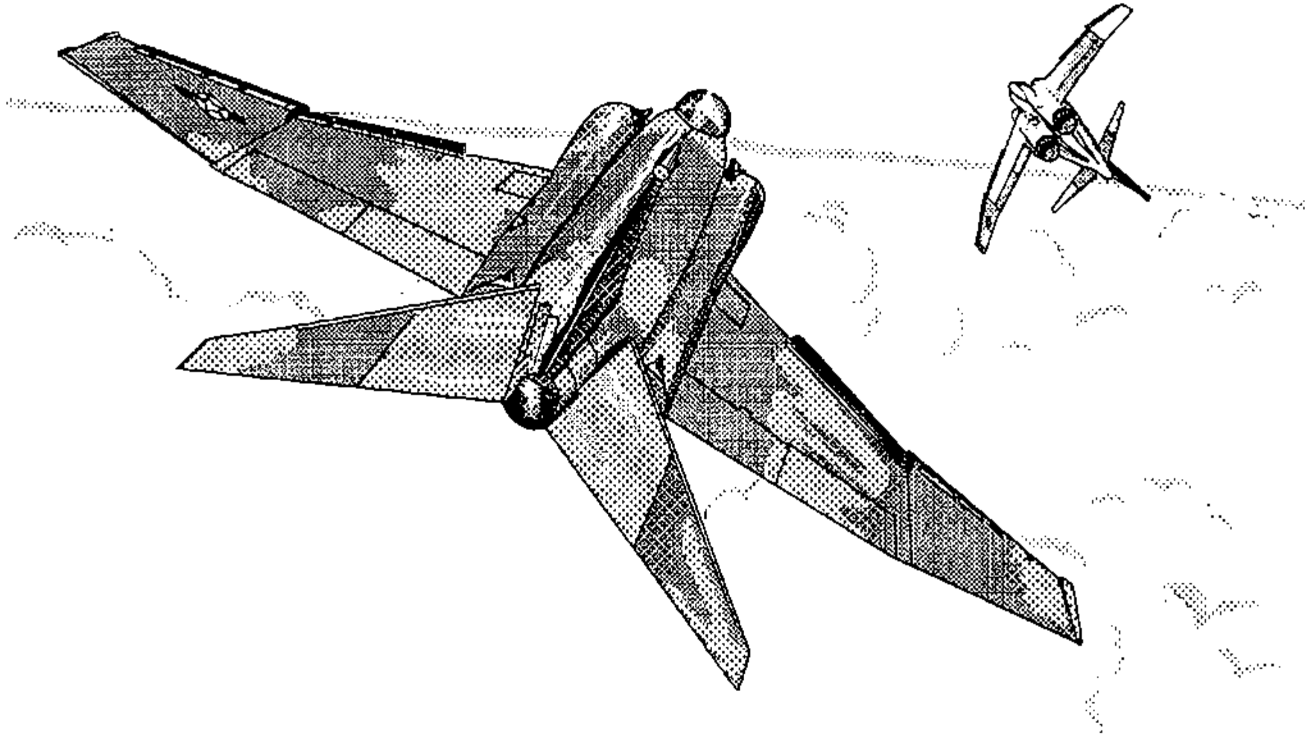
FLIGHT MANUAL

USAF SERIES F-4G AIRCRAFT



(ATOS)

MCDONNELL AIRCRAFT
F42600-75-C-1708
F42600-89-D-0284

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CHANGE 14 - 3 NOVEMBER 1993

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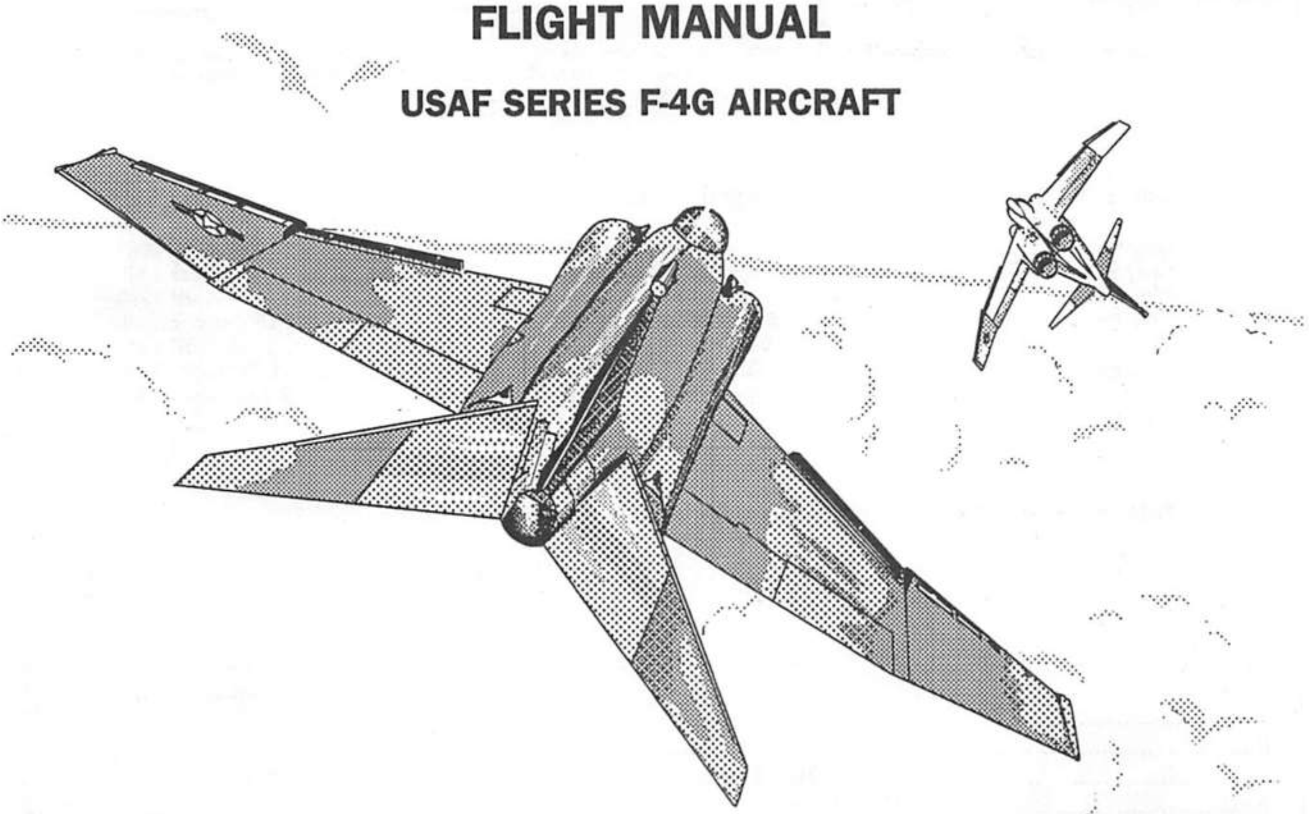
USAF SERIES F-4G AIRCRAFT



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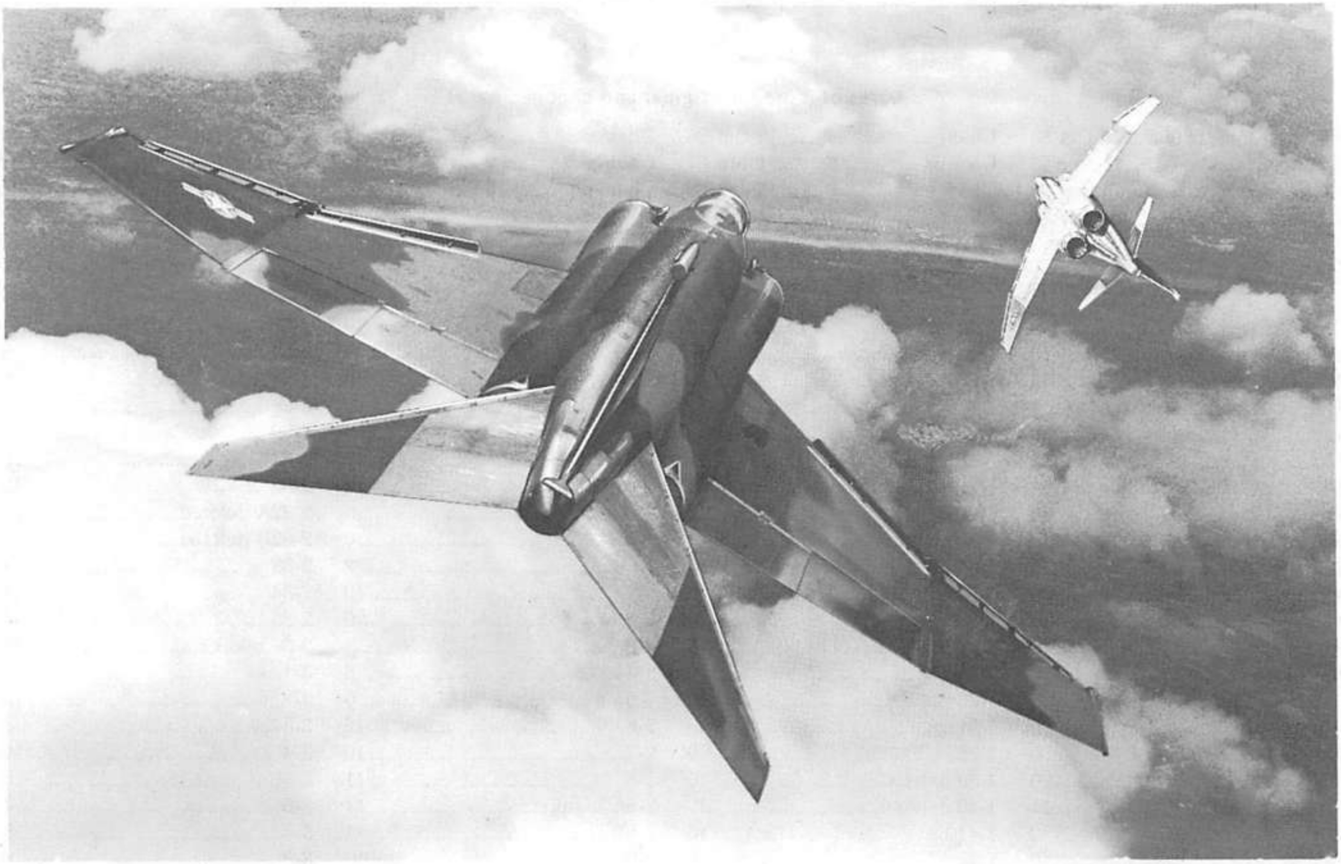
USAF SERIES F-4G AIRCRAFT



McDonnell Aircraft

F42600-75-C-1708

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MEET THE PHANTOM

SCOPE. This manual contains necessary information for the safe and efficient operation of the F-4G Phantom II. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and, therefore, basic flight principles are avoided.

SOUND JUDGMENT. Instructions in this manual are for a crew inexperienced in the operation of this aircraft. This manual provides the best possible operating instructions under most circumstances, but it is not intended to be used as a substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc. may require modification of the procedures.

PERMISSIBLE OPERATIONS. The Flight Manual takes a positive approach and normally states only what you can do. Clearance must be obtained from Ogden ALC before any questionable operation is attempted which is not specifically permitted in this manual.

CURRENCY. Currency of the manual is maintained through revisions, routine changes, rapid action changes, and safety and operational supplements. The revision is a completely reprinted manual, and, normally, contains the results of the Flight Manual Command Review. Routine changes are issued as required, and, normally, contain ECP/TCTO coverage and changes/additions to the manual that do not require immediate dissemination. Rapid action changes are expeditiously prepared and published as formal replacement pages for the manual, and are normally issued in lieu of, or to replace, safety/operational supplements.

SUPPLEMENTS. Information involving safety or urgent operational requirements will be promptly forwarded to you by either a safety supplement or an operational supplement. Interim supplements (in TWX form) will be replaced by either a formal supplement, a rapid action change, or during a routine change/revision. The title page of the flight manual and the title block of each supplement should be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements. A quarterly information sheet (in TWX form) will list the status of the latest flight manual and checklist changes, and all outstanding supplements.

