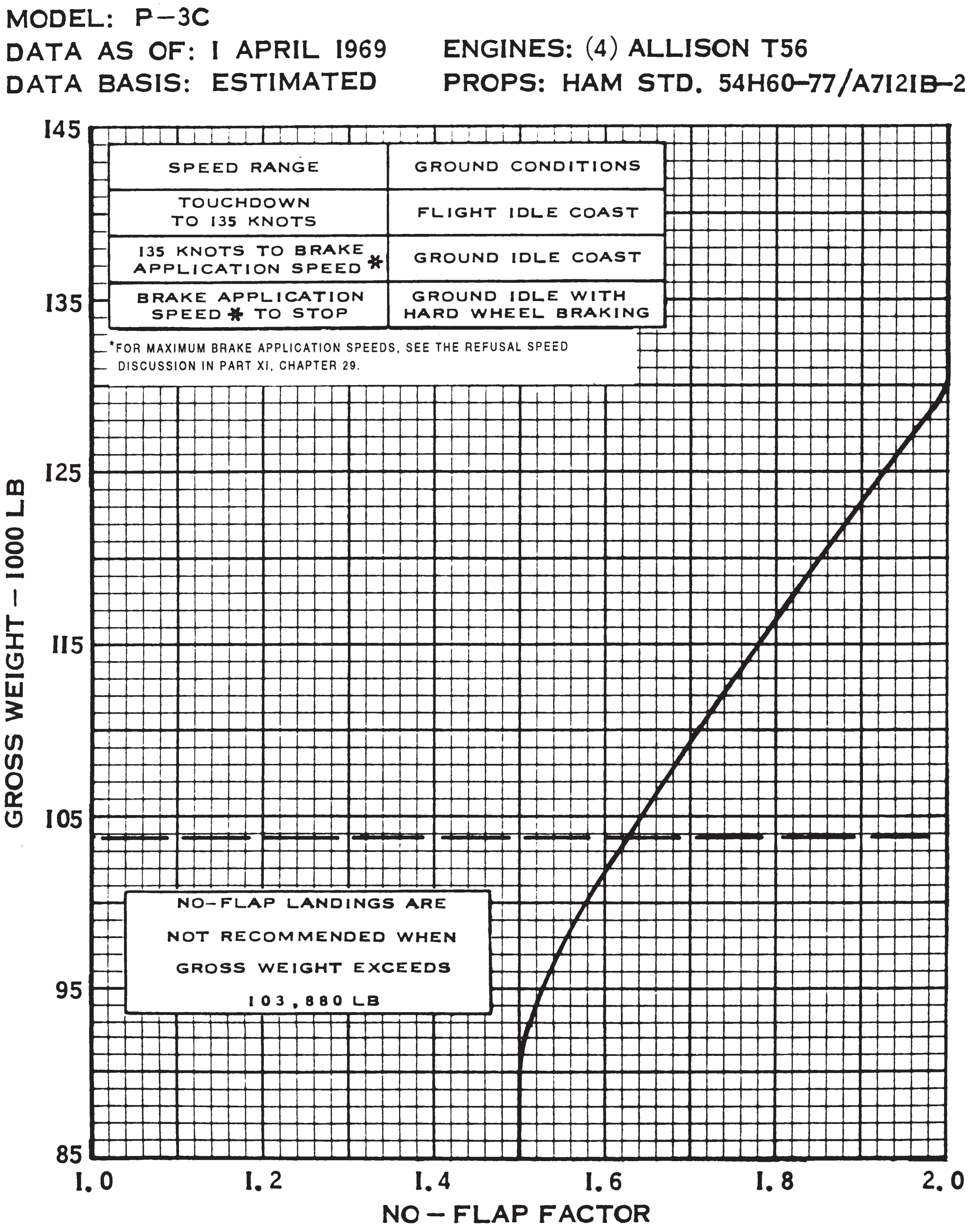


Figure 30-4. Gross Weight vs. No-Flap Factor (Emergency Procedure)

CHAPTER 31

Climb and Descent

31.1 CLIMB CONTROL CHARTS

The charts (Figures 31-1 through 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 a speed approximating gross weight plus 100 knots (sheet 1); descent at placard airspeeds (sheet 2) at flight idle power; a recommended operational descent at 275 KIAS (sheet 3); and a gear down, maximum speed (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. See single engine flight capability discussion for additional information.

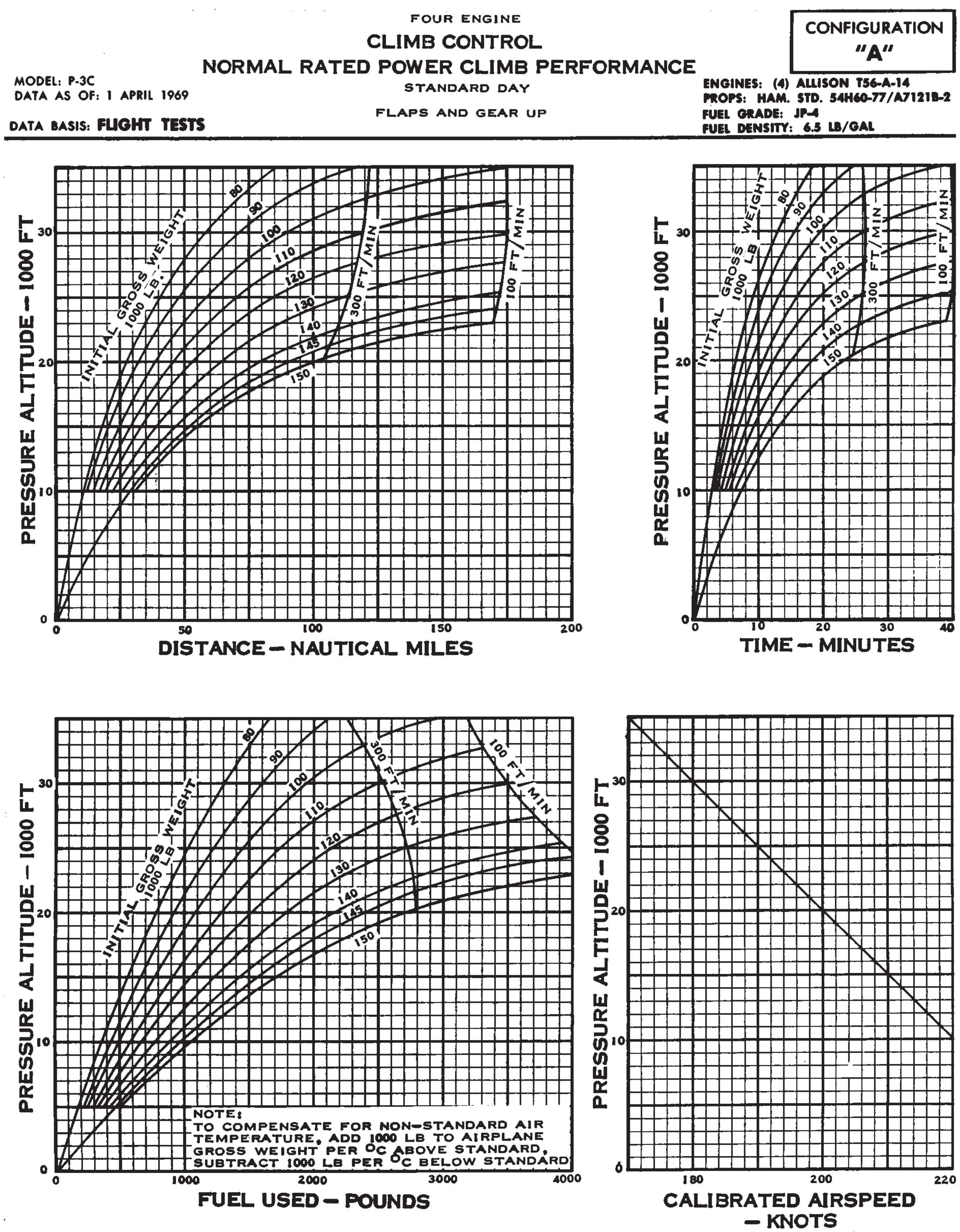


Figure 31-1. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration A

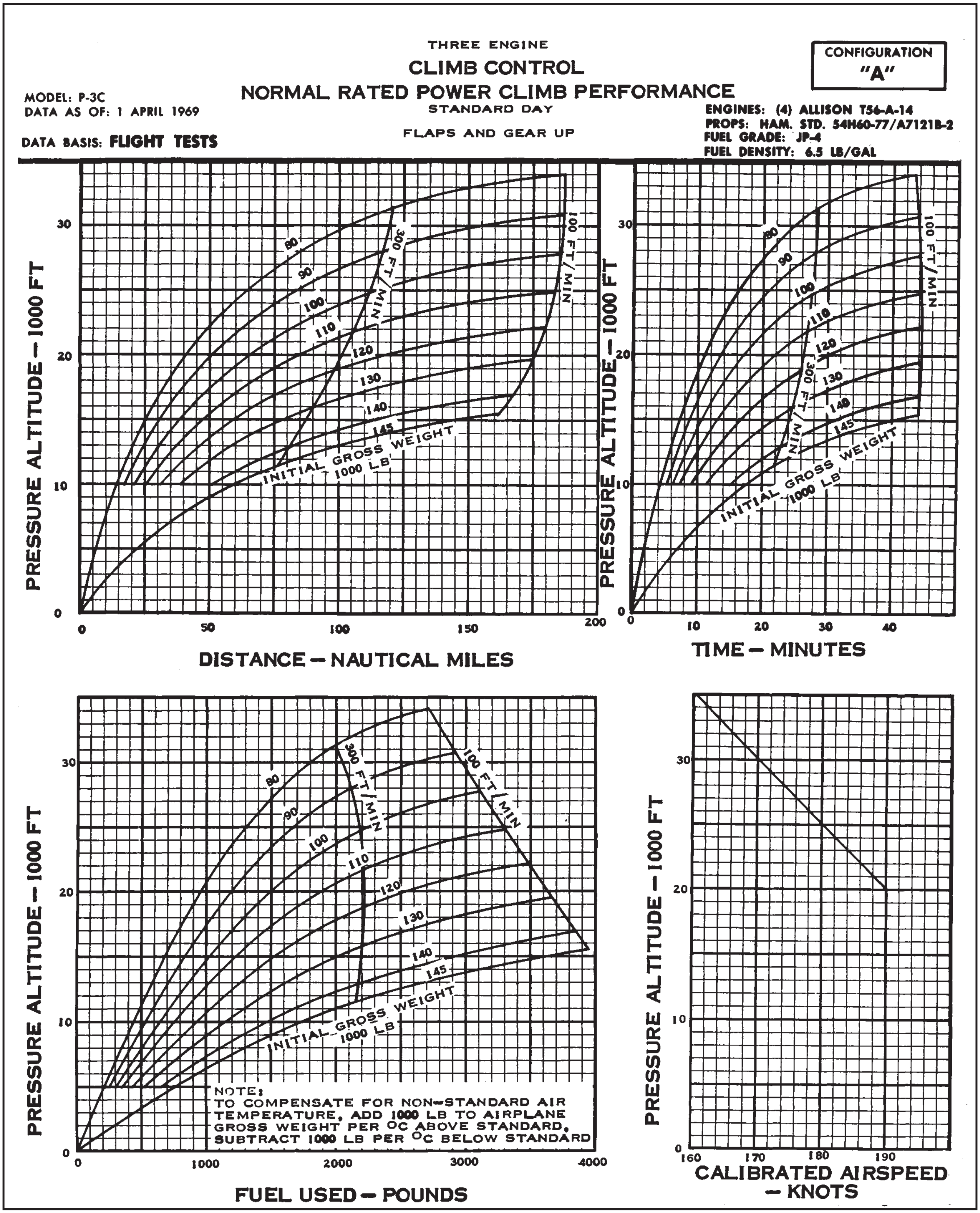


Figure 31-2. Three-Engine Climb Control — Normal Rated Climb Performance — Configuration A

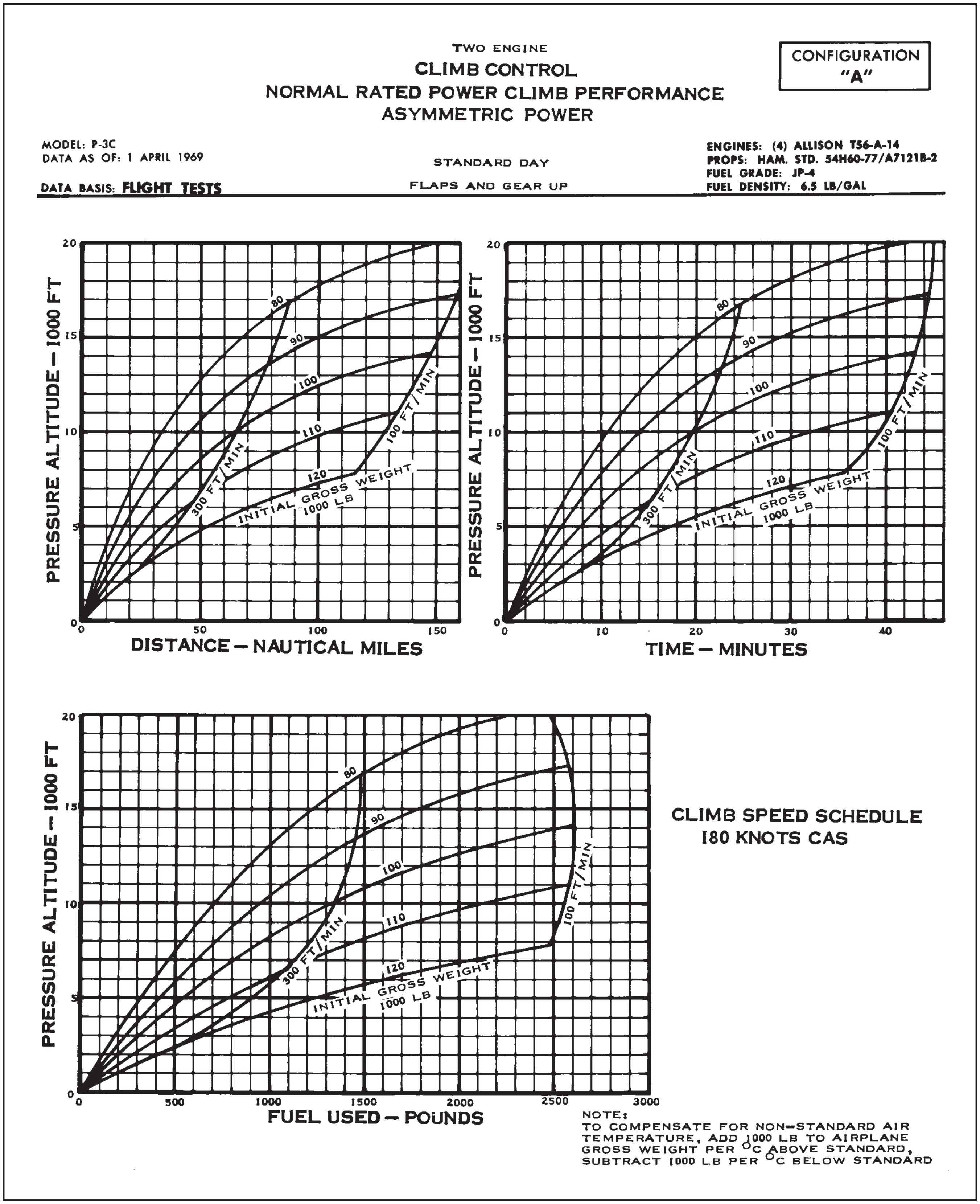


Figure 31-3. Two-Engine Climb Control — Normal Rated Power Climb — Asymmetric Power Performance — Configuration A

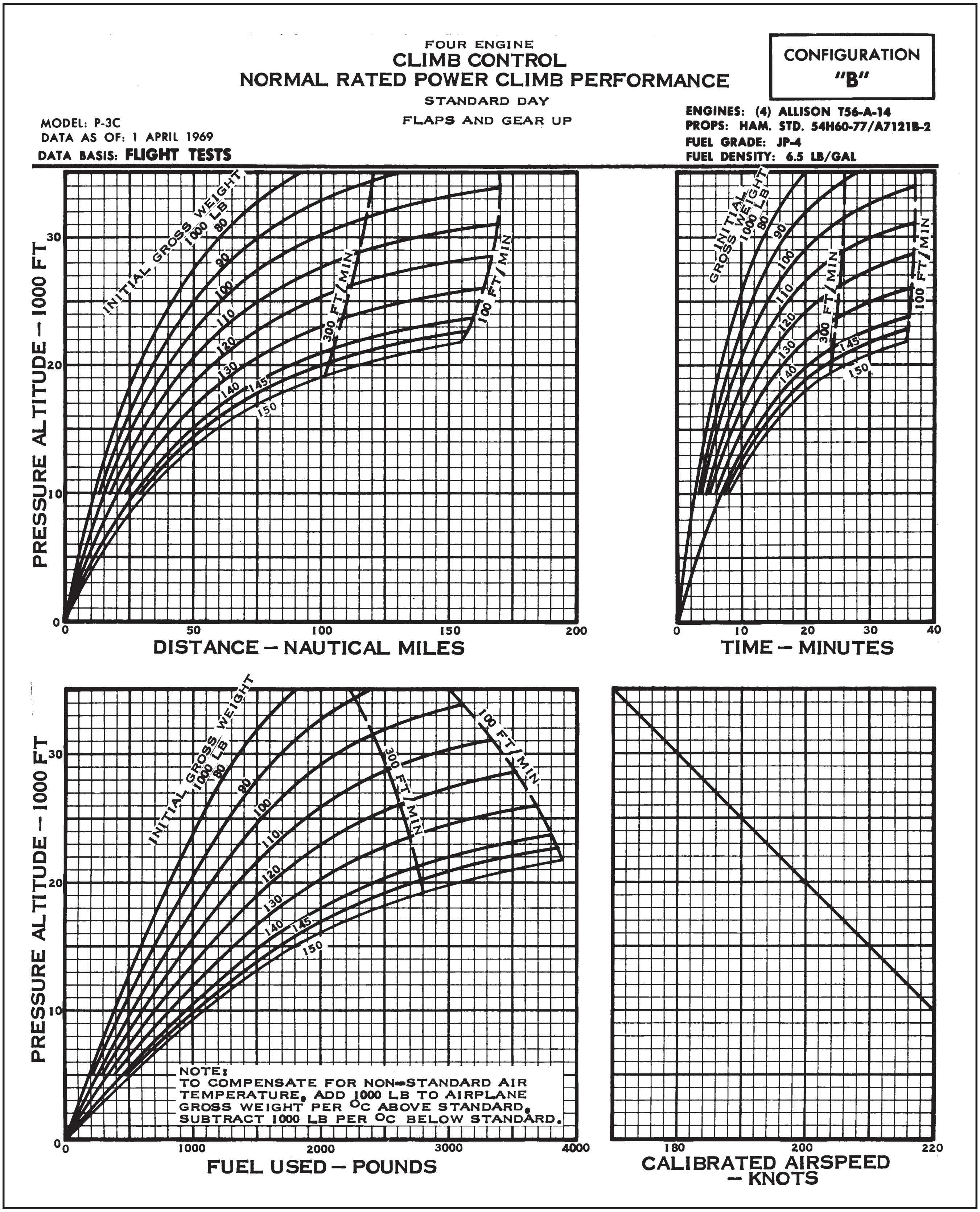


Figure 31-4. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration B

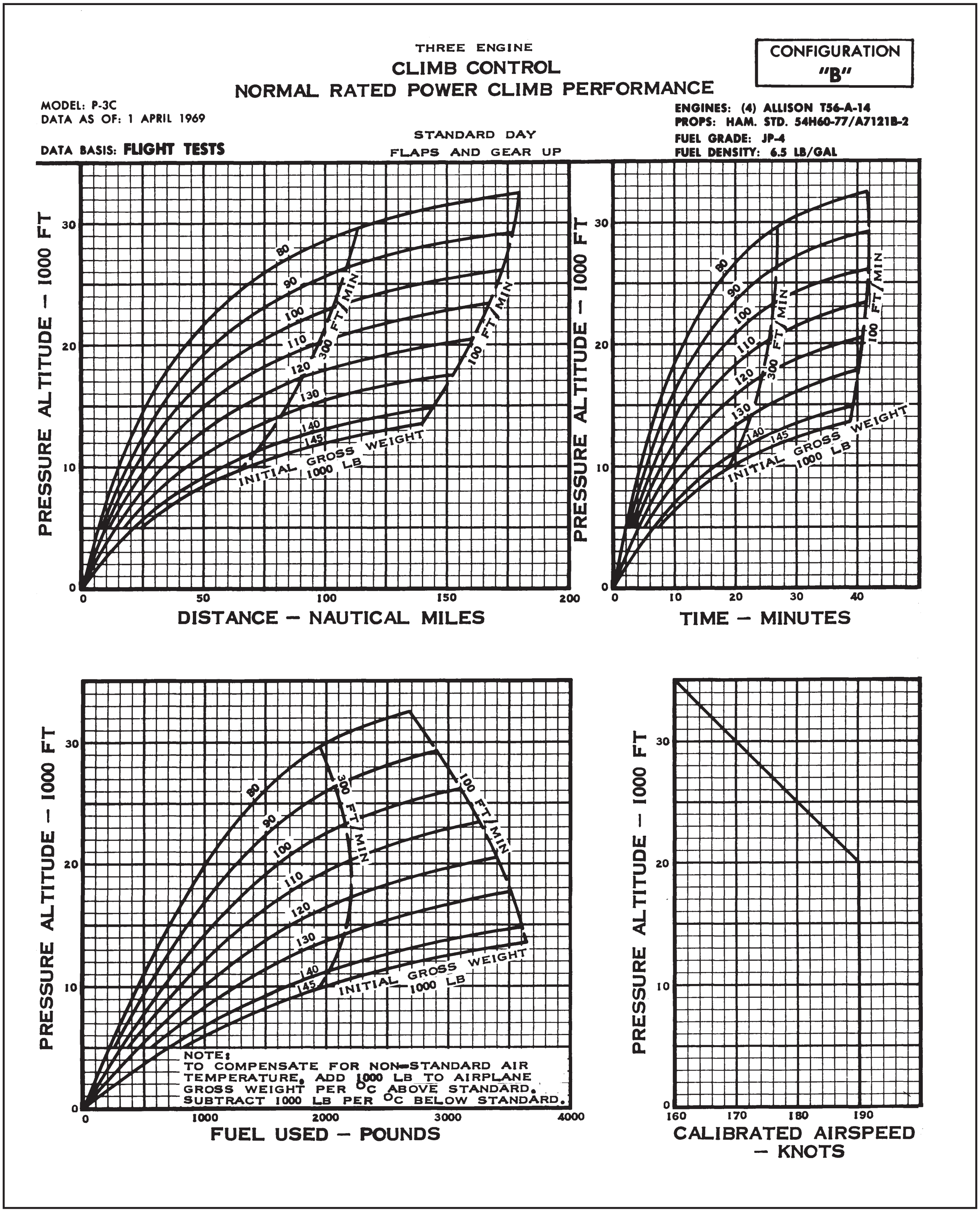


Figure 31-5. Three-Engine Climb Control — Normal Rated Power Climb Performance — Configuration B

TWO ENGINE
CLIMB CONTROL
NORMAL RATED POWER CLIMB PERFORMANCE
ASYMMETRIC POWER

CONFIGURATION "B"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

STANDARD DAY
FLAPS AND GEAR UP

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

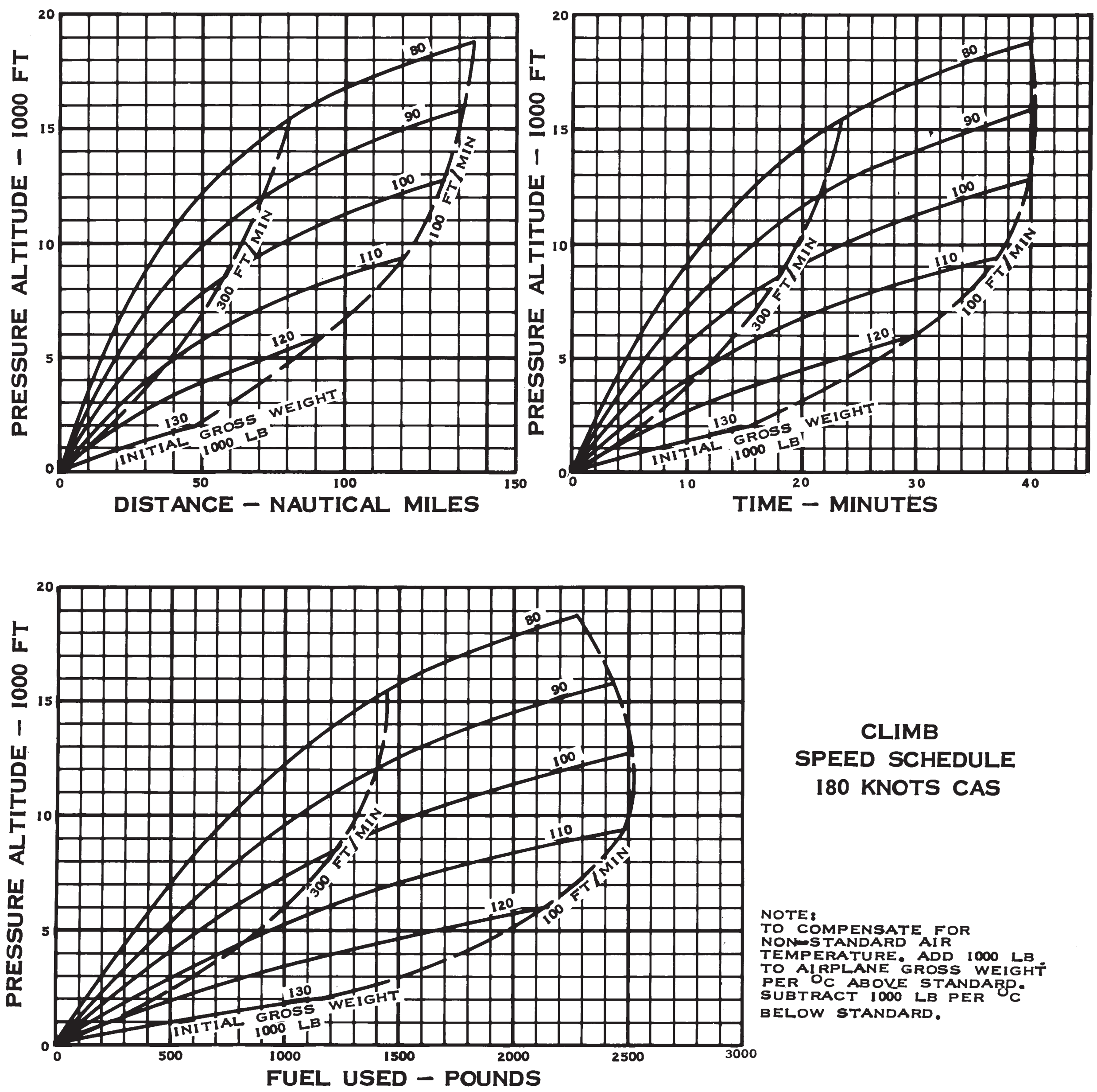


Figure 31-6. Two-Engine Climb Control — Normal Rated Power Climb — Asymmetric Power Performance — Configuration B

CONFIGURATION
"C"

FOUR ENGINE

CLIMB CONTROL

NORMAL RATED POWER CLIMB PERFORMANCE

STANDARD DAY

FLAPS AND GEAR UP

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

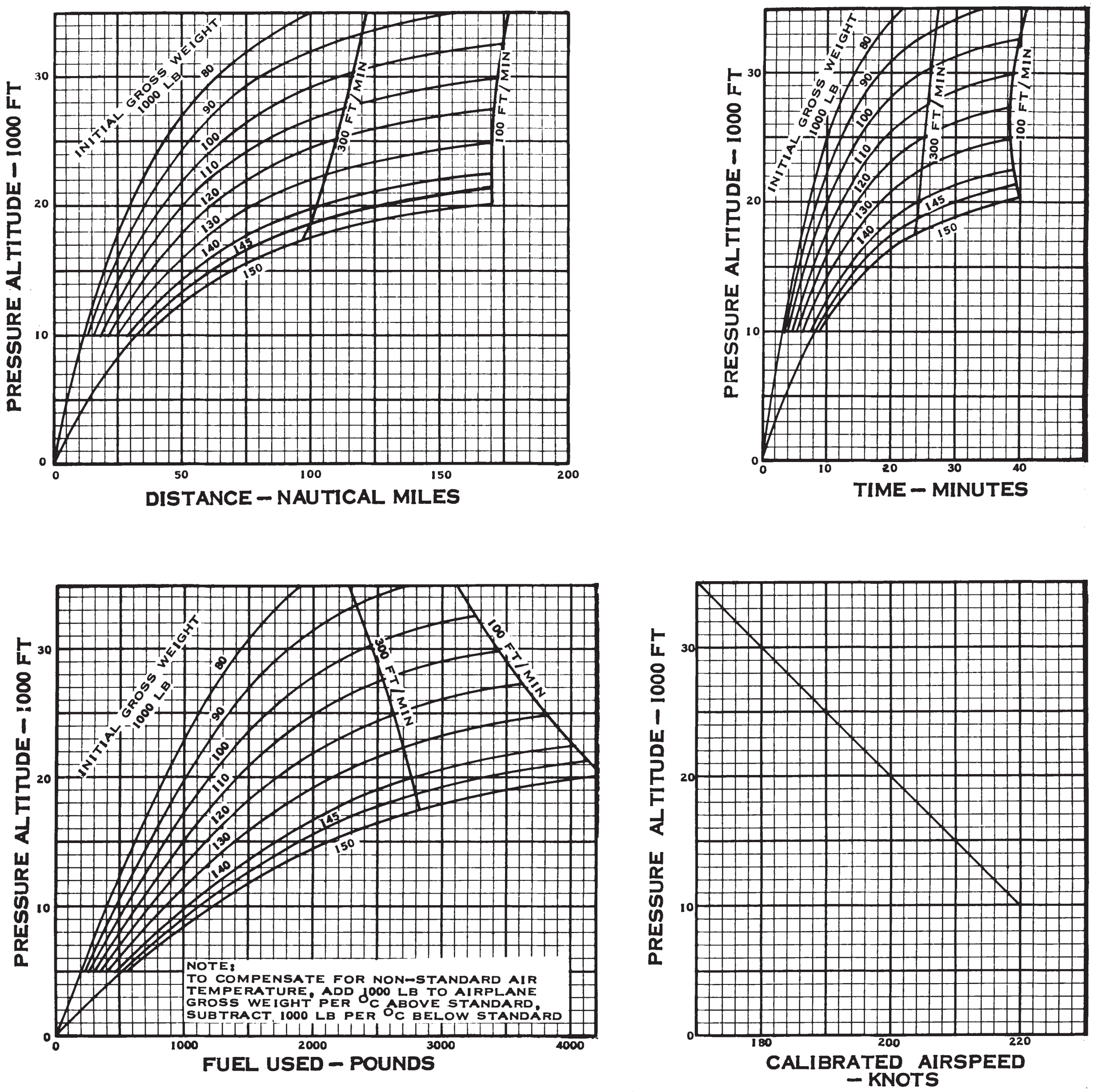


Figure 31-7. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration C

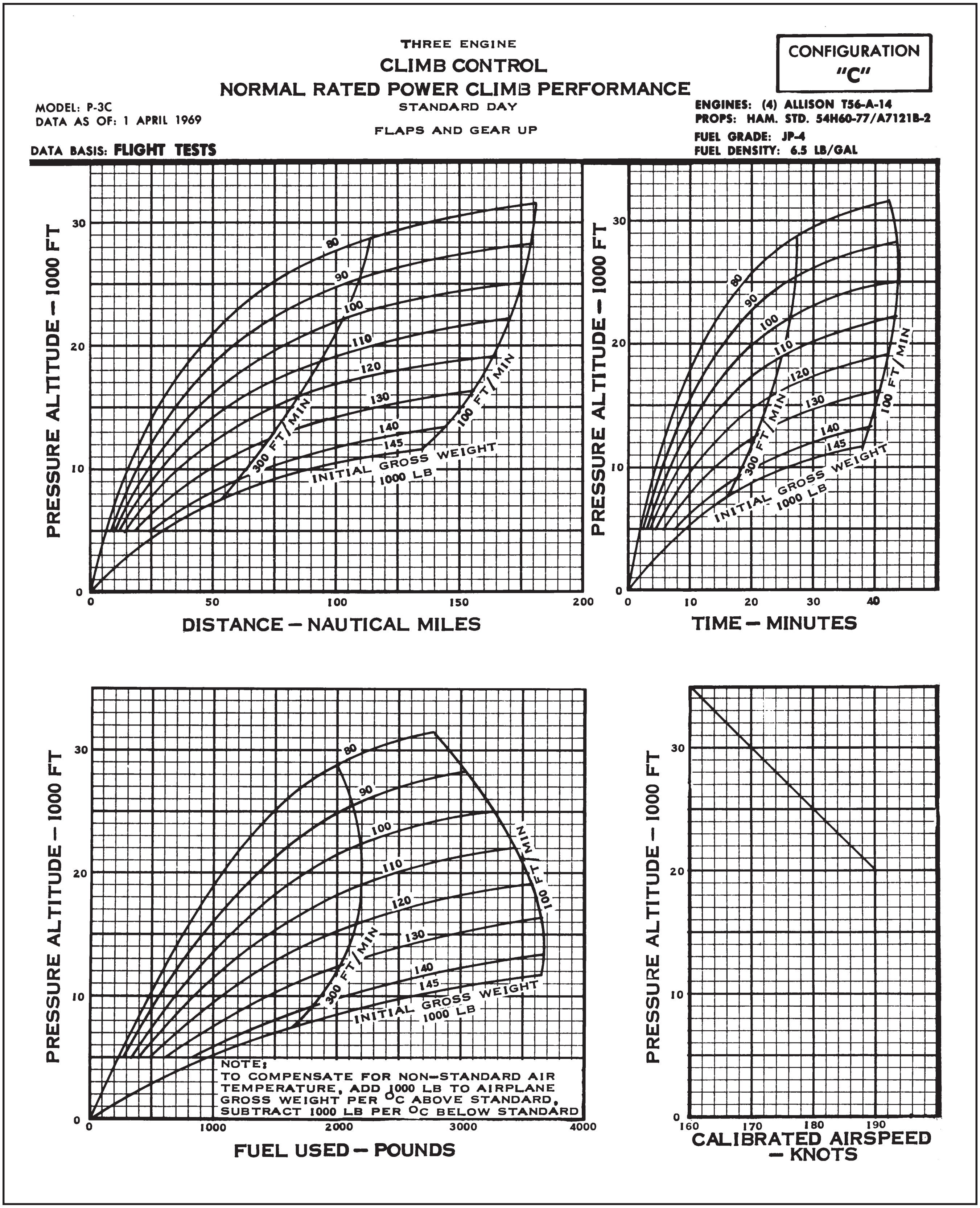


Figure 31-8. Three-Engine Climb Control — Normal Rated Power Climb Performance — Configuration C

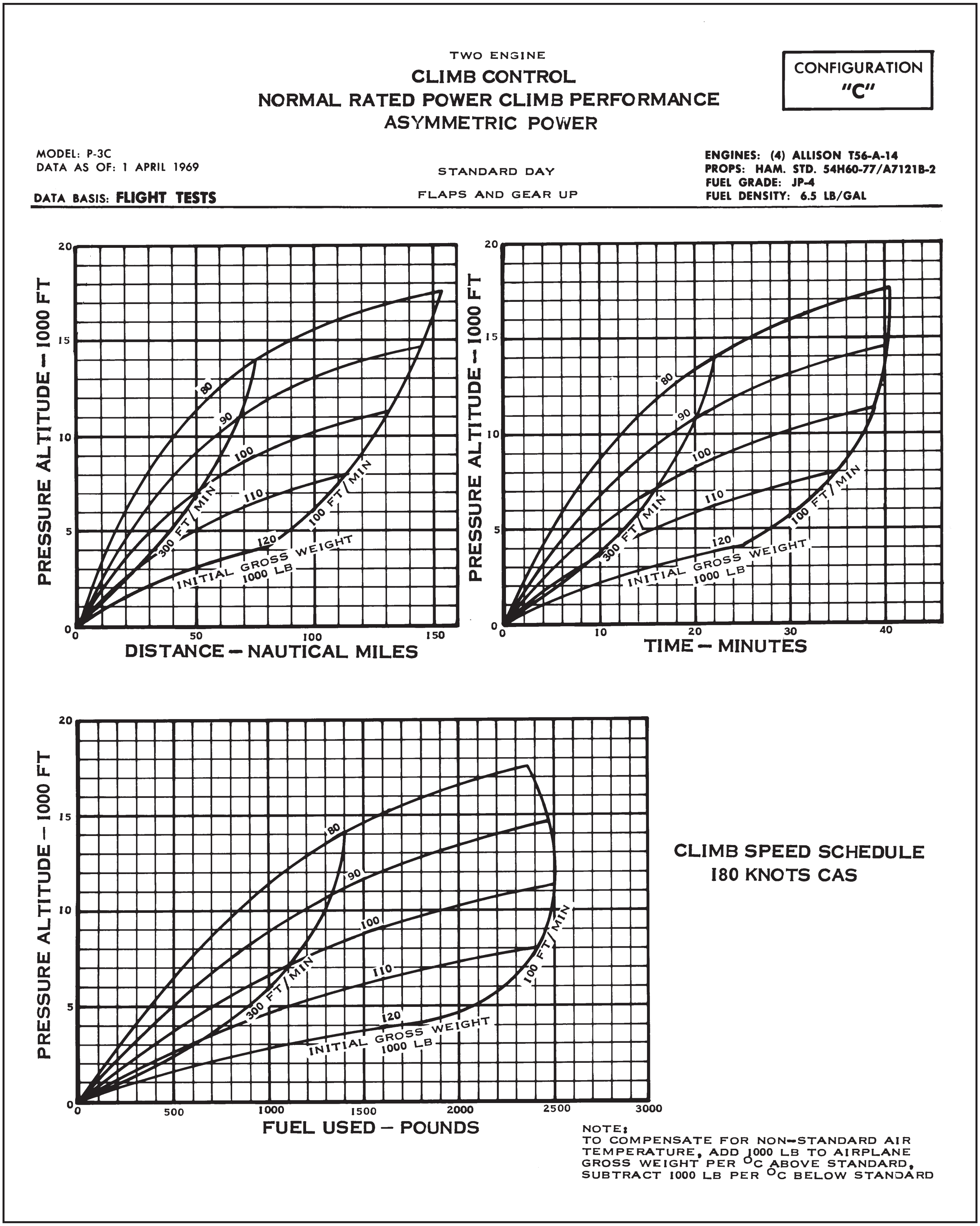


Figure 31-9. Two-Engine Climb Control — Normal Rated Power Climb Performance — Asymmetric Power — Configuration C

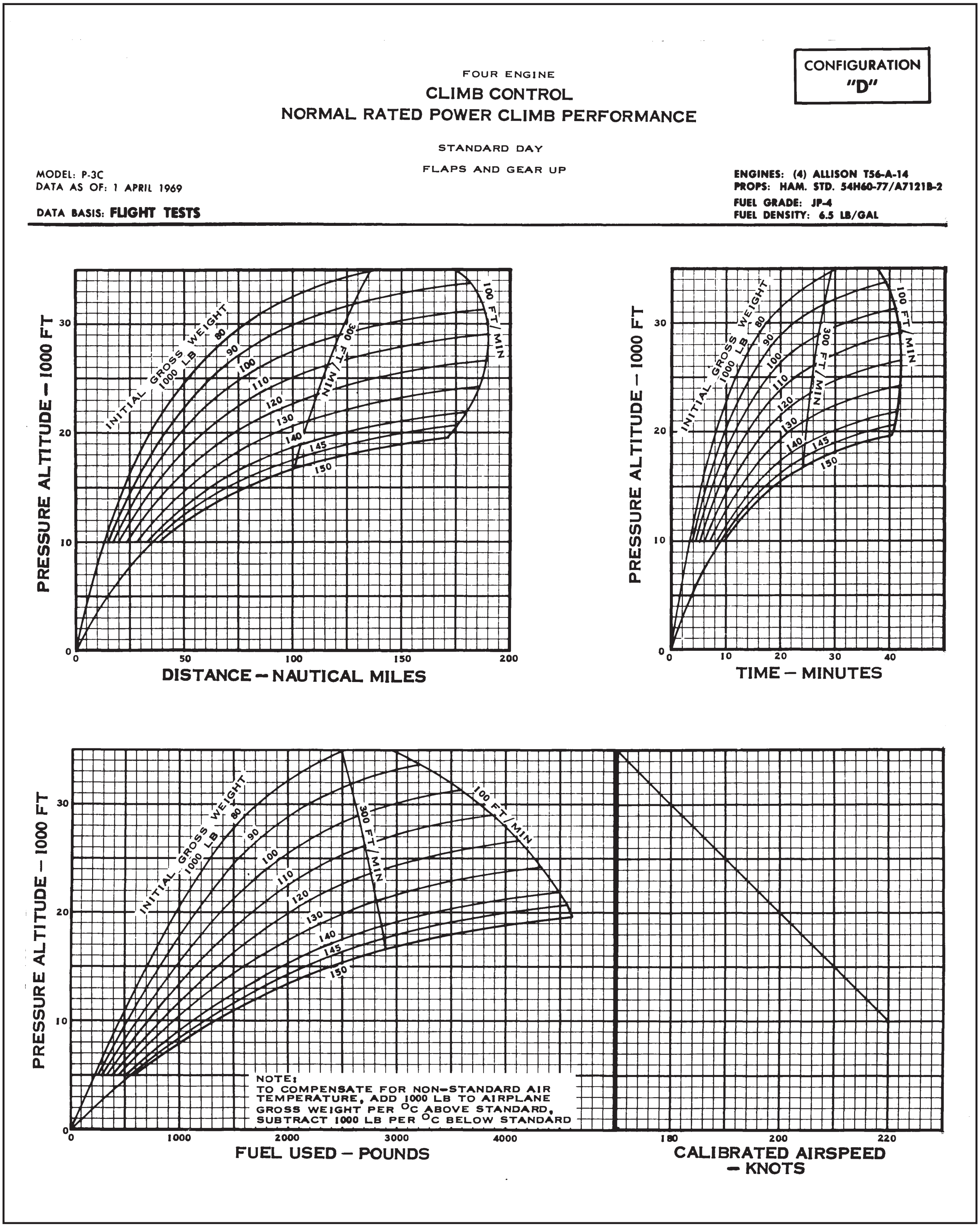


Figure 31-10. Four-Engine Control — Normal Rated Power Climb Performance — Configuration D

