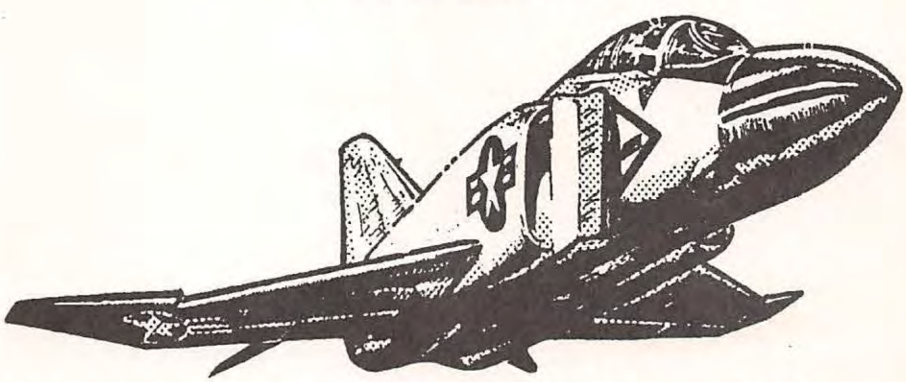
NAVAIR 01-245FDD-1

NATOPS FLIGHT MANUAL NAVY MODEL F-4J AND F-4S AIRCRAFT

THIS PUBLICATION SUPERSEDES NAVAIR 01-245FDD-1 DATED 1 MAY 1975, CHANGED 1 MAY 1985

This manual is incomplete without NAVAIR 01-245FDD-1A and NAVAIR 01-245FDD-1A-1



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1 DECEMBER 1988

0801-LP-142-1580

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

1 December 1988

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft accident 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 procedure 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 may be carried in naval aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

R.M. DUNLEAVY
Vice Admiral, USN
Assistant Chief of Naval Operations
(Air Warfare)

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RECORD OF CHANGES

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INTERIM CHANGE SUMMARY

The following Interim Changes have been canceled or previously incorporated in this manual:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1 thru 99	

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

INTERIM CHANGE NUMBER	REMARKS/PURPOSE
100	After Entering Cockpit — Pilot

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
101	141335Z SEP 90	V-12-48	HARDOVER RUDDER

TECHNICAL DIRECTIVE SUMMARY

In accordance with BUWEPS Instruction 5215.8, Technical Directive concerning modification, inspection, maintenance or operating procedures and limits of all Naval aircraft and related equipment are titled as follows:

Airframe Change (AFC) or Airframe Bulletin (AFB)
Power Plant Change (PPC) or Bulletin (PPB)
Aviation Armament Change (AAC) or Bulletin (AAB)
Avionics Change (AVC) or Bulletin (AVB)
Accessory Change (AYC) or Bulletin (AYB)
Support Equipment Change (SEC) or Bulletin (SEB)
Photographic Change (PHC) or Bulletin (PHB)
Air Crew System Change (ACC) or Bulletin (ACB)
Air Launched Missile Change (AMC) or Bulletin (AMB)
Target Control System Change (TCC) or Bulletin (TCB)
Clothing and Survival Equipment Change (CSEC) or Bulletin (CSEB)

TECHNICAL DIRECTIVE	ECP	TITLE	PRODUCTION EFFECTIVITY
AAC 483		ADDS ADAPTER ASSEMBLY FOR LAU-7/A	
AAC 509		AUTO HOMING CAPABILITY OF MER/TER – 7 RACKS	
AAC 537		MODIFIES LAU-7/A LAUNCHERS	
AAC 587		MODIFIES LAU-7/A LAUNCHERS	
AAC 688		INSTALLS DUAL FIN RETAINER SPRINGS ON LAU-7/A LAUNCHERS AND IMPROVES SAFETY PIN MECHANISM	
ACC 74		PROVIDES GRAVITY DROP LIFE RAFT INFLATION	
ACC 169		ADD MK-H7 ROCKET MOTOR SEAR BOOT	
ACC 176		IMPROVED 28 FOOT PERSONNEL PARACHUTE	
ACC 187		ADDS INTERDICTOR PIN AND GUARD	
ACC 217		REPLACES INERTIA REEL	
ACC 224		INSTALLS GAS OPERATED ROCKET MOTOR INITIATOR	
ACC 391		MODIFICATION OF F-4 MK 87A EJECTION SEAT PROBE GUN	
AVC 495		MODIFIES STEERING INFORMATION (RADAR MOD)	
AVC 496		ADDS DATA LINK SYMBOLS (RADAR MOD)	
AVC 498		MODIFIES SCOPE DISPLAY (RADAR MOD)	
AVC 588		ADDS B-SWEEP IN MAP MODE (RADAR MOD)	
AVC 642		MOD OF RADAR TRANSMISSION INTERLOCKS	
AVC 743		ADDS CAPABILITY OF DATA LINK COUPLING IN ACL PHASE	
AVC 750		MOD OF AN/APG-59	
AVC 752		LIMITS USE OF APCS FOR CARRIER LANDINGS	
AVC 801		ADDS GUARD TO ZEROIZE SW ON KY-28 PANEL	
AVC 833		INCREASES ANT SLEW RATE AND MISSILE CONTROL SIGNAL	
AVC 834		MODIFIES FEEDHORN NUTATION	
AVC 838		MOD OF RADAR SCOPE BRT CONTROL IN AFT COCKPIT	
IAVC 852, AVC 1007		MOD OF RADAR BORESIGHT MODE	
IAVC 873		ADDS CAPABILITY OF REMOVING RADAR B PLUS POWER	
AVC 925		CONVERTS MANUAL DATA LINK SYSTEM TO AUTOMATIC SYSTEM	
AVC 926		CONVERTS MANUAL DATA LINK SYSTEM TO AUTOMATIC SYSTEM	
AVC 927		CONVERTS MANUAL DATA LINK SYSTEM TO AUTOMATIC SYSTEM	
AVC 937		ADDS CAPABILITY OF DATA LINK COUPLING IN ACL PHASE	
AVC 940		IMPROVES TUNING AND FIRING CIRCUITS	
AVC 947		ADDS CAPABILITY OF DATA LINK COUPLING IN ACL PHASE	
AVC 1054	911	PROVIDES PILOT LOCKON MODIFICATION.	
IAVC 1198		PROVIDES AUTOMATIC PULSE SWITCHING AT SHORT RANGES.	
AVC 1234		ADDS AN&ALR-45(V) AND AN/ALR-50(V)	
AVC 1590	152	AWG 10A MISSILE CONTROL SYSTEM	
AVC 2038	447	MODIFICATION OF ASN-50	
AVC 2460		REMOVAL OF POWER INDICATING LIGHT	
AVC 2494	530	MODIFICATION OF AOA X-METER (WUC 56x27)	
AVC 2494 AMEND 1	530R1	RECALIBRATION OF AOA X-METER FOR 19 AOA OPTIMUM	
CSEC 4		ADDS HELICOPTER LIFT RING	
CSEC 14		ADDS SUIT MOUNTED PRESSURE SUIT CONTROLLER	
CSEC 15		ADDS OXYGEN MAKE-UP VALVE IN REGULATOR	

TECHNICAL DIRECTIVE SUMMARY

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TECHNICAL DIRECTIVE	ECP	TITLE	PRODUCTION EFFECTIVITY
AFC 263	610	INCORP 1/2 FLAP BLC MALFUNCTION LIGHT	153776aa
AFC 312	738	ADDS REMOTE UHF CHANNEL INDICATOR IN AFT COCKPIT	153840ae
AFC 328	792	ADDS THREE POSITION RAIN REMOVAL SWITCH	155867ak
AFC 331	703, S1	INSTALLS KY–28 SPEECH SECURITY UNIT	155529ag
AFC 335	745	REPLACEMENT OF FIRE/OVERHEAT WARNING LIGHT CAPS	153877af
AFC 346		REMOVES ALL POSITION FROM MISSILE JETTISON SELECT SW	153900af
AFC 364	743	INCORP OF STAB INPUT TO APCS	155785ai
AFC 370	739R1	INCORP OF EMERGENCY PNEUMATIC EXTENSION OF AIR REFUEL PROBE	155867ak
AFC 373	770R1	INCORP OF ENGINE SMOKE ABATEMENT	155867ak
AFC 388	840, S1, S2	ADDS B–SWEEP IN MAP MODE (AIRCRAFT MOD)	155529ag
		ADDS DATA LINK SYSTEM	155529ag
		ADDS AN/ALE–29A CHAFF DISPENSER	155529ag
		INCORP RHAW (AN/APR–25) CAPABILITY	155529ag
		ADDS ECM SET (AN/ALQ–51A/100) CAPABILITY	155529ag
		ADDS ECM SET (AN/ALQ–91) CAPABILITY	155529ag
		INSTALLS RADAR BEACON SYSTEM	155529ag
		INCORP INTERROGATOR SET (AN/APX–76) CAPABILITY	155529ag
		JET AIRCRAFT CONVENTIONAL LOW ALTITUDE BOMBING SYSTEM	155529ag
		ISOLATES GENERATOR PMG XFMR–RET OUTPUT	155785ai
		ADDS FAULT LIGHT FOR AN/APX–76	155793ai
		REPLACE ICS CONTROL PANEL	157242an
AFC 392	826	MOD OF APCS (DISENGAGE APCS WITH SPEED BRAKE SWITCH)	155867ak
AFC 399	862	PROVIDES EMER ELEC PWR FOR ENGING IGNITERS	155844aj
AFC 415	687S8	ADDS INTERROGATOR COMPUTER (AN/APX–76)	155844aj
AFC 417	758S5	PROVIDES ADDITIONAL BIT CAPABILITIES	155867ak
AFC 420		ADDS DUAL MODE BELLMOUTH	155785ai
AFC 433	864S7	REPLACE ICS CONTROL PANEL	157242an
AFC 439	754	INSTALLS BLEED AIR LEAKAGE DETECTION SYSTEM	155903ap
AFC 440	1013	ADDS ENGINE BLEED AIR SHUTOFF VALVE AND SWITCH	155903ap
AFC 448	896R1	INCORP FWD COCKPIT CHAFF DISPENSING SWITCH	155890am
AFC 450	912, S3P2	REMOVE PSEUDO AND MODIFIES AIM–7 TUNE–UP SEQUENCE	155844aj
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AFC 476	912S2	ADDS TIME DELAY TO AIM–7 SWEEP SELECT CIRCUIT	157261ao
AFC 477	714R1S13	ELIMINATES 3/4 SEC DELAY IN FRONT EJECT SEAT	155903ap
AFC 478	883R1	ADDS GYRO FAST ERRECT CAPABILITY	155903ap
AFC 482	938	MOD OF SEQUENCING SYSTEM FOR AFT SEAT	155903ap
AFC 486	822	ADDS RADAR ANNUNCIATOR LIGHTS DIMMING CONTROL	157242an
AFC 491	949	ADDS REAR COCKPIT CANOPY LEVER GUARD	157286aq

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AFC 496	968P2A2	ADDS COARSE SYNC OPERATION TO ALT ENCODER UNIT	158366au
AFC 497	967, S1	ADDS ELECTRICAL BALLISTIC THRUSTERS (FWD CANOPY)	157258an
AFC 500	971	INSTALLS VTAS	
AFC506	958, 971	INSTALLS COCKPIT OPT FOR ACM	158355at
		ADDS VISUAL TARGET ACQUISITION SET	158355at
		PROVIDES SIDEWINDER EXPANDED ACQUISITION MODE	158355at
		PROVIDES FIXED MOUNTING FOR REAR COCKPIT RADAR SCOPE	157298ar
		PROVIDES AIM–7E–2 DOGFIGHT MODE SELECTION CAPABILITY	158355at
AFC 508	863R1	ADDS ALL WEATHER CARRIER LANDING CAPABILITY	158355at
AFC 513		PROVIDES MODE SWITCHING LOGIC FOR DUAL MODE APCS	
AFC 514	996	PROVIDES LINE–OF–SIGHT RATE TO AIM–7 MISSILES	158355at
AFC 515	993	ADDS RADHAZ WARNING LIGHTS	158355at
AFC 516	850R1S1	ADDS AIM–7 CARRIAGE CAPABILITIES	158355at
AFC 517	970R1	ADDS DOGFIGHT COMPUTER	158355at
AFC 518		ADDS WIRING TO OPERATE LB–30A STRIKE CAMERA POD	
AFC 524	1023A2, S1, S2	ADDS AN/ALR–45(V) AND AN/ALR–50(V)	
AFC 526	1011	REPLACES COMMAND SELECTOR VALVE	
AFC 528		INSTALLS GAS OPERATED ROCKET MOTOR INITIATOR	
AFC 534	1008A1P1, P2	ADDS PILOT OPTION EMERGENCY AILERON DROOP	
AFC 535		30 KVA GENERATOR WIRING ISOLATION	155785ai
AFC 536	1018S1	IMPROVED PRIMARY FLIGHT INSTRUMENT LIGHTING	
AFC 541	1035S1	ADDS COUNTERMEASURES SET AN/ALQ–126	
AFC 545		RELOCATION OF REFUEL PROBE CIRCUIT BREAKER	158366au
AFC 550	1033A2	ADDS BLEED AIR OFF LIGHT AND BLEED AIR SWITCH GUARD	
AFC 555	952S3A1	REPLACES AIR COND PACKAGE WITH IMPROVED PACKAGE	158355at
AFC 576	325R1	AWG 10A MISSILE CONTROL SYSTEM	
AFC 599	387	AIRCRAFT AVIONICS AND ELECTRICAL SYSTEMS MODICATION PROGRAM (SLEP)	
AFC 601	1049R1/S2	ADDS TWO POSITION LEADING EDGE SLATS	
AFC 612		CHANGES EMERGENCY AILERON DROOP SWITCH NOMENCLATURE	
AFC 627	RAMEC P-47-78	MOD TO CONNECT BLEED AIR SHUTOFF TO 28 VDC BUS	
AFC 628	487	RETROFIT OF SLEP WIRING TO F-4S SLATS CONFIGURATION	
AFC 634	1065	F-4 CENTERLINE JOINT REDESIGN RETROFIT KITS	
AFC 636	512	DEACTIVATION OF F-4S INBOARD LEADING EDGE FLAPS	
AFC 639	514/4031	INSTALLATION OF AN/ASQ-154 DATA LINK DISPLAY	
AFC 640	513	STRUCTURAL IMPROVEMENT OF F-4S FIN CAP	
AFC 644	530	REPLACEMENT OF AIRCRAFT CONNECTOR, INTERFACE TO AOA X-METER	
AFC 644 AMEND 1	530R1	RECALIBRATION OF AOA SYSTEM FOR 19 UNITS OPTIMUM	
AFC 647	553	AN/ARN-118 TACAN SYSTEM (F-4S)	
AFC 660		AN/ARC-159(U) UHF RADIO	

GLOSSARY

A

AC. Aerodynamic Center

ac. Alternating current

ACK. Acknowledge

ACLS. Automatic carrier landing system

ACP. Aircraft communication procedures

ADCS. Air data computer set

ADI. Attitude director indicator

ADIZ. Air defense identification zone

AFC. Automatic frequency control

AFCS. Automatic flight control system

AGC. Automatic gain control

AI. Airborne intercept

AJB. Airborne, electro-mechanical bombing

AMCS. Airborne missile control system

AOA. Angle of attack

AOJ. Acquisition on jam

APA. Airborne, radar, auxiliary assembly

APCS. Approach power compensator system

APN. Airborne radar navigational aid

APQ. Airborne radar special purpose

AR. Air refueling

ARC. Airborne, radio control

ARI. Aileron rudder interconnect

ARTC. Air route traffic control

ASA. Airborne special type auxiliary assembly

ASE. Allowable steering error

ASN. Airborne special type navigational aid

ASQ. Airborne special type combination of purposes

ASN. Airborne special type navigational aid

ASQ. Airborne special type combination of purposes

ATC. Air traffic control

AWW. Airborne armament, control

B

BACSEB. BUWEPS aviation clothing and survival equipment bulletin

BDHI. Bearing distance heading indicator

bingo. Return fuel state; divert

BIT. Built-in test

BLC. Boundary layer control

bolter. Hook down, unintentional touch and go (missed wire)

BRC. Base recovery course

BST. Boresight

buster. Full military power

C

CADC. Central air data computer

CAP. Combat air patrol

CARQUAL. Carrier qualifications

CAS. Calibrated airspeed

CAT. Catapult

CAT. Clear air turbulence

CATCC. Carrier air traffic control center

CCA. Carrier control approach

CDI. Command display indicator

cg. Center of gravity

Charlie time. Expected time over ramp

CIC. Combat Information Center

CIT. Compressor inlet temperature

CMD. Command

CNI. Communication navigation identification

COT. Cockpit orientation trainer

CPLR. Coupler

cps. Cycles per second

CVA. Aircraft carrier (Attack)

CV. Aircraft carrier

cw. Continuous wave

D

dc. Direct current

DCU. Douglas control unit

DDI. Digital display indicator

dead beat. Causing the object, when disturbed, to return to its original position without oscillation

DL. Data link

DME. Distance measuring equipment

dog radial. An assigned radial on which to set up a holding pattern

DR. Dead reckoning

E

EAC. Estimated arrival carrier

EAS. Equivalent airspeed

EAT. Estimated approach time

ECCM. Electronic counter-countermeasure(s)

ECM. Electronic countermeasure(s)

EGT. Exhaust gas temperature

F

FAM. Familiarization

FL. Flight level

FMLP. Field mirror landing practice

FOJ. Fuse on jam

G

g. Gravity

gate. Maximum power

GCA. Ground control approach

GCI. Ground control intercept

gpm. Gallon per minute

H

hangfire. A delay or failure of an article of ordnance after being triggered

hang start. A start that results in a stagnated rpm and temperature

HOJ. Home on jam

hot start. A start that exceeds normal starting temperatures

HSI. Horizontal situation indicator

I

IAS. Indicated airspeed

IFF. Identification friend or foe

IFR. Instrument flight rules or in-flight refueling

ILS. Instrument landing system

IP. Identification point

I/P. Identification of position

IR. Infrared

J

JANAP. Joint Army Navy Air Force publication

JP. Jet petroleum

Judy. Radar contact with target taking over intercept

K

kt. Knot(s)

L

LABS. Low altitude bombing system

LBA. Limits of basic aircraft

LE. Leading edge

LID. Limited instrument departure

LOX. Liquid oxygen

lpm. Liters per minute

LSO. Landing signal officer (paddles)

M

MAC. Mean aerodynamic chord

meatball. Glide slope image of mirror landing system

MIL. Military

MIM. Maintenance instruction manual

Misfire. A permanent failure of an article of ordnance being triggered

MLP. Mirror landing practice

MSL. Mean sea level

N

NAMT. Naval air maintenance training

NATOPS. Naval air training and operating procedures standardization

NMPP. Nautical miles per pound

NOTAMs. Notices to airmen

NTDS. Naval tactical data system

NWIP. Naval warfare intercept procedures

NWP. Naval warfare publications

O

OAT. Outside air temperature

OMNI. Omnidirectional range

P

paddles. Landing signal officer

PC. Power control

pigeons. Bearing and distance

platform. Twenty miles, 5,000 feet commence descent, at 2,000 feet minimum level off at 1,000 feet

PMBR. Practice multiple bomb rack

pps. Pulses per seconds

prf. Pulse repetition frequency

psi. Pounds per square inch

punch. Target detected, aircraft still under ground control

Q

Q. Dynamic pressure, psf

R

radar. radio detection and ranging

RCVG. Replacement carrier air group

RESCAP. Rescue air patrol

rf. Radio frequency

RF. Reconnaissance - fighter

RIO. Radar intercept officer

S

SAR. Search and rescue

SATS. Short airfield for tactical support

SID. Standard instrument departure

SIF. Selective identification feature

6 MILE GATE. Six miles; descend to 600 feet

SOP. Standard operating procedure

SPC. Static pressure compensator

T

tacan. Tactical air navigation

TAS. True airspeed

TE. Trailing edge

10 MILE GATE. Ten miles; transition to landing configuration; maintain 1,200 feet

TILT. Transmission of intercept and landing information terminated

TMN. True Mach number

trap. Arrested landing

U

UHF. Ultrahigh frequency

UTM. Universal test message

V

VFR. Visual flight rules

VHF. Very high frequency

V_n. Velocity acceleration relationship

VORTAC. Very high frequency - omnirange and tactical air navigation

W

WST. Weapon system trainer

WSTH. Weapon system tactical handbook

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 judgement. 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's your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-245FDD-1A-1 (Supplement)

NAVAIR 01-245FDD-1B (Pocket Checklist)

NAVAIR 01-245FDD-1C (Servicing Checklist)

NAVAIR 01-245FDD-1F (Functional Checkflight Checklist)

NWP 55-5-F4 (Tactical Manual)
Vol. I (NAVAIR 01-245FDB-1T.1)
Vol. II (NAVAIR 01-245FDB-1T.2)
Vol. III (NAVAIR 01-245FDB-1T (A))

HOW TO GET COPIES

Each flight crewmember is entitled to personal copies of the NATOPS flight manual and appropriate applicable publications.

Automatic Distribution. To receive future changes and revisions to this manual or any other NAVAIR aeronautical publication automatically, a unit must be established on an automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list or to change existing NAVAIR publication requirements, a unit must submit the appropriate tables from NAVAIR 00-25DRT-1 (Naval Aeronautic Publications Automatic Distribution Requirement Tables) to NATSF, Code 321, 700 Robbins Avenue, Philadelphia, PA 19111. Publication requirements should be reviewed periodically and each time requirements change, a new NAVAIR 00-25DRT-1 should be submitted. NAVAIR 00-25DRT-1 only provides for future issues of basic, changes, or revisions and will not generate supply action for the issuance of publications from stock. For additional instructions, refer to NAVAIRINST 5605.4 series and Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002 (S/N 0535-LP-004-001).

Additional Copies. Additional copies of this manual and changes thereto may be procured by submitting DD Form 1348 to NAVPUBFORMCEN Philadelphia in accordance with Introduction to Navy Stocklist of Publications and Forms, NAVSUP Publication 2002.

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

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3710.7.

Routine change recommendations are submitted directly to the model manager on OPNAV form 3500-22 shown on the next page. The address of the model manager of this aircraft is:

Commanding Officer
Marine Aircraft Group 41
NAS Dallas, TX 75211
Attn: F-4 Model Manager

Change recommendations of an URGENT nature (safety of flight, etc.) should be submitted directly to

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV FORM 3500/22 (5-69) 0107-722-2002

DATE ____________________

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (originator)					Unit
TO (Model Manager)					Unit
Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (be specific)

CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

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

FROM	DATE

TO

REFERENCE

(a) Your Change Recommendation Dated ____________________

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

Your change recommendation is reclassified URGENT and forwarded for approval to ____________________ ______________ by my DTG ____________________ .

/S/____________________ MODEL MANAGER | ____________________ AIRCRAFT 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 SYMBOLS

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., which may result in injury or death if not carefully observed or followed.

CAUTION

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

Note

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

WORDING

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

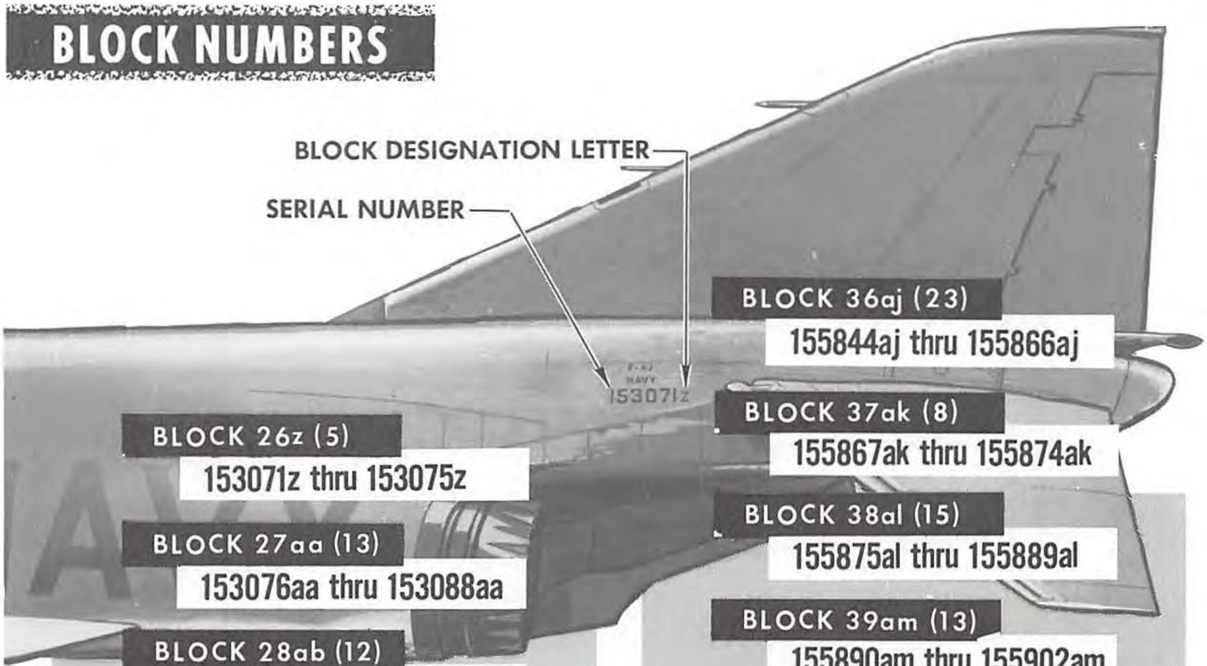
"Shall" has been used only when application of a procedure is mandatory.

"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.

BLOCK NUMBERS



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BLOCK 30ad (40)	153800ad thru 153839ad
BLOCK 31ae (37)	153840ae thru 153876ae
BLOCK 32af (40)	153877af thru 153911af 154781af thru 154785af
BLOCK 33ag (69)	154786ag thru 154788ag 155504ag thru 155569ag
BLOCK 34ah (65)	155570ah thru 155580ah 155731ah thru 155784ah
BLOCK 35ai (59)	155785ai thru 155843ai
BLOCK 36aj (23)	155844aj thru 155866aj
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BLOCK 38al (15)	155875al thru 155889al
BLOCK 39am (13)	155890am thru 155902am
BLOCK 40an (19)	157242an thru 157260an
BLOCK 41ao (13)	157261ao thru 157273ao
BLOCK 42ap (13)	155903ap, 157274ap thru 157285ap
BLOCK 43aq (12)	157286aq thru 157297aq
BLOCK 44ar (12)	157298ar thru 157309ar
BLOCK 45as (9)	158346as thru 158354as
BLOCK 46at (11)	158355at thru 158365at
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F-4J

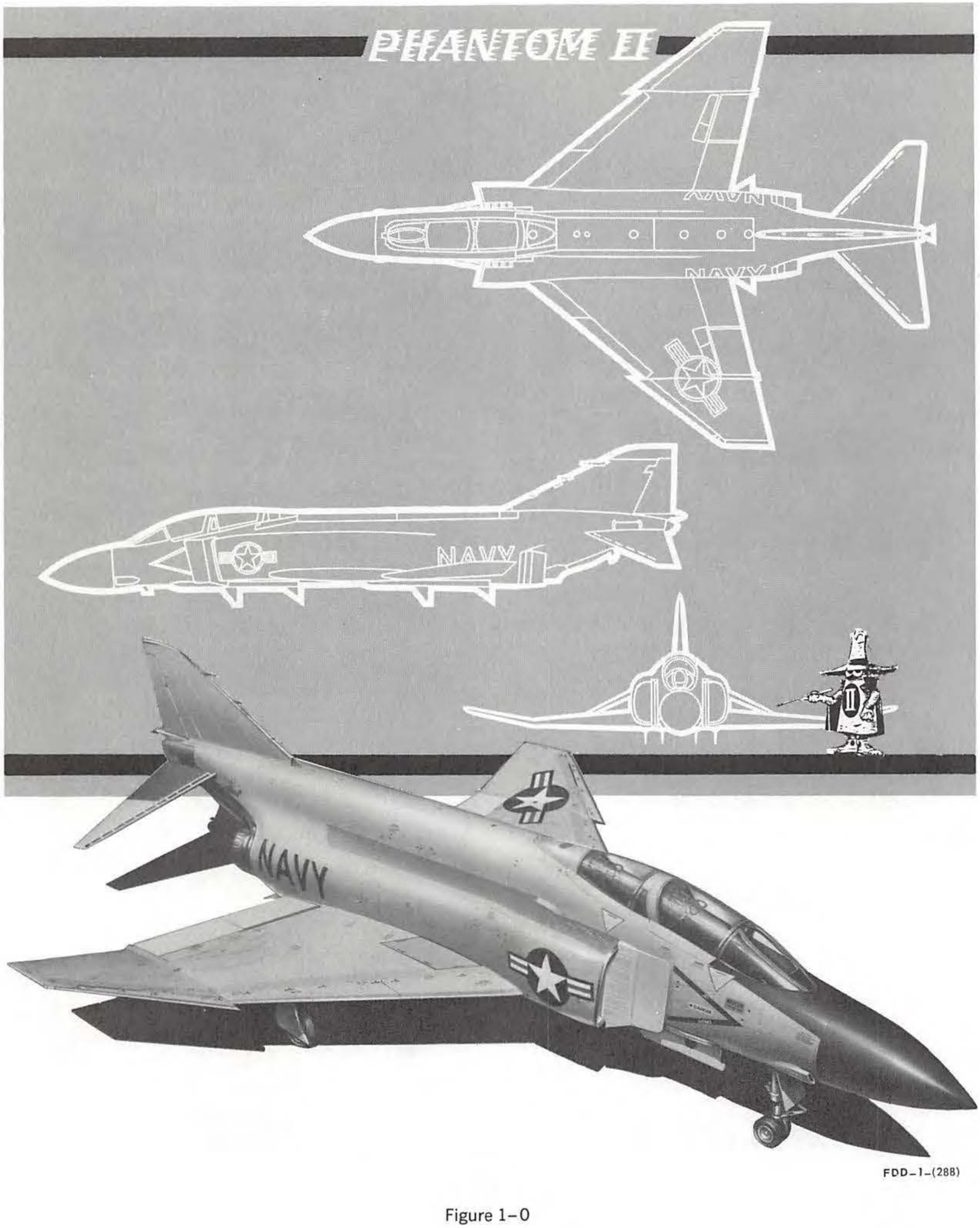

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Figure 1-0

PART I

Aircraft

CHAPTER 1

General Description

1.1 AIRCRAFT

Note

Some illustrations referred to in this chapter writeup may be located in the foldout section. These illustrations are referred to within the text as Figure FO- .

1.1.1 Description. The F-4J/S aircraft (Figure 1-1) is a two-place (tandem) supersonic, long-range, all-weather fighter built by McDonnell Douglas Corporation. The aircraft is designed for intermediate- and long-range high-altitude interceptions using missiles as the principal armament and for intermediate- or long-range attack missions to deliver airborne weapons/stores. The F-4J is powered by either two single-rotor, axial-flow, variable stator turbo-jet J79-GE-8, J79-GE-10, or J79-GE-10B engines with afterburner. The F-4S is powered by J79-GE-10B engines. The aircraft features a low-mounted swept-back wing with anhedral at the wing tips, and a one-piece stabilator with cathedral, mounted low on the aft fuselage. The wings have hydraulically operated leading edge and trailing edge flaps, ailerons, spoilers, and speedbrakes. All the control surfaces are positioned by irreversible hydraulic power cylinders to provide desired control effectiveness throughout the entire speed range. A self-charging pneumatic system provides normal, emergency, and secondary emergency canopy operation as well as emergency operation for the landing gear, in-flight refueling probe, and wing flaps. The pressurized cockpit is enclosed by two clamshell canopies. A drag chute, contained in the aft end of the fuselage, reduces landing roll distances.

1.1.2 Aircraft Dimensions. The approximate dimensions of the aircraft are as follows:

1. Span (wings spread) – 38 feet, 5 inches
2. Span (wings folded) – 27 feet, 7 inches
3. Length – 58 feet, 3 inches
4. Height (to top of fin) – 16 feet, 6 inches.

1.1.3 Armament. The aircraft is equipped to carry and deliver an assortment of air-to-air missiles, air-to-ground missiles, rockets, bombs, landmines, leaflet dispensers, and airborne weapons/stores. The aircraft is also equipped with gunnery capabilities with the addition of the Mk 4 gun pod on the centerline station. Refer to Chapter 15 for additional information on armament.

1.1.4 Technical Directive Summary. For technical directive incorporation and main difference between aircraft, refer to Technical Directive Summary in the introduction section of this manual.

1.1.5 Block Numbers. Refer to Block Numbers illustration in the introduction section of this manual for block production with corresponding assigned aircraft serial numbers.

1.1.6 Armor Plating. On F-4J 157286aq and up or after AFC 472 and all F-4S, provisions for attaching armor plating to doors 15, 16, 22, 23, 28 right, and 28 left are provided. This armor, when installed, provides protection for the oxygen bay and hydraulic/engine fuel feed compartment. The armor adds approximately 109 pounds to the weight of the aircraft and shifts the cg forward by approximately 0.1-percent MAC.

1.1.7 Aircraft Security Requirements. The occasion may arise when it will be necessary to land at a civilian field that does not have a military installation associated with it or when the aircraft is to be presented in a static display. In order to prevent the compromise of classified information, accidental damage to the aircraft, or injury to observers, the following guidelines are provided.

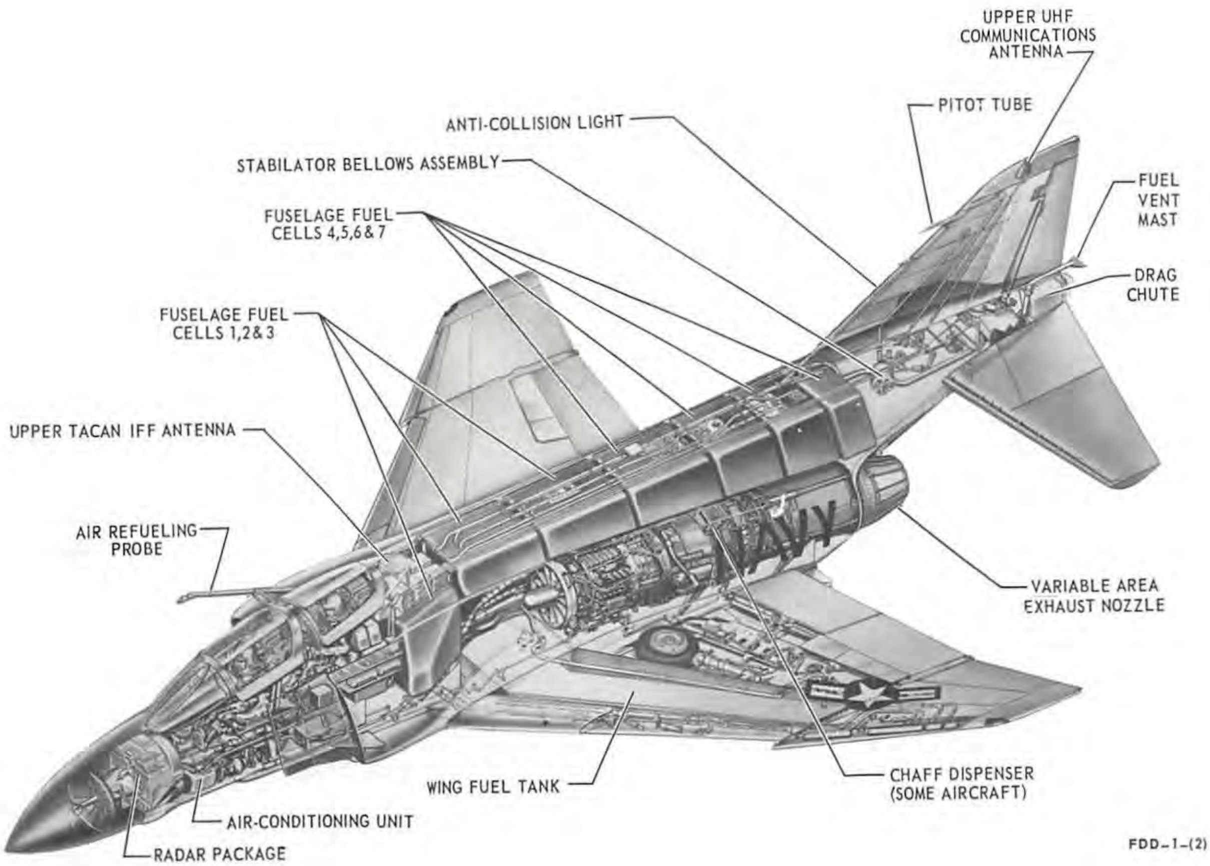


Figure 1-1. General Arrangement – Typical

1.1.7.1 Static Displays

1. Inert airborne weapons/stores may be carried on the aircraft in any combination.

2. External tanks may be carried.

3. The radome must be secured.

4. The front seat shall be completely pinned and the canopy must be secured.

5. The rear seat shall be completely pinned and the canopy must be secured.

6. The pneumatic system must be bled to prevent the canopies from being opened.

7. No smoking rules must be enforced.

1.1.7.2 RON at Civilian Fields

1. Make necessary security guard arrangements.

2. Secure radome.

3. The front seat shall be completely pinned and the canopy must be secured.

4. The rear seat shall be completely pinned and the canopy must be secured.

5. Consideration should be given to bleeding off pneumatic system pressure to prevent canopy opening.

1.2 COCKPITS

1.2.1 Description. Although the cockpits are separately enclosed, the cockpit pressure-oxygen environment is the same. Each cockpit incorporates an ejection seat that is adjustable in the vertical plane for comfort. The forward cockpit instrument panel contains the flight and engine instruments. Engine controls, autopilot and fuel management panels are on the left console. Communication, navigation, heating, and lighting controls are on the right console. Left and right vertical panels forward of the consoles contain the flight control trim position indicators and the telelight panels. The aft cockpit instrument panel contains the necessary instruments for navigation plus miscellaneous switches and indicator lights. Radar equipment is below the instrument panel. The right side of the cockpit contains the circuit breaker panels, and the left side contains the communication and oxygen controls. Refer to Figures FO-1 and FO-2 for the instrument panels and consoles.

CHAPTER 2

Systems

2.1 AIR-CONDITIONING AND PRESSURIZATION SYSTEM

Note

Some illustrations referred to in this chapter writeup may be located in the foldout section. These illustrations are referred to within the text as FO- .

2.1.1 Description. Both cockpits are pressurized and supplied with conditioned air from the cockpit air-conditioning unit. The same air that pressurizes and heats the cockpits also is used to keep the windshield free of fog, frost, and rain. The cockpit air-conditioning unit utilizes high-temperature, high-pressure, engine compressor bleed air from either or both engines. The cockpit air-conditioning system (Figure 2-1) consists of two air-to-air heat exchangers, an expansion turbine, pressure regulating, mixing, and shutoff valves, and temperature controls necessary to select cockpit temperatures, defogging, rain removal, and ram air operations. High-temperature/high-pressure engine compressor bleed air passes through the primary and secondary heat exchanger and is expanded through the cooling turbine. After being mixed with hot compressor bleed air (as required by pilot temperature selection), it enters the cockpits through several manifolds, one near the RIO's feet, one near the pilot's feet, one along the lower surface of each windshield side panel and one at the base at the flat optical panel of the windshield. Two eyeball-type air nozzles are just below the canopy sill on the right and left side of the RIO's cockpit. Air is also routed into the aft cockpit via an open tube duct behind the circuit breaker panels. On F-4J after AFC 328 and all F-4S, the inlet bleed air pressure to the air-conditioning system can be controlled by selecting the PRESS LOW or PRESS NORMAL position on the rain removal switch. When the PRESS NORMAL position is selected, the bleed air pressure is regulated at 62 (±5) psi. Selection of the PRESS LOW position reduces the bleed air pressure to 40 (±5) psi. The PRESS LOW position reduces the cockpit noise to the same level as produced when the rain removal system is operating.

2.1.2 Cockpit Air-Conditioning. The cockpit air-conditioning system operation can best be explained and understood by referring to the cockpit temperature schedule (Figure 2-2). The low temperature range, which refers to the curve labeled Foot Heat, produces temperatures from -20 °F to 100 °F. These temperatures refer to inlet air and not cockpit temperature, so cockpit temperature will be determined by a combination of inlet air and environmental conditions. The low temperature curve is the governing schedule for all air entering the cockpit while in automatic temperature control with the defog-foot heat lever in the LOW range. A little air is always entering through the defog port and this air increases (while foot heat air decreases) as the defog-foot heat lever is moved forward. But until a switch is made at the HI/LOW position, both defog and foot heat air enter on the low temperature schedule. Thus, full range of the temperature control knob (from 8 o'clock to 4 o'clock positions) will only produce -20 °F to 100 °F air unless the defog-foot heat lever is moved into the HI range. When the HI/LOW switch is made, the temperature schedule of all entering air switches to the high temperature curve. Thus, if the temperature control knob was positioned toward HOT (about 3 o'clock), 87 °F would be the temperature of incoming air in the low temperature range, but when the switch to HI is made, the temperature would change to 137 °F. The HI-LOW switch is actuated after approximately 50-percent of defog-foot heat lever travel to provide more air through the defog nozzles without switching to the high temperature range, thus aiding crew comfort at low altitudes. As the defog-foot heat lever is moved forward through full travel, the foot heat butterfly valves for both front and rear cockpits are closing as the defog valve opens. Thus, the defog air volume increases on a rather steep slope, and when the lever is closed to full defog position (full forward), the temperature of the air entering the cockpit is quite warm.

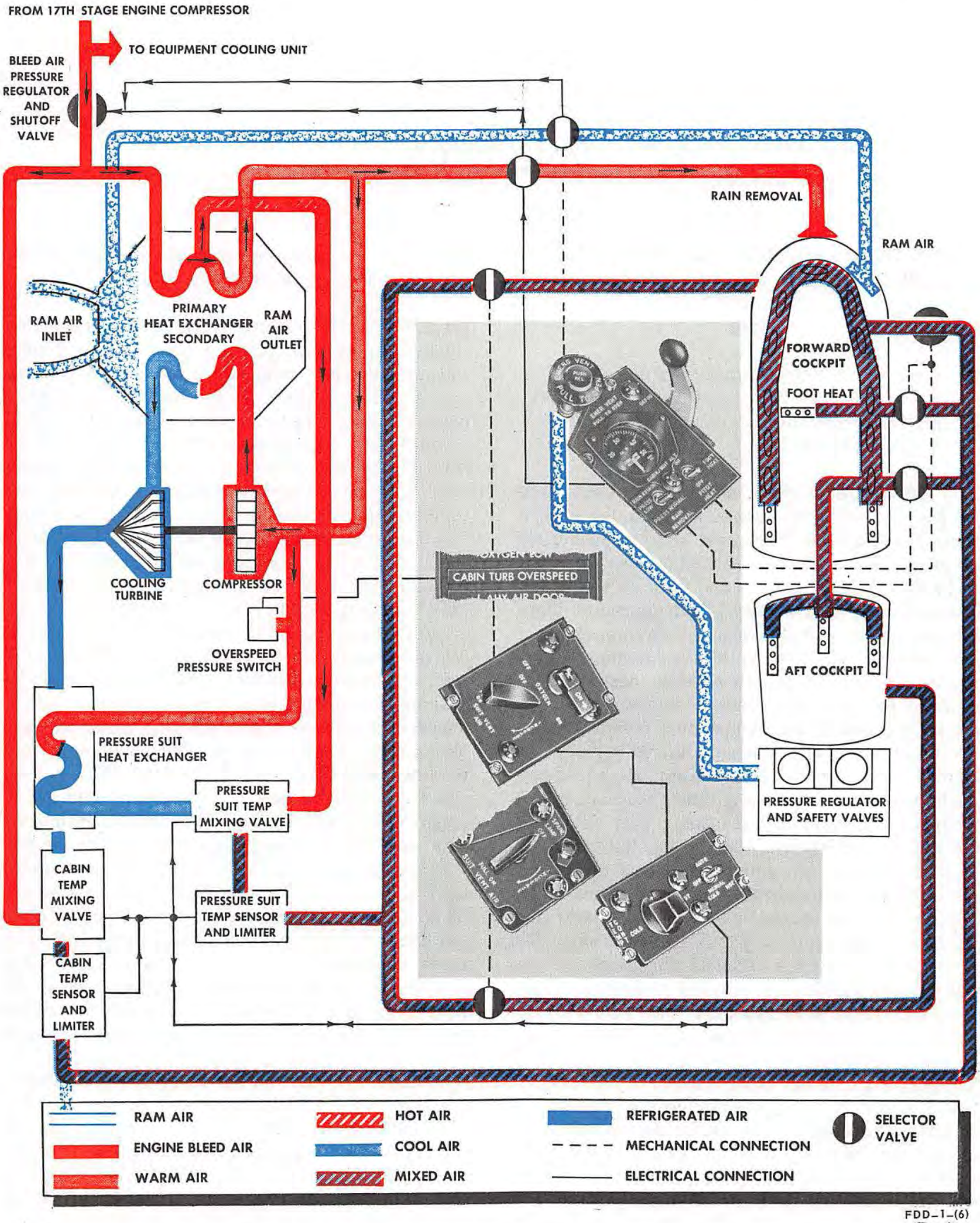


Figure 2-1. Cockpit Air-Conditioning and Pressurization System

Note

The detection of a low pitched howl in many cases indicates icing in the pressure suit heat exchanger. This "organ piping" effect can be eliminated by increasing the cabin air temperature.

2.1.2.1 Manual Override-Cockpit Temperature Mixing Valve. If the automatic temperature control malfunctions, the manual position of the temperature control auto-manual switch can be used to select a full range of temperatures up to 230 °F. The HI/LOW switch on the defog-foot heat lever is bypassed. Thus, the entire temperature range for both foot heat and defog air is scheduled directly by the mixing valve position, which in turn is moved only when the temperature control switch is held to either HOT or COLD. The switch is spring loaded to OFF and in the OFF position the mixing valve is held stationary.

CAUTION

The manual override should be used only if an automatic temperature control system malfunction occurs. To increase the temperature in this mode, the manual control switch should be held toward the HOT position for no more than 1/2 second at a time between pauses of at least 3 seconds until the desired temperature is reached. Actuating the switch for more extended periods does not allow the temperature limiter adequate time to function and may result in an overheat condition. Detection of smoke in the cockpit after use of manual control is evidence of improper use of the switch and requires the selection of a colder valve position to avoid overheating of the cockpit distribution ducting.

2.1.2.2 Manual Override-Pressure/Ventilated Wet Suit Temperature Mixing Valve. Manual override operation complicates the picture a bit when the pressure/ventilated wet suit is involved in that only the pressure/ventilated wet suit mixing valve is actuated when the override switch is moved to HOT or COLD. The cockpit air mixing valve remains in its last automatic selected position. The relative volumes of defog and foot heat air can be changed by defog-foot heat lever action, but the temperature is fixed when manual override is selected. This characteristic can cause an undesirable situation if the automatic temperature control becomes inoperative during the cruise portion of a flight. Cockpit air temperature will not normally be at a high setting with the suit on, so when manual override is selected, the cockpit air mixing valve remains at a fixed, moderate temperature position. Therefore, when higher temperature defog air is desired for letdown, it is not available since manual override only controls suit vent air. However, when the suit vent air lever is turned off, the suit mixing valve becomes stationary at the cold position and the cockpit mixing valve again is operative. Since suit vent air would not be absolutely necessary during letdown into fog producing altitudes, this method to control cockpit air temperatures is plausible. However, it must be remembered when operating in manual override, the suit vent air must be off if manual control of cockpit temperatures is desired. Suit vent air can be turned on again after increasing defog air temperature. It also must be remembered that the RIO has no control over suit air temperature. The RIO can control flow, but must accept the pilot selected temperature. So if the pilot turns vent air off, driving the mixing valve to cold, the RIO will be receiving full cold air unless he elects to turn it off.

2.1.2.3 Cockpit Ambient Fog. It is possible through selection of cold temperature settings, particularly on humid days, for the air-conditioning system to deliver air at temperatures well below the dewpoint with resultant cockpit fogging. This fog can be rapidly dissipated by selecting a slightly warmer temperature. When operating in high humidity conditions, it is recommended that warmer than normal temperatures be selected prior to starting the takeoff run to preclude the possibility of cockpit fogging as thrust is increased.

2.1.2.4 Emergency Vent Knob. The cockpits may be cleared of undesired smoke or fumes and the cabin air-conditioning unit may be shut off by pulling up on the emergency ventilating handle (Figure FO-1). Push button on top of knob and then pull up on the knob. The handle may be placed in an intermediate position to obtain desired amount of emergency ventilation. When pulled up, three actions occur simultaneously.

1. The rain removal system and all air-conditioning and pressurization air from the cabin air-conditioning unit to the cockpits is shut off.

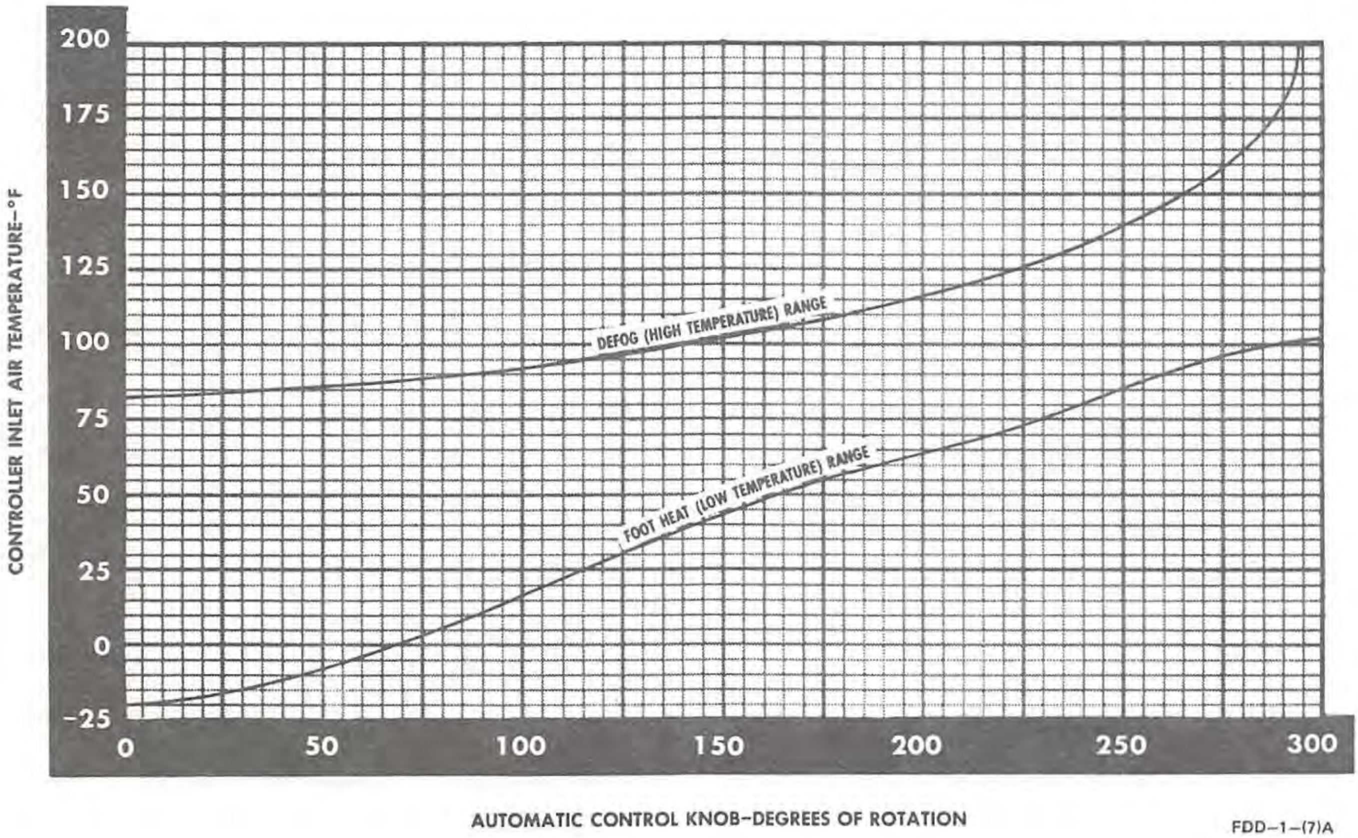


Figure 2-2. Cockpit Temperature Schedule

2. The cabin/pressure regulator and safety (dump) valve is opened and the cockpit becomes completely depressurized.

3. A ram air shutoff valve is opened and the atmospheric air is allowed to enter the cockpit through a port just forward of the pilot's feet.

2.1.3 Windshield Defogging. Fogging of the windshield is prevented by heating the inside surface with incoming cabin air that is diverted into the defogging manifolds along the lower surfaces of the side and center panels. The defog lever (Figure FO-1) on the pilot right console, outboard of the right utility panel, is provided to select windshield defogging. The lever proportions the cabin airflow between the foot heaters and windshield defogging tubes such that in the full aft (FOOT HEAT) position, approximately 90 percent of the total cockpit airflow is delivered to the pilot and RIO air distribution manifolds and 10 percent through the windshield defog manifold. At the full forward (DEFOG) position, approximately 20 percent of the total airflow is delivered through the foot heat manifold and 80 percent through the windshield defog manifold. Obtaining adequate defog air is achieved only after the defog-foot heat lever has been moved to the HI range. The pilot should attempt to anticipate fogging conditions and preheat the windshield.

Note

If the windshield starts to fog over and it is imperative that the pilot maintain visual contact outside the cockpit, the temperature rheostat should be turned full cold and windshield defog air applied. In the HOT position, the warm air picks up moisture in the air-conditioning system, and when it encounters the relatively cold windshield, condensation (fogging) invariably occurs. Generally, applying hot air to a partially fogged windshield will completely fog it over in a matter of seconds.

2.1.4 Windshield Rain Removal. Windshield rain removal is controlled by a rain removal switch (Figure FO-1) on the right utility panel, front cockpit.

Placing the switch ON opens a valve causing warm air to flow through nozzles directed up the outer surface of the windshield center panel. This air breaks up the rain drops into small particles and diverts the majority of them over the windshield. A W'SHIELD TEMP HI light on the telelight panel illuminates when the windshield material approaches a temperature which causes optical deterioration. If the light illuminates, the system should be turned off immediately. If the windshield rain removal system cannot be shut down, pull up on the cockpit emergency vent handle. Engine bleed air will be shut off prior to entering the rain removal ducts. If the windshield temperature sensors have not been calibrated properly, the light may illuminate as a result of aerodynamic heating (occurs only near level flight maximum speed with maximum afterburning). In this event, the overheat signal may be disregarded. On F-4J after AFC 328 and all F-4S, the rain removal switch is changed to a three-position switch with positions of RAIN REM-ON, PRESS LOW, and PRESS NORMAL. This switch provides two methods of reducing cockpit noise. Inlet bleed air pressure is controlled by selecting the PRESS LOW or PRESS NORMAL positions on the rain removal switch. When the PRESS NORMAL position is selected, the bleed air pressure is regulated at 62 (±5) psi. Selection of the RAIN-REM-ON position reduces the bleed air pressure to 40 (±5) psi, reducing the cockpit noise. This same lower cockpit noise level can be obtained by placing the switch to PRESS LOW position. This position enables the pilot to select a lower pressure setting on the bleed air pressure regulator without actuating the rain removal system.

CAUTION

- For a static ground check, the system must be operated with leading edge flaps in the down position and engines running at or below 88-percent rpm.
- Do not operate the rain removal system in flight with a dry windshield or at airspeed above Mach 1.0.
- Unless visibility is seriously restricted, the rain removal system should not be used in conjunction with afterburner.

Note

When throttles are retarded to idle after touchdown in rain with the windshield rain removal system on and flaps down, system performance is degraded and forward visibility may be further reduced.

2.1.5 Cockpit Pressurization. With the canopy closed and with the cockpit refrigeration system in operation, the cockpit automatically becomes pressurized at an altitude of 8,000 feet and above (Figure 2-3). The pressure in the cockpit is maintained by the cockpit pressure regulator (on the cockpit floor aft of the RIO seat) which controls the outflow of air from the cockpit. Below 8,000 feet, the regulator relieves cockpit air at a rate to keep the cockpit unpressurized. Above 8,000 feet, the regulator relieves cockpit air as necessary to follow a definite cockpit pressure schedule. Operation of the pressure regulator is completely automatic. The cockpit safety valve prevents the cockpit pressure differential from exceeding positive or negative differential pressure limits in case of a malfunction of the cockpit pressure regulator and provides an emergency means of dumping the cockpit air. The dump feature of the safety valve is pneumatically connected to a dump feature on the cockpit pressure regulator. Both valves which are operated pneumatically from a single control have sufficient capacity to permit the cockpit differential pressure to be reduced from 5.5 psi to 0.05 psi within 5 seconds or less.

CAUTION

Opening the canopy when the cockpit is overpressurized may result in canopy hinge damage or a canopy separation. Therefore, anytime the cockpit is overpressurized, dump cockpit pressurization prior to operating the canopies.

2.1.5.1 Cockpit Pressure Altimeters. The pressure altitude of the cockpit is indicated on a pressure altimeter. The pilot cabin altimeter (Figure FO-1) is on the right console. The RIO cabin altimeter (Figure FO-2) is in a panel on the left side of the aft cockpit.

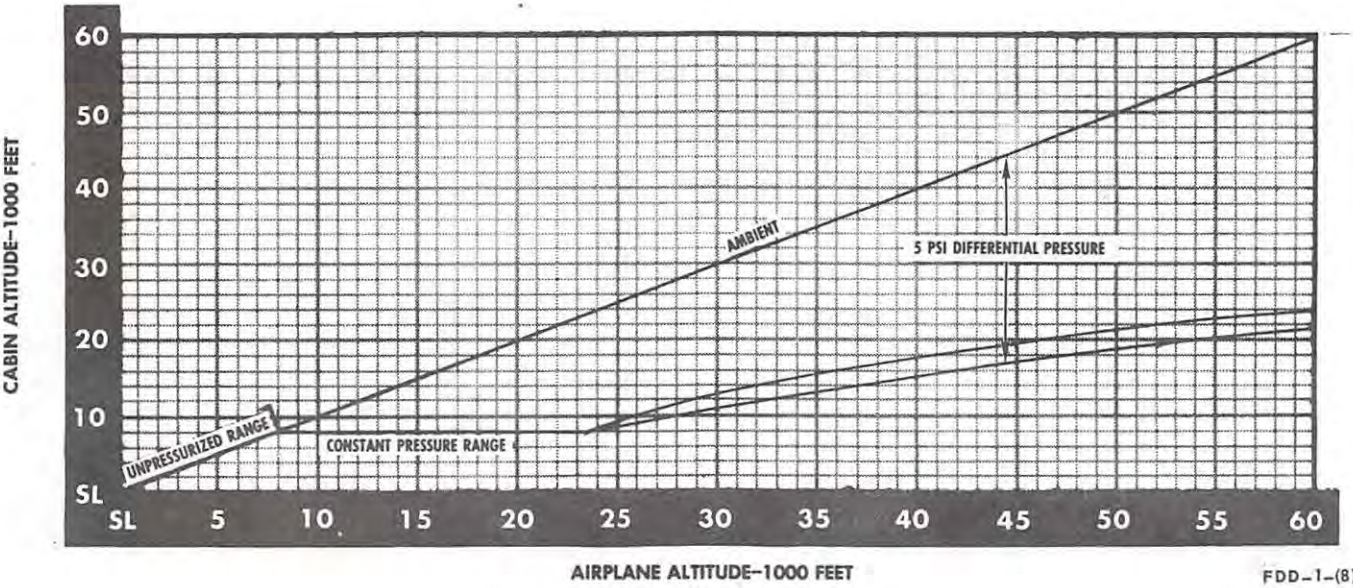


Figure 2-3. Cockpit Pressure Schedule

The cabin altimeters are vented directly to cockpit pressure.

2.1.5.2 Cabin Turbine Overspeed Indicator Light. The cabin turbine overspeed indicator light (FO-1) is on the pilot telelight panel. The indicator light illuminates when the cooling turbine in the cockpit refrigeration unit is being subjected to pressures and temperatures in excess of normal operation and is, therefore, subject to premature failure. If possible, the aircraft speed and engine power should be reduced until the light goes out. If the light fails to go out, the pilot should then select ram air by pulling UP on the emergency vent knob, which will divert ram air into the cockpit and at the same time shut off bleed air to the refrigeration unit, thereby stopping the cooling turbine. The cooling turbine may also be shut down by pulling the cockpit heat and vent circuit breakers (L9, M9 on F-4J before AFC 388; M9, N9 on F-4J after AFC 388 and all F-4S; No. 2 panel).

2.1.6 Equipment Air-Conditioning System. The equipment air-conditioning system consists of an air-to-air heat exchanger, pressure regulating and shutoff valve, expansion turbine, mixing valve, and temperature controls. It also includes a liquid coolant heater exchanger, coolant pump, coolant reservoir, and pressure and relief valves. The unit provides conditioned air to the nose radar package and radar unregulated power supply, the CNI equipment shelf aft of the nosewheel well, the electronic equipment shelf aft of the rear cockpit, and the liquid coolant heater exchanger. The conditioned air directed to the liquid coolant heat exchanger is used to cool the coolant which in turn cools the radar package in the nose. The equipment air conditioning system also provides high pressure air (auxiliary air) for fuselage fuel tank pressurization, wing fuel tank pressurization and transfer, anti-g suits, electronic equipment pressurization, high-pressure pneumatic system air source, ADC, and canopy seal pressure. Operation of the system is entirely automatic with airflow initiated on engine start. Engine bleed air after flowing through the heat exchanger and pressure regulating valve, is expanded through the cooling turbine and then mixed with warm bleed air as necessary to provide a delivery temperature of 85 °F from sea level to 25,000 feet and 40 °F above 25,000 feet. In the event of a system failure such that air temperatures exceed 150 ±10 °F, the air-conditioning unit is automatically shut off and emergency ram air cooling is provided. A warning light labeled RADAR CNI COOL OFF illuminates on the RIO instrument panel and the pilot right vertical panel whenever ram air is being utilized for cooling. A reset button labeled cooling reset is on the RIO main instrument panel and on the console below the pilot right vertical panel. On F-4J 158355at and up or after AFC 555 and all F-4S, the reset button on the RIO main instrument panel is integrated with the RADAR CNI COOL OFF light. If the RADAR CNI COOL OFF light illuminates, attempt to restart the refrigeration unit by reducing speed below that at which the light illuminated, waiting at least 15 seconds and then depressing the cooling reset button. If refrigeration unit fails to restart, no further restart should be made. On F-4J 155875al and up and all others after AFC 463 and all F-4S, a diverter valve in the air inlet duct of the liquid coolant heat exchanger diverts air to the nose radar package for pulse radar operation during sea level static conditions. The diverter valve is normally open in flight or during radar ground operations using high power modes. When the aircraft is on the ground and using internal electrical power, the diverter valve is closed (if a radar high power mode is not selected) and the RADAR COOL DIV CLOSED light on the telelight panel illuminates. This light illuminates only as an indicator light and should not illuminate in flight. If the light illuminates during flight, a radar low power mode must be selected. Since the RADAR COOL DIV CLOSED light causes the MASTER CAUTION light to illuminate, these lights normally come on at touchdown if the radar set is in a low power mode. Refer to limitations in NAVAIR 01-245FDD-1A. On F-4J 158355at and up or after AFC 555 and all F-4S, the equipment air-conditioning system is modified by the addition of three ground cooling fans, a water separator, and a RADAR LIQ COOL OVERHT light. The modified system supplies cooling air to the same aircraft units at approximately the same temperatures as the previous system; but ground cooling capabilities and moisture prevention are greatly improved. The ground cooling fans provide a positive airflow to the various systems requiring cooling air and operate automatically whenever the generators are ON and the aircraft weight is on the main gear. If the ambient temperature is below 0 °F the fans are not needed for adequate cooling and do not operate. Sufficient cooling is also provided for radar/CNI ground operation with external power applied and the ground cooling shutoff switch in the nosewheel well in the ON position. Engine operation or external cooling air is not required with the ground cooling fans operating, provided ambient temperature is below 103 °F. If one or more of the fans fail (when operation is required), the RADAR CNI COOL OFF light illuminates and cannot be reset. In this event, a radar low heat mode must be selected, utilization of equipment requiring cooling air must be kept at a minimum, and sustained static engine operation be kept below 80-percent rpm. After takeoff, the fans are not required and the warning circuit is removed from the RADAR CNI COOL OFF light; at this time the reset button must be pressed to reset the equipment cooling system. The RADAR COOL DIV CLOSED light is removed from the modified system and a RADAR LIQ COOL OVERHT light on the telelight panel is added. The RADAR LIQ COOL OVERHT and the MASTER CAUTION lights illuminate if the radar liquid coolant temperature reaches 145 (±5) °F. In this event, the radar is not receiving sufficient cooling and a low heat mode must be selected.

CAUTION

- Malfunction of the equipment cooling turbine may be indicated by a high pitch whine and/or vibration in the nose of aircraft. The turbine may be shut off by pulling equipment cooling circuit breakers (L8, N8, No. 2 panel, F-4J 153071z through 155528ag before AFC 388; N8, M8, No. 2 panel, F-4J 155529ag and up or after AFC 388; N8, No. 2 panel, F-4J after AFC 555 and all F-4S). This will shut off equipment air-conditioning and turn on emergency ram air cooling. Auxiliary air (fuel tank pressure and transfer, anti-g suits, etc.) will not be affected.

- When operating with emergency ram air cooling avoid high speed flight if possible. Maximum allowable cooling temperatures may be exceeded during high speed flight with the result that the following electronic equipment life and/or reliability may be affected: AIM-7 four-channel tuning drive radar package, tacan, IFF, and UHF communication radio receiver-transmitter.

- If the RADAR CNI COOL OFF light does not extinguish when the reset button is depressed, place the tacan to OFF (before AFC 647), the IFF and radar to STBY, and operate only when necessary.

Note

- If the RDAR CNI COOL OFF light illuminates on the ground, it may be due to a failed ground cooling fan. To determine if a fan is at fault, pull and immediately reset the EQUIP COOL circuit breaker (N8 No. 2 panel). If the RADAR CNI COOL OFF light illuminates immediately, the equipment cooling system has failed and the mission must be aborted. If the light takes approximately 10 seconds to illuminate, a ground cooling fan has failed and the equipment cooling system can be reset after takeoff.

- Illumination of the RADAR CNI COOL OFF light while airborne may be due to the AOA probe heater circuit breaker being popped.

- Illumination of the RADAR CNI COOL OFF light shall be logged on the yellow sheet (OPNAV form 3760-2).

2.1.7 Equipment Auxiliary Air System. The equipment auxiliary air system utilizes partially cooled 17th stage engine bleed air after it has passed through the equipment air-conditioning air-to-air heat exchanger. This partially cooled air is distributed to the anti-g suits, canopy seals, air data computer, fuel system pressurization, pneumatic system air compressor, radio receiver-transmitters (tacan), radar wave guide, and radar antenna.

CAUTION

On F-4J 158355at and up or after AFC 355 and all F-4S, if the RADAR CNI COOL OFF light illuminates on the ground because of a ground cooling fan failure, the equipment auxiliary system/components may be damaged if sustained static engine runs are made above 80-percent rpm.

2.1.7.1 Anti-G Suit System. The anti-g system delivers low pressure equipment auxiliary air to the anti-g suits. The air is routed through the anti-g suit control valve and then to the suit. The suit remains deflated up to approximately 1.5 g. As this force is reached or exceeded, air will flow into the suit in proportion to the g forces experienced. When the g force levels off to a constant, the suit remains inflated in proportion to the constant g-force. As the g forces decrease, the suit begins to deflate, again in proportion to the decreasing g forces. A manual inflation button in the anti-g suit control valve allows the crewman to manually inflate his suit for purposes of checking the system or for fatigue relief. A pressure relief valve incorporated within the system is set to relieve at approximately 11 psi and is used as a safety backup in the event of a malfunction. The system is automatic and operates anytime an engine is running.

2.1.8 Normal Operation. Optimum cockpit environment can be achieved by placing the override selector switch on the temperature control panel to AUTO and adjusting the temperature control knob for the desired cockpit temperature. Adjust the defog control lever on the right utility panel for personal comfort and effective windshield defogging. If the automatic temperature control system fails, a temporary adjustment may be obtained by bumping the override selector switch to the HOT or COLD position. To prevent windshield defogging during letdown into hot humid atmosphere, place the override selector switch to AUTO and have the defog lever positioned about three-quarters of the way forward. Five minutes prior to letdown select the full defog position and adjust the temperature control knob to the 2 o'clock (200° clockwise rotation) and maintain these settings throughout the letdown. If fogging persists and will not clear up, retract flaps if extended or increase power (use speedbrakes as necessary to maintain airspeed) to provide more engine bleed air to the mixing valves.

2.1.9 Emergency Operation. Although there are no provisions made for emergency operation of the cockpit air-conditioning system, emergency ventilating air is available. The cockpits may be cleared of undesired smoke or fumes and the cockpit air-conditioning unit may be shut off by depressing the button and pulling up on the emergency ventilating knob. The handle may be placed in an intermediate position to obtain the desired amount of emergency ventilation.

2.1.10 Limitations. There are no specific limitations pertaining to the operation of the air conditioning and pressurization system.

2.2 AIR DATA COMPUTER SYSTEM

2.2.1 Description. The air data computer (ADC) system receives inputs of static pressure, pitot pressure, total temperature, angle of attack, and 17th stage air. These inputs are supplied by two static ports, one on each side of the aft part of the radome, a total temperature sensor on the left air-conditioning inlet duct, a pitot tube on the vertical fin, an angle-of-attack probe on the left forward side of the fuselage, and bleed air from the equipment air-conditioning system. These inputs are corrected in the ADC to compensate for errors in the sensing equipment installation. The corrected inputs are converted to usable outputs by the ADC and are displayed on the airspeed/Mach indicator, the altimeter, and the vertical velocity indicator. Corrected signals are also used by other aircraft systems (see Figure 2-4). The instruments and/or systems utilizing the outputs from the ADC are inoperative or in error if a failure or an interruption occurs in the essential ac power supply, essential dc power supply, or engine bleed air system. An interruption or failure in any of the above systems illuminates the STATIC CORR OFF indicator light.

2.2.2 Static Pressure Compensator. One of the functions of the ADC is to supply all systems requiring static pressure inputs with a static source position error correction. This correction is accomplished through the static pressure compensator. When operating normally, the compensator utilizes the static air pressure as a balancing force only. The corrected static pressure output is actually auxiliary equipment air corrected for the static source error as dictated by the instantaneous flight situation. If a malfunction occurs in the compensator, a fail-safe solenoid is deenergized allowing static pressure from the static source to be routed directly to all systems requiring static pressure inputs. With a malfunction, overall accuracy suffers; however, no system dependent on static pressure becomes inoperative.

2.2.2.1 Static Pressure Compensator Switch. The pilot is alerted to a compensator malfunction by illumination of the STATIC CORR OFF indicator light on the telelight panel (Figure FO-1). Light illumination may be accompanied by a rapid change in the altimeter reading. A static pressure compensator switch is on the inboard engine control panel (Figure FO-1). This switch is the only control associated with the ADC system. The switch has positions of RESET CORR, NORM, and CORR OFF, which are used to reset or turn off the compensator. With the STATIC CORR OFF indicator light illuminated, moving the compensator switch to RESET position returns the compensator to normal operation and extinguishes the indicator light. The switch may then be released and it returns to the NORM position. If the compensator cannot be reset, as evidenced by the indicator light again illuminating when the switch returns to the NORM position, move the switch to the OFF position. The pressure instruments are in error anytime the light is illuminated or the switch is in the OFF position. Refer to the airspeed and altimeter position error correction charts in Chapter 18 and the NATOPS pocket checklist.

Note

> The static pressure compensator must be reset after the engines are started. The altimeter reading after the reset must not differ from the altimeter reading before reset by more than ±40 feet. This variation is an indication of the accuracy of the compensator and its effect on other instruments. It is possible to experience large errors in both altitude and airspeed if the altimeter jump exceeds 40 feet.

2.2.3 Altitude Encoder Unit. F-4J 153780ac and up or after AFC 388 and all F-4S have an altitude encoder unit installed. The altitude encoder is a dual purpose electronic unit in the rear cockpit that receives static pressure signals from the ADC. The altitude encoder in turn provides a digital output of altitude in 100-foot increments, referenced to a standard day (29.92 inches Hg), to the IFF transponder and a synchro output to two servoed altimeters. This synchro signal is modified within the altimeters to provide reference to the actual altimeter setting servoed altimeters. When mode C is selected on the IFF control panel, automatic altitude reporting, in a coded form, is provided to the air traffic control system, thereby eliminating a need for voice communications. For more information on mode C operation and on the servoed altimeters, refer to the sections on the identification system and instruments in this chapter.

2.2.4 Normal Operation. Normal operation of the ADC consists of momentarily placing the static pressure compensator switch in the spring-loaded RESET position after an engine has been started. This action extinguishes the STATIC CORR OFF light, and the ADC is operating with compensated static pressure. If the STATIC CORR OFF light illuminates in flight and cannot be reset, the AFCS, navigation computer, AMCS, and most flight instruments are in error. The ADC receives power from a three-phase, essential 115-vac bus, a 28-vdc essential bus, and a 28-vac essential bus. The system is protected by circuit breakers on No. 1 circuit breaker panel in the rear cockpit. The circuit breakers are marked CADC.

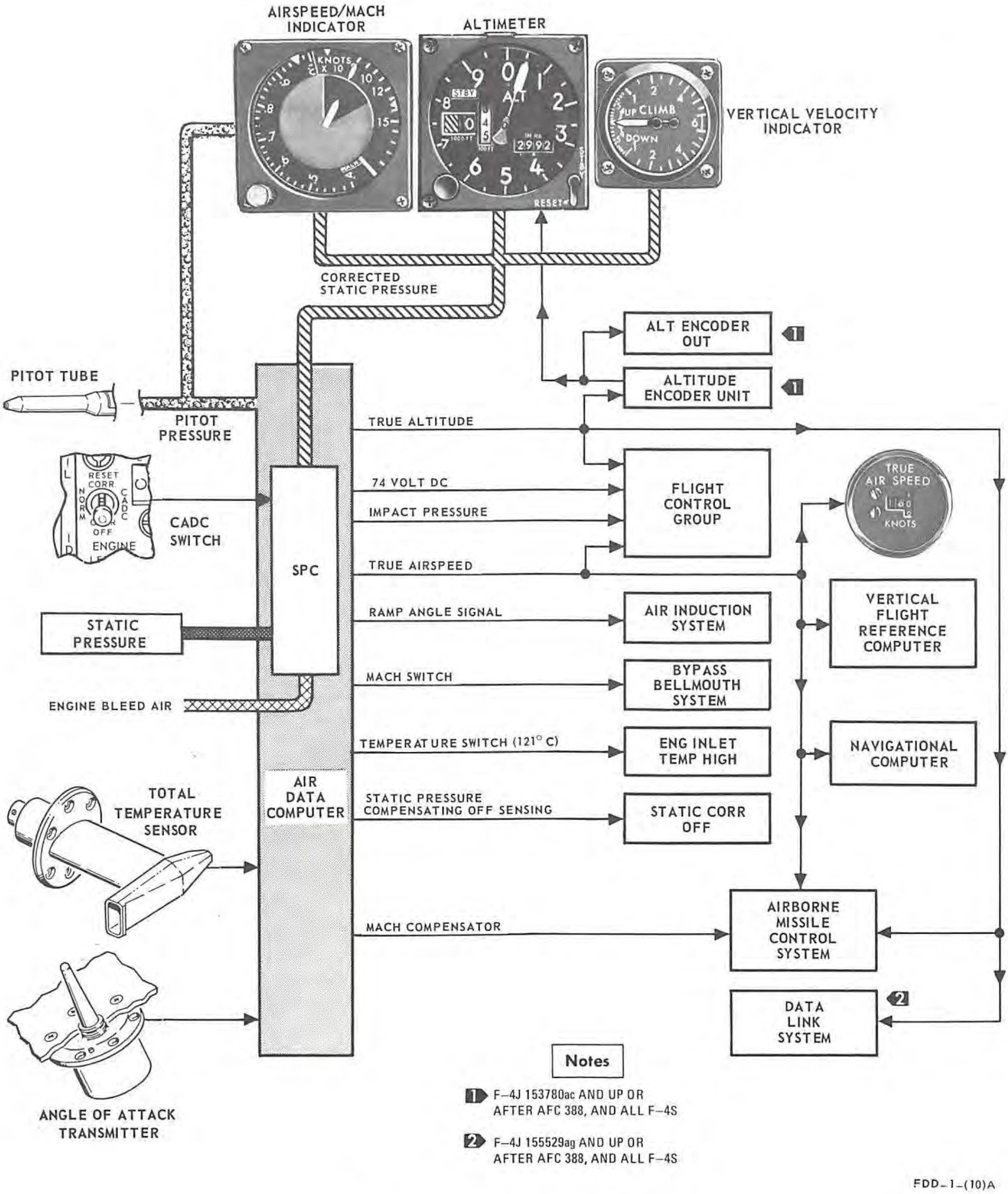


Figure 2-4. Air Data Computer

Note

The variable area inlet ramps may extend while taxiing behind another aircraft exhaust. Ensure that the variable area inlet ramps are fully retracted prior to takeoff.

2.2.5 Emergency Operation. No emergency operations pertain to the ADC. If the STATIC CORR OFF light illuminates in flight and cannot be reset, the AFCS, navigation computer, AMCS, GVR-10, and most of the flight instruments are in error.

2.2.6 Limitations. After initial altimeter jump, the altimeter variation should not exceed ±40 feet when the SPC is reset. Refer to Part XI for SPC OFF airspeed and altimeter position error corrections.

2.3 AIR REFUELING STORE

2.3.1 Description. The aircraft can be used as a probe-and-drogue-type air refueling tanker upon the installation of a D-704 air refueling store (hereafter referred to as buddy tank). The tank (Figure 2-5) is divided into three major sections: power supply, fuel cell, and hose-reel mechanism. The power supply section contains an electrically feathered and governed ram air turbine, a hydraulic pump, a hydraulic fluid radiator, and a hydraulic reservoir. The fuel cell contains a hydraulically driven fuel transfer pump, gravity and pressure fueling receptacles, emergency fuel dump and manual drain valves, float actuated fuel shutoff and vent valves, and electrical, fuel, and air connections. The hose-reel mechanism section contains a spool with 50 feet of hose, a drogue refueling receptacle, a level wind mechanism, a hydraulic motor, and a cartridge-actuated guillotine for emergency hose and drogue jettisoning. The ram air turbine drives the hydraulic pump which, in turn, drives the fuel transfer pump and hydraulic motor. The fuel transfer pump is capable of pumping 200 gallons per minute at 55 psi. The hydraulic motor is used to snub the hose and drogue during extension and to rewind the hose and drogue during retraction. The buddy tank contains 300 gallons of fuel, which can be transferred to the tanker aircraft for its own use or to a receiver aircraft. The tanker aircraft can transfer its internal and external fuel load to the buddy tank and subsequently to a receiver aircraft.

2.3.2 Buddy Tank Control Panel. The buddy tank control panel is on the left side of the rear cockpit instrument panel. The panel will normally be installed upon installation of the buddy tank and removed when the buddy tank is removed. The panel contains six switches and two indicators: a power switch, a hose control switch, a fuel transfer switch, a hose jettison switch, a tank light switch, a ship-tank transfer switch, a drogue position indicator, and a gallons-delivered indicator.

2.3.2.1 Buddy Tank Power Switch. The buddy tank power switch is a guarded toggle lock switch with positions of ON, OFF, and DUMP. Placing the switch to ON energizes the buddy tank electrical system, which electrically unfeathers the tank ram air turbine. Placing the switch to OFF feathers the ram air turbine. The DUMP position is guarded. When in DUMP, a solenoid-operated dump valve is opened for emergency fuel jettison. If an electrical failure occurs while jettisoning buddy tank fuel, the dump valve automatically closes and any fuel remaining in the tank will be trapped.

Note

Before dumping buddy tank fuel, ensure that the pilot buddy fill switch is in the STOP FILL position to preclude complete depletion of aircraft fuel system.

2.3.2.2 Hose Control Switch. The buddy tank hose control switch marked EXT and RET is used for normal extension and retraction of the hose and drogue.

2.3.2.3 Transfer Switch. A solenoid-operated transfer switch has positions of OFF and TRANS. Selecting TRANS allows automatic fuel transfer to a receiver aircraft upon proper drogue engagement. Selecting OFF discontinues fuel transfer. If an electrical failure occurs while transferring fuel to a receiver aircraft, the buddy tank transfer switch will revert to off.

2.3.2.4 Hose Jettison Switch. The buddy tank hose jettison switch marked OFF and CUT is a guarded toggle lock switch. Placing the switch to CUT electrically fires a cartridge that actuates the hose guillotine mechanism. Also, all electrical power, except power to operate the dump valve, is shut off.

2.3.2.5 Buddy Tank Light Switch. The buddy tank light switch marked BRT (bright) and DIM controls the brilliance of the two indicator lights on the tail cone of the tank. Normally, the BRT position

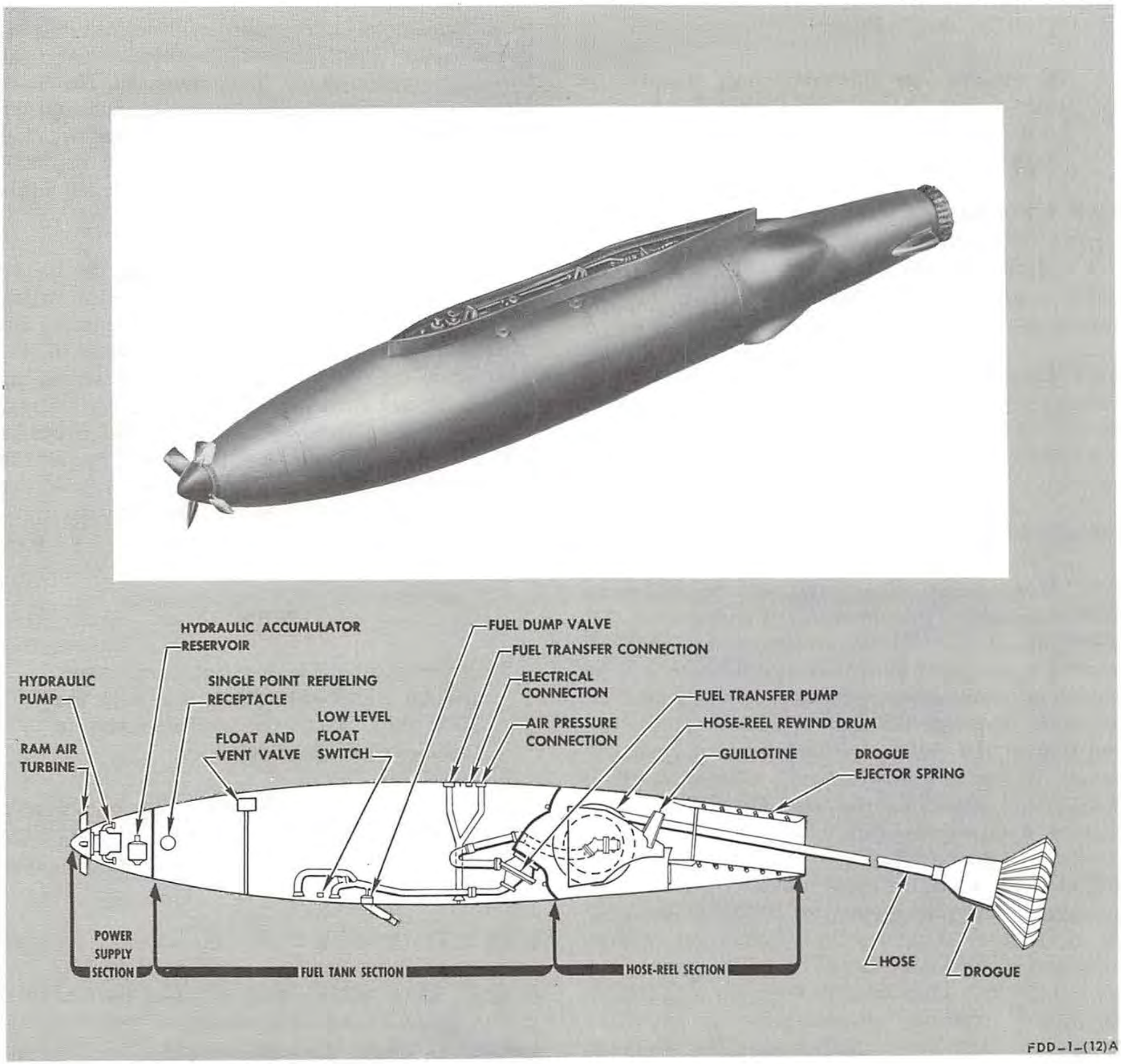


Figure 2-5. D-704 Air Refueling Store (Buddy Tank)

would be selected during daylight hours and the DIM position at night.

2.3.2.6 Ship-Tank Transfer Switch. This switch is not wired into the aircraft electrical system and is inoperative. Fuel is transferred to the buddy tank by placing the buddy fill switch on the fuel control panel (Figure FO-1) to FILL. Buddy tank fuel may be transferred to the aircraft fuselage cells by placing the external transfer switch on the fuel control panel to CENTER.

2.3.2.7 Drogue Position Indicator. The buddy tank drogue position indicator has readouts of RET (retract), EXT (extend), and TRA (transfer). The position of the drogue is indicated by a drum dial viewed through a cutout in the panel. The indicator shows RET when the hose and drogue are completely retracted, EXT when the hose and drogue is extended and ready for engagement, and TRA when the receiver aircraft has completed engagement and retracted hose and drogue a minimum of 2 feet.

Note

The drogue position indicator will not show TRA unless the hose and drogue have completely extended prior to its 2-foot rewind.

2.3.2.8 Gallons Delivered Indicator. A gallons delivered indicator presents a direct reading of total gallons delivered in 2 gallon increments. A reset knob located immediately adjacent to the indicator windows permits resetting the gallons delivered indicator to zero.

2.3.3 Normal Operation. When the buddy tank power switch is placed to ON, 28-vdc and 115/200-vac power energizes the buddy tank electrical system. Once the electrical system is energized, the ram air turbine unfeathers and drives the hydraulic pump. When the hydraulic pressure builds to approximately 1,600 psi, the hose-reel lock mechanism unlocks to allow action of the hose-reel mechanism. When the hose control switch is then placed to EXT, hydraulic pressure to the rewind motor is decreased from 3,000 psi to approximately 1,000 psi and the drogue ejector spring ejects the drogue out of its receptacle in the tail cone of the tank. Upon ejection, the drogue will blossom to its full target diameter of 24 inches. Air drag on the drogue will then complete the hose extension. The hydraulic rewind motor maintains heavy hose and drogue snubbing during the initial drogue ejection and the last few feet of hose extension. The snubbing reduces shock loading on the hose, drogue, and tank. When the hose and drogue are fully extended the amber READY light on the tailcone will illuminate, and the drogue position indicator will display EXT. For DRY receiver hookups, the transfer switch must remain in the OFF position. For WET hookups, the transfer switch must be placed in the TRANS position. After engagement of the drogue, the hose must be retracted a minimum of 2 feet before fuel will transfer. When the hose and drogue are retracted 2 feet, the drogue position indicator reads TRA. When fuel is being transferred to the receiver aircraft, the green TRANSFER light on the tailcone illuminates and the amber READY light goes out. If the buddy fill switch is in STOP FILL, only buddy tank fuel (300 gallons) will be transferred.

Note

If the buddy fill switch is held in the FILL position, the tanker airplane can transfer its entire fuel supply.

The amount of fuel transferred is indicated on the gallons delivered indicator. Buddy tank fuel transfer may be terminated by three means: by placing the fuel transfer switch to OFF; by emergency disengagement of the receiver; and by low level float switch actuation when the buddy tank empties. A major surge or reduction in fuel pressure will also terminate buddy tank fuel transfer. After probe separation, the hose control switch should be placed in the RET position. The hydraulic rewind motor retracts the hose and drogue. When the drogue position indicator reads RET, the buddy tank power switch may be placed to OFF. When the power switch is placed to OFF, the buddy tank electrical system is deenergized and the ram air turbine will feather, terminating hydraulic pump operation. As the hydraulic pressure decays, the hose-reel lock mechanism mechanically locks the hose and drogue in its retracted position. Also, the buddy tank indicator lights will go out.

2.3.4 Emergency Operation. Since an empty buddy tank with its hose and drogue retracted produces the same aerodynamic and/or cushioning effect as an empty external fuel tank, no special emergency procedures are required. Fire, structural damage, uncontrollable fuel loss, etc., may require that the tank be jettisoned. Normally the buddy tank may be safetied by placing the buddy tank power switch to OFF. Placing the power switch to OFF terminates all electrical power to the tank, except for the fuel dump valve, stops hydraulic pump operation, and as a result, mechanically locks the hose and drogue. Buddy tank fuel may be jettisoned at any time by placing the buddy tank power switch to DUMP. In-flight emergencies that do not allow sufficient time for hose and drogue retraction may require hose jettisoning. Placing the hose jettison switch to CUT electrically fires a cartridge which actuates the guillotine cutting blade. The inside segment of the hose is crimped fuel tight by the guillotine blades. Fuel may be dumped after hose and drogue jettison if required.

CAUTION

If the buddy tank hose and drogue is lost unintentionally, the buddy tank electrical system will not be deenergized by placing the power switch to OFF. In this case, the ram air turbine continues to turn and the hydraulic fluid temperature increases causing damage to the O-rings. To deenergize the system and feather the ram air turbine, place the buddy tank power switch to OFF and pull the buddy tank hydraulic pump circuit breaker C6, No. 2 panel on F-4J through 155528ag before AFC 388, and D8 on F-4J 155529ag and up or after AFC 388 and all F-4S. Once the buddy tank holding relay is broken, the buddy tank hydraulic pump circuit breaker may be reset.

2.3.5 Hose and Drogue Jettisoning. A violently whipping hose and drogue or the inability to retract the hose for any reason may require hose and drogue jettisoning. Placing the hose jettison switch to CUT deenergizes the buddy tank electrical system, feathers the ram air turbine, mechanically locks the hose reel mechanism, and electrically fires a cartridge which actuates the guillotine cutting blades. A holding relay delays (5 to 20 seconds) the firing of the guillotine hose cutter until the hose-reel mechanism has locked; thus, preventing the hose reel from rotating and the hose from whipping around and spraying fuel inside the tail cone. Fuel may be dumped after hose and drogue jettisoning if required. To jettison the hose and drogue proceed as follows:

1. Hose jettison switch – CUT.

CAUTION

Do not change the position of the hose jettison switch after being placed to CUT. If the switch is positioned to NORMAL after jettisoning, the buddy tank electrical system becomes energized.

2.3.6 Buddy Tank Jettisoning. The buddy tank may be jettisoned individually from the centerline station or it may be jettisoned along with all external stores. Refer to Figure 12-16.

2.3.7 Limitations. The following limitations apply for carriage and operation of the buddy tank:

1. With hose retracted and turbine feathered, the maximum airspeed for carriage is 500 KCAS or 1.1 Mach, whichever is less. The maximum acceleration for carriage is zero g to +4.0g.

2. With hose extended, the maximum airspeed is 300 KCAS or 0.8 Mach, whichever is less.

3. The recommended envelope during refueling is 200 KCAS to 300 KCAS or 0.8 Mach at any altitude from sea level to 35,000 feet. Maximum acceleration is +2.0g and no abrupt maneuvers are permitted.

4. The maximum airspeed for hose retraction is 250 KCAS.

Note

If the hose fails to retract fully at 250 knots, a reduction in airspeed to 230 KCAS should allow complete retraction.

5. The maximum airspeed for dumping fuel from the buddy tank is 250 KCAS.

CAUTION

Afterburners should not be used while dumping fuel from the buddy tank because of a fire hazard created by the dumped fuel passing through the engine exhaust close to the aft fuselage.

6. The maximum airspeed for jettisoning the buddy tank is 300 KCAS or 0.9 Mach, whichever is less.

2.4 ANGLE-OF-ATTACK SYSTEM

2.4.1 Description. An angle-of-attack system is incorporated into the aircraft to present a visual indication of optimum aircraft flight conditions (i.e., stall, landing approach, cruise, etc.). Optimum angles of attack are not affected by gross weight, bank angle, load factor, airspeed, density altitude, or aircraft configuration. For example, the optimum angle of attack for landing approach is always the same regardless of gross weight. The approach airspeed automatically varies to compensate for the change in weight. The system consists of an angle-of-attack probe and transmitter and angle-of-attack indicator, indexer lights, approach lights, and a stall warning vibrator (rudder pedal shaker). Two electrical heaters, one in the angle-of-attack probe and one in the case (adjacent to the fuselage skin), prevent the formation of ice while flying through precipitation. The case heater element is energized when the static compensator switch is placed to RESET CORR and both case and probe heater elements are automatically energized when weight is off the landing gear. The probe heater and the case heater are both powered by the left main 115-vac bus through the angle-of-attack probe heater circuit breaker (G8 or F-4J before AFC 388; K14 or F-4J after AFC 388 and all F-4S; No. 1 panel). Refer to Figure 2-6 for angle-of-attack conversions and displays.

WARNING

With gear up and flaps down (bolter configuration), aircraft angle of attack will be 3 units greater than indicated angle of attack because of a difference in the airflow about the AOA probe with the nose gear door closed vice open. Thus, the aircraft will stall at about 21 units indicated angle of attack with gear up and flaps down as compared to 24 units indicated angle of attack with both gear and flaps down.

2.4.2 Angle-of-Attack Indicator. This indicator (Figure 1-7) displays the angle of attack of the aircraft. This is accomplished by means of a probe with parallel slots protruding through the fuselage skin. When the aircraft changes its angle of attack, pressure becomes greater in one slot than the other and the probe rotates to align the probe slots with the airstream. Probe rotation moves potentiometer wiper arms, producing resistance variations which are sent to the angle-of-attack indicator. The angle-of-attack indicator is calibrated from 0 to 30 (F-4J) and 0 to 42 (F-4S) in arbitrary units. A reference bug is provided for approach (on speed) angle of attack which is set at 19.0 units (F-4J before AFC 388 and F-4S after AFC 644/AVC 2494 and Amendment 1) or 18.3 units (F-4J after AFC 388 and F-4S before AFC 644/AVC 2494 and Amendment 1). Approach angle-of-attack values are only valid with the landing gear down. Gear up angle-of-attack values are 3 to 4 units lower because of a local flow difference caused by the nose gear door. Additional bugs are provided and can be set at any desired angle of attack. The suggested values for the bug settings are as follows:

1. Climb (400 KCAS) – F-4J 5.5 UNITS AND F-4S 6.0 UNITS.

2. Maximum endurance – F-4J 8.5 UNITS AND F-4S 10.5 UNITS.

3. Stall warning (F-4J before AFC 388) – 21.3 UNITS.

4. Stall warning (F-4J after AFC 388 and F-4S before AFC 644/AVC 2494 and Amendment 1) – 20.6 UNITS; F-4S after AFC 644/AVC 2494 and Amendment 1 – 21.5 UNITS.

The angle-of-attack indicator also contains a switch that actuates the stall warning vibrator (rudder pedal shaker). On F-4J 155529ag and up or after AFC 388 and F-4S before AFC 644/AVC 2494 and Amendment 1, the approach (on speed) reference bug and the stall warning marker are set at 18.3 and 20.6 units, respectively. On F-4S after AFC 644/AVC 2494 and Amendment 1, the approach (on speed) reference bug and the stall warning marker are set at 19.0 and 21.5 units, respectively. When the indicator is inoperative, the word OFF shows in a small window on the face of the dial. Refer to Figure 12-14 to obtain angle-of-attack ranges for various drag indexes and flight conditions.

2.4.3 Angle-of-Attack Indexer. An angle-of-attack indexer is on the left side of the windshield in the front cockpit. On some aircraft there are two angle-of-attack indexers, one on each side of the windshield. The indexer presents landing approach angle-of-attack information by illuminating symbols. The symbols are energized through switches in the angle-of-attack indicator when the landing gear is down and weight is off the gear. At fast airspeeds (low angle of attack) the lower symbol (an inverted V) is illuminated; at slightly fast airspeed, the lower symbol and circular symbol are illuminated. At optimum approach speeds, only the center circular symbol illuminates. For slightly slow airspeeds, the center symbol and upper symbol illuminate. For slow airspeeds (high angle of attack), only the upper symbol (a V) is illuminated.

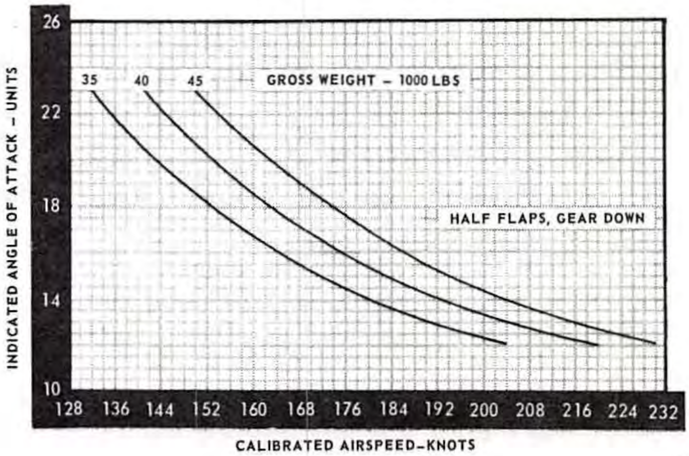
2.4.3.1 Indexer Lights Control Knob. An indexer lights control knob is on the front cockpit right

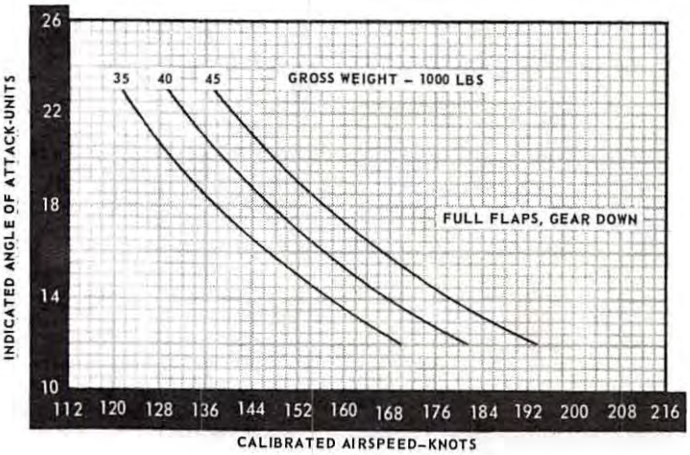
AIRCRAFT THRU 155528ag BEFORE AFC 388

APPROACH LIGHT	INDICATOR	INDEXER	ANGLE OF ATTACK UNIT	AIRSPEED
			20.1-30	VERY SLOW
			19.5-20.1	SLIGHTLY SLOW
			18.5-19.5	ON SPEED
			17.9-18.5	SLIGHTLY FAST
			0-17.9	VERY FAST

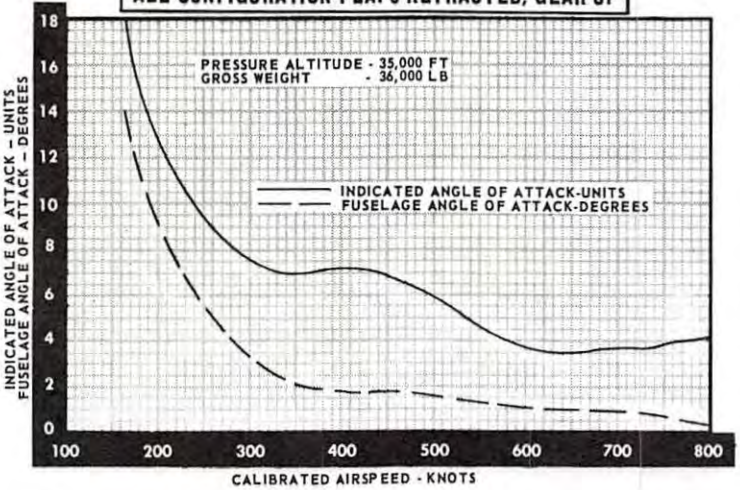
ALL CONFIGURATIONS – FLAPS AS NOTED, GEAR DOWN

1 "g" LEVEL FLIGHT





ALL CONFIGURATION-FLAPS RETRACTED, GEAR UP



FDD–1–(13–1)
RYG

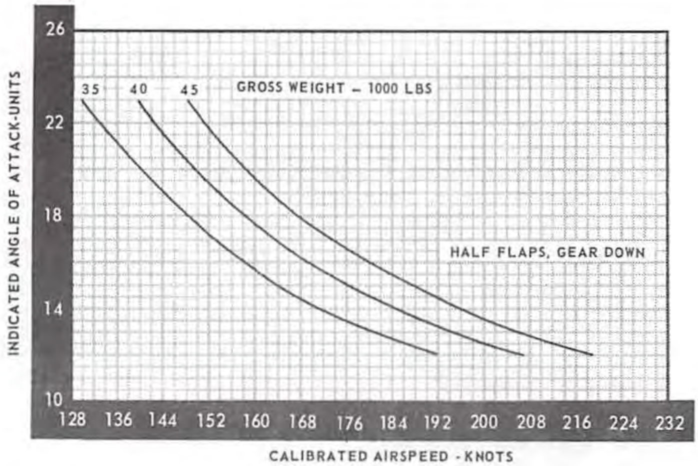
Figure 2-6. Angle-of-Attack Conversion and Displays (Sheet 1 of 3)

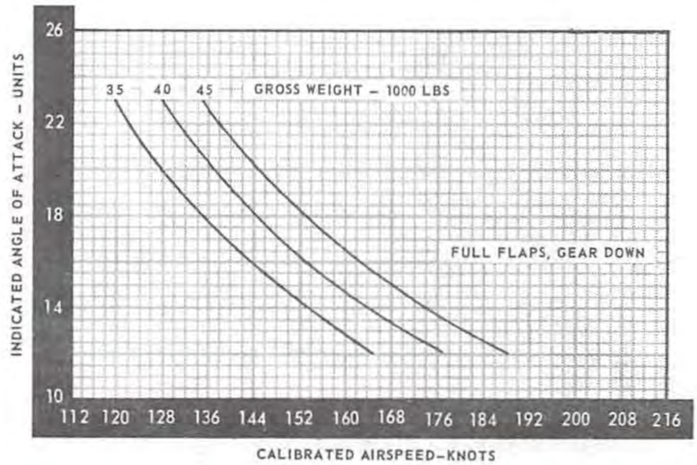
AIRCRAFT 155529ag AND UP, AND ALL OTHERS AFTER AFC 388

APPROACH LIGHT	INDICATOR	INDEXER	ANGLE OF ATTACK UNIT	AIRSPEED
			19.4-30	VERY SLOW
			18.8-19.4	SLIGHTLY SLOW
			17.8-18.8	ON SPEED
			17.2-17.8	SLIGHTLY FAST
			0-17.2	VERY FAST

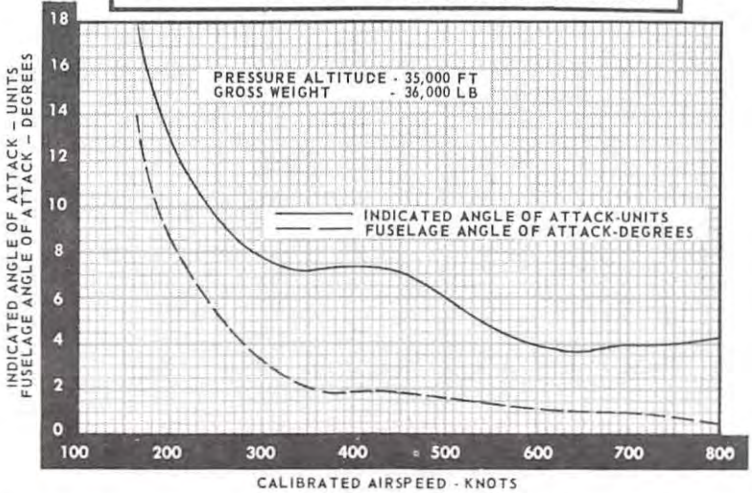
ALL CONFIGURATIONS – FLAPS AS NOTED, GEAR DOWN

1 "g" LEVEL FLIGHT



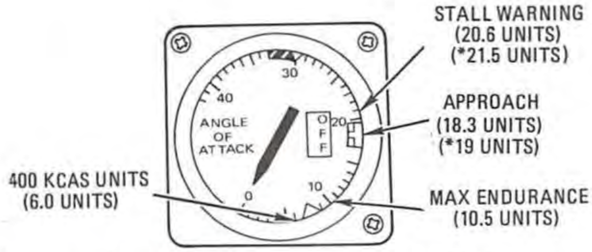


ALL CONFIGURATION-FLAPS RETRACTED, GEAR UP



FDD–1–(13–2)
RYG

Figure 2-6. Angle-of-Attack Conversion and Displays (Sheet 2 of 3)

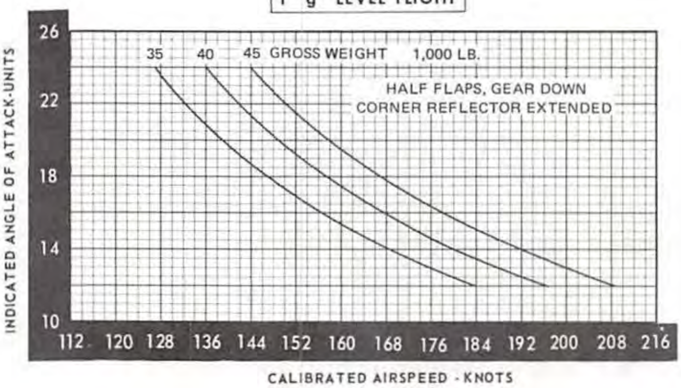


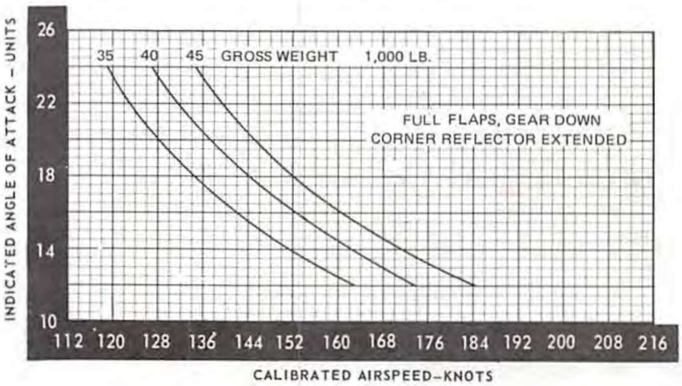
APPROACH LIGHT / INDICATOR / INDEXER	ANGLE OF ATTACK UNIT	AIRSPEED
	19.4-30 *20.1-30	VERY SLOW
	18.8-19.4 *19.5-20.1	SLIGHTLY SLOW
	17.8-18.8 *18.5-19.5	ON SPEED
	17.2-17.8 *17.9-18.5	SLIGHTLY FAST
	0-17.2 *1-17.9	VERY FAST

Note: ASTERISKED NUMBERS ARE FOR F-4S AFTER AFC 644/AVC 2494 AND AMEND 1.

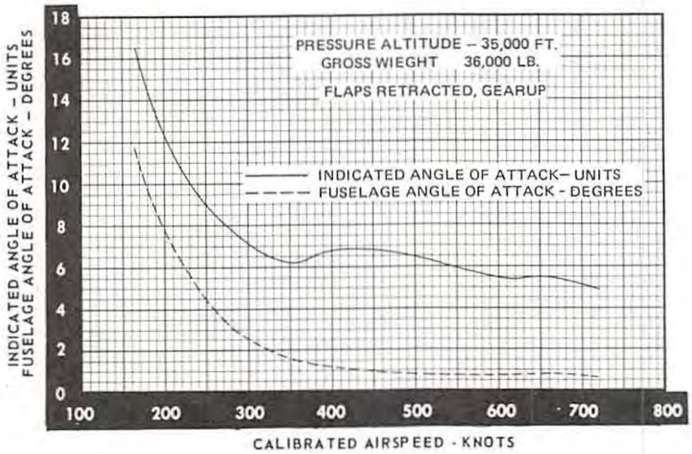
F-4S AIRCRAFT

1 "g" LEVEL FLIGHT





Note: ADD 7 KNOTS TO CAS FIGURES ABOVE.



N 11/82
FDD–1–(13–31A)
RGY

Figure 2-6. Angle-of-Attack Conversion and Displays (Sheet 3 of 3)

console (Figure FO-1). The indexer lights are automatically illuminated when the landing gear is down and the weight is off the gear. The indexer light control knob controls the intensity of the indexer lights. When testing the lights on the ground with the warning lights test switch, the knob can be used to adjust the light intensity.

Note

> On F-4J 158355at and up or after AFC 506 and all F-4S, the knob controls intensity of the weapon status panel (front cockpit), the AIM-9 and AIM-7 status panels, in addition to the AOA indexers. The instrument panel lights control knob (the flight instruments light control knob on F-4J after AFC 536 and all F-4S) must be in any position other than OFF before the ACM/indexer lights control knob (formerly indexer) is operational.

2.4.4 Stall Warning Vibrator. Refer to paragraph 2.19.5, RUDDER CONTROL SYSTEM.

2.4.5 Approach Lights. An approach light system with red, amber, and green indicator lights shows symbolic aircraft angle of attack during landing approaches. Four switches within the angle-of-attack indicator determine which of the three lights will be illuminated. The lights are energized through switches in the landing gear, wing flaps, and arresting hook systems. A hook bypass switch on the exterior lights control panel bypasses the wing flap and arresting hook switches. When the hook bypass switch is in NORMAL, the landing gear is down and locked and the arresting hook is down, the applicable approach light glows steady. With the hook bypass switch in NORMAL, the landing gear down, the wing flaps 1/2 or full down, and the arresting hook up, the approach light flashes. When the hook bypass switch is in BYPASS and the landing gear is down, the approach light glows steady regardless of the position of the arresting hook and wing flaps. A green approach light indicates a high angle of attack, low airspeed; an amber light indicates optimum angle of attack; and a red approach light indicates a low angle of attack, high airspeed.

2.4.6 Normal Operation. No controls pertain to the angle-of-attack system other than the indexer light control knob.

2.4.7 Emergency Operation. No alternate or emergency provisions pertain to the angle-of-attack system. However, if the indexer lights do not illuminate following a catapult launch, the nose gear catapult extension chamber has failed to deflate. Refer to paragraph 2.24.8, NOSE GEAR STRUT EXTENSION.

2.4.8 Limitations. No limitations pertain to the angle-of-attack system.

2.5 APPROACH POWER COMPENSATOR SYSTEM

2.5.1 Description. The approach power compensator system (APCS) maintains the aircraft at optimum approach angle of attack by automatically positioning engine throttles. The system consists of the approach power control set, angle-of-attack transmitter, integrated torque boosters, control switches, and the warning light. The approach power compensator, when engaged, automatically sets the throttles at the calculated thrust, regardless of previous settings, needed to maintain the aircraft at the proper angle of attack. If the pitch attitude is being changed by the pilot to place the aircraft on the desired glidepath, the engine speed automatically stabilizes at a thrust level needed to correct for this change in aircraft attitude. However, engine speed does not increase above 99-percent rpm or decrease below 73-percent. Manual throttle operation is available with the system turned off, and an emergency override feature allows the pilot to manually position the throttles anytime the system is engaged by applying a force of 20 to 25 pounds per throttle. The system may be disengaged by moving the speedbrake switch to the IN position if the emergency speedbrake switch is in NORMAL and the speedbrake circuit breaker is in or by moving the APCS system switch to OFF or to STBY. On F-4J 155867ak and up or after AFC 392 and all F-4S, the system may be disengaged by moving the speedbrake switch to IN regardless of the position of the emergency speedbrake switch (some F-4J) or the speedbrake circuit breaker.

2.5.2 AN/ASN-54(V) Approach Power Control Set. The approach power control set AN/ASN-54(V) is connected in parallel with the throttles to provide manual or automatic power control. The set consists of the aircraft accelerometer, throttle control computer, and electronic control amplifier. On F-4J 155785ai and up or after AFC 364 and all F-4S, the set includes the stabilator position transducer. The

APCS compensates for outside air temperature and is capable of controlling one or both engines. The set utilizes normal acceleration and angle-of-attack error inputs and, on F-4J 155785ai and up or after AFC 364 and all F-4S, stabilator position change input to position the throttle of the selected engine, thus commanding thrust changes to maintain an optimum angle of attack.

2.5.2.1 Aircraft Accelerometer. The aircraft accelerometer measures acceleration perpendicular to the glidepath and pitch axis. If the aircraft oscillates about the glidepath prior to arriving at the proper airspeed, an electrical signal is generated by the accelerometer. The signal is sent to the throttle computer to dampen these excursions off the glidepath by positioning the throttles for the proper thrust level.

2.5.2.2 Stabilator Position Transducer. On F-4J 155785ai and up or after AFC 364 and all F-4S, a stabilator position transducer is installed to measure the rate of displacement of the stabilator. Stabilator movement from a preset position is sensed by the transducer and sent as an electrical signal to the throttles control computer. The transducer signal allows the computer to anticipate an angle-of-attack change, thus reducing the time required by the APCS to react to pilot and vertical gust induced attitude changes. This function is not operable on F-4J until the APC computer is converted to the CP-974 configuration by incorporation of AVC 743.

2.5.2.3 Throttle Control Computer. The throttle control computer computes the throttle position required to maintain an optimum angle of attack. The computer utilizes an error input from the angle-of-attack transmitter and the accelerometer. When modified, it will also accept a stabilator position change input from the stabilator position transducer (F-4J 155785ai and up or after AFC 364, and all F-4S). The computer computes the throttle required for one or both engines as selected by the engine selector switch and compensates for temperature as selected by the temperature switch. The throttle control computer delivers the throttle position signal to the electronic control amplifier.

2.5.2.4 Electronic Control Amplifier. The electronic control amplifier commands throttle movement necessary to maintain the angle of attack. The amplifier receives a desired throttle position signal from the throttle control computer and the actual throttle position from the torque booster feedback. These two signals are compared by the amplifier and a command signal is applied to the torque boosters.

2.5.2.5 Integrated Torque Booster. The torque boosters (one per engine) amplify the input signal from the amplifier and position the throttle linkage as required to satisfy the amplifier signal. The torque boosters are hydromechanical servo motors which use engine fuel as the controlling medium. Power to the boosters is controlled by the engine selector switch and the APCS power switch. On F-4J 155867ak and up or after AFC 392 power is not available to the torque boosters unless both the throttle control computer and the electronic control amplifier are installed in the aircraft and are modified in accordance with AVC 924.

2.5.3 APCS Power Switch. The APCS power switch is a three-position toggle switch with positions of OFF, STBY, and ENGAGE. In OFF, all power to the system is removed and the throttles must be manually positioned. In STBY, power is supplied to the throttle computer so that the computer may synchronize with the prevailing flight conditions. However, the control amplifier is not active and the throttles must be manually positioned. In the ENGAGE position, the system automatically controls the engine thrust by varying throttle position. The power switch is held in the ENGAGE position by a holding coil. Should the pilot disengage the system or should disengagement occur because of a malfunction, the power switch automatically moves to STBY and the APCS OFF light illuminates. On F-4J 155867ak and up or after AFC 392, the APCS power switch does not remain in the ENGAGE position unless both the throttle control computer and the electronic control amplifier are installed in the aircraft and modified in accordance with AVC 924.

2.5.4 Air Temperature Switch. An air temperature switch with positions of COLD, NORM, and HOT allows the pilot to select a temperature input which is representative of the ambient conditions. Since thrust developed for any given throttle setting varies with outside air temperature, the pilot should select the correct temperature prior to engaging the APCS. The COLD position is used when temperature is below 40 °F and the HOT position when temperature is above 80 °F. When the temperature is between 40 °F and 80 °F, the NORM position is utilized. If the incorrect temperature is selected, the APCS throttle command signal is incorrect, but the computer compensates and produces the correct throttle movement.

However, less correction time is required if the correct temperature is selected.

2.5.5 APCS OFF Light. The APCS OFF light on the telelight panel and the MASTER CAUTION light illuminate whenever the system becomes disengaged or is in STBY regardless of the cause. On F-4J 158355at and up or after AFC 508 and all F-4S, an identical APCS OFF light is added on the left side of the glareshield near the AOA indicator. The APCS OFF light and the MASTER CAUTION light, when illuminated, can be extinguished by depressing the reset button, by engaging the system, or by turning the system off.

2.5.6 Normal Operation. It is possible to engage the approach power compensator system anytime the aircraft is in flight. However, it operates properly only in the 73- to 99-percent rpm throttle range. It is recommended that engagement be made while downwind so that the system operation can be observed prior to commencing the landing approach. Before engagement, ensure that the speedbrake switch is in the STOP position and the throttle friction lever is full aft. To engage the system, momentarily place the APCS power switch to STBY and then to ENGAGE. The system then remains engaged until disengagement is accomplished by the pilot, a malfunction, or immediately after touchdown through the landing gear scissors switch. The pilot must assume manual throttle control after disengagement occurs.

WARNING

Do not engage APCS with gear up and flaps 1/2 or full down. Gear up airspeeds at 19 units angle of attack correspond to gear down airspeeds at 22 to 23 units (10 to 12 knots slow). This is especially critical because landing configuration stalls occur at 24 units angle of attack.

Note

- On F-4J 155897ak and up or after AFC 392 and all F-4S, the APCS can be disengaged by moving the speedbrake switch to IN regardless of emergency speedbrake switch (some F-4J) or speedbrake circuit breaker position.
- On F-4J aircraft, do not engage approach power compensator unless all components are installed in system. With components removed, engagement of system causes throttles to assume any setting aside from 73 to 99 percent. On F-4J 155867ak and up or after AFC 392 and all F-4S, the APCS will not engage when the throttle control computer and/or the electronic control amplifier is not installed in the aircraft or the computer and amplifier are not modified in accordance with AVC 924. Absence of a complete system is indicative to the pilot by the APCS power switch failing to remain in the ENGAGE position.

2.5.7 Emergency Operation. There are no provisions for emergency operation of the approach power compensator system.

Note

When manually retarding the throttles with the approach power compensator engaged, the throttle can be pulled against the APCS minimum-speed stop. The throttles cannot be retarded below this point unless the force against the minimum speed stop is relieved and the APCS is disengaged.

2.5.8 Limitations. The approach power compensator system is limited to operation within the 73- to 99-percent throttle range. On F-4J aircraft, the APCS should not be utilized for carrier landings until AVC 752 is incorporated in aircraft with J79-GE-8 engines and either AVC 836 or AVC 743 (which also requires incorporation of AFC 364 and AFC 392) is incorporated in aircraft with J79-GE-10 engines.

2.6 ARRESTING HOOK SYSTEM

2.6.1 Description. The arresting hook system consists of an arresting hook, a combination hydraulic actuator and dashpot, a mechanical uplatch, and a control handle. The forward end of the arresting hook is pivoted in a manner which not only permits up and down movement, but left and right motion as well. Coil springs keep the hook centered for retraction. It is retracted up and aft by a hydraulic actuating cylinder and is caught and held there by a mechanical uplatch. It is extended by the pneumatic action of the dashpot and its own weight. Hook extension time is approximately 5 seconds, and retraction time is approximately 13 seconds. The arresting hook is controlled by a handle on the right side of the front cockpit instrument panel. The handle and the uplatch mechanism are joined by a control cable and in the event of a cable failure, the arresting hook extends.

2.6.2 Arresting Hook Control Handle. The arresting hook is controlled by an arresting hook shape handle (Figure FO-1) on the right side of the front cockpit instrument panel. When the handle is placed in the down position the uplatch is released and the arresting hook extends. Placing the handle in the up position energizes a solenoid valve which directs utility hydraulic pressure to the cylinder. A red warning light inside the control handle illuminates when the control handle is moved to the up or down position and remains illuminated until the arresting hook is fully extended or retracted. On F-4J 155529ag and up or after AFC 388 and all F-4S, placing the arresting hook handle down with the landing gear down causes the corner reflector to extend. If the arresting hook bypass switch is in the bypass position with the landing gear down, the corner reflector will also be extended.

2.6.3 Normal Operation. Normal operation of the arresting hook system consists of placing the arresting hook control handle down and observing the warning light to assure the arresting hook is fully extended. The warning light will remain on if the hook is in contact with the ground and prevented from reaching the down limit. To retract the arresting hook, place handle up and observe warning light to assure arresting hook is fully retracted. The hook should extend within 5 seconds and should retract within 13 seconds.

2.6.4 Emergency Operation. If the arresting hook fails to extend when the control handle is placed in the down position, the hookup limit switch has probably failed to deenergize the solenoid operated selector valve. To deenergize the solenoid selector valve, pull the arresting hook control circuit breaker (H7, No. 2 panel on F-4J thru 155528ag before AFC 388, and K7, No. 2 panel on F-4J 155529ag and up after AFC 388 and all F-4S). Utility hydraulic pressure is then removed from the up side of the arresting hook actuator cylinder and the hook extends. There are no provisions for arresting hook retraction in the event of a utility hydraulic failure or double generator failure.

2.6.5 Limitations. There are no practical arresting hook limitations for field arrestment; however, there are airspeed gross weight limitations for shipboard recovery. Refer to applicable recovery bulletins.

2.7 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

2.7.1 Description. The AFCS is an electrohydraulic system designed to provide stable and coordinated flight maneuvers without interfering with manual control. The AFCS is capable of performing two modes of operation: stability augmentation and AFCS. Stability augmentation operation provides aircraft stability in pitch, roll, and yaw in that it opposes any changes of altitude. It does not, however, return the aircraft to a given attitude or heading. This mode of operation may be used while the aircraft is under manual control. Stability augmentation can be engaged individually or in any combination for pitch, roll, or yaw axis. However, all three channels must be engaged before complete AFCS operation can be engaged. The AFCS mode of operation maintains any aircraft heading and/or attitude selected within the AFCS limits and corrects for any deviation from the selected heading or attitude of the aircraft within the AFCS limits. The altitude hold mode of operation holds any altitude selected while in the AFCS mode. The AFCS components are the AFCS panel, the control amplifier, force transducer, accelerometers, and rate gyro sensors. Equipment used in conjunction with AFCS operation are the attitude reference bombing and computer set, the air data computer, and the control servos.

2.7.2 Stability Augmentation (Stab Aug) Mode. In the stab aug mode of operation, the system senses motion about the horizontal, vertical, and lateral axis by means of rate gyro sensors. All attitude, heading, and bank angle changes cause these sensing devices to transmit signals representing the changing motion about their respective axes. These signals are sent to servo valves of the control surface power control cylinders. Therefore, any output signals from the rate gyro sensors, indicating yawing, pitching, or rolling motion or from the lateral accelerometer indicating sideslip, cause the flight controls system to position the appropriate control surfaces to oppose that motion. This action decreases any tendency of the aircraft to oscillate in roll, yaw, or pitch. The rate gyro sensors send signals to the surface controls to oppose any deviations from selected flight attitude but do not return the aircraft back to its original heading or attitude. Stability augmentation can be obtained individually or in any combination for pitch, roll, or yaw axis by placing the pitch, roll, and yaw stab aug switches to the ENGAGE position.

2.7.3 AFCS Mode. In the AFCS mode of operation, vertical gyro, directional gyro, and accelerometer signals are used in addition to the rate gyro sensor signals to maintain the aircraft in a desired attitude with pitch, roll, and yaw stability. The autopilot system can be engaged and hold maneuvers and attitudes within a range of ±70° in bank and pitch and unlimited in azimuth, provided the g limits are not being exceeded. The aircraft attitude may be less than 70° roll when the AFCS mode disengages or the roll attitude may be more than 70° when the mode reengages. This difference depends on the rate at which the roll maneuver is performed in the AFCS mode. Autopilot operation is interrupted when ±70° pitch or bank is exceeded. However, the AFCS engage switch remains engaged and the autopilot resumes normal operation when the aircraft is returned to within the ±70° limits. If a load factor of +4g or -1g is sensed by the g-limit accelerometer, the autopilot reverts to the stab aug mode and the AFCS engage switch must be reengaged for AFCS operation. On F-4J 158355at and up or after AFC 508 and all F-4S, the AFCS engage switch disengages when the right main landing gear scissors switch is actuated upon aircraft touchdown.

2.7.4 Control Amplifier. The control amplifier comprises the control center for the entire automatic flight control system. It receives the signals from the various sensing elements in the system and supplies power to the flight control components.

2.7.5 Coupler. On F-4J 155529ag and up and 153768ab through 155528ag after AFC 388 and all F-4S, an autopilot coupler is installed. With the coupler switch on the AFCS panel in the ENGAGE position, the coupler provides additional attitude and heading commands from the data link system to the AFCS control amplifier. Refer to Data Link System in section VIII in NAVAIR 01-245FDD-1A-1.

2.7.6 AN/AJB-7. The AN/AJB-7 attitude reference and bombing computer set provides vertical and directional references for the autopilot. The directional reference is controlled by the compass system controller on the pilot right console. With the compass system controller in the slaved mode, the autopilot receives magnetic heading as a directional reference. The DG mode on the compass system controller provides deviations from manually set heading as a directional reference to the autopilot. The compass mode is an emergency mode of the AN/AJB-7 and the autopilot cannot be engaged in this mode. The autopilot also disengages when the mode selector is switched from DG to the slaved mode or when the referenced system selector knob is switched between PRIM and STBY while in the slaved position. However, the autopilot can be reengaged after either of the controls has been switched to its new position.

Note

The AFCS should not be engaged when the AN/AJB-7 bombing mode is being used. Transients introduced into the attitude input of the AFCS at pullup can cause pitch and/or roll oscillations.

2.7.7 Air Data Computer (ADC). The ADC performs two functions for the autopilot. First, it provides all required gain changes. This is necessary to maintain constant maneuvering rates regardless of changes in airspeed and altitude. Second, the ADC contains a clutched synchro which supplies the autopilot with a signal proportional to the deviation from the barometric altitude which existed when altitude hold was engaged. This signal is used by the autopilot to move the stabilator as necessary to maintain constant barometric altitude.

2.7.8 Force Transducer. The force transducer is a unit which senses the force applied by the pilot to the control stick. This unit actually comprises the visible portion of the control stick with the stick grip mounted on top of it. The force transducer contains pressure sensitivity switches which react to longitudinal and lateral stick forces. A lateral stick force of 2.25 (±0.25) pounds or more closes a force switch. When a roll force switch closes, the roll rate gyro signal in stab aug and the roll rate and attitude gyro signals in AFCS mode are cut out so that pilot-initiated maneuvers are not bucked while in the AFCS and stab aug modes. The pilot maneuvers the aircraft by mechanical linkages until the lateral stick force is reduced to less than 2.25 (±0.25) pounds. At this time the roll channel is returned to normal stab aug or AFCS operation. Fore and aft stick forces close a switch to operate certain autopilot components and also cause a force sensing device to send a signal proportional to the applied stick force to the servo amplifier and stabilator actuator, thus causing the desired pitch attitude change. During this operation, the pilot controls stabilator position through the autopilot and the ailerons and spoilers are being manually controlled by the pilot. When the stick forces are released, the autopilot holds the new pitch attitude. This feature is commonly known as control stick steering (CSS). If the pitch or roll limits of the autopilot are exceeded (±70°), the autopilot is disengaged, although the autopilot switch remains ON. Therefore, when the aircraft returns to within the limits of the autopilot, the autopilot once again takes over.

2.7.9 Accelerometers. During autopilot operation, two accelerometers are being utilized to ensure proper functioning of the autopilot system. One of the accelerometers is of the g-limiting type which prevent g loads from occurring as a result of autopilot operation. The other accelerometer is a lateral accelerometer which performs coordinated maneuvers while in autopilot operation.

2.7.9.1 G-Limit Accelerometer. The normal load factor interlock (g-disengage) feature of the AFCS inhibits the system from commanding excessive load factors on the aircraft. The system reverts automatically, from whatever mode is engaged, to the stab aug mode if +4 or -1g absolute is sensed by the g-disengage accelerometer switch. This switch is mounted forward on the radar bulkhead so that if the aircraft is rotated rapidly into a maneuver, disengagement occurs at lower values of normal load factor because of the anticipation resulting from the forward location sensing a component of pitching acceleration. If, in addition to the g switch being operated, the stab aug servo is hard over in a direction that tends to increase the magnitude of the existing load factor, the stab aug mode also disengages. The g-disengage feature is inoperative outside the ±70° limits of the autopilot.

2.7.9.2 Lateral Accelerometer. This accelerometer detects aircraft skids or slips and produces error signals proportional to the lateral forces developed. These error signals cause the autopilot to take corrective action with the rudder to coordinate the maneuver being performed.

2.7.10 Servos. The automatic flight control system contains four control servos which function to operate the aircraft flight controls during stability augmentation and AFCS operation. Two lateral series servos (one in each wing) function to operate the spoilers and ailerons during AFCS and stab aug operation. A directional series servo on the rudder power control cylinder functions to operate the rudder during AFCS and stab aug operation. A longitudinal servo, integral with the stabilator power cylinder, functions in a series mode to operate the stabilator during stab aug operation. This same servo functions in a parallel mode to operate the stabilator during AFCS operation.

2.7.11 Rate Gyro Sensors. Refer to paragraph 2.7.2, STABILITY AUGMENTATION MODE.

2.7.12 AFCS Controls. The AFCS panel (Figure FO-1) is on the pilot left console. This panel contains all the controls for the normal operation of the automatic flight control system.

2.7.12.1 Stab Aug Switches. The three stab aug switches for pitch, roll, and yaw are two-position toggle switches on the AFCS panel. Placing any one of these switches in the ENGAGE position establishes the stability augmentation mode for the axis selected. These switches can be engaged individually or in any combination for stability augmentation in pitch, roll, or yaw. Yaw stab aug engaged also provides 5° of ARI rudder authority. In all F-4S with IAVC 2557 installed, roll stab aug engaged enables the lateral channel of the roll control augmentation (RCA) function and yaw stab aug engaged enables the yaw channel of the RCA function.

2.7.12.2 AFCS Switch. The AFCS switch is a two-position toggle switch on the AFCS panel. The switch positions are AFCS and ENGAGE. The AFCS switch can be energized with only the pitch stab aug switch engaged. However, for the AFCS mode to be fully selected, all three stab aug switches must be engaged.

Note

> On aircraft 153075z and up, if the AFCS switch does not readily engage, do not make a further attempt to engage as a pitch sync drive malfunction can exist within the system which could cause violent pitch maneuvers.

2.7.12.3 Altitude Hold Switch. The altitude hold switch is a two-position toggle switch on the AFCS panel. The switch positions are ALT and ENGAGE. The altitude hold feature functions only if AFCS is engaged. Placing the switch to ENGAGE energizes an altitude sensor in the air data computer which is controlled by barometric altitude. As the altitude varies, an error signal is produced and fed to the pitch servo amplifier. The amplifier then sends a signal to the stabilator actuator which deflects the stabilator as necessary to return the aircraft to its hold altitude. The altitude sensor holds the aircraft within ±50 feet or ±0.3 percent of the reference altitude at speeds up to 0.9 Mach and at speeds greater than 1.0 Mach. When using the AFCS altitude hold mode, the aircraft may experience pitch oscillations while accelerating through the transonic range (0.9 to 1.0 Mach) because of fluctuations in the ADC airspeed system. Engaging the altitude hold mode in climbs or descents greater than 1,000 feet per minute may result in reference altitude other than the engage altitude.

Note

When operating in the transonic region in altitude hold mode, the MASTER CAUTION light may flash. However, this is not an indication of failure in the air data computer system.

2.7.12.4 Coupler Switch. On F-4J 155529ag and up and 153768ab through 155528ag after AFC 388 and all F-4S, a two-position coupler switch is installed on the AFCS panel. The coupler switch selects data link information as autopilot control signals. The switch positions are COUPLER and ENGAGE. In COUPLER position, data link signals are removed from the autopilot coupler input. The ENGAGE position applies data link signals to the autopilot coupler input. Before engaging the coupler switch, the stab aug pitch, roll, and yaw switches and the AFCS switch must be engaged, and also the CPLR ON (COUPLER ON) light on the command display indicator must be illuminated. The light indicates that the displayed command data is suitable for autopilot control. On F-4J 158355at and up or after AFC 508 and all F-4S, the coupler switch disengages when the right main landing gear scissors switch is actuated upon aircraft touchdown.

2.7.13 Heading Hold Cutout. When operating in the AFCS mode, roll attitudes must be larger than 5° angle of bank in order to disengage the heading hold. Actuating the nosegear steering button provides the means of disengaging the heading hold to allow turns at an angle of bank of 5° or less. Heading hold may be reestablished by again actuating the nosegear steering button.

2.7.14 AFCS/ARI Emergency Disengage Switch. A spring-loaded emergency disengage switch (Figure FO-1) is on the control stick. Depressing the lever causes the AFCS and altitude hold switch to return to OFF. The stability augmentation mode and ARI are disengaged as long as the lever is held depressed. When the lever is released, the stability augmentation and ARI are again in operation, but the AFCS is no longer engaged. To permanently disengage the stability augmentation mode, the pitch, roll, and yaw stab aug switches must be placed off. To permanently disengage the ARI, the yaw stab aug switch must be off and the ARI circuit breaker on the front cockpit left sub panel must be pulled.

Note

In case of suspected flight control malfunction, the pilot should immediately disengage the AFCS by depressing the AFCS/ARI emergency disengage lever.

2.7.15 Autopilot Pitch Trim. An automatic pitch trim feature is included in the autopilot system which attempts to keep the aircraft longitudinally trimmed to the flight conditions experienced while in AFCS mode. Thus, an out-of-trim condition which would not be sensed while in autopilot mode is prevented, ensuring against an excessive pitch transient when disengaging the autopilot. The autopitch trim operates at approximately 40-percent the speed of the normal trim system resulting in a slight delay, after changing flight conditions, before the basic aircraft is properly trimmed. During CSS maneuvering, the autopitch trim is inoperative. Autopitch trim operation can be observed on the pitch trim indicator after changing flight conditions in the AFCS mode.

Note

The pilot shall not use the manual trim button when in AFCS mode except under the conditions specified in paragraph 2.7.16, AUTOPITCH TRIM LIGHT.

2.7.16 Auto-Pitch Trim Light. An AUTO PILOT PITCH TRIM light (Figure FO-1) is on the telelight panel. This light illuminates during AFCS operation if the automatic pitch trim is inoperative or lagging sufficiently behind aircraft maneuvering to cause an out-of-trim condition in the basic aircraft. Since autopitch trim rate is only 40 percent of normal trim rate and autopitch trim is inoperative anytime the stick grip transducer switches are made (i.e., during CSS maneuvering), it is possible to develop an out-of-trim condition while maneuvering in the AFCS mode. However, this out-of-trim condition must exist for approximately 10 seconds before the AUTO PILOT PITCH TRIM indicator light illuminates, thus eliminating constant light flickering. Momentary illumination of the light does not necessarily indicate a malfunction; however, if the light remains on and it is apparent from the pitch trim indication that the trim is not working, the pilot should realize that a pitch transient may be experienced when the AFCS mode is disengaged. Airspeed pitch trim indicator relationship should provide an indication of the severity of the transient. If an out-of-trim condition is realized by the steady illumination of the AUTO PILOT PITCH TRIM light, grasp the stick firmly before disengaging the AFCS mode in anticipation of a pitch bump. However, before disengaging the AFCS following an automatic pitch trim malfunction, the pilot may elect to alleviate the out-of-trim condition by operating the manual trim button and observing the pitch trim indicator. If the out-of-trim condition is thus reduced to within 5 pounds of trim, the AUTO PILOT PITCH TRIM light is extinguished. Illumination of the AUTO PILOT PITCH TRIM light also illuminates the MASTER CAUTION light. Depressing the master caution reset button only extinguishes the MASTER CAUTION light, leaving the AUTO PILOT PITCH TRIM light illuminated.

2.7.17 Autopilot Disengaged Indicator Light. The AUTO PILOT DISENGAGE light (Figure FO-1) is on the telelight panel. After initial engagement of the AFCS mode of operation, the AUTO PILOT DISENGAGE light and MASTER CAUTION light illuminate when the AFCS mode is disengaged by any means. Both lights are extinguished by pressing the master caution reset button. The lights remain extinguished until the AFCS is again disengaged.

Note

> If PC-1 hydraulic pressure is lost or drops below 500 psi, the pitch axis in stab aug and AFCS is inoperative. If utility hydraulic pressure is lost or drops below 500 psi, the roll axis and yaw axis in stab aug and AFCS are inoperative. In either case, the AUTO PILOT DISENGAGE light and the PITCH AUG OFF light do not illuminate. The CHECK HYD GAGES light and the MASTER CAUTION light illuminate at approximately 1,500 psi.

2.7.18 PITCH AUG OFF Indicator Light. The PITCH AUG OFF indicator light is on the telelight panel and remains illuminated unless pitch stab aug is engaged. After pitch stab aug engagement, disengagement also illuminates the MASTER CAUTION light.

2.7.19 Normal Operation. Prior to engaging the AFCS, the following conditions must exist: the stability augmentation mode can be selected individually or in any combination for pitch, roll, or yaw axis; however, all three switches must be engaged for complete AFCS operation; the aircraft should be in trim, and an attitude within the AFCS limits must be established. AFCS operation can then be achieved by engaging the AFCS switch. Manual trim during AFCS operation should not be used unless roll reversal is encountered, and then only a small amount of trim should be used to counteract the roll. Autopilot disengagement can be accomplished by placing the AFCS switch to off, the aircraft still is in the stab aug mode. To permanently disengage stab aug, the pitch, roll and yaw stab aug switches must be turned off. The autopilot system receives power from the three-phase left main 115-vac bus. The system also receives power from a left main 28-vdc bus, a warning light 28/14-vac bus, and a left main 28-vac bus. The autopilot system is protected by circuit breakers on No. 1 circuit breaker panel in the rear cockpit. The circuit breakers are marked AUTO PILOT.

2.7.20 Operational Precautions

2.7.20.1 Generator Switching. Power to the autopilot, ADC and AN/AJB-7 may be momentarily interrupted during the starting and stopping of aircraft engines or generators. When the left engine or generator is started with the right generator already on the line, the connection between the right and left main buses is momentarily opened to allow the left generator to come on the line. This momentary interruption allows the solenoid-held switches to disengage. This necessitates reengaging the autopilot to bring back autopilot operation. The autopilot, ADC, and AN/AJB-7 are not affected by starting or stopping the right engine or generator with the left generator on the line. If failure of the left generator occurs, place the left generator switch to OFF and disengage the stab aug, by depressing the emergency disengage switch, prior to cycling the left generator switch back to ON. This is done to prevent the possible occurrence of control surface transients. Stab aug may be engaged by releasing the emergency disengage switch after the left generator has been cycled to ON or may be engaged with the left generator switch retained in the OFF position.

2.7.20.2 Roll Reversal. There is a possibility of a condition called roll reversal occurring when operating the AFCS in the autopilot mode. This condition occurs infrequently and is apparent only when attempting small changes in bank angle. Roll reversal is associated with a small out-of-trim condition in the lateral control system and is apparent as a slow rolling of the aircraft in the opposite direction of the low lateral force. If, for instance, the aircraft is out of trim laterally to the left when the autopilot mode is engaged, roll reversal may occur when low right stick forces are applied. A roll reversal situation may also be caused by operating the lateral trim button while in the autopilot mode, followed by low lateral stick forces being applied opposite to the direction of the trim. There is also a possibility of roll reversal occurring even if the aircraft has been trimmed prior to engaging the autopilot mode and the manual trim button has not been touched. This condition is brought about by changes in aircraft trim accompanying changed flight conditions.

2.7.20.3 AFCS Operation With Static Correction OFF. A malfunction of the static pressure compensator (indicated by the illumination of the STATIC CORR OFF light) has no effect upon autopilot operation. The autopilot operates satisfactorily with the static pressure compensator out; however, the altitude hold mode may be affected. If the altitude hold mode is affected, the reference altitude changes when the static pressure compensator fails.

2.7.20.4 Pitch Oscillations (Altitude Hold Mode). When using the AFCS altitude hold mode, the aircraft may experience pitch oscillations in the transonic regions and below because of fluctuations in the ADC airspeed system. The nature of these oscillations varies from stick pumping to divergent pitch oscillations. It is recommended that in the event pitch oscillations occur at subsonic speed that the following corrective steps be attempted: disengage the AFCS; place the static correction switch OFF; reengage the AFCS; and engage altitude hold. If the oscillations persist after taking corrective action or if they are encountered at supersonic speeds, disengage the altitude hold mode. In any event, divergent pitch oscillations should not be allowed to develop. If any divergent pitch activity is noted, corrective action should be taken immediately.

Note

> When using AFCS/CSS or altitude hold, there are no automatic AFCS cutout features to prevent the aircraft from flying into a stall. Therefore, it is possible for the aircraft to enter uncontrolled flight with AFCS/CSS or altitude hold engaged if airspeed is allowed to dissipate.

2.7.21 Emergency Operation. There are no provisions for emergency operation of the automatic flight control system.

2.7.22 Limitations. Autopilot operation is interrupted when ±70° pitch or bank is exceeded. However, the AFCS engage switch remains engaged and the autopilot resumes normal operation when the aircraft is returned to within the ±70° limits. If a load factor of +4 or -1g is sensed by the g-limit accelerometer, the autopilot reverts to the stab aug mode and the AFCS engage switch must be reengaged for AFCS operation.

2.8 BRAKE SYSTEM

2.8.1 Description. The main landing gear wheels are equipped with power-operated brakes. Two power brake valves are in the nosewheel well and each is operated in a conventional manner from linkage attached to the rudder pedals. The brake control valves are power operated rather than a power-boost type. Excessive pedal travel and pumping of the brakes in order to obtain a firm pedal is eliminated since the fluid supply to the wheel cylinders is virtually unlimited. This brake system provides differential wheel brake pressures. With no utility hydraulic pressure available, a 25-cubic-inch hydraulic accumulator will provide pressure to actuate the normal brake system. In addition, the brake control valves act as master cylinders in a conventional nonpower system as long as integrity has been maintained between the control valves and the wheelbrakes. Pilot effort in this manual operation is capable of securing the aircraft in deck rolls up to 8°. Although it has not been determined by test flight, pilot assumption is that the manual brake system should be capable of stopping the aircraft on a typical jet runway provided the drag chute is also used. The manual braking feature is selective and may be used for differential brake steering while the emergency pneumatic brake system is employed in stopping the aircraft. Each main landing wheel contains three fuse plugs to protect against tire explosion. If the brakes are used excessively, causing overheating of the wheels and tires, the fuse plugs should melt and let the tire go flat before a tire explosion can occur. On aircraft 157242an and up, an antiskid system is incorporated into the normal brake system to prevent wheel skid.

Note

Only three maximum effort brake applications from the accumulator should be anticipated when utility hydraulic pressure is lost.

2.8.2 Wheelbrake Antiskid System

WARNING

The use of antiskid braking is prohibited during normal field taxi or during shipboard operations.

Aircraft 157242an and up are equipped with a wheelbrake antiskid system. The system detects the start of a skid at either wheel and automatically releases the brake pressure from both brakes in proportion to the severity of the skid. If a wheel locks, full brake pressure to both wheels is released for approximately 4 seconds, then control for each wheel will revert to its own sensor and brake pressure will be reduced in proportion to the severity of the skid for each wheel. If the locked wheel later begins to rotate, this cycle may be repeated and, with intermittent rotation of the locked wheel, can cause complete loss of brakes with the antiskid switch on. The antiskid system provides consistently shorter landing rolls on wet, icy, or dry runways. The system provides a failure detection circuit which indicates antiskid failures, but does not deactivate the system. The system is activated by placing the antiskid control switch ON and lowering the landing gear. It may be disengaged by placing the antiskid control switch to OFF or by depressing the emergency quick release lever on the stick force transducer below the stick grip. An ANTISKID INOPERATIVE light illuminates when the system is not activated.

Note

Whenever electrical power to the antiskid system is momentarily interrupted, the system fail-detection circuit is automatically rechecked.

2.8.2.1 Antiskid Control Switch. This two-position toggle switch is on the left console, front cockpit, adjacent to the oxygen quantity gauge. When the switch is ON and the landing gear handle is down, power is supplied to the system. The antiskid system may be shut off by placing the antiskid control switch to OFF.

2.8.2.2 ANTISKID INOPERATIVE Light. An ANTISKID INOPERATIVE light is on the left console, front cockpit. The light illuminates anytime the landing gear handle is down and the antiskid control switch is OFF, the system is inoperative, or when the emergency quick release lever is held depressed. The light flashes momentarily when the landing gear handle is placed in the DOWN position to indicate that the antiskid circuit has been checked and is operating properly. If the light remains illuminated, the antiskid system is inoperative and the control switch should be placed to OFF.

2.8.2.3 Emergency Quick Release Lever (Antiskid). An emergency quick release lever is on the control stick below the stick grip. This lever is provided to disengage the antiskid system as desired. The lever must be held depressed to disengage the system. Normal wheelbraking is immediately available when the lever is depressed and the ANTISKID INOPERATIVE light illuminates. When the antiskid emergency quick release lever interrupts electrical power to the system, the circuit to the ANTISKID INOPERATIVE light is completed and the light illuminates. The control stick-mounted emergency quick release lever and the console-mounted control switch are connected in series and actuation of either will deactivate the system. When the landing gear handle is up, all power to the antiskid system, including the light, is shut off.

2.8.3 Emergency Pneumatic Brake System. A completely independent pneumatic braking system (Figure FO-6) is provided and is controlled by a spring-loaded, hand-operated emergency brake handle (Figure FO-1) just inboard of the right console. The system is charged by the aircraft pneumatic system and provides sufficient air for ten maximum effort applications. It contains a power brake valve of conventional design and meters air pressure to the pneumatic brake cylinders in proportion to the effort applied. The emergency pneumatic brake does not provide differential wheelbrake pressure.

2.8.4 Antispin System. The aircraft has an antispin system which provides automatic and simultaneous actuation of the left and right wheelbrakes during main landing gear retraction. When the gear handle is UP and the weight is off the gear, utility hydraulic pressure from the main landing gear up line actuates the wheelbrakes and stops the wheels before stowage. When the gear is up and locked, pressure is automatically released from the antispin system.

2.8.5 Normal Operation. The brakes are conventionally operated by toe action on the rudder pedals. This action meters utility hydraulic pressure to force the brake discs together. Pedal pressure felt by the pilot is proportionate to braking force applied. The pilot is capable of locking the brakes by both normal and emergency braking systems. Caution must be exercised in overbraking since a fully locked wheel offers less retardation than very light normal braking. If one wheel is locked during application of the brakes, there is a very definite tendency for the aircraft to turn away from that wheel and further application of brake pressure offers no corrective action. This produces a rapidly decreasing coefficient of friction between the skidding tire and the runway, while the coefficient of friction between the other tire and the runway remains near optimum for braking effectiveness. It is, therefore, apparent that a wheel once locked never frees itself until brake pressure to that wheel is reduced sufficiently to permit the wheel to rotate. It has been found that optimum braking occurs when the wheel is in a slight skid. The wheel continues to rotate, but at a speed of approximately 80 to 85 percent of its normal free rolling rotational speed. Increasing the rolling skid above approximately 15 to 20 percent only decreases the braking effectiveness. Since no antiskid system is fitted, recognition of maximum braking force is strictly a matter of pilot sensitivity. As with other examples of operating on the limit, the only sure way of determining maximum braking effort is to exceed it. Since this is seldom a desirable technique, the pilot should attempt to mentally catalogue his body response to normal braking in order to more readily recognize the maximum if an emergency should require it. For all conditions, normal and emergency, the most desirable braking technique is a single, smooth application of the brakes with a constantly increasing pedal pressure (to just below the skid point) as the aircraft decelerates. In the event of a reduction in retardation being felt while exercising maximum braking, pedal force must be fully released in order to allow the skidding wheels to regain full rolling speed before further application of brakes. Rough runways tend to emphasize the skip or bounce characteristics of the aircraft which are caused by relatively stiff struts. To prevent locking a wheel while momentarily off the ground, use light braking until the aircraft is solidly on the ground and all skipping has ceased.

On aircraft 157242an and up, the antiskid system should be utilized at all times to protect against inadvertently locking a wheel or wheels during braking. The antiskid system is completely passive unless the wheel is approaching skid; therefore, under conditions of normal braking, it has no effect on the amount of brake applied. If maximum deceleration is desired, the antiskid system can be utilized to maintain the wheel at the optimum deceleration point. In this case, apply sufficient brake pressure to skid the wheel and allow the antiskid system to reduce applied pressure to proper values. Full pedal application or any amount of pedal which will produce antiskid action will provide maximum wheel braking for the existing conditions. A minimum roll landing using the antiskid system can be accomplished from a normal touchdown and drag chute deployment followed by full brake pedal deflection with the stick full aft and nose gear steering engaged. Less than full pedal can be used, if desired, as long as there is sufficient brake pressure to keep the antiskid system active. Cycling of the antiskid system can be detected by a change in longitudinal deceleration; however, cycling of the antiskid system may not be apparent when braking at high speeds (i.e., immediately after landing, wet runway, etc.).

CAUTION

- On aircraft without antiskid or with antiskid inoperative, at high speeds, brake pedal deflections as small as one-sixteenth of an inch have proven sufficient to blow a tire.
- Antiskid protection is not available until the wheels have initially come up to speed. Do not land with brake pedals depressed. In addition, antiskid protection is not available below approximately 10 to 20 knots.

CAUTION

If it is suspected that the brakes have been used excessively and are in a heated condition, the aircraft should not be taxied into a crowded parking area. Peak temperatures occur in the wheelbrake assembly from 5 to 15 minutes after maximum braking. To prevent brake fire and possible tire explosion, the specified procedures for cooling brakes should be followed. It is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the airstream and a minimum of 30 minutes between landings where the landing gear has been retracted to allow sufficient time for cooling. Additional time should be allowed for cooling if brakes are used for steering, crosswind taxiing operation, or a series of landings. To minimize brake fusing when brake-stored energy is known to be high, do not come to a full stop and hold brakes hard on; instead, allow aircraft to roll freely as much as possible.

Note

Nose gear steering may be required to maintain directional control when making a minimum roll landing.

2.8.6 Emergency Operation. If a utility hydraulic system failure occurs, the aircraft can be stopped by utilizing a combination of accumulator and pneumatic braking. This is best accomplished by an application of the pneumatic hand brake and differential braking from the hydraulic accumulator. In most cases, asymmetrical braking is prevalent when utilizing the air brakes, however, directional control can be maintained through differential application of the toe brakes. Do not pump either of the emergency brake systems as this rapidly depletes the system pressure.

WARNING

Do not use emergency air brakes when a known hot brake condition exists. Some combustible substances such as oil, grease, hydraulic fluid, etc., may be present in the wheel assembly. The combination of heat and the introduction of 3,000 psi compressed air sets up a high explosive or computable situation hazardous to personnel.

CAUTION

There is a noticeable time lag between pulling the emergency brake handle and braking action. Failure to take the system delay into consideration often results in blown tires.

2.8.7 Limitations. Maximum effort antiskid braking (pedals depressed to the limits) may be employed as follows (assuming a cool brake 75 °C at brake application velocity):

If brake/tire service life is the prime consideration:

1. One hundred and thirty knots maximum with drag chute deployed at a maximum landing weight of 38,000 pounds.

2. One hundred and ten knots maximum without drag chute deployed at a maximum landing weight of 38,000 pounds.

If short field performance is the prime consideration:

1. Braking to the limits shown on Figure 2-7 may be employed.

CAUTION

When brake energy reaches the defined limits of Figure 2-7, brake fusing may result if heavy pedal effort is applied with the wheels stopped.

2.9 CANOPY SYSTEM

2.9.1 Description. Each cockpit area is enclosed by a separate transparent, acrylic plastic, clamshell-type canopy, hinged aft of each cockpit enclosure. Canopy operation, both normal and emergency, is accomplished pneumatically. Clean dry air is supplied

NOTE

BASED UPON 10 MILLION FT–LBS. OF ENERGY PER BRAKE FOR THE STOP WITH A 75°C MAXIMUM BRAKE STACK TEMPERATURE AT START OF FLIGHT.

CAUTION

BRAKE LININGS WILL FUSE IF THESE LIMITS ARE REACHED AND THE AIRCRAFT IS BROUGHT TO A COMPLETE STOP ON THE RUNWAY.

EXAMPLE: A 38,000 LB AIRPLANE WITH DRAG CHUTE: MAXIMUM EFFORT BRAKING MAY BE APPLIED FROM 144 KTS. MAXIMUM.

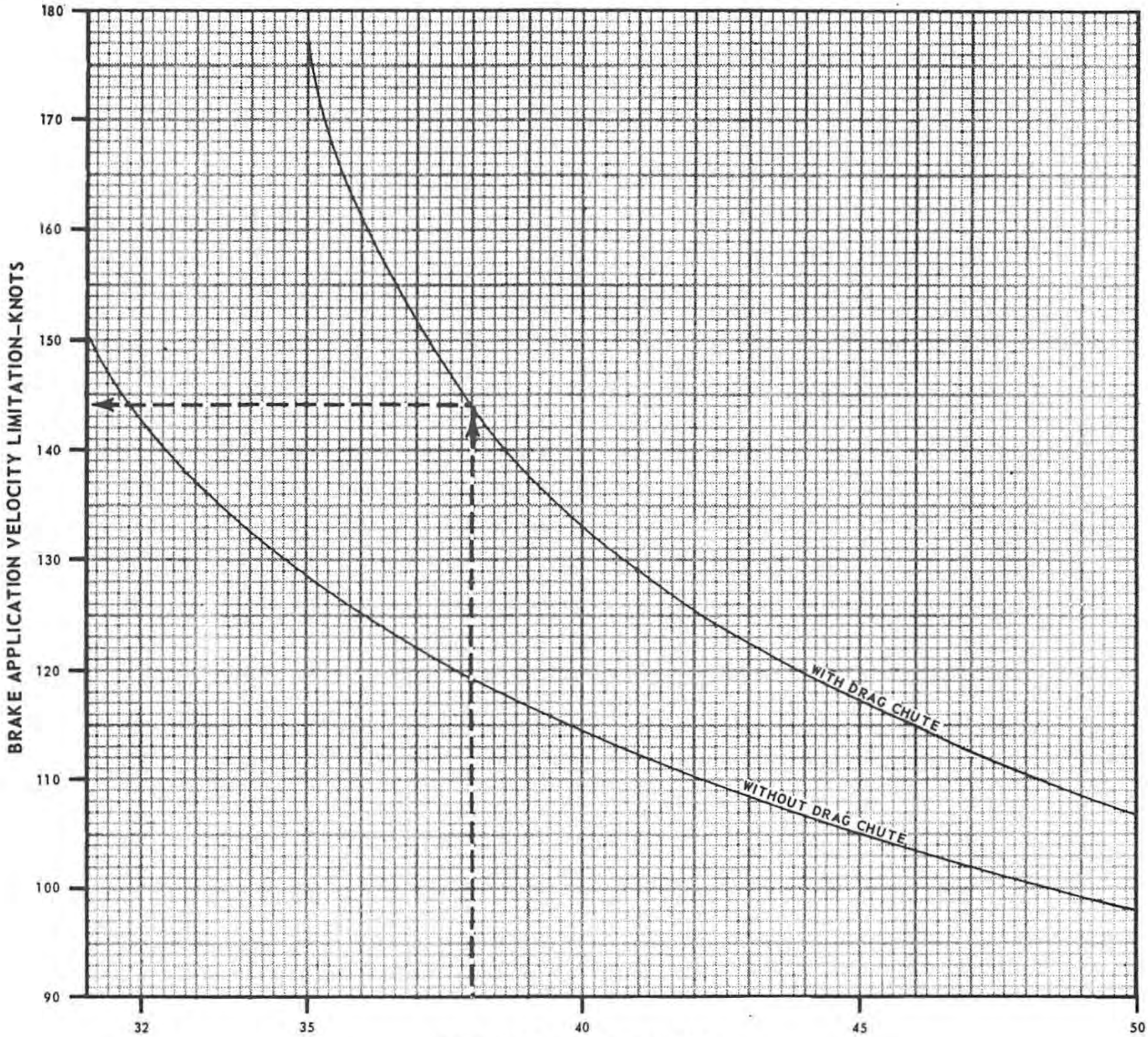


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Figure 2-7. Brake Energy Limitations

by the basic pneumatic system for use in the normal canopy system. Individual manual controls are provided for each cockpit. In addition, external operation is provided for each cockpit by individual pushbuttons on the exterior of the fuselage. In normal operation, the canopy operating time is set at 5 seconds. Each cockpit employs an inflatable canopy seal for cockpit pressurization. The canopy seals are automatically inflated and deflated upon opening and closing of the canopies. Canopy emergency operation is also accomplished pneumatically. The emergency canopy system utilizes clean dry air supplied from the basic pneumatic system to two 15 cubic-inch (forward canopy and aft canopy) air bottles. On F-4J 157256an and up or after AFC 474 and all F-4S, a secondary emergency system also provides jettisoning of the forward and aft canopies. This secondary source of emergency air, the emergency brake air bottle, is available, should the normal and emergency pneumatic systems experience battle damage. Each canopy has individual emergency manual control valves that operate independently of each other. These valves can be operated by pulling on the face curtain handles, lower ejection handles, or by actuating the emergency canopy jettison lever. In addition, one emergency control is provided on the fuselage to open both canopies simultaneously for ground crew rescue purposes. The canopy emergency system also actuates the forward and aft cockpit flooding doors in order to reduce the time required to equalize the cockpit pressure under water. Design time for deck operation or testing of canopy emergency system is 2 seconds. In-flight operation of the canopy emergency system takes 1 second. Design time for underwater pressure equalization of the cockpit is 7 seconds. On F-4J 157258an and up or after AFC 497 and all F-4S, electrically initiated cartridge thrusters under the forward canopy sills assist the canopy actuating cylinder in jettisoning of the forward canopy. The thrusters accomplish this operation by producing a thrust on the forward part of the canopy to lift it quickly into the airstream as soon as the canopy is unlocked. The thrusters are fired electrically by a thermal battery which is actuated by gases from either the seat-mounted or cockpit-mounted initiators.

2.9.2 External Canopy Controls

2.9.2.1 External Canopy Buttons. The forward cockpit external canopy control buttons are on the left side of the aircraft just forward of the engine air intake duct. The aft cockpit external canopy control buttons are on the left side of the aircraft just above the engine air intake ducts between the forward and aft canopies. The forward and aft canopy pushbuttons operate independently of each other, but their functions are the same. Push OPEN button to open the canopy; push CLOSE button to close the canopy. The pushbuttons operate the same valves as the internal canopy controls.

2.9.2.2 External Manual Unlock Handles. The forward canopy external manual unlock handle is on the left side of the fuselage below the aft end of the canopy. The aft canopy external manual unlock handle is in the same position below the aft canopy. Each handle operates independently, but their functions are the same. Operating a push-type latch causes the handle to pop out about 1 3/4 inches. A forward rotation of the handle unlocks the canopy downlock mechanism and permits the canopy to be lifted open manually.

2.9.3 Internal Canopy Controls

2.9.3.1 Canopy Control Handle. The forward cockpit canopy control handle is on the left side of the cockpit above the flap control panel and just below the canopy sill. The aft cockpit canopy control handle is in the same position in the aft cockpit. Each canopy control operates independently, but their functions are the same. Pull control handle aft to OPEN the canopy; push forward to CLOSE the canopy. When closing the canopy, to determine that the canopy is locked by the canopy hooks engaging the rollers, check that the alignment tape on the canopy lock push rod aligns with the alignment mark on the bracket hanging from the left canopy sill. If canopy alignment tape is not installed, assure rollers have engaged canopy hooks by observing approximately 1-inch aft travel of canopy push rod mechanism. On some aircraft, a guard is incorporated on the rear cockpit normal canopy lever to prevent inadvertent actuation.

2.9.3.2 Manual Canopy Unlock Handles. The forward cockpit manual canopy unlock handle (Figure FO-1) is on the right side of the cockpit above the arresting hook control handle. The aft cockpit manual canopy unlock handle is in the same position in the aft cockpit. Each cockpit manual canopy unlock handle operates independently, but their functions are the same. The handle when pulled aft, releases the canopy downlock linkage so the canopy may be pushed open to permit exit from the cockpit. Before manual unlocking of the canopy, the (normal) canopy control handle must be placed in the open position. When the canopy has been opened manually it should be held open while entering or leaving the cockpit since without power the actuator may not hold the canopy in the open position. The manual unlock handle is used normally when the aircraft pneumatic systems are depleted.

2.9.3.3 Canopy Unlocked Indicator Light. An amber CANOPY UNLOCKED light (Figure FO-1) in the forward and aft cockpits is used to notify the crew that a canopy is unlocked. The pilot CANOPY UNLOCKED light illuminates when either canopy is unlocked. The RIO light illuminates only when his canopy is unlocked.

2.9.4 External Emergency Canopy Controls

2.9.4.1 Emergency Jettison Lanyard. The external emergency canopy jettison lanyard is on the left lower side of the fuselage just forward of the nosewheel door. Pulling the handle jettisons both canopies.

2.9.5 Internal Emergency Canopy Controls

2.9.5.1 Emergency Canopy Release Handle. The forward cockpit emergency canopy jettison handle (Figure FO-1) is on the left side of the cockpit above the landing gear control. The aft cockpit emergency canopy jettison handle is in the same relative position. Each handle is painted with black and yellow stripes for ease of identification. The canopy emergency jettison handles operate independently of each other but function the same. Pulling the handle aft jettisons the canopy and opens the cockpit flooding doors. In addition, operation of the aft handle stows the rear cockpit radarscope, the radar set controls, and the hand control to provide more room for egress from the cockpit. On F-4J 157298ar and up or after AFC 506 and all F-4S, the radarscope is moved forward and no longer stows when the canopy jettisons. On F-4J 158355at and up or after AFC 506 and all F-4S, the radar set controls and radar antenna hand control will no longer stow when the canopy is jettisoned. A downward pull on the face curtain handle or an upward pull on the lower ejection handle jettisons the canopy, opens the flood doors, and, when an aft seat ejection handle is pulled, stows the applicable radar equipment. The applicable aft cockpit radar equipment will stow when a dual ejection is initiated from the forward cockpit.

2.9.6 Normal Operation. Normal operation of the canopies is accomplished through the use of the pushbuttons on the exterior of the aircraft and a lever in the cockpit. Refer to applicable canopy control, in paragraph 2.9.

Note

> If canopy closure is attempted with engines running, the engines should not be running above a stabilized idle rpm. Attempted canopy closure with engine rpm above idle may result in canopy not fully locking because of back pressure caused by the aircraft pressurization system.

2.9.7 Emergency Operation. Emergency operation of the canopies is accomplished through the use of an emergency jettison lanyard on the exterior of the aircraft and an emergency canopy jettison handle in each cockpit. Refer to applicable emergency canopy control in paragraph 2.9.

2.9.8 Limitations. The canopy is designed to remain in the full open position up to 60 knots and to separate from the aircraft at approximately 100 knots.

2.10 COMMUNICATION-NAVIGATION-IDENTIFICATION (CNI) EQUIPMENT BEFORE AFC 660

2.10.1 Description. CNI equipment consists of an intercom, a UHF communication receiver-transmitter and auxiliary receiver, a tacan set, an automatic direction finder system, and an identification system. The functions and control locations for each of the above equipment are listed in Figure 2-8. CNI equipment operating on external power without cooling air is limited to 10 minutes of accumulated operation in a 1-hour span. This limitation applies to all CNI equipment except the intercom and UHF communication receiver-transmitter until AFC 647, after which it will apply only to the IFF system. Cooling air is provided to the receiver-transmitter unit by two internal blowers. The maximum permissible altitude with the CNI equipment on is 70,000 feet. Flight above 70,000 feet with CNI equipment on may result in damage to the equipment because of arcing. Operation of the UHF communication receiver-transmitter is limited to a transmit-receive ratio of one-third or less transmitting time to two-thirds receiving time.

2.10.2 External Ground Power Operation. With external ground power connected to the aircraft and neither of the two generators connected to the line, the CNI equipment does not operate unless the CNI ground power switch is placed to the ON position. The CNI ground power switch, in the left wheel well, applies external power to the CNI equipment for ground operation. The switch is manually operated and electrically held and must be reset after each interruption of external power.

2.10.3 Intercom System. An intercom panel (Figures FO-1 and FO-2) in both cockpits provides intercockpit communication in the aircraft. An external station, connected in parallel with the aft cockpit microphone and headset, is used by ground personnel. An additional function of the intercom system is to amplify audio frequency signals received from various sources. Transmission over the UHF receiver-transmitter may be accomplished in either cockpit in conjunction with the intercom system.

2.10.4 Intercom Controls. The intercom controls consist of volume controls, function selector switches, emergency amplifier selector switches, intercom switches, and microphone buttons.

2.10.4.1 Volume Control. The intercom volume control knobs are on the left side of the intercom panel in each cockpit. The input level of the intercom signals to the headsets is increased by rotating the respective volume control knobs in a clockwise direction. The signals received from the radio receivers are not affected by operation of these intercom volume controls.

2.10.4.2 Function Selector Switch (Pilot's). A three-position toggle switch with positions of RADIO OVERRIDE, HOT MIC, and COLD MIC is on the right side of the pilot intercom control panel. The RADIO OVERRIDE position of the switch is momentary, the HOT MIC and COLD MIC positions are fixed. The HOT MIC position is used when duplex operation of the intercom system is desired. The RADIO OVERRIDE position is identical with HOT MIC except that all radio gain is reduced, communication between cockpits then overrides radio reception. When the switch is set to COLD MIC, normal radio reception and transmission is still available, but the pilot can no longer communicate with the RIO over the intercom system without using the ICS switch on the throttle. However, the RIO can still transmit to the pilot by either placing the radio override switch in the RADIO OVERRIDE position or by pressing the foot-operated intercom switch.

2.10.4.3 Function Selector Switch (RIO). A two-position toggle switch with positions of RADIO OVERRIDE and NORMAL is on the right side of the RIO intercom panel. The NORMAL position is used for normal duplex operation at the same time the pilot switch is set at HOT MIC. Radio signals are received at normal volume when the RIO switch is set at NORMAL. The RADIO OVERRIDE position is used to reduce the reception of radio signals in both cockpits. This switch position may also be employed to accomplish intercockpit communication if the pilot switch is set at COLD MIC. The RADIO OVERRIDE position is a momentary switch position. If the RIO has selected either EMER ICS or EMER RAD and then selects RADIO OVERRIDE, a one-way conversation results. The RIO can talk to the pilot, but the pilot cannot talk to the RIO until the RIO releases his function selector switch and allows it to return to NORMAL position.

2.10.4.4 Intercom Foot Switch (RIO). A foot-operated switch is on the left foot ramp in the RIO cockpit. This switch is wired in parallel with the pilot intercom switch. By depressing his foot switch, the RIO may override any of the positions selected on the pilot function selector switch, allowing intercom transmission without the necessity of releasing other manual controls.

2.10.4.5 Emergency Amplifier Selector Knobs. The emergency amplifier selector knobs are three-position rotary-type switches and are in the center of both intercom control panels. The operator uses these controls to bypass a defective amplifier. Both operators may have occasion to switch to one of the emergency settings at the same time. In certain instances of amplifier failure, this arrangement is necessary in order to maintain intercockpit communication. There are three possible settings for each control. The NOR position is used when both amplifying stages in the respective control boxes are functioning properly. The other two positions for each control are EMER RAD and EMER ICS, which are used when it is desired to bypass a defective amplifier. On F-4J 157242an and up, 153768ab through 155528ag after AFC 388, 155529ag through 155902am after AFC 433 (Part 1), and all F-4S, the emergency amplifier selector knobs have positions of B/U, NORM, and EMER. If the headset amplifier in either ICS station fails, place the switch to the B/U

TYPE DESIGNATION	FUNCTION	RANGE	CONTROL LOCATION
INTER COM SYSTEM	Intercockpit and cockpit-to-ground communications.	N/A	Front cockpit left console. Rear cockpit left console.*
UHF RADIO COMMUNICATION SYSTEM	UHF radio communication between airplane and ground, airplane and ship, or between airplanes.	Up to line of sight, depending upon frequency and antenna coverage.	Front cockpit right console. Rear cockpit left console.*
AUTOMATIC DIRECTION FINDER SYSTEM	Indicates relative bearing of and homes on Radio signal sources.	Up to line of sight depending upon frequency and antenna coverage.	Front cockpit, right console. Rear cockpit, left console.*
TACAN NAVIGATIONAL SET AN/ARN-86	Indicates bearing and distance to ground station. Determines identity and dependability of beacon. Also determines distance to other aircraft.	Line of sight distance up to 300 miles depending on attitude and altitude.	Front cockpit, right console. Rear cockpit, left console.
IDENTIFICATION SYSTEM	Identifies aircraft in which equipment is installed as friend or foe. Provides selective identification of a single airplane within a group.	0-200 miles or line of sight.	Front cockpit, right console.
ATTITUDE REFERENCE AND BOMBING COMPUTER SET AN/AJB-7	Provides continuous information of the aircrafts attitude and azimuth condition.	N/A	Front cockpit, right console.
VERTICAL FLIGHT REFERENCE SET CVR-10	Provides continuous information of the aircrafts attitude (roll and pitch only).	N/A	N/A, system operative with power on aircraft buses.
NAVIGATION COMPUTER AN/ASN-39	Provides continuous information of the aircrafts navigation situation.	N/A	Rear cockpit, instrument panel.
FLIGHT DIRECTOR GROUP	Provides an integrated display of the navigation situation of the airplane.	N/A	Front cockpit, instrument panel.
TACAN NAVIGATIONAL SET AN/ARN-118**	Indicates bearing and distance to ground station. Determines identity and dependability of beacon and has system self-test. Also determines distance to other aircraft and can give bearing information to suitably equipped aircraft.	Line of sight distance up to 390 miles depending on attitude and altitude.	Front cockpit, right console. rear cockpit, left console.

*F-4J 158355 and up or after AFC 506 and all F-4S, the control location is rear cockpit, right console.

**F-4S after AFC 647

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Figure 2-8. Communication-Navigation-Identification Equipment (backup) position in the cockpit with the defective station. This switches from the normal headset amplifier to the backup amplifier and restores normal operation. If selecting B/U does not restore ICS operation, select EMER (emergency). Audio from the operative station is then connected directly to the backup headset amplifier in the defective station. The volume control on the station with EMER selected has no effect on the audio level. The switch is left in NORM (normal) if the amplifiers in both ICS stations are operating normally.

Note

If both amplifier selector knobs are in an emergency position (EMER RAD and/or EMER ICS) and both intercom volume control knobs are above 75 percent of their volume range, a loud squeal is heard in both headsets. To eliminate this squeal, turn either volume control knob to a position below 75 percent of its volume range.

2.10.4.6 Microphone Buttons. The microphone buttons are used to connect microphone outputs to the UHF transmitter. The pilot microphone button is on the inboard throttle grip, the RIO microphone button is a foot-operated switch on the right foot ramp. When either crewmember wishes to transmit, he depresses the microphone button and the output from the microphone is fed into the transmitter. The positioning of other controls in no way affects the transmitting operation from either cockpit.

2.10.5 Communication Receiver-Transmitter (UHF). The main receiver-transmitter transmits and receives UHF frequencies in a range of 225.0 to 399.0 mc for air-to-air or air-to-ground communications. Complete control over the operation of the main radio receiver-transmitter can be maintained by either the pilot or the RIO through the communication/navigation group control panels (Figures FO-1 and FO-2), located in each cockpit. The communication/navigation group control panel provides controls for the operation of the main receiver-transmitter on any of 3,500 manually selected frequencies or any of 18 preset channels plus a guard channel and for ADF operation with associated direction finder equipment.

Note

On F-4J after AFC 331 and all F-4S, provisions for the installation of the speech security system (KY-28) are provided. This system can have a direct effect on UHF transmission and reception. Refer to NAVAIR 01-245FDB-1T(A) for detailed description of the system and its operational application.

2.10.5.1 Communication Receiver-Transmitter Controls. The controls for operation of the communication receiver-transmitter are on each communication/navigation group control panel (Figures FO-1 and FO-2). The controls consist of the UHF volume control, the communication-auxiliary pushbuttons, the mode selector switch, the communication channel knob, the set channel pushbutton, and the communication frequency thumbwheels.

2.10.5.1.1 UHF Volume Control. The UHF volume control is a thumbwheel-type control which turns on the UHF communications and ADF systems and controls the volume of the communication receiver-transmitter. The thumbwheel also has an on-off switch with the 0 position being off. When adjusting the volume, the higher the number the control is set to, the stronger is the incoming audio signal.

2.10.5.1.2 Communication-Auxiliary (COMM-AUX) Pushbuttons. The COMM-AUX pushbuttons control the mode of operation of the UHF communication receiver-transmitter, auxiliary receiver, and ADF systems. The communication receiver, communication transmitter, communication guard receiver, auxiliary receiver and auxiliary guard receiver are controlled by the pushbuttons as indicated below (only the communication receiver-transmitter shall be discussed at this time):

Mode	Functions
T/R-ADF	Comm receiver – Communication reception. Comm transmitter – Communication transmission. Comm guard receiver – Not used.
T/R+G-ADF	Comm receiver – Communication reception. Comm transmitter – Communication transmission. Comm guard receiver – Guard reception.

Mode	Functions
ADF+G -CMD	Comm receiver – ADF reception. Comm transmitter – Communication transmission with interruption of ADF during transmission. Comm guard receiver - Guard reception.
ADF-G	Comm receiver – ADF reception. Comm transmitter – Communication transmission with interruption of ADF during transmission. Comm guard receiver – Not used.

The pushbuttons are only effective from the cockpit with communication command.

2.10.5.1.3 Mode Selector Switch. The mode selector switch is a three-position toggle switch which controls the mode of channel selection as indicated below.

1. CHAN – When used in conjunction with the communication channel knob, provides selection of preset channels 1 through 18.

2. GUARD – Channels the communication receiver and transmitter to the guard frequency with the T/R-ADF pushbutton depressed. With the T/R+G-ADF pushbutton depressed, the communication receiver and transmitter are channelled to the guard frequency and the guard receiver is on. This control is effective only from the cockpit with communication command.

3. MANUAL – Permits manual selection of the communication receiver and transmitter frequency as indicated by the manual frequency dials. This control is effective only from the cockpit with communication command.

2.10.5.1.4 Communication (COMM) Channel Knob. The COMM channel knob is a rotary switch used to select preset communication channels 1 through 18. The mode selector switch must be in the CHAN position for the communication channel knob to be operative. The selected channel is indicated in the channel indicator adjacent to the communication channel knob.

2.10.5.1.5 Set Channel Pushbutton. The set channel pushbutton is used to present communication channels 1 through 18. To set in a frequency into a channel, the mode selector switch must be placed to the CHAN position, the communication channel knob must be rotated to the desired channel and the communication frequency thumbwheels must be positioned to the desired frequency. When the set channel pushbutton is then depressed, the frequency is set into the desired channel.

2.10.5.1.6 Communication (COMM) Frequency Thumbwheels. The COMM frequency thumbwheels are four rotary controls used to set a frequency into the communication receiver-transmitter or to preset frequencies into the communication receiver-transmitter channels. Frequencies can be set into the communication receiver-transmitter with the mode selector switch in the MANUAL position, and frequencies can be set into the communication receiver-transmitter channels with the mode selector switch in the CHAN position while depressing the set channel pushbutton. Frequencies from 225.0 to 399.0 mc, in increments of 0.05 mc, can be set using the COMM frequency thumbwheels. The frequency selected is displayed on the manual frequency dials located above the thumbwheels. The thumbwheels are effective only from the cockpit with communication command except when used for presetting communication channels 1 through 18.

2.10.5.1.7 UHF Remote Channel Indicators. A remote channel indicator is on the forward cockpit instrument panel. Aircraft 153840ae and up after AFC 312 have a remote channel indicator in the aft cockpit on the instrument panel. The indicators provide a secondary means of indicating the preset channel selected with the communication channel knob.

2.10.6 Auxiliary Receiver (UHF). An auxiliary receiver operates in conjunction with the communication receiver-transmitter under normal conditions and operates as an emergency receiver in the event of failure of the main radio receiver-transmitter. The auxiliary receiver can be used as a conventional radio receiver for reception of AM radio signals in the frequency range of 265.0 to 284.9 mc or as an ADF receiver for reception of radio signals in the same frequency range. A guard receiver, preset to 243.0 mc, is contained within the auxiliary receiver. Guard channel can be monitored when the ADF-G pushbutton is depressed. The auxiliary receiver can be placed in either function by operation of the controls on either communication/navigation group control panel. The auxiliary receiver contains 20 channels preset to frequencies within receiver range. Channel selection is also accomplished by operation of the auxiliary channel knob on one of the communication/navigation group control panels. The communication-auxiliary pushbuttons control the functions of the auxiliary receiver equipment and provide for either the auxiliary receiver or the main radio receiver-transmitter to be operating as an ADF receiver while the other equipment is operating as a voice receiver. The direction finder group of the auxiliary receiver provides the pilot with continuous indication of the direction of radio frequency signals intercepted by either the radio receiver-transmitter or the auxiliary receiver which is used in conjunction with the ADF system. These receivers function to intercept amplitude modulated and unmodulated signals in the frequency range of 225 through 400 mc and 265 through 284.9 mc depending on which receiver is used. Continuous indication of the bearing of the intercepted signals relative to the aircraft heading is presented on the horizontal situation indicator. Necessary primary power, 115 vac, is applied to the auxiliary receiver when the electrical system is energized.

2.10.6.1 Auxiliary Receiver Controls. The controls for operation of the auxiliary receiver are on each communication/navigation group control panel (Figures FO-1 and FO-2). The controls consist of the aux volume control, the communication-auxiliary pushbuttons, and the aux channel knob.

2.10.6.1.1 Auxiliary (AUX) Volume Control. The AUX volume control is a thumbwheel-type control which is used to control the volume of the auxiliary receiver.

2.10.6.1.2 Communication-Auxiliary (COMM-AUX) Pushbuttons. The COMM-AUX pushbuttons control the mode of operation of the UHF communication receiver-transmitter, auxiliary receiver, and ADF systems. The communication receiver, communication transmitter, communication guard receiver, auxiliary receiver, and auxiliary guard receiver are controlled by the pushbuttons as indicated below (only the auxiliary receiver shall be discussed at this time):

1. T/R-ADF –	Aux receiver - ADF reception. Aux guard - Not used.
2. T/R+G -ADF –	Aux receiver - ADF reception. Aux guard receiver - Not used.
3. ADF+G -CMD –	Aux receiver - Communication reception within auxiliary receiver frequency range. Aux guard receiver - Not used.
4. ADF-G –	Aux receiver - Not used. Aux guard receiver - Guard reception.

The pushbuttons are effective only from the cockpit with communication command.

2.10.6.1.3 Auxiliary (AUX) Channel Knob. The AUX channel knob is a rotary switch used to select preset auxiliary channels 1 through 20. The channel frequencies cannot be reset from the cockpit. This control is effective only from the cockpit with communication command.

2.10.7 Antenna Selector Switch. A two-position antenna selection switch is in each cockpit. The pilot antenna switch is on the left console outboard of the throttles; the antenna switch for the RIO is on the RIO instrument panel. The switch positions are UPR and LWR and are used to select one of two communication antennas to be used with the command communication set. The circuitry of the antenna selection switch is wired through the take command relay. Therefore, whoever has command of the communication/navigation group control panel has command of the antenna selection switch. F-4J 155529ag and up or after AFC 388 and all F-4S have the data link system installed. In these aircraft, the antenna selection switch is on the cockpit lights/data link control panel in the rear cockpit on the left side. When the antenna selection switch is placed to the UPR position, the upper communication antenna is selected for UHF communications and the lower antenna is selected for the data link system. Placing the antenna switch to the LWR position selects the lower communications antenna for UHF communications and the upper antenna for the data link system.

2.10.8 Tacan (Tactical Air Navigation) System Before AFC 647. The tacan system functions to give precise geographical bearing and distance information at ranges up to approximately 300 miles (depending on aircraft altitude) from an associated ground or shipboard radio beacon. It also determines the identity of the beacon and indicates the dependability of the beacon signal. It also provides deviation from a selected course. In the air-to-air mode, line-of-sight distance can be obtained between two aircraft operating their tacan sets 63 mc apart. Up to five aircraft can determine line-of-sight distance from a sixth lead aircraft in the A/A mode, providing their tacan sets are 63 mc apart from the lead aircraft. The lead aircraft indicates distance from one of the other five, but it cannot readily determine which one. Before operating in the A/A mode, the frequencies used by each aircraft must be coordinated. The tacan system employs UHF radio frequencies, the propagation of which is virtually limited to line-of-sight distances. The maximum distances from the beacon at which reliable tacan signals can be obtained depends on the altitude of the aircraft and the height of the beacon antenna. Tacan information is presented on the HIS and ADI in the pilot cockpit (refer to paragraph 2.26.11, FLIGHT DIRECTOR GROUP) and on the No. 2 pointer of the BDHI in the RIO cockpit. The BDHI is a conventional RMI display with the additional feature of displaying distance to a tacan station. The No. 2 bearing pointer of the BDHI is the tacan needle and indicates magnetic bearing to the tacan station. The No. 1 bearing pointer is the ADF needle and provides relative bearing to the selected UHF station. The BDHI indicator is also capable of displaying distance information to a tacan station. When a usable signal is not being received, the red warning flag partly obscures the distance indicators from view and the word OFF in black letters appears in the window. The units digit indicator dial is divided into 1/2-mile increments. The BDHI is controlled strictly from the aft cockpit by the CNI-NAV COMP switch on the aft instrument panel. Switch positions selected on the mode-bearing/distance selector panel in the pilot cockpit have no effect on BDHI operation.

2.10.8.1 Tacan Controls. The controls for tacan operation are on the tacan panel on the pilot right console (Figure FO-1) and the RIO left console (Figure FO-2), the communication/navigation group control panel on the RIO left console (Figure FO-2), and the communication/navigation group panels on the pilot right console. The controls on the tacan control panel are the function selector knob, the channel selector control, and the volume control. The controls on the HSI are the course set knob and the heading set knob. The controls on the navigation function selector panel are the mode selector knob and the BRG/DIST switch. The control on the cockpit lights/data link panel is the CNI-NAV COMP switch. The control on the communication/navigation group control panels is the NAV CMD pushbutton.

2.10.8.1.1 Function Selector Knob. The function selector knob is a four-position rotary knob used for selecting tacan modes of operation as follows:

1. OFF – Deenergizes tacan system.
2. REC – Tacan receives bearing signals from the tacan ground station for display on the HSI and BDHI.
3. T/R – Tacan receives bearing signals from the tacan ground station and, in addition, the tacan interrogates the tacan ground station to establish distance from the aircraft to the ground station. The bearing and distance information is displayed on the HSI and BDHI.
4. A/A – Tacan interrogates other aircraft which contain a tacan in the A/A mode and tuned 63 channels apart from the channel setting of the interrogating aircraft. The interrogation provides line-of-sight distance information for display on the HSI and BDHI of both (or up to six) aircraft.

The function selector knob is only operative in the cockpit having NAV COM.

2.10.8.1.2 Channel Selector Knob. The channel selector knob provides for selection of 126 tacan channels. The controls consist of an outer knob used to select the hundred and tens digit of the desired channel number and an inner knob used to select the units digit of the channel number. Positions 0, 00, 127, 128, and 129 are not used.

2.10.8.1.3 Volume Control Knob. The volume control knob is used for volume adjustment of the station identity tone signal.

2.10.8.1.4 Course Set Knob. The course set knob is used for manually selecting desired tacan magnetic course.

2.10.8.1.5 Heading Set Knob. The heading set knob is used for manually selecting desired magnetic heading. Its setting is initially the same as that set in by the course set knob, but then is normally reset to compensate for wind.

2.10.8.1.6 Mode Selector Knob. With the mode selector knob in the tacan position, the tacan supplies the HSI information used to determine the course of the selected tacan radial, and whether the course is to or from the tacan station. A steering signal which aids the pilot in making an asymptotic approach to the selected tacan radial is displayed on the vertical director pointer of the attitude director indicator.

2.10.8.1.7 Bearing/Distance (BRG/DIST) Switch. With the BRG/DIST switch in the tacan position, bearing and distance information from the tacan set is supplied to the HSI for display.

2.10.8.1.8 CNI-NAV COMP Switch. With the CNI-NAV COMP switch in the CNI position, bearing information from the ADF system and bearing distance information from the tacan system is displayed on the BDHI.

2.10.8.1.9 Navigation Command (NAV CMD) Button. The NAV CMD pushbutton transfers control of the tacan function from one cockpit to the other. When the green light illuminates, command of the tacan has been obtained in that cockpit. Once having obtained control, it can be relinquished to the other cockpit by pressing the NAV CMD button. The navigation volume control is effective in both cockpits regardless of the take command situation.

2.10.9 Antenna Selector Switch. The antenna selector switch is in the forward cockpit on the emergency floodlight control panel (Figure FO-1). The switch is used to give the pilot a choice of either manual or automatic selection of the upper or lower tacan antenna. The switch has positions of UPPER, AUTO, and LOWER. When the AUTO position is selected, the tacan coax switch is used for automatic antenna selection. On F-4J after AFC 599 and all F-4S, the antenna selector switch is in the forward cockpit on the miscellaneous light control panel. Operation of the AN/APR-27 or, on F-4J after AFC 524 and all F-4S, the AN/ALR-50, causes the tacan to utilize the upper antenna regardless of antenna selector switch position.

2.10.10 Tacan (Tactical Air Navigation) System After AFC 647. The tacan system produces slant-range distance, relative bearing, course deviation, to-from, and audio identification information at ranges up to approximately 390 miles (depending on aircraft altitude) from an associated ground or shipboard radio beacon. In the air-to-air mode (A/A T/R), line-of-sight distance can be obtained between two similarly equipped aircraft if operating their tacan sets 63 channels apart. Up to five aircraft can determine line-of-sight distance from a sixth lead aircraft in the A/A T/R mode, providing their tacan sets are 63 channels apart from the lead aircraft. The lead aircraft indicates distance from one of the other five, but it cannot readily determine which one. Before operating in the air-to-air mode, the frequencies used by each aircraft must be coordinated. The tacan system can also display bearing, course deviation, and to-from information as well as distance information in the air-to-air mode when operated in conjunction with another aircraft that is capable of transmitting bearing information. The tacan system employs UHF radio frequencies, the propagation of which is virtually limited to line-of-sight distances. The maximum distance from the beacon at which reliable tacan signals can be obtained depends on the altitude of the aircraft and the height of the beacon antenna. Tacan information is presented on the HSI and AI in the pilot's cockpit (refer to paragraph 2.26.11, FLIGHT DIRECTOR GROUP) and on the No. 2 pointer of the BDHI in the RIO cockpit. The BDHI is a conventional RMI display with the additional feature of displaying distance to a tacan station. When a usable signal is not being received, a vertical director pointer warning flag is displayed on the AI and the distance counters on the HSI and BDHI are covered. The BDHI is controlled strictly from the aft cockpit by the BDHI select switch located on the cockpit lights/data link panel. Switch positions selected on the flight director mode select panel in the pilot cockpit have no effect on BDHI operation.

2.10.10.1 Tacan Controls. The controls for tacan operation are on the tacan set control on the pilot right console (Figure FO-1) and the RIO left console (Figure FO-2), the communication/navigation group control panel on the RIO left console and the communication/navigation group panels on the pilot right console. The controls on the tacan control panel are the mode select switch, channel selector switch, volume control, test switch, and test indicator. The controls on the HSI are the course set knob and the heading set knob. The controls on the flight director mode select panel are mode selector knob and the BRG/DIST switch. The control on the cockpit lights/data link panel is the BDHI select switch. The radio set control NAV CMD pushbutton is used to give or take command of tacan functions in either cockpit.

2.10.10.1.1 Mode Selector Knob. The mode selector knob is a five-position knob used for selecting tacan modes of operation as follows:

1. OFF – Deenergizes tacan system.
2. REC – Receive mode. Tacan system receives and measures surface beacon fundamental bearing and calculates the relative bearing. No distance information calculated.
3. T/R – Transmit-receive mode. Tacan system interrogates a surface beacon and receives both bearing and distance information which is used to calculate slant-range distance and relative bearing to the surface beacon.
4. A/A REC – Air-to-air mode. Tacan system receives bearing information from a suitably equipped cooperating aircraft and calculates the relative bearing of the reference aircraft. No distance information available.
5. A/A T/R – Air-to-air transmit-receive mode. Tacan system interrogates a reference aircraft and receives and calculates the slant-range distance and relative bearing to the suitably equipped, cooperating aircraft. If the reference aircraft is not equipped with bearing producing equipment, only slant-range distance is calculated. In this mode, the tacan system provides distance replies to other aircraft when interrogated.

2.10.10.1.2 Channel Selector Knob. The channel selector knob provides for selection of 252 tacan channels. The 252 channels are equally divided into 126 X-channels and 126 Y-channels with both X and Y channels spaced at 1-MHz intervals.

2.10.10.1.3 Volume Control Knob. The volume control knob is used for volume adjustment of the tacan station identity tone signal. Each cockpit has individual control regardless of which cockpit has NAV CMD.

2.10.10.1.4 Test Pushbutton Switch. The self-test provides a complete test of the tacan system except for antennas. When the system is placed in the transmit-receive mode (T/R) and the TEST switch is depressed, a self-test or confidence test is initiated which checks transmitter power, receiver operation, distance, and bearing. If the TEST indicator illuminates and remains lighted during the self-test in the T/R mode, a malfunction is indicated. The test can be performed again in the receive only mode (REC) and, if the TEST indicator extinguishes, the malfunction is isolated to the transmitter section of the receiver-transmitter and bearing information displayed is still valid.

2.10.10.1.5 Test Indicator. The test indicator illuminates when a malfunction occurs during the confidence test or automatic system self-test. The indicator flashes at start of self-test cycle to check indicator operation.

2.10.10.1.6 Course Set Knob. The course set knob is used for manually selecting desired tacan magnetic course.

2.10.10.1.7 Heading Set Knob. The heading set knob is for manually selecting desired magnetic heading. Its setting is initially the same as that set in by the course set knob, but then is normally reset to compensate for wind.

2.10.10.1.8 Mode Selector Knob. With the mode selector knob in the tacan position, the tacan supplies the HSI information used to determine the course of the selected tacan radial and whether the course is to or from the tacan station. A steering signal which aids the pilot in making an asymptotic approach to the selected tacan radial is displayed on the vertical director pointer of the attitude indicator.

2.10.10.1.9 BRG/DIST Switch. With the BRG/DIST switch in the tacan position, bearing and distance information from the tacan set is supplied to the HSI for display.

2.10.10.1.10 BDHI Select Switch. With the BDHI select switch in the CNI position, bearing information from the ADF system and bearing distance information from the tacan system is displayed on the BDHI.

2.10.10.1.11 NAV CMD Pushbutton. The NAV CMD pushbutton is located on the radio set control and transfers control of the tacan function from one cockpit to the other. When the green light illuminates, command of the tacan has been obtained in that cockpit. Once having obtained control, it can be relinquished to the other cockpit by depressing the NAV CMD pushbutton. The navigation volume control is effective in both cockpits regardless of the take command situation.

2.10.10.2 Antenna Selection. Antenna selection is obtained by a self-contained, automatic antenna switch in the receiver-transmitter which allows the system to operate with dual antenna. Operation of the AN/ALR-50 causes the tacan automatic antenna switch to switch to the upper tacan antenna.

2.10.11 Identification System (IFF)

Note

> The following discussion of the identification system is applicable to the F-4J after AFC 388 and all F-4S. F-4J before AFC 388 will not have mode C (altitude reporting) or mode 4 (secure IFF) capability. However, the other functions are the same.

The identification system is capable of automatically reporting coded identification and altitude signals in response to interrogations from surface or airborne stations. These coded replies allow the stations to establish aircraft identification, 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 secure (encrypted) IFF mode. (Mode 4 is not operational unless the system includes a KIT-1A/TSEC transponder computer.) The basic identification system consists of a transponder and IFF control panel. The altitude reporting function requires an altitude encoder unit and the air data computer (ADC). The altitude encoder unit receives log pressure synchro signals from the ADC. These signals correspond to aircraft altitude corrected for static position error. The altitude encoder provides an output of altitude information in both synchro and digital-encoder form. The synchro output is supplied to the AAU-19/A servoed altimeters and the digital output is supplied to the transponder for transmission in mode C. The servoed altimeters are discussed in paragraph 2.22, INSTRUMENTS. An ALT ENCODER OUT light on the telelight panel monitors operation of the altitude encoder unit. When this light is illuminated, the transponder is not receiving digital altitude information for mode C operation.

2.10.11.1 IFF Control Panel. The controls for operation of the identification transponder are on the IFF control panel (Figure FO-1). The REPLY light and controls on the left side of the panel are concerned with mode 4. The TEST light and remaining controls are associated with modes 1, 2, 3/A, and C, except that the master control knob controls all modes of operation and the test lamp is associated only with modes 2 or 3A.

2.10.11.1.1 Master Control Knob. The master control knob applies power to the transponder but does not control power to the components necessary for altitude reporting (altitude encoder unit and ADC). These units are supplied power when aircraft power is available. The master control knob has positions of OFF, STBY, LOW, NORM, and EMER. The knob must be lifted over a detent to select EMER or OFF. STBY should be selected for 2 minutes prior to selecting LOW or NORM to allow the transponder to warm up. NORM initiates transponder operation at normal receiver sensitivity. LOW initiates transponder operation at a reduced sensitivity. In EMER, the transponder transmits emergency replies to mode 1, 2, or 3/A interrogations. The mode 3/A emergency reply includes code 7700. Modes C and 4 are automatically enabled when EMER is selected regardless of the position of the selector switches.

Note

> Emergency operation of the transponder is automatically activated whenever either crewmember ejects.

2.10.11.1.2 Mode Selector Switches. The four mode selector switches (M-1, M-2, M-3/A, and M-C) each have OUT, ON, and spring-loaded TEST positions. The center ON position of each switch enables that mode. To test the transponder, press either mode 2 or 3A selector switch to the TEST position. Illumination of the TEST light indicates proper operation of that mode. The master control knob must be in NORM for the test function to operate. The mode selector switches of the modes not being tested should be OUT when testing on the ground to prevent unnecessary interference with nearby ground stations.

2.10.11.1.3 Mode 1 and Mode 3/A Code Selectors. The two mode 1 code selectors allow selection of 32 mode 1 codes. The four mode 3/A code selectors allow selection of 4096 mode 3/A codes. The mode 2 code selector is on the transponder and cannot be changed in flight.

2.10.11.1.4 Identification of Position Switch. The identification of position switch has positions of IDENT, OUT, and MIC. The spring-loaded IDENT position adds an identification of position pulse to mode 1, 2, and 3/A replies for a period of 15 to 30 seconds. In MIC, the identification of position function is activated for 15 to 30 seconds each time the UHF microphone button is pressed. OUT disables the identification of position function.

2.10.11.1.5 Monitor - Radiation Test Switch. The switch has positions of RAD TEST, MON, and OUT. RAD TEST (radiation test) is used in conjunction with ground test equipment for testing modes 3/A and 4. It has no function during flight. MON (monitor) is used to monitor operation of modes 1, 2, 3/A, and C. With MON selected, the TEST light illuminates for 3 seconds each time an acceptable response is made to an interrogation on a selected mode. OUT disables the monitor function.

2.10.11.1.6 Mode 4 Selector Switch. Mode 4 is selected by placing the mode 4 selector switch to ON, provided that the master control knob is in NORM or LOW. OUT disables mode 4.

2.10.11.1.7 Mode 4 Code Selector. The mode 4 code selector has positions of ZERO, B, A, and HOLD. The knob must be lifted over a detent to select 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-1A/TSEC transponder computer by a single insertion of the KIK-18/TSEC code changing key. The codes are mechanically held in the KIT-1A/TSEC computer regardless of the position of the master control knob or status of aircraft power until after weight is off the landing gear. Thereafter, mode 4 codes will automatically zeroize anytime the master control knob or aircraft power is turned off. The code settings can be mechanically retained after the aircraft has landed by turning the code selector to HOLD and releasing it at least 15 seconds before the master control knob or aircraft power is turned off. The codes again will be held regardless of master control knob position or aircraft power status until the next time weight is off the landing gear. Mode 4 codes can be zeroized when power is on the aircraft and the master control knob is in any position but OFF by placing the code selector knob to ZERO.

2.10.11.1.8 Mode 4 Indication Switch. The switch has positions of AUDIO, OUT, and LIGHT. In AUDIO, an audio tone indicates that valid mode 4 interrogations are being received and the REPLY light illuminates if mode 4 replies are transmitted. In LIGHT, the REPLY light illuminates as mode 4 replies are transmitted, but no audio tone is present. In OUT, the audio and light indications are inoperative and the REPLY light will not press-to-test.

2.10.11.1.9 IFF Light. The IFF light on the telelight panel illuminates to indicate that mode 4 is inoperative. The light is operative with power on the aircraft and the master control knob out of OFF. However, the light will not operate unless the KIT-1A/TSEC transponder computer is installed in the aircraft. Illumination of the IFF light indicates that (1) the mode 4 codes have zeroized, (2) the self-test function of the KIT-1A/TSEC computer has detected a fault, or (3) the transponder is not replying to proper mode 4 interrogations. If the IFF light illuminates, place the master control knob to NORM (if in STBY) and ensure that mode 4 selector switch is ON. If illumination continues, employ operationally directed flight procedures for an inoperative mode 4 condition.

2.10.12 Normal Operation

2.10.12.1 Intercom System. The intercom system is placed in operation without additional switching as soon as the aircraft receives electrical power. The controls should be set in the following manner in order to check the equipment before takeoff:

PILOT CONTROLS

1. Function selector switch – HOT MIC.

2. Emergency amplifier selector switch – NOR.

3. Volume – ROTATE CLOCKWISE.

RADAR INTERCEPT OFFICER CONTROLS

1. Function selector switch – NORMAL.

2. Emergency amplifier selector switch – NOR.

3. Volume – ROTATE CLOCKWISE.

With controls positioned as stated, check the duplex operation of the equipment by talking into the microphones. Rotate the volume controls to ensure that they are operating properly. Switch to the EMER ICS - NOR - EMER RAD positions to ensure that they are mechanically sound. The radio override functions of the interphone should be checked by each operator. To check the equipment properly, the operators should not switch to RADIO OVERRIDE at the same time, since reduction in the volume for the radio receivers is accomplished in both headsets when only one of the operators selects RADIO OVERRIDE. Therefore, each control must be positioned at different times to check the radio override circuitry in each unit. With all four of the amplifying stages working and the intercom system functioning normally, the pilot and RIO should place their function selector switches in the HOT MIC and NORMAL positions, respectively. Both pilot and RIO emergency amplifier switches should be placed in the NOR positions and the volume controls on each panel should be set as desired. No further switching is necessary to operate in duplex. The system is turned off when aircraft electrical power is removed.

2.10.12.2 Communication Transmitter and Receivers. With aircraft power activated, the UHF communications and ADF systems are placed into operation by rotating the UHF volume control thumbwheel to the ON position. Either communication/navigation group control panel may be used in tuning the radio equipment to the communication and ADF channels required for operation; however, communication command must be established on whichever control panel is used for tuning. To enable the T/R-ADF and T/R+G-ADF modes, depress the T/R-ADF or the T/R+G-ADF pushbutton and set the UHF volume control thumbwheel to its midposition. The communication receiver-transmitter is set by use of the communication frequency thumbwheels with the mode selector switch in the MANUAL position; or, if a preset channel is available, it can be set into the communication receiver-transmitter channels with the mode selector switch in the CHAN position and depressing the set channel pushbutton. Voice communication is now possible and ADF bearing information can be displayed on the BDHI and HSI. To enable the ADF+G-CMD mode, depress the ADF+G-CMD pushbutton and set the UHF volume control and the auxiliary volume control to the approximate midposition. Set the ADF channel to be used by rotating the communication frequency thumbwheels with the mode selector switch in the MANUAL position. Or, if a preset channel is available which is the same frequency as the ADF channel, it can be selected by rotating the communication channel knob with the mode selector switch in the CHAN position. Select the channel to be used for communication reception by rotating the auxiliary channel knob. Voice reception is now possible and ADF information can be displayed on the BDHI and HSI. To enable the ADF-G mode, depress the ADF-G pushbutton and set the UHF volume control to approximately its midposition. To set ADF channel to be used, rotate the communication frequency thumbwheels with the mode selector switch in the MANUAL position; or, if a preset channel is available which is the same frequency as the ADF channel, it can be selected by rotating the communication channel knob with the mode selector switch in the CHAN position. ADF bearing information can now be displayed on the BDHI and HSI.

Note

When in the gear down configuration, the ADF antenna pattern is distorted because of the close proximity of the nose landing gear door to the antenna. Therefore, the ADF system should not be relied upon as a primary navigational aid in the gear down configuration.

2.10.12.3 Tacan Before AFC 647. The tacan system is made operational by placing the function selector switch to any position other than OFF. To operate the tacan receiver and transmitter, set the function selector knob to REC to allow the system to warm up, then select T/R if both bearing and distance information is desired. Allow a warmup period of approximately 2 minutes. Set the channel selector control to the channel of a tacan station within operating range. Place the BRG/DIST switch on the pilot instrument panel to TACAN, and the CNI-NAV COMP switch in the RIO cockpit to the CNI position. Bearing and distance to the tacan station is displayed on the HSI and BDHI. The identification signal tone for the selected tacan station should be heard in the headsets. For air-to-air ranging, set the function selector knob to the A/A position. The tacan interrogates the other aircraft which contain a tacan in the A/A mode and are tuned 63 channels apart from the channel setting of the interrogating aircraft. Place the BRG/DIST switch to TACAN and CNI-NAV COMP switch to CNI and the interrogation provides line-of-sight distance information for display on HSI and BDHI of both (or up to six) aircraft. To utilize the tacan set for steering purposes, place the BRG/DIST switch to the TACAN position and set the function selector knob to either REC or T/R mode. To fly directly to or from a tacan station, position the HSI course pointer and command heading marker to the desired tacan station radial (referenced to magnetic north). The HSI course deviation bar indicates the deviation from the desired course. The HSI to-from pointer indicates whether the selected radial will lead the aircraft to or away from the tacan station. The ADI displays a steering signal which aids in making an asymptotic approach on the desired radial. Should the tacan information be unreliable, the vertical director warning flag on the ADI comes into view.

CAUTION

To prevent blowing fuses in tacan R/T, set tacan function selector knob to REC for 2 minutes warmup prior to selecting T/R or A/A.

Note

Operation of the AN/APR-27 or, on F-4J after AFC 524 and F-4S, the AN/ALR-50 causes the tacan system to utilize the upper antenna only. The F-4 Tactical Manual (Vol. III), NAVAIR 01-245FDB-1T(A) provides additional details concerning ECM/tacan system integration.

2.10.12.4 Tacan After AFC 647. The NAV CMD circuits determine which cockpit controls tacan operations. Pressing the NAV CMD pushbutton on the take command control panel in either cockpit takes or relinquishes NAV CMD. Once NAV CMD has been established, the tacan system may be energized by placing the mode switch on the tacan set control to any position other than OFF. To operate the tacan receiver and transmitter, set the mode selector switch to REC to allow the system to warm up, then select T/R if both bearing and distance information is desired. Allow a warmup period of approximately 90 seconds. Place the BRG/DIST switch on the flight director mode selector panel to TACAN and the BDHI select switch in the rear cockpit to CNI position. Bearing distance and information can now be displayed on the HSI and BDHI. The identification tone for the selected tacan station should be heard in the headsets in both cockpits. When using the air-to-air receive mode A/A REC, the tacan receives bearing information only form an aircraft that is suitably equipped to produce and transmit bearing information. The other aircraft must be contacted to establish operating channels. Use either preassigned channel pairings or establish channel pairing with a 63-channel separation. For example, if the other aircraft is using channel 15Y, the tacan in your aircraft must be tuned to 78Y. If the other aircraft is equipped to respond to distance interrogations, only then the A/A T/R mode should be used. Channel separation is the same as for the receive air-to-air mode. The other aircraft will respond to the interrogations from your tacan system and supply line-of-sight distance information. Up to five aircraft can receive distance information from an interrogated aircraft. In the A/A T/R mode, the onboard tacan system also supplies distance information to other aircraft when interrogated. To utilize the tacan set for steering purposes, place the BRG/DST switch to the TACAN position and set the mode select switch to either REC or T/R mode. To fly directly to or from a tacan station, position the HSI course pointer and command heading marker to the desired tacan station radial (references to magnetic north). The HSI course deviation bar indicates the deviation from the desired course. The HSI to-from pointer indicates whether the selected radial will lead the aircraft to or away from the tacan station. The AI displays a steering signal, which aids in making an asymptotic approach on the desired radial. Should the tacan information become unreliable, the vertical director warning flag on the AI comes into view and the tacan switches to an automatic self-test to determine if operation is correct. During the self-test, the only indication on the HSI that indicates that an automatic self-test is occurring is a possible 270° bearing indication. If there is a detected malfunction in the tacan system, a TEST indicator light will illuminate at the end of the self-test cycle and all bearing and distance information should be disregarded. A manual self-test may also be initiated at anytime by setting the mode switch to T/R and pressing the TEST.

Note

Operation of the AN/ALF-50 causes the tacan system to utilize the upper antenna only. The F-4 Tactical Manual (Vol. III) (NAVAIR 01-245FDB-1T(A)) provides additional details concerning ECM/tacan system integration.

2.10.12.5 Identification System – IFF. To operate the system, rotate the master control knob to the NORM position and set the mode 1, mode 2, and mode 3/A switches ON unless otherwise directed. On aircraft 153071z through 153779ab, mode 1 (security identification feature) is automatically made operative when the master control knob is in an operation mode. On F-4J 153780ac and up or after AFC 388 and all F-4S, the ON and OUT positions are operative. Set the mode 1 and mode 3/A code selector dials as directed. The system is now ready for interrogation and response signals. In the event of an emergency, rotate the master control knob to the EMER position. The reply for modes 1 and 2 are special emergency signals of the codes selected on the applicable dials while mode 3/A reply is special emergency signals of code 7700. The same special emergency signals are replied when either or both crewmembers eject. For I-I/P switch operation, place the I/P switch in the INDENT position or place it in the MIC position and key the UHF microphone. The IFF system responds with special I/P signals.

2.10.13 Emergency Operation

CAUTION

Operation of the CNI while utilizing ram air with the RADAR CNI COOL OFF light illuminated could affect equipment life and/or reliability. If the RADAR CNI COOL OFF light does not go out when the reset button is depressed, place the TACAN to OFF and the IFF/SIF to STBY and operate only when necessary. After AFC 647, this CAUTION does not apply to the tacan system.

2.10.13.1 Intercom System. Each cockpit ICS unit is equipped with two amplifiers, both of which are used during normal duplex (hot microphone) operation. An emergency selector knob with EMER ICS, EMER RAD, and NOR positions is provided on the ICS panels. These selections enable an operator to bypass a faulty or dead amplifier in his unit. Assuming the pilot has selected HOT MIC, the operation during the various emergency selections is as follows:

Pilot's Switch Position	RIO's Switch Position	Resulting ICS Operation
Nor	Nor	Normal hot microphone
Emer ICS	Nor	Normal hot microphone
Emer RAD	Nor	Normal hot microphone
Nor	Emer ICS	Pilot's microphone is hot. RIO must actuate radio override switch to transmit on ICS. Foot button inoperative
Nor	Emer RAD	Pilot's microphone is hot. RIO must actuate radio override switch to transmit on ICS. Foot button inoperative

If both pilot and RIO intercom systems are in NOR operation and the pilot then selects the COLD MIC position of the function switch, actuation of either front or rear seat radio override switches or front or rear seat ICS microphone switches opens the system to HOT MIC operation from both cockpits. If it is necessary for both front and rear seat operators to select an emergency position, rear seat emergency conditions prevail. In addition, under NOR operation, both front and rear cockpit ICS microphone switches perform the same function as the radio override switches, reducing UHF volume.

Note

Even though the pilot function selector switch is set at COLD MIC, the RIO may talk and listen to the pilot if he switches to RADIO OVERRIDE or depresses the foot-operated ICS switch. This is the only instance where duplex operation may be maintained when the pilot is not at HOT MIC. This switching arrangement is not normally used for intercockpit communication since the pilot would usually be at

HOT MIC position regardless of the settings of the other controls and the RADIO OVERRIDE settings are momentary switch positions.

On F-4J 157242an and up, 153768ab through 155528ag after AFC 388, F-4J 155529ag through 155902am after AFC 433 (Part 1), and all F-4S, the emergency amplifier selector knob has positions of B/U, NORM, and EMER. If the headset amplifier in either ICS station fails, place the switch to the B/U (backup) position in the cockpit with the defective station. This switches from the normal headset amplifier to the backup amplifier and restores normal operation. If selecting B/U does not restore ICS operation, select EMER (emergency). Audio from the operative station is then connected directly to the backup headset amplifier in the defective station. The volume control on the station with EMER selected has no effect on the audio level. The switch is left in NORM (normal) if the amplifiers in both ICS stations are operating normally.

2.10.13.2 Auxiliary Receiver. The auxiliary receiver works in conjunction with the communication receiver-transmitter under normal conditions and operates as an emergency receiver in the event of power failure to the main radio receiver-transmitter. A guard receiver, contained within the auxiliary receiver, can also be monitored.

2.10.13.3 IFF System. In an emergency, replies may be transmitted for modes 1, 2, 3/A, and 4, but the modes must be operating. The system begins transmitting an emergency reply when the master control knobs is placed to the EMER position. In the emergency mode, the stem generates additional signals which readily identify the aircraft as being in distress. The reply is discontinued when the knob is removed from the emergency position.

2.10.14 Limitations. CNI equipment operating on external power without cooling air is limited to 10 minutes of accumulated operation in 1-hour span. This limitation applies to all CNI equipment except the intercom and UHF communication receiver-transmitter. After AFC 647, the 10-minute per hour limitation applies to the IDENTIFICATION system only. The maximum permissible altitude with CNI equipment ON is 70,000 feet. Flight above 70,000 feet with CNI equipment ON may result in damage to the equipment because of arcing.

2.11 COMMUNICATION-NAVIGATION-IDENTIFICATION (CNI) EQUIPMENT AFTER AFC 660

2.11.1 Description. The communication-navigation-identification (CNI) equipment consists of an intercom, two UHF communication receiver-transmitters, a tacan navigational set, an automatic direction finder system, and an identification system. The function and control locations for each of the above equipment are listed in Figure 2-8. The identification system operating on external power without cooling air is limited to 10 minutes of accumulated operation in a 1-hour span. Cooling air is provided to the tacan receiver-transmitter by an internal blower. The UHF receiver-transmitters are convection cooled. Flight above 70,000 feet with CNI equipment on may result in damage to the equipment because of arcing. Operation of the UHF communication receiver-transmitter is limited to 1 minute of continuous transmit to 5 minutes of receive time.

2.11.2 External Ground Power Operation. With external ground power connected to the aircraft and neither of the two generators connected to the line, the CNI equipment does not operate (except for UHF 1) unless the CNI ground power switch is placed to the ON position. The CNI ground power switch in the left wheelwell applies external power to the CNI equipment for ground operation. The switch is manually operated and electrically held and must be reset after each interruption of external power.

2.11.3 Intercom System. An intercom panel (Figures FO-1 and FO-2) in both cockpits provides inter-cockpit communication in the aircraft. An external station, connected in parallel with the aft cockpit microphone and headset, is used by ground personnel. An additional function of the intercom system is to amplify audio frequency signals received from various sources. Transmission over the UHF receiver-transmitter may be accomplished in either cockpit in conjunction with the intercom system.

2.11.3.1 Intercom Controls. The intercom controls consist of volume controls, function selector switches, emergency amplifier selector switches, intercom switches, and microphone buttons.

2.11.3.2 Volume Control. The intercom volume control knobs are on the left side of the intercom panel in each cockpit. The input level of the intercom signals to the headsets is increased by rotating the respective volume control knobs in a clockwise direction. The signals received from the radio receivers are not affected by operation of these intercom volume controls.

2.11.3.3 Function Selector Switch (Pilot). A three-position toggle switch with positions of RADIO OVERRIDE, HOT MIC, and COLD MIC is on the right side of the pilot intercom control panel. The RADIO OVERRIDE position of the switch is momentary, the HOT MIC and COLD MIC positions are fixed. The HOT MIC position is used when duplex operation of the intercom system is desired. The RADIO OVERRIDE position is identical with HOT MIC except that all radio gain is reduced; communication between cockpits then overrides radio reception. When the switch is set to COLD MIC, normal radio reception and transmission is still available, but the pilot can no longer communicate with the RIO over the intercom system without using the ICS switch on the throttle. However, the RIO can still transmit to the pilot by either placing the radio override switch in the RADIO OVERRIDE position or by pressing the foot-operated intercom switch.

2.11.3.4 Function Selector Switch (RIO). A two-position toggle switch with positions of RADIO OVERRIDE and NORMAL is on the left side of the RIO intercom panel. The NORMAL position is used for normal duplex operation at the same time the pilot switch is set at HOT MIC. Radio signals are received at normal volume when the RIO switch is set at NORMAL. The RADIO OVERRIDE position is used to reduce the reception of radio signals in both cockpits. This switch position may also be employed to accomplish intercockpit communication if the pilot switch is set at COLD MIC. The RADIO OVERRIDE position is a momentary switch position. If the RIO has selected either B/U or EMER and then selects RADIO OVERRIDE, a one-way conversation results. The RIO can talk to the pilot, but the pilot cannot talk to the RIO until the RIO releases his function selector switch and allows it to return to NORMAL position.

2.11.3.5 Intercom Foot Switch (RIO). A foot-operated switch is on the left foot ramp in the RIO cockpit. This switch is wired in parallel with the pilot intercom switch. By depressing his foot switch, the RIO may override any of the positions selected on the pilot function selector switch, allowing intercom transmission without the necessity of releasing other manual controls.

2.11.3.6 Emergency Amplifier Selector Knobs. The emergency amplifier selector knobs are three-position rotary-type switches and are in the center of both intercom control panels. The operator uses these controls to bypass a defective amplifier. Both operators may have occasion to switch to one of the emergency settings at the same time. In certain instances of amplifier failure, this arrangement is necessary in order to maintain intercockpit communication. There are three possible settings for each control. The emergency amplifier selector knobs have positions of B/U, NORM, and EMER. The NORM position is used when both amplifying stages in the respective control boxes are functioning properly. If the headset amplifier in either ICS station fails, place the switch to the B/U (backup) position in the cockpit with the defective station. This switches from the normal headset amplifier to the backup amplifier and restores normal operation. If selecting B/U does not restore ICS operation, select EMER (emergency). Audio from the operative station is then connected directly to the backup headset amplifier in the defective station. The volume control on the station with EMER selected has no effect on the audio level. The switch is left in NORM (normal) if the amplifiers in both ICS stations are operating normally.

Note

> If both amplifier selector knobs are in an emergency position and both intercom volume control knobs are above 75 percent of their volume range, a loud squeal is heard in both headsets. To eliminate this squeal, turn either volume control knob to a position below 75 percent of its volume range.

2.11.3.7 Microphone Buttons. The microphone buttons are used to connect microphone outputs to the UHF transmitters. The pilot microphone button is on the inboard throttle grip. It is a four-position switch spring loaded to center OFF position. Transmission over either transmitter is accomplished by depressing the microphone button to either UHF 1 or UHF 2 and the output from the microphone is fed to the transmitter. The RIO microphone button is a foot-operated switch on the right foot ramp. Transmission by the RIO is accomplished by manually selecting either UHF RADIO 1 or UHF RADIO 2 on the XMT SEL switch located on the take command control panel and depressing the UHF microphone button.

2.11.4 COMM Receiver-Transmitter (UHF). There are two complete UHF receiver-transmitters which can transmit and receive UHF frequencies in a range of 225.000 to 399.975 MHz for air-to-air or air-to-ground communications. Complete control over the operation of both receiver-transmitters can be maintained by either the pilot or the RIO. UHF 1 is designated as the main voice receiver-transmitter and UHF 2 is designated as the ADF receiver. UHF 2 can, however, be utilized as a voice receiver-transmitter as well as the ADF receiver. UHF 1 cannot be used for ADF operations. Individual identical controls are provided in both cockpits. The pilot radio set controls are located on the lower right console and the RIO radio set controls are located on the lower right side of his instrument panel. These control panels provide operation of both receiver-transmitters on any of 7,000 manually selected frequencies or any 20 preset channels plus a guard channel. Communication command and ADF function controls are located on a separate take command control panel positioned between the radio set controls in each cockpit. Radio relay operation (middleman) is obtained by using associated controls and equipment. Provisions for the installation of the speech security system (KY-58) are provided. Refer to NAVAIR 01-245FDB-1T(A) for detailed description of the system and its operational application.

2.11.4.1 COMM Receiver-Transmitter Controls. The controls for operation of the UHF receiver-transmitters are on each radio set control panel (Figures FO-1 and FO-2). There are two radio set control panels located in each cockpit, one for UHF 1 and one for UHF 2. Only the cockpit with communications command can control mode and frequency selection of the UHF. The controls consist of a mode selector switch, function selector switch, volume control, squelch control, manual frequency selector switches, a preset channel load switch, and, for the display, a test and brightness control. A tone switch is provided but not used.

2.11.4.1.1 UHF Volume Control. The UHF volume control knob controls the volume of the UHF voice communications and ADF audio. Each radio set control has individual control regardless of which cockpit is in communication command.

2.11.4.1.2 Mode Selector Switch. The mode selector switch is a four-position rotary switch which controls the mode of operation of the receiver-transmitter as indicated on the following page.

1. OFF – Turns off power to receiver-transmitter.
2. MAIN – Selects normal receiver and transmitter operation. Transmitter is keyed by microphone buttons.
3. BOTH – Enables guard receiver in addition to functions described for MAIN.
4. ADF – Not used.

2.11.4.1.3 Function Selector Switch. The function selector switch is a four-positioned rotary switch which controls the mode of channel selection as indicated below. It is also used in conjunction with the CHAN SEL (preset channel selector) switch.

1. GD (Guard) – Tunes main receiver-transmitter to guard frequency. Displays guard frequency on readout.
2. MNL – (Manual) Permits manual selection of frequency. Selected frequency is displayed on readout.
3. PRESET – Permits selection of any of 20 preset channels. Selected channel number displayed in readout in fourth and/or fifth digital position.
4. RD (Read) – Displays frequency of selected preset channel on readout.

2.11.4.1.4 CHAN SEL (Preset Channel Selector) Switch. The preset channel selector is a rotary-type switch that permits selection of any of 20 preset channels when the function selector switch is in the PRESET or RD position.

2.11.4.1.5 Load Pushbutton. If the frequency of a preset channel is to be changed, the function selector switch is set to MNL and the desired frequency is selected using the frequency selector switches. The CHAN SEL switch is then set to the channel to be changed and the LOAD pushbutton switch is pressed.

2.11.4.1.6 Manual Frequency Select Switches. There are four identical frequency select switches that are used when the function select switch is in the

MNL position. The system operating frequency is determined by these four up/down switches. The switches either raise or lower the existing frequency; they do not have defined positions for specific digits. Frequency selection is displayed on the digital readout in both cockpits. Only the cockpit with communication command can control frequency selection.

2.11.4.1.7 Squelch ON/OFF Switch. This is a toggle switch used to enable the main receiver squelch when in the ON position or disable the main receiver squelch when in the OFF position.

2.11.4.1.8 BRT (Brightness) Control Knob. The BRT control knob is a dimmer control that adjusts the intensity of the digital readout. Rotating the knob clockwise increases the intensity and counterclockwise decreases the intensity.

2.11.4.1.9 Test Control Pushbutton. To test the readout display for proper operation, press the TEST pushbutton. If all readout lights are operable, six 8's will be displayed.

2.11.4.1.10 UHF Remote Channel/Frequency Indicator. A remote channel/frequency indicator is on the forward cockpit instrument panel. The indicator provides a secondary means of indicating the preset channel or frequency selected on the radio set control for UHF 1.

2.11.5 Antenna Selector Switch. A two-position antenna selector switch is in each cockpit. The pilot antenna switch is on the left console outboard of the throttles; the antenna switch for the RIO is on the cockpit lights/data link control panel in the rear cockpit on the left side. The switch positions are UPR and LWR and are used to select one of two communication antennas to be used for voice communications. Antenna selection is limited to the cockpit with COMM CMD of UHF 1 (UHF 2 if BACKUP selected). When the AN/ASW-25 data link system is energized, the UHF receiver-transmitter will be on the antenna selected and the data link will be on the opposite antenna. During DUAL or RELAY operations, UHF 1 will be on the antenna selected and UHF 2 will be on the opposite.

Note

When data link is energized, DUAL and RLY operation is not possible.

2.11.6 Take Command Control Panel (TCCP). The take command control panel is located between the radio set control panels for UHF 1 and UHF 2 in both cockpits. The take command control panel referred to as the TCCP contains controls for communication command between the cockpits, navigation command, dual and ADF operations, BACKUP selection, and transmitter selection for the aft cockpit. The function of each control is as follows:

1. COMM CMD UHF RADIO 1 – Gives and takes command of UHF radio 1. Illuminated when in command.

2. COMM CMD UHF RADIO 2 – Gives and takes command of UHF radio 2. Illuminated when in command.

3. NAV CMD – Gives and takes command of tacan receiver-transmitter. Illuminated when in command.

4. DUAL/ADF ON – When DUAL is illuminated, both UHF receiver-transmitters will be utilized for voice communications.

   When ADF ON is illuminated, UHF 2 will be utilized for ADF operations.

5. BRT – Adjusts intensity of pushbutton in the individual cockpits.

6. XMT SEL – Selects UHF 1 or UHF 2 for transmission in the aft cockpit only.

7. BACKUP – Selects UHF 2 for primary voice communications if UHF 1 should fail. If selected, it will disable UHF 1.

2.11.7 Normal Operation of Intercom System. The intercom system is placed in operation without additional switching as soon as the aircraft receives electrical power. The controls should be set in the following manner in order to check the equipment before takeoff:

Pilot Controls

1. Function selector switch – HOT MIC.

2. Emergency amplifier selector switch – NORM.

3. Volume – ROTATE CLOCKWISE.

Radar Intercept Officer Controls

1. Function selector switch – NORMAL.

2. Emergency amplifier selector switch – NORM.

3. Volume – ROTATE CLOCKWISE

With controls positioned as stated, check the duplex operation of the equipment by talking into the microphones. Rotate the volume controls to ensure that they are operating properly. Switch to the B/U-NORM-EMER positions to ensure that they are mechanically sound. The radio override functions of the interphone should be checked by each operator. To check the equipment properly, the operators should not switch to RADIO OVERRIDE at the same time since reduction in the volume for the radio receivers is accomplished in both headsets when only one of the operators selects RADIO OVERRIDE. Therefore, each control must be positioned at different times to check the radio override circuitry in each unit. With all four of the amplifying stages working and the intercom system functioning normally, the pilot and RIO should place their function selector switches in the HOT MIC and NORMAL positions, respectively. Both the pilot and RIO emergency amplifier switches should be placed in the NORM positions and the volume controls on each panel should be set as desired. No further switching is necessary to operate in duplex. The system is turned off when aircraft electrical power is removed.

2.11.8 Normal Operation of Communication Transmitters and Receivers. With aircraft power activated, the UHF receiver-transmitters may be placed into operation by selecting COMM CMD in the cockpit desiring control and placing the MODE switch on the radio set controls for UHF 1 and UHF 2 to MAIN or BOTH. Under normal operations, UHF 1 should be placed in the BOTH position in order to monitor the guard frequency and UHF 2 in the MAIN position for ADF operation. The desired channel/frequency for each radio can be obtained by utilizing either the preset channels or the manual frequency selectors. The readout displayed on the radio set control in the cockpit with COMM CMD will also be displayed on the radio set control in the other cockpit. The remote channel/frequency indicator will display the channel/frequency selected for UHF 1 only. ADF operation is initiated by pressing the ADF ON pushbutton located on the take command control panel in either cockpit. The ADF ON light will be illuminated and UHF 2 will be utilized as the ADF receiver allowing ADF information to be displayed on the HSI and BDHI. DUAL operation is utilized when it is desirable to have two voice communications receiver-transmitters operational. To select DUAL operation, press the DUAL/ADF ON pushbutton on the TCCP; the ADF ON lamp will extinguish and the DUAL lamp will illuminate. This allows UHF 2 to utilize the communication antenna not in use by UHF 1. Nonsecure relay operation is initiated by placing the KY-58 control to P/OFF and RELAY and selecting DUAL on the TCCP. A frequency separation of at least 10 MHz should be maintained between the radios. Information will be received on one radio and be automatically retransmitted over the other radio.

Note

DUAL or RLY operation is not possible during data link operations. With gear down configuration, the ADF antenna pattern is distorted because of the close proximity of the nose landing gear door to the antenna. Therefore, the ADF system should not be relied upon as a primary navigational aid in the gear down configuration.

2.11.9 Emergency Operation

CAUTION

Operation of the CNI while utilizing ram air with the RADAR CNI COOL OFF light illuminated could affect equipment life and/or reliability. If the RADAR CNI COOL OFF light does not go out when the reset button is depressed, place the IFF/SIF to STBY and operate only when necessary.

2.11.9.1 Intercom System. The emergency amplifier selector knob has positions of B/U, NORM, and EMER. If the headset amplifier in either ICS station fails, place the switch to the B/U (backup) position in the cockpit with the defective station. This switches from the normal headset amplifier to the back-up amplifier and restores normal operation. If selecting B/U does not restore ICS operation, select EMER (emergency). Audio from the operative station is then connected directly to the backup headset amplifier in the defective station. The volume control on the station with EMER selected has no effect on the audio level. The switch is left in NORM (normal) if the amplifiers in both ICS stations are operating normally.

2.11.9.2 Communication Transmitters and Receivers. In the event of a failure of UHF 1, the primary voice communication receiver-transmitter, UHF 2 can be transferred to the communication antennas by selecting BACKUP on the take command control panel. This will completely disable UHF 1 and allow UHF 2 to control antenna selection.

2.11.10 Limitations. CNI equipment operating on external power without cooling air is limited to 10 minutes of accumulated operation in 1-hour span. This limitation applies only to the identification system. The maximum permissible altitude with CNI equipment ON is 70,000 feet. Flight about 70,000 feet with CNI equipment on may result in damage to the equipment because of arcing. Operation of the UHF transmitters is limited to 1-minute continuous transmit time to 5 minutes of receive time.

2.12 DRAG CHUTE SYSTEM

2.12.1 Description. The aircraft is equipped with a 16-foot, ring-slot-type parachute which is deployed after touchdown to aid in reducing landing roll distances. The drag chute may also be utilized for out of control/spin recovery. The chute is carried in a compartment within the empennage at the base of the vertical stabilizer and is pulled into the airstream by a pilot chute when the spring-loaded compartment door is opened. The design of the attaching mechanism is such that should the compartment door open, without operating the cockpit control handle, the chute is released and falls free of the aircraft. The drag chute is retained to the aircraft structure upon normal deployment. There is no breakaway fitting within the attaching mechanism.

CAUTION

Repacking a wet drag chute may result in freezing at altitude and failure of the drag chute to deploy on landing.

2.12.2 Drag Chute Handle. The drag chute is deployed by means of a control handle (Figure FO-1) beside the left console. A cable joins the handle, the release and jettison mechanism, and the door latch mechanism. Rotating the handle aft without depressing the button on the handle releases the door latch mechanism. The spring-loaded actuator then opens the drag chute door and, at the same time, the hook lock is positioned over the drag chute attach ring. The spring-loaded pilot chute pops out, opens, and pulls out the drag chute. The drag chute is jettisoned by pulling aft on the handle to clear the detent, depressing the thumb button, and lowering the handle. The release and jettison mechanism then returns to the normal position, permitting the drag chute to pull free.

2.12.3 Normal Operation. Normal operation of the drag chute system consists of deploying and jettisoning the drag chute. The drag chute is deployed by grasping the drag chute handle and rotating the handle aft. When landing with a known crosswind component equal to or greater than 20 knots, the drag chute should not be used because of excessive weathercocking. To jettison the drag chute, rotate the handle further aft to clear detent, depress the thumb button, and then rotate handle full forward.

2.12.4 Emergency Operation. There are no specific emergency operations pertaining to the drag chute system.

2.12.5 Limitations. Maximum airspeed for drag chute deployment is 215 KCAS.

2.13 EJECTION SEATS

2.13.1 Description. The MK-H7 ejection seat system (Figure 2-9) provides the occupant with a means of safe escape from the aircraft at practically all altitudes. The ejection seat is an automatic device that primarily regulates the opening of the personnel parachute at a predetermined altitude or after the seat has decelerated to within a safe limit for the occupant. The seat is equipped with two separate firing controls which are used to fire the seat during the ejection sequence. These two controls are the face curtain and lower ejection handle. The face curtain, located above the head, provides head protection and promotes proper ejection posture during the ejection sequence. The lower ejection handle, located between the occupant knees on the seat bucket, provides an alternate method of firing the seat. Either control will jettison the canopy and fire the catapult gun. A rocket pack on the underside of the seat fires as the seat leaves the cockpit to provide a higher seat trajectory. A sequencing system (Figure 2-10) provides an automatic ejection sequence if either of the crewmembers actuates his ejection seat. This allows both crewmembers to eject in a shorter period of time and precludes collisions between seats or a seat with a canopy. A command selector valve, installed in the aft cockpit, provides the capability of selecting single ejection or dual automatic ejection. Should the automatic sequencing system malfunction, single ejection from either cockpit can be accomplished by pulling an ejection handle after canopy removal. A shoulder harness snubber incorporates an inertial reel lock with a velocity retention system and a powered retraction device to retract the crewmember to the back of his seat during ejection. The velocity retention system locks the inertial reel whenever the crewmember pitches forward faster than a predetermined rate. The seat is linked to the canopy by the interlock mechanism to prevent accidental ejection through the canopy plexiglas. Ejection through the plexiglas is not possible because of the high strength qualities of the plexiglas used on the canopy.

The drogue chutes on the top of the seat stabilize the seat after ejection and deploy the personnel parachute. A hardshell container is provided for the 29.7-foot Skysail personnel parachute. On aircraft 157242an and up and all others after ACC 176, the Skysail chute is replaced by a 28-foot parachute which gives better performance at low airspeeds. The container separates from the crewmember after chute deployment. Three handles are incorporated on the seat bucket; they are the emergency restraint release handle, the shoulder harness lock lever, and the leg restraint manual release handle. The emergency restraint release handle permits manual release of the harness during manual separation procedures. The shoulder harness lock lever controls the upper harness movement. The leg restraint manual release handle releases the leg restraint cords. A seat position switch on the forward right side of the seat bucket controls the seat adjusting motor. Two finger rings, located adjacent to the leg restraint snubber units, provide a means of releasing the snubbers on the leg restraint cords.

2.13.2 Canopy Interlock Block. The canopy interlock block and various lever arrangements within the interlock mechanism prevent firing of the ejection seat before the canopy has been jettisoned from the aircraft. The interlock block is connected to the canopy by a cable and is pulled from the interlock mechanism by the canopy during the ejection sequence. On aircraft 158346as and up and all others after ACC 187, a safety link connects the canopy interlock block to the ejection gun firing mechanism (interdictor) safety pin. The interdictor safety pin remains inserted in the ejection gun firing mechanism until it is pulled by the interlock block as the canopy is jettisoned. This gives added protection against inadvertent ejection initiation.

Note

Although an ejection handle is pulled, ejection cannot occur if the canopy is fully opened. Since the canopy actuator is at the top limit of its travel, the canopy will not jettison to remove the interlock block and thus will not allow the ejection gun to fire.

2.13.3 Canopy Actuating Cylinder Guard. The canopy actuating cylinder guard protects the banana links if the canopy shear pin fails and the actuating cylinder falls against the seat. The guard is installed on the seat-mounted canopy initiator in the front cockpit only. On aircraft 158346as and up and all others after ACC 187, a guard is installed over the seat-mounted initiator linkages in the aft cockpit to give added protection against inadvertent initiation because of foreign objects.

2.13.4 Catapult Gun. The catapult gun mounted on the back of the ejection seat is used to propel the seat from the cockpit during the ejection sequence.

2.13.5 Rocket Motor. A rocket motor is incorporated to provide a propulsion system for the rocket thrust phase of the ejection sequence. The rocket motor is on the bottom of the seat bucket and consists of a number of small diameter combustion tubes that contain solid propellant screwed into a manifold containing nozzles. As the ejection seat nears the end of the ejection gun stroke, a static line attached to the cockpit floor withdrawals the sear from the rocket

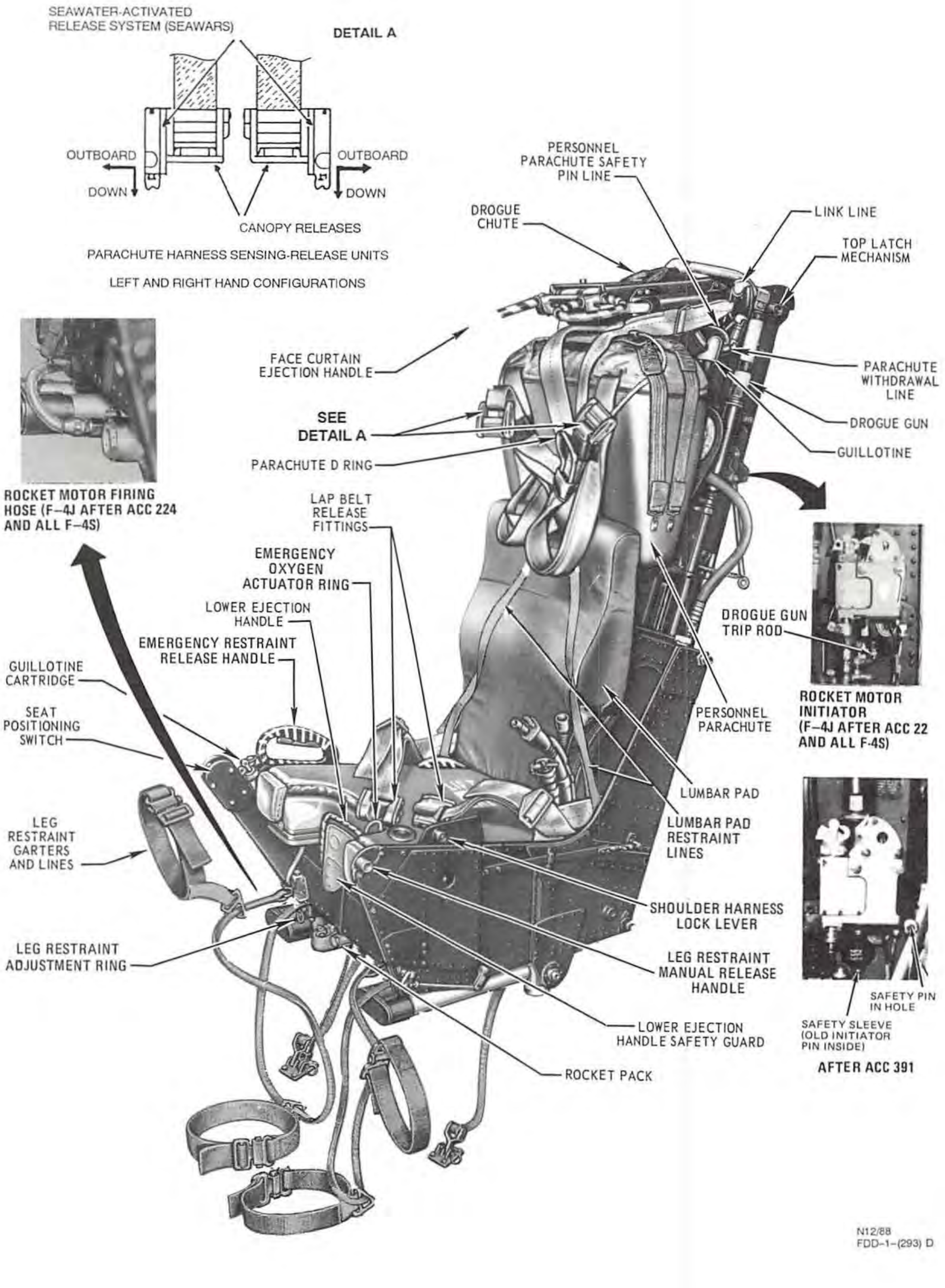
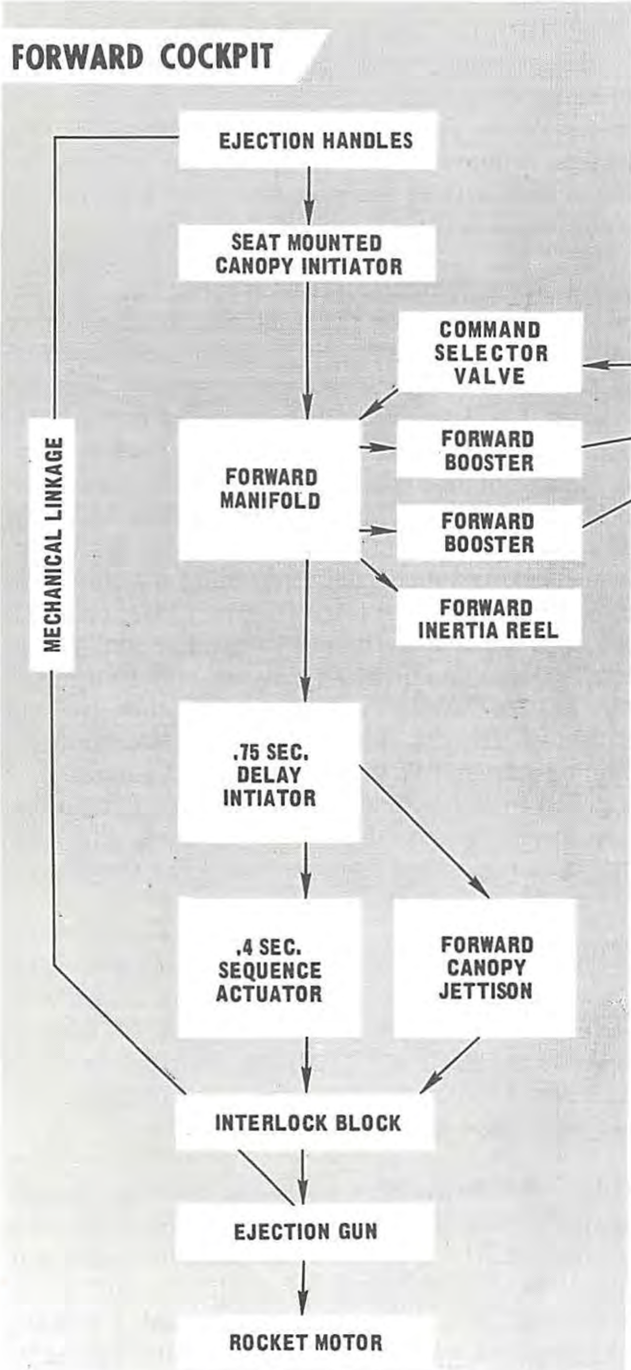
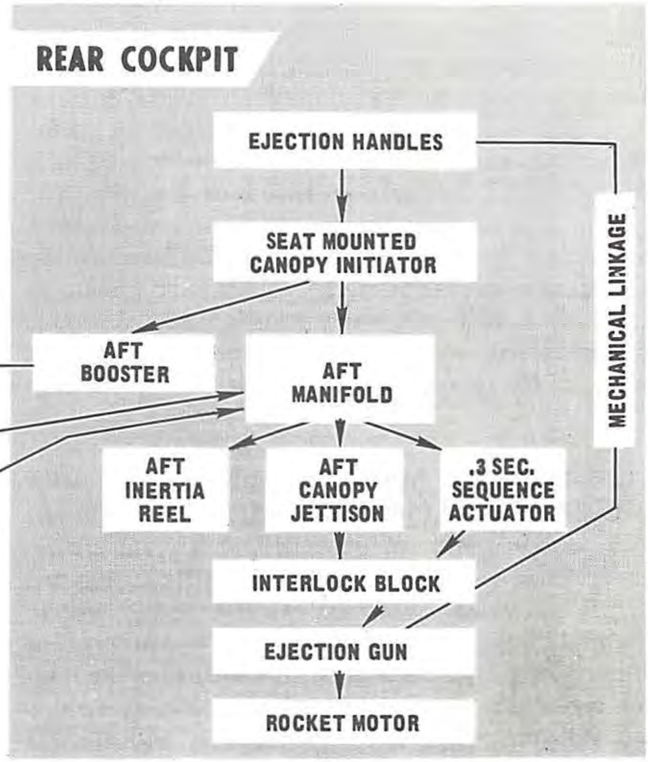


Figure 2-9. Ejection Seat



Note

ELAPSED TIME TO EJECTION GUN FIRING – 1.392 SECONDS.



Note

- ELAPSED TIME TO EJECTION GUN FIRING – 0.54 SECONDS.
- PRIOR TO 155903ap BEFORE AFC 482, .3 SEC. SEQUENCE ACTUATOR IS INOPERATIVE WITH SINGLE EJECTION SELECTED BY COMMAND SELECTOR VALVE. TO FIRE SEAT, EJECTION HANDLE MUST BE PULLED AFTER CANOPY REMOVAL.

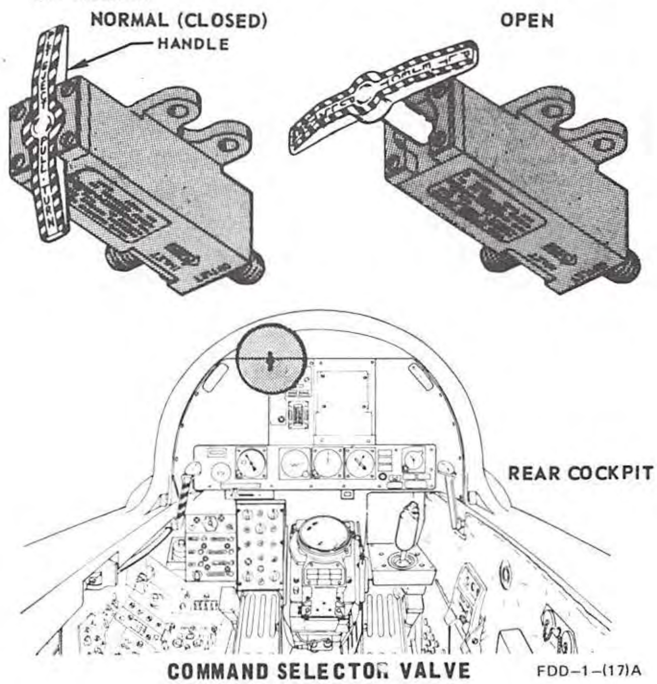


Figure 2-10. Automatic Sequencing System

motor firing mechanism causing ignition of the propellant. Since seat cg location is a function of seat bucket position, the rocket motor contains a thrust angle adjustment mechanism that changes the rocket motor thrust angle to compensate for the new cg location whenever the seat is raised or lowered. The ejection seat contains leg guards to prevent inadvertent contact between the crewmember's legs and the hot rocket tubes. On aircraft 157242an and up and all others after ACC 169, a protector is installed around the rocket sear and sear cable to prevent accidental pulling of the rocket sear.

2.13.5.1 Rocket Motor Initiator – F-4J After ACC 244 and all F-4S. On F-4J after ACC 224 and all F-4S, the rocket motor sear and lanyard are removed from beneath the seats. Rocket motor ignition is then provided by a gas rocket motor initiator mounted on the left side of the seat (Figure 2-9). The initiator contains a cable lanyard which fires the initiator when the seat reaches a predetermined height. The initiator when fired produces a ballistic gas which activates the firing pin in the firing body to fire the rocket motor. Removing the rocket motor sear and lanyard from the bottom of the seat makes the motor less susceptible to inadvertent firing.

2.13.6 Drogue Gun. The drogue gun is on the left side of the ejection seat headrest. Upon ejection, a trip rod fixed to the aircraft structure pulls a sear from the drogue gun to initiate a 0.75-second time delay, at which time a cartridge is fired and the resultant gas pressures propel a piston out of the drogue gun barrel. Attached to this piston is a lanyard which pulls the controller drogue chute from its container. When deployed, the controller drogue chute pulls the stabilizer drogue chute from its containers. Before ACC 391, Part 2, a cocking indicator is installed on the bottom of the drogue gun. When the gun is cocked, the indicator extends approximately one-half inch below the gun housing with the indicator shaft showing. If the indicator is flush with the bottom of the gun housing without the shaft showing, the drogue gun is not cocked and will not fire during ejection. After ACC 391, Part 2, the cocking indicator has been replaced by a safety sleeve. Assurance that the drogue gun is cocked is determined by the ability to insert the safety pin in the drogue gun or by observing that the safety pin hole is clear of obstruction. If the safety pin hole is partially obstructed by the locking plunger, the drogue is not cocked and will not fire during ejection.

2.13.7 Drogue Chute Restraining Scissors. The drogue chute restraining scissors are on the top of the seat and are used to connect the drogue chutes to the top of the seat when they are deployed during ejection. A movable jaw of the scissors releases the drogue chutes from the seat when the time release mechanism actuates.

2.13.8 Time Release Mechanism. The time release mechanism is on the right side of the ejection seat headrest. Its function is to delay deployment of the personnel parachute and seat separation until the occupant has descended from the upper atmosphere, and/or has slowed enough to prevent excessive opening shock of the personnel parachute. The time release mechanism is armed upon ejection by a trip rod secured to the aircraft. Initiation of the timing sequence follows immediately, providing the altitude is below 13,000 (±1,500) feet. If above 13,000 (±1,500) feet, initiation is delayed until the altitude condition is met. Two and one quarter (2.25) seconds after initiation of the timing sequence, the time release mechanism releases the drogue chutes from the restraining scissors allowing the personnel parachute to be pulled from its container. At the same time, it unlocks the harness and leg restraint lines to allow the occupant to be pulled from the seat when the personnel parachute deploys.

2.13.9 Sticker Clips. The sticker clips are on each side of the inner seat bucket. Each clip is made of spring steel with a detent point to hold the harness sticker strap lugs. The sticker clips retain the occupant in the seat until the personnel parachute blossoms and pulls the occupant clear of the seat.

2.13.10 Face Curtain Ejection Handle. A face curtain ejection handle (Figure 2-9) is provided for seat ejection. The ejection handle at the top of the seat projects forward and provides a gripping surface for the crewmember. When ejection is desired, a forward and downward pull on the handle initiates operation of the sequencing system. During dual ejection from either cockpit when the face curtain ejection handle is pulled to the first position, the automatic ejection sequence is initiated. After canopy jettison, the catapult gun can be fired by either the automatic sequencing system or the ejection handle. By continuing the pull on the handle, it is possible to beat the sequencing system in firing the catapult gun. This pulls the face curtain over the face and removes the wedge-shaped sear from the ejection gun, firing the main charge and ejecting the seat. For single ejection from the rear cockpit, an additional pull on the handle is required since the catapult gun will not fire automatically. On F-4J 155903ap and up or after AFC 482 and all F-4S, the sequencing system is modified so that the rear seat will fire automatically during single ejection and that an additional pull on the ejection handle is no longer required.

2.13.11 Lower Ejection Handle. The lower ejection handle (Figure 2-9) is on the seat bucket between the occupant's legs. this handle is connected to a cable assembly, routed under and behind the seat, that initiates the same sequences and firing functions as the face curtain. The lower ejection handle is guarded (by a plate) to prevent inadvertent actuation. The guard provides a mechanical stop to prevent the handle from moving and must be rotated to the down position before ejection.

2.13.12 Command Selector Valve Handle. The command selector valve handle (Figure FO-2) above the instrument panel on the left side of the aft cockpit is used to select single or dual ejection from the aft cockpit. The vertical position of the handle is the single ejection position and the handle is normally kept in this position during flight. To select dual ejection, the handle is pulled directly out (without applying torque to handle) from the valve. During the pull, the handle rotates 90° clockwise to the locked open position through cam action. On F-4J 158355at and up or after AFC 506 and all F-4S, the command selector valve is moved to the left console in the aft cockpit.

Note

> A cycle of the command selector valve handle is defined as movement from the vertical to horizontal to vertical position. Inspection of valve will be in accordance with applicable maintenance directives.

2.13.12.1 Command Selector Valve Handle – F-4J After AFC 526 and all F-4S. On F-4J after AFC 526 and all F-4S, the command selector valve is replaced by a more durable valve capable of 20,000 cycles. The new valve operates essentially like the old valve except for the following: the new valve is opened by applying torsion to the handle instead of a pulling action; the valve handle does not move away from the valve body when opening or closing; and the handle, if released in an intermediate position, will not always return to the vertical position, but to the vertical or 90° position depending on which side of the center of travel it is released.

2.13.13 Seat Positioning Switch. The ejection seats may be adjusted vertically only. Fore and aft seat positioning is compensated for by adjusting the rudder pedals (front cockpit only). Vertical seat positioning is accomplished by actuating a momentary contact switch (Figure 2-9) on the right forward side of the seat bucket. Each seat can be adjusted up or down through a total distance of 6 inches. It is not necessary to adjust the seat height before ejection; however, the seat should be low enough to afford adequate clearance between the helmet and face curtain ejection handle.

2.13.14 Shoulder Harness Snubber and Power Retraction Unit. The seat incorporates a shoulder harness snubber utilizing a velocity retention system, and a power retraction device. The snubbing unit prevents any forward shoulder movement whenever it is locked. When unlocked, the snubber automatically prevents rapid forward shoulder movement when the aircraft is subject to forces which tend to pitch the seat occupant forward, such as longitudinal crash forces or violent maneuvers. When forward motion of the seat occupant causes the harness straps to unwind faster than a safe predetermined rate of speed, the shoulder harness automatically locks. This feature is called the velocity retention system. The powered retraction device retracts the shoulder harness loop straps to position and locks the crewmember shoulder harness for ejection. The device is gas powered and can only be initiated by pulling the face curtain or lower ejection handles.

2.13.14.1 Shoulder Harness Lock Lever. The shoulder harness lock lever (Figure 2-9) has two positions: a forward or locked position and an aft or unlocked position. Selecting the locked position locks the shoulder harness. Selecting the unlocked position will not prevent the snubber from locking when the velocity retention system detects a high rate of velocity change of the crewmember in a forward direction. Once the shoulder harness is automatically locked, it must be manually unlocked by cycling the release handle full forward, then full aft. It is noteworthy that g forces on the aircraft by itself will not lock the snubber. On aircraft 155844aj and up and all others after ACC 217, the shoulder harness after being locked automatically can be unlocked by the crewmember relaxing tension on the harness, provided that the shoulder harness release handle is in the unlocked position.

2.13.15 Leg Restrainers. A leg restraint assembly on the seat holds the occupant's legs in place and prevents them from flailing during ejection. The leg restraint assembly consists of garters worn by the occupant, leg restraint lines with lockpins, snubber units, and shear fittings secured to the floor. Two garters on each restraint line are used. The calf garter is worn above the flight boot and the thigh garter is worn just above the knee. All four leg garters should be buckled on the inside of the legs. Each garter contains a quick release device which allows the garter to be released and left in the aircraft without disturbing garter adjustment. When routing the restraint lines through the garters, ensure that the lines are not twisted and route first through the calf garter then through the thigh garter before inserting the lockpins in the restraint lock-in mechanisms on the front of the seat pan (Figure 2-11). When the seat is ejected, the slack in the leg restraint lines is taken up by the upward travel of the seat, pulling the occupant's legs to the front face of the seat pan. When all slack has been removed, the tension on the lines will cause the shear fitting to separate. The occupant's legs are firmly held against the seat pan by the snubbing unit until the harness is released at seat separation. Leg restraint disengage rings (Figure 2-9) on the face of the seat pan are used to adjust the amount of slack in the leg restraint lines. This slack may be adjusted by the occupant by pulling out on the appropriate finger ring. This allows more restraint line to be pulled out to provide sufficient slack. To take in excess slack, the occupant need only reach under the seat bucket and pull in the excess restraint line through the snubber unit. A spring is contained in each of the lock-in mechanisms on the front of the seat pan. The spring ejects the lockpins whenever any of the following actions occur: the time release mechanism actuates, the emergency harness release handle is pulled, or the leg restraint manual release handle is moved to the unlocked position.

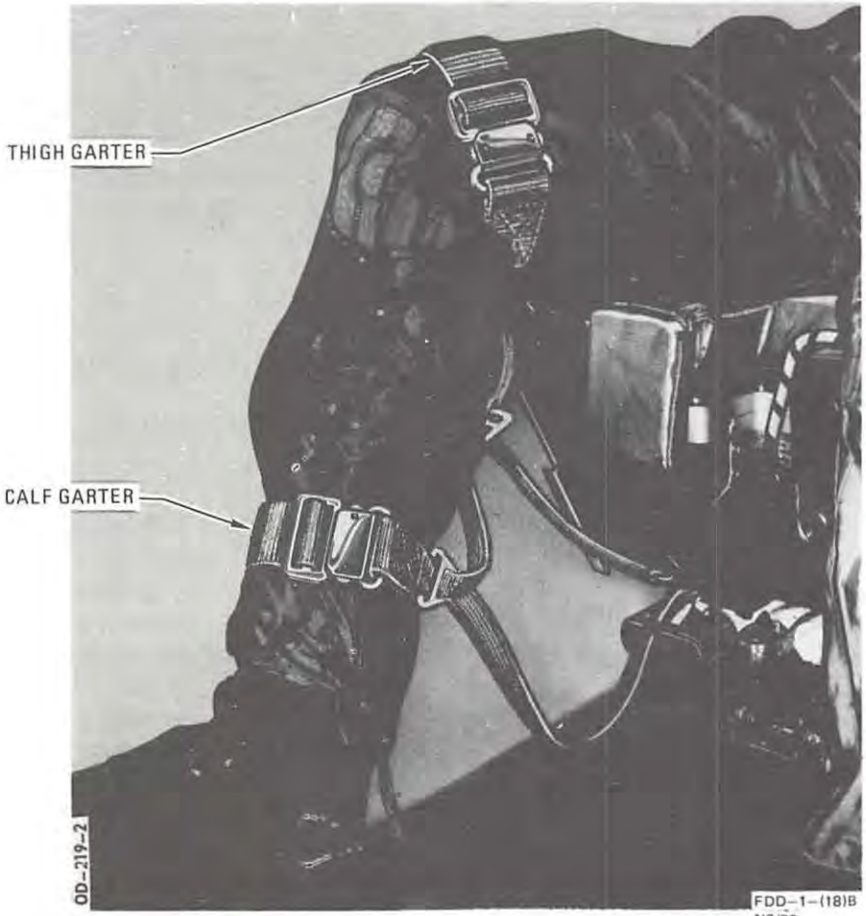


Figure 2-11. Leg Restrainers

2.13.15.1 Leg Restraint Manual Release Handle. The leg restraint manual release handle (Figure 2-9) is on the left forward side of the seat bucket. When the handle is moved to the aft (unlocked) position, the lockpins on the leg lines are released from the leg lock mechanism. This allows the occupant to thread the leg lines back through the garter, enabling him to leave the seat without removing the garters.

2.13.16 Guillotine Assembly. The guillotine (Figure 2-9) is a pyrotechnically operated device used to sever the personnel parachute withdrawal line during manual separation from the seat. When the emergency restraint release handle is pulled, the guillotine cartridge fires, gas pressure forces the guillotine blade upward, the withdrawal line is severed, and the personnel parachute is disconnected from the drogue chutes.

2.13.17 Integrated Harness. The integrated harness (Figure 2-12) is a vest-like garment or a series of web straps worn by the crewmember. The harness when used with the C/MBEU/615/PA integrated-type parachute takes the place of a lap belt and shoulder harness. Both of the harness configurations have four buckles for attaching the parachute of the crewmember. The lower two buckles when connected to the lap belt release fittings, which in turn is fastened to the seat, serve as the lap belt. The upper two buckles when connected to the parachute riser-shoulder harness canopy releases, which in turn is fastened to the locking reel assembly, serve as the shoulder harness. The integrated harness eliminates the need for the crewmember to wear his parachute to and from the aircraft, and it eliminates a separate lap belt and shoulder harness with its inherent limited restraint capabilities.

2.13.17.1 Parachute Harness Sensing-Release Units. This is a seawater-activated system that automatically releases the parachute from the crewmember. When the sensing-release units are immersed in seawater, cartridges are fired which allow the parachute risers to separate from the canopy releases.

2.13.18 Emergency Restraint Release Handle. The emergency restraint release handle (Figure 2-9) is located on the right side of the seat bucket. In landing emergencies, in ditching, and in the event of the drogue gun or automatic time release failing to function during an ejection, the occupant can release himself, his parachute, and his survival equipment kit from the seat by squeezing the trigger of the restraint release handle and pulling the handle up and aft. The initial 1 inch of travel of the handle fires the guillotine and severs the connecting line between the stabilizer drogue parachute and the personnel parachute. Once the connecting line is severed, the automatic parachute must be manually deployed. Continued travel of the handle up and aft causes the handle to lock in the open position and release the leg restraint lines, shoulder harness attach point, and lap belt attach points. The occupant is then held in the seat only by the sticker clips; it is necessary to push free of the sticker clips to release from the seat. When the emergency restraint release handle is actuated, it should be in a continuous motion to the full up and locked position. It is possible to partially rotate the handle and fire the guillotine and not release the leg lines, shoulder harness, or lap belt. The handle is spring loaded and returns to the down position, when released, unless locked in the fully up and aft position.

2.13.19 Survival Kit. A modified PK-2 survival kit is packed within a two-piece fiberglas container (Figure 2-13) which, in turn, is attached to the occupant by strap-harnessing. The content of the survival kit is the same as for the normal issue PK-2, but the packing arrangement has been changed to suit the requirements of the container. The kit contains as a minimum:

1. Pararaft with inflation bottle
2. Sleeve type sea anchor and lanyard
3. Water storage bags
4. Signal mirror
5. Bailing sponge
6. Fifty feet of nylon line
7. Two packs dye marker
8. Mk 13 Mod 0 day/night flare
9. Two cans of water
10. Can opener
11. General medical kit
12. General ration kit

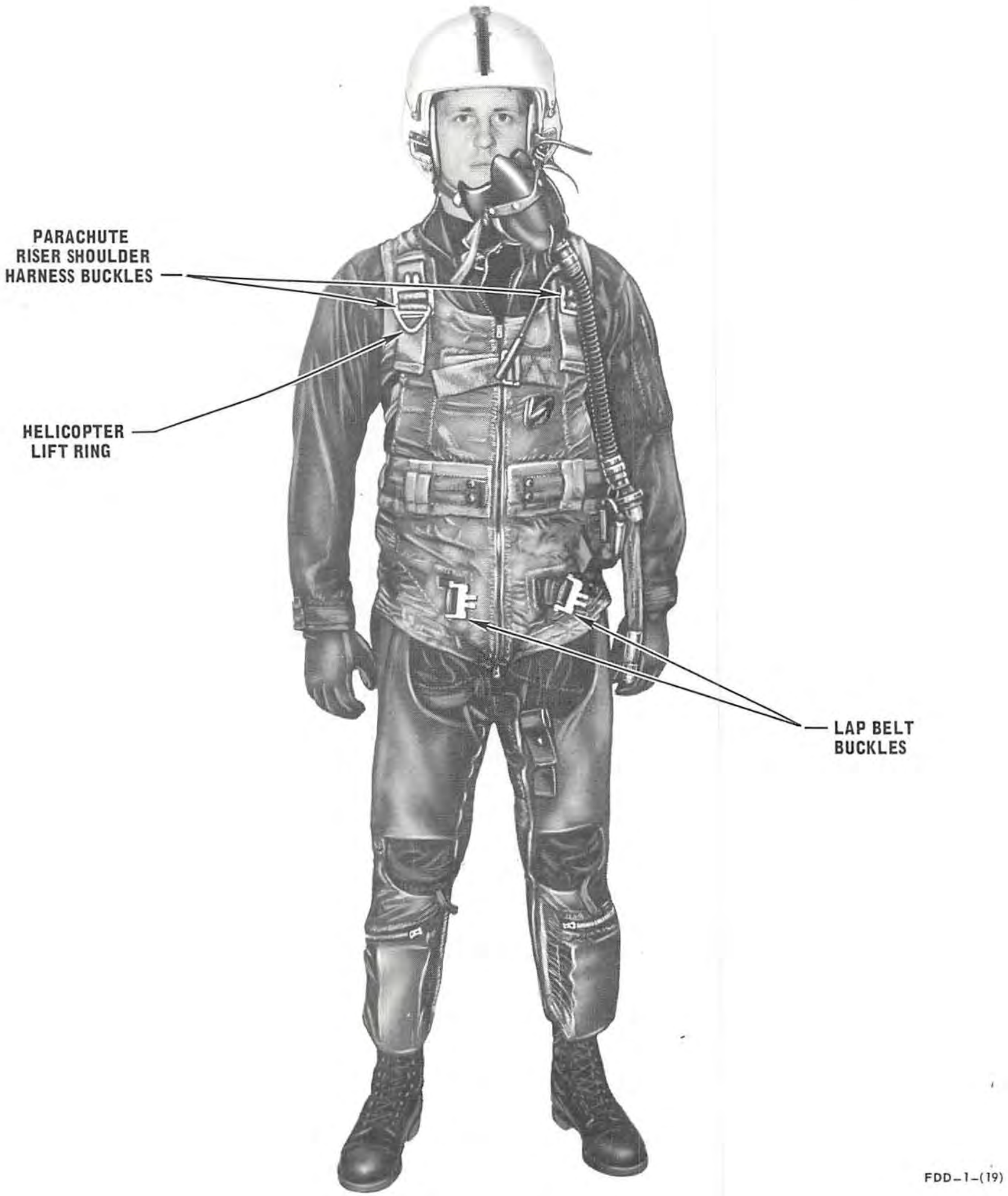


Figure 2-12. Integrated Harness

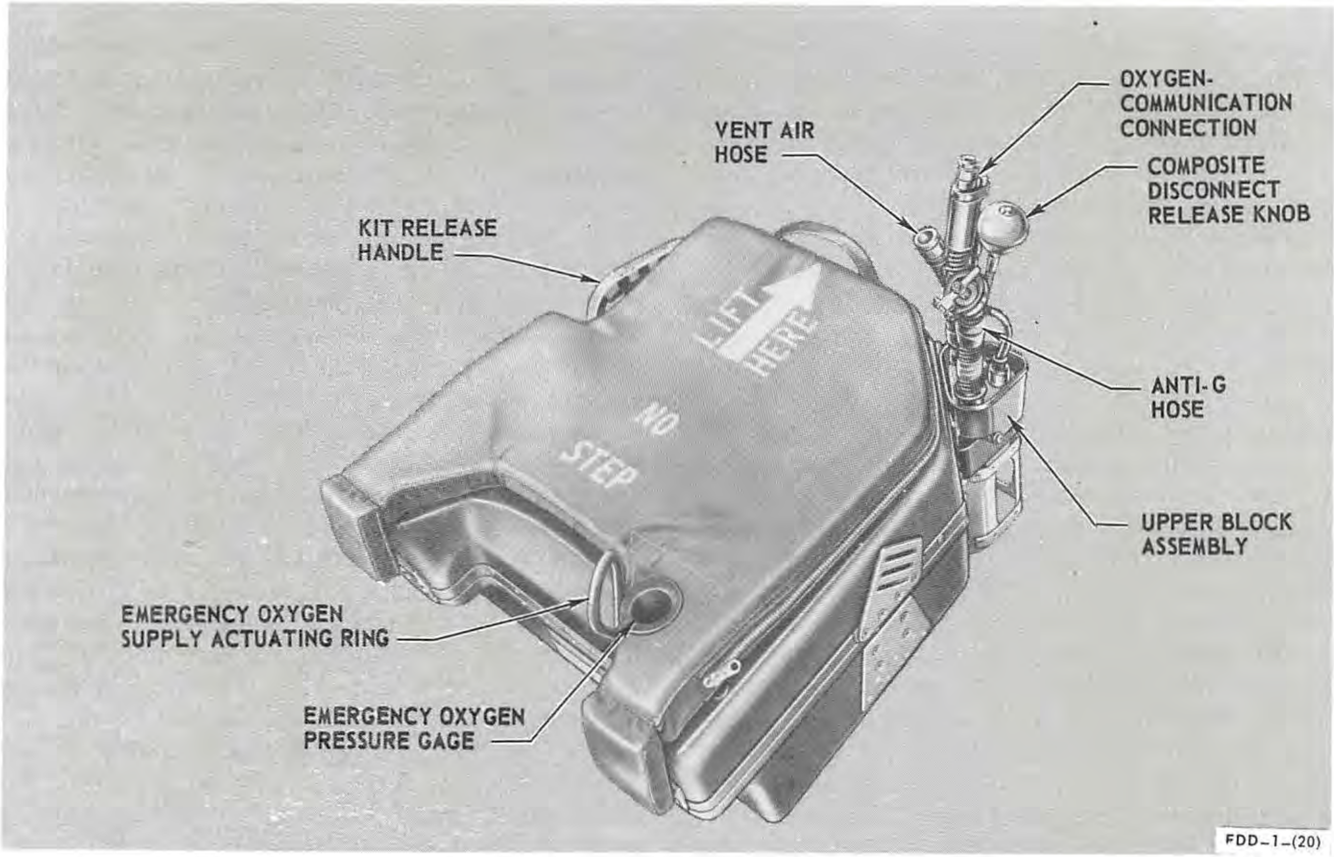


Figure 2-13. Survival Kit

13. Emergency code instruction sheets.

The emergency provisions included in the PK-2 survival kit are subjected to local option and may be altered at the discretion of the area commander. All items except the pararaft and its associated gear are packed in a zipper enclosed bag which is attached to the pararaft by a lanyard. Both the pararaft and bag are packed into the survival kit container and the pararaft is attached by a lanyard to the upper half of the container. The upper half of the container contains the emergency oxygen. A receptacle for the composite disconnect is located in the left rear corner of the survival kit container, and a kit release handle is on the right rear side of the survival kit container. Pulling up on the kit release handle unlocks the container which causes the lower half of the container and the liferaft to drop below the crewmember on a drop line. The dropping action initiates inflation of the liferaft. In the event of an ejection over water, the LPA should be inflated immediately. The liferaft should be inflated prior to entering the water since the kit release handle is accessible while still in the parachute harnessing and all survival equipment is secured to the crewmember. Should the crewmember enter the water before the survival kit release handle is pulled, the liferaft can only be inflated by pulling the release handle and then reaching into the opened kit and pulling the liferaft inflation bottle cable. The survival kit contains four negative g straps. These straps, located on each corner of the kit, prevent the kit from raising above the seat pan during negative g flight. The front straps are held in place by the leg restraint line lockpins. Care should be taken whenever the lockpins are removed from the leg restraint line leg lock-in mechanism to resecure the front negative g straps by rethreading the lockpin through the strap lugs.

2.13.20 Composite Disconnect. The composite disconnect is designed to connect aircraft oxygen, ventilating air, anti-g air, and communication lines to the crewmember. The composite disconnect assembly consists of a lower block, an intermediate block, and an upper block. The intermediate block is fastened to the upper part of the survival kit and contains the tie-in between the crewmember and the emergency oxygen supply. The disconnect is so designed that the crewmember, during normal aircraft entrance or departure, is capable of quickly attaching or detaching all hoses and electrical lines leading from the aircraft to the survival kit and man. The lower block contains check valves in the ventilating air, anti-g, and oxygen ports that are open when the three selections of the disconnect are plugged in and closed when either the upper or lower blocks are disconnected from the intermediate block. The check valves prevent gas leakage in the normal direction of flow when the valves are closed. The lower block is provided with a lanyard operated unlocking device, the free ends of the lanyard being attached to the aircraft structure. As the seat is ejected, tension in the lanyard unlocks the device and separates the lower block from the intermediate block. The intermediate block serves as the connecting link between upper and lower blocks and, in addition, by means of a tee in the oxygen line, connects the emergency oxygen to the system. The upper block provides the means for attaching all service lines corresponding to those leading to the lower block. This is accomplished by in-line connections between the crewmember and the upper block. It also contains a manual disconnect device that permits the crewmember to free himself from all kit connections during normal aircraft departure by a single pull on the normal composite disconnect release knob. This action unlocks the upper block from the intermediate block.

2.13.21 Normal Operation. Ejection from the aircraft is accomplished by propelling the seat from the aircraft with a pyrotechnically energized catapult gun, followed by the firing of the rocket pack on the bottom of the seat. Three ejection sequences may be selected. Dual ejection may be initiated from the forward cockpit and dual or single ejection may be initiated from the aft cockpit (Figure 2-10). A command selector valve is provided in the aft cockpit to select single or dual ejection. Ejection is initiated by pulling the face curtain or the lower ejection handle. Once an ejection handle is pulled, the sequencing system automatically fires the seat(s). Should the sequencing system malfunction, the automatic features of the system can be overridden, once the canopy is removed, by a continued pull on the ejection handle(s). Actuation of either handle fires an initiator which subsequently jettisons the canopy from the aircraft. When the canopy separates from the aircraft, the canopy interlock block which is attached to the canopy is pulled from the seat. Once the canopy is removed, the primary cartridge of the catapult gun is fired. Gas pressure generated by the cartridge causes the inner and intermediate tubes of the gun to extend upward. The upward travel of the inner tube actuates the top latch mechanism, which releases the seat from the aircraft. Continued movement of the inner tube propels the seat up the tracks. During upward travel of the seat, the sears of the drogue gun and time release mechanism are pulled by trip rods. Also during upward seat movement, the auxiliary cartridges are fired when they become exposed to the hot propellant gasses within the gun. Gas pressure generated by the auxiliary cartridges adds additional force to the gun during upward travel. Staggered firing of the catapult gun cartridges furnishes even pressure within the gun during the power stroke eliminating high acceleration forces during ejection. Separation of the inner tube from the gun occurs when the inner and intermediate tubes are fully extended in the outer tube. Upward seat travel after separation from the catapult gun continues by the momentum of the seat mass, and the rocket pack fires to propel the seat to a still greater height. Approximately 0.75 second after ejection, the drogue gun fires, deploying the controller drogue, which subsequently deploys the stabilizer drogue. The seat is stabilized and decelerated by the drogue chutes and the seat and occupant descend rapidly through the upper atmosphere. When an altitude of approximately 13,000 (±1,500) feet is reached, a barostat initiates the timing sequence of the time release mechanism which, after 2.25 seconds, actuates to release the occupant harnessing, leg restraint lines, and chute restraint straps. The drogue chute pulls the parachute link line and the parachute safety pin line to deploy the personnel parachute. The purpose of the safety pin is to secure the parachute from the premature opening because of windblast during descent prior to time release mechanism actuation. The occupant is held to the seat by sticker clips until the opening shock of the parachute snaps him out of the seat. If an ejection is made below 13,000 (±1,500) feet, the preceding sequence of events will occur approximately 2.25 seconds after the time release mechanism is tripped. The dual ejection sequence is initiated whenever the crewmember pulls either the face curtain handle or the lower ejection handle to fire the forward seat-mounted initiator. Gas pressure from the seat-mounted initiator is routed to the sequencing system stowing the aft cockpit equipment and operating the forward seat inertial reel, the aft seat inertial reel, aft canopy pressure-operated valve (jettisoning aft canopy and opening flooding doors), aft pressure-operated sequence actuator (ejecting aft seat), forward canopy pressure-operated valve (jettisoning forward canopy), and forward pressure-operated sequence actuator (ejecting forward seat), in that order. It is possible to save part of the 0.4-second sequence actuator delay time by maintaining a continuous pull on the ejection handle so that the catapult gun sear is pulled as soon as the canopy interlock block is removed.

2.13.21.1 Single Ejection From the Front Cockpit After Rear Cockpit Has Ejected Independently. Even though the rear cockpit has ejected independently, when the front seat occupant initiates the ejection sequence, the 0.75-second interlock delay is still present. This delay prevents collision between the front canopy and the rear seat in a sequenced ejection. When the ejection sequence is initiated by the crewmember, after a 0.75-second delay, gas pressure from the seat-mounted initiator is routed to the forward canopy pressure-operated valve (jettisoning the forward canopy), and then 0.4 second after canopy jettison, the forward pressure-operated sequence actuator operates to eject the forward seat. It is possible to save part of the 0.4-second sequence actuator delay time by maintaining a continuous pull on the ejection handle so that the catapult gun sear is pulled as soon as the canopy interlock block is removed. On F-4J 155903ap and up or after AFC 477 and all F-4S, the system is modified such that the 0.75-second delay will be bypassed after the rear cockpit has ejected independently. That is, if the rear cockpit has ejected, the front seat will eject approximately 0.4 second after a front ejection handle is pulled. However, in order for the 0.75-second delay to be completely bypassed, the rear ejection handle must be pulled at least 0.75 of a second before ejection is initiated from the front seat. If the front ejection handle is pulled sometime within 0.75 second of the rear handle, the delay will be reduced proportionally. That is, if the front seat initiates ejection 0.5 second after the rear seat, the 0.75-second delay is reduced to 0.25 second and the front seat then ejects approximately 0.65 second after the front ejection handle is pulled.

2.13.21.2 Dual Ejection Initiated From Rear Cockpit. The aft crewmember initiates a dual ejection by opening the command selector valve and pulling either the face curtain or lower handle to fire the seat-mounted initiator. Gas pressure generated by the initiator is routed to the sequencing system which operates the aft cockpit equipment stowage (before AFC 506), the aft seat inertial reel, aft canopy pressure-operated valve (jettisoning aft canopy and opening the flooding doors), aft pressure-operated sequence actuator (ejecting aft seat), forward canopy pressure-operated valve (jettisoning forward canopy), and forward pressure-operated sequence actuator (ejecting forward seat), in that order. It is possible to save part of the 0.3-second sequence actuator delay time by maintaining a continuous pull on the ejection handle so that the catapult gun sear is pulled as soon as the canopy interlock block is removed.

Note

> When opening the command selector valve, pull directly out on the valve handle without applying torque. The handle will rotate 90° clockwise through cam action. On F-4J after AFC 526 and all F-4S, the handle is turned by the application of torque only and there is no requirement to pull the handle.

2.13.21.3 Single Ejection Initiated From Rear Cockpit. Single ejection occurs when the aft cockpit crewmember pulls either the face curtain handle or lower ejection handle with the command selector valve in the normal (closed) position. Gas that is pressure-generated by the aft seat-mounted initiator is routed to the sequencing system which operates the aft seat inertia reel, the aft cockpit equipment stowage (before AFC 506), and the aft canopy pressure-operated valve (jettisoning the aft canopy and opening the flooding doors). An additional pull on the ejection handle then fires the seat catapult. On F-4J 155903ap and up or after AFC 482 and all F-4S, the sequencing system will fire the seat and there is no need for the additional pull on the ejection handle. However, the ejection handle may be still pulled to save part of the 0.3-second sequence actuator delay time so that the catapult gun sear is pulled as soon as the canopy interlock block is removed.

2.13.21.4 Ejection With Front/Both Canopies Missing. Should the front canopy or both canopies be lost, the front canopy interlock block will also be lost. If ejection is then initiated from the front seat, this could expose the rear crewman to the front seat rocket blast and, if conditions are right, a collision between seats could result. Should loss of the front canopy or both canopies occur, the rear crewman should be ordered to eject individually, allowing the front crewman to eject once the rear seat leaves, or have the rear crewman select command ejection by actuation of the command selector valve, and eject both seats by the automatic sequencing. The automatic sequence when initiated from the aft seat with the front canopy missing is not affected by the fact that the front interlock block is gone. With the loss of the rear canopy only, normal sequenced ejection can be initiated from either cockpit.

2.13.22 Ejection Handle Selection. Because of its greater accessibility and shorter travel when compared to the face curtain, the lower ejection handle should be used during situations requiring an expeditious ejection. Some of these situations are insufficient flying speed from catapult, ramp strike, parting of crossdeck pendants during carrier arrestment, low altitude, uncontrolled flight, and under high g during spin or air combat maneuvers.

2.13.23 Emergency Operation. There are no provisions for emergency operation of the ejection seats; however, if the ejection seats fail to eject, the crewmember can abandon the airplane by following the procedures outlined in Chapter 13.

2.13.24 Limitations. Assuming wings level and no aircraft sink rate, the ejection seats provide safe escape within the following parameters:

1. Ground level (zero altitude) – Zero airspeed (canopy must be closed).

2. Ground level and up – 400 KCAS maximum (based on human factors); 500 KCAS or Mach 0.92 maximum, whichever is less (based on seat limitations).

At airspeeds greater than 400 KCAS, appreciable forces are exerted on the body which makes escape more hazardous.

2.14 ELECTRICAL POWER SUPPLY SYSTEM

2.14.1 Description. The aircraft electrical power supply system consists of a primary ac electrical system powered by two ac generators, a secondary dc electrical power system composed of two dc transformer-rectifiers for conversion of ac power to dc, a power distribution (bus) system, an emergency power supply system, and a receptacle for plugging in external power. The generators supply ac power to the left main 115/200-vac bus, the left main 28-vac bus, the essential 115/200-vac bus, the essential 28-vac bus, the right main 115/200-vac bus, the right main 14-vac bus, and the right main 28-vac bus. The transformer-rectifiers convert 115/200-vac power to 28-vdc power, which is supplied to the essential 28-vdc bus, the right main 28-vdc bus, the left main 28-vdc bus, the armament 28-vdc bus, and the radar 28-vdc bus. Refer to FO-3 for the individual bus loading.

2.14.2 AC Electrical Power. The primary source of electrical power is derived from two 400-Hz, three-phase, 115/200-vac generators. The generators are engine driven and are rated at 30,000 volt-amperes. The generators are driven by constant speed drive (CSD) unit, which utilizes engine oil as a coolant and as the hydraulic media to regulate the generators at constant speed of 8,000 rpm. The CSD incorporates a mechanical shaft disconnect feature which disconnects the CSD unit from the engine when a malfunction occurs which causes an excessive temperature within the CSD unit housing. The right-engine generator supplies power to the right main 115/200-vac bus, and the right transformer-rectifier. The left-engine generator supplies power to the left main 115/200 vac bus, the essential 115/200-vac bus, the left essential transformer-rectifier, and, on F-4J 155844aj and up or after AFC 399 and all F-4S, the 115-vac ignition bus. Either generator is capable of supplying to the entire bus system through a bus tie relay contactor. The bus tie relay contactor is opened when both generators are operating and connected to their buses, resulting in split bus operation. Over/underexcitation and voltage protection is provided. Should any of these conditions occur, the system automatically detects it and removes the affected generator from its buses. The bus tie relay contractor then closes and the full bus load is assumed by the remaining generator. Each generator may be manually disconnected from the bus system by placing its generator control switch to OFF. Under maximum generator loads, a generator drops off the line at an engine rpm of approximately 53 percent. At less than maximum generator loads, a generator drops off the line at a lower engine rpm than for maximum generator loads. When a generator is disconnected from its buses by the generator control switch or the automatic fault protection circuits, the appropriate generator warning light, either L.H. GEN OUT or R.H. GEN OUT, illuminates. Operating checks consist of monitoring the above warning lights to determine if the generators are connected to the line. With both primary generators off the line or the left generator off the line with the bus tie contactor open, the emergency ac generator can be operated to supply power to the essential 115-vac bus, the ignition 115-vac bus (after AFC 399), the essential 28-vac bus, and the left transformer-rectifier. External power can be used to energize the ac buses in place of the engine-driven generator. The required power is three-phase, 40-cycle, 115/200-vac and is distributed to the bus system in the same manner as the generator output.

2.14.2.1 AC Power Distribution. The ac power distribution system consists of the following ac buses: right main 115/200-vac bus, essential 115/200-vac bus, left main 115/200-vac bus, and, on F-4J 155844aj and up or after AFC 399 and all F-4S, the 115-vac ignition bus. Auto transformers, powered by the right main 115/200-vac bus, the essential 115/200-vac bus, the essential 28-vac bus, and the left main 28-vac bus, and the left 115/200-vac bus, power the right main 28-vac bus, respectively. The right main 14-vac bus receives its power from the same auto-transformer as the right main 28-vac bus. See Figure FO-3. The circuit breakers protecting ac-powered equipment are located on the essential circuit breaker panel in the front cockpit and the No. 1 and No. 2 circuit breaker panels in the rear cockpit. See Figure FO-7 for circuit breaker location and Figure FO-3 for circuit breakers associated with each ac bus.

2.14.2.2 Emergency Generator. An emergency three-phase, 115/200-vac generator is provided as a source of electrical power in the event both generators go off the line or the left generator is off the line with the bus tie contactor open. The emergency generator is capable of supplying the essential ac and dc buses with 3,000 volt-amperes of electrical power. The generator is powered by a ram air turbine which is extended into the airstream pneumatically. When operating, the emergency generator energizes an ac relay which connects generator output to the essential 115/200-vac bus, the essential 28-vac bus, and the left transformer-rectifier which supplies power to the essential 28-vdc bus. The emergency generator ac relay will not become energized unless both engine-driven generators are off the line or the left generator is off the line with the bus tie contactor open. When operating with emergency power, the emergency generator does not deenergize until airspeed is reduced to approximately 90 KCAS. On F-4J 155844aj and up or after AFC 399 and all F-4S, operation of the emergency generator energizes the ignition bus relay to connect the 115-vac ignition bus directly to an output phase of the emergency generator. The ignition bus can be energized by the RAT without energizing the essential buses should the essential buses be overloaded, etc. To extend the ram air turbine, place the ram air turbine control handle to RAT OUT (push-down). If the engine-driven generators are restored, the emergency generator is automatically disconnected from the essential buses. The ram air turbine may then be retracted by placing the ram air turbine control handle to RAT IN (pull-up). Based on NATC tests, the emergency generator delivers fully rated power for a minimum continuous period of 3 hours.

2.14.3 DC Electrical Power. Two 100 ampere transformer-rectifiers receive 400-cycle, three-phase, 115/200-vac power and supply 28-vdc power. The right transformer-rectifier supplies power directly to the right main 28-vdc bus. The left transformer-rectifier supplies power directly to the essential 28-vdc bus and through an essential dc line relay to the left main 28-vdc bus. The output of both transformer-rectifiers is connected in parallel through a 60-ampere bus tie current limiter. If one of the transformer-rectifiers fails, the remaining transformer-rectifier supplies power to the entire dc bus system. The emergency ac generator will supply power through the left transformer-rectifier to the essential 28-vdc bus.

2.14.3.1 DC Power Distribution. The dc power distribution system consists of the following dc buses: left main 28-vdc bus, right main 28-vdc bus, essential 28-volt bus, armament 28-vdc bus, and radar 28-vdc bus. The left main 28-vdc bus is connected to the right main dc bus through a 60-ampere bus tie current limiter. The essential 28-vdc bus is connected to the left main 28-vdc bus through contacts of the essential dc line relay. The essential 28-vdc bus is connected to the left 28-vdc bus whenever the left generator is connected to the line. The essential 28-vdc bus becomes disconnected from the left main 28-vdc bus if the left generator fails and the bus tie relay remains open. The armament 28-vdc bus and the radar 28-vdc bus are connected to the tie between the right and left main 28-vdc buses. The armament 28-vdc bus is energized by closure of the armament safety switch in the landing gear control handle when the handle is moved to the UP position. The radar 28-vdc bus is energized by the missile power switch on the missile control panel being placed to the RADAR STBY or PWR ON position. The circuit breakers protecting dc-powered equipment in the front cockpit are on the left utility panel and the essential circuit breaker panel. Most of the aft cockpit circuit breakers are on circuit breaker panels No. 1 and No. 2. See Figure FO-7.

2.14.4 External Electrical Power Receptacle. To provide adequate power for ground operation of electrical equipment, an external power receptacle (Figure 1-1) is on the bottom of the left air duct. The external power required is three-phase, 400-cycle, 115/200-vac and it is distributed through the entire electrical system in the same manner as generator output (Figure FO-3).

2.14.5 Generator Control Switches. Two generator control switches, one for each generator, are on the generator control panel (Figure FO-1). The switches, labeled R GEN - ON, OFF, ON - EXT and L GEN - ON, OFF, ON - EXT, are utilized to select the source of electrical power for the aircraft bus system. With external electrical power applied and with both generator control switches in EXT ON, electrical power is supplied to the entire bus system. When either engine-driven generator is operating, its output may be connected to the entire bus system by placing its control switch to GEN ON.

Note

If either generator indicator light illuminates as a result of a temporary generator malfunction, the generator may be reset. To reset the generator, place the generator control switch to OFF and reposition it to GEN ON.

2.14.6 Circuit Breakers. Most of the circuits are protected by circuit breakers in the aft cockpit. The circuit breakers in essential circuits are on the left utility panel and a panel on the right console in the forward cockpit (Figure FO-1). The majority of the remaining circuit breakers are on panels in the rear cockpit (Figure FO-7).

2.14.7 Generator Indicator Lights. The LH GEN OUT and RH GEN OUT indicator lights and the BUS TIE OPEN light are on the generator control panel (Figure FO-1) in the front cockpit. One of the generator lights will illuminate anytime its generator is not on the line. The pilot may attempt to reset the generator by placing the generator switch to OFF and then placing it back to ON. If a double-generator failure occurs in aircraft 153071z through 155784ah prior to AFC 388 or AFC 535, both generator lights should be illuminated by dc control voltage generated from the permanent magnet generators contained within the ac generators. However, typical double-generator failure in aircraft 153071z through 155784ah prior to AFC 388 or AFC 535 is caused by loss of control voltage from the permanent magnet generators. The generator warning lights will not illuminate since the control voltage is utilized to illuminate the lights. Therefore, detection of double-generator failure without illumination of the generator warning lights must be determined by other means such as the appearance of OFF flags on the instrument panels and the sudden quiet caused by loss of electrical control power to the air-conditioning system. The generator warning lights cannot be restored by RAT power. On F-4J 155785ai and up or after AFC 388 or AFC 535 and all F-4S, double-generator failure because of permanent magnet generator control voltage failure is minimized, but the warning lights never illuminate unless the RAT is operating. As above, the double-generator failure is determined by the appearance of OFF flags and the quiet caused by shut down of the air-conditioning system. The warning lights will be restored on RAT power. Also, on F-4J 155785ai and up or after AFC 388 or AFC 535 and all F-4S, a left generator failure accompanied by a failure of the bus tie will not be noted by the illumination of the LH GEN OUT and BUS TIE OPEN lights if the pilot instrument light knob (flight instrument light knob on F-4J after AFC 536 and all F-4S) is OFF. Failure can be detected initially by noting the OFF flag appearing on the ADI, at which time the instrument lights should be turned on and the generator lights monitored for verification of the failure. If the pilot instrument lights are not in the OFF position when a right generator failure accompanied by a bus tie failure occurs, the RH GEN OUT and BUS TIE OPEN lights will not illuminate. The failure may be detected by loss of the front cockpit console floodlights if in the MED position, or loss of the rear cockpit floodlights if in the DIM position, or loss of the rear cockpit utility light. In this case, the failure is not obvious and may not be detected until attempting to land, at which time the APCS and indexer lights will be inoperative. Since a right generator failure accompanied by a bus tie failure is difficult to detect when using instrument lights, it is recommended that anytime instrument lighting is being used, the console floods should be in the MED position. The MED position of the console floods is powered by the right generator; therefore, the console floods can be used as a failure indicator. Warning lights power will be available at all times on the RAT, regardless of the position of the pilot instrument light knob (flight instrument light knob on F-4J after AFC 536 and all F-4S).

2.14.8 Essential DC Test Button. An essential dc test button and indicator light are on the right side of the rear cockpit (Figure FO-2). When the dc test button is depressed, the essential dc line relay is deenergized. Power will then be supplied to the essential dc test light by the left (essential) transformer-rectifier. If the indicator light illuminates, the left transformer-rectifier is receiving ac power and supplying dc power. If the indicator light does not illuminate, the left transformer-rectifier is either malfunctioning or not receiving ac power. With the dc test button depressed, the right transformer-rectifier can be checked by actuating the warning light test switch. If the warning lights illuminate, the right transformer-rectifier is operating properly.

2.14.9 Autopilot Ground Test Switch. With external power applied to the aircraft buses and the autopilot ground test switch in the NORM position, no electrical power is applied to the AFCS circuits. To apply power to the AFCS, the autopilot ground test switch must be placed to the TEST, solenoid held, position. The autopilot ground test switch, just aft of No. 2 circuit breaker panel (Figure FO-2), will remain in the TEST position with power applied to the autopilot until either external power is removed or the switch is manually placed to the NORM position. When either generator switch is placed to a position other than EXT, the autopilot ground test switch can no longer be used to remove power to the AFCS. The purpose of the switch is to prolong AFCS component life by removing power to the system while external power is applied to the aircraft for maintenance of other systems.

2.14.10 A-A/IFF Ground Test Switch. On F-4J 153071z, 153851ae, and 155529ag and up or after AFC 388 and all F-4S, an A-A/IFF ground test switch is installed just below the autopilot ground test switch in the rear cockpit. The manually actuated, electrically held switch permits ground operation of the AN/APX-76 interrogator set by by-passing circuitry provided to inhibit inadvertent ground operation. With external power on the aircraft and the switch in NORM, no power is applied to the AN/APX-76 circuits. To apply power, the switch must be placed to TEST, solenoid held, position. The switch will remain in TEST with power applied to the AN/APX-76 until either external power is removed or the switch is placed to NORM. When either generator switch is placed to a position other than EXT, the A-A/IFF ground test switch can no longer be used to remove power to the AN/APX-76.

2.14.11 Normal Operation. Normal operation of the electrical system commences when external power is applied to the aircraft and the generator switches are in EXT ON or when the engines are running and the generator control switches are in GEN ON.

2.14.12 Emergency Operation

2.14.12.1 Single-Generator Failure. Failure of one generator is indicated by illumination of either the LH or RH GEN OUT light. The light indicates which generator has failed. One generator in normal operation is sufficient to support the entire electrical demand or load. If generator failure occurs, cycle the affected generator control switch from ON to OFF, and back to ON. If the generator fault has been corrected, the generator is brought back on the line and the light goes out. If the light remains illuminated, monitor engine oil pressure and variable nozzle operation. If oil starvation is indicated, secure the affected engine if practicable. On aircraft 153088aa and up and all others after PPC 62, illumination of the applicable engine oil low warning light can be used as an indication of oil starvation.

CAUTION

- Upon illumination of a generator indicator light, immediately check the corresponding oil pressure gage. The generator failure could have been caused by oil starvation which will also affect the engine oil system.
- On aircraft 153088aa and up and all others after PPC 62, illumination of the applicable engine oil low warning light shall be used as an indication of oil starvation.

Note

Often the first indication of an engine failure will be the illumination of "MASTER CAUTION" and "GENERATOR OUT" lights. When these indications are noted, check engine rpm prior to proceeding to the generator failure portion of the checklist.

2.14.12.2 Double-Generator Failure. Although a double-generator failure is highly remote, the possibility of a double failure is still present. As previously stated, one generator out light will be illuminated when one of the generators fail. On aircraft 153071z through 155784ah prior to AFC 388 or AFC 535, when the other generator fails, both generator out lights should be illuminated by dc control voltage generated from the permanent magnet generators contained within the ac generators. However, typical double-generator failure in aircraft 153071z through 155784ah prior to AFC 388 or AFC 535 is caused by loss of control voltage from the permanent magnet generators. The generator warning lights will not illuminate since the control voltage is utilized to illuminate the lights. Therefore, detection of double-generator failure without illumination of the generator warning lights must be determined by other means such as the appearance of OFF flags on the instrument panels and the sudden quiet caused by loss of electrical control power to the air-conditioning system. The generator warning lights cannot be restored by RAT power. On F-4J 155785ai and up or after AFC 388 or AFC 535 and all F-4S, double-generator failure because of permanent magnet generator control voltage failure is minimized but the warning lights never illuminate unless the RAT is operating. As above, the double-generator failure is determined by the appearance of OFF flags and the quiet caused by shut down of the air-conditioning system. The warning lights will be restored on RAT power. Upon loss of both generators, extend the ram air turbine and turn off all electrical equipment not necessary to maintain flight. Attempt to return the generators to the line by cycling the generator controls switches to OFF, then back to ON. If the fault has been corrected, the generator lights will be extinguished. With the loss of all electrical power in flight, the emergency pneumatic system should be utilized to extend the landing gear. To preclude the loss of the utility hydraulic system, do not blow down the flaps unless a utility hydraulic system failure is indicated or a carrier landing is being anticipated. The utility hydraulic system gauge does not operate under RAT power.

Note

If the flaps had been lowered prior to electrical failure, air loads will return the flaps to a low drag position.

2.14.12.3 Bus Tie Open. Under normal conditions, both generators operate independently of each other with the bus tie relay open and without the BUS TIE OPEN light illuminated. But with certain electrical faults present in the system, it is possible to lose either of the generators while retaining the bus tie open. The result is a single generator operating to provide power to only part of the electrical buses with illumination of the BUS TIE OPEN light and either the LH GEN OUT light or the RH GEN OUT light. An important example of this kind of fault is the loss of the essential buses because of a short in the generator system. A short on one of the left generator buses will be noted by the illumination of the LH GEN OUT light followed in 2 seconds by the illumination of the BUS TIE OPEN light. All the buses powered by the left generator, including the essential buses, will be lost. An attempt shall be made to regain the left generator by placing the left generator control switch OFF and placing the switch back ON. If the left generator comes on the line, the short is no longer present and the generators will resume normal operation. Should the lost generator fail to be restored, cycle the right generator control switch in an attempt to close the bus tie. If none of these procedures succeed, the short is probably still present and the emergency generator must be used to restore the essential buses. Care, however, must be exercised after extending the RAT as the short might be on one of the essential buses. A short on one of the buses associated with the right generator is not of such a serious nature because the left main and essential buses will still be in operation. The same procedure shall be followed, however, to attempt to restore the lost generator and, failing that, to close the bus tie. On F-4J 155785ai and up or after AFC 388 or AFC 535 and all F-4S, a left generator failure accompanied by a failure of the bus tie will not be noted by the illumination of the LH GEN OUT and BUS TIE OPEN lights if the pilot instrument light knob (flight instrument light knob on F-4J after AFC 536 and all F-4S) is in the OFF position. Failure can be detected initially by noting the OFF flag appearing on the ADI, at which time the instrument lights should be turned on and the generator lights monitored for verification of the failure. If the pilot instrument light knob is not in the OFF position when a right generator failure accompanied by a bus tie failure occurs, the RH GEN OUT and BUS TIE OPEN lights will not illuminate. The failure may be detected by loss of the front cockpit console floodlights if in MED position, loss of the rear cockpit floodlights if in DIM position, or loss of the rear cockpit utility light. If the failure is not detected before attempting to land, the APCS and indexer lights will be inoperative. Since a right generator failure accompanied by a bus tie failure is difficult to detect when using instrument lights, it is recommended that anytime instrument lighting is being used, the console floods should be in the MED position. The MED position of the console floods is powered by the right generator; therefore the console floods can be used as a failure indicator. Warning lights power will be available at all times on the RAT regardless of the position of the pilot instrument light knob (flight instrument light knob on F-4J after AFC 536 and all F-4S). Refer to Chapter 13 for action to be taken upon illumination of the BUS TIE OPEN light.

2.14.12.4 Electrical Fire. Refer to Chapter 13.

2.14.13 Limitations. Based on NATC tests, the emergency generator delivers fully rated power for a minimum continuous period of 3 hours.

2.15 EMERGENCY EQUIPMENT

2.15.1 Description. The aircraft emergency equipment consists of a pneumatically extended and retracted ram air turbine, various jettison switches, and a comprehensive set of warning and indicator lights.

2.15.2 Ram Air Turbine. A ram air turbine in the upper left side of the center fuselage is provided as a power source for an emergency ac generator. The turbine assembly consists of a housing that contains two variable pitch turbine blades, a governing unit that controls the pitch of the blades, and the gearing to transfer blade rotation to a vertical driveshaft. The gearbox then drives the generator. When the ram air turbine is extended into the airstream, the turbine blades are at a maximum angle of attack. This results in a rapid acceleration of the turbine blades and governing unit. As the regulating speed of the governing unit is approached, the turbine blades decrease their angle of attack. Turbine blade angle of attack (as directed by the governing mechanism) then varies with respect to the velocity of the airstream in order to maintain a constant 12,000 rpm. In effect, the ram air turbine functions as a constant speed drive unit for the emergency generator, providing the airspeed is above approximately 180 knots. As the airspeed drops below approximately 180 knots, the velocity of the airstream across the turbine blades is not sufficient to maintain 12,000 rpm and, as a result, electrical power output will decrease in proportion to the decrease in rpm of the turbine. Electrical power output ceases at approximately 90 KCAS. Maximum airspeed for operation of the ram air turbine is 515 KCAS or Mach 1.1, whichever is less. Acceleration limits with RAT extended are -1.0 to +5.2g. Ram air turbine operating time shall be logged on the yellow sheet (OPNAV for 3760-2).

2.15.2.1 Ram Air Turbine Control Handle. The ram air turbine is extended and retracted pneumatically by a ram air turbine handle (Figure FO-1) in the forward cockpit. Air pressure for extension and retraction is taken from a 4.2-cubic inch air bottle (in reality, not a bottle but an enlarged air line) which is charged by the pneumatic system. If the pneumatic system loses pressure, the air line retains its pressure through the action of a check valve. However, after loss of pneumatic system pressure there is only enough charge left in the air line for a single actuation (extension or retraction). Pushing down on handle extends the turbine, pulling up on the handle retracts the turbine.

WARNING

Minimum RAT extension pressure is 1,000 psi. Therefore, to ensure RAT extension in the event of an air bottle check valve failure, the RAT should be extended whenever pneumatic pressure begins dropping and RAT utilization is anticipated.

Note

- During ram air turbine extension, it is normal for the FIRE and OVERHT lights to flicker until the RAT comes up to full speed. Disregard these lights unless they remain on after RAT has obtained full speed.

- Except for illumination resulting from RAT extension, illumination of the FIRE or OVERHT lights shall be logged on the yellow sheet (OPNAV form 3760-2).

2.15.3 Warning and Indicator Lights. Warning and indicator lights have been incorporated throughout the cockpits to reduce instrument surveillance to a minimum. The majority of the lights are in the front cockpit and most of them are grouped on the telelight panel.

2.15.3.1 Telelight Panels. Telelight panels on the front cockpit right vertical panel and the generator control panel (Figure FO-1) contain the telelight bars. When a condition exists that requires corrective action or is worthy of note, a telelight bar corresponding to the condition illuminates. Most of the lights on the telelight panels illuminate in conjunction with the MASTER CAUTION light. Indicator lights that do not illuminate in conjunction with the MASTER

CAUTION light are: SPEED BRAKE OUT, L EXT FUEL, CTR EXT FUEL, R EXT FUEL, and REFUEL READY. In addition, on F-4S aircraft, the FLAPS UP and SLATS MANUAL caution lights will not illuminate in conjunction with the MASTER CAUTION light. Electrical power to the telelights is supplied by the 28/14-vac warning light bus. The light(s) will be extinguished when the condition that causes the light(s) to illuminate is corrected. Amplification of conditions that exist upon illumination of a telelight, and its corrective action can be found in Figure 12-15.

2.15.3.2 Master Caution Light. A MASTER CAUTION light operates in conjunction with lights on the telelight panel. It is only necessary to monitor the MASTER CAUTION light for an indication of a condition requiring attention and then referring to the telelight panel for the specific condition. The MASTER CAUTION light may be extinguished by depressing the master caution reset button located on the generator control panel. The illuminated lights on the telelight panel will not be extinguished by the master caution reset button, with the exception of the AUTO PILOT DISENGAGE light and the APCS OFF light, until their respective faults have been cleared. After the MASTER CAUTION light is cleared and an additional condition exists that requires attention, the MASTER CAUTION light will again illuminate except when initial illumination is caused by a hydraulic system failure and the subsequent failure is also a hydraulic system failure.

CAUTION

When the MASTER CAUTION light illuminates with no other indications, activate the warning lights test switch to check for a burned out bulb in the telelight panel.

2.15.3.3 Warning Light Test and Dimmer Circuit. The warning light test and dimmer circuit provides a means of testing the operation of the bulbs in the warning and indicator lights. All warning and indicator lights are included in the test and dimmer circuit which is powered by the warning lights 28/14-vac bus. The circuit does not provide an operational check of any warning or indicator system, it checks only the light bulbs. The warning and indicator lights may be illuminated by actuating the warning light test switches on the interior light control panels.

2.15.3.4 External Store Emergency Release Button. The external store emergency release button (Figure FO-1) is on the left vertical panel. This button when depressed will jettison all external stores (including missiles and pylons) provided the gear handle is up or the main gear struts are extended. On F-4J 158355at and up or after AFC 506 and all F-4S, the jettison select switch limits the external stores jettisoned by the external store emergency release button.

2.15.3.5 Jettison Select Switch. On F-4J 158355at and up or after AFC 506 and all F-4S, the jettison select switch (Figure FO-1) is on the air-to-air panel in the front cockpit. The switch is used to limit the stores jettisoned by the external store emergency release button. Generally, the switch can be used to retain all air-to-air missiles (Sidewinders and Sparrows) and, if required, all air-to-air missiles and whatever store is on the centerline station (fuel tank, etc.), while jettisoning the remaining external stores by depressing the external store emergency release button (refer to Figure 12-16). The jettison select switch has three positions: ALL, AIR-GRD, and AIR-GRD + CL. In ALL, the external store emergency release button jettisons all external stores. In AIR-GRD + CL, all external stores are jettisoned except the air-to-air missiles and also various armament attachments when carried in combination with air-to-air missiles on the inboard wing stations as listed below. In AIR-GRD, all external stores are jettisoned except air-to-air missiles and whichever store is carried on the centerline station and also various armament attachments when carried in combination with air-to-air missiles on the inboard wing stations as listed below. With any combination of air-to-air missile(s) and other stores on the inboard wing stations (Sparrow on station 2 and TER on 8, Sidewinders and TER carried simultaneously on stations 2 and 8, etc.) and either AIR-GRD or AIR-GRD + CL selected on the jettison select switch, the inboard pylons regardless of whether they carry an air-to-air missile will not be jettisoned when the external store emergency release button is depressed. However, if TER are carried on either or both inboard wing stations, the stores carried on the TER stations will automatically be bombed off unarmed, although the TER is retained on the pylon.

2.16 ENGINES

2.16.1 Description. The aircraft is powered by two General Electric J79 engines. F-4J 153071z through 153087aa have J79-GE-8 engines installed with a thrust rating of 10,900 pounds each. Afterburner operation increases the maximum thrust to 17,000 pounds. F-4J 153088aa and up before PPC 162 have J79-GE-10 engines installed with a thrust rating 11,870 pounds each. Afterburner operation increases the maximum thrust to 17,900 pounds each. F-4J after PPC 162 and all F-4S have J79-GE-10B engines installed with a thrust rating of approximately 11,810 pounds each. Afterburner operation increases the maximum thrust to approximately 17,820 pounds each. The engine uses a variable stator (fist six stages), a 17-stage compressor, 10 annular combustion chambers, a three-stage turbine, a variable area exhaust nozzle, and a variable thrust afterburner. An impingement-type starter, supplied with air from an external auxiliary power unit, is used to crank the engine during staring. During operation, air enters the inlet of the engine and is directed into the compressor rotor by the variable inlet guide vanes. As it is compressed, the air is forced through the compressor rear frame into the combustion chambers. Fuel nozzles, projecting into the combustion chambers, eject a fuel spray which mixes with the compressed air. Ignition is provided by a spark plug in the No. 4 combustion chamber; the remaining nine combustion chambers are ignited through crossfire tubes. The gases resulting from combustion are directed onto the turbine. The three turbine wheels move as a unit on a common shaft which is directly splined to the compressor rotor. After passing through the turbine section, the exhaust gases flow into the afterburner where their flow is stabilized and the ejected through the variable exhaust nozzles. Additional fuel may be injected into hot exhaust gauges for afterburner combustion, producing considerable thrust augmentation. The engine oil system is a dry sump type completely contained on the engine. The compressor inlet guide vanes and the stators in the first six compressor states are variable and are controlled by the variable stator system. The variable stators and inlet guide vanes are interconnected externally and are positioned by two actuators which utilize high pressure engine fuel as the hydraulic medium. The variable nozzle system is hydromechanically controlled and schedules nozzle area by positioning the nozzle opening to obtain optimum thrust with respect to altitude and airspeed conditions. The purpose of the variable exhaust nozzles is to control the operating temperature of the engine as governed by the engine amplifier during military and maximum engine operation. Air bled from the 17th stage of each engine compressor is used by the auxiliary equipment cooling system, the boundary layer control system, the central air data computer system, the cockpit air-conditioning and pressurization system, the engine anti-icing system, the fuel tank pressurization system, the pneumatic system (air source), and the windshield rain removal system.

2.16.2 Engine Fuel Control System. The fuel control system (Figure FO-4) for each engine is complete in itself and the two systems are identical. For simplicity of discussion, only one system or engine shall be discussed. The engine fuel control system transports fuel from the engine fuel inlet to the combustion chambers. This fuel is discharged in the proper state of atomization for complete burning. Varying engine power settings and conditions demand changes in fuelflow; therefore, the engine fuel control system must also control fuelflow to obtain maximum engine efficiency within the design limits of the engine. Only the engine fuel system is discussed in the following paragraphs. The afterburner fuel system is discussed separately in this chapter.

2.16.2.1 Fuel Pump Unit. The engine fuel pump unit consists of a low-pressure impeller-type pumping element, a high-pressure gear-type main pumping element, a low-pressure fuel filter, a fuel filter bypass, and an output pressure relief valve. The centrifugal impeller performs a pressure boost function which assures pump operation at low inlet fuel pressures. Aircraft boosted fuel from the main fuel manifold passes through the impeller-pump. The impeller boosted fuel then passes through the fuel filter to the main gear-pump which delivers it to the main engine fuel control at approximately 1,000 psi. If the pressure differential across the fuel filter becomes excessive (indicating contamination), the CHECK FUEL FILTERS light will illuminate. At a slightly higher pressure differential, the fuel filter bypass will open. If the discharge pressure of the gearpump exceeds approximately 1,125 psi, the output pressure relief valve will open to maintain safe fuel pressures. The output pressure relief valve will reseat when discharge pressures reduce to approximately 1,025 psi.

2.16.2.2 Engine Fuel Control. The main engine fuel control governs engine speed by controlling fuelflow. Fuel is delivered to the fuel control under pressure by the main fuel pump. The fuel enters the control at the main inlet or the servo inlet. Fuel entering the servo inlet will be used for operation of the variable vanes and power lever control. Fuel entering at the main inlet will be divided into excess or metered fuel. Excess fuel is returned to the main fuel pump, metered fuel is directed to the fuel nozzles.

The main fuel control uses 5 signal inputs for operation: throttle positions, engine speed, compressor inlet air temperature, compressor discharge air pressure, and position of the variable vanes.

2.16.2.3 Fuel Oil Heat Exchanger. Metered fuel from the main fuel control passes through the coolant tubes of the fuel-oil heat exchanger and then to the fuel nozzles. The fuel serves as the coolant for the scavenge oil which flows around the heat exchanger tubes. The heat exchanger incorporates a bypass valve to regulate the flow of oil which controls the temperature of the oil and fuel. There are two fuel-oil heat exchangers on the engine; one utilizes normal engine fuel as a coolant while the other uses core afterburner fuel. Both fuel-oil heat exchangers serve the same purpose and their operation is the same.

2.16.2.4 Fuel Pressurization and Drain Valve. The fuel pressurization and drain valve prevents fuel flow to the engine until sufficient fuel pressure is attained in the main fuel control to operate the servo assemblies, which are used to compute the fuel flow schedules. It also drains the fuel manifold at engine shutdown to prevent postshutdown fires, but keeps the upstream portion of the system primed to permit faster starts. On the J79-GE-8 engines when the fuel pressure differential across the pressurization valves drops below 80 psi, the pressurization valve closes, cutting off fuel flow to the engine and the drain valve opens to drain the fuel manifold. On the J79-GE-10 engines when the fuel pressure differential across the pressurization valve drops below 90 psi, the pressurization valve closes, cutting off fuel flow to the engine and the drain valves open to drain the fuel manifold.

2.16.2.5 Fuel Nozzles. A flow-divider type fuel nozzle in each inner combustion chamber liner delivers metered fuel in the proper state of atomization for maximum burning into the compressor discharge air entering the combustion chamber. The nozzles produce a uniformly distributed, cone-shaped, hollow fuel spray. High velocity compressor air is directed around the nozzle by an air shroud to provide a cooling action around the nozzle orifice and to reduce carbon deposits.

2.16.2.6 Check Fuel Filter Indicator Light. The CHECK FUEL FILTERS indicator light is on the telelight panel. The CHECK FUEL FILTERS indicator light and MASTER CAUTION light illuminate when the fuel filter on either engine is being bypassed. The light circuit is completed through a pressure differential switch which senses filter inlet and filter outlet pressure. In the case of a partially clogged fuel filter, the CHECK FUEL FILTERS indicator light may be extinguished by reducing power on both engines. Check each engine individually by adding power to see if the light illuminates. In this manner, it can be determined if one or both engines are affected.

2.16.3 Oil System. Each engine is equipped with a completely self-contained, dry sump, full pressure oil system. Oil is stored in a 5.3 gallon pressurized reservoir located at the 1:00 o'clock position on the engine compressor front casing. The oil pump is a positive displacement, dual element, rotary vane-type unit (Figure 2-14). The lubrication element is capable of delivering 11.8 gpm at 60 psi. Each element contains a filter through which the oil is pumped before distribution. Engine oil is used for engine lubrication, variable exhaust nozzle operation, generator lubrication and cooling, and constant speed drive unit control. After distribution to various points throughout the engine the oil is picked up by three scavenge pumps, routed through a scavenge filter, through an air/oil cooler and two fuel/oil heat exchangers, and then back to the tank. The pressurizing system maintains the proper relationship between ambient air pressure and air pressure in the bearing sumps, gearboxes, damper bearing, and reservoir to ensure effective oil seal operation and to prevent damage to the reservoir and sumps during high speed climbs and descents. Oil is also supplied directly from the reservoir to the constant speed drive unit where it is used as both the control and final drive medium for controlling generator speed.

2.16.3.1 Oil Quantity Indicator Lights. A two-point oil level indicating system is provided to indicate servicing and operation level. A L ENG OIL LOW and R ENG OIL LOW light is on the telelight panel and illuminates when a low-level condition exists in either or both engine oil tanks. A detector in the right missile well detects a low-level condition and provides a signal to illuminate the appropriate indicator light. There is an oil quantity sensor switch on the utility panel on the left console. During flight with the switch in the NORM position, the indicator light will illuminate when the oil quantity drops to 3.1 (±0.1) gallons. During ground checking operations with the switch in the SERV CHK position, the indicator will illuminate if the oil level in either or both tanks is 4.6 (±0.1) gallons or less (provided the aircraft is in a level ground attitude, external electrical

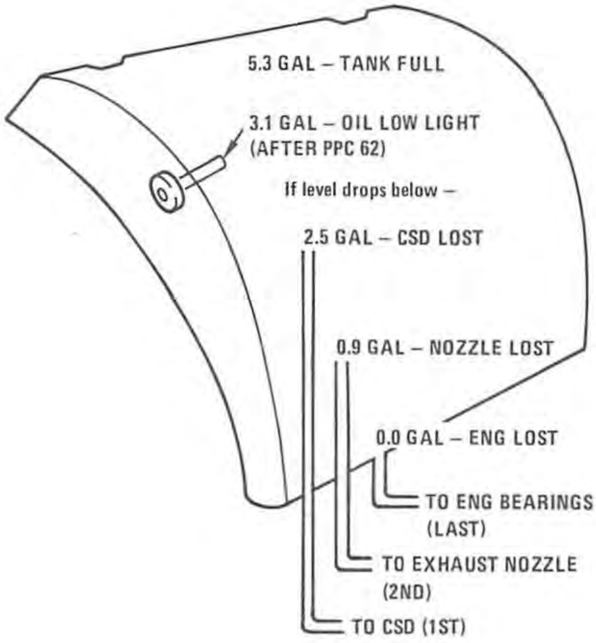


Figure 2-14. Engine Oil Tank

power is applied, both engines are off, and the check is performed within 20 minutes of engine shutdown). If more than 20 minutes have elapsed since engine shutdown, the engines may be windmilled to scavenge the oil system prior to making the ground check.

Note

On F-4J with J-79-GE-8 engines installed and before PPC 62, the indicating lights are installed; however, the oil level sensors are not installed in the engine oil tank. On these aircraft, the system will be inoperative; however, the indicating lights may flicker when the warning lights test switch is actuated.

2.16.3.2 Lubrication. The lubrication element of the oil pump supplies oil to cool and lubricate bearings, gears and other rubbing or moving parts in the engine. Lubricating oil is also circulated through the engine-driven generator for cooling purposes. Oil is drawn from the lowest standpipe in the reservoir by the constant displacement, rotary vane-type lubrication element of the oil pump, which is capable of delivering 11.8 gpm at 60 psi. By supplying the lubrication element from the lowest standpipe, oil will be available for lubrication should leakage occur in the nozzle control or constant speed drive unit.

Lubricating oil is routed from the lubricating element through the filter to three branch lines. The first branch distributes oil forward to the transfer gearbox, intermediate damper bearing, No. 1 bearing, front gearbox, and the afterburner fuel pump. The second branch distributes to the Nos. 2 and 3 bearings and the rear gearbox. The third branch distributes to the pressure transmitter and the pressure relief valve. The pressure relief valve protects the system and is set to relieve at approximately 95 psi. The oil is picked up from the bearing sumps by the scavenge pumps, which pumps the oil through the scavenge filter, the air/oil cooler, the two fuel/oil heat exchangers and returns it to the tank. Oil temperature is maintained by temperature regulators on the two fuel/oil heat exchangers. A check valve located in the lubrication element outlet prevents gravity flow of oil from the oil tank when the engine is not running.

2.16.3.3 Variable Nozzle Control. Engine oil is used as the hydraulic medium for positioning the variable nozzle flaps. During normal flight attitudes, oil flows through a gravity valve and into an accumulation compartment in the reservoir. During inverted flight, the gravity valve closes and oil for nozzle positioning is available for approximately 30 seconds. From this compartment, oil is drawn through a weighted, flexible standpipe which stays submerged regardless of flight attitude to the hydraulic element of the oil pump. This element is of the rotary vane type and is capable of delivering 4.1 gpm at 70 to 110 psi. A relief valve in the pump protects the system by opening at approximately 70 psi. Oil is routed from the pump through the hydraulic element filter to the nozzle pump. From here, it may return directly to the scavenge system or be boosted and directed to the nozzle actuators on command from the nozzle area control. From the actuators, oil is routed back to the nozzle pump and into the scavenge system. The scavenge system is the same as described previously.

2.16.4 Engine Air Induction System. There are two independent but identical air induction systems, one for each engine. The component units are fixed and variable ramps, which make up the primary air system, a variable bypass bellmouth, and an auxiliary air door which make up the secondary air system.

2.16.4.1 Variable Duct Ramp. The variable duck ramp system provides primary air at optimum subsonic airflow to the compressor face throughout the range of aircraft speeds. The ramp assembly consists of a fixed forward ramp and two variable ramps. The forward variable ramp is perforated to allow boundary layer air to be bled off and exhausted overboard. The aft variable ramp is solid. Movement of the aft ramp positions the forward variable ramp through mechanical linkage. The central air data computer supplies a total temperature input to the ramp control amplifier. The amplifier sends a signal to a utility hydraulic system servo unit which positions the ramps for optimum airflow at Mach numbers of 1.5 and above. The system has a fixed forward ramp angle of 10° and a variable ramp angle of 0° to 14° relative to the fixed forward ramp.

2.16.4.2 Engine Inlet Temperature High Indicator Light. The engine inlet temperature high indicator light marked ENG INLET TEMP HIGH is on the telelight panel (Figure FO-1). The light illuminates when the temperature within the engine intake duct (compressor inlet) is beyond allowable limits for steady state engine operation. The maximum steady state operation of the engine is limited to 121 °C (250 °F) compressor inlet temperature. Operating the engine at high altitudes with the compressor inlet temperature above the prescribed limit causes the life of the gears, bearings, and carbon seals to be reduced because the lubricating oil will exceed its design temperature. Exceeding the temperature will also cause structural components of the engine (compressor rear frame and combustion casings) to exceed their design limit because of high temperatures and pressures. The light is controlled by a cam-operated switch in the CADC which receives total temperature sensor input. Although the total temperature sensor is not located in an intake, the total temperature at the sensor and the intake is the same, thus providing an accurate indication of compressor inlet temperature. Temperature sensed by the total temperature sensor is the combined effect of outside air temperature and compressibility effect. As temperature rise because of compressibility is negligible subsonically, an illuminated light during subsonic flight is probably due to a failure in the sensor or CADC; therefore, subsonic flight with the light illuminated is permitted. Supersonic flight below 30,000 feet with the light illuminated is prohibited. With an ENG INLET TEMP HIGH light illuminated in flight, the possibility exists that the ramps may have extended to the full open position because of a total temperature sensor failure.

2.16.4.3 Variable Bypass Bellmouth. The variable bypass bellmouth is an automatic unit which allows excess induction air from the compressor face to flow into the engine compartment. Air diverted in this fashion is referred to as the Secondary Air System. The variable bellmouth is a perforated ring located between the aircraft duct structure and the engine compressor inlet. Between 0.4 to 0.98 Mach the bellmouth is closed; however, a limited amount of bypass air flows into the engine compartment through the perforations in the bypass bellmouth and the engine air-oil cooler bleed. On F-4J 155785al and up or after AFC 420 and all F-4S, the bellmouth is also closed below 225 KCAS. Above 0.98 Mach, the bypass bellmouth controller senses the optimum airflow (based on duct air velocity) for induction into the engine. When this airflow is exceeded (rapid throttle retardation), the controller signals a utility system hydraulic actuator which opens the bypass until the optimum airflow to the engine is established.

2.16.4.4 Auxiliary Air Doors. Two auxiliary air doors, one for each engine compartment, are on the center underside of the fuselage. They are normally controlled by the landing gear handle and actuated open or closed by utility hydraulic pressure. When the landing gear handle is placed in the down position, the doors open, making additional air available to the engine compartments for cooling purposes. When the landing gear handle is placed in the up position, the doors close. If the engine compartment pressures exceed the designed limits, the door will be forced open by an amount proportional to the overpressure. As soon as the overpressure is relieved, the actuator pulls the door closed.

CAUTION

In the event either auxiliary air door indicator light illuminates (other than momentary), corrective action should be taken as soon as possible. Refer to paragraph 12.3.1, AUXILIARY AIR DOOR MALFUNCTION.

2.16.4.5 Auxiliary Air Door Indicator Lights. The auxiliary air door indicator lights on the telelight panel (Figure FO-1) are marked L AUX AIR DOOR and R AUX AIR DOOR, respectively. The lights illuminate if the auxiliary air doors operate out of phase with the landing gear handle or momentarily when engine compartment overpressures are relieved. Illumination of the auxiliary air door indicator lights causes the MASTER CAUTION light to illuminate. Refer to Chapter 12 for operating instructions during auxiliary air door malfunction.

2.16.5 Variable Area Exhaust Nozzle System. Two sets of cylindrical nozzles, operating together, make up the variable area exhaust nozzle system. The primary nozzle, hinged to the aft end of the tailpipe, controls the convergent portion of the nozzle, while the secondary nozzle, hinged to a support ring, controls the divergent portion of the nozzle. The two sets of nozzles are linked together and maintain a scheduled area and spacing ratio which is infinitely variable between full open and full closed. The nozzles are regulated by the nozzle area control. Movement of the nozzles is accomplished automatically by four synchronized hydraulic actuators. The exhaust gases leave the primary flaps at sonic velocity and are accelerated to supersonic velocity by the controlled expansion of the gases. Control of this expansion is provided by the cushioning effect of the secondary airflow through the annular passage between the two sets of nozzles.

2.16.5.1 Exhaust Nozzle Control Unit. Throttle position, nozzle position feedback, and exhaust gas temperature are the parameters utilized to schedule the correct nozzle area. During engine operation in the submilitary region, nozzle area is primarily a function of throttle angle and nozzle position feedback. The nozzle is scheduled full open at idle and the area is decreased as the throttle is advanced toward the military position. However, during a rapid throttle burst from below 79-percent rpm to 98-percent rpm, a control alternator supplies engine speed information to the temperature amplifier which in turn schedules engine off speed inputs as a function of temperature limiting. This signal prevents the primary nozzle from closing down past a preset position, permitting a rapid increase in engine rpm. During engine operation in the military and afterburner region, it becomes necessary to limit the nozzle schedule as established by throttle angle and nozzle feedback to prohibit exhaust gas temperature from exceeding the design limits. Exhaust gas temperature is sensed by 12 thermocouples loops and the resulting millivoltage is transmitted to the magnetic temperature amplifier. The amplifier which receives its power supply from the control alternator, compares the thermocouple signal to a preset reference voltage, representing desired engine temperature. The difference is amplified and transmitted to the nozzle area control. Nozzle area control output signal directs the operation of the variable pressure, variable displacement nozzle pump.

Note

> Spasmodic exhaust nozzle operation shall be logged on the yellow sheet (OPNAV form 3760-2).

2.16.6 Afterburner System. The engine is equipped with an afterburner that can inject additional fuel into the hot exhaust gases for afterburner combustion, producing considerable thrust augmentation. The main components of the afterburner system are the afterburner fuel pump, afterburner fuel control, afterburner fuel manifold and spray bars, and the torch igniter.

2.16.6.1 Afterburner Fuel System. The afterburner fuel system (Figure FO-4) provides the fuel for augmentation of the thrust produced by the engine. A separate, constant pressure drop, variable fuel control meters afterburner fuel. Ignition is by a separate AB ignition system. In operation, the aircraft boost pumps supply fuel to the inlet of the afterburner fuel pump. The inlet valve is opened by a fuel pressure signal from the main fuel control when engine speed is above approximately 91-percent rpm. On the J79-GE-8 engines, the throttle angle is 76.5° On the J79-GE-10 engines, the throttle angle is 78° (in minimum afterburner range). Fuel passing through the check valve continues to the afterburner fuel control, is metered, separated into core and annulus flows, and directed to the afterburner pressurizing valve. The core fuel passes through the afterburner fuel oil heat exchanger on the way to the control and pressurizing valve. The core and annulus flows are further subdivided into primary and secondary flows by the pressurizing valve. The flow sequence, as the throttle is advanced in the afterburner range, is to the primary core, secondary core, primary annulus and secondary annulus.

2.16.6.2 Afterburner Fuel Pump. The afterburner fuel pump is an engine-driven centrifugal pump. It operates continuously, but discharges fuel to the afterburner fuel system only when the inlet valve on the pump is open. To open the inlet valve to the afterburner fuel pump, the pilot must move the throttle into the afterburner modulation range and engine speed must be sufficiently high (above 91-percent rpm) to support combustion.

2.16.6.3 Afterburner Fuel Control. The afterburner fuel control is linked mechanically to the main fuel control through the use of teleflex cabling. Any movement of the throttle moves the main fuel control teleflex and also moves the teleflex to the afterburner fuel control. Fuel entering the afterburner fuel control is metered and separated into core and annulus flows in response to throttle movement and changes in compressor discharge pressure. The control varies fuelflow between the minimum necessary for afterburner combustion for any flight condition and the maximum fuel flow allowable at the flight condition. The afterburner fuel control is designed to hold a constant pressure drop across an orifice while the area of that orifice is varied in accordance with throttle position and compressor discharge pressure.

2.16.6.4 Afterburner Fuel Distribution. The afterburner fuel pressuring valve delivers fuel to four separate fuel manifolds: primary annulus, primary core, secondary annulus, and secondary core. The fuel is distributed by these manifold to 21 multijet afterburner fuel nozzles which are equally spaced around the perimeter of the afterburner section. Each multijet nozzle contains four tubes, one for each manifold, and holes in the sides of the tubes spray the fuel into the exhaust gases. When the throttle is first placed into the afterburner position, the pressurizing valve directs fuel to the primary core manifold. Further advancement directs fuel to the secondary core manifold which joins the primary core manifold in delivering fuel for afterburner operation. When the throttle is advanced still further, the pressurizing valve directs fuel to the primary annulus manifold. As the throttles are advanced to the maximum afterburner position, the fuel is directed to the secondary annulus thus joining the other three manifolds in delivering fuel to the nozzles; this is full afterburner operation. The afterburner fuel manifolds and multijet nozzle system gives a smooth afterburner operation with no appreciable acceleration surge between full military and minimum afterburner or between minimum afterburner and maximum afterburner.

2.16.7 Ignition System. The ignition system consists of an ignition button on each throttle, a low-voltage high-energy ignition unit on the engine, a spark plug in No. 4 combustion chamber, and the necessary wiring. The main ignition system ignites the atomized fuel-air mixture in the No. 4 combustion can. The remaining nine combustion cans are ignited through the crossfire tubes. The afterburner ignition system includes the torch igniter, an afterburner ignition switch, and a torch igniter fuel metering valve. The metering valve supplies fuel to the torch igniter only during the time that afterburner operation is selected with the throttle. When the throttle is moved into the afterburner detent, fuel from the main engine fuel control is directed to the pressure-actuated afterburner ignition switch. Electrical power from the right main 115/200 vac ac bus is then supplied to the afterburner sparkplug which emits a continuous arc to ignite the fuel-air mixture in the torch igniter. Continuous ignition is provided as long as the throttle is in the afterburner detent. The torch igniter produces an intense flame which ignites the afterburner fuel.

2.16.7.1 Ignition Buttons. The ignition buttons are spring-loaded pushbutton-type switches on each throttle directly below the throttle grips. Depressing the ignition button causes the spark plug to discharge, igniting the fuel-air mixture as the throttle is moved from OFF to IDLE during engine start. The spark plugs fire only when the ignition button is depressed. The ignition duty cycle is 2 minutes on, 3 off, 2 on, and 23 off. The ignition circuits are completed anytime aircraft power is on and the ignition button is depressed.

2.16.8 Starting System. The impingement starting system consists of an assembly of ducting and valves which are airframe mounted and a manifold assembly which is mounted on the turbine frame of the engine. The single receptacle for connecting the air supply line is on the bottom left side of the fuselage aft of the main gear wheel well. Air from the external source is directed to the left or right selector valve which distributes the air to either the left or right engine, depending on cockpit selection. The engine manifold assembly distributes the starting air to seven impingement nozzles which direct the air against the second-stage turbine blades of the turbine wheel.

2.16.8.1 Engine Starter Switch. The engine starter switch (Figure FO-1) is on the left console in the pilot cockpit just inboard of the throttles. The starter switch is a three-position switch and is marked L, OFF, and R. The switch receives power from the essential 28-vdc bus. With APU air connected, actuating the starter switch to L energizes the left engine selector valve and permits air to flow to the left engine impingement nozzle. Selecting R energizes the right-engine selector valve and permits air to flow to the right-engine impingement nozzles. The OFF position closes both selector valves and stops airflow to the engines. For impingement starting, a 5.5:1 pressure ratio gas turbine starting unit is desired.

2.16.9 Engine Controls

2.16.9.1 Engine Master Switches. The toggle lock-type two-position engine master switches (Figure FO-1) are on the left console in the pilot cockpit on the inboard engine control panel. Placing the switch in the ON position directs power to the fuel boost pumps and fuel transfer pumps. The circuits for the fuel shutoff valve, which are normally operated by the throttles, are such that either valve is closed when its respective engine master switch is placed OFF regardless of the throttle position.

2.16.9.2 Throttles. A throttle (Figure FO-1) for each engine is on the left console of the forward cockpit. Mechanical linkage and teleflex cables transmit mechanical motion from the throttle to those accessories requiring coordination to obtain the degree of thrust desired. Movement of the throttle is transmitted by mechanical linkage to the main fuel control. The main fuel control unit incorporates a throttle booster which reduces the amount of effort needed to move the throttles. The boost power is supplied by fuel from the engine driven fuel pump. Teleflex cables from the main fuel control link the nozzle area control and afterburner fuel control to throttle movement so that fuel flow and nozzle area are compatible throughout the full range of engine operation. A friction adjusting lever is mounted between the throttles which permits adjustment of throttle friction to suit individual requirements. The throttle mechanism is a gear shift type. Included on the throttles are the ignition buttons (one for each engine on the applicable throttle), speedbrake switch, and microphone button on the right throttle and master lights control switch on the outboard side of the left throttle. On F-4J 155890am through 158354as or after AFC 448, but before AFC 506, a single chaff switch is added to the right throttle below the microphone button. On F-4J 158355at and up or after AFC 506, and all F-4S, the singles chaff switch is replaced by a flare/chaff switch. Limit switches which control the main fuel shutoff valves are built into the throttle quadrant. Advancing the throttle from OFF to IDLE (with the engine master switch ON) actuates electrical switches which open the main fuel shutoff valve corresponding with the throttle moved. With further advancement of the throttle from IDLE to MIL, engine thrust increases proportionally. At the MIL position of the throttles, the engine should be delivering its rated military power. Afterburner light-off can be initiated anywhere within the afterburner modulation range by shifting the throttles outboard and moving forward toward MAX position. Movement of the throttles from IDLE to OFF actuates a switch which closes the main fuel shutoff stopping fuelflow to the engine. Throttle movement through the cutouts is as follows: To move throttles from OFF to IDLE, push forward and then shift throttles inboard. To move from MIL to MAX, shift throttles outboard, throttles can now be moved forward in the afterburner range.

2.16.9.3 Catapult Throttle Grips. Catapult throttle grips secured to the pilot cockpit structure above the MIL throttle detent and MAX throttle detent may be hinged upward to line up with the throttle grips at the MIL and MAX throttle positions. The grips and throttles may then be held together during catapulting to prevent inadvertently throttling back. The grips are automatically stowed when released.

2.16.10 Engine Instruments

2.16.10.1 Engine Fuel Flow Indicators. The engine fuel flow indicators (Figure FO-1) are on the right side of the pilot instrument panel . The fuelflow indicating system indicates the amount of main fuel system flow in pounds per hour of fuel the engines are using at a particular power setting. The rate of fuelflow is shown in 1,000 pounds per hour by a pointer moving over a scale calibrated from 0 to 12. Maximum fuelflow fluctuation is: 100 pph for indicator readings of 0 to 3,000 pph; 750 pph for readings of 3,001 to 12,000 pph. The flow is measured by transmitters mounted on the engines. Afterburner fuelflow bypasses the fuelflow transmitters and, therefore, is not shown on the indicators.

2.16.10.2 Tachometers. The electric tachometer system is composed of two tachometer indicators (Figure FO-1) on the pilot instrument panel and one engine-driven tachometer generator on each engine. The system is completely self-contained in that it requires no external source of power. The tachometer generator develops a poly-phase alternating current which is used to indicate percentage of maximum engine rpm. The indicator dials are calibrated from 0 to 110. Each indicator includes two pointers: a large one operating on the 0 to 100 scale and a small one operating on a separate scale calibrated from 0 to 10.

2.16.10.3 Exhaust Gas Temperature Indicators. The exhaust gas temperature indicators (Figure FO-1) are on the pilot instrument panel. The scale range on the indicators is 0 to 11 with the reading multiplied by 100 °C. The system indicates the temperature of the exhaust gas as it leaves the turbine unit during engine operation. Twelve dual loop thermocouples are installed on each engine and are connected in parallel. The millivoltages produced by one of the sets of dual loop thermocouples is directed to an amplifier for temperature limiting. The millivoltages produced by the other set of 12 thermocouples is directed to the cockpit indicator. The indicator is a null-seeking potentiometer type. It balances a thermocouple voltage against a constant voltage source with a small servo simultaneously balancing a bridge circuit and operating the indicator pointers.

2.16.10.4 Exhaust Nozzle Position Indicators. Exhaust nozzle position indicators (Figure FO-1) which show the exit area of the exhaust nozzle are on the pilot instrument panel. The instruments are placarded Jet Nozzle Position and are calibrated from CLOSE to OPEN in one-quarter increments. The nozzle position indicators enable the pilot to make a comparison of nozzle position between engines and is also used to establish a relationship between nozzle position and exhaust gas temperature and nozzle position and throttle settings.

2.16.10.5 Oil Pressure Indicators. The oil pressure indicators (Figure FO-1) are on the pedestal panel. The scale range on the indicators is 0 to 10 with readings multiplied by 10. The oil pressure indication system senses oil pressure downstream of the main lube pump in the main lube discharge line.

2.16.11 Engine Anti-Icing System. The engine anti-icing system is a compressor discharge air bleed-type system, controlled by an on-off pressure regulating valve. Air for anti-icing purposes is supplied from the 17th stage of the engine compressor at pressures up to 275 psi, and temperatures up to 593°C. A regulator in the anti-icing valve reduces the incoming air to a pressure of approximately 14 to 20 psi. Air from the anti-icing valve is distributed through the first-stage stator vanes, the compressor front frame struts, the inlet guide vanes, and to a port in the front gearbox for engine nose dome anti-icing.

CAUTION

During supersonic flight, the anti-icing system should only be used when actual icing is noted.

Note

During subsonic flight, the anti-icing system should be used when icing conditions are anticipated.

2.16.11.1 Engine Anti-Icing Switch. A two-position engine anti-icing switch (Figure FO-1) is on the outboard engine control panel. The switch is marked engine anti-icing and the switch positions are DE-ICE and NORMAL. Placing the switch to DE-ICE opens the regulator valve which starts anti-icing airflow. With the switch in NORMAL, no anti-icing operation is being performed.

2.16.11.2 Engine Anti-Ice Lights. Engine anti-ice lights are on the telelight panel (Figure FO-1). The lights marked L ANTI-ICE ON and R ANTI-ICE ON operate from a pressure sensitive switch which is actuated by the pressure of engine bleed air when the system is turned on. There are two situations foreseen in which light illumination may be observed with the switch in the NORMAL position. One situation occurs in high Mach flight where impact pressure will trip the pressure switch and illuminate the light. The other situation occurs at any speed when the regulator valve leaks and allows sufficient anti-icing airflow to trip the pressure switch and illuminate the light. During high Mach flight, if the light illuminates while the anti-icing switch is in NORMAL, reduce speed to subsonic. If the light goes out, the indication is caused by impact pressure and high Mach flight may be continued regardless of the light indication. If a speed reduction will not extinguish the light, then the cause is probably a leaking regulator valve and high Mach flight may not be continued unless actual icing is present on the aircraft. Operation of the system is not limited in subsonic flight and, therefore, flight may be conducted in this region regardless of light indication. System output may be checked by placing the anti-icing switch to the DE-ICE position and observing a 10° rise in EGT. This check will not constitute clearance to operate at high Mach with the light illuminated if a speed reduction failed to extinguish it.

CAUTION

If the L ANTI-ICE ON and/or R ANTI-ICE ON lights illuminate during high Mach flight, reduce speed. If a speed reduction will not extinguish them operate at a subsonic speed. Continued operation in the high Mach range may cause engine damage.

Note

Illumination of the anti-ice light(s) with anti-ice selected may or may not occur at idle. Intermittent illumination occurring during engine transient speeds is acceptable.

2.16.12 Fire and Overheat Detector Systems

2.16.12.1 Engine Fire/Overheat/Bleed Air Leakage Warning Lights. The fire and overheat detection system consists of three separate and independent systems: engine fire detection system, aft fuselage overheat system, and, on F-4J 155903ap and 157274ap and up or after AFC 439 and all F-4S, a bleed air leakage detection system. The FIRE and OVERHT warning lights, one for each engine, are on the upper right portion of the main instrument panel. The BLEED AIR OVERHT lights (three each) are on the telelight panel. In addition to the lights, each system consists of a control unit and series of continuous sensing elements. The fire warning sensing elements are routed throughout the engine compartments. The right or left FIRE warning light illuminates if a temperature of approximately 765°F occurs in the corresponding engine compartment. The aft fuselage overheat sensing elements are routed in vertical recesses of the skin fairing on each side of the keel. These recesses are opposite the aft end of the secondary engine nozzle fingers. The left or right OVERHT warning light illuminates if a temperature of approximately 1,050 °F occurs at the corresponding aft fuselage skin. Do not use afterburner if an aft fuselage OVERHT warning light illuminates. This indicates a safety-of-flight condition such as an open engine compartment door or a damaged engine nozzle. Either of these conditions can lead to the loss of flight control if afterburner is used. The bleed air leakage sensing elements are routed along the bleed air ducts, and illuminate three different lights, depending on where the leak occurs. The elements routed under fuel cell 2 through the fuel/hydraulic bay (door 22) and then through the left and right refrigeration packages illuminates the FUS BLEED AIR OVERHT warning light if a temperature of approximately 410 °F occurs in this area. The elements routed along each wing leading edge outboard to the BLC shutoff valve illuminates the WING BLEED AIR OVERHT (F-4J only) light if a temperature of approximately 410 °F occurs in this area. The element routed along the engine bleed air duct, in the keel web, illuminates the ENG BLEED AIR OVERHT light if a temperature of approximately 575 °F occurs in this area. Illumination of any of the fire or overheat lights is a warning to initiate the appropriate emergency procedure(s). The MASTER CAUTION light does not illuminate in conjunction with the FIRE or OVERHT warning lights; however, it will illuminate in conjunction with any of the bleed air leakage warning lights. The engine fire and aft fuselage overheat lights operate on RAT power; however, the bleed air overheat lights do not.