CHECKLISTS. The Flight Manual contains only amplified checklists. Checklists have been issued as separate technical orders - see the back of the title page for TO number and date of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Safety Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As soon as possible, a new checklist page incorporating the supplement will be issued. This will keep handwritten entries of Safety Supplement information in your checklist to a minimum.

PERFORMANCE DATA. Performance Data is contained in Appendix A.

FLIGHT MANUAL BINDERS. Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures. The binders are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1).

CHANGE SYMBOL. The change symbol, as illustrated by the black line in the margin of this paragraph, indicates text and tabular illustration changes made to the current issue. Changes to illustrations (except tabular and performance data in appendix A) are indicated by a changed area box located at the upper right side of the illustration. The box is divided into eight equal parts which represent eight proportional areas of the illustration. The shaded area of the box represents the area of the illustration which contains a change. An unshaded box indicates no change. The word "NEW" will appear in the box for new illustrations.

WARNINGS, CAUTIONS, AND NOTES. The following definitions apply to Warnings, Cautions, and Notes found throughout the manual.

WARNING

Operating procedures, techniques, etc., which could result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, technique, etc., which is considered essential to emphasize.

YOUR RESPONSIBILITY - TO LET US KNOW. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters on AF Form 847 in accordance with AFR 50−9 to HQ Odgen ALC, Hill AFB, Utah 84056−5609; Attn: LACS−2.

TECHNICAL ORDER SUMMARY

The Technical Order Summary lists only those technical orders which affect this manual.

Technical Order	ECP	Title	Production Effectivity	Retrofit Effectivity
1F−4−1262		Adds voice warning system	none	All
1F−4−1320	MOD 3025	Adds KY−58 Vinson secure voice UHF radio communication	none	All
1F−4−1414		Improve fuel quantity gaging system and adds new indicator	none	All
1F−4−1448		Install HAVE QUICK II system	none	All
1F−4−1484		Adds aural warning (FIRE−FIRE) to voice warning system	none	All
1F−4−1503		Modification of the F−4 aircraft fire/overheat detection system	none	All
	MOD 3107	Modified aircraft for low smoke engine and high energy ignition	none	Selected aircraft
1F−4E−600 and −601	MOD 2740	Conversion of additional F−4E to F−4G configuration	none	Selected aircraft
1F−4−1495		Removal of KY−532B and replacement with KY−532C, F−4 aircraft	none	All
1F−4−1500		Installation of one−piece windscreen	none	Selected aircraft
1F−4−1518		Installation of redundant aft canopy emergency air bottle, F/RF−4 aircraft	none	All
1F−4−1552		Replacement of Have Quick control C−10832/ARC−164(V) with C−11815/ARC−164(C), F−4E/G aircraft	none	All

SAFETY/OPERATIONAL SUPPLEMENT SUMMARY

The following list contains: the previously cancelled or incorporated Safety/Operational Supplements; the outstanding Safety/Operational Supplements; if any; and the Safety/Operational Supplements incorporated in this issue. In addition, space is provided to list those Safety/Operational Supplements received since the latest issue.

NUMBER	SUBJECT OR DISPOSITION
TO 1F–4G–1S–1 THRU 1S–62	Previously cancelled or incorporated.
TO 1F–4G–1SS–63	Ejection seat survival kit selector switch incorporated in this issue.

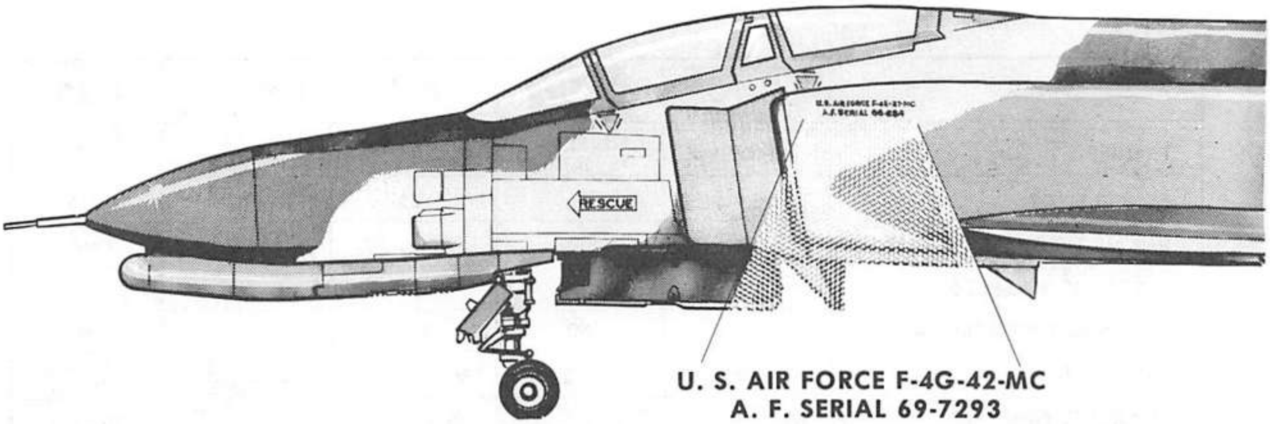
SOFTWARE NOTICE

OPERATIONAL FLIGHT PROGRAM (OFP) SOFTWARE IDENTIFICATION/ CHANCE SUMMARY

The OFP number and the functional changes resulting from an OFP change are identified in the following table. This manual is changed or an Operational Supplement is issued to provide rapid distribution of the new function and remove the old function. OFP changes that do not affect the aircrew are not listed.

OFP NUMBER	EQUIPMENT AFFECTED	IDENTIFICATION/CHANGE
OFP 12.04	AN/ARN−101	OFP number is located in the power on interactive list, item 1.

BLOCK NUMBERS



U. S. AIR FORCE F-4G-42-MC
A. F. SERIAL 69-7293

F-4G-42-MC

A.F. SERIAL 69-0236 thru 69-0255
A.F. SERIAL 69-0258 thru 69-0261
A.F. SERIAL 69-0263 thru 69-0265
A.F. SERIAL 69-0267
A.F. SERIAL 69-0269 thru 69-0275
A.F. SERIAL 69-0277 thru 69-0281
A.F. SERIAL 69-0284 thru 69-0286
A.F. SERIAL 69-0290 thru 69-0293
A.F. SERIAL 69-0297

F-4G-43-MC

A.F. SERIAL 69-0303 thru 69-0307
A.F. SERIAL 69-7201 thru 69-7202
A.F. SERIAL 69-7204
A.F. SERIAL 69-7206 thru 69-7212
A.F. SERIAL 69-7214 thru 69-7220
A.F. SERIAL 69-7223
A.F. SERIAL 69-7228
A.F. SERIAL 69-7231 thru 69-7236
A.F. SERIAL 69-7251 thru 69-7254
A.F. SERIAL 69-7256 thru 69-7258
A.F. SERIAL 69-7260

F-4G-44-MC

A.F. SERIAL 69-7261 thru 69-7263
A.F. SERIAL 69-7267
A.F. SERIAL 69-7270
A.F. SERIAL 69-7272
A.F. SERIAL 69-7286 thru 69-7291
A.F. SERIAL 69-7293 thru 69-7295
A.F. SERIAL 69-7297 thru 69-7298
A.F. SERIAL 69-7300 thru 69-7303
A.F. SERIAL 69-7546
A.F. SERIAL 69-7550 thru 69-7551
A.F. SERIAL 69-7556 thru 69-7558
A.F. SERIAL 69-7560 thru 69-7561
A.F. SERIAL 69-7566
A.F. SERIAL 69-7571 thru 69-7572
A.F. SERIAL 69-7574

F-4G-45-MC

A.F. SERIAL 69-7579 thru 69-7583
A.F. SERIAL 69-7586 thru 69-7588

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MAIN DIFFERENCES

	F-4C	F-4D	F-4E	F-4E AFTER TO 1F-4E-626	F-4G
ENGINES	J79-GE-15	J79-GE-15/15A/15E	J79-GE-17A/E/F/G	J79-GE-17A/E/F/G	J79-GE-17A/C/E/F/G
NO. 7 FUEL CELL	NO	NO	YES	YES	YES
RAM AIR TURBINE	YES	YES	NO	NO	NO
HYDRAULIC WING FOLD	YES	YES	NO	NO	NO
INTERNALLY MOUNTED GUN	NO	NO	YES	YES	NO
RADAR SET	AN/APQ-100	AN/APQ-109	AN/APQ-120	AN/APQ-120 MODIFIED	AN/APQ-120 MODIFIED
INTERCEPT COMPUTER	AN/APA-157	AN/APA-157 or AN/APA-165	AN/APQ-120	AN/APQ-120	AN/APQ-120
OPTICAL SIGHT	FIXED	AN/ASG-22	AN/ASG-26	AN/ASG-26 MODIFIED	AN/APQ-30 MODIFIED
TISEO (AN/ASX-1)	NO	NO	71-237 AND UP	AN/ASX-1 MODIFIED	NO
RADAR RECEIVING SET	NO	NO	NO	NO	AN/APR-47
WEAPONS RELEASE COMPUTER	NONE	AN/ASQ-91	AN/ASQ-91	NO	NO
INERTIAL NAVIGATION SET	AN/ASN-48	AN/ASN-63	AN/ASN-63	NO	NO
NAVIGATION COMPUTER	AN/ASN-46	AN/ASN-46A	AN/ASN-46A	NO	NO
AUXILIARY POWER UNIT	NO	NO	68-452 AND UP	YES	YES
SELF SEALING FUSELAGE FUEL CELLS	NO	NO	68-495 AND UP	YES	YES
LEADING EDGE BOUNDARY LAYER CONTROL	YES	YES	NO	NO	NO
LEADING EDGE SLATS	NO	NO	YES	YES	YES
ATTITUDE REFERENCE BOMBING COMPUTER SET	AN/AJB-7	AN/AJB-7	AN/AJB-7	AN/AJB-7 MODIFIED	AN/AJB-7 MODIFIED
DIGITAL MODULAR AVIONICS SYSTEM (DMAS)	NO	NO	NO	YES	YES
AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)	AN/ASA-32J	AN/ASA-32J	AN/ASA-32J	AN/ASA-32J MODIFIED	AN/ASA-32J MODIFIED