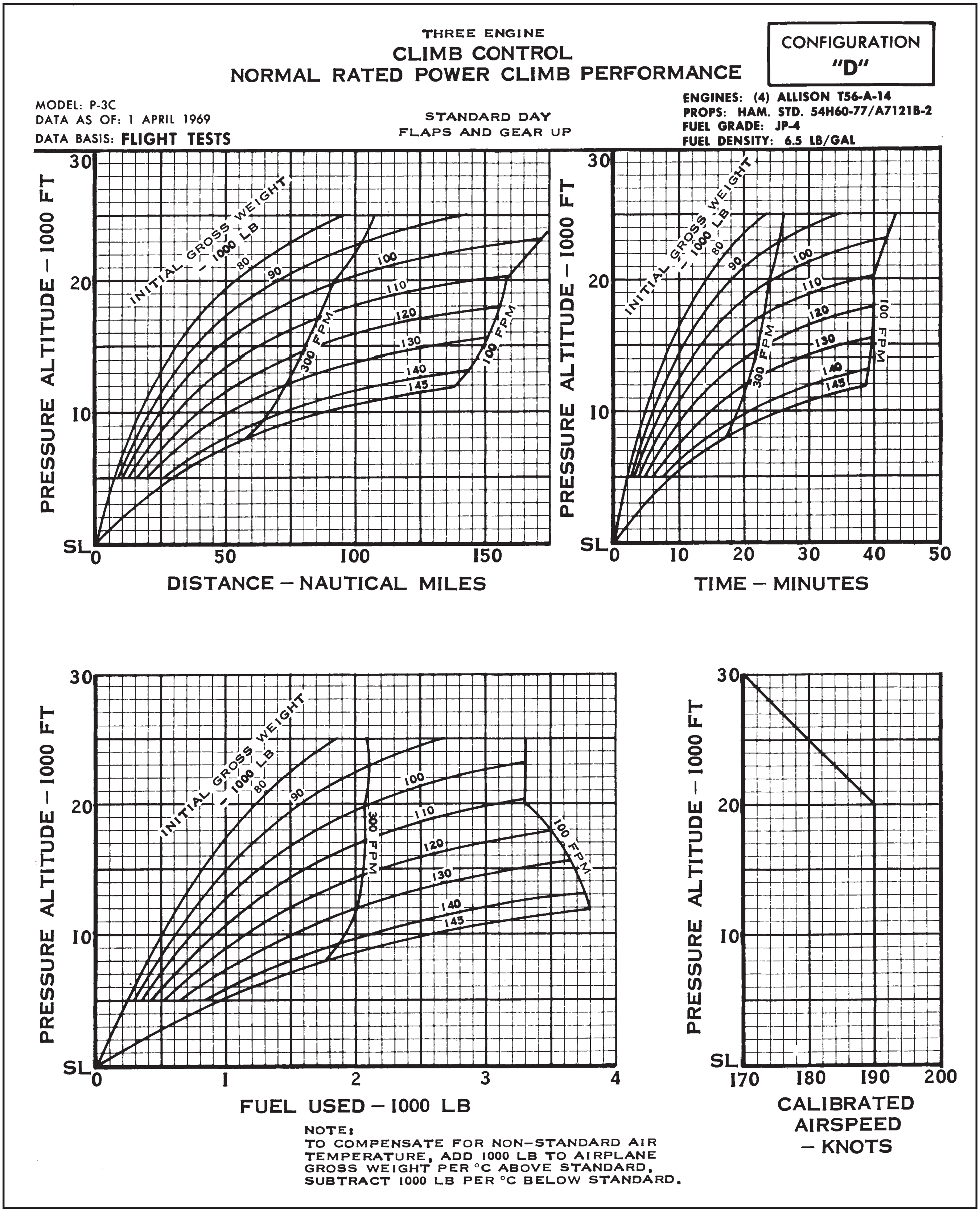


Figure 31-11. Three-Engine Climb Control — Normal Rated Power Climb Performance — Configuration D

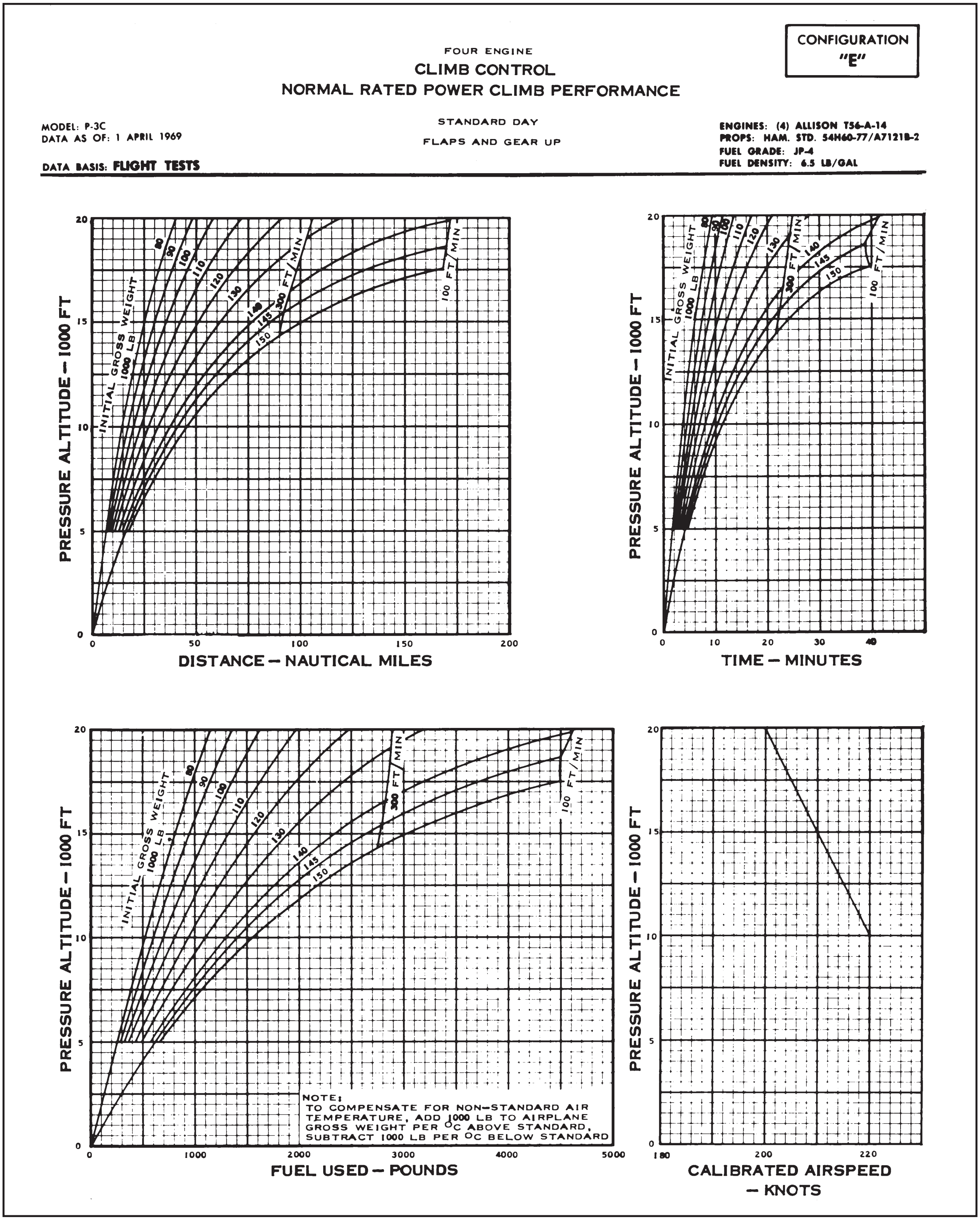


Figure 31-12. Four-Engine Climb Control — Normal Rated Power Climb Performance — Configuration E

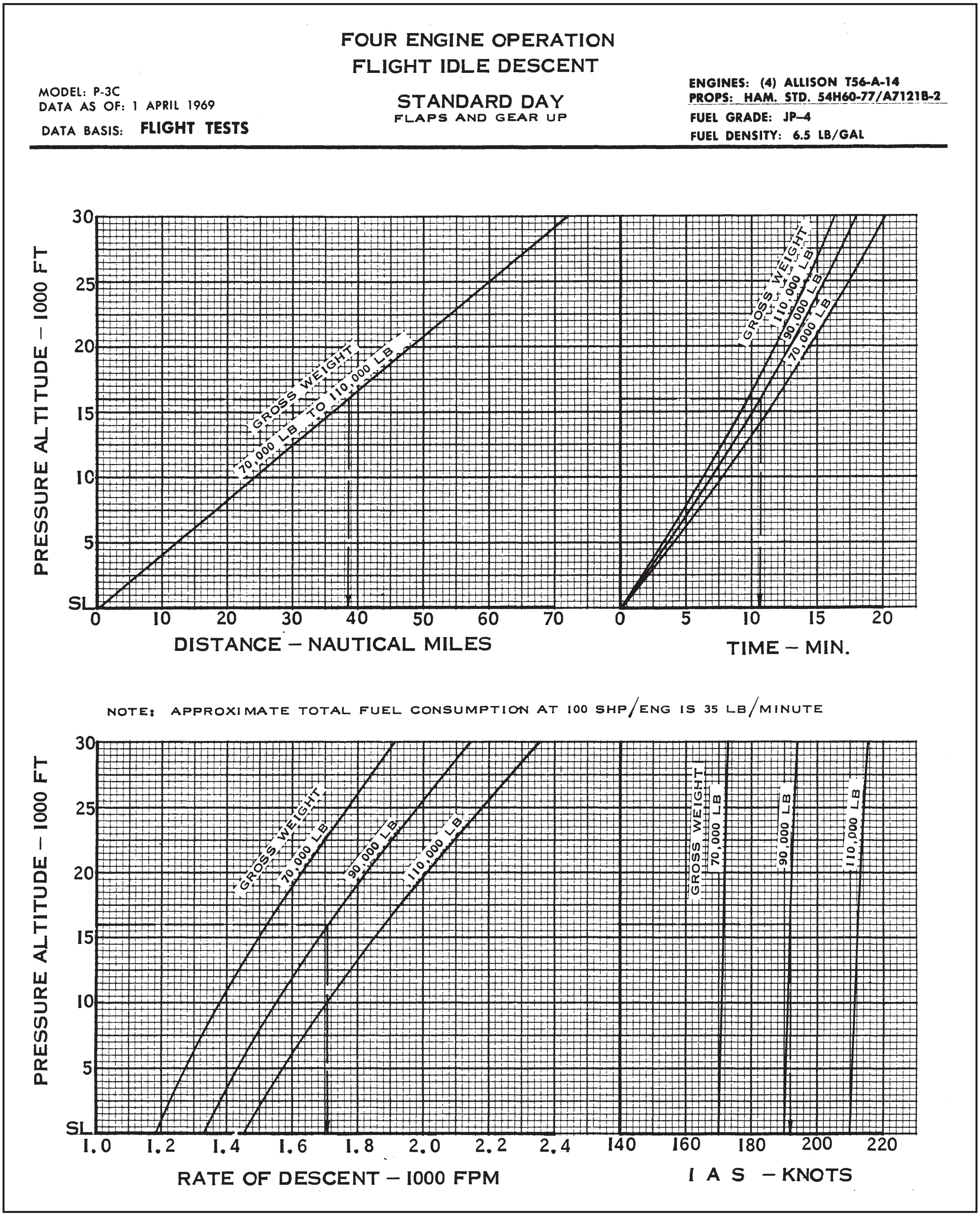


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 1 of 4)

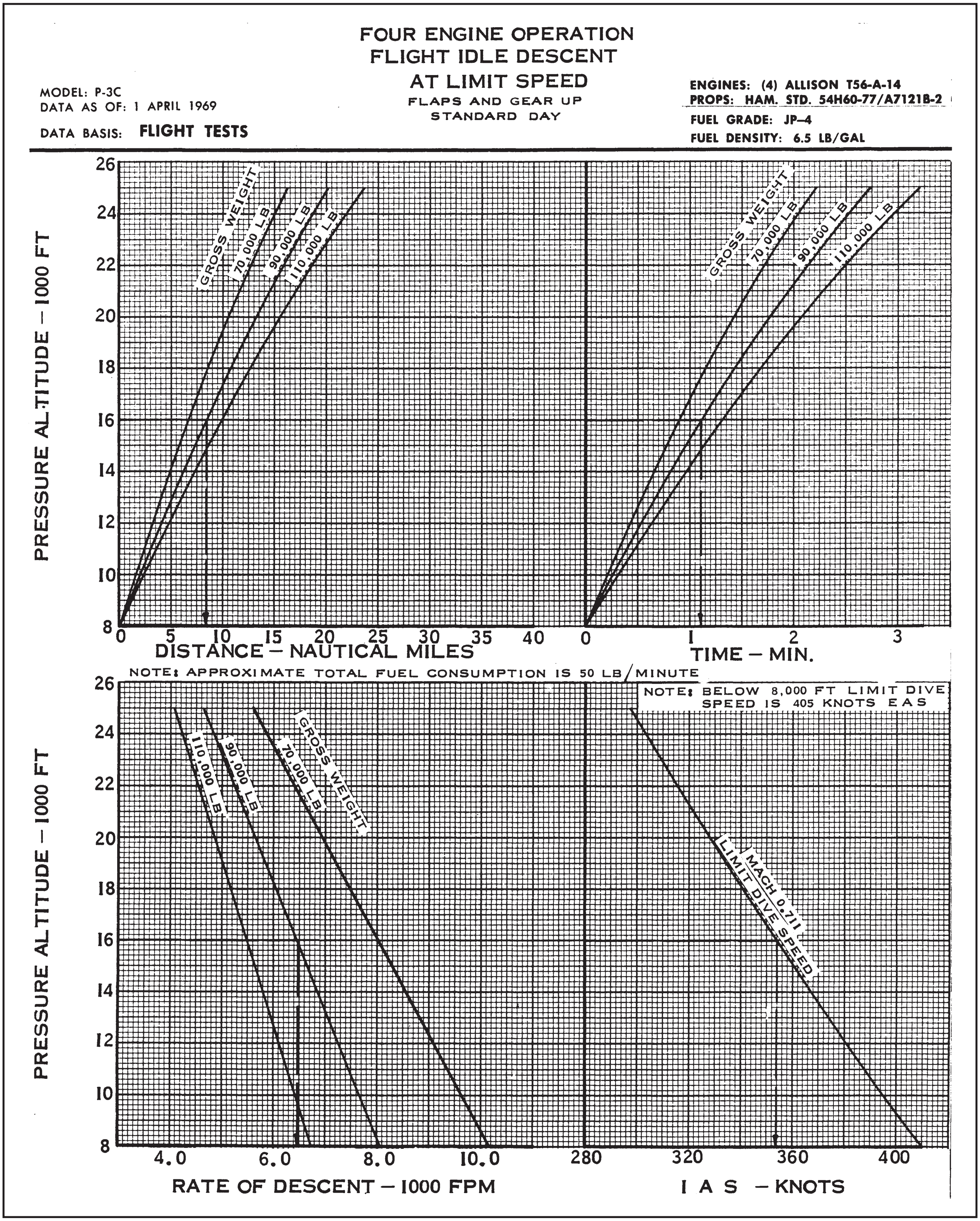


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 2 of 4)

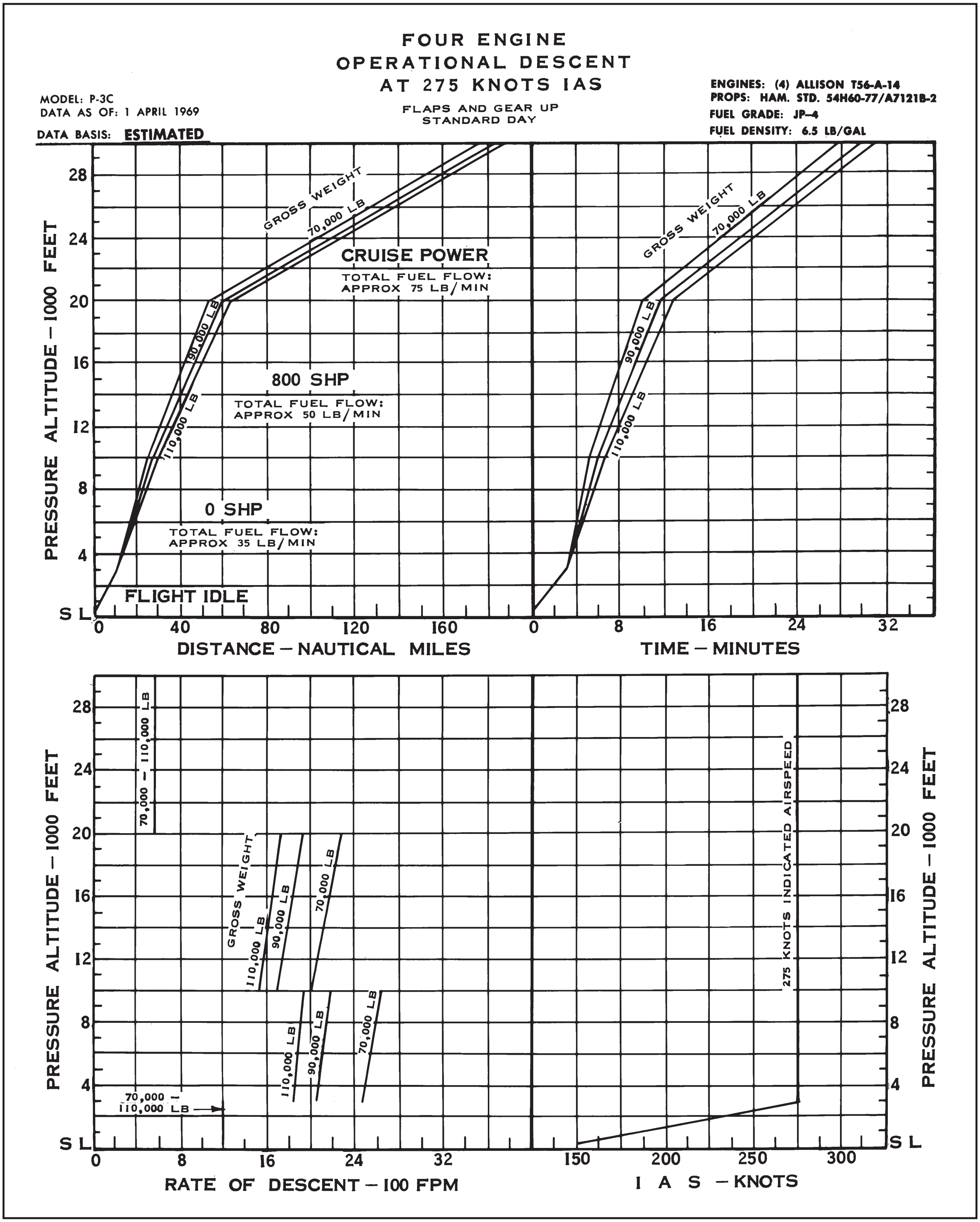


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 3 of 4)

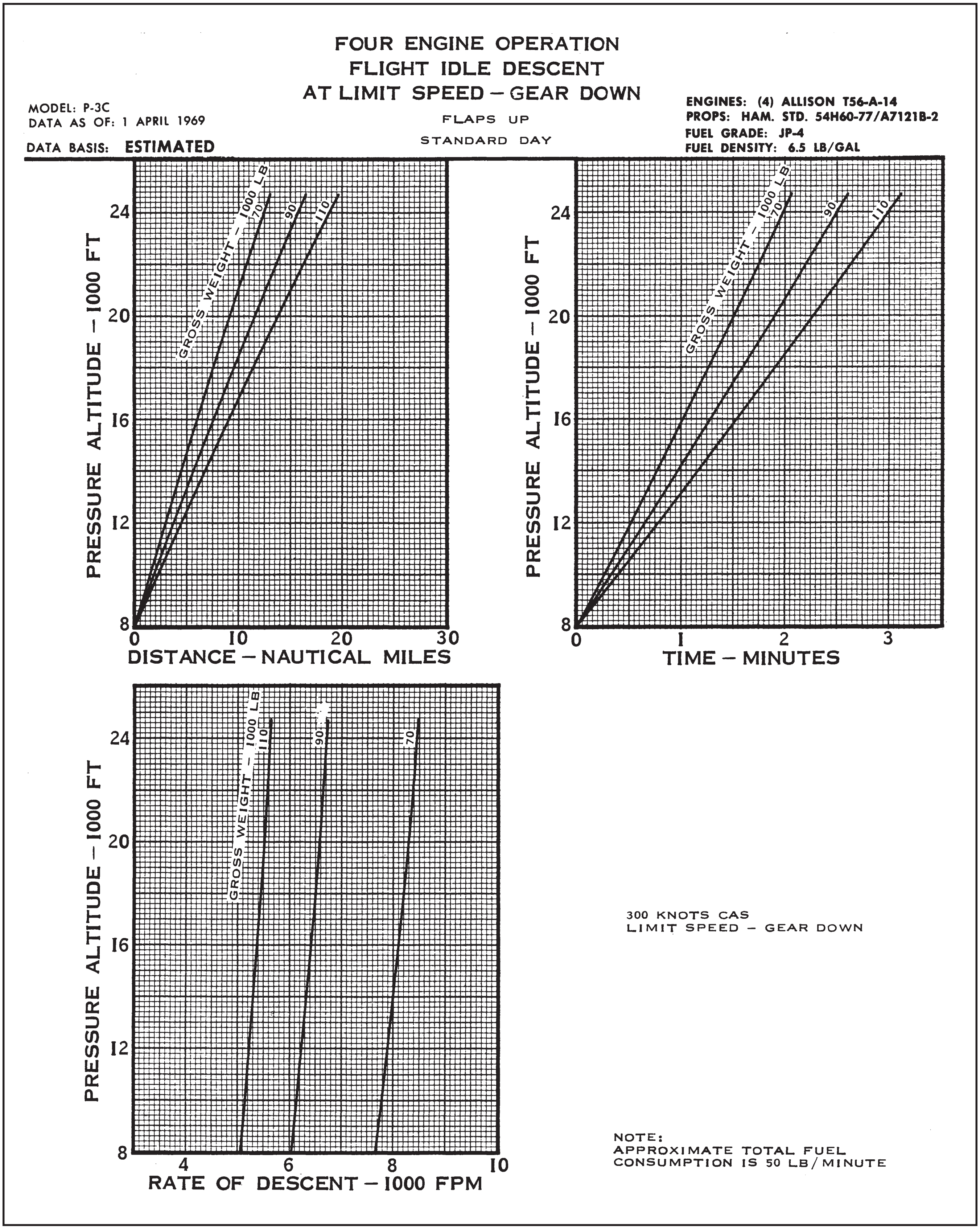


Figure 31-13. Four-Engine Operation — Flight Idle Descent (Sheet 4 of 4)

ESTIMATED SINGLE ENGINE PERFORMANCE AT LOITER SPEEDS

1000 FEET PRESSURE ALTITUDE

CONFIGURATION "B"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

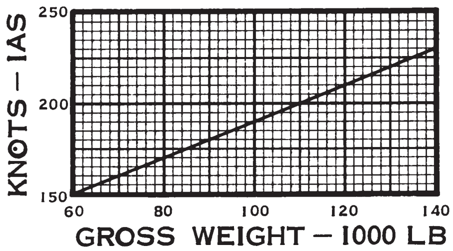
DATA BASIS: **ESTIMATED**

STANDARD DAY

NORMAL RATED POWER

THREE PROPELLERS FEATHERED

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



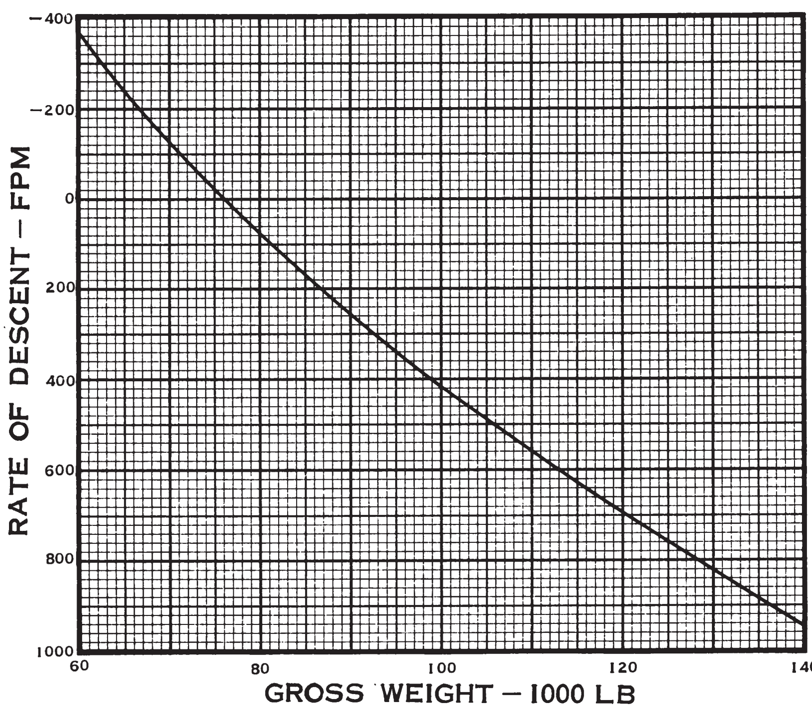


Figure 31-14. Estimated Single-Engine Performance at Loiter Speeds — 1,000-Foot Pressure Altitude — Configuration B

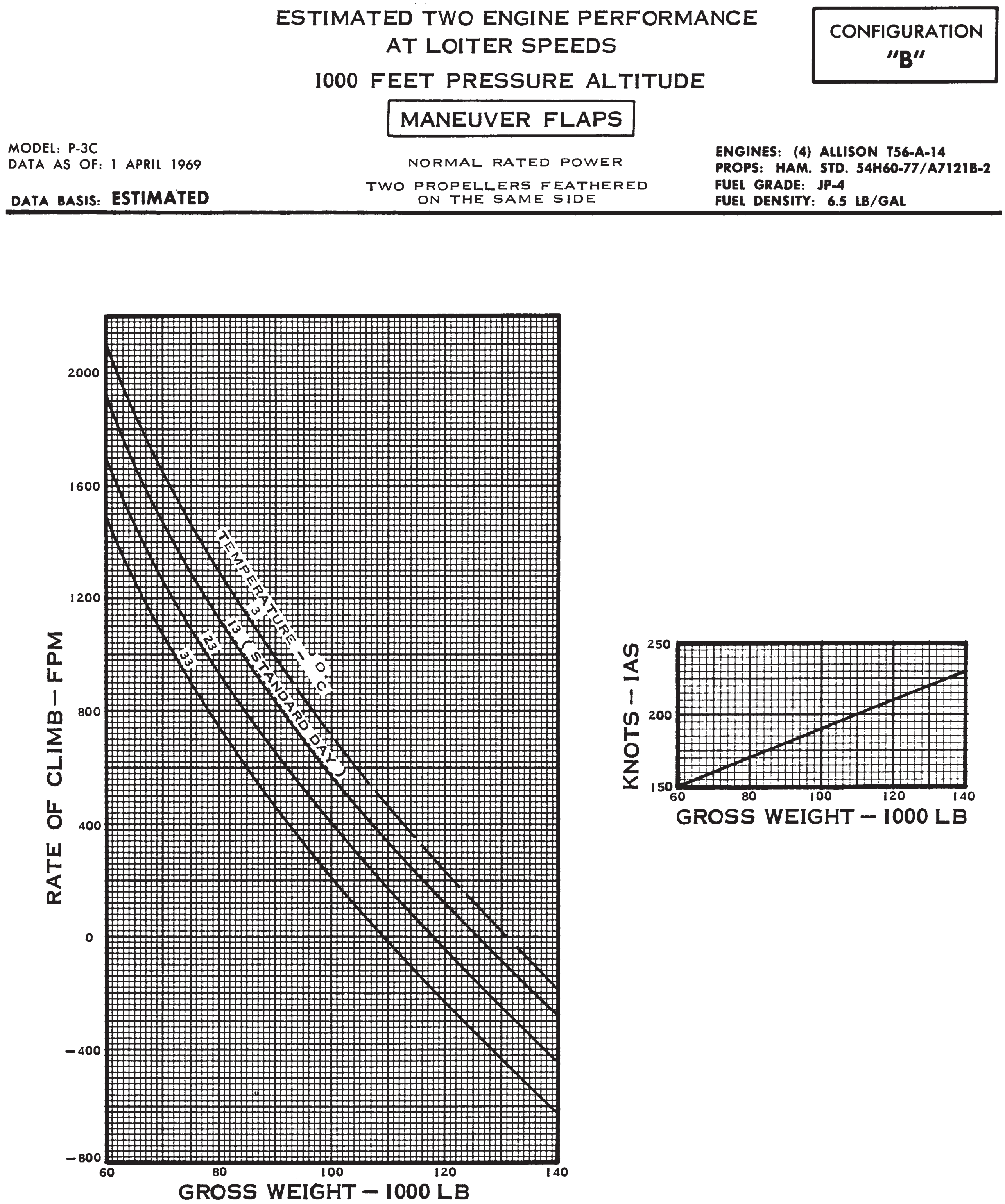


Figure 31-15. Estimated Two-Engine Performance at Loiter Speeds — 1,000-Foot Pressure Altitude — Configuration B (Sheet 1 of 2)

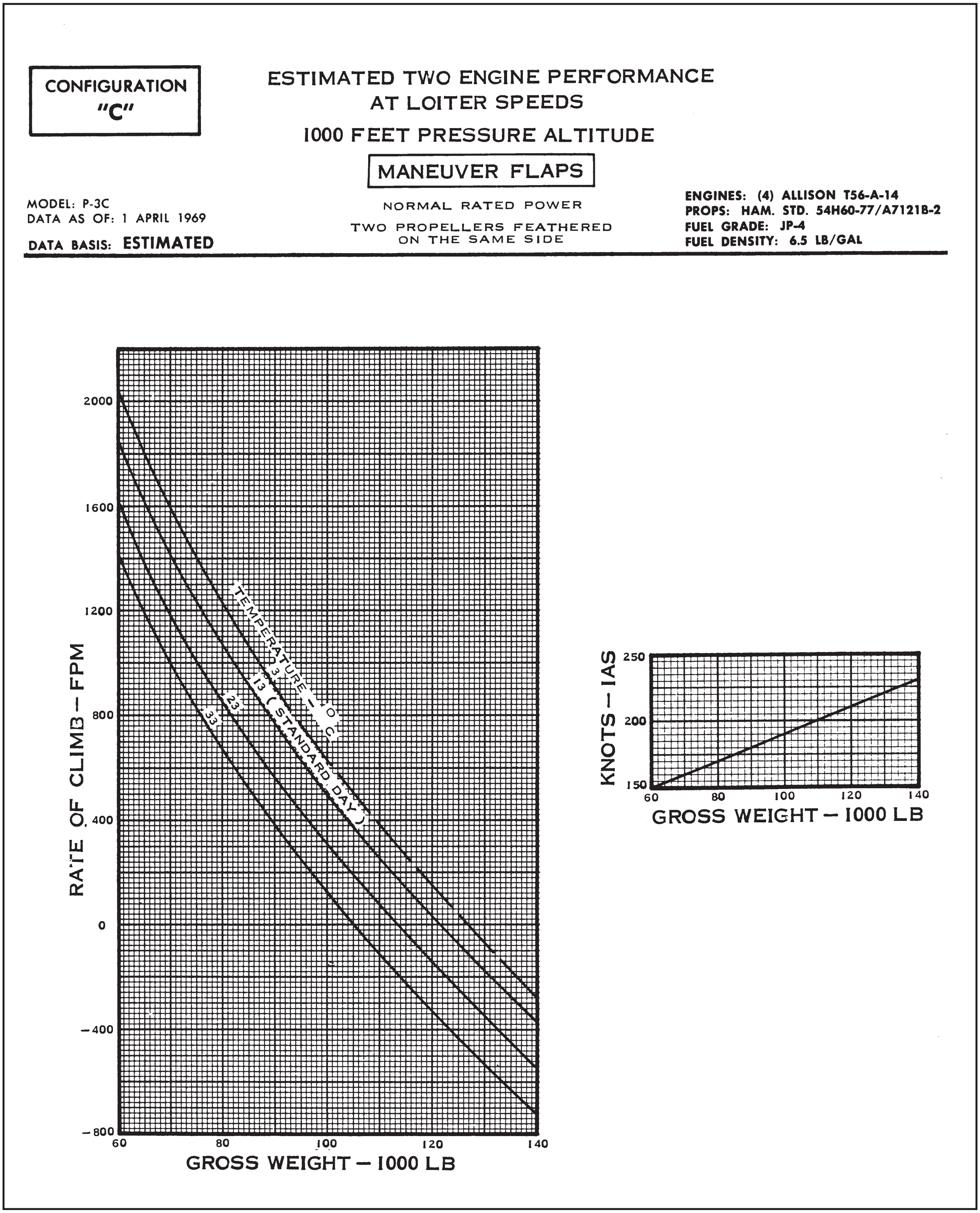


Figure 31-15. Estimated Two-Engine Performance at Loiter Speeds — 1,000-Foot Pressure Altitude — Configuration C (Sheet 2 of 2)

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 supplies 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.

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-14 through FO-25) 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 the following table (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

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 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. (See Figure 32-1.)

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 32-1. Wind Factor Table

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.

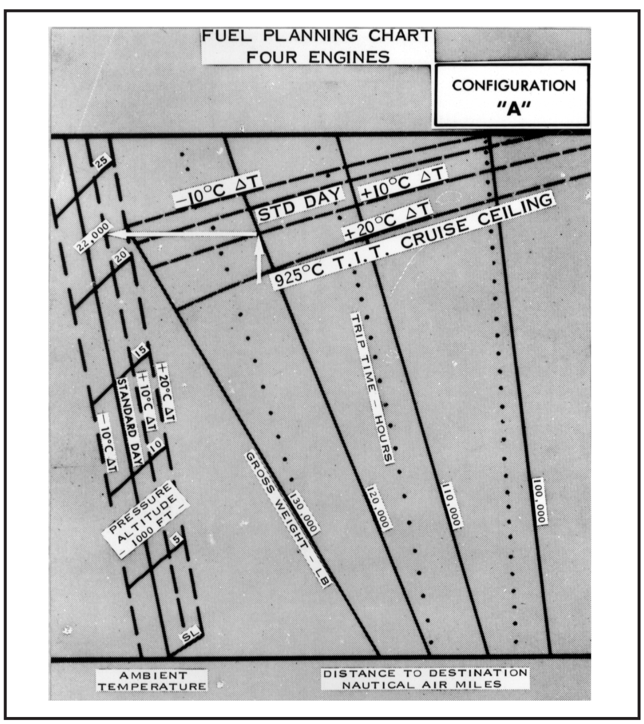
2. Four knots/1,000-foot maximum wind increase near the 925 °C TIT cruise ceiling.

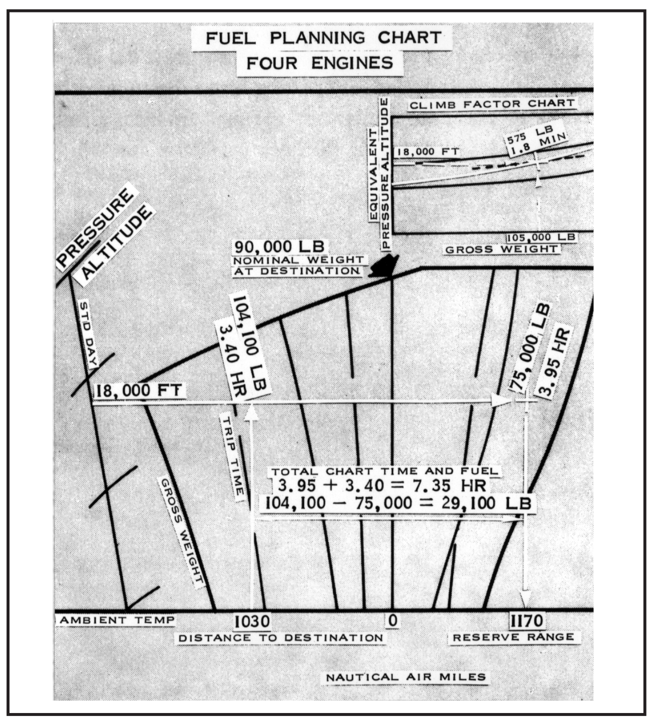
32.3.2 Use of Fuel Planning Charts.

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 ΔT and level-off gross weight are known, find intersection of gross weight and cruise ceiling ΔT lines. Proceed left and locate the intersection of ΔT and pressure altitude on the pressure altitude chart. For example, with drag count configuration A, four-engine operation, 925 °C TIT cruise ceiling; at ΔT = +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 × average true airspeed/average ground speed).

32.3.3 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).

32.3.4 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-17 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-17. Enter FO-17 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.

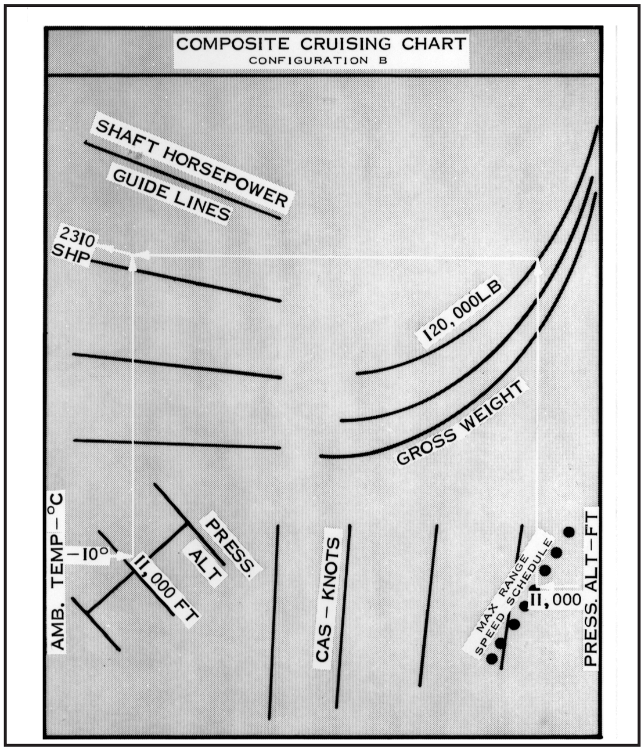
Chart time is 3.95 plus 3.40 hours, or 7.35 hours (7:21) and chart fuel is 104,100 minus 75,000, or 29,100 pounds. However, these values must be adjusted for greater time and fuel required during climb. The time and climb fuel factors for climb to 18,000 feet at an approximate takeoff weight of 105,000 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.

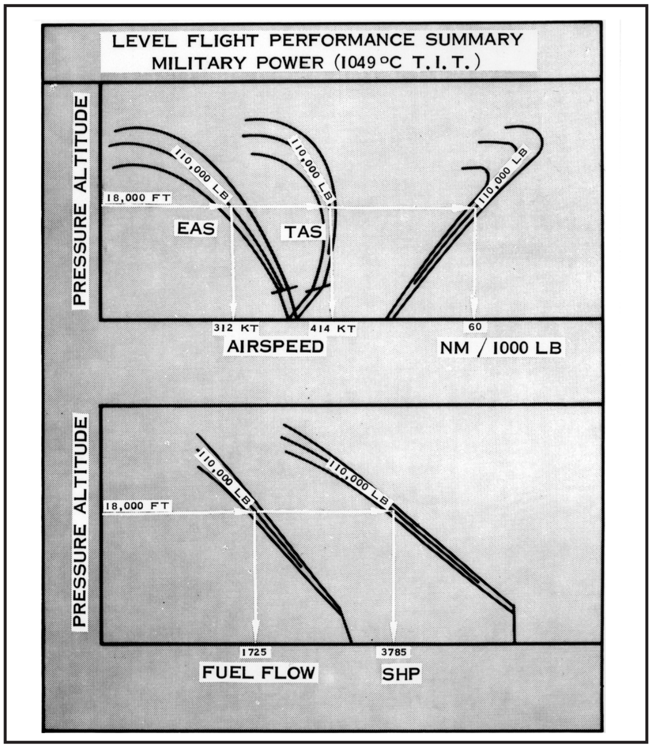
32.3.5 Return Fuel Planning. Aircraft malfunctions such as failure to pressurize, airframe damage, or engine failure, may limit return cruise altitude. Crews should plan return fuel accordingly. When operating over water, away from land, consider departing from the operating area based on three engines 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.

32.3.5.1 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-18 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. See Figures 32-2 and 32-3 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, ΔT 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 × 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. 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 32-6, 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 32-7, 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 32-8 through 32-12) 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 32-9, 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.