Note

- During ram air turbine extension, it is normal for the FIRE and OVERHT lights to flicker until the RAT comes up to speed. Disregard these light unless they remain on after RAT has obtained full speed.
- Except for illumination resulting from RAT extension, illumination of the FIRE or OVERHT lights shall be logged on the yellow sheet (OPNAV form 3760-2).

2.16.12.2 Fire Detector Check Switch. The engine fire, aft fuselage overheat, and, on F-4J 155903ap and 157274ap and up or after AFC 439 and all F-4S, the bleed air overheat warning light system may be checked by depressing the fire detector check switch. The lights should first be checked by placing the warning light test switch on the right console to test. This action only checks the light bulbs. Depressing the fire detector check switch illuminates the FIRE, OVERHT, FUS BLEED AIR OVERHT, WING BLEED AIR OVERHT (F-4J only), and ENG BLEED OVERHT lights and also checks the continuity of their sensors and the operation of each system control panel. The engine fire and aft fuselage overheat warning test circuit receives power from the right main 28-vdc bus. Therefore, when operating on RAT, these lights cannot be tested. The bleed air overheat warning lights do not operate on the RAT.

2.16.13 Engine Bleed Air System. The bleed air system (Figure 2-15) supplies high-temperature, high-pressure air from the engines to the boundary layer control system, the cabin air-conditioning system, the equipment air-conditioning system, and the fuel pressurization system. The functional control of the bleed air is initiated by the requirements of each individual system and the flow, temperature, and pressure is regulated by the system. The system utilizes engine compressor bleed air tapped off the 17th-stage compressor. Normally, both engines supply the air for the operation of these systems, but when necessar2.17.4y, single-engine operation supplies sufficient air for their operation. On F-4J 155903ap and 157274ap and up or after AFC 440 and all F-4S, during single-engine operation, trailing edge BLC will be lost on the wing adjacent to the inoperative engine. The system ducting routes the flow of bleed air from the engines to the systems and is insulated to protect the airframe structure from heat radiation. Check valves are installed in the ducting to prevent back flow into the nonoperating engine during starting and single-engine operation.

2.16.13.1 Engine Bleed Air Switch. On F-4J aircraft 155903ap and 157274ap and up or after AFC 440, but before AFC 550, the lever-locked engine bleed air switch is installed on front cockpit right utility panel. The switch has two positions, NORM and OFF, and controls a bleed air shutoff valve installed in the keel Y duct between the engines. On F-4J after AFC 550 and all F-4S, the lever-locked engine bleed air switch is replaced by a simple toggle switch and a red guard. Actuation of the switch to OFF shuts off engine bleed air to all systems except trailing edge BLC. CNI equipment (tacan, ADF, UHF, IFF, and SIF) and radar will lose cooling air from the equipment refrigeration package, but will still have ram air cooling available. Ram air is also available for cabin temperature control. With both generators failed, bleed air will be delivered to all systems regardless of switch position.

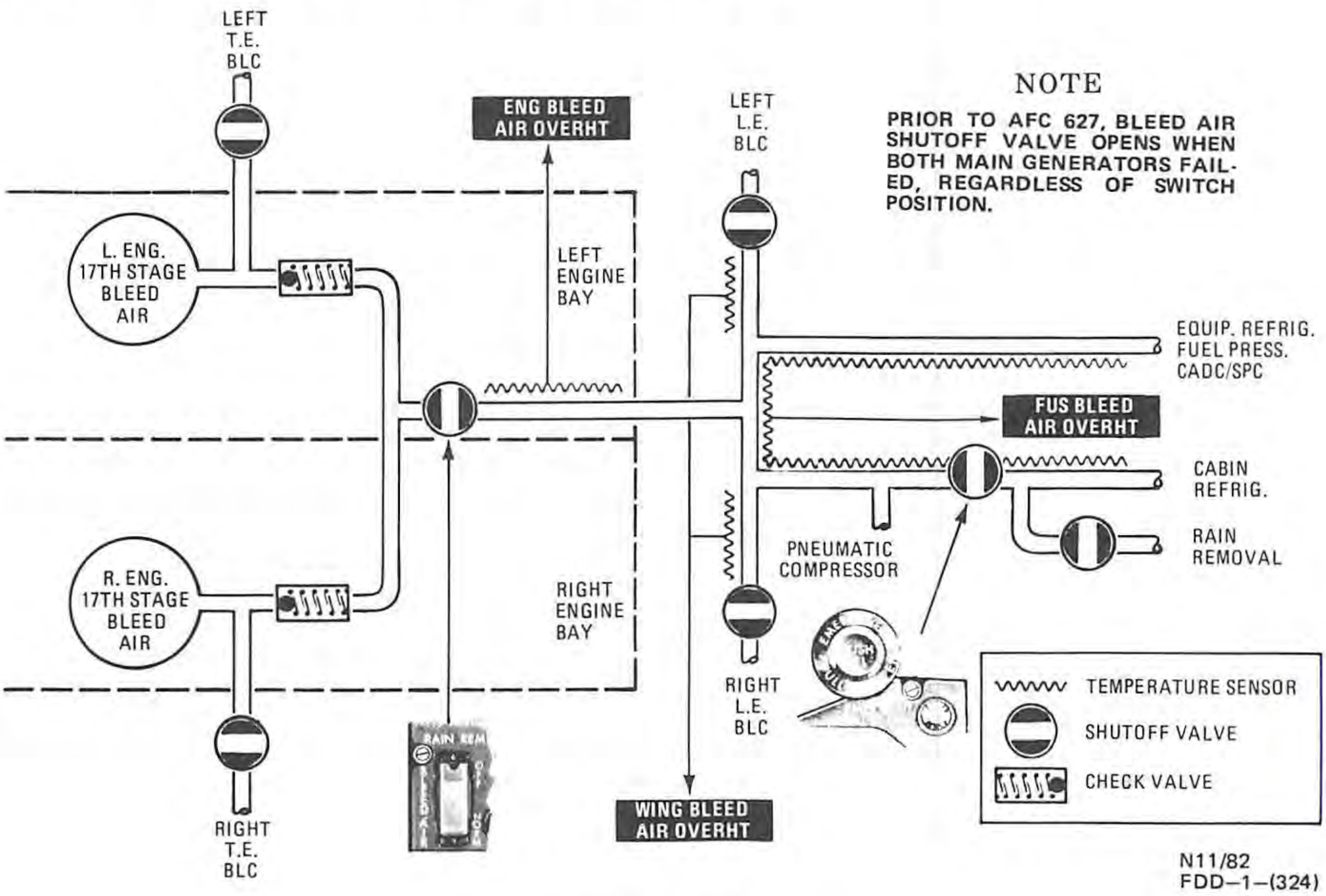


Figure 2-15. Bleed Air System

Note

Prior to AFC 627, deployment of the RAT will not restore power to the engine bleed air shutoff valve following dual-generator failure or left-generator failure or left-generator failure with bus tie open. After AFC 627, the engine bleed air shutoff valve is powered by the essential 28-vdc bus and is operable on RAT power. To regain use of the engine bleed air shutoff valve after AFC 627, deploy the RAT.

With the engine bleed air switch off, operation of the following equipment will be lost.

1. External fuel and internal wing fuel transfer
2. Leading edge BLC
3. Cockpit air-conditioning and pressurization
4. Rain removal air
5. Defog/foot heat
6. Equipment cooling air
7. Normal pneumatic compressor charging
8. SPC inputs to all systems
9. Automatic altitude reporting
10. Anti-g.

CAUTION

When the engine bleed air switch is positioned to OFF, radar and CNI equipment should be placed in the OFF position unless safety of the flight/operational necessity requires their use.

Note

With the engine bleed air switch in OFF, 17th-stage air is not available for pneumatic compressor charging; however, the pneumatic compressor will compress ram air (the rate of charging is dependent on altitude and airspeed).

2.16.13.2 Bleed Air Off Light. On F-4J after AFC 550 and all F-4S, a BLEED AIR OFF light is added to the caution light panel. The light illuminates any time the bleed air shutoff valve is in the off position. The MASTER CAUTION light illuminates in conjunction with the BLEED AIR OFF light. The BLEED AIR OFF light is powered by the warning lights 28/14-vac bus through the BLC warning light circuit breaker.

2.16.14 Normal Operation

2.16.14.1 Starting Engines. Refer to Starting Procedures in Chapter 8.

2.16.14.2 Engine Operating Characteristics

2.16.14.2.1 T2 Reset. During high compressor inlet temperature operation (high-speed flight), engine idle speed is rescheduled upward to maintain sufficient airflow to prevent compressor stall. When the inlet temperature increases from +57 °C to +108 °C, engine idle speed is raised from normal idle (65 percent) to 100 percent regardless of the throttle setting. To reduce engine idle speed once it has been reset, compressor inlet temperature must be reduced. This is effected by retarding the throttles out of afterburner to reduce thrust. Thrust can be further reduced by retarding the throttles below the military position so that the exhaust nozzles open, lowering exhaust gas velocity and temperature. As thrust decreases, compressor inlet temperature decreases as a result of lower airspeed and engine speed control is returned to the throttle.

2.16.14.2.2 T2 Cutback. When the compressor inlet temperature (T2) falls below a predetermined level, the maximum engine rpm is limited to prevent excessive mass air flow through the engine. On the J79-GE-8 engines, T2 cutback starts to occur at +4 °C and is reduced until at -54 °C the maximum rpm is approximately 91.5 percent. On the J79-GE-10 engines, T2 cutback starts to occur at -45 °C and reduced until at -54 °C the maximum rpm is approximately 90 percent.

2.16.14.2.3 T5 Reset (J79-8 Engines). The engines incorporate an exhaust gas temperature (T5) reset during military and full AB operation. This T5 reset occurs at the same point as T2 cutback, and reduces EGT at the same time that T2 cutback is reducing rpm. As a result of T5 reset, the engines run at lower EGTs, operate with larger nozzle areas, provide less net thrust, and consume less fuel while operating in the speed cutback region at low compressor inlet temperature conditions.

2.16.14.2.4 T5 Reset (J79-10 Engines). The engines incorporate an exhaust gas temperature reset during afterburner operation. When the compressor discharge pressure exceeds 290 (±5) psia while in afterburner operation, the exhaust gas temperature limit is lowered to 571 (±9) °C on -10 engines and 616 (±9) °C on -10B engines. As a result of T5 reset, the engines run at a lower exhaust gas temperature, operate with larger nozzle areas and consume less fuel. The purpose of T5 reset is to prevent certain components from exceeding their operating temperatures.

2.16.14.3 Ramp Scheduling. Ramps begin scheduling at +52 °C total temperature and stop at +146 °C total temperature. The following schedule is representative of ramp opening at 40,000 feet:

OAT °C	RAMPS BEGIN TO OPEN AT APPROXIMATE MACH
-40	1.40
-45	1.45
-50	1.50
-55	1.55
-60	1.60
-65	1.65
-70	1.70

2.16.14.3.1 Engine Operating Envelope. The engine operating envelopes (Figure 2-16) show pertinent engine operating data for an ICAO standard day. The various envelopes are plotted to show an approxi-

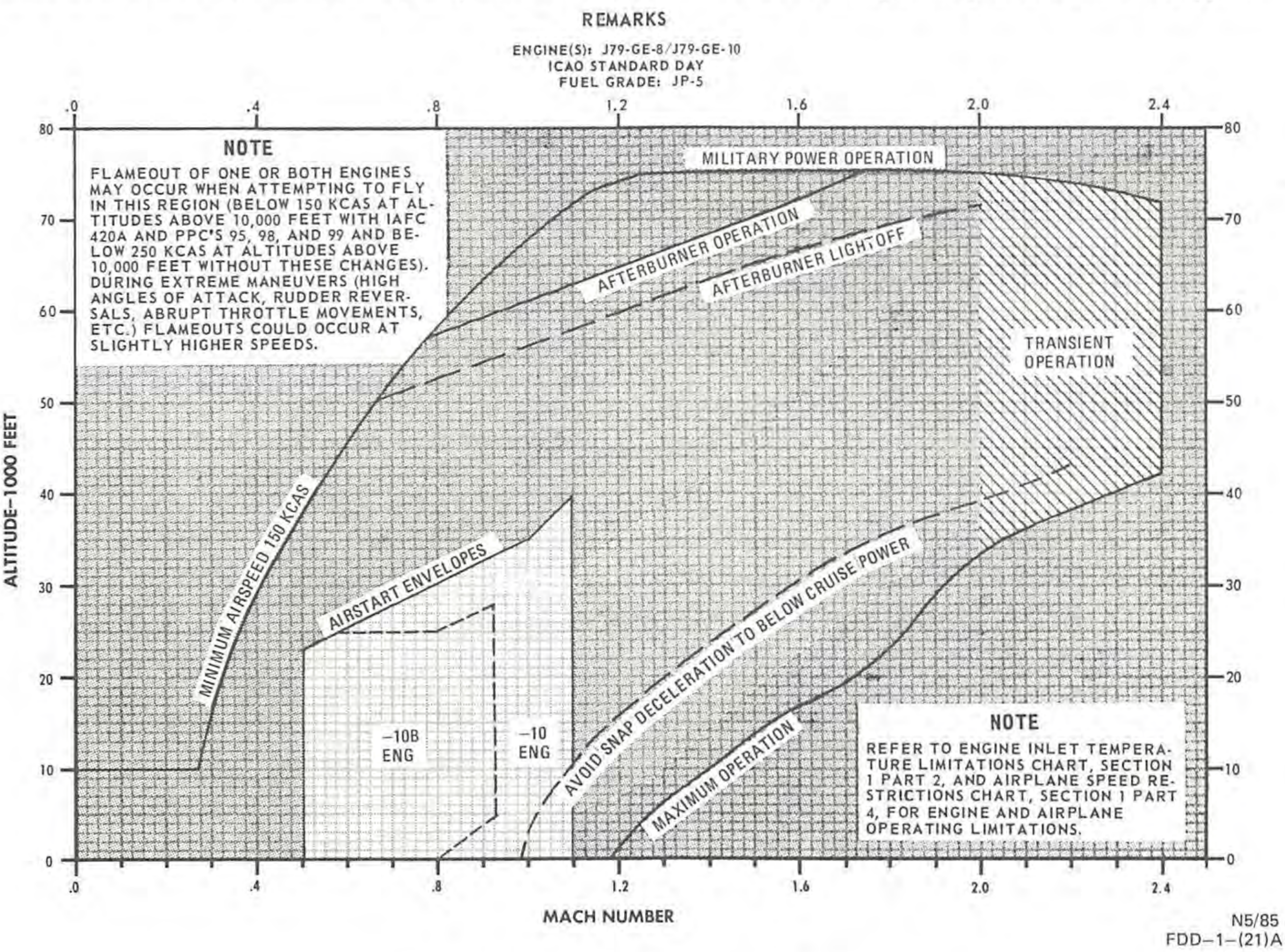


Figure 2-16. Engine Operating Envelopes

mate area of operation; therefore, airstarts, afterburner light-offs, minimum airspeed operation, etc., may occur, depending on prevailing flight conditions, on either side of the plotted operational area. However, under 1g level flight conditions, satisfactory engine operations can be expected within the plotted envelopes. The transient operation zone (Mach 2.0 to 2.4) and the maximum engine operation curve are standard day airspeed restrictions and are shown for reference only. In all cases, Figures 2-17 and 4-3 of this manual shall take precedence over any or all operations shown herein.

−8, −10 and −10B Engines

CONDITION	STATIC	INFLIGHT
NORMAL OPERATION*	100 ± 0.5% RPM	100 ± 0.5% RPM
ALLOWABLE OVERSPEED NON TIME LIMITED*	103% RPM	102% RPM
ALLOWABLE OVERSPEED TIME LIMITED	103-105% RPM FOR 3 MINUTES	102-103.6% RPM FOR 1 MINUTE
IDLE	65 ± 1% RPM	———

* Refer to power limitations this section.

Note

ANY RPM IN EXCESS OF THE ABOVE LIMITATIONS SHALL BE LOGGED ON THE YELLOW SHEET (OPNAV FORM 3760-2)

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Figure 2-17. Engine Speed Limitations

2.16.15 Emergency Operation

2.16.15.1 Engine Failures. Jet engine failures in most cases are caused by improper fuel scheduling because of malfunction of the fuel control system or incorrect techniques used during certain critical flight conditions. Engine instruments often provide indications of fuel control system failures before the engine actually stops. If engine failure is due to a malfunction of the fuel control system or improper operating technique, an airstart can usually be accomplished, providing time and altitude permit. If engine failure can be attributed to some obvious mechanical failure within the engine proper, do not attempt to restart the engine.

Note

Often the first indication of an engine failure will be the illumination of the MASTER CAUTION and GENERATOR OUT lights. When these indications are noted, check engine rpm prior to proceeding to the generator failure portion of the checklist.

2.16.15.2 Runaway Engine. There is no provision made on the main fuel control for stabilized engine rpm in the event the throttle linkage becomes disconnected from the control. If a disconnect occurs, vibration may cause the fuel control to hunt or assume any setting from idle to maximum power. Therefore, at the first indication of a runaway engine while on the ground, secure the engine with the engine master switch. If a runaway engine occurs in flight, use of the engine may be regained in the landing configuration by engaging the autothrottles, provided the disconnected throttle linkage is not binding the engine fuel control and the rpm has stabilized between 73 and 99 percent. If the autothrottle will not function properly, shut down the affected engine before commencing the approach or sooner if necessary.

2.16.15.3 Airstarts. In general, airstart capability is increased by higher airspeeds and lower altitudes; however, airstarts can be made over a wide range of airspeeds and altitudes. Depending on airspeed and altitude, the engine starts at various low rpm indications. Above 12-percent rpm, however, is considered optimum. An airstart is accomplished by depressing the ignition button with the throttle at IDLE. A start is indicated by a rapid increase in EGT followed by an increase in rpm. If light-off does not occur within 30 seconds after ignition, the engine does not continue to accelerate after light-off, the EGT exceeds maximum limitations, or the oil pressure does not attain 12 psi minimum at idle, retard the throttle to OFF. Wait 30 seconds before initiating a restart.

Note

If airstarts are attempted outside the airstart envelope (Figure 2-16) a hung acceleration condition may result. RPM will hang between 65 and 71 percent while EGT will continue to rise and the engine will not respond to throttle movement. To terminate this condition, the throttle may have to be retarded to OFF. Restart attempt may be initiated as soon as rpm drops below 60 percent.

Note

If one or both engines flame out, do not delay the airstart. If a mechanical failure is not immediately evident, depress and hold the ignition button(s) to restart the engine(s) before excessive rpm is lost.

2.16.15.4 Oil System Failure. The standpipes which supply the three systems utilizing engine oil are in the reservoir such that the pipe for the constant speed drive unit is the highest, the one for the nozzle control is the next highest, and the lubricating system pipe is the lowest. Therefore, a leak in the constant speed drive unit would probably cause a failure of that system only, while a leak in the nozzle control system may cause failure of that system and the constant speed drive unit. A leak in the lubricating or the scavenging system causes failure of the constant speed drive unit and the nozzle control system and, ultimately, engine bearing failure results. A GEN OUT light illumination, followed by sluggish exhaust nozzle action, are early indications of impending engine oil starvation. The engine oil pressure gauge should be monitored closely subsequent to a generator failure. In general, it is advisable to shut down the engine as early as possible after a loss of oil supply is indicated to minimize the possibility of damage to the engine and the constant speed drive unit. The engine operates satisfactorily at military power for a period of 1 minute with an interrupted oil supply. However, continuous operation at any engine speed with the oil supply interrupted results in bearing failure and eventual engine seizure. The rate at which a bearing fails, measured from the moment the oil supply is interrupted, cannot be accurately predicted. Such rate depends upon the condition of the bearing before oil starvation, temperature of the bearing, and loads on the bearing. Malfunctions of the oil system are indicated by a shift (high or low) from normal operating pressure, sometimes followed by a rapid increase in vibration. A slow pressure increase may be caused by partial clogging of one or more oil jets, while a rapid increase may be caused by complete blockage of an oil line. Conversely a slow pressure decrease may be caused by an oil leak, while a sudden decrease is probably caused by a ruptured oil line or a sheared oil or scavenge pump shaft. Vibration may increase progressively until it is moderate to severe before the pilot notices it. At this time, complete bearing failure and engine seizure is imminent. Limited experience has shown that the engine may operate for 4 to 5 minutes at 80- to 90-percent speed before a complete failure occurs. In the event of a drop in oil pressure or a complete loss of pressure, shut down the affected engine if power is not required or set the engine speed at 86- to 89-percent if partial power is required. If partial power is required on the affected engine, avoid abrupt maneuvers causing high g forces and avoid unnecessary or large throttle bursts.

2.16.15.5 Autoacceleration. If the auxiliary air doors fail to open when the landing gear is lowered, there is a possibility that the engines may automatically accelerate up to 100-percent rpm. A utility hydraulic system failure renders the variable bypass bellmouth and auxiliary air doors inoperative. Operation of an engine with an open variable bypass bellmouth and closed auxiliary air doors allows engine compartment secondary air to recirculate to the engine inlet. During low altitude or ground operation, the temperature of the recirculating air may be high enough to initiate T2 reset. When T2 reset is initiated, the engine(s) autoaccelerates. The autoaccelerated engine(s) can be shut down if on the ground by placing the throttle to OFF. If engine operation is required, the trust output can be regulated by modulation of the engine throttle. Modulation of the engine throttles repositions the exhaust nozzles. However, the engine rpm is not affected.

2.16.15.6 Variable Area Inlet Ramp Failure. There are no provisions made for emergency operation of the inlet ramps. Malfunctions of the inlet ramp control or actuating system may cause the ramp to assume the fully retracted (maximum duct area) position or the fully extended (minimum duct area) position. A failure of the ramp to the retracted position has no effect on engine operating characteristics or performance below approximately 1.5 Mach. Engine compressor stalls may occur above 1.7 Mach. A failure of the inlet ramps to the extended position below approximately 1.5 Mach will cause a substantial loss of thrust, and engine compressor stall and flameout may occur above approximately 18,000 feet altitude. Above 1.5 Mach, maximum airspeed attainable is reduced, and engine compressor stalls may occur. A gradual failure of the inlet ramps to the extended position at any power setting from idle to max AB at airspeeds from 400 knots to landing approach speed does not cause unstable engine operation. Extended inlet ramps may be detected by observing the ramp position in the rear view mirror; significantly reduced fuelflow at power settings above 85-percent rpm; high pitched howl at airspeeds above 300 knots;

and significantly reduced thrust (approximately 35 percent) at power settings above 90-percent rpm. Engine acceleration time and response to throttle movement are not affected by the extended ramp. No special procedures are required for throttle manipulation under these conditions below 18,000-foot altitude. Slam accelerations to military and maximum AB power, stabilized high power operation, sideslips, and airstarts may be performed without overtemperature or compressor stalls. Power settings above 94-percent rpm with the ramps extended produce increased fuel consumption without increasing engine thrust output. For this reason, cruising altitudes should be selected at which the recommended maximum range Mach number for existing configuration and gross weight can be maintained with 94-percent rpm or less. Refer to Chapter 12 for flight procedures with ramps extended.

CAUTION

A failure of the total temperature sensor may cause both ramps to extend or move in and out causing multiple compressor stalls. Compressor stalls may also occur at airspeeds above 1.7 Mach or high Q with the inlet ramps in the retracted position.

2.16.15.7 Afterburner Ignition Failure. If for any reason afterburner ignition is not available, afterburner light-offs should not normally be attempted. However, if operational necessity or safety of flight dictate, afterburner lights can be obtained through turbine torching. If afterburner thrust is required, slam accelerate the engine into afterburner range from 90-percent rpm or higher. If the first selection is not successful, an immediate slam reselection should achieve successful results.

2.16.16 Limitations

2.16.16.1 RPM Drop. When entering afterburner from throttle settings less than military, the allowable rpm drop is 14 percent. When entering afterburner from stabilized military power, allowable rpm drop is 10 percent. All exceeded engine speed limitations must be recorded on the flight forms (yellow sheets).

2.16.16.2 Engine Speed. Engine speed limitations are listed in Figures 2-17 and 2-19.

2.16.16.3 Engine Temperature. Engine temperatures are limited by degree and time as shown in Figures 2-18 and 2-20.

CONDITION	ENGINE	TEMPERATURE	TIME
STARTING FROM LIGHT-OFF	ALL	1000°C 980°C 930°C 900°C–733°C	3 SEC 10 SEC 60 SEC 90 SEC
DURING ALL ENGINE OPERATION OTHER THAN STARTING	–8 –10 –10B	ABOVE 750°C ABOVE 750°C ABOVE 774°C	3 SEC 3 SEC 3 SEC
	–8 –10 –10B	635°C 668°C 704°C	NO TIME LIMIT

Note

If any of the above limits are exceeded the aircraft will be aborted and written up. In addition, if 705°C is exceeded during start for any period of time, the engine will require corrective action to prevent recurrence. This is not an abort item.

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Figure 2-18. Engine Exhaust Temperature Limitations

(STATIC CONDITION ONLY)

OAT		RPM	EGT	
°F	°C	(±1%)	–10 ENG	–10B ENG
–58	–50	90.5	523–554	559–595
–49	–45	91.0	523–568	559–605
–40	–40	91.5	530–578	569–616
–31	–35	92.0	542–590	581–627
–22	–30	92.5	554–600	593–637
–13	–25	93.0	566–610	605–648
–4	–20	93.5	578–624	617–659
+5	–15	94.0	590–632	629–669
+14	–10	94.5	604–644	641–680
+23	–5	95.0	618–654	653–691
+32	0	95.5	628–668	665–701
+41	+5	96.0	640–668	677–704
+50	+10	96.5	651–668	688–704
+59	+15	97.0	651–668	688–704
+68	+20	97.5	651–668	685–704
+77	+25	98.0	640–668	676–704
+86	+30	98.5	632–660	667–697
+95	+35	99.0	627–652	663–690
+104	+40	99.5	627–646	663–683
+113	+45	100.00	627–644	663–680
+122	+50	100.00	627–644	663–680

Notes

- INDICATED RPM MUST BE WITHIN ±1% FOR A GIVEN OUTSIDE AIR TEMPERATURE.
- EGT MUST BE IN THE RANGE AS SHOWN USING ACTUAL INDICATED RPM.

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Figure 2-19. Military Power Operating Limits

CONDITION	TEMP	TIME
ENG INLET TEMP HIGH Warning light Illumination	121°C	Supersonic flight below 30,000 feet with light illuminated is prohibited.
Transient Temperature Operation	121°C–193°C (max. temperature occurs approximately .4 Mach above illumination of ENG INLET TEMP HIGH Warning light)	5 min. per hour (noncumulative) above 30,000 FT.

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Figure 2-20. Engine Inlet Temperature Limitations

2.16.16.4 Throttle Burst. When operating with maximum engine compressor bleed air (flaps down and cockpit pressurized) in outside air temperatures of -37 °C and below, rapid throttle bursts may result in an rpm hangup. If a throttle burst into maximum afterburner is made, cyclic engine operation may result. When rapid throttle bursting is necessary under these conditions, it is recommended that the throttle be advanced to minimum afterburner first and then engine rpm be allowed to stabilize before advancing further into the afterburner range.

2.16.16.5 Windmilling. Except for emergency shutdown, do not allow the engine to windmill below 7-percent rpm below 40,000 feet for periods greater than 10 minutes. Extended windmilling may result in engine damage from inadequate lubrication or oil depletion and may cause internal engine conditions that are conducive to sump fires when relighting. Prior to nonemergency conditions, the engine should be decelerated to the coolest operating point (lowest EGT) and this speed maintained long enough to stabilize EGT. The number of 10-minute intervals below 7-percent rpm is not limited, providing the engine is operated above 7-percent rpm for a minimum of 10 minutes between intervals.

2.16.16.6 Power Setting

2.16.16.6.1 Military Power. Military power is obtained with full nonafterburning thrust and is limited to 30 minutes below 35,000 feet and 2 hours above 35,000 feet.

2.16.16.6.2 Maximum Power. Maximum power is obtained with full afterburning thrust and is time limited to 30 minutes below 35,000 feet and 2 hours above 35,000 feet.

2.16.16.7 Engine Oil Pressure. The oil pressure limitations for the primary engine lubrication oil, MIL-L-23699, are as follows: 12 psi at idle, 45 to 70 psi during steady state ground operations at military power, 35 to 70 psi during steady state flight operation at 100-percent rpm. Oil pressure fluctuations of ±2.5 psi are allowed around a known steady state pressure. Below 20,000 feet during steady state operation, any erratic pressure change which exceeds 5 psi for more than 1 second must be investigated. At 20,000-foot altitude and above, pressure fluctuations are limited to the following: maximum of 20 psig below normal pressure for a duration of 3 seconds, occurring no more than 4 times per minute, or a maximum of 10 psig below normal pressure for a duration of 1 second, occurring no more than 15 times per minute. During any engine speed reduction, indicated oil pressure will decrease approximately 1 psi per 1-percent reduction in rpm from 100-percent. Pressure changes resulting from airspeed increases or going ON/OFF afterburner are acceptable down to 35 psi minimum. From flight to flight, indicated pressure must repeat within 5 psi of the known normal pressure for a particular aircraft/engine combination. When an alternate lubricating oil is utilized, refer to Chapter 4 of this publication for oil pressure limitations.

2.16.16.8 Engine Ignition. The engine ignition duty cycle is as follows:

2 minutes ON - 3 minutes OFF
2 minutes ON - 23 minutes OFF.

Note

In an emergency, use the ignition system as required. Exceeded limits must be entered in the flight forms (yellow sheets).

2.16.16.9 Emergency Fuel. The engines may be operated on MIL-G-5572B 115/145 AVGAS if JP-4 or JP-5 is not available. When AVGAS is used, the aircraft is restricted to one flight of no more than 5 hours duration at subsonic speeds. AVGAS has a specific gravity range between 0.730 to 0.685. The fuel control should be set to correspond to these values. The engine top speed should be adjusted as necessary.

If the fuel control adjustments cannot be made, the aircraft may be flown; however, the pilot should be aware that the following degradation in engine performance will occur:

1. Longer time to start and accelerate with possible missed-starts or start-stalls

2. Maximum engine rpm and EGT may not be attained

3. Slow acceleration throughout the operating range

4. Lower than normal afterburner thrust

5. Reduced aircraft range.

2.16.16.10 High Mach Flight Power Reduction Limitations. High differential pressure may occur across the inner secondary afterburner exhaust nozzle flaps during rapid throttle retardation from military or afterburner to below cruise power (throttle angle of 35° to 65°) with airspeed above 650 knots. When this condition occurs, it will cause distortion of the secondary flaps. Refer to aircraft speed restrictions (Figure 4-3) for gradual power reduction limitations.

CAUTION

If a compressor stall occurs above approximately 630 knots, retard the throttle to idle immediately to prevent engine overtemperature.

2.16.16.11 Engine G. Because of limited oil distribution to all systems utilizing engine oil for lubrication or operation during negative g or zero g flight, the aircraft is limited to the following:

1. Thirty seconds of negative g flight

2. Ten seconds of zero g flight.

2.17 FLAPS (F-4J)

2.17.1 Description. The wing flap system comprises two-position leading edge flaps, three-position trailing edge flaps, and drooped ailerons. The system is actuated by the utility hydraulic system. The leading edge flaps are mounted on the center and outer wing panels. Trailing edge flaps are mounted on the inboard portion of the wing adjacent to the fuselage. Each flap and aileron has its own hydraulic actuator. The leading edge flaps are locked in the retracted position by overcenter linkages. Trailing edge flaps and ailerons are locked in the retracted position by internal locks in the cylinders. A check valve is provided as in integral part of the selector valve to prevent unlocking of overcenter mechanisms and internal locks by back pressure in the return lines. A flow divider is provided to synchronize the trailing edge flaps. There is no synchronization between leading edge flaps or between leading and trailing edge flaps and ailerons. On aircraft 154786ag and up, the aileron droop is actuated by electrical droop actuators powered by the right 115-vac bus. The actuator is locked in the extended or retracted position by an integral brake.

2.17.2 Wing Flap Switch. The leading and trailing edge flap switch (Figure FO-1) on the wing flap control panel is mounted above the left console outboard of the throttles. The three-position toggle switch is marked UP, 1/2, and DN and is shaped like an airfoil for ease of identification. Selecting the 1/2 position moves the center and outboard leading edge flaps to the full down position (60°, 55°, respectively), droops the ailerons (16-1/2°), and moves the trailing edge flaps 1/2 (30°) down. Selection of the DN position moves the trailing edge flaps to the fully extended position (60°). Selecting the 1/2 position after the flaps have been fully extended raises the trailing edge flaps to the 1/2 (30°) position. Placing the flap switch in the UP position simultaneously returns all the flaps and ailerons to the full retracted position. There is no individual selecting of flaps.

2.17.3 Emergency Aileron Droop. On aircraft after AFC 534, an emergency aileron droop system provides selectable aileron droop with emergency flap operation. The system is controlled by a lever-locked switch on the left utility panel with positions of NORMAL and DISABLE. With the switch in NORMAL, the ailerons will droop when the flaps are pneumatically extended. The ailerons will droop if the switch is moved to NORMAL after the flaps are pneumatically extended with the switch in DISABLE. With the switch in DISABLE, the ailerons will not droop when the flaps are pneumatically extended. The ailerons will return to the nondroop position if the switch is moved to DISABLE after the flaps are pneumatically extended with the switch in NORMAL. On aircraft prior to 154786ag except for 153088aa, emergency aileron droop is accomplished by hydraulic/pneumatic actuators using pneumatic pressure from the emergency flap bottle. The actuators position control levers on the aileron power control cylinders which enable PC-1 hydraulic pressure to droop the port aileron and PC-2 hydraulic pressure to droop the starboard aileron. After AFC 599 or AFC 612, the switch positions are reversed. The NORMAL position is designated ON and the DISABLE position is designated OFF.

WARNING

In all aircraft, with emergency aileron droop selected and flaps pneumatically extended, a PC system failure will cause a split aileron and possible loss of control.

CAUTION

Prior to AFC 599 and AFC 612, the hydraulic/pneumatic actuators are deenergized to the droop position. If essential 28-vdc power is lost, emergency flap extension will cause the ailerons to droop regardless of emergency aileron droop switch position. After AFC 599 or AFC 612, the hydraulic/pneumatic actuators are modified so that they are energized to the drooped position. After AFC 599 or AFC 612 with loss of essential 28-vdc power, the ailerons cannot be drooped during emergency flap extension regardless of emergency aileron droop switch position. In F-4J 153088aa and 154786ag and up, emergency aileron droop is accomplished by electromechanical actuators powered by the right 115-vac bus. The actuators position control levers on the aileron power control cylinders which enable PC-1 hydraulic pressure to droop the port aileron and PC-2 hydraulic pressure to droop the starboard aileron.

Aileron Droop Control Condition	Electric	Pneumatic
RAT	Will not droop	Droop selectable
Total electrical failure	Will not droop	Droop regardless of switch position before AFC 599. Will not droop regardless of switch position after AFC 599
RH GEN out, bus tie open	Will not droop	Droop selectable
LH GEN out, bus tie open	Droop selectable	Droop regardless of switch position before AFC 599; will not droop regardless of switch position after AFC 599

2.17.4 Emergency Flap Extension. Emergency extension of the wing flaps is accomplished pneumatically. High pressure air (approximately 3,000 psi), stored in a 300-cubic inch air bottle, is released to extend the flaps by pulling the flap circuit breaker and pulling full aft on the emergency flap extension handle (Figure FO-1). The handle is airfoil shaped and is painted in alternating black and yellow stripes for ease of identification. Actuation of the emergency flap extension handle extends the leading edge flaps to the full down position, the trailing edge flaps to the 1/2 down position, and the aileron droop as follows: on aircraft before AFC 534, the ailerons remain in the nondrooped position (if normal flap extension preceded emergency extension, the ailerons would return to nondrooped condition). On aircraft after AFC 534, with the emergency aileron droop switch in NORMAL (ON after AFC 599 or AFC 612), the ailerons move to the drooped position. With the switch in DISABLE (OFF after AFC 599 or AFC 612) before emergency flap operation, the ailerons remain in the nondrooped position; however, if during emergency flap operation aileron droop is not desired, placing the switch to DISABLE (OFF after AFC 599 or AFC 612) will return the ailerons to a nondrooped condition.

WARNING

If flaps are lowered pneumatically, they will eventually retract (blow up) as pneumatic system pressure decays. The duration of pneumatic flap extension varies as a function of system integrity and cannot be predicted. Prior coordination between the aircrew and the controllers is necessary to minimize the time that flaps are pneumatically extended prior to landing. On F-4S's, slats will remain in the extended position even if pneumatic pressure is lost.

2.17.5 Flap Position Indicator. The leading edge and trailing edge flap indicators (Figure FO-1) are on the left vertical panel in the pilot cockpit. The indicators work in conjunction with position switches on the leading and trailing edge flaps. The position of the flaps is indicated by drum dials viewed through cutouts in the instrument panel. With flaps up, the word UP appears on the indicators; flaps in transit is indicated by a barberpole; half flaps is indicated by the fraction 1/2 appearing on the drum dial for the trailing edge flaps only; with flaps down, the letters DN appear on the indicators. On aircraft before AFC 534, the trailing edge flap indicator will show barberpole following pneumatic flap extension. On aircraft after AFC 534, if the emergency aileron droop switch is in DISABLE (OFF after AFC 599 or AFC 612), the trailing edge flap indicator will show barberpole following pneumatic extension, but if the switch is in NORMAL (ON after AFC 599 or AFC 612), the trailing edge flap indicator will show 1/2.

CAUTION

Should the leading edge flaps indicate barberpole throughout all flap positions, this should be treated as a bleed air duct failure.

2.17.6 WHEELS Warning Light. The WHEELS warning light is on the upper left corner of the main instrument panel. The light flashes anytime the flaps are down and the landing gear handle is UP. Failure of the flasher may cause the light to illuminate steady.

2.17.7 Boundary Layer Control System. The boundary layer control system utilizes air bled from the 17th stage of the engine compressor. This air passes through ducts attached to the rigid part of the wing between leading edge flaps and the spar and between the trailing edge flap and the flap closure beam. Slots along the ducts behind the outboard and center panel leading edge flaps and in front of the trailing edge flaps direct laminar air over the wing and flaps when the flaps have deflected sufficiently to expose the slots. The high temperature and high velocity laminar air directed over the wings and flaps delay flow separation over the airfoil, hence reducing turbulence and drag. This results in a lower stall speed and therefore a reduction of landing speed. Leading edge BLC is operative in the 1/2 or full flap position. Trailing edge BLC is operative only when the flaps are in the full down position. BLC air is controlled by four valves, one in each leading edge duct and one in each trailing edge duct. The BLC valves are actuated by mechanical linkages connecting the valves to the flaps. The leading edge flap BLC valves open with the flap switch in the 1/2 or full flap position, and the trailing edge flap BLC valves open with the flap switch in the full flap position. On aircraft 155903ap, 157274ap and up, and all others after AFC 440, leading edge BLC can be shut off by placing the engine bleed air switch OFF.

CAUTION

- F-4J operation of the engine(s) with the flaps down and wings folded should be avoided to protect the leading edge BLC bellows from unrestrained heat expansion. If engine operation must be accomplished, power settings should be kept at a minimum.

- On aircraft 155903ap, 157274ap and up, and all others after AFC 440, if an engine is shut down, trailing edge BLC will be lost on the wing adjacent to the shutdown engine.

2.17.7.1 BLC MALFUNCTION Indicator Light. A BLC MALFUNCTION light (Figure FO-1) is on the telelight panel. The purpose of the light is to indicate a BLC valve malfunction in the 1/2 flaps or flaps up condition. The light illuminates when any one of the four BLC valves is not fully closed in the flap-up condition or when one of the trailing edge BLC valves open in the 1/2 flaps condition. It must be remembered that the illumination of the BLC MALFUNCTION light only indicates that a BLC valve has failed to close when the flaps are up or that a trailing edge BLC valve has opened with the flaps 1/2 down. No indication is provided for a completely inoperative system nor is there an indication provided for a BLC valve failing to open when the flaps are down. On aircraft 153071z through 153075z before AFC 263, the BLC MALFUNCTION light does not indicate a condition where the trailing edge BLC valves are open at half flaps.

2.17.8 Normal Operation. The leading edge flaps and aileron droop actuators are operated by the use of a manifold-mounted selector valve and single-acting actuators, while the trailing edge flaps employ the same manifold-mounted selector valve, a wing-mounted selector valve, and dual-acting actuators. Placing the flap switch in the 1/2 position energizes the manifold-mounted selector valve, allowing utility hydraulic pressure to lower the leading edge flaps full travel, the ailerons drooped 16-1/2° down, and the trailing edge flaps to 1/2 down. Further movement of the switch to the DN position energizes the wing-mounted selector valve resulting in complete extension of the trailing edge flaps. Immediate movement of the switch from the UP position to the DN position causes both selector valves to become energized simultaneously, thereby completely extending the leading and trailing edge flaps and ailerons. The limit switches, provided on each flap, are all connected in parallel to deenergize the electrical circuits to the selector valves after all flaps are retracted. The electrical circuits are continuously energized to maintain hydraulic pressure on flaps down. Should the cockpit switch inadvertently be left in the down position, the leading and trailing edge flaps and ailerons are protected from structural damage by an airspeed pressure switch which operates the common solenoid selector valve. This switch is set so as to limit the maximum speed before automatic retraction between 230 and 244 knots. During deceleration, the flaps automatically extend (providing the flap switch is down) between 234 and 210 knots. Normal flap and aileron extension is accomplished in approximately 8 seconds and retraction in approximately 6 seconds. On aircraft 154786ag and up, the aileron droop is actuated electrically; however, the normal operation is the same.

WARNING

A pitot static system malfunction while in the landing configuration may give erroneous high airspeed indications to flap pressure switch and cause uncommanded flap retraction. Subsequent aircraft settle/deceleration will require immediate pilot response to preclude aircraft stall.

CAUTION

The airspeed switch receives its sensing pressure through the pitot system. If the pitot tube becomes clogged, erroneous indications will be sensed by the flap pressure switch as well as the ADC. It is therefore possible to lower the flaps by the normal means at excessive airspeeds. Conversely, if the flap blowup switch continually senses an erroneous airspeed greater than 230 to 240 knots, the flaps will not lower when selected normally. Breaking the rear cockpit airspeed indicator glass has proven effective in bleeding pressure from the airspeed indicating system, enabling normal flap lowering.

2.17.9 Emergency Operation. If normal wing flap operation fails, the flaps can be lowered by pulling the flap circuit breaker and pulling full aft on the emergency extension handle. The flap circuit breaker must be pulled prior to lowering the flaps by the emergency system. This causes the flap hydraulic selector valve to return to its full trail position, blocking hydraulic pressure to the flap actuators and ensuring that hydraulic fluid will not be forced into the actuators on top of pneumatic pressure. Once the emergency wing flap extension handle has been pulled, it should be left in the full aft position. Returning the handle to its normal position allows the compressed air from the flap down side of the actuating cylinder to be vented overboard, and the flaps are blown up by the airstream. If the flaps are inadvertently extended in flight by emergency pneumatic pressure, they must be left in the extended position until postflight servicing. If retraction in flight is attempted, rupture of the utility reservoir could occur with subsequent loss of the utility hydraulic system. When the flaps are lowered by the emergency system, the aileron droop action is as follows:

On aircraft before AFC 534, the ailerons remain in the nondrooped position.

On aircraft after AFC 534, the ailerons will droop if the emergency aileron droop switch is in NORMAL (ON after AFC 599 or AFC 612). If the emergency aileron droop switch is in DISABLE (OFF after AFC 599 or AFC 612), the ailerons remain in the nondrooped position.

CAUTION

Pull the flap circuit breaker prior to extending the flaps by the emergency system.

Note

- Any pneumatic extension of the wing flaps shall be logged on the yellow sheet (OPNAV form 3760-2).
- On aircraft before AFC 534, the trailing edge flap indicator will show barberpole following pneumatic flap extension. On aircraft after AFC 534, the trailing edge flaps will show barberpole following pneumatic flap extension if the emergency aileron droop switch is in DISABLE (OFF after AFC 599 or AFC 612), but will show 1/2 if the switch is in NORMAL (ON after AFC 599 or AFC 612).

2.17.10 Limitations. Do not attempt to lower flaps above 250 KCAS.

2.18 FLAPS/SLATS (F-4S)

2.18.1 Description. The flap and slat system is an integrated system that provides an automatic slat configuration for in-flight maneuvering and a selective flap/slat configuration for takeoff and landing. Each wing has two leading edge slats, one leading edge flap, one trailing edge flap, and aileron droop. The flaps/slats are electrically selected through a solenoid operated selector valve (essential 28 vdc) and hydraulically actuated (utility hydraulic system). The slats incorporate an overcenter feature which mechanically locks them in either the retracted or extended position. The flap actuators incorporate an integral lock for the retracted position; however, hydraulic or pneumatic pressure must be available to hold the extended position. The aileron droop actuators are either hydraulic/pneumatic or electromechanical. The hydraulic/pneumatic actuators are spring loaded up and require hydraulic or pneumatic pressure to maintain the drooped position. The electromechanical actuators are powered by the right 115-vac bus and are mechanically locked in the retract or extend position. If the normal system fails, the flaps/slats can be extended by an emergency pneumatic system with or without aileron droop at the pilot's option. Two airspeed switches protect the flaps/slats from structural damage if they are inadvertently left extended above their structural airspeed limit. Refer the Figure 2-21 for flap/slat operation.

2.18.2 Selective Flaps/Slats. For takeoff and landing, the flaps/slats operate together and are controlled by a flaps/slats switch in the front cockpit (Figure FO-1). To guard against a no-flap takeoff, a FLAPS UP light on the telelight panel comes on anytime the nose gear is down and locked, weight is on the main gear, and the trailing edge flaps are up. The normal takeoff position of the flaps/slats switch is 1/2-OUT.

2.18.3 Maneuvering Slats. With the flap/slat switch in UP-NORM, the maneuvering slats operate automatically as a function of AOA. As AOA is increased to approximately 11.5 units, the slats extend and remain extended until the AOA is reduced to approximately 10.5 units. If desired, the slats may be extended or retracted (regardless of AOA) by selecting OUT or IN on the slats override switch. If OUT is selected and the airspeed is increased above approximately 568 to 602 knots, the slats will automatically retract.

2.18.4 Flap/Slat Switch. The flap/slat switch (Figure FO-1) is mounted above the left console outboard of the throttles. The three-position switch is shaped like an airfoil for touch identification and has positions of UP-NORM, 1/2-OUT, and DN-OUT. Selecting 1/2-OUT moves the slats out, droops the ailerons, and moves the trailing edge flaps to 1/2. Selecting DN-OUT moves the trailing edge flaps to the fully extended position. Placing the flaps/slats to UP-NORM simultaneously returns all the slats, flaps,

FLAPS/SLATS NORMAL CONTROL SYSTEM OPERATION					
FLAPS/SLATS CONTROL SWITCH POSITION	SLATS OVERRIDE SWITCH	TRAILING EDGE FLAP POSITION	LEADING EDGE SLATS	AILERON POSITION (STICK NEUTRAL)	FLAPS/SLATS POSITION INDICATOR INDICATION
UP–NORM	NORM	FULL UP	IN	UP	LE: IN, TE: UP △1
1/2–OUT	NORM	1/2 DOWN	OUT	BOTH AILERONS DOWN 16 1/2°	LE: OUT, TE: 1/2
DN–OUT	NORM	FULL DOWN	OUT	BOTH AILERONS DOWN 16 1/2°	LE: OUT, TE: DN
UP–NORM	OUT △2	FULL UP	OUT	UP	LE: OUT, TE: UP △1
DN–OUT	IN △2	FULL DOWN	IN	BOTH AILERONS DOWN 16 1/2°	LE: IN, TE: DN

FLAPS/SLATS EMERGENCY CONTROL SYSTEM OPERATION					
FLAPS/SLATS EMERG CONTROL HANDLE POSITION	TRAILING EDGE FLAP POSITION	LEADING EDGE SLATS	AILERON POSITION (STICK NEUTRAL)	EMERGENCY AILERON DROOP SWITCH POSITION	FLAPS/SLATS POSITION INDICATOR INDICATION
FORWARD NORMAL POSITION	SHOULD AGREE WITH FLAPS/SLATS CONTROL SWITCH POSITION				
HANDLE PULLED AFT	1/2 DOWN	OUT	BOTH AILERONS NEUTRAL	OFF	OUT
HANDLE PULLED AFT	1/2 DOWN	OUT	BOTH AILERONS DOWN 16 1/2°	ON	OUT 1/2

△1 FLAPS UP LIGHT WILL COME ON

△2 SLATS MANUAL LIGHT WILL COME ON

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Figure 2-21. Flaps/Slats Operation

and ailerons to the retract position and the slats then operate automatically as a function of AOA.

2.18.5 Slats Override Switch. The slats override switch (Figure FO-1) is located on the auxiliary armament panel. The three-position cover-guarded switch has positions of OUT, NORM, and IN. With the switch in NORM, the slats operate as previously described using the flaps/slats switch or as a function of AOA. When IN is selected, the slats retract, if extended, and remain retracted regardless of AOA or flaps/slats switch position. When OUT is selected, the slats extend, if retracted, and remain extended (provide airspeed is below blow up speed) regardless of AOA or flaps/slats switch position. Anytime the switch is not in NORM, a SLATS MANUAL light on the telelight panel will come on.

2.18.6 Emergency Flap/Slat Extension Emergency extension of the flaps/slats is accomplished pneumatically. High-pressure air (approximately 3,000 psi), stored in a 300-cubic-inch air bottle, is released to extend the flaps/slats by pulling the flap/slat circuit breaker and pulling full aft on the emergency flap/slat extension handle (Figure FO-1). The handle is airfoil shaped and is painted in alternating black and yellow stripes for ease of identification. Emergency extension of the aileron droop is accomplished with the same pneumatic air as the slats/flaps. However, on aircraft through 154785af, the high-pressure air goes to the aileron droop actuator for extension; on aircraft 154786ag and up, the high-pressure air goes to a pressure switch that completes an electrical extend circuit to the electromechanical droop actuators. An emergency aileron droop switch on the left utility panel gives the pilot the option of selecting or rejecting aileron droop during emergency flaps/slats extension. With the switch OFF, the ailerons remain in the nondrooped position. With the switch ON, the ailerons move to the drooped position. If aileron droop is not desired after they were extended, placing the switch to OFF will return the ailerons to the nondrooped position.

Note

The flaps/slats, once extended pneumatically, will not be retracted through action of the flaps or slats airspeed blow up switches. The flaps may be retracted to a low-drag trail position by resetting the emergency flap/slat extension handle; however, since the slats have overcenter locks, they will not retract.

WARNING

If flaps are lowered pneumatically, they will eventually retract (blow up) as pneumatic system pressure decays. The duration of pneumatic flap extension varies as a function of system integrity and cannot be predicted. Prior coordination between the aircrew and the controllers is necessary to minimize the time that flaps are pneumatically extended prior to landing. On F-4S's, slats will remain in the extended position even if pneumatic pressure is lost.

2.18.7 Emergency Aileron Droop. The emergency aileron droop system provides selectable aileron droop with emergency flap/slat extension. The system is controlled by a lever-locked switch on the left utility panel and has position of OFF and ON. The switch is locked in the OFF position and must be lifted to select ON. On aircraft through 154785af with the switch in OFF, the emergency aileron droop selector valve is deenergized closed and pneumatic air will not go to the aileron droop actuator when the flaps/slats are extended by the emergency system. With the switch in ON, the emergency selector valve is energized open and pneumatic air passes through to the aileron droop actuator. On aircraft 154786ag and up with the switch in OFF, the electrical extend circuit activated by the flap/slat emergency extension system is electrically switched to a retract circuit and prevents the electromechanical actuators from extending. With the switch ON, the electrical extend circuit activated by the flap/slat emergency extension system remains unchanged and the electromechanical actuators extend. On all aircraft, the aileron droop actuators position control levers on the aileron power control cylinders which enables PC-1 pressure to droop the port aileron and PC-2 pressure to droop the starboard aileron. Emergency aileron droop may be rejected (before or after extension) by placing the switch to OFF.

WARNING

With emergency aileron droop selected and the flaps/slats pneumatically extended, a PC system failure will cause a split aileron droop condition and possible loss of control.

Emergency Condition	Aileron Droop Control	
	Electric	Pneumatic
RAT	Will not droop	Droop selectable
Total electrical failure	Will not droop	Will not droop
RH GEN out, bus tie open	Will not droop	Droop selectable
LH GEN out, bus tie open	Droop selectable	Will not droop

2.18.8 Flaps/Slats Position Indicators. The flaps/slats indicators (Figure FO-1) are on the left vertical panel. The indicators work in conjunction with position switches on the slats and trailing edge flaps. The position of the flaps/slats is indicated by drum dials viewed through cutouts in the instrument panel.

2.18.8.1 Selective Flaps. With the flaps/slats switch in UP-NORM and the flaps/slats up, the left indicator displays UP IN and the right indicator displays UP. With 1/2-OUT selected and slats out, ailerons drooped and trailing edge flaps 1/2, the left indicator displays DN OUT and the right indicator displays 1/2. With DN-OUT and slats out, all flaps fully down and ailerons drooped, the left indicator still displays DN OUT and the right indicator displays DN. Flaps/slats in transit is indicated by a barberpole. In addition, anytime the trailing edge flaps are at 1/2 or DN and the ailerons are not drooped, the right indicator will display barberpole.

2.18.8.2 Maneuvering Slats. With UP-NORM selected and AOA below 10.5 units, the left indicator displays UP IN and the right indicator displays UP. With AOA above 11.5 units, the left indicator displays UP OUT and the right indicator displays UP. Slats in transit is indicated by a barberpole.

2.18.9 WHEELS Warning Light. The WHEELS warning light is on the upper left corner of the main instrument panel. The light flashes anytime the flaps/slats are down and the landing gear handle is UP. Failure of the flasher may cause the light to come on steadily.

2.18.10 Boundary Layer Control System. The boundary layer control system utilizes air bled from the 17th stage of the engine compressor. This air passes through ducts between the trailing edge flap and the flap closure beam. Slots along the ducts in front of the trailing edge flaps direct laminar air over the flaps when the flaps have deflected sufficiently to expose the slots. The high temperature and high velocity laminar air directed over the flaps delay flow separation over the airfoil, hence reducing turbulence and drag. This results in a lower stall speed and therefore a reduction of landing speed. BLC is operative only when the trailing edge flaps are in the full down position. BLC air is controlled by two valves, one in each trailing edge duct. The BLC valves are actuated by mechanical linkages connecting the valves to the flaps.

CAUTION

If an engine is shut down, trailing edge BLC will not be available to or will be lost on the wing adjacent to the shutdown engine.

2.18.10.1 BLC MALFUNCTION Indicator Light. A BLC MALFUNCTION light (Figure FO-1) is on the telelight panel. The purpose of the light is to indicate a BLC valve malfunction in the 1/2-OUT or UP-NORM condition. The light illuminates when either of the two BLC valves is not fully closed in the 1/2-OUT or UP-NORM condition. It must be remembered that the illumination of the BLC MALFUNCTION light only indicates that a BLC valve has failed to close when the flaps/slats are UP-NORM or that a BLC valve has opened with the flaps/slats 1/2-OUT. No indication is provided for a completely inoperative system, nor is there an indication provided for a BLC valve failing to open when the trailing edge flaps are down.

2.18.11 Normal Operation. Normal operation of the flaps/slats is by utility hydraulic pressure. The three position flap/slat switch provides selective flaps/slats for takeoff and landing or maneuvering slats as a function of AOA. Placing the switch to 1/2-OUT, selects slats out, trailing edge flaps 1/2 down, and drooped ailerons. Selecting DN-OUT maintains all the above positions, except the trailing edge flaps move to the full down position. Placing the switch to UP-NORM retracts all slats/flaps and aileron droop and the slats then operate as a function of AOA. Should the flaps/slats switch be left in any position but UP-NORM, a flap airspeed switch will automatically retract the flaps and ailerons at approximately 230 to 240 knots. The slat airspeed switch will automatically retract the slats at approximately 586 to 602 knots.

WARNING

A pitot static system malfunction while in the landing configuration may give erroneous high airspeed indications to flap pressure switch and cause uncommanded flap retraction. Subsequent aircraft settle/deceleration will require immediate pilot response to preclude aircraft stall.

CAUTION

The airspeed switches receive their sensing pressure through the pitot system. If the pitot tube becomes clogged, erroneous indications will be sensed by the pressure switches as well as the ADC. It is therefore possible to lower the flaps/slats by the normal means at excessive airspeeds. Conversely, if the flap blowup switch continually senses an erroneous airspeed greater than 230 to 240 knots, the flaps will not lower when selected normally. Breaking the rear cockpit airspeed indicator glass has proven effective in bleeding pressure from the airspeed indicating system, enabling normal flap lowering.

2.18.12 Emergency Operation. If normal selective flap/slat operation fails, the flaps/slats can be lowered by pulling the flap/slat circuit breaker and pulling aft on the emergency extension handle. The flap/slat circuit breaker must be pulled prior to lowering the flaps/slats by the emergency system. This causes the hydraulic selector valves to return to full trail position, blocking hydraulic pressure to the flap/slat actuators, and ensuring that hydraulic fluid will not be forced into the actuators on top of pneumatic pressure. Once the emergency flap/slat extension handle has been pulled, it should be left in the full aft position. Returning the handle to its normal position allows the compressed air from the flaps/slats downside of the actuating cylinder to be vented overboard, and the flaps are blown up by the airstream; however, the slats are locked out by an overcenter device and they will remain out. If the flaps/slats are inadvertently extended in flight by emergency pneumatic pressure, they must be left in the extended position until postflight servicing. If retraction in flight is attempted, rupture of the utility reservoir could occur with subsequent loss of the utility hydraulic system. When the flaps/slats are lowered by the emergency system, the aileron droop action is as follows.

If the emergency aileron droop switch is OFF the ailerons will not droop. If the switch is ON, the ailerons will droop.

CAUTION

Pull the flap/slat circuit breaker prior to extending the flaps by the emergency system.

Note

- Any pneumatic extension of the flaps/slats shall be logged on the yellow sheet (OPNAV form 3760-2).
- The trailing edge flaps will show barberpole following pneumatic flap extension if the emergency aileron droop switch is in the OFF position.

2.18.13 Limitations. Do not attempt to lower flaps above 250 KCAS.

2.19 FLIGHT CONTROLS

2.19.1 Description. The aircraft primary flight controls consist of the stabilator, rudder, ailerons, and spoilers, The stabilator, ailerons and spoilers are actuated by irreversible, dual power cylinders. The rudder is actuated by a conventional, irreversible power cylinder. Artificial feel systems provide simulated aerodynamic control stick and rudder pedal forces because of the lack of aerodynamic feedback forces from the power control cylinders. The feel systems have trim actuators which, through the power cylinders, move the entire control surface. Secondary controls are leading edge flaps, trailing edge flaps, slats (F-4S), and wing-mounted speedbrakes. See Figure 2-22.

2.19.2 Lateral Control System. The lateral control system (Figure 2-22), an aileron-spoiler combination, basically consists of the control stick; left and right push-pull rod systems; left and right walking beam bellcranks; aileron dual power cylinders with integrated control valves; spoiler dual control valves; left and right autopilot series servos; left and right lateral feel trim actuators; and a left and right aileron droop actuating cylinder. The ailerons travel downward 30° from a full trail position. Upward travel is limited to 1°. The spoilers travel upward, 45° from a flush contour position in the upper wing surface. Lateral movement of the control stick is transmitted mechanically by the push-pull rods through the walking beam bellcranks to the spoiler and aileron control valves. The control valves meter hydraulic fluid to their respective dual power cylinders in proportion to the mechanical displacement. An override spring cartridge is incorporated into the left and right push-pull rod systems. In the event one side becomes jammed, the override spring will deflect under force, allowing operation of the other lateral control surfaces. The walking beam bellcranks receive control surface movement inputs from three sources: the control stick, the lateral trim system, and the autopilot series servos. A self-serviced hydraulic damper, attached to the aileron backup structure, is utilized as an up-stop for the aileron as well as a flutter damper. The control system uses dual power cylinders to provide the ailerons and spoilers with three independent sources of hydraulic pressure. PC-1 and utility systems provide hydraulic pressure to the left aileron and spoiler, and PC-2 and utility systems provide hydraulic pressure to the right aileron and spoiler. If a single hydraulic system fails, the remaining system(s) supply adequate power for control.

2.19.2.1 Aileron Control. The ailerons are controlled by dual, irreversible, power cylinders that receive metered hydraulic fluid from dual integrated control valves. The control valves, in turn, are controlled by the push-pull rods, through the walking beam bellcranks, and control stick. Each power cylinder contains four parallel inner cylinders with rods and pistons. The piston rods are joined at one end by a yoke that is attached to the aircraft structure. The cylinder portion of the power cylinder is attached to the aileron. The two outer cylinders of the left aileron and spoiler receive hydraulic fluid from the utility system, and the two inner cylinders receive hydraulic fluid from PC-1. The two outer cylinders of the right aileron and spoiler receive hydraulic fluid from PC-2, and the two inner cylinders receive hydraulic fluid from the utility system. This arrangement provides symmetrical loading of the yoke should one of the systems fail. The ailerons deflect 16-1/2° down when 1/2 or full flaps are selected. This is accomplished by utilizing an aileron droop actuating cylinder which repositions a bellcrank pivot point when flaps are selected. As the bellcrank pivot point is repositioned, linkage to the aileron control cylinder is deflected which, in effect, tells both ailerons that 16-1/2° of travel is required. Even though the ailerons are drooped, they will continue to function as originally designed except that the ailerons neutral point will be 16-1/2° down and any aileron movement will take place around this new neutral point. Aileron deflection up for a particular manuever will be as much as 16-1/2° back to the streamlined position instead of 1° up as is the case without the ailerons drooped. For instance, if the control stick is moved 5° to the right with the flaps half or full down, requiring 6-7/8° of aileron, the right aileron will raise 8-1/4° from the 16-1/2° position while the left aileron will deflect an additional 6-7/8° and assume a 23-3/8° down position. Therefore, the ailerons will move essentially in the same manner as the nondrooped ailerons; however, the aileron neutral point will be 16-1/2° lower. The aileron droop cylinder is positioned by utility hydraulic pressure. On aircraft 154786ag and up, the aileron droop cylinder is positioned by electromechanical droop aileron actuator.

2.19.2.2 Spoiler Control. Each wing contains two spoiler surfaces, two spoiler power cylinders, and a dual spoiler control valve. Each surface has a dual, irreversible power cylinder with a feedback linkage to a dual spoiler control valve. The spoiler control valve divides each power control system input into equal parts which is then distributed to each spoiler dual power cylinder. One portion of each power cylinder of the right wing receives hydraulic pressure from PC-2, and the other portion receives hydraulic pressure from the utility system. One portion of each power cylinder of the left wing receives hydraulic pressure from PC-1, and the other portion receives hydraulic pressure from the utility system. If one of

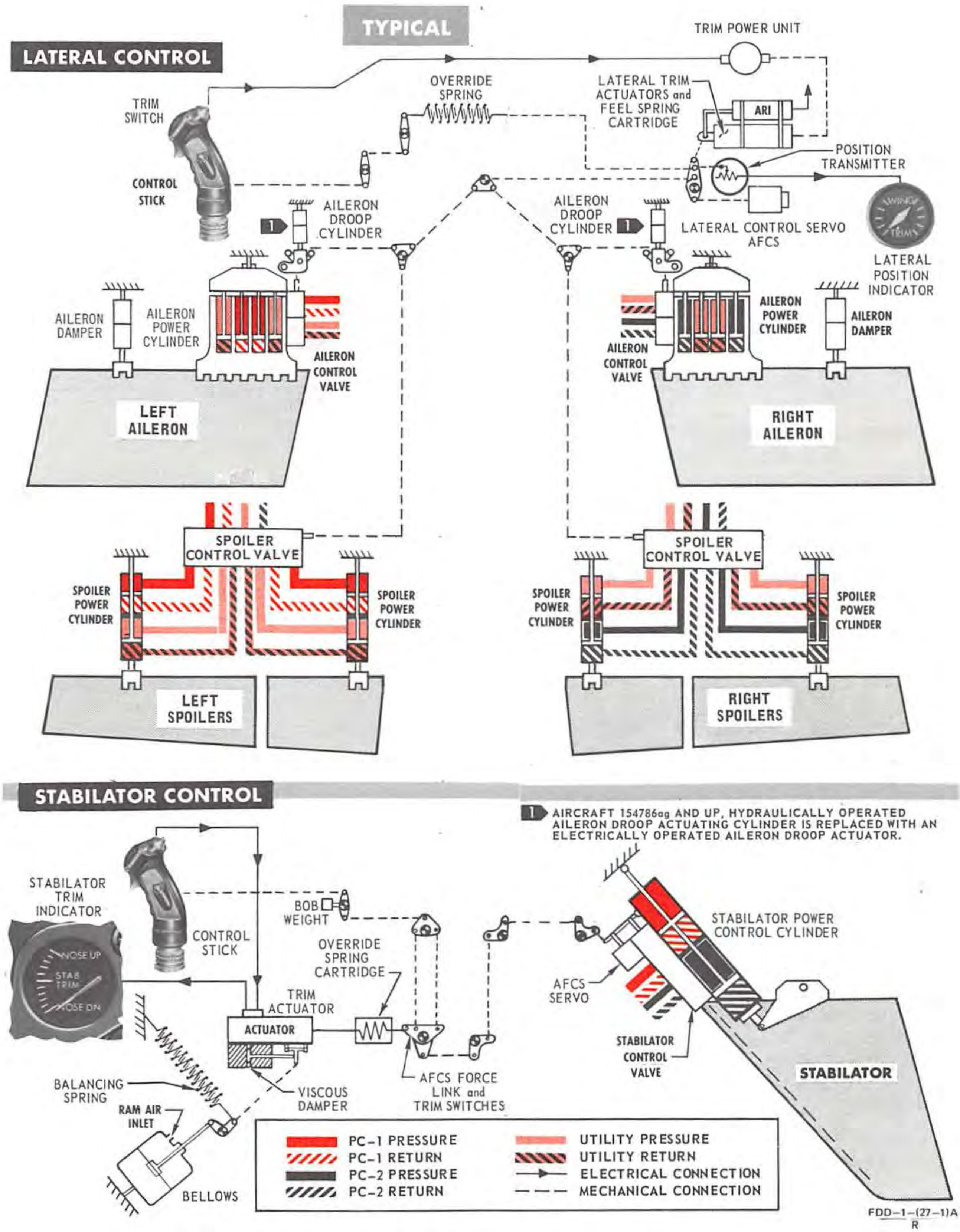


Figure 2-22. Flight Controls (Sheet 1 of 2)

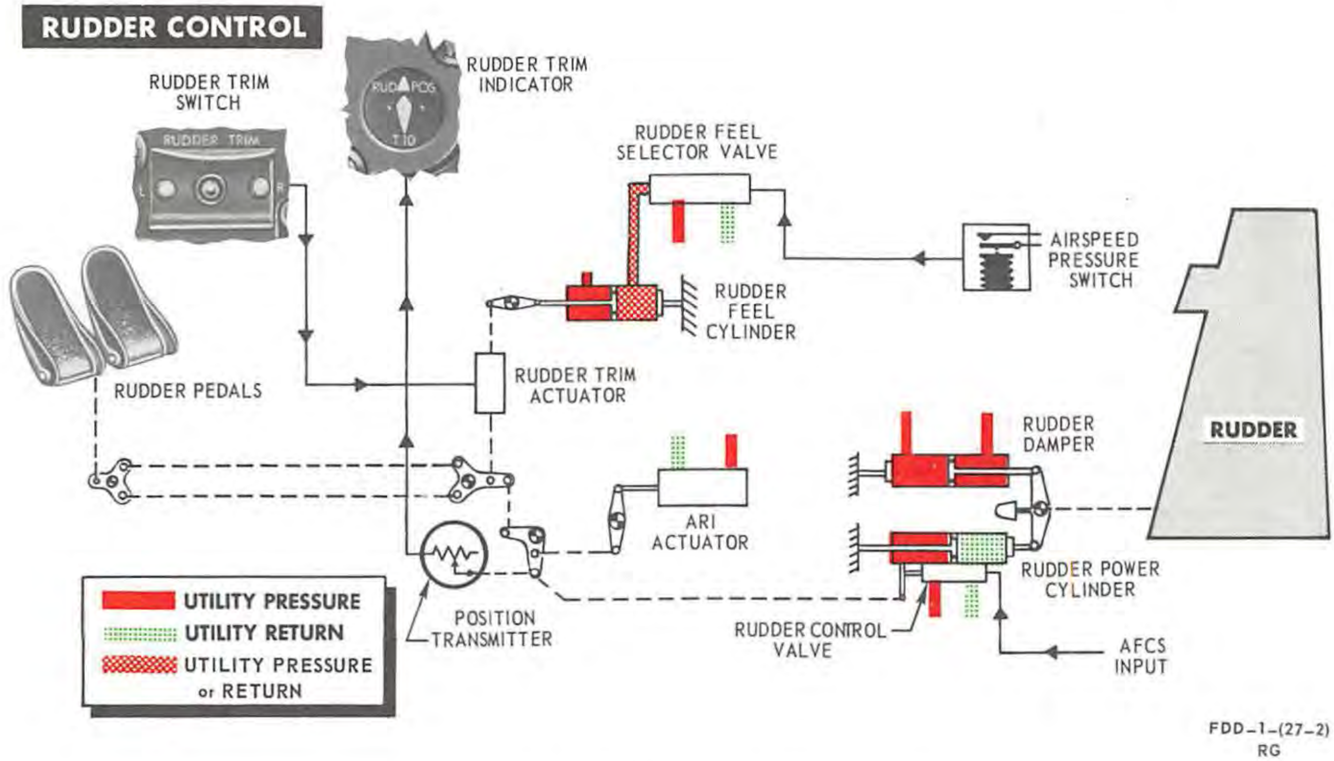


Figure 2-22. Flight Controls (Sheet 2 of 2)

the systems fails, the other(s) supply adequate pressure for spoiler control.

2.19.2.3 Lateral Control Feel and Trim System. The lateral trim system consists of the trim switch (Figure 2-22), a rotary power unit, two flexible driveshafts, and two screwjack actuators. When the trim switch is energized, the rotary power unit and flexible driveshafts position the screwjack actuators. The screwjack actuators are connected to the aircraft structure on one end and the walking beam bellcranks on the other end. As the screwjack actuators extend and retract, the lateral controls are repositioned and the control stick follows the trim movements. Lateral control artificial feel is provided by double-action spring cartridges connected in tandem with the screwjack actuators. When the control stick is moved from neutral, the springs are compressed. The farther the control stick is moved from the neutral, the greater the force required to compress the springs. The spring cartridges return the control stick to neutral when the force on the control stick is removed.

2.19.2.4 Aileron Position Indicator. An aileron position indicator (Figure FO-1) is on the left vertical panel in the front cockpit. A transmitter is mechanically connected to the lateral control linkage in the left wing. As the control linkage moves, the mechanical input is converted into electrical impulses which are sent to the position indicator. The indicator, marked in units of percent of system travel, represents actual control surface position. A wings level indication is zero trim, and a full down left or right indication is maximum trim travel. The maximum lateral trim available is 33-percent.

2.19.3 Stabilator Control System. Longitudinal control is provided by a single unit horizontal tail surface (stabilator) that is actuated by an irreversible dual power cylinder. A slotted stabilator is provided to increase stabilator effectiveness and thereby counters the nosedown pitching moment caused by the drooped ailerons. The stabilator control system components include the control stick, push-pull rods, cables, bellcranks, integrated control valve, and an irreversible dual power cylinder. Additional components include a ram air bellows and 5-pound-per-g bobweight for system artificial feel, a trim actuator, and an AFCS servo that is integral with the control valve. When the control stick is moved longitudinally, the motion is transmitted by push-pull rods to a bellcrank. It is then transmitted by a cable assembly to another push-pull rod set. The second push-pull rod set actuates the control valve which meters hydraulic fluid to the dual power cylinder. Hydraulic pressure to the stabilator power cylinder is supplied by both power control hydraulic systems. If one of the power control hydraulic systems should fail, the remaining system will provide adequate control response. A hydraulic AFCS servo is integrated into the stabilator dual servo valve. It positions the dual servo valve in the same manner as control stick inputs. As a result, when the autopilot signals for a pitch attitude change, the control stick will follow the movement. The bobweight in the control linkage also increases stick forces proportionately to increases in g forces.

2.19.3.1 Stabilator Control Feel and Trim System. Artificial feel is provided by a dynamic (ram air) pressure bellows acting through a variable bellcrank on the stabilator trim actuator and a 5-pound-per-g bobweight. When the aircraft is in trim, the ram air force on the bellows is balanced by the bobweight. As the aircraft increases or decreases in airspeed, the pressure on the bellows changes, causing the bellows bobweight assembly to become off balance. The off-balance condition is then transmitted through the trim actuator, control cables, and push-pull rods back to the control stick. Actuating the trim switch causes the stabilator trim actuator to move, balancing the forces between the bellows and the bobweight, thereby eliminating force on the control stick. A viscous damper, attached to the trim actuator, prevents abrupt control surface movements by increasing control stick forces with rapid stick movements. An override spring cartridge allows the feel and trim portion of the stabilator control system to be bypassed in the event of a noseup trim malfunction (runaway trim and/or bellows diaphragm failure). A heater is installed in the bellows ram air inlet probe and venturi to prevent freezing of moisture which causes restriction of airflow in these units. The heaters are controlled by the pitot heat switch on the right console (Figure FO-1).

2.19.3.2 Stabilator Trim Position Indicator. The stabilator trim indicator (Figure FO-1) is on the left vertical panel in the front cockpit. It is directly controlled by a transmitter which is integral with the stabilator feel trim actuator. The indicator, marked in units of percent of trim, represents trim actuator position.

Note

F-4S slatted aircraft (AFC 601, part 2 installed) incorporate a noseup shift in trim limits in comparison with F-4J aircraft. All F-4J aircraft recommended trim settings are consequently reduced by one unit for F-4S slatted aircraft.

2.19.4 Control Stick. The control stick, consisting of a stick grip and motional pickup transducer, is mounted in a yoke to permit left, right, fore, and aft movement. The control stick grip contains five controls: a four-way trim switch, a bomb and centerline store release button, a nose gear steering/heading hold cutout button, a missile trigger switch, and an emergency disengage switch. On F-4J 158355at and up or after AFC 506 and all F-4S, a weapon select switch and a target slave and acquisition switch is added; the nose gear steering/heading hold cutout button is relocated to the lower part of the stick grip. The motional pickup transducer is utilized in conjunction with the automatic flight control system to provide control stick steering. The nose gear steering button also functions as a heading hold cutout button for the automatic flight control system. Refer to Figure 2-23 for the location of the control stick grip controls.

2.19.5 Rudder Control System. The rudder control system consists of the rudder pedals, push-pull rods, cable assemblies, bellcranks, a rudder feel trim system, an aileron-rudder interconnect actuator, a rudder damper, and an irreversible power cylinder with integral control valve. When the rudder pedals are moved, the motion is transmitted by the push-pull rods, bellcranks, and cable assemblies to the control valve of the power cylinder. The control valve meters utility system hydraulic fluid to the power cylinder which positions the rudder. It is possible to have limited mechanical authority over the rudder if a utility hydraulic system failure occurs. A bypass valve in the power cylinder opens when system pressure is lost, allowing fluid to pass from one side of the cylinder to the other. Total amount of rudder deflection available is then a function of airloads on the rudder; however, under all speed conditions, it requires a considerable amount of pilot effort to manually deflect the rudder. A hydraulic servo for yaw damping and AFCS operation is incorporated into the control valve of the power cylinder. Operation of the AFCS, however, does not move the rudder pedals.

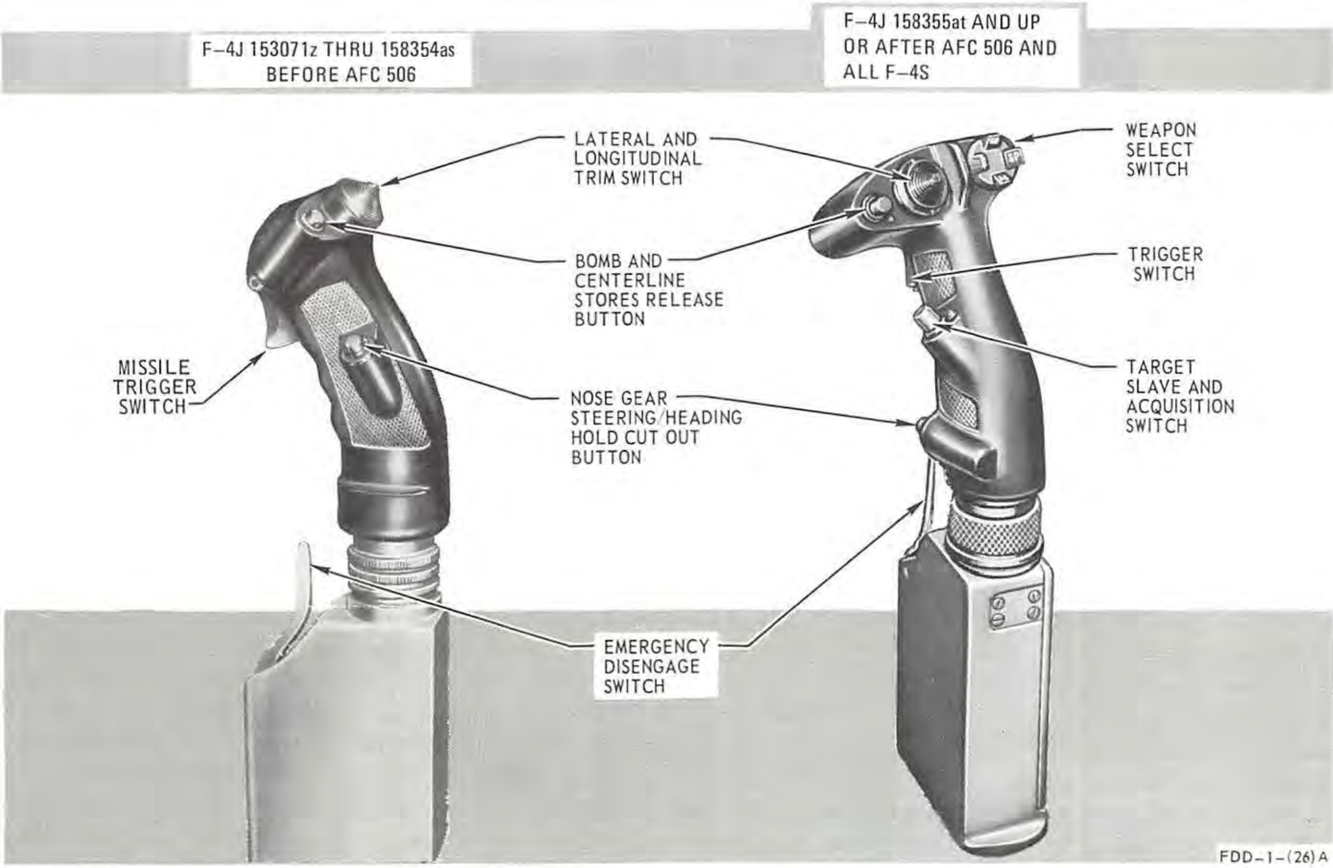


Figure 2-23. Control Stick Grips

2.19.5.1 Rudder Feel Trim System. Artificial feel is supplied to the rudder pedals by an artificial feel trim system. A hydraulic cylinder with utility system hydraulic pressure on both sides of a differential area piston provides a pedal force of approximately 2.6 pounds per degree of rudder deflection below an airspeed between 228 and 252 knots during acceleration and below an airspeed between 232 and 218 knots during deceleration. At the accelerating airspeed, a pressure switch in the pitot static system cuts off hydraulic pressure to the low area side of the piston and the pedal force becomes approximately 11.5 pounds per degree of rudder deflection. Use of trim switch on the console in conjunction with an electric trim actuator removes loads from the pedals after the rudder has been positioned to the proper flight attitude. Normal trim range is 7.5° (±1) of rudder deflection left and right.

CAUTION

In the event of a loss of the essential main 28-vdc bus while above approximately 235 KCAS, the rudder feel force of approximately 11.5 pounds per degree of rudder deflection automatically reverts to approximately 2.6 pounds per degree of rudder deflection. As a result, rudder pedal forces become more sensitive and excessive structural loads can be imposed on the aircraft if full rudder deflection is commanded.

2.19.5.2 Rudder Trim Switch. The rudder trim switch (Figure FO-1) is in the front cockpit on the inboard engine control panel. This switch controls the trim actuator in the rudder feel and trim system to trim the aircraft directionally.

2.19.5.3 Rudder Position Indicator. A rudder position indicator (Figure FO-1) is on the left vertical panel in the front cockpit. A transmitter is mechanically connected to the rudder control linkage. As the control linkage moves, the mechanical input is converted into electrical impulses which are sent to the indicator. The indicator is only marked for takeoff trim which is 0° of rudder deflection.

2.19.5.4 Rudder Pedals. The rudder pedals are conventional-type suspended units which are coupled to the rudder push-pull rod system by individual screwjacks. The screwjacks provide adjustment of the rudder pedals for comfort and are adjusted simultaneously by turning a crank on the pedestal panel. The pedals are also coupled to the power brake valves so that toe pressure on the pedal will apply the brakes. The rudder pedals are also used to control the nose gear steering unit when the nose gear steering button on the control stick grip is depressed.

2.19.5.5 Stall Warning Vibrator. A stall warning vibrator is on the front cockpit left rudder pedal to warn of approaching stall conditions. The vibrator is electrically connected to a switch in the angle-of-attack indicator which is set at 21.3 units. On F-4J 155529ag and up or after AFC 388 and all F-4S, the switch is set at 20.6 units. The stall warning vibrator motor is powered from the right main 28-vdc bus through the angle-of-attack probe heater circuit breaker in the rear cockpit G8, No. 1 panel (on F-4J 155529ag and up or after AFC 388 and all F-4S, K14, No. 1 panel). If the vibrator runs continuously, it may be rendered inoperative by pulling this circuit breaker.

2.19.6 Aileron Rudder Interconnect (ARI). The aileron-rudder interconnect system causes rudder displacement proportional to aileron displacement which provides coordinated turns at low airspeeds. The limits of the system are 15° of rudder displacement when the automatic flight control system is in the yaw stab aug mode, and 10° rudder displacement when the yaw stab aug switch is disengaged. Components of the system include the control amplifier, the 10° servo actuator, acting through a walking beam, an airspeed pressure switch, and two aileron transducers. The ARI circuit is completed through the flap blowup airspeed pressure switch. When the flap switch is in either the 1/2 or DN position with the airspeed pressure switch in the low airspeed position, 28-vdc is applied to engage relay solenoids of the ARI system. This allows the hydraulic 10° servo actuator to move the control linkage (if aileron displacement is present) and cause rudder displacement. The system can be disengaged by depressing the emergency disengage switch on the control stick; this will disengage yaw stab aug and the ARI only as long as it is held depressed. When the switch is released, the ARI (10°) and the yaw stab aug (5°) rudder authority will be regained. Regardless of the amount of ARI rudder authority engaged, the pilot can easily override the ARI system by pushing on the rudder pedals.

Note

> There are various in-flight situations where rudder jump will be experienced when the ARI system cuts in or out with a lateral input to the control stick. Rudder jumps are most apt to occur in situations where the flaps/slats are extended or retracted during a turn, such as retracting the flaps/slats during a climb out after takeoff or during a goaround. Assuming no manual rudder inputs, it is possible that after the flap/slat switch is placed to UP-NORM during a goaround; for example, the rudder can jump from a deflected position to neutral after the flap/slat switch is actuated. Another jump displacing the rudder back from neutral will then occur when the right hand trailing edge one half down limit switch closes. When the flaps go above the limits of the one half down limit switch, the rudder will again deflect to neutral. Sometimes the first jump just described will not occur because the one half down limit switch will not be open when flaps/slats UP-NORM is selected. Rudder jumps will also occur whenever the flap airspeed switch is actuated when the flaps limit speed is exceeded or by placing the flap/slat switch to DN-OUT or 1/2-OUT.

2.19.7 Roll Control Augmentation (RCA). On F-4S aircraft with IAVC 2557 installed, an RCA function is incorporated in the autopilot amplifier. The RCA function operates through the roll and yaw stability augmentation system in the landing configuration only. RCA quickens roll response slightly by boosting the aileron spoiler to stick gain and reduces adverse yaw buildup by coordinating rudder deflections with stick inputs and roll rate. RCA commanded aileron/spoiler surface deflections are reduced as roll rate increases. The limits of RCA authority are 6.5° aileron/11° spoiler displacement when roll stab aug is engaged and 5° rudder displacement when yaw stab aug is engaged. The 10° rudder displacement authority of the ARI system is retained as previously described. The RCA function is operable when the flaps switch is in the 1/2 or DN position and the airspeed pressure switch is in the low airspeed position.

2.19.8 Normal Operation. Normal operation of the flight controls is accomplished through the use of the control stick for longitudinal axis (ailerons) and lateral axis (stabilator) control and the rudder pedals for vertical axis control.

WARNING

With any uncommanded control stick movement or binding prior to flight, other than that associated with AFCS checkout, flight control malfunction should be assumed and the mission should be aborted.

2.19.9 Emergency Operation

2.19.9.1 Stabilator Feel Trim Failure

2.19.9.1.1 Partial Bellows Failure. Partial bellows failure is recognized by a mild nosedown stick force proportional to the airspeed unless the failure occurs during maneuvering flight, at which time it may not be noticeable. Reduction of stick centering and pitch stability will result. Should this failure occur, reduce airspeed to 250 to 300 KCAS, retrim the aircraft, avoid abrupt fore and aft stick movements, and land as soon as practicable.

2.19.9.1.2 Complete Bellows Failure. A complete bellows failure is recognized by a somewhat heavier nosedown feel force at the control stick. Stick force will never exceed approximately 5 pounds/g and this force cannot be trimmed out. Should a complete bellows failure occur, reduce airspeed to 250 to 300 KCAS, avoid abrupt fore and aft stick movements, and land as soon as practicable.

2.19.9.1.3 Ice/Water Blockage of Ram Air Line. The ram air bellows line is equipped with a heater which operates in conjunction with the pitot heat switch. With this arrangement, bellows line icing should not be encountered. If, however, the bellows line is allowed to ice up, the pilot will experience a situation similar to complete bellows failure. If ice or water blockage is suspected, ensure that the pitot heat switch is in the ON position and do not apply longitudinal trim to relieve control stick forces. The intermittent nature of this condition and the suddenness of return to normal can cause violent pitch transients. When the ram air line is blocked, no stick force gradient will be felt by the pilot should a change in stick position be required. If ice or water blockage of the ram air line occurs, reduce airspeed to 250 to 300 KCAS, maintain attitude by pilot effort, and, if practicable, descend to air that is above freezing. If the condition persists, land as soon as practicable.

2.19.9.1.4 Runaway Stabilator Trim. If stabilator trim appears to be running away, it is possible under certain conditions to lessen the situation. Runaway stabilator trim can be alleviated by engaging the autopilot, provided the stab trim circuit breaker has been pulled immediately upon detection of runaway trim, runaway trim is in the noseup direction, nosedown runaway trim has not exceeded 2-1/2 units, and airspeed is reduced to 300 KCAS or less. If the above conditions are met, engage the autopilot. When the autopilot is used to alleviate a runaway trim condition and excessive out-of-trim forces are present (full nose down runaway trim), the autopilot will alternately disengage and reengage. If this occurs, discontinue use of the autopilot and plan to land as soon as practicable. If the autopilot is still engaged when in the landing configuration (gear and flaps extended), grasp the control stick firmly and disengage the autopilot at 180 to 190 KCAS. Depending upon the severity of the malfunction, the aircraft may or may not be in trim; if out of trim, the forces should not be too high and the aircraft can be landed with the out-of-trim condition or the autopilot can be reengaged and the landing made with control stick steering. If the landing is made with autopilot engaged, disengage the autopilot immediately after touchdown to prevent damage to autopilot components.

2.19.9.1.5 ARI System Disengagement. The ARI system can be temporarily disengaged by depressing the emergency disengage switch; this will disengage the ARI and stab aug only as long as it is held depressed. To permanently disengage the ARI system, the circuit breaker on the left utility panel must be pulled and the yaw stab aug switch must be disengaged. Pulling the circuit breaker only and keeping the yaw stab aug engaged still provides 5° of ARI rudder authority. To permanently disengage the ARI while retaining complete stab aug, pull the rudder feel trim circuit breaker (G15, F-4J before AFC 388; B13, F-4J 155529ag and up or after AFC 388 and all F-4S; No. 1 panel). Pulling the rudder trim circuit breaker is the preferred method.

2.19.10 RCA Function Disengagement. The RCA function can be temporarily disengaged by depressing and holding the emergency disengage switch. To permanently disengage RCA, the roll and stab aug switches must be disengaged. To permanently disengage RCA while retaining complete stab aug, pull the rudder feel trim and bellmouth circuit breaker (B13, No. 1 panel).

2.19.11 Limitations. There are no specific limitations pertaining to the flight controls.

2.20 FUEL SYSTEM

2.20.1 Description

Note

> All fuel weights in this manual are based on JP-5 at 6.8 pounds per gallon.

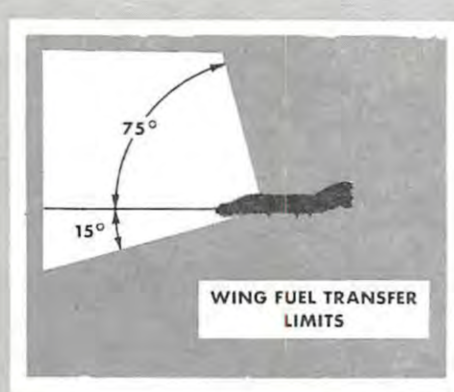
The fuel system (Figure FO-4) consists of seven interconnected fuel cells in the fuselage and two integral wet wing cells located in the wing torque boxes. Provisions are made for two externally mounted droppable wing tanks and a droppable fuselage centerline external tank which is interchangeable with a refueling tanker external store (hereafter referred to as buddy tank). Provisions are also made for an air refueling system. The function of fuselage cells Nos. 2, 3, 4, 5, 6, and 7 is to keep cell No. 1 supplied with fuel. See Figure 2-24 for fuel quantities. An air pressure fuel transfer system is provided to transfer wing and external tank fuel to the fuselage cells. Hydraulic and electric transfer pumps plus gravity feed are utilized to transfer fuel from the fuselage cells to No. 1 tank which is the engine feed tank. Single-point ground pressure fueling at the rate of approximately 1,700 pounds per minute may be accomplished. Two-point ground pressure fueling is available by using the air refueling probe. There are no gravity fueling or defueling provisions made for the internal or external fuel systems. Single-point defueling is accomplished by using the single-point fueling receptacle. All internal fuel cells incorporate capacitance-type fuel gauging units which continuously indicate the total fuel quantity in pounds in all internal cells. The fuel system is equipped with refueling level control valves which are float-type valves that shut off the pressure fueling when predetermined fuel levels are reached. All internal and external fuel tanks are pressurized in flight by regulated engine bleed air which is also utilized to transfer wing or external fuel to the fuselage cells or to dump wing fuel. The internal cells and external centerline tank or buddy tank are all vented to a common manifold which dumps overboard from the fuel vent mast located immediately below the rudder. The external wing tanks are vented to the wing cell dump lines. With the buddy tank installed, the aircraft becomes a tanker with the capabilities of transferring in flight a predetermined amount of its internal fuel supply (plus the buddy tank fuel supply) to a receiver aircraft or return transfer from the buddy tank to its own internal fuel supply.

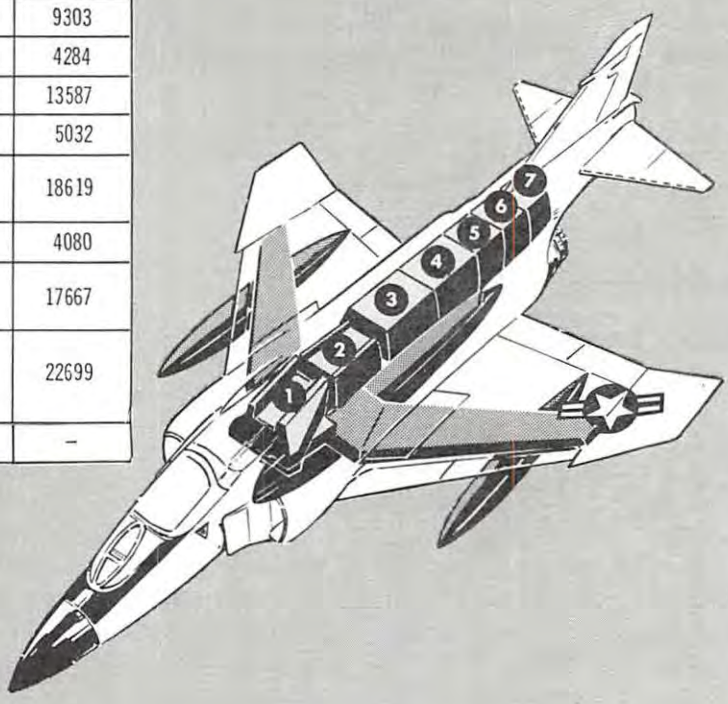
2.20.2 Fuel Boost System. Fuel is supplied to the engine during all flight attitudes by two submerged electric motor-driven centrifugal-type boost pumps. The left pump is a two-speed unit. During normal operation, both pumps operate at high speed. If a complete electrical failure or a double-engine failure occurs, extending the ram air turbine automatically switches the left pump from high to low speed and shuts off the right pump, thereby reducing a high amperage load and conserving electrical power and, at the same time, maintaining positive fuel pressure at the engine inlet. The boost pumps are in the engine feed (No. 1) tank. Both pumps are mounted on the bottom of the tank and provide for negative g requirements. Because of internal tank baffling and check valves, which trap approximately 905 pounds of fuel in the lower third of the tank during negative g flight, the boost pumps will always remain submerged and provide a continuous fuelflow to the engines. The two boost pumps operate when either engine master switch is ON, provided ac power is supplied to the system.

Note

> When the electrical fuel boost pumps are inoperative, gravity fuel is sufficient to maintain full military power at altitudes below 20,000 feet, provided no unusual attitudes and/or negative g conditions are present.

	FULLY SERVICED		USABLE FUEL	
	(GALLONS)	(POUNDS)	(GALLONS)	(POUNDS)
FUSELAGE CELL NO. 1			231	1571
CELL NO. 2			221	1503
CELL NO. 3			164	1115
CELL NO. 4			221	1503
CELL NO. 5			201	1367
CELL NO. 6			235	1598
CELL NO. 7			95	646
TOTAL FUSELAGE FUEL	139	9473	1368	9303
INTERNAL WING TANKS	638	4338	630	4284
TOTAL INTERNAL	2031	13811	1998	13587
EXTERNAL WING TANKS	744	5059	740	5032
INTERNAL FUEL PLUS EXT. WING TANKS	2775	18870	2738	18619
EXTERNAL CENTER TANK	602	4094	600	4080
INTERNAL FUEL PLUS EXT. CENTER TANK	2633	17905	2598	17667
MAX. FUEL LOAD TOTAL INTERNAL AND ALL EXTERNAL FUEL	3377	22964	3338	22699
TOTAL UNUSABLE	39	265	–	–





Note

FUEL WEIGHTS ARE BASED ON THE JP-5 AVERAGE WEIGHTS OF 6.8 POUNDS PER GALLON AT 60 DEGREES FAHRENHEIT.

FDD-1-(28)

Figure 2-24. Fuel Quantity Data

Note

In the event of a double-engine failure and loss of electrical power, extending the ram air turbine automatically switches the left boost pump to low speed and shuts off the right pump. The low-speed boost pump plus gravity feed will supply enough fuel pressure to the engine-driven fuel pumps to enable the engines to be started.

2.20.2.1 Boost Pump Pressure Indicators. The boost pump pressure indicator (Figure FO-1) are on the left console in the front cockpit. The gauge dials are calibrated from 1 to 5 with readings multiplied by 10. Pressure transmitters on the aircraft keel in the engine compartment measure pressure in the aircraft fuel system as it enters the engine fuel pump. This signal is transmitted to the indicators in the cockpit. Fuel pressure will increase or decrease with positive or negative g flight, respectively. This condition is normal and should be disregarded as long as fuel pressure is normal in 1g flight.

2.20.2.2 Fuel Boost Pump Check. It is possible for the pilot to check the operation of the fuel boost pumps through use of the fuel pump check switches.

The left and right boost pump check switches with a CHECK position and a spring-loaded NORMAL position are on the fuel control panel. On aircraft 155903ap and aircraft 157274ap and up, the left and right boost pump check switches are red press-to-check switches on the left utility panel (Figure FO-1). A boost pump check may be made only with external power applied to the aircraft, both engine master switches OFF, and the refuel/defuel switch (in the right wheel well) OFF. Holding either check switch in the CHECK position operates the corresponding left or right engine shutoff valve, allowing a pressure transmitter to pick up boost pump pressure. Fuel boost pump pressure transmitters transmit an electrical signal to the applicable pressure indicator on the left vertical panel. To perform a boost pump pressure check, operate each boost pump check switch individually and check for a reading of 30 (±5) psi on the applicable pressure indicator. Should fuel in cell No. 1 be less than approximately 1,000 pounds when the boost pump check is being performed, a low boost pump pressure reading may be experienced. In flight with the fuel tanks pressurized, if a reading of more than 4 psig above the reading is noted, the fuel cells are overpressurized and a malfunctioning pressure regulator and/or fuel vent valve should be suspected. The system should be vented by slowing down and extending the probe. If it is not practicable to slow down, pull the refuel probe circuit breaker (G5, No. 1 panel on F-4J before AFC 388 and AFC 545; J14, No. 1 panel on F-4J after AFC 388 before AFC 545; J5, No. 1 panel after AFC 545 and all F-4S) and place the refuel probe switch to REFUEL.

2.20.3 Fuselage Fuel Transfer System. Fuel from the fuselage cells (Nos. 3 through 7) will transfer into cell Nos. 1 and 2 by gravity feed and transfer pumps. Cell No. 3 will gravity feed cell No. 4; cell Nos. 5 and 7 will gravity feed cell No. 6. The fuel is then transferred from cell Nos. 6 and 4 to cell Nos. 1 and 2 by electrical and/or hydraulic transfer pumps located within the cells. The electrical transfer pumps (two each) will commence transferring fuel when ac electrical power is available and either engine master switch is ON. The hydraulic transfer pumps (two each) will commence transferring when hydraulic power is available with no electrical power (electrical system failure) when either engine is in afterburner or when the fuel low level warning circuit is energized. Float-type level control valves, in cell Nos. 1 and 2, will open to allow fuel from the transfer pumps to enter when the level in these cells drops below that of the floats. Fuselage cell No. 7 gravity feed is controlled by the pilot valve in cell No. 2. When the fuel level in cell Nos. 1 and 2 drops below 2,050 (±200) pounds, the valve will open and direct air and/or fuel pressure to the dual (air and fuel) actuator transfer valve in cell No. 7, thus allowing cell No. 7 fuel to gravity feed cell No. 6. On F-4J 155903ap and 157274ap and up and all F-4S, cell No. 7 has an electric transfer pump which transfers fuel into cell No. 6. The pump is controlled by two thermistors: one in the upper portion of cell No. 5, and one on the bottom of cell No. 7. When the fuel level drops below the thermistor in cell No. 5, the pump is energized and fuel transfer is initiated. After all the fuel in cell No. 7 is transferred, the exposed thermistor in cell No. 7 interrupts the pump circuit and energizes the TANK 7 EMPTY light. If the transfer pump fails, the fuel will gravity feed into cell No. 6.

2.20.4 Internal Wing Transfer System. Wing fuel will transfer (if selected) to cell Nos. 1 and 3 only as soon as the internal wing tanks are pressurized. The internal wing tanks are pressurized when the gear handle is UP and an engine is running. The internal wing tanks incorporate an automatic transfer feature that will transfer wing fuel into cell Nos. 1 and 3 when energized (regardless of switch position). Wing fuel normally enters cell No. 3 and will enter cell No. 1 when the fuel level in the cell drops low enough to permit the refuel level control valve to open. Internal wing fuel can be transferred when operating on the emergency generator.

Note

> The wing transfer control circuit breaker (H-4 for F-4J before AFC 388; J-13 after AFC 388) operates the internal wing transfer valve. This circuit breaker is collocated with external wing transfer control circuit breaker (H-3 for F-4J before AFC 388; J-12 after AFC 388).

2.20.4.1 Internal Wing Transfer Switch. The internal wing transfer switch is a two-position toggle switch on the fuel control panel. The switch positions are marked NORMAL and STOP TRANSFER. In NORMAL, internal wing fuel is transferred to fuselage cell No. 3 as soon as the internal wing tanks are pressurized and the refueling level control valve is open. Internal wing fuel will also transfer to cell No. 1 if space is available in the cell. Selecting STOP TRAN closes the internal wing valves, thus preventing internal wing fuel transfer. If the automatic fuel transfer circuit is energized, the internal wing fuel transfer valves will open regardless of the internal transfer switch position and all internal wing fuel will transfer.

2.20.4.2 Wing Transfer Pressure Switch. The wing transfer pressure switch (Figure FO-1) is a two-position switch on the fuel control panel. The switch positions are marked NORMAL and EMERG. When the landing gear handle is UP and the wing transfer pressure switch is in NORMAL, all internal and external tanks become pressurized by the pressure regulator valves being deenergized open and the pressure relief valves energized closed. If the landing gear is down, internal wing or external fuel will not transfer unless the wing transfer pressure switch is in the emergency position. Placing the switch in EMERG performs the same function as the landing gear handle switch: all pressure regulators open and all pressure relief valves close; the tanks are thereby pressurized and ready to transfer. To prevent the external tanks from collapsing during a high-altitude descent with wheels down, place the wing transfer pressure switch to EMERG before lowering the landing gear. If the tanks have been depressurized in level flight, place the wing transfer pressure switch to EMERG and continue in level flight for approximately 30 seconds to ensure adequate repressurization before commencing descent. Place wing transfer pressure switch to NORMAL prior to landing.

2.20.5 External Fuel Transfer System. External fuel will transfer (if selected) to cell Nos. 1, 3, and 5 as soon as the external tanks are pressurized. The external tanks become pressurized when the gear handle is UP and an engine is running. The external tanks will automatically transfer fuel to cell Nos. 1 and 3 if the automatic fuel transfer circuit is energized regardless of external tank switch position. External fuel will normally enter cell Nos. 3 and 5 and will enter cell No. 1 when the fuel level in the cells drop low enough to permit the refuel level control valve to open. External fuel can be transferred when operating on the emergency generator.

2.20.5.1 External Tank Transfer Switch. The external transfer switch (Figure FO-1) is a three-position toggle switch on the fuel control panel. The switch positions are marked CENTER, OFF, and OUTBD. Upon selection of the CENTER position, the centerline tank fuel transfers to cell Nos. 3 and 5, provided the external tanks are pressurized. Placing the switch to OUTBD transfers outboard wing tank fuel to cell Nos. 3 and 5, provided the external tanks are pressurized. When the switch is OFF, no external fuel can be transferred. When selecting fuel transfer with the transfer switch, only the tanks selected will transfer. However, if the automatic fuel transfer circuit is energized, all external tanks will transfer simultaneously.

CAUTION

Catapult launching acceleration can force fuel out of the external tanks through the transfer lines to the fuselage cells at a rate beyond tank venting capability, thus creating a partial vacuum in the external tanks. Therefore, to prevent external tank collapse during a catapult launch, ensure that the external transfer switch is OFF prior to launch.

Note

If external tanks are being carried, internal wing fuel will not transfer (prior to the automatic level) if the external transfer switch is in any position other than OFF.

2.20.6 Fuel Transfer Selector Knob. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, a four-position fuel transfer selector knob replaces the individual internal wing transfer switch and the external tank transfer switch. This makes it impossible to select external fuel transfer and internal wing fuel transfer simultaneously. The knob positions are marked STOP, OUTBD, CTR, and INT WING. Selecting INT WING transfers internal wing fuel to fuselage cell No. 3. Selecting OUTBD or CRT transfers fuel from the external wing tanks or the centerline tank, respectively, to cell Nos. 3 and 5. Selecting STOP provides only fuselage fuel transfer. Selecting STOP until TANK 7 EMPTY light illuminates is the fastest way to transfer cell No. 7 fuel. If the automatic fuel transfer circuit is energized, all external tanks and the external wing tanks will transfer regardless of the position of the fuel transfer selector knob.

2.20.7 Automatic Fuel Transfer. In-flight, when the fuel level in cell Nos. 1 and 2 drops below 2,615 (±200) pounds, all internal wing fuel, external wing fuel, and centerline fuel will simultaneously transfer to cell Nos. 1 and 3 regardless of fuel transfer switch or landing gear positions. However, the buddy tank (if installed) will not automatically transfer if FILL is selected. This fuel will not enter cell Nos. 5, 6, or 7. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the automatic fuel transfer sensor is in cell No. 1 and the circuit is energized when the fuel level drops below 1,465 (±200) pounds. On these aircraft during landing approach or loiter, the automatic transfer circuit may activate early because of high AOA and a partially full cell No. 1. The automatic fuel transfer system is completely independent of the fuel quantity indicating system. The automatic fuel transfer system is inoperative when the air refuel is in the refuel position.

2.20.8 Emergency Fuel Transfer. Transfer system failure can usually be attributed to failure of the fuel system to become pressurized. If the fuel system fails to become pressurized, place the wing transfer switch in the EMERG position. This performs the same functions as the landing gear handle switch: all pressure regulators open and all pressure relief valves close.

2.20.9 Pressurization and Vent System. The pressurization and vent system provides regulated engine bleed air pressure to all internal and external tanks for pressurization, fuel transfer, and wing fuel dump. The system also provides venting of external tanks to prevent collapse during rapid descents.

2.20.9.1 Wing Tank Pressurization and Vent. The wing cells and external tanks pressurization system utilizes pressure regulators and pressure relief valves which are set respectively at 15 (±0.5) psi and 17.5 (±0.5) psi. The wing cell pressure relief valves, which provide fuel tank pressure and vacuum relief, dump into a common manifold which is vented overboard under the rudder. The external wing tanks are vented through their pressure relief valves to the wing cell dump lines. The wing cells and external wing tanks are vented to the atmosphere when the landing gear is extended.

2.20.9.2 Fuselage Tank Pressurization and Vent. The fuselage tank pressure regulator, in conjunction with the flow limiter and pressure relief vent valve, will maintain regulated air pressure at 2 (±0.5) psi and pressure relief at 3.5 (±0.5) psi. The fuselage cells and the buddy tank or centerline external tank are vented to the common fuel vent manifold and then vented overboard through the fuselage pressure relief valve. When the aircraft is on the ground, all pressure relief valves are open, venting all tanks to the atmosphere.

2.20.10 Wing Fuel Dump. Wing fuel may be dumped in flight at anytime regardless of any other transfer position by selecting the DUMP position on the internal wing dump switch (Figure FO-1). The two-position toggle switch marked NORMAL and DUMP is on the fuel control panel on the left console of the pilot cockpit. A hex-head is installed on the internal wing dump switch to make it more easily recognized. Selecting DUMP opens the left and right wing dump shutoff valves and closes the wing transfer and vent valves (if not previously closed). The wing air pressure regulators open (if not previously open) allowing the wing tanks to pressurize and force fuel out the dump lines at the wing fold trailing edge. At 85-percent rpm in level flight, the fuel dumping capability is approximately 680 pounds per minute. The dumping rate varies directly with rpm and pitch attitude (i.e., lower rpm and/or nose pitch down will decrease the dumping rate). Air pressure will continue to bleed out the dump line until the internal wing dump switch is placed in the NORM position to close the dump valve.

Note

- Wing fuel dump cannot be initiated on RAT power.
- Since the internal wing dump switch will function with the engine master switch ON or OFF and the landing gear UP or DOWN, wing fuel will be dumped on the deck when internal wing dump switch is placed in the DUMP position and external power is applied to the aircraft.

2.20.11 Fuel Quantity Indicating System. The fuel quantity indicating system is of the capacitance type and provides a reading in pounds of total internal fuel. The system components include the fuel quantity indicators, feed tank check switch, and a fuel level low indicator light. There are 14 fuel gauging units located throughout the internal tanks which register at the one cockpit fuel quantity gauge.

2.20.11.1 Fuel Quantity Indicator. A combination (countersector) fuel quantity indicator (Figure FO-1) is in the upper right corner of the pilot instrument panel. On F-4J 158355at and up or after AFC 506 and all F-4S, a fuel quantity indicator is installed on the left side of the RIO main instrument panel. The forward cockpit indication is more dependable than the aft cockpit indication. Therefore, if a discrepancy occurs between the two indications, the forward indicator is more likely to give the best reading. The counter unit of the gauge(s) continuously indicates the total usable fuel quantity (with readings multiplied by 10) in all internal tanks. The sector portion of the indicator(s) simultaneously indicates the total usable fuel quantity in fuselage cell Nos. 1 through 6 only with readings multiplied by 1,000. Fuselage cell No. 7 and internal wing fuel quantities are not indicated on the sector portion of the indicator(s). After all wing fuel has transferred, the counter should read approximately 640 pounds higher than the sector when fuselage cell No. 7 is full. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, cell No. 7 feeds before the internal wings transfer. With both internal wing tanks and fuselage cell No. 7 empty, the counter and sector should read within 350 pounds of each other. There is a possibility that fuel quantity variations will be noted on the fuel quantity indicator during aircraft accelerations and decelerations. These variations are due to the high acceleration and deceleration rates which can be achieved with the aircraft. Transient increases in fuel quantity readings may be noted during deceleration, and transient decreases in fuel quantity readings may be noted during acceleration. Therefore, an optimum fuel quantity gauge indication is achieved with the aircraft in a straight and level attitude in conjunction with moderate stabilized power settings.

WARNING

At the low end of the fuel scale, the counter portion of the fuel quantity gauge has a tolerance of ±200 pounds and the sector portion has a tolerance of ±150 pounds. Therefore, if the FUEL LEVEL LOW light illuminates above an indicated 2,080 pounds, the warning light should be used as the primary indication of a low fuel state and continued aircraft operation should be judiciously considered. The feed tank check switch should be actuated in an effort to gain additional information as to the location of the fuel and time of flight remaining.

2.20.11.2 Feed Tank Check Switch. The two-position feed tank check (Figure FO-1) with switch positions of CHECK and NORMAL permits the pilot to check the fuel quantity in the engine feed tank. When the switch is placed in the spring-loaded CHECK position, the sector portion and the counter portion of the fuel quantity gauge(s) indicates engine feed tank fuel quantity. In addition to checking feed tank fuel quantity, it is also an indication that there is power to the fuel quantity circuits and that the gauge is functioning properly.

2.20.11.3 Fuel Level Low Indicator Light. The FUEL LEVEL LOW indicator lights on the telelight panel in the forward cockpit and on the instrument panel in the aft cockpit illuminate when the combined usable fuel in the engine feed tank and cell 2 is reduced to approximately 1,880 (±200) pounds. The FUEL LEVEL LOW lights illuminate at the above fuel quantities only if the aircraft is in a perfectly level attitude and moderate stabilized power settings are being used. However, because of the various attitudes and power settings required during a normal flight, the illumination of the FUEL LEVEL LOW indicator lights is not an accurate indication of the amount of fuel remaining in cells 1 and 2. The illuminated lights only indicate that the fuel is low. In this system, the unit which operates the low-level indicator lights is a thermistor sensing switch which is located in cell 2. When the fuel level in cell Nos. 1 and 2 is above the thermistor sensing switch, its resistance is increased and no current flows to the fuel level low light relay. At this time, the FUEL LEVEL LOW light is OFF. When the fuel level in cell Nos. 1 and 2 is below the thermistor sensing switch, its resistance is decreased and current flows to the fuel level low light relay. At this time, the FUEL LEVEL LOW light illuminates. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the low-level sensor is in cell No. 1. On these aircraft, during landing approach or loiter, the FUEL LEVEL LOW light may illuminate early because of high AOA and a partially full cell No. 1. The fuel level low light is completely independent of the fuel quantity indicating system.

2.20.11.4 TANK 7 FUEL Light (F-4J). The TANK 7 FUEL light on the telelight panel illuminates in conjunction with the FUEL LEVEL LOW indicator light if cell No. 7 fuel is not being transferred. The light indicates that the dual actuator transfer valve in cell No. 7 did not open when the fuel level in the engine feed tank and cell No. 2 reached 2,050 pounds.

Note

With the TANK 7 FUEL light illuminated, the counter portion of the fuel quantity indicator indicates approximately 640 pounds more fuel remaining than is actually available.

2.20.11.5 Tank 7 Empty Light. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the TANK 7 EMPTY light replaces the TANK 7 FUEL light and illuminates when cell No. 7 is empty. After cell 7 has transferred, the light may be extinguished by depressing the master caution reset button.

2.20.11.6 Left and Right External Fuel Lights. The L EXT FUEL or R EXT FUEL indicator lights on the telelight panel are provided to indicate an empty left or right outboard external tank with OUTBD position selected on the external transfer switch. The corresponding external fuel indicator light will illuminate when fuelflow from its external wing tank ceases. This indicates to the pilot that the tank indicated is empty or flow is interrupted. Since external fuel transfer is intermittent rather than continuous, the L EXT FUEL and the R EXT FUEL indicator lights will come on during a temporary halt of fuelflow. Although the external tanks fuel indicator lights have gone out, the lights will again illuminate (approximately 10 to 30 seconds later) during the next interruption of fuelflow. Intermittent external fuel transfer is desired since this means the transfer rate is greater than engine consumption and fuselage fuel is being maintained at its highest possible volume. The L EXT FUEL or R EXT FUEL indicator lights will illuminate when selecting the OUTBD or REFUEL position on the fuel control panel and during automatic transfer when the fuelflow is less than 5 gpm. Each external fuel indicator light will also illuminate when the tanks are full during refueling operations. When the fuel level in cell Nos. 1 and 2 drops below automatic fuel transfer and the outboard tanks are empty or MERS are installed, the L EXT FUEL and R EXT FUEL warning lights illuminate.

2.20.11.7 Centerline External Tank Fuel Light. The CTR EXT FUEL indicator light is provided to indicate an empty centerline tank with CENTER position selected on the external transfer switch. The CTR EXT FUEL indicator light illuminates when fuelflow ceases. When selecting the CENTER, BUDDY, FILL, or REFUEL positions on the fuel control panel or during automatic fuel transfer, the CTR EXT FUEL light will illuminate anytime fuelflow is less than 5 gpm. The CTR EXT FUEL indicator light will also illuminate when the tank flow stops during fuel transfer to the buddy tank. When the fuel level in cell Nos. 1 and 2 drops below automatic fuel transfer and the centerline tank is empty, the CTR EXT FUEL warning light illuminates.

2.20.11.8 TK Light. The TK light, on the missile status panel, is located on the lower left side of the main instrument panel. The light illuminates when the centerline tank or any other store is installed on the centerline station. When the TK light is illuminated, the forward fuselage missiles cannot be fired. On F-4J 158355at and up or after AFC 506 and all F-4S, the TK light is located on the AIM 7 status panel which is relocated to the upper right side of the main instrument panel. The light illuminates only when a weapon is selected with the weapon select switch (on the stick grip) and the centerline tank or other store is installed on the centerline station. If the weapon lights reset switch (on the right console) is actuated, the TK light will go out.

2.20.12 External Tank Jettison System

2.20.12.1 External Tank Jettison Switch. The external wing tanks can be jettisoned by selecting the JETT position on the fuel control panel (Figure FO-1) on the left console in the pilot cockpit. On F-4J 158355at and up or after AFC 506 and all F-4S, the external tank jettison switch is on the bomb control panel of the pilot main instrument panel. The tanks can be jettisoned before or after the flow indicating light illuminates. Illumination of the flow light indicates flow has ceased and external tanks are empty. If the external transfer switch has been inadvertently left in either the OUTBD or CENTER position and external tanks are not installed on the aircraft or the tanks have been jettisoned, the external wing tanks fuel shutoff valve will close and the switch will be ineffective, allowing wing fuel to transfer in its normal manner.

CAUTION

The external wing tanks can be jettisoned by the external wing tank jettison switch anytime power is on the aircraft and the external tanks safety pins are removed. This circuit is not wired through the landing gear handle.

Note

Refer to Figure 4-7 for external tank jettison restrictions.

2.20.12.2 External Centerline Tank Jettison. Centerline external stores may be made ready for jettison by accomplishing the following: landing gear handle, UP; centerline station switch, READY; bomb control switch, DIRECT; weapons switch, CONV-OFF NUCL-ON. With these switches set, the centerline store may be jettisoned by depressing the bomb release button on the control stick grip. In AN/AWG-10A-equipped aircraft after AFC-576, the LRU 15 and 16 computer must be installed to enable any air-to-ground ordnance circuits or to selectively jettison the centerline tank.

2.20.12.3 External Store Emergency Release Button. The external store emergency release button (Figure FO-1) is on the left vertical panel. This button may be used to jettison the external tanks. The external tanks can be jettisoned before or after the flow indicating light illuminates. Illumination of the flow light indicates flow has ceased and external tanks are empty. If the external transfer switch is in the CENTER position at time of jettison, the centerline tanks fuel shutoff valve will close and the switch will be ineffective, allowing wing fuel to transfer in its normal manner. For a complete description of the external store emergency release button, refer to paragraph 2.15, EMERGENCY EQUIPMENT.

2.20.13 Air Refueling (Receiver) System. The air refueling probe is on the right side of the fuselage above the engine air inlet duct. The probe is equipped with an MA-2 refueling nozzle which is capable of receiving fuel from any drogue-type refueling system. The refueling operation is actuated by the refuel probe switch on the fuel control panel. The refuel probe switch has three positions: REFUEL, EXTEND, and RETRACT. The REFUEL position conditions the aircraft fuel system for in-flight refueling of all tanks and extends the in-flight refueling probe. The EXTEND position retains the probe in the extended position, but returns the aircraft fuel system to normal operation with the exception that fuselage cell Nos. 1 and 3 will accept fuel from the tanker at full flow until full, then at a rate equal to fuel consumption. This position is used when it is necessary to replenish the fuel in the engine feed tank either by normal fuel transfer or from the tanker. It is also used if the probe is damaged and cannot be retracted. The RETRACT position returns the fuel system to normal transfer operation and retracts the probe. When the refuel probe switch is placed in the REFUEL position, a REFUEL READY light on the telelight panel illuminates if the fuselage pressurization and vacuum relief valve opened properly. This assures that the fuselage tanks are properly vented for refueling. On F-4J 155867ak and up or after AFC 370 and all F-4S, the air refueling probe can be extended by pneumatic pressure from the canopy air bottle when the normal extension system fails. Pneumatic extension is initiated by the emergency refuel probe control switch on the outboard engine control panel. The switch, marked NORM and EMER EXT, extends the probe when placed in the EMER EXT position. When extension is accomplished by pneumatic pressure, the probe remains extended for the remainder of the flight. The refuel selection switch is on the fuel control panel. This is a two-position guarded switch with ALL TANKS and INT ONLY position. The ALL TANKS position opens the external tank fuel shutoff valves when refueling. The INT ONLY position closes the external tank fuel shutoff valves and allows only the internal tanks to be refueled during air refueling. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the emergency refuel probe switch is removed from the engine control panel and installed (with a red guard) on the fuel control panel. The refuel selection switch is also replaced with a four-positioned rotary switch that provides options of refueling internal only and all tanks with or without refueling cell No. 7.

2.20.13.1 IFR Probe Unlock Indicator Light. The IFR PROBE UNLOCKED indicator light on the telelight panel will illuminate when the air refueling probe is not fully retracted. The illumination of the IFR PROBE UNLOCKED light also energizes the MASTER CAUTION light. The indicator light circuit is completed through a limit switch located within the air refueling probe latching actuator.

CAUTION

If IFR probe operation results in an intermediate position, if probe/door damage is suspected, or if the IFR probe unlock light illuminates with RETRACT selected, cycling the probe in flight at or near probe extension speed may result in probe door separation and consequent aircraft damage.

2.20.13.2 Air Refueling Probe Light. An air refueling probe light is on the right side of the fuselage forward of the air refueling probe. The light is used during night air refueling operations to illuminate the refueling probe and the drogue from the refueling aircraft. The light is controlled by the IFR switch and variable intensity control knob that are both on the exterior lights control panel.

2.20.14 Ground Refueling. The aircraft is capable of either single-point or two-point pressure refueling. The single-point refueling receptacle is on the right underside of the fuselage in the area below the aft cockpit. Single-point pressure fueling at the rate of approximately 250 gallons per minute may be accomplished. Two-point pressure fueling at the rate of approximately 480 gallons per minute may be accomplished by utilizing the in-flight refueling probe with a special fitting attached. The system allows a controlled partial refueling capability. If desired, fuel is locked out of the left and right wing tanks, and cell Nos. 5, 6, and 7. This allows the aircraft to be partially refueled to an amount of 837 gallons (approximately 5,692 pounds) without creating an undesirable cg condition.

2.20.14.1 Cockpit Switch Positions. The switches on the fuel control located on the left console in the pilot cockpit should be in the following position before single-point pressure fueling; external transfer switch OFF, wing transfer pressure switch NORMAL, refuel selection switch ALL TANKS, buddy fill switch STOP FILL, refuel probe switch RETRACT. Refueling of the internal tanks only with any or all external tanks installed may be accomplished by selecting INT ONLY on the refuel selection switch. The Buddy Tank is interchangeable with the centerline external tank and is refueled in the same manner as the centerline tank. The landing gear control handle must be in the gear down position and master switches and throttles should be in the OFF position. The generator control switches should be in the EXT ON position. If two-point pressure refueling is desired, the refueling probe switch should be placed in the REFUEL position. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the fuel transfer selector knob replaces the external transfer switch and should be placed to STOP. Also, the refuel selection switch is replaced by a refuel selection knob and should be placed to ALL WITH 7 or ALL W/O 7 as required.

2.20.14.2 Refueling Operation. Apply external ac power to the aircraft and place the generator control switches to EXT ON. Open filler door and attach fueling nozzle to service inlet valve. Set ground fueling switch in the right wheel well to REFUEL position. (The ground fueling switch is only effective with the engine master switches OFF and ground electrical power applied.) With the REFUEL position selected on the ground fueling switch, all valves in the fuel system are closed with the following exception. The fuselage air pressure regulators will be open, all internal tank vent valves will be open, all external tank vent valves will open if their respective tanks are installed and the refuel selection switch is on ALL TANKS. All fuel level control valves are open to receive fuel until their respective tanks are filled at which time floats rise in the valves to shut off fuel. Outboard and centerline external tank motor-operated shutoff valves are open, allowing fuel to fill the external tanks installed. A fuel flow transmitter in each refueling line to any external tank energizes a caution indicator light in the cockpit corresponding to the tank not accepting fuel. Partial refueling is accomplished by actuating and holding the left and right wing tank and No. 5 fuselage tank fuel level control valve switches. This prevents fuel from entering the left- and right-wing tanks and fuselage cell Nos. 5, 6, and 7. Fuel can be prevented from entering fuselage cell No. 7 only by depressing and holding the air and fuel actuator checkout plungers which are located in the right wheel well. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the air and fuel actuator checkout plungers are removed and refueling of cell 7 is controlled by a switch on the refuel-defuel control panel in the right wheelwell.

Note

> No. 7 tank will not fill until the interconnect valve opens. The valve will not open until fuselage tanks 1 through 6 are full and fuel pressure builds up to approximately 12 psi in the interconnect valve actuator line. No. 7 fuel tank will take approximately 5 minutes to fill after the interconnect valve opens.

2.20.14.3 Functional Precheck of Electric Transfer Pumps. Individual momentary-type check switches for each electrically operated transfer pump and a pressure indicator light are on a panel in the left wheel well to provide a functional check for each electric transfer pump. The check can be performed only while external power is connected to the aircraft. When either switch is placed in CHECK, the primary circuit shuts off both fuselage fuel level control valves in fuselage cell Nos. 1 and 2, energizes the pressure transmitter switch, and operates the transfer pumps in cell Nos. 4 and 6. The pressure transmitter switch energizes the green indicator light if the discharge pressure of the selected pump is normal. No light, while the pump is being checked, indicates a malfunction in the pump.

2.20.14.4 Functional Precheck of Hydraulic Transfer Pumps. A momentary-type check switch is provided on a panel in the left wheelwell to check the operation of the hydraulic transfer pumps. The switch operates in conjunction with two indicator lights. The check switch, when placed in CHECK, energizes closed the transfer pump level control valves in fuselage cell Nos. 1 and 2, opens the hydraulic shutoff valve to allow both pumps to operate, and energizes each pressure transmitter switch. Each pressure transmitter switch illuminates the green indicator light for each pump if their discharge pressure is normal. No light with the switch in the CHECK position indicates a malfunction of that pump. Hydraulic and electrical ground power must be connected to the aircraft to conduct the above check.

2.20.14.5 Functional Precheck of Refueling Level Control Valves. A double throw momentary-type master check switch and seven individual momentary-type check switches are located in a panel in the right wheelwell. The master switch has positions of CHECK NO. 1 and CHECK NO. 2. With fuelflow started from the fueling source, hold the master check switch to the CHECK NO. 1 position. This position closes the motor-operated shutoff valves of any external tank installed and energizes a solenoid in the primary float unit of the refueling level control valves, causing the primary floats to rise and shut off fuel flow to all internal tanks. Placing the master check switch in CHECK NO. 2 closes the motor-operated shutoff valves of any external tank installed and energizes a solenoid in the secondary float unit of the refueling level control valves which causes the secondary floats to rise and shut off fuel flow to all internal tanks. Continuation of fuel flow with the master switch in CHECK NO. 1 or CHECK NO. 2 indicates a malfunction of one or more of the refueling level control valves and/or motor-operated shutoff valves. When a malfunction occurs in the primary or secondary system, that respective position on the master switch shall be held. Malfunction of any refueling level control valve can then be isolated by operating the individual momentary-type check switches one at a time to their respective position until fuelflow is stopped. The respective position of the individual switches energizes the solenoid in the circuit of each valve opposite to the circuit checked on the master switch. The individual switch that stops fuel flow indicates a malfunction of that valve in the primary or secondary unit respective to the circuit checked. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, cell No. 7 refuel switch (on refuel-defuel panel in the right wheelwell) must be in the STOP position when making CHECK NO. 1 and CHECK NO. 2.

Note

> If the master check switch is in the CHECK NO. 1 or CHECK NO. 2 position does not stop fuelflow and operational necessity dictates, refuel normally except for the following: Pull the fuel transfer pump circuit breakers on circuit breaker panel No. 1 at approximately 6,000 pounds total reading on the counter. Cut down the source pressure to 30 psig maximum until a counter reading of 9,000 pounds is reached. Then cut the source pressure down to 4 to 5 psig until the aircraft is fully fueled.

2.20.15 Normal Operation. Operation of the fuel system is normally controlled through the fuel control panel. However, if the proper switch settings for fuel transfer have not been selected, the unselected fuel will automatically be transferred when the automatic fuel transfer circuit is energized. With no external tanks aboard, all switches on the fuel control panel should be in the inboard position with the exception of the external transfer switch which should be OFF. With this switch arrangement, the fuel system is set up for proper fuel transfer and no further switching is required. If external tanks are carried, switch positions are the same as with no external tanks except that the external transfer switch is placed in an appropriate external tank position. In this case, it will be necessary to switch to another external tank position or place the external transfer switch off when the fuel in the selected tank(s) is depleted. After all external fuel is expended and the external transfer switch is OFF, internal wing fuel will transfer automatically and no further switching will be required. The L EXT

FUEL, R EXT FUEL and CTR FUEL warning lights will illuminate when flow from the selected tank is interrupted; therefore, the only indication of completed external fuel transfer is the illumination of the external fuel warning lights accompanied by a decrease in internal fuel. Upon depletion of external tank fuel, the fuselage cells will continue to supply fuel to the engine feed tank; however, internal wing fuel will not commence transferring until the external transfer switch is turned OFF. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the internal wing fuel, centerline fuel, and external wing fuel is controlled by a common four-position fuel transfer selector knob. Therefore, normal operation is as follows: STOP until TANK 7 EMPTY light illuminates; OUTBD or CTR until their corresponding L EXT FUEL, R EXT FUEL, or CTR FUEL light(s) illuminate (with a decrease in internal fuel quantity); INT WING when internal wing fuel is required. During carrier operation, manage internal wing fuel so as to arrive at the carrier with the maximum trap weight.

2.20.16 Emergency Operation

2.20.16.1 Fuel Boost Pump. If fuel boost pumps fail, fuel is still supplied to the engines by gravity feed. If both boost pumps fail above 20,000 feet and/or at a high-power setting, flamed out or an unstable rpm indication on one or both engines may occur. During gravity feed, high fuelflow rates required by afterburner operation cannot be met. A boost pump pressure indication of 0 psi indicates that both boost pumps are inoperative. If both engines have flamed out, reduce airspeed to 515 KCAS or Mach 1.1 whichever is less and extend the ram air turbine. Extending the ram air turbine operates the left fuel boost pump at low speed. This will supply enough fuel to either engine to accomplish an airstart. If an airstart has been accomplished or the engines have not flamed out, reduce power and/or descend until stable engine operation can be maintained. Since the boost pumps feed into a common manifold before branching off to the engines and boost pump pressure transmitters, an operative pump will be noted on both boost pump indicators. Therefore, a boost pump pressure reading below normal (30 (±5) psi) is a good indication that one of the boost pumps is inoperative. The power settings on each engine should be reduced as necessary until boost pump pressure reading of 5 psi or greater is obtained.

2.20.16.2 Internal Tank Transfer System. Transfer system failure can usually be attributed to failure of the fuel system to become pressurized. This will only affect external and internal wing fuel transfer. Fuselage fuel is transferred by two electrically driven transfer pumps that run continuously whenever electrical power is applied. In case of complete electrical failure, two hydraulically driven pumps take over. The hydraulically driven pumps will commence transferring fuel when hydraulic power is available with no electrical power (electrical system failure), when either engine is in afterburner, or when the fuel low level warning circuit is energized. If the fuel system fails to become pressurized, place the wing transfer pressure switch in the EMER position. This performs the same functions as the landing gear handle switch: all pressure regulators open and all pressure relief valves close.

2.20.16.3 Air Refueling Probe. On aircraft 155867ak and up and all others after AFC 370, the air refueling probe can be extended with pneumatic pressure by pulling the refuel probe circuit breaker (G5 before AFC 388, J14 after AFC 388 and before AFC 545, J5 after AFC 388 and AFC 545 and all F-4S, No. 1 panel), placing the probe switch to REFUEL, and placing the emergency refuel probe switch to EMER EXT. This extends the refueling probe with canopy air and cycles the fuel system for refueling. After air refueling is completed, the fuel system is pressurized by placing the refuel probe switch (on the fuel control panel) to EXTEND. The emergency refuel probe switch must stay in EMERG EXT. On F-4J 155903ap and aircraft 157274ap and up and all F-4S, the emergency refuel probe switch is removed from the engine panel and installed on the fuel control panel with a red guard.

CAUTION

To prevent possible damage to the utility reservoir and/or loss of utility pressure, the air refueling probe must be left in the extended position, once it is extended with pneumatic pressure.

2.20.16.4 Centerline Tank Jettisoning. Jettisoning the centerline tank when it is partially full may result in aircraft damage and severe control problems. If release of the centerline tank is necessary, proceed as follows:

1. Maintain flight integrity or attempt to rendezvous with an available aircraft if a single plane flight and conditions permit.

2. Maintain an altitude at or above 5,000 feet if possible.

3. Maintain a wings-level attitude and 1g flight.

4. Establish appropriate release airspeed determined from NATOPS publications.

5. Jettison tank according to the type of situation as defined below.

a. If the tank is ruptured:

(1) Wingman advise the extent of streaming fuel.

(2) If fire hazard from streaming fuel is imminent, jettison the tank and be prepared for control difficulties.

(3) If wingman indicates fire danger is not imminent, allow the tank to drain and land ashore with it empty. If landing ashore is not practicable, jettison the tank after it is empty.

(4) Do not select afterburner power with fuel streaming from a ruptured tank.

b. If the tank is not ruptured:

(1) If the tank is partially full, attempt to fill it with fuselage fuel if total fuel available permits. If time or total fuel available permits. If time or total fuel available preclude such procedures, be prepared for aircraft damage and control difficulties after jettisoning the tank.

(2) Completely empty or completely full tank – establish proper jettison airspeed and jettison the tank.

2.20.17 Limitations

2.20.17.1 Wing Fuel Transfer. Internal wing fuel will not transfer above 75° noseup attitude or below 15° nosedown attitude.

2.21 HYDRAULIC POWER SUPPLY SYSTEM

2.21.1 Description. Hydraulic power is supplied by three completely independent, closed-center hydraulic systems. They are power control system one (PC-1), power control system two (PC-2), and utility system. The systems have operating pressure of approximately 3,000 psi and are pressurized anytime the engines are running. The power control systems supply hydraulic pressure to the dual power control cylinders of the ailerons, spoilers, and stabilator. The utility system supplies hydraulic pressure to the power control cylinder of the rudder, ailerons, spoilers, and to all other hydraulically operated systems. Each system can be pressurized by an external hydraulic power source.

2.21.2 Power Control System One (PC-1). PC-1 (Figure FO-5) is pressurized to 3,000 (±250) psi by a variable volume (18 to 26 gpm), constant pressure hydraulic pump mounted on the left engine. This system supplies hydraulic pressure to one side of the dual power control cylinders of the stabilator and one side of the left aileron and left spoiler. Fluid is supplied to the pump by an airless, pressure-loaded, piston-type hydraulic reservoir that has a usable capacity of 0.83 gallons. The reservoir ensures positive hydraulic pressure and fluid supply to the pump suction port regardless of airplane altitude or flight attitude. A 50-cubic-inch accumulator, precharged to 1,000 psi, is utilized as a pump surge suppressor and as a limited source of hydraulic fluid and pressure when system demands exceed pump output. A pressure relief valve protects the system from pressure surges and limits pressure buildup by dumping excessive pressures to return. The relief valve begins to relieve at 3,250 psi and fully opens at 3,850 psi. A pressure transmitter for the PC-1 hydraulic pressure indicator (Figure FO-1), is in a main pressure line. In the event of a loss of system pressure, a CHECK HYD GAGES indicator light and MASTER CAUTION light illuminate. The hydraulic fluid is maintained at a usable temperature by a fuel-hydraulic fluid heat exchanger.

2.21.3 Power Control System Two (PC-2). PC-2 (Figure FO-5), is pressurized to 3,000 (±250) psi by a variable volume (18 to 26 gpm), constant pressure hydraulic pump mounted on the right engine. This system supplies hydraulic pressure to one side of the dual power control cylinders of the stabilator and one side of the right aileron and right spoiler. Fluid is supplied to the pump by an airless, pressure-loaded, piston-type hydraulic reservoir that has a usable capacity of 0.83 gallons. The reservoir ensures positive hydraulic pressure and fluid supply at the pump suction port regardless of airplane altitude or flight attitude. A 50-cubic-inch accumulator precharged to 1,000 psi, is utilized as a pump surge suppressor and as a limited source of hydraulic fluid and pressure when system demands exceed pump output. A pressure relief valve protects the system from pump surges and limits pressure buildup by dumping excessive pressures to return. The relief valve begins to relieve at 3,250 psi and fully opens at 3,850 psi. A pressure transmitter for the PC-2 hydraulic pressure indicator (Figure FO-1) is in a main pressure line. In the event of a loss of system pressure, a CHECK HYD GAGES indicator light and MASTER CAUTION light illuminate. The hydraulic fluid is maintained at a usable temperature by a fuel-hydraulic fluid heat exchanger.

2.21.4 Utility System. The utility hydraulic system (Figure FO-5), is pressurized to 3,000 (±250) psi by two variable volume (22 to 30 gpm combined) constant pressure hydraulic pumps, one on each engine. To prevent the utility hydraulic pumps from resonating, check valves with different cracking pressures are installed on the pump output lines. As a result, the right-engine utility hydraulic pump delivers 2,775 (±225) psi at idle rpm while the left engine utility hydraulic pump delivers 3,000 (±250) psi at idle rpm. Fluid is supplied to the pumps by an airless, pressure loaded, piston-type hydraulic reservoir that has a usable capacity of 1.84 gallons. The reservoir ensures positive hydraulic pressures and fluid supply at the suction ports of the pumps regardless of aircraft altitude of flight attitude. A 50-cubic-inch accumulator, precharged to 1,000 psi, is utilized as a pump surge suppressor and as a limited source of hydraulic fluid and pressure when system demands exceed the output of the pumps. A pressure relief valve protects the system from pump surges and limits pressure buildup by dumping excessive pressures to return. The relief valve begins to relieve at 3,250 psi and is fully open at 3,850 psi. A pressure transmitter for the utility hydraulic pressure indicator is in a main pressure line. If either pump fails, a CHECK HYD GAGES indicator light and MASTER CAUTION light illuminate. The hydraulic fluid is maintained at a usable temperature by two fuel-hydraulic fluid heat exchangers. The utility hydraulic system supplies hydraulic pressure to the:

1. Aileron power control cylinders
2. Aileron dampers
3. Aileron droop cylinders
4. Aileron-rudder interconnect
5. Air refueling probe
6. Antiskid (aircraft 157242an and up)
7. Arresting hook (retraction)
8. Auxiliary air doors
9. Chaff dispenser doors
10. Corner reflector
11. Flaps (leading and trailing edge) (F-4J)
12. Flaps/slats (F-4S)
13. Forward missile cavity doors
14. Fuel transfer pumps (hydraulic)
15. Landing gear
16. Lateral control servo (autopilot)
17. Nosegear steering
18. Pneumatic system air compressor
19. Radar antenna drive
20. Rudder feel/trim
21. Rudder power control cylinder
22. Speedbrakes
23. Spoiler power control cylinders
24. Variable engine bellmouth
25. Variable engine intake duct ramps
26. Wheelbrakes

27. Wing fold

28. Yaw and roll augmentation.

2.21.5 Hydraulic Pressure Indicators. Three hydraulic pressure indicators (Figure FO-1) are on the pedestal panel in the front cockpit. Pressure transmitters, one for each system, convert pressure impulses into electrical impulses which, in turn, are supplied to the indicators. The indicators are identical and cover a pressure range of 0 to 5,000 psi and are marked from 0 to 5 with readings multiplied by 1,000. Electrical power for PC-1 and PC-2 indicators is supplied by the essential 28-vac bus. Electric power for the utility hydraulic pressure indicator is supplied by the right main 28-vac bus.

Note

> Electrical power for the utility pressure indicator is supplied by the right main 28-vac bus; therefore, the utility hydraulic pressure gauge will be inoperative on RAT power or when the right generator is inoperative and the bus tie is open.

2.21.6 Hydraulic System Indicator Light. An amber CHECK HYD GAGES indicator light is on the telelight panel (Figure FO-1). This single light is utilized by both the power control system and the utility system to indicate loss of hydraulic system pressure and direct pilot attention to the hydraulic pressure indicators. Illumination of the CHECK HYD GAGES indicator light is controlled by the hydraulic system pressure switches. The CHECK HYD GAGES light illuminates when the pressure in any one system drops below 1,500 (±100) psi and/or when one of the utility hydraulic pumps fail. In all cases, a loss of system pressure is noted on the applicable hydraulic pressure indicator, but a failed utility hydraulic pump may not register a significant pressure drop on the utility pressure indicator. However, it can be generally concluded that an illuminated CHECK HYD GAGES light with no noted pressure drop on any of the hydraulic pressure indicators signifies that the right utility hydraulic pump has failed. An illuminated CHECK HYD GAGES light in conjunction with a utility hydraulic pressure drop of 200 psi signifies that the left utility pump has failed. The MASTER CAUTION light will illuminate in conjunction with the CHECK HYD GAGES indicator light. The MASTER CAUTION light may be extinguished by depressing the reset button. The CHECK HYD GAGES light remains illuminated until the pressure in the faulty system increases beyond 1,750 psi. If a failure occurs in one of the remaining hydraulic systems while the CHECK HYD GAGES light is already illuminated, the MASTER CAUTION light does not illuminate again and the pilot is not alerted to the second failure.

Note

> The MASTER CAUTION light, AUX AIR DOOR light, and CHECK HYD GAGES light may illuminate momentarily when the landing gear is being lowered because of high system demands.

2.21.7 Normal Operation. Normal operation of the hydraulic system commences with engine operation. Hydraulic pressure indicators are on the pilot pedestal panel.

2.21.8 Emergency Operation. The loss of a hydraulic pressure in either power control system, or in the utility hydraulic system is indicated by the illumination of the CHECK HYD GAGES light. This single light serves all three systems, and the pilot should check the hydraulic gauges to determine which system has malfunctioned. A hydraulic failure in either PC-1 or PC-2 presents no problem in that both systems are independent of each other and the normal operating hydraulic supply system assumes the full demand of the stabilator control cylinder. A hydraulic failure in either PC-1, PC-2, or utility presents no problem in that the systems are independent and the two remaining systems will assume the full demand of the power control cylinders of the ailerons and spoilers. Thus, each flight control hydraulic supply system serves as an emergency system for the other(s). If simultaneous loss of the utility system and one of the power control systems, the operable aileron and spoiler provides adequate lateral control for an emergency landing.

2.21.9 Complete Power Control System Failure. The pilot should upon initial detection of hydraulic power loss note the trend of failure as to whether the gauges show a definite steady drop or gauge fluctuations. With a steady drop indication, hydraulic power will probably not recover. In the event of complete power control hydraulic failure, the aircraft becomes uncontrollable.

2.21.10 Utility Hydraulic System Failure. Failure of the utility system will prevent/degrade the hydraulic operation of the following essential items:

1. Antiskid (some aircraft)
2. Auxiliary air doors
3. Drooped ailerons (some aircraft)
4. Flaps (F-4J)
5. Flaps/slats (F-4S)
6. Fuel transfer pumps
7. Landing gear
8. Nose gear steering
9. Rudder
10. Speedbrakes
11. Spoilers
12. Variable bypass bellmouth
13. Variable engine intake ramps
14. Wheelbrakes.

Of the above items, emergency pneumatic operation is provided for the following:

1. Landing gear
2. Wheelbrakes
3. Wing flaps (F-4J)
4. Flaps/slats (F-4S)
5. Drooped ailerons (some aircraft).

In addition to emergency (pneumatic) operation of the landing gear, wheelbrakes, flaps/slats, and air refueling probe, backup or alternate operation is provided for the rudder and fuel transfer pumps, the ailerons, and the spoilers. The rudder can be manually operated; however, deflection is entirely dependent upon air loads on the rudder surface. The electrical fuel transfer pumps, the primary means of fuel transfer, continue to operate even though the hydraulic transfer pumps may have failed. The speedbrakes can be retracted to a low drag trail position by placing the emergency speedbrake switch to RETRACT. The air refueling probe can be extended pneumatically by selecting EMER EXT on the air refuel switch. The power control hydraulic systems act as a backup for the ailerons and spoilers.

2.21.11 Limitations. No specific limitations pertain to the hydraulic power supply systems.

2.22 INSTRUMENTS

2.22.1 Description. Most of the instruments are electrically operated by power from the electrical system (see Figure FO-3). Some instruments, such as the accelerometer, are self contained and do not require external power. Only the instruments which are not covered under another system are discussed herein.

2.22.2 True Airspeed Indicator. A true airspeed indicator (Figure FO-1) is on the pilot and RIO instrument panels. The airspeed is indicated by a small counter which rotates to show a row of numbers through a window on the indicator face. The airspeed indicator is read directly in KTAS; the range of the instrument is from 0 to 1,500 knots to the nearest knot. The true airspeed system calibrated range is 150 to 1,500 knots. Therefore, true airspeed readings below 150 knots are not reliable. The true airspeed indicator may indicate between 60 and 180 knots while the aircraft is motionless on the ground. The true airspeed outputs are produced from the signal from the total temperature sensor of the ADCS by routing this signal through a potentiometer driven by one of the Mach number function cams. Thus, Mach number is translated into true airspeed.

2.22.3 Altimeter. An altimeter (Figures FO-1 and FO-2) on the pilot and RIO instrument panel indicates the altitude of the aircraft above sea level. This unit is of the counterpointer type which displays the whole thousands numbers in a counterwindow and indicates the increments of the whole number with a pointer which rotates on the face of the instrument. The pointer scale is graduated in 50-foot units with major 100-foot scale divisions from 1 to 10. The range of the altimeter is 0 to 80,000 feet. An adjustable barometric scale is provided so that the altimeter may be set to sea level pressure. This scale range is from 28.50 to 30.90 inches mercury. The altimeter is positioned by a corrected static pressure supplied by the

ADC, and no position error correction need be made to the indicated altitude as long as the static correction source is operative. In the event static correction monitors off (illumination of STATIC CORR OFF light), the altimeter indications will be in error.

Note

> Even though the ADCS supplies corrected static pressure to the altimeters, it is normal for the altimeter to fluctuate when passing through the transonic speed range. Refer to NAVAIR 01-245FDB-6 for allowable tolerances.

2.22.4 Servoed Altimeters (AN/AAU-19/A). F-4J 153780ac and up or after AFC 388 and all F-4S have a servoed altimeter in each cockpit (Figures FO-1 and FO-2). The AAU-19/A counterdrum-pointer servo altimeter consists of a pressure altimeter combined with an ac-powered servomechanism. Altitude is displayed in digital form by a 10,000-foot counter, a 1,000-foot counter, and a 100-foot drum. A single pointer also indicates hundreds of feet on a circular scale with center graduations of 50 feet. Below 10,000 feet, a diagonal warning symbol appears on the 10,000-foot counter. A barometric pressure setting (baroset) knot is provided to insert barometric pressure in inches of Hg. The baroset knob has no effect on the digital output (mode C) of the altitude computer that is always referenced to 29.92 inches of Hg. The altimeter has a reset (servo) mode and a standby (pressure) mode of operation, controlled by a spring-loaded self-centering mode switch placarded RESET and STBY. In the reset (servo) mode, the altimeter displays altitude, corrected for position error, from the synchro output of the altitude computer. In the standby mode, the altimeter displays altitude directly from the static system (corrected for position error with SPC engaged) and operates as a standard pressure altimeter. A dc-powered internal vibrator is automatically energized while in the standby mode to minimize friction in the display mechanism.

2.22.4.1 Operating Characteristics. 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 a fixed position. When each 1,000-foot increment is completed, the counter(s) abruptly index to the next digit. However, when operating in the standby mode, 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). The momentary pause is followed by a noticeable acceleration as the counter(s) change. The pause-and-accelerate behavior occurs in the 9 to 1 section 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 in the standby mode. If operating in the standby mode, be watchful for this behavior when the minimum approach altitude lies within the 8 to 2 sector of the scale (i.e., 800 to 1,200 feet, 1,800 to 2,200 feet, etc.).

2.22.4.2 Normal Operating Procedures. During poststart checks, conduct field elevation checks as follows:

1. Set local field altimeter with a baroset knob. Indicated altitude should be published field elevation ±75 feet.

Note

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

2. Place reset/standby switch to RESET position for 1 to 3 seconds until STBY flag disappears. Indicated altitude should be published field elevation ±75 feet. In addition, the altitudes indicated in the RESET and STANDBY modes should be within ±75 feet of each other. Return to STANDBY mode for operation below 18,000 feet. Select RESET when above 18,000 feet.

Note

- The allowable difference in RESET mode readings between cockpits is 75 feet at all altitudes.
- The AAU-19/A altimeter will automatically switch from RESET to STBY operation in case of an electrical power interruption for longer than 3 seconds, loss of SPC, or failure of the altitude encoder unit. In addition, loss of SPC will cause loss of the automatic altitude reporting function of the transponder.
- If the STBY position on the altimeter is selected, the altitude encoder unit will continue to provide servoed corrected altitude information to the transponder while the altimeter is displaying barometric altitude.

2.22.5 Airspeed and Mach Number Indicator. The combination airspeed and Mach number indicator (Figure FO-1) shows airspeed reading at low speeds and includes Mach number readings at high speeds. Both readings are provided by a single pointer moving over a fixed airspeed scale, graduated from 80 to 850 knots, and a rotatable Mach number scale graduated from Mach 0.4 to Mach 2.5. A movable bug is included as a landing speed reference and can be positioned by the knob on the face of the instrument. The same knob can position another bug on the Mach number scale for maximum indicated airspeed reference. The airspeed indicator pointer and the Mach number scale are synchronized so that a proper relationship between the two is assured throughout all altitude changes. Thus, at sea level and under standard conditions, the pointer indicates Mach 1 approximately 660 knots. Under the same conditions, but at 50,000 feet, if the same true airspeed is maintained, the pointer indicates approximately 292 knots and a Mach number of 1.15. The airspeed and Mach number indicator utilizes a corrected static pressure source from the ADC which eliminates the need for instrument position error correction. Therefore, the airspeed and Mach number indicator displays calibrated airspeed (CAS) and true Mach number (TMN) when the static pressure correction portion of the ADC is operative. In the event the static correction source is lost (illumination of STATIC CORR OFF light), the airspeed and Mach number indicator reverts to displaying indicated airspeed (IAS) and indicated Mach number (IMN).

2.22.6 Vertical Velocity Indicator. A vertical velocity indicator (Figure FO-1) is on the pilot instrument panel. The indicator shows the rate of ascent or descent of the aircraft and is so sensitive that it can register a rate of gain or loss of altitude which would be too small to cause a noticeable change in the altimeter reading. The upper half of the indicator face is graduated in 500-foot units from 0 to 6,000 feet with 100-foot scale divisions from 0 to 1,000 feet. The upper half of the instrument indicates rate of climb in thousands of feet per minute. The lower half of the indicator face is identical to the upper half except that it indicates rate of descent in thousands of feet per minute. The vertical velocity indicator is connected to the corrected static pressure system of the aircraft and measures the change in atmospheric pressure as the aircraft climbs or descends. Since the vertical velocity indicator utilizes corrected static pressure, a failure of the corrected static pressure source (illumination of STATIC CORR OFF light) may result in a slightly erroneous vertical velocity indication.

2.22.7 Turn-and-Slip Indicator. A slip inclinometer and rate-of-turn needle is incorporated into the attitude director indicator (Figure FO-1) on the front cockpit instrument panel of all aircraft. A conventional turn-and-slip indicator (Figure FO-2) is on the rear cockpit instrument panel of dual control aircraft. The rear cockpit indicator displays a 90° per minute turn rate for a single needle width deflection (4-minute turn). The turn indicator consists of an electrically driven gyro, linked to a pointer needle.

When the needle is offcenter, it indicates that the aircraft is turning in the direction shown by the needle. The amount the needle is offcenter is proportional to the rate of turn. The slip indicator is a ball-type inclinometer. The ball is in a curved, fluid-filled tube. When the aircraft is flying straight and level, the ball is centered in the tube by its own weight. When the aircraft is making a turn, the ball is acted upon by centrifugal and gravity forces. During a coordinated turn, both forces balance out to hold the ball centered in the tube. The ball, therefore, indicates proper lateral attitude for any rate of turn as well as for straight-and-level flight. The front cockpit turn-and-slip indicator, however, displays turn rate about the vertical axis of the aircraft and, as a result, does not provide an accurate indication of actual aircraft rate of turn. When the aircraft bank angle is increased, the rate-of-turn needle shows increased turn rate up to a point beyond which the rate of turn around the vertical axis of the aircraft decreases. This characteristic will normally preclude obtaining a full needle width deflection at high altitudes and/or high airspeeds. Therefore, the front cockpit rate-of-turn needle should not be used as a primary turn rate instrument. At low airspeeds, however, a single needle width deflection is approximately equivalent to a 2-minute turn. The turn needle is deflected electronically, and, therefore, an electrical failure renders the needle immediately inoperative despite the fact that the gyro is still spinning.

2.22.8 Accelerometer. An accelerometer to measure and record positive and negative acceleration g loads is on the front cockpit instrument panel (Figure FO-1). The indicator has three movable pointers. One pointer moves in the direction of the g load being applied, while the other two (one for positive g, and one for negative g) follow the indicator pointer to its maximum travel. These recording points remain at their respective maximum travel position of the g load being applied. Depressing a PUSH TO SET button in the lower left corner of the instrument allows the recording pointers to return to the one g position.

Note

Accelerometers may read as much as 0.5 g low; possibly lower if the pull-in rate is high.

2.22.9 Standby Attitude Indicator. A standby attitude indicator on the pilot main instrument panel (Figure FO-1) and a remote attitude indicator, on the RIO instrument panel (Figure FO-2) are identical except for size. Attitude information is supplied by the AN/AJB-7 and is limited to pitch and roll. On F-4J after AFC 478 and all F-4S, a gyro fast erect switch on the main instrument panel may be used to increase the erection rate of both attitude indicators. The indicators display an OFF flag when power is interrupted.

2.22.10 Standby Compass. A conventional magnetic compass on the cockpit windshield frame is provided for navigation in event of instrument or electrical malfunction. Compass deviation cards are above the canopy sill on the right side of both cockpits.

2.22.11 Radar Altimeter Set. The AN/APN-141 radar altimeter set is a pulsed range-tracking radar that provides the pilot with accurate terrain clearance information from 0 to 5,000 feet within ±5 feet or ±5 percent of the indicated altitude, whichever is greater. The set functions normally up to 30° bank angles and 50° pitch angles. The set consists of two identical antennas, a receiver-transmitter unit, a r-f switching unit, and a height indicator. The receiving antenna is on the lower left front fuselage near the left inboard leading edge flap and the transmitting antenna is on the corresponding spot on the starboard side of the fuselage. On F-4J after AFC 570 and all F-4S, AN/APN-194 is installed. This is a pulsed range-tracking radar that provides the pilot with accurate terrain clearance information from 0 to 5,000 feet within ±1 percent of the indicated altitude. The set functions normally up to 45° bank and 45° pitch angle. It consists of two identical antennas, a receiver-transmitter unit, a blanker unit, and a height indicator. The transmitting antenna is on the lower left front fuselage near the left inboard leading edge flap and the receiving antenna is in the corresponding location on the starboard side of the fuselage.

2.22.11.1 Height Indicator. The height indicator on the left side of the pilot main instrument panel (Figure FO-1) provides the readout for the set. The face of the indicator contains a dial scale, an altitude pointer, a movable low altitude index pointer, and an OFF flag. The dial scale is logarithmic throughout its range. The OFF flag indicates that power is not supplied to the set, that the 5,000-foot altitude range has been exceeded, or that the altitude indication is unreliable.

2.22.11.2 Function Control Knob. The functional control knob, on the lower left side of the height indicator, provides complete control of the set. By rotating the knob clockwise past the off detent, power is supplied to the set. Rotating the knob further clockwise positions the low-altitude pointer. Pushing in on the knob activates a self-test function and when airborne, provides the set with an artificial return signal. The altitude pointer moves to 5 (±5) feet. The test function is activated continuously on the ground by a scissors switch on the right main landing gear. After AFC 570, pushing in on the knob activates the self-test function and the altitude pointer moves to 100 (±10) feet. While the aircraft is on the ground, the scissors switch on the right main landing gear activates the disable unit of the blanker, permitting the indicator to indicate 0 (±7) feet.

2.22.11.3 Low-Altitude Warning Light. A red low-altitude warning light is directly below the front cockpit true airspeed indicator. The light illuminates any time the aircraft descends below the altitude set on the low-altitude index pointer.

2.22.12 Normal Operation

2.22.12.1 Radar Altimeter Set. With electrical power supplied to the aircraft, rotate the function control knob clockwise to turn the set on. Move the knob further clockwise to set the low-altitude index pointer as desired. After a 3-minute warmup period, the set is ready for operation. As the aircraft ascends through 5,000 feet (approximately), the OFF flag becomes visible and above 14,000 feet the transmitter is disabled by a barometric pressure switch. The set test function may be activated anytime the aircraft is airborne below 14,000 feet. On F-4J after AFC 570 and all F-4S, the AN/APN-194 altimeter set (requiring a 2-minute warmup) is installed and transmitter disabling above 14,000 feet is not accomplished.

2.22.13 Emergency Operation. There are no specific emergency operations pertaining to the instruments.

2.22.14 Limitations

2.22.14.1 Radar Altimeter Set. The set is limited to 5,000-foot altitude range and 30° bank angle/50° pitch angle. On F-4J after AFC 570 and all F-4S, and AN/APN-194 is limited to 5,000-foot altitude range and 45° bank angle/45° pitch angle.

WARNING

High-frequency radar waves can penetrate snow and ice fields. When operating in areas covered with snow and ice, the radar altimeter may indicate a greater terrain clearance than actually exists.

2.23 AN/ARA-63 INSTRUMENT LANDING SYSTEM

2.23.1 Description. F-4J 157309ar and up or after AFC 470, Part 1, and all F-4S aircraft contain an AN/ARA-63 instrument landing system (ILS). This system can be used for primary manual instrument landing approach or it can be used to monitor the automatic landing performance of an automatic landing approach system. The ILS is used with carrier-based azimuth and elevation transmitters. The major components of the AN/ARA-63 system are a receiver, decoder, and a control panel.

2.23.2 Surface Transmitters. The AN/ARA-63 ILS receives continuous coded angular guidance azimuth and elevation signals from the carrier based AN/SPN-41 transmitters. These signals maintain the aircraft on the approach path toward the touchdown point. The transmitted elevation scan pattern is from ground 0° to 10° looking up. Proportional angle steering in elevation is displayed ±1.4° from the 3° glide slope. The azimuth channel sweeps ±20° from an established reference. The reference used is the carrier deck centerline. For azimuth, proportional angle steering is displayed between ±6°. At a range of 20 miles, the azimuth scanning beam sweeps an area approximately 8 miles wide, while the elevation or glidepath is about 4 miles high.

2.23.3 ILS Receiver. The ILS receiver receives coded transmissions of azimuth and elevation guidance data from the surface transmitters. The receiver transforms these coded signals to video pulses suitable for processing in the decoder.

2.23.4 ILS Decoder. The ILS decoder receives the azimuth and elevation video pulses from the receiver, and converts them to azimuth and elevation command signals which drives the pitch and bank steering bars and their associated warning flags on the ADI.

2.23.4.1 Azimuth Command Signals. If the decoder receives azimuth signals of sufficient strength for tracking, the signals control the movement of the bank steering bar and the vertical director warning flag (at the 12 o'clock position) deflects out of view. If the decoder receives weak azimuth signals or no signals, the bank steering bar deflects to the right side of the ADI and the warning flag comes into view.

2.23.4.2 Elevation Command Signals. If the decoder receives elevation signals of sufficient strength for tracking, the signals control the movement of the pitch steering bar and the vertical displacement warning flag (at the 9 o'clock position) deflects out of view. If the decoder receives weak elevation signals or no signals, the pitch steering bar deflect to the upper portion of the ADI and the warning flag comes into view.

2.23.5 ILS Controls and Indicators. The controls and indicators for the ILS are on the AN/ARA-63 control panel. The ADI and the navigation function selector panel on the front cockpit main instrument panel are used, but are not part of the AN/ARA-63 system.

2.23.6 ILS Control Panel. The ILS control panel is on the right console in the front cockpit (Figure FO-2). The panel contains an on-off power switch, a built-in-test pushbutton, and a channel selector knob.

2.23.6.1 Power Switch. The power switch is a lock-type toggle switch with positions of ON and OFF. Placing the switch to ON applies power to the ILS.

2.23.6.2 Built-In Test. The BIT pushbutton is depressed to check for correct system operation. If the system is operating properly, the bank steering bar on the ADI slowly oscillates one-half scale to the left and then to the right. The pitch steering bar indicates the glide slope (3°).

2.23.6.3 Channel Selector Knob. The channel selector knob is a rotary-type knob that can select any 1 of 20 channels.

2.23.7 Navigation Function Selector Panel (ILS). On F-4J 157309ar and up or after AFC 470, Part 1, and all F-4S, the navigation function selector panel has a DL/ILS position added. Placing the mode selector knob to the DL/ILS position enables the ILS system to operate in a manual instrument landing approach or to monitor an automatic landing approach during which the aircraft is receiving signals from the data link and AN/SPN-42 systems. At the time the automatic approach is being monitored, the pitch and bank steering bars on the ADI are responding to signals from the AN/ARA-63 system.

2.23.8 Normal Operation. The AN/ARA-63 ILS is operational when the ILS power switch is placed to ON. To receive the transmitted azimuth and elevation signals from the surface transmitters, set the mode selector knob to DL/ILS and set the channel selector knob to the correct channel for receiving the incoming signals. When the aircraft is within the range of the transmitters, the bank steering bar and the pitch steering bar on the ADI indicate in which direction the aircraft must be flown to line up with the fixed approach path to the carrier deck. If the pitch steering bar is below the miniature wings on the ADI and the bank steering bar is to the right of center, the aircraft must be flown down and to the right to attain optimum glidepath. When the aircraft is lined up in azimuth and elevation, both steering bars on the ADI are centered. When the aircraft reaches a point within one-half mile of the carrier deck at a 200-foot altitude, transition to visual landing cues.

2.24 LANDING GEAR SYSTEM

2.24.1 Description. The aircraft is equipped with fully retractable tricycle landing gear which are completely covered by flush doors when retracted. The gear is electrically controlled by the right main 28-vdc bus and hydraulically actuated by the utility hydraulic system. The aircraft is not equipped with a tailskid. Accidental retraction of the landing gear when the aircraft is on the ground is prevented by safety switches on the main gear torque scissors and ground safety locks.

2.24.2 Main Gear. Each main gear is hydraulically retracted and extended. When the gear handle is in the UP position and the weight is off the gear, the gear will retract. As the main gear retracts, the wheels are automatically braked to a stop by the antispin system and the struts are mechanically compressed. When the gear is up and locked, pressure is automatically released from the antispin system. The struts automatically return to the normally extended position when the gear is extended. The gear is locked down by an internal finger-type latch in the side brace actuator. The main gear retracts inboard and is enclosed by fairing doors that are flush with the underside of the wing. The gear is locked up by a hydraulically actuated mechanism. All main gear doors remain open when the gear is extended.

2.24.3 Nose Gear. The nose gear is hydraulically retracted and extended. The gear is locked in the down position by an integral downlock mechanism within the gear actuating cylinder. A hydraulically operated nose gear uplock cylinder is located in the nose gear wheelwell and is employed in the system as part of the nose gear uplatch mechanism. The nose gear retracts aft into the fuselage and is covered by mechanically operated doors that close flush with the underside of the fuselage. The forward door is attached to the nose gear strut and closes with retraction; the aft door is operated and latched closed by the gear uplatch mechanism. The nose gear is equipped with dual nose wheels, a combination shimmy damper steering actuator, and a self-centering mechanism. The nose gear can be steered by differential braking of the main gear wheels in the event nosewheel steering is not utilized.

2.24.4 Landing Gear Control Handle. Operation of the landing gear is controlled by a handle (Figure FO-1) at the left side of the main instrument panel. The handle has a wheel-shaped knob for ease of identification. Placing the handle in the UP or DOWN position energizes a solenoid valve to connect system pressure to the landing gear. Placing the handle in the gear UP position energizes switches in the fuel tank vent and pressurization, jettison, and armament circuit. A red warning light is located in the landing gear control handle knob. This light comes on whenever the control handle is moved to retract or extend the gear and it remains on until the gear completes its cycle and locks.

2.24.5 Emergency Landing Gear Control. Two 100-cubic inch air bottles provide sufficient compressed air to extend the gear pneumatically in the event of a hydraulic system failure. Pulling the landing gear control handle full AFT, when it is in any position, operates an air valve which directs 3,000 psi compressed air to open all gear doors, release the uplocks, and extend all gear.

2.24.6 Landing Gear Position Indicators. The landing gear position indicators (Figure FO-1) are on the left vertical panel in the front cockpit. The indicators operate in conjunction with position switches on the landing gear. The position of the landing gear wheels is indicated by drum dials viewed through cutouts in the instrument panel. With gear up, the word UP appears on the three indicators; gear in transient is indicated by a barberpole; with gear down, a picture of a wheel is seen through the cutouts.

2.24.7 Landing Gear Warning Lights. The WHEELS warning light flashes anytime the flaps are down and the landing gear handle is UP. The landing gear handle light illuminates anytime any gear is unlocked.

2.24.8 Nose Gear Strut Extension. The nose gear strut extension system is utilized to increase the aircraft angle of attack for catapult launches. A nose gear extension switch in the left main gear wheel well operates a solenoid valve that ports high pressure air into a chamber above the nose gear shock strut piston. The shock strut piston is then forced down to extend the nose gear. The high pressure air is dumped when the left main gear strut extends after launching or when the landing gear handle is moved to the UP position. The nose gear strut extension chamber may also be deflated on the deck by cycling the landing gear circuit breaker thus interrupting electrical power.

CAUTION

- If the angle-of-attack indexer lights and approach lights are not illuminated during a landing approach, it may mean that the nose gear catapult extension is still pressurized. To preclude the possibility of exploding the nose gear strut upon touchdown, relieve the catapult extension pressure by cycling the landing gear.
- During normal operations, the aircraft pneumatic system must be fully charged (2,750 psi minimum) before extending the nose gear strut and must indicate a minimum of 1,350 psi after extension. Pneumatic system pressures below these values may not be capable of extending the strut enough to give the aircraft the proper angle of attack for a catapult takeoff. Insufficient pneumatic pressure may allow the strut to bottom out causing damage to the strut or fuselage structure.
- Do not allow the pneumatic system pressure to exceed 2,300 psi with the nosegear strut extended. If the pneumatic pressure approaches this value, actuate the emergency air brakes as necessary to maintain the pressure below 2,300 psi. If the pneumatic pressure exceeds 2,300 psi, the emergency brakes will not release the pressure in the nose strut. To release this excess pressure, the nose strut will have to be deflated and then reinflated. Allowing the pneumatic system pressure to exceed 2,300 psi subjects the nose strut to excessive loads during catapulting.

Note

See Figure 9-1 for lower than normal launch weights.

2.24.9 Nosewheel Steering. An electrically controlled, hydraulically operated nose gear steering system is installed in the aircraft. It provides directional control of the aircraft during ground operation in two modes: nose gear steering and shimmy damping. For nose gear steering, the rudder pedals through mechanical linkage control a variable gain electrical output from the command potentiometer. Low gain (for fine, more precise steering) occurs near rudder pedal neutral and increases nonlinearly in the command potentiometer to high gain (for coarse, quick steering) near full rudder pedal deflection. The first 5° of rudder pedal deflection from neutral deflects the nosewheel approximately 3°, but the last 5° of rudder pedal deflection deflects the nosewheel approximately 40°. Steering is limited to approximately 70° either side of center. The control unit receives the signal from the command potentiometer and electrically selects a servo valve setting in the utility hydraulic system. This electrical subsystem is energized and the servo setting is continually following the rudder pedals when there is electrical power in the aircraft, the nose gear is not locked up, and there is weight on the right main landing gear. Hydraulic pressure to turn the nosewheel is provided by depressing the nose gear steering button (Figure 2-23) continuously (on F-4J and F-4S aircraft before AFC 650) or momentarily (on F-4S aircraft after AFC 650).

WARNING

Nose gear steering remains engaged after release of nose gear steering button. The button must be depressed momentarily a second time to disengage nose gear steering on F-4S aircraft after AFC 650.

This button energizes a relay which opens the selector valve in the hydraulic system. Hydraulic pressure is supplied to the servo valve which moves to the selected setting and ports hydraulic pressure to the power unit, a rotary vane hydraulic motor, on the nose gear strut. The power unit turns the nosewheel through a geared strut torque collar. As the nosewheel turns, the followup potentiometer on the power unit balances the electrical circuit in the control unit so that the servo valve closes as the nosewheel reaches the position commanded by the rudder pedals. Releasing the nose gear steering button (F-4J and F-4S aircraft before AFC 650) or depressing the nose gear steering button a second time (F-4S aircraft after AFC 650) closes the servo valve and removes hydraulic pressure from the power unit. A failure detection circuit will shut off hydraulic power to the system upon detection of an electrical short or open. However, the failure detection circuit requires a definite time to operate and may not preclude some degree of nose deflection.

WARNING

The failure detection circuit was designed only to detect an internal electrical short or open circuit. It will not prevent rapid turning of the nosewheel unit when the nose gear steering button is depressed with the rudder pedals already deflected. To prevent skidding of the nosewheel tires and possible loss of control, rudder pedals should be neutralized prior to nose gear steering engagement.

Shimmy damping is automatically activated whenever the nose gear steering button is not activated. A restrictor, bypassing the selector valve, allows a balanced pressure of 275 psi (regulated by the compensator) to remain in the power unit. This pressure prevents cavitation of the rotary vane hydraulic motor as the nosewheel swivels. Fluid flow is metered through one-way restrictors in the power unit to damp wheel shimmy. The nosewheel can swivel to any direction in this mode.

CAUTION

- To prevent the landing gear struts from being subjected to abnormal side loads, do not use nosewheel steering and brakes simultaneously while in a turn.

- The electrohydraulic nose gear steering unit is susceptible to uncommanded inputs induced by moisture and/or condensation. Do not engage nosewheel steering above a slow taxi speed unless emergency dictates its use for directional control.

2.24.9.1 Nose Wheel Warning Light. Nose gear steering engaged warning light is provided on aircraft incorporated with AFC 650 (see Figure FO-1). A STEERING ENGAGED warning light indication can only be extinguished by release of the nose gear steering button followed by depressing the button a second time.

2.24.10 Normal Operation. Operation of the landing gear is controlled by the wheel shaped landing gear control handle. To lower the landing gear, push the handle down. A red warning light in the control handle knob illuminates and stays illuminated until the gear is fully extended and locked. To raise the gear, move the landing gear handle up; the warning light again illuminates until the landing gear is up and locked.

2.24.10.1 Flight Without Main Landing Gear Doors. If maintenance or operational consideration require flight without main landing gear doors, the aircraft is limited as follows:

1. Below 20,000 feet – 250 KCAS.

2. Between 20,000 and 35,000 feet – Mach 0.85.

3. Above 35,000 feet – 250 KCAS or Mach 0.85, whichever is greater.

4. Descent – 250 KCAS or onset of any buffet.

5. After each flight, wheel wells should be inspected for evidence of cracks or malformed lines and fittings.

2.24.11 Emergency Operation. If normal gear operation fails, the gear can be lowered by pushing the landing gear handle down pulling the landing gear circuit breaker and then pulling aft on the landing gear handle. The landing gear circuit breaker must be pulled prior to lowering the gear by the emergency system. This causes the landing gear hydraulic selector valve to return to its full trail position, blocking hydraulic pressure to the landing gear and ensuring that hydraulic fluid will not be forced into the actuators on top of the pneumatic pressure. Should this occur, system hammering may result with possible eventual rupture and loss of system integrity. Hold the handle aft until the gear indicates down and locked. Do not retract the landing gear following an emergency extension. If the landing gear is inadvertently extended in flight by emergency pneumatic pressure, it must be left in the extended position until postflight servicing.

CAUTION

Hold handle in full aft position until gear indicates down and locked and then leave the landing gear handle in the full aft position. Returning the handle to its normal position allows the compressed air from the gear down side of the actuating cylinder to be vented overboard. In this condition, the main landing gear side brace integral mechanical latch will be the only device preventing the landing gear from collapsing upon landing. Pull the landing gear circuit breaker prior to extending the landing gear by the emergency system.

Note

Any pneumatic extension of the landing gear shall be logged on the yellow sheet (OPNAV form 3760-2).

2.24.12 Limitations. Maximum permissible airspeed for lowering of the landing gear is 250 KCAS.

2.25 LIGHTING EQUIPMENT

2.25.1 Exterior Lighting. The exterior lights consists of the position lights (wing and tail), join-up lights (wings only), fuselage lights, anticollision light, angle-of-roll light, approach lights, air refueling probe light, and taxi light. An exterior lights master switch on the outboard left throttle grip which controls some of these lights is also utilized in the operation of night catapult launches. The exterior light control panel on the right console in the front cockpit contains all of the manual controls with the exception of the master switch for the exterior lights.

2.25.1.1 Exterior Light Master Switch. The exterior light master switch provides a master control for the following exterior lights: position lights, join-up lights, fuselage lights, and the anticollision light. Before any of these lights can be operated, the master switch must be in either the ON or the SIGNAL position. Further control of these lights is accomplished from the exterior light control panel. The switch on the outboard throttle grip has three positions: ON, OFF and SIGNAL. Placing the switch to ON energizes the switches on the exterior light control panel for the above lights. The SIGNAL position functions identically to the ON position except that it is spring loaded to OFF. In addition to controlling the above exterior lights, the ON and SIGNAL positions dim the approach lights should they be illuminated. The master switch and exterior light panel receive power from the right main 28-vdc bus.

2.25.1.2 Position and Join-Up Lights. The position lights include the wing tip position lights and the tail lights. The join-up light consists of a red or green light on the trailing edge of the applicable wing tip. The wing tip position lights and join-up lights are both operated by the exterior light master switch on the outboard throttle and the WING switch on the exterior lights control panel. With the exterior light master switch to ON or SIGNAL, the lights are controlled by BRT, DIM, and OFF positions of the WING switch. The wing and join-up lights do not have flash capabilities. The taillight is controlled by the exterior light master switch, TAIL switch, and FLASHER switch on the exterior light control panel. With the exterior light master switch to ON or held in SIGNAL, the taillight can be controlled by the BRT, DIM, and OFF positions of the TAIL switch. The taillight will flash or illuminate steady depending on whether the flasher switch is in the STEADY or FLASH position. The dim circuit of the position and join-up lights is powered by the right main 14-vac bus. The bright lights circuit is powered by the right main 28-vac bus.

2.25.1.3 Fuselage and Anticollision Lights. Three semiflush white lights are installed on the fuselage, one above the No. 2 fuel cell and one below each of the engine air inlet ducts. In addition to the fuselage lights, one red anticollision light is installed in the leading edge of the vertical stabilizer. The anticollision and fuselage lights are controlled by the fuselage lights switch labeled FUS with positions marked DIM, MAN, and BRT. The three fuselage lights illuminate in the DIM and BRT positions in conjunction with the exterior light master switch. They illuminate steady or flashing depending on the position of the flasher switch. The anticollision light illuminates only when the fuselage switch is in BRT position and the flasher switch is in the FLASH position. The light does not function in the steady condition or with the FUS switch in MAN or DIM positions. The MAN position of the switch allows the fuselage lights to be energized by the manual key button. The fuselage lights are powered by the right main 28-vac bus. Both of the lamps in the anticollision light are powered by the right main 28-vac bus.

2.25.1.4 Exterior Light Flasher Switch. The exterior light flasher switch on the exterior light control panel has two positions: FLASH and STEADY. If STEADY is selected, the taillight and fuselage lights produce a steady illumination, provided the FUS light switch and TAIL light switch are in DIM or BRT positions. Placing the flasher switch to FLASH causes the fuselage lights and taillights to flash and anticollision lights to flash if the FUS switch is in BRT. The flasher unit for this switch receives power from the right main 28-vdc bus.

2.25.1.5 Manual Key Button. The manual key button on the exterior light control panel energizes the fuselage lights when the fuselage light switch is in the MAN position. With the key button depressed and the exterior lights flasher switch in STEADY, the fuselage lights illuminate steady; with the FLASHER switch in FLASH, the fuselage lights flash. An indicator light on the exterior light control panel glows when the manual key button is depressed. The manual key button receives its power from the right main 28-vac bus.

2.25.1.6 Angle of Roll Light. The low, swept-wing design of the aircraft prevents the landing signal officer from observing the right-wing tip light during a normal carrier approach until the aircraft is almost on final; therefore, a green angle of roll light is installed aft of the left-engine air intake duct just above the trailing edge of the wing. This light illuminates with a steady glow and serves as a roll reference for the landing signal officer until such time that the right-wing tip is visible. The angle-of-roll light illuminates steady, in flight, with landing gear down, the flaps 1/2 or full down, and the arresting hook down. With the landing gear down and locked, the flaps 1/2 or full down, and the arresting hook up, the angle-of-roll light will flash (unless the hook bypass switch is in the BYPASS position). The angle-of-roll light receives power from the right main 28-vac bus.

2.25.1.7 Hook Bypass Switch. The hook bypass switch on the exterior light control panel has two positions: NORMAL and BYPASS. This is the only operating control in the cockpit for the approach lights and the angle-of-roll light systems. The switch, when placed in the BYPASS position, completes a circuit which causes the approach lights to illuminate steady without having the arresting hook extended. With the switch in the NORMAL position and with the gear down and the flaps in full or half down, the approach lights flash unless the arresting hook is down. With the arresting hook down, the approach lights illuminate steady. Also, with utility hydraulic and electrical power applied, if the landing gear control handle is in the DOWN position and the hook bypass switch is in the BYPASS position, the corner reflector extends.

2.25.1.8 Approach Lights. Refer to paragraph 2.4, ANGLE-OF-ATTACK SYSTEM.

2.25.1.9 Air Refueling Probe Light. The in-flight refueling probe light is on the right side of the fuselage forward of the air refueling probe. The light is used during night air refueling operations to illuminate the refueling probe and the drogue from the refueling aircraft. The light is controlled by the IFR switch and variable intensity control knob, both of which are located on the exterior lights control panel. The in-flight refueling probe light receives power from the right main 115-vac bus.

2.25.1.10 Taxi Light. The taxi light is adjacent to the approach light assembly on the nose gear door. The light is controlled by the taxi light switch on the exterior light control panel. Power to the light is supplied by the right 28-vac bus.

2.25.2 Pilot Interior Lighting. Interior lighting in the aircraft is powered by the ac electrical system, either from the engine-driven generators or by the emergency generator. Most of the pilot interior lighting controls are on the cockpit lights control panel (Figure FO-1).

2.25.2.1 Instrument Lights. The instruments are illuminated by integral instrument lights. Variations in instrument lighting intensity on all aircraft is controlled by the instrument panel lights control knob on the forward inboard corner of the cockpit light control panel. The control knob varies the brilliance of the instrument lights from OFF to BRT. Also, as the control is rotated from OFF to BRT, a switch within the control knob energizes the warning lights dimming relay, reducing the brilliance of the warning lights in both cockpits. On F-4J after AFC 536 and all F-4S, integral lighting for the following flight instruments is no longer controlled by the instrument panel lights control knob: altimeter, airspeed/mach indicator, vertical velocity indicator, angle-of-attack indicator, horizontal situation indicator, attitude director indicator, and standby attitude indicator. Individual intensity control of the above lights is provided by seven controls on the flight instrument light balance control panel added above the right console under the canopy sill. Prior to this change, the intensity of the standby attitude indicator lighting is less than the other flight instrument lights. With the flight instrument light balance controls installed, the standby attitude indicator lighting can be balanced with the other flight instrument lights. On F-4J after AFC 536 and all F-4S, the flight instrument light knob is installed on the engine control panel on the left console. The flight instrument light knob simultaneously varies the intensity of the above seven lights so that they can be balanced with the remaining instrument lighting still controlled by the instrument light knob on the right console. The flight instrument light knob varies the flight instrument lights from OFF to BRT. In addition, a switch within the knob dims HSI mode lights and also takes over the function of dimming the warning lights from the instrument light knob. In the event of normal instrument lighting system failure, secondary instrument lighting is provided by red floodlights on the glareshield. These floodlights are controlled by the INSTR PANEL EMER FLOOD switch mounted on the floodlight control panel above the cockpit light control panel. The three-position switch labeled OFF, DIM, and BRT provides only bright or dim positions. After AFC 599, the flight instrument light balance control panel and the emergency floodlight control panel are replaced by the miscellaneous light control panel. The miscellaneous light control panel, above the right console, contains the same switches and controls as the previous two panels in addition to formation lights controls.

2.25.2.2 Console Lights. Console lighting is combination edge and floodlighting. Variation in edge lighting intensity is controlled by the console light control knob on the cockpit light control panel. This knob controls all edge lighting on the left and right console, the pedestal panel, and the armament control panel. The console control knob varies the brilliance of the console edge lights from OFF to BRT. Also, as the control is rotated from OFF to BRT, a switch within the control knob energizes the DIM position of the console flood switch, thus providing console floodlight illumination and edgelighting. The console flood switch above the console control knob selects BRT, DIM, or MED brilliance for the red console floodlights. The console floodlights are off only when the console flood switch is in the DIM position and the console control knob is rotated to the OFF position.

2.25.2.3 White Flood Switch. One white floodlight is provided above each console under the canopy sill. Control is by the white flood switch in the forward outboard corner of the cockpit light control panel. This switch is one of the lever-lock type to prevent inadvertent operation. No intensity variation is provided on these lights.

2.25.2.4 Standby Compass Switch. The standby compass switch on the cockpit lights control panel turns the standby compass light ON and OFF. The console light control knob must be turned ON before the standby compass switch is energized.

2.25.2.5 Warning Light Test Switch. The warning light test switch is a two-position, spring-loaded toggle switch on the cockpit light control panel. The switch is spring loaded to NORMAL and when placed to TEST illuminates all front cockpit warning lights simultaneously, and the FUEL LEVEL LOW light in the rear cockpit. In F-4J 158355at and up or after AFC 506 and all F-4S, the warning light test switch is a three-position, spring-loaded toggle switch. The switch is spring loaded to the mid or off position; the other two positions are WARN LT TEST and WPN LTS RESET. The new WPN LTS RESET position is used to cancel the air-to-air weapon selections and to deenergize the lights on the weapon status panel and AIM-9 and AIM-7 status panels (including the TK light). This is the only way to reset once the lights are selected. The test circuit for these warning lights receives power from the right main 28-vdc bus and the warning lights 14/28-vac bus.

2.25.2.6 Utility Light. The utility light is located on the right bulkhead and incorporates a clip to hold the light where needed. Its color may be changed from red to white by depressing the latch button and rotating the lens housing.

2.25.2.7 Spare Edge Lamps. Spare edge lamps are in a spring-loaded cylindrical container on the wing fold control panel on the right console.

2.25.2.8 Indexer Lights Control Knob. Refer to paragraph 2.4, ANGLE-OF-ATTACK SYSTEM.

2.25.2.9 Radar Annunciator Lights. On F-4J 157242an and up or after AFC 486 and all F-4S, the interior lighting system includes the radar annunciator light control knob on the indicator light control panel. With the instrument light control knob (flight instrument lights knob after AFC 536) out of the OFF position, the intensity of the radar annunciator lights is independently controlled by the radar annunciator light control knob in both cockpits.

2.25.2.10 Formation Lights. After AFC 599, green electroluminescent formation lights are added to the outer wing tips between the position lights and join-up lights and on both sides of the vertical stabilizer, midfuselage and forward fuselage. These lights are controlled by the FORM LIGHTS switch and a variable control knob on the front cockpit miscellaneous light control panel. The switch has positions ON, OFF, and MOM (momentary). The control knob beneath this switch controls the intensity of the formation lights with positions OFF, DIM, MED, BRT, and JOIN UP; JOIN UP is the brightest position. Power for these lights is provided by the right 115-vac bus.

CAUTION

Use of these lights during daylight hours is prohibited and a 3-amp fuse on the panel protects the dimming circuitry in the event of accidental daytime or ground switch actuation which could result in excessive current. To restrict use on ground at night, lights should not be turned on until just before takeoff and they should be turned off immediately after landing.

2.25.3 RIO Interior Lighting. The RIO interior lighting is controlled from the RIO main instrument panel (Figure FO-2) and consists of an instrument light control knob, an equipment light control knob, a cockpit flood switch, and a warning light test switch. In addition to these controls, a utility light is provided for auxiliary lighting. On aircraft 155529ag and up or after AFC 388 and all F-4S, the RIO interior lighting controls are on the cockpit lights/data link control panel under the RIO left canopy sill.

2.25.3.1 Instrument Lights. The instrument lights are controlled by a variable intensity control knob. As the control knob is rotated from OFF towards BRT, instrument light intensity increases.

2.25.3.2 Equipment Lights. The equipment lights utilize a variable intensity-type control knob to control the intensity of the equipment panel edge lights.

As the knob is rotated from OFF towards BRT, equipment light intensity increases.

2.25.3.3 Cockpit Flood Switch. The cockpit flood switch is a three-position switch with switch positions OFF, DIM, and BRT. The switch is used to select operation and intensity of the four red floodlights in the RIO cockpit. On F-4J 155529ag and up or after AFC 388 and all F-4S, three floodlights have been added to the RIO cockpit.

2.25.3.4 Warning Light Test Switch. The warning light test switch is a two-position switch with positions OFF and TEST. The switch is spring loaded to the OFF position. When placed in the TEST position, all the warning lights illuminate except the FUEL LEVER LOW light. The FUEL LEVEL LOW light will test only when the test switch in the front cockpit is placed to the TEST position. On aircraft 155529ag and up, the warning light test switch is on the cockpit lights/data link control panel. The warning light test circuit receives power from the right main 28-vdc bus and the warning lights 14/28-vac bus.

2.25.3.5 Utility Light. The utility light is above and to the left of the RIO instrument panel. An additional plug-in socket for the light on the upper structure aft of the instrument panel provides an alternate location from which to illuminate the chartboard when it is being used. This light may be changed from red to white by rotating the lens housing. The light has an integral ON-OFF and intensity control.

2.25.3.6 Radar Annunciator Lights. On F-4J 157242an and up or after AFC 486 and all F-4S, with the instrument lights knob (flight instrument lights knob on F-4J after AFC 536 and all F-4S) in the front cockpit out of the OFF position, the intensity of the radar annunciator lights is independently controlled by the radar annunciator lights control knob. This knob is on the radar annunciator light control panel, outboard and adjacent to the navigation computer control panel.

2.25.3.7 Spare Edge Lamps. Spare edge lamps are in a spring-loaded cylindrical container on the utility panel in the left forward section of the cockpit.

2.25.4 Normal Operation. Normal operation of the exterior lights and pilot and RIO interior lights are controlled by the various switches on their control panels.

2.25.5 Emergency Operation. There are no provisions for emergency operation of the exterior or interior lighting. However, the pilot instrument panel and consoles and the RIO cockpit floodlights illuminate when the ram air turbine is extended by placing the respective floodlight switches in the BRT position. The taxi lights, pilot and RIO instrument panel lights, and the warning lights also operate on RAT power. However, the warning lights cannot be dimmed.

2.25.6 Limitations. No limitations pertain to the lighting equipment.

2.26 NAVIGATION EQUIPMENT

2.26.1 Description. The navigational systems on the aircraft consist of the AN/AJB-7 attitude reference and bombing computer set, the GVR-10 vertical flight reference set, the flight director group, and the AN/ASN-39A navigation computer. Each of these systems provides its share of information to supply the crewmembers adequate navigational assistance.

2.26.2 AN/AJB-7 Attitude Reference and Bombing Computer Set. The AN/AJB-7 is an all attitude reference platform which supplies standby attitude and azimuth information to the attitude director indicator, the horizontal situation indicator, and the bearing distance heading indicator in the rear cockpit. The rear cockpit remote attitude indicator, the forward cockpit standby attitude indicator, the autopilot system, and the bombing computer receive attitude information from the AN/AJB-7 at all times. The bombing computer functions of the AN/AJB-7 are described in the special purpose bombing system, this section. The major components of the AN/AJB-7 system are the compass adapter-compensator, displacement gyroscope, and the compass transmitter. The compass adapter-compensator obtains heading information from the compass transmitter and the displacement gyroscope. It processes this information and provides heading outputs to the attitude director indicator, horizontal situation indicator, and to other aircraft systems. The displacement gyro also sends pitch-and-roll signals to the attitude director indicator and the AN/APG-59 radar set. The compass transmitter is a direction sensing device. It accurately detects its alignment relative to the lines of force of the Earth's magnetic field and transmits this information electrically to the compass adapter-compensator.

2.26.3 Compass System Controller. The compass system controller (Figure FO-1) provides the controls and indicator necessary for proper operation of the azimuth system and the selection between the primary and standby attitude sources. The mode selector knob initiates the proper relay switching in the compass adapter compensator to select the operating modes (compass, DG, and slaved). The sync position of the mode selector knob, spring-loaded to return to the SLAVED position, is used for fast synchronization of the compass transmitter and the azimuth reference system. The degree of synchronization is indicated by the sync indicator meter. The set heading control knob, spring-loaded to return to the center or zero position, provides a means to manually adjust the azimuth setting of the ADI, HSI, and BDHI. Compensation is provided by the hemisphere switch (N-S) and the latitude control, when they are set to the local hemisphere and latitude, respectively. The attitude reference selector knob, with positions of PRIM and STBY, provides selection between the GVR-10 vertical flight reference set and the displacement gyroscope of the AN/AJB-7 system as the source of attitude information. When switching from STBY to PRIM or vise versa, attitude information appears almost immediately but may be accompanied by some unusual but normal gyrations of the attitude director indicator. This phenomenon is a simultaneous 180° flop about all three axes after which normal attitude reference is displayed. Whether or not this occurs is determined by which side of the AJB-7 gyro is uppermost during the initial erection. Accurate heading information may not be immediately available after completing a turn with a rate of more than 15° per minute. To correct this situation, the aircraft must be flown straight and level (rate of turn less than 15° per minute) for approximately 20 seconds and then manually synchronized by placing the mode selector knob to the SYNC position.

2.26.3.1 Compass Mode. The compass mode is considered an emergency mode. If the displacement gyroscope fails, the attitude reference selector knob may be placed on PRIM and the mode selector knob on COMP, resulting in display of compass transmitter magnetic heading on the attitude director indicator. However, the interlock with the AFCS mode of operation of the automatic flight control system is automatically opened in the compass mode to prevent erratic magnetic heading signals from being applied to the autopilot. Also, if the attitude reference selector knob is on STBY and the mode selector knob is on COMP, the attitude director indicator azimuth indications should not be used since it is still connected to the malfunctioning gyroscope. To place the attitude reference system in the compass mode, place the bomb control switch on the bomb control panel to OFF and the mode selector knob on the compass controller to COMP.

2.26.3.2 DG Mode. The DG mode is used in north and south latitudes greater than 70° and in areas where the Earth's magnetic field is appreciably distorted. When the DG mode is initially selected, the magnetic heading of the aircraft must be set into the system with the set heading control on the compass controller. The system then uses this reference for subsequent heading indication. Apparent and real drift compensating voltages are inserted by use of the hemisphere switch (N-S) and latitude control on the compass system controller. To place the reference system in the DG mode, place the bomb control switch on the bomb control panel to OFF and the mode selector knob on the compass controller to DG. Then set the hemisphere switch to the local hemisphere and the latitude control knob to the local latitude. Set the aircraft magnetic heading on the ADI with the set heading knob, and readjust the latitude control knob for each 5° change in latitude.

2.26.3.3 Slaved Mode. The slaved mode is the mode used under normal conditions. In the slaved mode, the azimuth system is primarily controlled by signals from the compass transmitter (flux valve). Since system accuracy is now dependent upon the Earth's magnetic field, the slaved mode should not be used in latitudes greater than 70° and in areas where the Earth's magnetic field is distorted. To place the reference system in the slaved mode, place the bomb control switch on the bomb control panel to OFF and then place the mode selector knob on the compass controller to the SLAVED position. Allow 10 seconds for automatic fast synchronization and check the sync indicator meter for a center-scale indication. Slight deviation of the needle from the center position is corrected by normal sync. Adjust the pitch trim control knob on the ADI for zero pitch attitude.

2.26.4 Gyro Erection Switch. On F-4J after AFC 478 and all F-4S, there is a gyro fast erect switch on the front cockpit main instrument panel with positions of FAST and NORMAL. When placed to the momentary FAST position a high erection voltage is applied to the AN/AJB-7 displacement gyro roll and pitch torques. This provides fast erection after aircraft maneuvering. However, the aircraft must be in straight-and-level flight approximately 20 seconds before going to fast erect. In NORMAL, low erection voltage is utilized and the gyro erects normally. During the time that the erection switch is held in the FAST position, the power fail flag on the attitude director indicator, standby attitude indicator, and remote attitude indicator is in view and the autopilot is disengaged.

CAUTION

Do not hold the gyro erection switch in the FAST position longer than 1 minute as damage to the gyro could result.

2.26.5 GVR-10 Vertical Flight Reference Set. The function of the vertical flight reference set is to furnish pitch and roll attitude to the velocity computer of AN/APG-59 radar set for stabilization functions and pitch and roll to the attitude director indicator for display on the sphere. It also provides flightpath angle and vertical acceleration information to the terrain clearance tracker of AN/APG-59 radar set for use in computations of climb/dive signals to be displayed by the pitch steering bar in the attitude director indicator. The vertical flight reference set is comprised of the attitude sensing unit and the electronic computer unit. These components are on the left side of the aft cockpit on the equipment shelf assembly. The attitude sensing unit is basically a vertical gyro which generates pitch and roll signals that are sent to the attitude director indicator and the radar set. An accelerometer is incorporated within the unit to measure vertical acceleration. The electronic computer unit contains operation circuits which are necessary for proper functioning of the attitude sensing unit. The electronic computer unit furnishes flightpath angle information to the terrain clearance tracker of AN/APG-59 radar set. Vertical acceleration, barometric altitude, and true airspeed information are routed to the flight angle circuits for computing climb/dive signals.

2.26.5.1 Attitude Reference Selector Knob. The attitude reference selector knob on compass system controller (Figure FO-1) is a two-position knob which selects the source of attitude reference information for the attitude director indicator and the AN/APG-59 radar set. When the knob is placed in the PRIM position, pitch and roll from the GVR-10 system and heading from the AN/AJB-7 is displayed on the attitude director indicator. Pitch and roll information is also furnished by the GVR-10 to the AN/APG-59 radar set. When the knob is in the STBY position, the AN/AJB-7 transmits heading, pitch, and roll signals to the attitude director indicator, and pitch and roll signals to the AN/APG-59 radar set. However, the remote attitude indicator in the rear cockpit and the standby attitude indicator in the front cockpit always display the pitch and roll information from the AN/AJB-7 regardless of the position of the attitude reference selector knob. Prior to taxiing, ensure the attitude reference selector knob is in the primary position. If the standby mode is selected and a failure occurs in the AN/AJB-7, there is no accurate attitude information displayed on any gyro including the AN/APG-59 radar set.

Note

On F-4J 153071z through 154785af before AFC 388 with the left generator failed, bus tie open, and the right generator and ram air turbine operating, pull the GVR-10 circuit breaker on the No. 1 panel (zone A16). Switch the attitude reference selector knob from the PRIM to the STBY position. Pitch and roll information is then obtained from the AJB-7 system. On F-4J 154786ag and up or after AFC 388 and all F-4S with the left generator failed, bus tie open, and the right generator and the ram air turbine operating, the pitch and roll information is automatically obtained from the STBY mode instead of the PRIM mode. However, when the ram air turbine is extended, switch the attitude reference selector knob to the STBY position so that if power from the left generator is restored, the attitude information to the ADI is not interrupted.

2.26.6 Built-in-Test (BIT) Checks. A BIT switch is on the AN/AJB-7 test system panel in the aft cockpit. In the F-4J 155529ag and up, this switch is in the nosewheel well. The switch has positions of INT TEST, OPEN, and EXT TEST. Place the switch to EXT TEST and if there is a malfunction in the GVR-10 system or in the air data computer, the vertical displacement warning flag on the ADI comes into view (with radar operating or on STBY), the OFF flag on the ADI appears, and the PRIMARY GYRO OFF warning light illuminates. These are all steady indications. If the GVR-10 is functioning properly, the flags cycle in and out of view and the warning light flashes on and off at a steady rate. If no malfunction is indicated, it is not necessary to proceed further with the BIT checks. If a malfunction is indicated in EXT TEST, place the switch to the INT TEST. If there is a malfunction indication, the vertical flight reference system (GVR-10) is unreliable. If there is no malfunction indication, the airspeed inputs from the air data computer to the GVR-10 system are unreliable. When the BIT switch is in OPEN, the BIT circuit is inoperative.

2.26.7 AN/ASN-39A Navigation Computer. The navigation computer is a great circle computer and consists of a control panel and an amplifier-computer. The system furnishes the following information during flight:

1. The aircraft present position latitude and longitude based on dead reckoning computations from an initial fix.

2. The continuous great circle magnetic bearing and distance to either of two preset targets. This is an instantaneous spherical trigonometric solution based on true north.

The dead reckoning computations are only as accurate as the wind vectors and magnetic variation references furnished the system by the RIO. Inputs of magnetic heading and true airspeed are automatically supplied by the AN/AJB-7 and ADCS. For purposes of discussion, the navigation computer can be divided into two functional sections. The first is the present position computer section which performs the basic dead reckoning computation. The second is a course and distance computer section which provides great circle course and distance to a target (or base).

2.26.8 Present Position Computer. The present position computer is a group of servo-mechanisms contained in the computer control panel with their amplifiers in the amplifier-computer. The present position computer receives magnetic heading from the AN/AJB-7 and true airspeed from the ADCS. Magnetic variation and the latitude and longitude of the starting position, the base, and destination are set manually on the computer control panel. Radar wind updates were deleted after AFC 576. The present position computer resolves true airspeed and wind velocity to their north-south and east-west components and adds them algebraically to derive the components of aircraft groundspeed. Groundspeed is integrated with respect to time to attain distance which is then converted to a change of latitude and longitude. The north-south mileage covered is converted directly into degrees and minutes of latitude by the position latitude counter on the computer control panel since one nautical mile is always equal to 1 minute of latitude. In the longitude channel, an additional step is necessary since a direct conversion can only be made at the equator. At other latitudes, the east-west mileage covered is multiplied by the secant of the latitude at which the aircraft is traveling. The modified east-west mileage is then converted directly to degrees and minutes longitude by the position longitude counter on the computer control panel. The present position computer continuously computes the change in latitude and longitude from the aircraft starting position (initial fix). These coordinate changes are applied to the corresponding position counters, both of which have been manually set to the coordinates of the starting position. Since the position counters add the change in coordinates to the staring coordinates, they provide continuous indication of the aircraft present position.

2.26.9 Course and Distance Computer. The basis of course and distance computation is the solution of the spherical triangle (each side of which is a segment of a great circle) formed on the Earth's surface by the geographic north pole (true north), the present position, and the preselected target or base. The latitude and longitude of the base and the target are manually inserted into the system by means of the position and target counters on the computer control panel. The base coordinates are retained by memory circuits of the position counters. Since this information is known within the system, as is present position of the aircraft which is available continuously from the present position computer, two sides of the spherical triangle and the angle between them are known. This makes it possible to solve for the third side and angle using the information available. The third side represents the great circle distance and the angle represents the great circle bearing or course angle.

2.26.10 Computer Control Panel. The computer control panel (Figure FO-2) has been modified to accept radar-derived wind inputs from the radar set. The panel contains the operating controls and counters which provide a readout of inserted information. The position counters also provide a continuous readout of present position during flight.

2.26.10.1 Function Switch. The function switch is a five-position rotary switch with positions of OFF, TARGET, BASE, STBY, and RESET. The OFF position removes all power from the navigation computer. The TARGET position selects output displays of target range, ground track relative to magnetic heading, and bearing relative to magnetic heading to the preselected target coordinates set on the target counters. The BASE position selects the same output displays as the TARGET position, but is referenced to the preselected base or alternate target coordinates which are retained in the memory circuits of the position counters. The STBY position supplies filament power to the amplifier-computer and the latitude and longitude integrator channels of the system are inoperative. The RESET position is used to set base alternate target or return point coordinates in the memory circuits of the position counters. Placing the switch to the RESET position causes the original memorized coordinates to be lost. A restriction on the switch prevents accidental switching to the RESET position. The switch must be pulled outward slightly to override the restriction when switching to the OFF or RESET positions.

2.26.10.2 Wind Control Knobs. The wind control knobs consist of the wind velocity control knob and the wind from control knob. The wind velocity control knob is used to manually insert the wind velocity affecting flight into the system and is displayed on the wind velocity counter. The wind from control knob is used to manually insert the true wind direction. The true wind direction is expressed as an angle measured clockwise from true north and is presented in degrees on the wind from counter.

Note

The wind control knobs are inoperative once the radar set has supplied wind signals to the navigation computer. To remove radar winds and regain manual winds before AFC 576, see section VIII of NAVAIR 01-245FDD-1A-1. After AFC 576, radar wind updates are deleted.

2.26.10.3 Magnetic Variation Control Knobs. The magnetic variation control knob is used to manually insert the magnetic variation angle into the system. The magnetic variation is the angular difference between true north and magnetic north.

2.26.10.4 Position Control Knobs. The position control knobs are initially used to insert the base, alternate target, or return point latitude and longitude into the system. To insert these coordinates, the function switch must be in the RESET position. With the function switch in any position but RESET, the position control knobs are used to manually insert present position latitude and longitude to establish an initial fix for the dead reckoning function of the navigation computer. The base, alternate target, or return point latitude and longitude are not displayed anywhere during flight; a memory of these coordinates is retained by the system so long as the function switch is not placed to the RESET position. The position latitude and longitude counters continuously indicate the aircraft present position in degrees and minutes during flight.

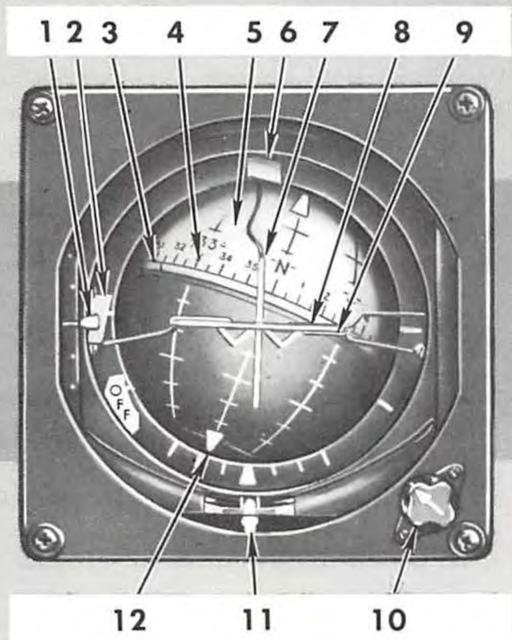
2.26.10.5 Target Control Knobs. The target control knobs are used to manually insert the target latitude and longitude into the system. These coordinates are displayed on the target latitude and longitude counters. The system provides output displays to fly to these coordinates when the function switch is placed to TARGET.

2.26.11 Flight Director Group. The purpose of the flight director group is to provide an integrated display of the navigation situation of the aircraft. The flight director group consists of a flight director computer, the horizontal situation indicator (HSI), and a selector panel. Although the attitude director indicator (ADI) is not a component of the flight director group, it does receive some signals from the flight director computer and shall be discussed along with the flight director group.

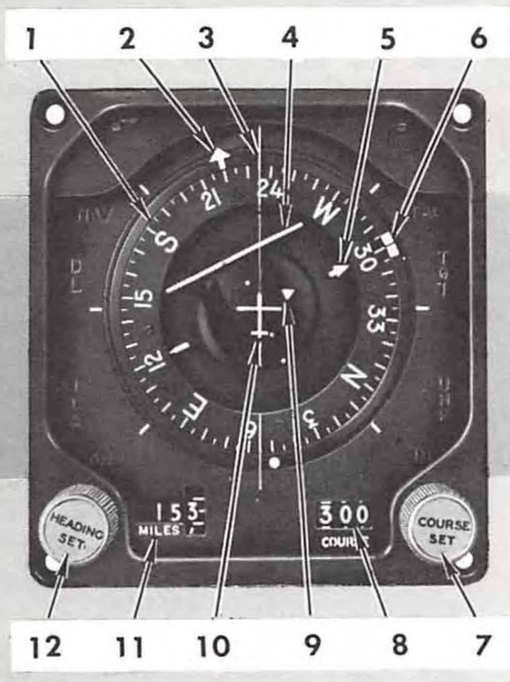
2.26.11.1 Flight Director Computer. The flight director computer provides navigation information to the HSI and steering information to the ADI. Except for the bearing and distance display on the HSI, all signals for the HSI and signals for portions of the ADI pass through or originate in the computer. The flight director computer has no control over the three-axis sphere portion of the ADI. Steering signals are computed to provide the pilot with flight direction information when flying either manually or remotely set headings and manually selected tacan radials. These computed signals together with the required flag signals and off scale signals are supplied by the computer to the ADI.

2.26.11.2 Horizontal Situation Indicator. The HSI (Figure 2-25) provides the horizontal or plan view of the aircraft with respect to the navigation situation. That is, the HSI is a platform picture of aircraft present situation as seen from above the aircraft. The aircraft symbol in the center of the HSI is the aircraft superimposed on a compass rose. The compass card rotates so the aircraft magnetic heading is always under the lubber line. Index marks are provided every 45° around the perimeter of the compass card, which can be used in holding patterns, procedure turns, etc. The bearing pointer provides magnetic bearing to a selected tacan or navigation computer station, depending on which is selected on the bearing distance selector switch. When ADF is selected on the bearing distance selector switch, the bearing pointer indicates relative bearing to the UHF station. The heading marker is controlled by the heading set knob except when navigation computer steering is desired, at which time it is automatically set. The needle which reflects the steering asked for by the heading marker is the bank steering bar on the ADI. The heading marker is centered under the lubber line when ATT is selected on the mode selector knob, but indicates a command heading for the bank steering bar to steer to in any other mode. The course arrow has two functions. For tacan steering, it must be set (using the course set knob) to coincide with the desired tacan track. The course selector window always agrees with the course arrow when used for tacan. Just as the heading marker provides steering information to the bank steering bar on the ADI, the course arrow provides the course deviation indicator on the HSI with displacement information. When the navigation computer is being used for steering information, the course arrow automatically indicates the magnetic ground track presently being flown. The to-from indicator indicates whether the aircraft is approaching or going away from the tacan station on the course selected, provided tacan azimuth is locked-on. It doesn't indicate whether the aircraft is actually heading toward the selected station. If the to-from indicator points toward the head of the course arrow (equivalent to a TO indication), it indicates the tacan course selected will steer the aircraft toward the station and not away from it. The to-from indicator only operates when tacan mode is selected. The course deviation indicator operates in conjunction with the course arrow and is only operative when in the tacan mode. The course deviation indicator represents the selected tacan radial. The relationship between the aircraft symbol and the course deviation indicator is the same as an actual plan view of the selected tacan radial and the aircraft. The course deviation indicator indicates direction and angular relationship to the tacan radial. In addition, angular error from the tacan radial can be read up to 5°. The two dots on each side of center each indicate 2.5° of angular error from the selected tacan radial. Once the course deviation indicator is fully deflected, angular error cannot be read directly, but up to 5° on either side of the selected tacan radial can be read. Four mode-of-operation word messages are shown around the HSI display. These lights are illuminated internally to indicate the selected operating mode, provided the instrument panel lights control knob is in the ON position. The intensity of the mode lights is also controlled by this knob. On F-4S after AFC 647 (AN/ARN-118 tacan installation), the course deviation indicator will indicate 5° per dot and will give course steering up to 10° on either side of the selected tacan radial.

2.26.11.3 Attitude Director Indicator. The primary function of the ADI (Figure 2-25) is to provide aircraft attitude reference. The black and gray sphere is movable and stabilized through all attitudes so that the miniature aircraft wings, against the moving horizon line on the sphere, give the pilot attitude reference. Pitch angle increments of 10° are marked on the sphere and can be set using the pitch trim knob. Heading indications are also provided around the sphere horizon line. Ten degree bank increments, up to 30°, are marked on the bottom of the instrument. The bank steering bar is the only bar used in conjunction with the flight director group. The bank steering bar indicates corrective action necessary to intercept the selected heading, tacan radial or navigation computer destination. The bank steering bar receives its bank information from the heading marker on the HSI through the flight director computer. When the heading marker is positioned either manually or automatically, the bank steering bar deflects right or left to direct the pilot to the new heading. The bank steering bar does not indicate direction or displacement from the desired heading, but rather the corrective action required. The maximum bank angle that is commanded by the bank steering bar is 30°. This is because the maximum error the computer commands is 90°. If the heading marker on the HSI is set at 90° or more from the present position, the bank steering bar indicates a maximum bank of 30°. Any heading error of less than 90° produces a bank angle indication of something less than 30°. Obviously, there are times when more than 30° of bank are desired to intercept the new heading or tacan radial and, in these cases, the bank steering bar must be disregarded. The bank steering bar information is only reliable for tacan steering if the selected tacan track is within ±60° of the present inbound track. The course deviation indicator on the HSI is reliable regardless of the tacan track selected. The ±60° limitation applies only to the bank steering bar. If when on the selected



1. VERTICAL DISPLACEMENT POINTER
2. VERTICAL DISPLACEMENT WARNING FLAG (TACAN, ILS, GVR-10, RADAR)
3. HORIZON BAR
4. HEADING REFERENCE SCALE
5. 3-AXIS SPHERE
6. VERTICAL DIRECTOR WARNING FLAG (TACAN, DATA LINK, INS)
7. BANK STEERING BAR
8. PITCH STEERING BAR
9. MINIATURE AIRCRAFT
10. PITCH TRIM KNOB
11. TURN AND SLIP INDICATOR
12. BANK POINTER



1. COMPASS CARD
2. BEARING POINTER
3. LUBBER LINE
4. COURSE DEVIATION INDICATOR
5. COURSE ARROW
6. HEADING MARKER
7. COURSE SET KNOB
8. COURSE SELECTOR WINDOW
9. TO-FROM INDICATOR
10. AIRCRAFT SYMBOL
11. RANGE INDICATOR
12. HEADING SET KNOB

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Figure 2-25. Attitude Director Indicator and Horizontal Situation Indicator tacan radial, it becomes necessary to establish a crab angle because of wind draft (aircraft heading different from selected radial), the bank steering bar indicates a heading error. To eliminate this apparent heading error, the heading marker on the HSI should be manually set to correspond to the new heading. Do not expect the bank steering bar to automatically correct for wind drift. The vertical director warning flag on the ADI (12 o'clock position), normally out of view, appears if an unreliable signal is received from the tacan, data link (some aircraft), and ILS systems (some aircraft). The vertical displacement warning flag (9 o'clock position) appears if an unreliable signal is received from the tacan, ILS, GVR-10, or the range terrain clearance tracker (if the radar is turned to ON or STBY). The OFF power fail flag on the ADI appears if there is a failure of the GVR-10 or AJB-7 systems, if the gyro is in the start cycle, if the gyro fast erect switch is held on, or if there is a power failure to the indicator.

2.26.12 Navigation Function Selector Panel. The navigation function selector panel (Figure FO-1) is on the pilot main instrument panel. The panel contains a mode selector knob and a bearing/distance selector switch. The mode selector knob and bearing/distance selector switch control separate functions of the ADI and HSI and do not necessarily have to be set up as a pair.

2.26.12.1 Mode Selector Knob. The mode selector knob is a rotary-type switch with positions of ATT, HDG, TACAN, NAV COMP, and DL. The knob is used to select the source of information to be displayed on the HSI and ADI as shown in Figures 2-26, 2-27, and 2-28.

2.26.12.2 Bearing/Distance Selector Switch. The bearing/distance selector switch is a three-position toggle switch with switch positions of NAV COMP, ADF, and TACAN. The bearing/distance switch activates only the bearing pointer and range indicator (and the mode word which reflects what is selected) on the HSI. The information displayed for the three positions of the bearing/distance switch are shown in Figure 2-29.

2.26.13 Normal Operation

2.26.13.1 AN/AJB-7 System. There is no on-off switch for the AN/AJB-7 system. Power is applied when the circuit breakers are engaged and the aircraft bus system is energized. The AN/AJB-7 system receives three-phase, 115-vac, essential bus power, and 28-vdc essential bus power. The system also receives power from the single-phase, 115-vac essential bus, and 28-vac essential bus. The system is protected by circuit breakers on the No. 1 circuit breaker panel in the rear cockpit. The circuit breakers are marked AJB-7. After the system is energized, the azimuth modes in which the compass adapter compensator may operate are the compass, directional gyro, and the slaved modes.

2.26.13.2 GVR-10 System. The GVR-10 system becomes operational when electrical power is applied to the aircraft. The system receives three-phase power for the left main 115-ac bus, and the left main 28-vdc bus. The GVR-10 system is protected by circuit breakers on No. 1 circuit breaker panel in the rear cockpit. The circuit breakers are marked GVR-10.

2.26.13.3 Flight Director Group. The flight director group receives power when the circuit breakers for the AN/AJB-7, CNI, and navigation computer systems are engaged. To operate the flight director group, the mode selector knob and bearing/distance selector switch should be positioned to the mode desired for proper display on the ADI and HSI.

2.26.13.4 Navigation Computer. All controls required to operate the navigation computer are on the computer control panel. To simplify the procedure, it will be understood that where a counter setting is specified, the control knob associated with the counter will be rotated to set the counter. The position latitude and longitude control knobs must be pressed in to engage them with their associated counter. The initial flight plan may be set into the navigation computer at any time. Electrical power is not required to set in the flight plan. However, for the navigation computer system to be operative, the appropriate protective circuit breakers must be engaged. The system receives power from the left main single-phase 115-vac bus, and the left main 28-vdc bus. The AN/ASN-39A system is protected by circuit breakers on the No. 1 circuit breaker panel in the rear cockpit. The circuit breakers are marked NAV CMPTR.

2.26.13.4.1 Initial Flight Plan (Electrical Power Not Required)

1. Set magnetic variation counter to local magnetic variation.

ATT (Attitude)

THE COURSE ARROW, COURSE DEVIATION INDICATOR AND HEADING MARKER ARE SLAVED TO THE MAGNETIC HEADING OF THE AIRPLANE (I. E. VERTICAL ON THE FACE OF THE HSI). NO MODE LIGHT IS ILLUMINATED.

ALL POINTERS ARE DEFLECTED OUT OF VIEW. ONLY ATTITUDE AND AZIMUTH INFORMATION IS DISPLAYED.

HDG (Heading)

THE HEADING MARKER IS POSITIONED BY THE HEADING SET KNOB TO PROVIDE THE ADI BANK STEERING BAR WITH BANK AND AZIMUTH INFORMATION IN ORDER TO TURN TO THE SELECTED HEADING. THE MAN MODE LIGHT IS ILLUMINATED.

THE BANK STEERING BAR INDICATES BANK ANGLE STEERING UP TO 30° OF BANK TO APPROACH THE HEADING SELECTED BY THE HEADING SET KNOB ON THE HSI.

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Figure 2-26. Attitude and Heading Displays

2. Set wind from counter and wind velocity counter to wind direction and windspeed that affects the flight.

Note

Weather stations may provide the magnetic wind direction which must be corrected for variation to obtain the true wind direction.

3. If memory base information is desired, place function switch to RESET and set latitude and longitude of alternate target, base, or return point on position counters.

4. Place function switch to any position, but RESET and set local latitude and longitude in position counters.

5. Set latitude and longitude of the target or destination on the target counters.

6. Place function switch to OFF until after starting engines.

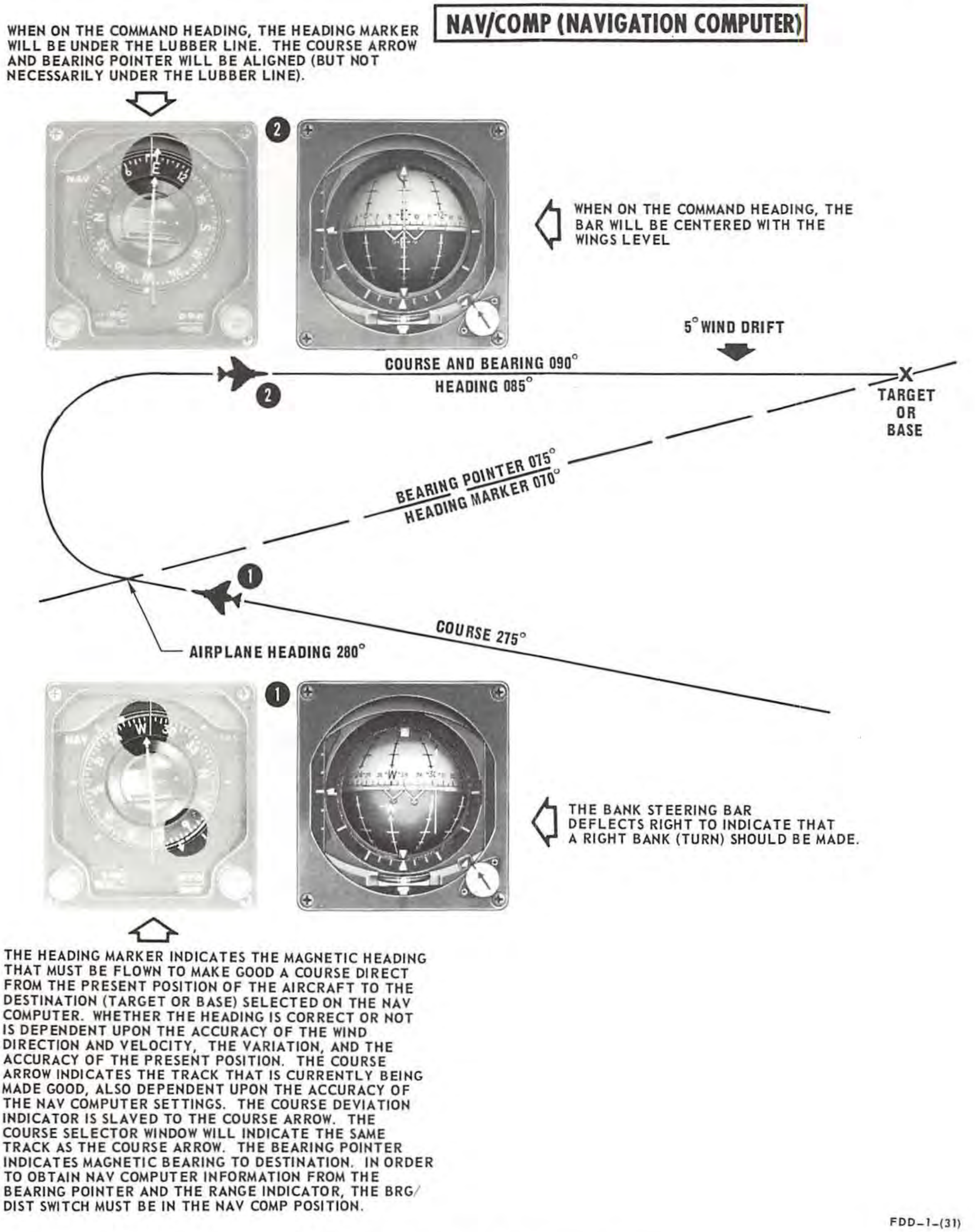

Figure 2-27. Navigation Computer Displays

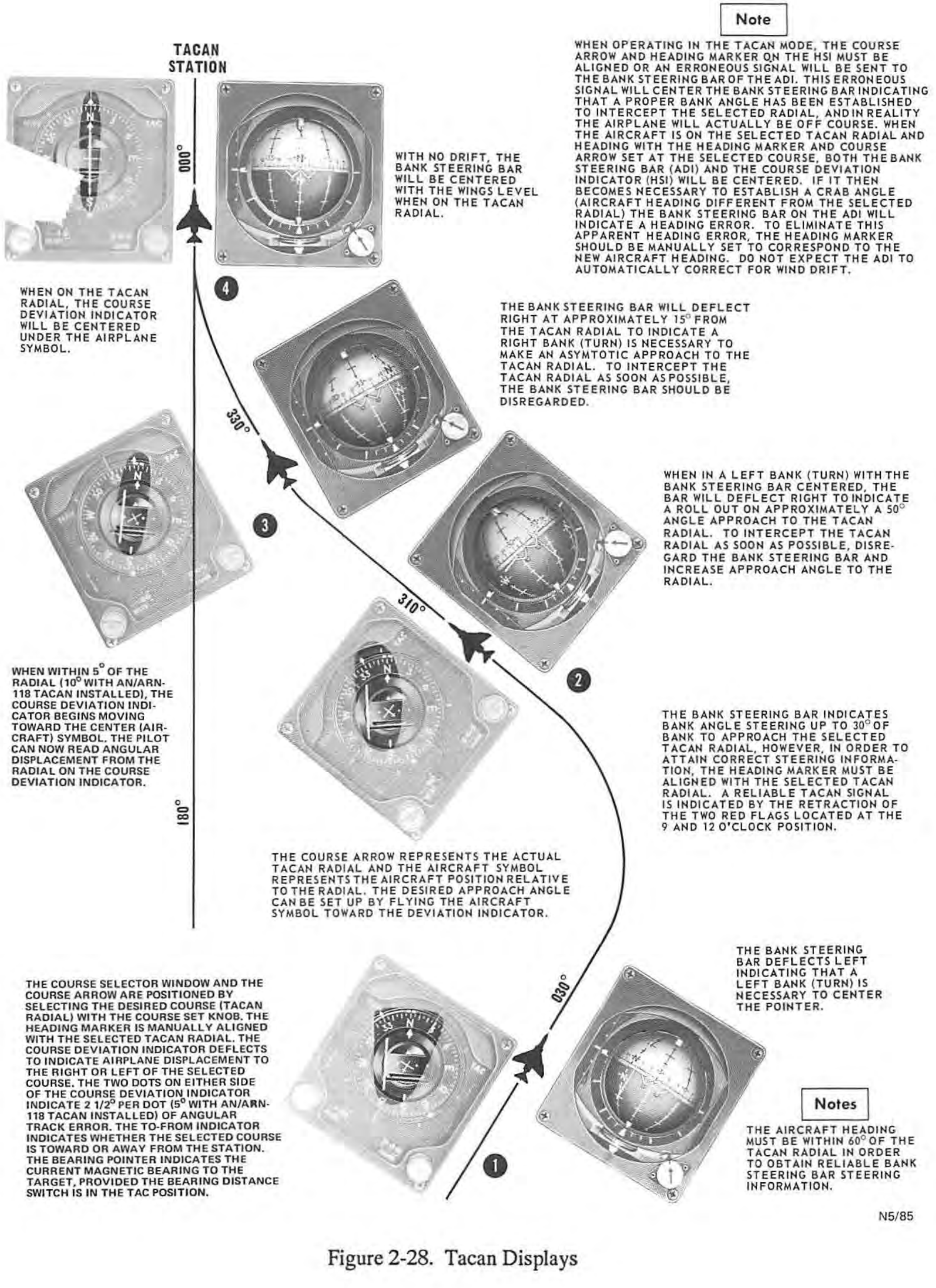

Figure 2-28. Tacan Displays

THE BEARING DISTANCE SWITCH CONTROLS ONLY THE INDICATIONS DISPLAYED BY THE BEARING POINTER AND RANGE INDICATOR OF THE HSI.

BEARING DISTANCE SWITCH

NAV COMP (Navigation Computer)

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE DESTINATION SELECTED ON THE NAV COMPUTER. THE RANGE INDICATOR INDICATES THE NAUTICAL MILES TO THE DESTINATION SELECTED ON THE NAV COMPUTER (TARGET OR BASE). THE NAV LIGHT WILL BE ILLUMINATED.

BEARING DISTANCE SWITCH

ADF (Automatic Direction Finder)

THE BEARING POINTER INDICATES RELATIVE BEARING TO THE UHF STATION SELECTED ON THE COMMUNICATION CONTROL PANEL (EITHER COMM OR AUX ADF POSITION MUST BE SELECTED). THE RANGE INDICATOR WINDOW WILL BE BLANK. THE UHF LIGHT WILL BE ILLUMINATED.

BEARING DISTANCE SWITCH

TACAN

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE SELECTED TACAN STATION. THE RANGE INDICATOR WILL INDICATE TACAN RANGE WHEN TACAN IS IN THE A/A OR T/R MODE AND, AFTER AFC 647, THE A/A T/R OR T/R MODE. THE TAC LIGHT WILL BE ILLUMINATED.

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Figure 2-29. Horizontal Situation Indicator Bearing and Distance Displays

Note

- In order for the AN/AWG-10A weapons control system to properly display air-to-air and/or air-to-ground computer symbology for accurate firing and/or bombing solutions, the navigation computer (AN/ASN-39A) must be installed and the navigation computer control panel function control switch placed in any position but OFF.

- Select an operating mode (TARGET or BASE) prior to takeoff roll.

2.26.13.4.2 Output Displays. The navigation computer display information in the front cockpit is shown in Figure 2-27. To display navigation computer information on the BDHI in the rear cockpit, select the NAV COMP position on the navigation selector switch. The displayed information of the BDHI is as follows:

1. Magnetic bearing to target or base displayed on No. 1 needle when read against the compass card. A relative bearing to the target or base can also be read by noting the number of degrees from the index clockwise to No. 1 needle.

2. Magnetic groundtrack displayed on No. 2 needle when read against the compass card. Left or right drift angle can also be read by noting the number of degrees left or right from the index.

3. Distance to the target or base displayed on the range counter.

To travel the great circle route to the target or base, the aircraft should be flown on a course that causes the two needles to coincide. However, it is not necessary to fly the course shown by the coincidental needles.

Departure from the route may be made as a part of evasive maneuvers or to fly a search pattern without affecting the operation of the system. Since computations are being made continuously, the current position of the aircraft is shown at all times on the position counters regardless of the path flown. As the target (or base) is approached, the distance on the range counter decreases. When the target is reached, uncertainty is exhibited by No. 1 needle which turns 180° as the target is passed in order to indicate bearing to target. At anytime during flight, the present position may be compared with a known checkpoint or a fix obtained from radar, tacan, or GCI and the position counters changed accordingly. This corrects errors in computation that have previously occurred but does not disturb the memory of the base or target position.

2.26.13.4.2 Updating Methods. The position counters should be checked and updated at each opportunity by one of the following methods:

1. Visual reference to a geographical position. While in one of the operating modes or temporarily in STBY, adjust the position latitude and longitude to agree with the latitude and longitude of the visual fix. This latitude and longitude may be obtained from maps, charts, or publications.

2. Radar reference to a geographical position. Use radar mapping to obtain a bearing and distance to a known geographical position. Set the latitude and longitude of this position in the target counters or in base memory. Adjust the position counters so that No. 1 needle and the range counter on the BDHI agree with the radar bearing and distance.

3. Tacan fix. Set the latitude and longitude of the acquired tacan station in the target counters or in base memory. Adjust the present position counters so that the No. 1 needle and the range counter on the BDHI agree with the tacan readout.

4. GCI or radar-monitored fix. Set the latitude and longitude of the controlling agency in the target counters or in base memory. Adjust the position counters so that No. 1 needle and range counter on the BDHI agree with the bearing and distance provided by the controller.

2.26.13.4.3 Radar Wind Updating. For information on updating the radar-derived east-west and north-south wind velocity, refer to NAVAIR 10-245FDD-1A.

2.26.13.4.4 Wind Finding Technique. To find a true wind utilizing a tacan fix, it is assumed that a constant altitude is maintained while the wind is being found. The wind velocity counter is set to zero; the latitude and longitude of the reference tacan station are set on the target counters; and the position latitude and longitude counters are set so that the tacan range and bearing and the computer range and bearing on the BDHI are identical. After a convenient time interval has elapsed, the tacan range and bearing and the computer range and bearing should be plotted, either on a chart, a grid such as that on an MB-4 computer or pictured on the face of the BDHI itself. The difference between these two plotted positions gives the wind vector for the elapsed time interval. Applying variation, the direction of the wind vector is from the computer or fix to the tacan fix. Multiply the distance by the factor necessary for an hourly rate to produce an accurate windspeed setting. For best results, repeat this process as necessary and add the new vector to the original vector.

2.26.14 Emergency Operation. There is no emergency operation for the GVR-10, the flight director group, or the navigation computer system.

2.26.14.1 AN/AJB-7 Compass Mode. The compass mode is considered an emergency mode in the AN/AJB-7 system and should be used only if the displacement gyro fails. To place the system in the compass mode, place the attitude reference selector knob to the PRIM position and the mode selector knob to the COMP position. Magnetic heading is displayed on the ADI.

2.26.15 Limitations. There are no limitations for the AN/AJB-7, the GVR-10, or the flight director group.

2.26.15.1 Navigation Computer. Beyond 70 °N or 72 °S latitude, the navigation computer continues to operate, but with a progressive loss of accuracy as either geographic pole is approached.

2.27 OXYGEN SYSTEM

2.27.1 Description. The liquid oxygen (LOX) system consists of a ten-liter capacity vacuum-insulated container, buildup coils, check valves, vent valves, and quantity gauges. The system is designed to deliver gaseous oxygen to the crew at a continuous rate of up to 120 liters per minute at 60 to 90 psi. From the container, the liquid oxygen flows to the buildup coils which are predetermined lengths of tubing wrapping around the outside bottom of the container. When the liquid flows through the buildup coil, it absorbs heat from the surrounding area and becomes gaseous. The gaseous oxygen is then increased in pressure to assure 40 to 90 psi to the regulators. From the buildup coils, the oxygen flows into the warmup plate in the rear cockpit aft of the ejection seat. The warmup coils warm it to a temperature no colder than 20°F under the cockpit temperature. From the warmup plate, the oxygen is now ready for crew consumption. A system relief valve set a 110 psi vents excessive pressures that may occur because of the boil-off of the LOX when the system is not being used. A blowout patch in the oxygen container provides added safety if a relief valve should fail. An electrical capacitance-type indicator provides the pilot and RIO with an accurate means of determining the amount of LOX remaining at anytime. An OXYGEN LOW indicator light operated by the indicator circuit and on the telelight panel alerts the pilot when the liquid oxygen gauge indicates one liter of oxygen remaining in the system.

2.27.2 Oxygen Supply Levers. A two-position ON-OFF oxygen supply lever is on a panel in each cockpit. The pilot supply lever (Figure FO-1) is on the forward end of the left console. The RIO supply lever (Figure FO-2) is on the utility panel which is in the left forward section of the cockpit.

2.27.3 Oxygen Quantity Gauge. An oxygen quantity gauge is in each cockpit which reads 10 liters maximum. The pilot oxygen gauge (Figure FO-1) is on the forward end of the left console. The RIO oxygen gauge (Figure FO-2) is on the utility panel which is in the left forward section of the cockpit.

2.27.4 Oxygen Regulator. The oxygen breathing regulator is personnel mounted and is used both in the in-flight and bailout or emergency conditions. The regulator is so designed that with an inlet pressure of 40 to 90 psi, it will deliver 100-percent oxygen automatically to the user between the altitudes of 0 to 50,000 feet. In addition, the regulator incorporates automatic safety pressure buildup to a maximum of 2 inches of water below 35,000 feet and automatic pressure breathing for altitudes above 35,000 feet and is designed to integrate with the A13/A oxygen breathing mask.

2.27.5 Emergency Oxygen. Emergency oxygen is stored in a cylinder in the upper half of the survival kit container. The emergency oxygen cylinder is a coil assembly constructed of steel tubing closed at both ends with a volume of 100 cubic inches. The cylinder is normally charged to 1,800 psi and supplies gaseous oxygen in emergencies for breathing. The flow of oxygen from this coil is controlled and regulated by the pressure reducer manifold which is actuated either manually or automatically. The pressure reducer manifold is within the survival kit and is attached to the forward left corner of the upper half of the container. It is used to reduce the oxygen pressure within the emergency oxygen cylinder to 65 (±15) psi with a flow up to 140 lpm. Components of the manifold include a toggle arm, pressure gauge, relief valve, filler valve, and safety plug. When the toggle arm of the manifold is in the cocked position, flow of oxygen from the emergency oxygen cylinder is prevented by action of the pressure reducer valve within the manifold. When the toggle is tripped, emergency oxygen flows through the manifold at a reduced pressure to the intermediate block for breathing. The emergency oxygen is delivered through the miniature demand regulator and duration of the supply will depend upon altitude and demand. Under a normal workload, there is sufficient oxygen for 10 minutes at sea level. At 40,000 feet, this supply would last approximately 50 minutes. The relief valve attached to the manifold prevents excessive pressure buildup in the system when manifold pressure regulation fails. The emergency oxygen filler valve is accessible through a hole in the upper half of the container which permits ease of servicing. The safety plug of the manifold prevents excessive pressure within the emergency oxygen cylinder because of overservicing or thermal expansion. A pressure gauge attached to the pressure reducer manifold provides pressure indication for the cylinder and is visible through a hole in the kit cushion.

2.27.5.1 Emergency Oxygen Supply Actuating Ring. The emergency oxygen supply actuating ring is on the left forward end of the survival kit container. There are two types of rings that are both colored green: a round metal ring and a flexible rubber ring. During normal flight conditions, the metal ring is stowed under the seat cushion beneath the left thigh. The rubber ring is stowed partially exposed in approximately the same position. When emergency oxygen is needed for breathing, the ring is pulled to actuate the emergency oxygen. The rubber ring when pulled separates from the kit after the emergency oxygen has been actuated; the metal ring, however, when pulled, remains attached to the survival kit after emergency oxygen actuation.

WARNING

When pulling either emergency oxygen supply actuating ring, apply the force of the pull at an angle perpendicular to the horizontal plane of the survival kit. A pull at any other angle may cause the ring to malfunction, resulting in no emergency oxygen available to the crewmember.

Note

On preflight, aircrew should note which type of actuating ring is installed on the seat pan and the location of the ring when strapped in.

2.27.6 Normal Operation. Operation of the oxygen system consists of turning the oxygen supply lever from OFF to ON. Oxygen shall be used routinely by all crewmembers from takeoff to landing. The quantity of oxygen must be sufficient to accomplish the planned mission. Use of the oxygen system in this manner provides protection against explosive decompression, smoke, fumes, and enhances instant communications. An oxygen duration chart is shown in Figure 2-30.

2.27.7 Emergency Operation. Emergency oxygen is obtained by pulling up on the emergency oxygen manual release ring.

2.27.8 Limitations. There are no limitations pertaining to the operation of the oxygen system.

2.28 PITOT STATIC SYSTEM

2.28.1 Description. A conventional pitot-static system is used in the aircraft with a single pitot tube near the top of the vertical stabilizer and two static ports, one on each side of the radome. The purpose of the pitot-static system is to supply both impact and atmospheric pressure to various instruments and system components. The pitot-static system is composed of two separate systems. Both pressures may be utilized by the same instruments, but at no time do the pressures intermingle. Both pitot and static pressures are supplied to airspeed pressure switches that retract the flaps and actuate the rudder feel system. The pitot and static pressures are also directed to the air data computer where they are calibrated and corrected (static pressure only) and then sent to the various instruments and systems requiring pitot-static pressures.

2.28.2 Pitot Heat Switch. A pitot heat switch on the right utility panel in the front cockpit right console (Figure FO-1) has positions of OFF and ON. When placed to the ON position, the heating element in the pitot tube is energized, thereby preventing formation of ice during flight.

2.28.3 Emergency Operation. Refer to flaps section for effects of erroneous airspeed indications on flap operation.

2.28.4 Limitations. Extended ground operation with the pitot heat switch ON should be avoided.

2.29 PNEUMATIC SYSTEM

2.29.1 Description. The pneumatic system (Figure FO-6), provides high pressure air for the normal and emergency operation of the canopies, normal operation of the ram air turbine (extension and retraction), the nose gear strut extension, emergency operation of the landing gear, wing flaps, cockpit flooding doors, wheelbrakes, and, on F-4J after AFC 370 and all F-4S, emergency extension of the in-flight refuel probe. On F-4J 155890am and up or after AFC 474 and all F-4S, a secondary emergency canopy pneumatic system provides canopy jettison capability. Air for the pneumatic system is drawn from the engine bleed air supply via the electronic equipment air-conditioning system and is compressed to approximately 3,100 psi by a hydraulic motor-driven air compressor. A pneumatic pressure sensor in the system moisture separator opens a hydraulic shutoff valve to activate the air compressor when the system pressure falls below 2750 (+50, -0) psi minimum. When the pneumatic system pressure builds to 3100 (+100, -50 psi), the pneumatic pressure sensor closes the hydraulic shutoff valve which deactivates the air compressor. The air compressor discharges through a moisture separator and chemical air dryer to pneumatic system air bottles. Check valves prevent the air bottles from discharging back to the air compressor. Shutoff valves isolate the air bottles from their component systems

• DURATION TIME IS HALVED WHEN TWO CREW MEMBERS ARE USING OXYGEN

OXYGEN DURATION-HOURS							
Cabin Pressure Altitude Feet	Gage Quantity-Liters						
	10	8	6	4	2	1	Below 1
40,000 and Above	60.6	48.5	36.4	24.2	12.0	6.0	-EMERGENCY- DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	37.0	29.6	22.2	14.8	7.4	3.6	
30,000	27.2	21.8	16.4	10.8	5.4	2.8	
25,000	20.4	16.4	12.4	8.2	4.0	2.0	
20,000	16.0	12.8	9.6	6.4	3.2	1.6	
15,000	12.8	10.2	7.6	5.2	2.6	1.2	
10,000	10.0	8.0	6.0	4.0	2.0	1.0	
5,000	8.4	6.6	5.0	3.2	1.6	0.8	
SEA LEVEL	7.0	5.6	4.2	2.8	1.4	0.6	

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Figure 2-30. Oxygen Duration

until they are manually discharged. A pressure transmitter for the pneumatic pressure indicator is installed in a main pressure line.

2.29.2 Pneumatic Pressure Indicator. The pneumatic pressure indicator (Figure FO-1) is on the pedestal panel and operates in conjunction with the pneumatic pressure transmitter. The indicator has a range of 0 to 5,000 pounds with calibrations of 0 to 50 and readings multiplied by 100. Normal system pressures range from 2680 to 3270 psi because of pressure transmitter and pressure gauge tolerances.

2.29.3 Normal Operation. Normal operation of the pneumatic system is accomplished automatically when the engines are running or by the application of external pneumatic power. A check of the pneumatic system cockpit pressure indicator or the basic system pressure gauge denotes only the pressure in the supply line. Operating pressure for the emergency subsystems are indicated by their individual pressure gauges. To deactivate the air compressor, pull out the pneumatic system control circuit breaker on No. 2 panel.

2.29.4 Emergency Operation. There is no emergency operation of the pneumatic system air compressor. However, all the normal and emergency systems have air storage bottles that assure adequate air pressure to the individual pneumatic subsystems. Operation of the normal and emergency subsystems is discussed under the applicable individual systems.

2.29.5 Limitations. The normal pneumatic system pressure as read on the cockpit indicator is 2680 to 3270 psi.

2.30 AN/APN-154 RADAR BEACON SYSTEM

2.30.1 Description. The radar beacon system AN/APN-154 is installed on F-4J 155529ag and up or after AFC 388 and on all F-4S aircraft. The system enhances range tracking capabilities of certain ground-based radars. These ground-based radars are transported to forward areas for vectoring the aircraft to a target area or a specific target. The radar transponder equipment emits X-band signals which interrogate the radar beacon equipment in the aircraft. The radar beacon system transmitter, in turn, transmits a pulse reply to the interrogating radar. Hence, the radar site receives a transmitted signal which is considerably stronger than a radar echo. This improves the radar site acquisition capabilities at the maximum radar ranges, especially in adverse environmental conditions. With the radar site's accurate knowledge of aircraft and target positions, it can precisely direct the aircraft to the target. The radar beacon system is comprised of the following components: the receiver-transmitter which includes receiving, transmitting, decoding, and power supply assemblies; the duplexer which permits signal reception and transmission with a single antenna; the antenna (X-band) which is installed on the surface of the aircraft; and the control panel which contains the operating controls.

2.30.2 Radar Beacon Controls. The radar beacon control panel (Figure FO-2) is in the rear cockpit on the left console. The panel contains a power switch and a mode selector knob. The OFF position of the power switch removes radar beacon system power. The STDBY position places the radar beacon system in a standby (warmup) condition. The POWER position places the radar beacon system in full operation. For optimum performance, leave the switch in the STDBY (warmup) position for at least 5 minutes before selecting the POWER position. The mode selector knob allows selection of single- or double-pulse radar interrogation reception. There are five DOUBLE positions (labeled 1, 2, 3, 4, and 5). With the knob in the SINGLE position, the system responds only to single-pulse interrogations. The DOUBLE positions (modes 1 through 5) enable the set to respond to double-pulse interrogations. The mode the RIO selects should be determined either during mission briefing or by direct voice communication with the radar site. When operating the radar beacon system in conjunction with the data link system, the RIO receives a signal on the digital display indicator as to whether SINGLE or DOUBLE should be selected, but the mode of the DOUBLE position is still established in the mission briefing or by voice communications.

2.30.3 Normal Operation. X-band pulse signals from an interrogating radar are received by the antenna and directed by the duplexer to the receiver portion of the receiver-transmitter. These signals may be single- or double-pulse trains, depending on the selected operating mode at the radar site. The signals are amplified and decoded and, when the mode of incoming signals matches the mode selected by the RIO, the decoded signals trigger the transmitter. The transmitter output is directed by the duplexer to the antenna for transmission to the radar site. There are no indicators that indicate system operation. The RIO simply energizes the system and selects the operating mode. Vectoring information is obtained by normal voice communications between the aircraft and the interrogating radar site. When operating the radar beacon system in conjunction with the data link system, vectoring information is automatically displayed on various cockpit indicators.

2.30.4 Emergency Operation. There is no emergency operation pertaining to the radar beacon system.

2.30.5 Limitations. There are no limitations pertaining to the radar beacon system.

2.31 SPEEDBRAKES

2.31.1 Description. The hydraulically operated speedbrakes are on the underside of the inboard wing panels and are hinged on the forward side permitting the brakes to open downward. The speedbrakes may be positioned at any point in their travel and are controlled by a switch on the inboard throttle grip. If the throttle mounted switch fails the speedbrakes can be retracted with the emergency speedbrake retract switch on the oxygen panel. On F-4J after AFC 534 and all F-4S, the emergency speedbrake switch is replaced by the emergency aileron droop switch. The speedbrakes are controlled by the right main 28-vdc bus and powered by the utility hydraulic system.

2.31.2 Speedbrake Switch. The speedbrake switch (Figure FO-1) on the throttle grip has three positions: IN, STOP, and OUT. The STOP position is the normal position of the switch. Only the OUT position of the switch is momentary. Placing the switch in the OUT position operates the speedbrakes toward the extend position. When the switch is released, it returns to the STOP position. The STOP position deenergizes the selector valve and blocks all ports giving a hydraulic lock for holding the speedbrakes to any desired position. Selecting the IN position of the switch closes the speedbrakes flush with the wing. The speedbrakes take 2 to 3 seconds to fully open and 2 to 3 seconds to fully close. The speedbrake switch IN position also serves as an emergency disengage switch for the approach power compensator system.

Note

The STOP position of the speedbrake switch may not hold the speedbrakes completely closed. This is indicated by the illumination of the SPEED BRAKE OUT light. If this occurs, position the speedbrake switch to IN and leave in that position. However, with the speedbrake switch IN, the APCS system is inoperative.

2.31.3 SPEED BRAKE OUT Light. An amber SPEED BRAKE OUT light (Figure FO-1) on the telelight panel illuminates when either or both of the speedbrakes are not fully closed.

Note

SPEED BRAKE OUT light does not light the MASTER CAUTION light.

2.31.4 Normal Operation. Normal operation of the speedbrakes is accomplished through the three-position throttle-mounted speedbrake switch. The IN position retracts the speedbrakes, the OUT position extends the speedbrakes, and the STOP position holds the speedbrakes in any intermediate position. A SPEED BRAKE OUT light on the telelight panel illuminates any time the speedbrakes are not closed.

Note

Extension of the speedbrakes with the flaps lowered will reduce flap efficiency and actually increase approach speed slightly.

2.31.5 Emergency Operation. The speedbrakes automatically close if an electrical failure occurs. If a hydraulic failure occurs, air loads close the speedbrakes to a low drag trail position. If a failure occurs in the throttle-mounted speedbrake switch, the speedbrakes can be closed by placing the emergency speedbrake switch in the RETRACT position. On aircraft after AFC 534, the emergency speedbrake retract switch is removed and emergency retraction is accomplished by pulling the SP BK (speedbrake) circuit breaker on the essential circuit breaker panel.

Note

On F-4J 155897ak and up or after AFC 392 and all F-4S, the APCS can be disengaged by moving the speedbrake switch to IN regardless of emergency speedbrake switch (some F-4J) or speedbrake circuit breaker position.

2.31.6 Limitations. There are no specific limitations pertaining to the operation of the speedbrakes.

2.32 A/A47U-3/4 TOW TARGET SYSTEMS

2.32.1 Description. The A/A47U-3/4 tow target reeling machine-launcher system provides the capability for semiautomatic launching, towing and recovery of aerial tow targets by the pilot. The A/A47U-3 system consists of a PEK-84 reeling machine-launcher control (Figure 2-31), a RMK-19 reeling machine-launcher (Figure 2-32), and an adaptive aircraft electrical harness. The A/A47U-4 system is identical to the A/A47U-3 except that the RMK-31 reeling machine-launcher is substituted for the RMK-19.

2.32.2 RMK-19/31 Reel Launcher. The RMK-19/31 is a jettisonable store which is attached to the centerline station of the F-4J aircraft using an AERO-27 bomb rack. Electrical wiring harness, part No. 502AS2007, is required for electrical interface.

The RMK-19/31 (Figure 2-32) consists of a reversible pitch ram air turbine, a transmission, a towline storage spool, and a target launcher. The RMK-19/31 is capable of streaming a towline at a rate of 5,000 feet per minute. The ram air turbine rotates counterclockwise (as viewed from the rear) during reel-out and functions as a brake against the trailing towline and target. The unit rotates clockwise to furnish drive power for reel-in and recovery of target.

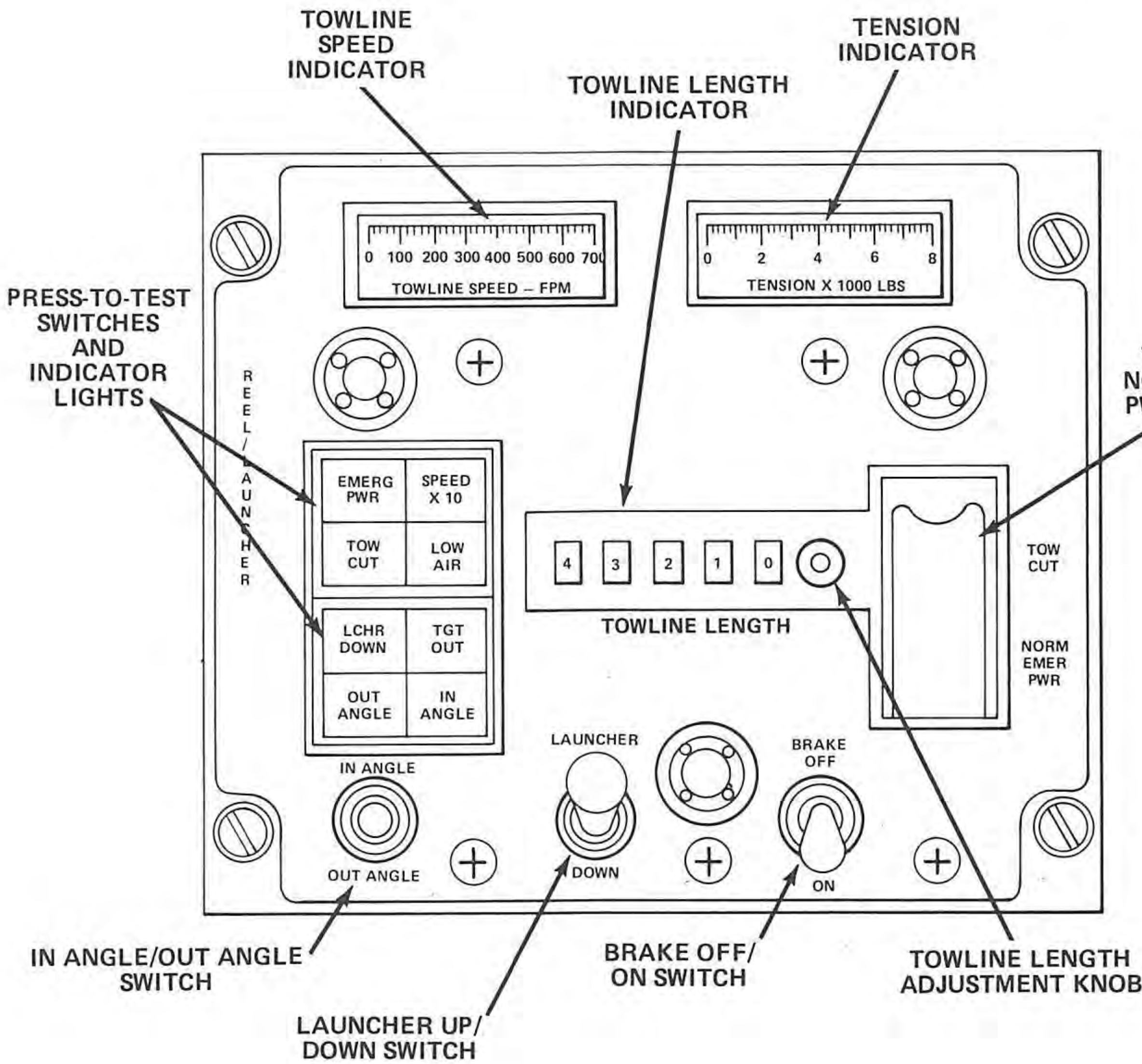
Note

Carriage of the RMK-19/31 does not cause any adverse flight characteristics. However, the pilot should expect to encounter the following phenomena:

1. Minor vibrations during reeling operation, particularly during reel acceleration and deceleration.

2. High-pitched whine (like a siren) during high-speed reeling

3. Torque effect during high-speed reeling.



NOTE

All switches are in secured position.

Figure 2-31. PEK-84 Reel Launcher Control

2.32.3 Limitations

1. Airspeed (KIAS/IMN whichever is less)

   a. No target (ferry/logistics) – 500/0.90

   b. Target streamed (level flt) – 450/0.80

   c. Target stowed – 400/0.80

   d. Target streamed (turning) – 375

   e. Reeling in or out – 275

   f. Launch or recovery – 250 ±25.

2. Altitude (feet maximum)

   a. Launch or recovery – 20,000

   b. Reeling in or out – 25,000.

3. Acceleration (g's maximum)

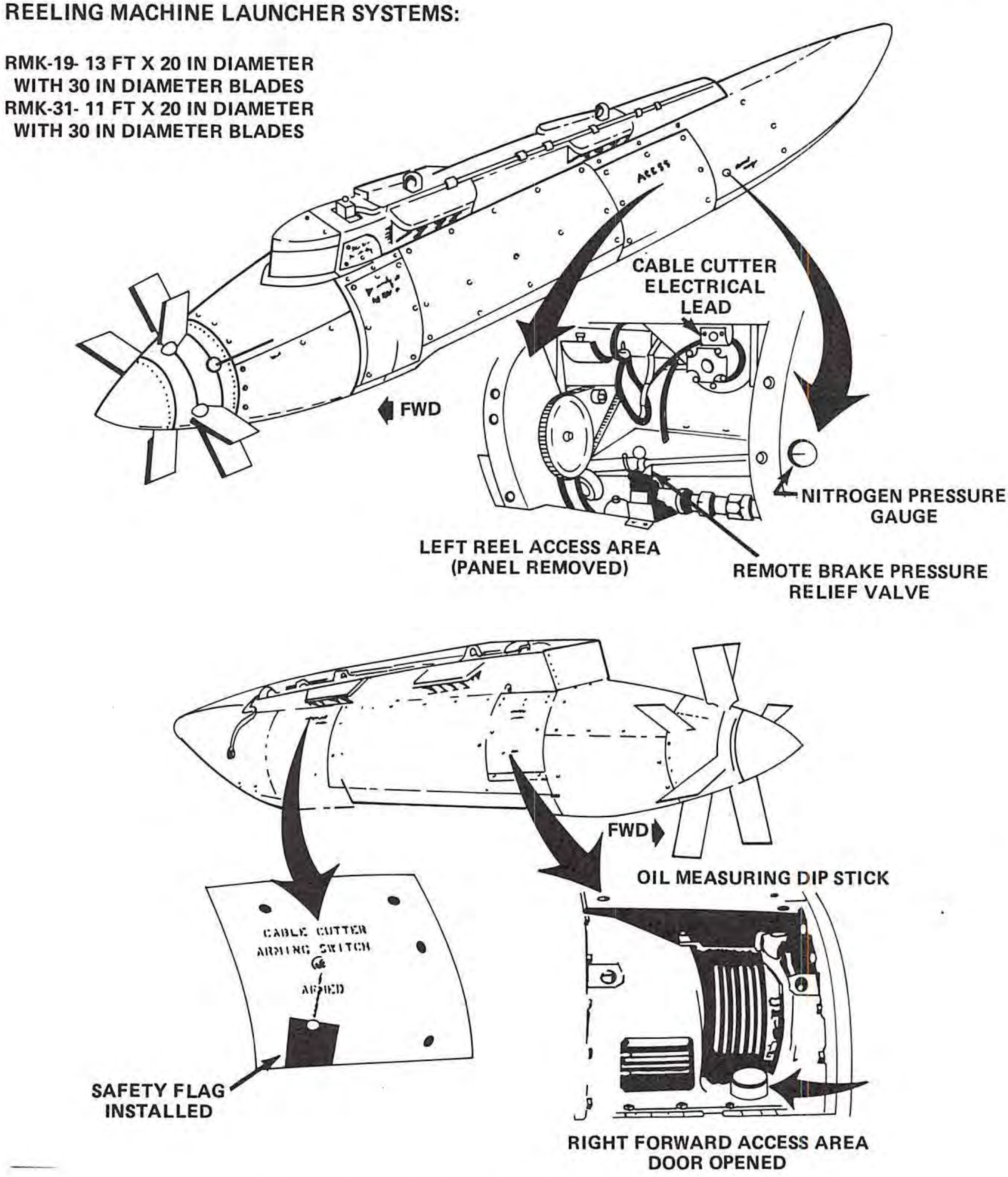


Figure 2-32. RMK-19/31 Reeling Machine Launchers

a. No target – +0.5 to +4.0

b. Target stowed – +0.5 to +3.0

c. Target streamed (turning) – +3.0

d. Target streamed (level flt) – +1.0.

4. Maneuvering (degrees of angle of bank)

a. Launch or recovery – 0

b. Reeling in or out – 20

c. Target streamed – 60.

5. Turbine operation (fpm)

a. Normal reel in or out – 3,000 to 4,000

b. Maximum reel in or out – 4,000

c. Final recovery – 250

d. Target/launcher contact – 50.

6. Store weight (pounds)

a. Tow reel (full spool) – 1,800

b. Tow reel (no towline) – 800:RMK-19; 790:RMK-31

c. Target – 45: TDU-37/B 75:TDU-34/A.

2.32.4 Lubrication. A wet sump-type lubrication system is provided in the transmission. The transmission is capable of operating only 10 seconds with an interrupted oil supply. An oil dipstick (Figure 2-32) is used to check the oil level.

2.32.5 Pneumatic System. A 300-psi pneumatic system provides the power to extend and retract the launcher and to apply the brakes of the RMK-19/31. A high-pressure storage bottle supplies compressed nitrogen up to 3,000 psi. The supply permits no more than four complete operating cycles of the launcher and brakes. The pressure gauge is located on the left side of the tow reel (Figure 2-32).

Under normal operating conditions, pneumatic line flow restrictors provide for soft brake application and slow launcher retraction. Launcher extension is restrained by towline tension and turbine torque during launch and the aft pull of the towline during recovery (LAUNCHER DOWN should occur at 500 feet of towline streamed). Under emergency conditions of STOP & CUT, turbine and spool brake application is instantaneous. Without the towline or if the pull of the towline is downward (aircraft on the ground or target streamed close to the launcher), launcher extension is also instantaneous. (This is required to permit jettison of the target.)

2.32.6 Cable Cutter Arming Switch. The cable cutter (and launcher) arming switch is located on the starboard aft portion of the RMK-19/31 (Figure 2-32). The switch provides electrical ground safing of the RMK-19/31. The switch is positioned in the SAFE position to provide ground safety because the cable cutter power is not routed through the aircraft armament safety weight-on-wheels switch.

2.32.7 Cable Cutters. One explosive, cartridge-operated cable cutter (Figure 2-32) is mounted on the launcher support structure and provides for cutting the towline under flight operating conditions. The cutter is fired by actuation of the tow cut switch on the reel/launcher panel (Figure 2-31). An alternate cartridge-operated cable cutter is provided in case of a failure of the primary cutter.

2.32.8 PEK-84 Control. The PEK-84 reel/launcher panel (Figure 2-31) contains all the instruments and switches required to control and monitor reel/launcher functions.

2.32.9 Towline Speed Indicator. The towline speed indicator identifies reeling unit speed in feet per minute. The indicator operates with and without towline. With the speed X 10 light ON, towline speed is 10 times the dial reading.

2.32.10 Tension Indicator. The tension indicator identifies the tension load in the towline.

2.32.11 Towline Length Indicator. The towline length indicator indicates the distance the target is aft of the reel/launcher. The fourth digit changes every 10 feet. The last digit is a constant zero. The indicator operates only when towline is streamed from the RMK-19/31. The indicator can be reset to zero by depressing and rotating the reset knob counterclockwise.

2.32.12 EMERG PWR Light. The emergency power light illuminates when the emergency power switch is actuated and electrical power is being received from the essential 28-vdc bus. When this occurs, only the tow cut switch can be operated.

2.32.13 SPEED X 10 Light. The speed X 10 light illuminates when the towline speed indicator is operating in the high-speed range (700 to 7,000 feet per minute).

2.32.14 Tow Cut Light. The tow cut light illuminates when electrical power has been applied to the cutting cartridge, but does not indicate that the towline has been cut.

2.32.15 Low Air Light. The low air light illuminates when the nitrogen storage bottle pressure drops below 750 pounds per square inch.

2.32.16 LCHR DOWN Light. The launcher down light illuminates when the launcher is unlocked.

2.32.17 TGT OUT Light. The target out light illuminates when the target has been launched or is not engaged in the launcher during recovery.

2.32.18 In Angle and Out Angle Lights. The in angle light illuminates when the turbine blades are at a reel-in pitch of 5° or greater. The out angle light illuminates when the turbine blades are pitched for reel-out. When both lights are out, the blades are between 0° and 5° in pitch. The lights should be out for all ferry (nontowing) flights and at anytime the brake is on.

2.32.19 Press-to-Test Switches. The PWR/SPEED/CUT/AIR warning light block and the LCHR/TGT/ANGLE status light block are press-to-test switches. The warning light block illuminates, when depressed, if essential 28-vdc bus power is available to the system. The status light block illuminates, when depressed, if primary 28-vdc bus power is available to the system.

2.32.20 TOW CUT/NORM/EMER PWR Switch. The tow cut/normal/emergency power switch is used to control the emergency functions of the RMK-19/31. The TOW CUT position provides an emergency means of cutting the towline and applying the spool and turbine brakes at any time. The EMER PWR position connects limited system functions to the essential 28-vdc bus. The NORM position is a guarded position which guards all nonemergency operations.

2.32.21 Brake OFF/ON Switch. The brake switch is used to control the ram air turbine brake. The brake can be applied at anytime if an emergency exists. However, it should normally be applied only after the turbine has stopped turning.

2.32.22 Launcher UP/DOWN Switch. The launcher switch is used to control the launcher. The UP position of the switch is guarded.

2.32.23 In Angle/Out Angle Switch. The angle switch is used in conjunction with the speed, length, and tension indicators to control the speed and torque of the ram air turbine. Reel-out speeds are increased by beeping the switch in the OUT direction. Reel-out is terminated by beeping the switch in the IN direction until the reel indicators indicate that the reel has stopped (i.e., reel-speed zero and towline length indicator stopped). Reel-in is accomplished by beeping the switch in the IN position until the towline length indicator indicates decreasing towline length.

2.33 WING FOLD SYSTEM

2.33.1 Description. Each outer wing panel is folded upward to a vertical position by a conventional hydraulic actuator that receives hydraulic pressure from the utility hydraulic system. A mechanical locking system is used to lock wing pins in hinge fittings when wings are spread. A flush-mounted control lever (Figure FO-1) on the right console in the pilot cockpit is connected by push rods and push-pull cables to a pin locking device in the wing fold area. Pulling UP on the lever unlocks wing pins, extends warning flags on the upper wing surfaces, illuminates amber L WING PIN UNLOCK and R WING PIN UNLOCK lights in both cockpits, and energizes the wing fold. Wing fold is actually accomplished by a two-position toggle switch underneath the wing pin release lever and is exposed when the lever is raised. The switch is marked FOLD and SPREAD. As an added safety precaution, the wing fold hydraulic system receives its hydraulic pressure from the landing gear down pressure line; this prevents pressurizing the wing fold system when the landing gear is UP. When folding or spreading the outer panels, observe the following precautions:

1. Jury struts removed.

2. Do not fold or spread wings broadside of the blast of aircraft engines.

3. Do not fold or spread wings in winds over 60 knots.

4. Ensure wings are spread and locked prior to taxiing or prior to being spotted directly aft of the jet blast deflector during launch operations.

2.33.2 Normal Operation. Normal operation consists of folding and spreading the wings and is accomplished through the wing fold panel on the right console. To fold the wings, pull UP on the wing lock lever and place the wing fold switch in the FOLD position. To spread the wings, remove the jury struts and place the wing fold switch to SPREAD and visually determine that both outer wing panels are in the full spread position prior to placement of the manual wing pin lock lever in the down (locked) position. Red warning flags which are attached to the wing pin locks are flush with the wing skin if the wing pin locks are fully inserted. The warning flags extend above the wing surface, inboard of the wing fold line, when the wing pin locks are not inserted. When the wing pin locks are fully inserted, the L. WING PIN UNLOCK and R. WING PIN UNLOCK warning lights are extinguished.

2.33.3 Emergency Operation. There is no emergency operation pertaining to the wing fold system.

2.33.4 Limitations. Whenever the aircraft is parked or towed with wings folded, jury struts are to be installed. Taxiing with wings folded and jury struts not installed should be held to a minimum. Aboard ship, jury struts must be inserted anytime wings are folded.

CHAPTER 3

Servicing

For information pertaining to servicing (i.e., authorized AGE, consumable materials, capacities, pressures, and cockpit procedures), refer to NAVAIR 01-245FDD-1C, NATOPS Servicing Checklist.

CHAPTER 4

Operating Limitations

4.1 AIRCRAFT

All aircraft system limitations that must be observed during normal operation are covered or referenced herein. Some limitations that are characteristic only of a specialized phase of operation (emergency procedures, flight through turbulent air, starting procedures, etc.) are not covered here; however, they are contained along with the discussion of the operation in question.

4.1.1 Instrument Markings. The limitation markings appearing on the instrument faces are shown in Figure 4-1 and noted in the applicable text.

4.1.2 Instrument Fluctuation

4.1.2.1 Fuel Flow

100 PPH maximum for indicator readings of 0 to 3,000 PPH.

750 PPH maximum for indicator readings of 3,001 to 12,000 PPH.

4.1.2.2 RPM

±0.2% from steady-state condition.

4.1.2.3 EGT

±5°C maximum for steady-state operation from IDLE through MIL power settings. ±8°C maximum for steady-state afterburning.

4.1.2.4 Exhaust Nozzle

Limited by EGT fluctuation.

4.1.2.5 Oil Pressure

±2.5 PSI from steady-state pressure.

4.1.3 Engine Limitations. Refer to paragraph 2.16, ENGINES.

4.1.4 Airspeed Limitations. The maximum permissible airspeeds in smooth or moderately turbulent air with arresting hook, landing gear, wing flap retracted, and with speedbrakes retracted or extended are as shown in Figure 4-3. Airspeed limitations for operation of various systems are presented in Figure 4-2.

CAUTION

When flying at airspeeds in excess of 350 KCAS below 10,000 feet with cg location aft of 32-percent mean aerodynamic chord (MAC), avoid abrupt control motions. The cg location aft of 32-percent MAC will normally occur whenever full internal fuel is maintained in conjunction with external stores. Prior to takeoff, refer to the Handbook of Weight and Balance Data (AN 01-1B-40) to determine cg location for the specific configuration.

4.1.5 Prohibited Maneuvers

1. Full-deflection aileron rolls in excess of 360°.

2. Intentional spins.

3. Abrupt control movements when carrying the 600-gallon external fuel tank or the D-704 air refueling store.

4. Lateral control deflections in excess of one-half of the total stick travel when carrying the Mk-104, the 600-gallon external fuel tank, the 370-gallon external wing tanks, or the D-704 air refueling store. This restriction does not apply when in the takeoff or landing configuration.

BASED ON JP-4 or JP-5 FUEL

J79 GE-8

EXHAUST GAS TEMPERATURE		
635°C	red	MAXIMUM STEADY STATE TEMP.

EXHAUST GAS TEMPERATURE		
668°C	red	MAXIMUM STEADY STATE TEMP. -10 ENG
704°C	red	MAXIMUM STEADY STATE TEMP. -10B ENG

MIL-L-7808 OIL		MIL-L-23699 OIL
60 PSI	MAXIMUM	70 PSI
35 PSI	MINIMUM AT MILITARY RPM STEADY-STATE GROUND OPERATION	45 PSI
12 PSI	MINIMUM AT IDLE POWER	12 PSI
30-60 PSI	INFLIGHT NORMAL OPERATION AT MIL POWER AND ABOVE	35-70 PSI

TACHOMETER	
102%	red. MAXIMUM

Notes

- PLACARD PRESSURE ON THE OIL PRESSURE GAGES IS CORRECTED TO 100 PERCENT RPM. AT MILITARY THROTTLE SETTING DURING T_2 CUTBACK, OR ANY OTHER SPEED REDUCTION, INDICATED PRESSURE WILL DECREASE BELOW PLACARD PRESSURE APPROXIMATELY 1 PSI PER 1 PERCENT REDUCTION IN RPM BELOW 100 PERCENT RPM.
- INDICATED OIL PRESSURE CORRECTED TO 100 PERCENT RPM MUST REPEAT WITHIN 5 PSI OF THE PLACARDED OIL PRESSURE.
- BELOW 20,000 FEET DURING STEADY STATE OPERATION, ANY ERRATIC PRESSURE CHANGE WHICH EXCEEDS 5 PSI FOR MORE THAN 1 SECOND MUST BE INVESTIGATED. AT AND ABOVE 20,000 FEET, PRESSURE FLUCTUATIONS ARE LIMITED TO THE FOLLOWING: MAXIMUM OF 20 PSI BELOW NORMAL PRESSURE FOR A DURATION OF 3 SECONDS, OCCURRING NO MORE THAN 4 TIMES PER MINUTE; OR A MAXIMUM OF 10 PSI BELOW NORMAL PRESSURE FOR A DURATION OF 1 SECOND, OCCURING NO MORE THAN 15 TIMES PER MINUTE.
- WHEN OPERATING WITH MIL-L-23699 OIL AND THE OUTSIDE AIR TEMPERATURE IS 100°F OR ABOVE, A MINIMUM OF 40 PSI AT MILITARY RPM STEADY STATE GROUND OPERATION IS PERMISSIBLE.

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Figure 4-1. Instrument Markings

- SYSTEMS -

REFUELING PROBE	EXTENDING–RETRACTING	300 KT/.9 IMN
	EXTENDED	400 KT/.9 IMN
RAM AIR TURBINE	MAX SPEED	515 KT/1.1 IMN
	G LIMIT EXTENDING	0 – +3G
	G LIMIT OUT	–1.0 – +5.2G
	MINIMUM AIR PRESSURE EXTENSION	1000 PSI
	MINIMUM AIR PRESSURE RETRACTION	200 PSI
	WORKS TO	90 KT
LANDING GEAR	EXTENSION–RETRACTION	250 KT
FLAPS	LOWERING–RAISING	250 KT
	AUTO BLOW UP	230–240 KT
	AUTO BLOW DOWN	234–210 KT
SLATS	AUTO BLOW UP	568–602 KT
	AUTO BLOW DOWN	BLOW UP SPEED – 10 – 30 KT
CORNER REFLECTOR	EXTENSION–RETRACTION	250 KT
RUDDER CHANGEOVER	ACCELERATING	228–252 KT
	DECELERATING	232–218 KT
CANOPY	MAX NORMAL OPENING	60 KT
	DEPARTS AIRCRAFT	100 KT
RAMPS	PROGRAM	1.4–1.7 IMN
BOARDING LADDER EXTENDED		400 KCAS
DRAG CHUTE	MAX DEPLOYMENT	215 KT
	CROSSWIND LANDING	20 KT @ 90°
EJECTION LIMITATIONS	HUMAN	400 KT
	SEAT	500 KT/.92 IMN
BAROSTAT	INITIATION	13,000 ±1500 FT
AIRCRAFT SPEED RESTRICTIONS (CLEAN)	0–30,000	750 KT
	ABOVE 30,000	710 KT/2.1 IMN
AFCS LIMITS	±70° PITCH & ROLL	–1 +4G

RADAR ALTIMETER (BEFORE AFC 570)	±30° BANK	±50° PITCH	5,000 FT ALT
(AFTER AFC 570)	±45° BANK	±45° PITCH	
CG LIMITATIONS	27.0% THRU 36.0% MAC F-4J 26.0% THRU 37.0% MAC F-4S		

- ACCELERATION LIMITS -

CLEAN (37,500)	–3.0 +8.5 (LESS THAN .72 IMN)	+6.5 (MORE THAN 1.05 IMN)

- GROSS WEIGHT/AOA -

					F-4J	F-4S
MAXIMUM ALLOWABLE GROSS WEIGHT	FIELD TAKEOFF	56,000 LB	ANGLE OF ATTACK AIRSPEED (DRAG COUNT 0–60)	CLIMB (400–.88)	5.5 UNITS	6.0
	FIELD LANDING	46,000		MAX ENDURANCE	8.5–9.0	10.5
	CATAPULTING	56,000		MAX RANGE	7.5–8.0	9.5
	ARRESTED LDG	40,000		GEAR EXTENSION	9.0	9.5
	TOUCH & GO	40,000		FLAP EXTENSION	13.0	12.0
	FMLP	40,000		APPROACH	18.3	18.3**
	BARRICADE*	34,000		NO FLAP	18.3	18.3**
	SINGLE ENGINE	36,000			(ON FINAL)	(ON FINAL)

- FUEL -

FUEL QUANTITIES (USABLE)	MAX FUSELAGE		9,303 LB
	MAX INTERNAL		13,587 LB
	MAX INTERNAL & ℄		17,667 LB
LOW FUEL/TRANSFER	LOW FUEL	AUTO XFR	TK 7 XFR
THRU BLK 41	1880 ±200 LB	2615 ±200 LB	2050 ±200 LB
BLK 42 & UP	1880 ±200 LB	1465 ±200 LB	WHEN ROOM AVAIL.
WING FUEL TRANSFER LIMITS	+75° TO –15° PITCH		
DUMP CAPACITY	680 POUNDS/MINUTE		

*F-4S BARRICADE – 36,000 LB.
**19.0 AFTER AFC 644/AVC 2494 AND AMEND 1

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Figure 4-2. Operations/Limitations (Sheet 1 of 2)

- PRESSURES -

		PC 1 PSI	PC 2 PSI	UTILITY PSI
HYDRAULIC PRESSURE	R ENGINE ONLY	0	2750–3250	2550–3000
	L ENGINE ONLY	2750–3250	0	2750–3250
	BOTH ENGINES	2750–3250	2750–3250	2750–3250
	STAB AUGS	PITCH AUG	———	YAW & ROLL AUG
	CHK HYD LIGHT	ON BELOW 1500 ±100		OUT ABOVE 1750
	ACCUM PREFLIGHT	1000 ±50	1000 ±50	1000 ±50
	WHEEL BRAKE ACCUMULATOR			1000 ±50

PNEUMATIC SYSTEM GAGE PRESSURE	NORMAL COCKPIT INDICATION		2680–3270 PSI
	PRESSURES FOR NOSE GEAR EXTENSION	BEFORE	2750 PSI MIN
		AFTER	1350 PSI MIN
			2300 PSI MAX
	ALL GAGES ON PREFLIGHT		2750–3100 PSI

- ENGINE -

	CONDITION	TEMP (°C)			TIME (SEC)
EXHAUST TEMPERATURE LIMITATIONS	STEADY STATE FOR CONTINUOUS OPS	–8 625±10	–10 660±8	–10B 696±8	NO LIMIT
	TEMPERATURE DURING STARTING	ALL ENG 1000			3
		980			10
		930			60
		900			
		DOWN TO 733			90
	ABOVE 705° DURING START REQUIRES DISCREPANCY CARD				
	DURING ALL ENGINE OPERATIONS OTHER THAN STARTING	750	750	774	3
		635	668	704	NO LIMIT

INLET TEMPERATURE LIMITATIONS	ENGINE INLET TEMP HIGH WARNING LIGHT	121°	SUPERSONIC BLW 30,000 FT PROHIBITED
	TRANSIENT TEMP OPERATION	121°-193°	5 MINUTES PER HR ABOVE 30,000 FT

		STATIC (RPM)	INFLIGHT (RPM)
SPEED LIMITATIONS	NORMAL OPERATION	100 ±0.5%	100 ±0.5%
	ALLOWABLE OVERSPEED NON TIME LIMITED	103%	102%
	ALLOWABLE OVERSPEED TIME LIMITED	103–105% 3 MIN	102–103.6% 1 MIN
	IDLE	65 ±1%	

		BELOW 35,000 FT	ABOVE 35,000 FT
POWER TIME LIMITS	MILITARY	30 MIN	2 HRS
	MAXIMUM	30 MIN	2 HRS

G (LUBRICATION)	NEGATIVE G		30 SEC
	ZERO G		10 SEC
BLEED AIR CHECK VALVE FAILURE (RUN–UP)	RPM ABOVE 67.5%	EGT DOWN 25°C	FUEL FLOW DOWN 100 pph
IGNITION	2 MIN ON 3 OFF 2 ON 23 OFF		

OIL PRESSURE (MIL–L–23699)	MAXIMUM	70 psi
	MIN. AT MILITARY STEADY STATE GROUND OPS	45 psi
	MIN. AT IDLE	12 psi
	NORMAL INFLIGHT MILITARY AND ABOVE	35–70 psi
	FLUCTUATION ALLOWABLE	±2.5 psi
	OIL PRESSURE BELOW 50 PSI PRIOR TO ENGAGING GEN.	

NORMAL FUEL FLOW (PPH)	LIGHT OFF/15 SEC 225–800 (500–1200,–10B)	IDLE 800–1400 (800–1500,–10B)	MILITARY (APPROX) 7500–9000
	THROTTLE CHOP 365 (440,–10B)		
BOOST PUMP PRESSURE	30 ±5 psi		

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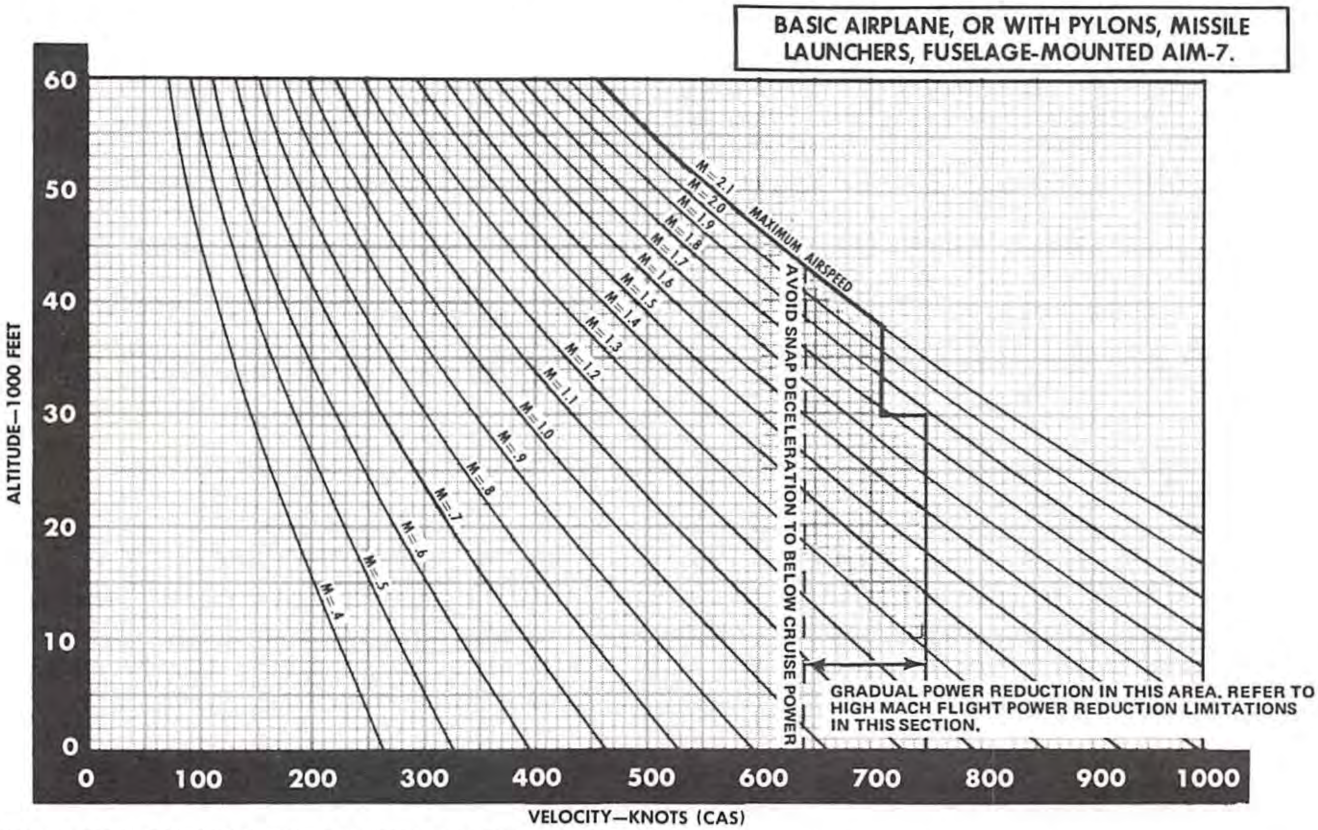
Figure 4-2. Operations/Limitations (Sheet 2 of 2)



NOTE: • UNDER SOME CONDITIONS, MAXIMUM AIRSPEEDS ARE DETERMINED BY INLET TEMPERATURE LIMITATIONS. REFER TO ENGINE INLET TEMPERATURE LIMITATIONS CHART, PART 2 OF SECTION I.

• FOR AIRSPEED RESTRICTIONS CONCERNING OTHER CONFIGURATIONS, REFER TO EXTERNAL STORE LIMITATIONS CHART.

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Figure 4-3. Aircraft Speed Restrictions

5. With the AFCS engaged, intentional maneuvers that exceed the automatic disengagement limits of the system.

6. Lateral control deflections in excess of one-third of the total stick travel when carrying the RCPP-105 starter pod. This restriction does not apply when in the takeoff or landing configuration.

7. Negative g in excess of 30 seconds.

8. Zero g in excess of 10 seconds.

9. Airborne deployment of the drag chute except for emergency out-of-control/spin recovery.

10. Carrier operations without AFC 636 incorporated (inboard leading edge flap fixed up, F-4S only).

4.1.6 F-4S Crosswind Landing Limitations (Recommended)

1. Full flaps, 19 units – 15 KNOTS.

2. Half flaps, 17 units with roll modification (IAVC-2557) operative – 25 KNOTS.

3. Single-engine – 15 KNOTS.

4. Wind from asymmetrical load side – 25 KNOTS.

5. Wind opposite asymmetrical load – 5 KNOTS.

6. Drag chute deployment (dry runway) – 20 KNOTS.

4.1.7 Center-of-Gravity (CG) Limitations. CG for all currently permissible gross weights and configurations must be kept between 27-percent and 36-percent MAC for all F-4J aircraft and nonslatted F-4S aircraft and between 26-percent and 37-percent MAC for all slatted F-4S aircraft. However, the maximum allowable aft CG will be forward of 37-percent MAC with certain external loading configurations. To maintain minimum acceptable longitudinal stability, the allowable aft cg must be moved forward as wing-mounted stores are added to the aircraft.

Note

Although F-4S in-flight aft cg limit with zero stability index (SI) remains at 37-percent MAC, the aft cg limit at higher SI has shifted forward relative to the F-4J aft limit, effectively reducing the cg envelope available for wing-mounted external stores by approximately 1.0 percent. Permissible F-4J external store loadings may not be satisfactory for the F-4S.

The minimum acceptable level of stability is based on aircraft controllability. Refer to paragraph 11.1.1, LONGITUDINAL STABILITY for a discussion of flight characteristics near the aft cg limit. Stability numbers for individual stores are contained in Chapter 18 for the F-4J or Chapter 28 for the F-4S. After compiling the aircraft stability index (sum of stability numbers), refer to (Figure 4-4) to determine maximum allowable aft cg. For precise loading and cg data, refer to the Handbook of Weight and Balance Data (AN-01-1B-40) for the specific aircraft.

4.1.8 Weight Limitations. The maximum allowable gross weights are as follows:

1. Field takeoff – 56,000 POUNDS.
2. Field landing (flared) – 46,000 POUNDS.
3. Catapulting – 56,000 POUNDS.
4. Arrested landing, touch-and-go, and FMLP – 40,000 POUNDS.
5. Barricade engagement – 34,000 POUNDS.

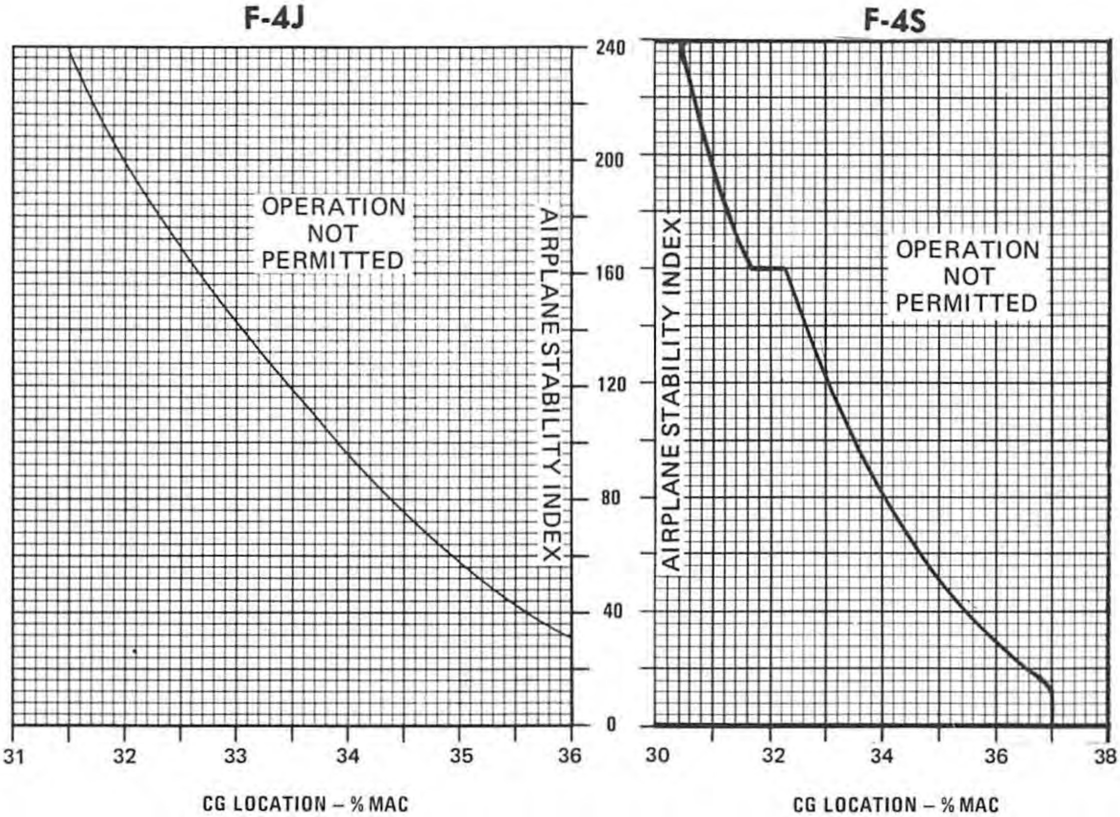
4.1.9 Acceleration Limitations. The maximum permissible accelerations shown in Figures 4-5 and 4-6 are for flight in smooth air. Moderate and heavy buffet should be avoided whenever possible. In conditions of moderate turbulence, it is essential that accelerations resulting from deliberate maneuvers be reduced 2.0g's below that shown in Figure 4-5. This is to minimize the possibility of overstressing the aircraft as a result of the combined effects of gust and maneuvering loads. Acceleration limitations for ram air turbine operation is 0.0 to +3.0g's for extension/retraction and -1.0 to +5.2g's with the RAT fully extended. Carriage and release acceleration limitations for the various external stores are shown in Figure 4-7 and Appendix A of NAVAIR 01-245FDB-1T.

CAUTION

Normal accelerations of 8.5g are permissible only when gross weight and airspeed are equal to or less than 37,500 pounds and 0.72 Mach respectively. Acceleration to 8.5g at conditions outside these limitations will impose excessive stresses on aircraft structure. Since aircraft fatigue life depends largely on the number and magnitude of g application, accelerations above 6.5g should be used only as necessary in mission performance. Care should be taken to avoid g overshoot beyond authorized limits under all conditions.

4.1.10 Flight Strength Diagram. The flight strength diagram (Figure 4-6) is a composite presentation of the aircraft operating envelope at three different gross weights. Parameters of each envelope include maximum allowable Mach number, wings level stall speed at sea level, and the positive and negative load factor limits. This diagram further restricts allowable negative load factors at speeds above 1.5 Mach and allowable positive load factors at speeds above 1.8 Mach.

4.1.11 Carrier Operations. For carrier arrested landings, total fuel in fuselage cells 1 through 6 shall not exceed 5,100 pounds. This restriction applies to cells 1 through 6 (sector reading on fuel quantity gauge) only. Fuselage cell 7 may be either full or empty; however, internal wing tanks should be empty. This restriction does not apply to touch-and-go landings. For carrier approach and arrestment limitations, refer to applicable recovery bulletins.



Note

The aft CG limit curve is based on inflight conditions. Before starting engines, initial CG positions up to 0.4% MAC aft of the limit curve are permissible, but shall not exceed 36% MAC for F-4J aircraft or 37% MAC for F-4S aircraft. This assumes a corresponding forward shift in CG during ground operation.

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Figure 4-4. Aft CG Limits

CAUTION

If it is necessary to make an arrested landing with fuel in the internal wing tanks, a notation to this effect must be made on the yellow sheet.

4.2 EXTERNAL STORES

Note

Most of the operating limitations data for air-to-ground weapons have been moved to appendix A of the F-4 Tactical Manuals, NWP 55-5-F4 (NAVAIR 01-245FDB-1T.1 and -1T.2).

Only the external stores listed in this section and in Appendix A of the F-4 Tactical Manual may be carried and released, singly or in combination, by the aircraft. The External Stores Limitations charts (Figure 4-7 and Appendix A of the F-4 Tactical Manual illustrate all authorized loading configurations; maximum permissible airspeeds and accelerations for carriage, launch, release, and jettison; maximum dive angles for delivery; and pertinent remarks/notes for each authorized store. Catapult launches and arrested landing with the external stores depicted in Figure 4-7 are authorized unless otherwise specified.

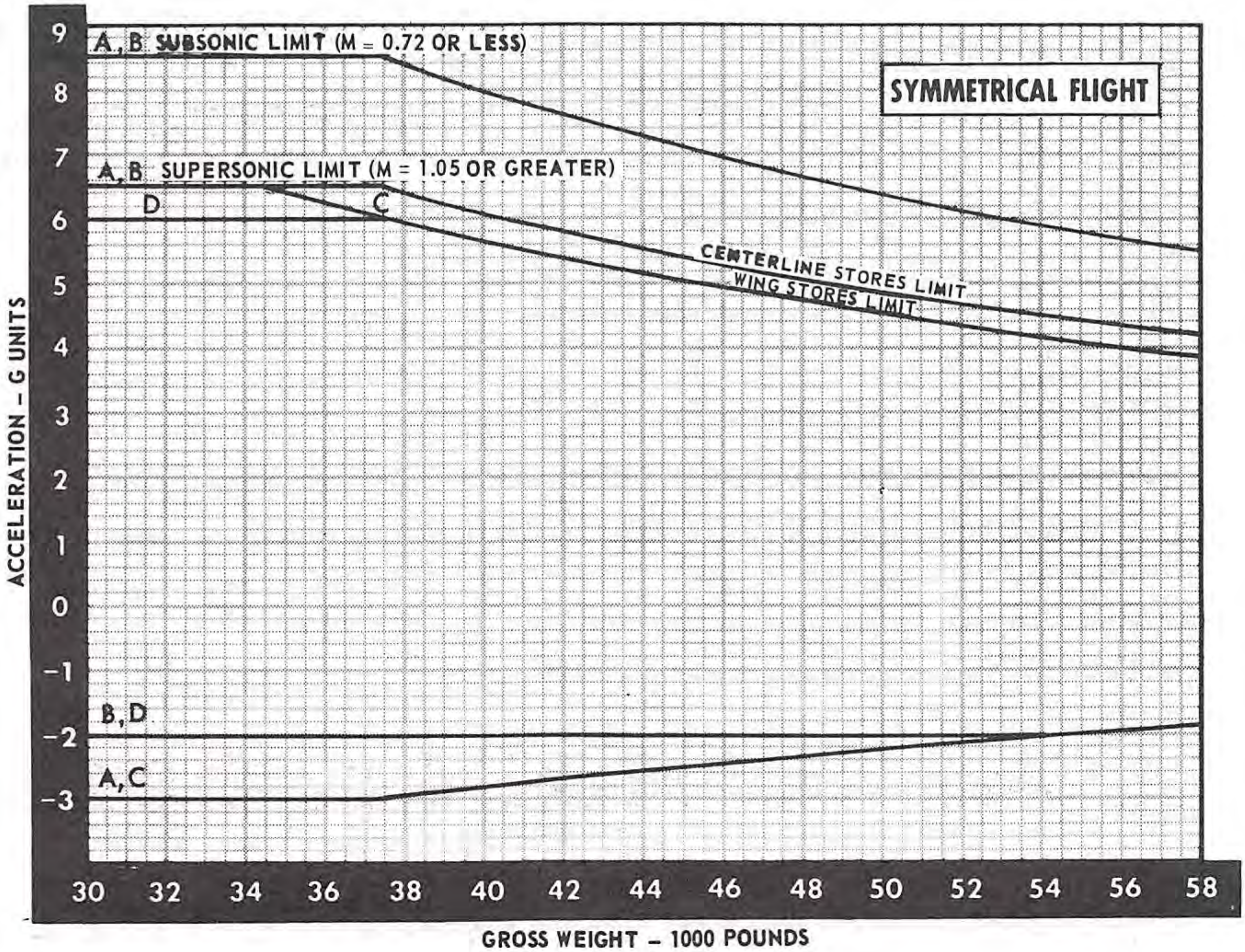
WARNING

Ordnance shall be jettisoned above the minimum fragmentation clearance altitude when possible, even though jettison safe is selected.

4.2.1 Carrier Operations. Normal carrier operations are not permitted with external store loadings in excess of 60,000 inch-pounds of static moment. Under emergency landings only, twin-engine arrestments with asymmetric loading up to 212,000 inch-pounds are permitted, and asymmetric loadings up to 60,000 inch-pounds are permitted for single-engine arrestments.

Note

For carrier landing capability with hung ordnance, refer to Appendix A of the F-4 Tactical Manuals, NWP 55-5-F4 (NAVAIR 01-245FDB-1T.1 and -1T.2).



CONFIGURATIONS:

A. BASIC AIRPLANE, OR WITH PYLONS, MISSILE LAUNCHERS, FUSELAGE-MOUNTED AIM-7.
B. EMPTY 600-GALLON TANK (MCDONNELL WELDED TANK ONLY).
C. AIM-7 OR AIM-9 MISSILES AT STATIONS 2 AND 8.
D. EMPTY 370-GALLON TANKS (MCDONNELL OR SARGENT FLETCHER).

CAUTION

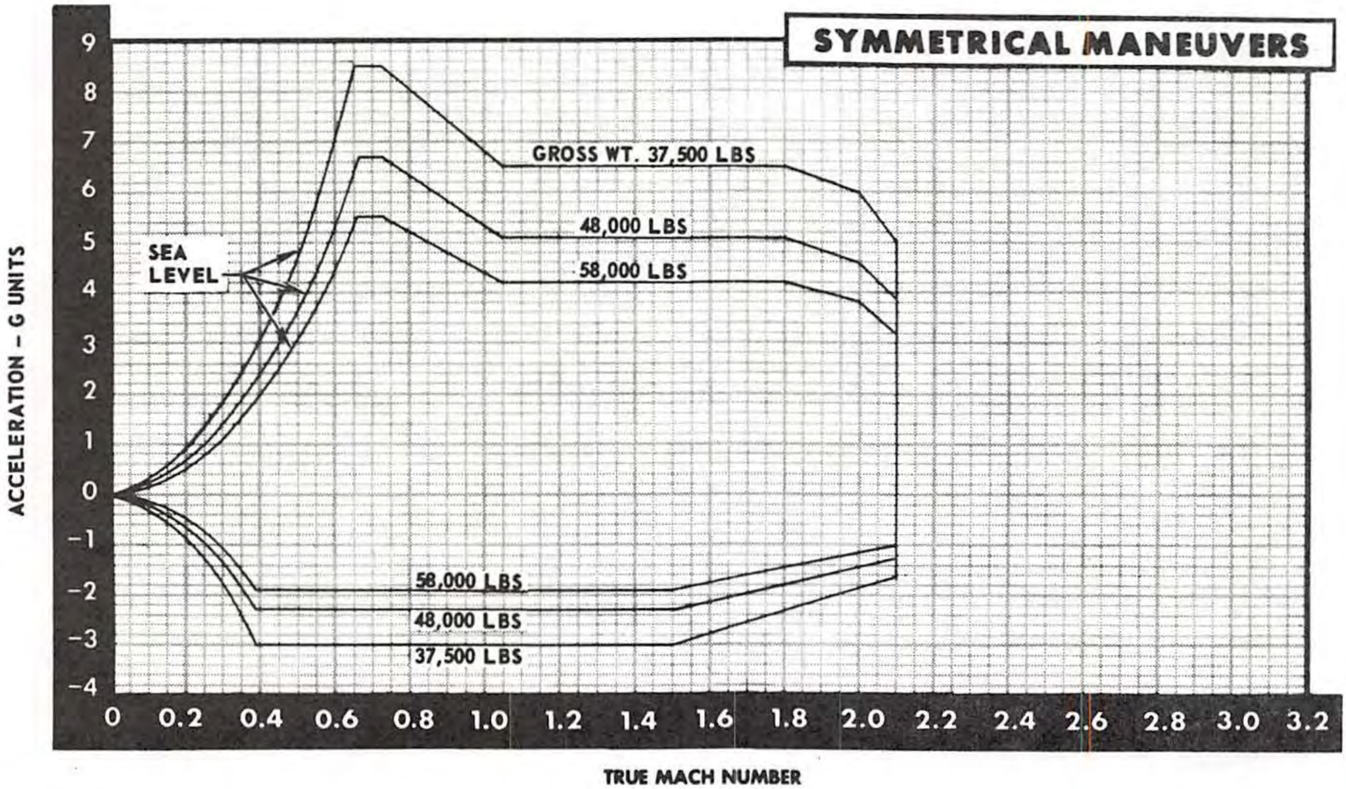
THE ENVELOPE FOR A SYMMETRICAL FLIGHT (FLIGHT IN WHICH ROLL OR YAW ACCELERATION IS APPLIED) IS FROM 0.0 G TO 80% OF SYMMETRICAL FLIGHT LIMIT.

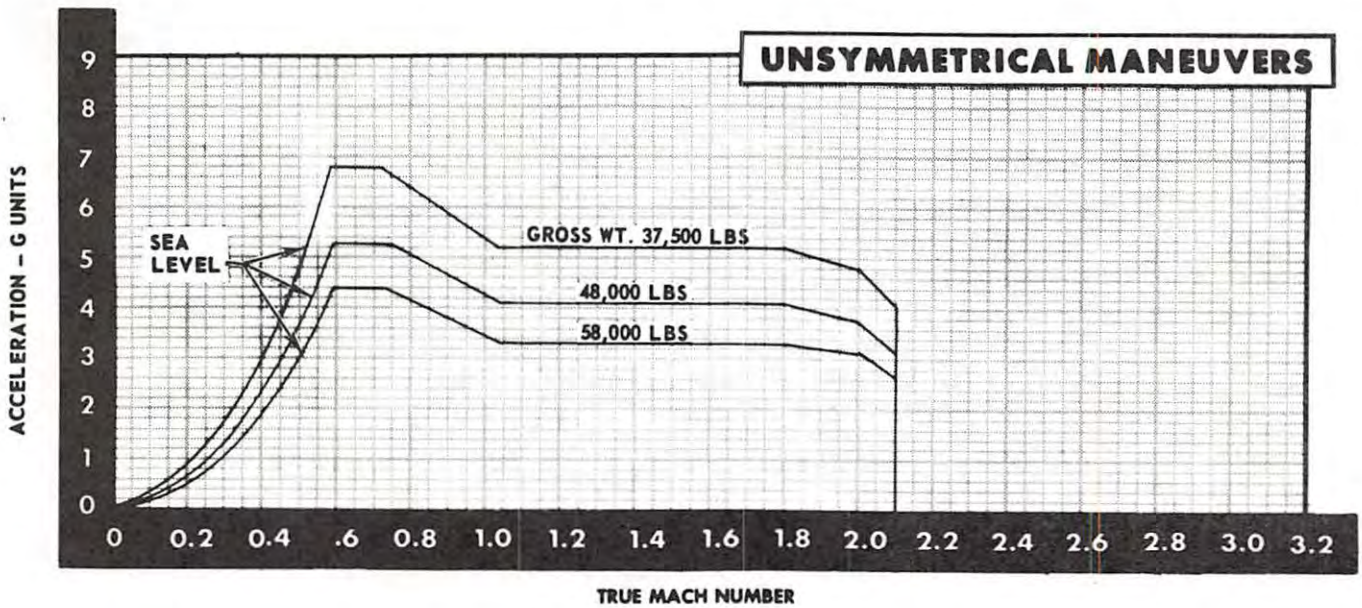
NOTES

- FOR STORES NOT SPECIFICALLY LISTED HEREON, REFER TO EXTERNAL STORES LIMITATIONS CHART. DO NOT EXCEED APPLICABLE CENTERLINE OR WING STORES LIMIT CURVE.
- REFER TO FLIGHT STRENGTH DIAGRAM FOR ADDITIONAL LOAD FACTOR LIMITS AT SPEEDS ABOVE 1.5 MACH.

Figure 4-5. Acceleration Limitations

BASIC AIRPLANE, OR WITH PYLONS, MISSILE LAUNCHERS, FUSELAGE-MOUNTED AIM-7.





FDD-1-(42)

Figure 4-6. Flight Strength

STORES			STATIONS 1	2	3	4	5	6	7	8	9	CARRIAGE MAX KCAS/MACH	CARRIAGE ACCELERATION SYM	CARRIAGE ACCELERATION UNSYM	JETTISON MAX KCAS/MACH	REMARKS
370-Gal. Wing Tanks	McDonnell or Sargent Fletcher	EMPTY	X								X	750/1.6	-2.0 to +6.0	0.0 to +4.8	375 Below 30,000 Ft. 410 Above 30,000 Ft.	See Notes 1, 2, and 3. Arrested landings, both shipboard and shore-based, are permitted only with empty external tanks. Catapulting with partially full external tanks is not permitted. Full or empty only 370-gallon external wing tanks can be jettisoned at 450 KCAS in symmetrical maneuvers between 2G and 3G below 5000 feet; however, this may result in tank/airplane contact and minor aircraft damage. * Jettisoning the 600-gallon tank between 375 KCAS and 425 KCAS below 15,000 feet may result in airplane contact and minor damage. ** The symmetrical acceleration limitations for the empty Royal Jet centerline tank are 0.0 to +6.5G.
		EMPTY TO 3/4 FULL	X								X	550/1.6	-2.0 to +5.0	0.0 to +4.0		
		FULL	X								X	550/1.6	-1.0 to +4.0	0.0 to +2.0		
	Royal Jet	EMPTY TO 3/4 FULL	X								X	550/1.6	-2.0 to +5.0	0.0 to +4.0		
		FULL	X								X	550/1.6	-1.0 to +4.0	0.0 to +2.0		
600-Gal. Centerline Tanks	McDonnell Short Fairing	EMPTY TO 3/4 FULL					X					600/1.8 Above 30,000 Ft. 0.8 Below 30,000 Ft.	0.0 to +5.0	+1.0 to +3.0	300/0.9	
		FULL					X						+0.5 to +3.0	+1.0 Only		
	McDonnell Nestable (Accessory Bulletin 18-62 Incorporated)	EMPTY TO 3/4 FULL					X					600/1.8	0.0 to +5.0	+1.0 to +3.0		
		FULL					X						+0.5 to +3.0	+1.0 Only		
	McDonnell Welded	EMPTY					X					LBA	-2.0 to LBA	LBA	425/1.8 *	
		EMPTY TO 3/4 FULL					X						-2.0 to +6.5	0.0 to +5.2		
		FULL					X						-2.0 to +5.0	0.0 to +4.0		
	Royal Jet	EMPTY TO 3/4 FULL					X					600/1.8	** 0.0 to +5.0	+1.0 to +3.0		Royal Jet 600 gal. centerline tanks with AYC 531 incorporated will bear the McDonnell Douglas part label MD-32G55101-5, but remain subject to Royal Jet 600 gal. centerline limitations.
		FULL					X						+0.5 to +3.0	+1.0 Only		
RCPP-105 Starter Pod							X					550/0.9	-1.0 to +5.0	0.0 to +3.0	300/0.9	See Notes 1 and 2. Jettison in level flight.
CNU-169/A FERRY MISSION EQUIPMENT STORE (MODIFIED AERO 1A, 150 GALLON EXTERNAL FUEL TANK, P/N 12E1034-1 OR -2)				X						X		550/1.0	-2.0 to +6.5	0.0 to +5.0	400 Max. 200 Min.	See Notes 1, 2 and 3. **WARNING** The CNU-169/A ferry mission equipment store must be loaded so that the CG is maintained between the attachment lugs. Maximum equipment loading is 250 pounds. The CNU-169/A is carried captive to the LAU-17/A pylon.
ASDC (Air-Ship Delivery Container System)	Delivery Container on TER STA 1; Wire Container on TER STA 2.		X	X								400/0.9	+1.0 to +3.0	+1.0	Release 250/0.40	Release altitude – 400 ft. Release mode – Single only; Bomb sight setting – 290 mils. Carrier operations with ASDC permitted. Release in 1G level flight.
	Delivery Container on TER STA 1; Wire Container on TER STA 3.									X	X					

FDD-1-(43-1)C

Figure 4-7. External Store Limitations (Sheet 1 of 2)

LBA – Limits of Basic Airplane
NE – Not Established

STORES		STATIONS 1	2	3	4	5	6	7	8	9	CARRIAGE MAX KCAS/MACH	CARRIAGE ACCELERATION SYM	CARRIAGE ACCELERATION UNSYM	JETTISON MAX KCAS/MACH	REMARKS
D-704 Air Refueling Store						X					500/1.1	0.0 to +4.0	0.0 to +3.2	300/0.9	See Notes 1 and 2. Buddy tank adapter pylon kit is required. Arrested landing, both shipboard and shore-based, are permitted only with empty tank. Catapulting with partially full tank is not permitted. AB operation is not permitted while dumping fuel. Maximum acceleration for operation is +2.0G, and no abrupt maneuvers are permitted. Maximum airspeeds for operation are 300/0.8 with the hose extended and 250 KCAS for fuel dumping and hose retraction. Jettison in level flight.
AQM-37A Missile Target (LAU-24A Launcher)						X					550/0.95	0.0 to +4.0	-1.0 to +3.0	550/0.92	See Notes 1 and 2. Maximum bank angle not to exceed 60 degrees. Abrupt maneuvers not permitted. Avoid slipping and skidding. Buffet boundary operation not permitted except in landing configuration. Release in level flight.
RMU-8A Reel Launcher with TDU-22 Target	Target reel-in, reel-out, or being launched					X					500/0.9	NE	NE	0.95	See Notes 1 and 2. Refer to Tow Target procedures in Section IV for additional limitations.
	Target reel-in, reel-out, or fully streamed					X					500/1.6				
	Target being recovered					X					350/0.85				
RMU-8A Reel Launcher Without Target						X					500/1.6	NE	NE	0.95	

Notes

1. Below 10,000 feet, the following airspeed limitations shall be observed when carrying external stores other than Sparrow missiles:
   - Airplanes with C G location aft of 34% MAC – 0.70 Mach or external store limit, whichever is less.
   - Airplanes with C G location forward of 34% MAC – Basic aircraft limit as shown in Airplane Speed Restrictions Chart or the external store limit, whichever is less.
2. Refer to Acceleration Limitations Chart for additional acceleration limitations while carrying external stores.
3. Jettison, empty or full, in 1.0 G level flight with speed brakes, landing gear, and flaps retracted.

FDD-1-(43-2)B

Figure 4-7. External Store Limitations (Sheet 2 of 2)

PART II

Indoctrination

CHAPTER 5

Indoctrination

5.1 GROUND TRAINING

5.1.1 Minimum Ground Training Syllabus. The overall ground training syllabus for each activity will vary according to local conditions, field facilities, requirements from higher authority, and the immediate unit commander estimate of squadron readiness. The minimum ground training syllabus (pilot/RIO) for each phase is set forth below:

1. Familiarization

    a. Flight physiological training as appropriate

    b. NAMT pilot course

    c. COT/WST (within 10 days).

2. Flight support lectures

    a. J79 engine

    b. Air induction system

    c. Flight controls, flaps, BLC, and AFCS

    d. Aircraft systems and emergency procedures

    e. Aircraft operating limitations

    f. Flight characteristics

    g. No less than two preflight inspections utilizing the preflight and daily maintenance requirements cards

    h. Cockpit/pressure suit air-conditioning

    i. Ejection seat and survival kit

    j. Cockpit procedures/checklists

    k. BIT checks (RIO only)

    l. Climb, loiter, and cruise performance

    m. Fuel management/mission planning

    n. Single-engine performance

    o. CNI equipment

    p. NATOPS flight manual (open and closed book) stressing normal and emergency procedures and aircraft/engine limitations.

3. Intercept flight support lectures

    a. NAMT or Replacement Aircrew Training Squadron AMCS course

    b. NAMT or Replacement Aircrew Training Squadron, AIM-7 missile

    c. NAMT or Replacement Aircrew Training Squadron, AIM-9 missile

    d. AN/APG-59 missile control system functions and computations, AIM-7 missile

    e. AN/APG-59 missile control system computations, AIM-9 missile

    f. NTDS/ATDS operating procedures

    g. Tactical employment of the weapon system

    h. Basic intercept procedures

    i. Voice procedures

    j. High altitude-high Mach intercepts

    k. Low-altitude intercepts

    l. AIM-7 beam intercepts with AIM-9 reattack

m. Forward hemisphere intercepts

n. Electronic counter-countermeasures

o. Air intercept control techniques and procedures–broadcast control

p. Multiple intercept procedure

q. Missile firing procedures

r. Fighter versus fighter combat maneuvering.

4. Weapon firing flight support lectures

a. Arming/dearming procedures

b. Firing procedures

c. Safety procedures

d. Jettison/dump areas.

5. FMLP/CARQUAL flight support lectures

a. Mirror and Fresnel lens optical landing system

b. Day landing pattern and procedures

c. Night landing pattern and procedures

d. Shipboard procedures and landing patterns

e. CCA procedures

f. Air refueling (day/night).

5.1.2 Waiving of Minimum Ground Training Requirements. All F/RF-4 qualified crewmembers shall be instructed on the differences from model in which qualified and comply with those items listed below as directed by the unit commanding officer.

Where recent crewmember experience in similar aircraft models warrant, unit commanding officers may waive the minimum ground training requirements provided the crewmember meets the following mandatory qualifications:

1. Has obtained a current medical clearance

2. He is currently qualified in flight physiology

3. Has satisfactorily completed the NATOPS flight manual open and closed book examinations.

4. Has completed at least one emergency procedure period in the COT/WST (if available)

5. Has received adequate briefing on normal and emergency operating procedures

6. Has received adequate instructions on the use/operation of the ejection seat and survival kit.

5.2 FLIGHT TRAINING SYLLABUS

5.2.1 Aircrew Flight Training Syllabus. Prior to flight, all crewmembers will have completed the familiarization and flight support lectures previously prescribed. A qualified instructor pilot will be assigned for the first familiarization flight. The instructor pilot will occupy the rear seat. The geographic location, local command requirements, squadron mission, and other factors will influence the actual flight training syllabus and the sequence in which it is completed. The specific phases of training are:

1. Familiarization

a. Military and afterburner power takeoffs

b. Buffet boundary investigation

c. Approach to stalls

d. Slow flight

e. Acceleration run to Mach 2.0

f. Subsonic and supersonic maneuvering

g. Investigate all features of the AFCS/ stabilization augmentation

h. Formation flight

i. Aerobatics

j. Single-engine flight at altitude and airstarts

k. Landings with and without drag chute

l. Use of nose gear steering

m. Simulated single engine

n. Landing with full, 1/2, and no flaps

o. Acceleration runs at various altitudes.

2. Instruments

a. Basic instrument work

b. Penetrations and approaches

c. Local area round robin (day and night) flights.

3. Weapon system employment

a. In accordance with existing training and readiness directives.

4. Field mirror landing practice and carrier qualification

a. Slow flight

b. Field mirror landing practice

c. Carrier qualification flights.

5.3 OPERATING CRITERIA

5.3.1 Ceiling/Visibility Requirements. Prior to the pilot becoming instrument qualified in the aircraft, field ceiling/visibility and operating area weather must be adequate for the entire flight to be conducted in a clear air mass according to visual flight rules. After the pilot becomes instrument qualified, the following weather criteria apply:

Time in Model (hr)	Ceiling (ft)/Visibility (mi)
10 to 20	800/2; 900/1-1/2; 1,000/1
20 to 45	700/1; 600/2; 500/3
Over 45	Field minimums or 200/1/2, whichever is higher

Where adherence to these minimums unduly hampers pilot training, commanding officers may waive time-in model requirements for actual instrument flight, provided pilots meet the following criteria:

1. Have a minimum of 10 hours in model

2. Completed two simulated instrument sorties

3. Completed two satisfactory tacan penetrations.

5.3.2 Minimum Flight Qualifications. Where recent crewmember experience in similar aircraft models warrant, unit commanding officers may waive the minimum flight training requirements for basic qualifications. Minimum flight hour requirements to maintain pilot and RIO qualifications after initial qualification in each specific phase will be established by the unit commanding officer. Crewmembers who have more than 45 hours in model are considered current subject to the following criteria:

1. Must have a NATOPS evaluation check with the grade of Conditionally Qualified or better within the past 12 months and must have flown 5 hours in model and made two takeoffs and landings within the last 90 days.

2. Must have satisfactorily completed the ground phase of the NATOPS evaluation check, including COT/WST emergency procedures check (if available), and be considered qualified by the commanding officer of the unit having custody of the aircraft.

5.3.3 Requirements for Various Flight Phases

5.3.3.1 Night

1. Pilot – Not less than 10 hours in model as first pilot.

2. RIO – Not less than 3 hours in model as crewmember.

5.3.3.2 Crosscountry

1. Pilot

a. Have a minimum of 15 hours in model as first pilot

b. Have a valid instrument card

c. Have completed at least one night familiarization flight.

2. RIO – Have completed at least one night familiarization flight.

5.3.3.3 Air-to-Air Missile Firing

1. Pilot

   a. Have a minimum of 15 hours in model

   b. Be considered qualified by the commanding officer

2. RIO

   a. Have a minimum of 15 hours in model as crewmember

   b. Have satisfactorily completed a minimum of two intercept flights on which simulated firing runs were conducted utilizing the voice procedures and clear to fire criteria to be utilized in live firings

   c. Be considered qualified by the commanding officer.

5.3.3.4 Carrier Qualification. Each crewmember will have a minimum of 50 hours in model and meet the requirements set forth in the LSO NATOPS Manual.

5.3.3.5 Pilot in Command. Pilot may be designated pilot in command after successful completion of appropriate familiarization phase.

5.3.4 Minimum Crew Requirements. The pilot and RIO (or two pilots) constitute the normal crew for performing the assigned mission for all flights. Unit commanders may authorize rear seat flights for personnel other than qualified pilots and RIOs provided such personnel have received thorough indoctrination in the use of the ejection seat and oxygen equipment and in the execution of rear seat checklist and emergency procedures. Where operational necessity dictates, unit commanders may authorize flights with the rear seat unoccupied provided the requirements for such flights clearly overrides the risk involved and justifies the additional burden placed on the pilot. Although a rear seat occupant is required in order to properly comply with the procedures in Part V of the NATOPS manual, the infrequency of occurrence of these situations tends to justify judiciously selected instances of solo flight. Ferry squadron commanders may authorize solo ferry flights of F-4 aircraft. In no case is solo flight authorized for shipboard operations, combat, or combat training missions.

5.4 CREWMEMBER FLIGHT EQUIPMENT

5.4.1 Minimum Requirements. In accordance with OPNAVINST 3710.7, the flying equipment listed below will be worn by crewmembers on every flight. All survival equipment will be secured in such a manner that it will be easily accessible and will not be lost during ejection or landing. This equipment shall be the latest available as authorized by Aircrew Personal Protective Equipment Manual (NAVAIR 13-1-6).

1. Antibuffet helmet modified in accordance with current aviation clothing and survival equipment bulletins
2. Oxygen mask
3. Anti-g suit
4. Fire retardant flight suit
5. Steel-toed flight safety boots
6. Life preserver
7. Harness assembly
8. Shroud cutter
9. Sheath knife
10. Flashlight (for all night flights)
11. Strobe light
12. Pistol with tracer ammunition or approved flare gun
13. Fire retardant flight gloves
14. Identification tags

15. Antiexposure suit in accordance with OPNAVINST 3710.7

16. Personal survival kit

17. Other survival equipment appropriate to the climate of the area

18. Full pressure suit and Mk-4 life preserver on all flights above 50,000 feet MSL.

PART III

Normal Procedures

CHAPTER 6

Briefing/Debriefing

6.1 BRIEFING

The mission commander shall be a naval aviator or naval flight officer who is NATOPS qualified, mission qualified, and designated by the commanding officer. The mission commander/flight leader is responsible for briefing all crewmembers on all aspects of the mission to be flown. The pilot/RIO will assist the mission commander/flight leader in preparing required flight or briefing forms and may, if applicable, brief that portion of the mission pertaining to the other crewmember. A briefing guide or syllabus card, as appropriate, will used in conducting the briefing. Each crewmember will maintain a kneepad and will record all flight numbers, call signs, and all other data necessary to assume the lead and complete the assignment. However, this does not relieve the flight leader of the responsibility for briefing all crews in the operation and conduct of the flight. The briefing guide will include the following.

6.1.1 Assignments

1. Aircraft assigned, call sign, and deck spot when appropriate.

2. Engine start, taxi, and takeoff times

3. Visual signals and rendezvous instructions

6.1.1.1 Mission

1. Primary

2. Secondary

3. Operating area

4. Control agency

5. Time on station or over target

6.1.1.2 Weapons

1. Loading

2. Safety

3. Arming, dearming

4. Duds

5. Special routes with ordnance aboard

6. Minimum pull-out altitude

7. Jettison area.

6.1.1.3 Communications

1. Frequencies

2. Radio procedure and discipline

3. Navigational aids

4. Identification and ADIZ procedures.

6.1.1.4 Weather

1. Local area

2. Local area and destination forecast

3. Weather at alternate

4. High altitude weather for the jet stream, temperature, and contrail bandwidth.

6.1.1.5 Navigation and Flight Planning

1. Takeoff speed

2. Takeoff distance

3. Abort distance

4. Crosswind effects

5. Climbout

6. Mission route, including ground controlling agencies

7. Fuel/oxygen management

8. Marshal

9. Penetration

10. GCA or CCA

11. Recovery.

6.1.1.6 Emergencies

1. Aborts

2. Divert fields

3. Bingo and low state fuel

4. Waveoff pattern

5. Ready deck

6. Radio failure

7. Loss of visual contact with flight

8. Ejection

9. SAR procedures

10. System failures.

6.1.1.7 Air Intelligence and Special Instructions

1. Friendly and enemy force disposition

2. Current situation

3. Targets

4. Safety precautions

5. ECM and ECCM.

6.1.1.8 Operating Area Briefings. Prior to air operations in and around a new area, it is mandatory that a comprehensive area briefing be given, including but not limited to the following.

6.1.1.8.1 Bingo Fields

1. Instrument approach facilities

2. Runway length and arresting gear

3. Terrain and obstructions.

6.1.1.8.2 Emergency Fields

1. Fields suitable for landing but without required support equipment

2. Include information under bingo fields.

6.1.1.8.3 SAR Facilities

1. Type

2. Frequencies

3. Locations.

6.2 DEBRIEFING

Postflight debriefing is an integral part of every flight. The mission commander/flight leader should review the entire flight from takeoff to landing, including not only errors and poor techniques but also the methods of correcting them. Also, the mission commander/flight leader shall cover completely any deviations from standard operating procedures. All intercepts should be reviewed using scope camera and controller information when available.

CHAPTER 7

Mission Planning

7.1 GENERAL

The pilot and RIO shall be responsible for the preparation of required charts, flight logs, navigation computations including fuel planning, checking weather, and NOTAMs, and for filing required flight plans. Refer to Part XI to determine fuel consumption, correct airspeed, power settings, and optimum altitude for the intended flight mission. Planning data for specialized missions will be contained in the F-4 Tactical Manual.

7.2 FLIGHT CODES

The proper kind of flight classification and codes to be assigned individual flights is established by OPNAVINST 3710.7.

CHAPTER 8

Shore-Based Procedures

8.1 PREFLIGHT

The yellow sheet must be checked for flight status, configuration, armament loading, and servicing prior to manning the aircraft. At least the 10 previous B sections should be reviewed for discrepancies noted and the corrective action taken. Weight and balance clearance is the responsibility of the maintenance department.

8.1.1 Exterior Inspection

1. Approaching aircraft – CHOCKS, TIEDOWNS, DOWNLOCKS, LEAKS, DOORS AND PANELS SECURE, STRUTS, TIRES, HOOK UPLOCK REMOVED, COVERS REMOVED.

2. Left intake – DUCT CLEAR OF FOD, INLET GUIDE VANES SECURE, BELLMOUTH BYPASS CLEAR, PITOT AND STATIC PORTS CLEAR, RAMP SECURE, RAMP BLEED AIR HOLES CLEAR.

3. Nosewheel well – CNI SHELF DOOR SECURE, WHEELBRAKE ACCUMULATOR PRESSURE GAUGE 1,000 (±50) PSI, VERTICAL REFERENCE BIT SWITCH OFF AND COVER CLOSED; RAT, LANDING GEAR, AND FLAP GAUGES 2,750 TO 3,100 PSI; DOOR ROLLER MECHANISM FREE.

4. Nose gear – GENERAL CONDITION, NGS UNIT ELECTRICAL AND HYDRAULIC CONNECTIONS, TIRE INFLATION AND CONDITION, WHEEL NUTS SECURE, JACKING PAD SAFETY WIRED, APPROACH AND TAXI LIGHTS SECURE, ANTENNAS SECURE.

5. Left forward fuselage – ACCESS PANELS SECURE, AOA PROBE COVER REMOVED, AOA PROBE SECURE AND FREE TO ROTATE, ROTATE FULL COUNTERCLOCKWISE, CHECK BOTTOM SLOT (5:30 POSITION F-4S WITH SLATS; 6:30 POSITION F-4J/S WITHOUT SLATS), ROTATE AOA TO CENTER RANGE, TOTAL TEMPERATURE SENSOR SECURE, EQUIPMENT COOLING INTAKE CLEAR, RADOME LOCKING LUGS SECURE, STATIC PORTS CLEAR, STATIC SYSTEM DRAIN DRY.

6. Right forward fuselage – RADOME LOCKING LUGS SECURE, STATIC PORTS CLEAR, CABIN COOLING INLET CLEAR, ACCESS PANELS SECURE.

7. Right intake – DUCT CLEAR OF FOD, INLET GUIDE VANES SECURE, BELLMOUTH BYPASS CLEAR, PITOT AND STATIC PORTS CLEAR, RAMP SECURE, RAMP BLEED AIR HOLES CLEAR.

8. Bottom fuselage – LOX CONVERTER CONNECTIONS SECURE, CANOPY JETTISON GAUGES 2,750 TO 3,000 PSI, FUEL CELL CAVITY DRAINS DRY, MAIN SYSTEM PNEUMATIC GAUGE 2,200 PSI MINIMUM.

9. Centerline tank – TANK SECURE, SIGHT GAUGE CHECK, FILL CAP SECURE.

10. Right auxiliary door – DOOR ACTUATING CYLINDER SECURE, DOOR LIMIT SWITCH CHECK, THROTTLE LINKAGE SECURE, OIL CAPS SECURE, CSD AND FUEL CONTROL CONDITION.

11. Lower right wing – PYLONS, SUSPENSION EQUIPMENT, AND ORDNANCE SECURE.

12. Right wheel well – INNER DOOR SECURE AND DOWN, PC-2 PRESSURE GAUGE 1,000 (±50) PSI, GROUND REFUEL SWITCH OFF, NUMBER 7 CELL REFUEL A & F BUTTONS OUT TO REFUEL, HYDRAULIC SERVICING CAPS SECURE.

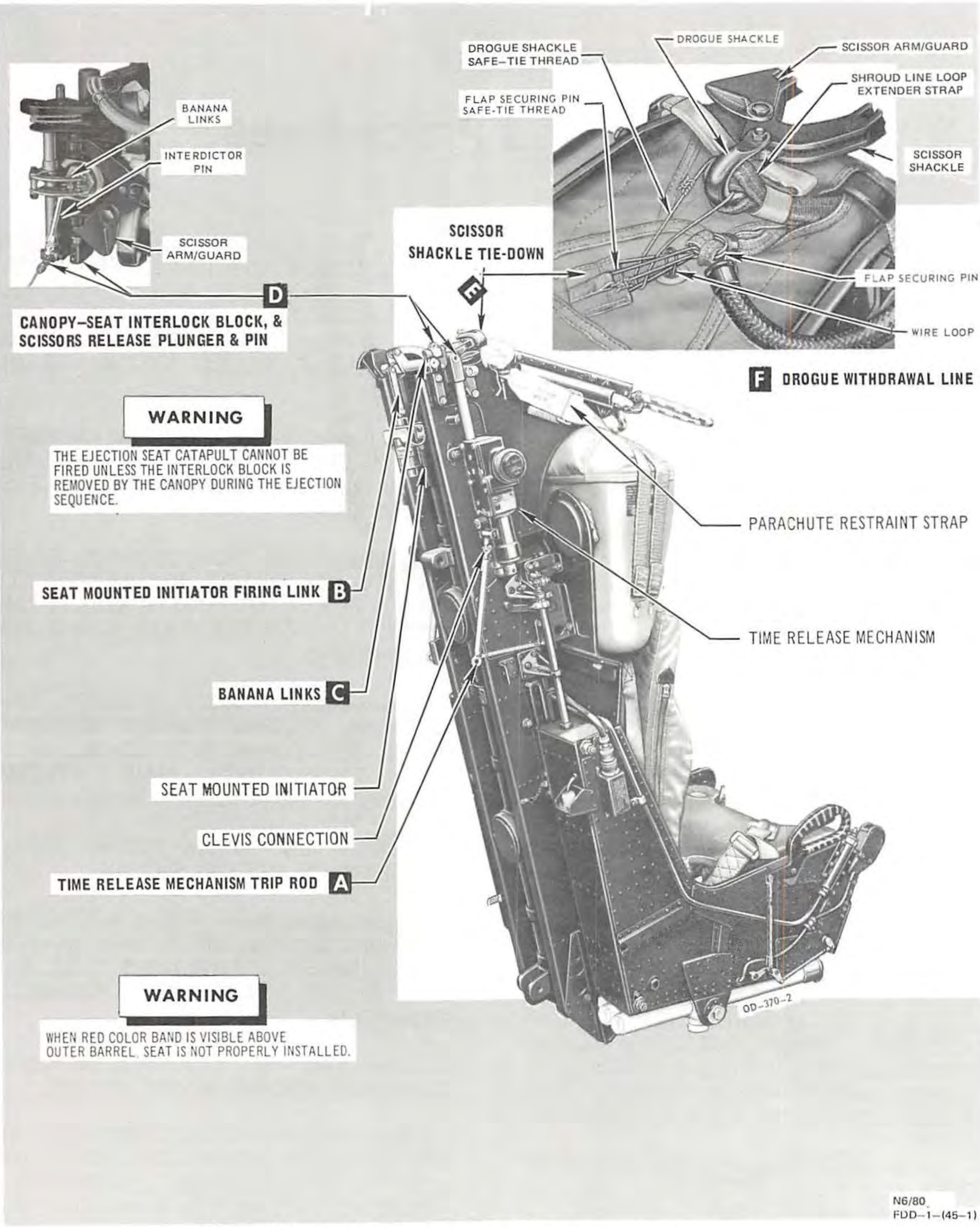


Figure 8-1. Ejection Seat and Canopy Checkpoints (Sheet 1 of 2)

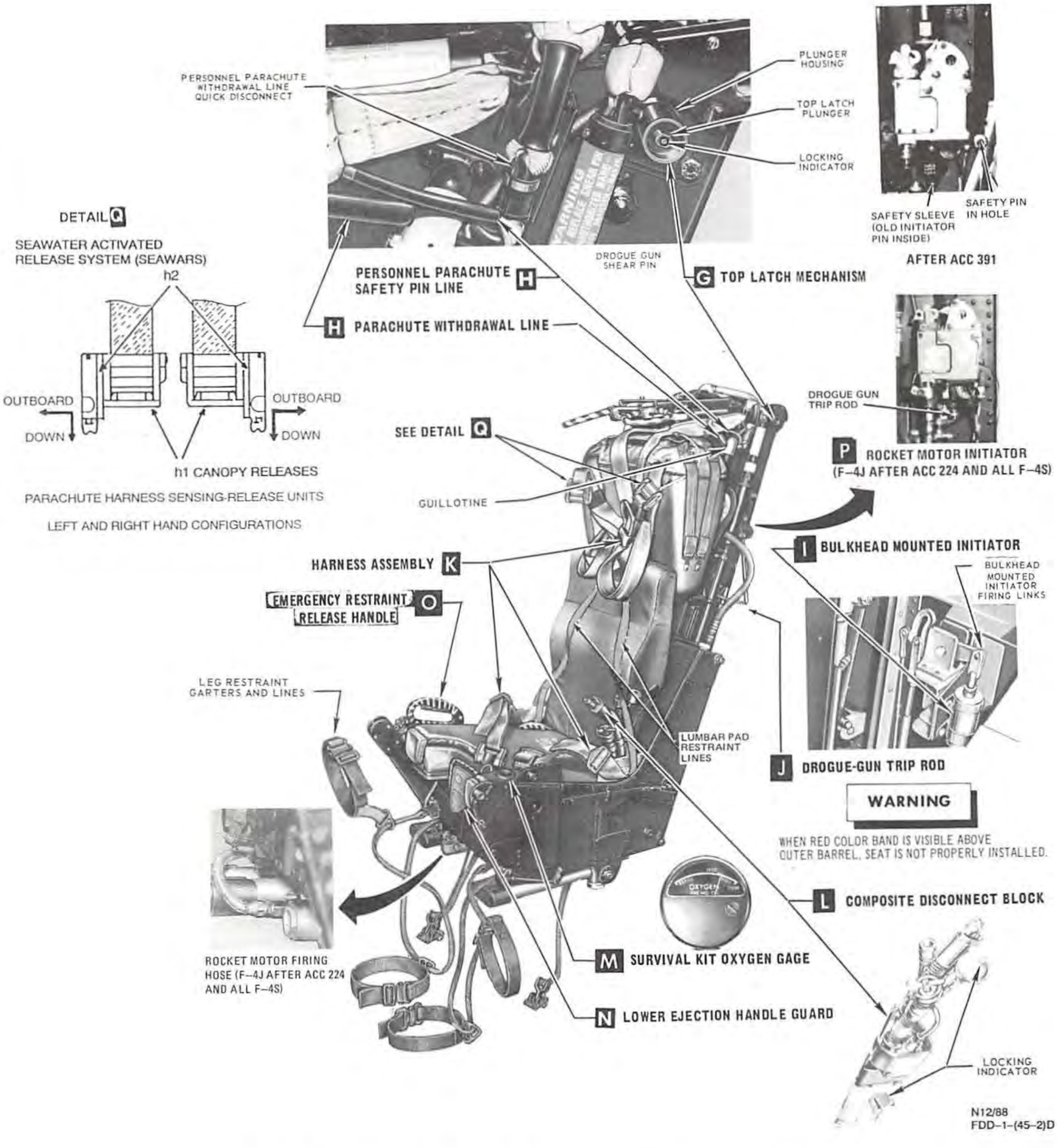


Figure 8-1. Ejection Seat and Canopy Checkpoints (Sheet 2 of 2)

13. Right main gear – DOOR SECURE, UPPER STRUT GAUGE IN GREEN, SHRINK LINK STRAIGHT AND SECURE, BRAKE LINES CONDITION.

14. Right main wheel–TIRE INFLATION AND CONDITION, JACK PAD AND DOOR SECURE.

15. Right wing – GENERAL SECURITY AND CHECK LEADING EDGE SLATS (F-4S ONLY).

16. Right wing fold area – WING LOCKING LUGS FREE OF CRACKS. MANUAL LOCKPIN SECURE, WING LIGHTS SECURE.

17. Right aft wing area – DUMP MAST SECURE. SPEEDBRAKE SECURE AND FREE OF FLUID.

18. Bottom aft fuselage – FUEL CELL CAVITY DRAINS DRY, CATAPULT HOLDBACK SECURE, ENGINE ACCESS DOORS AND PANELS SECURE.

19. Left and right engine exhaust area – TURBINE BLADES, AB SPRAY BARS, FLAME HOLDER, TORCH IGNITER, SECURITY AND CONDITION; NOZZLE CONDITION; OVERHEAT CIRCUIT SECURE; AB AND NOZZLE AREA FREE OF FLUIDS AND FOD.

20. Aft tail area – DASH POT PRESSURE GAUGE, ANTICOLLISION LIGHT SECURE, PITOT TUBE AND BELLOWS RAM AIR INLET SECURE AND COVERS REMOVED, HOOK POINT CONDITION AND WEAR, STABILATOR SECURE AND FREE OF CRACKS, DRAG CHUTE DOOR CLOSED AND SECURE, VENT MAST SECURE, RUDDER SECURE, TAILLIGHT SECURE.

21. Left aft wing area – DUMP MAST SECURE, SPEEDBRAKE SECURE AND FREE OF FLUID.

22. Left wing fold area – WING LOCKING LUGS FREE OF CRACKS, MANUAL LOCKPIN SECURE, WING LIGHTS SECURE.

23. Left wing – GENERAL SECURITY AND CHECK LEADING EDGE SLATS (F-4S ONLY).

24. Left main wheel – TIRE INFLATION AND CONDITION, JACK PAD AND DOOR SECURE.

25. Left main gear – DOOR SECURE, UPPER STRUT GAUGE IN GREEN, SHRINK LINK STRAIGHT AND SECURE, BRAKE LINES CONDITION.

26. Left wheel well – INNER DOOR SECURE AND DOWN, PC-1 PRESSURE GAUGE 1,000 (±50) PSI, HYDRAULIC SERVICING CAPS SECURE.

27. Lower left wing – PC-1 RESERVOIR FULL AND O PRESSURE; PYLONS, SUSPENSION EQUIPMENT, AND ORDNANCE SECURE.

28. Left auxiliary air door – DOOR ACTUATING CYLINDER SECURE, DOOR LIMIT SWITCH CHECK, THROTTLE LINKAGE SECURE, OIL CAPS SECURE, CSD AND FUEL CONTROL CONDITION, CENTERLINE JETTISON CARTRIDGES CAPS SECURE.

29. Upper fuselage – RAT DOOR SECURE, ACCESS DOORS AND PANELS SECURE.

8.1.2 Aft Cockpit Interior Check for Solo Flight

1. Canopy initiator safety pin (bulkhead mounted) – REMOVED

Check pin removed to ensure operation of forward initiator.

CAUTION

Exercise caution regarding hand movements in the vicinity of the aircraft mounted canopy initiator linkages. Also, do not stow flight equipment or personal items in this area. Failure to comply could result in inadvertent jettisoning of the canopy.

2. Seat safety pins – INSTALLED.

3. Circuit breakers – IN.

4. Navigation computer function switch – OFF.

5. Radar function switch – OFF.

6. Suit vent air valve – OFF.

7. Oxygen supply lever – OFF.

8. Cockpit light switches – OFF.

9. Seat harness – STOWED.

10. All loose gear – STOWED.

11. Aft cockpit electrical test receptacle – PLUG SECURED.

It is possible to trip both generators off the line if the electrical test receptacle plug 3P325 under the right canopy sill is loose. The generators cannot be restored until the plug is secured.

12. All armament switches – OFF OR SAFE.

After electrical power:

13. Essential dc test button – DEPRESS.

Depress button and check that essential dc bus indicator light illuminates. If light illuminates, the left transformer-rectifier is delivering dc power. If the light does not illuminate, the left transformer-rectifier is inoperative or not receiving power. With the dc test button depressed, the right transformer-rectifier can be checked by actuating the warning lights test switch. If the warning lights illuminate, the right transformer-rectifier is operating properly.

14. Canopy – LOCKED.

8.1.3 Before Entering Cockpit

1. Normal opening canopy handle – AFT/OPEN.

2. Ejection seat and canopy rigging – CHECK.

WARNING

On F-4J before ACC 224, the rocket motor sear is under the seat. Do not use the area for stowage and exercise caution when performing any function in the vicinity of the rocket pack (i.e., pulling rocket motor safety pin, adjusting leg restraint lines, etc.).

a. Time release mechanism trip rod – Check time release mechanism trip rod secured to anchor beam and engaged in time release mechanism. Check for correct distance between the outer sleeve and the point where it bottoms against the clevis connection (approximately one-half inch). If the clevis connection (point where trip rod connects to the time release mechanism sear) on the inner shaft of the trip rod is bottomed down on the outer sleeve of the trip rod, the time release mechanism sear is probably not seated properly. In aircraft with locking indicator-type top latch plunger, check that the red color band on the trip rods is not visible.

b. Seat-mounted initiator firing link – Check seat-mounted initiator firing link installed.

c. Banana links – Check banana links pin engaged in firing mechanism sear.

d. Canopy-seat interlock block – Check canopy-seat interlock block in place and interlock block cable secure to the canopy. On aircraft 158346as and up and all others after ACC 187, check interdictor pin inserted in firing mechanism sear. The ejection seat will not fire if the interlock block is not removed by the canopy during the ejection sequence.

e. Scissor shackle tiedown and scissor guard – Check that the drogue shackle safe-tie thread passes under the flap securing pin safe-tie thread and loops around both legs of the flap securing pin in front of the wire loop, then passes aft through the loop of the shroud line loop extender strap and through the drogue shackle, and then passes forward to be tied to the other end of the safe-tie thread. Check drogue shackle engaged in scissors and scissor release plunger extended against movable scissor arm (arm/guard) with plunger pin visible on top of scissors plunger housing. Check scissor guard on the lower right side of the scissor shackle assembly to ensure that the guard is not bent.

WARNING

A bent scissor guard could prevent the scissor jaw from opening during ejection and thereby preclude man/seat separation.

f. Drogue withdrawal line – Check drogue withdrawal line (in wire braid sleeve) passes over and lays on top of all other lines.

g. Top latch mechanism – Check that top latch plunger is flush with the end of the top latch mechanism housing. The locking indicator must be flush with the end of the top latch plunger.

WARNING

If the top latch mechanism check does not meet the outlined requirements, an inadvertent ejection could result.

h. Parachute withdrawal line – Check that the parachute withdrawal line passes through the guillotine and is routed underneath the parachute restraint strap. In addition, check the withdrawal line quick disconnect for proper connection and swivel action. Check personnel parachute safety pin line not routed through guillotine and both the parachute safety pin line and parachute withdrawal line loop routed through the alignment ring on the parachute pack.

i. Canopy releases – SECURE.

j. SEAWARS – PROPER INSTALLATION.

k. Canopy initiator (bulkhead mounted) firing line – Check that bulkhead mounted canopy initiator firing link is installed.