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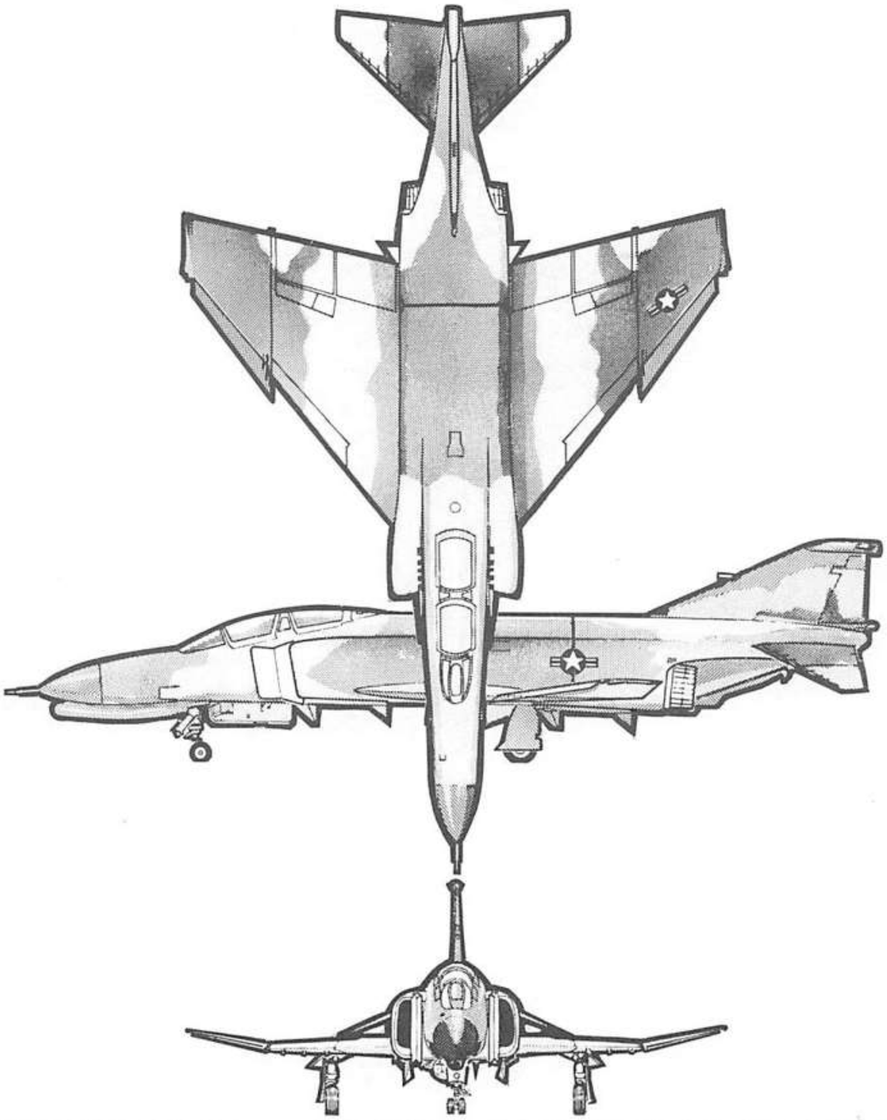
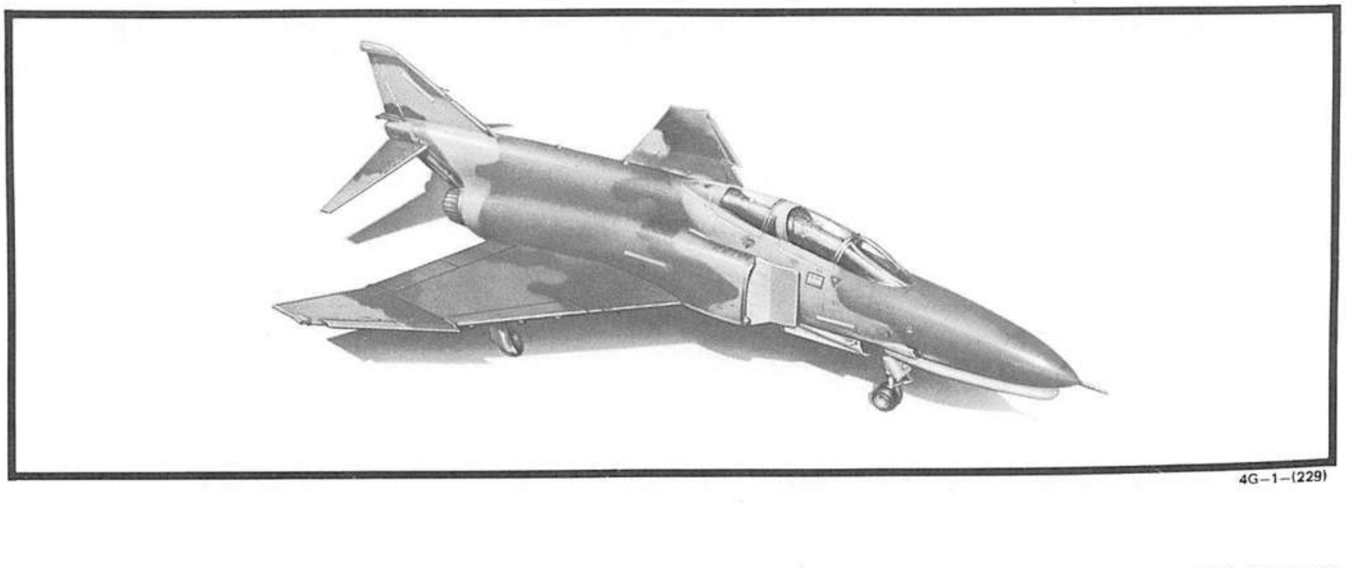
F-4G





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SECTION I
DESCRIPTION

TABLE OF CONTENTS

NOTE

- All references to airspeed in this manual quoted in Knots will equate to IAS.
- Throughout the manual, retrofit (TCTO) effectivities are presented in abbreviated form. Refer to the Technical Order Summary at the front of the manual for detailed production/retrofit effectivities.

AIRCRAFT

The aircraft is a two-place (tandem), supersonic, long-range, all-weather fighter-bomber built by McDonnell Douglas Corporation. Refer to foldout section for general arrangement illustration. Mission capabilities include: defense suppression using anti-radiation missiles (ARMS); elector-optical (EO) guided weapons and unguided bombs; long-range attack using conventional or nuclear weapons; close air support using a choice of bombs and missiles; and long-range, high-altitude intercepts utilizing air-to-air missiles. Aircraft thrust is provided by two axial-flow turbo jet engines with variable stators and variable afterburner. Dual, irreversible power control cylinders, position the stabilator, ailerons, and spoilers. A single, irreversible hydraulic power control cylinder positions the rudder. An integral pneumatic system, charged by a hydraulically driven air compressor, supplies compressed air for normal and emergency canopy operation, as well as emergency operation for the landing gear and slats flaps. The wings can be folded for ease of airplane storage and ground handling. A drag chute, contained in the end of the fuselage, significantly reduces landing roll distances and an arresting hook, that is hydraulically retracted, can be utilized to stop the airplane under a wide range of gross weight-airspeed combinations.

DIMENSIONS

The approximate overall dimensions of the aircraft are:

Span (wings spread) - 38 feet, 5 inches

Span (wings folded) - 27 feet, 7 inches

Length - 63 feet

Height - 16 feet, 5 inches

Distance between main landing gear - 17 feet, 11 inches

Minimum recommended turning radius during taxi for nose boom clearance 41 feet, 1 inch.

GROSS WEIGHT

The approximate gross weights (to the nearest 500 pounds) are as follows. For specific gross weights refer to the handbook of Weight and Balance Data TO 01-1B-40.

Operating weight	33,500 lb.
Operating weight, plus a full internal fuel load	46,000 lb.
Operating weight, plus a full internal fuel load, plus an external centerline tank	50,000 lb.
Operating weight, plus a full internal fuel load, plus two external wing tanks	51,500 lb.
Operating weight, plus a full internal fuel load, plus three external fuel tanks	55,500 lb.

NOTE

The operating weight is basic weight plus two crewmembers (440 pounds) and engine oil (99 pounds). The weight of the fuel, and external stores must be added to the operating weight to obtain gross weight. Refer to Airplane Loading chart, appendix A.

ARMOR PLATING

There are provisions for attaching parasitic steel armor plating to doors 15, 16, 22, 23, 28 left and right; and internal ceramic armor in the aft fuselage. This armor, when installed, protects the oxygen bay, hydraulic/engine fuel feed compartment and stabilator actuator. The armor adds approximately 144 pounds to the weight of the aircraft and shifts the CG forward approximately 0.1% MAC.

ARMAMENT

Refer to TO 1F-4G-34-1-1, for information on armament.

ENGINES

The aircraft is powered by two General Electric J79-GE-17A, -17C, -17E, -17F or -17G engines with modulated afterburner. The -17C/E/G engines are equipped with a low smoke combustion section which slightly degrades range performance. Refer to the NOTE on page A1-1. If operational requirements dictate, low smoke and non low smoke engines may be installed in the same airplane. A turbine type starter, operated by air from an external source or by the expanding gases of a solid propellant cartridge is used to crank the engines for starting. Either the aircraft battery or an external electrical power source is used to provide electrical power during starting. Engine bleed air, taken from the 17th stage of the compressor, is ducted to the cockpit air conditioning and pressurization system, and the equipment air conditioning system. From these systems, it is further ducted to supply air to the air data computer, the engine anti-icing system, the fuel tank pressurization system, the pneumatic system air compressor, and the windshield rain removal system. The -17C engines slightly degrade range performance. See note in Performance Section, Part 1.

ENGINE FUEL SYSTEM

The fuel system for each engine is complete in itself, and the systems are identical. Refer to foldout section for airplane and engine fuel system illustration. For clarity, only one system will be discussed. The afterburner fuel system is discussed separately in this subsection. The engine driven fuel pump receives fuel from the aircraft boost pumps after it has passed through a hydraulic/fuel heat exchanger. The engine driven pump ensures a positive fuel pressure to the fuel control which performs the following functions: provides engine speed control by regulating fuel flow; provides fuel surge protection during throttle bursts; limits turbine inlet temperature to a safe value; schedules variable stator vane angle to control airflow through the compressor; supplies signal to the afterburner; and provides positive fuel cutoff at engine shutdown. The fuel control also incorporates a throttle booster which reduces the amount of effort to move the throttles. Teleflex cables link the exhaust nozzle area control and the afterburner fuel control to the engine fuel control, so that fuel flow and nozzle area are compatible throughout the full range of engine operation. Advancing the throttle from OFF to IDLE mechanically opens the fuel cutoff valve in the fuel control. Fuel passing through the cutoff valve flows through a fuel-oil heat exchanger, which effects a transfer of heat from the scavenge oil to the fuel. The fuel then flows through the pressurizing and drain valve which prevents fuel from entering the engine fuel nozzles until sufficient fuel pressure is attained in the fuel control to compute the fuel flow schedules.

Check Fuel Filters Indicator Light

The CHECK FUEL FILTERS indicator light, on the telelight panel, illuminates informing the pilot that the filter is clogged. The filter automatically opens to bypass, allowing normal fuel flow to the engine. There are no operational restrictions on the aircraft with the CHECK FUEL FILTERS indicator light illuminated. If the light illuminates, an entry to that effect should be made on Form 781. The MASTER CAUTION light illuminates in conjunction with the CHECK FUEL FILTERS light.