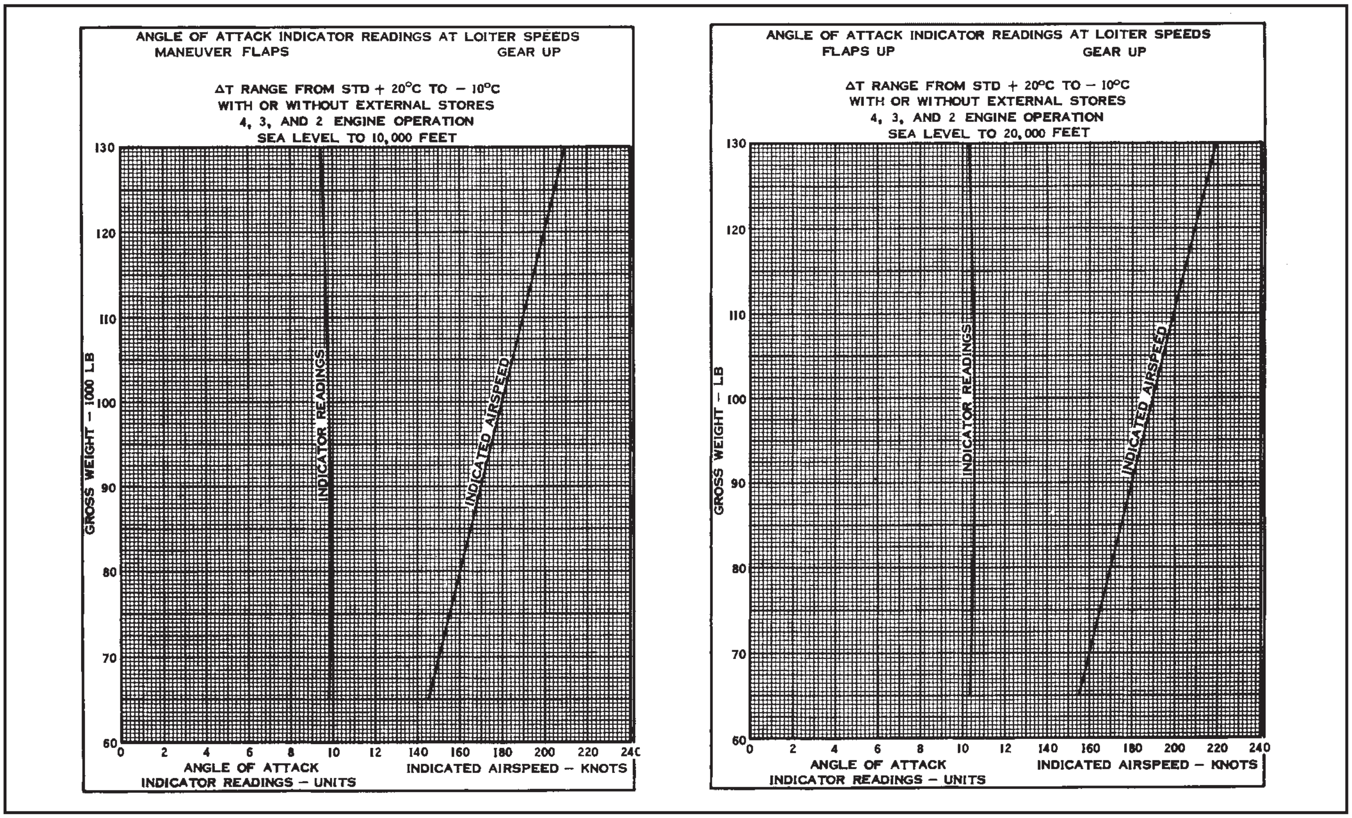


Figure 32-2. Angle-of-Attack Indicator Readings at Loiter Speeds

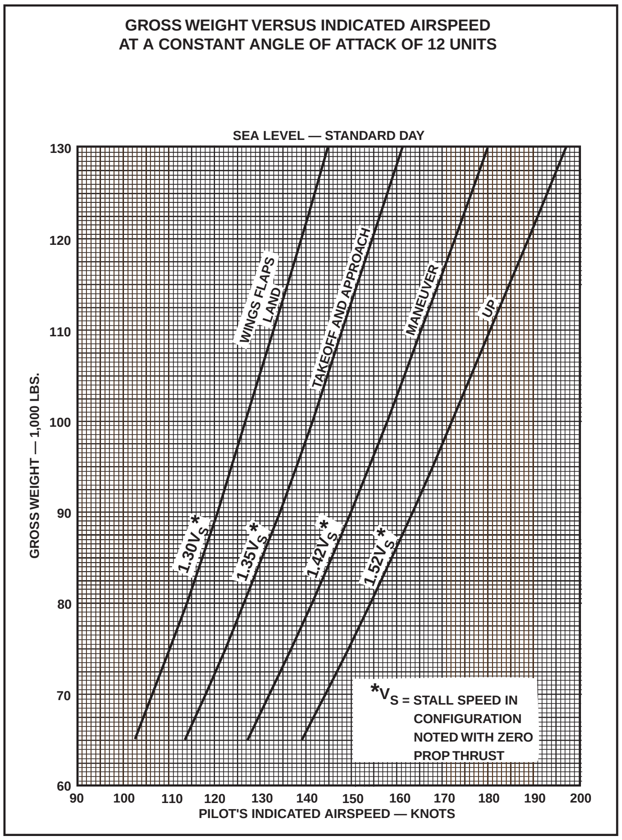


Figure 32-3. Gross Weight vs. Indicated Airspeed at a Constant Angle-of-Attack of 12 Units

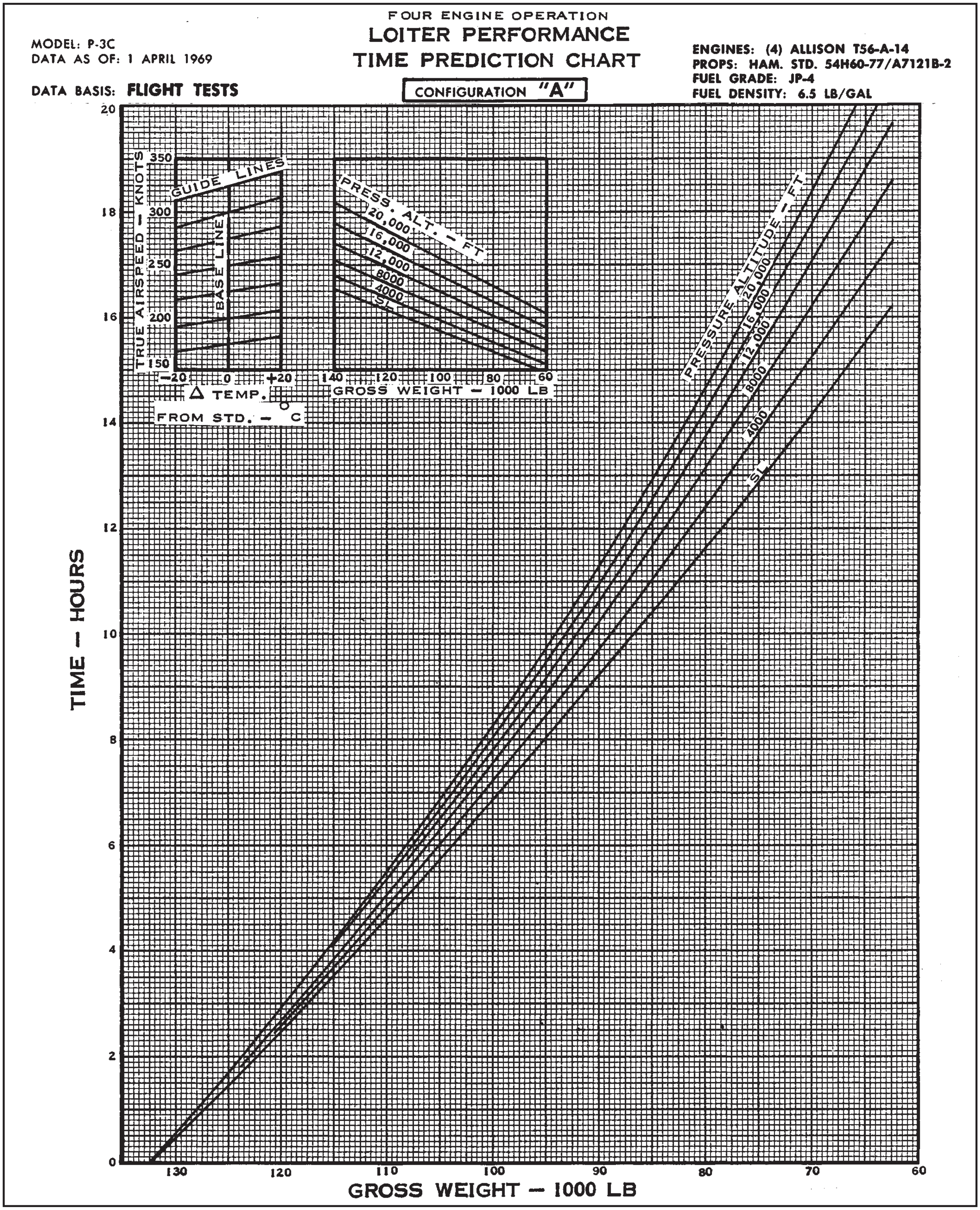


Figure 32-4. Loiter Performance Time Prediction — Configuration A (Sheet 1 of 3)

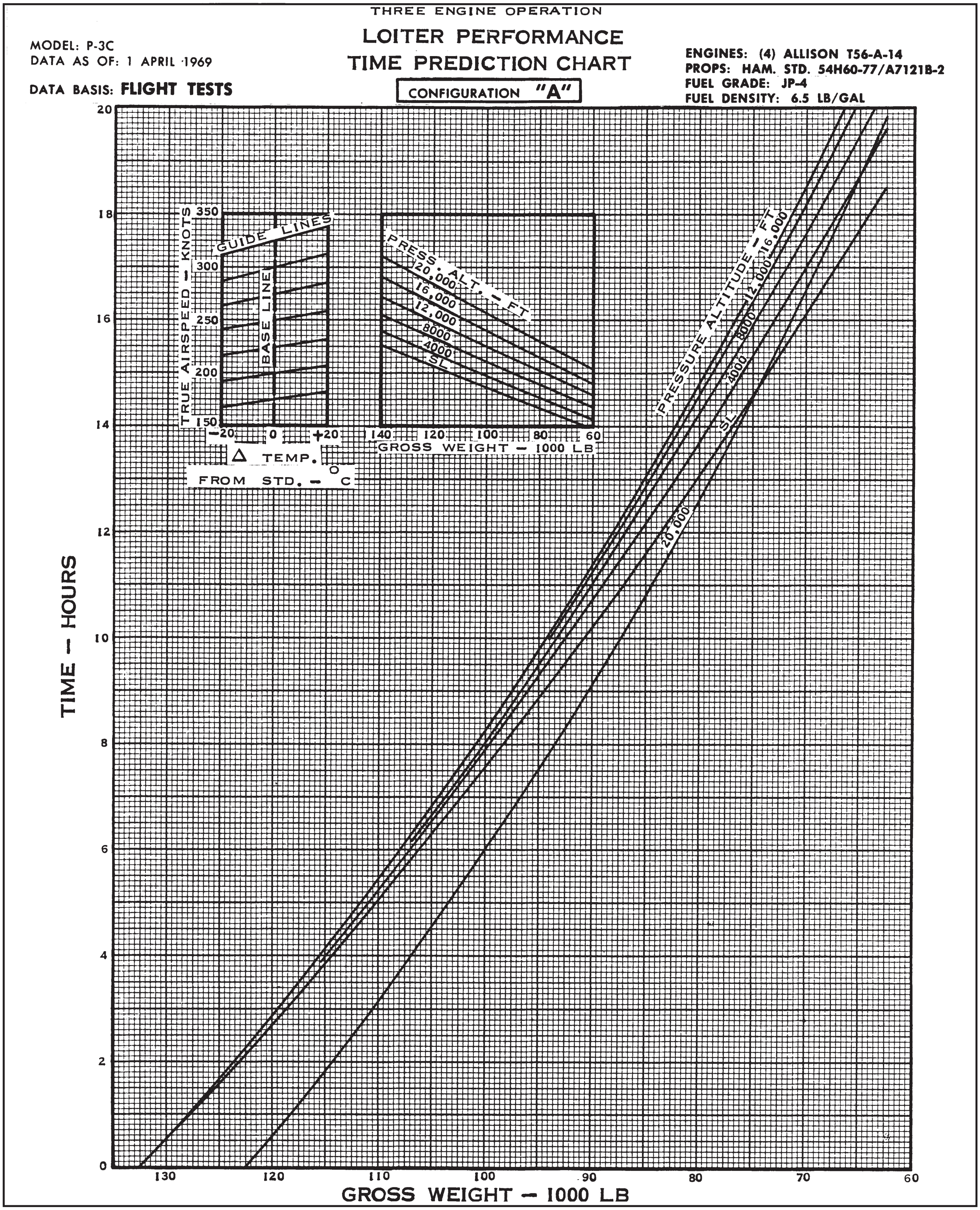


Figure 32-4. Loiter Performance Time Prediction — Configuration A (Sheet 2 of 3)

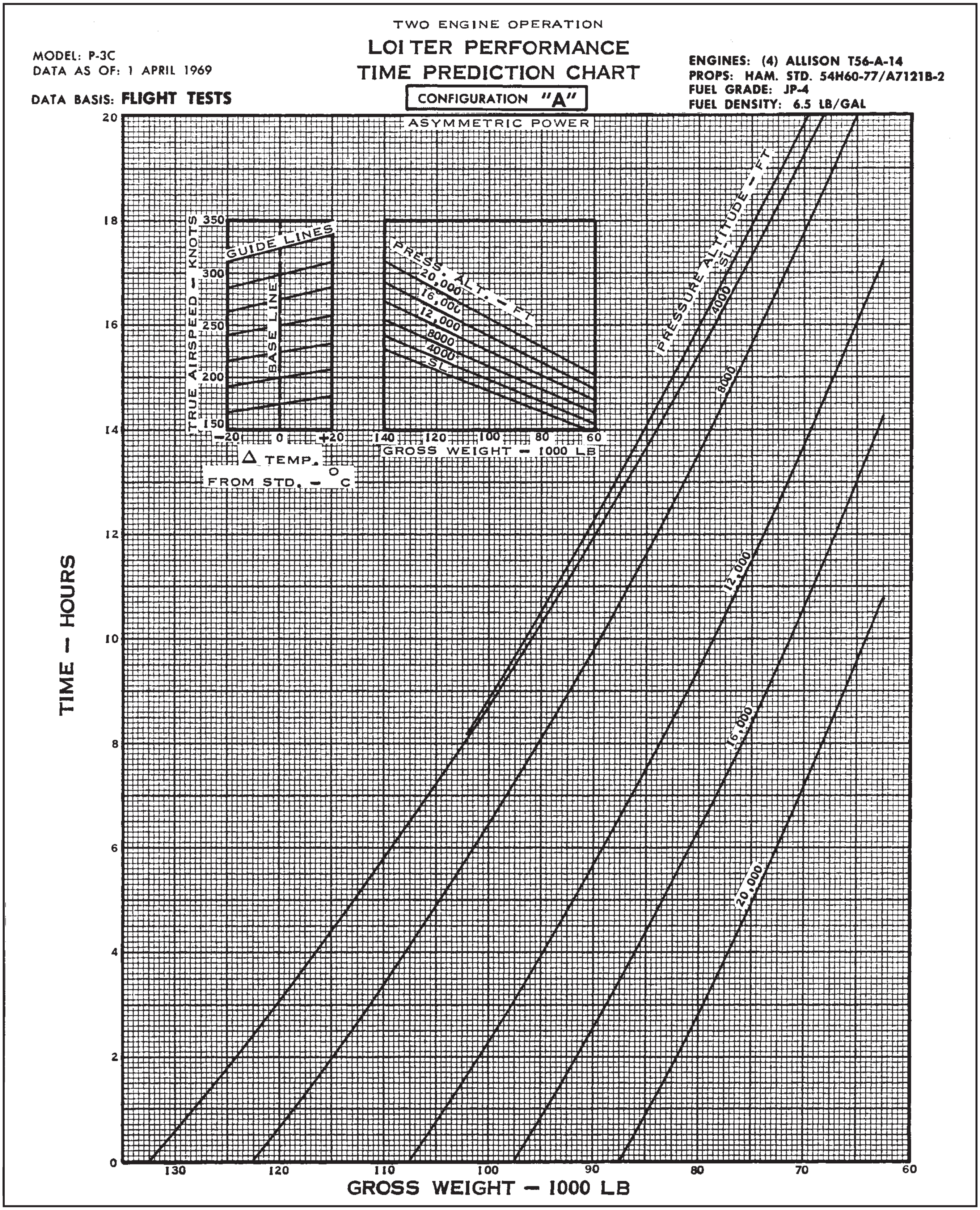


Figure 32-4. Loiter Performance Time Prediction — Configuration A (Sheet 3 of 3)

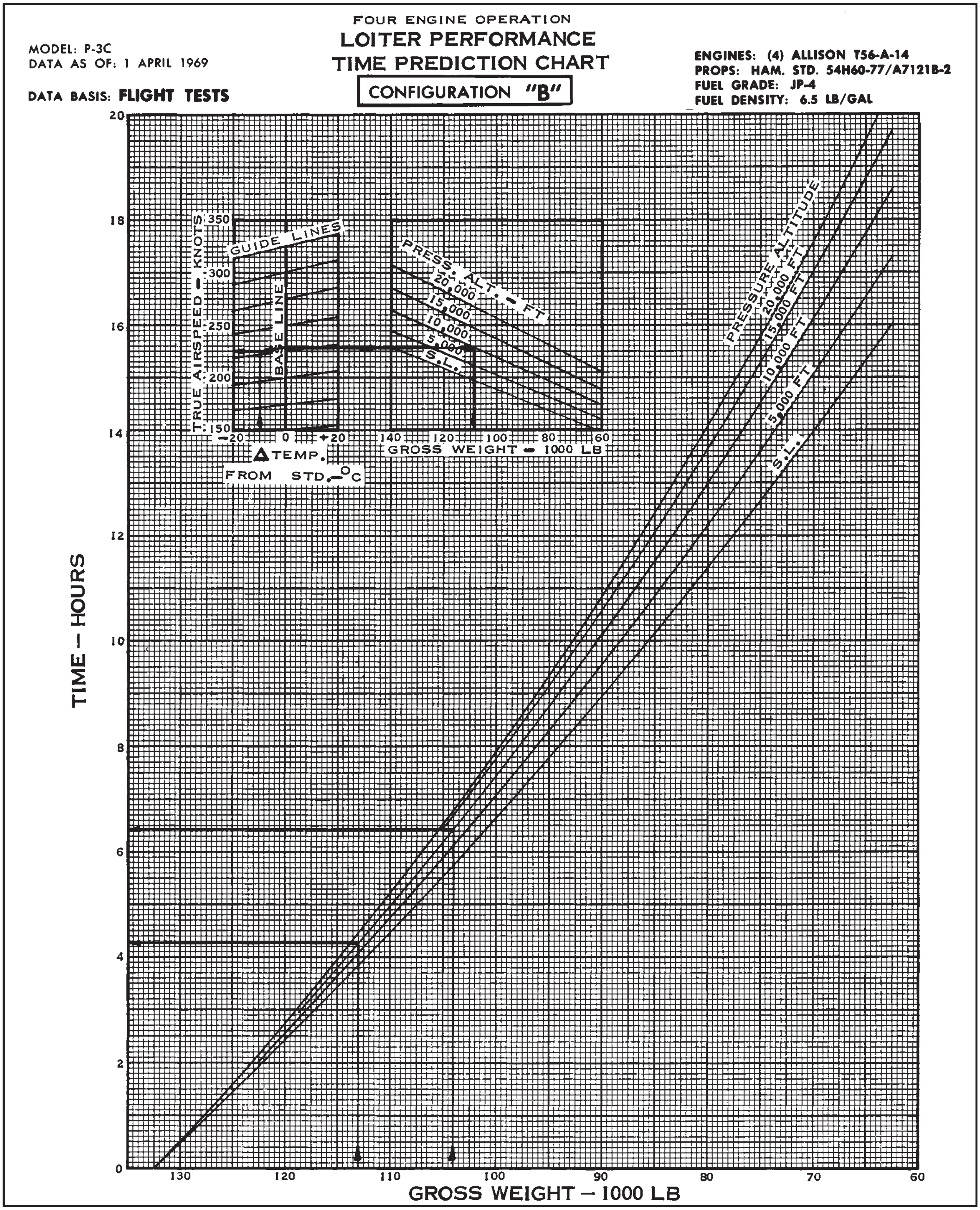


Figure 32-5. Loiter Performance Time Prediction — Configuration B (Sheet 1 of 3)

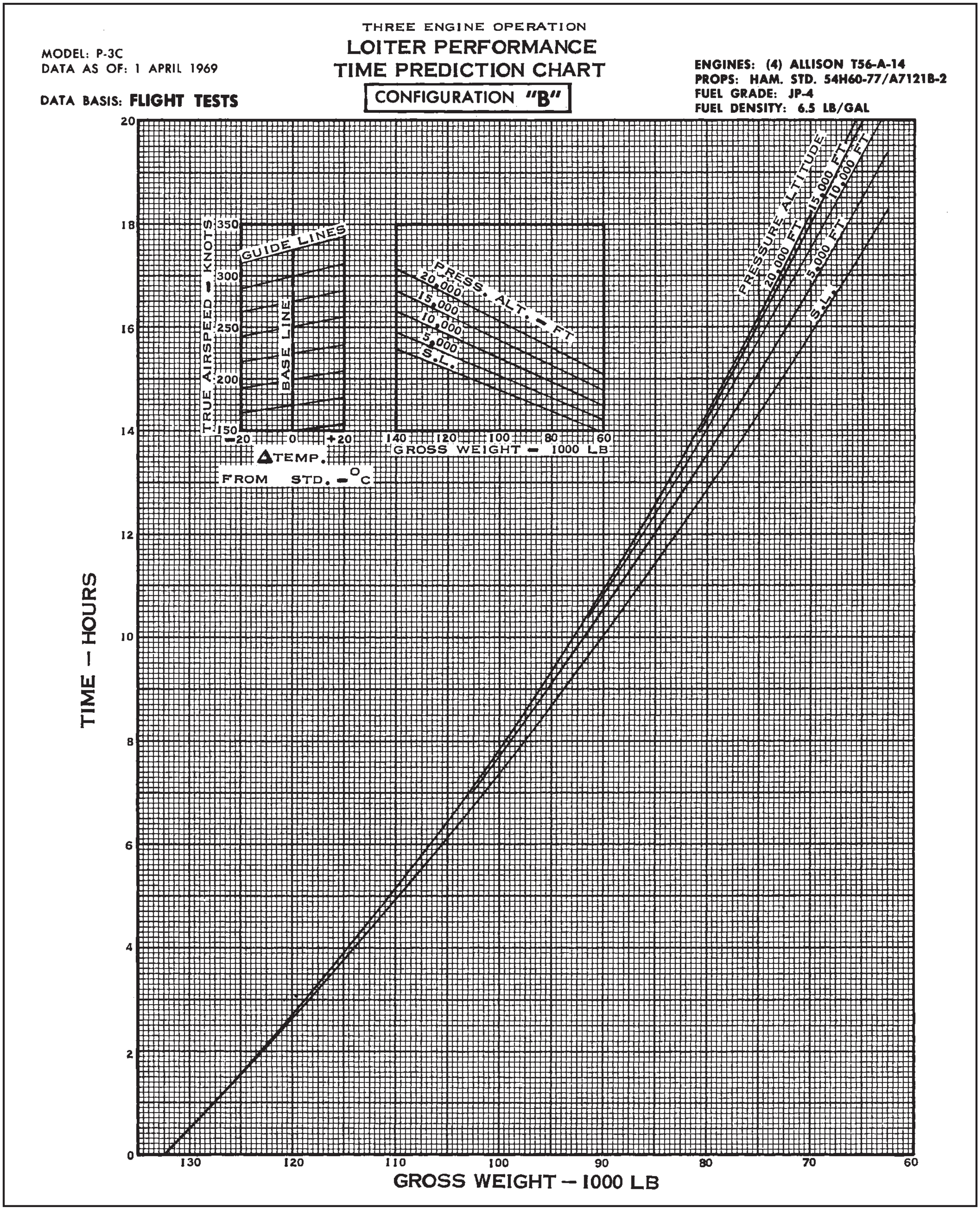


Figure 32-5. Loiter Performance Time Prediction — Configuration B (Sheet 2 of 3)

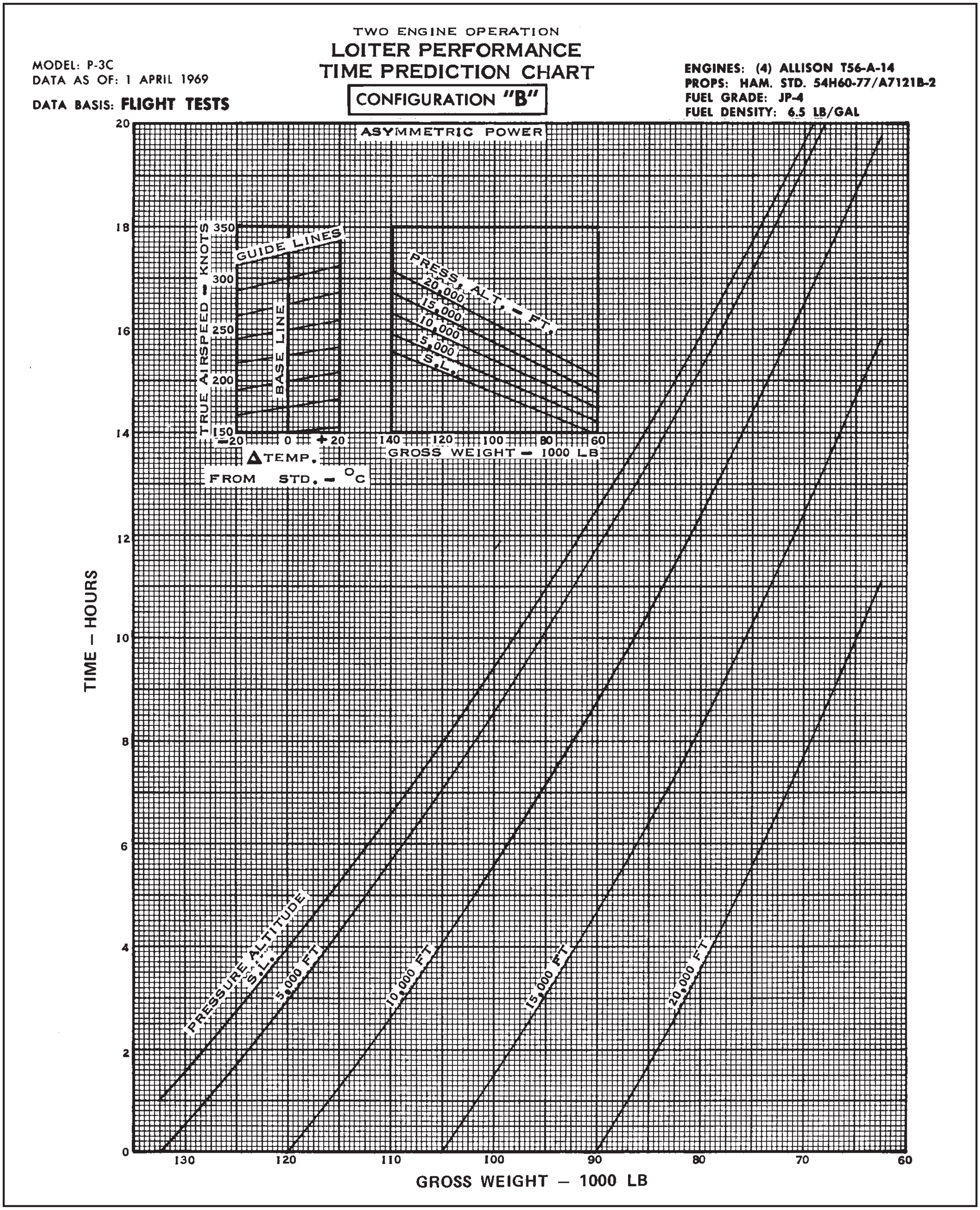


Figure 32-5. Loiter Performance Time Prediction — Configuration B (Sheet 3 of 3)

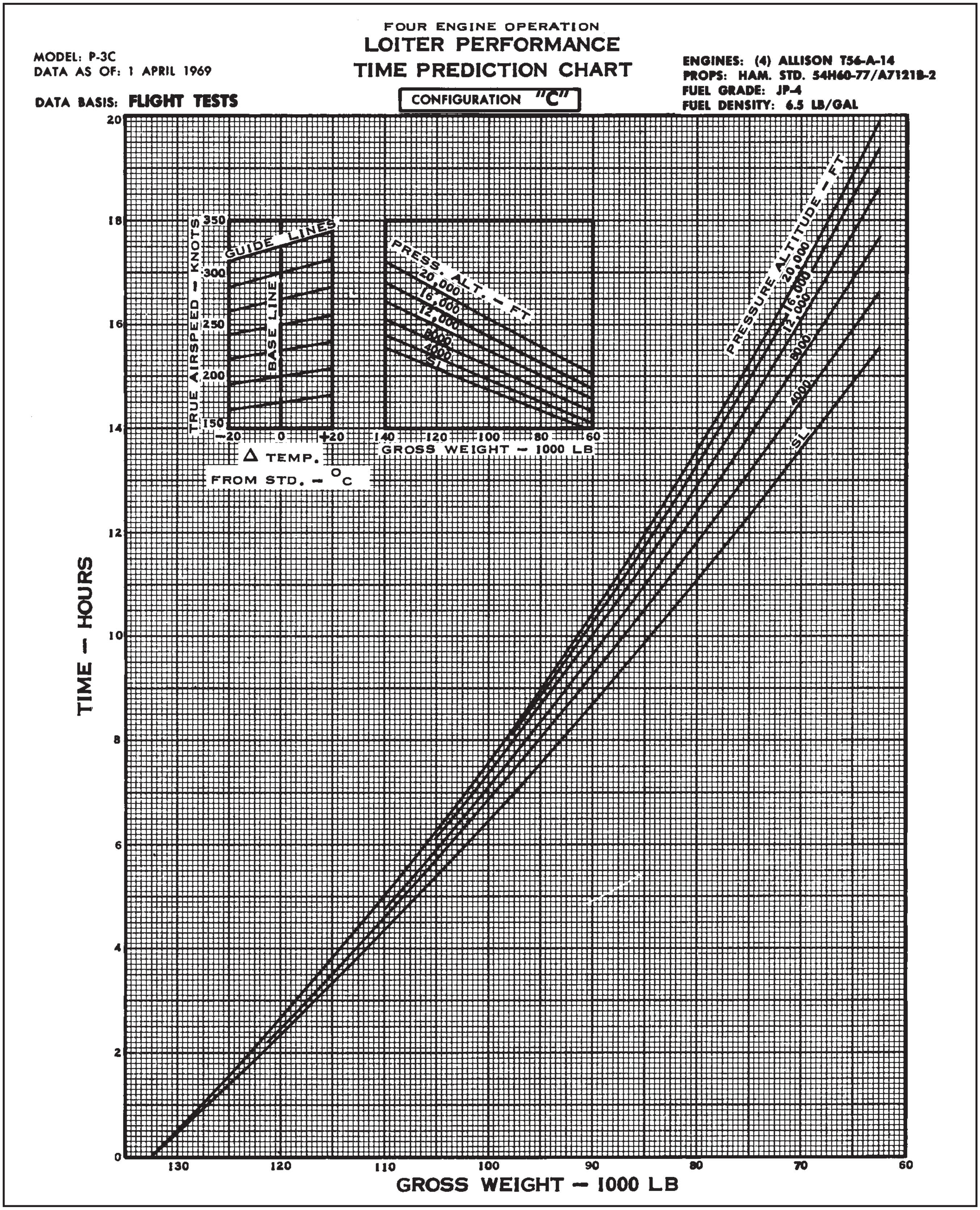


Figure 32-6. Loiter Performance Time Prediction — Configuration C (Sheet 1 of 3)

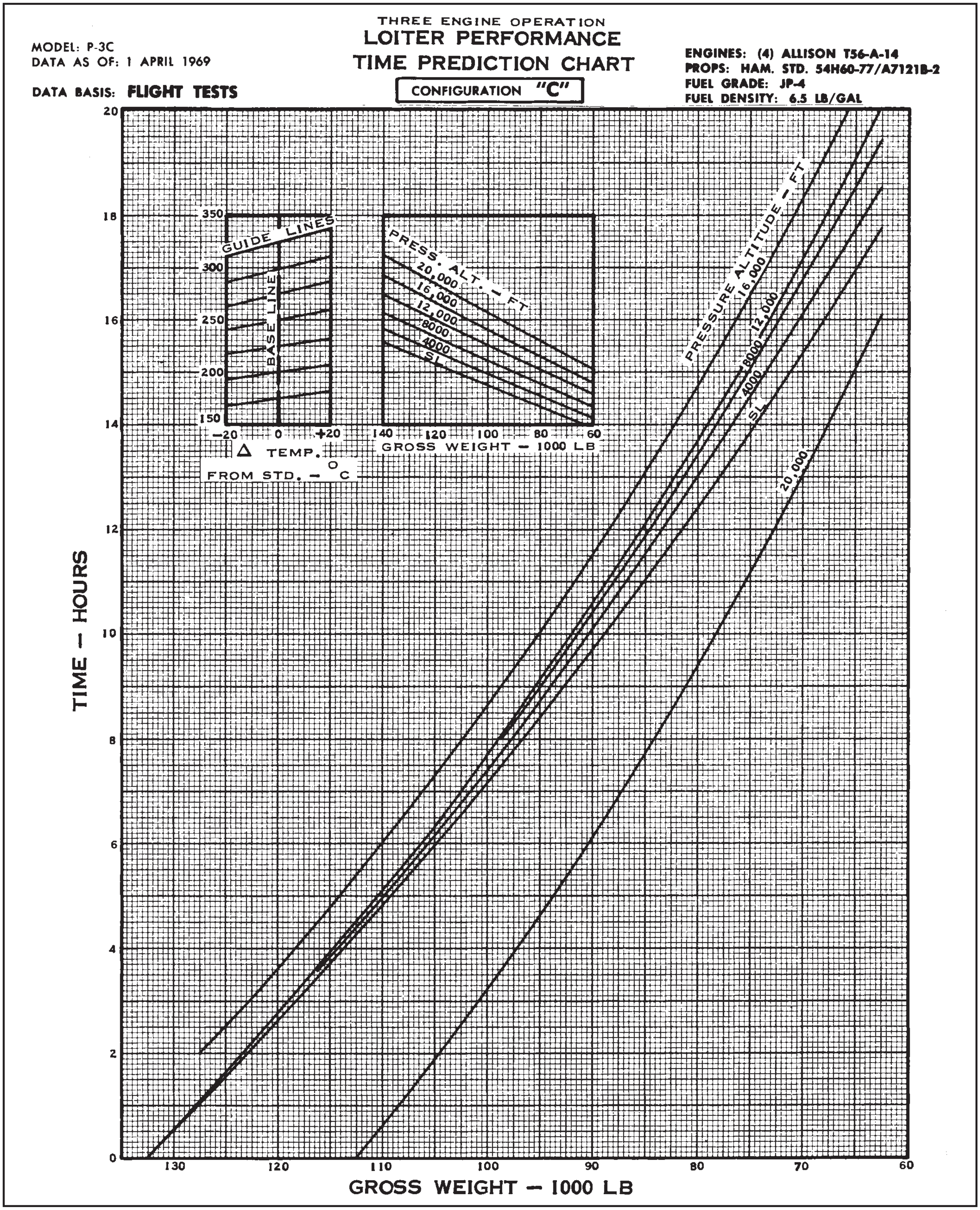


Figure 32-6. Loiter Performance Time Prediction — Configuration C (Sheet 2 of 3)

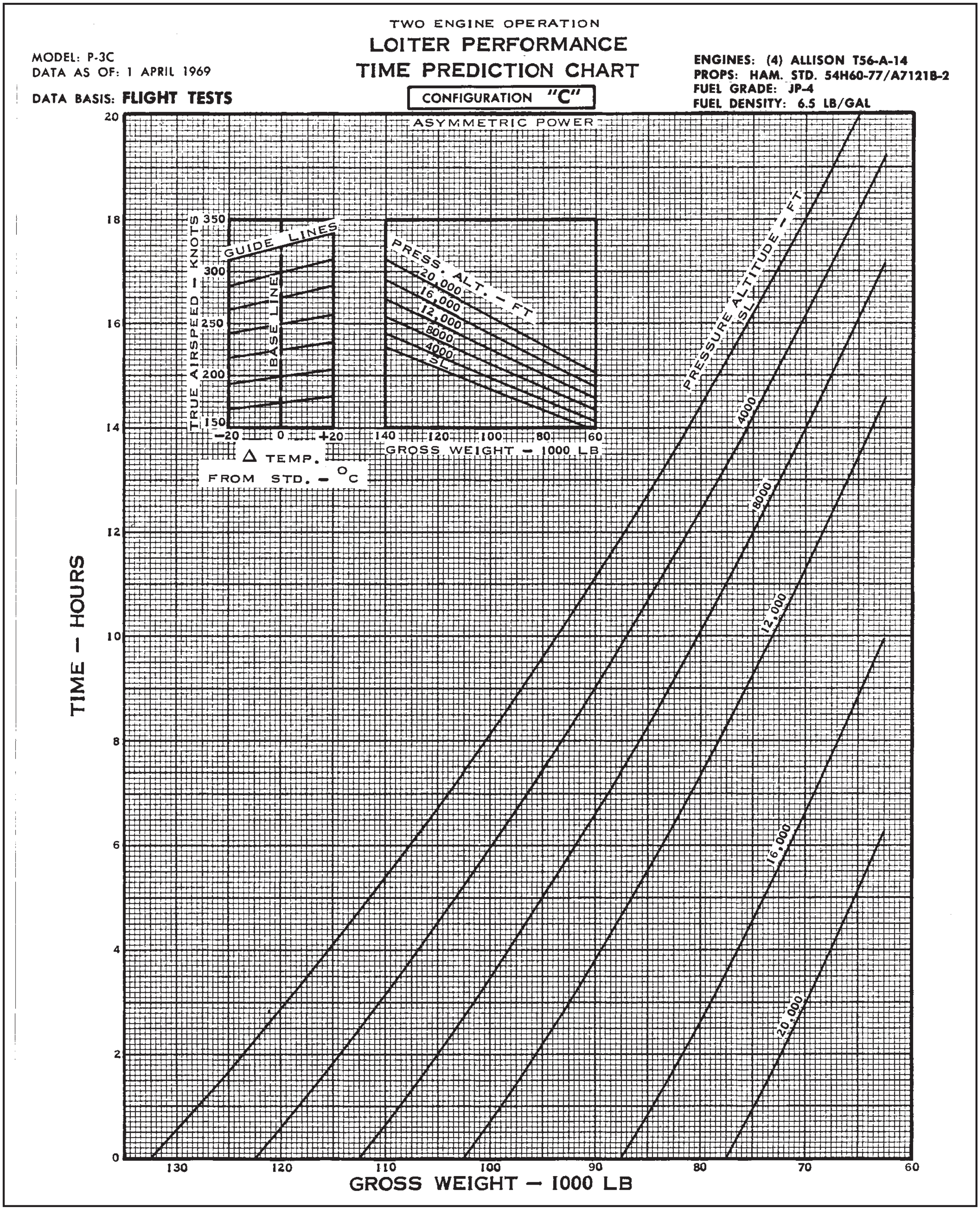


Figure 32-6. Loiter Performance Time Prediction — Configuration C (Sheet 3 of 3)

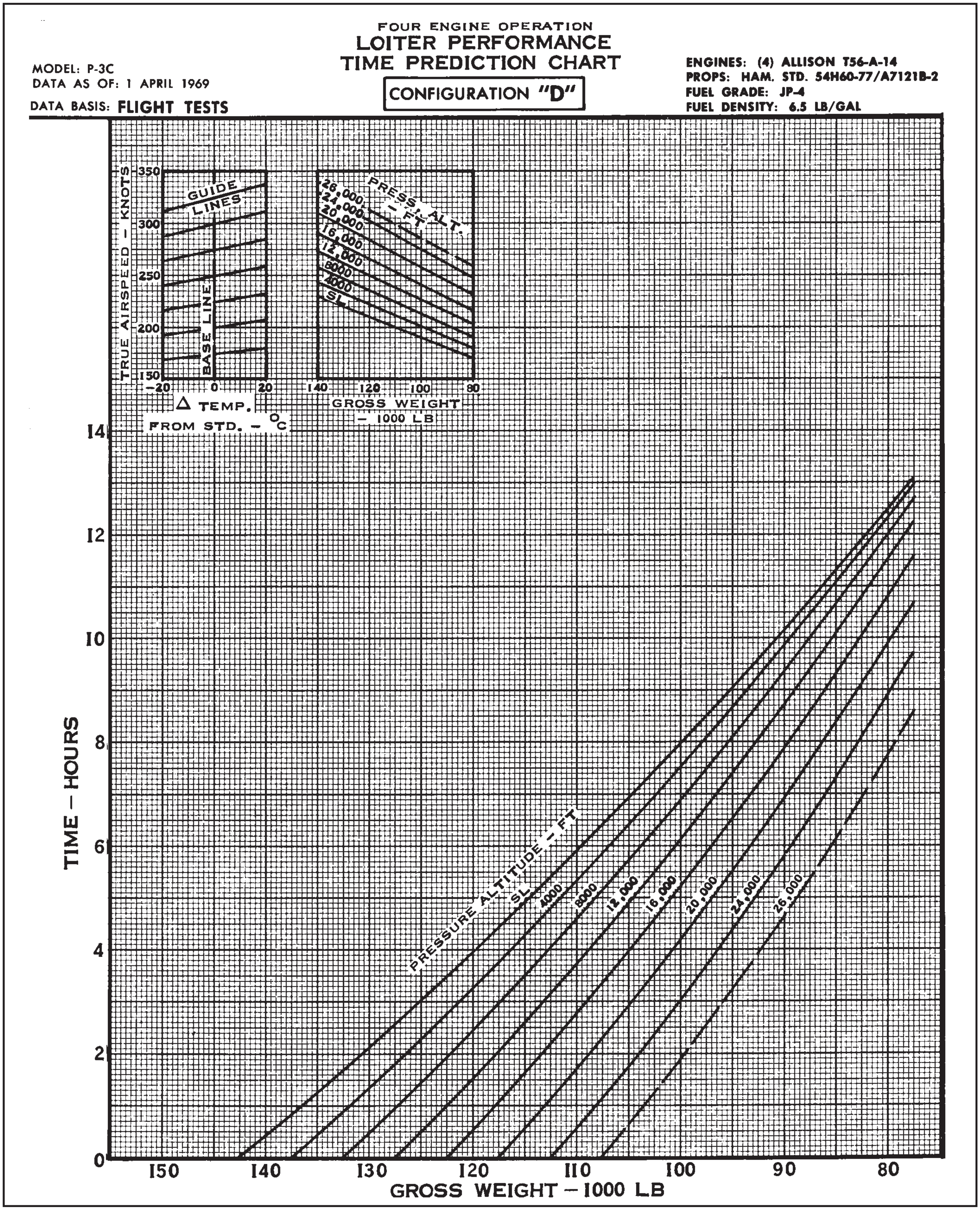


Figure 32-7. Loiter Performance Time Prediction — Configuration D (Sheet 1 of 2)

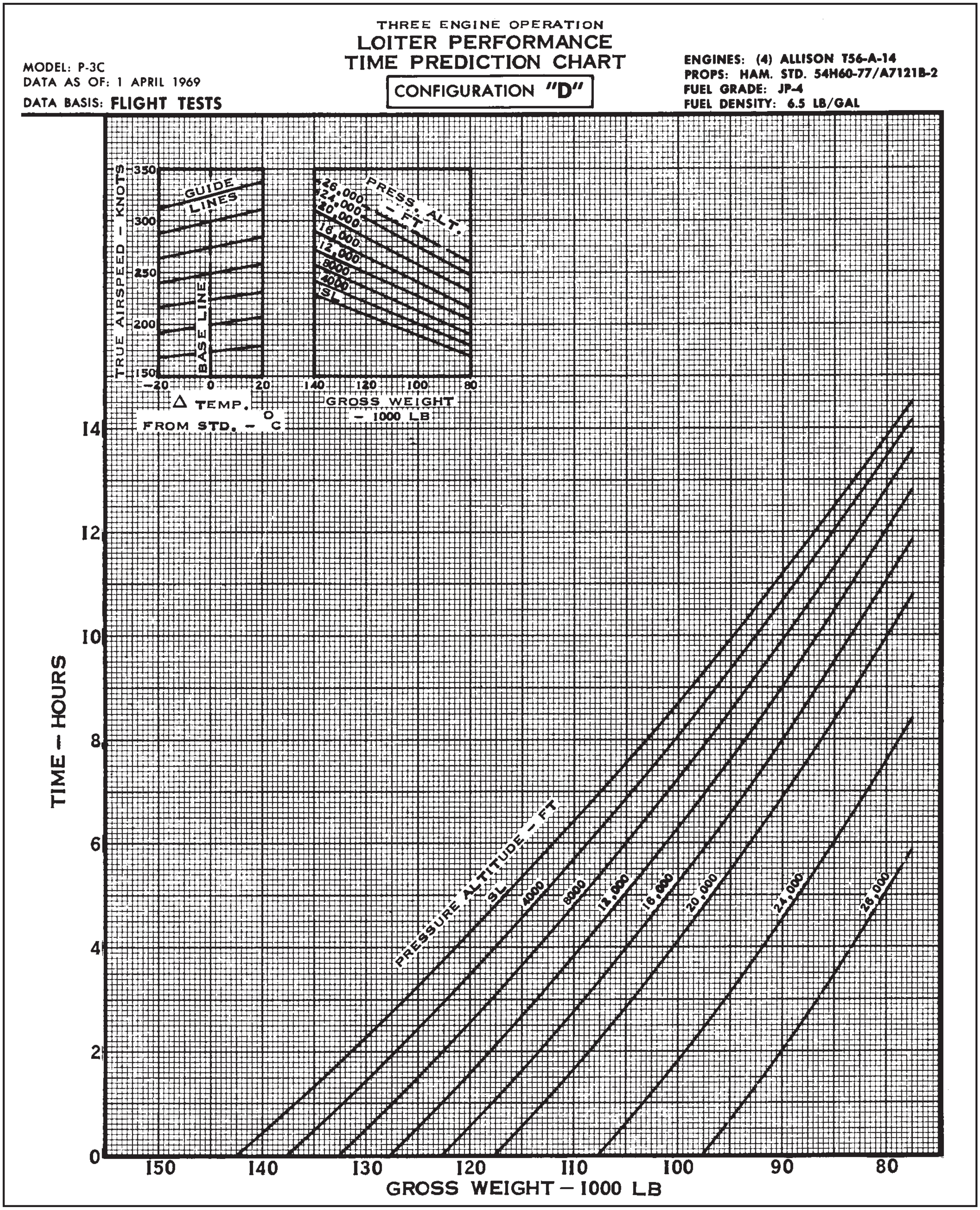


Figure 32-7. Loiter Performance Time Prediction — Configuration D (Sheet 2 of 2)