CAUTION

Exercise caution regarding hand movements in the vicinity of the aircraft-mounted canopy initiator linkages. Also, do not stow flight equipment or personal items in this area. Failure to comply could result in inadvertent jettisoning of the canopy.

l. Drogue gun trip rod – Before ACC 391, Part 2, check drogue gun trip rod secured to anchor beam and engaged in drogue gun. Check that red color band on the trip rod is not visible. Check drogue gun cocking indicator protruding approximately one-half inch from the bottom of the drogue gun. After ACC 391, Part 2, verify that the drogue gun is cocked by observing that the plunger does not protrude into the safety pin hole.

m. Harness assembly – Check that the shoulder harness retaining pin is installed at the retraction reel. Check that the pins securing the lap belt and survival kit to the seat are in place.

n. Composite disconnect block – Check that lower block locking indicator (yellow metal flag) is tight. Check that the upper block is positively locked to the intermediate block by depressing the yellow knob on the composite disconnect release cable and noting that the indicator button is flush with the top of the knob. If indicator button is protruding from the top of the knob, the upper block assembly is not positively locked to the intermediate block. Check upper block properly inserted and locked into intermediate block by exerting an upward pull on block assembly after composite disconnect release knob is locked to cable housing.

Note

If unlocked, the composite disconnect should be carefully inserted with a downward force parallel to the seat ejection plane. After the composite disconnect is fully inserted, push down on composite disconnect release knob to lock knob to cable housing and prevent the release knob from laying over and dangling.

o. Survival kit oxygen gauge – Check survival kit oxygen gauge for at least 1,800-psi pressure.

WARNING

If an RSSK-1A survival kit is installed in the ejection seat, the seat must also have a lumbar pad installed. If the RSSK-1A survival kit and lumbar pad compatibility is not present and an ejection becomes necessary, the seat occupant will most likely suffer a fractured vertebrae.

Note

There are two different emergency oxygen supply actuating rings: a flexible rubber ring and a round metal ring. Aircrew should note which ring is installed on the survival kit and the location of the ring when strapped in.

p. Lower ejection handle guard – Check lower ejection handle guard is in the up (vertical) position.

q. Emergency restraint release handle – Check emergency restraint release handle down and firing sear installed in guillotine initiator.

r. Rocket motor initiator and rocket motor firing body (if applicable) – Check initiator cable lanyard connected to drogue gun trip rod without excessive cable hanging from initiator housing. Initiator sear installed with cable lever assembly link inserted. Initiator hose connected with hose pin in hose connection (not in initiator sear). After ACC 224 amendment 1 and all F-4S, hose pin is replaced with a nut and bolt combination. On bottom of seat, rocket motor firing body installed and hose connected.

3. Seat safety pins, except face curtain pin, and after ACC 187, interdictor pin – REMOVE.

Check seat safety pins – Ejection gun (before ACC 187, gullotine, canopy initiator (seat mounted), drogue gun, rocket motor (before ACC 224), rocket motor initiator (F-4J after ACC 224 and all F-4S), canopy initiator (bulkhead mounted) removed.

8.1.4 After Entering Cockpit

8.1.4.1 Pilot

Before electrical power:

1. Generator switches – OFF.

2. Oxygen, communications, anti-g lines and helmet mounted sight (if applicable) – CONNECT.

Connect oxygen, communications and anti-g line disconnects, as applicable, and check for position lock. When the helmet-mounted sight is utilized, verify that the VTAS egress disconnect will operate normally. After connection, an upward motion from the snap location (seated) should effect release. Reconnect and verify that the movement flange is seated to preclude inadvertent disconnection during maneuvers. During disconnection, a taut lanyard moves the flange to release the lock.

WARNING

An improperly operating VTAS egress disconnect could cause serious injury during ejection.

3. Oxygen – CHECK.

Turn oxygen lever on, check normal flow with mask held away from face. Put mask on, check normal breathing. Turn oxygen off, check no breathing.

WARNING

Do not pull emergency oxygen actuator ring prior to actual use. If the emergency oxygen actuator ring is actuated prior to intended use, the pressure reducer manifold may not prevent emergency oxygen from flowing to the oxygen regulator. If this happens, the crewmember has no way of knowing how much or if any emergency oxygen remains and has no way of replenishing the depleted supply.

4. Leg restraint lines – CONNECTED.

Ensure leg lines are not twisted. Route lines through calf garter, then through thigh garter, then insert lockpins in snubber boxes.

WARNING

It is imperative that leg restraint system be hooked up at all times during flight to ensure legs are pulled aft upon ejection. This will prevent leg injury and enhance seat stability by preventing legs from flailing following ejection. An unhooked leg restraint system necessitates pulling legs aft against seat to preclude hitting canopy bow. This action will cause spine to flex and will increase the possibility of spinal injury during ejection. Be sure leg lines are routed through calf garters before thigh garters since incorrect routing could result in serious leg injury during ejection.

5. Harnessing – FASTENED.

WARNING

- Ensure harness assembly is securely fastened to the seat. The pins must be in their proper receptacles, one pin on each side of the bucket seat and one pin on the harness locking reel assembly. The emergency restraint release handle must be down.

- The VTAS helmet line must be routed under the shoulder harness to preclude the possibility of the crewmember helmet being jerked from his head after ejection. This action is caused by the parachute riser (shoulder harness strap) snapping up against the integrated line with the opening of the personnel parachute.

6. Shoulder harness lock lever – CHECK OPERATION.

7. Face curtain pin – REMOVE; SECURELY STOW PIN BAG.

WARNING

- To prevent inadvertent firing of seat or canopy, all ejection seat safety pins must be either installed or removed and properly stowed prior to operating the canopy.

- When removing or checking for the removal of the face curtain safety pin, make sure that the safety pin shank has been removed from the hole. The safety pin collar has been known to separate from the pin shank upon attempted safety pin removal, leaving the pin shank in the hole and the face curtain safetied.

- Do not pull down on the face curtain ejection handle. Seat and canopy ejection systems are fully armed when safety pins are removed.

- When a qualified plane captain is present, he will remove the face curtain pin and hand the pin bag to the aircrewman as his last step prior to dismounting the aircraft.

8. Lower ejection handle safety guard – AS DESIRED.

WARNING

The lower ejection handle safety guard, when lowered, can rebound to the safe position if it is lowered too rapidly.

9. Rudder pedals – ADJUST.

10. Stick grip – CHECK SECURITY.

11. Gun switch – OFF (some F-4J).

12. Aural tone control – AS DESIRED (some F-4J).

13. Dogfight computer training/test switch – NORM (F-4S; some F-4J).

14. Strike camera mode switch – OFF (F-4S; some F-4J).

15. Armament safety override switch – OUT.

WARNING

If armament safety override switch is IN with landing gear handle down, and electrical power is applied to the aircraft, landing gear armament safety override feature is bypassed and power is supplied to armament bus relay. This could result in inadvertent dropping or firing of ordnance while aircraft is on the ground.

16. Suit vent air – OFF.

17. Slats override switch – NORM (F-4S).

18. Intercom control panel – CHECK.

   a. Volume selector knob – AS DESIRED.

   b. Function selector switch – HOT MIC.

19. Fuel control panel – SET.

   a. External tank jettison switch – NORM (GUARD DOWN) (some F-4J).

   b. Buddy fill switch – STOP FILL.

   c. Refuel selection switch – AS DESIRED.

   d. Refuel probe switch – RETRACT.

   e. Internal wing dump switch – NORMAL.

   f. Wing transfer pressure switch – NORMAL.

   g. Internal wing transfer switch – NORMAL (some F-4J).

   h. External transfer switch – OFF (some F-4J).

   i. Emergency probe extend switch – GUARD DOWN (F-4S; some F-4J).

   j. Fuel transfer selector knob – STOP (F-4S; some F-4J).

20. RAT handle – RAT IN.

21. Flap/slat switch – UP-NORM.

22. Flaps/slats emergency handle – UP.

23. Stab aug switches – OFF.

24. Smoke abate switch – OFF (F-4J).

25. UHF antenna selector switch – UPR.

WARNING

- Electromagnetic interference (EMI) caused by UHF transmissions radiating from the lower UHF antenna may interfere with steering commands when nosewheel steering is engaged and result in hardover nosewheel steering inputs. Therefore, use of the lower UHF antenna is restricted to in-flight operations.

- For aircraft with AFC 660 incorporated, UHF transmissions from the lower UHF antenna will occur during dual or relay operations and may interfere with nosewheel steering commands. The cockpit with command of UHF 1 (UHF 2 when backup is selected) has control of the antenna selection. During dual or relay operations, UHF 1 is carried by the antenna selected and UHF 2 is carried by the other antenna.

26. Engine anti-icing switch – NORMAL.

27. Throttles – OFF.

28. Master lights switch – OFF.

29. Speedbrake switch – STOP (neutral).

30. Throttle friction lever – SET AS DESIRED.

31. Engine master switches – OFF.

32. Engine start switch – NEUTRAL.

33. Flight instrument light control knob – AS REQUIRED (F-4S; some F-4J).

34. Drag chute handle – DOWN AND SECURE.

35. ARI circuit breaker – IN.

36. Emergency speedbrake switch – GUARD DOWN (some F-4J).

37. Emergency aileron droop switch – DISABLE or OFF (F-4J); OFF (F-4S).

38. Approach power compensator switch – OFF.

39. Gear handle – DOWN.

40. Emergency canopy jettison handle – CHECK FORWARD AND SAFETYWIRED.

41. True airspeed indicator – 60 TO 180 KNOTS.

42. Radar altimeter – OFF.

43. Accelerometer – SET.

44. Servoed optical sight mode knob – OFF (F-4S; some F-4J).

45. Radarscope – SECURE.

46. Missile jettison selector switch – OFF.

47. Missile power switch – OFF.

48. Missile (gun/missile) arm switch – SAFE.

49. Missile select switch – RADAR (some F-4J).

50. Missile interlock switch – IN.

51. AIM-9 coolant switch – OFF (F-4S; some F-4J).

52. Aural tone control – AS DESIRED (F-4S; some F-4J).

53. Jettison select switch – ALL (F-4S; some F-4J).

54. VTAS power switch – OFF (F-4S; some F-4J).

55. External wing tank jettison switch – GUARD DOWN (some F-4J).

56. Centerline station safe switch – SAFE.

57. Bomb control switch – OFF.

58. Weapons switch – AS REQUIRED.

59. Data link bomb switch – MANUAL (F-4S; some F-4J).

60. Bomb arming switch – SAFE.

61. Multiple weapons station selector switch – OFF.

62. Vertical velocity indicator – CHECK.

63. Clock – WIND AND SET.

64. Navigation function selector panel – SET.

65. Arresting hook control handle – UP.

66. Manual canopy handle – FWD.

67. Telelight panel – CHECK SECURE.

68. Emergency vent knob – IN.

69. Defog footheat handle – AS REQUIRED.

70. Pitot heat switch – OFF.

71. Rain removal switch – OFF/LOW.

72. Bleed air switch – NORM (F-4S; some F-4J).

73. UHF volume control – OFF.

   a. F-4S after AFC 660:

      UHF 1 mode switch – OFF.

      UHF 2 mode switch – OFF.

74. Comm-aux pushbutton – TR + G – ADF (not applicable to F-4S after AFC 660).

76. Circuit breakers – IN.

77. IFF master switch – OFF/MODE SET.

78. Compass system controller – SET.

a. Latitude compensator – SET.

b. Mode switch – SLAVE.

79. Cockpit temperature control panel – CHECK.

a. Heat knob – SET AS DESIRED.

b. Temperature control switch – AUTO.

WARNING

The MAN position of the temperature control switch should not be used except as a backup in the event of a failure in the automatic system. The full hot manual position can produce temperatures in excess of 300 °C at military power settings.

80. Instrument panel emergency floodlight switch – OFF.

81. Tacan antenna selector switch (before AFC 647) – AUTO.

82. ECM warning lights switch – OFF (F-4S; some F-4J).

83. Cockpit lights – OFF.

84. Exterior lights – AS DESIRED.

85. Formation lights – OFF (F-4S; some F-4J).

86. Wing fold switch – COINCIDES WITH WING POSITION.

87. Spare lamps – CHECK.

88. KY–58 power switch – OFF (F-4S; some F-4J).
KY–58 cipher switch (F-4S after AFC 660) – P/OFF.

89. KY–58 cipher switch – P (F-4S; some F-4J).
KY–58 selector switch (F-4S after AFC 660) – RAD–1.

90. ARA–63 (ILS) power switch – OFF (F-4S; some F-4J).

91. Flight instrument balance control panel – AS REQUIRED (some F-4J).

After electrical power:

CAUTION

Do not place generator control switch to the EXT position until external power has been connected and has had time to reach rated voltage and frequency.

1. Generator control switches – EXT ON.

2. KY–58 (if installed) – AS DESIRED.

3. Intercom system – CHECK.

4. Seat – ADJUST.

5. Data link light control – AS DESIRED (F-4S; some F-4J).

6. Radar annunciator lights – AS DESIRED (F-4S; some F-4J).

7. Cockpit lights – AS DESIRED.

8. ECM warning lights – AS DESIRED (F-4S; some F-4J).

9. Warning lights – CHECK.

Depress warning light test switch and note master caution light, warning light panel, command and digital display indicator lights (F-4S; some F-4J), ECM warning lights (F-4S; some F-4J), radarscope warning lights, missile status panel lights, arresting hook warning light, and landing gear warning lights are illuminated. Check warning light dimming circuit by holding warning light test button depressed and rotating instrument panel light control knob from OFF to BRIGHT. Warning lights should dim and revert to bright when knob is returned to OFF.

10. Fire warning lights – CHECK.

Depress the fire check button and note engine FIRE/OVERHT and on some aircraft the three BLEED AIR OVERHT warning lights illuminated.

11. Fuel quantity gauge – CHECK.
Actuate feed tank check switch and fuel gauge will stabilize at 1,571 pounds. Check aft gauge sector and counter within 100 and 200 pounds, respectively, of the forward gauge.

12. Fuel quantity – CHECK.

Check fuel quantity indicators against known fuel quantity. Check aft gauge sector and counter within 100 and 200 pounds, respectively, of the forward gauge.

13. Flap/slat position indicators – UP/IN AND UP.

Check flap/slat position indicators correspond with flap/slat position.

14. Landing gear indicator – DOWN.

Check landing gear position indicators indicate gear down.

15. Liquid oxygen gauge – CHECK.

16. Antiskid switch – OFF; LIGHT ON (some aircraft).

17. Boost pumps and engine fuel shutoff valve – CHECK.

Observe boost pump pressure indicators while actuating boost pump check switches one at a time. Normal pressure (30 (±5) psi) on side being checked indicates engine fuel shutoff valve open and boost pump running. Concurrent pressure on other indicator indicates other valve faulty (not properly closed). Lack of pressure on side being checked indicates faulty valve (not properly open) or pump inoperative. Also, note that zero fuelflow is registered on the fuelflow indicator.

CAUTION

Allow minimum of 3 seconds between release of one fuel boost pump test switch and actuation of other. Failure to do so could result in burning of switch contacts and subsequent engine flameout.

18. Master light switch – AS REQUIRED.

8.1.4.2 RIO

8.1.4.2.1 Before Electrical Power

1. Oxygen, communications, and anti-g lines – CONNECT.

Connect oxygen, communications, and anti-g lines, as applicable, and check for positive lock.

2. Oxygen – CHECK.

Turn oxygen selector on, check normal flow with mask held away from face. Put mask on, check normal breathing. Turn oxygen off, check no breathing.

WARNING

Do not pull emergency oxygen actuator ring before actual use. If emergency oxygen actuator ring is actuated prior to intended use, pressure reducer manifold may not prevent emergency oxygen from flowing to suit controller and/or oxygen regulator. If this happens, crewmember has no way of knowing how much or if any emergency oxygen remains and has no way of replenishing depleted supply.

3. Leg restraint lines – CONNECTED.

Ensure leg lines are not twisted. Route lines through calf garter, then through thigh garter, and then insert lock pins in snubber boxes.

WARNING

It is imperative that leg restraint system be hooked up at all times during flight to ensure legs are pulled aft upon ejection. This will prevent leg injury and enhance seat stability by preventing legs from flailing following ejection. An unhooked leg restraint system necessitates pulling legs aft against seat to preclude hitting canopy bow. This action will cause spine to flex and will increase the possibility of spinal injury during ejection. Be sure leg lines are routed through calf garters before thigh garters since incorrect routing could result in serious leg injury during ejection.

4. Harnessing – FASTENED.

WARNING

Ensure harness assembly is securely fastened to the seat. The pins must be in their proper receptacles, one pin on each side of the bucket seat and one pin on the harness locking reel assembly. The emergency restraint release handle must be down.

5. Shoulder harness lock lever – CHECK OPERATION.

6. Face curtain pin – REMOVE; SECURELY STOW PIN BAG.

WARNING

- To prevent inadvertent firing of seat or canopy, all ejection seat safety pins must be either installed or removed and properly stowed prior to operating the canopy.
- When removing or checking for the removal of the face curtain safety pin, make sure that the safety pin shank has been removed from the hole. The safety pin collar has been known to separate from the pin shank upon attempted safety pin removal, leaving the pin shank in the hole and the face curtain safetied.

WARNING

When a qualified plane captain is present, he will remove the face curtain pin and hand the pin bag to the aircrewman as his last step prior to dismounting the aircraft.

7. Lower ejection handle safety guard – AS DESIRED.

WARNING

The lower ejection handle safety guard, when lowered, can rebound to the safe position if it is lowered too rapidly.

8. Tacan – OFF.

9. UHF – OFF.

   a. After AFC 660:

      UHF 1 – OFF.

      UHF 2 – OFF.

10. Integrated control panel – SET (F-4S; some F-4J).

   a. Dispenser selector knob – OFF (F-4S; some F-4J).

   b. ECM mode selector knob – OFF.

   c. Receiver power switch – OFF.

   d. Payload selector knob – OFF (some F-4J).

   e. Warning receiver interface switch – OFF (some F-4J).

   f. Dispenser mode select switch – STBY (some F-4J).

11. Data link power switch – OFF (F-4S; some F-4J).

12. Data link BIT switch – NORM (F-4S; some F-4J).

13. Radar beacon power switch – OFF.

14. ALQ–91 function selector switch – OFF (F-4S; some F-4J).

CAUTION

Failure to ensure that AN/ALQ-91 function selector switch is turned OFF and remains in the OFF position until aircraft is switched to internal power may result in damage to the equipment or a blown fuse.

15. Destruct circuit arm switch – SAFETY PIN INSTALLED (F-4S; some F-4J).

16. Command selector valve handle – POSITION IN ACCORDANCE WITH TYPE COMMANDER/SQUADRON POLICY.

CAUTION

When actuating the command selector valve from the closed (vertical) to open (horizontal) position, pull the handle straight out allowing the cam action of the valve to rotate the handle to the open position. This procedure will prolong the service life of the selector valve. After AFC 526, the handle is turned by the application of torque only, and there is no requirement to pull the handle.

17. Communication antenna selector switch – UPPER.

18. Cockpit lights – AS DESIRED.

19. Altimeter – SET.

20. Clock – CHECK.

21. Band disable panel – SET (F-4S; some F-4J).

   a. Band switches – DISABLE.

22. Antenna correlation disable panel – SET (F-4S; some F-4J).

   a. Correlation switch – DISABLE.

   b. Antenna switch – DISABLE.

23. Manual canopy unlock handle – FORWARD.

24. Circuit breakers – CHECK.

25. Antenna handle control panel – EXTEND (some F-4J).

26. Radarscope – AS DESIRED (some F-4J).

27. Radar set control panel – EXTENDED (some F-4J).

28. Radar function switch – OFF.

29. Navigational computer – SET/STBY.

30. Aft cockpit electrical test receptacle – PLUG SECURED.

It is possible to trip both generators off the line if the electrical test receptacle plug 3P325 under the right canopy sill is loose. The generators cannot be restored until the plug is secured.

8.1.4.2.2 After Electrical Power

1. Warning lights – TEST.

2. Perform data link BIT 3 and 4 checks (F-4S; some F-4J).

Data link BIT 3 and 4 checks must be performed with external power connected and the autopilot ground test switch in TEST.

3. Navigation selector switch – NAV COMP.

Check DME runoff to zero, note error, and return switch to CNI.

4. Oxygen quantity gauge – CHECK.

5. Navigation command – AS DESIRED.

6. Communication command – AS BRIEFED.

7. Navigation channel – AS BRIEFED.

8. Auxiliary channel – AS BRIEFED.

   a. After AFC 660:

      ADF channel – AS BRIEFED.

9. Communication channel – AS BRIEFED.

10. Radar set control switches – AS REQUIRED.

11. Radar annunciator lights – AS DESIRED (F-4S; some F-4J).

12. Seat – ADJUST.

13. Essential dc bus test button – DEPRESS.

Depress button and check that essential dc bus indicator light illuminates. If light illuminates, the left transformer–rectifier is delivering dc power. If the light does not illuminate, the left transformer–rectifier is inoperative or not receiving power. With the dc test button depressed, the right transformer–rectifier can be checked by actuating the warning light test switch. If the warning lights illuminate, the right transformer–rectifier is operating properly.

14. Circuit breakers – CHECK IN.

15. Notify pilot – PRESTART CHECKS COMPLETED; CIRCUIT BREAKERS IN.

8.1.5 Before Starting Engines

8.1.5.1 Pilot

1. Fire bottle – MANNED.

2. Intake and exhaust areas – CLEAR.

3. Boarding steps – UP.

4. External air supply – CONNECTED AND PRESSURE UP.

5. Rudder – CHECK MOVEMENT.

CAUTION

The center mirror on the forward canopy can be tilted sufficiently to prevent canopy closing; therefore, ensure the mirror will clear the windshield bow before closing the canopy.

6. Inform RIO – READY TO START.

8.1.6 Starting Engines.

The pilot starts engines and keeps the RIO informed of any unusual occurrences. The RIO remains alert for any emergency signals from the ground crew and informs the pilot if such signals are observed. When practicable, start and run up engines on paved surface to minimize the possibility of foreign objects being drawn into the compressor with resultant engine damage. Start the engines with the nose into or at right angles to the wind as exhaust temperatures may be aggravated by tailwind.

WARNING

- Suction at the intake is sufficient to kill or severely injure personnel drawn into or pulled suddenly against the duct.
- Danger areas aft of the aircraft are created by high exhaust temperature and velocities. The danger increases with afterburner operation.

8.1.6.1 Pilot

CAUTION

With flaps/slats extended, the BLC ducts are open and the loss of engine bleed air while attempting to start the engines may result in a hot or false (no ignition) start. If it is imperative that a start be made with flaps/slats down, start with bleed air switch OFF to improve start capability.

Note

The following engine start procedure establishes the right engine as being started first and was adopted in order to ascertain that both utility hydraulic system pumps are operating. The right engine pump delivers 2,775 (±225) psi at idle rpm, and the left engine pump delivers approximately 3,000 (±250) psi at idle rpm. Therefore, the single–needle utility hydraulic pressure indicator cannot be used to determine pump operation unless the right engine is started first.

1. Throttles – OFF.

2. External compressed air source – CONNECTED.

3. Engine master switches – ON.

Note

When attempting an engine start, there is a possibility that the starter air valve will not open when the start switch is actuated. This does not mean that the solenoid–operated valve is completely inoperative, it may be that the valve is only sticking in the closed position. If the valve will not open, have the air shut off at the starter cart and then actuate the start switch. The stuck valve, unopposed by air pressure, may open.

4. Engine start switch – RIGHT.

CAUTION

If there is no identification of engine rpm within 15 seconds or no indication of oil pressure within 30 seconds after start cycle begins, shut down immediately and investigate.

At 10-percent rpm:

5. Right engine ignition button – DEPRESS.

At approximately 10-percent rpm, depress right engine ignition button and simultaneously advance the throttle halfway up the quadrant and then snap it back to the idle stop position while monitoring fuelflow. If the throttle is properly rigged, the snapback will not affect initial starting fuelflow. However, if a momentary drop of more than 75 pph below minimum starting fuelflow is indicated, the throttle is out of rig. This can be confirmed by snapping the throttle forward and back several times while keeping ignition button depressed.

CAUTION

- Do not attempt to start the engine before reaching 10-percent rpm. If the starting procedure is initiated at a lower rpm, additional heat distress of the engine hot suction is anticipated. Overtemperature of the turbine will generally occur during a low rpm start if starter air is inadvertently interrupted during the start cycle. However, starting below 10-percent rpm may be helpful with a hard to start engine in an emergency situation.

- If the engine does not light off by the time fuelflow reaches 800 pph (1,200 pph in -10B engine) or within 15 seconds after fuelflow or pressure is indicated, chop throttle to full OFF position, release ignition button.

Note

The engine usually fires at approximately 10- to 16-percent rpm.

6. Release ignition button when light-off is indicated by a sudden increase in EGT.

CAUTION

If engine does not continue to accelerate after light-off, discontinue start. Monitor EGT. If EGT continues to rise, continue windmilling engine.

7. Start switch – NEUTRAL.

When the engine is operating at a self-sustaining rpm (usually about 45–percent), move the starter switch to the neutral position.

8. Exhaust temperature gauge – CHECK WITHIN LIMITS (980 °C max for 10 seconds).

CAUTION

- At no time should EGT exceed maximum starting limits.
- With only one engine in operation, do not move control stick (surface controls) excessively. If the stick is moved rapidly with hydraulic pressure on only one side of the tandem power cylinders, the fluid that is in the other side of the cylinder is forced back through the return line to the reservoir, filling the reservoir, and either rupturing the reservoir or forcing the excess fluid overboard. The seals within the tandem power cylinders may also be damaged because of the ingesting and expelling of air and lack of lubrication. The power control hydraulic systems must be reserviced and checked.

Note

After the engine reaches idle rpm, the EGT should recede and stabilize.

9. Fuelflow indicator – CHECK.

Fuelflow should not exceed 800 pph at light-off (1,200 pph in -10B engine), up to 2,400 pph during the transition to idle, and 800 to 1,400 pph (800 pph to 1,500 pph in -10B engine) at IDLE.

CAUTION

If fuel flow is in excess of 800 pph (1,200 pph in -10B engine), a hot start will likely result.

Note

Fuel consumed while starting engines is approximately 65 pounds.

10. Oil pressure gauge – CHECK.

Check oil pressure 12 psi minimum at idle rpm.

CAUTION

After any wet start or false (no-ignition) start, allow 1 minute or longer for the combustion system to drain before attempting subsequent start of the engine.

Note

- With the right engine started, the PC-2 and utility hydraulic pressure indicators should read within normal. The CHECK HYD GAGES warning light will remain illuminated until the other engine is started and all four hydraulic pumps (PC-1, PC-2, and utility) are operating properly.
- If the throttles cannot be returned to OFF, the engine may be shut down from any throttle setting by placing the respective engine master switch to the OFF position. This will close the corresponding fuel shutoff valve, thus depriving the engine of fuel. The engine(s) will flame out in approximately 15 seconds from MIL power.

11. Right generator switch – GEN ON.

Note

Oil pressure should be below 50 psi before placing the generator control switches to GEN ON.

Check LH GEN OUT warning light illuminated and BUS TIE OPEN warning light out.

12. Left spoiler – CHECK.

With right engine operating, PC-1 pressure zero, slowly deflect control stick approximately 1 inch to the left. Have ground crew/RIO verify that the left spoiler does not fully deflect and it returns to a flush position when the stick is returned to neutral.

13. Check fuel boost pump gauges for normal indications.

If right generator phase reversal is present, the boost pumps will run in reverse and the gauges will indicate substantially lower than normal.

14. Start the left engine as per items 4 through 10.

15. Left generator switch – GEN ON.

16. External power and air – DISCONNECT.

17. Right generator switch – OFF.

Check RH GEN OUT warning light illuminated and BUS TIE OPEN warning light out.

WARNING

If both generator switches are placed to the OFF position with engines running, auxiliary air doors and speedbrakes will close violently.

18. Check both boost pump pressure gauges for normal indications.

If left generator phase reversal is present, the boost pumps will run in reverse and the gauges will indicate substantially lower than normal.

19. Right generator switch – GEN ON.

Check RH GEN OUT and BUS TIE OPEN warning lights out.

20. Notify RIO that BUS TIE OPEN light is out.

Note

- Nonstart or abnormal starts shall be logged on the yellow sheet (OPNAV form 3760-2).
- Fuel consumption at idle rpm is approximately 42 ppm.
- After satisfactory starts are accomplished, the engines do not require any warmup time prior to placing throttles in any position.

8.1.6.2 RIO

1. Notify pilot of any emergency signals noted from ground crew.

8.1.6.3 Starting With Low Air Pressure. If low air pressure units are employed for operational necessity and starting rpm seems to be hanging up, proceed as follows:

At any rpm over 5 percent:

1. Ignition button – DEPRESS, THROTTLE IDLE.
2. Exhaust gas temperature – MONITOR.
3. If EGT starts to move up rapidly as it passes 650 °C – DISCONTINUE START, THROTTLE OFF.
4. Let engine coast until EGT drops to 250 °C – DEPRESS IGNITION BUTTON, THROTTLE IDLE.

At 250 °C, the engine rpm should be approximately 12-percent rpm, so the second relight should be successful. If it is not successful, repeat the procedure, cutting the engine when it starts to overtemperature and relighting when it cools to 250 °C. A little rpm will be gained each time.

CAUTION

Do not attempt to manually meter fuelflow with the throttles at a position between OFF and IDLE. This results in a premature hot section deterioration without any abnormal EGT indication.

8.1.7 Before Taxiing

8.1.7.1 Pilot. After switching to internal power, the pilot shall inform the RIO, "On internal power: bus tie closed/open." The pilot will then complete all before taxiing checks. When checks are completed, he will inform the RIO, "Ready to taxi." The pilot will turn the missile power (CW) switch ON when requested by the RIO and will acknowledge by stating, "Power switch on."

1. IFF – STBY/ON.

2. Compass system controller – SET.

   a. Sync button – PUSH.

   b. Sync indicator – CHECK.

Note

The wings must be spread and locked prior to compass sync to prevent false bearing information.

3. Attitude reference selector knob – PRIM–STBY–PRIM.

Switch to STBY and note shift of ADI to AJB-7 system. Switch back to PRIM.

4. Tacan – REC.

5. Radios – ON.

6. Altimeter and SPC – SET AND CHECK.

   a. Place the SPC switch in the RESET CORR position; the STATIC CORR OFF light must go out and remain extinguished. After reset, the altimeter should indicate within ±40 feet of the before reset indication. Altimeter oscillations of any magnitude are unacceptable.

Note

On some aircraft, the altimeter may momentarily jump to 90 feet before settling to the actual engagement error. Disregard this initial momentary jump.

   b. Obtain field barometric pressure from tower and set altimeter barometric pressure correction dial. Altimeter pointer should indicate the field elevation within ±75 feet.

   c. Place reset/standby switch to RESET for 1 to 3 seconds until standby flag disappears. Indicated altitude should be published field elevation ±75 feet. In addition, the altitudes indicated in the RESET and STANDBY modes should be within ±75 feet of each other. Return to STANDBY mode for operation below 18,000 feet. Select RESET when above 18,000 feet.

7. ADI and standby attitude indicator – SET.

8. Radar altimeter – ON AND SET.

Turn the altimeter on and set the low altitude limit. Ensure that the altitude pointer moves to 5 (±5) feet after warmup.

9. AFCS – CHECK.

Note

Before engaging stab aug, neutralize the controls by using the force transducer to place the control stick in the vertical position. Use of the stick grip to neutralize the controls will introduce erroneous signals into the system. If stick is not off forward or aft stops, AFCS may not engage.

   a. Stab aug switches – ENGAGE.

   b. AFCS switch – ENGAGE.

   c. AFCS/ARI disengage switch – DEPRESS.

   Check that AFCS switch returns to OFF.

Note

Only the AFCS switch will move to OFF when the AFCS/ARI emergency disengage switch is depressed. The stab aug switches must be individually disengaged.

   d. Stab aug switches – DISENGAGE

10. Trim switches – CHECK AND SET FOR TAKEOFF.

Check operation of trim switches and set rudder and aileron trim to neutral. Set stabilator trim to two units nosedown. (For F-4S slatted aircraft (AFC 601, part 2 installed), set stabilator trim to three units nosedown.)

On signal from plane captain:

11. Wings – SPREAD AND LOCKED.

12. Speedbrakes – CYCLE.

Ascertain from ground crew that speedbrakes are fully closed and warning light is out.

13. Flaps/slats and bleed air – CYCLE AND CHECK.

Actuate the flaps/slats to 1/2-OUT and then to DN-OUT. Monitor flaps/slats indicator and EGT. EGT should rise 10° to 15° as flaps move from 1/2 to DN. Have ground crew confirm both trailing edge flaps extend together and both ailerons droop together. Check that BLC system is operating. Turn bleed air switch OFF. Note illumination of BLEED AIR OFF light and drop of 20° to 40° on F-4J aircraft, have ground crew confirm leading edge BLC is off. Turn bleed air switch ON (after signal from ground crew on F-4J). Ensure BLEED AIR OFF light goes out and note EGT rise of 20° to 40° on F-4J or 10° to 15° on F-4S aircraft. On F-4J aircraft, have ground crew confirm leading edge BLC is on. Raise flaps/slats to 1/2–OUT. Note EGT drop 10° to 15°. If flaps/slats indicate barberpole in any position, leave as set and have maintenance check. Takeoff with flaps/slats barberpole is prohibited.

14. Flight control surfaces and hydraulic systems – CHECK TRAVEL; NOTE PRESSURE DROP.

a. Cycle the flight controls and check corresponding movement of the control surface. While cycling the ailerons, perform RCA and ARI checks. See steps 6a.(8) and 6a.(9) in the before taxiing procedure in Chapter 10.

b. Set takeoff pitch trim (two units nosedown) and release the control stick from the full aft stop. The control stick should move forward to at least the 1/2 travel position and further movement toward the forward stop should require no more than approximately 1-pound push force. Moderate stick movement should be smooth and free of any restrictions.

15. Flap/slat switch – UP–NORM.

Actuate the flaps/slats to UP–NORM and monitor the BLC MALFUNCTION light for a valve malfunction.

16. Arresting hook/corner reflector – CYCLE.

17. Canopy rigging – CHECK AND PREFLIGHT.

a. Engines – IDLE.

b. Cabin pressure vent knob – IN.

c. Defog footheat handle – AFT.

d. Cockpit temperature control knob – SET AT 2 O'CLOCK.

e. Aft canopy – CLOSE, LIGHT OUT.

f. Front canopy – CLOSE (closing and locking not to exceed 9 seconds).

The canopy is closed when warning light is out, alignment marks aligned, and overcenter links moved over center.

g. Open aft canopy, keep forward canopy closed, and repeat timing check on aft canopy.

h. If either canopy fails timing check, in-flight loss of canopy may result.

18. Probe and RAT – CYCLE (if practicable) AND CHECK.

19. Perform VTAS BIT (F-4S; some F-4J).
Refer to Section VIII in NAVAIR 01-245FDD-1A-1.

20. Perform dogfight computer BIT (F-4S; some F-4J).

Refer to Section VIII in NAVAIR 01-245FDD-1A-1.

21. Tune AIM-7 missiles (if aboard).

22. Perform digital and command display indicator BIT checks (F-4S; some F-4J).

Refer to data link system in Section VIII in NAVAIR 01-245FDD-1A-1.

23. Perform ARA-63 (ILS) BIT (F-4S; some F-4J).

Refer to Part I for BIT procedures.

24. Anticollision light – ON (day or night) and all external lights ON (dusk to dawn) during shore–based operations.

25. Servoed optical sight – CAGED.

CAUTION

The cage lever should be in the caged position for all takeoffs and landings to prevent damage to the sight.

26. Report – READY TO TAXI.

8.1.7.2 RIO

1. Ascertain from the pilot that the generator control switches are ON and the bus tie and generator warning lights are out.

2. Remote attitude indicator (VGI) – SET.

3. Radios – TR + G.

   a. After AFC 660:

      Radio 1 – BOTH

      Radio 2 – MAIN.

4. Tacan – REC.

5. Vent air – AS DESIRED.

6. Altimeter – SET AND CHECK (compare with pilot).

7. Radar function switch – STBY (safety/operational necessity only, otherwise OFF).

The radar function switch should be in the OFF position, but may be placed on STBY or ON if safety of flight or operational necessity requires use of the radar.

8. Perform BIT as required.

Refer to Section VIII in NAVAIR 01-245FDD-1A-1 for BIT procedures.

9. Data link system operation – CHECK (F-4S; some F-4J).

Refer to data link system in Section VIII in NAVAIR 01-245FDD-1A-1 for universal test message checks, data link BIT checks, and digital display indicator BIT check.

10. Data link BIT switch – NORM (F-4S; some F-4J).

WARNING

Do not select BIT checks with the data link BIT switch on the cockpit lights/data link control panel while in flight. This could result in application of deflection signals to the aircraft control surfaces.

11. ECM equipment operation – CHECK (F-4S; some F-4J)

Refer to Section V in NAVAIR 01-245FDB-1T(A) for BIT procedures.

CAUTION

Assure that the UHF antenna is in the upper position prior to taxi, takeoff, and landing. Upper UHF antenna should be used during these phases because lower UHF antenna radiation may cause the nosewheel to go left or right.

Note

If after engagement of nose gear steering with upper UHF antenna selected, no response is noted or unscheduled steering commands are detected, disengage nose gear steering and do not reengage.

12. Clock – SET.

13. Report – READY FOR TAXI.

8.1.8 Taxiing

8.1.8.1 Pilot. High takeoff gross weight combined with the small wheels and tires dictate that a positive technique be used while taxiing this aircraft. After the chocks have been pulled, add power as required on both engines and engage nose gear steering. After the aircraft has started rolling, check the brakes and reduce power. Taxi at the lowest practicable rpm and use nose gear steering for directional control, where possible, to minimize brake heating. Do not ride or pump the brakes; use a steady pressure when needed. Keep the taxi speed slow and make as few stops as possible. Slow the aircraft before entering a turn in order to reduce side loads while in the turn. Make turns as wide as practicable, 75-foot radius if possible, at 12 to 13 knots. See Figure 8-2 for minimum turning radius and ground clearance.

8.1.8.2 RIO. Complete BIT checks as required if not previously completed. Return the radar function switch to STBY/OFF (as required) after completion of BIT checks.

8.2 TAKEOFF

8.2.1 Before Takeoff. When in the runup area, allow the aircraft to roll straight ahead to align the nosewheel. Apply the brakes with a firm, steady pressure and assure the flaps are up. Note the idle rpm, EGT and fuelflow of both engines. When engine runup is required, check the engines individually at MIL power and observe that the rpm, EGT, exhaust nozzle, fuelflow, oil pressure, and hydraulic pressure are within their normal operating ranges on the engine being checked; also check that the rpm, EGT and fuelflow on the idling engine remains stable and that the ramps are fully retracted.

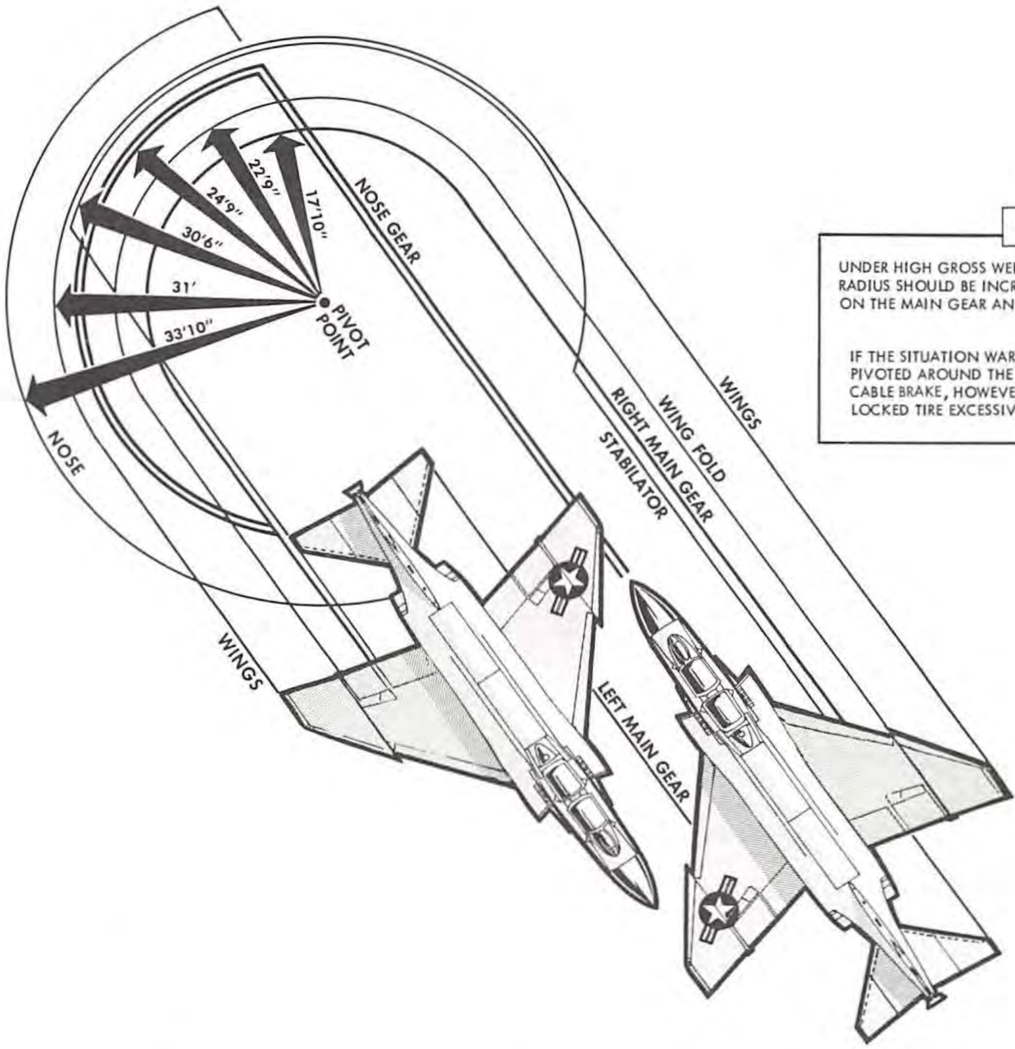
CAUTION

During engine runup with flaps full up, a rise in rpm above 67.5 percent, a drop in EGT of more than 25 °C, or a drop of more than 100 pph in fuelflow on the idling engine indicates a defective bleed air check valve on that engine. In cases where this check cannot be made at full military power, a valid check for an inoperative valve may be made at 80-percent rpm. Failure indications with such a check would be proportionally lower and should be verified at full military power if possible. This check performed with the flaps in any position other than full up is invalid (except F-4S).

To guard against possible engine flameout during throttle chops at low altitude, check the throttle rigging and fuel control behavior by abruptly retarding each throttle from MIL power to IDLE. Monitor the fuelflow indicator. The momentary minimum acceptable fuelflow during this check is 365 pph (-10) or 440 pph (-10B). Observe that engine rpm returns to its originally noted value. If fuelflow drops below 365 pph (440 pph in -10B engines), but the engine recovers to original rpm, proceed with flight; however, do not snap decelerate these engines below 10,000 feet. If engine rpm fails to recover to the original idle rpm value regardless of fuelflow reading, the flight should be aborted. It is mandatory that an entry be made in OPNAV form 3760-2 (yellow sheet) on all engines which drop below the minimum fuelflow during snap deceleration and/or fail to recover to the original idle rpm. Do not attempt to check the engine in the MAX power range and do not operate the engine at MIL power with bleed air operating for more than 1 minute. When the engine checks are completed, complete the remainder of the Takeoff Checklist. If canopy closure is attempted with engines running, the engines should not be operating above a stabilized idle rpm. Attempted canopy closure with engine rpm above idle may result in canopy not fully locking because of back pressure caused by the aircraft pressurization system.

8.2.1.1 Flap Positions. Three flap positions are available for takeoff: 1/2-OUT, DN-OUT, and UP-NORM. However, the 1/2-OUT configuration is recommended for all takeoffs. DN-OUT is not an acceptable takeoff configuration for field operations since it affords no advantages and several disadvantages (increased drag, reduced thrust, reduced stabilator effectiveness, and large trim change during transition to climb) over any other configuration. UP-NORM is not a recommended takeoff configuration. If an UP-NORM takeoff is attempted in a heavy or draggy aircraft in the same distance as 1/2-OUT takeoff, the attitude of the aircraft at liftoff will result in the aircraft flying closer to the stall margin and aircraft control will be more critical. In order to achieve the same takeoff attitude as that obtained with 1/2-OUT, the aircraft takeoff speed must be further increased. By increasing the takeoff speed, the takeoff distance and the aircraft kinetic energy are also increased proportionally, thereby making an abort more difficult. In addition, the increased takeoff speed begins to approach the rotational speed limitations of the tires, making the possibility of tire failure more probable. Stabilator effectiveness during an UP-NORM takeoff is considerably greater than during a 1/2-OUT takeoff; therefore, the stick must be programmed forward more rapidly to prevent overrotation beyond the desired 10° to 12° takeoff attitude. Since ARI is avail-

AIRCRAFT BEING TAXIED



Note

UNDER HIGH GROSS WEIGHT CONDITIONS, THE TURN RADIUS SHOULD BE INCREASED TO RELIEVE SIDE LOADS ON THE MAIN GEAR AND TIRES.

IF THE SITUATION WARRANTS THE AIRCRAFT CAN BE PIVOTED AROUND THE GEAR BY LOCKING THE APPLICABLE BRAKE, HOWEVER DOING SO SCUFFS THE LOCKED TIRE EXCESSIVELY.

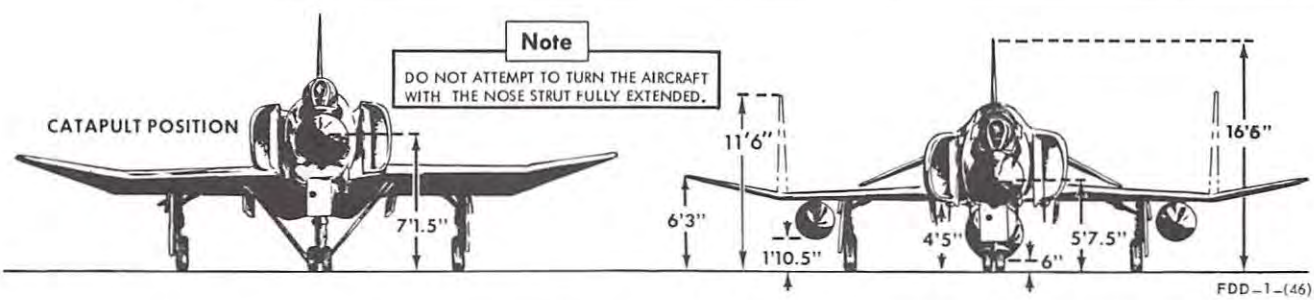


Figure 8-2. Minimum Turning Radius and Ground Clearance

able only when flaps/slats are used, increased adverse yaw may be expected in the UP–NORM configuration.

8.2.1.2 Pilot

1. Engine runups – AS REQUIRED.

2. Pneumatic pressure – 2,680 TO 3,270 PSI.

3. Engine anti–ice – AS DESIRED.

4. Antiskid switch – ON; light–OUT (some aircraft).

5. Radar horizon – SET.

6. External transfer switch – CHECK.

7. Stab augs – ON.

8. Defog footheat handle – AS DESIRED.

9. Pitot heat – ON.

10. Tacan – T/R.

Allow a minimum of 2 minutes receive time before selecting T/R.

11. Compass – CHECK SYNC.

12. IFF – AS DESIRED.

13. Takeoff Checklist – COMPLETE WITH RIO.

 a. Controls – CHECKED.

 Check controls for freedom of movement, normal pressure drop, and direction of movement.

 b. Wings – LOCKED

 Check wing pin unlock handle down, and WING PIN UNLOCK lights out.

 c. Trim – SET.

 d. Flaps/slats – 1/2; 1/2-OUT.

 e. Hook – UP.

 f. Harness – LOCKED AND LAP BELT SECURE.

 g. Warning lights – OUT.

14. Seat pins – REMOVE.

15. Lower ejection handle guard – DOWN.

16. Command selector valve – AS DESIRED.

17. ICS – HOT MIC.

18. Engine instrument check – NORMAL (relay to RIO).

8.2.1.3 RIO

1. Tacan – T/R.

Allow a minimum of 2 minutes receive time before selecting T/R.

2. Compass heading sync – CHALLENGE PILOT.

3. Circuit breakers – CHECK IN.

4. Radar antenna elevation stobe – 17° DOWN.
5. Equipment – STOW.

6. Lower ejection handle guard – DOWN.

7. Command selector valve – INFORM PILOT OF POSITION.

8. Takeoff Checklist – COMPLETED.

 a. Controls – CHECK.

 b. Wings – LOCK.

 Visually check each wing lock pin down and both WING PIN UNLOCK lights out.

 c. Trim – CHECK SETTING.

 d. Flaps/slats – VISUALLY CHECK.

 e. Hook – CHECK UP.

 f. Harness – LOCK AND LAP BELT SECURE.

g. Warning lights – OUT.

h. Seat pins – PULL.

9. Report flaps, ready for takeoff.

10. ICS – HOT MIC.

11. Navigation computer – TGT or BASE when airspeed reaches 160 knots.

12. Variable area inlet ramps – CHECK ON TAKEOFF ROLL.

8.2.2 Normal Takeoff Technique. For individual takeoff, the centerline of the runway should be used as a directional guide. When in position, roll forward slightly to align the nosewheel. If nose gear steering is desired, engagement must be made prior to commencing takeoff roll. Do not engage after the takeoff roll has started. The takeoff roll may be started with the engines in IDLE or the brakes can be applied until 80-percent rpm is reached on each engine. After the takeoff roll has begun, the throttles are advanced to MIL power and EGT and rpm are checked. If an afterburner takeoff is desired, afterburner is selected by moving both throttles into the afterburner detent and advancing smoothly to MAX power. If one afterburner fails to light or blows out during takeoff, the resulting loss of thrust is significant. Sufficient directional control is available with the rudder to continue the takeoff with asymmetric power. If the afterburner fails to light early in the takeoff roll and airspeed, runway remaining, and conditions permit, abort the takeoff rather than attempting relight. Very light braking or nose gear steering can be used to maintain directional control until the rudder becomes effective at approximately 70 knots. Nose gear steering should be disengaged when the rudder becomes effective. In any case, nose gear steering must be disengaged prior to liftoff to ensure nosewheel centering and nose gear retraction. Optimum liftoff speeds are contained in the F-4J/S NATOPS Pocket Checklist and in Part XI or Part XII of this publication. Location of the main landing gear a good bit aft of the normal cg prevents this aircraft from being rotated early in the takeoff roll. In the normal rotation technique, position the stick slightly aft of neutral until reaching 120 knots. While the exact stabilator position required to achieve 10° to 12° rotation at liftoff will vary with gross weight and CT, stick position slightly aft of neutral will ensure initial rotation for field takeoff. If cg is located in or near the amber caution area of Figure 11-4, the aircraft will exhibit light longitudinal stick forces and be very sensitive to longitudinal stick position and movement immediately after takeoff. Awareness of aft cg position and smooth stick inputs will help preclude pilot-induced oscillations or overrotation. As flying speed and stabilator effectiveness are gained, stick position may be smoothly adjusted to achieve the desired 10° to 12° attitude for liftoff. The takeoff attitude of 10° to 12° is identical in the 1/2-OUT and UP-NORM configurations. UP-NORM takeoff speed will be 10 to 20 knots faster than 1/2–OUT speed. The AUX AIR DOOR and MASTER CAUTION lights may illuminate momentarily as the landing gear and flaps controls are actuated. This is normal and should be no cause for alarm.

8.2.3 Minimum Run Takeoff. For a minimum run takeoff full aft stick is applied at brake release. As the aircraft starts to rotate, the stick should be adjusted forward to maintain 10° to 12° of pitch. Concentrate on a smooth rotation and do not exceed 22 units angle of attack. This will allow the aircraft to fly off at optimum liftoff speed. Takeoff data is based on minimum run takeoff.

WARNING

From 30 knots below takeoff speed until aircraft is normally airborne, rapid full aft stick movement may cause aircraft overrotation with resultant stalled flight condition, liftoff prior to reaching safe flying speed, or the stabilator striking the runway. With gear down and flaps down, do not exceed 22 units angle of attack. After gear retraction, do not exceed 18 units angle of attack, since the angle-of-attack system indicates 3 to 4 units low with gear retracted.

CAUTION

Because of the effectiveness of the stabilator, rapid noseup pitching movement will occur during UP-NORM takeoff if the stick is held full aft at rotation.

CAUTION

Attempting a minimum run, full aft stick takeoff when the cg is located in or near the amber caution area of Figure 11-4 will result in a rapid noseup pitch rate at liftoff. Pitch attitude must be smoothly controlled to avoid pilot–induced oscillations.

8.2.4 Crosswind Takeoff. If nose gear steering is to be used, it must be engaged before commencing takeoff roll. Release brakes evenly; do not ride or keep pressure on the brakes during the initial part of the roll. The brakes should be used sparingly to prevent overheating. Excessive braking will increase the takeoff roll. The rudder will become effective at approximately 70 knots. Hold the nosewheel down until flying speed is reached. Fly the aircraft off the runway at optimum liftoff speed. Do not assume an immediate wing low attitude in order to counteract for wind drift; the pilot cannot properly judge the wingtip ground clearance on a swept–wing aircraft.

8.2.5 Formation Takeoff. For formation takeoff, all aspects of the takeoff must be prebriefed by the flight leader. This should include flap/slat settings, use of nose gear steering, power changes, power settings, and signals for actuation landing gear, flaps/slats, and afterburner. The leader will take position on the downwind side of the runway with other aircraft in tactical order maintaining normal parade bearing (normal parade is minimum safe aircraft separation). After pretakeoff checks are completed and the flight is in position, engines are run up to approximately 85 percent, instruments checked, and nose gear steering engaged (procedures for nose gear steering technique are the same as for single aircraft takeoff technique). On signal from leader, brakes are released and throttles are advanced to military power minus 2-percent rpm. (If afterburner is desired, the lead pilot may go into midburner immediately without stopping at military power or he may select afterburner during the takeoff roll at a later time.) During the takeoff roll, the leader should maintain stick between center and three quarters aft position until reaching 120 knots, then smoothly rotate the aircraft to a 10° to 12° nose-high attitude. The lead should maintain this attitude until the flight is airborne. The wingman should strive to match the lead aircraft's attitude as well as maintain a position in parade bearing with wingtip separation. The gear and flaps/slats are raised on signal. Turns into the wingman will not be made at altitudes less than 500 feet above ground level. The first section must be airborne before the second section commences its takeoff roll. Visual communication procedures are contained in Part VII.

CAUTION

- In the event of an aborted takeoff, the aircraft aborting must immediately notify the other aircraft. The aircraft not aborting should add maximum power and accelerate ahead and out of the way of the aborting aircraft. This will allow the aborting aircraft to steer to the center of the runway and engage the arresting gear if required.
- It is imperative that the wingman always be alert for an overrunning situation and take timely steps to preclude such an occurrence. Should an overrunning/overshooting situation develop after becoming airborne, the wingman should immediately move laterally away from the lead and, if feasible, reduce power in order to maintain wing position; safe flight of both aircraft must not be jeopardized in an attempt to maintain formation. The leader should detach the wingman if he is experiencing loss of thrust and flying speed. The wingman should detach and add power if unable to maintain a safe wing position on the lead.

8.2.6 After Takeoff. When the aircraft is definitely airborne, perform the following.

8.2.6.1 Pilot

1. Ensure that aircraft is definitely airborne before retracting the landing gear.

2. Raise landing gear.

3. Place flaps/slats switch to UP–NORM at 300 feet or 200 knots while maintaining a 10° to 12° noseup attitude.

4. Deselect AB at 250 knots minimum.

5. External transfer switch – AS DESIRED.

6. IFF – AS DESIRED.

7. Compass – SLAVED/SYNC.

8.2.6.2 RIO. The RIO will challenge the pilot on the following:

1. Landing gear – UP.

2. Flaps/slats – UP–NORM.

3. External transfer switch – AS DESIRED.

4. IFF – AS DESIRED.

5. Compass – SLAVED/SYNC.

6. Lower ejection handle – DOWN.

7. Command selector valve – AS DIRECTED.

8.2.7 Transition to Climb. When the aircraft is definitely airborne, raise the landing gear. Raise the flaps/slats at 300 feet or 200 knots while maintaining a 10° to 12° noseup attitude.

8.2.8 Climb. A simplified MIL power climb at normal gross weights can be made by maintaining a 10° to 12° noseup attitude until reaching 350 knots. Vary the pitch attitude as necessary to maintain 350 knots until reaching final cruise Mach. Then vary the pitch attitude as necessary to maintain cruise Mach until reaching cruise altitude. A simplified MAX power climb at normal gross weights can be made by maintaining a 10° to 12° noseup attitude until reaching 250 knots. At 250 knots, smoothly rotate to a 20° to 25° noseup attitude and hold until reaching Mach 0.9. Vary the pitch attitude as necessary to maintain Mach 0.9 until reaching cruise altitude. For optimum climb performance, refer to Chapter 20 or Chapter 30.

Note

The possibility exists that engine flameouts may occur while flying at altitudes above 35,000 feet in cirrus clouds. Such incidents have occurred and are generally believed to have been caused by excessive ingestion of ice crystals. Under such conditions, ice buildup on the duct lips or other parts of the aircraft are not likely to occur and flameouts can, therefore, occur without warning. However, in all known incidents of this type, relights have been accomplished and maintained at lower altitudes. Therefore, if flameout occurs at high altitudes in clouds, it is recommended that relight attempts be deferred until descent to a lower altitude and, if possible, to a less dense part of the cloud.

8.3 IN FLIGHT

Refer to in-flight procedures in Parts IV, XI, and XII.

8.4 LANDING

8.4.1 Descent/Instrument Penetration

8.4.1.1 Pilot. In all descents, care will be taken not to exceed any airframe limitations (see Chapter 4). In any descents from altitude, 5 minutes prior to letdown, select the desired DEFOG position on the defog lever and place the temperature control at the 2 o'clock (200° of clockwise rotation) position. Since rapid descents cannot always be anticipated, the maximum comfortable interior temperature should be maintained. This will aid in defrosting the windshield. Refer to Chapter 24 or Chapter 34 for recommended descent. Before starting descent, perform the following:

1. Engine anti–ice – AS DESIRED.

2. Altimeters – SET AND CHECK.

3. Tacan and UHF homer – CROSSCHECK.

4. ARA–63 (ILS) power switch – ON AND CHANNEL SET.

5. Defog footheat handle – DEFOG.

6. Pitot heat – ON.

7. Cabin heat – AS REQUIRED.

8. Compass – SYNC (check against STBY).

9. Missile power switch – OFF (STBY with AIM–7 missiles aboard).

10. Hook bypass – AS REQUIRED.

11. ICS – HOT MIC BELOW 2,500 FEET AGL.

Note

If it becomes necessary to dump fuel during a descent, thrust settings in excess of 85-percent rpm may be required to ensure rapid in-flight dumping.

8.4.1.2 RIO

1. Altimeter – SET.

2. Compass – CHECK.

3. Challenge pilot as required for cabin heat, pitot heat, engine anti-ice, compass sync, and radar altimeter – ON AND SET.

4. Challenge pilot for all armament switches – OFF or SAFE.

5. ICS – HOT MIC BELOW 2,500 FEET AGL.

8.4.2 Pattern Entry. Enter the traffic pattern at the altitude and airspeed prescribed by the local course rules. Whenever possible, pattern entry will be made in accordance with Figure 8-3.

8.4.3 Landing

8.4.3.1 Pilot

1. ICS – HOT MIC.

2. Landing Checklist – COMPLETED.

   a. Wheels

   b. Flaps/slats (F-4S)

   c. Hook

   d. Armament

CAUTION

Landing with the SOS uncaged will damage the sight.

   e. Harness.

3. Drag chute – BRIEFED.

4. APCS – AS DESIRED.

5. UHF antenna – UPR.

6. Command selector valve – AS DESIRED.

7. Antiskid – ON (some aircraft).

8. Rain removal – AS REQUIRED.

9. Taxi light – AS REQUIRED.

8.4.3.2 RIO

1. ICS – HOT MIC.

2. Landing Checklist – COMPLETE WITH PILOT.

3. Communication antenna – UPR.

4. Radar – SECURE.

5. Command selector valve – AS DIRECTED.

8.4.4 Landing Technique

8.4.4.1 Approach. Refer to Figure 8–3. Enter the pattern as local course rules dictate. At the break, reduce thrust and extend the speedbrakes (if required). As the airspeed decreases through 250 knots, lower the landing gear and extend the flaps/slats on the downwind leg. If speedbrakes were extended during the break, retract the speedbrakes for approach since approach with speedbrakes extended will increase speed at optimum AOA by 3 knots. Continue to decelerate to and maintain 150 knots, crosschecking angle of attack and airspeed. After completing the Landing Checklist, roll into the base leg and establish a rate of descent, maintaining an ON SPEED angle of attack. On final approach, maintain an ON SPEED angle of attack and a rate of descent of approximately 700 fpm. This will result in a 2-1/2° to 3° glide slope. Avoid overcontrolling the throttles as power response is immediate. If the APCS is utilized, engage the system after completing the Landing Checklist with the throttles above 75 percent and the aircraft at approximately approach speed.

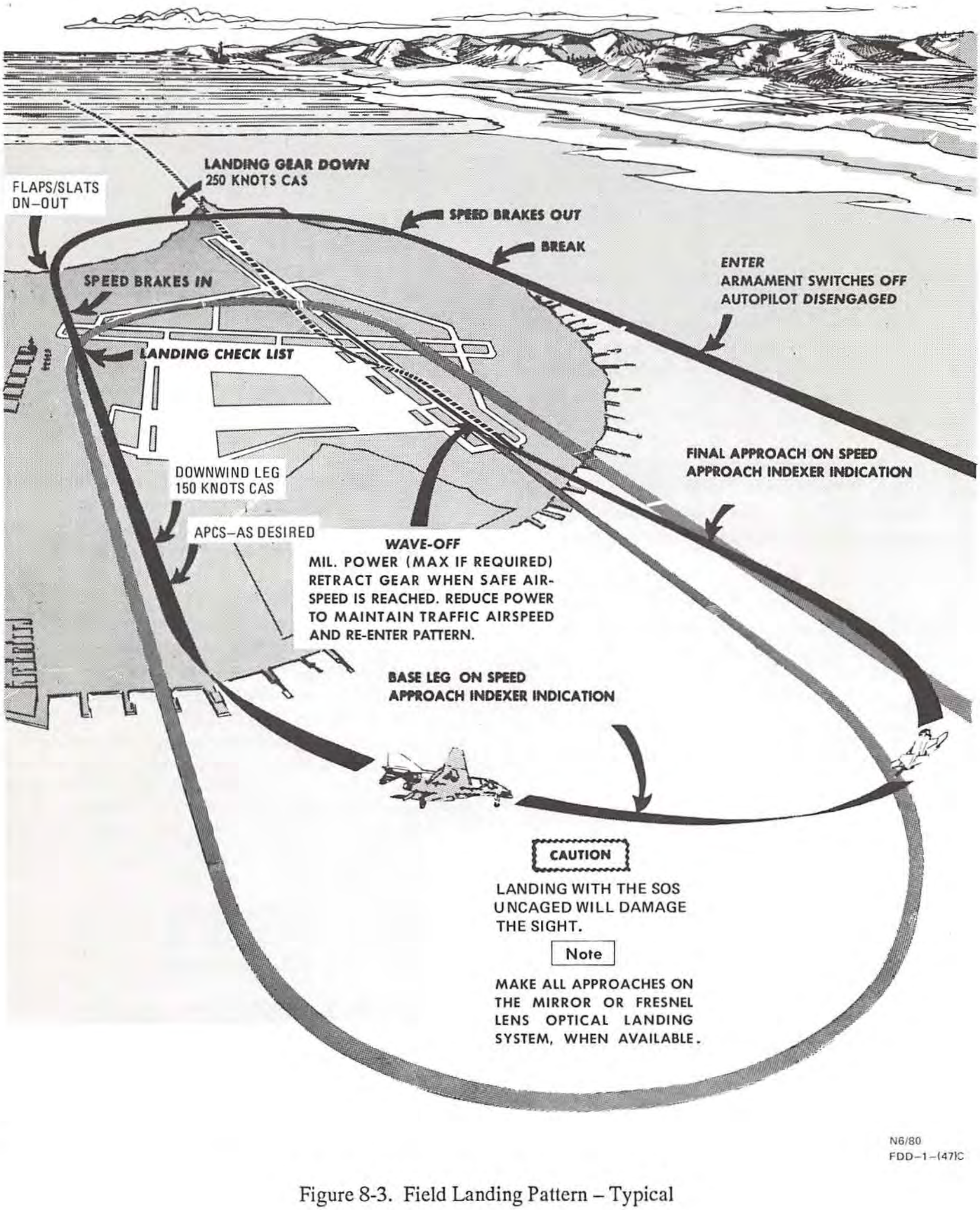


Figure 8-3. Field Landing Pattern – Typical

WARNING

The increased landing speed required for landing with more than 15 knots of crosswind may require an arrested landing because of a significant increase in landing distance over that presented in Chapter 35.

On F-4J, compensate for crosswind in the traffic pattern to guard against undershooting or overshooting the final turn. Fly the final approach course with the aircraft ground track properly aligned with the runway. The crosswind may be compensated for either by using the wing–low method, the crab method, or a combination of the two. When using the wing–low method, the ARI can be overpowered by use of the rudder pedals. If the crab method is employed, the aircraft heading should be aligned with the runway just prior to touchdown. On a wet runway crosswind landing, the aircraft shall be flown to touchdown in a crab.

On F-4S, compensate for crosswind in the traffic pattern to guard against undershooting or overshooting the final turn. Fly the final approach course with the aircraft ground track aligned with the runway. The crab technique should be used to compensate for crosswinds and should be held throughout touchdown whether on a wet or dry runway.

WARNING

For crosswinds in excess of 15 knots, the F-4S should be flown at 17 units, half-flaps, using the crabbed approach technique. Just prior to touchdown, the pilot should smoothly reduce the crab angle by use of rudder coordinated with lateral stick to hold the wings level. Attempting to reduce the crab angle to zero or making a very rapid rudder input may result in loss of lateral control.

WARNING

Aircrews shall exercise extreme caution, such as a double landing interval, during calm or light wind conditions to avoid possible encounters with wake turbulence generated by preceding aircraft on final approach. Avoidance of wake turbulence is critical in the F-4S because of reduced lateral and directional control response in the landing configuration.

CAUTION

Attempts to use the wing-low method or to remove the crab prior to touchdown may cause loss of lateral control or sudden wing drop because of the powerful rudder rolling movements and relatively weak aileron roll control at approach angles of attack.

8.4.4.2 Touchdown. Maintain approach attitude, crab (F-4S), power setting, and touchdown utilizing the mirror or 500 to 700 feet past the runway threshold. On touchdown, place the speedbrake switch IN, retard the throttles to idle, and deploy the drag chute. A firm touchdown will absorb energy, decreasing the landing roll. A minimum sink rate landing should not be made unless required. After touchdown, the nose drops almost immediately because of the aircraft center-of-gravity and stabilator location. When the nose gear is on the runway, hold full back stick to increase drag.

CAUTION

- Do not chop power prior to touchdown as the sudden loss of boundary layer control air causes the aircraft to settle immediately.

- Do not deploy the drag chute before touchdown. Sink rate and AOA increase rapidly, resulting in large deviations from optimum airspeed and glidepath.

CAUTION

With extreme aft cg, do not use full or rapid aft stick displacement immediately after landing. It is possible to overrotate and inadvertently scrape the stabilator tips or become airborne.

8.4.5 Landing Rollout

8.4.5.1 Directional Control. After touchdown, maintain runway track with aerodynamic controls. Lateral stick as well as rudder should be used. In light crosswinds, aerodynamic controls are effective in maintaining track down to very low speeds. Do not engage nosewheel steering at high speed unless required to maintain directional control.

CAUTION

Directional control is a primary consideration during the landing rollout. The most important aspect of directional control is keeping the aircraft precisely tracking down the runway rather than trying to correct back to the runway centerline after it has deviated.

8.4.5.2 Deceleration. The aircraft is aerodynamically clean and, even with fairly low residual thrust, it will tend to roll down the runway with little deceleration. Leave the flaps/slats DN-OUT to increase aerodynamic drag and to decrease residual thrust by utilizing BLC air. As the drag chute is the most effective means of deceleration early in the landing roll, it should normally be deployed on all landings except for specified no-drag chute landings during the familiarization phase or landings made with a known crosswind component greater than 20 knots. Use of the drag chute intensifies the weather vane effect for any given condition. The weather vane effect increases as the forward velocity of the aircraft decreases. If the drag chute is to be used, it should be deployed immediately after touchdown.

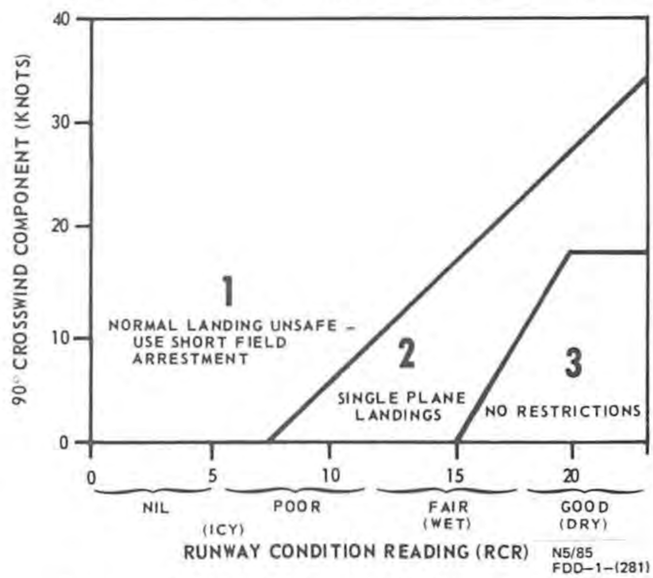
All landings should be planned and flown as no-drag chute landings. In case of drag chute nondeployment, a waveoff shall be initiated if conditions are not ideal to stop the aircraft. If a waveoff is initiated, the drag chute handle should be stowed immediately to preclude inadvertent chute deployment/jettison in the landing pattern. If committed for a no-drag chute landing and there is any possibility that speed or runway conditions will preclude stopping the aircraft on the runway, the pilot must be prepared to drop the hook and engage available arresting gear.

Note

- The drag chute should not be used under normal circumstances with a known crosswind component greater than 20 knots. It should not be used at low RCR with a known crosswind component greater than 10 knots. See Figure 8-4.
- If the drag chute is used and excessive weathervaning is encountered, jettison the drag chute.

8.4.5.3 Braking Technique

8.4.5.3.1 With Antiskid. The antiskid system should be utilized at all times to protect against inad-



F-4 CROSSWIND LANDING LIMITATIONS (RECOMMENDED)

FULL FLAPS, 19 UNITS	15 kt
HALF FLAPS, 17 UNITS, WITH ROLL MODIFICATION (IAVC-2557) OPERATIVE	25 kt
SINGLE-ENGINE	15 kt
WIND FROM ASYMMETRICAL LOAD SIDE	25 kt
WIND OPPOSITE ASYMMETRICAL LOAD	5 kt
DRAG CHUTE DEPLOYMENT (DRY RUNWAY)	20 kt

Figure 8-4. Crosswind Landing Guide (Recommended)

vertently locking a wheel or wheels during braking. The antiskid system is completely passive unless the wheel is approaching skid; therefore, under conditions of normal braking, it has no effect on the amount of brake the pilot applies. If maximum deceleration is desired, the antiskid system can be utilized to maintain the wheel at the optimum deceleration point. In this case, the pilot must apply sufficient brake pressure to ensure antiskid cycling and allow the antiskid system to reduce applied pressure to proper values. Full pedal application or any amount of pedal which will produce antiskid action will provide maximum wheelbraking for the existing conditions. A minimum roll landing using the antiskid system can be accomplished from a normal touchdown and drag chute deployment followed by full brake pedal deflection with the stick full aft. Less than full pedal can be used, if desired, as long as there is sufficient brake pressure to keep the antiskid system active. Cycling of the antiskid system can be detected by a change in longitudinal deceleration; however, cycling of the antiskid system may not be apparent when braking at high speeds (i.e., immediately after landing, wet runway, etc.).

CAUTION

Antiskid protection is not available until the wheels have initially come up to speed. Do not land with brake pedals depressed. In addition, antiskid protection is not available below approximately 20 knots.

8.4.5.3.2 Without Antiskid. Wheelbrakes are the primary means of deceleration and directional control when the drag chute and flight control surfaces effectiveness is reduced. The brakes are fully powered rather than boosted, and there is very little feel at the pedals. The tire pressures are high and the tires tend to break loose and skid even with light applications. Normally, wheelbrakes should be used only below 100 knots since the probability of blowing a tire decreases significantly with a reduction in groundspeed. The most desirable braking technique is a single, smooth application of the brakes with a constantly increasing pedal pressure as the aircraft decelerates. Maintain directional control by easing pressure on the brake opposite the desired direction of turn.

CAUTION

- At high speeds, brake pedal deflections as small as one–sixteenth inch have proved sufficient to blow a tire.
- Release brake pressure just prior to crossing arresting gear cables. Maintaining brake pressure across arresting gear cables will cause damage which may be sufficient to blow the tire.

8.4.6 Crosswind/Wet Runway/Runway Surface Considerations. The problem of maintaining directional control on a wet runway is greatly intensified with an increase in crosswind component. Characteristics of the runway surface also have a great bearing on directional control capability. A grooved concrete runway provides a good braking surface in most conditions, while a smooth asphalt runway becomes slippery when wet. Heavy rubber marks on the runway surface are very slippery, especially when wet. Standing water greatly decreases braking effectiveness and may cause total hydroplaning under some conditions. Intermittent puddles of water may cause wheels to lock. Without antiskid, as the locked wheel leaves the puddle and encounters a good braking surface, it will remain locked, skid, and blow unless brake pressure is released. Brakes should be reapplied only after wheel spin-up has occurred. The following procedures are recommended when landing on a wet runway.

1. Determine field condition prior to approach.

   a. Braking action

   b. Crosswind component

   c. Type, status, and location of arresting gear.

2. Reduce landing weight as much as possible/practicable.
3. Land on runway centerline, using normal FMLP landing with no flare.

4. When a crosswind or adverse RCR exists, refer to the crosswind landing guide (Figure 8–4) to determine the recommended drag chute deployment and arrested landing parameters.

5. If adverse wind and runway conditions exist, plan to make a no drag chute arrested landing being sure to keep groundspeed high enough to maintain effective directional control with aerodynamic control surfaces (ailerons, spoilers, and rudders). Braking and nose gear steering may not be effective because of hydroplaning. In the event of a hook skip/bolter, execute a waveoff.

6. If a rollout landing is desired or short field arresting gear is not available, a wet runway landing should be made at the lowest practicable gross weight. Plan the pattern to be well established on final in a wings–level crab and with an ON SPEED indication. Plan to touch down on centerline within the first 500 feet. Make a firm touch down while maintaining the wings-level crab. Touching down in the crab results in a continuation of a straight track down the runway. Do not attempt to align the aircraft heading with the runway as this will result in a drift off the runway if the aircraft is sliding or hydroplaning. Immediately after touchdown, retard throttles to IDLE and deploy the drag chute. Maintain full forward stick to increase nosewheel traction. As wheel cornering capability overcomes aerodynamic effects, the nose of the aircraft will gradually assume the track down the runway. Do not attempt to hasten this process. Be ready to jettison the drag chute if the weathervaning effect begins to interfere with maintaining desired track. When directional control is firmly established, utilize normal braking. Be prepared to engage the arresting gear if the aircraft is not slowing down properly. During high speed portion of the landing roll, particularly under wet or icy conditions, little deceleration will be felt because the braking potential is very low. Unless the pilot is familiar with the variables in braking potential of the aircraft, this low deceleration might be mistakenly interpreted as brake failure.

CAUTION

Do not allow the aircraft to deviate from a straight track down the runway. Jettison the drag chute if necessary. If aerodynamic controls lose effectiveness before effective differential braking can be initiated, engage nose gear steering, as required, to maintain directional control.

Loss of directional control results from poor pilot technique, blown tires, wet runway, crosswinds, nose gear steering malfunctions, or a combination thereof. In all but the most extreme crosswind/low RCR conditions, directional control can be maintained through application of proper technique.

A blown tire on landing rollout may result in a swerve which can be more severe at higher speeds. If a tire should blow above 100 knots, a waveoff is optional. Below this speed a waveoff is not recommended. See Part V for emergency procedures for a blown tire on landing rollout.

Hydroplaning may cause severe directional control problems on a wet or flooded runway, especially if a significant crosswind component exists. The best way to avoid this situation is to make an arrested landing, keeping speed high enough to maintain effective aerodynamic directional control until engagement or making a waveoff in the event of a hook skip/bolter.

8.4.7 Maintaining/Regaining Directional Control. Directional control can be maintained/regained by using any or all of the following techniques. Corrective action must be immediate.

1. Necessary aerodynamic controls (stick and rudder) should be applied immediately.

2. Differential wheelbraking should be used as necessary. Of course, it is desirable not to blow a tire; however, the primary consideration is to avoid departing the runway. In an extreme situation, if hard differential braking has caused a tire to blow and directional control problems persist, braking may be continued on the wheel with the blown tire. The metal-to-runway contact of a wheel with a blown tire can be effective for deceleration and directional control, especially on a flooded runway. This procedure should be used only to prevent departing the runway. Do not brake on a blown tire under normal circumstances.

3. Use nose gear steering only if required to maintain directional control. If nose gear steering is required, center the rudder pedals and, conditions permitting, momentarily engage nose gear steering. Lateral stick deflection will provide up to 15° rudder deflection through the ARI while rudder pedals are neutralized. If the system operates normally, reengage. The nose gear steering system includes a failure detection network to detect a hardover com-

mand because of a short or open circuit and automatically revert the system to the shimmy damper mode. The failure detection network requires a finite time to operate and may not prevent some nosewheel displacement. The timing device in the failure detection network resets when the nose gear steering button is released. If the nose gear steering system fails to respond or responds unfavorably, release the button and do not reengage.

4. Jettison the drag chute if adverse weathervaning is encountered.

CAUTION

Do not use differential thrust. The possible benefits are outweighed by the increase in energy that will be undesirable should the aircraft depart the paved surface.

If runway departure cannot be prevented, secure both engines prior to departing the runway.

8.4.8 Section Landing. The leader should transition to optimum approach speed when the runway is sighted, touching down 500 to 1,000 feet down the runway on his side. The wingman should avoid getting "sucked" and maintain a normal wing position except that as he approaches the runway, he moves out to give additional wingtip clearances at touchdown.

8.4.9 MOREST Landing. The techniques for engaging MOREST are essentially the same as for other types of arresting equipment and are as follows:

1. Notify control tower as soon as possible of intention of engaging MOREST and transmit estimated gross weight for touchdown.
2. At the 180° position, receive clearance for a MOREST landing.
3. Approach on mirror.
4. Touchdown on runway centerline and deploy drag chute as required.
5. Lower arresting hook 1,000 feet in front of MOREST gear.
6. Longitudinal controls neutral prior to engagement.
7. Engage wire with feet off the brakes.

8.4.10 Waveoff. The decision to take a waveoff should be made as early as possible. Advance the throttles to MIL or MAX as required to stop the sink rate. The landing gear should be raised only after the sink rate has been stopped and there is no possibility of the aircraft contacting the ground. At a safe airspeed and altitude, raise the flaps/slats.

Note

Even at extreme forward cg locations, adequate aft stick is available to overrotate and exceed optimum AOA.

8.4.11 Touch and Go. Touch–and–go landings are easily accomplished by simultaneously adding full power and aft stick to smoothly rotate the aircraft to flyaway altitude (10° to 12° noseup). With extreme forward cg position, full aft stick will be required to initiate rotation and prevent excessive ground roll. While at extreme aft cg positions, full aft stick application will result in overrotation.

8.5 POSTFLIGHT

8.5.1 Postflight Procedures. Care must be exercised while taxiing with the drag chute deployed to ensure that the drag chute does not become entangled in the taxi lights, other aircraft, or obstructions. The drag chute will be released on signal from the taxisignalman in an area where the possibility of interference with other aircraft turning up or taxiing is least. The pilot must advise tower personnel if the drag chute is released elsewhere on the field.

Before engine shutdown, it is recommended (but not required) that the engines be operated at IDLE power for 3 to 5 minutes in order to allow engine temperatures to stabilize. Landing roll and taxi time may be included. Carrier landings may require that the engines be shut down almost immediately after touchdown from high power settings. If the engines are shut down before the recommended idle time, a notation should be made on the yellow sheet. To shut down an engine, move the throttle to OFF, the engine master switch to OFF, and the generator control switch to OFF. With only one engine operating, do not move the control stick excessively. Excessive stick movement with hydraulic pressure on only one side of the tandem power control cylinders will cause the hydraulic fluid that is in the unpressurized side of the cylinder to be forced back through the pressure lines to the reservoir, filling the reservoir, and causing the excess fluid to be dumped overboard. The seals within the power cylinders may also be damaged by air ingestion and lack of lubrication. If the above situation occurs, the power control hydraulic systems must be reserviced and checked. Perform the postflight checks as listed in the F-4J/S NATOPS Pocket Checklist with the exception that during operations where the temperature is below freezing or expected to drop below freezing, the aircraft may be parked with wings spread and flaps/slats in the DN–OUT position.

8.5.2 Postlanding

WARNING

- After flight, especially if negative g has been encountered, account for all loose items before opening canopy. Inadvertent seat ejection may occur if any foreign object in the cockpit becomes jammed between the canopy actuator and primary seat–mounted initiator or the ejection gun firing mechanism sear. If all known loose objects cannot be accounted for, leave the canopy closed until the inspection of the banana link area is made by a knowledgeable person.

- After flight, except in those instances where emergency ground egress is the primary consideration, remain completely strapped in until the canopy is fully raised.

8.5.2.1 Pilot

1. Flaps/slats – UP–NORM (when clear of active runway).

2. Antiskid switch – OFF (some aircraft).

3. Speedbrakes – IN.

4. Lower ejection handle guard – UP.

5. Stab aug – OFF.

6. Radar altimeter – OFF.

7. Missile power switch – OFF/STBY.

8. VTAS power switch – OFF (F-4S; some F-4J).

9. Pitot heat – OFF.

10. Temperature control knob – FULL HOT.

Place the temperature control knob to HOT to evaporate any water that may have collected in the air-conditioning system.

11. Defog footheat handle – DEFOG.

12. IFF – OFF.

13. ARA–63 (ILS) power switch – OFF (F-4S; some F-4J).

14. Notify RIO – READY FOR SHUTDOWN.

15. Formation lights – OFF (F-4S; some F-4J).

16. Right throttle – OFF.

17. Right engine master switch – OFF.

18. Right generator switch – OFF.

19. Right spoiler – CHECK.

With left engine operating, PC-2 pressure zero, slowly deflect control stick approximately 1 inch to the right. Have ground crew/RIO verify that the right spoiler does not fully deflect and it returns to a flush condition when the stick is returned to neutral.

20. Left throttle – OFF.

21. Left engine master switch – OFF.

22. Left generator switch – OFF.

23. Face curtain pin – INSTALLED.

24. All switches, levers, and personal equipment – OFF or DISCONNECTED.

Note

If the aircraft is on a stopover other than its home base and no plane captain qualified in the F-4 ejection seat is present, the aircrewman will completely pin his seat.

8.5.2.2 RIO

1. Lower ejection handle guard – UP.

2. Radar – PERFORM BITS/OFF (if safety/operational necessity requires, otherwise OFF).

3. Navigation computer – OFF.

4. Data link system – OFF (F-4S; some F-4J).

5. Tacan – OFF.

6. Oxygen – OFF.

7. UHF/COMM – OFF.

8. AN/ALQ–91A function selector switch – OFF (F-4S; some F-4J).

CAUTION

Failure to ensure AN/ALQ–91A function selector switch is turned OFF may result in damage to equipment or a blown fuse when external power is reconnected to aircraft.

9. Destruct circuit arm switch – SAFE (safety pin inserted).

10. Face curtain pin – INSTALLED (after engine shutdown).

11. All switches, levers, and personal equipment – OFF or DISCONNECTED.

Note

If the aircraft is on a stopover other than its home base and no plane captain qualified in the F-4 ejection seat is present, the aircrewman will completely pin his seat.

8.5.3 Hot Refueling

Prior to entering refueling pit:

1. Postlanding Checklist steps 1 through 14 – COMPLETED.

2. Air Refueling Checklist – COMPLETED.

WARNING

Stop short of refueling pit for tire inspection. If notified of hot brakes, taxi clear of refueling area.

3. Monitor ground control frequency during refueling operation.

WARNING

- Do not operate any transmitter during refueling operations except in an emergency.
- If fuel starts running from the wing dump masts or the fuselage vent mast, place the refuel selection switch to INT ONLY. If fuel continues to vent on INT ONLY, discontinue fueling. Log either occurrence on the yellow sheet.

When refueling is completed:

4. Air refuel switch – RETRACT.

8.5.4 Refueling

8.5.4.1 Engines Off, Without Electrical Power. If operational expediencies dictate, the aircraft fuel system may be set up for refueling without electrical power. However, the transfer pumps and fuel level shutoff valves cannot be checked using this procedure.

Prior to engine shutdown:

1. Refuel probe circuit breaker – PULL (G5, F-4J through 158365at before AFC 388; J14, F-4J through 158365at after AFC 388; J5, F-4J

158366au and up or after AFC 545 and all F-4S; No. 1 panel).

2. Refuel probe switch – REFUEL.

3. Refuel selector switch – AS REQUIRED.

4. Throttles – OFF.

After engine shutdown:

5. After generators drop off the line, engine master switch – OFF.

6. Refuel probe switch – RETRACT.

7. Refuel probe circuit breaker – RESET.

8.6 SCRAMBLE OPERATION

8.6.1 Scramble Interior Check

8.6.1.1 Pilot

1. AIM–9 tone control – ONE–QUARTER TURN.

2. ICS – HOT MIC.

3. Fuel switches – SET FOR NORMAL OPERATION.

4. Smoke abate switch – OFF (F-4J).

5. Flap/slat switch – UP–NORM.

6. Antiskid switch – ON (some aircraft).

7. Speedbrake switch – STOP (neutral).

8. Engine master switches – ON.

9. Engine start switch – RIGHT.

10. Anti-ice switch – AS REQUIRED.
11. Missile power switch – RADAR STBY.

12. Radar altimeter – ON AND SET.

13. Altimeter – SET.

14. Generator control switches – OFF.

15. Radio – ON (TR+G).

    a. After AFC 660:

       Radio 1 – ON (BOTH).

       Radio 2 – ON (MAIN).

16. Tacan – ON (TR).

17. IFF – NORM.

18. Pitot heat switch – ON.

19. Bleed air switch – NORM (F-4S; some F-4J).

20. Light switches – AS REQUIRED.

8.6.1.2 RIO

1. Radar function switch – OFF.

2. All other radar switches for immediate use after normal warmup.

3. Radio – ON (TR+G).

    a. After AFC 660:

       Radio 1 – ON (BOTH).

       Radio 2 – ON (MAIN).

4. Tacan – ON (TR).

5. ICS – NORMAL.

6. Light switches – AS REQUIRED.

7. Blackout curtain – AS DESIRED.

8.6.2 Scramble Engine Start

8.6.2.1 Pilot

1. Starting unit up to power – EXTERNAL POWER CONNECTED.

2. Generator switches – EXT ON.

3. Signal plane captain to turn CNI ground power switch – ON.

4. At 10–percent rpm, right ignition button – DEPRESS WHILE ADVANCING THROTTLE TO IDLE.

5. At 35 percent on right engine, engine start switch – LEFT.

6. At 53 percent on right engine, generator switches – GEN ON.

7. Signal to disconnect external ac power.

8. Stab aug – ENGAGE.

9. At 10 percent on left engine, left ignition button – DEPRESS WHILE ADVANCING THROTTLE TO IDLE.

10. At 35 percent on left engine, engine start switch – NEUTRAL.

11. Static pressure compensator – RESET.

12. Complete Takeoff Checklist.

8.6.2.2 RIO

1. Notify pilot of any emergency signals noted from ground crew.

8.6.3 Scramble Takeoff. Aircraft scrambles invariably take place under various conditions of radio silence (refer to NAVAIR 00–80T–113, NATOPS Aircraft Signals Manual). The following procedures will be followed for an alert which will probably result in the actual launching of the aircraft. Normal preflight, start, and poststart checks will be conducted in accordance with the NATOPS flight manual and the NATOPS pocket checklist. Shut down the engines but leave the aircraft as prepared as possible for takeoff. Remove all seatpins except the face curtain pin. If awaiting the scramble order requires the use of the aircraft radio, observe ground operating limitations. The ground equipment will be positioned to provide rapid removal after starting. When the scramble order is received, start the engines, establish radio communications, determine that all ground locks and safety pins are removed, and that the ground crew and equipment are clear before taxiing. Taxi safely but expeditiously and energize all necessary electrical-electronic equipment. Complete the Scramble Checklist prior to scramble.

8.7 NIGHT FLYING

8.7.1 External Light Management. During night operations, the external lights should be set as follows:

1. On the line – BRIGHT AND STEADY.

2. When ready for taxiing – BRIGHT AND FLASH.

3. In flight:

   a. Single aircraft – BRIGHT AND FLASH FORMATION LIGHTS ON (or as weather conditions dictate).

   b. Formations – AS REQUESTED BY WINGMAN.

   The last aircraft in formation flight should have his external lights on BRIGHT and FLASH unless tactical situation demands otherwise (actual penetrations, etc.).

8.7.2 Taxiing. Night operation demands extra caution while taxiing. It is difficult to judge actual groundspeed at night. Pilots can best judge their speed by frequently observing the runway or taxiway close to their aircraft as illuminated by the bottom fuselage light. Taxi slowly for it is possible that unlighted aircraft, vehicles, and/or obstructions are on the taxiways.

8.7.3 Takeoff. A night takeoff is accomplished in exactly the same manner as one outlined for daylight operations with the following addition: Be prepared to transition to complete instrument flight immediately upon leaving the runway.

8.7.4 In-Flight Procedures. See Part IV of this publication.

8.7.5 Landing. Night landing procedures are identical to day procedures with the following exceptions: There is often a tendency to be fast. Be positive about checking angle of attack and airspeed. Determination of altitude and sink rate are difficult at night. This necessitates reference to the vertical velocity indicator. Rates of descent up to 750 feet per minute are acceptable; use mirror when available.

8.8 FIELD CARRIER LANDING PRACTICE

8.8.1 Preflight Inspection. A normal preflight inspection will be conducted with specific attention being given to tire condition, nosestrut extension, angle–of–attack probe condition, and windshield cleanliness. Check that the hook bypass switch is in the BYPASS position.

8.8.2 Takeoff. The takeoff will be individual using either MIL or MAX power depending on fuel weight, mission, etc.

8.8.3 Radio Procedures and Pattern Entry. It is advisable to call "Paddles" before pattern entry to confirm Charlie time. Ensure ICS remains in the HOT MIC position in the FCLP pattern. Approaches to the field for break will be controlled by the tower and then switched to "Paddles" for FCLP pattern control. At no time will an aircraft remain in the pattern without a UHF receiver. On each succeeding pass, the following voice report will be made at normal meatball acquisition positions:

1. Side number
2. Type aircraft
3. Meatball or Clara (no meatball)
4. Fuel state (nearest 100 pounds).

8.8.4 Pattern. The pattern should be a race track pattern with the 180° position approximately 1–1/4 miles abeam at 600 feet above field elevation. The length of the groove should be adjusted to give a wings-level descent on the glide slope of 20 to 25 seconds (approximately 1 mile). For maximum gross weight at touchdown, refer to Chapter 4. For a 38,000-pound aircraft, an optimum ON SPEED indexer indication results in an airspeed of 141 knots. The turn to downwind leg should be 30° angle of bank and 140 to 150 knots, climbing to 600 feet above field elevation. Recommended airspeed at the 180° position is 140 to 150 knots. Power will be added to effect a level turn onto final. From the 180° to 190° position, the airspeed should be corrected for the optimum angle of attack. At approximately the 45° position, the meatball appears on the mirror. A common error is to begin the descent upon first seeing the meatball. Maintain altitude until the meatball is centered on the mirror, then adjust power and angle of attack as necessary to start a rate of descent that will keep the meatball centered. When a Fresnel lens is used, care must be taken to avoid commencing descent until the aircraft is aligned with the centerline since an idiosyncrasy of this lens is to display a false meatball indication when viewed from the approach turn.

8.8.5 Approach Power Compensator Technique. The technique required for an APC approach differs from a manual approach in that all glide slope corrections are made by changing aircraft attitude. Since this technique violates the basic rule that altitude is primarily controlled by throttle, practice is required to develop the proper control habits necessary to use APC. For the APC to perform satisfactorily, smooth attitude control is essential. Large abrupt attitude changes result in excessive thrust changes. Close-in corrections are very critical. A large attitude correction for a high-in-close condition causes excessive power reduction and can easily result in a hard landing. If a high-in-close situation develops, the recommended procedure is to stop meatball motion and not attempt to recenter it. A low-in-close condition is difficult to correct with APC and usually results in an over-the-top bolter. It may be necessary to manually override APC in order to safely recover from a low-in-close condition. Throughout the approach the pilot should keep his hand on the throttles in the event it is necessary to manually override the APC.

8.8.6 Interval. The downwind turn should be commenced when the aircraft on the downwind leg is approximately in the 8 o'clock position. The turn should be made with a 30° angle of bank and 140 to 150 knots, climbing 500 feet above field elevation.

8.8.7 Glide Slope. A 2–1/4° to 3° glide slope will be used dependent upon wind conditions. This slope is chosen in order to give the same approximate rate of descent that would be used on the ship.

8.8.8 Touch and Go. Touch–and–go landings are easily accomplished by simultaneously adding full power and aft stick to smoothly rotate the aircraft to flyaway altitude (10° to 12° noseup). With extreme forward cg position, full aft stick will be required to initiate rotation and prevent excessive ground roll. While at extreme aft cg positions, full aft stick application will result in overrotation.

8.8.9 Waveoff Technique. When a waveoff signal is given, either via Fresnel lens lights or over UHF, immediately add full military/afterburner power, level the wings, and hold existing attitude (unless the LSO is verbally directing changes to attitude). Once well clear of the landing area with a positive rate of climb, rotation to a normal takeoff attitude is recommended. This waveoff technique should apply to all phases of the approach both at the field and at the ship.

Note

If a waveoff is executed by manually overriding the APC and the APC is not disengaged, the throttles, when released, will retard and attempt to reestablish the optimum approach angle of attack.

8.8.10 Bingo Fuel. No FCLP approach will be commenced with 1,500 or less pounds of fuel.

8.8.11 Night FCLP. All provisions which apply to day FCLP also apply to night FCLP plus the following items:

1. External lights – BRIGHT AND STEADY.

2. Hook bypass switch – BYPASS.

3. When comfortably situated in the pattern, simulated instruments should be flown as much as possible up to the 45° position.

8.9 SHORT AIRFIELD FOR TACTICAL SUPPORT (SATS) PROCEDURES

8.9.1 Day Operations. Preflight, start, and poststart checks shall be accomplished in accordance with normal field procedures and the additions noted.

8.9.1.1 Preflight

1. Record the expected gross weight of the aircraft for catapult launch on the nose gear door.

2. Ensure that the tension bar retainer clip is installed securely and is in good condition.

8.9.1.2 Start

1. Start engine sufficiently ahead of time to allow for taxi, catapult launches, and rendezvous before proceeding on the assigned mission.

8.9.1.3 Poststart

1. Set the emergency-jettison armament switch to the proper position prior to taxi.

2. Set trim and flaps as follows:

   a. Rudder – 0.

   b. Aileron – 0.

   c. Longitudinal – Refer to Figure 9-2.

   d. Flaps/slats – DN-OUT.

8.9.1.4 Taxi

1. Taxiing on advanced airfields presents little difficulty provided attention is given to keeping speed under control.

2. Wet or oily metal runway and taxiway surfaces require especially slow taxi speeds because of a greatly reduced coefficient of friction. Sharp turns cannot be made and the wheels will slide with moderate braking action.

8.9.1.5 SATS Catapult Launches. Prior positioning on the catapult is not easily accomplished because of surface irregularities in the holdback and arrester area. If the previously launched aircraft utilized afterburner, expect the area aft of the dolly arrester ropes to be wet and slippery. Approach the launch area slowly and be alert for signals from the taxi director.

WARNING

Do not taxi into the dolly arrester ropes area immediately following the launch of another aircraft until the dolly returns and is arrested. Failure of the arrester ropes may occur on dolly rebound.

1. Approximately 80- to 85-percent rpm is required to taxi up and over the arrester ropes and dolly ramp.

CAUTION

Keep speed under control.

2. As the main wheels roll over the arrester ropes be prepared for immediate braking and power reduction.

3. When the come-ahead signal is given by the taxi director, move ahead cautiously to prevent overstressing the tension bar.

4. Ground handling crew will extend nose strut upon signal from plane director (prior to tensioning).

CAUTION

If pneumatic pressure approaches 2,300 psi with nose strut extended, actuate emergency air brakes to keep pressure below 2,300 psi. If the pneumatic pressure exceeds 2,300 psi, the emergency brakes will not release the pressure in the nose strut. To release this excess pressure, the nose strut will have to be deflated and then reinflated. High pressures will subject nose strut to excessive loads during catapulting.

Note

Cycle the landing gear control circuit breaker to deflate the nose strut. It may take as much as 40 seconds for the strut to begin deflating.

5. After the aircraft is properly positioned and the holdback engaged, the taxi director will signal for the pilot to release brakes while the catapult is tensioned. Advance power to MIL.

CAUTION

Ensure that the brakes are released and power advanced to MIL before tension is taken.

6. After tension is taken and power has been advanced to MIL, the taxi director will transfer control of the aircraft to the catapult officer.

7. Recheck ADI and standby attitude indicator, engine instruments, trim indicators, and flap setting. Grip throttle and catapult handgrip firmly.

8. If launch is to be made at MAX A/B, nod to catapult officer after completing MIL power checks. When catapult officer signals, select MIN A/B and ease throttles forward to MAX A/B. Recheck engine instruments.

CAUTION

Failure to ease throttles from MIN A/B to MAX A/B may cause premature tension bar failure.

Note

Below 44,000 pounds gross weight, use MIL power. At 44,000 pounds gross weight or above, use MAX (AB) power.

9. When ready for launch, place head against head rest and give an exaggerated left hand salute to the catapult officer while maintaining aft stick with the right hand, observe the green cutoff light, and wait. Launch will occur approximately 3 to 5 seconds after the catapult officer gives the launch signal.

CAUTION

After receiving the signal for full-power turnup, do not allow your hands to appear above the canopy rails unless you intend to salute as a launch signal. Unusual hand movements, such as lowering a helmet visor, will probably result in a premature launch.

8.9.1.6 Technique. Maintain aft stick until start of rotation. Upon perceiving the change in the cutoff light from green to amber, be prepared for rotation as this is the signal that denotes catapult engine cutoff. Allow the aircraft to rotate to a liftoff attitude (10° to 12° on the ADI) while maintaining positive control of rotation rate by easing stick forward. Do not exceed 21 units AOA. The pilot must avoid gross control movement as the aircraft becomes airborne, but should be prepared to make any attitude changes required. When safely airborne, retract gear and flaps/slats as appropriate. Avoid turns until airspeed is well above takeoff speed.

WARNING

- Do not apply brakes during launch.
- Do not change power setting during launch.
- Avoid overrotation. Overrotation can result in stabilator contact with matting, excessive distance to clear obstacles, deceleration/stall.
- Rotation rates increase noticeably for cg positions in or near the amber caution area of Figure 11–4. Longitudinal control inputs must be smooth to avoid overcontrolling pitch.

8.9.1.7 Aircraft or Catapult Malfunction

1. If, after established at MIL power, the pilot determines that the aircraft is down, he so indicates to the launching officer by shaking his head from side to side. Never raise a hand into the catapult officer's view in order to give a "thumbs down" signal. Simultaneously broadcast, "Suspend," to the tower. When the catapult officer observes the "no-go" signal, he will immediately give a suspend signal.

2. If bridle shed or bridle failure occurs after holdback release, the pilot will note a sudden loss of acceleration; the dolly will continue to accelerate and move ahead of the aircraft. Wait until the dolly can be seen ahead of the aircraft, then maneuver to the side of the runway to avoid contact with the rebounding dolly. If safe abort or takeoff is not possible and ejection speed has been attained: EJECT.

3. A cold shot can result from inadequate catapult engine acceleration, early catapult cutoff, failure of the capstan brake to release completely, or failure of the dolly jaws. If an abort is attempted and the dolly moves ahead of the aircraft, maneuver to the side of the runway to avoid contact with the rebounding dolly. If safe abort or takeoff is not possible and ejection speed has been attained: EJECT.

8.9.1.8 Landing Pattern. Approach the break point either individually or in echelon, parade formation, at 250 to 300 knots. A 17- to 20-second break interval will provide a 35- to 40-second touchdown interval. Have the Landing Checklist completed and be at optimum AOA/approach speed by the 180° position.

8.9.1.9 Approach. Plan for and execute an optimum AOA, on-speed approach. Pay particular attention to maintaining the proper airspeed and correct lineup.

8.9.1.10 Waveoff. When a waveoff signal is given, either via Fresnel lens lights or over UHF, immediately add full military/afterburner power, level the wings, and hold existing attitude (unless the LSO is verbally directing changes to attitude). Once well clear of the landing area with a positive rate of climb, rotation to a normal takeoff attitude is recommended. This waveoff technique should apply to all phases of the approach both at the field and at the ship.

Note

Even at extreme forward cg location, adequate aft stick is available to overrotate and exceed optimum AOA.

8.9.1.11 Arrested Landing. The aircraft should be on runway centerline at touchdown. Aircraft alignment should be straight down the runway with no drift. Upon touchdown, maintain the throttle at the approach position. When arrestment is assured, retard the throttle to idle. Allow the aircraft to roll back to permit the hook to disengage from the pendant. When directed by the taxi director, apply both brakes to stop the rollback, raise the hook and flaps. If further rollback is directed, release brakes and allow the aircraft to be pulled back until a brake signal is given. Then apply brakes judiciously to prevent the aircraft from tipping or rocking back.

CAUTION

Use extreme caution when taxiing on a wet SATS runway.

8.9.1.12 Bolter. Bolters are easily accomplished. Simultaneously apply full power and retract the arresting gear hook. Smoothly rotate the aircraft to a liftoff attitude and fly away. At extreme forward cg positions, full aft stick will be required to initiate rotation and prevent excessive ground roll. While at extreme aft cg positions, full aft stick application will result in overrotation.

WARNING

If landing on a runway with a SATS catapult installed, care must be taken to prevent engagement of the dolly arrester ropes with the aircraft tailhook. Structural damage to the aircraft and catapult will result.

8.9.2 Night Operations. This section covers only that portion of night operations significantly different from day operations.

8.9.2.1 Poststart and Taxi. It is prudent to perform the poststart and taxi phase with the aircraft exterior lights and rotating beacon operating if allowed by local regulations and combat conditions. Wing lights should be on BRT/STDY.

8.9.2.2 Catapult Launches. Immediately prior to taxi, check master exterior light switch OFF, external light switches BRT and STDY. Rely upon and follow closely the directions of the plane director. Upon receiving the signal from the plane director, release brakes, advance power to MIL, and check all instruments as tension is applied. When given the turnup signal by the catapult officer, apply power and check all instruments. When satisfied that the aircraft is ready for launch, so signify by placing the master exterior light switch in the ON position and the fuselage light OFF. Be prepared to establish a wings-level climbing attitude on instruments. An initial attitude of 10° to 12° noseup is recommended. Retract gear when above 300 feet altitude; retract flaps/slats at no lower than 500 feet. When climbing through 2,500 feet, adjust lights and radio as briefed.

CHAPTER 9

Carrier-Based Procedures

9.1 PREFLIGHT

The CV NATOPS Manual and the applicable aircraft launching bulletins shall be read by all flight crewmembers prior to carrier qualification. A normal shore-based preflight inspection should be accomplished with particular attention given the landing gear, tires, hook, and underside of the fuselage for possible launching pendant or arresting cable damage. In the cockpit, particular attention should be given to the pilot scope to ensure that the retaining devices have been installed. Tiedowns shall not be removed from the aircraft unless the emergency brake air pressure gauge indicates at least 1,500 psi. The pneumatic brake shall be used for stopping the aircraft anytime it is being moved while the engines are not running.

9.1.1 Taxiing. Any signal from the plane director above the waist is intended for the pilot. Any signal below the waist is intended for deck handling personnel. Taxiing aboard ship is much the same as on the land with the exception of additional power requirements. Nose gear steering is excellent and requires use of minimum power while taxiing. Taxi speed should be kept under control at all times especially on wet decks and approaching the catapult area. Be prepared to use the emergency air brake should normal braking fail. The lower ejection handle guard should be down while taxiing.

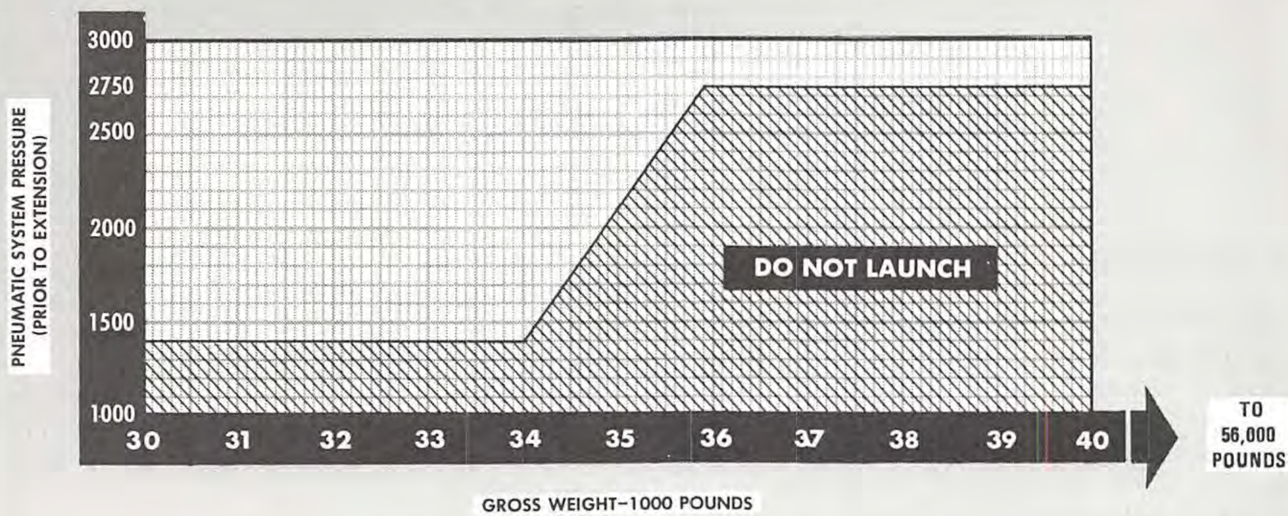
9.2 LAUNCH

9.2.1 Prior to Catapult Hookup. Prior to taxi onto the catapult, pilots and RIOs shall ensure through verbal checkoff that the takeoff checklists are completed, the compass controller is in the FREE mode, and the radar horizon is set for backup attitude control. Errors are introduced into the SLAVED mode of the HSI because of the magnetic influence of the ship. To use the radar gyro horizon as an emergency backup for attitude control if the ADI fails during launch, the pilot should set the radar horizon to zero. The RIO will position the elevation strobe to 17° down, the pilot should verify his elevation strobe is 17° down and have the RIO make adjustments as necessary. Refer to Figure 9-2 for temperature, gross weight, flap position, and trim setting considerations. Directional and lateral trim should be set at neutral in all cases regardless of gross weight, flap position, or power settings.

CAUTION

Catapult launching acceleration can force fuel out of the external tanks through the transfer lines to the fuselage cells at a rate beyond tank venting capability, thus creating a partial vacuum in the external tanks. Therefore, to prevent external tank collapse during a catapult launch, ensure that the external transfer switch is in the OFF position before launch.

9.2.2 Catapult Hookup. Proper positioning on the catapult is easily accomplished if the entry is made with only enough power to maintain forward motion and the plane director signals are followed explicitly. All functional checks will be performed before taxiing onto the catapult if practicable. The best technique for positioning is to approach the catapult track with a minimum amount of power utilizing nose gear steering. The pilot should sight down the catapult track, acquire the plane director, and follow his signals very closely. The pilot should anticipate an initial hold after the nosewheel drops over the shuttle. After crossing the shuttle, prior to catapult tensioning, the nose strut will be extended (see Figure 9-1 for nose strut extension pressure minimums prior to extension). The normal minimum pressure after extension is 1,350 psi. On signal of catapult tensioning, release



Note

DURING CARRIER QUALIFICATIONS, THE REPEATED NOSE STRUT EXTENSIONS PLACE SUCH A HEAVY LOAD ON THE PNEUMATIC SYSTEM THAT SYSTEM PRESSURE CAN NOT BE BUILT BACK UP TO NORMAL. ALTHOUGH 2750 PSI IS THE NORMAL MINIMUM PRESSURE FOR NOSE STRUT EXTENSION, THIS MINIMUM MAY BE LOWERED AS GROSS WEIGHT DECREASES FOR CARRIER QUALIFICATION PURPOSES. THIS CURVE SPECIFIES THE MINIMUM PNEUMATIC SYSTEM PRESSURE FOR A SPECIFIC GROSS WEIGHT. SATISFACTORY NOSE STRUT EXTENSIONS CAN BE OBTAINED AT THESE MINIMUMS, HOWEVER THERE IS A DECREASE IN ANGLE OF ATTACK ON TAKEOFF.

FDD–1–(48)A

Figure 9-1. Nose Strut Extension Pressure Minimums

brakes and advance power to MIL, anticipating a handoff signal to the catapult officer. After catapult tension, set ADI to zero and recheck standby attitude indicator.

WARNING

Once the nose strut is extended, any interruption of electrical power will release the solenoid held pneumatic pressure selector valve. With the pneumatic pressure selector deenergized, the air pressure in the strut extension cylinder will be relieved and the nose strut will deflate from the catapult extended condition.

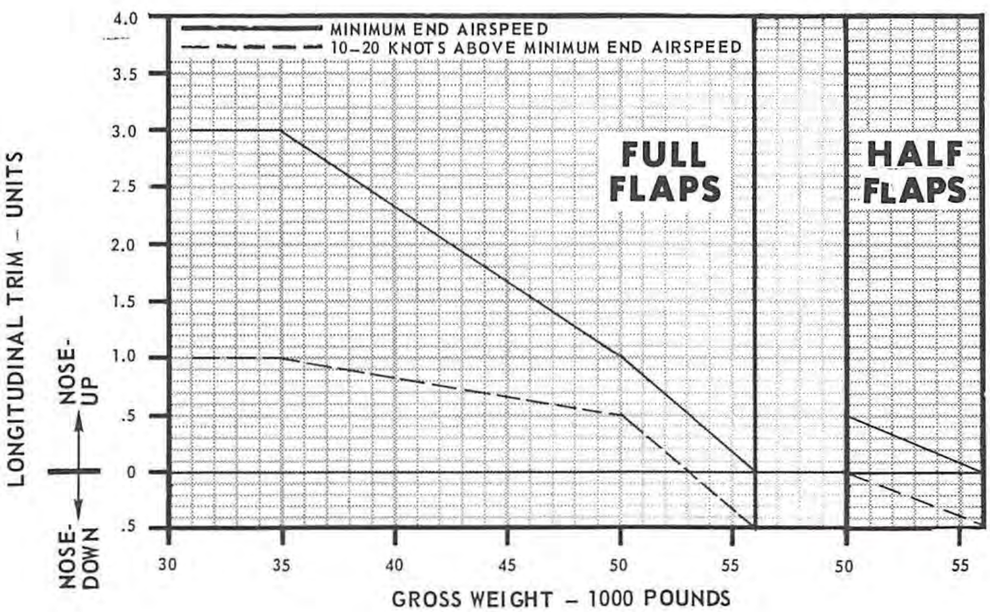
CAUTION

Do not allow the pneumatic system pressure to exceed 2,300 psi with the nose gear extended. If the pneumatic pressure starts to build up above this value, actuate the emergency air brakes as necessary to maintain the pressure below 2,300 psi. If the pneumatic pressure exceeds 2,300 psi, the emergency brakes will not release the pressure in the nose strut. To release this excess pressure, the nose strut will have to be deflated and then reinflated. Allowing the pneumatic system pressure to exceed 2,300 psi subjects the nose strut to excessive loads during catapulting.

POWER AND FLAP SETTINGS

A/C GROSS WT – LBS	POWER SETTING	AMBIENT AIR TEMPERATURE DEGREES F	FLAP SETTING
BELOW 50,000	MRT	ALL	FULL
	MAX A/B	ALL	HALF OR FULL
AT 50,000	MRT	70 OR BELOW	FULL
	MRT	ALL	HALF
	MAX A/B	ALL	HALF OR FULL
ABOVE 50,000	MRT	ALL	HALF
	MAX A/B	ALL	HALF OR FULL

PITCH TRIM SETTING



Note

Subtract one unit for the F-4S slatted aircraft (AFC 601, part 2 installed).

FDD–1–(290)A

Figure 9-2. Power/Flap/Trim Settings

Note

Cycle the landing gear control circuit breaker to deflate the nose strut. It may take as much as 40 seconds for the strut to begin deflating.

9.2.3 Prelaunch

9.2.3.1 Pilot

1. ICS – HOT MIC.

2. External transfer switch – OFF.

3. Centerline tank – CHECK (if installed).

   a. Buddy tank switch – FILL.

   b. Observe momentary illuminations of CTR EXT FUEL light and decreasing sector and counter readings.

   When CTR EXT FUEL light reilluminates:

   c. Buddy tank switch – STOP FILL.

   If the CTR EXT FUEL light fails to illuminate, it may indicate centerline fuel transfer problems and should be investigated prior to flight.

4. Stab aug switches – ENGAGE.

5. Engine anti-ice – AS DESIRED.

6. Trim – SET (refer to Figure 9-2).

7. Radar horizon – SET.

8. Altimeters – CHECK.

9. Pneumatic pressure indicators – CHECK.

10. After nose extension – RECHECK PNEUMATIC PRESSURE.

11. ADI and standby attitude indicator – CHECK AFTER NOSE EXTENSION.

CAUTION

Do not attempt to turn aircraft utilizing nose gear steering after nose strut is extended.

12. Defog foot heat handle – AS DESIRED

13. Pitot heat – ON.

14. Rain removal – OFF/LOW.

15. Bleed air switch – CHECK NORM (F-4S; some F-4J).

16. Bleed air off light – OFF (F-4S; some F-4J).

17. Compass – DG MODE.

18. Command selector valve – AS DESIRED.

19. Lower ejection handle guard – DOWN.

20. Complete panel-mounted Takeoff Checklist.

21. Engine runup on signal from catapult officer.

22. Flight and engine instruments – CHECK.

9.2.3.2 RIO

1. ICS – HOT MIC.

2. Compass heading sync – CHALLENGE PILOT.

3. Circuit breakers – CHECK IN.

4. Equipment – STOW.

5. Command selector valve – INFORM PILOT OF POSITION.

6. Lower ejection handle guard – DOWN.

7. Takeoff Checklist – CHALLENGE PILOT FOR COMPLETION.

8. Report circuit breakers in, flaps/slats, and ramps – READY FOR TAKEOFF.

9. Navigation computer – TGT OR BASE (immediately prior to launch).

9.2.4 Launch

WARNING

A verbal report from the pilot to the RIO on stick position and a visual check of stabilator position in the RIO mirrors followed by a verbal report to the pilot must be made before the pilot salute to the catapult officer.

9.2.4.1 Military Power. On catapult tensioning signal, advance throttle to MIL, place the control stick full aft (note fluctuation of PC-1 and PC-2), and check engine instruments and trim settings. Ensure that the head is positioned firmly against the headrest. Use MIL power catapult hand grips or move throttles outboard into the afterburner detent and use as a throttle stop. When satisfied the aircraft is ready, give an exaggerated left-hand salute to the catapult officer while maintaining aft stick with the right hand. Control stick positioning during catapult launch is a function of aircraft gross weight and stabilator effectiveness. An increase in gross weight results in an aft cg shift with a resultant decrease in aft stick requirement. For normal-to-heavy gross weights, the control stick shall be placed in the full aft position for initial positioning and then moved forward slightly reducing aft stick approximately one-quarter. For carrier qualification weights, the control stick should be positioned full aft and held in this position until rotation off the bow.

WARNING

- Holding the control stick in any position that will not place the stabilator in a leading edge down position during a carrier qualification weight launch will impart nosedown pitch to the aircraft off the bow from which it may be impossible to recover.
- During F-4S slatted aircraft (AFC 601, Part 2 installed) catapult launch, aft longitudinal stick force required to maintain stabilator position may exceed 30 pounds. Force will vary depending on aircraft gross weight, wind over deck, and catapult type; force will terminate at catapult release. Longitudinal stick position vice stick force must be constant. Overcorrecting for changing force may result in slight stick pumping.

Although the aircraft has no trimmed neutral stick position that will meet the requirements for all gross weight launches, pilot experience is gained rapidly with a minimum number of launches, and stick positioning poses no problem. After launch, establish a 10° to 12° pitch angle on the ADI, crosschecking the pressure instruments to ensure a positive rate of climb. If the ADI fails or is unreliable during launch, the standby attitude indicator and radar horizon are available for attitude reference. The altimeter, airspeed, and rate of climb may dip slightly during catapult stroke but will recover shortly after shuttle release.

WARNING

Rotation rates increase noticeably for cg positions in or near the amber caution of Figure 11-4. Longitudinal control inputs must be smooth to avoid pitch oscillations with an aft cg.

Note

Holding the control stick fully aft during a high gross weight launch will impart a higher than desired aircraft rotation rate. Although this overrotation may be stopped with forward stick, it creates an undesirable and unnatural control movement, especially during night or IFR conditions.

9.2.4.2 Maximum Power. When a MAX power launch is scheduled, the following signals will be used:

1. After completing MIL power checks, the pilot will nod to the catapult officer.

2. Catapult officer responds with five fingers (open hand held towards pilot).

3. Pilot advances power from military to maximum afterburner noting rpm, EGT, fuelflow, and nozzles

ship. The break interval will be approximately one-half of the desired ramp interval time. Radio procedures will be in accordance with ship procedures. When established wings-level on the downwind leg, complete the Landing Checklist, descend to and fly the pattern at 600 feet MSL. The 180° turn is commenced when abeam the LSO platform to arrive at the 45° position at approximately 400 feet MSL. Glide slope/meatball acquisition will occur at approximately three-fourths of a mile. On rollout to final, slightly overshoot the ship's wake.

9.5.1.1 Pilot

1. ICS – HOT MIC.
2. Landing Checklist – COMPLETED.
   a. Wheels
   b. Flaps/slats (F-4S)
   c. Hook
   d. Armament

CAUTION

Landing with the SOS uncaged will damage the sight.

   e. Harness.
3. APCS – AS DESIRED.
4. UHF antenna – UPR.
5. Command selector valve – AS DESIRED.
6. Rain removal – AS REQUIRED.

9.5.1.2 RIO

1. ICS – HOT MIC.
2. Landing Checklist – COMPLETE WITH PILOT.
3. Communication antenna – UPR.
4. Radar – SECURE.
5. Command selector valve – AS DIRECTED.

9.5.1.3 Approach Power Compensator Technique. Refer to approach power compensator technique, field carrier landing practice in this chapter.

9.5.2 Glide Slope. The technique of flying the glide slope is the same as FCLP except that more power may be required and lineup will be much harder to maintain. With rough seas and pitching decks, some erratic meatball movements may be encountered. If this is the case, average out the bouncing ball to maintain a smooth and safe rate of descent. In no case overcorrect if the ball moves to a high indication.

9.5.3 Waveoff. When the waveoff signal is given by the LSO, apply military/afterburner power to stop the rate of decent. Adjust nose position to landing attitude. During an in-close waveoff, excessive pitch movement will cause a cocked-up or overrotated altitude which can result in an in-flight engagement.

9.5.4 Bolter. As the aircraft touches down, advance the throttles to MIL. When no deceleration is felt, smoothly apply aft stick to ensure proper rotation to flyaway attitude (10° to 12° pitch attitude). Full aft stick may be required when near the forward cg limit. Climb out straight ahead at 150 KCAS.

9.5.5 Arrestment

Note

In the event of a blown tire on landing, do not raise the flaps/slats until the flaps/slats area has been inspected.

9.5.5.1 Arrested Landing and Exit From Landing Area. As the aircraft touches down, advance throttles to MIL. Upon completion of landing rollout, reduce power to IDLE, raise the hook, and allow the aircraft to roll aft. Apply brakes on signal. Fold wings and have the RIO report wingfold position. Taxi forward on the come ahead and keep the engines running until the CUT signal is given by the plane director. If at anytime during this phase of operations one or both brakes fail, utilize the emergency pneumatic brakes, call the tower, and drop the arresting hook. Do not leave cockpit until tiedowns have been installed, the number of which will be dictated by the ship.

Note

After each arrested landing, inspect the stabilator leading edge for damage from arresting cable.

9.6 CARRIER-CONTROLLED APPROACHES

Should conflict exist between these procedures and those contained in CV NATOPS Manual (and augmenting ship's instructions), the latter shall govern. Figure 9-4 illustrates a typical carrier-controlled approach. All weather carrier landing system approaches are illustrated in Figures 9-5 and 9-6.

9.6.1 Holding Phase. Five minutes before penetration, defogging shall be actuated and maximum comfortable interior temperature will be maintained to prevent possible fogging or icing on the windscreen and canopy.

9.6.1.1 Letdown Procedures

1. Before descent, check shoulder harness handle locked, set lights as dictated by existing weather, and lower arresting hook.

2. Turn on pitot heat and select engine anti-icing system as appropriate.

3. Accomplish final changes to radio and IFF upon departing marshal or earlier. After these changes are made, pilot will make no further changes except under emergency conditions.

4. When commencing penetration, initiate a standard descent of 250 knots, 4,000 feet per minute, speedbrakes as desired.

5. Radar and barometric altimeters shall be cross-checked continuously when below 10,000 feet.

6. ICS – HOT MIC.

Note

If it becomes necessary to dump fuel during a descent, thrust settings in excess of 85-percent rpm may be required to ensure rapid in-flight dumping.

9.6.1.2 Platform. At 20 miles passing through 5,000 feet, aircraft descent shall be slowed to 2,000 feet per minute. At this point, a mandatory unacknowledged voice report will be broadcast by each pilot. The aircraft side number will be given, the word "platform" will be stated.

9.6.1.3 Ten-Mile Gate

1. At 10 miles, call "side number" and "10-mile gate."

2. Commence transition to landing configuration, maintaining 1,200 feet.

3. Gear down at 10 miles – Flaps/slats DN-OUT at 195 knots.

4. Complete the Landing Checklist. Check anti-ice, lights, rain removal, and pitot heat as desired.

9.6.1.4 Six-Mile Gate. When passing 6 miles, check exterior lights on, call side number, fuel state, and 6-mile gate. For a PAR approach, unless otherwise directed, maintain 1,200 feet at approach speed until intercepting the glidepath at 2-3/4 miles. For an ASR approach, a gradual descent to 600 feet shall be commenced departing the 6-mile gate. In order that intervals remain constant, ship procedures as to when aircraft are slowed to final approach speed after passing 6 miles should be followed. Altitude of 600 feet is maintained until the final controller calls, "Commence landing descent," or the meatball is observed to be centered. At 600 feet, aircraft will intercept the center of the glide slope at 1-1/4 miles on a 4° slope. If ceilings or visibility preclude visual acquisition of the meatball at 1-1/4 miles, 500 to 700 feet per minute descent passing the following checkpoints should be continued.

1. One mile – 500 feet.

2. Three-quarter mile – 400 feet.

3. One-half mile – 300 feet.

Note

Restricted field of view over the nose when on speed in level flight interferes with visual glide slope acquisition and lineup cues while approaching the pushover point. The pilot should raise his seat to the highest

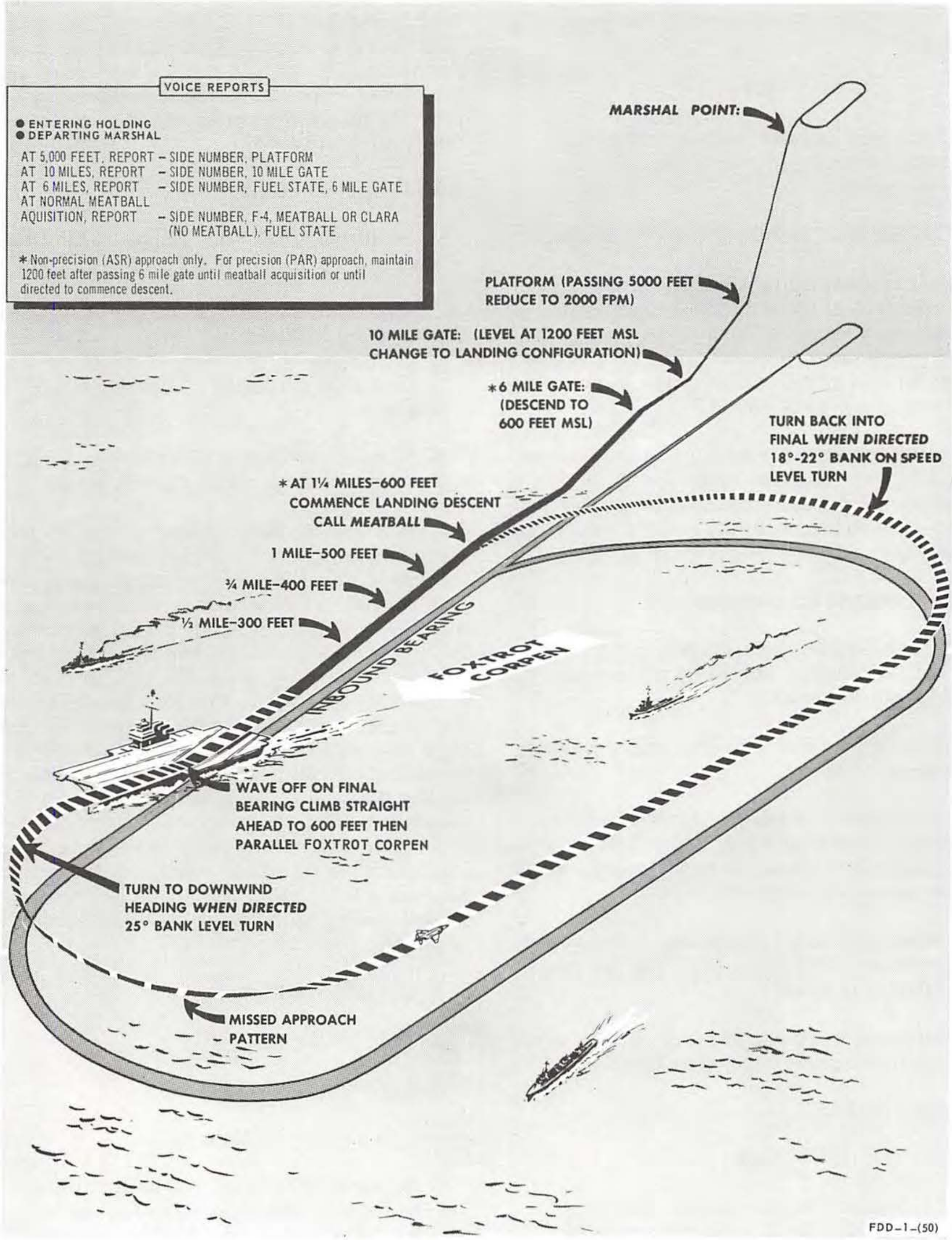


Figure 9-4. Carrier-Controlled Approach

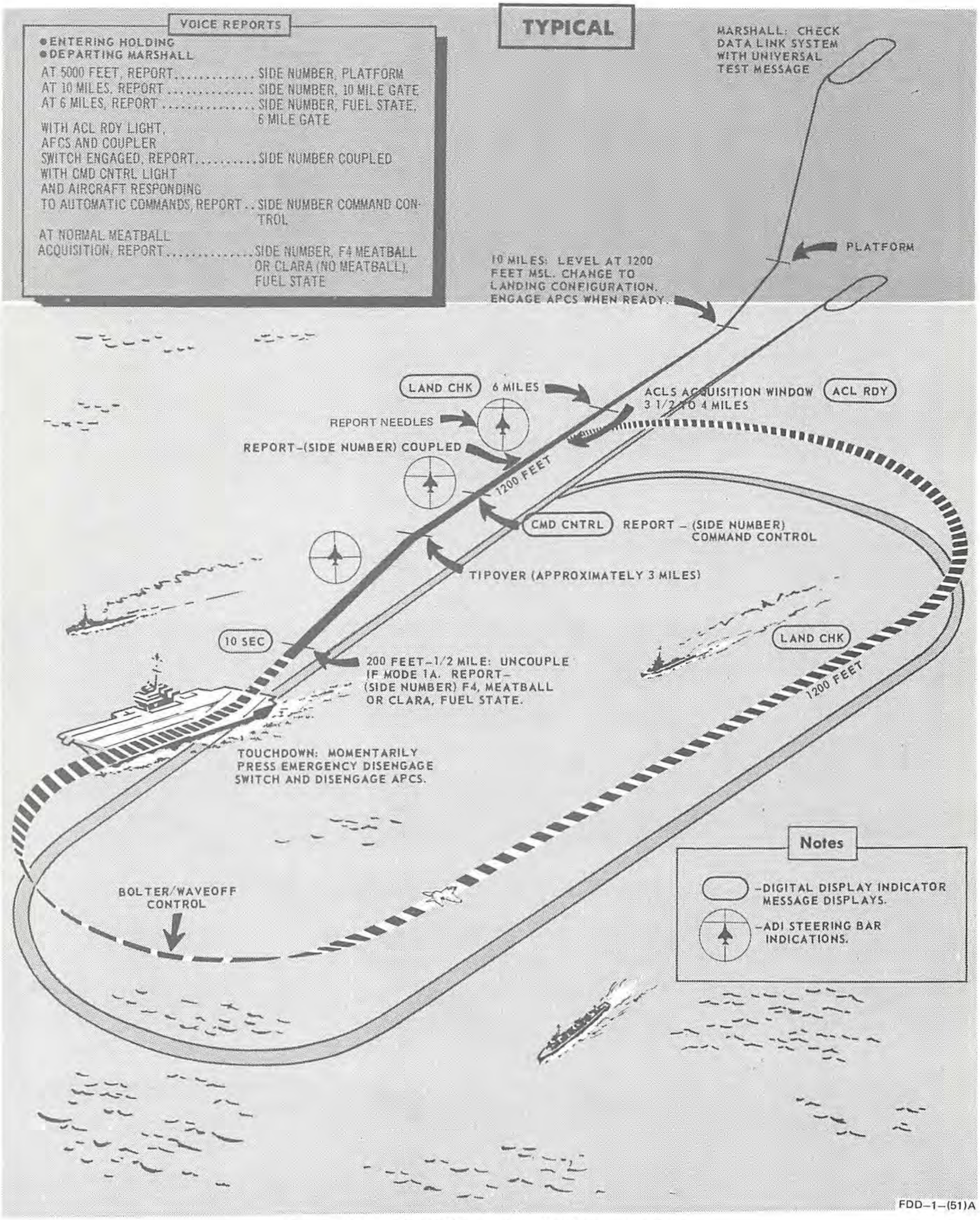


Figure 9-5. ACLS Mode 1 and 1A Approaches

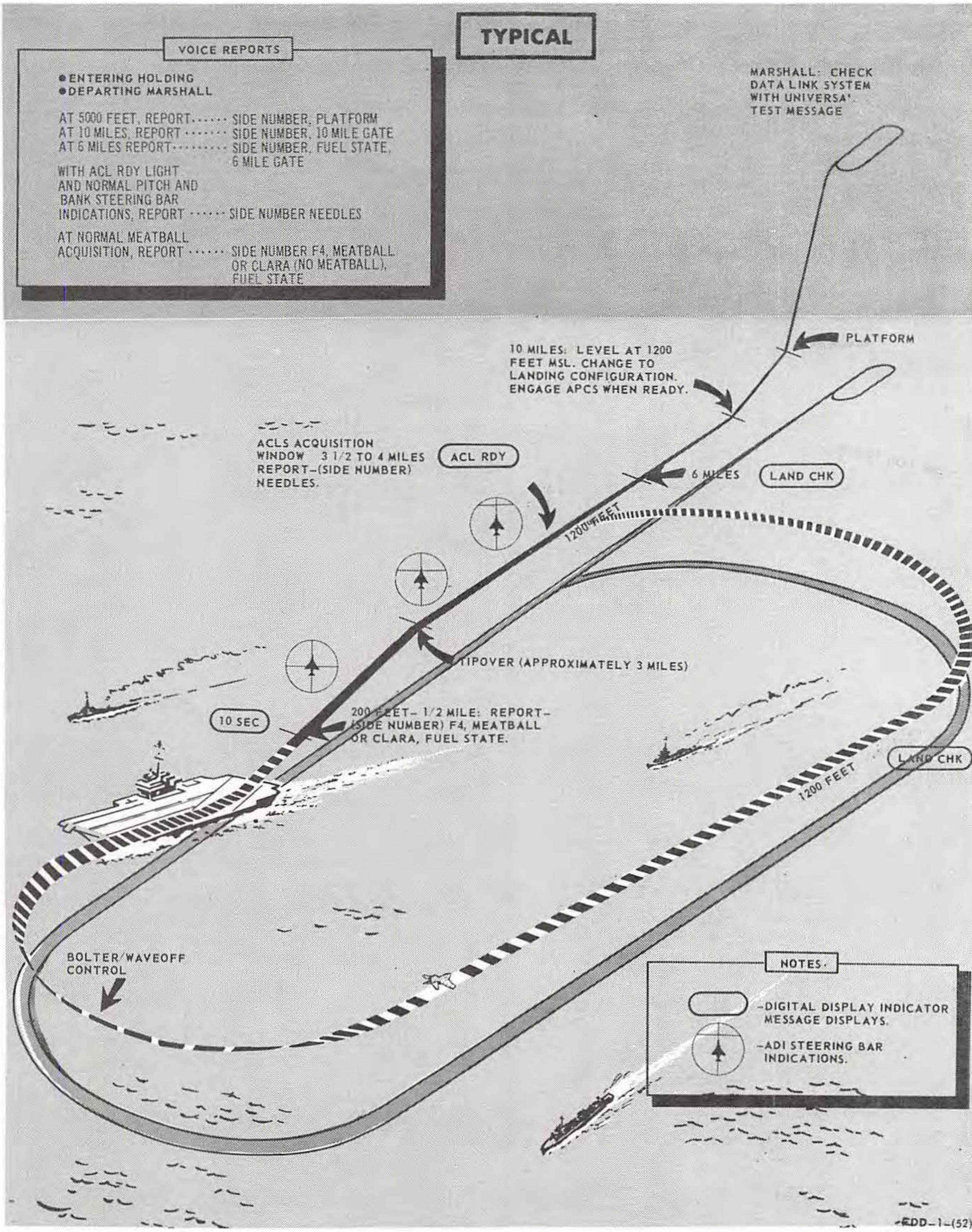


Figure 9-6. ACLS Mode 2 Approach

comfortable position and use available instrument backups (ACLS, ILS, DME/ALT) to avoid unconsciously lowering the nose in attempts to gain visual cues.

9.6.1.5 Meatball Contact. When ready to continue a visual approach, the pilot reports side number, F-4, meatball or Clara (no meatball), fuel state. The LSO will acknowledge and instructions from the final controller will cease. Because of this, pilots are cautioned against premature contact reports during night recoveries when visibility permits sighting the ship beyond 2 to 3 miles. There is little depth perception even under the most ideal conditions and it is difficult to judge distance from the ship without reference to tacan. During night VFR conditions, pilots must crosscheck tacan DME to ensure that they are actually at 1-1/4 miles, 600 feet, prior to reporting meatball. The height, dimension of the lens or mirror optical beam at 1-1/4 miles is over 200 feet and the true center is difficult to distinguish. This, coupled with the relatively short length of the runway lights, will give the pilot the illusion of being on glide slope and high when, in fact, the aircraft may be 50 to 100 feet below the glide slope. An additional advantage of delaying the meatball report until reaching 1-1/4 miles – even though the meatball is in sight – is that final control will continue lineup instructions that can greatly assist the pilot in establishing satisfactory lineup. Use the vertical velocity indicator to set up a rate of descent of 500 to 700 feet per minute.

9.6.1.6 Voice Procedure. Detailed pilot/controller voice procedure must be established in accordance with each ship's CCA doctrine.

9.6.2 Waveoff and Bolter Phase

WARNING

Because of stabilator ineffectiveness at low airspeeds, the aircraft will settle off the angle unless rotation to a takeoff attitude is commenced immediately upon leaving the deck. In order to avoid settling, position the stick well aft during the deck roll. Full aft stick may be required when near the forward cg limit.

In the event of a waveoff or bolter, MIL/MAX power should be added as necessary, climb straight ahead to 1,200 feet, and maintain 150 knots. When directed by CCA, initiate a level turn to the downwind leg. (If no instructions are received within 2 minutes or 4 miles distance on tacan, assume communication failure and initiate the downwind turn to the reciprocal of base recovery course (BRC) and report abeam. If no acknowledgement is received, reenter the final through the 6-mile gate.) A 25° bank angle at 150 knots on the upwind turn will establish the aircraft at the desired 1-3/8 to 1-1/2 miles abeam on the downwind leg. Aircraft that undershoot or overshoot a proper downwind leg may be vectored back to a proper abeam position. Slow to proper approach speed when approaching the abeam position. This position can be established by using a relative tacan bearing of 15° aft of the wing at 1-3/4 to 3 miles on DME when on the downwind heading. Final control will clear the aircraft to turn back inbound to intercept the final bearing. A level, on-speed approach turn of 18° to 20° bank angle from the normal abeam position will allow the aircraft to properly intercept the final inbound bearing at 1-1/4 to 1-1/2 miles aft of the ship. Traffic spacing ahead may require that the aircraft continue on downwind leg well past the normal abeam position before being directed to turn to final bearing. No attempt should be made to establish visual contact with the ship when executing a CCA until the final approach turn has been executed. When fuel considerations become critical in an extended bolter pattern, 300 to 400 pounds per pass may be saved by raising the landing gear and selecting 1/2-OUT on the flaps/slats switch. Lower landing gear and select DN-OUT on finals. The WHEELS light on the pilot instrument panel will flash with the gear up and the flaps/slats down.

WARNING

Do not attempt to fly an optimum (on-speed) angle of attack with the slats/flaps switch in 1/2-OUT or DN-OUT and the landing gear retracted. Gear up airspeeds at optimum (on-speed) angle of attack correspond to gear down airspeeds at 22 to 23 units (10 to 12 knots slow). This is especially critical with ailerons drooped because landing configuration stalls occur at 24 units angle of attack.

9.6.3 Fouled-Deck Holding. Detailed procedures for fouled-deck holding are contained in the CV

NATOPS Manual. The best gauge for maximum endurance at any altitude is to fly nine units on the angle-of-attack indicator and utilize minimum bank angles. This presupposes that all aircraft in the landing configuration will retract gear and flaps/slats. If necessary as fuel becomes critical with no bingo field available, jettison external stores. In extreme emergency situations, a small amount of fuel (approximately 10 pounds per minute) can be saved by securing one engine at sea level with average landing gross weights. If holding must be accomplished with flaps/slats in DN-OUT, the normal endurance time will be decreased by 4.5 minutes per 1,000 pounds of fuel for average landing gross weights at sea level. Because of the increase in drag with flaps/slats in DN-OUT and decreased efficiency because of the bleed air loss through the BLC system, this decrement increases with altitude. For example, at 25,000 feet, the decrement is 9.0 minutes per 1,000 pounds of fuel. It is, therefore, recommended that holding with flaps fully extended be accomplished at sea level.

9.6.4 Automatic Carrier Landing System (ACLS) Approaches. ACLS approaches apply to properly modified data link aircraft utilizing carrier or shore-based SPN-10, SPN-41, SPN-42, or MPN-T1 ACLS radar facilities. Three approach modes are available; however, utilization of specific modes is dependent on the aircraft modifications, which are listed in Section VIII of NAVAIR 01-245FDD-1A-1. In mode 1 approaches, data link/ACLS control signals are coupled to the autopilot after radar lockon and remain coupled until touchdown. Mode 1A approaches differ from mode 1 approaches in that the data link/ACLS control signals are uncoupled one-half mile (approximately 200 feet above flight deck level) from touchdown. Mode 2 approaches are similar to mode 1/1A approaches; however, data link/ACLS control signals are not coupled to the autopilot and the pilot flies the approach using the needles presentation.

9.6.4.1 ACLS Mode 1 and 1A Approach Procedures. ACLS mode 1 and 1A approaches are illustrated in Figure 9-5. Mode 1 approaches require the approach power compensator system (APCS). The following steps describe typical mode 1 and 1A approach procedures. Light illumination and extinguishments (other than acknowledge button extinguishments) on the front cockpit digital display indicator (DDI), command display indicator (CDI), telelight panel, and HSI follow each step.

1. Position the following controls as indicated to prepare the aircraft for receiving ACLS signals. (Also refer to Section VIII of NAVAIR 01-245FDD-1A-1.)

   a. Navigation function selector panel.

      (1) Bearing/distance selector switch – TACAN.

      (2) Mode selector knob – DL (HSI course deviation indicator is slaved to lubber line).

Note

On F-4J 157309ar and up or after AFC 470 and all F-4S, the AN/ARA-63 instrument landing system (ILS) or DL/ILS position on the knob should be utilized until AN/SPN-42 (ACLS) lockon. At lockon, the DL position should be selected; agreement of the ADI steering bars will verify the AN/SPN-42 is locked on correct aircraft. Shortly after tipover, the DL/ILS position should again be selected to verify alignment of AN/SPN-41 with AN/SPN-42 and confirm proper aircraft control. The DL/ILS position should be maintained until the approach is completed. The DL/ILS position does not affect the operation of the AN/SPN-42 system in any way other than the ADI steering bar presentation, which will be that of the AN/SPN-41. The pilot may, therefore, compare the presentations of each system at anytime while coupled, but should not attempt switches inside of 1 nm.

   b. DDI ACK button – PRESS WHEN ILLUMINATED.

   c. Day-night controls – AS DESIRED.

   d. Communication set control

      (1) Data link power switch – ON.

      (2) Message selector switch – NORM.

      (3) Frequency select dials – AS BRIEFED.

   e. Data link BIT switch – NORM.

CDI – TILT.

HSI – DL, TAC (same throughout approach).

2. Before or while in marshal, receive the universal test message (UTM) to check the data link system for proper operation. Refer to Section VIII of NAVAIR 01-245FDD-1A-1 for UTM procedures and displays.

CDI – TILT (extinguished during testing).

3. Perform a normal CCA. At 10-mile gate with aircraft level at 1,200 feet MSL or as assigned, change to landing configuration.

CDI – TILT.

4. Engage APCS. While heading inbound with aircraft in level flight at 1,200 feet (or as assigned), stabilize at approach speed.

CAUTION

In the event of an APCS malfunction, do not attempt to couple the aircraft. Execute a mode 2 (Figure 9-6) or a mode 3 (talk-down) approach.

Note

To fly mode 1 approaches, the APCS must be utilized. APCS is recommended but not required in mode 1A.

CDI – TILT.

5. Check that corner reflector is extended. An interlock prevents engagement of coupler switch without extension of the corner reflector. Corner reflector extends when gear and hook are lowered. If approach is made with hook up, place hook bypass switch to BY-PASS.

CDI – TILT.

6. Engage AFCS. It is desirable that the aircraft be flown in altitude hold prior to coupling. Altitude hold automatically disengages when aircraft is coupled.

CDI – TILT.

7. At approximately 6 miles, controller inserts aircraft address.

CDI – TILT (extinguishes).

DDI – LAND CHK.

8. At approximately 4 to 6 miles with aircraft level at 1,200 feet (or as assigned) and on final bearing, control reports, "ACL lockon, report needles." Report position of bank and pitch steering bars (needles) on ADI.

The ADI pitch and bank steering bars commence providing glide slope line-up indications and the HSI heading marker displays the final bearing (command heading).

9. If the controller concurs, he will then transmit, "Concur, report coupled."

CDI – CPLR ON (indicates aircraft is receiving autopilot engage/enable signal) or MANUAL (indicates aircraft not receiving autopilot engage enable signal and aircraft cannot be coupled).

DDI – ACL RDY.

a. A below glide slope indication by the pitch steering bar is normal. An above glide slope indication indicates passage of the glide slope extended and coupling should not be attempted.

b. If the bank steering bar indicates the aircraft is not on the glide slope centerline extended (lateral error), establish a corrective cut before coupling. This reduces the initial lateral error command.

c. With wings level at assigned altitude (vertical velocity indication less than ±500 feet per minute), engage coupler switch on AFCS control panel.

Note

If aircraft is not coupled with wings level, it initially rolls to a wings-level attitude upon coupling.

CDI – CPLR ON.

DDI – ACL RDY.

10. Report (side number) coupled.

CDI – CPLR ON.

DDI – ACL RDY.

11. Controller sends ACL commands. In event of radio failure, commands are sent 10 seconds after ACLS lockon. Upon observing DDI CMD CNTRL light illumination and aircraft response to commands, report (side number) command control.

CDI – CPLR ON.

DDI – ACL RDY (extinguishes).

CMD CNTRL.

Note

The pilot should downgrade the approach from mode 1 to mode 1A if ADA excursions repeatedly exceed ±1.5 units and should downgrade to mode 2 if ADA excursions repeatedly exceed ±2.5 units.

12. Under certain circumstances, the aircraft may become uncoupled. The cockpit indications and recommended pilot action for each instance are as follows:

a. Intentional disengagement by pilot. Pilot presses the AFCS/ARI emergency disengage switch on control stick and the AFCS and coupler switches disengage. The stab aug and ARI are disengaged as long as the AFCS/ARI emergency disengage switch is pressed.

CDI – CPLR ON.

DDI – CMD CNTRL.

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

(1) If disengagement occurs before intercepting the glide slope, continue the approach in mode 2/mode 3 or recouple (pilot discretion). Recoupling is accomplished by reengaging the AFCS switch and the coupler switch in that order. If the aircraft is uncoupled for an excessive length of time, large initial corrective commands may result when the aircraft is recoupled. Attempt to center the bank steering bar before recoupling. Never recouple if the ADI pitch steering bar indicates glide slope passage. Continue with a mode 2 approach.

(2) If disengagement occurs while on glide slope, continue the approach in mode 2/mode 3 or waveoff (pilot discretion). No recoupling should be attempted at ranges less than 2 miles.

b. Unintentional disengagement

(1) AFCS malfunction. The coupler switch disengages concurrently with the AFCS switch. Cockpit indications and pilot action are the same as with intentional disengagement.

CDI – CPLR ON.

DDI – CMD CNTRL.

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

(2) System malfunction. AFCS and coupler switches disengage. Continue approach in mode 2 or 3. The aircraft cannot be recoupled.

CDI – CPLR ON (extinguishes).

MANUAL (if malfunction because of loss of AFCS engage/enable signal) or TILT (if malfunction because of termination of data link signals).

DDI – CMD CNTRL.

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

Note

If APCS disengages, it does not uncouple aircraft. Without APCS, a mode 2 or 3 approach should be flown.

c. System waveoff. A system parameter has been exceeded and the AFCS and coupler switches disengage. If waveoff is received after glide slope interception and in IFR conditions, execute a waveoff. The aircraft cannot be recoupled. Upon placing the speedbrake switch IN to cancel (extinguish) the flashing WAVEOFF lights, the APCS is disengaged.

CDI – MANUAL WAVEOFF (flashing: extinguished when speedbrake switch is positioned to IN).

DDI – CMD CNTRL WAVEOFF (flashing: extinguished when speedbrake switch is positioned to IN).

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

Glareshield/telelight panel – APCS OFF (with speedbrake switch IN).

13. At one-half mile in mode 1A approaches, the controller downgrades the approach to mode 2. Although the AFCS and coupler switches automatically disengage, momentary actuation of the AFCS/ARI emergency disengage switch is recommended to ensure that the switches disengage.

CDI – CPLR ON (extinguishes) MANUAL.

DDI – CMD CNTRL.

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

14. In mode 1 approaches, the pilot receives the 10 seconds discrete 12.5 seconds before touchdown.

CDI – CPLR ON.

DDI – CMD CNTRL (extinguishes) 10 SEC.

15. At touchdown in a mode 1 approach, momentarily actuate the AFCS/ARI emergency disengage switch to disengage the AFCS and coupler switches. Actuate speedbrake switch to disengage APCS. Do not hold the AFCS/ARI emergency disengage switch pressed after AFCS disengagement since on a bolter or a touch-and-go landing, the aircraft would depart the flight deck with stab aug disengaged.

CDI – CPLR ON.

DDI – 10 SEC.

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

Glareshield/telelight panel – APCS OFF.

Note

Although the AFCS switch automatically disengages at touchdown on some aircraft F-4J and all F-4S, the AFCS/ARI emergency disengage switch shall be momentarily pressed to ensure switch disengagement.

16. If the aircraft bolters, the SPN-10/42 computer clears the data link discretes and terminates data link transmissions to the aircraft approximately 7 seconds after touchdown.

CDI – CPLR ON (extinguishes) TILT.

DDI – 10 SEC (extinguishes).

Telelight panel – AUTOPILOT DISENGAGE.

Windshield – COUPLER OFF (F-4S; some F-4J).

Glareshield/telelight panel – APCS OFF.

9.6.4.2 ACLS Mode 2 Approach Procedures. An ACLS mode 2 approach is illustrated in Figure 9-6. In a mode 2 approach, the ADI pitch and bank steering bars present vertical and lateral glide slope errors, respectively, in relation to the aircraft. The pilot flies the aircraft toward the steering bars as in an ILS approach. Light illumination and extinguishments are noted following the procedural steps as in ACLS mode 1 and 1A approach procedures.

1. Perform steps 1 through 5 in the ACLS mode 1 and 1A approach procedures. APCS engagement is optional and at pilot discretion.

   CDI – TILT (extinguishes during testing).

   HSI – DL, TAC (same throughout approach).

2. At approximately 6 miles, controller inserts aircraft address. Pilot rechecks Landing Checklist.

   CDI – TILT (extinguishes) MANUAL.

   DDI – LAND CHK.

3. ACLS radar lockon. Pilot observes fly-up signal on ADI pitch steering bar and the final bearing on both the ADI bank steering bar and the HSI heading marker. Report (side number) needles. (A fly-down needle indicates erroneous information if further aft of the carrier than 3 miles at 1,200 feet or indicates glide slope passage if within 3 miles at 1,200 feet. If glide slope passage has occurred, attempts to intercept it are at pilot discretion.) Fly aircraft level as the pitch steering bar moves down from the top of the ADI. When the pitch steering bar approaches the ADI miniature wings, pitch the aircraft over onto the glide slope. Fly glide slope by keeping ADI steering bars centered.

   CDI – MANUAL.

   DDI – ACL RDY or CMD CNTRL (refer to following steps a and b).

   a. For approaches that were begun in mode 2, the DDI ACL RDY light illuminates and remains illuminated throughout the approach.

   b. If a mode 1/1A approach was initiated and the pilot uncoupled and continued in mode 2, the CMD CNTRL light remains illuminated throughout the approach unless the controller recycles his console.

4. At one-half mile to touchdown or sooner (pilot discretion), transfer to the standard visual approach and call the meatball.

   CDI – MANUAL.

   DDI – ACL RDY or CMD CNTRL (refer to previous remarks).

Note

On F-4J 157309ar and up or after AFC 470 and all F-4S, the AN/ARA-63 ILS should be utilized provided the AN/SPN-41 installation is certified because it does not require AN/SPN-42 (ACLS) lockon.

CHAPTER 10

Functional Checkflight Procedures

10.1 GENERAL

The functional checkflight will be performed after the completion of the calendar maintenance requirements using the applicable functional checkflight checklist. This chapter contains a detailed description of the checkflight requirements, sequenced in the order in which they will be performed. The checkflight personnel will familiarize themselves with these requirements prior to the flight. NATOPS procedures will apply during the entire checkflight. Only those pilots designated in writing by the squadron commanding officer shall perform squadron checkflights. Checkflight procedures will be in accordance with the current edition of OPNAVINST 4790.2. For ready reference, excerpts from OPNAVINST 4790.2 are quoted below.

"At the discretion of the Commanding Officer, checkflights may be flown in combination with operational flights, provided the operational portion is not conducted until the checkflight requirements have been satisfied and the results have been entered on the checkflight checklist. The general purpose code assigned to a combination check and operational flight will be the one that describes the primary purpose of the flight.

"Pilots and crew members who perform checkflights are qualified in accordance with OPNAVINST 3710.7 Series and the applicable NATOPS manual, and are provided a thorough briefing by the Maintenance Officer or his designated representative (normally the QA Officer). This briefing should describe the requirements for that particular flight, the expected results, and corrective emergency action to be taken if required.

"Checkflights are conducted with the minimum crew necessary to ensure proper operation of all required equipment.

"Checkflights must be of sufficient duration to perform the prescribed checks and to determine whether any additional maintenance work is required.

"Checkflights shall be conducted in accordance with the criteria established by OPNAVINST 3710.7 Series (NATOPS).

"Checkflight forms must be properly completed and returned to the Maintenance Department."

Checkflights are required to determine whether the airframe, powerplant, accessories, and items of equipment are functioning in accordance with predetermined requirements. Depending upon the maintenance performed, the functional checkflight will be either a complete or a partial checkflight. If a complete checkflight is to be flown, all the items contained in the functional checkflight procedures must be accomplished. If a partial checkflight is to be flown because of engine change, flight control rigging, etc., only those items that directly relate to the equipment being checked need be accomplished. Therefore, some items contained in the functional checkflight procedures are coded. This coding is intended to assist the FCF crewmembers in determining which items pertain to the various conditions requiring checkflights. Items coded (E) pertain to engine/fuel control maintenance as outlined in OPNAVINST 4790.2. Items coded (FC) pertain to flight control/rigging maintenance as outlined in OPNAVINST 4790.2. The uncoded items in conjunction with the coded items constitute a complete functional checkflight, requirements for which are outlined in OPNAVINST 4790.2. Coding shall appear adjacent to a paragraph title or a step. If it appears adjacent to a paragraph title, all steps following that paragraph title will apply. If the coding appears adjacent to a step, only that step and its subordinates will apply.

10.2 CHECKFLIGHT PROCEDURES (PILOT)

10.2.1 Preflight

Note

Because of expanded checks required by the checkflight procedures, external intercommunication shall be used by the ground crew.

1. Exterior preflight

The aircraft exterior preflight will be conducted in accordance with Part III of this manual. Particular attention shall be made to check for loose or improperly installed panels in those areas where maintenance has been performed.

2. Interior preflight

Internal inspection and proper switch positions will be accomplished in accordance with Part III of this manual.

10.2.2 (E) Starting Engines. Start engine in accordance with Part III of this manual. Check normal indications for the following:

1. Fuelflow

Fuelflow is 225 to 800 pph (500 to 1,200 pph, -10B engines) at light-off, up to 2,400 pph during the engine transition to idle.

2. Light-off (within 15 seconds)

Ignition should occur within 15 seconds after fuelflow or oil pressure is indicated.

3. EGT within limits

4. Nozzle movement

Afterburner nozzles should be monitored during start. Nozzle positions to full open at approximately 30-percent rpm and seven-eighths to three-quarters open at idle.

5. Idle rpm 65 (±1) percent

6. Boost pump pressure

Pressure indicating 30 (±5) psi at idle.

7. Idle fuelflow 800 to 1,400 pph (800 to 1,500 pph, -10B engines)

8. Idle EGT 220 °C to 420 °C (250 °C to 540 °C, -10B engines)

9. Idle oil pressure 12 psi minimum

10. PC-2 pressure (right engine) 2,750 to 3,250 psi

11. Utility pressure (right engine) 2,550 to 3,000 psi

12. Extend refuel probe (right engine)

This will ensure that the probe will extend on the reduced utility pressure.

13. (FC) Left spoiler check

With right engine only operating and PC-1 pressure zero, slowly deflect control stick approximately 1 inch to left. Have ground crew verify that spoiler does not fully deflect and returns to a flush condition when the stick is returned to neutral.

14. PC-1 pressure (both engines) 2,750 to 3,250 psi

15. Utility pressure (both engines) 2,750 to 3,250 psi

16. Bus tie light out within 18 seconds

a. When the right generator is turned on, the RH GEN OUT light goes out. The BUS TIE light comes on momentarily, then goes out. When turning on the left generator, the LH GEN OUT light goes out and the BUS TIE light comes on and may stay on up to a maximum of 18 seconds, then goes out. The same indication occurs when the right generator is cycled.

b. With both generators on the line, turn off right generator and check boost pump pressure gauges. Turn right generator on and then turn the left generator off and again check boost pump pressure gauges. If reverse phasing is present, the boost pumps will run in reverse and the boost pump pressure gauges will indicate substantially lower than normal. Select left generator on.

17. SPC light

STATIC CORR OFF light must go out and remain extinguished after placing SPC switch in the RESET CORR position. After reset, altimeter should indicate within ±40 feet of the before reset indication. Altimeter oscillations of any magnitude are unacceptable.

18. Wing fold

Operate the wing fold system. Check that the lights on the telelight panel operate and extension or retraction occurs in 12 to 16 seconds.

10.2.3 Before Taxiing

1. (FC) Aileron trim 10 to 15 seconds

Move aileron trim left. Have ground crew confirm left spoiler up and right aileron down. Mark time and move aileron trim to the full right position. Maximum time to travel from full left to full right is 15 seconds. Ensure stick moves from left to right and have ground crew confirm that left spoiler going down and right spoiler up after passing neutral position. Move trim back to neutral and have ground crew confirm spoilers and ailerons neutral. Check control stick neutral position ±one-quarter inch.

a. Lateral control system checkout

(1) Mechanical system checks

(a) With ailerons trimmed neutral, slowly trim the stick to the left until the left spoiler just breaks the stops. Have ground crew check that the right aileron is deflected down one-quarter to 1 inch.

(b) Repeat this check on the opposite side to ensure that when the right spoiler breaks the stop, the left aileron is down one-quarter to 1 inch.

CAUTION

If this check fails, the lateral controls must be rerigged before flight as large yaw angles and possible poststall gyration can occur at high angles of attack since it will be impossible to neutralize the lateral controls.

(2) Operation system checks

(a) With STAB AUG off, trim the lateral system as close to neutral as possible. Spoilers should be flush with the wing and ailerons aligned approximately with the trailing edge flaps.

(b) Engage STAB AUG while observing both ailerons for movement. Ailerons should not move more than one-quarter inch.

2. Tail hook/corner reflector (F-4J 155529ag and up or after AFC 388, and all F-4S)

Extension of hook should be 5 seconds maximum. Reflector door opens, reflector extends, and CORNER REFLECTOR OUT warning light remains out. Retraction of hook should be 10 (±3) seconds. Reflector retracts and reflector door closes.

3. Hook bypass switch

Place hook bypass switch in BY-PASS position; reflector door opens, reflector extends, and CORNER REFLECTOR OUT warning light remains out. The hook remains up and locked. Place hook bypass switch in NORMAL position; reflector retracts and reflector door closes.

4. Speedbrakes

Should extend to full deflection in 2.5 (±0.5) seconds and retract in 2.5 (±0.5) seconds on the ground.

5. RAT

Pneumatic pressure should not drop below 2,200 (±200) psi on extension and 1,200 (+400, -200) psi on retraction (when immediately following extension).

6. Flaps/slats/aileron droop/BLC/ARI

a. Flaps/slats – DN-OUT.

(1) Trailing edge flaps extend within 8 (±1) seconds.

(2) Slats extend within 3 seconds.

(3) Ailerons droop within 6 seconds.

(4) Check for presence of BLC at trailing edge.

(5) On F-4J check for presence of BLC at leading edge.

(6) Place engine bleed air switch OFF and on F-4J, ensure leading edge BLC is shut off (on F-4J 155903ap, 157274ap and up or after AFC 440, and all F-4S). On F-4J after AFC 550 and all F-4S, ensure BLEED AIR OFF light illuminates and then goes out after bleed air switch is returned to NORM (guard down).

(7) Place engine bleed air switch NORM.

(8) Place YAW STAB AUG switch OFF and pull ARI circuit breaker. Move stick full left and check left spoiler up and right aileron down, rudder neutral. Place YAW STAB AUG switch ON and check for 5° left rudder, reset ARI circuit breaker and check for additional 10° left rudder. Repeat this procedure with full right stick.

(9) On F-4S with IAVC 2557, place ROLL STAB AUG switch OFF. Move stick slightly left and observe spoiler movement. Engage roll stab aug while maintaining one-half left stick and observe approximately 6.5° additional aileron/11° additional spoiler deflection. Repeat check to the right.

b. Flaps/slats – 1/2-OUT.

(1) Check for absence of BLC at trailing edge.

(2) Conduct left and right ARI check as checked with flaps/slats at DN-OUT.

(3) Extend to DN-OUT.

(4) Flaps/slats switch UP-NORM; retract within 6 (±1) seconds.

(5) Check FLAPS UP light on (F-4S).

(6) Ailerons return to neutral (after initial movement) within 6 seconds.

7. Anti-ice

Stabilize at 80-percent engine rpm or higher. Place anti-icing switch to ON and check for illumination of L ANTI-ICE ON and R ANTI-ICE ON lights. Observe approximate 10 °C rise in EGT and slight rise in fuelflow. When switch is turned off, check drop in fuelflow, EGT, and that the lights go out.

10.2.4 Taxiing

1. Nosewheel steering

Engage the nosewheel steering after aircraft begins to roll and ascertain that nosewheel responds to steering command signals in both direction and magnitude.

2. Air brakes

When a reasonably clear area is reached, move air brake lever slowly to on. Ascertain that both brakes are applied.

10.2.5 (E) Before Takeoff

1. MIL power check

Check engines individually at MIL thrust and note any variation from the following limitations.

2. Throttle check

Force required to move each throttle from IDLE to MIL requires approximately 5 pounds. Abruptly retard each throttle from MIL to IDLE. Momentary minimum acceptable fuelflow is 365 pph (440 pph, -10B engines). Observe that engine rpm returns to its originally noted idle rpm.

3. EGT

a. Exhaust gas temperature at MIL power for the -8 engine is 625 (±10) °C.

b. Exhaust gas temperature at MIL power for the -10 engine is 660 (±8) °C.

c. Exhaust gas temperature at MIL power for the -10B engine is 696 (±8) °C.

4. Fuelflow

Fuelflow for each engine at MIL power is 7,500 to 9,000 pounds per hour (approximately).

5. Oil pressure

Engine oil pressure at MIL power for MIL-L-23699 oil is 45 to 70 psi.

6. RPM

RPM at MIL power for the -8 engine is 100 (±5) percent. For rpm at MIL power for the -10 engine, refer to Military Power Operating Limits chart in NAVAIR 01-245FDD-1B.

Note

Because of T2 cutback, the -10 engine will not reach 100-percent rpm if CIT is below approximately 45 °C (113 °F). Nevertheless, engine performance (EGT vs. rpm relationship) can be determined during ground runup by using the Military Power Operating Limits chart and assuming that CIT equals OAT when the aircraft is in a static condition. Theoretically, an in-flight engine performance check cannot be made since there is no means available for the crewmembers to determine in-flight CIT. However, if the engine rpm vs. EGT relationship was within tolerance during the ground MIL power check, it can be assumed that rpm is correct. Therefore, a check of in-flight EGT can be made by entering the Military Power Operation Limits chart with rpm and obtaining an EGT readout. The actual engine EGT should fall within the range of EGT obtained from the chart.

7. Nozzle position

Check and record nozzle position, ensure that both openings are approximately the same.

10.2.6 Takeoff. Perform a normal afterburner takeoff. Observe and record any variations to following limitations:

1. (E) EGT

-8 engine – 635° MAXIMUM.

-10 engine – 668° MAXIMUM.

-10B engine – 704° MAXIMUM.

2. (E) Nozzle position – Five-eighths to seven-eighths open.

3. Gear retraction – 4 to 6 seconds.

4. (FC) Rudder switchover

Accelerating – 228 to 252 knots.

Decelerating – Approximately 10 to 20 knots below accelerating switchover (minimum 218 knots).

10.2.7 Fifteen Thousand Feet. Climb to 15,000 feet and proceed with following checks:

1. Cabin pressure (8,000 feet)

Check that both cockpit pressure altimeters read 8,000 feet.

2. (FC) Flight control system

a. Turn off stability augmentation (stab aug). Trim aircraft for hands off flight and check position of spoiler and ailerons. Reengage each stab aug axis separately and check for transits.

b. Stabilator – Establish 350 knots and check for normal longitudinal feel. Establish a 2g pullup and release the stick. Oscillations should dampen in one-half cycle. Trim full noseup, full nosedown and check for 15 to 20 pounds of stick force. Return trim to neutral.

c. Ailerons – Trim for hands off flight. Check ailerons and spoilers in trimmed position. Roll aircraft into a 60° bank and release the stick. Roll should stop and the stick should center. Repeat check in the opposite direction.

d. Rudder – With wings level, trim aircraft so the yaw string is centered (if installed) or trim aircraft so the needle and ball on the ADI are centered. Displace rudder pedal to develop yaw. Release pedal, yaw should cease in one-half cycle. Repeat check in the opposite direction. Symmetrical flight should occur in 5 seconds following yaw input. Trim right and left ensuring rudder trims in proper direction.

3. Compass system

a. Standby, ADI, HSI – Heading accuracy (mode selector knob in SLAVED mode) within ±5° of known magnetic heading. No more than 2-1/2° difference can exist between ADI and HSI headings. Standby compass headings should take into account corrections as noted on correction cards located in cockpit.

b. ADF (PRI, AUX) – Accuracy is within ±5° of heading toward or away from the transmitter. Bearings off wingtip are accurate with ±20°. Needle oscillations must not exceed ±3°.

c. Tacan – Accuracy of all bearings will be within ±1°; however, reading accuracy prompts an arbitrary tolerance of ±2°. Distance accuracy will be ±0.2 mile plus 0.1 percent of total distance to station. Course bar pointer and bearing pointer have no discernible difference in bearings. Erratic course bar movement is unacceptable except when close-in to station.

d. Compass system control – No more than 2° difference exists between the AJB-7 and ASN-70 system output.

4. (E) Engine idle power

Reduce engine power to idle and observe the following limitations:

a. EGT – 100 °C to 300 °C.

b. RPM – Minimum 65 percent at 0.55 to 0.84 Mach.

5. (E) Engines military power

Advance the throttles to military power and observe the following limitations:

a. EGT

(1) -8 engine – 625 °C ± 10 °C.

(2) -10 engine – RPM vs. EGT (refer to Military Power Operating Limits chart in NAVAIR 01-245FDD-1B).

b. RPM – 100 (±0.5) percent (-8 only).

c. Oil pressure – 40 to 70 psi.

6. (E) Engines (AB power)

Advance the throttles to maximum power and observe the following limitations:

a. EGT

(1) -8 engine – 625 °C ± 10 °C.

(2) -10 engine – RPM vs. EGT (refer to Military Power Operating Limits chart in NAVAIR 01-245FDD-1B).

b. RPM – 100 ± 1.0 percent (-8 only).

7. Cabin vent

Perform a functional check of cabin vent by pulling up on emergency vent handle. Observe following action:

a. All air-conditioning and pressurization air to cockpit and pressure suit is shut off.

b. Cabin pressure regulator and safety (dump) valve is opened and cockpit becomes depressurized.

c. Cabin and aircraft altimeter will read approximately same within 5 to 6 seconds after handle is pulled.

d. Ram air shutoff valve is opened and atmospheric air is allowed to enter cockpit through a port located just forward of pilot's feet.

8. Wing fuel dump

Perform a check of wing fuel dump system, observing through rearview mirror that fuel actually dumps. RIO confirms dump with a visual check.

10.2.8 Forty Thousand Feet. Climb to 40,000 feet and perform following checks:

1. (E) Engines (idle power)

Reduce engine power to idle and observe following limitations:

a. EGT – 100 °C to 300 °C.

b. RPM – 80 percent (approximately).

2. (E) Engines (MIL power)

a. EGT

(1) -8 engine – 532 °C to 537 °C at 91 percent; 619 °C to 635 °C at 100.5 percent.

(2) -10 engine – RPM vs. EGT (refer to Military Power Operating Limits chart in NAVAIR 01-245FDD-1B).

b. RPM – 91 percent to 100.5 percent (-8 only).

3. (E) Engines (AB power)

a. EGT

(1) -8 engine – Military ±10 °C.

(2) -10 engine – RPM vs. EGT (refer to Military Power Operating limits chart in NAVAIR 01-245FDD-1B).

b. RPM – Military rpm ±0.5 percent.

4. Altimeter

The following lists allowable fluctuation in altitude with normal static pressure compensator operation.

a. Mach range 0 to 0.91 – Stable (25 feet random variation).

b. Accelerating through 0.91 to 0.93 – Two altitude breaks of ±200 feet. Continuous oscillations should not exceed ±50 feet.

c. Acceleration through 0.93 to 1.05 – Two altitude breaks of ±1,000 feet. Continuous oscillations should not exceed ±50 feet.

d. 1.05 to V_{max} – Stable (25 feet random variations).

Note

Static pressure compensator must continue to function through flight envelope. Occasional dropouts (warning light ON) are unacceptable.

5. (E)/(FC) VMAX

Maximum power V_{max} is attained at 40,000 feet. Special instrumentation is required to check performance precisely; however, a check for minimum maximum-speed is felt to be a reasonable compromise. By using performance data contained in Part XI and subtracting 0.12 TMN from the V_{max} given and a further correction for temperature (0.02 IMN/°C) from standard day, an acceptable figure is reached. An aircraft not meeting this minimum requirement may have malfunctioning bellmouth/ ramp schedules for low-thrust engines and must be given a complete ground check. Thrust surging, directional oscillations, and cyclic ramps are unacceptable characteristics.

10.2.9 Descending to 20,000 Feet

1. (FC) Slats override/blow up

At approximately 558 knots, place the slats override switch to OUT. Ensure the SLATS MANUAL light is on. As the aircraft accelerates, ensure the slats retract at 568 to 602 knots and extend 10 to 30 knots below retract speed. Place override switch to NORM and ensure the SLATS MANUAL light goes out.

2. Gyro horizon

Residual bank angle not to exceed ±2° after erection period. Following 360° turn at a bank angle of 30° or more, the bank angle at rollout will be no more than ±2° from indication before beginning turn. Horizon is adjustable through minimum angle of 5° climb and 10° dive. A 360° roll will cause no precession in bank or pitch. Erratic motion of sphere is unacceptable. Crosscheck standby attitude gyro with ADI gyro; the maximum difference is ±1 percent.

3. Turn and bank indicator

A single needle width turn results in turn rates of 165° to 195° per minute.

4. Vertical velocity indicator

Must not exhibit erratic motion (except in transonic region where static pressure fluctuation normally occurs) and zeroes in level flight.

5. Accelerometer

All needles return to within 1 (±0.2) g in 1g flight or on ground after reset button is actuated.

6. Anti-g valve

Commence airflow to g-suit connection at 1.5g. Flow rate may vary. At 2g, a suit pressure of near 0 to 1.2 psi may be obtained. The suit pressure may vary between 2.9 and 4.3 psi at 4g (qualitative check only).

7. True airspeed indicator

The computation range is 150 to 1,500 knots. Readings on ground of 108 to 150 knots are normal and will vary considerably. In-flight check requires free air temperature information.

8. Air refueling probe (300 knots or 0.90 Mach, whichever is less)

Extend the air refueling probe and check READY light on. Check that reverse fuel transfer does not occur (rapid sector decrease). Retract probe.

9. (FC) Lateral control check

At approximately 25,000 feet, disengage the stab aug (roll aug) and have the RIO visually check the ailerons for neutral trim. When neutral trim has been established, check the control stick for neutral position. Leave the roll aug disengaged. Slowly trim to establish a 3 to 5g pullout. Hands off stick and visually check aileron position. Accelerate to 350 knots, increase the angle of attack to 19 units, and execute rudder rolls left and right (ailerons neutral). Large erratic yaw oscillations shall not occur. Establish a turn at 300 knots and 29 units AOA and gradually increase AOA until wing rock occurs, approximately 23 to 25 units (28 to 29 units for F-4S). If any adverse characteristics are exhibited, establish 5 to 10 units AOA. If the aircraft was not retrimmed, then hands off flight should again show the ailerons neutral.

CAUTION

F-4S slat extension during a hands-off pullout can cause a rapid increase in pitch rate and g forces. Exercise care to ensure that g limits are not exceeded.

10. Automatic/manual temperature control

Cockpit temperature is fully controllable over a range of -20 °F to 100 °F on AUTO setting. Manual selection may result in inlet temperature of -130 °F to well above 220 °F depending on flight conditions and techniques in using switch. For example, temperature limiter will limit the inlet air to 220 (±10) °F when active; however, the unit is active only when manual switch is held in HOT position and does not react to higher temperatures than may occur as a result of speed and power changes. Pressure suit vent air control must be fully off to obtain control of the manual system.

11. Defog foot heat control

Defog air temperature is controllable from 85 °F to 200 °F, depending upon cabin temperature setting at time defog air is selected. Moving the defog lever through 50-percent travel position results in an increase in defog air temperature of approximately 100 °F. In full defog position, 80-percent of available air is directed to windshield. In FOOT HEAT position, only 10 percent of the air is directed to windshield.

12. Horizontal situation indicator (HSI/TACAN)

The following functions will be checked for accuracy:

a. DMI – Accuracy is ±0.2 mile plus 0.1 percent of total distance from station; however, reading and flying accuracy will permit an accuracy check of no better than ±1 mile.

b. Course indication – The course bar centers within ±1° of known course to station. Erratic course bar movement is unacceptable. Course pointer and bearing pointer have no discernible difference in bearing in TACAN mode. Course selected in window and course pointer have no discernible difference in readings. Erratic movement of the bearing pointer is unacceptable except for ±3° jitter in ADF mode.

13. Tacan

Volume control is sufficient to eliminate audible station identification signal. Lockon normally occurs within 60 seconds following channel selection on T/R mode. This time will vary with bearing and distance from station.

14. Attitude director indicator (ADI)

Vertical displacement pointer (VDP) moves opposite to direction of bank and centers with no discernible deviation when on selected heading.

15. Antenna functional check

16. Gunsight functional check.

10.2.10 Twenty Thousand Feet

1. Automatic flight control system

Engagement of any mode or function of AFCS does not produce transients of sufficient magnitude to cause the aircraft to jump in pitch and/or roll. Performance of the system is unacceptable if an engagement jump occurs.

Stability augmentation mode – Stab aug damps yaw inputs (rudder kicks) within one-half cycle to zero amplitude, and symmetrical flight (ball centered) will occur within 5 seconds following the yaw input. Transients in pitch and roll damp within one-half cycle; however, a slight residual pitch rate is considered normal because the stick longitudinal centering band may exceed the authority of the damper (±2° stabilator travel) where excessive friction exists. Lateral inputs damp within one-half cycle. Random or cyclic transients about any axis are unacceptable.

b. Control stick steering (CSS) – Control stick longitudinal breakout force will not exceed 4.0 pounds forward or 3.0 pounds aft, while lateral breakout force will not exceed 4.0 pounds. Self-induced lateral, longitudinal, or directional transients, random or cyclic, are unacceptable. Control stick steering in excess of 70° (±3°) in pitch and bank will cause AFCS to disengage. While in a 0° to 70° bank, a reduction of stick force within these bank limits is unacceptable. Lateral return-to-level bank will not exceed 5° (±2°). Heading hold error will not exceed ±10° of the actual heading when return-to-level function becomes operative.

c. Heading hold cutout – While operating in AFC mode, depress and release nosewheel steering button to activate heading hold cutout option. Minute heading changes between 0° and 5° angle of bank can then be made. Again depress and release nosewheel steering button and ensure that AFCS heading hold function returns to normal operation.

d. Altitude hold – Altitude hold function maintains altitude within ±50 feet or 0.3 percent of reference altitude, whichever is greater, up to 0.9 Mach subsonic and above 1.0 Mach supersonic. While accelerating through transonic region, Mach jump may produce transients which will result in noticeably abrupt altitude hold corrections. This condition is considered normal as long as corrections do not become sharply erratic; once this region is traversed, aircraft settles down on reference altitude or a new reference altitude and holds it. A change in altitude greater than 200 feet will cause reference altitude to slip by the amount that transient altitude limit (200 feet) is exceeded. Altitude hold function will become disengaged if control stick forces exceed 4.0 pounds maximum forward or 2.75 pounds maximum aft for a period exceeding 0.5 seconds. When performing altitude hold function check, do not make initial engagement while in a climb which exceeds 1,000 feet per minute. Engaging altitude hold mode in climbs greater than 1,000 feet per minute may result in a reference altitude other than engage altitude.

e. Emergency disengage – Disengaging the AFCS with emergency disengage switch will produce slight transients, but will not result in a g jump of more than ±0.3g.

f. G-Limiter – Autopilot disengage at 4 (±1/4) g (positive) and -1 (±1/4) g (negative).

g. Automatic pitch trim

(1) Assume flight conditions of 300 KCAS.

(2) With AFCS switch off, manually trim aircraft for straight-and-level flight (make a mental note of stabilator trim position indicator).

(3) Engage AFCS.

(4) While holding control stick for straight-and-level flight, manually mistrim 2 units noseup.

(5) Pull stab feel trim circuit breaker (pilot right console) as trim indicator reaches 2 units out of trim.

(6) In 2 to 15 seconds, A/P PITCH TRIM warning light shall illuminate.

(7) Depress stab feel trim circuit breaker. The stabilator trim position indicator shall show a retrim toward the predetermined straight-and-level position.

(8) The autopilot pitch trim indicator light shall go out when indicator is between 1-1/2 units and three-quarter unit from predetermined straight and level position.

(9) Disengage AFCS, transient shall not exceed 0.3g.

(10) Repeat steps (2) through (8) only in nosedown direction.

10.2.11 Ten Thousand Feet to Landing. Between 10,000 feet and landing, perform following checks:

1. Angle of attack

a. Basic limitations and pictorial display of system will be found in Part I of this manual. The following are additional tolerances.

b. The airspeed will be within ±4 knots except as noted in Part I of this manual.

c. Pedal shaker activates at 21.3 units angle of attack on F-4J before AFC 388 and 20.6 units on F-4J after AFC 388 and all F-4S.

d. On F-4S, ensure the slats extend at 11.5 (±0.5) units and retract at 10.5 (±0.5) units AOA.

2. Flaps – Flap blowup switch test

Decrease airspeed below 205 knots and lower flaps. Slowly increase airspeed; the flaps will blow up at 230 to 240 knots. Slowly decrease airspeed; flaps will extend approximately (providing flap switch is down) 10 to 20 knots below noted retraction airspeed (minimum 210 knots). Flaps extend and retract within 8 (±1) second and 6 (±1) seconds, respectively.

3. Ram air turbine

a. Reduce airspeed to 250 knots.

b. Secure tacan, IFF, radar altimeter, and STAB AUG; (RIO) secure tacan, radar.

c. Extend RAT and check rotation.

d. Secure right engine and relight.

e. Secure both generators.

f. Secure left engine and relight.

g. Check normal operation of the following:

(1) ICS

(2) UHF (front and rear)

(3) CADC RESET

(4) Wing fuel transfer

(5) Boost pump pressure 5 to 15 psi

(6) Landing gear/flap position indicators

(7) Longitudinal trim

(8) ADI/HSI

(9) Fuel quantity, feet tank check switch, and fuelflow indicators

(10) RPM, EGT, nozzle indicators

(11) Oil/pneumatic pressure indicators

(12) Caution light reset

(13) Warning lights bright

(14) Instrument floodlights bright

(15) AOA indicator

(16) PC-1/PC-2 pressure gauges

(17) Check for electrical output at speeds down to 170 knots

(18) Bleed air switch (after AFC 627)

(19) Flaps/slats (F-4S).

h. Right and left generator – ON.

i. Retract RAT and accelerate.

4. (E) APCS functional check

WARNING

Do not engage the APCS unless all system components are installed and the landing gear is down.

a. Ensure speedbrake switch is in STOP position, throttle friction lever is full aft, and emergency speedbrake switch is in MAN position (some aircraft).

b. Engage APCS at approximately approach airspeed and between 75 percent and MIL power rpm. Stabilize in level flight and observe that proper approach AOA is maintained.

c. Cycle APCS air temperature switch between HOT, COLD, and NORM positions to observe that each position is operational with slight throttle/fuelflow surges between positions. Place air temperature switch in applicable temperature position.

d. Move control stick slightly but sharply aft and observe that stabilator input causes throttle and fuelflow increase before AOA increases significantly.

e. Move control stick slightly but sharply forward and observe that stabilator input causes throttle and fuelflow decrease before AOA decreases significantly. Response to forward stick inputs should be less than for aft stick inputs.

f. Perform a turn to maintain AOA greater than approach AOA and observe maximum rpm.

g. Perform a pushover to maintain AOA less than approach AOA and observe minimum rpm.

h. Neutralize controls, grasp throttles, and override the APCS. Twenty to forty pounds of force is required to override the APCS. Relay throttle pressure and observe that throttles return to their former position. APCS should be operating normally.

i. Place speedbrake switch to the IN position and observe that APCS engage switch moves to STBY and the APCS OFF and master caution lights illuminate. Throttles remain in the same position when APCS is disengaged.

5. Radar altimeter

a. Drop-out altitude is 5,000 feet over land or water.

b. Low level warning – Accuracy is ±5 feet of the selected altitude.

c. Drop out angles occur at no less than 45° bank angle and 45° pitch angle.

d. Accuracy will be ±5 feet below 100 feet and ±5 percent of terrain clearance between 100 and 500 feet.

6. Speedbrakes (some aircraft)

Extend speedbrakes and move emergency speedbrake switch to RETRACT. Speedbrakes will be hydraulically closed and warning light extinguished.

7. Landing gear

Landing gear extends in 5 to 7 seconds.

10.2.12 Landing

1. (E) APCS disengagement

Prior to landing, engage APCS and check for disengagement on touchdown.

2. Drag chute

The force to deploy chute is approximately 50 pounds.

3. Antiskid (some aircraft)

Between 90 and 100 knots on the runway, engage nose gear steering and depress the brakes until the antiskid cycles. Ensure tires do not skid and the antiskid system does not cause the aircraft to yaw on the runway.

4. Brakes

Check for spongy, draggy, or pulling brakes.

5. Rain removal

During taxi with one or both engine(s) running at or below 88 percent and flaps at 1/2 or down, actuate the rain removal switch and check that air is coming from the rain removal ports in front of the windshield. Turn the switch off immediately and ensure the airflow decreases within a maximum of 6 seconds and stops within 17 seconds. If it does not stop, pull the EMERG VENT handle to prevent possible damage to the windshield.

6. Fuel level low

Check that the FUEL LEVEL LOW light illuminates at 1,880 (±200) pounds. Check feed tank level at 1,350 (±200) pounds.

7. (E) Right engine shutdown

With right engine stabilized at idle, place right throttle off. Check engine for smooth coastdown.

8. (FC) Right spoiler check

With left engine operating at PC-2 pressure zero, slowly deflect control stick approximately 1 inch to right. Have ground crew verify that spoiler does not fully deflect and returns to a flush condition when the stick is returned to neutral.

9. (E) Left engine

With left engine stabilized at idle, place left throttle off, check engine for smooth coastdown.

10.2.13 After Flight

10.2.13.1 Pilot

1. Before leaving aircraft, complete procedures in accordance with Part III of this manual.

2. All discrepancies or maintenance action requirements shall be properly posted on appropriate forms.

10.2.13.2 Ground Crew. Perform postflight inspection in accordance with applicable publications and as follows when applicable.

1. Engines for audible bearing roughness; shrouds to turbine rotor seals for interference after shutdown; turbine wheels for contact with adjacent surfaces.

2. Evidence of structural failure in areas where major structural modification or repair was accomplished prior to test flight.

3. New or newly overhauled engine checks.

   a. CSD and engine oil filter elements for metal particles.

   b. Engine low and high pressure fuel filter elements for metal particles or foreign material.

4. Remove emergency generator contact brush access cover.

   a. Rotate RAT blades clockwise and observe armature for rotation. Failure of armature to rotate indicates probable quill shaft failure.

10.3 CHECKFLIGHT PROCEDURES (RIO)

10.3.1 Taxiing

1. AMCS

   a. Perform built-in-test function checks.

10.3.2 Fifteen Thousand Feet. After climb to 15,000 feet, proceed with following checks.

1. ADF

Crosscheck ADF operation with front cockpit; allowable difference between instrument is ±1°.

2. Tacan

Crosscheck tacan operation with front cockpit; there should be no discernible difference between cockpit indicators.

3. BDHI

Crosscheck BDHI with HSI in front cockpit; allowable difference between instrument is ±1°.

4. Navigation computer

In-flight check of NAV computer is basically a functional check because of inherent inaccuracy of the necessary high-altitude wind information. Normal procedure is to set in your home field as a base, a tacan station as a target, and to utilize Weather Bureau altitude winds. System readouts are crosschecked with tacan information during flight and unless an apparent error of appreciable magnitude is obvious, additional detailed checking is not performed. If closer checking is dictated by particular system performance, a leg of at least 12 minutes duration is flown (departing and exact fix) and all applicable parameters are noted at the departure and destination points (i.e., heading, TAS, computer settings, and readouts). Resultant information is subsequently checked against the below tolerances.

a. Present position latitude – ±1 mile for each 12 minutes of elapsed time after start of problem or ±1 percent of the distance traveled, whichever is greater.

b. Present position longitude – Same tolerance as latitude.

c. Aircraft ground track angle (relative to true heading) – ±2° from groundspeed of 150 to 1,700 knots.

d. Aircraft bearing (relative to true heading) – Bearing error shall not exceed an amount which is defined by a line passing through the present position and a point 5 miles to either side of the target or base (as selected) or ±2° deviation from a line passing through the target or base, whichever tolerance is larger.

e. Great circle distance (range) – The range error shall not exceed 5 miles ±1 percent of the theoretical range.

10.3.3 Forty Thousand Feet. After climb to 40,000 feet, proceed with the following checks.

1. Airspeed and Mach indicator

Crosscheck the airspeed and Mach indicator with the front cockpit, allowable airspeed difference at 1.4 Mach is ±14 knots and allowable Mach difference at 1.4 Mach is ±0.04 Mach.

10.3.4 Descending to 20,000 Feet

1. AMCS operational check.

10.3.5 Twenty Thousand Feet

1. Attitude gyro

Crosscheck remote attitude gyro with ADI in front cockpit; allowable error between instruments is 1°.

2. Altimeter

Crosscheck altimeter with front cockpit; allowable difference between instruments is 30 feet.

10.3.6 Ten Thousand Feet to Landing. No check at this altitude.

PART IV

Flight Characteristics

CHAPTER 11

Flight Characteristics

11.1 STABILITY AND CONTROL

In discussing stability and control, it must be realized that a large variation exists throughout the flight envelope. Stability varies with Mach number and also cg location. Control effectiveness is also affected by Mach number, but just as much if not more so by Q (dynamic pressure).

11.1.1 Longitudinal Stability. The forward cg limits of 27-percent MAC for the F-4J are based on aircraft strength and longitudinal control effectiveness. The aft cg limits are based on static and maneuvering stability considerations and vary with stability index as shown in Figure 11-4. The static limit of a clean aircraft is 36-percent MAC for the F-4J and 37-percent MACH for the F-4S. The maneuvering flight limit for a clean aircraft is 35-percent MAC for both the F-4J and F-4S. This cg location provides an acceptable static margin. Refer to paragraph 4.1.7, CENTER-OF-GRAVITY LIMITATIONS. Static margin is a physical measurement of longitudinal stability and is normally stated as the distance in percent MAC between the cg and the aerodynamic center (AC), or nominal point of lift (A, Figure 11-1). As the cg moves aft toward the AC, stability is reduced (B, Figure 11-1). CG position alone does not define stability, but rather it is defined by the relative positions of the cg and the AC. The movement of the AC is a major contributor to changes in stability. An actual shift in the AC can be felt during an accelerated transonic speed reduction where the AC moves from its aft supersonic location to a forward subsonic location, noticeably changing (reducing) the stability (C, Figure 11-1). Attempting to maintain a constant stick force through this deceleration will produce a pitchup or load factor increase when the AC shifts. At high-angles of attack, the AC moves forward when the wingtip stalls, and, again, a reduction in stick forces occurs. When a store or tank is loaded under the wing, a change in the AC position results. The amount of AC movement is a function of the geometric characteristics of the store/tank (D, Figure 11-1). Centerline stores have essentially no aerodynamic effect on stability. The aerodynamic effect of any wing-mounted store/tank is always destabilizing. The static margin for a given configuration will change throughout the flight. Figure 11-2 (Sheets 1 through 5) illustrates cg travel because of fuel consumption for specific configurations. Figure 11-3 illustrates the trend of cg travel during the normal fuel transfer sequence with two external wing tanks installed. During ground operation, the cg moves forward as fuselage fuel is transferred forward and consumed (A to B). When external fuel transfer is commenced, the cg starts moving aft and continues to move aft slowly throughout the climb (B to C). During cruise, the cg remains near the aft starting point as external fuel maintains full fuselage cells (C to D). When the external tanks are empty and turned OFF (point D), the cg again moves forward as internal (wing and fuselage) fuel is consumed. In order to preclude flight with unacceptably low static margins, a stability index system has been established. Aerodynamic effects of stores, tanks, and associated suspension equipment are assigned unit stability numbers. For any given configuration, the stability index is the sum of the stability numbers of the tanks/stores and suspension equipment. Once the aircraft stability index has been computed and the aircraft cg location for the given configuration has been determined, Figure 11-4 may be used to plot the point which represents these two numbers. If this point falls within the red area, flight is not permitted because of the excessive pitch attitude control caused by inadequate stability. If the point falls within the amber area, flight is permitted; however, smooth coordinated control inputs are required and the aircraft is restricted to nonmaneuvering flight (AOA below buffet onset). Within the amber area, longitudinal stick forces are very light and the possibility of overstressing the aircraft or entering an accelerated stall prohibits air combat maneuvering. Pitchup (where the nose of the aircraft pitches up during maneuvering flight without additional back stick force) can also be encountered, again resulting in possible overstress and stall. High-

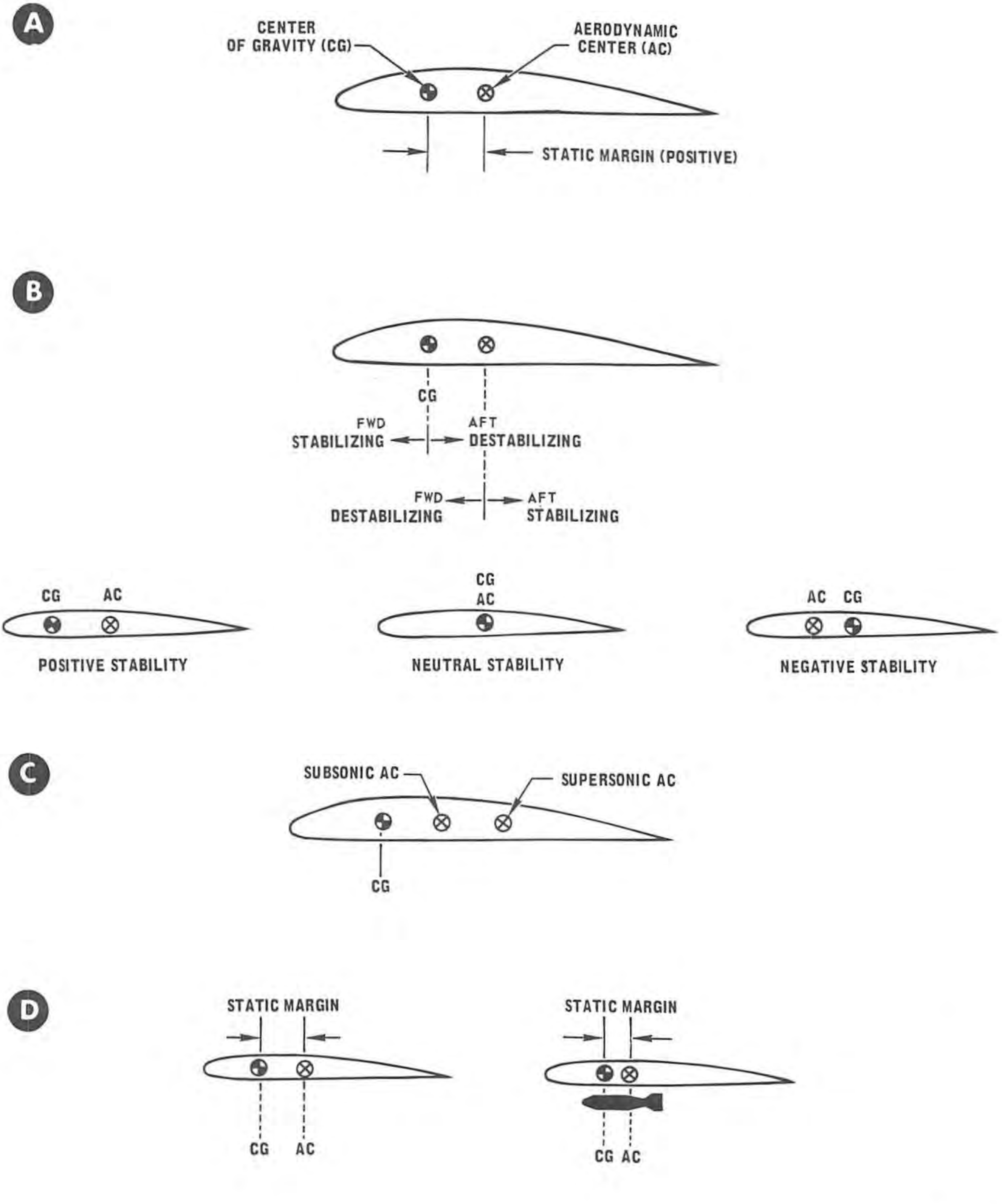


Figure 11-1. Stability Effects

APPROXIMATE

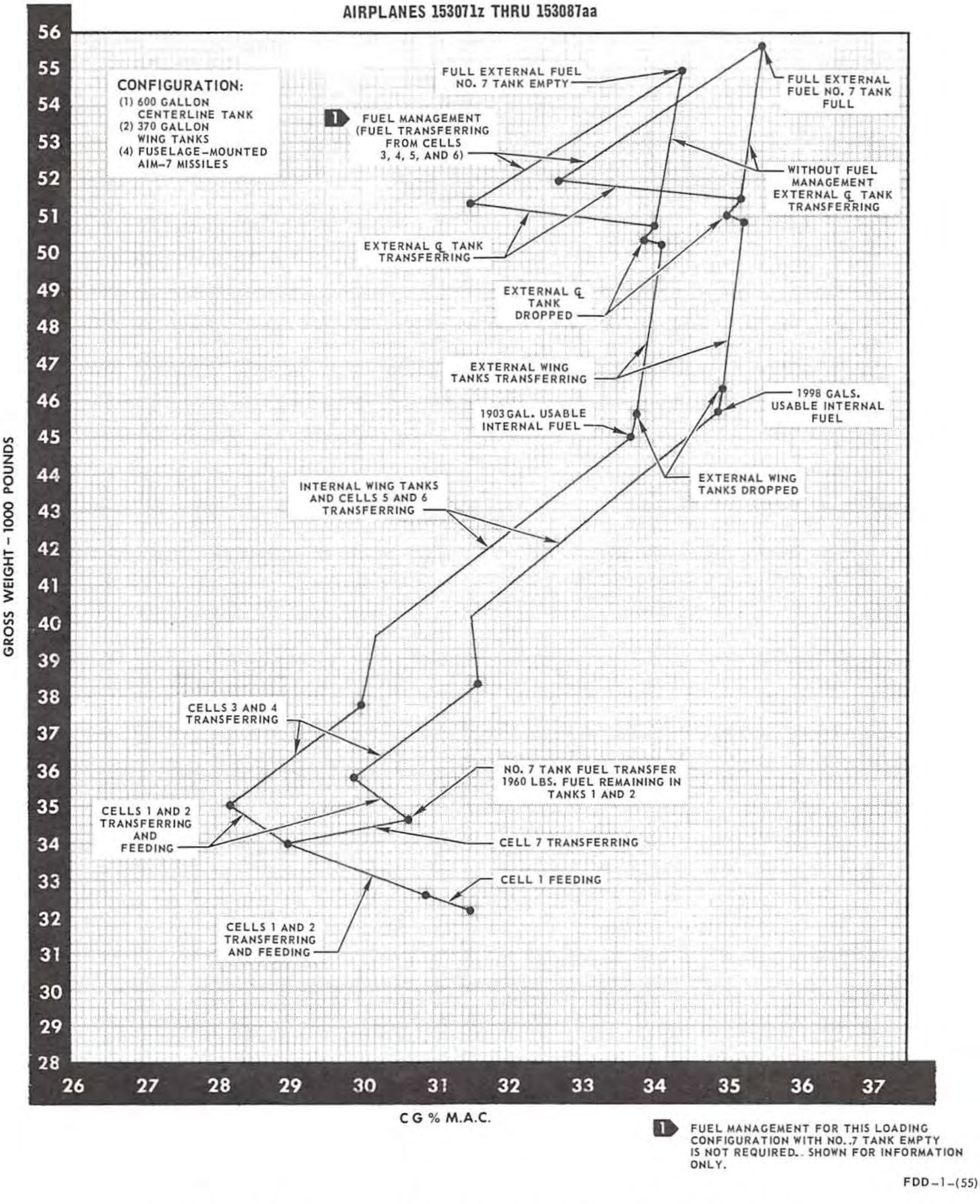


Figure 11-2. CG Travel Because of Fuel Consumption (Sheet 1 of 5)

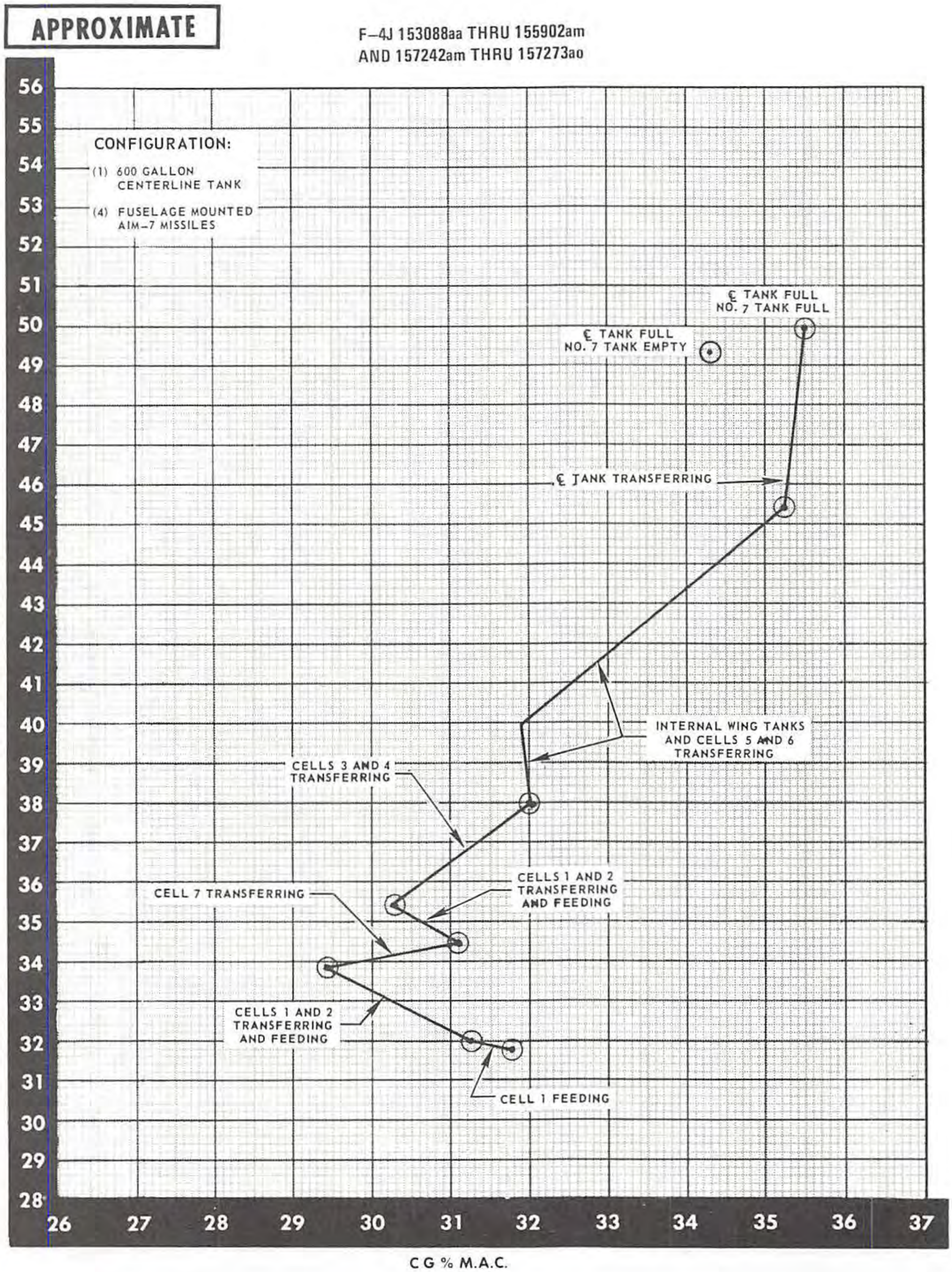


Figure 11-2. CG Travel Because of Fuel Consumption (Sheet 2 of 5)

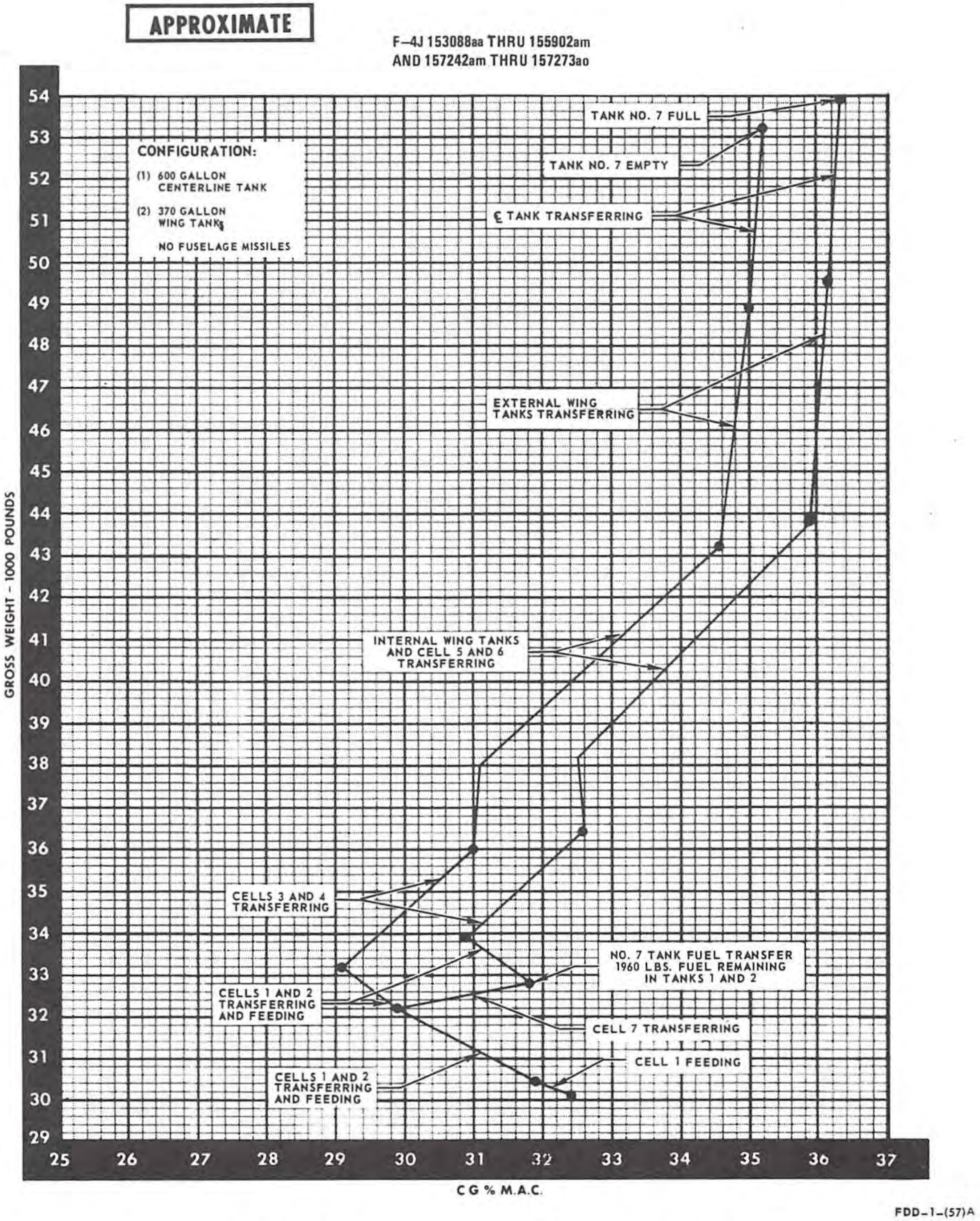


Figure 11-2. CG Travel Because of Fuel Consumption (Sheet 3 of 5)

APPROXIMATE

F-4J 155903ap AND 157274ap AND UP; AND F-4S

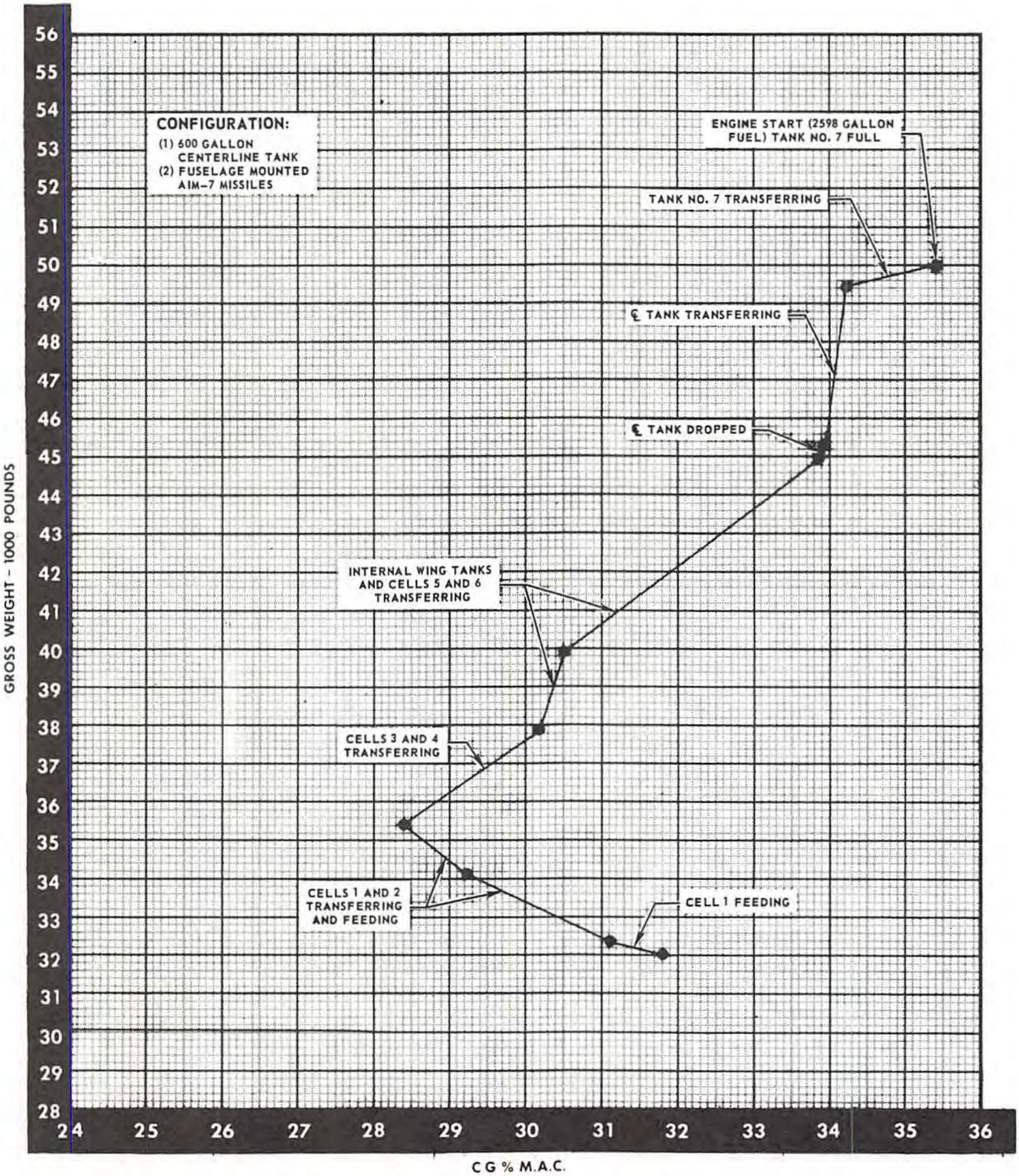


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Figure 11-2. CG Travel Because of Fuel Consumption (Sheet 4 of 5)

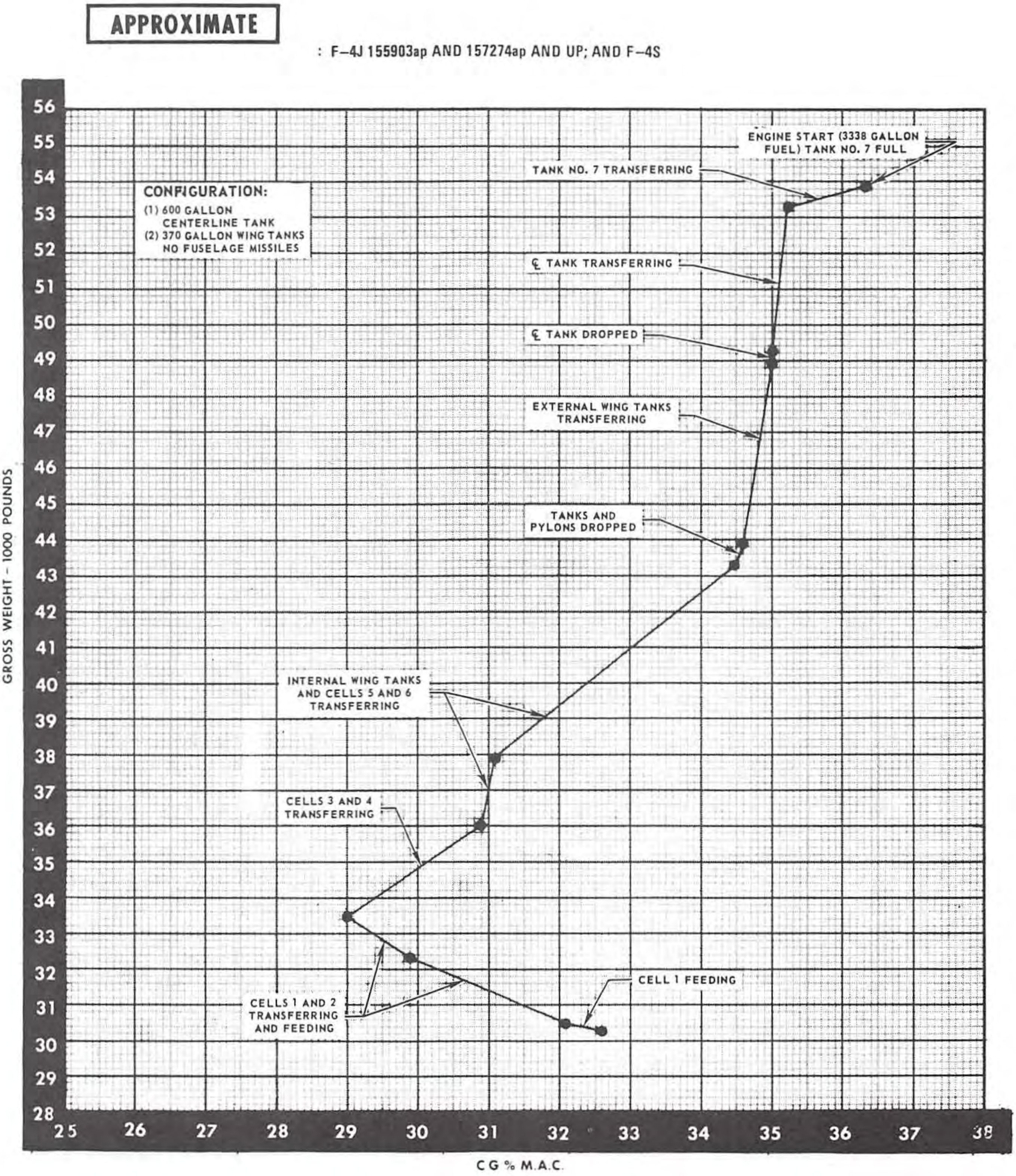


Figure 11-2. CG Travel Because of Fuel Consumption (Sheet 5 of 5)

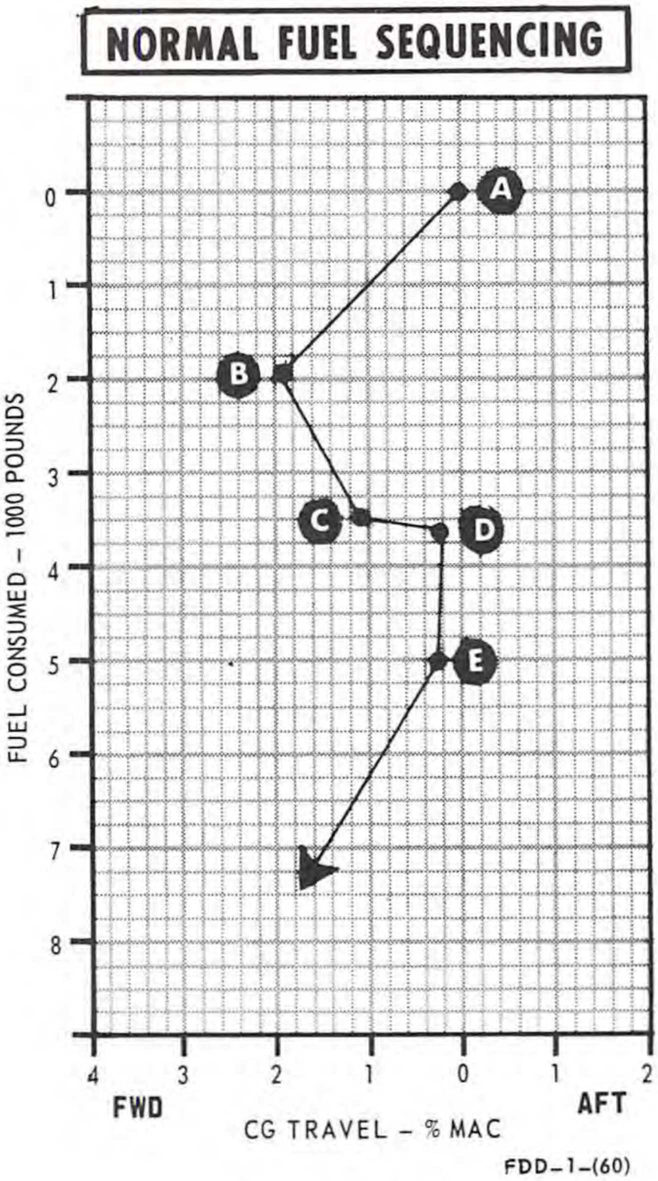


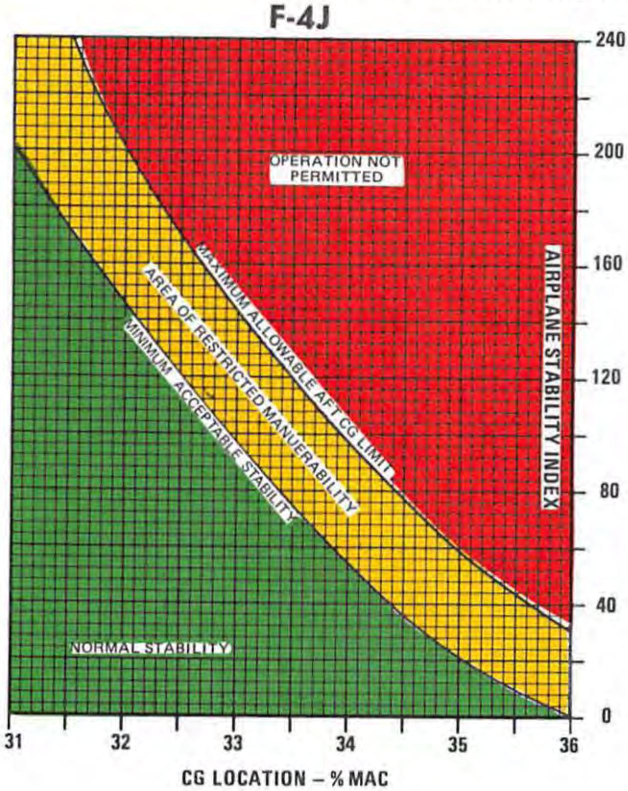
Figure 11-3. Initial CG Travel

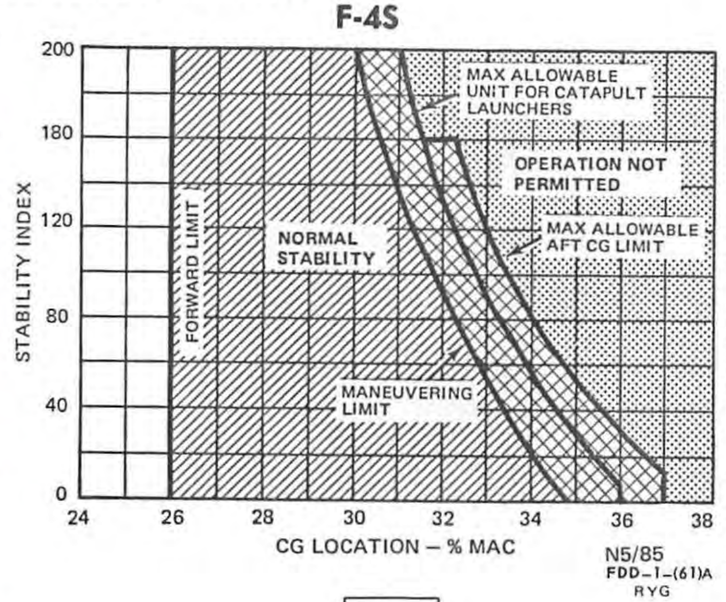
speed, low-altitude flight should also be avoided in this area since extremely sensitive pitch attitude control may lead to a dangerous pilot-induced oscillation (PIO). If the point falls within the green area, maneuvering flight is permitted, but maneuvering within 1- to 2-percent MAC of the amber area must be undertaken with a reasonable degree of caution. The unsafe maneuvering characteristics present in the amber area are still present near the aft limit in the green area, but of a sufficiently reduced magnitude to allow safe operation. For flight in the green area, within approximately 1- to 2-percent MAC of the aft limit, every effort should be made to make smooth control inputs during all maneuvering. As the cg moves forward, the longitudinal stability characteristics improve and result in good flying qualities. The aircraft exhibits satisfactory longitudinal stability characteristics for nonmaneuvering flight in the amber and green area. The aft cg limits of Figure 11-4 are based on operation with PITCH AUG engaged. Loss of PITCH AUG results in an apparent loss of longitudinal stability of at least 2-percent MAC. In this condition, maneuvering flight at the PITCH AUG ON limits should not be attempted. Individual pilot proficiency and operational necessity dictate whether to continue a mission upon failure of the PITCH AUG mode of the AFCS when near the aft cg limits for PITCH AUG ON operation.

WARNING

A degraded pitch augmentation may not be immediately apparent to the pilot because of no pitch augmentation off light, but the reduction in longitudinal stability can be significant and insidiously dangerous. With an aft cg and/or heavy gross weight, no pitch-sensitive, high-gain tasks, such as in-flight refueling, high-speed low-altitude flight or combat maneuvering, should be attempted prior to successfully completing the pitch augmentation rig check described in this chapter. Failure to dampen after one pitch overshoot should be treated as a pitch augmentation off situation for stability consideration.

11.1.2 Longitudinal Stability Improvement. Several approaches may be used to improve the longitudinal stability of the aircraft. The primary method is by control of the aircraft cg through fuel management and external stores loadings. On F-4J before 155903ap and 157274ap and up, the fuel in the No. 7 fuselage cell is a major contributing factor toward an aft cg condition. For a clean configuration aircraft, a full No. 7 cell shifts the cg aft 1.33-percent MAC. Flight with the No. 7 empty thus provides increased longitudinal stability and allows more external stores to be carried prior to reaching the aft cg limits. Selective loading of external stores can significantly affect aircraft cg. All stores on stations 2 and 8 result in a forward cg shift, whereas the majority of stores on stations 1 and 9 result in an aft cg shift. Stores on the centerline station normally result in a slight aft cg shift. Maximum utilization of aircraft stations 2 and 8





Note

- With the amber area, normal flight only (angle of attack for less than buffet onset) permitted. Only slow deliberate control movements allowed.
- Although F-4S in-flight aft CG limit with zero stability index (SI) remains at 37.0 percent Mach, the aft CG limit at higher SI has shifted forward relative to the F-4J aft limit, effectively reducing the CG envelope available for wing-mounted external stores by approximately 1.0%. Permissible F-4J external store loadings may not be satisfactory for the F-4S.
- Within the amber area of the F-4S chart, flight limited to airspeeds less than 0.70 Mach and AOA less than 20 units. Only slow, deliberate, coordinated control inputs allowed.

Figure 11-4. Longitudinal Stability

for external stores can thus result in more forward cg conditions. Fuselage-mounted Sparrow III missiles can also be utilized to adjust cg location. Listed below are the approximate cg effects because of loading fuselage-mounted AIM-7E missiles:

Configuration	CG Shift
Two Missiles Forward (stations 4 and 6 only)	Forward 1.48-percent MAC
Two Missiles Aft (stations 3 and 7)	Aft 0.82-percent MAC
Four Missiles (stations 3, 4, 6, and 7)	Forward 0.66-percent MAC

Fuselage fuel distribution is the primary in-flight cg position control. Burning down fuselage fuel provides improved stability as the aft tanks empty first. As previously shown (A to B in Figure 11-3), holding external and internal wing fuel causes a favorable rate of forward cg movement. Obviously, sometime during the flight external and internal wing fuel must be transferred and consumed with a resultant aft cg shift. Holding internal wing fuel, as opposed to simultaneous internal wing and fuselage transfer, will provide for a slightly more rapid rate of forward cg movement from the point of full internal fuel. Caution must be exercised during any nonstandard fuel transfer sequence to preclude fuel starvation because of not turning external tanks off. In order to transfer internal wing fuel, the external tanks must be turned off and internal wing transfer selected. Automatic fuel transfer should not be depended upon to correct for improper fuel switchology. Since the cg shifts because of fuel transfer and consumption, the fuel quantity gauge (Figure 11-5) can be used as an approximate indication of cg condition. A sector (fuel quantity of fuselage cells Nos. 1 through 6) indication of 8,500 pounds indicates an aft cg condition as all fuselage cells are full. At 6,000 pounds on the sector, the cg is approximately midrange of its possible travel (fuel cell Nos. 5 and 6 nearly empty and fuel distributed in cell

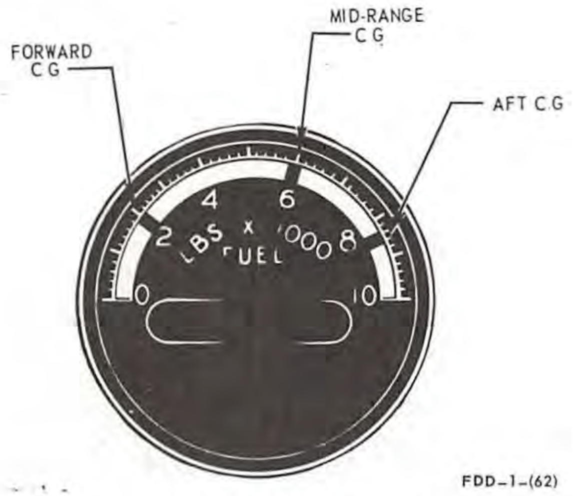


Figure 11-5. CG-Fuel Remaining Relationship

Nos. 1 through 4). The cg continues to move forward as the sector indication drops to approximately 2,000 pounds. On F-4J before 155903ap and 157274ap and up, the most forward cg shift (because of fuel consumption) occurs immediately after fuel from cell No. 7 has been consumed and cell Nos. 1 and 2 are full. On F-4J 155903ap and 157274ap and up and all F-4S, cell No. 7 transfers into cell Nos. 5 and 6 as soon as the fuel level in these tanks drops to a specified level. The maximum forward cg condition occurs at approximately 3,000 pounds of fuel remaining.

11.2 F-4J CHARACTERISTICS

11.2.1 Angle of Attack. Flight characteristics of swept-wing high performance aircraft like the F-4 are predictable and repeatable. The most significant factors influencing flight characteristics are angle of attack and static margin. Angle of attack is defined as the angle formed by the chord line of the wing and the aircraft flightpath (relative wind). Static margin is defined and discussed under paragraph 11.1.1, LONGITUDINAL STABILITY.

11.2.1.1 Low Angle-of-Attack Maneuvering. Induced drag is at a minimum at approximately 5 units angle of attack (nearly zero g); therefore, acceleration characteristics are exceptional. To achieve maximum performance acceleration from subsonic Mach numbers to supersonic flight, a 5-unit angle of attack pushover will provide minimum drag and allow gravity to enhance aircraft acceleration. This technique provides the minimum time, fuel, and distance to accelerate from subsonic Mach numbers to the optimum supersonic climb schedule. When confronted with a recovery from a condition of low airspeed and high pitch attitude, the angle-of-attack indicator becomes the primary recovery instrument. A smooth pushover to 5 units angle of attack will unload the aircraft and reduce the stall speed to nearly zero. Recovery can be accomplished safely at any speed which will provide stabilator effectiveness (ability to control angle of attack). Smooth control of angle of attack is a necessity, and no attempt to control bank angle or yaw should be made. High pitch angles with rapidly decreasing airspeed will result in loss of stabilator effectiveness and subsequent loss of control of angle of attack.

11.2.1.2 Medium Angle-of-Attack Maneuvering. Maneuvering at angles of attack from 5 to 15 units will produce normal aircraft response to control movement.

11.2.1.3 High Angle-of-Attack Maneuvering. Above 15 units angle of attack, aircraft response and flight characteristics begin to exhibit the changes expected in swept-wing high performance aircraft. The primary flight characteristics exhibited at high angles of attack are adverse yaw (yaw because of roll) and dihedral effect (roll because of yaw).

11.2.1.3.1 Adverse Yaw. Attempts to roll the aircraft with lateral stick deflections (ailerons and spoilers) will result in yaw opposite to the direction of the intended turn. This adverse yaw becomes more severe at high angles of attack. In the high angle of attack flight regime, aileron inputs provide very low roll rates. At very high angles of attack (near stall), aileron inputs cause increased adverse yaw and roll opposite to that intended. The natural tendency to raise the wing with aileron must be avoided. Aileron deflection at the point of departure from controlled flight will increase the probability of spin entry. At the first indication of adverse yaw, the ailerons must be neutralized.

Note

> With roll stab aug engaged, roll rates not commanded by lateral stick deflection will cause aileron deflection against the roll. At high angles of attack, this will cause prospin adverse yaw in opposition to rudder induced roll and will increase the probability of departure from controlled flight. Roll

aug should be selected OFF for air combat maneuvering.

11.2.1.3.2 Dihedral Effect. Attempts to yaw the aircraft with rudder will produce roll in the same direction as yaw. This dihedral effect becomes more pronounced at high angles of attack. The use of rudder inputs to produce yaw and, in turn, generate roll will provide the highest attainable roll rates at high angles of attack. Above 15 units angle of attack, desired roll should be generated primarily through use of the rudder. The rudder must be used judiciously, however, since excessive rudder inputs will induce excessive yaw.

11.2.1.4 Landing. The optimum approach (ON SPEED) indicated angle of attack with the landing gear down is 19.0 units, and stall warning (rudder pedal shaker) is set at 21.3 units. On aircraft 155529ag and up after AFC 388, the optimum approach angle of attack is set at 18.3 units, and stall warning indication is set at 20.6 units. This change in optimum approach (ON SPEED) angle of attack compensates for error induced by extending the corner reflector. The angle-of-attack reference changes with nose gear position in the approach speed range. The indicated angle of attack increases approximately 3 units when the nose gear is extended. This change in indicated angle of attack with nose gear position is due to a change in the airflow pattern over the fuselage-mounted angle-of-attack probe with the nose gear retracted. All references to indicated angle of attack should take this factor into consideration. Optimum approach angle of attack is adequate for all allowable gross weight and flap configurations. No adjustment is required for gusting crosswinds, runway, or weather conditions.

11.2.1.5 Minimum Performance Maneuvering. Maneuverability and handling qualities are degraded at lower airspeeds with sluggish response and low available g; therefore, maintain a minimum of 300 knots except during maximum range descent, holding, instrument approach, and landing. This airspeed provides reasonable handling qualities and adequate maneuver margin for terrain and collision avoidance.

11.2.1.6 Maximum Performance Maneuvering. The three factors that determine maximum performance maneuvering capability are structural limitations, stabilator effectiveness, and aerodynamic limitations. Structural limitations are outlined in Chapter 4. The limit in stabilator effectiveness occurs at high altitudes and supersonic speeds where full aft stick can be attained without reaching aerodynamic or structural limits. Aerodynamic limitations (stall) are primarily a function of angle of attack. In this area of flight, maximum performance turns are achieved by maintaining 19 to 20 units angle of attack while utilizing afterburner as required. The adverse yaw produced by the use of aileron during high angle of attack maximum performance maneuvering has been discussed and is of paramount importance in air combat maneuvering. If a high angle of attack must be maintained and a roll is necessary, rudder must be used to produce roll because of yaw as previously discussed. During maximum performance maneuvering, higher roll rates may be achieved by momentarily unloading the aircraft (reducing angle of attack to between 5 and 10 units), utilizing aileron to roll to the desired bank angle, then neutralizing aileron and reestablishing the required angle of attack. At the first indication of departure from controlled flight, controls must be neutralized to preclude aggravating the out-of-control condition. Maximum performance maneuvering must be fully understood and demonstrated by a qualified instructor pilot prior to attempting any practice in this area of flight.

11.2.1.6.1 Maneuvering Flight Rig Check. On all flights where high performance maneuvering (high angle of attack or high speed) is anticipated, a check of the aircraft rig and proper operation of the stab aug system shall be made.

1. Roll aug – DISENGAGE.

   With the aircraft trimmed for level flight at 350 to 400 knots, RIO observe ailerons and spoilers flush. High performance maneuvering shall not be attempted with the aircraft out of basic rig.

2. Pitch aug – ENGAGED.

   Pull 2g, then relax stick pressure. If pitch aug fails to dampen within one-half cycle, high performance maneuvering shall not be attempted.

3. Yaw aug – ENGAGED.

   Deflect slip indicator one ball width and release rudder. Ensure turn needle deflects in direction of rudder input. Yaw should dampen within 5 seconds. High performance maneuvering shall not be attempted with a defective yaw aug engaged or defective turn needle.

11.2.2 Handling Qualities. A large variation in handling qualities exists throughout the flight envelope. Considerations must be given in Mach number, cg position, airspeed, AOA, and external store loading.

11.2.2.1 Subsonic Region

11.2.2.1.1 Takeoff Configuration. Takeoff performance is based on aircraft gross weight and cg position. Liftoff speed is a function of gross weight and is essentially the speed at which the wings develop sufficient lift to raise the weight of the aircraft. Nosewheel liftoff speed is a function of cg, stabilator position, and gross weight. Nosewheel liftoff occurs when the noseup aerodynamic moment exceeds the nosedown weight moment. The stabilator cannot be stalled in the takeoff maneuver. Therefore, full aft stick takeoff technique (full leading edge down stabilator) provides the lowest nosewheel liftoff speed and the shortest takeoff distance. For full aft stick, the cg position will determine when the rotation begins; a lower speed than liftoff with an aft cg, and a higher speed than liftoff with a forward cg. The rate of rotation is a function of aircraft acceleration (rate of buildup of down taillift) and cg. Therefore, because of the rapid buildup of pitch-rate at aft cg's, full aft or rapid stick displacements can cause overrotation following the nosewheel liftoff phase. In computing cg for takeoff, allowance must be made for the forward shift of cg during ground operation. The cg will move forward approximately 1 percent for every 1,000 pounds of internal fuel used. In the forward cg range, nosewheel liftoff speed is increased approximately 4 to 5 knots for every percent of forward cg movement. After nosewheel liftoff, desired pitch attitude is maintained by using whatever control movement is required.

11.2.2.1.2 Landing Configuration. In this configuration, the aircraft exhibits positive longitudinal static stability except for an area about 10 knots before stall where a mild stick force lightening occurs. This is followed by a regaining of static stability after the stall so that if back pressure is released, the aircraft recovers by itself. In the speed range between 130 to 180 knots, where most landing configuration flying is done, the aircraft demonstrates almost neutral stick force stability up to about 150 knots and mild stick force stability above this speed. This is due to control system friction and rather weak stick centering at this low Q. Stabilator effectiveness is reduced with full flaps because of an aft center-of-pressure shift and a change in the downwash pattern over the tail. However, adequate effectiveness still remains for all known configurations. Since ground effect also decreases stabilator effectiveness, the aft stick-stop may be bumped during flareout from a high sink rate landing. Stabilator effectiveness is not sufficient to hold the nose up after landing since the center of rotation is now about the main gear instead of the cg. Lateral and directional control response in the landing configuration is good; however, adverse yaw generated by high roll rates produces a decrease in commanded roll because of strong dihedral effect. This strong dihedral effect can be utilized in the landing configuration to provide roll with rudder deflection. Judicious use of rudder in the landing configuration at approach angles of attack can provide desired roll response. The ARI (aileron-rudder interconnect) feeds in rudder automatically to counteract yaw so that when large amounts of aileron are being used, the turns will be coordinated. Except for unusually asymmetrical external loadings or very rough, gusty air, only small lateral control motions are required for landing. The approach to stall is characterized by a decrease in lateral stability which becomes evident by a mild wing-rock (5° to 10°) which gets progressively worse as speed is reduced.

11.2.2.1.3 Clean Configuration. Lateral and directional control response is good in the clean configuration and the aircraft exhibits good pilot feel. Rate of roll is quite high in this area and directional stability is strong enough so that ball-centered turns are made without the use of rudder. During abrupt aileron rolls where some adverse yaw is experienced, the yaw damper is effective in keeping the ball centered.

11.2.2.2 Transonic Region

11.2.2.2.1 High Altitude. In the transonic region, longitudinal static stability becomes more positive and stabilator effectiveness somewhat reduced, resulting in slightly higher maneuvering stick force gradient. Transition from transonic to subsonic speeds while holding g on the aircraft results in a mild to moderate nose rise. If corrective action is not taken, this could place the aircraft in buffet at the higher altitudes or cause a significant load factor increase at the lower altitudes. This is characteristic of most swept-wing aircraft and is a result of going from an area of higher stability and lowered stabilator effectiveness to an area of lowered static stability and higher stabilator effectiveness. Speedbrakes increase the nose rise tendency during transition from transonic to subsonic speeds. Lateral and directional control in the transonic region is about the same as that experienced in the subsonic region except that roll rate capability is higher. Roll rates are highest in the transonic regions; however, in both transonic and subsonic regions, roll rate resulting from full aileron is much too great for any practical use.

11.2.2.2.2 Low Altitude. Transonic flight at low altitude presents low stick force gradient and high stabilator effectiveness which results in an area of high sensitivity and possible overcontrol. Even though the inherent dynamic stability of the aircraft is positive, it may be possible to create a short period longitudinal oscillation if the pilot response becomes out of phase with the aircraft motion, thereby inducing negative damping. Such a condition is commonly known as pilot-induced oscillation (PIO). Since the dampers will decrease the stabilator response to rapid stick inputs, the possibility of inducing PIO is minimized with dampers on. It is recommended that the stability augmentation be used when flying at high speeds and low altitudes. The standard and most effective recovery technique from a pilot-induced oscillation is to release the controls. An out-of-trim condition is conducive to PIO and releasing controls while stick forces are present, because of an out-of-trim condition, could amplify the oscillation. Therefore, it becomes advisable to trim out longitudinal stick forces during a rapid afterburner acceleration at low altitudes. It should be noted, however, that if longitudinal forces are trimmed out while maneuvering, an out-of-trim condition will be present when returning to wings-level flight necessitating a push-force to hold altitude. If the altitude of a mission is such that it would not be desirable to release the flight controls, recovery from a PIO can be accomplished by making the arm and body as rigid as possible, even bracing the left hand against the canopy and either holding the stick in the approximate trim position or by applying slight positive g-loading. In addition, afterburner shutdown at high indicated airspeeds can produce a pitch transient. Abrupt pitch inputs could cause an oscillation to begin; therefore, all corrections should be performed smoothly. Always lock the shoulder straps when flying under conditions of high speed and low altitude. The body, from the lap belt up, could become the forcing function during an inadvertent pitch input if the shoulder straps are unlocked.

11.2.2.3 Supersonic Region

11.2.2.3.1 High Altitude. Longitudinal static stability gets more positive as Mach number is increased in the supersonic region. Stabilator effectiveness decreases somewhat, so maneuvering stick forces become higher, but do not exceed 10 to 12 pounds per g. Maneuvering capability is limited by stabilator effectiveness at the higher Mach numbers at higher altitudes; for example, full aft stick at Mach 2 at 50,000 feet will produce about 3.5g. No abnormal lateral or directional control problems exist during supersonic flight. Directional stability remains strong and rate of roll, although decreasing with Mach number, remains quite adequate out to limit Mach numbers.

11.2.2.4 Effect of External Stores. The effect on longitudinal stability and control is discussed under paragraph 11.1.1, LONGITUDINAL STABILITY. Inertial effects are evidenced during abrupt pitch maneuvers at very high angles of attack. The most noticeable effect is the increase in inertia about the longitudinal axis. This shows up as simply reducing roll rate and rolling acceleration. In other words, it takes longer to build up a given roll rate, but once a roll rate is established, it takes longer to stop it. Most restrictions on high-speed flight with external stores are based on structural considerations.

11.2.2.5 Flight With Asymmetric Loading

11.2.2.5.1 Takeoff. Emergency takeoff and landing with asymmetric loadings can be made with an asymmetric load equivalent to one full external wing tank loaded on a clean aircraft. The recommended technique is essentially the same as that used for a crosswind. A strong turning moment into the heavy wing will exist during takeoff roll. This characteristic becomes more prominent during rapid acceleration. Nose gear steering and rudder (when rudder becomes effective) should be used for directional control. As the aircraft breaks ground, there is a tendency to roll into the heavy wing. Therefore, trimming ailerons prior to takeoff roll is desirable. The actual liftoff should not be abrupt. Establish an attitude and allow the aircraft to fly itself off the ground using rudder and aileron as required.

11.2.2.5.2 Maneuvering. Caution must be exercised because of a rapid buildup of asymmetric forces during maneuvering. Roll tendencies increase with load factor whereas control to counter this roll is a function of airspeed. Loss of lateral (roll) control can occur at angles of attack well below buffet and stall. Use of excessive lateral control (aileron) will produce adverse yaw. Control can be regained only when an airspeed is reached which will provide sufficient aerodynamic control to overcome the rolling force of the asymmetric load. The rolling moment produced by failure of one internal wing tank to transfer will be essentially undetectable in 1g flight. At higher load factors this rolling moment will become significant. Every asymmetric condition has airspeed/load factor combinations beyond which control cannot be maintained. Control can be regained only by an increase in airspeed and/or reduction of load factor.

11.2.2.5.3 Landing. When a significant asymmetric condition exists, determine the minimum control airspeed with one-half flaps and gear down (see paragraph 11.2.2.6, MINIMUM CONTROL AIRSPEED). Make an extended straight-in approach with one-half flaps at minimum control airspeed +10 knots. Directional trim is important, particularly to eliminate any sideslip from the side opposite the heavy wing. For large asymmetric loading, lateral trim may not be sufficient to trim the aircraft for wings level flight. However, for those conditions, lateral stick forces do not exceed 5 pounds and do not degrade the approach characteristics. If at any time lateral control becomes marginal, use rudder to obtain the roll response required and increase airspeed to increase lateral control effectiveness. During the approach, avoid abrupt or accelerated maneuvers, particularly an abrupt landing flare, since these may cause a strong roll into the heavy wing. Single- and double-engine emergency landing can be accomplished with asymmetric loadings up to the limits of Part V. Single-engine approaches are slightly worse than two-engine approaches because of asymmetric thrust characteristics. In a left turn with the right engine at IDLE and the asymmetric load on the right wing, full MIL thrust and nearly full left stick is required for a 25° banked turn. Similarly, with the engine operating on the side opposite the asymmetric load, increases in thrust on final result in yaw and roll into the heavy wing which must be countered with additional lateral stick opposite the asymmetric load. This characteristic is especially noticeable during single-engine AB waveoffs; however, the lateral control effectiveness increases rapidly with increasing airspeed. Approaches and landings can be accomplished in crosswinds up to 10 knots from the side opposite the heavy wing. To maintain maximum available lateral control in crosswind approaches, the technique of establishing a crab angle into the wind rather than the wing down technique is recommended. If possible, a runway should be selected such that the crosswind is from the same side as the asymmetric load. The aircraft should be landed on the downwind side of the runway because the advantages of the crosswind from the heavy wing side are reversed during landing rollout. The aircraft tends to weathercock into the wind during the normal landing rollouts especially with the drag chute deployed. The vertical tail, the drag chute, and the higher drag on the upwind wing (the asymmetric load) all tend to turn the aircraft into the wind. This tendency is more pronounced than any tendency to turn away from the heavy wing because of differential braking conditions. The weathercock into the wind can be satisfactorily countered with rudder and aileron opposite to the wind direction and the nosewheel steering as a last resort. For carrier operations, the same approach techniques apply.

Note

Refer to Chapter 4 and Part V for asymmetric load limitations.

11.2.2.6 Minimum Control Airspeed. Flying characteristics may be degraded under abnormal conditions of flight controls or configuration to the point that an airspeed higher than normal approach speed is required for adequate control during landing approach. Minimum control airspeed is that airspeed below which the aircraft can no longer be adequately controlled to a landing under existing conditions. This speed will vary as a function of aircraft condition, turbulence, temperature, field elevation, winds, and pilot experience. Minimum control airspeed should be determined at a safe altitude (normally 5,000 to 10,000 feet) through investigation of the flying characteristics by applying landing approach type roll, pitch, and thrust inputs while gradually slowing the aircraft. When aircraft reaction to flightpath-type corrections reaches a minimum acceptable response rate, minimum control airspeed has been reached and the aircraft must not be flown slower than this airspeed. Airspeed should normally be used as a reference because of possible errors in angle of attack because of aircraft yaw. Caution must be exercised so as not to take this investigation to the point of losing control of the aircraft. When minimum control airspeed is determined, a decision must then be made whether this airspeed is slow enough to accomplish a successful landing at available landing facilities. If a landing can be made, an additional 10 knots should always be added to minimum control airspeed to provide a safety margin for the landing approach. If landing cannot be safely accomplished, a controlled ejection should be made.

11.2.2.7 Heavy Gross Weight Operation

11.2.2.7.1 Takeoff. Consideration must be given to gross weight and cg effect on liftoff and nosewheel rotation speeds as discussed under paragraph 11.2.2.1, SUBSONIC REGION (Takeoff Configuration). Full aft stick takeoff is required to achieve handbook takeoff performance data.

11.2.2.7.2 Maneuvering. Aft cg conditions are usually encountered during heavy gross weight operation. Also, refer to paragraph 11.1.1, LONGITUDINAL STABILITY. For any given indicated airspeed, the aircraft will be at a higher angle of attack. This condition reduces the margin of angle of attack prior to stall. A significant change in flight characteristics occurs during air refueling because of the immediate increase in gross weight; mission planning must consider this change in aircraft flight characteristics.

11.2.2.7.3 Landing. Every reasonable technique must be pursued to attempt to reduce gross weight prior to an emergency landing. Excess weight reduces excess thrust, thereby narrowing the margin for recovery from any subsequent problem. Execute a wider-than-normal or straight-in landing pattern and avoid abrupt or accelerated maneuvers. Utilize available power (including afterburner) as required to preclude excessive sink rates.

11.2.3 Stalls

11.2.3.1 Cruise/Combat Configuration

11.2.3.1.1 Normal Stalls. Normal (1g) stalls are preceded by a wide band of buffet. First noticeable buffet occurs at 12 to 14 units angle of attack and usually increases from moderate to heavy buffet immediately prior to stall or departure. The rudder pedal shaker is activated at 21.3 units (20.6 units on aircraft 155529ag and up and all others after AFC 388); however, it may not be recognizable because of heavy buffet. Wing rock, if encountered, will commence at approximately 23 units and variations in bank angle of up to 30° from wings level can be expected near the stall. The angle of attack at stall varies with loading and is normally above 25 units. The stall is characterized by a slight nose rise and/or yawing motion in either direction. Recovery from the stall is easily and immediately effected when angle of attack is reduced by positioning the stick forward, maintaining neutral ailerons and making judicious use of rudder to avoid inducing excessive yaw.

11.2.3.1.2 Accelerated Stalls. Only general stall characteristics are discussed herein; specific characteristics vary with airspeed, Mach number, loading, center-of-gravity position, g level, aircraft attitude, and control techniques. Accelerated stalls are preceded by moderate buffet which increases to heavy buffet immediately prior to the stall. Wing rock is unpredictable, but generally starts at about 22 to 25 units and progresses to a high frequency, large amplitude roll oscillation. The amplitude of the roll oscillations will be less with a heavy wing loaded aircraft. The angle of attack at stall varies considerably with loading, but is above 25 units for all loadings. Rapidly entered accelerated stalls may occur at lower indicated angles of attack. Increasing the rate of aft stick displacement increases the magnitude and rate of yaw and roll oscillations at the stall. Applying and holding full aft stick, even with ailerons and rudder neutral, can result in a spin. Prompt neutralization of controls will effect recovery from an accelerated stall. Oscillations in roll and yaw, which may be present during recovery, should be allowed to damp themselves out and should not be countered with ailerons or rudder.

11.2.3.1.3 Inverted Stalls. An inverted (negative angle of attack) stall can only be obtained with abrupt application of full forward stick in vertical maneuvers or an inverted climb of greater than 20° noseup. Light to moderate buffet occurs at the stall and there are no distinct yaw or roll tendencies. Recovery from the inverted stall is effected by relaxing the forward stick pressure and maintaining an angle of attack between 5 and 10 units until recovered from the unusual attitude.

11.2.3.2 Landing Configuration Stalls

Note

> Do not practice landing configuration stalls above 10,000 feet. The effectiveness of the BLC system and engine bleed pressures decrease with altitude. Use of BLC above 10,000 feet may cause the systems using bleed air to become inoperative.

With the gear and flaps down, the stall occurs at approximately 24 units angle of attack and is characterized by simultaneous nose rise and apparent loss of lateral stability. With the flaps down and the landing gear up (bolter configuration), the stall angel of attack will be approximately 3 units lower because of the different airflow pattern over the fuselage mounted angle-of-attack probe with the nose gear retracted. There is virtually no increase in general airframe buffet during stall approaches, and very little aerodynamic warning (stick force lightening and wing rock is apparent prior to the stall). Stall warning is in the form of a rudder pedal shaker set at 21.3 units regardless of gear or flap position (20.6 units on aircraft 155529ag and up and all others after AFC 388). With the gear and flaps down, the pedal shaker actuates approximately 8 knots prior to the stall. In the bolter configuration, the pedal shaker does not provide stall warning; the only stall warning being stick forces lightening and slight wing rock just prior to the stall. The rate of increase of angle of attack above the stall is difficult to control and is a function of pitch rate and center-of-gravity position (aft cg most critical). Recovery from the stall is effected by placing the stick forward to reduce the angle of attack to below stall and increasing the throttles to MIL thrust. Recovery attitude is about 30° nosedown. Stalls with on-half flaps are similar to full-flap stalls.

11.2.4 Loss of Control. A loss of control or departure from controlled flight (departure) is best described as random motions about any or all axes. Departure characteristics are highly dependent on airspeed, Mach number, g level, type of entry, and loading. In addition to the stall warning discussed under normal and accelerated stalls, a buildup in sideforces (tendency to move the pilot to the side of the cockpit) will be encountered immediately prior to a departure. The sideforces may not be detectable in a high-speed, high-g condition where wing rock will be the most positive indication of impending departure. If angle of attack is not reduced to below stall, departures can be expected to develop into spins. The angle of attack at departure is highly dependent upon loading. Clean or Sparrows-only aircraft will depart at slightly greater than 30 units, while heavy wing loaded air-to-ground configurations may depart as low as 27 to 28 units. Departures are best prevented by proper control of angle of attack. Although aileron deflection may aggravate the situation, excessive angle of attack is the primary cause of departure. Ailerons or excessive rudder deflection at departure increase the probability of spin entry following departure. Departures are characterized by a yawing motion with roll in the direction of yaw. The yawing motion at departure will be more violent when encountered during a high-speed, high-g condition than during a low-speed, low-g condition. At the first indication of departure or when a nose high, rapidly decaying airspeed situation is encountered, attempt to reduce the angle of attack by moving the stick smoothly forward, simultaneously neutralizing ailerons and rudder. The throttles should be retarded to idle to reduce the probability of engine flameout unless, in the pilot's opinion, the altitude is so low that thrust will be required to minimize altitude loss during the recovery. The stick should be smoothly, yet positively, moved forward, but not jammed forward. Forward stick should be applied until negative g is felt or until full forward stick is reached. An aircraft unloading (zero or negative g) is the most positive indication of recovery. The majority of recoveries will be effected before the stick reaches the forward stop. If recovery is not apparent after the application of full forward stick, deploy the drag chute without hesitation. Large roll and yaw oscillations may be present during recoveries from departures. Angle-of-attack indications will be erroneous during these oscillations and should not be used as a departure recovery indication. Applying full forward stick and neutralizing ailerons and rudder is the most effective means of damping the oscillations and should be maintained until the oscillations cease. An out-of-control situation may be reentered if stick movement off the forward stop is commenced prior to aircraft unloading and the oscillations ceasing. A series of rolls at 15 to 20 units angle of attack may be encountered with full forward stick; however, the unloading will not be present. Do not attempt to fly out of this condition; rather maintain full forward stick until negative g is felt. Do not confuse the rolls with a spin. Maintain 5 to 10 units until airspeed is sufficient for dive pullout (approximately 200 knots). Use angle of attack to minimize altitude loss and do not exceed 19 units during dive pullout. Recovery action upon departure from controlled flight is as follows:

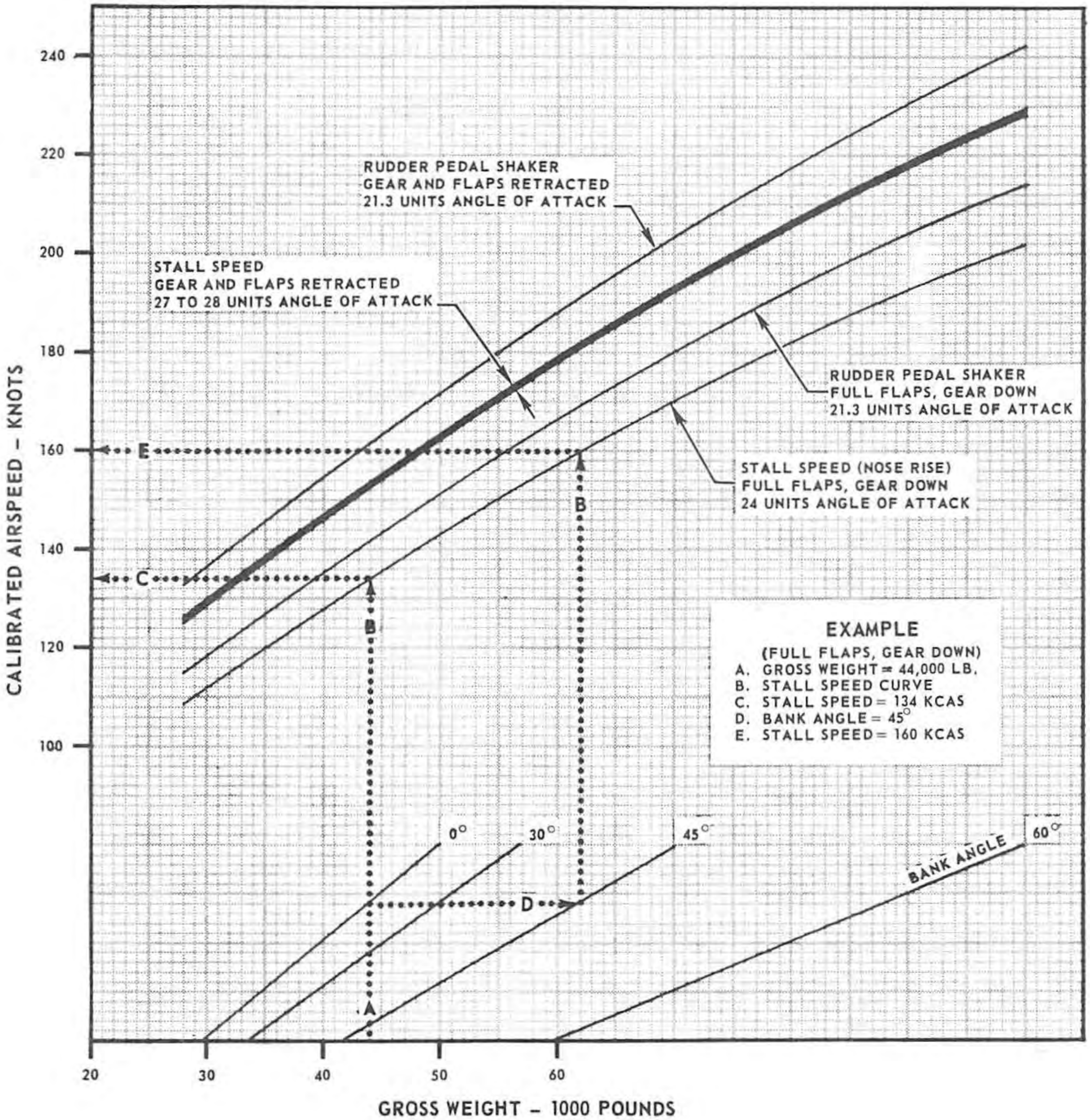
1. Smoothly apply forward stick to reduce angle of attack (full forward if necessary), simultaneously neutralizing aileron and rudder and reducing power to idle (altitude permitting).

2. If positive indications of recovery are not obvious after application of full forward stick, deploy the drag chute while maintaining full forward stick and neutral ailerons and rudder.

ALL CONFIGURATIONS

ALTITUDES
10,000 FEET AND BELOW
POWER-ON STALL SPEEDS

AIRCRAFT THRU 155528ag BEFORE AFC 388



FDD-1-(255)

Figure 11-6. Stall Speeds – F-4J (Sheet 1 of 2)

ALL CONFIGURATIONS

AIRCRAFT 155529ag AND UP, AND
ALL OTHERS AFTER AFC 388

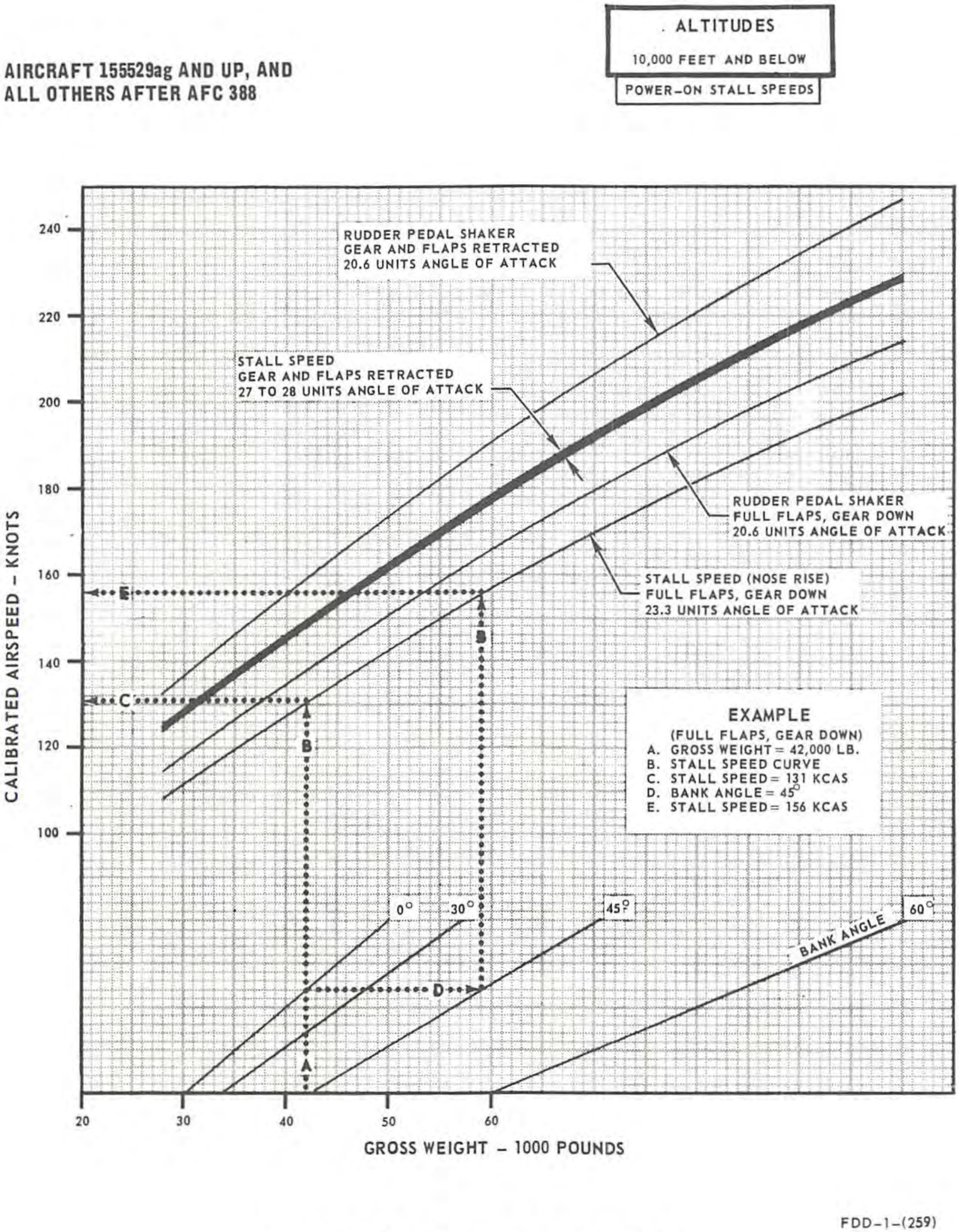


Figure 11-6. Stall Speeds – F-4J (Sheet 2 of 2)

3. Do not exceed 19 units during dive pullout.

Note

Engine stall or flameouts may occur during departure; however, engine relights can be obtained with the throttles at idle even during a developed spin. Disengage the AFCS if in use.

If the angle of attack has been reduced to below the stall, the aircraft will not spin. The drag chute should produce recovery shortly after deployment and will reduce the oscillations encountered during recovery. It is not necessary to jettison the chute since it will separate as airspeed builds up. The altitude loss following departure is dependent upon nose attitude at recovery, which is usually very nose low. Altitude loss pulling out of a 90° dive, initiated at 200 knots and utilizing 19 units, is approximately 5,000 feet. The out of control recovery procedure is summarized in Figure 11-7.

11.2.5 Spins. Spins have been entered from level flight stalls, accelerated turns, vertical climbs, 60° dive pullouts, and inverted climbs. Departure and spin characteristics were investigated with a clean aircraft, various heavy wing loadings, and with asymmetric loads. The angle-of-attack indicator is the primary instrument for verifying the type of spin (upright or inverted). During upright spins, the angle-of-attack indicator will be pegged at 30 units and during inverted spins will indicate zero units. The direction of spin can easily be determined from visual clues if ground reference is available; however, the direction of spin should be verified by referencing the turn needle (not the ball). The turn needle will always be pegged in the direction of the spin.

Note

Angle of attack may momentarily indicate less than 30 units (off the peg) during a spin; however, a sustained yawing motion in one direction verifies the spin condition.

The RIO should relay airspeed and altitude information to the pilot continuously during uncontrolled flight. If the airspeed is increasing through 200 knots, the aircraft is not spinning. Fly the aircraft.

11.2.5.1 Upright Spins

11.2.5.1.1 Steep Oscillatory Mode. The upright spin is oscillatory in pitch, roll, and yaw. The aircraft pitch attitude may vary from slightly above the horizon to 90° nosedown and large roll angle excursions will be encountered. Yaw rate in the spin may vary between 10° and 80° per second, while airspeed will vary between 80 and 150 knots. The altitude lost during an upright spin is approximately 2,000 feet per turn, and the spin turn rates average about 5 to 6 seconds per turn. Initially, spin oscillations may produce slightly uncomfortable accelerations in the cockpit; however, the oscillations should not be confusing. If recovery from the departure has not been effected after deploying the drag chute and the aircraft has been determined to be in an upright spin, POSITIVELY determine the spin direction and apply full aileron in the direction of the spin. Recovery from most spins will occur within two turns for a symmetrically loaded aircraft. The upright spin recovery procedure is:

1. Positively determine spin direction.

2. Maintain full forward stick and neutral rudder and apply full aileron in the direction of the spin (right turn needle deflection, right spin, right ailerons).

3. When the aircraft unloads (negative g) and/or yaw rate stops, neutralize the ailerons and fly out of the unusual attitude.

4. Do not exceed 19 units during dive pullout.

5. If still out of control by 10,000 feet above the terrain, EJECT.

The most positive indication of recovery from a spin is the aircraft unloading. Incidents have been encountered, however, where the yaw rate stopped and the aircraft entered 15 to 20 unit angle-of-attack rolls. If this occurs, the ailerons should be neutralized when the yaw rate stops and full forward stick maintained until the rolls cease and the aircraft unloads. Large excursions in roll and yaw may be encountered during recovery; do not mistake these excursions for a spin direction reversal. If the aircraft nose remains on one spot on the ground or horizon, the aircraft is rolling, not spinning. Spin direction reversals are rare using the recommended recovery procedure; however, if reversal occurs, again positively determine the spin

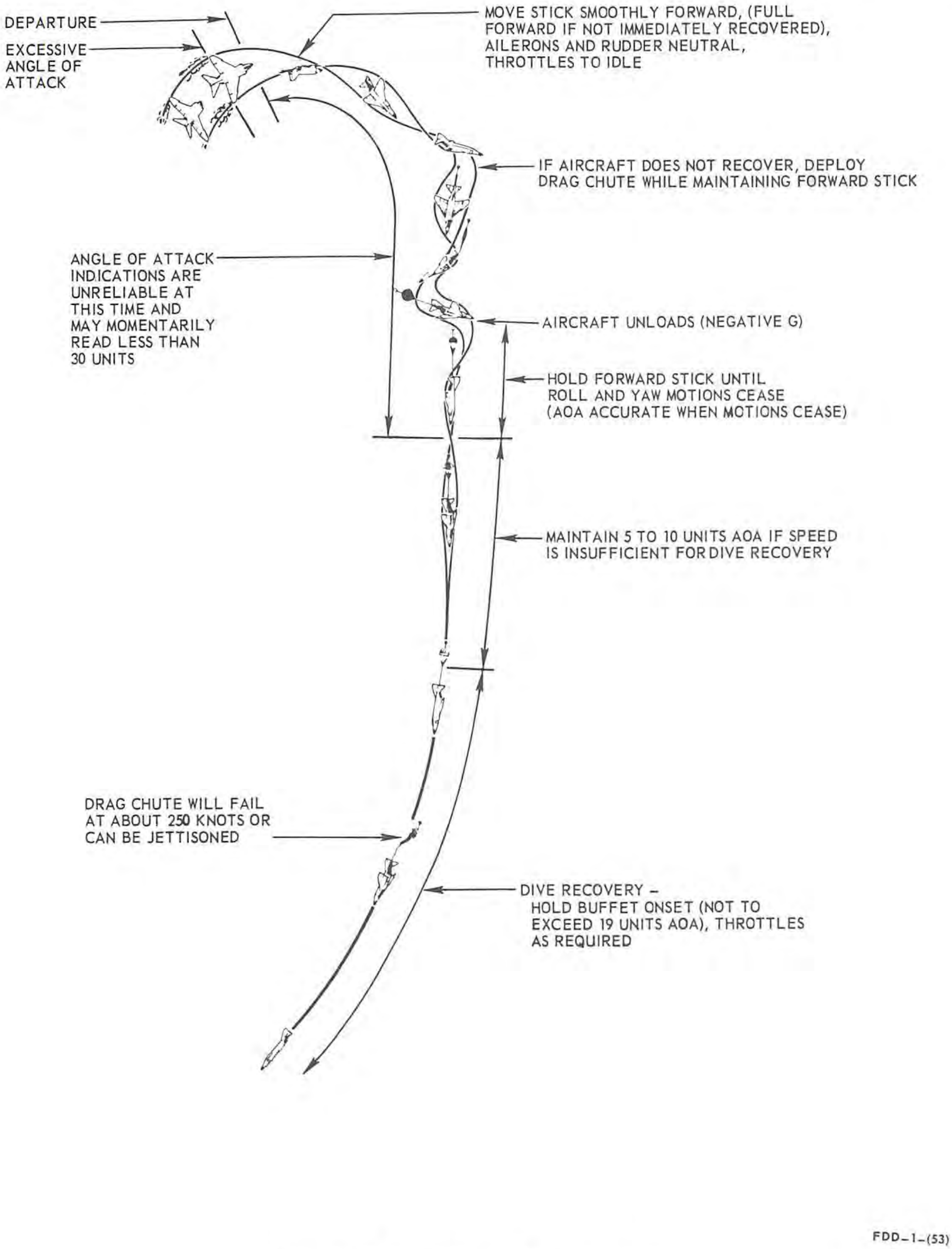


Figure 11-7. Out-of-Control Recovery – F-4J

direction and reapply the upright spin recovery procedure. An out-of-control situation will be reentered if aft stick pressure is applied prior to aircraft unloading and the oscillations ceasing. Maintain 5 to 10 units until airspeed is sufficient for dive pullout (approximately 200 knots). Total altitude loss from a departure that develops into a spin until flight is achieved can be as little as 10,000 feet; however, it will be closer to 15,000 feet if too much time is consumed determining spin direction. If the pilot considers that there is insufficient altitude for recovery, the crew should eject immediately. Figure 11-8 summarizes the upright spin recovery procedure.

11.2.5.1.2 Flat Mode. There have been isolated cases of the aircraft exhibiting an upright flat spin mode. The flat spin can develop within one or two turns after departure from controlled flight or after several turns of an upright steep oscillatory spin. Oscillations in pitch and roll are not apparent in the flat spin. The spin turn rate is 3 to 4 seconds per turn, and the altitude lost per turn is 1,000 to 1,500 feet. There is no known technique for recovery from a flat spin. Tests indicate that a very high angle of attack, well in excess of 30 units, is required for flat spin entry. Proper use of controls at departure will preclude entering a flat spin.

11.2.5.2 Inverted Spins. The aircraft is highly resistant to an inverted spin entry and tests indicate that prospin controls are necessary to maintain an inverted spin. The inverted spin is characterized by zero units indicated angle of attack and negative g and is less oscillatory than the upright steep oscillatory spin. Spin direction can be determined visually by the yawing motion of the aircraft or more positively by the deflection of the turn needle which is always pegged in the direction of the spin. Airspeed will vary up to 150 knots. During an inverted spin, roll rate is opposite yaw rate and can cause pilots to misinterpret spin direction. If recovery from uncontrolled flight is not effected by utilizing the out-of-control recovery procedure and the aircraft has been determined to be in an inverted spin, apply the following:

1. Positively determine the spin direction.

2. Full rudder against the spin (opposite the turn needle deflection).

3. Stabilator and ailerons neutral.

4. When the yaw rate stops, neutralize all controls and fly out of the unusual attitude.

5. Do not exceed 19 units AOA during recovery.

6. If still out of control at 10,000 feet AGL, EJECT.

The RIO should relay airspeed and altitude information to the pilot continuously during uncontrolled flight. This is particularly important in an apparent inverted spin, since airspeed may be the only recognizable difference between such a spin and a high-speed inverted spiral. Rudder deflection at negative angle of attack causes roll opposite to rudder. After recovery from an inverted spin, continued rudder deflection will probably cause entry into an opposite inverted spiral. Angle of attack and turn needle may cause the pilot to believe he is still in the spin as his interpretation of visual cues may be unreliable. The best indication the aircraft is in a spiral will be increasing airspeed and, possibly, high negative g forces (depending on stabilator trim and position). If airspeed is increasing through 200 knots, the aircraft is not spinning.

11.2.5.3 Engine Effects. Engine flameout (one or both) may occur during departure. The probability of engine flameout is greatest at MIL or MAX thrust and least at IDLE thrust. The best indication of a flameout is a MASTER CAUTION light and one or both GEN OUT lights. Engine relights can be accomplished at idle throttle setting during a spin. Normal operation of the flight controls will deteriorate if a relight is not accomplished. The RAT will not be effective while in a spin, but will be an immediate source of electrical power following spin recovery.

11.2.5.4 Asymmetric Load Effects. Aircraft departure and spin characteristics were tested to an asymmetric moment of 117,000 inch-pounds. An asymmetrically loaded aircraft will depart at a slightly lower angle of attack (approximately 25 to 27 units) and will always depart in the direction opposite the heavy wing. Asymmetric load spin characteristics are more oscillatory about all axes than spins with symmetric loads. With large asymmetric loads it may be impossible to prevent a spin if a departure occurs. The same procedures for recovery should be utilized for asymmetric load departures and spins as were presented for symmetric loads. Asymmetrically loaded configurations will require more turns for recovery than symmetrically loaded aircraft.

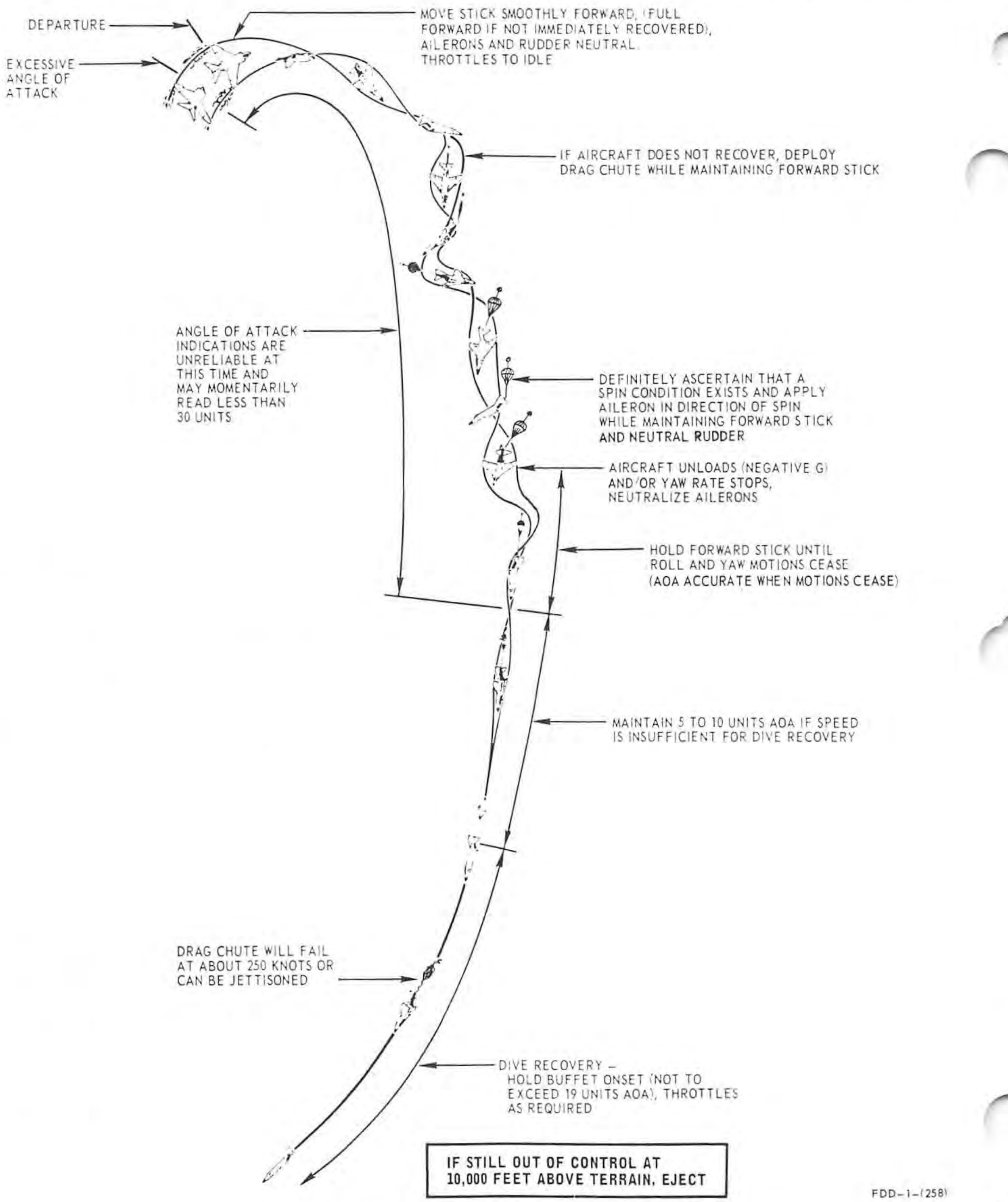


Figure 11-8. Spin Recovery – F-4J

CAUTION

Angle of attack should be closely monitored when maneuvering with an asymmetric load because of the possibility of entering a spin immediately following departure from controlled flight.

11.2.6 Zoom Climb. A zoom climb can be performed by accelerating to a high energy condition and then slowly rotating to a pitch attitude higher than normal climb. Pitch angles in excess of 60° detract from the zoom climb capability and produce more uncomfortable recovery conditions. During a zoom climb to altitudes above 65,000 feet, the EGT must be monitored. Afterburner blowout will usually occur around 67,000 to 70,000 feet. When the afterburners blow out, the throttles should be taken out of the afterburner range to preclude unexpected or hard lightoffs during descent. Above 70,000 feet, the engines will have to be shut down if they tend to overspeed or overtemperature. Engine windmill speed at altitudes above 70,000 feet are high enough to maintain some cockpit pressurization and normal electrical power. Stabilator effectiveness will decrease noticeably above 50,000 feet and an increased amount of aft stick will be required to hold a given pitch attitude. Zoom climb recovery can be initiated at anytime during the zoom maneuver by relaxing back pressure on the control stick and flying the aircraft over the top at a g loading which will prevent stall. Maintaining a constant value of angle of attack between 5 and 10 units will properly decrease g with decreasing airspeed during the recovery while still maintaining a safe positive g loading on the aircraft. Negative g recoveries are not recommended because of aircraft and physiological limitations and lack of pilot ability to detect impending stall. Two basic methods of recovering from the zoom climb are possible. A wings-level recovery can be effected by smoothly decreasing angle of attack to the minimum positive g value and holding this until the aircraft is diving. An inverted recovery can be effected by controlling angle of attack while rolling the aircraft to inverted and then increasing angle of attack to produce the maximum g loading on the aircraft. A comparison of the two techniques show that the positive g loading on the aircraft assists the recovery trajectory in the inverted case whereas it detracts from the recovery trajectory in the wings-level case. The resulting flatter trajectory of the wings-level recovery produces a lower minimum airspeed and higher maximum altitude over the top in addition to a longer overall recovery time. Although the inverted recovery is superior from the standpoint of speed, altitude, and exposure time, it exhibits certain risks because of pilot capabilities to properly control angle of attack during the rolling maneuvers. All zoom climb recoveries demand smooth coordinated control action. The angle-of-attack indication is the primary recovery aid regardless of recovery method. As speed decreases, the stabilator required to develop a given pitch command increases. Higher than normal stick displacements and rates will be necessary to command or hold angle of attack at very low speeds. Inadvertent pitch inputs because of abrupt roll action or pilot inattention to required pitch control can quickly put the aircraft in a stalled condition. Zoom climb recoveries initiated from indicated airspeeds in excess of 250 knots can be made inverted or wings-level. For the wings-level recovery, smoothly reduce angle of attack to 5 units and hold this value until the aircraft is in a recovery dive and speed has increased through 250 knots. Attempts to hasten the recovery by pushing over to a value below 5 units angle of attack will produce negative g on the aircraft and possible stall. Precise roll attitude is not important during the recovery. Any aileron used to correct or maintain roll attitude should be smooth and coordinated. For the inverted recovery, smoothly reduce angle of attack to 5 units and holding this value, smoothly roll the aircraft to inverted. Increase and hold angle of attack at 10 units to produce maximum safe g loading on the aircraft. When the aircraft is in an inverted recovery dive, the roll to wings-level must again be accomplished with smooth slow control action while holding angle of attack between 5 to 10 units. As before, angle of attack should be maintained in the recovery dive until airspeed builds up to 250 knots. Zoom climb recoveries initiated at airspeeds less than 250 knots should be accomplished with pilot's sole attention devoted to proper control of angle of attack between 5 to 10 units. Roll attitude should be completely ignored with aileron and rudder held generally neutral to maintain coordinated flight. In the event a pilot becomes confused or disoriented during any recovery, he should immediately concentrate only on angle of attack and ignore all other parameters. If angle of attack is maintained between 5 to 10 units, the aircraft will recover safely to a nosedown accelerating condition regardless of roll attitude.

11.3 F-4S CHARACTERISTICS

11.3.1 F-4S/F-4J Differences. The F-4S with leading edge slats instead of the blown leading flaps as on the F-4J possesses certain unique flight characteristics. Pilots transitioning from the nonslatted F-4 aircraft to the F-4S must be especially conscious of these differences. F-4S flight characteristics vary with AOA and cg position similar to the F-4J except that the changes occur somewhat more abruptly. At high speed (near 1.0 IMN) and low altitude with the cg near the aft limit, a self-sustaining pitch oscillation can be induced which is difficult for the pilot to dampen. At low speeds, gear and flaps up or down, particularly with an aft cg, there is a strong tendency for the aircraft to "dig in" or sharply overshoot desired AOA following an abrupt longitudinal stick input in either direction. The "dig-in" tendency is strongest when maneuvering near and slightly above optimum AOA. Above 25 to 26 units, the pitchup tendency is less. The F-4S also has less lateral control power than the F-4J with gear and flaps down, which can cause problems in turbulence or gusts on final approach.

11.3.2 Angle of Attack. Flight characteristics of swept-wing high performance aircraft like the F-4 are predictable and repeatable. The most significant factors influencing flight characteristics are angle of attack and static margin. Angle of attack is defined as that angle formed by the chord line of the wing and the aircraft flightpath (relative wind). Static margin is defined and discussed under paragraph 11.1.1, LONGITUDINAL STABILITY.

11.3.2.1 Low Angle-of-Attack Maneuvering. Induced drag is at a minimum at approximately 5 units angle of attack (nearly zero g); therefore, acceleration characteristics are exceptional. To achieve maximum performance acceleration from subsonic Mach numbers to supersonic flight, a 5-unit angle-of-attack pushover will provide minimum drag and allow gravity to enhance aircraft acceleration. This technique provides the minimum time, fuel, and distance to accelerate from subsonic Mach numbers to the optimum supersonic climb schedule. When confronted with a recovery from a condition of low airspeed and high pitch attitude, the angle-of-attack indicator becomes the primary recovery instrument. A smooth pushover to 5 units angle of attack will unload the aircraft and reduce the stall speed to nearly zero. Recovery can be accomplished safely at any speed which will provide stabilator effectiveness (ability to control angle of attack). Smooth control of angle of attack is a necessity, and no attempt to control bank angle or yaw should be made. High pitch angles with rapidly decreasing airspeed will result in loss of stabilator effectiveness and subsequent loss of control of angle of attack.

11.3.2.2 Medium Angle-of-Attack Maneuvering. Maneuvering at angles of attack from 5 to 20 units will produce normal aircraft response to control movement.

11.3.2.3 High Angle-of-Attack Maneuvering. Above 20 units angle of attack, aircraft response and flight characteristics begin to exhibit the changes expected in swept-wing high performance aircraft. The primary flight characteristics exhibited at high angles of attack are adverse yaw (yaw because of roll) and dihedral effect (roll because of yaw).

Prolonged operations above 30 units AOA should be avoided. The usable AOA of the slatted F-4S is generally defined by lateral-directional oscillations (wing rock) which may exceed 60° peak-to-peak angle of bank at 35 units AOA. Above 30 units AOA, the slatted F-4S is susceptible to yaw rate divergence. If operating above 30 units AOA, in order not to aggravate or induce excessive yaw, the pilot should:

1. Ensure neutral lateral controls.

2. Avoid abrupt or prolonged rudder inputs.

3. Use smooth applications of aft longitudinal stick.

4. Reduce AOA upon onset of rapid yaw rate.

11.3.2.3.1 Adverse Yaw. Attempts to roll the aircraft with lateral stick deflections (ailerons and spoilers) will result in yaw opposite to the direction of the intended turn. Rolling moments caused by this adverse yaw oppose the intended roll with increasing strength as AOA is increased. At approximately 30 units AOA, roll caused by adverse yaw cancels roll caused by lateral stick so that no roll occurs for even full lateral stick. Above 30 units AOA, roll caused by adverse yaw becomes predominant and roll occurs opposite to lateral stick deflections. However, since rudder effectiveness decreases above 33 units AOA, adverse yaw can overpower even full rudder and generate excessive yaw rates, causing departure and increasing the probability of spin entry. Because of their adverse effect, ailerons should be held neutral above 30 units AOA.

CAUTION

At the first indication of adverse yaw and resulting uncommanded roll, the ailerons must be neutralized.

Note

- With roll stab aug engaged, roll rates not commanded by lateral stick deflection will cause aileron deflection against the roll. At high angles of attack, this will cause prospin adverse yaw in opposition to rudder induced roll and will increase the probability of departure from controlled flight. Roll aug should be selected OFF for air combat maneuvering or flight above 25 units AOA.

- Use of LAU-17A pylons on wing stations 2 and 8 significantly improve F-4S high angle of attack stability and handling qualities. Installation of LAU-17A on wing stations 2 and 8 is recommended whenever high angle-of-attack maneuvering is contemplated.

11.3.2.3.2 Dihedral Effect. Attempts to yaw the aircraft with rudder will produce roll in the same direction as yaw. This dihedral effect becomes more pronounced at high angles of attack. The use of rudder inputs to produce yaw and, in turn, generate roll will provide the highest attainable roll rates at high angles of attack. Above 20 units angle of attack, desired roll should be generated primarily through use of the rudder.

11.3.2.3.3 Center-of-Gravity (CG) Effects. CG position creates a noticeable effect on high AOA flight characteristics. With the cg at its forward limit, it is possible to control AOA and reach the full aft stick stop with AOA stabilized below 40 units. At the aft cg limit, AOA control is very difficult above 21 units and frequent applications of forward stick are required to control uncommanded pitchups.

11.3.2.4 Landing. For F-4J/S before AFC 644/AVC 2494 and Amendment 1, the optimum approach (ON SPEED) indicated AOA with the landing gear down is 18.3 units and stall warning (rudder pedal shaker) is set at 20.6 units. For all F-4S after AFC 644/AVC 2494 and Amendment 1, the optimum approach (ON SPEED) indicated AOA with the landing gear down is 19.0 units and stall warning is set at 21.5 units. The angle-of-attack reference changes with nose gear position in the approach speed range. The indicated angle of attack increases approximately 3 units when the nose gear is extended. This change in indicated angle of attack with nose gear position is due to a change in the airflow pattern over the fuselage mounted angle-of-attack probe with the nose gear retracted. All references to indicated angle of attack should take this factor into consideration. Optimum approach angle of attack is adequate for all allowable gross weight and flap/slat configurations.

11.3.2.5 Minimum Performance Maneuvering. Maneuverability and handling qualities are degraded at lower airspeeds with sluggish response and low available g; therefore, maintain a minimum of 300 knots except during maximum range descent, holding, instrument approach, and landing. This airspeed provides reasonable handling qualities and adequate maneuver margin for terrain and collision avoidance.

11.3.2.6 Maximum Performance Maneuvering. The three factors that determine maximum performance maneuvering capability are structural limitations, stabilator effectiveness, and aerodynamic limitations. Structural limitations are outlined in Chapter 4. The limit in stabilator effectiveness occurs at high altitudes and supersonic speeds where full aft stick can be attained without reaching aerodynamic or structural limits. Aerodynamic limitations (stall) are primarily a function of angle of attack. In this area of flight, maximum performance turns are achieved by maintaining 19 to 20 units angle of attack while utilizing afterburner as required. The adverse yaw produced by the use of aileron during high angle-of-attack maximum performance maneuvering has been discussed and is of paramount importance in air combat maneuvering. If a high angle of attack must be maintained and a roll is necessary, rudder must be used to produce roll because of yaw as previously discussed. During maximum performance maneuvering, higher roll rates may be achieved by momentarily unloading the aircraft (reducing angle of attack to between 5 and 10 units), utilizing aileron to roll to the desired bank angle, then neutralizing aileron and reestablishing the required angle of attack. At the first indication of departure from controlled flight, controls must be neutralized to preclude aggravating the out-of-control condition. Maximum performance maneuvering must be fully understood and demonstrated by a qualified instructor pilot prior to attempting any practice in this area of flight.

11.3.2.6.1 Maneuvering Flight Rig Check. On all flights where high performance maneuvering (high angle of attack or high speed) is anticipated, a check of the aircraft rig and proper operation of the stab aug system shall be made.

1. Roll aug – DISENGAGE.

   With the aircraft trimmed for level flight at 350 to 400 knots, RIO observes ailerons and spoilers flush. High performance maneuvering shall not be attempted with the aircraft out of basic rig.

2. Pitch aug – ENGAGED.

   Pull 2g, then relax stick pressure. If pitch aug fails to dampen within one-half cycle, high performance maneuvering shall not be attempted.

3. Yaw aug – ENGAGED.

   Deflect slip indicator one ball width and release rudder. Ensure turn needle deflects in direction of rudder input. Yaw should dampen within 5 seconds. High performance maneuvering shall not be attempted with a defective yaw aug engaged or defective turn needle.

11.3.3 Handling Qualities. A large variation in handling qualities exists throughout the flight envelope. Considerations must be given to Mach number, cg position, airspeed, AOA, and external store loading. Refer to Figure 11-4 prior to flight to ensure stability limits are not exceeded.

11.3.3.1 Subsonic Region

11.3.3.1.1 Takeoff Configuration. Takeoff performance is based on aircraft gross weight and cg position. Liftoff speed is a function of gross weight and is essentially the speed at which the wings develop sufficient lift to raise the weight of the aircraft. Nosewheel liftoff speed is a function of cg, stabilator position, and gross weight. Nosewheel liftoff occurs when the noseup aerodynamic moment exceeds the nosedown weight moment. The stabilator cannot be stalled in the takeoff maneuver. Therefore, full aft stick takeoff technique (full leading edge down stabilator) provides the lowest nosewheel liftoff speed and the shortest takeoff distance. For full aft stick, the cg position will determine when the rotation begins: a lower speed than liftoff with an aft cg and a higher speed than liftoff with a forward cg. The rate of rotation is a function of aircraft acceleration (rate of buildup of down taillift) and cg. Therefore, because of the rapid buildup of pitch-rate at aft cg's, full aft or rapid stick displacements can cause overrotation following the nosewheel liftoff phase. In computing cg for takeoff, allowance must be made for the forward shift of cg during ground operation. The cg will move forward approximately 1 percent for every 1,000 pounds of internal fuel used. In the forward cg range, nosewheel liftoff speed is increased approximately 4 to 5 knots for every percent of forward cg movement. After nosewheel liftoff, desired pitch attitude is maintained by using whatever control movement is required.

11.3.3.1.2 Landing Configuration. In this configuration, the aircraft exhibits positive longitudinal static stability except for a mild pitchup at 22.5 units AOA. In the speed range between 130 to 180 knots, where most landing configuration flying is done, the aircraft demonstrates almost neutral stick force stability up to about 150 knots and mild stick force stability above this speed. This is due to control system friction and rather weak stick centering at this low Q. Stabilator effectiveness is reduced with full flaps because of an aft center-of-pressure shift and change in the downwash pattern over the tail. However, adequate effectiveness still remains for all known configurations. Since ground effect also decreases stabilator effectiveness, the aft stick-stop may be bumped during flareout from a high sink rate landing or with extreme forward cg. Stabilator effectiveness is not sufficient to hold the nose up after landing since the center of rotation is now about the main gear instead of the cg. Lateral and directional control response in the landing configuration is reasonably good; however, adverse yaw generated by high roll rates produces a decrease in commanded roll because of strong dihedral effect. This strong dihedral effect can be utilized in the landing configuration to provide roll with rudder deflection. Judicious use of rudder in the landing configuration at approach angles of attack can provide best roll response. The ARI (aileron-rudder interconnect) feeds in rudder automatically to counteract yaw so that when large amounts of aileron are being used, the turns will be coordinated. Except for unusually asymmetrical external loadings or very rough, gusty air, only small lateral control motions are required for landing. The approach to stall is characterized by a mild pitchup at approximately 22.5 units AOA. Mild wing-rock (10° to 20°) may occur, depending on configuration, commencing at 26 units AOA.

WARNING

Aircrews shall exercise extreme caution, such as a double landing interval, during calm or light wind conditions to avoid possible encounters with wake turbulence generated by preceding aircraft on final approach. Avoidance of wake turbulence is critical in the F-4S because of reduced lateral and directional control response in the landing configuration.

11.3.3.1.3 Clean Configuration. Lateral and directional control response is good in the clean configuration, and the aircraft exhibits good pilot feel. Rate of roll is quite high in this area, and directional stability is strong enough so that ball-centered turns are made without the use of rudder. During abrupt aileron rolls where some adverse yaw is experienced, the yaw damper is effective in keeping the ball centered.

11.3.3.2 Low-Altitude, High-Speed Region. Flight in the low-altitude, high-speed region is most critical at high subsonic airspeeds (475 KCAS to 0.95 Mach) where aircraft response is high and stick forces are low, resulting in an area of increased sensitivity and possible overcontrol. Even though the inherent dynamic stability of the aircraft is positive, it may be possible to create a short period longitudinal oscillation if the pilot response becomes out of phase with the aircraft motion, thereby inducing negative damping. Such a condition is commonly known as pilot-induced oscillation (PIO). Since pitch aug decreases the stabilator response to rapid stick inputs, the possibility of inducing PIO is reduced with pitch aug on. Stability augmentation should, therefore, be used when flying at high speeds and low altitudes. In addition, afterburner shutdown at high indicated airspeeds can produce pitch transients. Abrupt pitch inputs can also cause a pitch oscillation to start; therefore, all corrections should be performed smoothly. An out-of-trim condition is also conducive to PIO. Therefore, it is advisable to remain trimmed for approximately 1g flight while in the low-altitude, high-airspeed region. The standard and most effective recovery technique from a pilot-induced oscillation is to release the controls. If the altitude of a mission is such that it would not be desirable to release the controls, recovery from the PIO can be accomplished by freezing the stick in the approximate trim position or applying a slightly positive g loading. Always lock the shoulder straps and have the lap belt securely fastened when flying under conditions of high speed and low altitude. The body from the lap belt up could become the forcing function during an inadvertent pitch input if the shoulder straps were unlocked.

11.3.3.3 Transonic Region. A significant change in handling qualities occurs at 0.92 to 0.95 Mach where the shift of aerodynamic pressures are the greatest. Below this transition area, static longitudinal stability is low and stabilator effectiveness high, causing some pitch sensitivity and low stick forces. Above this Mach number, static longitudinal stability is higher as the pressures shift aft and stabilator effectiveness is somewhat lower, causing less sensitivity and higher stick forces. Consequently, during acceleration through this region, a slight nose drop or nose heaviness may be noted. Conversely, upon deceleration, a slight nose rise tendency (or dig in) may be noted which increases in magnitude with g and with decreasing altitude. If caution is not used, this tendency could place the aircraft in buffet at high altitude or cause a significant load factor increase at low altitude and high g levels with a possible resultant overstress. Speedbrakes increase this nose rise tendency. Lateral and directional control in the transonic region is about the same as that experienced in the subsonic region except that roll rate capability is slightly higher.

11.3.3.4 Supersonic Region

11.3.3.4.1 High Altitude. Longitudinal static stability gets more positive as Mach number is increased in the supersonic region. Stabilator effectiveness decreases somewhat, so maneuvering stick forces become higher but do not exceed 10 to 12 pounds per g. Maneuvering capability is limited by stabilator effectiveness at the higher Mach numbers at higher altitudes; for example, full aft stick at Mach 2 at 50,000 feet will produce about 3.5g. No abnormal lateral or directional control problems exist during supersonic flight. Directional stability remains strong and rate of roll, although decreasing with Mach number, remains quite adequate out to limit Mach numbers.

11.3.3.5 Effect of External Stores. The effect on longitudinal stability and control is discussed in paragraph 11.1.1, LONGITUDINAL STABILITY. Inertial effects are evidenced during abrupt pitch maneuvers at very high angles of attack. The most noticeable effect is the increase in inertia about the longitudinal axis. This shows up as simply reducing roll rate and rolling acceleration. In other words, it takes longer to build up a given roll rate, but once a roll rate is established, it takes longer to stop it. Most restrictions on high-speed flight with external stores are based on structural considerations.

11.3.3.6 Flight With Asymmetric Loading

11.3.3.6.1 Takeoff. Takeoff with asymmetric loadings equivalent to one full external wing tank is not recommended. However, mild asymmetric loading takeoffs may be conducted. The recommended technique is similar to that used for a crosswind. A strong turning moment into the heavy wing will exist during takeoff roll. This characteristic becomes more prominent during rapid acceleration. Nose gear steering and rudder should be used for directional control. As the aircraft breaks ground, there is a tendency to yaw and roll into the heavy wing, which should be countered with both rudder and lateral stick. Therefore, trimming some rudder and aileron deflection is desirable prior to takeoff roll. The actual liftoff should not be abrupt. Establish an attitude and allow the aircraft to fly itself off the ground using rudder and lateral stick as required.

11.3.3.6.2 Maneuvering. Caution must be exercised because of a rapid buildup of asymmetric forces during maneuvering. Roll tendencies increase with load factor whereas control to counter this roll is a function of airspeed. Loss of lateral (roll) control can occur at angles of attack well below buffet and stall. Use of excessive lateral control (aileron) will produce adverse yaw. Control can be regained only when an airspeed is reached which will provide sufficient aerodynamic control to overcome the rolling force of the asymmetrical load. The rolling moment produced by failure of one internal wing tank to transfer will be essentially undetectable in 1g flight. At higher load factors, this rolling moment will become significant. Every asymmetric condition has airspeed/low factor combinations beyond which control cannot be maintained. Control can be regained only by an increase in airspeed and/or reduction of load factor.

11.3.3.6.3 Landing. When a significant asymmetric condition exists, determine the minimum control airspeed. The flaps/slats DN-OUT configuration has been found adequate for asymmetry of up to one full and one empty external tank. However, flaps/slats 1/2-OUT may be desirable for greater asymmetry or compounding problems such as single-engine failure or trailing edge BLC or hydraulic problems (see paragraph 11.2.2.6, MINIMUM CONTROL AIRSPEED). Make an extended straight-in approach with flaps/slats DN-OUT or 1/2-OUT at minimum control airspeed +10 knots. Directional trim is important, particularly to eliminate any yaw into the heavy wing. For large asymmetric loadings, lateral trim may not be sufficient to trim the aircraft for wings-level flight. However, for those conditions, lateral stick forces do not exceed 5 pounds and do not degrade the approach characteristics. If at anytime lateral control becomes marginal, use rudder to obtain the roll response required and increase airspeed to increase lateral control effectiveness. Fly a crabbed approach away from the asymmetric store. This assures a balance of aerodynamic side forces and minimizes the need for lateral and lineup corrections. The correct amount of crab is determined by applying rudder to center the turn needle while holding wings level. Rudder trim may be adjusted to hold this crab angle. Do not kick out the crab prior to touchdown; otherwise, an uncontrollable roll into the heavy wing may occur even with full lateral stick. Avoid abrupt or accelerated maneuvers, particularly an abrupt landing flare, since these may cause a strong roll into the heavy wing. Single- and double-engine emergency landings can be accomplished with asymmetric loadings up to the limits of Part V. Single-engine approaches are slightly worse than two-engine approaches because of asymmetric thrust characteristics. In a left turn with the right engine at IDLE and the asymmetric load on the right wing, full MIL thrust and nearly full left stick is required for a 25° banked turn. Similarly, with the engine operating on the side opposite the asymmetric load, increases in thrust on final result in yaw and roll into the heavy wing which must be countered with additional rudder and lateral stick opposite the asymmetric load. This characteristic is especially noticeable during single-engine AB waveoffs; however, the lateral control effectiveness increases rapidly with increasing airspeed. Landings with an asymmetric load on the downwind side can be safely accomplished up to 5 knots of wind from the side of the light wing. Up to 25 knots of wind from the side of the heavy wing is allowable. To maintain maximum available lateral control in crosswind approaches, the techniques of establishing a crab angle into the wind rather than the wing down technique is required. If possible, a runway should be selected such that the crosswind is from the same side as the asymmetric load. The aircraft should be landed on the centerline of the runway. The aircraft tends to weathercock into the wind during normal landing rollouts, especially with the drag chute deployed. The vertical tail, the drag chute, and the higher drag on the upwind (the asymmetric load) all tend to turn the aircraft into the wind. This tendency is more pronounced than any tendency to turn away from the heavy wing because of differential braking conditions. The weathercock into the wind can be satisfactorily countered with rudder, aileron, and nosewheel steering opposite to the wind direction. For carrier operations, the same approach techniques apply.

CAUTION

- When attempting to land the F-4S with a significant asymmetric load (500 pounds or more on a wing station), all turns in the landing configuration should be made away from the heavy wing. This is especially important during high crosswind or gusty wind conditions.

- When landing the F-4S with a significant asymmetric load (500 pounds or more on a wing station), the crosswind component from the side of the light wing must be 5 knots or less because of limited lateral control effectiveness. A downwind landing may be preferable to exceeding this 5-knot limit.

Note

Refer to Chapter 4 and Part V for asymmetric load limitations.

11.3.3.7 Minimum Control Airspeed. Flying characteristics may be degraded under abnormal conditions of flight controls or configuration to the point that an airspeed higher than normal approach speed is required for adequate control during landing approach. Minimum control airspeed is that airspeed below which the aircraft can no longer be adequately controlled to a landing under existing conditions. This speed will vary as a function of aircraft conditions, turbulence, temperature, field elevation, winds, and pilot experience. Minimum control airspeed should be determined at a safe altitude (normally 5,000 to 10,000 feet) through investigation of the flying characteristics by applying landing approach type roll and pitch inputs while gradually slowing the aircraft. When aircraft reaction to flightpath-type corrections reaches a minimum acceptable response rate, minimum control airspeed has been reached and the aircraft must not be flown slower than this airspeed. Airspeed should normally be used as a reference because of possible errors in angle of attack because of aircraft yaw. Caution must be exercised so as not to take this investigation to the point of losing control of the aircraft. When minimum control airspeed is determined, a decision must then be made whether this airspeed is slow enough to accomplish a successful landing at available landing facilities. If a landing can be made, an additional 10 knots should always be added to minimum control airspeed to provide a safety margin for the landing approach. If landing cannot be safely accomplished, a controlled ejection should be made.

11.3.3.8 Heavy Gross Weight Operation

11.3.3.8.1 Takeoff. Consideration must be given to gross weight and cg effect on liftoff and nosewheel rotation speeds as discussed in paragraph 11.2.2.1, SUBSONIC REGION (Takeoff Configuration). Full aft stick takeoff is required to achieve handbook takeoff performance data, but because of the rapid buildup of pitch rate with aft cg positions, full aft or rapid aft stick displacements may cause overrotation during the nosewheel liftoff phase.

11.3.3.8.2 Maneuvering. Aft cg conditions are usually encountered during heavy gross weight operation. Also refer to paragraph 11.1.1, LONGITUDINAL STABILITY. For any given indicated airspeed, the aircraft will be at a higher angle of attack. This condition reduces the margin of attack prior to stall. A significant change in flight characteristics occurs during air refueling because of the immediate increase in gross weight; mission planning must consider this change in aircraft flight characteristics.

11.3.3.8.3 Landing. Every reasonable technique must be pursued to attempt to reduce gross weight prior to an emergency landing. Excess weight reduces excess thrust, thereby narrowing the margin for recovery from any subsequent problem. Execute a wider-than-normal or straight-in landing pattern and avoid abrupt or accelerated maneuvers. Utilize available power (including afterburner) as required to preclude excessive sink rates. With extreme aft cg, do not use full aft or rapid aft stick displacement immediately after landing as it is possible to overrotate and inadvertently scrape the stabilator tips or become airborne.

11.3.4 Stalls

11.3.4.1 Cruise/Combat Configuration

11.3.4.1.1 Normal Stalls. Normal (1g) stalls with leading edge slats are not easily defined since handling qualities change gradually with angle of attack until departure occurs. Additionally, wing lift increases smoothly with little buffet with increasing AOA; there is no classical stall defined by longitudinal nose rise or g break. However, it is important to control AOA to prevent excessive drag and airspeed loss as well as prevent departure.

Buffet is generally light and is of little use to determine AOA. Wing rock onset occurs at approximately 28 units, but may be delayed or totally absent if external wing stores are present. As AOA is further increased, wing rock (really a combination of yawing and rolling oscillations) becomes more noticeable with a relatively long period of about 4 or 5 seconds for a complete cycle. Attempts to counter these oscillations must be avoided since they are impossible to dampen and pilot inputs invariably aggravate the motions, hastening departure from controlled flight. Departure occurs generally above 35 units AOA and may be recognized by an excessive yaw rate (or nose slice) immediately followed by an uncommanded roll in the same direction. Recovery from the departure is effected by promptly positioning the stick forward to break the angle of attack while maintaining neutral ailerons and rudder.

11.3.4.1.2 Accelerated Stalls. Accelerated stalls (2g's or more) differ somewhat from normal stalls in that wing rock (if present) is quicker, requiring approximately 2 seconds per cycle at the higher airspeeds characteristic of accelerated maneuvers. Departure occurs generally at 32 to 35 units and is preceded by little warning. Departure may be recognized by a yaw (or nose slice), preceded by a buildup of side force, and immediately followed by an uncommanded roll in the same direction as the yaw. Depending upon the pilot's area of attention, the yaw may be unnoticed; but the roll is easily perceptible. At first recognition of the yaw or uncommanded roll, the stick should be moved forward briskly to reduce the angle of attack while maintaining neutral aileron and rudder.

11.3.4.1.3 Inverted Stalls. An inverted (negative angle of attack) stall can only be obtained with abrupt application of full forward stick in vertical maneuvers or an inverted climb of greater than 20° noseup. Light to moderate buffet occurs at the stall and there are no distinct yaw or roll tendencies. Recovery from the inverted stall is effected by relaxing the forward stick pressure and maintaining an angle of attack between 5 and 10 units until recovered from the unusual attitude.

11.3.4.2 Landing Configuration Stalls. With the gear down and flaps/slats 1/2-OUT or DN-OUT, the approach to stall is characterized by a mild pitchup or nose rise which occurs at 22.5 units AOA and by slight buffet. At 26 units AOA, the buffet becomes moderately heavy and moderate wing rock commences. However, with external wing stores, wing rock may be negligible or totally absent. At 28 units, the nose rise tendency decreases; however, the wing rock oscillations will continue to increase in amplitude. Recovery from the stall is effected by a moderate amount of forward stick to lower the AOA to less than 22 units. Aileron and rudder inputs remain positive in their effect all the way to 30 units. However, rudder is the most effective control for roll when at AOAs above 22 units. With the gear down and flaps/slats DN-OUT, the pedal shaker actuates approximately 8 knots prior to the stall. In the bolter configuration, the pedal shaker does not provide stall warning; the only stall warning being pitchup and stick force lightening prior to the stall. The rate of increase of angle of attack beyond pitchup is difficult to control and is a function of pitch rate and center-of-gravity position (aft cg most critical). Recovery from the stall is effected by placing the stick forward to reduce the angle of attack to below stall and increasing the throttles to MIL or MAX thrust. Recovery attitude is about 20° nosedown. Stalls with flaps/slats 1/2-OUT are similar to stalls with flaps/slats DN-OUT.

11.3.5 Loss of Control. A loss of control or departure from controlled flight (departure) is best described as random motions about any or all axes.

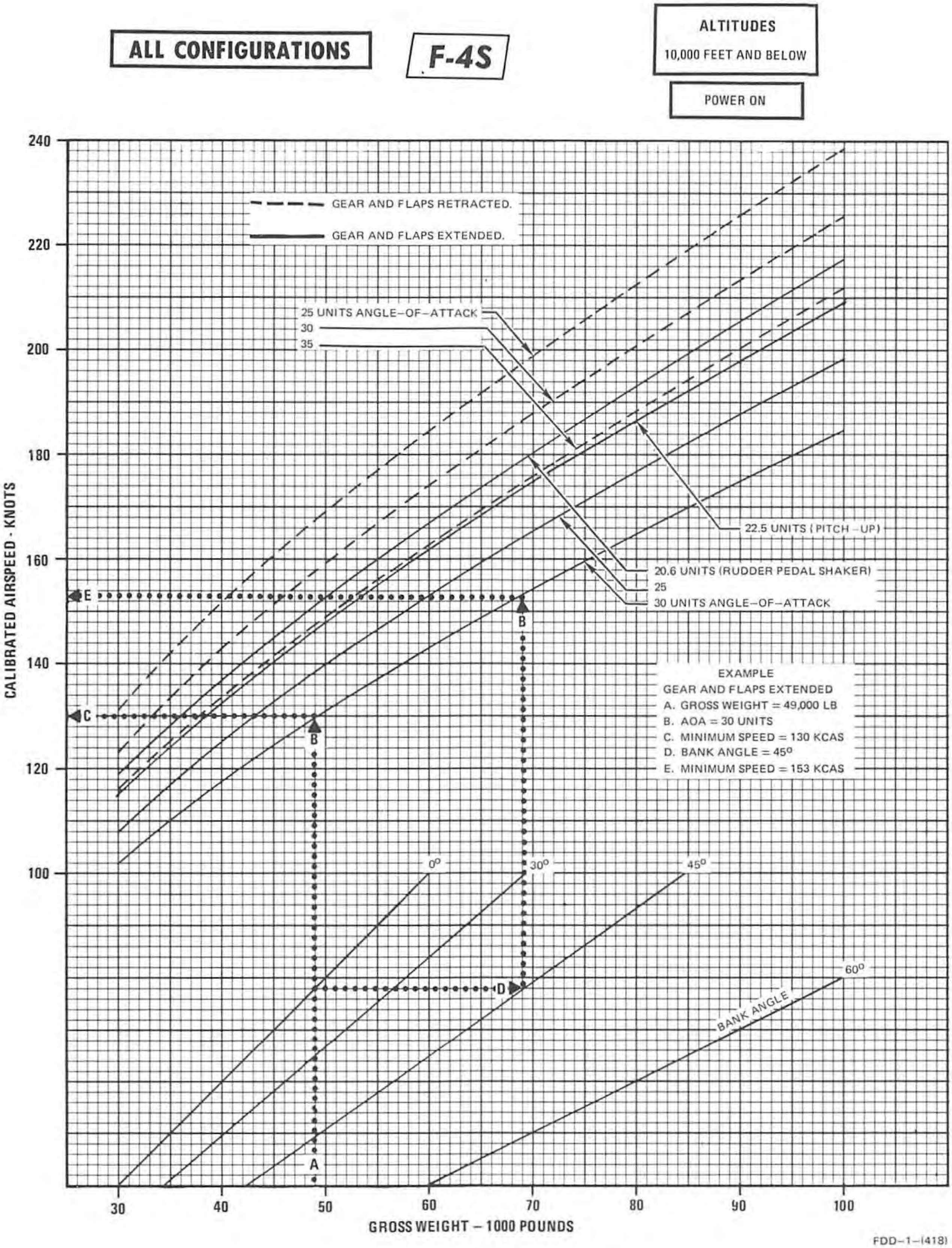


Figure 11-9. Minimum Speeds

Departure characteristics are highly dependent on airspeed, Mach number, g level, type of entry, and loading. In addition to the deteriorating flying qualities discussed under normal and accelerated stalls, a buildup in sideforces (tendency to move the pilot to the side of the cockpit) will be encountered immediately prior to a departure. If angle of attack is not reduced, departures can be expected to develop into spins. Departures are best prevented by proper control of angle of attack and yaw rate. Although aileron deflections aggravate the situation, excessive angle of attack is the primary cause of departure. Ailerons or excessive air rudder deflection at departure increase the probability of spin entry following departure. Departures are characterized by a yawing motion with roll in the direction of yaw. The yawing motion at departure will be more violent when encountered during a high-speed, high-g condition than during low-speed, low-g condition. At the first indication of departure, reduce the angle of attack by moving the stick smoothly forward, simultaneously neutralizing ailerons and rudder. The throttle should be retarded to idle to reduce the probability of engine flameout unless, in the pilot's opinion, the altitude is so low that thrust will be required to minimize altitude loss during the recovery. The stick should be promptly, yet smoothly, moved forward, but not jammed forward. Forward stick should be applied until negative g is felt or until full forward stick is reached. An aircraft unloading (zero or negative g) is the most positive indication of recovery. The majority of recoveries will be effected before the stick reaches the forward stop. If recovery is not apparent after the application of full forward stick, deploy the drag chute without hesitation. Large roll and yaw oscillations may be present during recoveries from departures. Angle-of-attack indications will be erroneous during these oscillations and should not be used as a departure recovery indication. Applying full forward stick and neutralizing ailerons and rudder is the most effective means of damping the oscillations and should be maintained until the oscillations cease. An out-of-control situation may be reentered if stick movement off the forward stop is commenced prior to aircraft unloading and the oscillations ceasing. A series of rolls at 15 to 20 units angle of attack may be encountered with full forward stick; however, the unloading will not be present. Do not attempt to fly out of this condition; rather maintain full forward stick until negative g is felt. Do not confuse the rolls with a spin. Maintain 5 to 10 units until airspeed is sufficient for dive pullout (approximately 200 knots). Use angle of attack of minimize altitude loss and do not exceed 25 units during dive pullout. Recovery action upon departure from controlled flight is as follows:

1. Smoothly apply forward stick to reduce angle of attack (full forward if necessary), simultaneously neutralizing aileron and rudder and reducing power to idle (altitude permitting).

2. If positive indications of recovery are not obvious after application of full forward stick, deploy the drag chute while maintaining full forward stick and neutral ailerons and rudder.

3. Do not exceed 25 units during dive pullout.

Note

Engine stall or flameouts may occur during departure; however, engine relights can be obtained with the throttles at idle even during a developed spin. Disengage the AFCS if in use.

If the angle of attack has been reduced to below 30 units, the aircraft will not spin. The drag chute should produce recovery shortly after deployment and will reduce the oscillations encountered during recovery. It is not necessary to jettison the chute since it will separate as airspeed builds up. The altitude loss following departure is dependent upon nose attitude at recovery, which is usually very nose low. Altitude loss pulling out of a 90° dive, initiated at 200 knots and utilizing 25 units, is approximately 4,000 feet. The out of control recovery procedure is summarized in Figure 11-10.

11.3.6 Spins. The spin characteristics of the F-4S are based on wind tunnel test and computer simulations. The angle-of-attack indicator is the primary instrument for verifying the type of spin (upright or inverted). During upright spins, the angle-of-attack indicator will be pegged at 42 units and during inverted spins will indicate zero units. The direction of spin can easily be determined from visual cues if ground reference is available; however, the direction of spin should be verified by referencing the turn needle (not the ball). The turn needle will always be pegged in the direction of the spin.

Note

Angle of attack may momentarily indicate less than 42 units (off the peg) during a

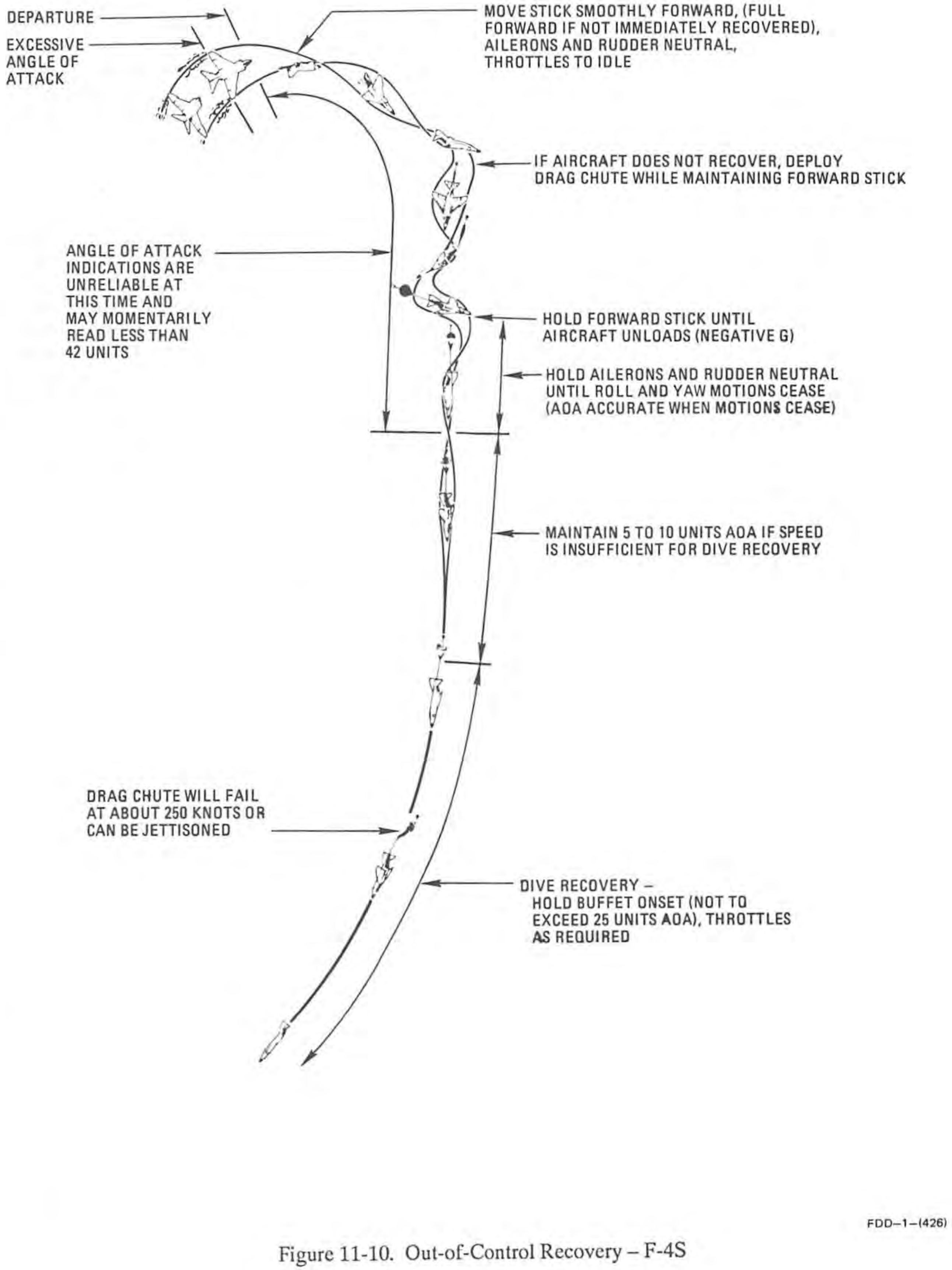


Figure 11-10. Out-of-Control Recovery – F-4S

spin. However, a sustained yawing motion in one direction verifies the spin condition.

The RIO should relay airspeed and altitude information to the pilot continuously during uncontrolled flight. If the airspeed is increasing through 200 knots, the aircraft is not spinning. Fly the aircraft.

11.3.6.1 Upright Spins

11.3.6.1.1 Steep Oscillatory Mode. The upright spin is oscillatory in pitch, roll, and yaw. The aircraft pitch attitude may vary from slightly above the horizon to 90° nosedown and large roll angle excursions will be encountered. Yaw rate in the spin may vary between 10° and 80° per second, while airspeed will vary between 80 and 150 knots. The altitude lost during an upright spin is approximately 2,000 feet per turn, and the spin turn rates average about 5 to 6 seconds per turn. Initially, spin oscillations may produce slightly uncomfortable accelerations in the cockpit; however, the oscillations should not be confusing. If recovery from the departure has not been effected after deploying the drag chute and the aircraft has been determined to be in an upright spin, POSITIVELY determine the spin direction and apply full lateral stick in the direction of the spin. Recovery from most spins will occur within two turns for a symmetrically loaded aircraft. The upright spin recovery procedure is:

1. Positively determine spin direction.

2. Maintain full forward stick and neutral rudder and apply full lateral stick in the direction of the spin (right turn needle deflection, right spin, right lateral stick).

3. When the aircraft unloads (negative g) and/or yaw rate stops, neutralize the ailerons and fly out of the unusual attitude.

4. Do not exceed 25 units during dive pullout.

5. If still out of control by 10,000 feet above the terrain, EJECT.

The most positive indication of recovery from a spin is the aircraft unloading. Incidents have been encountered, however, where the yaw rate stopped and the aircraft entered 15 to 20 unit angle-of attack rolls. If this occurs, the ailerons should be neutralized when the yaw rate stops and full forward stick maintained until the rolls cease and the aircraft unloads. Large excursions in roll and yaw may be encountered during recovery; do not mistake these excursions for a spin direction reversal. If the aircraft nose remains on one spot on the ground or horizon, the aircraft is rolling, not spinning. Spin direction reversals are rare using the recommended recovery procedure; however, if reversal occurs, again positively determine the spin direction and reapply the upright spin recovery procedure. An out-of-control situation will be reentered if aft stick pressure is applied prior to aircraft unloading and the oscillations ceasing. Maintain 5 to 10 units until airspeed is sufficient for dive pullout (approximately 200 knots). Total altitude loss from a departure that develops into a spin until level flight is achieved can be as little as 10,000 feet; however, it will be closer to 15,000 feet if too much time is consumed determining spin direction. If the pilot considers that there is insufficient altitude for recovery, the crew should eject immediately. Figure 11-11 summarizes the upright spin recovery procedure.

11.3.6.1.2 Flat Mode. There have been isolated cases of the F-4J exhibiting an upright flat spin mode. Computer simulation analysis of spin characteristics indicates the F-4S is more spin resistant than the F-4J and also exhibits a nonrecoverable upright flat spin mode. The flat spin can develop within one or two turns after departure from controlled flight or after several turns of an upright steep oscillatory spin. Oscillations in pitch and roll are not apparent in the flat spin. The spin turn rate is 3 to 5 seconds per turn, and the altitude lost per turn is 1,000 to 1,500 feet. Yaw rates are quite high and angle of attack is approximately 80° to 90°. There is no know technique for recovery from a flat spin. Tests indicate that a very high angle of attack, in excess of 35 units and misapplication of controls, is required for flat spin entry. Proper use of controls at departure will preclude entering a flat spin.

11.3.6.2 Inverted Spins. The aircraft is highly resistant to an inverted spin entry, and tests indicate that prospin controls are necessary to maintain inverted spin. The inverted spin is characterized by zero units indicated angle of attack and negative g and is less oscillatory than the upright steep oscillatory spin. Spin direction can be determined visually by the yawing motion of the aircraft or more positively by the deflection of the turn needle which is always pegged in the direction of the spin. Airspeed will vary up to 150 knots. During an inverted spin, roll rate is opposite yaw rate and can cause pilots to misinterpret spin di-

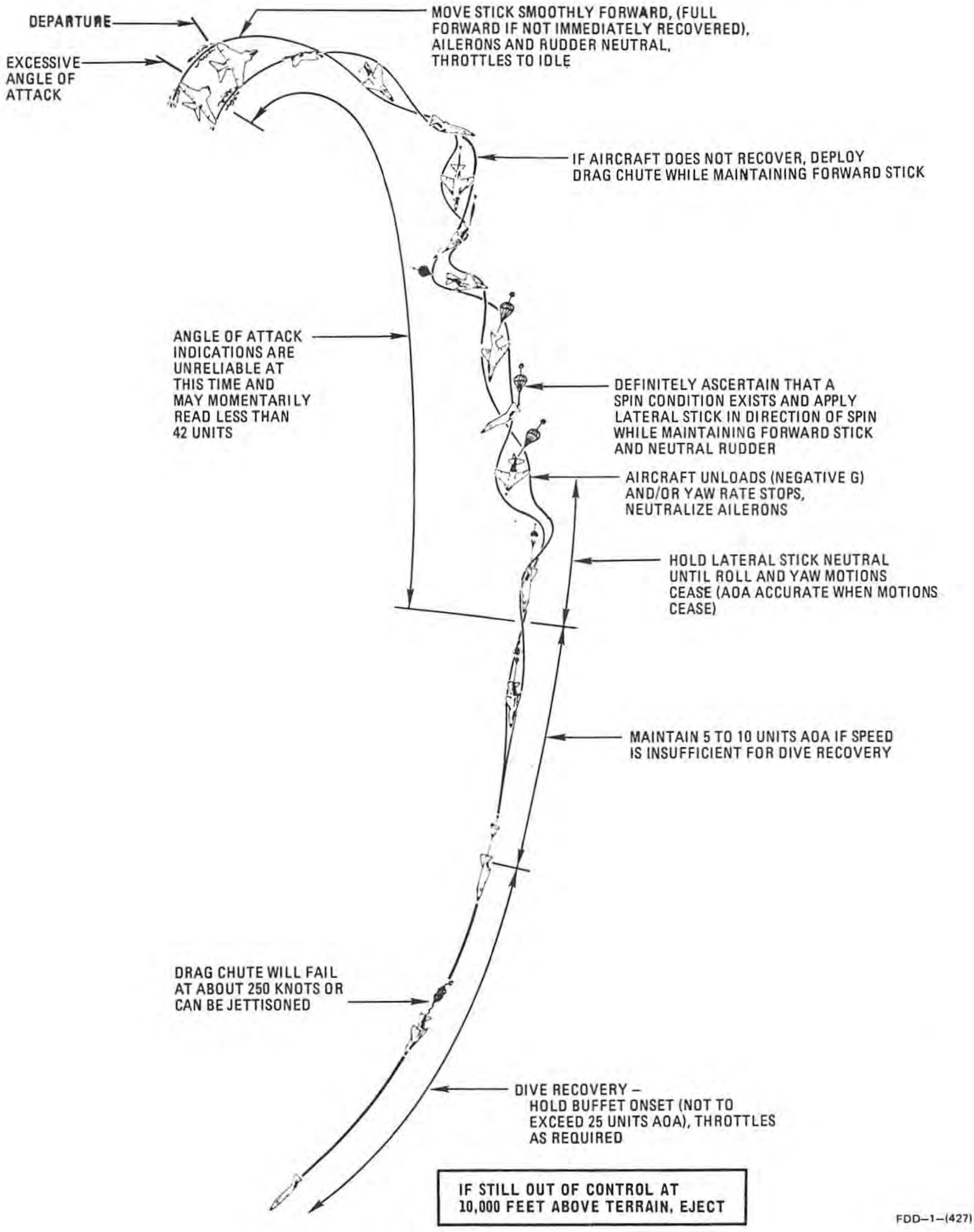


Figure 11-11. Spin Recovery – F-4S

rection. If recovery from uncontrolled flight is not effected by utilizing the out-of-control recovery procedure and the aircraft has been determined to be in an inverted spin, apply the following:

1. Positively determine the spin direction.

2. Full rudder against the spin (opposite the turn needle deflection).

3. Stabilator and ailerons neutral.

4. When the yaw rate stops, neutralize all controls and fly out of the unusual attitude.

5. Do not exceed 25 units AOA during recovery.

6. If still out of control at 10,000 feet AGL, EJECT.

The RIO should relay airspeed and altitude information to the pilot continuously during uncontrolled flight. This is particularly important in an apparent inverted spin, since airspeed may be the only recognizable difference between such a spin and a high-speed inverted spiral. Rudder deflection at negative angles of attack causes roll opposite to rudder. After recovery from an inverted spin, continued rudder deflection will probably cause entry into an opposite inverted spiral. Angle of attack and turn needle may cause the pilot to believe he is still in the spin as his interpretation of visual cues may be unreliable. The best indication the aircraft is in a spiral will be increasing airspeed and, possibly, high negative g forces (depending on stabilator trim and position). If airspeed is increasing through 200 knots, the aircraft is not spinning.

11.3.6.3 Engine Effects. Engine stall or flameout (one or both) may occur during departure. The probability of engine flameout is greatest at MIL or MAX thrust and least at IDLE thrust. The best indication of a flameout is a MASTER CAUTION light and one or both GEN OUT lights. Engine relights can be accomplished at idle throttle setting during a spin. Normal operation of the flight controls will deteriorate if a relight is not accomplished. The RAT will not be effective while in a spin, but will be an immediate source of electrical power following spin recovery.

Occasionally hung engine accelerations and/or afterburner cycling in addition to isolated self-recovering audible compressor stalls may occur with variable throttle operations above 30,000 feet and 30 units AOA. Above 35,000 feet, fixed throttle maneuvering above 30 units AOA may result in self-recovering engine stalls.

11.3.6.4 Asymmetric Load Effects. An asymmetrically loaded aircraft will depart at a slightly lower angle of attack (approximately 30 to 33 units) and will normally depart in the direction opposite the heavy wing. Asymmetric load spin characteristics are more oscillatory about all axes than spins with symmetric loads. With large asymmetric loads, it may be impossible to prevent a spin if a departure occurs. The same procedures for recovery should be utilized for asymmetric load departure and spins as were presented for symmetric loads. Asymmetrically loaded configurations will require more turns for recovery than symmetrically loaded aircraft.

CAUTION

Angle of attack should be closely monitored when maneuvering with an asymmetric load because of the possibility of entering a spin immediately following departure from controlled flight.

11.3.7 Zoom Climb. A zoom climb can be performed by accelerating to a high energy condition and then slowly rotating to a pitch attitude higher than normal climb. Pitch angles in excess of 60° detract from the zoom climb capability and produce more uncomfortable recovery conditions. During a zoom climb at altitudes above 65,000 feet, the EGT must be monitored. Afterburner blowout will usually occur around 67,000 to 70,000 feet. When the afterburners blow out, the throttles should be taken out of the afterburner range to preclude unexpected or hard lightoffs during descent. Above 70,000 feet, the engines will have to be shut down if they tend to overspeed or overtemperature. Engine windmill speed at altitudes above 70,000 feet are high enough to maintain some cockpit pressurization and normal electrical power. Stabilator effectiveness will decrease noticeably above 50,000 feet and an increased amount of aft stick will be required to hold a given pitch attitude. Zoom climb recovery can be initiated at any time during the zoom maneuver by relaxing back pressure on the control stick and flying the aircraft over the top at a g loading which will prevent stall. Maintaining a constant value of angle of attack between 5 and 10 units will properly decrease g with decreasing airspeed during the recovery while still maintaining a safe positive g loading on the aircraft. Negative g recoveries are not recommended because of aircraft and physiological limitations and lack of pilot ability to detect impending stall. Two basic methods of recovering from the zoom climb are possible. A wings-level recovery can be effected by smoothly decreasing angle of attack to the minimum positive g value and holding this until the aircraft is diving. An inverted recovery can be effected by controlling angle of attack while rolling the aircraft to inverted and then increasing angle of attack to produce maximum g loading on the aircraft. A comparison of the two techniques show that the positive g loading on the aircraft assists the recovery trajectory in the inverted case whereas it detracts from the recovery trajectory in the wings-level case. The resulting flatter trajectory of the wings-level recovery produces a lower minimum airspeed and higher maximum altitude over the top in addition to a longer overall recovery time. Although the inverted recovery is superior from the standpoint of speed, altitude, and exposure time, it exhibits certain risks because of pilot capabilities to properly control angle of attack during the rolling maneuvers. All zoom climb recoveries demand smooth coordinated control action. The angle-of-attack indication is the primary recovery aid regardless of recovery method. As speed decreases, the stabilator required to develop a given pitch command increases. Higher than normal stick displacements and rates will be necessary to command or hold angle of attack at very low speeds. Inadvertent pitch inputs caused by abrupt roll action or pilot inattention to required pitch control can quickly put the aircraft in a stalled condition. Zoom climb recoveries initiated from indicated airspeeds in excess of 250 knots can be made inverted or wings-level. For the wings-level recovery, smoothly reduce angle of attack to 5 units and hold this value until the aircraft is in a recovery dive and speed has increased through 250 knots. Attempts to hasten the recovery by pushing over to a value below 5 units angle of attack will produce negative g on the aircraft and possible stall. Precise roll attitude is not important during the recovery. Any aileron used to correct or maintain roll attitude should be smooth and coordinated. For the inverted recovery, smoothly reduce angle of attack to 5 units and holding this value, smoothly roll the aircraft to inverted. Increase and hold angle of attack at 10 units to produce maximum safe g loading on the aircraft. When the aircraft is in an inverted recovery dive, the roll to wings-level must again be accomplished with smooth slow control action while holding angle of attack between 5 to 10 units. As before, angle of attack should be maintained in the recovery dive until airspeed builds up to 250 knots. Zoom climb recoveries initiated at airspeeds less than 250 knots should be accomplished with pilot's sole attention devoted to proper control of angle of attack between 5 to 10 units. Roll attitude should be completely ignored with aileron and rudder held generally neutral to maintain coordinated flight. In the event a pilot becomes confused or disoriented during any recovery, he should immediately concentrate only on angle of attack and ignore all other parameters. If angle of attack is maintained between 5 to 10 units, the aircraft will recover safely to a nosedown accelerating condition regardless of roll attitude.

11.4 FORMATION FLIGHT

11.4.1 Parade Formation. The following description is a recommended guideline for pilots flying the aircraft in a basic parade position. This position is flown by the wingman placing the ramp hinge on the lead aircraft in line with the lead pilot's head, and placing his eye level directly abreast of the fuselage seam just aft of the wings on the lead aircraft. This triangulation should position the wingman at approximately a 6-foot stepdown with approximately 6 feet wingtip clearance. See Figure 11-12.

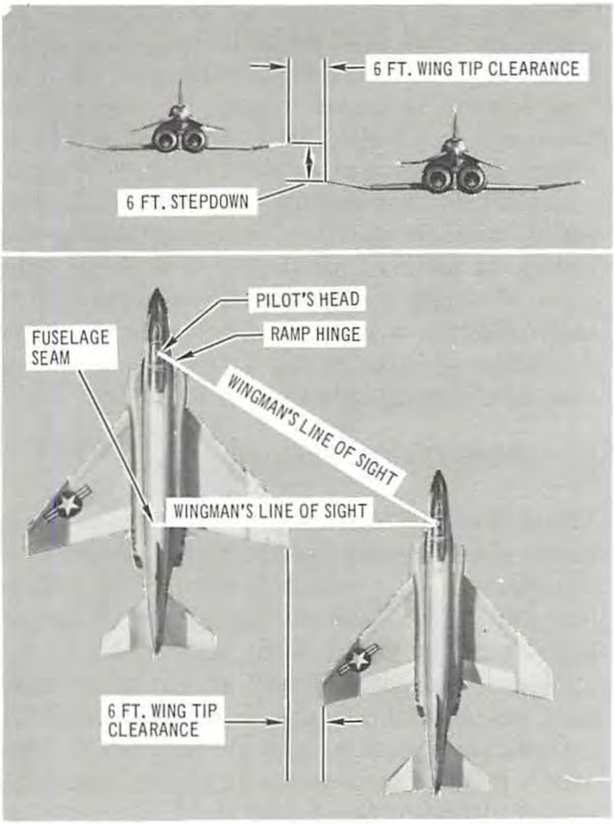
Note

> When flying formation, do not use flaps at an airspeed greater than 200 KCAS, since the variable actuation between flap airspeed pressure switches might cause unintentional retraction of one aircraft flaps while the flaps of the other aircraft remain down.

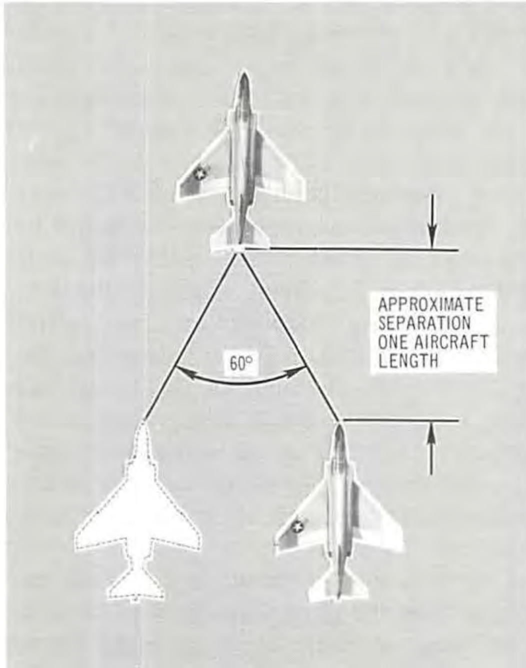
11.4.2 Free Cruise Formation. Free cruise formation allows for increased flight maneuverability and lookout coverage. The free cruise position is approximately one aircraft length nose-to-tail clearance, slightly stepped down (to avoid the leaders jet wash) and within a 60° cone aft of the leader. Power settings should be constant while maneuvering within the 60° cone.

11.4.3 Instrument Wing Formation. The position for instrument wing is identical to the parade position. All turns are performed on the axis of the leader. It is important to maintain this position to avoid possible vertigo in actual instrument conditions.

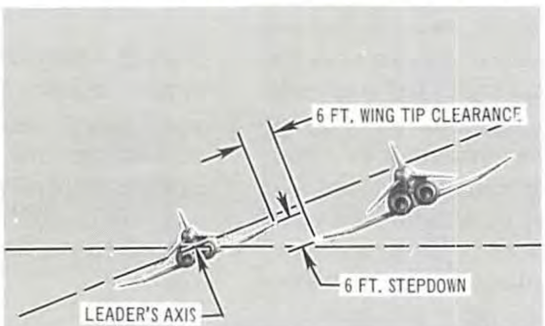
PARADE FORMATION



FREE CRUISE FORMATION



INSTRUMENT WING FORMATION



FDD-1-(63)

Figure 11-12. Formations

11.5 AIR REFUELING

Note

Before air refueling operations, each crewmember will become familiar with NATOPS Air Refueling Manual (NAVAIR 00-80T-110).

11.5.1 Probe Switch Operation. The air refuel probe switch has three positions marked RETRACT, EXTEND, and REFUEL. Placing the switch to EXTEND merely extends the air refueling probe. However, with the switch in this position, fuselage cell Nos. 1 and 3 can accept fuel if/when space is available. Selecting REFUEL conditions the fuel system by venting all tanks to atmosphere, shutting off tank pressurization air, opening the refueling level control valves in cell Nos. 3 and 5 and the wing tanks, and by opening the fuel shutoff valves to the external tanks (providing the refuel selection switch is in the ALL TANKS). Immediately after selecting the REFUEL position, monitor the sector portion of the fuel quantity gauge. If the fuel quantity shown on the sector depletes more rapidly than the fuel quantity shown on the counter, it is a positive indication that the defuel valve has failed open and that fuselage fuel is transferring into the internal wing tanks. If the wing tanks are sufficiently empty, the fuselage fuel may be depleted completely. Should this indication occur, move the refuel probe switch to the EXTEND position and allow fuel from the tanker to replenish the fuselage fuel tanks to approximately 6,000 pounds to guard against flameout. Then move the switch back to the REFUEL position and continue the air refueling. It is also possible to deplete the fuselage fuel supply when attempting wet plug-ins. Since all tanks are vented, no internal wing or external fuel will transfer. If an excessive amount of time is used in attempting a plug-in, the fuselage cells may deplete to a low fuel state. In this event, place the air refuel probe switch to EXTEND. This will permit the internal wing and external tanks to transfer to the engine feed tank. Once the engine feed tank is full, the switch may again be placed to REFUEL and air refueling resumed.

11.5.2 Before Plug-In. The Air Refueling Checklist should be completed prior to plug in.

1. Radar function switch – STBY.
2. Missile power switch – OFF (STBY with AIM-7D/E).
3. Arming switches – OFF/SAFE.
4. Internal wing dump switch – NORMAL.
5. Refuel probe switch – REFUEL (EXTEND for dry plug-ins).
6. Refuel selection switch – AS DESIRED.
7. Check probe fully extended.
8. Check REFUEL READY light illuminated.
9. Visor recommended down.