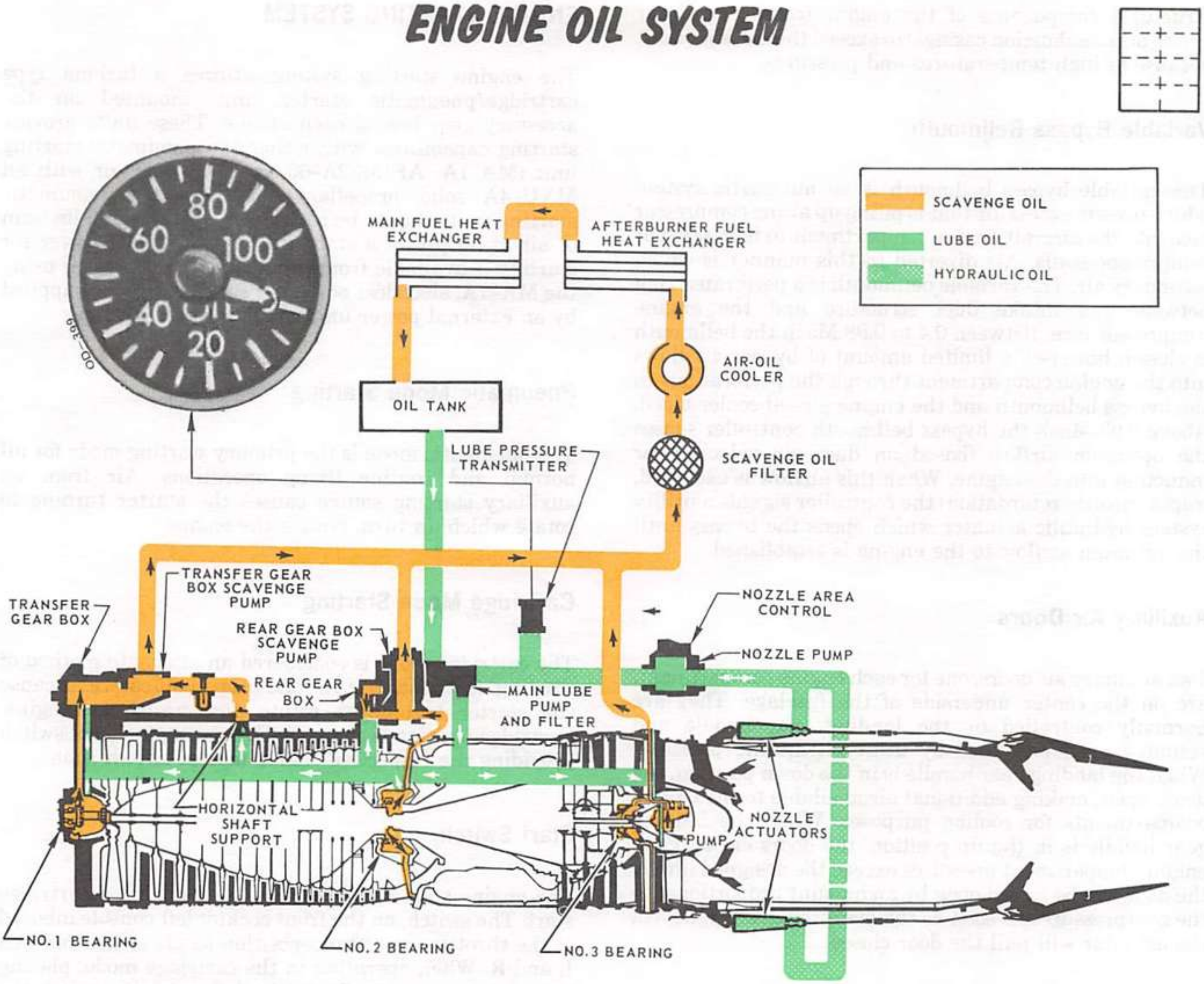
Fuel Flow Indicators

The engine fuel flow indicating system consists of a fuel flow transmitter and a fuel flow indicator (one for each engine). The fuel flow indicators on the right side of the front cockpit instrument panel display engine fuel consumption in pounds per hour. The indicator is calibrated from 0 to 12 with readings multiplied by 1000. The fuel flow indicating system indicates fuel consumption of the basic engine only (afterburner fuel flow is not indicated). When in full afterburner, total fuel flow is approximately 4 times the indicated fuel flow.

ENGINE OIL SYSTEM

See figure 1-1. Each engine is equipped with a completely self-contained, dry sump, full pressure oil system. Oil supply to the lubrication system is interrupted during negative G flight, due to the inability of the scavenge pumps to recover oil from the sumps and gear boxes. Engine oil is used for lubrication, variable nozzle positioning, and constant speed drive unit operation. 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 will cause failure of the constant speed drive unit and the nozzle control system, and ultimately, engine bearing failure will result. 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. 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. See figure 1-32 for oil servicing specifications.

ENGINE OIL SYSTEM



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G-Y

Figure 1-1

ENGINE AIR INDUCTION SYSTEM

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

Variable Duct Ramp

The variable duct ramp system provides primary air, at optimum subsonic airflow, to the compressor face throughout a wide range of 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. The air data computer supplies a total temperature input to the ramp control amplifier which, in turn, sends a signal to a utility hydraulic system servo unit to position the ramps for optimum airflow at high Mach numbers. The total temperature sensor is below the right air conditioning duct. While taxiing in the exhaust envelope of an operating jet engine, the sensor may detect a temperature change which causes the variable duct ramps to cycle.

Duct Temperature High Indicator Light

The duct temperature high indicator light, marked DUCT TEMP HI, is on the telelight panel. The light, when illuminated, indicates that the temperature within the engine intake duct (compressor inlet) is beyond allowable limits for steady-state engine operation. Operating the engine at high altitudes, with the compressor inlet temperature above the prescribed limit, will cause the life of the gears, bearings, and carbon seals to be reduced because the lubricating oil will exceed its design temperature. Exceeding the temperature also causes structural components of the engine (compressor rear frame and combustion casings) to exceed their design limit because of high temperatures and pressures.

Variable Bypass Bellmouth

The variable bypass bellmouth is an automatic system which diverts excess air that is piling up at the compressor face into the aircraft engine compartment to help prevent compressor stalls. Air diverted in this manner is called secondary air. The variable bellmouth is a perforated ring between the intake duct structure and the engine compressor face. 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. 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.

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 in the down position, the doors open, making additional air available to the engine compartments for cooling purposes. When the landing gear handle is 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 will pull the door closed.

Auxiliary Air Door Indicator Lights

The auxiliary air door indicator lights, on the telelight panel and marked L AUX AIR DOOR and R AUX AIR DOOR, illuminate when the auxiliary air doors operate out of phase with the landing gear handle. The lights may also illuminate momentarily when engine compartment overpressures are relieved. Illumination of either auxiliary air door indicator light causes the MASTER CAUTION light to illuminate. If either auxiliary air door indicator light illuminates (other than momentarily), corrective action should be taken immediately.

ENGINE BLEED AIR SYSTEM

The bleed air system supplies high temperature, high pressure air from the engines to the cabin air conditioning system and the fuel cell pressurization system. See figure 1–2. Control of the bleed air flow, temperature, and pressure is initiated and regulated by the requirements of each 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 necessary, single engine operation will supply sufficient air for their operation.

ENGINE STARTING SYSTEM

The engine starting system utilizes a turbine type cartridge/pneumatic starter unit, mounted on the accessory gear box of each engine. These units provide starting capabilities with either the pneumatic starting unit (MA–1A, AF/M32A–60, or equivalent) or with an MXU–4A solid propellant cartridge. The pneumatic starting units should be capable of delivering 45 lbs/min of air at 50 psi on a standard day. Electrical power for starting is available from the AF/M32A–60. When using the MA–1A, electrical power for starting may be supplied by an external power unit or the aircraft battery.

Pneumatic Mode Starting

The pneumatic mode is the primary starting mode for all normal and routine flying operations. Air from an auxiliary starting source causes the starter turbine to rotate which, in turn, cranks the engine.

Cartridge Mode Starting

The cartridge mode is considered an alternate method of starting. Hot gases from a solid propellant cartridge cause the starter turbine to rotate and crank the engine. Cartridge ignition is controlled by the engine start switch providing the respective engine master switch is on.

Start Switch

The engine start switch is only used during a cartridge start. The switch, on the front cockpit left console inboard of the throttles, is a three–position toggle switch marked L and R. When operating in the cartridge mode, placing the switch momentarily to the left or right ignites the corresponding starter cartridge.

ENGINE IGNITION SYSTEM

The –17A/C/F engine is equipped with two 28 volt, low energy ignition units. The –17E/G engine is the same except one ignition unit is a high energy unit that improves ground starts in cold weather and air starts using alternate fuel. The main ignition system produces an electrical arc which ignites the atomized fuel–air mixture in the numbers four and five combustion chambers. The remaining eight combustion chambers are ignited through the crossfire tubes. Depressing the ignition button causes the spark plugs to discharge, igniting the fuel–air mixture as the throttle is moved from OFF to IDLE during engine start. The spark plugs fire only while the ignition button is depressed.

Ignition Buttons

The ignition buttons are spring–loaded, push–button type switches, located on each front cockpit throttle directly below the throttle grips.

ENGINE OIL SYSTEM

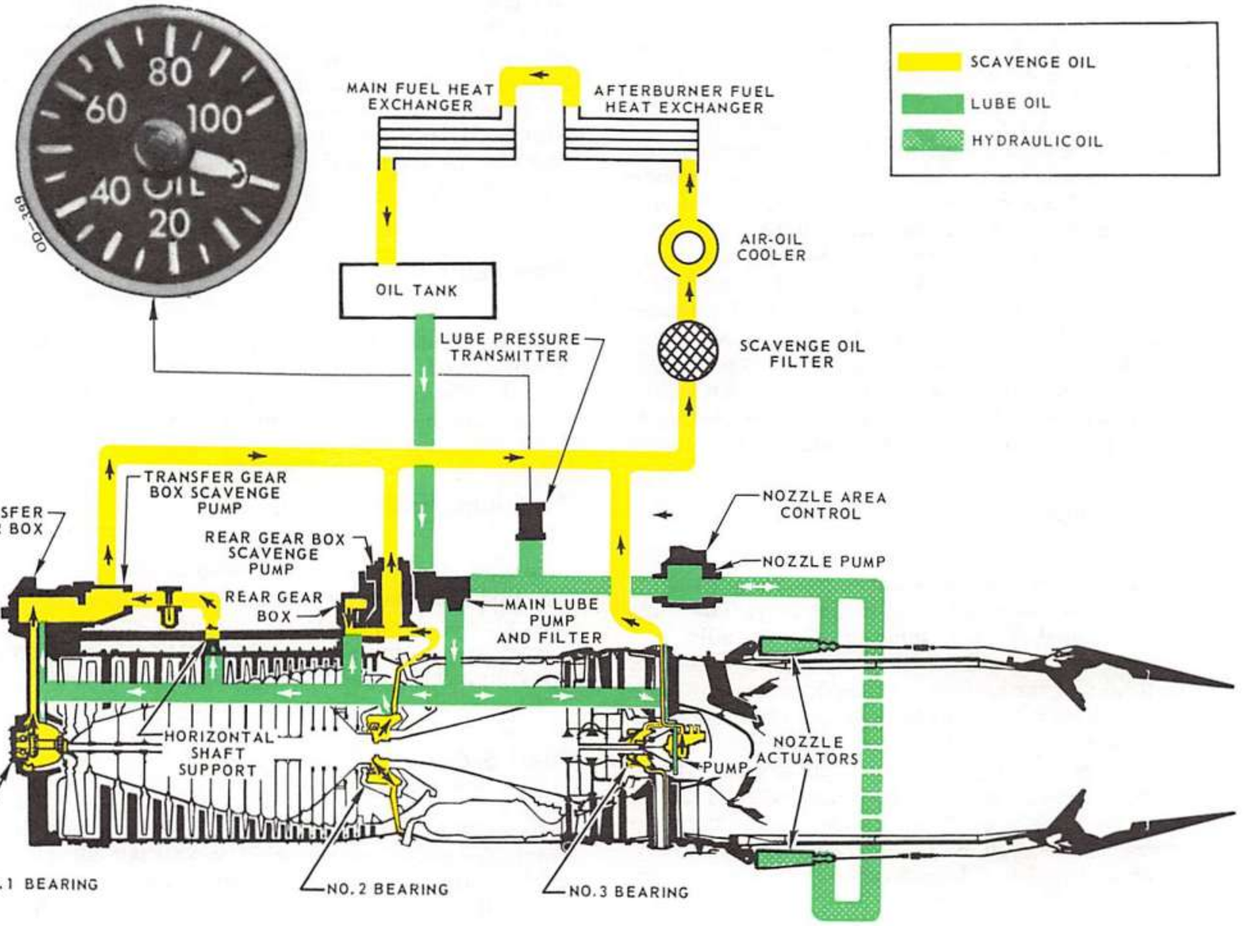

Figure 1-1

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Ignition Buttons

The ignition buttons are spring-loaded, push-button type switches, located on each front cockpit throttle directly below the throttle grips.