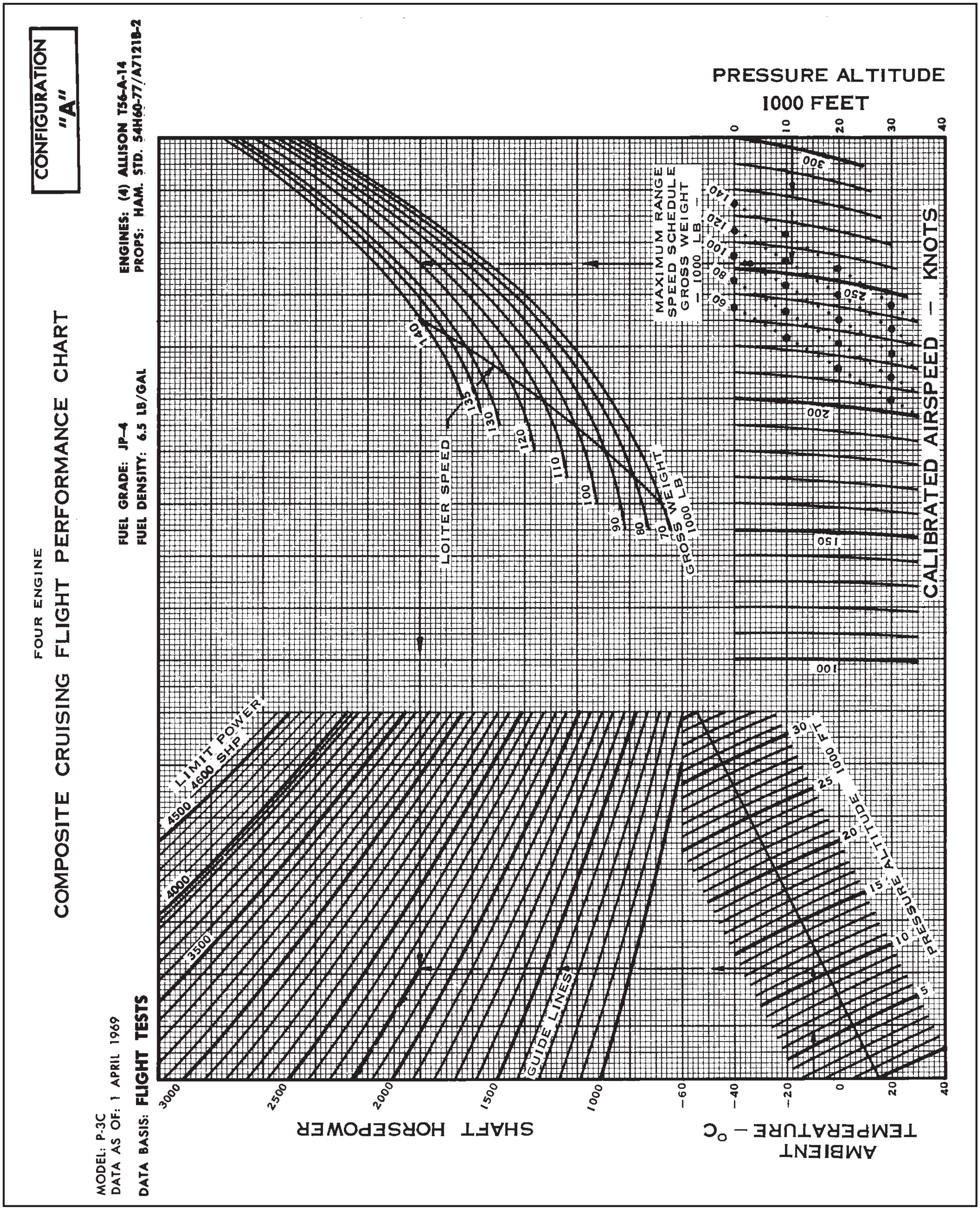


Figure 32-8. Composite Cruising Flight Performance — Configuration A (Sheet 1 of 3)

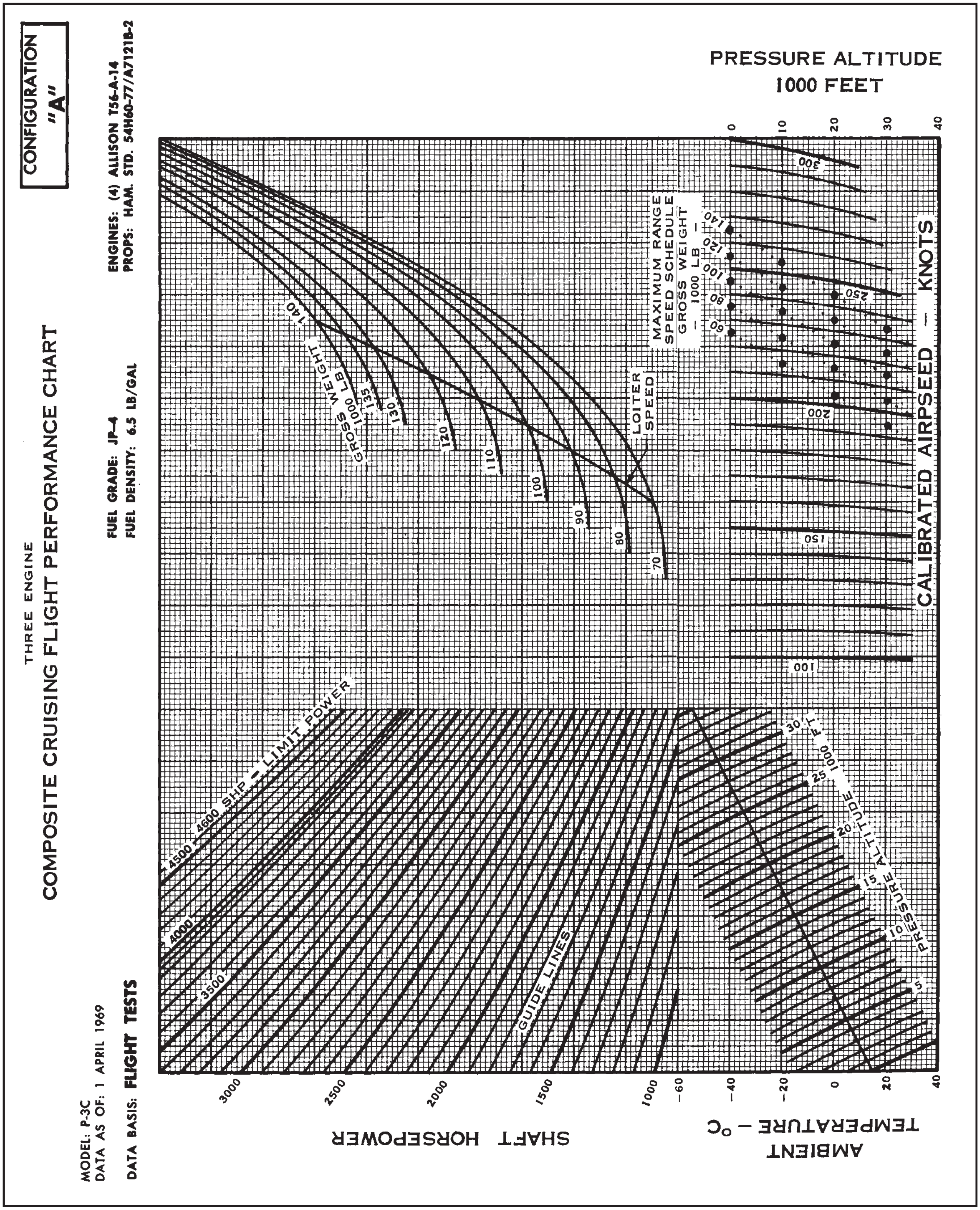


Figure 32-8. Composite Cruising Flight Performance — Configuration A (Sheet 2 of 3)

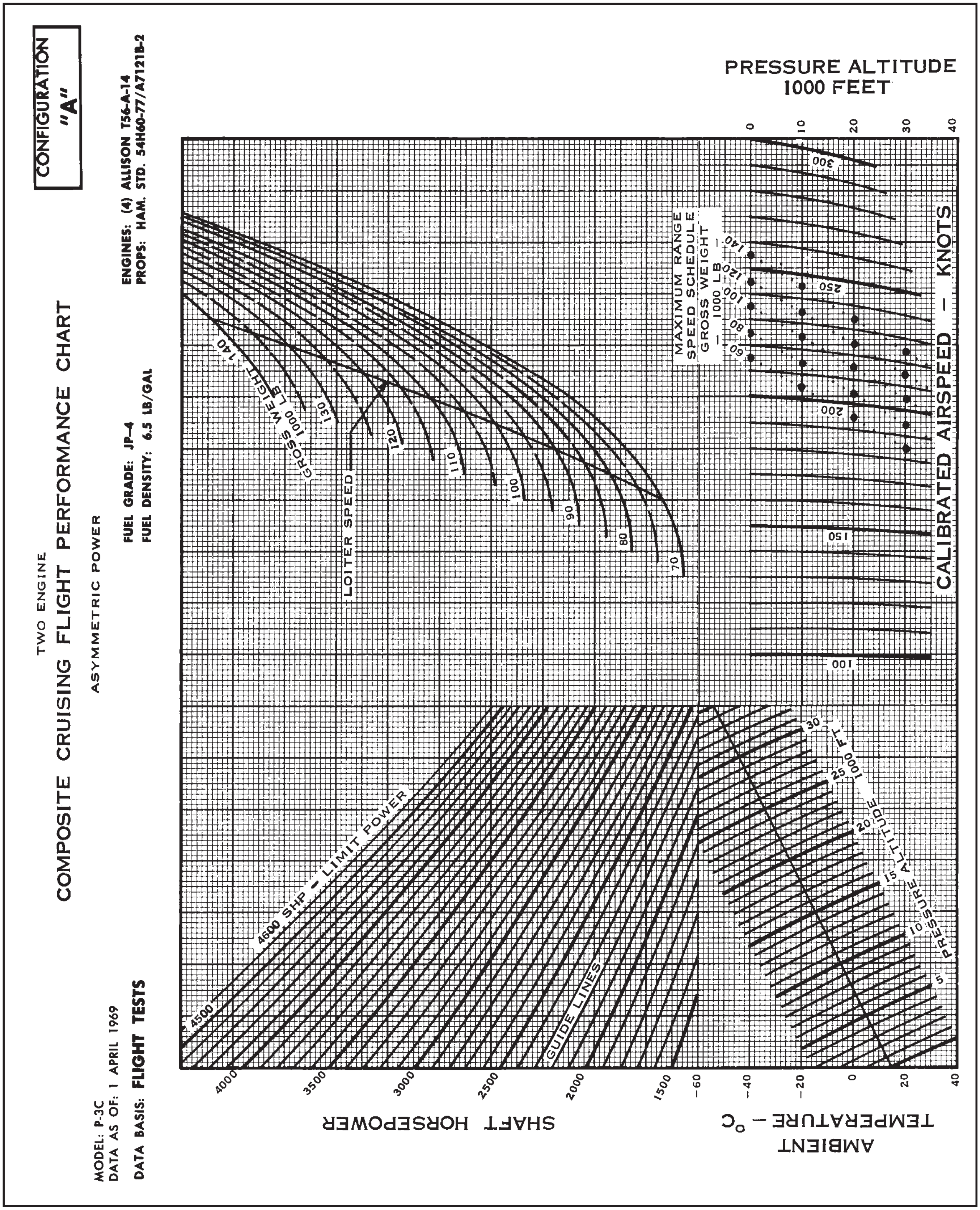


Figure 32-8. Composite Cruising Flight Performance — Configuration A (Sheet 3 of 3)

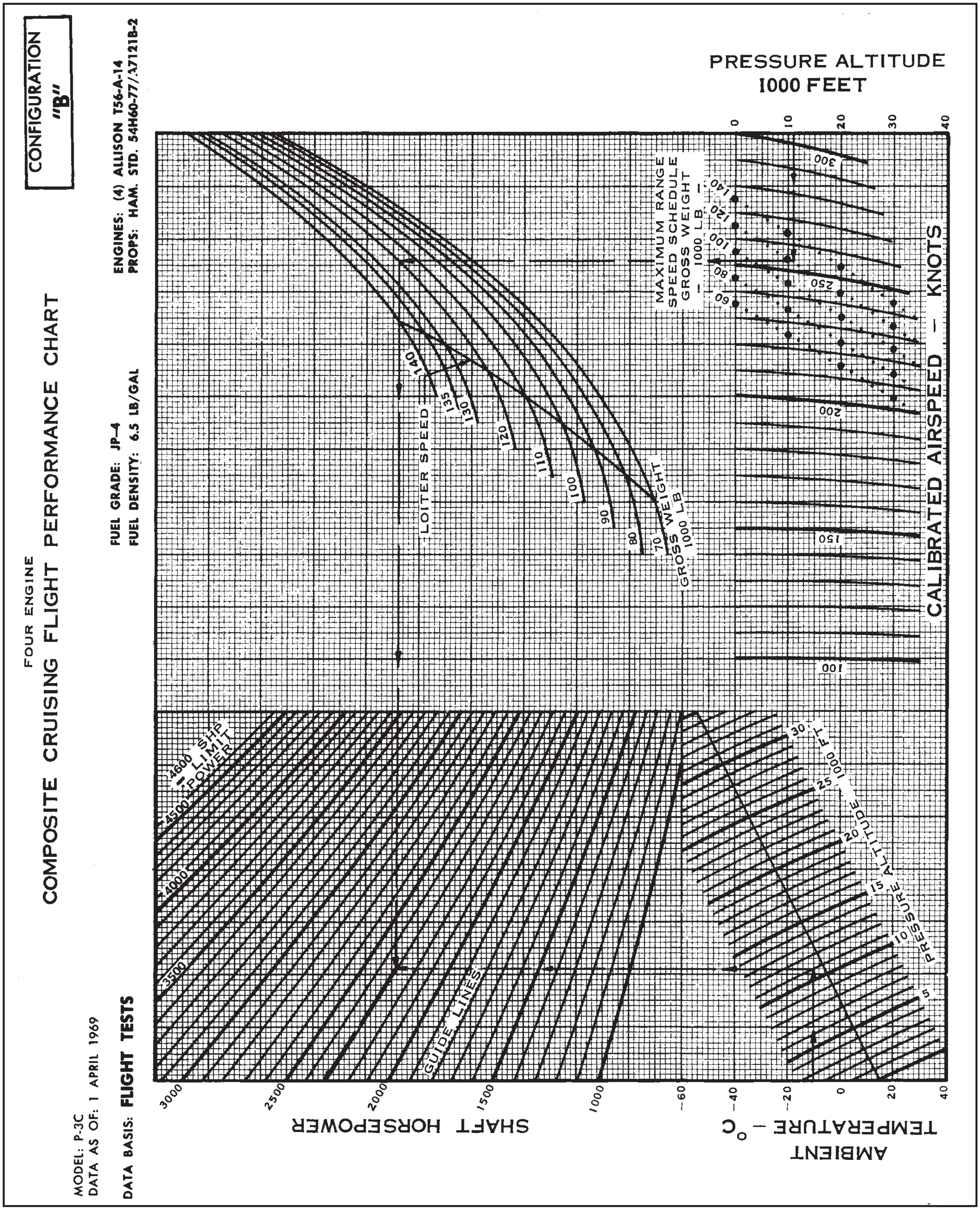


Figure 32-9. Composite Cruising Flight Performance — Configuration B (Sheet 1 of 3)

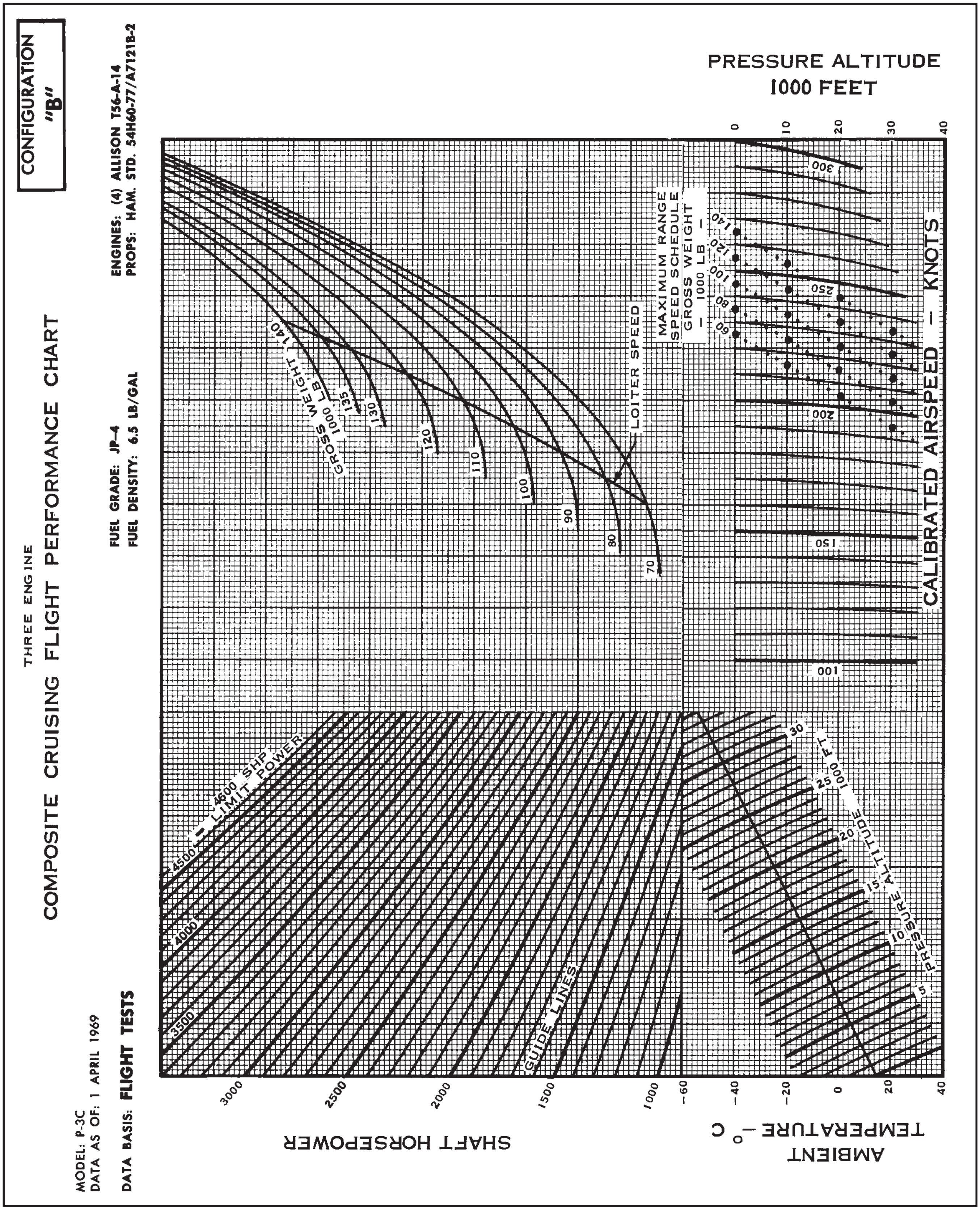


Figure 32-9. Composite Cruising Flight Performance — Configuration B (Sheet 2 of 3)

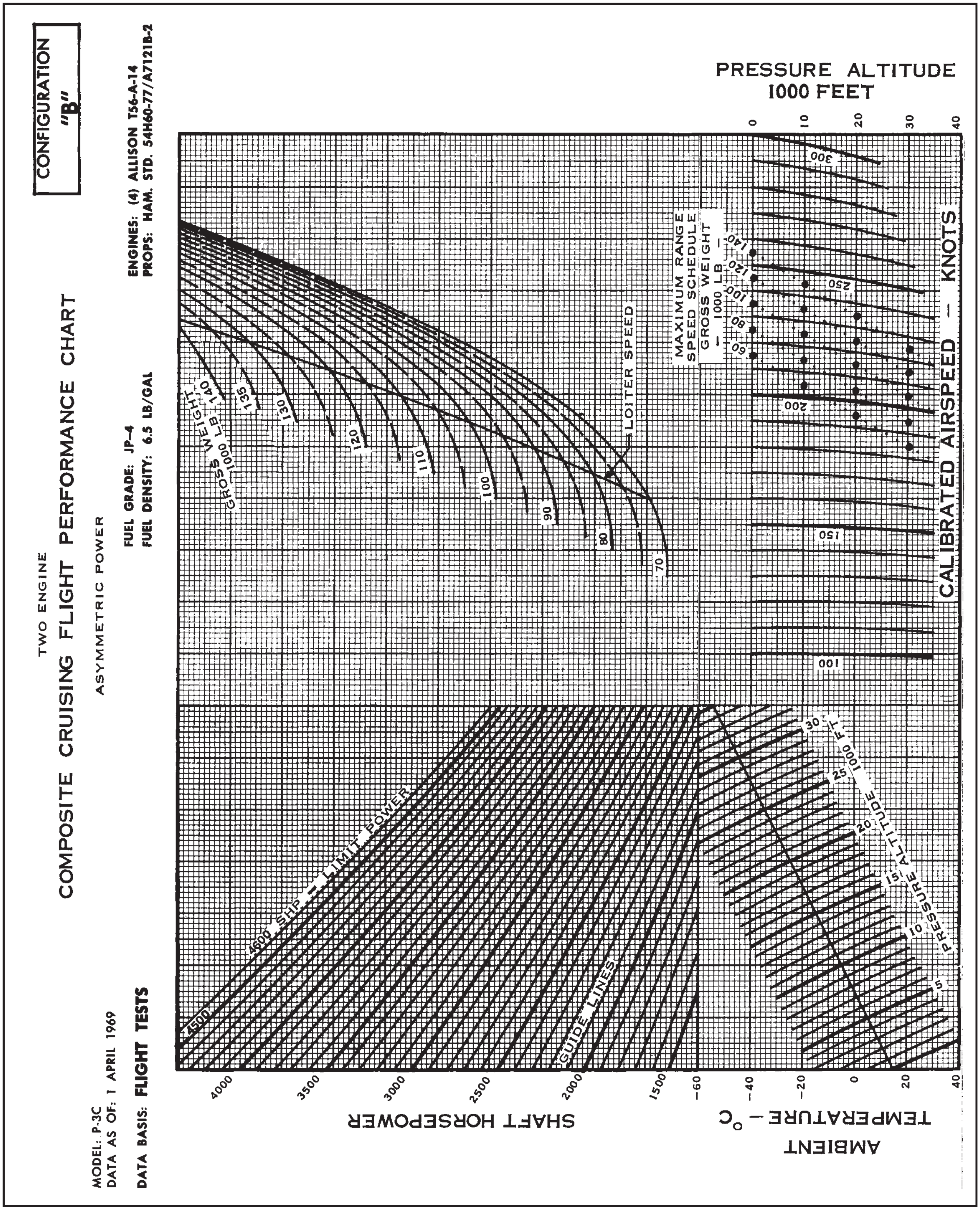


Figure 32-9. Composite Cruising Flight Performance — Configuration B (Sheet 3 of 3)

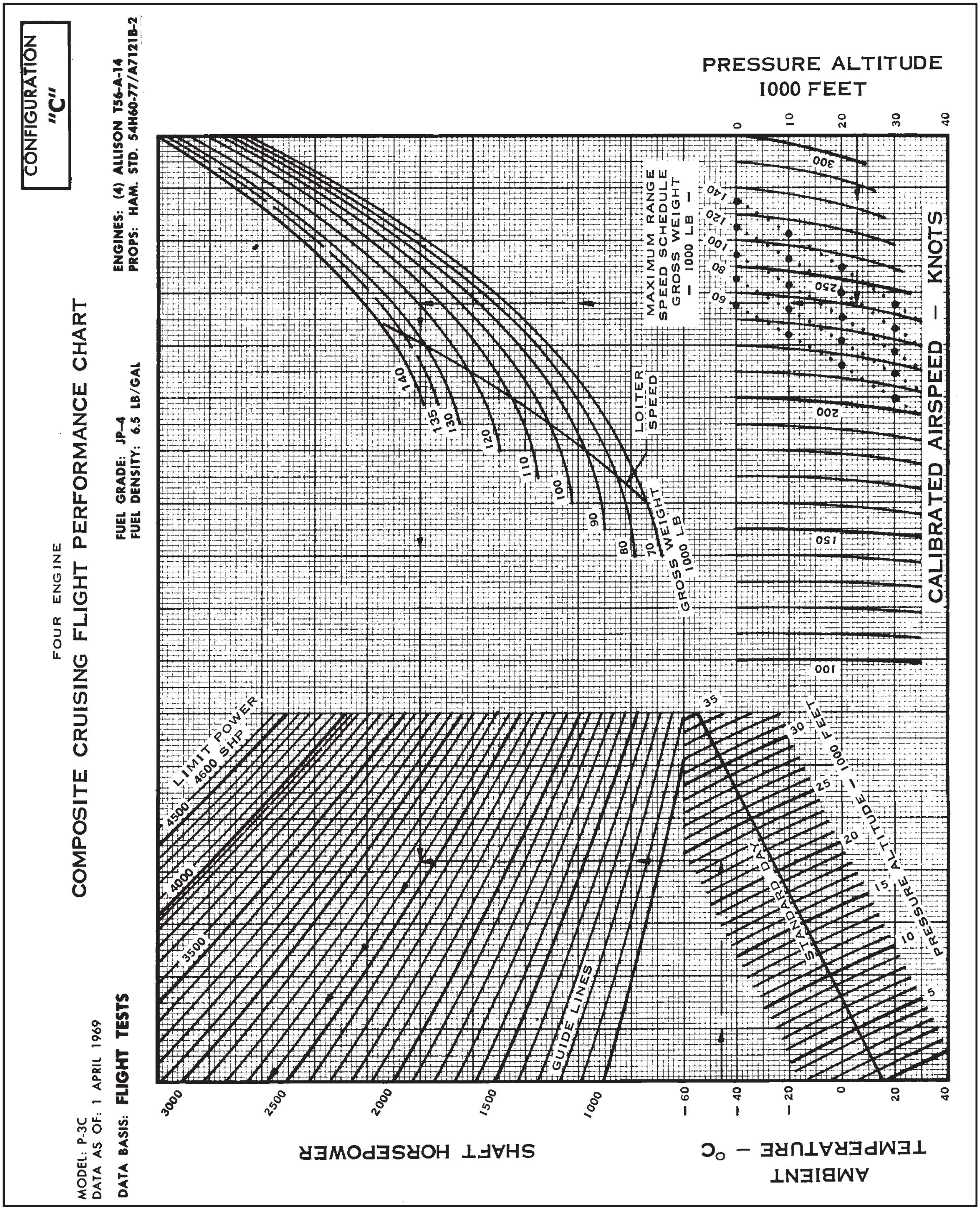


Figure 32-10. Composite Cruising Flight Performance — Configuration C (Sheet 1 of 3)

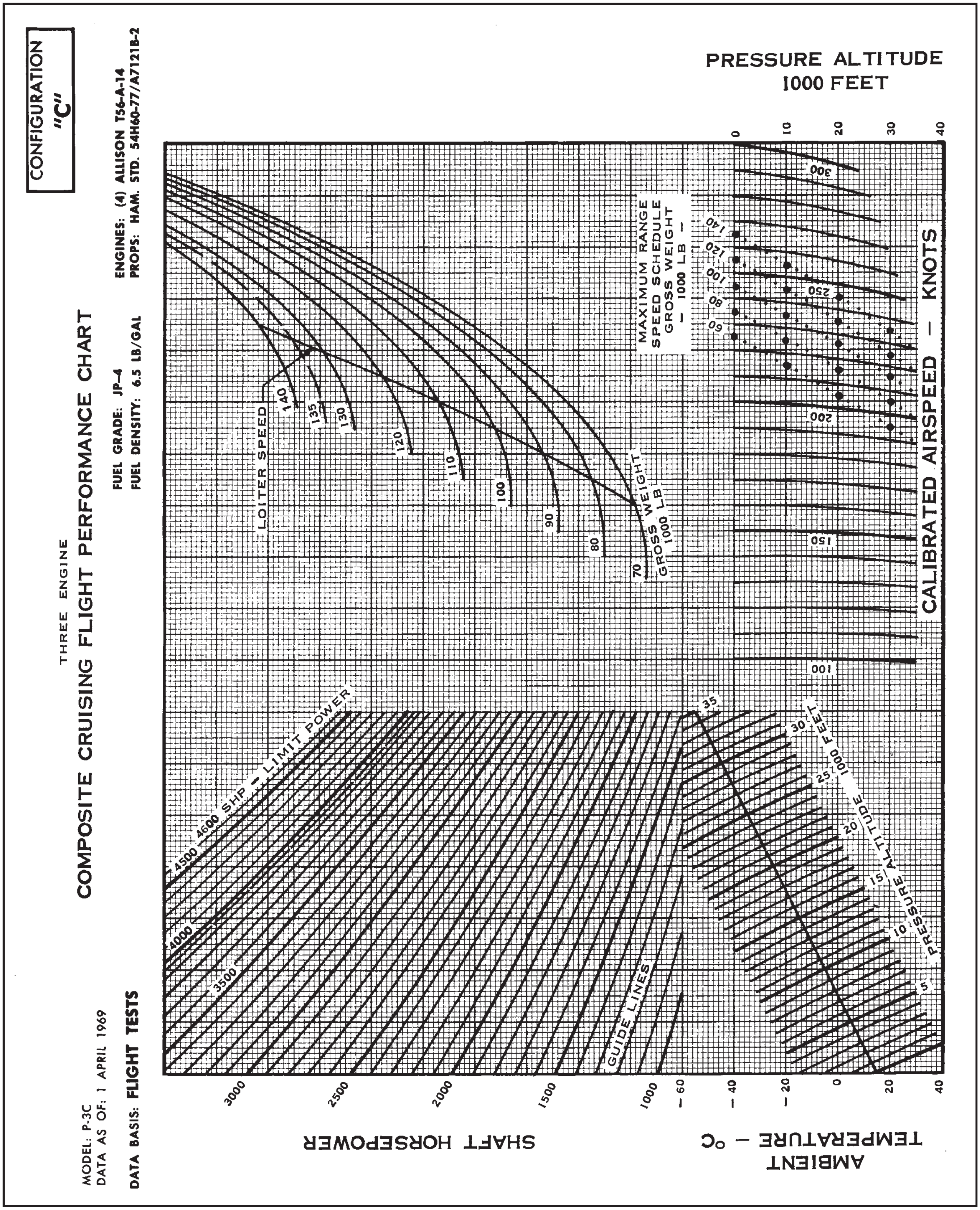


Figure 32-10. Composite Cruising Flight Performance — Configuration C (Sheet 2 of 3)

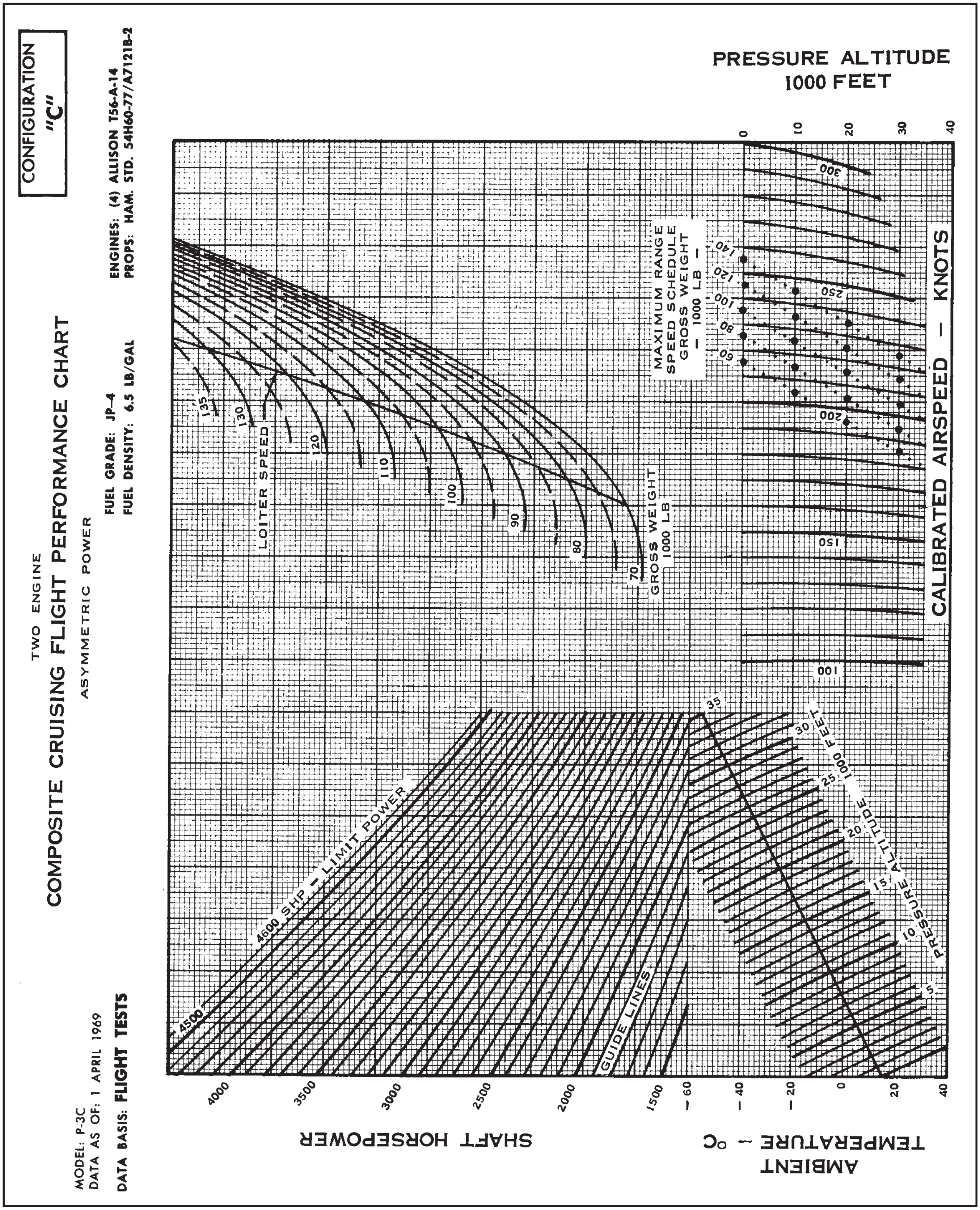


Figure 32-10. Composite Cruising Flight Performance — Configuration C (Sheet 3 of 3)

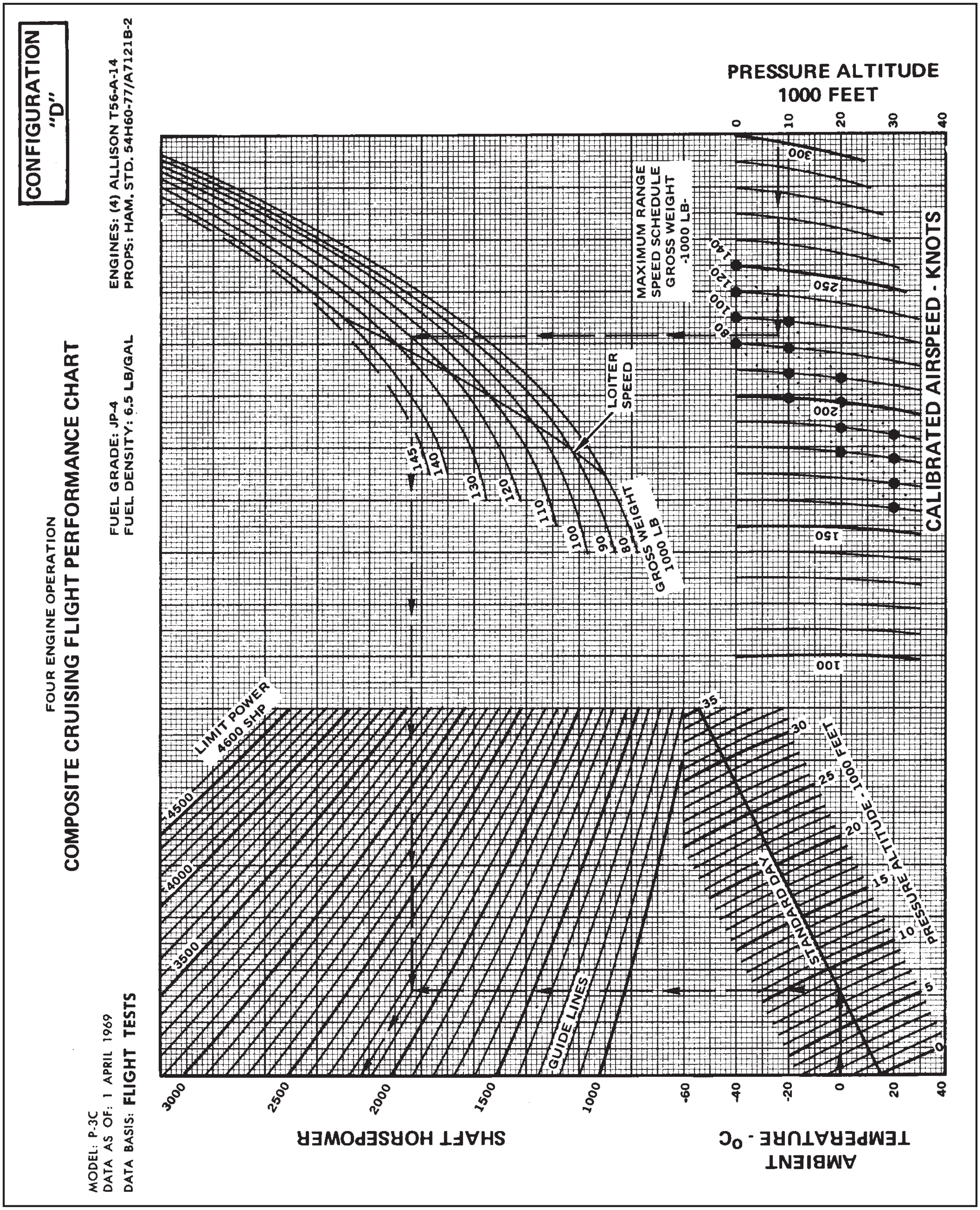


Figure 32-11. Composite Cruising Flight Performance — Configuration D (Sheet 1 of 2)

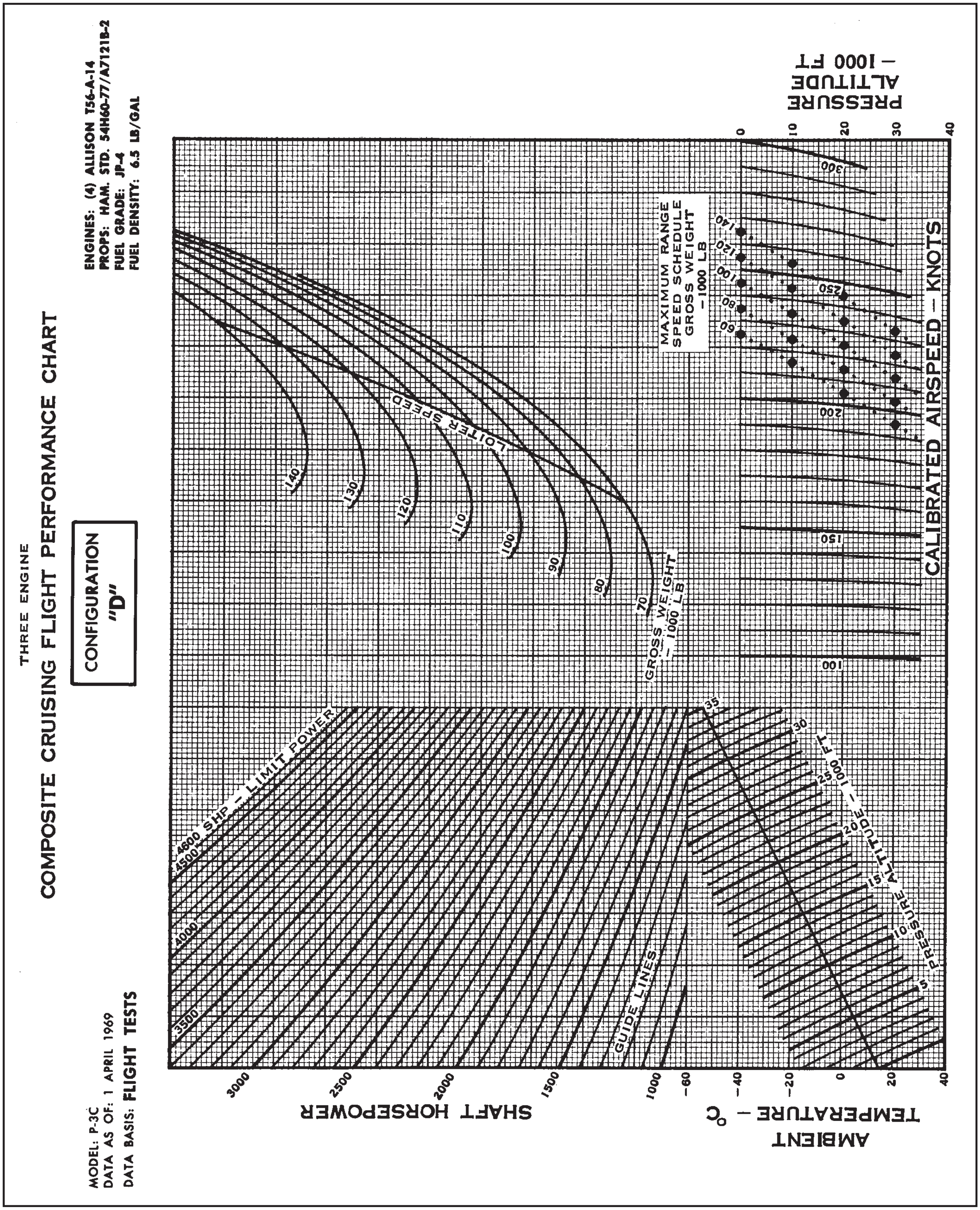


Figure 32-11. Composite Cruising Flight Performance — Configuration D (Sheet 2 of 2)

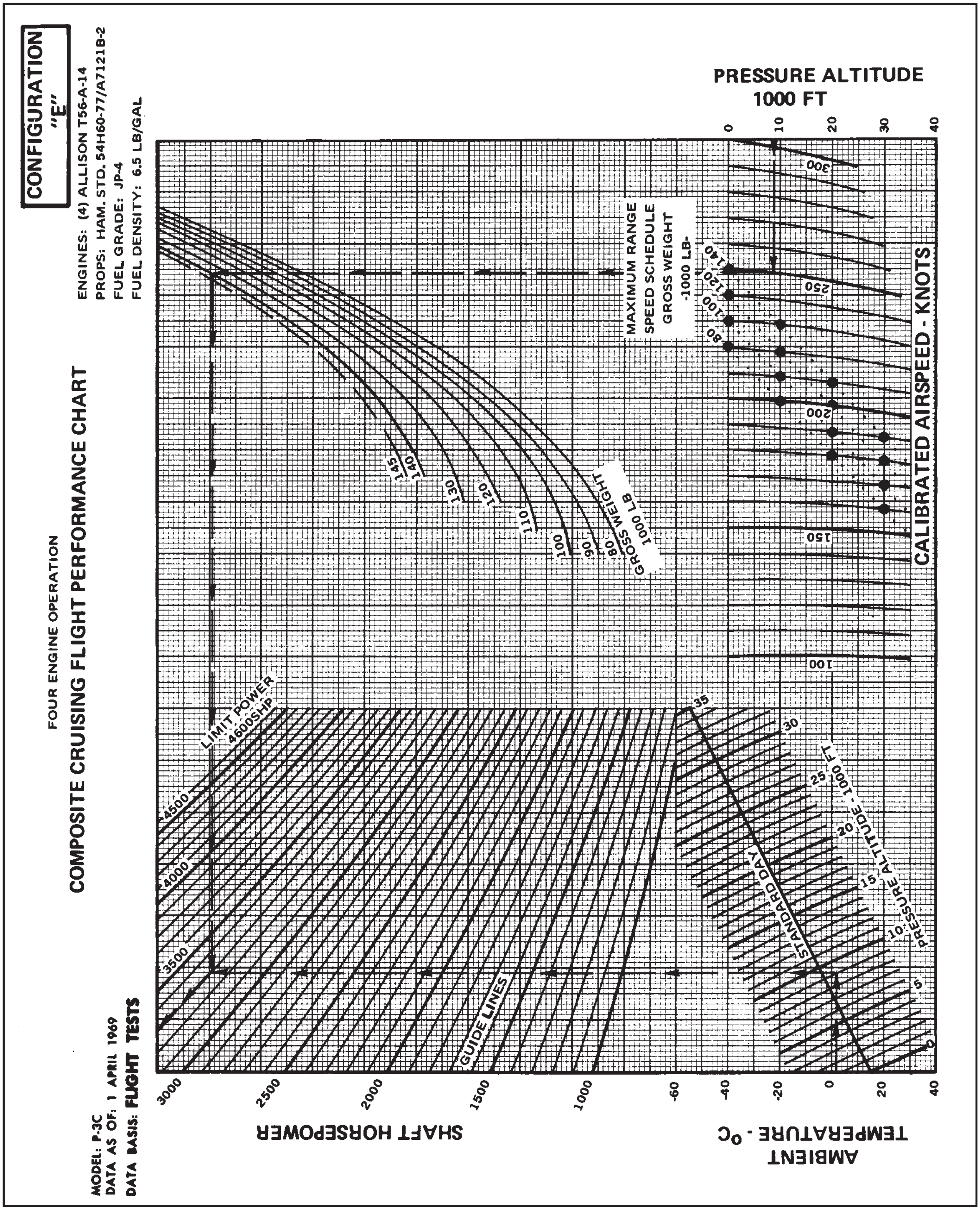


Figure 32-12. Four-Engine Composite Cruising Flight Performance — Configuration E

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 factor 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 paragraph 33.3, "Use of Operating Tables," 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 through 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.