Note

A failed open defuel valve is indicated by a rapid depletion of fuel after selecting the REFUEL position.

For night air refueling:

10. Exterior lights – STEADY BRIGHT.
11. Air refuel probe light – ON.
12. Tanker lights – AS DESIRED.

11.5.3 Refueling Technique

WARNING

When receiving fuel from KC-135 tanker aircraft, the maximum total fuel on board shall not exceed 12,400 pounds of JP-4 or 13,200 pounds of JP-5. Failure to observe these limitations may result in overpressurization and rupture of the fuel tanks.

Note

The following procedures as applied to tanker operation refer only to single drogue refuelers.

Refueling altitudes and airspeed are dictated by receiver and/or tanker characteristics and operational needs, consistent with tanker performance and refueling capabilities. This, generally, covers a practical spectrum from the deck to 35,000 feet and 190 to 300 KCAS.

11.5.3.1 Approach. Once cleared to commence an approach, refueling checklists completed, assume a position 10 to 15 feet in trail of the drogue with the refueling probe in line in both the horizontal and vertical reference planes. Trim the aircraft in this stabilized approach position and ensure that the tanker (amber) ready light is illuminated before attempting an approach. Select a reference point on the tanker as a primary alignment guide during the approach phase; secondarily, rely on peripheral vision of the drogues and hose and supplementary remarks by the RIO. Increase power to establish an optimum 3- to 5-knot closure rate on the drogue. It must be emphasized that an excessive closure rate will cause a violent hose whip following contact and/or increase the danger of structural damage to the aircraft in the event of misalignment; whereas, too slow a closure rate results in the pilot fencing with the drogue as it oscillates in close proximity to the aircraft nose. During the final phase of the approach, the drogue has a tendency to move slightly upward and to the right as it passes the nose of the receiver aircraft because of the aircraft-drogue airstream interaction. Small corrections in the approach phase are acceptable; however, if alignment is off in the final phase, it is best to immediately retire to the initial approach position and commence another approach, compensating for previous misalignment by adjusting the reference point selected on the tanker. Small lateral corrections with a "shoulder probe" are made with the rudder and vertical corrections with the stabilator. Avoid any corrections about the longitudinal axis since they cause probe displacement in both the lateral and vertical reference planes.

CAUTION

Abrupt control inputs should be avoided as gross weight increases and cg moves aft because of the tendency of the F-4S to "dig-in" at high AOA. Rapid throttle movements or cycling afterburners with an aft cg condition will also aggravate the longitudinal stability problems during in-flight refueling. Aggressive stabs at the drogue should be avoided because of the possibility of pilot-induced oscillations (PIOs).

11.5.3.2 Missed Approach. If the receiver probe passes forward of the drogue basket without making contact, a missed approach should be initiated immediately. Also, if the probe impinges on the canopy lined rim of the basket and tips it, a missed approach should be initiated. Realization of this situation can be readily ascertained through the RIO. A missed approach is executed by reducing power and backing to the rear at an opening rate commensurate with the optimum 3- to 5-knot closure rate made on an approach. By continuing an approach past the basket, a pilot might hook his probe over the hose and/or permit the drogue to contact the receiver aircraft fuselage. Either of the two aforementioned hazards require more skill to calmly unravel the hose and drogue without causing further damage than to make another approach. If the initial approach position is well in line with the drogue, the chance of hooking the hose is diminished when last minute corrections are kept to a minimum. After executing a missed approach, analyze previous misalignment problems and apply positive corrections to preclude a hazardous tendency to blindly stab at the drogue.

11.5.3.3 Contact. When the receiver probe engages the basket, it will seat itself into the drogue coupling and a slight ripple will be evident in the refueling hose. Here again the RIO can readily inform the pilot by calling contact. The tanker drogue and hose must be pushed forward 3 to 5 feet by the receiver probe before fuel transfer can be effected. This advanced position is evident by the tanker (amber) ready light going out and the (green) fuel transfer light coming on. The tanker (green) fuel transfer light will illuminate only when the receiver aircraft has the REFUEL position selected and the tanker has all required switches selected and other conditions met. While plugged-in, merely fly a close tail chase formation on the tanker. Although this tucked-in condition restricts tanker maneuverability, gradual changes involving heading, altitude, and/or airspeed may be made. A sharp lookout doctrine must be maintained because of the precise flying imposed on both the tanker and receiver pilots. In this respect, the tanker can be assisted by other aircraft in the formation. The receiver RIO can also assist in maintaining a visual lookout since the receiver radar is in the STBY position.

Note

With gross weight above 48,000 pounds when tanking in the 190 to 210 knot region, high power settings and one-half flaps may be required. If tobogganing is used with one-half flaps, there is a possibility of flap blowup.

11.5.3.4 Disengagement. Disengagement from a successful contract is accomplished by reducing power and backing out at a 3- to 5-knot separation rate. Care should be taken to maintain the same relative alignment on the tanker as upon engagement. The receiver probe will separate from the drogue coupling when the hose reaches full extension. When clear of the drogue, place the refueling probe switch in the RETRACT position. Ensure that the IFR PROBE UNLOCK light is extinguished on the telelight panel before resuming normal flight operations. At night, turn off the probe floodlight.

11.5.4 Buddy Tank System

11.5.4.1 Before Takeoff

1. Buddy tank – SERVICED.
   a. Filler cap – SECURE.
   b. Guillotine cartridge – INSTALLED.
2. Hose jettison switch – OFF.
3. Power switch – OFF.
4. Transfer switch – OFF.
5. Hose control switch – RET.
6. Light switch – AS REQUIRED.

   For daylight refueling, place the light switch to BRT; for night refueling, place the light switch to DIM.

7. Buddy fill switch – STOP FILL.

11.5.4.2 Air Refueling

1. Power switch – ON.
2. Hose control switch – EXT.

   If the airstream driven turbine is not at governed speed when the hose control switch is placed to EXT, the drogue may momentarily delay ejection into the airstream.

3. Buddy fill switch – AS DESIRED.

   To transfer buddy tank fuel only, the buddy fill switch must be in the STOP FILL position. To transfer buddy tank fuel plus aircraft (tanker) fuel, the buddy fill switch must be held in the FILL position.

4. Drogue position indicator – EXT.

   When the hose and drogue are fully extended, the amber READY light on the tailcone will illuminate and the drogue position indicator will display EXT.

5. Fuel transfer switch – TRANS.
6. Drogue position indicator – TRA.

   After engagement of the drogue and the hose has been retracted a minimum of 2 feet, the green transfer light on the tailcone will illuminate and the drogue position indicator will read TRA.

7. Gallons delivered indicator – MONITOR.

   Periodically check the total gallons transferred. Do not transfer excessive amounts of internal fuel.

8. Fuel transfer switch – OFF.

   Upon completion of refueling, place the buddy fuel transfer switch to OFF.

9. Hose control switch – RET.
10. Drogue position indicator – RET.

    When the hose and drogue are completely retracted, the drogue position indicator will read RET.

11. Power switch – OFF.

11.5.5 Buddy Tank Emergencies

11.5.5.1 Hose and Drogue Jettisoning. A violently whipping hose and drogue or the inability to retract the hose for any reason may require hose and drogue jettisoning. To jettison the hose and drogue, proceed as follows:

1. Hose jettison switch – CUT.

CAUTION

Do not change the position of the hose jettison switch after being placed to CUT. If the switch is positioned to NORMAL after jettisoning, the buddy tank electrical system will become energized.

Note

The guillotine may not fire immediately since there is an electrical holding relay that will not close until the hose-reel mechanism is locked. Once the hose-reel mechanism locks, the guillotine hose cutter will fire.

11.5.5.2 Buddy Tank Jettisoning. The buddy tank may be jettisoned individually from the centerline station or it may be jettisoned along with all external stores. Refer to Figure 12-16.

11.6 A/A47U-3/4 TOW PROCEDURES

CAUTION

Failure to adhere to the following preflight and poststart checks and flight procedures during any flight with the RMK-19/31 installed may result in damage to the reel or to the aircraft.

11.6.1 Preflight Check

1. Confirm ground crew preflight checks which include:

   a. Towline threaded through the cable cutters, cutter cartridges installed, and the cutter assembly lockwired.

   b. Spool locks secure and lockwired.

   c. Level-wind drive in line with cable-on spool and secure.

   d. Towline evenly wound with no snarls.

   e. Oil level checked.

   f. Ram air turbine blade guard removed.

2. Check the following:

   a. Pneumatic pressure – 2,900 PSI (2,900 psi minimum).

   b. Target secure in launcher. If a drag launch target, 250 to 300 feet takeoff leader unwound and tow fitting installed on leader. Target will be installed when in position on runway or taxi area.

   Note

   Determine and note length of unwound towline. This length must be added to all cockpit towline length readings.

   c. Ram air turbine spinner and blades free of unblended nicks, scratches, and dents.

   d. Brakes on the blades feathered.

   e. Access panels secure.

CAUTION

For flight missions not involving towing, accomplish above preflight checks. Additionally, ensure that either the towline is secured or the target adapter is latched in the launcher if a target is not installed.

11.6.2 Poststart Check

1. All the indicator lights OFF.

   Note

   If a target is not installed or for drag launching, TGT OUT light will be ON.

2. Press-to-test indicator lights on the control panel.

3. Towline length indicator reset to zero.

4. Tension indicator 0 to 200 pounds.

5. Brake ON.

6. Launcher in UP position.

Note

The LOW AIR light, TGT OUT light, IN ANGLE and OUT ANGLE light, and EMER PWR are considered critical to flight.

11.6.3 TDU-22/37/34 Tow Procedures

11.6.3.1 Poststart Check

1. Complete steps 1 through 6 in the A/A47U-3/4 tow procedures poststart check.

2. Confirm safety in and flag removed.

11.6.3.2 Launching (225 to 275 KIAS, 0.75 IMN, and Level Flight)

CAUTION

Operation of the A/A47U-3A/4 tow systems with towline deployed in the close vicinity of stratus layers is not recommended. Differences in electrical potential between parallel cloud layers or cloud layers and the surface may develop into an electrical discharge through the aircraft and towline resulting in loss of the towline and/or damage to the aircraft.

1. Beep IN ANGLE until IN ANGLE light comes ON.

Note

Assure sufficient altitude for reeling and towing operations before launching (see Figure 11-13). Use 220 KIAS separation data during reeling out.

2. Brake OFF.

3. Use LAUNCHER DOWN until LCHR DOWN light comes on.

Note

Launcher may not extend until OUT ANGLE light comes on.

4. Use OUT ANGLE until IN ANGLE light goes out, OUT ANGLE light comes on, TGT OUT light comes on, and TOWLINE LENGTH increases. Chase plane, if available, confirms target away.

5. Use LAUNCHER UP until LCHR DOWN light goes out.

11.6.3.3 Reeling Out (275 KIAS Airspeed Using a Maximum Bank Angle of 20°)

Note

Each tension indicator division reads 200 pounds.

1. Use OUT ANGLE to increase reeling speed. Speed X 10 light comes on, speed indicator changes to high range, tension increases.

Note

Operation of the RMK-19/31 is manually controlled with automatic acceleration and overspeed protection. All controls are operable at anytime without significant damage to the equipment. Brake operation above 100 feet per minute reeling speed may result in loss of the target. When reeling, 500 feet of towline reeling length must be allowed for each 1,000 feet per minute of reeling speed to perform a normal stopping sequence. Reeling speeds up to a maximum of 5,000 feet per minute are allowed, but are advisable only when lengths in excess of 10,000 feet are to be streamed. Towline tension limits for stepped (varying diameter) towline can be exceeded at line lengths in excess of 8,000 feet.

11.6.3.4 Stopping and Secure for Towing

1. Use IN ANGLE until speed decreases to 0 feet per minute; OUT ANGLE light goes out and IN ANGLE may come on.

TDU-34/A & TDU-37/B TOW TARGETS NADC P/N TE 20851 (30,000 FT.)
STEPPED-DIAMETER TOWLINE

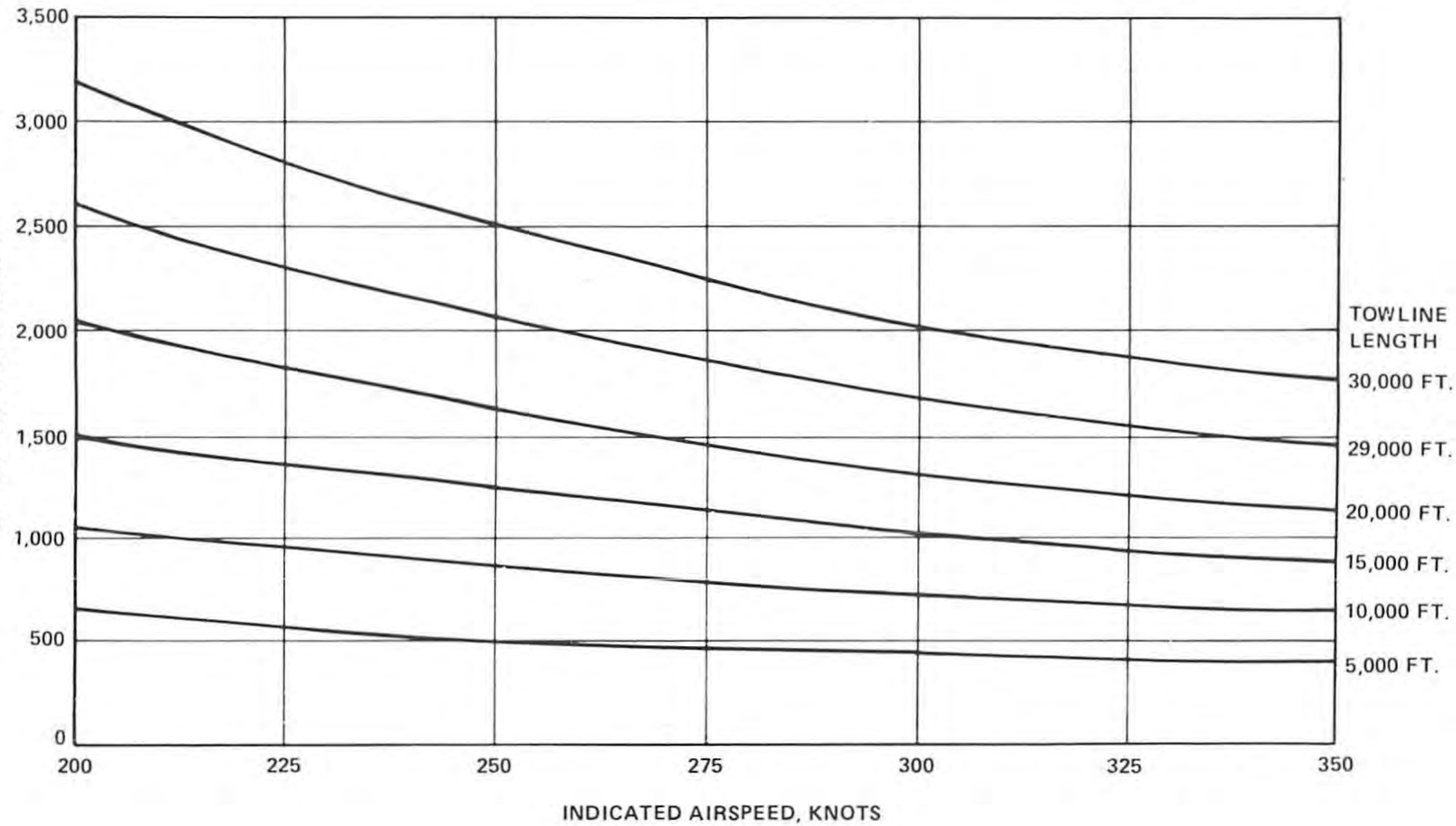


Figure 11-13. Vertical Separation Versus Airspeed

When desired towline length is obtained and the TOWLINE LENGTH and TOWLINE SPEED indicators indicate that the ram air turbine is stopped:

2. Brake ON.

3. Adjust blade angle so that both OUT and IN ANGLE lights are out.

4. Adhere to flight limitations (Figure 11-14).

CAUTION

Turning the aircraft will cause the target to lose altitude. If at low altitude, it is recommended that a climb be initiated before commencing a turn.

11.6.3.5 Recovering (225 to 275 KIAS and Level Flight)

CAUTION

When recovering the target, assure that SPEED X 10 light is out and TOWLINE SPEED indicator has changed to low range before TOWLINE LENGTH has decreased to 500 feet.

1. Use OUT ANGLE to decrease reeling speed, SPEED X 10 light goes out when TOWLINE SPEED indicator changes to low range for recovery.

2. At approximately 500 feet, select LAUNCHER DOWN, LCHR DOWN light comes on.

3. Adjust blade angle for recovery speed of approximately 200 feet per minute when 100 feet of cable is streamed, and then use approximately 50 feet per minute until launcher contact.

4. When target contacts launcher, beep IN ANGLE until IN ANGLE light comes on, TGT OUT light goes off, TOWLINE SPEED is zero, and TOWLINE LENGTH stops changing. Because of towline stretch, towline length readings may go below 99990. Adjust blade angle until tension reads between 300 and 400 pounds.

CAUTION

If minimum tension of 300 pounds is not obtained, the launcher may retract without the target. In this event (TGT OUT light on with LCHR DOWN light off), restream target to a minimum of 200 feet and reattempt target recovery. Do not put launcher down until target is restreamed.

5. Select LAUNCHER UP, LCHR DOWN light goes out and the target out light remains off.

CAUTION

If the target has successfully contacted the launcher and the launcher will not come up, a landing in this situation will result in major damage to the tow reel.

Note

If TGT OUT light does not extinguish at recovery, move the stick laterally to try to seat target. If that is not successful, obtain a visual check if possible.

6. Brake ON.

7. Adjust blade angle so that both OUT and IN ANGLE lights are out.

8. Adhere to flight limitation with TARGET STOWED.

11.6.4 TDU-32 Procedures

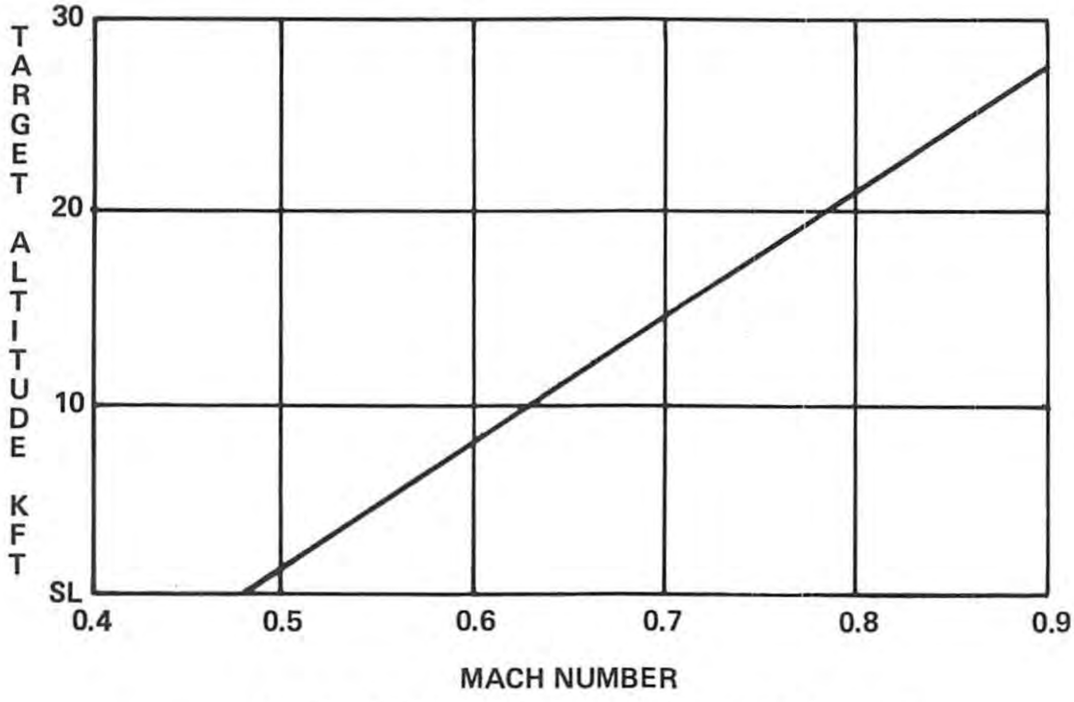
11.6.4.1 Drag Takeoff and Landing

11.6.4.1.1 Target Hookup Method One. With target located in the taxiway runup area, taxi 250 feet past the target. Hold this position until the hookup crew attaches the tow cable to the target. When the crew signals, take up slack until the crew (or chase pilot) indicates the target is moving. Hold this position until tower clearance is received. When cleared, taxi onto the runway. Make a wide sweeping turn across centerline and then back to the center of the runway. Taxi straight ahead until the chase pilot indi-

TOWLINE DATA		LIMITATIONS				
P/N (80206)	DIA (IN)	MAX LENGTH (FT)		MAX SPEED	TENSION LIMIT (LB)	
		RMK-19	RMK-31		TOTAL	RECOVERY
TE20091	.097	40,000	20,000	TENSION ONLY	1500	1500
TE20061	.190	10,000	5,000	TENSION ONLY	4000	–
TE20851	STEPPED	30,000	30,000	SEE CHART	1600	1500
TE20741	STEPPED	40,000	–	SEE CHART	2300	1500

CAUTION

- AOA IS NOT TO EXCEED 12 UNITS IN TURNS.
- NO ABRUPT CONTROL DEFLECTIONS.
- MAXIMUM REELING RATE IS 2,000 FPM FOR LENGTHS 10,000 FT OR LESS.
- MAXIMUM TOWING BANK ANGLE IS 60 DEGREES.
- MAXIMUM AIRSPEED FOR BANNERS IS 220 KIAS.



SPEED LIMITATION FOR TE20851 STEPPED WITH LESS THAN 30,000 FT STREAMED AND FOR TE20741 STEPPED WITH LESS THAN 40,000 FT STREAMED.

N11/82

Figure 11-14. A/A47U-3/4 Towing Limitations cates the target is in trail. Hold this position until the ground crew checks the target and shows the pilot the reel safety pin. When the chase pilot indicates that the ground crew is clear of the runway, request takeoff clearance.

11.6.4.1.2 Target Hookup Method Two. When cleared by the tower, have ground crew position the tow target on runway centerline. Taxi 250 feet past the target and hold this position until the hookup crew attaches the tow cable to the target and signals to takeup slack. Taxi straight ahead until ground crew or chase aircraft indicates towline is tight. Ensure that the ground crew checks the target and shows either the pilot or chase pilot the reel safety pin. Hold position. When the chase pilot indicates the ground crew is clear of the runway, request takeoff clearance.

11.6.4.2 Takeoff. Takeoff is made using one-half flaps and military power. Hold the aircraft on the runway until reaching 150 KIAS. Reduce thrust to basic engine to reduce heat damage to the towline. Rotate to LIFT-OFF at 155 KIAS and raise the gear when definitely airborne. Maintain 160 to 170 KIAS during climb to 1,000 feet and monitor AOA (18.5 to 19.5 units maximum). At 1,000 feet AGL, accelerate to 200 KIAS, raise the flaps, and continue acceleration to climb speed.

Note

Because it is extremely difficult to see the target from the chase pilot position, the tower should call target liftoff and release the escort aircraft for takeoff.

11.6.4.3 Climb. Burner may be used after airborne and chase is aboard the target. For TDU-32 (banners), maintain a maximum of 200 KIAS to avoid fraying the banner.

11.6.4.4 Reeling Out (220 KIAS and Maximum Bank Angle of 20°)

1. Beep IN ANGLE until IN ANGLE light comes ON.

2. Brake OFF.

3. Use OUT ANGLE until IN ANGLE light goes out, OUT ANGLE light comes ON, and TOWLINE LENGTH increases.

4. Use OUT ANGLE to increase reeling speed. SPEED X 10 light comes ON, speed indicator changes to high range, and tension increases.

Note

Operation of the RMK-19/31 is manually controlled with automatic acceleration and overspeed protection. All controls are operable at anytime without significant damage to the equipment. Brake operation above 100 feet per minute reeling speed may result in loss of the target. While reeling, 500 feet of towline length must be allowed for each 1,000 feet per minute of reeling speed to perform a normal stopping sequence. The reeling speed should therefore be adjusted according to the length to be streamed (i.e., for 2,000 feet, a reeling speed of 500 feet per minute is advisable).

11.6.4.5 Stopping and Secure for Towing

1. Use IN ANGLE until speed decreases to 0 feet per minute; OUT ANGLE light goes out and IN ANGLE light may come on.

When desired towline length is obtained and the reel speed and TOWLINE LENGTH indicator show that the reel is stopped:

2. Brake ON.

3. Adjust blade angle so that both OUT and IN ANGLE lights are OUT.

4. Adhere to flight limitations (Figure 11-13).

11.6.4.6 Reeling In (220 KIAS and Maximum Bank Angle of 20°)

1. Beep IN ANGLE until IN ANGLE light comes ON.

2. Brake OFF.

3. Use IN ANGLE to increase reeling speed, tension increases, SPEED X 10 light comes ON when TOWLINE SPEED indicator changes to high range, towline length decreases, and tension decreases. As cable length decreases, speed increases above original setting unless monitored.

4. Reel target into 300 feet and then slowly reel in speed to 100 feet per minute. Stop the reel and set the brake when actual towline length is 200 feet.

5. Adjust the blade angle so both the OUT and IN ANGLE lights are out.

11.6.4.7 Drop Procedures. With the banner reeled in to 200 feet (actual length), make approach to the banner drop area with gear and flaps down at 160 KIAS at a minimum of 1,000-foot altitude. When advised by the tower to drop the banner, activate the cut switch to release the banner. If the cutters fail to cut the towline, use TDU-32 landing procedure.

11.6.4.8 Landing Procedure. This procedure can be used when either the cutter will not fire or will not sever towline or for a normal recovery.

1. Make approach to longest available runway, check gear and flaps down.

2. After target touchdown, continue minimum rate descent until 20 to 30 feet above the runway. Hold this altitude until the chase pilot assures you that the target has started deceleration and is aft of your aircraft, then land the aircraft (touchdown will normally occur 3,000 feet down the runway).

11.6.5 A/A47U-3/4 Tow System Malfunctions

WARNING

If it becomes necessary to eject from the aircraft during towing operations, and time allows, select TOW CUT prior to ejection.

CAUTION

If it becomes necessary to jettison the tow target when retracted onto the reel launcher, select TOW CUT and LAUNCHER DOWN. If on the ground, taxi clear of target. After 2 seconds, select LAUNCHER UP.

11.6.5.1 Loss of Electrical Power to RMK-19/31 Reel Launcher

11.6.5.1.1 Indications. Indicators and lights on control panel and response of control switches are lost. Ram air turbine has stopped as the result of automatic brake application.

Note

Loss of primary 28-vdc bus power to the RMK-19/31 will automatically apply the ram air turbine brake. Application of the brake at towline speeds in excess of 100 feet per minute may result in the loss of the target or RMK-19/31 damage. Following automatic brake application at towline speeds in excess of 100 feet per minute, further operation of the RMK-19/31 is not recommended. TOW CUT selection is available from the essential 28-vdc bus.

11.6.5.1.2 Procedures

If the brake was off when power was lost:

1. Brake – ON.

CAUTION

Reapplication of primary 28-vdc bus power with the brake off may damage the RMK-19/31.

2. Shielded switch – TOW CUT.

CAUTION

Illumination of the TOW CUT light indicates that only electrical power has been applied to the cable cutting circuitry. It does not ensure that the cartridge has fired or that the towline has separated from the aircraft.

3. Do not attempt to operate the RMK-19/31.

If the brake was on when power was lost:

1. Brake – ON.

12.3.1 Auxiliary Air Door Malfunction (Gear Up, Door(s) Open)

1. Reduce power and slow to 250 knots or below.

2. Landing gear – CYCLE.

If light(s) remain on:

3. Ensure hook up and hook bypass switch is in NORM.

4. Close auxiliary air door(s) by pulling the applicable circuit breaker(s).

   a. F-4J before AFC 388 (3D and 4D, No. 1 panel).

   b. F-4J after AFC 388 and all F-4S (15K and 16K, No. 1 panel).

CAUTION

If the arresting hook is lowered or the hook bypass switch is in the bypass position, pulling the right auxiliary air door circuit breaker will cause the corner reflector to extend. Airspeed should be reduced to 250 knots prior to lowering hook or selecting hook bypass.

If light(s) still remain on:

5. Maintain no more than cruise power setting.

A cruise power setting will avoid engine compartment overheating.

CAUTION

Extended engine operation at high power settings will result in engine compartment and aft fuselage overheating.

6. Reset auxiliary air door circuit breaker(s) prior to lowering landing gear.

12.3.2 Auxiliary Air Door Failure (Gear Down, Door(s) Closed). If the auxiliary air doors fail to open when the landing gear is lowered, there is a possibility that the engines may automatically accelerate up to 100-percent rpm. A utility hydraulic system failure or double generator failure will render the variable bypass bellmouth and auxiliary air doors inoperative. Operation of an engine with an open variable bypass bellmouth and closed auxiliary air door will allow engine compartment secondary air to recirculate to the engine compressor inlet. During low altitude or ground operation, the temperature of the recirculating air may be high enough to initiate T2 reset through normal detection by the compressor inlet temperature sensor. As T2 reset occurs, it increases the engine idle speed to maintain proper engine airflow and thrust under high temperature conditions and can cause the idle speed to increase up to 100-percent rpm. The autoaccelerated engine can be shut down if on the ground by placing the throttle to OFF. If a false reset occurs while airborne, a near normal landing can be made by modulating the exhaust nozzles of the affected engine(s). If auxiliary air doors fail to open when the landing gear is lowered:

1. Landing gear – CYCLE.

12.3.2.1 Autoacceleration of One Engine

1. Throttle of affected engine – IDLE.

2. Make an ON SPEED approach.

Modulate throttle of unaffected engine for desired thrust. Under no conditions will the combined thrust of the autoaccelerated engine in idle and the unaffected engine in idle be in excess of that required to make an optimum ON SPEED approach.

At touchdown:

3. Affected engine – SHUT DOWN.

12.3.2.2 Autoacceleration of Both Engines

1. Throttle of either engine – IDLE.

2. Modulate the exhaust nozzle of the remaining engine for desired thrust.

3. Make an ON SPEED approach.

At touchdown:

4. Right engine – SHUT DOWN.

Shutting down the right engine at touchdown will leave you in a more favorable position (more systems available) in the event of a bus tie failure.

12.4 BLEED AIR SYSTEM

12.4.1 Bleed Air Duct Failure. Severe damage to the aircraft may result from a bleed air duct failure because of the high temperature produced by the bleed air system. The extremely hot air leaking from a failed duct may ignite flammables in the immediate vicinity of the duct failure. The following symptoms may be indicative of a bleed air system failure: a mild audible thump or bang on the airframe, leading edge barberpole flap indication throughout all flap positions, complete or partial loss of cockpit pressurization; loss of pylons, missiles, or other external stores; generator failure, popping of circuit breakers, and illumination of fire/overheat warning lights, bleed air overheat warning lights (F-4J 155903ap, 157274ap and up, or after AFC 439 and all F-4S) with the MASTER CAUTION lights and/or several other warning/indicator lights, erratic fuel quantity indications; mild stick transients; stiffness of throttles; hydraulic failure; smoke emitting from the intake duct louvers, fuel fumes in the cockpit; high fuel flow/erratic response to throttle movement (indicative of main fuel hose rupture).

CAUTION

Early analysis of a bleed air duct failure is required in order to prevent serious damage to or possible loss of the aircraft.

If several of the preceding symptoms occur in close sequence (F-4J before AFC 440):

*1. Reduce power to lowest practicable setting.

2. Check for indications of fire.

If circumstances permit:

3. Lower flaps.

4. Rain removal – ON.

5. Land as soon as practicable.

F-4J after AFC 440 and all F-4S:

*1. Bleed air switch – OFF.

With the engine bleed air switch off, operation of the following equipment will be lost:

a. External fuel and internal wing fuel transfer

b. Leading edge BLC (F-4J)

c. Cockpit air-conditioning and pressurization

d. Rain removal air

e. Defog/foot heat

f. Equipment cooling air

g. Normal pneumatic compressor charging

h. SPC inputs to all systems

i. Automatic altitude reporting.

Note

With the engine bleed air switch in OFF, 17th stage air is not available for pneumatic compressor charging; however, the pneumatic compressor will compress ram air (the rate of charging is dependent on altitude and airspeed).

2. Secure radar and CNI equipment unless safety of flight/operational necessity dictates otherwise.

If bleed air light(s) go out:

3. Check bleed air overheat detection system for continuity.

If bleed air light(s) stay on:

4. Slats override switch – IN (F-4S).

5. Lower flaps, check for light(s) out.

CAUTION

If fuel considerations preclude flaps down bingo, raise flaps. If bleed air overheat light(s) reilluminate, the individual situation (evidence of fire/overheat damage, etc.) must dictate whether to attempt flaps up bingo with light(s) illuminated.

6. Rain removal – ON.

7. Check for indications of fire.

If indications of fire or trailing edge bleed air duct failure exists:

8. Affected engine – THROTTLE OFF, MASTER SWITCH OFF.

Note

If indications of fire exist or if bleed air duct failure can be isolated to one engine bay, all trailing edge bleed air to the affected side can be shut off by shutting down that engine.

9. Land as soon as practicable (slats override switch – NORM, F-4S).

10. Refer to paragraph 12.15.12, LANDING WITH BLEED AIR SWITCH OFF(F-4J).

12.4.2 Bleed Air Check Valve Failure. No indication of a bleed air check valve failure will be noted in flight until the throttle is retarded and then readvanced on the engine with the failed bleed air check valve. If the throttle has been retarded and then readvanced, either rpm will hang up or minor compressor stalls and flameout may occur at approximately 85-percent rpm. If a flameout occurs, a restart can be made, but rpm will probably not go above 65 percent, EGT will rise to approximately 625°, and the nozzle will go full open. In either case, the engine can be regained as follows:

1. Normal operating engine – IDLE.

Idling the normal operating engine will equalize the pressure in the bleed air line.

2. Accelerate the engine with the failed bleed air check valve.

3. Accelerate normal engine.

The normal operating engine should not be accelerated to or operated at an rpm greater than that of the affected engine for the remainder of the flight.

12.5 BOUNDARY LAYER CONTROL (BLC)

12.5.1 BLC Malfunction. A BLC system malfunction is indicated by the illumination of the BLC MALFUNCTION warning light. The only type of malfunctions indicated by the light are: a leading edge BLC valve stuck open when the flaps are up (F-4J only) or a trailing edge BLC valve stuck open when the flaps are in any position other than fulldown. If the BLC MALFUNCTION light flickers or illuminates when flaps are raised, follow the procedures for BLC malfunction.

*1. Flaps/slats – DN-OUT.

2. Maintain airspeed consistent with gross weight and flap blowup speed.

3. Land as soon as practicable.

CAUTION

Operating at normal power setting in excess of 30 seconds with the BLC MALFUNCTION light illuminated and flaps/slats UP-NORM or 1/2-OUT may result in damage to the warning circuit wiring which will extinguish the warning light. Continued flight with the flaps/slats UP-NORM can then result in additional electrical, hydraulic, and structural damage to the wing from overheating. Hot BLC air can melt the insulation off the wiring to the flap up limit switch, allowing the bare wire to short to ground. This short results in the same indication as a flaps down condition to the WHEELS light circuit, thereby illuminating the WHEELS light. In view of the above, a steady or flashing WHEELS light with the landing gear handle and flaps up or the gear handle DN and the flaps up or 1/2 should be treated as a BLC malfunction.

CAUTION

- F-4S aircraft have demonstrated occasional flap chatter problems denoted by intermittent trailing edge barberpoled and/or a flashing wheels warning light. There is no way to ensure in flight that this particular set of indications is due to flap chatter or a BLC malfunction. In all cases of trailing edge barberpoled and/or a flashing wheels warning light, assume a BLC malfunction and take the appropriate action.
- If after lowering the flaps, the outboard leading edge flaps should remain/blow up, but the inboard leading edge flaps remain down, a BLC malfunction condition will exist with no BLC malfunction light. If such a condition is encountered, the bleed air switch should be turned off or the flaps should be raised to the up position.
- If the BLC valve fails internally, a BLC malfunction is possible with no BLC MALFUNCTION light.

On F-4J after AFC 440 and all F-4S, if fuel state precludes flaps down bingo:

1. Flaps/slats – DN-OUT.
2. BLC MALFUNCTION light and EGT – MONITOR.
3. Slat override switch – IN (F-4S).
4. Flaps – 1/2.
5. Slat override switch – NORM FOR LANDING (F-4S).
6. Flaps/slats – 1/2-OUT.

Note

Drag index is reduced if the slats are locked in.

7. Engine on affected side – SHUT DOWN.

The affected side is the side which registers little or no drop in EGT when raising the flaps to 1/2. The EGT on the unaffected side will decrease 10 °C to 15 °C.

8. Flaps/slats – UP-NORM (light may remain on).
9. Follow single-engine bingo procedure.

CAUTION

Single-engine bingo fuel required is higher than for two-engine bingo. Bingo charts must be referenced for the particular situation.

On F-4J, if BLC MALFUNCTION light remains out with 1/2 flaps:

7. Bleed air switch – OFF.

With the bleed air switch OFF, the following systems will be lost: cockpit air-conditioning and pressurization, rain removal, equipment air-conditioning, external fuel and internal wing fuel transfer, pneumatic system charging, leading edge BLC, SPC, and automatic altitude reporting.

8. Flaps/slats – UP-NORM (light may remain on).

After flaps are lowered for landing:

9. Bleed air switch – ON.

12.5.2 Unsafe Flaps/Slats After Takeoff. A barberpoled flap/slat indication airborne with flaps/slats selected UP-NORM may be caused by a faulty indicator, an improperly rigged limit switch, or a leak in the BLC system.

1. Maintain airspeed consistent with gross weight and flap blowup speed.
2. Flaps/slats – CYCLE 1/2-OUT THEN UP-NORM.

If flaps/slats indicate UP/IN:

3. Continue mission.

If flaps/slats still indicate barberpole:

3. Flaps/slats – DN-OUT.

4. Land as soon as practicable.

12.5.3 BLC Failures. A BLC system failure affects the handling characteristics and approach speeds of the aircraft. The BLC system failure usually does not affect the complete BLC system, but rather a portion of the system and will probably be one of the following variations:

1. Trailing edge BLC inoperative on one side (F-4J and F-4S).

   This condition is characterized by a moderate roll when the flaps reach full down. Trim requirements vary only slightly as speed is reduced.

2. Leading edge BLC inoperative on one side (F-4J only).

   This condition is characterized by little or no lateral trim requirements when flaps are first lowered, followed by increased trim requirements as airspeed is reduced.

3. Leading and trailing edge BLC inoperative on the same side (F-4J only).

   With this condition, the initial flap down lateral trim requirements of the trailing edge is first apparent, followed by increased trim as airspeed decreases. Full lateral trim will be required well above approach airspeed.

The BLC failure will probably occur prior to or in the transition to flaps down during a landing approach with the result being an asymmetric BLC condition. The asymmetric BLC condition has been found to be safe and easily controllable even with both leading edge and trailing edge BLC inoperative on the same side. There is no reason to raise flaps to avoid an asymmetrical BLC condition. In general, for these types of BLC failure, an onspeed angle of attack gives satisfactory approach control. For F-4J aircraft, BLC loss on both wings presents a different problem in that lateral control may be lost at on speed AOA. For these conditions, refer to paragraph 12.15.12, LANDING WITH BLEED AIR SWITCH OFF (F-4J).

1. Retrim aircraft.

2. Fly on speed angle of attack.

3. Land as soon as practicable.

Refer to Figure 12-1.

12.6 CANOPY

12.6.1 Canopy Malfunction. If the front or aft CANOPY UNLOCK light remains on after an attempted closure, the canopy actuator shear pin may have failed, and the following procedures will apply:

1. Do not actuate the normal canopy control selector, raise or lower the ejection seat, or allow external canopy control buttons to be operated.

2. Call for an external visual inspection of the ejection seat and canopy rigging, checking especially for foreign objects lodged between the ejection seat and canopy.

If no discrepancy is found or external inspection is impossible:

3. Attempt to operate manual canopy release handle to full aft position. Apply approximately 20 pounds force.

If canopy unlocks:

4. Push canopy open and evacuate with extreme caution while staying clear of canopy control lever.

If canopy does not unlock:

5. Actuate normal canopy control lever. Further attempts to relock the canopy are not recommended.

12.6.2 Canopy Unlock Light On in Flight

1. Power – REDUCE.

2. Begin descent to below 25,000 feet.

3. Tighten mask and lower visor.

4. Emergency vent knob – PULL.

5. If aft canopy is unsafe, select single eject.

Note

ADJUST THE APPROACH SPEED 2 KNOTS FOR EACH 1000 POUNDS ABOVE OR BELOW 36, 000 POUNDS

– GROSS WEIGHT 36,000 POUNDS –

NORMAL FLAP OPERATION
– WITH AILERON DROOP –

– BEFORE AFC 388 –

FLAP POSITION	INDICATED ANGLE OF ATTACK	APPROACH SPEED
DOWN	19	138
1/2	19	148
1/2	17	157
UP	17	178
UP	19	165

– AFTER AFC 388 –

FLAP POSITION	INDICATED ANGLE OF ATTACK	APPROACH SPEED	
		COR. REFL. OUT	COR. REFL. IN
DOWN	18.3	146	149
1/2	18.3	157	159
1/2	17	163	165
UP	17	183	186
UP	19	174	177

EMERGENCY FLAP OPERATION

– WITHOUT AILERON DROOP –

BEFORE AFC 534 OR AFTER AFC 534 WITH THE EMERGENCY AILERON DROOP SWITCH IN DISABLE OR OFF

1/2	19	154
1/2	17	164

– WITH AILERON DROOP –

AFTER AFC 534 WITH EMERGENCY AILERON DROOP SWITCH IN NORMAL OR ON AND ALSO AFTER AFC 388

1/2	18.3	157	159
1/2	17	163	165

– WITHOUT AILERON DROOP –
AFTER AFC 388

1/2	18.3	164	166
1/2	17	172	175

NORMAL FLAP OPERATION
WITH CB PULLED TO DEFEAT ASYMMETRIC DROOP

– BEFORE AFC 388 –

CIRCUIT BREAKER J12 NO. 1 PANEL PULLED

DOWN	19	146
1/2	19	154

– AFTER AFC 388 –

CIRCUIT BREAKER H15 NO. 1 PANEL PULLED

DOWN	18.3	153	156
1/2	18.3	164	166

IF A BLC LOSS OCCURS IN CONJUNCTION WITH ANY FLAP CONFIGURATION DEPICTED ABOVE, THE AIRSPEED FOR ANY GIVEN AOA WILL INCREASE AS FOLLOWS:

7 KNOTS – LEADING EDGE BLC ON ONE SIDE ONLY.
7 KNOTS – TRAILING EDGE BLC ON ONE SIDE ONLY.
18 KNOTS – LEADING AND TRAILING EDGE BLC ON ONE SIDE ONLY.

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Figure 12-1. Approach Speeds (Sheet 1 of 2)

Note

ADJUST THE APPROACH SPEED
2 KNOTS FOR EACH 1000 POUNDS
ABOVE OR BELOW 36,000 POUNDS

– GROSS WEIGHT 36,000 POUNDS –

NORMAL SLATS/FLAPS AILERON OPERATION

SLAT POSITION	FLAP POSITION	INDICATED AOA (UNITS)	APPROACH SPEED (KCAS)
OUT	DOWN	19	142
OUT	DOWN	18.3	145
OUT	1/2	19	153
OUT	1/2	18.3	156
OUT	1/2	17	162
OUT	UP	19	172
OUT	UP	18.3	176
OUT	UP	17	186
IN	UP	19	170
IN	UP	18.3	174
IN	UP	17	184
	– WITHOUT AILERON DROOP –		
OUT	1/2	19	160
OUT	1/2	18.3	163
OUT	1/2	17	169

Notes

- BASED ON 36,000 LB GROSS WEIGHT, LANDING GEAR DOWN, SPEED BRAKES RETRACTED, SPC ON.
- ADJUST SPEED 2 KT FOR EACH 1,000 LB GROSS WEIGHT CHANGE.
- CORNER REFLECTOR RETRACTION HAS NEGLIGIBLE EFFECT.
- LEVEL FLIGHT AIRSPEEDS WILL BE 2 TO 3 KTS SLOWER THAN APPROACH SPEED.
- IF A BLC LOSS OCCURS IN CONJUNCTION WITH FULL FLAP CONFIGURATION, THE AIRSPEED FOR ANY GIVEN AOA WILL INCREASE 7 KNOTS.

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Figure 12-1. Approach Speeds (Sheet 2 of 2)

6. Ejection seat – LOWER.

7. Normal canopy control levers – CHECK CLOSED.

8. Land as soon as practicable.

12.7 CHARTS

The charts and illustrations in this chapter contain procedures and information which complement the text in the rest of the chapter. These charts should be used as necessary, in conjunction with the text, in order to analyze and judiciously perform the emergency procedures in an expeditious manner.

12.8 EJECTION

Escape from the aircraft in flight should be made with the ejection seat (Figures 12-2 (Sheets 1 and 2), 12-3, and 12-4). For most conditions requiring ejection, it is the pilot's responsibility to give the eject command and then remain with the aircraft until the RIO has ejected. In the event of a controlled ejection where the time required to leave the aircraft is not of an immediate nature, it is recommended that individual ejection be performed. A rear cockpit nonsequenced ejection (command selector valve handle in the closed position) followed by a front cockpit ejection has several advantages over pilot/RIO initiated-sequenced ejection.

1. Individual ejection eliminates the possibility of a sequencing system failure.

2. If the rear system fails to function properly under individual ejection, the pilot is available to assist the RIO by using the Ejection Seat Failure procedures.

3. Since each crewmember initiates his own ejection, he can properly position his body in preparation for the ejection shock and is aware of exactly when the ejection will commence.

Should the front canopy or both canopies be lost, the front canopy interlock block will also be lost. If ejection is then initiated from the front seat, this could expose the rear crewman to the front seat rocket blast; if conditions are right, a collision between seats could result. Should loss of the front canopy or both canopies occur, the rear crewman should be ordered to eject individually, allowing the front crewman to eject once the rear seat leaves or have the rear crewman select command ejection by actuation of the command selector valve and eject both seats by automatic sequencing. The automatic sequence when initiated from the aft seat with the front canopy missing is not affected by the fact that the front interlock block is gone. With loss of the rear canopy only, normal sequenced ejection can be initiated from either cockpit. If at anytime during an emergency, especially with loss of intercom, the RIO believes that the condition of the aircraft has reached or passed extremes, he must use his own judgement in ejecting. Should a situation arise where it would be desirable for the RIO to eject singly, the command selector valve handle in the rear cockpit must be in the vertical (closed) position. RIO-initiated ejection of the pilot shall be limited to emergency/combat situations, when so directed by the pilot or in the event of pilot incapacitation. For catapult shots, the pilot may elect to have the RIO initiate crew ejection under certain emergency conditions such as obvious insufficient flying speed or other situations wherein pilot tasks may impede the pilot's timely initiation of crew ejections. In exercising this option, the pilot shall consider the experience level of his RIO, the degree of training/proficiency and meticulously brief on ejection signals (ICS and visual), and the exact circumstances under which the RIO will eject the crew. It is vital that all pilots continuously keep the RIO informed during normal flight as well as in emergency conditions. The following signals are used by the pilot to order the RIO to eject.

1. DAY or NIGHT (WITH INTERCOM) WITH/WITHOUT EJECT LIGHT

Pilot actuates EJECT light and verifies light with an EJECT transmission. Without eject light, pilot transmits "eject."

2. DAY (NO INTERCOM) WITH EJECT LIGHT

Pilot actuates EJECT light and verifies light by repeatedly striking left side of his canopy.

3. NIGHT (NO INTERCOM) WITH EJECT LIGHT

Pilot actuates EJECT light and verifies light by moving his flashlight in a vertical motion over his left shoulder.

4. DAY (NO INTERCOM) NO EJECT LIGHT

Pilot will strike the left side of his canopy repeatedly.

5. NIGHT (NO INTERCOM) NO EJECT LIGHT

Pilot will move his flashlight in a vertical motion over his left shoulder.

6. DAY or NIGHT NO RIO RESPONSE

Initiate normal ejection sequence.

The study and analysis of escape techniques by means of the ejection seat reveals that:

1. Ejection at airspeeds ranging from stall speed to 400 knots results in relatively minor forces being exerted on the body, thus reducing injury hazard.

2. Appreciable forces are exerted on the body when ejection is performed at airspeeds of 400 to 600 knots rendering escape more hazardous.

3. At speeds above 600 knots, ejection is extremely hazardous because of excessive forces on the body.

AIRPLANES THRU 155902am BEFORE ACC 176 (SKYSAIL CHUTE)

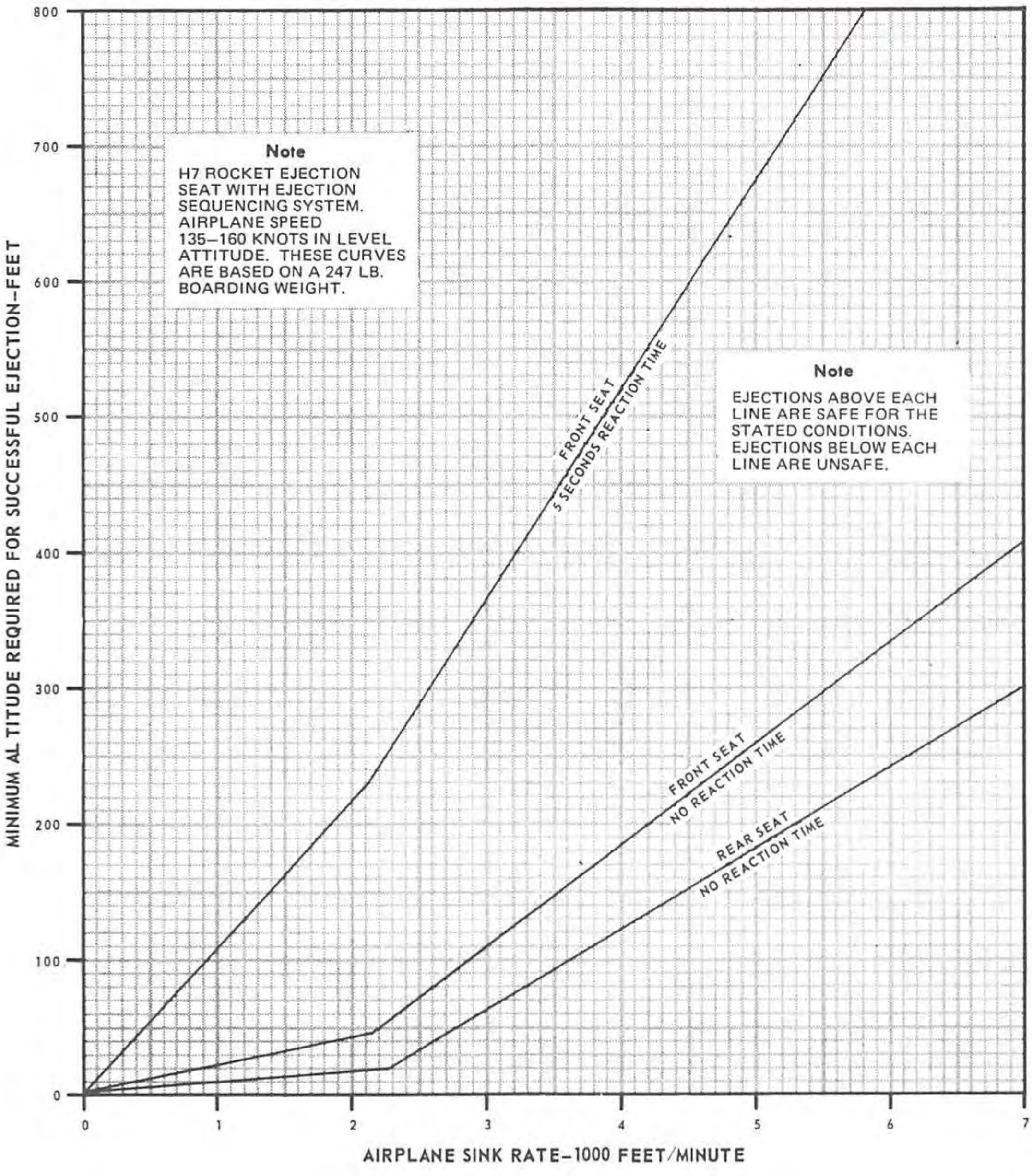


Figure 12-2. Minimum Ejection Altitude Versus Sink Rate (Sheet 1 of 2)

AIRPLANES 157242an AND UP
AND ALL OTHERS AFTER ACC 176

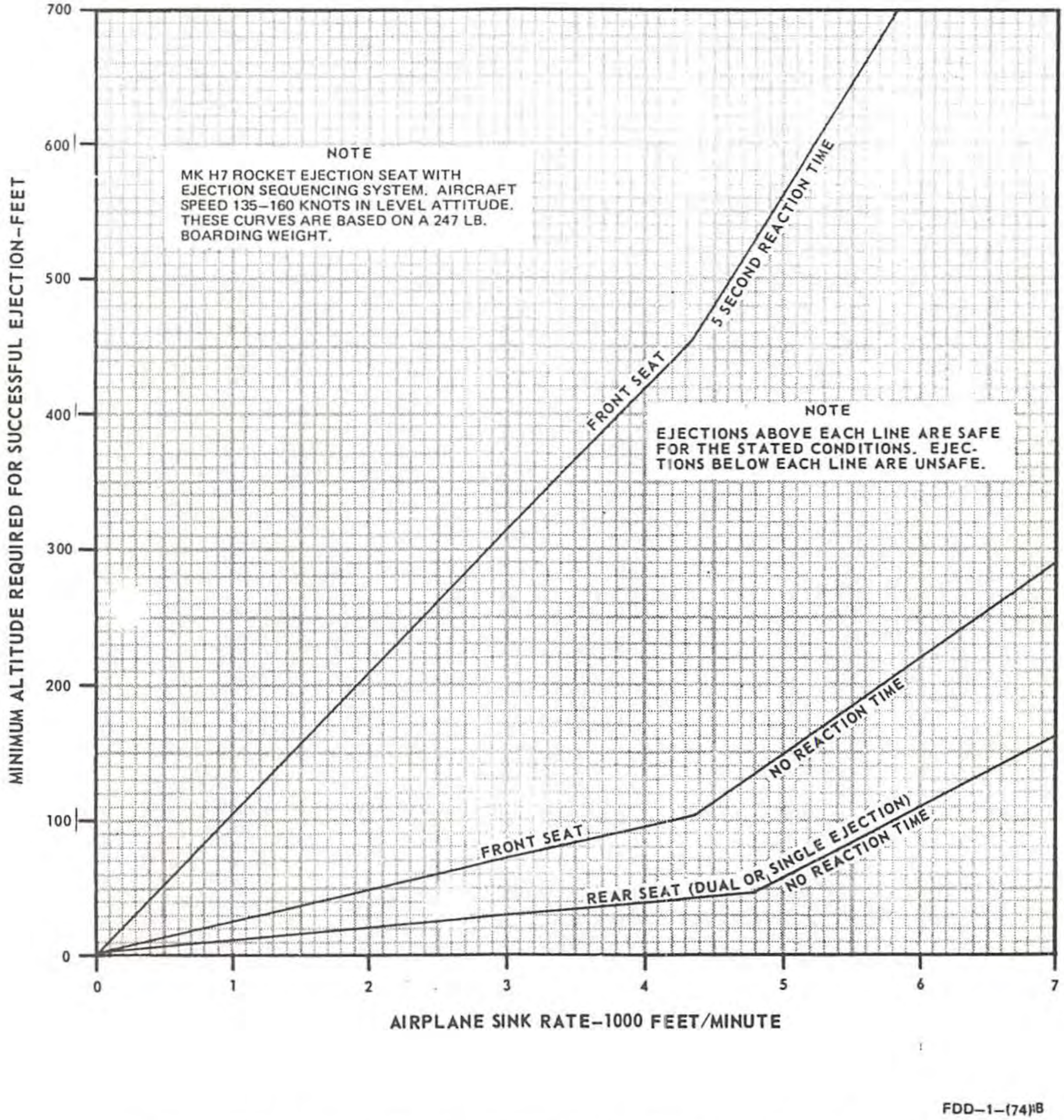
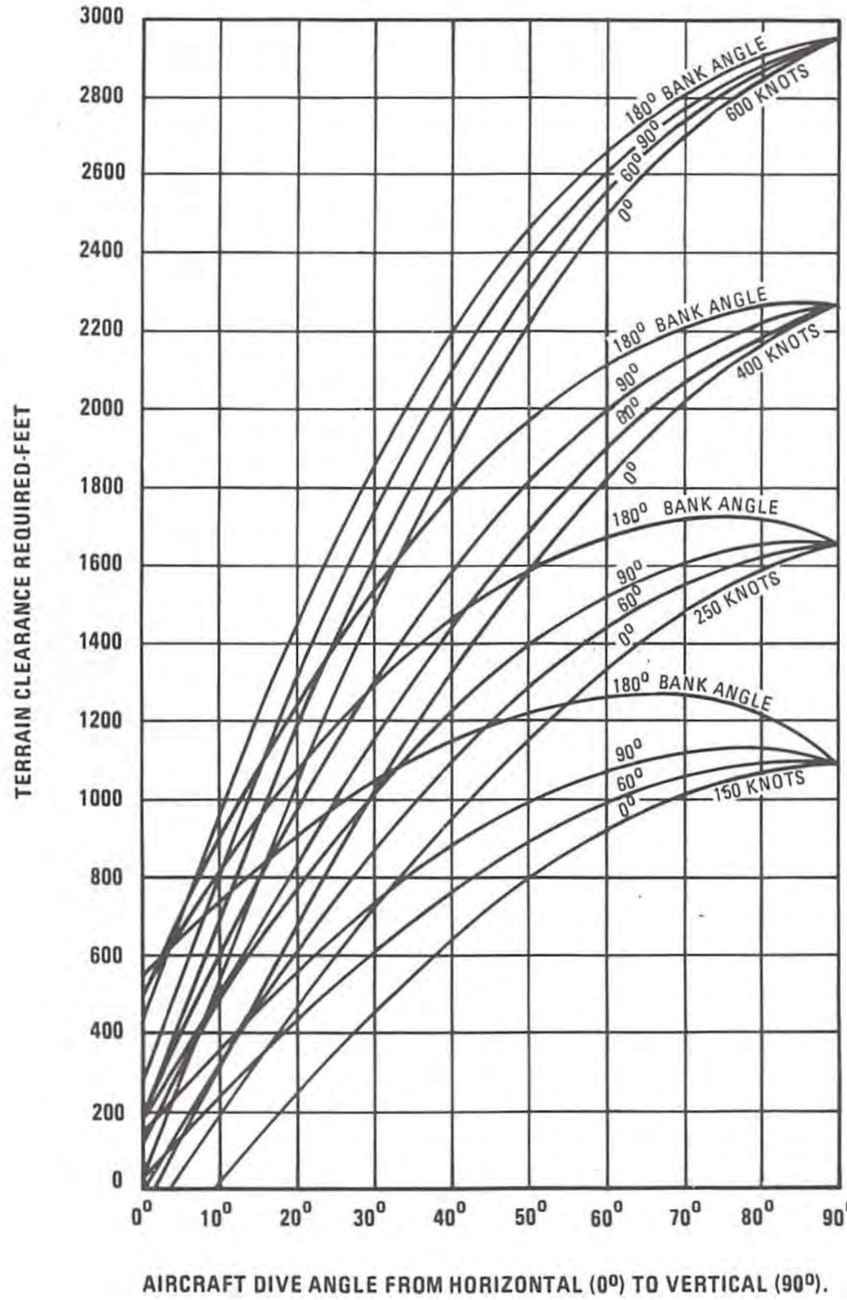


Figure 12-2. Minimum Ejection Altitude Versus Sink Rate (Sheet 2 of 2)



Notes

- MINIMUM EJECTION HEIGHTS ARE BASED ON INITIATION OF THE ESCAPE SYSTEM. SEQUENCING SYSTEM TIMES FOR A NORMAL DUAL EJECTION ARE INCLUDED.
- BANK ANGLE DATA ARE FOR COORDINATED FLIGHT. YAW OR SLIP WILL INCREASE THE HEIGHT REQUIRED FOR RECOVERY.
- PILOT REACTION TIME IS NOT INCLUDED.

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Figure 12-3. Minimum Ejection Altitude Versus Airspeed, Dive Angle, and Bank Angle

If time and conditions permit -

- IFF EMERGENCY
- MAKE RADIO DISTRESS CALL
- SLOW AIRPLANE AS MUCH AS POSSIBLE.

*** 1. ALERT RIO**

*** 2. ASSUME PROPER EJECTION POSITION**

ADJUST SEAT POSITION SO TOP OF HELMET IS BELOW FACE CURTAIN HANDLES. BRACE THIGHS ON SEAT CUSHION, LEGS EXTENDED. SIT ERECT, BUTTOCKS BACK, SPINE STRAIGHT, HEAD BACK AGAINST HEADREST, AND CHIN IN.

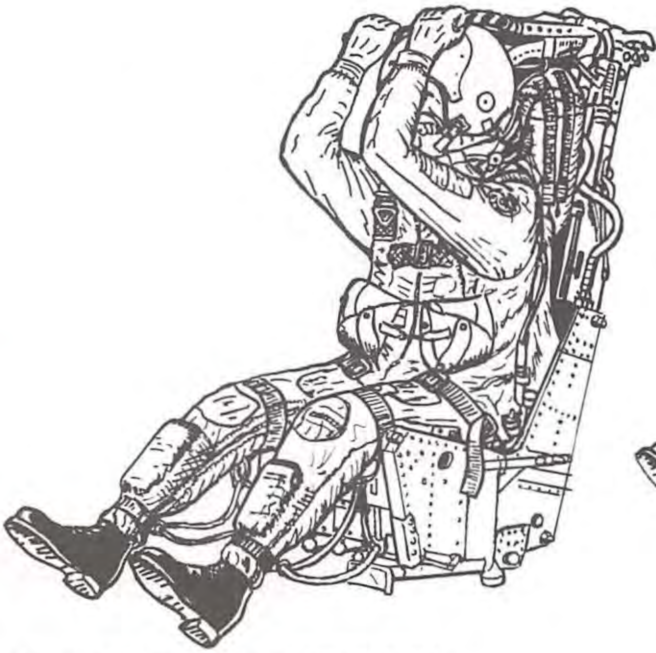
- STOW ALL LOOSE EQUIPMENT
- PULL EMERGENCY VENTILATING KNOB TO MINIMIZE DECOMPRESSION EFFECTS WHEN JETTISONING THE CANOPY.

Note

- THE LOWER EJECTION HANDLE SHOULD BE USED WHEN IT IS NECESSARY TO RETAIN CONTROL OF THE AIRCRAFT AND WHEN IT IS IMPRACTICABLE TO REACH THE FACE CURTAIN HANDLE.

WARNING

- IF CREWMEMBER ELECTS TO USE LOWER EJECTION HANDLE AFTER PULLING FACE CURTAIN HANDLE, THE FACE CURTAIN HANDLE SHOULD BE RETAINED WITH ONE HAND TO PREVENT THE POSSIBILITY OF ENTANGLEMENT WITH DROGUE GUN WHEN IT FIRES.



*** 3. FACE CURTAIN HANDLE-PULL**

REACH OVERHEAD, WITH PALMS AFT KEEPING ELBOWS TOGETHER, GRASP FACE CURTAIN HANDLE, PULL FACE CURTAIN AND MAINTAIN DOWNWARD FORCE UNTIL STOP IS ENCOUNTERED. WHEN CANOPY JETTISONS, CONTINUE PULLING FACE CURTAIN UNTIL FULL TRAVEL IS REACHED.

*** 3. LOWER EJECTION HANDLE-PULL**

GRASP THE LOWER EJECTION HANDLE, USING A TWO-HANDED GRIP WITH THE THUMB AND AT LEAST TWO FINGERS. OF EACH HAND. PULL UP ON LOWER HANDLE UNTIL STOP IS ENCOUNTERED. WHEN CANOPY JETTISONS, CONTINUE PULLING UP ON LOWER EJECTION HANDLE UNTIL FULL TRAVEL IS REACHED.

WARNING

DURING THE SINGLE EJECTION FROM THE REAR COCKPIT, THE SEAT CATAPULT WILL NOT FIRE AUTOMATICALLY AS IN DUAL EJECTION, AND THE CREWMAN MUST CONTINUE PULL ON THE EJECTION HANDLE AFTER CANOPY REMOVAL TO FIRE THE SEAT GUN. ON F-4J 155903ap AND UP OR AFTER AFC 482 AND ALL F-4S, SEQUENCING SYSTEM AUTOMATICALLY FIRES THE SEAT AND NO EXTRA PULL IS REQUIRED.

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Figure 12-4. Before Ejection Sequence – Typical Both Cockpits (Sheet 1 of 2)

IF CANOPY FAILS TO JETTISON

Note

IF CANOPY FAILS TO JETTISON RELEASE TENSION ON FACE CURTAIN HANDLE, AND WHILE HOLDING HANDLE WITH ONE HAND, PERFORM THE APPROPRIATE FOLLOWING PROCEDURE. WHEN CANOPY JETTISONS, AGAIN GRASP EJECTION HANDLE WITH BOTH HANDS, AND PULL UNTIL FULL TRAVEL IS REACHED.

* 4. Normal canopy control handle – OPEN

* 5. Manual canopy unlock handle – PULL

If canopy still fails to jettison -

* 6. Emergency canopy jettison handle – PULL

If canopy still fails to jettison -

* 7. Put negative G on aircraft

When canopy separates -

* 8. Face curtain/lower ejection handle – PULL

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Figure 12-4. Before Ejection Sequence – Typical Both Cockpits (Sheet 2 of 2)

When circumstances permit, slow the aircraft prior to ejection to reduce the forces exerted on the body. The emergency restraint release handle should never be actuated before ejection for the following reasons:

1. Actuating the emergency restraint release handle creates a hazard to survival during uncontrollable flight since negative g forces may prevent the crew from assuming the correct ejection position. A full understanding of the particular situation must be established between crewmembers so that there is no erroneous or time consuming activity.

2. Actuating the emergency restraint release handle creates a hazard to survival if the pilot decides that he has insufficient altitude for ejection and is required to proceed with a forced landing. Once the emergency restraint release handle has been pulled, the lap belt shoulder harnessing is released and cannot be refastened in flight.

3. Actuating the emergency restraint release handle prior to ejection causes the occupant to separate from the seat immediately after ejection, and severe shock loads will be imposed on the body.

When it is necessary to perform the actual ejection, the final judgement of which ejection handle to use is left to the individual crewmember. There are circumstances which dictate the use of the lower ejection handle. The circumstances are: high g forces on the aircraft, bulky flight equipment worn by the crewmember, and narrow clearances between the crewmember helmet and the canopy because of seat adjustment or crewmember size. These factors could make actuation of the face curtain handle difficult if not sometimes impossible.

12.8.1 Low-Altitude Ejection. Low-altitude ejection must be based on the minimum speed, minimum altitude, and sink rate limitations of the ejection system (Figures 12-2 (Sheets 1 and 2), and 12-3). Figure 12-2 (Sheets 1 and 2) show minimum ejection altitude for a given sink rate, and Figure 12-3 shows minimum ejection altitude for a given airspeed, dive angle, and bank angle, such as encountered in a dive bombing run. Although these figures indicate minimum ejection altitudes based on seat capability and a representative pilot reaction time, the ultimate decision as to which altitude to eject must be made by the pilot. The minimum ejection altitude charts are based on a 247-pound boarding weight which is defined to include the crewman, his clothing, and personnel equipment excluding his parachute and seat pan survival kit. Ejection at low altitudes is facilitated by pulling the nose of the aircraft above the horizon (zoom up maneuver). This maneuver affects the trajectory of the ejection seat, providing a greater increase in altitude than if ejection is performed in a level flight attitude. This gain in altitude increases time available for seat separation and deployment of the personnel parachute. Ejection should not be delayed when the aircraft is in a descending attitude and cannot be leveled out. Assuming wings level and no aircraft sink rate, the ejection seats provide safe escape within the following parameters:

1. Ground level (zero altitude) – Zero airspeed (canopy must be closed).

2. Ground level and up –400 knots maximum (based on human factors);
   –500 knots or M equal 0.92 maximum, whichever is less (based on seat limitations).

At airspeeds greater than 400 knots, appreciable forces are exerted on the body which make escape more hazardous.

12.8.2 High-Altitude Ejection. For a high-altitude ejection, the basic low-level ejection procedure is applicable. Furthermore, the zoom up maneuver is still useful to slow the aircraft to a safer ejection speed or provide more time and glide distance as long as an immediate ejection is not mandatory. If the aircraft is descending uncontrolled as a result of a mid-air collision, control failure, spin, or any other reason, the pilot and RIO will abandon the aircraft at a minimum altitude of 10,000 feet above the terrain if possible. If the pilot has decided to abandon the aircraft while still in controlled flight at altitude, the pilot and RIO will abandon the aircraft at a minimum altitude of 10,000 feet above the terrain with the aircraft headed to sea or toward an unpopulated area.

12.8.3 Ejection Handle Selection. Because of its greater accessibility and shorter travel when compared to the face curtain, the lower ejection handle should be used during situations requiring an expeditious ejection. Some of these situations are insufficient flying speed from catapult, ramp strike, parting of crossdeck pendants during carrier arrestment, low altitude, uncontrolled flight, and under high g during spin or ACM maneuvers.

12.8.4 Postejection Sequence

*1. LPA – INFLATE IMMEDIATELY (See Figure 12-6, Sheet 4).

a. Fasten lobes together

b. Ensure neck lobes inflated.

Note

If you are downed in seawater, SEAWARS will release the parachute canopy within 2 seconds. However, if able, each canopy release should immediately be unlocked on water entry. The SEAWARS does not operate in freshwater.

*2. Canopy releases – LOCATE.

Be prepared to activate canopy releases immediately upon water impact to avoid parachute entanglement.

If time and conditions permit:

3. Deploy survival kit.

If ground contact is anticipated among trees, rugged terrain, high tension wires, etc., it may be to the crewmember's advantage to land with the survival kit intact or to jettison it just prior to impact (see Figure 12-6, Sheet 5).

Note

Deployment of the survival kit may aggravate parachute oscillations if the four-line release is not used.

4. Check canopy for proper inflation (see Figure 12-6, Sheet 3).

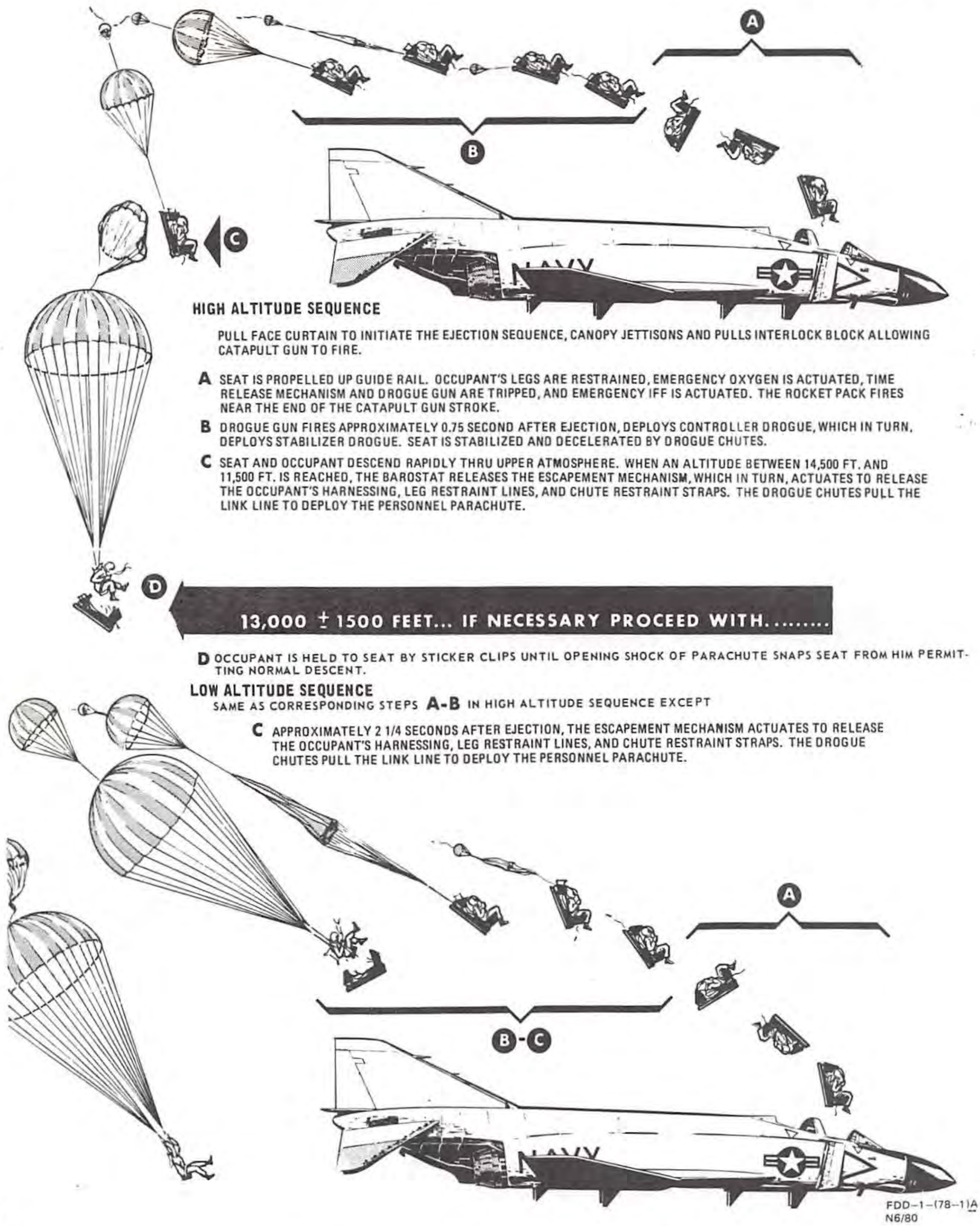
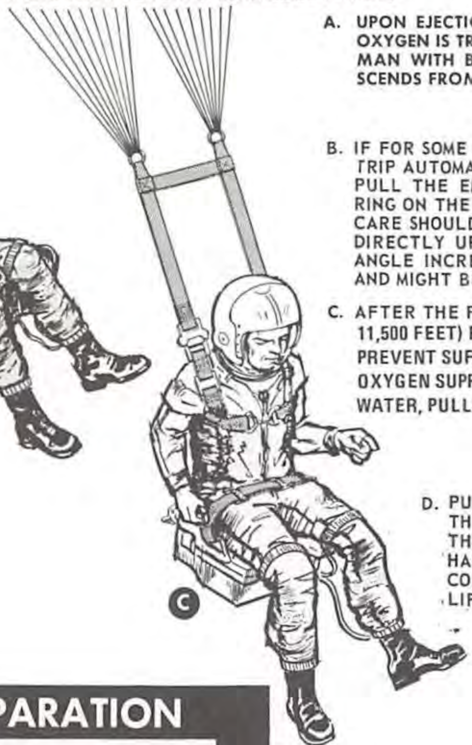


Figure 12-5. Ejection Seat Sequence (Sheet 1 of 2)

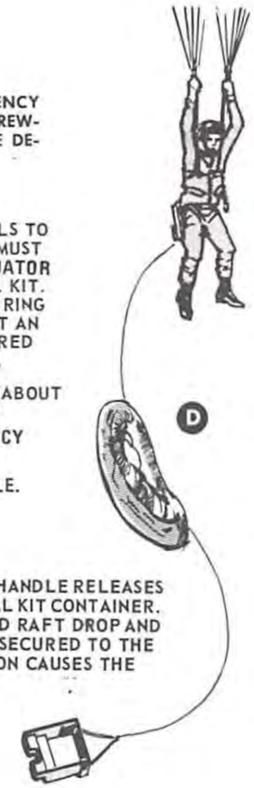
SURVIVAL KIT DEPLOYMENT



A. UPON EJECTION, SURVIVAL KIT EMERGENCY OXYGEN IS TRIPPED. THIS PROVIDES THE CREWMAN WITH BREATHING OXYGEN AS HE DESCENDS FROM HIGH ALTITUDES.

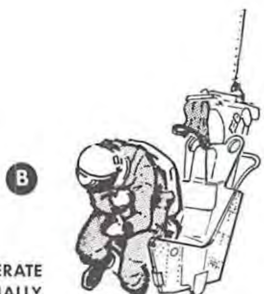
B. IF FOR SOME REASON THE OXYGEN FAILS TO TRIP AUTOMATICALLY, THE CREWMAN MUST PULL THE EMERGENCY OXYGEN ACTUATOR RING ON THE FRONT OF THE SURVIVAL KIT. CARE SHOULD BE TAKEN TO PULL THE RING DIRECTLY UPWARD, AS PULLING IT AT AN ANGLE INCREASES THE FORCE REQUIRED AND MIGHT BREAK THE RING LANYARD.

C. AFTER THE PARACHUTE HAS OPENED (ABOUT 11,500 FEET) RELEASE OXYGEN MASK TO PREVENT SUFFOCATION WHEN EMERGENCY OXYGEN SUPPLY IS DEPLETED. IF OVER WATER, PULL UP ON KIT RELEASE HANDLE.



D. PULLING THE KIT RELEASE HANDLE RELEASES THE BOTTOM OF THE SURVIVAL KIT CONTAINER. THE CONTAINER BOTTOM AND RAFT DROP AND HANG FROM A 26 FOOT LINE SECURED TO THE CONTAINER TOP. THIS ACTION CAUSES THE LIFE RAFT TO INFLATE.

MANUAL SEPARATION



SHOULD THE TIME RELEASE MECHANISM FAIL TO OPERATE AUTOMATICALLY, THE OCCUPANT WOULD MANUALLY SEPARATE FROM THE SEAT AS FOLLOWS:

A. ACTUATE EMERGENCY HARNESS RELEASE HANDLE ON RIGHT SIDE OF SEAT TO ITS FULL AFT POSITION. THIS ACTION WILL RELEASE RESTRAINT HARNESS, LEG RESTRAINT CORD, AND A CARTRIDGE ACTUATED GUILLOTINE WILL SEVER THE LINK LINE BETWEEN THE PERSONNEL CHUTE AND DROGUE CHUTE. THE OCCUPANT IS NOW HELD IN SEAT ONLY BY STICKER CLIPS.

B. PUSH FREE OF STICKER CLIPS AND CLEAR OF SEAT.

C. PULL PARACHUTE RIPCORD D RING (LOCATED ON LEFT SHOULDER) AND MAKE A NORMAL PARACHUTE DESCENT TO THE GROUND.

WARNING

AIRCREWS USING THE MANUAL METHOD OF SEAT SEPARATION AND PARACHUTE DEPLOYMENT SHOULD IMMEDIATELY CHECK FOR PARACHUTE ACTUATION AND BE PREPARED TO FORCIBLY DEPLOY THE CHUTE BY HAND AFTER "D" RING ACTUATION.

Note

AIRCREWS SHOULD RIGIDLY HOLD LEFT FRONT RISER WITH LEFT HAND AND PULL RIPCORD "D" RING WITH RIGHT HAND IN ORDER TO INSURE FULL TRAVEL OF THE LANYARD

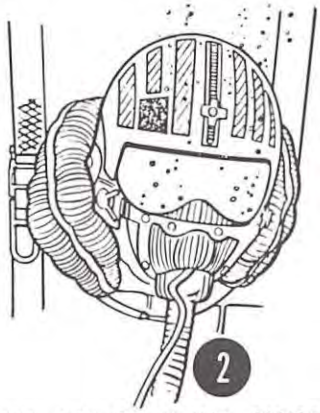
FDD–1–(78–2)A

Figure 12-5. Ejection Seat Sequence (Sheet 2 of 2)

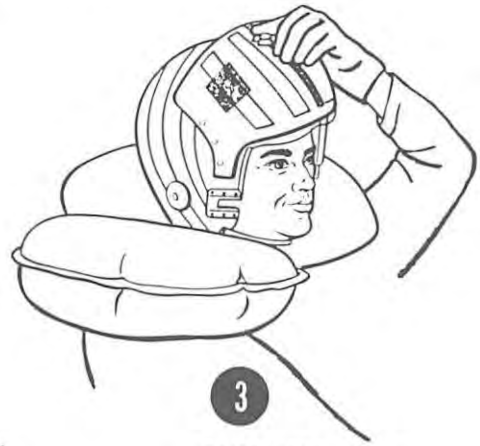
OPTIONS

IF TIME AND ALTITUDE PERMIT OR RESCUE IS NOT IMMINENT, THE FOLLOWING OPTIONS FOR OXYGEN MASK, VISOR, GLOVES, AND FOUR-LINE RELEASE SYSTEM MAY BE CONSIDERED.

REMOVE OXYGEN MASK. OXYGEN HOSE MAY BE DISCONNECTED AND DISCARDED IF DESIRED.

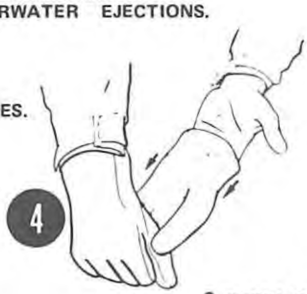


THE A-13 OR MBU-14 OXYGEN MASK AND MINIATURE REGULATOR PROVIDE UNDERWATER BREATHING CAPABILITIES AND WHEN FUNCTIONING PROPERLY SHOULD BE RETAINED IN LOW-LEVEL OVERWATER EJECTIONS.



RAISE VISOR.

REMOVE GLOVES.



NOTE

- STOW GLOVES IN A SAFE PLACE TO PREVENT LOSS. REMOVAL OF GLOVES MAY FACILITATE SUBSEQUENT RELEASE OF CANOPY RELEASES.
- FOUR-LINE RELEASE SYSTEM SHOULD BE UTILIZED TO REDUCE OSCILLATIONS OF THE 28-FOOT FLAT CIRCULAR CANOPY AND TO MAKE THE CANOPY STEERABLE BY PROVIDING A CONTROLLED CHANNEL OF ESCAPE FOR THE AIR.

WARNING

- CAREFULLY INSPECT THE CANOPY AND SUSPENSION LINES PRIOR TO USING THE FOUR-LINE SYSTEM.
- IF ANY CANOPY DAMAGE IS EVIDENT OR IF THERE ARE BROKEN SUSPENSION LINES, DO NOT USE THE FOUR-LINE RELEASE SYSTEM. THE SYSTEM SHOULD ALSO NOT BE USED AT NIGHT SINCE CANOPY DAMAGE MAY BE DIFFICULT TO DETERMINE.

TO OPERATE FOUR LINE RELEASE, LOCATE LANYARD PULL LOOPS ON THE INSIDE OF REAR RISERS.

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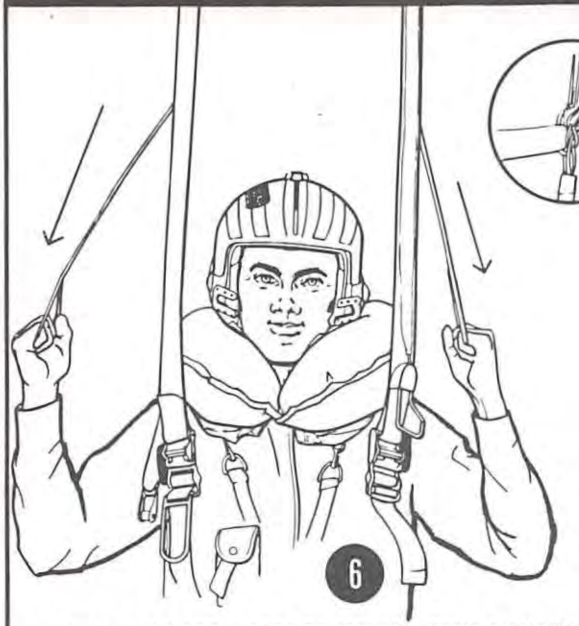
Figure 12-6. Postejection/Bailout Procedures (Sheet 1 of 11)

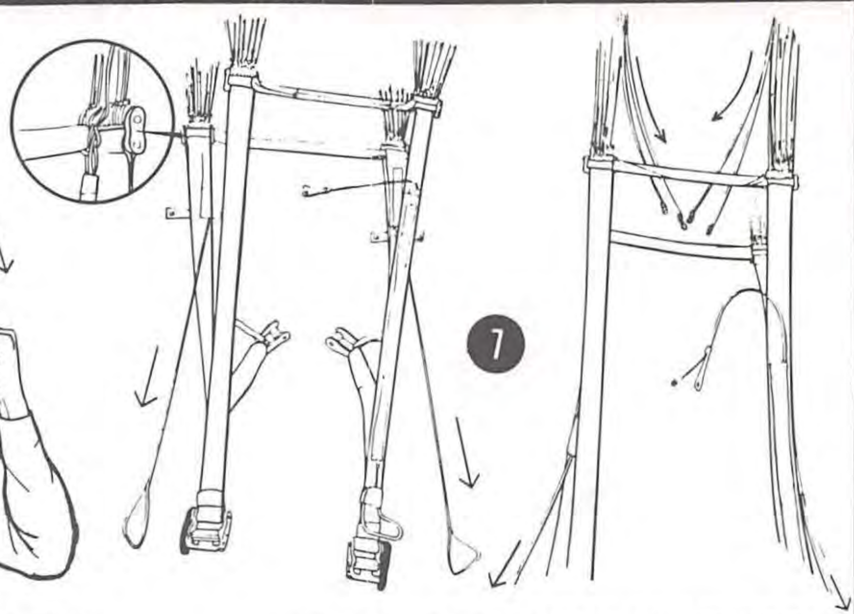
OPTIONS — CONT



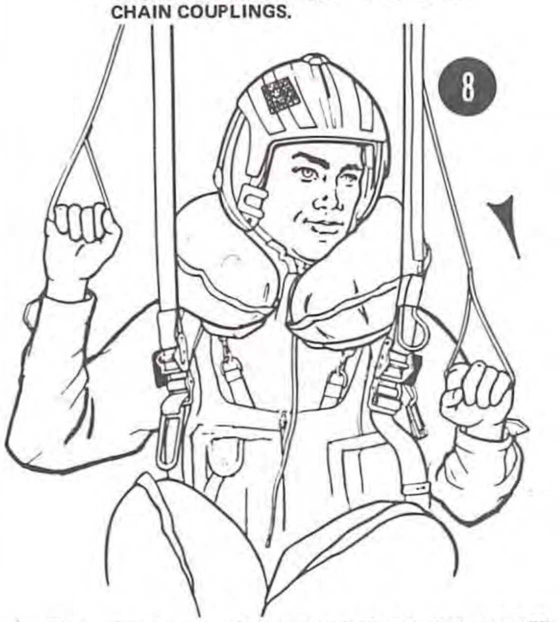
PULL LANYARD LOOPS DOWNWARD WITH A SHARP TUG.

NOTE

APPROXIMATELY 20 POUNDS OF PULL FORCE ARE NEEDED TO BREAK THE TACKINGS AND FREE THE DAISY CHAIN COUPLINGS.



FOUR SUSPENSION LINES ARE RELEASED FROM THE CONNECTOR LINKS AND A LOBE FORMS AT THE CENTER REAR OF THE CANOPY CREATING A CONTROLED CHANNEL FOR AIR ESCAPE.



PULL DOWN ON LEFT LANYARD TO STEER LEFT.

PULL DOWN ON RIGHT LANYARD TO STEER RIGHT.

NOTE

A 180-DEGREE TURN CAN BE ACCOMPLISHED IN ABOUT 20 SECONDS.

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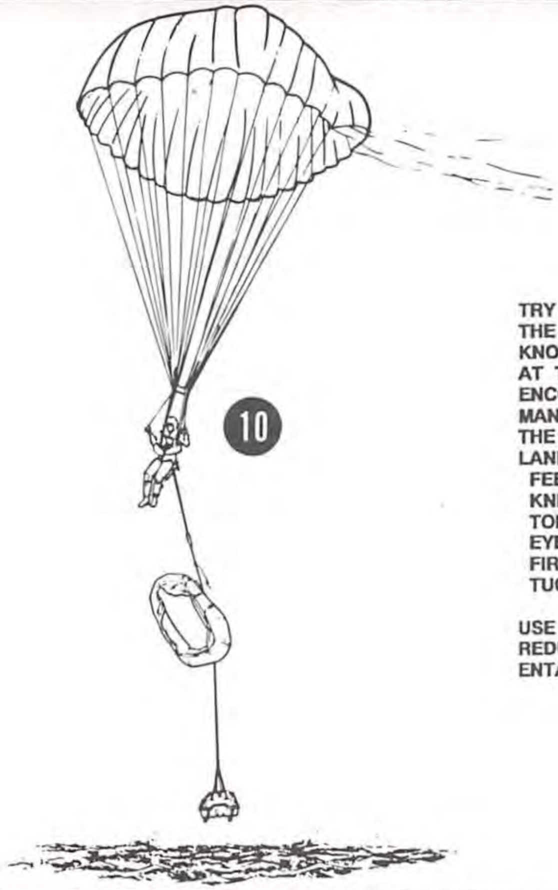
ADC1–112–5

Figure 12-6. Postejection/Bailout Procedures (Sheet 2 of 11)

LANDING PREPARATION



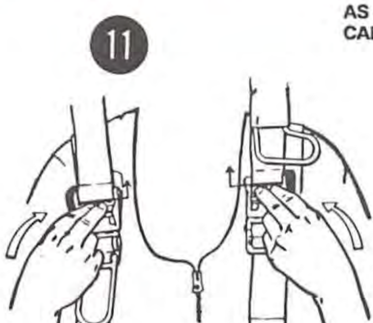
TRY TO DETERMINE THE WIND DIRECTION AT THE SURFACE OF THE WATER USING WHITECAPS, SMOKE FROM WRECKAGE, OR KNOWN SURFACE WINDS IN THE VICINITY. NOTE THAT WINDS AT THE SURFACE MAY BE QUITE DIFFERENT FROM THOSE ENCOUNTERED AT ALTITUDE. WHEN NEARING THE SURFACE, MANEUVER THE PARACHUTE SO THAT YOU ARE FACING INTO THE WIND, THEN ASSUME THE PROPER BODY POSITION FOR LANDING:

- FEET TOGETHER
- KNEES BENT
- TOES POINTED SLIGHTLY DOWNWARD
- EYES ON THE HORIZON
- FIRMLY GRASP CANOPY RELEASES
- TUCK ELBOWS IN PRIOR TO WATER ENTRY.

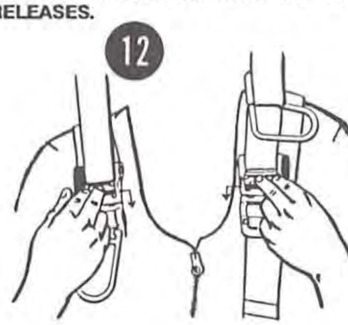
USE OF THE FOUR-LINE RELEASE SYSTEM SIGNIFICANTLY REDUCES THE CHANGES IN PARACHUTE OSCILLATION OR ENTANGLEMENT.

CANOPY RELEASES

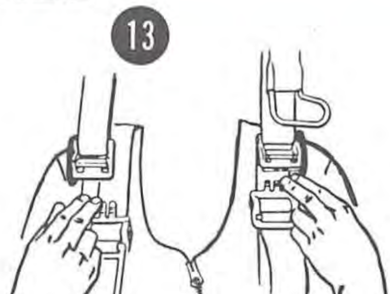
AS THE FEET MAKE CONTACT WITH THE WATER, RELEASE CANOPY RELEASES.



PUSH UP ON CANOPY RELEASE LOCKING LEVER COVER.



PULL DOWN ON RELEASE LEVER.



CANOPY RELEASED.

NOTE

THE PROCEDURES OUTLINED THUS FAR APPLY AS WELL TO OVERLAND EJECTION. IN SOME INSTANCES, HOWEVER, INFLATION OF THE LPA/LPU MAY BE UNDERSIRABLE OVER LAND. DEPLOYMENT OF THE RIGID SEAT SURVIVAL KIT IS NOT RECOMMENDED FOR OVERLAND EJECTIONS.

IF YOU ARE DOWNED IN SEAWATER, SEAWARS WILL RELEASE THE PARACHUTE CANOPY WITHIN 2 SECONDS. HOWEVER, IF ABLE, YOU SHOULD MANUALLY UNLOCK EACH CANOPY RELEASE IMMEDIATELY ON WATER ENTRY. THE SEAWARS DOES NOT OPERATE IN FRESHWATER.

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Figure 12-6. Postejection/Bailout Procedures (Sheet 3 of 11)

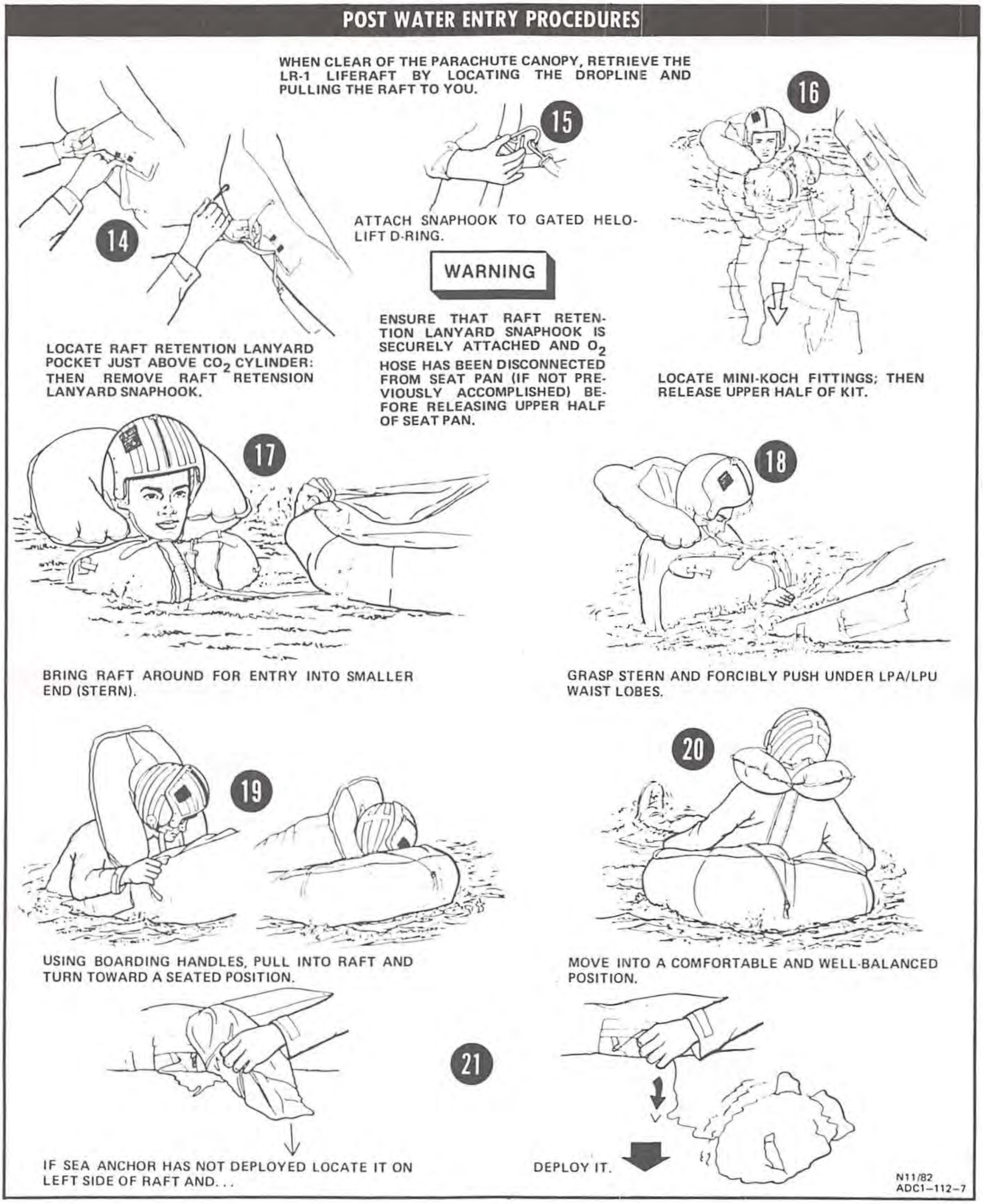


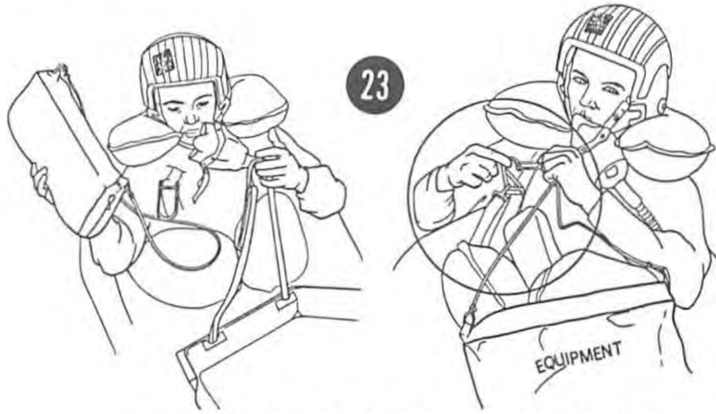
Figure 12-6. Postejection/Bailout Procedures (Sheet 4 of 11)

POST WATER ENTRY PROCEDURES — CONT.

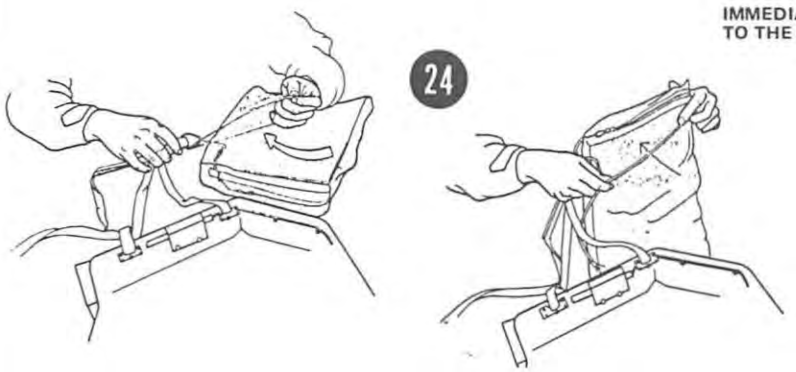
RETRIEVE THE LOWER HALF OF THE SEAT PAN AND LOCATE URT-33.

Note

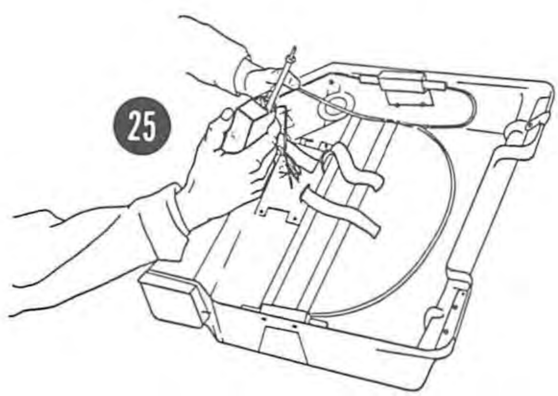
ENSURE THAT NO SHARP EDGES CONTACT THE LIFERAFT.



IMMEDIATELY SECURE THE EQUIPMENT CONTAINER TO THE GATED HELO-HOIST D-RING.



RSSK-1 EQUIPMENT CONTAINER CAN BE REMOVED FROM THE DROPLINE BY SLIPPING IT BACK THROUGH THE LARKSHEAD KNOT.



RELEASE THE VELCRO STRAPS, THEN REMOVE URT-33 FROM ITS BRACKET.

CAUTION

URT-33 IS NOT TIED AND ONCE REMOVED FROM ITS BRACKET CARE MUST BE OBSERVED TO PREVENT ITS LOSS.

Note

URT-33 MUST BE TURNED OFF WHEN USING THE PRC-90 ON 243.0 MHZ TO PREVENT INTERFERENCE FROM THE URT-33.

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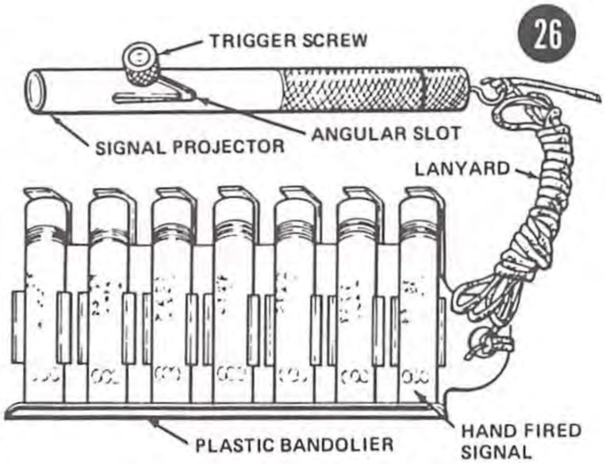
Figure 12-6. Postejection/Bailout Procedures (Sheet 5 of 11)

SIGNALING PROCEDURES

THE FOLLOWING PROCEDURES DESCRIBE THE USE OF SIGNALING DEVICES WHILE IN THE LIFERAFT AND ARE NOT INTENDED TO PRESCRIBE ANY GIVEN ORDER OF PRIORITY WHICH WOULD BE DICTATED BY THE IMMEDIATE SITUATION OF THE SURVIVOR.

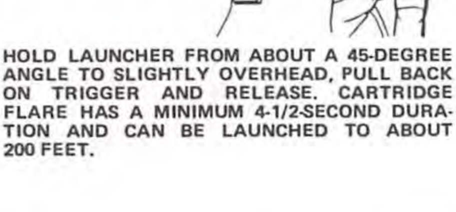


THE MK-79 MOD 0 ILLUMINATION SIGNAL KIT USES A PENCIL-TYPE LAUNCHER AND CARTRIDGE FLARE TO ATTRACT ATTENTION OF SAR.

WARNING

ENSURE PENCIL-TYPE LAUNCHER IS IN COCKED POSITION.

SCREW CARTRIDGE FLARE INTO LAUNCHER WHILE KEEPING FLARE POINTED IN A SAFE DIRECTION.



HOLD LAUNCHER FROM ABOUT A 45-DEGREE ANGLE TO SLIGHTLY OVERHEAD, PULL BACK ON TRIGGER AND RELEASE. CARTRIDGE FLARE HAS A MINIMUM 4-1/2-SECOND DURATION AND CAN BE LAUNCHED TO ABOUT 200 FEET.

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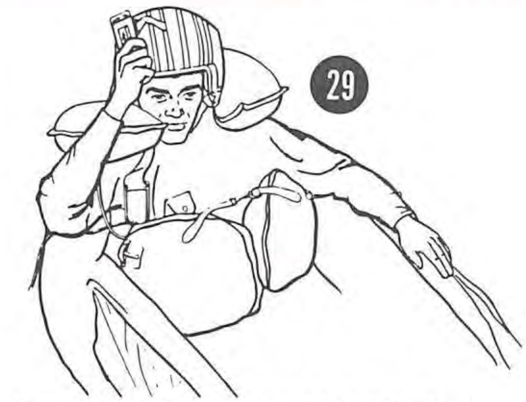
Figure 12-6. Postejection/Bailout Procedures (Sheet 6 of 11)

SIGNALING PROCEDURES — CONT



SDU-5/E STROBE LIGHT CAN BE ATTACHED TO HELMET BY MATING HOOK AND PILE (VELCRO) TAPE. THIS FREES HANDS FOR USE OF OTHER SIGNALING DEVICES WHILE ALLOWING LIGHT TO FLASH UP INTO SKY AND REFLECT OFF HELMET.

MIRROR SIGNALING

1. REFLECT SUNLIGHT ONTO NEARBY SURFACE (RAFT, HAND, ETC.).
2. SLOWLY BRING MIRROR UP TO EYE LEVEL AND LOOK THROUGH SIGHTING HOLE. THE BRIGHT SPOT INSIDE IS THE AIM INDICATOR.
3. HOLD MIRROR CLOSE TO EYE, SLOWLY TURN AND MANIPULATE SO THAT BRIGHT LIGHT IS ON TARGET.
4. EVEN IF NO AIRCRAFT OR SHIPS ARE IN SIGHT, CONTINUE TO SWEEP HORIZON. MIRROR FLASHES CAN BE SEEN FOR MANY MILES, EVEN IN HAZY WEATHER.

MK-13 MOD 0 MARINE SMOKE AND ILLUMINATION SIGNAL (USED TO ATTRACT ATTENTION OF SAR AIRCRAFT AND TO GIVE WIND DRIFT DIRECTION).

IDENTIFICATION:

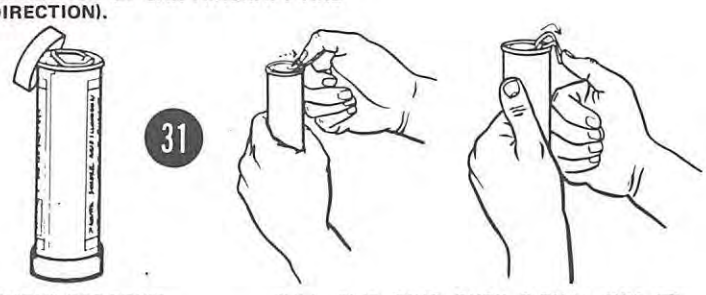
NIGHT
- RED CAP
- PROTRUSIONS ON CAP
- PROTRUSIONS ON CASE
- METAL WASHER ATTACHED TO LANYARD.

NOTE

FLARE INCORPORATING PAPER VICE PLASTIC END CAPS HAS NO PROTRUSIONS ON CAP.

DAY
- ORANGE CAP
- NO PROTRUSIONS ON CAP OR CASE

BURNS APPROXIMATELY 20 SECONDS WITH AN INTENSITY OF 3,000 CANDLEPOWER.



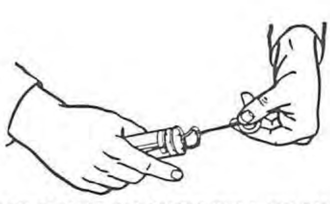
REMOVE CAP FROM DESIRED END.

PULL FLIP RING OVER SIGNAL RIM TO BREAK LEAD SEAL. IF SEAL DOESN'T BREAK, PUSH RING UNTIL IT BENDS AGAINST CASE.

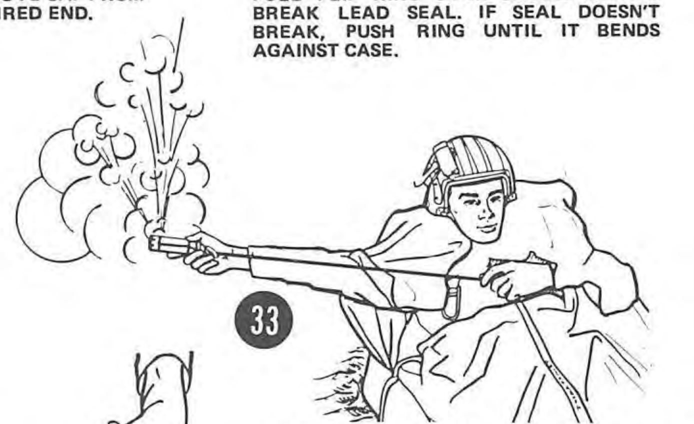
FLIP BENT RING BACK TO ORIGINAL POSITION AND USE AS A LEVER TO BREAK SEAL.

WARNING

MK-13 MOD 0 SIGNAL MAY REACH A TEMPERATURE THAT IS UNCOMFORTABLE TO HAND AFTER IGNITION. USE OF GLOVES IS SUGGESTED.



IGNITE SIGNAL BY QUICK PULL ON RING.



IGNITED MK-13 MOD 0 MUST BE HELD AT ARMS LENGTH, DOWN WIND, NO MORE THAN SHOULDER HIGH, AND OVER THE SIDE OF LIFERAFT TO PREVENT DAMAGE TO RAFT FROM HOT RESIDUE.

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Figure 12-6. Postejection/Bailout Procedures (Sheet 7 of 11)

SIGNALING PROCEDURES — CONT

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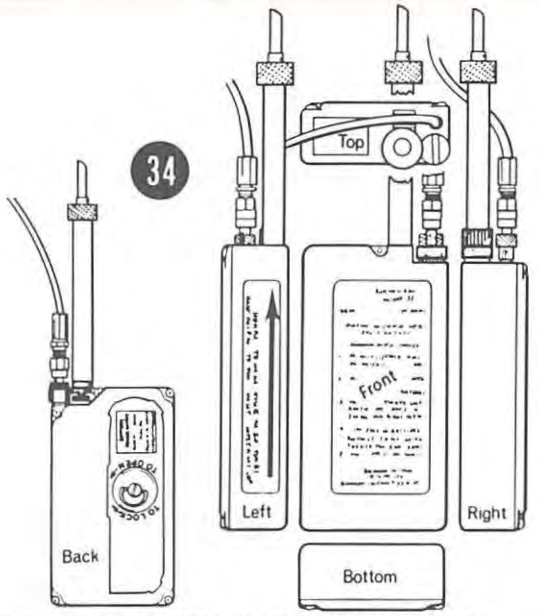
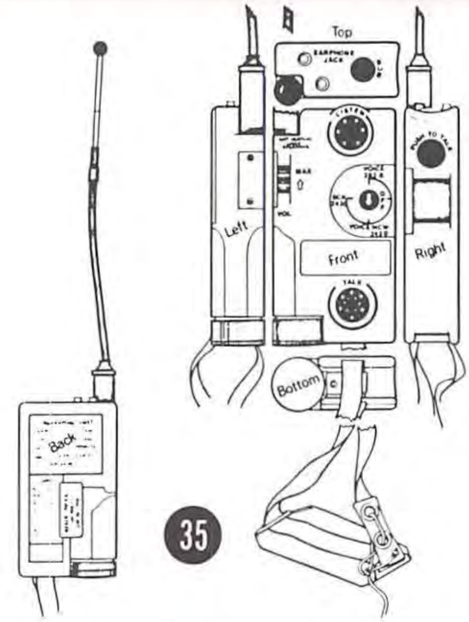


THE AN/URT-33 RADIO AUTOMATICALLY TRANSMITS A SWEPT-TONE SIGNAL ON 243.0 MHZ WHEN THE EJECTION SEAT LEAVES THE FLOOR OF THE AIRCRAFT.

NOTE

- URT-33 MUST BE TURNED OFF WHEN USING PRC-90 ON 243.0 MHZ TO PREVENT INTERFERENCE FROM URT-33.
- DO NOT POINT ANTENNA DIRECTLY AT RECEIVING AIRCRAFT.
- WHEN WORD ON IS VISIBLE, RADIO IS ON.

35



THE AN/PRC-90 IS A DUAL-CHANNEL TRANSMITTER/RECEIVER SURVIVAL RADIO CAPABLE OF TRANSMITTING (VOICE MODE) UP TO 60 NM (LINE OF SIGHT, DEPENDING ON RECEIVING AIRCRAFT ALTITUDE). IT OPERATES ON GUARD (243.0 MHZ) OR SAR PRIMARY OPERATING FREQUENCY (282.8 MHZ) WITH A MODE FOR SWEPT-TONE SIGNAL ON 243.0 MHZ ONLY. TRANSMISSION OF THE BEACON OR CODE CAN BE UP TO 80 NM. SIGNAL ON 243.0 MHZ ONLY. TRANSMISSION OF THE BEACON OR CODE CAN BE UP TO 80 NM.

RESCUE

WHEN RECOVERY AIRCRAFT IS READY TO EFFECT RESCUE:

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STOW OR DISCARD LOOSE GEAR, ROLL OUT OF RAFT ON RIGHT SIDE (SIDE WITH CO_2 CYLINDER).

SWIM AWAY FROM RAFT. ENSURE THAT HELMET VISOR HAS BEEN LOWERED.

37

REMOVE RAFT RETENTION LANYARD AFTER RESCUE DEVICE HAS BEEN LOWERED.

WARNING

TO ALLOW DISCHARGE OF STATIC ELECTRICITY AND PREVENT ELECTRICAL SHOCK, DO NOT TOUCH HELO-HOIST CABLE OR RESCUE DEVICE UNTIL IT HAS MADE CONTACT WITH WATER/GROUND.

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Figure 12-6. Postejection/Bailout Procedures (Sheet 8 of 11)

RESCUE — CONT

NOTE

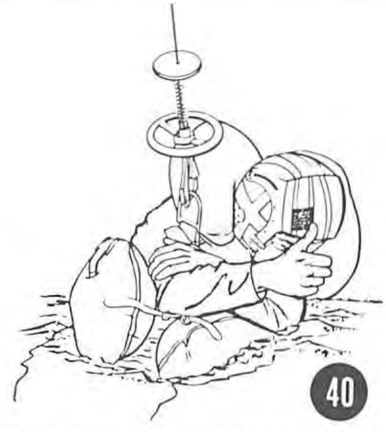
THE RESCUE HOOK HAS A SMALL AND LARGE HOOK. THE LARGE HOOK IS THE PRIMARY HOOK FOR HOISTING PERSONNEL.

PROCEDURES FOR D-RING WITH GATE.

ATTACH LARGE HOOK TO HELO-LIFT D-RING.

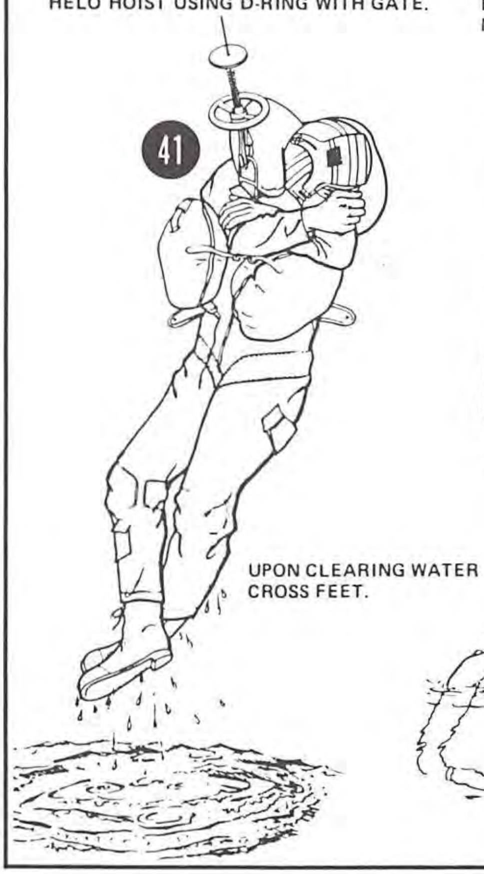
WARNING

TO ALLOW DISCHARGE OF STATIC ELECTRICITY AND PREVENT ELECTRICAL SHOCK, AVOID TOUCHING RESCUE HOOK UNTIL IT HAS MADE CONTACT WITH WATER/GROUND.

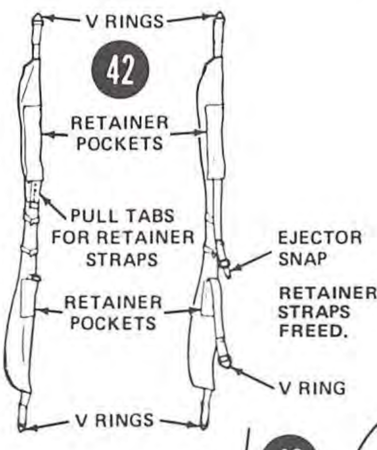


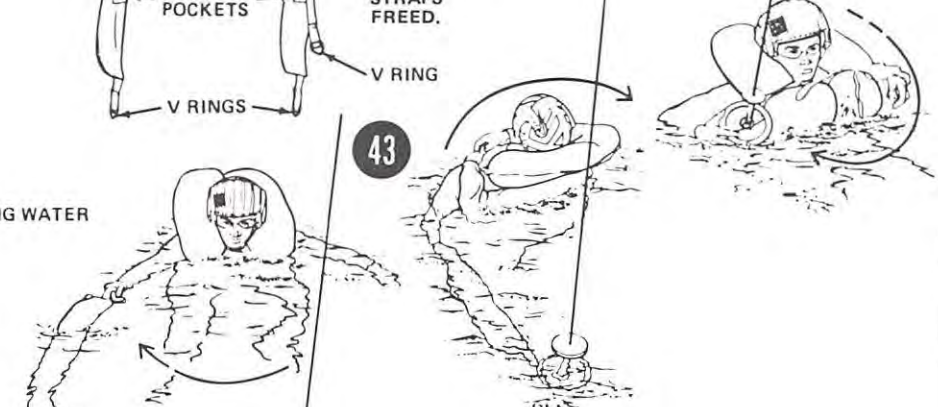
CROSS ARMS IN FRONT OF CHEST AND PLACE HEAD DOWN AND TO LEFT. GIVE THUMBS UP SIGNAL TO HELO-HOIST OPERATOR.

POSITION OF AIRCREWMAN DURING HELO HOIST USING D-RING WITH GATE.



PROCEDURES FOR SURVIVOR'S SLING/HORSE COLLAR (DESIGNED TO ACCOMMODATE ONE SURVIVOR AT A TIME).





GRASP FREE END OF RESCUE SLING. SWIM IN A CIRCLE TOWARD RESCUE HOOK.

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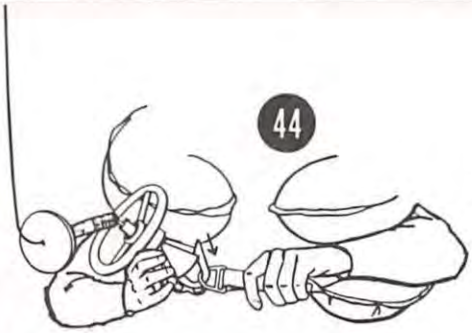
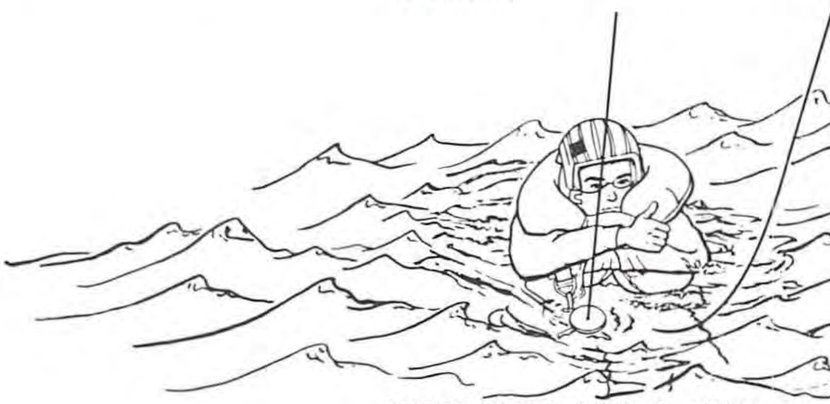
Figure 12-6. Postejection/Bailout Procedures (Sheet 9 of 11)

RESCUE — CONT



ATTACH FREE END OF SLING TO LARGE HOOK.

PULL BOTH RETAINER STRAPS FREE AND CONNECT EJECTOR SNAP TO V RING OF OTHER RETAINER STRAP. PULL TIGHT.



ENSURE RESCUE SLING IS ABOVE LPA/LPU WAIST LOBES AND HIGH ON BACK. WRAP ARMS AROUND SLING. KEEP HEAD DOWN, CROSS LEGS, AND GIVE THUMBS UP SIGNAL TO HELO-HOIST OPERATOR.

POSITION OF AIRCREWMAN DURING HOIST. UPON CLEARING WATER, CROSS FEET.

PROCEDURES FOR USE OF FOREST PENETRATOR

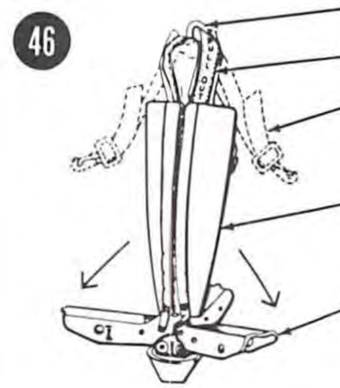
FOREST PENETRATOR WITH FLOTATION COLLAR AND SEATS RETRACTED.

(SAFETY STRAPS OMITTED TO SHOW CONNECTION OF RESCUE HOOK TO EYE-BOLT.)

WARNING

TO ALLOW DISCHARGE OF STATIC ELECTRICITY AND PREVENT ELECTRICAL SHOCK, AVOID TOUCHING RESCUE HOOK/FOREST PENETRATOR UNTIL IT HAS MADE CONTACT WITH WATER/GROUND.

FOREST PENETRATOR WITH FLOTATION COLLAR AND SEATS EXTENDED.



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ADC1–112–13

Figure 12-6. Postejection/Bailout Procedures (Sheet 10 of 11)

RESCUE — CONT

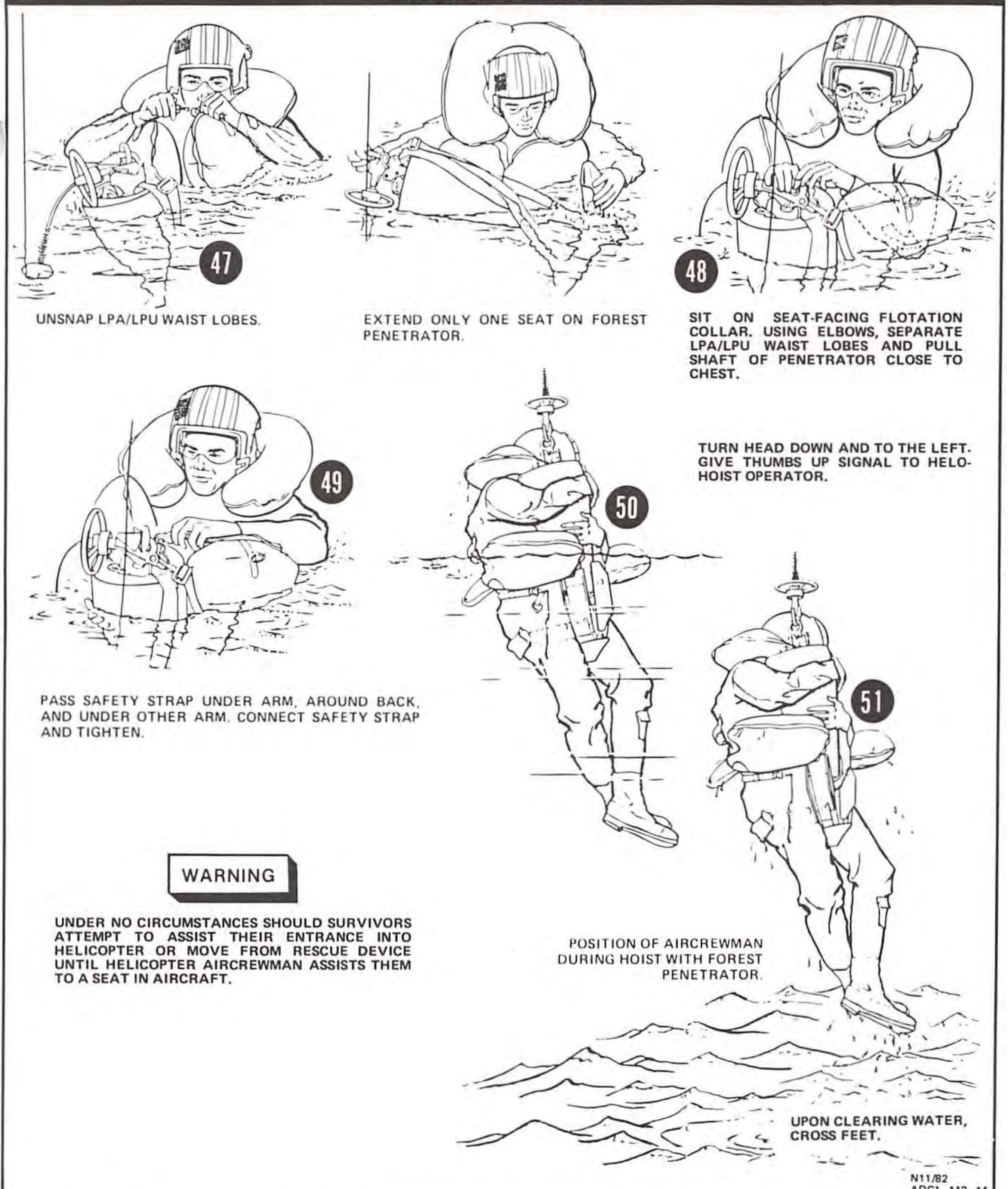

Figure 12-6. Postejection/Bailout Procedures (Sheet 11 of 11)

5. Oxygen mask – RECOMMEND LEAVING ON FOR WATER ENTRY, LOOSEN OR REMOVE FOR OVERLAND.

6. Four-line release lanyards – PULL (see Figure 12-6, Sheet 3).

If descending into water:

7. Canopy releases – RELEASE IMMEDIATELY ON WATER ENTRY.

If descending on land:

8. Turn into the wind and assume the appropriate parachute landing fall (PLF) position.

9. Canopy releases – RELEASE AFTER LANDING.

12.8.5 Survival Kit Jettisoning

1. Open face visor or disconnect oxygen mask.

2. Composite disconnect release knob – PULL.

3. Release left lap belt release fitting.

4. Take hold of survival kit lifting handle with right hand.

5. Release right lap belt release fitting.

12.8.6 Ejection Seat Failure (Bailout). If the canopy has been jettisoned, but the ejection seat fails, proceed as follows:

*1. Reduce speed to 200 to 250 knots.

*2. Emergency restraint release handle – PULL.

Pull up on the emergency restraint release handle on the right side of the seat bucket to disconnect the parachute harness and the leg restraint harness from the seat. This handle also fires the cartridge-actuated guillotine and severs the link line between the drogue chute and the personnel parachute.

*3. Full nose down trim, full rudder trim, and opposite aileron trim as required to hold wings level.

4. Release stick.

When clear of aircraft and at 11,500 feet or below:

5. Parachute D ring – PULL.

WARNING

Aircrews using the manual method of seat separation and parachute deployment should immediately check for parachute actuation and be prepared to forcibly deploy the chute by hand after D-ring actuation.

Note

Aircrews should rigidly hold left front riser with left hand and pull ripcord D-ring with right hand to ensure full travel of the lanyard.

12.9 ELECTRICAL

If an electrical system failure occurs, various components of the combined aircraft systems will be inoperative. Refer to Figure 12-7 for equipment that will be lost/available with one or both generators inoperative.

Note

- With stability augmentation engaged, small transients in yaw and roll will be experienced whenever power to the system is cut off and then reapplied. To prevent these transients, disengage the stab aug by the emergency disengage switch before turning on or cycling either of the generator switches.

- If the right engine fails on final and the bus tie remains open, afterburner ignition will not be available. However, if afterburner thrust is required, afterburner light-offs are generally obtainable through turbine torching by jam accelerating the left engine at 90-percent rpm or above.

RH GEN OUT - BUS TIE OPEN

INOPERATIVE BUSES

RIGHT MAIN 115/200 VAC
RIGHT MAIN 28 VAC
RIGHT MAIN 14 VAC
28/14 VAC WARNING LIGHTS (DIM)
– IF SELECTED

INOPERATIVE EQUIPMENT

AFT CKPT FLOOD LT (DIM)
AFT CKPT UTILITY LT
AFTERBURNER IGNITION
4 AILERON DROOP
AILERON FEEL TRIM
AIRSPEED PITOT HEATER
1 ALTIMETER VIBRATOR
19 AN/AWW–1 BOMB FUZING
ANGLE OF ROLL LIGHT
ANTI–COLLISION LT
ANTI–ICE
8 ANTI–SKID
AOA INDEXER LIGHTS
36 APN–141 RADAR ALTM
37 APN–194 RADAR ALTM
APPROACH LIGHT
AUTO THROTTLE
BELLMOUTH PITOT HEATER

INOPERATIVE EQUIPMENT (CONT)

BUDDY TANK HYD PUMP
℄ GUN POD
CKPT HEAT & VENT
COM–NAV COMMAND LTS
20 CONV WPN BOMB FUZING
33 25 EMER AIL DROOP SWITCH
12 ENG BLEED AIR LEAKAGE DETECTION
EQPT COOLING
FLIGHT REFUEL PROBE LT
38 FORMATION LTS
FUSLG AND ANTI–COLLISION LTS
FWD CKPT RED CSL FLOOD LT (MED)
FWD CKPT RED INSTR FLOOD LT (DIM)
FWD CKPT UTILITY LT
17 GROUND COOLING FANS
NO. 4 FUEL XFR PUMP
11 NO. 7 TANK FUEL XFR PUMP
OXYGEN GAGE
RADAR ANNUNCIATOR LIGHTS (DIM)
– IF SELECTED
RADAR MISSILES
RIGHT FUEL BOOST PUMP
SIDEWINDER
18 STRIKE CAMERA
TAXI LT
UTILITY FLOOD LTS
UTILITY HYD PRESS INDICATOR
WARNING LTS (ALL/DIM) – IF SELECTED
WARNING LIGHTS TEST (ALL/DIM)
– IF SELECTED
WHITE FLOOD LTS (FWD CKPT)
WING AND TAIL LTS (BRT)
WING AND TAIL LTS (DIM)

LH GEN OUT - BUS TIE OPEN

INOPERATIVE BUSES

LEFT MAIN 115/200 VAC
LEFT MAIN 28 VAC
IGNITION 115 VAC
ESSENTIAL 115/200 VAC
ESSENTIAL 28 VAC
ESSENTIAL 28 VDC
28/14 VAC WARNING LTS(BRT)
– IF SELECTED

INOPERATIVE EQUIPMENT

ADF
AFT CKPT EQPT LT
AFT CKPT FLOOD LT (BRT)
AFT CKPT INST LT
AILERON FEEL TRIM
AILERON POSITION INDICATOR
AILERON RUDDER INTERCONNECT
28 ALQ–51/100 COUNTERMEASURES SET
27 ALQ–91 COUNTERMEASURES SET
29 AN/APQ–126 COUNTERMEASURES SET
21 ALR–45
AN/AJB–7
2 ALT ENCODER
ANGLE–OF–ATTACK XMTR HEATER
22 APR–25 RADAR HOMING AND WARNING
5 APX–76 INTERROGATOR SET
AUTOMATIC FUEL XFR
AUTOPILOT
BUDDY TANK HOSE JETTISON
CADC
CENTERLINE STORE SAFETY
5 DATA LINK
32 23 EMER AIL DROOP SWITCH
7 EMER REFUEL PROBE
41 ENG BLEED AIR SHUTOFF VALVE
3 ENG OIL LEVEL AND CHECK
EXTERNAL STORES EMER JETT
EXTERNAL FUEL XFR
FIRE DETECTOR
FIRE DETECTOR CHECK SWITCH
39 FLAPS/SLATS
FLIGHT DIRECTOR GP
FUEL FLOW INDICATOR
FUEL LOW WARNING LT
FUEL PRESSURE INDICATOR
FUEL QUANTITY
26 FWD CKPT FLT INSTR LT
FWD CKPT INST LT
FWD CKPT RED CSL FLOOD LT (BRT)
FWD CKPT RED INSTR FLOOD LT (BRT)

INOPERATIVE EQUIPMENT (CONT)

FWD CSL LT
GVR–10 (VERT FLT REFERENCE)
IFF
INBOARD WG JETTISON
16 INSTRUMENT LANDING SYSTEM (AN/ARA–63)
INTERCOM
INTERNAL WING FUEL XFR
10 KY–28
L & R ENG RAMP CONTROL
L & R ENG TURBINE OUTLET TEMP
L & R MAIN IGNITION
LANDING GEAR AND FLAP POS IND
LEFT ENGINE FUEL SHUTOFF
LH FUEL BOOST PUMP (HI OR LOW SPEED)
MAIN FUEL CONTROL (RT ENG FUEL SHUTOFF)
MASTER CAUTION LT RESET
MISSILE JETTISON
NAV COMPUTER
NO. 6 FUEL XFR PUMP
NOSEWHEEL STEERING
NOZZLE POSITION INDICATOR
OIL PRESSURE INDICATORS
35 OPTICAL SIGHT
OUTBD WG JETTISON
PC1 & PC2 HYD PRESSURE INDICATORS
PNEUMATIC PRESS IND
PNEUMATIC SYSTEM CONT
RADAR
15 RADAR SCOPE CAMERA
REFUEL PROBE
5 R AND L ENG BELLMOUTH CONT
RUDDER FEEL TRIM
RUDDER POSITION INDICATOR
SCOPE LTS
9 SEAT ADJUST
6 SMOKE ABATEMENT SYSTEM
STAB FEEL TRIM
TACAN
UHF COMM
UTILITY RECEPTACLE (AC)
14 VTAS
WARNING LTS (BRT) – IF SELECTED
WINDSHIELD TEMP SENSOR

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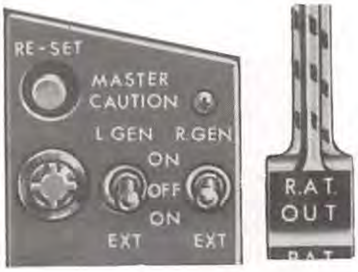
Figure 12-7. Emergency Power Distribution (Sheet 1 of 3)

RAT OPERATING - LH GEN OUT - BUS TIE OPEN



OPERATIVE BUSES

ESSENTIAL 115/200 VAC
ESSENTIAL 28 VAC
ESSENTIAL 28 VDC
IGNITION 115 VAC
RIGHT MAIN 115/200 VAC
RIGHT MAIN 28 VAC
RIGHT MAIN 14 VAC
RIGHT MAIN 28 VDC
LEFT MAIN 28 VDC
ARMAMENT 28 VDC
RADAR 28 VDC
28/14 WARNING LTS – BRT & DIM

OPERATIVE EQUIPMENT

AFT CKPT FLOOD LTS (BRT)
AFT CKPT FLOOD LTS (DIM)
AFT CKPT INSTR LTS
AFT CKPT UTILITY LT
AFTERBURNER IGNITION
4 AILERON DROOP
AILERON FEEL TRIM
AILERON POSITION INDICATOR
AIRSPEED PITOT HEATER
AJB–7
1 ALTIMETER VIBRATOR
AN/ARW–73
19 AN/AWW–1 BOMB FUZING
AOA INDEXER LTS

OPERATIVE EQUIPMENT (CONT)

AOA INDICATOR
AOA PROBE HEATER
ANTI–COLLISION LT
ANTI–ICE
8 ANTI–SKID
5 AN/ALE–29A CHAFF DISPENSER

36 APN–141 RADAR ALTM
37 APN–194 RADAR ALTM
APN–154 RADAR BEACON
APPROACH LT
ARMAMENT BUS CONTROL
ARR HOOK CONTROL
AUTOMATIC FUEL XFR
AUTO THROTTLE
AUX RECEIVER
BELLMOUTH PITOT HEATER
BOMB & ROCKET REL CONTROL
BOMB & ROCKET REL POWER
BUDDY TANK FUEL DUMP
BUDDY TANK HOSE JETTISON
BUDDY TANK HYD PUMP
CADC
CKPT HEAT & VENT
℄ GUN POD
20 CONV WPN BOMB FUZING
CTR STORE POWER
CTR STORE SAFETY
33 24 EMER AIL DROOP SWITCH
7 EMER REFUEL PROBE
12 ENG BLEED AIR LEAKAGE DETECTION
13 ENG BLEED AIR SHUTOFF VALVE
3 ENG OIL LEVEL AND CHECK
EQUIPMENT COOLING
EXT LT CONTROL
EXTERNAL STORES EMER JETT
EXTERNAL FUEL XFR
FIRE AND OVERHEAT DETECTOR
FIRE DETECTOR CHECK SWITCH
40 FLAPS
39 FLAPS/SLATS
FLIGHT DIRECTOR GP
FLIGHT REFUEL PROBE LT
38 FORMATION LTS
FUEL FLOW INDICATOR
FUEL LOW WARNING LT
FUEL PRESSURE INDICATOR
FUEL QUANTITY
FSLG AND ANTI–COLLISION LTS
26 FWD CKPT FLT INSTR LTS
FWD CKPT INSTR LTS
FWD CKPT RED CSL FLOOD LTS (MED)
FWD CKPT RED CSL FLOOD LTS (BRT)
FWD CKPT RED INSTR FLOOD LTS (DIM)

OPERATIVE EQUIPMENT (CONT)

FWD CKPT RED INSTR FLOOD LTS (BRT)
FWD CKPT UTILITY LT
IFF
INBOARD WG JETTISON
INTERCOM
INTERNAL WING FUEL DUMP
INTERNAL WING FUEL XFR
10 KY–28
LANDING GEAR
LANDING GEAR AND FLAP POS IND
LEFT ENGINE FUEL SHUTOFF
L & R ENGINE TURBINE OUT TEMP
L & R MAIN IGNITION
LH FUEL BOOSTER PUMP (34 LOW SPEED)
MAIN FUEL CONTROL (R ENG FUEL SHUT-OFF)
MASTER CAUTION LT RESET
MISSILE ARM
MISSILE FIRING
MISSILE JETTISON
NO. 4 FUEL XFR PUMP
11 NO. 7 TANK FUEL XFR PUMP
NOZZLE POSITION IND
OIL PRESSURE IND
OXYGEN GAGE
OUTBOARD WG JETTISON
PC1 & PC2 HYD PRESSURE INDICATORS
PNEUMATIC PRESSURE INDICATORS
PNEUMATIC SYSTEM CONT
R & L AUX DOORS
R & L ENG BELLMOUTH CONT
RADAR MISSILE FAIRING
RAIN REMOVAL
REFUEL PROBE
RIGHT FUEL BOOST PUMP
RUDDER FEEL TRIM
RUDDER POSITION INDICATOR
RUDDER TRIM
SIDEWINDER
6 SMOKE ABATEMENT SYSTEM
SPEED BRAKE
STABILATOR FEEL TRIM
STABILATOR POSITION IND
STATIC ACCEL
STORES RELEASE CONT
TAXI LT
UHF COMM
UTILITY FLOOD LT
UTILITY HYD PRESS IND
UTILITY RECEPTACLE (D–C)
WARNING LTS
WARNING LTS TEST SWITCH
WHITE FLOOD LTS (FWD CKPT)
WINDSHIELD TEMP SENSOR
WING AND TAIL LTS (BRT)
WING AND TAIL LTS (DIM)
WINGFOLD CONTROL

RAT OPERATING - LH GEN OUT - RH GEN OUT

OPERATIVE BUSES

ESSENTIAL 115/200 VAC
ESSENTIAL 28 VAC
ESSENTIAL 28 VDC
IGNITION 115 VAC
28/14 VAC WARNING LTS – BRT

OPERATIVE EQUIPMENT

AFT CKPT FLOOD LTS (BRT)
AFT CKPT INSTR LTS
AILERON POSITION IND
AN/AJB–7
AOA INDICATOR
AUTOMATIC FUEL XFR
BUDDY TANK HOSE JETTISON

OPERATIVE EQUIPMENT (CONT)

CADC
CTR STORE SAFETY
33 23 EMER AIL DROOP SWITCH
7 EMER REFUEL PROBE
41 ENG BLEED AIR SHUTOFF VALVE
EXT STORES EMER JETT
EXT FUEL XFR
FIRE AND OVERHEAT DETECTOR
39 FLAPS/SLATS
FLT DIRECTOR GP
FUEL FLOW INDICATOR
FUEL LOW WARNING LT
FUEL PRESSURE INDICATOR
FUEL QUANTITY
26 FWD CKPT FLT INSTR LTS
FWD CKPT INSTR LTS
FWD CKPT RED CSL FLOOD LTS (BRT)
FWD CKPT RED INST FLOOD LT (BRT)
IFF
INBOARD WG JETTISON
INTERCOM
INTERNAL WING FUEL TRANSFER
10 KY–28
LANDING GEAR AND FLAP POSN IND

OPERATIVE EQUIPMENT (CONT)

LEFT BOOST PUMP EMER (LOW SPEED)
L & R ENG TURBINE OUT TEMP IND
L & R MAIN IGNITION
LEFT ENG FUEL SHUTOFF
MAIN FUEL CONTROL (R ENG FUEL SHUTOFF)
MASTER CAUTION LT RESET
MISSILE JETTISON
NOZZLE POSITION IND
OIL PRESS INDICATORS
OUTBOARD WING JETTISON
PC1 & PC2 HYD PRESS INDICATORS
PNEUMATIC PRESS INDICATOR
PNEUMATIC SYSTEM CONTROL
REFUEL PROBE
5 R & L ENG BELLMOUTH CONT
RUDDER FEEL TRIM
RUDDER POSITION INDICATOR
6 SMOKE ABATEMENT SYSTEM
STAB FEEL TRIM
UHF COMM
WARNING LTS (BRT)
WINDSHIELD TEMP SENSOR

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Figure 12-7. Emergency Power Distribution (Sheet 2 of 3)

RAT OPERATING - LH GEN OUT - RH GEN OUT

INOPERATIVE BUSES

RIGHT MAIN 200/115 VAC
RIGHT MAIN 28 VAC
RIGHT MAIN 14 VAC
LEFT MAIN 115/200 VAC
LEFT MAIN 28 VAC
RIGHT MAIN 28 VDC
LEFT MAIN 28 VDC
ARMAMENT 28 VDC
RADAR 28 VDC

INOPERATIVE EQUIPMENT

ADF
AFT CKPT FLOOD LT (DIM)
AFT CKPT UTILITY FLOOD LT
AFT CKPT WARNING LT TEST
AFTERBURNER IGNITION
4 AILERON DROOP
AILERON FEEL TRIM
AIRSPEED PITOT HEATERS
1 ALTIMETER VIBRATORS
2 ALTITUDE ENCODER (AIMS)
AN/AJB-7 (BOMBING CAPACITY)
5 AN/ALE-29 (CHAFF DISPENSER)
28 AN/ALQ-51/100 COUNTERMEASURES SET
27 AN/ALQ-91 ELECTRONIC COUNTER MEASURES

INOPERATIVE EQUIPMENT (CONT)

21 AN/ALR-45 RADAR RECEIVER
36 AN/APN-141 RADAR ALTM
37 AN/APN-194 RADAR ALTM
AN/APN-154 RADAR BEACON
22 AN/APR-25 RADAR RECEIVER
29 AN/ALQ-126 COUNTERMEASURES SET
5 AN/APX-76 INTERROGATOR SET
AN/ARW-73
AN/ASN-39A NAV COMPUTER
AN/ASW-25 DATA LINK
AN/AWG-10 RADAR SET
AN/AWW-1 BOMB FUZING
AOA INDEXER LTS
AOA PROBE AND TRANSMITTER HEATERS
ANGLE OF ROLL LT
ANTI-COLLISION LT
8 ANTI-SKID
APPROACH LT
ARI
ARRESTING HOOK CONT (RETRACT)
AUTOPILOT
AUTO THROTTLE (APCS)
AUX AIR DOORS
AUX RECEIVER
30 BELLMOUTH
BELLMOUTH PITOT HEATERS
BOMBS, ROCKETS AND BULLPUP RELEASE
CATAPULT EXTENSION
℄ GUN POD
CKPT HEAT TEMP CONTROL
CORNER REFLECTOR
33 25 EMER AILERON DROOP SWITCH
ENG ANTI-ICE
12 ENG BLEED AIR LEAKAGE DETECTION
13 ENG BLEED AIR SHUTOFF VALVE
EQPT COOLING AND PRESSURIZATION
FIRE DETECTOR CHECK SWITCH
40 FLAPS
FLT REFUEL PROBE LT
FSLG LT
38 FORMATION LTS
FWD CKPT CONSOLE LT
FWD CKPT RED CONSOLE FLOOD LT (DIM-MED)
FWD CKPT RED INSTR FLOOD LT (DIM)
FWD CKPT UTILITY FLOOD LT
FWD CKPT WHITE FLOOD LT

INOPERATIVE EQUIPMENT (CONT)

GVR-10 VERT FLT REFERENCE
17 GROUND COOLING FANS
16 INSTR LANDING SYSTEM (AN/ARA-63)
INTRL WING FUEL DUMP
LANDING GEAR
L FUEL BOOST PUMP (HIGH SPEED)
MISSILE ARMING
MISSILE FAIRING DOORS
MISSILE FIRING
NO. 4 FUEL CELL XFMR PUMP
NO. 6 FUEL CELL XFMR PUMP
11 NO. 7 FUEL CELL XFMR PUMP
NOSE WHEEL STEERING
35 OPTICAL SIGHT
OXYGEN GAGE
15 RADAR SCOPE CAMERA
RADAR MISSILES
RAIN REMOVAL
R FUEL BOOST PUMP
RUDDER TRIM
9 SCOPE LTS
SEAT ADJUST
SIDEWINDER
SPEED BRAKES
STAB AUG
STABILATOR POSITION INDICATOR
STALL WARNING VIBRATOR
STATISTICAL ACCELERATOR
STORES RELEASE
18 STRIKE CAMERA
TACAN
TAXI LT
UTILITY HYD PRESSURE INDICATOR
UTILITY RCPT (DC)
VARIABLE RAMP SCHEDULING
14 VTAS
WARNING LT (DIM)
WARNING LTS TEST SWITCH
WING FOLD
WING POSITION AND JOIN-UP LT

LEGEND

1 AIRCRAFT 153071z THRU 153779ab
2 F-4J AIRCRAFT 153780ac AND UP OR AFTER AFC 388 AND ALL F-4S
3 AIRCRAFT 153076aa AND UP
4 AIRCRAFT 154786ag AND UP
5 F-4J 155529ag AND UP OR 153768ab THRU 155528ag AFTER AFC 388 AND ALL F-4S
6 F-4J AIRCRAFT 155867ak AND UP AND ALL OTHERS AFTER AFC 373
7 F-4J 155867ak AND UP OR AFTER AFC 370 AND ALL F-4S
8 AIRCRAFT 157242an AND UP
9 F-4J AIRCRAFT 157242an AND UP OR AFTER AFC 486 AND ALL F-4S
10 F-4J AIRCRAFT 155529ag AND UP OR 153768ab THRU 155528ag AFTER AFC 331 AND ALL F-4S
11 AIRCRAFT 155903ap, AND 157274ap AND UP
12 F-4J AIRCRAFT 155903ap, AND 157274ap AND UP OR AFTER AFC 439 AND ALL F-4S
13 F-4J 157274ap AND UP OR AFTER AFC 440 AND ALL F-4S BUT BEFORE AFC 627
14 F-4J 158355at AND UP, OR 153768ab THRU 158354as AFTER AFC 506 AND ALL F-4S
15 F-4J 153768ab THRU 158354as BEFORE AFC 506
16 F-4J 157309ar AND UP, OR AFTER AFC 470 AND ALL F-4S
17 158355at AND UP
18 AFTER AFC 518 AND ALL F-4S
19 F-4J 153071z, 153531ac, 153768ab THRU 157309ar
20 158346as AND UP
21 F-4J AFTER AFC 524 AND ALL F-4S
22 F-4J 155529ag AND UP, AND 153768ab THRU 155528ag AFTER AFC 388 AND BEFORE AFC 524
23 153768ab THRU 153838ad AND 153840ae THRU 154785af AFTER AFC 534 OR AFC 599
24 F-4J AFTER AFC 534 AND ALL F-4S
25 154786ag THRU 158379au AFTER AFC 534 OR AFC 599
26 F-4J 153768ab THRU 153838ad OR 153840ae THRU 158379au AFTER 536 AND ALL F-4S
27 155570ah AND UP
28 F-4J 155570ah AND UP BEFORE AFC 541
29 F-4J AFTER AFC 541 AND ALL F-4S
30 F-4J 153071z THRU 153088aa; 543768ab THRU 155528ag BEFORE AFC 388
31 DELETED
32 ON F-4J BEFORE AFC 599 OR AFC 612 AILERONS WILL DROOP WITH SWITCH IN DISABLED POSITION AND FLAPS LOWERED PNEUMATICALLY, ON F-4J AFTER 599 OR AFC 612 AND F-4S, AILERONS WILL NOT DROOP WITH SWITCH IN EITHER ON OR OFF POSITION AND FLAPS LOWERED PNEUMATICALLY
33 AILERONS WILL NOT DROOP WITH SWITCH IN DISABLED POSITION (OFF POSITION ON F-4J AFTER AFC 599 OR AFC 612 AND F-4S) AND FLAPS LOWERED PNEUMATICALLY
34 HIGH SPEED AND LOW SPEED OPERATIVE F-4J 153072z THRU 153088aa; 153768ab THRU 154785af BEFORE AFC 388
35 F-4J 153768ab THRU 158379au AFTER AFC 576 PT 1 AND ALL F-4S
36 F-4J BEFORE AFC 570
37 F-4J AFTER AFC 570 AND ALL F-4S
38 F-4J AFTER AFC 599 AND ALL F-4S
39 F-4S
40 F-4J
41 AFTER AFC 627

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Figure 12-7. Emergency Power Distribution (Sheet 3 of 3)

Note

Often the first indication of an engine failure will be the illumination of MASTER CAUTION and GENERATOR OUT lights. When these indications are noted, check engine rpm prior to proceeding to the generator failure portion of the checklist.

12.9.1 Single-Generator Failure or Intermittent-Generator Operation. In F-4J 155785ai and up or after AFC 388 or AFC 535 and all F-4S, a left-generator failure accompanied by a failure of the bus tie will not be noted by the illumination of the LH GEN OUT and BUS TIE OPEN lights if the pilot instrument light knob (flight instrument light knob on F-4J after AFC 536 an all F-4S) is in the OFF position. Failure can be detected initially by noting the OFF flag appearing on the ADI, at which time the instrument lights should be turned on and the generator lights monitored for verification of the failure. If the pilot instrument lights are not in the OFF position when a right-generator failure accompanied by a bus tie failure occurs, the RH GEN OUT and BUS TIE OPEN lights will not illuminate. The failure may be detected by loss of all external lights, loss of COM-NAV command lights, appearance of OFF flags in oxygen gauges, loss of the front and rear cockpit utility flood lights, or loss of indexer lights with gear down. Warning light power will be available at all times on the RAT regardless of the position of the pilot instrument light knob (flight instrument light knob on F-4J after AFC 536 and all F-4S).

With or without bus tie failure:

1. Determine malfunctioning/failed generator.

Without bus tie open or bus tie open condition permitting warning lights illumination:

a. Check for illumination of generator warning lights and bus tie open light.

With bus tie open condition preventing warning lights illumination and day VFR:

a. With flight instrument lights (instrument lights on F-4J before AFC 536) OFF:

(1) Initial indications will be:

(a) OFF flag on ADI

(b) Loss of intercom.

b. Flight instrument lights (instrument lights on F-4J before AFC 536) – ON.

Night or IFR:

2. Check engine operation.

a. With flight instrument lights (instrument lights on F-4J before AFC 536) ON:

(1) Initial indications will be:

(a) Loss of COM-NAV command lights

(b) OFF flag in oxygen gauge

(c) Loss of utility flood lights

(d) Loss of indexer lights (gear down)

(e) Loss of all external lights.

b. Flight instrument lights (instrument lights on F-4J before AFC 536)– OFF.

3. Failed generator switch – CYCLE.

4. Check generator switch – OUT.

5. If light remains illuminated, failed generator switch – OFF.

6. Monitor engine oil pressure and nozzle operation – SECURE ENGINE IF NECESSARY.

Note

On aircraft after PPC 62, engine oil loss will be indicated by the illumination of the applicable engine oil low warning light.

During night or IFR conditions prior to penetration and approach:

7. Extend RAT and place console flood lights switch to BRIGHT.

Note

Multiple emergencies, adverse weather, and other peculiar conditions may require relighting of the engine. In this case, a relight should be initiated to ensure minimum time on the engine.

8. Land as soon as practicable.

If BUS TIE OPEN light is also illuminated:

9. Set throttles for cruise power or below.

Throttles should be set for cruise power or below to prevent engine flameout caused by power interruption to fuel boost pumps when operating generator is cycled.

10. Operating generator switch – CYCLE (OFF, then ON).

11. Check bus tie warning light – OUT.

12. If light remains illuminated, turn off all electrical equipment not essential to flight.

Note

During night or IFR flying if the right generator remains inoperative with the bus tie open, there will not be power available to illuminate the warning lights while the instrument light knob (flight instrument light knob on F-4J after AFC 536 and all F-4S) in the forward cockpit is in any position except OFF. To retain power for the warning lights, turn the instrument light knob OFF and place the emergency instrument panel flood light switch to BRT.

To regain use of essential bus and right generator on F-4J 153072z through 154785af before AFC 388 with left generator out and bus tie open:

1. Both generators – OFF.

CAUTION

Failure to turn off both generators before extending RAT will result in RAT burning out.

2. Ram air turbine – EXTEND.

3. Left boost pump normal control circuit breaker – PULL (E11, No. 1 panel).

4. GVR-10 circuit breaker – PULL (A16, No. 1 panel).

5. Attitude reference knob – STBY.

Note

In order for the ADI, HSI, and BDHI to receive reliable heading and attitude information on RAT power, the source of these signals must be switched from the GVR-10 to the AJB-7.

6. Right generator switch – ON.

CAUTION

With the BUS TIE OPEN light illuminated, cycling of the emergency generator should be done with caution. The original short/fault probably still exists and could be further aggravated by application of emergency power. Should evidence be found that a short/fault exists on the essential buses, power can only be removed by RAT retraction.

To regain use of essential bus and right generator on F-4J 153071z, 154786ag and up, or after AFC 388 and all F-4S with the left generator out and bus tie open:

1. Ram air turbine – EXTEND.

12.9.2 Double-Generator Failure

Note

On F-4J, the flaps will retract to a trail position if lowered prior to the double-generator failure. On F-4S, the flaps will also retract but the slats will remain OUT.

On F-4J 153071z through 155874ah before AFC 388 or AFC 535, a double-generator failure is determined by the illumination of all the generator indicator lights. However, typical double failure on these aircraft is caused by loss of dc control voltage from the permanent magnet generators. The generator indicator lights will not illuminate since the control voltage is utilized to illuminate the lights. Therefore, detection of double-generator failure without illumination of the indicator lights must be determined by other means, such as the appearance of OFF flags on the instrument panels and the sudden quiet caused by loss of electrical control power to the air-conditioning system. The generator indicator lights cannot be restored by RAT power. On F-4J 155785ai and up or after AFC 388 or 535 and all F-4S, the generator indicator lights receive power at all times from the warning lights bus, and the lights will not be illuminated after a double-generator failure. The lights can be restored, however, when RAT power is applied to the warning lights bus. As above, the double-generator failure is determined by the appearance of OFF flags and the quiet caused by shutdown of the air-conditioning system. The indicator lights will be restored on RAT power.

*1. Ram air turbine – EXTEND.

Reduce airspeed to RAT extension speed and extend RAT.

2. All unessential electrical switches – OFF.

3. Generator control switches – OFF.

4. Aft cockpit 3P325 plug – CHECK SECURED.

5. Generator control switches – ON.

6. Check generator warning light(s) – OUT.

7. If generator warning light(s) go out – RETRACT RAT.

8. Judiciously continue mission, be prepared to land as soon as practicable.

If both generator warning lights remain illuminated or reilluminate:

9. Generator control switches – OFF.

10. Console floodlights – BRIGHT.

During night or IFR conditions, turn console floodlights to BRT as it is the only source of console illumination on RAT power.

11. Landing gear – BLOW DOWN FOR LANDING.

If the landing gear is down and locked before loss of electrical power, do not blow the gear down.

12. Flaps (F-4J) – BLOW DOWN FOR CARRIER LANDING;

– UP FOR FIELD LANDING (if facilities permit).

Slats/flaps (F-4S) – LOWER BY NORMAL MEANS FOR CARRIER AND FIELD LANDINGS.

CAUTION

Emergency pneumatic extension of the flaps/slats may cause a utility hydraulic failure.

13. Consider straight-in arrested landing.

14. Land as soon as practicable.

12.9.3 Complete Electrical Failure. In event of a double-generator failure and a ram air turbine failure, neither external fuel nor internal wing fuel will transfer (regardless of fuel control panel switch position prior to the failure). Usable fuel at the time of the complete electrical failure will be indicated by the tape on the fuel quantity gauge. Therefore, the pilot must time his remaining fuel to adjust gross weight for landing. The only available method for internal fuselage fuel transfer will be the hydraulic transfer pumps. In the event of a utility hydraulic failure, approximately 1,500 pounds of fuselage fuel will not be available. The utility hydraulic gauge will be inoperative; therefore, monitoring of the utility pressure must be accomplished by rudder feel. In any event, regardless of possible multiple failures, the main consideration must be to land as soon as possible giving due regard to available field arresting gear limitations.

WARNING

Normal afterburner ignition and fuel boost pressures will not be available. Attempted use of afterburner may cause a double-engine flameout.

If facilities permit a no-flap/slat landing:

1. Land as soon as possible.

2. Gear – BLOW DOWN FOR LANDING.

Note

If possible, get visual check of gear down and locked.

3. Flaps/slats –BLOW DOWN FOR CARRIER LANDING;

   –UP FOR FIELD LANDING (if facilities permit).

On F-4J through 154785af before AFC 534 and 154786ag and up, the ailerons will not droop when the flaps are blown down. On F-4J through 154785af after AFC 534 but before AFC 612, the ailerons will droop regardless of the emergency aileron droop switch position. On all F-4J after AFC 599 or 612 and all F-4S, the ailerons will not droop when the flaps are blown down regardless of emergency aileron droop switch position.

WARNING

Emergency pneumatic extension of the flaps may cause a utility hydraulic failure. On F-4J through 154785af after AFC 534 but before AFC 599 or AFC 612, a subsequent PC hydraulic failure will cause split aileron droop and an immediate roll into the dead wing from which recovery is impossible.

4. Perform controllability check.

5. Consider a straight-in arrested landing.

Note

- Refer to Figures 12-1, 18-7, and 19-7 for approximate approach airspeed with SPC off.

- A flaps/slats 1/2-OUT carrier landing should be attempted only if a divert field is not available and only under the most optimum gross weight, arresting gear limitations, wind over deck, and weather conditions.

If carrier landing conditions are not optimum:

6. Eject.

12.10 ENGINE

Jet engine failures in most cases will be caused by improper fuel scheduling because of malfunction of the fuel control system or incorrect techniques used during certain critical flight conditions. Engine instruments often provide indications of fuel control system failures before the engine actually stops. If engine failure is due to a malfunction of the fuel control system or improper operating techniques, an airstart can usually be accomplished, providing time and altitude permit. If engine failure can be attributed to some obvious mechanical failure within the engine proper, do not attempt to restart the engine.

12.10.1 Single-Engine Flight Characteristics. Single-engine flight characteristics are essentially the same as normal flight characteristics because of proximity of the thrust lines to the center of the aircraft. With one engine inoperative, slight rudder deflection is required to prevent yaw toward the failed engine. Thus, good control is assured in the single-engine range. Minimum single-engine control speed varies with gross weight, flap/slat setting, and landing gear position. The aircraft design is such that no one system (flight control, pneumatic, electrical, etc.) is dependent on a specific engine. Thus, loss of an engine will not result in a loss of a complete system.

12.10.2 Engine Failure During Takeoff. If an engine fails before aircraft liftoff, the decision to abort or continue the takeoff is dependent on the length of runway remaining, aircraft gross weight, airspeed at time of failure, field elevation, runway temperature, and arresting gear availability. Takeoff speed will increase approximately 8 knots with an engine failed. Excessive application of aft stick which causes a higher angle of attack than necessary for takeoff will increase drag and reduce acceleration. If engine failure occurs after rotation, it may be necessary to lower the nose to the runway to attain single-engine takeoff speed. This is especially important at high gross weights and high density altitude. Increase airspeed as much above single-engine takeoff speed as available runway permits (not to exceed

200 knots) before attempting takeoff. If an engine fails immediately after becoming airborne, it may be necessary to allow the aircraft to settle back on the runway until single-engine takeoff speed is attained. Immediately after becoming airborne, establish near level flight for acceleration prior to climb. Lateral and directional control can be maintained if the aircraft remains above stall speed, but the ability to maintain altitude or to climb depends upon aircraft gross weight, configuration, airspeed, altitude, and temperature. Consider leaving the landing gear down. At low speeds, the drag is negligible. With the gear down, the indexers provide a head-up display of AOA for optimum climb and acceleration. With the gear up and flaps/slats 1/2-OUT, indicated AOA is 3 to 4 units lower than actual aircraft AOA and the stall margin is critical. External stores should be jettisoned if necessary to reduce weight and drag. Reduction of gross weight and drag will enhance climbout performance with available thrust. Flaps should not be raised until a safe altitude and airspeed have been attained. Accelerate and climb straight ahead if terrain permits. If turns are necessary, they should be made with minimum angle of bank. All control movements should be smoothly coordinated.

Note

- During takeoff using military power where takeoff will not be aborted, immediately advance both engines to maximum power and follow engine failure in flight procedures in paragraph 12.10 as soon as possible.
- If a single-engine failure occurs using maximum power and takeoff will not be aborted, retard "dead" engine throttle from afterburning range after safely airborne and follow engine failure in flight procedures in paragraph 12.10 as soon as possible.
- On aircraft 155903ap and up or after AFC 440 and all F-4S with flaps down, an engine failure causes a subsequent loss of trailing edge BLC on the same side as the failed engine. Because of asymmetric lift (wing adjacent to failed engine drops), mild trim control is necessary to correct this condition.
- Often the first indication of an engine failure will be the illumination of MASTER CAUTION and GENERATOR OUT lights. When these indications are noted, check engine rpm prior to proceeding to the generator failure portion of the checklist.

If decision to stop is made:

*1. Abort.

Refer to aborted takeoff procedure in paragraph 12.18.1.

If takeoff is continued:

If an engine fails immediately after takeoff, lateral and directional control of the aircraft can be maintained if airspeed remains above stalling speed. However, the ability to maintain altitude or to climb depends upon aircraft gross weight and airspeed. If level flight cannot be maintained:

*1. Both engines – MAX (AFTERBURNER).

*2. External stores – JETTISON (if necessary).

If altitude cannot be maintained, jettison the external stores.

3. Landing gear – UP.

4. Flaps/slats – UP-NORM.

5. Failed engine – SHUT DOWN.
6. Nonmechanical failure – INITIATE AIRSTART.

7. Land as soon as practicable.

12.10.3 Afterburner Failure During Takeoff. If the afterburner(s) fail during takeoff, the resulting thrust loss is significant. If the afterburner(s) fail to ignite early in the takeoff roll and airspeed, runway remaining, and other conditions permit, abort the takeoff immediately and do not attempt a relight. When an afterburner fails, the variable area exhaust nozzle continues to function as directed by exhaust gas temperature. The nozzle moves as a function of temperature limiting only.

If decision to stop is made:

*1. Abort.

If takeoff is continued:

*1. Throttle failed afterburner – MIL.

*2. If the exhaust nozzle is operating properly – RELIGHT IF REQUIRED.

CAUTION

Torch ignition of a failed afterburner is not desirable and should be attempted only when safety of flight or operational necessity dictates.

12.10.4 Engine Failure in Flight

1. Nonmechanical failure – INITIATE AIRSTART.

2. Mechanical failure – SHUT DOWN FAILED ENGINE.

3. Land as soon as practicable.

12.10.5 Double Engine Failure in Flight. With double engine failure, flight below glide speed will result in degraded flight control response because of insufficient hydraulic pressure from the windmilling engines.

*1. Ram air turbine – EXTEND.

Extend the ram air turbine to provide engine ignition and also to operate the left fuel boost pump at low speed. This will supply enough fuel to either engine for an airstart.

*2. Either throttle – OFF.

*3. Other engine – INITIATE AIRSTART.

To provide maximum fuelflow for an airstart, retain the throttle of the remaining engine in the OFF position.

If no start within 30 seconds:

4. Throttle – OFF.

5. Remaining engine – ATTEMPT AIRSTART.

6. If neither engine can be started – NOTIFY RIO AND EJECT.

12.10.6 Airstart. In general, airstart capability is increased by higher airspeeds and lower altitudes; however, airstarts can be made over a wide range of airspeeds and altitudes.

Note

If one or both engines flame out, do not delay the airstart. If no engine mechanical failure is immediately evident, depress and hold the ignition button(s) to restart the engine(s) before excessive rpm is lost.

*1. Engine master switch(es) – CHECK ON.

*2. Ignition button – DEPRESS (more than 12-percent rpm optimum).

*3. Throttle – IDLE.

4. EGT and rpm – MONITOR.

Note

Be sure to give the engine sufficient time for a relight to occur before placing the throttle off and deciding that the engine is not going to start.

5. If any of the following conditions occur, retard the throttle to OFF.

a. Lightoff does not occur within 30 seconds after ignition.

b. The engine does not continue to accelerate after lightoff.

c. The EGT exceeds maximum limitations.

d. The oil pressure does not attain 12 psi minimum at idle.

6. Wait 30 seconds before initiating another restart.

12.10.7 Runaway Engine/Stuck Throttle. There is no provision made on the main fuel control for stabilized engine rpm in the event the throttle linkage becomes disconnected from the fuel control. If a disconnect occurs, vibration may cause the fuel control to hunt or assume any position between idle and maximum power. In the event of a runaway engine while on the ground, shut down the engine by turning the engine master switch OFF. For an in-flight runaway engine (throttle disconnected from fuel control), the approach power compensator system (APCS) may be used to control engine rpm. If the throttle is stuck, the APCS cannot control the engine rpm. If the disconnected throttle linkage is not binding and rpm is stabilized between 73 and 99 percent, the use of the engine may be regained for a normal landing utilizing APCS. In the event that APCS disengages or control of rpm is lost, follow single-engine landing procedures in this chapter.

1. APCS – ENGAGE (5,000 feet AGL minimum).

If APCS operates satisfactorily:

2. APCS – STBY.

3. Landing gear – DOWN.

4. Flaps/slats – 1/2-OUT.

5. APCS – ENGAGE.

6. Make on-speed AOA straight-in approach to shortfield arrestment.

7. At touchdown, affected engine master switch – OFF.

The APCS is automatically disengaged on touchdown and the fuel control may assume any position between IDLE and MIL.

If APCS will not control rpm or arresting gear not available:

2. Affected engine – SECURE (before entering pattern).

3. Follow paragraph 12.15.10, SINGLE-ENGINE LANDING.

WARNING

With one engine at or near military power, the pilot's task is considerable. The decision to attempt a landing should be made only when conditions are optimum.

12.10.8 Variable Area Inlet Ramp Failure

12.10.8.1 Ramps Retracted at Speeds Above 1.5 Mach. If the inlet ramps fail to move toward the extended (minimum duct area) position while accelerating between 1.5 and 1.8 Mach, reduce airspeed to below 1.5 Mach and continue the mission. Engine performance and operating characteristics with the ramps failed to the retracted (maximum duct area) position are normal below 1.5 Mach.

CAUTION

Compressor stalls may occur at airspeeds above 1.7 Mach or high "Q" with the inlet ramps in the retracted position.

12.10.8.2 Ramps Extended Below 1.5 Mach. If the inlet ramps fail to the fully extended position, reduce engine power to below 80-percent rpm and descend to below 18,000 feet altitude. Engine operation will be unaffected below 18,000 feet altitude, but a substantial loss of thrust will occur at all power settings. Jam accelerations, afterburner operation, and airstarts may be performed without overtemperature conditions or compressor stalls below 18,000 feet altitude. It may be possible to retract a ramp which has failed in the EXTENDED position by cycling the applicable ramp control circuit breaker (J13 or J19, No. 1 panel F-4J before AFC 288; D12 or D13, No. 1 panel F-4J after AFC 388 and all F-4S).

1. Applicable circuit breaker(s) – CYCLE (D12, D13, No. 1 panel).

If ramp(s) remain extended:

2. Reduce power below 80 percent and descent below 18,000 feet.

3. Use power settings below 94 percent.

CAUTION

A gradual failure of the inlet ramp to the extended position at any power setting from idle to maximum afterburner (AB) at airspeeds from 400 knots to landing approach speed does not cause unstable engine operation. However, a sudden failure of the inlet ramp to the extended position at high power settings and low airspeeds will disrupt inlet flow and may cause compressor stalls. Compressor stall and flameout may occur at power settings above 80-percent rpm at 18,000 feet altitude and above with the inlet ramps in the extended position. A failure of the total temperature sensor may cause both ramps to extend or move in and out repeatedly, causing multiple compressor stalls.

Range and waveoff performance are degraded. Power settings above 94-percent rpm produce increased fuel flows without increasing engine thrust output. If the inlet ramps fail to the extended position, maintain the highest altitude below 18,000 feet at which the maximum range Mach number recommended for existing gross weight and configuration can be maintained with 94-percent rpm or less.

Note

With the inlet ramps extended, the reduction in maximum range varies from 5 percent at 10,000 feet to 18 percent at 30,000 feet. Single-engine range is reduced by 10 percent at all attainable altitudes.

12.10.8.3 Landing. If both engines are operating, flaps/slats DN-OUT landings (both field and carrier) can be safely made with the inlet ramp fully extended. Normal power settings must be increased 1- to 2-percent rpm to maintain an on-speed approach. Safe waveoffs can be performed with military power at gross weights up to 33,000 pounds. At higher gross weights, afterburner may be required for a late waveoff.

12.10.8.4 Single-Engine Landing. Single-engine carrier landings should not be attempted with the inlet ramps fully extended. Thrust necessary to maintain approach angle of attack and rate of descent would require a throttle setting between MIL and MIN AB. Waveoff performance, at all gross weights, is marginal under these conditions. Approximately 100 feet of altitude and 15 seconds are required to stop a normal rate of descent after MAX AB has been attained. Field landings at a minimum gross weight can be made with flaps/slats at 1/2-OUT. However, afterburner will be required occasionally to maintain normal approach angle of attack and rate of descent.

12.10.9 Compressor Stall. A compressor stall is an aerodynamic disruption of airflow through the compressor and is caused by subjecting the compressor to a pressure ratio above its capabilities at the existing conditions. The compressor capability may be reduced by FOD, corrosion, misrigged or malfunctioning IGVs, or the compressor may be subject to abnormal operating conditions as a result of a malfunction of the ramp or bellmouth system. Compressor stalls may be self clearing, may cause the engine to flame out, or may result in a steady-state, fully developed stall. The first case requires no immediate action. In the second case, the flameout clears the stall and an airstart is required. The third case requires recognition and corrective action to restore thrust and prevent engine damage by overtemperature. The stall can be recognized by the simultaneous existence of high EGT, low rpm, low fuelflow, open nozzle, loss of thrust, and lack of engine response to throttle. Compressor stalls may be accompanied by muffled bangs. The most positive stall clearing procedure is to shut down the engine and perform an airstart. Retard throttle to idle immediately to prevent engine overtemperature. A throttle chop to IDLE may clear the stall if a significant fuelflow reduction from the stalled condition is achieved. In the event of a compressor stall, proceed as follows:

*1. Throttle(s) – IDLE (altitude and/or airspeed permitting).

*2. Ignition – HOLD DEPRESSED.

*3. Throttle affected engine – OFF.

*4. Throttle – IDLE.

5. RPM, EGT, and fuelflow – MONITOR.

Note

If stall is cleared, but desired thrust cannot be obtained because of repeated stalling, the engine may be operated at any obtainable rpm, as long as EGT is within limits.

12.10.10 Exhaust Nozzle Failed Open. If an exhaust nozzle fails to the full open position, a significant loss of thrust will be noted; however, it is not necessary that the engine be shut down. Continued engine operation with a fully open nozzle will not damage the engine. The majority of exhaust nozzle failures result from engine oil starvation, but because of the CSD oil standpipe is above that of the nozzle control, oil starvation will usually be first indicated by a generator warning light,. If the exhaust nozzle fails in the open position, military thrust on the affected engine will be reduced approximately 70 percent. Maximum afterburner thrust will be reduced approximately 20 percent. Retarding the throttle from maximum afterburner may cause after burner blowout. Once afterburner is terminated, relight may require 1 to 3 minutes. In the event of a failed open nozzle:

1. Throttle (engine indicating failed open nozzle) – IDLE.

2. Do not advance thrust on affected engine unless necessary.

3. Monitor oil pressure.

4. Land as soon as practicable.

5. Follow single-engine landing procedures as appropriate.

12.10.11 Both Exhaust Nozzles Failed Open. If both exhaust nozzles fail to the full open position, the thrust available above 80-percent rpm will be approximately equal to the thrust available during normal single-engine operation. Afterburner lightoff above 15,000 feet is marginal; however, afterburner lightoff probability increases with a decrease in altitude.

1. Follow single-engine landing procedures.

12.10.12 Exhaust Nozzle Failed Closed in Afterburner. Upon initiating afterburner, a rapid increase in exhaust temperature and a drop in rpm indicates that the exhaust nozzle has not opened. If an overtemperature condition exists:

*1. Throttle – MIL OR BELOW.

CAUTION

Do not attempt to relight afterburner. Damage to engine and airframe structure could result.

12.10.13 Afterburner Blowout in Flight/Abnormal AB Indications. In the event of an afterburner blowout or loss of afterburning, proceed as follows:

*1. Throttle failed AB – MIL.

The failed engine afterburner throttle should be moved inboard immediately to terminate fuelflow to the afterburner nozzles.

2. Do not relight unless operational necessity or safety of flight dictates.

CAUTION

Torch ignition of a failed afterburner is not desirable and should be attempted only when safety of flight or operational necessity dictates.

12.10.14 Oil System Failure. An oil system failure of either engine is recognized by a drop in oil pressure or a complete loss of pressure. Since the constant speed drive unit which drives the generator is supplied with oil under pressure by the engine oil system, a GEN OUT light, followed by sluggish exhaust nozzle action, are early indications of impending engine oil starvation. The engine oil pressure gauge should be monitored closely after a generator failure. On aircraft after PPC 62, L and R ENG OIL LOW lights are provided to give an indication of impending oil starvation. In general, it is advisable to shut the engine down as early as possible after a loss of oil supply is indicated to minimize the possibility of damage to the engine and the constant speed drive unit. The engine will operate satisfactorily at military power for a period of 1 minute with an interrupted oil supply. However, continuous operation at any engine speed with the oil supply interrupted will result in bearing failure and eventual engine seizure. The rate at which a bearing will fail, measured from the moment the oil supply is interrupted, cannot be accurately predicted. Such rate depends upon the condition of the bearing before oil starvation, temperature of the bearing, and loads on the bearing. Malfunctions of the oil system are indicated by a shift (high or low) from normal operating pressure, sometimes followed by a rapid increase in vibration. A slow pressure increase may be caused by partial clogging of one or more oil jets while a rapid increase may be caused by complete blockage of an oil line. Conversely, a slow pressure decrease may be caused by an oil leak, while a sudden decrease is probably caused by a ruptured oil line or a sheared oil or scavenge pump shaft. Vibration may increase progressively until it is moderate to severe before the pilot notices it. At this time, complete bearing failure and engine seizure is imminent. Limited experience has shown that the engine may operate for 4 to 5 minutes at 80- to 90-percent rpm before a complete failure occurs. In view of the above, the following operating procedures are recommended:

1. If a minimum oil pressure of 35 psi (MIL-L-23699 oil) at military rpm cannot be maintained, throttle – IDLE.

2. If a minimum of 12 psi at idle rpm cannot be maintained or if the oil pressure change is accompanied by vibrations, engine – SHUT DOWN.

CAUTION

Increasing vibration is an indication of bearing failure. Severe vibration indicates that engine seizure will occur within a few seconds. Chop the throttle to OFF to prevent major engine and possible aircraft damage.

3. If engine shutdown is not feasible – REDUCE THRUST.

Shut down the engine when partial power is not required from the affected engine. Where mission or flight requirements demand partial power from the affected engine, set engine speed at 86 to 89 percent.

4. Avoid abrupt maneuvers causing high positive g or negative g forces.

5. Avoid unnecessary or large throttle movements.

Note

To keep bearing temperature and loads at a minimum, do not use high thrust settings.

6. In either of the above instances – LAND AS SOON AS PRACTICABLE USING SINGLE-ENGINE PROCEDURE (paragraph 12.15.10).

12.10.15 Engine Oil Level Low Light(s) Illuminated

If operational requirements permit:

1. Affected engine – SHUT DOWN.

2. If no other indication of low oil – RELIGHT FOR LANDING.

Relight just before entering pattern. Leave engine at IDLE unless needed for safe landing/waveoff.

If shutdown is not feasible:

1. Affected engine oil pressure – MONITOR.

2. Affected engine GEN OUT light – MONITOR.

3. Affected engine nozzle – MONITOR.

4. Obtain visual inspection by another aircraft, if available.

5. Avoid high positive or negative g.

6. Land as soon as practicable.

12.11 FIRE

The pilot's first indication of a fire will be noted by the steady illumination of the FIRE/OVERHT warning light. However, a momentary illumination of the FIRE or OVERHT warning light should not be completely ignored. A momentary illumination should be followed by a check of the fire test circuit to determine if a fire actually exists and has burned through the fire detector wiring.

12.11.1 Engine Fire During Start/Shutdown

*1. Throttles – OFF.

*2. Engine master switches – OFF.

*3. Generator control switches – EXT ON.

*4. Continue to crank engine.

5. Leave aircraft as soon as possible.

12.11.2 Engine Fire or Overheat During Takeoff. If FIRE or OVERHT warning light illuminates during takeoff roll, it is preferable to abort immediately if sufficient runway is available to stop safely. Refer to Figures 19-3 and 29-3.

If decision to stop is made:

*1. Abort.

Refer to ABORTED TAKEOFF procedure in paragraph 12.18.1.

If takeoff is continued:

*1. Throttle good engine – MAX (afterburner).

*2. External stores – JETTISON (if necessary).

*3. Throttle bad engine – IDLE.

4. Landing gear – UP.

5. Flaps/slats – UP-NORM (above 200 KIAS).

6. Climb to safe ejection altitude and investigate.

After reaching safe ejection altitude, proceed with ENGINE FIRE OR OVERHEAT IN FLIGHT procedures in paragraph 12.11.3.

12.11.3 Engine Fire or Overheat in Flight

*1. Throttle bad engine – IDLE.

*2. If warning light goes out – CHECK FIRE DETECTION SYSTEM.

If light remains on or fire is confirmed:

*3. Throttle – OFF.

Shut down engine if FIRE/OVERHT warning light illuminates after reducing thrust, if the fire detection system is inoperative, or if fire is apparent.

*4. Engine master switch – OFF.

5. If fire persists – NOTIFY RIO AND EJECT.

6. If fire ceases – LAND AS SOON AS PRACTICABLE.

If fire detection system check is normal:

3. Land as soon as practicable. Do not advance throttle on affected engine unless absolutely necessary.

CAUTION

Advancing throttle on affected engine after it has been retarded and the warning light extinguished may cause fire or overheat damage and possibly burn through the fire detecting elements.

12.11.4 Aft Section Fuel Leak/Fire. In-flight fires may be caused by fuel or hydraulic leaks in the aft fuselage/empennage sections without the engine or overheat warning circuits being activated. Hence, secondary indications must be used to detect this condition. Such fires often relate to maneuvering flight conditions and afterburner use. Discovery of any fluid leaking in the aft sections prior to a fire being ignited is critical. Any indication of abnormal (i.e., prolonged or continuous) fuel streaming from the fuselage fuel vent, empennage, or engine nozzle areas must be considered a potential aft section fire situation. Indications that an aft section fire has already occurred include fuel streaming, noises similar to compressor stalls, utility hydraulic failure, pronounced lateral control stick transients, loss of rudder control, loss of the rudder position indicator, or the popping of any rudder-associated circuit breakers.

If fuel streaming occurs or fire is evident:

*1. Disengage afterburner. Do not reengage.

*2. Cease fuel transfer.

*3. Reduce speed to below 300 knots.

*4. Air refuel switch – REFUEL.

5. Do not allow subsequent fuel transfer to exceed 3,500 pounds fuselage fuel.

6. Prepare for ejection.

WARNING

With an aft section fire, simultaneous loss of PC-1 and PC-2 pressure to the stabilator is imminent. This will cause a violent noseup pitch and loss of flight control.

7. Land as soon as possible.

8. Hook bypass switch – NORM.

If hook bypass switch is in BYPASS when the right auxiliary air door circuit breaker is pulled, the corner reflector will extend and, if above 250 knots, may depart the aircraft causing a utility hydraulic failure and/or engine FOD.

9. Auxiliary air door circuit breakers – PULL PRIOR TO LOWERING LANDING GEAR (3D, 4D, F-4J before AFC 388; 15K, 16K, F-4J after AFC 388 and all F-4S; No. 1 panel).

10. Field arrested landing not recommended.

Sparks and heat from a lowered arresting hook may ignite the streaming fuel.

11. Throttles – OFF AFTER AIRCRAFT COMES TO A COMPLETE STOP.

12. Engine master switches – OFF.

12.11.5 Fire After Catapult Launch. An external fire after catapult launch may not be indicated by cockpit fire or overheat warning lights. The aircrew's first warning that such a fire exists may come from a source outside the aircraft (i.e., another aircraft, ship tower, LSO, etc.). A centerline tank fire, an aft section fire, or an engine fire could be similar in appearance to outside observers and difficult to distinguish immediately from within the cockpit. If advised of an external fire after catapult launch, immediately jettison all external stores using the external store emergency release button. This eliminates explosive or inflammable stores, reduces aircraft gross weight, and optimizes the climb to a safe altitude. The effect of jettisoning a partially full centerline tank will be minimized. If afterburner was selected for launch, select military power as soon as maximum thrust is not essential.

*1. External stores – JETTISON.

*2. Throttles – MIL.

CAUTION

Damage to main landing gear may occur when stores on stations 2 and 8 are jettisoned while landing gear is in transit. When practicable, obtain visual inspection prior to landing.

If fire persists and there is no cockpit indication:

3. Follow aft section fire procedure in paragraph 12.11.4.

If cockpit indication of fire exists:

3. Follow engine fire or overheat procedures in paragraphs 12.11.2 and 12.11.3 as appropriate.

4. Obtain visual inspection prior to landing if practicable.

If fire persists:

5. Eject.

12.11.6 Electrical Fire. Causes and effects of electrical fires are many and varied. The primary concern is to eliminate the fire and not reignite it with unwarranted application of electrical power. If the fire is due to a short in a bus powered by the ram air turbine, it may be necessary to retract it and induce a total electrical failure. If the cause can be isolated to a specific system or item of equipment, pull appropriate circuit breakers and consider restoring normal generator power. Consider restoring normal generator power before landing for gear, flap, and nosewheel steering operation. At night or IFR, circumstances may warrant restoring normal generator power before penetration (e.g., tacan may be required and is not available on the RAT).

*1. Ram air turbine – EXTEND.

*2. Generator switches – OFF.

3. All electrical switches – OFF.

4. Restore electrical power to essential equipment.

5. Land as soon as practicable.

12.11.7 Elimination of Smoke and Fumes

*1. Emergency vent knob – PULL.

2. Initiate an immediate descent to 25,000 feet or below.

If smoke or fumes persist:

3. Command selector valve handle – AS DESIRED.

4. Rear ejection seat – FULL DOWN.

5. Aft canopy – JETTISON.

If smoke or fumes still persist:

6. Put the aircraft in a nose-high attitude.

A nose-high attitude precludes front canopy to rear cockpit collision.

7. Front canopy – JETTISON.

WARNING

The aft cockpit occupant must eject first with the front canopy off. A possibility of seat to seat collision exists if ejection is sequenced from the front cockpit with the front canopy off.

12.12 FLIGHT CONTROLS

Upon initial detection of any abnormal flight control movement, immediately depress the paddle switch to determine if the stab aug ARI or AFCS was causing the abnormality.

12.12.1 Runaway Stabilator Trim. If stabilator trim appears to be running away, it is possible under certain conditions to lessen the situation. Runaway stabilator trim can be alleviated by engaging the AFCS, providing:

1. The stab feel trim circuit breaker has been pulled immediately upon detection of runaway trim.

2. The runaway trim has not exceeded 2-1/2 units nosedown.

If the above conditions are met:

1. Reduce airspeed – BELOW 300 KNOTS.

2. AFCS – ENGAGE.

Note

- The AUTO PILOT PITCH TRIM light may illuminate when the AFCS is engaged.
- When the AFCS is used to alleviate a runaway trim condition and excessive out of trim forces are present (full nose down runaway trim), the AFCS may not be able to hold the engagement pitch attitude and pitch oscillations could result. If this occurs, disengage the AFCS.

3. Plan to land as soon as practicable.

4. Prior to landing, disengage AFCS.

When in the landing configuration (gear down and flaps/slats DN-OUT) and at 180 to 190 knots, grasp stick firmly and disengage the AFCS. Depending upon severity of the malfunction, the aircraft may or may not be in trim; if out of trim, the forces should not be too high and the aircraft can be landed with the out-of-trim condition or the AFCS can be reengaged and the landing made with control stick steering.

5. If landing is made with AFCS engaged, disengage immediately after touchdown.

Disengage AFCS immediately after touchdown to prevent damage to AFCS components. Flight below 350 KCAS with stabilator trim full nose up or down does not require extremely high stick forces.

If runaway stabilator trim has exceeded the limits at which the AFCS can be engaged:

1. Reduce airspeed – BELOW 300 KNOTS.

2. Land as soon as practicable.

12.12.2 Uncommanded Spoiler Extension. An uncommanded, full deflection of the spoilers on one wing is characterized by an uncommanded roll of 20° to 100° per second into the affected spoiler. The roll rate will be greater at higher airspeeds and, to a lesser degree, at lower altitudes. This flight condition can be distinguished from a departure from controlled flight by crosschecking angle of attack and airspeed. The uncommanded roll can be stopped and a roll established in the opposite direction with full opposite aileron. The opposite roll rate will not exceed approximately 20° per second because of reduced aileron effectiveness as a result of the raised spoiler ahead of the deflected aileron. Recovery should be accomplished within 10 seconds. Stick forces vary between 8 to 15 pounds at full stick deflection. Full trim will reduce stick forces to approximately 6 pounds to maintain wings level.

*1. Reduce airspeed – BELOW 300 KNOTS.

*2. Aileron and rudder – OPPOSITE DIRECTION OF ROLL.

Maintain full opposite aileron and rudder until roll rate stopped (approximately 10 seconds).

3. Trim to relieve stick forces wings level.

4. Perform controllability check.

5. Land as soon as possible.

12.12.3 Stabilator Feel Trim Failure

12.12.3.1 Partial Bellows Failure. Partial bellows failure is recognized by a mild nosedown stick force proportional to the airspeed unless the failure occurs during maneuvering flight at which time it may not be noticeable. Reduction of stick centering and pitch stability will result. If this failure occurs:

1. Reduce airspeed – 250 to 300 KNOTS.

2. Retrim aircraft.

3. Avoid abrupt fore and aft stick movements.

4. Land as soon as practicable.

12.12.3.2 Complete Bellows Failure. A complete bellows failure is recognized by a nosedown feel force heavier than with partial bellows failure, with a maximum nosedown feel force of 5 pounds/g. This force cannot be trimmed out. If a complete bellows failure occurs:

1. Reduce airspeed to 250 to 300 knots.

2. Set trim for airspeed.

3. Avoid abrupt fore and aft stick movements.

4. Pilot heat – ON.

5. Land as soon as practicable.

12.12.4 Aileron Rudder Interconnect (ARI) System Disengagement. The ARI system can be temporarily disengaged by depressing the AFCS/ARI emergency disengage switch; this will disengage the ARI only as long as it is held depressed. To permanently disengage the ARI system, the ARI circuit breaker on the left utility panel must be pulled and the yaw stab aug switch must be disengaged. Pulling the circuit breaker only and keeping the stab aug engaged still provides 5° of ARI rudder authority. To permanently disengage the ARI while retaining complete stab aug, pull the rudder feel trim circuit breaker on circuit breaker panel No. 1. For an ARI system malfunction, proceed as follows:

1. Emergency disengage switch – DEPRESS.

Depressing the emergency disengage switch will disengage the ARI system only while the switch is held depressed.

2. ARI circuit breaker, front cockpit – PULL.

3. To permanently disengage system, pull rudder feel trim circuit breaker (G15, F-4J before AFC 288; B13, F-4J after AFC 388 and all F-4S; No. 1 panel).

12.12.5 Hardover Rudder. A hardover rudder that cannot be corrected by disengaging the AFCS, yaw stab aug, and rudder trim is in all probability caused by a mechanical malfunction. In this event, the only

To maintain aircraft control while experiencing a hardover rudder, careful control of angle of attack (AOA) is imperative. Satisfactory aileron control is available up to 16 units AOA to counter yaw induced roll. Above 16 units AOA there may not be sufficient lateral control to reduce the roll rate of any yaw induced roll. If an inadvertent roll occurs into the hardover rudder and full lateral stick will not reduce the roll rate, the angle of attack must be ruduced to regain lateral control. Due to aircraft sideslip with a hardover rudder, indicated AOA will be in error. To rely solely on the airspeed indicator or the AOA is inappropriate. Cross referencing airspeed and AOA will provide adequate input to determine an AOA of less than 16 units. 13 units AOA is the target indicated AOA. Due consideration for changes in aircraft attitude and configuration and the effect they have on AOA is necessary while maintaining control of the aircraft. Safe gear extension can occur with AOA between 9.5 and 13 units.

3. Yaw stab aug – DISENGAGE.

4. Rudder feel trim circuit breaker – PULL (G15, F-4J before AFC 388; B13, F-4J after AFC 388 and all F-4S; No. 1 panel)

If hardover rudder persists, fail utility system:

5. Gear – DOWN.

6. Flap circuit breaker – IN.

7. Flaps – BLOW DOWN.

Note

It may take as long as 8 minutes before the utility system eventually fails.

If hardover rudder still persists:

8. Perform controllability check.

If minimum control speed/gross weight combinations do not exceed available arresting gear limits:

9. Perform arrested landing as soon as practicable.

If control speed/gross weight combinations exceed available arresting gear limits:

10. Eject.

12.13 FUEL

12.13.1 Fuel Boost Pump Failure. The possibility of a simultaneous mechanical failure of both boost pumps is highly remote; however, double failure may occur as a result of an electrical malfunction. Provisions are made to supply fuel to the engines by gravity flow in the event of a double boost pump failure. This will allow engine operation at a reduced power setting. If both boost pumps fail above 20,000 feet and/or at a high power setting, flameout or an unstable rpm indication on one or both engines may occur.

12.13.1.1 Double-Boost Pump Failure

1. If both engines have flamed out, execute procedure for double-engine failure.

2. If an airstart has been accomplished or the engines have not flamed out, adjust engine thrust or descend until a stable rpm can be maintained.

Note

Afterburner operation is not recommended. Military power operation is unrestricted at any airspeed from sea level to 20,000 feet.

3. Land as soon as practicable.

12.13.1.2 Single-Boost Pump Failure

1. Adjust throttle to maintain a minimum of 5 psi boost pump pressure if practicable.

Note

Afterburners may have to be modulated or shut off, depending on airspeed and altitude, to maintain 5-psi boost pressure.

12.13.2 Fuel Transfer Failures

12.13.2.1 Internal Wing Fuel Fails to Transfer. Failure of internal wing fuel to transfer can be caused by either the wing tanks failing to pressurize or the wing transfer valves failing to open. If internal wing fuel is not transferring, check the following switch and circuit breaker positions:

1. External transfer switch – OFF (some F-4J).

2. Internal wing transfer switch – NORMAL (some F-4J).

3. Fuel transfer selector knob – INT WING (some F-4J and all F-4S).

4. Refuel probe switch – RETRACT.

5. Wing transfer control circuit breaker – IN (H4, F-4J before AFC 388; J13, F-4J after AFC 388 and all F-4S; No.1 panel).

Note

The wing transfer control circuit breaker (H-4 for F-4J before AFC 388; J-13 after AFC 388) operates the internal wing transfer valve. The circuit breaker is colocated with external wing transfer control circuit breaker (H-3 for F-4J before AFC 388; J-12 after AFC 388).

To ensure wing tank pressurization:

6. Wing transfer pressure switch – EMERG. Continue in level flight for 30 seconds.

Note

If fuel transfers when the wing transfer pressure switch is placed in EMERG, leave the switch in this position for remainder of flight. Pressurization has been obtained and fuel can be transferred.

12.13.2.2 Centerline Fuel Fails to Transfer. Failure of the centerline fuel to transfer can be caused by either the defueling shutoff valve failing to the open position, the refueling valve failing to the closed position, the tank shutoff valve failing to the closed position, or the tank failing to become pressurized. If the centerline fuel fails to transfer, check the following switch and circuit breaker positions:

1. Buddy tank switch – STOP FILL.

2. External transfer switch – CENTER (some F-4J).

3. Fuel transfer selector knob – CTR (some F-4J and all F-4S).

4. External wing fuel control circuit breaker – IN (H3, F-4J before AFC 388; J12, F-4J after AFC 388 and all F-4S; No. 1 panel).

5. L fuel valve power circuit breaker – IN (G4, F-4J before AFC 388; J15, F-4J after AFC 388 and all F-4S; No. 1 panel).

6. Refuel probe switch – RETRACT.

To ensure tank pressurization:

7. Wing transfer pressure switch – EMERG.

Continue in level flight for 30 seconds. If fuel transfers when the wing transfer pressure switch is placed in EMERG, leave the switch in this position for remainder of flight. Pressurization has been obtained and fuel can be transferred.

8. Buddy tank switch – CYCLE.

9. Refuel probe switch – CYCLE.

10. Apply alternating symmetrical positive and negative g up to the acceleration limits of the store.

12.13.2.3 External Wing Fuel Fails To Transfer. Failure of the external wing fuel to transfer can be caused by either the external wing tank shutoff valve failing to the closed position or the tanks failing to become pressurized. If the external wing tanks fail to transfer, check the following switch and circuit breaker positions:

1. External wing transfer switch – OUTBD (some F-4J).

2. Fuel transfer selector knob – OUTBD (some F-4J and all F-4S).

3. External wing fuel control circuit breaker – IN (H3, F-4J before AFC 388; J12, F-4J after AFC 388 and all F-4S; No. 1 panel).

4. Refuel probe switch – RETRACT.

5. Fuel valve power circuit breaker – IN (G4, F-4J before AFC 388; J15, F-4J after AFC 388 and all F-4S; No. 1 panel).

To ensure tank pressurization:

6. Wing transfer pressure switch – EMERG.

Note

If fuel transfers when the wing transfer pressure switch is placed in EMERG, leave the switch in this position for remainder of flight. Pressurization has been obtained and fuel can be transferred.

Note

If above procedures fail to produce fuel transfer from either centerline or external wing tanks, it may be possible to effect transfer by using high power settings for a period of time and/or climbing to an altitude of 35,000 feet or higher.

12.13.2.4 Reverse Transfer of Fuselage Fuel. Reverse transfer is caused by a failed open defuel valve. Reverse transfer normally does not occur until the fuel tanks are depressurized. The fuel sector and counter should be monitored after lowering the landing gear or placing the refuel probe switch to REFUEL. Boost pump pressure forces fuel from the engine fuel manifold through the open defuel valve to the internal wing tanks. If external wing tank fuel is available and transferring, the counter may be slowly increasing while the sector is constant or decreasing.

*1. Buddy tank switch – STOP FILL.

*2. Ram air turbine – EXTEND.

*3. Generators – OFF.

4. Wing transfer control circuit breaker – IN (H4, F-4J before AFC 388; J13, F-4J after AFC 388 and all F-4S; No. 1 panel).

5. Boost pump control circuit breakers – PULL (A11, D8, E11, F-4J before AFC 388; A6, H6, H7, F-4J after AFC 388 and all F-4S; No. 1 panel).

With boost pump circuit breakers pulled, it is recommended that flight be restricted to below 20,000 feet.

6. Generators – ON.

7. Ram air turbine – RETRACT.

8. Wing transfer pressure switch – EMERG.

12.13.2.5 Fuel Streaming From Underside After Centerline Tank Jettison. If the centerline tank is jettisoned with an open defuel valve, cockpit indications are identical to reverse transfer of fuselage fuel. Fuel loss on the sector and counter will be 500 to 700 pounds per minute and will not cease when a low fuel state is reached. The fuel streaming may be confirmed by a wingman or the RIO in his external rearview mirror.

1. Buddy tank switch – STOP FILL.

2. Wing transfer pressure switch – NORMAL.

3. Refuel probe circuit breaker – PULL (G5, F-4J before AFC 388; J14, F-4J after AFC 388; J5, F-4J after AFC 545 and all F-4S; No. 1 panel).

4. Refuel probe switch – REFUEL.

If fuel continues to stream:

5. Boost pump control circuit breakers – PULL (A11, D8, E11, F-4J before AFC 388; A6, H6, H7, F-4J after AFC 388 and all F-4S; No. 1 panel)

Pulling the boost pump control circuit breakers will minimize fuel loss. With the circuit breakers pulled, it is recommended that flight be restricted to below 20,000 feet.

6. Hook bypass switch – NORM.

If the hook bypass switch is in BYPASS when the right auxiliary air door circuit breaker is pulled, the corner reflector will extend and, if above 250 knots, may depart the aircraft causing a utility hydraulic failure and/or engine FOD.

7. Auxiliary air door circuit breakers – PULL PRIOR TO LOWERING LANDING GEAR (3D, 4D, F-4J before AFC 388; 15K, 16K, F-4J after AFC 388 and all F-4S; No. 1 panel).

8. Field arrested landing is not recommended.

Sparks and heat from a lowered arresting hook may ignite the streaming fuel.

9. Throttles – OFF AFTER AIRCRAFT COMES TO A COMPLETE STOP.

10. Engine master switches – OFF.

12.13.3 Failed Open Defuel Valve During Air Refueling. If the defuel valve is failed open and the refuel probe switch is placed to REFUEL, boost pump pressure forces fuel from the engine fuel manifold through the open defuel valve as follows:

a. If external tanks on board and ALL TANKS selected, fuel will be forced into the external tanks and internal wing tanks. Both the sector and counter will indicate rapid depletion.

b. If external tanks on board and INTERNAL ONLY selected or if no external tanks on board, fuel will be forced into the internal wing tanks. Only the sector will indicate rapid depletion while the counter will remain normal.

In either case, failure to recognize and take corrective action immediately can cause depletion of fuel in fuselage cell Nos. 1 and 2, resulting in flameout.

*1. Refuel probe switch – EXTEND.

2. Buddy tank switch – STOP FILL.

3. Refuel selector – INT ONLY.

4. Wing transfer control circuit breaker – IN (H4, F-4J before AFC 388; J13, F-4J after AFC 388 and all F-4S; No. 1 panel).

Note

The wing transfer control circuit breaker (H-4 for F-4J before AFC 388; J-13 after AFC 388) operates the internal wing transfer valve. This circuit breaker is colocated with external wing transfer control circuit breaker (H-3 for F-4J before AFC 388; J-12 after AFC 388).

5. External transfer switch – OFF (some F-4J).

6. Fuel transfer selector knob – STOP (some F-4J and all F-4S).

If fuel still being forced out of fuselage:

7. Ram air turbine – EXTEND.

8. Both generator switches – OFF.

9. Boost pump control circuit breakers – PULL (A11, D8, E11, F-4J before AFC 388; A6, H6, H7, F-4J after AFC 388 and all F-4S; No. 1 panel).

With boost pump control circuit breakers pulled, air refueling should be accomplished below 20,000 feet.

10. Both generator switches – ON.

11. Ram air turbine – RETRACT.

12. Refueling – COMMENCE.

When approximately 6,000 pounds are indicated on the sector:

13. Refuel probe switch – REFUEL.

14. Refuel selector – ALL TANKS.

15. Refueling – CONTINUE.

After refueling completed:

16. Boost pump control circuit breakers – RESET.

12.13.4 Fuselage Fuel Dump

12.13.4.1 Transfer of Fuselage Fuel to Internal Wings for Dumping. To allow expeditious reduction to landing weight, excess fuel can be transferred from fuselage cell Nos. 1 and 2 to the internal wings, allowing it to be dumped using normal dump procedures. Reverse transfer can be accomplished by the following procedures:

1. Wing transfer control circuit breaker – PULL (H4, F-4J before AFC 388; J13, F-4J after AFC 388 and all F-4S; No. 1 panel).

Note

The wing transfer control circuit breaker (H-4 for F-4J before AFC 388; J-13 after AFC 388) operates the internal wing transfer valve. This circuit breaker is colocated with external wing transfer control circuit breaker (H-3 for F-4J before AFC 388; J-12 after AFC 388).

3. Internal wing dump switch – DUMP.

Fuel transfers at approximately 1,000 pounds per minute and dumps at approximately 680 pounds per minute.

WARNING

Exercise care when using reverse transfer to avoid depleting fuselage cell Nos. 1 and 2.

After fuel is transferred/dumped:

4. Buddy fill switch – STOP FILL.

2. Internal wing dump switch – NORMAL.

6. Wing transfer control circuit breaker – RESET.

7. External centerline tank fuel – TRANSFER.

With external centerline tank aboard, some fuel is transferred into the centerline tank using reverse fuel transfer.

12.13.5 Wing Fuel Leak

1. Afterburner – DISENGAGE, DO NOT REENGAGE.

2. Speed – REDUCE TO BELOW 300 KNOTS.

3. Air refuel switch – REFUEL.

4. Land as soon as practicable.

5. Arrested landing recommended.

With a serious wing fuel leak, fuel dripping in the vicinity of the main landing gear constitutes a strong potential for fire if hot brakes occur during a landing rollout.

12.13.6 Air Refueling Fuselage Tanks Only. If the internal wing tanks become damaged and cannot hold fuel, emergency refueling of the fuselage tanks only can be accomplished as follows:

1. External transfer switch – OFF (some F-4J).

2. Fuel transfer selector knob – STOP (some F-4J and all F-4S).

3. Refuel selector switch – INT ONLY.

4. Fuel valve power circuit breaker – PULL (G4, F-4J before AFC 388; J15, F-4J after AFC 388 and all F-4S; No. 1 panel).

5. Refuel probe switch – REFUEL.

6. Commence refueling.

Note

Do not attempt to refuel external tanks. Damage to internal wing tanks may prevent external wing tanks from transferring. The centerline tank cannot be refueled using the above procedure.

12.13.7 Air Refuel Probe Unlocked in Flight or Inadvertent Probe Extension Above 300 KIAS. If the air refuel probe unlocked light illuminates in flight or the probe stops in an intermediate position during actuation, the following corrective measures should be taken in sequence to prevent probe door separation and possible aircraft damage:

*1. Reduce airspeed – BELOW 300 KIAS/0.9 IMN.

2. Leave probe switch as set, do not cycle.

3. Land as soon as practicable.

If fuel is observed streaming from the probe area or the refuel probe separates from the aircraft resulting in damage to the fuselage cells:

4. Refuel probe circuit breaker – PULL (G5, F-4J before AFC 388; J14, F-4J after AFC 388; J5, F-4J after AFC 545 and all F-4S; No. 1 panel).

5. Refuel probe switch – REFUEL.

6. Refer to paragraph 12.11.4, AFT SECTION FUEL LEAK/FIRE.

12.14 HYDRAULIC

The loss of a hydraulic pump in power control systems No.1, No. 2 or in the utility hydraulic system is indicated by the illumination of the CHECK HYD. GAGES warning light. This single light serves all three systems, and the pilot should check the hydraulic gauges to determine which system has malfunctioned.

12.14.1 Single Power Control System Failure. A hydraulic pump failure of either PC-1 or PC-2 presents no immediate problem since the utility system is capable of assuming the full demand of either system. In the event of a single PC system failure:

If PC-1 failed:

1. Pitch stab aug – DISENGAGE.

2. Land as soon as practicable.

Note

- The AFCS, if engaged, should be immediately disengaged since the stab aug system will be lost and erratic AFCS operation may occur because of the loss of AFCS stabilator authority. No indication of a stab aug failure will be noted since the PITCH AUG OFF light will illuminate only upon switch disengagement.

- If the CHK HYD GAGES indicator light illuminates and remains illuminated, monitor the hydraulic system gauges for the remainder of the flight since warning of a second hydraulic system failure will not be given.

12.14.2 Single Power Control and Utility System Failure. If a simultaneous loss of the utility system and one of the power control systems occurs, the operable aileron and spoiler will provide adequate lateral control for an emergency; however, handling qualities are significantly degraded and stabilator and aileron/spoiler combination of only one wing will be powered by the remaining power control system. With this combined failure, the rudder is unpowered; however, some manual rudder is available and should be used to the maximum to counter any rolling tendency. The most noticeable change will be variable response to lateral inputs depending upon which control surface (aileron or spoiler) is used for rolling or turning. The aileron will be the more effective surface; therefore, turns should be made into the operating wing (use of spoiler), thus allowing use of aileron for rollout. Lateral control response is reduced below 300 knots and continues to be degraded down to final approach airspeed. Rapid roll rates should be avoided.

1. Reduce speed below 500 knots (no less than 230 KIAS).

WARNING

Do not allow airspeed to drop below 230 KIAS.

2. Pneumatic pressure – MONITOR.

If pneumatic pressure begins to drop and fuel permits, extend the landing gear before pressure drops below 2,000 psi. If IFR, extend ram air turbine.

3. Yaw and roll aug – OFF.

If PC-1 failed:

4. Pitch stab aug – DISENGAGE.

5. Asymmetric load – JETTISON.

6. Proceed to suitable divert field.

7. Blow down gear for landing (minimum 5,000 feet AGL).

8. Flaps/slats – UP-NORM.

9. Perform controllability check.

10. Enter wide extended downwind leg.

11. Plan early lineup for straight-in approach.

Select runway to minimize crosswind if possible. Full lateral stick may be required to provide adequate roll response.

12. Plan for field arrested landing.

13. Maintain a minimum of 230 KIAS after the controllability check/gear lowered until on final approach.

14. On final approach to touchdown, fly minimum controllable airspeed +10 knots, but no slower than 17 units AOA.

CAUTION

If you miss the arresting gear and decide to go around, do not rotate the aircraft before the airspeed is at least that corresponding to the angle of attack used during approach.

If field landing cannot be made:

15. Eject.

The minimum control airspeed is greater than carrier arresting gear limits.

12.14.3 Double Power Control System Failure. The pilot should upon initial detection of hydraulic power loss note trend of failure as to whether the gauges show a definite steady drop or gauge fluctuations. With a steady drop indication, hydraulic power will probably not recover. In the event of complete power control hydraulic failure, the aircraft will become uncontrollable.

*1. If hydraulic pressure does not recover – NOTIFY RIO AND EJECT.

12.14.4 Utility Hydraulic System Failure. Failure of the utility hydraulic system will prevent/degrade hydraulic operation of the following essential items:

1. Auxiliary air doors

There are no alternate or emergency provisions for opening the auxiliary air doors. Refer to paragraph 12.3, AUXILIARY AIR DOOR, for procedures to follow in the event of an auxiliary air door failure.

2. Flaps/slats/drooped ailerons

Emergency pneumatic operation is provided. Refer to paragraph 12.14.6, FLAP/SLAT EMERGENCY EXTENSION.

3. Fuel transfer pumps (hydraulic)

There are no alternate or emergency provisions for hydraulic transfer pump operation

4. Landing gear

Emergency pneumatic operation of the landing gear is provided. Refer to paragraph 12.14.4.4, LANDING GEAR EMERGENCY LOWERING.

5. Nose gear steering

There are no emergency provisions for nose gear steering.

6. Rudder power control system

Limited manual control of the rudder is available; however, pedal forces will be much higher than normal.

7. Variable bypass bellmouth

There are no alternate or emergency provisions for operation of the variable bypass bellmouth. Refer to paragraph 12.3, AUXILIARY AIR DOOR, for side effects of simultaneous variable bypass bellmouth and auxiliary air door failures.

8. Variable engine intake ramps

There are no alternate or emergency provisions for operation for the variable engine intake ramps.

9. Wheelbrakes

Emergency pneumatic and hydraulic operation of the wheelbrakes is provided. Refer to paragraph 12.14.6.1, WHEELBRAKE EMERGENCY OPERATION.

Note

If the CHK HYD GAGES indicator light illuminates and remains illuminated, monitor the hydraulic system gauges for the remainder of the flight since warning of a second hydraulic system failure will not be given. With a utility hydraulic failure, disengage roll and yaw stab aug to avoid control surface transients caused by fluctuating utility hydraulic pressure.

1. Pneumatic system – MONITOR.

If pneumatic pressure begins to drop and fuel permits, extend the landing gear before pressure drops below 2,000 psi. If IFR, extend ram air turbine.

2. Yaw and roll stab aug – OFF.

3. Land as soon as practicable.

4. If gear is not down and locked – BLOW DOWN FOR LANDING.

5. Flaps/slats – BLOW DOWN WHEN READY FOR LANDING.

For field landing:

6. Plan short-field arrested landing.

WARNING

- If a partial/complete utility hydraulic failure occurs with the flap/slat handle selected down, the possibility exists for asymmetric flap blow up and/or BLC damage to the outboard leading edge section of the wing. In the event this condition should occur, raise the flap/slat handle to up and extend the flaps/slats pneumatically.

- If flaps are lowered pneumatically, they will eventually retract (blow up) as pneumatic system pressure decays. The duration of pneumatic flap extension varies as a function of system integrity and cannot be predicted. Prior coordination between the air crew and the controllers is essential to minimize the time that the flaps are pneumatically extended prior to landing (on F-4S, slats will remain in the extended position because of overcenter locks if pneumatic pressure is lost).

After carrier arrestment:

7. Engines – SUFFICIENT POWER TO MAINTAIN ARRESTING WIRE TENSION.

12.14.4.1 Directional Control With Utility Hydraulic System Failure. Without utility hydraulic pressure, nose gear steering is lost and rudder control reverts to manual operation. The extra force required to operate the rudder may cause inadvertent brake actuation and result in depressurizing the accumulator. Should this occur, the lack of boost pressure will permit only slight braking and little, if any, directional control. Only small rudder deflections are available at landing speeds because of the high pedal forces required to overcome the airloads. Therefore, differential braking becomes the primary heading control during landing and is accomplished through the use of the brake hydraulic accumulator pressure (several applications normally are available) or through application of the emergency brakes (pneumatic) in conjunction with manual braking (which requires high pedal forces and large pedal deflections) for differential control. Use of accumulator pressure provides braking action and "feel" identical to the normal utility system, but the number of applications are limited. For this reason, the pilot should hold steady pedal pressure to obtain braking action once pedal force has been applied even though differential pedal force may be required. If accumulator pressure becomes depleted through consecutive brake applications or a system malfunction, manual brakes must provide any differential braking required to maintain heading while using emergency pneumatic brakes to stop the aircraft. It should be reemphasized that the normal brake system accumulator is capable of providing sufficient brake power to stop the aircraft while providing heading control through differential braking. Ailerons and spoilers provide some directional control and will be more effective at higher speeds. The drag chute should be used with caution in a strong crosswind if the utility hydraulic system has failed. A deployed drag chute in a strong crosswind will increase substantially the requirement for differential braking. This is especially applicable when the hydraulic accumulator pressure has been depleted and the emergency pneumatic brakes are employed to brake the aircraft, which leaves only the manual brake with associated high pedal forces and deflections for heading control.

12.14.4.2 Landing Gear Unsafe Up. An unsafe landing gear up indication may be caused by a malfunctioning, damaged, or binding of the landing gear or the retraction system. In such cases, any attempt to cycle the landing gear may aggravate the problem and prevent subsequent lowering.

1. Airspeed below 250 KIAS.

2. Landing gear handle – DOWN.

If safe down indications:

3. Leave gear down.

If unsafe down indications:

4. Follow procedures for landing gear unsafe down.

12.14.4.3 Landing Gear Unsafe Down. An unsafe gear down indication does not necessarily constitute an emergency. The unsafe indication could be caused by a malfunction within the indicating system or the result of an incorrect gear lowering procedure coupled with a low pressure condition of the utility hydraulic system. Upon initial detection of unsafe gear down indication, proceed as follows:

1. Airspeed – BELOW 250 KNOTS.

2. If utility hydraulic pressure is normal, recycle landing gear.

3. Landing gear position indicators – CHECK.

If unsafe condition still exists:

4. Landing gear circuit breaker – CYCLE.

5. Landing gear handle – UP.

6. Apply negative g to aircraft.

7. While under negative g, place gear handle down. Negative g will help if unsafe gear is caused by high breakout forces.

8. If unsafe condition still exists, utilize landing gear emergency lowering procedure.

12.14.4.4 Landing Gear Emergency Lowering. If normal gear operation fails, the gear can be lowered by utilizing the following procedures:

1. Airspeed – BELOW 250 KNOTS.

2. Landing gear handle – DOWN.

3. Landing gear circuit breaker – PULL (do not reset).

4. Landing gear handle – PULL AFT AND HOLD.

Pull handle full aft (full limit of travel) and hold in full aft position until gear indicates down and locked.

CAUTION

- Hold handle in full aft position until gear indicates down and locked and then leave the landing gear handle in the full aft position. Returning the handle to its normal position allows compressed air from the gear down side of the actuating cylinder to be vented overboard.

- If the landing gear is inadvertently extended in flight by emergency pneumatic pressure, it must be left in the extended position until postflight servicing. If retraction in flight is attempted, rupture of the utility reservoir will probably occur with subsequent loss of the utility hydraulic system.

Note

It is possible to actuate the landing gear emergency system by pulling the landing gear control handle aft while the handle is in any position from UP through DOWN. If the handle cannot be pulled aft while in the down position, slowly raise the handle while continuing to pull aft. Once the handle moves aft, hold the handle in the full aft position until the landing gear indicates down and locked; then continue to hold back pressure on the handle and return it to the full down position.

5. Landing gear position indicators – CHECK.

CAUTION

To prevent drop tank collapse during high altitude descent with wheels down, place wing transfer pressure switch to EMERG. Prior to landing, return wing transfer pressure switch to NORMAL.

If landing gear is still unsafe:

6. Yaw aircraft to assist locking main gear.

7. If gear is still unsafe, refer to Figure 12-8.

Note

Any pneumatic extension of the landing gear shall be logged in the yellow sheet (OPNAV form 3760-2).

12.14.5 Landing Gear Emergency Retraction. If gear retraction is desired after an attempted landing gear emergency lowering and the utility system pressure is within limits, retract the gear using the following procedures.

Note

Unless operational necessity dictates otherwise, this procedure should be used only when an unsafe gear condition exists after an attempted landing gear emergency lowering. It should not be used if the emergency gear was inadvertently actuated and all three gears are down and indicating locked.

1. Return the emergency gear handle to the normal position.

2. Wait a minimum of 1 minute.

3. Landing gear handle – UP.

4. Landing gear circuit breaker – RESET.

5 After gear is retracted, refer to Figure 12-8.

CAUTION

The landing gear circuit breaker must not be reset until the emergency handle is returned to normal, maintained in that position for a minimum of 1 minute, and the landing gear handle placed UP. Only then may the circuit breaker be safely reset.

12.14.6 Flaps/Slats Emergency Extension. The flaps may be pneumatically extended to the 1/2 position and, on F-4S, the slats extended to OUT if normal extension fails. Emergency extension of the flaps/slats with good utility hydraulic pressure will eventually cause utility hydraulic system failure with loss of nosewheel steering and normal wheelbrakes. Emergency flaps/slats extension should normally be used only if there is an existing utility hydraulic system failure. For carrier landings or field landings where runway length and/or arresting gear limits dictate, the flaps/slats should be pneumatically extended even if there is no failure of the utility hydraulic system. Any pneumatic extension of the flaps/slats shall be logged on the yellow sheet (OPNAV form 3760-2).

CAUTION

If the flaps/slats are inadvertently extended by emergency pneumatic pressure, they must be left in the extended position. Rupture of the utility hydraulic reservoir and loss of the utility hydraulic system will occur if retraction is attempted.

On F-4S aircraft, the slats will extend when the emergency flaps/slats handle is actuated regardless of the position of the flaps/slats switch or the slats override switch. The slats are held out by an overcenter mechanism and will not retract even though pneumatic pressure is depleted. Utility hydraulic pressure is required to retract the slats.

Note

If slats cannot be retracted, drag increase will be negligible at maximum endurance airspeed and equivalent to 20 drag counts at maximum range airspeed.

On F-4J before AFC 534, the ailerons will not droop when the flaps are extended by the emergency system. On F-4J after AFC 534, but before AFC 612 with the emergency aileron droop switch in NORMAL or on F-4J after AFC 599 or AFC 612 and all F-4S with the emergency aileron droop switch ON, the ailerons will droop when the flaps/slats are extended by the emergency system. The ailerons will not droop with the switch in DISABLE (F-4J before AFC 599 or AFC 612) or OFF (F-4J after AFC 599 or AFC 612 and all F-4S). Emergency aileron droop should only be used for carrier landings with insufficient wind over the deck to permit landing without aileron droop or for field landings where runway length and/or arresting gear limitations do not permit a landing without aileron droop. If the ailerons are not drooped when the flaps/slats are extended by the emergency system, the trailing edge flaps will indicate barberpole

FINAL CONFIGURATION	CARRIER LANDING		FIELD LANDING ARRESTING GEAR AVAILABLE		FIELD LANDING NO ARRESTING GEAR	
		Notes		Notes		Notes
ALL GEAR UP	EJECT	2,4,5,10	NO ARRESTED LANDING	5,6,10,11,12,13,16	LAND	5,6,10,12,13,16
NOSE GEAR UP	LAND	4,10	NO ARRESTED LANDING	5,6,10,11,12,13,14,15	LAND	5,6,10,12,13,14,15
STUB NOSE GEAR	LAND	4	NO ARRESTED LANDING	1,5,6,11,12,13,14,15	LAND	1,5,6,12,13,14,15
ONE MAIN GEAR UP	LAND	4, 5	**ARRESTED LANDING**	1,5,12,13	LAND	1,5,6,8,9,12
ONE OR BOTH STUB MAIN GEAR	LAND	4	NO ARRESTED LANDING	1,5,6,8,9,12,17	LAND	1,5,6,8,9,12,17
ONE MAIN GEAR UP NOSE GEAR UP	EJECT	1,2,4,5,10	NO ARRESTED LANDING	1,3,5,6,8,9,10,12,14,17	LAND	1,3,5,6,8,9,10,12,14,17
BOTH MAIN GEAR UP	LAND	3,4,5	NO ARRESTED LANDING	5,6,7,9,12,14	LAND	5,6,9,12,14

Notes

1. If External tanks installed and landing gear can be actuated, emergency retract all gear. Refer to All Gear Up Configuration.
2. Option to land if wing tanks installed.
3. Option to eject if wing tanks not installed.
4. Hook down barricade engagement in accordance with current aircraft barricade engagement recovery bulletin.
5. Retain External tanks.
6. Deploy drag chute at touchdown in accordance with crosswind landing criteria.
7. Option of midfield arrestment if 4000 feet of runway plus overrun available.
8. Land off–center to gear down side/good tire.
9. Keep engines operating in order to retain nose wheel steering and/or power boost brakes.
10. Angle of attack will indicate 3 to 4 units low with the nose gear up.
11. Remove all field arresting cables.
12. Land with fuel weight as low as practicable.
13. Both engines, secure after touchdown.
14. Hold nose off the runway until stabilator effectiveness is lost.
15. Make a minimum sink rate landing.
16. Option to eject if centerline or wing tanks not installed.
17. Use of either normal wheelbrakes or the pneumatic handbrake may help maintain directional control.

- Multiple emergencies, adverse weather and other peculiar conditions may require modifications to these procedures.
- If available, an LSO is recommended for all field arrested landings.
- If a gear up landing is made with external tanks aboard, depressurize the external tanks by first pulling the landing gear circuit breaker, and then place the landing gear handle down.
- A field arrested landing should not be attempted during any gear malfunction involving a stub main gear due to the probability of severing the arresting cables with the stub.
- During some emergencies it is desirable to remove certain crossdeck pendants or field arresting cables. For additional information see applicable aircraft recovery bulletins.
- Jettison or fire off all external ordance including missles, in order to retain external fuel tanks and suspension equipment.

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Figure 12-8. Landing Gear Malfunction-Emergency Landing Guide because the trailing edge flap indicating circuit is wired through the aileron droop down limit switch. Therefore, there is no positive indication that the trailing edge flaps have reached 1/2; however, the barberpole indication may be used as an indirect indication of trailing edge flap extension. On F-4J aircraft, the leading edge flap indications are not affected by the aileron droop position and should read DN. On F-4S aircraft, the slat indications are not affected by aileron droop position and should read OUT. Pneumatic pressure from the emergency air bottle is the only means for maintaining the flaps in the 1/2 position after the flaps are blown down. A subsequent massive air leak on one side may cause an asymmetric flap retraction as airloads push the flaps up. On F-4S aircraft, the slats are held OUT or IN by overcenter locks and loss of pneumatic pressure will not affect their position. Approach speeds with various flaps/slats/drooped aileron configurations are tabulated in Figure 12-1. The flaps/slats can be extended using the following procedure:

1. Airspeed – 200 KNOTS AT 5,000 FEET AGL IF PRACTICAL.

2. Flaps/slats circuit breaker – PULL (do not reset).

Failure to pull the flaps/slats circuit breaker can result in asymmetric flaps.

3. Emergency aileron droop switch – DISABLE OR OFF (F-4J); OFF (F-4S).

WARNING

If a PC hydraulic failure has occurred or occurs after emergency extension of the flaps, and the emergency extension aileron droop switch is not in DISABLE or OFF, or on F-4J prior to 154786ag, regardless of switch position, essential 28-vdc bus power is not available, a split aileron condition will occur which will cause an immediate uncontrollable roll into the dead wing.

WARNING

If flaps are lowered pneumatically, they will eventually retract (blow up) as pneumatic system pressure decays. The duration of pneumatic flap extension varies as a function of system integrity and cannot be predicted. Prior coordination between the aircrew and the controllers is essential to minimize the time that the flaps are pneumatically extended prior to landing (on F-4S, slats will remain in the extended position because of overcenter locks if pneumatic pressure is lost).

4. Emergency flap/slat handle – PULL FULL AFT.

Pull the emergency flap/slat handle full aft to limit of travel. Leave the handle full aft. Returning the handle to the forward position allows the compressed air from the down side of the actuators to be vented. Emergency extension of the flaps/slats may cause a momentary roll which can be easily countered by normal control application.

5. Flap/slat position indicators – CHECK (trailing edge barberpole).

On F-4J aircraft, if an asymmetric leading edge flap occurs and controllability dictates:

WARNING

If an asymmetric flap exists after emergency flap extension and the pilot elects to retain this condition to reduce landing speed, the approach should be conducted with caution as the remaining flaps may retract without warning.

6. Emergency flap handle – PUSH FORWARD.

Push the emergency flap handle forward to vent air and allow the flaps to retract under airloads. An asymmetric trailing edge flap is easily controllable and approach speed with an asymmetric trailing edge flap is lower than with flaps up.

If aileron droop is required:

6. PC-1 and PC-2 hydraulic pressure – CHECK NORMAL.

7. Emergency aileron droop switch – NORMAL OR ON (F-4J); ON (F-4S).

If asymmetric droop occurs:

8. Emergency aileron droop switch – DISABLE OR OFF (F-4J); OFF (F-4S).

The ailerons will return to the undrooped position.

9. Determine approach speed and notify carrier.

Refer to Figure 12-1.

12.14.6.1 Wheelbrake Emergency Operation. If a utility hydraulic system failure or loss of brake action occurs, the aircraft can be stopped by using the emergency brake system. However, if arresting gear is available, plan to make a short-field arrested landing.

1. Hydraulic wheelbrakes – APPLY.

Depress brakes and keep a constantly increasing brake pressure, do not pump the brakes. There may be brake application available from the emergency hydraulic accumulator to provide a limited amount of differential braking.

Note

With no utility hydraulic system pressure available, the manual hydraulic brakes are still capable of furnishing flow and pressure to accomplish a limited amount of differential braking. Manual braking utilized with the emergency brake system becomes the primary method of maintaining directional control of the aircraft. The number of such applications is limited and higher pedal travel and higher brake pedal forces will be necessary.

2. If unable to stop aircraft, pull emergency brake handle.

The emergency brake system meters air pressure in proportion to applied pilot effort, but does not provide differential braking. There will be a time lag between pulling the emergency brake handle and the application of pneumatic pressure to the wheel cylinders.

3. Manual braking (heavy pedal forces) – AS REQUIRED.

Manual braking may be required for directional control as asymmetrical braking is prevalent during use of the emergency braking handle. The asymmetrical braking could be due to runway crown or crosswinds as well as unequal brake torque.

4. Do not taxi with emergency brakes.

12.14.6.2 Speedbrake Emergency Operation. Three basic failures and their combinations can affect the speedbrakes. They are switch failures, electrical failure, and utility hydraulic system failure. In the event of a utility hydraulic system failure with the speedbrakes extended, the speedbrakes will be forced by airloads to a low drag trail position regardless of switch positions. If an electrical failure occurs, the speedbrakes automatically retract to a fully closed position. In the event the throttle-mounted switch fails:

1. Emergency speedbrake switch – RETRACT (F-4J before AFC 534).

If switch fails or on F-4J after AFC 534 and all F-4S:

2. Speedbrake circuit breaker – PULL.

12.14.6.3 Air Refuel Probe Emergency Extend. On F-4J 155867ak and up or after AFC 370 and all F-4S, if the air refueling probe cannot be extended normally, it can be extended with pneumatic pressure. With a utility hydraulic system failure and the main pneumatic line pressure decreasing, consideration should be given to early pneumatic extension of the air refueling probe. Early extension of the probe will ensure that air refueling can be accomplished without relying solely on the charge in the air refueling probe pneumatic bottle.

1. Refuel probe circuit breaker – PULL (G5, F-4J before AFC 388; J14, F-4J after AFC 388; J5, F-4J after AFC 545 and all F-4S; No. 1 panel).

2. Refuel probe switch – REFUEL.

3. Emergency refuel probe switch – EMER EXT.

After refueling is accomplished:

4. Refuel probe switch – EXTEND.

CAUTION

To prevent possible damage to the utility reservoir and/or loss of utility pressure, the emergency refuel probe switch must be left in EMER EXT.

12.15 LANDING EMERGENCIES

12.15.1 Landing Gear Malfunction. Refer to Figure 12-8.

12.15.2 Field Arresting Gear. The various types of field arresting gear in use are the anchor chain cable, water squeezer, and the MOREST type. All of these types require engagement of the arresting hook in a cable pendant rigged across the runway. Location of the pendant in relation to the runway will classify the gear as follows:

1. Midfield gear – Located near the halfway point of the runway and usually requires prior notification in order to rig for arrestment in the direction desired.

2. Abort gear – Located 1,500 to 2,500 feet short of the upwind end of the duty runway and usually will be rigged for immediate use.

3. Overrun gear – Located shortly past the upwind end of the duty runway and is usually rigged for immediate use.

All pilots should be aware of the type, its location, and capability of the arresting gear in use with the aircraft, and the policy of the local air station with regard to which gear is rigged for use and when. The approximate maximum permissible engaging speed, gross weight, and offcenter engagement distance for field arrestment of aircraft are listed in Figure 12-9.

WARNING

If offcenter just prior to engaging the arresting gear, do not attempt to go for the center of the runway. Continue straight ahead parallel to the centerline.

As various modifications to the basic type of arresting gear are used, exact speeds will vary accordingly. Certain aircraft service changes may also affect engaging speed and weight limitations. Severe damage to the aircraft is usually sustained if an engagement into the chain gear is made in the wrong direction.

In view of the existing emergency runway conditions (i.e., weather, time, fuel remaining, and other considerations), it may be impractical or impossible to adhere strictly to the following general recommendations. In an emergency situation, first determine the extent of the emergency by whatever means are possible (instruments, other aircraft, LSO, RDO, tower or other ground personnel). Next determine the most advantageous arresting gear available and the type of arrestment to be made under the conditions which prevail. Whenever deliberate field arrestment is intended, notify control tower personnel as much in advance as possible and state estimated landing time in minutes. If gear is not rigged, it will probably require 10 to 20 minutes to prepare it for use. If foaming of the runway or area of arrestment is required or desired, it should be requested by the pilot at this time. In general, the arresting gear is engaged on the centerline at as slow a speed as possible. While burning down fuel, make practice passes to accurately locate the arresting gear. Engagement should be made with feet off the brakes, shoulder harness locked, and with the aircraft in a three-point attitude. When speed has been reduced to approximately 20 knots, braking should be applied to prevent the aircraft with idle power from pulling the gear through to a two-block position. In the event of brake malfunction, the aircraft engines should be shut down.

12.15.3 Short-Field Arrestment. If at anytime prior to landing, it is known that a directional control problem exists or a minimum rollout is desired, a short-field arrestment should be made and the assistance of an LSO requested. He should be stationed near the touchdown point and equipped with a radio. Inform the LSO of the desired touchdown point. A constant glide slope approach to touchdown is permitted (mirror or Fresnel lens landing aid utilized) with touchdown on centerline at or just prior to the arresting wire with the hook extended. The hood should be lowered while airborne and a positive hook-down check should be made (observe light in the hook control handle). If midfield gear or MOREST type is available, it should be used. If neither are available, use abort gear. Use an approach speed commensurate with the emergency experienced. Landing approach

TYPE OF ARRESTING GEAR	MAXIMUM ENGAGING SPEED KNOTS (a) GROSS WEIGHT X 10^{-3} POUNDS									MAXIMUM OFF-CENTER ENGAGEMENT FEET
	SHORT FIELD LANDING (b, c)				LONG FIELD LANDING (d)		ABORTED TAKEOFF (f)			
	31	34	38	40	42	46	50	54	56	
E-27	156	153	149	146	144	140	136	132	130	35
E-15 200' SPAN	180	180	180	180	180	178	176	173	172	35
E-15 300' SPAN	180	180	180	180	180	180	180	179	177	50
M-21	150	150	145	145	140	135	135	135	125	10
E-28	180	180	180	180	180	180	179	177	176	40
E-28 (h)	180	180	180	180	178	175	160	160	160	40
E-5 STD CHAIN (g)	150	150	150	150	147	142	138	134	132	(e)
E-5-1 STD CHAIN (g)	165	159	153	150	147	142	138	134	132	(e)
E-5 HEAVY CHAIN (g)	150	150	150	150	150	150	150	150	150	(e)
E-5-1 HEAVY CHAIN (g)	165	165	165	165	165	165	165	165	162	(e)
BAK-9	160	160	160	160	160	160	160	150	146	30
BAK-12 (j)	160	160	160	160	160	160	153	137	126	50
DUAL BAK-12 (k)	160	160	160	160	160	160	160	160	160	30

(a) All engaging speeds limited by arresting gear capacity.
(b) Maximum of 3.0-degree glide slope.
(c) Consult appropriate section for recommended approach speed.
(d) Flared or minimum rate of descent landing.
(e) Off-center engagement may not exceed 25% of the runway span.
(f) Data provided in the aborted takeoff columns may be used for emergency high gross weight arrestments.
(g) Before making an arrestment, the pilot must check with the air station to confirm his maximum engaging speed because of a possible installation with less than minimum required rated chain length.
(h) Only for the E-28 Systems at Keflavik, Bermuda, and Wallops Flight Center with 920-foot tapes.
(j) Standard BAK-12 limits are based on 150-foot span, 1-inch crossdeck pendant, 40,000-lb weight setting and 950-foot runout. No information available regarding applicability to other configurations.
(k) Dual BAK-12 limits are based on 225-foot span, 1-1/4 inch crossdeck pendant, 50,000-lb weight setting and 1,200-foot runout. No information available regarding applicability to other configurations.
(l) M-21 offcenter distance is determined by pendant width.

OFFCENTER ENGAGEMENT (FEET)	SPAN WIDTH OF M-21 (FEET)
10	150
20	210
30	225
40	325
50	425

Figure 12-9. Emergency Field Arrestment Data

power will be maintained until arrestment is assured or a waveoff is taken. Be prepared for a waveoff if the gear is missed. After engaging the gear, retard the throttle to IDLE or secure engine and abandon aircraft, depending on existing conditions.

1. Notify tower and request LSO assistance.

Notify tower of intended action, request LSO assistance (if required), and supply required information (e.g., type of emergency, estimated landing time, gross weight, etc.).

2. Reduce gross weight.

Dump and/or burn fuel to reduce gross weight to lowest practicable.

3. Fly pattern as dictated by emergency.

4. Arresting hook – DOWN.

5. Fly final approach on LSO or for touchdown just short of wire. If LSO is available, fly final approach and touchdown on centerline and just short of the crossdeck pendant.

6. Maintain landing approach power until engagement.

7. Longitudinal control neutral until engagement.

8. Engage wire with feet off brakes.

9. Throttles IDLE or OFF at engagement as desired.

Note

Placing longitudinal control to neutral reduces the possibility and limits the severity of stabilator slaps.

12.15.4 Long-Field Arrestment. The long-field arrestment is used when a stopping problem exists with insufficient runway remaining (i.e., aborted takeoffs, icy or wet runways, loss of brakes after touchdown, etc.). Lower the hook, allowing sufficient time for it to extend fully prior to engagement. Line up the aircraft on the runway centerline. Inform the control tower of your intentions to engage the arresting gear so that aircraft landing behind you may be waved off. If no directional control problem exists (crosswind, brakes out, etc.), secure the engine. Avoid large pitch control inputs to prevent becoming airborne during rollout. When airspeed permits, maintain full aft stick for aerodynamic braking and to decrease the probability of stabilator and crossdeck pendant contact.

1. Engines – IDLE.

2. Drag chute – DEPLOY.

3. Hook – DOWN.

Lower the tail hook at least 1,000 feet ahead of the wire. Allow 5 seconds for full extension.

4. Brakes – APPLY optimum wheelbraking.

5. Brakes – RELEASE 100 FEET BEFORE WIRE.

6. Engage wire in center at 90°.

12.15.5 Barricade Engagement

1. Jettison all missiles.

2. Lower hook if possible.

Lowering the arresting hook will assist the barricade in stopping the aircraft and will help to keep the aircraft on the deck at barricade entry.

3. Fly a normal on-speed approach, on centerline and on meatball. Anticipate loss of meatball for a short period of time late in approach because of barricade stanchions obscuring the meatball.

12.15.6 Expending Hung Ordnance. Before making an arrested landing with hung ordnance on a MER/TER, the following should be accomplished in an effort to expend ordnance.

1. Reselect station on which ordnance is hung and again depress bomb button.

2. Rock wings and/or pull positive g load.

12.15.7 Landing With Hung Ordnance. For emergency landing conditions only, the following asymmetric moments because of external store loading are permitted:

1. Field landing (minimum sink-rate) – 379,000 inch-pounds.

Twin or single-engine – 2,879 pounds total on stations 1/9 or 4,650 pounds total on stations 2/8.

2. Field arrested landings and FCLP – 212,000 inch-pounds.

Twin or single-engine – 1,600 pounds total on stations 1/9 or 2,610 pounds total on stations 2/8.

3. Carrier landing (twin-engine) –212,000 inch pounds.
–1,600 pounds total on stations 1/9 or 2,610 pounds total on stations 2/8.

4. Carrier landing (single-engine) –60,000 inch pounds.
–450 pounds total on stations 1/9 or 740 pounds total on stations 2/8.

The above asymmetrics are defined as the asymmetric load at the outboard wing stations (1 or 9) X 132.5 plus the asymmetric load at the inboard wing stations (2 or 8) X 81.5.

CAUTION

- The hung ordnance restrictions of the F-4 Tactical Manual, NAVAIR 01-245FDB-1T, in Appendix A apply and take precedence over the above limits.

- If a landing must be made with an asymmetric load, refer to paragraph 11.2.2.5, FLIGHT WITH ASYMMETRIC LOADING, for handling characteristics.

12.15.8 Blown Tire. The situation may occur when a landing with a blown tire must be made or a tire may rupture during the landing ground roll. A blown tire and high speed require immediate corrective action to keep the aircraft aligned with the runway.

12.15.8.1 Landing With a Known Blown Tire

1. Plan to make a short-field arrestment (if available).

If short-field arresting gear is not available:

2. Make a normal on-speed approach.

3. Antiskid switch – OFF (some aircraft).

4. Land on side of runway opposite blown tire.

5. Touch down with weight on good tire.

6. Use nose gear steering to maintain directional control.

If nose gear steering is inoperative, use of aerodynamic steering should be considered.

7. Use light opposite braking to slow aircraft.

CAUTION

Avoid braking on the wheel with the blown tire. Heavy braking could cause a flat spot on the wheel which could prevent further wheel rotation and make aircraft control more difficult.

After coming to stop:

8. Do not retract flaps/slats.

The flap seals may have been damaged by pieces of broken tire and retracting the flaps will increase the damage.

If fire equipment is available:

9. Throttles – OFF.

If possible, do not shut down engines until adequate firefighting equipment is available.

WARNING

The damaged wheel may either be on fire or very hot, and fuel drained overboard during engine shutdown could contact the hot wheel and cause a fire.

12.15.8.2 Blown Tire During Landing Rollout

*1. Nose gear steering – ENGAGE (rudder centered).

*2. Antiskid – DISENGAGE.

*3. Hook – DOWN (if arresting gear available).

4. Use light opposite braking to slow aircraft.

CAUTION

Avoid braking on the wheel with the blown tire. Heavy braking could cause a flat spot on the wheel which could prevent further wheel rotation and make aircraft control more difficult.

After coming to stop:

5. Do not retract flaps/slats.

The flap seals may have been damaged by pieces of broken tire and retracting the flaps will increase damage.

6. If fire equipment is available, throttles – OFF.

If possible, do not shut down engines until adequate firefighting equipment is available.

WARNING

The damaged wheel may either be on fire or very hot, and fuel drained overboard during engine shutdown could contact the hot wheel and cause a fire.

CAUTION

If nosewheel tires are blown on landing, secure both engines as soon as possible to preclude portions of the tire entering either of both intake ducts.

Note

The aircraft can be safely taxied or towed with a flat tire on either main or nose gear.

12.15.9 Engine Failure on Final. At the first indication of engine failure, advance both throttles to afterburner and raise the flaps/slats to 1/2-OUT. Any unnecessary delay in applying power will result in excessive sink rate and/or airspeed bleed-off that may not be able to be overcome (even with full afterburner thrust) before ground impact. The excessive sink-rate condition will develop if the angle of attack is allowed to increase beyond 20 units. If the angle of attack reaches 22 units, even the use of full afterburner thrust will not stop the sink rate prior to ground impact unless the angle of attack is again reduced to 20 units or below. Raising the flaps/slats to 1/2-OUT while flying on-speed angle of attack will reduce drag and minimize power loss to the BLC system, but an altitude loss of 100 to 300 feet can be expected. Do not attempt to immediately level the aircraft; accept a continued rate of descent and maintain aircraft control with smooth coordinated attitude corrections, being careful not to exceed 20 units angle of attack. External store drag is negligible at low airspeeds and will have little effect on aircraft performance. The aircraft gross weight will dictate the thrust required to continue the approach or execute a go-around. At normal landing gross weights, once the situation is stabilized (i.e., flaps/slats 1/2-OUT and the sink rate stopped or under control), afterburner thrust will no longer be required. Very little yaw rate is induced by military thrust on one engine; however, a slight asymmetrical control problem is created by use of afterburner thrust on one engine. These yaw rates must be controlled with the rudder since excessive aileron inputs could induce additional adverse control conditions. The approach can normally be continued and the aircraft landed on the runway from a situation created by single-engine failure on final.

*1. Throttles – AFTERBURNER.

If the right engine fails on final and the bus tie remains open, afterburner ignition will not be available. However, if afterburner thrust is required, afterburner light-offs are generally obtainable through turbine torching by jam accelerating the left engine at 90-percent rpm or above.

*2. Flaps/slats – 1/2-OUT.

3. Land or waveoff.

If decision to waveoff is made:

4. Initiate waveoff – CLIMB TO SAFE ALTITUDE.

5. Landing gear – UP.

6. Nonmechanical failure – INITIATE AIRSTART.

7. Mechanical failure – SHUT DOWN FAILED ENGINE.

8. Land as soon as practicable.

12.15.10 Single-Engine Landing. A single-engine landing is basically the same as a normal landing except that the pattern is expanded to avoid steep turns, final approach speeds are increased for better lateral control, and flaps/slaps 1/2-OUT are used in lieu of DN-OUT. Single-engine carrier landings are to be considered as emergency situations and, as such, diverting to a land base should be a first consideration. For single-engine carrier landings, all stores including racks (MER, TER, etc.) should be jettisoned. Sparrows may be retained provided that weight and atmosperhic temperature restrictions are adhered to.

For single-engine crosswind landing, utilize the crabbed approach technique at 17 units, half-flaps, with the pilot smoothly using rudder to reduce the crab angle by use of rudder coordinated with lateral stick to hold the wings level. Attempting to reduce the crab angle to zero or making a very rapid rudder input may result in loss of lateral control.

1. Turn off nonessential electrical equipment.

2. Reduce gross weight to 36,000 pounds or less.

Reduce gross weight to 36,000 pounds or less at atmospheric temperatures below 80 °F with Mk 7 Mod 2 or 3 arresting gear. Above 80 °F, reduce weight linearly to 32,000 pounds at 100 °F. The maximum gross weight for Mk 7 Mod 1 arresting gear is 32,000 pounds. Recommended approach speeds (flaps/slats – 1/2-OUT) versus weight are presented in Figure 12-1.

3. Variable area inlet ramp on operating engine – CHECK FULL OPEN.

Note

If the inlet ramp on the operating engine is in the closed position, the afterburner may be required to make a safe approach.

4. Cycle afterburner of operating engine to ensure rapid lightoff for possible afterburner operation.

5. Ram air turbine – EXTEND.

6. Gear – DOWN.

7. Flaps/slats – 1/2-OUT.

Note

Full flaps shall not be used during a single-engine approach and landing since the engine bleed air that would be utilized for the trailing edge BLC system deprives the engine of fully rated thrust. Also, the full flaps configuration increases drag appreciably over the flaps/slats 1/2-OUT configuration. For F-4J aircraft in the 1/2 flaps configuration, approximately 25 percent of the available thrust of the good engine is diverted to maintain leading edge BLC.

Note

- If the generator on the operating engine is lost, the flap solenoid-operated selector valves revert to a full trail position and the flaps are blown up by the airstream.
- The ARI system is inoperative with flaps retracted.

8. Field landing – FLY 17 UNITS ANGLE OF ATTACK UNTIL LANDING IS ASSURED.

Carrier landing – ON-SPEED APPROACH.

Do not exceed 20 units angle of attack as the aircraft waveoff performance will be degraded.

CAUTION

Attempting to aggressively crab the aircraft toward the dead engine during a single-engine landing may result in loss of lateral control because of the rapid buildup of roll rate following a rapid rudder input. Rudder inputs toward the dead engine must be small and smooth.

Note

Single-engine landings are easier with the crosswind component from the side of the dead engine.

9. For waveoff, place throttle of operating engine to MIL or MAX as required.

10. For carrier landing, place throttle of operating engine to MAX AB upon main gear touchdown.

Note

If the right engine is shut down and the bus tie is open, afterburner ignition will not be available. However, if afterburner thrust is required, afterburner light-offs are generally obtainable through turbine torching by jam accelerating the left engine at 90-percent rpm or above.

12.15.11 Utility System and Engine Failure (With or Without Single PC Failure). The problems associated with landing a combination single-engine and utility hydraulic failure are severe. The effects of losing powered rudder, rudder trim, yaw and roll or pitch augmentation, and possibly roll control surfaces on one wing when flying on only one engine seriously degrade flying qualities and control of the aircraft.

WARNING

- Carrier landing shall not be attempted.
- If the combination of weather, landing facilities, and pilot experience is less than ideal, consideration should be given to a controlled ejection.

If the decision is made to land, plan a straight-in, no flaps/slats approach; aircraft maneuvering should be held to a minimum. Required turns should be made away from the dead engine. Care should also be taken to avoid excessive sink rates as acceleration of the good engine to reduce the sink rate could result in adverse yaw and loss of aircraft control. The aircrew should plan an arrested landing commensurate with arresting gear limitations. On final approach to touchdown, fly indicated airspeed and not angle of attack.

1. Maintain a minimum speed of 250 knots.

2. Yaw and roll stab – OFF (pitch aug – OFF IF PC-1 FAILED).

3. External stores – JETTISON IF NECESSARY.

4. Reduce gross weight to single-engine weight or less.

5. Landing gear – BLOW DOWN AT A MINIMUM 10,000 FEET AGL (maintain 230 knots minimum).

6. Nonessential electrical equipment – OFF.

7. Ram air turbine – EXTEND.

8. Slat override switch – IN.

9. Flaps/slats – UP-NORM.

10. Perform controllability check and investigate aircraft handling characteristics at 10,000 feet AGL (minimum) from 230 knots down to but no lower than recommended touchdown speed (see Figure 12-10).

11. Plan a straight-in approach with all turns away from the dead engine (230 knots minimum).

WARNING

- Any throttle movements should be made slowly to minimize yaw/roll transients. Minimum practical power should be used at all times to minimize yaw and roll because of yaw. Minimum control airspeed is a direct function of throttle setting.

- If afterburner is required at anytime during the approach, there may not be sufficient roll control to compensate for the asymmetric thrust.

WARNING

Power must be added slowly and airspeed increased to ensure adequate control during any attempted waveoff. Waveoff capability in afterburner may not exist below 230 knots because of inadequate lateral and directional control. Afterburner should not be selected below 230 knots unless absolutely necessary to prevent catastrophe and the pilot must be aware that this could cause loss of control.

12. When the aircraft is approaching the landing threshold and no further lineup corrections are required, reduce airspeed to touchdown no slower than the airspeed given in Figure 12-10.

13. Land or eject.

After landing:

14. Drag chute – DEPLOY (215 knots maximum).

15. Hook – DOWN (if taking mid- or long-field arrestment).

FLAPS UP AND GEAR DOWN

GROSS WEIGHT	TOUCHDOWN SPEED
34,000	184
35,000	187
36,000	190
37,000	192
38,000	195
39,000	198
40,000	200

N11/82

Figure 12-10. Touchdown Speed

CAUTION

Only emergency brakes will be available during landing rollout. Nosegear steering will be inoperative. Differential braking should be used judiciously to maintain directional control. The use of the drag chute in a crosswind may increase directional control difficulties.

12.15.12 Landing With Bleed Air Switch Off (No Leading Edge BLC) (F-4J)

1. Perform controllability check.

2. Fly 17.0 units AOA for approach and touchdown (field or carrier).

WARNING

- Actual stall occurs before the rudder pedal shaker is activated in the no leading edge BLC configuration. The aircraft stalls at approximately 20 units AOA and is characterized by a nose rise.

- In the single-engine, half-flap, leading-edge BLC off configuration, the pilot task during a carrier landing and approach is considerable. The decision to recover the aircraft aboard ship should be made only when conditions are optimum. Suitability of a divert field should be considered.

12.15.13 Arresting Hook Malfunction. If the hook fails to extend upon handle actuation:

1. Arresting hook control circuit breaker – PULL (H7, F-4J before AFC 388; K7, F-4J after AFC 388 and all F-4S; No. 2 panel).

12.15.14 Landing With Stuck/Inoperative AOA Transmitter. A stuck or inoperative AOA transmitter provides an erroneous input to the CADC which may cause unreliable altitude and airspeed with the SPC engaged. Before approach, verify airspeed and altitude in the dirty configuration with wingman if possible.

1. SPC – OFF.

2. Fly indicated airspeed.

Refer to Figures 18-7 and 28-7.

12.15.15 Controllability Check. During any inflight emergency when structural damage or any other failure is known or suspected that may adversely affect aircraft handling characteristics, a controllability check should be performed as follows:

1. Proceed to a safe altitude (minimum 5,000 feet AGL).

2. Reduce gross weight to minimum practicable.

3. Establish landing configuration required by type of emergency.

4. Slow aircraft to determine minimum control speed, but no slower than 17 units AOA.

If adequate control is available:

5. Plan for straight-in approach.

6. Fly final approach no slower than minimum control speed + 10 knots.

12.15.16 Approach Power Compensator System (APCS) Disengagement. If a malfunction occurs in the system, APCS disengagement should be attempted in the following sequence:

1. Emergency speedbrake switch – MANUAL (F-4J through 155866aj before AFC 392).

2. Speedbrake circuit breaker – IN (F-4J through 155866aj before AFC 392).

3. Speedbrake switch – IN.

On F-4J 155867ak and up or after AFC 392 and all F-4S, the APCS may be disengaged at anytime by moving the speedbrake switch to IN regardless of the position of the emergency speedbrake switch or the speedbrake circuit breaker.

If this fails:

4. APCS power switch – OFF OR STBY.

If this fails:

5. Autothrottle circuit breakers – PULL. (J3, K4, K5, F-4J before AFC 388; M3, K3, L3, F-4J after AFC 388 and all F-4S; No. 2 panel).

This should ensure positive disengagement, but if it still remains engaged:

6. Manually override throttles.

The pilot can manually override the throttles by exerting a 20- to 25-pound force per throttle. In this case, the throttles must be held in the desired position.

If time does not permit the accomplishment of the preceding steps:

1. RAT – OUT.

2. Generators – OFF.

3. Climb to a safe altitude.

4. Autothrottle circuit breakers – PULL (J3, K4, K5, F-4J before AFC 388; M3, K3, L3, F-4J after AFC 388 and all F-4S; No. 2 panel).

5. Generators – ON.

6. RAT – IN.

Note

When using the above procedures, discretion must be used as the flaps will blow up.

12.15.17 Unsafe Flaps/Slats During Approach/Landing

1. Flaps/slats – LEAVE AS SET.

2. Land as soon as possible.

If excessive roll is encountered with flaps/slats extended:

1. Flaps/slats – 1/2-OUT OR UP-NORM (as required for controllability).

2. Do not cycle flaps/slats.

3. Land as soon as possible.

CAUTION

If a barberpole trailing edge flap indication is due to a broken flap actuating rod, cycling flaps/slats DN-OUT may increase damage.

12.15.18 No-Flaps/Slats Landing

WARNING

Care must be taken to maintain a neutral stick position after touchdown. Failure to do so may result in severe damage to the stabilator because of wire slaps generated by increased stabilator effectiveness.

A no-flap/slat landing pattern is basically the same as for a normal landing except that it should be expanded to avoid steep turns. In the no-flap/slat landing configuration, stabilator effectiveness is increased and aileron/spoiler effectiveness is decreased relative to that experienced in normal flap landing configurations. For field landings, fly 17 units AOA until wings level on final, then reduce speed to on-speed AOA. For carrier approaches, on-speed AOA must be flown on final to remain within shipboard arresting gear engagement limitations. Careful control of nose attitude is required and large pitch control inputs should be avoided. For field landings, care must be exercised so as not to become airborne again during landing rollout.

1. Fly on-speed AOA.

Effective for aircraft 154786ag and up, aileron droop is provided by electromechanical actuators when flaps/slats 1/2-OUT or DN-OUT are selected. If one aileron fails to droop, a pronounced aircraft roll will occur. The following action allows a flaps/slats 1/2-OUT or DN-OUT landing without aileron droop. Refer to Figure 12-1.

12.15.19 Asymmetric Aileron Droop (Aircraft 154786ag and Up)

1. Flaps/slats – UP-NORM.

2. Pull aileron droop actuator circuit breaker (J12, F-4J before AFC 388; H15, F-4J after AFC 388 and all F-4S; No. 1 panel).

3. Flaps/slats – 1/2-OUT OR DN-OUT (ailerons will not droop).

4. Fly on-speed angle of attack.

12.15.20 Hot Brake Procedures. Hot brake procedures are contained in BUAER/BUWEPS INST 13420.1. In view of the varied climatic conditions, field conditions, and safety devices available, specific procedures must be covered in local squadron/field SOP.

12.15.21 Landing With Both Engines Inoperative. Landing with both engines inoperative will not be attempted.

12.15.22 Glide Distance. The aircraft will glide approximately 6 nautical miles for every 5,000 feet of altitude. The recommended glide airspeed is 215 KCAS. Below 50,000 feet, 215 KCAS will provide near maximum glide distance and will allow the windmilling engines to maintain power control hydraulic pressure within safe limits.

12.15.23 Precautionary Emergency Approach. The standard precautionary emergency approach for the aircraft is the straight-in GCA/CCA approach modified to accommodate single-engine, flaps/slats 1/2-OUT or DN-OUT approach speeds as power available dictates. The precautionary emergency approach depicted in Figure 12-11 will be used for field landings if one engine has failed and the remaining engine has suffered a malfunction that results in only partial power. This procedure may be used day or night, provided ceiling and visibility are such that visual contact can be maintained with the field. Although the approach depicted is the classic overhead entry to a left-hand pattern, the precautionary approach may be initiated from any checkpoint, using either a left- or right-hand pattern. The pilot must select a checkpoint in either the straight-in or overhead approach at which the decision to continue the approach or eject must be made. Sink rate, power available, configuration, and position relative to the runway or obstructions must be considered. The flaps/slats may have to be blown down because of airspeed being above flap blow-up speed. The checkpoint selected must be early enough to permit safe ejection and in such a position so as not to compromise or endanger the safety of populated areas, military installations, or other aircraft. In no case should this checkpoint be lower than 1,000 feet AGL for the straight-in approach or 3,000 feet AGL for the overhead approach. The pilot should plan the approach to utilize available field arresting gear. If the success of the approach and landing appear to be marginal to the pilot, consideration should be given to heading the aircraft into a clear area and ejecting instead of attempting the approach.

12.15.24 Forced Landing

WARNING

All forced landings on land shall be made with the landing gear extended regardless of terrain. A greater injury hazard is present whenever emergency landings are made with the landing gear retracted. Increased airspeed or nose-high angle of impact during landings with landing gear retracted is common practice and contributes greatly to pilot injury and damage to the aircraft. This nose-high attitude causes the aircraft to slap the ground on impact, subjecting the pilot to possible spinal injury. Less aircraft damage will result with the gear extended.

It is recommended that a landing on unprepared terrain not be attempted with this aircraft; the crew should eject. If a forced landing is unavoidable, proceed as follows:

1. Ram air turbine – EXTEND.

2. If time and conditions permit, dump or burn excess fuel.

3. Notify RIO of existing emergency and intended action.

4. Shoulder harness – LOCK.

5. Canopies – JETTISON (forward canopy first).

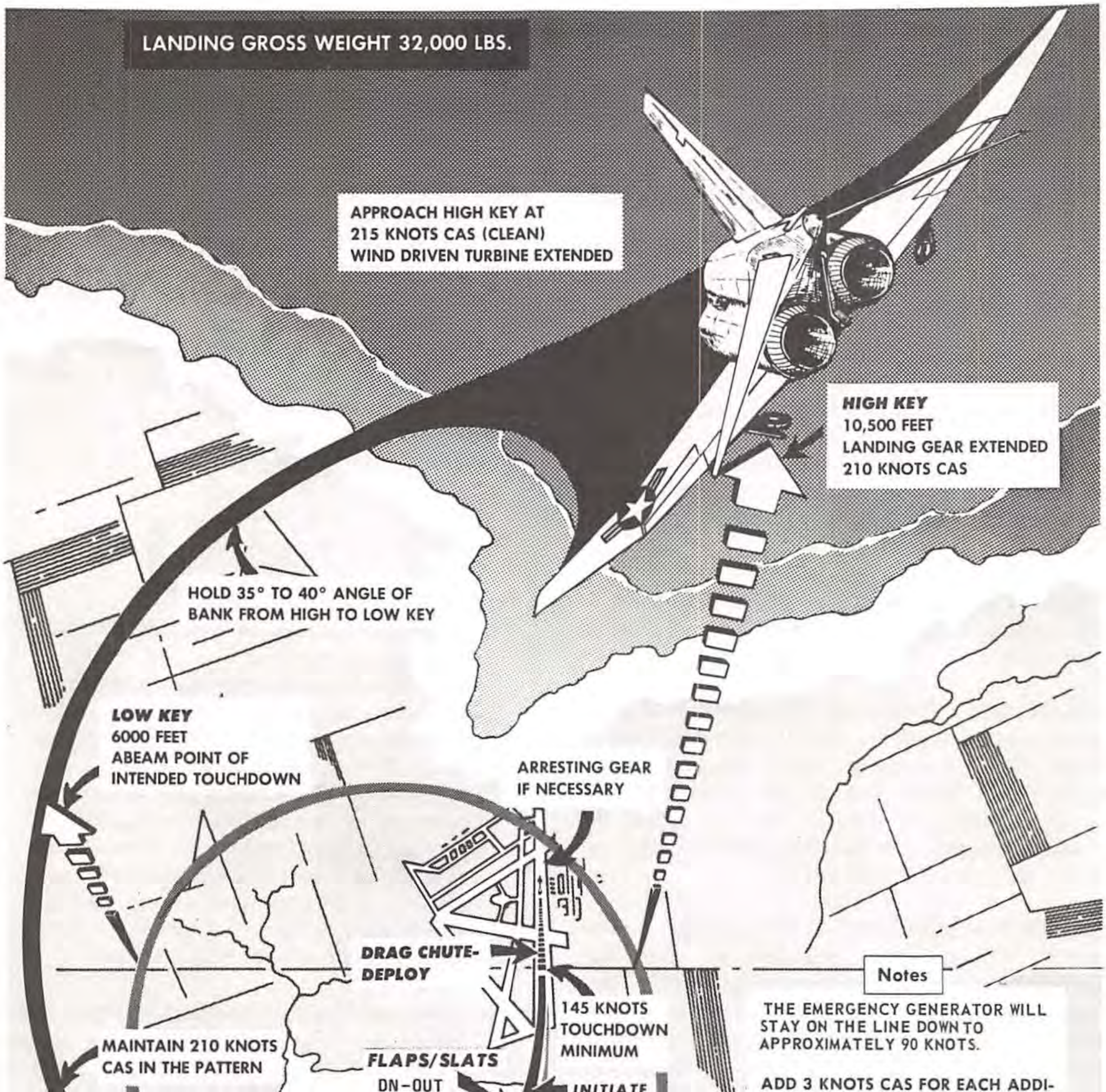

Figure 12-11. Precautionary Emergency Approach Procedure

The aft canopy should be jettisoned last to preclude the possibility of the forward canopy entering the aft cockpit when jettisoned.

6. Armament – JETTISON.

7. Landing gear – DOWN AND LOCKED.

8. Flaps/slats – DN-OUT.

9. External tanks – RETAIN IF EMPTY AND UNPRESSURIZED.

Empty external tanks should be retained to absorb the shock of landing.

Note

If gear is not lowered, external tanks can be unpressurized by pulling the landing gear circuit breaker and placing the landing gear handle down.

10. Make normal approach.

11. Drag chute – DEPLOY AFTER TOUCH-DOWN.

12. Engines – SHUT DOWN.

a. Throttles – OFF.

b. Engine master switches – OFF.

13. As soon as stopped – EVACUATE AIRCRAFT.

12.15.25 Antiskid Failure (Aircraft 157242an and Up). If brake loss occurs with normal utility hydraulic pressure and the antiskid switch ON:

*1. Wheelbrakes – RELEASE.

CAUTION

The brakes should be released before the antiskid system is disengaged to prevent the possibility of skidding. When the antiskid system is disengaged manually or because of a malfunction, the brakes will immediately be applied proportional to pedal displacement.

Note

The antiskid system will not protect against skids below approximately 10 to 20 knots. A malfunctioning antiskid system which relieves brake pressure below this speed range might be interpreted as wheelbrake failure. Assuming a normal utility hydraulic pressure, brakes can be regained by deactivating the antiskid system and reapplying the brakes.

*2. Antiskid – DISENGAGE.

Note

The antiskid system can be temporarily disengaged by depressing the emergency quick release lever on the control stick. This lever, however, must be held depressed to keep the system disengaged.

3. Wheelbrakes – REAPPLY.

If braking returns, leave anti-skid switch OFF; if not, activate the emergency brake system.

CAUTION

If normal braking is available and antiskid protection is lost, it is possible to lock a wheel(s) and produce a skid which could result in a blown tire(s). The runway condition and aircraft speed will dictate the amount of braking that can be applied without skidding a wheel.

12.15.26 Emergency Egress. Because of forced landing, ditching, or landing emergency such as barricade engagement or runway overrun, rapid egress is essential. The most rapid method of egress is by divestment of both the seat survival kit and the parachute. On land, if the aircraft is burning, the extra time required to egress retaining the seat kit could cause serious injury or death. After safely egressing, if conditions permit, return to the aircraft and retrieve the survival kit. If ditching, the parachute should be divested and the seat kit retained to allow for underwater breathing and use of the raft/survival equipment.

WARNING

During emergency egress from aircraft with the H-7 rocket assist ejection seat, actuation of the emergency harness release handle allows the personnel parachute to slide down and wedge against the seat survival kit, thereby causing serious difficulty in egressing with the seat survival kit attached.

To evacuate cockpit without survival kit and parachute:

*1. Canopy – OPEN.

a. Normal

b. Canopy emergency release handle

c. Manual unlock handle.

Note

If circumstances dictate, open canopy after remaining steps are performed.

*2. Rotate lower ejection handle guard – UP.

*3. Leg restraint release handle – PULL AFT.

*4. Arch back to apply tension to lap belt and release lap belt fittings.

*5. Oxygen mask/face plate – RELEASE/OPEN.

*6. Composite disconnect – RELEASE.

*7. Shoulder harness fittings – RELEASE.

Note

To evacuate cockpit with survival kit only, refer to Figure 12-12.

12.15.27 Ditching. Ditching the aircraft should be the pilot's last choice. All survival equipment is carried by the crewmember, thus ejection is advisable. However, if altitude and situation demand ditching, the procedures set forth in Figure 12-12 should be observed.

Note

In the event of ditching and sinking in water when immediate escape is impossible, it is possible for the crewmember to survive underwater with oxygen equipment until escape can be made. The oxygen regulator is a suitable underwater breathing device since the regulator is always on 100-percent oxygen. It is essential that the mask be tightly strapped in place.

12.16 OPERATIONAL EMERGENCIES

12.16.1 Pilot/RIO Emergency Communications. Provided that the aircraft intercom system is in working order, it is assumed that any communication required between the pilot and RIO concerning any emergency will be carried out on the intercom. If the intercom is inoperative for any reason, the following procedures will be utilized:

1. Check microphone and earphone plugs.

2. Check upper block connections.

3. Use emergency ICS and emergency radio positions in conjunction with the override switch.

4. Try intercommunication with UHF transceiver.

5. Check all circuit breakers.

If conditions are suitable:

6. Remove mask and shout.

12.16.1.1 Pilot/RIO Attention Signals. The following may be used as pilot/RIO attention signals under emergency conditions with no method of communicating:

WARNING
THE AIRCRAFT SHOULD BE DITCHED ONLY WHEN ALL OTHER ATTEMPTS OF EGRESS HAVE FAILED.

CREW MEMBER	DUTIES BEFORE IMPACT	POSITION	DUTIES AFTER IMPACT	EQUIPMENT	EXIT
PILOT	1. RIO–ALERT. 2. Make radio distress call. 3. IFF–EMERGENCY 4. External stores–JETTISON. 5. Landing Gear–UP. 6. Wing Flaps–DOWN. 7. Arresting Hook–DOWN. 8. Leg restraint release handle–PULL AFT. Release leg restraint lines before ditching to expedite egress from the cockpit. 9. Visor–DOWN. 10. Oxygen mask or face visor–TIGHTEN or SEAL. 11. Canopy–JETTISON (forward canopy first). **Note** In the event of a ditching following such situations as catapult shots or bolters, attempt to jettison the canopy prior to hitting the water. Once the aircraft is immersed under water the canopy might not jettison until water introduced by the folloding doors equalize pressures between the inside and outside of the canopy, an event which would occur at a considerable water depth. 12. Lower seat, assume position for ditching. 13. Shoulder Harness–LOCK. 14. Fly parallel to swell pattern. 15. Attempt, to touch down along wave crest. 16. When hook contacts water– SHUT DOWN ENGINES.	1. In Seat. 2. Feet on rudder pedals knees flexed.	1. Lower ejection handle Guard–UP 2. Shoulder harness release fittings– RELEASE 3. Emergency restraint release handle – PULL. 4. Stand straight up without twisting to release survival kit sticker clips from the seat. **Note** The Bail–Out Bottle will actuate when the crewmember stands up. In the event of ditching and sinking in water when immediate escape is impossible, it is possible to survive under water with oxygen equipment or full pressure suit until escape can be made. 5. Abandon aircraft. **WARNING** Should aircraft be abandoned under water, exhale while ascending to the surface to prevent bursting of lungs due to pressure differential between lungs and outside of body. 6. Inflate life vest. 7. See that RIO is clear. 8. Inflate life raft and secure Emergency equipment. 9. Proceed away from aircraft and tie rafts together.	1. One man raft and Emergency equipment. 2. Life vest 3. Flash light.	Over canopy sill.
RADAR INTERCEPT OFFICER	1. Acknowledge pilots ditching order. 2. Radar equipment–STOW. 3. Leg restraint release handle–PULL AFT. Release leg restraint lines before ditching to expedite egress from the cockpit. 4. Visor–DOWN. 5. Oxygen mask or face visor– TIGHTEN or SEAL. 6. Canopy–JETTISON (Aft canopy last). **Note** In the event of a ditching following such situations as catapult shots or bolters, attempt to jettison the canopy prior to hitting the water. Once the aircraft is immersed under water the canopy might not jettison until water introduced by the flooding doors equalize pressures between the inside and outside of the canopy, an event which would occur at a considerable water depth. 7. Lower seat, assume position for ditching. 8. Shoulder Harness–LOCK.	1. In Seat. 2. Feet on deck knees flexed.	7. Same as for Pilot Except: See that Pilot is clear.	1. One man raft and Emergency equipment. 2. Life vest. 3. Flash light.	Over canopy sill.

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Figure 12-12. Ditching

1. The pilot will attract the RIO's attention by a rapid rocking of the wings.

2. The RIO will attract the pilot's attention by slamming home his radarscope to the stow position or actuate the hand control to the limits of the antenna.

3. Acknowledgement of the attention signals will be a thumbs-up and future communications will be conducted by visual signals.

HEFOE signals (Figure 12-14) may be utilized by the pilot and RIO. As the RIO is always flying with the left side of the curtain of his hood open, the pilot will be signaling over his left shoulder and looking in his left mirror for the return signals. The same signals will apply at night except that a flashlight must be held up to outline the fingers. If the RIO upper block is unplugged as indicated by the four-finger signal, the pilot will maintain a cockpit altitude of 10,000 feet or below for the duration of the flight. If the RIO desires an immediate landing, he will give a thumbs-down signal to the pilot.

12.16.2 Downed-Plane Procedures

12.16.2.1 Declaration of an Emergency. When flying without a wingman or section leader, it is critically important that the pilot advise someone of his trouble and location. Even a deferred emergency can develop into a first-rate emergency. The initial radio contact should be preceded with the word PAN when the situation requires urgent action, but is not an actual distress; the word MAYDAY should be used when threatened by serious or imminent danger and immediate assistance is required. If a serious emergency has arisen, shift immediately to EMERGENCY IFF; set up SIF mode 3, code 77; place UHF to GUARD; and broadcast MAYDAY. The following information should be relayed to a ground station immediately:

1. PAN or MAYDAY (depending upon situation)

2. Identification

3. Model aircraft

4. Position

5. Situation

6. Intentions.

12.16.2.1.1 Single Aircraft. If the situation permits, prior to ejection or crash landing:

1. Switch IFF to EMERGENCY.

2. Transmit MAYDAY over guard channel.

Conditions existing following ejection or crash landing will dictate whether to remain near the scene of the crash or attempt to find assistance.

12.16.2.1.2 Section. If one member of a section goes down, the other member should:

1. Establish contact with a ground station, preferably a GCI site or radar control agency. Switch IFF to EMERGENCY and UHF to GUARD.

2. Make every effort to follow the other aircraft or crew during descent. It is of primary importance to keep the crew in sight at all times while on the ground or in the water. Note, as accurately as possible, bearings, distances from known prominent landmarks, or navigational aids in order to direct rescue planes or boats to the scene.

3. Establish a RESCAP.

4. Maintain sufficient altitude to assure radio contact with the rescue facility.

5. Leave the area with sufficient fuel to positively ensure return to base or alternate field.

12.16.2.1.3 Division. Everything mentioned earlier holds true if there are more than two members to the flight. Some additional procedures can be followed which will ensure a greater likelihood of a successful rescue. The other member of the section in which the downed crew has been flying should:

1. Follow the aircraft/crew and circle them at low altitude, making every effort to keep the downed crew in sight.

Other members of the flight:

1. Remain at altitude.

2. Alert appropriate facilities.

3. Relay communications.

4. Conserve fuel.

12.16.3 Navigation/Communication Emergency Procedures. These procedures deal with communication emergencies. Other types of emergencies where navigation and communication aids are available should be handled according to the individual circumstances under which they arise and as the factors involved indicate. An aircraft with running lights flashing usually indicates that an emergency condition exists.

12.16.3.1 Lost Aircraft (Without Navigation Aids). The pilot will have navigated to best position by dead reckoning. The following procedures will apply.

12.16.3.1.1 With Radio Receiver

1. Fly a minimum of two triangular patterns to the right with 1-minute legs. Repeat pattern at 20-minute intervals.

2. Conserve fuel and maintain altitude.

3. Squawk appropriate mode and be alert for aircraft vectored to join.

12.16.3.1.2 Without Radio Receiver

1. Fly a minimum of two triangular patterns to the left with 1-minute legs. Repeat pattern at 20-minute intervals.

2. Conserve fuel and facilitate radar pickup by maintaining highest feasible altitude consistent with situation.

3. Squawk appropriate mode and be alert for aircraft vectored to join.

4. After joining, inform healthy aircraft of all emergency conditions by appropriate hand signals in order to prevent separation during penetration/letdown.

12.16.3.2 No Radio Aircraft (With Navigation Aids)

1. Proceed to alternate marshal.

2. Energize I/P function at least once each minute.

3. Commence penetration/letdown at EAC as briefed.

4. Be alert for aircraft vectored to join.

5. If immediate assistance is required, energize emergency IFF.

12.16.3.3 Penetration/Letdown Navigation/Communication Emergencies. Even though communication aids have failed, if navigation equipment is still available:

1. Continue approach.

Regardless of weather, any jet aircraft having passed platform must continue its approach.

2. If no contact has been made after 2 minutes past individual expected ramp time, conduct lost aircraft (without navigation aids and without radio receiver) procedures.

If all communication and navigation equipment is lost, and last known weather at the ship was 800 feet with 2 miles visibility or better:

1. Continue approach by dead reckoning.

2. Maintain dead reckoning until 2 minutes past individual expected ramp time.

3. Conduct lost aircraft (without navigation aids and without radio receiver) procedures.

If last known weather at ship was below 800 feet with 2 miles visibility or better:

1. Level off.

2. Conserve fuel.

3. Execute a one-half standard rate timed turn to a heading of 90° to the right of previous penetration heading.

4. Maintain new heading for 2 minutes.

5. Conduct lost aircraft (without navigation aids and without radio receiver) procedures.

12.16.3.4 Landing Without UHF Communications (Escorting Wingman). Exact procedures to be followed in the event one aircraft in a flight experiences communication failures must be covered in detail on every preflight brief. In general, the following procedures are recommended for the approach and landing:

1. Escorting aircraft determine the escorted (no radio) aircraft fuel state through hand signals.

2. Escorting aircraft determine escorted aircraft UHF guard and auxiliary receiver status.

3. Escorting aircraft establishes flight for a straight-in approach, extends gear and flaps/slats through hand signals, and passes the lead to the escorted aircraft after clearance to land is received.

4. Passing of the lead should ideally be done at about 1 mile from touchdown. At this time, the flight should be lined up with the runway with the proper rate of descent established.

12.16.4 Section Carrier-Controlled Approach. Should a section approach become necessary because of radio or instrument failure:

1. Place a wingman on right side prior to commencing descent.

2. Reduce speed to 145 knots during last part of final approach so as to be approximately on speed when meatball is sighted.

3. Indicate meatball to wingman (blink external lights at night) to indicate carrier in sight.

4. Wingman will continue approach and land.

5. Leader will make definite turn to port and parallel final bearing in order to be in position should wingman bolter.

6. Following the wingman trap/bolter, the leader will execute the normal CCA waveoff procedure and be vectored in for an additional section approach or final landing.

12.16.5 Carrier Emergency Navigation/Communication Signals. Refer to CV NATOPS Manual.

12.17 OUT-OF-CONTROL/SPIN RECOVERY

12.17.1 Out-of-Control Recovery

*1. Smoothly apply forward stick to reduce angle of attack (full forward if necessary), simultaneously neutralizing aileron and rudder, and reducing pow to idle (altitude permitting).

*2. If positive indications of recovery are not obvious after full forward stick application, deploy the drag chute while maintaining full forward stick and neutralize ailerons and rudder.

*3. Do not exceed 19 units AOA (F-4J) or 25 units AOA (F-4S) during dive pullout.

Note

Engine flameouts may occur during departure; however, engine relights can be obtained with the throttles at idle even during a developed spin. Disengage the AFCS if in use.

12.17.2 Spin Recovery

*1. Positively determine spin direction.

*2. Maintain full forward stick and neutral rudder and apply full aileron in the direction of the spin (right turn needle deflection, right spin, right aileron).

*3. When the aircraft unloads (negative g) and/or yaw rate stops, neutralize the ailerons and fly out of the unusual attitude.

*4. Do not exceed 19 units AOA (F-4J) or 25 units AOA (F-4S) during dive pullout.

*5. If still out of control at 10,000 feet AGL – EJECT.

12.17.3 Inverted Spin Recovery

*1. Positively determine spin direction.

*2. Full rudder against the spin (opposite the turn needle deflection).

*3. Stick and ailerons neutral.

*4. When the yaw rate stops, neutralize all controls and fly out of the unusual attitude.

*5. Do not exceed 19 units AOA (F-4J) or 25 units AOA (F-4S) during recovery.

*6. If still out of control at 10,000 feet AGL – EJECT.

12.18 TAKEOFF EMERGENCIES

12.18.1 Abort. The decision to abort a takeoff must be based on the type of emergency and the parameters of runway remaining, distance required to stop, and arresting gear capability. If your speed is above the computed maximum abort speed from Part XI, yet within arresting gear limits, the seriousness of the emergency and your good judgement will dictate whether to abort or continue the takeoff. When takeoff is aborted, engagement of arresting gear is recommended to prevent overrun. The taxi light may aid in locating the arresting gear at night. The aircraft is cleared to the arresting gear limits. Make an arrestment if a stopping problem exists (i.e., late abort, icy or wet runway, or loss of brakes). Lower the hook in time for it to extend fully (normally 1,000 feet before wire). Line up on runway centerline. Inform tower of your indication to engage gear. At high speed, avoid large pitch control inputs to prevent becoming airborne. When speed permits, maintain full aft stick for aerodynamic braking and to decrease the probability of stabilator and crossdeck pendant contact.

*1. Throttles – IDLE.

*2. Hook – DOWN.

*3. Chute – DEPLOY.

4. Brakes – RELEASE 100 FEET BEFORE WIRE.

5. Engage wire in center at 90°.

12.18.2 Blown Tire on Takeoff. A situation may occur when the main wheel tire(s) or nosewheel tire(s) blow on takeoff roll. If the nosewheel tire(s) blow on takeoff, it is likely that one or both engines will receive FOD.

If decision to stop is made:

*1. Abort.

*2. Nose gear steering – ENGAGE (rudder centered).

*3. Antiskid – DISENGAGE.

Release brakes before disengaging antiskid to prevent blowing good tire.

4. Use opposite braking to slow and for directional control.

5. Flaps/slats – LEAVE AS SET.

Leave flaps/slats in takeoff position to prevent additional damage to flap seals if they were damaged by pieces of tire.

If takeoff is continued:

*1. Leave gear down and flaps/slats set for takeoff.

Leave the landing gear extended to preclude fouling the blown tire(s) in the wheel well(s). Leave flaps/slats in their takeoff position to prevent additional damage to flap seals in the event they have been damaged by pieces of broken tire.

2. Monitor engine instruments.

If any abnormal indications, such as rpm, EGT, or engine vibrations are noted, it is possible that FOD is present.

3. Plan to make a short-field arrested landing.

Refer to paragraph 12.15.3, SHORT-FIELD ARRESTMENT.

12.18.3 Aircraft Settling Off Catapult. Off the catapult, an engine failure, flap retraction, or BLC loss will cause the aircraft to settle and the pilot cannot troubleshoot to determine the specific cause. If the settling cannot be rapidly arrested, the only solution is an immediate ejection. If there is time, the following procedures provide the optimum method for controlling a settle when the cause is unknown.

If aircraft is uncontrollable:

*1. Eject immediately.

If time permits:

*1. Throttles – MAXIMUM AFTERBURNER.

*2. External stores – JETTISON.

*3. Gear -- UP.

*4. Flaps/slats – 1/2-OUT ABOVE 180 KNOTS.

*5. Flaps/slats – UP-NORM ABOVE 200 KNOTS.

6. Climb to safe altitude and investigate.

MALFUNCTION AND EMERGENCIES

TYPE OF EMERGENCY	SIGNAL		RESPONSE	
	DAY	NIGHT	DAY	NIGHT
I am in trouble, I want to land immediately.	Arm bent across forehead, followed by landing motion with open palm.	Circular motion of flashlight shined at other aircraft.	Carry out squadron doctrine of escort for disabled planes. Assume lead if indicated, and return to base or nearest suitable field.	
Are you having difficulty?	Point to pilot and give series of thumb down movements.	Flash a series of dots using exterior lights.	Thumb up, I am all right. Thumb down, I am having trouble.	Lights off once then on steady, I am all right. Lights flashing, I am having trouble
Initiation of "HEFOE" code.	Clench fist held to top of canopy.	Hold flashlight to top of canopy with steady light pointed at wingman, then flash exterior lights in accordance with code listed below.	Repeat signal to show acknowledgement.	

"HEFOE" SIGNALS

TYPE OF EMERGENCY	SIGNAL		RESPONSE	
	DAY	NIGHT	DAY	NIGHT
Hydraulic trouble.	One finger extended upward.	One flash of exterior lights.	Nod of head (I understand)	Series of Flashes (I understand)
Electrical trouble.	Two fingers extended upward.	Two flashes of exterior lights.	Nod of head (I understand)	Series of Flashes (I understand)
Fuel trouble.	Three fingers extended upward.	Three flashes of exterior lights.	Nod of head (I understand)	Series of Flashes (I understand)
Oxygen trouble.	Four fingers extended upward.	Four flashes of exterior lights.	Nod of head (I understand)	Series of Flashes (I understand)
Engine trouble.	Five fingers extended upward.	Five flashes of exterior lights.	Nod of head (I understand)	Series of Flashes (I understand)

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Figure 12-13. Emergency Visual Communications

FLIGHT CONDITION		INDICATED AOA-UNITS F-4J	F-4S
CATAPULT		F-4J	F-4S
Transition From Catapult (Gear Down)		21.0	21.0
(Gear Up)		18.0	18.0
MILITARY THRUST CLIMB			
Drag Index 0	Sea level	5.5	5.5
	combat ceiling	7.6	9.5
Drag Index 120	Sea level	7.6	8.0
	combat ceiling	8.5	10.0
MAXIMUM THRUST CLIMB			
All Drag Indexes	Sea level	5.0	4.5
	combat ceiling	9.2	11.5
CRUISE AT ALTITUDES BELOW 20,000 FT. (all gross weights)			
Drag Index – 0		5.8	7.5
Drag Index 130		8.0	9.5
CRUISE AT OPTIMUM ALTITUDE			
Drag Index 0		6.9	9.0
Drag Index 130		8.0	10.5
ENDURANCE AT OPTIMUM ALTITUDE			
Drag Index 0		7.9	9.0
Drag Index 130		9.3	12.0
DESCENTS (low to medium gross weight)			
250 KCAS, idle thrust		8.5	9.5
300 KCAS, 80% rpm		6.5	–
GEAR AND FLAPS EXTENSION			
Safe Gear Extension (with flaps up)		9.0	9.5
Safe Flap Extension (with gear down and corner reflector retracted)		13.0	12.0
(with gear down and corner reflector extended)		12.3	11.0
STALL WARNING (pedal shaker)		20.6	20.6
F-4J before AFC 388		21.3	–
F-4S after AFC 644/AVC 2494 and Amend 1		21.5	–
STALL			
Gear Down, Flaps Down, (with corner reflector retracted)		24.0	* 22.5
Gear Down, Flaps Down (with corner reflector extended)		23.3	* 22.5
Gear Down, 1/2 Flaps (with corner reflector retracted)		24.5	* 22.5
Gear Down, 1/2 Flaps (with corner reflector extended)		23.8	* 22.5
Gear Down, Flaps Up (with corner reflector retracted)		30.0	* *
Gear Down, Flaps Up (with corner reflector extended)		29.3	* *
Gear Up, Flaps Down		21.5	* 20.5
Gear Up, 1/2 Flaps		22.0	* 20.5
Gear Up, Flaps Up		27.0	* *
APPROACH			
CCA GCA Pattern (200 KCAS, gear up, half flaps)		9.5	8.5
Final ON SPEED approach (gear down, all engine flap configurations)		18.3	18.3
F-4J before AFC 388		19.0	–
F-4S after AFC 644/AVC 2494 and Amend 1		19.0	–

- Due to the basic inaccuracy of setting up flight conditions (other than landing approach) by reference to the angle of attack indicator, the information included in this table should be used only in an emergency situation.
- The ranges shown for angle of attack versus drag index, while not entirely linear, may be interpolated linearly for practical purposes.

* Pitch-up occurs at these angles of attack; however, the aircraft is responsive to control imputs up to 30 units AOA.

* * Not defined – Flight may be safely conducted to 30 units AOA.

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Figure 12-14. Airspeed Indicator Failure

WHEELS	FLAPS DOWN-GEAR UP	LOWER LANDING GEAR OR RAISE FLAPS TO EXTINGUISH LIGHT	AN ILLUMINATED WHEELS LIGHT WITH THE FLAPS SWITCH UP AND THE GEAR HANDLE UP SHOULD BE TREATED AS A BLC MALFUNCTION.
FIRE OVERHT	FIRE OR OVERHEAT CONDITION EXISTS IN INDICATED ENGINE COMPARTMENT	CARRY OUT EMERGENCY PROCEDURE	LIGHT INDICATES TEMPERATURE IN EXCESS OF 765° F IN AFFECTED ENGINE COMPARTMENT.
MASTER CAUTION	SOME SYSTEM HAS A CAUTION CONDITION	CHECK TELELIGHT PANEL.	LIGHT ILLUMINATES WITH LIGHTS ON THE TELELIGHT PANEL EXCEPT: ● L/R/CTR EXT FUEL. ● REFUEL READY ● SPEEDBRAKES OUT.
L. ENG OIL LOW R. ENG OIL LOW	CORRESPONDING ENGINE OIL CAPACITY IS LOW	CARRY OUT EMERGENCY PROCEDURE	THESE LIGHTS INOPERATIVE WITH J–79–8 ENGINES BEFORE PPC 62.
L WING PIN UNLOCK R WING PIN UNLOCK	WING(S) IS UNLOCKED.	WING PIN HANDLE--LOCKED.	MAY BE NECESSARY TO RECYCLE THE WING FOLD SYSTEM.
L ANTI-ICE ON R ANTI-ICE ON	SWITCH ON – NORMAL INDICATION.	INFO ONLY.	SWITCH OFF: ● IF LIGHT GOES OUT, ACCELERATE AND DISREGARD INDICATION. ● IF LIGHT STAYS ON, REMAIN AT REDUCED SPEED.
	SWITCH OFF – ERRONEOUS INDICATION	REDUCE SPEED.	
IFF	MODE 4 FAILED		THIS LIGHT IS INOPERATIVE UNTIL MODE 4 IS MADE OPERATIVE
L AUX AIR DOOR R AUX AIR DOOR	DOOR(S) OUT OF PHASE WITH GEAR HANDLE.	CARRY OUT PRESCRIBED EMERGENCY PROCEDURES AS NECESSARY.	DISREGARD MOMENTARY LIGHT.
ALT ENCODER OUT	UNRELIABLE SIGNAL OR NO SIGNAL FROM ALTITUDE ENCODER UNIT	NONE–INFO ONLY	IF LIGHT STAYS ON: PERFORM THIS FUNCTION THROUGH VOICE COMMUNICATION.
IFR PROBE UNLOCKED	NORMAL INDICATION WITH PROBE EXTENDED.	INFO ONLY.	CYCLING PROBE WHEN OPERATION RESULTS IN AN INTERMEDIATE POSITION OR WHEN PROBE DOOR DAMAGE IS SUSPECTED MAY RESULT IN PROBE DOOR SEPARATION.
	PROBE IN INTERMEDIATE POSITION OR UNLOCK LIGHT ILLUMINATES WITH RETRACT SELECTED	LEAVE REFUEL PROBE SWITCH AS SET. DO NOT CYCLE PROBE. REMAIN BELOW 300 KCAS/.91 IMN.	
CHK FUEL FILTERS	ONE OR BOTH FUEL FILTERS ARE PARTIALLY CLOGGED.	NONE – INFO ONLY	LOG ON YELLOW SHEET (OPNAV 3760-2). MONITOR ENGINE OPERATION
REFUEL READY	FUSELAGE PRESSURIZATION AND VACUUM RELIEF VALVE OPEN	NONE – INFO ONLY	INDICATES THAT FUSELAGE TANKS ARE PROPERLY VENTED FOR REFUELING.
CABIN TURB OVERSPEED	TURBINE SUBJECTED TO EXTREME PRESSURE AND/OR TEMPERATURE.	● REDUCE THRUST. ● REDUCE SPEED.	IF LIGHT STAYS ON: ● EMERGENCY VENT KNOB–PULL
W'SHIELD TEMP HIGH	WINDSHIELD IS OVERHEATED.	● RAIN REMOVAL SWITCH – OFF. ● EMER. VENT KNOB–PULL (IF NECESSARY)	INTERMITTENT ILLUMINATION DURING HIGH MACH FLIGHT, RAIN REMOVAL SYSTEM OFF, IS NORMAL.
CORNER REF L OUT	CORNER REFLECTOR EXTENDED	DO NOT EXCEED 250 KCAS	CORNER REFLECTOR EXTENDED AND THE NOSE LANDING GEAR IS UP
L EXT FUEL CTR EXT FUEL R EXT FUEL	● TANK IS EMPTY. ● FUEL FLOW HAS STOPPED. ● TANK IS FULL (DURING AIR REFUELING) ● MERS INSTALLED AND AUTOMATIC FUEL TRANSFER CIRCUIT ENERGIZED.	NONE – INFO ONLY	INTERMITTENT ILLUMINATION DURING FUEL TRANSFER IS NORMAL.
PRIMARY GYRO OFF	PRIMARY ATTITUDE REFERENCE IS UNRELIABLE	SELECT STBY ON THE REFERENCE SYSTEM SELECTOR KNOB	MALFUNCTION HAS OCCURRED IN THE AN/ASN-70 VERTICAL FLIGHT REFERENCE SET USE AN/AJB-7 ATTITUDE REFERENCE

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Figure 12-15. Warning Indicator Lights (Sheet 1 of 2)

LIGHT	CAUSE	CORRECTIVE ACTION	REMARKS
RADAR LIQ COOL OVERHT	LIQUID COOLANT TEMP ABOVE 145 ± 5°F	NONE	IF LIGHT ILLUMINATES SELECT A RADAR LOW HEAT MODE
RADAR-CNI COOL OFF	EQUIPMENT COOLING TURBINE SHUTDOWN	● AIRSPEED - REDUCE ● WAIT 15 SECONDS ● CHECK THE AOA PROBE HEATER CIRCUIT BREAKER IN ● RESET - PUSH	IF LIGHT STAYS ON: ● REMAIN AT REDUCED AIR SPEED TO PREVENT EQUIPMENT DAMAGE ● IFF & RADAR – STBY ● TACAN - OFF (BEFORE AFC 647)
AUTO PILOT PITCH TRIM	PITCH TRIM CIRCUIT IS NOT FUNCTIONING	● STICK – GRASP FIRMLY ● AUTOPILOT – DISENGAGE	DISREGARD A MOMENTARY LIGHT
BLC MALFUNCTION	● FLAPS/SLATS ARE UP–NORM AND AT LEAST ONE BLC VALVE IS OPEN ● FLAPS/SLATS ARE 1/2–OUT AND TRAILING EDGE BLC VALVE IS OPEN	● REDUCE SPEED BELOW 200 KTS ● FLAPS/SLATS DN–OUT	CONTINUED FLIGHT WITH FLAPS/SLATS UP–NORM AND LIGHT ON MAY RESULT IN ELECTRICAL HYDRAULIC AND STRUCTURAL DAMAGE TO AIRCRAFT
ENG INLET TEMP HIGH	INLET TEMPERATURE IS ABOVE 121°C	BELOW 30,000 FEET – REDUCE SPEED BELOW MACH 1.0	ABOVE 30,000 FEET – 5 MIN. PER HOUR (NONCUMULATIVE)
AUTO PILOT DISENGAGE	AUTOPILOT HAS DISENGAGED	AUTOPILOT – RE-ENGAGE IF PRACTICAL	NONE
OXYGEN LOW	SUPPLY DEPLETED TO 1 LITER	DESCEND TO SAFE ALTITUDE	REFER TO OXYGEN DURATION TABLE
SPEED BRAKE OUT	SPEED BRAKES ARE NOT CLOSED	NONE – INFO ONLY	MASTER CAUTION WILL NOT ILLUMINATE
PITCH AUG OFF	PITCH STAB AUG IS DISENGAGED	NONE – INFO ONLY	ILLUMINATES ANY TIME BUSES ARE ENERGIZED AND PITCH STAB AUG IS DISENGAGED
FUEL LEVEL LOW	1880 ± 200 POUNDS (JP-5) TOTAL FUEL REMAINING IN CELLS 1 & 2	NONE – INFO ONLY	CHECK ALL FUEL TRANSFERRED TO THE FUSELAGE
TANK 7 FUEL	FUSELAGE CELL 7 TRANSFER VALVE HAS FAILED TO OPEN WHEN FUEL LEVEL LOW LIGHT ILLUMINATES	INFO ONLY	FUSELAGE CELL 7 TANK WILL NOT BE AVAILABLE AND THE FUEL QUANTITY COUNTER WILL READ APPROX. 700 POUNDS HIGH
TANK 7 EMPTY	FUSELAGE CELL 7 IS EMPTY	INFO ONLY	LIGHT CAN BE EXTINGUISHED BY DEPRESSING THE MASTER CAUTION RESET BUTTON
APCS OFF	APCS IS DISENGAGED	NONE – INFO ONLY	ILLUMINATES ANYTIME BUSES ARE ENERGIZED AND APCS BECOMES DISENGAGED.
CHK HYD GAGES	PRESSURE BELOW 1500 ± 100 PSI IN ANY SYSTEM	ANALYZE SITUATION	CARRY OUT PRESCRIBED EMERGENCY PROCEDURES
STATIC CORR OFF	AIR DATA COMPUTER MALFUNCTION	● AUTOPILOT – DISENGAGED ● STATIC COMPENSATOR SWITCH – RESET.	IF LIGHT STAYS ON: ● STATIC COMPENSATOR SWITCH – CORR OFF ● USE INSTRUMENT POSITION CORRECTION DATA AS NECESSARY
CANOPY UNLOCKED	FORWARD, AFT OR BOTH CANOPIES ARE UNLOCKED	CARRY OUT PRESCRIBED EMERGENCY PROCEDURE AS NECESSARY	INSURE ADEQUATE PNEUMATIC PRESSURE FOR PROPER CANOPY OPERATION
RADAR COOL DIV CLOSED	AIR DIVERTER CLOSED	NONE	IF LIGHT ILLUMINATES DURING FLIGHT: SELECT A RADAR LOW HEAT MODE
ANTI-SKID INOPERATIVE	ANTI-SKID IS NOT ENGAGED OR HAS MALFUNCTIONED	ANTI-SKID SWITCH – ON	LIGHT ON AND SWITCH ON: CARRY OUT PRESCRIBED EMERGENCY PROCEDURE. DISREGARD MOMENTARY LIGHT
FUS BLEED AIR OVERHT	TEMPERATURE IN EXCESS OF 410°F EXISTS IN FORWARD FUSELAGE AREA.	● REDUCE POWER ● BLEED AIR SWITCH – OFF	● MASTER CAUTION ILLUMINATES ● CONTINUED OPERATION WITH LIGHT(S) ON MAY RESULT IN EQUIPMENT DAMAGE ● SEE BLEED AIR OFF LIGHT
ENG BLEED AIR OVERHT	TEMPERATURE IN EXCESS OF 575°F EXISTS IN KEEL WEB AREA		
WING BLEED AIR OVERHT	TEMPERATURE IN EXCESS OF 410°F EXISTS IN WING L. E.		
BLEED AIR OFF	BLEED AIR SHUTOFF VALVE IS CLOSED	NONE – INFO ONLY	● LOSS OF L.E. BLC, FUEL PRESSURIZATION, PNEUMATIC SYSTEM CHARGING, CABIN AND EQUIPMENT REFRIGERATION AND SPC ● LANDING SPEED INCREASES 7 KNOTS (F-4J ONLY)
COUPLER OFF	DATA LINK COUPLER HAS DISENGAGED	ASSUME MANUAL CONTROL OF AIRCRAFT	INDICATES UNRELIABLE DATA LINK CONTROL SIGNALS OR INTENTIONAL DISENGAGEMENT
SLATS MANUAL	SLATS OVERRIDE SWITCH NOT IN NORM	INFO ONLY	MASTER CAUTION WILL NOT ILLUMINATE
FLAPS UP	FLAPS NOT DOWN	INFO ONLY	MASTER CAUTION WILL NOT ILLUMINATE.

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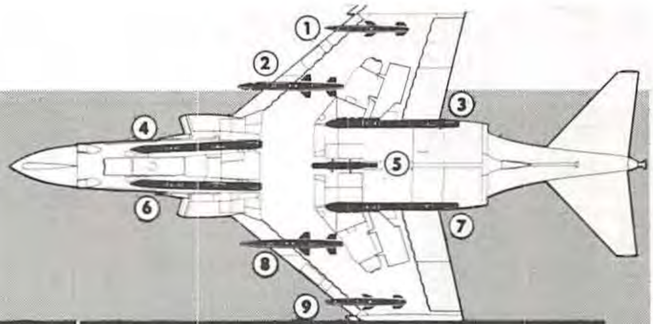
Figure 12-15. Warning Indicator Lights (Sheet 2 of 2)



* WEIGHT MUST BE OFF GEAR
† MISSILES MOUNTED ON FUSELAGE STATIONS 4 AND 6 CANNOT BE JETTISONED IF A 600-GALLON TANK, BUDDY TANK OR MER IS INSTALLED ON CENTERLINE STATION 5.
†† ARMAMENT SAFETY OVERRIDE SWITCH BYPASSES THE GEAR HANDLE SWITCH AND ALLOWS RELEASE WITH GEAR HANDLE DOWN.

EXTERNAL STATION	GEAR HDLE. POSITION	METHOD OF RELEASE
1 thru 9	UP or DOWN*	EXTERNAL STORES EMERG RELEASE BUTTON - **DEPRESS** 2
1 & 9	UP or DOWN	EXTERNAL (WING) TANKS JETTISON SW. - **JETT**
2 & 8	UP or DOWN	MISSILE JETTISON SELECTOR SW. - **APPROPRIATE STA (L. WING, R. WING)** MISSILE JETTISON SELECTOR SW. - **PUSH**
3, 4 †, 6 † & 7	UP or DOWN	MISSILE JETTISON SELECTOR SW. - **APPROPRIATE STATION (L. FWD, R. FWD L. AFT, R. AFT)** MISSILE JETTISON SW. - **PUSH**
2,3,4 †,6 †,7 & 8	UP or DOWN	MISSILE JETTISON SELECTOR SW. - **ALL** 1 MISSILE JETTISON SELECTOR SW. - **PUSH**
5	UP ††	CENTERLINE STATION SAFE SW. - **READY** BOMB CONTROL SW. - **DIRECT** WEAPONS SW. - **CONV OFF-NUCL ON** BOMB / ℄ STORE RELEASE BUTTON - **DEPRESS**

1 THE ALL POSITION OF THE MISSILE JETTISON SELECTOR SW IS ELIMINATED ON F-4J AIRCRAFT 153900af AND UP OR AFTER AFC 346 AND ALL F-4S. HOWEVER, ON AIRCRAFT PRIOR TO 153900af, EITHER THE FORMER ALL POSITION OR THE R AFT POSITION CAN BE USED TO JETTISON THE RIGHT AFT FUSELAGE MISSILE, BUT ON 153900af AND UP ONLY THE R AFT POSITION CAN BE USED.

2 ON F-4J 158355af AND UP OR AFTER AFC 506 AND ALL F-4S, THE CHART BELOW LISTS STORES JETTISONED BY THE EXTERNAL STORES RELEASE BUTTON FOR EACH POSITION OF THE JETTISON SELECT SW.

	EXTERNAL STORES STATIONS					
JETTISON SELECT SWITCH POSITION	LEFT OUTBOARD	LEFT INBOARD	CENTER-LINE	RIGHT INBOARD	RIGHT OUTBOARD	FUSELAGE MISSILES
ALL	X	X	X	X	X	X
AIR-GRD	X	O	⊙	O	X	
AIR-GRD+CL	X	O	X	O	X	

X - DENOTES JETTISONING OF STORE AND ITS ASSOCIATED JETTISONABLE ARMAMENT ATTACHMENT (PYLONS, MERS, ETC.). THE WORD STORE DENOTES NON-WEAPON ITEMS, SUCH AS FUEL TANKS, AS WELL AS WEAPONS.
⊙ - STORE RETAINED ON CENTERLINE.
O - JETTISONING FROM INBOARD WING STATIONS DEPENDS ON LOADING AS SHOWN BELOW.

LOADING	LEFT INBOARD	RIGHT INBOARD	JETTISON
1	PYLON ONLY	PYLON ONLY	YES
2	TER	TER	YES
3	SIDEWINDER OR SPARROW	SIDEWINDER OR SPARROW	NO
4	SIDEWINDER OR SPARROW	EMPTY	NO
5	EMPTY	SIDEWINDER OR SPARROW	NO
6	SIDEWINDER OR SPARROW	SIDEWINDER/TER OR TER	ONLY TER
7	SIDEWINDER/TER OR TER	SIDEWINDER OR SPARROW	SUSPENDED
8	SIDEWINDER/TER	SIDEWINDER/TER	STORES JETTISONED

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Figure 12-16. External Stores Jettison

PART VI

All-Weather Operation

CHAPTER 13

All-Weather Operation

13.1 SIMULATED INSTRUMENT PROCEDURES

Instrument flight is primarily a problem of time and distance navigation wherein all or part of the flight is conducted under instrument conditions. To complete a successful instrument flight, crewmembers must be properly prepared and have conducted the necessary planning. All pilots will be current in latest instrument flight rules and regulations published by higher authority and, when operating aircraft under instrument flight conditions, will be guided by the current OPNAVINST 3710.7 and Federal air regulations.

13.1.1 Safety Precautions. It is the responsibility of the chase pilot to ensure that the flight is clear of other aircraft at all times.

The instrument pilot will not go hooded on departure until reaching a minimum of 2,000 feet above the terrain.

At a minimum of 500 feet above terrain, the instrument pilot will go contact on any hooded penetration or ground-controlled approach.

The chase pilot will conduct communication checks with the instrument pilot and receive an acknowledgement at 1-minute intervals below FL 240 and at 3-minute intervals above FL 240 if not under positive control.

If loss of radio contact occurs, the instrument pilot will immediately go contact and remain VFR until radio contact is reestablished. If necessary, the chase pilot will pass to the right and pull ahead/in front to attract the instrument pilot's attention to go contact. Lighting afterburner when passing the instrument pilot will usually get his attention.

Radio contact will be positively established immediately before and after any channel or frequency change.

Unless under positive control, the instrument pilot will call the indicated altitude at each 5,000-foot interval during descent and at level-off.

13.1.2 Chase Plane Procedures. The chase pilot duties on instrument flights are to act as lookout and to be a flight monitor. The best position for this is a loose tactical wing position where airspeed, attitude, and altitude may be monitored while maintaining a good lookout. During GCA approaches, the chase will fly a position as directed by GCA. This position is normally about 4 or 5 o'clock from the GCA aircraft, 500 feet away, and slightly stepped up.

After AFC 660, the chase aircraft will set up its radios in the following manner: the frequency in use set on UHF 1 and GD (guard) position selected on UHF 2. The instrument aircraft shall have UHF 1 mode switch set to BOTH in order to monitor the guard frequency. If the chase pilot suspects radio failure or cannot "burn through" transmissions by GDA or other controlling agencies, he can transmit instructions to the instrument pilot on guard channel.

13.1.2.1 Chase Plane Radio Procedure. The chase aircraft will set up its radios in the following manner: the frequency in use with communication command in one cockpit and the guard position set in the communication channel of the other cockpit. The instrument aircraft shall monitor the TR + G position. If the chase pilot suspects radio failure or cannot "burn through" transmissions by GCA or other controlling agencies, he can take command and transmit instructions to the instrument pilot on guard channel.

13.2 ACTUAL INSTRUMENT PROCEDURES

13.2.1 Instrument Flight. This is an all-weather aircraft designed to perform operational missions in all extremes of weather. Rapid acceleration rates and high pitch angles during climb of necessity dictate some modification or standard instrument procedures.

Note

Approach airspeeds listed in this part are suggested airspeeds only. Actual airspeeds should be determined by aircraft weight, AOA, and individual squadron SOP.

13.2.1.1 Instrument Flight Planning. On instrument flights, delays in departure and descent and low climb rates to altitude are often required in high density control areas. These factors make fuel consumption and flight endurance critical. All instrument flights should be carefully planned and consideration given to the additional time and fuel which may be required. A complete weather briefing for all pilots on the flights will be obtained and the appropriate flight plan will be filed.

13.2.1.2 Before Starting Engines. When practical, an ATC clearance should be obtained from the tower before starting engines. When operating on external power, all CNI equipment except the UHF and intercom are limited to 10 minutes of accumulated operation in a 1-hour span.

13.2.1.3 Before Takeoff. It is essential that the instrument and navigation equipment be thoroughly checked prior to takeoff. If a climb through precipitation or clouds is anticipated, place the pitot heat switch to ON and the engine anti-ice switch to DE-ICE. At idle rpm, the operation of the engine deicers can be checked by noting a slight rise (approximately 10 °C) in EGT and a slight increase in fuelflow. The ADI wing symbol should be set with the wings 1° above the horizon and the compass should be aligned with the runway heading. The stab aug should be engaged.

13.2.1.4 Instrument Takeoff. Instrument takeoff is same as normal takeoff.

13.2.1.5 Instrument Climb. The simplified climb technique described in Chapter 8 can be used with minimum sacrifice in fuel consumption and climb rates. Turns should be kept to a minimum during climb because of the difficulty of determining bank angles and rates of turn while at high pitch angles. Upon reaching clear air, turn off the engine anti-icing and the pitot heat. Follow the clearance exactly as given. If unable to comply with the clearance, it is mandatory that ATC be advised immediately. Climb speed will conform to local procedures, but should be a comfortable airspeed with transition to the published climb schedule accomplished at a comfortable altitude above the terrain.

13.2.1.6 Penetration Procedures. Three to five minutes prior to making a descent, the cabin temperature control should be set at the maximum comfortable level and the defog/footheat lever to the DEFOG position. Contact approach control 10 minutes prior to EAT or as directed by ARTC and conform to the provision of section 2, flight planning document. Three minutes prior to entering holding, adjust power to arrive at the holding fix with maximum endurance airspeed (265 KCAS maximum). Prior to descent, the pilot will check missed approached procedures and will obtain the latest weather information at the destination and at the alternate if required. Refer to paragraph 8.4.1, DESCENT/ INSTRUMENT PENETRATION.

13.2.1.7 Penetration With Gear and Flaps/ Slats Extended. Under certain conditions, it may be necessary to penetrate with the gear and flaps/slats extended. If such is the case, advise approach control that the approach will be executed with a nonstandard approach speed. Prior to commencing the approach, slow to below 250 knots and lower the landing gear and flaps/slats. If external tanks are carried, place the wing transfer switch to EMERG before extension of the landing gear to avoid depressurizing the fuel tanks. Commencing penetration, reduce the pitch attitude to maintain 195 knots. This attitude will seem extremely nose-low. Make throttle adjustments as necessary to maintain a 3,500 fpm rate of descent. Initiate a round-out in order to reach GCA pickup or tacan gate altitude at a speed of 150 to 160 knots. If the descent has been made with the wing transfer in the EMERG position, return the switch to NORMAL prior to landing.

13.2.1.8 Radar-Controlled Penetration. The approaches are basically the same as previously described with the following additions. The controlling activity will normally ask for turns or specific IFF squawks for positive identification. The controlling activity will advise turns or headings which will produce the desired flightpath. They will also advise as to distance from the destination and direct a descent to lower minimum altitudes as traffic and terrain permit.

13.2.1.9 GCA (PAR) Approaches. This aircraft handles exceptionally well in the GCA pattern. It is very stable directionally and is very responsive to minor corrections about all axes. When directed, descend to GCA pickup altitude and transition to landing configuration. Slow to 150 to 160 knots which will require approximately 88 to 92 percent. Trim required will be approximately three units noseup. When the pilot is told to commence a normal rate of descent for his aircraft, he should retard the power to approximately 82 to 84 percent. Allow the aircraft to slow to 145 KCAS minimum (section). If alone, adjust the nose to maintain 140 KCAS or a donut on the angle-of-attack indexer, whichever is greater. While holding the attitude constant, make smooth but positive power adjustments to maintain a desired rate of descent of approximately 600 to 800 feet per minute or as directed. For heading corrections after starting descent, recommended bank angle is 10°. Up to 3° heading corrections may be made by using rudder alone. When the controller announces "minimums have been reached," the pilot will look up. If the runway is not in sight, he will immediately execute a missed approach. If the pilot has the runway in sight, he will adjust power to establish optimum angle of attack/airspeed and complete the landing.

13.2.1.9.1 GCA Box Pattern. To enter the GCA pattern from other than a penetration, contact approach control and proceed as follows. The downwind leg is flown at 230 to 250 knots with gear and flaps/slats retracted. The base leg is flown at 150 knots with gear and flaps down. After completing the turn on final and slowing to approach speed, the normal GCA procedures apply. If entering the GCA pattern after a touch-and-go landing, aircraft will comply with approach control instructions.

13.2.2 Turbulent Air and Thunderstorm Operation. Intentional flight through thunderstorms should be avoided unless the urgency of the mission precludes a deviation from course because of the high probability of damage to the airframe by impact ice, hail, and lightning. The radar provides an excellent means of navigating between or around storm cells and the aircraft is capable of climbing over the top of small and moderately developed thunderstorms.

13.2.2.1 Penetration. If necessary to penetrate, the basic structure of the aircraft is capable of withstanding the accelerations and gust loadings associated with the largest thunderstorms. The aircraft is exceptionally stable and comparatively easy to control in the severe turbulence; however, the effects of turbulence become noticeably more abrupt and uncomfortable at airspeeds above optimum cruise and below 35,000 feet. The aircraft is not displaced significantly from the intended flightpath and desired heading. Altitude, airspeed, and attitude can be maintained with reasonable accuracy.

13.2.2.1.1 Penetration Airspeeds. The optimum thunderstorm penetration speeds, based on pilot comfort, controllability, and engine considerations, are between optimum cruise and 280 knots below 35,000 feet, and no less than 300 knots above 35,000 feet. The afterburner should be utilized if necessary to maintain airspeed.

13.2.2.2 Approaching the Storm. If the storm cannot be seen, it may be located by radar. Adjust power to establish the recommended approach speed. Note stabilator trim position. Place the pitot heat switch to ON, the engine anti-ice switch to DE-ICE, and the autopilot OFF. The seat should be lowered in order to view the instruments and to minimize the buffeting because of turbulence. Do not try to top thunderstorms at subsonic speeds above 40,000 feet; the stall margin of both the airframe and engines becomes critical in this region. Flight through a thunderstorm at the proper airspeed and attitude is much more advantageous than floundering into the storm at a dangerously slow airspeed while attempting to reach the top. If the penetration is made at night, the daylight floodlights should be ON and the console and instrument lights should be full bright.

13.2.2.3 In the Storm. Maintain a normal instrument scan with added emphasis on the attitude gyro (ADI). Attempt to maintain a constant pitch attitude and, if necessary, accept moderate altitude and airspeed fluctuations. In heavy precipitation, a reduction in engine rpm may be necessary because of the increased thrust resulting from water ingestion. If compressor stalls or engine stagnation develops, attempt to regain normal engine operation by momentarily retarding the throttle to IDLE, then advance to the operating range. If the stall persists, shut down the engine and attempt to relight. If the engine remains stagnated at reduced power and the EGT is within limits, maintain reduced power until clear of the thunderstorm. While in the storm, the longitudinal feel trim, and angle-of-attack, total temperature, windshield overheat, static pressure correction, and cabin pressurization systems may experience some abnormalities because of rain, ice, or hail damage. No difficulty should be encountered in maintaining control of the aircraft; however, the rapid illumination of numerous warning lights may be somewhat distracting to the pilot if he is not prepared.

13.2.2.3.1 Longitudinal Feel Trim Failure. Longitudinal feel trim system failures are caused by ice blockage of the ram air bellows venturi located in the vertical fin. The failure is characterized by either a complete or intermittent failure of the feel system. The failure can also be verified by noting that the pointer on the stab trim indicator has moved from the previously noted position.

13.2.2.3.2 Angle-of-Attack System Failure. The angle-of-attack system may become temporarily inaccurate because of probe icing or it may permanently fail because of structural damage of the probe from ice or hail. Icing of the probe is usually characterized by a zero angle of attack indication which will return to normal in clear air. Structural damage may cause erroneous readings or fail the system completely.

13.2.2.3.3 Total Temperature System Failure. The total temperature sensor may fail because of water or ice damage. This failure is characterized by a flashing or steady ENG INLET TEMP HI light, erroneous true airspeed indications, and possible cycling of the engine intake ramps.

13.2.2.3.4 Windshield Overheat Sensor Failure. The windshield overheat sensor may fail in heavy rain or icing conditions. The failure is characterized by a steady W'SHIELD TEMP HIGH light.

13.2.2.3.5 SPC Failure. The SPC system will monitor off during thunderstorm penetrations between speeds of 0.93 to 1.0 Mach. Immediately prior to SPC disengagement, the altimeter, airspeed indicator, and vertical velocity indicator will be highly erratic. Attempts to reset the SPC in precipitation will usually be unsuccessful; however, the SPC can be reset for normal operation upon reaching clear air.

13.2.2.3.6 Cabin Pressurization System Failure. Cabin pressurization fluctuation occurs in precipitation above the freezing level. This is evidenced by a significant decrease in available cabin pressurization flow and is caused by ice at the pressure suit heat exchanger.

13.2.3 Ice and Rain. The possibility of engine and/or airframe icing is always present when the aircraft is operating under instrument conditions. Icing is most likely to occur when takeoffs must be made into low clouds with temperature at or near freezing. Normal flight operations are carried on above the serious icing levels, and the aircraft high performance capabilities will usually enable the pilot to move out of the dangerous areas quickly. When an icing condition is encountered, immediate action should be taken to avoid further accumulation by changing altitude and/or course and increasing the rate of climb or airspeed. When icing conditions are anticipated, actuate the engine anti-ice switch to DE-ICE and the pitot heat switch to ON.

13.2.3.1 Windshield Rain Removal. The following precautions must be observed when contemplating the use of the windshield rain removal system.

1. Do not operate on a dry windshield.

2. Turn system OFF immediately if W'SHIELD TEMP HIGH indicator light illuminates.

3. Do not operate above Mach 1.0.

13.2.3.2 Longitudinal Feel Trim. When flying through areas of precipitation, partial or complete failure of the longitudinal control artificial feel system may result because of ice and/or water blockage of the bellows ram air line. If this condition occurs, excessive stick force will be required to maintain the desired aircraft attitude. Since sudden longitudinal trim changes may occur several minutes after flying through freezing precipitation (especially during descent to altitudes below the freezing level), the application of corrective longitudinal trim when a blocked bellows inlet is suspected is not recommended.

13.2.3.3 Air Data Computer. The air data computer may malfunction during flight through ice and/or because of impact forces imposed by water and ice on the ADC total temperature sensor. A momentarily flashing ENG INLET TEMP HIGH warning light usually indicates that the sensor probe has been blocked or shorted by ice accumulation.

13.2.4 Hydroplaning. Operations on wet or flooded runways may produce three conditions under which tire traction may be reduced to an insignificant value.

1. Dynamic hydroplaning

2. Viscous hydroplaning

3. Reverted rubber skids.

13.2.4.1 Dynamic Hydroplaning. As the tire velocity is increased, the hydrodynamic pressure acting on the leading portion of the tire footprint will increase to a value sufficient to support the vertical load acting on the tire. The speed at which this occurs is called total hydroplaning speed. Any increase in groundspeed above this critical value lifts the tire completely off the pavement, leaving it supported by the fluid alone. Since the fluid cushion is incapable of sustaining any appreciable shear forces, braking and sideforce coefficients become almost nonexistent. Total hydroplaning speed of the main landing gear tires at 400 psi is 180 knots, the nose gear tire inflated to 150 psi is 110 knots.

13.2.4.2 Viscous Hydroplaning. Viscous hydroplaning occurs because of the inability of the tire to penetrate the very thin fluid film found under damp runway conditions. This condition is aggravated when more viscous fluids such as oil or road dust and water mixed are present and is improved in the presence of a coarse textured runway surface. Viscous hydroplaning occurs at medium to high speed with rolling or skidding tires, and the speed at which it occurs is not dependent on tire pressure.

13.2.4.3 Reverted Rubber Skids. Reverted rubber skids occur after a locked-wheel skid has started on wet runway. Enough heat may be produced to turn the entrapped water to steam. The steam in turn melts the rubber. The molten rubber forms a seal preventing the escape of water and steam. Thus, the tire rides on a cushion of steam which greatly reduces the friction coefficient and may continue to do so to very low speeds.

13.3 EXTREME WEATHER PROCEDURES

13.3.1 Cold-Weather Operation

13.3.1.1 Preflight. Check that the aircraft is free of frost, snow, and ice. These accumulations present a major flight hazard resulting in loss of lift and increased stall speeds. Do not allow ice to be chipped or scraped from the aircraft; damage to the airframe may result. Shock struts, actuating cylinders, pitot-static sources, and fuel vents should be inspected for ice and dirt accumulation. In addition to the above checks, the BLC duct tape (if applied) should be removed.

13.3.1.2 Warmup and Ground Check. If the aircraft has been parked in heavy rain when subsequent freezing has been anticipated, a protective pressure-sensitive tape should have been applied to the trailing edge wing/flap junctures to prevent precipitation and, thereby, ice from accumulating in the BLC ducts and valves. If the tape has not been applied and it is suspected that ice has formed in the ducts and valves, the flap actuating check should not be performed until the engines have been running for 12 to 15 minutes at 85-percent rpm. This permits hot BLC air to thaw any ice which may have accumulated in the BLC valves. After it is felt that the valves have been thawed:

1. Flaps/slats switch – CYCLE AND CHECK.

Actuate the flaps/slats to the 1/2-OUT and DN-OUT positions. Check that the BLC system is operating. Actuate the flaps to up and monitor the BLC MALFUNCTION light for malfunction indication.

CAUTION

A BLC MALFUNCTION light illumination with flaps up constitutes a flight hazard. Refer to paragraph 12.8.1, BLC MALFUNCTION.

In addition to normal walkaround, check that:

1. Shock struts, pitot tube, fuel vents, and actuating cylinders are free of ice or dirt.

2. Fuel drain cocks free of ice and drain condensation and ensure that all pneumatic bottles have been adequately serviced.

3. All exterior covers and BLC duct tape (if applied) removed.

4. Closely inspect nozzle shroud flaps for any signs of ice deposits. If any ice is present, apply heat to the nozzle control feedback housing area for 5 to 10 minutes just prior to engine start.

13.3.1.3 Interior Check. In temperatures below 0 °F, difficulty may be experienced when connecting the oxygen mask hose to the T-connector because of a stiff O-ring in the T-connector. Application of a small amount of heat to the T-connector will alleviate this problem. Also, if the oxygen mask is not fastened, keep it well clear of the face to prevent freezing of the inhalation valves. Because of the bulk of arctic flying clothes, difficulty may be experienced in getting strapped in and in removing the face curtain safety pin. Assistance from the plane captain may be required.

13.3.1.4 Engine Start. During engine start operation, press ignition buttons at approximately 6-percent rpm; however, do not advance the throttles until approximately 10-percent rpm is reached. Pressing the ignition buttons prior to throttle advance will dry out the igniter plugs, thereby enhancing a successful start. If any abnormal sounds or noises are present during starting, discontinue starting and apply intake duct preheating for 10 to 15 minutes. Immediately after starting the engine at extremely low temperatures, the engine oil pressure indication will become excessive and may peg out at 100+ psi. When this condition occurs, the generators may not connect to the aircraft load when the generator control switch is placed to GEN ON. This is caused by either the limit governor not porting oil to the underspeed switch or the contacts within the underspeed switch not closing. Both of these problems are associated with low temperature, high viscosity oil. Repeated cycling of the generator switch in an attempt to get a generator on the line will not damage the CSD or generator, but may prove futile until the engine/oil warms up (oil pressure drops below 50 psi). Occasionally because of cold oil, the spool valve in the limit governor does not move fully to the open position. If this occurs, it also prevents the generators from connecting to the aircraft load. An increase in oil temperature does not always correct this condition. However, engine shutdown and restart often exercises the system sufficiently to free the spool valve. Spool valve operation is not critical as this valve operates once to open at engine start and again to close at engine shut down. An aircraft flight should not be aborted for failure of a generator to come on or stay on the line prior to engine/oil warmup nor should an abort be declared if an engine shutdown and restart will bring and keep a generator on the line.

13.3.1.5 Taxiing. Avoid taxiing in deep or rutted snow; frozen brakes will probably result. Increase the interval between taxiing aircraft to ensure a safe stopping distance and to prevent icing of the aircraft surfaces by the snow and ice melted by the jet blast of the preceding aircraft.

13.3.1.6 Before Takeoff Check. During the engine runups, an ice-free area should be selected if possible. The engine thrust is noticeably greater at low temperatures and the probability of skidding the aircraft is likely. If icing conditions are encountered or expected, place the engine anti-ice switch in the DE-ICE position and the pitot heat ON.

13.3.1.7 Takeoff. When operating from runways which are covered with excessive water, snow, or slush, high-speed aborts may result in engine flameout because of precipitation ingestion. The probability of flameout is highest when throttles are chopped from afterburner to IDLE at speeds above 100 knots. With a double flameout, normal braking, antiskid on aircraft 157242an and up, and nose gear steering will be lost. After takeoff from runways covered with snow or slush, packed snow/slush in the auxiliary air door area may make throttle movement difficult until the snow/slush can be melted. Check applicable takeoff distance charts in Chapter 19.

Note

> If in-flight freezing within the longitudinal control system is experienced, excessive stick forces may be required to move the control stick. Normal aircraft control is available, but requires higher force inputs. Normal control forces and AFCS operation will return at lower (warmer) altitudes.

13.3.1.8 Landing. If snow and ice tires are installed, use brakes intermittently to keep the tire thread from filling and glazing. As soon as practicable after the landing roll, the flaps should be placed in the full UP position. This will shut off the BLC air which otherwise causes the loose snow to swirl and be drawn in through the auxiliary air doors and pass along the engine. If this happens, the snow melts and deposits of ice form shortly after engine shutdown. The ice can cause binding of the nozzle feedback housing and possibly result in nozzle failure upon the next engine start.

13.3.1.9 After Landing. During operations where the temperature is below freezing with heavy rain or expected to drop below freezing with heavy rain, the aircraft may be parked with wings spread and flaps in the full down position.

13.3.1.10 Before Leaving Aircraft. Weather permitting, leave the canopy partially open to allow for air circulation. This will help prevent canopy cracking from differential cooling and decreases the possibility of windshield and canopy frosting.

13.3.2 Hot-Weather Operation

13.3.2.1 Taxiing. While taxiing in hot weather, the canopies may be opened, if necessary, to augment crew comfort. Do not operate the engines in a sand or dust storm if avoidable. Park the aircraft crosswind and shut down the engines to minimize damage from sand or dust.

13.3.2.2 Takeoff. The required takeoff distances are increased by a temperature increase. Check the applicable takeoff distance charts in Chapter 19.

PART VII

Communication Procedures

Chapter 14 — Communication Procedures

CHAPTER 14

Communication Procedures

14.1 RADIO COMMUNICATIONS

It is the responsibility of the pilot to ensure that all radio and electronic transmissions from the aircraft are in compliance with applicable directives and squadron doctrine. It is mandatory that the pilot and RIO be thoroughly indoctrinated in all communication equipment, methods, and procedures including hand signals. Radio communications will be in accordance with procedures set forth in NATOPS Aircraft Signals Manual, ACP 165, JANAP 119, and local fleet/shore instructions.

14.1.1 Pilot/RIO Intercept Commentary

14.1.1.1 Descriptive Commentary. Descriptive commentary is given in a specific order when existing conditions allow (i.e., azimuth, elevation, closing rate). Under certain conditions, it is impossible to give the description in the desired sequence since adhering rigidly to the sequence may interfere with positive control of target movement. The description of target action or position is normally given in a conversational tone of voice. Upon initial contact, the RIO will immediately start giving descriptive commentary. It is apparent that if the RIO gives "contact" followed immediately by range reading, the pilot is aware of the urgency or need of positive action by the RIO. The RIO will also, upon initial contact, give any directive commentary that is necessary to ensure that the target does not exceed the limitations of the set. Descriptive commentary is not required to be particularly accurate at long ranges, but as the fighter approaches visual or attack range, the description must be accurate and still not interfere with commands to the pilot. Sufficient descriptive commentary should be given to keep the pilot constantly informed of the position of the target in terms of azimuth angle, range, elevation angle, and overtaking speed.

14.1.1.1.1 Contact Report. Contact reports will be given to the controlling agency in the following manner:

1. CONTACT followed by AZIMUTH – Degrees followed by LEFT or RIGHT.

2. Range – Nearest mile.

An example is: CONTACT, 25 LEFT, 30 MILES.

14.1.1.1.2 Target Position Reporting. Position reports will be given in a specific order (i.e., azimuth angle, range, elevation angle, and overtaking speed). The following items will be used:

1. AZIMUTH – Degrees followed by LEFT or RIGHT.

2. RANGE – In miles (yards may be used when appropriate).

3. ELEVATION – Degrees followed by above, below, or level.

4. OVERTAKING SPEED – Knots.

Examples are: 10 RIGHT, 8 MILES, LEVEL, OVERTAKE 300; 20 LEFT, 12 MILES, 5 ABOVE, OVERTAKE 50.

14.1.1.1.3 Judy. "JUDY" will be given to the controlling agency when assuming responsibility and control of the intercept.

14.1.1.2 Directive Commentary. Directive commentary is divided into three categories and is used when the situation calls for a change of the aircraft direction, speed, or elevation. A considerable amount of information as to the urgency may be obtained from the inflection of the RIO's voice as well as speed with which one command follows the other. Voice modulation properly employed will give flexibility to commentary. If the RIO places emphasis in his voice commands, it ensures that the pilot hears each and every command and will also cause to pilot to react accordingly. Directive commentary will at all times take precedence over descriptive commentary. The pilot will also inform the RIO whenever the limitations of the aircraft are reached. Upon achieving a speed change, leveling off, or resuming straight and level flight, the pilot will inform the RIO with commentary such as "Speed set," "Steady and level," or "Altitude set."

14.1.1.2.1 Heading Change Commands

1. "EASY PORT" or "EASY STARBOARD" – 15° angle of bank.

2. "PORT" or "STARBOARD" – 30° angle of bank.

3. "PORT HARD" or "STARBOARD HARD" – 45° angle of bank.

4. "HARD AS POSSIBLE" – Maximum possible turn, maintaining airspeed and altitude.

5. "EASE" – Roll out slowly toward steady.

6. "HOLD" – Maintain present bank angle.

7. "STEADY" – Roll out of turn.

8. "HARDER" – Increase angle of bank to next higher increment. For example, if at 30° angle of bank, pilot will increase bank angle to 45°; if at 15° bank, increase to 30°, etc.

9. "WRAP IT UP" – Maximum possible turn within aircraft acceleration limitations.

10. "REVERSE" – Immediate identical turn in opposite direction.

11. "OVERBANK" – More than 90° of bank angle, (can be further amplified by "HARDER").

Note

Turns may be given as a specific number of degrees. For example, "PORT HARD 40," etc.

14.1.1.2.2 Elevation Commands

1. "GO DOWN" – Descend a specified number of feet designed by the RIO.

2. "CLIMB" – Climb as directed by RIO (GATE, BUSTER, or specified number of feet).

3. "NOSEUP"/"NOSEDOWN" – Change pitch angle until given "HOLD" by RIO. Leave throttles at same setting.

4. "DIVE" – Maximum rate descent until given "HOLD DIVE" by RIO or until maximum permissible rate of descent is established.

5. "LEVEL OFF" – Return to level flight.

14.1.1.2.3 Speed Commands

1. "BUSTER" – Full military power.

2. "GATE" – Maximum power.

3. "BUSTER" or "GATE" – Military or maximum power to CAS or indicated Mach number specified.

4. "SPEED UP" – Increase airspeed by amount specified (CAS or IMN).

*5. "THROTTLE BACK" – Decrease speed by amount specified (CAS or IMN).

*6. "THROTTLE RIGHT BACK" – Decrease airspeed as rapidly as possible until minimum airspeed reached or RIO gives "HOLD SPEED."

7. "HOLD SPEED" – Maintain present airspeed.*

14.1.1.2.4 Less Frequent Commands

1. "BREAK STARBOARD" or "BREAK PORT" – Immediate maximum possible turn within aircraft acceleration limitations in the direction indicated. An "UP" or "DOWN" elevation command may be given as appropriate.

2. "COMPASS RECOVERY" – Immediate, hard as possible, turn 30° beyond target's last known heading.

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*Speed will normally be reduced as rapidly as possible utilizing speedbrakes and/or throttle as appropriate.

14.2 VISUAL COMMUNICATIONS

Communications between aircraft will be conducted visually whenever practicable, provided no sacrifice in operational efficiency is involved. Flight leaders shall ensure that all pilots in the formation receive and acknowledge signals when given. The visual communications section of the NATOPS Aircraft Signals Manual must be reviewed and practiced by all pilots and RIOs. For ease of reference, visual signals applicable to flight operations are contained in Figure 14-1 and deck/ground handling signals are contained in Figure 14-2.

GENERAL CONVERSATION

MEANING	SIGNAL	RESPONSE
Affirmative (I understand).	Thumb up, or nod of head.	
Negative (I do not know).	Thumb down, or turn of head from side to side.	
Question (repeat). Used in conjunction with another signal, this gesture indicates that the signal is interrogatory.	Hand cupped behind ear as if listening.	As appropriate.
Wait.	Hand held up with palm outward.	
Ignore last signal.	Hand waved in an erasing motion in front of face, with palm turned forward.	
Numerals, as indicated.	With forearm in vertical position, employ fingers to indicate desired numerals 1 through 5. With forearm and fingers horizontal, indicate number which, added to 5, gives desired number from 6 through 9. A clenched fist indicates zero.	A nod of the head (I understand). To verify numerals, addressee repeats. If originator nods, interpretation is correct. If originator repeats numerals, addressee should continue to verify them until they are understood.

CONFIGURATION CHANGES

MEANING	SIGNAL	RESPONSE
Lower landing gear.	Rotary movement of hand in cockpit, as if cranking wheels.	Execute.
Lower arresting gear hook.	Leader lowers hook.	Wingman lowers arresting gear hook. Leader indicates wingman's hook is down with thumb up signal.
Extend or retract flaps or speed brakes as appropriate.	Open and close four fingers and thumb.	

FUEL AND ARMAMENT

MEANING	SIGNAL	RESPONSE
How much fuel have you?	Raise fist with thumb extended in a drinking position.	Indicate fuel in hundreds of pounds by finger numbers.
1—Arm or safety missiles as applicable; 2—how much ammo do you have? 3—I am unable to fire.	1—Pistol cocking motion with either hand; 2—followed by question signal; 3—followed by nose-held signal.	1—Execute and return signal; 2—thumb up, over half; down, less than half; 3—nod head (I understand).
1—Arm or safety tanks as applicable; 2—how many tanks do I have? 3—I am unable to drop.	1—Shaking fist; 2—followed by question signal; 3—followed by nose-held signal.	1—Execute and return signal; 2—indicate with appropriate finger numerals; 3—nod head (I understand).

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Figure 14-1. Visual Communications (Sheet 1 of 2)

FORMATION

MEANING	SIGNAL	RESPONSE
1) I have completed my takeoff check list and am, in all respects ready for takeoff; 2) I have completed my takeoff check list and am, in all respects, ready for a section takeoff; 3) Takeoff path is clear, I am commencing takeoff.	1) Section takeoff leader raises arm (either) over head; 2) Wingman raises arm over head; 3) Leader lowers arm.	1) Stands by for reply from wingman, holding arm over head until answered; 2) Wingman lowers arm and stands by for immediate section takeoff; 3) Executes section takeoff.
Leader shifting lead to wingman. (Day)	Leader pats self on head points to wingman.	Wingman pats head and assumes lead.
Leader shifting lead to wingman. (Night)	1) Two aircraft – lead aircraft puts external lights on bright and flash. 2) More than two aircraft – leader places flight in echelon and then use two aircraft procedures.	Wingman turns external lights to DIM and STEADY and assumes lead.
	3) With external light failure – leader shines flashlight on hardhat, then shines at Wingman.	Wingman turns external lights to DIM and STEADY and assumes lead. With external light failure – Wingman shines flashlight at leader, then on his hardhat.
Leader shifting lead to division designated by numerals.	Leader pats self on head points to wingman and holds up two or more fingers.	Wingman relays signal; division leader designated assumes lead.
Take cruising formation.	Thumb waved backward over the shoulder.	Execute.
I am leaving formation.	Any pilot blow kiss.	Nod (I understand).
Aircraft pointed out leave formation.	Leader blows kiss and points to aircraft.	Execute.
Directs plane to investigate object or vessel.	Leader beckons wing plane, then points to eye, then to vessel or object.	Wingman indicated blows kiss and executes.
Refers to landing of aircraft, generally used in conjunction with another signal; 1) I am landing; 2) Directs indicated aircraft to land.	Landing motion with open hand; 1) Followed by patting head; 2) Followed by pointing to another aircraft.	1) Execute; 2) Execute.
a) Join up or break up, as appropriate. b) On GCA/CCA final: Leader has runway/ship in sight.	Flashing external lights.	a) Comply. b) Wingman repeats, indicating runway/ship in sight. Ship: Leader waves-off wingman lands. Field: When runway conditions preclude a safe section landing leader will wave-off.

FORMATION SIGNALS MADE BY AIRCRAFT MANEUVER

COMBAT OR FREE CRUISE

MEANING	SIGNAL	RESPONSE
Single aircraft cross under in direction of wing dip.	Single wing dip.	Execute.
Section cross under.	Double wing dip.	Execute.
Close up.	Series of small zooms.	Execute.
Join up; join up on me.	Series of pronounced zooms.	Expedite join-up.

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Figure 14-1. Visual Communications (Sheet 2 of 2)

Figure 14-2. Deck/Ground Handling Signals (Sheet 1 of 3)

CAUTION

1 THE PILOT MUST HAVE CORRECT PNEUMATIC PRESSURE BEFORE EXTENSION AND GIVE ACKNOWLEDGEMENT TO THE GROUND CREWMAN FOR EXTENSION.

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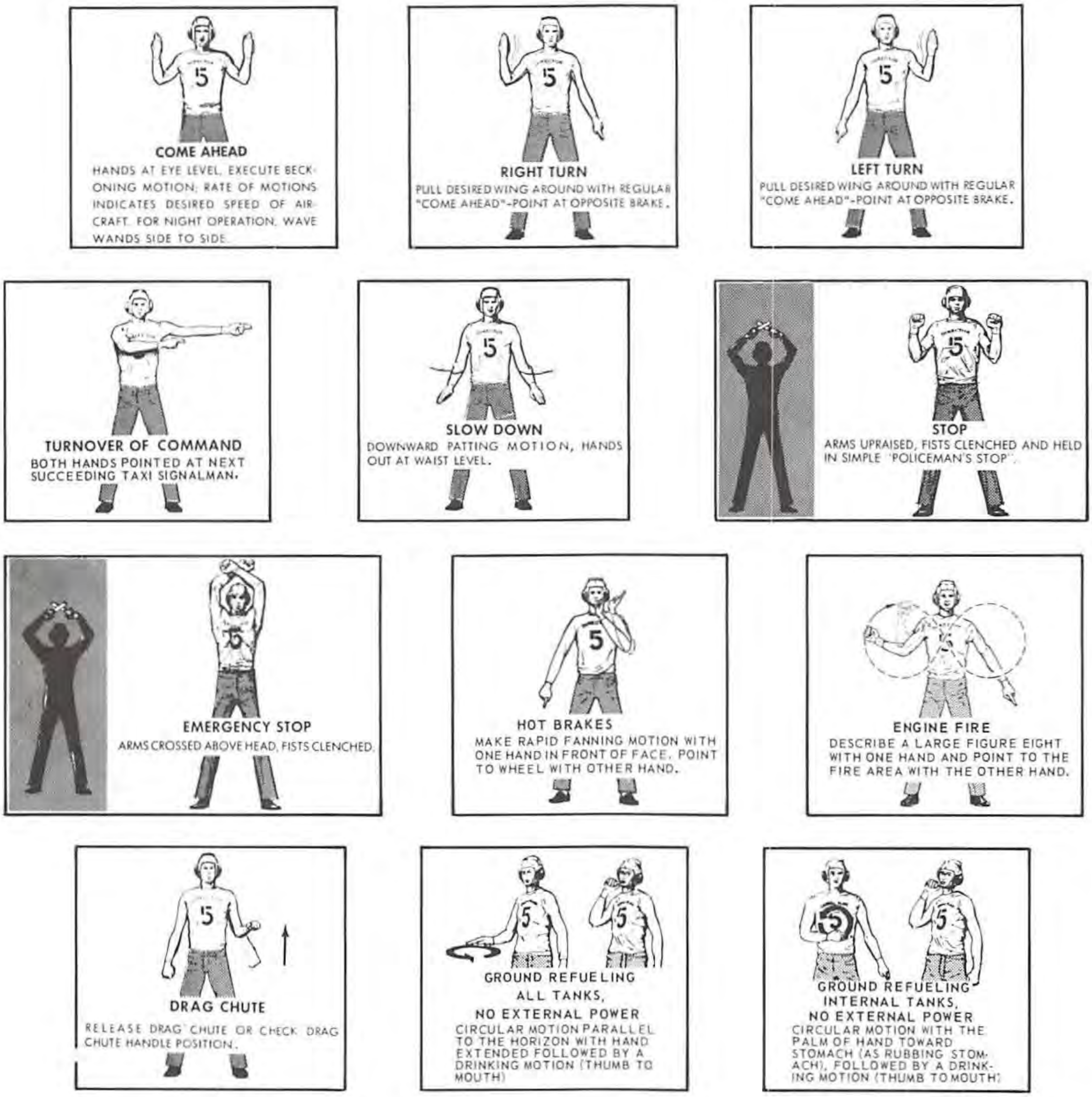
Figure 14-2. Deck/Ground Handling Signals (Sheet 2 of 3)



NIGHT SIGNALS

NIGHT SIGNALS ARE THE SAME AS DAY SIGNALS EXCEPT AS NOTED. FLASHLIGHTS OR WANDS WILL SUBSTITUTE FOR HAND AND FINGER MOVEMENTS DURING NIGHT OPERATIONS.