BLEED AIR AND ASSOCIATED SYSTEMS

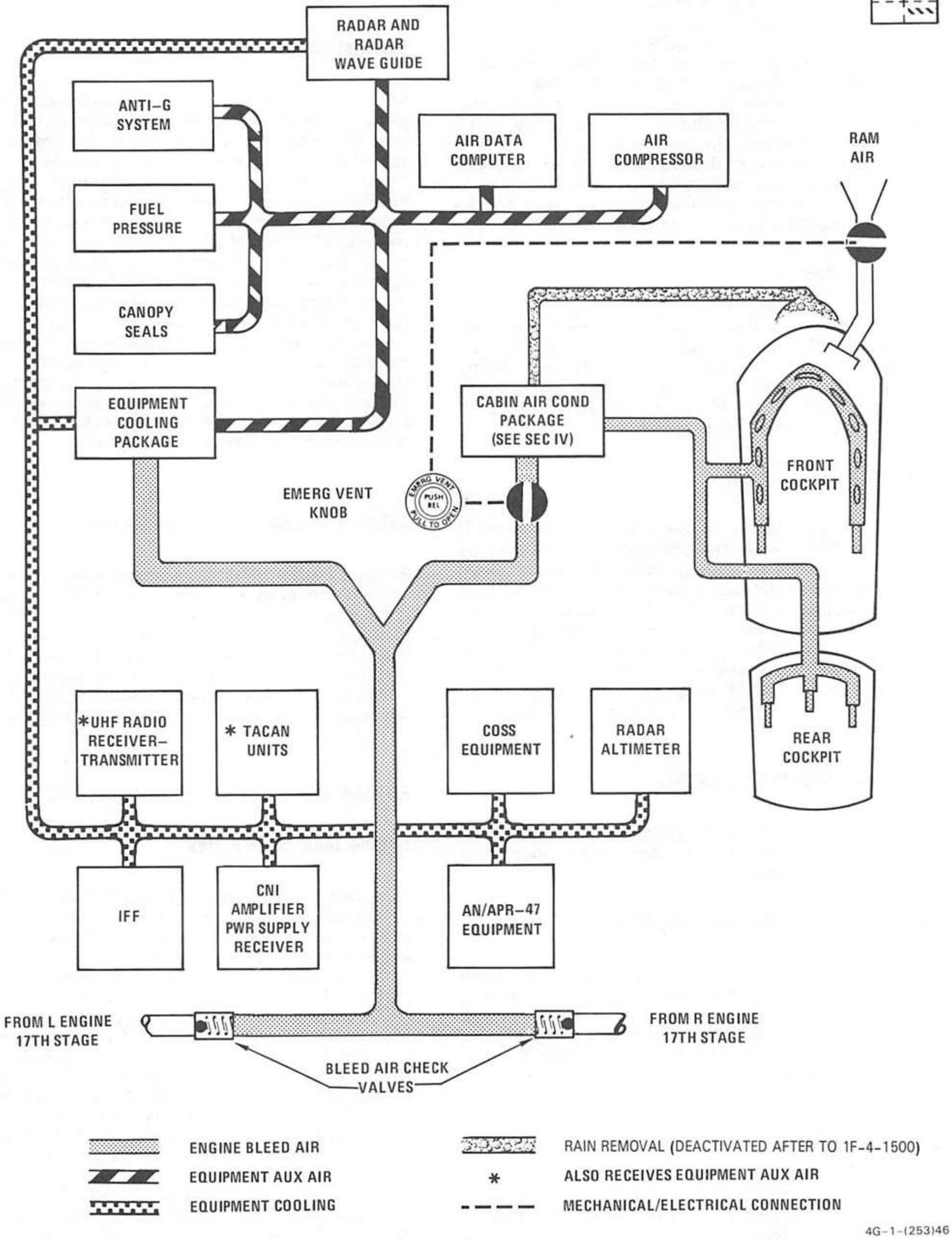


Figure 1–2

ENGINE ANTI–ICING SYSTEM

Engine bleed air is supplied to the engine anti–icing system which prevents the formation of ice on the engine frontal area. The bleed air is distributed to ducts in the compressor front frame, inlet guide vanes, nose dome, and nose dome struts. It then flows from these components through small bleed holes, and enters the engine primary airstream. The system is an anti–icing, not a de–icing system, since an actual buildup of ice will block the small bleed holes and render the system inoperative. Engine anti–ice is not needed or desired at high Mach numbers since the compressor inlet temperature is sufficient to prevent any ice accumulation and continued operation in this range could cause engine damage.

Anti–Icing Switch

A two–position anti–icing switch is on the left console, front cockpit. 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 air flow. With the switch in NORMAL, no anti–icing operation is being performed.

Anti–Ice Indicator Lights

A set of anti–icing lights, marked L ANTI–ICE ON, and R ANTI–ICE ON, are on the telelight panel. The lights operate from a pressure sensitive switch which is actuated by the pressure of the engine bleed air when the anti–ice system is turned on. If the lights illuminate during flight, with the anti–icing switch in NORMAL, the anti–icing shutoff valve has failed to the open position. If a failed shutoff valve is indicated during high Mach number flight (approximately 1.2 Mach or greater), reduce speed. An illuminated anti–ice light also illuminates the MASTER CAUTION light.

AFTERBURNER FUEL SYSTEM

The fuel is scheduled as a function of throttle angle and compressor discharge pressure. Ignition is provided by a separate ignition system.

AFTERBURNER IGNITION SYSTEM

The afterburner ignition system consists of the torch igniter, a spark plug, and an afterburner ignition switch. When the throttle is moved into the afterburner detent, the afterburner ignition switch closes and the spark plug supplies a continuous arc. Ignition and torch igniter fuel flow are maintained until the throttle is removed from the afterburner detent.

VARIABLE AREA EXHAUST NOZZLE

Two sets of cylindrical nozzles, operating together, make up the variable area exhaust nozzle system. The primary nozzle (inner nozzle), controls the convergent portion of the nozzle, while the secondary nozzle (outer nozzle), controls the divergent portion of the nozzle. Movement of the nozzles is accomplished automatically by four synchronized actuators using engine oil as its actuating fluid.

Exhaust Nozzle Control Unit

Throttle position, nozzle position feedback, and exhaust gas temperature are utilized to schedule the correct nozzle area. (Refer to figure 1–3.) During engine operation in the submilitary region, nozzle area is primarily a function of throttle angle and nozzle position feedback. The nozzle is scheduled to approximately ⅞ 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% rpm to 98% rpm, a control alternator supplies engine speed information to the temperature amplifier, which in turn schedules engine speed inputs as a function of temperature limiting. This signal prevents the primary nozzle from closing beyond 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 engine design limits.

Exhaust Nozzle Position Indicators

Exhaust nozzle position indicators, which show the exit area of the exhaust nozzle, are on the front cockpit instrument panel. The instruments are calibrated from CLOSE to OPEN in four increments. The nozzle position indicators enable the pilot to make a comparison of nozzle position between engines, and are also used to establish a relationship between nozzle position and exhaust gas temperature, and nozzle position and throttle settings.

ENGINE CONTROLS AND INDICATORS

Engine Master Switches

Two lever–lock, two–position engine master switches are on the left console in the front cockpit on the inboard engine control panel. A guard is installed between the engine master switches to prevent inadvertent operation of the master switch(es) when selecting similar type switches. Placing the switch to ON, directs power to the corresponding fuel boost pump (left master switch on, left boost pump on) and both fuel transfer pumps if the aircraft is supplied with a source of ac power. If there is no source of ac power, placing either switch to ON, connects the aircraft battery to the essential 28 volt dc bus. Electrical power is then available for operating the fuel shutoff valves and for the engine ignition circuits. With AC power available, the circuits for the fuel shutoff valves, which are normally operated by the throttles, are such that either valve will be closed when its respective engine master switch is placed OFF, regardless of the throttle position. With 28 volt dc power only, the throttle must be placed in the cutoff position prior to the engine master switches being placed off or the fuel shutoff valve will remain open.

THROTTLES

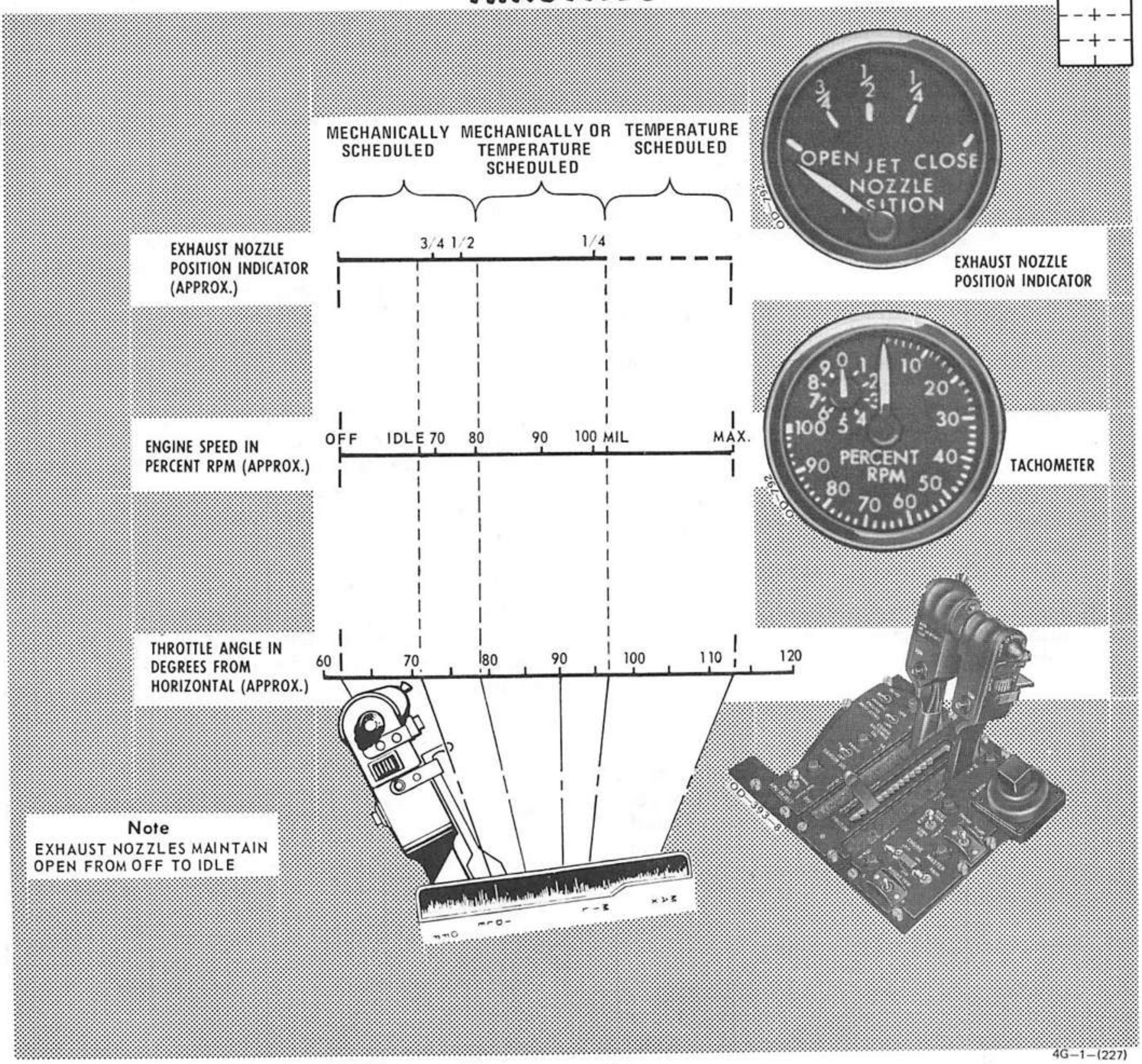


Figure 1-3

Throttles

A throttle for each engine is on the front and rear cockpit left console. Movement of the throttle is transmitted by mechanical linkage to the engine fuel control. A friction adjusting lever is mounted between the front cockpit throttles to permit adjustment of throttle friction to suit individual requirements. Afterburner light–off can be initiated anywhere within the afterburner modulation range by shifting the throttles outboard and moving forward from the MIL position. As the throttles are advanced from minimum to the maximum afterburner position, the increase in thrust will be smooth and continuous. Movement of the throttles from IDLE to OFF actuates a switch which closes the fuel shutoff valve, stopping fuel flow to the engine. Throttle movement through the cutouts is as follows: To move from OFF to IDLE or MIL, advance the throttles straight forward. To move from MIL to MAX, shift throttles outboard; throttles can then be moved forward in the afterburner range. The throttles in the front cockpit are equipped with finger lifts, enabling rapid throttle chops to IDLE while preventing inadvertent shutoff. The finger lifts, on forward side of throttles, must be raised before the throttles in either cockpit can be retarded to OFF. The rear cockpit throttles are linked to the front cockpit throttles such that only the pilot can start the engines, or move the throttles into the afterburner thrust range. The rear cockpit throttles can be moved from the OFF position with no front seat assistance. The rear cockpit throttles can be used to control thrust throughout the entire range (providing the pilot selects afterburner). The throttles can be retarded from MAX to IDLE from the rear cockpit although OFF position must be selected from the front cockpit. The rear cockpit throttles each contain a load limiting device to prevent damage of the teleflex cable in the event an opposing force is applied to both front and rear cockpit throttles simultaneously. The rear cockpit throttles become disengaged from the airframe throttle system when a force of 55 to 100 pounds is applied to the rear cockpit throttles (opposing front cockpit throttles) in either the forward or aft direction. Under this condition, selection of maximum afterburner may be restricted. The rear cockpit throttles can be reset by placing the front cockpit throttles against the IDLE or MIL stop and moving the rear cockpit throttles in the opposite direction from which the disconnect occurred. The rear cockpit throttles incorporate only a microphone button and a speed brake switch.