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MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

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	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	
	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 +11 °C	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	
	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 +7 °C	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	
	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 +3 °C	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	
	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 −1 °C	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	
	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 −5 °C	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	
	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 −9 °C	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	
	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 −13 °C	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	
	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	

Figure 33-1. Four-Engine Maximum Range Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb 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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
16,000 FT	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	
−17 °C	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	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	
−21 °C	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	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	
−25 °C	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	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	
−29 °C	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	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	
−33 °C	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	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	
−37 °C	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	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	
−41°C	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	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	
−44 °C	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"

Figure 33-1. Four-Engine Maximum Range Operating Table — Configuration A (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

THREE-ENGINE MAXIMUM RANGE OPERATING TABLE

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	

Figure 33-2. Three-Engine Maximum Range Operating Table — Configuration A (Sheet 1 of 2)

ALTITUDE STD TEMP		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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
		Gross Weight Bracket—1000 Lb														
16,000 FT —17 °C	SHP		3480	3325	3180	3035	2900	2770	2640	2515	2395	2275	2165	2060	1955	0.55
	FF—LB/HR/ENG		1670	1605	1550	1490	1435	1385	1335	1285	1240	1195	1155	1115	1080	
	IAS—KNOTS		246	244	241	239	236	234	231	229	226	224	221	219	216	
	TAS—KNOTS		311	308	305	302	299	296	293	290	287	284	280	278	274	
	SEG RANGE—NM		310	319	328	337	347	356	366	376	385	395	404	415	424	
18,000 FT —21 °C	SHP			3390	3240	3095	2955	2815	2685	2550	2430	2305	2190	2080	1980	0.57
	FF—LB/HR/ENG			1610	1550	1490	1430	1375	1325	1270	1225	1180	1140	1095	1060	
	IAS—KNOTS			242	239	237	234	232	229	227	224	222	219	217	214	
	TAS—KNOTS			315	312	309	305	303	299	296	293	290	287	284	280	
	SEG RANGE—NM			326	336	346	356	367	377	388	398	410	420	432	442	
20,000 FT —25 °C	SHP						3010	2865	2730	2595	2465	2345	2220	2105	2000	0.59
	FF—LB/HR/ENG						1430	1370	1315	1265	1215	1170	1125	1080	1040	
	IAS—KNOTS						232	230	227	225	222	220	217	215	212	
	TAS—KNOTS						313	310	306	303	300	297	293	290	287	
	SEG RANGE—NM						366	376	388	400	412	424	435	448	460	
22,000 FT —29 °C	SHP						3065	2920	2775	2640	2505	2380	2250	2135	2025	0.61
	FF—LB/HR/ENG						1440	1375	1315	1260	1210	1160	1115	1065	1025	
	IAS—KNOTS						230	228	225	223	220	218	215	213	210	
	TAS—KNOTS						320	317	314	310	307	304	300	297	294	
	SEG RANGE—NM						370	384	397	410	424	437	450	465	477	
24,000 FT —33 °C	SHP								2830	2685	2550	2415	2285	2165	2050	0.63
	FF—LB/HR/ENG								1325	1265	1210	1155	1105	1055	1015	
	IAS—KNOTS								223	221	218	216	213	211	208	
	TAS—KNOTS								321	318	314	311	307	304	300	
	SEG RANGE—NM								404	418	434	448	464	480	494	
26,000 FT —37 °C	SHP									2735	2595	2455	2320	2195	2075	0.66
	FF—LB/HR/ENG									1280	1215	1160	1105	1055	1010	
	IAS—KNOTS									219	216	214	211	209	206	
	TAS—KNOTS									325	322	318	315	311	308	
	SEG RANGE—NM									424	442	457	475	491	507	
28,000 FT —41°C	SHP											2500	2360	2230	2105	0.68
	FF—LB/HR/ENG											1175	1115	1060	1010	
	IAS—KNOTS											212	209	207	204	
	TAS—KNOTS											326	322	318	315	
	SEG RANGE—NM											462	482	501	518	
30,000 FT —44°C	SHP												2405	2270	2140	0.70
	FF—LB/HR/ENG												1135	1075	1020	
	IAS—KNOTS												207	205	202	
	TAS—KNOTS												330	326	322	
	SEG RANGE—NM												486	505	526	
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"

Figure 33-2. Three-Engine Maximum Range Operating Table — Configuration A (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

TWO-ENGINE MAXIMUM RANGE OPERATING TABLE

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	

Figure 33-3. Two-Engine Maximum Range Operating Table — Configuration A (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
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"

Figure 33-3. Two-Engine Maximum Range Operating Table — Configuration A (Sheet 2 of 2)

FOUR-ENGINE LOITER 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
		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	

Figure 33-4. Four-Engine Loiter Operating Table — Configuration A (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	SHP	1895	1775	1670	1570	1470	1380	1290	1205	1115	1035	955	875	**0.41**
−5 °C	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	SHP	1950	1830	1725	1620	1515	1425	1330	1240	1150	1065	985	900	**0.43**
−9 °C	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	SHP	2010	1890	1775	1670	1565	1465	1370	1275	1185	1095	1015	925	**0.45**
−13 °C	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	SHP	2075	1950	1830	1725	1610	1510	1410	1315	1220	1130	1040	955	**0.47**
−17 °C	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	SHP	2140	2010	1890	1775	1660	1555	1455	1355	1255	1165	1075	980	**0.49**
−21 °C	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	SHP	2210	2070	1950	1830	1715	1605	1500	1395	1295	1200	1105	1015	**0.51**
−25 °C	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"**

Figure 33-4. Four-Engine Loiter Operating Table — Configuration A (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

THREE-ENGINE LOITER OPERATING TABLE

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 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
SEA LEVEL +15 °C	SHP	2385	2250	2120	1990	1860	1745	1630	1520	1410	1310	1205	1105	0.33
	FF—LB/HR/ENG	1570	1515	1465	1420	1375	1335	1290	1255	1215	1175	1135	1100	
	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	1:04	1:06	1:08	1:11	1:13	1:15	1:17	1:20	1:22	1:25	1:28	1:31	
2000 FT +11 °C	SHP	2450	2315	2175	2045	1910	1790	1675	1560	1450	1345	1235	1135	0.35
	FF—LB/HR/ENG	1535	1485	1435	1385	1335	1295	1255	1215	1175	1135	1100	1060	
	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	1:05	1:07	1:10	1:12	1:15	1:17	1:20	1:22	1:24	1:28	1:31	1:34	
4000 FT +7 °C	SHP	2520	2380	2235	2100	1965	1840	1725	1605	1490	1380	1270	1165	0.36
	FF—LB/HR/ENG	1510	1460	1410	1355	1310	1265	1225	1185	1145	1105	1065	1025	
	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	1:06	1:09	1:11	1:14	1:16	1:19	1:22	1:24	1:29	1:31	1:34	1:37	
6000 FT +3 °C	SHP	2600	2450	2305	2160	2025	1895	1770	1650	1530	1420	1310	1200	0.38
	FF—LB/HR/ENG	1495	1440	1390	1340	1290	1245	1195	1155	1110	1070	1035	995	
	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	1:07	1:09	1:12	1:15	1:17	1:20	1:23	1:26	1:30	1:33	1:37	1:40	
8000 FT −1 °C	SHP	2675	2525	2375	2225	2080	1950	1825	1700	1575	1460	1345	1230	0.40
	FF—LB/HR/ENG	1480	1430	1375	1325	1275	1225	1175	1130	1085	1045	1005	960	
	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	1:07	1:10	1:13	1:16	1:18	1:22	1:25	1:29	1:32	1:36	1:40	1:44	

Figure 33-5. Three-Engine Loiter Operating Table — Configuration A (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	2755	2600	2445	2290	2145	2010	1875	1750	1620	1500	1380	1265	0.41
	FF—LB/HR/ENG	1475	1420	1365	1315	1260	1210	1155	1110	1065	1020	975	935	
	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	1:08	1:10	1:13	1:16	1:19	1:23	1:26	1:30	1:34	1:38	1:42	1:47	
12,000 FT —9 °C	SHP	2840	2680	2520	2365	2210	2070	1935	1800	1670	1545	1425	1305	0.43
	FF—LB/HR/ENG	1475	1420	1365	1305	1250	1200	1145	1095	1050	1000	960	915	
	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	1:08	1:10	1:13	1:17	1:20	1:23	1:27	1:31	1:35	1:40	1:44	1:50	
14,000 FT —13 °C	SHP	2930	2765	2600	2440	2275	2135	1995	1855	1720	1590	1465	1345	0.45
	FF—LB/HR/ENG	1480	1420	1360	1300	1245	1190	1135	1085	1035	985	940	895	
	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	1:08	1:10	1:14	1:17	1:20	1:24	1:28	1:32	1:37	1:41	1:46	1:52	
16,000 FT —17 °C	SHP	3020	2850	2680	2515	2350	2200	2055	1910	1775	1640	1510	1385	0.47
	FF—LB/HR/ENG	1490	1425	1360	1300	1240	1185	1130	1075	1025	975	925	880	
	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	1:14	1:17	1:21	1:24	1:29	1:33	1:38	1:43	1:48	1:54	
18,000 FT —21 °C	SHP	3115	2940	2765	2590	2420	2270	2120	1970	1830	1690	1555	1425	0.49
	FF—LB/HR/ENG	1505	1435	1365	1300	1235	1180	1125	1070	1015	965	910	865	
	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	1:06	1:10	1:13	1:17	1:21	1:25	1:29	1:34	1:38	1:44	1:50	1:56	
20,000 FT —25 °C	SHP		3035	2860	2680	2500	2340	2185	2035	1885	1740	1605	1470	0.51
	FF—LB/HR/ENG		1450	1375	1305	1240	1180	1120	1060	1005	950	900	850	
	IAS—KNOTS		215	210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS		290	284	277	271	264	257	251	244	237	231	224	
	TIME—HR:MIN		1:09	1:13	1:17	1:21	1:25	1:29	1:34	1:39	1:45	1:51	1:58	
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"

Figure 33-5. Three-Engine Loiter Operating Table — Configuration A (Sheet 2 of 2)

TWO-ENGINE LOITER 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
		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	

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"

Figure 33-6. Two-Engine Loiter Operating Table — Configuration A (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: FLIGHT TESTS

FOUR-ENGINE MAXIMUM RANGE 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
		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	

Figure 33-7. Four-Engine Maximum Range Operating Table — Configuration B (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb 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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
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"

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	

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"

Figure 33-8. Three-Engine Maximum Range Operating Table — Configuration B (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

TWO-ENGINE MAXIMUM RANGE 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		4440	4250	4070	3900	3735	3575	3420	3270	3125	2985	2855	0.40
	FF—LB/HR/ENG		2330	2260	2190	2115	2060	2005	1950	1895	1840	1785	1740	
	IAS—KNOTS		247	245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS		247	245	242	240	237	235	232	230	227	225	222	
	SEG RANGE—NM		265	271	278	284	287	292	298	305	309	315	320	
2000 FT +11 °C	SHP		4490	4300	4120	3945	3780	3610	3450	3300	3155	3000	2865	0.41
	FF—LB/HR/ENG		2310	2230	2160	2095	2030	1970	1915	1855	1800	1745	1695	
	IAS—KNOTS		245	243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS		253	250	247	245	242	240	237	234	232	230	227	
	SEG RANGE—NM		274	280	286	292	298	304	310	316	322	329	334	
4000 FT +7 °C	SHP		4545	4350	4175	3995	3820	3650	3490	3330	3180	3025	2880	0.42
	FF—LB/HR/ENG		2290	2205	2135	2070	2005	1940	1880	1820	1765	1705	1650	
	IAS—KNOTS		243	241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS		258	255	253	250	247	245	242	239	237	234	231	
	SEG RANGE—NM		281	289	296	302	308	315	322	328	336	344	350	
6000 FT +3 °C	SHP		4600	4415	4230	4045	3860	3685	3525	3360	3205	3050	2905	0.44
	FF—LB/HR/ENG		2275	2185	2120	2050	1980	1915	1850	1790	1730	1670	1615	
	IAS—KNOTS		241	239	236	234	231	229	226	224	221	219	216	
	TAS—KNOTS		263	260	258	255	252	250	247	244	241	239	236	
	SEG RANGE—NM		290	298	304	310	318	326	333	341	349	357	365	
8000 FT −1 °C	SHP			4490	4285	4095	3905	3730	3560	3390	3235	3070	2920	0.45
	FF—LB/HR/ENG			2175	2110	2035	1960	1890	1825	1760	1700	1640	1585	
	IAS—KNOTS			237	234	232	229	227	224	222	219	217	214	
	TAS—KNOTS			266	263	260	257	255	252	249	246	244	241	
	SEG RANGE—NM			305	312	320	328	337	345	353	362	371	380	
10,000 FT −5 °C	SHP					4155	3955	3765	3600	3425	3260	3100	2940	0.47
	FF—LB/HR/ENG					2020	1945	1870	1805	1735	1675	1615	1555	
	IAS—KNOTS					230	227	225	222	220	217	215	212	
	TAS—KNOTS					266	263	260	257	254	251	249	246	
	SEG RANGE—NM					328	338	348	356	366	375	385	395	
12,000 FT −9 °C	SHP						4020	3815	3640	3465	3295	3125	2965	0.49
	FF—LB/HR/ENG						1935	1855	1790	1720	1655	1595	1535	
	IAS—KNOTS						225	223	220	218	215	213	210	
	TAS—KNOTS						268	266	262	260	257	254	251	
	SEG RANGE—NM						347	358	367	377	388	399	409	
14,000 FT −13 °C	SHP							3875	3685	3505	3330	3155	2990	0.51
	FF—LB/HR/ENG							1845	1780	1715	1645	1575	1515	
	IAS—KNOTS							221	218	216	213	211	208	
	TAS—KNOTS							271	268	265	262	259	256	
	SEG RANGE—NM							368	378	386	396	412	422	

Figure 33-9. Two-Engine Maximum Range Operating Table — Configuration B (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
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"

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	

Figure 33-10. Four-Engine Loiter Operating Table — Configuration B (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	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"		

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 FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2495 1605 220 220 1:02	2350 1550 215 215 1:05	2215 1500 210 210 1:07	2075 1450 205 205 1:09	1945 1400 200 200 1:11	1825 1355 195 195 1:14	1705 1310 190 190 1:16	1590 1265 185 185 1:19	1475 1225 180 180 1:22	1365 1185 175 175 1:25	1260 1145 170 170 1:28	1160 1105 165 165 1:31	0.33
2000 FT +11 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2570 1580 220 226 1:04	2415 1525 215 221 1:05	2275 1470 210 216 1:08	2135 1420 205 211 1:10	2000 1370 200 206 1:13	1875 1325 195 201 1:16	1750 1280 190 195 1:18	1630 1235 185 190 1:21	1510 1195 180 185 1:23	1405 1155 175 180 1:26	1290 1115 170 175 1:29	1190 1070 165 170 1:33	0.35
4000 FT +7 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2640 1560 220 233 1:04	2485 1500 215 228 1:07	2340 1445 210 222 1:09	2195 1395 205 217 1:11	2055 1350 200 212 1:14	1925 1300 195 206 1:17	1800 1255 190 2C1 1:20	1675 1210 185 196 1:23	1555 1165 180 190 1:26	1440 1125 175 185 1:29	1325 1085 170 180 1:32	1220 1040 165 175 1:36	0.36
6000 FT +3 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2720 1545 220 240 1:05	2560 1485 215 234 1:07	2410 1430 210 229 1:10	2260 1375 205 223 1:13	2115 1330 200 218 1:16	1980 1280 195 213 1:18	1850 1230 190 207 1:21	1725 1185 185 202 1:25	1600 1140 180 196 1:28	1480 1095 175 191 1:31	1365 1055 170 185 1:35	1255 1010 165 180 1:39	0.38
8000 FT −1 °C	SHP FF—LB/HR/ENG IAS—KNOTS TAS—KNOTS TIME—HR:MIN	2800 1535 220 247 1:05	2635 1475 215 241 1:08	2480 1415 210 236 1:11	2325 1360 205 230 1:13	2175 1310 200 225 1:16	2040 1260 195 219 1:19	1905 1210 190 214 1:23	1775 1160 185 208 1:26	1645 1115 180 202 1:29	1525 1070 175 197 1:33	1405 1025 170 191 1:37	1290 985 165 186 1:41	0.40

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	2885	2715	2555	2395	2240	2100	1960	1825	1695	1565	1445	1325	0.41
	FF—LB/HR/ENG	1530	1465	1410	1350	1300	1245	1195	1140	1095	1050	1005	960	
	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	1:11	1:14	1:17	1:20	1:24	1:28	1:31	1:35	1:40	1:44	
12,000 FT —9 °C	SHP	2970	2800	2630	2465	2310	2165	2020	1880	1745	1610	1485	1365	0.43
	FF—LB/HR/ENG	1530	1465	1405	1340	1285	1230	1180	1125	1075	1030	985	940	
	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	1:05	1:08	1:11	1:14	1:18	1:21	1:25	1:29	1:33	1:37	1:42	1:46	
14,000 FT —13 °C	SHP	3065	2885	2715	2545	2380	2225	2080	1935	1800	1660	1530	1405	0.45
	FF—LB/HR/ENG	1540	1465	1405	1340	1280	1225	1170	1115	1060	1015	965	920	
	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	1:05	1:08	1:11	1:15	1:18	1:22	1:25	1:30	1:34	1:38	1:44	1:49	
16,000 FT —17 °C	SHP	3160	2975	2800	2625	2455	2295	2145	1995	1855	1710	1575	1445	0.47
	FF—LB/HR/ENG	1550	1475	1405	1340	1280	1220	1165	1105	1050	1000	950	905	
	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	1:08	1:11	1:15	1:19	1:23	1:26	1:31	1:35	1:40	1:46	1:51	
18,000 FT —21 °C	SHP	3260	3070	2890	2710	2535	2370	2215	2060	1910	1760	1620	1490	0.49
	FF—LB/HR/ENG	1570	1495	1415	1345	1280	1215	1160	1095	1035	985	935	885	
	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	1:11	1:14	1:18	1:23	1:26	1:31	1:37	1:41	1:47	1:53	
20,000 FT —25 °C	SHP			2980	2795	2615	2445	2285	2125	1970	1820	1675	1540	0.51
	FF—LB/HR/ENG			1440	1365	1290	1220	1155	1090	1030	975	925	875	
	IAS—KNOTS			210	205	200	195	190	185	180	175	170	165	
	TAS—KNOTS			284	277	271	264	257	251	244	237	231	224	
	TIME—HR:MIN			1:10	1:13	1:17	1:22	1:26	1:32	1:37	1:42	1:48	1:55	
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"

Figure 33-11. Three-Engine Loiter Operating Table — Configuration B (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

TWO-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 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
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	

Figure 33-12. Two-Engine Loiter Operating Table — Configuration B (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				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	
MODEL P-3C		TWO-ENGINE LOITER OPERATING TABLE										CONFIGURATION "B"		

Figure 33-12. Two-Engine Loiter Operating Table — Configuration B (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

FOUR-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	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	

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"

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	

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	SHP				3485	3330	3180	3030	2890	2750	2620	2490	2370	2250	2140	0.55
	FF—LB/HR/ENG				1665	1610	1550	1495	1440	1385	1330	1280	1235	1190	1150	
	IAS—KNOTS				241	239	236	234	231	229	226	224	221	219	216	
—17 °C	TAS—KNOTS				305	302	299	296	293	290	287	284	280	278	274	
	SEG RANGE—NM				305	313	322	330	340	349	359	368	378	388	398	
18,000 FT	SHP					3390	3235	3080	2935	2795	2655	2525	2400	2275	2165	0.57
	FF—LB/HR/ENG					1610	1550	1490	1430	1370	1315	1265	1220	1170	1130	
	IAS—KNOTS					237	234	232	229	227	224	222	219	217	214	
—21 °C	TAS—KNOTS					309	305	303	299	296	293	290	287	284	280	
	SEG RANGE—NM					319	328	339	348	360	371	382	393	403	414	
20,000 FT	SHP							3130	2980	2840	2700	2560	2430	2305	2185	0.59
	FF—LB/HR/ENG							1485	1425	1365	1305	1255	1205	1155	1105	
	IAS—KNOTS							230	227	225	222	220	217	215	212	
—25 °C	TAS—KNOTS							310	306	303	300	297	293	290	287	
	SEG RANGE—NM							348	359	370	383	394	406	419	432	
22,000 FT	SHP								3035	2885	2740	2600	2465	2335	2215	0.61
	FF—LB/HR/ENG								1430	1365	1305	1250	1195	1145	1095	
	IAS—KNOTS								225	223	220	218	215	213	210	
—29 °C	TAS—KNOTS								314	310	307	304	300	297	294	
	SEG RANGE—NM								366	378	392	405	420	433	447	
24,000 FT	SHP										2785	2640	2500	2365	2235	0.63
	FF—LB/HR/ENG										1315	1255	1195	1135	1085	
	IAS—KNOTS										218	216	213	211	208	
—33 °C	TAS—KNOTS										314	311	307	304	300	
	SEG RANGE—NM										398	413	429	446	462	
26,000 FT	SHP											2685	2540	2400	2265	0.66
	FF—LB/HR/ENG											1265	1200	1140	1085	
	IAS—KNOTS											214	211	209	206	
—37 °C	TAS—KNOTS											318	315	311	308	
	SEG RANGE—NM											419	437	456	472	
28,000 FT	SHP												2580	2435	2295	0.68
	FF—LB/HR/ENG												1210	1150	1095	
	IAS—KNOTS												209	207	204	
—41°C	TAS—KNOTS												322	318	315	
	SEG RANGE—NM												444	463	480	
30,000 FT	SHP														2330	0.70
	FF—LB/HR/ENG														1105	
	IAS—KNOTS														202	
—44°C	TAS—KNOTS														322	
	SEG RANGE—NM														487	
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"

Figure 33-14. Three-Engine Maximum Range Operating Table — Configuration C (Sheet 2 of 2)

TWO-ENGINE MAXIMUM RANGE OPERATING TABLE

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

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			4475	4290	4100	3925	3755	3590	3435	3280	3125	2990	0.40
	FF—LB/HR/ENG			2345	2275	2210	2145	2080	2015	1955	1900	1845	1790	
	IAS—KNOTS			245	242	240	237	235	232	230	227	225	222	
	TAS—KNOTS			245	242	240	237	235	232	230	227	225	222	
	SEG RANGE—NM			260	267	272	276	283	288	294	299	305	310	
2000 FT +11 °C	SHP			4530	4335	4145	3965	3790	3625	3465	3305	3155	3010	0.41
	FF—LB/HR/ENG			2320	2245	2170	2105	2040	1975	1915	1860	1800	1750	
	IAS—KNOTS			243	240	238	235	233	230	228	225	223	220	
	TAS—KNOTS			250	247	245	242	240	237	234	232	230	227	
	SEG RANGE—NM			270	275	282	288	294	300	306	312	318	325	
4000 FT +7 °C	SHP			4590	4390	4190	4005	3830	3660	3495	3335	3180	3030	0.42
	FF—LB/HR/ENG			2300	2220	2145	2075	2005	1945	1880	1820	1765	1710	
	IAS—KNOTS			241	238	236	233	231	228	226	223	221	218	
	TAS—KNOTS			255	253	250	247	245	242	239	237	234	231	
	SEG RANGE—NM			278	284	290	298	305	312	318	325	332	338	
6000 FT +3 °C	SHP				4440	4245	4055	3870	3695	3525	3360	3205	3055	0.44
	FF—LB/HR/ENG				2205	2120	2050	1980	1915	1850	1790	1730	1670	
	IAS—KNOTS				236	234	231	229	226	224	221	219	216	
	TAS—KNOTS				258	255	252	250	247	244	241	239	236	
	SEG RANGE—NM				292	300	308	314	322	330	337	346	353	
8000 FT −1 °C	SHP					4300	4105	3915	3735	3555	3390	3230	3075	0.45
	FF—LB/HR/ENG					2100	2030	1955	1890	1820	1760	1700	1640	
	IAS—KNOTS					232	229	227	224	222	219	217	214	
	TAS—KNOTS					260	257	255	252	249	246	244	241	
	SEG RANGE—NM					309	317	326	334	342	351	358	367	
10,000 FT −5 °C	SHP						4160	3965	3775	3590	3410	3255	3095	0.47
	FF—LB/HR/ENG						2015	1940	1870	1795	1735	1670	1610	
	IAS—KNOTS						227	225	222	220	217	215	212	
	TAS—KNOTS						263	260	257	254	251	249	246	
	SEG RANGE—NM						326	335	344	354	362	372	380	
12,000 FT −9 °C	SHP							4010	3815	3630	3455	3285	3120	0.49
	FF—LB/HR/ENG							1935	1855	1780	1715	1655	1590	
	IAS—KNOTS							223	220	218	215	213	210	
	TAS—KNOTS							266	262	260	257	254	251	
	SEG RANGE—NM							343	354	365	374	384	394	
14,000 FT −13 °C	SHP								3865	3675	3495	3320	3145	0.51
	FF—LB/HR/ENG								1855	1770	1705	1640	1575	
	IAS—KNOTS								218	216	213	211	208	
	TAS—KNOTS								268	265	262	259	256	
	SEG RANGE—NM								362	375	384	396	407	

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"

Figure 33-15. Two-Engine Maximum Range Operating Table — Configuration C (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

FOUR-ENGINE LOITER 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
		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	

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	

MODEL P-3C — FOUR-ENGINE LOITER OPERATING TABLE — CONFIGURATION "C"

Figure 33-16. Four-Engine Loiter Operating Table — Configuration C (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

THREE-ENGINE LOITER 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
		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	

Figure 33-17. Three-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	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"

Figure 33-17. Three-Engine Loiter Operating Table — Configuration C (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

TWO-ENGINE LOITER 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 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
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	

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					3745	3505	3260	3030	2805	2585	2370	2170	0.41
	FF—LB/HR/ENG					1865	1775	1685	1595	1515	1430	1350	1275	
	IAS—KNOTS					200	195	190	185	180	175	170	165	
	TAS—KNOTS					232	226	220	214	208	203	197	191	
	TIME—HR:MIN					1:20	1:24	1:29	1:34	1:39	1:45	1:51	1:57	
12,000 FT —9 °C	SHP						3610	3360	3120	2890	2665	2445	2240	0.43
	FF—LB/HR/ENG						1785	1690	1600	1510	1425	1345	1265	
	IAS—KNOTS						195	190	185	180	175	170	165	
	TAS—KNOTS						233	227	221	215	209	203	197	
	TIME—HR:MIN						1:24	1:29	1:34	1:39	1:45	1:51	1:58	
14,000 FT —13 °C	SHP							3465	3220	2980	2750	2515	2305	0.45
	FF—LB/HR/ENG							1700	1610	1515	1430	1345	1265	
	IAS—KNOTS							190	185	180	175	170	165	
	TAS—KNOTS							234	228	222	216	210	203	
	TIME—HR:MIN							1:28	1:33	1:39	1:45	1:51	1:59	
16,000 FT —17 °C	SHP								3380	3075	2835	2600	2380	0.47
	FF—LB/HR/ENG								1620	1525	1435	1350	1260	
	IAS—KNOTS								185	180	175	170	165	
	TAS—KNOTS								235	229	222	216	210	
	TIME—HR:MIN								1:33	1:38	1:45	1:51	1:59	
18,000 FT —21 °C	SHP										2930	2685	2455	0.49
	FF—LB/HR/ENG										1445	1355	1260	
	IAS—KNOTS										175	170	165	
	TAS—KNOTS										230	223	217	
	TIME—HR:MIN										1:44	1:51	1:59	
20,000 FT —25 °C	SHP											2770	2530	0.51
	FF—LB/HR/ENG											1365	1265	
	IAS—KNOTS											170	165	
	TAS—KNOTS											231	224	
	TIME—HR:MIN											1:50	1:58	
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"

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	1360	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	

Figure 33-19. Four-Engine Maximum Range Operating Table — Configuration D (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb 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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
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"

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 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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
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	

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"

Figure 33-20. Three-Engine Maximum Range Operating Table — Configuration D (Sheet 2 of 2)

FOUR-ENGINE LOITER OPERATING TABLE

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

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	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	
+15 °C	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	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	
+11 °C	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	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	
+7 °C	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	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	
+3 °C	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	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	
−1 °C	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	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	
−5 °C	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	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	
−9 °C	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	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	
−13 °C	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	

Figure 33-21. Four-Engine Loiter Operating Table — Configuration D (Sheet 1 of 2)

ALTITUDE STD TEMP		Gross Weight Bracket—1000 Lb 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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
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"

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 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	AIRSPEED CORRECTION FACTORS (ADD ABOVE STD) ΔTAS/°C
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	

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"

Figure 33-22. Three-Engine Loiter Operating Table — Configuration D (Sheet 2 of 2)

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

FOUR-ENGINE MAXIMUM RANGE OPERATING TABLE

CONFIGURATION "E"

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	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	
	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 +11°C	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	
	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 +7°C	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	
	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 +3°C	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	
	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 −1°C	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	
	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	

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) $\Delta TAS/^oC$
		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^oC	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^oC	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^oC	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^oC	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^oC	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^oC	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) $\Delta SHP/^oC$		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"

Figure 33-23. Four-Engine Maximum Range Operating Table — Configuration E (Sheet 2 of 2)

INDEX

C

J

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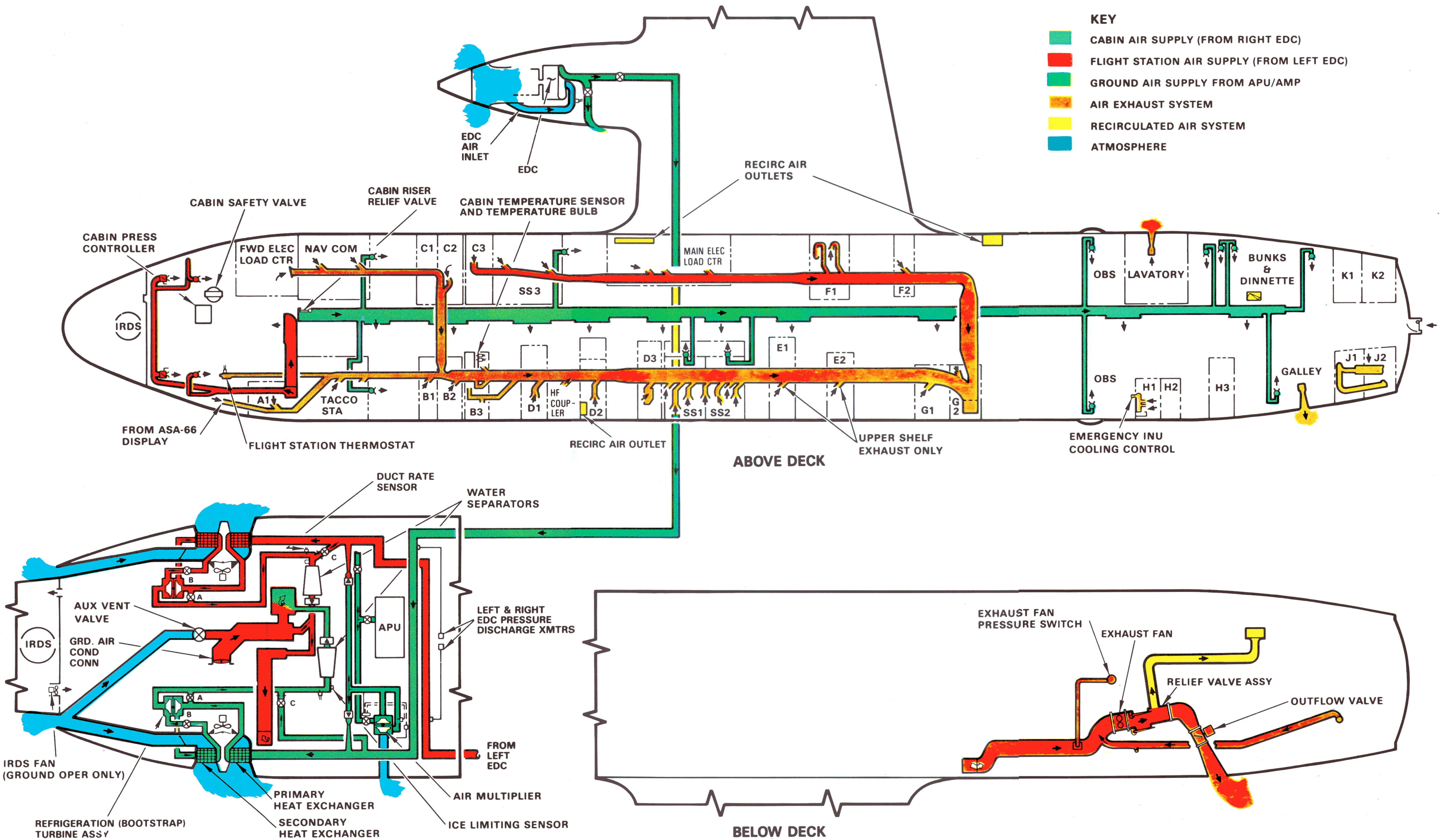
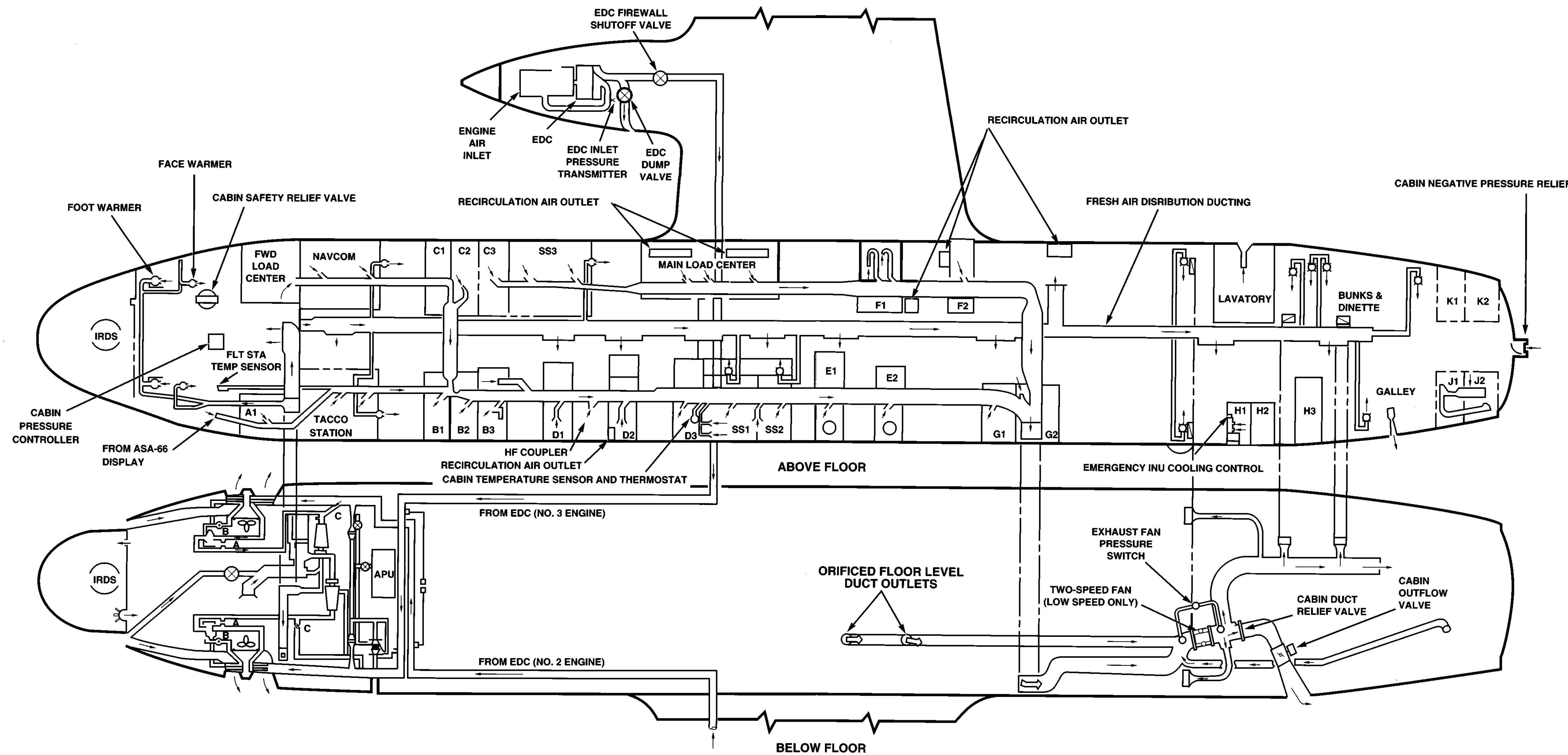
U

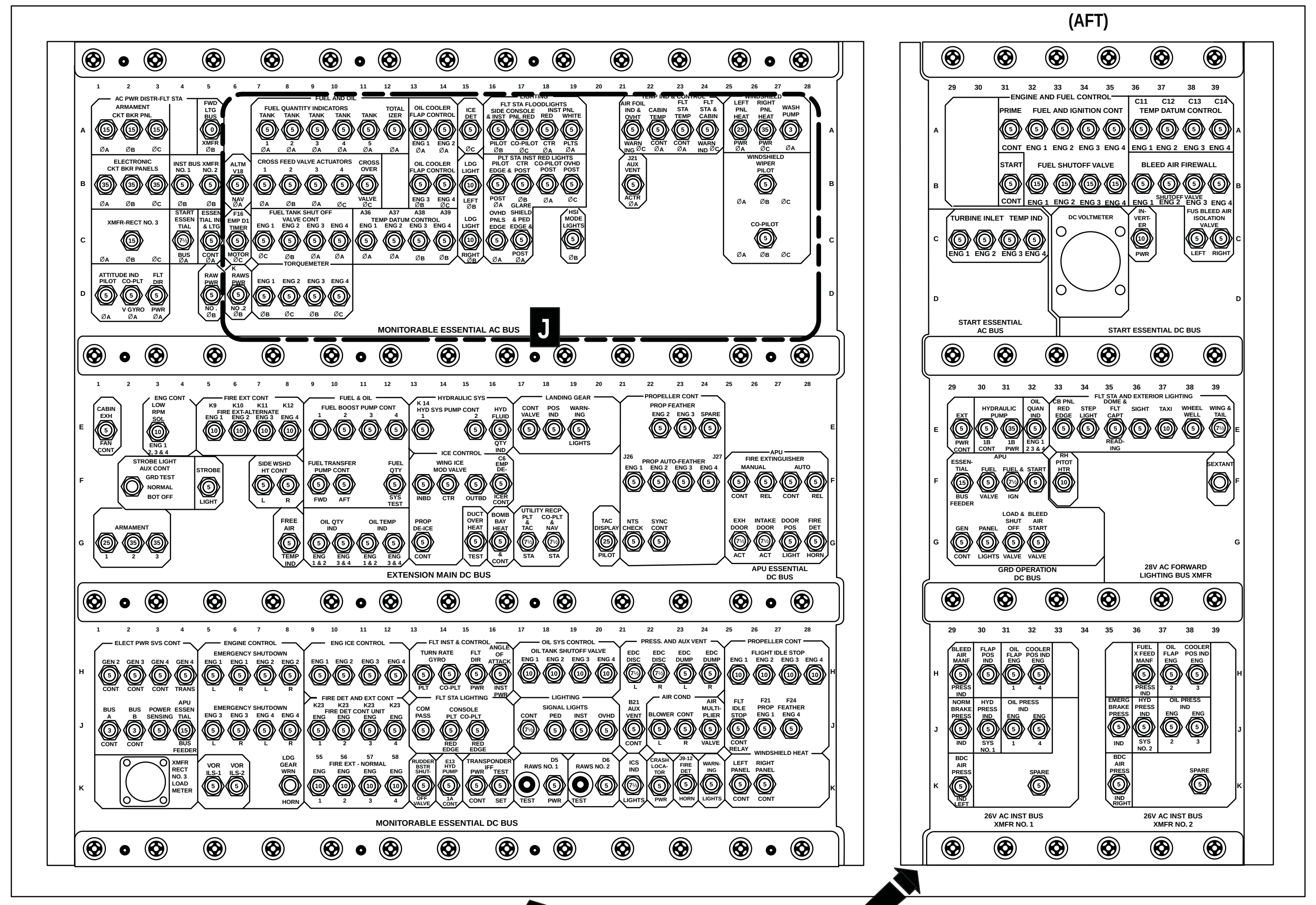


Environmental Control System, Air Distribution System, and Air Exhaust System — Update II Aircraft

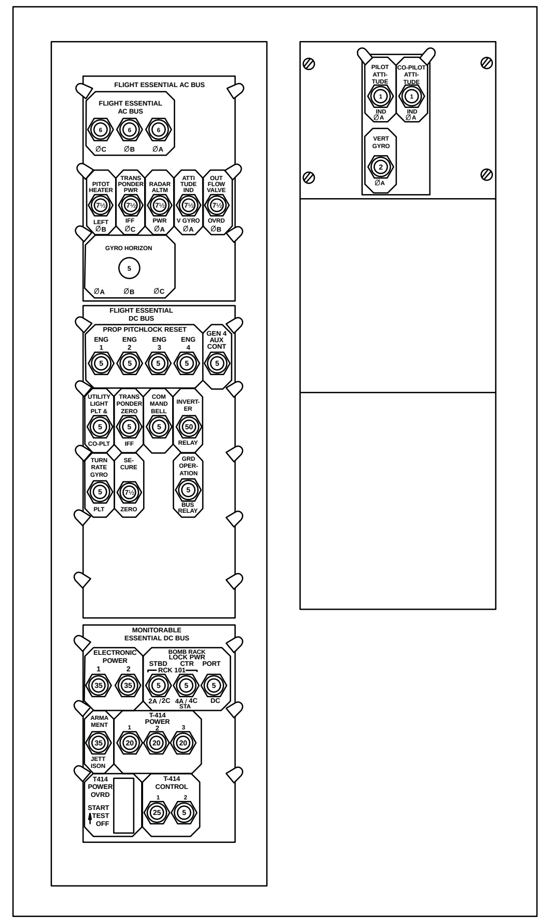


Air Distribution System, Exhaust System, and Related Components — Aircraft BuNo 161410 and Subsequent and Aircraft Incorporating AFC 450

FORWARD LOAD CENTER CIRCUIT BREAKER PANELS

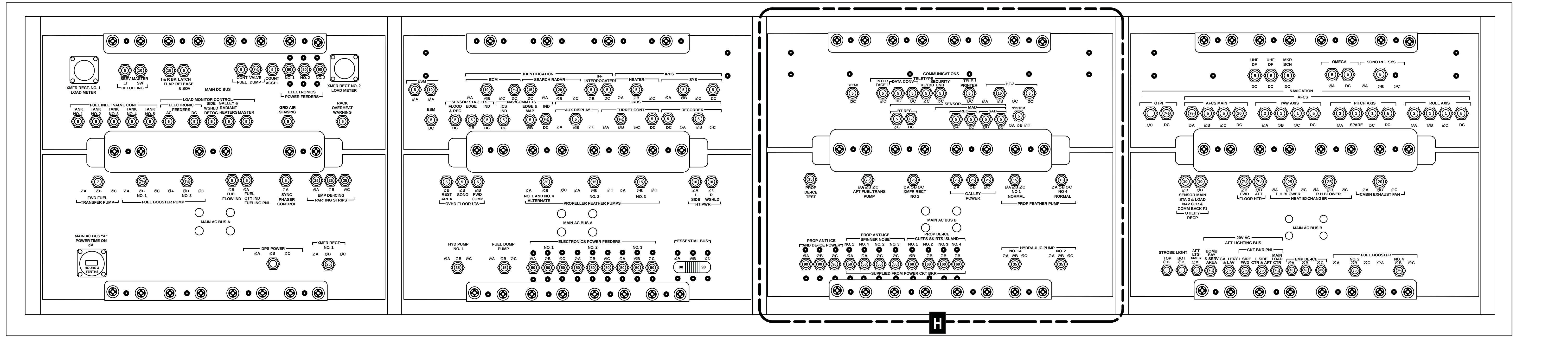


FORWARD LOAD CENTER
LOWER CIRCUIT BREAKER PANELS



DETAIL A

MAIN LOAD CENTER CIRCUIT BREAKER PANELS



DETAIL B

NOTE

ON AIRCRAFT EQUIPPED WITH SASP, THE FUEL DUMP PUMP THREE-PHASE 15-AMP AC CIRCUIT BREAKER IS RELOCATED AND REPLACED BY THE ACOUSTIC SYS ASP POWER THREE-PHASE 15-AMP AC CIRCUIT BREAKER.