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Figure 14-2. Deck/Ground Handling Signals (Sheet 3 of 3)

PERSONNEL	HELMET	JERSEY/ FLOTATION VEST	SYMBOLS FRONT AND BACK
AIRCRAFT HANDLING CREW AND CHOCKMEN	BLUE	BLUE	CREW NUMBER
AIRCRAFT HANDLING OFFICERS AND PLANE DIRECTORS	YELLOW	YELLOW	BILLET TITLE – CREW NUMBER
ARRESTING GEAR CREW	GREEN	GREEN	A
AVIATION FUELS CREW	PURPLE	PURPLE	F
CATAPULT AND ARRESTING GEAR OFFICERS	GREEN	YELLOW	BILLET TITLE
CATAPULT CREW	GREEN	GREEN	C
CATAPULT SAFETY OBSERVER (ICCS)	GREEN	YELLOW	BILLET TITLE
CRASH AND SALVAGE CREWS	RED	RED	CRASH/SALVAGE
ELEVATOR OPERATORS	WHITE	BLUE	E
EXPLOSIVE ORDNANCE DISPOSAL (EOD)	RED	RED	"EOD" IN BLACK
HELICOPTER LSE	RED	GREEN	H
HELICOPTER PLANE CAPTAIN	RED	BROWN	H
HOOK RUNNER	GREEN	GREEN	A
LANDING SIGNAL OFFICER	NONE	WHITE	LSO
LEADING PETTY OFFICERS:			
MAINTENANCE	GREEN	GREEN	SQUADRON DESIGNATOR PLUS "MAINT. CPO"
LINE	GREEN	BROWN	SAME, EXCEPT "LINE CPO"
SQUADRON PLANE INSPECTOR	GREEN	WHITE	BLACK AND WHITE CHECKERBOARD PATTERN AND SQUADRON DESIGNATOR
LOX CREW	WHITE	GREEN	LOX
MAINTENANCE CREWS	GREEN	GREEN	BLOCK STRIPE AND SQUADRON DESIGNATOR
MEDICAL	WHITE	WHITE	RED CROSS
MESSENGERS AND TELEPHONE TALKERS	WHITE	BLUE	T
ORDNANCE	RED	RED	BLACK STRIPE AND SQUADRON DESIGNATOR/SHIPS BILLET TITLE
PHOTOGRAPHERS	GREEN	GREEN	P
PLANE CAPTAINS	BROWN	BROWN	SQUADRON DESIGNATOR
SAFETY	WHITE	WHITE	"SAFETY"
TRANSFER OFFICER	WHITE	WHITE	"TRANSFER OFFICER"
TRACTOR DRIVER	BLUE	BLUE	TRACTOR

Notes

1. ONLY OFFICERS CHARGED WITH THE ACTUAL CONTROL OR DIRECTION OF AIRCRAFT MOVEMENTS ON THE FLIGHT OR HANGAR DECKS SHALL WEAR YELLOW JERSEYS. OFFICERS IN CHARGE OF A DETAIL SUCH AS AVIATION FUELS, ORDNANCE, AND MAINTENANCE SHALL WEAR A HELMET AND JERSEY CORRESPONDING IN COLOR TO THAT OF THEIR RESPECTIVE DETAIL, WITH THEIR BILLET TITLE ON THE JERSEY AND FLOTATION VEST.

2. HELMETS FOR THE FOLLOWING PERSONNEL SHALL BE MARKED WITH THREE REFLECTIVE INTERNATIONAL ORANGE STRIPES, ONE INCH WIDE, EVENLY SPACED, RUNNING FORE AND AFT:
   1. ALL AIR DEPARTMENT OFFICERS.
   2. FLIGHT AND HANGAR DECK CHIEF PETTY OFFICERS AND LEADING PETTY OFFICERS.
   3. CRASH AND SALVAGE CHIEF PETTY OFFICER AND LEADING PETTY OFFICER.
   4. EOD TEAM MEMBERS.
   5. AIR WING ORDNANCE OFFICER AND GUNNER.
   6. SHIP'S ORDNANCE OFFICER AND AIR GUNNER.

3. HELMETS FOR ALL OTHER PERSONNEL SHALL BE MARKED WITH A 4 INCH SQUARE (OR EQUIVALENT) OF WHITE REFLECTIVE TAPE ON THE BACK SHELL AND A 2 INCH BY 4 INCH (OR EQUIVALENT) OF WHITE REFLECTIVE TAPE ON THE FRONT SHELL. LANDING SIGNAL OFFICERS ARE NOT REQUIRED TO WEAR HELMETS OR SOUND ATTENUATORS WHEN ENGAGED IN AIRCRAFT CONTROL.

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Figure 14-3. Authorized Flight Quarter Clothing

PART VIII

Weapon Systems

Chapter 15 — Weapon Systems

CHAPTER 15

Weapon Systems

15.1 BOMBING EQUIPMENT

Refer to F-4 Tactical Manual, NAVAIR 01-245FDB-IT.

15.2 DATA LINK SYSTEM

Refer to section VIII in NAVAIR 01-245FDD-1A-1.

15.3 DIRECT RADAR SCOPE CAMERA

Refer to section VIII in NAVAIR 01-245FDD-1A-1.

15.4 ELECTRONIC COUNTERMEASURE EQUIPMENT

Refer to F-4 Tactical Manual, NAVAIR 01-245FDB-1T(A).

15.5 GUNNERY EQUIPMENT

Refer to F-4 Tactical Manual, NAVAIR 01-245FDB-1T.

15.6 MISSILE CONTROL SYSTEM

Refer to section VIII in NAVAIR 01-245FDD-1A-1.

15.7 STRIKE CAMERA SYSTEM

15.7.1 Description. F-4J after AFC 518 and all F-4S are equipped with a strike camera system. The system consists of a camera pod LB-30A mounted in the left forward fuselage missile cavity. The camera pod contains a KB-18B panoramic camera and a KB-19A forward looking motion picture camera. The panoramic camera provides continuous film documentation of the strike area throughout an air-to-ground armament delivery. The forward looking camera provides motion picture coverage of the area forward of the aircraft along the boresight line during air-to-air or air-to-ground armament delivery. Both cameras operate simultaneously when energized by automatic or manual control circuits.

15.7.1.1 KB-18B Camera. The KB-18B camera components contained in the pod are the camera body with an LB-29A accessory magazine and a LB-17A camera control. The camera has a 3-inch focal length f/2.8 lens. The shutter speeds range from approximately 1/100 second to 1/4,000 second depending on limits established by a cycle rate switch and an aerial exposure index (AEI) switch. The accessory magazine accommodates 250 feet of film (300 exposures) and produces photographs with a format size of 2.25 by 9.40 inches. Panoramic photography is accomplished by rotating a double dove prism in front of the lens while the film is advanced across a narrow slit at the focal plane of the camera. Film advance is synchronized with prism rotation, projecting the panoramic image of the strike area on the film as the prism scans 180° fore and aft. Side coverage is 20° either side of the aircraft vertical axis. The automatic exposure control senses variations in the light source and initiates compensatory aperture adjustments. The camera control contains switches for ground testing the camera and preselecting camera operating functions required for the mission. The controls include the ground test switch, cycle rate switch, overrun dial, and the AEI switch.

15.7.1.1.1 Overrun Dial. The overrun dial setting determines the amount of time the camera will run (automatic mode only) after the trigger switch or bomb button is released. Dial settings are calibrated in 2-second increments from 0 to 20 seconds plus an additional setting of 32 seconds.

15.7.1.1.2 Cycle Rate Switch. The cycle rate switch permits selection of one, two, or four frames per second during camera operation. The switch is set in accordance with the planned mission altitude/airspeed combination.

15.7.1.1.3 AEI Switch. The AEI switch is set as determined by the type of film in the camera. Films speeds (exposure sensitivity) of 40, 64, 80, or 200 are selectable.

15.7.1.2 KB-19A Camera. The KB-19A camera mounted in the forward fairing of the pod provides 16-mm motion picture coverage of the area forward of aircraft along the boresight line. The film magazine attached to the camera contains 100 feet of film. An automatic exposure control (AEC) controls the shutter sector opening to assure proper exposure.

15.7.1.2.1 Overrun Switch. The overrun switch controls the time the camera continues to operate after trigger or bomb button release and provides the following overrun selections: 0, 5, 10, or 15 seconds. An overrun indicator light marks the film at the release of the trigger or bomb button and continues marking until completion of the overrun period.

15.7.1.2.2 Test Switch. The test switch on the rear of the camera is utilized by the ground crew to test operation of the camera.

15.7.1.3 Strike Camera Control Panel. The strike camera control panel on the left console (Figure FO-1) controls the operating modes of the strike camera system. The panel labeled CAMERAS contains a mode switch and a PAN OPERATE light. The mode switch has three positions: OFF, AUTO, and MANUAL. With the mode switch in AUTO, when the armament circuits are energized and the pilot presses the trigger switch or the bomb button, the cameras begin operating. When the trigger switch or bomb button is released, the cameras continue operating for the preselected overrun time. MANUAL is a momentary position and the cameras operate as long as the switch is held in MANUAL. The manual mode does not involve the armament systems and enables film coverage of specific terrain without armament delivery. The PAN OPERATE light blinks on for each cycle of operation of the KB-18B camera (i.e., illuminates during each panoramic scan and extinguishes between scans). If a film failure occurs or the film supply is exhausted in the KB-18B camera, the PAN OPERATE ceases to blink. This light may be tested by pressing the light.

15.7.2 Normal Operation. With the camera mode switch in AUTO, the cameras operate automatically during armament delivery (i.e., with the specific arming circuits energized, both cameras operate when the trigger switch or bomb button is pressed). Furthermore, camera operation continues for the preselected overrun time. The pilot may operate the cameras without expending armament by holding the mode switch in MANUAL.

15.7.3 Emergency Operation. There are no special provisions for emergency operation of the strike camera system.

15.7.4 Limitations. The limits of the basic aircraft apply to the strike camera system.

PART IX

Flight Crew Coordination

Chapter 16 – Flight Crew Coordination

CHAPTER 16

Flight Crew Coordination

16.1 PILOT/RIO RESPONSIBILITIES

The most successful fighter teams are those who work together continuously and know each other's reactions, weaknesses, and strengths. The mission commander bears responsibility for mission success, sharing safety of flight responsibilities whether he be pilot or RIO. The pilot is the aircraft commander and is responsible for the safe control of the aircraft through its entire mission. The RIO should assist the pilot in every way possible, anticipating rather than awaiting developments. The duties of the pilot/RIO team are necessarily integrated and each must support and contribute to the performance of the other. Each crewmember must share the responsibility of every evolution encountered. In other words, the crew concept is a system of checks and balances and, as such, it is a dual obligation equally shared. The interruption of routine functions is usually caused by an emergency; however, routine habit patterns may be broken through complacency. The assistance of the RIO in these instances is of the utmost value, challenging the pilot with the appropriate emergency checklist and monitoring flight performance of the aircraft.

The crew responsibilities are written with the premise that the RIO will handle UHF communications throughout the flight; however, it is recommended that prior to takeoff, the pilot initiate at least one transmission to check out his communications.

The importance of each crewmember being completely aware of all his responsibilities has to be continuously stressed. Both crewmembers must realize that successful mission accomplishment and safety depends on flight crew coordination. In this respect, it is stressed that the crew coordination functions, duties, and responsibilities listed in this chapter are not meant to be utilized as in-flight checklists. While frequent reference is made to checklists and certain important procedures are highlighted, the contents of this chapter are designed to be utilized as a basis for squadron and unit ground training syllabuses. So utilized, this chapter will enhance the successful and safe completion of each unit mission through intelligent and proper compliance with all NATOPS procedures and other applicable aviation directives.

To further the strengthening of aircrew integrity, it is imperative that the team concept be employed as early in the training evolution as is practicable. The best balance of talent and experience divided into permanent pilot/RIO teams will develop the coordination required of the truly professional combat team.

16.1.1 Specific Responsibilities

16.1.1.1 Flight Planning

16.1.1.1.1 Mission Commander

1. Responsible for all phases of the assigned mission and for the effectiveness of the flight.

16.1.1.1.2 Flight Leader

1. Assist the mission commander in preparing required charts, flight logs, navigation computations (including fuel planning, checking weather, and NOTAMs) and for completing required flight plans.

16.1.1.1.3 Pilot

1. Assist the mission commander/flight leader in preparing required charts, flight logs, navigation computations (including fuel planning, checking weather and NOTAMs) and for completing required flight plans.

2. Be prepared to assume flight lead; thus have a thorough understanding of the conduct of the flight.

16.1.1.1.4 RIO

1. Assist the mission commander/flight leader/pilot in preparing required charts, flight logs, navigation

computations (including fuel planning, checking weather, and NOTAMs) and for completing required flight plans.

2. Be prepared to assist the pilot in assuming flight lead; thus have a thorough understanding of the conduct of the flight.

16.1.1.2 Briefing

16.1.1.2.1 Mission Commander

1. Responsible for briefing all crewmembers on all aspects of the operation and conduct of the flight.

2. Utilize a briefing guide or syllabus card as outlined in Chapter 6.

16.1.1.2.2 Flight Leader

1. Assist the mission commander in preparing required flight or briefing forms and if directed brief all crewmembers on all aspects of the operation and conduct of the flight.

2. When directed, in addition to using the briefing guide or syllabus card, brief the following:

a. Crew coordination in each flight evolution

b. Command/control of aircraft

c. Utilization of each weapon system

d. System degradation.

16.1.1.2.3 Pilot

1. Assist the mission commander/flight leader in preparing required flight or briefing forms, and, if directed, brief all crewmembers on all aspects of the operation and conduct of the flight.

2. When directed, in addition to using the briefing guide or syllabus card, brief the following:

a. Crew coordination in each flight evolution

b. Command/control of aircraft

c. Utilization of each weapon system

d. System degradation.

16.1.1.2.4 RIO

1. Assist the mission commander/flight leader in preparing required flight or briefing forms, and, if directed, brief all crewmembers on all aspects of the operation and conduct of the flight.

2. When directed, in addition to using the briefing guide or syllabus card, brief the following:

a. Crew coordination in each flight evolution

b. Command of aircraft

c. Utilization of each weapon system

d. System degradation.

16.1.1.3 Preflight

16.1.1.3.1 Pilot

1. Check yellow sheet for flight status, configurations, armament loading, and servicing.

2. Review at least the 10 previous B sections for discrepancies noted and corrective actions taken.

3. Responsible for accepting the aircraft assigned.

4. Responsible for preflighting the aircraft assigned in accordance with this manual, appropriate NATOPS pocket checklists, and tactical manuals.

5. Note any preflight discrepancies and ensure they are logged on yellow sheet.

6. Calculate gross weight of aircraft for catapult launch and compare with RIO figures.

16.1.1.3.2 RIO

1. Check yellow sheet for flight status, configuration, armament loading, and servicing.

2. Review at least the 10 previous B sections for discrepancies noted and corrective action taken.

3. Conduct a thorough individual preflight of entire aircraft in accordance with this manual, appropriate NATOPS pocket checklists, and tactical manuals.

4. Check missile security and log missile serial numbers.

5. Note any preflight discrepancies and ensure they are logged on yellow sheet.

6. Calculate gross weight of aircraft for catapult launch and compare with pilot figures.

16.1.1.4 Before Starting Engines

16.1.1.4.1 Pilot

1. Execute prestart checks in accordance with this manual and appropriate NATOPS pocket checklist.

2. During intercom system check, report "ordnance switches safe, CW power off, interlocks in."

3. Receive a "clear to start" signal from plane captain ensuring security of aircraft and adjacent area.

4. Inform RIO, "Prestart checks completed, ready to start."

16.1.1.4.2 RIO

1. Execute prestart checks in accordance with this manual and appropriate NATOPS pocket checklist.

2. Challenge pilot to check ordnance switches safe, CW power off, interlocks in.

3. Respond to ICS check with "intercom status, eject light status, CB in, transformer/rectifier check status, and position of command selector valve handle."

4. Ensure intake ramps are clear of any personal flight equipment.

5. Inform pilot, "Prestart checks completed."

16.1.1.5 Starting Engines

16.1.1.5.1 Pilot

1. Start engines in accordance with this manual and appropriate NATOPS pocket checklists.

2. Remain alert for any emergency signals from ground crew or RIO.

16.1.1.5.2 RIO

1. Notify pilot of any emergency signals noted from ground crew or any unusual occurrences you may observe.

2. Report any circuit breakers that do not remain seated.

3. Observe wings, reporting any movement to pilot.

4. Alert pilot of possibility of any foreign object which might be drawn into compressor.

5. Report any movement of aircraft to the pilot.

16.1.1.6 Before Taxiing

16.1.1.6.1 Pilot

1. After switching to internal power, inform RIO, "On internal power, bus tie light out" (missile power switch in standby in accordance with appropriate directives).

2. Complete all before taxi checks in accordance with this manual and appropriate NATOPS pocket checklists.

3. Acknowledge that CW power switch is on when requested (in accordance with appropriate directives.)

4. Report time to close and lock front canopy, checking rod alignment marks after closure.

5. Obtain verbal clearance from RIO prior to cycling refueling probe.

6. Inform RIO when ready to taxi.

16.1.1.6.2 RIO

1. Ascertain generator control switches ON and bus tie and generator warning lights out.

2. Complete all before taxi checks in accordance with this manual and appropriate NATOPS pocket checklists.

3. Request pilot to turn on CW power (in accordance with appropriate directives).

4. Advise pilot when performing BIT checks (in accordance with appropriate directives).

5. Inform pilot on status of all systems.

6. Check navigation computer operation.

7. Check pilot radio/navigation equipment.

8. Take command of radio and navigation equipment and report any malfunction to pilot.

9. Report time of close and lock rear canopy, checking rod alignment marks after closure.

10. Scan instruments and circuit breakers, reporting any discrepancies.

11. Challenge pilot on position of UHF antenna switch.

12. Challenge pilot on following items:

   a. Fuel transfer – STOP TRANSFER/OFF.

   b. Bleed air switch – NORM.

   c. Tacan/UHF – CHANNEL NUMBER/FREQUENCY.

13. Advise pilot when ready for taxi.

14. Call clearance delivery and ground control when directed by pilot.

16.1.1.7 Taxiing

16.1.1.7.1 Pilot

1. Aboard ship remain on HOT MIC position during taxi.

2. After aircraft has started rolling, check brakes and report to RIO.

3. Remain watchful for obstructions and taxi signals and inform RIO.

4. Check wing clearance.

5. Be alert for calls from ground/tower control concerning taxi information.

16.1.1.7.2 RIO

1. Aboard ship remain on HOT MIC position during taxi.

2. Challenge pilot on brake check.

3. Monitor taxi speed.

4. Remain watchful for obstructions and taxi signals, relaying them to pilot.

5. Check wing clearance.

6. Be alert for calls from ground/tower control concerning taxi information.

7. Complete BIT checks (in accordance with appropriate directives).

8. Return radar function switch to STBY/OFF (as required) after completion of BIT checks.

16.1.1.8 Before Takeoff

16.1.1.8.1 Pilot

1. Complete pretakeoff checks in accordance with this manual and appropriate NATOPS pocket checklists.

2. During engine runup, relay engine instrument readings to RIO.

3. Use challenge and reply system when going over Takeoff Checklist.

4. Inform RIO of acknowledged aircraft gross weight for catapult launch.

5. Complete Takeoff Checklist prior to crossing shuttle aboard ship, ensuring compass FREE DG mode and radar horizon set at zero.

6. Report gauges normal, controls free, gyro set.

7. Inform RIO when ready for takeoff.

16.1.1.8.2 RIO

1. Complete pretakeoff checks in accordance with this manual and appropriate NATOPS pocket checklists.

2. During engine runup:

   a. Check variable area inlet ramps fully retracted.

   b. Record oil pressure reported by pilot.

3. Use challenge and reply system when going over Takeoff Checklist.

4. Report command eject handle position.

5. Inform pilot of acknowledged aircraft gross weight for catapult launch.

6. Report visual check of the wing lock indicator pins and leading edge flaps.

7. Complete Takeoff Checklist prior to crossing shuttle aboard ship.

8. After nose-strut extension, RIO challenge pilot, "Reset gyro/check gauges normal."

9. Report stabilator position.

10. Maintain hands below canopy sill while on catapult.

11. Report, "Ready for takeoff, circuit breakers in."

16.1.1.9 Takeoff/Departure

16.1.1.9.1 Pilot

1. Ensure ICS remains in HOT MIC position.

2. Inform RIO when ready for tower clearance.

3. Copy and ensure RIO acknowledges all clearances.

4. Report engine operation normal to RIO after throttles are advanced to takeoff power.

5. Report rolling, saluting, or lights as appropriate to RIO.

6. Advise RIO of any unusual occurrences.

7. Report gear up and flaps up to RIO.

8. Inform RIO when going from gauges to visual or vice versa.

9. Inform RIO when changing radio/tacan/IFF.

10. Advise RIO prior to engaging autopilot.

11. Confirm headings and altitudes with RIO.

12. Maintain a lookout doctrine.

16.1.1.9.2 RIO

1. Ensure ICS remains in HOT MIC position.

2. Copy and acknowledge all clearances.

3. Challenge pilot for engine operation after throttles are advanced to takeoff power.

4. During section takeoff, check wingman aircraft and position.

5. Monitor airspeed and runway remaining.

6. Remind pilot to deploy drag chute and drop hook if takeoff aborted.

7. Challenge pilot if aircraft doesn't have 10° to 12° on rotation with a positive rate of climb.

8. Challenge pilot on After Takeoff Checklist.

9. Monitor instruments, maintain a diligent lookout doctrine.

10. Monitor the published or clearance departure procedures and challenge the pilot on any deviations from prescribed heading or altitude.

11. When not monitoring gauges, inform pilot.

16.1.1.10 Rendezvous

16.1.1.10.1 Pilot

1. Maintain a good lookout doctrine.

2. Ensure RIO establishes radio contact as briefed.

3. Advise RIO of any signals received from other aircraft or signals to be passed to other aircraft.

16.1.1.10.2 RIO

1. Maintain a good lookout doctrine.

2. Monitor airspeed, angle of bank, altitude.

3. Establish radio contact as briefed.

4. Confirm all lights BRIGHT/FLASH (if applicable).

5. Utilize radar to provide azimuth, range, closure rates to targets.

6. Monitor closure rate, relative bearing, altitude separation.

7. Advise pilot of any signals received from other aircraft.

8. Be prepared to give hand signals to other aircraft.

16.1.1.11 Cruise and Mission

16.1.1.11.1 Pilot

1. Maintain a good lookout doctrine.

2. Report fuel switchology, transfer, and fuel state to RIO periodically.

3. Inform RIO when going from gauges to visual or vice versa.

4. Inform RIO when changing radio/tacan/IFF.

5. Advise RIO when engaging AFCS.

6. Be constantly aware of geographical position.

7. Maintain howgozit chart, flight log, and frequencies assigned.

16.1.1.11.2 RIO

1. Maintain a good lookout doctrine.

2. Maintain a scan pattern.

3. Challenge pilot on fuel switchology, transfer, and state periodically.

4. Inform pilot when going from gauges to visual or vice versa.

5. Be constantly aware of geographical position and bingo distance for alternate/emergency airfields along route of flight. Be prepared to give immediate steer to home base.

6. Know winds at operating and bingo profile altitude.

7. Copy all clearances, headings/altitude changes.

8. Maintain howgozit chart, flight log, and frequencies assigned.

9. Update navigation computer regularly.

16.1.1.12 Instruments

16.1.1.12.1 Pilot

1. Transitioning from VFR to IFR conditions, the pilot should shift completely to the gauges prior to entering IFR flight and so inform the RIO.

2. Remain on instruments anytime the aircraft is climbing or descending through layers or when in and out of IFR conditions at low altitudes.

3. If experiencing vertigo/disorientation, notify RIO immediately, stay on gauges and refrain from making any UHF or IFF changes.

4. If RIO experiences vertigo/disorientation, inform him of altitude, attitude, and airspeed.

5. Inform RIO anytime the scan is broken to change an IFF squawk, tacan channel, radio frequency, or light configuration.

6. Inform RIO anytime a change in heading or altitude is to be made.

16.1.1.12.2 RIO

1. Assume all lookout responsibilities anytime the pilot is flying instruments, monitor the flight instruments, and advise the pilot in VFR conditions.

2. If pilot experiences vertigo/disorientation, carefully monitor gauges, informing pilot of attitude, altitude, and airspeed. Be prepared to advise pilot

how to maneuver the aircraft back to a wings-level attitude.

3. Inform pilot if the gauges go off or vertigo/disorientation is experienced.

4. Inform pilot anytime prior to changing radio frequencies or tacan channel.

5. Challenge pilot if not at assigned altitude or heading.

6. Be particularly aware of attitude, altitude, airspeed, and geographical position at all times.

7. Advise the pilot of bank angle and changes in altitude, airspeed, or heading when flying formation.

8. Utilize radar as appropriate and ensure radar gyro is indicating properly.

9. Do not conduct BIT checks under actual instrument conditions.

10. Maintain a good lookout doctrine.

16.1.1.13 Air Intercepts/MISSILEX

16.1.1.13.1 Pilot

1. Complete with RIO the checklists in accordance with the NAVAIR 01-245FDD-1A-1.

2. Report synchronization of compass to RIO.

3. Maneuver the aircraft as directed by GCI/CIC/RIO, observing normal operating limitations.

4. Report weapon status, data link status, weapon selected and armed, and visual contact on target to RIO on each run.

5. Monitor aircraft positioning from initial vector through breakaway by pigeons or navigational display.

6. Make missile away reports.

7. Report "switches safe" to RIO after each run.

8. Report fuel switches and state to RIO periodically.

9. Call aborting if any unsafe circumstances are observed.

16.1.1.13.2 RIO

1. Complete with pilot the checklist in accordance with NAVAIR 01-45FDD-1A-1.

2. Challenge pilot on synchronization of compass.

3. Monitor the maneuvering of the aircraft as directed by GCI/CIC.

4. Direct and coordinate maneuvering the aircraft with the pilot as necessary to complete the intercept.

5. Challenge pilot on weapon status, weapon selected and armed, data link, and visual contact with target on each run.

6. Know aircraft positioning from initial vector through breakaway by pigeons or navigational display.

7. Conduct UHF communications from initial vector through breakaway, excluding missile away transmission.

8. Provide pilot with descriptive/directive commentary.

9. Challenge pilot on armament switchology after each run.

10. Challenge pilot on fuel switches and state periodically.

11. Call aborting if any unsafe circumstances are observed.

12. Be especially alert and precise to safely complete a MISSILEX (i.e., differentiate between tractor and target radar return).

16.1.1.14 Tanking

16.1.1.14.1 Pilot

1. Maintain good lookout doctrine.

2. Complete with RIO the Air Refueling Checklist.

3. Monitor sector position of the fuel quantity gauge for a failed-open defuel valve.

4. Report to RIO when fuel transfer is completed.

5. After disengagement, stay behind the drogue until all members of the flight are sighted.

6. Complete with RIO the Postrefueling Checklist.

7. Report fuel received, fuel remaining, and fuel switchology to the RIO.

16.1.1.14.2 RIO

1. Acquire tanker on radar.

2. Keep pilot informed on azimuth, range, and overtake during joinup.

3. Maintain good lookout doctrine.

4. Complete with the pilot the Air Refueling Checklist.

5. Challenge pilot for status of defuel valve.

6. Ensure amber light visible prior to commencing approach.

7. Monitor closure rate on and "coach" pilot into the drogue if requested.

8. Make required voice reports as briefed.

9. Maintain sharp lookout doctrine while engaged.

10. Monitor heading, airspeed and altitude, and report variances to pilot while engaged.

11. Advise pilot of unusual fuel spillage or unsafe probe/drogue conditions.

12. Complete with pilot the Postrefueling Checklist.

13. Challenge pilot on fuel received, fuel remaining, and fuel switchology.

16.1.1.15 Air Combat Maneuvering

16.1.1.15.1 Pilot/RIO. Delineating the entire realm of aircrew responsibility during ACM is beyond the scope of this manual. Careful preplanning and briefing are necessary to ensure adequate crew coordination prior to any ACM mission. As a minimum, each crewmember must have a constant awareness of the rules of engagement, flight safety, fuel state (including bingo), attitude and minimum prebriefed base altitude, and carry on a continuous supportive commentary.

16.1.1.16 Conventional Weapons

16.1.1.16.1 Pilot

1. Complete with RIO the combat checklists.

2. Report fuel switches and state to RIO periodically.

3. Confirm with RIO the dive angle, airspeed, release altitude, and minimum safe altitude for pullout and ejection.

4. Report visual acquisition of target to RIO.

5. Advise RIO of other than prebriefed release parameters if weather/target dictates.

16.1.1.16.2 RIO

1. Complete with pilot the combat checklists.

2. Challenge pilot on fuel state periodically.

3. Confirm with pilot dive angle, airspeed, release altitude, and minimum safe altitude for pullout and ejection.

4. Report visual acquisition of target to pilot.

5. Be prepared to give pilot other than prebriefed release parameters if weather/target dictates.

6. Provide CW commentary if dive angle (steep/shallow), airspeed (fast/slow), altitude, "standby," "mark," and "pull."

7. Be prepared to provide pilot with unusual attitude recovery procedures.

16.1.1.17 Descent/Approach

16.1.1.17.1 Pilot

1. Select the type approach to be made with respect to existing weather.

2. Complete with RIO the Descent/Instrument Penetration Checklist.

3. Challenge RIO on approach plate availability and bingo profile.

4. Monitor UHF communication conducted by the RIO and copy all clearances.

5. When executing a CCA, conform to procedures contained in this manual, CV NATOPS Manual, and augmenting ship instructions.

6. Inform RIO when going from gauges to visual or vice versa.

7. Inform RIO when changing IFF/UHF/tacan.

8. Confirm headings and altitudes with RIO.

9. Crosscheck with RIO pressure altimeter and radar altimeter below 5,000 feet.

10. Ensure ICS remains in the HOT MIC position anytime operating below 2,500 feet AGL unless the use of HOT MIC would significantly detract from safety or mission effectiveness.

11. Advise RIO if fuel dump switch has been activated/deactivated.

12. Advise RIO if experiencing vertigo/disorientation.

13. If RIO experiences vertigo/disorientation, inform him of attitude, altitude, and airspeed.

16.1.1.17.2 RIO

1. Assist the pilot in his decision to commence the approach with existing weather and the selection of the type approach to be made.

2. Prior to penetration, complete with the pilot the Descent/Instrument Penetration Checklist.

3. Update navigation computer prior to commencing an approach.

4. Conduct UHF communications being prepared to request, copy, and readback clearance and provide the pilot with any required information.

5. Aid in planning holding/marshal entry and pattern timing.

6. Monitor altitude, attitude, airspeed during holding, penetration, and approach.

7. Monitor appropriate approach plate, advising pilot of heading changes and altitudes prescribed on the approach plate.

8. When executing a CCA, monitor the procedures of this manual, CV NATOPS Manual, and augmenting ship instruction.

9. Utilize radar during CCA prior to landing. Inform pilot if radar horizon does not match aircraft attitude and place gyro switch out if directed by pilot.

10. When not monitoring the gauges, inform the pilot.

11. Challenge pilot on deviations from published/assigned course or altitude.

12. Know ship/field position relative to bingo field.

13. Report to pilot during penetration and/or descents (VFR or IFR) the aircraft descending through each 5,000 feet of altitude above 5,000 feet and each 1,000 feet below 5,000 feet until reaching desired altitude.

14. Challenge pilot on crosschecking pressure altimeter and radar altimeter passing 5,000 feet.

15. Ensure ICS remains in the HOT MIC position anytime operating below 2,500 feet AGL unless the use of HOT MIC would significantly detract from safety or mission effectiveness.

16. Monitor the fuel dump.

17. Advise the pilot of experiencing vertigo/disorientation.

18. If pilot experiences vertigo/disorientation, inform him of attitude, altitude, and airspeed.

19. Be prepared to talk-down pilot through distance/altitude checkpoints when executing a CCA utilizing radar, tacan, navigation computer, and data link.

20. Inform pilot when going contact or achieving a "ball" when on GCA/CCA.

21. For field landing, brief pilot on location of arresting gear available in terms of runway remaining.

16.1.1.18 Landing

16.1.1.18.1 Pilot

1. Complete with RIO the Landing Checklist.

2. Doublecheck pressure altimeter with radar altimeter and inform RIO.

3. Report indexer lights to RIO (secondary gear check).

4. During mode 1/1A/2 approaches, maintain a running commentary on position of the needles.

16.1.1.18.2 RIO

1. Monitor traffic pattern entry, altitude, airspeed as prescribed by local course rules or CV NATOPS Manual while maintaining a good lookout doctrine and assisting pilot in determining interval.

2. Complete with pilot the Landing Checklist.

3. Challenge pilot on pressure versus radar altimeter.

4. Look in mirrors to check droop of ailerons; look over ducts and check leading edge flaps down; attempt to check gear handle down, hook handle, indexer lights, and no flashing wheels light.

5. Make UHF transmissions as directed by pilot.

6. Be alert for and report conflicting traffic to the pilot.

7. Call for "power" to pilot on touchdown aboard ship.

8. On rollout, confirm status of drag chute. On section landing, lead RIO calls wingman drag chute status and be prepared to advise of arresting gear location.

9. Report to pilot airspeed in conjunction with runway remaining.

16.1.1.19 After Landing

16.1.1.19.1 Pilot

1. Perform Postflight Checklist with the RIO.

2. Report to RIO when wing fold is actuated.

16.1.1.19.2 RIO

1. Perform Postflight Checklist with the pilot.

2. When informed wing fold is actuated, report wing position to pilot.

3. Advise pilot of clearances when taxiing.

4. Complete BIT checks remaining.

5. Monitor and report drag chute clearance from obstructions.

6. Advise pilot when ready for shutdown.

16.1.1.20 Debriefing

16.1.1.20.1 Mission Commander

1. Review the entire flight from takeoff to landing.

2. Specifically comment on errors and techniques and review procedures for correcting/improving them.

16.1.1.20.2 Flight Leader

1. Assist the mission commander when requested and, if directed, debrief all crewmembers on all aspects of the flight from takeoff to landing.

2. When directed, comment on errors and techniques and review procedures for correcting/improving them.

3. When directed, cover completely any deviations from standard operating procedures.

4. Complete all required debriefing forms.

5. Utilize Anymouse reporting to pass the word on unusual flight occurrences if applicable.

16.1.1.20.3 Pilot

1. Assist the mission commander/flight leader when requested and, if directed, debrief all crewmembers on all aspects of the flight from takeoff to landing.

2. When directed, comment on errors and techniques and review procedures for correcting/improving them.

3. When directed, cover completely any deviations from standard operating procedures.

4. Complete the yellow sheet and all required debriefing forms.

5. Utilize Anymouse reporting to pass the word on unusual flight occurrences if applicable.

16.1.1.20.4 RIO

1. Assist the mission commander/flight leader when requested and, if directed, debrief all crewmembers on all aspects of the flight from takeoff to landing.

2. When directed, comment on errors and techniques and review procedures for correcting/improving them.

3. When directed, cover completely any deviations from standard operating procedures.

4. Assist pilot in completing the yellow sheet and all required debriefing forms.

5. Utilize Anymouse reporting to pass the word on unusual flight occurrences if applicable.

PART X

NATOPS Evaluation

CHAPTER 17

NATOPS Evaluation

17.1 NATOPS EVALUATION PROGRAM

17.1.1 Concept. The standard operating procedures prescribed in this manual represent the optimum method of operating this 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 program is achieved only through the vigorous support of the program by commanding officers as well as flight crewmembers.

17.1.2 Implementation. The NATOPS evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flight crewmembers desiring to attain/retain qualification in this aircraft shall be evaluation initially in accordance with OPNAVINST 3710.7 and at least once during the 12 months following initial and subsequent evaluations. Individual and unit NATOPS evaluations will be conducted annually; however, instruction in observation of 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. Evacuees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a reevaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed. Crewmembers possessing a valid F/RF-4 NATOPS evaluation report form, OPNAV form 3510-8, are considered qualified in all F/RF-4 model aircraft provided the conditions outlined in Part II are met.

17.1.3 Definitions

The following terms used throughout this chapter 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 an Unqualified grade for any of his ground examinations or the flight evaluations. Only those areas in which an unsatisfactory level was noted need be observed during a reevaluation.

3. Qualified – Well standardized; evaluee demonstrated highly professional knowledge of and compliance with NATOPS standards and procedures; momentary deviations from or minor omission in noncritical areas are permitted if prompt and timely remedial action is initiated by the evacuee.

4. Conditionally Qualified – Satisfactorily standardized; one or more significant deviations from NATOPS standards and procedures, but no errors in critical areas and no errors jeopardizing mission accomplishment or flight safety.

5. Unqualified – Not acceptably standardized; evaluee fails to meet minimum standards regarding knowledge of and/or ability to apply NATOPS procedures, one or more significant deviations from NATOPS standards and procedures which could jeopardize mission accomplishment or flight safety.

6. Area – A routine of preflight, flight, or postflight.

7. Subarea – A performance subdivision within an area, which is observed and evaluated during an evaluation flight.

8. Critical Area/Subarea – Any area or subarea which covers items of significant importance to the overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

9. Emergency – An aircraft component, system failure, or condition which requires instantaneous recognition, analysis, and proper action.

10. Malfunction – An aircraft component or system failure or condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

17.2 GROUND EVALUATION

Prior to commencing the flight evaluation, an evacuee must achieve a minimum grade of Qualified on the open-book and closed-book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS instructors may use the bank of questions contained in this chapter in preparing portions of the written examinations.

17.2.1 Open-Book Examination. The open-book examination shall consist of but not be limited to the question bank. The purpose of the open-book examination portion of the written examination is to evaluate crewmember knowledge of appropriate publications and the aircraft.

17.2.2 Closed-Book Examination. The closed-book examination may be taken from but not limited to the question bank and shall include questions concerning normal/emergency procedures and aircraft limitations. Questions designated critical will be so marked.

17.2.3 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.

17.2.4 COT/WST Procedure Evaluation. A COT may be used to assist in measuring crewmember efficiency in the execution of normal operating procedures and his reaction to emergencies and malfunctions. In areas not served by the COT facilities, this may be done by placing the crewmember in an aircraft and administering appropriate questions.

17.2.5 NAMT System Check. If desired by the individual squadron, naval air maintenance trainer facilities may be utilized to evaluate pilot and RIO knowledge of aircraft systems and normal and emergency procedures.

17.2.6 Grading Instructions. Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

17.2.6.1 Open-Book Examination. To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

17.2.6.2 Closed-Book Examination. To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

17.2.6.3 Oral Examination and OFT Procedure Check (If Conducted). A grade of Qualified or Unqualified shall be assigned by the instructor/evaluator.

17.3 FLIGHT EVALUATION

The flight evaluation may be conducted on any routine syllabus flight with the exception of flights launched for FMLP/CARQUAL or ECCM training. Emergencies will not be simulated.

The number of flights required to complete the flight evaluation should be kept to a minimum (normally, one flight). The areas and subareas to be observed and graded on a flight evaluation are outlined in the grading criteria with critical areas 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. At the discretion of the squadron or unit commander, the evaluation may be conducted in a WST, OFT, or COT.

17.3.1 Operational Deployable Squadrons. Pilots and RIOs assigned to operational deployable squadrons will normally be checked as a team with the flight evaluation being conducted by the checkcrew flying wing. RIO commentary will be transmitted on the GCI/CIC control frequency in use.

17.3.2 Training and Evaluation Squadrons. Units with training or evaluation missions that are concerned with individual instructor pilot/RIO standardization rather than team standardization may conduct the flight evaluation with the checkcrew/pilot flying wing or on an individual basis. A pilot may be individually checked with the instructor/evaluator conducting the flight evaluation from the rear seat. The RIO may be individually checked by flying with the instructor/evaluator as his crewmember.

17.3.3 Flight Evaluation. The areas and subareas in which pilots and RIOs may be observed and graded for adherence to standardized operating procedures are outlined in the following paragraphs.

Note

If desired, units with training missions may expand the flight evaluation to include evaluation of standardized training methods and techniques.

The IFR portions of the flight evaluation shall be in accordance with the procedures outlined in the NATOPS Instrument Flight Manual.

1. Mission planning/briefing

   a. Flight planning (pilot/RIO)

   b. Briefing (pilot/RIO)

   *c. Personal flying equipment (pilot/RIO).

2. Preflight/line operations – Inasmuch as preflight/line operations procedures are graded in detail during the ground evaluation, only those areas observed on the flight check will be graded.

   a. Aircraft acceptance (pilot/RIO)

   b. Start

   c. Before taxiing procedures (pilot).

3. Taxi/runup

*4. Takeoff/transition

   a. ATC clearance (pilot/RIO)

   b. Takeoff

   c. Transition to climb schedule.

5. Climb/cruise

   a. Departure (pilot)

   b. Climb and level-off (pilot)

   c. Procedures en route (pilot).

*6. Approach/landing

   a. Radar, ADF (pilot)

   b. Recovery (pilot).

7. Communications

   a. R/T procedures (pilot/RIO)

   b. Visual signals (pilot/RIO)

   c. IFF procedures (pilot).

*8. Emergency/malfunction procedures. – In this area, the pilot/RIO will be evaluated only in the case of actual emergencies unless evaluation is conducted in the COT/WST.

9. Postflight procedures

   a. Taxi-in (pilot)

   b. Shutdown (pilot/RIO)

   c. Inspection and records (pilot/RIO)

   d. Flight debriefing (pilot/RIO).

10. Crew coordination

11. Mission evaluation – This area includes missions covered in the NATOPS flight manual, F-4 tactical manuals, and NWPs for which standardized procedures/techniques have been deployed.

12. Applicable Publications – The NATOPS flight manual contains the standard operations criteria for this aircraft. Publications relating to environmental

procedures peculiar to shore-based and shipboard operations and tactical missions are listed below:

F-4 tactical manuals

NWPs

ATC/CATCC manual

Local air operations manual

Carrier air operations manual.

17.3.4 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 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.

17.3.5 Flight Evaluation Grade Determination. The following procedure shall be used in determining the flight evaluation grade: A grade of Unqualified in any critical area/subarea will result in an overall grade of Unqualified for the flight. Otherwise, flight evaluation (or area) 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 subarea. No interpolation is allowed.

Unqualified – 0.0

Conditionally Qualified – 2.0

Qualified – 4.0.

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the subareas and divide this sum by the number of subareas graded. The adjective grade shall then be determined on the basis of the following scale.

0.0 to 2.19 – Unqualified

2.2 to 2.99 – Conditionally Qualified

3.0 to 4.0 – Qualified.

EXAMPLE (add subarea numerical equivalents):

4 + 2 + 4 + 2 + 4 + 5 = 3.20 Qualified

17.3.6 Final Grade Determination. The final NATOPS evaluation grade shall be the same as the grade assigned to the flight evaluation. An evaluee who receives an Unqualified on any ground examination or the flight evaluation shall be placed in an Unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a reevaluation.

17.3.7 Records and Reports. A NATOPS evaluation report (OPNAV form 3510-8) (Figure 17-1) shall be completed for each evaluation and forwarded to evaluee's commanding officer only. This report shall be filed in the individual's NATOPS qualification jacket. In addition, an entry shall be made in the pilot/RIO flight logbook under "Qualifications and Achievements" as follows:

Qualification			Date	Signature
NATOPS EVAL.	(Aircraft Model)	(Crew Position)	(Date)	(Authenticating Signature) (Unit which administered Eval.)

In the case of enlisted crewmembers, an entry shall be made in the Administrative Remarks of his Personnel Record upon satisfactory completion of the NATOPS evaluation as follows:

(Date) Completed a NATOPS evaluation in (aircraft designation) as (flight crew position) with an overall grade of (Qualified or Conditionally Qualified).

17.3.7.1 Critique. The critique is the terminal point in the NATOPS evaluation and will be given by the evaluator/instructor administering the check. Preparation for the critique involves processing, reconstructing data collected, and oral presentation of the NATOPS Evaluation Report. Deviations from standard operating procedures will be covered in detail using all collected data and worksheets as a guide. Upon completion of the critique, the pilot/RIO will receive the completed copy of the NATOPS evaluation report for certification and signature. The completed NATOPS evaluation report will then be presented to the unit commanding officer.

NATOPS EVALUATION REPORT
OPNAV FORM 3510/8 (7-78) S/N 0107-LF-035-1040

REPORT SYMBOL OPNAV 3510-3

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

EXPIRATION DATE

RANK, NAME OF UNIT COMMANDER	SIGNATURE	DATE

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3710.7

N12/88

Figure 17-1. NATOPS Evaluation Report

17.4 NATOPS EVALUATION QUESTION BANK

The following bank of questions is intended to assist the unit NATOPS instructor/evaluator in the preparation of ground examinations and to provide an abbreviated study guide. The questions from the bank may be combined with locally originated questions in the preparation of ground examinations. The closed book exam will consist of no less than 50 questions nor more than 75 questions. The time limit for the closed-book exam is 1 hour and 30 minutes. The requirements for the open-book exam are the same as those for closed-book exam except there is no time limit.

1. An operating procedure, practice, or condition, etc., which if not strictly observed may damage equipment is indicated in the NATOPS manual by _________.

2. Operating procedures, practices, etc., which will result in personnel injury or loss of life if not carefully followed are indicated in the NATOPS manual by _________.

3. The eight circuit breakers in the front cockpit are:

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

   e. ____________________

   f. ____________________

   g. ____________________

   h. ____________________

4. List the warning lights in the RIO cockpit.

   a. Before AFC 506:

      (1) ____________________

      (2) ____________________

      (3) ____________________

      (4) ____________________

      (5) ____________________

      (6) ____________________

   b. F-4J after AFC 506 and all F-4S:

      (1) ____________________

      (2) ____________________

      (3) ____________________

      (4) ____________________

      (5) ____________________

(6) ______________________________

(7) ______________________________

5. The cockpit will begin to pressurize at __________ feet. At 40,000 feet, the cabin altitude should be approximately __________.

6. The rain removal system directs __________ over the center windshield panel.

7. To stop the cooling turbine if the CABIN TURB OVERSPEED light illuminates ____________________.

8. The only control the RIO has over his ventilated wet suit environment is the volume of airflow. T / F

9. To prevent smoke and fumes from entering the cockpit through the air-conditioning system, pull the __________.

10. Illumination of the RADAR CNI COOL OFF light shall be logged on the yellow sheet. T / F

11. Either the pilot or RIO can reset the CNI cooling reset button. T / F

12. Prior to resetting the CNI cooling reset button, what action must be taken:

    a. ______________________________

    b. ______________________________

13. If the CNI COOL OFF light cannot be extinguished, high speed flight should be avoided. T / F

14. Suggested angle-of-attack settings are:

    a. Climb (400 KCAS) __________units

    b. Maximum endurance__________units

    c. Stall warning__________units

    d. Safe gear extension__________units

    e. Safe flap extension (gear already down)__________units

    f. No flap landing__________units

15. The arresting hook is lowered primarily by__________and raised by__________. Once the arresting hook is lowered, it is held on deck by__________.

16. The arresting hookup latch is mechanically operated. T / F

17. With a loss of electrical power, the arresting hook cannot be extended. T / F

18. On F-4J after AFC 534, emergency retraction of the speedbrakes is accomplished by________________.

19. The two modes of operation of the automatic flight control system are (PILOT ONLY)

a. ____________________

b. ____________________

20. The stab aug switches can be engaged individually or in any combination. T / F

21. In the AFCS mode of operation, the pitch limits are__________°, and the roll limits are__________°.

22. The autopilot will disengage when acceleration forces exceed plus__________or minus__________ g.

23. A malfunction in the static pressure compensator will have no effect on autopilot operation, but will affect the altitude hold function. T / F

24. Only__________maximum effort applications of the normal wheelbrakes should be anticipated when utility hydraulic pressure is lost.

25. Actuation of the emergency pneumatic braking system will introduce air into the wheelbrake hydraulic system. T / F

26. The emergency pneumatic brake system does not provide differential braking. T / F

27. Before actuating the canopy manual unlock handle, the normal canopy control handle must be placed in the__________position to relieve any opposing pneumatic pressure.

28. The pilot CANOPY UNLOCKED indicator light will illuminate if the RIO canopy is jettisoned. T / F

29. The canopy is designed to remain in the full open position up to __________knots and to separate from the aircraft at __________knots.

30. Canopy closure should not be attempted with engines running above a stabilized idle rpm. T / F

31. Actuation of the canopy emergency system also actuates the cockpit flooding doors. T / F

32. Under what circumstances is it advisable for the RIO to select command eject?

a. ____________________

b. ____________________

c. ____________________

33. On ejection, the radar indicator and the control box stow automatically; however, the hand control remains out (before AFC 506). T / F

34. With the STATIC CORR OFF light illuminated, actual altitude and airspeed will usually be__________than that indicated by the cockpit instruments.

35. List the five inputs to the ADC:

a. ____________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

36. The ADC supplies corrected information to the following instruments and systems.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

j. ______________________________

k. ______________________________

l. ______________________________

m. ______________________________

n. ______________________________

o. ______________________________

37. The static pressure compensator will automatically reset during engine start. T / F

38. When in the CNI mode, the RIO No. 1 needle on the BDHI will indicate________bearing to the ________ and the No. 2 needle will indicate_____________bearing to the_____________.

39. a. Who can select the UHF antenna to be utilized?______________________________

b. Who can select the tacan antenna to be utilized?______________________________

40. Emergency operation of the intercom system is provided by placing the amplifier selector knob in the B/U position, thereby bypassing the faulty amplifier. T / F

41. If the pilot selects emergency intercom operation, it is necessary for the RIO to also select emergency in order to regain satisfactory intercom communications. T / F

42. The position of the intercom controls will not affect UHF radio operation from either cockpit except volume attenuation in radio override. T / F

43. The CNI equipment operating on external power without cooling air is limited to________________ minutes of accumulated operation in a 1-hour span (excluding ICS and UHF).

44. The items that are released or disconnected when the emergency harness release handle is actuated are:

    a. ____________________

    b. ____________________

    c. ____________________

    d. ____________________

45. The primary source of all electrical power is two______________cycle, ______________ phase, ______________vac generators.

46. With external electrical power connected and either generator control switch in the EXT position, the aircraft buses will be energized. T / F

47. If the left generator is inoperative and the BUS TIE OPEN light is illuminated, all dc buses will be energized. T / F

48. When operating on emergency electrical power, the following items of CNI equipment will be lost:

    a. ____________________

    b. ____________________

49. In F-4S aircraft, the slat blowup speed is approximately ______________knots.

50. Pilot action upon the illumination of a generator warning light is to______________the generator control switch. If the generator does not come back on the line, secure the______________and monitor ______________, ______________, and ______________.

51. After a complete electrical failure, the landing gear should be lowered by______________.

52. The BUS TIE OPEN light may illuminate momentarily when one generator drops off the line. T / F

53. The sea level, standard day, static thrust ratings for the J79-10 engine are______________pounds in MIL and ______________pounds in MAX.

54. The torch igniter plug will operate momentarily each time the throttles are moved to afterburner. T / F

55. The engine start switch should be moved to__________when the engine reaches __________rpm.

56. In the event of a generator or exhaust nozzle failure, the pilot should immediately check the corresponding ______________gauge and______________light.

57. The ignition duty cycle is__________________minutes ON, __________________minutes OFF, __________________minutes ON, and__________________ minutes OFF.

58. Operation with the ENG INLET TEMP HIGH warning light illuminated is prohibited below ___________ feet and is limited to __________________ above __________________ feet.

59. MIL and MAX thrust are time limited to __________________ minutes below 35,000 feet and _______________ hours above 35,000 feet.

60. Because of limited oil distribution to the variable nozzle system during negative g and zero g flight, the aircraft is limited to the following:

    a. __________________seconds of negative g flight.

    b. __________________seconds of zero g flight.

61. The emergency flap system air bottles store enough air for _______________ extension(s) of the wing flaps.

62. If pneumatic pressure is lost when the flaps are blown down, they (will/will not) be blown up by the airstream.

63. When lateral trim corrections are made, the control stick moves in proportion to the amount of trim applied. T / F

64. The stabilator system utilizes a __________________ to increase stick forces during rapid fore and aft stick movement.

65. To temporarily disengage the ARI:

    a. ____

    To permanently disengage the ARI and retain YAW stab aug:

    a. ____

66. The stall warning vibrator is set at:

    a. _______________________units angle of attack.

67. Disengagement of the yaw stability augmentation mode decreases the ARI authority by 5°. T / F

68. Normal rudder trim range is __________________ ±__________________° of rudder deflection.

69. All fuel tanks can be pressure or gravity filled. T / F

70. Two electrically operated fuel boost pumps are located in fuselage fuel cell number __________________. In the event of an electrical failure, the left pump, which is a __________________ speed pump, will operate on low speed when __________________.

71. The internal and external wing tanks are vented to the atmosphere when the landing gear is down and the wing transfer pressure switch is in the EMERG position. T / F

72. Two methods available to pressurize the internal fuel cells and the external wing tanks are:

    a. Landing gear handle – ______________________________

    b. Wing transfer pressure switch – ______________________________

73. With an engine running, fuel from the centerline tank will start transferring upon selection of the ______________ position of the external transfer switch provided that the landing gear handle is in the ______________ position or the wing press switch is in the ______________ position.

74. When operating on RAT electrical power, external tanks may be transferred normally. T / F

75. The internal wing tanks can be pressurized on the ground by moving the wing transfer pressure switch to the ______________ position. Transfer of internal wing fuel can then be accomplished by moving the internal wing transfer switch to the ______________ position if the external tank transfer switch is in the OFF position.

76. The internal wing tanks will be pressurized anytime the wing transfer pressure switch is placed to EMERG and an engine is running and the probe is retracted. T / F

77. Fuel transfer pumps are located in fuselage cells ______________ and ______________. Two are ______________ and two are ______________ operated.

78. Seventeenth-stage engine bleed air is used to transfer ______________ and ______________ fuel. Fuel in fuselage cells ______________, ______________, ______________, and ______________ is transferred by ______________ only (aircraft through block 41).

79. With the bleed air switch in the OFF position, what will be lost?

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

    e. ______________________________

    f. ______________________________

    g. ______________________________

    h. ______________________________

    i. ______________________________

80. Wing fuel may be dumped at anytime regardless of any other transfer switch position by selecting the DUMP position on the internal wing dump switch with external power or normal internal electrical power applied. T / F

81. Wing fuel will be dumped on the deck if the internal wing dump switch is in the DUMP position and external electrical power is applied to the aircraft. T / F

82. The fuel quantity indicator counter indicates fuel quantity in the ____________ and _____________. The tape indicates fuel quantity in ____________ cells ____________ through ___________.

83. To prevent external tank collapse during high-altitude descent with the gear down, place the ___________ in the _______________ position.

84. The internal wing dump control operates normally on RAT electrical power. T / F

85. Internal wing fuel can be dumped regardless of the landing gear handle position when operating on normal electrical power. T / F

86. Illumination of the external fuel warning light is an indication of no flow rather than low fuel quantity. T / F

87. When the air refueling probe is fully extended, the IFR PROBE UNLOCK warning light will not be illuminated. T / F

88. Fuselage fuel cell number seven will transfer either by ________________ or ________________.

89. The FUEL LEVEL LOW warning light will illuminate anytime the combined fuel in fuselage cells and __________________ reaches __________________ pounds.

90. The total internal fuel capacity is approximately __________________ pounds.

91. Fuel boost pump pressure limits on preflight check is ________________ to ________________ psi.

92. Wing fuel transfer limits are __________________° noseup, and __________________° nosedown.

93. a. List the procedures for emergency probe extension.

(1) ____

(2) ____

(3) ____

(4) ____

b. Why is it not recommended to return the emergency probe switch to the normal position?

____

94. Internal wing fuel will not transfer unless the external transfer switch is in the __________________ position.

95. If both fuel boost pumps fail while operating above _______ feet, flameout of both engines may occur.

96. Fuel will be supplied to the engines by gravity feed if a failure of both fuel boost pumps occurs. T / F

97. If one fuel boost pump fails, engine thrust settings should be reduced until a minimum boost pump pressure of ___________________ psi can be maintained.

98. The power control systems supply hydraulic power to the __________, _________, and ___________.

99. There are three independent hydraulic systems in the aircraft; they are the ___________, the___________, and the _______________ systems.

100. Which hydraulic pumps utilize the same reservoir? ____

101. The three hydraulic systems operate in a pressure range of ___________________psi. The CHK HYD GAUGES light will illuminate when any system pressure drops below ___________________± 100 psi and will go out when system pressure recovers to above ___________________psi.

102. A PC-1 or a PC-2 failure will limit full travel of the lateral control surfaces and the stabilator at high airspeeds. T / F

103. A CHK HYD GAUGES warning light with all three gauges indicating 3,000 psi indicates _____________.

104. The PC-1 and PC-2 hydraulic systems utilize the same accumulators and reservoirs. T / F

105. The rudder will be completely inoperative in the event of a utility hydraulic system failure. T / F

106. There is no safety feature incorporated in the landing gear system to prevent retraction on the ground. T / F

107. Nose gear steering is limited to ___________________° either side of center.

108. Two possible ways to deflate the nose gear strut while airborne are:

a. ____

b. ____

109. The nose gear steering system also functions as a ___________________.

110. Actuation of the warning lights test switch by the RIO will illuminate the pilot master caution light. T / F

111. List the data that should be preset into the navigation computer.

a. ____

b. ____

c. ____

d. ____

e. ____

112. The OXYGEN LOW warning light will illuminate when the supply is reduced to 1 liter. T / F

113. The normal pneumatic system pressure range on the cockpit indicator is __________ to __________ psi.

114. The systems operated with pneumatic system pressure are:

a. Normal system operation:

(1) ____

(2) ____________________

(3) ____________________

b. Emergency system operation (F-4J after AFC 370 and all F-4S):

(1) ____________________

(2) ____________________

(3) ____________________

(4) ____________________

(5) ____________________

(6) ____________________

115. If the SPEED BRAKE OUT indicator light illuminates, the MASTER CAUTION light will also illuminate. T / F

116. The wings cannot be folded with the landing gear retracted. T / F

117. The authorized fuels for the aircraft are:

a. Ashore – ____________________

b. Afloat – ____________________

c. Emergency – ____________________

118. For ground pressure refueling with engines off and external electrical power connected, list the fuel control panel switch positions:

a. External transfer switch – ____________________

b. Wing transfer pressure switch – ____________________

c. Refuel selection switch – ____________________

d. Buddy fill switch – ____________________

e. Refuel probe switch – ____________________

119. When pressure refueling on the ground with engines not running and electrical power connected, the engine master switches should be in the ____________________ position.

120. The ground fueling switch is located in the ____________________ wheel well.

121. The main and afterburner fuel controls should be adjusted for the specific density of the fuel grade being used. T / F

122. The maximum airspeed for drag chute deployment is ____________________ KCAS.

123. List the airspeed limitations for:

a. Landing gear extended – ______________________________

b. Wing flap extended – ______________________________

c. Canopy open – ______________________________

d. RAT extension – ______________ KCAS or ______________ Mach, whichever is less.

e. Boarding ladder extended ______________________________

124. The center-of-gravity limitations for all current permissible gross weights and configurations are between ______________ percent and ______________ percent of the mean aerodynamic chord.

125. The weight limitations for the following conditions are:

a. Field takeoff – ______________ pounds.

b. Field landing (flared) – ______________ pounds.

c. Catapulting – ______________ pounds.

d. Arresting landing, touch and go, and FCLP – ______________ pounds.

e. Single-engine approach – ______________ pounds.

126. What is the maximum airspeed and Mach number for the air refueling probe:

a. Extension ______________ KCAS or ______________ Mach, whichever is less.

b. Fully extended ______________ KCAS or ______________ Mach, whichever is less.

127. The maximum gross weight for a flared field landing is ______________ pounds.

128. Maximum gross weight for a field carrier landing is ______________ pounds.

129. List nine prohibited maneuvers:

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ____________________

130. Full pressure suits will be worn on all flights above ____________ feet.

131. The pressure altimeter should be set and checked prior to engaging the static pressure compensator. T / F

132. The limiting crosswind component for drag chute deployment is:

a. Dry runway ____________ knots.

b. Low RCR ____________ knots.

133. The FCLP pattern altitude is ____________ above ground level.

134. The pilot NO-GO signals for catapult abort are:

a. Day – ____________________

b. Night – ____________________

135. If a BLC failure is experienced, approach and landing speeds must be increased. T / F

136. The day signal for HEFOE code commencing is ____________________

____

137. The RIO has just given you a HEFOE signal – four fingers – followed by a thumbs down. What pilot action is required? ____________________

138. The HEFOE signals and meanings are:

FINGERS –	ONE	TWO	THREE	FOUR	FIVE
MEANING –	___	___	___	___	___

139. The ejection signals given to the RIO if the intercom is inoperative with no eject light are:

a. Day ____________________

b. Night ____________________

If there is no response to either a. or b.: ____________________

140. An attempt is made to eject, but the canopy fails to jettison. What is done to manually jettison the canopy?

a. ____________________

If the canopy still fails to jettison:

b. ____________________

c. ____________________

141. After ejection, the crewmember must manually actuate his oxygen supply. T / F

142. The recommended maximum airspeeds for ejection are: ________________.

143. The minimum published altitude for safe ejection is 200 feet. T / F

144. List the procedures required to obtain the use of the essential bus when the left generator failed and the BUS TIE OPEN light is illuminated. ____

____

145. List the NATOPS procedure for engine failure during takeoff, takeoff continued.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

146. List the NATOPS procedure for double-engine failure during flight.

a. ____

b. ____

c. ____

d. ____

e. ____

f. ____

g. ____

147. List the NATOPS airstart procedure.

a. ____

b. ____

c. ____

d. ____

e. ____

148. List the NATOPS procedure for engine fire during start.

a. ______

b. ______

c. ______

d. ______

e. ______

149. List the procedures for recovery from poststall gyrations.

a. ______

b. ______

c. ______

150. List the procedures for recovery from an upright spin.

a. ______

b. ______

c. ______

d. ______

e. ______

151. After the gear and flaps are extended, using the emergency systems, their respective control handles should be reset by the pilot to ready the systems for normal operation. T / F

152. The emergency procedure for lowering the landing gear is:

a. ______

b. ______

c. ______

d. ______

e. ______

153. If a hardover rudder occurs, proceed as follows:

a. ______

b. ______

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

h. ______________________________

i. ______________________________

If unable:

j. ______________________________

154. The flap position for a single-engine landing is ______________ flaps.

155. If a forced landing on unprepared terrain is unavoidable, land with the wheels ______________.

156. If it becomes necessary to jettison both canopies, jettison the ______________ canopy first.

157. If it is necessary to ditch the aircraft, ditch with the wheels ______________.

158. What steps should be taken in the event the intercom became inoperative:

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

159. The pilot/RIO attention signals under emergency conditions with no other means of communication are:

a. Pilot – ______________________________

b. RIO – ______________________________

160. When lost and there is an operative radio receiver, fly two triangles to the ______________, repeating the pattern at ______________ minute intervals.

161. When lost and there are no operative radios, fly two triangles to the ______________, repeating the pattern every ______________ minutes.

162. Supply the bank angles for the following directive commentary:

a. EASY ______________________________

b. PORT (STBD) ____________________

c. HARD ____________________

d. HARD AS POSSIBLE ____________________

e. WRAP IT UP ____________________

163. The proper sequence for information given in description commentary is:

a. ____________________

b. ____________________

c. ____________________

d. ____________________

164. The pilot will echo all directive commentary given by the RIO. T / F

165. Supply the interpretation of the following directive commentary:

a. EASE ____________________

b. HOLD ____________________

c. HARDER ____________________

d. BREAK ____________________

e. COMPASS RECOVERY ____________________

f. BUSTER ____________________

g. GATE ____________________

166. The term JUDY informs the controlling agency that the aircraft radar is locked on the target. T / F

167. The daylight, emergency stop signal is raised crossed arms with clenched fists. T / F

168. BIT checks should not be conducted during:

a. ____________________

b. ____________________

169. In the landing pattern, the RIO will challenge the pilot on the gear, flaps, and hook positions if a report is not received. T / F

170. The RIO will monitor all instrument departures and approaches and will advise the pilot of any course or minimum altitude deviations. T / F

171. A gradual afterburner shutdown must be made at speeds above ________________ KCAS or ________________ Mach, whichever is less, when operating at 40,000 feet.

172. The maximum limiting Mach number for a clean aircraft is ________________ and begins at ________________ feet on a standard day.

173. The maximum allowable airspeed for a clean aircraft below 10,000 feet with cg forward of 30 percent MAC is ________________ KCAS.

174. Maximum allowable acceleration limits of the centerline tank are:

a. Full ________________ to ________________.

b. Empty to three-quarters full ________________ to ________________.

175. Maximum allowable acceleration limits of the external wing tank are:

a. Full ________________ to ________________.

b. Empty to three-quarters full ________________ to ________________.

176. The maximum speed for jettisoning:

a. Wing tanks – ____________ KCAS below 30,000 feet and ____________ KCAS above 30,000 feet.

b. Centerline tank – ____________ KCAS below 15,000 feet ____________ KCAS above 15,000 feet.

177. When the wing missiles are jettisoned, the missiles remain attached to the pylon and the pylon is jettisoned. T / F

178. Which of the following jettison switch(es) is/are hot anytime electrical power is on the aircraft?

a. External stores emergency release button.

b. External wing tank jettison switch.

c. Missile jettison selector switch.

179. In F-4S aircraft, automatic extension of the slats occurs at approximately ________________ units AOA, and automatic slats retraction occurs at approximately ________________ units AOA.

180. In F-4S aircraft and F-4J aircraft after AFC 599, the valves utilized to pneumatically droop the ailerons during emergency flap extension are electrically energized to the open position. T / F

181. In F-4S aircraft if the FLAPS UP or the SLATS MANUAL indicator light illuminates, the MASTER CAUTION light will also illuminate. T / F

Note

For questions pertaining to Weapon Systems, refer to F-4J/S NATOPS Flight Manual Supplement, NAVAIR 01-245FDD-1A-1.

PART XI

F-4J Performance Data

CHAPTER 18

Introduction

18.1 GENERAL

This part is divided into 10 chapters to present performance data in proper sequence for preflight planning. Two concepts of data presentation are utilized to show drag effects on aircraft performance (i.e., specific configuration charts and drag index charts). The drag index concept presents subsonic climb data, nautical miles per pound for cruise/endurance, and descents. All other data are presented as a specific-configuration per chart. All performance data is based on flight tests or the contractor estimate, ICAO standard day conditions, and/or provisions to correct for nonstandard temperatures. Where required, separate charts are provided for J79-GE-8 and J79-GE-10 engines using JP-5 fuel.

Note

> The indication of the fuel quantity indicator presents the readings of actual fuel weight remaining. This is accomplished by means of compensator capacitors which provide accurate readings regardless of changes in the dielectric value of the fuel or variations in specific density because of temperature changes. Therefore, adjustment for various fuel densities is not necessary.

18.2 ARMAMENT ATTACHMENT ASSOCIATION CHART

The information necessary to determine the total weight of the stores loaded on the aircraft and their effect on the aircraft center of gravity is contained in the armament attachment association chart (Figure 18-1) and the station loading chart (Figure 18-2). The armament attachment association chart lists the various attachments (launcher, pylons, racks, and adapters) that are needed to carry an external store on any one particular station.

18.3 STATION LOADING

The station loading chart (Figure 18-2) lists the individual weight, drag number, stability number, station location, and incremental center-of-gravity shift of the various pylons, adapters, racks, and external stores. It also lists the average operating weight with its corresponding center of gravity and the basic takeoff gross weight with its corresponding center of gravity for various aircraft. The chart does not intend to list the quantity and total gross weight of the external stores that can be carried on each station. However, the takeoff gross weight and approximate takeoff center of gravity can be computed by first referring to the armament attachment association chart and determining the various attachments necessary to carry the particular stores that are to be loaded. Next, refer to the station loading chart to find the individual weights and incremental center of gravity shifts of the selected stores and attachments. Once the individual weights have been noted, multiply the individual weights by the quantity to be carried (this figure will be the total external store weight). The external store weight, added to the aircraft basic takeoff weight will result in a close approximation of the takeoff gross weight. The takeoff center of gravity can be computed by adding the incremental center-of-gravity values for each station that the various pylons, adapters, racks, and external stores are intended to be carried on. The summation of the center-of-gravity values, added or subtracted as necessary from the center of gravity corresponding to the basic takeoff weight, will result in a close approximation of the actual takeoff center of gravity.

18.3.1 Incremental CG Shift

18.3.1.1 Sample Problem

CONFIGURATION: Six LAU-68/A rocket launchers on aircraft stations 1 and 9 (full) (three each station).

Six MK 82 LDGP bombs on aircraft station 5.

Estimated cg of 33.7 percent MAC (estimated operating weight plus weight of full internal fuel, not including tank No. 7)

A. LAU-68/A (stations 1 and 9) – +0.10 X 6 = +0.60.

B. Suspension equipment (stations 1 and 9)

(1) Wing tank pylon – +0.04 X 2 = +0.08.

(2) MW adapter – +0.01 X 2 = +0.02.

(3) TER – +0.06 X 2 = +0.12.

C. MK-82 LDGP (station 5)

(1) Forward cluster – -0.31 X 3 = -0.93.

(2) Aft cluster – +0.26 X 3 = +0.78.

D. Suspension equipment (station 5)

(1) MW centerline adapter – 0.

(2) MER (shifted forward) – -0.02 X 1 = -0.02.

E. Incremental cg shift – 0.65.

F. Estimated takeoff cg – 33.7 percent +0.65 = 34.35 percent.

18.3.2 Drag Index System. The drag number for each externally carried store and its associated suspension equipment is listed. The drag index for a specific configuration may be found by multiplying the number of stores carried by its drag number and adding the drag number of the applicable suspension equipment (if not included). The total drag index may then be used to enter the planning data charts. Charts applicable for all loads and configurations are labeled ALL DRAG INDEXES. Charts labeled INDIVIDUAL DRAG INDEXES contain data for a range of drag numbers (i.e., individual curves/columns for a specific drag number). Supersonic data is not compatible to the drag index system; therefore, each chart is labeled for a specific configuration.

18.3.2.1 Sample Problem

CONFIGURATION: Six LAU-68/A rocker launchers on aircraft stations 1 and 9 (full) (three each station).

Six MK 82 LDGP bombs on aircraft station 5.

A. LAU-68/A drag number – 2.7 X 6 = 16.2.

B. Wing tank pylon, MW adapter, TER – 2 (1.1 + 0.4 + 5.5) =14.0.

C. MK 82 LDGP drag number – 1.1 X 6 = 6.6.

D. MW centerline adapter, MER – 2 + 8 = 10.0.

E. Total drag index – 46.8.

18.3.3 Stability Index System. With the many possible external loading configurations and their resulting aerodynamic effects, it is possible to load the aircraft past the aft cg limit. Adding wing-mounted stores tends to shift the aerodynamic center forward toward the cg of the aircraft, thereby reducing the longitudinal maneuvering stability. To be assured of an acceptable static margin, it is necessary to consider stability effects in conjunction with cg location. Each wing-mounted store and its associated suspension equipment is assigned a unit stability number corresponding to its aerodynamic effect. Each stability index (sum of stability numbers) has a corresponding aft cg limit. After the loading configuration has been determined, compute the aircraft stability index. Enter Figure 4-4 with the aircraft stability index to obtain maximum allowable aft cg location. The cg location is determined in the normal manner by using a weight and balance clearance form F in conjunction with the Handbook of Weight and Balance Data, AN-1-1B-40.

Note

- In some cases where the originally desired configuration is not within the allowable envelope, an acceptable static margin may be achieved through rearrangement of wing-mounted stores.
- Tandem-mounted weapons count as a single weapon when computing the aircraft stability index.

Note

- Fuselage-mounted stores are not used in determining aircraft stability index but they are used in computing takeoff cg location.
- Unit stability numbers are assigned for single-mounted and cluster-mounted weapons. The cluster-mounted unit stability number will be used when two or more weapons are mounted on the same rack with each weapon being assigned this number.

18.3.3.1 Sample Problem

CONFIGURATION: Six LAU-68/A rocket launchers on aircraft stations 1 and 9 (full) (three each station).

Six MK 82 LDGP bombs on aircraft station 5.

A. LAU-68/A (cluster-mounted stations 1 and 9) – 5.2 X 6 = 31.2.

B. Wing tank pylon, MW adapter, TER – 2 (4.3 + 6.6) = 21.8.

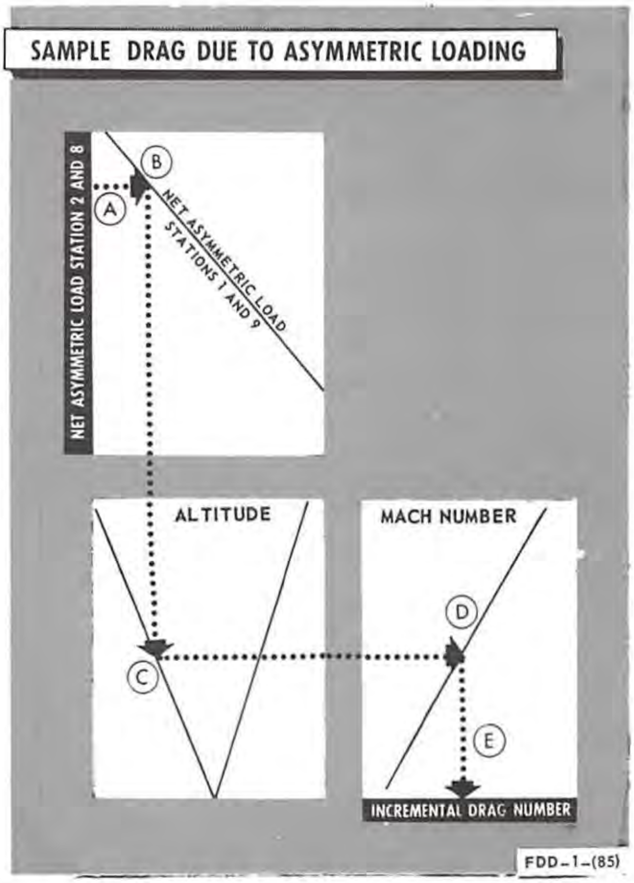
C. Stability index – 53.0.

D. Aft cg limit based on stability index – 35.2 percent MAC.

18.4 DRAG BECAUSE OF ASYMMETRIC LOADING

This chart (Figure 18-3) provides the drag number that results from trimming out an asymmetric store loading. The drag number is added to the computed drag of the aircraft to obtain the drag index. Asymmetric drag varies with Mach number and altitude.

18.4.1 Use. Find the net asymmetric load on stations 2 and 8 (stations 2 and 8 are indicated on the left vertical axis and stations 1 and 9 are indicated by the diagonal parallel lines) by subtracting the lighter from the heavier weight. Attach to this net load the position, RWH (right wing heavy) or LWH (left wing heavy) as appropriate. In the same manner, find the net asymmetric load on stations 1 and 9. Enter the chart with the net asymmetric load for stations 2 and



8 corresponding to the load position. Proceed horizontally to the right to the net asymmetric load on stations 1 and 9 and its position. Proceed vertically downward to the altitude, horizontally to the right to the Mach number, and then vertically downward to obtain the incremental drag number.

18.4.2 Sample Problem

A. Load on station 2 – 1,000 POUNDS.

Load on station 8 – 3,000 POUNDS.

Net asymmetric load on stations 2 and 8 = 2,000 POUNDS RWH.

B. Load on station 1 – 2,500 POUNDS.

Load on station 9 – 2,000 POUNDS.

Net asymmetric load on stations 1 and 9 – 500 POUNDS LWH.

C. Altitude – 25,000 FEET.

D. Mach number – 0.7.

E. Incremental drag number – 5.8.

18.5 AIRSPEED CONVERSION

The airspeed conversion chart (Figure 18-5) provides a means of converting calibrated airspeed to true Mach number and true airspeed.

18.5.1 Use. Enter the chart with the calibrated airspeed and proceed vertically to intersect the applicable altitude. From this point, proceed horizontally to the left to read true Mach number. From the calibrated airspeed-altitude intersection, proceed horizontally to the right to intersect the sea level line. From this point, descend vertically to intersect the applicable flight level temperature. Then proceed horizontally to the right to read true airspeed. To obtain the standard day true airspeed, parallel the curved dash lines from the calibrated airspeed-altitude intersection to the sea level line.

18.5.2 Sample Problem

A. Calibrated airspeed – 330 KNOTS.

B. Altitude – 25,000 FEET.

C. True Mach – 0.782.

D. Sea level line.

E. Flight level temperature – -20 °C.

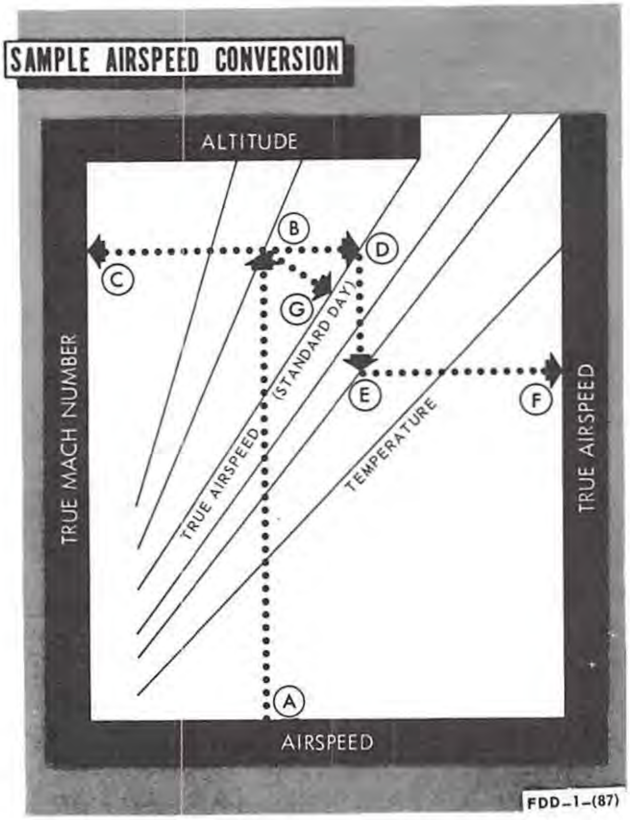
F. True airspeed – 486 KNOTS.

G. True airspeed (standard day) – 472 KNOTS.

18.5.3 Indicated Airspeed. Indicated airspeed (IAS) is the uncorrected airspeed read directly from the indicator when the ADC is inoperative.

18.5.4 Calibrated Airspeed. Calibrated airspeed (CAS) is indicated airspeed corrected for static source error. In the aircraft, the ADC automatically compensates for this error so that calibrated airspeed may be read directly from the indicator.

18.5.5 Equivalent Airspeed. Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility effect. There is no provision for reading EAS; however, it may be obtained by multiplying the TAS by square root of the density ratio.



18.5.6 True Airspeed. True airspeed (TAS) is equivalent airspeed corrected for atmospheric density. Refer to airspeed conversion (Figure 18-5).

18.6 STATIC PRESSURE COMPENSATOR (SPC)/ALTIMETER TOLERANCE

The SPC/altimeter tolerance check chart (Figure 18-6) provides a means of checking the accuracy of the SPC in flight. The chart is plotted for nine units angle of attack between 5,000 and 20,000 feet. The Δ altitude between the curves represents the allowable tolerance of the system.

18.6.1 Use. With the SPC on and operating, establish the aircraft at nine units angle of attack between 5,000 and 20,000 feet at a constant Mach number. Record the Mach number and altitude. Enter the chart with the Mach number and proceed vertically to intersect both curves. From these intersections, proceed horizontally to the left and record the two corresponding Δ altitudes. Add these to the indicated altitude to obtain the upper and lower allowable limits. Move the

SPC switch (labeled CADC), located on the pilot left console, to the OFF position. The altimeter must jump. Note and record the indicated altitude. If the indicated altitude with the SPC turned off falls on or between the previously computed limits, reset the SPC and ensure that the STATIC CORR OFF light is extinguished.

WARNING

If the altimeter does not jump or the indicated altitude with the SPC off does not fall within the limits established by the SPC/altimeter tolerance check chart, leave the SPC off during the remainder of the flight and utilize the altimeter and airspeed position error correction charts (STATIC CORRECTION OFF) in this chapter.

18.6.2 Sample Problem

A. Altitude – 15,000 FEET.

B. Mach – 0.77.

C. Intersect both curves.

D. Lower Δ altitude – 180 FEET.

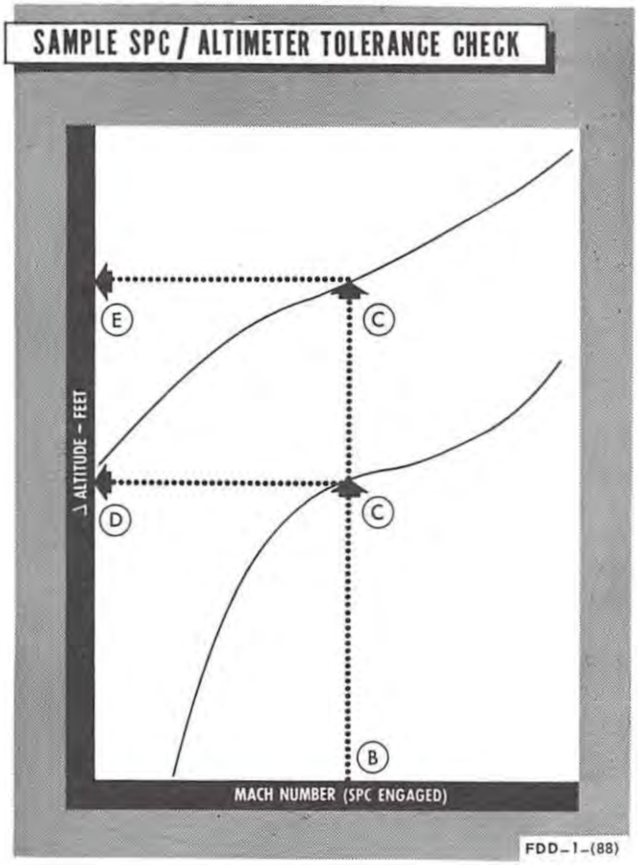
E. Upper Δ altitude – 320 FEET.

F. Lower limit (A + D) – 15,180 FEET.

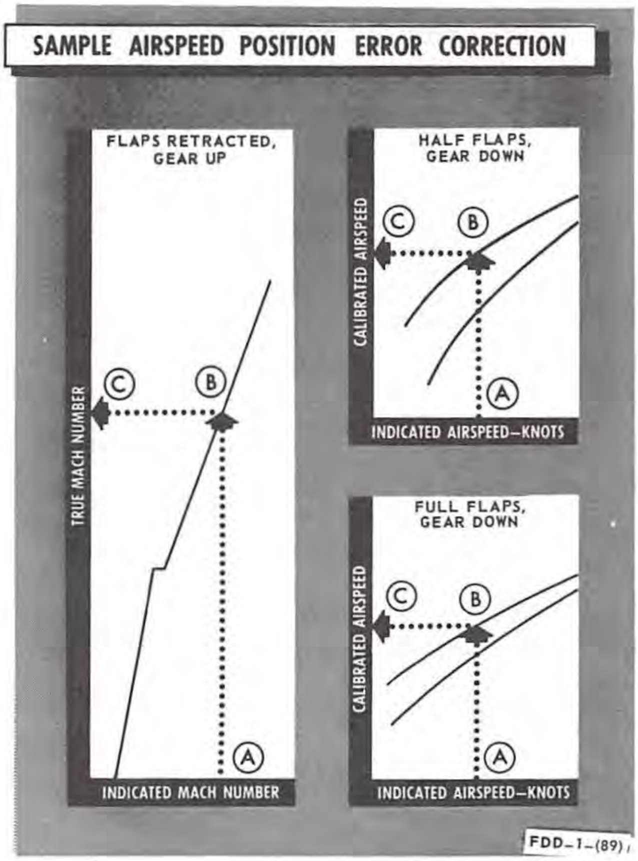
G. Upper limit (A + E) – 15,320 FEET.

18.7 AIRSPEED POSITION ERROR CORRECTION

Under normal conditions, airspeed position error is automatically compensated for by the air data computer system (ADC). However, if a malfunction of the ADC occurs, position error must be applied to the cockpit indication. These charts (Figures 18-7 and 18-8) provide a direct-reading conversation from indicated to calibrated airspeed and from indicated to true Mach number.



FDD-1-(88)



FDD-1-(89)

18.7.1 Sample Problem

CONFIGURATION: Gear Down, Full Flaps

A. Indicated airspeed – 160 KNOTS.

B. Gross weight – 40,000 POUNDS.

C. Calibrated airspeed – 155 KNOTS.

CONFIGURATION: Gear and Flaps Up

A. Indicated Mach number – 1.4.

B. Indicated altitude – 40,000 FEET.

C. True Mach number – 1.34.

18.8 ALTIMETER POSITION ERROR CORRECTION

Under normal operating conditions, compensation for the static source position error as it affects the altimeter is provided by the ADC. If the ADC fails in flight (STATIC CORR OFF), the altimeter must be corrected by means of Figure 18-8. The chart contains three altitude correction (ΔH) plots, one cruise configuration, and two landing configurations. The altitude correction (ΔH) must be added (algebraically) to the assigned altitude to obtain indicated altitude.

Note

Assigned altitude + ΔH = indicated altitude. Fly indicated altitude.

18.8.1 Use. Enter the cruise plot with indicated Mach number. Proceed vertically upward to intercept the assigned altitude curve, then horizontally to the left to read the altitude correction (ΔH). Enter either of the landing plots with the indicated airspeed, proceed vertically to the applicable gross weight reflector, then horizontally to the left to read altitude correction (ΔH). Apply ΔH to the assigned altitude to obtain the indicated altitude.

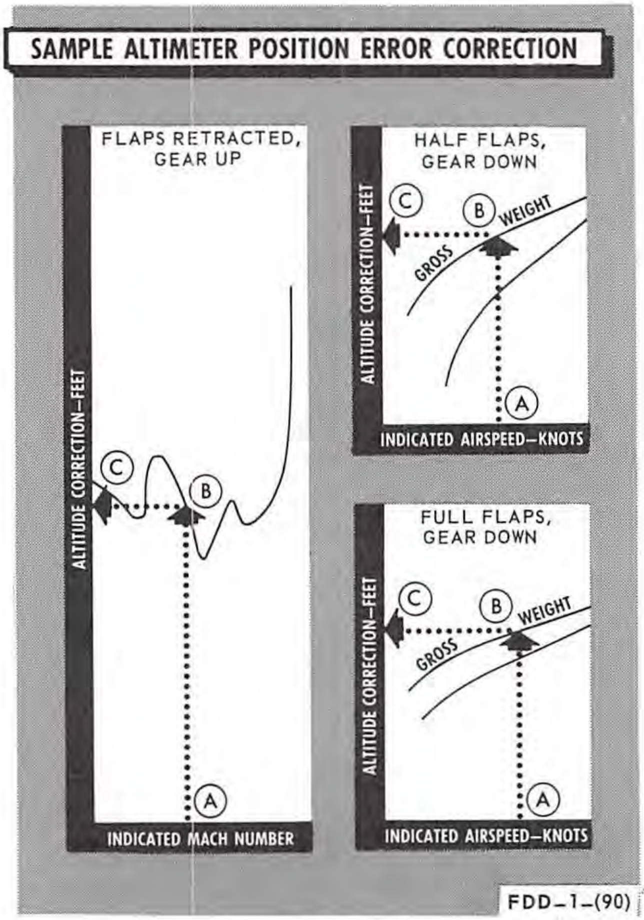
18.8.2 Sample Problem. To maintain 40,000 feet at 1.4 Mach (cruise plot), proceed as follows:

A. Indicated Mach number – 1.4.

B. Assigned altitude – 40,000 FEET.

C. Altitude correction (ΔH) – +2,270 FEET.

D. Fly indicated altitude (B + C) – 42,270 FEET.



18.9 ALTIMETER LAG CHART

These charts Figure 18-9 (sheets 1 and 2) provide a means of obtaining the altimeter lag (difference between indicated altitude and actual altitude) resulting from diving flight. Data is provided for dive angles up to 60° and airspeeds up to 600 KTAS.

18.9.1 Use. Enter the chart with dive airspeed and project horizontally to the right to intersect the dive angle curve. From this point, project vertically downward to read the resulting altimeter lag. Add the altimeter lag data to desired/required pullout altitude to obtain indicated altitude for pullout.

18.9.2 Sample Problem

For aircraft with SPC operative:

A. Dive airspeed – 400 KTAS.

B. Dive angle – 45°.

C. Altimeter lag – 92 FEET.

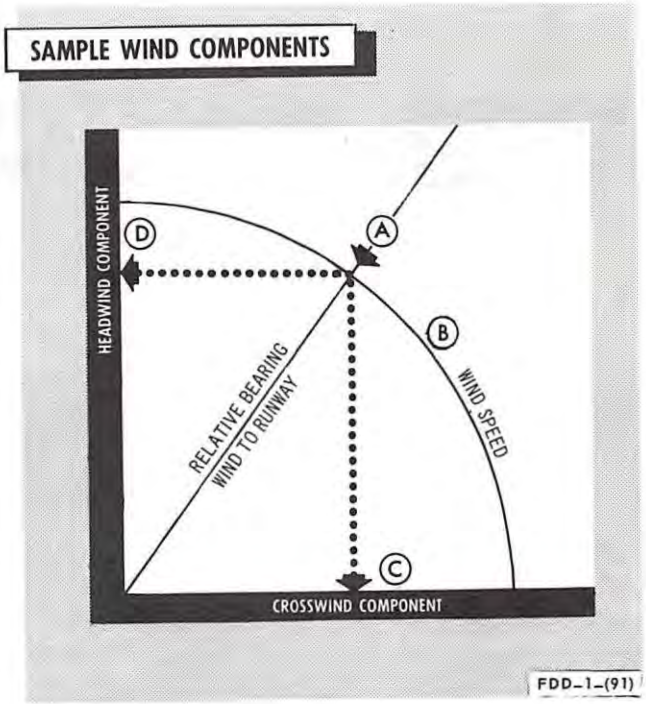
18.10 WIND COMPONENT CHART

A standard wind component chart (Figure 18-10) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind components for takeoff and landing computations. It may, however, be used whenever wind component information is desired. To determine effective wind velocity, add one-half the gust velocity to the steady-state velocity (e.g., reported wind 050/20 G 30, effective wind is 050/25).

18.10.1 Use. Reduce the reported wind direction to a relative bearing by determining the difference between the wind direction and the runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the wind speed arc. From this point, descend vertically to read the crosswind component. From the intersection of bearing and wind speed, project horizontally to the left to read headwind component.

18.10.2 Sample Problem

Reported wind is 050/35; runway heading is 030.



A. Relative bearing – 20°.

B. Intersect windspeed arc – 35 KNOTS.

C. Crosswind component – 12 KNOTS.

D. Headwind component – 33 KNOTS.

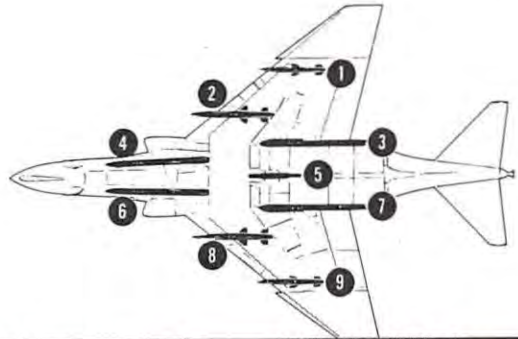
STORES TO BE CARRIED	STATIONS AND ARMAMENT ATTACHMENTS								
	1	2	3	4	5	6	7	8	9
370 GAL. EXT. WING TANK	1								1
MK 81, MK 82, MK 83 LDGP BOMB, MK 86, MK 87, MK 88, MK 124 PRACTICE BOMB	2 14	4			10 15			4	2 14
ADSID I (NORMAL) SENSOR	2 14	4						4	2 14
MK 81, MK 82 LDGP BOMB, MK MK 36 DST, MK 40 DST	2 14	4			10 15			4	2 14
MK 77 MOD 4 FIRE BOMB	2 14	4			10 15			4	2 14
MK 20 MOD 2/3, CHAFFEYE	2 14	4			10 15			4	2 4
MK 12 CHEMICAL TANK	14	4						4	14
LAU-10/A, LAU-10A/A OR LAU-10B/A ROCKET POD	14	4			15			4	14
LAU-32A/A, LAU-32B/A, LAU-56/A, LAU-61/A,LAU-61A/A, LAU-68/A, LAU-68B/A, LAU-69/A, LAU-69A/A ROCKET POD	14	4			15			4	14
MK 76, MK 89, MK 105 PRACTICE BOMB	2 3 14	4 8			10 11 15			4 8	2 3 14
600 GAL. EXT. TANK					9				
CBU-24, -29 -49	2 14	4			10 15			4	2 14
NAMAR CAMERA POD		17						17	
CTU-1/A DELIVERY CONTAINER	2 14				10				2 14

STORES TO BE CARRIED	STATIONS AND ARMAMENT ATTACHMENTS								
	1	2	3	4	5	6	7	8	9
SUU-40/44 FLARE DISPENSER	2 14								2 14
D-704 AIR REFUELING STORE					9				
RCPP-105 STARTER POD					9				
AIM-7 MISSILES		5	16	16		16	16	5	
AIM-9 MISSILE		6						6	
MK 24, MK 45 FLARE	2 3 14	4 8			10 11 15			4 8	2 3 14
RMU-8/A REEL LAUNCHER					9				
CNU-169/A FERRY EQUIPMENT STORE		5						5	
AQM-37A MISSILE TARGET					7				
MK 4 MOD 0 GUN POD					13				
LAU-33A/A		6						6	
MK 82 LGB, MK 83 LGB	2 14	4			10 15			4	2 14
LB-30A STRIKE CAMERA			12						

1 WING TANK PYLON
2 WING TANK PYLON, MULTIPLE WEAPONS ADAPTER, MER
3 WING TANK PYLON, MULTIPLE WEAPONS ADAPTER, A/A37B-3 PMBR
4 LAU-17/A WING MISSILE PYLON, MULTIPLE WEAPONS ADAPTER, TER
5 LAU-17/A WING MISSILE PYLON
6 LAU-17/A WING MISSILE PYLON, LAU-7/A MISSILE LAUNCHER
7 AERO 27A RACK WITH LAU-24 LAUNCHER
8 LAU-17/A WING MISSILE PYLON, MULTIPLE WEAPONS ADAPTER, A/A37B-3 PMBR
9 AERO 27A RACK
10 AERO 27A RACK, MULTIPLE WEAPONS ADAPTER AND CENTERLINE MER
11 AERO 27A RACK AND A/A37B-3 PMBR
12 MISSILE STATION 3 WITH AERO 7A LAUNCHER REMOVED.
13 AERO-27A RACK, MULTIPLE WEAPONS ADAPTER AND GUN POD ADAPTERS
14 WING TANK PYLON, MULTIPLE WEAPONS ADAPTER, TER
15 AERO-27A RACK, MULTIPLE WEAPONS ADAPTER AND TER
16 NO ADDITIONAL EQUIPMENT REQUIRED
17 LAU-17/A WING MISSILE PYLON, MULTIPLE WEAPONS ADAPTER

FDD-1-(92)A

Figure 18-1. Armament Attachment Association



WARNING

For precise external store and attachment information, refer to charts C and E of the Weight and Balance Data Handbook (AN-01-1B-40) for your airplane.

STORES — BOMBS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER — SINGLE MOUNTED	STABILITY NUMBER — CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION		STATION LOCATION and INCREMENTAL C G SHIFT FOR INDIVIDUAL UNIT — 1	2	3	4	5	6	7	8	9
CBU–24/29/49	835	4.2	7.4	9.9	MER	FWD CLUSTER	–.26				–.52				–.26
					MER	AFT CLUSTER	+.57				+.36				+.57
					TER		+.31	–.42			+.05			–.42	+.31
CBU–59/B APAM	750	2.9	7.1	9.4	MER	FWD CLUSTER	–.24				–.49				–.24
					MER	AFT CLUSTER	+.57				+.55				+.57
					TER		+.35	.40			+.08			–.49	+.33
MK 40 DESTRUCTOR (WITH MAU–91 FIN)	1057	3.9	NE	NE	MER	FWD CLUSTER									
					MER	AFT CLUSTER									
					TER										
MK 81 LDGP (WITH CONICAL FIN)	270	0.8	1.8	2.4	MER	FWD CLUSTER	–.10				–.16				–.10
					MER	AFT CLUSTER	+.21				+.10				+.21
					TER		+.10	–.16			+.05			–.16	+.10
MK 81 LDGP (WITH MK 14 FIN OR BSU–33/B)	300	1.2	1.8	2.4	MER	FWD CLUSTER	–.10				–.19				–.10
					MER	AFT CLUSTER	+.23				+.14				+.23
					TER		+.10	–.20			+.05			–.20	+.10
MK 82 LDGP, MK 36 DESTRUCTOR (WITH CONICAL FIN)	531	1.1	2.8	3.7	MER	FWD CLUSTER	–.16				–.31				–.16
					MER	AFT CLUSTER	+.41				+.26				+.41
					TER		+.26	–.36			+.05			–.36	+.26
MK 82 LDGP, MK 36 DESTRUCTOR (WITH MK–15 FIN)	570	2.4	2.8	3.7	MER	FWD CLUSTER	–.16				–.31				–.16
					MER	AFT CLUSTER	+.41				+.26				+.41
					TER		+.26	–.36			+.05			–.36	+.26
MK 82 LGB (KMU–388B) (NON–EXTENDED FIN)	668	2.3	7.8	NA	MER	FWD CLUSTER									
					MER	AFT CLUSTER									
					TER										
MK 82 LGB (MUU–388) (EXTENDED FIN)	682	3.1	7.8	NA	MER	FWD CLUSTER									
					MER	AFT CLUSTER									
					TER										
MK 83 LDGP	985	1.8	4.6	6.1	MER	FWD CLUSTER	–.05				–.62				–.05
					MER	AFT CLUSTER					+.44				
					TER		+.36	–.68			+.10			–.68	+.36
MK 83 LGB	1088	3.6	13.1	NA	MER	FWD CLUSTER									
					MER	AFT CLUSTER									
					TER										
MK 77 MOD 4	520	3.5	14.3	19.1	MER	FWD CLUSTER	–.16				–.21				–.16
					MER	AFT CLUSTER	+.38				+.37				+.38
					TER		+.21	–.36			+.05			–.36	+.21
MK 20 MOD 2/3	475	2.9	NE	NE	MER	FWD CLUSTER	–.16				–.31				–.16
					MER	AFT CLUSTER	+.36				+.21				+.36
					TER		+.15	–.31			+.05			–.31	+.15

STORES — MISSILES		UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER — SINGLE MOUNTED	STABILITY NUMBER — CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	STATION LOCATION and INCREMENTAL C G SHIFT FOR INDIVIDUAL UNIT — 1	2	3	4	5	6	7	8	9
SPARROW III	AIM–7D	402	FUSELAGE MOUNTED 1.3 WING MOUNTED 2.6	FUSELAGE MOUNTED NA WING MOUNTED 2.7	NA	——		–.30	+.35	–.68		–.68	+.35	–.30	
	AIM–7E	455			NA	——		–.33	+.39	–.76		–.76	+.39	–.33	
	AIM–7E–2	427			NA	——		–.33	+.39	–.76		–.76	+.39	–.33	

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Figure 18-2. Station Loading (Sheet 1 of 5)

								1	2	3	4	5	6	7	8	9
SIDEWINDER	AIM-9B	157	1.7	1.0	1.4	—			-.10						-.10	
	AIM-9D/G	197	1.7	1.0	1.4	—			-.14						-.14	
	AIM-9H	195	1.7	1.0	1.4	—			-.14						-.14	
ALQ-120 ECM POD		197	3.8	4.4	NA	—										

A NOSE AND TAIL CONES ON
B NOSE CONE OFF TAIL CONE ON
C NOSE AND TAIL CONES OFF – FULL
D NOSE AND TAIL CONES OFF – EMPTY

STORES	UNIT WEIGHT		UNIT DRAG		STABILITY NUMBER		BOMB RACK or BOMB CLUSTER POSITION	STATION LOCATION and INCREMENTAL C G SHIFT FOR INDIVIDUAL UNIT								
ROCKETS	F / E	FULL / EMPTY	A / B	C / D	SINGLE MOUNTED	CLUSTER MOUNTED		1	2	3	4	5	6	7	8	9
LAU-10/A, A/A, B/A	F	533	3.6	11.2	8.0	10.6										
	E	105	10.2	10.0			TER	+.21	-.36			+.05			-.36	+.21
LAU-32A/A	F	174	2.7	6.8	3.9	5.2										
	E	51	6.3	6.2			TER	+.05	-.14			.00			-.14	+.05
LAU-32B/A	F	175	2.7	6.8	3.9	5.2										
	E	53	6.3	6.2			TER	+.05	-.14			.00			-.14	+.05
LAU-33A/A	F	286	F	2.2	NE	NA										
	E	72	E	2.2			TER									
LAU-56/A	F	188	2.7	6.8	3.9	5.2										
	E	60	6.3	6.2			TER	+.05	-.14			.00			-.14	+.05
LAU-60/A	F	434	4.2	13.5	10.1	13.5										
	E	74	12.5	12.0			TER	+.21	-.36			+.05			-.36	+.21
LAU-61/A, A/A	F	502	4.2	13.5	10.1	13.5										
	E	115	12.5	12.0			TER	+.21	-.36			+.05			-.36	+.21
LAU-68/A, B/A	F	200	2.7	6.8	3.9	5.2										
	E	58	6.3	6.2			TER	+.10	-.16			.00			-.16	+.10
LAU-69/A, A/A	F	483	4.2	13.5	10.1	13.5										
	E	95	12.5	12.0			TER	+.21	-.16			+.05			.16	+.21

STORES	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER		BOMB RACK or BOMB CLUSTER POSITION		STATION LOCATION and INCREMENTAL C G SHIFT FOR INDIVIDUAL UNIT								
PRACTICE BOMBS & ROCKETS			SINGLE MOUNTED	CLUSTER MOUNTED			1	2	3	4	5	6	7	8	9
MK 76	24	0.3	1.0	1.0	PMBR WITH (6) UNITS		+.10	-.16			+.05			-.16	+.10
MK 76	24	0.3	NE	NE	MER	FWD CLUSTER									
						AFT CLUSTER									
					TER										
MK-86 (WATER-SAND FILL)	200	0.8	1.8	2.4	MER	FWD CLUSTER	-.08				-.15				-.08
						AFT CLUSTER	+.17				+.10				+.17
					TER			-.15			+0.0			-.15	
MK-87 (WATER-SAND FILL)	330	1.1	2.8	3.7	MER	FWD CLUSTER	-.12				-.22				-.12
						AFT CLUSTER	+.25				+.15				+.25
					TER			-.24			+.05			-.24	
MK-88 (WATER-SAND FILL)	750	1.8	4.6	6.1	MER	FWD CLUSTER	-.07				-.52				-.07
						AFT CLUSTER					+.36				
					TER			-.56			+.10			-.56	

FDD-1-(93-2)C

Figure 18-2. Station Loading (Sheet 2 of 5)

STORES PRACTICE BOMBS & ROCKETS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
MK 89	56	0.2	NE	NE	PMBR WITH (6) UNITS	+.15	-.26			-.05			-.26	+.15
MK 89	56	0.2	NE	NE	MER FWD CLUSTER									
					MER AFT CLUSTER									
					TER									
MK 106	5	0.4	1.0	1.0	PMBR WITH (6) UNITS	+.05	-.05			.00			-.05	+.05
MK 106	5	0.4	NE	NE	MER FWD CLUSTER									
					MER AFT CLUSTER									
					TER									
MK 124	565	2.8	NE	NE	NE									

STATION LOCATION and INCREMENTAL C G SHIFT FOR INDIVIDUAL UNIT (columns 1–9)

STORES TANKS, RACKS AND PODS		UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
370 GALLON EXTERNAL WING TANKS (INCLUDES PYLON)	MCDONNELL	F 2856	4.8	29.8 [1]	NA		+.13								+.13
		E 340		20.0 [2]			+.04								+.04
	SARGENT FLETCHER	F 2824	6.4	29.8 [1]	NA		+.13								+.13
		E 308		20.0 [2]			+.04								+.04
	ROYAL JET	F NE	6.4	NE	NE										
		E NE													
600 GALLON EXTERNAL CENTERLINE TANK	MCDONNELL	F 4329	9.6	NA	NA						+.21				
		E 249									+.01				
	ROYAL JET	F 4384	9.6	NA	NA						+.21				
		E 304									+.01				
MK 4 GUN POD		F 1390	11.6	NA	NA						+.21				
		E 787									.00				
MK 12 MOD 0 CHEMICAL TANK		F 1000	3.3	8.0	10.6	TER									
		E 350	3.3												
WING TANK PYLON		92	1.1	4.3	NA		+.04								+.04
LAU-17/A GUIDED MISSILE LAUNCHER		150	2.4	6.9	NA			-.07						-.07	
MULTIPLE WEAPONS ADAPTER (OUTBOARD)		24	0.4	NA	NA		+.01								+.01
MULTIPLE WEAPONS ADAPTER (INBOARD)		24	0.3	NA	NA			-.02						-.02	
MULTIPLE WEAPONS TER ℄ ADAPTER		55	2.0	NA	NA						.00				
LAUNCHER LAU-7/A		87	0.4	2.2	NA			-.06						-.06	
MER	℄ STATION	215	8.0	NA	NA	RACK SHIFTED FWD					-.02				
						RACK SHIFTED AFT					+.05				
	WING STATION	225	8.0	7.1	NA	RACK SHIFTED FWD	+.05								+.05
						RACK SHIFTED AFT	+.11								+.11
TER	℄ STATION	95	5.5	NA	NA						+.01				
	WING STATION	95	5.5	6.6	NA		+.06	-.06						-.06	+.06
℄ BOMB RACK AERO-27A		51	NA	NA	NA						.00				
RCPP-105 STARTER POD (FULLY SERVICED)		2016	7.4	NA	NA						+.03				
D-704 AIR REFUEL STORE		F 2773	10.0	NA	NA						+.20				
		E 733	10.0	NA	NA						+.25				
CNU-169/A FERRY MISSION EQUIPMENT STORE		F 435	4.4	18.0	NA										
		E 185													
LB-30A STRIKE CAMERA POD		126	3.0	NA	NA										
ALE-37 DISPENSER		NE	2.8	7.9	10.5										

[1] WING TANK AND PYLON (WITH WEAPONS OR PYLONS INSTALLED ON STATIONS 2 & 8)
[2] WING TANK AND PYLON (WITHOUT WEAPONS OR PYLONS INSTALLED ON STATIONS 2 & 8)

FDD-1-(93-3)B

Figure 18-2. Station Loading (Sheet 3 of 5)

STORES: FLARES, SENSORS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER: SINGLE MOUNTED	STABILITY NUMBER: CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
MK-24, MK 45 FLARE	27	1.0	1.0	1.3	MER FWD CLUSTER	.00				.00				.00
					MER AFT CLUSTER	.00				.00				.00
					TER	.00	.00			.00			.00	.00
SUU-40/44 FLARE DISPENSER	F 365	3.6	NE	NE	MER FWD CLUSTER									
	E 125	3.6			MER AFT CLUSTER	+.31				+.04				+.31
					TER	+.31	-.16			+.10			-.16	+.31
ADSID I (NORMAL) SENSOR	26	4.5	NE	NE	–									
SUU-40/44 DISPENSER WITH AN/GSQ-117/-117LS/-141 SENSOR	NE	3.6 / 3.6	NE	NE	–									
NAMAR CAMERA POD	275	3.8	NE	NE	–									
CTU-1/A DELIVERY CONTAINER (EMPTY) *SEE NOTES	230	4.9	NE	NE	MER									
					TER									
ASDC (AIR-SHIP DELIVERY CONTAINER SYSTEM) — DELIVERY CONTAINER	180 Max	3.7	NA	8.3	TER	+.08	-.12						-.12	+.08
ASDC (AIR-SHIP DELIVERY CONTAINER SYSTEM) — WIRE CONTAINER	F85 E41	4.8	9.3	12.3	TER	+.03	-.06						-.06	+.03

FDD-1-(93-4)B

Figure 18-2. Station Loading (Sheet 4 of 5)

Notes

- THE DRAG INDEX OF THE CLEAN AIRPLANE IS ZERO.
- INDIVIDUAL STORE DRAG X NUMBER OF STORES TO BE CARRIED + SUSPENSION EQUIPMENT DRAG (IF NOT INCLUDED) = DRAG INDEX
- DRAG NUMBERS FOR SINGLE STORES ARE SLIGHTLY CONSERVATIVE. INTERFERENCE DRAG BETWEEN MULTIPLE STORES HAS BEEN CONSIDERED.
- FUSELAGE-MOUNTED STORES ARE NOT USED IN DETERMINING AIRPLANE STABILITY INDEX BUT THEY ARE USED IN COMPUTING TAKEOFF CG LOCATION.
- TANDEM-MOUNTED WEAPONS COUNT AS A SINGLE WEAPON WHEN COMPUTING THE AIRCRAFT STABILITY INDEX.
- UNIT STABILITY NUMBERS ARE ASSIGNED FOR SINGLE MOUNTED AND CLUSTER MOUNTED WEAPONS. THE CLUSTER MOUNTED UNIT STABILITY NUMBER WILL BE USED WHEN TWO OR MORE WEAPONS ARE MOUNTED ON THE SAME RACK, WITH EACH WEAPON BEING ASSIGNED THIS NUMBER.
- NE = NOT ESTABLISHED
- NA = NOT APPLICABLE
- E = EMPTY, F = FULL

* CTU-1/A CARRIER OPERATIONS NOT ALLOWED.

ESTIMATED OPERATING WEIGHT (Basic airplane plus the weight of oil, unusable fuel, and two crew members)

Airplanes	153071z thru 153087aa	29,834 Lbs. 31.6% M.A.C.
	153768ab thru 155528ag	30,280 Lbs. 32.6% M.A.C.
	155529ag and up (Shoehorn equipment included)	31,538 Lbs. 31.4% M.A.C.
	158355at and up	31,785 Lbs. 31.0% M.A.C.

ESTIMATED TAKEOFF GROSS WEIGHT (Estimated operating weight plus weight of full internal fuel including tank no. 7)

Airplanes:	153071z thru 153087aa	43,421 Lbs. 35.2% M.A.C. (NOT INCLUDING NO. 7 TANK 42,775 Lbs. 33.9% M.A.C.)
	153768ab thru 155528ag	43,867 Lbs. 35.9% M.A.C. (NOT INCLUDING NO. 7 TANK 43,221 Lbs. 34.6% M.A.C.)
	155529ag and up (Shoehorn equipment included)	45,125 Lbs. 35% M.A.C. (NOT INCLUDING NO. 7 TANK 44,479 Lbs. 33.7% M.A.C.)
	158355at and up	45,372 Lbs. 34.7% M.A.C. (NOT INCLUDING NO. 7 TANK 44,726 Lbs. 33.4% M.A.C.)

NOTES:

1. The Incremental CG shift effects are in terms of % M.A.C. (+ = AFT CG shift). (− = FWD CG shift). These unit stores increments are approximations only, and will vary depending on the individual airplane gross weight and CG.
2. Fuel weight based on JP−5 at 6.8 lb. per gallon.

FDD-1-(93-5)

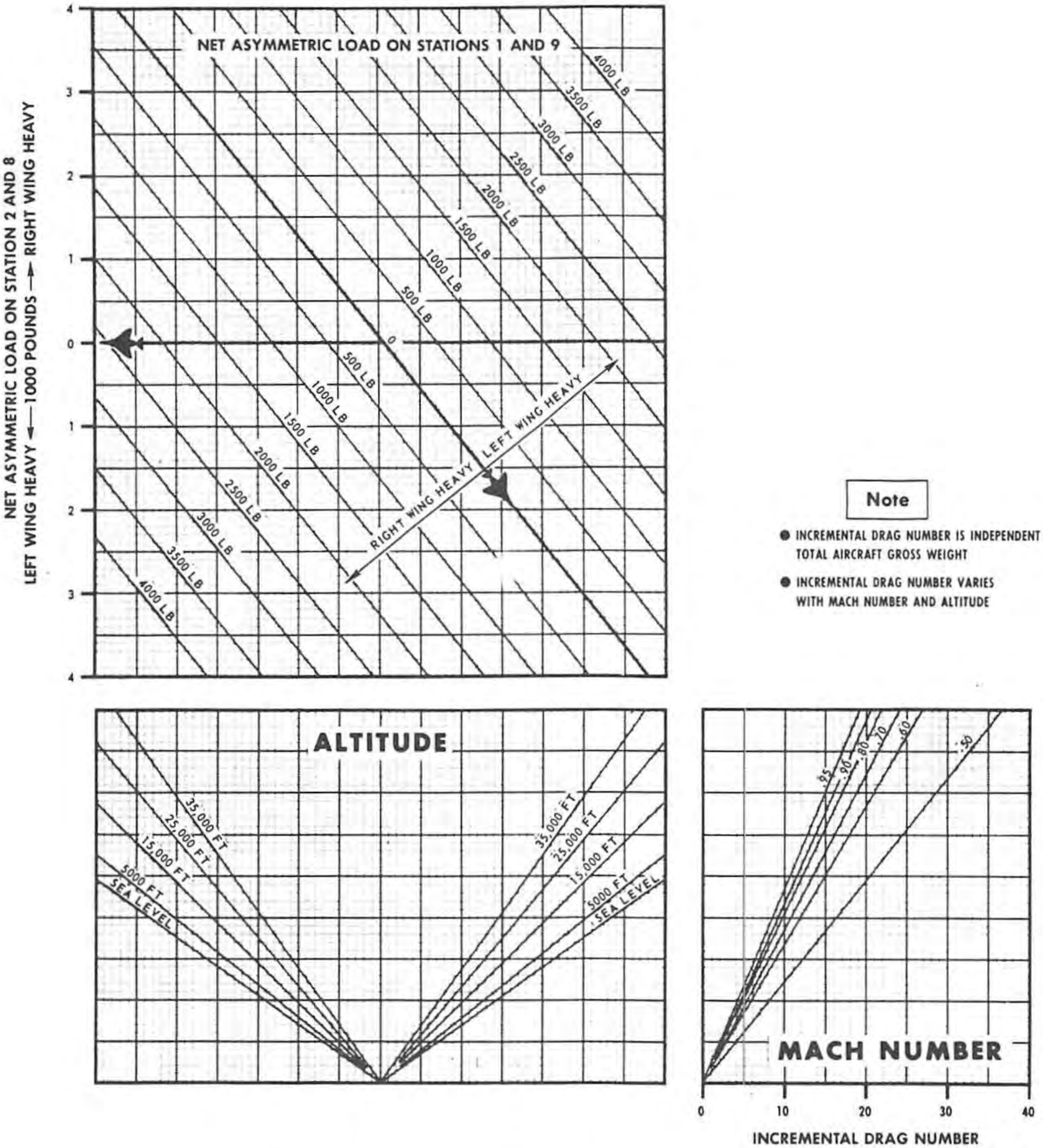
Figure 18-2. Station Loading (Sheet 5 of 5)

REMARKS
ENGINE(S): (2) J79-GE-8 or -10
ICAO STANDARD DAY

GUIDE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MAY 1968
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)



Note

- INCREMENTAL DRAG NUMBER IS INDEPENDENT OF TOTAL AIRCRAFT GROSS WEIGHT
- INCREMENTAL DRAG NUMBER VARIES WITH MACH NUMBER AND ALTITUDE

FDD-1-(94)

Figure 18-3. Drag Because of Asymmetric Loading

Standard Sea Level Air:
T = 15°C.
P = 29.921 in. of Hg.

W = .07651 lb/cu. ft. ρ_0 = .002378 slugs/cu. ft.
1" of Hg. = 70.732 lb/sq. ft. = 0.4912 lb/sq. in.
a = 1116 ft./sec.

This table is based on NACA Technical Report No. 218

ALTITUDE FEET	DENSITY RATIO ρ/ρ_0	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND RATIO a/a_0	PRESSURE	
			DEG. C	DEG. F		IN. OF Hg	RATIO P/P_0
0	1.0000	1.0000	15.000	59.000	1.000	29.92	1.0000
1000	.9710	1.0148	13.019	55.434	.997	28.86	.9644
2000	.9428	1.0299	11.038	51.868	.993	27.82	.9298
3000	.9151	1.0454	9.056	48.301	.990	26.81	.8962
4000	.8881	1.0611	7.075	44.735	.986	25.84	.8636
5000	.8616	1.0773	5.094	41.169	.983	24.89	.8320
6000	.8358	1.0938	3.113	37.603	.979	23.98	.8013
7000	.8106	1.1107	1.132	34.037	.976	23.09	.7716
8000	.7859	1.1280	-0.850	30.471	.972	22.22	.7427
9000	.7619	1.1456	-2.831	26.904	.968	21.38	.7147
10,000	.7384	1.1637	-4.812	23.338	.965	20.58	.6876
11,000	.7154	1.1822	-6.793	19.772	.962	19.79	.6614
12,000	.6931	1.2012	-8.774	16.206	.958	19.03	.6359
13,000	.6712	1.2206	-10.756	12.640	.954	18.29	.6112
14,000	.6499	1.2404	-12.737	9.074	.950	17.57	.5873
15,000	.6291	1.2608	-14.718	5.507	.947	16.88	.5642
16,000	.6088	1.2816	-16.699	1.941	.943	16.21	.5418
17,000	.5891	1.3029	-18.680	-1.625	.940	15.56	.5202
18,000	.5698	1.3247	-20.662	-5.191	.936	14.94	.4992
19,000	.5509	1.3473	-22.643	-8.757	.932	14.33	.4790
20,000	.5327	1.3701	-24.624	-12.323	.929	13.75	.4594
21,000	.5148	1.3937	-26.605	-15.890	.925	13.18	.4405
22,000	.4974	1.4179	-28.586	-19.456	.922	12.63	.4222
23,000	.4805	1.4426	-30.568	-23.022	.917	12.10	.4045
24,000	.4640	1.4681	-32.549	-26.588	.914	11.59	.3874
25,000	.4480	1.4940	-34.530	-30.154	.910	11.10	.3709
26,000	.4323	1.5209	-36.511	-33.720	.906	10.62	.3550
27,000	.4171	1.5484	-38.493	-37.287	.903	10.16	.3397
28,000	.4023	1.5768	-40.474	-40.853	.899	9.720	.3248
29,000	.3879	1.6056	-42.455	-44.419	.895	9.293	.3106
30,000	.3740	1.6352	-44.436	-47.985	.891	8.880	.2968
31,000	.3603	1.6659	-46.417	-51.551	.887	8.483	.2834
32,000	.3472	1.6971	-48.399	-55.117	.883	8.101	.2707
33,000	.3343	1.7295	-50.379	-58.684	.879	7.732	.2583
34,000	.3218	1.7628	-52.361	-62.250	.875	7.377	.2465
35,000	.3098	1.7966	-54.342	-65.816	.871	7.036	.2352
36,000	.2962	1.8374	-55.000	-67.000	.870	6.708	.2242
37,000	.2824	1.8818	-55.000	-67.000	.870	6.395	.2137
38,000	.2692	1.9273	-55.000	-67.000	.870	6.096	.2037
39,000	.2566	1.9738	-55.000	-67.000	.870	5.812	.1943
40,000	.2447	2.0215	-55.000	-67.000	.870	5.541	.1852
41,000	.2332	2.0707	-55.000	-67.000	.870	5.283	.1765
42,000	.2224	2.1207	-55.000	-67.000	.870	5.036	.1683
43,000	.2120	2.1719	-55.000	-67.000	.870	4.802	.1605
44,000	.2021	2.2244	-55.000	-67.000	.870	4.578	.1530
45,000	.1926	2.2785	-55.000	-67.000	.870	4.364	.1458
46,000	.1837	2.3332	-55.000	-67.000	.870	4.160	.1391
47,000	.1751	2.3893	-55.000	-67.000	.870	3.966	.1325
48,000	.1669	2.4478	-55.000	-67.000	.870	3.781	.1264
49,000	.1591	2.5071	-55.000	-67.000	.870	3.604	.1205
50,000	.1517	2.5675	-55.000	-67.000	.870	3.436	.1149

FDD-1-(95)

Figure 18-4. Standard Atmosphere

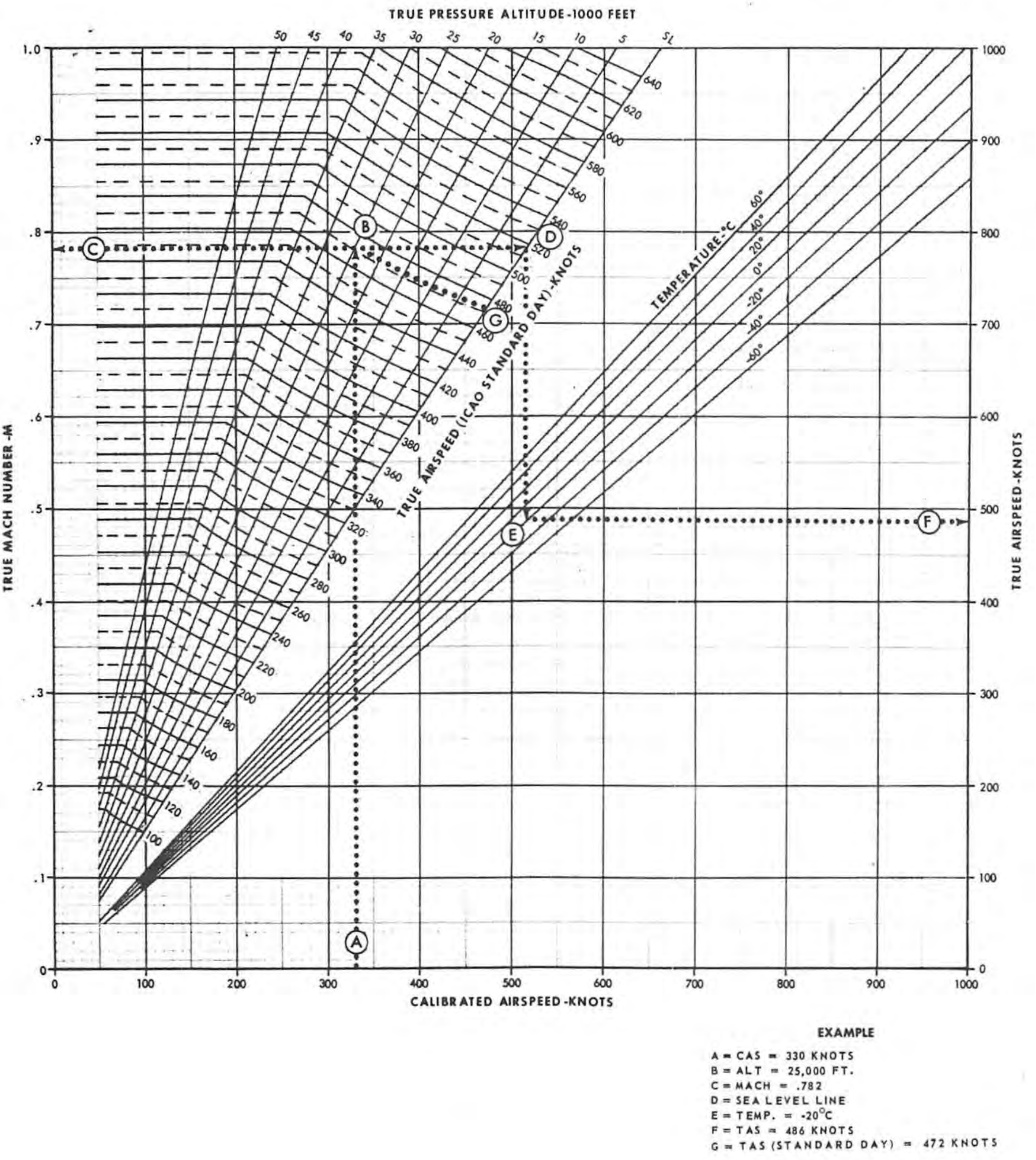


Figure 18-5. Airspeed Conversion (Sheet 1 of 2)

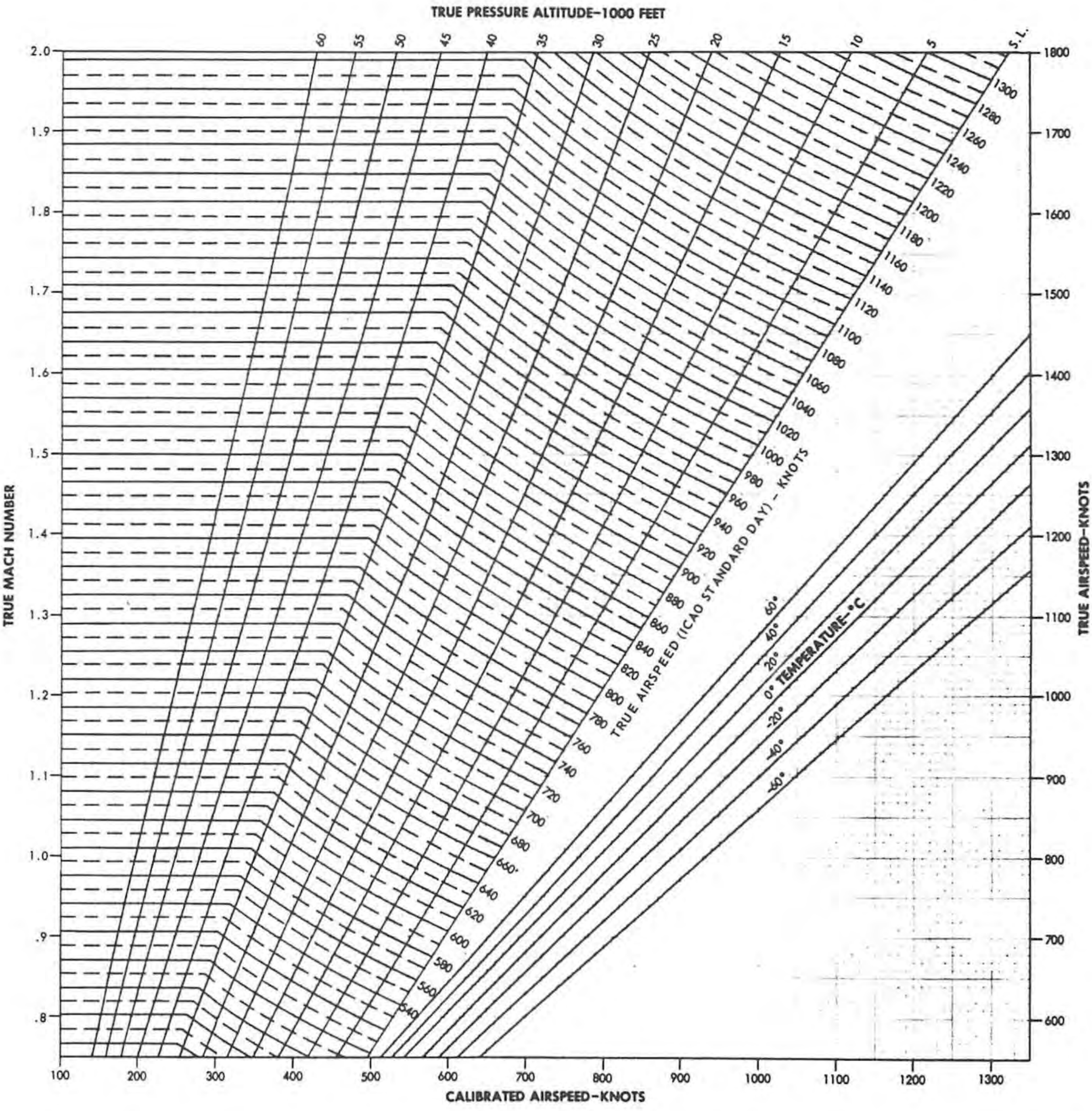
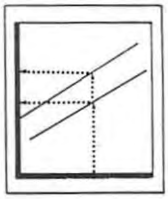


Figure 18-5. Airspeed Conversion (Sheet 2 of 2)

5000 TO 20,000 FEET

REMARKS
ENGINE(S): (2) J79-GE-8 OR-10
ICAO STANDARD DAY

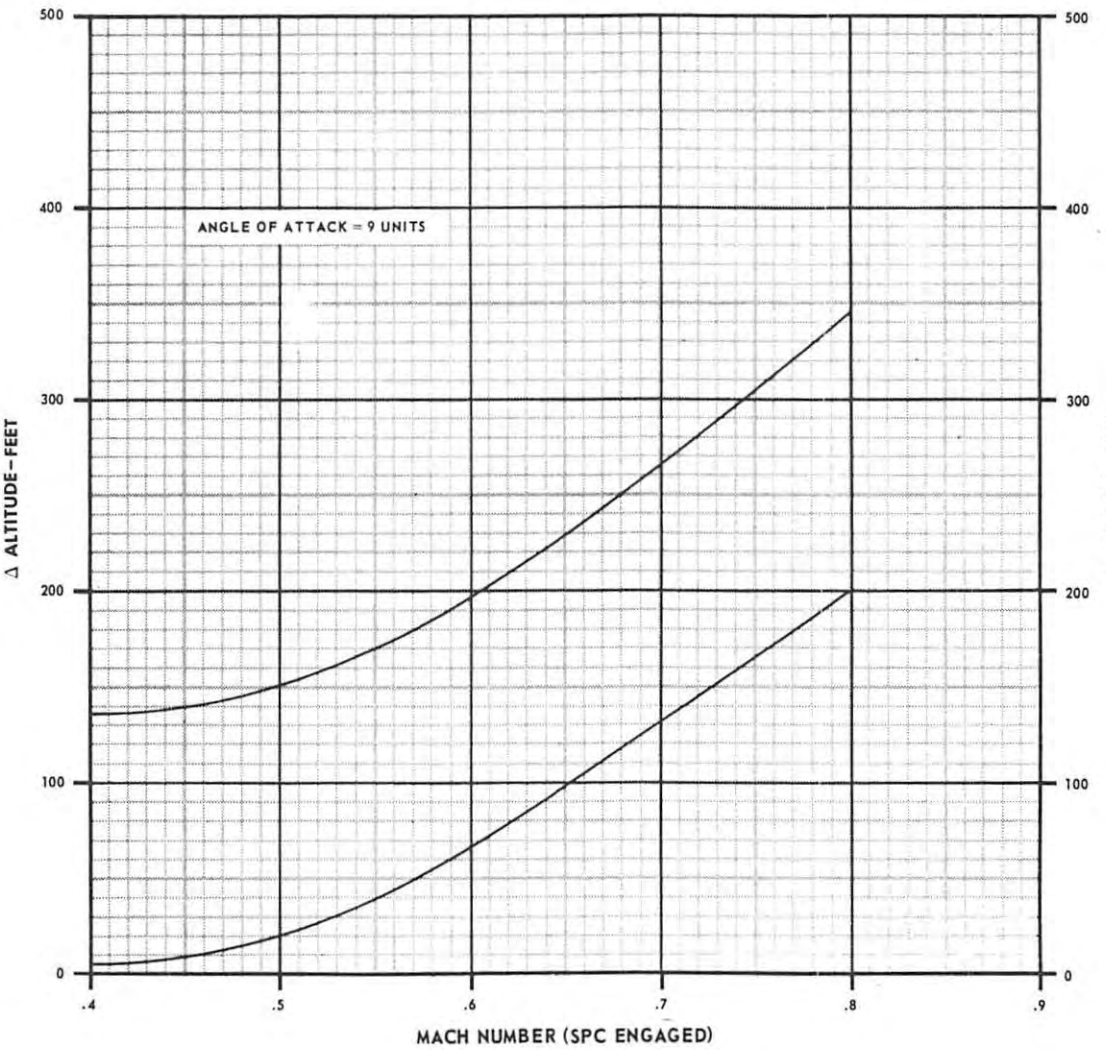
GUIDE



AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS RETRACTED, GEAR UP

DATE: 15 MAY 1967
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8LB/GAL



FDD-1-(97)

Figure 18-6. SPC/Altimeter Tolerance Check

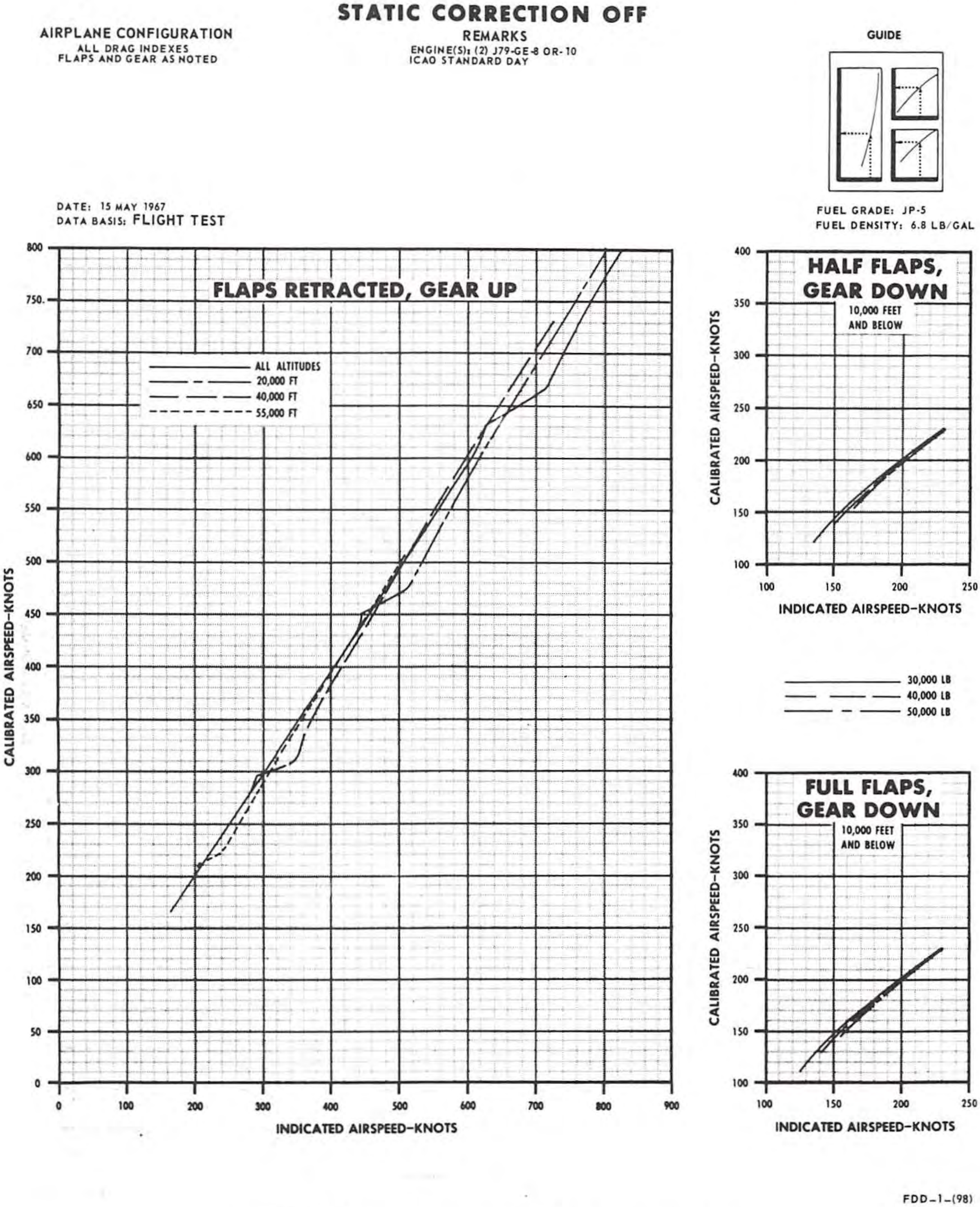


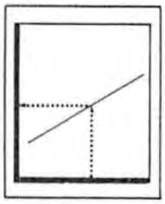
Figure 18-7. Airspeed Position Error Correction (Sheet 1 of 2)

STATIC CORRECTION OFF

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS RETRACTED, GEAR UP

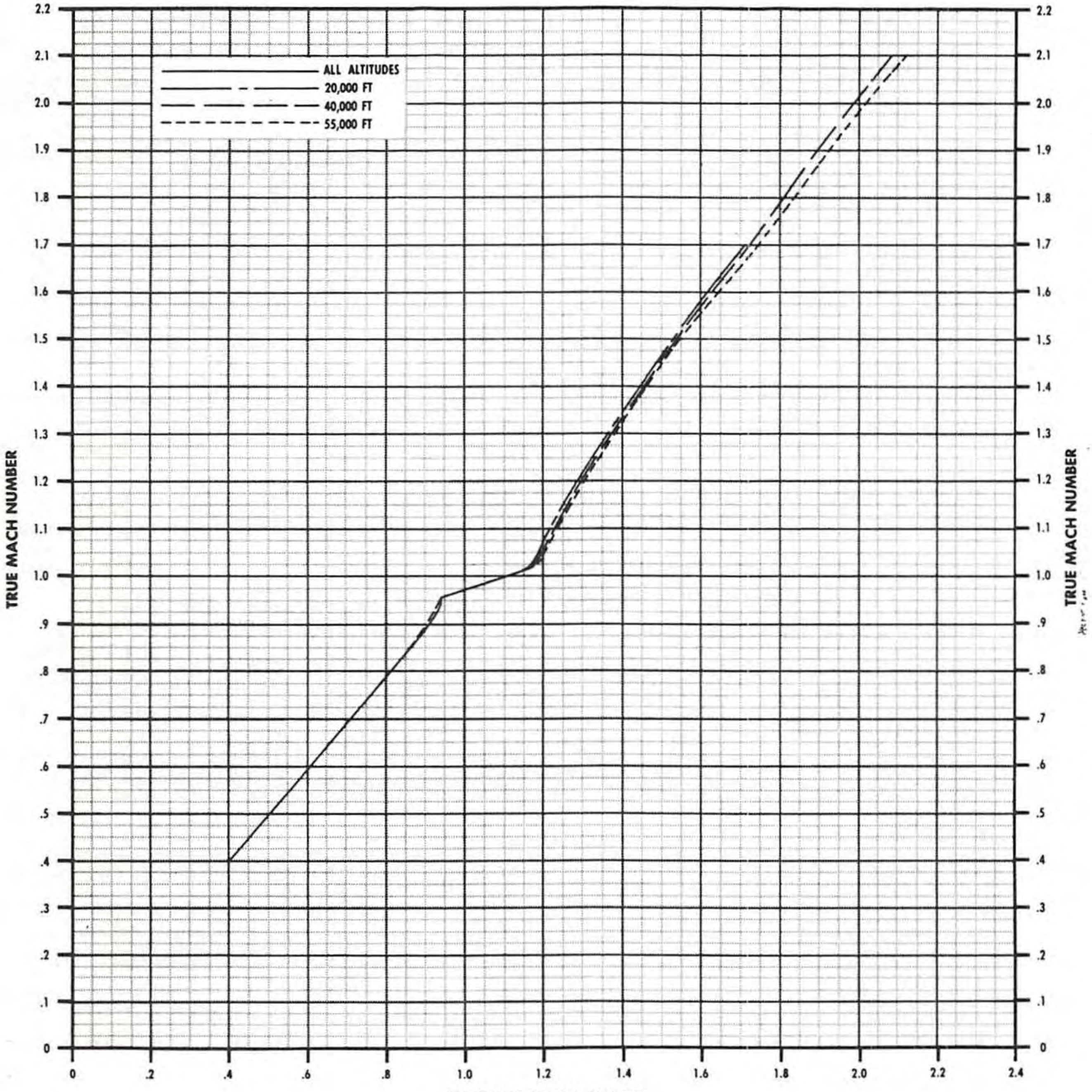
REMARKS
ENGINE(S): (2) J79-GE-8 OR-10
ICAO STANDARD DAY

GUIDE



DATE: 15 MAY 1967
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(99)

Figure 18-7. Airspeed Position Error Correction (Sheet 2 of 2)

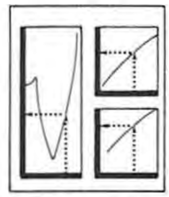
STATIC CORRECTION OFF

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS AND GEAR AS NOTED

REMARKS
ENGINE(S): (2) J79-GE-8 OR-10
ICAO STANDARD DAY

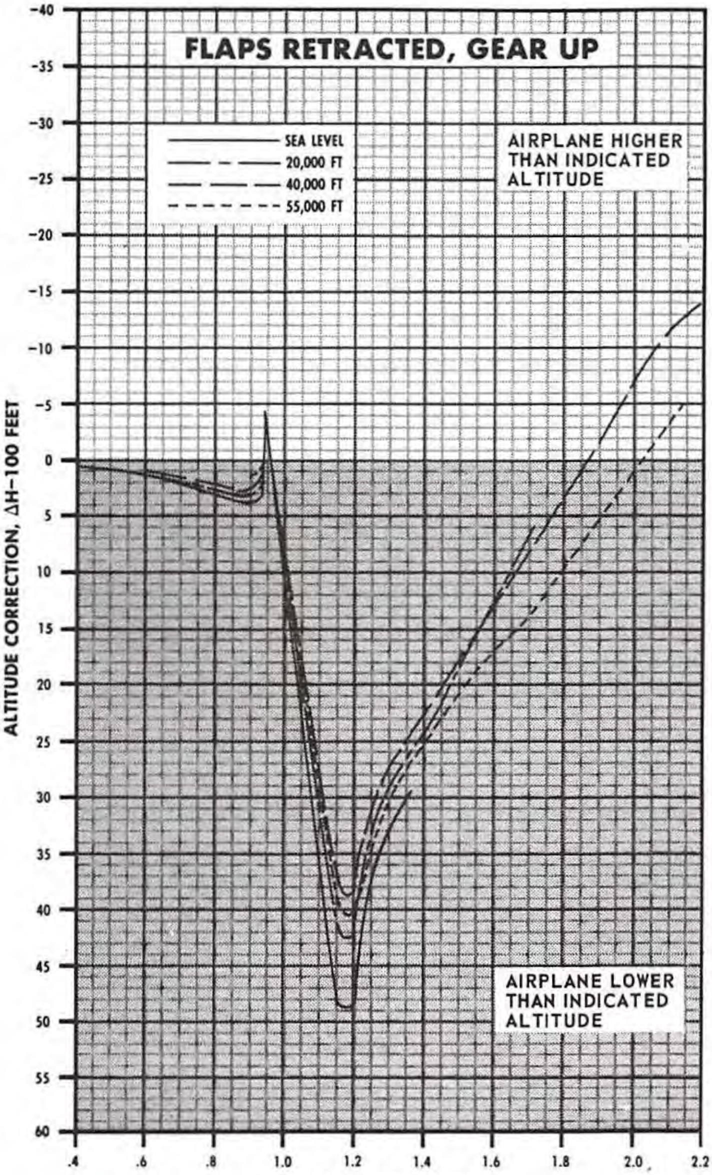
NOTE: ASSIGNED ALTITUDE + ΔH = INDICATED ALTITUDE. FLY INDICATED ALTITUDE.

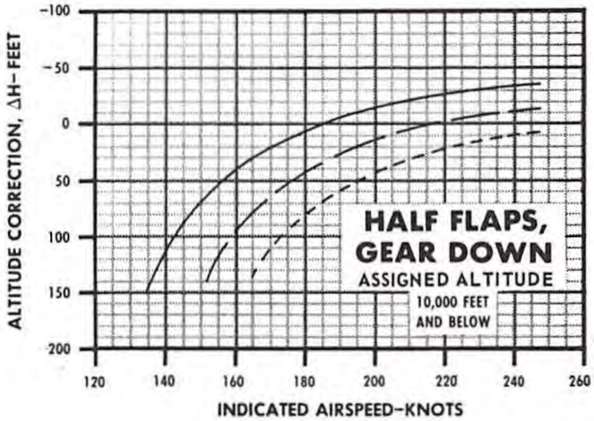
GUIDE

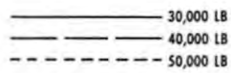


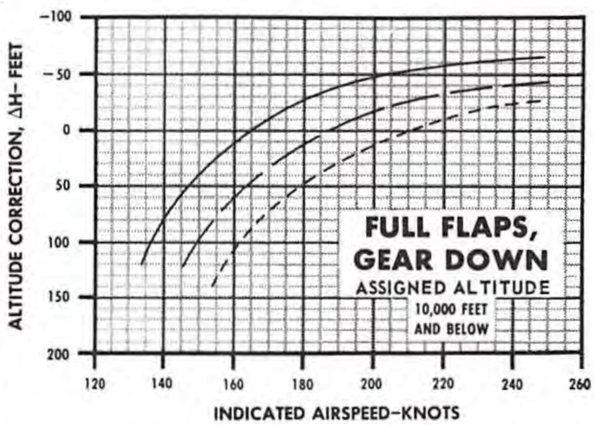
DATE: 15 MAY 1967
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL









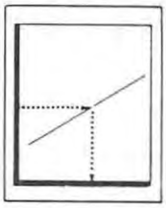
FDD-1-(100)

Figure 18-8. Altimeter Position Error Correction

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

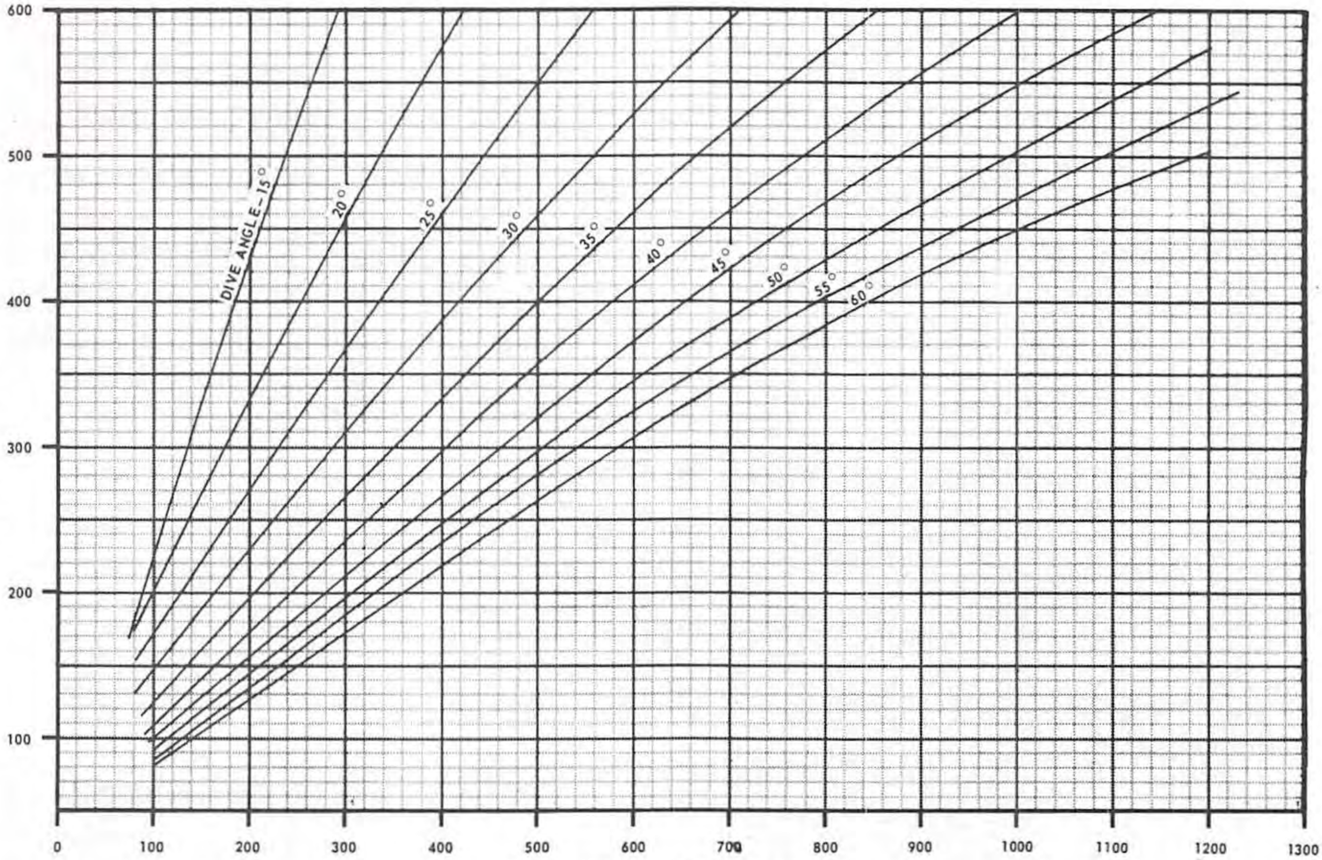
GUIDE



WITH SPC INOPERATIVE

DATE: 1 AUGUST 1969
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(257)

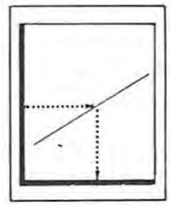
Figure 18-9. Altimeter Lag (Sheet 1 of 2)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

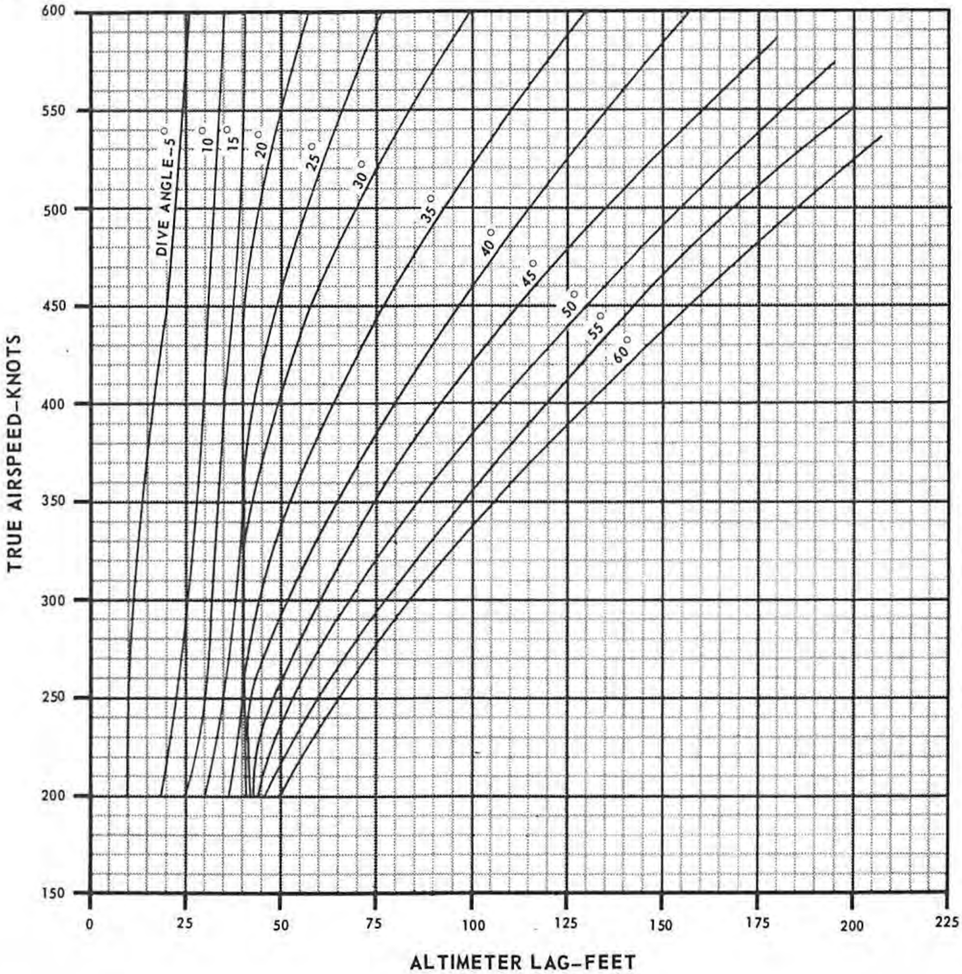
WITH SPC OPERATIVE

GUIDE



DATE: 15 DECEMBER 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(256)

Figure 18-9. Altimeter Lag (Sheet 2 of 2)

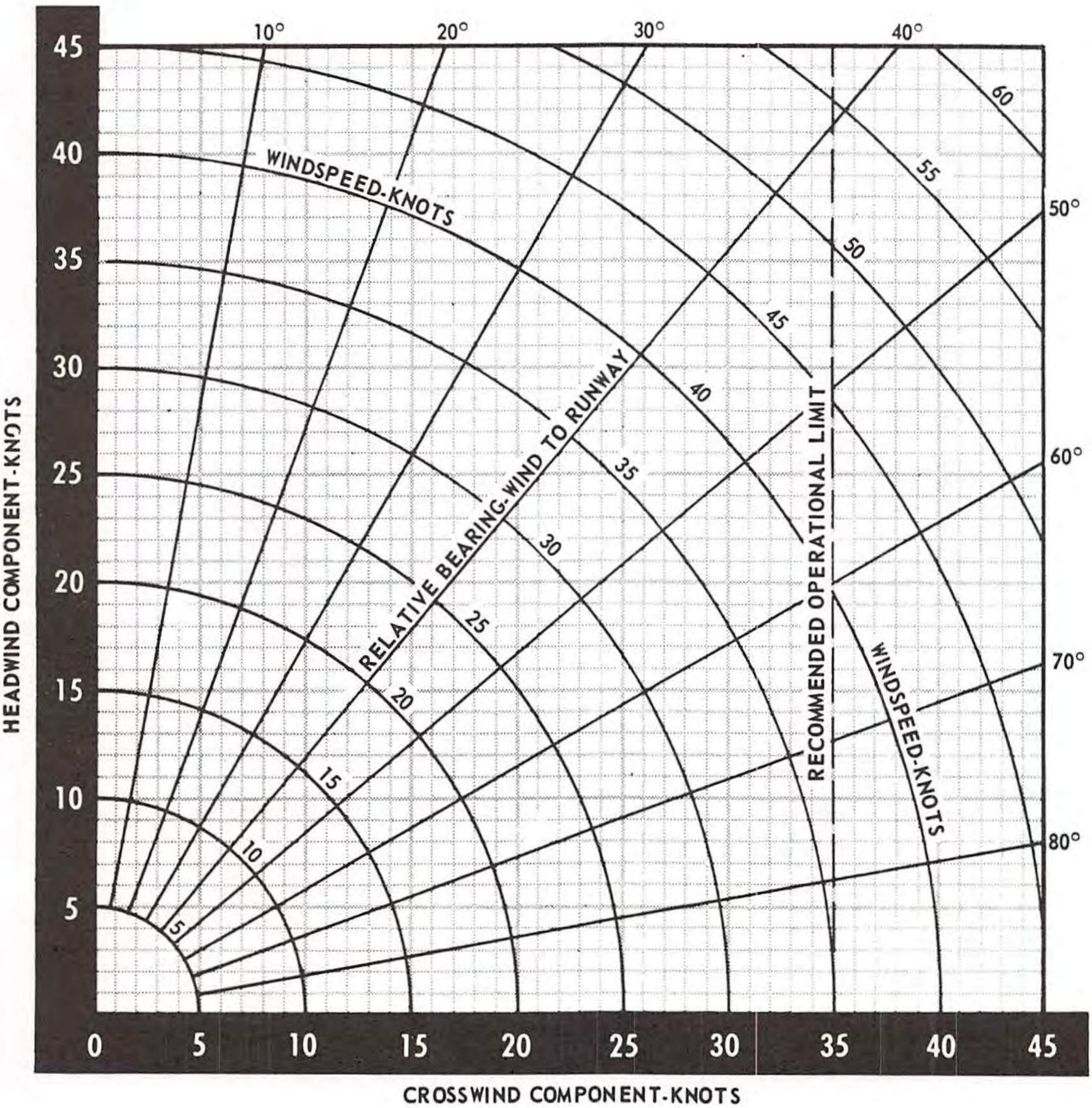


Figure 18-10. Wind Components

CHAPTER 19

Takeoff

19.1 DENSITY RATIO CHART

This chart (Figure 19-1) provides a means of obtaining a single factor (density ratio) that may be used to represent a combination of temperature and pressure altitude. Density ratio must be determined before the takeoff data charts can be utilized.

19.1.1 Use. Enter the chart with the pressure altitude and project horizontally to the right to intersect the appropriate temperature curve. From this intersection, project vertically downward to read density ratio.

19.1.2 Sample Problem

A. Pressure altitude – 5,000 FEET.

B. Temperature – 0 °C.

C. Density ratio – 0.88.

19.2 MINIMUM GO SPEED CHART

This chart (Figure 19-2) provides the means of determining the minimum speed at which the aircraft can experience an engine failure and still take off under existing conditions of temperature, pressure altitude, gross weight, and the runway length remaining. Separate plots are provided for maximum and military thrust conditions. The data is based on an engine failure occurring at the minimum go speed and allows for a 3-second decision period with one engine operating at its initial thrust setting. In the case of a military thrust takeoff, an additional 3-second period is allowed for advancing the operating engine throttle to maximum thrust.

WARNING

Under heavy gross weight/high temperature and/or low RCR factors, it is possible to have a minimum go speed that is higher than the maximum abort speed. Under these conditions, if an engine is lost above the maximum abort speed but below the minimum go speed, the pilot can neither abort nor take off safely on the runway length remaining without considering such factors as reducing gross weight or engaging the overrun end arrestment cable.

19.2.1 Use. Enter the applicable plot with the prevailing density ratio and project horizontally to the available runway length grid line. Parallel the nearest guideline up or down to intersect the baseline. From this point, descend vertically to intersect the applicable takeoff gross weight curve, then horizontally to read minimum go speed. If this projected line does not intersect the computed takeoff gross weight curve, then there will be no corresponding minimum go speed. If the gross weight curve lies to the right of the projected line, a single-engine takeoff cannot be made under the combined conditions.

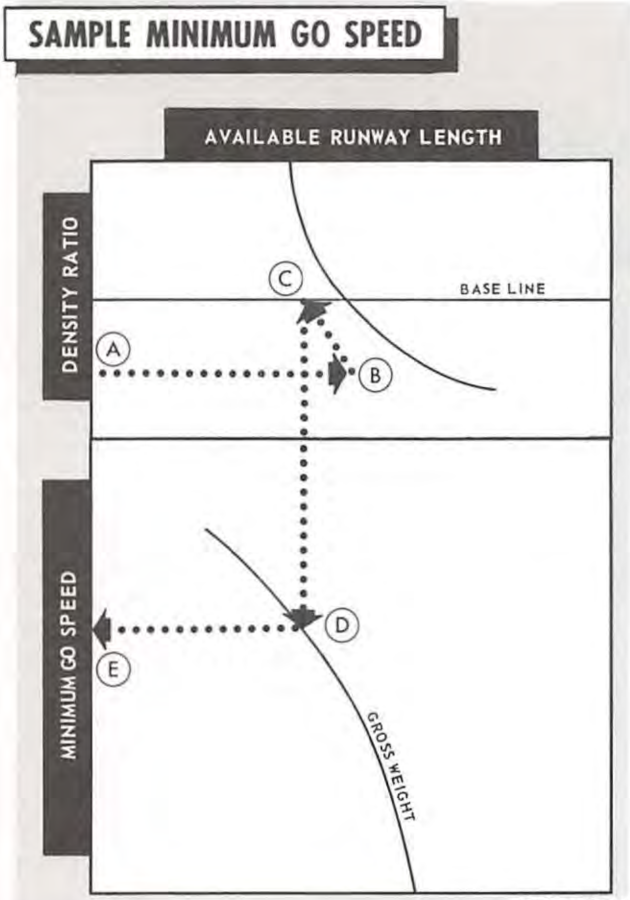
19.2.2 Sample Problem

Note

This problem assumes maximum thrust on operating engine within 6 seconds after engine failure.

Military Thrust Takeoff

A. Density ratio – 0.95.



FDD-1-(312)

B. Available runway length – 11,000 FEET.

C. Parallel guideline to baseline.

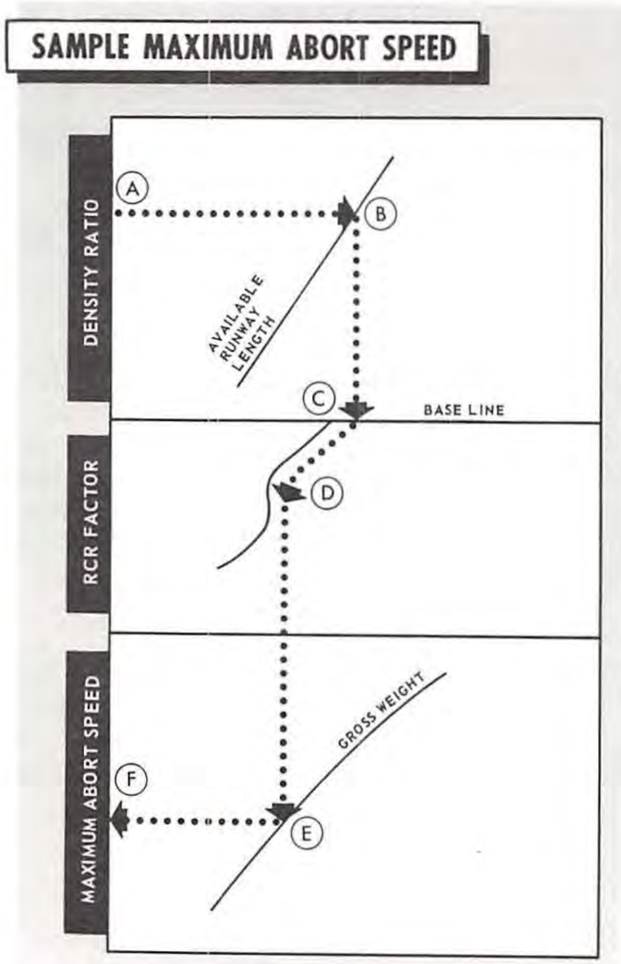
D. Takeoff gross weight – 52,000 POUNDS.

E. Minimum go speed – 156 KCAS.

19.3 MAXIMUM ABORT SPEED CHARTS

Note

The maximum abort speed charts do not include the capability of any arrestment gear which may be installed and take into account only aircraft stopping performance for the given field conditions. However, the capability of the arrestment gear should be considered when computing maximum abort speed. Takeoff may be aborted at the maximum engagement speed for the arrestment gear installed or the maximum abort speed computed from the charts, whichever is higher.



FDD-1-(313)

These charts (Figure 19-3 (sheets 1 and 2)) provide a means of determining the maximum speed at which an abort may be started and the aircraft stopped within the remaining runway length. Separate charts are provided for maximum and military thrust and each chart has separate plots to relate drag chute effects. Allowances included in this data are based on 3-second decision period (with both engines operating at the initial thrust setting) and a 5-second period to accomplish abort procedures (throttles to IDLE, wheelbrakes applied, and drag chute deployed (if used).

19.3.1 Runway Condition Reading (RCR) Factors. RCR factors are synonymous with runway condition and climatic conditions. If RCR factors are not available (i.e., not provided at local base of operation), use RCR factor 23 for a dry runway, RCR factor 14 for a wet runway, and RCR factor 5 for an icy runway.

19.3.2 Use. Enter applicable plot with the prevailing density ratio and project horizontally to intersect the available runway length curve. From this point, descend vertically to the RCR baseline and parallel nearest guideline down to the forecast RCR factor. From this point, descend further to intersect the computed takeoff gross weight, then horizontally to read the corresponding maximum abort speed.

19.3.3 Sample Problem

Maximum Thrust Takeoff Without Drag Chute

A. Density ratio – 1.0.

B. Available runway length – 8,000 FEET.

C. RCR baseline.

D. RCR factor – 16.

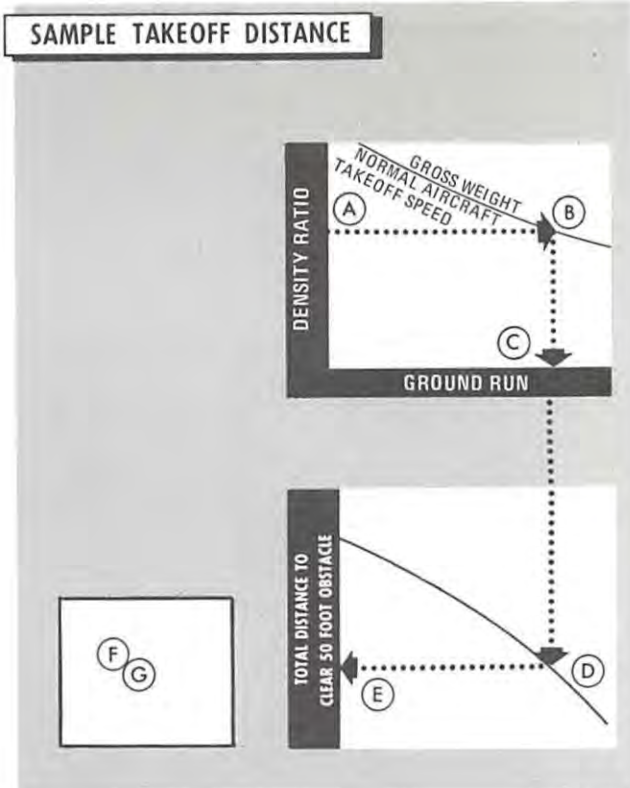
E. Gross weight – 50,000 POUNDS.

F. Maximum abort speed – 69 KNOTS.

19.4 TAKEOFF DISTANCE CHARTS

These charts (Figure 19-4 (sheets 1 and 2)) are used to determine the no wind ground run distance, wind adjusted ground run, and the total distance required to clear a 50-foot obstacle. Separate charts are provided for maximum and military thrust. A table has been provided to show nosewheel liftoff speed with the corresponding aircraft takeoff speed for various gross weight and cg combinations.

19.4.1 Use. Enter the chart with the applicable density ratio and proceed horizontally to the right and intersect the takeoff weight line. Then descend vertically to read no wind ground run distance. Parallel the appropriate wind guideline (headwind or tailwind) to intersect the takeoff wind velocity. From this point, project vertically down to read the ground run adjusted for wind effects. To find the total distance required to clear a 50-foot obstacle, continue downward to the reflector line and project horizontally to the left scale.



FDD–1–(314)

19.4.2 Sample Problem

Maximum Thrust

A. Density ratio – 0.98.

B. Gross weight – 46,000 POUNDS.

C. No wind ground run distance – 2,600 FEET.

D. Effective headwind – 10 KNOTS.

E. Ground run (wind corrected) – 2,400 FEET.

F. Intersect reflector line.

G. Total distance required to clear 50-foot obstacle – 3,500 FEET.

H. Nosewheel liftoff speed for cg of 27 MAC (from table) – 163 KNOTS.

I. Takeoff speed (from table) – 176 KNOTS.

AIRPLANE CONFIGURATION

ALL DRAG INDEXES

DATE: 1 FEBRUARY 1969

DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

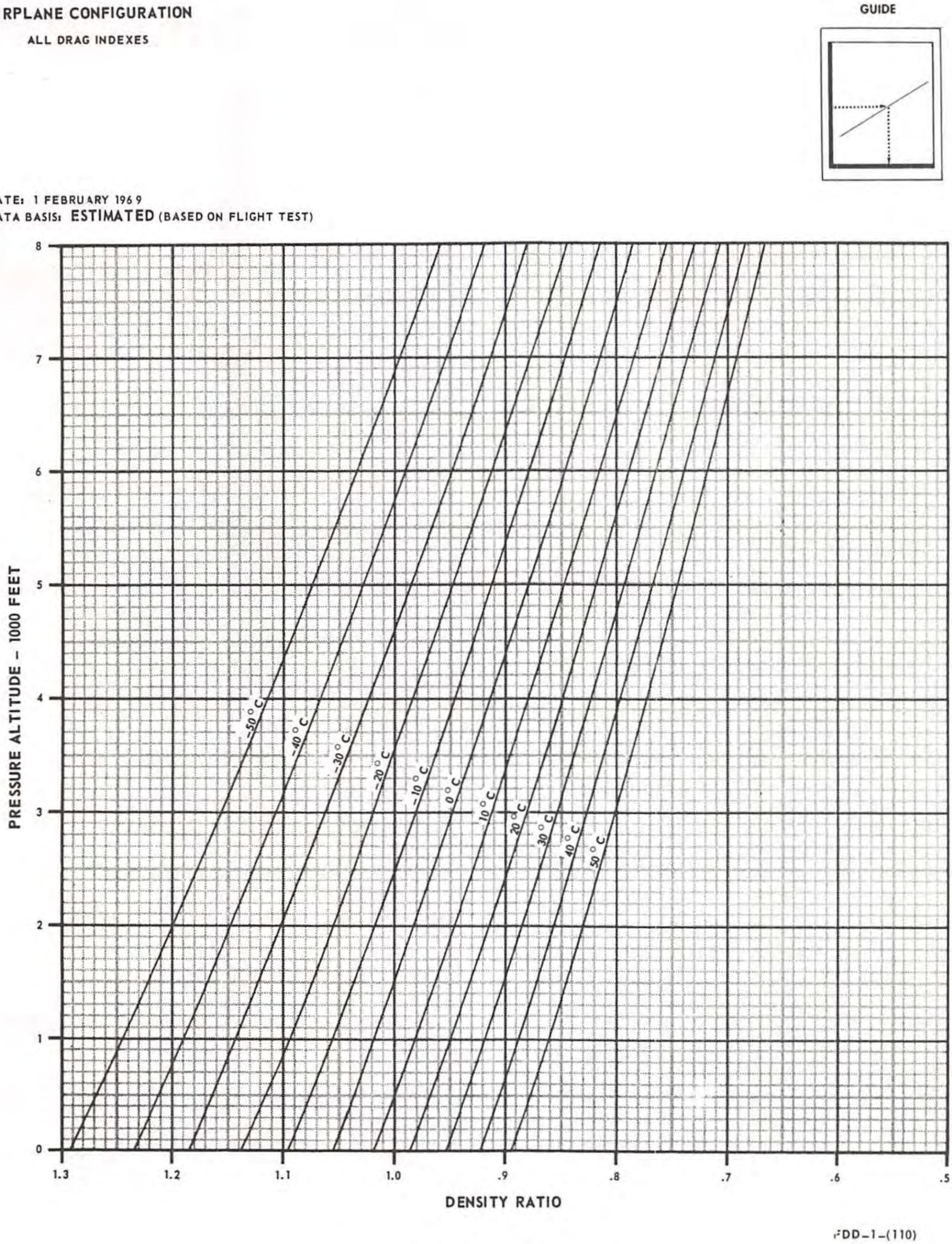


Figure 19-1. Density Ratio

AIRPLANE CONFIGURATION
1/2 FLAPS, DOWN
ALL DRAG INDEXES

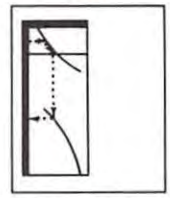
REMARKS
ENGINE(S): (2) J79–GE–10

NOTES

- SINGLE–ENGINE TAKEOFF, WITH AFTERBURNER IGNITED ON OPERATING ENGINE AFTER FAILURE DURING MILITARY THRUST TAKEOFF.
- SINGLE–ENGINE TAKEOFF/CLIMB–OUT CAPABILITY IS CRITICAL WITH HIGH GROSS WEIGHT AT LOW DENSITY RATIOS.

DATE: 1 MAY 1975
DATA BASIS: FLIGHT TEST

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

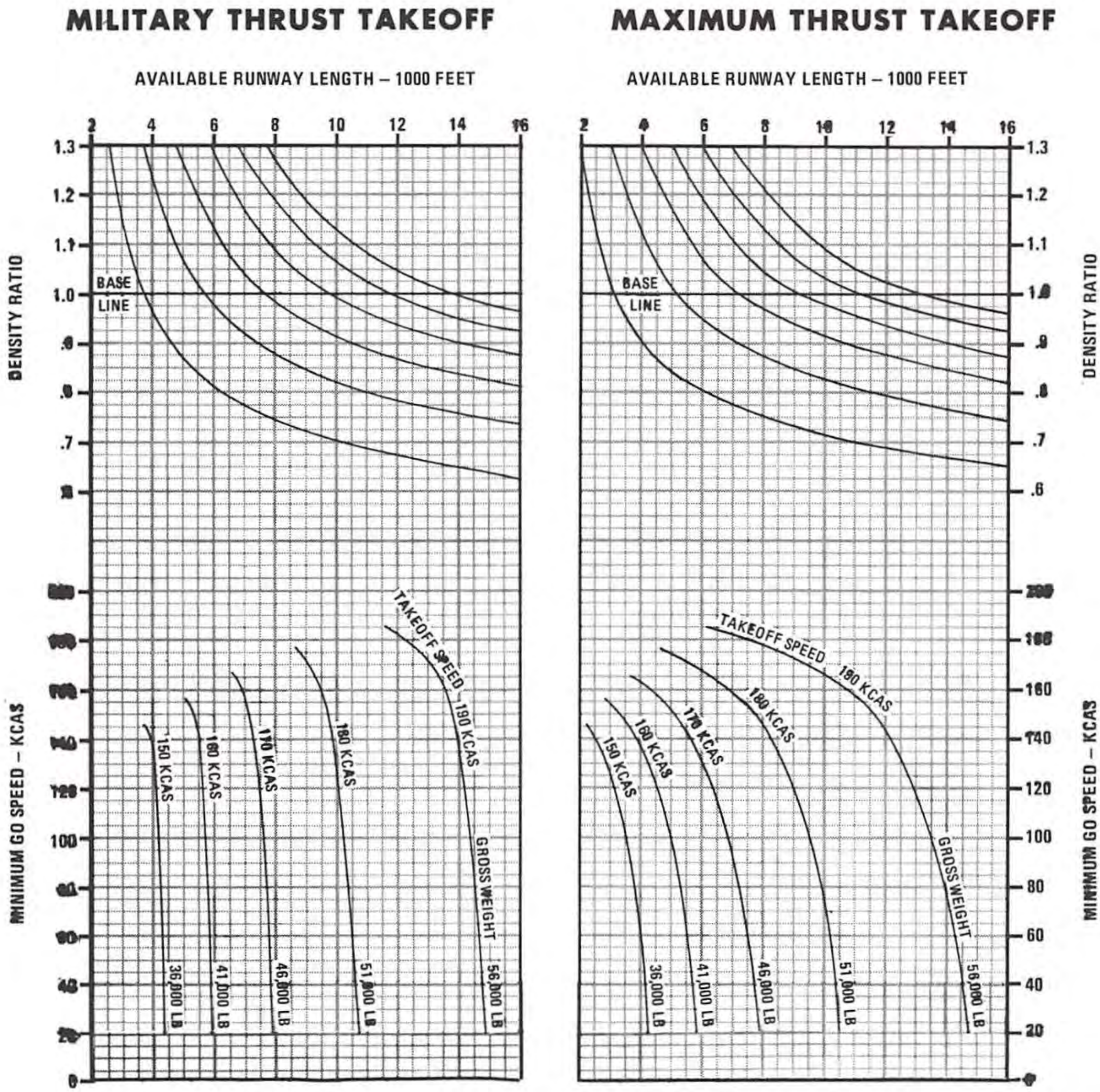


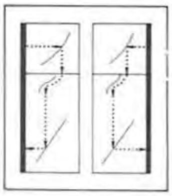
Figure 19-2. Minimum Go Speed (With Single-Engine Failure)

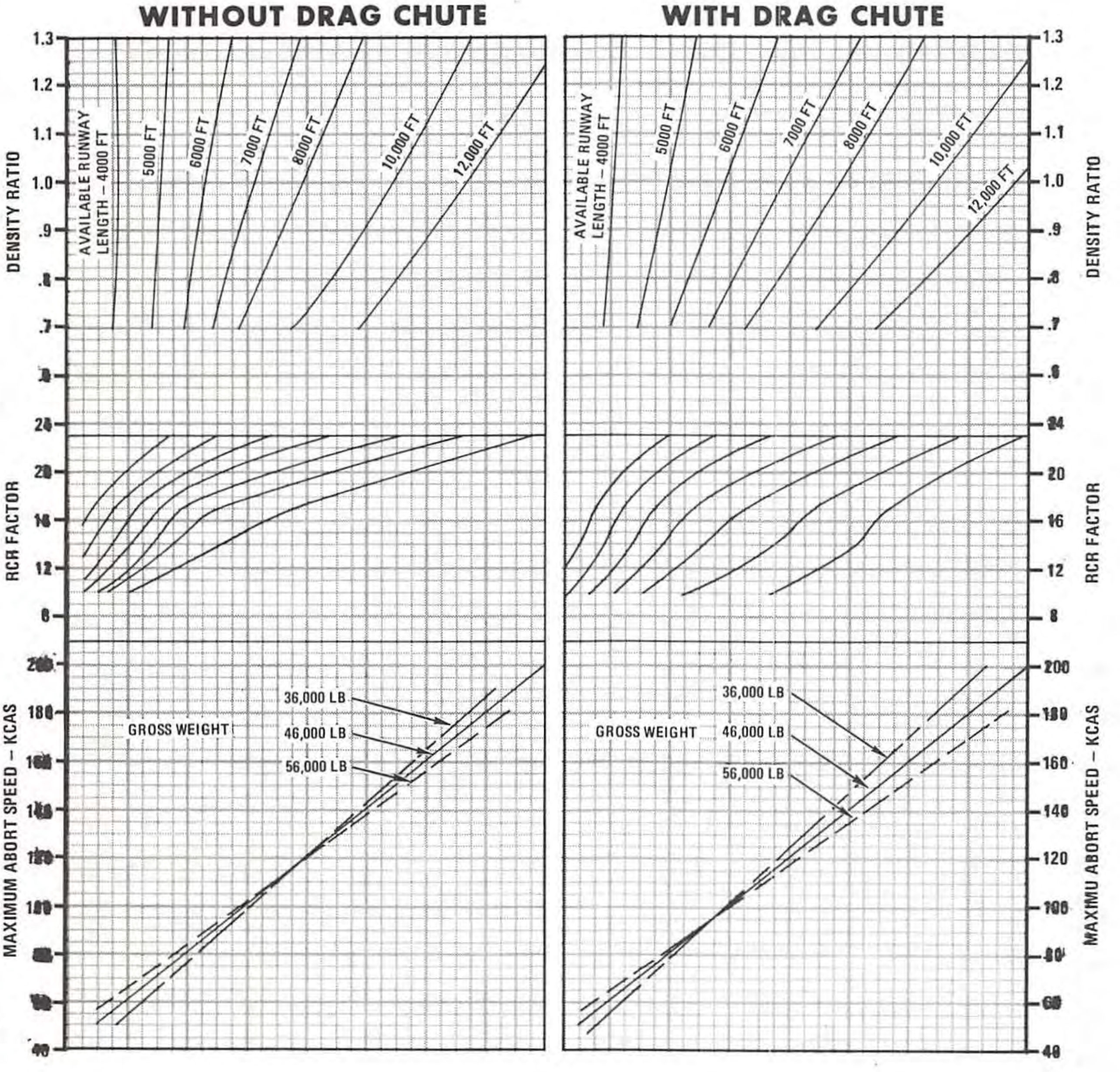
MAXIMUM THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
1/2 FLAPS

REMARKS
ENGINE(S): (2) J79-GE-10
WITH ANTISKID INSTALLED AND OPERATING

DATE: 1 MAY 1975
DATA BASIS: **FLIGHT TEST**





FDD-1-(318)

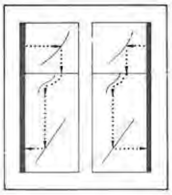
Figure 19-3. Maximum Abort Speed (Sheet 1 of 2)

MILITARY THRUST

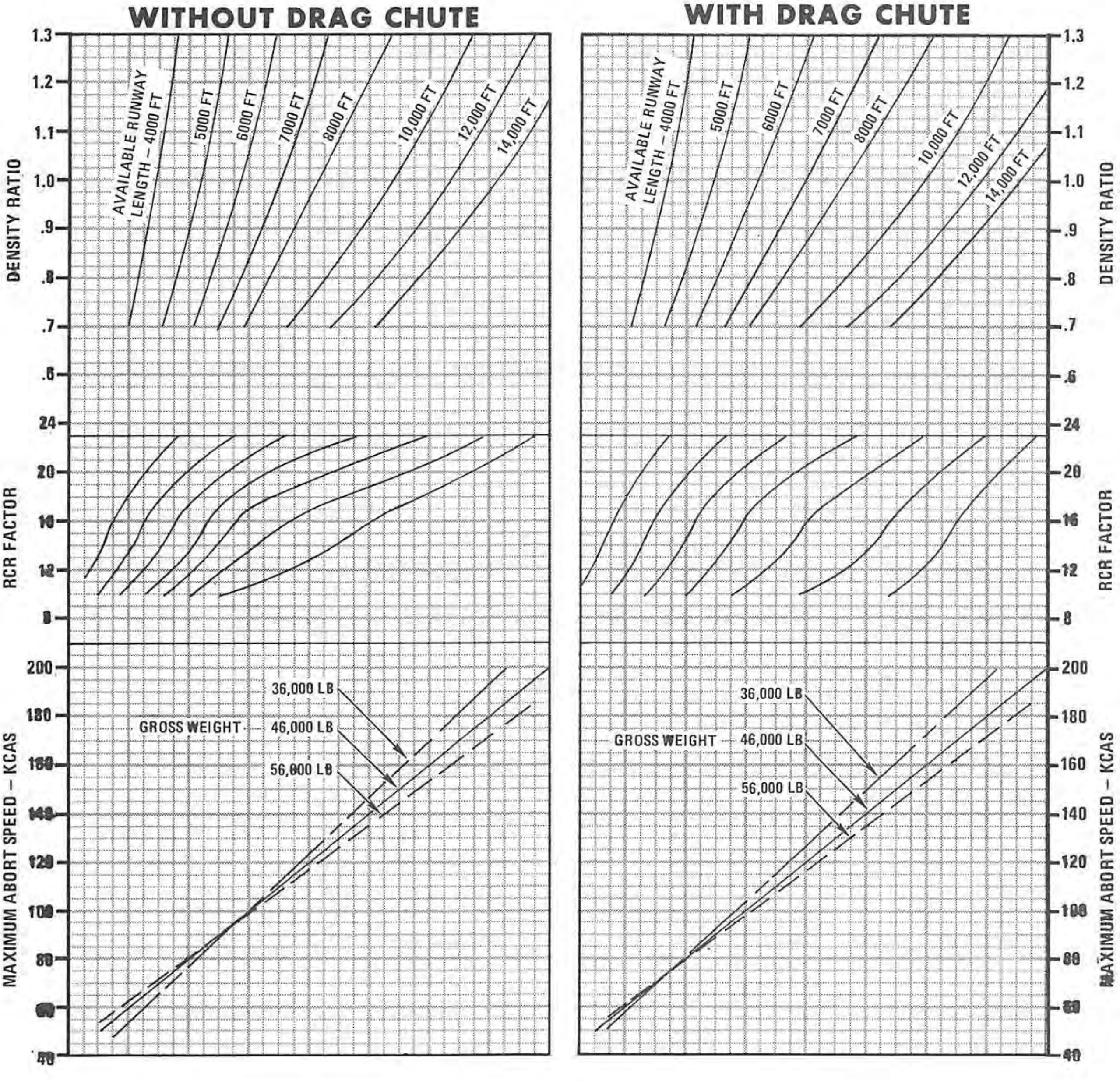
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
1/2 FLAPS

REMARKS
ENGINE(S): (2) J79–GE–10
WITH ANTISKID INSTALLED AND OPERATING

GUIDE



DATE: 1 MAY 1975
DATA BASIS: FLIGHT TEST



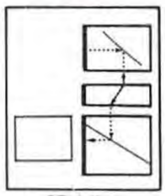
FDD–1–(319)

Figure 19-3. Maximum Abort Speed (Sheet 2 of 2)

AIRPLANE CONFIGURATION
1/2 FLAPS, GEAR DOWN
ALL DRAG INDEXES

MAXIMUM THRUST HARD DRY RUNWAY

REMARKS
ENGINE(S): (2) J79–GE–10

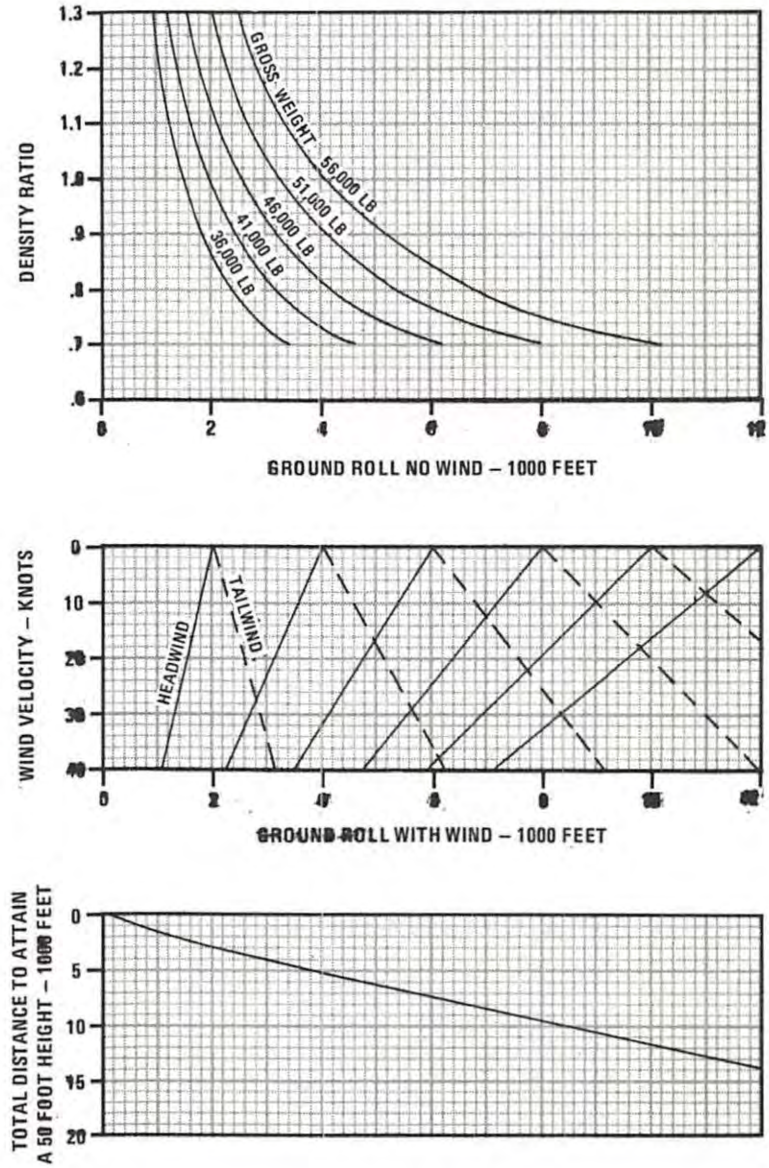


DATE: 1 MAY 1975
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

NOTES

- IF ONE AFTERBURNER FAILS TO LIGHT, TAKEOFF DISTANCE WILL BE INCREASED BY 35%.
- GROSS WEIGHTS SHOWN REFLECT LIFT–OFF VALUES.
- ENGINE START AND TAXI FUEL WEIGHTS ARE FOUND IN PART 3.
- LIFT–OFF CENTER OF GRAVITY SHALL BE CALCULATED USING WEIGHT AND BALANCE HANDBOOK, AN1–1B–40.



CG % MAC	GROSS WEIGHT – 1000 POUNDS									
	36		41		46		51		56	
	NOSEWHEEL LIFT–OFF SPEED / TAKEOFF SPEED									
27	144	158	154	167	163	176	172	184	180	192
29	138	154	147	163	156	171	165	179	173	186
31	131	149	140	157	149	166	157	173	165	183
33	124	145	133	152	141	162	149	172	156	181
35	117	140	126	149	134	160	141	170	148	180

FDD–1–(320)

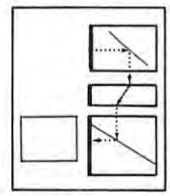
Figure 19-4. Takeoff Distance (Sheet 1 of 2)

MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
1/2 FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79–GE–10

GUIDE



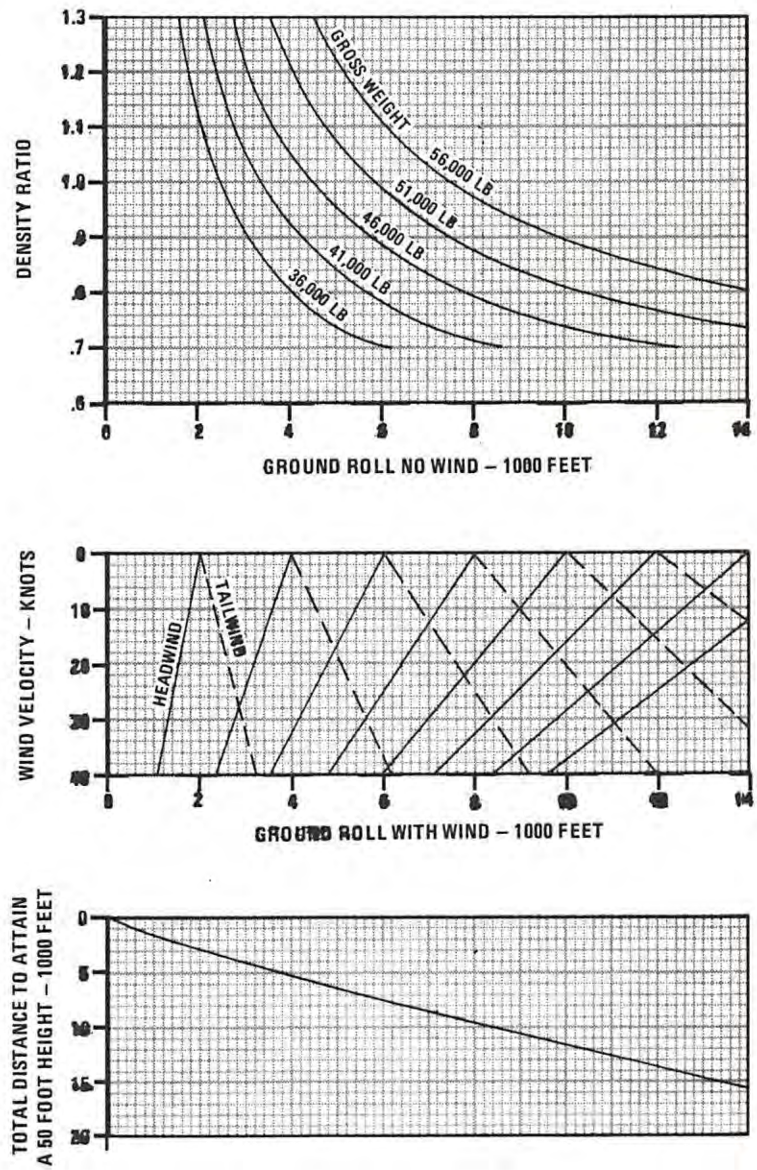
FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MAY 1975
DATA BASIS: **FLIGHT TEST**

NOTES

- GROSS WEIGHTS SHOWN REFLECT LIFT–OFF VALUES.
- ENGINE START AND TAXI FUEL WEIGHTS ARE FOUND IN PART 3.
- LIFT–OFF CENTER OF GRAVITY SHALL BE CALCULATED USING WEIGHT AND BALANCE HANDBOOK, AN1–1B–40.

CG % MAC	GROSS WEIGHT – 1000 POUNDS									
	36		41		46		51		56	
	NOSEWHEEL LIFT–OFF SPEED / TAKEOFF SPEED									
27	145	156	155	165	164	173	173	181	181	190
29	139	151	148	159	157	170	166	180	174	189
31	132	146	141	158	150	169	158	179	166	188
33	125	143	134	157	142	167	150	177	157	187
35	118	145	127	156	135	166	142	176	149	186



FDD–1–(321)

Figure 19-4. Takeoff Distance (Sheet 2 of 2)

CHAPTER 20

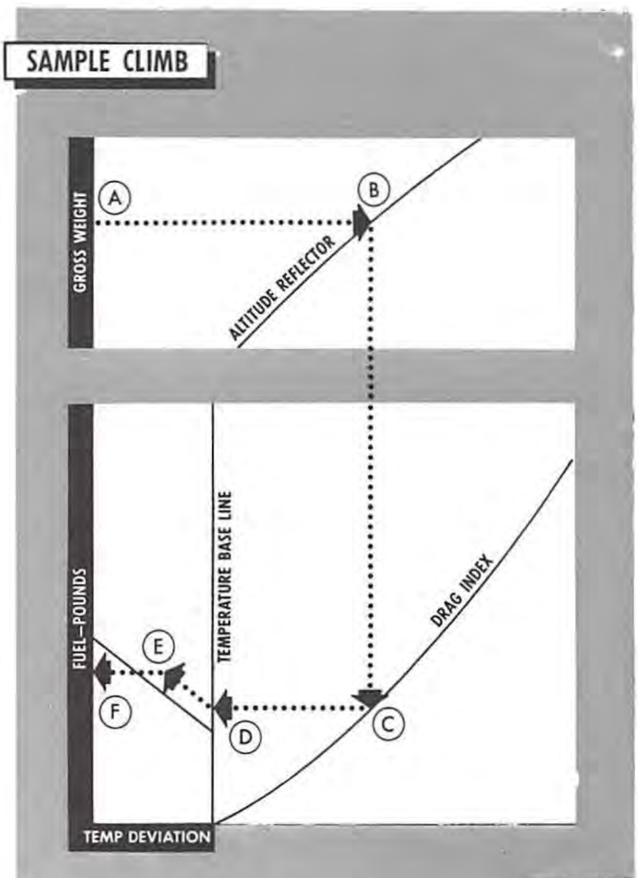
Climb

20.1 CLIMB CHARTS

Two series of charts are presented: one for military and one for maximum thrust climb schedules (Figures 20-1 and 20-2). Each series include charts for determining time, distance covered, and fuel used while in the climb and tables for determining climb indicated airspeed and Mach number. Preclimb requirements are included in a table that presents time, fuel, and distance to intercept the climb schedule after takeoff. Time, fuel, and distance for a simplified military thrust climb are presented in Figure 20-3. This data is based on climbing at 350 knots until interception of optimum cruise Mach number, then maintaining cruise Mach to cruise altitude.

20.1.1 Use. Enter the climb speed schedule tables corresponding to the climb thrust and the computed drag index. Read the column of indicated airspeeds and the Mach numbers to be used during climb. Determine the preclimb fuel, distance, and time to intercept the climb schedule which corresponds to the applicable takeoff and acceleration options.

20.1.2 Charts. The method of presenting data on the time, distance, and fuel charts is identical, and the use of all three charts will be undertaken simultaneously here. Enter the charts with the initial climb gross weight. Project horizontally to the right and intersect the assigned cruise altitude or the optimum cruise altitude for the computed drag index. Project vertically downward to intersect the applicable drag index line, then project horizontally to the left to the temperature baseline (corresponds to ICAO standard day (°C)). Parallel the applicable guideline (hotter or colder) to intersect a vertical gridline corresponding to the degree of deviation between forecast flight temperature and standard ICAO day temperature. From this point, continue horizontally to the left to read the planning data.



FDD-1-(121)

20.1.3 Sample Problem

Fuel Required – Military Thrust

A. Gross weight – 50,000 POUNDS.

B. Cruise altitude – 30,000 FEET.

C. Drag index – 60.

D. Temperature baseline.

E. Temperature deviation – +5 °C.

F. Fuel required – 1,975 POUNDS.

G. Time to climb – 8 MINUTES.

H. Distance – 60 NM.

20.2 COMBAT CEILING CHARTS

This chart (Figure 20-4) presents the military and maximum thrust combat ceiling for various combinations of gross weight and drag index.

20.2.1 Use. Enter the applicable graph with estimated gross weight at end of climb. Project vertically upward to intersect applicable drag index, then horizontally to the left to the temperature baseline (corresponds to ICAO standard day (°C)). From this point, parallel the applicable guideline (hotter or colder) to intersect a vertical gridline corresponding to the degree of deviation between altitude at end of climb and standard day temperature. From this point, continue horizontally to the left to read combat ceiling.

20.2.2 Sample Problem

Combat Ceiling – Maximum Thrust and Two Engines

A. Gross weight at end of climb – 45,000 POUNDS.

B. Drag index – 40.

C. Temperature baseline.

D. Temperature deviation – +8 °C.

E. Combat ceiling – 47,200 FEET.

CLIMB SPEED SCHEDULE

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ALTITUDE	DRAG INDEX 0 KCAS	0 MACH	10 KCAS	10 MACH	20 KCAS	20 MACH	30 KCAS	30 MACH	40 KCAS	40 MACH	50 KCAS	50 MACH	60 KCAS	60 MACH
S. L.	606	.92	602	.91	598	.90	591	.89	583	.88	573	.87	562	.85
5000	564	.92	561	.92	556	.91	550	.90	543	.89	535	.87	525	.86
10000	520	.92	519	.92	517	.92	513	.91	508	.90	499	.89	490	.87
15000	481	.93	479	.93	476	.92	471	.91	466	.90	460	.89	453	.88
20000	442	.94	439	.93	436	.93	432	.92	427	.91	423	.90	418	.89
25000	404	.94	402	.94	398	.93	395	.92	392	.92	388	.91	384	.90
30000	367	.95	364	.94	362	.94	359	.93	357	.93	355	.92	352	.91
35000	332	.95	330	.95	328	.94	326	.94	324	.94	322	.93	321	.93
40000	296	.96	294	.95	292	.94	291	.94	289	.94	288	.93	287	.93
45000	265	.96	263	.95	261	.94	259	.94	258	.94	257	.93	256	.93

ALTITUDE	DRAG INDEX 70 KCAS	70 MACH	80 KCAS	80 MACH	90 KCAS	90 MACH	100 KCAS	100 MACH	110 KCAS	110 MACH	120 KCAS	120 MACH	130 KCAS	130 MACH	140 KCAS	140 MACH
S. L.	547	.83	531	.80	511	.77	492	.74	472	.71	453	.69	439	.66	427	.65
5000	512	.84	498	.82	482	.79	465	.76	448	.74	432	.71	418	.69	408	.67
10000	478	.85	467	.83	453	.81	437	.78	424	.76	408	.73	396	.71	386	.69
15000	444	.86	436	.85	426	.83	416	.81	403	.79	388	.76	376	.74	367	.72
20000	412	.88	404	.86	396	.85	387	.83	379	.81	368	.79	358	.77	349	.75
25000	380	.89	374	.88	368	.87	361	.85	353	.83	346	.82	338	.80	331	.79
30000	349	.91	345	.90	341	.89	337	.88	331	.86	324	.85	318	.83	312	.82
35000	319	.92	318	.92	315	.91	313	.91	310	.90	305	.89	300	.87	293	.86
40000	286	.93	284	.92	283	.92	282	.92	281	.91	279	.91	277	.90	275	.90
45000	255	.93	254	.92	252	.92	251	.92	-	-		-	-	-		-

TAKEOFF ALLOWANCES & ACCELERATION TO CLIMB SPEED

START - 65 LBS / ENG

RUNUP 50 LBS /ENG

TAXI - 21 LB /MIN / ENG

	BRAKE RELEASE TO CLIMB SPEED MAX T. O. MAX ACCEL TO MAX CLIMB SPEED
FUEL - LBS	1225
DIST - N M	5.0
TIME - MIN	1.0

FDD-1-(126-1)A

Figure 20-1. Climb – Maximum Thrust (Sheet 1 of 4)

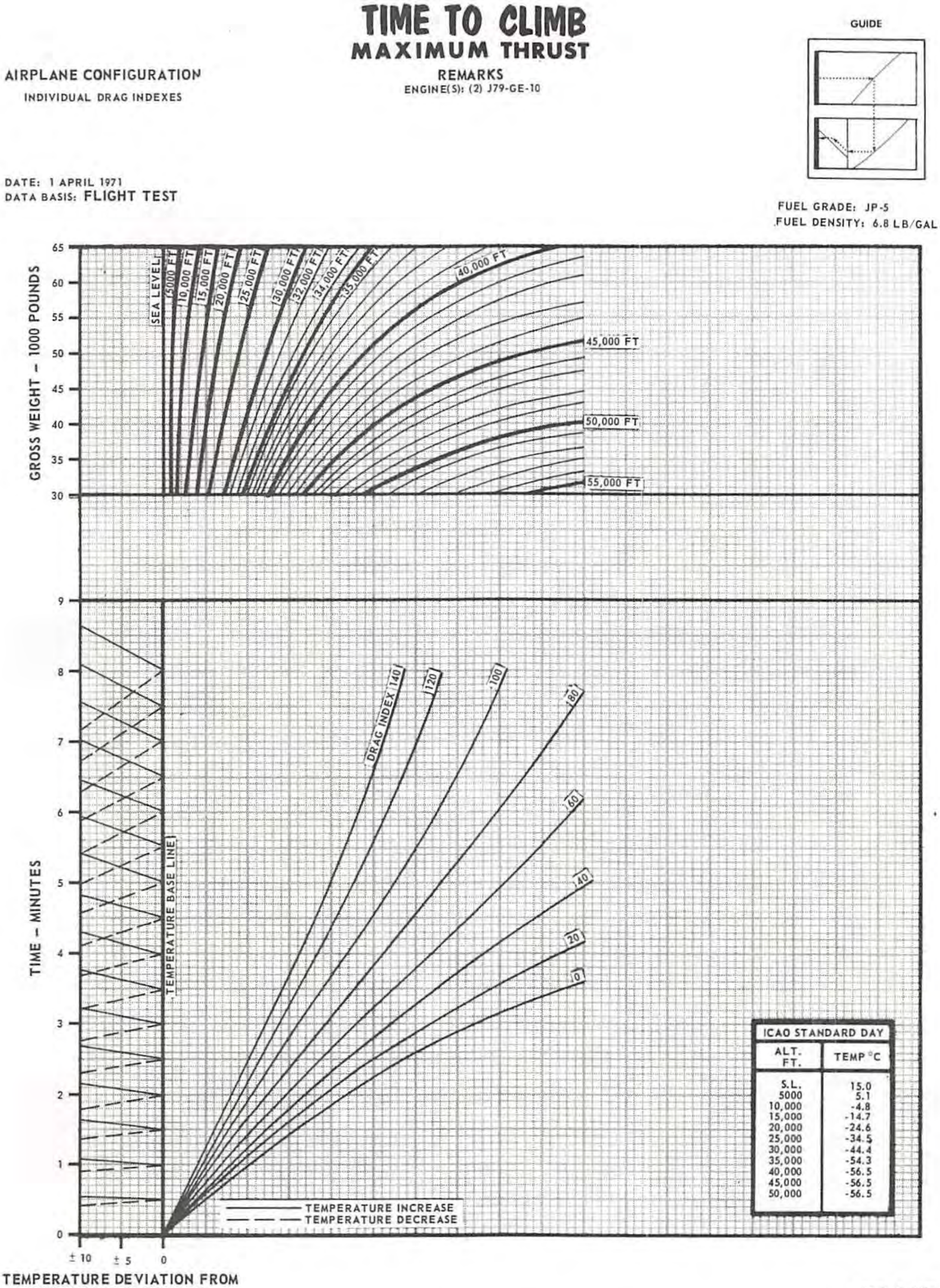
TIME TO CLIMB
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(126-2)A

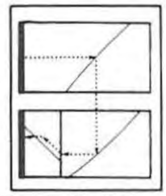
Figure 20-1. Climb – Maximum Thrust (Sheet 2 of 4)

FUEL REQUIRED TO CLIMB
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

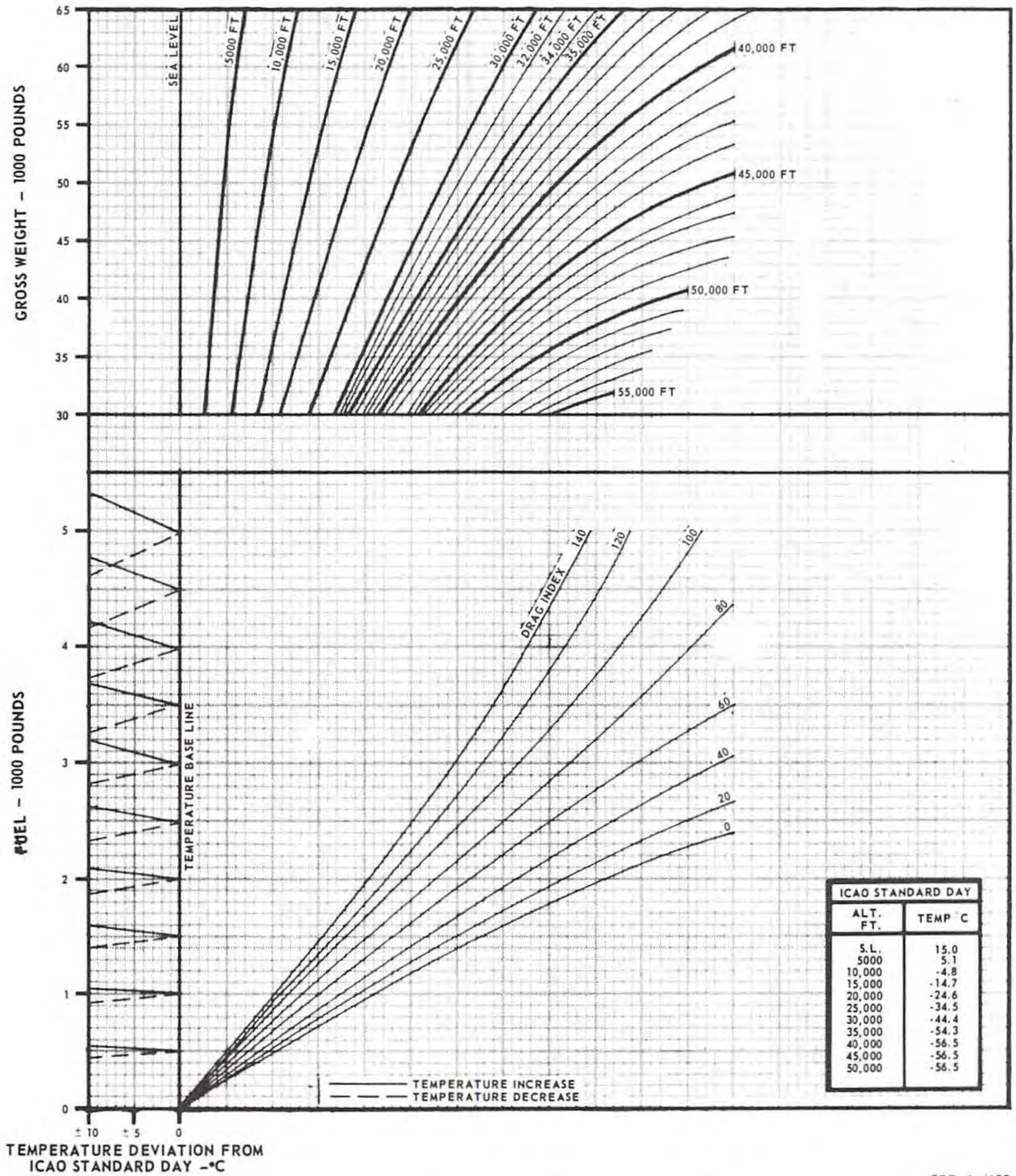
REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE



DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(126-3)B

Figure 20-1. Climb – Maximum Thrust (Sheet 3 of 4)

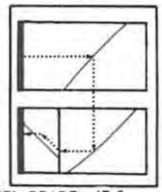
DISTANCE REQUIRED TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

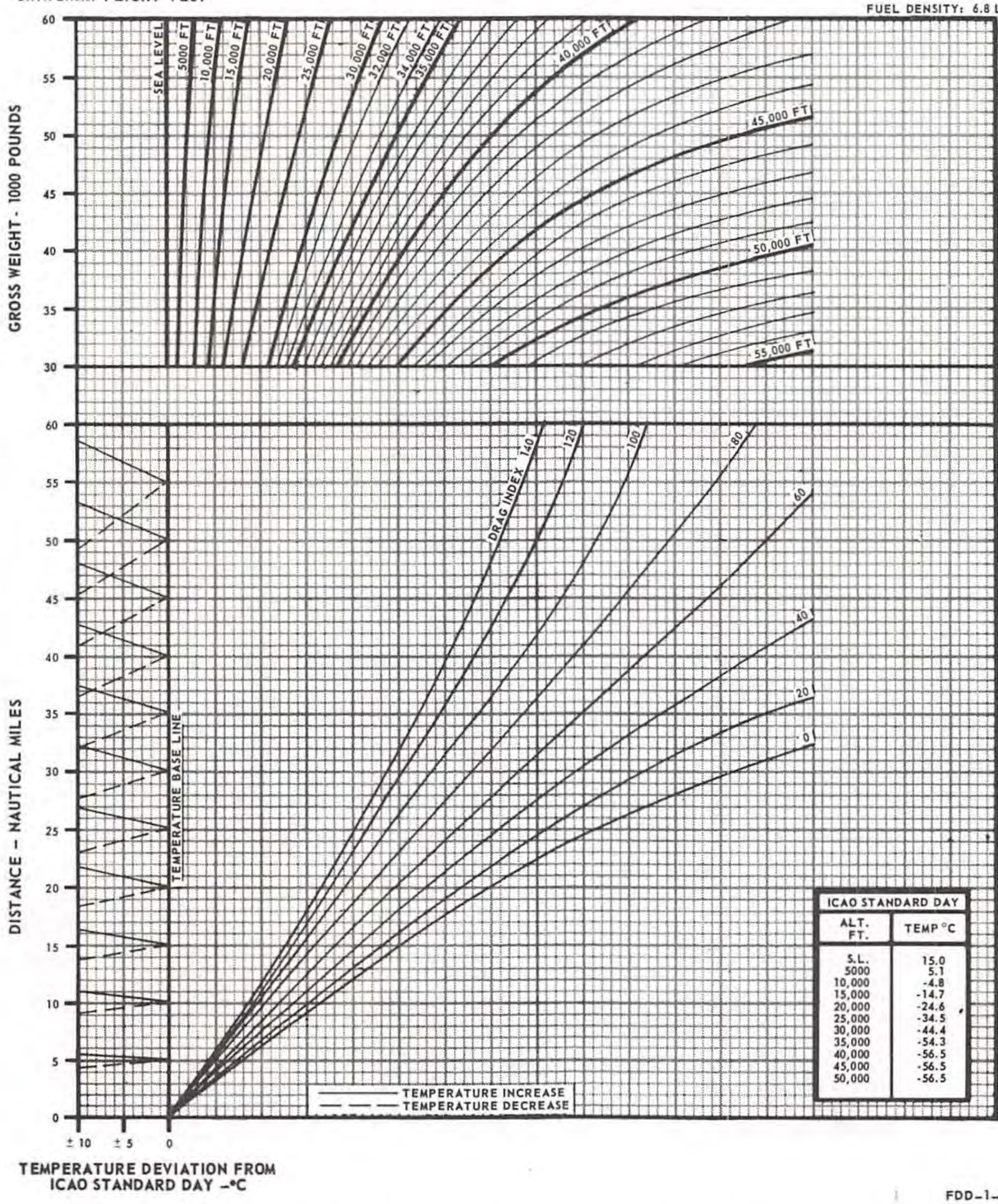
REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE



DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(126-4)A

Figure 20-1. Climb – Maximum Thrust (Sheet 4 of 4)

CLIMB SPEED SCHEDULE

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ALTITUDE	DRAG INDEX 0 KCAS	0 MACH	10 KCAS	10 MACH	20 KCAS	20 MACH	30 KCAS	30 MACH	40 KCAS	40 MACH	50 KCAS	50 MACH	60 KCAS	60 MACH
S. L.	508	.77	484	.73	459	.69	435	.66	413	.62	396	.60	379	.57
5000	474	.78	454	.74	432	.71	413	.68	395	.65	382	.63	368	.61
10000	443	.79	429	.77	413	.74	398	.71	383	.69	369	.66	356	.64
15000	414	.81	403	.79	392	.77	380	.74	369	.72	357	.70	345	.68
20000	386	.83	374	.81	369	.79	360	.77	350	.75	340	.73	330	.71
25000	358	.84	353	.83	348	.82	342	.81	336	.80	329	.78	320	.76
30000	331	.86	330	.86	328	.86	325	.85	322	.84	317	.83	309	.81
35000	308	.89	306	.89	305	.89	303	.88	300	.87	294	.86	286	.84
40000	278	.90	277	.90	276	.90	-	-	-	-	-	-	-	-

ALTITUDE	DRAG INDEX 70 KCAS	70 MACH	80 KCAS	80 MACH	90 KCAS	90 MACH	100 KCAS	100 MACH	110 KCAS	110 MACH	120 KCAS	120 MACH	130 KCAS	130 MACH	140 KCAS	140 MACH
S. L.	365	.55	351	.53	340	.51	329	.50	319	.48	311	.47	304	.46	296	.45
5000	353	.58	343	.56	328	.54	318	.52	309	.51	303	.50	297	.49	291	.48
10000	344	.62	330	.59	318	.57	310	.56	301	.54	295	.53	289	.52	284	.51
15000	332	.65	321	.63	310	.61	302	.60	293	.58	287	.57	282	.56	278	.55
20000	319	.69	308	.67	298	.65	289	.63	281	.61	275	.60	270	.59	266	.58
25000	311	.74	300	.72	291	.70	283	.68	276	.66	269	.65	264	.64	260	.63
30000	300	.79	287	.76	274	.73	267	.71	259	.69	254	.68	-	-	-	-
35000	276	.81	265	.78	-	-	-	-	-	-	-	-	-	-	-	-
40000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

TAKEOFF ALLOWANCES & ACCELERATION TO CLIMB SPEED

START - 65 LBS / ENG

RUNUP 50 LBS / ENG

TAXI - 21 LB / MIN / ENG

	BRAKE RELEASE TO CLIMB SPEED: MIL T.O. MIL ACCEL TO MIL CLIMB SPEED	MAX T.O. MIL ACCEL TO MIL CLIMB SPEED	MAX T.O. MAX ACCEL TO MIL CLIMB SPEED
FUEL - LBS	525	725	925
DIST - N M	6.0	5.3	3.0
TIME - MIN	1.7	1.3	.8

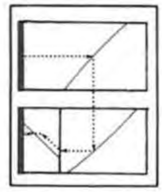
FDD-1-(127-1)A

Figure 20-2. Climb – Military Thrust (Sheet 1 of 4)

TIME TO CLIMB
MILITARY THRUST

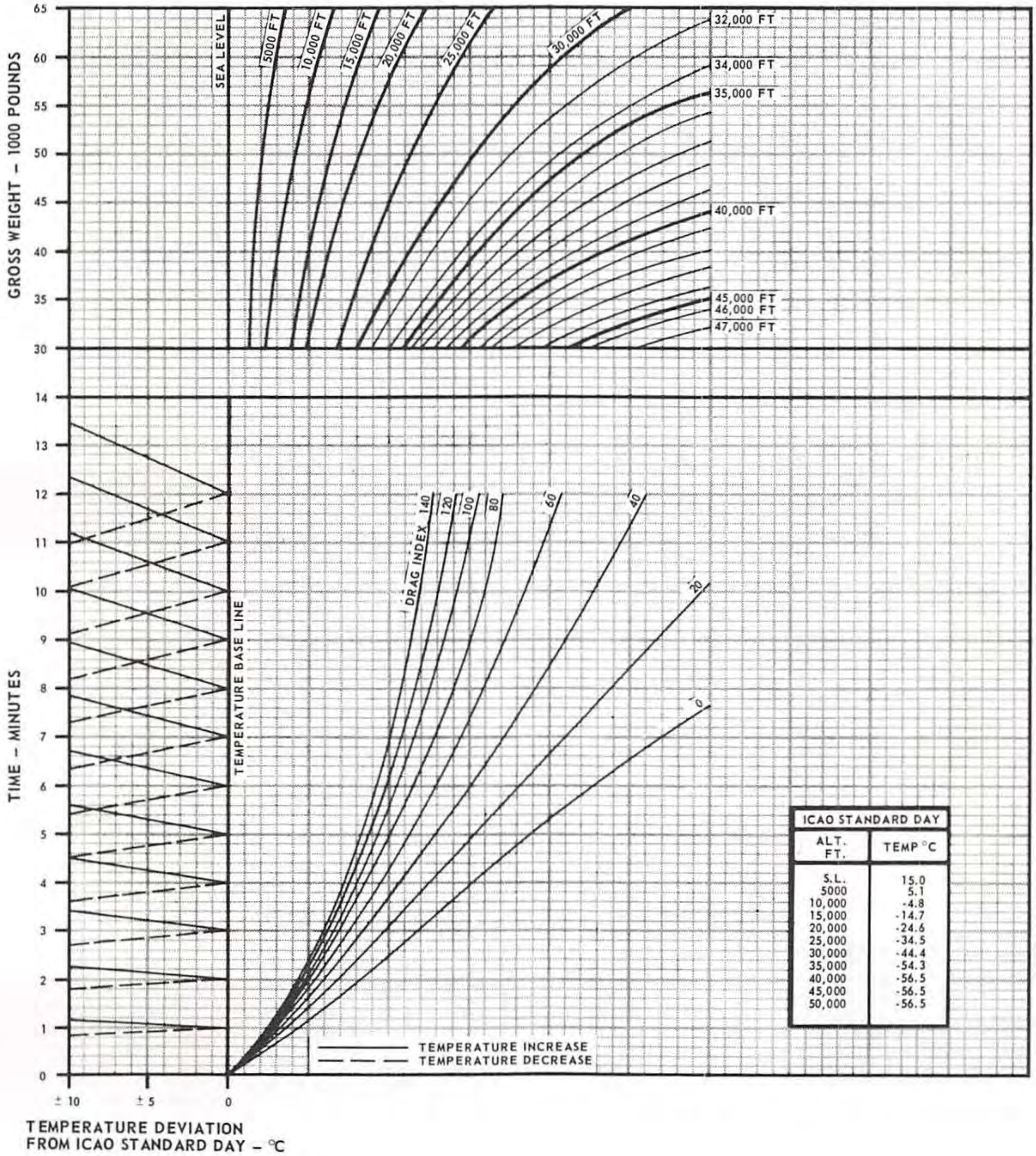
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10



DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(127-2)A

Figure 20-2. Climb – Military Thrust (Sheet 2 of 4)

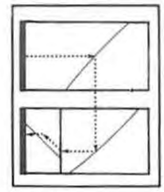
FUEL REQUIRED TO CLIMB

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

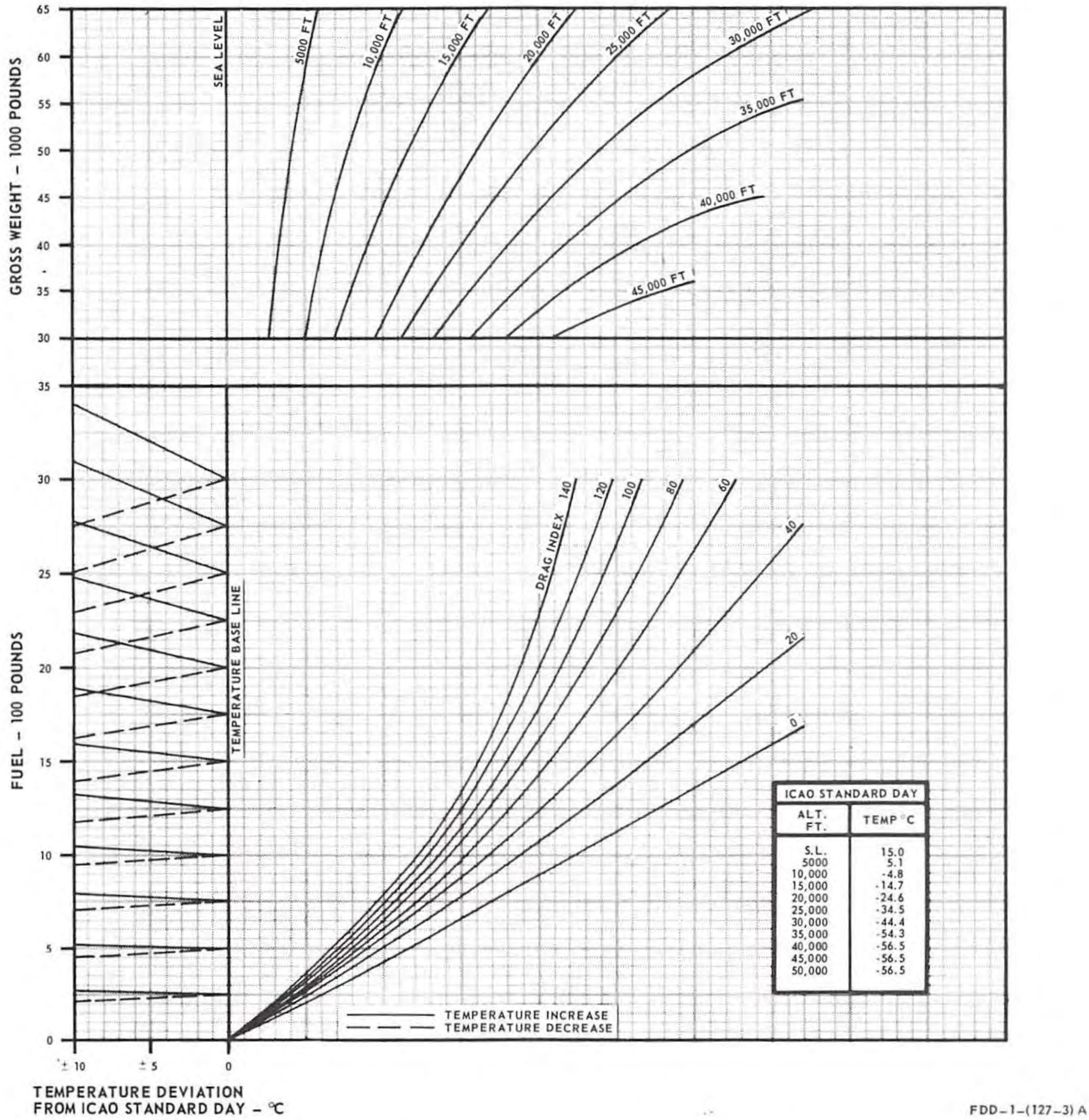
REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE



DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(127-3) A

Figure 20-2. Climb – Military Thrust (Sheet 3 of 4)

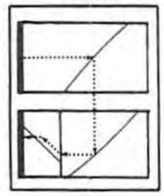
DISTANCE REQUIRED TO CLIMB

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

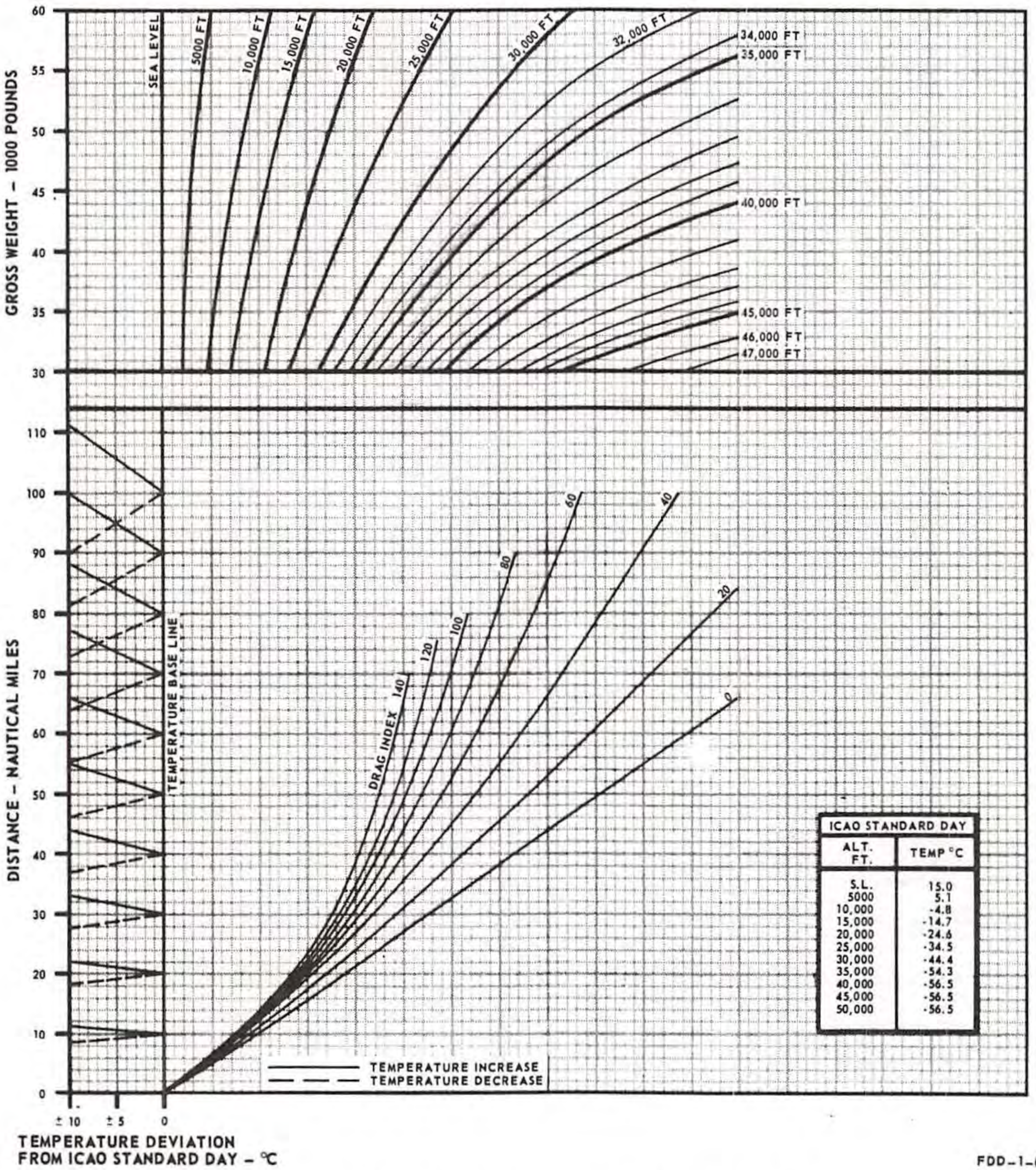
REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE



DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(127-4)A

Figure 20-2. Climb – Military Thrust (Sheet 4 of 4)

TIME TO CLIMB

350 KCAS-MILITARY THRUST

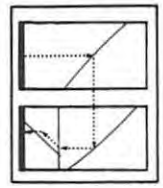
AIRPLANE CONFIGURATION

INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

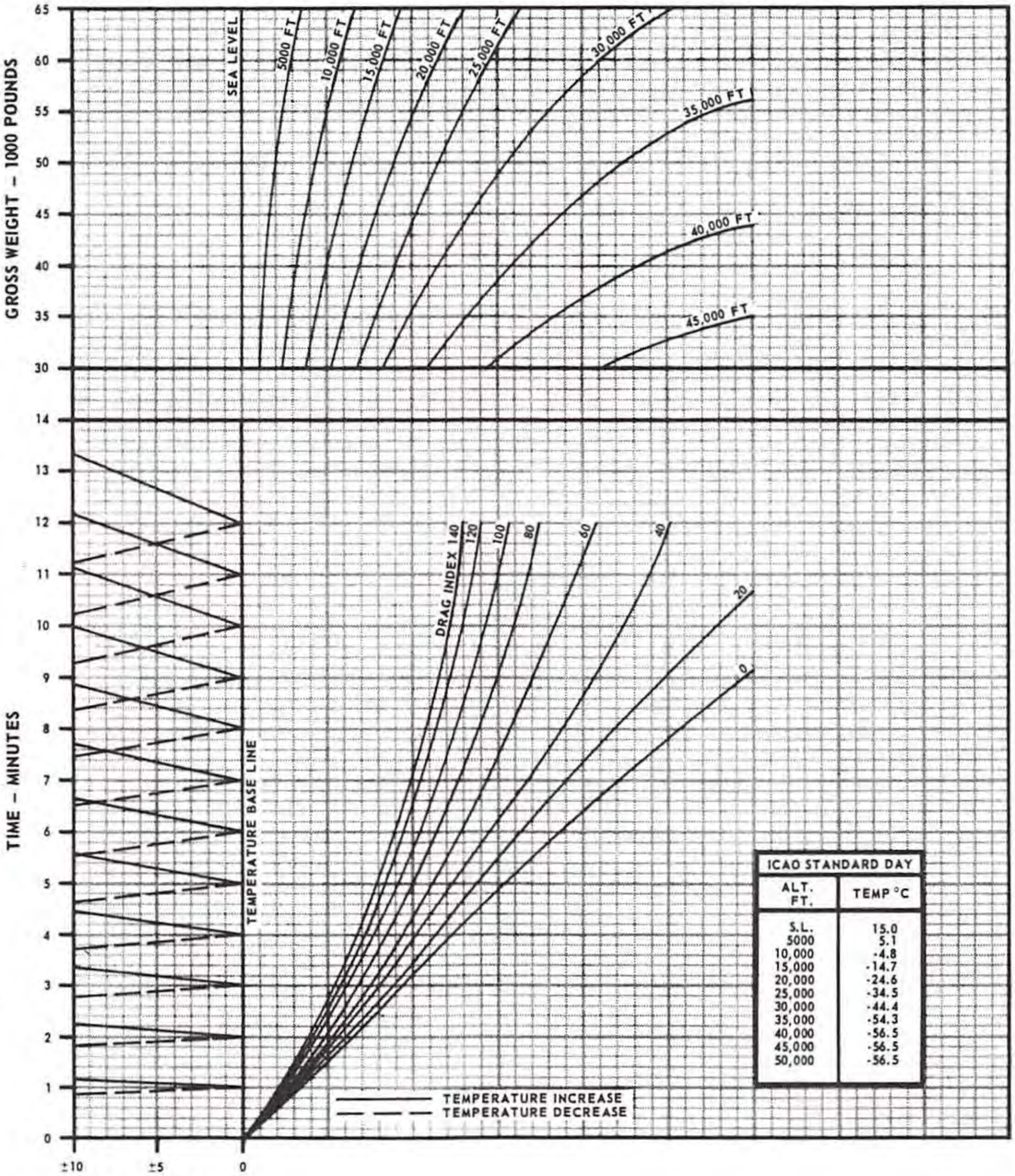
NOTE
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/TAS, THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE



DATE: 1 MARCH 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY

ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(296-1)

Figure 20-3. Climb – 350 KCAS and Military Thrust (Sheet 1 of 3)

FUEL REQUIRED TO CLIMB
350 KCAS-MILITARY THRUST

AIRPLANE CONFIGURATION

INDIVIDUAL DRAG INDEXES

REMARKS

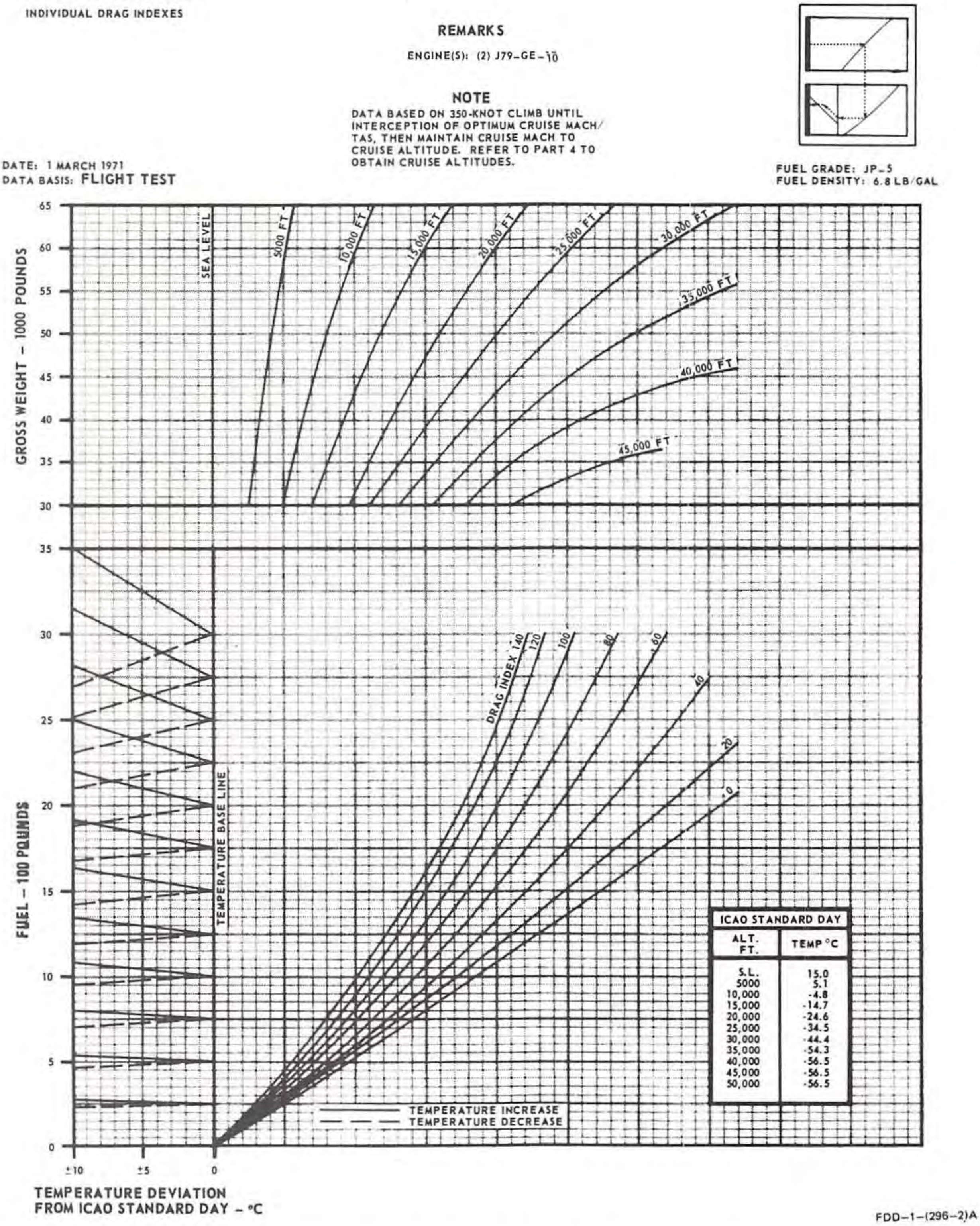
ENGINE(S): (2) J79-GE-10

NOTE

DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/TAS, THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

DATE: 1 MARCH 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

Figure 20-3. Climb – 350 KCAS and Military Thrust (Sheet 2 of 3)

DISTANCE REQUIRED TO CLIMB

350 KCAS-MILITARY THRUST

AIRPLANE CONFIGURATION

INDIVIDUAL DRAG INDEXES

REMARKS

ENGINE(S): (2) J79-GE-10

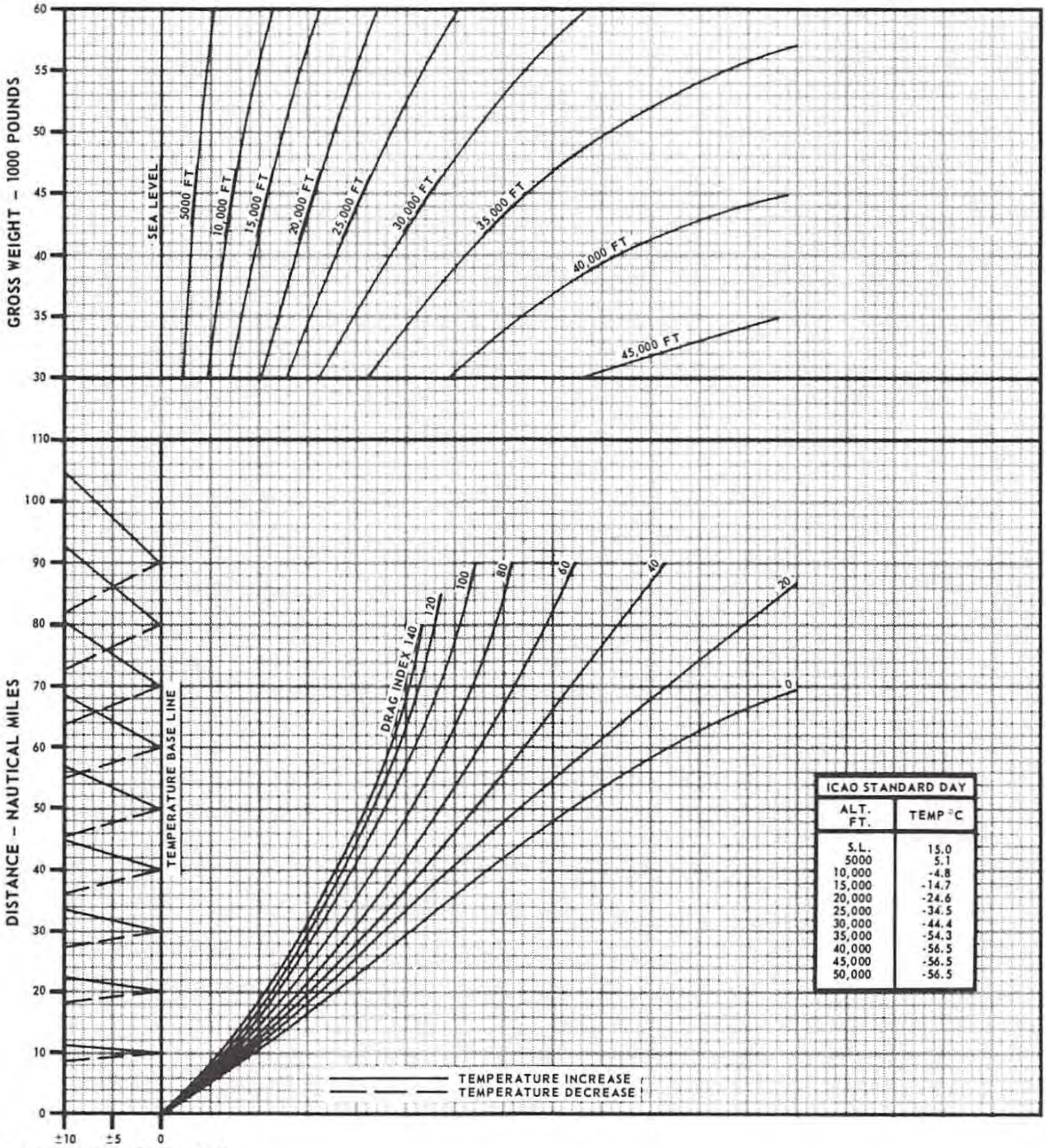
NOTE

DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/ TAS, THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE

DATE: 1 MARCH 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(296-3)

Figure 20-3. Climb – 350 KCAS and Military Thrust (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

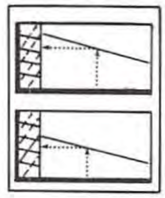
DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

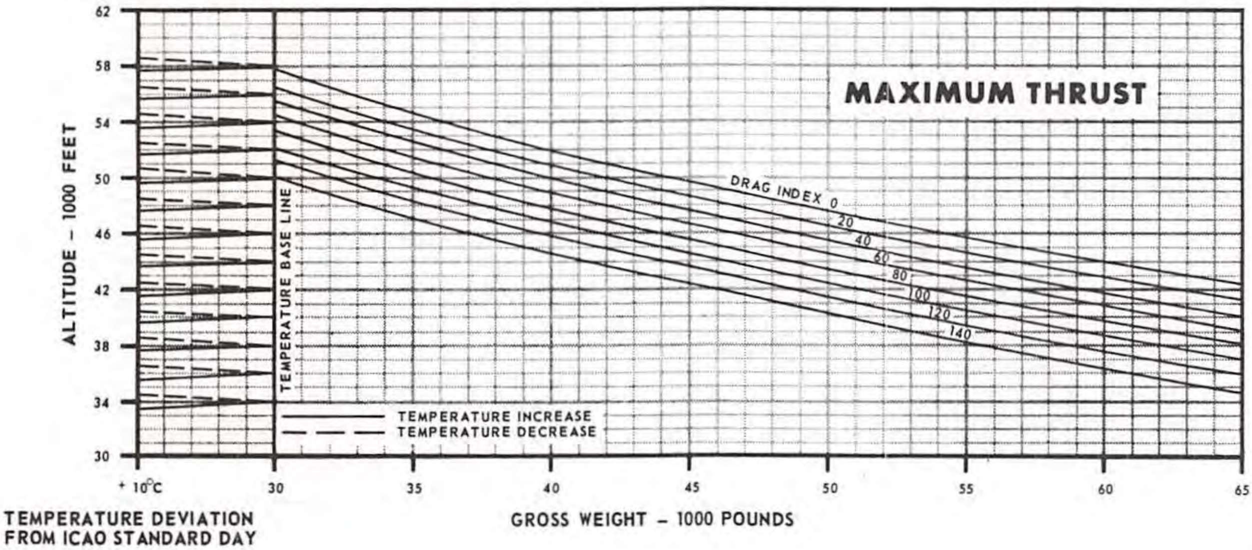
NOTE

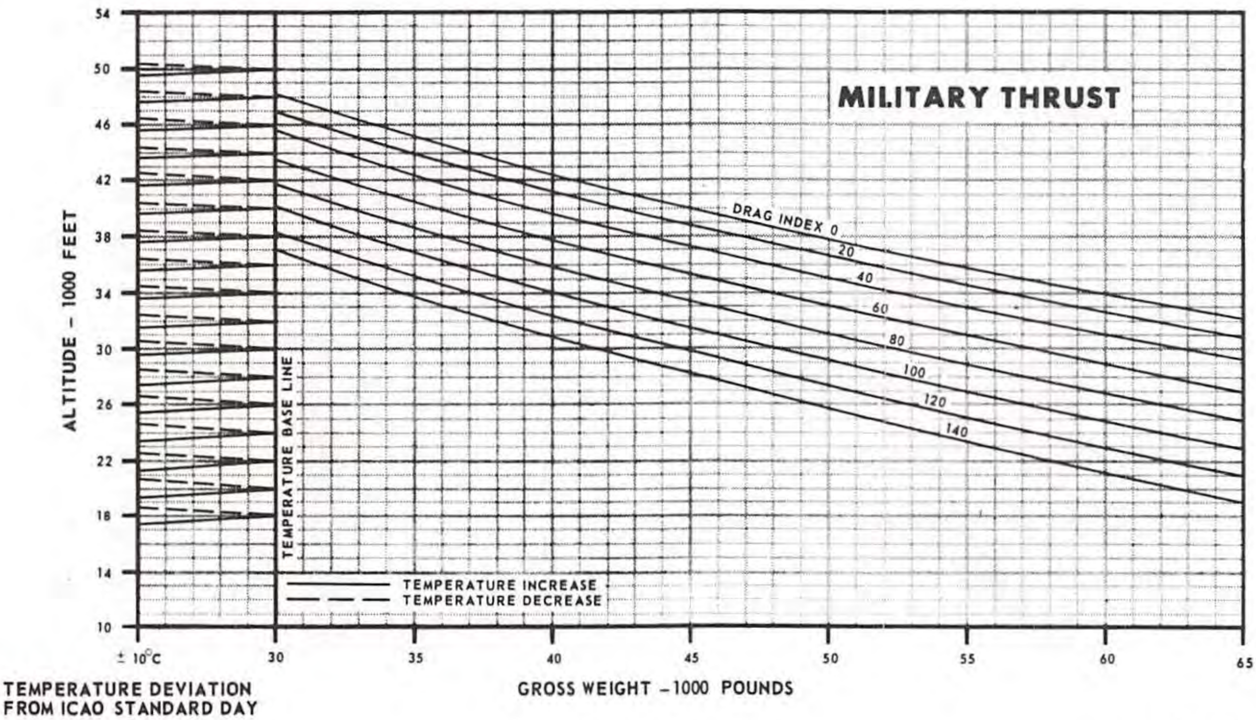
COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE.

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





FDD–1–(130)A

Figure 20-4. Combat Ceiling

CHAPTER 21

Range

21.1 RANGE-WIND CORRECTION CHART

This chart (Figure 21-1) provides a means of correcting computed range (specific or total) for existing wind effects. The presented range factors consider windspeeds up to 150 knots from any relative wind direction for aircraft speeds of 200 to 1,300 KTAS.

21.1.1 Use. Determine the relative wind direction by subtracting the aircraft heading from the forecast wind direction. If the aircraft heading is greater than the forecast wind direction, add 360° to the wind direction and then perform the subtraction. Enter the chart with relative wind direction and proceed vertically to the interpolated windspeed. From this point, project horizontally to intersect the aircraft true airspeed and reflect to the lower scale to read the range factor. Multiply computed range by this range factor to find range as affected by wind.

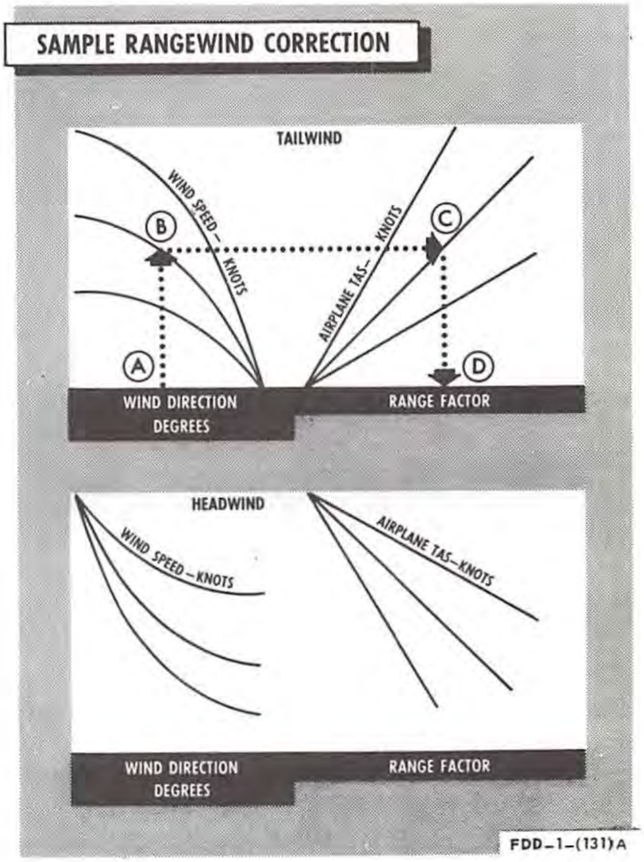
21.1.2 Sample Problem

A. Relative wind direction – 150°.

B. Windspeed – 125 KNOTS.

C. Aircraft speed – 400 KTAS.

D. Range factor – 1.25.



21.2 OPTIMUM CRUISE SUMMARY

This chart (Figure 21-2) presents optimum cruise data for two-engine operation. The chart depicts cruise altitude, specific range (in nautical miles per pound), and cruise Mach number for all gross weights and drag indexes.

21.2.1 Use. Enter the chart with the previously computed drag index and project vertically to intersect the gross weight curves of all three plots. At the intersection of the appropriate gross weight curves, reflect horizontally to the left and read cruise Mach number, specific range in nautical miles per pound, and cruise altitude.

21.2.2 Sample Problem

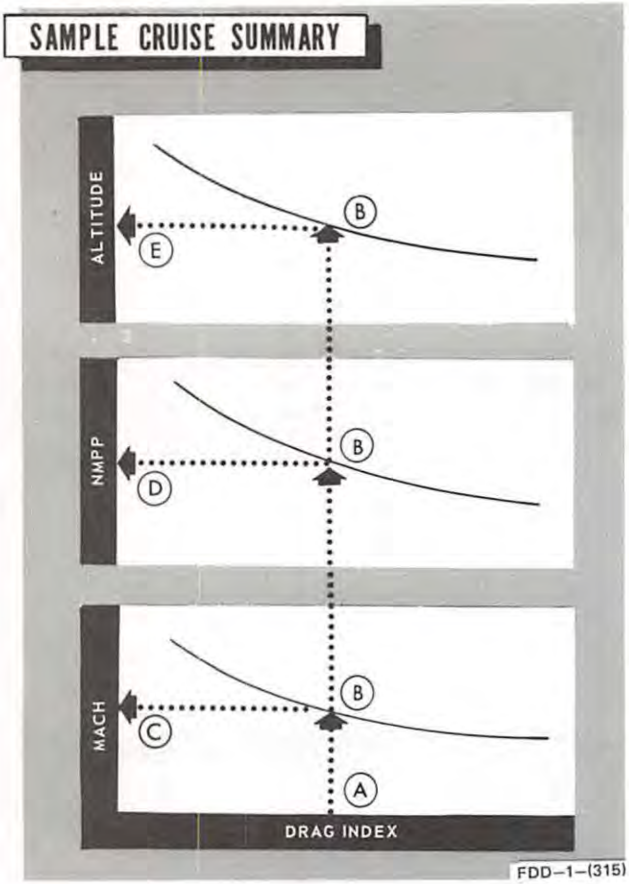
A. Drag index – 20.

B. Gross weight – 40,000 POUNDS.

C. Mach number – 0.88.

D. Specific range – 0.92 NMPP.

E. Cruise altitude – 37,900 FEET.



FDD-1-(315)

21.3 LOW-ALTITUDE CRUISE TABLES

These charts (Figure 21-3 (sheets 1 through 3)) present total fuelflow values for various combinations of true airspeed and drag index at altitudes of sea level, 4,000, 8,000, 12,000, and 16,000 feet. Also included is the resultant V_{max} (maximum attainable TAS) for a particular altitude-drag index combination at a MIL thrust setting. Separation charts are provided for several gross weights. Fuelflow values are tabulated for ICAO standard day; however, correction factors are given for nonstandard temperatures.

21.3.1 Use. After selecting the applicable table for gross weight and altitude, determine the equivalent standard day true airspeed by dividing the desired true airspeed by the nonstandard day temperature correction factor obtained from the appropriate TEMP EFFECTS column. Enter the table with the equivalent standard day true airspeed and project horizontally to the applicable drag index column and read total fuelflow for a standard day. To obtain the total fuelflow at the desired true airspeed, multiply the total fuelflow for a standard day by the nonstandard day temperature correction factor.

21.3.2 Sample Problem

Gross Weight 45,000 Pounds, Sea Level (15 °C)

A. Desired airspeed – 540 KTAS.

B. Drag index – 20.

C. Nonstandard day temperature – 20 °C.

D. Correction factor – .937.

E. Equivalent standard day true airspeed (A ÷ D) – 576 KTAS.

F. Standard day total fuelflow – 20,811 PPH.

G. Total fuelflow at desired true airspeed (F X D) – 19,500 PPH.

21.4 CONSTANT MACH/ALTITUDE CRUISE

These charts (Figures 21-4 and 21-5) present nautical miles per pound and total fuelflow for various combinations of Mach number, gross weight, altitude, and drag index. This data is based on cruise at a constant Mach number and a constant altitude. Specifics are presented for 0 °C; however, correction factors are provided for temperature deviations.

21.4.1 Use. After selecting the desired cruise Mach, enter the chart with the estimated gross weight at end of climb. Project horizontally to the right to intersect the desired cruise altitude, then vertically downward to intersect the applicable drag index. From this point, project horizontally to both sides of the graph and read nautical miles per pound and total fuelflow 0 °C temperature. If required, correct these values for the actual temperatures.

21.4.2 Sample Problem

A. Mach number – 0.85.

B. Gross weight – 40,000 POUNDS.

C. Altitude – 30,000 FEET.

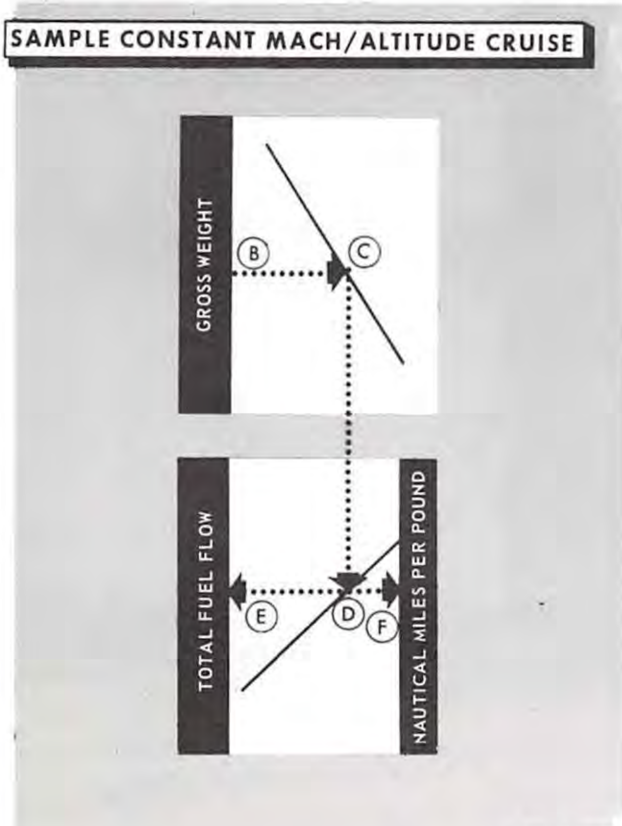
D. Drag index – 40.

E. Total fuelflow – 7,850 PPH.

F. Specific range – 0.069 NMPP.

G. Actual temperature – -20 °C.

H. Total fuelflow (corrected) – 7,536 PPH.



21.5 CONSTANT ALTITUDE CRUISE

These charts (Figures 21-6 and 21-7) present the necessary planning data to set up optimum cruise schedules for normal two-engine and single-engine operation at a constant altitude. The recommended procedure is to use an average gross weight for a given leg of the mission. One way to find the average gross weight is to divide the mission into weight segments. With this method, readjust the cruise schedule each time a given amount of fuel is used. Subtract one-half of the fuel weight allotted for the first leg from the initial cruise gross weight. The remainder is the average gross weight for the leg. It is possible to obtain instantaneous data if desired.

21.5.1 Use. Enter the left side of sheet 1 with the average gross weight. Project horizontally to the right to intersect desired cruise altitude, then vertically downward to the computed drag index, and then horizontally to the right to obtain specific range (nautical miles per pound). Repeat these projections on the right side of sheet 1 to obtain optimum cruise Mach number for the desired altitude. Enter sheet 2 with the optimum cruise Mach number. Project horizontally to the right to intersect predicted flight-level temperature, then vertically downward to obtain corresponding true airspeed. Continue this projection vertically downward to intersect the interpolated specific range (obtained from sheet 1), then horizontally to the left to obtain total fuelflow required in pounds per hour.

21.5.2 Sample Problem

Two Engines

A. Average gross weight for first leg – 45,000 POUNDS.

B. Cruise altitude – 35,000 FEET.

C. Computed drag index – 40.

D. Specific range – 0.074 NMPP.

E. Gross weight – 45,000 POUNDS.

F. Altitude – 35,000 FEET.

G. Drag index – 40.

H. True Mach number – 0.86.

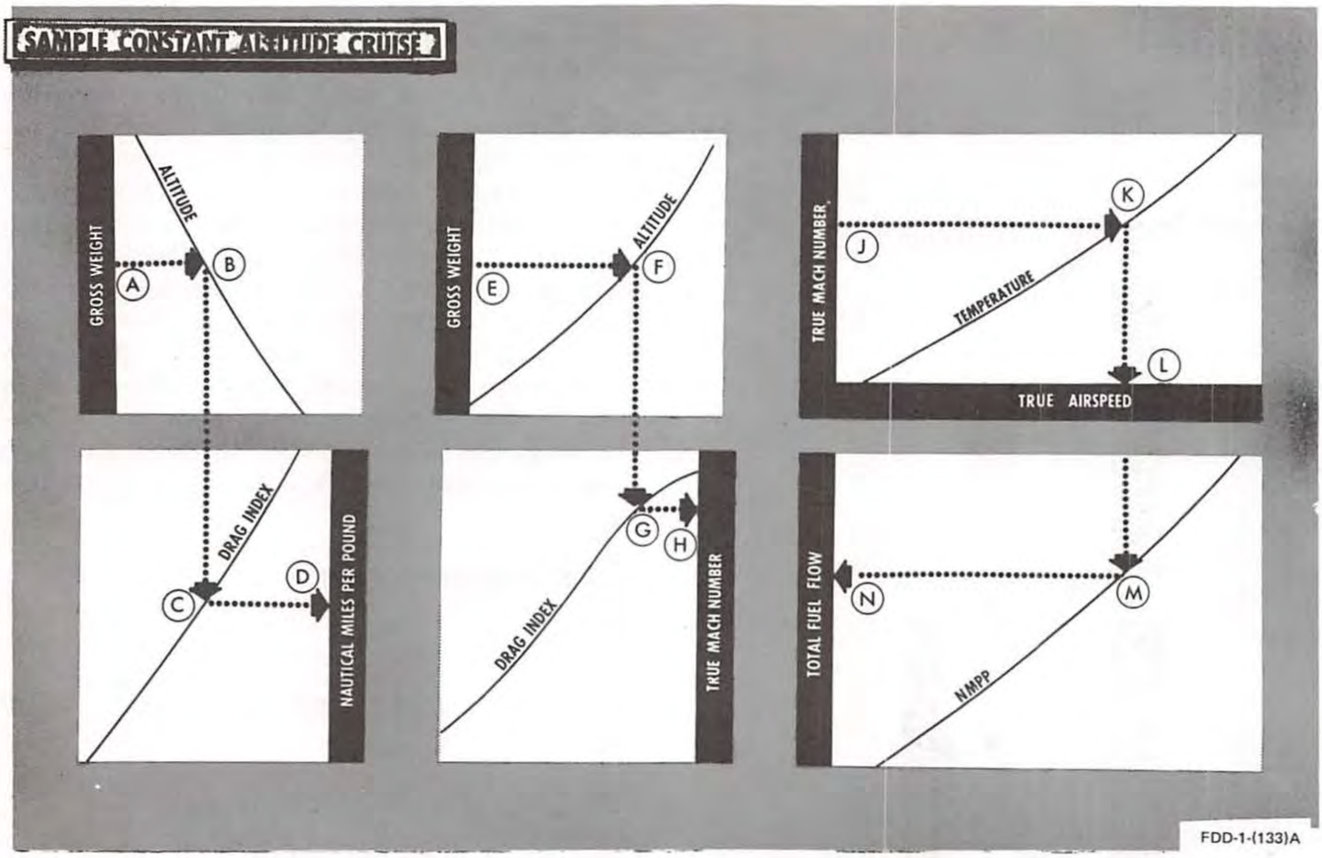
J. True Mach number – 0.86.

K. Temperature at flight altitude – -40 °C.

L. True airspeed – 510 KNOTS.

M. Specific range – 0.08 NMPP.

N. Total fuelflow – 6,800 PPH.


SAMPLE CONSTANT ALTITUDE CRUISE
GROSS WEIGHT
ALTITUDE
A
B
DRAG INDEX
C
D
NAUTICAL MILES PER POUND
GROSS WEIGHT
ALTITUDE
E
F
DRAG INDEX
G
H
TRUE MACH NUMBER
TRUE MACH NUMBER
J
K
TEMPERATURE
L
TRUE AIRSPEED
TOTAL FUEL FLOW
N
M
NMPP

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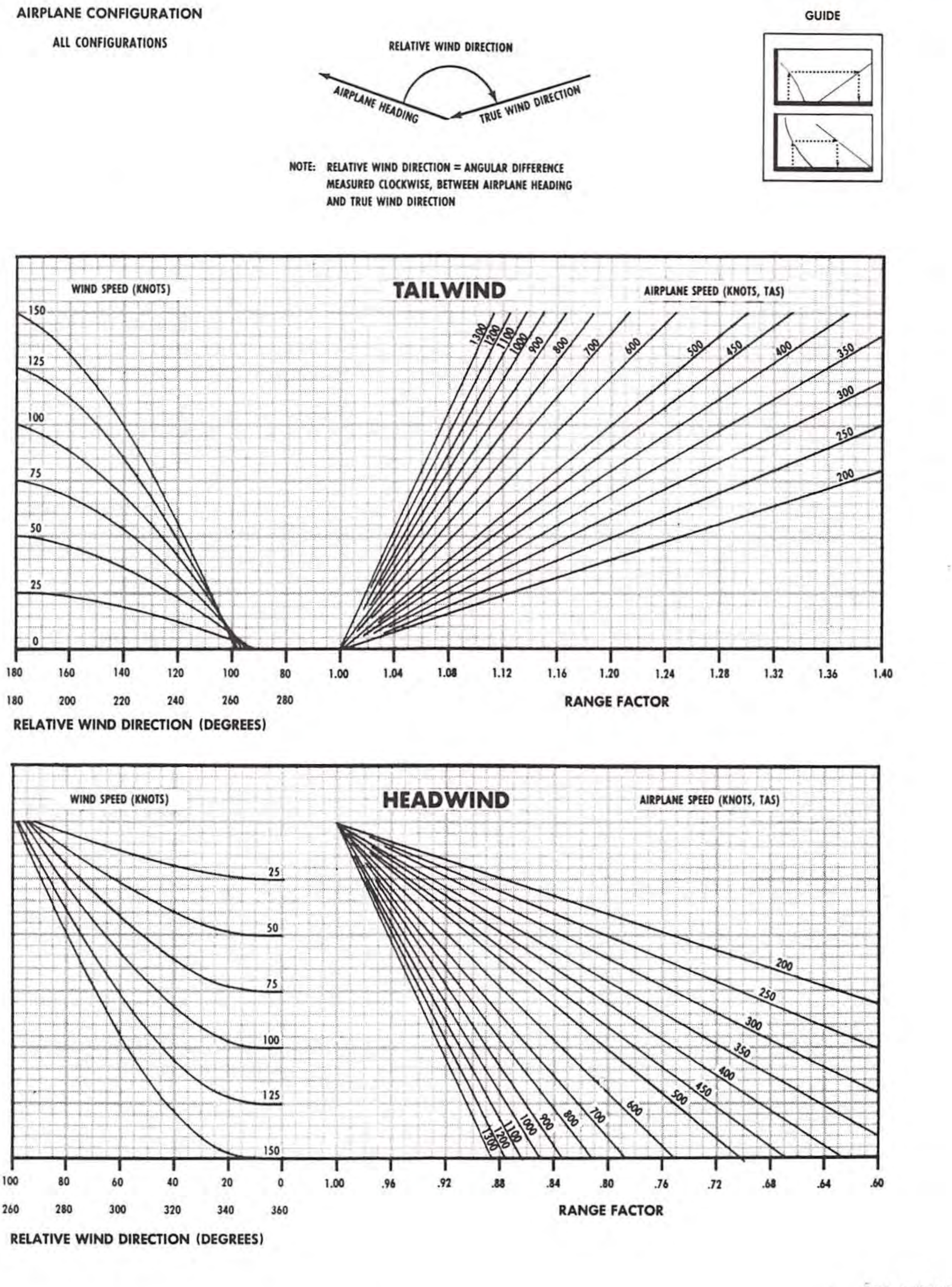

Figure 21-1. Range-Wind Correction

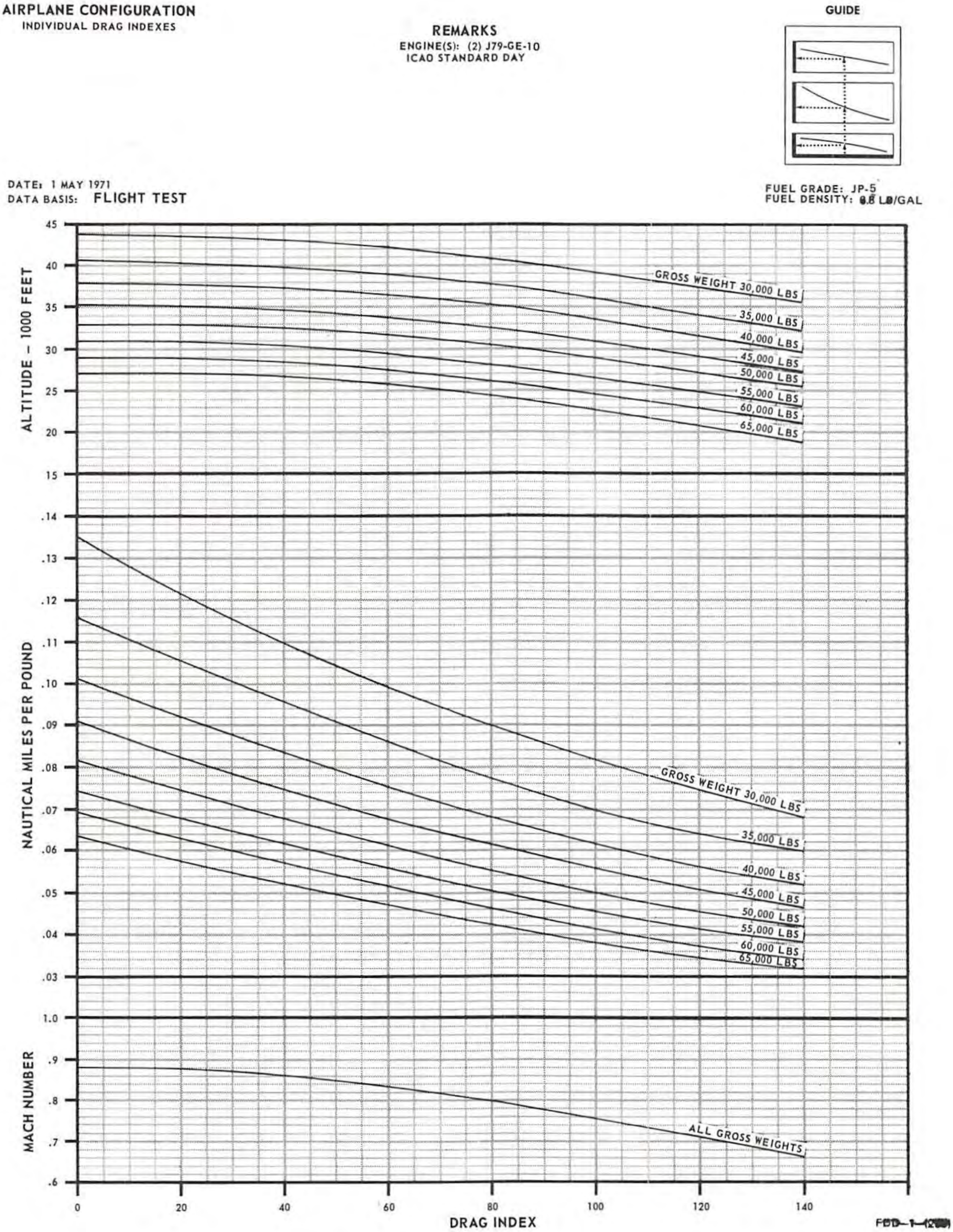

Figure 21-2. Optimum Cruise Summary

GROSS WEIGHT – 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINES: (2) J79-GE-10

DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	DRAG INDEX: TOTAL FUEL FLOW-LB/HR							TEMP. EFFECTS	
		0	20	40	60	80	100	120	°C	FACTOR
SEA LEVEL (15°C)	360	7185	7963	8767	9590	10436	11304	12125		
	420	9053	10188	11373	12547	13876	15143	16530	−40	.899
	480	11381	12954	14641	16358	18191	20092	22408	−20	.937
	540	14296	16394	18496	21118	24390			0	.973
	600	20230	23256	27556					20	1.008
	MIL	28200	27894	27643	27099	26604	26085	25421	40	1.042
	VMAX	630.5	614.7	601.9	576.1	553.9	531.9	504.3		
4,000 FEET (7°C)	360	6477	7194	7896	8624	9371	10135	10927		
	420	8067	9093	10132	11194	12274	13492	14813	−40	.913
	480	10096	11477	12859	14469	16352	18238	20149	−20	.949
	540	12743	14599	16475	19405	22153			0	.987
	600	18779	22276	25117					20	1.022
	MIL	25869	25467	25146	24566	24110	23725	23159	40	1.057
	VMAX	631.9	614.3	600.7	575.5	555.2	537.1	509.7		
8,000 FEET (-1°C)	360	5837	6457	7087	7740	8387	9059	9765		
	420	7191	8088	9005	9927	10911	11874	12986	−40	.925
	480	8934	10149	11388	12673	14233	16115	18154	−20	.963
	540	11303	12835	14530	16870	19998	21480		0	1.001
	600	17164	20660						20	1.037
	MIL	23513	23006	22654	22154	21799	21528	21099	40	1.072
	VMAX	633.3	613.6	597.9	574.4	556.1	541.2	514.7		
12,000 FEET (-9°C)	360	5272	5811	6366	6916	7511	8084	8713		
	420	6405	7186	8009	8817	9672	10548	11440	−40	.939
	480	7890	8967	10041	11216	12413	13879	15670	−20	.978
	540	10012	11382	12800	14732	17157	19399		0	1.016
	600	15549	18742						20	1.052
	MIL	21219	20725	20351	19993	19722	19500	19135	40	1.088
	VMAX	634.0	612.3	593.7	572.6	556.2	542.8	517.9		
16,000 FEET (-16°C)	360	4781	5252	5732	6218	6700	7235	7764		
	420	5747	6432	7104	7831	8614	9383	10252	−40	.953
	480	6991	7909	8841	9883	11033	12174	13582	−20	.993
	540	8963	10156	11545	13254	15086	17548		0	1.032
	600	14366	17333						20	1.069
	MIL	19102	18622	18289	18038	17825	17633	17232	40	1.105
	VMAX	634.3	609.0	588.1	569.1	554.5	542.6	518.3		

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Figure 21-3. Low-Altitude Cruise (Sheet 1 of 3)

GROSS WEIGHT – 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	DRAG INDEX / TOTAL FUEL FLOW LB/HR							TEMP. EFFECTS	
		0	20	40	60	80	100	120	°C	FACTOR
SEA LEVEL (15°C)	360	7672	8475	9277	10102	10953	11788	12678		
	420	9401	10559	11774	12930	14247	15564	16917	−40	.899
	480	11681	13256	14932	16712	18536	20431	22830	−20	.937
	540	14587	16681	18780	21421	24796			0	.973
	600	20463	23565	27573					20	1.008
	MIL	28183	27879	27629	27057	26562	26007	25348	40	1.042
	VMAX	629.5	613.9	601.2	574.2	552.2	528.5	501.2		
4,000 FEET (7°C)	360	6988	7689	8423	9175	9918	10678	11456		
	420	8493	9527	10571	11634	12711	13963	15355	−40	.913
	480	10438	11856	13233	14861	16770	18705	20556	−20	.949
	540	12987	14854	16787	19700	22525			0	.987
	600	19082	22676						20	1.022
	MIL	25838	25443	25120	24521	24071	23649	23088	40	1.057
	VMAX	630.5	613.3	599.6	573.5	553.4	533.5	506.1		
8,000 FEET (-1°C)	360	6365	7002	7639	8292	8969	9635	10333		
	420	7654	8573	9500	10431	11413	12389	13586	−40	.925
	480	9308	10541	11778	13079	14681	16604	18734	−20	.963
	540	11602	13139	14830	17299	20406			0	1.001
	600	17447	21064						20	1.037
	MIL	23471	22975	22608	22114	21761	21481	21038	40	1.072
	VMAX	631.7	612.4	595.8	572.4	554.1	538.3	510.5		
12,000 FEET (-9°C)	360	5829	6384	6934	7532	8100	8709	9317		
	420	6930	7715	8526	9345	10213	11093	11990	−40	.939
	480	8327	9394	10458	11600	12858	14376	16265	−20	.978
	540	10357	11740	13170	15113	17750	19442		0	1.016
	600	15788	19093						20	1.052
	MIL	21177	20696	20317	19956	19686	19464	19061	40	1.088
	VMAX	632.2	611.0	591.7	570.4	554.0	540.6	512.7		
16,000 FEET (-16°C)	360	5420	5900	6395	6876	7420	7929	8494		
	420	6300	6975	7706	8404	9186	9996	10891	−40	.953
	480	7447	8383	9325	10374	11488	12730	14218	−20	.993
	540	9335	10513	11884	13642	15551	17586		0	1.032
	600	14687	17797						20	1.069
	MIL	19042	18586	18252	18004	17786	17596	17122	40	1.105
	VMAX	631.6	606.8	585.3	566.5	552.1	540.3	511.8		

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Figure 21-3. Low-Altitude Cruise (Sheet 2 of 3)

GROSS WEIGHT – 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINES: (2) J79-GE-10

DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

SEA LEVEL 15°C

KTAS	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS °C	FACTOR
	TOTAL FUEL FLOW LB/HR								
360	8196	8999	9823	10672	11528	12361	13341		
420	9901	11060	12247	13470	14742	16133	17455	−40	.899
480	12076	13654	15312	17077	18947	20871	23381	−20	.937
540	14926	17014	19108	21770	25265			0	.973
600	20702	23882	27592					20	1.008
MIL	28164	27862	27615	27012	26516	25912	25256	40	1.042
V_{MAX}	628.4	613.1	600.5	572.1	550.2	524.6	497.4		

4,000 FEET 7°C

KTAS	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS °C	FACTOR
360	7544	8282	9021	9756	10519	11290	12066		
420	9001	10037	11096	12137	13313	14579	16100	−40	.913
480	10825	12236	13653	15300	17188	19134	21004	−20	.949
540	13335	15200	17202	20100	23049			0	.987
600	19395	23090						20	1.022
MIL	25807	25419	25067	24468	24022	23547	23004	40	1.057
V_{MAX}	629.2	612.2	597.3	571.1	551.1	528.7	501.9		

8,000 FEET -1°C

KTAS	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS °C	FACTOR
360	6976	7608	8263	8942	9603	10278	10994		
420	8238	9153	10073	11006	11961	13037	14318	−40	.925
480	9797	11014	12223	13630	15288	17219	19339	−20	.963
540	11987	13528	15211	17851	20923			0	1.001
600	17821	21601						20	1.037
MIL	23425	22939	22549	22064	21714	21391	20962	40	1.072
V_{MAX}	629.9	611.0	593.1	569.7	551.6	532.7	505.1		

12,000 FEET -9°C

KTAS	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS °C	FACTOR
360	6592	7142	7743	8324	8912	9528	10136		
420	7499	8316	9143	9970	10829	11675	12673	−40	.939
480	8836	9909	10987	12113	13477	15084	17072	−20	.978
540	10740	12072	13589	15542	18431			0	1.016
600	16223	19736						20	1.052
MIL	21121	20649	20260	19907	19642	19382	18968	40	1.088
V_{MAX}	629.7	608.9	588.4	567.5	551.4	535.1	506.2		

16,000 FEET -16°C

KTAS	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS °C	FACTOR
360	6385	6866	7410	7910	8459	8988	9590		
420	6937	7659	8360	9089	9900	10751	11558	−40	.953
480	8069	9008	9946	11020	12102	13458	15086	−20	.993
540	9786	10996	12370	14152	16261			0	1.032
600	15100	18399						20	1.069
MIL	18965	18541	18204	17959	17734	17452	16972	40	1.105
V_{MAX}	628.2	604.1	581.7	563.1	548.9	531.4	502.9		

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Figure 21-3. Low-Altitude Cruise (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	-60	-40	-20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07

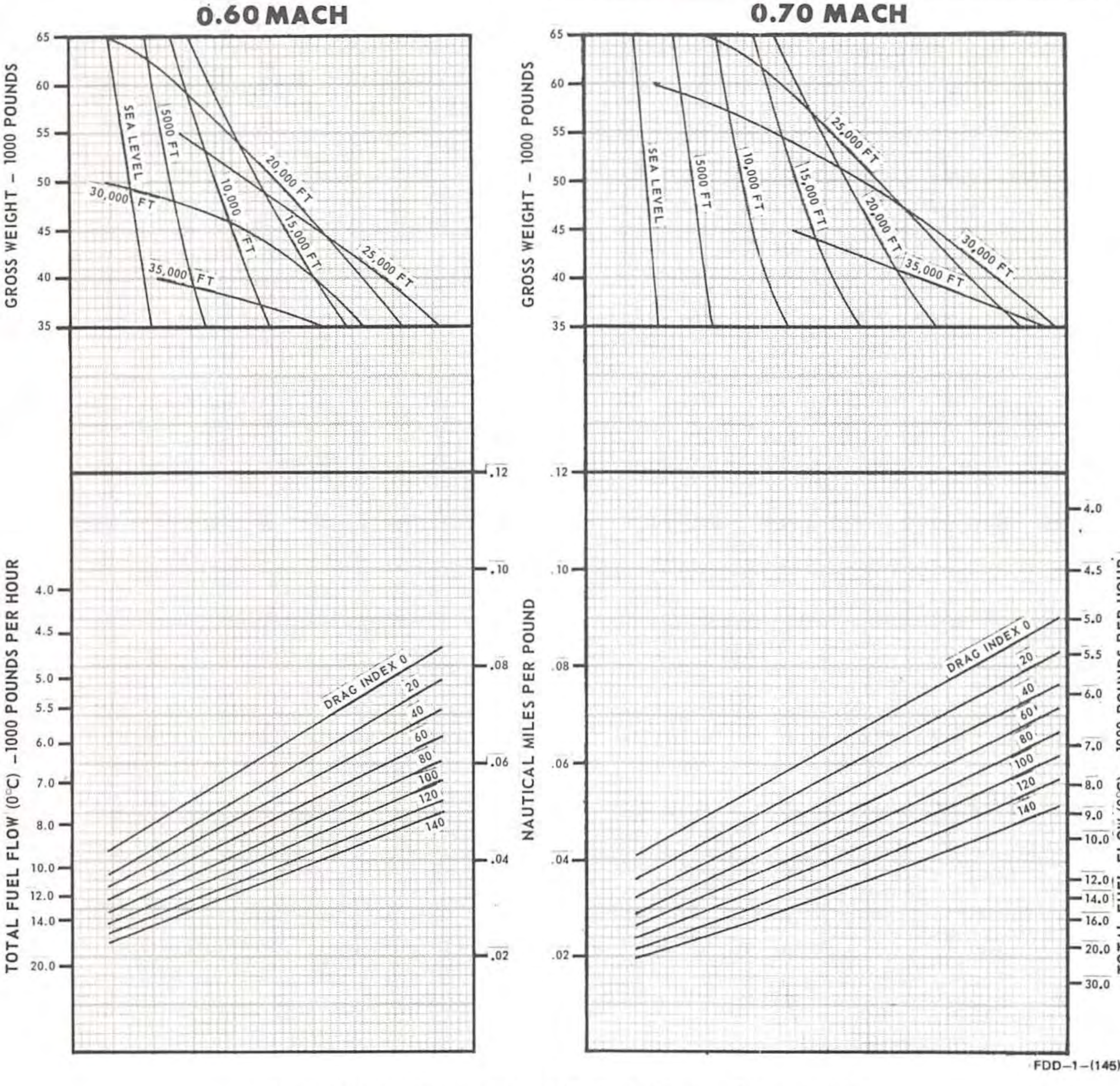


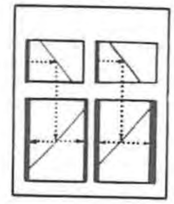
Figure 21-4. Constant Mach/Altitude Cruise (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

GUIDE

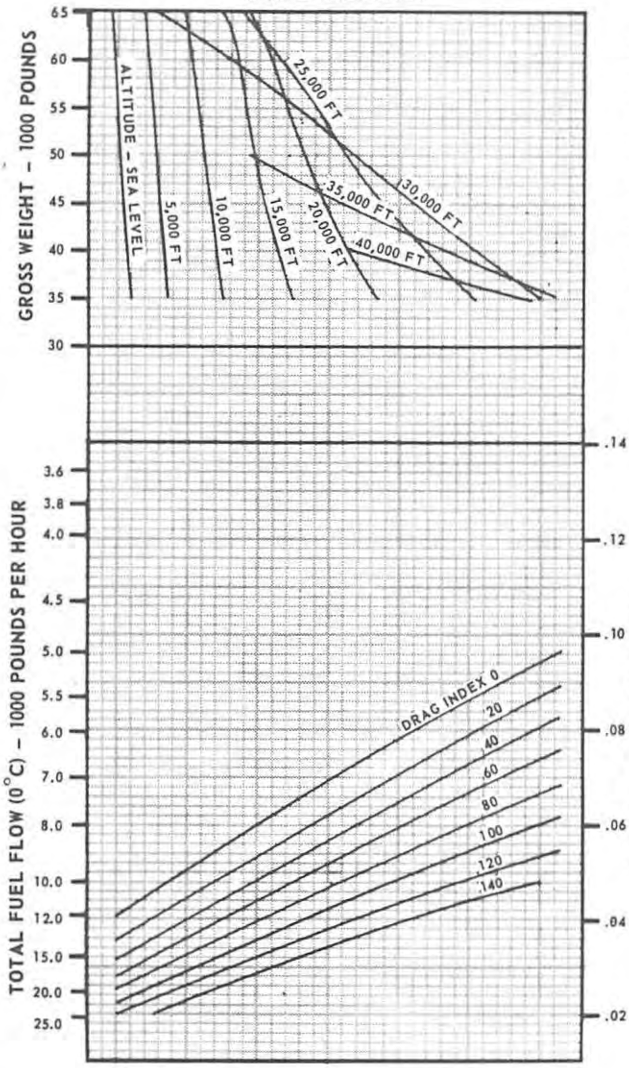


FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

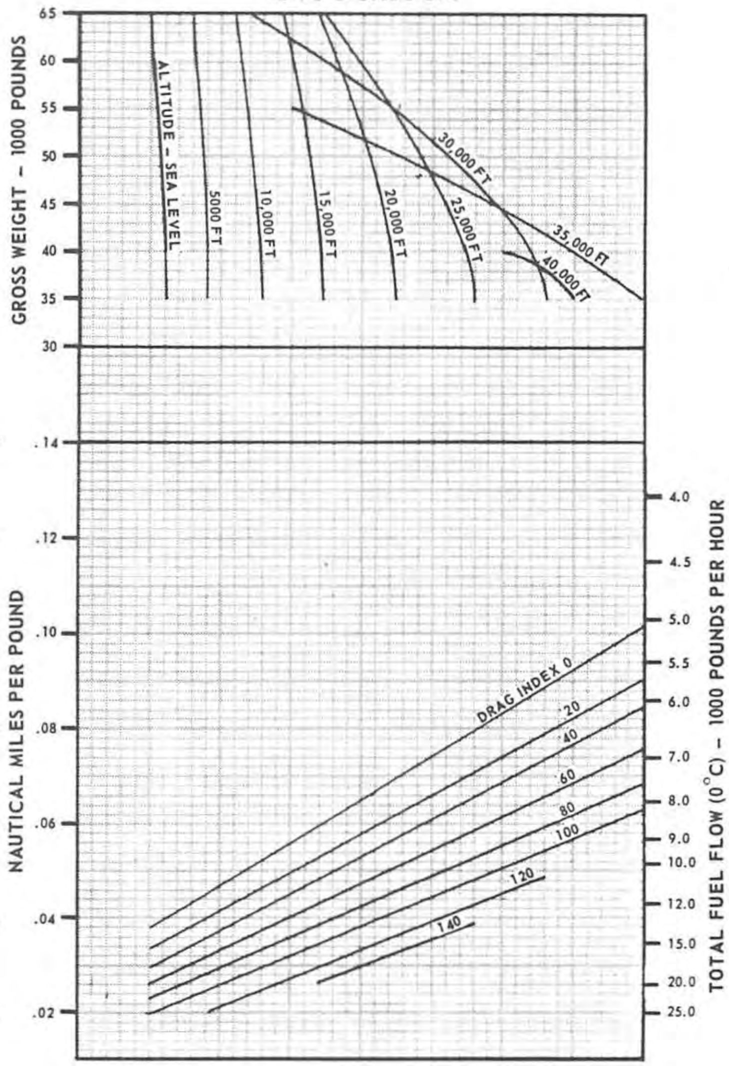
ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	-60	-40	-20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07

0.75 MACH



0.80 MACH



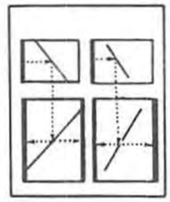
FDD-1-(146) A

Figure 21-4. Constant Mach/Altitude Cruise (Sheet 2 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE



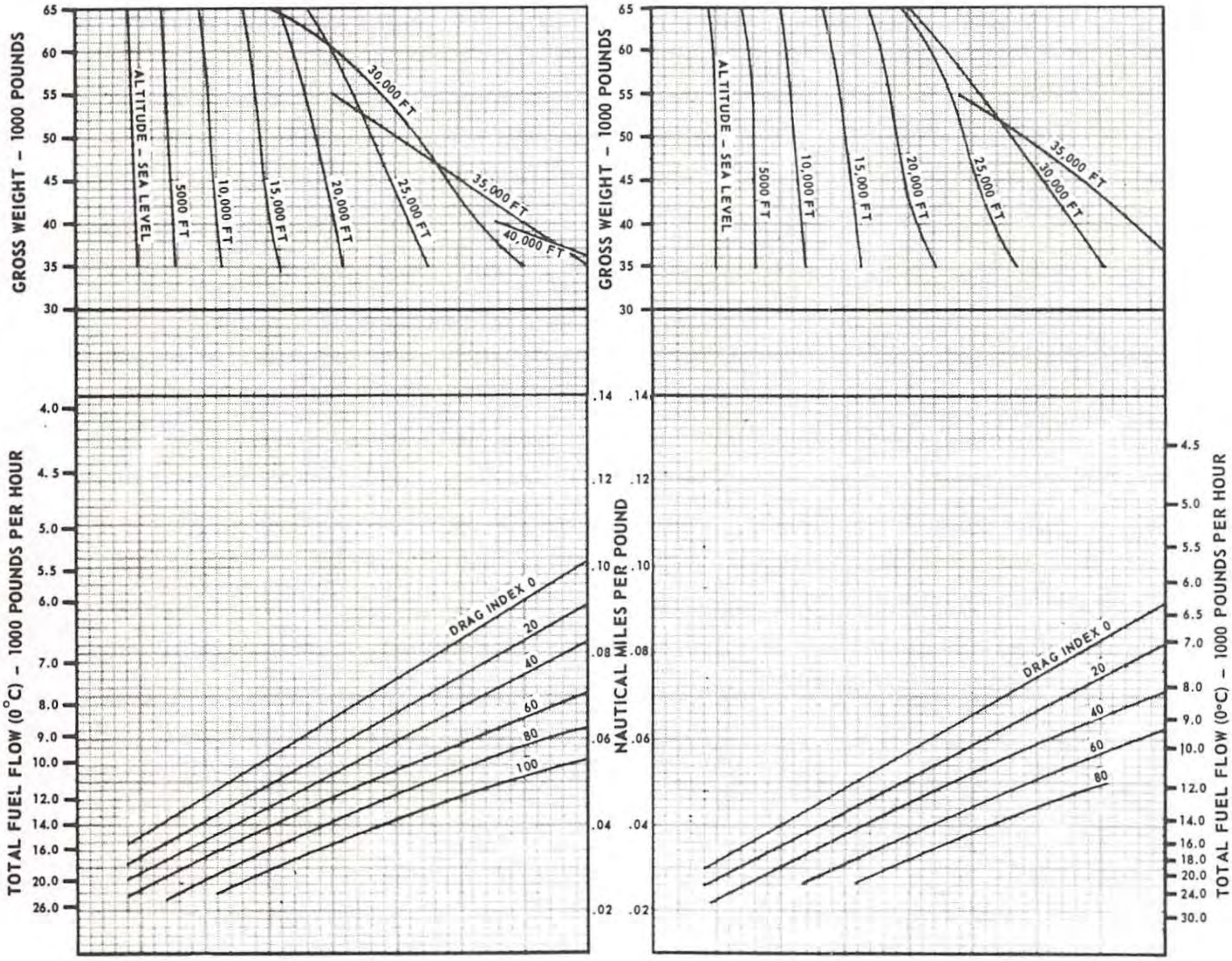
DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	-60	-40	-20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07

0.85 MACH **0.90 MACH**



FDD-1-(147)A

Figure 21-4. Constant Mach/Altitude Cruise (Sheet 3 of 3)

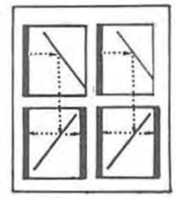
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10
INOPERATIVE ENGINE WINDMILLING

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

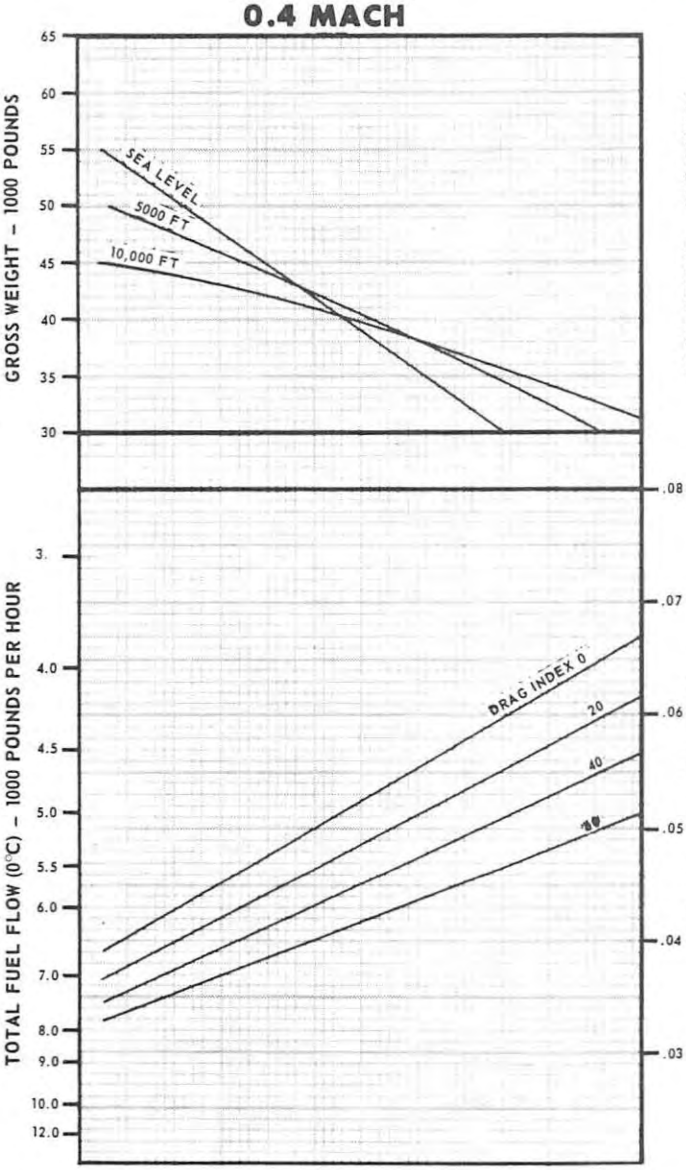
GUIDE

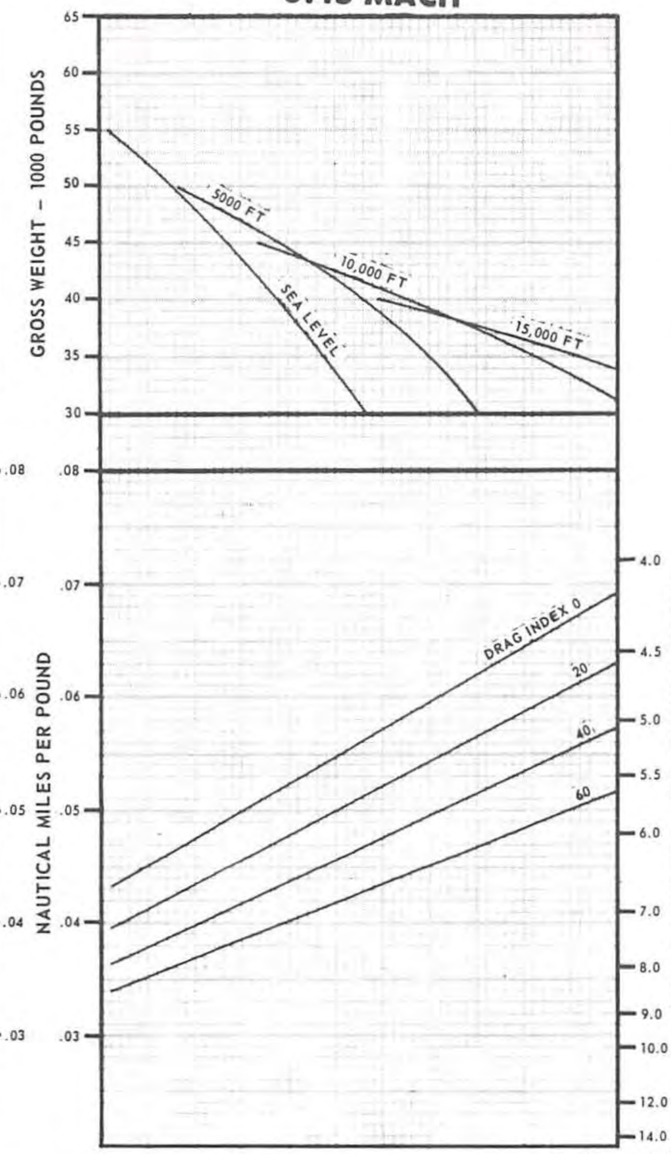


FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	-60	-40	-20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07





FDD-1-(148)A

Figure 21-5. Constant Mach/Altitude Cruise – One Engine Operating (Sheet 1 of 3)

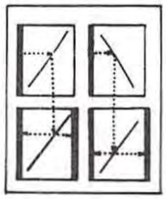
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10
INOPERATIVE ENGINE WINDMILLING

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

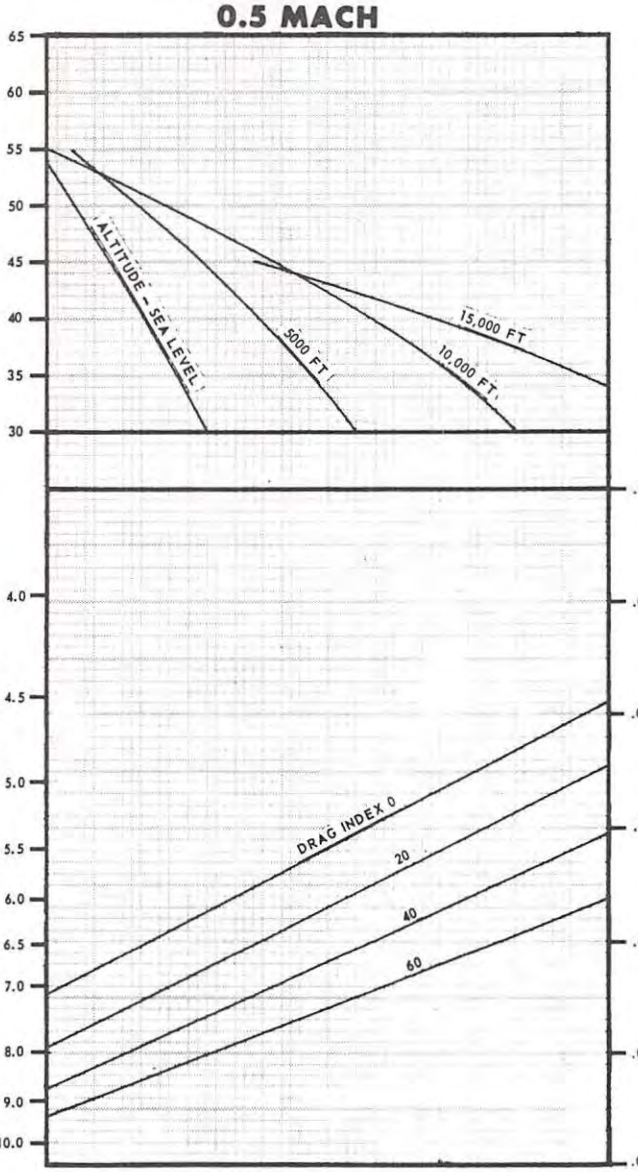
GUIDE

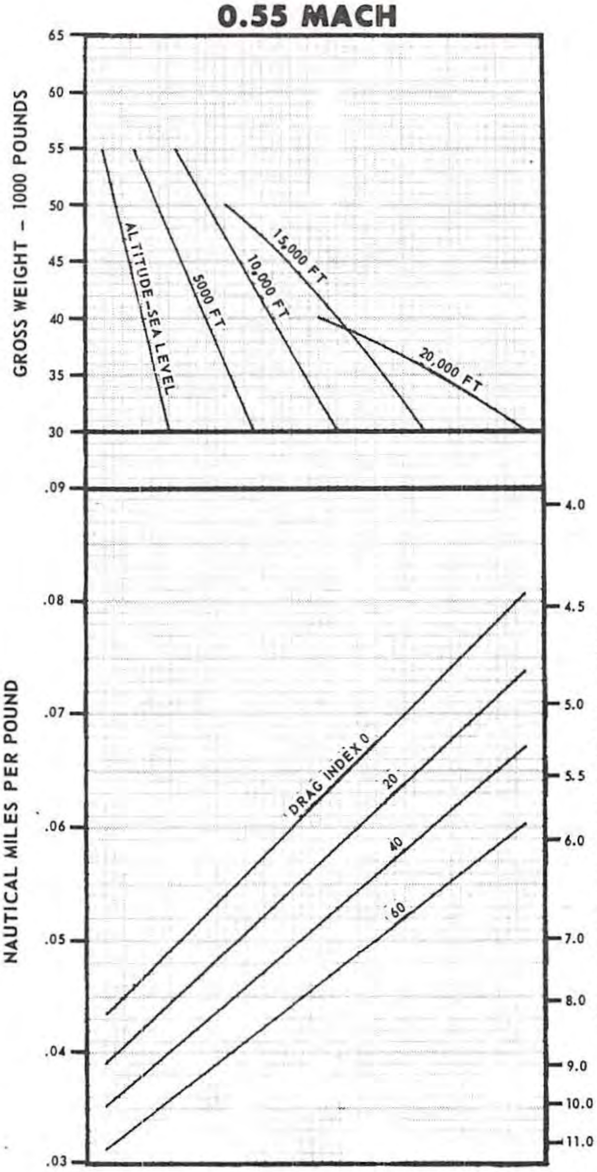


FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	-60	-40	-20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07





FDD-1-(149)A

Figure 21-5. Constant Mach/Altitude Cruise – One Engine Operating (Sheet 2 of 3)

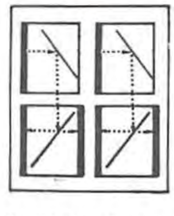
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10
INOPERATIVE ENGINE WINDMILLING

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

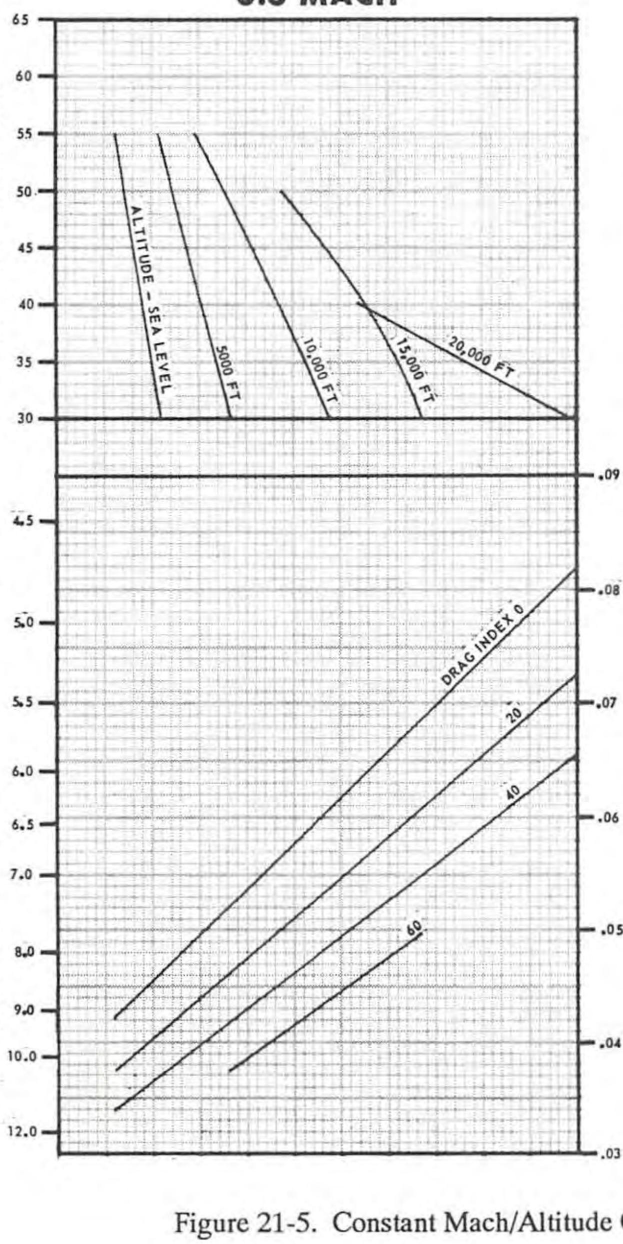
GUIDE

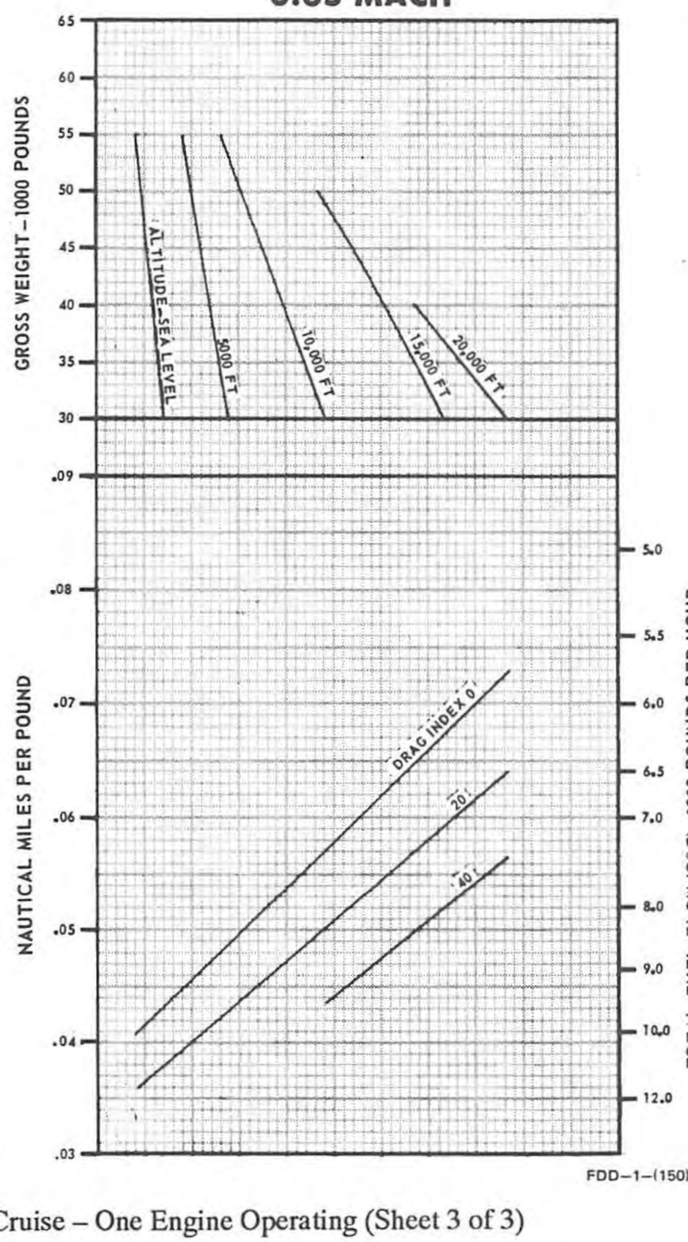


FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	-60	-40	-20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07





FDD-1-(150)A

Figure 21-5. Constant Mach/Altitude Cruise – One Engine Operating (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

LONG RANGE SPEED NAUTICAL MILES PER POUND AND MACH NUMBER

REMARKS
ENGINE(S): (2) J79–GE–10

DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

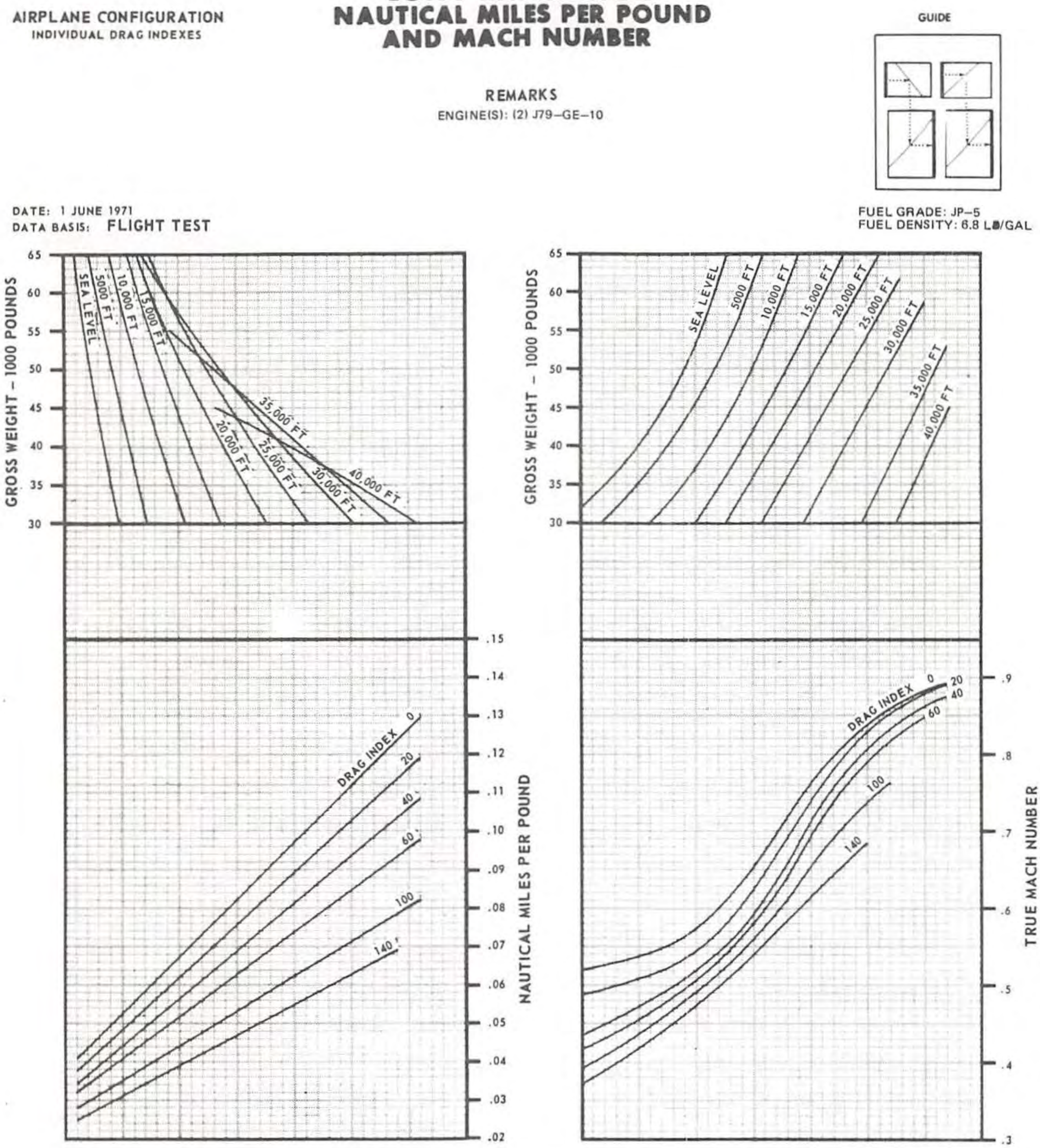


Figure 21-6. Constant Altitude Cruise (Sheet 1 of 2)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

LONG RANGE SPEED TRUE AIRSPEED AND FUEL FLOW

REMARKS
ENGINE(S): (2) J79-GE-10

DATE: 1 MARCH 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

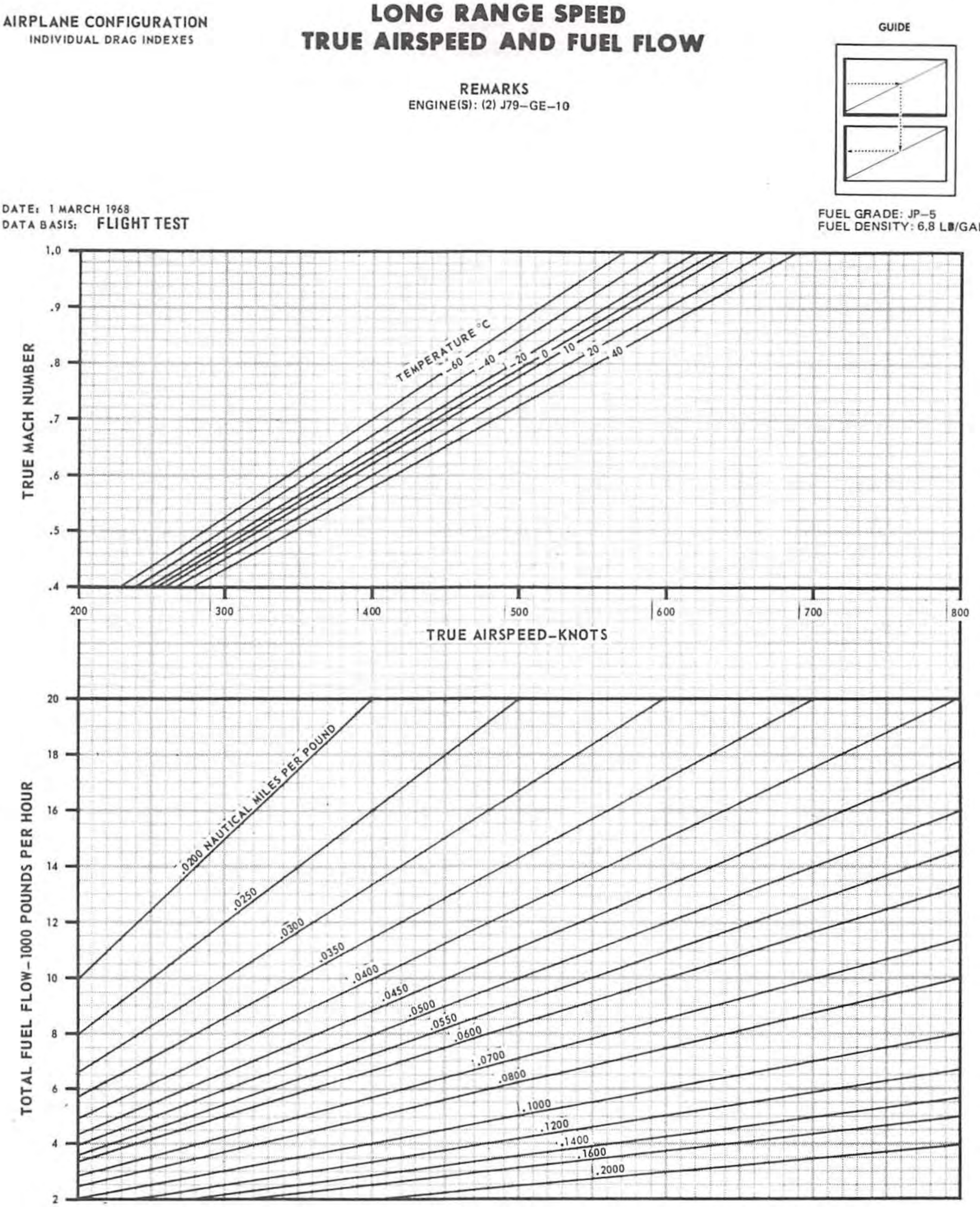


Figure 21-6. Constant Altitude Cruise (Sheet 2 of 2)

LONG RANGE SPEED
NAUTICAL MILES PER POUND
AND MACH NUMBER
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

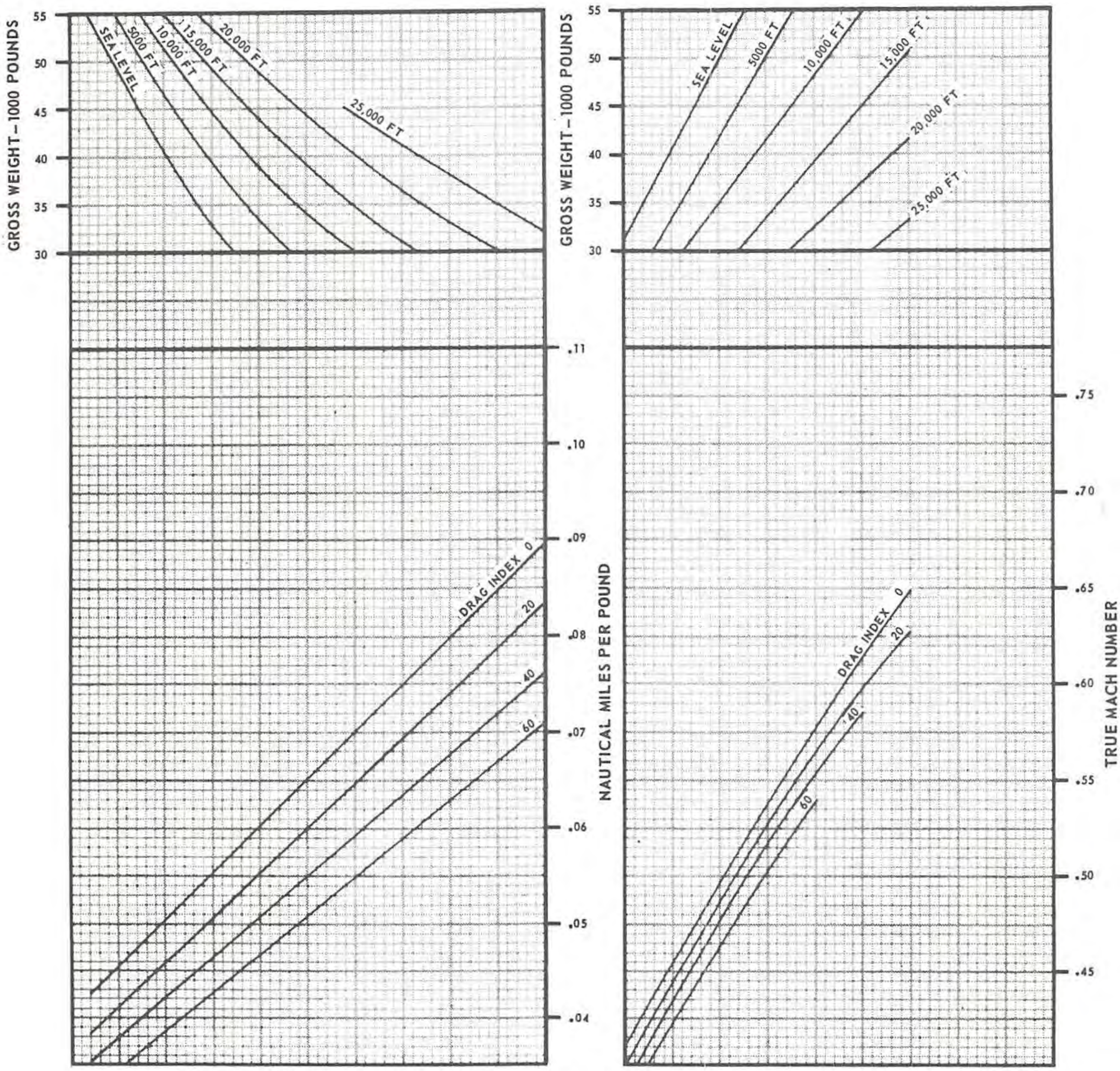
REMARKS
ENGINE(S): (2) J79–GE–10
INOPERATIVE ENGINE WINDMILLING

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

GUIDE

DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(298–1)

Figure 21-7. Constant Altitude Cruise – One Engine Operating (Sheet 1 of 2)

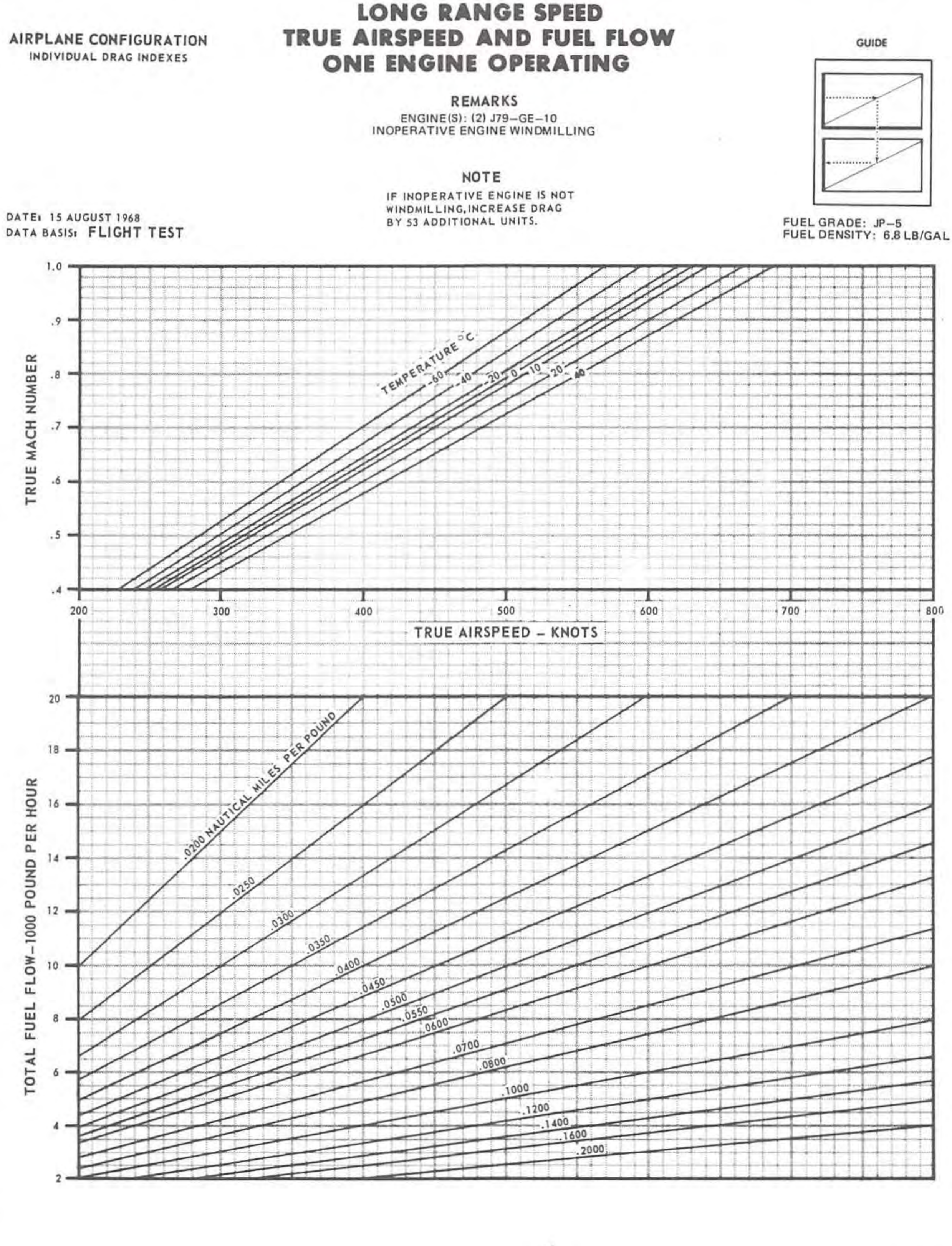


Figure 21-7. Constant Altitude Cruise – One Engine Operating (Sheet 2 of 2)

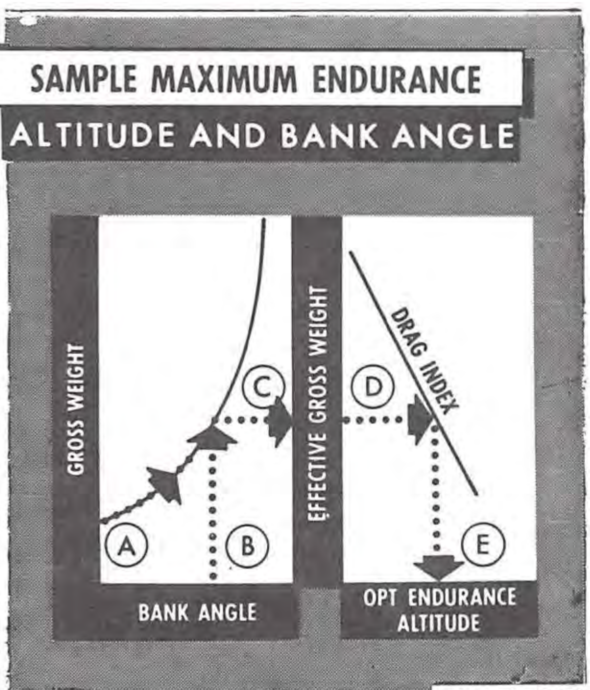
CHAPTER 22

Endurance

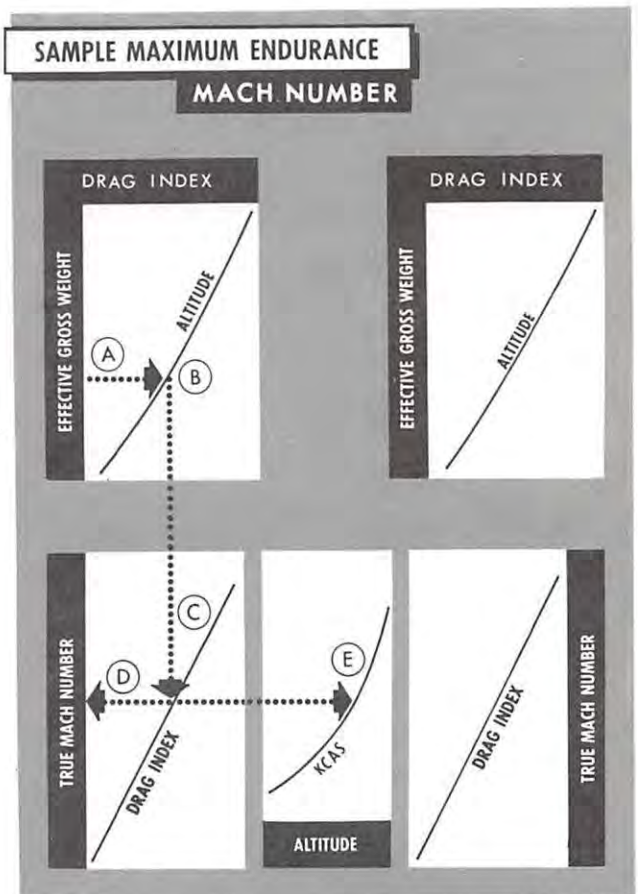
22.1 MAXIMUM ENDURANCE CHARTS

These charts (Figures 22-1 and 22-2) present optimum endurance altitude and maximum endurance specifics (fuelflow and Mach number) for all combinations of effective gross weight and altitude. Separate charts are included for single-engine operation.

22.1.1 Use. Enter the altitude and bank angle chart with the average gross weight. If bank angles are to be considered, follow the gross weight curve until it intersects the bank angle to be used, then horizontally to the right to obtain effective gross weight. (If bank angles are not to be considered, enter the chart at the effective gross weight scale.) From this point, proceed horizontally to the right and intersect the computed drag index. Reflect downward and read the optimum endurance altitude. Enter the Mach number plots with the effective gross weight and proceed horizontally to intersect the optimum endurance altitude. Then descend downward and intersect the computed drag index and horizontally to read true Mach number. From the intersection of endurance altitude and drag index, proceed horizontally to the right and intersect the optimum altitude. At this point, read endurance airspeed. Enter the fuelflow plots with the effective gross weight, proceed horizontally to intersect the optimum endurance altitude. Reflect downward to the computed drag index and then horizontally to read total fuelflow.



FDD–1–(154)



FDD–1–(155)

22.1.2 Sample Problem

22.1.2.1 Altitude and Bank Angle

A. Gross weight – 45,000 POUNDS.

B. Bank angle – 20°.

C. Effective gross weight – 48,000 POUNDS.

D. Drag index – 40.

E. Optimum endurance altitude – 25,000 FEET.

22.1.2.2 Mach Number

A. Effective gross weight – 48,000 POUNDS.

B. Endurance altitude – 25,000 FEET.

C. Drag index – 40.

D. Mach number – 0.64.

E. Airspeed – 265 KIAS.

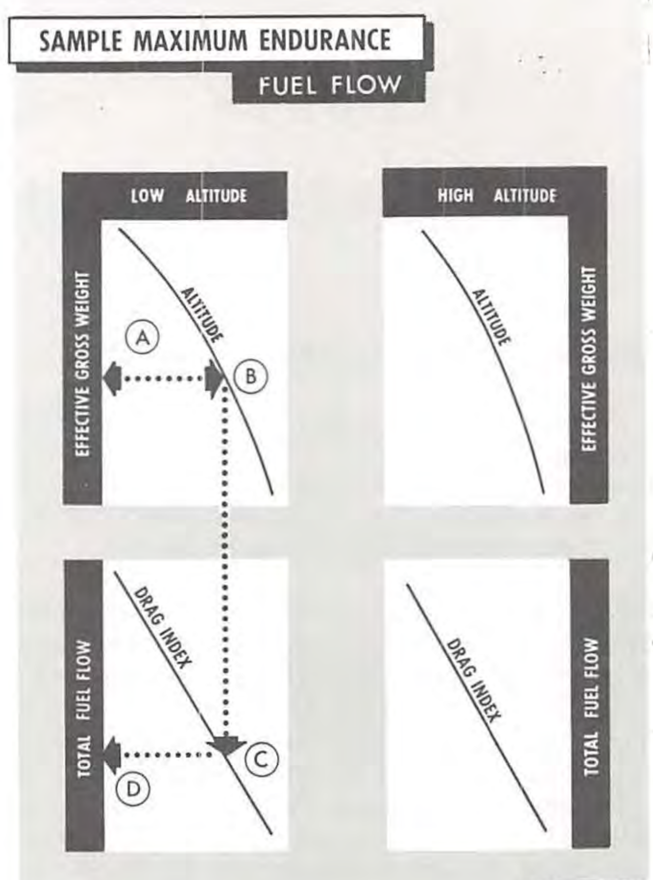
22.1.2.3 Fuelflow

A. Effective gross weight – 48,000 POUNDS.

B. Endurance altitude – 25,000 FEET.

C. Drag index – 40.

D. Fuelflow – 6,200 PPH.



FDD-1-(156)

ALTITUDE AND BANK ANGLE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

DATE: 1 MAY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

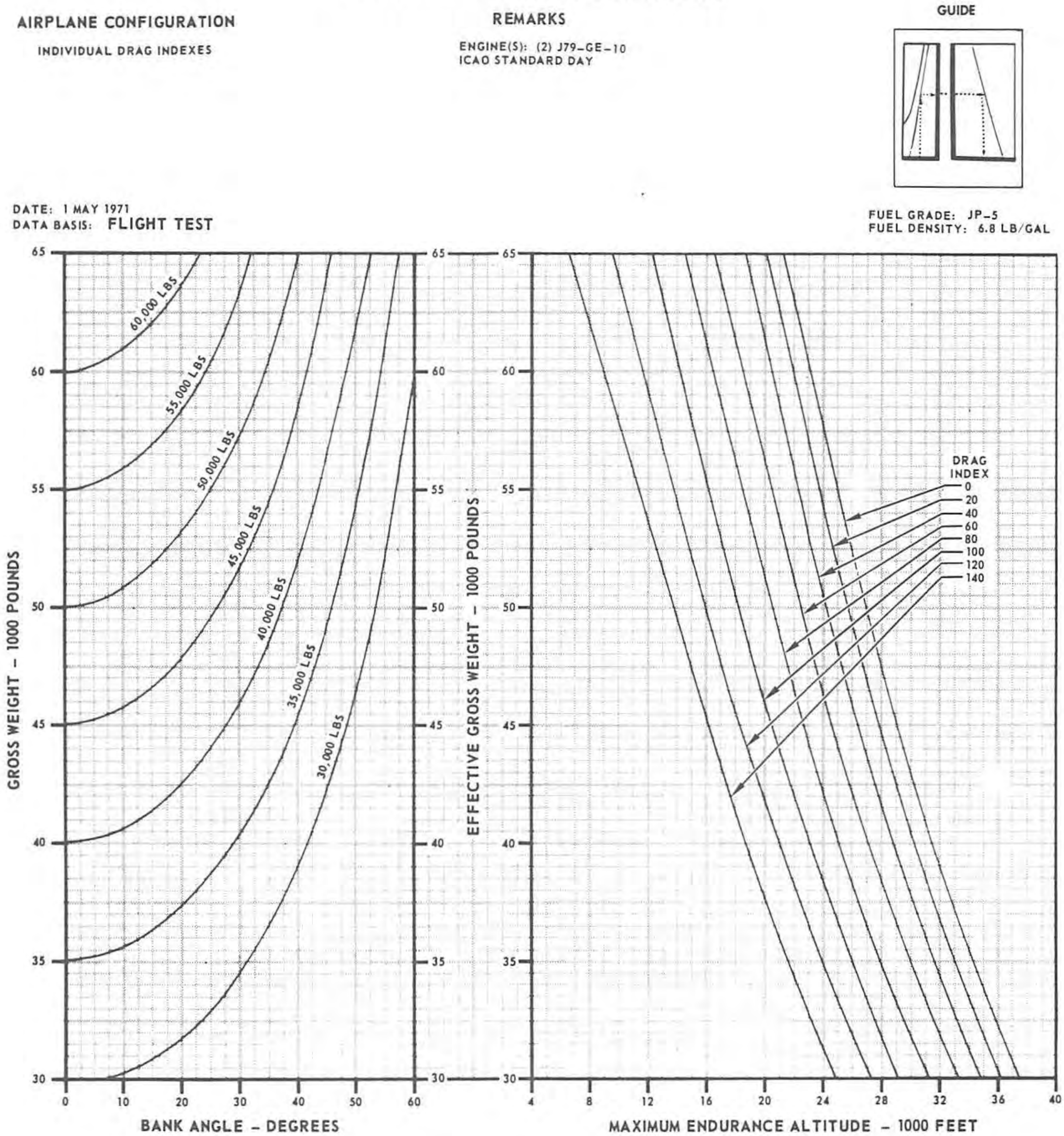


Figure 22-1. Maximum Endurance (Sheet 1 of 4)

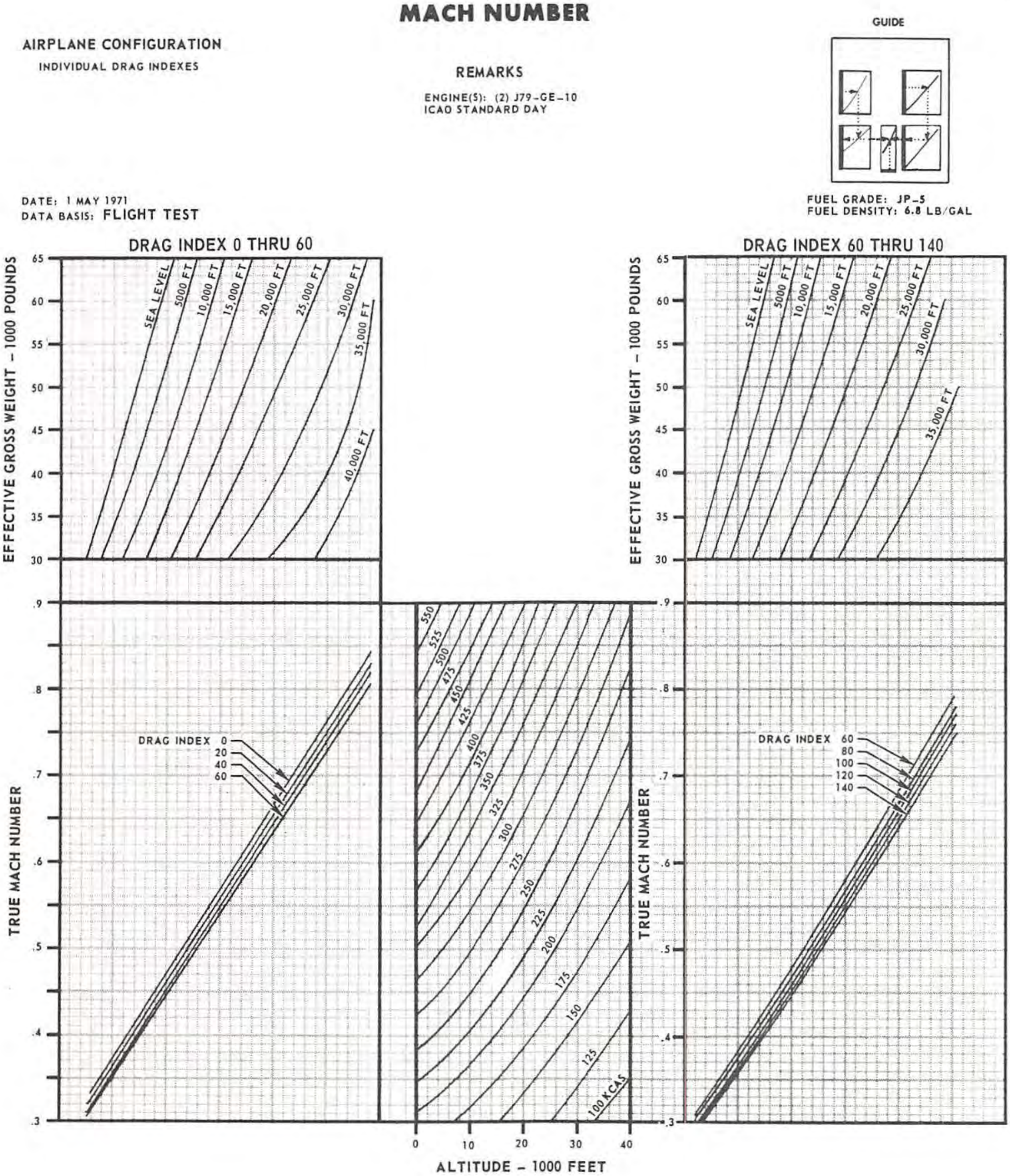
MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

DATE: 1 MAY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(161)A

Figure 22-1. Maximum Endurance (Sheet 2 of 4)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
(0–60)

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

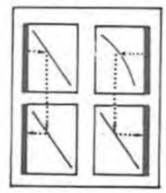
FUEL FLOW

REMARKS

ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

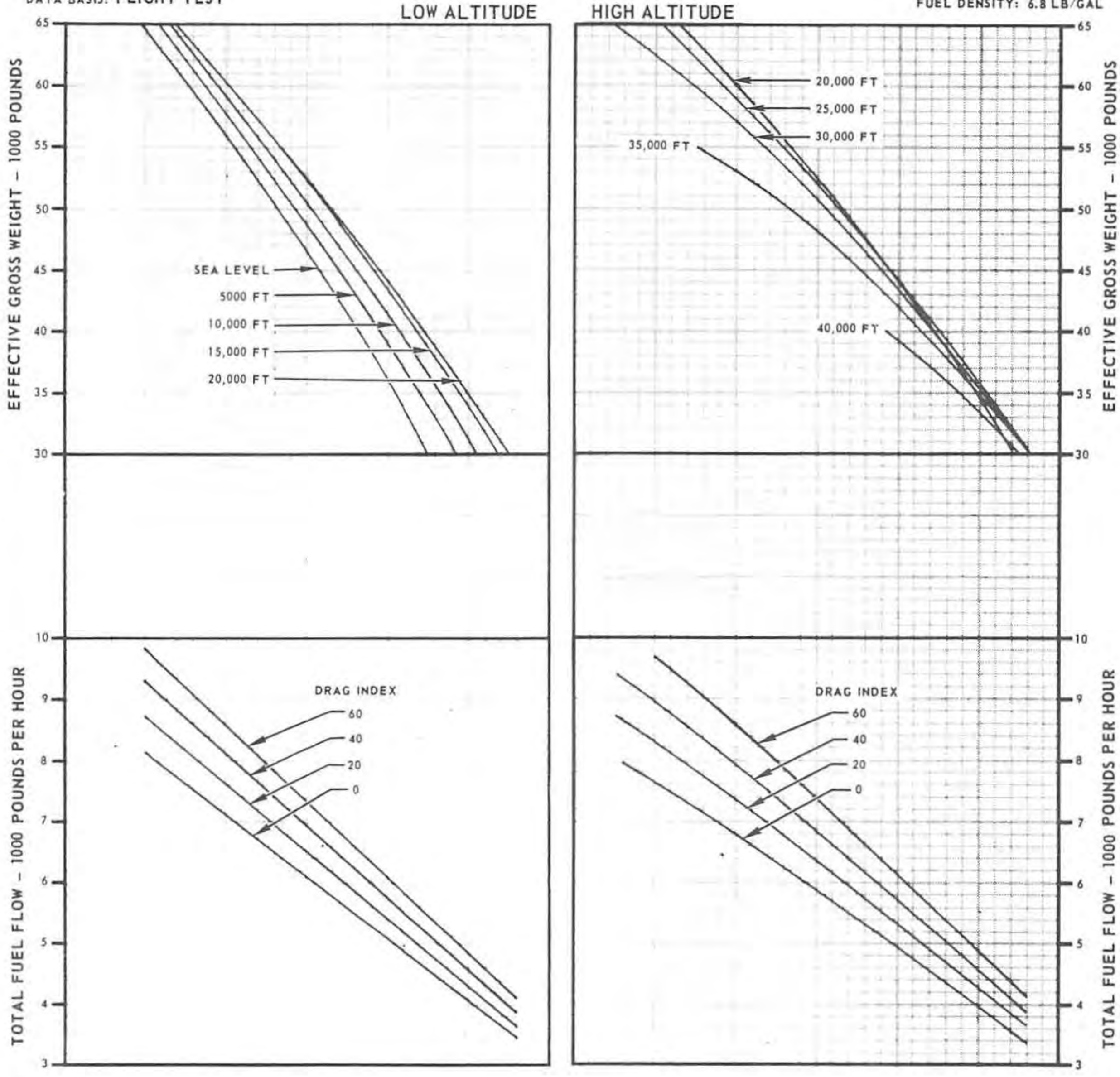
NOTE
TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FROM STANDARD DAY.