NOTE

- If the rear cockpit throttles are held steady or jammed, extremely high breakout forces may be necessary to disconnect rear cockpit throttles.
- To avoid possible internal mechanical interference, reconnect throttles before retarding to the OFF position.

Tachometers

A tachometer for each engine is mounted on the right side of the front cockpit instrument panel. A single tachometer with dual pointers is mounted on the right side of the rear cockpit instrument panel. The system is self-contained and requires no external source of power.

Exhaust Gas Temperature Indicators

The exhaust gas temperature indicators are mounted on the front cockpit instrument panel. Each indicator includes two pointers: a large pointer operating on a scale from 0 to 12 with the readings multiplied by 100°C and a smaller pointer operating on a separate scale from 0 to 10 with readings multiplied by 10. The system indicates the temperature of the exhaust gas as it leaves the turbine unit during engine operation. During a battery start, exhaust gas temperature information is available.

AIRCRAFT FUEL SYSTEM

NOTE

Engine flameout can occur on the ground with up to 650 pounds of fuel remaining.

Fuel is carried internally in a fuselage tank, made up of interconnected cells, and two internal wing tanks. External fuel is carried in two 370-gallon, wing-mounted tanks, and a 600-gallon, fuselage-mounted tank. Refer to foldout section for aircraft and engine fuel system illustration. All tanks may be refueled on the ground through a single pressure refueling point, or while airborne, through the air refueling receptacle. External tanks may be individually fueled through external filler points. The fuselage cells are arranged so cell 1, the engine feed cell, is behind the aft bulkhead of the rear cockpit. The remainder of the cells are numbered consecutively, with cell 7 being the most aft cell. The fuselage cells are self-sealing. Flapper valves in cells 1, 2, and 4 prevent reverse flow through the cells when the aircraft is in a climbing attitude. Cells 4 and 6 each contain one hydraulic and one electric fuel transfer pump to transfer fuselage fuel to cells 1 and 2. Regulated engine bleed air pressure transfers internal wing fuel and all external fuel to the fuselage cells. Fuel will not transfer from internal wing or external tanks until the weight is off the gear and the tanks are pressurized. Air pressure is also used to facilitate dumping internal wing fuel, and to maintain a positive pressure in all tanks. Float type fuel level control valves control fuel level during refueling or fuel transfer operations. The fuselage cells and internal wing tanks contain capacitance-type fuel gaging units which read out in pounds on the fuel quantity indicator. The external wing tanks are vented to the internal wing tank dump lines, while all other tanks are vented to the fuel vent mast, located immediately below the rudder. See figures 1-4 and 1-5 for fuel quantities. If a complete transfer pump failure occurs, cells 2 through 7 are so arranged that they will gravity flow into cell 1. During gravity feed, usable fuselage fuel is dependent upon flight attitude and longitudinal acceleration. For example, during a 17 unit AOA emergency approach with full internal fuel, half of cell 3 and all of cells 4 through 7 will not be available.

SELF-SEALING CELLS

The fuselage cells have a self-sealing capability for up to 50-caliber ammunition. Reticulated foam has also been placed in each fuselage cell to reduce fire and explosion with straight or tumbling ammo penetration.

TRANSFER SYSTEM

The electrical fuel transfer pumps run continuously when electrical power is applied to the aircraft and either or both engine master switches are ON. The hydraulically driven fuel pumps run only under the following conditions: when hydraulic power is available with no electrical power on the aircraft, when either engine is in afterburner operation, when automatic transfer is initiated (low level fuel state is reached) or when the air refuel switch is in the EXTEND position. If the hydraulic transfer pumps are started by automatic transfer and the fuel level is increased above that which starts automatic transfer, the air refuel switch must be cycled from the RETRACT to EXTEND and back to RETRACT to terminate hydraulic pump operation. The pumps transfer fuselage fuel to cells 1 and 2. The level control valves open to allow fuel from the transfer pumps to enter cells 1 and 2 when the fuel level drops below that of the floats. Cell 2 transfers to cell 1 by gravity only; cell 3 gravity feeds cell 4; and cell 5 gravity feeds cell 6. Cell 7 gravity feeds cell 6 when the fuel level in cells 1 and 2 drops below 1800 pounds (as indicated on the tape). Fuel carried in the internal wing tanks and all external tanks is transferred by regulated air pressure to the fuselage cells, providing the weight is off the gear and the tanks are pressurized. The internal wing fuel does not enter cell 5 so as to prevent an undesirable aft CG condition. None of the internal or external fuel will enter cell 1 unless the fuel level in this cell drops low enough to allow the refueling level control valve to open. The internal and external fuel transfer is controlled by switches on the fuel control panel. When transfer of external fuel is selected, transfer of internal wing fuel is stopped automatically and cannot be regained until the external transfer switch is returned to OFF. When external fuel tanks are not carried, the external transfer switch is inoperative. An automatic fuel transfer system is incorporated. When the fuel level in cells 1 and 2 drops below 2300 (±200) pounds, all external and internal wing fuel, not previously transferred, will transfer to cells 1 and 3 regardless of fuel transfer switch position. Since the automatic fuel transfer occurs before cell 7 transfer is initiated, cell 7 fuel is not available until all external fuel and internal wing fuel has transferred. The automatic fuel transfer system is inoperative when the air refuel switch is in the EXTEND position. The automatic transfer system resets during ground or air refueling to allow normal transfer. Fuel will not transfer to cells 5 and 6 during automatic transfer. The automatic fuel transfer system is completely independent of the fuel quantity indicating system.

Internal Wing Transfer Switch

A two-position internal wing transfer switch with positions of NORMAL and STOP TRANS is on the fuel control panel. The toggle-type switch, lever-locked to NORMAL, directly controls the positioning of the internal wing transfer low level shutoff valves through the solenoid operated function of the valve. In NORMAL, the valves are de-energized, open, allowing internal wing fuel to transfer to fuselage cells 1 and 3 only, providing the internal wing tanks are pressurized and the fuel level control valves in cells 1 and 3 are open. In STOP TRANS, the internal wing transfer low-level shutoff valves are energized closed, stopping transfer of internal wing fuel to the fuselage cells. Power to operate the internal wing transfer valves is supplied by the essential 28 vdc bus. This provides the capability to transfer internal wing fuel on battery power.

External Transfer Switch

The external transfer switch, on the fuel control panel, is a three-position toggle switch with a triangle head. The switch is operative only with external tanks installed. If the external transfer switch is placed to a position on which tanks are not installed (OUTBOARD or CENTER), internal wing fuel will transfer in the normal manner), provided the internal wing transfer switch is in the normal position. Placing the external fuel transfer switch to OUTBOARD or CENTER opens the applicable external fuel transfer valve(s) and allows external fuel to transfer. The external fuel transfer valve does not affect external fuel pressurization. All external tanks automatically pressurize when weight is off the wheels regardless of the position of the external transfer switch. The switch positions are marked CENTER, OFF, and OUTBD. All external fuel transfers to fuselage cells 1, 3, and 5. Power to operate the external transfer valves is supplied by the essential 28 volt dc bus which provides the capability to transfer external fuel on battery power.

FUEL BOOST SYSTEM

Fuel is supplied to the engine during all flight attitudes by two submerged electric motor-driven centrifugal-type boost pumps. The boost pumps are in the engine feed cell. Both pumps are mounted on the bottom of the cell and provide fuel during negative G flight. Due to internal cell baffling and check valves, which trap approximately 850 pounds of fuel in the lower third of the cell during negative G flight, the boost pumps will provide (for a limited time) a continuous fuel flow to the engines. Normal output of each pump, at idle rpm, is 30 (±5) psi. Both pumps are single high-speed units. The engine feed manifold is divided and the left boost pump supplies fuel to the left engine only, while the right boost pump supplies fuel to the right engine. Each pump is controlled by its corresponding engine master switch (left master switch on, left boost pump on) provided ac power is supplied to the system. Boost pump output for each manifold is indicated on the left or right boost pump pressure indicator. After engine start, each gage will indicate 30 ±5 psi with its corresponding engine at idle.

The boost pump pressure indicators are mounted on the left subpanel in the front cockpit. The gage dials are calibrated from 0 to 5 and readings must be multiplied by 10. Pressure transmitters mounted on the aircraft keel in the engine compartment measure the pressure in the aircraft fuel system on the inlet side of the engine fuel pump. This signal is transmitted to the indicators in the cockpit.

Tank Depressurization Switch

A tank depressurization switch is installed on the fuel control panel. This guarded switch is marked NORM, ALL FUS and ALL INT. When the switch is in NORM, fuel cell pressurization operates as previously described. Placing the switch to ALL FUS depressurizes only the fuselage cells. If ALL INT is selected the fuselage cells and wing cells are depressurized. The fuel cells should be depressurized any time the possibility of a fuel vapor explosion exists, a hit is taken in the fuselage cells (depressurized fuel system enhances the self sealing capabilities of the fuselage cells), or during any landing emergency when aircraft damage may be sustained. If the automatic fuel transfer is actuated (2300 pounds) pressurization is restored to the internal wing cells. When the switch is not in NORM, the fuel cells are partially pressurized by the scarf affect of the fuel dump mast. This action supplies sufficient pressurization during most flight regimes to prevent the collapse of the fuselage cells.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indicating system is of the capacitance-type and provides a reading, in pounds, of total usable internal fuel. The system components include the fuel quantity indicator, the fuel check switch (before TO 1F-4-1414) or feed tank CHECK/BIT switch (after TO 1F-4-1414), and the FUEL LEVEL LOW warning light. There are 14 fuel gaging units located throughout the internal cells.

Fuel Quantity Indicator

BEFORE TO 1F-4-1414

An independent counter-tape fuel quantity indicator is on the instrument panel in each cockpit. The counter unit of the gage continuously indicates the total fuel quantity (with readings multiplied by 10) of all usable internal fuel. The tape portion of the indicator simultaneously indicates the total usable fuel quantity (with readings multiplied by 1000) of fuselage fuel in cells 1 through 6 only. Cell 7 fuel quantity is included in the counter reading. After all wing fuel has transferred, the counter should read 600 ±350 pounds higher than the tape when fuselage cell 7 is full. With both internal wing tanks and fuselage cell 7 empty, the difference between the tape and counter should not exceed 350 pounds. At the low end of the fuel scale, the counter portion of the fuel quantity gage has a tolerance of ±200 pounds and the tape portion has a tolerance of ±150 pounds. Therefore, if the FUEL LEVEL LOW light illuminates above an indicated 1850 pounds, the fuel level low warning light should be used as the primary indication of a low fuel state. There is a possibility that the fuel quantity variations will be noted on the fuel quantity indicator during aircraft accelerations and decelerations. These variations are due to the movement of fuel within the cells which is a result of the high acceleration and deceleration rates of 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.