(NONUPDATE IN AIRCRAFT)

NOTE

ON AIRCRAFT EQUIPPED WITH ASQ-10 THE MAD SYS CIRCUIT BREAKER HAS A SINGLE-PHASE 5-AMP A/C CIRCUIT BREAKER

NOTE

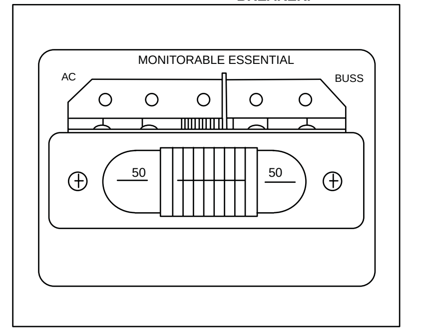
1 ON AIRCRAFT EQUIPPED WITH ARN-197 THE MKR BCN CIRCUIT BREAKER HAS BEEN REMOVED

2 ON AIRCRAFT EQUIPPED WITH LTN-211 OMEGA, A 5-AMPERE LORAN CIRCUIT BREAKER HAS BEEN REPLACED BY TWO OMEGA CIRCUIT BREAKERS

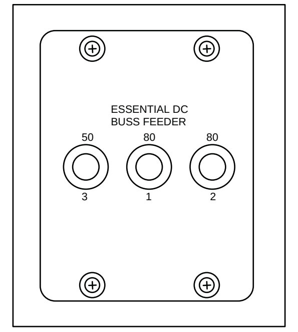
3 ON AIRCRAFT EQUIPPED WITH ARN-99, A 7.5-AMPERE OMEGA CIRCUIT BREAKER REPLACES THE 5-AMPERE LORAN CIRCUIT BREAKER

4 ON AIRCRAFT EQUIPPED WITH SASP THE OTPI CIRCUIT BREAKERS HAVE BEEN REMOVED

5 AIRCRAFT WITH ASW-31 AFCS HAVE 16 CIRCUIT BREAKERS LABELED AFCS. AIRCRAFT WITH PB-20N AUTOPILOT HAVE 4 CIRCUIT BREAKERS LABELED AUTOPILOT



DETAIL C

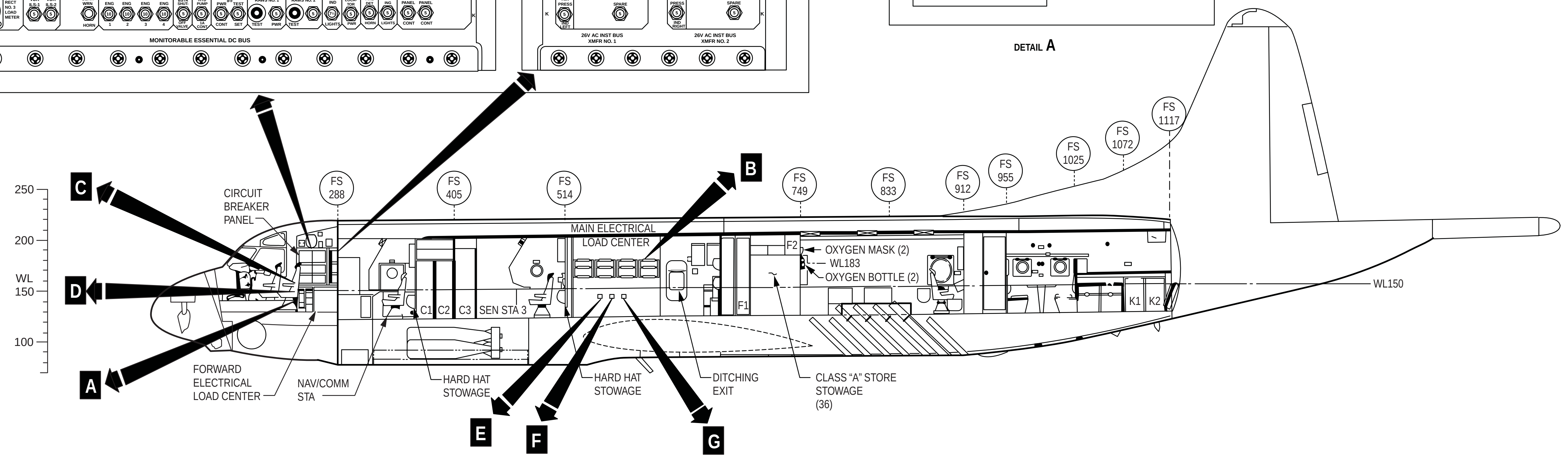


DETAIL D

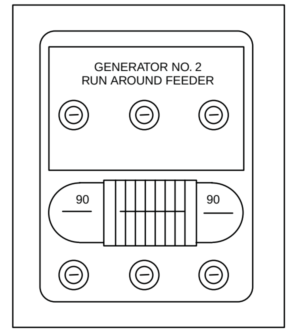
NOTE

1 VOR-ILS-1 AND VOR-ILS-2 CIRCUIT BREAKERS ON AIRCRAFT EQUIPPED WITH ARN-197 VOR SYSTEM

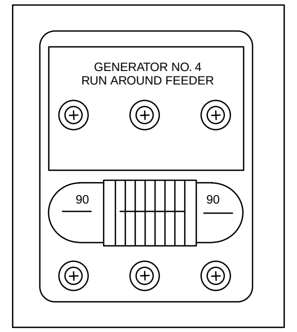
2 ALTM VIB NAV CIRCUIT BREAKER ON NUD AIRCRAFT



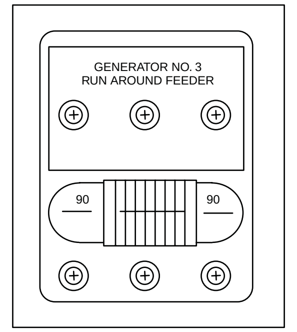
STARBOARD SIDE LOOKING OUTBOARD



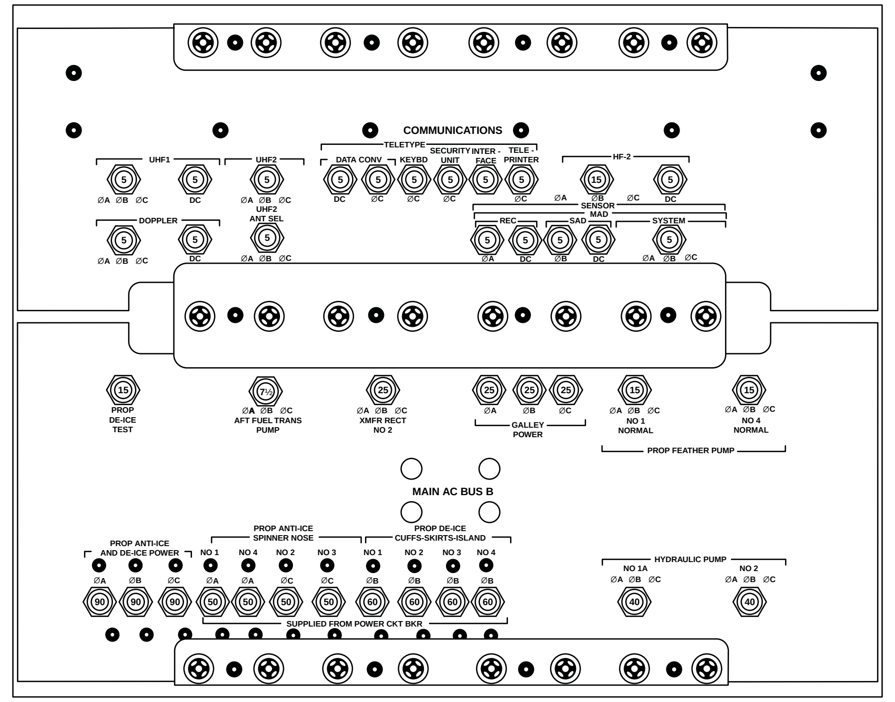
DETAIL E



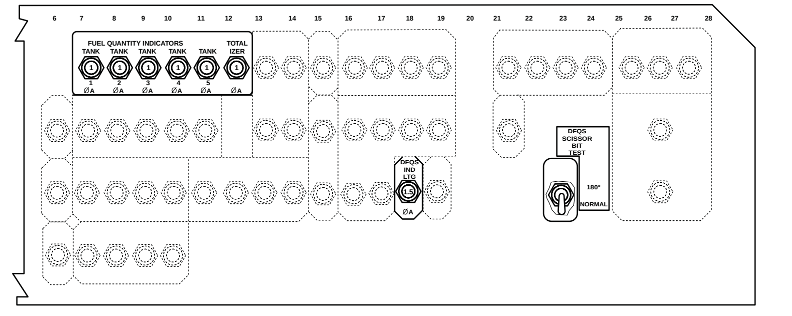
DETAIL F



DETAIL G



DETAIL H
(AIRCRAFT EQUIPPED WITH SASP)



DETAIL J
(AIRCRAFT INCORPORATING AFC-578)

Power istribution Circuit reaker Panels

Power istribution Circuit reaker Panels
ircraft Prior to pdate

NOTE

1. LOGIC UNIT NO. 4 CIRCUIT BREAKER HAS BEEN REMOVED ON UPDATE III AIRCRAFT INCORPORATING MODERNIZED LOGIC UNITS.

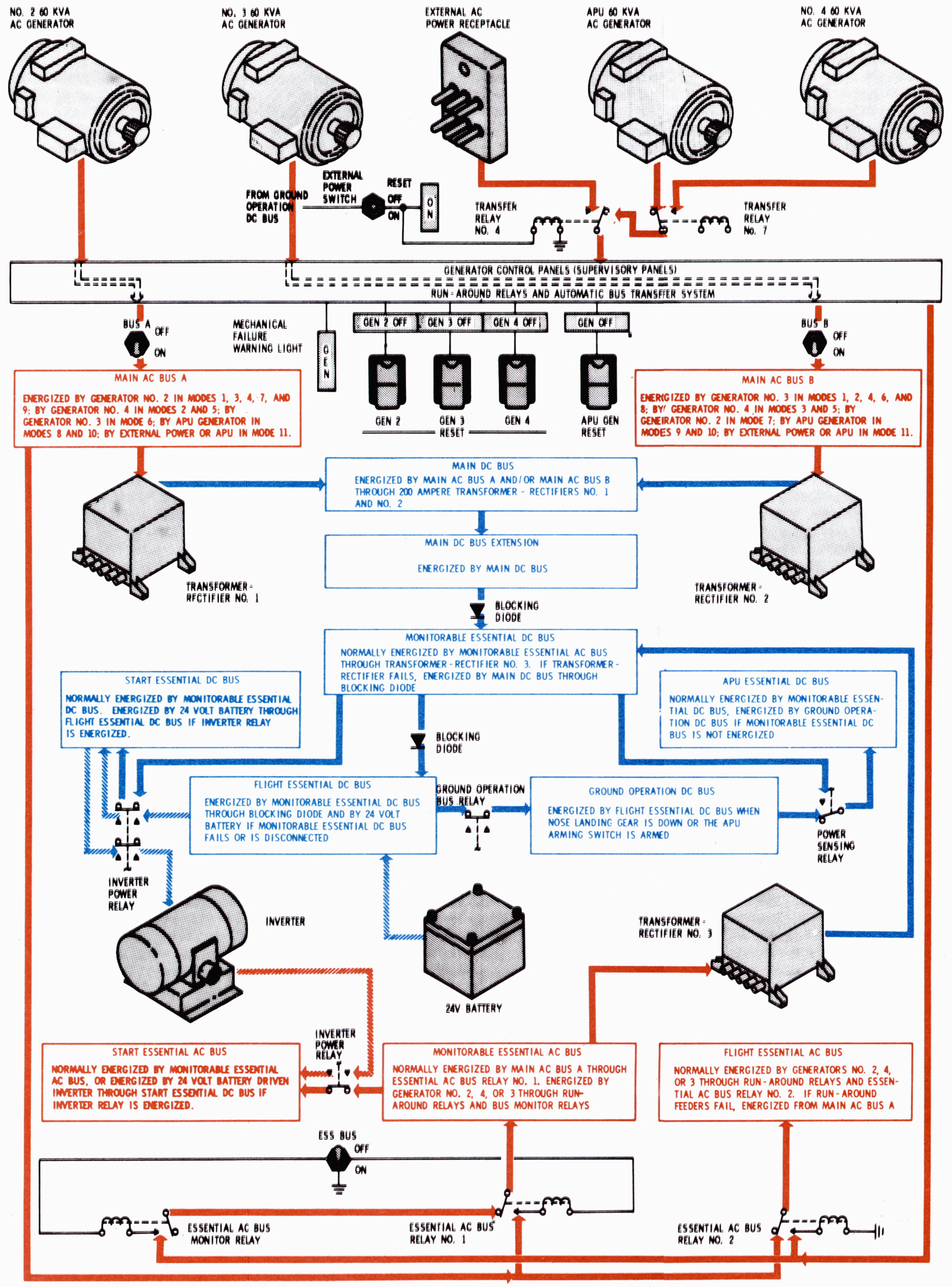
Power istribution Circuit realer Panels
pdate ircraft

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	SEDC 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	

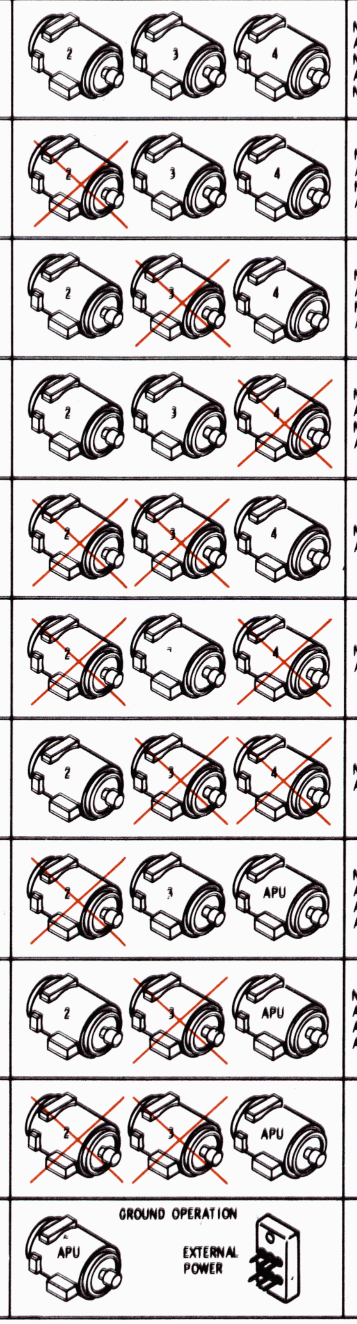
Transfer/Runaround System Priority

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.	GOB 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.

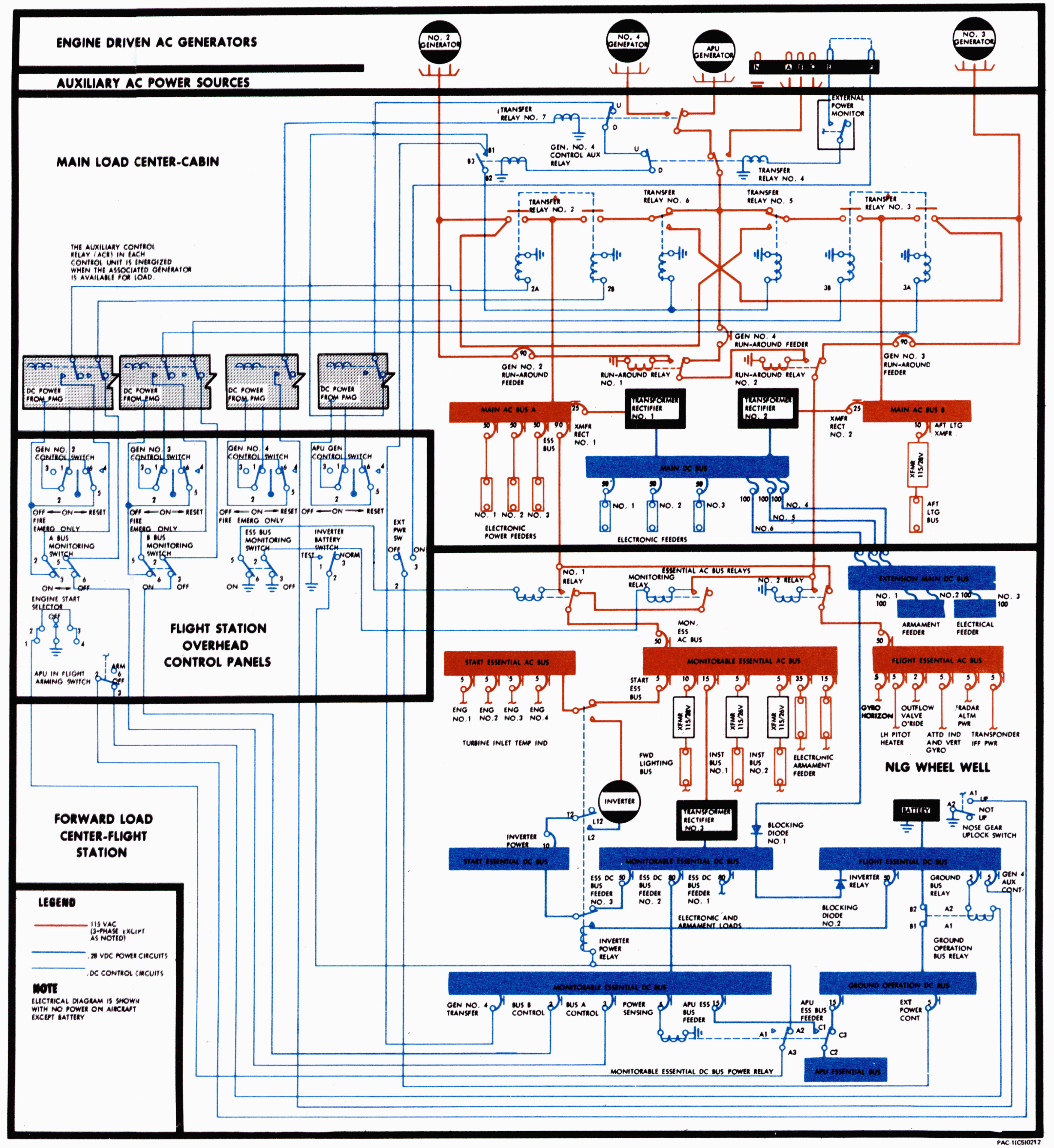
Transfer Relay Purposes and Power Sources



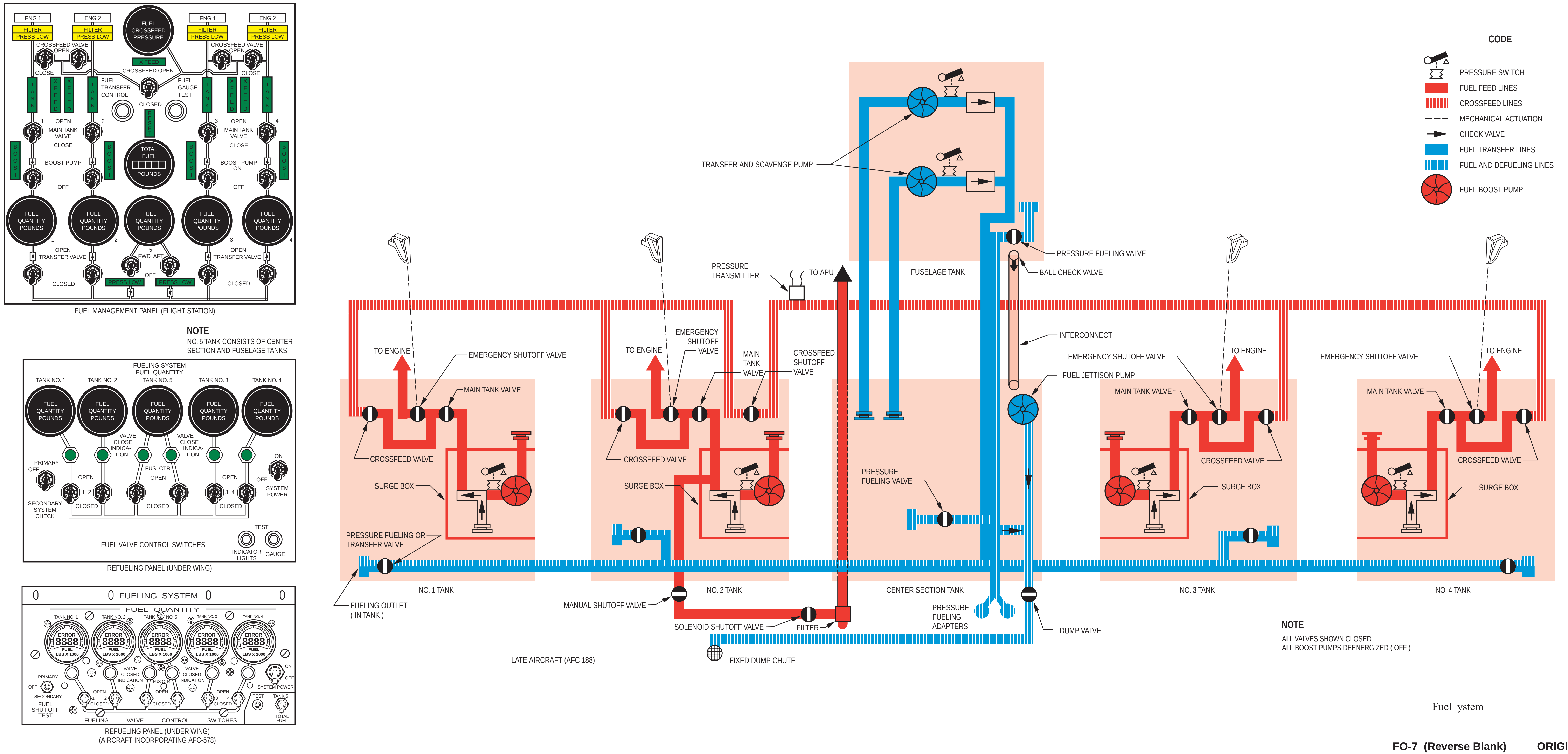
CODE
- NORMAL 115 VAC 3Ø EXCEPT AS NOTED
- EMERGENCY AC
- NORMAL 28 VDC POWER
- EMERGENCY DC
- CONTROL POWER
- MECHANICAL LINKAGE



MODE	GENERATORS	OPERATION
1		NO. 2 GENERATOR ENERGIZES MAIN AC BUS A NO. 3 GENERATOR ENERGIZES MAIN AC BUS B NO. 4 GENERATOR - SPARE
2		NO. 3 GENERATOR ENERGIZES MAIN AC BUS B NO. 4 GENERATOR ENERGIZES MAIN AC BUS A
3		NO. 2 GENERATOR ENERGIZES MAIN AC BUS A NO. 4 GENERATOR ENERGIZES MAIN AC BUS B
4		NO. 2 GENERATOR ENERGIZES MAIN AC BUS A NO. 3 GENERATOR ENERGIZES MAIN AC BUS B
5		NO. 4 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
6		NO. 3 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
7		NO. 2 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
8		NO. 3 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
9		NO. 2 GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
10		NO. 3 GENERATOR ENERGIZES MAIN AC BUS B APU GENERATOR ENERGIZES MAIN AC BUS A
11		NO. 2 GENERATOR ENERGIZES MAIN AC BUS A APU GENERATOR ENERGIZES MAIN AC BUS B
12		APU GENERATOR ENERGIZES MAIN AC BUS A AND MAIN AC BUS B
13	GROUND OPERATION / EXTERNAL POWER	APU GENERATOR OR EXTERNAL POWER ENERGIZES MAIN AC BUS A AND MAIN AC BUS B

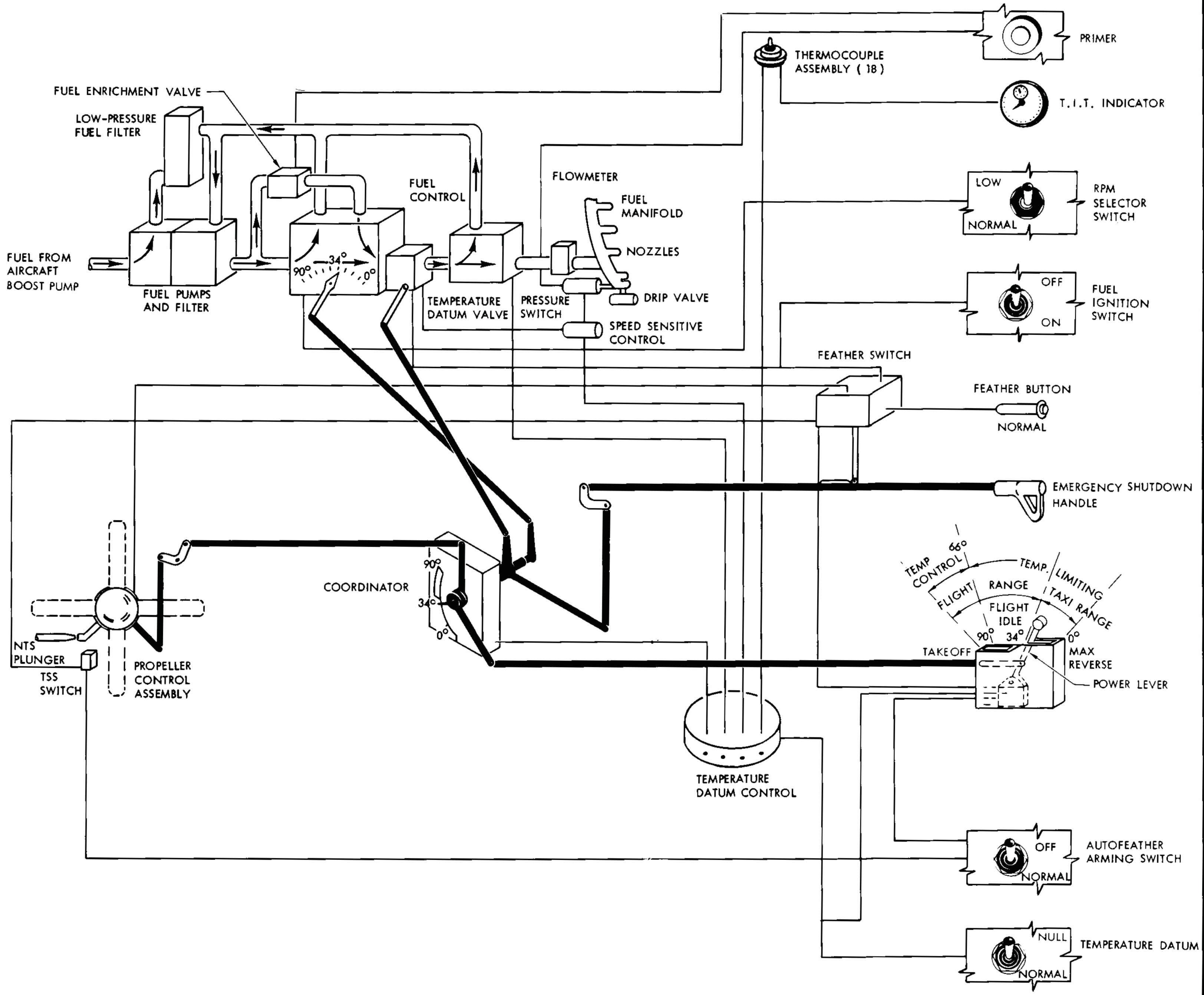


Electrical Power Distribution and Control

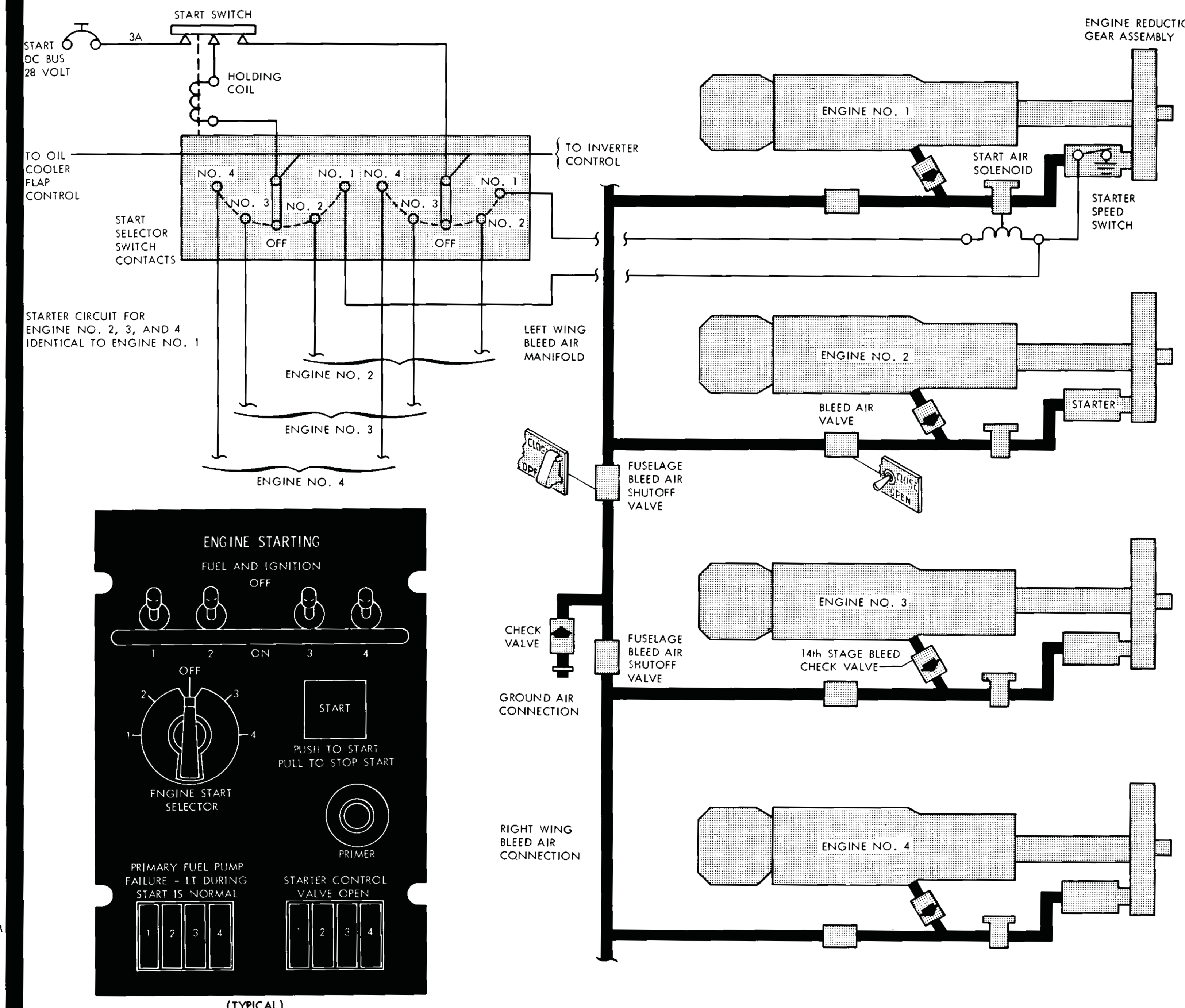

CODE
PRESSURE SWITCH
FUEL FEED LINES
CROSSFEED LINES
MECHANICAL ACTUATION
CHECK VALVE
FUEL TRANSFER LINES
FUEL AND DEFUELING LINES
FUEL BOOST PUMP
FUEL MANAGEMENT PANEL (FLIGHT STATION)
NOTE
NO. 5 TANK CONSISTS OF CENTER SECTION AND FUSELAGE TANKS
FUELING SYSTEM FUEL QUANTITY
FUEL VALVE CONTROL SWITCHES
REFUELING PANEL (UNDER WING)
FUELING SYSTEM
FUEL QUANTITY
REFUELING PANEL (UNDER WING)
(AIRCRAFT INCORPORATING AFC-578)
TRANSFER AND SCAVENGE PUMP
PRESSURE FUELING VALVE
BALL CHECK VALVE
FUSELAGE TANK
PRESSURE TRANSMITTER
TO APU
INTERCONNECT
FUEL JETTISON PUMP
TO ENGINE
EMERGENCY SHUTOFF VALVE
MAIN TANK VALVE
CROSSFEED VALVE
SURGE BOX
MAIN TANK VALVE
CROSSFEED SHUTOFF VALVE
PRESSURE FUELING VALVE
PRESSURE FUELING OR TRANSFER VALVE
FUELING OUTLET (IN TANK)
NO. 1 TANK
NO. 2 TANK
CENTER SECTION TANK
NO. 3 TANK
NO. 4 TANK
MANUAL SHUTOFF VALVE
SOLENOID SHUTOFF VALVE
FILTER
PRESSURE FUELING ADAPTERS
DUMP VALVE
FIXED DUMP CHUTE
LATE AIRCRAFT (AFC 188)
NOTE
ALL VALVES SHOWN CLOSED
ALL BOOST PUMPS DEENERGIZED (OFF)

Fuel ystem

POWER UNIT CONTROLS



ENGINE PNEUMATIC STARTING SYSTEM



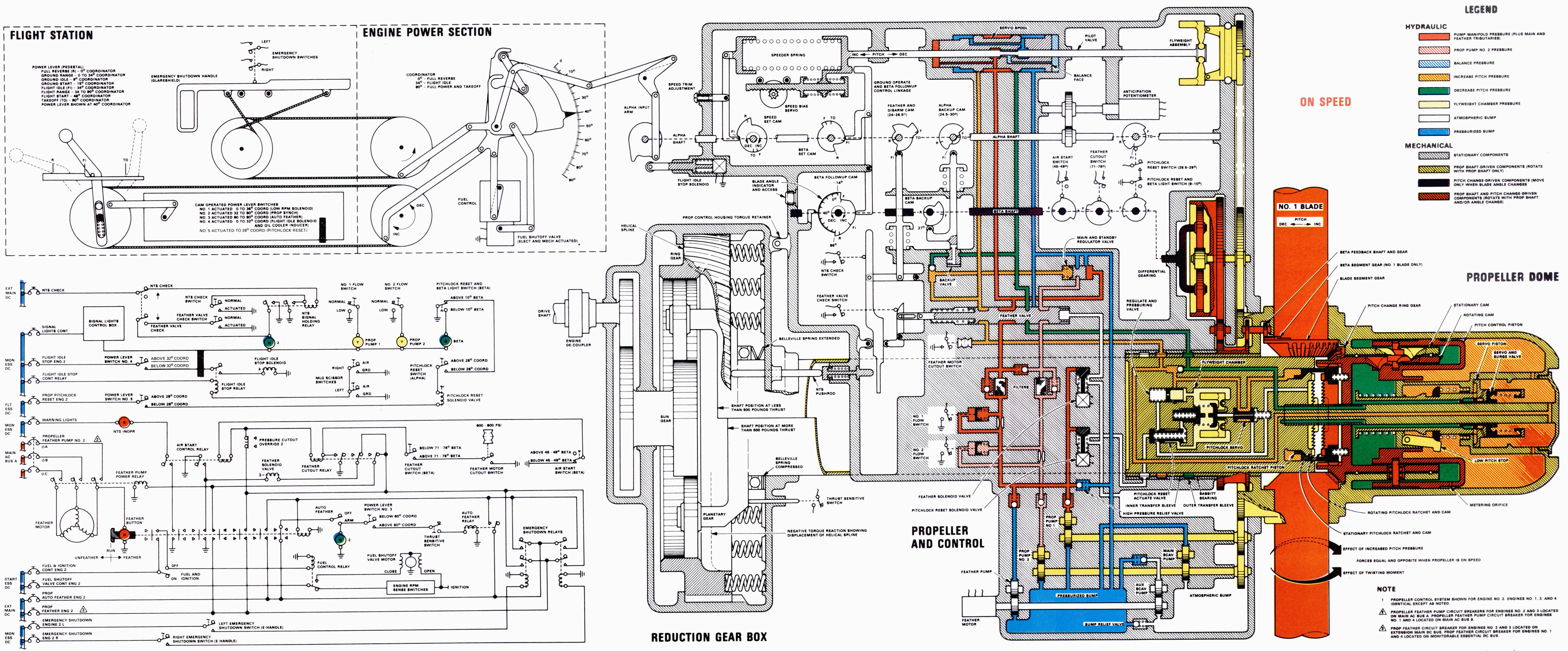
(TYPICAL)