GUIDE



DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(162)A

Figure 22-1. Maximum Endurance (Sheet 3 of 4)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
(60–140)

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

DATE: 1 MAY 1971
DATA BASIS: FLIGHT TEST

FUEL FLOW

REMARKS

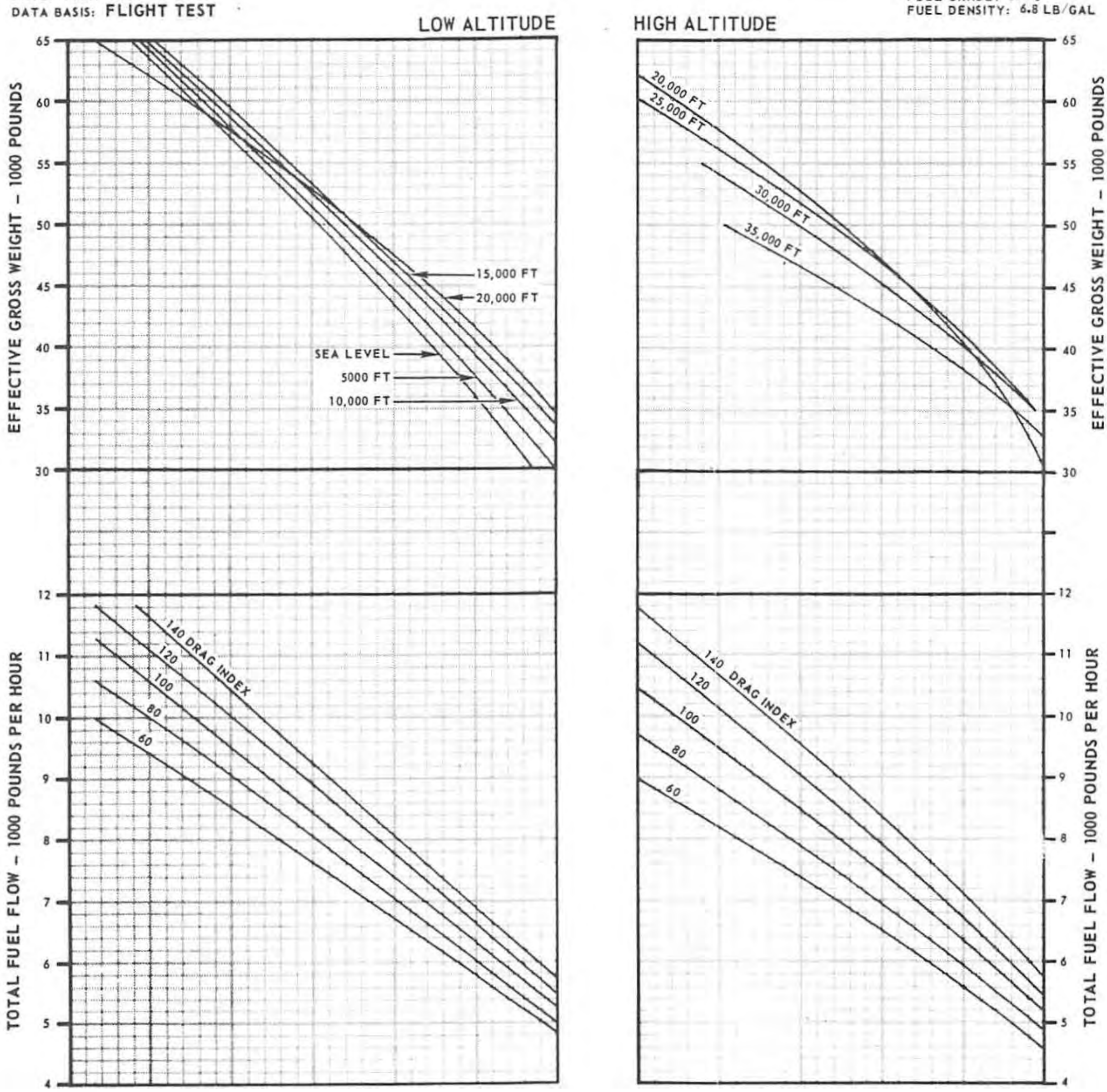
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

NOTE

TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FROM STANDARD DAY.

GUIDE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(163)A

Figure 22-1. Maximum Endurance (Sheet 4 of 4)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

ALTITUDE AND BANK ANGLE ONE ENGINE OPERATING

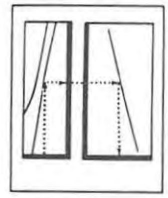
REMARKS

ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

NOTE

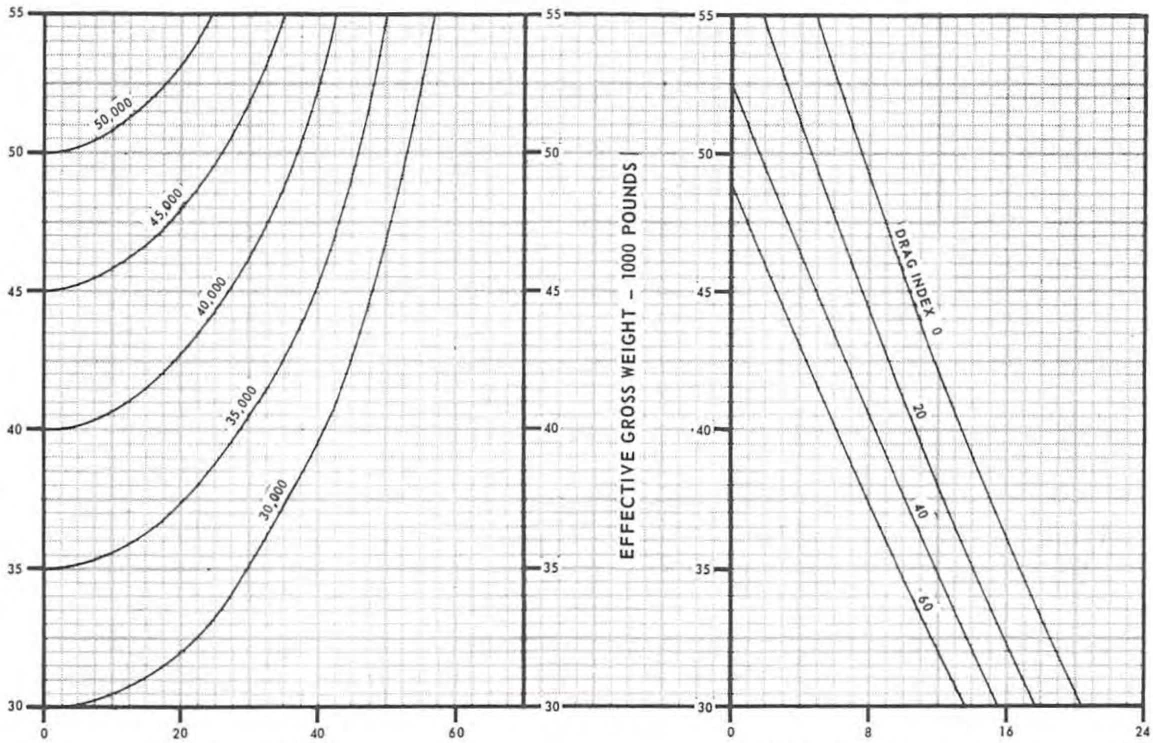
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

GUIDE



DATE: 1 MAY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(164)A

Figure 22-2. Maximum Endurance – One Engine Operating (Sheet 1 of 2)

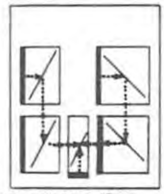
MACH NUMBER AND FUEL FLOW ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

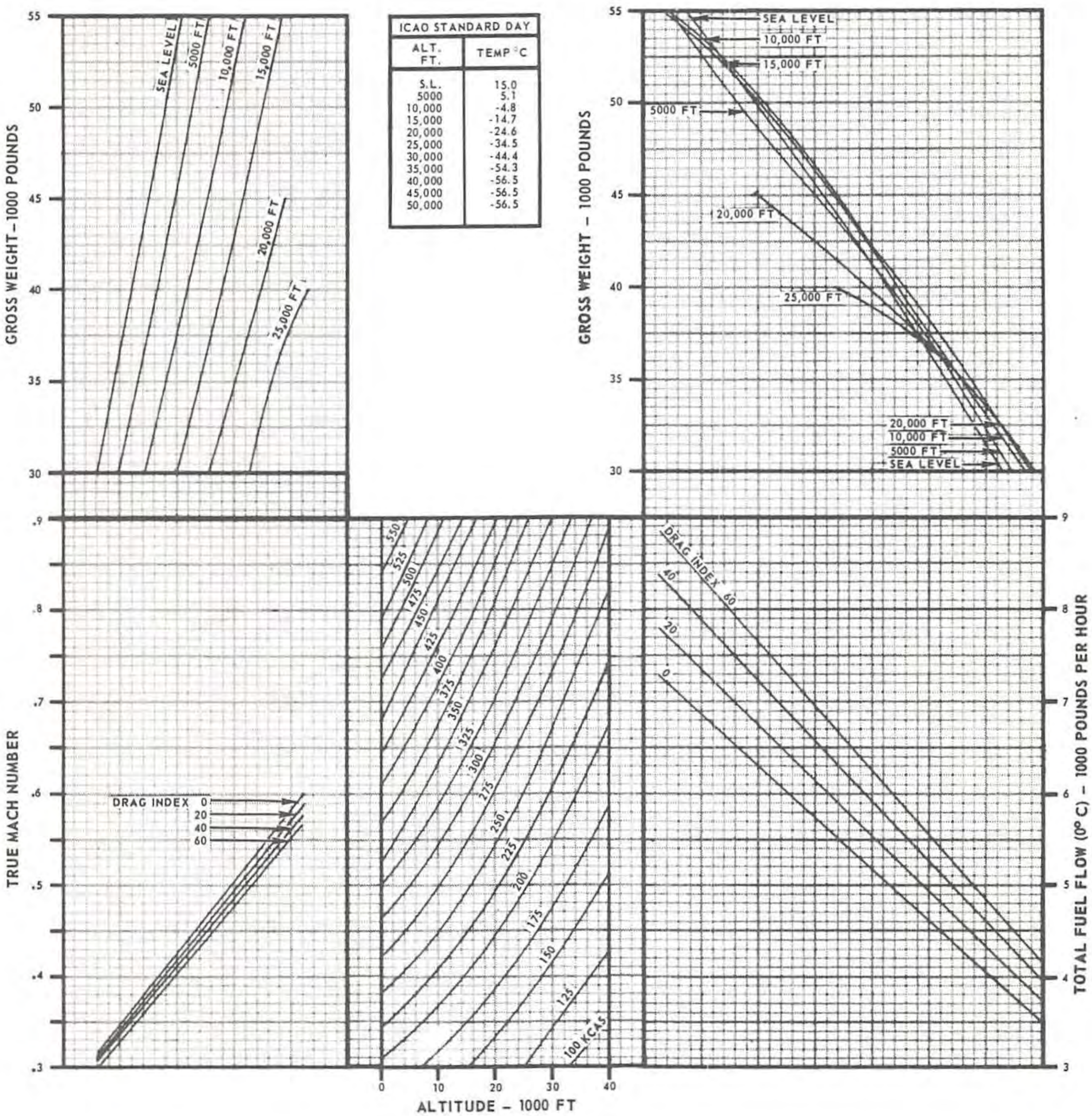
NOTE
- IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.
- TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FROM STANDARD DAY.

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MAY 1971
DATA BASIS: FLIGHT TEST



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(165)A

Figure 22-2. Maximum Endurance – One Engine Operating (Sheet 2 of 2)

CHAPTER 23

Air Refueling

Note

Refer to NATOPS Air Refueling Manual.

23.1 AIR REFUELING TRANSFER TIME CHART

This chart (Figure 23-1) provides the capability of determining the amount of time required to take on a certain amount of fuel at a specified rate. This time segment should then be added to the planning profile.

23.1.1 Use. Enter the chart with a specified amount of fuel to be received and project horizontally to the right and intersect the applicable rate of transfer. From this point, descend vertically to read the amount of time required for the transfer.

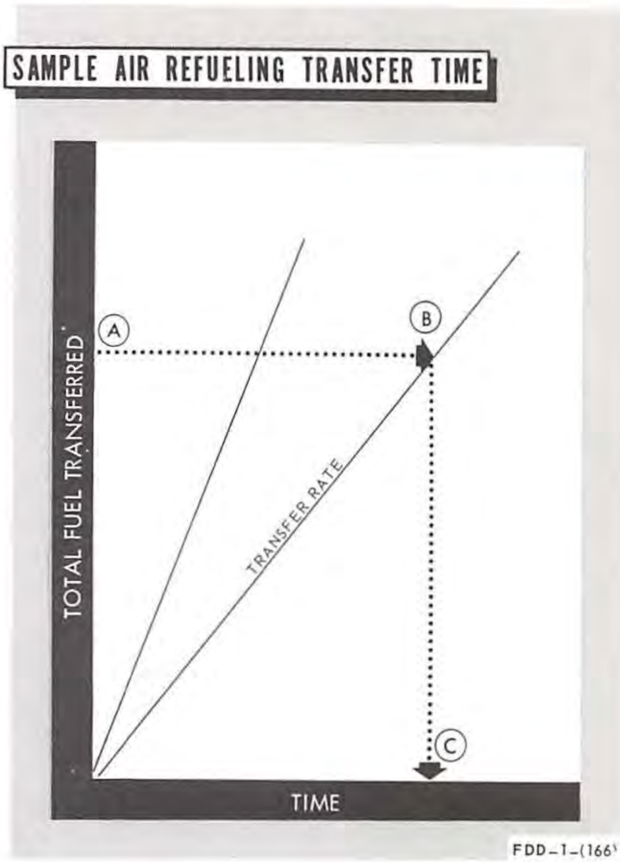
23.1.2 Sample Problem

D704 Buddy Tank

A. Total fuel transferred – 12,000 POUNDS.

B. Transfer rate for D704 buddy tank – 180 GALLONS/MINUTE.

C. Time of transfer – 10 MINUTES.



FDD-1-(166)

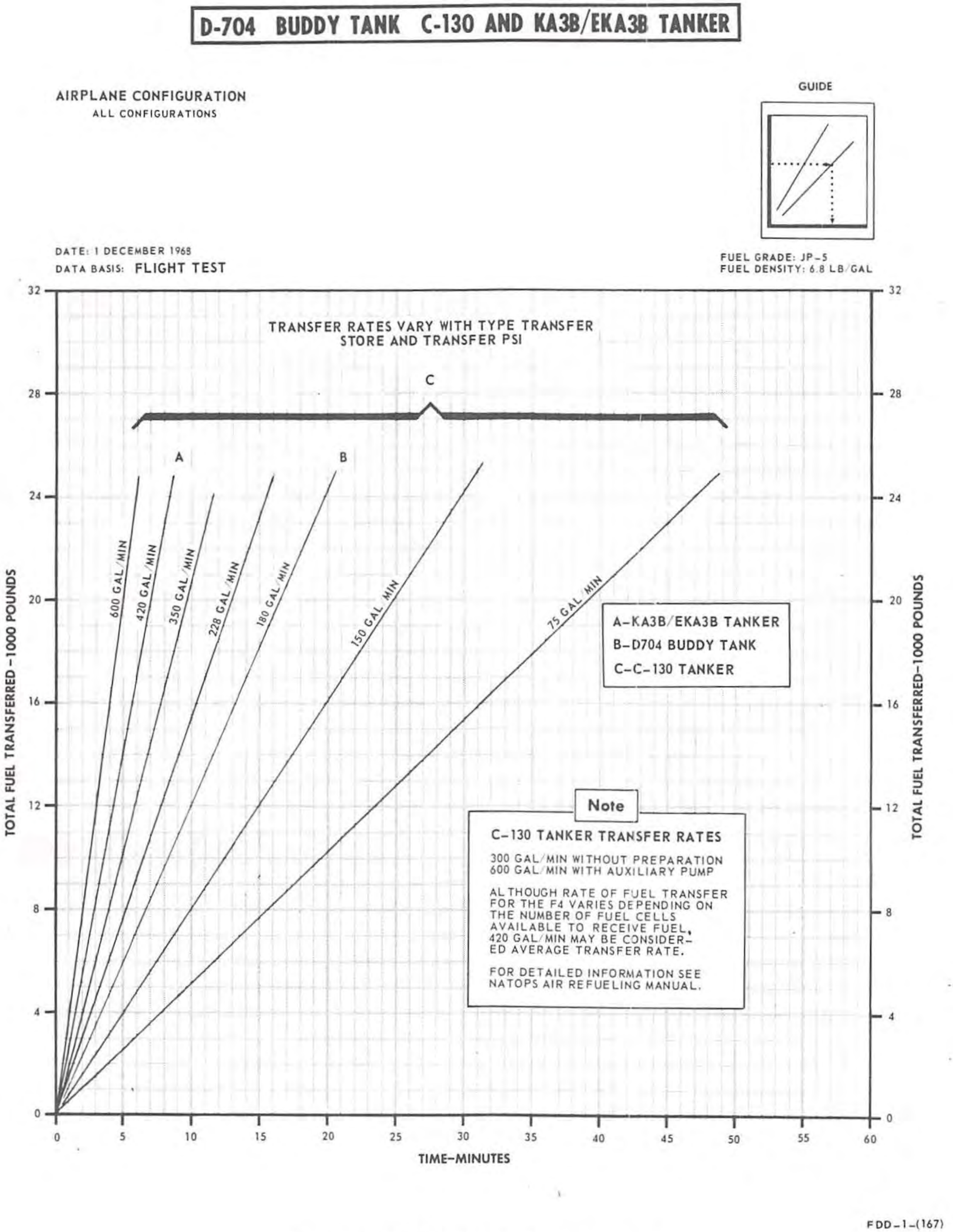


Figure 23-1. Air Refueling Transfer Time

CHAPTER 24

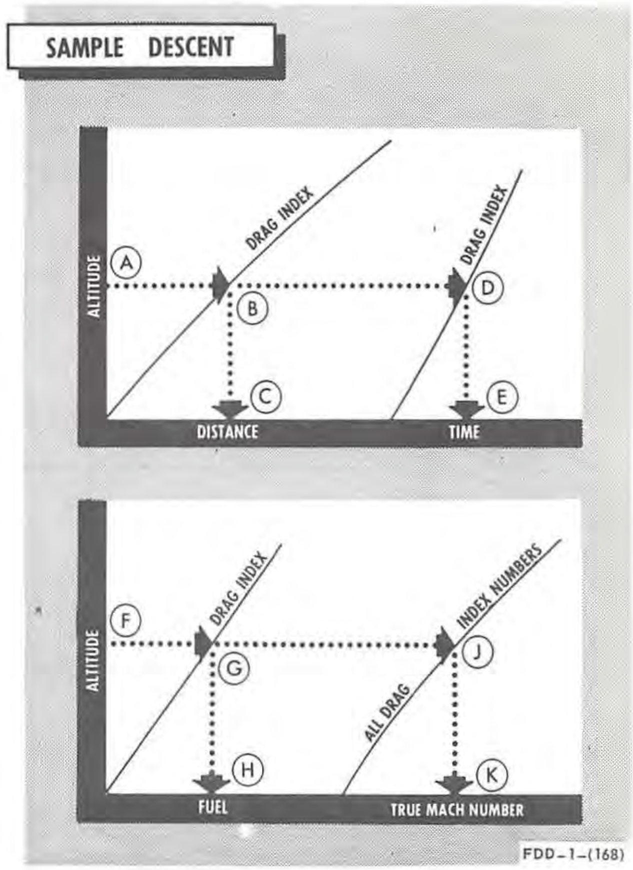
Descent

24.1 DESCENT CHARTS

This chart (Figure 24-1) presents the distance, time, and fuel required to make a 250-knot, idle thrust descent. Also included is a Mach number curve that corresponds to the 250 KCAS maintained throughout the descent.

24.1.1 Use. Enter the upper graph with the flight altitude and project horizontally to intersect the applicable drag index within both plots. From the first intersection, project vertically downward to read distance traveled. From the second intersection, project vertically downward to read time to descend. Enter the lower graph with the flight altitude and project horizontally to intersect both plots. From the intersection of the applicable drag index, project vertically downward to read total fuel used. From the intersection of the Mach number curve, project vertically downward to read Mach number corresponding to 250 KCAS at the beginning of descent.

24.1.2 Sample Problem



FDD-1-(168)

A. Altitude – 30,000 FEET.

B. Computed drag index – 40.

C. Distance traveled – 45 MILES.

D. Computed drag index – 40.

E. Time required – 8.7 MINUTES.

F. Altitude – 30,000 FEET.

G. Computed drag index – 40.

H. Fuel used – 202 POUNDS.

J. Single drag reflector.

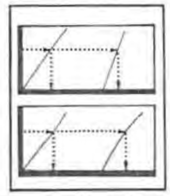
K. Mach number at start of descent – 0.675.

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

250 KCAS-IDLE [redacted]
SPEED BRAKES RETRACTED

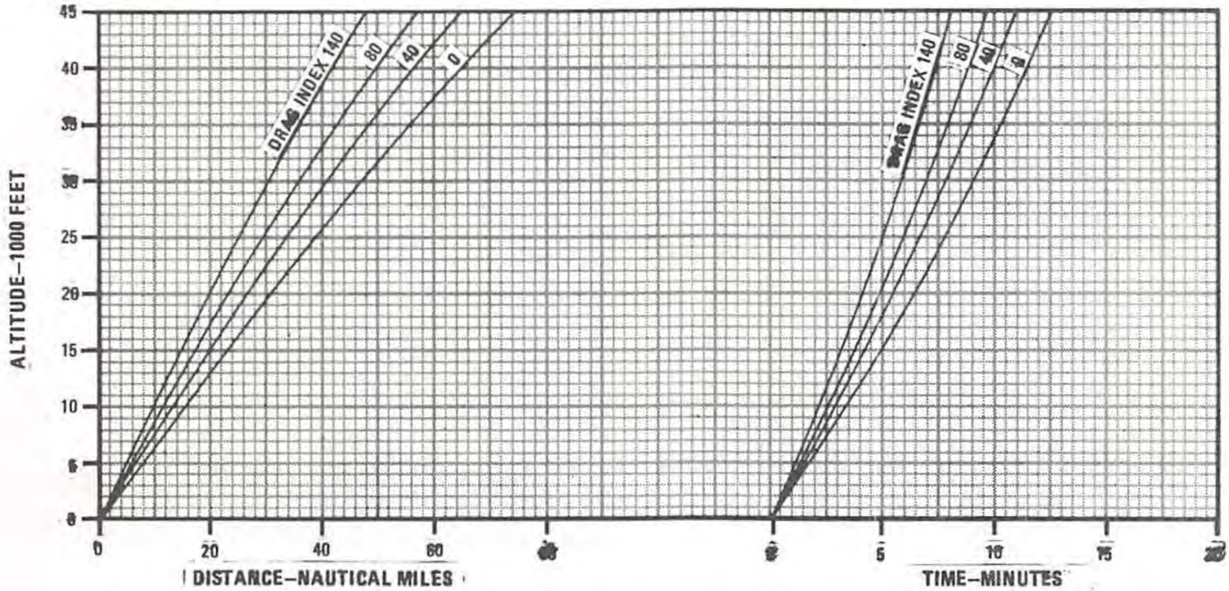
REMARKS
ENGINES(S): (2) J79–GE–10
ALL GROSS WEIGHTS
ICAO STANDARD DAY

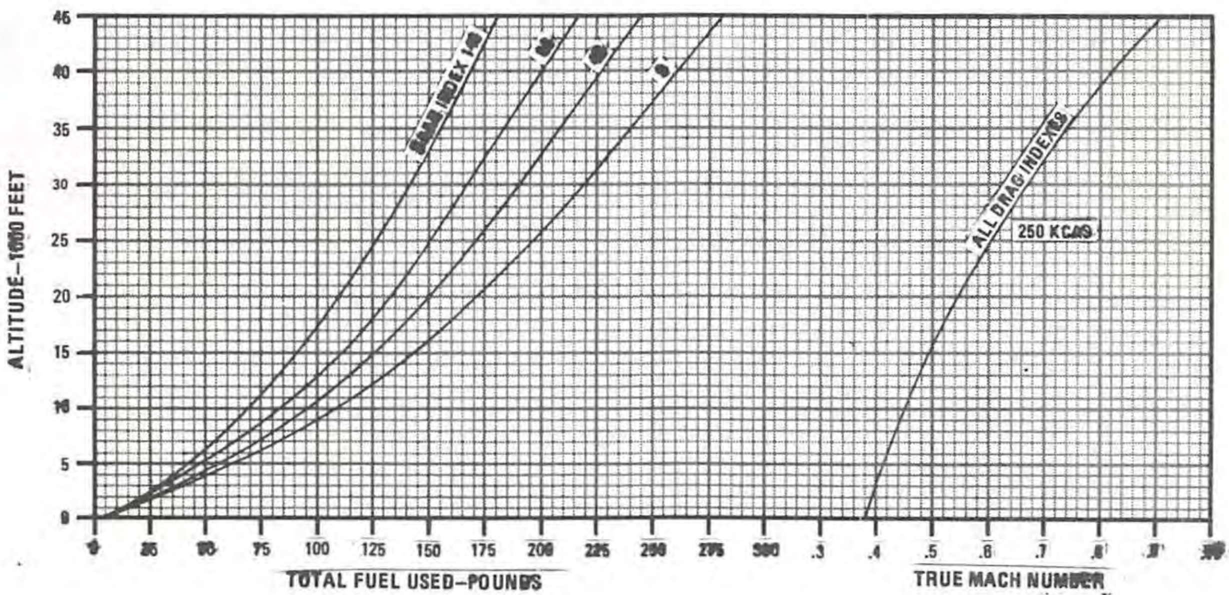
GUIDE



DATE: 1 JUNE 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL





FDD–1–(1

Figure 24-1. Descent

CHAPTER 25

Landing

25.1 MINIMUM LANDING ROLL DISTANCE CHART

Note

Landing distance charts are based on making an on-speed AOA approach. For additional AOA/approach speeds, refer to Figure 12-1.

This chart (Figure 25-1) contains landing roll distance information. The variables of temperature, altitude, gross weight, wind, runway condition reading (RCR), and drag chute are taken into consideration.

25.1.1 Use. Enter the chart with the runway temperature and project vertically upward to the correct pressure altitude. From this point, proceed horizontally to the right to the landing gross weight. From this point, descend vertically to the wind baseline. Parallel the nearest guideline down to the effective headwind or tailwind. From this point, descend vertically to the appropriate RCR and then horizontally to the left to read landing roll distance with drag chute. If the landing is to be made without the drag chute, continue further to the left to the appropriate RCR reflector and then proceed down to read the landing roll distance. If the landing is to be made over a 50-foot obstacle, allow 1,900 feet for airborne distance required from the obstacle to the landing touchdown point. If field RCR factors are not available, use RCR 23 for dry, RCR 14 for wet, and RCR 5 for icy runway conditions.

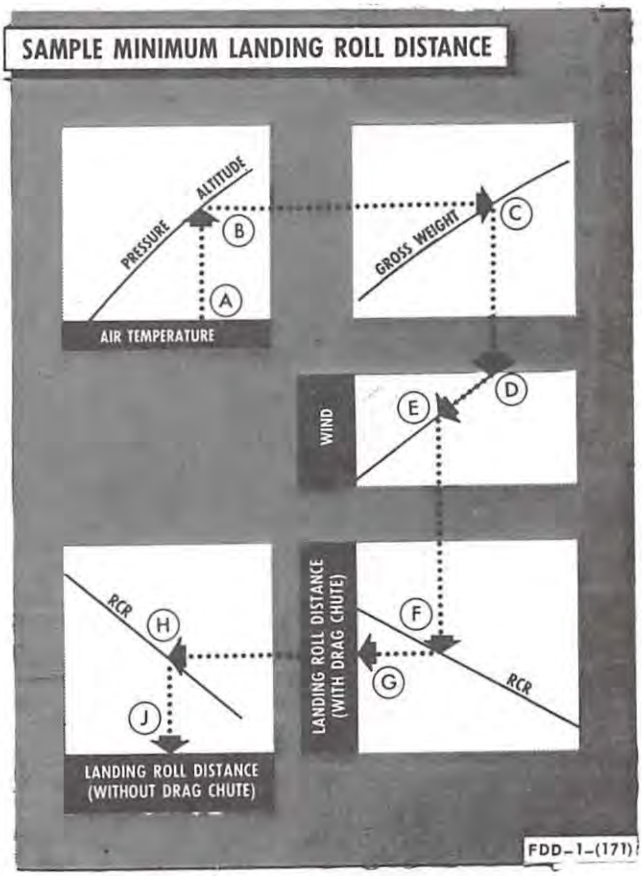
25.1.2 Sample Problem

A. Temperature – 15 °C.

B. Pressure altitude – 2,000 FEET.

C. Gross weight – 30,000 POUNDS.

D. Wind baseline.



E. Effective headwind – 20 KNOTS.

F. RCR – 14.

G. Landing roll distance – 4,000 FEET.

If operating without drag chute:

H. RCR – 14.

J. Landing roll distance – 5,800 FEET.

IDLE THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS EXTENDED, GEAR DOWN
DRAG CHUTE DEPLOYED

REMARKS
ENGINE(S) (2) J79-GE-10
ANTISKID INSTALLED AND OPERATING

NOTE

FOR TOTAL DISTANCE FROM A 50 FT. HEIGHT, ADD 1900 FT. TO THE GROUND ROLL DISTANCE.

DATE: 1 MAY 1975
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

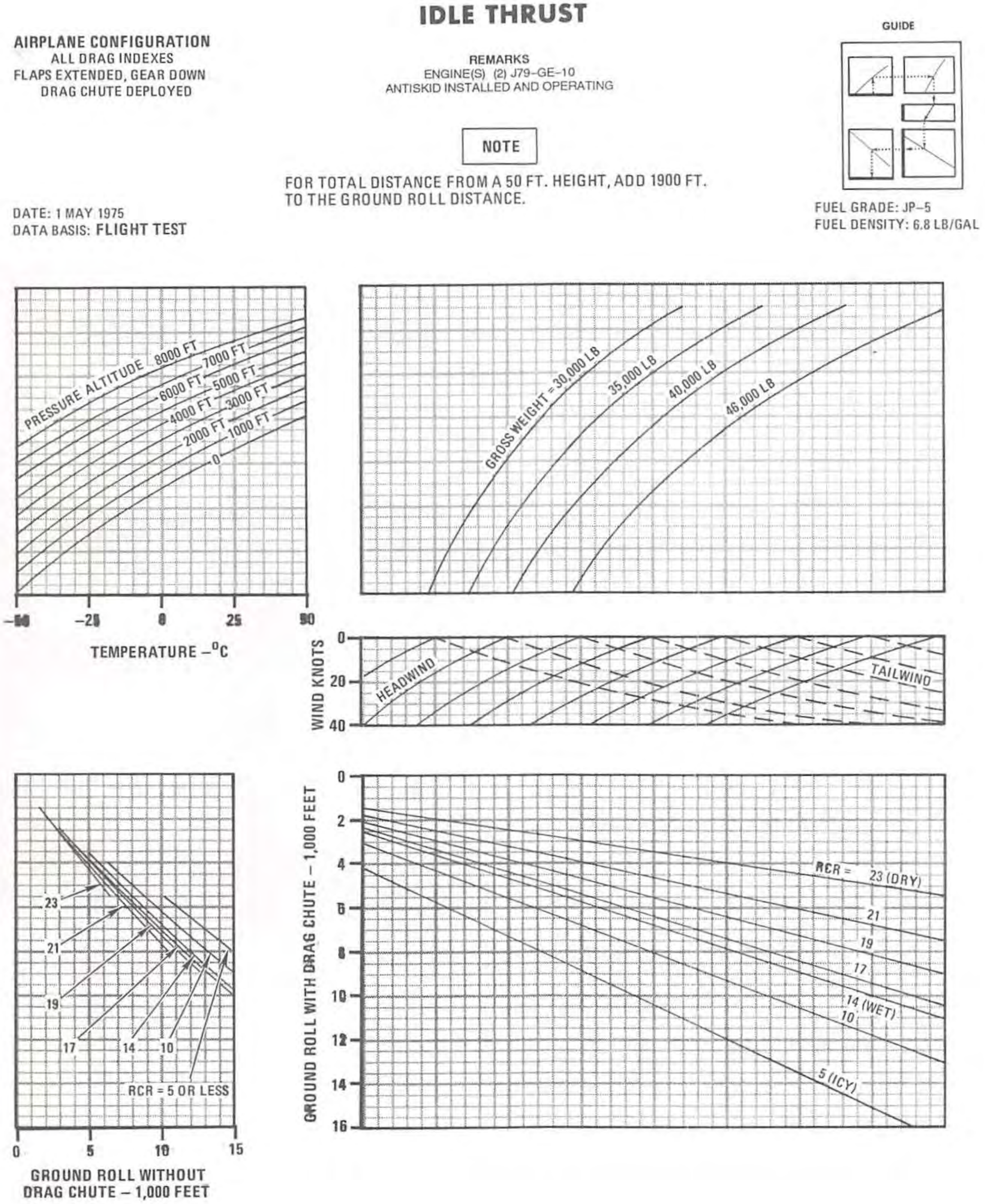


Figure 25-1. Minimum Landing Roll Distance

CHAPTER 26

Combat Performance

26.1 COMBAT FUEL FLOW CHARTS

These charts (Figure 26-1 (sheets 1 through 3)) present the specific fuelflow and general thrust setting to maintain a constant Mach number for an ICAO standard day and standard day +10 °C at all altitudes between sea level and 50,000 feet. Each chart is plotted for a specific configuration. The fuelflow values are based on a stabilized level flight condition and do not represent the fuelflow required to accelerate to a given Mach number.

26.1.1 Use. Enter the chart corresponding to the aircraft configuration with the desired Mach number for stabilized level flight. Proceed vertically upward to the selected flight altitude. Note the general thrust setting required and then project horizontally left to read fuelflow.

26.1.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles

A. Desired Mach number – 1.5.

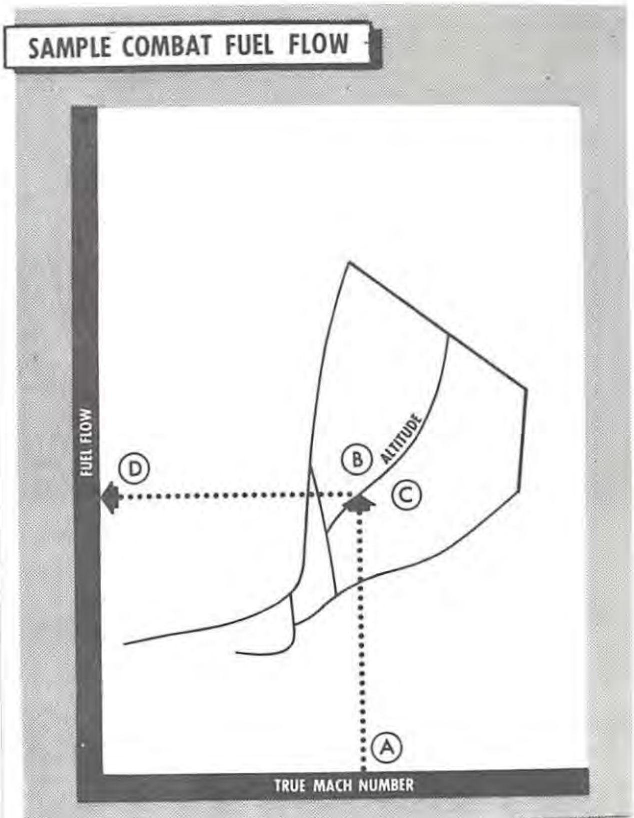
B. Altitude (ICAO standard day) – 25,000 FEET.

C. Power setting required – MODULATED AFTERBURNERS.

D. Total fuelflow – 890 PPM.

26.2 COMBAT SPECIFIC RANGE

These charts (Figure 26-2 (sheets 1 through 3)) present the specific range and the general power settings required to maintain a constant Mach number for an ICAO standard day and standard day +10 °C at all altitudes from sea level to 50,000 feet. The specific range values are based on a stabilized level flight condition and do not represent the fuelflow required to accelerate to a given Mach number.



FDD-1-(174)

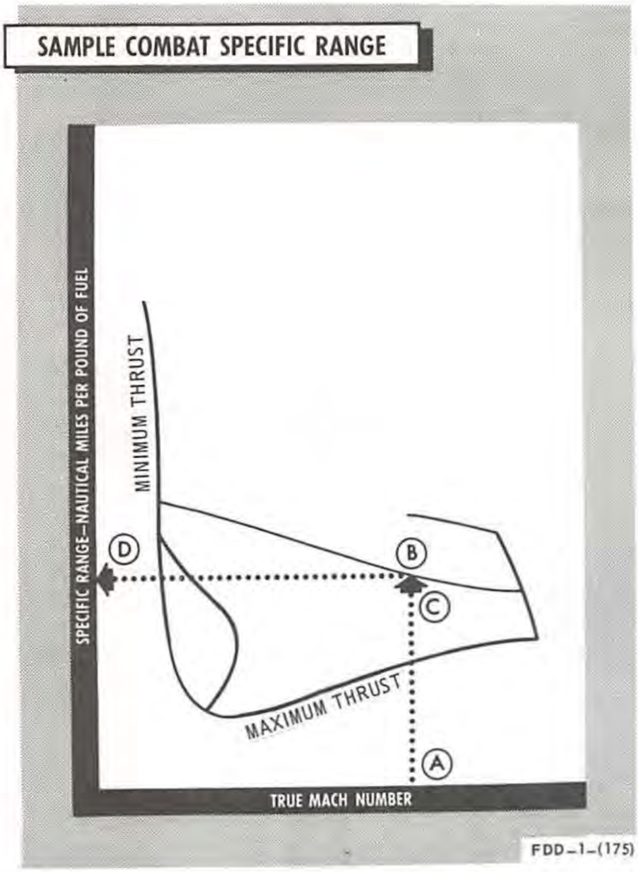
26.2.1 Use. Enter the chart corresponding to the aircraft configuration with the desired Mach number for stabilized level flight. Proceed vertically upward to the selected flight altitude. Note the general thrust setting required and then project horizontally left to obtain the specific range.

26.2.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles

A. Desired Mach number – 1.5.

B. Altitude – 30,000 FEET.



C. Thrust required – MODULATED AFTERBURNERS.

D. Specific range – 0.016 NMPP.

26.3 SUPERSONIC MAXIMUM THRUST CLIMB CHARTS

These charts (Figure 26-3 (sheets 1 through 3)) are plotted for supersonic maximum thrust climb from 35,000 feet to the supersonic combat ceiling. Distance traveled in the climb is plotted against gross weight with guidelines provided to show the weight reduction as the climb progresses. The time to distance/altitude relationship is superimposed on the plot. Level flight acceleration data is provided which includes time, fuel used (gross weight change), and distance required to accelerate from the subsonic to the supersonic climb Mach number at 35,000 feet. If supersonic climb is contemplated, acceleration at 35,000 feet followed by the climb is recommended since acceleration to supersonic Mach numbers at this altitude provides for the optimum performance capability.

Note

If ramp cycling occurs during supersonic climb, the climb schedule Mach number can be increased until cycling stops. This produces an insignificant degradation in climb performance.

26.3.1 Use. Enter the chart with the gross weight and proceed vertically to the initial Mach number and note the corresponding distance and time. Proceed parallel to the guidelines to the desired supersonic climb Mach number (end of acceleration). Project both vertically downward and horizontally left from this point to read gross weight and distance traveled; also note the time. From these values, subtract the distance, weight, and time corresponding to the initial Mach number to determine the distance, fuel, and time required to accelerate. From the climb Mach number gross weight intersection (start of climb), proceed parallel along the guidelines to the desired altitude. Obtain the distance, gross weight, and time for this point. Subtract from this data the corresponding values at the start of climb to obtain the distance traveled, the weight change (fuel used), and the time required to complete the climb. If total distance, fuel, and time are desired, add the climb and acceleration values together.

26.3.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles

A. Initial gross weight – 40,000 POUNDS.

B. Initial Mach number – 1.2.

C. Time corresponding to initial Mach number – 0.5 MINUTE.

D. Distance corresponding to initial Mach number – 6.7 MILES.

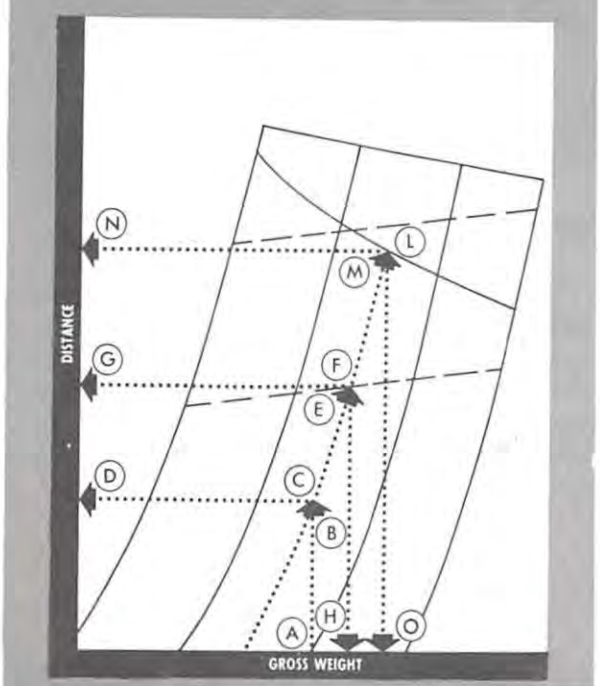
E. Climb Mach number – 1.745.

F. Time at end of acceleration – 2 MINUTES.

G. Distance at end of acceleration – 26 MILES.

H. Gross weight at end of acceleration – 38,000 POUNDS.

SAMPLE SUPERSONIC MAXIMUM THRUST CLIMB



FDD-1-(176)

I. Time required for acceleration (F to C) – 1.5 MINUTES.

J. Fuel required for acceleration (A to H) – 1,200 POUNDS.

K. Distance required for acceleration (G to D) – 19.3 MILES.

L. Altitude at end of climb – 55,000 FEET.

M. Time at end of climb – 4.4 MINUTES.

N. Distance at end of climb – 66 MILES.

O. Gross weight at end of climb – 37,200 POUNDS.

P. Time required for climb (M to F) – 2.4 MINUTES.

Q. Distance required for climb (N to G) – 40 MILES.

R. Fuel required for climb (H to O) – 1,600 POUNDS.

S. Total time required to accelerate and climb (I + P) – 3.9 MINUTES.

T. Total distance required to accelerate and climb (K + Q) – 59.3 MILES.

U. Total fuel required to accelerate and climb (J + R) – 2,800 POUNDS.

26.4 LOW-ALTITUDE ACCELERATIONS

These charts (Figures 26-4 and 26-5) present time and fuel required to accelerate from 0.5 to 0.9 Mach at altitudes of sea level, 2,000, 4,000, and 6,000 feet. Separate charts are provided for several gross weights and for both maximum and military thrust. The time and fuel values are tabulated for ICAO standard day conditions; however, correction factors are given for nonstandard temperature.

26.4.1 Use. After selecting the applicable chart for thrust, gross weight, and altitude, enter with the Mach number desired at end of acceleration and project horizontally to the applicable drag index column. Read time/fuel required to accelerate from 0.5 Mach.

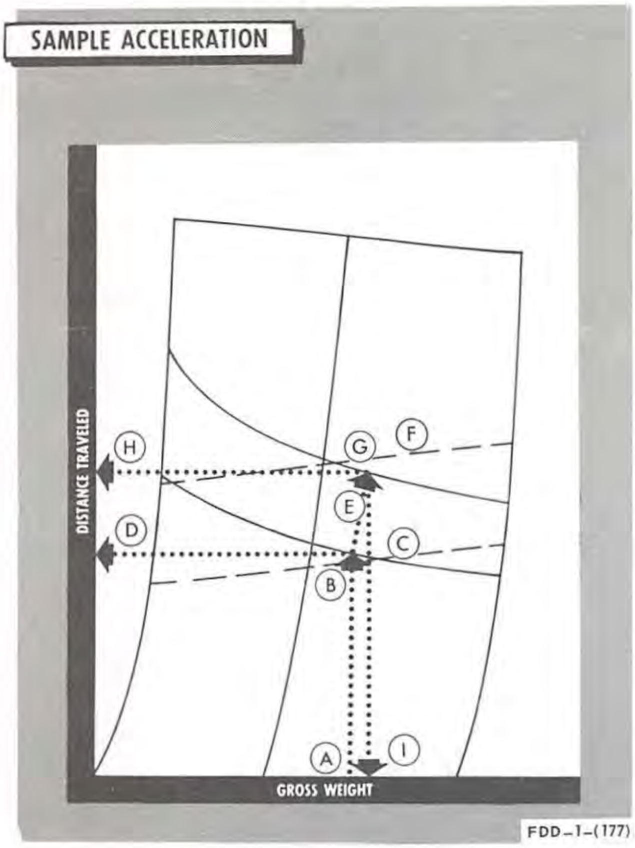
26.5 ACCELERATION CHARTS

These charts (Figures 26-6 and 26-7) show the relationship of time, distance, and fuel required for level flight maximum or military thrust accelerations. The data is presented for various altitudes and configurations.

WARNING

Refer to Part V for external store operating limitations.

26.5.1 Use. Enter the applicable chart with the aircraft gross weight. Proceed vertically upward to the initial Mach number and note the time. Project horizontally and note the distance. From the initial Mach number, proceed parallel to the guidelines to the Mach number desired at the end of acceleration. At this point, note the time, then project horizontally and vertically and note the distance and gross weight. From this data, subtract the time, distance, and weight corresponding to the initial Mach number to determine the time, distance, and fuel required for acceleration.



26.5.2 Sample Problem

CONFIGURATION: Maximum Thrust, Four AIM-7 Missiles, and Two Wing Tanks, 45,000 Feet.

A. Gross weight – 45,000 POUNDS.

B. Initial Mach number – 1.0.

C. Time – 2 MINUTES.

D. Distance – 10 MILES.

E. Parallel guidelines.

F. Desired Mach number – 1.30.

G. Time corresponding to new Mach number – 8 MINUTES.

H. Distance corresponding to new Mach number – 75 MILES.

I. Gross weight corresponding to new Mach number – 42,600 POUNDS.

J. Time required for acceleration (G to C) – 0.26 MINUTE.

K. Distance required for acceleration (H to D) – 65 MILES.

L. Fuel required for acceleration (A to I) – 2,400 POUNDS.

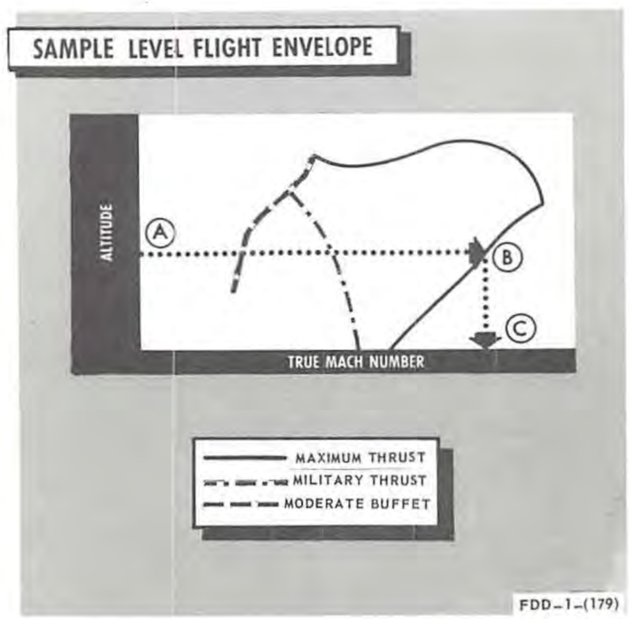
26.6 LEVEL FLIGHT ENVELOPE

This chart (Figure 26-8) presents the aircraft level flight speed envelope for various configurations and average combat gross weights. Parameters of the envelopes extend from buffet onset to V_{max} throughout the altitude range. Maximum Mach number curves for additional aircraft configurations are plotted within the envelopes.

WARNING

Refer to Part V for external store operating limitations.

26.6.1 Use. Enter the chart with the desired combat altitude. Proceed horizontally to intersect the applicable configuration power curve. From this point, proceed vertically downward to read the maximum attainable Mach number in level flight.



26.6.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles

A. Combat altitude – 36,000 FEET.

B. Aircraft complete load – AIM-7 MISSILES and ONE CENTERLINE TANK.

C. Maximum attainable Mach number (curve 2) – 2.0.

26.7 V-N

The symmetrical flight V-N envelopes (Figure 26-9 (sheets 1 through 4)) are a graphical presentation of airspeed versus acceleration with lines of indicated angle of attack superimposed. The data are supplied for one gross weight at four altitudes. The charts may be used to determine the allowable maximum symmetrical maneuvering capability of the aircraft as well as the indicated angle of attack for any desired g. The charts may be considered to be linear between altitudes for all practical purposes, provided the interpolation is carried out for a constant airspeed.

26.7.1 Use. To find the allowable maximum symmetrical performance capability, enter the chart with the calibrated airspeed and proceed vertically to the stall boundary (positive or negative g) or the maximum allowable acceleration (upper and lower) as applicable. From these intersections, project horizontally to the left to read the positive and negative g obtainable in the case of the stall boundaries or the upper and lower maximum allowable g for the selected gross weight. To find the angle of attack for a given condition of g and airspeed, enter the appropriate chart with these parameters. Project horizontally to the right from the load factor and vertically upward from the airspeed. At the intersection of these two projections, read the indicated angle of attack.

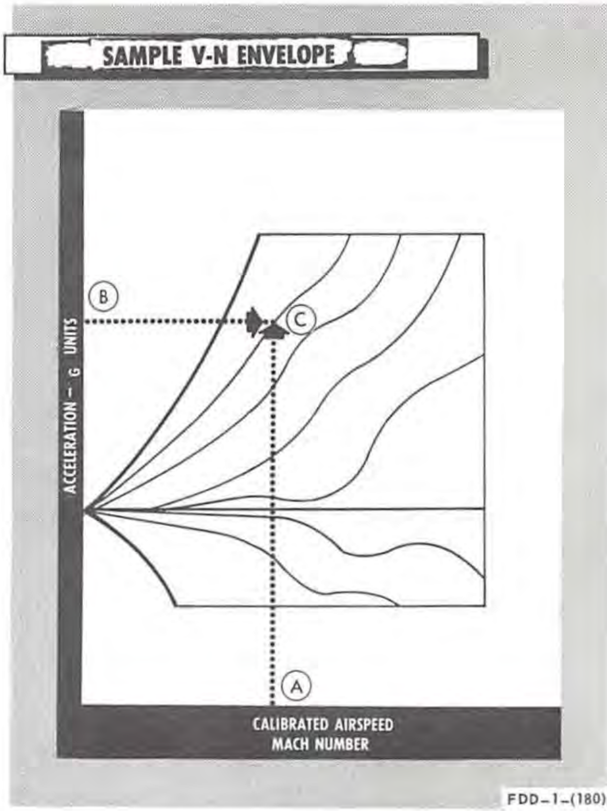
26.7.2 Sample Problem

ALTITUDE: 5,000 FEET, Gross Weight 37,500 pounds

A. Speed – 550 KCAS.

B. Load factor – 5G.

C. Angle of attack – 8.6 UNITS.



FDD-1-(180)

26.8 TEMPERATURE EFFECT ON MAXIMUM SPEED

This chart (Figure 26-10) shows the effect of non-standard day temperatures on the maximum speed at maximum thrust. The speed variation is read out as the change in Mach number (Δ Mach) for a 10 °C variation in temperature (hot or cold) from standard day.

26.8.1 Use. Determine the temperature variation from standard day for the desired altitude. M_{max} may be obtained from the maximum thrust acceleration charts. Enter the chart at the desired Mach number on the standard day M_{max} line. Proceed vertically into either the hot or cold day plot depending on the temperature variation. Continue vertically to the selected altitude, then proceed horizontally to the left to read Δ Mach. When the temperature variation differs from 10 °C, simply divide the variation by 10 to reduce it to a decimal. Then multiply the Δ Mach by the decimal to obtain the Δ Mach for a specific situation.

26.8.2 Sample Problem. Find Δ Mach for a standard day M_{max} of 1.8 at 30,000 feet. Forecast flight level temperature is -46.8 °C.

A. Temperature variation – -2.4 °C.

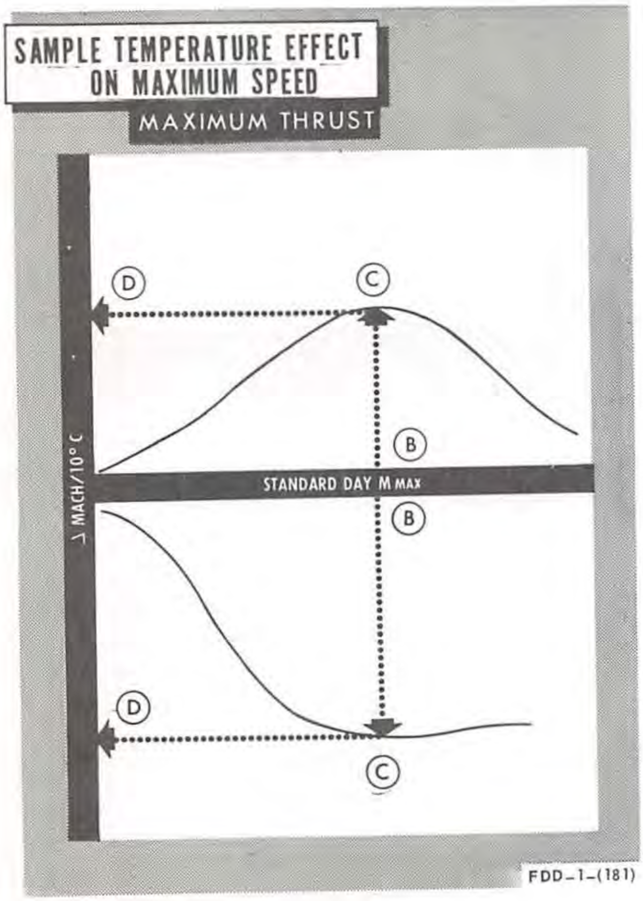
B. Standard day M_{max} – 1.8 MACH.

C. Altitude – 30,000 FEET.

D. Mach/10 °C variation – 0.159.

E. Mach/2.4 °C variation – 0.04.

F. Mach number (B + E) – 1.84 MACH.



26.9 DIVE RECOVERY CHARTS

These charts (Figures 26-11 and 26-12) present the aircraft dive recovery capability for various speeds (subsonic and supersonic), altitudes, and dive angles at 16 units and 19 units AOA.

26.9.1 Use. Enter the applicable chart at the start of the pullout and project horizontally to intersect the Mach number at the start of the pullout. From this point, descend vertically and intersect the dive angle at the start of pullout, then proceed horizontally to the left to read altitude lost during pullout.

26.9.2 Sample Problem

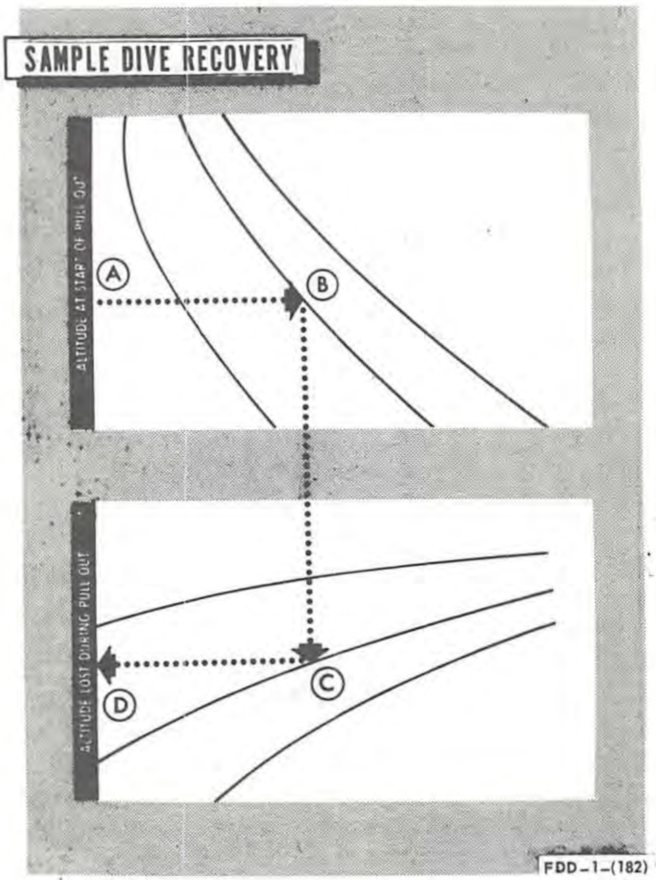
CONFIGURATION: Four AIM-7 Missiles, 16 Units AOA, Supersonic

A. Altitude at start of pullout – 40,000 FEET.

B. Mach number at start of pullout – 1.5 MACH.

C. Dive angle at start of pullout – 70°.

D. Altitude loss during constant 16 unit AOA pullout – 13,200 FEET.



26.10 TURN CAPABILITIES

This chart (Figure 26-13) presents the radius of turn and the rate of turn for a constant altitude, constant speed turn. Turn data is available for various speeds and bank angles. Load factor is also included for each bank angle.

26.10.1 Use. Enter the radius of turn plot with the true airspeed. Proceed horizontally to the right to the desired bank angle. Note the load factor, then proceed vertically downward and read the radius of turn. Enter the rate of turn plot with the true airspeed. Proceed horizontally to the right to the bank angle, note the load factor, and then proceed vertically downward to read the rate of turn.

26.10.2 Sample Problem

Radius of Turn

A. True airspeed – 400 KNOTS.

B. Bank angle – 20°.

C. Load factor – 1.07G.

D. Radius of turn – 40,000 FEET.

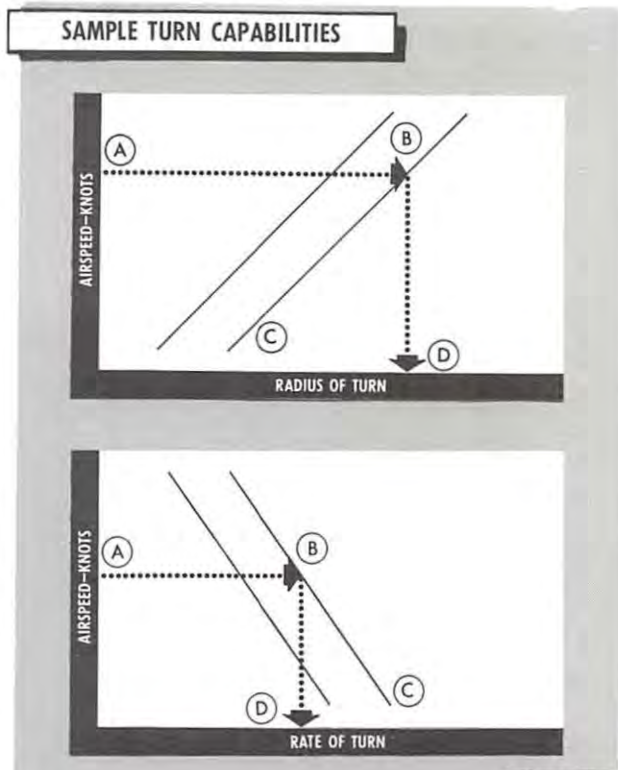
Rate of Turn

A. True airspeed – 500 KNOTS.

B. Bank angle – 30 °C.

C. Load factor – 1.15G.

D. Rate of turn – 1.25 DEGREES/SECOND.



FDD-1-(183)

STABILIZED LEVEL FLIGHT

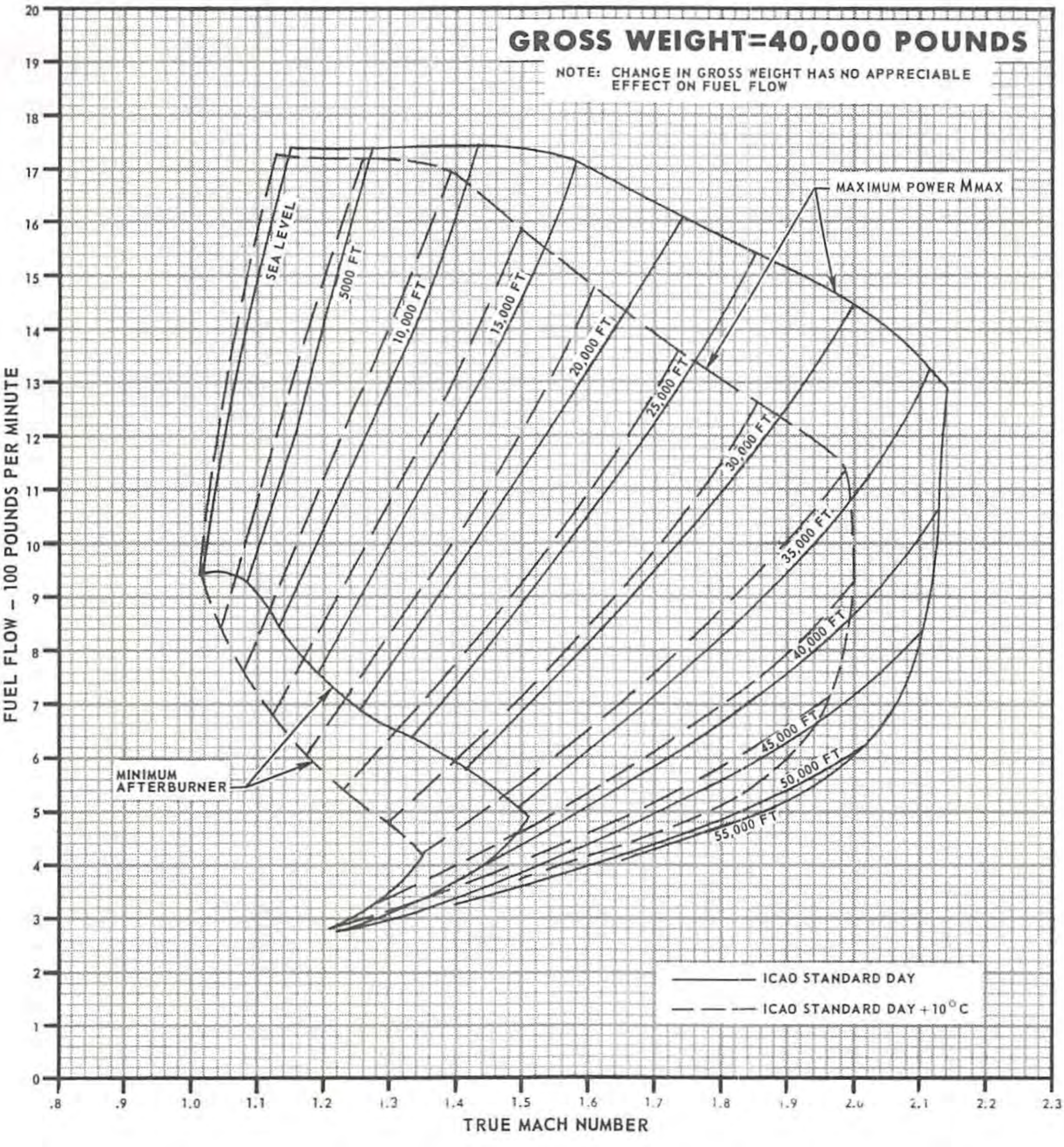
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(184) A

Figure 26-1. Combat Fuelflow (Sheet 1 of 3)

STABILIZED LEVEL FLIGHT

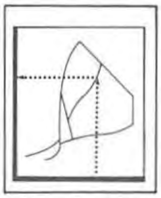
AIRPLANE CONFIGURATION

(4) AIM-7 AND (1) ℄ TANK

REMARKS

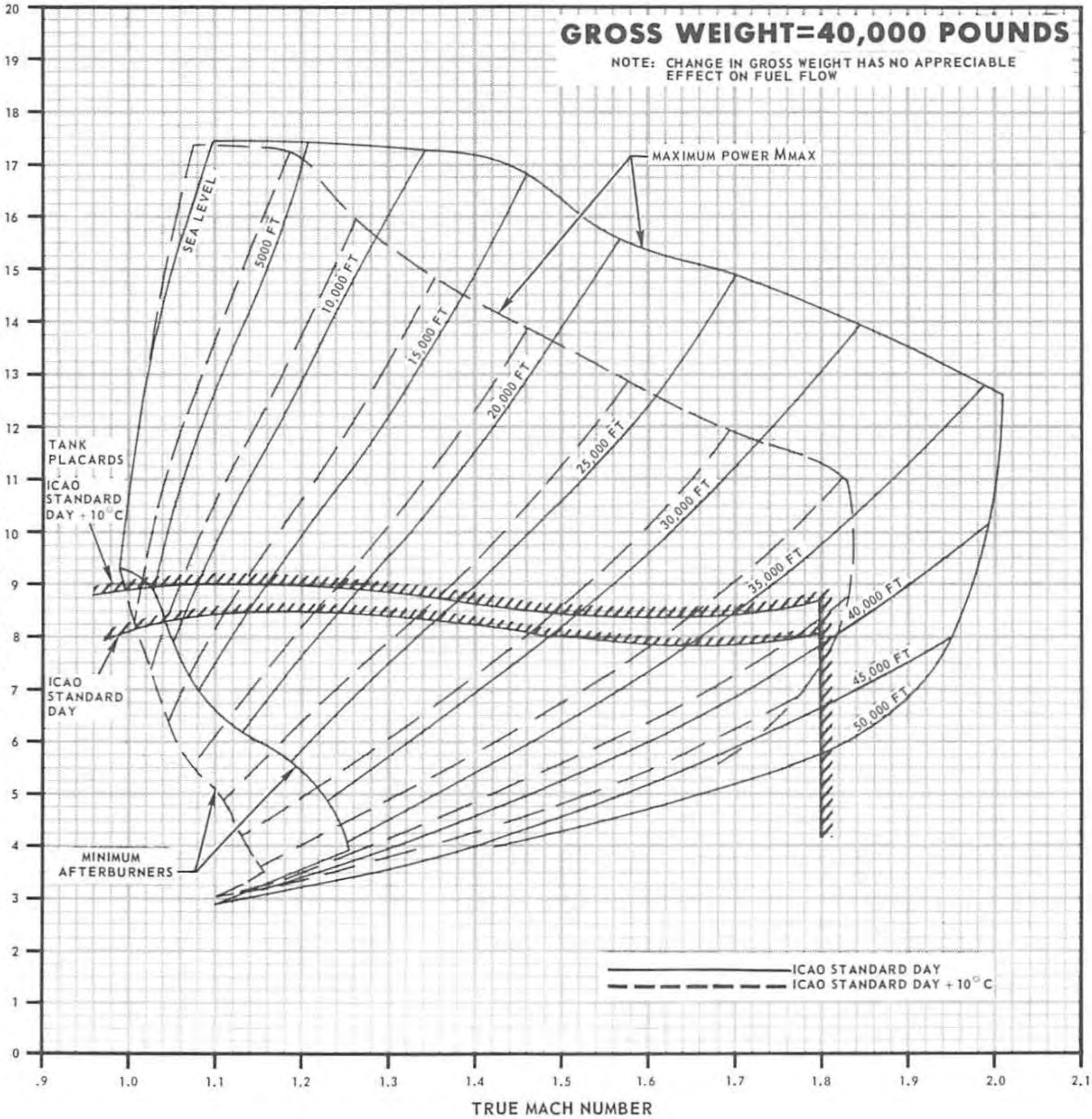
ENGINES: (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(186)A

Figure 26-1. Combat Fuelflow (Sheet 2 of 3)

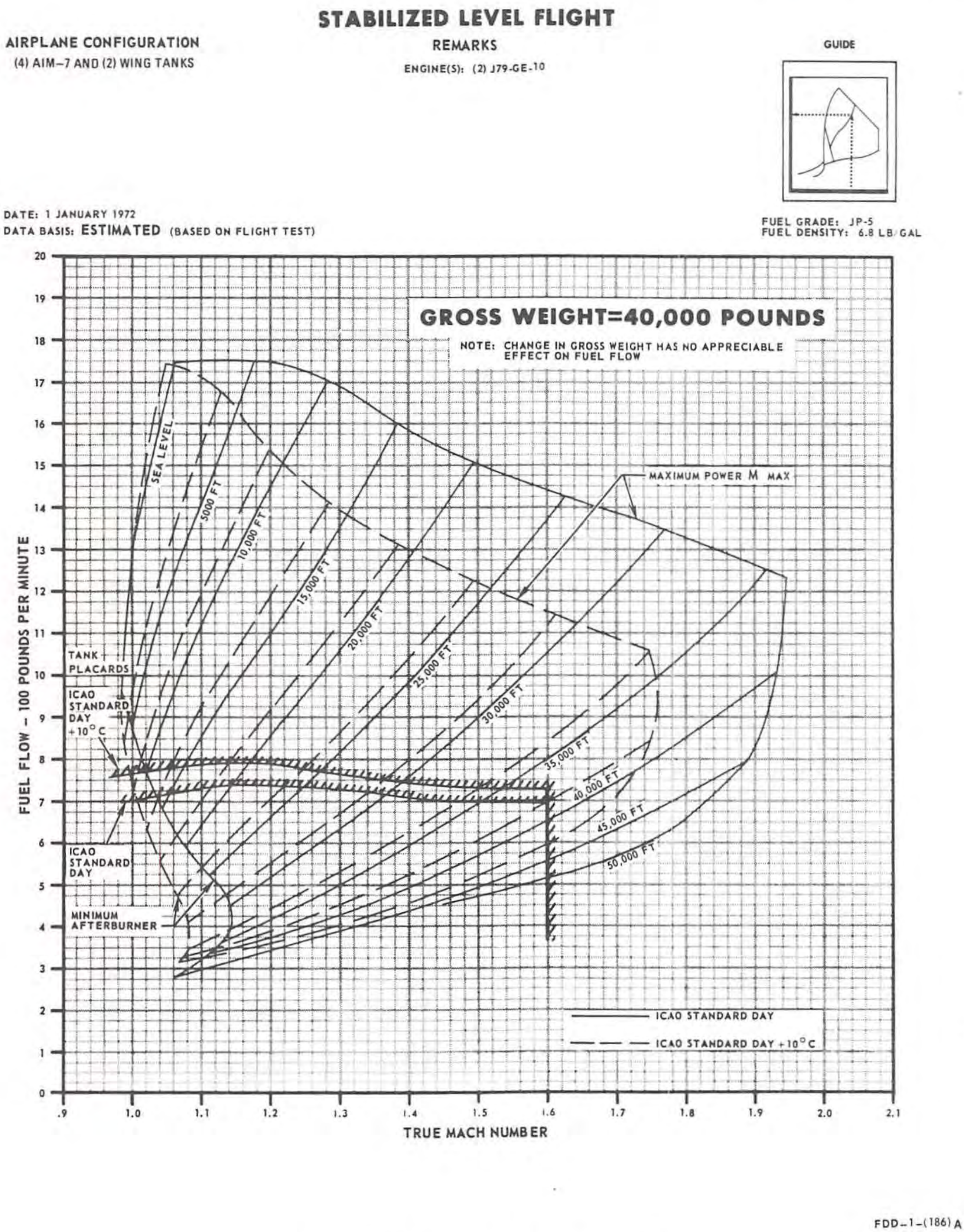


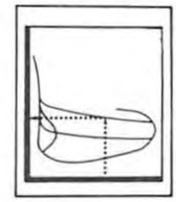
Figure 26-1. Combat Fuelflow (Sheet 3 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7

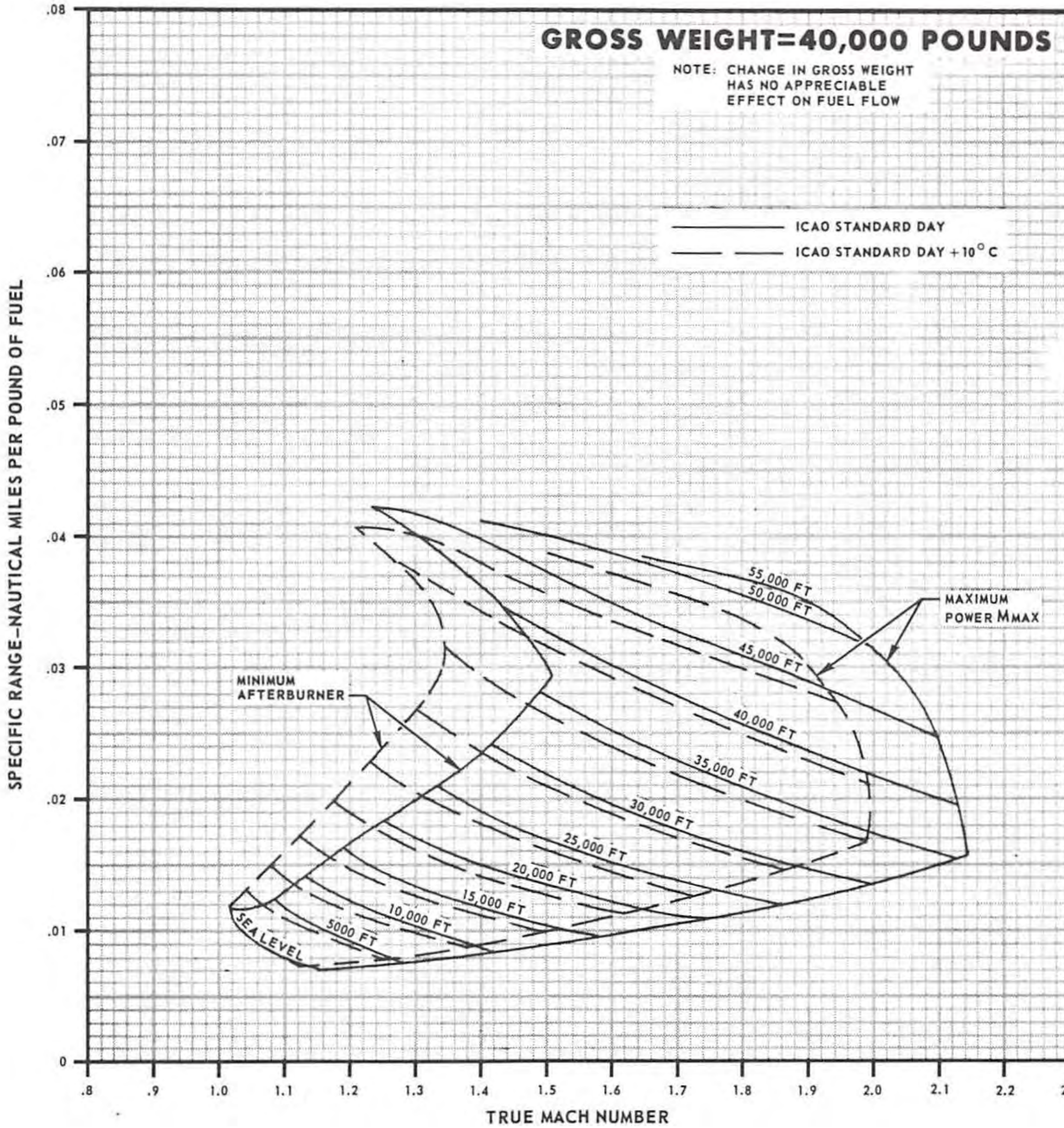
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(190)A

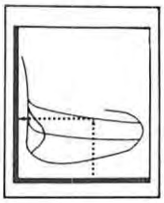
Figure 26-2. Combat Specific Range (Sheet 1 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

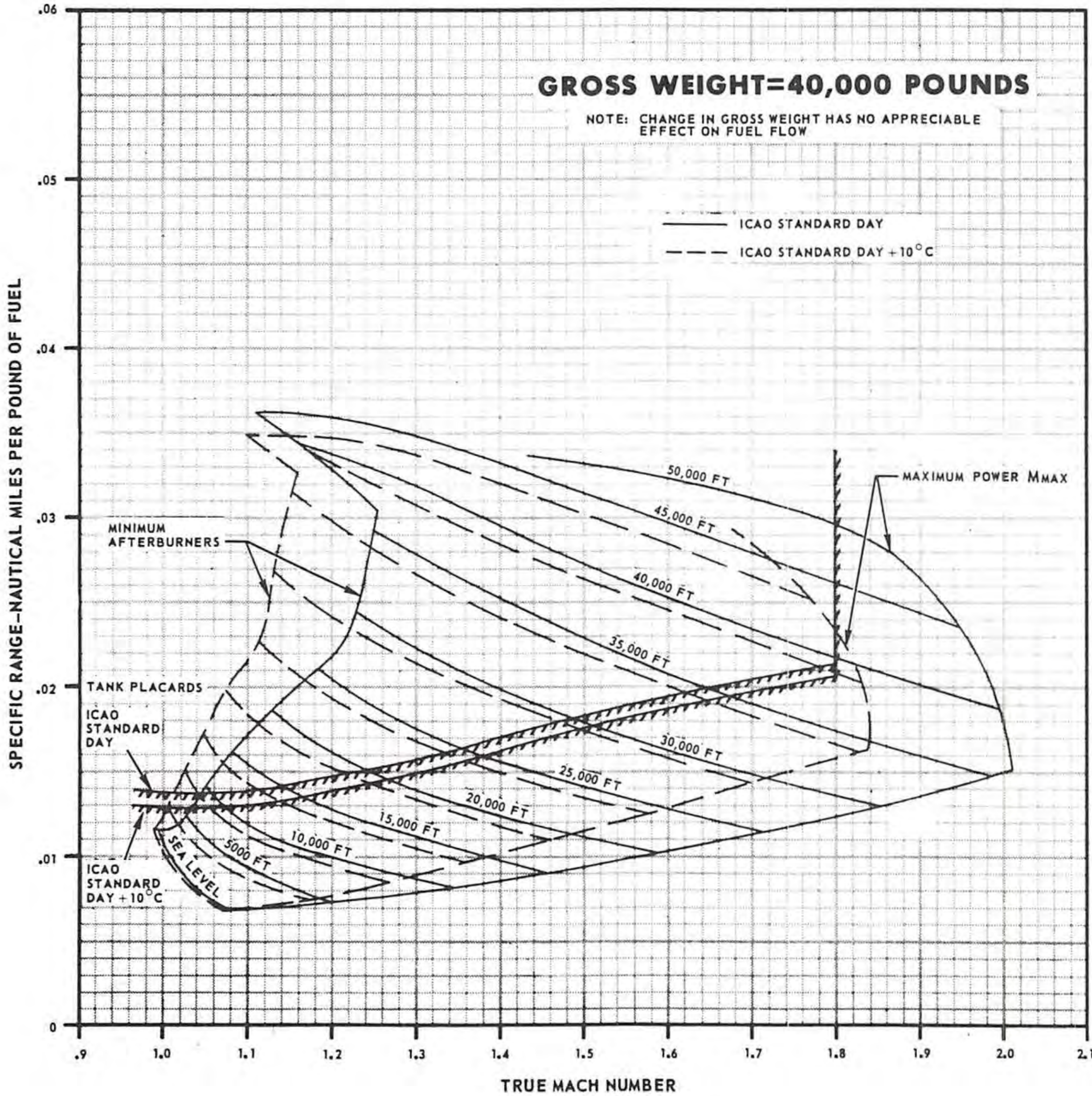
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(191)A

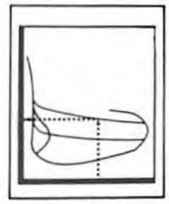
Figure 26-2. Combat Specific Range (Sheet 2 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7
AND (2) WING TANKS

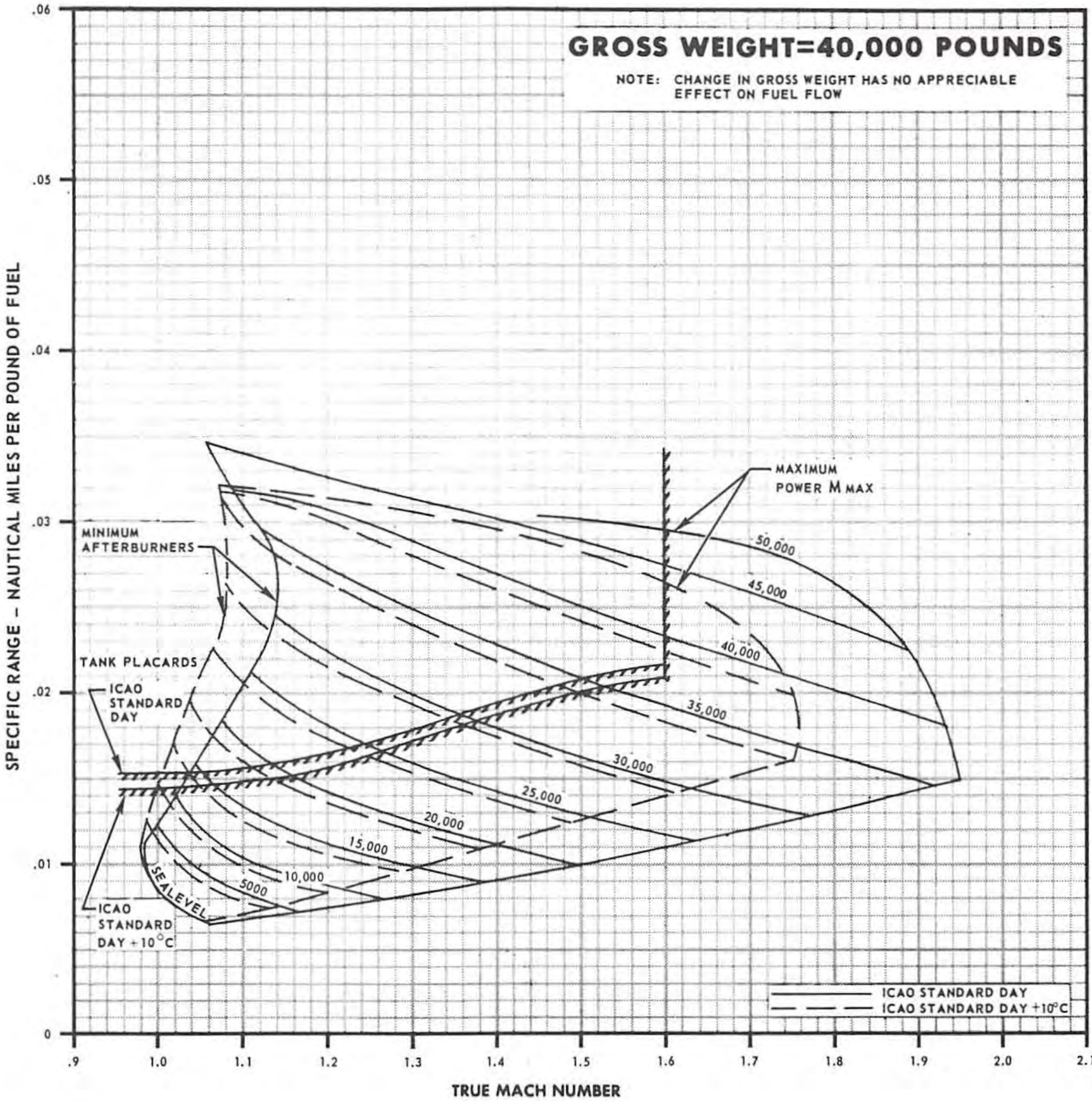
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(192)A

Figure 26-2. Combat Specific Range (Sheet 3 of 3)

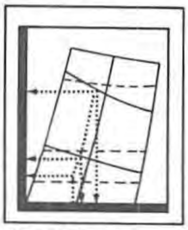
AIRPLANE CONFIGURATION

(4) AIM-7

REMARKS

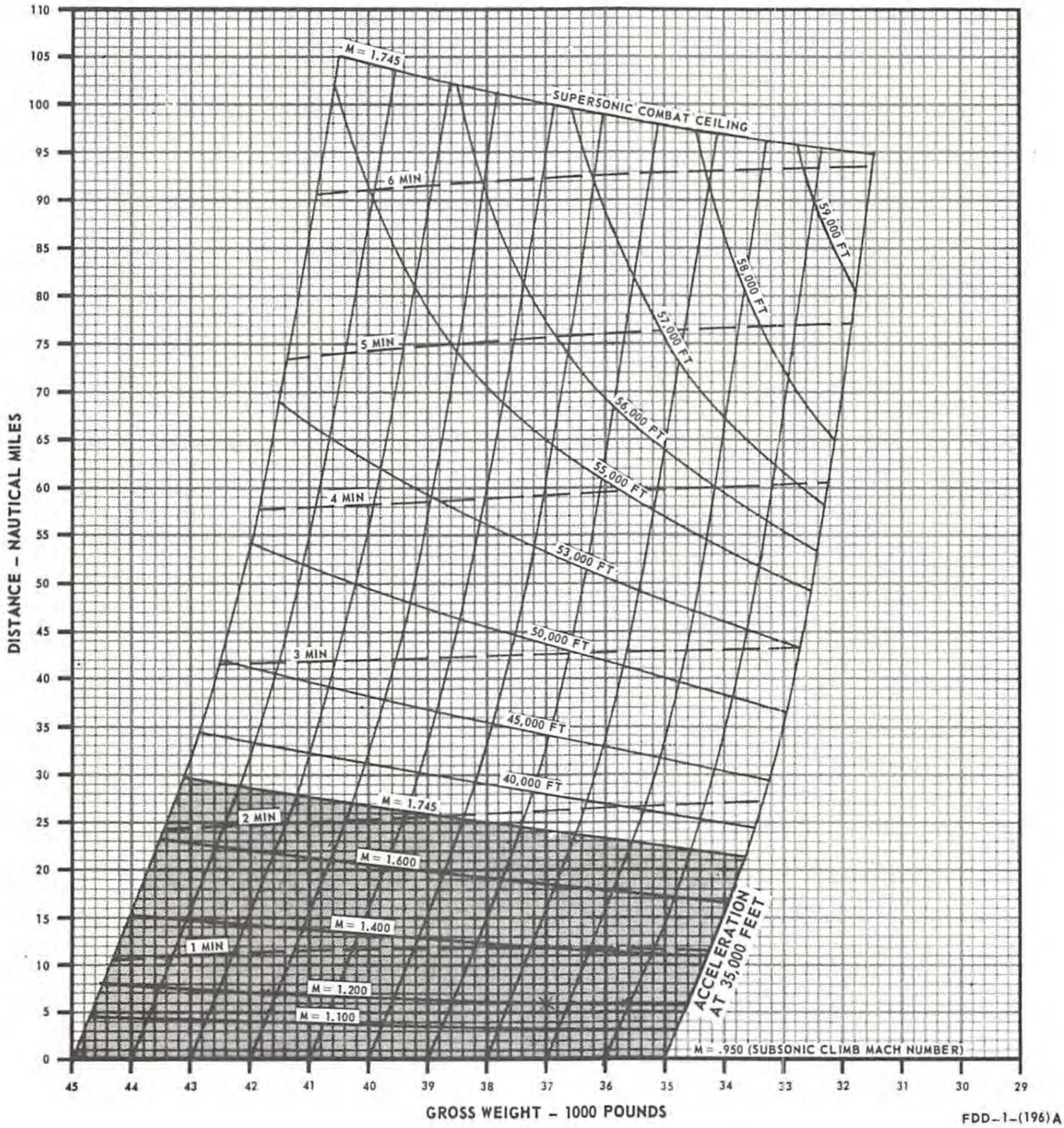
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 OCTOBER 1971
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(196)A

Figure 26-3. Supersonic Maximum Thrust Climb (Sheet 1 of 3)

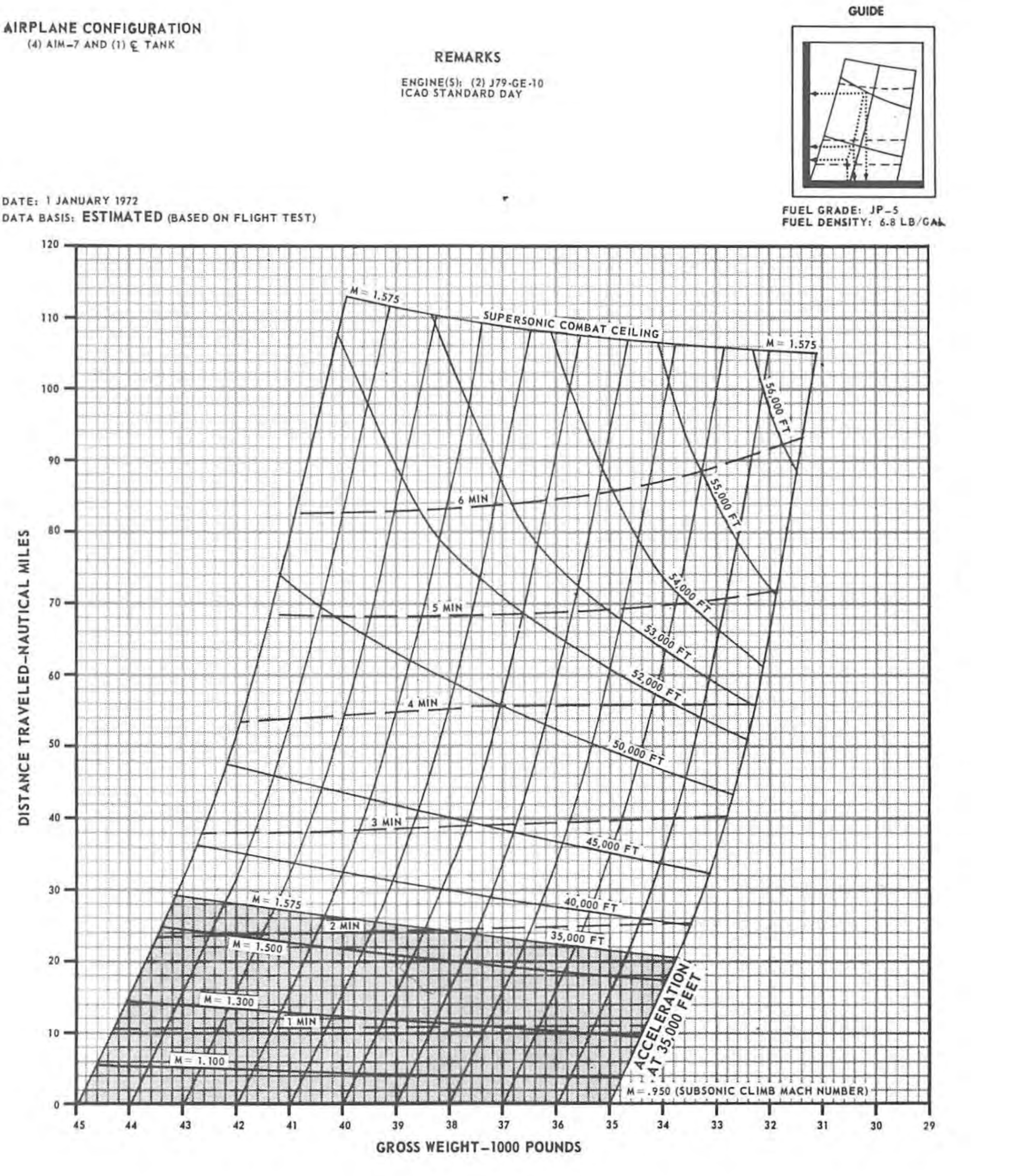
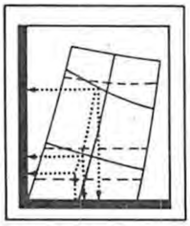


Figure 26-3. Supersonic Maximum Thrust Climb (Sheet 2 of 3)

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

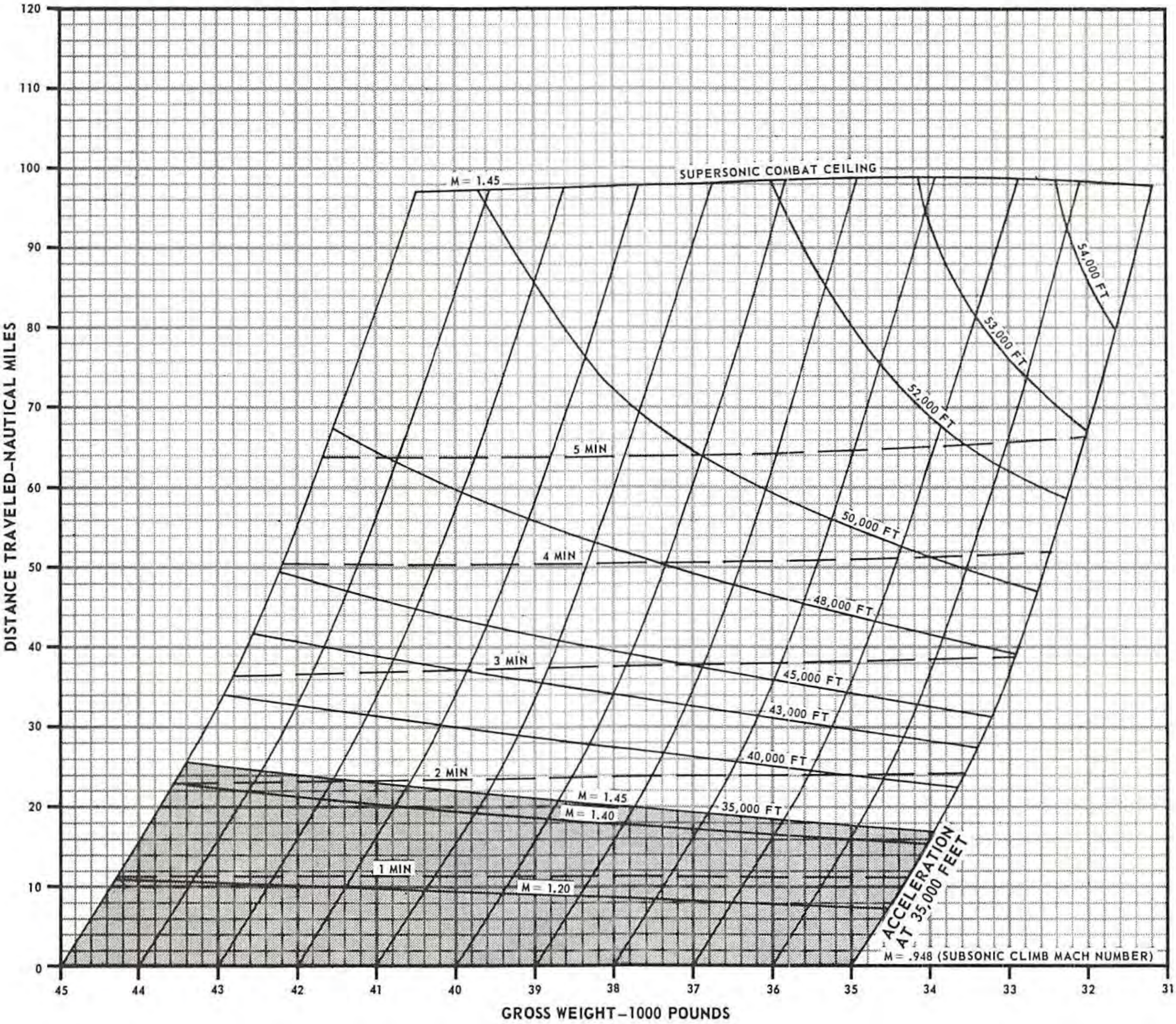
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(198)A

Figure 26-3. Supersonic Maximum Thrust Climb (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LBS).						TEMP. EFFECTS FACTOR	
		0	20	40	60	80	100	120	+10°C	−10°C
SEA LEVEL (15°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.04/ 48	.04/ 50	.04/ 51	.04/ 53	.04/ 55	.04/ 56	.04/ 58	1.10/1.07	.90/.93
	.6	.07/ 98	.07/101	.08/105	.08/109	.08/112	.08/117	.09/121	1.10/1.07	.90/.93
	.65	.11/150	.11/155	.11/161	.12/167	.12/174	.13/182	.14/190	1.10/1.07	.89/.92
	.7	.14/203	.15/211	.15/220	.16/229	.17/240	.18/252	.19/266	1.10/1.08	.89/.92
	.75	.18/258	.19/269	.19/282	.20/295	.21/312	.23/330	.24/352	1.11/1.08	.89/.91
	.8	.21/314	.22/329	.23/346	.25/366	.26/389	.28/417	.30/451	1.11/1.08	.88/.91
	.85	.25/373	.26/392	.28/414	.29/441	.31/475	.34/516	.38/571	1.12/1.09	.88/.90
	.9	.28/432	.30/457	.32/486	.34/525	.37/573	.41/638	.47/733	1.14/1.10	.87/.90
2000 FEET (11°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.04/ 48	.04/ 49	.04/ 50	.04/ 52	.04/ 53	.04/ 55	.04/ 57	1.10/1.07	.90/.93
	.6	.07/ 96	.08/100	.08/103	.08/106	.08/110	.09/114	.09/118	1.10/1.07	.90/.93
	.65	.11/147	.11/152	.12/157	.12/163	.13/170	.13/177	.14/185	1.10/1.07	.89/.92
	.7	.15/199	.15/206	.16/215	.17/224	.17/234	.18/245	.19/258	1.10/1.08	.89/.92
	.75	.18/252	.19/263	.20/275	.21/288	.22/303	.23/320	.25/340	1.11/1.08	.89/.91
	.8	.22/307	.23/322	.24/337	.25/355	.27/377	.29/402	.31/434	1.11/1.08	.88/.91
	.85	.26/364	.27/382	.28/403	.30/428	.32/459	.35/497	.38/547	1.12/1.09	.88/.90
	.90	.29/422	.31/445	.33/473	.35/508	.38/553	.42/611	.42/695	1.14/1.10	.87/.90
4000 FEET (7°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.04/ 47	.04/ 48	.04/ 49	.04/ 51	.04/ 52	.04/ 54	.05/ 56	1.10/1.07	.90/.93
	.6	.08/ 95	.08/ 98	.08/101	.08/104	.09/107	.09/111	.09/115	1.10/1.07	.90/.93
	.65	.11/144	.12/149	.12/154	.13/160	.13/166	.14/172	.14/180	1.10/1.07	.89/.92
	.7	.15/195	.16/202	.16/210	.17/218	.18/228	.19/238	.20/250	1.10/1.08	.89/.92
	.75	.19/247	.20/257	.21/268	.22/280	.23/294	.24/310	.25/328	1.11/1.08	.89/.91
	.8	.23/300	.24/314	.25/328	.26/345	.28/365	.29/389	.31/418	1.11/1.08	.88/.91
	.85	.27/355	.28/373	.29/392	.31/416	.33/444	.35/479	.39/524	1.12/1.09	.88/.90
	.9	.30/412	.32/434	.34/459	.36/493	.39/534	.43/587	.48/661	1.14/1.10	.87/.90
6000 FEET (3°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.04/ 46	.04/ 47	.04/ 49	.04/ 50	.04/ 52	.05/ 53	.05/ 55	1.10/1.07	.09/.93
	.6	.08/ 93	.08/96	.08/ 99	.09/102	.09/105	.09/109	.10/113	1.10/1.07	.90/.93
	.65	.12/141	.12/146	.13/151	.13/156	.14/162	.14/168	.15/175	1.10/1.07	.89/.92
	.7	.16/191	.16/198	.17/205	.18/213	.18/222	.19/232	.20/243	1.10 1.08	.89/.92
	.75	.20/242	.21/251	.21/261	.22/273	.23/286	.25/301	.26/318	1.11/1.08	.89/.91
	.8	.24/294	.25/306	.26/320	.27/336	.28/355	.30/377	.32/403	1.11/1.08	.88/.91
	.85	.28/347	.29/364	.30/382	.32/404	.34/430	.36/462	.40/503	1.12/1.09	.88/.90
	.9	.31/402	.33/423	.35/447	.37/478	.40/515	.43/564	.48/629	1.14/1.10	.87/.90

FDD-1-(201)A

Figure 26-4. Low-Altitude Acceleration – Maximum Thrust (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LBS).						TEMP. EFFECTS FACTOR	
		0	20	40	60	80	100	120	+10°C	−10°C
SEA LEVEL (15°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	1.0 / .0	.0 /.0
	.55	.05/ 63	.05/ 65	.05 /67	.05/ 69	.05/ 72	.05/ 74	.06/ 77	1.10/1.07	.90/.93
	.6	.09/129	.10/133	.10/137	.10/142	.11/147	.11/153	.12/159	1.10/1.07	.90/.93
	.65	.14/196	.14/203	.15/211	.16/219	.16/228	.17/238	.18/250	1.10/1.07	.89/.92
	.7	.19/265	.19/276	.20/287	.21/300	.22/314	.23/331	.24/349	1.10/1.08	.89/.92
	.75	.23/336	.24/351	.25/368	.27/386	.28/407	.30/432	.32/461	1.11/1.08	.89/.91
	.8	.28/410	.29/430	.31/451	.32/477	.34/508	.37/545	.40/591	1.11/1.08	.88/.91
	.85	.32/485	.34/511	.36/540	.38/576	.41/620	.45/675	.49/748	1.12/1.09	.88/.90
	.9	.37/562	.39/595	.41/633	.45/684	.49/748	.54/834	.62/960	1.14/1.10	.87/.90
2000 FEET (11°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.05/ 62	.05/ 64	.05/ 66	.05/ 68	.05/ 70	.06/ 73	.06/ 75	1.10/1.07	.90/.93
	.6	.10/126	.10/131	.10/135	.11/139	.11/144	.11/150	.12/156	1.10/1.07	.90/.93
	.65	.14/192	.15/199	.15/206	.16/214	.17/223	.17/232	.18/243	1.10/1.07	.89/.92
	.7	.19/260	.20/270	.21/281	.22/293	.23/306	.24/322	.25/339	1.10/1.08	.89/.92
	.75	.24/330	.25/344	.26/359	.27/376	.29/396	.30/419	.32/446	1.11/1.08	.89/.91
	.8	.29/401	.30/420	.31/440	.33/465	.35/493	.38/527	.40/569	1.11/1.08	.88/.91
	.85	.33/475	.35/499	.37/526	.39/559	.42/600	.45/651	.50/717	1.12/1.09	.88/.90
	.9	.38/550	.40/580	.43/616	.46/664	.50/722	.55/800	.62/911	1.14/1.10	.87/.90
4000 FEET (7°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.05/ 61	.05/ 63	.05/ 65	.05/ 67	.06/ 69	.06/ 71	.06/ 74	1.10/1.07	.90/.93
	.6	.10/124	.10/128	.11/132	.11/137	.11/142	.12/147	.12/152	1.10/1.07	.90/.93
	.65	.15/189	.16/195	.16/202	.17/210	.17/218	.18/227	.19/237	1.10/1.07	.89/.92
	.7	.20/255	.21/264	.21/275	.22/286	.23/299	.24/313	.26/329	1.10/1.08	.89/.92
	.75	.25/323	.26/336	.27/351	.28/367	.30/386	.31/407	.33/432	1.11/1.08	.89/.91
	.8	.30/393	.31/410	.33/430	.34/452	.36/479	.39/511	.41/549	1.11/1.08	.88/.91
	.85	.35/464	.36/487	.38/512	.40/544	.43/582	.47/628	.51/688	1.12/1.09	.88/.90
	.9	.39/537	.41/566	.44/600	.47/644	.51/698	.56/769	.63/867	1.14/1.10	.87/.90
6000 FEET (3°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / .0	.0 /.0
	.55	.05/ 61	.05/ 62	.06/ 64	.06/ 66	.06/ 68	.06/ 70	.06/ 73	1.10/1.07	.90/.93
	.6	.10/123	.11/126	.11/130	.12/135	.12/139	.12/144	.13/149	1.10/1.07	.90/.93
	.65	.16/186	.16/192	.17/199	.17/206	.18/214	.19/222	.19/232	1.10/1.07	.89/.92
	.7	.21/251	.22/260	.22/270	.23/280	.24/292	.25/306	.27/321	1.10/1.08	.89/.92
	.75	.26/317	.27/329	.28/343	.29/359	.31/376	.32/396	.34/419	1.11/1.08	.89/.91
	.8	.31/385	.32/402	.34/420	.35/441	.37/466	.40/495	.42/531	1.11/1.08	.88/.91
	.85	.36/454	.38/476	.40/500	.42/529	.44/565	.48/607	.52/662	1.12/1.09	.88/.90
	.9	.41/526	.43/553	.45/585	.48/626	.52/676	.57/740	.63/828	1.14/1.10	.87/.90

FDD–1–(202)A

Figure 26-4. Low-Altitude Acceleration – Maximum Thrust (Sheet 2 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 55,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS FACTOR +10°C	TEMP. EFFECTS FACTOR −10°C
		TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LBS).								
SEA LEVEL (15°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	0 /0	0 / 0
	.55	.06/ 79	.06/ 82	.06/ 84	.06/ 87	.07/ 90	.07/ 93	.07/ 96	1.10/1.07	.90/.93
	.6	.12/161	.12/166	.12/172	.13/178	.13/185	.14/ 192	.14/ 200	1.10/1.07	.90/.93
	.65	.17/244	.18/253	.19/263	.19/274	.20/285	.21/ 298	.22/ 313	1.10/1.07	.89/.92
	.7	.23/330	.24/343	.25/358	.26/374	.27/393	.29/ 413	.31/ 437	1.10/1.08	.89/.92
	.75	.29/418	.30/437	.32/458	.33/481	.35/508	.37/ 540	.40/ 577	1.11/1.08	.89/.91
	.8	.35/509	.36/534	.38/562	.40/594	.43/633	.46/ 680	.50/ 738	1.11/1.08	.88/.91
	.85	.40/602	.42/634	.45/671	.48/716	.51/772	.56/ 842	.62/ 935	1.12/1.09	.88/.90
	.9	.46/697	.48/738	.51/786	.55/850	.61/931	.67/1039	.77/1200	1.14/1.10	.87/.90
2000 FEET (11°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	0 /0	0 / 0
	.55	.06/ 78	.06/ 80	.06/ 83	.07/ 86	.07/ 88	.07/ 91	.07/ 95	1.10/1.07	.90/.93
	.6	.12/158	.12/163	.13/169	.13/175	.14/181	.14/ 188	.15/ 196	1.10/1.07	.90/.93
	.65	.18/240	.19/249	.19/258	.20/268	.21/279	.22/ 292	.23/ 305	1.10/1.07	.89/.92
	.7	.24/324	.25/337	.26/351	.27/366	.28/384	.30/ 403	.31/ 425	1.10/1.08	.89/.92
	.75	.30/411	.31/428	.33/448	.34/470	.36/495	.38/ 574	.41/ 559	1.11/1.08	.89/.91
	.8	.36/499	.37/523	.39/549	.41/580	.44/616	.47/ 659	.51/ 713	1.11/1.08	.88/.91
	.85	.42/590	.44/620	.46/654	.49/697	.52/749	.57/ 813	.63/ 898	1.12/1.09	.88/.90
	.9	.47/683	.50/721	.53/767	.57/826	.62/900	.68/ 998	.78/1140	1.14/1.10	.87/.90
4000 FEET (7°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	0 /0	0 / 0
	.55	.06/ 77	.07/ 80	.07/ 82	.07/ 84	.07/ 87	.07/ 90	.08/ 93	1.10/1.07	.90/.93
	.6	.13/156	.13/161	.13/166	.14/172	.14/178	.15/ 185	.15/ 192	1.10/1.07	.90/.93
	.65	.19/236	.19/245	.20/254	.21/263	.22/274	.23/ 285	.24/ 298	1.10/1.07	.89/.92
	.7	.25/319	.26/331	.27/344	.28/359	.29/375	.31/ 393	.32/ 414	1.10/1.08	.89/.92
	.75	.31/403	.32/420	.34/439	.35/459	.37/483	.39/ 510	.42/ 543	1.11/1.08	.89/.91
	.8	.37/490	.39/512	.41/537	.43/566	.45/600	.48/ 640	.52/ 689	1.11/1.08	.88/.91
	.85	.43/578	.45/607	.48/639	.51/679	.54/727	.58/ 787	.64/ 864	1.12/1.09	.88/.90
	.9	.49/669	.52/705	.55/748	.59/803	.63/872	.70/ 962	.79/1088	1.14/1.10	.87/.90
6000 FEET (3°C)	.5	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	.0 / 0	0 /0	0 / 0
	.55	.07/ 77	.07/ 79	.07/ 81	.07/ 84	.07/ 86	.08/ 89	.08/ 92	1.10/1.07	.90/.93
	.6	.13/154	.14/159	.14/164	.15/170	.15/176	.16/ 182	.16/ 189	1.10/1.07	.90/.93
	.65	.20/233	.20/242	.21/250	.22/259	.23/269	.24/ 281	.25/ 293	1.10/1.07	.89/.92
	.7	.26/314	.27/326	.28/339	.29/352	.30/368	.32/ 385	.34/ 405	1.10/1.08	.89/.92
	.75	.32/397	.34/413	.35/430	.37/450	.38/473	.41/ 498	.43/ 529	1.11/1.08	.89/.91
	.8	.39/481	.40/502	.42/526	.44/553	.47/585	.50/ 623	.53/ 669	1.11/1.08	.88/.91
	.85	.45/567	.47/595	.49/625	.52/663	.56/708	.60/ 763	.65/ 833	1.12/1.09	.88/.90
	.9	.51/655	.54/690	.57/730	.61/782	.65/846	.71/ 928	.80/1041	1.14/1.10	.87/.90

FDD-1-(203)A

Figure 26-4. Low-Altitude Acceleration – Maximum Thrust (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: UP-5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS FACTOR +10°C	−10°C
		TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LBS)								
SEA LEVEL (15°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	0/0	0/0
	.55	.07/25	.07/26	.07/28	.08/30	.08/31	.09/34	.10/36	1.17/1.11	.87/.93
	.6	.13/51	.14/55	.15/58	.16/63	.18/68	.19/74	.21/81	1.18/1.11	.86/.91
	.65	.21/80	.22/86	.24/92	.26/100	.28/110	.32/123	.36/139	1.19/1.13	.84/.90
	.7	.28/111	.31/120	.33/131	.37/145	.41/163	.48/187	.57/224	1.23/1.16	.83/.88
	.75	.36/144	.40/158	.44/176	.50/199	.58/233	.72/290	1.05/426	1.24/1.18	.79/.83
	.8	.45/181	.50/202	.57/228	.66/269	.84/343	1.41/586		1.26/1.20	.80/.85
	.85	.54/223	.62/253	.72/296	.93/385				1.30/1.24	.83/.87
	.9	.66/275	.78/325	1.02/435					1.22/1.17	.81/.85
2000 FEET (11°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	0/0	0/0
	.55	.07/25	.07/26	.08/27	.08/29	.09/31	.09/33	.10/35	1.17/1.11	.87/.93
	.6	.14/51	.15/54	.16/57	.17/61	.18/66	.20/71	.21/78	1.18/1.11	.86/.91
	.65	.21/78	.23/84	.24/90	.26/98	.29/107	.32/118	.36/132	1.19/1.13	.84/.90
	.7	.29/108	.31/117	.34/127	.37/140	.42/156	.47/178	.56/209	1.23/1.16	.83/.88
	.75	.37/141	.41/154	.45/170	.50/191	.58/220	.70/265	.94/361	1.24/1.18	.79/.83
	.8	.46/176	.51/195	.57/220	.66/255	.81/314	1.18/463		1.26/1.20	.80/.85
	.85	.56/216	.62/244	.72/282	.90/354	1.48/596			1.30/1.24	.83/.87
	.9	.67/266	.78/310	.99/399					1.22/1.17	.81/.85
4000 FEET (7°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	0/0	0/0
	.55	.07/24	.07/26	.08/27	.08/29	.09/30	.09/32	.10/35	1.17/1.11	.87/.93
	.6	.14/50	.15/53	.16/56	.17/60	.18/64	.20/69	.22/76	1.18/1.11	.86/.91
	.65	.22/77	.23/82	.25/88	.27/95	.29/103	.32/114	.36/127	1.19/1.13	.84/.90
	.7	.30/106	.32/114	.35/124	.38/135	.42/150	.47/169	.55/196	1.23/1.16	.83/.88
	.75	.38/137	.42/150	.46/164	.51/183	.58/209	.68/248	.88/320	1.24/1.18	.79/.83
	.8	.47/172	.52/189	.58/211	.66/243	.80/293	1.08/401		1.26/1.20	.80/.85
	.85	.57/210	.64/236	.73/270	.88/331	1.28/486			1.30/1.24	.83/.87
	.9	.68/258	.79/297	.97/371					1.22/1.17	.81/.85
6000 FEET (3°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	0/0	0/0
	.55	.07/24	.08/25	.08/27	.09/28	.09/30	.10/32	.10/34	1.17/1.11	.87/.93
	.6	.15/49	.16/52	.17/55	.18/59	.19/63	.21/68	.22/74	1.18/1.11	.86/.91
	.65	.23/76	.24/81	.26/87	.28/93	.30/101	.33/110	.37/122	1.19/1.13	.84/.90
	.7	.31/104	.33/112	.36/121	.39/132	.43/146	.48/163	.55/187	1.23/1.16	.83/.88
	.75	.39/135	.43/146	.47/160	.52/177	.59/201	.68/234	.85/294	1.24/1.18	.79/.83
	.8	.49/168	.53/184	.59/205	.67/233	.79/277	1.02/359		1.26/1.20	.80/.85
	.85	.58/205	.65/228	.74/260	.88/312	1.19/425			1.30/1.24	.83/.87
	.9	.70/250	.80/286	.97/349					1.22/1.17	.81/.85

Figure 26-5. Low-Altitude Acceleration – Military Thrust (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	MACH	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LBS). DRAG INDEX 0	20	40	60	80	100	120	TEMP EFFECTS FACTOR +10°C	−10°C
SEA LEVEL (15°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/.0	.0/.0
	.55	.09/33	.09/35	.10/37	.10/40	.11/42	.12/46	.13/49	1.17/1.11	.87/.93
	.6	.18/68	.19/73	.20/78	.22/84	.24/91	.26/99	.29/109	1.18/1.11	.86/.91
	.65	.27/106	.29/114	.32/123	.35/134	.38/148	.43/165	.49/188	1.19/1.13	.84/.90
	.7	.37/147	.41/159	.45/175	.49/194	.56/219	.65/254	.79/311	1.23/1.16	.83/.88
	.75	.48/191	.53/210	.59/234	.67/266	.79/313	.98/393	1.53/619	1.24/1.18	.79/.83
	.8	.59/239	.66/267	.75/304	.89/360	1.11/464	2.17/903		1.26/1.20	.80/.85
	.85	.72/294	.82/335	.96/395	1.24/516				1.30/1.24	.83/.87
	.9	.87/364	1.03/431	1.38/587					1.22/1.17	.81/.85
2000 FEET (11°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/.0	.0/.0
	.55	.09/33	.10/35	.10/37	.11/39	.12/42	.12/45	.13/48	1.17/1.11	.87/.93
	.6	.18/67	.20/72	.21/77	.23/82	.24/89	.26/97	.29/106	1.18/1.11	.86/.91
	.65	.28/104	.30/112	.33/121	.35/131	.39/144	.43/159	.49/180	1.19/1.13	.84/.90
	.7	.39/144	.42/156	.45/170	.50/188	.56/210	.64/241	.78/289	1.23/1.16	.83/.88
	.75	.49/187	.54/205	.60/227	.67/256	.78/297	.96/366	1.34/513	1.24/1.18	.79/.83
	.8	.61/233	.68/259	.76/293	.89/343	1.10/428	1.70/669		1.26/1.20	.80/.85
	.85	.73/286	.83/324	.96/377	1.21/478	2.29/926			1.30/1.24	.83/.87
	.9	.89/352	1.04/412	1.33/537					1.22/1.17	.81/.85
4000 FEET (7°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/.0	.0/.0
	.55	.09/33	.10/34	.11/36	.11/39	.12/41	.13/44	.14/47	1.17/1.11	.87/.93
	.6	.19/67	.20/71	.22/76	.23/81	.25/87	.27/95	.30/103	1.18/1.11	.86/.91
	.65	.29/103	.31/110	.34/118	.36/128	.40/140	.44/155	.49/173	1.19/1.13	.84/.90
	.7	.40/141	.43/153	.47/166	.51/182	.57/203	.65/231	.76/273	1.23/1.16	.83/.88
	.75	.51/183	.55/200	.61/220	.68/247	.79/284	.94/342	1.24/452	1.24/1.18	.79/.83
	.8	.63/228	.69/252	.77/283	.89/328	1.09/403	1.53/567		1.26/1.20	.80/.85
	.85	.75/279	.85/314	.97/362	1.21/451	1.83/697			1.30/1.24	.83/.87
	.9	.91/342	1.05/396	1.31/500					1.22/1.17	.81/.85
6000 FEET (3°C)	.5	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/0	.0/.0	.0/.0
	.55	.10/33	.11/34	.11/36	.12/38	.13/41	.13/44	.14/47	1.17/1.11	.87/.93
	.6	.20/66	.21/70	.23/75	.24/80	.26/86	.28/93	.31/102	1.18/1.11	.86/.91
	.65	.31/102	.33/109	.35/117	.38/126	.41/137	.45/151	.50/168	1.19/1.13	.84/.90
	.7	.41/140	.45/151	.48/163	.53/178	.58/198	.66/223	.76/259	1.23/1.16	.83/.88
	.75	.53/180	.57/196	.63/215	.70/240	.80/273	.94/325	1.20/414	1.24/1.18	.79/.83
	.8	.65/224	.71/247	.79/275	.91/316	1.09/381	1.44/506		1.26/1.20	.80/.85
	.85	.78/273	.87/305	.99/349	1.20/426	1.66/596			1.30/1.24	.83/.87
	.9	.93/333	1.07/382	1.30/470					1.22/1.17	.81/.85

FDD-1-(205) A

Figure 26-5. Low-Altitude Acceleration – Military Thrust (Sheet 2 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 55,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-10

DATE: 1 JULY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX 0	20	40	60	80	100	120	TEMP. EFFECTS FACTOR +10°C	TEMP. EFFECTS FACTOR −10°C
		TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LBS).								
SEA LEVEL (15°C)	.5	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	0 0	.0 .0	.0 .0
	.55	.11 42	.12 45	.13 48	.13 51	.14 55	.16 59	.17 64	1.17 1.11	.87 .93
	.6	.23 87	.24 93	.26 100	.28 108	.31 117	.34 129	.37 143	1.18 1.11	.86 .91
	.65	.35 135	.38 145	.41 158	.45 172	.49 191	.55 215	.64 247	1.19 1.13	.84 .90
	.7	.47 186	.52 203	.57 223	.63 248	.72 283	.84 331	1.05 414	1.23 1.16	.83 .88
	.75	.61 241	.67 267	.75 298	.86 341	1.02 407	1.30 523	2.26 918	1.24 1.18	.79 .83
	.8	.75 302	.84 339	.96 388	1.14 464	1.49 608			1.26 1.20	.80 .85
	.85	.91 372	1.04 426	1.25 515	1.61 671				1.30 1.24	.83 .87
	.9	1.10 459	1.31 547	1.79 762					1.22 1.17	.81 .85

	MACH	DRAG INDEX 0	20	40	60	80	100	120	+10°C	−10°C
2000 FEET (11°C)	.5	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	.0 .0	.0 .0
	.55	.12 42	.12 45	.13 47	.14 50	.15 54	.16 58	.17 63	1.17 1.11	.87 .93
	.6	.24 86	.25 92	.27 99	.29 106	.31 115	.34 126	.38 139	1.18 1.11	.86 .91
	.65	.37 133	.39 143	.42 155	.46 169	.50 186	.56 208	.64 237	1.19 1.13	.84 .90
	.7	.49 183	.53 199	.58 218	.65 242	.73 273	.84 316	1.02 385	1.23 1.16	.83 .88
	.75	.63 237	.69 261	.77 290	.87 329	1.02 387	1.27 485	1.87 722	1.24 1.18	.79 .83
	.8	.77 296	.86 331	.98 375	1.15 443	1.45 564	2.47 974		1.26 1.20	.80 .85
	.85	.93 363	1.06 413	1.23 483	1.53 629				1.30 1.24	.83 .87
	.9	1.12 446	1.32 525	1.72 694					1.22 1.17	.81 .85

	MACH	DRAG INDEX 0	20	40	60	80	100	120	+10°C	−10°C
4000 FEET (7°C)	.5	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	.0 .0	.0 .0
	.55	.12 42	.13 45	.14 47	.15 50	.16 54	.17 58	.18 63	1.17 1.11	.87 .93
	.6	.25 86	.26 92	.28 98	.30 105	.33 114	.36 124	.39 137	1.18 1.11	.86 .91
	.65	.38 132	.40 142	.43 153	.47 166	.52 183	.58 203	.65 230	1.19 1.13	.84 .90
	.7	.51 181	.55 196	.60 214	.66 236	.74 265	.85 304	1.01 362	1.23 1.16	.83 .88
	.75	.65 234	.71 256	.79 283	.89 319	1.03 371	1.25 454	1.72 626	1.24 1.18	.79 .83
	.8	.80 291	.88 323	1.00 364	1.16 425	1.48 544	2.14 795		1.26 1.20	.80 .85
	.85	.96 355	1.08 401	1.25 466	1.57 588	2.62 1001			1.30 1.24	.83 .87
	.9	1.15 434	1.34 506	1.70 647					1.22 1.17	.81 .85

	MACH	DRAG INDEX 0	20	40	60	80	100	120	+10°C	−10°C
6000 FEET (3°C)	.5	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	.0 0	.0 .0	.0 .0
	.55	.13 42	.14 45	.15 47	.15 50	.17 54	.18 58	.19 63	1.17 1.11	.87 .93
	.6	.26 86	.28 91	.30 98	.32 105	.34 113	.37 123	.41 135	1.18 1.11	.86 .91
	.65	.39 132	.42 141	.45 152	.49 165	.54 181	.60 200	.67 225	1.19 1.13	.84 .90
	.7	.53 180	.58 194	.63 212	.69 233	.77 260	.87 296	1.03 348	1.23 1.16	.83 .88
	.75	.68 231	.74 253	.81 279	.91 312	1.05 360	1.26 433	1.64 569	1.24 1.18	.79 .83
	.8	.83 287	.92 317	1.03 356	1.18 411	1.44 504	1.98 698		1.26 1.20	.80 .85
	.85	.99 349	1.12 392	1.28 451	1.58 559	2.30 828			1.30 1.24	.83 .87
	.9	1.19 425	1.37 491	1.70 612					1.22 1.17	.81 .85

FDD-1-(206)A

Figure 26-5. Low-Altitude Acceleration – Military Thrust (Sheet 3 of 3)

10,000 FEET

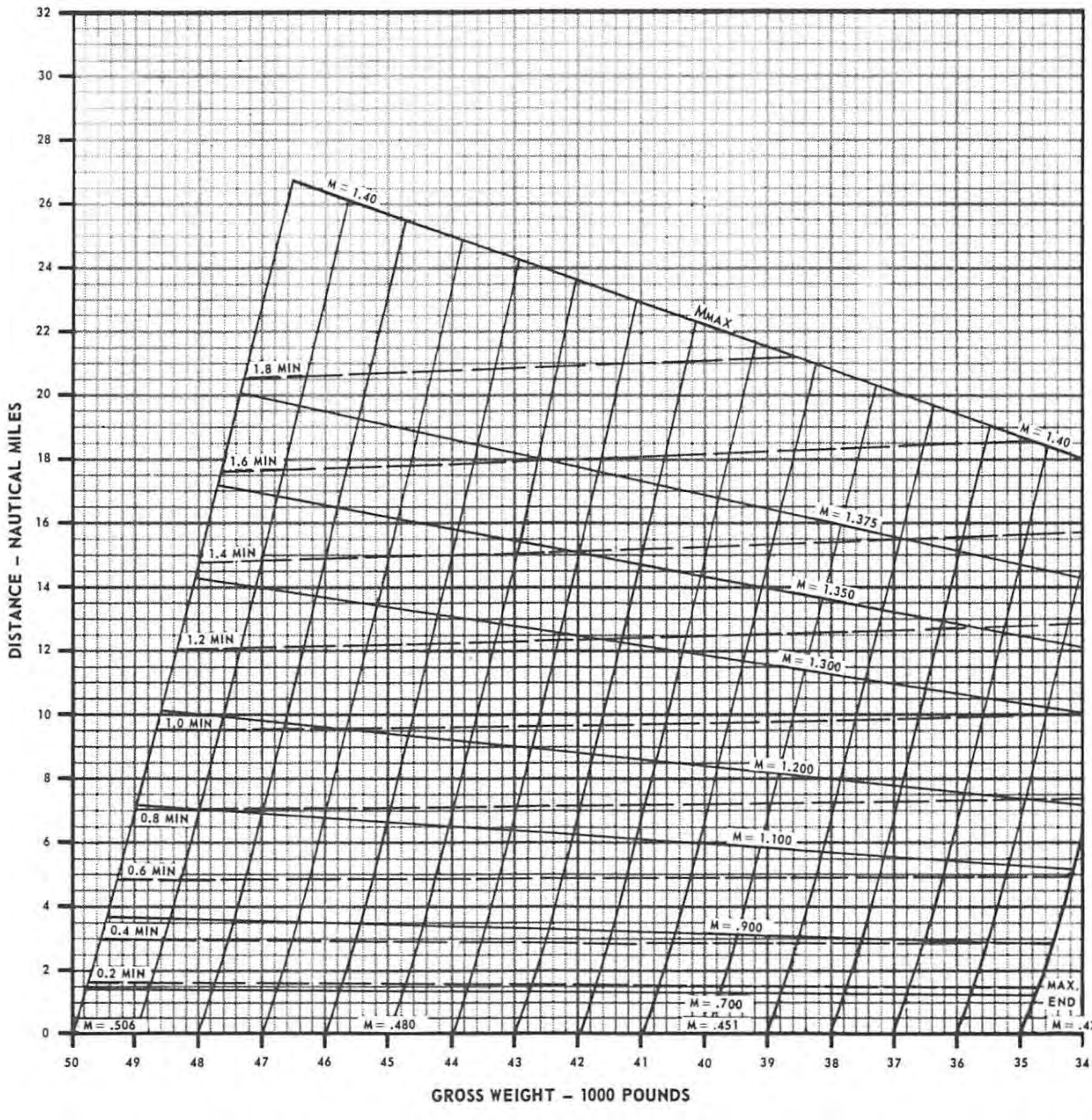
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(207)A

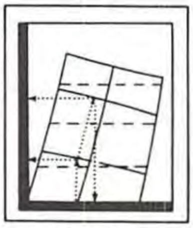
Figure 26-6. Maximum Thrust Acceleration (Sheet 1 of 13)

30,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7

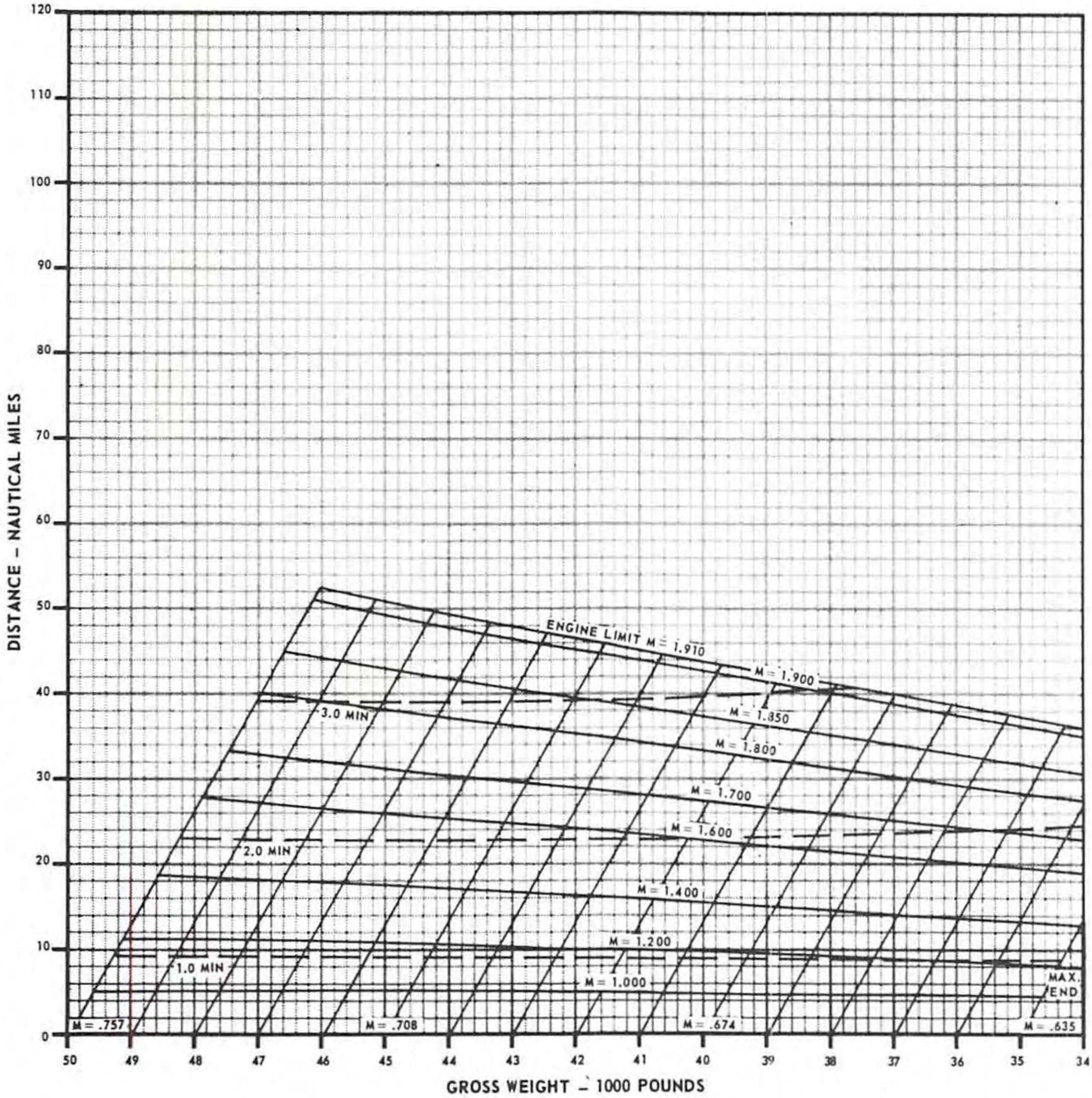
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(209)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 2 of 13)

35,000 FEET

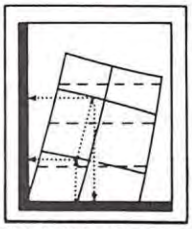
AIRPLANE CONFIGURATION

(4) AIM-7

REMARKS

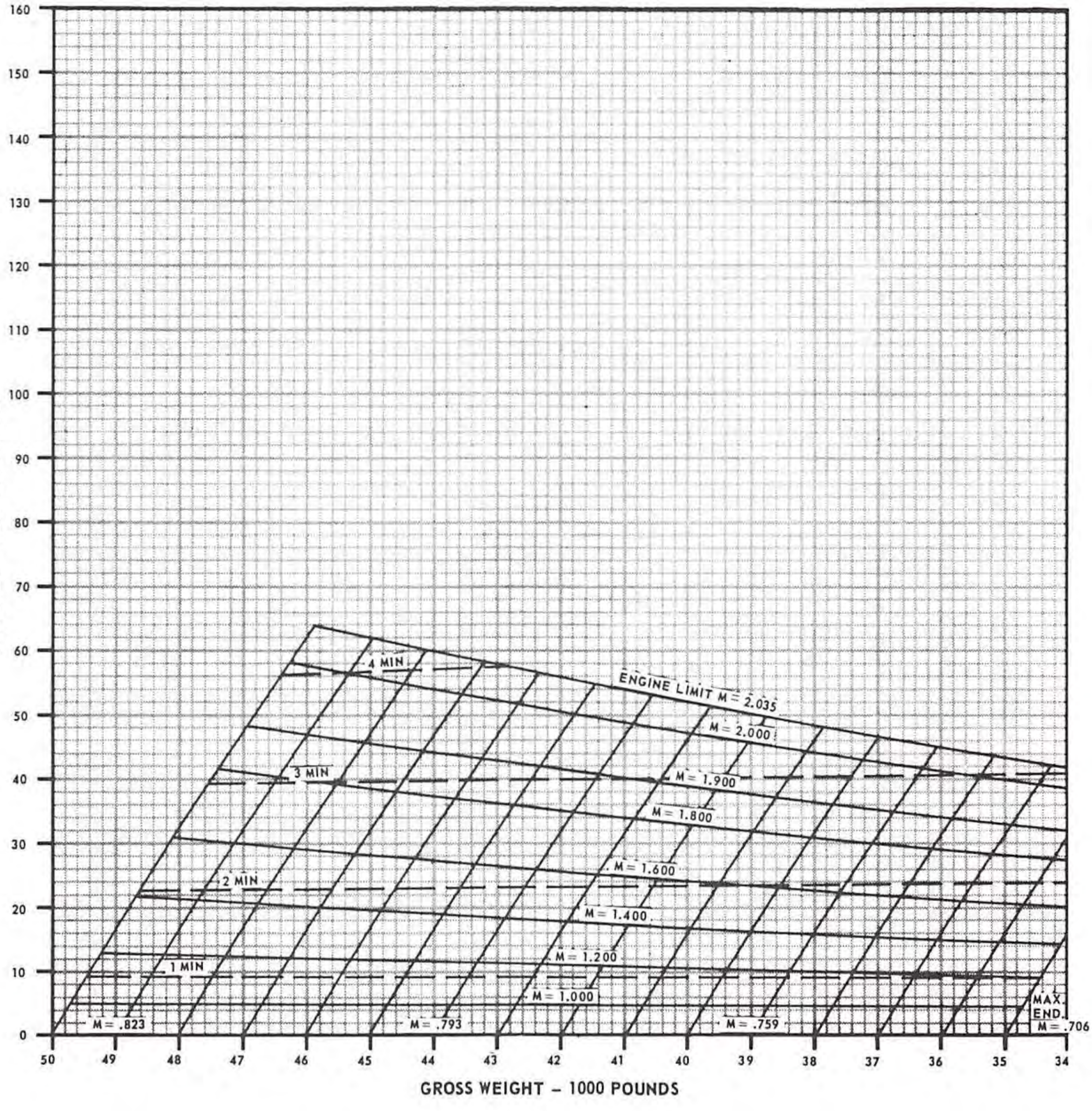
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(210)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 3 of 13)

40,000 FEET

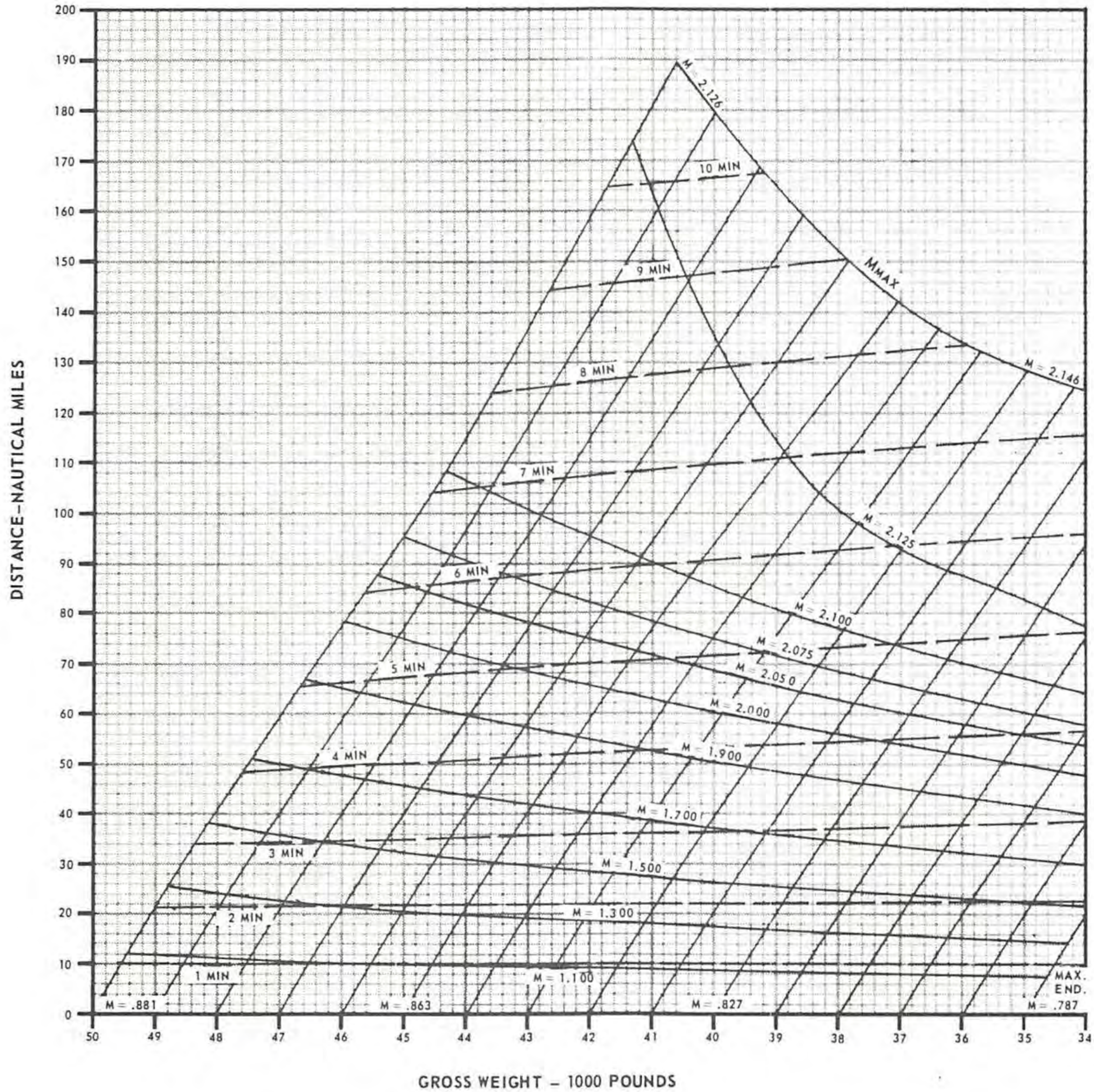
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB GAL



FDD-1-(211)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 4 of 13)

AIRPLANE CONFIGURATION
(4) AIM-7

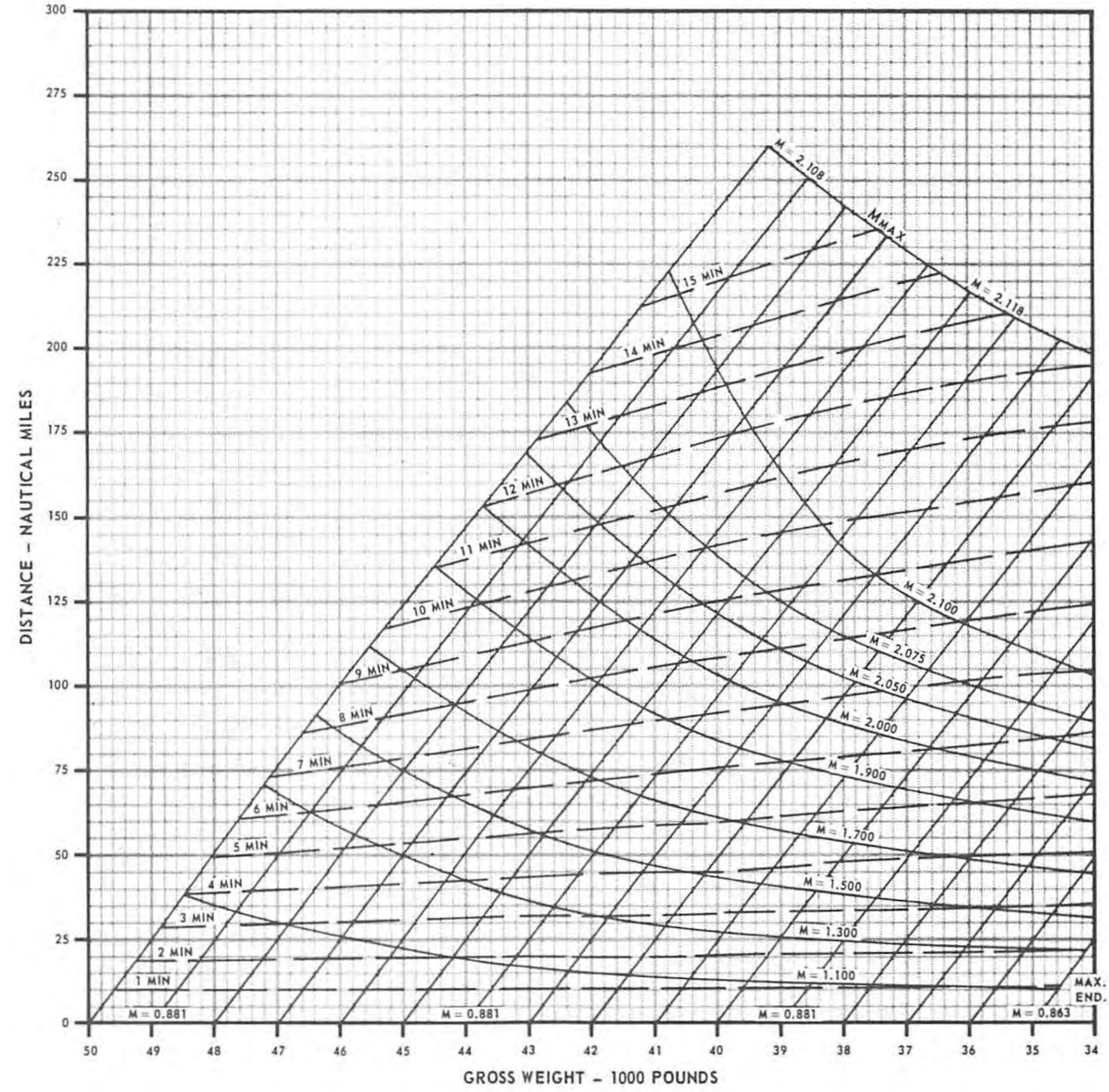
45,000 FEET

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(212)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 5 of 13)

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

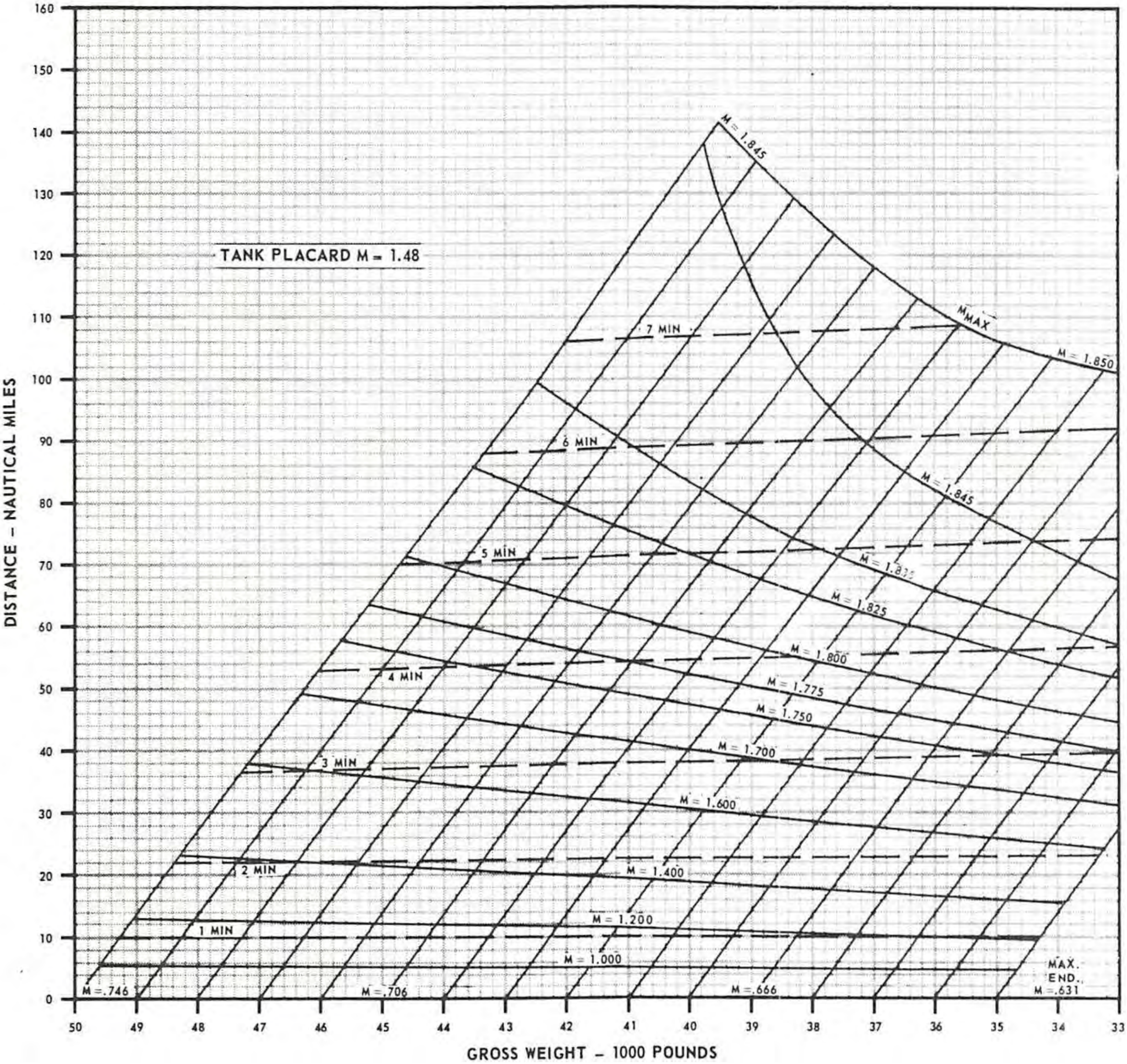
30,000 FEET

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST



FDD-1-(215)A

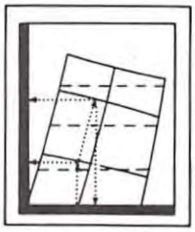
Figure 26-6. Maximum Thrust Acceleration (Sheet 6 of 13)

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

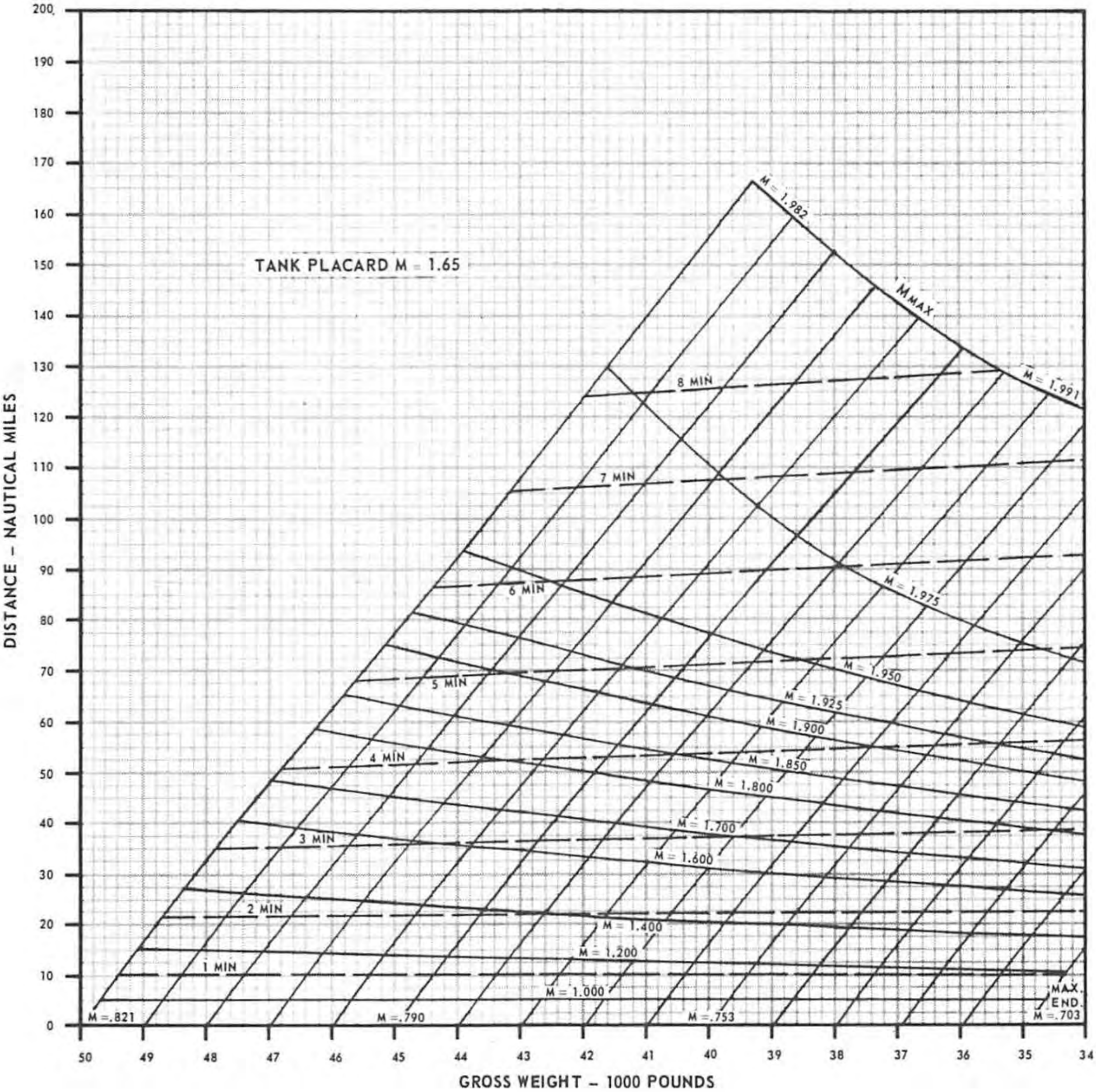
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(216)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 7 of 13)

40,000 FEET

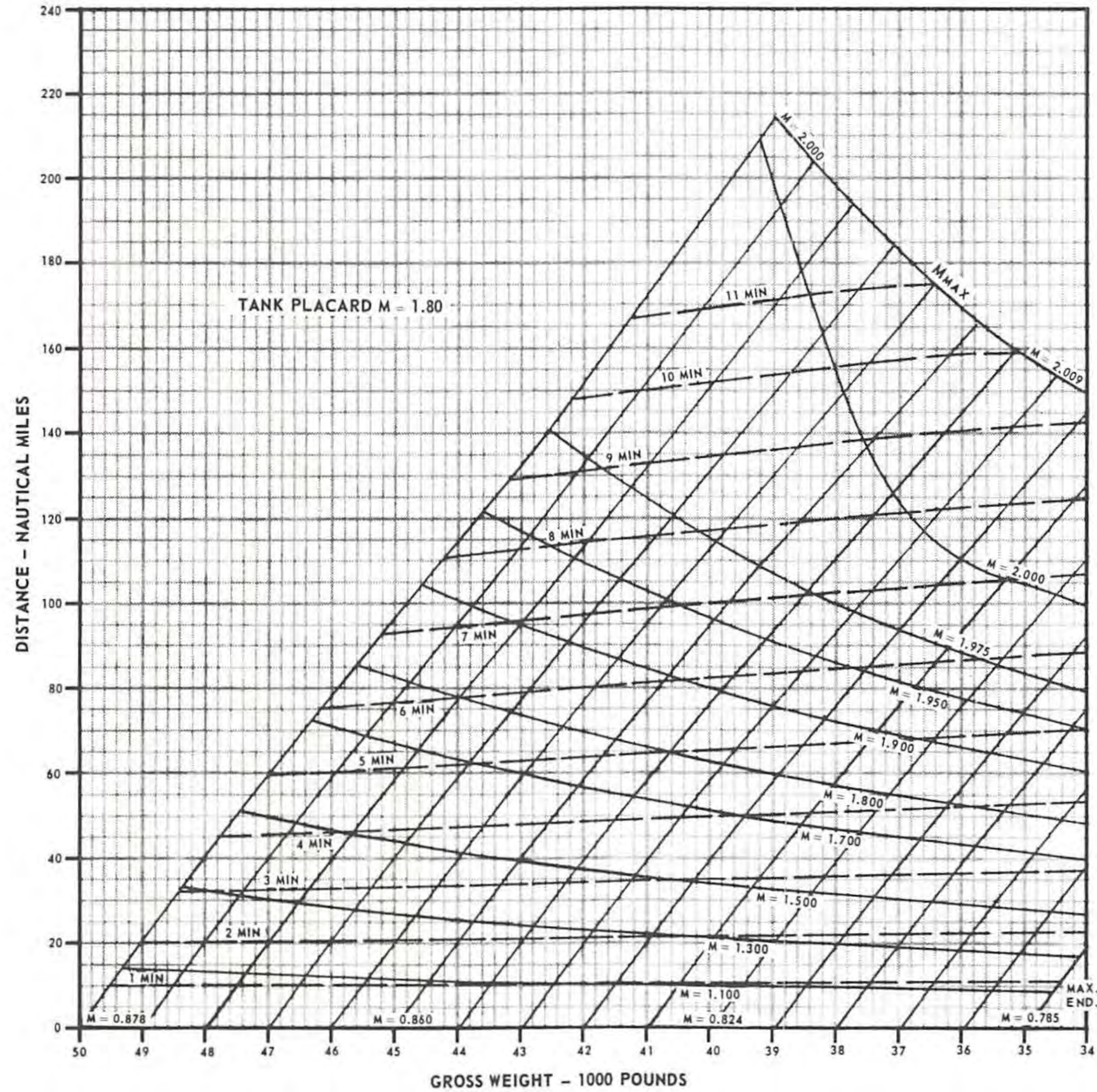
AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB GAL



FDD-1-(217)A

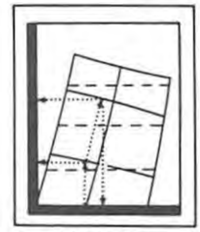
Figure 26-6. Maximum Thrust Acceleration (Sheet 8 of 13)

45,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

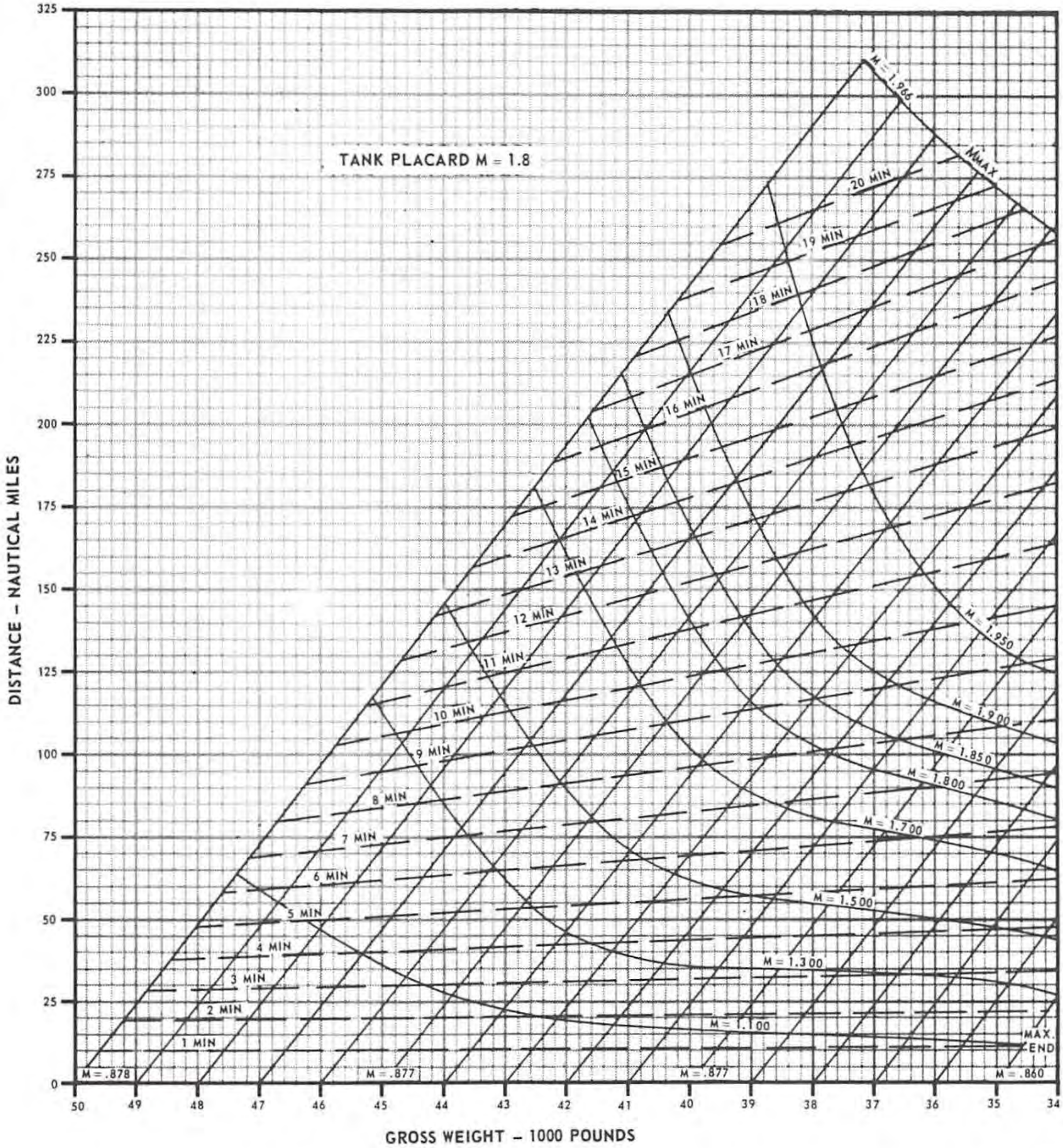
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(218)A

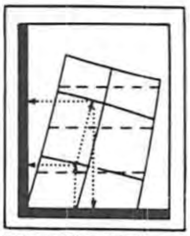
Figure 26-6. Maximum Thrust Acceleration (Sheet 9 of 13)

30,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

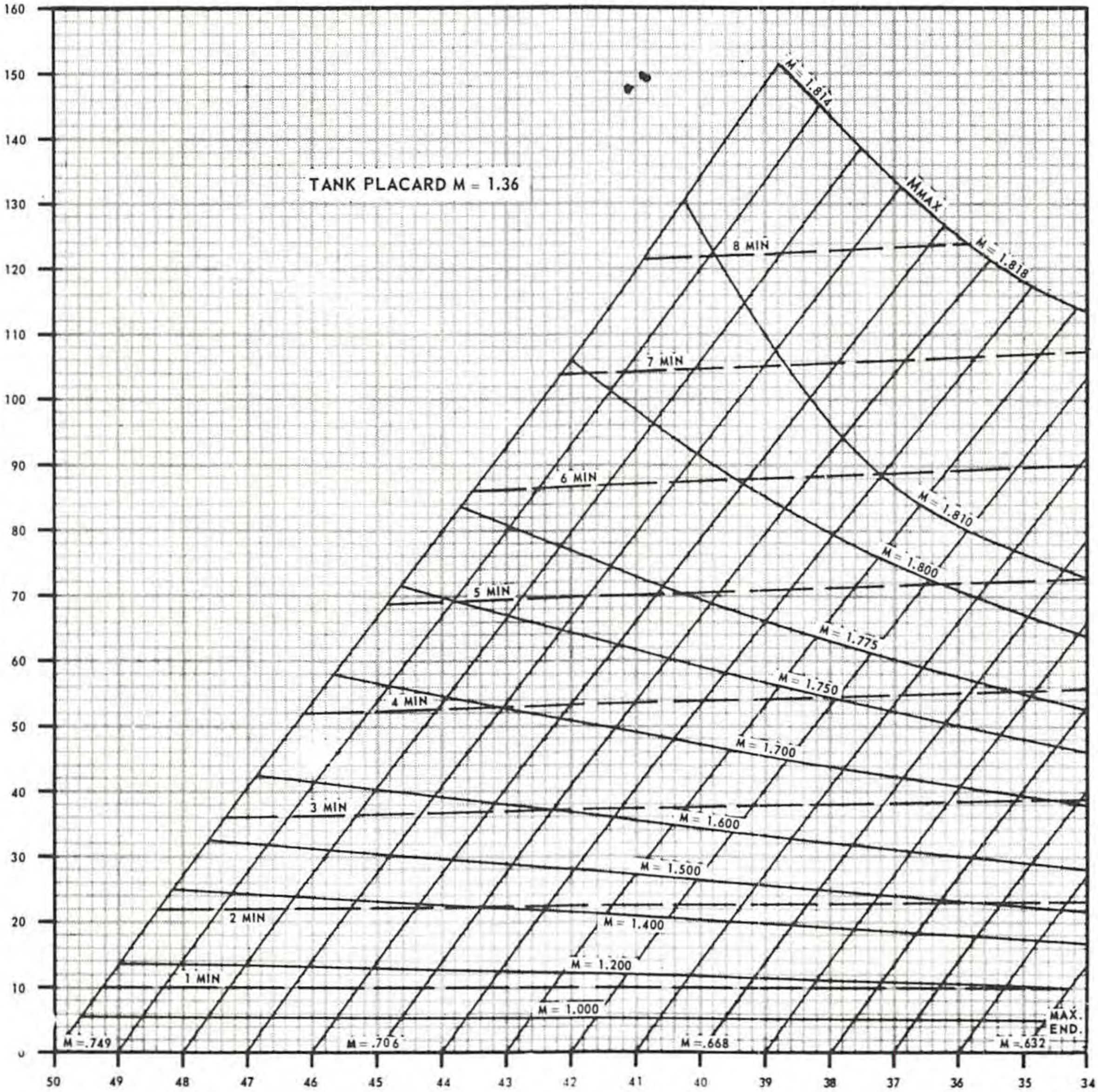
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(221)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 10 of 13)

35,000 FEET

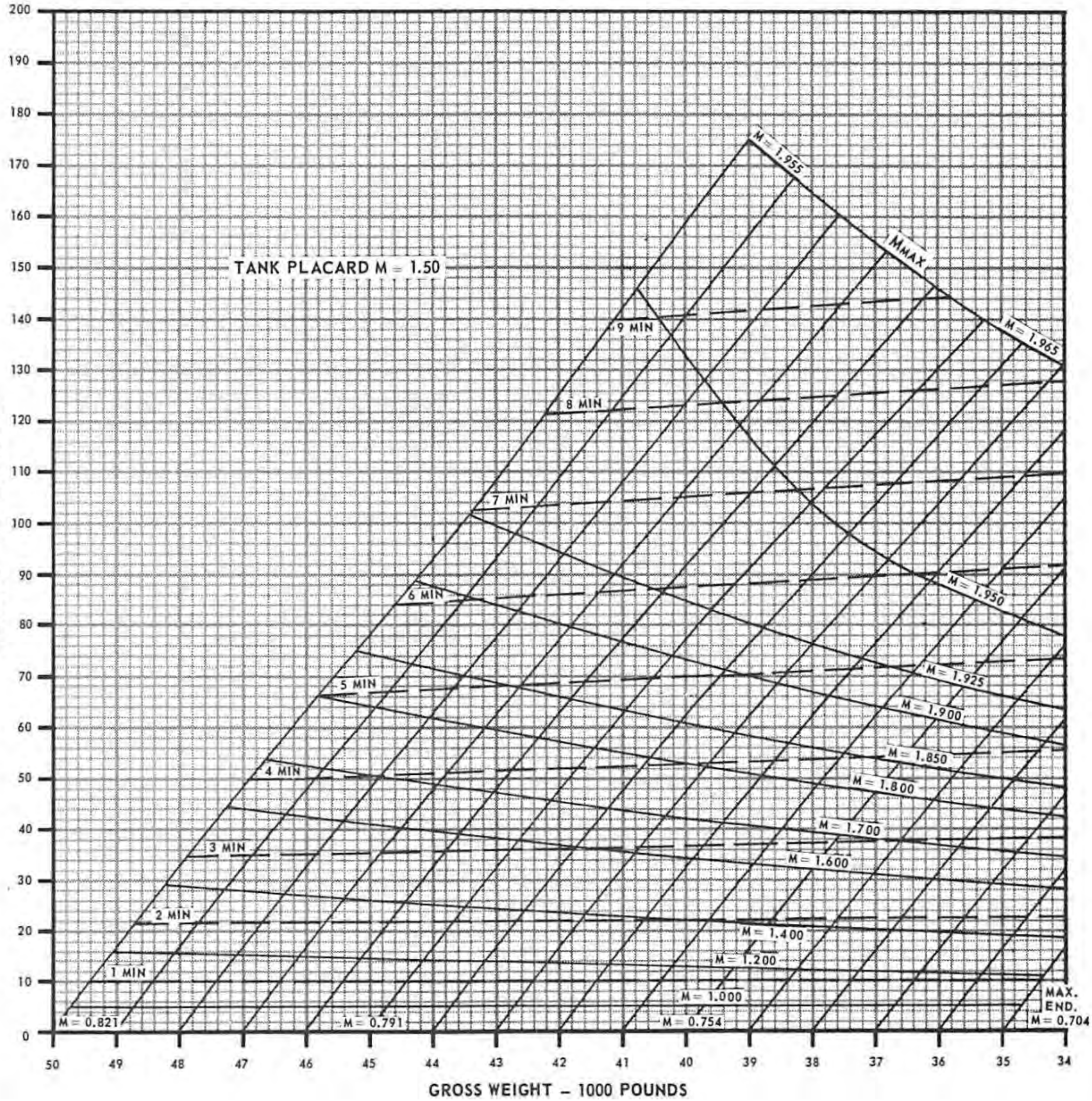
AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(222)A

Figure 26-6. Maximum Thrust Acceleration (Sheet 11 of 13)

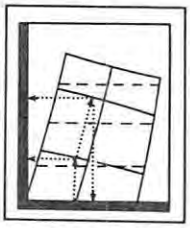
AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

40,000 FEET

REMARKS

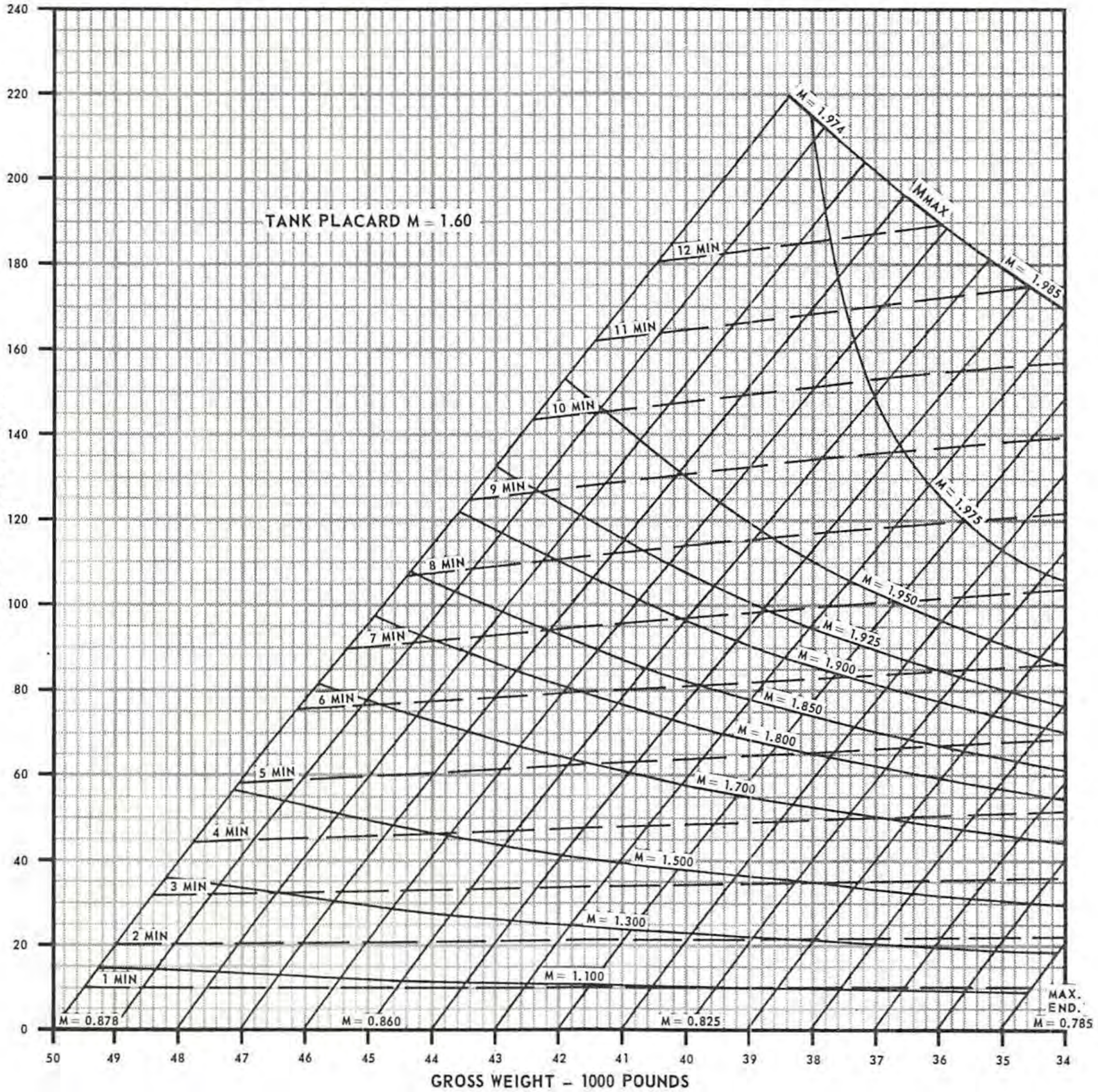
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 JANUARY 1972
DATA BASIS: **FLIGHT TEST**



FDD-1-(223)A

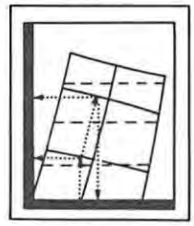
Figure 26-6. Maximum Thrust Acceleration (Sheet 12 of 13)

45,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

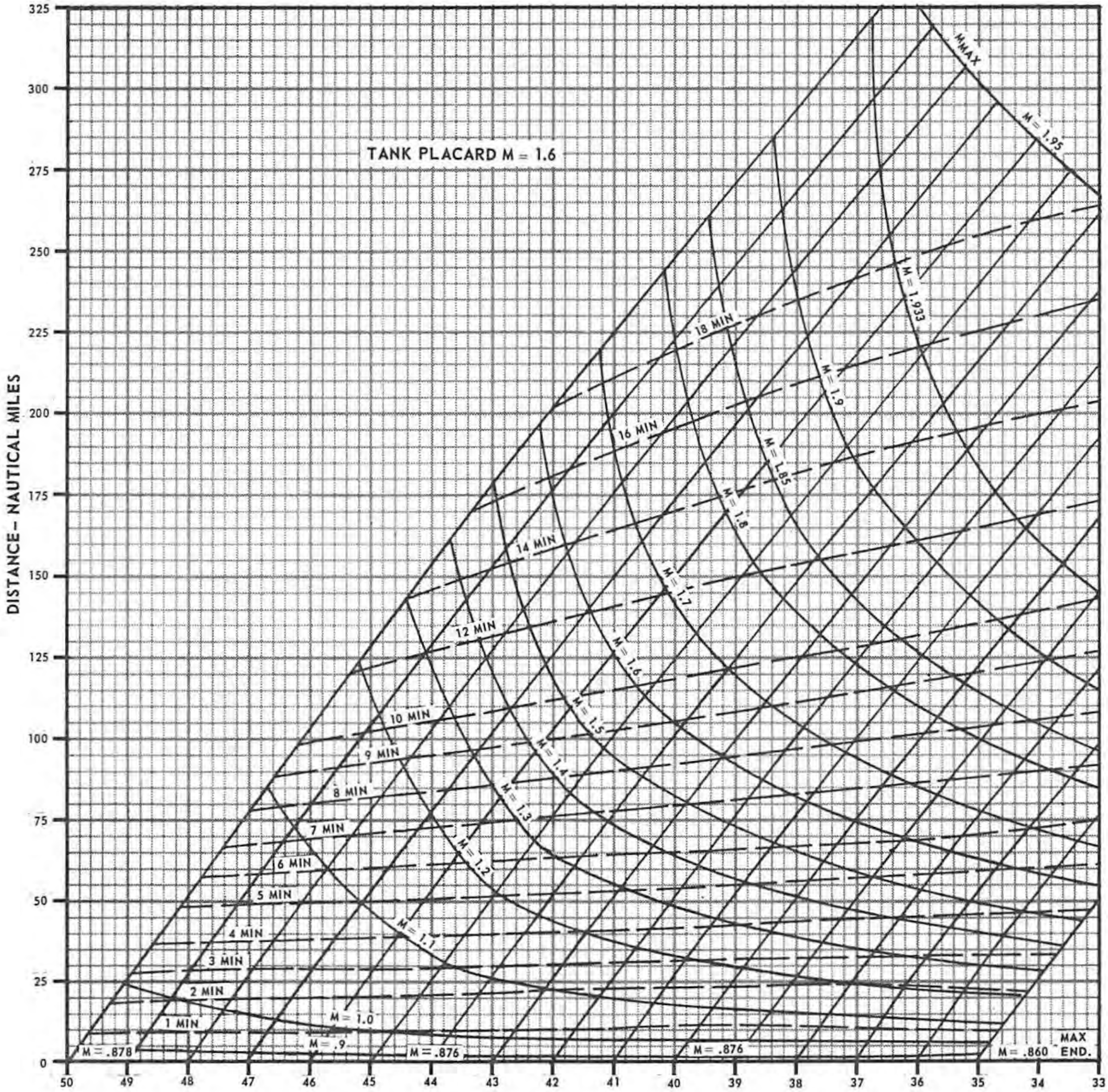


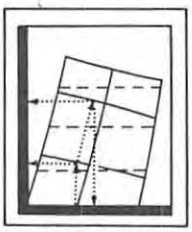
Figure 26-6. Maximum Thrust Acceleration (Sheet 13 of 13)

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7

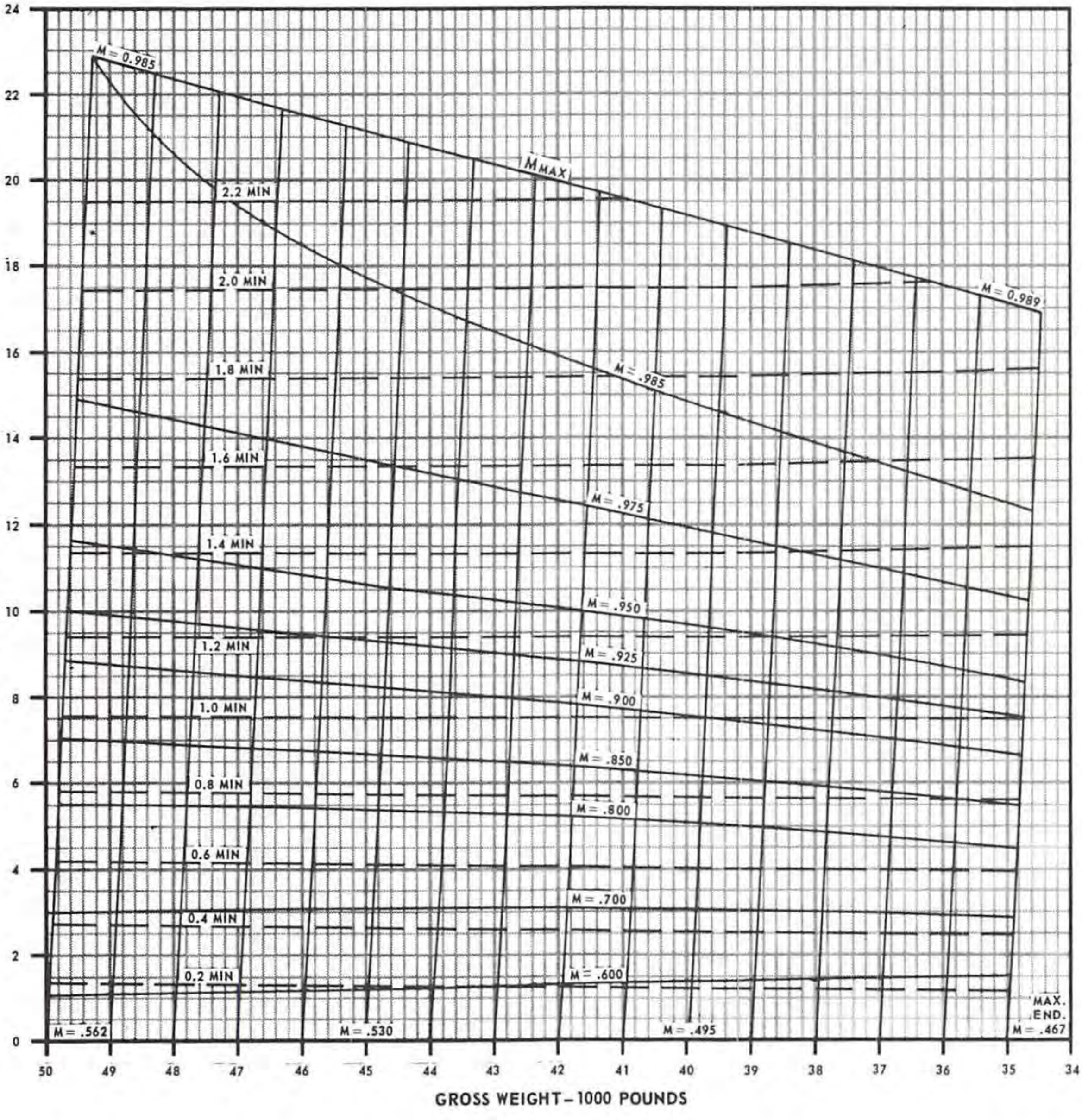
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(240)A

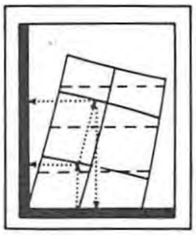
Figure 26-7. Military Thrust Acceleration (Sheet 1 of 12)

25,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7

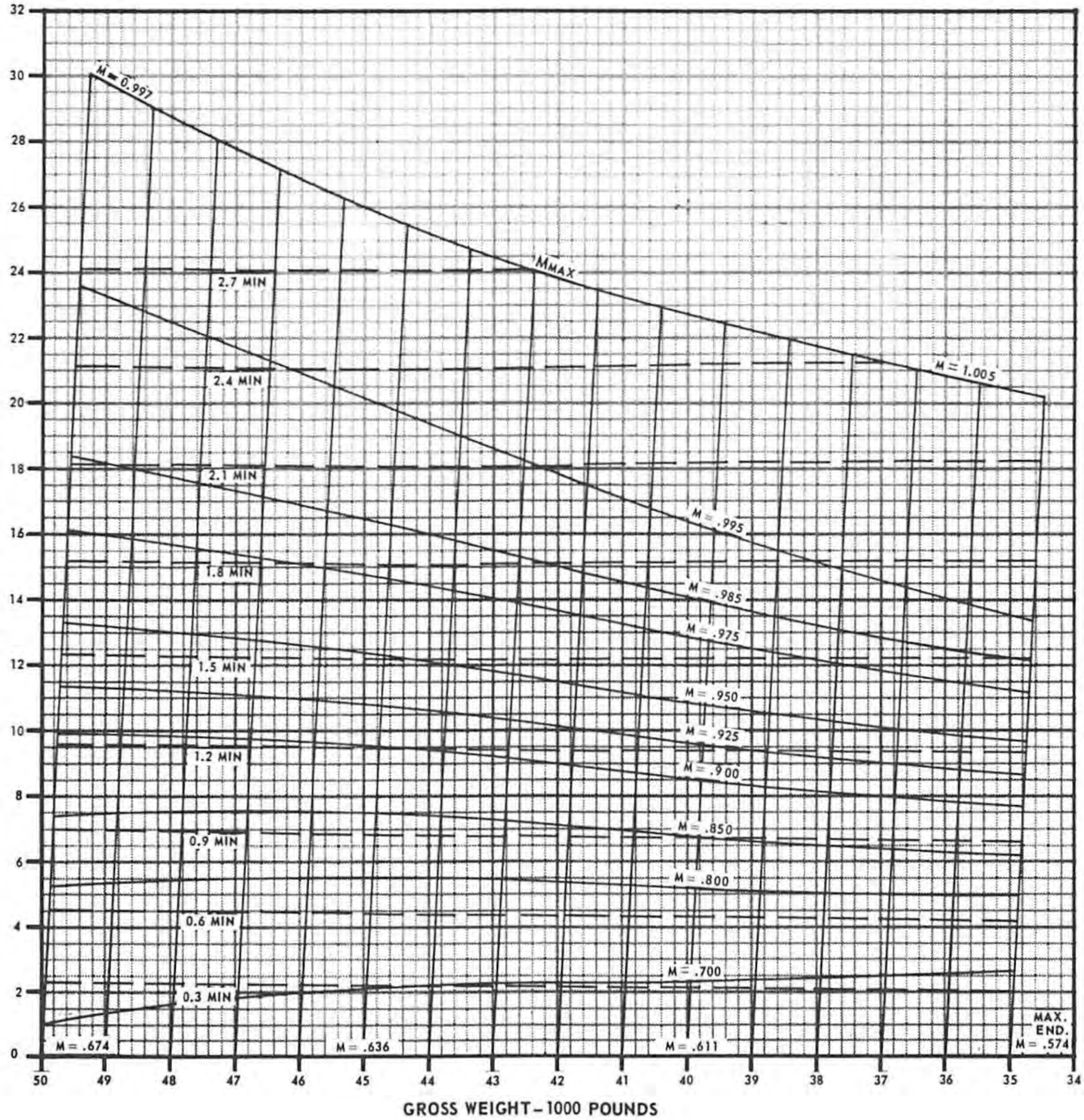
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(241)A

Figure 26-7. Military Thrust Acceleration (Sheet 2 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7

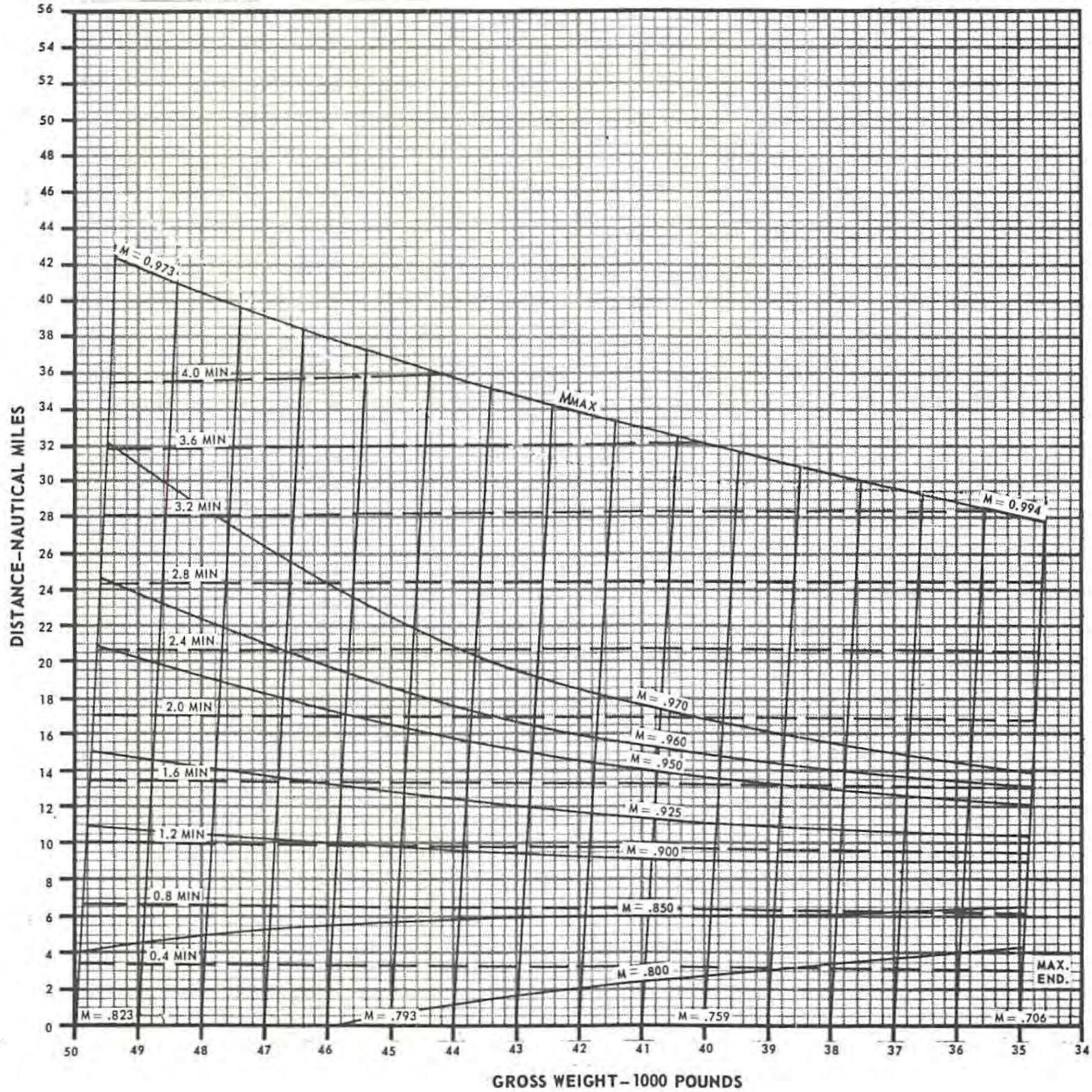
35,000 FEET

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(242)A

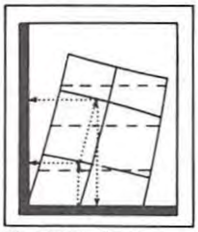
Figure 26-7. Military Thrust Acceleration (Sheet 3 of 12)

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK

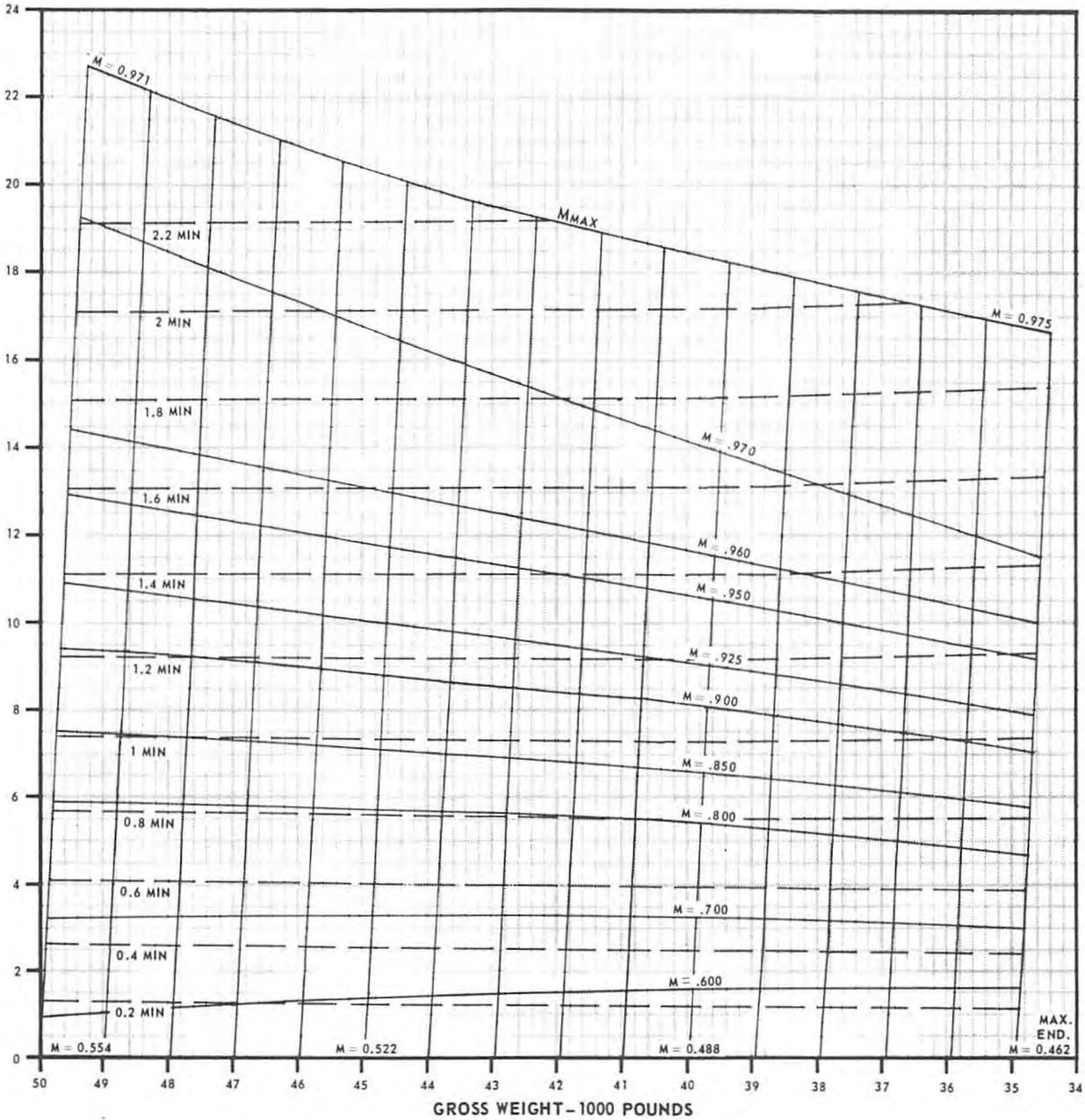
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



FDD-1-(246)A

Figure 26-7. Military Thrust Acceleration (Sheet 4 of 12)

25,000 FEET

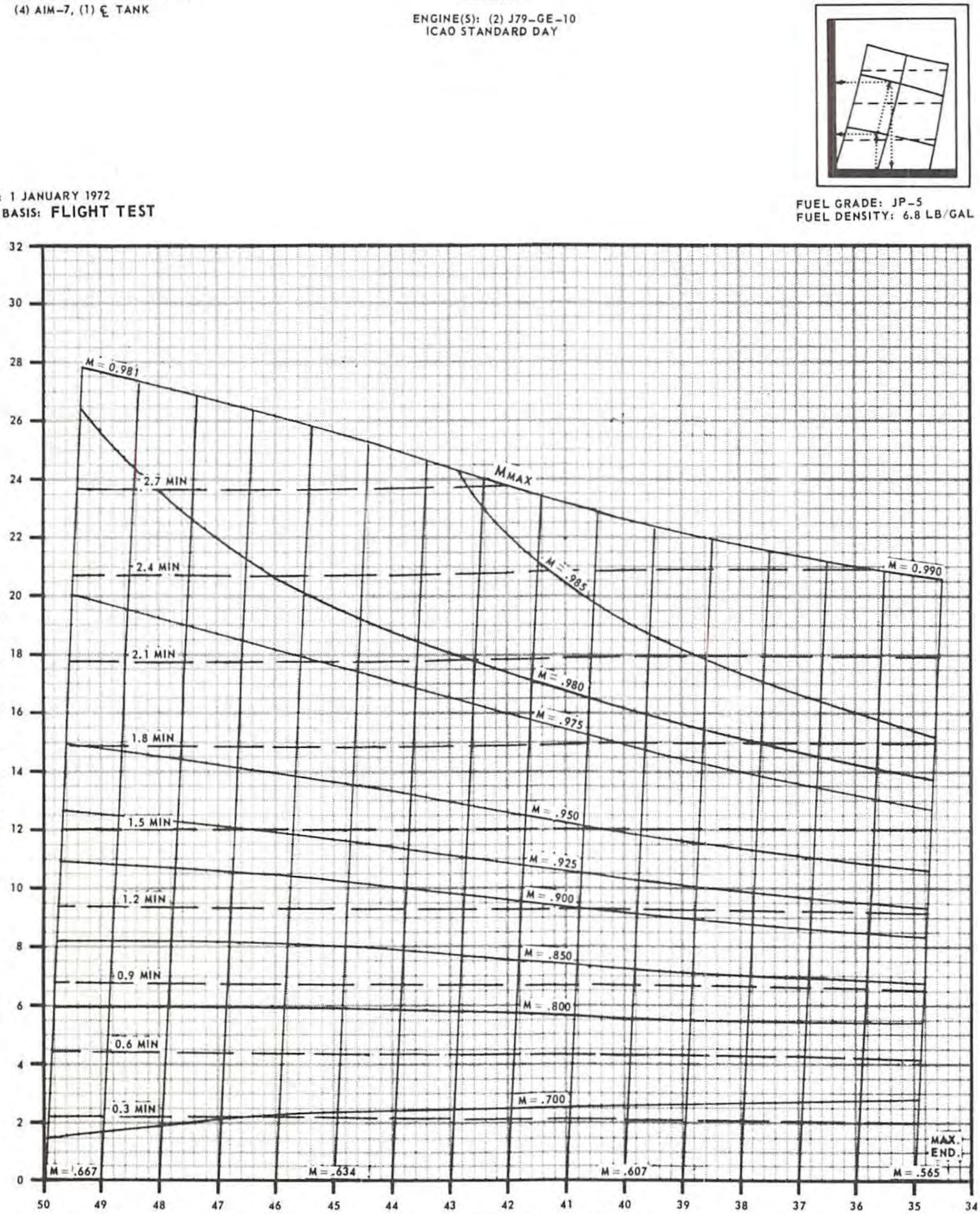
AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(247)A

Figure 26-7. Military Thrust Acceleration (Sheet 5 of 12)

35,000 FEET

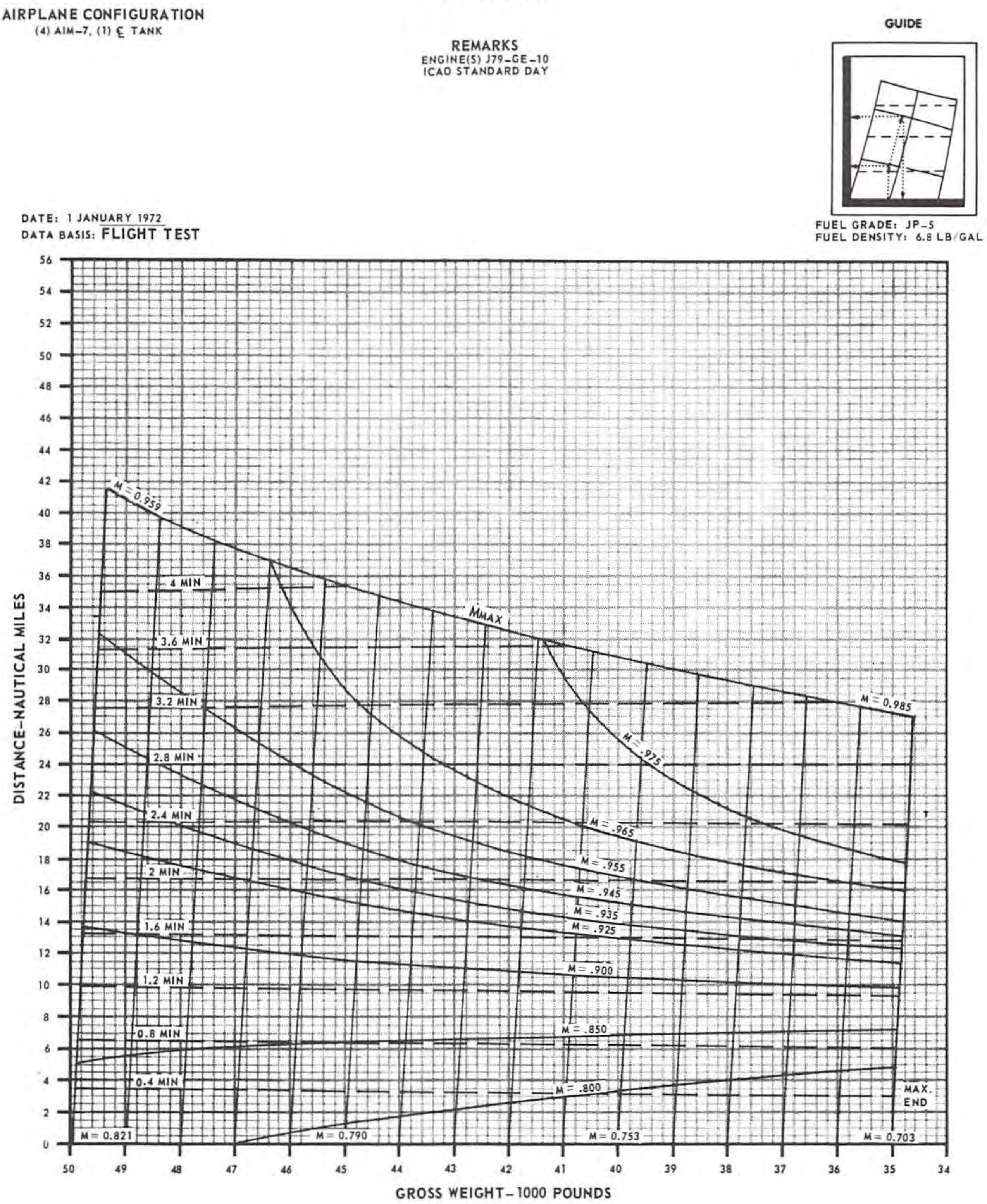


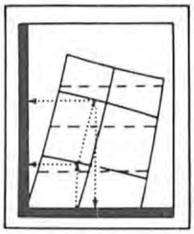
Figure 26-7. Military Thrust Acceleration (Sheet 6 of 12)

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

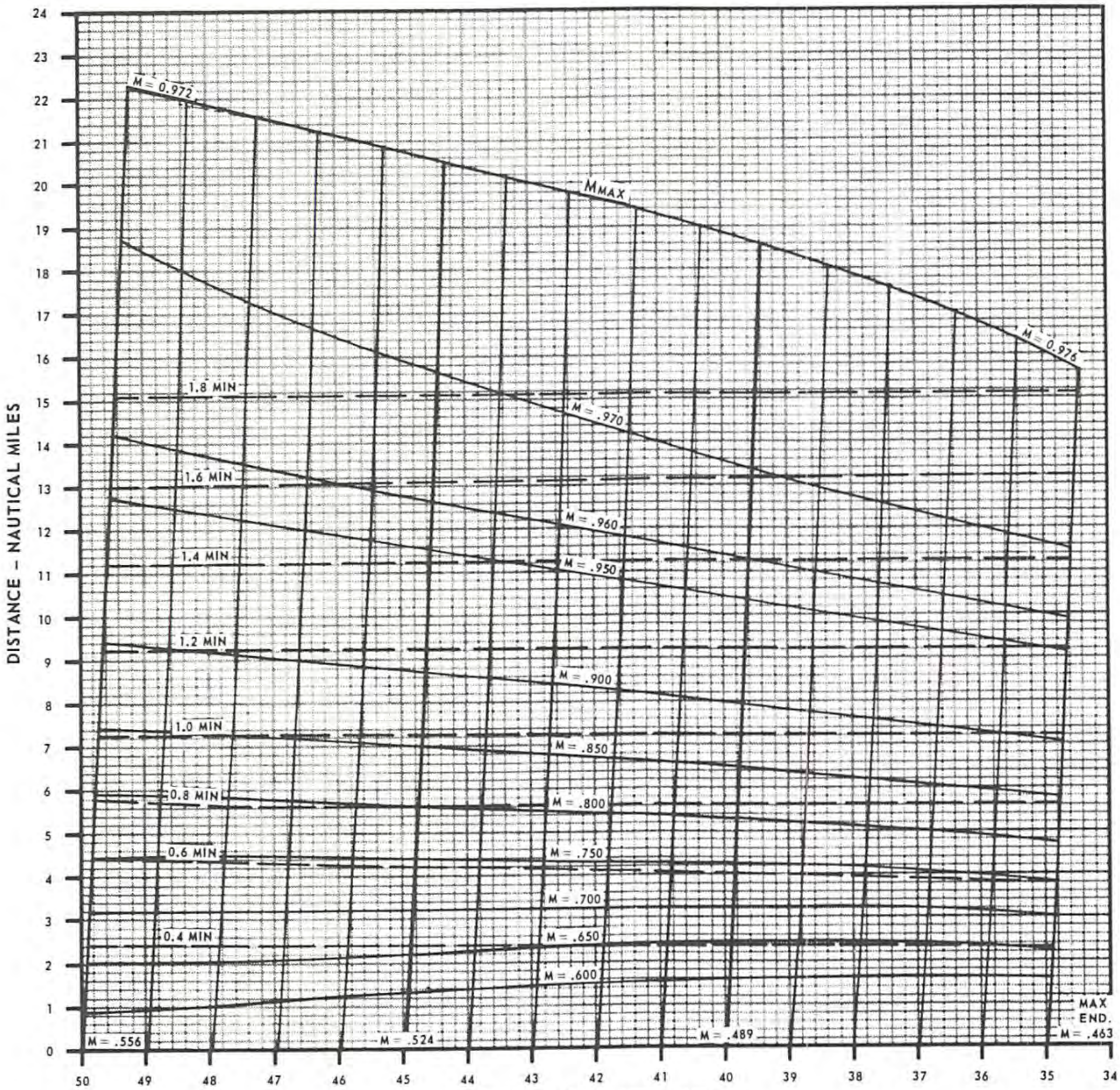
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(249) A

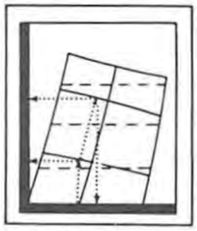
Figure 26-7. Military Thrust Acceleration (Sheet 7 of 12)

25,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7E AND (2) WING TANKS

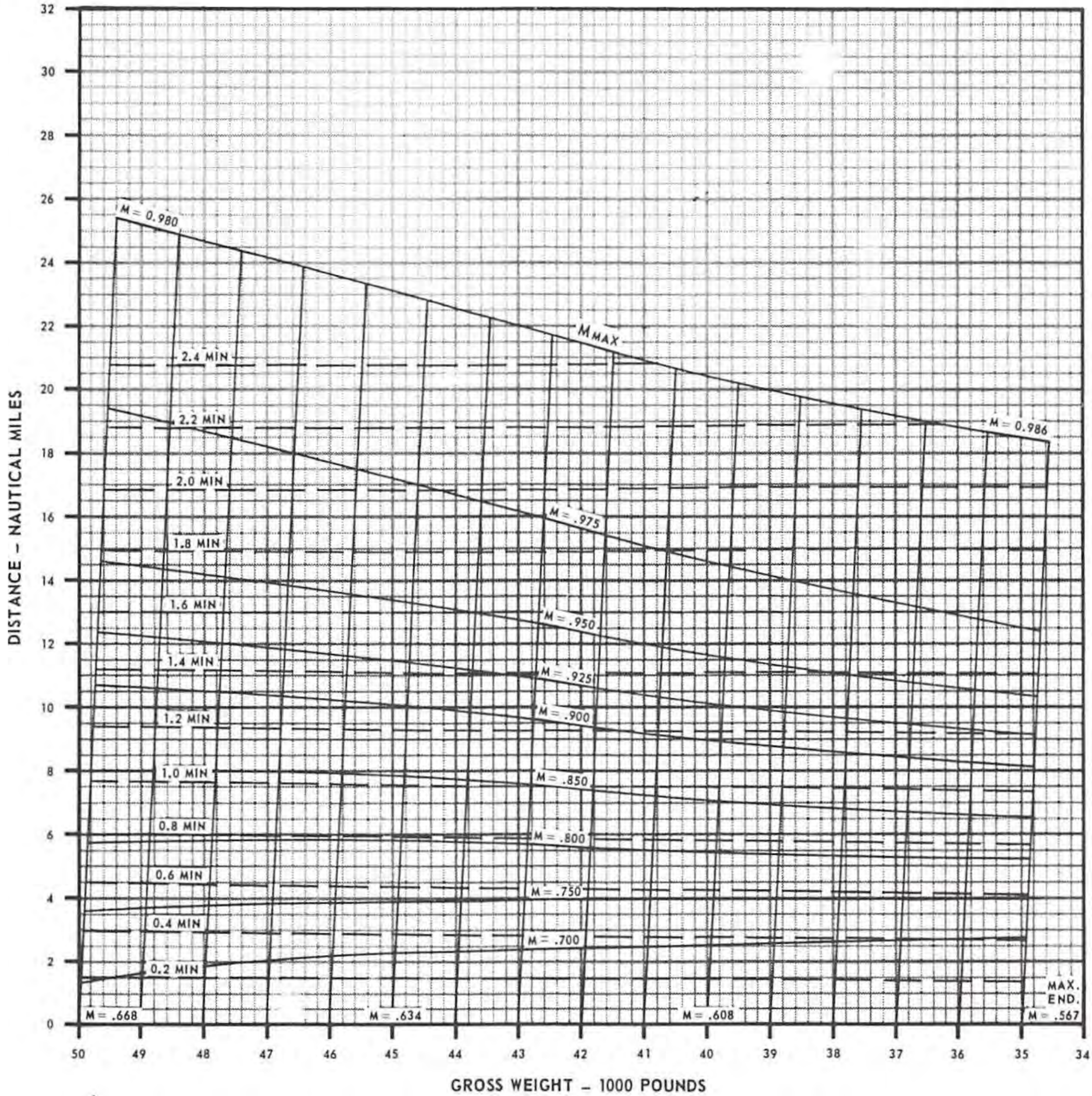
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1972
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(250)A

Figure 26-7. Military Thrust Acceleration (Sheet 8 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

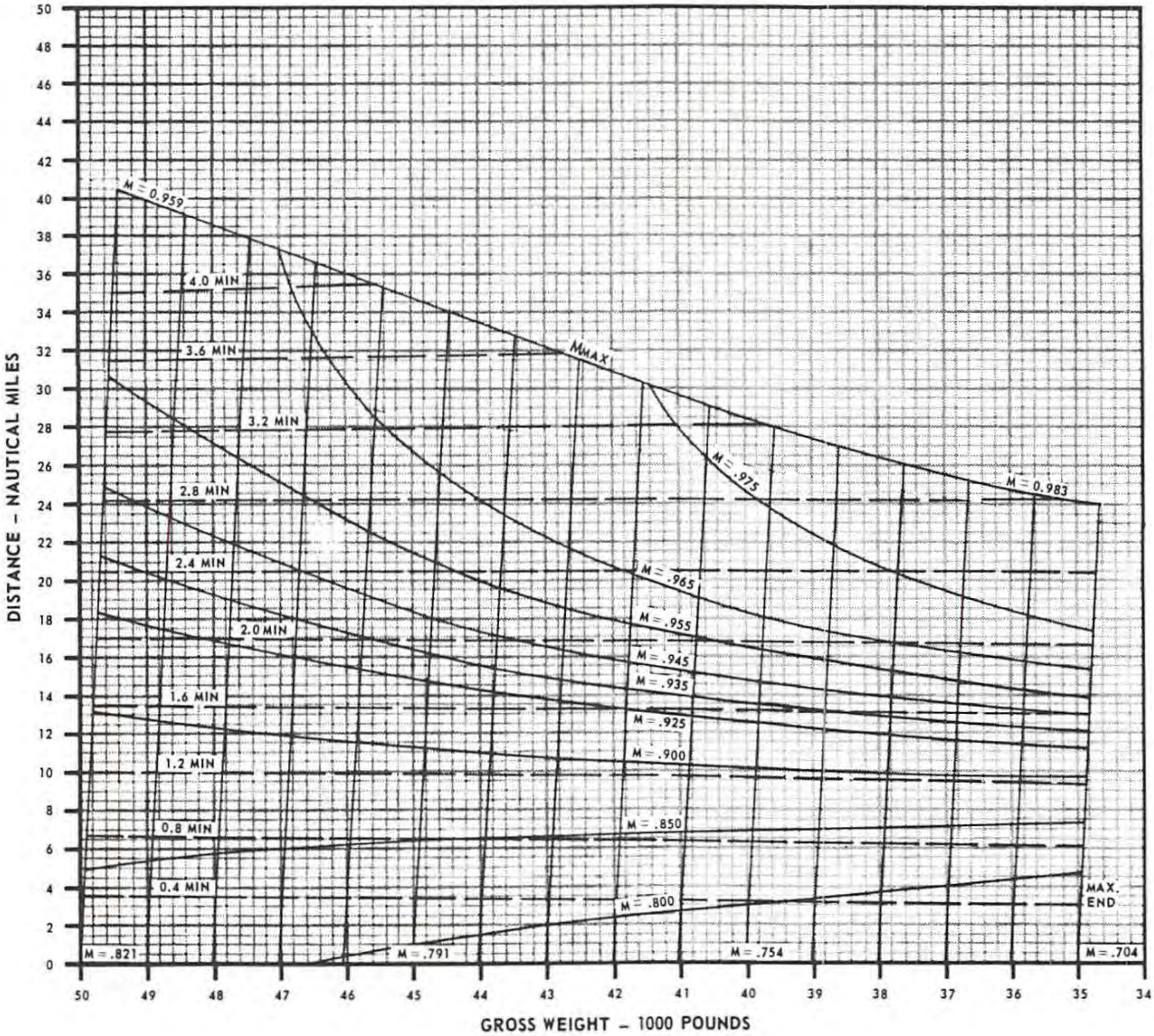
35,000 FEET

REMARKS
ENGINES: (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(251)A

Figure 26-7. Military Thrust Acceleration (Sheet 9 of 12)

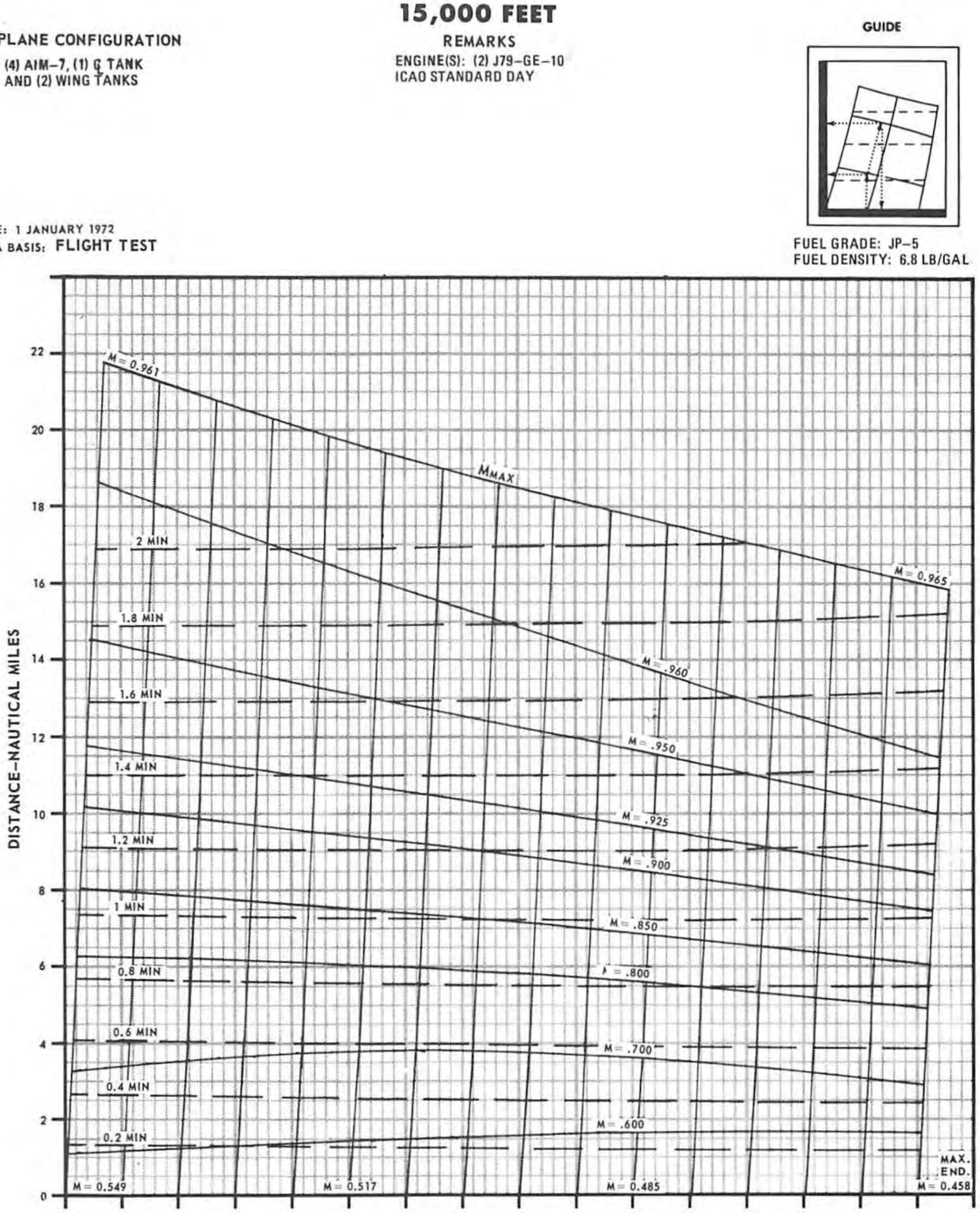
15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK
AND (2) WING TANKS

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(389)

Figure 26-7. Military Thrust Acceleration (Sheet 10 of 12)

AIRPLANE CONFIGURATION

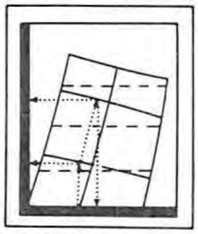
(4) AIM–7, (1) ℄ TANK
AND (2) WING TANKS

25,000 FEET

REMARKS

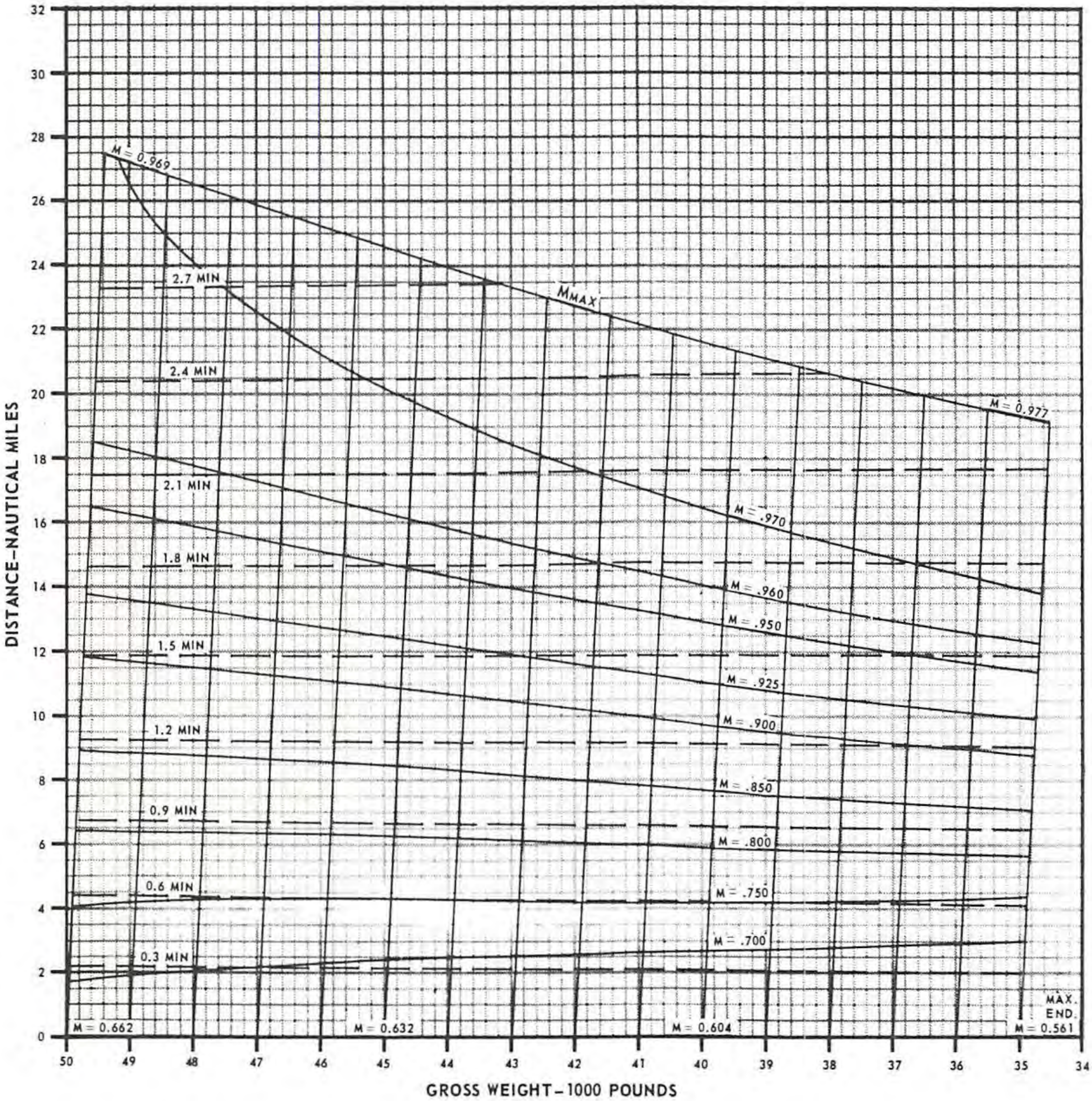
ENGINE(S): (2) J79–GE–10
ICAO STANDARD DAY

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST



FDD–1–(301)

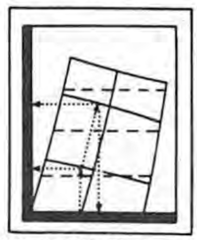
Figure 26-7. Military Thrust Acceleration (Sheet 11 of 12)

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK
AND (2) WING TANKS

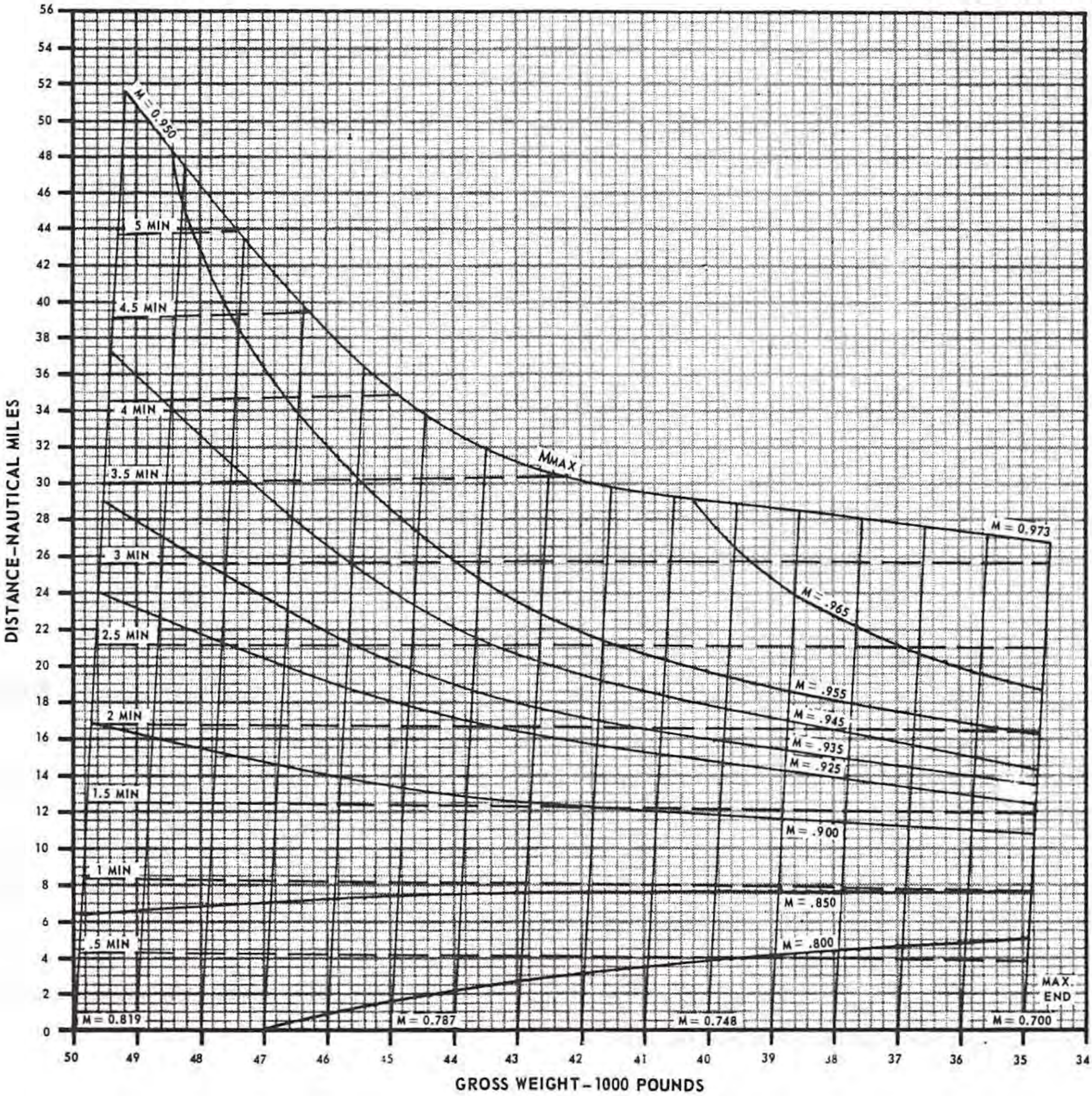
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



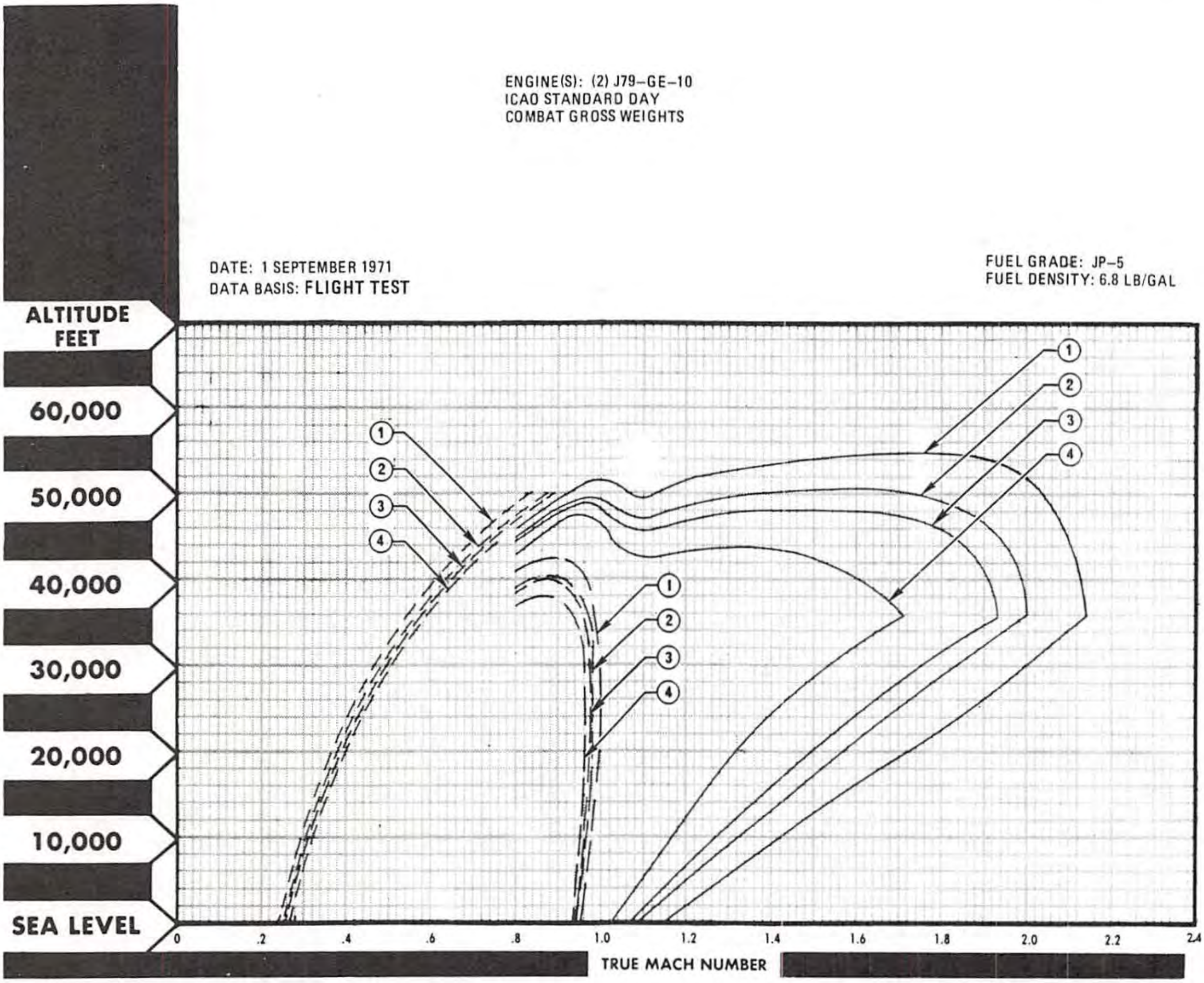
DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(302)

Figure 26-7. Military Thrust Acceleration (Sheet 12 of 12)



CURVE NO.	CONFIGURATION	GROSS WEIGHT
1	(4) AIM – 7	41,487 LBS
2	(4) AIM – 7, AND (1) ℄ TANK	44,182 LBS
3	(4) AIM – 7, AND (2) WING TANKS	45,120 LBS
4	(4) AIM – 7, (1) ℄ TANK, AND (2) WING TANKS	47,684 LBS

LEGEND	
————————	MAXIMUM THRUST
— — — — —	MILITARY THRUST
– – – – – –	MODERATE BUFFET

FDD-1-(303)

Figure 26-8. Level Flight Envelope

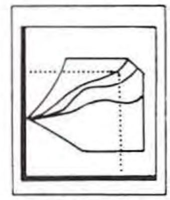
SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN
OR
(4) AIM-7

GROSS WEIGHT – 37,500 POUNDS

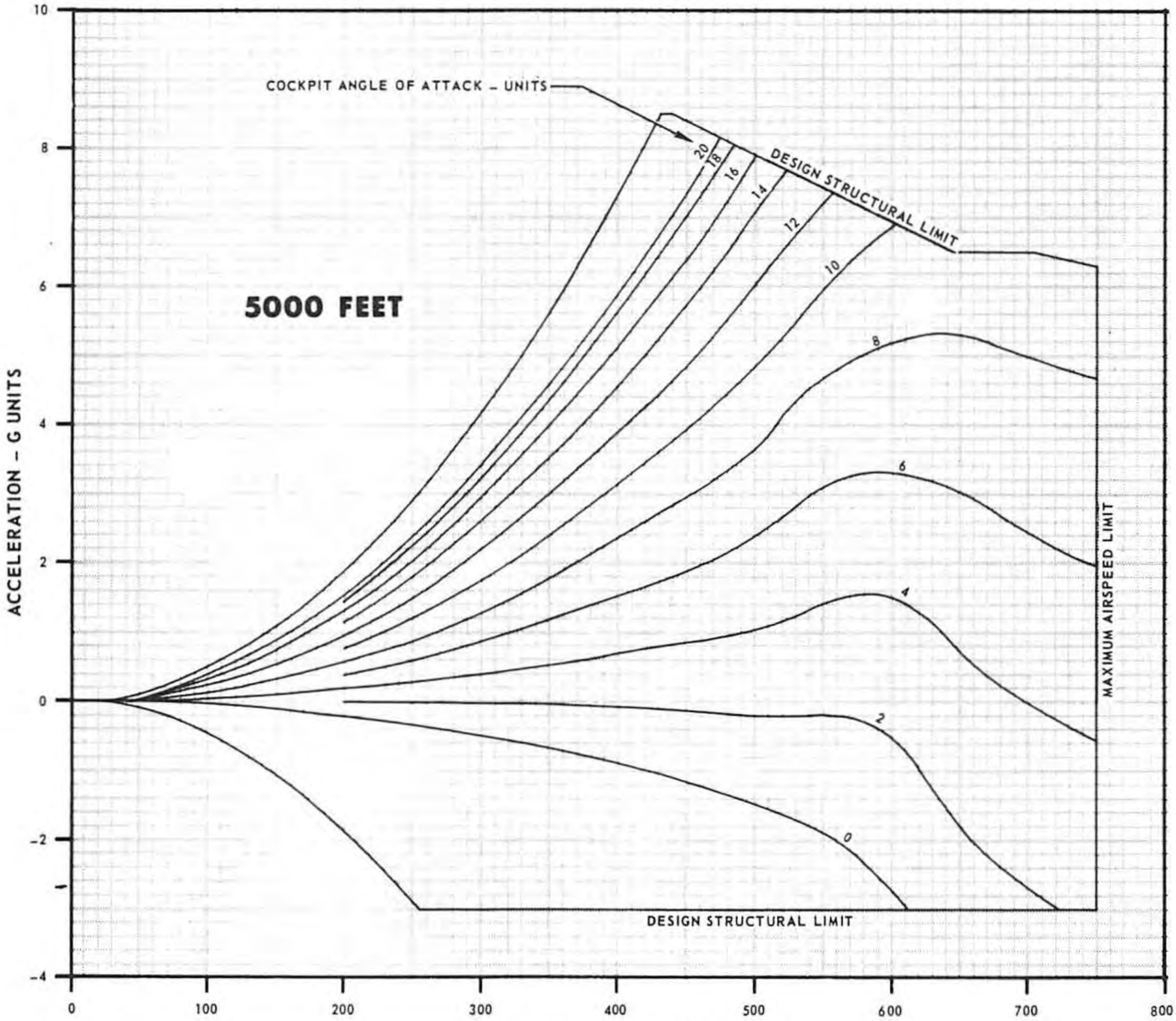
REMARKS
ENGINES: (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 15 AUGUST 1969
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(305)

Figure 26-9. V-N Envelope (Sheet 1 of 4)

SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN
OR
(4) AIM-7

GROSS WEIGHT – 37,500 POUNDS

REMARKS

ENGINES: (2) J79-GE-10
ICAO STANDARD DAY

GUIDE

FUEL GRADE: JP-5
FUEL DESNITY: 6.8 LB/GAL

DATE: 15 AUGUST 1969
DATA BASIS: FLIGHT TEST

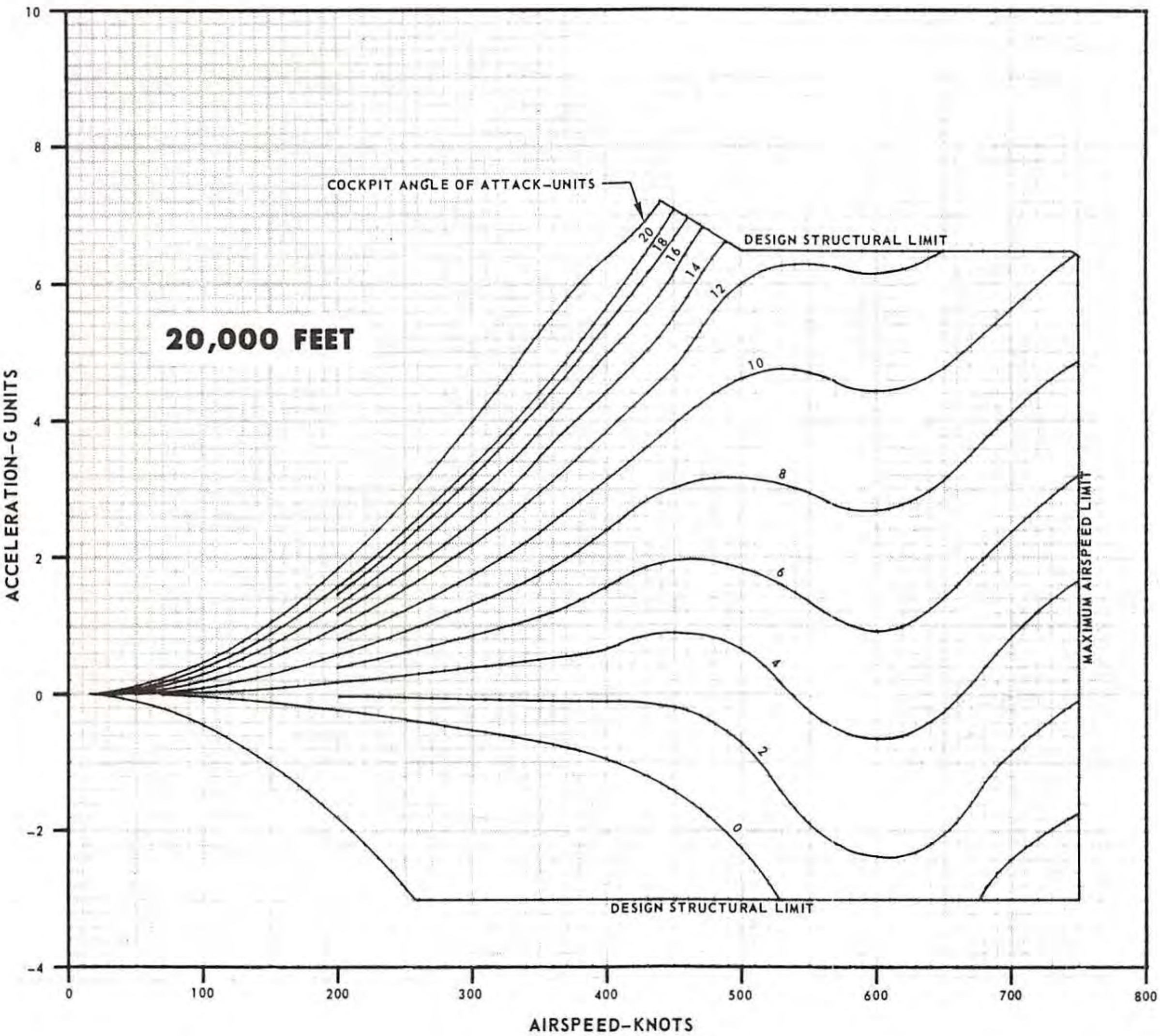


Figure 26-9. V-N Envelope (Sheet 2 of 4)

SYMMETRICAL FLIGHT

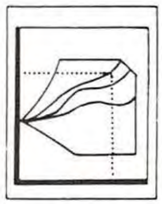
AIRPLANE CONFIGURATION
CLEAN
OR
(4) AIM-7

GROSS WEIGHT–37,500 POUNDS

REMARKS

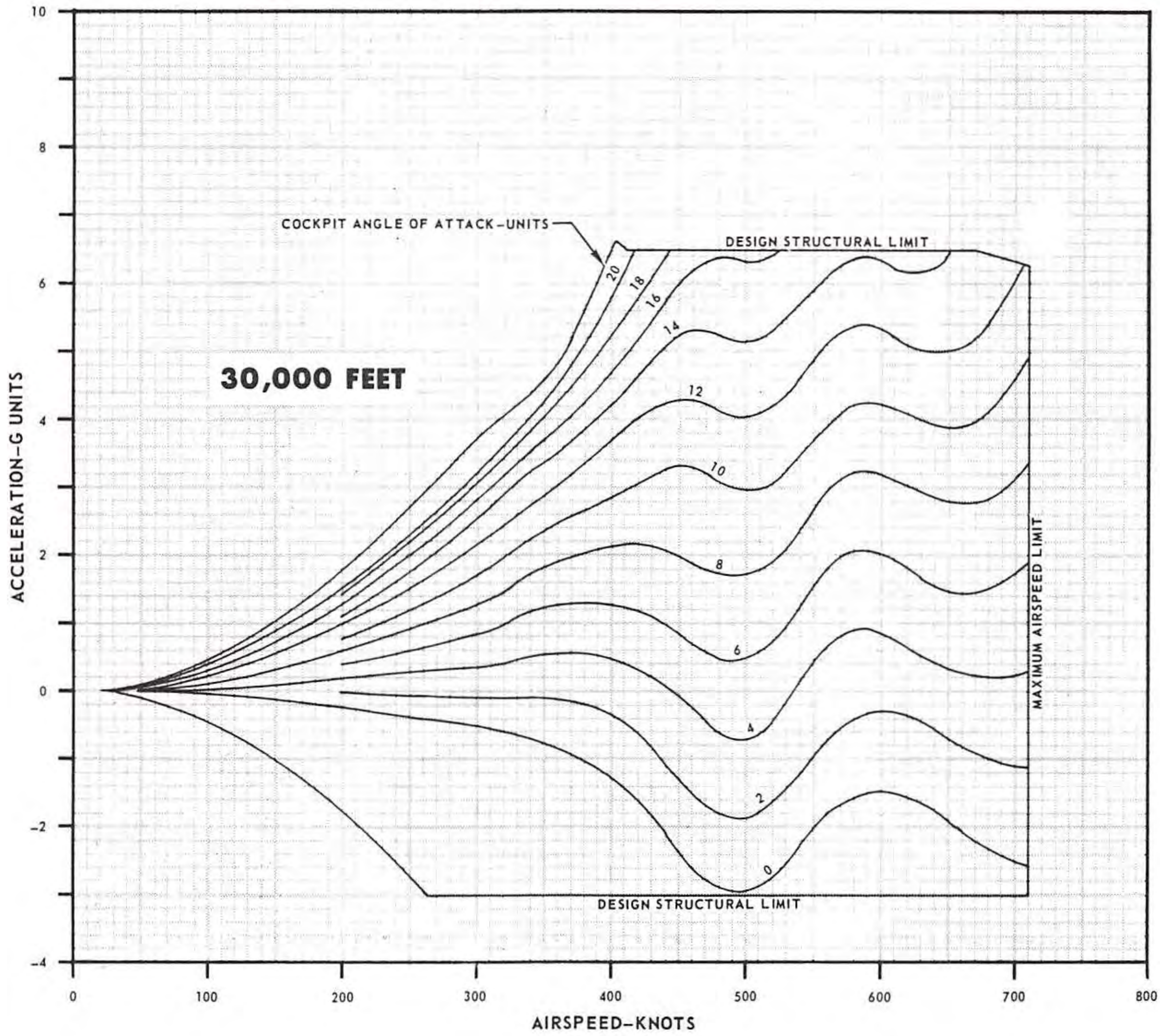
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 15 AUGUST 1969
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(306)

Figure 26-9. V-N Envelope (Sheet 3 of 4)

SYMMETRICAL FLIGHT

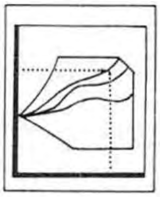
AIRPLANE CONFIGURATION
CLEAN
OR
(4) AIM-7

GROSS WEIGHT - 37,500 POUNDS

REMARKS

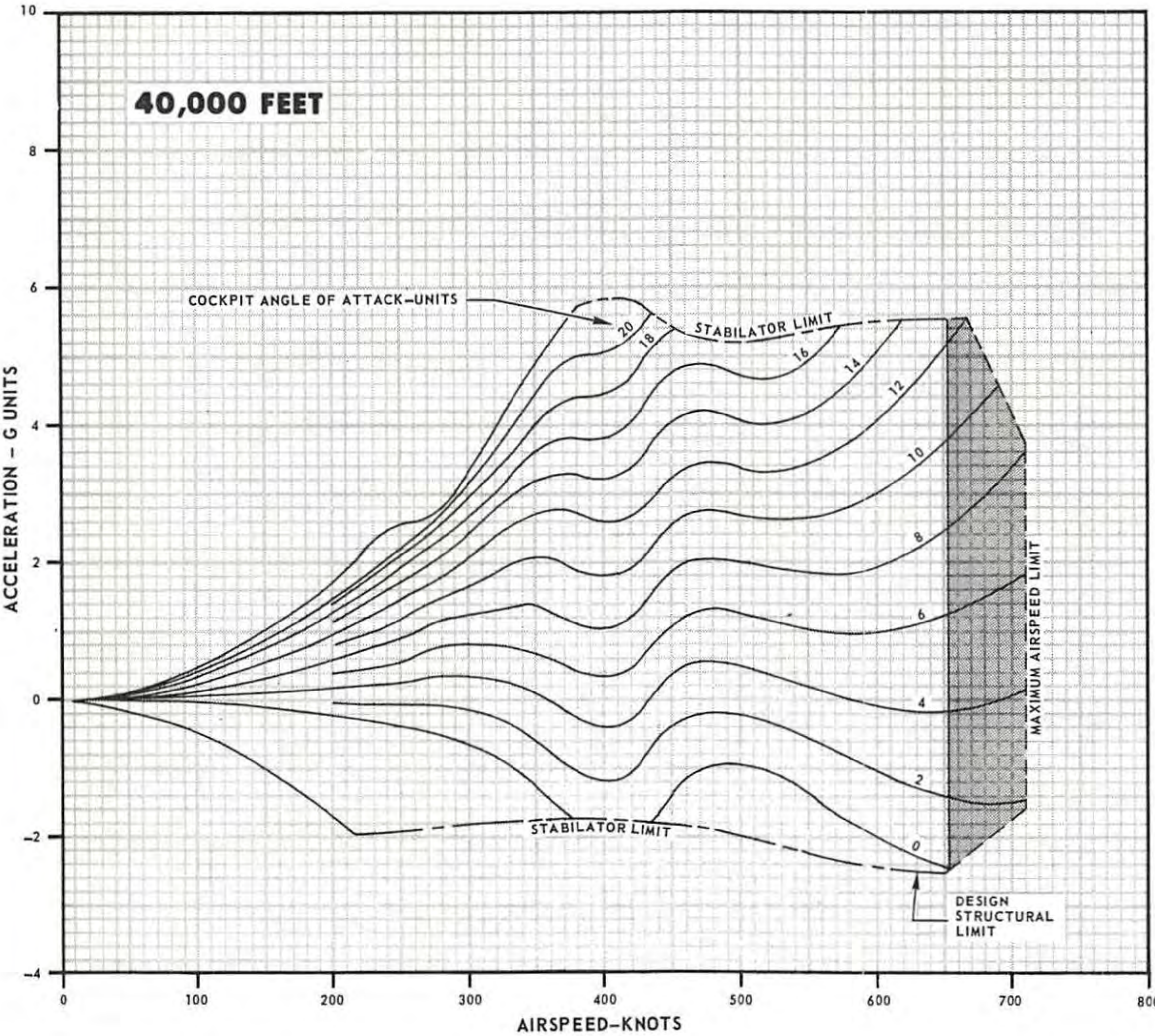
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

GUIDE



DATE: 15 AUGUST 1969
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(307)

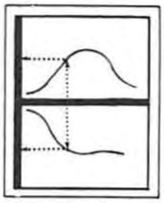
Figure 26-9. V-N Envelope (Sheet 4 of 4)

MAXIMUM THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

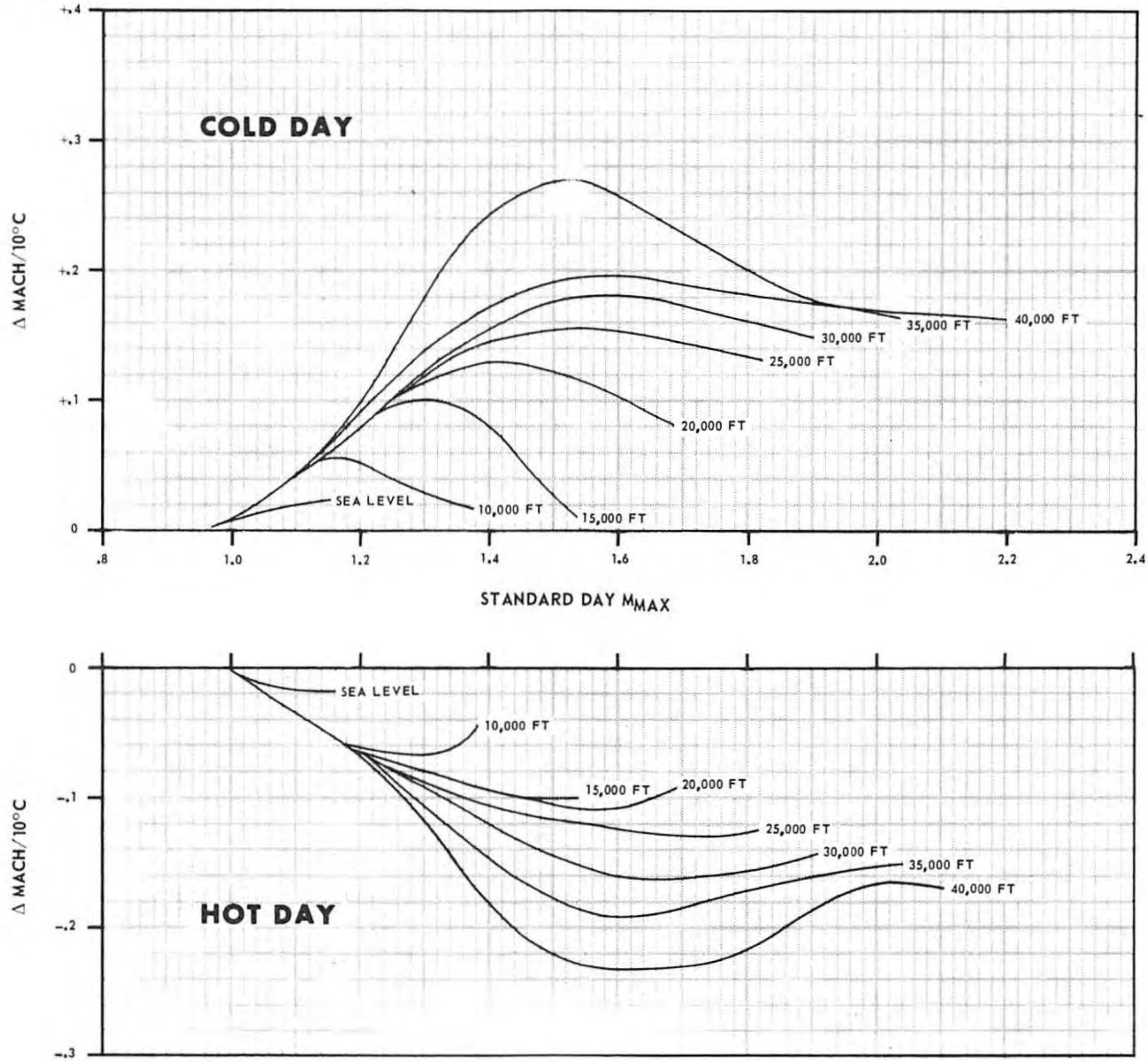
REMARKS
ENGINE(S): (2) J79-GE-10

GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(267)A

Figure 26-10. Temperature Effect on Maximum Speed

SUBSONIC-SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4) AIM-7

GROSS WEIGHT 40,000 POUNDS

REMARKS

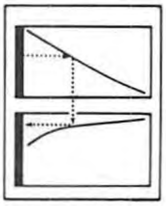
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

NOTES

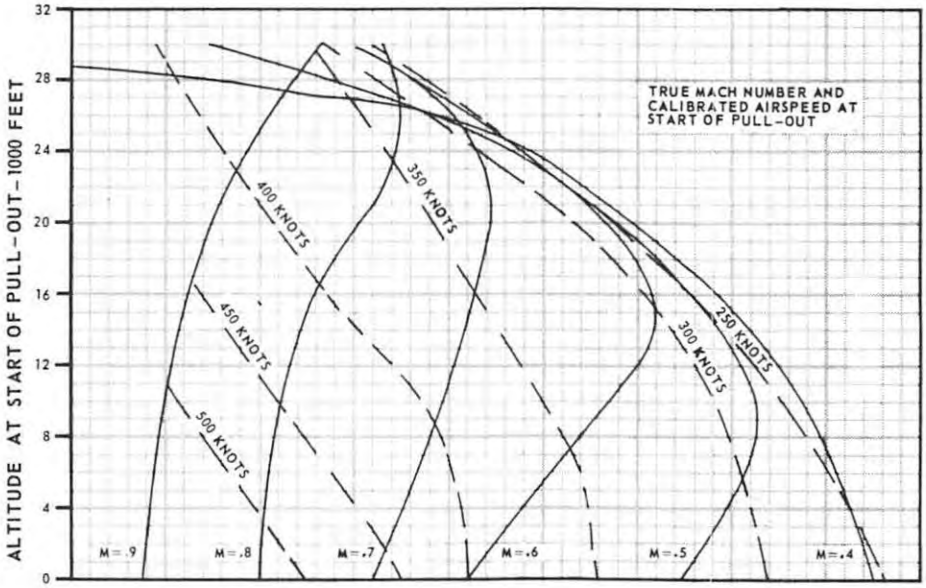
1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 16 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

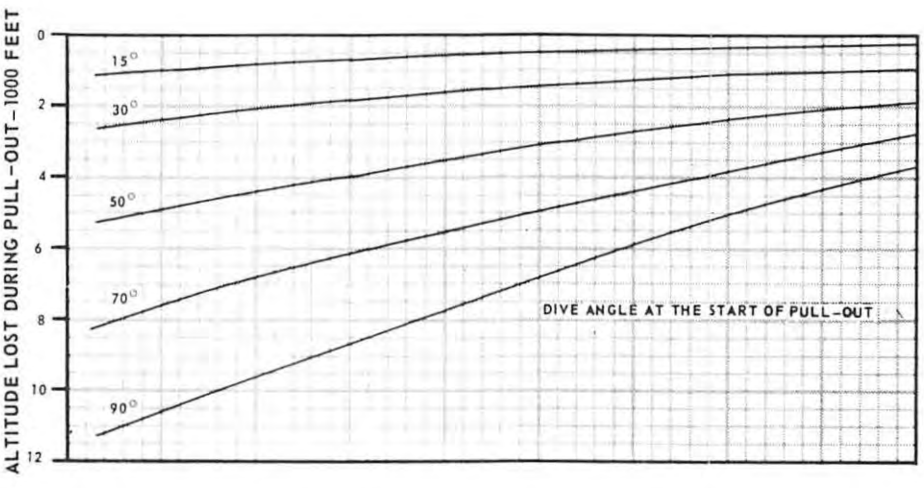
DATE: 1 AUGUST 1968
DATA BASIS: FLIGHT TEST

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





N6/80
FDD-1-(309)

Figure 26-11. Dive Recovery – 16 Units AOA (Sheet 1 of 2)

SUPERSONIC-SPEED BRAKES RETRACTED

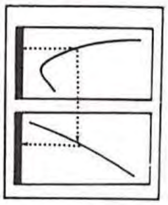
GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

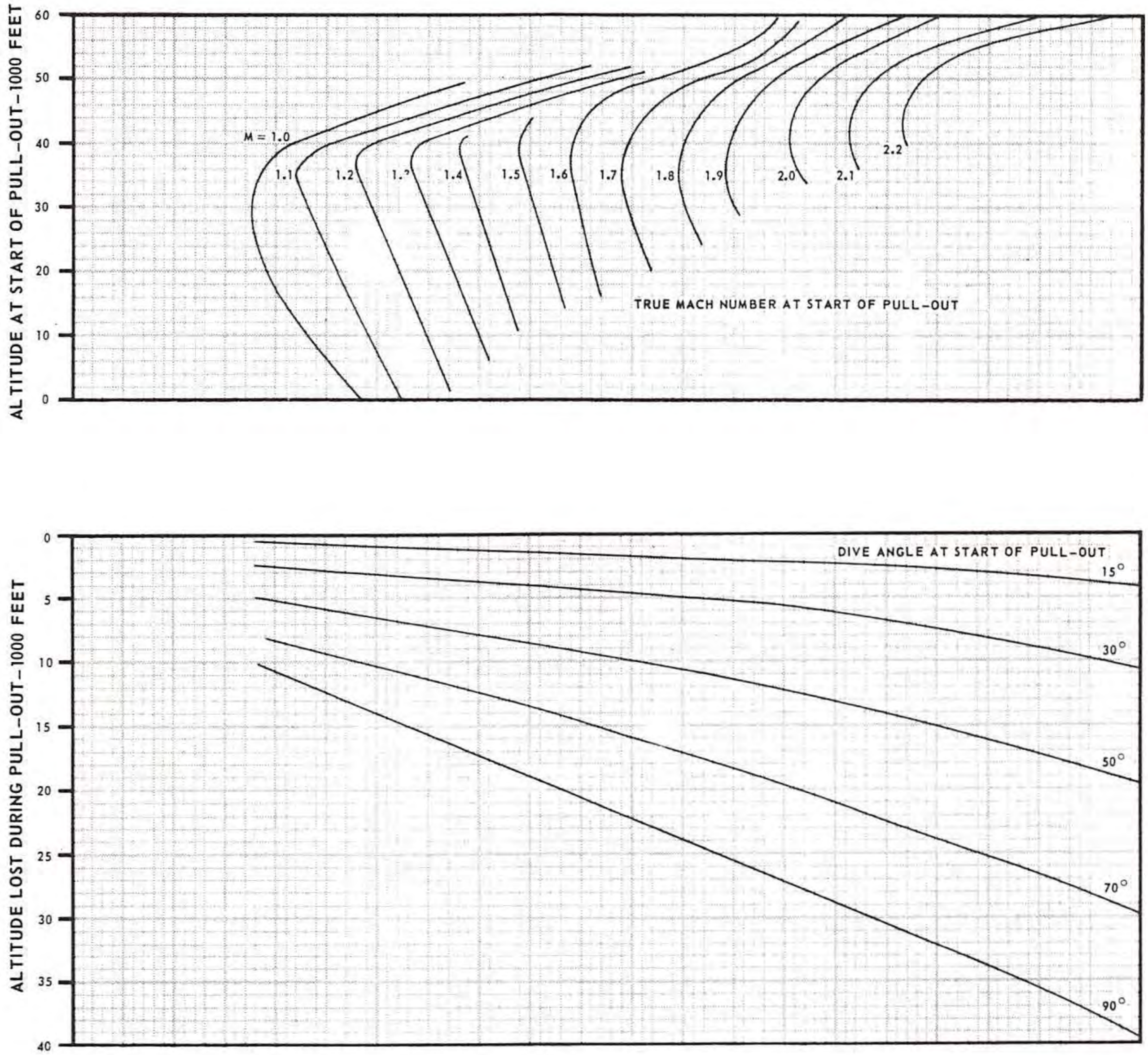
NOTES
1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 16 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

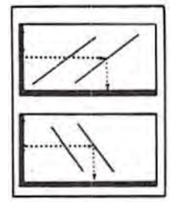


FDD-1-(311)

Figure 26-11. Dive Recovery – 16 Units AOA (Sheet 2 of 2)

CONSTANT SPEED AND ALTITUDE

GUIDE



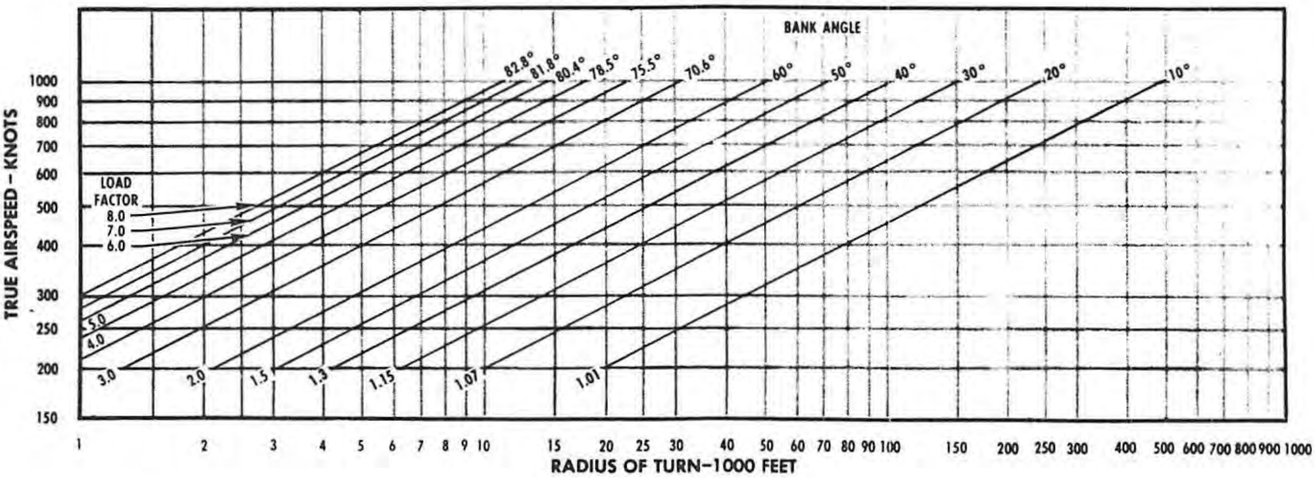
REMARKS

ENGINE(S): (2) J79-GE -10
ICAO STANDARD DAY

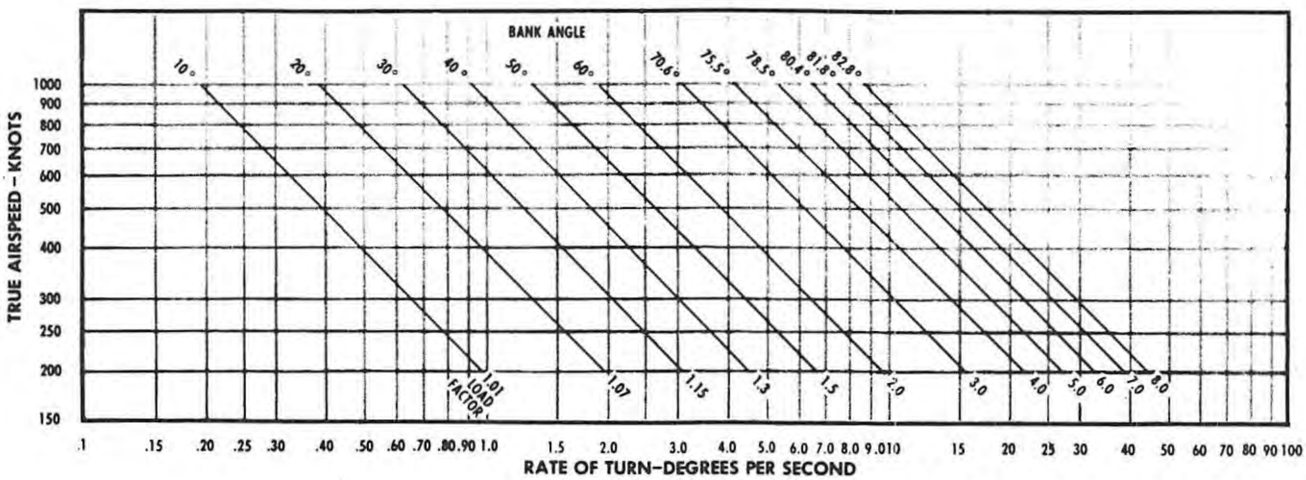
DATE: 1 MAY 1968
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

RADIUS OF TURN



RATE OF TURN



FDD-1-(272)A

Figure 26-13. Turn Capabilities

CHAPTER 27

Mission Planning

This information will be supplied when available.

PART XII

F-4S Performance Data

SUPERSONIC-SPEED BRAKES RETRACTED

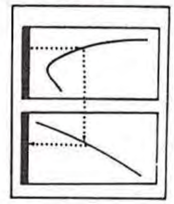
AIRPLANE CONFIGURATION
(4) AIM-7

GROSS WEIGHT 40,000 POUNDS

REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

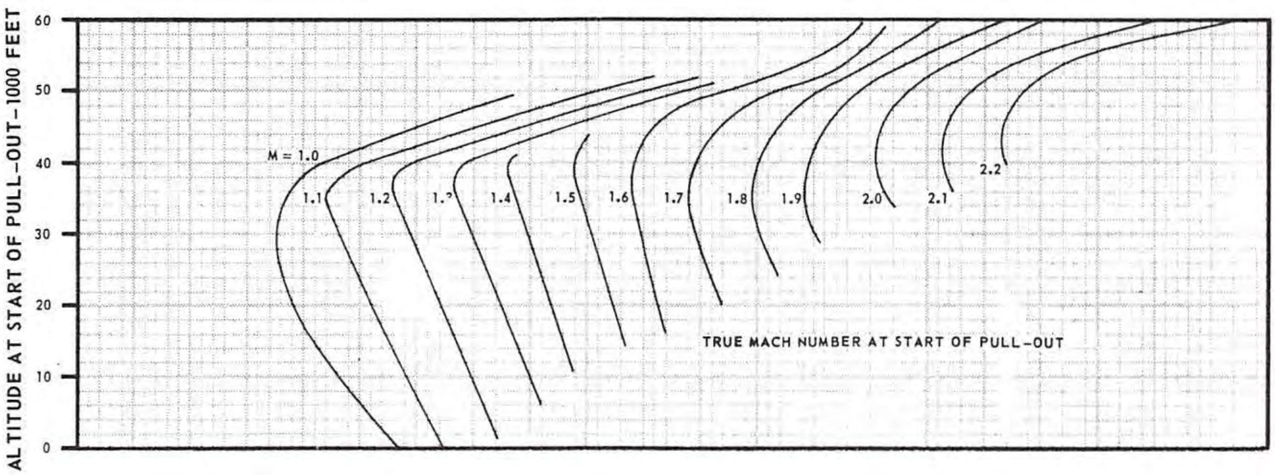
NOTES
1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 16 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

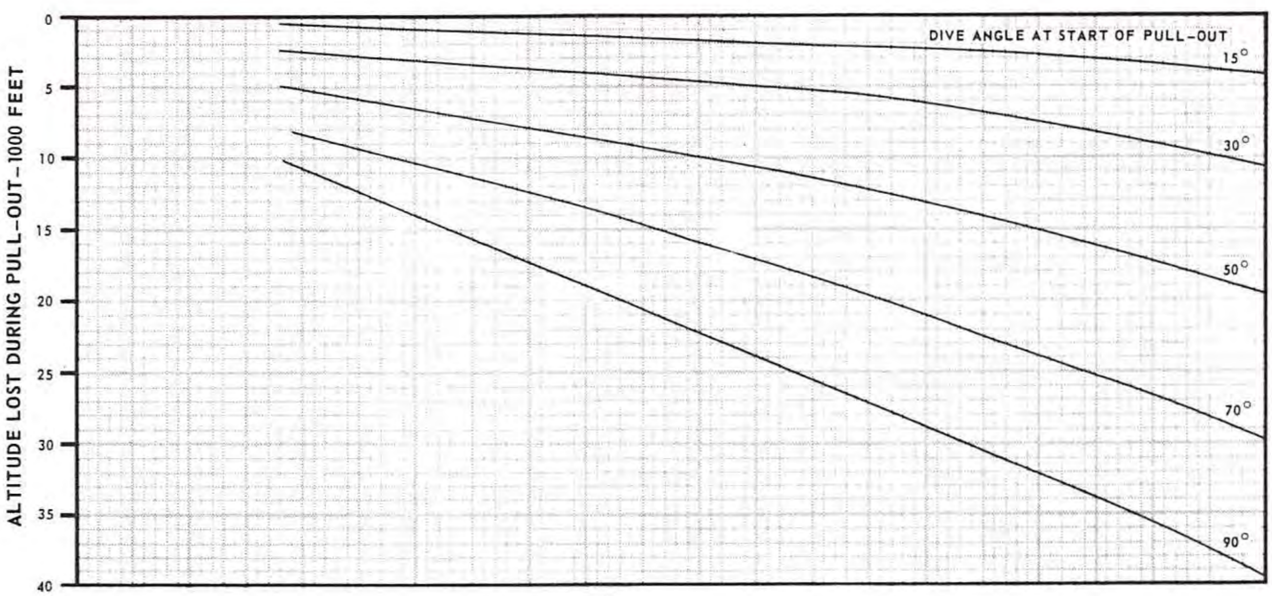
GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





FDD-1-(311)

Figure 26-11. Dive Recovery – 16 Units AOA (Sheet 2 of 2)

SUBSONIC-SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4) AIM-7

GROSS WEIGHT 40,000 POUNDS

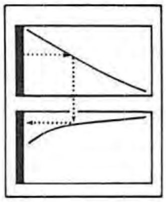
REMARKS
ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

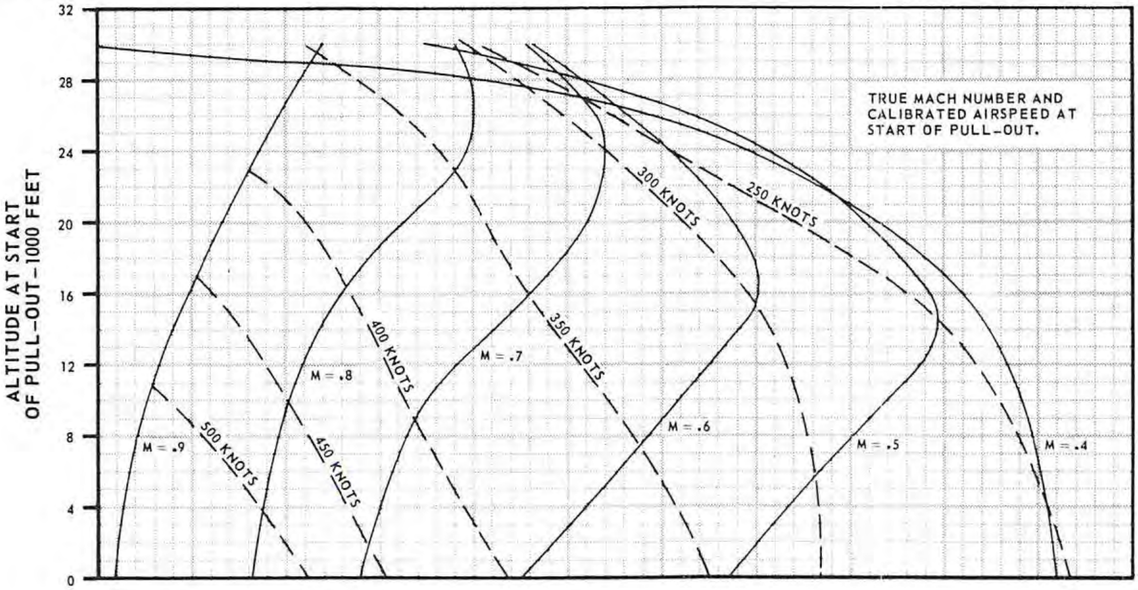
NOTES
1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 19 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

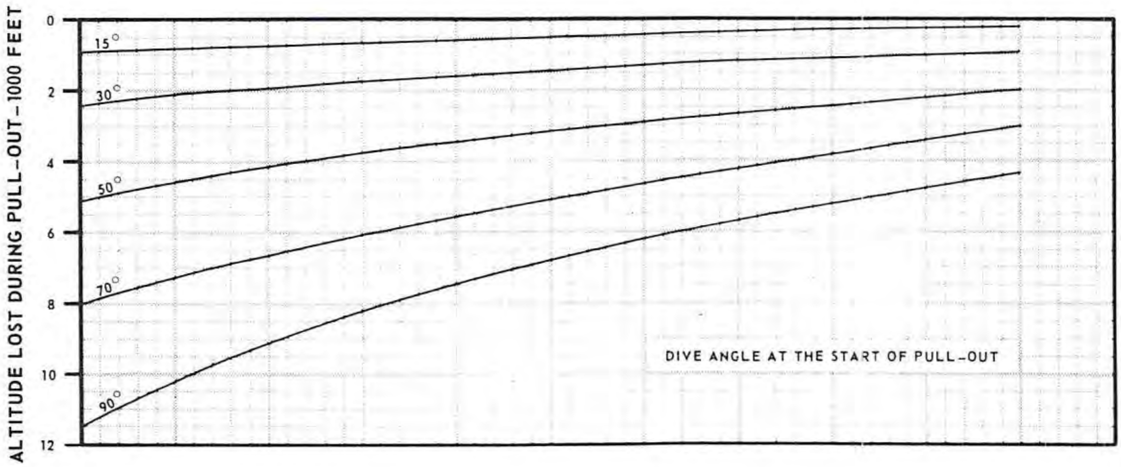
DATE: 1 AUGUST 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

GUIDE







FDD-1-(310)

Figure 26-12. Dive Recovery – 19 Units AOA (Sheet 1 of 2)

SUPERSONIC-SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4) AIM-7

GROSS WEIGHT 40,000 POUNDS

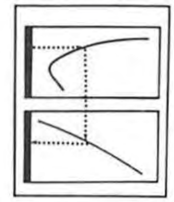
REMARKS

ENGINE(S): (2) J79-GE-10
ICAO STANDARD DAY

NOTES

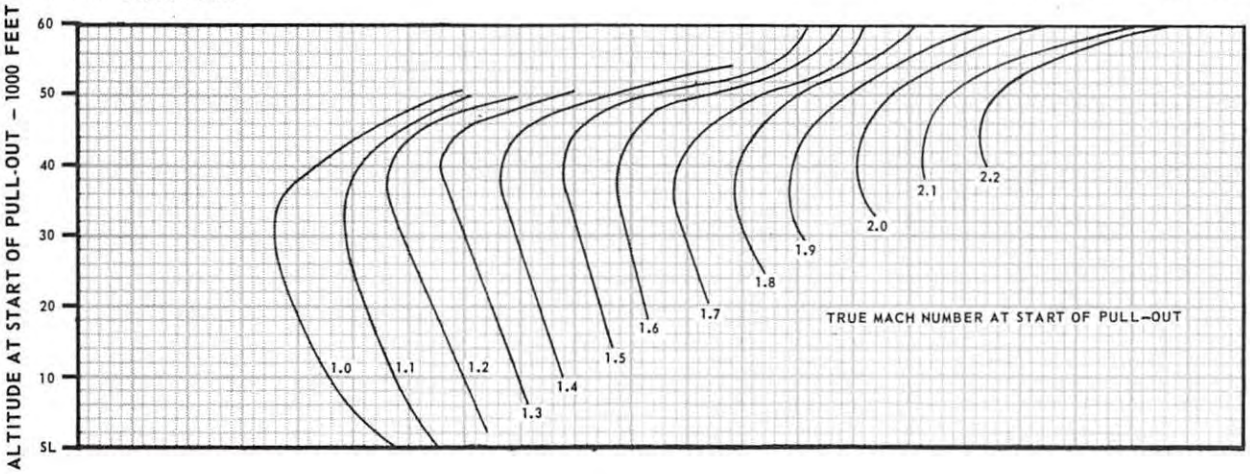
1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULL-OUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 19 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

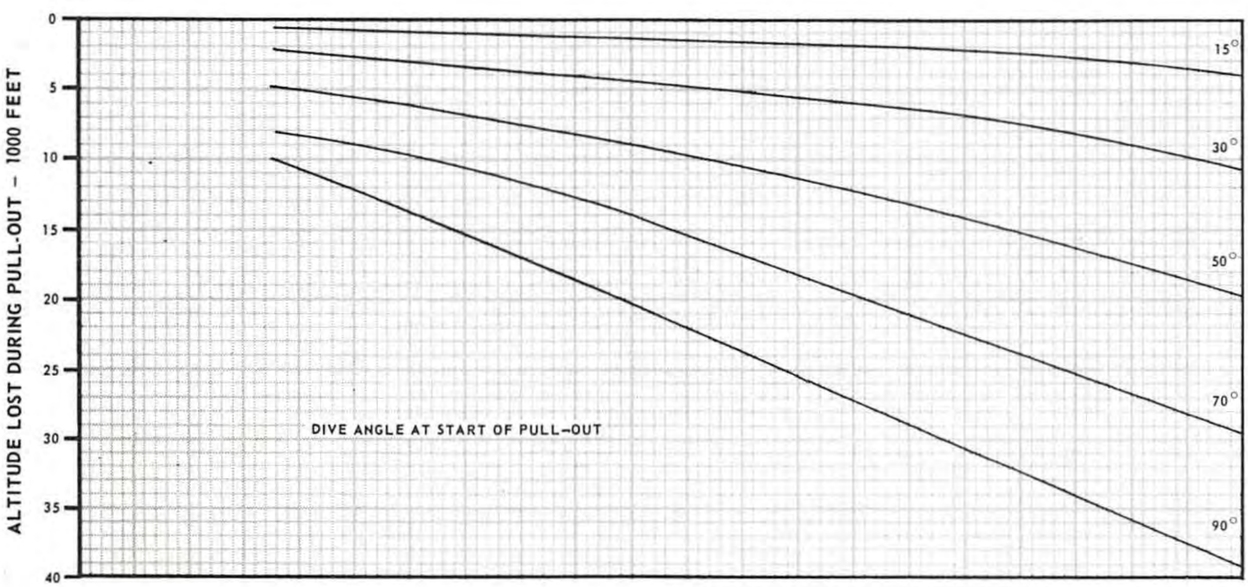
GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





FDD-1-(386)

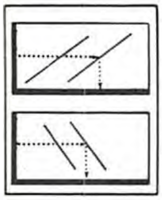
Figure 26-12. Dive Recovery – 19 Units AOA (Sheet 2 of 2)

CONSTANT SPEED AND ALTITUDE

REMARKS

ENGINE(S): (2) J79-GE -10
ICAO STANDARD DAY

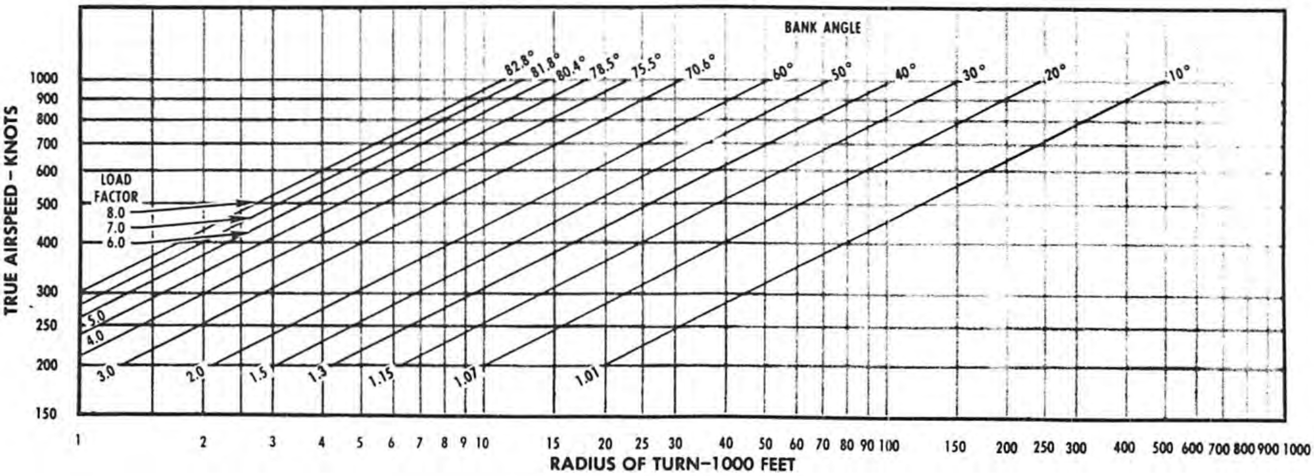
GUIDE



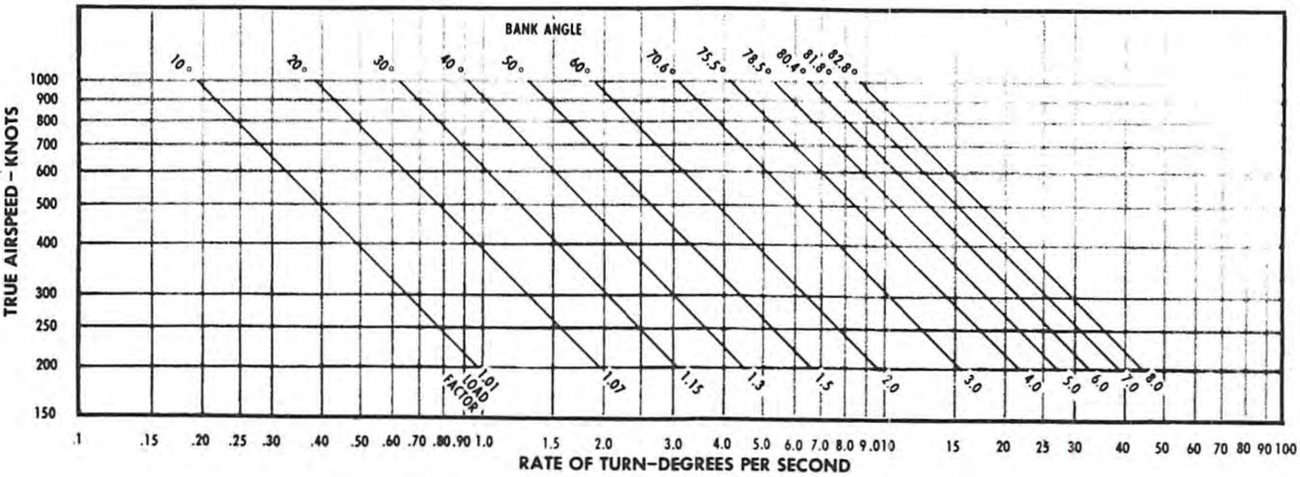
DATE: 1 MAY 1968
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

RADIUS OF TURN

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RATE OF TURN



FDD-1-(272)A

Figure 26-13. Turn Capabilities

CHAPTER 28

Introduction

28.1 GENERAL

This part is divided into nine chapters to present performance data in proper sequence for preflight planning. Two concepts of data presentation are utilized to show drag effects on aircraft performance (i.e., specific configuration charts and drag index charts.) The drag index concept presents subsonic climb data, nautical miles per pound for cruise/endurance, and descents. All other data are presented as a specific-configuration per chart. All performance data is based on flight tests or the contractor estimate, ICAO standard day conditions, and/or provisions to correct for nonstandard temperatures.

Note

The indication of the fuel quantity indicator presents the readings of actual fuel weight remaining. This is accomplished by means of compensator capacitors which provide accurate readings regardless of changes in the dielectric value of the fuel or variations in specific density because of temperature changes. Therefore, adjustment for various fuel densities is not necessary.

28.2 ARMAMENT ATTACHMENT ASSOCIATION CHART

The information necessary to determine the total weight of the stores loaded on the aircraft and their effect on the aircraft center of gravity is contained in the armament attachment association chart (Figure 28-1) and the station loading chart (Figure 28-2). The armament attachment association chart lists the various attachments (launcher, pylons, racks, and adapters) that are needed to carry an external store on any one particular station.

28.3 STATION LOADING

The station loading chart (Figure 28-2) lists the individual weight, drag number, stability number, station location, and incremental center-of-gravity shift of the various pylons, adapters, racks, and external stores. It also lists the average operating weight with its corresponding center of gravity and the basic takeoff gross weight with its corresponding center of gravity for various aircraft. The chart does not intend to list the quantity and total gross weight of the external stores that can be carried on each station. However, the takeoff gross weight and approximate takeoff center of gravity can be computed by first referring to the armament attachment association chart and determining the various attachments necessary to carry the particular stores that are to be loaded. Next, refer to the station loading chart to find the individual weights and incremental center-of-gravity shifts of the selected stores and attachments. Once the individual weights have been noted, multiply the individual weights by the quantity to be carried (this figure will be the total external store weight). The external store weight, added to the aircraft basic takeoff weight will result in a close approximation of the takeoff gross weight. The takeoff center of gravity can be computed by adding the incremental center-of-gravity values for each station that the various pylons, adapters, racks, and external stores are intended to be carried on. The summation of the center-of-gravity values, added or subtracted as necessary from the center of gravity corresponding to the basic takeoff weight, will result in a close approximation of the actual takeoff center of gravity.

28.3.1 Incremental CG Shift

28.3.1.1 Sample Problem

CONFIGURATION: Six LAU-68/A rocket launchers on aircraft stations 1 and 9 (full) (three each station).

Six MK 82 LDGP bombs on aircraft station 5.

Estimated CG of 33.7-percent MAC (estimated operating weight plus weight of full internal fuel, not including tank No. 7)

A. LAU-68/A (stations 1 and 9) – +0.10 X 6 = +0.60.

B. Suspension equipment (stations 1 and 9)

(1) Wing tank pylon – +0.04 X 2 = 0.08.

(2) MW adapter – + 0.01 X 2 = +0.02.

(3) TER – +0.06 X 2 = +0.12.

C. MK-82 LDGP (station 5)

(1) Forward cluster – -0.31 X 3 = 0.93.

(2) Aft cluster – +0.26 X 3 = +0.78.

D. Suspension equipment (station 5)

(1) MW centerline adapter – 0.

(2) MER (shifted forward) – -0.02 X 1 = -0.02.

E. Incremental cg shift – +0.65.

F. Estimated takeoff cg – 33.7 percent + 0.65 = 34.35 percent.

28.3.2 Drag Index System. The drag number for each externally carried store and its associated suspension equipment is listed. The drag index for a specific configuration may be found by multiplying the number of stores carried by its drag number and adding the drag number of the applicable suspension equipment (if not included). The total drag index may then be used to enter the planning data charts. Charts applicable for all loads and configurations are labeled ALL DRAG INDEXES. Charts labeled INDIVIDUAL DRAG INDEXES contain data for a range of drag numbers (i.e., individual curves/columns for a specific drag number). Supersonic data is not compatible to the drag index system; therefore, each chart is labeled for a specific configuration.

28.3.2.1 Sample Problem

CONFIGURATION: Six LAU-68/A rocket launchers on aircraft stations 1 and 9 (full) (three each station).

Six MK 82 LDGP bombs on aircraft station 5.

A. LAU-68/A drag number – 2.7 X 6 = 16.2.

B. Wing tank pylon, MW adapter, TER 2 – (1.1 + 0.4 + 5.5) = 14.0.

C. MK 82 LDGP drag number – 1.1 X 6 = 6.6.

D. MW centerline adapter, MER – 2 + 8 = 10.0.

E. Total drag index – 46.8.

28.3.3 Stability Index System. With the many possible external loading configurations and their resulting aerodynamic effects, it is possible to load the aircraft past the aft cg limit. Adding wing-mounted stores tends to shift the aerodynamic center forward toward the cg of the aircraft, thereby reducing the longitudinal maneuvering stability. To be assured of an acceptable static margin, it is necessary to consider stability effects in conjunction with cg location. Each wing-mounted store and its associated suspension equipment is assigned a unit stability number corresponding to its aerodynamic effect. Each stability index (sum of stability numbers) has a corresponding aft cg limit. After the loading configuration has been determined, compute the aircraft stability index. Enter Figure 4-4 with the aircraft stability index to obtain maximum allowable aft cg location. The cg location is determined in the normal manner by using a weight and balance clearance form F in conjunction with the Handbook of Weight and Balance Data, AN-1-1B-40.

Note

- In some cases where the originally desired configuration is not within the allowable envelope, an acceptable static margin may be achieved through rearrangement of wing-mounted stores.
- Tandem-mounted weapons count as a single weapon when computing the aircraft stability index.

Note

- Fuselage-mounted stores are not used in determining aircraft stability index but they are used in computing takeoff cg location.

- Unit stability numbers are assigned for single-mounted and cluster-mounted weapons. The cluster-mounted unit stability number will be used when two or more weapons are mounted on the same rack with each weapon being assigned this number.

28.3.3.1 Sample Problem

CONFIGURATION: Six LAU-68/A rocket launchers on aircraft stations 1 and 9 (full) (three each station).

Six MK 82 LDGP bombs on aircraft station 5.

A. LAU-68/A (cluster-mounted stations 1 and 9) – 5.2 X 6 = 31.2.

B. Wing tank pylon, MW adapter, TER – 2 (4.3 + 6.6) = 21.8.

C. Stability index – 53.0.

D. Aft cg limit based on stability index – 35.2-PERCENT MAC.

28.4 DRAG BECAUSE OF ASYMMETRIC LOADING

This chart (Figure 28-3) provides the drag number that results from trimming out an asymmetric store loading. The drag number is added to the computed drag of the aircraft to obtain the drag index. Asymmetric drag varies with Mach number and altitude.

28.4.1 Use. Find the net asymmetric load on stations 2 and 8 (stations 2 and 8 are indicated on the left vertical axis and station 1 and 9 are indicated by the diagonal parallel lines) by subtracting the lighter from the heavier weight. Attach to this net load the position, RWH (right wing heavy) or LWH (left wing heavy) as appropriate. In the same manner, find the net asymmetric load on stations 1 and 9. Enter the chart with the net asymmetric load for stations 2 and 8 corresponding to the load position. Proceed horizontally to the right to the net asymmetric load on stations 1 and 9 and its position. Proceed vertically downward to the altitude, horizontally to the right to the Mach number, and then vertically downward to obtain the incremental drag number.

28.4.2 Sample Problem

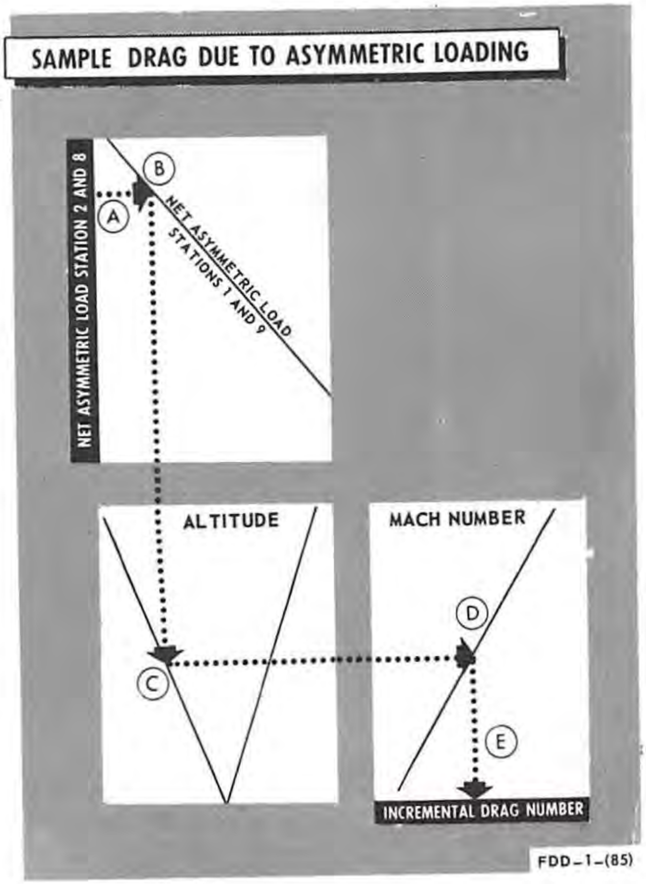
A. Load on station 2 – 1,000 POUNDS.
Load on station 8 – 3,000 POUNDS.
Net asymmetric load on stations 2 and 8 = 2,000 POUNDS RWH.

B. Load on station 1 = 2,500 POUNDS.
Load on station 9 = 2,000 POUNDS.
Net asymmetric load on stations 1 and 9 = 500 POUNDS LWH.

C. Altitude – 25,000 FEET.

D. Mach number – 0.7.

E. Incremental drag number – 5.8.



28.5 AIRSPEED CONVERSION

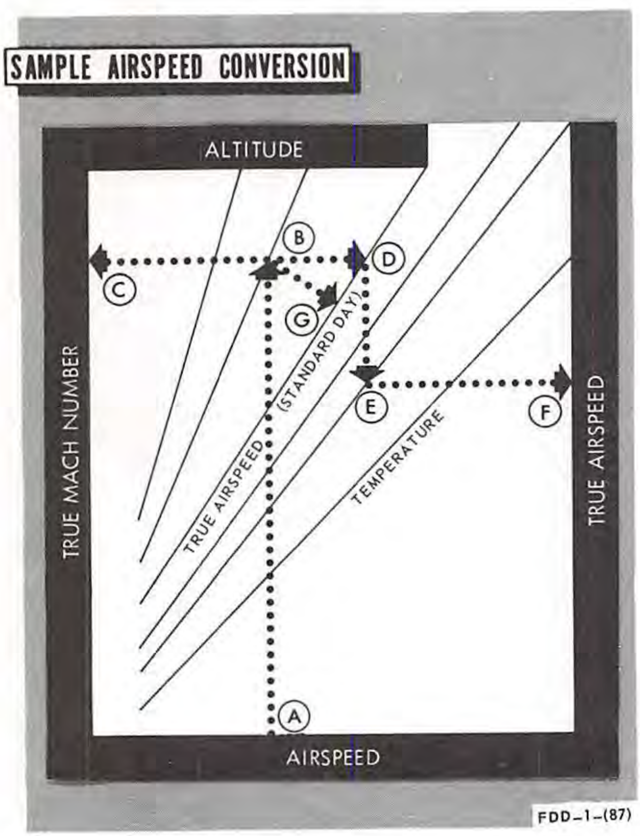
The airspeed conversion chart (Figure 28-5) provides a means of converting calibrated airspeed to true Mach number and true airspeed.

28.5.1 Use. Enter the chart with the calibrated airspeed and proceed vertically to intersect the applicable altitude. From this point, proceed horizontally to the left to read true Mach number. From the calibrated airspeed-altitude intersection, proceed horizontally to the right to intersect the sea level line. From this point, descend vertically to intersect the applicable flight level temperature. Then proceed horizontally to the right to read true airspeed. To obtain the standard day true airspeed, parallel the curved dash lines from the calibrated airspeed-altitude intersection to the sea level line.

28.5.2 Sample Problem

A. Calibrated airspeed – 330 KNOTS.

B. Altitude – 25,000 FEET.



C. True Mach – 0.782.

D. Sea level line.

E. Flight level temperature – -20 °C.

F. True airspeed – 486 KNOTS.

G. True airspeed (standard day) – 472 KNOTS.

28.5.2 Indicated Airspeed. Indicated airspeed (IAS) is the uncorrected airspeed read directly from the indicator when the ADC is inoperative.

28.5.3 Calibrated Airspeed. Calibrated airspeed (CAS) is indicated airspeed corrected for static source error. In this aircraft, the ADC automatically compensates for this error so that calibrated airspeed may be read directly from the indicator.

28.5.4 Equivalent Airspeed. Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility effect. There is no provision for reading EAS; however, it may be obtained by multiplying the TAS by square root of the density ratio.

28.5.5 True Airspeed. True airspeed (TAS) is equivalent airspeed corrected for atmospheric density. Refer to airspeed conversion (Figure 28-5).

28.6 STATIC PRESSURE COMPENSATOR (SPC)/ALTIMETER TOLERANCE

The SPC/altimeter tolerance check chart (Figure 28-6) provides a means of checking the accuracy of the SPC in flight. The chart is plotted for nine units of attack between 5,000 and 20,000 feet. The Δ altitude between the curves represents the allowable tolerance of the system.

28.6.1 Use. With the SPC on and operating, establish the aircraft at nine units angle of attack between 5,000 and 20,000 feet at a constant Mach number. Record the Mach number and altitude. Enter the chart with the Mach number and proceed vertically to intersect both curves. From these intersections, proceed horizontally to the left and record the two corresponding Δ altitudes. Add these to the indicated altitude to obtain the upper and lower allowable limits. Move the SPC switch (labeled CADC), located on the pilot left console, to the OFF position. The altimeter must jump. Note and record the indicated altitude. If the indicated altitude with the SPC turned off falls on or between the previously computed limits, reset the SPC and ensure that the STATIC CORR OFF light is extinguished.

WARNING

If the altimeter does not jump or the indicated altitude with the SPC off does not fall within the limits established by the SPC/altimeter tolerance check chart, leave the SPC off during the remainder of the flight and utilize the altimeter and airspeed position error correction charts (STATIC CORRECTION OFF) in this chapter.

28.6.2 Sample Problem

A. Altitude – 15,000 FEET.

B. Mach – 0.77.

C. Intersect both curves.

D. Lower Δ altitude – 180 FEET.

E. Upper Δ altitude – 320 FEET.

F. Lower limit (A + D) – 15,180 FEET.

G. Upper limit (A + E) – 15,320 FEET.

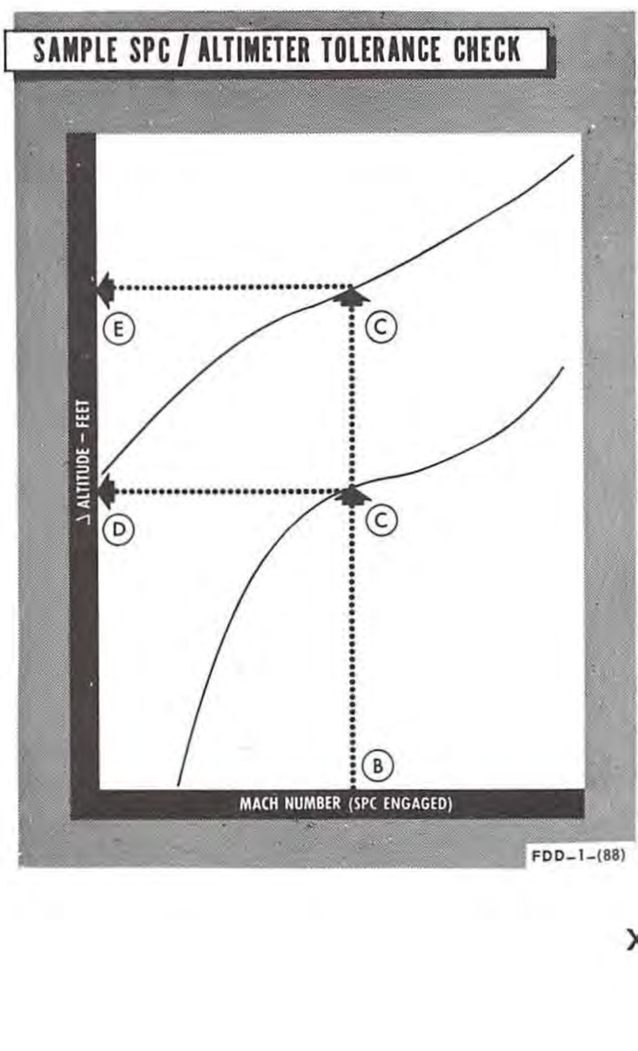
28.7 AIRSPEED POSITION ERROR CORRECTION

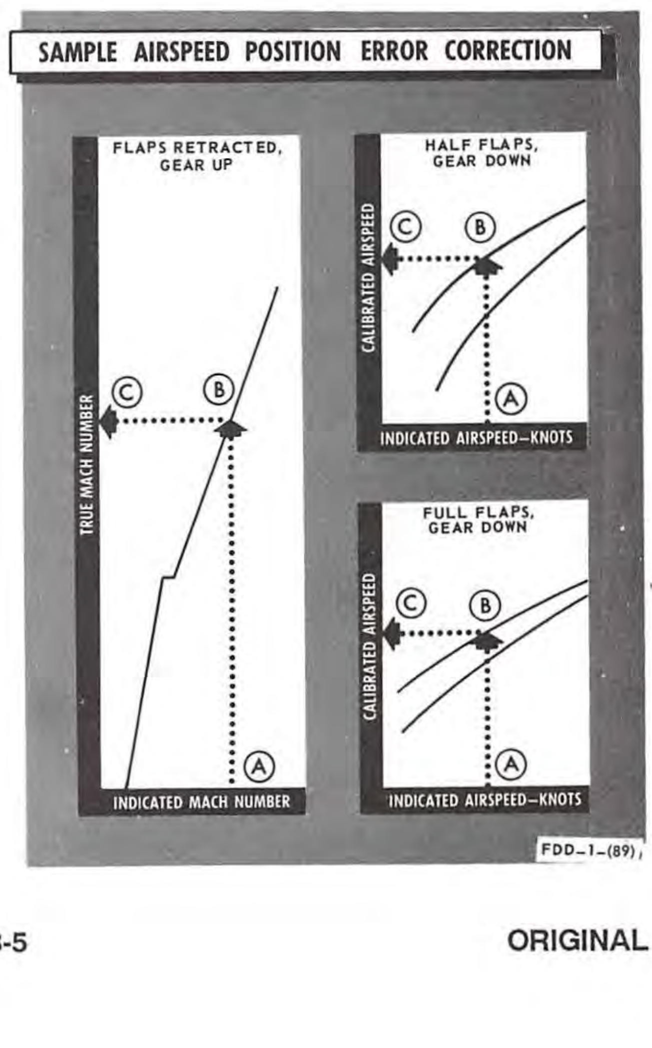
Under normal conditions, airspeed position error is automatically compensated for by the air data computer system (ADC). However, if a malfunction of the ADC occurs, position error must be applied to the cockpit indication. These charts (Figures 28-7 and 28-8) provide a direct-reading conversion from indicated to calibrated airspeed and from indicated to true Mach number.

28.7.1 Sample Problem

CONFIGURATION: Gear Down, Full Flaps

A. Indicated airspeed – 160 KNOTS.





B. Gross weight – 40,000 POUNDS.

C. Calibrated airspeed – 155 KNOTS.

CONFIGURATION: Gear and Flaps Up

A. Indicated Mach number – 1.4.

B. Indicated altitude – 40,000 FEET.

C. True Mach number – 1.34.

28.8 ALTIMETER POSITION ERROR CORRECTION

Under normal operating conditions, compensation for the static source position error as it affects the altimeter is provided by the ADC. If the ADC fails in flight (STATIC CORR OFF), the altimeter must be corrected by means of Figure 28-8. The chart contains three altitude correction (Δ H) plots, one cruise configuration, and two landing configurations. The altitude correction (Δ H) must be added (algebraically) to the assigned altitude to obtain indicated altitude.

Note

> Assigned altitude +Δ H = indicated altitude. Fly indicated altitude.

28.8.1 Use. Enter the cruise plot with the indicated Mach number. Proceed vertically upward to intercept the assigned altitude curve, then horizontally to the left to read the altitude correction (Δ H). Enter either of the landing plots with the indicated airspeed, proceed vertically to the applicable gross weight reflector, then horizontally to the left to read altitude correction (Δ H). Apply Δ H to the assigned altitude to obtain the indicated altitude.

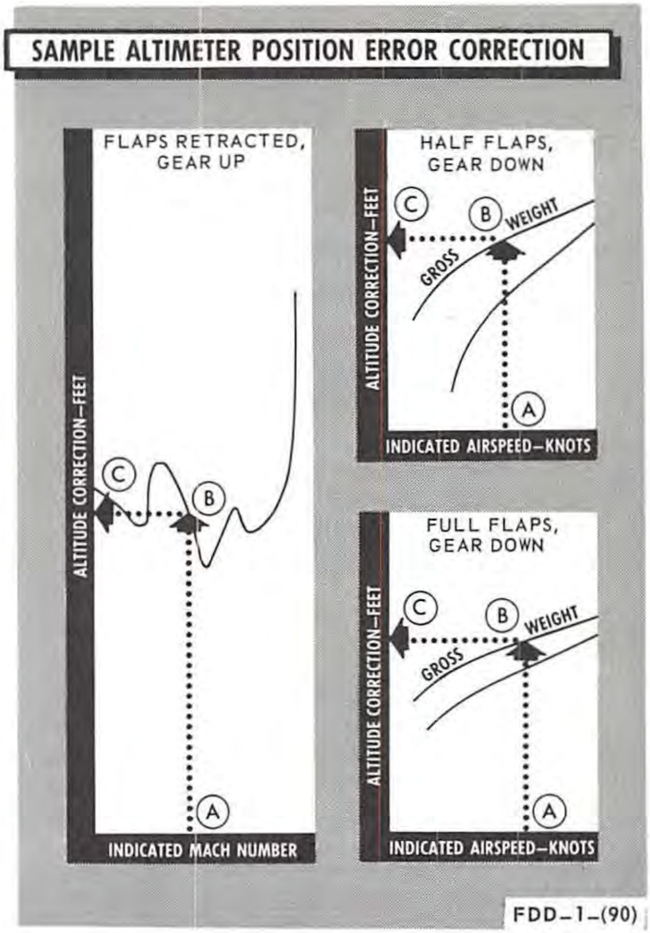
28.8.2 Sample Problem. To maintain 35,000 feet at 1.4 Mach (cruise plot), proceed as follows:

A. Indicated Mach number – 1.4.

B. Assigned altitude – 40,000 FEET.

C. Altitude correction (Δ H) – +2,270 FEET.

D. Fly indicated altitude (B + C) – 42,270 FEET.



28.9 ALTIMETER LAG CHART

These charts (Figure 28-9 (sheets 1 and 2)) provide a means of obtaining the altimeter lag (difference between indicated altitude and actual altitude) resulting from diving flight. Data is provided for dive angles up to 60° and airspeeds up to 600 KTAS.

28.9.1 Use. Enter the chart with dive airspeed and project horizontally to the right to intersect the dive angle curve. From this point, project vertically downward to read the resulting altimeter lag. Add the altimeter lag data to desired/required pullout altitude to obtain indicated altitude for pullout.

28.9.2 Sample Problem

For aircraft with SPC operative:

A. Dive airspeed (TAS) – 400 KNOTS.

B. Dive angle – 45°.

C. Altimeter lag – 92 FEET.

28.10 WIND COMPONENTS CHART

A standard wind components chart (Figure 28-10) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind components for takeoff and landing computations. It may, however, be used whenever wind component information is desired. To determine effective wind velocity, add one-half the gust velocity to the steady state velocity (e.g., reported wind 050/20 G 30, effective wind is 050/25).

28.10.1 Use. Reduce the reported wind direction to a relative bearing by determining the difference between the wind direction and the runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the wind speed arc. From this point, descend vertically to read the crosswind component. From the intersection of bearing and wind speed, project horizontally to the left to read headwind component.

28.10.2 Sample Problem

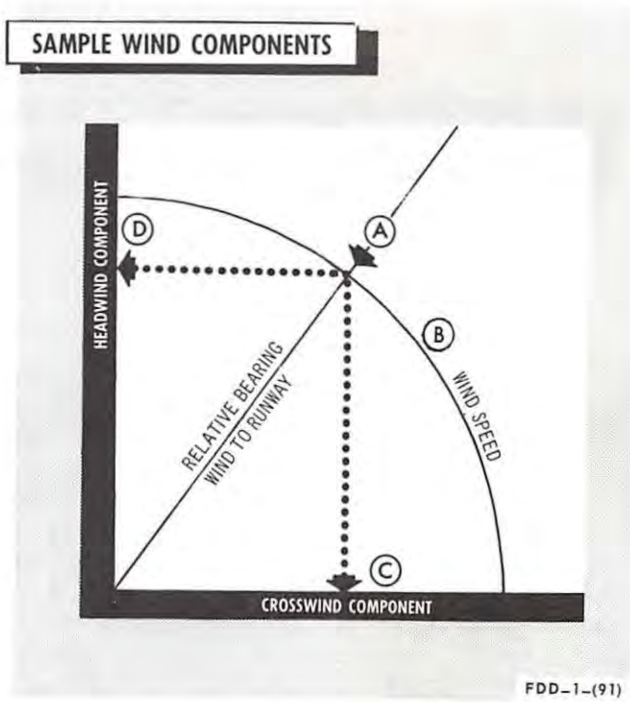
Reported wind is 050/35; runway heading is 030.

A. Relative bearing – 20°.

B. Intersect windspeed arc – 35 KNOTS.

C. Crosswind component – 12 KNOTS.

D. Headwind component – 33 KNOTS.



STORES TO BE CARRIED	STATIONS AND ARMAMENT ATTACHMENTS 1	2	3	4	5	6	7	8	9
370 GAL. EXT. WING TANK	1								1
MK 81, MK 82, MK 83 LDGP BOMB, MK 86, MK 87, MK 88, MK 124 PRACTICE BOMB	2 14	4			10 15			4	2 14
ADSID I (NORMAL) SENSOR	2 14	4						4	2 14
MK 81, MK 82 LDGP BOMB, MK MK 36 DST, MK 40 DST	2 14	4			10 15			4	2 14
MK 77 MOD 4 FIRE BOMB	2 14	4			10 15			4	2 14
MK 20 MOD 2/3, CHAFFEYE	2 14	4			10 15			4	2 4
MK 12 CHEMICAL TANK	14	4						4	14
LAU-10/A, LAU-10A/A OR LAU-10B/A ROCKET POD	14	4			15			4	14
LAU-32A/A, LAU-32B/A, LAU-56/A, LAU-61/A, LAU-61A/A, LAU-68/A, LAU-68B/A, LAU-69/A, LAU-69A/A ROCKET POD	14	4			15			4	14
MK 76, MK 89, MK 105 PRACTICE BOMB	2 3 14	4 8			10 11 15			4 8	2 3 14
600 GAL. EXT. TANK					9				
CBU-24, -29 -49	2 14	4			10 15			4	2 14
NAMAR CAMERA POD		17						17	
CTU-1/A DELIVERY CONTAINER	2 14				10				2 14

STORES TO BE CARRIED	STATIONS AND ARMAMENT ATTACHMENTS 1	2	3	4	5	6	7	8	9
SUU-40/44 FLARE DISPENSER	2 14								2 14
D-704 AIR REFUELING STORE					9				
RCPP-105 STARTER POD					9				
AIM-7 MISSILES		5	16	16		16	16	5	
AIM-9 MISSILE		6						6	
MK 24, MK 45 FLARE	2 3 14	4 8			10 11 15			4 8	2 3 14
RMU-8/A REEL LAUNCHER					9				
CNU-169/A FERRY EQUIPMENT STORE		5						5	
AQM-37A MISSILE TARGET					7				
MK 4 MOD 0 GUN POD					13				
LAU-33A/A		6						6	
MK 82 LGB, MK 83 LGB	2 14	4			10 15			4	2 14
LB-30A STRIKE CAMERA			12						

1 WING TANK PYLON
2 WING TANK PYLON, MULTIPLE WEAPONS ADAPTER, MER
3 WING TANK PYLON, MULTIPLE WEAPONS ADAPTER, A/A37B-3 PMBR
4 LAU-17/A WING MISSILE PYLON, MULTIPLE WEAPONS ADAPTER, TER
5 LAU-17/A WING MISSILE PYLON
6 LAU-17/A WING MISSILE PYLON, LAU-7/A MISSILE LAUNCHER
7 AERO 27A RACK WITH LAU-24 LAUNCHER
8 LAU-17/A WING MISSILE PYLON, MULTIPLE WEAPONS ADAPTER, A/A37B-3 PMBR
9 AERO 27A RACK
10 AERO 27A RACK, MULTIPLE WEAPONS ADAPTER AND CENTERLINE MER
11 AERO 27A RACK AND A/A37B-3 PMBR
12 MISSILE STATION 3 WITH AERO 7A LAUNCHER REMOVED.
13 AERO-27A RACK, MULTIPLE WEAPONS ADAPTER AND GUN POD ADAPTERS
14 WING TANK PYLON, MULTIPLE WEAPONS ADAPTER, TER
15 AERO-27A RACK, MULTIPLE WEAPONS ADAPTER AND TER
16 NO ADDITIONAL EQUIPMENT REQUIRED
17 LAU-17/A WING MISSILE PYLON, MULTIPLE WEAPONS ADAPTER

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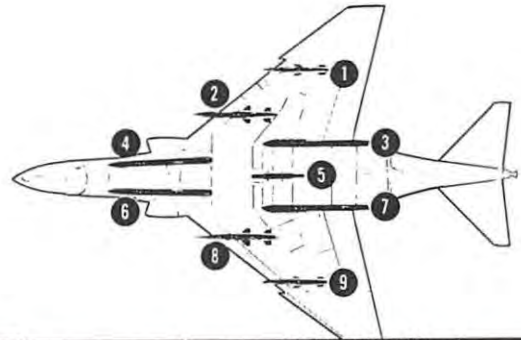
Figure 28-1. Armament Attachment Association



WARNING

For precise external store and attachment information, refer to charts C and E of the Weight and Balance Data Handbook (AN-01-1B-40) for your airplane.

STORES — BOMBS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION		1	2	3	4	5	6	7	8	9
CBU–24/29/49	835	4.2	7.4	9.9	MER	FWD CLUSTER	–.26				–.52				–.26
						AFT CLUSTER	+.57				+.36				+.57
					TER		+.31	–.42			+.05			–.42	+.31
CBU–59/B APAM	750	2.9	7.1	9.4	MER	FWD CLUSTER	–.24				–.49				–.24
						AFT CLUSTER	+.57				+.55				+.57
					TER		+.35	–.49			+.08			–.49	+.33
MK 40 DESTRUCTOR (WITH MAU–91 FIN)	1057	3.9	NE	NE	MER	FWD CLUSTER									
						AFT CLUSTER									
					TER										
MK 81 LDGP (WITH CONICAL FIN)	270	0.8	1.8	2.4	MER	FWD CLUSTER	–.10				–.16				–.10
						AFT CLUSTER	+.21				+.10				+.21
					TER		+.10	–.16			+.05			–.16	+.10
MK 81 LDGP (WITH MK 14 FIN OR BSU–33/B)	300	1.2	1.8	2.4	MER	FWD CLUSTER	–.10				–.19				–.10
						AFT CLUSTER	+.23				+.14				+.23
					TER		+.10	–.20			+.05			–.20	+.10
MK 82 LDGP, MK 36 DESTRUCTOR (WITH CONICAL FIN)	531	1.1	2.8	3.7	MER	FWD CLUSTER	–.16				–.31				–.16
						AFT CLUSTER	+.41				+.26				+.41
					TER		+.26	–.36			+.05			–.36	+.26
MK 82 LDGP, MK 36 DESTRUCTOR (WITH MK–15 FIN)	570	2.4	2.8	3.7	MER	FWD CLUSTER	–.16				31				–.16
						AFT CLUSTER	+.41				+.26				+.41
					TER		+.26	–.36			+.05			–.36	+.26
MK 82 LGB (KMU–388B) (NON–EXTENDED FIN)	668	2.3	7.8	NA	MER	FWD CLUSTER									
						AFT CLUSTER									
					TER										
MK 82 LGB (MUU–388) (EXTENDED FIN)	682	3.1	7.8	NA	MER	FWD CLUSTER									
						AFT CLUSTER									
					TER										
MK 83 LDGP	985	1.8	4.6	6.1	MER	FWD CLUSTER	–.05				–.62				–.05
						AFT CLUSTER					+.44				
					TER		+.36	–.68			+.19			–.68	+.36
MK 83 LGB	1088	3.6	13.1	NA	MER	FWD CLUSTER									
						AFT CLUSTER									
					TER										
MK 77 MOD 4	520	3.5	14.3	19.1	MER	FWD CLUSTER	–.16				–.21				–.16
						AFT CLUSTER	+.38				+.37				+.38
					TER		+.21	–.36			+.05			–.36	+.21
MK 20 MOD 2/3	475	2.9	NE	NE	MER	FWD CLUSTER	–.16				–.31				–.16
						AFT CLUSTER	+.36				+.21				+.36
					TER		+.15	–.31			+.05			–.31	+.15

STORES — MISSILES		UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
SPARROW III	AIM–7D	402	FUSELAGE MOUNTED 1.3 WING MOUNTED 2.6	FUSELAGE MOUNTED NA WING MOUNTED 2.7	NA	—		–.30	+.35	–.68		–.68	+.35	–.30	
	AIM–7E	455			NA	—		–.33	+.39	–.76		–.76	+.39	–.33	
	AIM–7E–2	427			NA	—		–.33	+.39	–.76		–.76	+.39	–.33	

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Figure 28-2. Station Loading (Sheet 1 of 5)

SIDEWINDER	AIM–9B	157	1.7	1.0	1.4	—		–.10						–.10	
SIDEWINDER	AIM–9D/G	197	1.7	1.0	1.4	—		–.14						–.14	
SIDEWINDER	AIM–9H	195	1.7	1.0	1.4	—		–.14						–.14	
ALQ–120 ECM POD		197	3.8	4.4	NA	—									

A NOSE AND TAIL CONES ON
B NOSE CONE OFF TAIL CONE ON
C NOSE AND TAIL CONES OFF – FULL
D NOSE AND TAIL CONES OFF – EMPTY

STORES / ROCKETS	F / E	UNIT WEIGHT FULL / EMPTY	UNIT DRAG A / B	UNIT DRAG C / D	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
LAU–10/A, A/A, B/A	F	533	3.6	11.2	8.0	10.6										
	E	105	10.2	10.0			TER	+.21	–.36			+.05			–.36	+.21
LAU –32A/A	F	174	2.7	6.8	3.9	5.2										
	E	51	6.3	6.2			TER	+.05	–.14			.00			–.14	+.05
LAU –32B/A	F	175	2.7	6.8	3.9	5.2										
	E	53	6.3	6.2			TER	+.05	–.14			.00			–.14	+.05
LAU –33A/A	F	286	F	2.2	NE	NA										
	E	72	E	2.2			TER									
LAU–56/A	F	188	2.7	6.8	3.9	5.2										
	E	60	6.3	6.2			TER	+.05	–.14			.00			–.14	+.05
LAU –60/A	F	434	4.2	13.5	10.1	13.5										
	E	74	12.5	12.0			TER	+.21	–.36			+.05			–.36	+.21
LAU–61/A, A/A	F	502	4.2	13.5	10.1	13.5										
	E	115	12.5	12.0			TER	+.21	–.36			+.05			–.36	+.21
LAU–68/A, B/A	F	200	2.7	6.8	3.9	5.2										
	E	58	6.3	6.2			TER	+.10	–.16			.00			–.16	+.10
LAU–69/A, A/A	F	483	4.2	13.5	10.1	13.5										
	E	95	12.5	12.0			TER	+.21	–.16			+.05			–.16	+.21

STORES / PRACTICE BOMBS & ROCKETS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
MK 76	24	0.3	1.0	1.0	PMBR WITH (6) UNITS	+.10	–.16			+.05			–.16	+.10
MK 76	24	0.3	NE	NE	MER FWD CLUSTER									
					MER AFT CLUSTER									
					TER									
MK–86 (WATER–SAND FILL)	200	0.8	1.8	2.4	MER FWD CLUSTER	–.08				–.15				–.08
					MER AFT CLUSTER	+.17				+.10				+.17
					TER		–.15			+0.0			–.15	
MK–87 (WATER–SAND FILL)	330	1.1	2.8	3.7	MER FWD CLUSTER	–.12				–.22				–.12
					MER AFT CLUSTER	+.25				+.15				+.25
					TER		–.24			+.05			–.24	
MK–88 (WATER–SAND FILL)	750	1.8	4.6	6.1	MER FWD CLUSTER	–.07				–.52				–.07
					MER AFT CLUSTER					+.36				
					TER		–.56			+.10			–.56	

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Figure 28-2. Station Loading (Sheet 2 of 5)

STORES — PRACTICE BOMBS & ROCKETS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
MK 89	56	0.2	NE	NE	PMBR WITH (6) UNITS	+.15	−.26			−.05			−.26	+.15
MK 89	56	0.2	NE	NE	MER FWD CLUSTER									
					MER AFT CLUSTER									
					TER									
MK 106	5	0.4	1.0	1.0	PMBR WITH (6) UNITS	+.05	−.05			.00			−.05	+.05
MK 106	5	0.4	NE	NE	MER FWD CLUSTER									
					MER AFT CLUSTER									
					TER									
MK 124	565	2.8	NE	NE	NE									

STORES — TANKS, RACKS AND PODS		UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER SINGLE MOUNTED	STABILITY NUMBER CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION	1	2	3	4	5	6	7	8	9
370 GALLON EXTERNAL WING TANKS (INCLUDES PYLON)	MCDONNELL	F 2856	4.8	29.8 [1]	NA		+.13								+.13
		E 340		20.0 [2]			+.04								+.04
	SARGENT FLETCHER	F 2824	6.4	29.8 [1]	NA		+.13								+.13
		E 308		20.0 [2]			+.04								+.04
	ROYAL JET	F NE	6.4	NE	NE										
		E NE													
600 GALLON EXTERNAL CENTERLINE TANK	MCDONNELL	F 4329	9.6	NA	NA						+.21				
		E 249									+.01				
	ROYAL JET	F 4384	9 6	NA	NA						+.21				
		E 304									+.01				
MK 4 GUN POD		F 1390	11.6	NA	NA						+.21				
		E 787									.00				
MK 12 MOD 0 CHEMICAL TANK		F 1000	3.3	8.0	10.6	TER									
		E 350	3.3												
WING TANK PYLON		92	1.1	4.3	NA		+.04								+.04
LAU-17/A GUIDED MISSILE LAUNCHER		150	2.4	6.9	NA			−.07						−.07	
MULTIPLE WEAPONS ADAPTER (OUTBOARD)		24	0.4	NA	NA		+.01								+.01
MULTIPLE WEAPONS ADAPTER (INBOARD)		24	0.3	NA	NA			−.02						−.02	
MULTIPLE WEAPONS TER ℄ ADAPTER		55	2.0	NA	NA						.00				
LAUNCHER LAU-7/A		87	0.4	2.2	NA			−.06						−.06	
MER	℄ STATION	215	8.0	NA	NA	RACK SHIFTED FWD					−.02				
						RACK SHIFTED AFT					+.05				
	WING STATION	225	8.0	7.1	NA	RACK SHIFTED FWD	+.05								+.05
						RACK SHIFTED AFT	+.11								+.11
TER	℄ STATION	95	5.5	NA	NA						+.01				
	WING STATION	95	5.5	6.6	NA		+.06	−.06						−.06	+.06
℄ BOMB RACK AERO-27A		51	NA	NA	NA						.00				
RCPP-105 STARTER POD (FULLY SERVICED)		2016	7.4	NA	NA						+.03				
D-704 AIR REFUEL STORE		F 2773	10.0	NA	NA						+.20				
		E 733	10.0	NA	NA						+.25				
CNU-169/A FERRY MISSION EQUIPMENT STORE		F 435	4.4	18.0	NA										
		E 185													
LB-30A STRIKE CAMERA POD		126	3.0	NA	NA										
ALE-37 DISPENSER		NE	2.8	7.9	10.5										

[1] WING TANK AND PYLON (WITH WEAPONS OR PYLONS INSTALLED ON STATIONS 2 & 8)
[2] WING TANK AND PYLON (WITHOUT WEAPONS OR PYLONS INSTALLED ON STATIONS 2 & 8)

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Figure 28-2. Station Loading (Sheet 3 of 5)

STORES: FLARES, SENSORS	UNIT WEIGHT (LBS)	UNIT DRAG	STABILITY NUMBER: SINGLE MOUNTED	STABILITY NUMBER: CLUSTER MOUNTED	BOMB RACK or BOMB CLUSTER POSITION		STATION LOCATION and INCREMENTAL C G SHIFT FOR INDIVIDUAL UNIT: 1	2	3	4	5	6	7	8	9
MK-24, MK 45 FLARE	27	1.0	1.0	1.3	MER	FWD CLUSTER	.00				.00				.00
					MER	AFT CLUSTER	.00				.00				.00
					TER		.00	.00			.00			.00	.00
SUU-40/44 FLARE DISPENSER	F 365	3.6	NE	NE	MER	FWD CLUSTER									
					MER	AFT CLUSTER	+.31				+.04				+.31
	E 125	3.6			TER		+.31	−.16			+.10			−.16	+.31
ADSID I (NORMAL) SENSOR	26	4.5	NE	NE	–										
SUU-40/44 DISPENSER WITH AN/GSQ-117/-117LS/-141 SENSOR	NE	3.6 / 3.6	NE	NE	–										
NAMAR CAMERA POD	275	3.8	NE	NE	–										
CTU-1/A DELIVERY CONTAINER (EMPTY) *SEE NOTES	230	4.9	NE	NE	MER										
					TER										
ASDC (AIR-SHIP DELIVERY CONTAINER SYSTEM) DELIVERY CONTAINER	180 Max	3.7	NA	8.3	TER		+.08	−.12						−.12	+.08
ASDC (AIR-SHIP DELIVERY CONTAINER SYSTEM) WIRE CONTAINER	F85 E41	4.8	9.3	12.3	TER		+.03	−.06						−.06	+.03
PRIDE antennas	NE	2.8	NA	NA	–										

FDD-1-(406-4)

Figure 28-2. Station Loading (Sheet 4 of 5)

NOTES

- THE DRAG INDEX OF THE CLEAN AIRPLANE IS ZERO.
- INDIVIDUAL STORE DRAG X NUMBER OF STORES TO BE CARRIED + SUSPENSION EQUIPMENT DRAG (IF NOT INCLUDED) DRAG INDEX
- DRAG NUMBERS FOR SINGLE STORES ARE SLIGHTLY CONSERVATIVE. INTERFERENCE DRAG BETWEEN MULTIPLE STORES HAS BEEN CONSIDERED.
- FUSELAGE-MOUNTED STORES ARE NOT USED IN DETERMINING AIRPLANE STABILITY INDEX BUT THEY ARE USED IN COMPUTING TAKEOFF CG LOCATION.
- TANDEM-MOUNTED WEAPONS COUNT AS A SINGLE WEAPON WHEN COMPUTING THE AIRCRAFT STABILITY INDEX.
- UNIT STABILITY NUMBERS ARE ASSIGNED FOR SINGLE MOUNTED AND CLUSTER MOUNTED WEAPONS. THE CLUSTER MOUNTED UNIT STABILITY NUMBER WILL BE USED WHEN TWO OR MORE WEAPONS ARE MOUNTED ON THE SAME RACK, WITH EACH WEAPON BEING ASSIGNED THIS NUMBER.
- NE = NOT ESTABLISHED
- NA = NOT APPLICABLE
- E = EMPTY, F = FULL

* CTU-1/A CARRIER OPERATIONS NOT ALLOWED.

ESTIMATED OPERATING WEIGHT (Basic airplane plus the weight of oil, unusable fuel, and two crew members)

(NOT INCLUDING PRIDE) .... 32,644 Lbs. 31.6 MAC

(INCLUDING PRIDE) .... 32,764 Lbs. 31.5 MAC

ESTIMATED TAKEOFF GROSS WEIGHT (Estimated operating weight plus weight of full internal fuel)

(INCLUDING TANK NO. 7, NOT INCLUDING PRIDE) .... 46,231 Lbs. 35.1 MAC

(NOT INCLUDING TANK NO. 7, NOT INCLUDING PRIDE) .... 45,585 Lbs. 33.8 MAC

(INCLUDING TANK NO. 7, INCLUDING PRIDE) .... 46,351 Lbs. 35.0 MAC

(NOT INCLUDING TANK NO. 7, INCLUDING PRIDE) .... 45,705 Lbs. 33.7 MAC

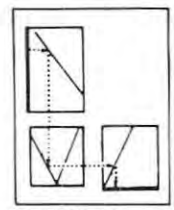
NOTES:

1. The Incremental CG shift effects are in terms of % M.A.C. (+ = AFT CG shift). (– = FWD CG shift). These unit stores increments are approximations only, and will vary depending on the individual airplane gross weight and CG.
2. Fuel weight based on JP–5 at 6.8 lb. per gallon.

FDD–1–(406–5)

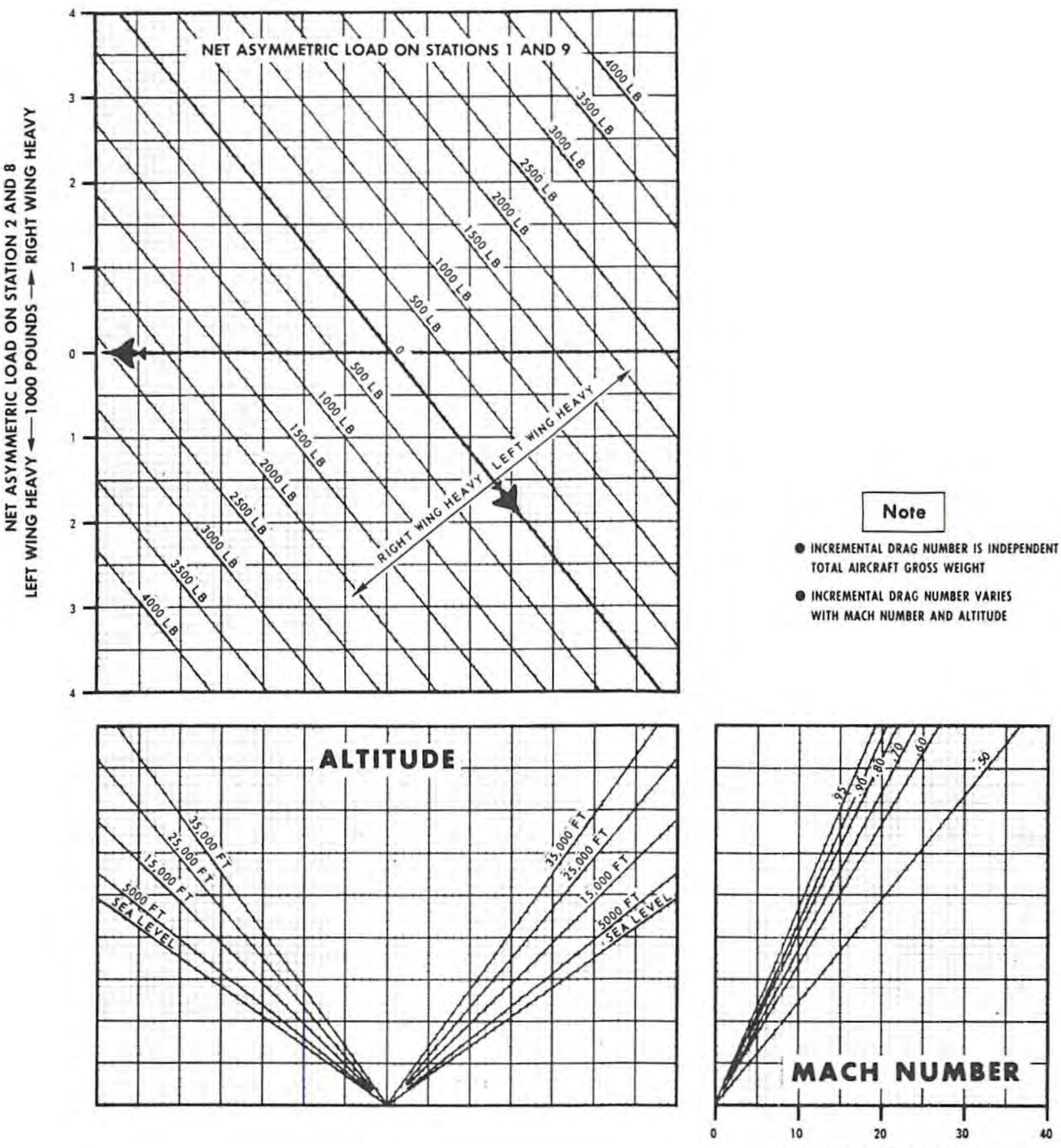
Figure 28-2. Station Loading (Sheet 5 of 5)

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MAY 1968
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)



Note

- INCREMENTAL DRAG NUMBER IS INDEPENDENT OF TOTAL AIRCRAFT GROSS WEIGHT
- INCREMENTAL DRAG NUMBER VARIES WITH MACH NUMBER AND ALTITUDE

FDD–1–(407)

Figure 28-3. Drag Because of Asymmetric Loading

Standard Sea Level Air:
T = 15°C.
P = 29.921 in. of Hg.

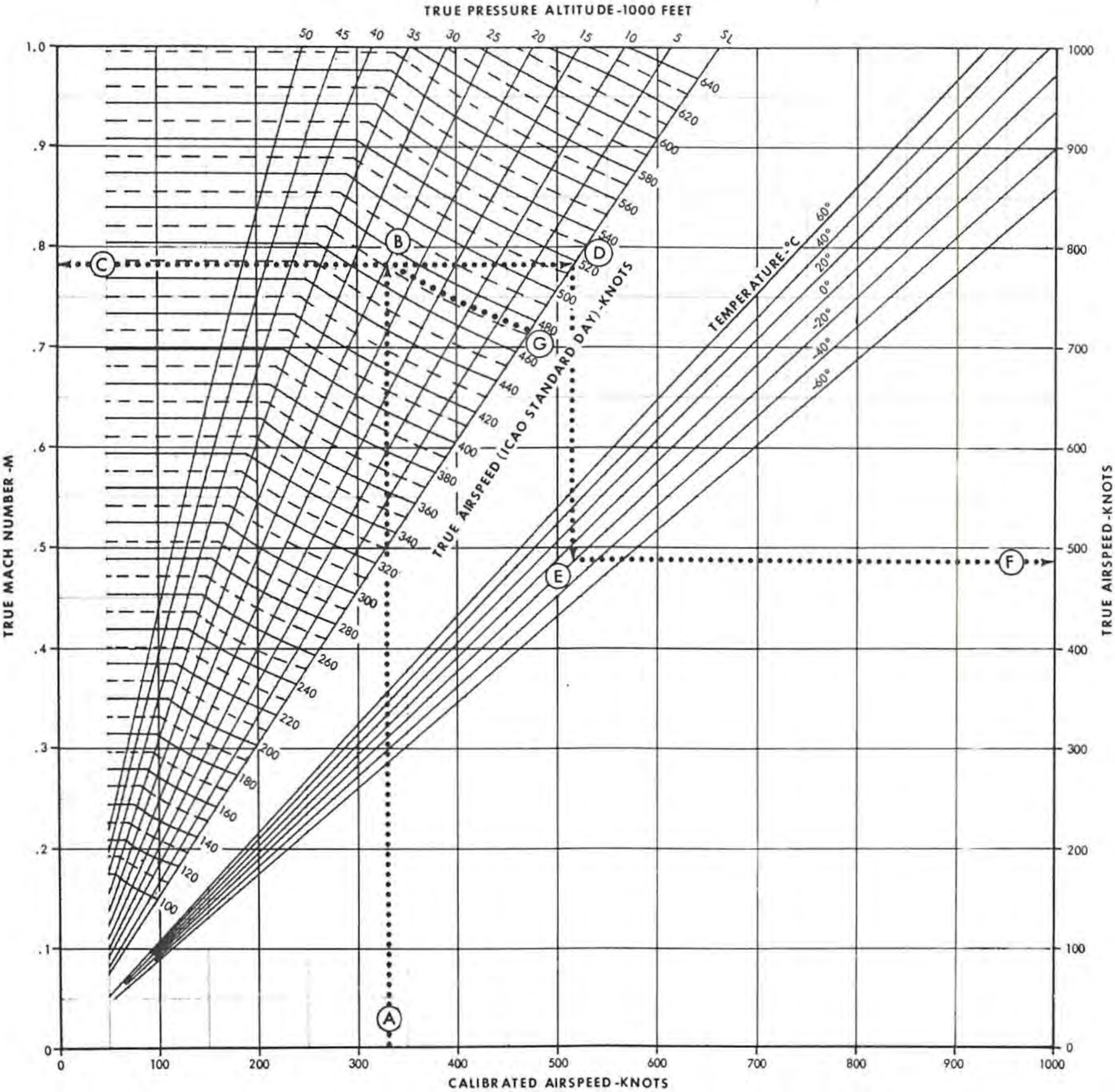
W = .07651 lb/cu. ft. ρ_0 = .002378 slugs/cu. ft.
1" of Hg. = 70.732 lb/sq. ft. = 0.4912 lb/sq. in.
a = 1116 ft./sec.