AFTER TO 1F-4-1414

An independent counter sector fuel quantity indicator is on the instrument panel in each cockpit. The counter unit of the gage indicates total fuel quantity of all usable internal fuel from 0 to 19,900 pounds in increments of 100 pounds. The sector display indicates fuel quantity in fuselage tanks 1 through 6 only. The display ranges from 0 to 10,000 pounds (200 pound increments up to 3,000 and 500 pound increments above 3,000). After all wing fuel has transferred, the counter should read 600 ±100 pounds higher than the sector when fuselage cell 7 is full. With both internal wing tanks and fuselage cell 7 empty, the difference between the tape and counter should not exceed 500 pounds. With less than 3,000 pounds of fuel remaining, the sector–counter difference should not exceed 200 pounds. If the FUEL LEVEL LOW light illuminates above an indicated 1850 pounds, the fuel level low warning light should be used as the primary indication of a low fuel state. There is a possibility that the fuel quantity variations will be noted on the fuel quantity indicator during aircraft accelerations and decelerations. These variations are due to the movement of fuel within the cells which is a result of the high acceleration and deceleration rates of 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.

CAUTION

Do not tap on indicator face as damage to liquid crystal display will result.

Feed Tank Check Switch (Before TO 1F-4-1414)

The two–position feed tank check switch, with switch positions of FEED TANK CHECK and NORM, is used to check the fuel quantity in the engine feed tank. When the switch is in the spring–loaded FEED TANK CHECK position, the tape portion and the counter portion of the fuel quantity gage indicate engine feed tank fuel quantity.

FUEL QUANTITY DATA TABLE

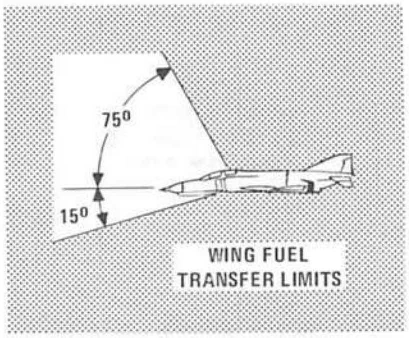
JP-4 OR JP-8

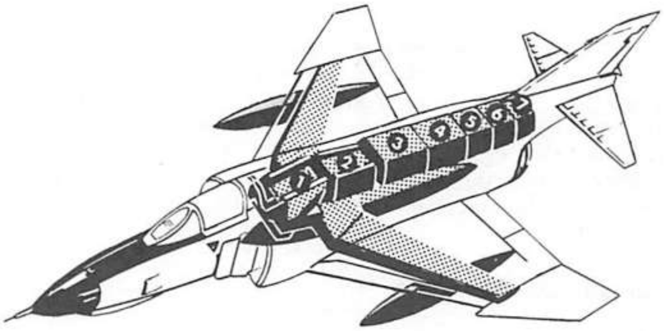
TANK	USABLE FUEL		
	GALLONS	POUNDS JP-4	POUNDS JP-8
FUSELAGE CELL 1	215	1397	1462
CELL 2	185	1203	1258
CELL 3	147	955	1000
CELL 4	201	1307	1367
CELL 5	180	1170	1224
CELL 6	213	1385	1448
CELL 7	84	546	571
TOTAL FUSELAGE FUEL	1225	7963	8330
INTERNAL WING TANKS	630	4095	4284
TOTAL INTERNAL FUEL	1855	12,058	12,614
EXTERNAL WING TANKS	740	4810	5032
INTERNAL FUEL PLUS EXTERNAL WING TANKS	2595	16,868	17,646
EXTERNAL CENTERLINE TANK	600	3900	4080
INTERNAL FUEL PLUS EXTERNAL CENTERLINE TANK	2455	15,958	16,694
MAXIMUM FUEL LOAD TOTAL INTERNAL PLUS ALL EXTERNAL TANKS	3195	20,768	21,726

NOTES

FUEL WEIGHTS ARE BASED ON REFUELING WITH EXTERNAL POWER USING JP-4 OR JP-8 AVERAGE WEIGHTS OF 6.5 OR 6.8 POUNDS PER GALLON RESPECTIVELY AT 60°F (15°C). WHEN REFUELING WITH BATTERY POWER, TOTAL FUSELAGE FUEL WILL BE APPROXIMATELY 200 POUNDS LOWER.

REFER TO FUEL WEIGHT VARIATIONS, SECTION VII, FOR INFORMATION ON FUEL DENSITY VARIATIONS AND TEMPERATURE EFFECTS ON TOTAL FUEL WEIGHT.





4G-1-(226)C

Figure 1-4

NOTE

At low fuel states, a feed tank check does not normally indicate the total amount of useable fuel remaining. The useable fuel may be distributed between cells 1 and 2. Under normal conditions, cell 2 is useable.

Feed Tank Check and BIT Switch (After TO 1F-4-1414)

The three–position, momentary switch, with switch positions of BIT, FEED TANK CHECK and NORM (center position), is used to check the fuel quantity in the engine feed tank and built–in–test (BIT) functions. When the switch is in the spring–loaded FEED TANK CHECK position the sector portion and the counter portion of the fuel quantity gage indicate engine feed tank fuel quantity. When cell 1 is full, the counter should read 1400 ±100 pounds and the sector should read 1400 ±200 pounds. The feed tank check switch also provides an indication that there is power to the fuel quantity circuits and that the gage is functioning properly.

NOTE

At low fuel states, a feed tank check does not normally indicate the total amount of useable fuel remaining. The useable fuel may be distributed between cells 1 and 2. Under normal conditions, cell 2 is useable.

Built-In-Test (BIT) (After TO 1F-4-1414)

The BIT is performed on the indicator and includes extensive tank probe and compensator testing. The legend ERR indicates a BIT error, or errors, have been detected. BIT error codes define the type of fault and tank identification (ID) codes locate the fault area. The BIT operates automatically and continuously. Errors are detected within 7 seconds of occurance and and stored in memory until erased. The BIT/feed tank check switch enables BIT error codes and tank ID numbers to be displayed, eliminates the flashing error code and resets the system. After all LCD segments come on for 2 seconds, each current flight error code is displayed for 2 seconds. Simultaneously, tank IDs are displayed on the counter. Continuing to hold the BIT switch closed allows playback of previous flight error codes. Previous flight error codes are distinguished by a dashed sector display. The ERR legend is located at the bottom of the fuel quantity indicator along with error codes. During feed tank check, "FTC" will appear on the error digits display located to the right of the ERR light.

NOTE

- Numerous error code combinations are possible for which there is no aircrew corrective action except to clear the error with the BIT switch. If the error cannot be cleared, a significant difference may exist between the fuel quantity reading and actual fuel quantity; therefore, the fuel level low light should be monitored and a landing made as soon as practical.
- Do not hold the BIT switch closed for more than 20 seconds after error code is displayed as it will erase fault history memory.

Fuel Quantity Indicator (FQI) Display Modes are Displayed As Follows:

	FQI Display Mode	Counter	Sector	ERR Legend	ERR Digits	Indicator
Normal Mode	No Errors	Total Fuel	Fuselage	OFF	OFF	ON
	Errors	Total Fuel	Fuselage	ON or FLASHING**	OFF	ON
Feed Tank Check	No Errors	Feed Tk Qty	Feed Tk Qty	OFF	FTC	ON
	Errors	Feed Tk Qty	Feed Tk Qty	ON or FLASHING**	FTC	ON
	Power Up	All ON	All ON	ON	All ON	ON
BIT Error Display	Current Flight	Tank ID	Blanked	ON	*	OFF
	Previous Flight	Tank ID	Dashed	ON	*	OFF

*As appropriate, 2 seconds each

**A flashing ERR legend means that an error has occurred which has not yet been reported by BIT playback for the current flight. It does not necessarily mean that the error condition is still present. The following description should clarify this feature:

EVENT	ERR LEGEND
Normal Operations, No Faults	Blanked
First Time Fault Occurs This Flight	Flashing
Error Condition Goes Away	Remains Flashing
BIT Switch Activated	Blanked
Error Condition Does Not Go Away	Remains Flashing
BIT Switch Activated	Steady
Same Fault Reappears	Steady
Different Fault Appears and Persists	Flashing
BIT Switch Activated	Steady

Error digits are used by maintenance personnel in troubleshooting defective fuel quantity system.Tank ID codes identify the tank/group tank and aircraft wiring sections responsible for the error condition.

TANK ID CODES

ID	Description	Aircrew Action
1	Fault in Tank 1 Circuit	Check Fuel Level Low Light.
26	Fault In Tanks 2 - 6 Circuits	Compare Sector & Counter for Fuel Location. Check Fuel Level Low Light.
00	Fault In Wing Tanks and Tank 7 Circuit	Compare Sector & Counter for Fuel Location. Check Fuel Level Low Light.
C	Fault in Compensator Circuit	None (Resulting Quantity Error is Less Than 5%)

Faults in a tank/tank group will result in the indicator displaying only fuel contained in unaffected tank/tank group regardless of amount actually in affected tank/tank group. (Tanks 2 through 6 constitute one tank group and tank 7 and the wing tanks constitute one tank group).

FUEL DISTRIBUTION & INDICATION

LEGEND

FUEL ▨

Notes

- THE FUEL VALUES SHOWN ARE NOMINAL VALUES AND SHOULD NOT BE USED TO CHECK ACTUAL GAGE READINGS.
- THIS ILLUSTRATION ASSUMES THAT ALL EXTERNAL FUEL IS TRANSFERRED FIRST, FOLLOWED BY INTERNAL WING FUEL.

4G-1-(225)46

Figure 1-5

Fuel Level Low Warning Light

The FUEL LEVEL LOW warning light, on the front cockpit telelight panel, illuminates when the usable fuel in cells 1 and 2 has reached a predetermined low fuel state (stabilized level flight). The light illuminates at 1650 ±200 pounds. The low level sensor is located in cell 2. The fuel level low warning system is completely independent of the fuel quantity indicating system.

CAUTION

An illuminated FUEL LEVEL LOW warning light may be the first indication of fuselage fuel failure to transfer.

External Tanks Fuel Lights

The external tank fuel lights come on whenever external tanks are selected or the automatic fuel transfer is activated and there is no fuel flow from these tanks. Since external fuel transfer is intermittent rather than continuous, the L EXT FUEL, CTR EXT FUEL, or R EXT FUEL light illuminates during any temporary halt of fuel flow. Intermittent external fuel transfer is desired since this means the transfer rate is greater than engine consumption, and that the fuselage fuel is being maintained at its highest possible volume. When selecting OUTBD or CENTER the corresponding indicator light illuminates when there is no fuel flow. The indicator lights illuminate any time the air refuel switch is placed in the EXTEND position (provided the refuel selector switch is in ALL TANKS). The lights also illuminate any time both the external and internal wing tanks are empty and the automatic fuel transfer circuit is energized.

External Tanks Full Lights

Before TO 1F-4-1500, the external tanks full indicator lights are just below the canopy/windscreen junction (canopy bow). After TO 1F-4-1500, the lights are mounted under the upper right side of the center glare shield. These lights, marked LH FULL, RH FULL, and CTR FULL illuminate during air refueling when their respective tanks are full. The lights remain illuminated any time the air refueling receptacle is in the extend position, with the engine master switch on, and the respective tanks are full. The lights also illuminate when the tanks become full during ground refueling, and remain illuminated until the ground refueling switch in the right wheel well is moved to OFF.

INTERNAL WING FUEL DUMP SYSTEM

Wing fuel may be dumped in flight regardless of the air refueling switch position or any other transfer switch positions, by placing the hex-head dump switch to DUMP. This two-position lever-locked toggle switch is marked NORMAL and DUMP. Selecting DUMP opens the left and right wing dump shutoff valves and closes the wing transfer and vent valves. The wing air regulator will open,

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allowing the wing tank to remain pressurized and force fuel out the dump lines at the wing-fold trailing edge. The dump valves utilize electrical power from the main dc bus and operate only when external power is applied or the generators are operating. At 85% rpm in level flight, the fuel dumping capability is approximately 650 ppm. The dumping rate varies directly with rpm and pitch attitude; i.e., lower rpm and/or nose pitched down decreases the dumping rate. Air pressure continues to bleed out the dump line until the internal wing dump switch is placed in the NORM position to close the dump valves.

ELECTRICAL POWER SUPPLY SYSTEM

The aircraft electrical power supply system consists of two engine driven ac generators, two dc transformer-rectifiers, a battery, and a power distribution (bus) system. Refer to foldout illustrations for Electrical System schematic and circuit breakers.