NOTE

STARTER VALVE LIGHTS INSTALLED IF AFC 255 INCORPORATED

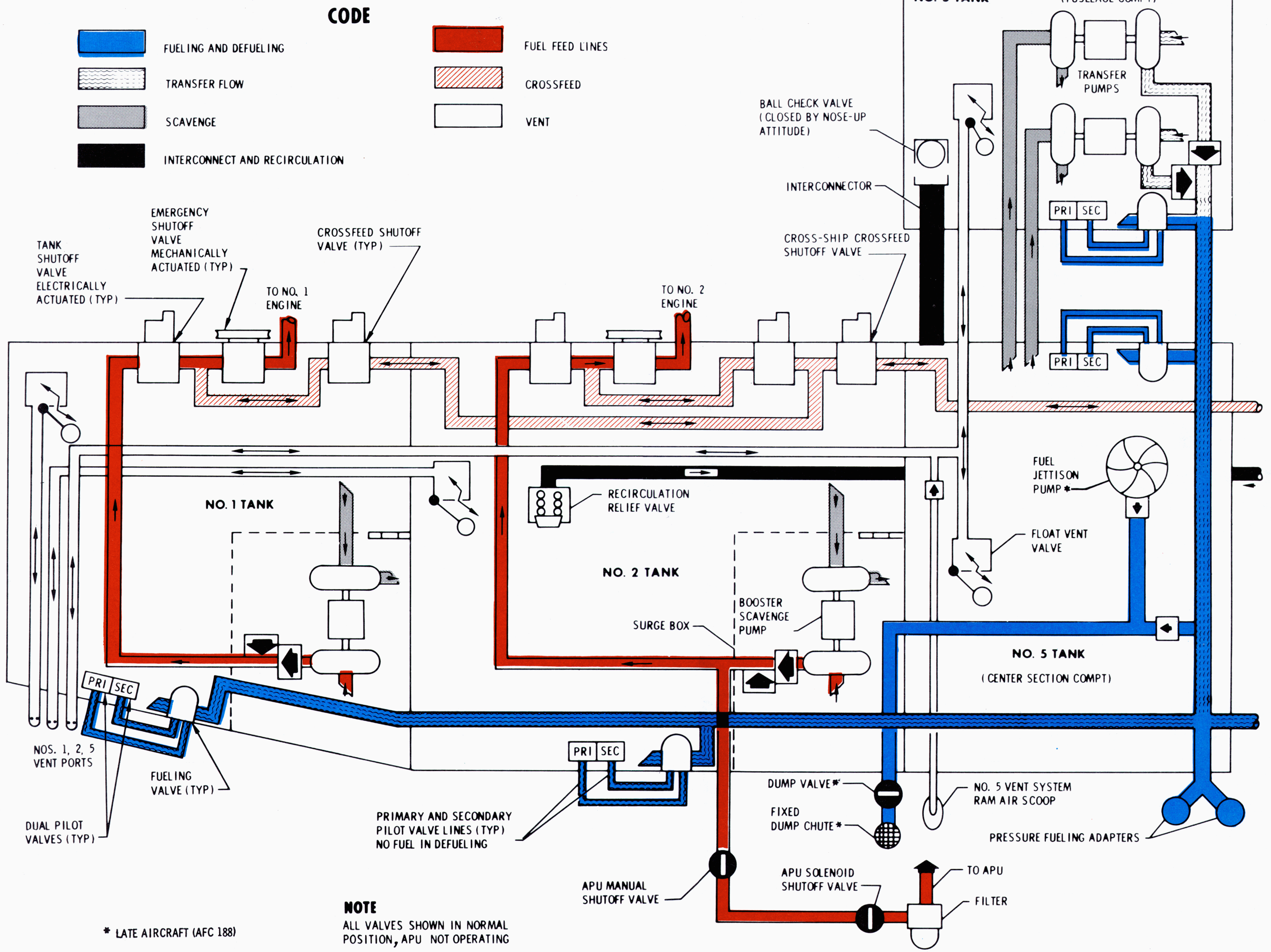
PAC-1(D)0259

Power Unit Controls/Engine Pneumatic Starting System



Propeller Control Master Schematic

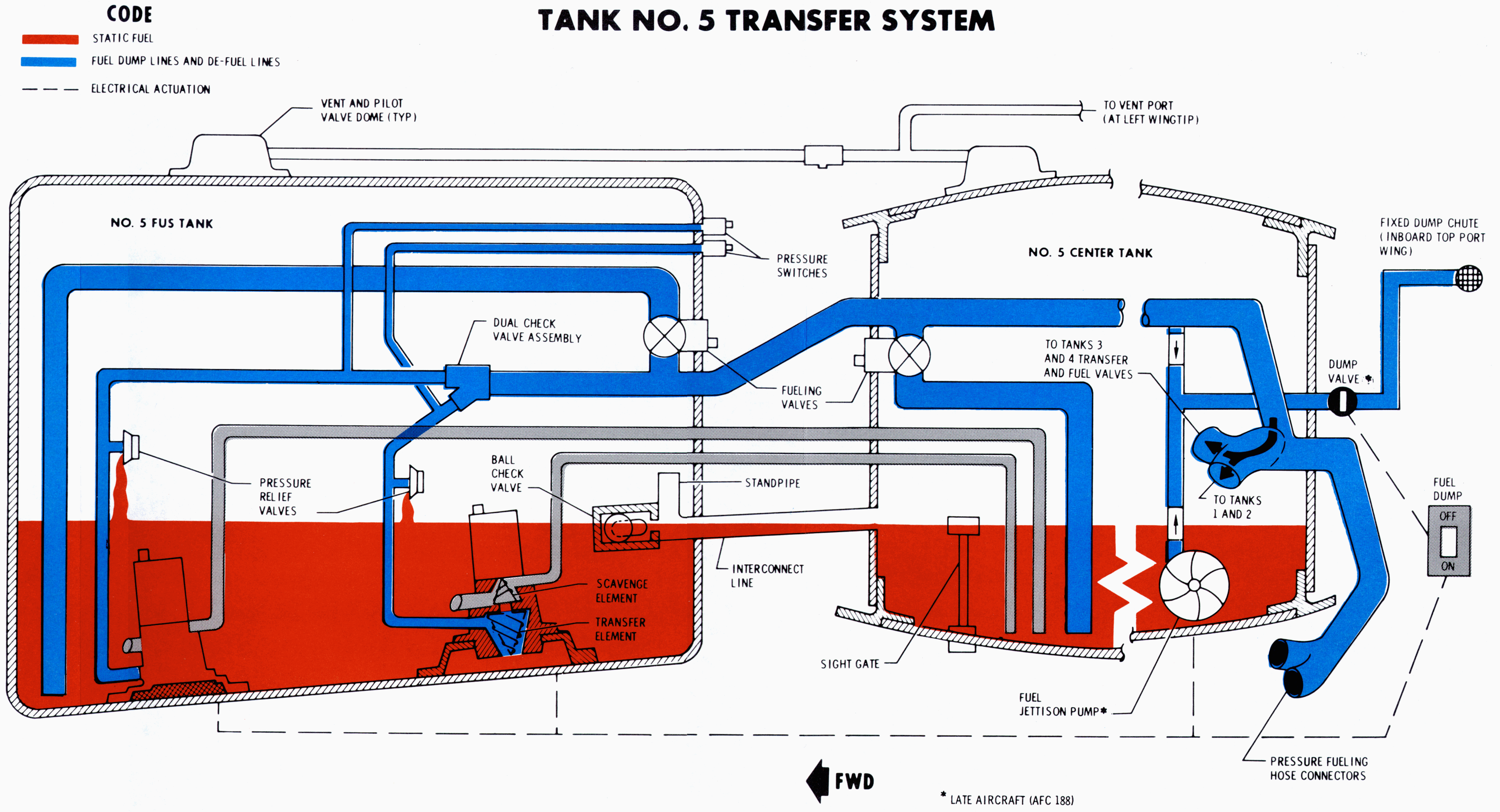
FUEL FLOW



* LATE AIRCRAFT (AFC 188)

NOTE
ALL VALVES SHOWN IN NORMAL POSITION, APU NOT OPERATING

TANK NO. 5 TRANSFER SYSTEM

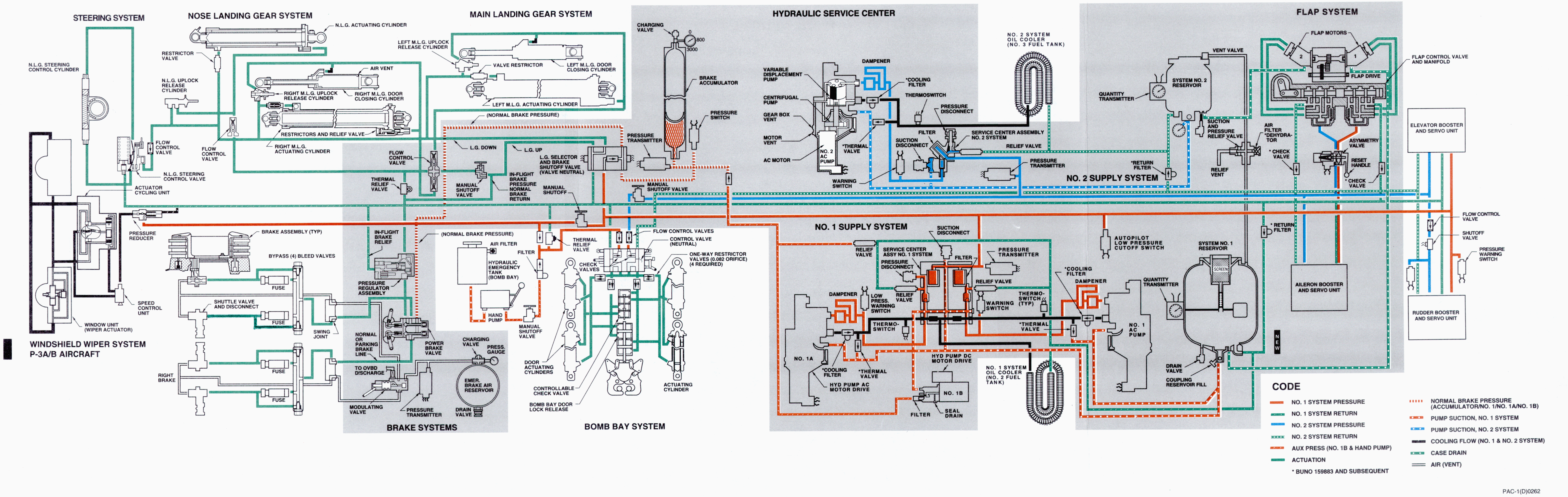


* LATE AIRCRAFT (AFC 188)

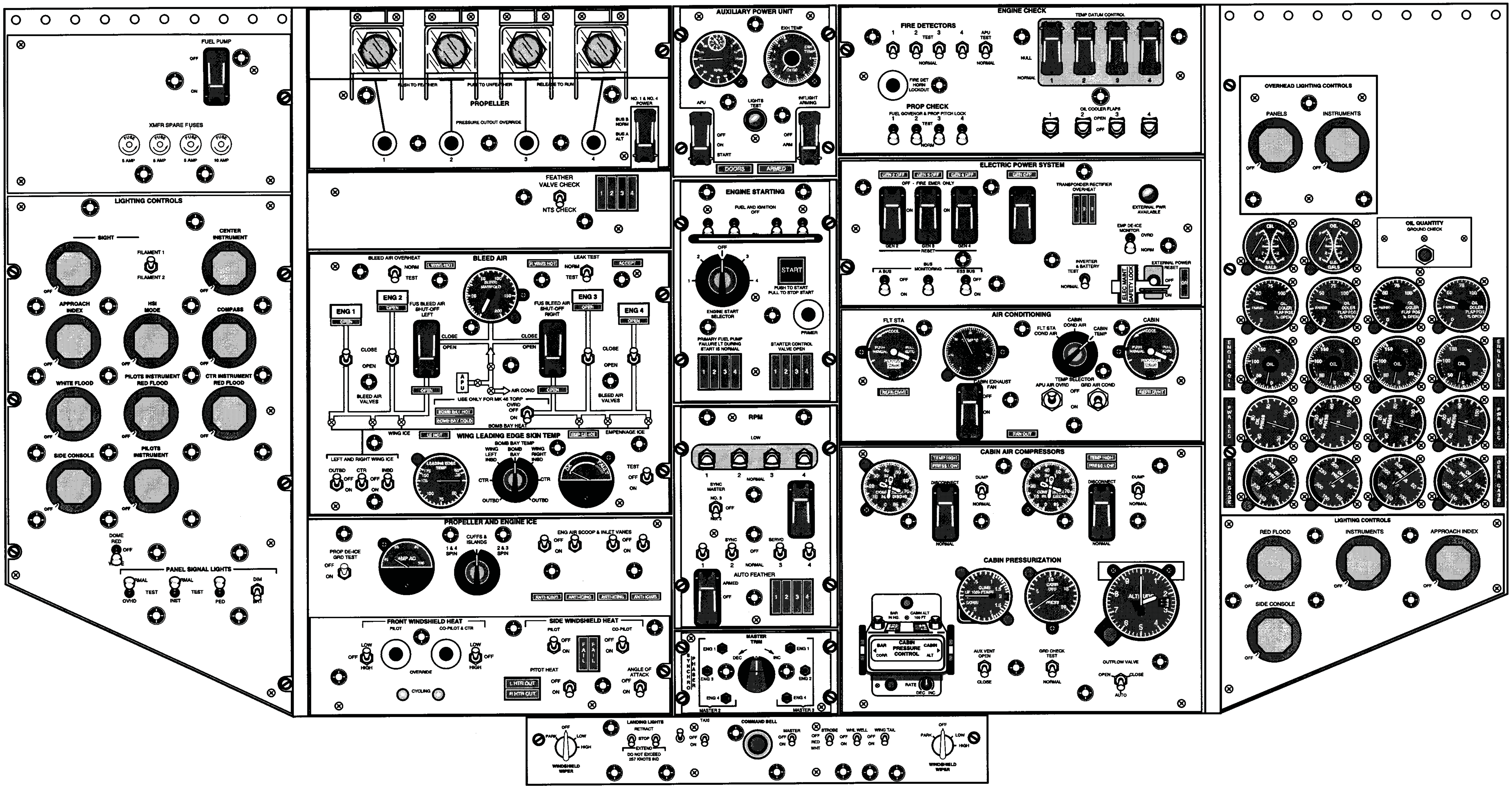
PAC-1(C5)0242

Fuel Flow/Tank No. 5 Transfer System

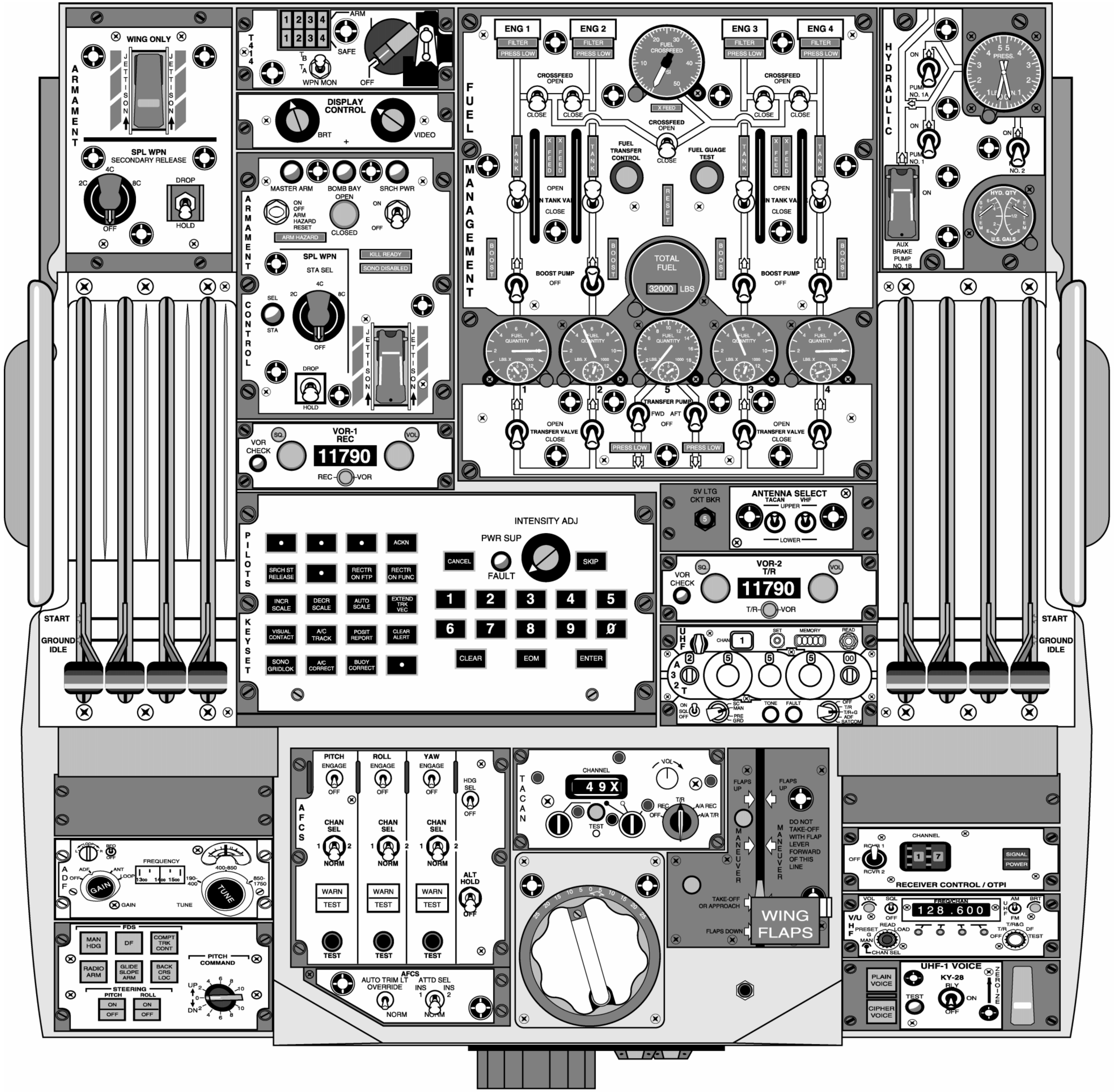
HYDRAULIC SYSTEM



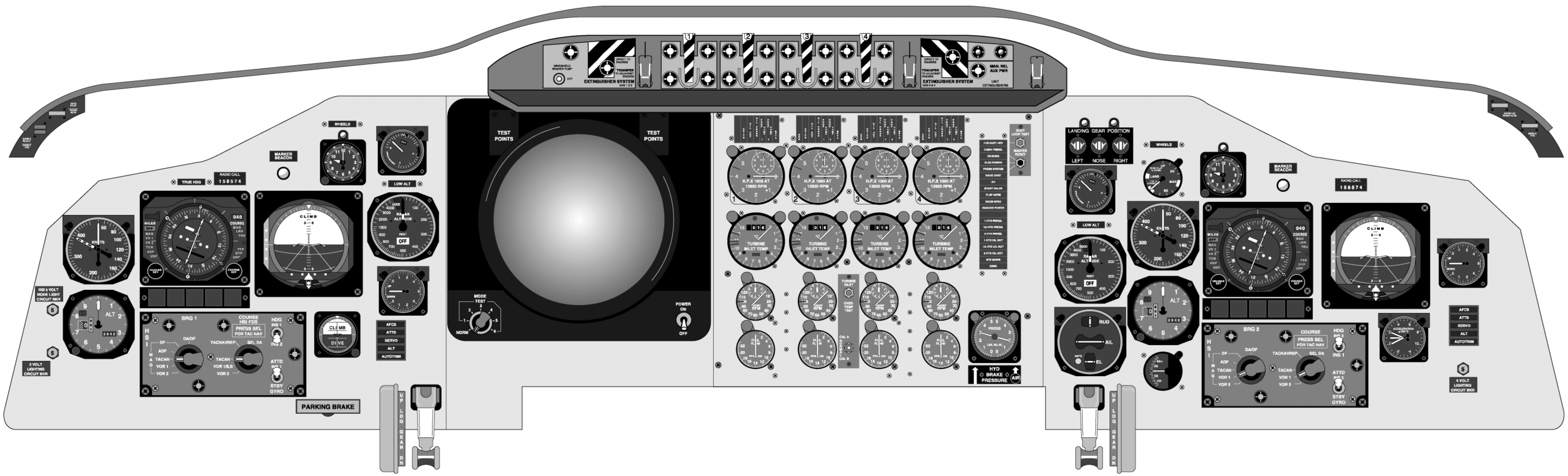
Hydraulic System — Aircraft BuNo 156507 to 159875



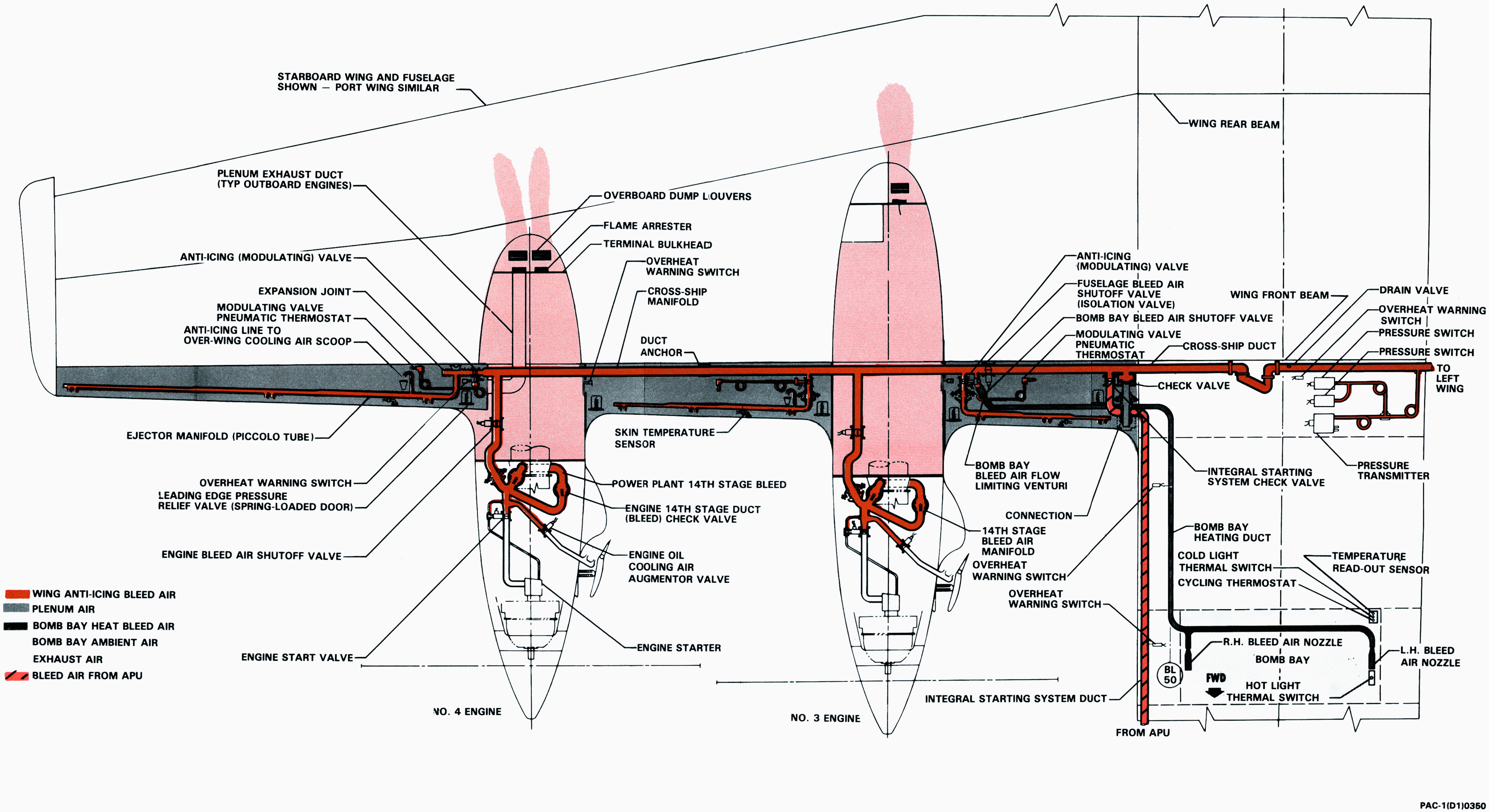
P-3 Flight Station



P-3Flight tation



P-3Flight tation



Bleed Air System

FOUR ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

CONFIGURATION "A"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

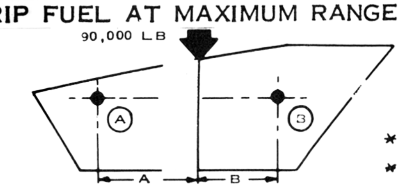
DATA BASIS: **FLIGHT TESTS**

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 (B)

TRIP DISTANCE A + B

* TRIP FUEL (A) − (B)

* TRIP TIME (A) + (B)

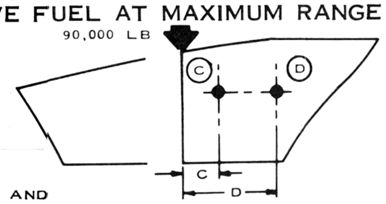
* ADD CLIMB TIME AND FUEL FACTORS.

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)

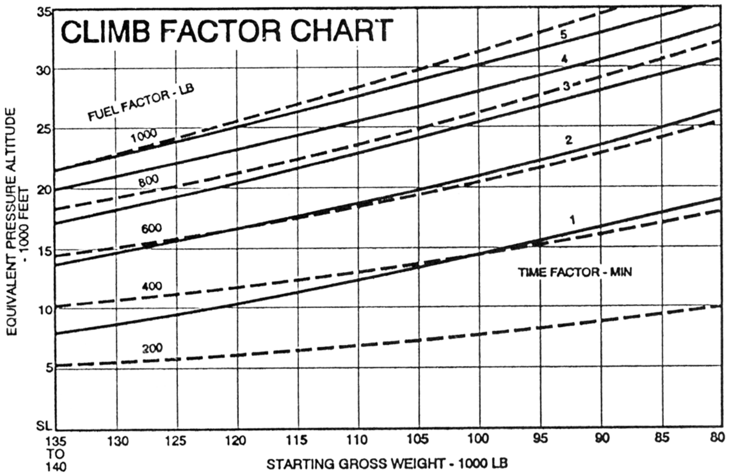
RESERVE RANGE D − C

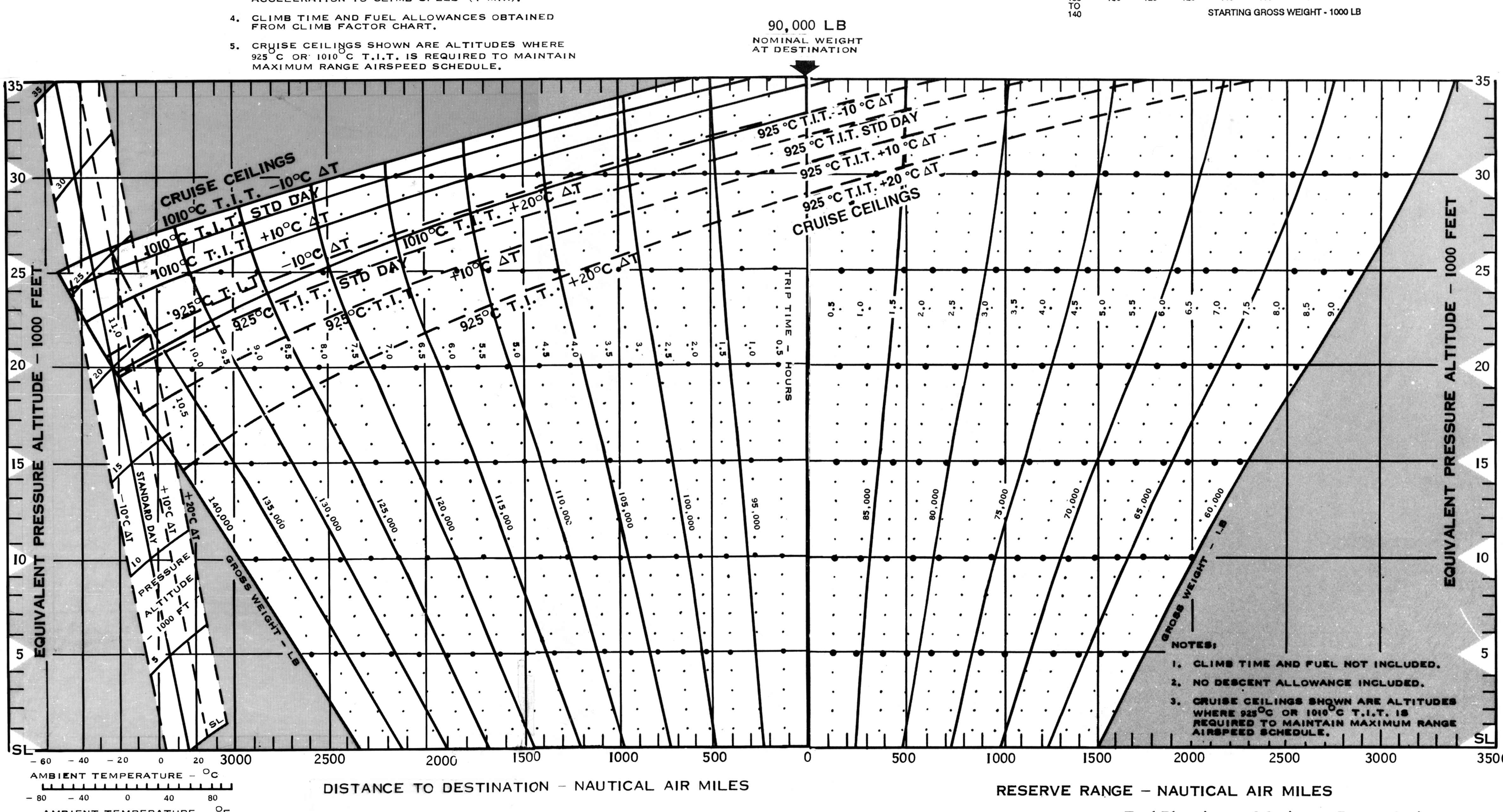
RESERVE TIME (D) − (C)

RESERVE FUEL (C) − (D)

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.





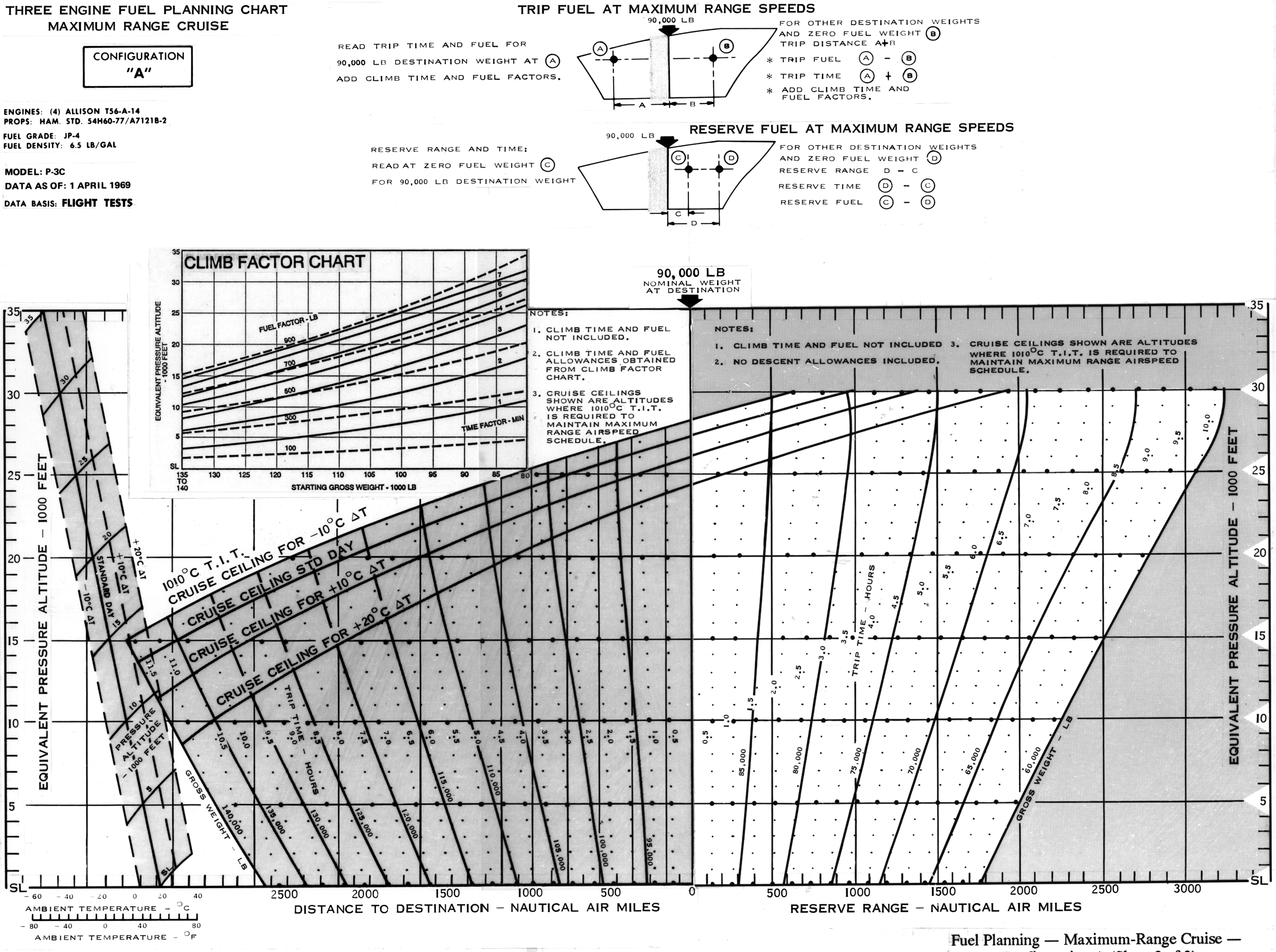
Fuel Planning — Maximum-Range Cruise — Configuration A (Sheet 1 of 3)

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**



Fuel Planning — Maximum-Range Cruise — Configuration A (Sheet 2 of 3)

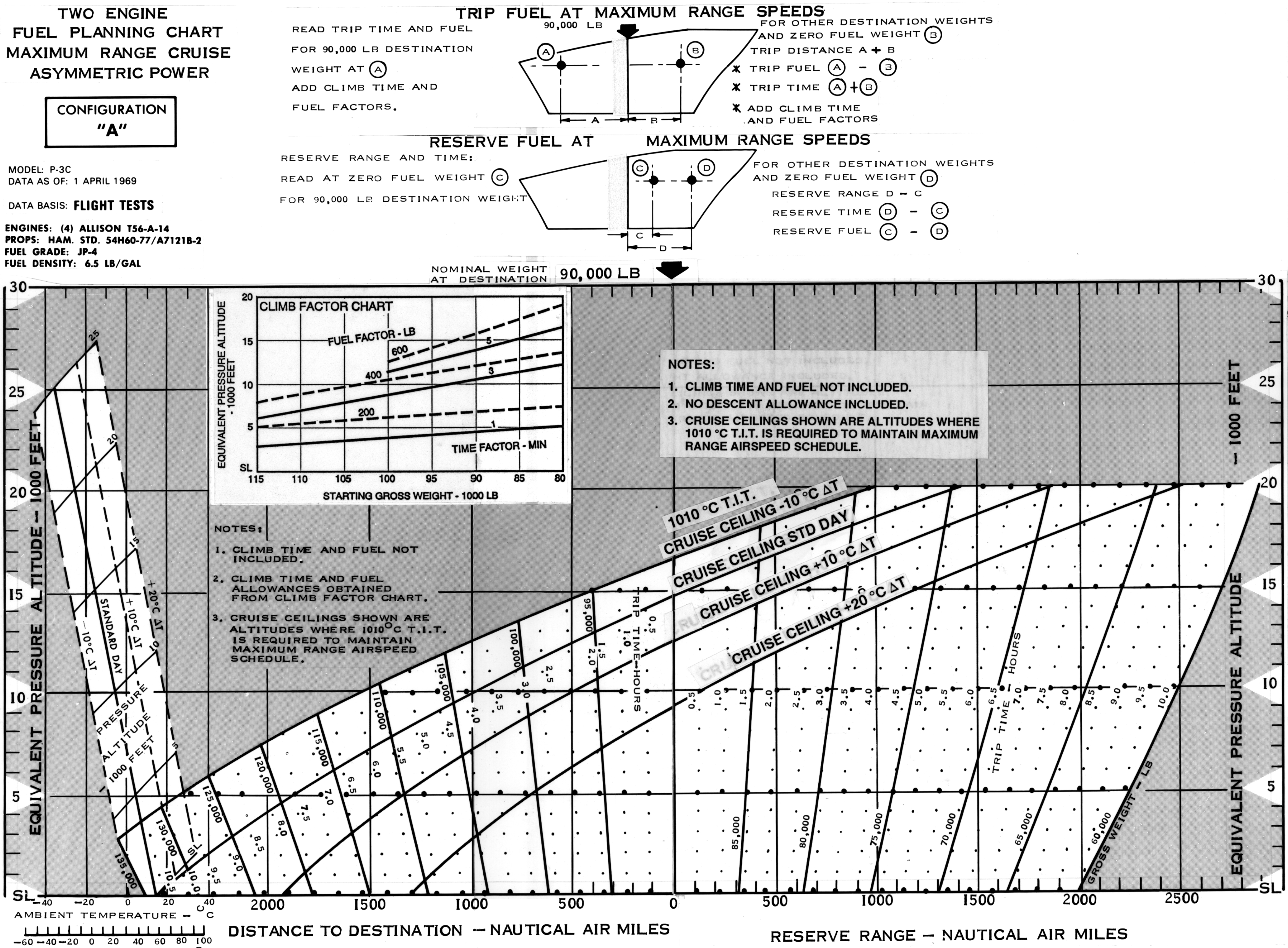
TWO ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE ASYMMETRIC POWER

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



Fuel Planning — Maximum-Range Cruise — Configuration A (Sheet 3 of 3)

FOUR-ENGINE
FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

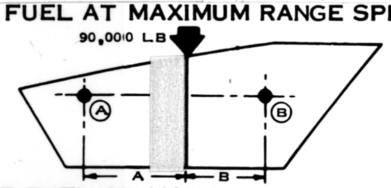
CONFIGURATION "B"

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.



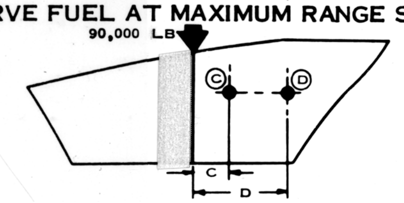
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B).

TRIP DISTANCE A + B
*TRIP FUEL (A)−(B)
*TRIP TIME (A)+(B)

*ADD CLIMB TIME AND FUEL FACTORS.

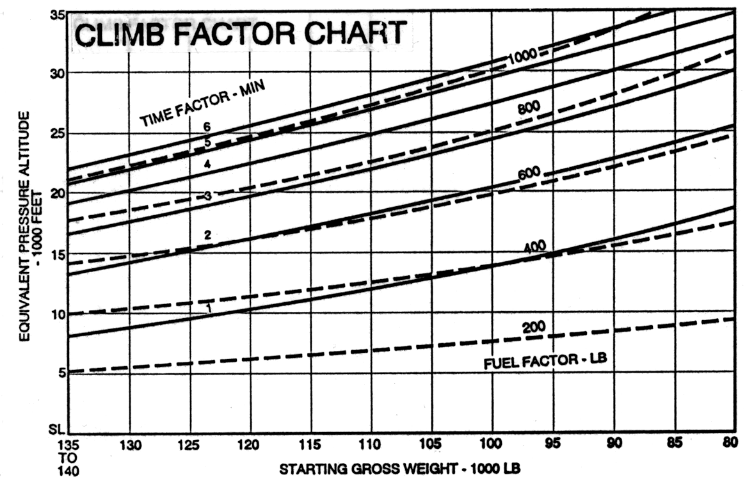
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME: READ AT ZERO FUEL WEIGHT (C) FOR 90,000 LB DESTINATION WEIGHT.

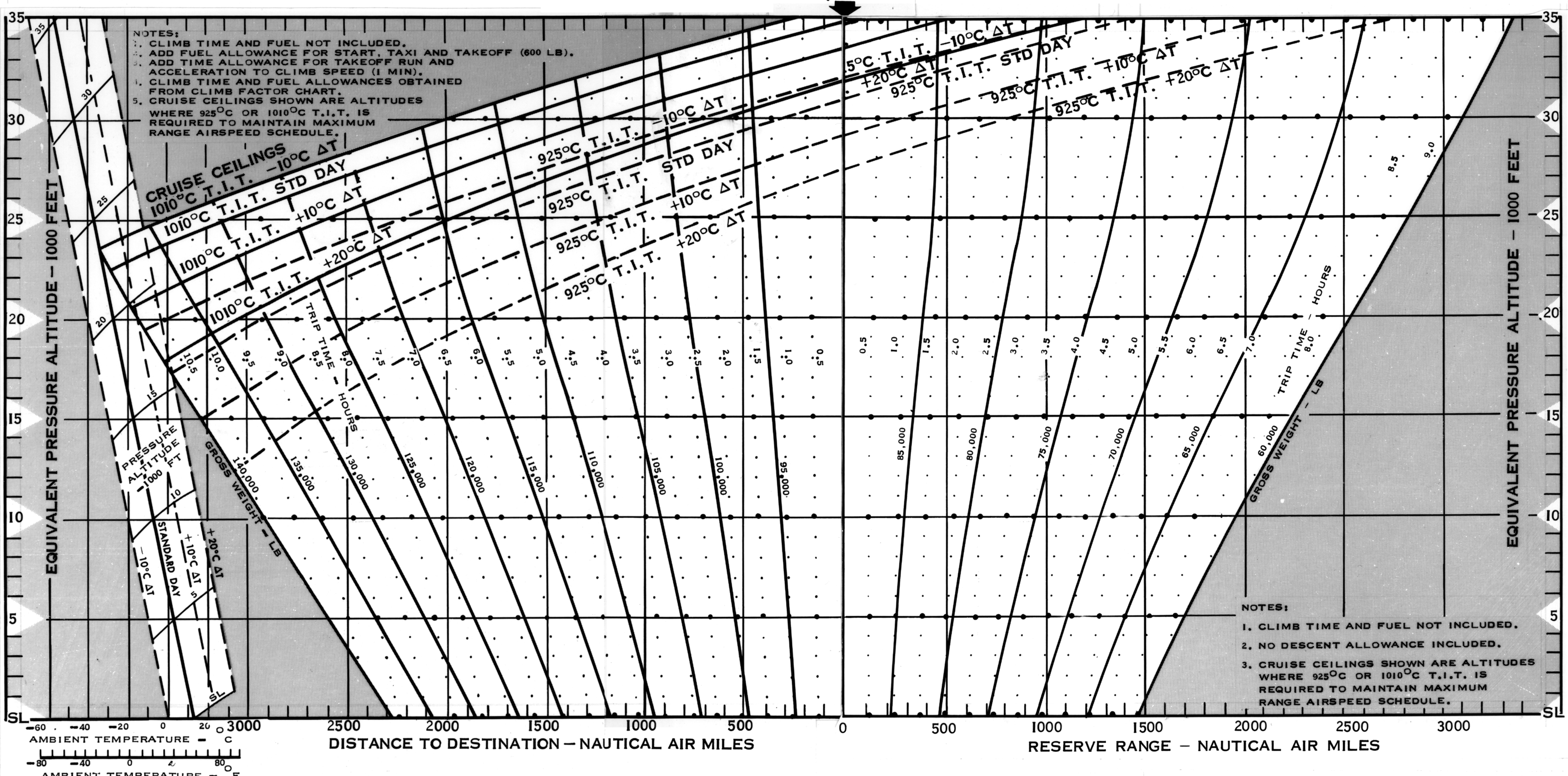


FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D).

RESERVE RANGE D − C
RESERVE TIME (D)−(C)
RESERVE FUEL (C)−(D)



NOMINAL WEIGHT AT DESTINATION
90,000 LB



Fuel Planning — Maximum-Range Cruise — Configuration B (Sheet 1 of 3)

THREE-ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

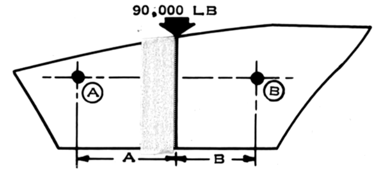
CONFIGURATION "B"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969
DATA BASIS: **FLIGHT TESTS**

ENGINES: (4) ALLISON T56-A-14
PROPS: HAM. STD. 54H60-77/A7121B-2
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

TRIP FUEL AT MAXIMUM RANGE SPEEDS

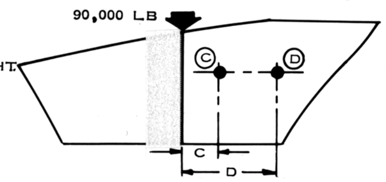
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT Ⓐ. ADD CLIMB TIME AND FUEL FACTORS.