This table is based on NACA Technical Report No. 218

ALTITUDE FEET	DENSITY RATIO ρ/ρ_0	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND RATIO a/a_0	PRESSURE	
			DEG. C	DEG. F		IN. OF Hg	RATIO P/P_0
0	1.0000	1.0000	15.000	59.000	1.000	29.92	1.0000
1000	.9710	1.0148	13.019	55.434	.997	28.86	.9644
2000	.9428	1.0299	11.038	51.868	.993	27.82	.9298
3000	.9151	1.0454	9.056	48.301	.990	26.81	.8962
4000	.8881	1.0611	7.075	44.735	.986	25.84	.8636
5000	.8616	1.0773	5.094	41.169	.983	24.89	.8320
6000	.8358	1.0938	3.113	37.603	.979	23.98	.8013
7000	.8106	1.1107	1.132	34.037	.976	23.09	.7716
8000	.7859	1.1280	-0.850	30.471	.972	22.22	.7427
9000	.7619	1.1456	-2.831	26.904	.968	21.38	.7147
10,000	.7384	1.1637	-4.812	23.338	.965	20.58	.6876
11,000	.7154	1.1822	-6.793	19.772	.962	19.79	.6614
12,000	.6931	1.2012	-8.774	16.206	.958	19.03	.6359
13,000	.6712	1.2206	-10.756	12.640	.954	18.29	.6112
14,000	.6499	1.2404	-12.737	9.074	.950	17.57	.5873
15,000	.6291	1.2608	-14.718	5.507	.947	16.88	.5642
16,000	.6088	1.2816	-16.699	1.941	.943	16.21	.5418
17,000	.5891	1.3029	-18.680	-1.625	.940	15.56	.5202
18,000	.5698	1.3247	-20.662	-5.191	.936	14.94	.4992
19,000	.5509	1.3473	-22.643	-8.757	.932	14.33	.4790
20,000	.5327	1.3701	-24.624	-12.323	.929	13.75	.4594
21,000	.5148	1.3937	-26.605	-15.890	.925	13.18	.4405
22,000	.4974	1.4179	-28.586	-19.456	.922	12.63	.4222
23,000	.4805	1.4426	-30.568	-23.022	.917	12.10	.4045
24,000	.4640	1.4681	-32.549	-26.588	.914	11.59	.3874
25,000	.4480	1.4940	-34.530	-30.154	.910	11.10	.3709
26,000	.4323	1.5209	-36.511	-33.720	.906	10.62	.3550
27,000	.4171	1.5484	-38.493	-37.287	.903	10.16	.3397
28,000	.4023	1.5768	-40.474	-40.853	.899	9.720	.3248
29,000	.3879	1.6056	-42.455	-44.419	.895	9.293	.3106
30,000	.3740	1.6352	-44.436	-47.985	.891	8.880	.2968
31,000	.3603	1.6659	-46.417	-51.551	.887	8.483	.2834
32,000	.3472	1.6971	-48.399	-55.117	.883	8.101	.2707
33,000	.3343	1.7295	-50.379	-58.684	.879	7.732	.2583
34,000	.3218	1.7628	-52.361	-62.250	.875	7.377	.2465
35,000	.3098	1.7966	-54.342	-65.816	.871	7.036	.2352
36,000	.2962	1.8374	-55.000	-67.000	.870	6.708	.2242
37,000	.2824	1.8818	-55.000	-67.000	.870	6.395	.2137
38,000	.2692	1.9273	-55.000	-67.000	.870	6.096	.2037
39,000	.2566	1.9738	-55.000	-67.000	.870	5.812	.1943
40,000	.2447	2.0215	-55.000	-67.000	.870	5.541	.1852
41,000	.2332	2.0707	-55.000	-67.000	.870	5.283	.1765
42,000	.2224	2.1207	-55.000	-67.000	.870	5.036	.1683
43,000	.2120	2.1719	-55.000	-67.000	.870	4.802	.1605
44,000	.2021	2.2244	-55.000	-67.000	.870	4.578	.1530
45,000	.1926	2.2785	-55.000	-67.000	.870	4.364	.1458
46,000	.1837	2.3332	-55.000	-67.000	.870	4.160	.1391
47,000	.1751	2.3893	-55.000	-67.000	.870	3.966	.1325
48,000	.1669	2.4478	-55.000	-67.000	.870	3.781	.1264
49,000	.1591	2.5071	-55.000	-67.000	.870	3.604	.1205
50,000	.1517	2.5675	-55.000	-67.000	.870	3.436	.1149

FDD-1-(489)

Figure 28-4. Standard Atmosphere

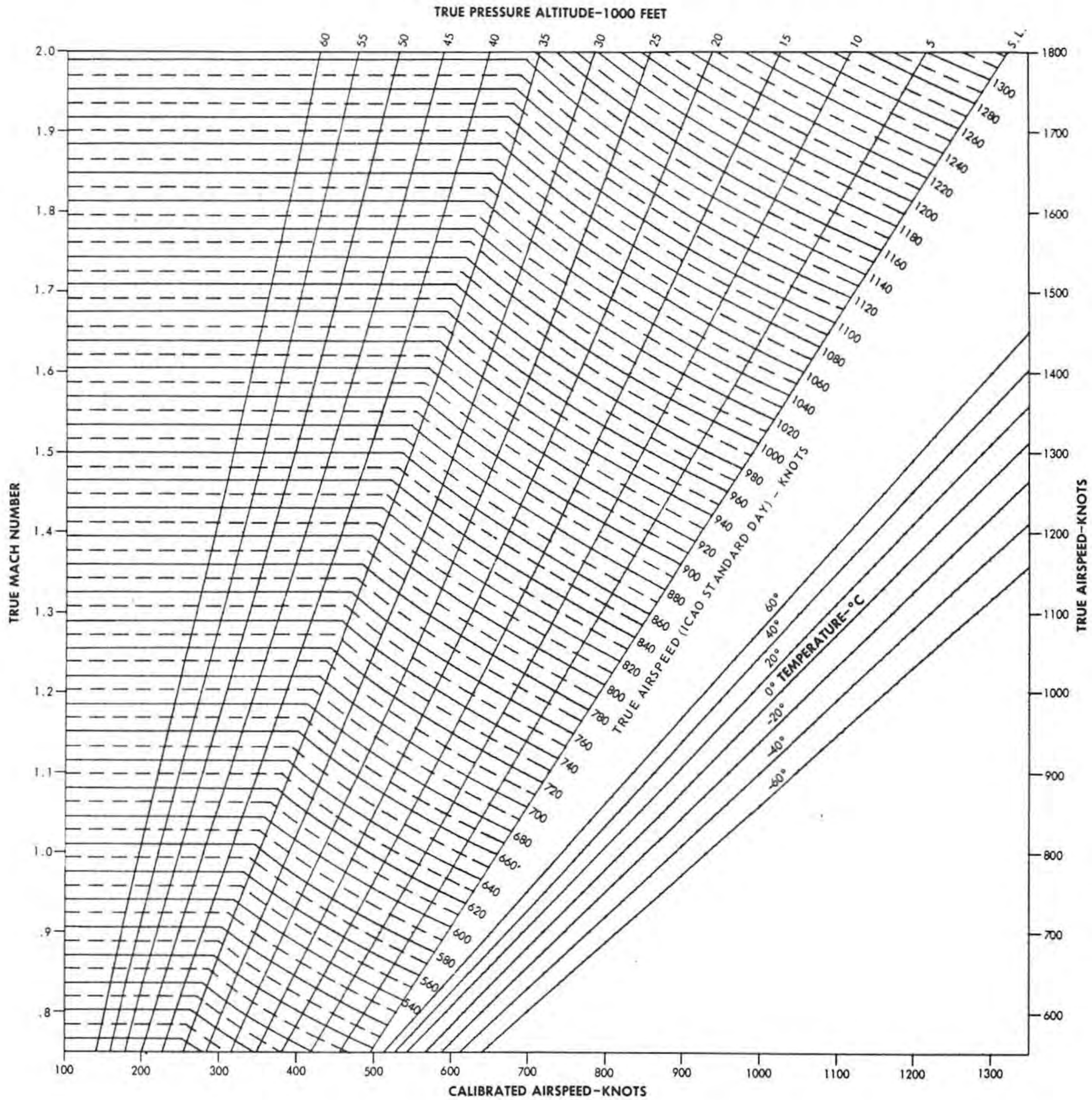


EXAMPLE

A = CAS = 330 KNOTS
B = ALT = 25,000 FT.
C = MACH = .782
D = SEA LEVEL LINE
E = TEMP. = -20°C
F = TAS = 486 KNOTS
G = TAS (STANDARD DAY) = 472 KNOTS

FDD-1-(409-1)

Figure 28-5. Airspeed Conversion (Sheet 1 of 2)



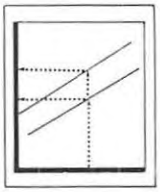
FDD-1–(409–2)

Figure 28-5. Airspeed Conversion (Sheet 2 of 2)

5000 TO 20,000 FEET

REMARKS
ENGINE(S): (2)J79-GE-10B
ICAO STANDARD DAY

GUIDE

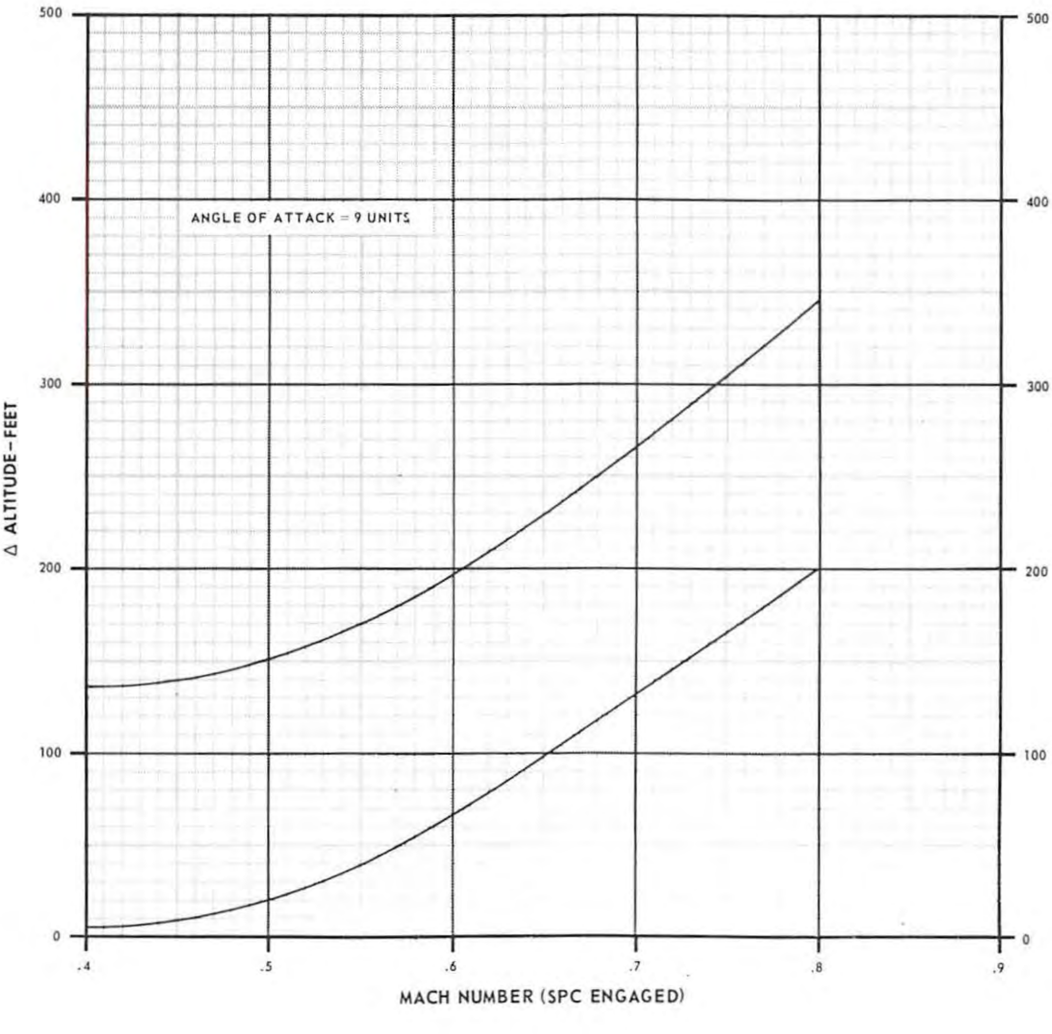


AIRPLANE CONFIGURATION

ALL DRAG INDEXES
FLAPS RETRACTED, GEAR UP

DATE: 15 MAY 1967
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8LB/GAL



FDD-1-(410)

Figure 28-6. SPC/Altimeter Tolerance Check

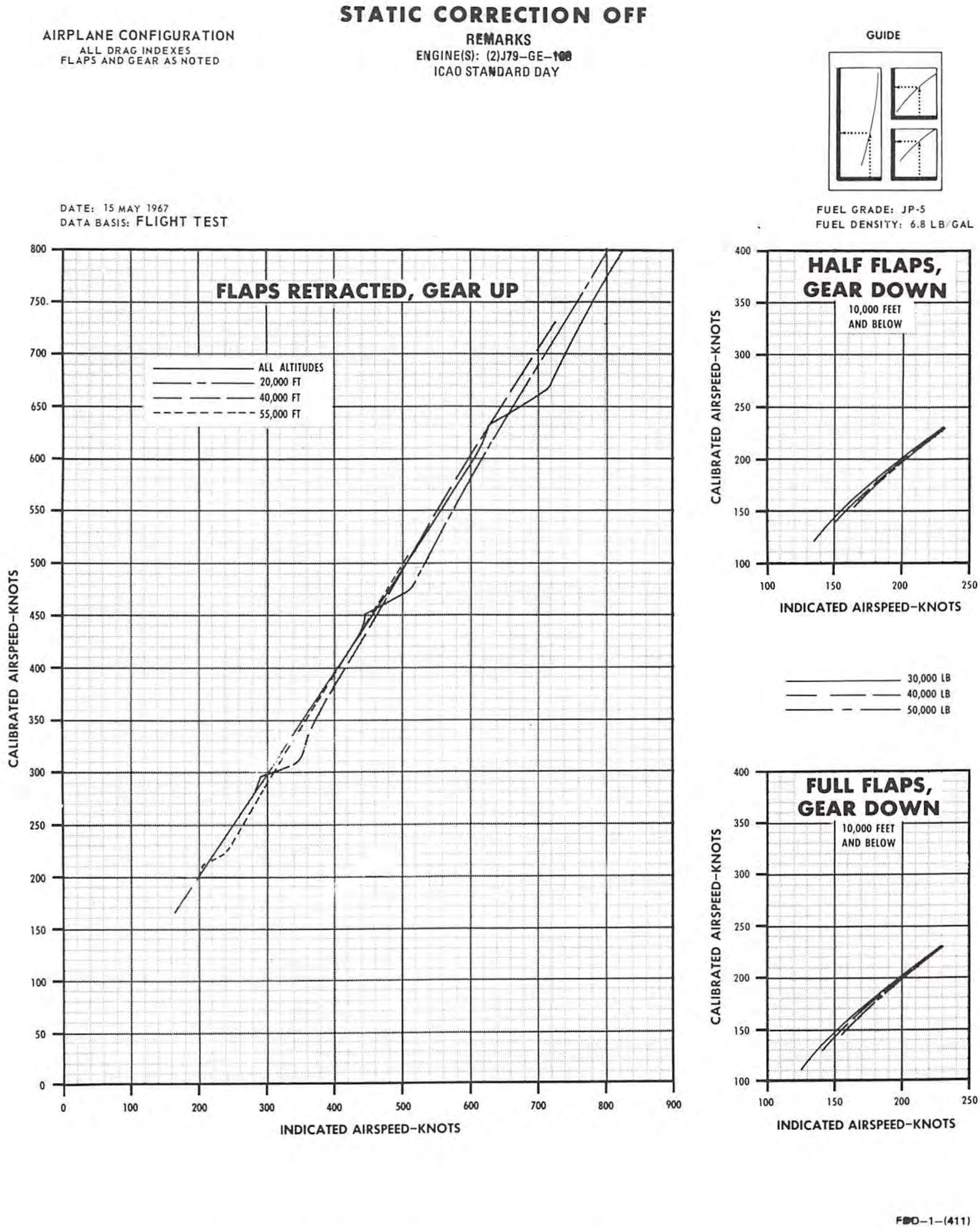


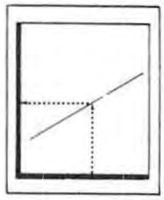
Figure 28-7. Airspeed Position Error Correction (Sheet 1 of 2)

STATIC CORRECTION OFF

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS RETRACTED, GEAR UP

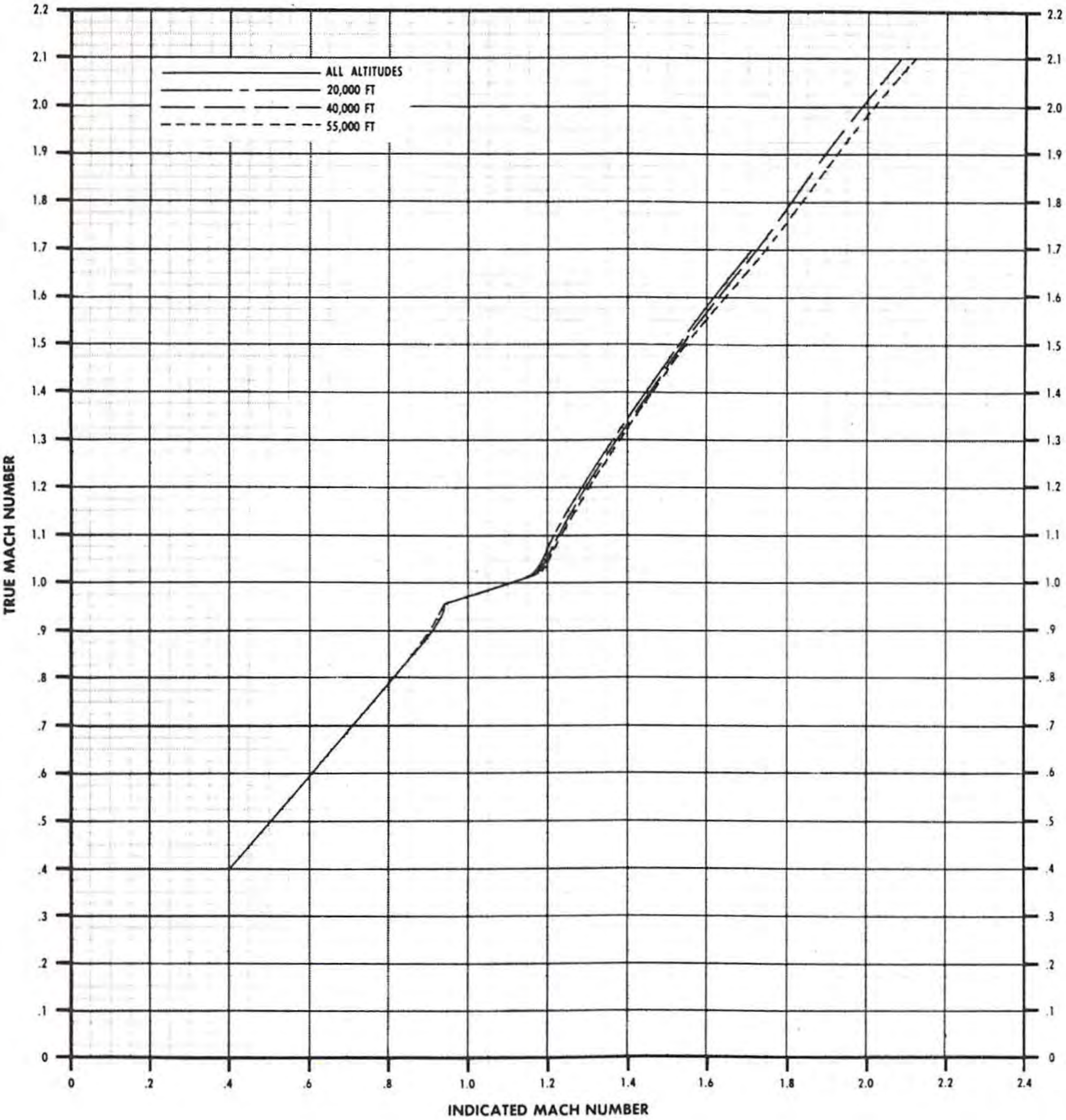
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 15 MAY 1967
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(412)

Figure 28-7. Airspeed Position Error Correction (Sheet 2 of 2)

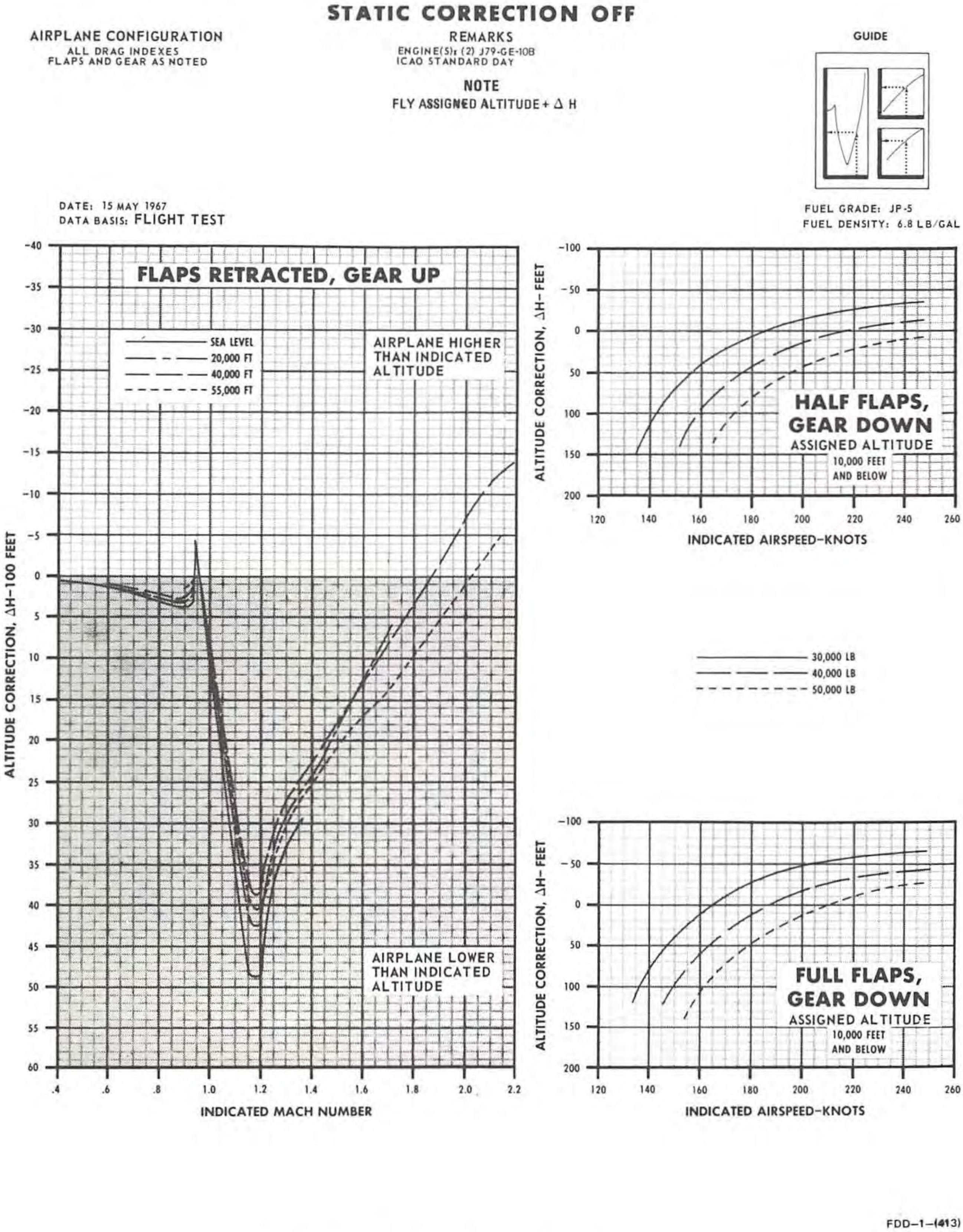
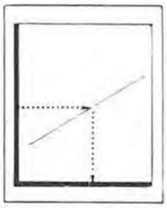


Figure 28-8. Altimeter Position Error Correction

GUIDE



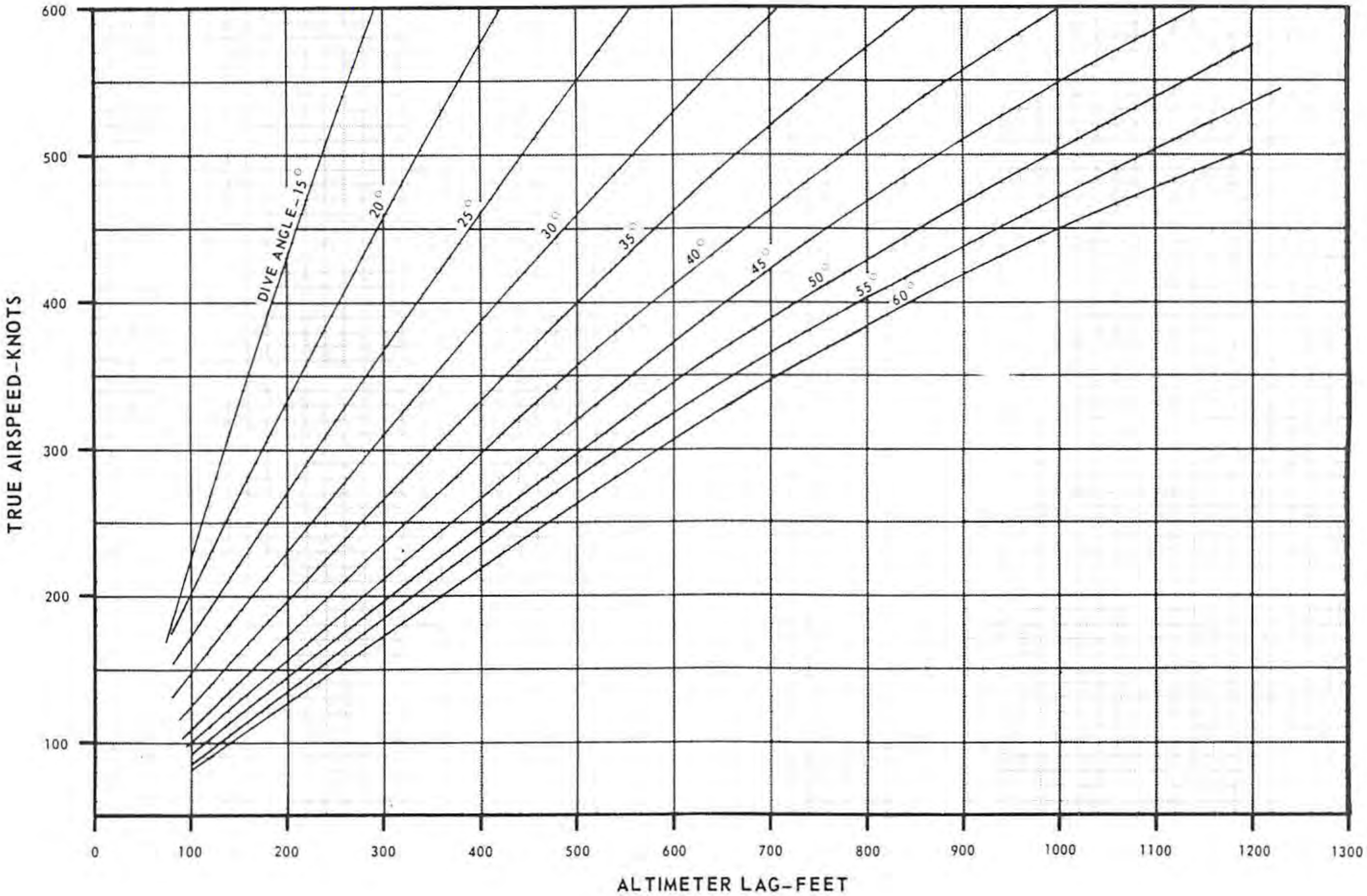
AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B

WITH SPC INOPERATIVE

DATE: 1 AUGUST 1969
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(414)

Figure 28-9. Altimeter Lag (Sheet 1 of 2)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

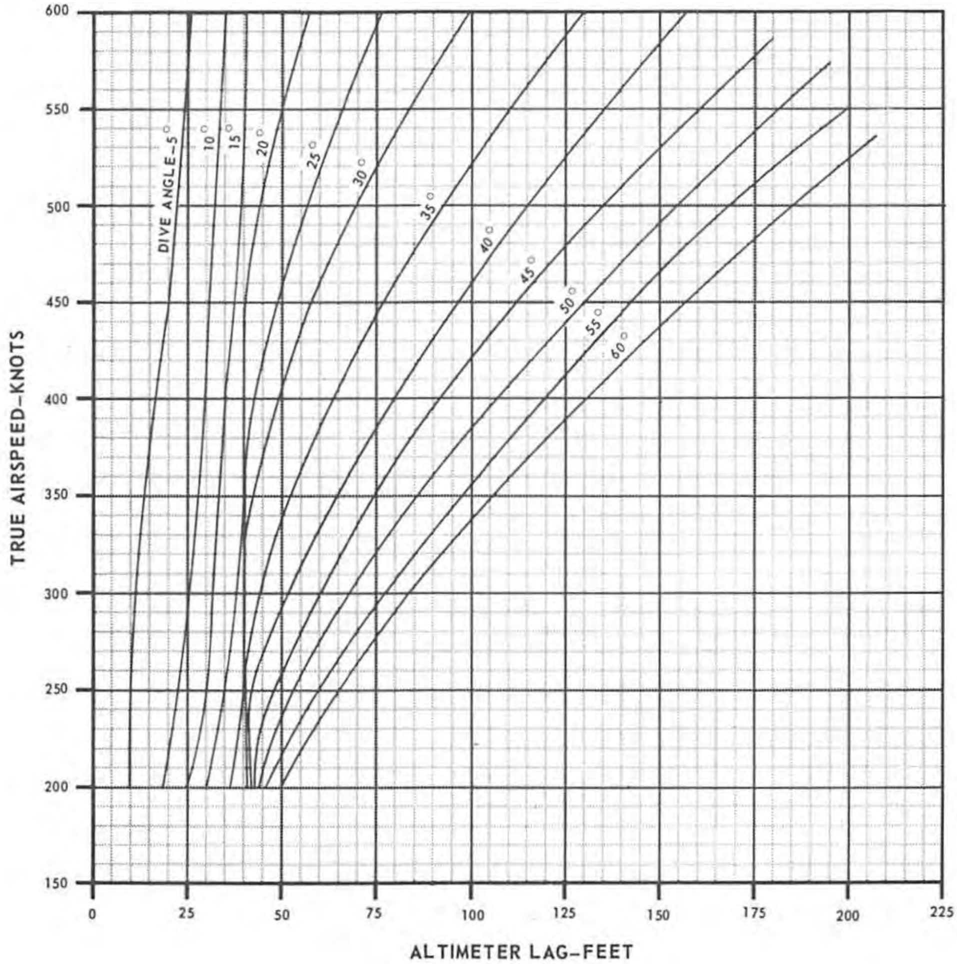
REMARKS
ENGINE(S): (2) J27-GE-10B

WITH SPC OPERATIVE

GUIDE

DATE: 15 DECEMBER 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(417)

Figure 28-9. Altimeter Lag (Sheet 2 of 2)

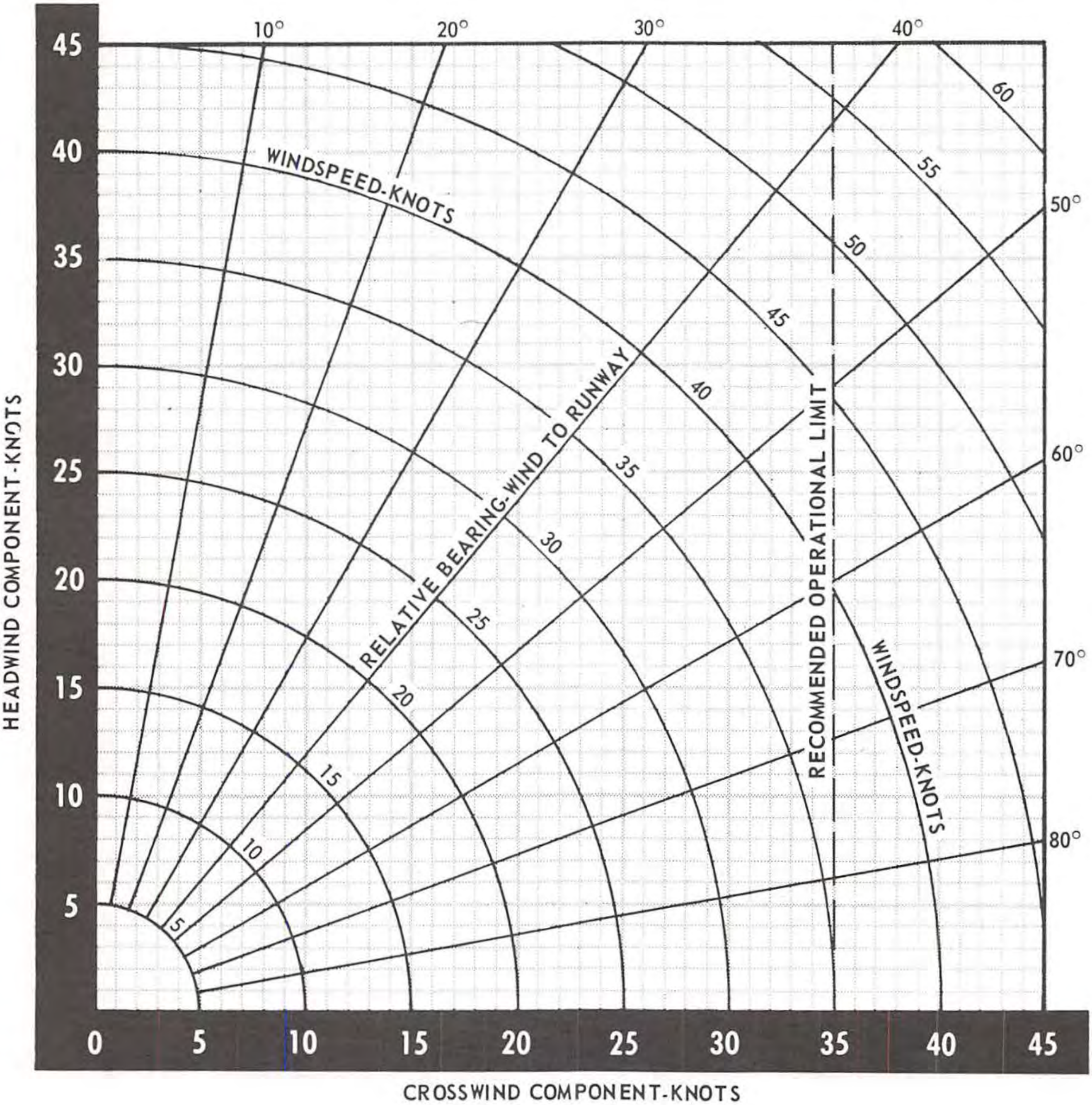


Figure 28-10. Wind Components

CHAPTER 29

Takeoff

29.1 DENSITY RATIO CHART

This chart (Figure 29-1) provides a means of obtaining a single factor (density ratio) that may be used to represent a combination of temperature and pressure altitude. Density ratio must be determined before the takeoff data charts can be utilized.

29.1.1 Use.

Enter the chart with the pressure altitude and project horizontally to the right to intersect the appropriate temperature curve. From this intersection, project vertically downward to read density ratio.

29.1.2 Sample Problem

A. Pressure altitude – 5,000 FEET.

B. Temperature – 0 °C.

C. Density ratio – 0.88.

29.2 MINIMUM GO SPEED CHART

This chart (Figure 29-2) provides the means of determining the minimum speed at which the aircraft can experience an engine failure and still take off under existing conditions of temperature, pressure altitude, gross weight, and the runway length remaining. Separate plots are provided for maximum and military thrust conditions. The data is based on an engine failure occurring at the minimum go speed and allows for a 3-second decision period with one engine operating at its initial thrust setting. In the case of a military thrust takeoff, an additional 3-second period is allowed for advancing the operating engine throttle to maximum thrust.

WARNING

Under heavy gross weight/high temperature and/or low RCR factors, it is possible to have a minimum go speed that is higher than the maximum abort speed. Under these conditions, if an engine is lost above the maximum abort speed but below the minimum go speed, the pilot can neither abort nor take off safely on the runway length remaining without considering such factors as reducing gross weight or engaging the overrun end arrestment cable.

29.2.1 Use.

Enter the applicable plot with the prevailing density ratio and project horizontally to the available runway length grid line. Parallel the nearest guideline up or down to intersect the baseline. From this point descend vertically to intersect the applicable takeoff gross weight curve, then horizontally to read minimum go speed. If this projected line does not intersect the computed takeoff gross weight curve, then there will be no corresponding minimum go speed. If the gross weight curve lies to the right of the projected line, a single-engine takeoff cannot be made under the combined conditions.

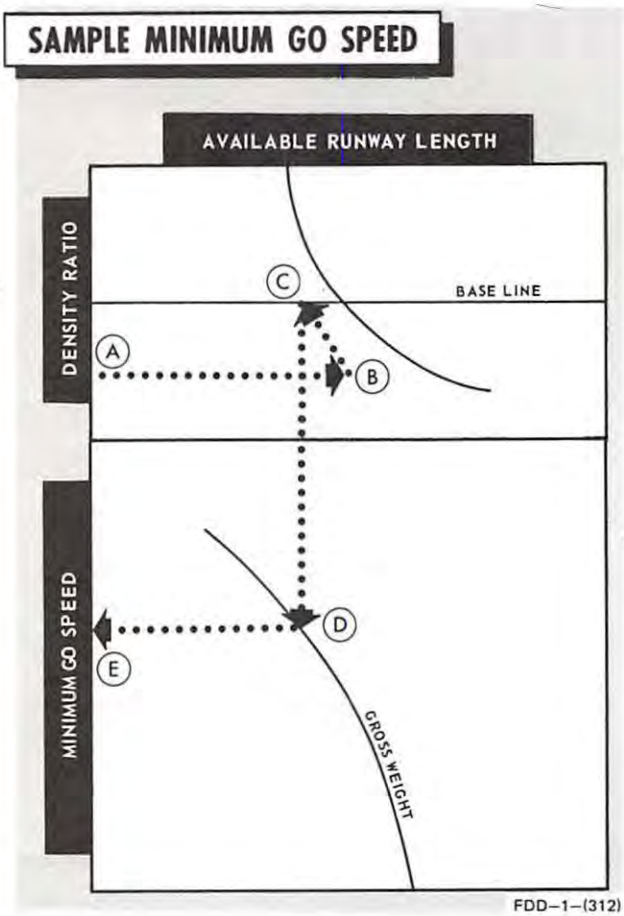
29.2.2 Sample Problem

Note

This problem assumes maximum thrust on operating engine within 6 seconds after engine failure.

Military Thrust Takeoff

A. Density ratio – 0.95.



FDD–1–(312)

B. Available runway length – 8,000 FEET.

C. Parallel guideline to baseline.

D. Takeoff gross weight – 56,000 POUNDS.

E. Minimum go speed – 175 KCAS.

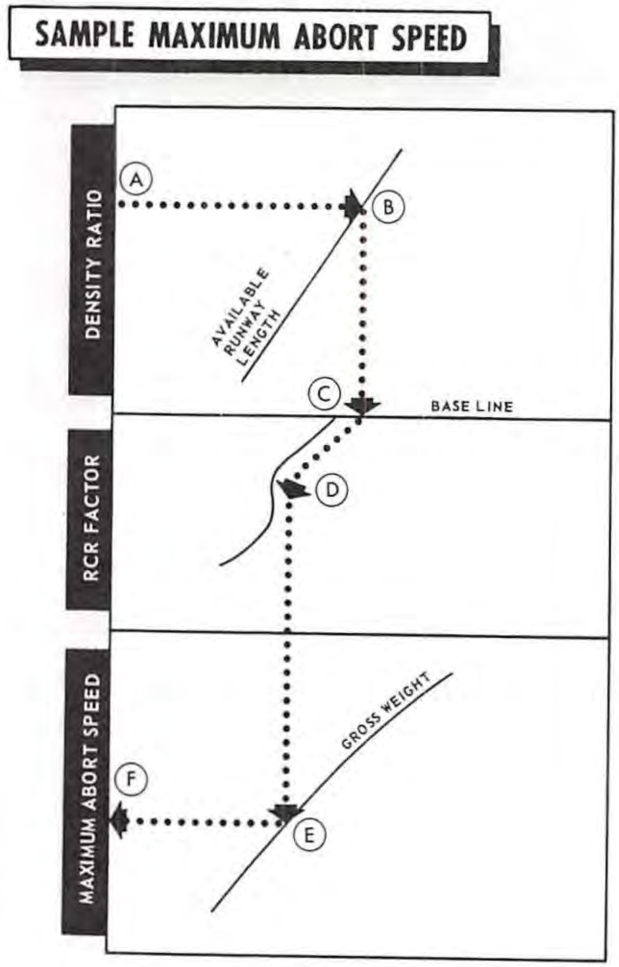
29.3 MAXIMUM ABORT SPEED CHARTS

Note

The maximum abort speed charts do not include the capability of any arrestment gear which may be installed and take into account only aircraft stopping performance for the given field conditions.

These charts (Figure 29-3 (sheets 1 and 2)) provide a means of determining the maximum speed at which an abort may be started and the aircraft stopped within the remaining runway length. Separate charts are provided for maximum and military thrust and each chart has separate plots to relate drag chute effects. Allowances included in this data are based on 3-second decision period (with both engines operating at the initial thrust setting) and a 5-second period to accomplish abort procedures (throttles to IDLE, wheelbrakes applied, and drag chute deployed (is used)).

29.3.1 Runway Condition Reading (RCR) Factors. RCR factors are synonymous with runway condition and climatic conditions. If RCR factors are not available (i.e., not provided at local base of operation), use RCR factor 23 for a dry runway, RCR factor 14 for a wet runway, and RCR factor 5 for an icy runway.



FDD–1–(313)

29.3.2 Use. Enter applicable plot with the prevailing density ratio and project horizontally to intersect the available runway length curve. From this point descend vertically to the RCR baseline and parallel nearest guideline down to the forecast RCR factor. From this point, descend further to intersect the computed takeoff gross weight, then horizontally to read the corresponding maximum abort speed.

29.3.3 Sample Problem

Maximum Thrust Takeoff Without Drag Chute

A. Density ratio – 1.0.

B. Available runway length – 8,000 FEET.

C. RCR baseline.

D. RCR factor – 16.

E. Gross weight – 56,000 POUNDS.

F. Maximum abort speed – 67 KNOTS.

29.4 TAKEOFF DISTANCE CHARTS

These charts (Figure 29-4 (sheets 1 and 2)) are used to determine the no wind ground run distance, wind adjusted ground run, and the total distance required to climb to a height of 50 feet. Separate charts are provided for maximum and military thrust. A table has been provided to show nosewheel liftoff speed with the corresponding aircraft takeoff speed for various gross weight and cg combinations.

29.4.1 Use. Enter the chart with the applicable density ratio and proceed horizontally to the right and intersect the takeoff weight line. Then descend vertically to read no wind ground run distance. Parallel the appropriate wind guideline (headwind or tailwind) to intersect the takeoff wind velocity. From this point, project vertically down to read the ground run adjusted for wind effects. To find the total distance required to climb to a height of 50 feet, continue downward to the reflector line and project horizontally to the left scale.

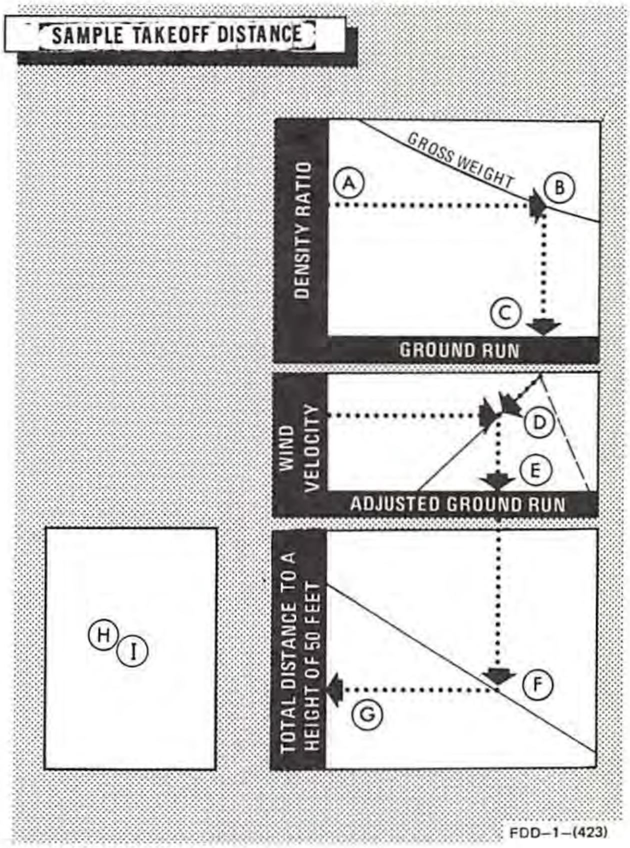
29.4.2 Sample Problem

Maximum Thrust

A. Density Ratio – 0.98.

B. Gross weight – 46,000 POUNDS.

C. No wind ground run distance – 2,200 FEET.



D. Effective headwind – 10 KNOTS.

E. Ground run (wind corrected) – 1,900 FEET.

F. Intersect reflector line.

G. Total distance required to climb to a height of 50 feet – 3,000 FEET.

H. Nosewheel liftoff speed for cg of 27 MAC (from table) – 139 KNOTS.

I. Takeoff speed (from table) – 164 KNOTS.

29.5 TAKEOFF GROUND RUN CORRECTION FOR CG

These charts (Figure 29-5 (sheets 1 and 2)) are used to adjust takeoff distances resulting from adverse conditions of high gross weight and forward cg.

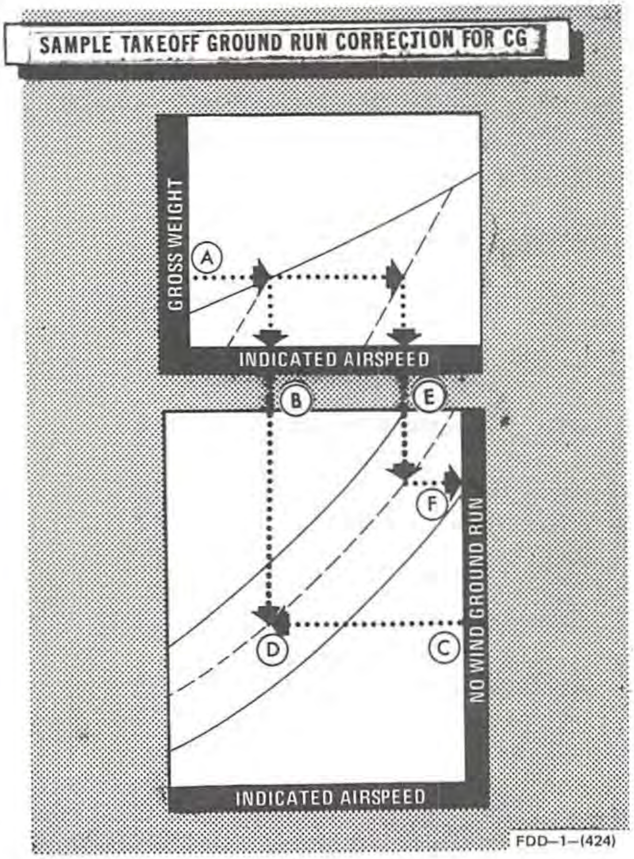
29.5.1 Use. To find takeoff speeds for various gross weight and cg combinations, enter the upper plot with the applicable gross weight and project horizontally to the right and intersect the normal takeoff speed cg line. From this point, descend vertically and read takeoff airspeed. To adjust ground run computed on takeoff distance charts for forward cg effects, enter the upper plot with the applicable gross weight and project horizontally to the right to intersect the applicable cg line. From this point, descend vertically and read normal aircraft takeoff speed. Reenter the chart at the ground run scale with the computed normal ground run distance (from takeoff distance chart) and project horizontally to the left and intersect line projected vertically from normal aircraft takeoff speed scale. From this intersection, parallel nearest acceleration guideline. Reenter with the tabulated takeoff speed and descend vertically to intersect newly plotted acceleration guideline. From this intersection, project horizontally to the right and read cg adjusted no wind ground run.

29.5.2 Sample Problem

Maximum Thrust, 27-Percent MAC

A. Gross weight – 46,000 POUNDS.

B. Normal aircraft takeoff speed – 160 KNOTS.



C. Normal no wind ground run (from takeoff distance chart) – 2,200 FEET.

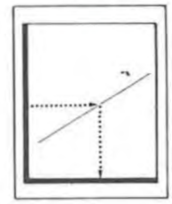
D. Parallel acceleration guideline.

E. Tabulated takeoff speed – 164 KNOTS.

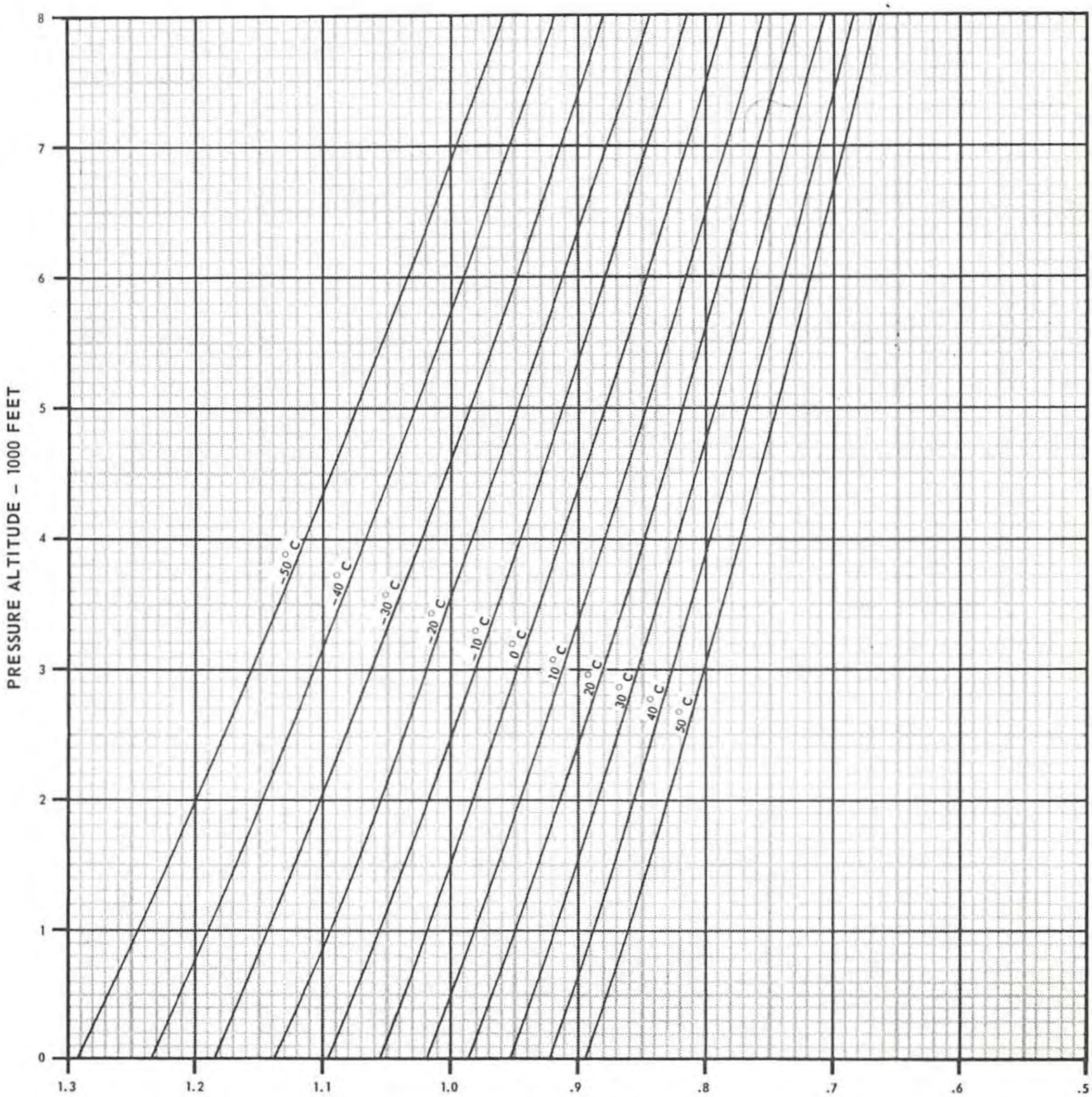
F. Corrected cg no wind ground run – 2,300 FEET.

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

GUIDE



DATE: 1 FEBRUARY 1969
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)



FDD-1-(418)

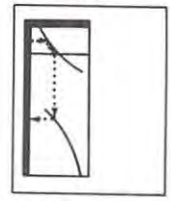
Figure 29-1. Density Ratio

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS 1/2 (30°)

REMARKS
ENGINE(S): (2) J79–GE–10B

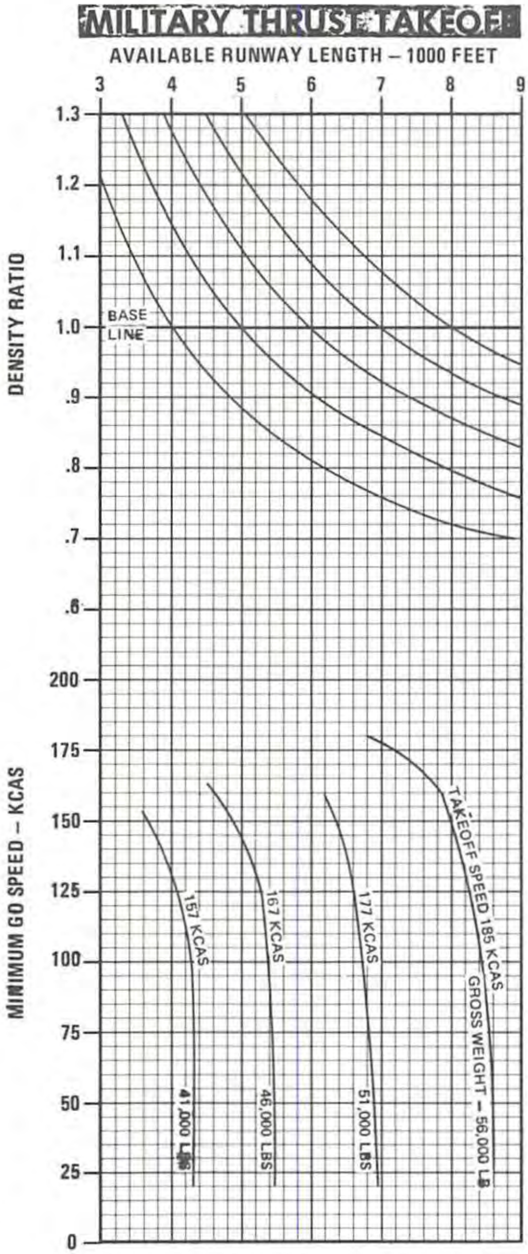
NOTE

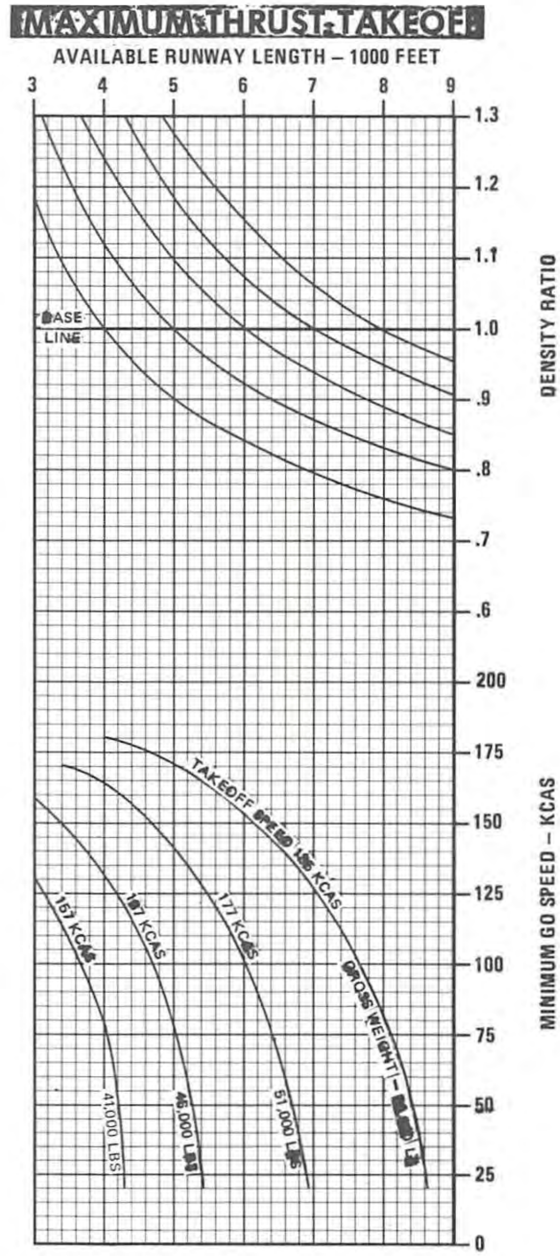
- SINGLE–ENGINE TAKEOFF, WITH AFTERBURNER IGNITED ON OPERATING ENGINE AFTER FAILURE DURING MILITARY THRUST TAKEOFF.
- SINGLE–ENGINE TAKEOFF/CLIMB–OUT CAPABILITY IS CRITICAL WITH HIGH GROSS WEIGHT AT LOW DENSITY RATIOS.



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



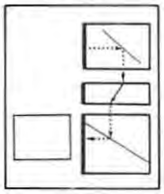


FDD–1–(325)

Figure 29-2. Minimum Go Speed (With Single-Engine Failure)

MAXIMUM THRUST
HARD DRY RUNWAY

GUIDE



AIRPLANE CONFIGURATION

1/2 FLAPS (30°)
ALL DRAG INDEXES

REMARKS

ENGINE(S): (2) J79–GE–10B

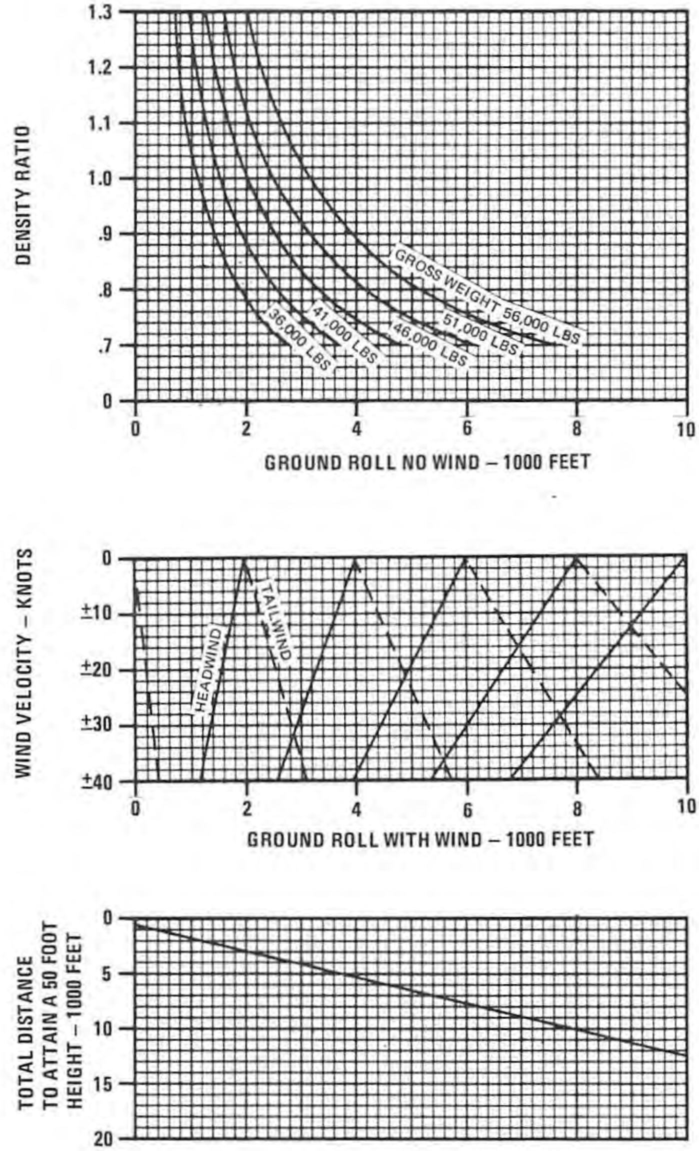
DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

NOTES

- IF ONE AFTERBURNER FAILS TO LIGHT, TAKEOFF DISTANCE WILL BE INCREASED BY 35%.
- GROSS WEIGHTS SHOWN ARE LIFT–OFF VALUES.
- ENGINE START AND TAXI FUEL WEIGHTS ARE FOUND IN PART 3.
- LIFT–OFF CENTER OF GRAVITY SHALL BE CALCULATED USING WEIGHT AND BALANCE HANDBOOK, AN1–1B–40.

CG % MAC	GROSS WEIGHT – 1000 LBS.				
	36	41	46	51	56
	NOSE WHEEL LIFTOFF SPEED/ TAKEOFF SPEED				
27	123/145	131/154	139/164	146/174	154/184
29	117/141	125/151	133/162	140/172	147/183
31	111/139	120/150	127/161	133/171	140/181
33	106/138	113/149	120/160	127/170	133/180
35	100/137	107/148	113/159	120/169	126/179



FDD–1–(419)

Figure 29-3. Maximum Abort Speed (Sheet 1 of 2)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
1/2 FLAPS (30°)
SLATS OUT

REMARKS
ENGINE (S): (2) J79-GE-10B
WITH ANTISKID INSTALLED AND OPERATING

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

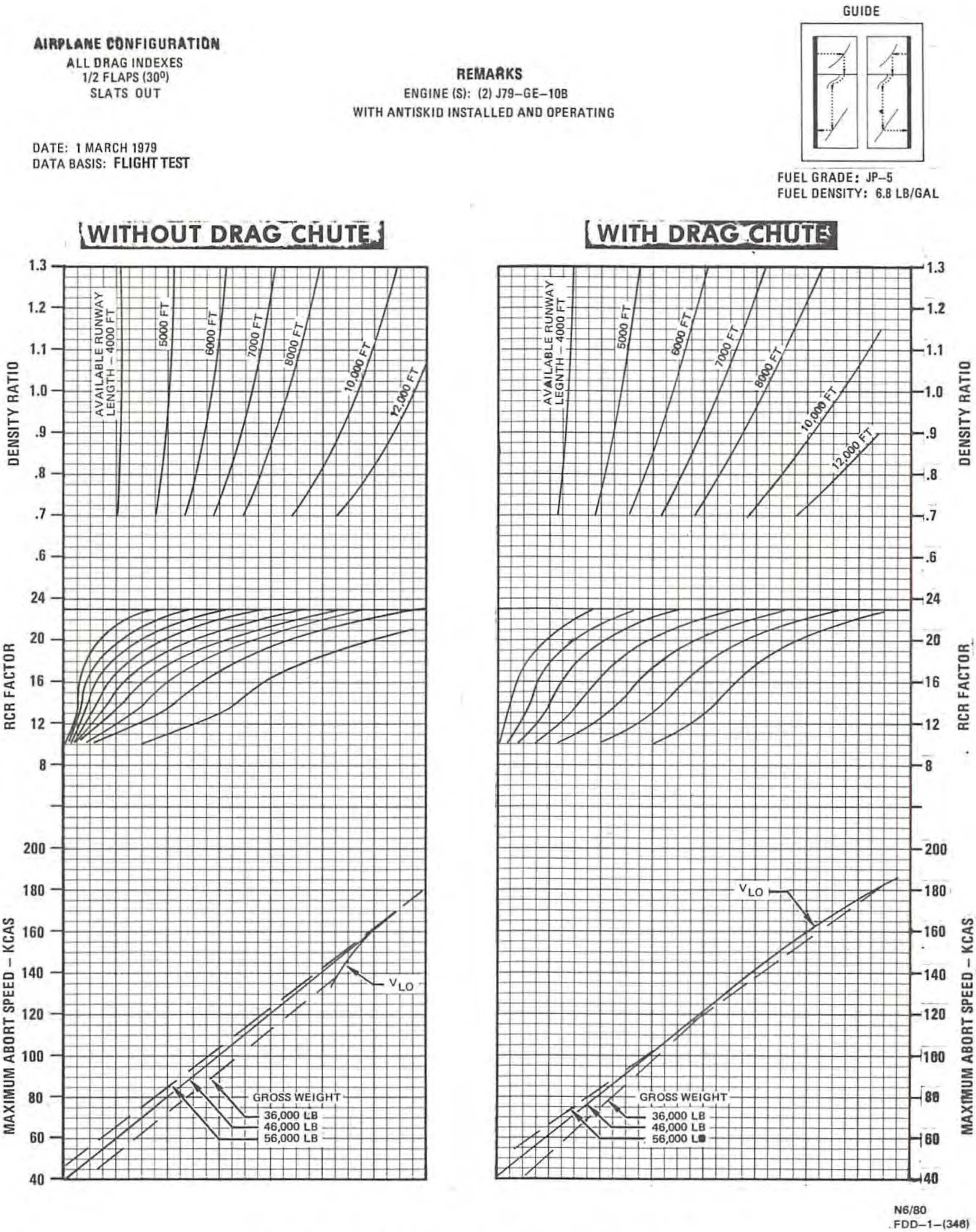
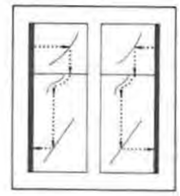


Figure 29-3. Maximum Abort Speed (Sheet 2 of 2)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
1/2 FLAPS (30°)
SLATS OUT

REMARKS
ENGINE(S): (2) J79-GE-10B
WITH ANTISKID INSTALLED AND OPERATING

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

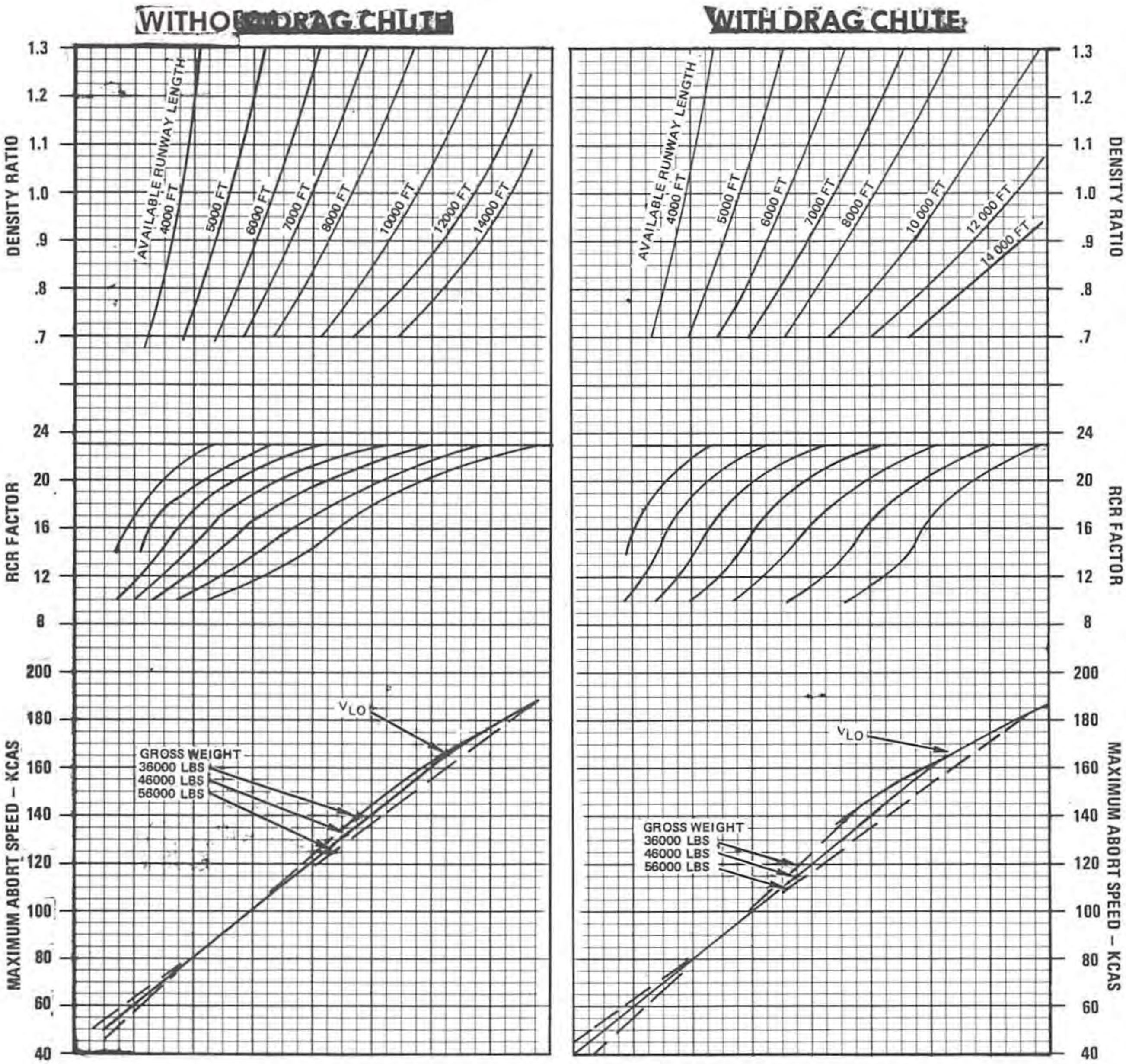


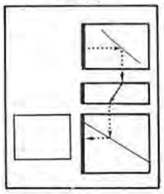
Figure 29-4. Takeoff Distance (Sheet 1 of 2)

AIRPLANE CONFIGURATION
1/2 FLAPS (30°)
ALL DRAG INDEXES

MILITARY THRUST
HARD DRY RUNWAY

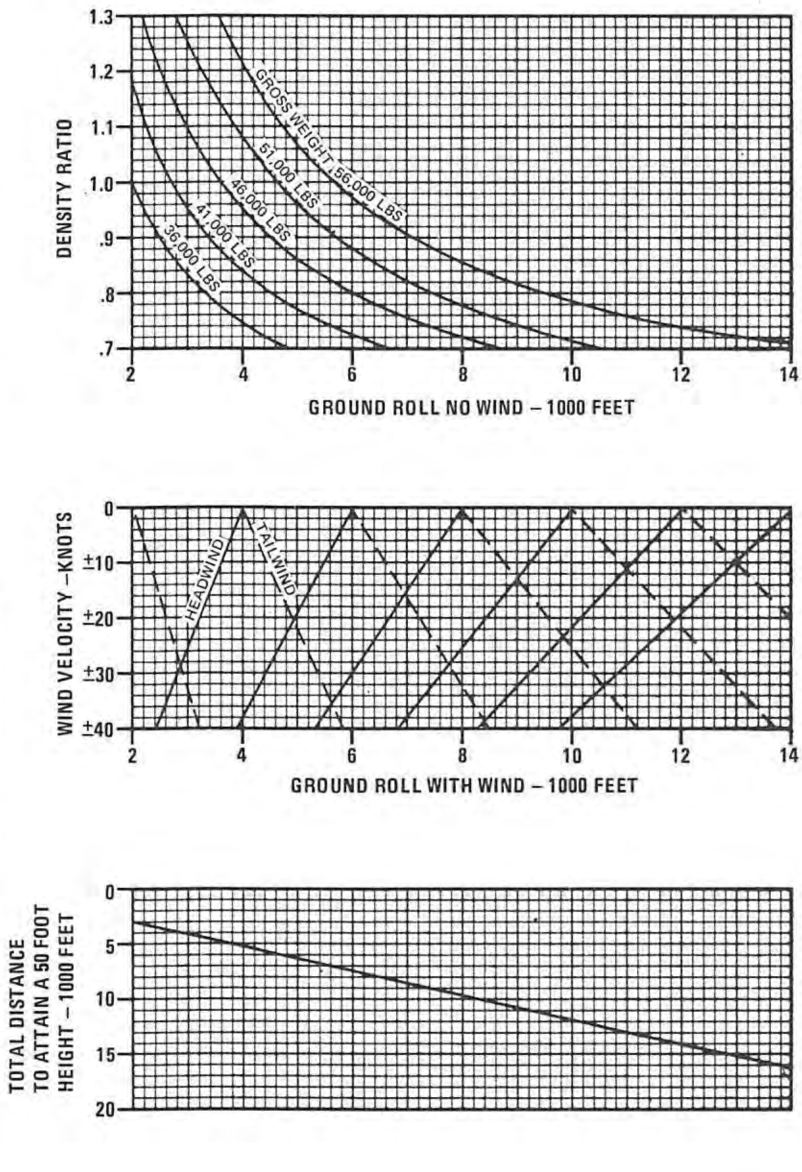
REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST



NOTES

- GROSS WEIGHTS SHOWN ARE LIFT–OFF VALUES.
- ENGINE START AND TAXI FUEL WEIGHTS ARE FOUND IN PART 3.
- LIFT–OFF CENTER OF GRAVITY SHALL BE CALCULATED USING WEIGHT AND BALANCE HANDBOOK, AN1–1B–40.

CG % MAC	GROSS WEIGHT – 1000 LB				
	36	41	46	51	56
	NOSEWHEEL LIFTOFF SPEED/ TAKEOFF SPEED				
27	124/148	132/159	140/170	147/180	155/188
29	118/146	126/158	134/168	141/178	148/187
31	112/145	121/157	128/167	134/177	141/186
33	107/144	114/156	121/166	128/176	134/185
35	101/143	108/155	114/165	121/175	127/184

FDD–1–(420)

Figure 29-4. Takeoff Distance (Sheet 2 of 2)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS 1/2 (30°)
GEAR DOWN

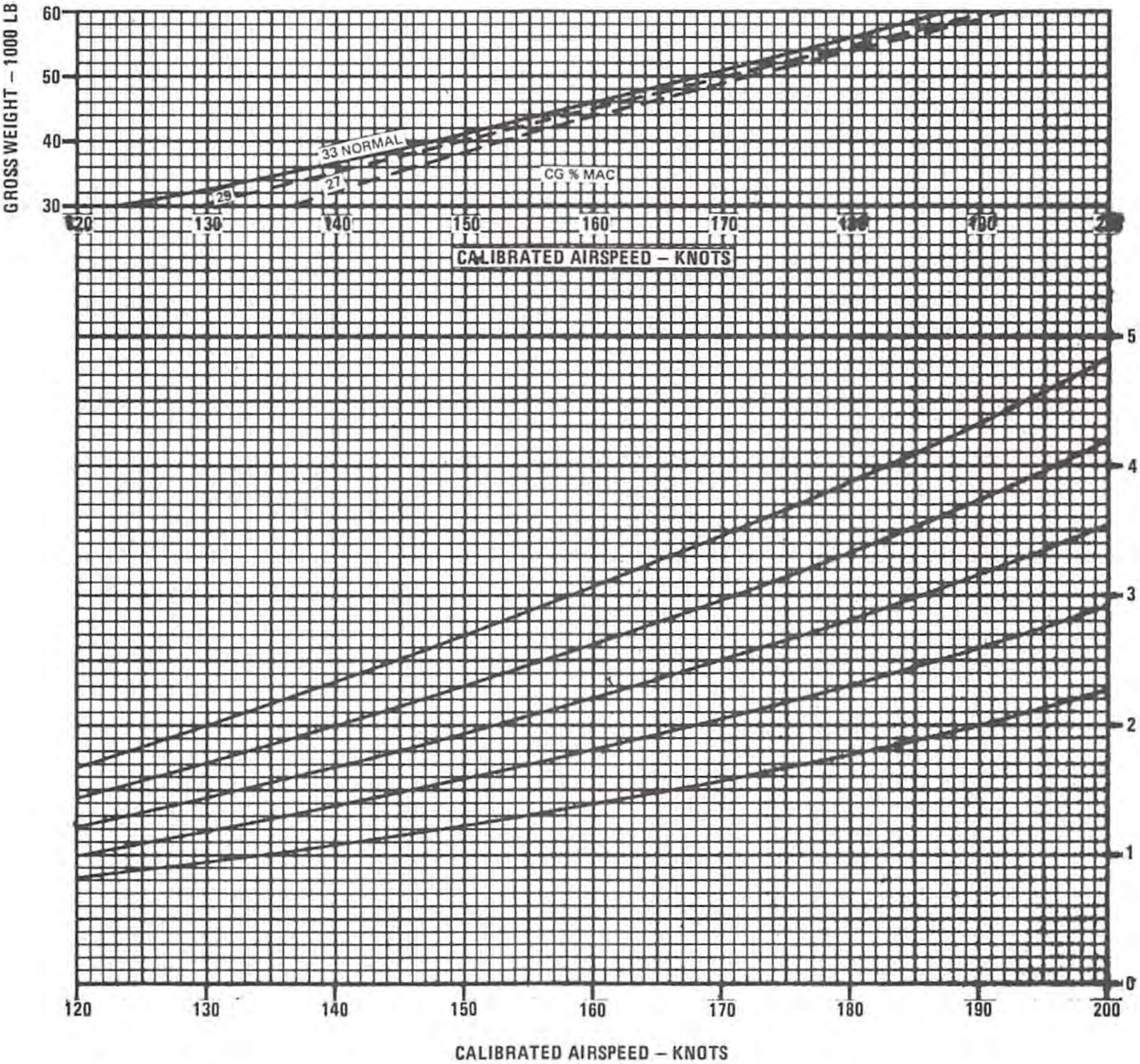
MAXIMUM THRUST HARD DRY RUNWAY

REMARKS
ENGINE(S): 2J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



FDD-1-(422)

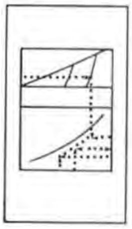
Figure 29-5. Takeoff Ground Run Correction for CG (Sheet 1 of 2)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS 1/2 (30°)
GEAR DOWN

MILITARY THRUST
HARD DRY RUNWAY

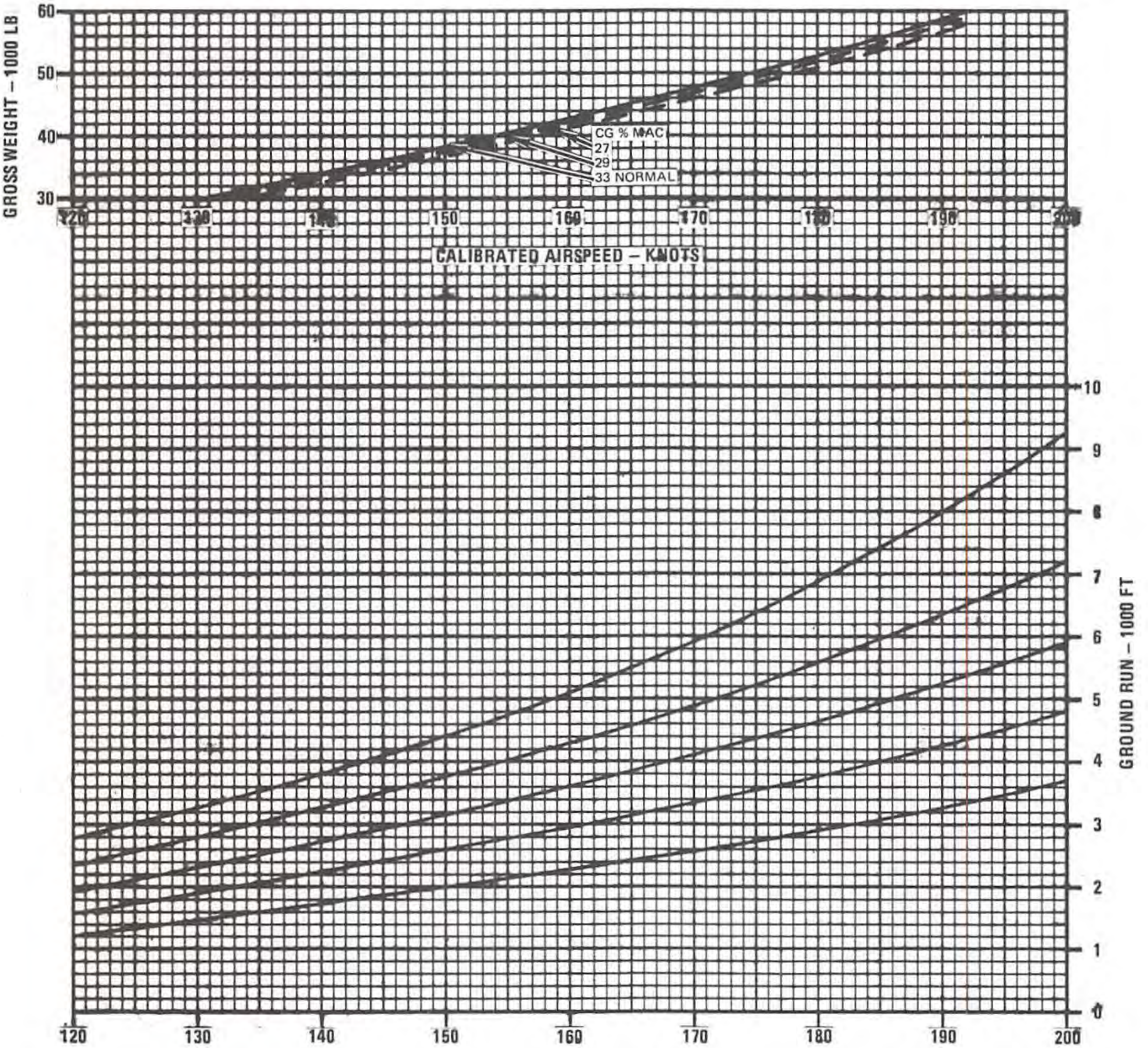
REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



FDD-1-(421)

Figure 29-5. Takeoff Ground Run Correction for CG (Sheet 2 of 2)

CHAPTER 30

Climb

Note

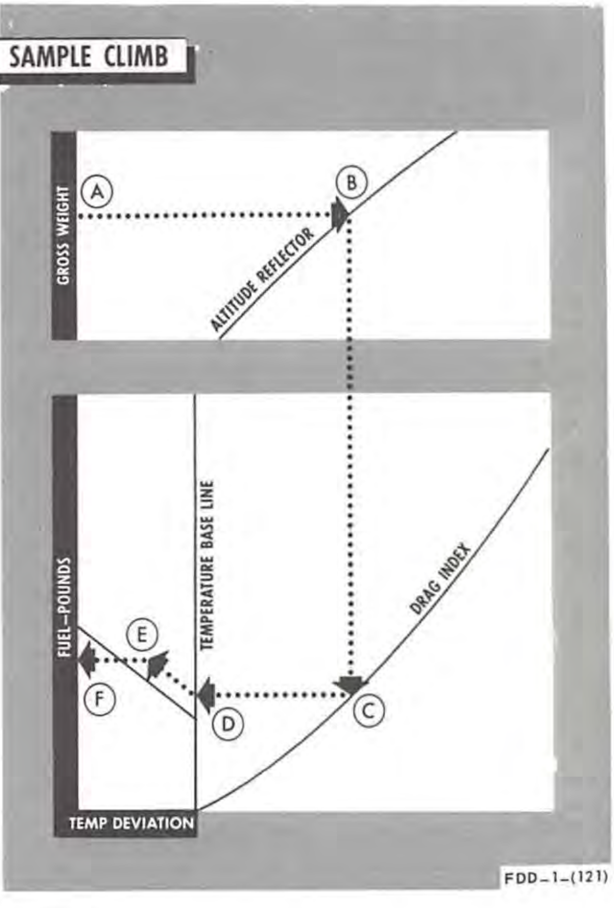
For aircraft with PRIDE antennas installed, additional units of drag must be applied to the computed drag index. Refer to Figure 28-2.

30.1 CLIMB CHARTS

Two series of charts are presented: one for military and one for maximum thrust climb schedules (Figures 30-1 and 30-2). Each series includes charts for determining time, distance covered, and fuel used while in the climb and tables for determining climb indicated airspeed and Mach number. Preclimb requirements are included in a table that presents time, fuel, and distance to intercept the climb schedule after takeoff. Time, fuel, and distance for a simplified military thrust climb are presented in Figure 30-3. This data is based on climbing at 350 knots until interception of optimum cruise Mach/TAS number, then maintaining cruise Mach to cruise altitude.

30.1.1 Use. Enter the climb speed schedule tables corresponding to the climb thrust and the computed drag index. Read the column of indicated airspeeds and the Mach numbers to be used during climb. Determine the preclimb fuel, distance, and time to intercept the climb schedule which corresponds to the applicable takeoff and acceleration options.

30.1.2 Charts. The method of presenting data on the time, distance, and fuel charts is identical, and the use of all three charts will be undertaken simultaneously here. Enter the charts with the initial climb gross weight. Project horizontally to the right and intersect the assigned cruise altitude or the optimum cruise altitude for the computed drag index. Project vertically downward to intersect the applicable drag index line, then project horizontally to the left to the temperature baseline (corresponds to ICAO standard day (°C)). Parallel the applicable guideline (hotter or colder) to intersect a vertical gridline corresponding to the degree of deviation between forecast flight temperature and standard ICAO day temperature. From this point, continue horizontally to the left to read the planning data.



FDD-1-(121)

30.1.3 Sample Problem

Fuel Required – Military Thrust

A. Gross weight – 50,000 POUNDS.

B. Cruise altitude – 30,000 FEET.

C. Drag index – 60.

D. Temperature baseline.

E. Temperature deviation – +5 °C.

F. Fuel required – 1,950 POUNDS.

G. Time to climb – 8.6 MINUTES.

H. Distance – 62 NM.

30.2 COMBAT CEILING CHARTS

This chart (Figure 30-4) presents the military and maximum thrust combat ceiling for various combinations of gross weight and drag index.

30.2.1 Use. Enter the applicable graph with estimated gross weight at end of climb. Project vertically upward to intersect applicable drag index, then horizontally to the left to the temperature baseline (corresponds to ICAO standard day (°C)). From this point, parallel the applicable guideline (hotter or colder) to intersect a vertical gridline corresponding to the degree of deviation between altitude at end of climb and standard day temperature. From this point, continue horizontally to the left to read combat ceiling.

30.2.2 Sample Problem

Combat Ceiling – Maximum Thrust and Two Engines

A. Gross weight at end of climb – 45,000 POUNDS.

B. Drag index – 40.

C. Temperature baseline.

D. Temperature deviation – +8 °C.

E. Combat ceiling – 48,000 FEET.

CLIMB SPEED SCHEDULE

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	DRAG INDEX													
	0		10		20		30		40		50		60	
ALTITUDE	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
0	592	.89	589	.89	585	.89	573	.87	560	.85	550	.83	540	.82
5000	549	.90	546	.89	543	.89	532	.87	521	.85	513	.84	505	.83
10000	510	.90	508	.90	505	.89	495	.88	485	.86	479	.85	472	.84
15000	466	.91	464	.90	461	.90	454	.88	447	.87	441	.86	435	.85
20000	430	.91	427	.90	424	.90	419	.89	413	.88	408	.87	403	.86
25000	390	.91	388	.91	385	.90	381	.89	376	.88	373	.88	370	.87
30000	357	.92	354	.91	350	.91	347	.90	344	.89	341	.89	338	.88
35000	320	.93	318	.92	315	.91	313	.91	310	.90	309	.90	307	.89
40000	286	.93	284	.92	281	.91	280	.91	279	.90	277	.90	275	.90
45000	254	.93	253	.92	251	.91	249	.91	247	.90	246	.90	245	.90

	DRAG INDEX															
	70		80		90		100		110		120		130		140	
ALTITUDE	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
0	524	.79	508	.77	492	.74	476	.72	462	.70	447	.68	436	.66	425	.64
5000	490	.80	475	.78	463	.76	450	.74	438	.72	425	.70	415	.68	405	.66
10000	460	.82	448	.80	437	.78	425	.76	415	.74	404	.72	393	.70	382	.69
15000	425	.83	415	.81	406	.79	396	.78	388	.76	380	.74	371	.73	362	.71
20000	395	.84	387	.83	379	.81	371	.80	366	.78	360	.77	352	.75	343	.74
25000	364	.86	357	.84	351	.83	345	.82	340	.81	335	.80	330	.78	325	.77
30000	334	.87	330	.86	326	.85	321	.84	318	.83	315	.83	310	.81	305	.80
35000	304	.89	301	.88	299	.87	296	.87	294	.86	292	.86	289	.85	285	.84
40000	273	.89	270	.88	269	.88	267	.87	266	.87	265	.86	264	.86	262	.86
45000	243	.89	240	.88	239	.88	237	.87	236	.87	235	.86	234	.86	232	.86

TAKEOFF ALLOWANCES & ACCELERATION TO CLIMB SPEED

START – 65 LB/ENG
RUNUP – 50 LB/ENG
TAXI – 21 LB/MIN/ENG

BRAKE RELEASE TO CLIMB SPEED	
MAX T.O. MAX ACCEL TO MAX CLIMB SPEED	
FUEL – LBS	1215
DIST. – NM	4
TIME – MIN	1

FDD-1-(348-1)

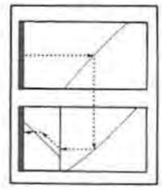
Figure 30-1. Climb – Maximum Thrust (Sheet 1 of 4)

TIME TO CLIMB
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

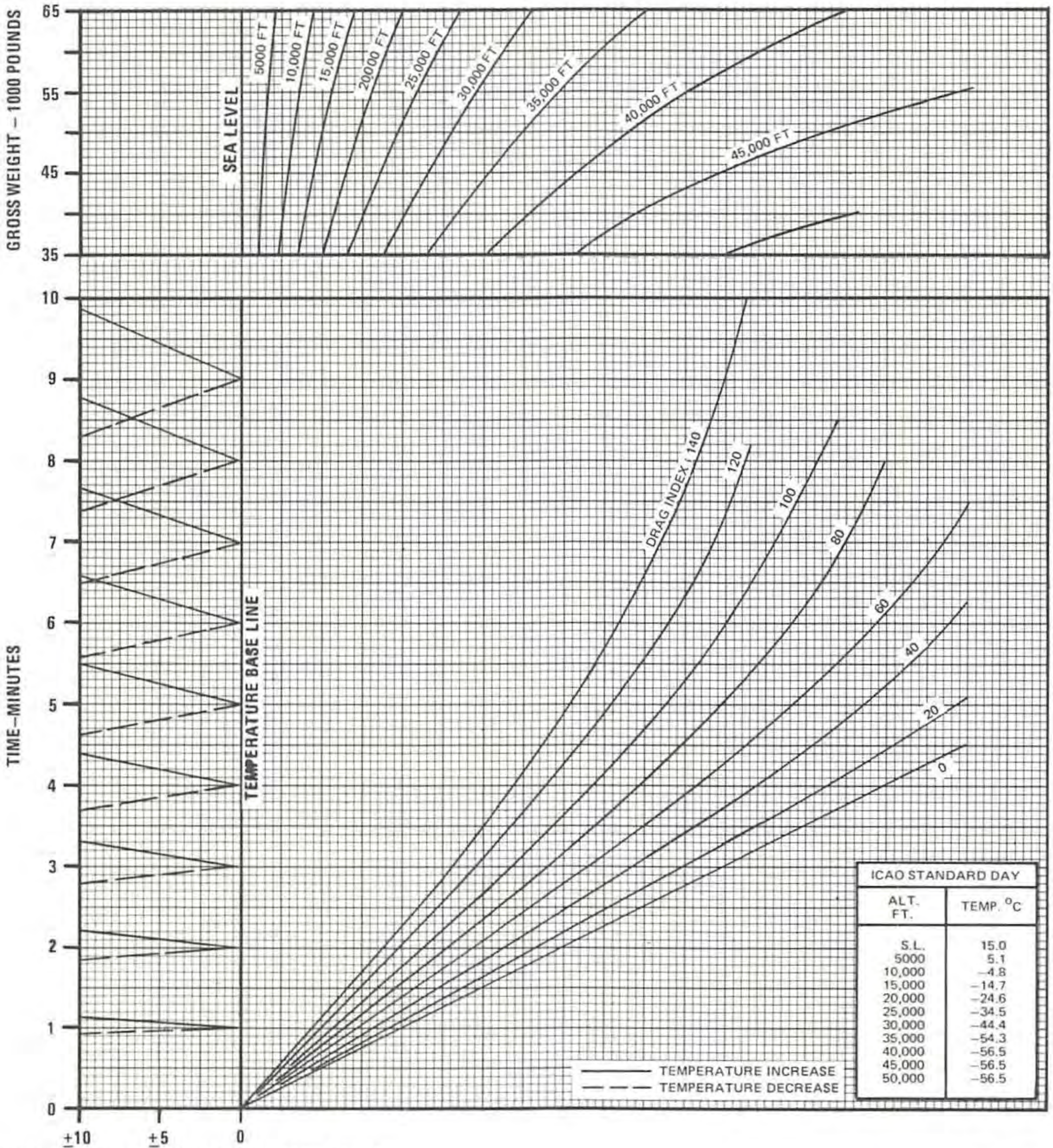
REMARKS
ENGINE(S): (2) J79–GE–10B

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY

ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	–4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

FDD–1–(348–2)

Figure 30-1. Climb – Maximum Thrust (Sheet 2 of 4)

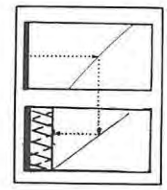
FUEL REQUIRED TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

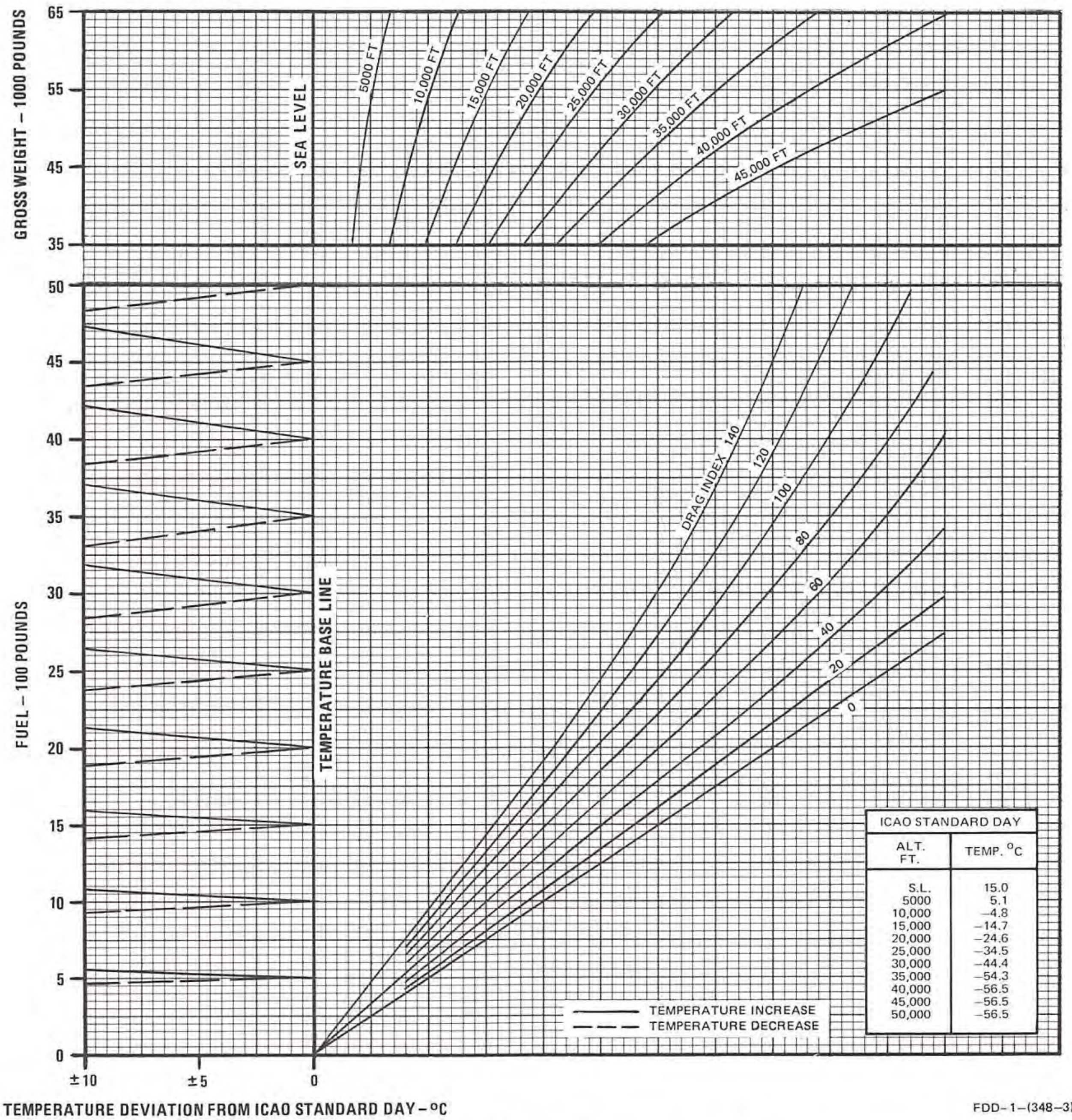
REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	–4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

FDD-1-(348-3)

Figure 30-1. Climb – Maximum Thrust (Sheet 3 of 4)

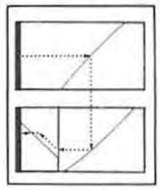
DISTANCE REQUIRED TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

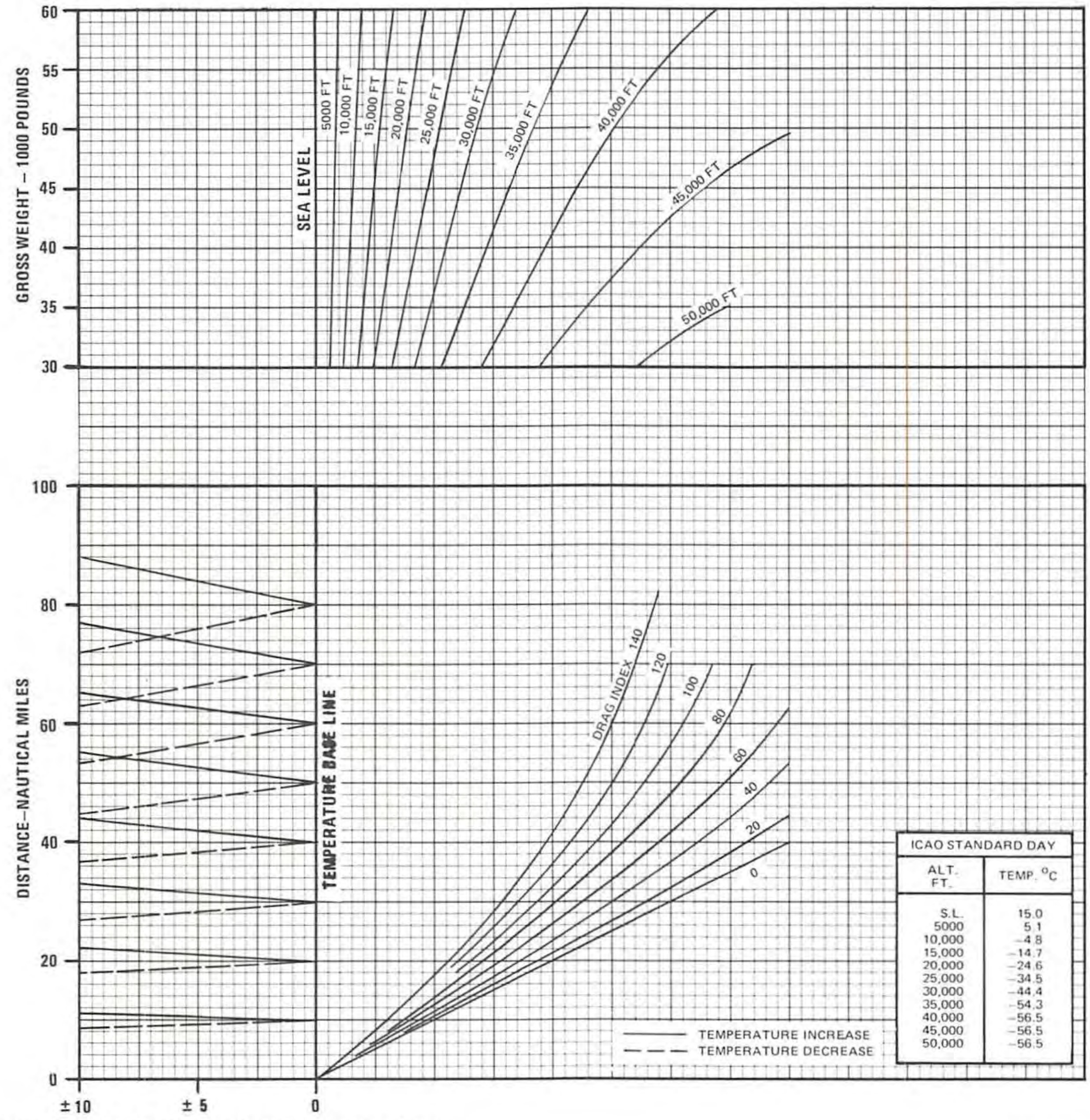
REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(348-4)

Figure 30-1. Climb – Maximum Thrust (Sheet 4 of 4)

CLIMB SPEED SCHEDULE

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	DRAG INDEX													
	0		10		20		30		40		50		60	
ALTITUDE	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
0	467	.71	447	.68	426	.65	413	.63	400	.61	388	.59	375	.57
5000	442	.73	426	.70	410	.67	398	.65	385	.63	373	.61	360	.59
10000	420	.75	406	.72	391	.70	381	.68	370	.66	360	.64	349	.63
15000	394	.77	382	.75	370	.73	362	.71	354	.70	346	.68	337	.66
20000	370	.79	363	.78	355	.76	348	.75	341	.73	334	.72	326	.70
25000	345	.82	341	.81	336	.80	331	.78	326	.77	321	.76	315	.75
30000	322	.84	320	.84	317	.83	314	.82	310	.81	307	.81	303	.80
35000	298	.87	298	.87	298	.87	294	.86	289	.85	285	.84	280	.83
40000														

	DRAG INDEX															
	70		80		90		100		110		120		130		140	
ALTITUDE	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH	KCAS	MACH
0	360	.54	344	.52	335	.50	325	.49	320	.48	315	.48	309	.47	303	.46
5000	347	.57	334	.55	325	.54	315	.52	314	.52	312	.52	301	.50	290	.48
10000	339	.61	328	.59	320	.57	311	.56	303	.55	295	.53	288	.52	281	.51
15000	329	.65	320	.63	312	.62	304	.60	295	.58	285	.56	278	.55	271	.54
20000	320	.69	313	.68	305	.66	297	.65	287	.62	267	.60	268	.58	260	.57
25000	309	.74	303	.72	296	.71	289	.69	275	.66	260	.63	253	.61	245	.59
30000	297	.78	290	.77	281	.75	272	.72	259	.69	245	.65	236	.63	227	.61
35000	274	.81	268	.79	262	.77	255	.75	241	.72	226	.68	219	.66	212	.64
40000																

TAKEOFF ALLOWANCES & ACCELERATION TO CLIMB SPEED

START – 65 LB/ENG.
RUNUP – 50 LB/ENG.
TAXI – 21 LB/MIN/ENG.

	BRAKE RELEASE TO CLIMB SPEED		
	MIL T.O. MIL ACCEL TO MIL CLIMB SPEED	MAX T.O. MIL ACCEL TO MIL CLIMB SPEED	MAX T.O. MAX ACCEL TO MIL CLIMB SPEED
FUEL – LBS	420	615	750
DIST – N.M.	4	4	2
TIME – MIN.	1	1	1

FDD–1–(349–1)

Figure 30-2. Climb – Military Thrust (Sheet 1 of 4)

TIME TO CLIMB

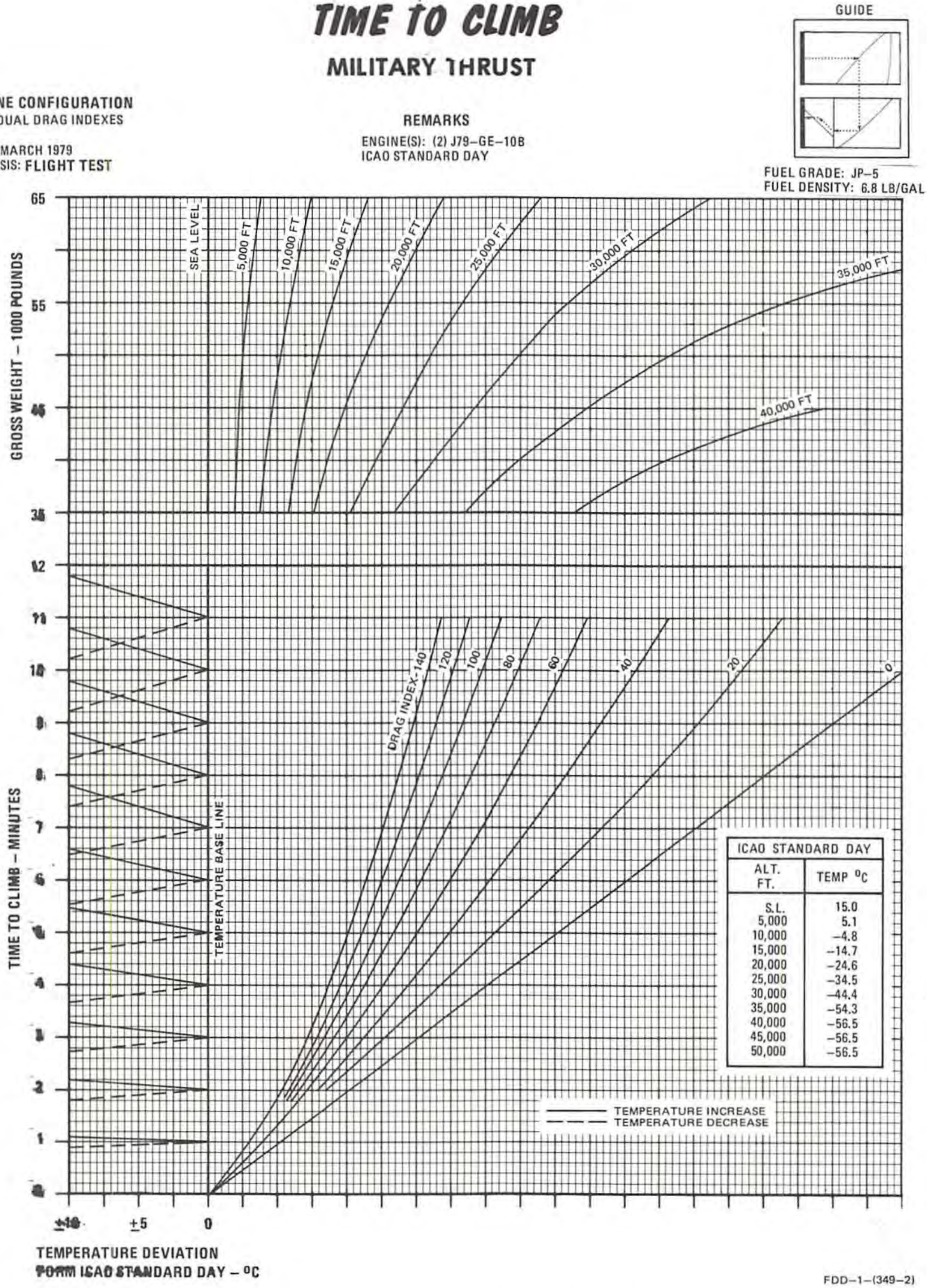
MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

FDD-1-(349-2)

Figure 30-2. Climb – Military Thrust (Sheet 2 of 4)

FUEL REQUIRED TO CLIMB

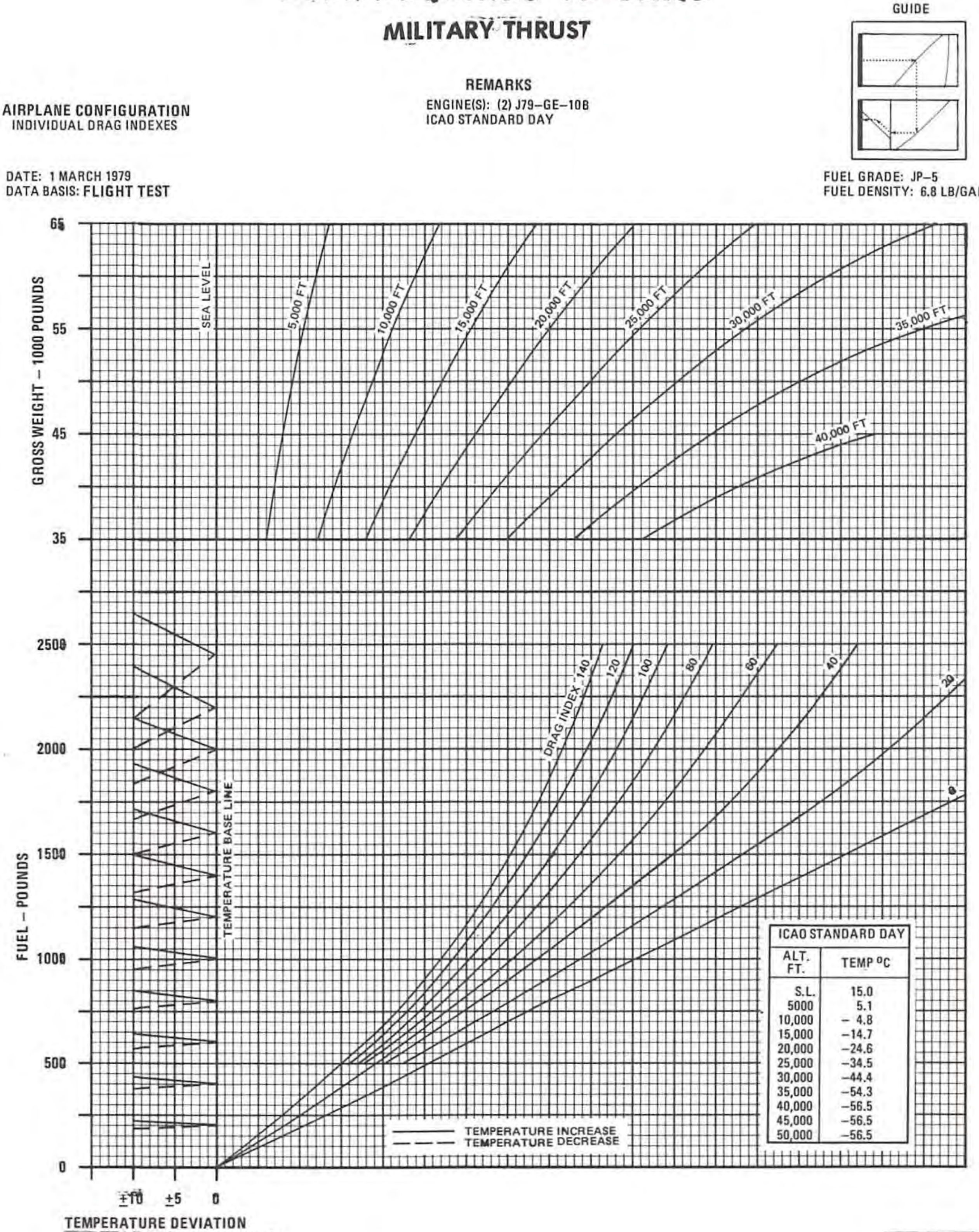
MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	– 4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

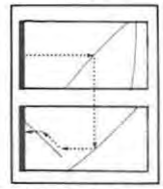
FDD–1–(349–3)

Figure 30-2. Climb – Military Thrust (Sheet 3 of 4)

DISTANCE REQUIRED TO CLIMB

MILITARY THRUST

GUIDE

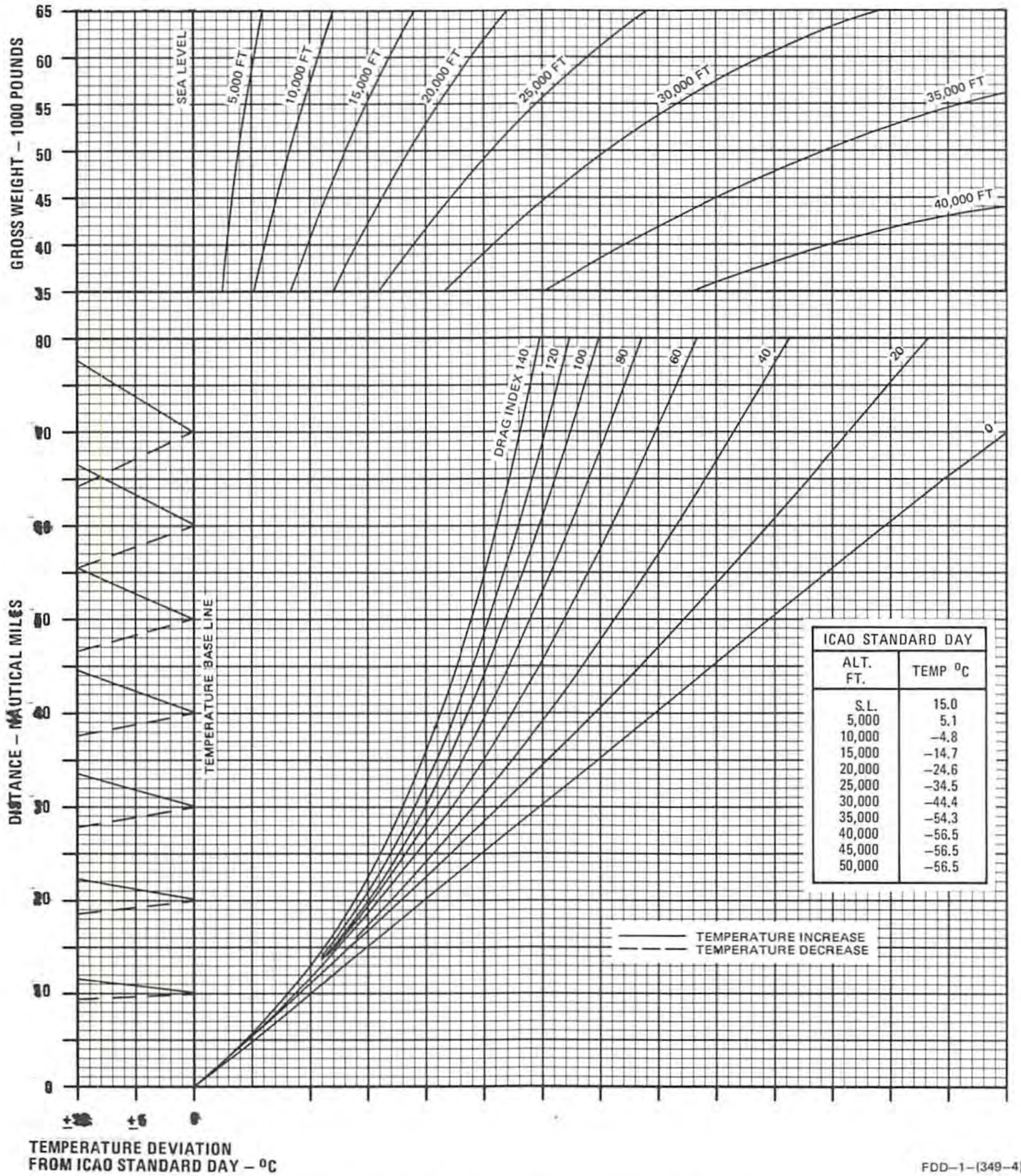


AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

FDD-1-(349-4)

Figure 30-2. Climb – Military Thrust (Sheet 4 of 4)

TIME TO CLIMB

350 KCAS MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

REMARKS

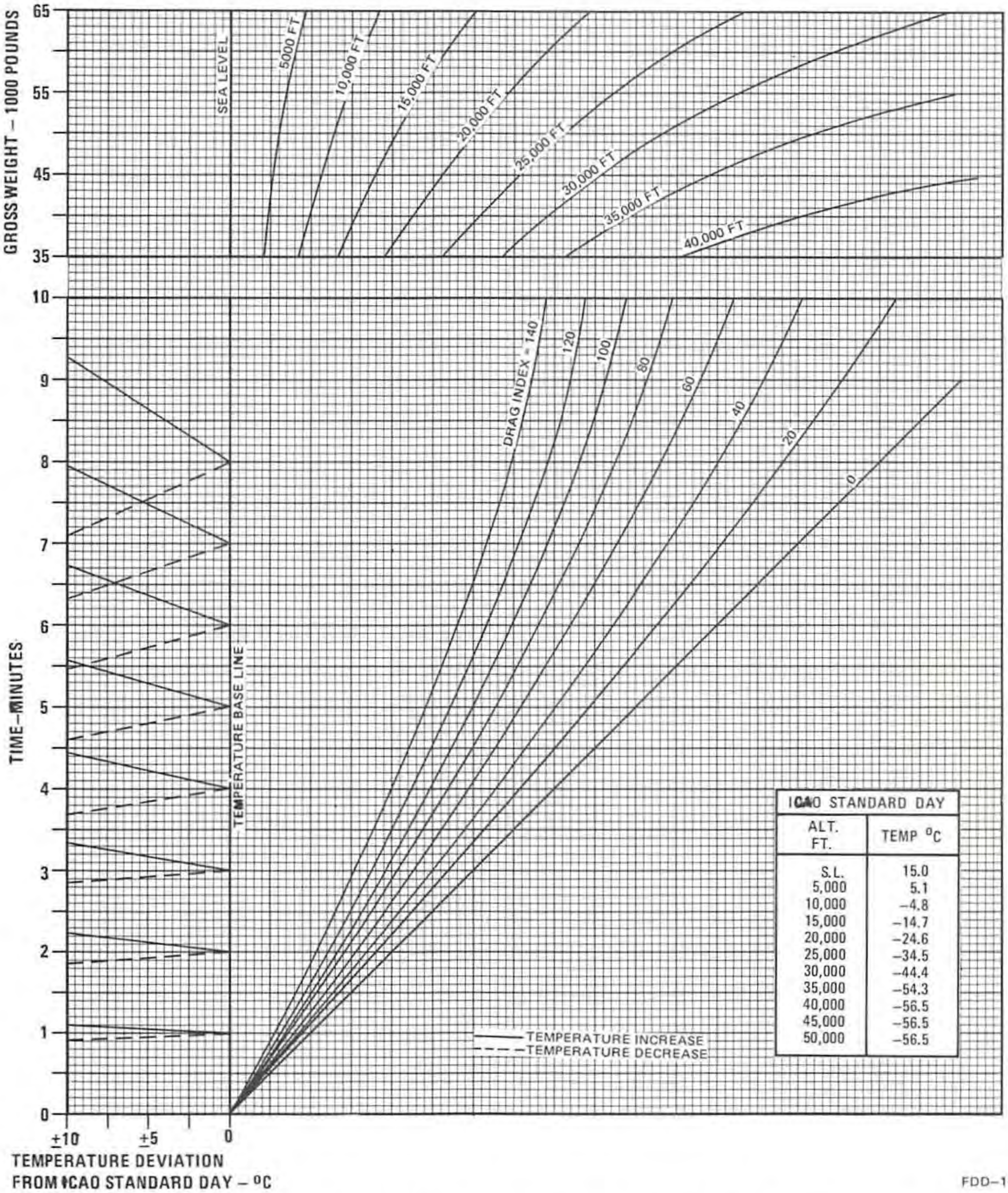
ENGINE(S): (2) J79-GE-10B

NOTE

DATA BASED ON 350 – KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/ TAS. THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

Figure 30-3. Climb – 350 KCAS and Military Thrust (Sheet 1 of 3)

FUEL REQUIRED TO CLIMB
350 KCAS MILITARY THRUST

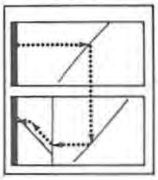
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B

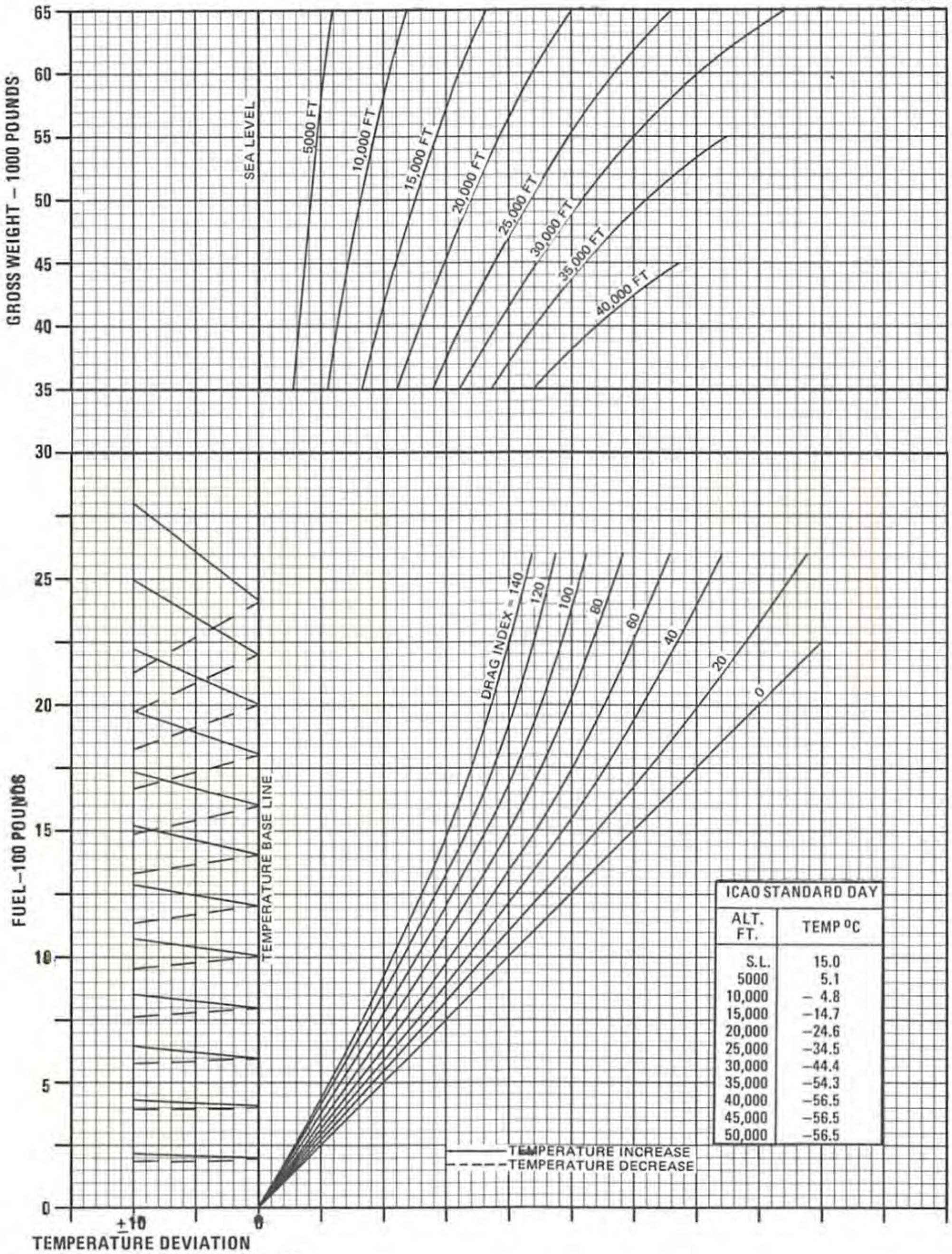
NOTE
DATA BASED ON 350 – KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/TAS. THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	– 4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

FDD-1-(3█-2)

Figure 30-3. Climb – 350 KCAS and Military Thrust (Sheet 2 of 3)

DISTANCE REQUIRED TO CLIMB

350 KCAS MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

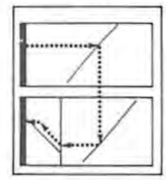
REMARKS

ENGINE(S): (2) J79-GE-10B

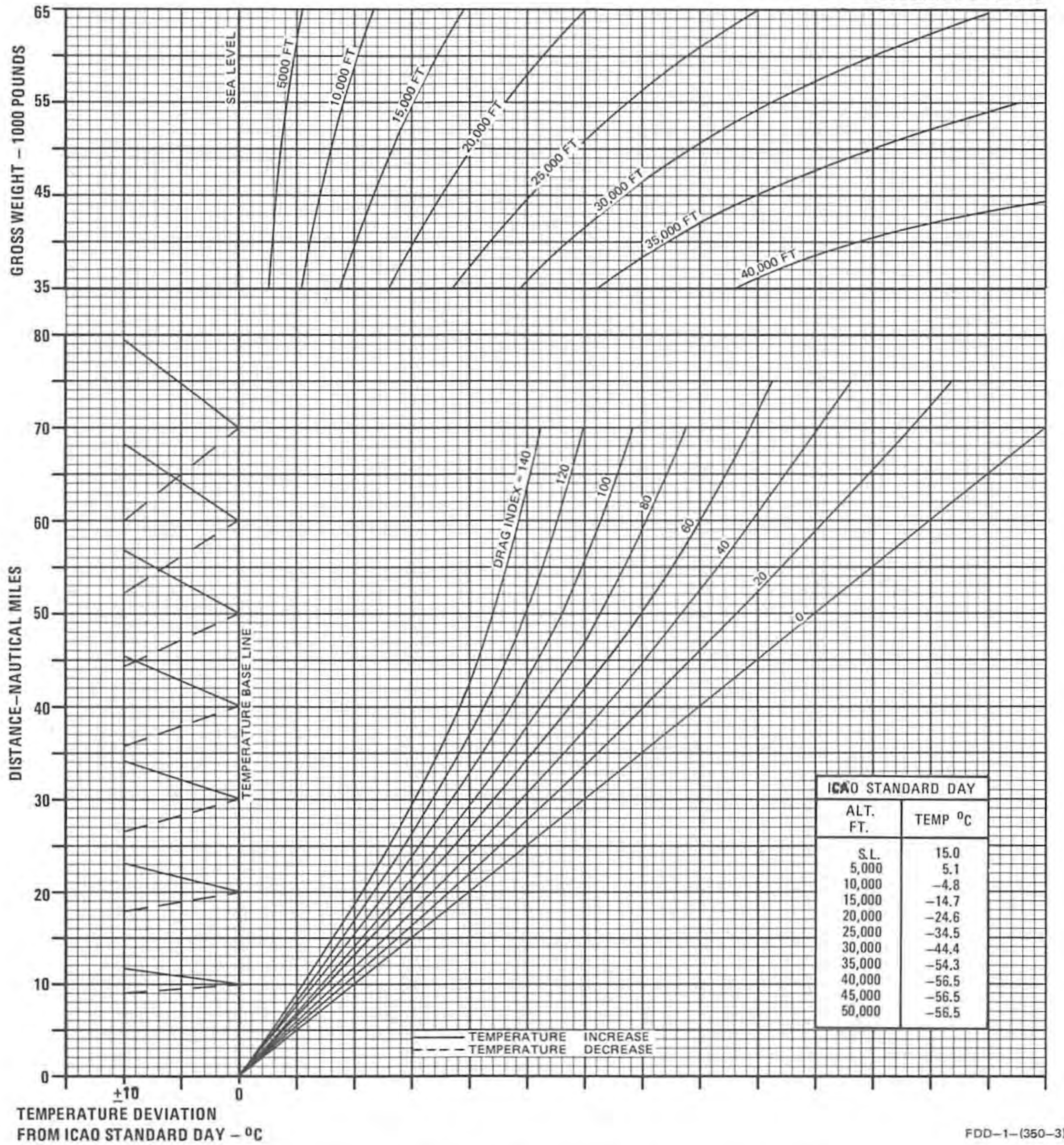
NOTE

DATA BASED ON 350 – KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/TAS. THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	–4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

FDD–1–(350–3)

Figure 30-3. Climb – 350 KCAS and Military Thrust (Sheet 3 of 3)

COMBAT CEILING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

IACO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

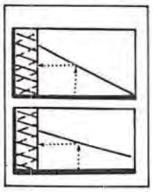
DATE: 1 MARCH 1979
DATE BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79–GE–10
ICAO STANDARD DAY

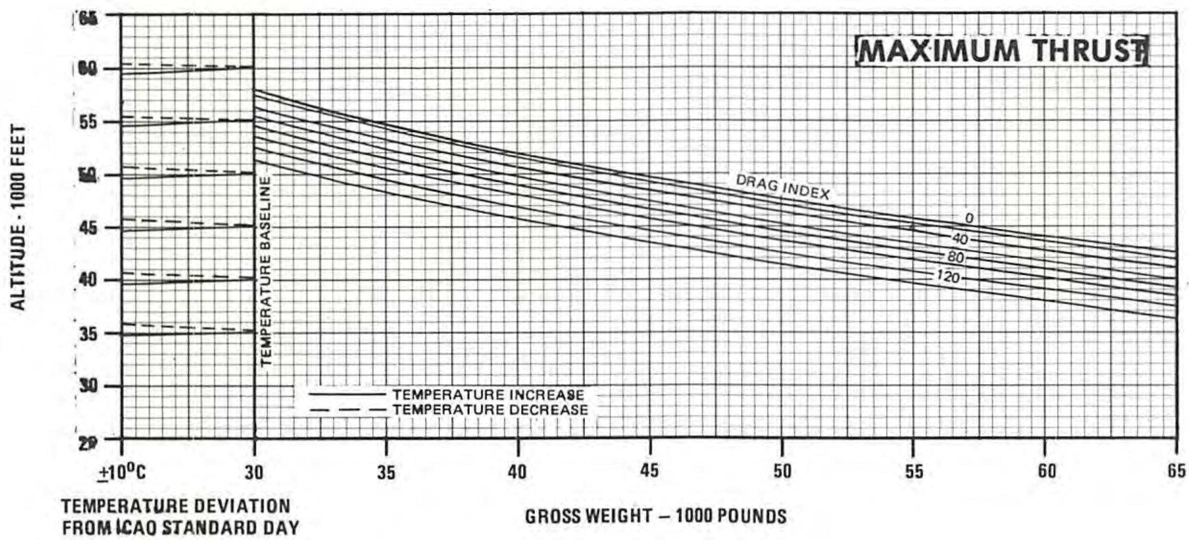
NOTE

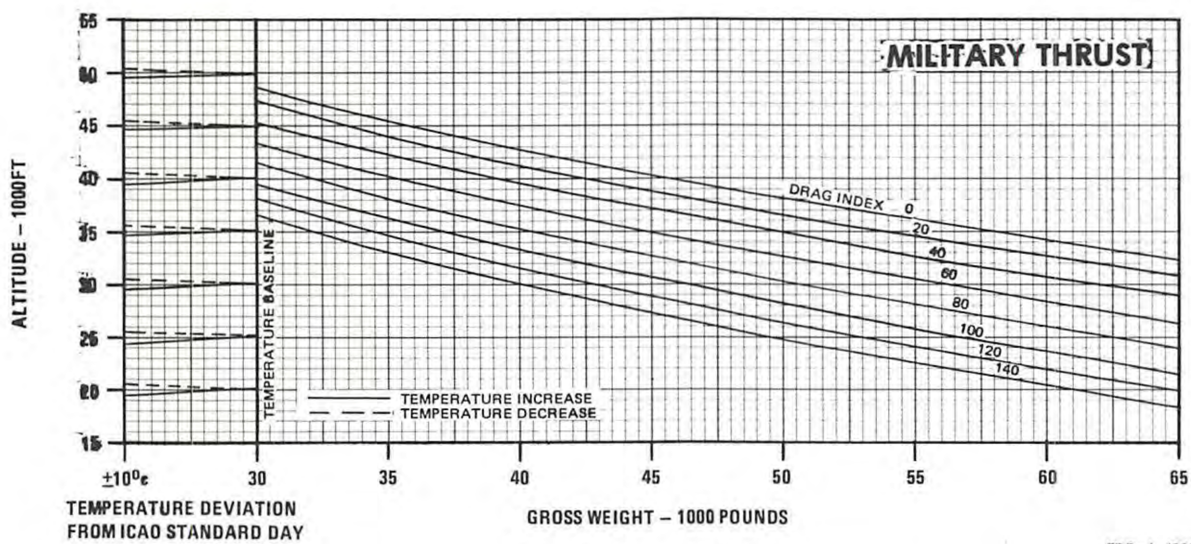
COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE.

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8LB./GAL.





FDD–1–(326)

Figure 30-4. Combat Ceiling

CHAPTER 31

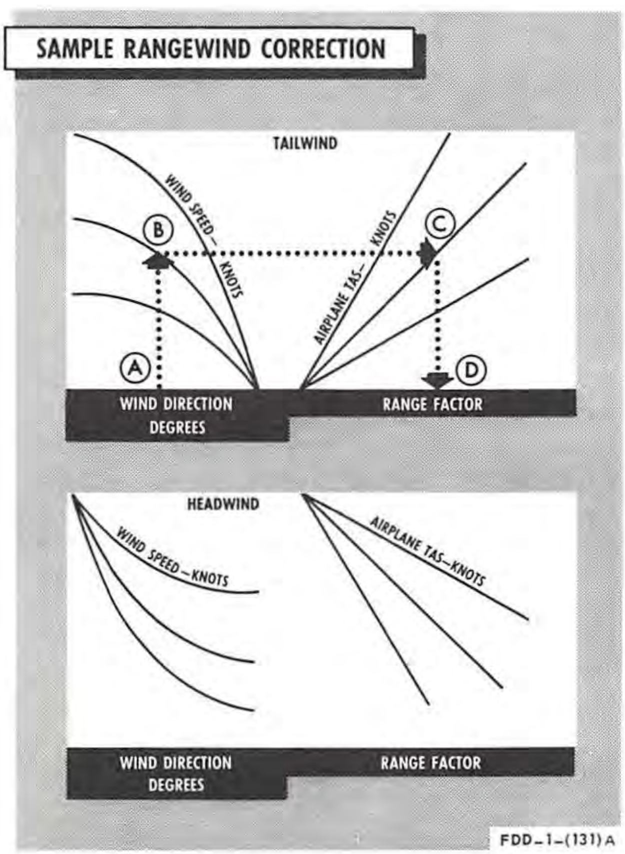
Range

Note

For aircraft with PRIDE antennas installed, additional units of drag must be applied to the computed drag index. Refer to Figure 28-2.

31.1 RANGE-WIND CORRECTION CHART

This chart (Figure 31-1) provides a means of correcting computed range (specific or total) for existing wind effects. The presented range factors consider windspeeds up to 150 knots from any relative wind direction for aircraft speeds of 200 to 1,300 KTAS.



31.1.1 Use. Determine the relative wind direction by subtracting the aircraft heading from the forecast wind direction. If the aircraft heading is greater than the forecast wind direction, add 360° to the wind direction and then perform the subtraction. Enter the chart with relative wind direction and proceed vertically to the interpolated windspeed. From this point, project horizontally to intersect the aircraft true airspeed and reflect to the lower scale to read the range factor. Multiply computed range by this range factor to find range as affected by wind.

31.1.2 Sample Problem

A. Relative wind direction – 150°.

B. Windspeed – 125 KNOTS.

C. Aircraft speed – 400 KTAS.

D. Range factor – 1.25.

31.2 OPTIMUM CRUISE SUMMARY

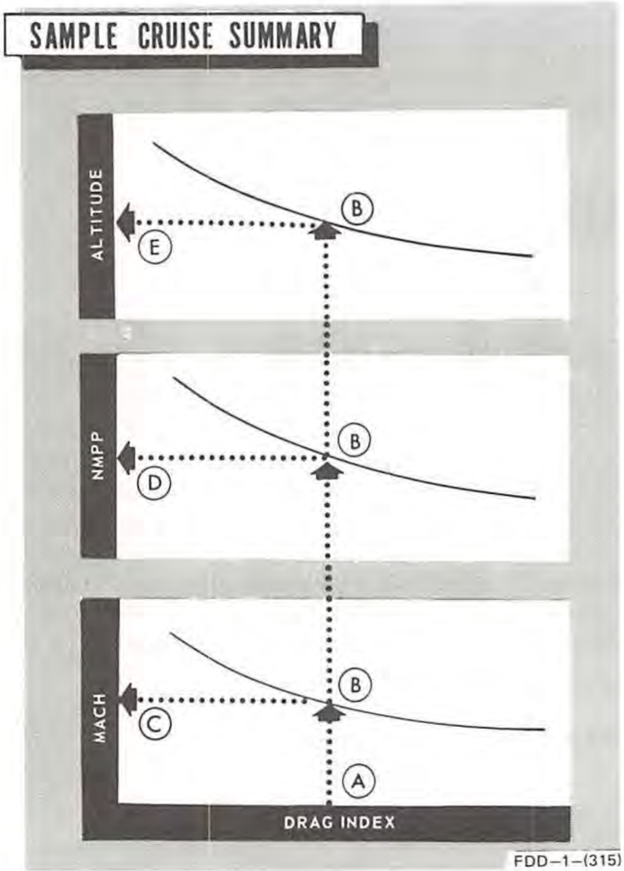
This chart (Figure 31-2) presents optimum cruise data for two-engine operation. The chart depicts cruise altitude, specific range (in nautical miles per pound), and cruise Mach number for all gross weights and drag indexes.

31.2.1 Use. Enter the chart with the previously computed drag index and project vertically to intersect the gross weight curves of all three plots. At the intersection of the appropriate gross weight curves, reflect horizontally to the left and read cruise Mach number, specific range in nautical miles per pound, and cruise altitude.

31.2.2 Sample Problem

A. Drag index – 20.

B. Gross weight – 40,000 POUNDS.



C. Mach number – 0.86.

D. Specific range – 0.94 NMPP.

E. Cruise altitude – 39,500 FEET.

31.3 LOW-ALTITUDE CRUISE TABLES

These charts (Figure 31-3 (sheets 1 through 3)) present total fuelflow values for various combinations of true airspeed and drag index at altitudes of sea level, 4,000, 8,000, 12,000, and 16,000 feet. Also included is the resultant V_{max} (maximum attainable TAS) for a particular altitude-drag index combination at a MIL thrust setting. Separate charts are provided for several gross weights. Fuelflow values are tabulated for ICAO standard day; however, correction factors are given for nonstandard temperatures.

31.3.1 Use. After selecting the applicable table for gross weight and altitude, determine the equivalent standard day true airspeed by dividing the desired true airspeed by the nonstandard day temperature correction factor obtained from the TEMP EFFECTS column. Enter the table with the equivalent standard day true airspeed and project horizontally to the applicable drag index column and read total fuelflow for a standard day. To obtain the total fuelflow at the desired true airspeed, multiply the total fuelflow for a standard day by the nonstandard day temperature correction factor.

31.3.2 Sample Problem

Gross Weight 45,000 Pounds, Sea Level (15 °C)

A. Desired airspeed – 540 KTAS.

B. Drag index – 20.

C. Nonstandard day temperature – -20 °C.

D. Correction factor – .937.

E. Equivalent standard day true airspeed (A ÷ D) – 576 KTAS.

F. Standard day total fuelflow – 21,746 PPH.

G. Total fuelflow at desired true airspeed (F X D) – 20,376 PPH.

31.4 CONSTANT MACH/ALTITUDE CRUISE

These charts (Figures 31-4 and 31-5) present nautical miles per pound and total fuelflow for various combinations of Mach number, gross weight, altitude, and drag index. This data is based on cruise at a constant Mach number and a constant altitude. Specifics are presented for 0 °C; however, correction factors are provided for temperature deviations.

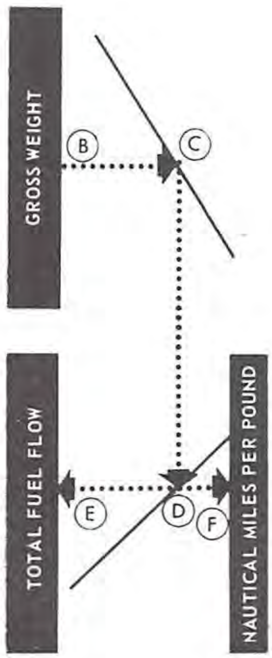
31.4.1 Use. After selecting the desired cruise Mach, enter the chart with the estimated gross weight at end of climb. Project horizontally to the right to intersect the desired cruise altitude, then vertically downward to intersect the applicable drag index. From this point, project horizontally to both sides of the graph and read nautical miles per pound and total fuelflow for 0 °C temperature. If required, correct these values for the actual temperatures.

31.4.2 Sample Problem

A. Mach number – 0.85.

B. Gross weight – 40,000 POUNDS.

SAMPLE CONSTANT MACH/ALTITUDE CRUISE



FDD-1-(132)

C. Altitude – 30,000 FEET.

D. Drag index – 40.

E. Total fuelflow – 7,200 PPH.

F. Specific range – 0.056 NMPP.

G. Actual temperature – -20 °C.

H. Total fuelflow (corrected) – 6,912 PPH.

31.5 CONSTANT ALTITUDE CRUISE

These charts (Figures 31-6 and 31-7) present the necessary planning data to set up optimum cruise schedules for normal two-engine and single-engine operation at a constant altitude. The recommended procedure is to use an average gross weight for a given leg of the mission. One way to find the average gross weight is to divide the mission into weight segments. With this method, readjust the cruise schedule each time a given amount of fuel is used. Subtract one-half of the fuel weight allotted for the first leg from the initial cruise gross weight. The remainder is the average gross weight for the leg. It is possible to obtain instantaneous data if desired.

31.5.1 Use. Enter the left side of sheet 1 with the average gross weight. Project horizontally to the right to intersect desired cruise altitude, then vertically downward to the computed drag index and then horizontally to the right to obtain specific range (nautical miles per pound). Repeat these projections on the right side of sheet 1 to obtain optimum cruise Mach number for the desired altitude. Enter sheet 2 with the optimum cruise Mach number. Project horizontally to the right to intersect predicted flight-level temperature, then vertically downward to obtain corresponding true airspeed. Continue this projection vertically downward to intersect the interpolated specific range (obtained from sheet 1), then horizontally to the left to obtain total fuelflow required in pounds per hour.

31.5.2 Sample Problem

(2) Engines

A. Average gross weight for first leg – 45,000 POUNDS.

B. Cruise altitude – 35,000 FEET.

C. Computed drag index – 40.

D. Specific range – 0.077 NMPP.

E. Gross weight – 45,000 POUNDS.

F. Altitude – 35,000 FEET.

G. Drag index – 40.

H. True Mach number – 0.84.

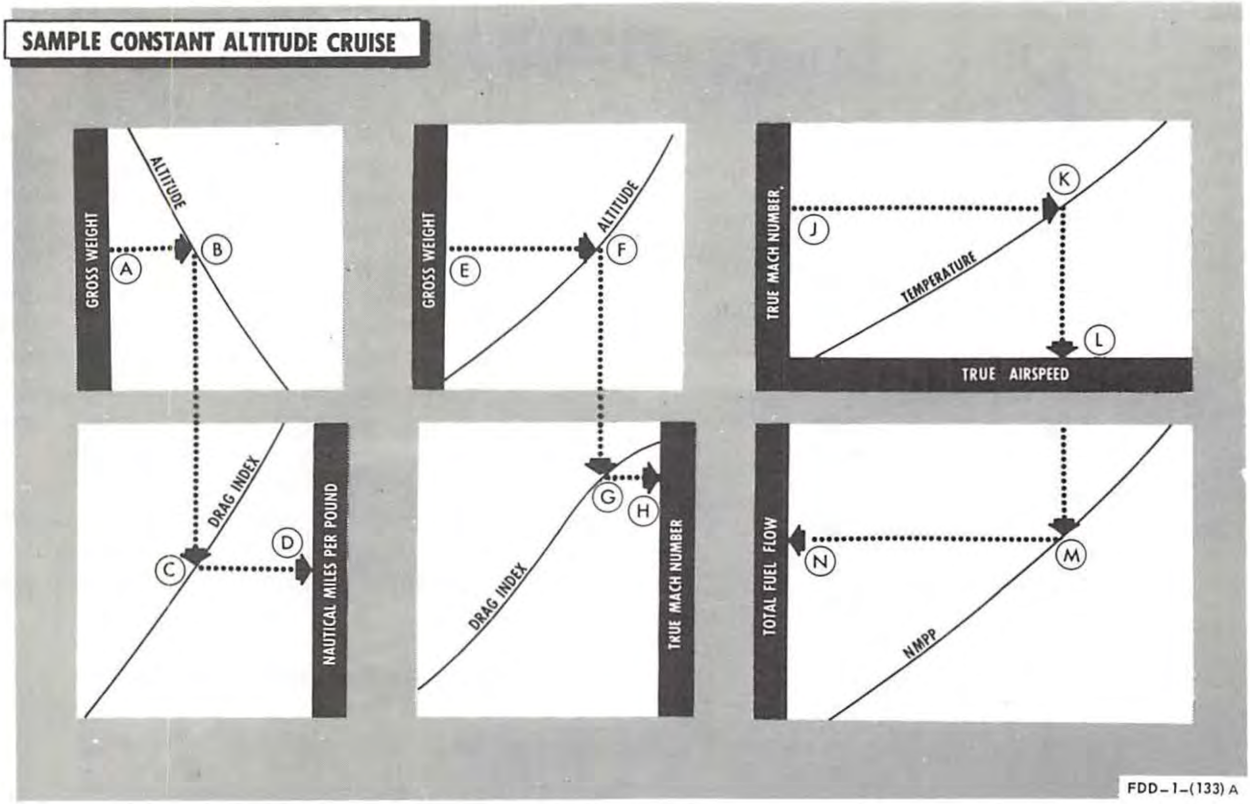
J. True Mach number – 0.84.

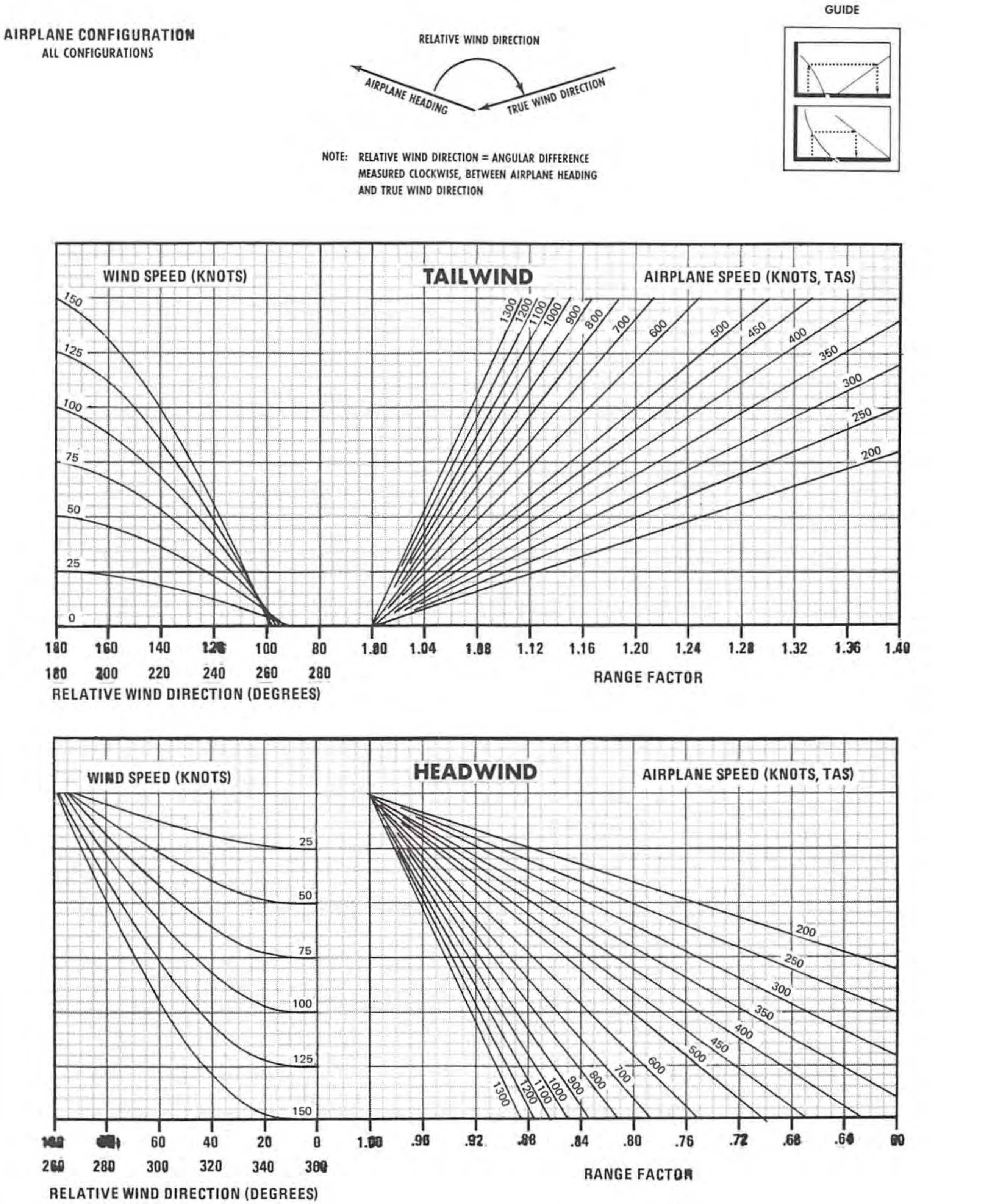
K. Temperature at flight altitude – -40 °C.

L. True airspeed – 500 KNOTS.

M. Specific range – 0.077 NMPP.

N. Total fuelflow – 6,500 PPH.


SAMPLE CONSTANT ALTITUDE CRUISE
GROSS WEIGHT
ALTITUDE
A
B
GROSS WEIGHT
ALTITUDE
E
F
TRUE MACH NUMBER
J
K
TEMPERATURE
L
TRUE AIRSPEED
DRAG INDEX
NAUTICAL MILES PER POUND
C
D
DRAG INDEX
G
H
TRUE MACH NUMBER
TOTAL FUEL FLOW
N
M
NMPP
FDD-1-(133) A



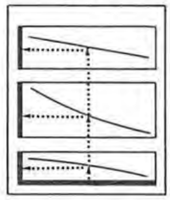
FDD–1–(327)

Figure 31-1. Range-Wind Correction

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

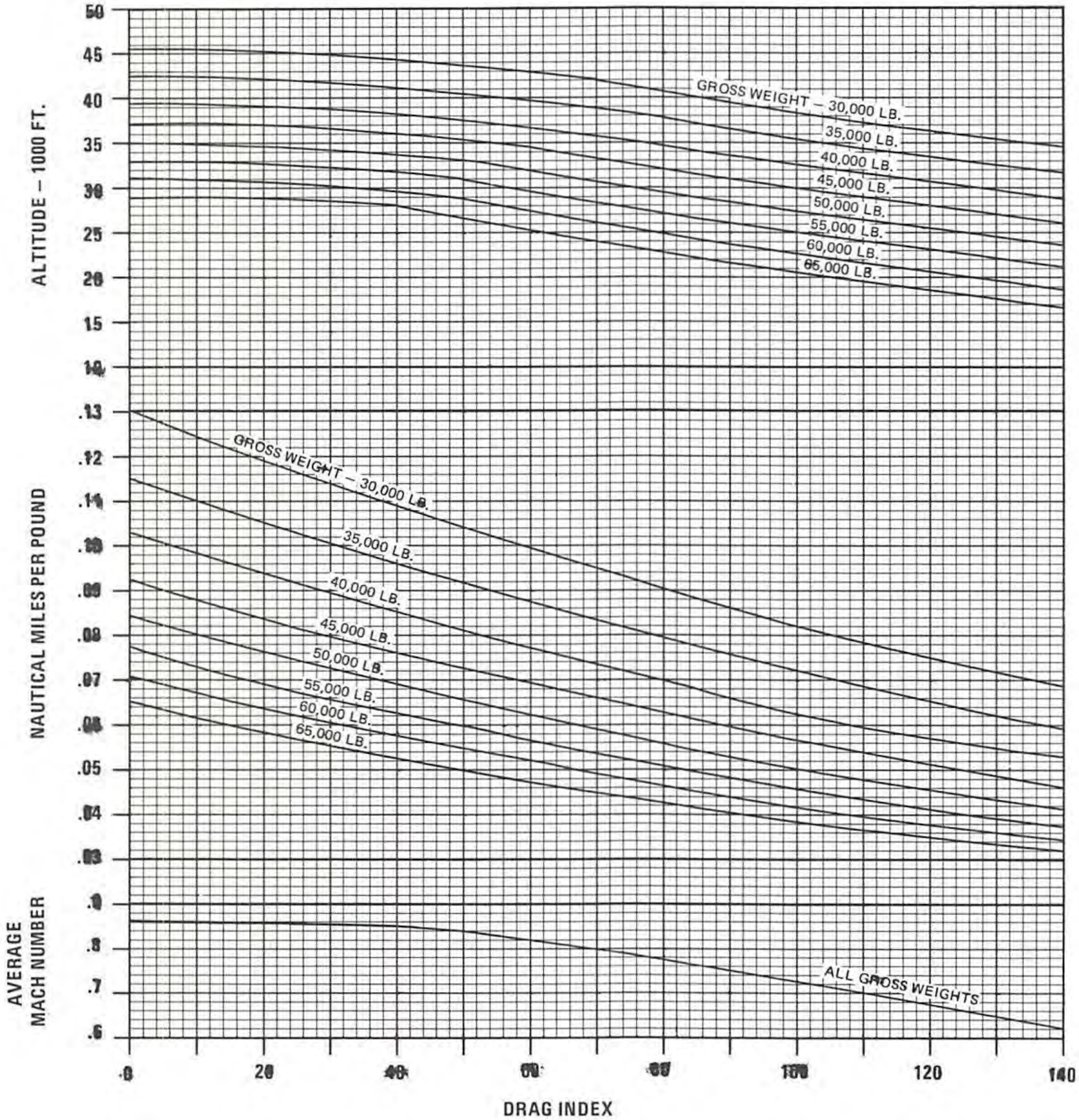
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(328)

Figure 31-2. Optimum Cruise Summary

GROSS WEIGHT – 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINES: (2) J79–GE–10B

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	DRAG INDEX 0	TOTAL FUEL FLOW – LB/HR					
			20	40	60	80	100	120
SEA LEVEL (15°C)	360	7523	8260	8997	9796	10612	11427	12259
	420	9554	10680	11821	12961	14178	15464	16778
	480	12307	13838	15423	17098	18924	20847	22897
	540	15767	17783	19861	22443			
	600	21914	24495					
	MIL	26730	26466	26103	25570	24983	24449	23965
	V_{MAX}	623.8	607.1	587.2	564.1	537.6	512.5	488.7
4,000 FT. (7°C)	360	6658	7286	7939	8667	9395	10124	10873
	420	8405	9408	10415	11426	12513	13619	14767
	480	10739	12080	13459	14922	16499	18136	19936
	540	13857	15614	17416	19695	22005		
	600	19856	22445					
	MIL	24424	24074	23683	23202	22681	22146	21753
	V_{MAX}	622.8	606.5	588.2	566.7	543.2	518.4	495.6
8,000 FT. (–1°C)	360	5933	6485	7088	7717	8346	8978	9640
	420	7388	8269	9150	10039	10995	11951	12966
	480	9364	10542	11734	13009	14391	15833	17453
	540	12129	13652	15242	17313	19349		
	600	17973	20263					
	MIL	22056	21715	21322	20928	20557	20165	19833
	V_{MAX}	619.8	605.0	587.6	569.0	547.8	525.2	503.4
12,000 FT. (–9°C)	360	5352	5848	6378	6910	7441	7993	8578
	420	6547	7300	8055	8832	9669	10505	11420
	480	8185	9207	10239	11368	12598	13898	15297
	540	10605	11929	13359	15210	17097		
	600	16294	18678					
	MIL	19792	19531	19227	18950	18678	18369	18049
	V_{MAX}	616.3	602.4	585.9	570.1	551.7	530.8	509.3
16,000 FT. (–16°C)	360	4905	5349	5794	6240	6699	7194	7707
	420	5844	6471	7114	7792	8523	9262	10077
	480	7144	8027	8917	9916	10997	12166	13392
	540	9336	10491	11840	13483	15236		
	600	15068						
	MIL	17782	17580	17375	17171	16932	16619	16270
	V_{MAX}	612.7	598.9	584.0	570.2	554.0	534.1	512.2

TEMP. EFFECTS	
°C	FACTOR
–40	.899
–20	.937
0	.973
20	1.008
40	1.042
–40	.913
–20	.949
0	.987
20	1.022
40	1.057
–40	.925
–20	.963
0	1.001
20	1.037
40	1.072
–40	.939
–20	.978
0	1.016
20	1.052
40	1.088
–40	953
–20	993
0	1.032
20	1.069
40	1.105

FDD–1–(329)

Figure 31-3. Low-Altitude Cruise (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–10B

DATE: 1 MARCH 79
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	DRAG INDEX 0	TOTAL FUEL FLOW LB/HR						TEMP. EFFECTS	
			20	40	60	80	100	120	°C	FACTOR
SEA LEVEL (15°C)	360	7819	8557	9314	10124	10940	11756	12587		
	420	9790	10928	12068	13214	14442	15729	17047	−40	.899
	480	12363	13893	15481	17156	18985	20908	22962	−20	.937
	540	15760	17776	19855	22436				0	.973
	600	21817	24392						20	1.008
	MIL	26730	26469	26120	25574	24985	24444	23954	40	1.042
	V_{MAX}	623.8	607.1	588.6	564.1	537.6	511.8	488.0		
4,000 FT. (7°C)	360	7046	7676	8391	8667	9847	10577	11338		
	420	8681	9688	10696	11426	12805	13911	15064	−40	.913
	480	10835	12178	13559	14922	16600	18240	20047	−20	.949
	540	13853	15610	17411	19695	22004			0	.987
	600	19826	22411						20	1.022
	MIL	24422	24074	23695	23215	22683	22137	21737	40	1.057
	V_{MAX}	622.8	606.5	588.8	567.3	543.2	517.8	494.9		
8,000 FT. (−1°C)	360	6432	7027	7656	8286	8916	9563	10238		
	420	7718	8599	9480	10378	11335	12292	13319	−40	.925
	480	9470	10649	11842	13118	14501	15948	17573	−20	.963
	540	12197	13721	15311	17386	19430			0	1.001
	600	17979	20263						20	1.037
	MIL	22054	21713	21327	20937	20552	20148	19813	40	1.072
	V_{MAX}	619.8	605.0	587.6	569.6	547.1	524.0	501.5		
12,000 FT. (−9°C)	360	5971	6504	7038	7575	8130	8704	9293		
	420	6967	7721	8491	9276	10113	10964	11888	−40	.939
	480	8373	9401	10434	11569	12799	14107	15515	−20	.978
	540	10727	12054	13485	15339	17243			0	1.016
	600	16404	18787						20	1.052
	MIL	19786	19524	19223	18944	18655	18346	18019	40	1.088
	V_{MAX}	615.7	601.7	585.3	569.4	549.8	529.5	506.7		
16,000 FT. (−16°C)	360	5630	6081	6539	7009	7505	8010	8531		
	420	6345	6986	7659	8338	9075	9834	10656	−40	.953
	480	7440	8328	9220	10228	11317	12497	12763	−20	.993
	540	9562	10720	12075	13737	15505			0	1.032
	600	15347							20	1.069
	MIL	17763	17559	17354	17146	16882	16583	16219	40	1.105
	V_{MAX}	611.4	597.1	582.7	568.4	550.9	532.2	509.1		

FDD–1–(330)

Figure 31-3. Low-Altitude Cruise (Sheet 2 of 3)

GROSS WEIGHT – 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINES: (2) J79-GE-10B

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

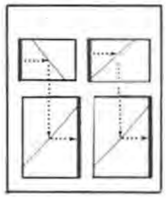
	KTAS	DRAG INDEX 0	TOTAL FUEL FLOW – LB/HR 20	40	60	80	100	120	TEMP. EFFECTS °C	FACTOR
SEA LEVEL (15°C)	360	8327	9064	9871	10687	11503	12319	13180		
	420	10109	11250	12390	13543	14787	16073	17397	−40	.899
	480	12480	14010	15603	17278	19113	21037	23098	−20	.937
	540	15801	17817	19897	22479				0	.973
	600	21719	24290						20	1.008
	MIL	26729	26471	26138	25574	24974	24418	23928	40	1.042
	V_{MAX}	623.8	607.7	589.2	564.1	537.0	510.5	486.7		
4,000 FT (7°C)	360	7625	8335	9064	9792	10521	11263	12043		
	420	9056	10064	11071	12103	13197	14303	15463	−40	.913
	480	10992	12339	13721	15186	16766	18410	20228	−20	.949
	540	13989	15746	17548	19844	22146			0	.987
	600	19817	22400						20	1.022
	MIL	24420	24074	23700	23199	22654	22106	21714	40	1.057
	V_{MAX}	622.1	606.5	589.5	566.7	541.9	516.5	493.0		
8,000 FT (−1°C)	360	7174	7804	8436	9069	9720	10380	11060		
	420	8238	9120	10009	10916	11873	12841	13878	−40	.925
	480	9752	10935	12129	13411	14795	16258	17889	−20	.963
	540	12349	13873	15465	17549	19583			0	1.001
	600	18121	20357						20	1.037
	MIL	22037	21690	21308	20903	20523	20118	19781	40	1.072
	V_{MAX}	619.1	603.7	587.0	567.0	545.8	522.0	499.5		
12,000 FT (−9°C)	360	6838	7380	7936	8496	9048	9649	10261		
	420	7581	8352	9136	9923	10775	11642	12572	−40	.939
	480	8776	9809	10844	11992	13224	14548	15976	−20	.978
	540	10958	12293	13724	15585	17514			0	1.016
	600	16731	19016						20	1.052
	MIL	19757	19492	19196	18906	18620	18299	17962	40	1.088
	V_{MAX}	614.4	599.8	584.0	566.9	547.9	526.4	502.9		
16,000 FT (−16°C)	360	6605	7075	7573	8075	8578	9098	9660		
	420	7051	7724	8407	9092	9857	10633	11484	−40	.953
	480	7930	8822	9725	10741	11853	13043	14376	−20	.993
	540	9895	11058	12424	14107	15915			0	1.032
	600	15826							20	1.069
	MIL	17763	17527	17325	17105	16824	16503	16108	40	1.105
	V_{MAX}	611.4	595.2	580.9	565.3	547.2	527.2	502.2		

Figure 31-3. Low-Altitude Cruise (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79–GE–10B

GUIDE



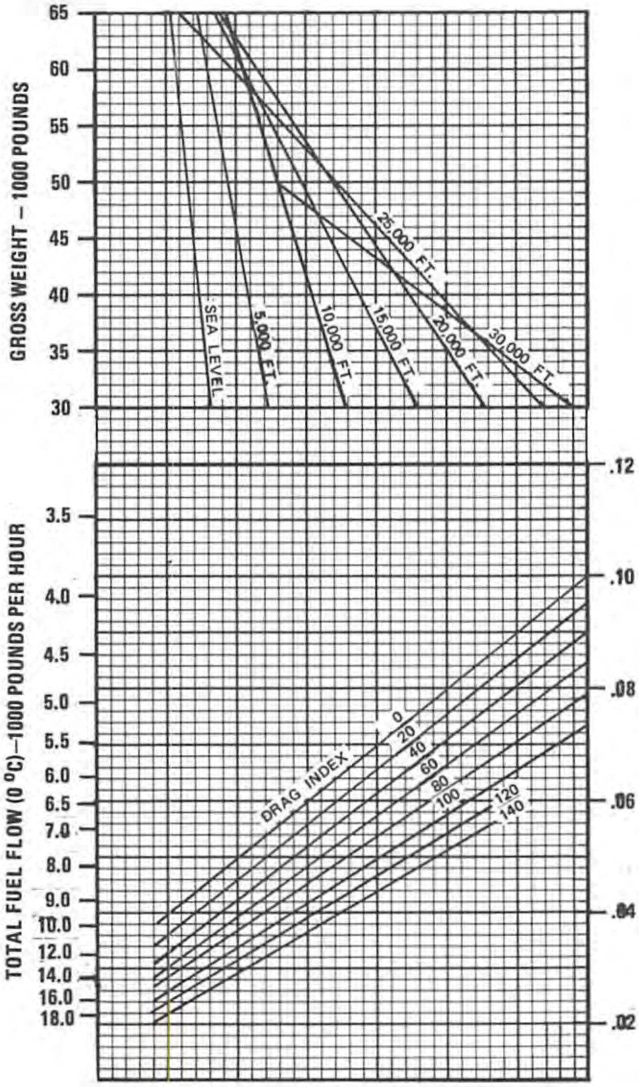
ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

DATE: 1 MARCH 1979
DATA BASIC: **FLIGHT TEST**

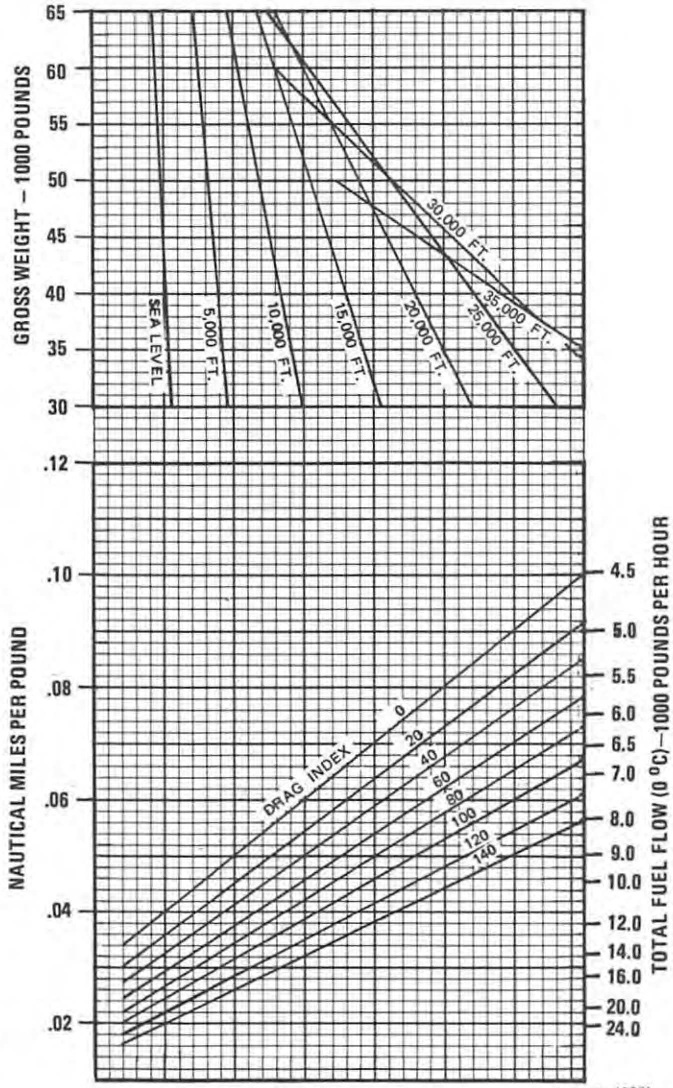
FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	−60	−40	−20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07

0.60 MACH



0.70 MACH



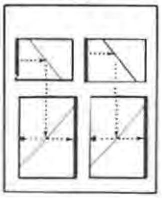
FDD–1–(332)

Figure 31-4. Constant Mach/Altitude Cruise (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE

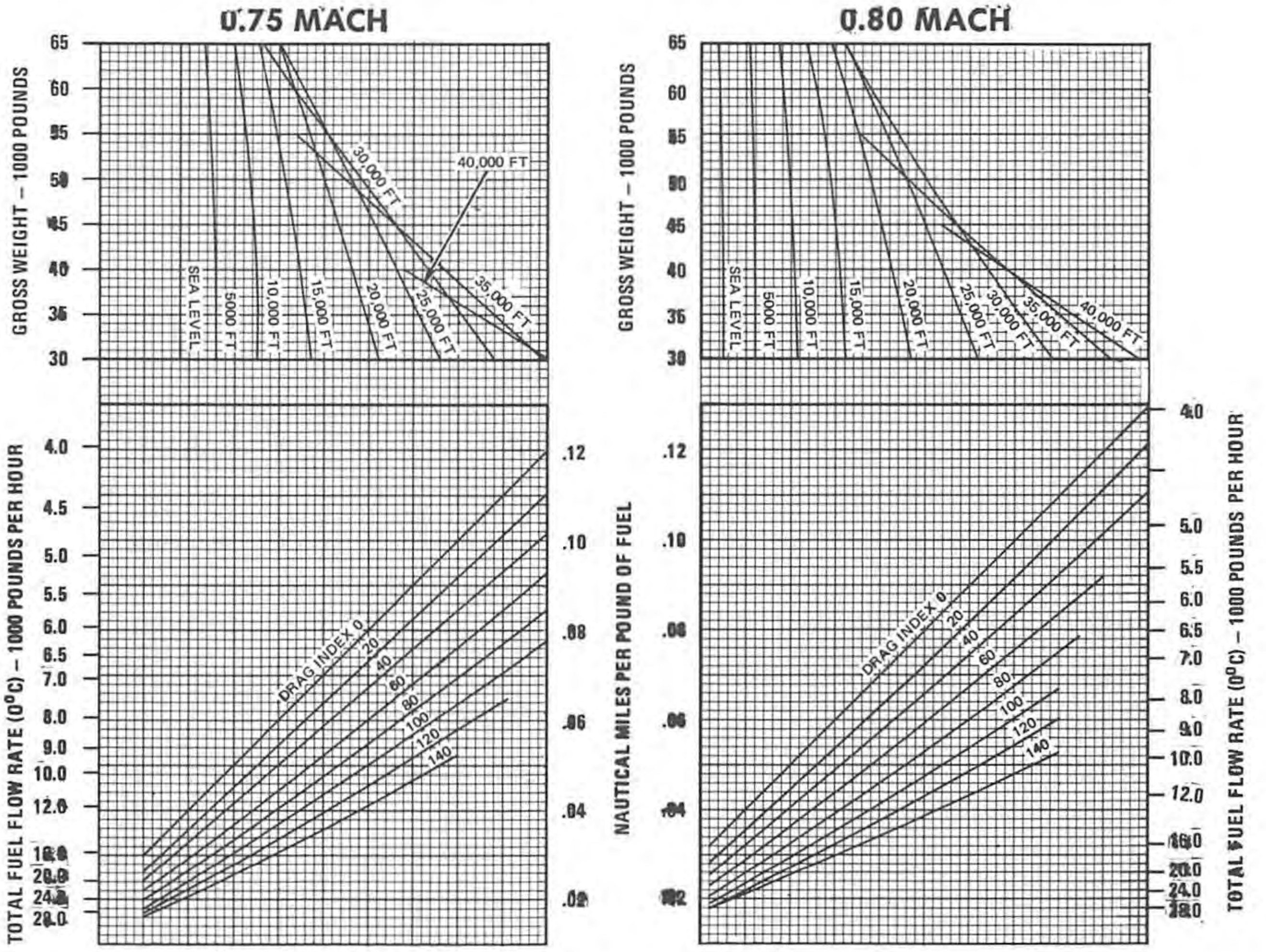


FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	− 4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	−60	−40	−20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07



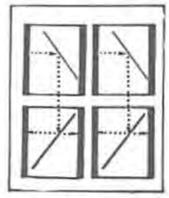
FDD-1-(333)

Figure 31-4. Constant Mach/Altitude Cruise (Sheet 2 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE



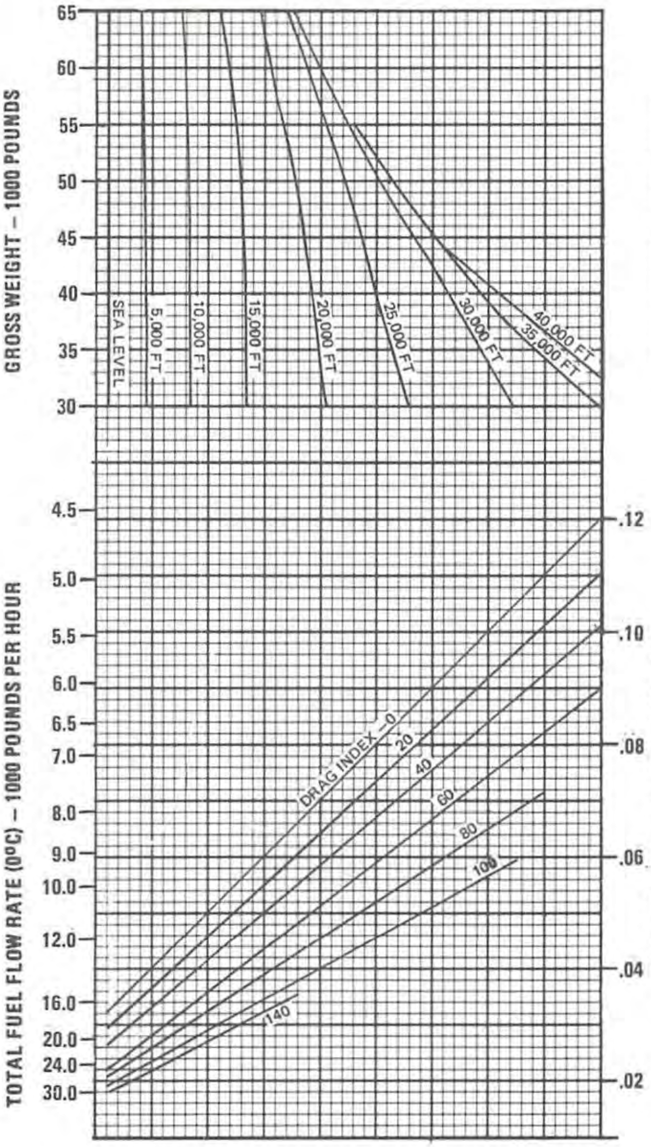
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

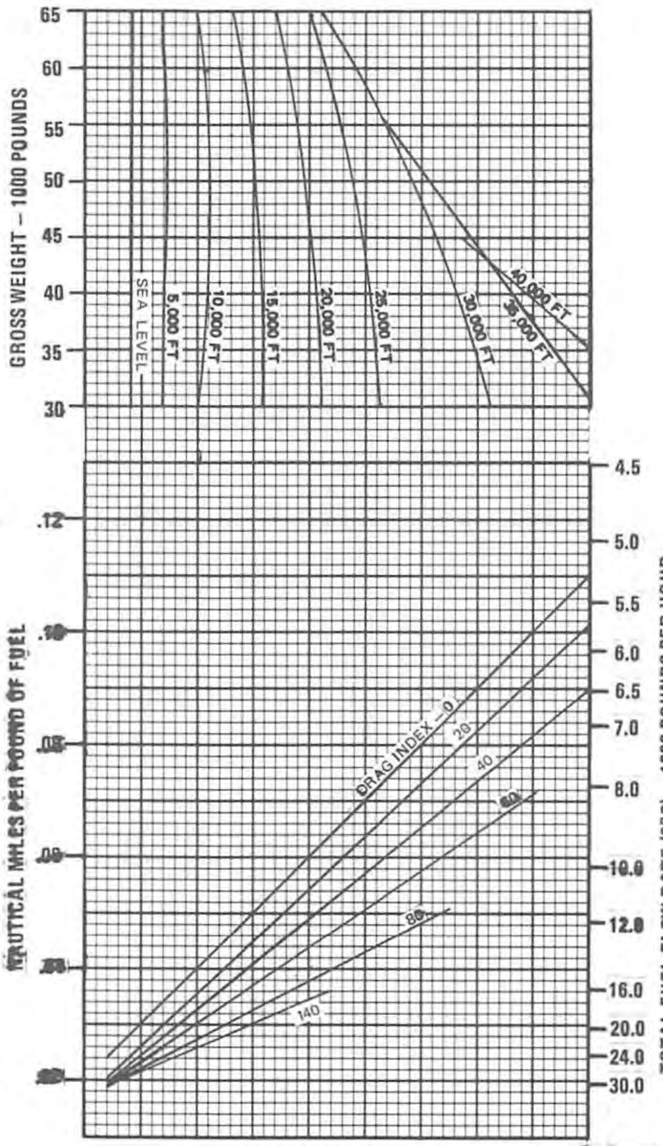
ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	−60	−40	−20	0	20	40
FUEL FLOW FACTOR	0.88	0.92	0.96	1.00	1.04	1.07

0.85 MACH



0.90 MACH



FDD-1-(334)

Figure 31-4. Constant Mach/Altitude Cruise (Sheet 3 of 3)

ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79–GE–10B
INOPERATIVE ENGINE WINDMILLING

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

GUIDE

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	− 4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

FUEL FLOW RATE CORRECTION FACTORS						
TEMPERATURE °C	−60	−40	−20	0	20	40
CORRECTION FACTOR	0.88	.092	0.96	1.00	1.04	1.07

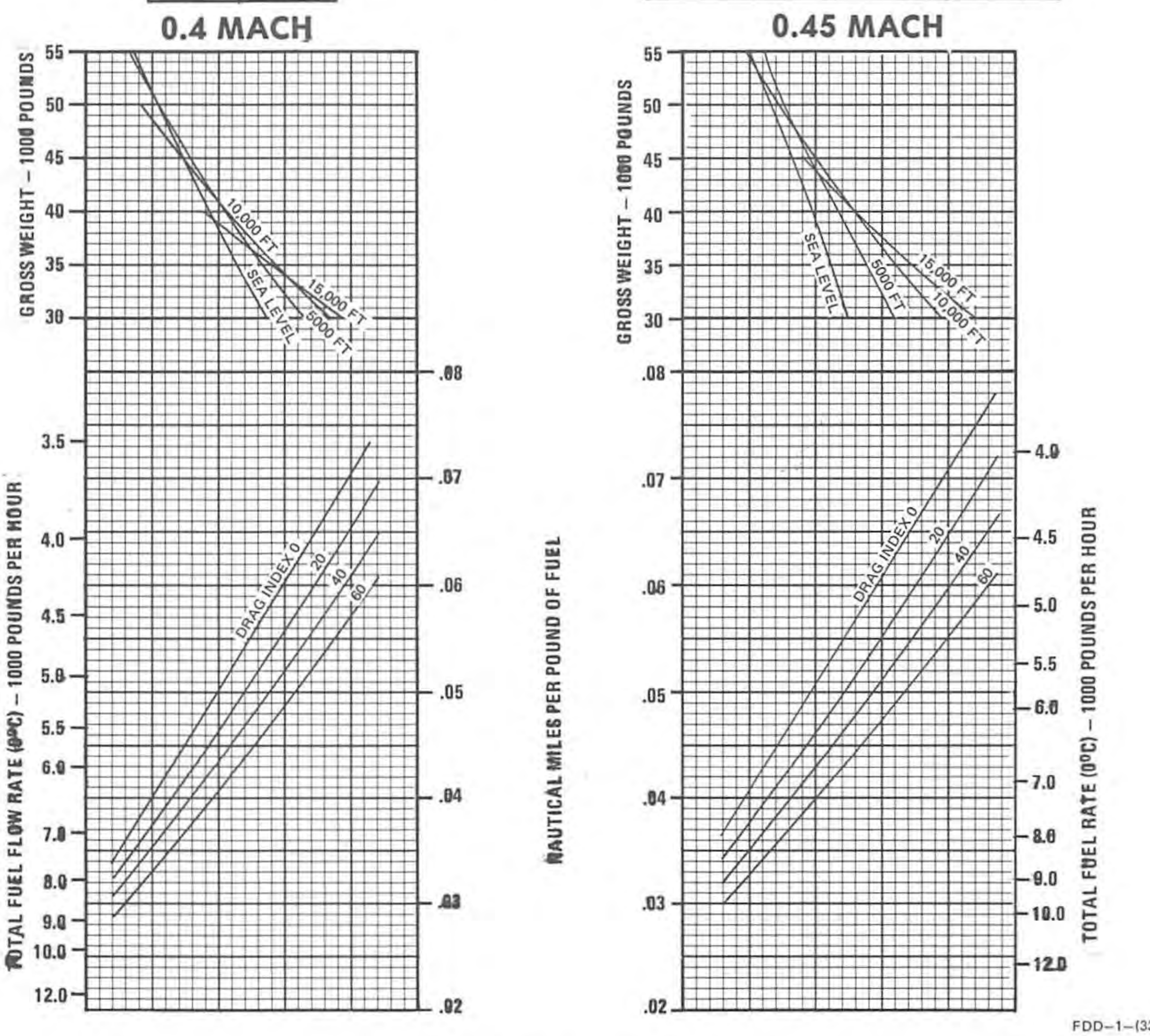


Figure 31-5. Constant Mach/Altitude Cruise – One Engine Operating (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 MARCH 1979
DATE BASIS: **FLIGHT TEST**

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

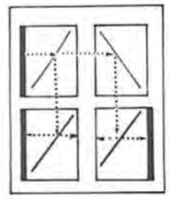
REMARKS

ENGINES: (2) J79–GE–10B
INOPERATIVE ENGINE WINDMILLING

NOTE

IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

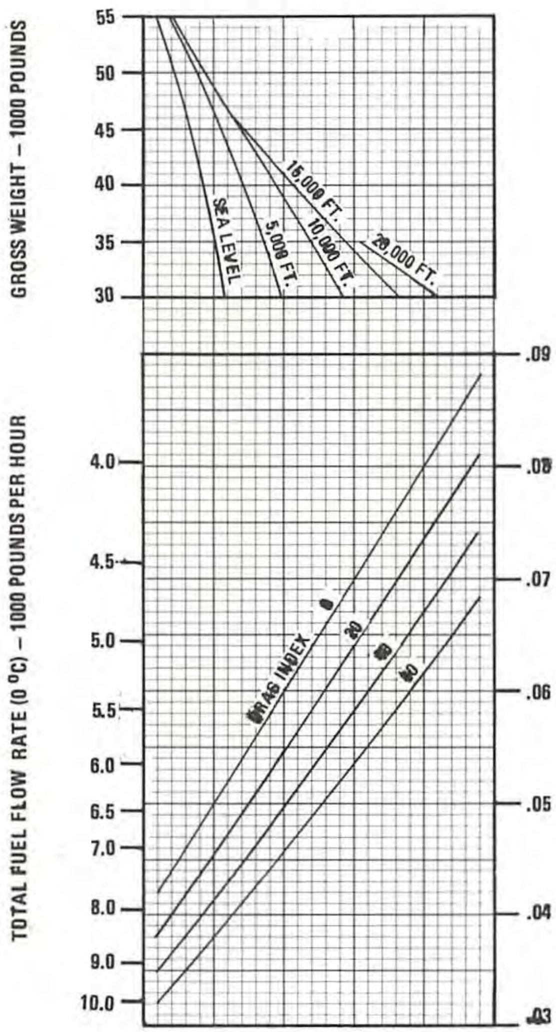
GUIDE



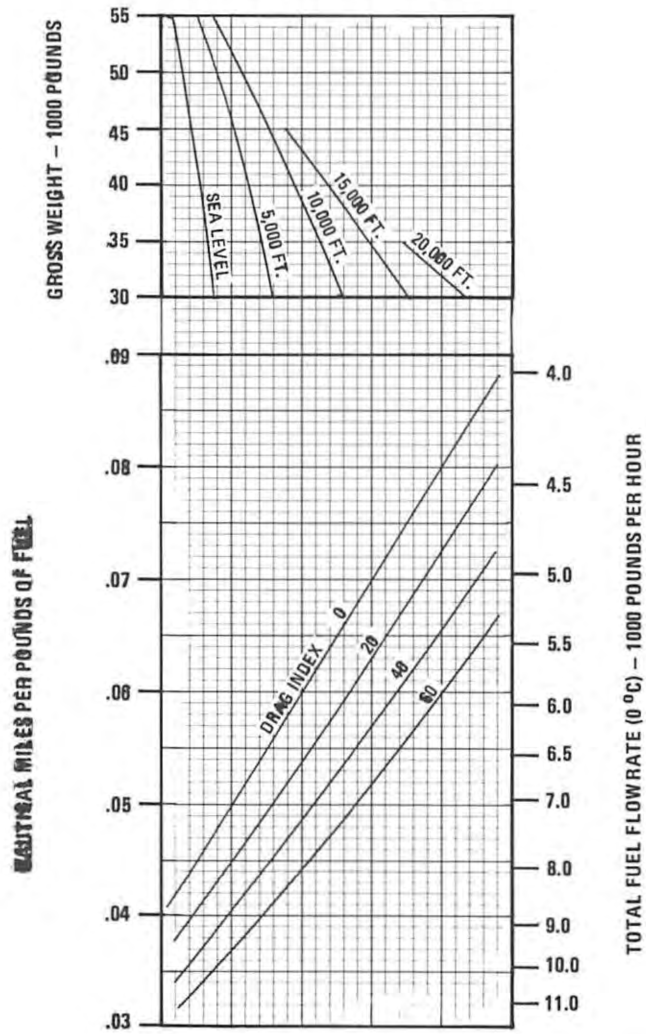
FUEL GRADE: JP–5
FUEL DENSITY: 6.8LB./GAL.

FUEL FLOW CORRECTION FACTORS						
TEMPERATURE °C	−60	−40	−20	0	20	40
CORRECTION FACTORS	0.88	0.92	0.96	1.00	1.04	1.07

0.50 MACH CRUISE



0.55 MACH CRUISE



FDD–1–(336)

Figure 31-5. Constant Mach/Altitude Cruise – One Engine Operating (Sheet 2 of 3)

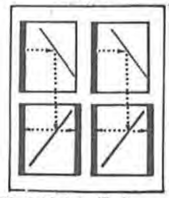
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

REMARKS
INOPERATIVE ENGINE WINDMILLING
ENGINE(S): (2)–J79–GE–10B

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS

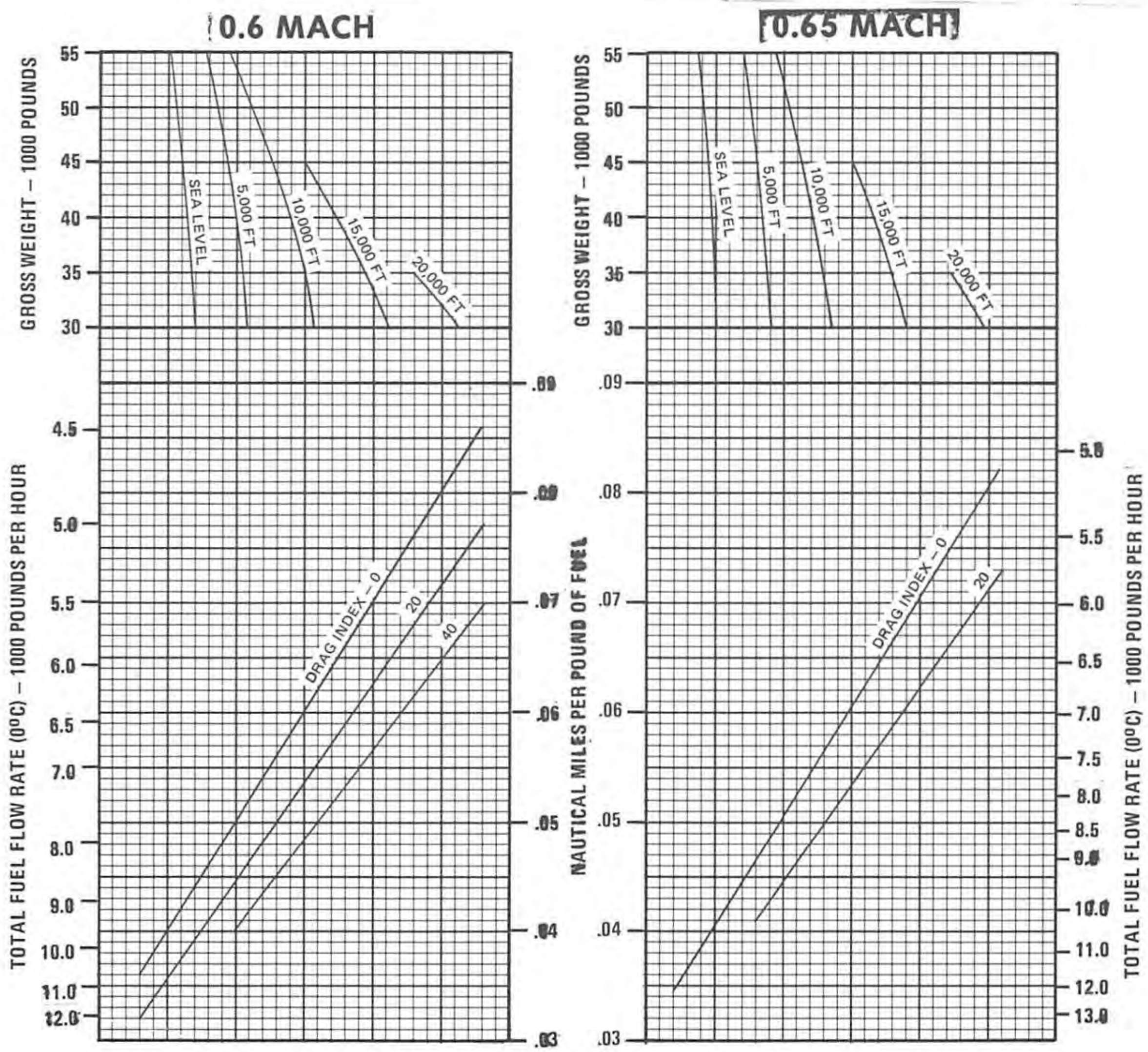
GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5000	5.1
10,000	– 4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

FUEL FLOW RATE CORRECTION FACTORS						
TEMPERATURE °C	–60	–40	–20	0	20	40
CORRECTION FACTOR	0.88	.092	0.96	1.00	1.04	1.07



FDD–1–(337)

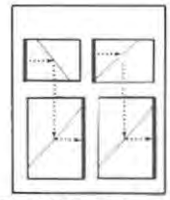
Figure 31-5. Constant Mach/Altitude Cruise – One Engine Operating (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

LONG RANGE SPEED NAUTICAL MILES PER POUND AND MACH NUMBER

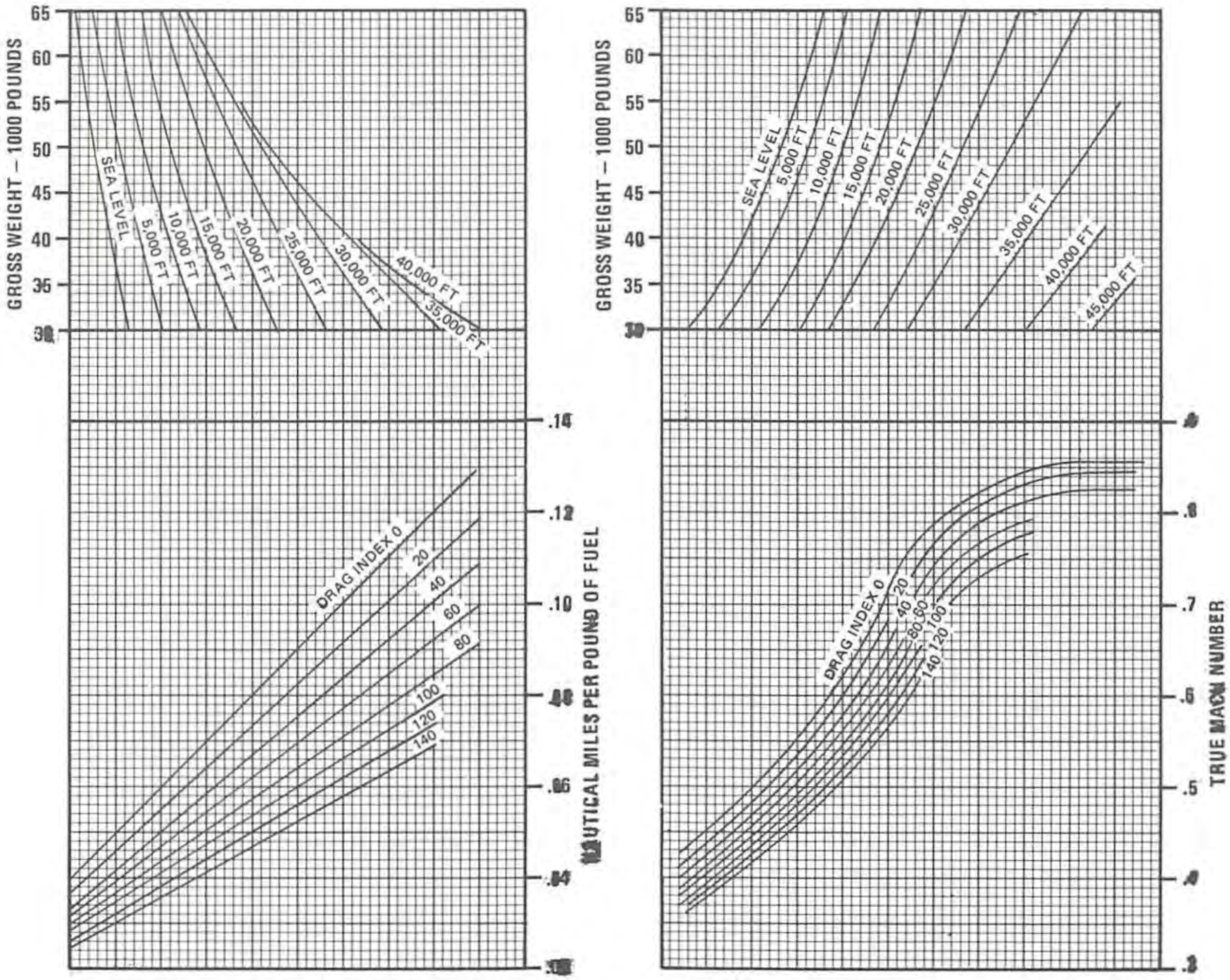
REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST



FDD-1-(338-1)

Figure 31-6. Constant Altitude Cruise (Sheet 1 of 2)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

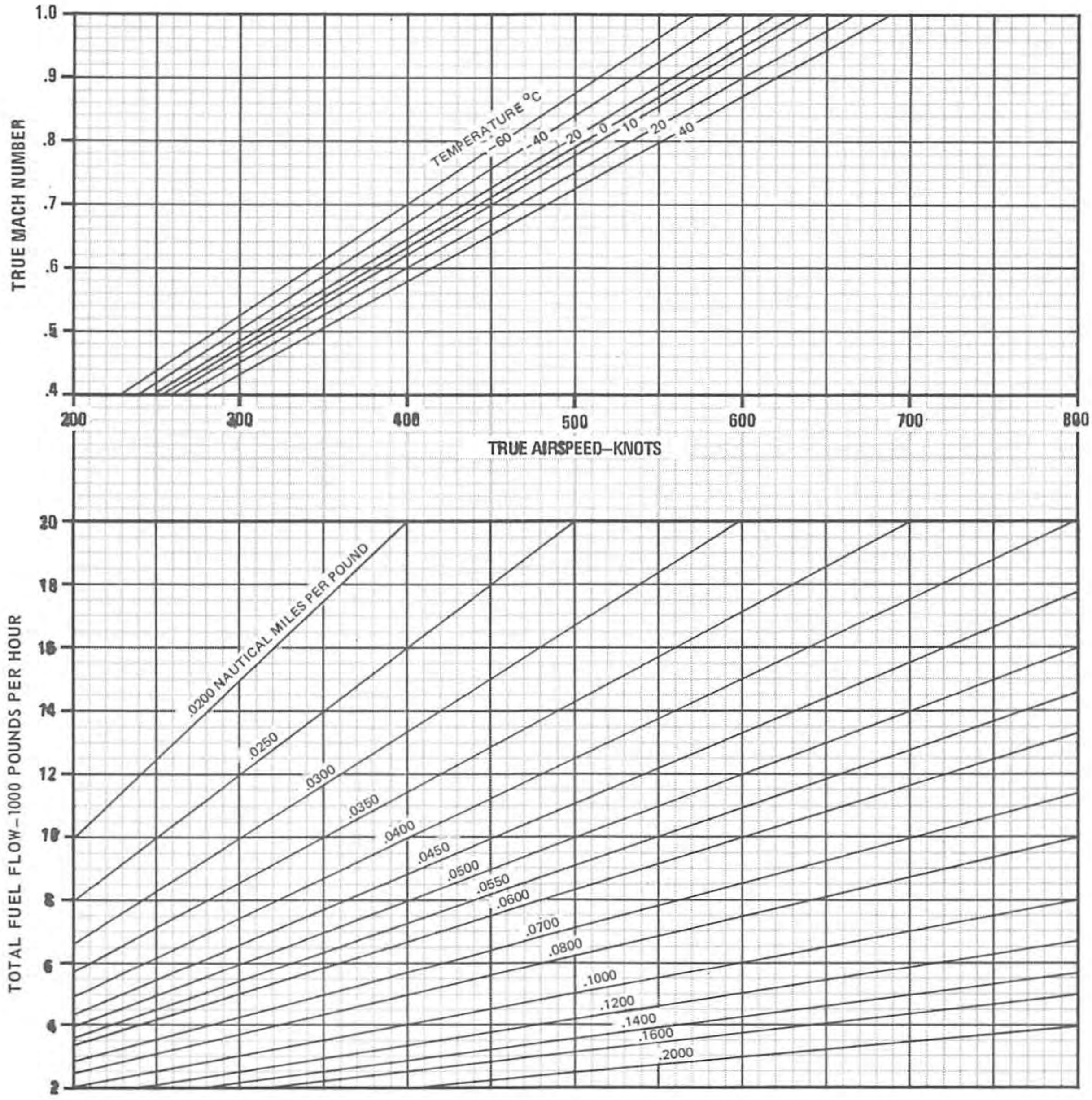
LONG RANGE SPEED TRUE AIRSPEED AND FUEL FLOW

REMARKS
ENGINE(S): (2) J79-GE-10B

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(338-2)

Figure 31-6. Constant Altitude Cruise (Sheet 2 of 2)

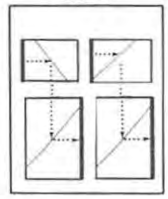
LONG RANGE SPEED (NAUTICAL MILES PER POUND) AND MACH NUMBER (ONE ENGINE OPERATING)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79–GE–10B
INOPERATIVE ENGINE WINDMILLING

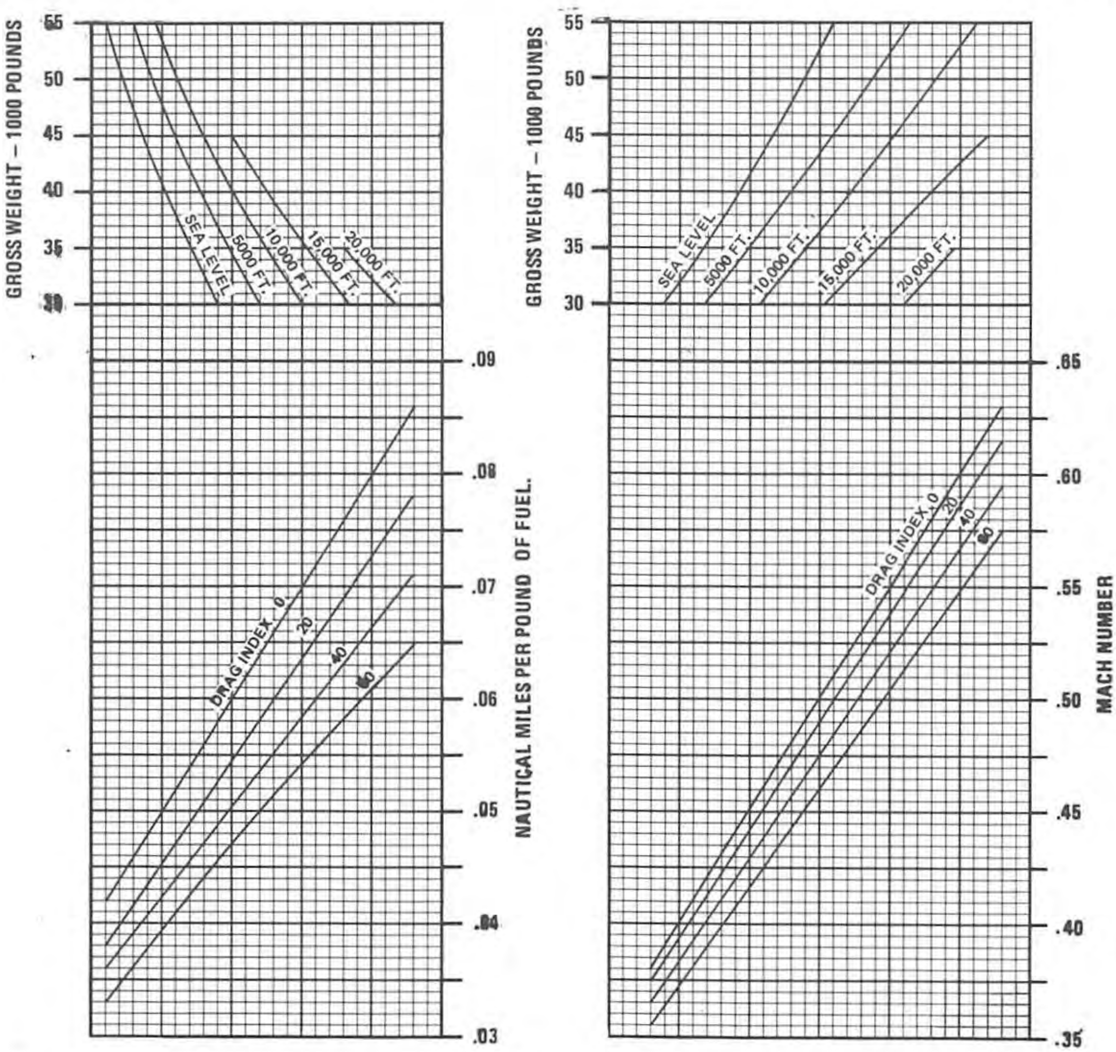
NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8LB/GAL



FDD–1–(340–1)

Figure 31-7. Constant Altitude Cruise – One Engine Operating (Sheet 1 of 2)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

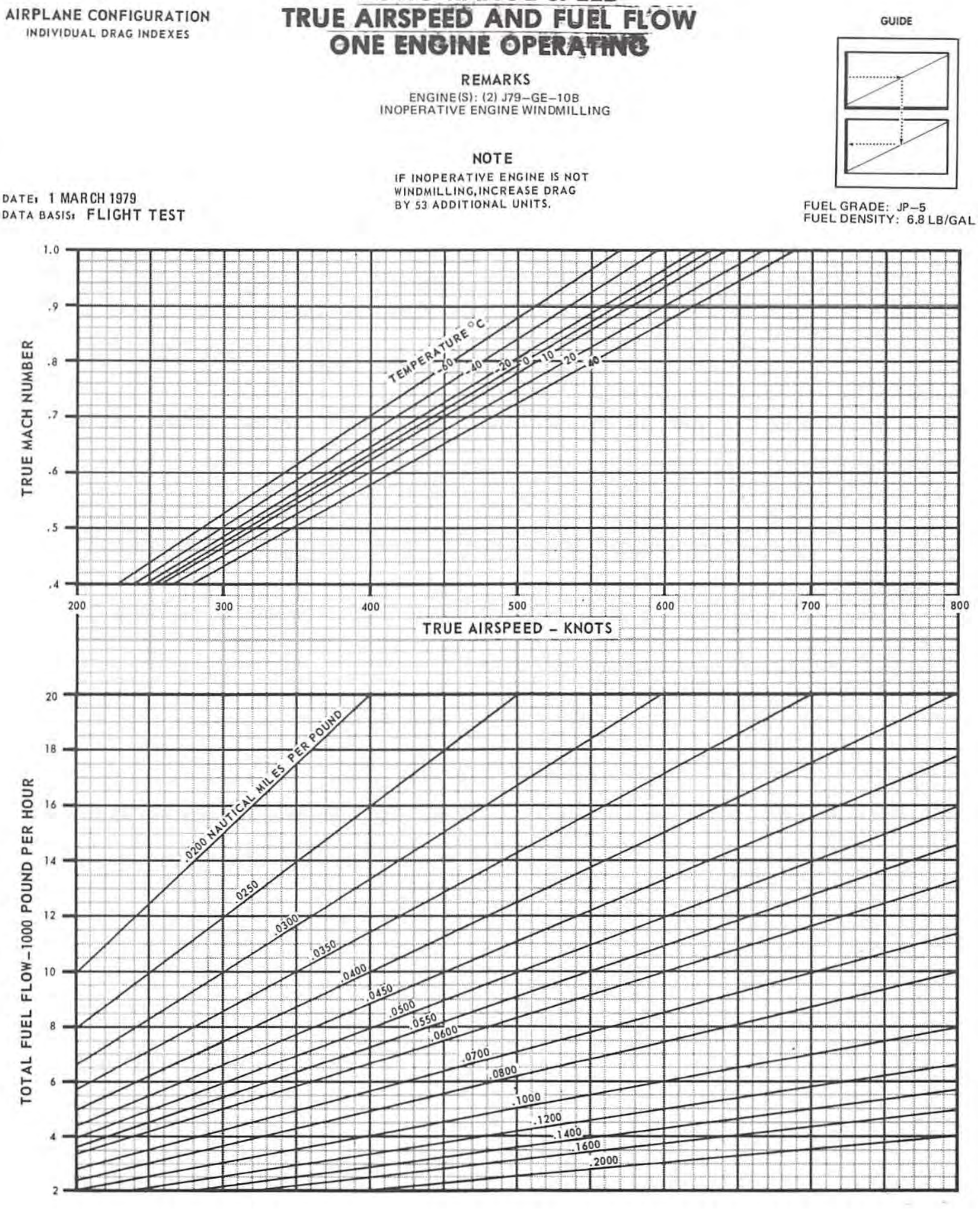
LONG RANGE SPEED
TRUE AIRSPEED AND FUEL FLOW
ONE ENGINE OPERATING

REMARKS
ENGINE(S): (2) J79-GE-10B
INOPERATIVE ENGINE WINDMILLING

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(340-2)

Figure 31-7. Constant Altitude Cruise – One Engine Operating (Sheet 2 of 2)

CHAPTER 32

Endurance

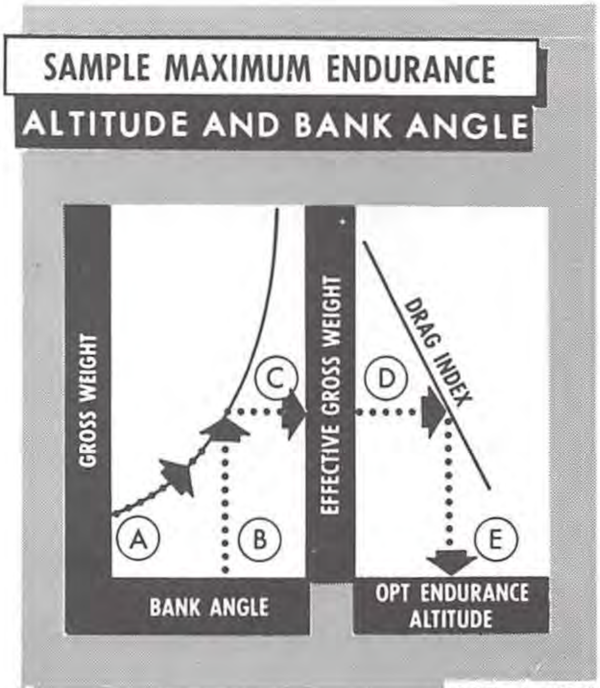
32.1 MAXIMUM ENDURANCE CHARTS

Note

For aircraft with PRIDE antennas installed, additional units of drag must be applied to the computed drag index. Refer to Figure 28-2.

These charts (Figures 32-1 and Figure 32-2) present optimum endurance altitude and maximum endurance specifics (fuelflow and Mach number) for all combinations of effective gross weight and altitude. Separate charts are included for single-engine operation.

32.1.1 Use. Enter the altitude and bank angle chart with the average gross weight. If bank angles are to be considered, follow the gross weight curve until it intersects the bank angle to be used, then horizontally to the right to obtain effective gross weight. (If bank angles are not to be considered, enter the chart at the effective gross weight scale.) From this point, proceed horizontally to the right and intersect the computed drag index. Reflect downward and read the optimum endurance altitude. Enter the Mach number plots with the effective gross weight and proceed horizontally to intersect the optimum endurance altitude. Then descend downward and intersect the computed drag index and horizontally to read true Mach number. From the intersection of endurance altitude and drag index, proceed horizontally to the right and intersect the optimum altitude. At this point, read endurance airspeed. Enter the fuelflow plots with the effective gross weight, proceed horizontally to intersect the optimum endurance altitude. Reflect downward to the computed drag index and then horizontally to read total fuelflow.



FDD-1-(154)

32.1.2 Sample Problem

32.1.2.1 Altitude and Bank Angle

A. Gross weight – 45,000 POUNDS.

B. Bank angle – 20°.

C. Effective gross weight – 48,000 POUNDS.

D. Drag index – 40.

E. Optimum endurance altitude – 26,000 FEET.

32.1.2.2 Mach Number

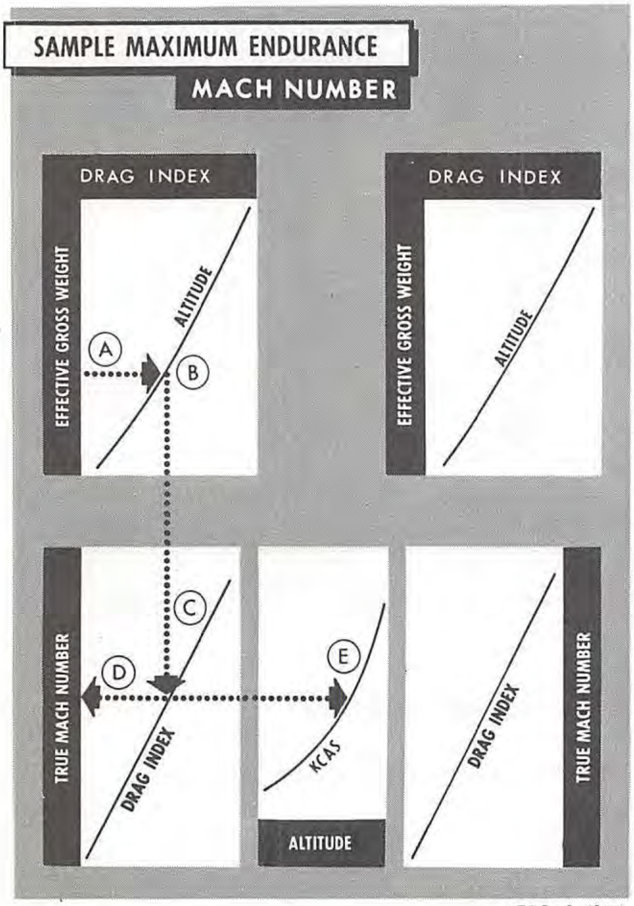
A. Effective gross weight – 48,000 POUNDS.

B. Endurance altitude – 25,000 FEET.

C. Drag index – 40.

D. Mach number – 0.62.

E. Airspeed (KCAS) – 250.



FDD-1-(155)

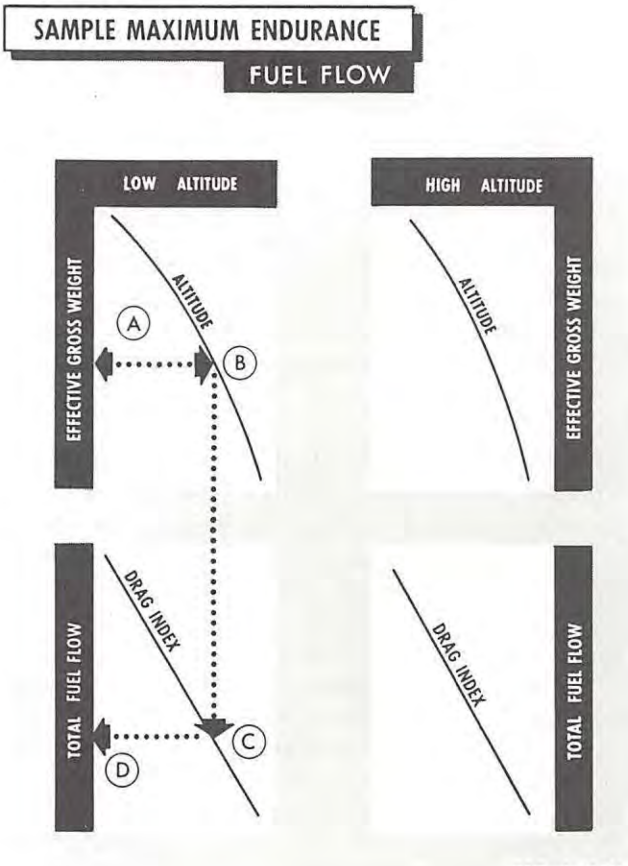
32.1.2.3 Fuelflow

A. Effective gross weight – 48,000 POUNDS.

B. Endurance altitude – 25,000 FEET.

C. Drag index – 40.

D. Fuelflow – 6,250 PPH.



FDD-1-(156)

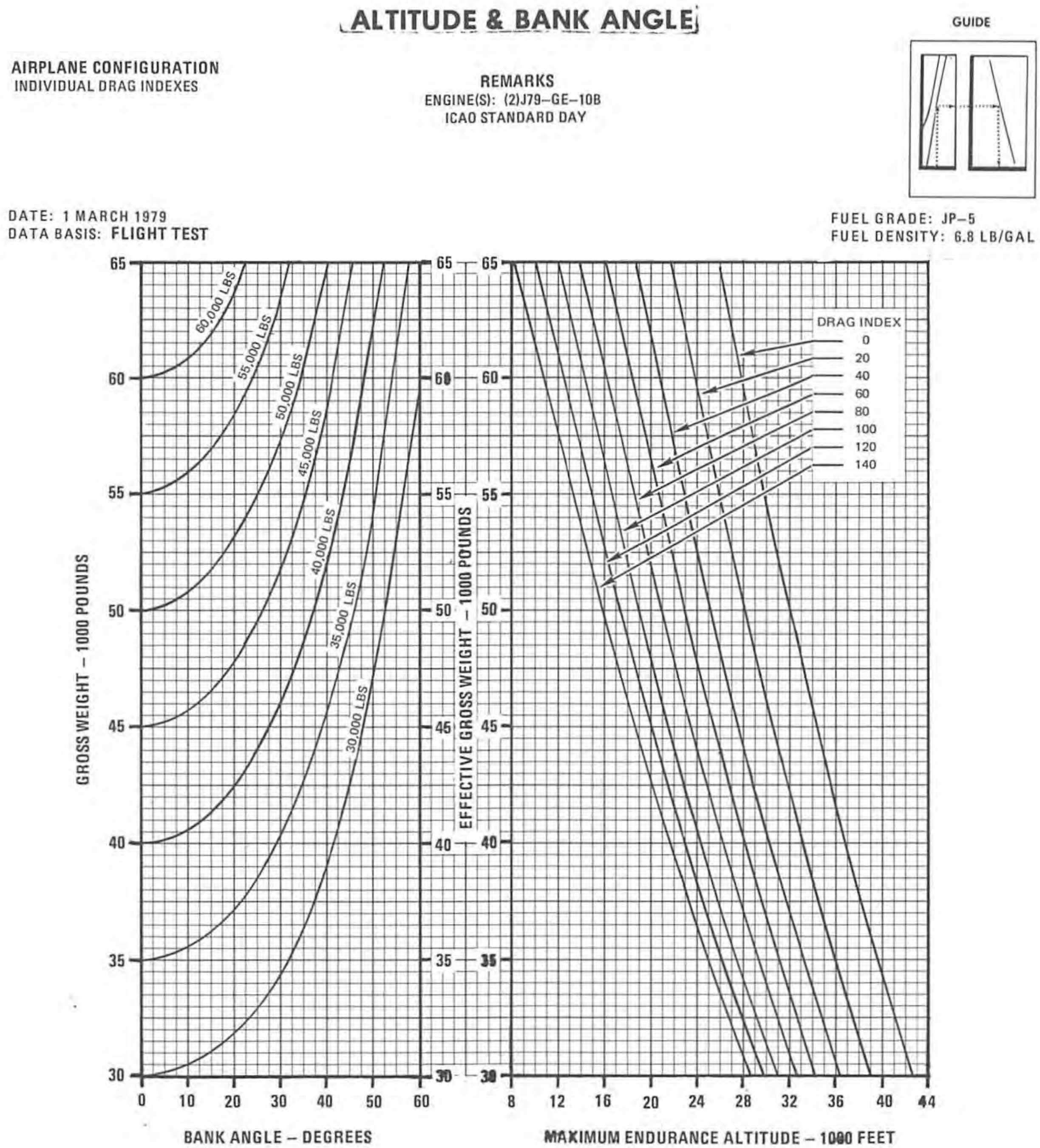


Figure 32-1. Maximum Endurance (Sheet 1 of 4)

MACH NUMBER

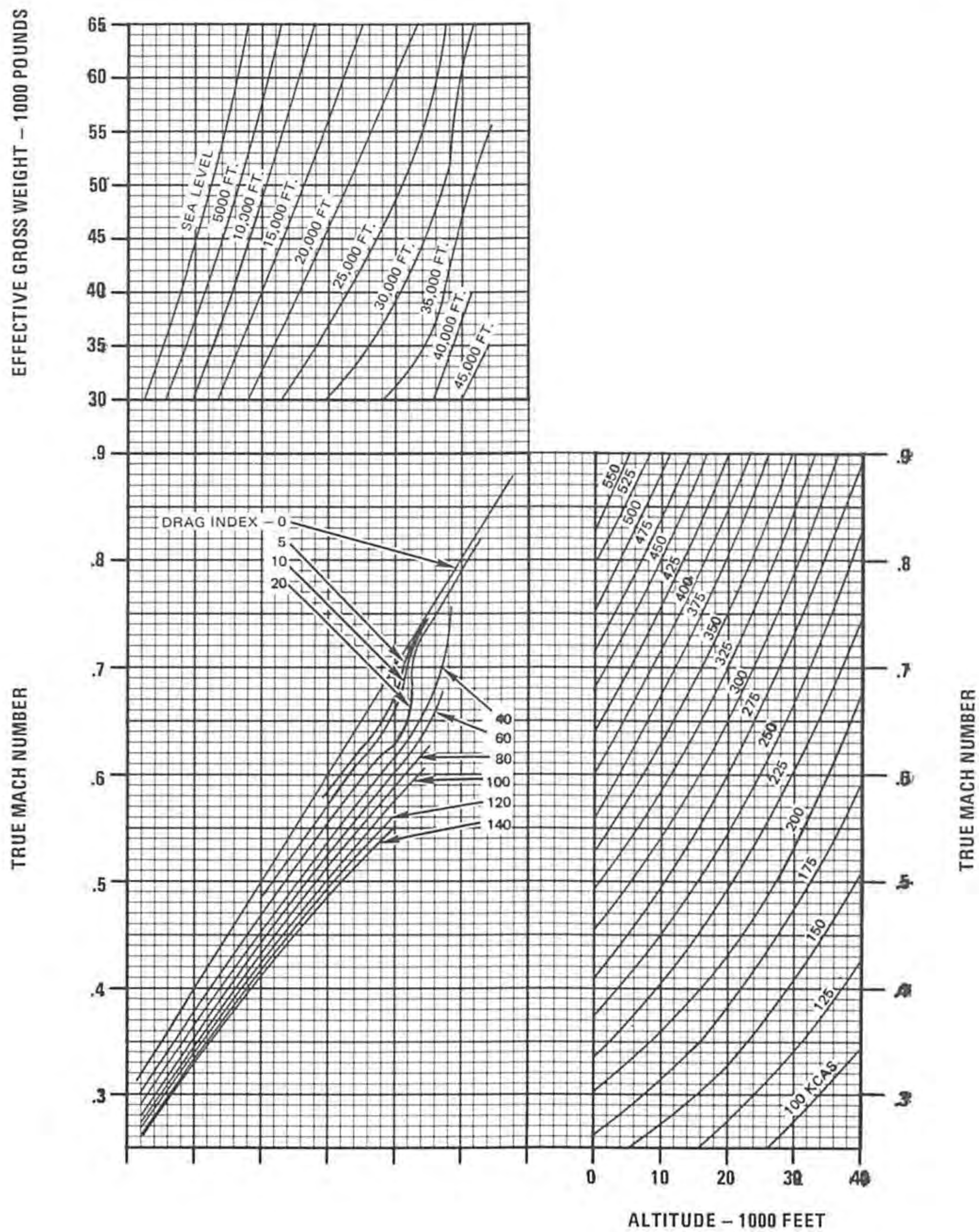
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINES: (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 79
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(341)

Figure 32-1. Maximum Endurance (Sheet 2 of 4)

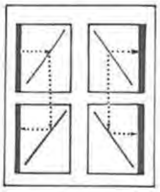
FUEL FLOW

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
(0–60)

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

NOTE
TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO THE TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FROM STANDARD DAY.

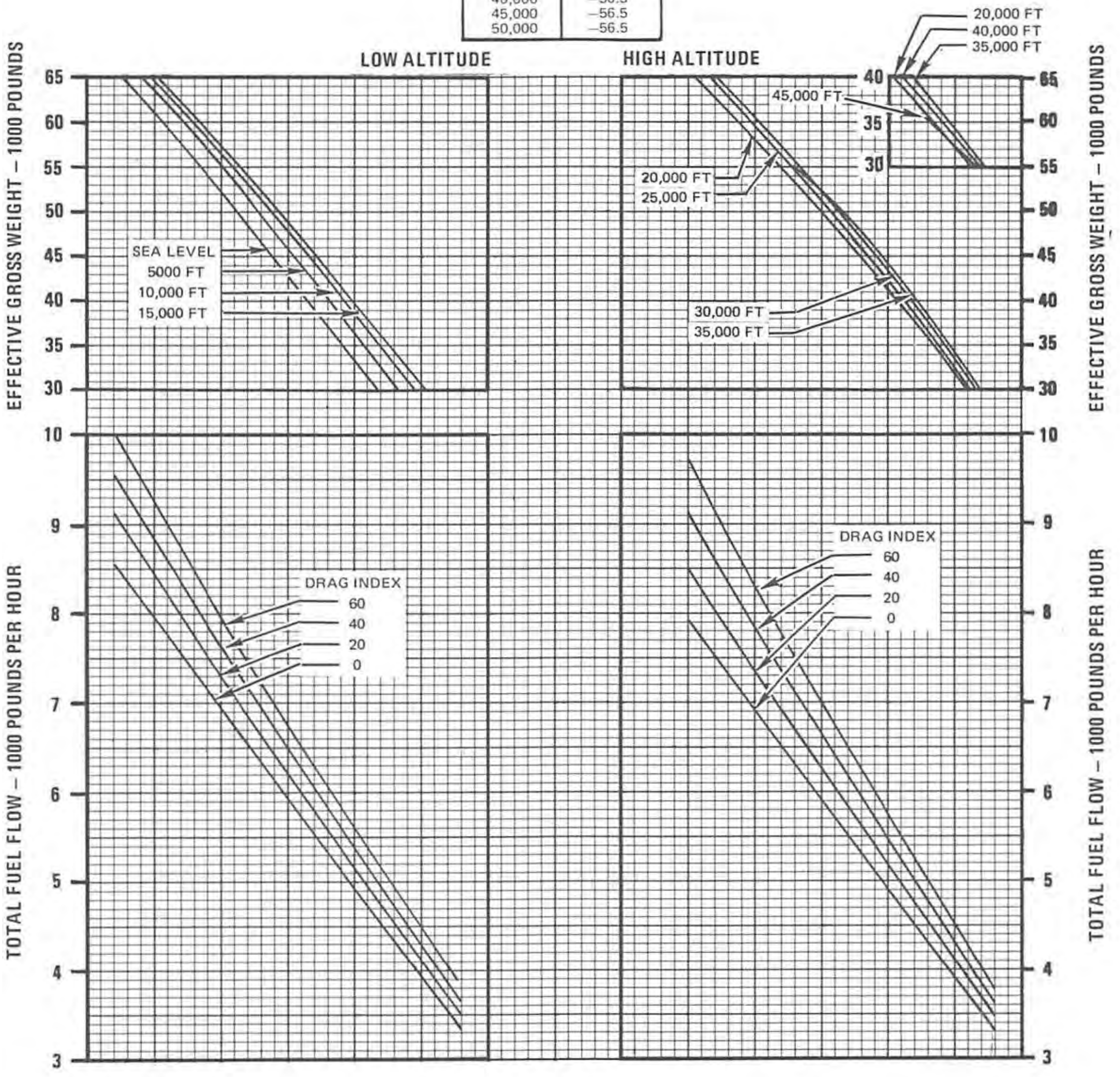
GUIDE



DATA: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

ICAO STANDARD DAY	
ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	–4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(342)

Figure 32-1. Maximum Endurance (Sheet 3 of 4)

FUEL FLOW

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
(60–140)

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
40,000	−56.5
45,000	−56.5
50,000	−56.5

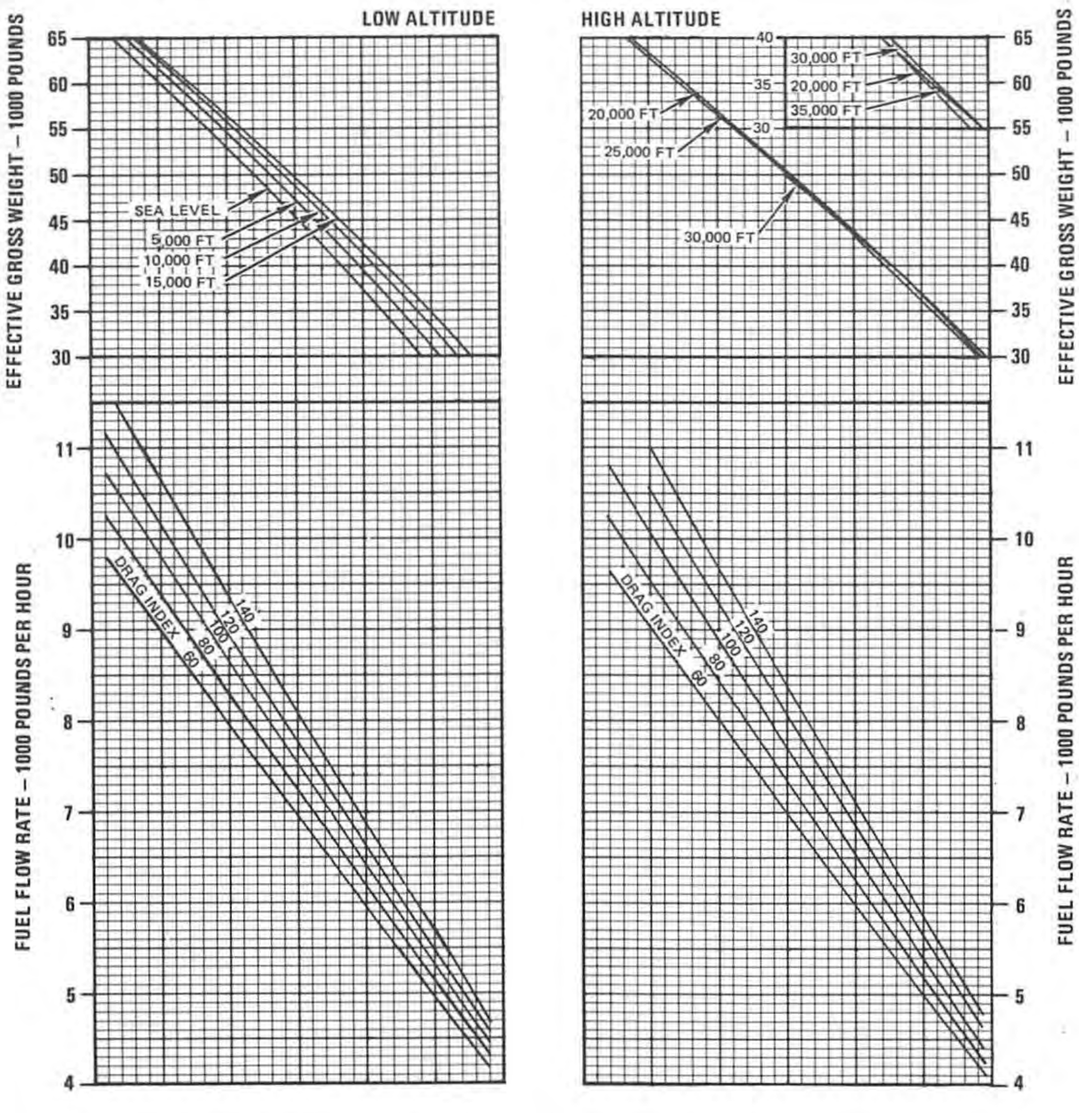
DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

NOTE
TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FROM STANDARD DAY.

GUIDE

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(343)

Figure 32-1. Maximum Endurance (Sheet 4 of 4)

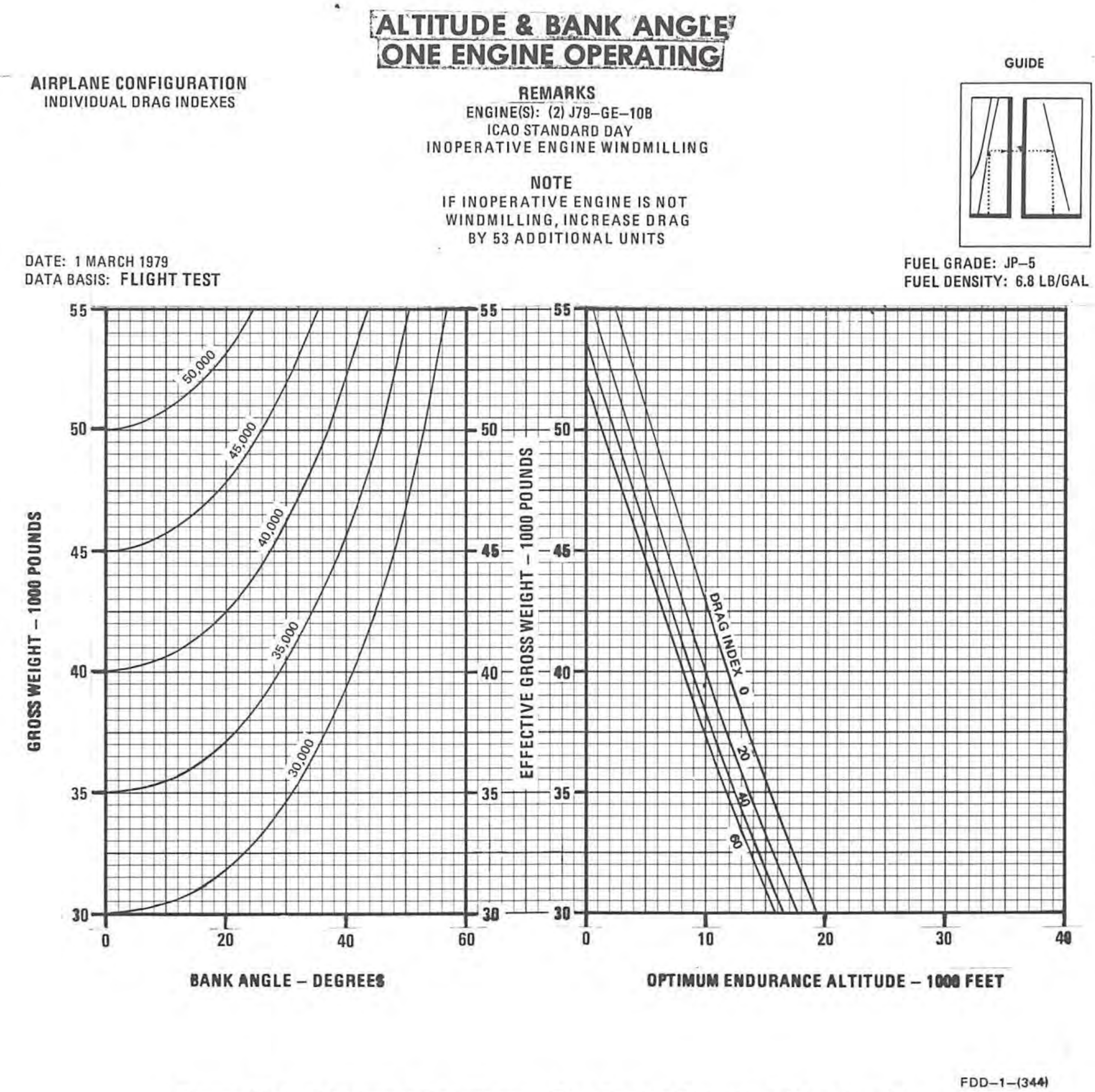


Figure 32-2. Maximum Endurance – One Engine Operating (Sheet 1 of 2)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

MACH NUMBER AND FUEL FLOW ONE ENGINE OPERATING

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

NOTES

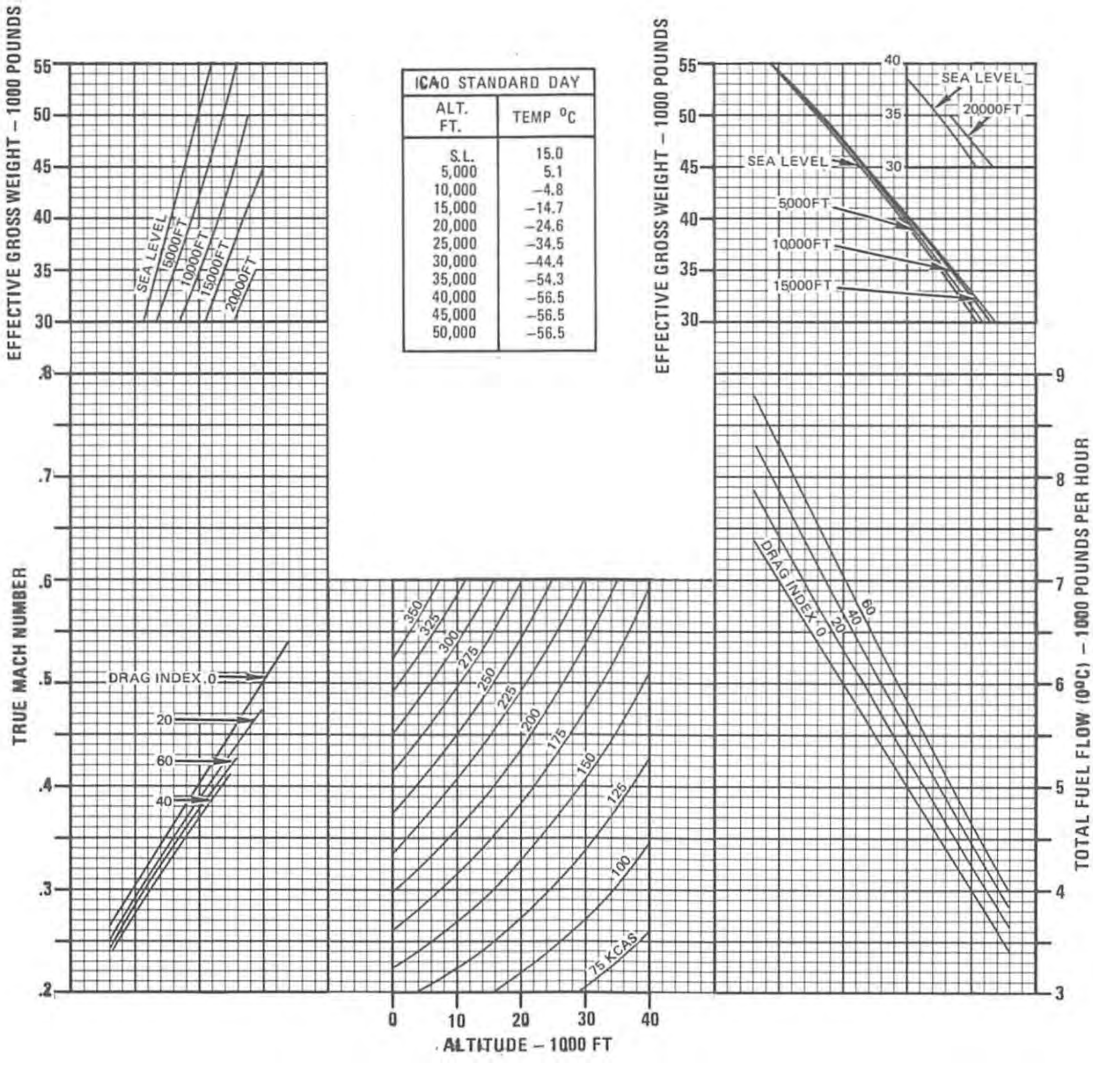
- IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG BY 53 ADDITIONAL UNITS.
- TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FORM STANDARD DAY.

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

GUIDE

FUEL GRADE: JP–6
FUEL DENSITY: 6.8 LB/GAL

ICAO STANDARD DAY	
ALT. FT.	TEMP °C
S.L.	15.0
5,000	5.1
10,000	–4.8
15,000	–14.7
20,000	–24.6
25,000	–34.5
30,000	–44.4
35,000	–54.3
40,000	–56.5
45,000	–56.5
50,000	–56.5



FDD–1–(345)

Figure 32-2. Maximum Endurance – One Engine Operating (Sheet 2 of 2)

CHAPTER 33

Air Refueling

Note

Refer to NATOPS Air Refueling Manual.

33.1 AIR REFUELING TRANSFER TIME CHART

This chart (Figure 33-1) provides the capability of determining the amount of time required to take on a certain amount of fuel at a specified rate. This time segment should then be added to the planning profile.

33.1.1 Use. Enter the chart with a specified amount of fuel to be received and project horizontally to the right and intersect the applicable rate of transfer. From this point, descend vertically to read the amount of time required for the transfer.

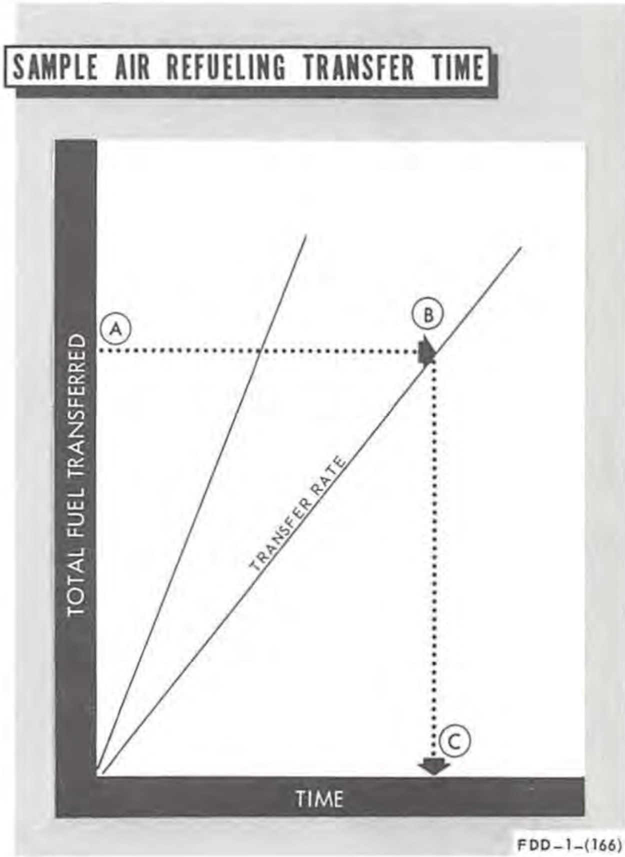
33.1.2 Sample Problem

D704 Buddy Tank

A. Total fuel transferred – 12,000 POUNDS.

b. Transfer rate for D704 buddy tank – 180 GALLONS/MINUTE.

C. Time of transfer – 9.7 MINUTES.



D-704 BUDDY TANK C-130 AND KA3B/EKA3B TANKER

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DATE 1 DECEMBER 1978
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

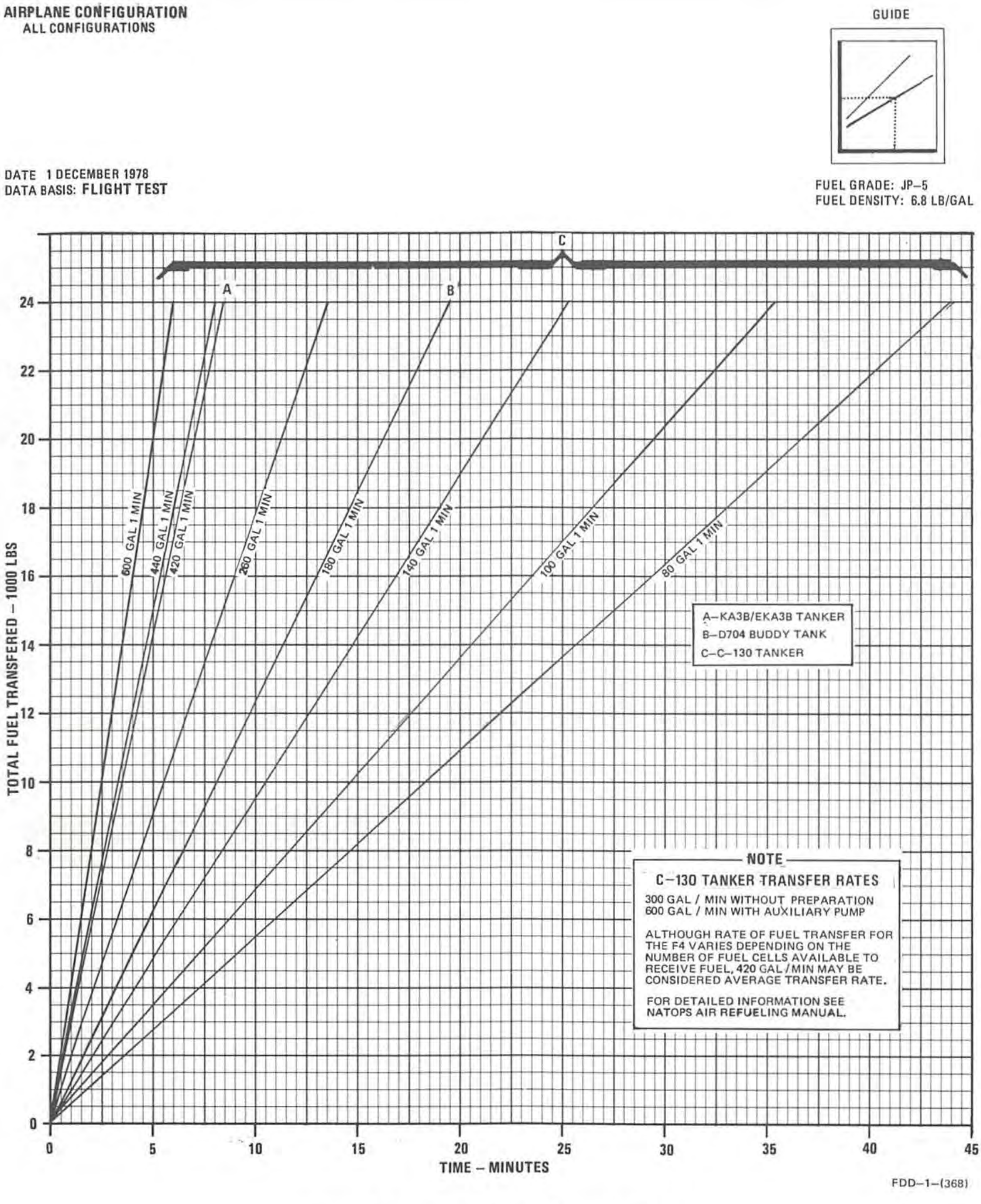


Figure 33-1. Air Refueling Transfer Time

CHAPTER 34

Descent

34.1 DESCENT CHARTS

Note

> For aircraft with PRIDE antennas installed, additional units of drag must be applied to the computed drag index. Refer to Figure 28-2.

This chart (Figure 34-1) presents the distance, time, and fuel required to make a 250-knot, idle thrust descent. Also included is a Mach number curve that corresponds to the 250 KCAS maintained throughout the descent.

34.1.1 Use. Enter the upper graph with the flight altitude and project horizontally to intersect the applicable drag index within both plots. From the first intersection, project vertically downward to read distance traveled. From the second intersection, project vertically downward to read time to descend. Enter the lower graph with the flight altitude and project horizontally to intersect both plots. From the intersection of the applicable drag index, project vertically downward to read total fuel used. From the intersection of the Mach number curve, project vertically downward to read Mach number corresponding to 250 KCAS at the beginning of descent.

34.1.2 Sample Problem

A. Altitude – 30,000 FEET.

B. Computed drag index – 40.

C. Distance traveled – 38 MILES.

D. Computed drag index – 40.

E. Time required – 7.3 MINUTES.

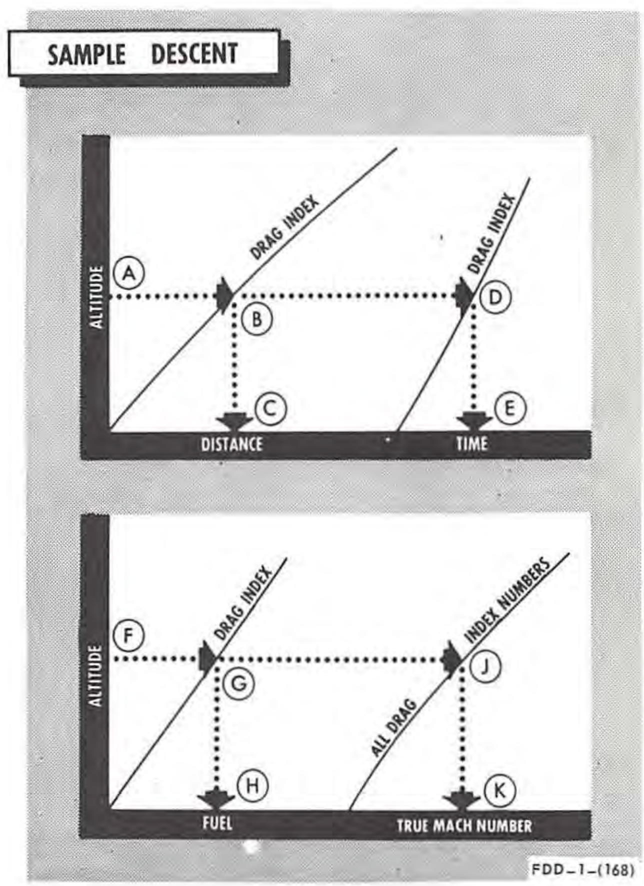
F. Altitude – 30,000 FEET.

G. Computed drag index – 40.

H. Fuel used – 185 POUNDS.

J. Single drag reflector.

K. Mach number at start of descent – 0.66.

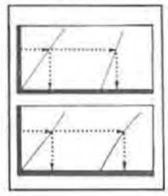


250 KCAS-IDLE THRUST
SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEX

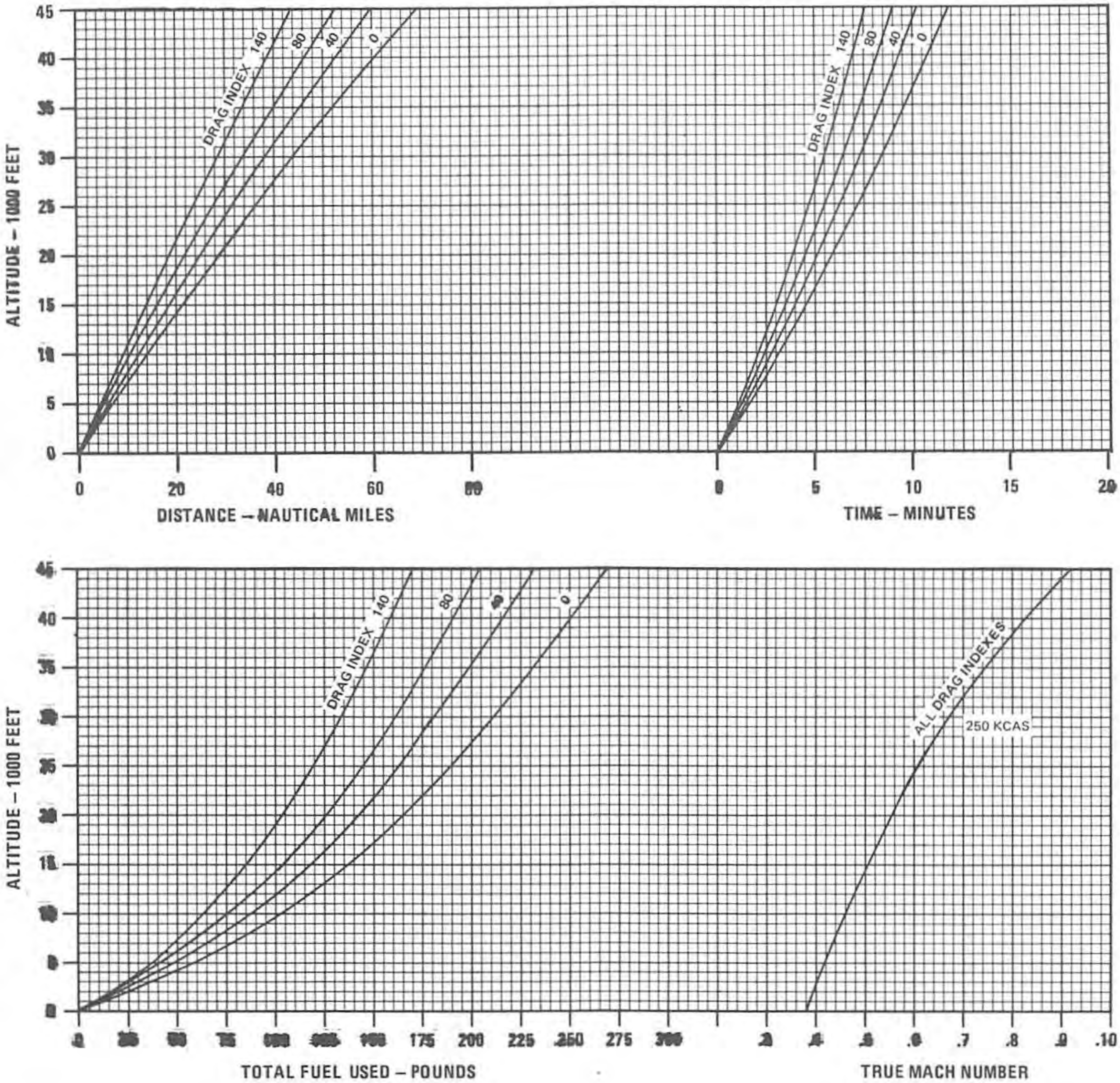
REMARKS
ENGINE(S): (2) J79-GE-10B
ALL GROSS WEIGHTS
ICAO STANDARD DAY

GUIDE



DATA: 1 FEBRUARY 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8LB/GAL



FDD-1-(367)

Figure 34-1. Descent

CHAPTER 35

Landing

35.1 MINIMUM LANDING ROLL DISTANCE CHART

Note

Landing distance charts are based on making an on-speed AOA approach. For additional AOA/approach speeds, refer to Figure 12-1.

This chart (Figure 35-1) contains landing roll distance information. The variables of temperature, altitude, gross weight, wind, runway condition reading (RCR), and drag chute are taken into consideration.

35.1.1 Use. Enter the chart with the runway temperature and project vertically upward to the correct pressure altitude. From this point, proceed horizontally to the right to the landing gross weight. From this point, descend vertically to the wind baseline. Parallel the nearest guideline down to the effective headwind or tailwind. From this point, descend vertically to the appropriate RCR and then horizontally to the left to read landing roll distance with drag chute. If the landing is to be made without the drag chute, continue further to the left to the appropriate RCR reflector and then proceed down to read the landing roll distance. If the landing is to be made over a 50-foot obstacle, allow 1,900 feet for airborne distance required from the obstacle to the landing touchdown point. If field RCR factors are not available, use RCR 23 for dry, RCR 14 for wet, and RCR 5 for icy runway conditions.

35.1.2 Sample Problem

A. Temperature – 15 °C.

B. Pressure altitude – 2,000 FEET.

C. Gross weight – 30,000 POUNDS.

D. Wind baseline.

E. Effective headwind – 20 KNOTS.

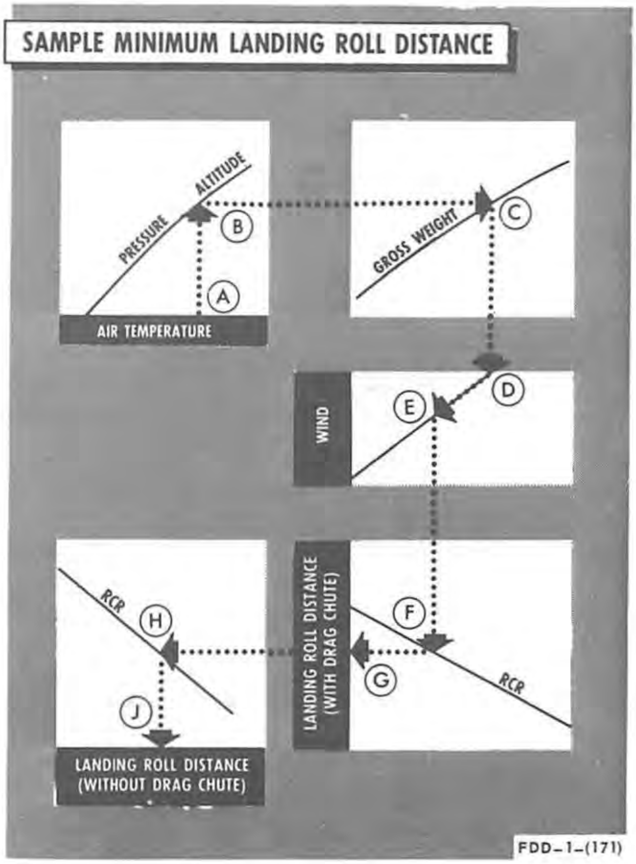
F. RCR – 14.

G. Landing roll distance – 3,800 FEET.

If operating without drag chute:

H. RCR – 14.

J. Landing roll distance – 5,700 FEET.



FDD-1-(171)

IDLE THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS FULL DOWN
SLATS OUT
DRAG CHUTE DEPLOYED

REMARKS
ENGINE(S) (2) J79-GE-10B
ANTISKID INSTALLED AND OPERATING

NOTE
FOR TOTAL DISTANCE FROM A 50 FT. HEIGHT, ADD 1900 FT. TO THE GROUND ROLL DISTANCE

GUIDE

DATE: 1 JANUARY 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

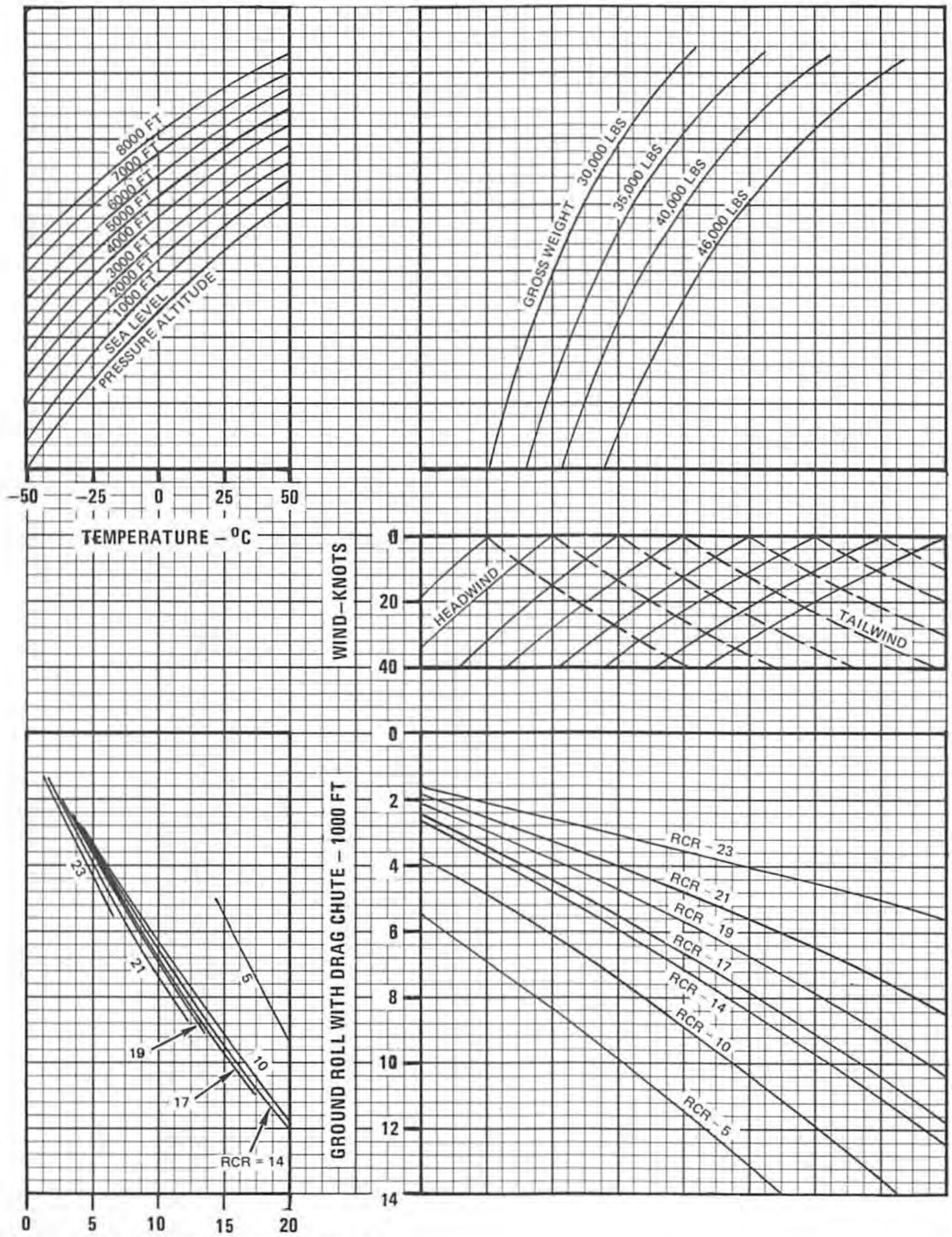


Figure 35-1. Minimum Landing Roll Distance

CHAPTER 36

Combat Performance

36.1 COMBAT FUEL FLOW CHARTS

Note

For aircraft with PRIDE antennas installed, additional units of drag must be applied to the computed drag index. Refer Figure 28-2.

These charts (Figure 36-1 (sheets 1 through 3)) present the specific fuelflow and general thrust setting to maintain a constant Mach number for an ICAO standard day and standard day +10 °C at all altitudes between sea level and 50,000 feet. Each chart is plotted for a specific configuration. The fuelflow values are based on a stabilized level flight condition and do not represent the fuelflow required to accelerate to a given Mach number.

36.1.1 Use. Enter the chart corresponding to the aircraft configuration with the desired Mach number for stabilized level flight. Proceed vertically upward to the selected flight altitude. Note the general thrust setting required and then project horizontally left to read specific fuelflow.

36.1.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles + PRIDE

A. Desired Mach number – 1.5.

B. Altitude (ICAO standard day) – 25,000 FEET.

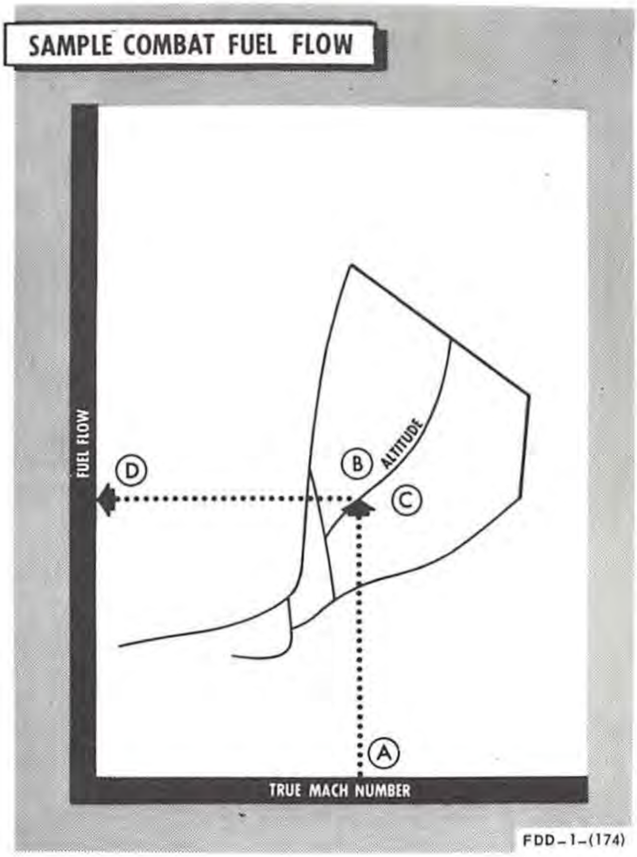
C. Power setting required – MODULATED AFTERBURNERS.

D. Specific fuelflow – 1,060 PPM.

32.2 COMBAT SPECIFIC RANGE

These charts (Figure 36-2 (sheets 1 through 3)) present the specific range and the general power settings required to maintain a constant Mach number for an ICAO standard day and standard day +10 °C at all altitudes from sea level to 50,000 feet. The specific range values are based on a stabilized level flight condition and do not represent the fuelflow required to accelerate to a given Mach number.

36.2.1 Use. Enter the chart corresponding to the aircraft configuration with the desired Mach number for stabilized level flight. Proceed vertically upward to the selected flight altitude. Note the general thrust setting required and then project horizontally left to obtain the specific range.



FDD-1-(174)

36.2.2 Sample Problem

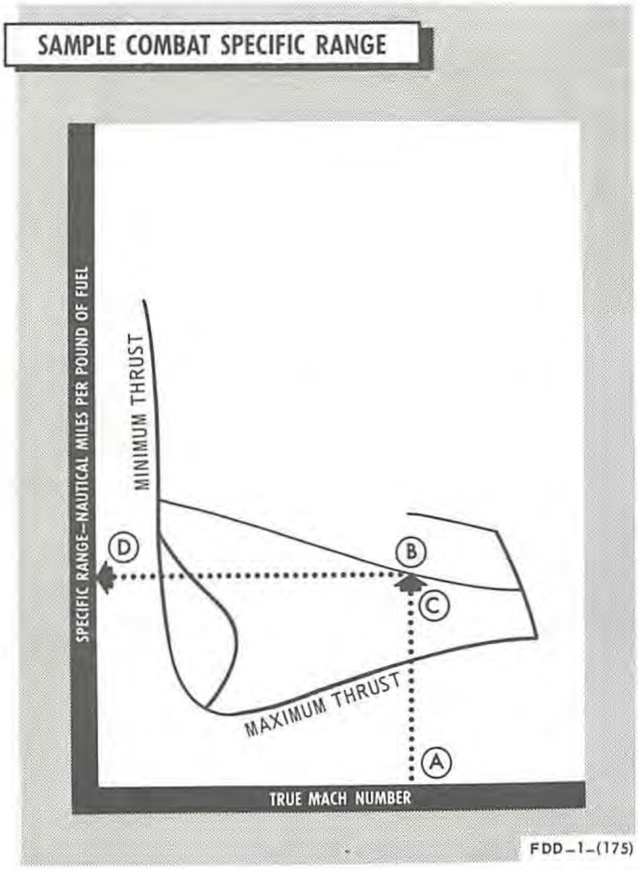
CONFIGURATION: Four AIM-7 Missiles + PRIDE

A. Desired Mach number – 1.5.

B. Altitude (ICAO standard day) – 30,000 FEET.

C. Thrust required – MODULATED AFTER-BURNERS.

D. Specific range – 0.017 NMPP.



36.3 SUPERSONIC MAXIMUM THRUST CLIMB CHARTS

These charts (Figure 36-3 (sheets 1 through 3)) are plotted for supersonic maximum thrust climb from 35,000 feet to the supersonic combat ceiling. Distance traveled in the climb is plotted against gross weight with guidelines provided to show the weight reduction as the climb progresses. The time to distance/altitude relationship is superimposed on the plot. Level flight acceleration data is provided which includes time, fuel used (gross weight change), and distance required to accelerate from the subsonic to the supersonic climb Mach number at 35,000 feet. If supersonic climb is contemplated, acceleration at 35,000 feet followed by the climb is recommended since acceleration to supersonic Mach numbers at this altitude provides for the optimum performance capability.

Note

> If ramp cycling occurs during supersonic climb, the climb schedule Mach number can be increased until the cycling stops. This produces an insignificant degradation in climb performance.

36.3.1 Use. Enter the chart with the gross weight and proceed vertically to the initial Mach number and note the corresponding distance and time. Proceed parallel to the guidelines to the desired supersonic climb Mach number (end of acceleration). Project both vertically downward and horizontally left from this point to read gross weight and distance traveled; also note the time. From these values, subtract the distance, weight, and time corresponding to the initial Mach number to determine the distance, fuel, and time required to accelerate. From the climb Mach number gross weight intersection (start of climb), proceed parallel along the guidelines to the desired altitude. Obtain the distance, gross weight, and time for this point. Subtract from this data corresponding values at the start of climb to obtain the distance traveled, the weight change (fuel used), and the time required to complete the climb. If total distance, fuel, and time are desired, add the climb and acceleration values together.

36.3.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles + PRIDE

A. Initial gross weight – 40,000 POUNDS.

B. Initial Mach number – 1.2.

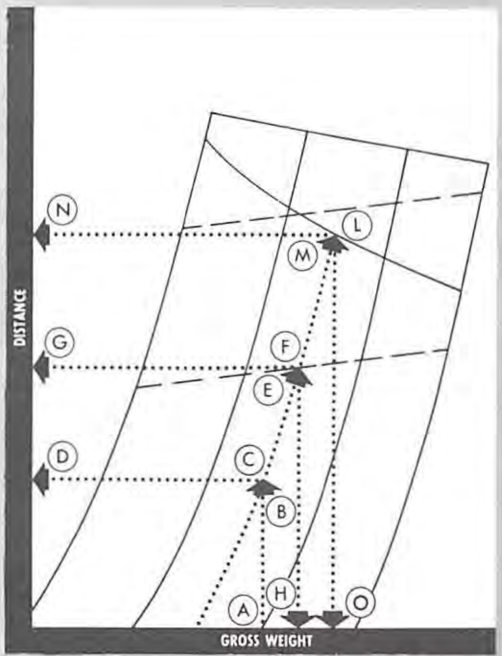
C. Time corresponding to initial Mach number – 0.8 MINUTE.

D. Distance corresponding to initial Mach number – 9 MILES.

E. Climb Mach number – 1.4.

F. Time at end of acceleration – 1.5 MINUTES.

SAMPLE SUPERSONIC MAXIMUM THRUST CLIMB



FDD-1-(176)

G. Distance at end of acceleration – 17 MILES.

H. Gross weight at end of acceleration – 39,500 POUNDS.

I. Time required for acceleration (F to C) – 0.7 MINUTE.

J. Fuel required for acceleration (A to H) – 500 POUNDS.

K. Distance required for acceleration (G to D) – 8 MILES.

L. Altitude at end of climb – 50,000 FEET.

M. Time at end of climb – 3.9 MINUTES.

N. Distance at end of climb – 49 MILES.

O. Gross weight at end of climb – 38,200 POUNDS.

P. Time required for climb (M to F) – 2.4 MINUTES.

Q. Distance required for climb (N to G) – 32 MILES.

R. Fuel required for climb (H to O) – 1,300 POUNDS.

S. Total time required to accelerate and climb (I + P) – 3.1 MINUTES.

T. Total distance required to accelerate and climb (K + Q) – 40 MILES.

U. Total fuel required to accelerate and climb (J + R) – 1,800 POUNDS.

36.4 LOW-ALTITUDE ACCELERATIONS

These charts (Figures 36-4 and 36-5) present time and fuel required to accelerate from 0.5 to 0.9 Mach at altitudes of sea level, 2,000, 4,000, and 6,000 feet. Separate charts are provided for several gross weights and for both maximum and military thrust. The time and fuel values are tabulated for ICAO standard day conditions; however, correction factors are given for nonstandard temperature.

36.4.1 Use. After selecting the applicable chart for thrust, gross weight, and altitude, enter with the Mach number desired at end of acceleration and project horizontally to the applicable drag index column. Read time/fuel required to accelerate from 0.5 Mach.

36.5 ACCELERATION CHARTS

These charts (Figures 36-6 and 36-7) show the relationship of time, distance, and fuel required for level flight maximum or military thrust accelerations. The data is presented for various altitudes and configurations.

WARNING

Refer to Part V for external store operating limitations.

36.5.1 Use. Enter the applicable chart with the aircraft gross weight. Proceed vertically upward to the initial Mach number and note the time. Project horizontally and note the distance. From the initial Mach number, proceed parallel to the guidelines to the

Mach number desired at the end of acceleration. At this point, note the time, then project horizontally and vertically and note the distance and gross weight. From this data, subtract the time, distance, weight corresponding to the initial Mach number to determine the time, distance, and fuel required for acceleration.

36.5.2 Sample Problem

CONFIGURATION: Maximum Thrust, Four AIM-7 Missiles, and One Centerline Tank + PRIDE, 45,000 Feet

A. Gross weight – 45,000 POUNDS.

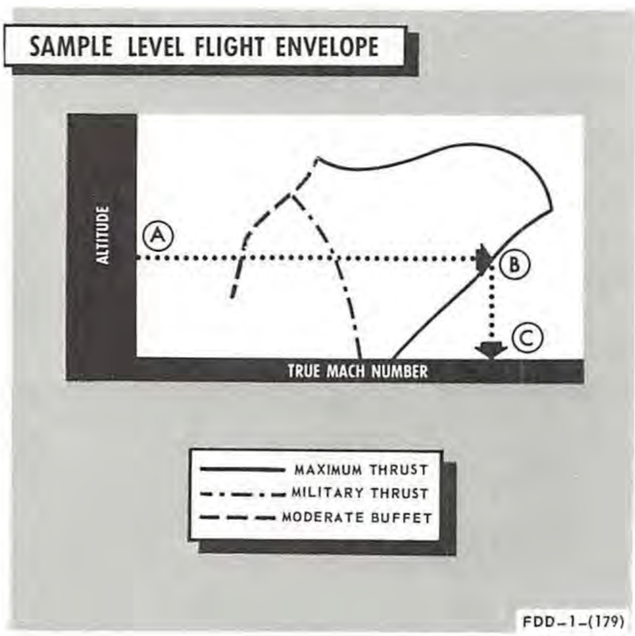
B. Initial Mach number – 1.0.

C. Time – 1.8 MINUTES.

D. Distance – 16 MILES.

E. Parallel guidelines.

F. Desired Mach number – 1.30.



G. Time corresponding to new Mach number – 8.2 MINUTES.

H. Distance corresponding to new Mach number – 86 MILES.

I. Gross weight corresponding to new Mach number – 42,500 POUNDS.

J. Time required for acceleration (G to C) – 6.4 MINUTES.

K. Distance required for acceleration H to D) – 70 MILES.

L. Fuel required for acceleration (A to I) – 2,500 POUNDS.

36.6 LEVEL FLIGHT ENVELOPE

This chart (Figure 36-8) presents the aircraft level flight speed envelope for various configurations and average combat gross weights. Parameters of the envelopes extend from buffet onset to V_{max} throughout the altitude range. Maximum Mach number curves for additional aircraft configurations are plotted within the envelopes.

WARNING

Refer to Part V for external store operating limitations.

36.6.1 Use. Enter the chart with the desired combat altitude. Proceed horizontally to intersect the applicable configuration power curve. From this point, proceed vertically downward to read the maximum attainable Mach number in level flight.

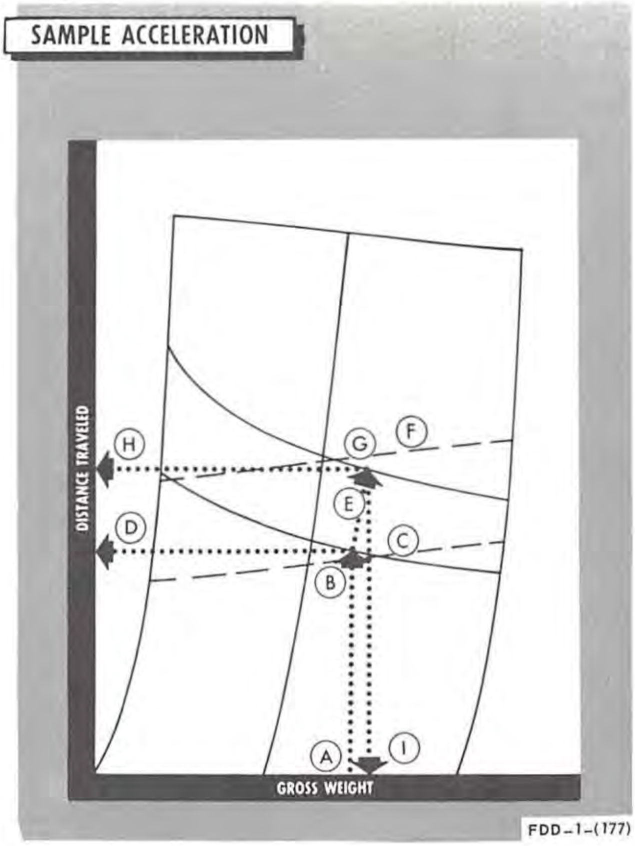
36.6.2 Sample Problem

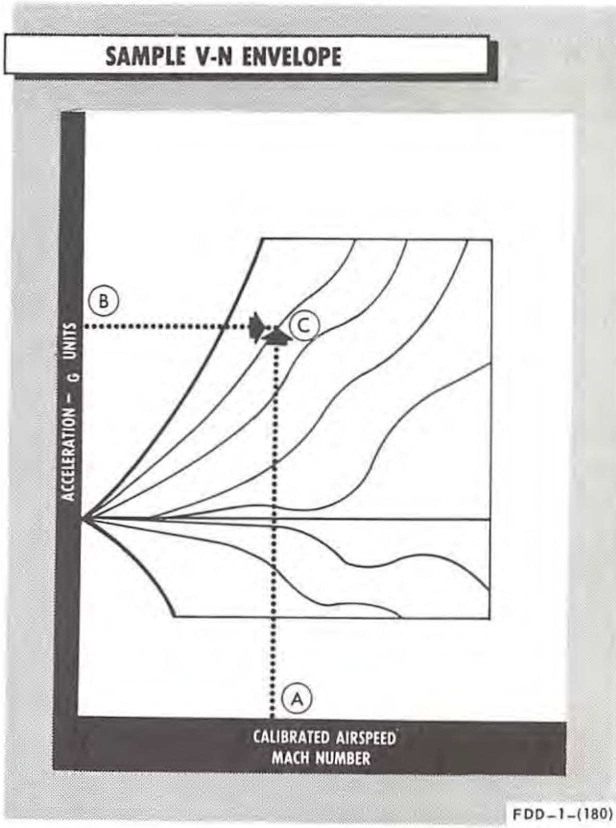
CONFIGURATION: Four AIM-7 Missiles + PRIDE

A. Combat altitude – 36,000 FEET.

B. Aircraft complete load – FOUR AIM-7 MISSILES AND ONE CENTERLINE TANK.

C. Maximum attainable Mach number (curve 2)–1.79.





36.7 V-N

The symmetrical flight V-N envelopes (Figure 36-9 (sheets 1 through 4)) are a graphical presentation of airspeed versus acceleration with lines of indicated angle of attack superimposed. The data are supplied for one gross weight at four altitudes. The charts may be used to determine the allowable maximum symmetrical maneuvering capability of the aircraft as well as the indicated angle of attack for any desired g. The charts may be considered to be linear between altitudes for all practical purposes, provided the interpolation is carried out for a constant airspeed.

36.7.1 Use. To find the allowable maximum symmetrical performance capability, enter the chart with the calibrated airspeed and proceed vertically to the stall boundary (positive or negative g) or the maximum allowable acceleration (upper and lower) as applicable. From these intersections, project horizontally to the left to read the positive and negative g obtainable in the case of the stall boundaries or the upper and lower maximum allowable g for the selected gross weight. To find the angle of attack for a given condition of g and airspeed, enter the appropriate chart with these parameters. Project horizontally to the right from the load factor and vertically upward from the airspeed. At the intersection of these two projections, read the indicated angle of attack.

36.7.2 Sample Problem

ALTITUDE: 5,000 Feet, Gross Weight 37,500 pounds

A. Speed – 550 KCAS.

B. Load factor – 5G.

C. Angle of attack – 8.6 UNITS.

36.8 TEMPERATURE EFFECT ON MAXIMUM SPEED

This chart (Figure 36-10) shows the effect of non-standard day temperatures on the maximum speed at maximum thrust. The speed variation is read out as the change in Mach number (Δ Mach) for a 10 °C variation in temperature (hot or cold) from standard day.

36.8.1 Use. Determine the temperature variation from standard day for the desired altitude. M_{max} may be obtained from the maximum thrust acceleration charts. Enter the chart at the desired Mach number on the standard day M_{max} line. Proceed vertically into either the hot or cold day plot depending on the temperature variation. Continue vertically to the selected altitude, then proceed horizontally to the left to read Δ Mach/10 °C. When the temperature variation differs from 10 °C, simply divide the variation by 10 to reduce it to a decimal. Then multiply the Δ Mach by the decimal to obtain the Δ Mach for a specific situation. Add this figure to the standard day M_{max} to obtain nonstandard day Mach.

36.8.2 Sample Problem. Find Δ Mach for standard day M_{max} of 1.8 at 30,000 feet. Forecast flight level temperature is -46.8 °C.

A. Temperature variation – -2.4 °C.

B. Standard day M_{max} – 1.8 MACH.

C. Altitude – 30,000 FEET.

D. Δ Mach/10 °C variation – 0.14.

E. Δ Mach/2.4 °C variation (0.14 ÷ 10 X 2.4) – 0.034.

F. Nonstandard day Mach number (B + E) – 1.83 MACH.

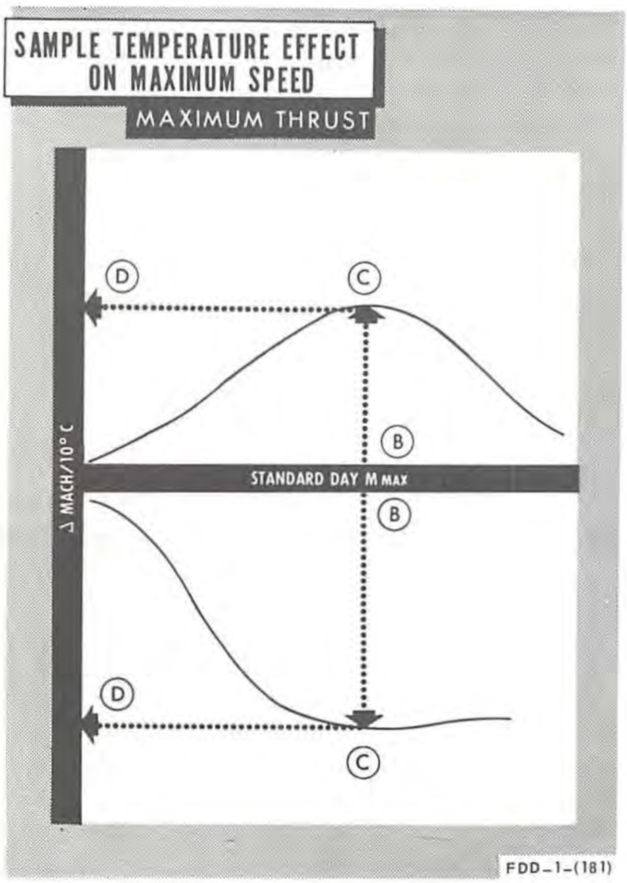
36.9 DIVE RECOVERY CHARTS

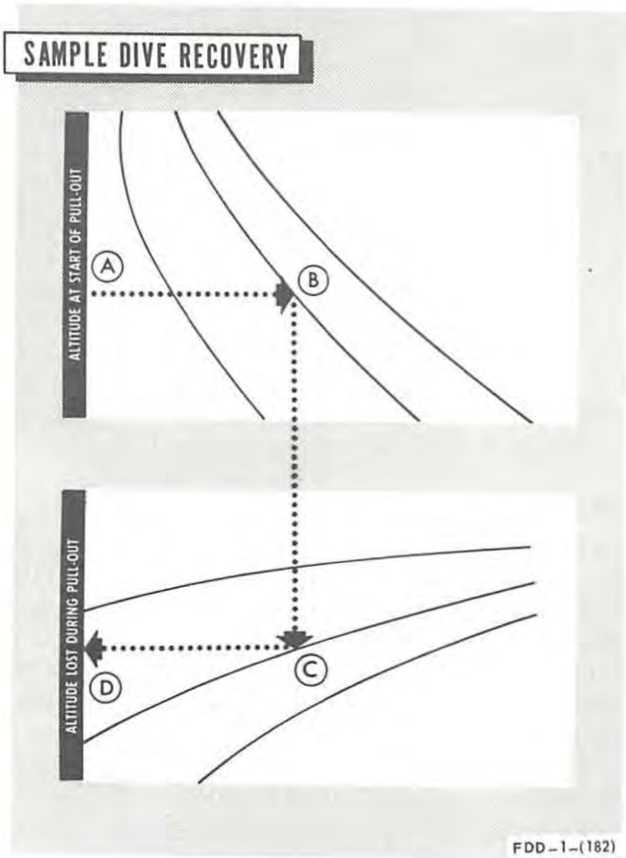
These charts (Figures 36-11 and 36-12) present the aircraft dive recovery capability for various speeds (subsonic and supersonic), altitudes, and dive angles at 16 units and 25 units AOA.

36.9.1 Use. Enter the applicable chart at the start of the pullout and project horizontally to intersect the Mach number at the start of the pullout. From this point, descend vertically and intersect the dive angle at the start of pullout, then proceed horizontally to the left to read altitude lost during pullout.

36.9.2 Sample Problem

CONFIGURATION: Four AIM-7 Missiles + PRIDE, 16 Units AOA, Supersonic





A. Altitude at start of pullout – 40,000 FEET.

B. Mach number at start of pullout – 1.5 MACH.

C. Dive angle at start of pullout – 70°.

D. Altitude loss during constant 16 unit AOA pullout – 14,000 FEET.

36.10 TURN CAPABILITIES

This chart (Figure 36-13) presents the radius of turn and the rate of turn for a constant altitude, constant speed turn. Turn data is available for various speeds and bank angles. Load factor is also included for each bank angle.

36.10.1 Use. Enter the radius of turn plot with the true airspeed. Proceed horizontally to the right to the desired bank angle. Note the load factor, then proceed vertically downward and read the radius of turn. Enter the rate of turn plot with the true airspeed. Proceed horizontally to the right to the bank angle, note the load factor, and then proceed vertically downward to read the rate of turn.

36.10.2 Sample Problem

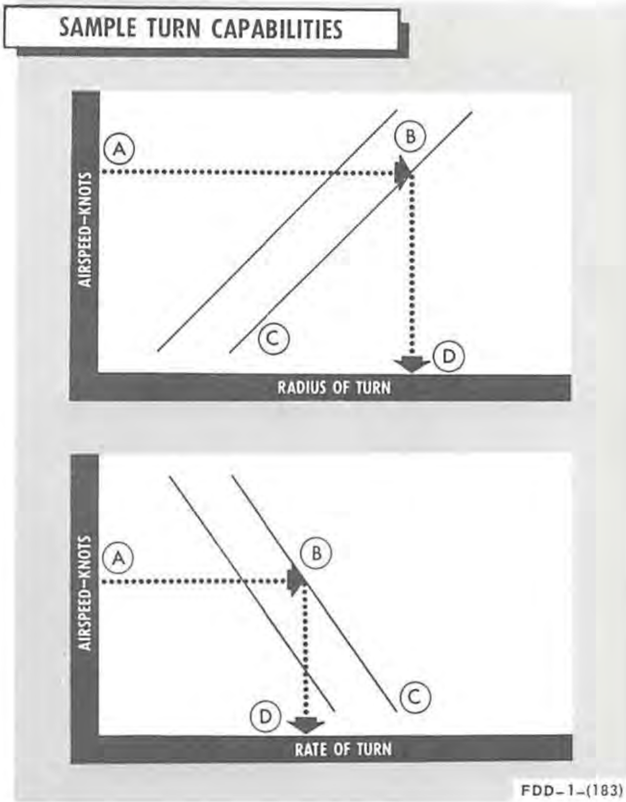
Radius of Turn

A. True airspeed – 400 KNOTS.

B. Bank angle – 20°.

C. Load factor – 1.07G'S.

D. Radius of turn – 40,000 FEET.



Rate of Turn

A. True airspeed – 500 KNOTS.

B. Bank angle – 30°.

C. Load factor – 1.15G'S.

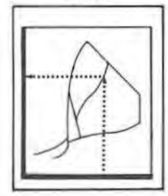
D. Rate of turn – 1.25°/SECOND.

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

REMARKS
ENGINE(S): (2) J79–GE–10B

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JS–5
FUEL DENSITY: 6.8 LB./GAL.

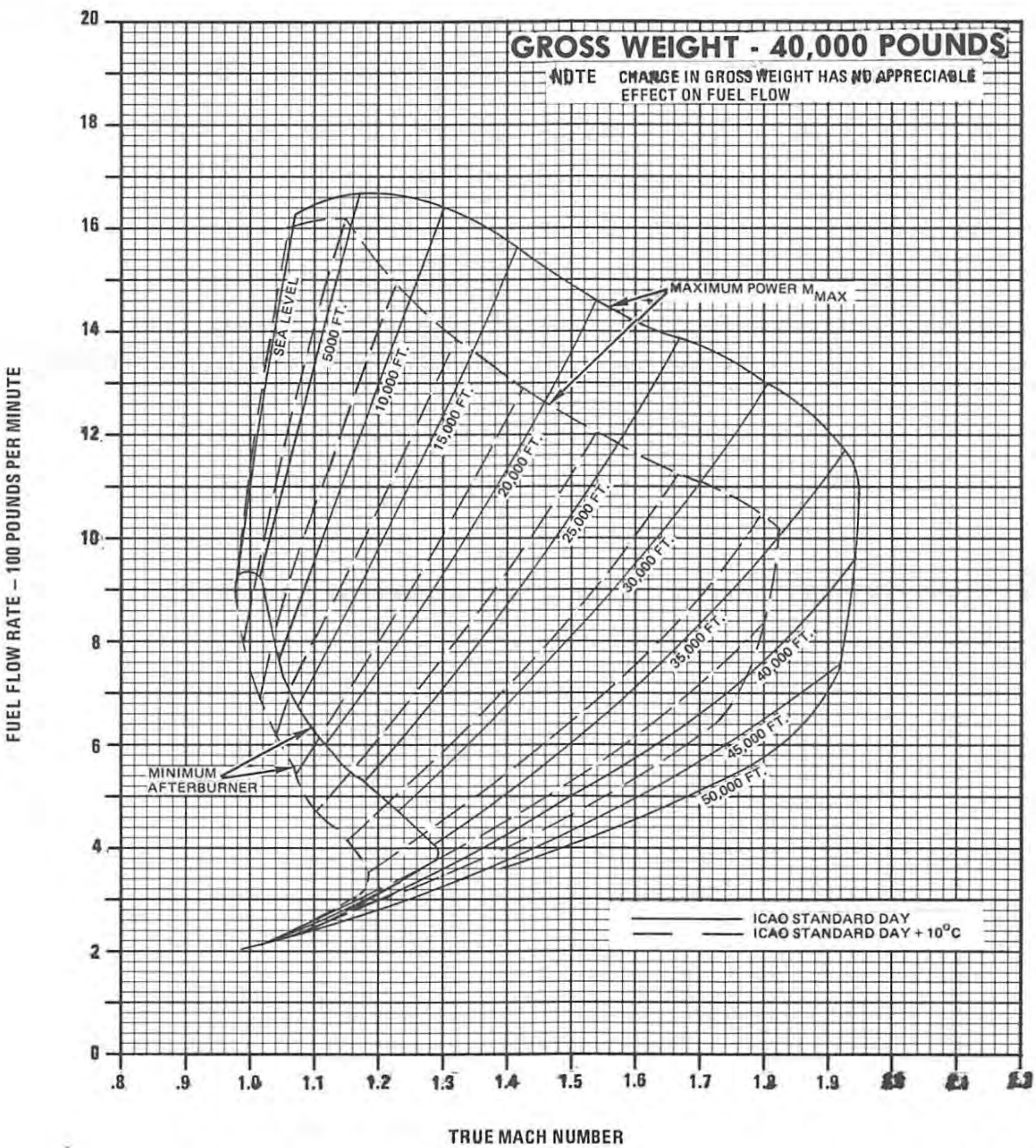


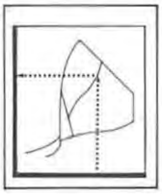
Figure 36-1. Combat Fuelflow (Sheet 1 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (1) ℄ TANK

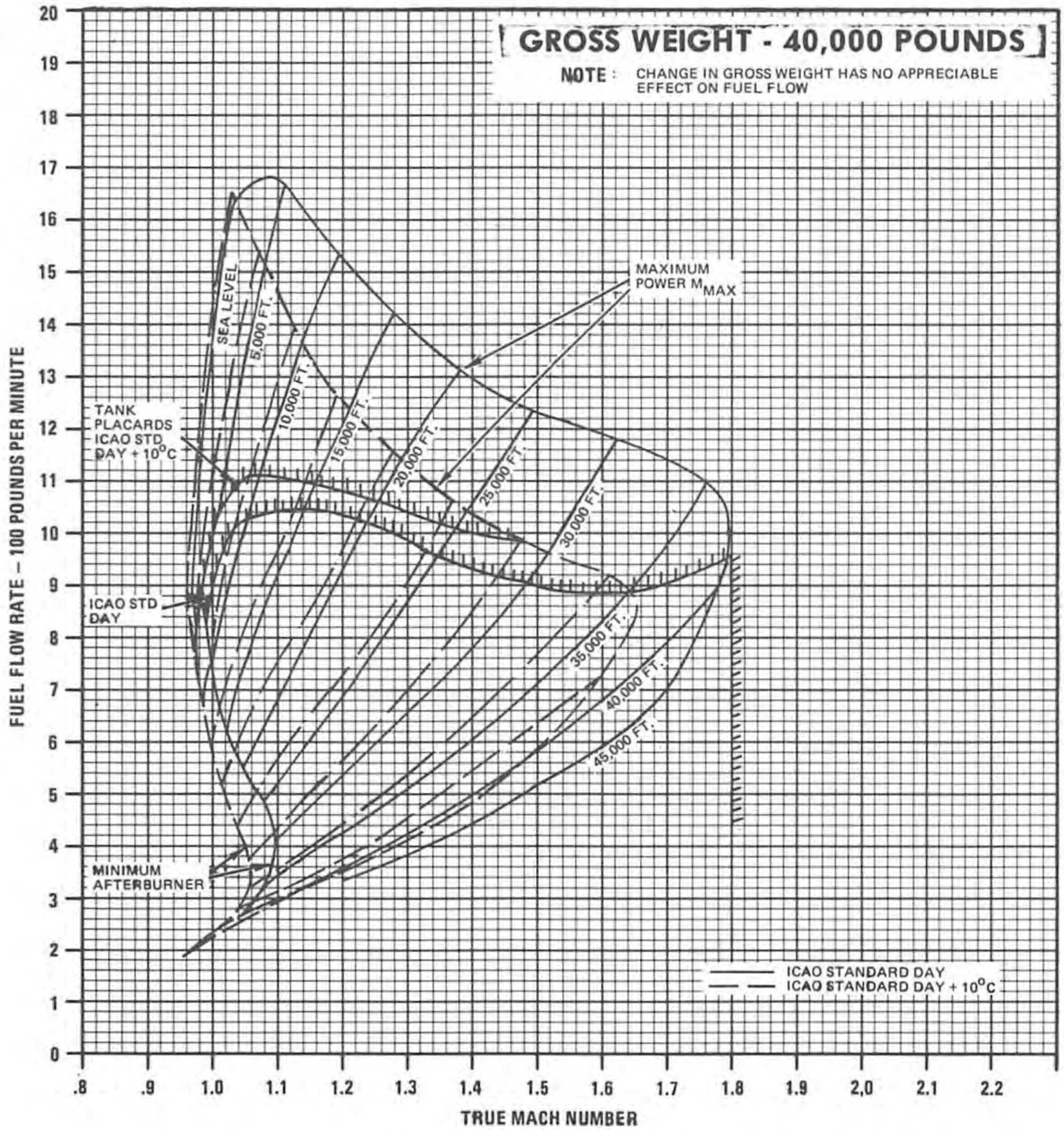
REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(364)

Figure 36-1. Combat Fuelflow (Sheet 2 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (2) WING TANKS

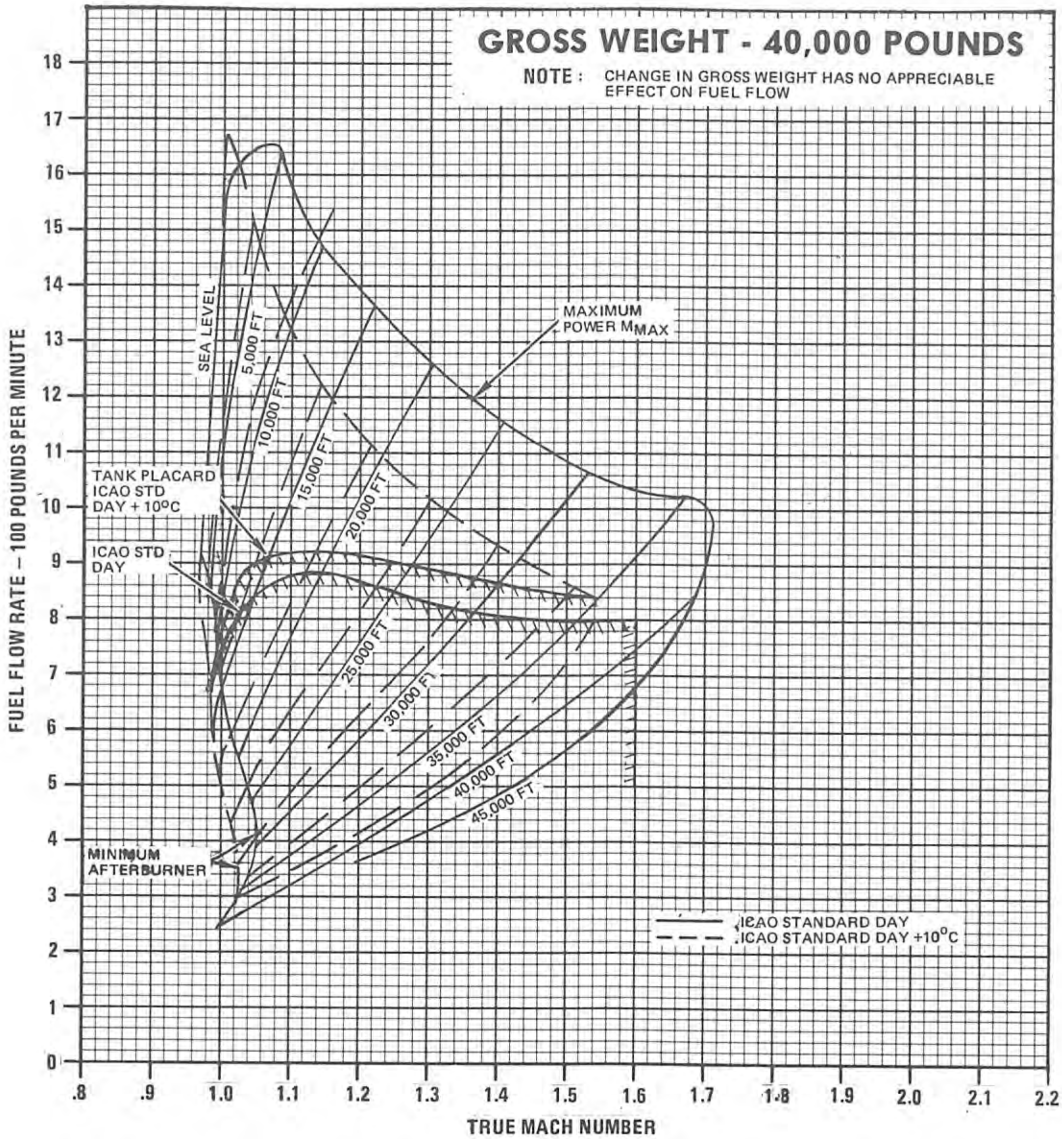
REMARKS

ENGINE(S) J79-GE-10B

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(363)

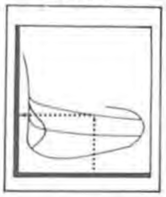
Figure 36-1. Combat Fuelflow (Sheet 3 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE

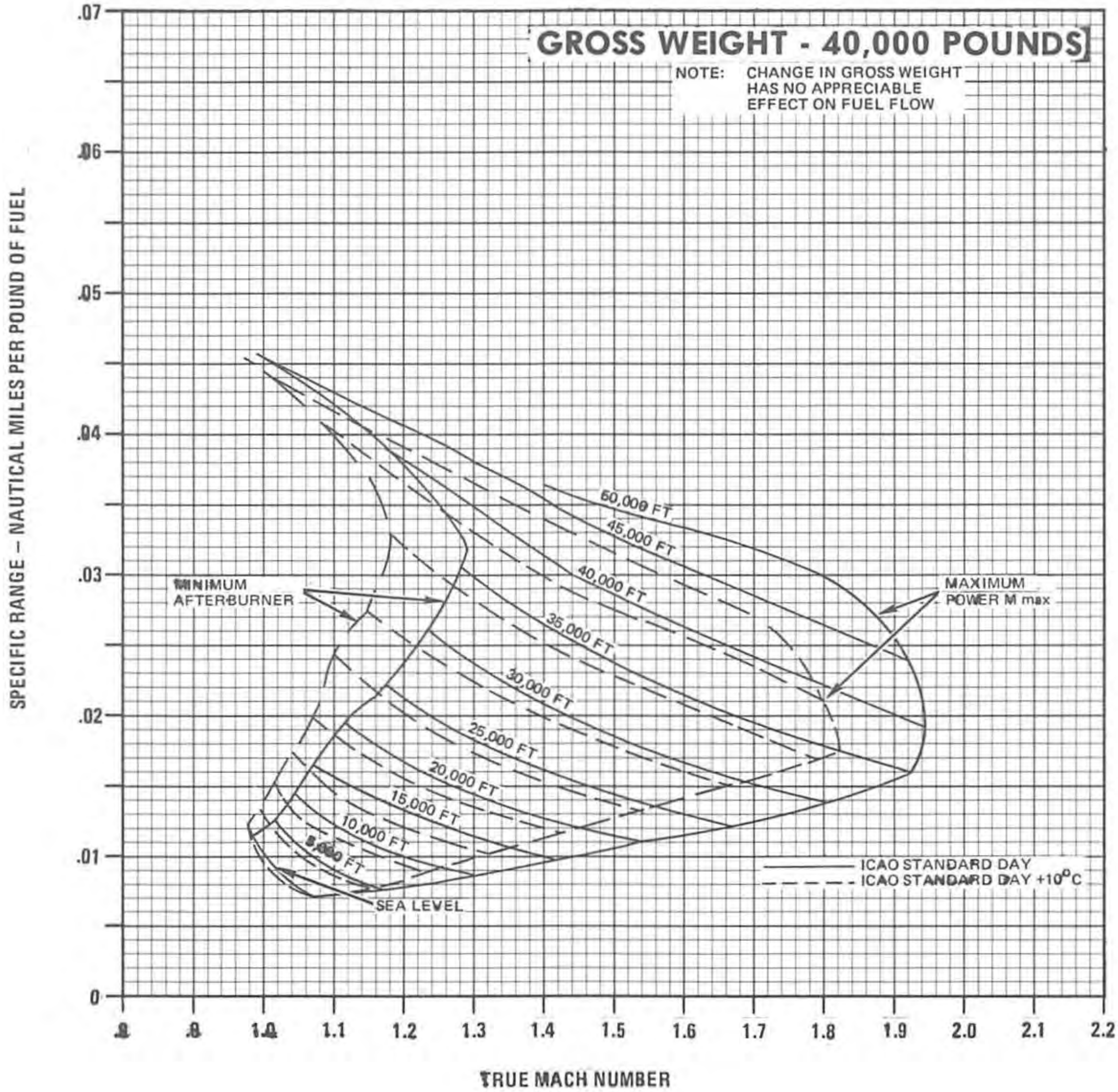
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(362)

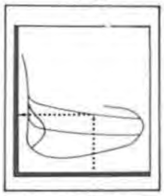
Figure 36-2. Combat Specific Range (Sheet 1 of 3)

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE
+ (1) ℄ TANK

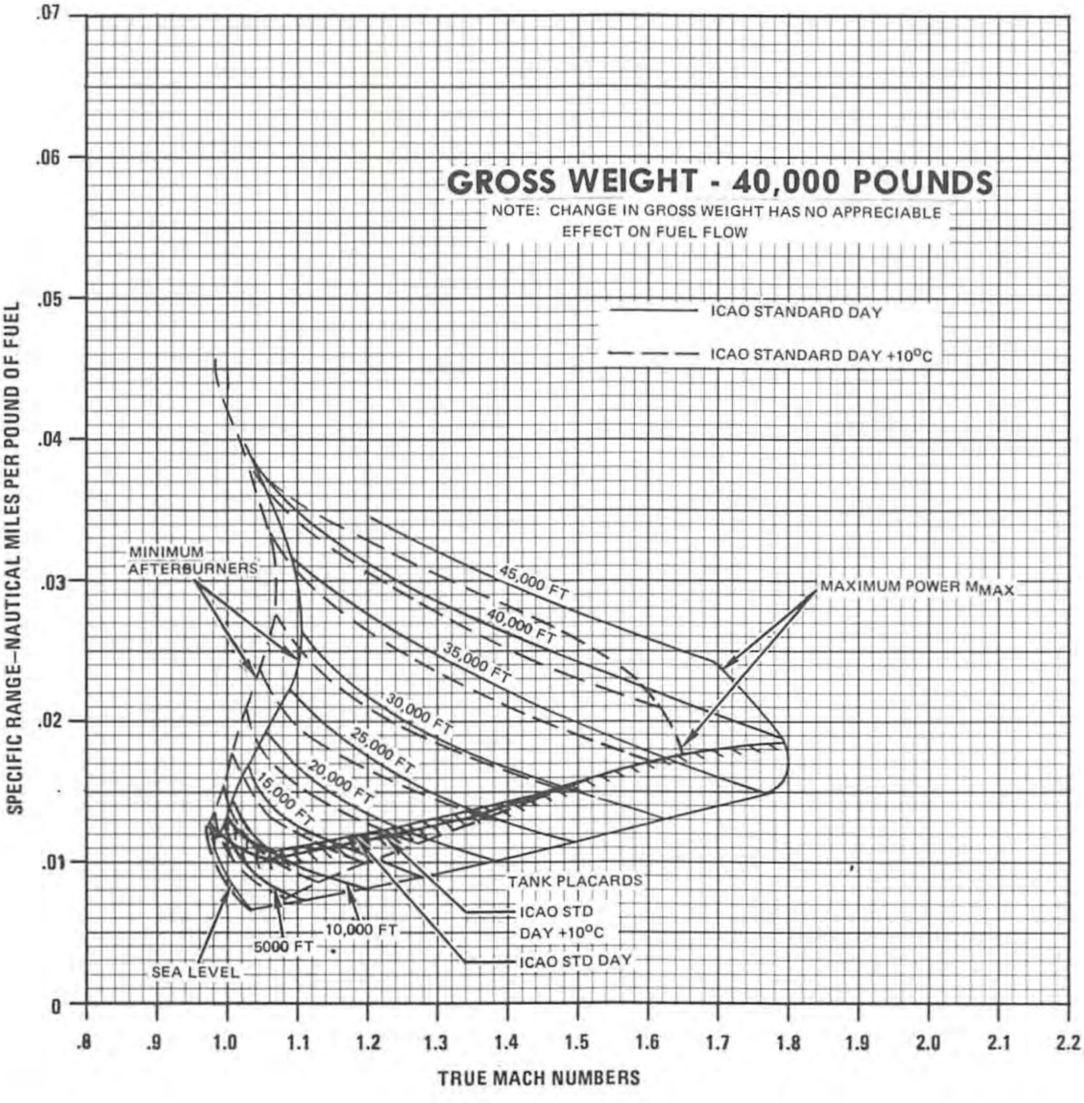
REMARKS
ENGINE (S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(361)

Figure 36-2. Combat Specific Range (Sheet 2 of 3)

STABILIZED LEVEL FLIGHT

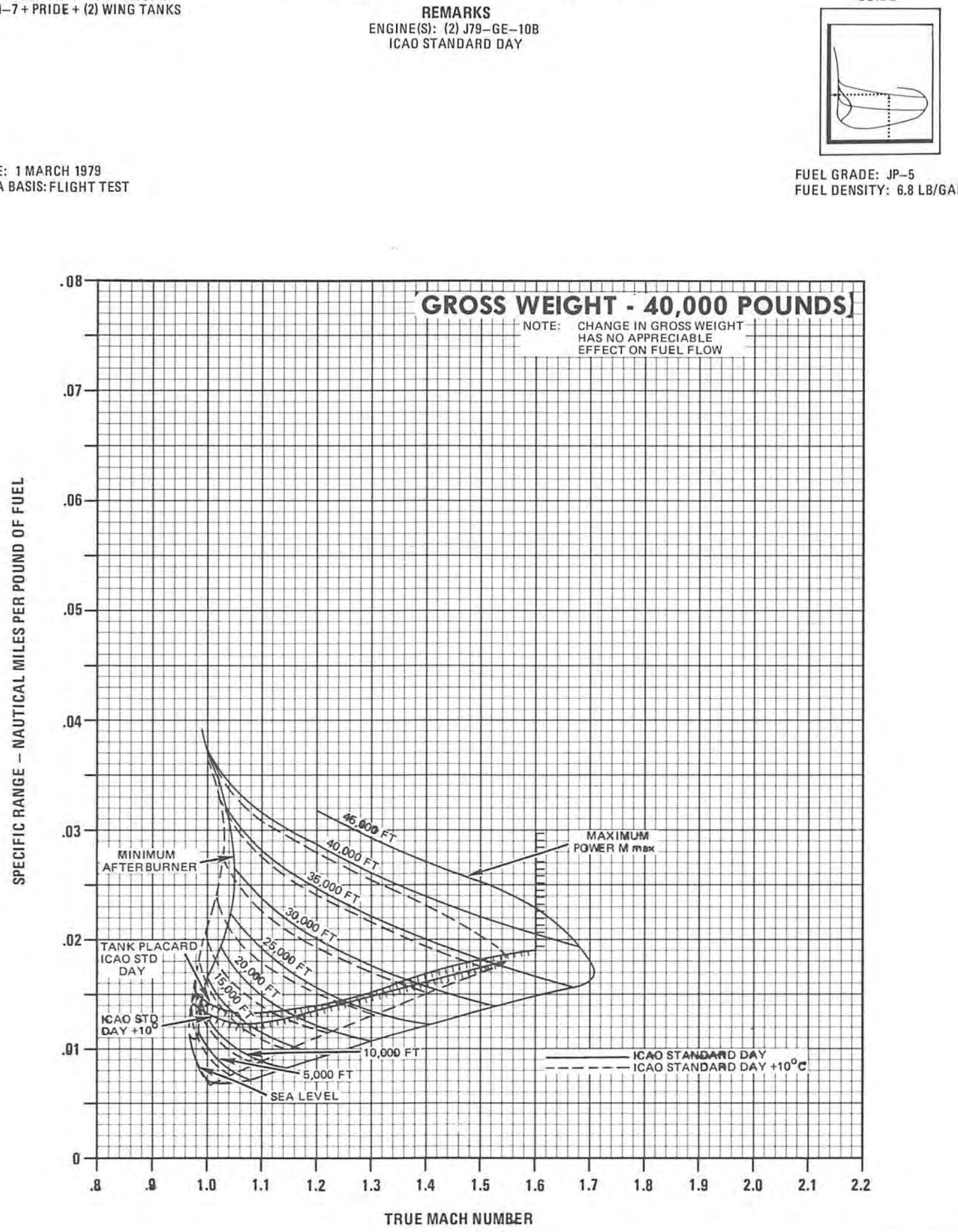
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (2) WING TANKS

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(360)

Figure 36-2. Combat Specific Range (Sheet 3 of 3)

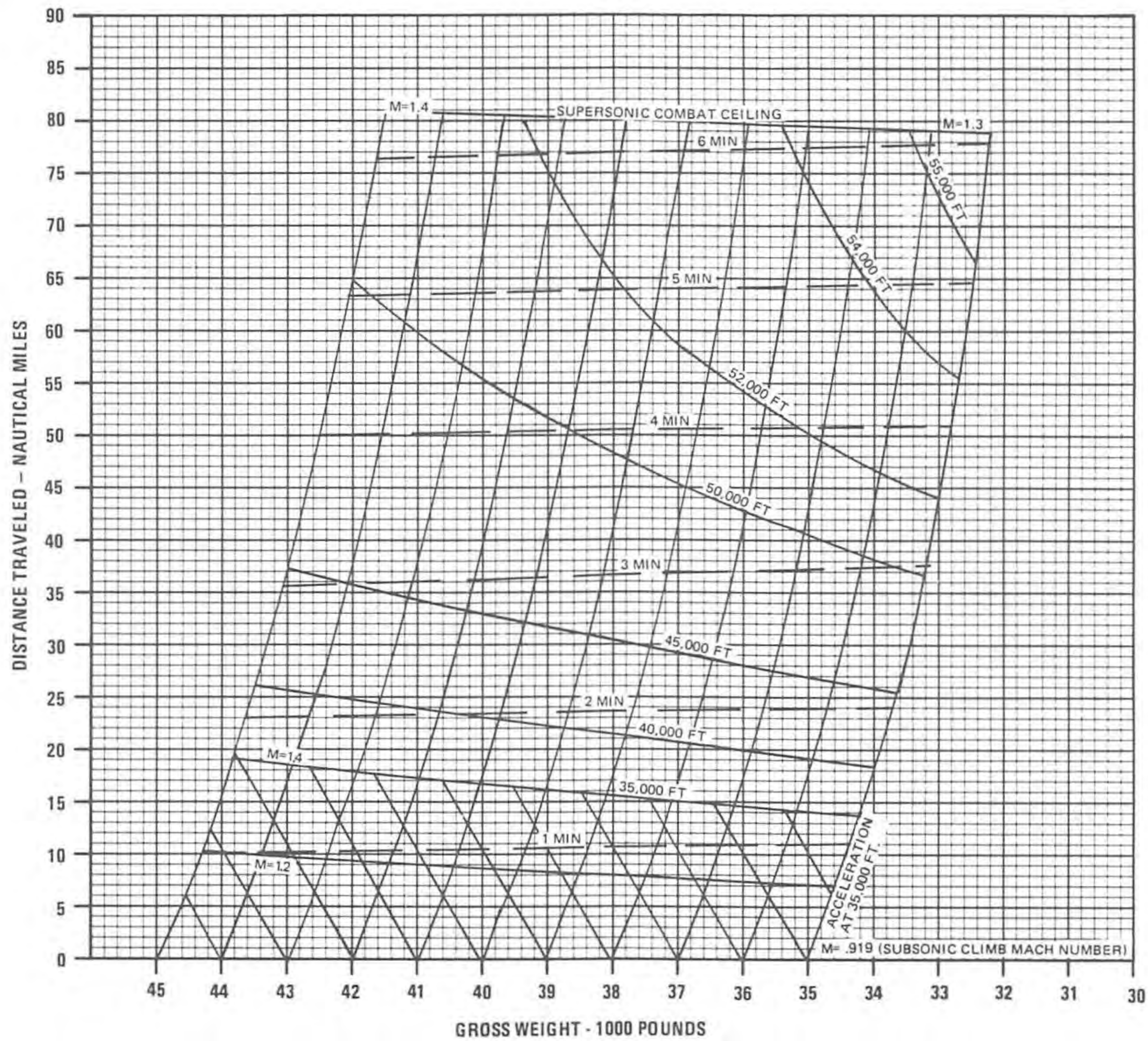
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(351)

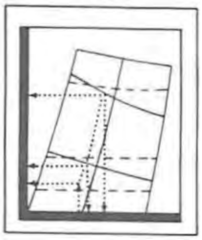
Figure 36-3. Supersonic Maximum Thrust Climb (Sheet 1 of 3)

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (1) ℄ TANK

REMARKS

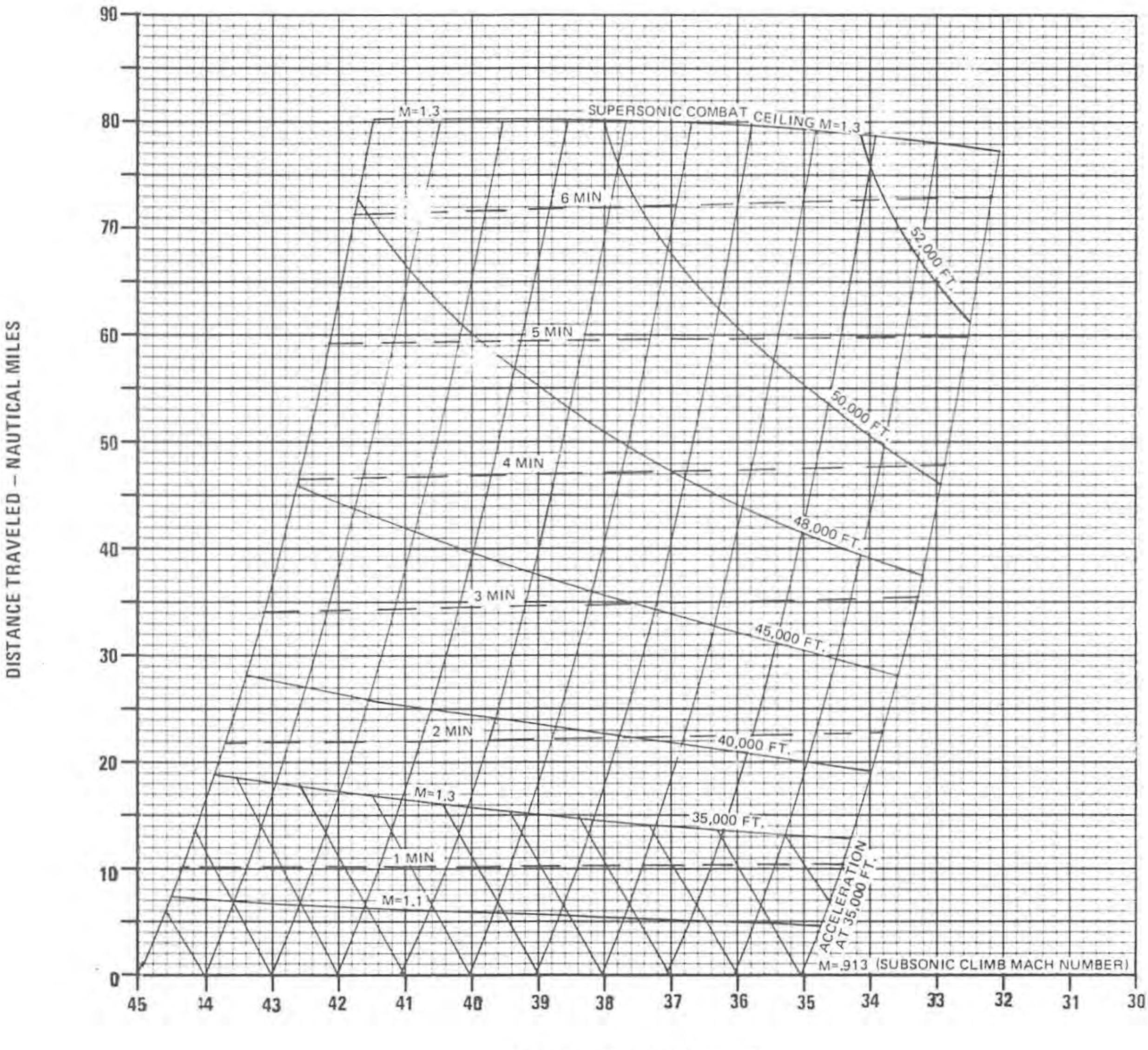
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



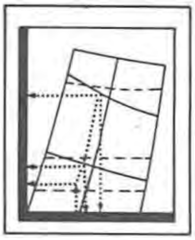
FDD–1–(352)

Figure 36-3. Supersonic Maximum Thrust Climb (Sheet 2 of 3)

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (2) WING TANKS

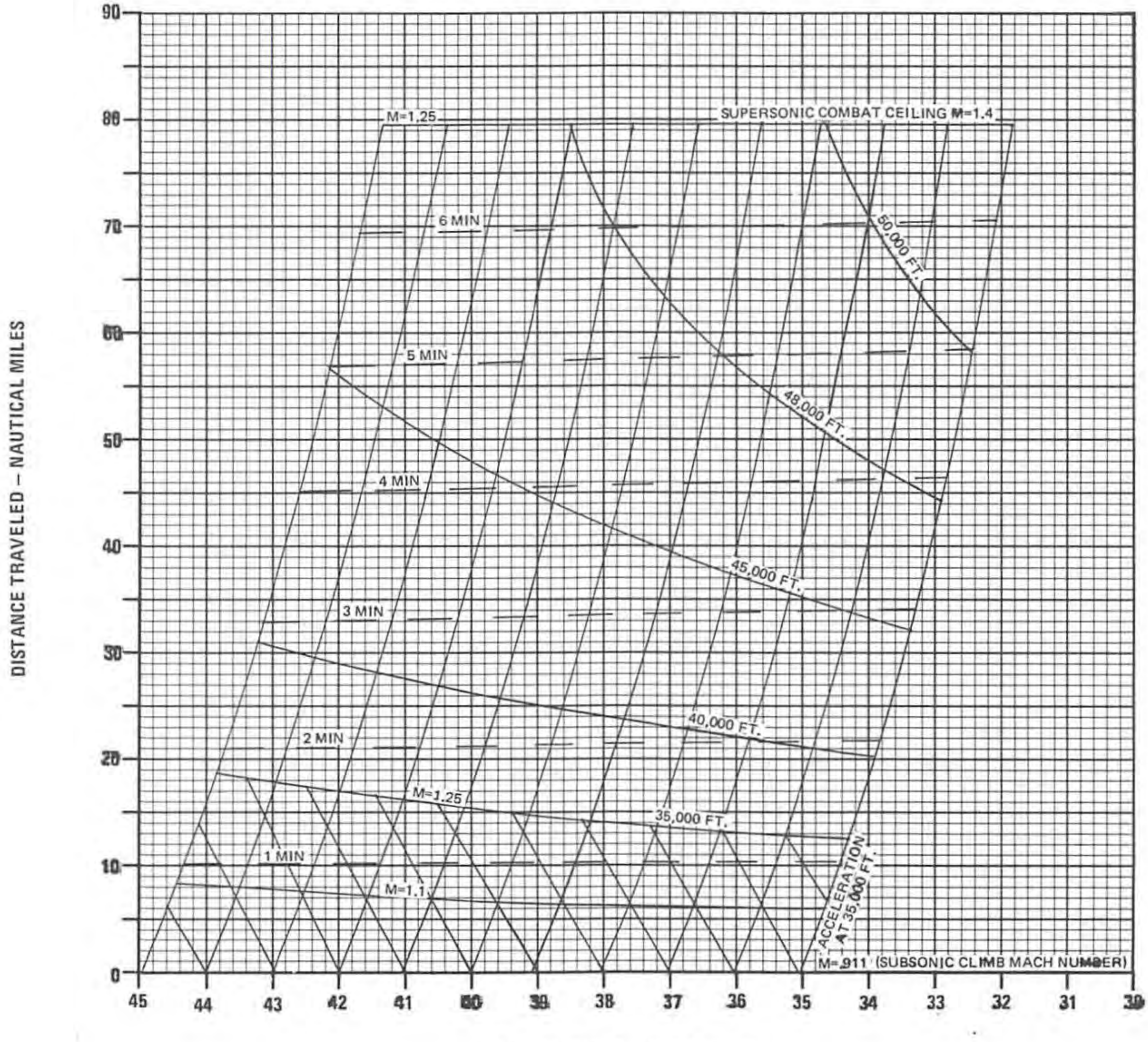
REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL.