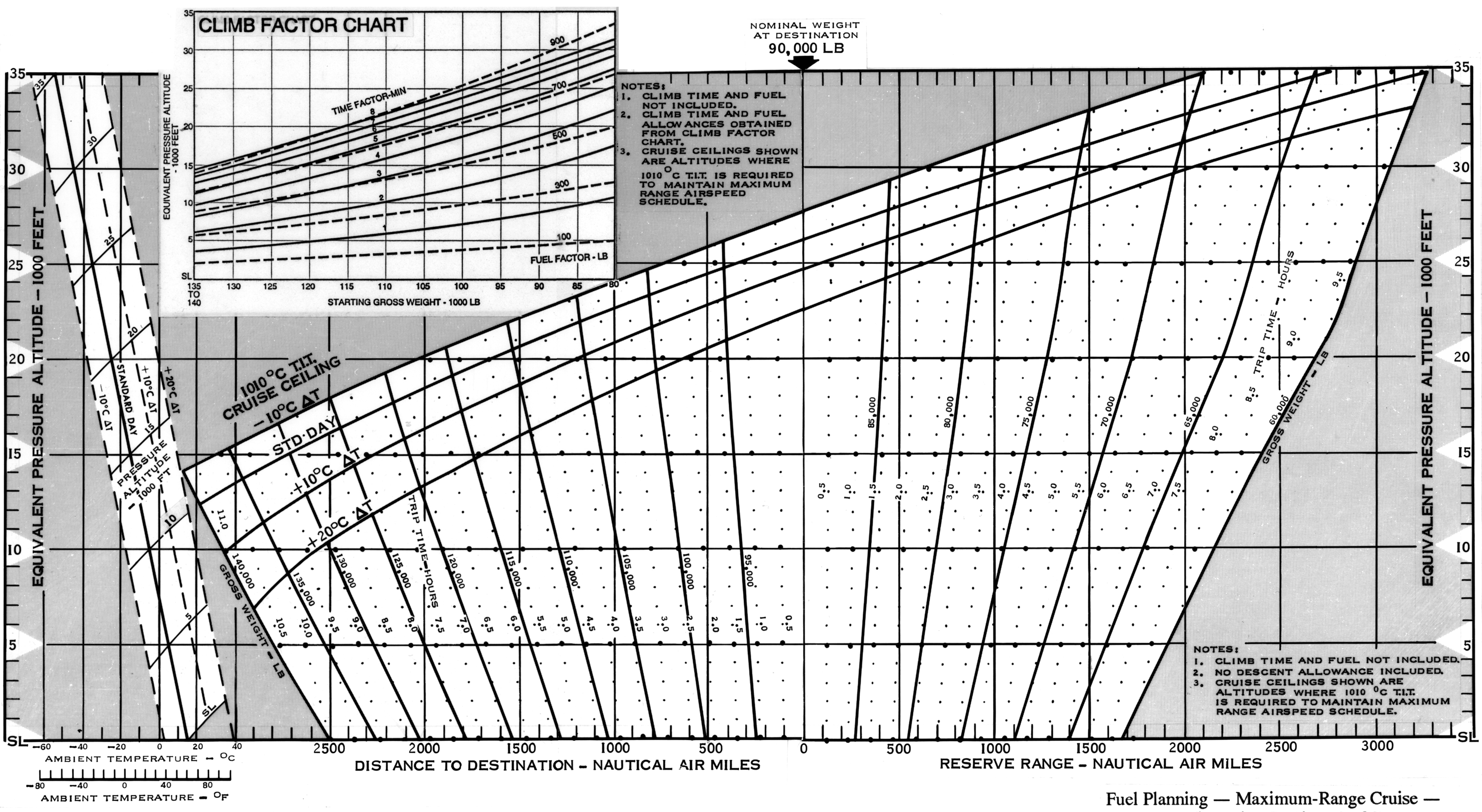
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT Ⓑ.
TRIP DISTANCE A + B
* TRIP FUEL Ⓐ − Ⓑ
* TRIP TIME Ⓐ + Ⓑ
* ADD CLIMB TIME AND FUEL FACTORS.

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

RESERVE RANGE AND TIME: READ AT ZERO FUEL WEIGHT Ⓒ FOR 90,000 LB DESTINATION WEIGHT.



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT Ⓓ.
RESERVE RANGE D − C
RESERVE TIME Ⓓ − Ⓒ
RESERVE FUEL Ⓒ − Ⓓ



Fuel Planning — Maximum-Range Cruise — Configuration B (Sheet 2 of 3)

TWO-ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE
ASYMMETRIC POWER

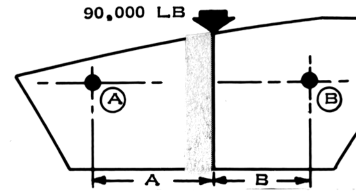
CONFIGURATION
"B"

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

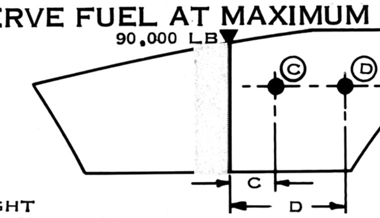
READ TRIP TIME AND FUEL FOR 90,000 LB DESTINATION WEIGHT AT (A).
ADD CLIMB TIME AND FUEL FACTORS.



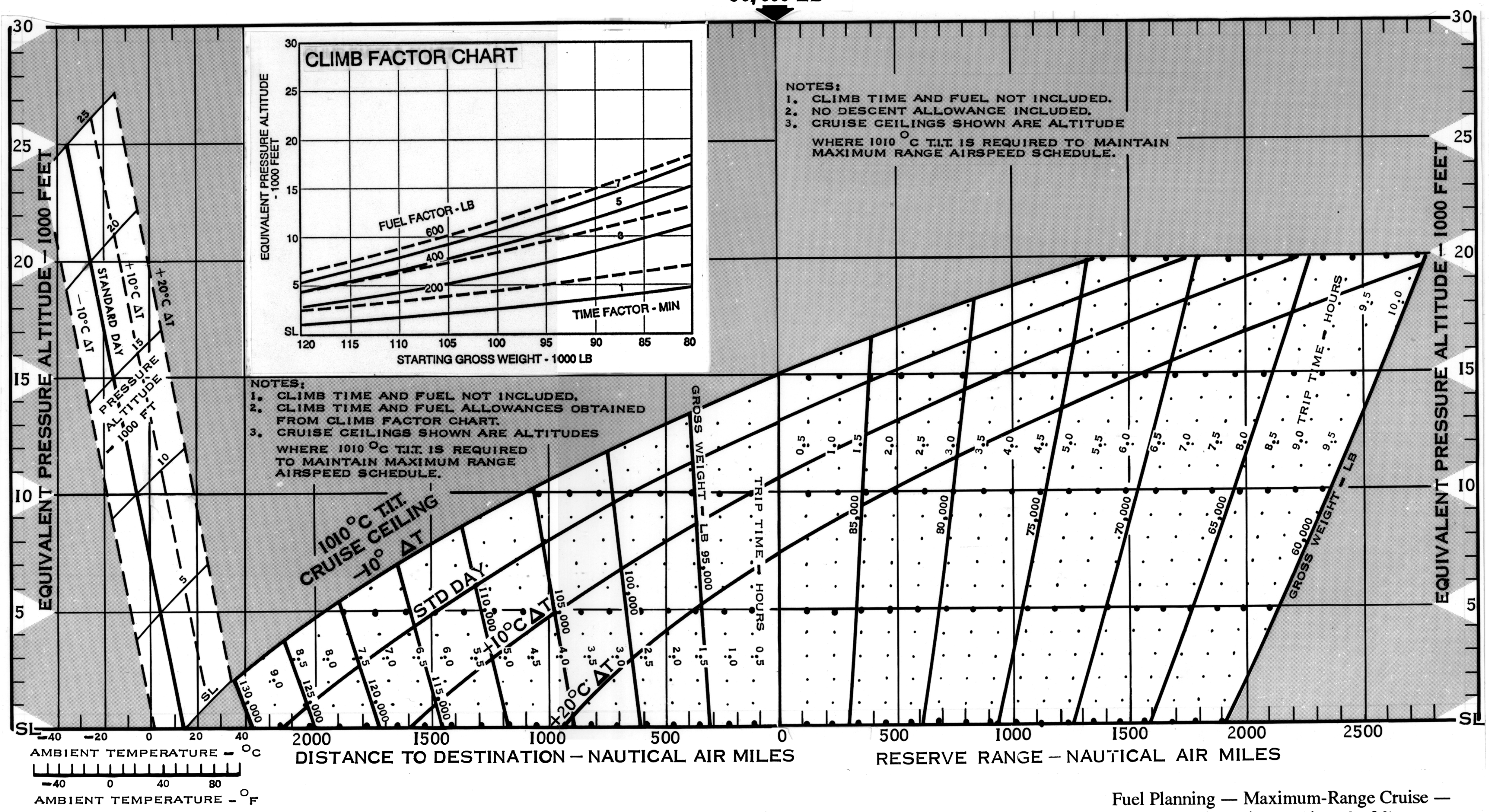
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B).
TRIP DISTANCE A + B
* TRIP FUEL (A) − (B)
* TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS

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)



Fuel Planning — Maximum-Range Cruise — Configuration B (Sheet 3 of 3)

FOUR ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

CONFIGURATION "C"

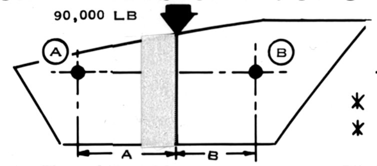
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

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

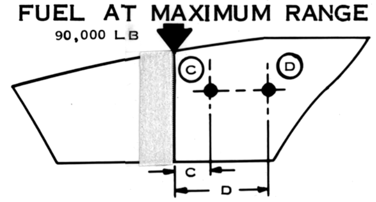
* TRIP FUEL (A) − (B)

* 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.

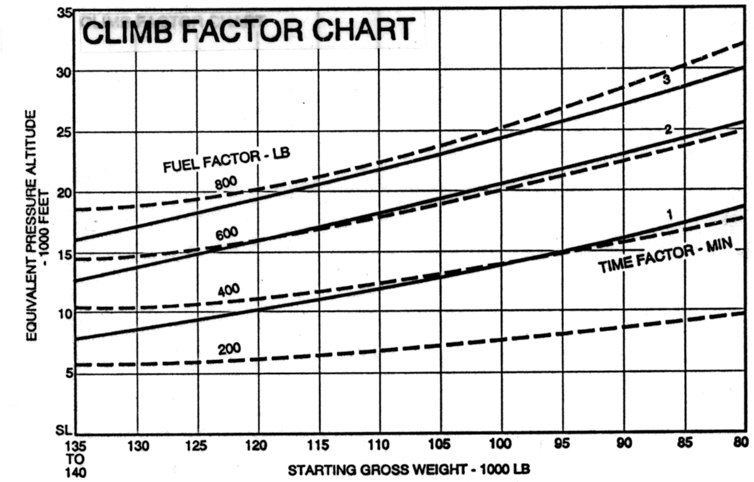


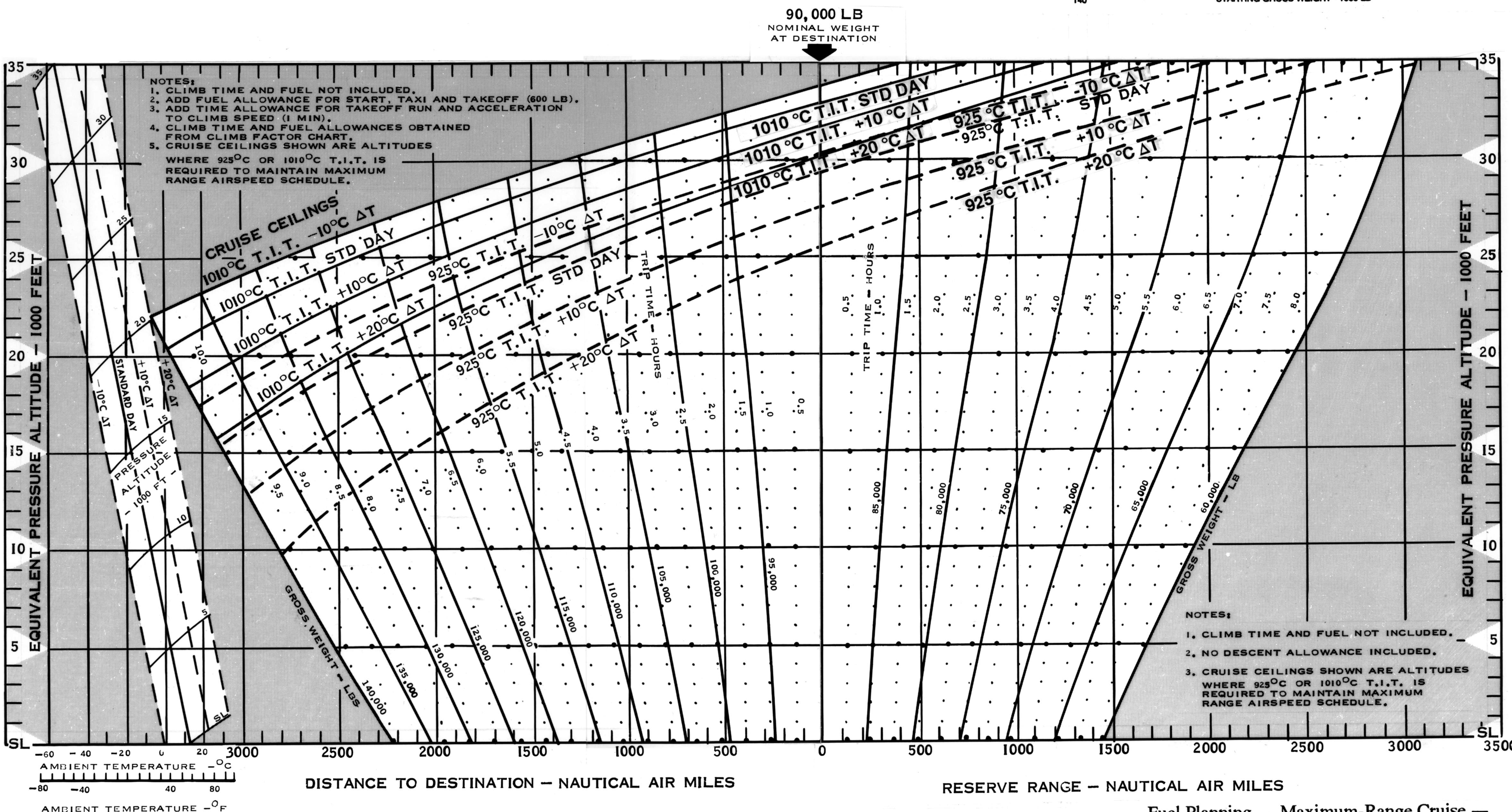
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (D)

RESERVE RANGE D − C

RESERVE TIME (D) − (C)

RESERVE FUEL (C) − (D)





Fuel Planning — Maximum-Range Cruise — Configuration C (Sheet 1 of 3)

THREE ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

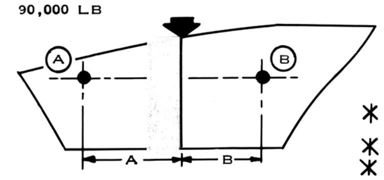
CONFIGURATION "C"

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.

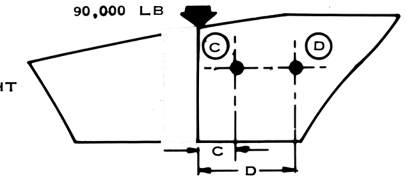


FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)

TRIP DISTANCE A+B
* TRIP FUEL (A) − (B)
* TRIP TIME (A) + (B)
* ADD CLIMB TIME AND FUEL FACTORS.

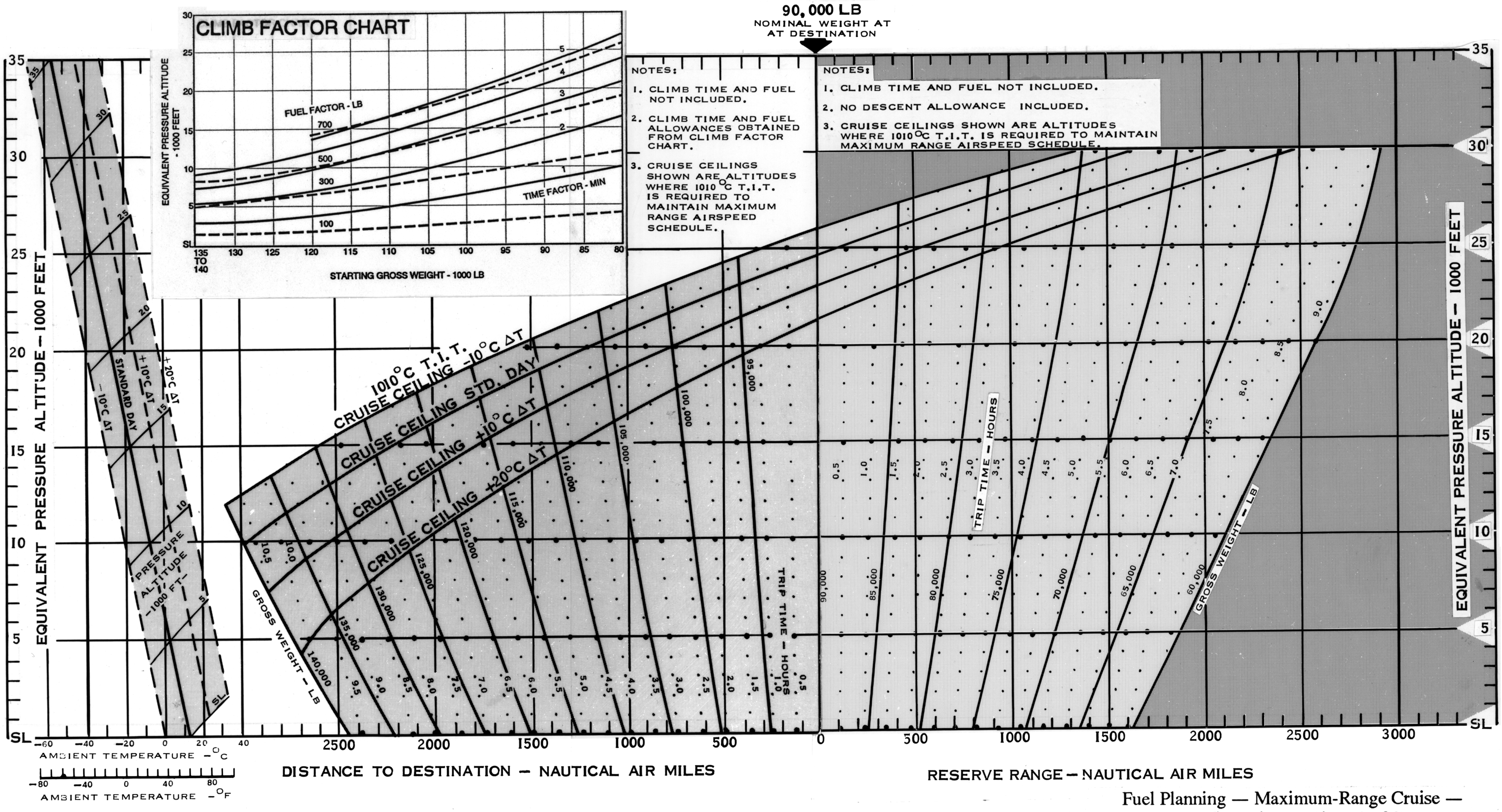
RESERVE FUEL AT MAXIMUM RANGE SPEEDS

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)



Fuel Planning — Maximum-Range Cruise — Configuration C (Sheet 2 of 3)

TWO ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

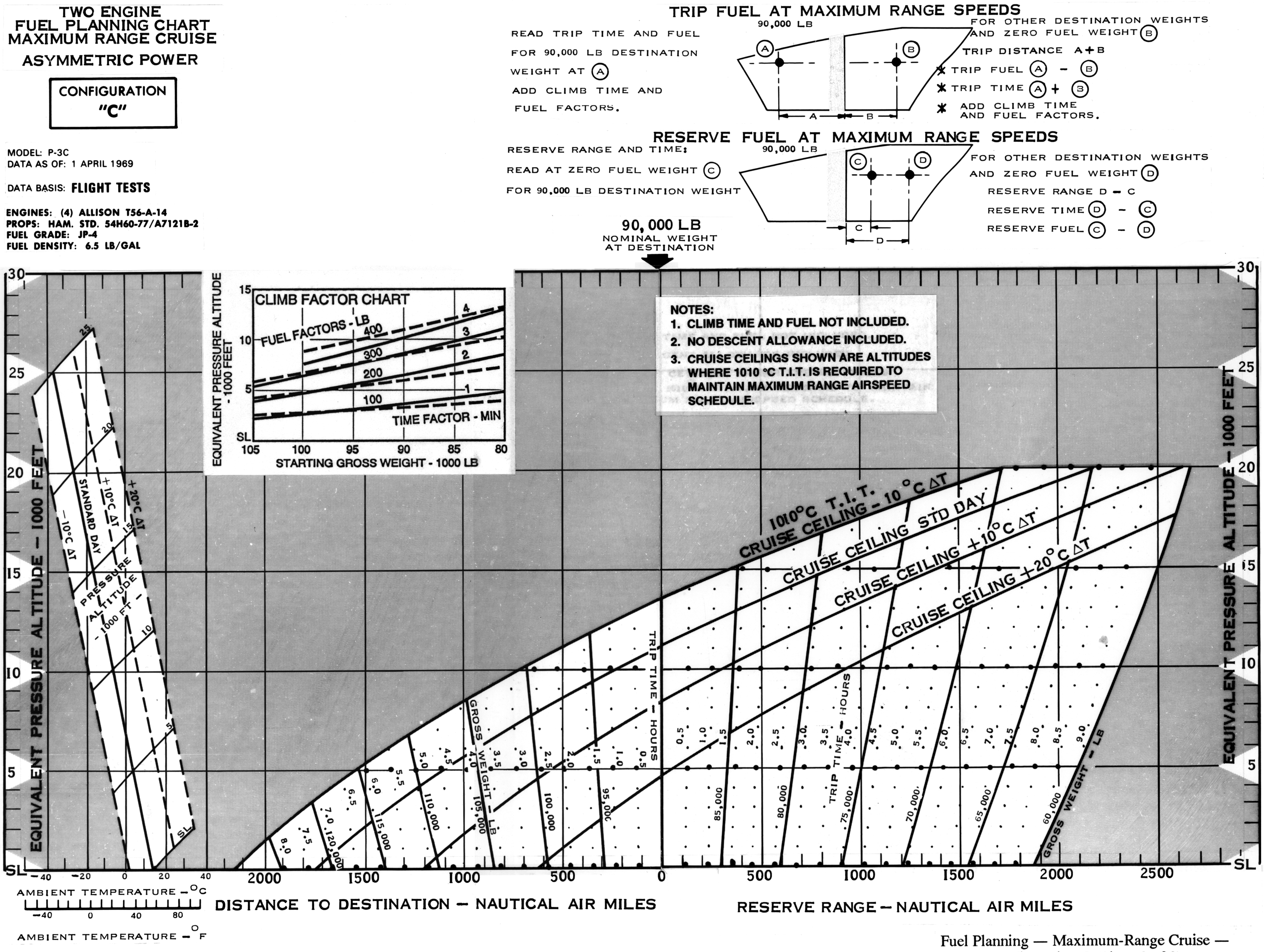
ASYMMETRIC POWER

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



Fuel Planning — Maximum-Range Cruise — Configuration C (Sheet 3 of 3)

FOUR ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

CONFIGURATION "D"

MODEL:
P-3C

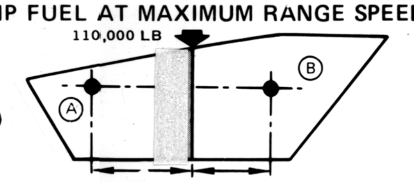
DATA AS OF:
1 APRIL 1969

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 Ⓐ ADD CLIMB TIME AND FUEL FACTORS.

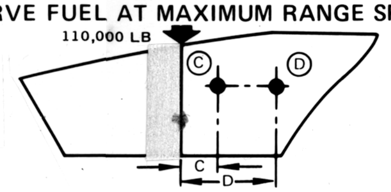


FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT Ⓑ
TRIP DISTANCE A + B
*TRIP FUEL Ⓐ − Ⓑ
*TRIP TIME Ⓐ + Ⓑ

*ADD CLIMB TIME AND FUEL FACTORS.

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

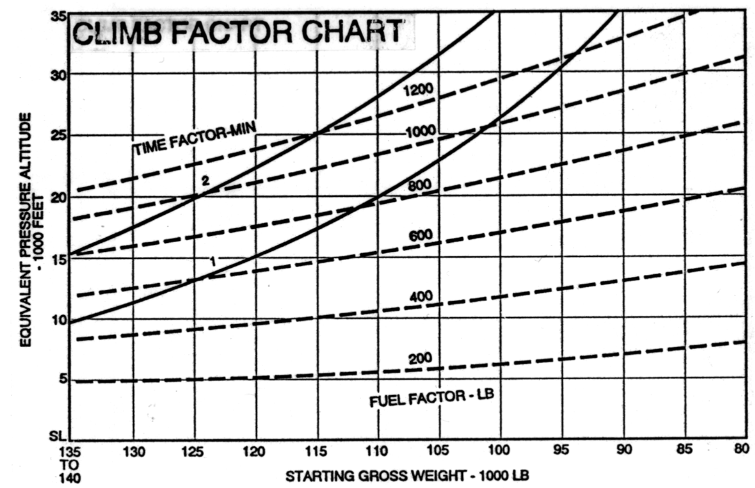
RESERVE RANGE AND TIME: READ AT ZERO FUEL WEIGHT Ⓒ FOR 110,000 LB DESTINATION WEIGHT.

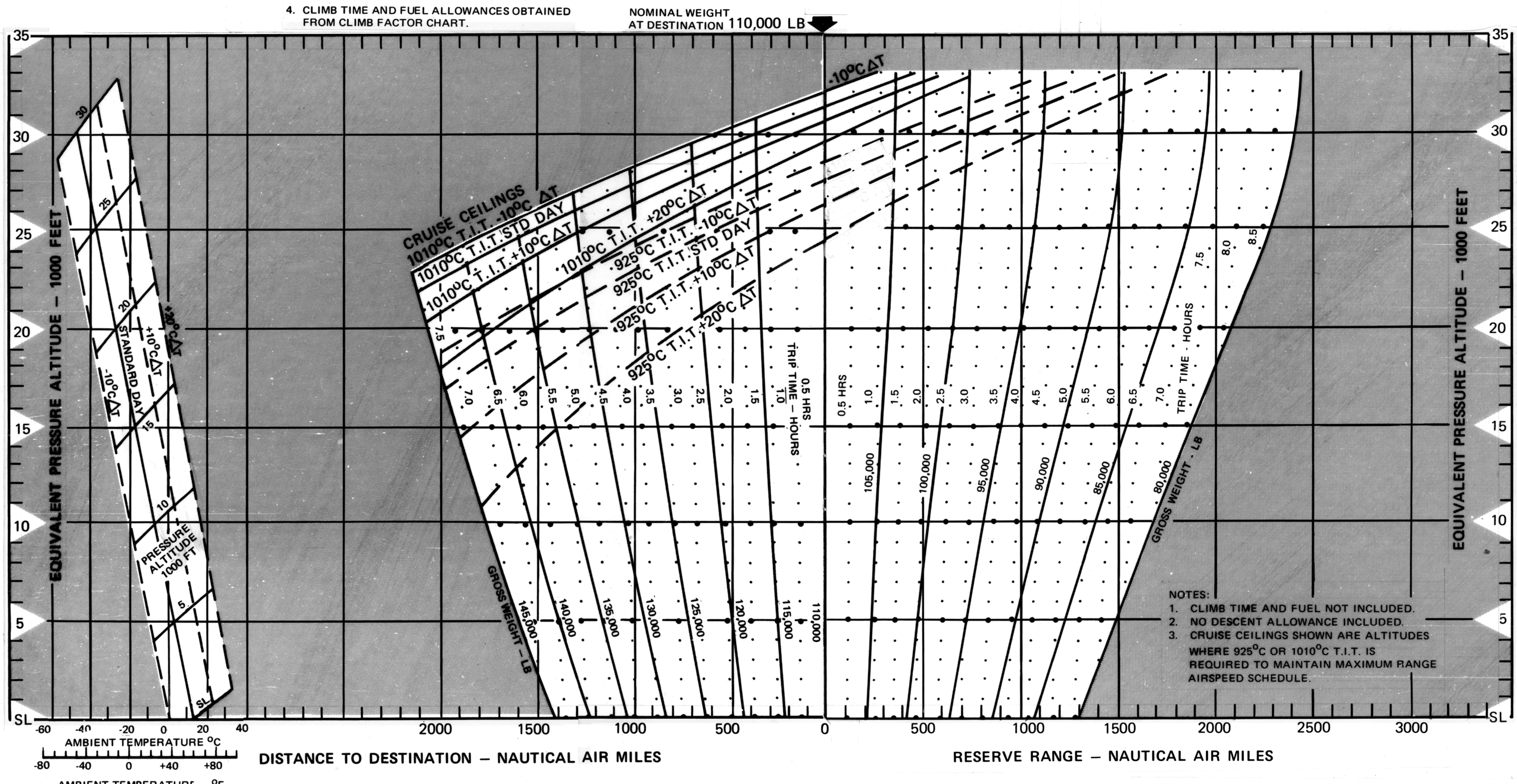


FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT Ⓓ
RESERVE RANGE D − C
RESERVE TIME Ⓓ − Ⓒ
RESERVE FUEL Ⓒ − Ⓓ

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.





Fuel Planning — Maximum-Range Cruise — Configuration D (Sheet 1 of 3)

THREE ENGINE FUEL PLANNING CHART MAXIMUM RANGE CRUISE

CONFIGURATION "D"

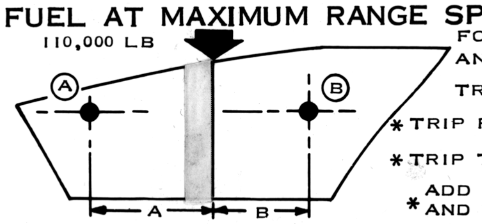
MODEL: P-3C
DATA AS OF: 1 APRIL 1969

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

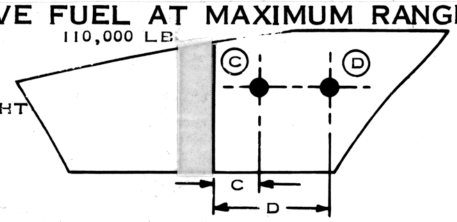
READ TRIP TIME AND FUEL FOR 110,000 LB DESTINATION WEIGHT AT (A)
ADD CLIMB TIME AND FUEL FACTORS.



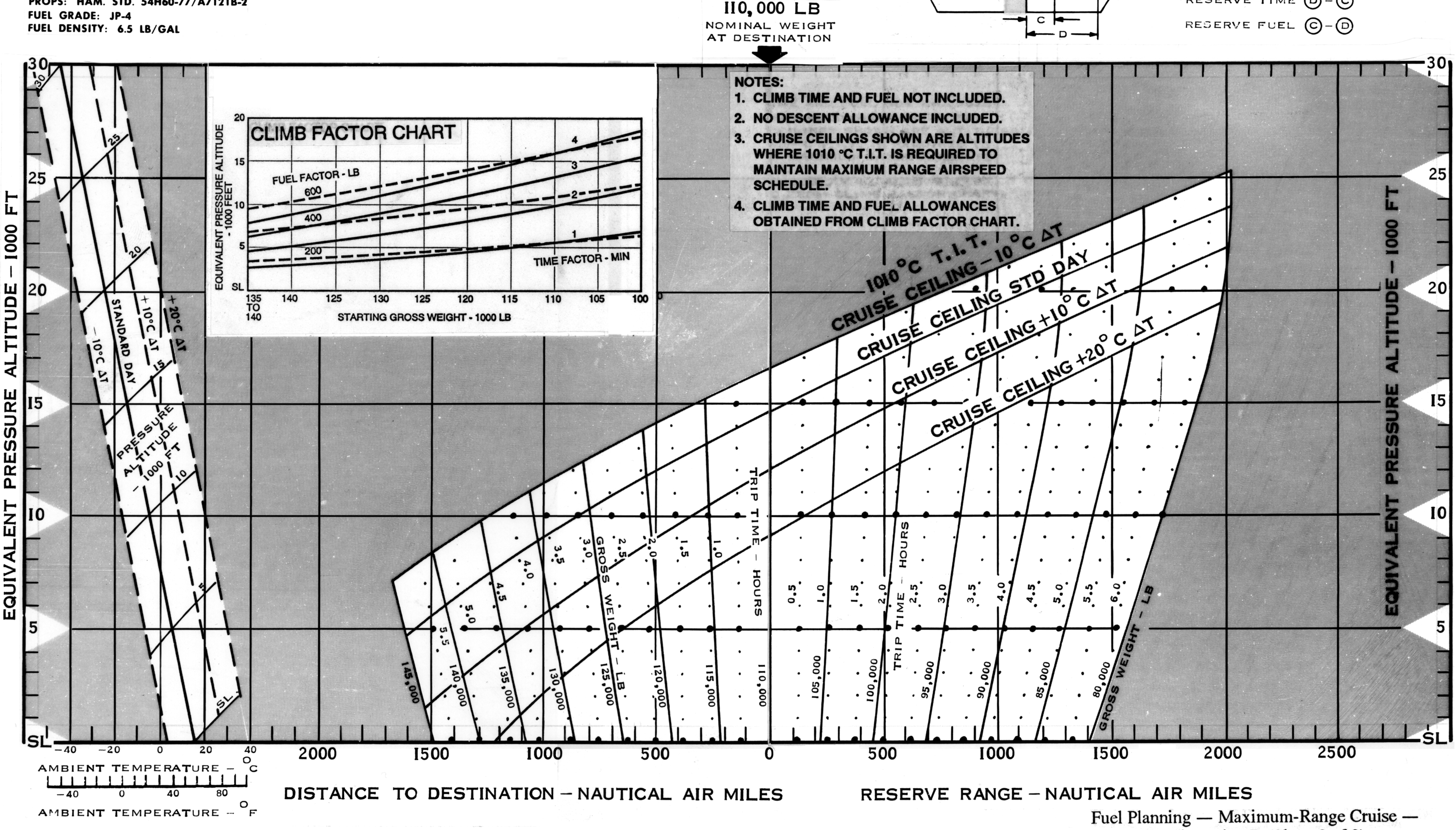
FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT (B)
TRIP TIME A + B
*TRIP FUEL (A) − (B)
*TRIP TIME (A) + (B)
*ADD CLIMB TIME AND FUEL FACTORS.

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)



Fuel Planning — Maximum-Range Cruise — Configuration D (Sheet 2 of 3)

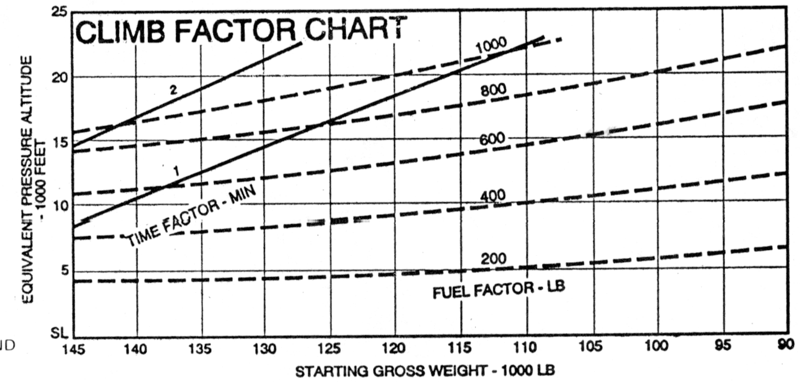
FOUR ENGINE FUEL PLANNING CHART
MAXIMUM RANGE CRUISE

CONFIGURATION
"E"

MODEL: P-3C
DATA AS OF: 1 APRIL 1969

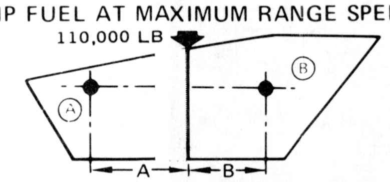
DATA BASIS: **FLIGHT TESTS**

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

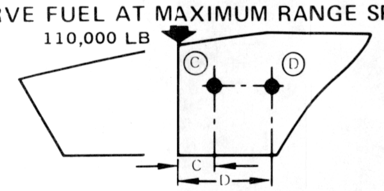
READ TRIP TIME AND FUEL FOR 110,000 LB DESTINATION WEIGHT AT Ⓐ ADD CLIMB TIME AND FUEL FACTORS



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT Ⓑ
TRIP DISTANCE A + B
TRIP FUEL Ⓐ Ⓑ
TRIP TIME Ⓐ Ⓑ
ADD CLIMB TIME AND FUEL FACTORS

RESERVE FUEL AT MAXIMUM RANGE SPEEDS

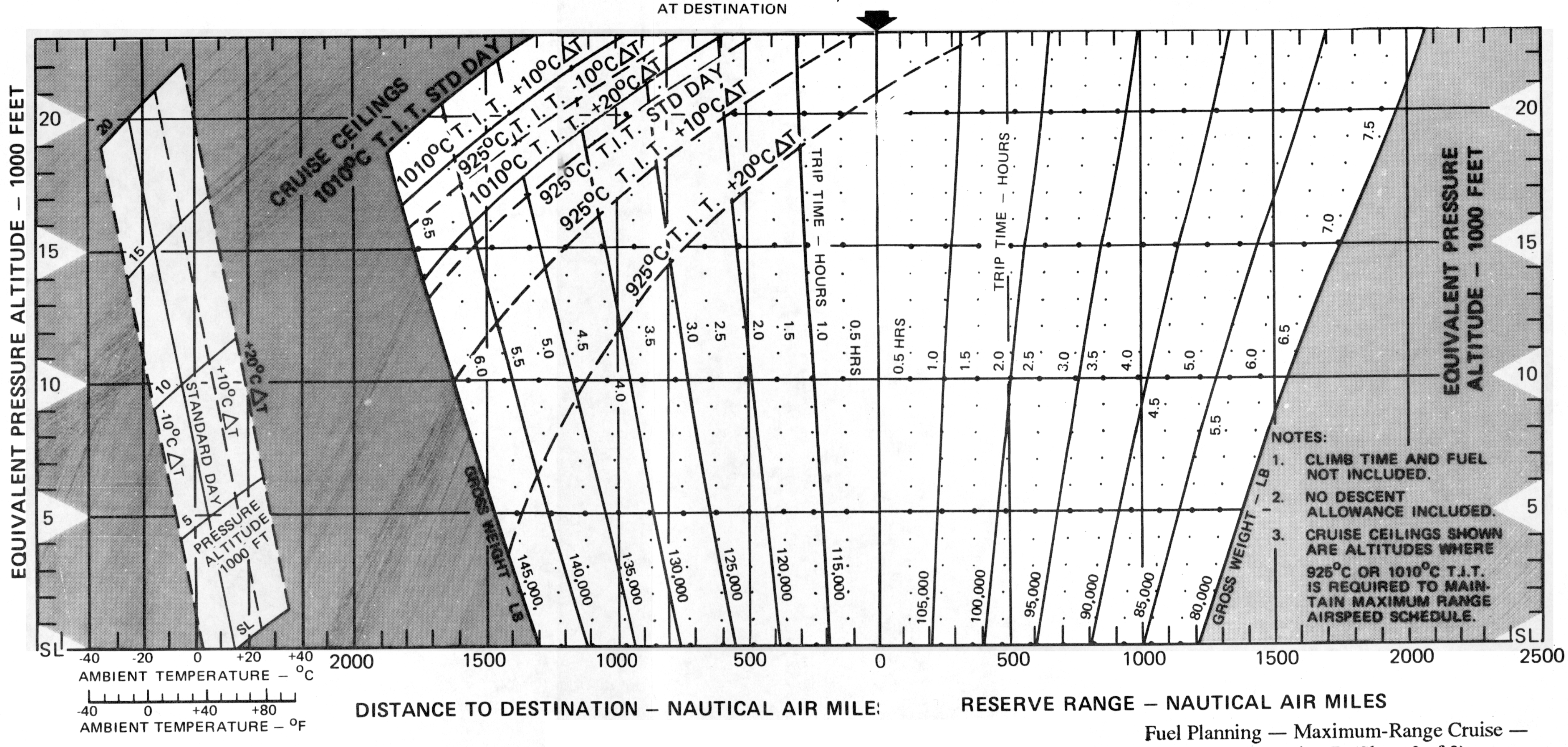
RESERVE RANGE AND TIME:
READ AT ZERO FUEL WEIGHT Ⓒ
FOR 110,000 LB DESTINATION WEIGHT



FOR OTHER DESTINATION WEIGHTS AND ZERO FUEL WEIGHT Ⓓ
RESERVE RANGE D C
RESERVE TIME Ⓓ Ⓒ
RESERVE FUEL Ⓒ Ⓓ

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.



Fuel Planning — Maximum-Range Cruise — Configuration D (Sheet 3 of 3)

LIST OF EFFECTIVE PAGES

Effective Pages	Page Numbers
Original	1 (Reverse Blank)
Original	3 (Reverse Blank)
Original	5 (Reverse Blank)
Original	7 thru 8
Original	9 (Reverse Blank)
Original	11 thru 32
Original	33 thru 39 (Reverse Blank)
Original	41 thru 51 (Reverse Blank)
Original	53 thru 55 (Reverse Blank)
Original	57 (Reverse Blank)
Original	1-1 thru 1-3 (Reverse Blank)
Original	2-1 thru 2-95 (Reverse Blank)
Original	3-1 thru 3- 15 (Reverse Blank)
Original	4-1 thru 4-11 (Reverse Blank)
Original	5-1 thru 5-11 (Reverse Blank)
Original	59 (Reverse Blank)
Original	6-1 thru 6-3 (Reverse Blank)
Original	61 (Reverse Blank)
Original	7-1 thru 7-12
Original	8-1 thru 8-39 (Reverse Blank)
Original	9-1 thru 9-30
Original	63 (Reverse Blank)
Original	10-1 thru 10-12
Original	65 (Reverse Blank)
Original	11-1 thru 11-10
Original	12-1 thru 12-33 (Reverse Blank)
Original	13-1 thru 13-2
Original	14-1 thru 14-2
Original	15-1 thru 15-17 (Reverse Blank)
Original	16-1 thru 16-10
Original	17-1 thru 17-8
Original	67 (Reverse Blank)
Original	18-1 thru 18-14
Original	69 (Reverse Blank)
Original	19-1 thru 19-6
Original	20-1 thru 20-35 (Reverse Blank)
Original	71 (Reverse Blank)
Original	21-1 thru 21-2
Original	22-1 thru 22-56
Original	23-1 thru 23-29 (Reverse Blank)
Original	73 (Reverse Blank)

Effective Pages	Page Numbers
Original	24-1 thru 24-5 (Reverse Blank)
Original	25-1 thru 25-4
Original	75 (Reverse Blank)
Original	26-1 thru 26-43 (Reverse Blank)
Original	77 (Reverse Blank)
Original	27-1 thru 27-10
Original	28-1 thru 28-7 (Reverse Blank)
Original	29-1 thru 29-32
Original	30-1 thru 30-6
Original	31-1 thru 31-21 (Reverse Blank)
Original	32-1 thru 32-29 (Reverse Blank)
Original	33-1 thru 33-49 (Reverse Blank)
Original	Index-1 thru Index-29 (Reverse Blank)
Original	FO-1 (Reverse Blank)
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Original	FO-3 (Reverse Blank)
Original	FO-4 (Reverse Blank)
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Original	FO-12 sheet 2 (Reverse Blank)
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Original	LEP-1 (Reverse Blank)