FDD–1–(353)

Figure 36-3. Supersonic Maximum Thrust Climb (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS

REMARKS

ENGINES: (2) J79–GE–10B

DAT : 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX 0	TIME TO ACCELERATE (MIN.)/ FUEL TO ACCELERATE (LBS.)						TEMP EFFECTS FACTOR	
			20	40	60	80	100	120	+10°C	−10°C
SEA LEVEL (15°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.04/47	.04/48	.04/50	.04/51	.04/53	.04/55	.04/57	1.09/1.06	.89/.94
	.6	.07/95	.07/98	.08/102	.08/105	.08/109	.09/113	.09/118	1.09/1.06	.89/.94
	.65	.11/145	.11/151	.12/157	.12/163	.13/170	.13/177	.14/186	1.09/1.06	.89/.93
	.7	.15/198	.15/206	.16/214	.16/224	.17/235	.18/247	.19/261	1.091/1.06	.89/.93
	.75	.18/252	.19/263	.20/276	.21/290	.22/306	.23/325	.25/348	1.10/1.07	.89/.93
	.8	.22/309	.23/324	.24/341	.26/361	.27/385	.29/414	.32/451	1.10/1.07	.89/93
	.85	.26/367	.27/388	.29/410	.31/439	.33/475	.36/520	.40/582	1.10/1.07	.89/.93
	.9	.30/430	.31:456	.33/488	.36/530	.40/585	.45/662	.53/786	1.13/1.08	.89/.92
2000 FEET (11°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.04/46	.04/47	.04/49	.04/50	.04/52	.04/53	.04/55	1.09/1.06	.89/.94
	.6	.07/93	.08/96	.08/99	.08/103	.09/107	.09/110	.09/115	1.09/1.06	.89/.94
	.65	.11/142	.12/147	.12/153	.12/159	.13/165	.14/172	.14/180	1.09/1.06	.89/.93
	.7	.15/193	.16/201	.16/209	.17/218	.18/228	.19/239	.20/252	1.09/1.06	.89/.93
	.75	.19/246	.20/257	.20/268	.21/281	.23/297	.24/314	.25/335	1.10/1.07	.89/.93
	.8	.23/301	.24/315	.25/331	.26/350	.28/372	.30/399	.32/432	1.10/1.07	.89/.93
	.85	.26/358	.28/377	.29/398	.31/425	.34/457	.36/498	.40/553	1.10/1.07	.89/.93
	.9	.30/419	.32/443	.34/472	.37/511	.40/561	.45/629	.52/733	1.13/1.08	.89/.92
4000 FEET (7°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.04/45	.04/46	.04/48	.04/49	.04/51	.04/52	.05/54	1.09/1.06	.89/.94
	.6	.08/91	.08/94	.08/97	.09/101	.09/104	.09/108	.09/112	1.09/1.06	.89/.94
	.65	.12/139	.12/144	.12/149	.13/155	.13/161	.14/167	.15/175	1.09/1.06	.89/.93
	.7	.16/189	.16/196	.17/204	.17/212	.18/222	.19/232	.20/244	1.09/1.06	.89/.93
	.75	.19/240	.20/250	.21/261	.22/273	.23/287	.24/304	.26/323	1.10/1.07	.89/.93
	.8	.23/294	.24/307	.26/322	.27/339	.29/360	.30/384	.33/414	1.10/1.07	.89/.93
	.85	.27/349	.29/367	.30/386	.32/411	.34/441	.37/478	.41/528	1.10/1.07	.89/.93
	.9	.31/408	.33/430	.35/457	.38/493	.41/538	.45/599	.52/688	1.13/1.08	.89/.92
6000 FEET (3°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.04/44	.04/46	.04/47	.04/48	.05/50	.05/.51	.05/53	1.09/1.06	.89/.94
	.6	.08/90	.08/93	.09/96	.09/99	.09/102	.09/105	.10/109	1.09/1.06	.89/.94
	.65	.12/137	.12/141	.13/146	.13/151	.14/157	.14/163	.15/170	1.09/1.06	.89/.93
	.7	.16/185	.17/192	.17/199	.18/207	.19/216	.20/226	.21/237	1.09/1.06	.89/.93
	.75	.20/235	.21/244	.22/255	.23/266	.24/279	.25/294	.27/312	1.10/1.07	.89/.93
	.8	.24/287	.25/299	.26/313	.28/329	.29/348	.31/371	.33/398	1.10/1.07	.89/.93
	.85	.28/340	.30/357	.31/375	.33/398	.35/426	.38/460	.41/504	1.10/1.07	.89/.93
	.9	.32/397	.34/418	.36/443	.38/476	.42/517	.46/571	.52/648	1.13/1.08	.89/.92

FDD–1–(354)

Figure 36-4. Low-Altitude Acceleration – Maximum Thrust (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–10B

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX 0	TIME TO ACCELERATE (MIN.)/ FUEL TO ACCELERATE (LBS.) 20	40	60	80	100	120	TEMP. EFFECTS FACTOR +10°C	−10°C
SEA LEVEL (15°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.05/61	.05/63	.05/65	.05/67	.05/69	.05/71	.06/74	1.09/1.07	.88/.93
	.6	.09/124	.10/128	.10/133	.10/137	.11/143	.11/148	.12/154	1.09/1.07	.88/.93
	.65	.14/189	.15/196	.15/204	.16/212	.16/221	.17/231	.18/242	1.10/1.07	.88/.93
	.7	.19/257	.20/267	.20/279	.21/291	.22/306	.24/322	.25/340	1.11/1.07	.88/.92
	.75	.24/327	.25/342	.26/358	.27/376	.29/398	.30/422	.32/452	1.11/1.08	.88/.92
	.8	.28/400	.30/419	.31/442	.33/468	.35/499	.38/537	.41/584	1.12/1.08	.88/.92
	.85	.33/475	.35/501	.37/531	.40/568	.43/614	.47/673	.52/753	1.12/1.09	.88/.91
	.9	.38/555	.40/589	.43/630	.47/685	.51/756	.58/812	.68/1013	1.15/1.11	.88/.91
2000 FEET (11°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.05/60	.05/62	.05/64	.05/66	.06/68	.06/70	.06/72	1.09/1.07	.88/.93
	.6	.10/122	.10/126	.10/130	.11/135	.11/139	.12/145	.12/150	1.09/1.07	.88/.93
	.65	.15/186	.15/192	.16/199	.16/207	.17/216	.18/225	.18/235	1.10/1.07	.88/.93
	.7	.19/251	.20/261	.21/272	.22/284	.23/297	.24/312	.25/329	1.11/1.07	.88/.92
	.75	.24/320	.25/333	.27/349	.28/366	.29/386	.31/409	.33/436	1.11/1.08	.88/.92
	.8	.29/390	.31/409	.32/430	.34/454	.36/483	.39/518	.42/561	1.12/1.08	.88/.92
	.85	.34/464	.36/488	.38/516	.40/550	.43/593	.47/646	.52/717	1.12/1.09	.88/.91
	.9	.39/541	.41/573	.44/611	.48/661	.52/725	.58/812	.67/946	1.15/1.11	.88/.91
4000 FEET ([illegible])	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.05/59	.05/61	.05/63	.06/65	.06/67	.06/69	.06/71	1.09/1.07	.88/.93
	.6	.10/120	.10/124	.11/128	.11/132	.12/137	.12/142	.12/147	1.09/1.07	.88/.93
	.65	.15/182	.16/188	.16/195	.17/203	.18/211	.18/219	.19/229	1.10/1.07	.88/.93
	.7	.20/246	.21/256	.22/266	.23/277	.24/290	.25/303	.26/319	1.11/1.07	.88/.92
	.75	.25/313	.26/326	.27/340	.29/356	.30/375	.32/396	.34/421	1.11/1.08	.88/.92
	.8	.30/381	.32/399	.33/418	.35/441	.37/468	.40/500	.43/539	1.12/1.08	.88/.92
	.85	.35/453	.37/476	.39/501	.42/534	.45/572	.48/621	.53/685	1.12/1.09	.88/.91
	.9	.41/528	.43/557	.45/592	.49/639	.53/697	.59/775	.67/889	1.15/1.11	.88/.91
6000 FEET ([illegible])	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.05/59	.06/60	.06/62	.06/64	.06/66	.06/68	.06/70	1.09/1.07	.88/.93
	.6	.11/118	.11/122	.11/126	.12/130	.12/134	.12/139	.13/144	1.09/1.07	.88/.93
	.65	.16/179	.16/185	.17/192	.18/199	.18/206	.19/215	.20/224	1.10/1.07	.88/.93
	.7	.21/242	.22/251	.23/260	.24/271	.25/283	.26/296	.27/311	1.11/1.07	.88/.92
	.75	.26/306	.27/319	.28/332	.30/347	.31/365	.33/384	.35/408	1.11/1.08	.88/.92
	.8	.31/373	.33/390	.34/408	.36/429	.38/454	.41/484	.44/520	1.12/1.08	.88/.92
	.85	.37/442	.38/464	.40/488	.43/518	.46/554	.49/598	.54/655	1.12/1.09	.88/.91
	.9	.42/515	.44/542	.47/575	.50/618	.54/671	.60/740	.67/840	1.15/1.11	.88/.91

FDD–1–(355)

Figure 36-4. Low-Altitude Acceleration – Maximum Thrust (Sheet 2 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 55,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–10B

DATE: 1 MARCH 79
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX 0	TIME TO ACCELERATE (MIN.)/ FUEL TO ACCELERATE (LBS.)						TEMP. EFFECTS FACTOR	
			20	40	60	80	100	120	+10°C	–10°C
SEA LEVEL (15°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.06/76	.06/79	.06/81	.06/84	.07/87	.07/90	.07/93	1.11/1.08	.86/.92
	.6	.12/155	.12/160	.13/166	.13/172	.13/178	.14/185	.15/193	1.11/1.08	.87/.92
	.65	.18/235	.18/244	.19/254	.20/264	.21/276	.21/288	.23/303	1.11/1.08	.88/.92
	.7	.23/319	.24/332	.25/346	.27/362	.28/380	.29/400	.31/424	1.12/1.09	.88/.91
	.75	.29/405	.31/423	.32/443	.34/466	.36/493	.38/524	.40/561	1.12/1.09	.87/.91
	.8	.35/494	.37/518	.39/546	.41/579	.44/618	.47/665	.51/724	1.13/1.10	.86/.90
	.85	.41/586	.43/619	.46/655	.49/702	.53/759	.58/831	.64/931	1.15/1.12	.86/.89
	.9	.47/684	.50/726	.53/776	.58/844	.63/931	.71/1052	.84/1246	1.23/1.19	.85/.88
2000 FEET (11°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.06/76	.06/78	.07/80	.07/83	.07/86	.07/88	.07/92	1.11/1.08	.86/.92
	.6	.12/153	.13/158	.13/163	.13/169	.14/175	.15/182	.15/189	1.11/1.08	.87/.92
	.65	.18/232	.19/240	.20/249	.20/259	.21/270	.22/282	.23/295	1.11/1.08	.88/.92
	.7	.24/313	.25/325	.26/339	.27/354	.29/371	.30/390	.32/412	1.12/1.09	.88/.91
	.75	.30/397	.32/414	.33/433	.35/455	.37/480	.39/509	.41/543	1.12/1.09	.87/.91
	.8	.36/483	.38/507	.40/533	.42/563	.45/599	.48/643	.52/697	1.13/1.10	.86/.90
	.85	.42/573	.45/604	.47/638	.50/681	.54/734	.59/800	.65/889	1.15/1.12	.86/.89
	.9	.48/668	.51/707	.55/754	.59/816	.64/895	.72/1002	.83/1166	1.23/1.19	.85/.88
4000 FEET (7°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.06/75	.07/77	.07/79	.07/82	.07/85	.07/87	.08/90	1.11/1.108	.86/.92
	.6	.13/151	.13/156	.14/161	.14/166	.15/172	.15/179	.16/186	1.11/1.08	.87/.92
	.65	.19/228	.20/236	.20/245	.21/255	.22/265	.23/276	.24/289	1.11/1.08	.88/.92
	.7	.25/308	.26/320	.27/333	.28/347	.30/363	.31/381	.33/401	1.12/1.09	.88/.91
	.75	.31/389	.33/406	.34/424	.36/444	.38/468	.40/495	.42/527	1.12/1.09	.87/.91
	.8	.38/474	.39/496	.41/520	.44/549	.46/583	.49/623	.53/673	1.13/1.10	.86/.90
	.85	.44/561	.46/590	.49/622	.52/663	.55/711	.60/772	.66/852	1.15/1.12	.86/.89
	.9	.50/653	.53/690	.56/733	.61/791	.66/863	.73/960	.83/1101	1.23/1.19	.85/.88
6000 FEET (3°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.07/74	.07/77	.07/79	.07/81	.08/84	.08/87	.08/90	1.11/1.08	.86/.92
	.6	.13/150	.14/154	.14/159	.15/165	.15/171	.16/177	.16/184	1.11/1.08	.87/.92
	65	.20/226	.21/234	.21/242	.22/251	.23/261	.24/272	.25/284	1.11/1.08	.88/.92
	.7	.26/303	.27/315	.28/327	.30/341	.31/356	.32/373	.34/393	1.12/1.09	.88/.91
	.75	.33/383	.34/399	.36/416	.37/436	.39/458	.41/483	.44/513	1.12/1.09	.87/.91
	.8	.39/465	.41/486	.43/509	.45/536	.48/568	.51/605	.55/651	1.13/1.10	.86/.90
	.85	.46/550	.48/577	.50/608	.53/646	.57/691	.62/747	.67/819	1.15/1.12	.86/.89
	.9	.52/639	.55/674	.58/715	.62/769	.68/835	.74/922	.84/1046	1.23/1.19	.85/.88

FDD–1–(356)

Figure 36-4. Low-Altitude Acceleration – Maximum Thrust (Sheet 3 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
GROSS WEIGHT – 35,000 POUNDS
ENGINES: (2) J79–GE–10B

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX 0	TIME TO ACCELERATE (MIN.)/ FUEL TO ACCELERATE (LBS.)						TEMP. EFFECTS FACTOR	
			20	40	60	80	100	120	$+10^{\circ}C$	$-10^{\circ}C$
SEA LEVEL ($15^{\circ}C$)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.07/25	.07/26	.08/28	.08/30	.09/32	.09/34	.10/37	1.14/1.08	.87/.92
	.6	.14/51	.15/55	.16/59	.17/64	.19/69	.21/76	.23/84	1.15/1.09	.87/.92
	.65	.22/81	.24/87	.26/94	.28/103	.31/115	.35/129	.40/148	1.15/1.09	.86/.92
	.7	.30/113	.33/123	.36/136	.41/152	.47/174	.55/206	.71/266	1.16/1.10	.85/.91
	.75	.40/150	.44/166	.49/187	.57/217	.69/264	.95/365		1.16/1.11	.84/.90
	.8	.50/191	.56/217	.65/253	.81/315	1.22/481			1.20/1.14	.84/.89
	.85	.62/242	.72/284	.89/354	1.65/670				1.27/1.20	.82/.86
	.9	.78/313	.99/400						1.46/1.39	.81/.85
2000 FEET ($11^{\circ}C$)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.07/24	.07/26	.08/27	.08/29	.09/31	.10/33	.10/36	1.14/1.08	.87/.92
	.6	.14/50	.15/54	.16/57	.18/62	.19/67	.21/73	.23/80	1.15/1.09	.87/.92
	.65	.22/79	.24/85	.26/91	.28/100	.31/110	.35/122	.39/139	1.15/1.09	.86/.92
	.7	.31/110	.34/119	.37/131	.41/143	.46/165	.54/191	.66/237	1.16/1.10	.85/.91
	.75	.40/145	.44/160	.49/179	.56/204	.67/243	.87/317		1.16/1.11	.84/.90
	.8	.50/185	.57/208	.65/239	.78/289	1.08/401			1.20/1.14	.84/.89
	.85	.62/232	.72/269	.87/326	1.29/491				1.27/1.20	.82/.86
	.9	.78/296	.96/367						1.46/1.39	.81/.85
4000 FEET ($7^{\circ}C$)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.07/24	.08/25	.08/27	.09/28	.09/30	.10/32	.11/35	1.14/1.08	.87/.92
	.6	.15/49	.16/52	.17/56	.18/60	.19/64	.21/70	.23/76	1.15/1.09	.87/.92
	.65	.23/77	.25/82	.26/89	.29/96	.31/105	.35/117	.39/131	1.15/1.09	.86/.92
	.7	.32/107	.34/116	.37/126	.41/139	.46/156	.53/179	.63/216	1.16/1.10	.85/.91
	.75	.41/140	.45/154	.50/171	.56/194	.66/227	.82/284	1.28/447	1.16/1.11	.84/.90
	.8	.51/178	.57/199	.65/227	.77/269	1.00/352			1.20/1.14	.84/.89
	.85	.63/223	.72/256	.85/304	1.16/419				1.27/1.20	.82/.86
	.9	.78/282	.94/340	1.44/533					1.46/1.39	.81/.85
6000 FEET ($3^{\circ}C$)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.08/24	.08/25	.08/26	.09/28	.10/30	.10/32	.11/34	1.14/1.08	.87/.92
	.6	.15/49	.16/52	.17/55	.19/59	.20/63	.22/68	.24/74	1.15/1.09	.87/.92
	.65	.24/76	.25/81	.27/87	.29/94	.32/102	.35/112	.39/125	1.15/1.09	.86/.92
	.7	.33/105	.35/113	.38/123	.42/135	.46/150	.53/170	.61/199	1.16/1.10	.85/.91
	.75	.42/137	.46/149	.50/165	.57/185	.65/213	.79/259	1.07/355	1.16/1.11	.84/.90
	.8	.52/173	.58/192	.65/216	1.09/372	.95/319	1.59/538		1.20/1.14	.84/.89
	.85	.64/215	.73/244	.85/285					1.27/1.20	.82/.86
	.9	.79/269	93/319	1.27/440					1.46/1.39	.81/.85

FDD–1–(357)

Figure 36-5. Low-Altitude Acceleration – Military Thrust (Sheet 1 of 3)

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINE(S): (2) J79–GE–10B

DATE: 1 MARCH 79
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX 0	TIME TO ACCELERATE (MIN.)/ FUEL TO ACCELERATE (LBS.)						TEMP. EFFECTS FACTOR	
			20	40	60	80	100	120	+10°C	−10°C
SEA LEVEL (15°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.09/33	.10/35	.10/37	.11/39	.12/42	.13/46	.14/50	1.18/1.10	.87/.92
	.6	.19/68	.20/73	.21/78	.23/84	.25/92	.28/101	.31/112	1.18/1.13	.85/.91
	.65	.29/106	.31/115	.34/125	.37/137	.41/152	.47/172	.54/200	1.19/1.13	.84/.89
	.7	.40/149	.44/162	.48/180	.54/201	.62/231	.74/278	.95/358	1.21/1.15	.83/.87
	.75	.52/196	.57/218	.65/246	.75/285	.92/351	1.28/492		1.26/1.20	.80/.85
	.8	.65/250	.74/284	.86/330	1.06/414	1.62/639			1.27/1.21	.75/.79
	.85	.80/315	.94/369	1.17/462	2.12/859				1.27/1.21	.73/.76
	.9	1.01/405	1.28/516						1.42/1.36	.81/.85
2000 FEET (11°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.09/32	.10/34	.11/36	.11/39	.12/41	.13/45	.14/48	1.18/1.10	.87/.92
	.6	.19/67	.20/71	.22/76	.24/82	.26/89	.28/97	.31/108	1.18/1.13	.85/.91
	.65	.30/104	.32/112	.34/121	.38/133	.42/146	.47/164	.53/187	1.19/1.13	.84/.89
	.7	.41/145	.44/158	.49/173	.54/193	.61/219	.72/256	.89/319	1.21/1.15	.83/.87
	.75	.53/190	.58/210	.65/235	.74/270	.89/325	1.16/425		1.26/1.20	.80/.85
	.8	.66/241	.74/272	.85/313	1.03/382	1.43/554			1.27/1.21	.75/.79
	.85	.81/302	.94/350	1.14/428	1.69/643				1.27/1.21	.73/.76
	.9	1.01/384	1.24/474						1.42/1.36	.81/.85
4000 FEET (7°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.10/32	.10/34	.11/36	.12/38	.12/41	.13/44	.14/47	1.18/1.10	.87/.92
	.6	.20/66	.21/70	.23/75	.24/80	.26/87	.28/95	.31/104	1.18/1.13	.85/.91
	.65	.30/102	.33/110	.35/118	.38/129	.42/144	.47/157	.53/178	1.19/1.13	.84/.89
	.7	.42/141	.45/153	.49/168	.55/186	.61/208	.71/241	.85/290	1.21/1.15	.83/.87
	.75	.54/185	.59/203	.66/226	.75/257	.88/302	1.09/379	1.73/607	1.26/1.20	.80/.85
	.8	.67/234	.75/261	.86/298	1.02/357	1.33/469			1.27/1.21	.75/.79
	.85	.82/291	.94/334	1.12/398	1.52/547				1.27/1.21	.73/.76
	.9	1.02/366	1.22/442	1.82/671					1.42/1.36	.81/.85
6000 FEET (3°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.10/32	.11/34	.12/36	.12/38	.13/41	.14/43	.15/47	1.18/1.10	.87/.92
	.6	.21/65	.22/69	.24/74	.25/79	.27/88	.28/93	.32/102	1.18/1.13	.85/.91
	.65	.32/101	.34/108	.37/116	.40/126	.43/138	.48/152	.54/171	1.19/1.13	.84/.89
	.7	.43/139	.47/150	.51/164	.56/180	.62/201	.71/230	.84/273	1.21/1.15	.83/.87
	.75	.55/181	.61/198	.67/219	.75/246	.87/285	1.06/349	1.47/485	1.26/1.20	.80/.85
	.8	.69/227	.76/253	.86/286	1.01/335	1.26/422	2.17/737		1.27/1.21	.75/.79
	.85	.84/282	.95/320	1.11/375	1.44/492				1.27/1.21	.73/.76
	.9	1.03/351	1.21/416	1.63/567					1.42/1.36	.81/1.85

FDD–1–(358)

Figure 36-5. Low-Altitude Acceleration – Military Thrust (Sheet 2 of 3)

GROSS WEIGHT – 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINES: (2) J79–GE–10B

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

	MACH	DRAG INDEX 0	TIME TO ACCELERATE (MIN.)/ FUEL TO ACCELERATE (LBS.)						TEMP. EFFECTS FACTOR	
			20	40	60	80	100	120	+10°C	−10°C
SEA LEVEL (15°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.12/42	.12/45	.13/48	.14/51	.15/55	.17/60	.18/65	1.20/1.14	.84/.89
	.6	.24/86	.25/93	.27/100	.30/108	.33/118	.36/131	.40/147	1.22/1.16	.81/.87
	.65	.37/135	.40/146	.43/159	.48/175	.53/196	.60/223	.71/263	1.22/1.18	.79/.84
	.7	.50/187	.55/205	.61/228	.69/256	.79/296	.94/354	1.23/462	1.26/1.21	.76/.80
	.75	.65/245	.72/273	.82/310	.95/360	1.17/446	1.63/625		1.26/1.21	.74/.79
	.8	.81/312	.92/355	1.07/415	1.34/521	2.05/807			1.27/1.21	.74/.78
	.85	1.00/392	1.17/460	1.45/574	2.62/1060				1.27/1.21	.72/.76
	.9	1.25/501	1.58/635						1.39/1.33	.81/.85
2000 FEET (11°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.12/42	.13/44	.14/47	.15/50	.16/54	.17/59	.19/64	1.20/1.14	.84/.89
	.6	.25/86	.26/92	.28/98	.31/106	.33/116	.37/128	.41/142	1.22/1.16	.81/.87
	.65	.38/133	.41/143	.44/156	.48/171	.54/189	.61/214	.70/247	1.22/1.18	.79/.84
	.7	.52/184	.56/200	.62/221	.69/247	.79/282	.93/333	1.17/420	1.26/1.21	.76/.80
	.75	.66/239	.73/265	.82/298	.95/343	1.14/413	1.49/545		1.26/1.21	.74/.79
	.8	.83/303	.93/342	1.07/395	1.30/481	1.82:679			1.27/1.21	.74/.78
	.85	1.02/378	1.18/439	1.42/533	2.12/805				1.27/1.21	.72/.76
	.9	1.26/477	1.54/588						1.39/1.33	.81/.85
4000 FEET (7°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.13/42	.14/44	.14/47	.15/50	.16/54	.18/58	.19/64	1.20/1.14	.84/.89
	.6	.26/85	.27/91	.29/98	.32/105	.35/114	.38/126	.42/139	1.22/1.16	.81/.87
	.65	.39/131	.42/141	.46/153	.50/167	.55/185	.62/207	.70/237	1.22/1.18	.79/.84
	.7	.53/181	.58/197	.64/216	.71/240	.80/272	.93/317	1.14/391	1.26/1.21	.76/.80
	.75	.68/235	.75/259	.84/289	.96/329	1.13/390	1.43/494	2.35/823	1.26/1.21	.74/.79
	.8	.85/295	.95/331	1.09/379	1.30/454	1.71/602			1.27/1.21	.74/.78
	.85	1.04/367	1.19/422	1.42/504	1.95/700				1.27/1.21	.72/.76
	.9	1.27/458	1.53/553	2.23/823					1.39/1.33	.81/.85
8000 FEET (3°C)	.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	.55	.14/42	.14/45	.15/47	.16/51	.18/54	.19/59	.21/64	1.20/1.14	.84/.89
	.6	.27/85	.29/91	.31/98	.33/105	.36/114	.40/125	.44/138	1.22/1.16	.81/.87
	.65	.41/131	.44/141	.48/152	.52/166	.57/183	.64/204	.73/232	1.22/1.18	.79/.84
	.7	.56/179	.60/195	.66/213	.73/236	.82/265	.95/306	1.14/370	1.26/1.21	.76/.80
	.75	.71/232	.78/254	.87/282	.98/320	1.14/374	1.41/462	2.01/664	1.26/1.21	.74/.79
	.8	.88/290	.98/323	1.11/366	1.30/431	1.64/549	3.18/1082		1.27/1.21	.74/.78
	.85	1.07/357	1.21/407	1.42/479	1.85/630				1.27/1.21	.72/.76
	.9	1.30/443	1.54/527	2.09/725					1.39/1.33	.81/.85

FDD–1–(359)

Figure 36-5. Low-Altitude Acceleration – Military Thrust (Sheet 3 of 3)

10,000 FEET

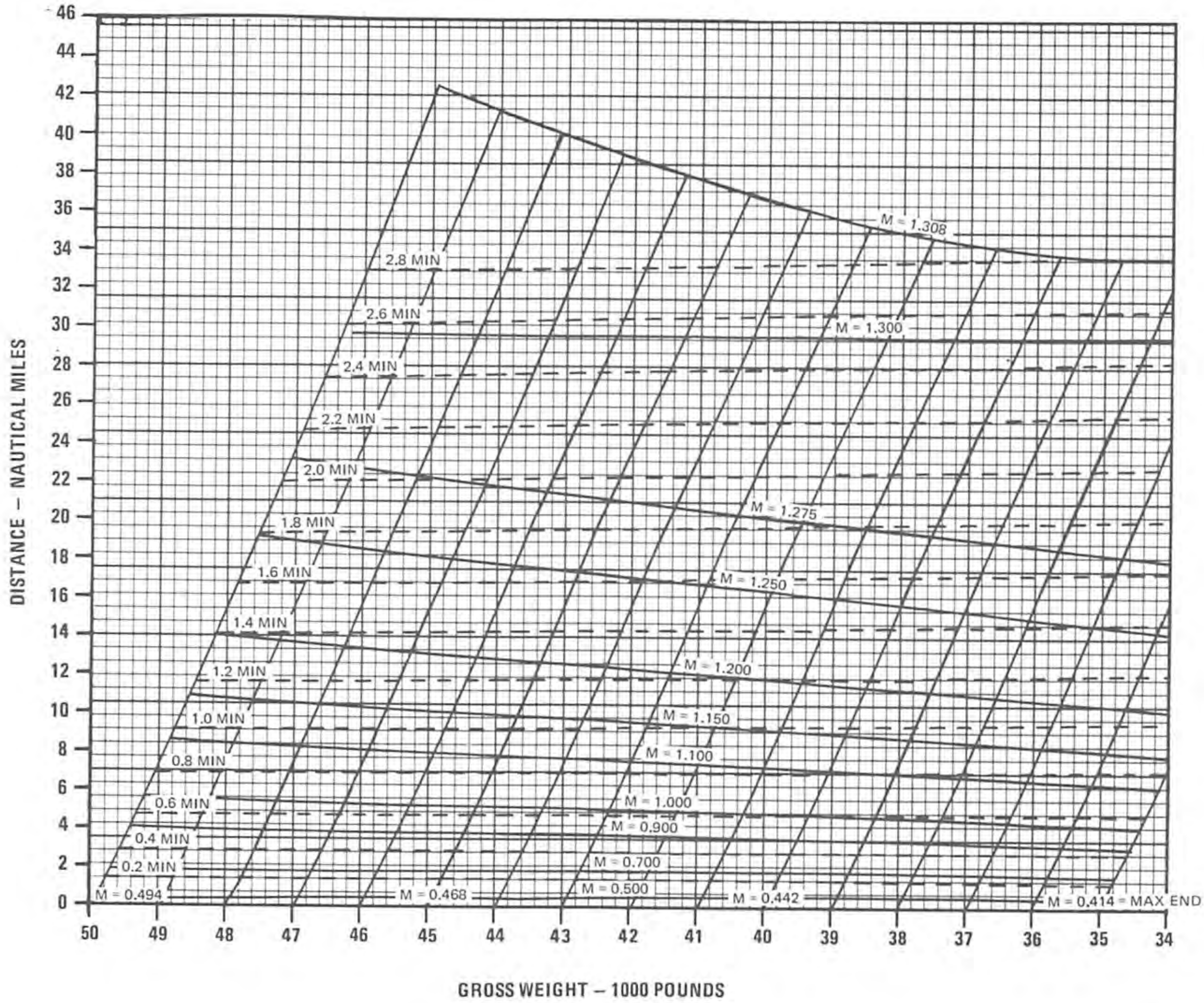
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(369)

Figure 36-6. Maximum Thrust Acceleration (Sheet 1 of 12)

30,000 FEET

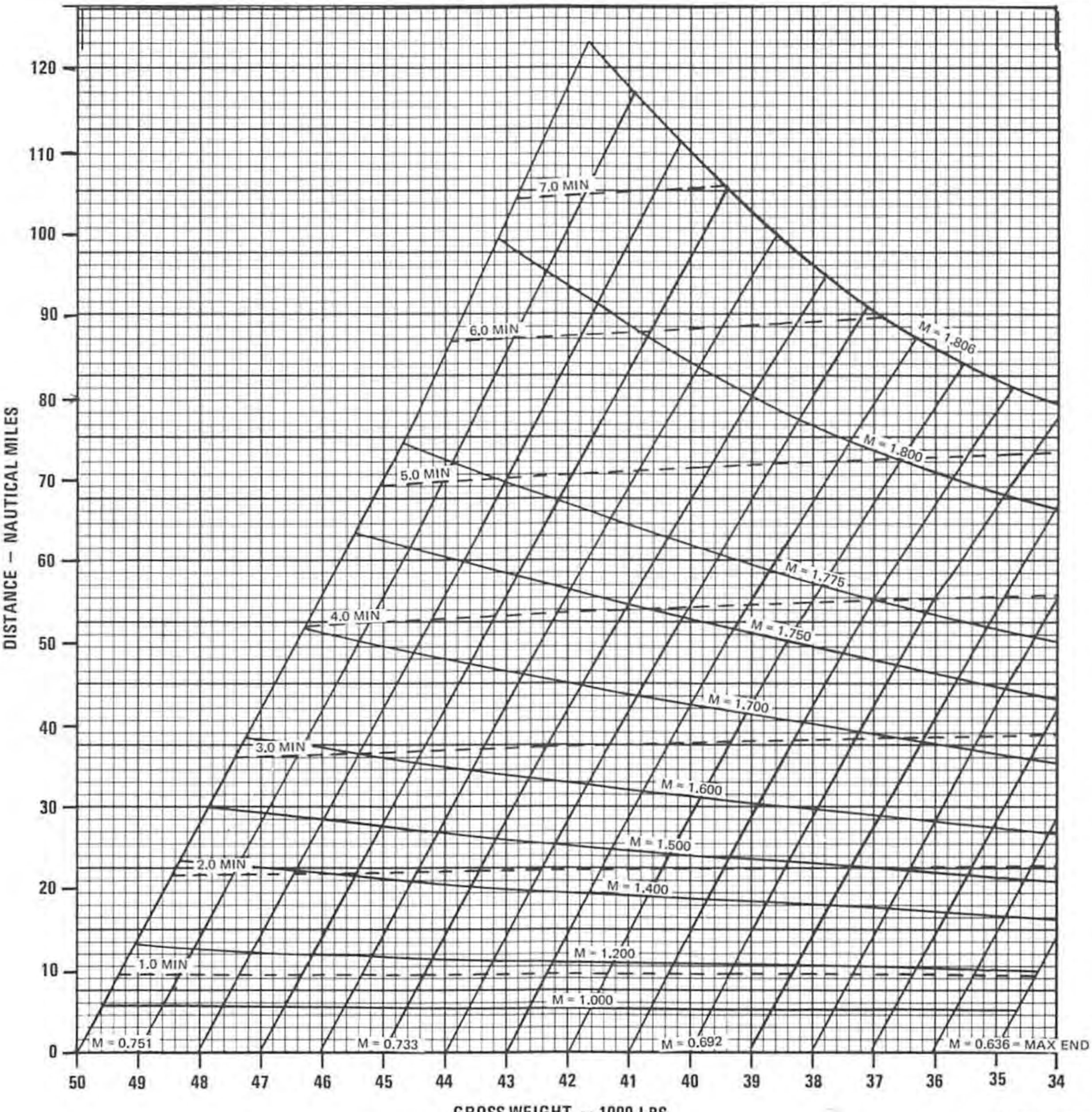
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(370)

Figure 36-6. Maximum Thrust Acceleration (Sheet 2 of 12)

35,000 FEET

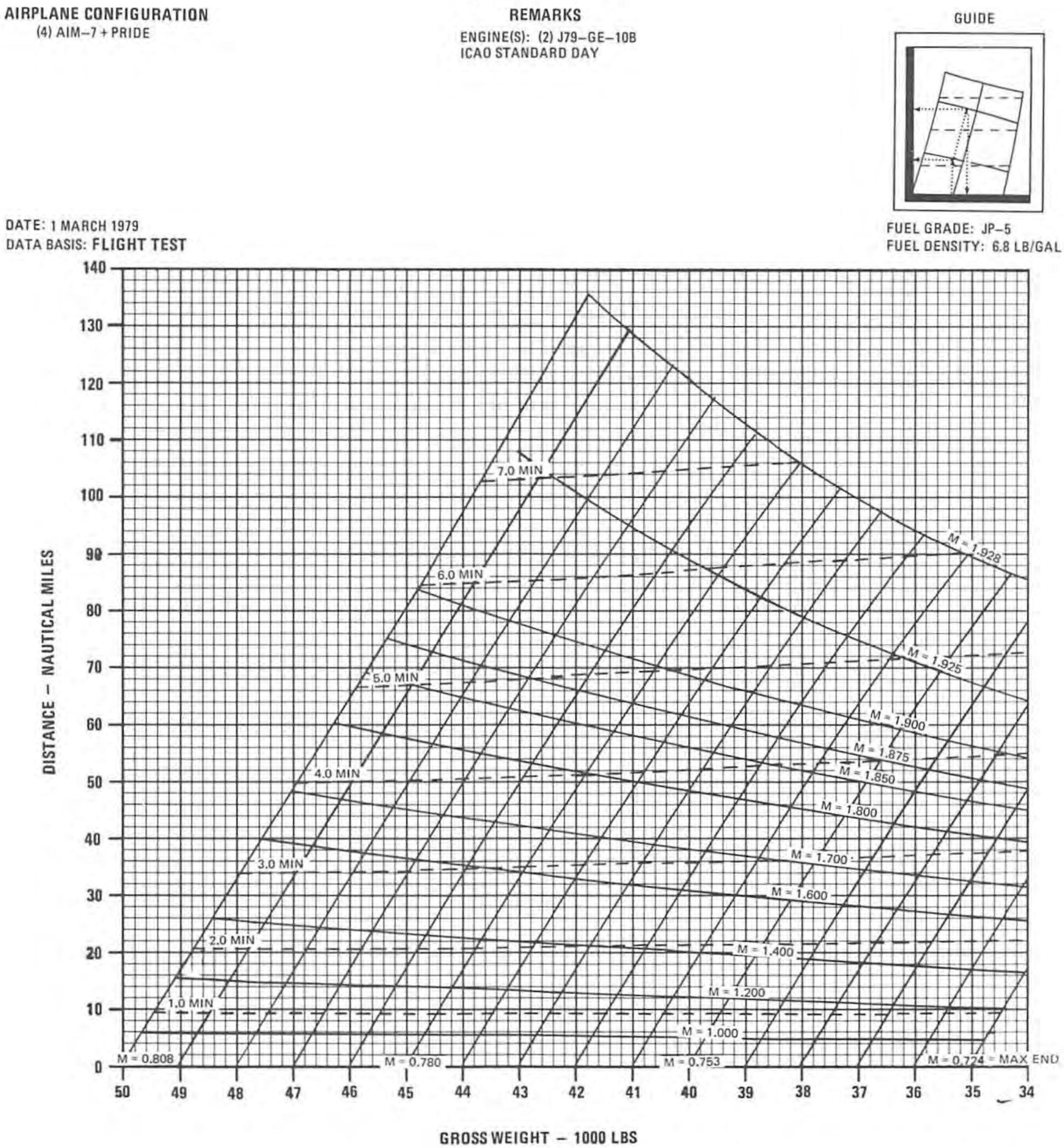


Figure 36-6. Maximum Thrust Acceleration (Sheet 3 of 12)

40,000 FEET

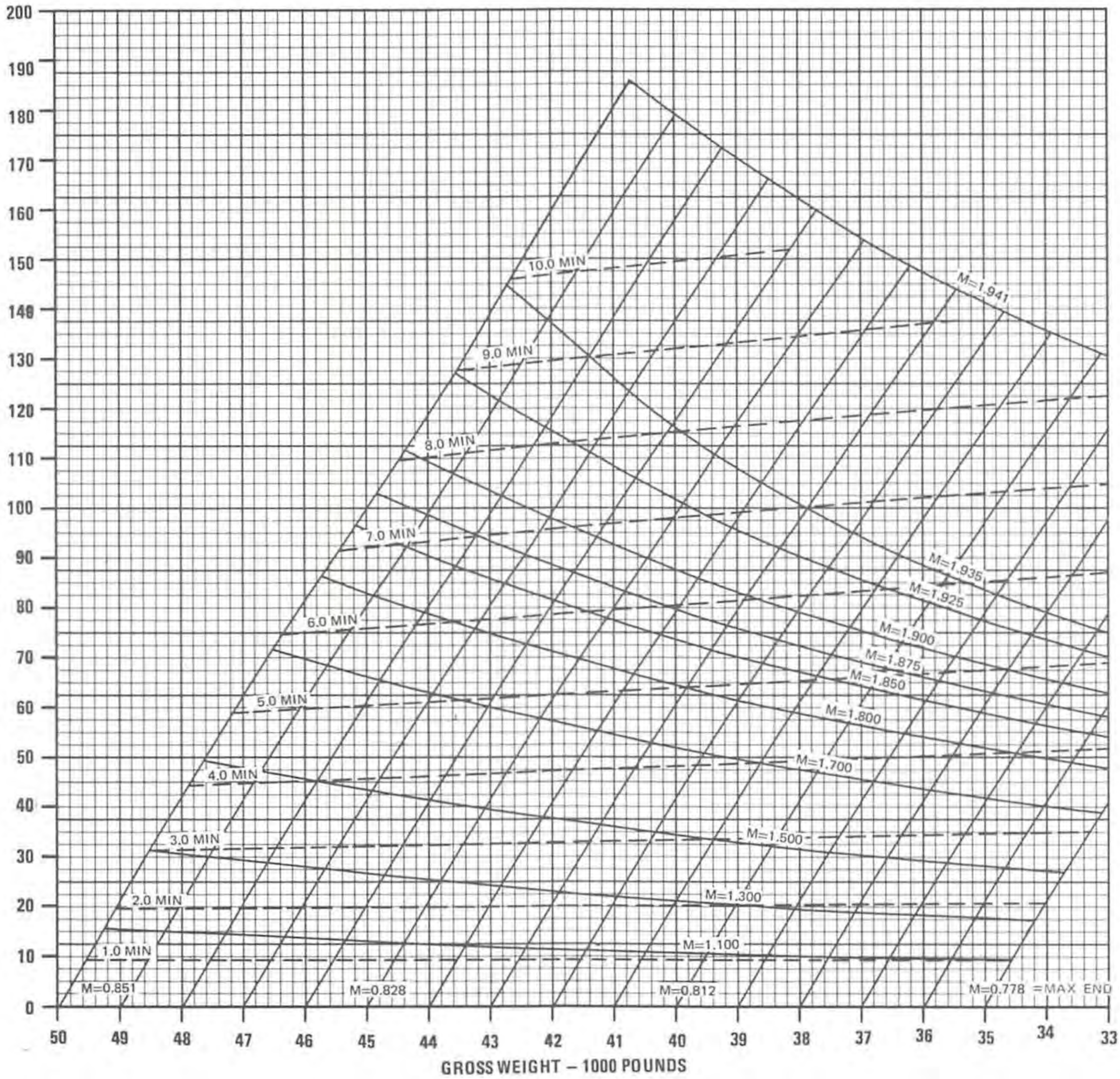
AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8LB/GAL



FDD–1–(372)

Figure 36-6. Maximum Thrust Acceleration (Sheet 4 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE

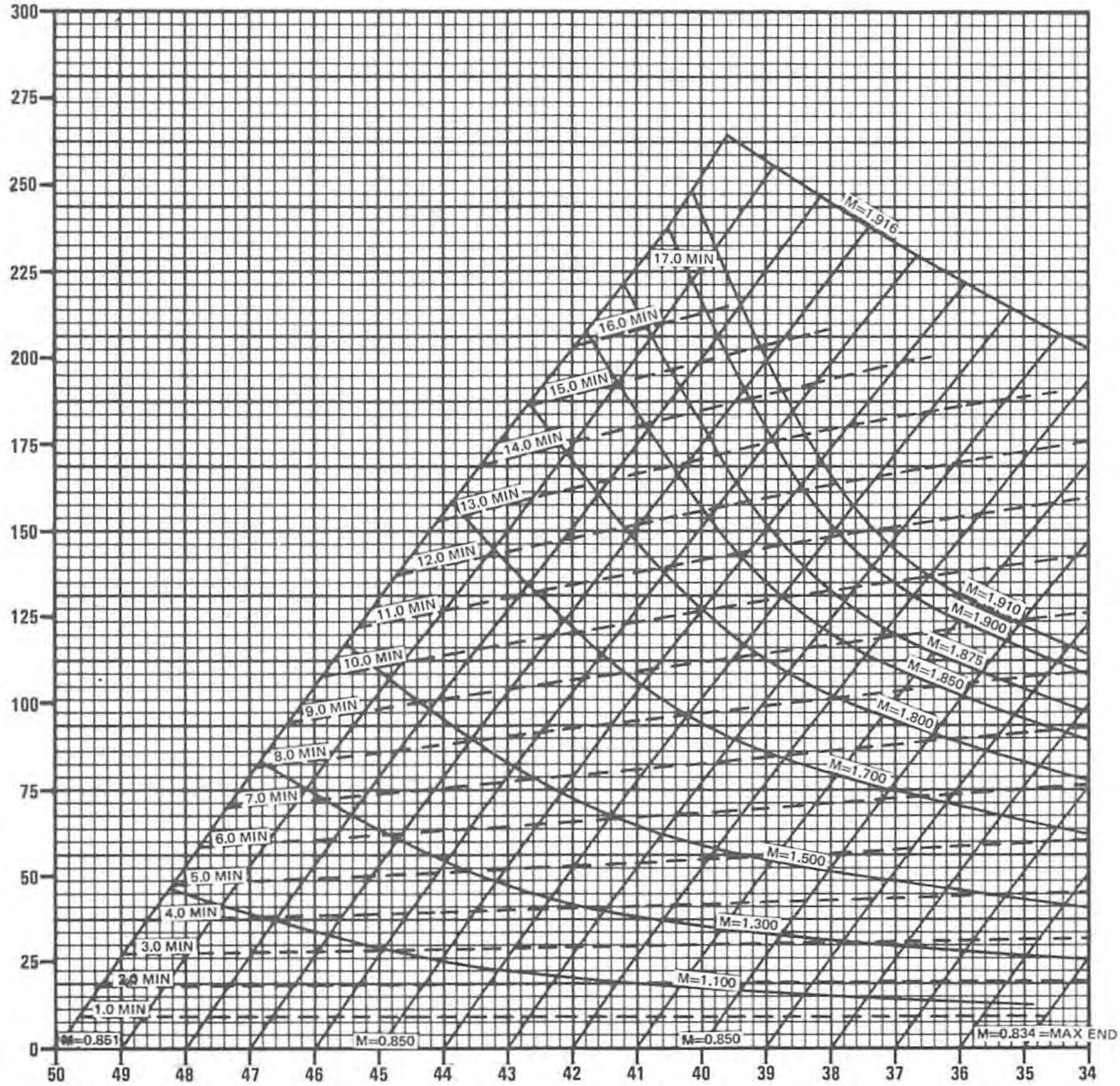
45,000 FEET

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(373)

Figure 36-6. Maximum Thrust Acceleration (Sheet 5 of 12)

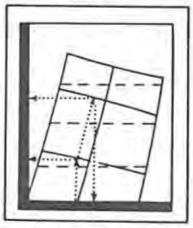
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (1) ℄ TANK

30,000 FEET

REMARKS

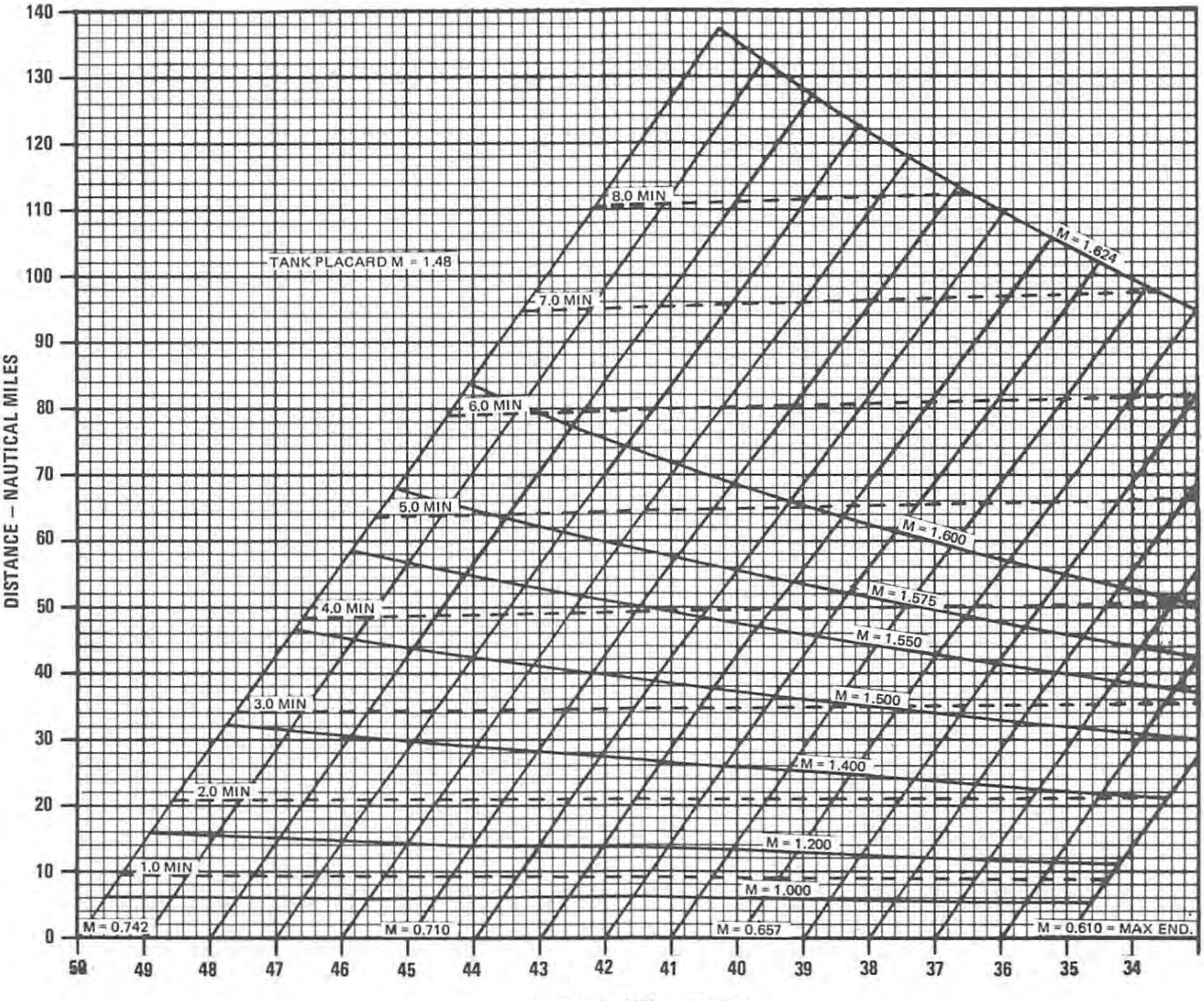
ENGINE(S): J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8LB/GAL



FDD–1–(374)

Figure 36-6. Maximum Thrust Acceleration (Sheet 6 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (1) ℄ TANK

35,000 FEET

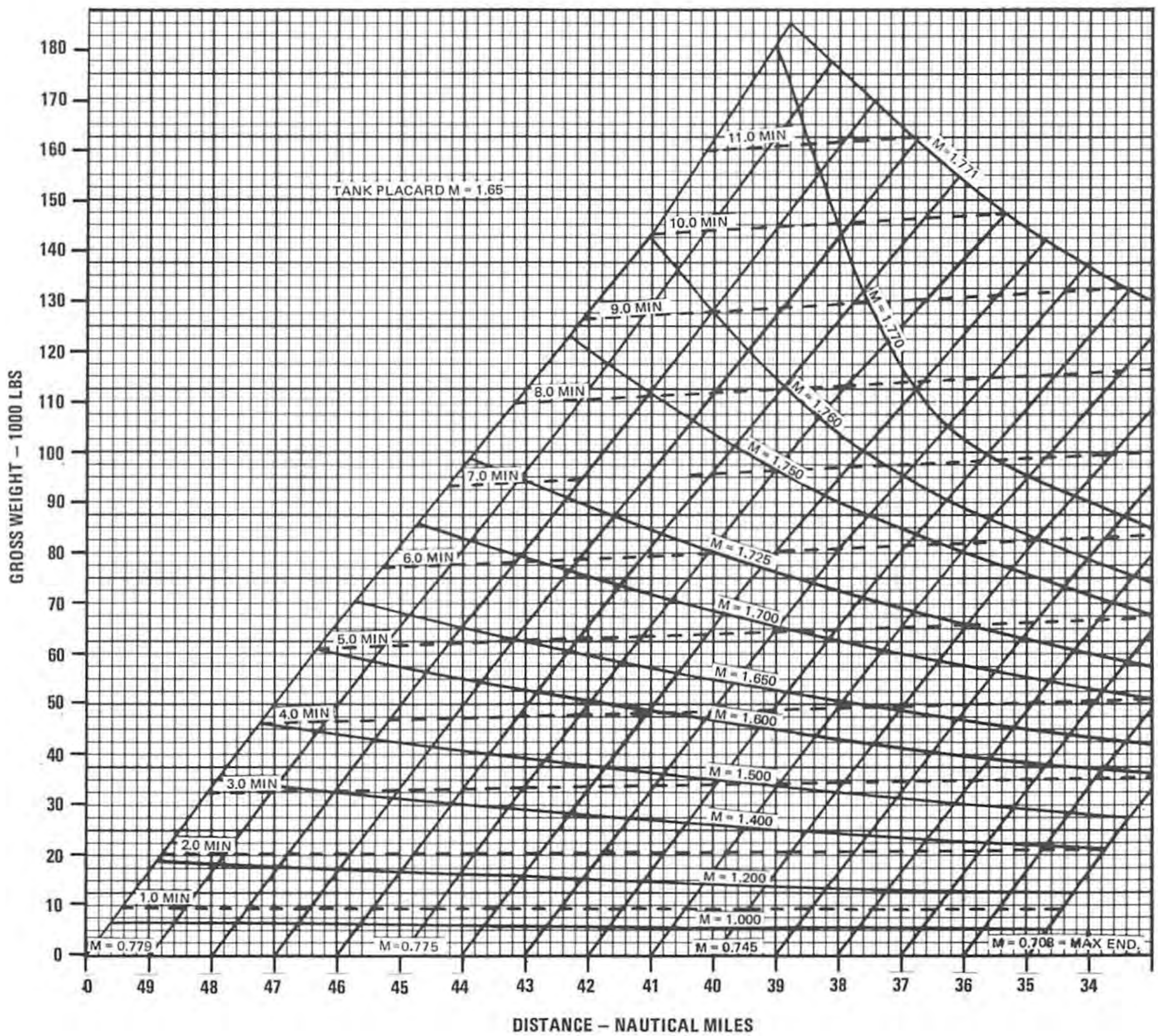
REMARKS

ENGINE(S): J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8LB/GAL



FDD-1-(375)

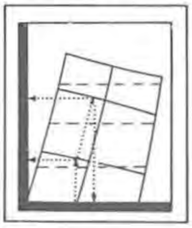
Figure 36-6. Maximum Thrust Acceleration (Sheet 7 of 12)

40,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (1) ℄ TANK

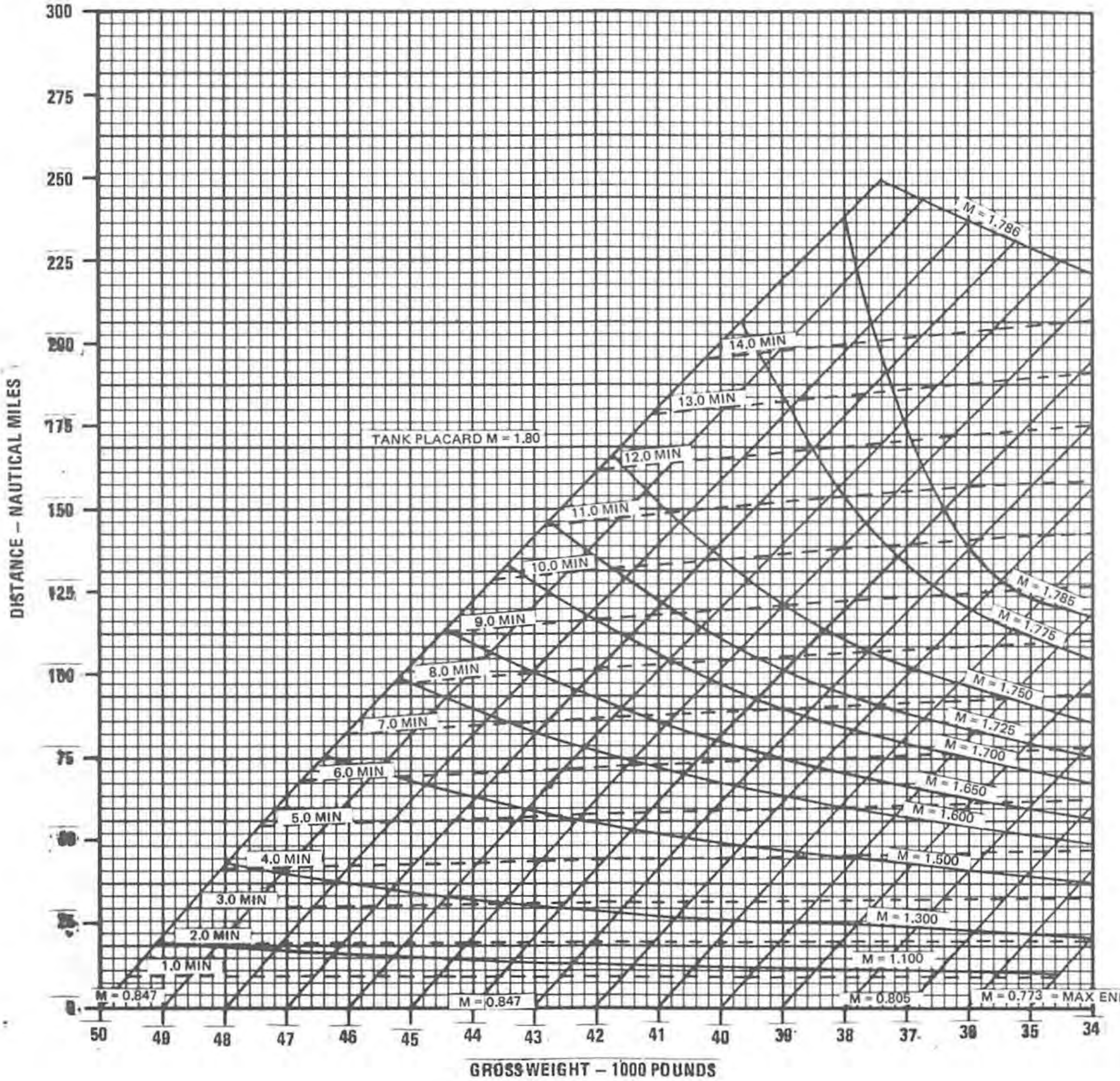
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 79
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



FDD-1-(376)

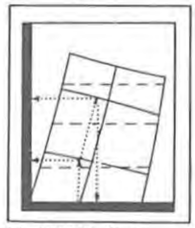
Figure 36-6. Maximum Thrust Acceleration (Sheet 8 of 12)

45,000 FEET

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (1) ℄ TANK

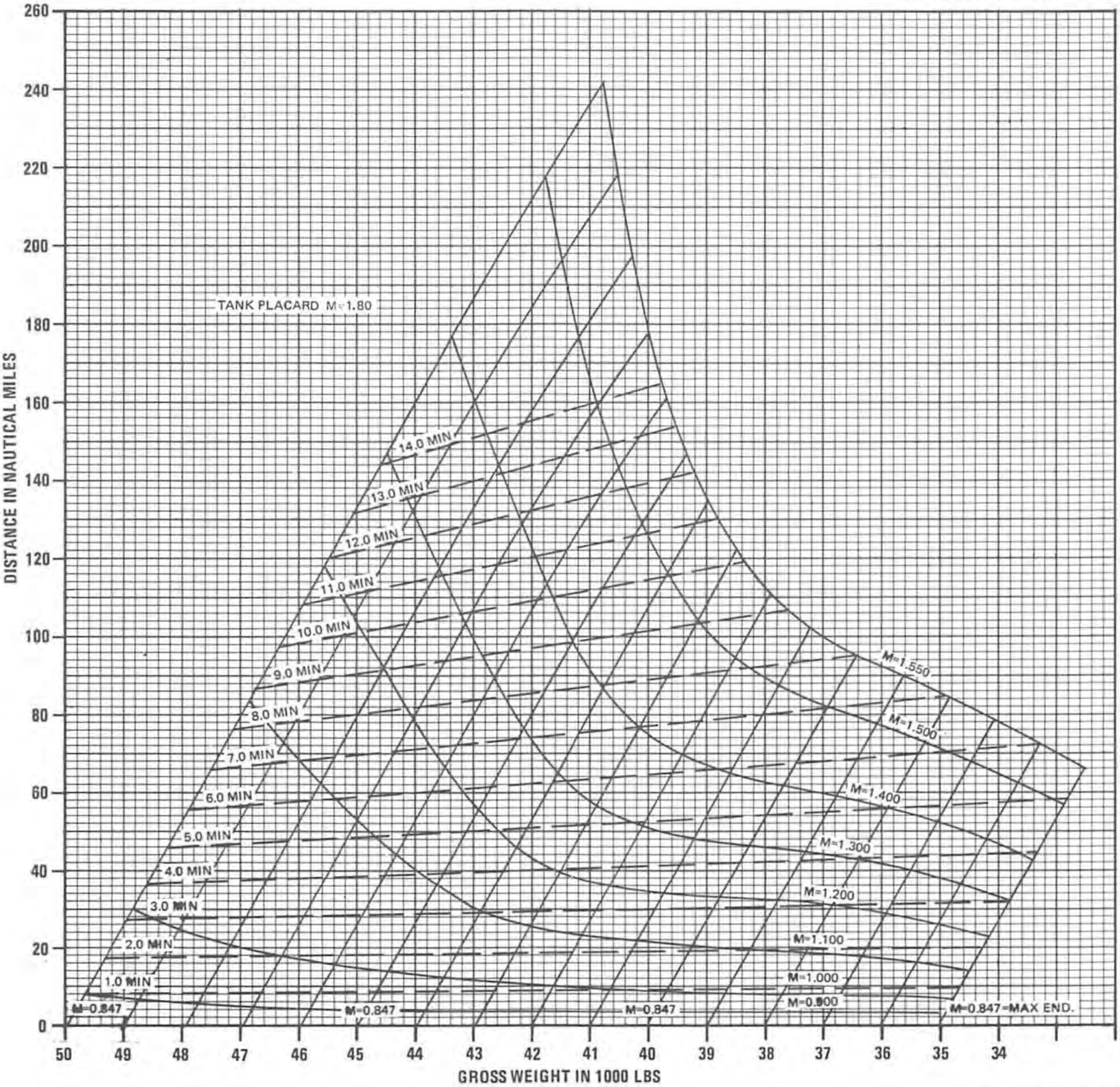
REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**



FDD–1–(377)

Figure 36-6. Maximum Thrust Acceleration (Sheet 9 of 12)

30,000 FEET

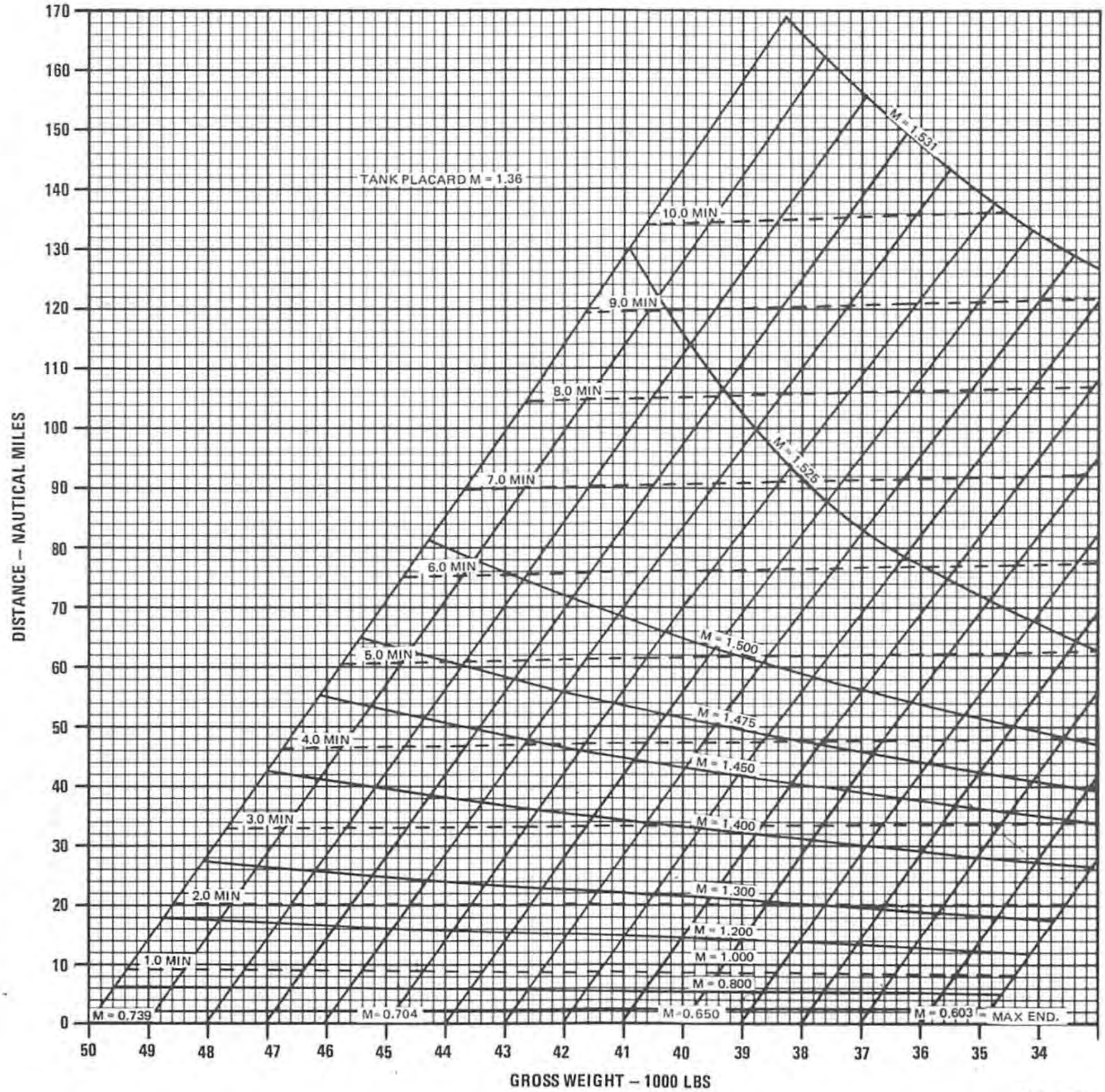
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (2) WING TANKS

REMARKS
ENGINE(S): J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 79
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8LB/GAL



FDD–1–(378)

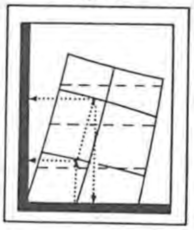
Figure 36-6. Maximum Thrust Acceleration (Sheet 10 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (2) WING TANKS

35,000 FEET

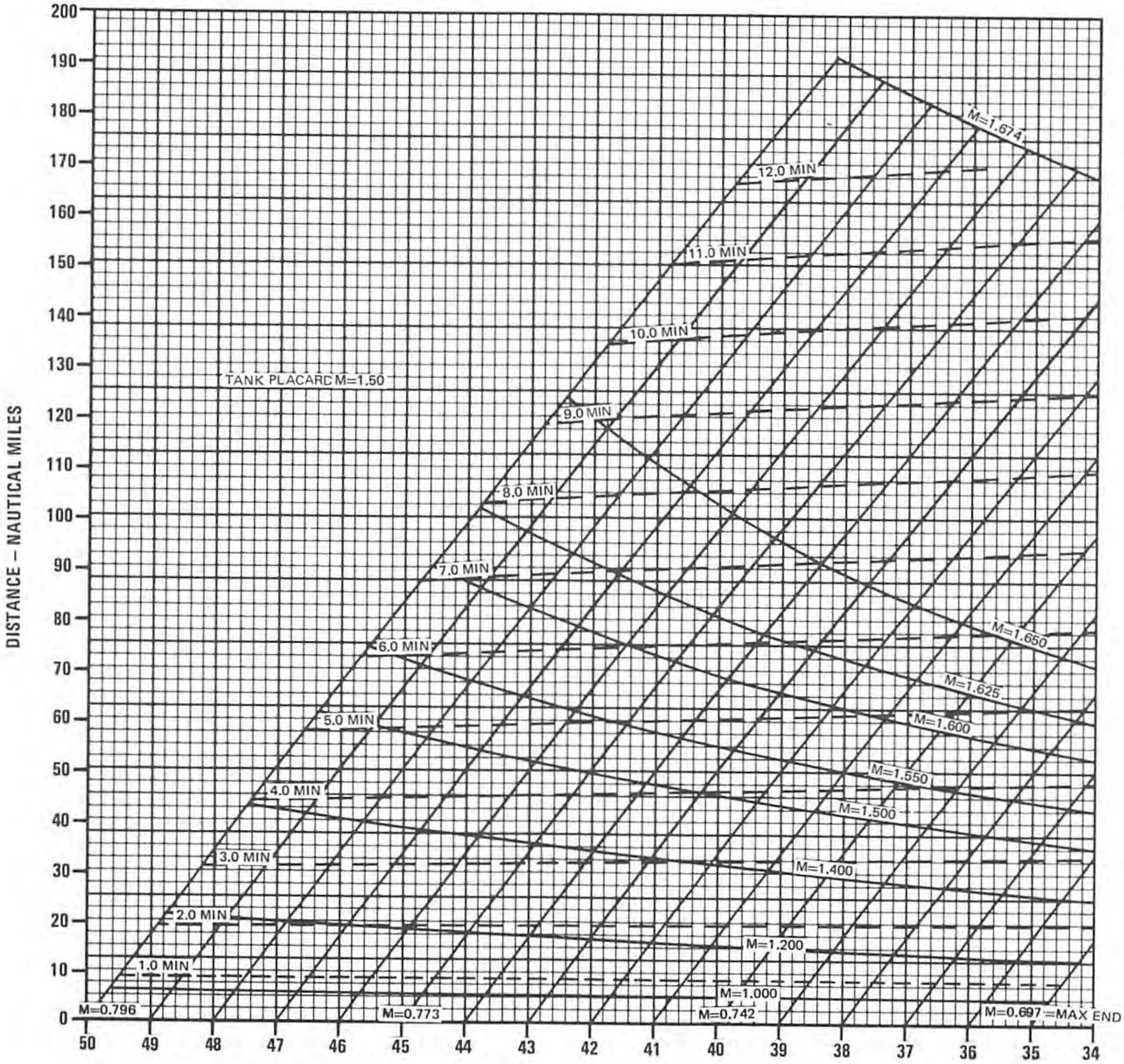
REMARKS
ENGINE(S): (2) J79-6E-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(379)

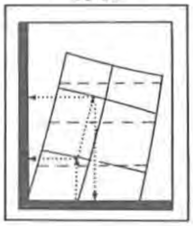
Figure 36-6. Maximum Thrust Acceleration (Sheet 11 of 12)

40,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (2) WING TANKS

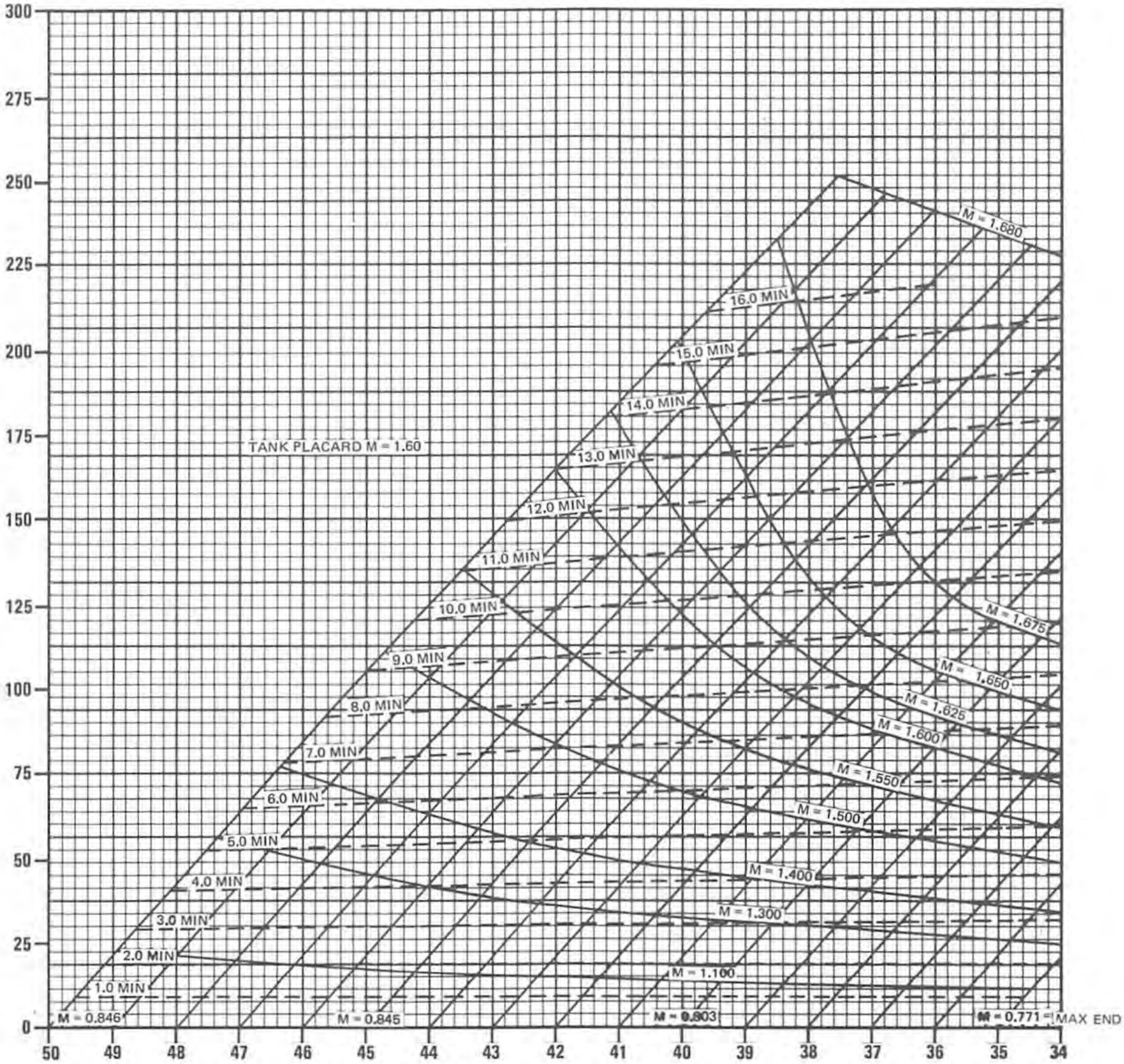
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(380)

Figure 36-6. Maximum Thrust Acceleration (Sheet 12 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE

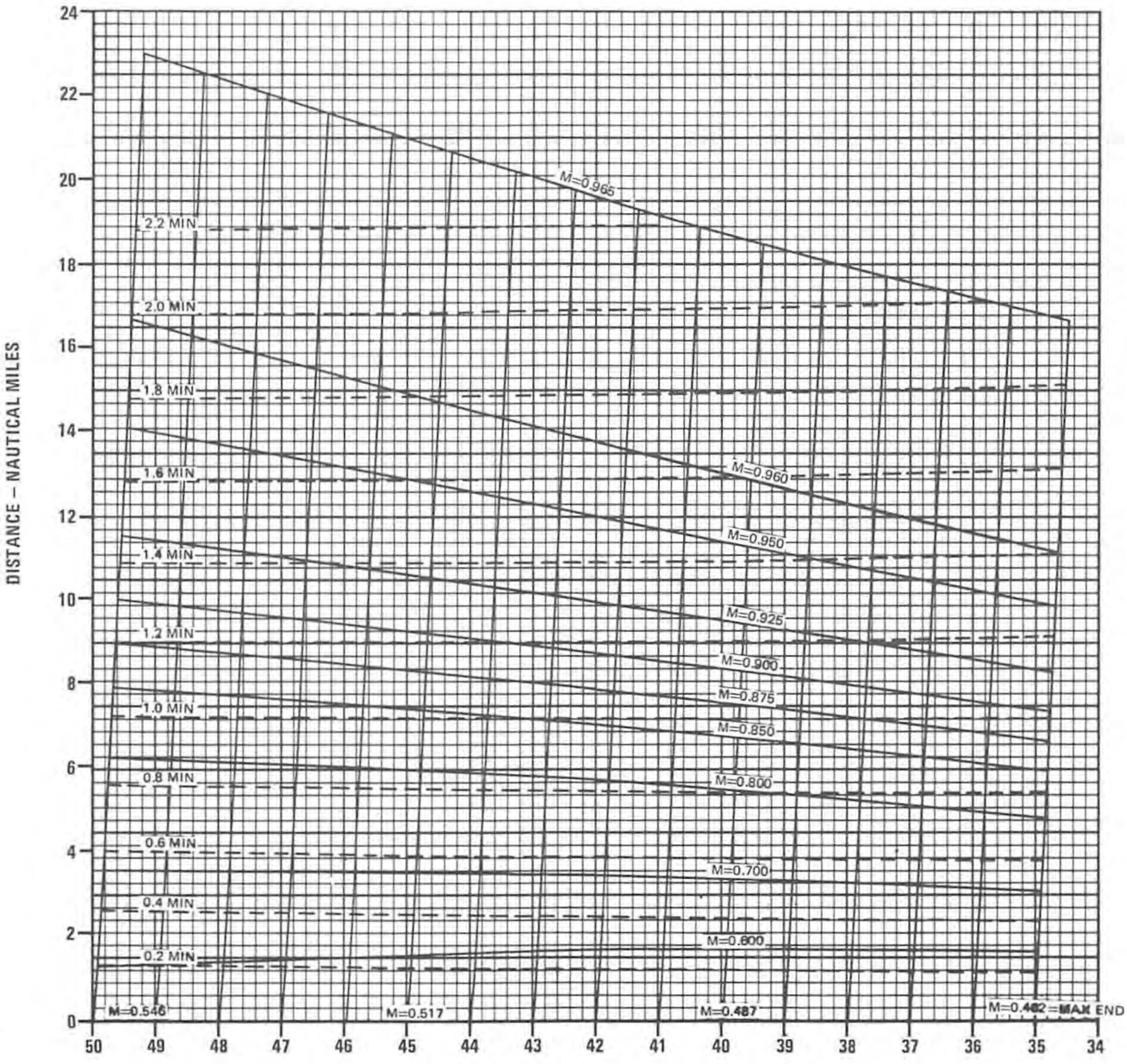
15,000 FEET

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(381)

Figure 36-7. Military Thrust Acceleration (Sheet 1 of 12)

AIRPLANE CONFIGURATION
(4) AIM–7+PRIDE

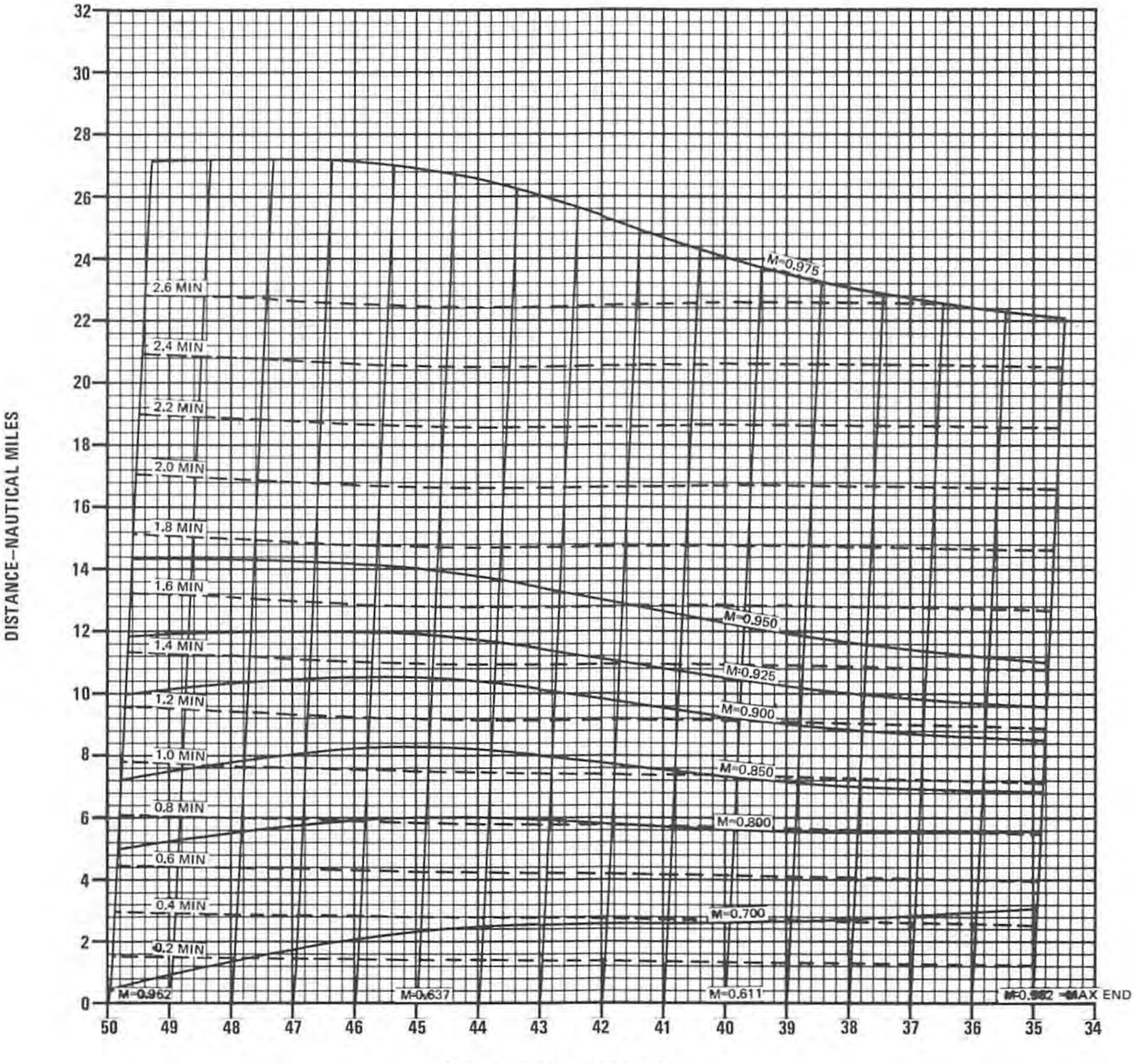
25,000 FEET

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIC: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(382)

Figure 36-7. Military Thrust Acceleration (Sheet 2 of 12)

35,000 FEET

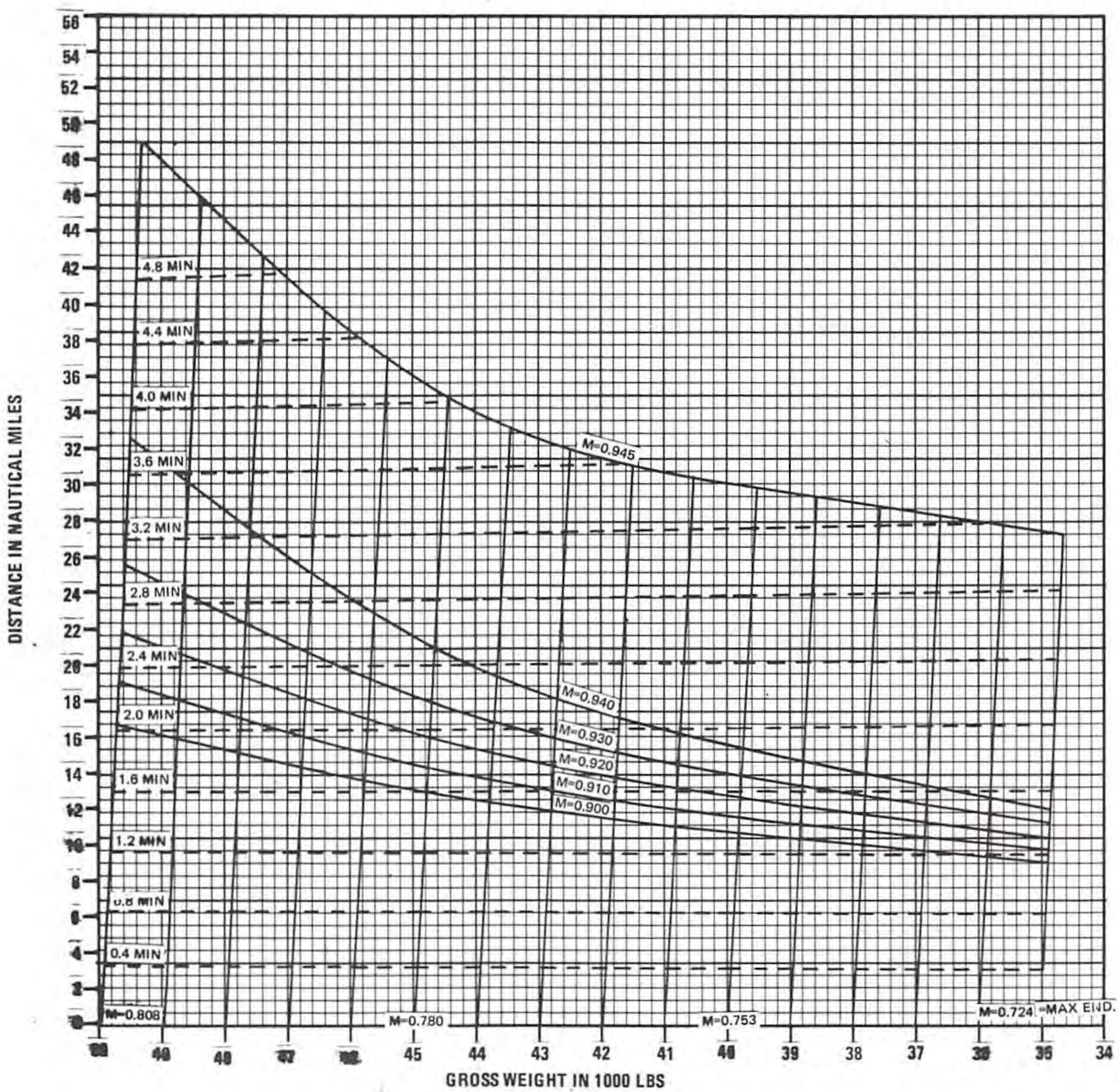
AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(383)

Figure 36-7. Military Thrust Acceleration (Sheet 3 of 12)

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (1) ℄ TANK

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

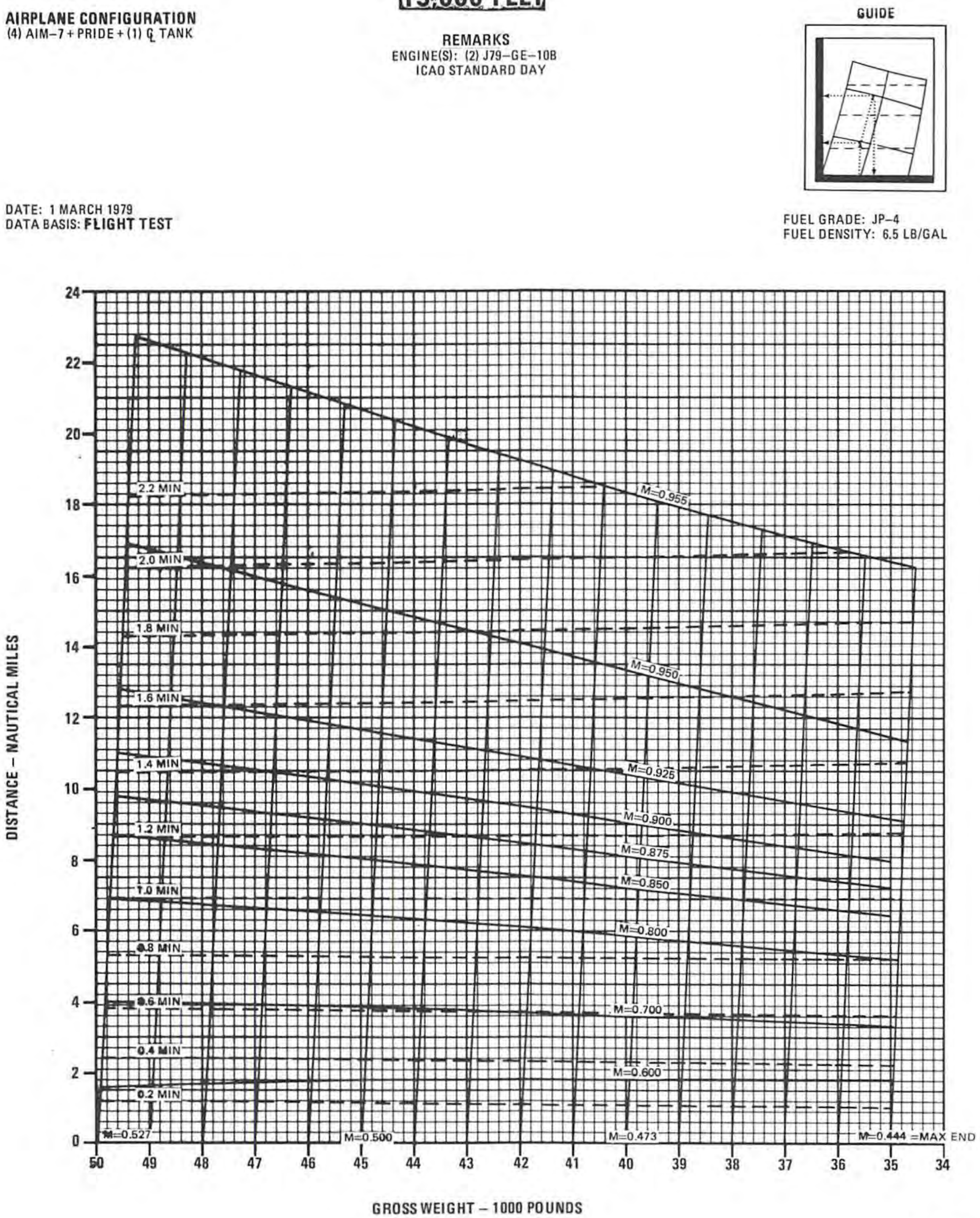


Figure 36-7. Military Thrust Acceleration (Sheet 4 of 12)

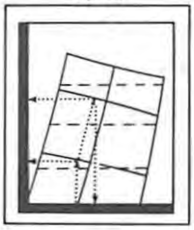
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (1) ℄ TANK

25,000 FEET

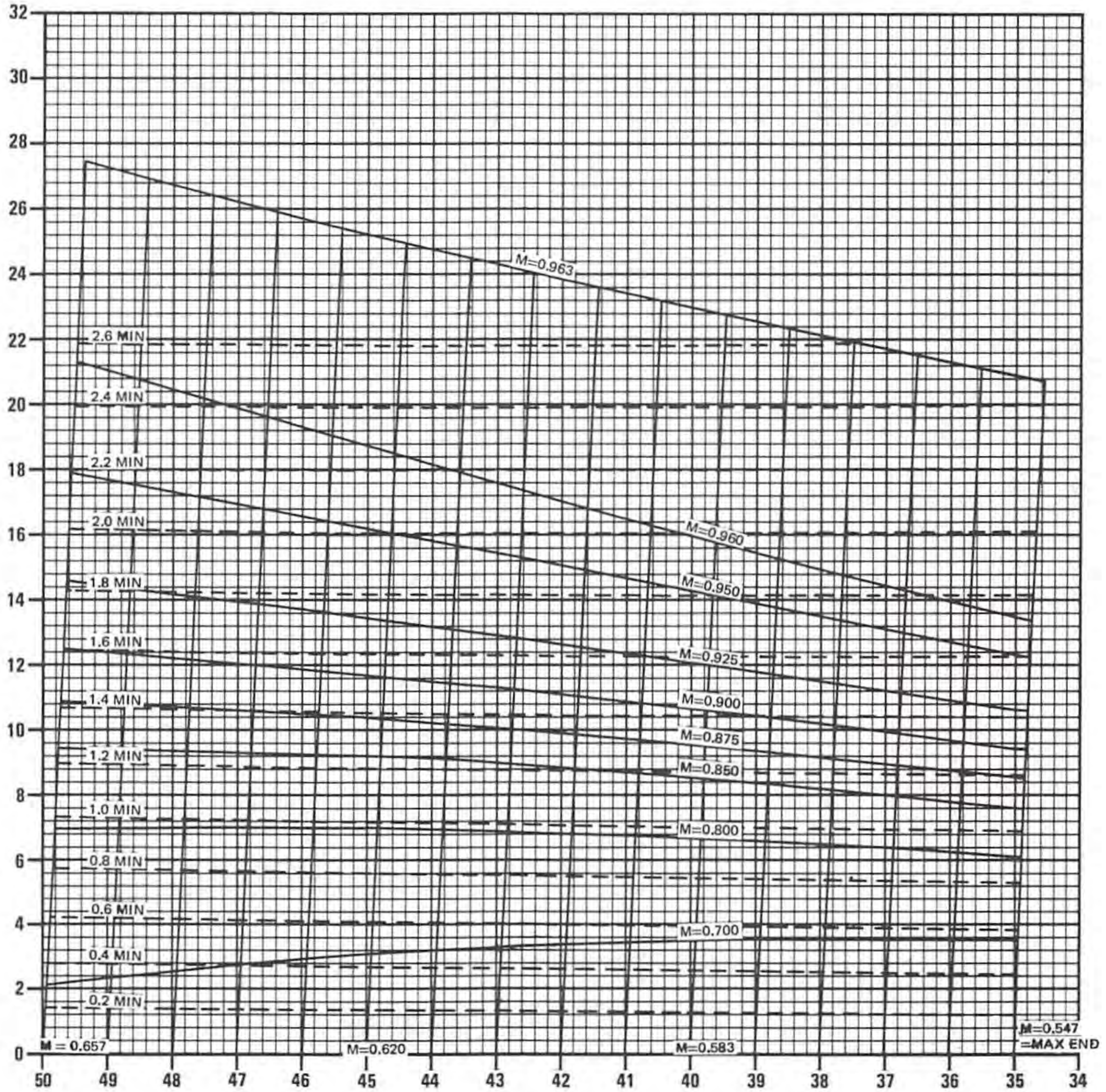
REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(385)

Figure 36-7. Military Thrust Acceleration (Sheet 5 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (1) ℄ TANK

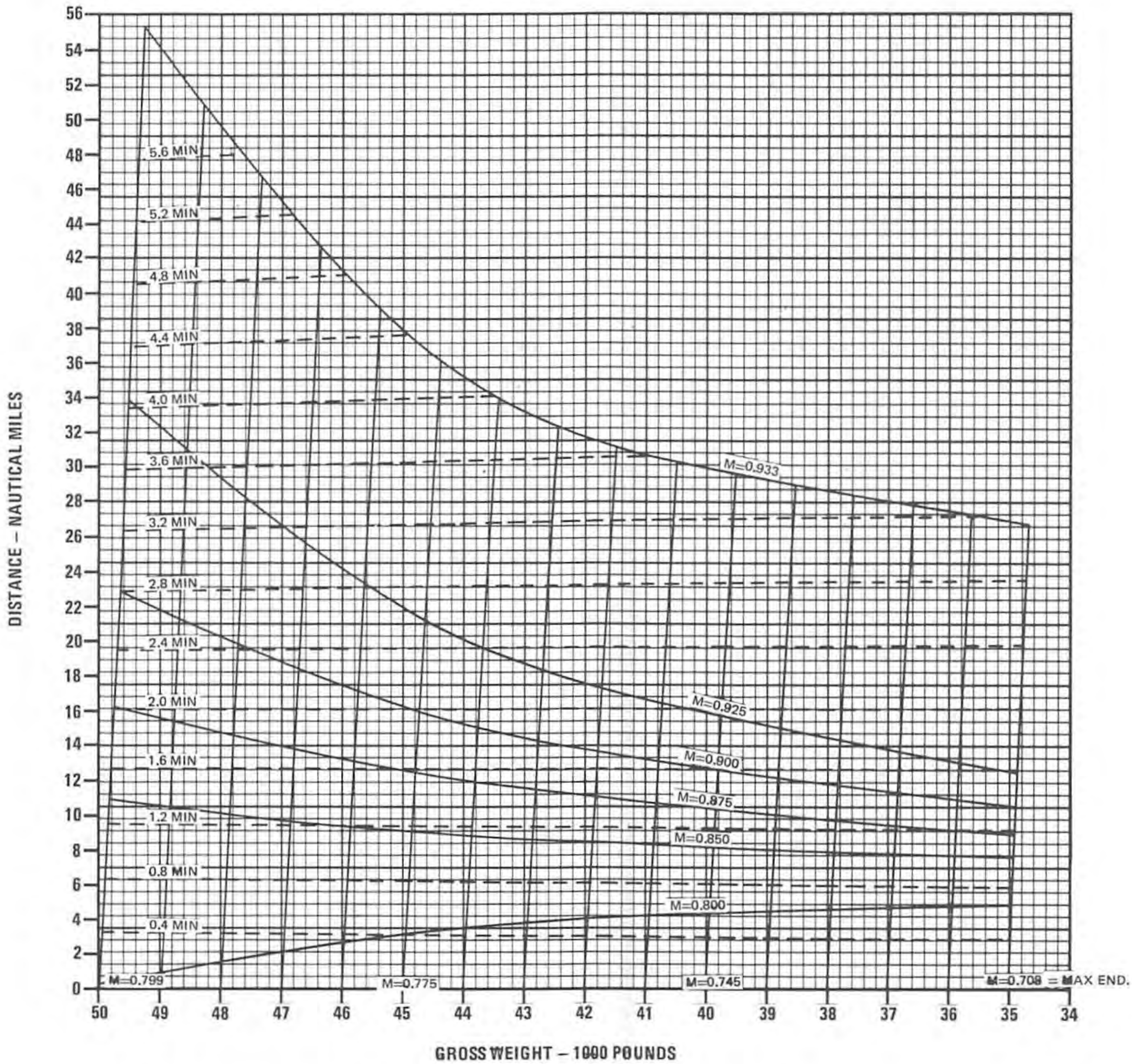
35,000 FEET

REMARKS
ENGINE(S) J79-GE-10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(386)

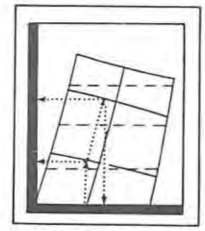
Figure 36-7. Military Thrust Acceleration (Sheet 6 of 12)

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE
+ (2) WING TANKS

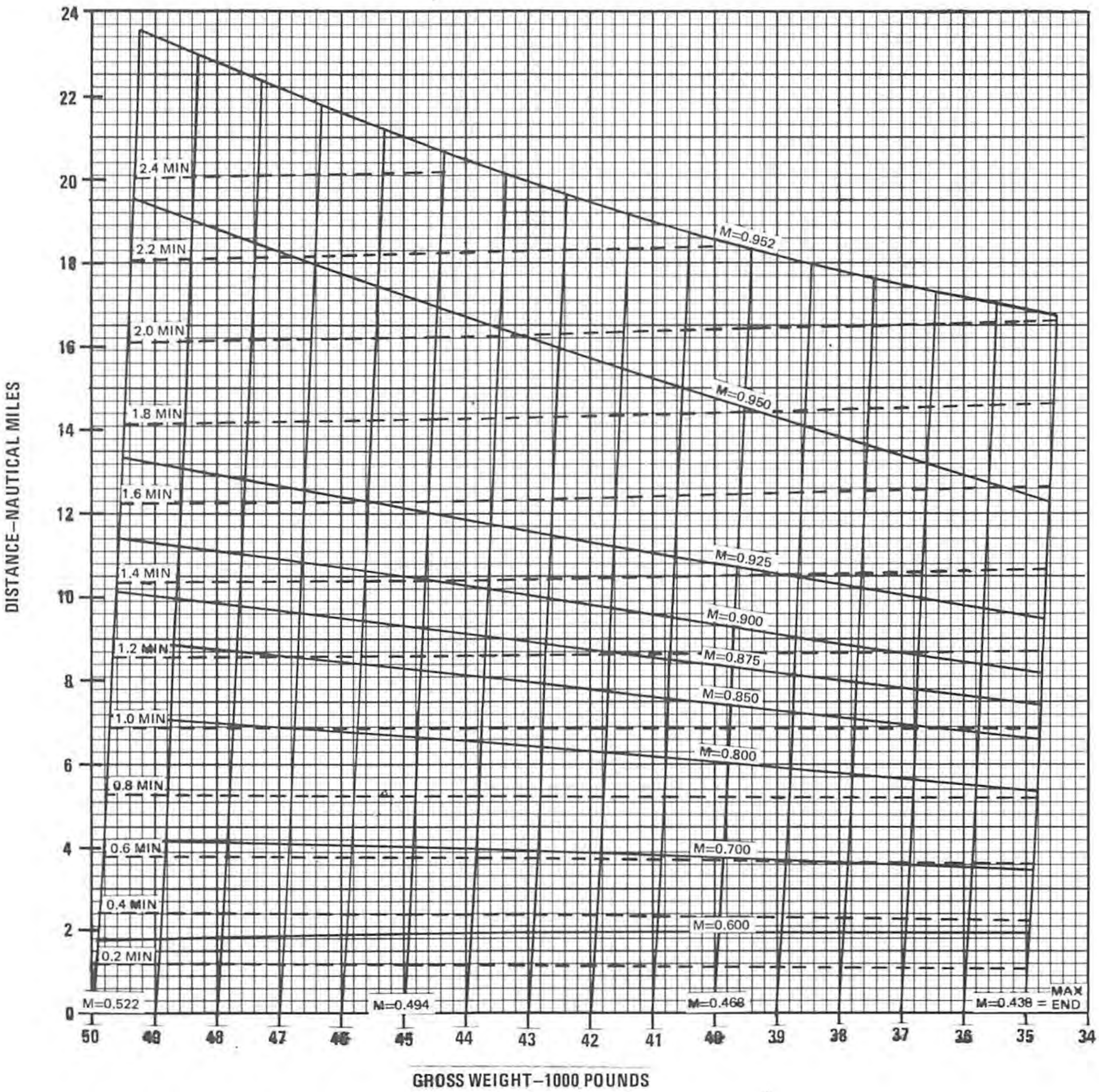
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(387)

Figure 36-7. Military Thrust Acceleration (Sheet 7 of 12)

25,000 FEET

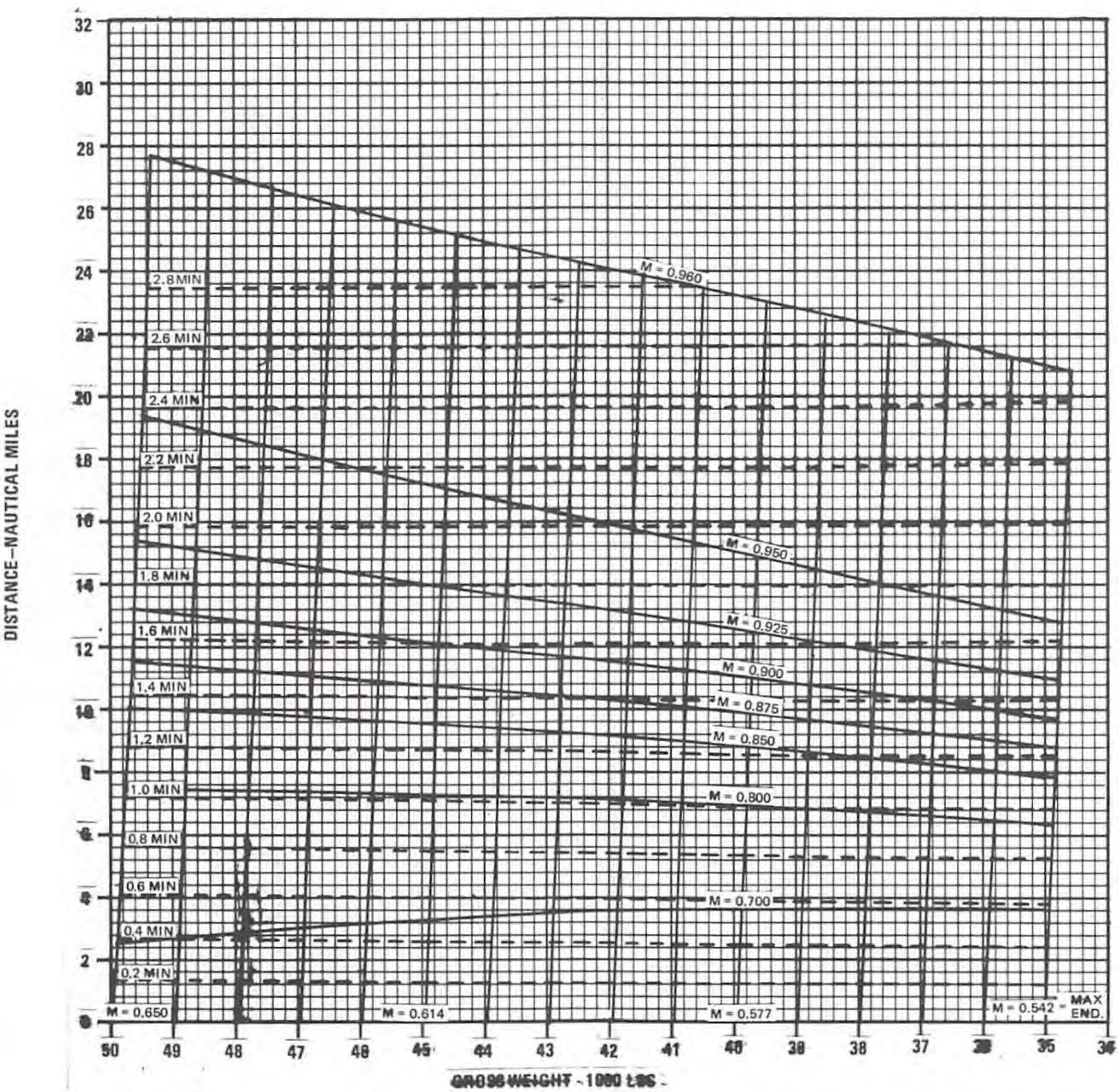
AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (2) WING TANKS

REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARY DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(388)

Figure 36-7. Military Thrust Acceleration (Sheet 8 of 12)

35,000 FEET

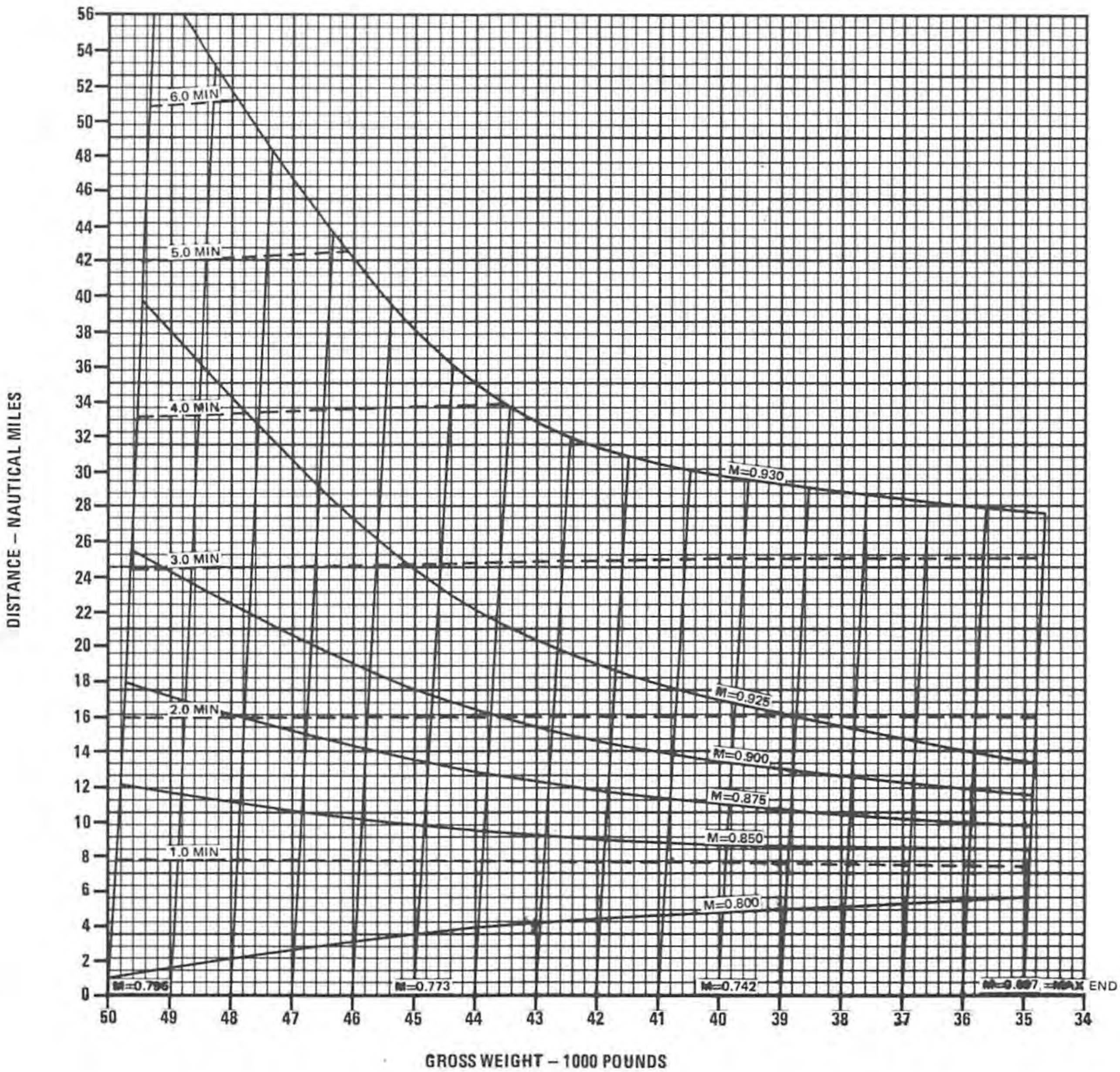
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (2) WING TANKS

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(389)

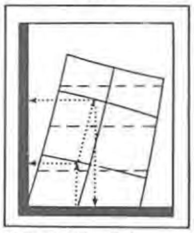
Figure 36-7. Military Thrust Acceleration (Sheet 9 of 12)

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (1) ℄ TANK
+ (2) WING TANKS

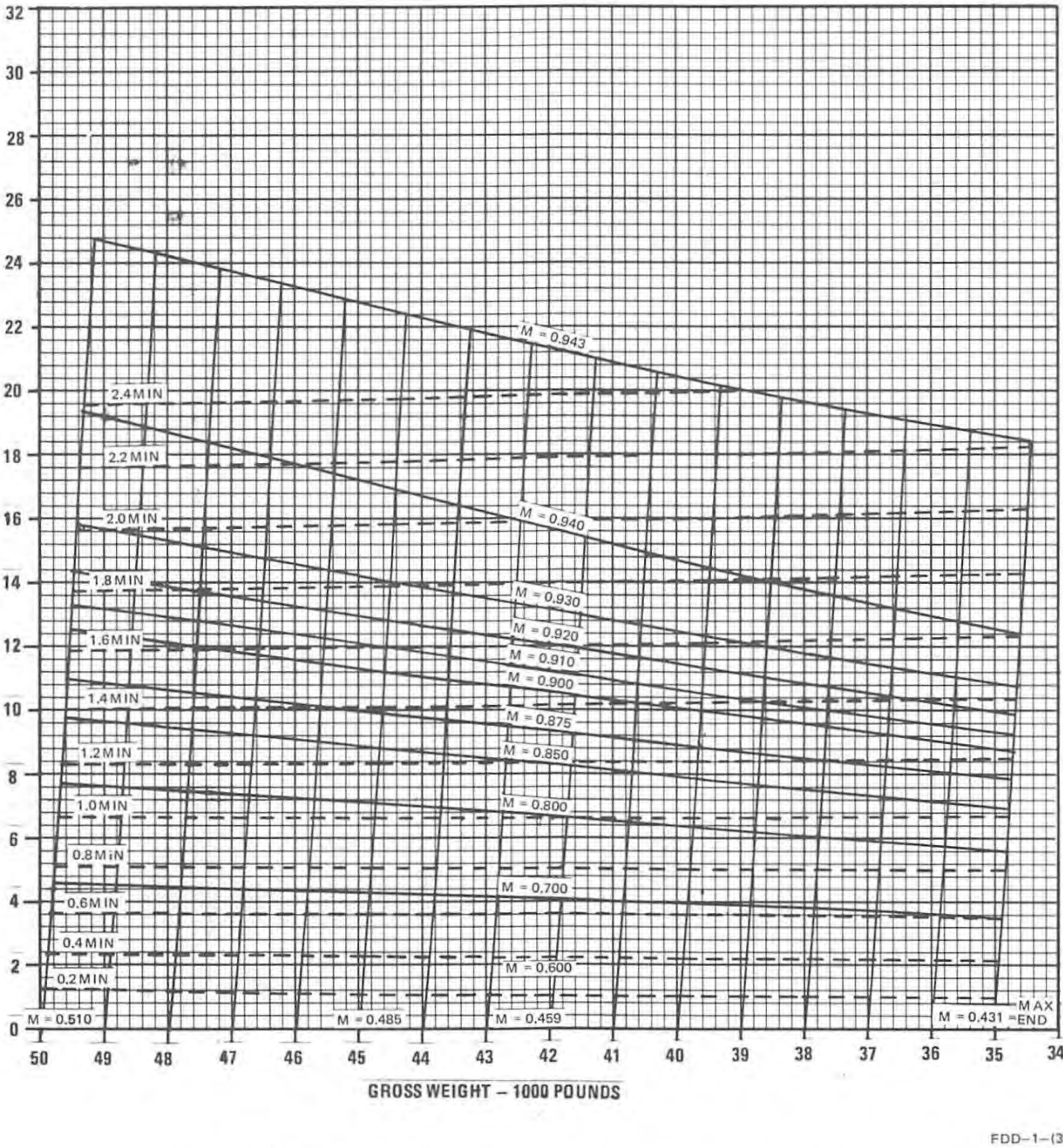
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT BASIS

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(390)

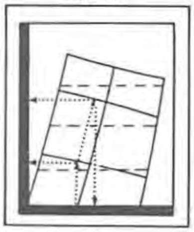
Figure 36-7. Military Thrust Acceleration (Sheet 10 of 12)

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE + (1) ℄ TANK + (2) WING TANKS

25,000 FEET

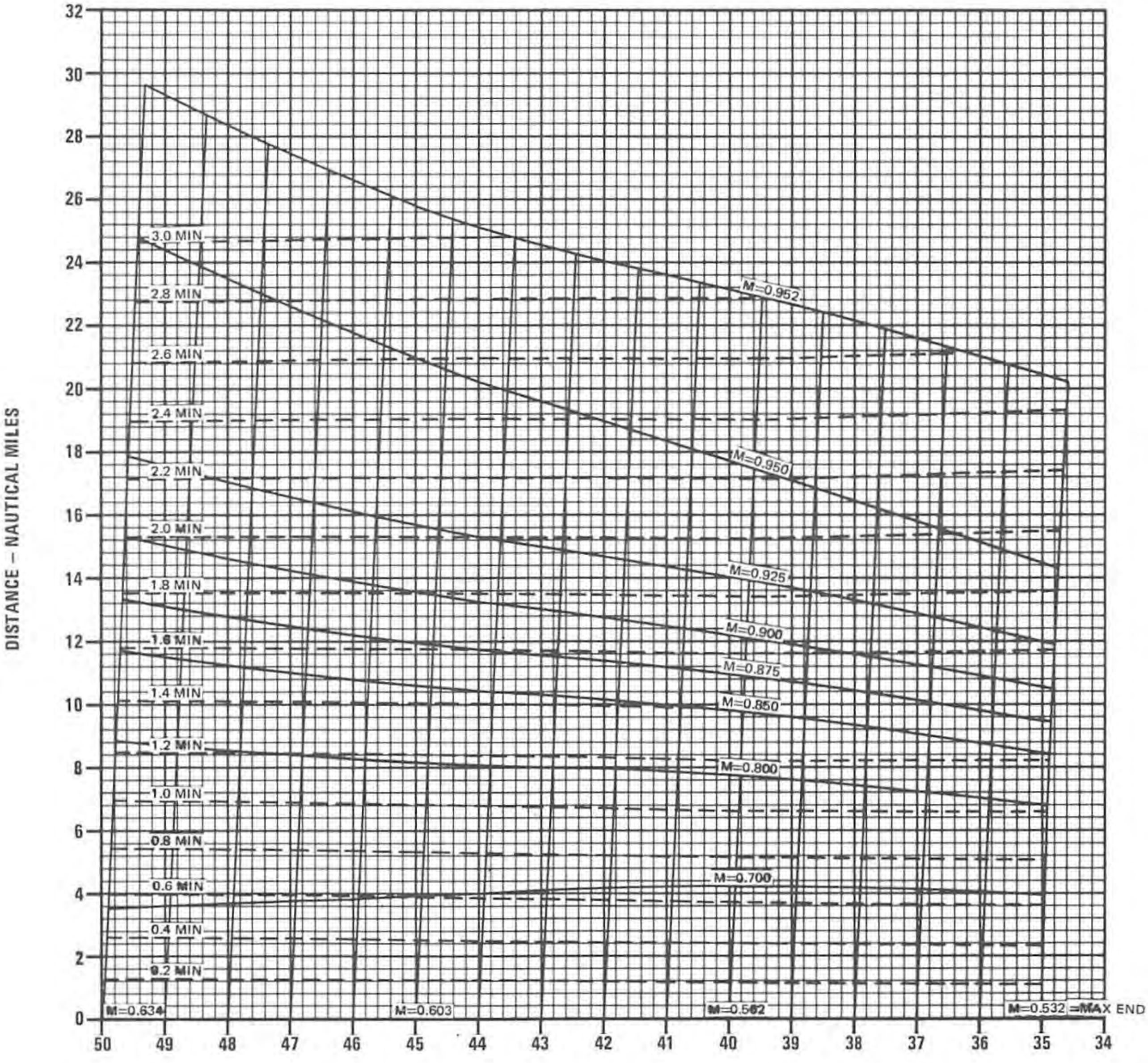
REMARKS
ENGINE(S): (2) J79-GE-10B
ICAO STANDARD DAY

GUIDE



DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



FDD-1-(391)

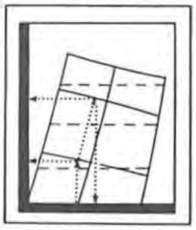
Figure 36-7. Military Thrust Acceleration (Sheet 11 of 12)

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE + (1)
℄ TANK + (2) WING TANKS

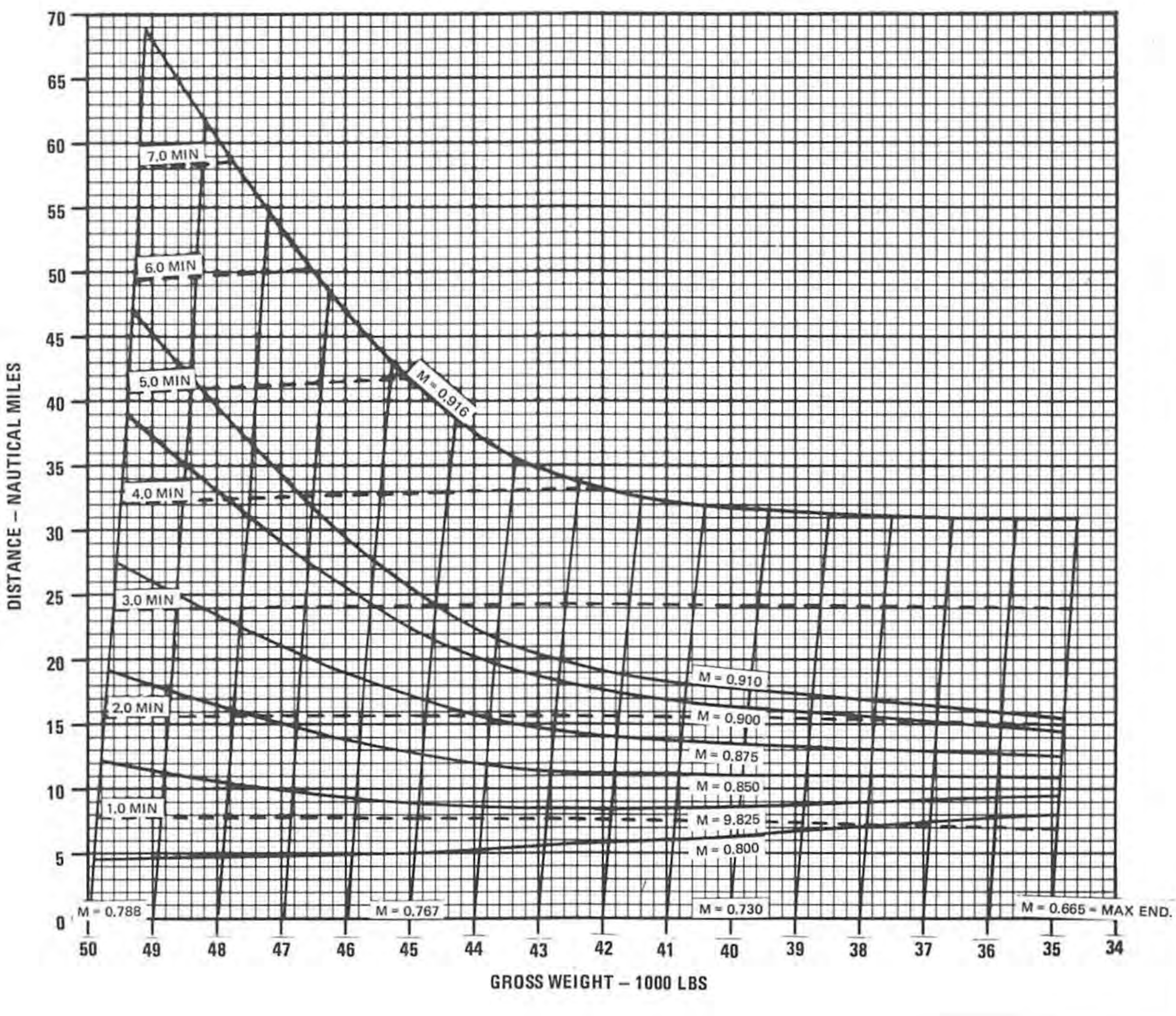
REMARKS
ENGINE(S): J79–GE–10B
ICAO STANDARD DAY

GUIDE



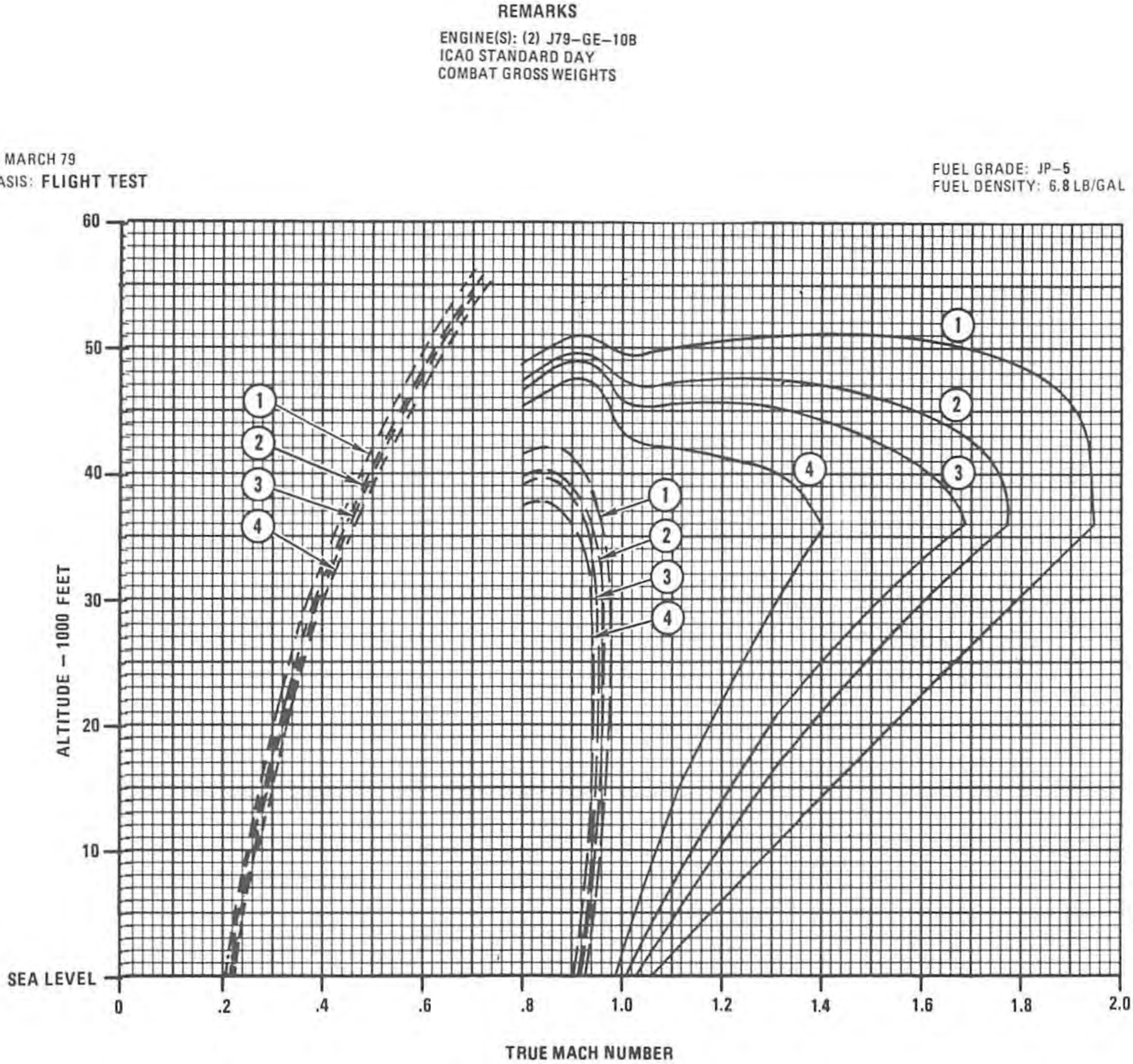
DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DESNITY: 6.8 LB/GAL



FDD–1–(392)

Figure 36-7. Military Thrust Acceleration (Sheet 12 of 12)



CURVE NO.	CONFIGURATION	GROSS WEIGHT
1	(4) AIM-7 + PRIDE	42640 LB
2	(4) AIM-7 + PRIDE + (1) ℄ TANK	45443 LB
3	(4) AIM-7 + PRIDE + (2) WING TANKS	46275 LB
4	(4) AIM-7 + PRIDE + (1) ℄ TANK + (2) WING TANKS	49046 LB

LEGEND	
———	MAXIMUM THRUST
— —	MILITARY THRUST
- - - -	MAXIMUM USABLE LIFT LIMIT

FDD-1-(393)

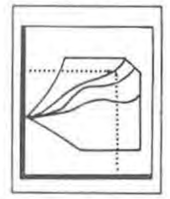
Figure 36-8. Level Flight Envelope

SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM–7

GROSS WEIGHT – 37,500 POUNDS

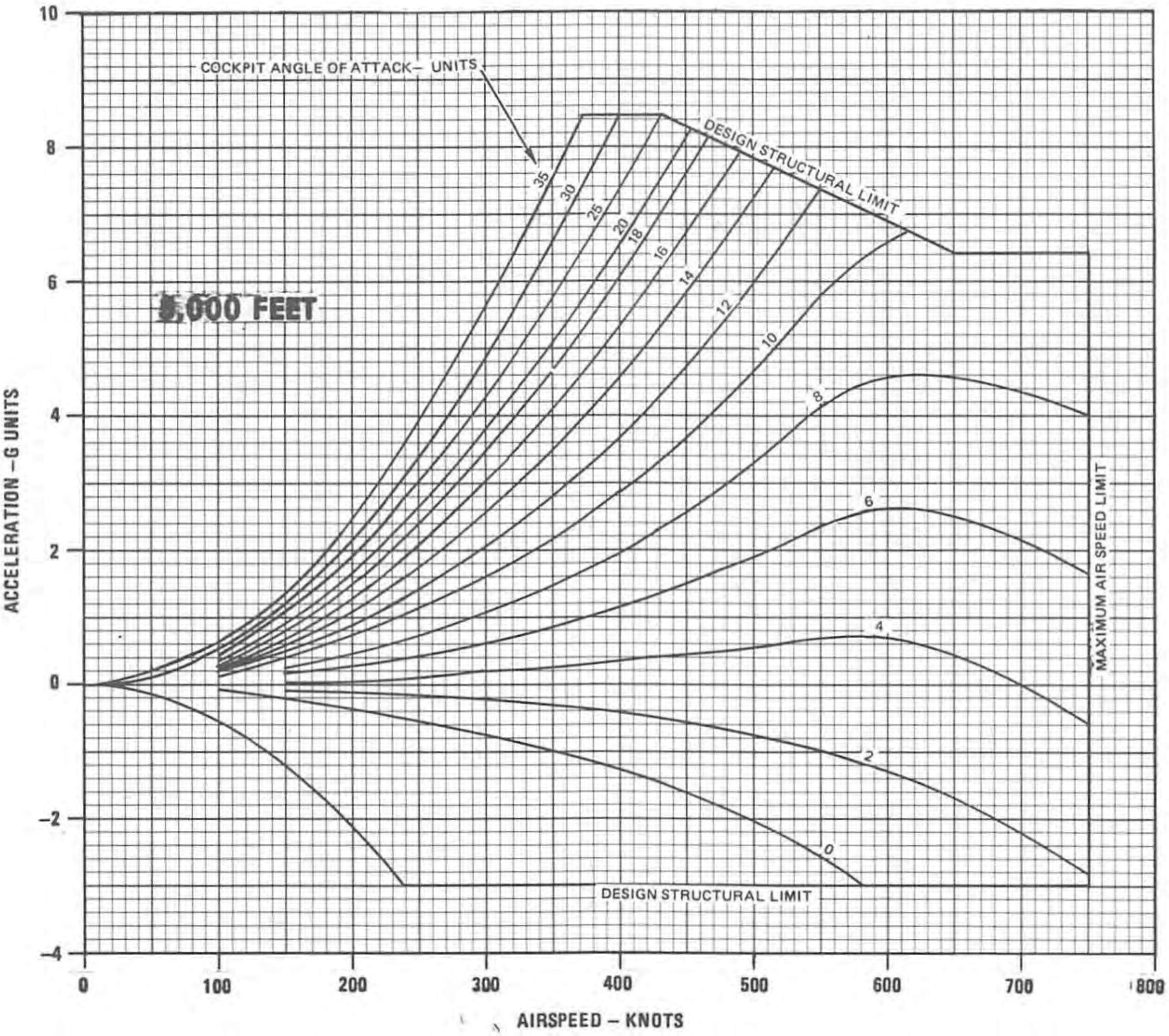
GUIDE



REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

DATE: 1 DECEMBER 1978
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



FDD–1–(394)

Figure 36-9. V-N Envelope (Sheet 1 of 4)

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM – 7

SYMMETRICAL FLIGHT

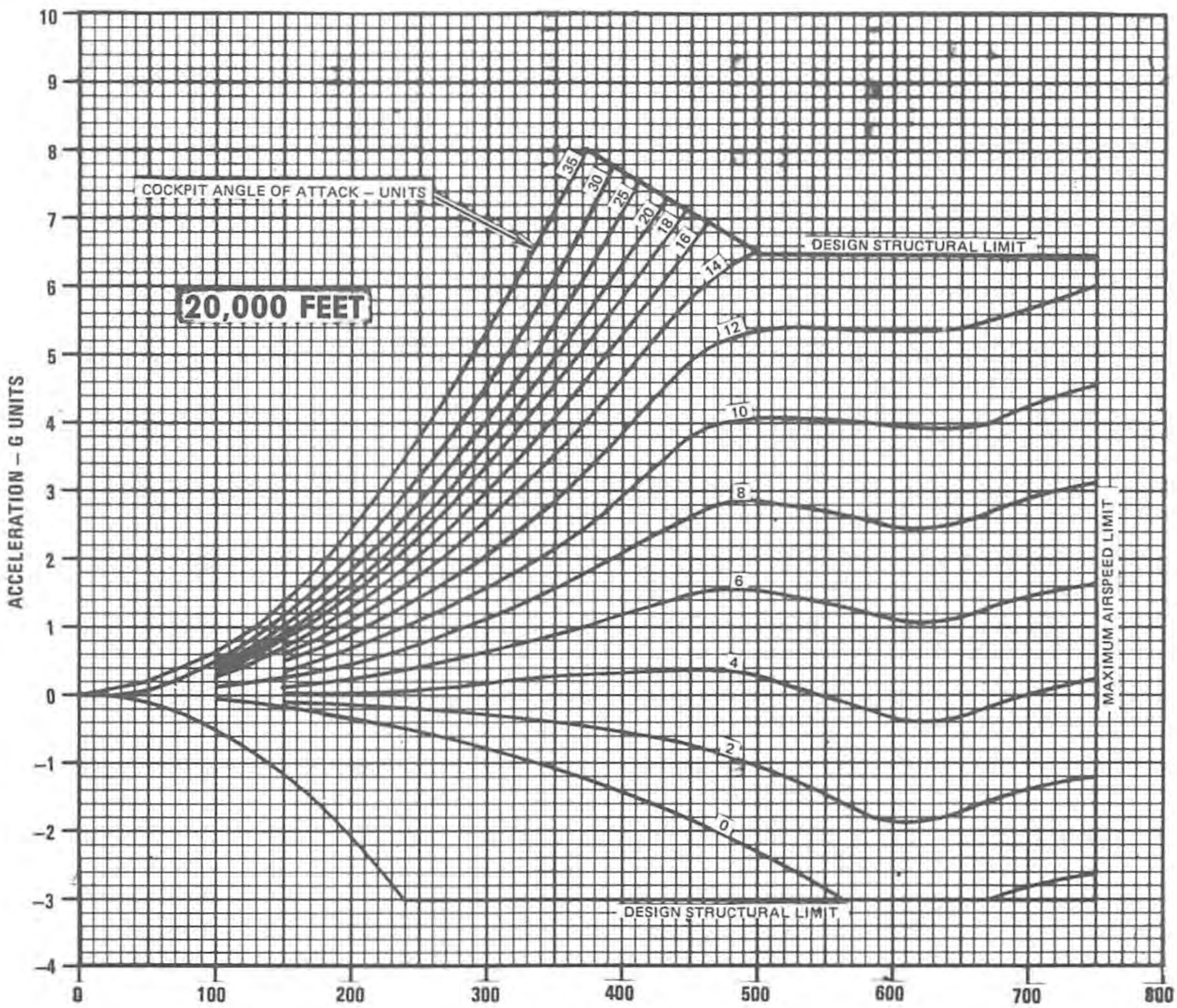
GROSS WEIGHT–37,500 POUNDS

REMARKS
ENGINE(S): J79–GE–10B
ICAO STANDARD DAY

GUIDE

DATE: 1 DECEMBER 1978
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8LB/GAL



FDD–1–(395)

Figure 36-9. V-N Envelope (Sheet 2 of 4)

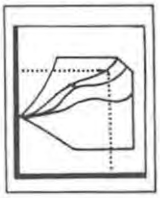
SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM–7

GROSS WEIGHT – 37,500 POUNDS

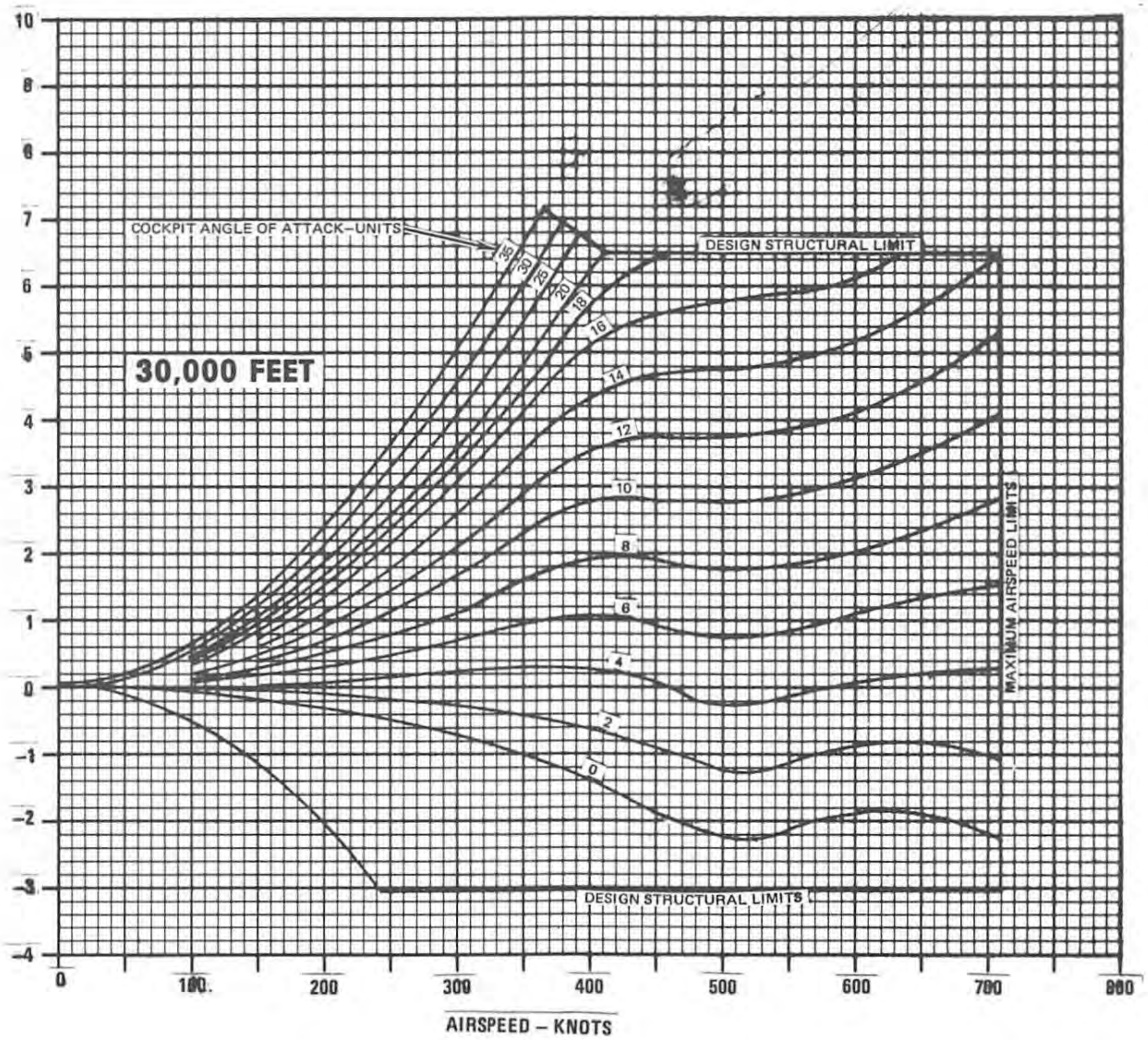
REMARKS
ENGINES: (2) J79–GE–10B
ICAO STANDARD

GUIDE



DATE: 1 DECEMBER 1978
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



FDD–1–(396)

Figure 36-9. V-N Envelope (Sheet 3 of 4)

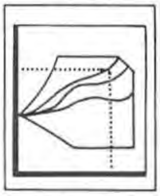
SYMMETRICAL FLIGHT

GROSS WEIGHT – 37,500 POUNDS

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM – 7

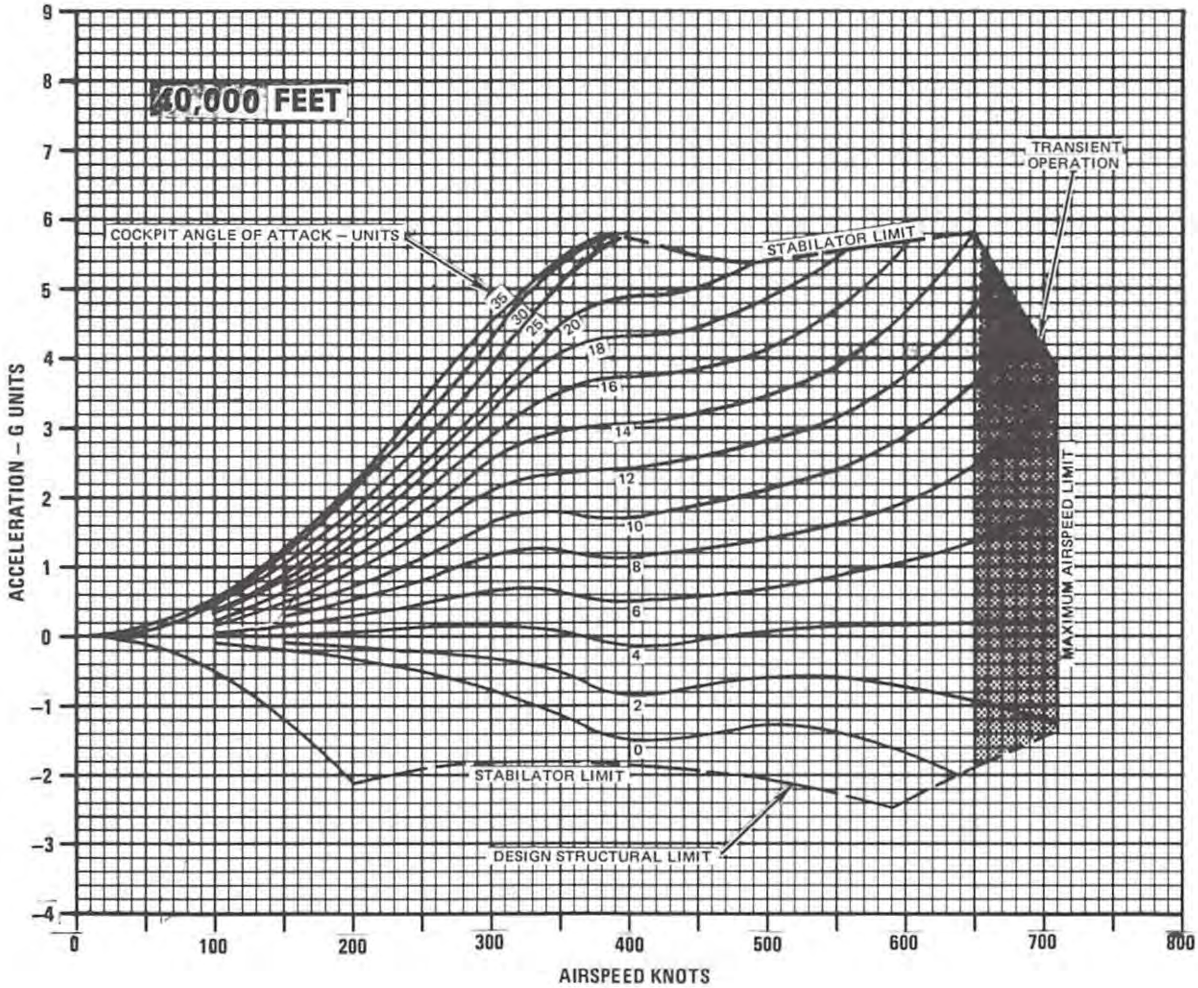
REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

GUIDE



DATE: 1 DECEMBER 1978
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(397)

Figure 36-9. V-N Envelope (Sheet 4 of 4)

MAXIMUM THRUST

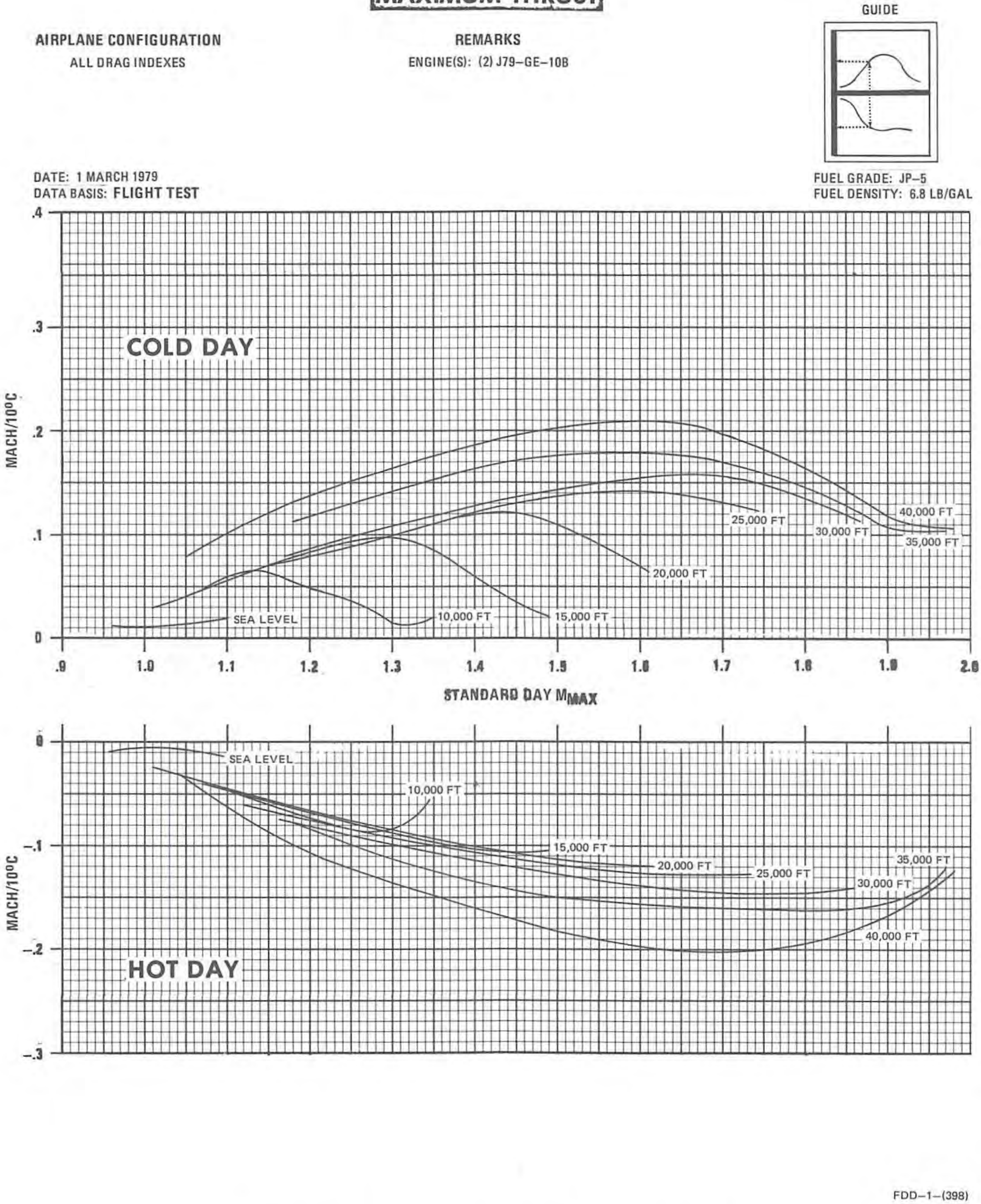


Figure 36-10. Temperature Effect on Maximum Speed

SUBSONIC - SPEED BRAKES RETRACTED

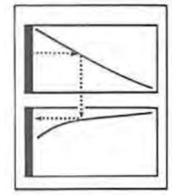
AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

GROSS WEIGHT 40,000 POUNDS

REMARKS
ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

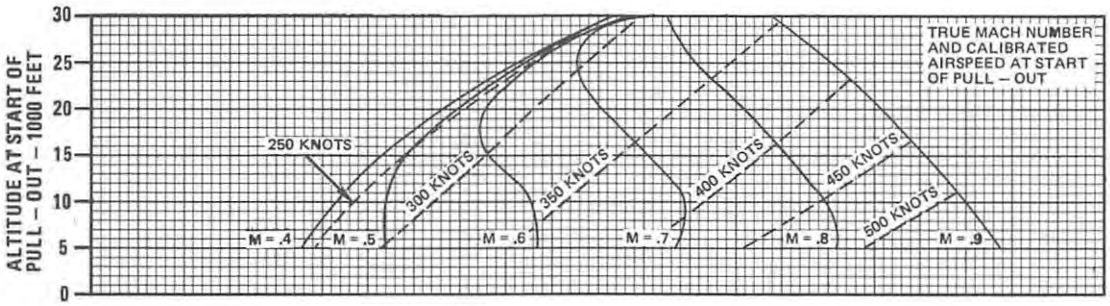
NOTES
1. ALTITUDE LOSS IS ESSENTIALLY THE SAME FOR MAXIMIM OR MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 16 UNITS (AOA) STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

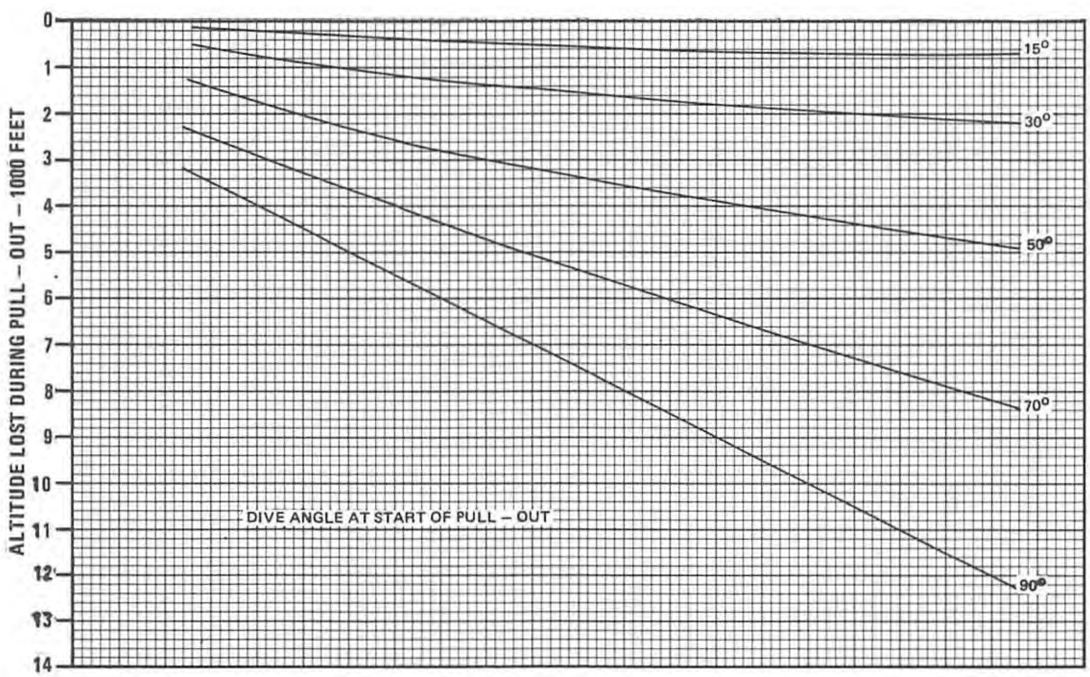
GUIDE



DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL





FDD–1–(399)

Figure 36-11. Dive Recovery – 16 Units AOA (Sheet 1 of 2)

SUPERSONIC-SPEED BRAKES RETRACTED

GROSS WEIGHT – 40,000 POUNDS

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

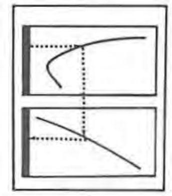
REMARKS

ENGINE(S): (2) J79–GE–10B
ICAO STANDARD DAY

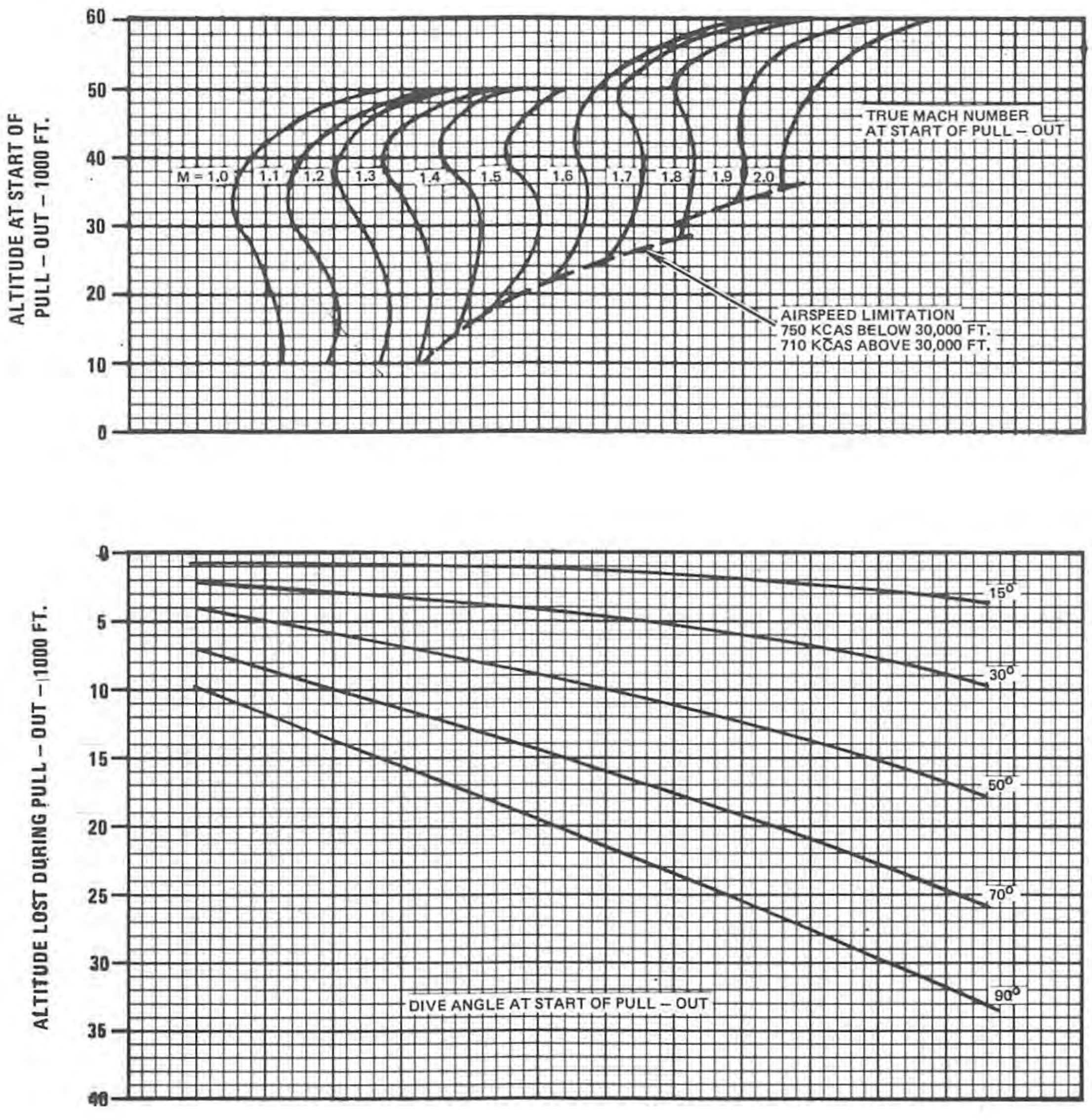
1. ALTITUDE LOSS IS ESSENTIALLY THE SAME FOR MAXIMUM OR MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILD UP TO 16 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

DATE: 1 MARCH 1979
DATA BASIS: FLIGHT TEST

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



FDD–1–(401)

Figure 36-11. Dive Recovery – 16 Units AOA (Sheet 2 of 2)

SUBSONIC-SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4) AIM–7 + PRIDE

DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

GROSS WEIGHT – 40,000 POUNDS

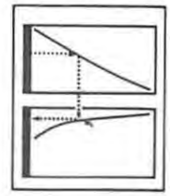
REMARKS

ENGINES: (2) J79–GE–10B
ICAO STANDARD DAY

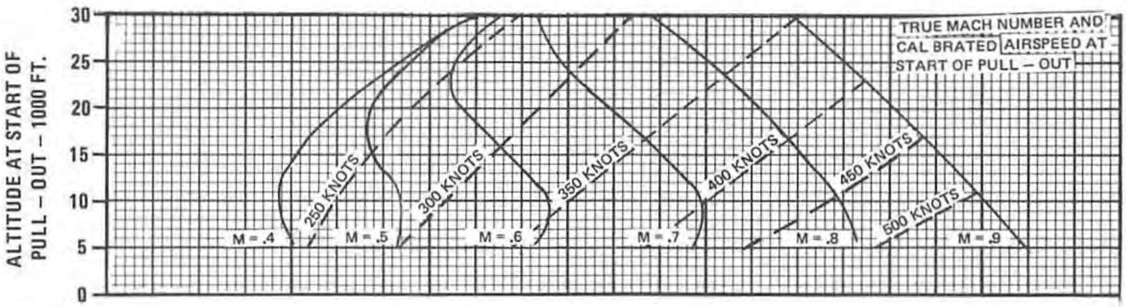
NOTES

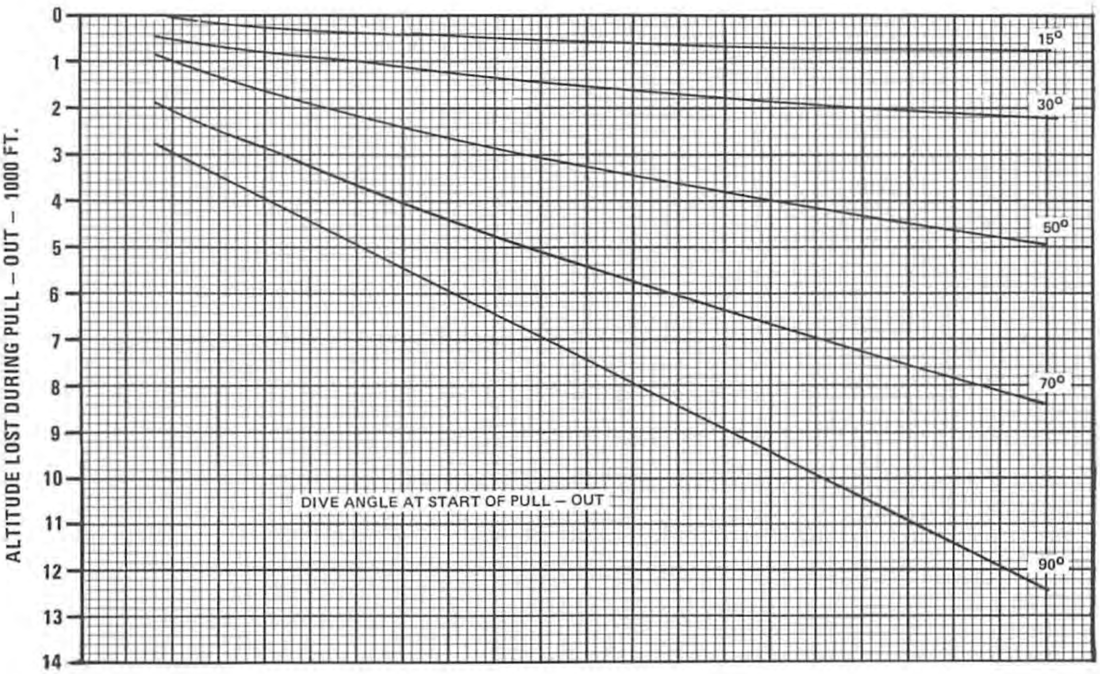
1. ALTITUDE LOSS IS ESSENTIALLY THE SAME FOR MAXIMUM OR MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 25 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

GUIDE



FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL





FDD–1–(400)

Figure 36-12. Dive Recovery – 25 Units AOA (Sheet 1 of 2)

SUPERSONIC - SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4) AIM-7 + PRIDE

GROSS WEIGHT 40,000 POUNDS

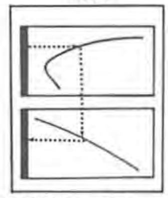
REMARKS
ENGINE(S): (2) J79-GE-10B

NOTES

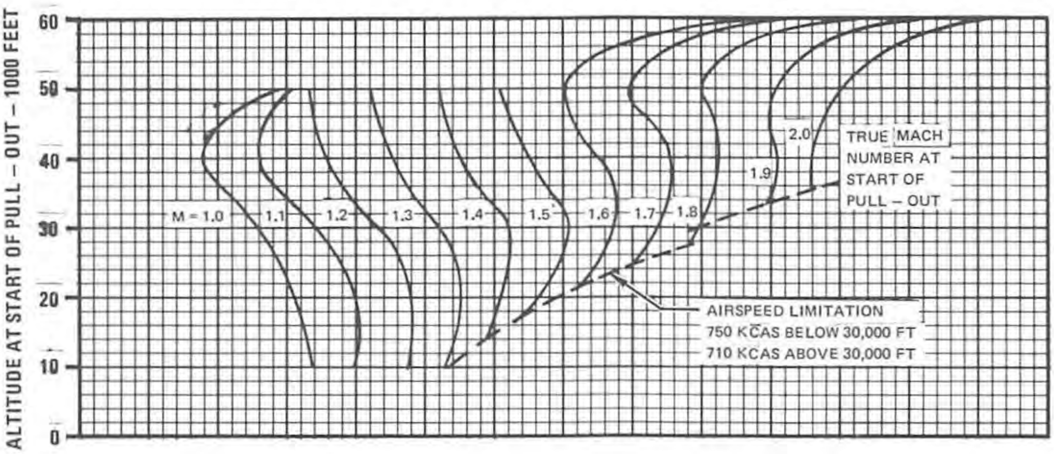
1. ALTITUDE LOSS IS ESSENTIALLY THE SAME FOR MAXIMUM OR MILITARY THRUST.
2. PULL-OUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 25 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

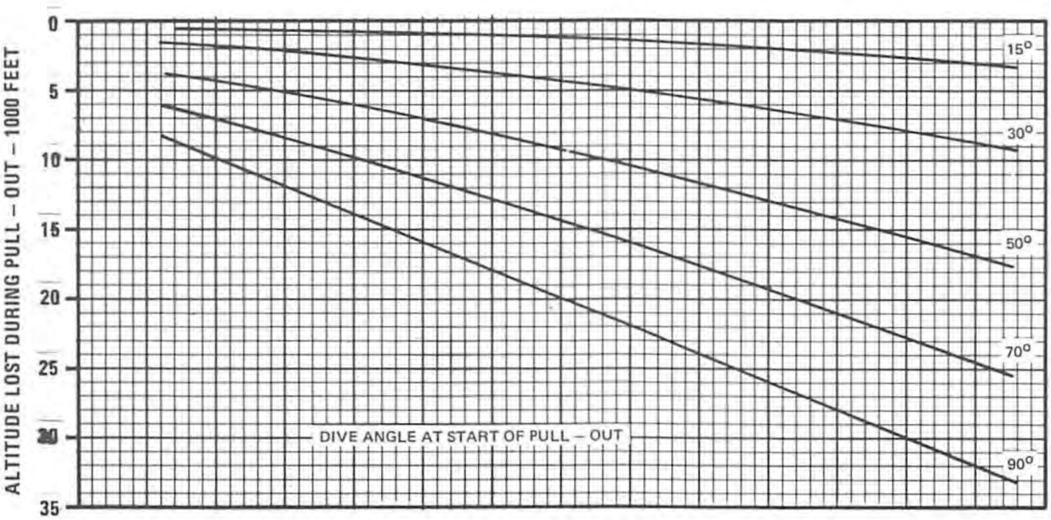
DATE: 1 MARCH 1979
DATA BASIS: **FLIGHT TEST**

GUIDE



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





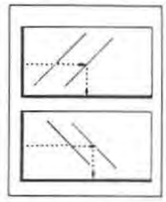
FDD-1-(402)

Figure 36-12. Dive Recovery – 25 Units AOA (Sheet 2 of 2)

CONSTANT SPEED AND ALTITUDE

REMARKS
ENGINE(S): (2)J79–GE–10B
ICAO STANDARD DAY

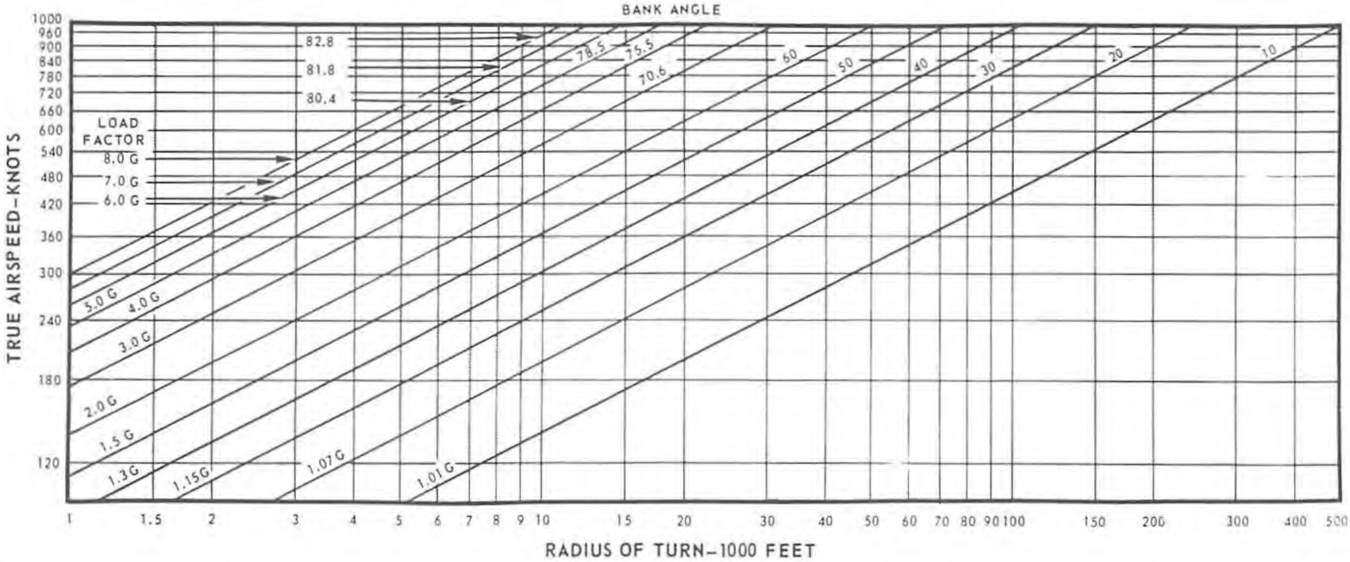
GUIDE



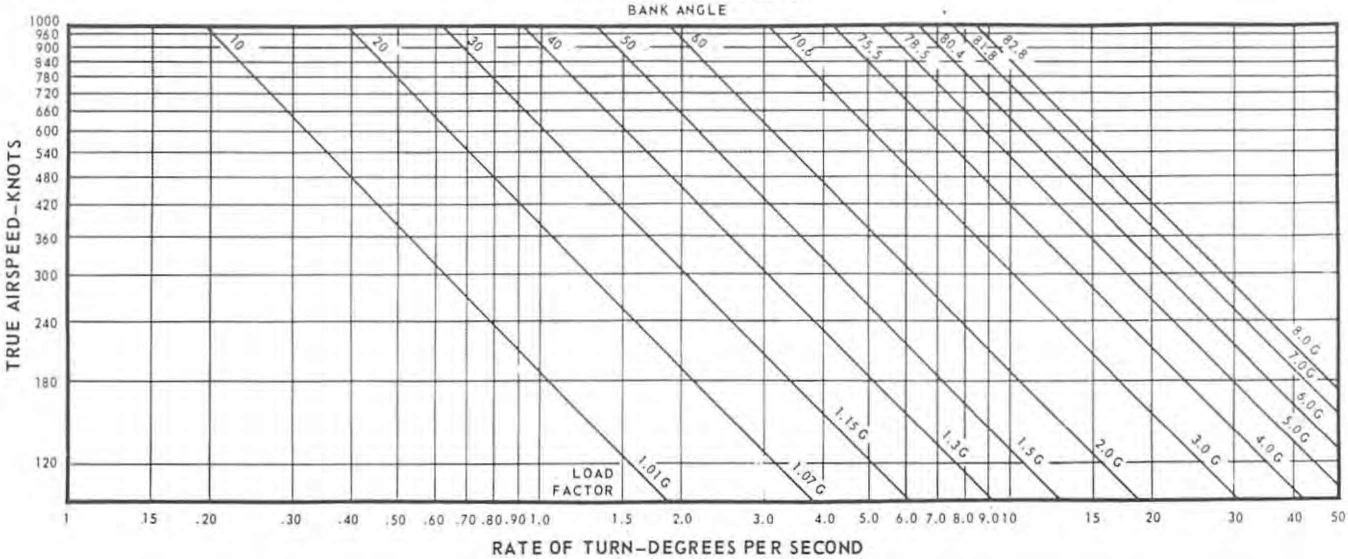
DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5LB GAL

RADIUS OF TURN



RATE OF TURN



FDD–1–(403)

Figure 36-13. Turn Capabilities

INDEX

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M

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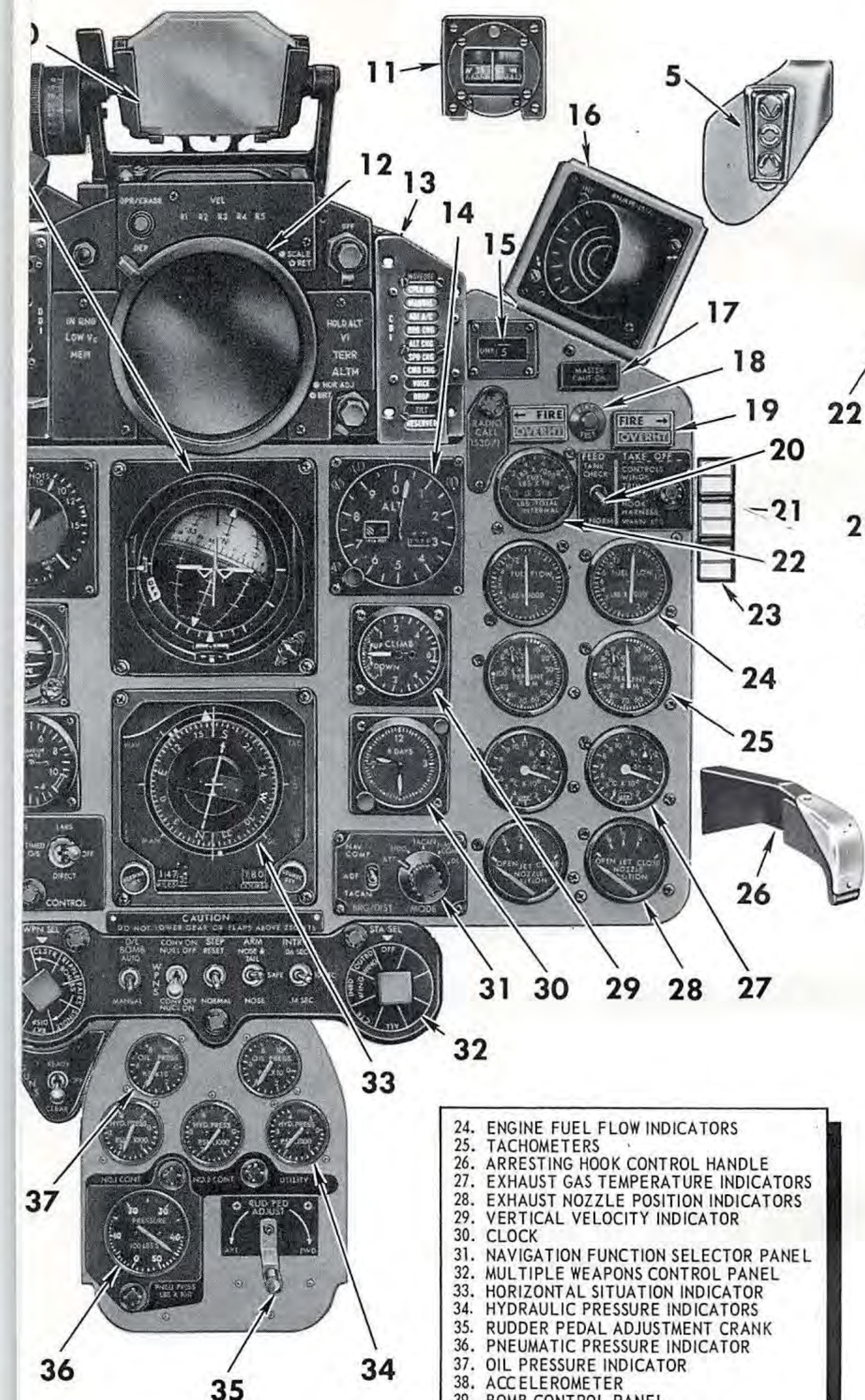
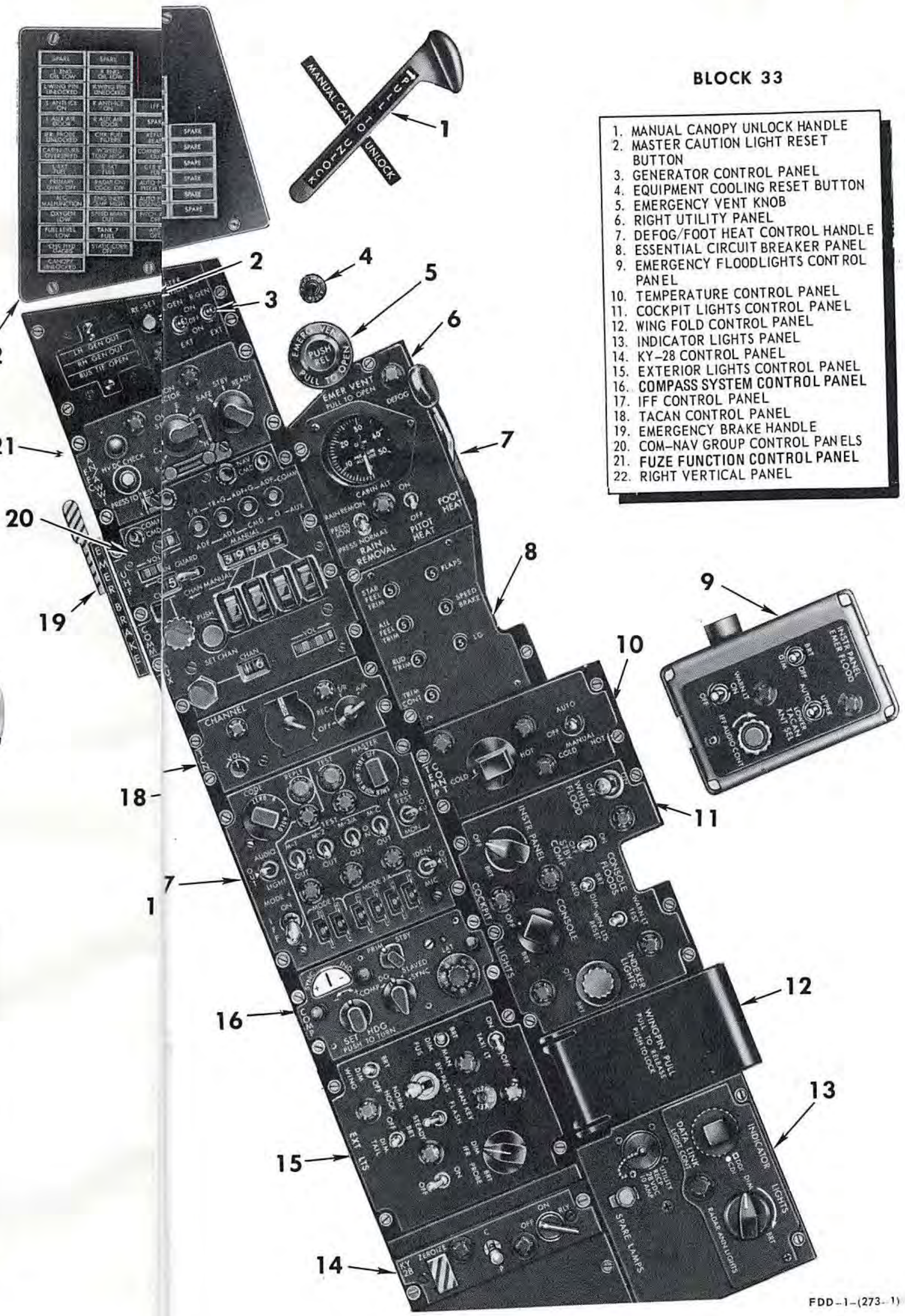


24. ENGINE FUEL FLOW INDICATORS
25. TACHOMETERS
26. ARRESTING HOOK CONTROL HANDLE
27. EXHAUST GAS TEMPERATURE INDICATORS
28. EXHAUST NOZZLE POSITION INDICATORS
29. VERTICAL VELOCITY INDICATOR
30. CLOCK
31. NAVIGATION FUNCTION SELECTOR PANEL
32. MULTIPLE WEAPONS CONTROL PANEL
33. HORIZONTAL SITUATION INDICATOR
34. HYDRAULIC PRESSURE INDICATORS
35. RUDDER PEDAL ADJUSTMENT CRANK
36. PNEUMATIC PRESSURE INDICATOR
37. OIL PRESSURE INDICATOR
38. ACCELEROMETER
39. BOMB CONTROL PANEL
40. STANDBY ATTITUDE INDICATOR
41. MISSILE CONTROL PANEL
42. MISSILE STATUS PANEL
43. LANDING GEAR CONTROL HANDLE
44. ELECTRONIC (RADAR) ALTIMETER
45. LANDING CHECKLIST
46. LOW ALTITUDE WARNING LIGHT

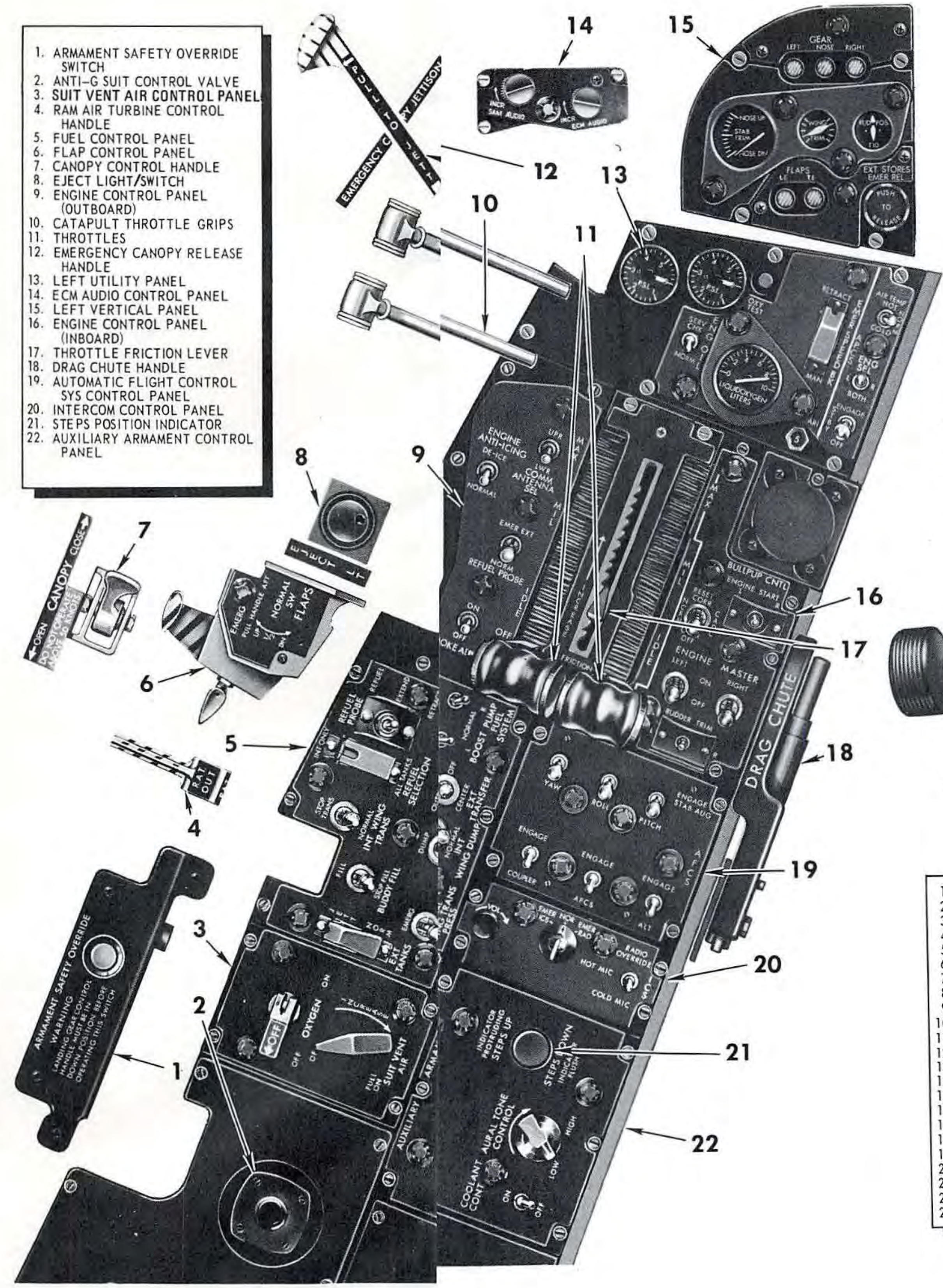


BLOCK 33

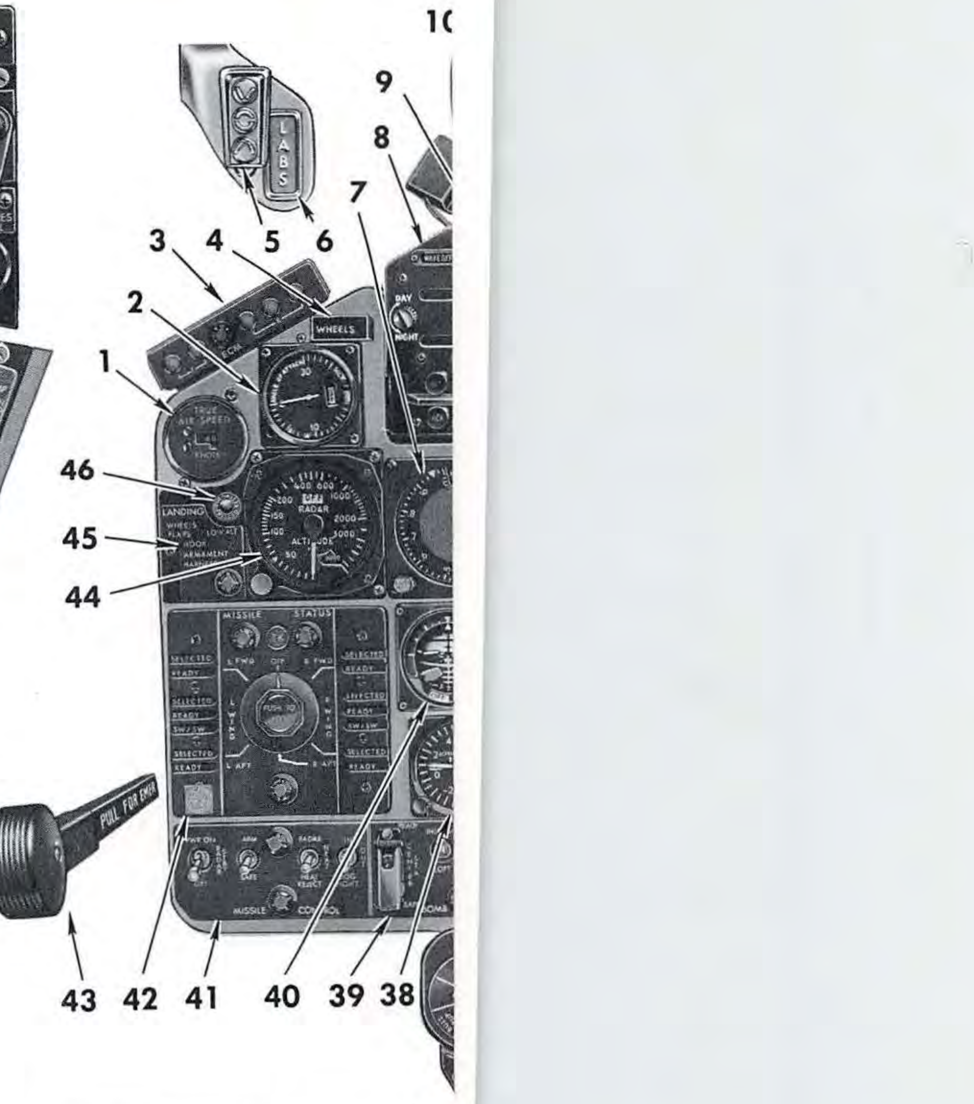
1. MANUAL CANOPY UNLOCK HANDLE
2. MASTER CAUTION LIGHT RESET BUTTON
3. GENERATOR CONTROL PANEL
4. EQUIPMENT COOLING RESET BUTTON
5. EMERGENCY VENT KNOB
6. RIGHT UTILITY PANEL
7. DEFOG/FOOT HEAT CONTROL HANDLE
8. ESSENTIAL CIRCUIT BREAKER PANEL
9. EMERGENCY FLOODLIGHTS CONTROL PANEL
10. TEMPERATURE CONTROL PANEL
11. COCKPIT LIGHTS CONTROL PANEL
12. WING FOLD CONTROL PANEL
13. INDICATOR LIGHTS PANEL
14. KY-28 CONTROL PANEL
15. EXTERIOR LIGHTS CONTROL PANEL
16. **COMPASS SYSTEM CONTROL PANEL**
17. IFF CONTROL PANEL
18. TACAN CONTROL PANEL
19. EMERGENCY BRAKE HANDLE
20. COM-NAV GROUP CONTROL PANELS
21. **FUZE FUNCTION CONTROL PANEL**
22. RIGHT VERTICAL PANEL

FDD-1-(273-1)

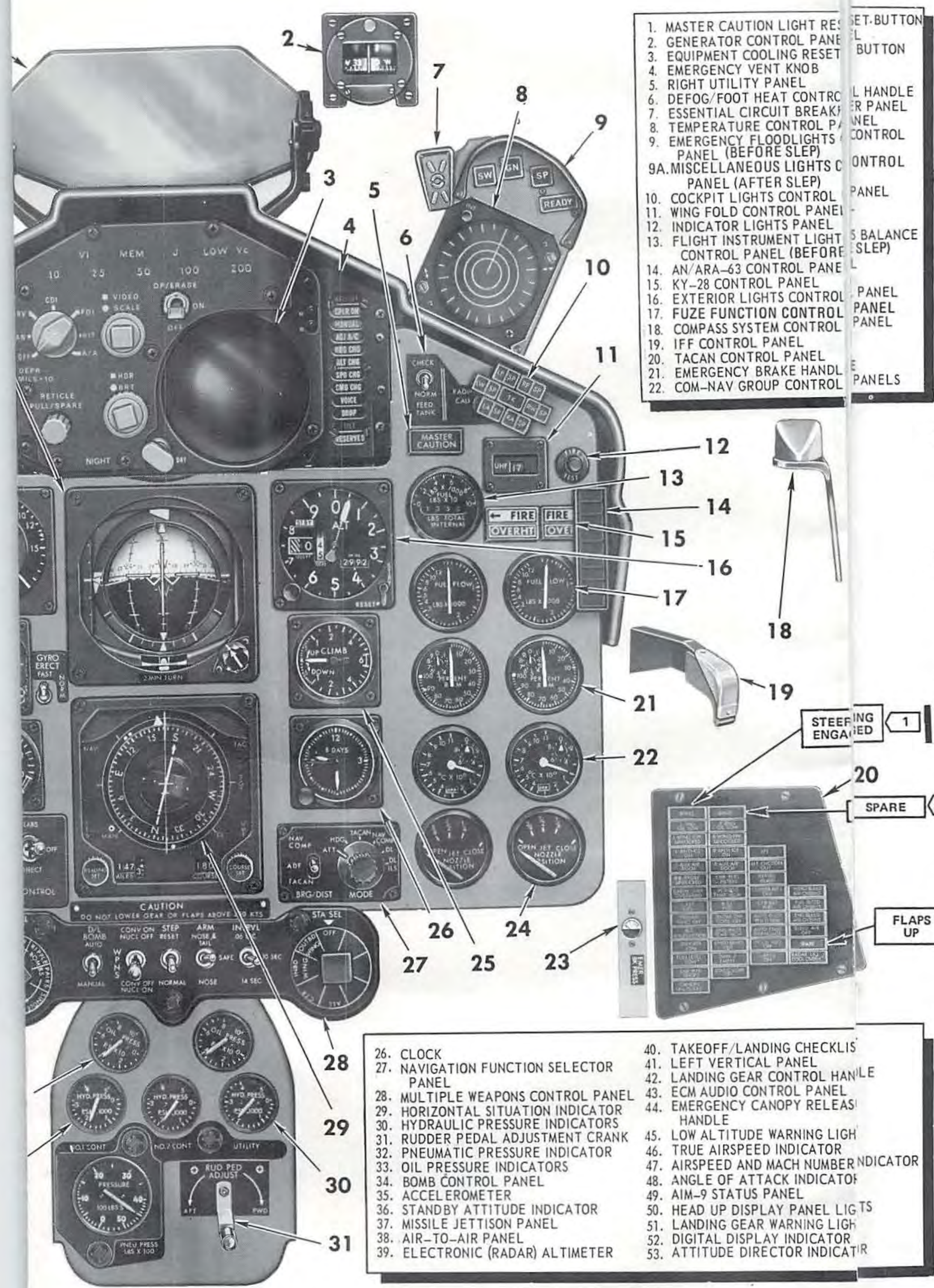
Figure FO-1. Front Cockpit – Typical (Sheet 1 of 3)



1. ARMAMENT SAFETY OVERRIDE SWITCH
2. ANTI-G SUIT CONTROL VALVE
3. SUIT VENT AIR CONTROL PANEL
4. RAM AIR TURBINE CONTROL HANDLE
5. FUEL CONTROL PANEL
6. FLAP CONTROL PANEL
7. CANOPY CONTROL HANDLE
8. EJECT LIGHT/SWITCH
9. ENGINE CONTROL PANEL (OUTBOARD)
10. CATAPULT THROTTLE GRIPS
11. THROTTLES
12. EMERGENCY CANOPY RELEASE HANDLE
13. LEFT UTILITY PANEL
14. ECM AUDIO CONTROL PANEL
15. LEFT VERTICAL PANEL
16. ENGINE CONTROL PANEL (INBOARD)
17. THROTTLE FRICTION LEVER
18. DRAG CHUTE HANDLE
19. AUTOMATIC FLIGHT CONTROL SYS CONTROL PANEL
20. INTERCOM CONTROL PANEL
21. STEPS POSITION INDICATOR
22. AUXILIARY ARMAMENT CONTROL PANEL



1. TRUE AIRSPEED INDICATOR
2. ANGLE OF ATTACK INDICATOR
3. INDICATOR LIGHTS PANEL
4. LANDING GEAR WARNING LIGHT
5. ANGLE OF ATTACK INDEXER LIGHTS
6. LABS PULL-UP LIGHT
7. AIRSPEED AND MACH NUMBER INDICATOR
8. DIGITAL DISPLAY INDICATOR
9. ATTITUDE DIRECTOR INDICATOR
10. OPTICAL SIGHT UNIT
11. MAGNETIC COMPASS
12. RADAR SCOPE
13. COMMAND DISPLAY INDICATOR
14. ALTIMETER
15. UHF REMOTE CHANNEL INDICATOR
16. AN/APR-25 STROBE DISPLAY SCOPE
17. MASTER CAUTION LIGHT
18. FIRE DETECTOR CHECK SWITCH
19. FIRE WARNING LIGHTS
20. FEED TANK CHECK SWITCH
21. TAKEOFF CHECKLIST
22. FUEL QUANTITY INDICATOR
23. ECM WARNING LIGHTS



1. MASTER CAUTION LIGHT RESET-BUTTON
2. GENERATOR CONTROL PANEL
3. EQUIPMENT COOLING RESET BUTTON
4. EMERGENCY VENT KNOB
5. RIGHT UTILITY PANEL
6. DEFOG/FOOT HEAT CONTROL HANDLE
7. ESSENTIAL CIRCUIT BREAKER PANEL
8. TEMPERATURE CONTROL PANEL
9. EMERGENCY FLOODLIGHTS CONTROL PANEL (BEFORE SLEP)
9A. MISCELLANEOUS LIGHTS CONTROL PANEL (AFTER SLEP)
10. COCKPIT LIGHTS CONTROL PANEL
11. WING FOLD CONTROL PANEL
12. INDICATOR LIGHTS PANEL
13. FLIGHT INSTRUMENT LIGHTS BALANCE CONTROL PANEL (BEFORE SLEP)
14. AN/ARA-63 CONTROL PANEL
15. KY-28 CONTROL PANEL
16. EXTERIOR LIGHTS CONTROL PANEL
17. FUZE FUNCTION CONTROL PANEL
18. COMPASS SYSTEM CONTROL PANEL
19. IFF CONTROL PANEL
20. TACAN CONTROL PANEL
21. EMERGENCY BRAKE HANDLE
22. COM-NAV GROUP CONTROL PANELS

26. CLOCK
27. NAVIGATION FUNCTION SELECTOR PANEL
28. MULTIPLE WEAPONS CONTROL PANEL
29. HORIZONTAL SITUATION INDICATOR
30. HYDRAULIC PRESSURE INDICATORS
31. RUDDER PEDAL ADJUSTMENT CRANK
32. PNEUMATIC PRESSURE INDICATOR
33. OIL PRESSURE INDICATORS
34. BOMB CONTROL PANEL
35. ACCELEROMETER
36. STANDBY ATTITUDE INDICATOR
37. MISSILE JETTISON PANEL
38. AIR-TO-AIR PANEL
39. ELECTRONIC (RADAR) ALTIMETER
40. TAKEOFF/LANDING CHECKLIST
41. LEFT VERTICAL PANEL
42. LANDING GEAR CONTROL HANDLE
43. ECM AUDIO CONTROL PANEL
44. EMERGENCY CANOPY RELEASE HANDLE
45. LOW ALTITUDE WARNING LIGHT
46. TRUE AIRSPEED INDICATOR
47. AIRSPEED AND MACH NUMBER INDICATOR
48. ANGLE OF ATTACK INDICATOR
49. AIM-9 STATUS PANEL
50. HEAD UP DISPLAY PANEL LIGHTS
51. LANDING GEAR WARNING LIGHT
52. DIGITAL DISPLAY INDICATOR
53. ATTITUDE DIRECTOR INDICATOR

1 AFTER AFC 650

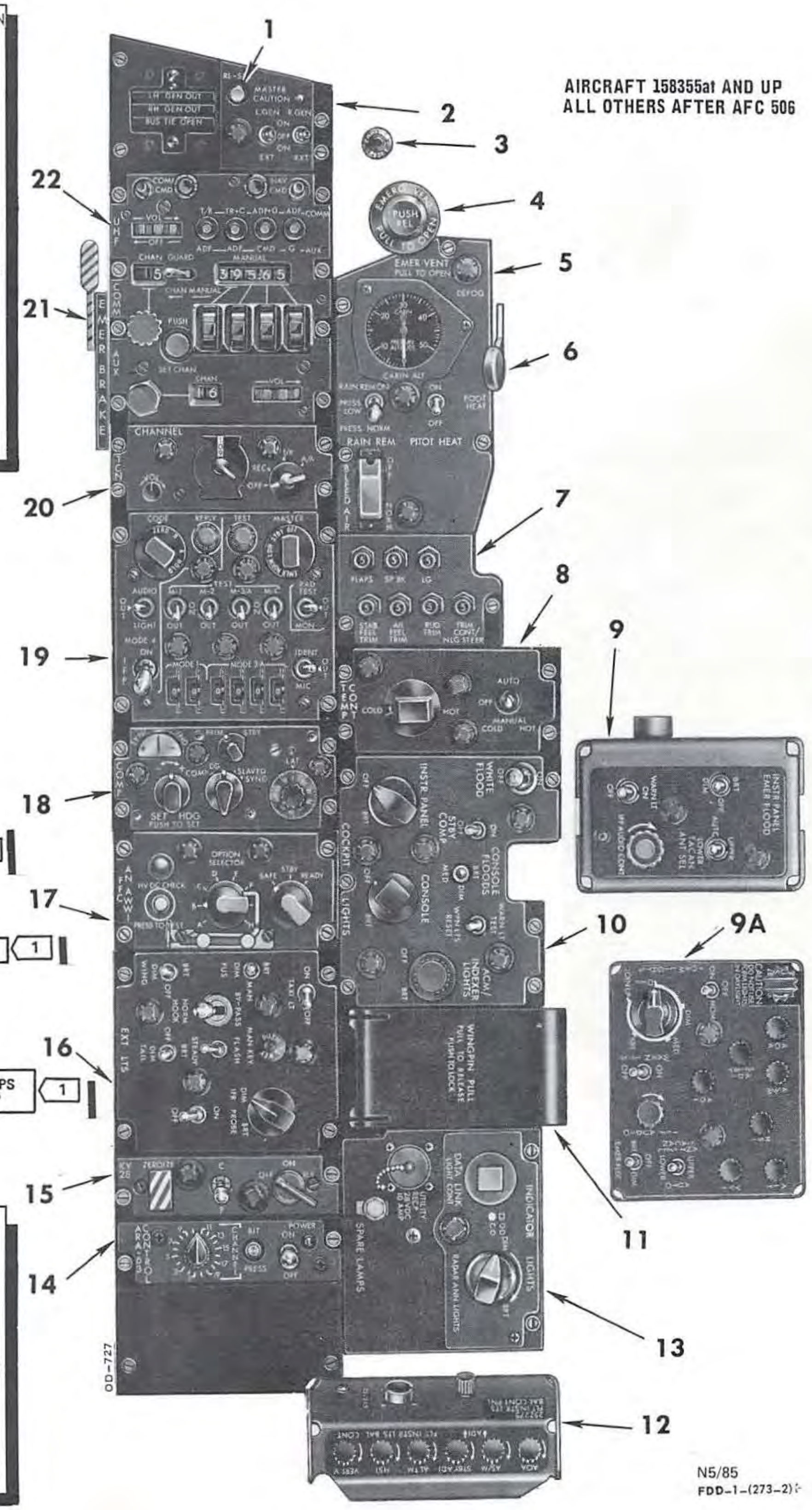


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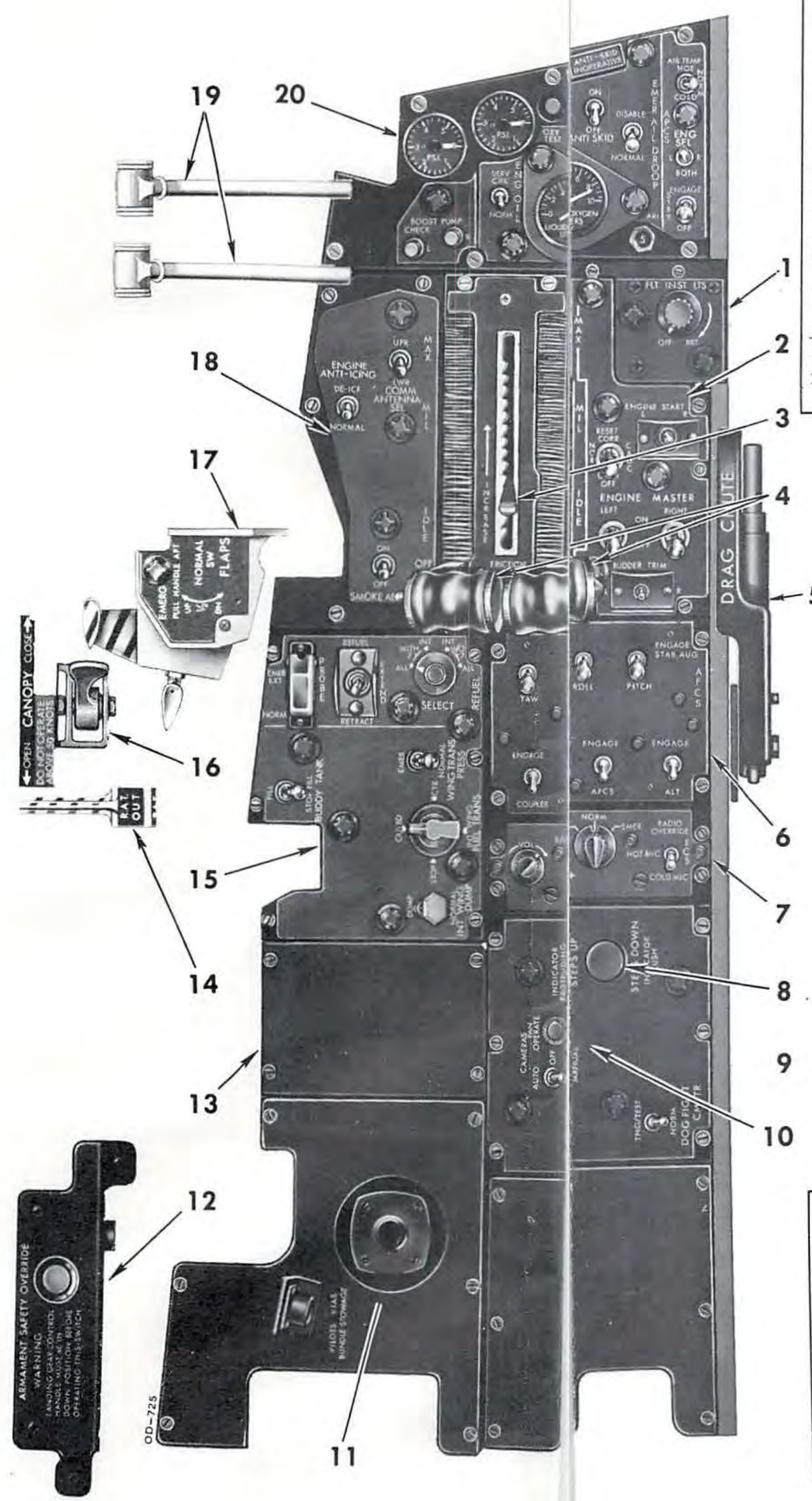
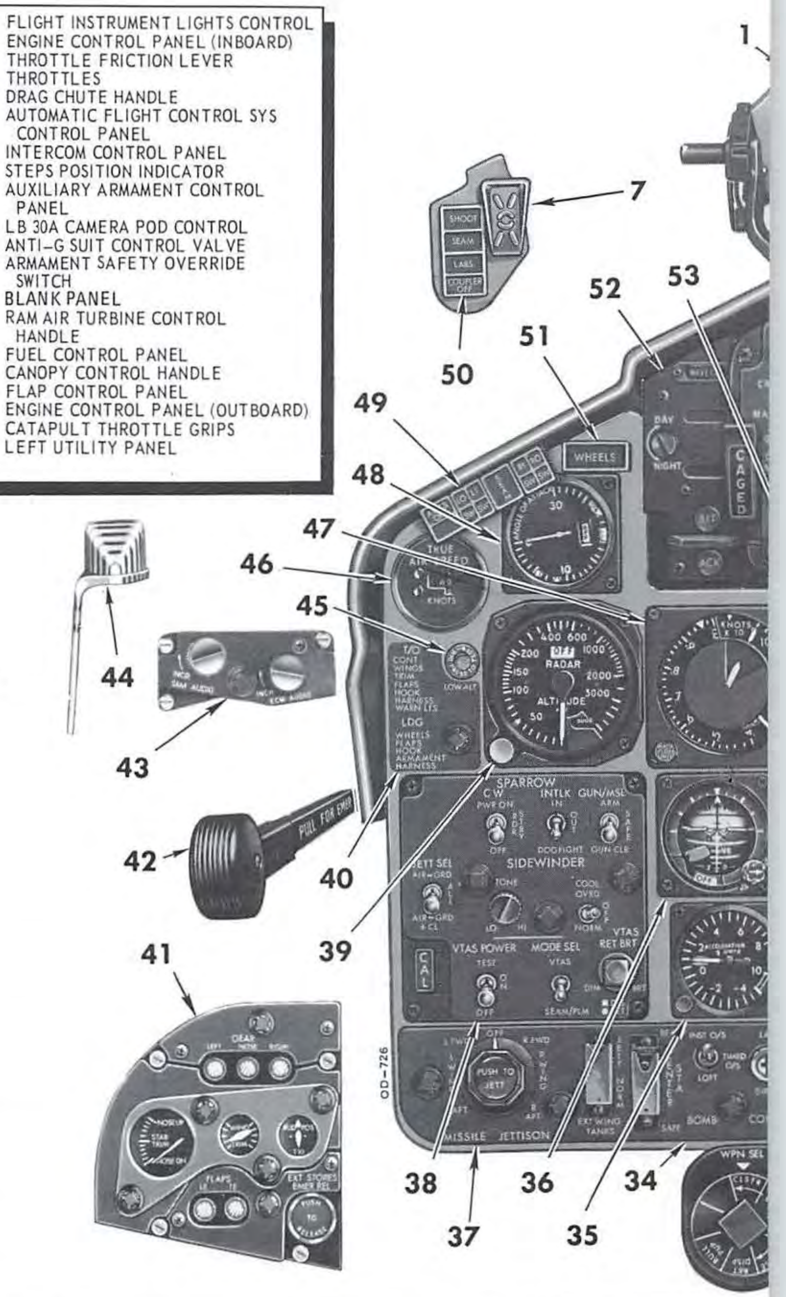
Figure FO-1. Front Cockpit – Typical (Sheet 2 of 3)



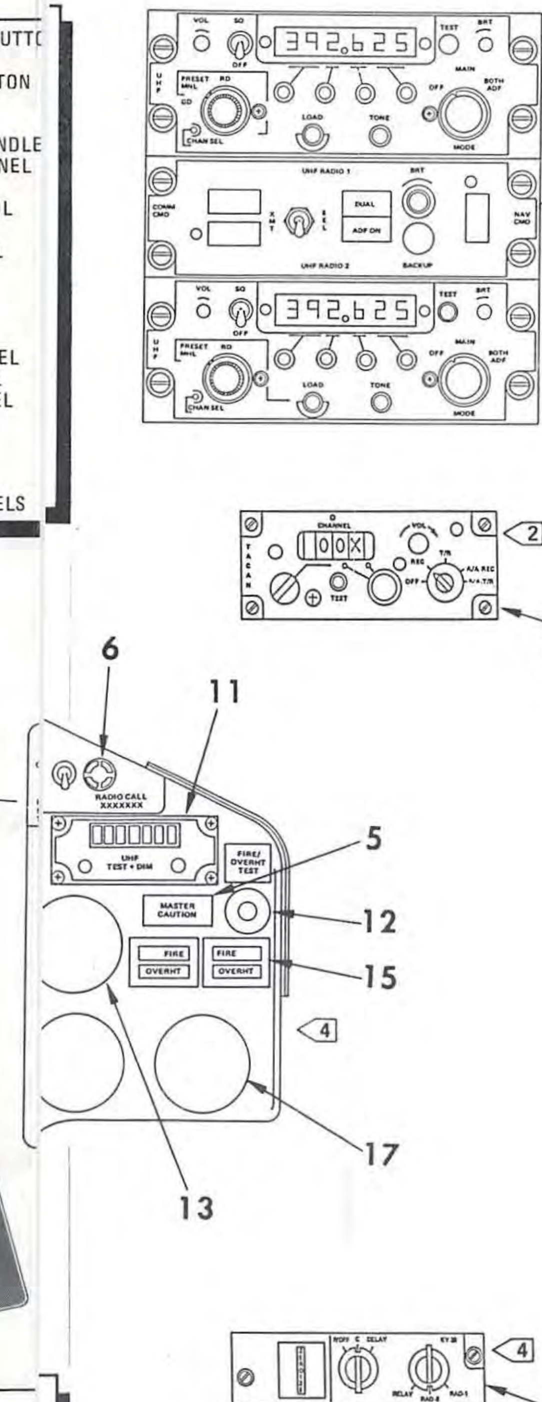
1. FLIGHT INSTRUMENT LIGHTS CONTROL
2. ENGINE CONTROL PANEL (INBOARD)
3. THROTTLE FRICTION LEVER
4. THROTTLES
5. DRAG CHUTE HANDLE
6. AUTOMATIC FLIGHT CONTROL SYS CONTROL PANEL
7. INTERCOM CONTROL PANEL
8. STEPS POSITION INDICATOR
9. AUXILIARY ARMAMENT CONTROL PANEL
10. LB 30A CAMERA POD CONTROL
11. ANTI-G SUIT CONTROL VALVE
12. ARMAMENT SAFETY OVERRIDE SWITCH
13. BLANK PANEL
14. RAM AIR TURBINE CONTROL HANDLE
15. FUEL CONTROL PANEL
16. CANOPY CONTROL HANDLE
17. FLAP CONTROL PANEL
18. ENGINE CONTROL PANEL (OUTBOARD)
19. CATAPULT THROTTLE GRIPS
20. LEFT UTILITY PANEL

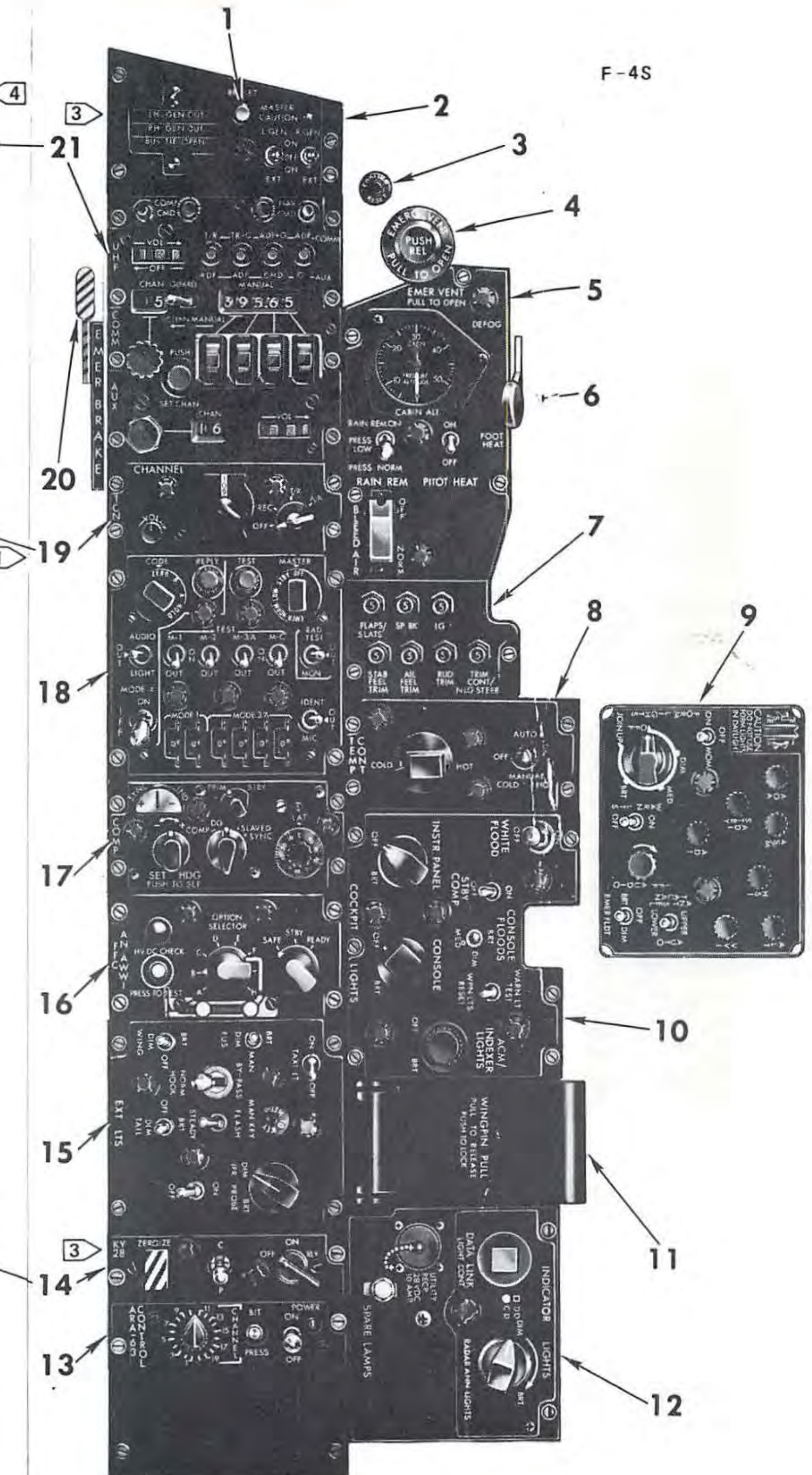


1. OPTICAL SIGHT UNIT
2. MAGNETIC COMPASS
3. RADAR SCOPE
4. COMMAND DISPLAY INDICATOR
5. MASTER CAUTION LIGHT
6. FEED TANK CHECK SWITCH
7. ANGLE OF ATTACK INDEXER LIGHTS
8. STROBE DISPLAY SCOPE
9. WEAPON STATUS PANEL
10. AIM-7 STATUS PANEL
11. UHF REMOTE CHANNEL
12. FIRE DETECTOR CHECK SWITCH
13. FUEL QUANTITY INDICATOR
14. ECM WARNING LIGHTS
15. FIRE WARNING LIGHTS
16. ALTIMETER
17. ENGINE FUEL FLOW INDICATORS
18. MANUAL CANOPY UNLOCK HANDLE
19. ARRESTING HOOK CONTROL HANDLE
20. RIGHT VERTICAL PANEL
21. TACHOMETERS
22. EXHAUST GAS TEMPERATURE INDICATORS
23. EMERGENCY BRAKE PRESSURE INDICATOR
24. EXHAUST NOZZLE POSITION INDICATORS
25. VERTICAL VELOCITY INDICATOR

1. MASTER CAUTION LIGHT RESET BUTTC
2. GENERATOR CONTROL PANEL
3. EQUIPMENT COOLING RESET BUTTON
4. EMERGENCY VENT KNOB
5. RIGHT UTILITY PANEL
6. DEFOG/FOOT HEAT CONTROL HANDLE
7. ESSENTIAL CIRCUIT BREAKER PANEL
8. TEMPERATURE CONTROL PANEL
9. MISCELLANEOUS LIGHTS CONTROL PANEL
10. COCKPIT LIGHTS CONTROL PANEL
11. WING FOLD CONTROL PANEL
12. INDICATOR LIGHTS PANEL
13. AN/ARA-63 CONTROL PANEL
14. KY-28 CONTROL PANEL
15. EXTERIOR LIGHTS CONTROL PANEL
16. FUZE FUNCTION CONTROL PANEL
17. COMPASS SYSTEM CONTROL PANEL
18. IFF CONTROL PANEL
19. TACAN CONTROL PANEL 1
    TACAN CONTROL PANEL 2
20. EMERGENCY BRAKE HANDLE
21. COM-NAV GROUP CONTROL PANELS

27. NAVIGATION FUNCTION SELECTOR PANEL
28. MULTIPLE WEAPONS CONTROL PANEL
29. HORIZONTAL SITUATION INDICATOR
30. HYDRAULIC PRESSURE INDICATORS
31. RUDDER PEDAL ADJUSTMENT CRANK
32. PNEUMATIC PRESSURE INDICATOR
33. OIL PRESSURE INDICATORS
34. BOMB CONTROL PANEL
35. ACCELEROMETER
36. STANDBY ATTITUDE INDICATOR
37. MISSILE JETTISON PANEL
38. AIR-TO-AIR PANEL
39. ELECTRONIC (RADAR) ALTIMETER
40. TAKEOFF/LANDING CHECKLIST
41. LEFT VERTICAL PANEL
42. LANDING GEAR CONTROL HANDLE
43. ECM AUDIO CONTROL PANEL
44. EMERGENCY CANOPY RELEASE HANDLE
45. LOW ALTITUDE WARNING LIGHT
46. TRUE AIRSPEED INDICATOR
47. AIRSPEED AND MACH NUMBER INDICA
48. ANGLE OF ATTACH INDICATOR
49. AIM-9 STATUS PANEL
50. HEAD UP DISPLAY PANEL LIGHTS
51. LANDING GEAR WARNING LIGHT
52. DIGITAL DISPLAY INDICATOR
53. ATTITUDE DIRECTOR INDICATOR





F-4S

1 153768 & UP BEFORE AFC 647
2 153768 & UP AFTER AFC 647
3 F-4S BEFORE AFC 660
4 F-4S AFTER AFC 660

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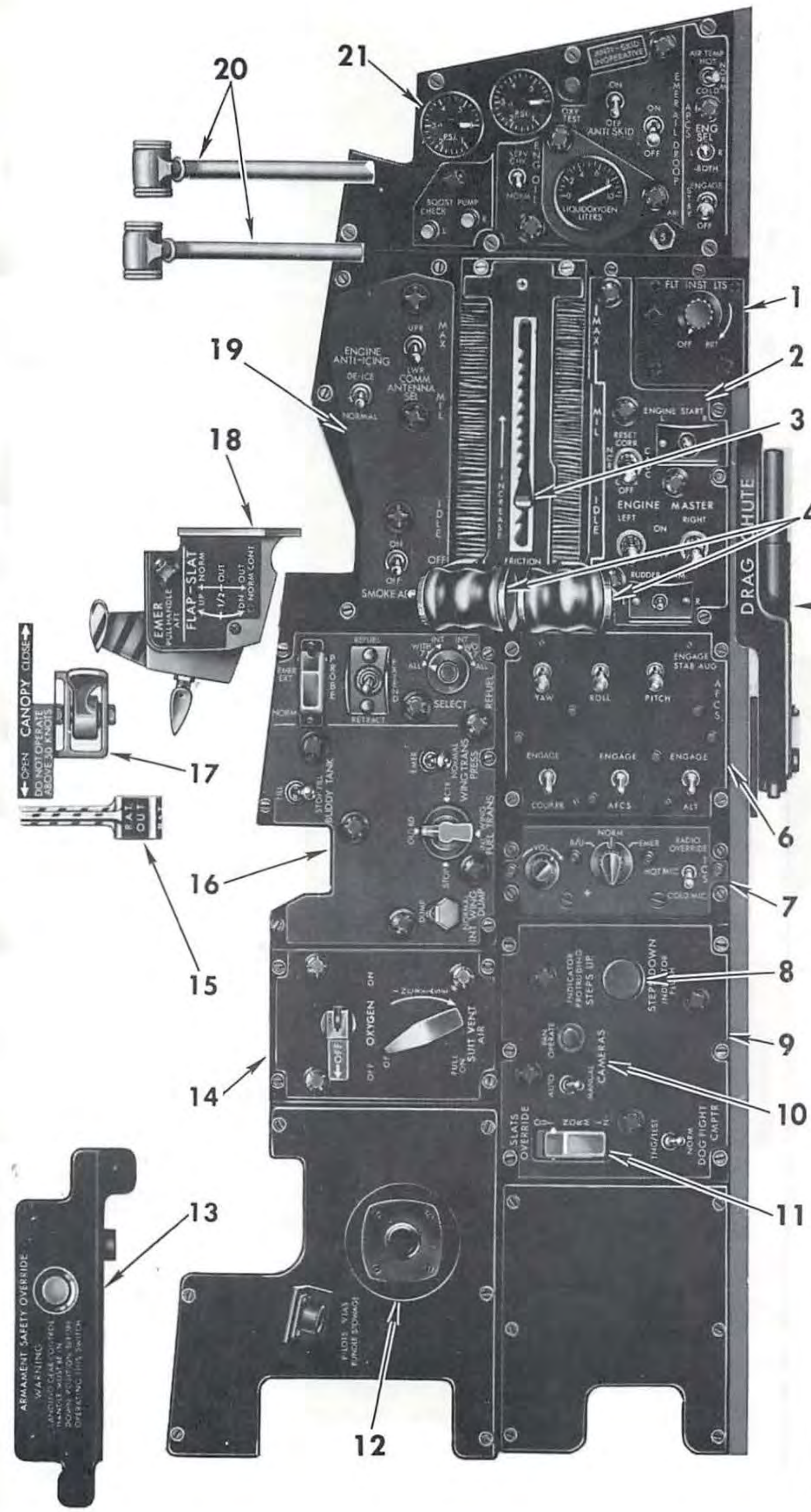
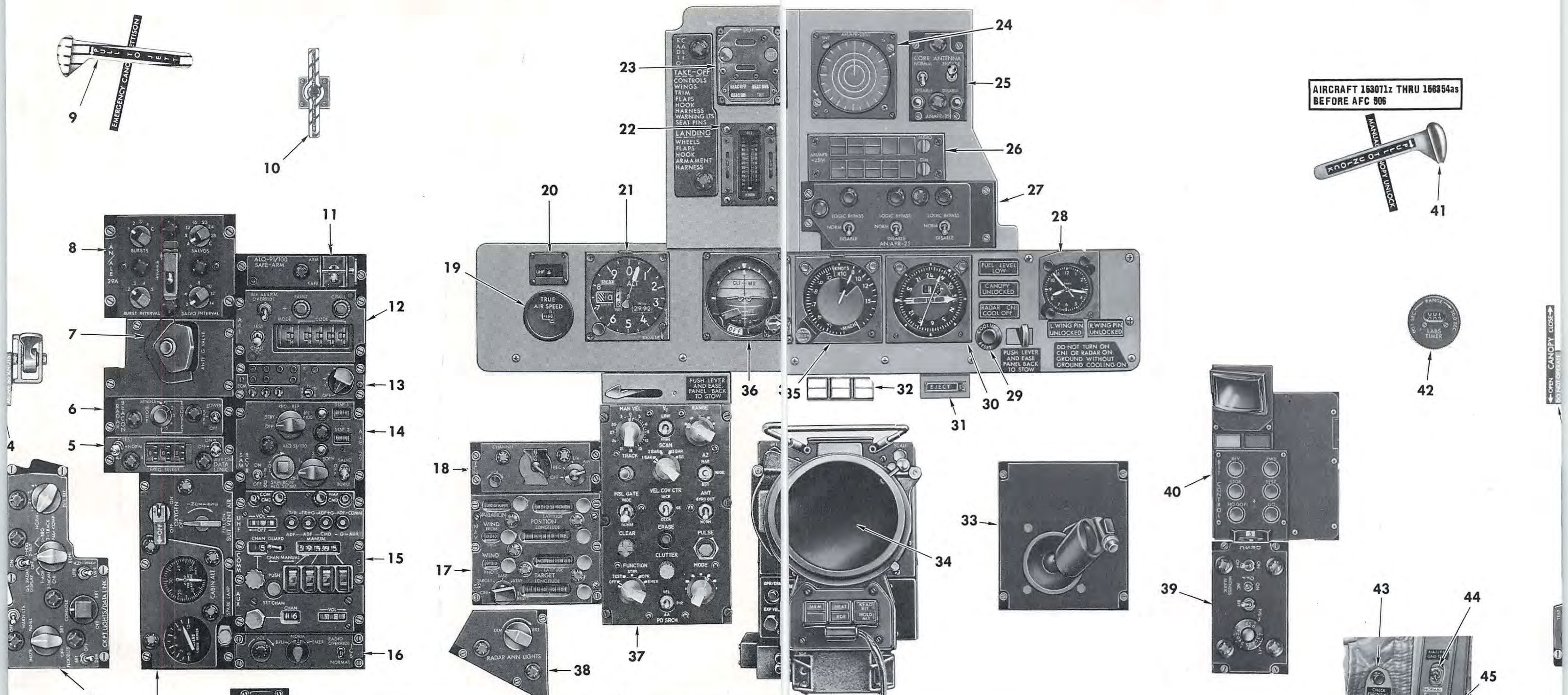
Figure FO-1. Front Cockpit – Typical (Sheet 3 of 3)



1. FLIGHT INSTRUMENT LIGHTS CONTROL
2. ENGINE CONTROL PANEL (INBOARD)
3. THROTTLE FRICTION LEVER
4. THROTTLES
5. DRAG CHUTE HANDLE
6. AUTOMATIC FLIGHT CONTROL SYS CONTROL PANEL
7. INTERCOM CONTROL PANEL
8. STEPS POSITION INDICATOR
9. AUXILIARY ARMAMENT CONTROL PANEL
10. LB 30A CAMERA POD CONTROL
11. SLATS OVERRIDE SWITCH
12. ANTI–G SUIT CONTROL VALVE
13. ARMAMENT SAFETY OVERRIDE SWITCH
14. SUIT VENT AIR CONTROL PANEL
15. RAM AIR TURBINE CONTROL HANDLE
16. FUEL CONTROL PANEL
17. CANOPY CONTROL HANDLE
18. FLAPS/SLATS CONTROL PANEL
19. ENGINE CONTROL PANEL (OUTBOARD)
20. CATAPULT THROTTLE GRIPS
21. LEFT UTILITY PANEL

1. OPTICAL SIGHT UNIT
2. MAGNETIC COMPASS
3. RADAR SCOPE
4. COMMAND DISPLAY INDICATOR
5. MASTER CAUTION LIGHT
6. FEED TANK CHECK SWITCH
7. ANGLE OF ATTACH INDEXER LIGHTS
8. STROBE DISPLAY SCOPE
9. WEAPON STATUS PANEL
10. AIM–7 STATUS PANEL
11. UHF REMOTE CHANNEL
12. FIRE DETECTOR CHECK SWITCH
13. FUEL QUANTITY INDICATOR
14. ECM WARNING LIGHTS
15. FIRE WARNING LIGHTS
16. ALTIMETER
17. ENGINE FUEL FLOW INDICATO
18. MANUAL CANOPY UNLOCK HA
19. ARRESTING HOOK CONTROL H
20. RIGHT VERTICAL PANEL
21. TACHOMETERS
22. EXHAUST GAS TEMPERATURE INDICATORS
23. EMERGENCY BRAKE PRESSUR INDICATOR
24. EXHAUST NOZZLE POSITION INDICATORS
25. VERTICAL VELOCITY INDICAT
26. CLOCK



1. BOMB RELEASE ANGLE COMPUTER
2. UTILITY PANEL
3. COCKPIT LIGHTS DATA LINK CONTROL PANEL
4. CANOPY CONTROL HANDLE
5. COMMUNICATIONS SET CONTROL
6. AN/APN-154 RADAR BEACON CONTROL PANEL
7. ANTI-G VALVE
8. AN/ALE-29 DISPENSER PROGRAMMER
9. EMERGENCY CANOPY RELEASE HANDLE
10. COMMAND SELECTOR VALVE HANDLE
11. AN/ALQ-91/100 SAFE-ARM CONTROL PANEL
12. AN/APX-76 INTERROGATOR SET CONTROL PANEL
13. AN/ALQ-91 CONTROL-INDICATOR PANEL
14. INTEGRATED CONTROL PANEL
15. COMM-NAV GROUP CONTROL PANEL
16. INTERCOM CONTROL PANEL
17. NAVIGATION COMPUTER CONTROL PANEL
18. TACAN CONTROL PANEL
19. TRUE AIRSPEED INDICATOR
20. UHF REMOTE CHANNEL INDICATOR
21. ALTIMETER
22. COMMAND TARGET ALTITUDE INDICATOR
23. DIGITAL DISPLAY INDICATOR
24. AN/APR-25 STROBE DISPLAY SCOPE
25. AN/APR-25 ANT CORRELATION DISABLE PANEL
26. AN/APR-25 THREAT DISPLAY PANEL
27. AN/APR-25 BAND DISABLE PANEL
28. CLOCK
29. EQUIPMENT COOLING RESET BUTTON
30. BEARING-DISTANCE-HEADING INDICATOR
31. EJECT LIGHT
32. ECM WARNING LIGHTS PANEL
33. ANTENNA HAND CONTROL PANEL
34. RADAR SCOPE
35. AIRSPEED AND MACH INDICATOR
36. REMOTE ATTITUDE INDICATOR
37. RADAR SET CONTROL PANEL
38. RADAR ANNUNCIATOR LIGHTS CONTROL PANEL
39. DIRECT RADAR SCOPE CAMERA CONTROL PANEL
40. BIT PROGRAMMER
41. MANUAL CANOPY UNLOCK HANDLE
42. LABS TIMER
43. ESSENTIAL DC TEST BUTTON
44. IFF GROUND TEST SWITCH
45. AUTOPILOT GROUND POWER TEST SWITCH

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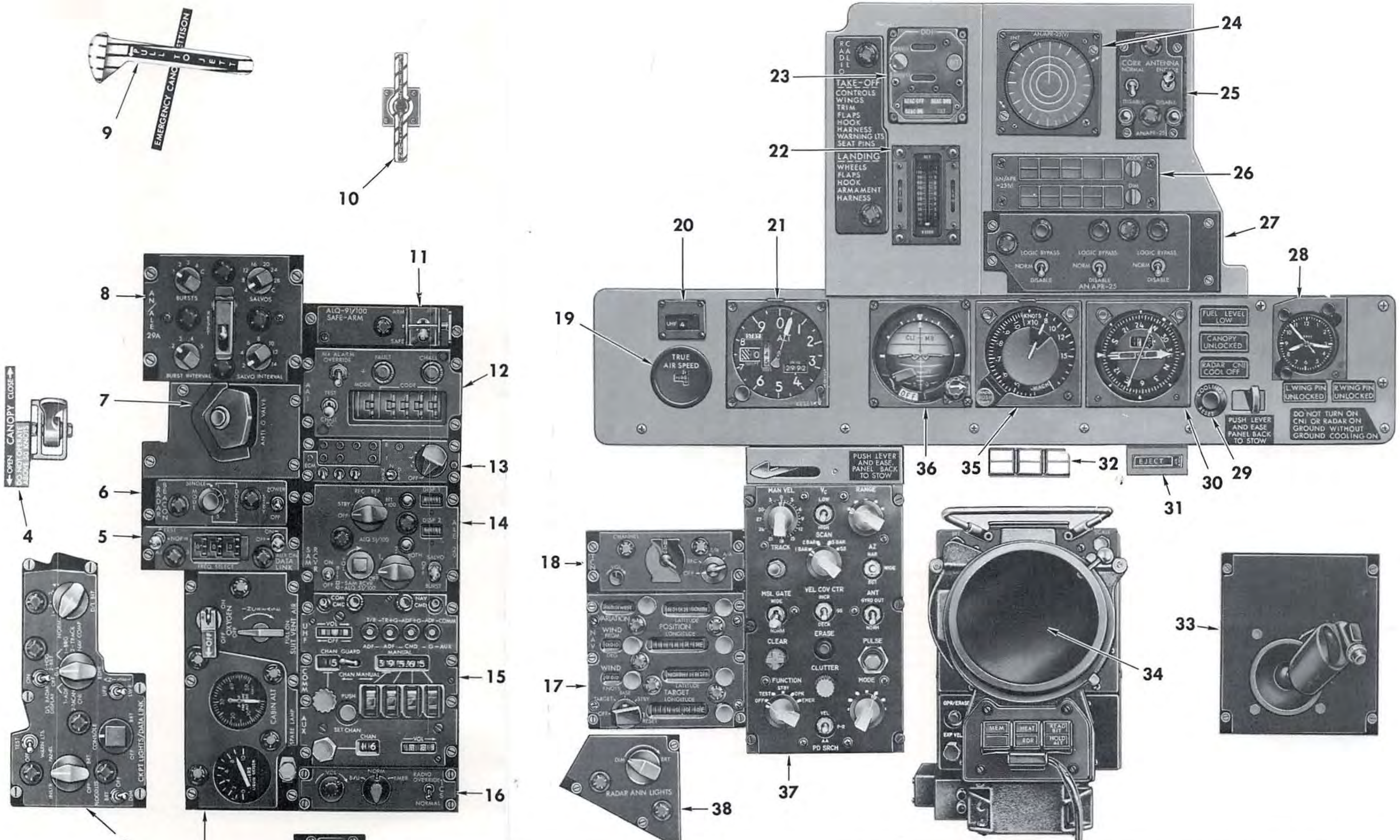
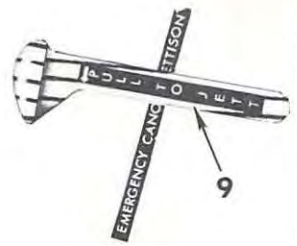
Figure FO-2. Rear Cockpit – Typical (Sheet 1 of 2)

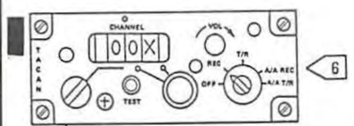


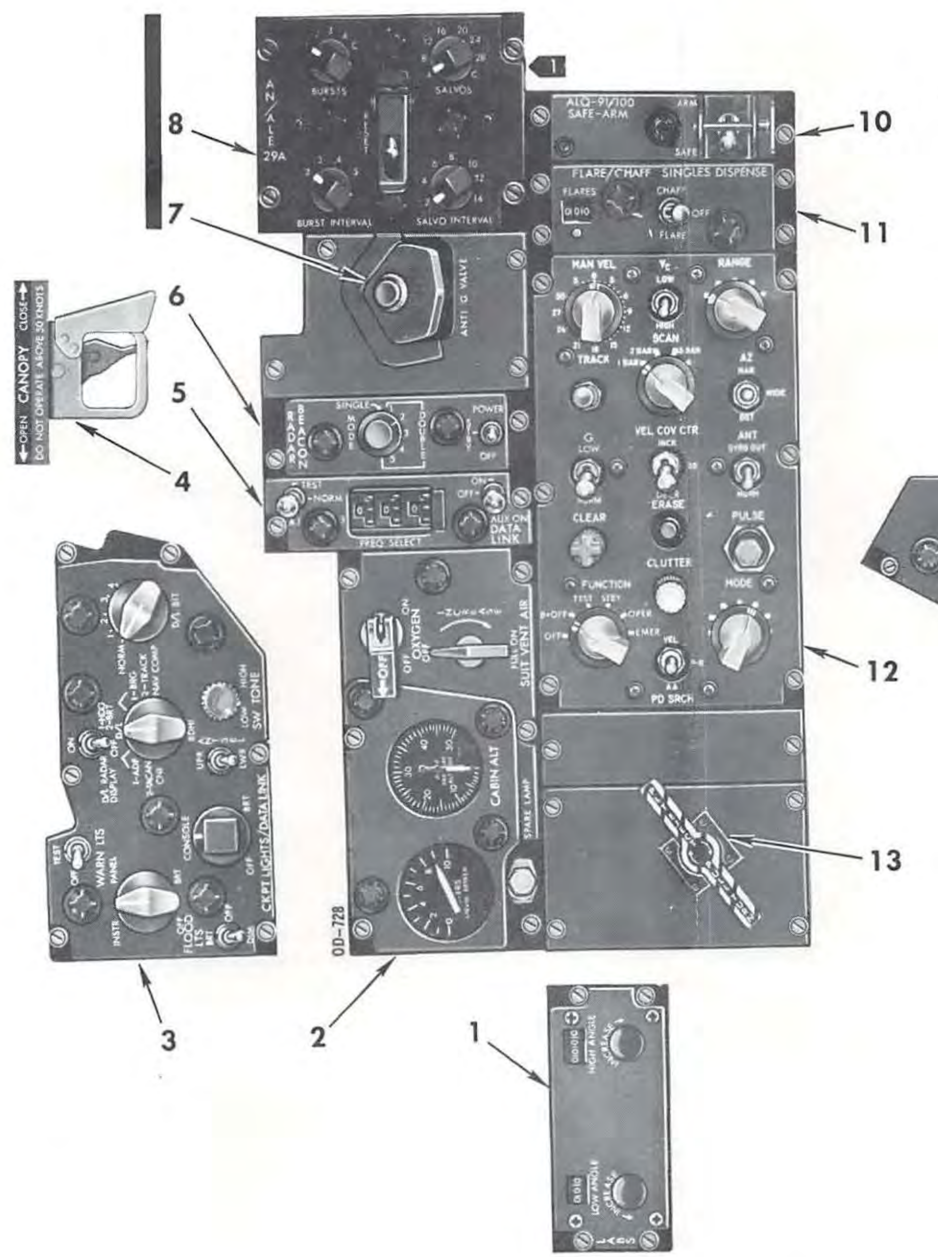
1. BOMB RELEASE ANGLE COMPUTER
2. UTILITY PANEL
3. COCKPIT LIGHTS/DATA LINK CONTROL PANEL
4. CANOPY CONTROL HANDLE
5. COMMUNICATIONS SET CONTROL
6. AN/APN-154 RADAR BEACON CONTROL PANEL
7. ANTI-G VALVE
8. AN/ALE-29 DISPENSER PROGRAMMER
9. EMERGENCY CANOPY RELEASE HANDLE
10. COMMAND SELECTOR VALVE HANDLE
11. AN/ALQ-91/100 SAFE-ARM CONTROL PANEL
12. AN/APX-76 INTERROGATOR SET CONTROL PANEL
13. AN/ALQ-91 CONTROL-INDICATOR PANEL
14. INTEGRATED CONTROL PANEL
15. COMM-NAV GROUP CONTROL PANEL
16. INTERCOM CONTROL PANEL
17. NAVIGATION COMPUTER CONTROL PANEL
18. TACAN CONTROL PANEL
19. TRUE AIRSPEED INDICATOR
20. UHF REMOTE CHANNEL INDICATOR
21. ALTIMETER
22. COMMAND TARGET ALTITUDE INDICATOR
23. DIGITAL DISPLAY INDICATOR
24. AN/APR-25 STROBE DISPLAY SCOPE
25. AN/APR-25 ANT CORRELATION DISABLE PANEL
26. AN/APR-25 THREAT DISPLAY PANEL
27. AN/APR-25 BAND DISABLE PANEL
28. CLOCK
29. EQUIPMENT COOLING RESET BUTTON
30. BEARING-DISTANCE-HEADING INDICATOR
31. EJECT LIGHT
32. ECM WARNING LIGHTS PANEL
33. ANTENNA HAND CONTROL PANEL
34. RADAR SCOPE
35. AIRSPEED AND MACH INDICATOR
36. REMOTE ATTITUDE INDICATOR
37. RADAR SET CONTROL PANEL
38. RADAR ANNUNCIATOR LIGHTS CONTROL PANEL
39. DIRECT RADAR SCOPE CAMERA CONTROL PANEL
40. BIT PROGRAMMER
41. MANUAL CANOPY UNLOCK HANDLE
42. LABS TIMER
43. ESSENTIAL DC TEST BUTTON
44. IFF GROUND TEST SWITCH
45. AUTOPILOT GROUND POWER TEST SWITCH

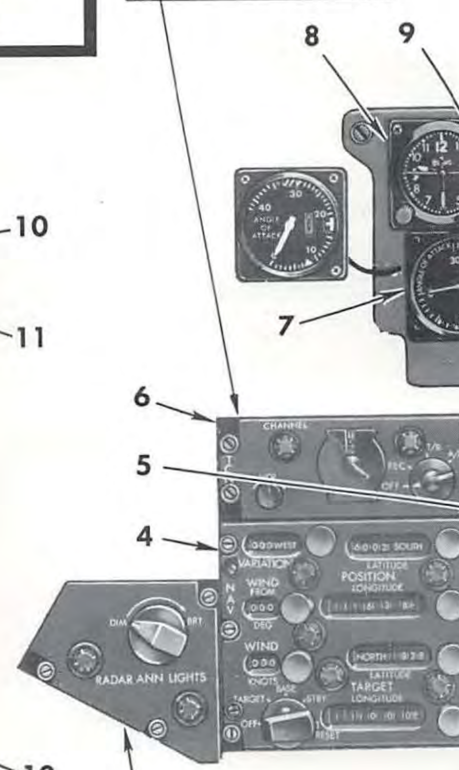
Figure FO-2. Rear Cock

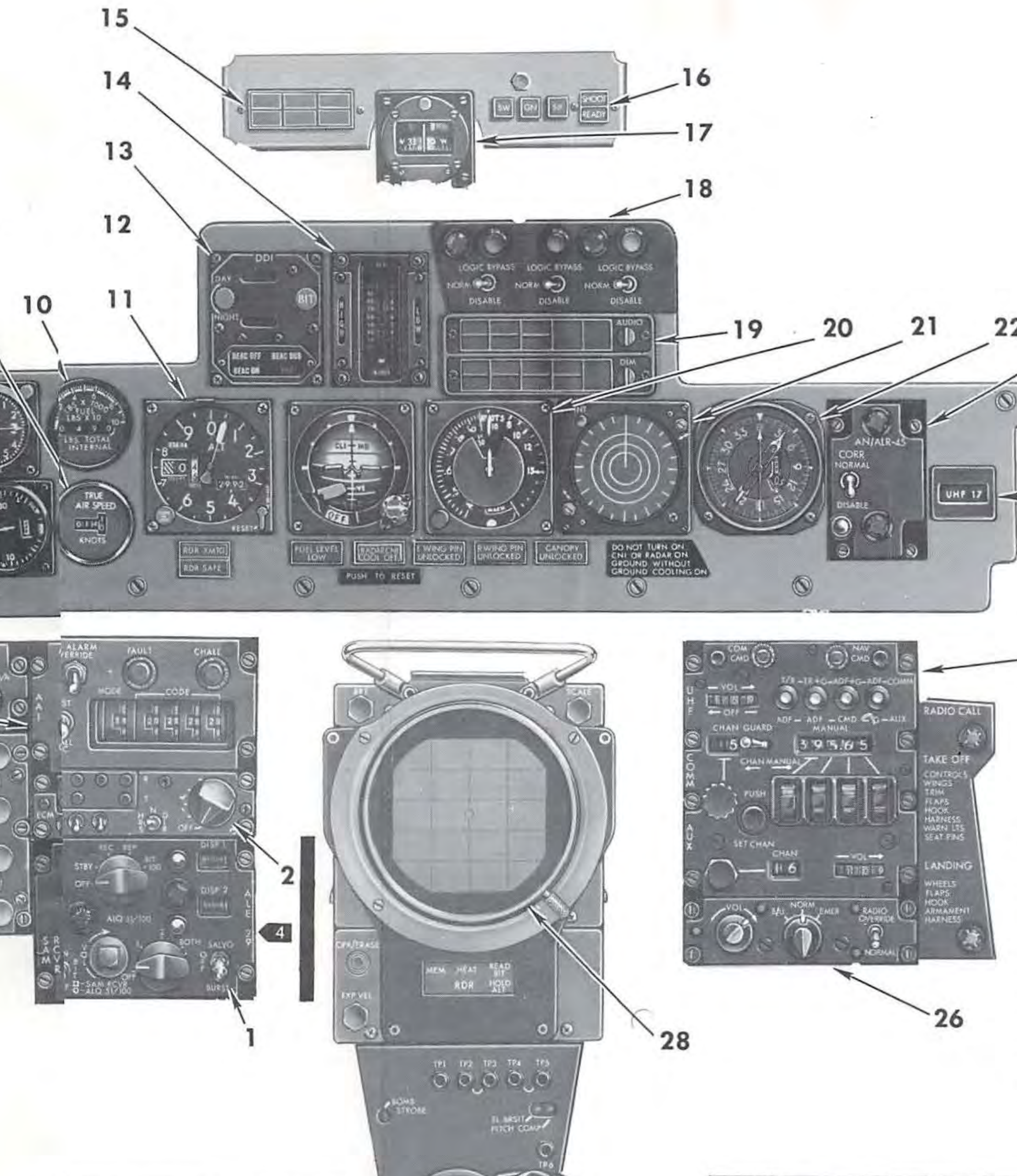


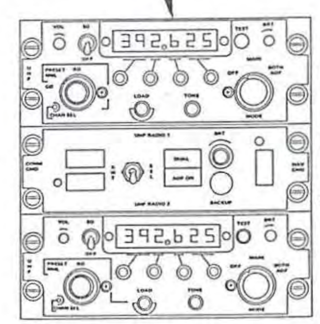
1. BOMB RELEASE ANGLE COMPUTER
2. UTILITY PANEL
3. COCKPIT LIGHTS/DATA LINK CONTROL PANEL
4. CANOPY CONTROL HANDLE
5. COMMUNICATIONS SET CONTROL
6. AN/APN-154 RADAR BEACON CONTROL PANEL
7. ANTI-G VALVE
8. AN/ALE-29 DISPENSER PROGRAMMER (F-4S; SOME F-4J) 1
9. EMERGENCY CANOPY RELEASE HANDLE
10. AN/ALQ-91/100 SAFE-ARM CONTROL PANEL
11. FLARE/CHAFF CONTROL PANEL (F-4S; SOME F-4J)
12. RADAR SET CONTROL PANEL
13. COMMAND SELECTOR VALVE HANDLE











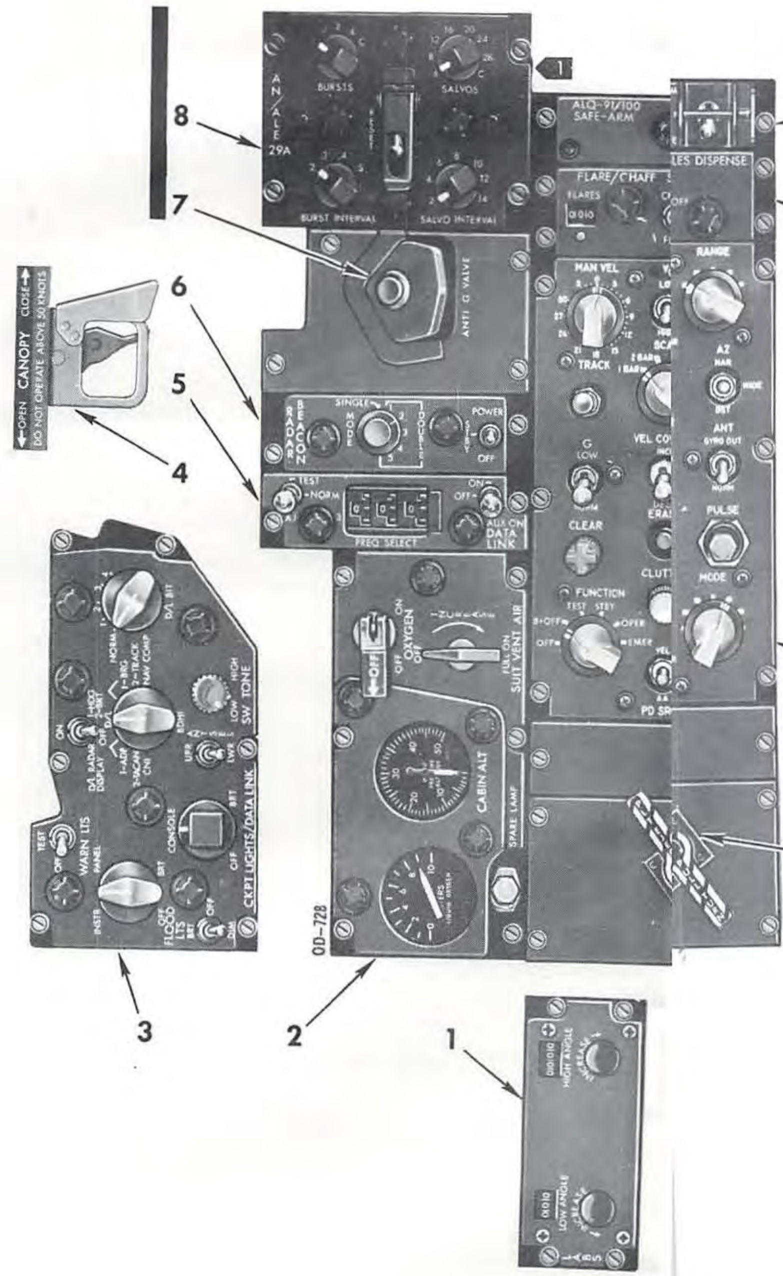
OD-728

1. TEST CONTR
2. LABS TIMER
3. MANUAL CAN
4. AUTOPILOT (
5. IFF GROUND
6. ESSENTIAL D

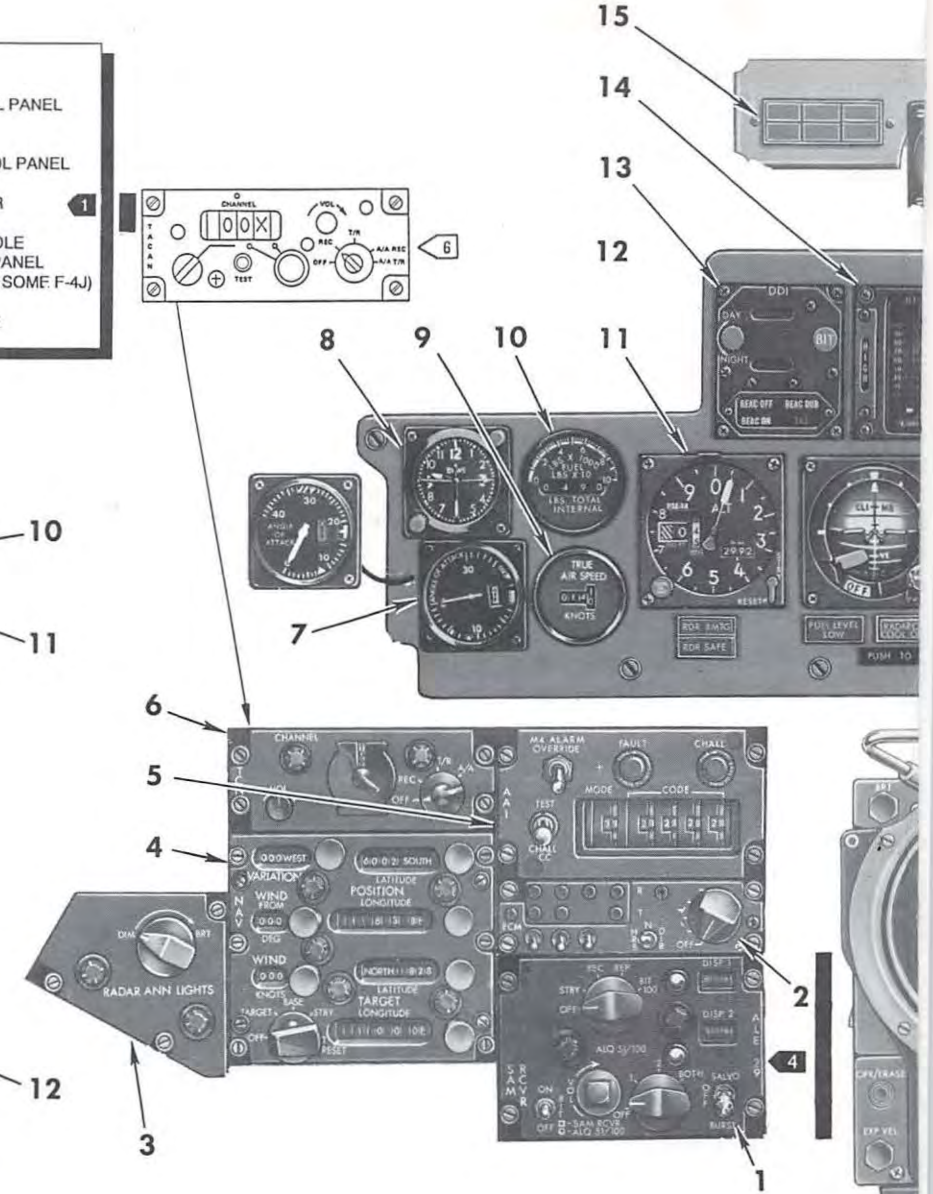
1. INTEGRATED CONTROL PANEL (SOME F-4J) 4
2. AN/ALQ-91 CONTROL-INDICATOR PANEL
3. RADAR ANNUNCIATOR LIGHTS CONTROL PANEL
4. NAVIGATION COMPUTER CONTROL PANEL
5. AN/APX-76 INTERROGATOR SET CONTROL PANEL
6. TACAN CONTROL PANEL (F-4S BEFORE AFC 647) 5
7. ANGLE OF ATTACK INDICATOR
8. CLOCK
9. TRUE AIRSPEED INDICATOR
10. FUEL QUANTITY INDICATOR
11. ALTIMETER
12. REMOTE ATTITUDE INDICATOR
13. DIGITAL DISPLAY INDICATOR
14. COMMAND TARGET ALTITUDE INDICATOR

TACAN CONTROL PANEL (F-4S BEFORE AFC 647) 6

15. ECM WARNING LIGHTS PANEL
16. WEAPON STATUS PANEL
17. MAGNETIC COMPASS
18. BAND DISABLE PANEL
19. THREAT DISPLAY PANEL
20. AIRSPEED AND MACH INDICATOR
21. STROBE DISPLAY SCOPE
22. BEARING-DISTANCE-HEADING INDICATOR
23. ANTENNA CORRELATION DISABLE PANEL
24. UHF REMOTE CHANNEL INDICATOR
25. COMM-NAV GROUP CONTROL PANEL
26. INTERCOM CONTROL PANEL
27. ANTENNA HAND CONTROL
28. RADAR SCOPE



1. BOMB RELEASE /LE COMPUTER
2. UTILITY PANEL TA LINK CONTROL PANEL
3. COCKPIT LIGHTS HANDLE
4. CANOPY CONTRCET CONTROL
5. COMMUNICATIONBEACON CONTROL PANEL
6. AN/APN-154 RAD/
7. ANTI-G VALVE ER PROGRAMMER
8. AN/ALE-29 DISPE
(F-4S; SOME F-4Y RELEASE HANDLE
9. EMERGENCY CAN ARM CONTROL PANEL
10. AN/ALQ-91/100 SAROL PANEL (F-4S; SOME F-4J)
11. FLARE/CHAFF COL PANEL
12. RADAR SET CONTR VALVE HANDLE
13. COMMAND SELEC

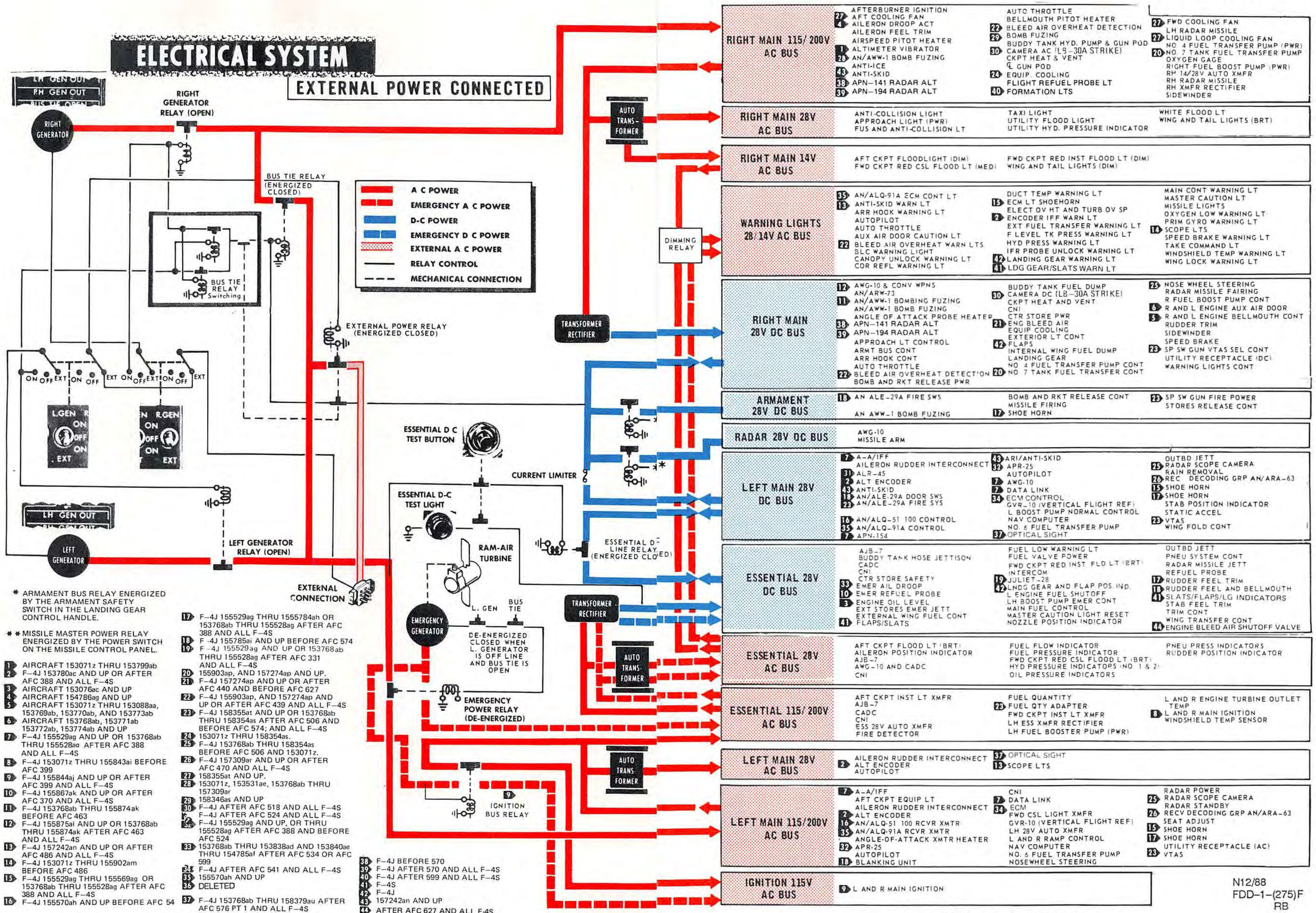


1. INTEGRATED CONTROL PANEL (SOME F-4J) 4
2. AN/ALQ-91 CONTROL-INDICATOR PANEL
3. RADAR ANNUNCIATOR LIGHTS CONTROL PANEL
4. NAVIGATION COMPUTER CONTROL PANEL
5. AN/APX-76 INTERROGATOR SET CONTROL PANEL
6. TACAN CONTROL PANEL (F-4S BEFORE AFC 647) 5
7. ANGLE OF ATTACK INDICATOR
8. CLOCK
9. TRUE AIRSPEED INDICATOR
10. FUEL QUANTITY INDICATOR
11. ALTIMETER
12. REMOTE ATTITUDE INDICATOR
13. DIGITAL DISPLAY INDICATOR
14. COMMAND TARGET ALTITUDE INDICATOR

TACAN CONTROL PANEL (F-4S BEFORE AFC 647) 6

ELECTRICAL SYSTEM

EXTERNAL POWER CONNECTED



* ARMAMENT BUS RELAY ENERGIZED BY THE ARMAMENT SAFETY SWITCH IN THE LANDING GEAR CONTROL HANDLE.

** MISSILE MASTER POWER RELAY ENERGIZED BY THE POWER SWITCH ON THE MISSILE CONTROL PANEL.

1 AIRCRAFT 153071z THRU 153799ab
2 F-4J 153780ac AND UP OR AFTER AFC 388 AND ALL F-4S
3 AIRCRAFT 153076ac AND UP
4 AIRCRAFT 154786ag AND UP
5 AIRCRAFT 153071z THRU 153088aa, 153769ab, 153770ab, AND 153773ab
6 AIRCRAFT 153768ab, 153771ab 153772ab, 153774ab AND UP
7 F-4J 155529ag AND UP OR 153768ab THRU 155528ag AFTER AFC 388 AND ALL F-4S
8 F-4J 153071z THRU 155843ai BEFORE AFC 399
9 F-4J 155844aj AND UP OR AFTER AFC 399 AND ALL F-4S
10 F-4J 155867ak AND UP OR AFTER AFC 370 AND ALL F-4S
11 F-4J 153768ab THRU 155874ak BEFORE AFC 463
12 F-4J 155875al AND UP OR 153768ab THRU 155874ak AFTER AFC 463 AND ALL F-4S
13 F-4J 157242an AND UP OR AFTER AFC 486 AND ALL F-4S
14 F-4J 153071z THRU 155902am BEFORE AFC 486
15 F-4J 155529ag THRU 155569ag OR 153768ab THRU 155528ag AFTER AFC 388 AND ALL F-4S
16 F-4J 155570ah AND UP BEFORE AFC 54
17 F-4J 155529ag THRU 1555784ah OR 153768ab THRU 155528ag AFTER AFC 388 AND ALL F-4S
18 F-4J 155785ai AND UP BEFORE AFC 574
19 F-4J 155529ag AND UP OR 153768ab THRU 155528ag AFTER AFC 331 AND ALL F-4S
20 155903ap, AND 157274ap AND UP.
21 F-4J 157274ap AND UP OR AFTER AFC 440 AND BEFORE AFC 627
22 F-4J 155903ap, AND 157274ap AND UP OR AFTER AFC 439 AND ALL F-4S
23 F-4J 158355at AND UP OR 153768ab THRU 158354as AFTER AFC 506 AND BEFORE AFC 574; AND ALL F-4S
24 153071z THRU 158354as.
25 F-4J 153768ab THRU 158354as BEFORE AFC 506 AND 153071z.
26 F-4J 157309ar AND UP OR AFTER AFC 470 AND ALL F-4S
27 158355at AND UP.
28 153071z, 153531ae, 153768ab THRU 157309ar
29 158346as AND UP
30 F-4J AFTER AFC 518 AND ALL F-4S
31 F-4J AFTER AFC 524 AND ALL F-4S
32 F-4J 155529ag AND UP, OR THRU 155528ag AFTER AFC 388 AND BEFORE AFC 524
33 153768ab THRU 153838ad AND 153840ae THRU 154785af AFTER AFC 534 OR AFC 599
34 F-4J AFTER AFC 541 AND ALL F-4S
35 155570ah AND UP
36 DELETED
37 F-4J 153768ab THRU 158379au AFTER AFC 576 PT 1 AND ALL F-4S
38 F-4J BEFORE 570
39 F-4J AFTER 570 AND ALL F-4S
40 F-4J AFTER 599 AND ALL F-4S
41 F-4S
42 F-4J
43 157242an AND UP
44 AFTER AFC 627 AND ALL F-4S

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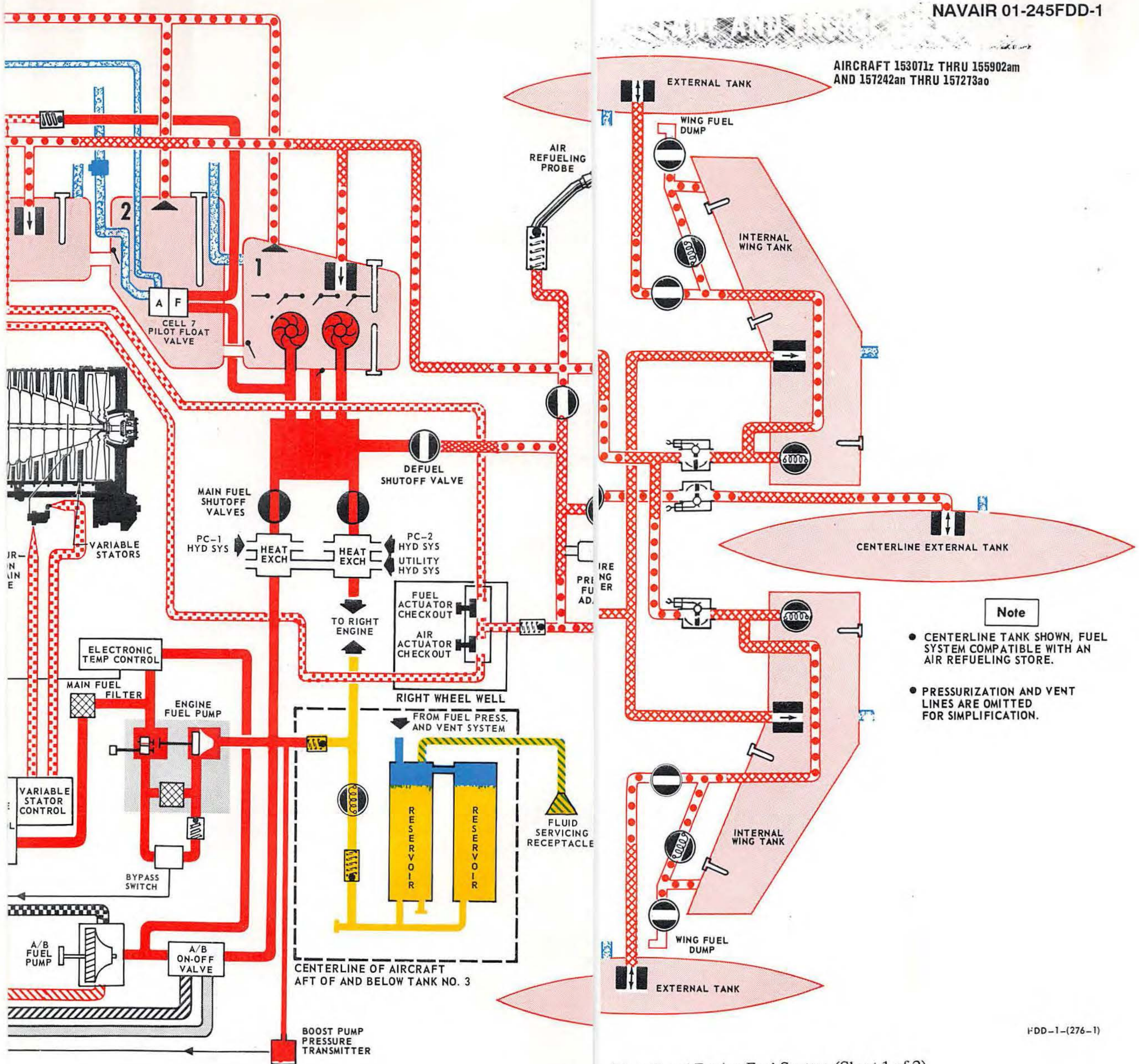
FDD-1-(275)F
RB

Figure FO-3. Electrical System

AIRCRAFT 153071z THRU 155902am AND 157242an THRU 157273ao



Note

- CENTERLINE TANK SHOWN, FUEL SYSTEM COMPATIBLE WITH AN AIR REFUELING STORE.
- PRESSURIZATION AND VENT LINES ARE OMITTED FOR SIMPLIFICATION.

Figure FO-13. Aircraft and Engine Fuel System (Sheet 1 of 2)

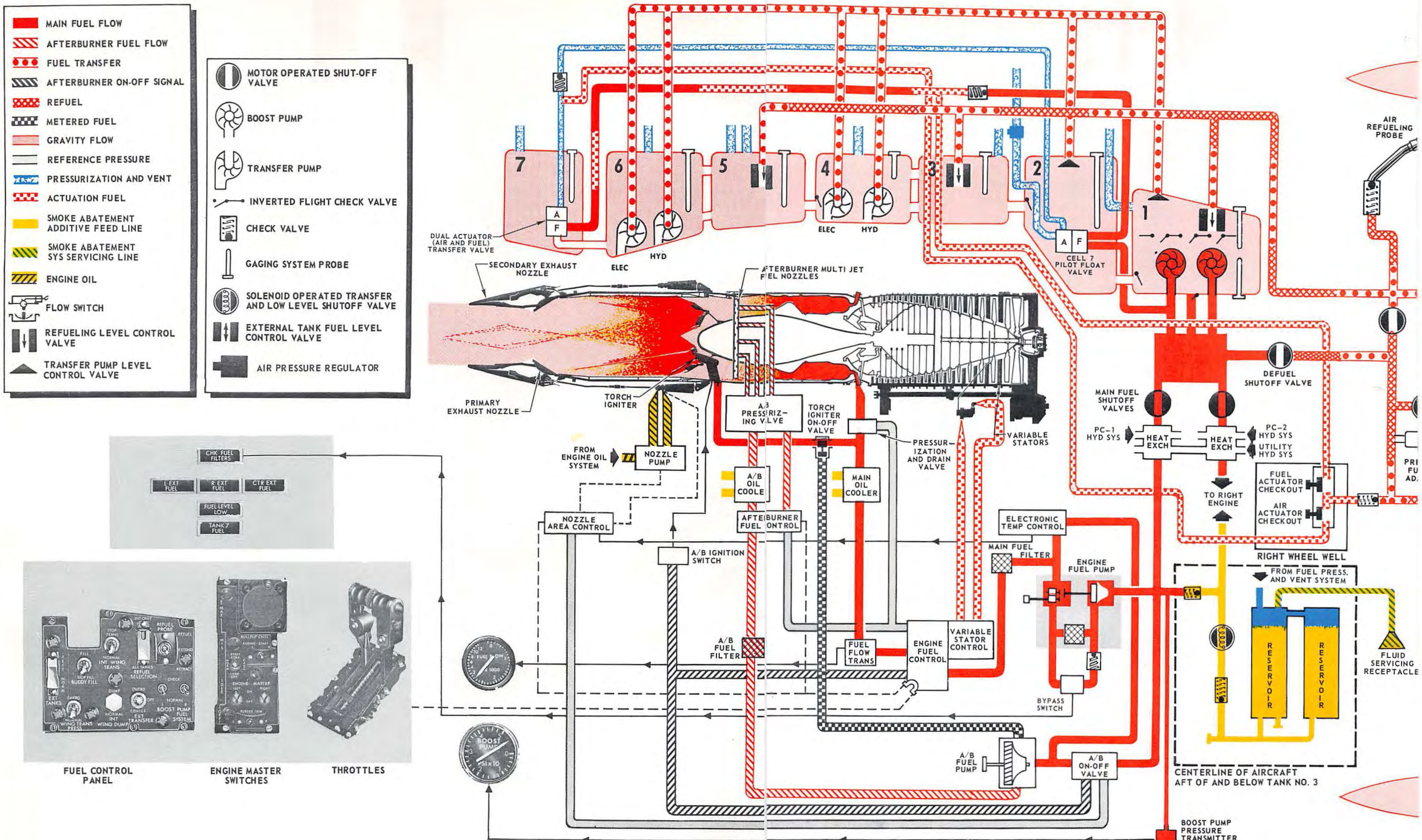
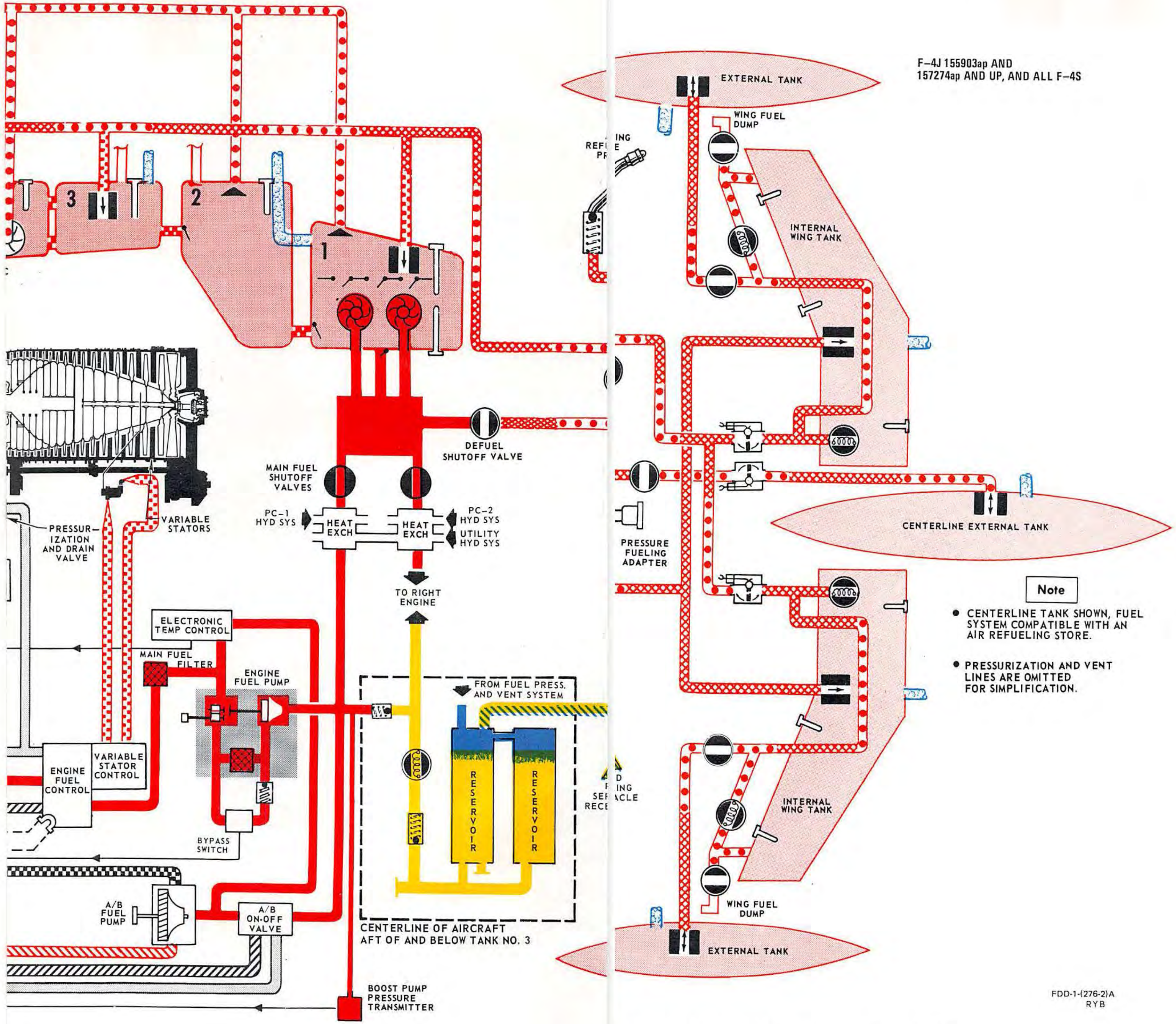

MAIN FUEL FLOW
AFTERBURNER FUEL FLOW
FUEL TRANSFER
AFTERBURNER ON-OFF SIGNAL
REFUEL
METERED FUEL
GRAVITY FLOW
REFERENCE PRESSURE
PRESSURIZATION AND VENT
ACTUATION FUEL
SMOKE ABATEMENT ADDITIVE FEED LINE
SMOKE ABATEMENT SYS SERVICING LINE
ENGINE OIL
FLOW SWITCH
REFUELING LEVEL CONTROL VALVE
TRANSFER PUMP LEVEL CONTROL VALVE
MOTOR OPERATED SHUT-OFF VALVE
BOOST PUMP
TRANSFER PUMP
INVERTED FLIGHT CHECK VALVE
CHECK VALVE
GAGING SYSTEM PROBE
SOLENOID OPERATED TRANSFER AND LOW LEVEL SHUTOFF VALVE
EXTERNAL TANK FUEL LEVEL CONTROL VALVE
AIR PRESSURE REGULATOR
7
6
5
4
3
2
1
A
F
DUAL ACTUATOR (AIR AND FUEL) TRANSFER VALVE
ELEC
HYD
ELEC
HYD
CELL 7 PILOT FLOAT VALVE
AIR REFUELING PROBE
SECONDARY EXHAUST NOZZLE
AFTERBURNER MULTI JET FUEL NOZZLES
PRIMARY EXHAUST NOZZLE
TORCH IGNITER
A/B PRESSURIZING VALVE
TORCH IGNITER ON-OFF VALVE
PRESSURIZATION AND DRAIN VALVE
VARIABLE STATORS
MAIN FUEL SHUTOFF VALVES
DEFUEL SHUTOFF VALVE
PC-1 HYD SYS
HEAT EXCH
HEAT EXCH
PC-2 HYD SYS
UTILITY HYD SYS
TO RIGHT ENGINE
FUEL ACTUATOR CHECKOUT
AIR ACTUATOR CHECKOUT
RIGHT WHEEL WELL
FROM ENGINE OIL SYSTEM
NOZZLE PUMP
A/B OIL COOLER
MAIN OIL COOLER
NOZZLE AREA CONTROL
AFTERBURNER FUEL CONTROL
A/B IGNITION SWITCH
ELECTRONIC TEMP CONTROL
MAIN FUEL FILTER
ENGINE FUEL PUMP
FROM FUEL PRESS. AND VENT SYSTEM
RESERVOIR
RESERVOIR
FLUID SERVICING RECEPTACLE
A/B FUEL FILTER
FUEL FLOW TRANS
ENGINE FUEL CONTROL
VARIABLE STATOR CONTROL
BYPASS SWITCH
A/B FUEL PUMP
A/B ON-OFF VALVE
CENTERLINE OF AIRCRAFT AFT OF AND BELOW TANK NO. 3
BOOST PUMP PRESSURE TRANSMITTER
CHK FUEL FILTERS
L EXT FUEL
R EXT FUEL
CTR EXT FUEL
FUEL LEVEL LOW
TANK 7 FUEL
FUEL CONTROL PANEL
ENGINE MASTER SWITCHES
THROTTLES
BOOST PUMP
PSI x 10

Figure FO-

F–4J 155903ap AND
157274ap AND UP, AND ALL F–4S



Note

- CENTERLINE TANK SHOWN, FUEL SYSTEM COMPATIBLE WITH AN AIR REFUELING STORE.
- PRESSURIZATION AND VENT LINES ARE OMITTED FOR SIMPLIFICATION.

FDD-1-(276-2)A
RYB

Figure FO-4. Aircraft and Engine Fuel System (Sheet 2 of 2)

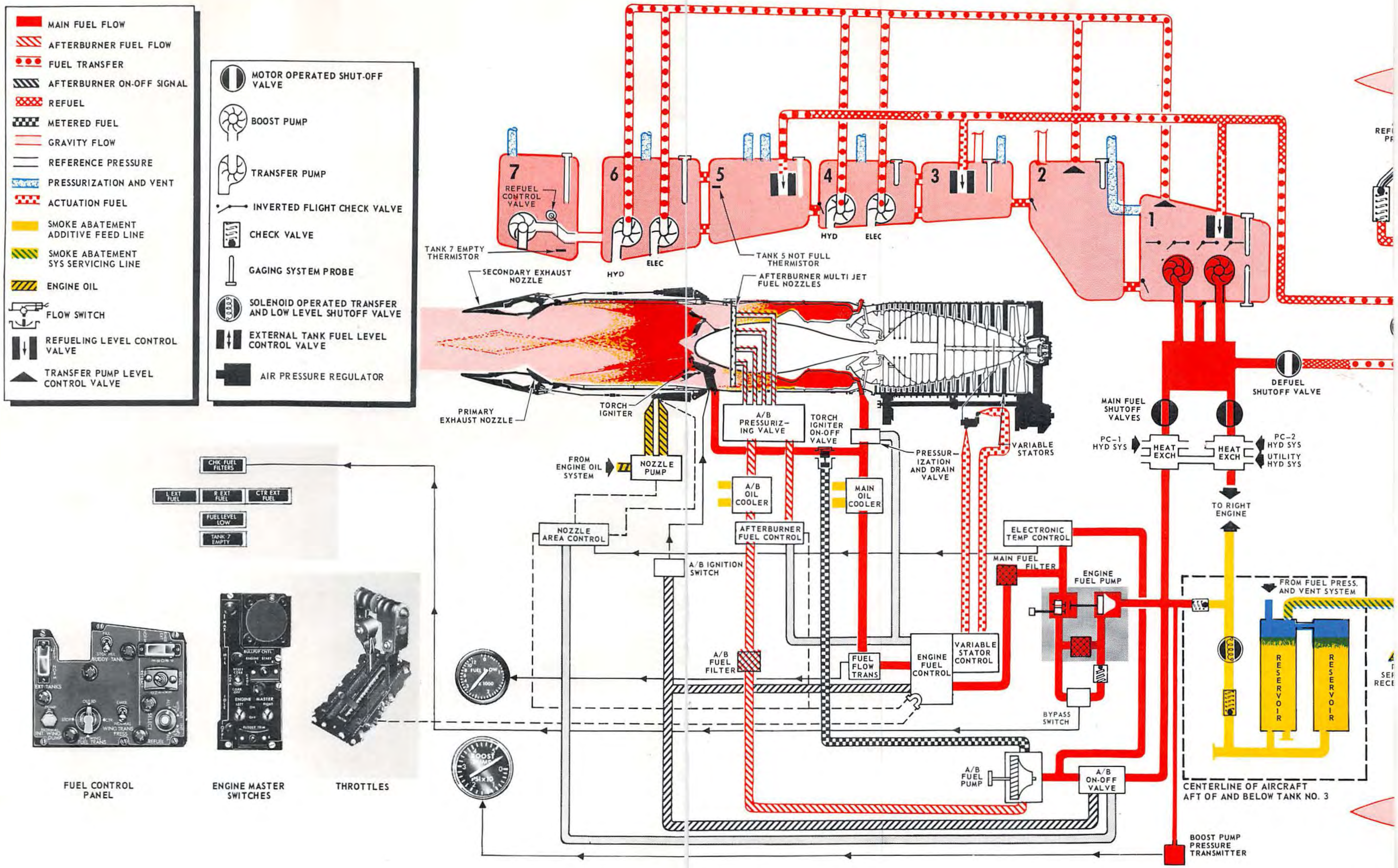

MAIN FUEL FLOW
AFTERBURNER FUEL FLOW
FUEL TRANSFER
AFTERBURNER ON-OFF SIGNAL
REFUEL
METERED FUEL
GRAVITY FLOW
REFERENCE PRESSURE
PRESSURIZATION AND VENT
ACTUATION FUEL
SMOKE ABATEMENT ADDITIVE FEED LINE
SMOKE ABATEMENT SYS SERVICING LINE
ENGINE OIL
FLOW SWITCH
REFUELING LEVEL CONTROL VALVE
TRANSFER PUMP LEVEL CONTROL VALVE
MOTOR OPERATED SHUT-OFF VALVE
BOOST PUMP
TRANSFER PUMP
INVERTED FLIGHT CHECK VALVE
CHECK VALVE
GAGING SYSTEM PROBE
SOLENOID OPERATED TRANSFER AND LOW LEVEL SHUTOFF VALVE
EXTERNAL TANK FUEL LEVEL CONTROL VALVE
AIR PRESSURE REGULATOR
7
REFUEL CONTROL VALVE
6
5
4
3
2
1
HYD
ELEC
TANK 7 EMPTY THERMISTOR
TANK 5 NOT FULL THERMISTOR
SECONDARY EXHAUST NOZZLE
AFTERBURNER MULTI JET FUEL NOZZLES
PRIMARY EXHAUST NOZZLE
TORCH IGNITER
A/B PRESSURIZ-ING VALVE
TORCH IGNITER ON-OFF VALVE
PRESSUR-IZATION AND DRAIN VALVE
VARIABLE STATORS
FROM ENGINE OIL SYSTEM
NOZZLE PUMP
A/B OIL COOLER
MAIN OIL COOLER
AFTERBURNER FUEL CONTROL
NOZZLE AREA CONTROL
A/B IGNITION SWITCH
ELECTRONIC TEMP CONTROL
MAIN FUEL FILTER
ENGINE FUEL PUMP
A/B FUEL FILTER
FUEL FLOW TRANS
ENGINE FUEL CONTROL
VARIABLE STATOR CONTROL
BYPASS SWITCH
A/B FUEL PUMP
A/B ON-OFF VALVE
MAIN FUEL SHUTOFF VALVES
PC-1 HYD SYS
HEAT EXCH
PC-2 HYD SYS
UTILITY HYD SYS
DEFUEL SHUTOFF VALVE
TO RIGHT ENGINE
FROM FUEL PRESS. AND VENT SYSTEM
RESERVOIR
CENTERLINE OF AIRCRAFT AFT OF AND BELOW TANK NO. 3
BOOST PUMP PRESSURE TRANSMITTER
CHK FUEL FILTERS
L EXT FUEL
R EXT FUEL
CTR EXT FUEL
FUEL LEVEL LOW
TANK 7 EMPTY
FUEL CONTROL PANEL
ENGINE MASTER SWITCHES
THROTTLES

Figure FC

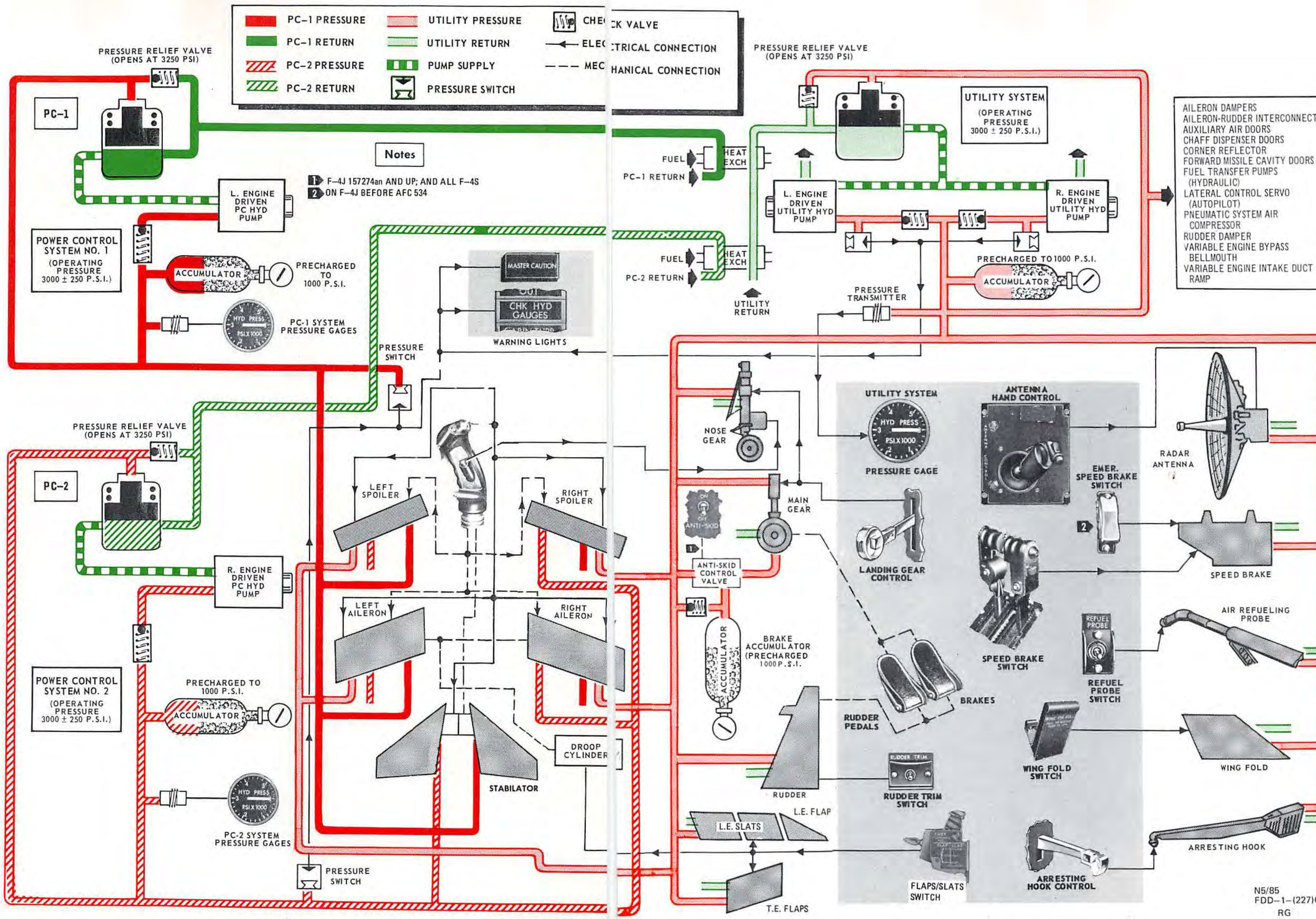
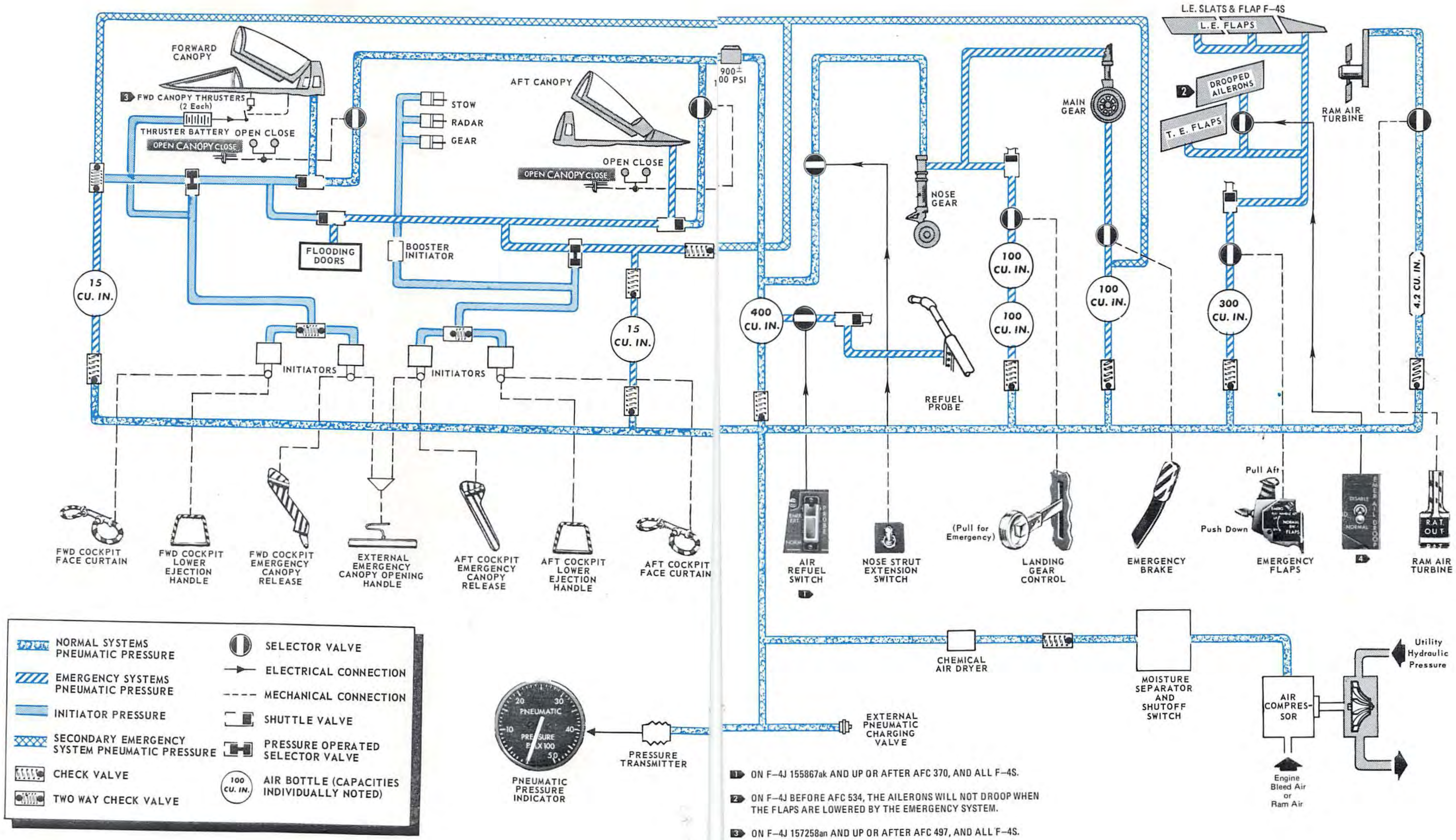


Figure FO-5. Hydraulic Systems



1 ON F-4J 155867ak AND UP OR AFTER AFC 370, AND ALL F-4S.

2 ON F-4J BEFORE AFC 534, THE AILERONS WILL NOT DROOP WHEN THE FLAPS ARE LOWERED BY THE EMERGENCY SYSTEM.

3 ON F-4J 157258an AND UP OR AFTER AFC 497, AND ALL F-4S.

4 ON F-4J THROUGH 154785af AFTER AFC 534 AND ALL F-4S (PNEUMATIC EMERGENCY AILERONS DROOP).

FDD-1-(278)C B

Figure FO-6. Pneumatic System

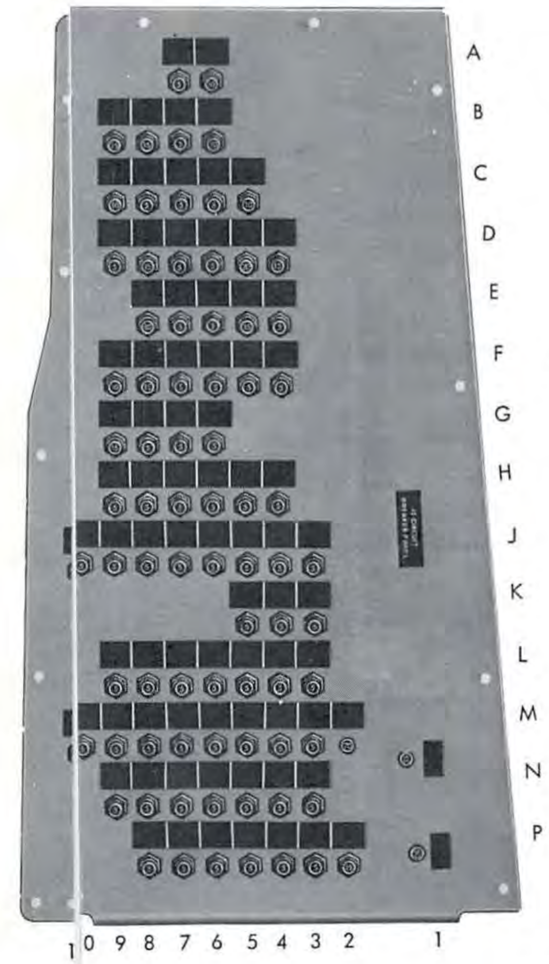
LH ESS XMFR RECT
F LEVEL TK PRESS WARN LT
EXT FUEL TRANS WARN LT
ENCODER IFF WARN LT (2)
AILERON POS IND
RUDDER POSIT IND
NO 6 FUEL TRANS PUMP
ALT ENCODER (2)
FUEL FLOW IND
FUEL PRESS IND
OIL PRESS IND
CNI
AWG-10 & CADC
AJB-7
BLEED AIR OVERHEAT DETECTION (9)
LH ESS XMFR RECT
FUEL LOW WARN LT
MAIN FUEL CONT
FUEL VALVE PWR LH
REFUEL PROBE
STAB POSIT IND
ALT ENCODER (2)
ALT VIBRATOR (1)
A.O.A. PROBE HEATER
AUTO PILOT
SIDEWINDER
NO 6 FUEL TRANS PUMP
CNI
ENG OIL LEVEL (3)
INTERCOM
RUDDER FEEL TRIM
BLEED AIR OVERHEAT DETECTION (9)
RH XMFR RECT
FUEL QTY
INT WING FUEL DUMP
EXT WING FUEL CONT
WING TRANS CONT
LDG GEAR AND FLAP POS IND
AUTO PILOT
AUTO PILOT
AUTO PILOT
AUTO PILOT
SIDEWINDER
NO 6 FUEL TRANS PUMP
ALT ENCODER (2)
A.O.A. XMTR HEATER
TAKE COMMAND LT
SCOPE LTS
℄ GUN POD
RH XMFR RECT
MASTER CAUTION LT RESET
MASTER CAUTION LT
IFR PROBE UNLOCK WARN LT
BLC WARN LT
OXYGEN LOW WARN LT
OXYGEN GAGE
AILERON RUDDER INTER-CONNECT
AILERON RUDDER INTER-CONNECT
AUTO PILOT
SIDEWINDER
NO 6 FUEL TRANS PUMP
AILERON DROOP ACT (4)
RAMP CONT R ENG
RAMP CONT L ENG
BELLMOUTH PITOT HEATER
AIRSPEED PITOT HEATER
RH XMFR RECT
RH RADAR MISSILE
AN/AWW-1 BOMB FUZING

Zone	C/B Panel	
B6	2	RH RADAR MISSILE
B7	2	AN/AWW-1 BOMB FUZING
B8	2	CTR STORE PWR
B9	2	CTR STORE SAFETY
C5	2	RH RADAR MISSILE
C6	2	BUDDY TANK HYD PUMP
C7	2	AN/AWW-1 BOMB FUZING
C8	2	EXT LT CONT
C9	2	UTILITY RECEP
D4	2	AN/AWW-1 BOMB FUZING
D5	2	BOMB & RKT REL PWR
D6	2	BUDDY TANK HOSE JETTI-SON
D7	2	AN/AWW-1 BOMB FUZING
D8	2	WING AND TAIL LT BRT
D9	2	UTILITY RECEP AC
E4	2	BOMB & RKT REL CONT
E5	2	AN/ARW-73
E6	2	BUDDY TANK FUEL DUMP
E7	2	PNEU SYS CONT
E8	2	WING & TAIL LT DIM
F4	2	RADAR SCOPE CAMERA
F5	2	RADAR SCOPE CAMERA
F6	2	HYD PRESS IND NO 1
F7	2	PNEU PRESS IND
F8	2	TAXI LT
F9	2	ANTI-COLLISION LT
G6	2	HYD PRESS IND NO 2
G7	2	UTILITY HYD PRESS IND
G8	2	APPROACH LT PWR
G9	2	FUS AND ANTI-COLLISION LT
H4	2	FLT REFUEL PROBE LT
H5	2	AUX AIR DOOR CAUTION LT
H6	2	HYD PRESS WARNING LT
H7	2	ARR HOOK CONT
H8	2	APPROACH LT CONT
H9	2	WING FOLD CONT
J3	2	AUTO THROT
J4	2	MAIN CONT WARNING LT
J5	2	SPEED BRAKE WARNING LT
J6	2	DUCT TEMP WARNING LT
J7	2	ARR HOOK WARNING LT
J8	2	CANOPY UNLOCK WARNING LT
J9	2	WING LOCK WARNING LT
J10	2	COR REFL WARNING LT
K3	2	WARNING LT CONT
K4	2	AUTO THROT
K5	2	AUTO THROT
L3	2	AFT CKPT EQUIP LT
L4	2	WHT FLOOD LT
L5	2	UTILITY FLOOD LT
L6	2	NOSE WHEEL STEER
L7	2	NOSE WHEEL STEER
L8	2	EQUIP COOLING
L9	2	CKPT HEAT AND VENT
M2	2	AWG-10
M3	2	AFT CKPT FLOOD LT DIM
M4	2	FWD CKPT RED INST/FLOOD LT DIM
M5	2	FWD CKPT RED CSL FLOOD LT DIM
M6	2	LH 28V AUTO XMFR
M7	2	WSHLD TEMP WARNING LT
M8	2	ELECT OVHT AND TURB OVSP
M9	2	CKPT HEAT AND VENT
M10	2	PRIM GYRO WARNING LT
N1	2	RADAR STANDBY
N3	2	AFT CKPT FLOOD LT BRT
N4	2	FWD CKPT RED CSL FLOOD LT BRT
N5	2	FWD CKPT RED INST FLOOD LT BRT
N6	2	ESS 28V AUTO XMFR
N7	2	WSHLD TEMP SENSOR

Zone	C/B Panel	
N8	2	EQUIP COOLING
N9	2	SEAT ADJUST
P1	2	RADAR PWR
P2	2	AWG-10
P3	2	AFT CKPT INST LT XMFR
P4	2	FWD CKPT INST LT XMFR
P5	2	FWD CSL LT XMFR
P6	2	RH 14/28V AUTO XMFR
P7	2	RAIN REM
P8	2	STATIC ACCEL
–	LUP	ARI
–	RUP	AIL FEEL TRIM
–	RUP	FLAPS
–	RUP	LG
–	RUP	RUD TRIM
–	RUP	SPEED BRAKE
–	RUP	TRIM CONT

1. 153072z THRU 153779ab
2. 153780ac AND UP
3. 153076aa AND UP
4. 154786ag AND UP
5. 153072z THRU 153088aa, 153769ab 153770ab AND 153773ab
6. 153768ab, 153771ab, 153772ab, 153774ab AND UP
7. AFTER AFC 370
8. 153072z THRU 153088aa AFTER AFC 440
9. 153072z THRU 153088aa AFTER AFC 439

LUP – LEFT UTILITY PANEL (FWD CKPT)
RUP – RIGHT UTILITY PANEL (FWD CKPT)



153072z THRU 153088aa, AND 153768ab THRU 155528ag BEFORE AFC 388.

NO. 2 CIRCUIT BREAKER PANEL

FWD

UP

NO. 1 CIRCUIT BREAKER PANEL

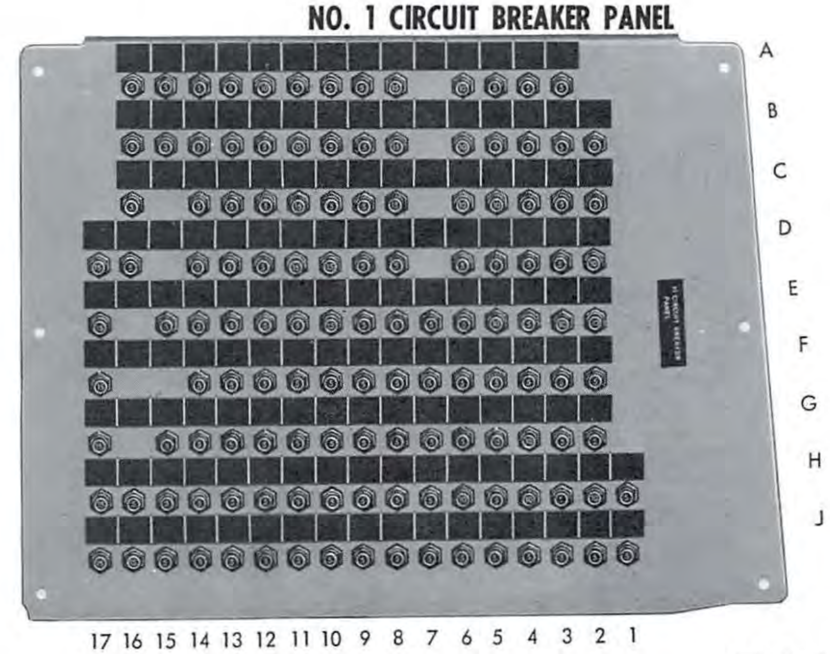


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Figure FO-7. Circuit Breaker Location (Sheet 1 of 3)

ALPHABETICAL LISTING

	C/B Panel	Zone
A/B IGN. L. ENG	1	4A
A/B IGN. R. ENG	1	3A
AFT CKPT. EQUIP. LT.	2	3L
AFT CKPT. FLOOD LT. BRT	2	3N
AFT CKPT. FLOOD LT. DIM	2	3M
AFT CKPT. INST. LT. XMFR	2	3P
AIL. FEEL TRIM	RUP	–
AILERON DROOP ACT [4]	1	12J
AILERON POS. IND.	1	5F
AILERON RUDDER INT.	1	7J
AILERON RUDDER INT.	1	8J
AIRSPEED PITOT HEATER	1	16J
AJB-7	1	14A
AJB-7	1	14B
AJB-7	1	14C
AJB-7	1	14D
AJB-7	1	14F
AJB-7	1	15B
ALT. ENCODER [2]	1	8F
ALT. ENCODER [2]	1	7G
ALT. ENCODER [2]	1	12H
ALT. VIBRATOR [1]	1	7G
AN/ARW-73	2	5E
AN/AWW-1 BOMB FUZING	2	7A
AN/AWW-1 BOMB FUZING	2	7B
AN/AWW-1 BOMB FUZING	2	7C
AN/AWW-1 BOMB FUZING	2	7D
AN/AWW-1 BOMB FUZING	2	4D
ANTI-COLLISION LT.	2	9F
ANTI-ICE	1	15E
A.O.A. PROBE HEATER	1	8G
A.O.A. XMTR. HEATER	1	13H
APN-141	1	13E
APN-141	1	14E
APPROACH LT. CONT.	2	8H
APPROACH LT. POWER	2	8G
ARI	LUP	–
ARMT. BUS CONT.	1	7E
ARRESTING HOOK CONT.	2	7H
ARRESTING HOOK WARN. LT.	2	7J
AUTOPILOT	1	9G
AUTOPILOT	1	9H
AUTOPILOT	1	9J
AUTOPILOT	1	6H
AUTOPILOT	1	7H
AUTOPILOT	1	8H
AUTO. THROTTLE	2	4K
AUTO. THROTTLE	2	5K
AUTO. THROTTLE	2	3J
AUX. AIR DOOR CAUTION LT.	2	5H
AUX AIR DOOR, L. ENG.	1	4D
AUX AIR DOOR, R. ENG.	1	3D
AWG-10	2	2M
AWG-10	2	2P
AWG-10 AND CADC	1	13F
BELLMOUTH PITOT HEATER	1	15J
BLC WARN. LT.	1	4J
BLEED AIR OFF VALVE [8]	1	15C
BLEED AIR OVERHEAT DETECTION [9]	1	16F
BLEED AIR OVERHEAT DETECTION [9]	1	16G
BLEED AIR OVERHEAT WARN LT [9]	1	16E
BOMB AND RKT. REL. CONT.	2	4E
BOMB AND RKT. REL. PWR.	2	5D
BUDDY TANK FUEL DUMP	2	6E
BUDDY TANK HOSE JETT.	2	6D
BUDDY TANK HYD. PUMP	2	6C
CADC	1	13A
CADC	1	13B
CADC	1	13C
CADC	1	13D
CANOPY UNLOCK WARN. LT.	2	8J
CKPT. HEAT AND VENT	2	9L
CKPT. HEAT AND VENT	2	9M
℄ GUN POD	1	16H
CNI	1	12A
CNI	1	12B
CNI	1	12C
CNI	1	12D
CNI	1	12E
CNI	1	12F
CNI	1	12G
CORNER REFL. WARN LT.	2	10J
CTR. STORE PWR.	2	8B
CTR. STORE SAFETY	2	9B
DUCT TEMP. WARN. LT.	2	6J
ELECT. OVHT. AND TURBINE OVSP.	2	8M
EMER. REFUEL PROBE [7]	1	15A
ENCODER IFF WARN. LT. [2]	1	4F

	C/B Panel	Zone
ENGINE OIL LEVEL [3]	1	13G
EQUIP. COOLING	2	8L
EQUIP. COOLING	2	8N
ESS. 28V AUTO. XMFR.	2	6N
EXT. FUEL TRANS. WARN LT.	1	3F
EXT. LT. CONT.	2	8C
EXT. STORES EMER. JETT.	1	3E
EXT. WING FUEL CONT.	1	3H
FIRE DETECTOR	1	5A
FLAPS	RUP	–
FLT. REFUEL PROBE LT.	2	4H
FUEL FLOW IND.	1	9F
FUEL LEVEL TK. PRESS. WARN. LT.	1	2F
FUEL LOW WARN. LT.	1	2G
FUEL PRESS. IND.	1	10F
FUEL QTY.	1	1H
FUEL VALVE POWER L.H.	1	4G
FUS. AND ANTI-COLL LT.	2	9G
FWD. CKPT. INST. LT. XMFR.	2	4P
FWD. CKPT. RED CSL FLOOD LT.	2	4N
FWD. CKPT. RED CSL FLOOD LT.	2	5M
FWD. CKPT. RED INST. FLOOD LT.	2	5N
FWD. CKPT. RED INST. FLOOD LT.	2	4M
FWD. CSL LT. XMFR.	2	5P
GVR-10	1	16A
GVR-10	1	16B
GVR-10	1	16C
GVR-10	1	16D
HYD. PRESS. IND. NO. 1	2	6F
HYD. PRESS. IND. NO. 2	2	6G
HYD. PRESS. WARN. LT.	2	6H
IFR PROBE UNLOCK WARN LT.	1	3J
IGN. L. MAIN	1	3B
IGN. R. MAIN	1	2B
INTERCOM	1	14G
INT. WING FUEL DUMP	1	2H
LG	RUP	–
LDG. GEAR AND FLAP POS. IND.	1	5H
LDG. GEAR WARN LT.	1	4B
L. ENG. BELLMOUTH CONT. [5]	1	4D
L. ENG. FUEL SHUTOFF	1	4E
L.H. BOOST PUMP EMER. CONT.	1	11A
L.H. BOOST PUMP NORM CONT.	1	11E
L.H. ESS. XMFR. RECT.	1	17D
L.H. ESS. XMFR. RECT.	1	17E
L.H. ESS. XMFR. RECT.	1	17F
L.H. FUEL BOOST PUMP	1	11B
L.H. FUEL BOOST PUMP	1	11C
L.H. FUEL BOOST PUMP	1	11D
L.H. RADAR MISSILE	1	6A
L.H. RADAR MISSILE	1	6B
L.H. RADAR MISSILE	1	6C
L.H. 28V AUTO. XMFR.	2	6M
MAIN CONT. WARN. LT.	2	4J
MAIN FUEL CONT.	1	3G
MASTER CAUTION LT.	1	2J
MASTER CAUTION LT. RESET	1	1J
MISSILE ARM	1	6D
MISSILE FIRING	1	6E
MISSILE LTS.	1	5B
NAV COMPUTER	1	8E
NAV COMPUTER	1	9E
NOSE WHEEL STEER.	2	6L
NOSE WHEEL STEER.	2	7L
NOZZLE POS. IND.	1	4C
NO. 4 FUEL TRANS. PUMP	1	9A
NO. 4 FUEL TRANS. PUMP	1	9B
NO. 4 FUEL TRANS. PUMP	1	9C
NO. 4 FUEL TRANS. PUMP	1	9D
NO. 6 FUEL TRANS. PUMP	1	7F
NO. 6 FUEL TRANS. PUMP	1	11G
NO. 6 FUEL TRANS. PUMP	1	11H
NO. 6 FUEL TRANS. PUMP	1	11J
OIL PRESS. IND.	1	11F
OUTBD. JETT.	1	2D
OUTBD. JETT.	1	2E
OXYGEN GAGE	1	6J
OXYGEN LOW WARN. LT.	1	5J
PNEU. PRESS. IND.	2	7F
PNEU. SYS. CONT.	2	7E
PRIM. GYRO WARN. LT.	2	10M
RADAR MISSILE FAIRING	1	5D

	C/B Panel	Zone
RADAR MISSILE JETT.	1	5C
RADAR POWER	2	1P
RADAR SCOPE CAMERA	2	5F
RADAR SCOPE CAMERA	2	4F
RADAR STANDBY	2	1N
RAIN REMOVAL	2	7P
RAMP CONT. L. ENG.	1	14J
RAMP CONT. R. ENG.	1	13J
REFUEL PROBE	1	5G
R. ENG. BELLMOUTH CONT. [5]	1	3D
R.H. FUEL BOOST PUMP CONT.	1	8D
R.H. FUEL BOOST PUMP	1	8A
R.H. FUEL BOOST PUMP	1	8B
R.H. FUEL BOOST PUMP	1	8C
R.H. RADAR MISSILE	2	6A
R.H. RADAR MISSILE	2	6B
R.H. RADAR MISSILE	2	5C
R.H. XMFR. RECT.	1	17G
R.H. XMFR. RECT.	1	17H
R.H. XMFR. RECT.	1	17J
RUDDER FEEL TRIM	1	15G
RUDDER POS. IND.	1	6F
R.H. 14/28V AUTO. XMFR.	2	6P
RUD. TRIM	RUP	–
SCOPE LTS.	1	15H
SEAT ADJUST	2	9N
SIDEWINDER	1	10A
SIDEWINDER	1	10B
SIDEWINDER	1	10C
SIDEWINDER	1	10D
SIDEWINDER	1	10E
SIDEWINDER	1	10G
SIDEWINDER	1	10H
SIDEWINDER	1	10J
SPEED BRAKE	RUP	–
SPEED BRAKE WARN. LT.	2	5J
STAB. FEEL TRIM	RUP	–
STAB. POS. IND.	1	6G
STATIC ACCEL.	2	8P
STORES REL. CONT.	1	5E
TAKE COMMAND LT.	1	14H
TAXI LT.	2	8F
TRIM CONT.	RUP	–
TURBINE OUTLET TEMP. L. ENG.	1	2C
TURBINE OUTLET TEMP. R. ENG.	1	3C
UTILITY FLOOD LT.	2	5L
UTILITY HYD. PRESS. IND.	2	7G
UTILITY RECEP.	2	9C
UTILITY RECEP. AC	2	9D
WARNING LT. CONT.	2	3K
WHITE FLOOD LT.	2	4L
WING AND TAIL LT. DIM	2	8E
WING AND TAIL LT. BRT.	2	8D
WING FOLD CONT.	2	9H
WING LOCK WARNING LT.	2	9J
WING TRANS. CONT.	1	4H
WSHLD. TEMP. SENSOR	2	7N
WSHLD. TEMP. WARN. LT.	2	7M

ZONE LISTING

Zone	C/B Panel	
A3	1	A/B IGN R ENG
A4	1	A/B IGN L ENG
A5	1	FIRE DETECTOR
A6	1	LH RADAR MISSILE
A8	1	RH FUEL BOOSTER PUMP
A9	1	NO 4 FUEL TRANS PUMP
A10	1	SIDEWINDER
A11	1	LH BOOST PUMP EMER CONT
A12	1	CNI
A13	1	CADC
A14	1	AJB-7
A15	1	EMER REFUEL PROBE [7]
A16	1	GVR-10
B2	1	IGN R MAIN
B3	1	IGN L MAIN
B4	1	LDG GEAR WARN LT
B5	1	MISSILE LTS
B6	1	LH RADAR MISSILE
B8	1	RH FUEL BOOST PUMP
B9	1	NO 4 FUEL TRANS PUMP
B10	1	SIDEWINDER
B11	1	LH FUEL BOOST PUMP
B12	1	CNI
B13	1	CADC
B14	1	AJB-7
B15	1	AJB-7
B16	1	GVR-10
C2	1	TURBINE OUTLET TEMP L ENG
C3	1	TURBINE OUTLET TEMP R ENG
C4	1	NOZZLE POSITION IND
C5	1	RADAR MISSILE JETT
C6	1	LH RADAR MISSILE
C8	1	RH FUEL BOOST PUMP
C9	1	NO 4 FUEL TRANS PUMP
C10	1	SIDEWINDER
C11	1	LH FUEL BOOST PUMP
C12	1	CNI
C13	1	CADC
C14	1	AJB-7
C15	1	BLEED AIR OFF VALVE [8]
C16	1	GVR-10
D2	1	OUTBD JETT
D3	1	R ENG AUX AIR DOOR [6]
D3	1	R ENG BELLMOUTH CONT [5]
D4	1	L ENG AUX AIR DOOR [6]
D4	1	L ENG BELLMOUTH CONT [5]
D5	1	RADAR MISSILE FAIRING
D6	1	MISSILE ARM
D8	1	RH FUEL BOOST PUMP CONT
D9	1	NO 4 FUEL TRANS PUMP
D10	1	SIDEWINDER
D11	1	LH FUEL BOOST PUMP
D12	1	CNI
D13	1	CADC
D14	1	AJB-7
D16	1	GVR-10
D17	1	LH ESS XMFR RECT
E2	1	OUTBD JETT
E3	1	EXT STORES EMER JETT
E4	1	L ENG FUEL SHUTOFF
E5	1	STORES RELEASE CONT
E6	1	MISSILE FIRING
E7	1	ARMT BUS CONT
E8	1	NAV CMPTR
E9	1	NAV CMPTR
E10	1	SIDEWINDER
E11	1	LH BOOST PUMP NORM CONT
E12	1	CNI
E13	1	APN 141
E14	1	APN 141
E15	1	ANTI-ICE
E16	1	BLEED AIR OVERHEAT WARN LT [9]

Zone	C/B Panel	
E17	1	LH ESS XMFR RECT
F2	1	F LEVEL TK PRESS WARN LT
F3	1	EXT FUEL TRANS WARN LT
F4	1	ENCODER IFF WARN LT [2]
F5	1	AILERON POS IND
F6	1	RUDDER POSIT IND
F7	1	NO 6 FUEL TRANS PUMP
F8	1	ALT ENCODER [2]
F9	1	FUEL FLOW IND
F10	1	FUEL PRESS IND
F11	1	OIL PRESS IND
F12	1	CNI
F13	1	AWG-10 & CADC
F14	1	AJB-7
F16	1	BLEED AIR OVERHEAT DETECTION [9]
F17	1	LH ESS XMFR RECT
G2	1	FUEL LOW WARN LT
G3	1	MAIN FUEL CONT
G4	1	FUEL VALVE PWR LH
G5	1	REFUEL PROBE
G6	1	STAB POSIT IND
G7	1	ALT ENCODER [2]
G7	1	ALT VIBRATOR [1]
G8	1	A.O.A. PROBE HEATER
G9	1	AUTO PILOT
G10	1	SIDEWINDER
G11	1	NO 6 FUEL TRANS PUMP
G12	1	CNI
G13	1	ENG OIL LEVEL [3]
G14	1	INTERCOM
G15	1	RUDDER FEEL TRIM
G16	1	BLEED AIR OVERHEAT DETECTION [9]
G17	1	RH XMFR RECT
H1	1	FUEL QTY
H2	1	INT WING FUEL DUMP
H3	1	EXT WING FUEL CONT
H4	1	WING TRANS CONT
H5	1	LDG GEAR AND FLAP POS IND
H6	1	AUTO PILOT
H7	1	AUTO PILOT
H8	1	AUTO PILOT
H9	1	AUTO PILOT
H10	1	SIDEWINDER
H11	1	NO 6 FUEL TRANS PUMP
H12	1	ALT ENCODER [2]
H13	1	A.O.A. XMTR HEATER
H14	1	TAKE COMMAND LT
H15	1	SCOPE LTS
H16	1	℄ GUN POD
H17	1	RH XMFR RECT
J1	1	MASTER CAUTION LT RESET
J2	1	MASTER CAUTION LT
J3	1	IFR PROBE UNLOCK WARN LT
J4	1	BLC WARN LT
J5	1	OXYGEN LOW WARN LT
J6	1	OXYGEN GAGE
J7	1	AILERON RUDDER INTER-CONNECT
J8	1	AILERON RUDDER INTER-CONNECT
J9	1	AUTO PILOT
J10	1	SIDEWINDER
J11	1	NO 6 FUEL TRANS PUMP
J12	1	AILERON DROOP ACT [4]
J13	1	RAMP CONT R ENG
J14	1	RAMP CONT L ENG
J15	1	BELLMOUTH PITOT HEATER
J16	1	AIRSPEED PITOT HEATER
J17	1	RH XMFR RECT
A2	2	RH RADAR MISSILE
A7	2	AN/AWW-1 BOMB FUZING

Zone	C/B Panel	
B6	2	RH RADAR MISSILE
B7	2	AN/AWW-1 BOMB FUZING
B8	2	CTR STORE PWR
B9	2	CTR STORE SAFETY
C5	2	RH RADAR MISSILE
C6	2	BUDDY TANK HYD PUMP
C7	2	AN/AWW-1 BOMB FUZING
C8	2	EXT LT CONT
C9	2	UTILITY RECEP
D4	2	AN/AWW-1 BOMB FUZING
D5	2	BOMB & RKT REL PWR
D6	2	BUDDY TANK HOSE JETTI-SON
D7	2	AN/AWW-1 BOMB FUZING
D8	2	WING AND TAIL LT BRT
D9	2	UTILITY RECEP AC
E4	2	BOMB & RKT REL CONT
E5	2	AN/ARW-73
E6	2	BUDDY TANK FUEL DUMP
E7	2	PNEU SYS CONT
E8	2	WING & TAIL LT DIM
F4	2	RADAR SCOPE CAMERA
F5	2	RADAR SCOPE CAMERA
F6	2	HYD PRESS IND NO 1
F7	2	PNEU PRESS IND
F8	2	TAXI LT
F9	2	ANTI-COLLISION LT
G6	2	HYD PRESS IND NO 2
G7	2	UTILITY HYD PRESS IND
G8	2	APPROACH LT PWR
G9	2	FUS AND ANTI-COLLISION LT
H4	2	FLT REFUEL PROBE LT
H5	2	AUX AIR DOOR CAUTION LT
H6	2	HYD PRESS WARNING LT
H7	2	ARR HOOK CONT
H8	2	APPROACH LT CONT
H9	2	WING FOLD CONT
J3	2	AUTO THROT
J4	2	MAIN CONT WARNING LT
J5	2	SPEED BRAKE WARNING LT
J6	2	DUCT TEMP WARNING LT
J7	2	ARR HOOK WARNING LT
J8	2	CANOPY UNLOCK WARNING LT
J9	2	WING LOCK WARNING LT
J10	2	COR REFL WARNING LT
K3	2	WARNING LT CONT
K4	2	AUTO THROT
K5	2	AUTO THROT
L3	2	AFT CKPT EQUIP LT
L4	2	WHT FLOOD LT
L5	2	UTILITY FLOOD LT
L6	2	NOSE WHEEL STEER
L7	2	NOSE WHEEL STEER
L8	2	EQUIP COOLING
L9	2	CKPT HEAT AND VENT
M2	2	AWG-10
M3	2	AFT CKPT FLOOD LT DIM
M4	2	FWD CKPT RED INST FLOOD LT DIM
M5	2	FWD CKPT RED CSL FLOOD LT DIM
M6	2	LH 28V AUTO XMFR
M7	2	WSHLD TEMP WARNING LT
M8	2	ELECT OVHT AND TURB OVSP
M9	2	CKPT HEAT AND VENT
M10	2	PRIM GYRO WARNING LT
N1	2	RADAR STANDBY
N3	2	AFT CKPT FLOOD LT BRT
N4	2	FWD CKPT RED CSL FLOOD LT BRT
N5	2	FWD CKPT RED INST FLOOD LT BRT
N6	2	ESS 28V AUTO XMFR
N7	2	WSHLD TEMP SENSOR

Zone	C/B Panel	
N8	2	EQUIP COOLING
N9	2	SEAT ADJUST
P1	2	RADAR PWR
P2	2	AWG-10
P3	2	AFT CKPT INST LT XMFR
P4	2	FWD CKPT INST LT XMFR
P5	2	FWD CSL LT XMFR
P6	2	RH 14/28V AUTO XMFR
P7	2	RAIN REM
P8	2	STATIC ACCEL
–	LUP	ARI
–	RUP	AIL FEEL TRIM
–	RUP	FLAPS
–	RUP	LG
–	RUP	RUD TRIM
–	RUP	SPEED BRAKE
–	RUP	TRIM CONT

[1] 153072z THRU 153779ab
[2] 153780ac AND UP
[3] 153076aa AND UP
[4] 154786ag AND UP
[5] 153072z THRU 153088aa, 153769ab 153770ab AND 153773ab
[6] 153768ab, 153771ab, 153772ab, 153774ab AND UP
[7] AFTER AFC 370
[8] 153072z THRU 153088aa AFTER AFC 440
[9] 153072z THRU 153088aa AFTER AFC 439

LUP – LEFT UTILITY PANEL (FWD CKP
RUP – RIGHT UTILITY PANEL (FWD CKF

ALPHABETICAL LISTING

	C/B Panel	Zone
A-A/IFF (13)	1	13A
A/A IFF (27)	1	13A
A-A/IFF (13)(26)	1	14A
AA/IFF (12)	1	15A
A/B IGN. L. ENG.	1	14E
A/B IGN. R. ENG.	1	13E
AFT CKPT. EQUIP. LT.	2	3N
AFT CKPT. FLOOD LT. BRT.	2	3Q
AFT CKPT. FLOOD LT. DIM.	2	3P
AFT CKPT. INST. LT. XMFR.	2	3R
AILERON DROOP ACT.	1	15H
AILERON FEEL TRIM	RUP	—
AILERON POS. IND.	1	5K
AILERON RUDDER INT.	1	11K
AILERON RUDDER INT.	1	12K
AIRSPEED PITOT HEATER	1	15D
AJB-7	1	16E
AJB-7	1	16G
AJB-7	1	17E
AJB-7	1	17F
AJB-7	1	17G
AJB-7	1	17H
ALR-45 (21)	1	11G
ALR-45 (21)	1	11H
ALT-ENCODER	1	10G
ALT. ENCODER	1	10H
ALT. ENCODER	1	10K
AN/ALE-29A DOOR SWS (6)	1	12A
AN/ALE-29A FIRE SWS (6)	1	11A
AN/ALE-29A FIRE SYS (26)	1	13A
	1	11A
	1	12A
AN/ALQ-51 100 CONTROL (6)	2	5E
AN/ALQ-51 100 RCVR XMTR (6)	2	5B
AN/ALQ-51/100 RCVR XMTR (6)	2	5C
AN/ALQ-51 100 RCVR XMTR (6)	2	5D
AN/ALQ-91A CONTROL (24)	2	4E
AN/ALQ-91A ECM LT CONT (24)	2	4F
AN/ALQ-91A RCVR XMTR (24)	2	4B
AN/ALQ-91A RCVR XMTR (24)	2	4C
AN/ALQ-91A RCVR XMTR (24)	2	4D
AN/ARW-73	2	5F
AN/AWW-1 BOMB FUZING (3)	2	6E
AN/AWW-1 BOMB FUZING (18)	2	7B
AN/AWW-1 BOMB FUZING (18)	2	7C
AN/AWW-1 BOMB FUZING (18)	2	7D
AN/AWW-1 BOMB FUZING (18)	2	7E
ANTI-COLLISION LT.	2	10H
ANTI-ICE	1	14H
ANTI-SKID (2)	1	2B
ANTI-SKID (2)	1	2C
ANTI-SKID (2)	1	2D
ANTI-SKID (2)	1	2E
ANTI-SKID WARN LT (2)	1	2G
A.O.A. PROBE HEATER	1	14K
A.O.A. XMTR. HEATER	1	4J
APN-141 (29)	1	13G
APN-141 (29)	1	13H
APN-194 (30)	1	13G
APN-194 (30)	1	13H
APN-154	1	8J
APPROACH LT. CONT.	2	8K
APPROACH LT. POWER	2	7J
APR-25 (20)	1	11G
APR-25 (20)	1	11H
ARI	LUP	—
ARI ANTI-SKID (2)	1	2F
ARMT. BUS CONT.	1	5A
ARRESTING HOOK CONT.	2	7K
ARRESTING HOOK WARN. LT.	2	7L
AUTO PILOT	1	9F
AUTO PILOT	1	9G
AUTO PILOT	1	9H
AUTO PILOT PITCH	1	9J
AUTO PILOT	1	9E
AUTO PILOT	1	9K
AUTO THROTTLE	2	3M

	C/B Panel	Zone
AUTO THROTTLE	2	3K
AUTO THROTTLE	2	3L
AUX. AIR DOOR CAUTION LT	2	5K
AUX AIR DOOR, L. ENG.	1	16K
AUX AIR DOOR, R. ENG.	1	15K
AWG-10	2	2Q
AWG-10	2	2R
AWG-10 & CONV WPNS (4)	2	6E
BLANKING UNIT (8)	1	10F
BELLMOUTH PITOT HEATER	1	14D
BLC WARNING LT.	1	10C
BLEED AIR OVERHEAT DETECTION (9)	1	1J
BLEED AIR OVERHEAT DETECTION (11)	1	1E
BLEED AIR OVERHEAT DETECTION (9)	1	1H
BLEED AIR OVERHEAT DETECTION (11)	1	1C
BLEED AIR OVERHEAT WARN LT (9)	1	1G
BLEED AIR OVERHEAT WARN LT (11)	1	1D
BOMB AND RKT. REL. CONT.	2	5G
BOMB AND RKT. REL. PWR.	2	6F
BOMB FUZING (19)	2	7B
BOMB FUZING (19)	2	7C
BOMB FUZING (19)	2	7D
BOMB FUZING (19)	2	7E
BUDDY TANK FUEL DUMP	2	9C
BUDDY TANK HOSE JETT.	2	8B
BUDDY TANK HYD PUMP	2	8D
CADC	1	4E
CADC	1	4H
CADC	1	4G
CADC	1	4F
CADC	1	4K
CAMERA AC (25)	2	9D
CAMERA DC (25)	2	10G
CANOPY UNLOCK WARN. LT.	2	8L
CKPT. HEAT AND VENT	2	9M
CKPT. HEAT AND VENT	2	9N
CL GUN POD	1	13K
CNI	1	3E
CNI	1	3F
CNI	1	3G
CNI	1	2K
CNI	1	3K
CNI	1	2J
CNI	1	2H
CORNER REFL. WARN LT.	2	10L
CTR. STORE PWR	2	8C
CTR. STORE SAFETY	2	9B
DATA LINK	1	8E
DATA LINK	1	8F
DATA LINK	1	8G
DATA LINK	1	8H
DUCT TEMP WARNING LT.	2	6L
ECM (23)	2	5B
ECM (23)	2	5C
ECM (23)	2	5D
ECM CONTROL (23)	2	5E
ECM LT. SHOEHORN (7)	2	4F
ELECT. OVHT AND TURBINE OVSP.	2	8P
EMER AIL DROOP (22)	1	1F
EMER. REFUEL PROBE (1)	1	14G
ENCODER IFF WARN. LT.	1	10J
ENGINE BLEED AIR (10)	1	2A
ENGINE OIL LEVEL	1	14B
EQUIP. COOLING (14)	2	8M
EQUIP. COOLING	2	8N
ESS. 28V AUTO XMFR	2	6Q
EXT. FUEL TRANS. WARN LT.	1	14C
EXT. LT. CONT.	2	8F
EXT. STORES EMER. JETT.	1	10B
EXT. WING FUEL CONT.	1	12J
FIRE DETECTOR	1	15E

	C/B Panel	Zone
FLAPS (33)	RUP	
FLAPS/SLATS (32)	RUP	–
FORMATION LTS (31)	2	5H
FUEL FLOW IND.	1	7K
FUEL LEVEL TK. PRESS. WARN. LT.	1	11C
FUEL LOW WARN. LT.	1	11B
FUEL PRESS. IND.	1	8K
FUEL QTY.	1	11D
FUEL QTY ADAPTER (12)	1	11E
FUEL VALVE POWER L.H.	1	15J
FUS. AND ANTI-COLL. LT.	2	9H
FWD. CKPT. INST. LT. XMFR	2	4R
FWD. CKPT. RED CSL FLOOD LT. DIM.	2	5P
FWD. CKPT. RED CSL FLOOD LT. BRT.	2	4O
FWD. CKPT. RED INST. FLOOD LT. DIM.	2	4P
FWD. CKPT. RED INST. FLOOD LT. BRT.	2	5Q
FWD. CSL LT. XMFR	2	5R
GVR-10	1	12E
GVR-10	1	12F
GVR-10	1	12G
GVR-10	1	12H
HYD. PRESS. IND. NO. 1	2	6G
HYD. PRESS. IND. NO. 2	2	6J
HYD. PRESS. WARNING LT.	2	6K
INTERCOM	1	3H
IFR PROBE LT.	2	9G
IFR PROBE UNLOCK WARN LT	1	11J
IGN L. MAIN	1	16F
IGN R. MAIN	1	15F
INT. WING FUEL DUMP	1	17K
JULIET-28 (KY-28)	1	5H
LG	RUP	—
LDG. GEAR AND FLAP POS. IND. (33)	1	15B
LDG GEAR/SLATS WARN LT (32)	1	13C
LDG. GEAR WARN LT. (33)	1	13C
L. ENG. FUEL SHUTOFF	1	17J
L.H. BOOST PUMP EMER. CONT.	1	6H
L.H. BOOST PUMP NORM CONT.	1	7H
L.H. ESS. XMFR. RECT	1	5E
L.H. ESS. XMFR. RECT	1	5F
L.H. ESS. XMFR. RECT	1	5G
L.H. FUEL BOOST PUMP	1	6E
L.H. FUEL BOOST PUMP	1	6F
L.H. FUEL BOOST PUMP	1	6G
L.H. RADAR MISSILE	1	8B
L.H. RADAR MISSILE	1	8C
L.H. RADAR MISSILE	1	8D
L.H. 28V AUTO. XMFR	2	6P
MAIN CONT. WARN. LT.	2	4L
MAIN FUEL CONT.	1	16J
MASTER CAUTION LT.	1	12C
MASTER CAUTION LT. RESET	1	12B
MISSILE ARM	1	9D
MISSILE FIRING	1	9A
MISSILE LTS.	1	9C
NAV COMPUTER	1	10E
NAV COMPUTER	1	10D
NOSE WHEEL STEER.	2	7M
NOSE WHEEL STEER. (13)	2	7N
NOZZLE POS. IND.	1	15G
NO. 4 FUEL TRANS PUMP	1	7A
NO. 4 FUEL TRANS PUMP	1	7B
NO. 4 FUEL TRANS PUMP	1	7C
NO. 4 FUEL TRANS. PUMP	1	7D
NO. 6 FUEL TRANS. PUMP	1	7E
NO. 6 FUEL TRANS. PUMP	1	7F
NO. 6 FUEL TRANS. PUMP	1	7G
NO. 6 FUEL TRANS. PUMP	1	7J

	C/B Panel	Zone
NO. 7 TANK F TRANS PUMP (9)	2	G4
NO. 7 TANK F TRANS PUMP (9)	2	H4
NO. 7 TANK F TRANS PUMP (9)	2	J4
NO. 7 TANK F TRANS PUMP (9)	2	K4
OIL PRESS. IND.	1	16H
OPTICAL SIGHT (28)	1	K1
OPTICAL SIGHT (28)	2	M10
OUTBD. JETT.	1	16A
OUTBD. JETT.	1	16B
OXYGEN GAGE	1	16D
OXYGEN LOW WARN. LT.	1	16C
PNEU. PRESS. IND.	2	7G
PNEU. SYS. CONT.	2	7F
PRIM. GYRO WARN. LT.	2	9P
RADAR MISSILE FAIRING	1	8A
RADAR MISSILE JETT.	1	9B
RADAR POWER	2	1R
RADAR SCOPE CAMERA (13)	2	10K
RADAR SCOPE CAMERA (13)	2	10J
RADAR STANDBY	2	1P
RAIN REMOVAL	2	7P
RAMP CONT. L. ENG.	1	13D
RAMP CONT. R. ENG.	1	12D
RECEIVING DECODING GROUP AN/ARA-63 (15)	2	4A
RECEIVING DECODING GROUP AN/ARA-63 (15)	2	5A
RECEIVING DECODING GROUP AN/ARA-63 (15)	2	6A
RECEIVING DECODING GROUP AN/ARA-63 (15)	2	7A
REFUEL PROBE (16)	1	14J
REFUEL PROBE (17)	1	5J
R.H. FUEL BOOST PUMP CONT.	1	6A
R.H. FUEL BOOST PUMP	1	6B
R.H. FUEL BOOST PUMP	1	6C
R.H. FUEL BOOST PUMP	1	6D
R.H. RADAR MISSILE	2	6B
R.H. RADAR MISSILE	2	6C
R.H. RADAR MISSILE	2	6D
R.H. XMFR. RECT.	1	5B
R.H. XMFR. RECT.	1	5C
R.H. XMFR. RECT.	1	5D
RUDDER FEEL TRIM (7)	1	13B
RUDDER FEEL TRIM AND BELLMOUTH (8)	1	13B
RUDDER POS IND.	1	6K
R.H. 14/28V AUTO. XMFR.	2	6R
RUDDER TRIM	RUP	—
SCOPE LTS. (34)	1	15C
SEAT ADJUST	2	8E
SHOE HORN (7)	1	11A
SHOE HORN (7)	1	12A
SHOE HORN (7)	1	10F
SHOE HORN (7)	2	4B
SHOE HORN (7)	2	4C
SHOE HORN (7)	2	4D
SHOE HORN (7)	2	4E
SHOE HORN (7)	2	5B
SHOE HORN (7)	2	5C
SHOE HORN (7)	2	5D
SHOE HORN (7)	2	5E
SIDEWINDER	1	3A
SIDEWINDER	1	3B
SIDEWINDER	1	3C
SIDEWINDER	1	3D
SIDEWINDER	1	4A
SIDEWINDER	1	4B
SIDEWINDER	1	4C
SIDEWINDER	1	4D
SLATS/FLAPS/LG (32)	1	—
SPEED BRAKE	RUP	
SPEED BRAKE WARN. LT.	2	5L
SP SW GUN VTAS SEL CONT	1	17C
SP SW GUN FIRE POWER (12)	1	17D
STAB. FEEL TRIM	RUP	

	C/B Panel	Zone
STAB. POS. IND.	1	6J
STATIC ACCEL.	2	5M
STORES REL. CONT.	1	10A
TAKE COMMAND LT.	1	3J
TAXI LT.	2	7H
TRIM CONT. (13)	RUP	—
TRIM CONT NLG STEER (12)	RUP	—
TURBINE OUTLET TEMP L. ENG.	1	13F
TURBINE OUTLET TEMP. R. ENG.	1	14F
UTILITY FLOOD LT.	2	5N
UTILITY HYD. PRESS. IND.	2	6H
UTILITY RECEP.	2	9F
UTILITY RECEP. AC	2	9E
VTAS (12)	2	8J
VTAS (12)	2	9J
VTAS (12)	2	10J
VTAS (12)	2	10K
WARNING LT. CONT.	2	4M
WHITE FLOOD LT.	2	4N
WING AND TAIL LT. DIM	2	8G
WING AND TAIL LT. BRT.	2	8H
WING FOLD CONT.	2	9K
WING LOCK WARNING LT.	2	9L
WING TRANS. CONT.	1	13J
WSHLD. TEMP. SENSOR	2	6M
WSHLD. TEMP. WARN. LT.	2	6N

1. F-4J 155867ak AND UP OR AFTER AFC 370 AND ALL F-4S
2. 157242an AND UP
3. 153768ab THRU 155874ak BEFORE AFC 463
4. F-4J 155875al AND UP OR 153768ab THRU 155874ak AFTER AFC 463 AND ALL F-4S
5. F-4J 155529ag THRU 155569ag OR 153768ab THRU 155528ag AFTER AFC 388 BEFORE AFC 541
6. 155570ah AND UP BEFORE AFC 541
7. F-4J 155529ag THRU 155784ah OR 153768ab THRU 155528ag AFTER AFC 388 AND BEFORE AFC 574; IN ALL F-4S
8. 155785ai AND UP BEFORE AFC 574 AND IN ALL F-4S
9. 155903ap AND 157274ap AND UP
10. F-4J 157274ap AND UP OR AFTER AFC 440 AND ALL F-4S
11. 153071z, 153851ae, 158768ab THRU 157273ao AFTER AFC 439 OR AFC 599
12. F-4J 158355at AND UP OR 153768ab THRU 158354as AFTER AFC 506 AND ALL F-4S
13. 153768ab THRU 158354as BEFORE AFC 506, AND 153071z
14. 153071z AND 153768ab THRU 158354as BEFORE AFC 555
15. F-4J 157309ar AND UP OR AFTER AFC 470 AND ALL F-4S
16. 153071z, 153768ab THRU 158365at BEFORE AFC 545
17. F-4J 158366au THRU 158379au OR AFTER AFC 545 AND ALL F-4S
18. 153071z, 153531ae, 153768ab THRU 157309ar
19. 158346as AND UP
20. BEFORE AFC 524
21. F-4J AFTER AFC 524 AND ALL F-4S
22. 153768ab THRU 153838ad OR 153840ae THRU 154785af AFTER AFC 534 OR AFC 599
23. F-4J AFTER AFC 541 AND ALL F-4S
24. 155570ah AND UP
25. F-4J 153768ab THRU 158379au AFTER AFC 518 AND ALL F-4S
26. F-4J 158355at AND UP OR 153768ab THRU 158354as AFTER AFC 506
27. DELETED
28. F-4J 153768ab THRU 158379au AFTER AFC 576 PT I AND ALL F-4S
29. BEFORE AFC 570
30. F-4J AFTER AFC 570 AND ALL F-4S
31. F-4J AFTER AFC 599 AND ALL F-4S
32. F-4S
33. F-4J
34. F-4J 157242an AND UP OR AFTER AFC 486 AND ALL F-4S

LUP-LEFT UTILITY PANEL (FWD CKPT)
RUP-RIGHT UTILITY PANEL (FWD CKPT)

153071z, 153851ae, 155529ag AND UP, AND 153768ab THRU 155528ag AFTER AFC 388.

Figure FO-7. Circuit Breaker Location (Sheet 2 of 3)

ZONE LISTING

	ZONE	C/B Panel
ENGINE BLEED AIR (10)	A2	1
SIDEWINDER	A3	1
SIDEWINDER	A4	1
ARMT BUS CONT	A5	1
RH FUEL BOOST PUMP/CONT	A6	1
NO. 4 FUEL TRANS PUMP	A7	1
RADAR MISSILE FAIRING	A8	1
MISSILE FIRING	A9	1
STORES RELEASE CONT	A10	1
SHOEHORN (7)	A11	1
AN/ALE-29A FIRE SW (8)	A11	1
	A11	1
SHOEHORN (7)	A12	1
AN/ALE-29A DOOR SW (8)	A12	1
	A12	1
A-A IFF (13)	A13	1
AN/ALE-29A FIRE SYS (26)	A13	1
A-A IFF (27)	A13	1
A-A IFF (13) (26)	A14	1
AA/IFF (12)	A15	1
OUTBD JETT	A16	1
ANTI-SKID (2)	B2	1
SIDEWINDER	B3	1
SIDEWINDER	B4	1
RH XMFR RECT	B5	1
RH FUEL BOOST PUMP	B6	1
NO. 4 FUEL TRANS PUMP	B7	1
LH RADAR MISSILE	B8	1
RADAR MISSILE JETT	B9	1
EXT STORES EMER JETT	B10	1
FUEL LOW WARN LT	B11	1
MASTER CAUTION LT RESET	B12	1
RUDDER FEEL TRIM (7)	B13	1
RUDDER FEEL AND BELL-MOUTH (8)	B13	1
ENG OIL LEVEL	B14	1
LG AND FLAP POS IND (33)	B15	1
SLATS/FLAPS/LG (32)	B15	1
OUTBD JETT	B16	1
ENGINE OVERHEAT DETECTION (11)	C1	1
ANTI-SKID (2)	C2	1
SIDEWINDER	C3	1
SIDEWINDER	C4	1
RH XMFR RECT	C5	1
RH FUEL BOOST PUMP	C6	1
NO. 4 FUEL TRANS PUMP	C7	1
LH RADAR MISSILE	C8	1
MISSILE LTS	C9	1
BLC WARN LT	C10	1
F LEVEL TK PRESS WARN LT	C11	1
MASTER CAUTION LT	C12	1
LDG GEAR WARN LT (33)	C13	1
LDG/GEAR/SLATS WARN LT (32)	C13	1
EXT FUEL TRANS WARN LT	C14	
SCOPE LTS (34)	C15	
OXYGEN LOW WARN LT	C16	
SP SW GUN VTAS SEL CONT (12)	C17	
BLEED AIR OVERHEAT WARN LT (11)	D1	
ANTI-SKID (2)	D2	
SIDEWINDER	D3	
SIDEWINDER	D4	
RH XMFR RECT	D5	
RH FUEL BOOST PUMP	D6	
NO. 4 FUEL TRANS PUMP	D7	
LH RADAR MISSILE	D8	
MISSILE ARM	D9	
NAV CMTR	D10	
FUEL QTY	D11	
RAMP CONT R ENG	D12	
RAMP CONT L ENG	D13	
BELLMOUTH PITOT HEATER	D14	
AIRSPEED PITOT HEATER	D15	
OXYGEN GAGE	D16	
SP SW GUN FIRE POWER (12)	D17	
BLEED AIR OVERHEAT DETECTION (11)	E1	

	ZONE	C/B Panel
ANTI-SKID (2)	E2	1
CNI	E3	1
CADC	E4	1
LH ESS XMFR RECT	E5	1
LH FUEL BOOST PUMP	E6	1
NO.6 FUEL TRANS PUMP	E7	1
DATA LINK	E8	1
AUTO PILOT	E9	1
NAV CMTR	E10	1
FUEL QTY ADAPTER (12)	E11	1
GVR-10	E12	1
A/B IGN R, ENG	E13	1
A/B IGN L, ENG	E14	1
FIRE DETECTOR	E15	1
AJB-7	E16	1
AJB-7	E17	1
EMER AIL DROOP (22)	F1	1
ARI/ANTI-SKID (2)	F2	1
CNI	F3	1
CADC	F4	1
LH ESS XMFR RECT	F5	1
LH FUEL BOOST PUMP	F6	1
NO. 6 FUEL TRANS PUMP	F7	1
DATA LINK	F8	1
AUTO PILOT	F9	1
SHOEHORN (7)	F10	1
BLANKING UNIT (8)	F10	1
GVR-10	F12	1
TURBINE OUTLET TEMP L ENG	F13	1
TURBINE OUTLET TEMP R ENG	F14	1
IGN R MAIN	F15	1
IGN L MAIN	F16	1
AJB-7	F17	1
BLEED AIR OVERHEAT WARN LT (9)	G1	1
ANTI-SKID WARN LT (2)	G2	1
CNI	G3	1
CADC	G4	1
LH ESS XMFR RECT	G5	1
LH FUEL BOOST PUMP	G6	1
NO. 6 FUEL TRANS PUMP	G7	1
DATA LINK	G8	1
AUTO PILOT	G9	1
ALT ENCODER	G10	1
APR-25	G11	1
ALR-45	G11	1
GVR-10	G12	1
APN-141 (29)	G13	1
APN-194 (30)	G13	1
EMER REFUEL PROBE (1)	G14	1
NOZZLE POS IND	G15	1
AJB-7	G16	1
AJB-7	G17	1
BLEED AIR OVERHEAT DETECTION (9)	H1	1
CNI	H2	1
INTERCOM	H3	1
CADC	H4	1
JULIET-28	H5	1
LH BOOST PUMP EMER CONT	H6	1
LH BOOST PUMP NORM CONT	H7	1
DATA LINK	H8	1
AUTO PILOT	H9	1
ALT ENCODER	H10	1
APR-25 (20)	H11	1
ALR-45 (21)	H11	1
GVR-10	H12	1
APN-141 (29)	H13	1
APN-194 (30)	H13	1
ANTI-ICE	H14	1
AILERON DROOP ACTR	H15	1
OIL PRESS	H16	1
AJB-7	H17	1
BLEED AIR OVERHEAT DETECTION (9)	J1	1
CNI	J2	1

	ZONE	C/B Panel
TAKE COMMAND LT	J3	1
A.O.A. XMTR HEATER	J4	1
REFUEL PROBE (17)	J5	1
STAB POS IND	J6	1
NO. 6 FUEL TRANS PUMP	J7	1
APN-154	J8	1
AUTO PILOT PITCH	J9	1
ENCODER IFF WARN LT	J10	1
IFR PROBE UNLOCK WARN LT	J11	1
EXT WING FUEL CONT	J12	1
WING TRANS CONT	J13	1
REFUEL PROBE (16)	J14	1
FUEL VALVE PWR LH	J15	1
MAIN FUEL CONT	J16	1
L ENG FUEL SHUTOFF	J17	1
OPTICAL SIGHT (28)	K1	1
CNI	K2	1
CNI	K3	1
CADC	K4	1
AILERON POS IND	K5	1
RUDDER POS IND	K6	1
FUEL FLOW IND	K7	1
FUEL PRESS IND	K8	1
AUTO PILOT	K9	1
ALT ENCODER	K10	1
AILERON RUDDER INTER-CONNECT	K11	1
AILERON RUDDER INTER-CONNECT	K12	1
CL GUN POD	K13	1
A.O.A. PROBE HEATER	K14	1
R ENG AUX AIR DOOR	K15	1
L ENG AUX AIR DOOR	K16	1
INT WING FUEL DUMP	K17	1
RECEIVING DECODING GROUP AN/ARA-63 (8)	A4	2
RECEIVING DECODING GROUP AN/ARA-63 (15)	A5	2
RECEIVING DECODING GROUP AN/ARA-63 (15)	A6	2
RECEIVING DECODING GROUP AN/ARA-63 (15)	A7	2
SHOEHORN (5)	B4	2
AN/ALQ-91A RCVR XMTR (24)	B4	2
SHOEHORN (5)	B5	2
AN/ALQ-51/100 RCVR XMTR (6)	B5	2
ECM (23)	B5	2
RH RADAR MISSILE	B6	2
AN/AWW-1 BOMB FUZING (18)	B7	2
BOMB FUZING (19)	B7	2
BUDDY TANK HOSE JETT	B8	2
CTR STORE SAFETY	B9	2
SHOEHORN (5)	C4	2
AN/ALQ-91A RCVR XMTR (24)	C4	2
SHOEHORN (5)	C5	2
AN/ALQ-51/100 RCVR XMTR (6)	C5	2
ECM (23)	C5	2
RH RADAR MISSILE	C6	2
AN/AWW-1 BOMB FUZING (18)	C7	2
BOMB FUZING (19)	C7	2
CTR STORE PWR	C8	2
BUDDY TANK FUEL DUMP	C9	2
SHOEHORN (5)	D4	2
AN/ALQ-91A RCVR XMTR (24)	D4	2
SHOEHORN (5)	D5	2
AN/ALQ-51/100 RCVR XMTR (6)	D5	2
ECM (23)	D5	2
RH RADAR MISSILE	D6	2
AN/AWW-1 BOMB FUZING (18)	D7	2
BOMB FUZING (19)	D7	2
BUDDY TANK HYD PUMP	D8	2
CAMERA AC	D9	2
SHOEHORN (5)	E4	2
AN/ALQ-91A CONTROL (24)	E4	2
SHOEHORN (5)	E5	2

	ZONE	C/B Panel
AN/A LQ-51/100 CONT (6)	E5	2
ECM CONTROL (23)	E5	2
AWG- -10 & CONV WPNS (4)	E6	2
AN/W W-1 BOMB FUZING (3)	E6	2
AN/W W-1 BOMB FUZING (18)	E7	2
BOMB FUZING (19)	E7	2
SEAT ADJUST	E8	2
UTILI TY RECEP AC	E9	2
ECM LT SHOEHORN (5)	F4	2
AN/A LQ-91A ECM LT CONT (24)	F4	2
AN/A RW-73	F5	2
BOMB & ROCKET REL PWR	F6	2
PNEU SYS CONT	F7	2
EXT LTS CONTROL	F8	2
UTILI TY RECEP	F9	2
NO. 7 TANK F TRANS PUMP (9)	G4	2
BOMB & RKT REL CONTROL	G5	2
HYD PRESS IND NO. 1	G6	2
PNEU PRESS IND	G7	2
WING & TAIL LT DIM	G8	2
IFR PROBE LT	G9	2
CAMERA DC	G10	2
NO. 7 TANK F TRANS PUMP (9)	H4	2
FORMATION LTS (31)	H5	2
UTIL TY HYD PRESS IND	H6	2
TAXI LT	H7	2
WING AND TAIL LT BRT	H8	2
FUS & ANTI-COLLISION LT	H9	2
ANTI-COLLISION LT	H10	2
NO. 7 TANK F TRANS PUMP (9)	J4	2
HYD PRESS IND NO. 2	J6	2
APPROACH LT PWR	J7	2
VTAS (12)	J8	2
VTAS (12)	J9	2
VTAS (12)	J10	2
RADAR SCOPE CAMERA (13)	J10	2
AUTO THROT	K3	2
NO. TANK F TRANS PUMP (9)	K4	2
AUX AIR DOOR CAUTION LT	K5	2
HYD PRESS WARN LT	K6	2
ARR HOOK CONT	K7	2
APPROACH LT CONT	K8	2
WING FOLD CONT	K9	2
RADAR SCOPE CAMERA (13)	K10	2
VTAS (12)	K10	2
AUTO THROT	L3	2
MAIN CONT WARNING LT	L4	2
SPEED BRAKE WARNING LT	L5	2
DUCT TEMP WARNING LT	L6	2
ARR HOOK WARNING LT	L7	2
CANOPY UNLOCK WARN LT	L8	2
WING LOCK WARNING LT	L9	2
COR REFL WARNING LT	L10	2
AUTO THROT	M3	2
WARNING LT CONT	M4	2
STAT IC ACCEL	M5	2
WSHLD TEMP SENSOR	M6	2
NOSE WHEEL STEER	M7	2
EQUIP COOLING (14)	M8	2
CKPT HEAT AND VENT	M9	2
OPTICAL SIGHT (28)	M10	2
AFT CKPT EQUIP LT	N3	2
WHT FLOOD LT	N4	2
UTIL ITY FLOOD LT	N5	2
WSHLD TEMP WARNING LT	N6	2
NOSE WHEEL STEER (13)	N7	2
EQUIP COOLING	N8	2
CKPT HEAT AND VENT	N9	2
RADAR STANDBY	P1	2
AFT CKPT FLOOD LT DIM	P3	2
FWD CKPT RED INST LT DIM	P4	2
FWD CKPT RED CSL FLOOD LT DIM	P5	2

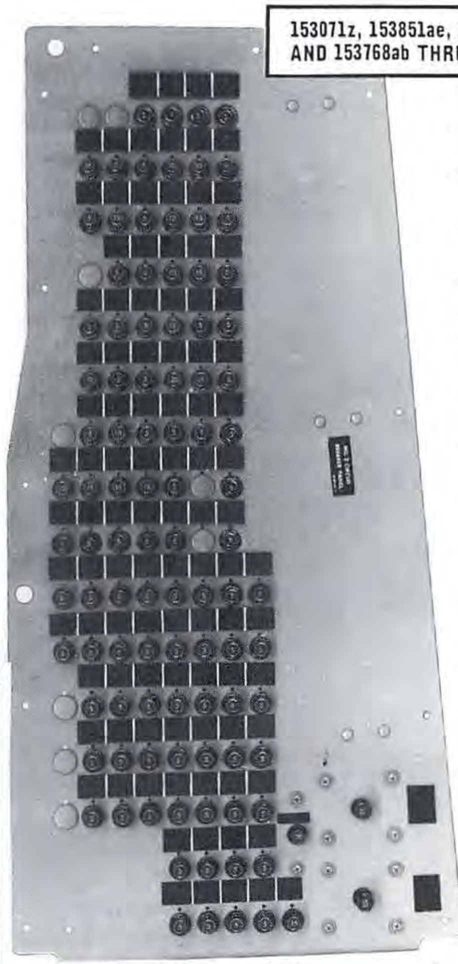
	ZONE	C/B Panel
L28 V AUTO XMFR	P6	2
RAIN REMOVAL	P7	2
ELECT OVHT AND TURB OVSP	P8	2
PRIM GYRO WARNING LT	P9	2
AWG-10	Q2	2
AFT CKPT FLOOD LT BRT	Q3	2
FWD CKPT RED CSL FLOOD LT BRT	Q4	2
FWD CKPT RED INST FLOOD LT BRT	Q5	2
ESS 28V AUTO XMFR	Q6	2
RADAR POWER	R1	2
AWG-10	R2	2
AFT CKPT INST LT XMFR	R3	2
FWD CKPT INST LT XMFR	R4	2
FWD CSL LT XMFR	R5	2
RH 14/28V AUTO XMFR	R6	2
ARI	–	LUP
AILERON FEEL TRIM	–	RUP
FLAPS (33)	–	RUP
FLAPS/SLATS (32)	–	RUP
LG	–	RUP
RUDDER TRIM	–	RUP
SPEED BRAKE	–	RUP
STAB FEEL TRIM	–	RUP
TRIM CONT (13)	–	RUP
TRIM CONT NLG STEER (12)		RUP

1. F-4J 155867ak AND UP OR AFTER AFC 370 AND ALL F-4S
2. 157242an AND UP
3. 153768ab THRU 155874ak BEFORE AFC 463
4. F-4J 155875al AND UP OR 153768ab THRU 155874ak AFTER AFC 463 AND ALL F-4S
5. F-4J 155529ag THRU 155569ag OR 153768ab THRU 155528ag AFTER AFC 388 BEFORE AFC 541
6. 155570ah AND UP BEFORE AFC 541
7. F-4J 155529ag THRU 155784ah OR 153768ab THRU 155528ag AFTER AFC 388 AND BEFORE AFC 574; IN ALL F-4S
8. 155785ai AND UP BEFORE AFC 574 AND IN ALL F-4S
9. 155903ap AND 157274ap AND UP
10. F-4J 157274ap AND UP OR AFTER AFC 440 AND ALL F-4S
11. 153071z, 153851ae, 158768ab THRU 157273ao AFTER AFC 439 OR AFC 599
12. F-4J 158355at AND UP OR 153768ab THRU 158354as AFTER AFC 506 AND ALL F-4S
13. 153768ab THRU 158354as BEFORE AFC 506, AND 153071z
14. 153071z AND 153768ab THRU 158354as BEFORE AFC 555
15. F-4J 157309ar AND UP OR AFTER AFC 470 AND ALL F-4S
16. 153071z, 153768ab THRU 158365at BEFORE AFC 545
17. F-4J 158366au THRU 158379au OR AFTER AFC 545 AND ALL F-4S
18. 153071z, 153531ae, 153768ab THRU 157309ar
19. 158346as AND UP
20. BEFORE AFC 524
21. F-4J AFTER AFC 524 AND ALL F-4S
22. 153768ab THRU 153838ad OR 153840ae THRU 154785af AFTER AFC 534 OR AFC 599
23. F-4J AFTER AFC 541 AND ALL F-4S
24. 155570ah AND UP
25. F-4J 153768ab THRU 158379au AFTER AFC 518 AND ALL F-4S
26. F-4J 158355at AND UP OR 153768ab THRU 158354as AFTER AFC 506.
27. DELETED
28. F-4J 153768ab THRU 158379au AFTER AFC 576 PT I AND ALL F-4S
29. BEFORE AFC 570
30. F-4J AFTER AFC 570 AND ALL F-4S
31. F-4J AFTER AFC 599 AND ALL F-4S
32. F-4S
33. F-4J
34. F-4J 157242an AND UP OR AFTER AFC 486 AND ALL F-4S

LUP-LEFT UTILITY PANEL (FWD CKPT)
RUP-RIGHT UTILITY PANEL (FWD CKPT)

153071z, 153851ae, 155529ag AND UP, AND 153768ab THRU 155528ag AFTER AFC 388.

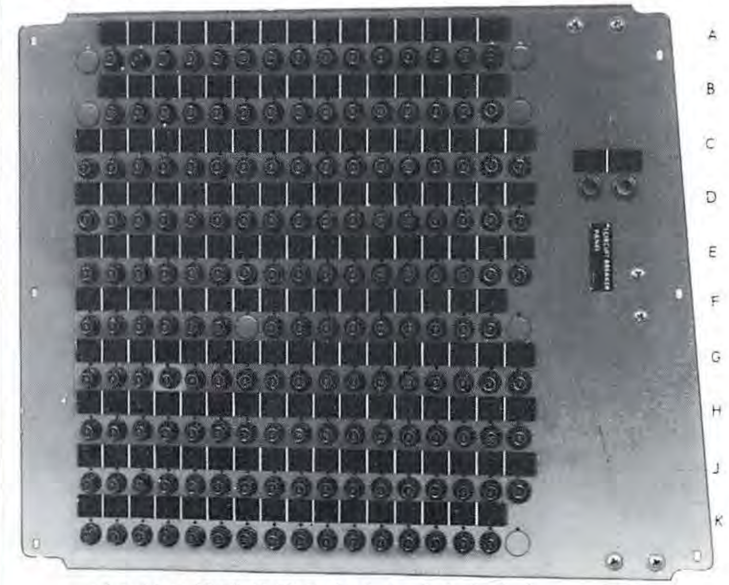
ZONE LISTING



NO. 2 CIRCUIT BREAKER PANEL

FWD

UP



NO. 1 CIRCUIT BREAKER PANEL

N12/88
FDD-1-(279-3)G

Figure FO-7. Circuit Breaker Location (Sheet 3 of 3)

LIST OF EFFECTIVE PAGES

Effective Pages	Page Numbers
Original	1 (Reverse Blank)
Original	3 (Reverse Blank)
Original	5 thru 9 (Reverse Blank)
Original	11 thru 45 (Reverse Blank)
Original	47 (Reverse Blank)
Original	49 thru 51(Reverse Blank)
Original	53 thru 59 (Reverse Blank)
Original	61 thru 63 (Reverse Blank)
Original	I-1-1 thru I-1-3 (Reverse Blank)
Original	I-2-1 thru I-2-151 (Reverse Blank)
Original	I-3-1 (Reverse Blank)
Original	I-4-1 thru I-4-11 (Reverse Blank)
Original	65 (Reverse Blank)
Original	II-5-1 thru II-5-5 (Reverse Blank)
Original	67 (Reverse Blank)
Original	III-6-1, III-6-2
Original	III-7-1 (Reverse Blank)
Original	III-8-1 thru III-8-43 (Reverse Blank)
Original	III-9-1 thru III-9-18
Original	III-10-1, III-10-13 (Reverse Blank)
Original	69 (Reverse Blank)
Original	IV-11-1 thru IV-11-51 (Reverse Blank)
Original	71 (Reverse Blank)
Original	V-12-1 thru V-12-19 (Reverse Blank)
Original	73 (Reverse Blank)
Original	VI-13-1 thru VI-13-7 (Reverse Blank)
Original	75 (Reverse Blank)
Original	VII-14-1 thru VII-14-9 (Reverse Blank)
Original	77 (Reverse Blank)
Original	VIII-15-1, VIII-15-2
Original	79 (Reverse Blank)
Original	IX-16-1 thru IX-16-20
Original	81 (Reverse Blank)
Original	X-17-1 thru X-17-23 (Reverse Blank)

Effective Pages	Page Numbers
Original	83 (Reverse Blank)
Original	XI-18-1 thru IX-18-24
Original	X-19-1 thru X-19-9 (Reverse Blank)
Original	XI-20-1 thru XI-20-14
Original	XI-21-1 thru XI-21-19 (Reverse Blank)
Original	XI-22-1 thru XI-22-8
Original	XI-23-1, XI-23-2
Original	XI-24-1, XI-24-2
Original	XI-25-1, XI-25-2
Original	XI-26-1 thru XI-26-58
Original	XI-27-1 (Reverse Blank)
Original	85 (Reverse Blank)
Original	XII-28-1 thru XII-28-10
Original	XII-29-1 thru XII-29-12
Original	XII-30-1 thru XII-30-14
Original	XII-31-1 thru XII-31-19 (Reverse Blank)
Original	XII-32-1 thru XII-32-8
Original	XII-33-1, XII-33-2
Original	XII-34-1, XII-34-2
Original	XII-35-1, XII-35-2
Original	XII-36-1 thru XII-36-57 (Reverse Blank)
Original	Index-1 thru Index-11 (Reverse Blank)
Original	FO-1 (Reverse Blank)
Original	FO-3 (Reverse Blank)
Original	FO-5 (Reverse Blank)
Original	FO-7 (Reverse Blank)
Original	FO-9 (Reverse Blank)
Original	FO-11 (Reverse Blank)
Original	FO-13 (Reverse Blank)
Original	FO-15 (Reverse Blank)
Original	FO-17 (Reverse Blank)
Original	FO-19 (Reverse Blank)
Original	FO-21 (Reverse Blank)
Original	FO-23 (Reverse Blank)
Original	FO-25 (Reverse Blank)
Original	LEP-1 (Reverse Blank)