AC ELECTRICAL POWER

Two ac generators are the primary source of electrical power. Each generator (one on each engine) is capable of supplying the entire electrical system thru a bus tie relay. The generators are regulated by constant speed drive units. Engine oil is used as a hydraulic media in the drive units and to keep the generators cool. If one generator becomes out of phase or frequency with the other, or the electrical load division between the two generators becomes unbalanced, the bus tie relay will open. The generators will then be powering only their respective bus system. If one generator fails, it drops off the line and the bus tie relay energizes allowing the remaining generator to supply power to the entire system. Each generator may be disconnected from the bus system by placing its generator switch to OFF. The generators drop off the line as engine rpm decreases thru approximately 53% rpm.

Electrical Test Receptacle Plug 3P325

It is possible to trip both generators off the line if the electrical test receptacle plug 3P325 under the right canopy sill in the rear cockpit is loose. The plug uses a knurled (twist clockwise to lock) lock ring which should not be confused with the chain equipped threaded cap. The plug is located just aft of circuit breaker panel no. 3 and below electrical test receptacle plug 3P324. See figure 1-6.

DC ELECTRICAL POWER

Two transformer-rectifiers convert ac to dc. If one transformer-rectifier fails, the remaining transformer-rectifier supplies power to the entire dc system. If both generators fail or if a voltage drop occurs between the main dc bus and essential dc bus, these buses become disconnected and the DC BUS light comes on. Reconnection of the buses may be attempted by simultaneously cycling both generator switches. A limited source of dc power is also provided by a battery.

Battery

A nickel cadmium battery is installed outboard of the rear cockpit right rudder pedal. The battery bus is energized any time the battery is installed and connected to the aircraft. The battery bus is connected to the essential dc bus, thru a battery relay, when either engine master switch is ON or the ground refuel switch is in REFUEL or DEFUEL. A check for battery relay closure is proper indication of gear and flap position. The battery will discharge if the aircraft is parked with the battery relay closed.

NOTE

> Nickel cadmium batteries are subject to thermal runaway. Thermal runaway is caused by prolonged overcharging. The only cockpit indication of thermal runaway is the smoke and fumes generated by the process.

BATTERY BYPASS SWITCH

A battery bypass switch is on the No. 2 circuit breaker panel in the rear cockpit. The battery bypass switch is used to stop battery charging when thermal runaway is suspected. When the switch is ON, the battery bus is disconnected from the source of charging current and will only provide DC power to the battery bus. Battery starts cannot be made. Only white floodlights, and the ejection lights will only be powered for the remaining battery life.

ELECTRICAL TEST RECEPTACLE PLUG 3P325 LOCATION

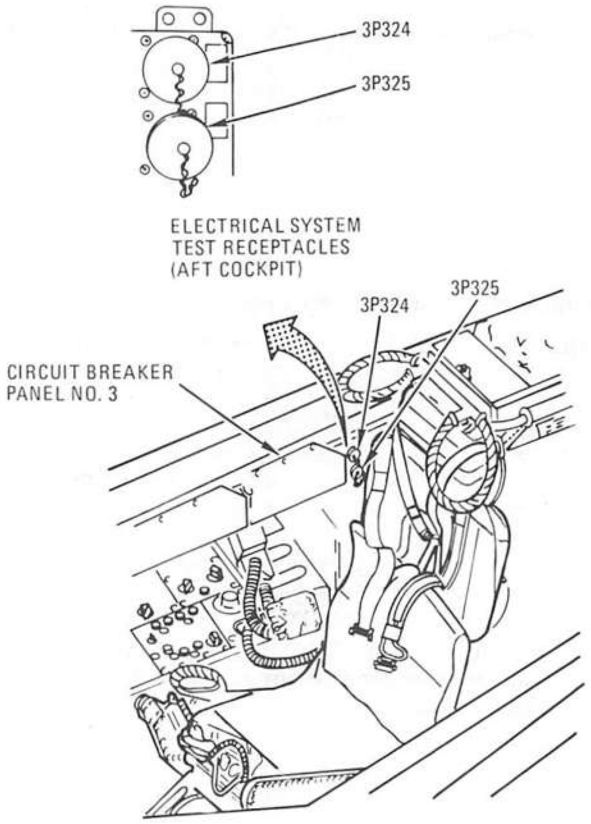


Figure 1-6

EXTERNAL ELECTRICAL POWER

External electrical power may be connected to the aircraft bus system through an external electrical power receptacle. External power required is 400 cycle, three phase, 115/200 volt ac.

ELECTRICAL SYSTEM CONTROLS AND INDICATORS

Generator Switches

Two generator switches, one for each generator, are on the utility panel on the right console. With external electrical power connected to the aircraft, placing both generator switches to EXT ON supplies power to all buses except the instrument buses, the CNI and the AFCS. When either generator is operating, it may be connected to the entire bus system by placing its respective generator switch to GEN ON.

Instrument Ground Power Switch

An instrument ground power switch, on the No. 2 circuit breaker panel, connects external electrical power to the instrument buses. The instrument ground power switch will disengage upon loss of external electrical power or bringing the left generator on the line. When operating on external power, the instrument buses may be deenergized by placing the instrument ground power switch to NORM (down position).

Autopilot Ground Test Switch

An autopilot ground test switch, on the No. 2 circuit breaker panel, connects external electrical power to the AFCS circuits. The autopilot ground power test switch will disengage upon loss of external electrical power or bringing a generator on the line. When operating on external power, the AFCS circuit may be deenergized by placing the autopilot ground test switch to NORM (down position).

A/A IFF Ground Test Switch

An A/A IFF ground test switch, on the No. 2 circuit breaker panel, connects external electrical power to the AN/APX-80 circuits. The A/A IFF ground test switch will disengage upon loss of external electrical power or bringing a generator on the line. When operating on external power, the AN/APX-80 circuits may be deenergized by placing the A/A IFF ground test switch to NORM (down position).

Circuit Breakers

The front cockpit contains eight essential circuit breakers, one on the left subpanel and seven above the right console. There are two lighting circuit breakers on the instrument lights intensity circuit breaker panel in the front cockpit outboard of the right subpanel. A circuit breaker is installed on the standby attitude circuit breaker and intensity control panel, located above the right console. All remaining circuit breakers are in the rear cockpit. Refer to the circuit breaker panels in the foldout section.

NOTE

> Though a circuit breaker may not appear "popped" it may actually be open. To restore power in such a case, pulling and resetting the circuit breaker is recommended.

Generator Indicator Lights

The LH GEN OUT, RH GEN OUT and BUS TIE OPEN lights are on the right of the main instrument panel in the front cockpit. A generator light illuminates when a generator is removed from the bus system and the BUS TIE OPEN light illuminates when the generators are not paralleled. The indicator lights do not illuminate in the event of double generator failure. Refer to Double Generator Failure and Bus Tie Open, section III. The MASTER CAUTION light illuminates in conjunction with the generator indicator lights.

HYDRAULIC POWER SUPPLY SYSTEM

Hydraulic power is supplied by three, completely independent, closed center hydraulic systems. Refer to foldout illustrations for Hydraulic System schematic. They are Power Control System One (PC-1), Power Control System Two (PC-2), and Utility System. The systems have an operating pressure of approximately 3000 psi and are pressurized any time 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 hydraulic system supplies hydraulic pressure to all systems except the stabilator actuator. Each system may be pressurized by an external hydraulic power source. A stabilator auxiliary power unit (APU) is installed. This system is an electrically operated, self-contained unit with an operating pressure of approximately 1700 psi. The APU supplies pressure to the stabilator actuator and pitch stab aug.

POWER CONTROL SYSTEMS

The PC-1 and PC-2 systems are pressurized to 3000 ±250 psi by a hydraulic pump mounted on each engine. The PC-1 pump, on the left engine, supplies pressure to one side of the left aileron, left spoiler, and stabilator dual power control cylinders. Pressure to one side of the right aileron, right spoiler, and stabilator dual power control cylinders is supplied by the PC-2 pump on the right engine. Utility pressure is supplied to the remaining side of both aileron and spoiler dual power control cylinders. The PC-1, PC-2, and utility hydraulic systems are independent of each other; therefore, each aileron and spoiler has two independent sources of hydraulic pressure and one system functions as a backup for the other.

STABILATOR AUXILIARY POWER UNIT (APU)

An APU system provides backup hydraulic pressure for longitudinal control. An electrically driven hydraulic pump pressurizes the APU system to 1700 ±100 psi. The APU supplies pressure to the PC–1 side of the stabilator actuator and pitch stab augmentation if PC–1 pressure drops below 1000 psi. Fluid pressure is sufficient to supply stabilator demands of moderate flight maneuvers including landing. Flight speed is restricted below 600 knots/.95 Mach with normal load factors from 0 to +4 G. Stick rate input is limited to 1 G per second. A pressure switch in the pump illuminates an APU light on the telelight panel, when the pump is operating. Stick movement in pitch can cause the APU light to flicker or remain on for as long as six seconds. This is normal and should be disregarded. It does not indicate actual operation of the APU. An APU reject switch provides an option to reject the APU system should PC–1 pressure drop below 1000 psi (left engine shut down) with the PC–2 system operating normally. This switch also has a test position for ground check of the system. Operation of the system is automatic, provided the reject switch is in NORMAL, as soon as PC–1 drops below 1000 psi. If the reject switch is in REJECT, operation is automatic as soon as PC–2 pressure drops below 1000 psi (provided PC–1 has previously failed or the left engine was shut down). Momentary drops of the PC system below 1000 psi will cause the APU system to be energized. A holding relay in the control system will keep it activated for 1 minute after the PC pressure has recovered.

Auxiliary Power Unit Reject Switch

The APU reject switch, on the outboard engine control panel, is a three position switch marked NORMAL, REJECT and TEST. The TEST position is spring loaded to REJECT and provides an operational check of the APU system with external power (engines shut down). The NORMAL position provides automatic operation of the APU system if PC–1 pressure drops below 1000 psi. The REJECT position is lever locked and provides an option to de-activate the APU after PC–1 fails, and PC–2 is still operating normally. Placing the switch to REJECT (after PC–1 failure) turns off the APU and completes a circuit to automatically re-activate the APU system if PC–2 should also fail. Loss of PC–2 with a good PC–1 system will not activate the APU.

APU Light

The APU light, on the telelight panel, illuminates anytime the APU is operating. A holding relay in the control circuit causes the light and APU to remain on for 1 minute, if momentary PC pressure drops occur. The APU light does not illuminate the MASTER CAUTION light.

If the APU CONT circuit breaker (F–5, Circuit Breaker Panel No. 1) has been pulled after the system has been activated in flight, the light will remain on until the APU pump pressure bleeds off.

UTILITY SYSTEM

The utility hydraulic system is pressurized to 3000 ±250 psi by a hydraulic pump on each engine. To prevent the utility hydraulic pumps from resonating, check valves with different operating pressures are installed on the pump output lines. As a result, the right engine utility hydraulic pump will deliver 2775 ±225 psi at idle rpm, and the left engine utility hydraulic pump will deliver approximately 3000 ±250 psi at idle rpm. The utility hydraulic system supplies hydraulic pressure to the:

AFCS
Aileron Power Control Cylinders
Aileron Dampers
Aileron–Rudder Interconnect
Air Refueling Receptacle
Anti–Skid
Arresting Hook (retraction)
Auxiliary Air Doors
Slats flaps
Forward Missile Cavity Doors
Fuel Transfer Pumps (hydraulic)
Landing Gear
Lateral Control Servo (autopilot)
Nose Gear Steering
Pneumatic System Air Compressor
Radar Antenna Drive
Roll Stab Aug
Rudder Damper
Rudder–Feel System
Rudder Power Control Cylinder
Speed Brakes
Spoiler Power Control Cylinders
Variable Engine Bellmouth
Variable Engine Intake Duct Ramps
Wheel Brakes (normal and emergency accumulator)
Yaw Stab Aug

HYDRAULIC PRESSURE INDICATORS

Two hydraulic pressure indicators are on the pedestal panel in the front cockpit. One is for the utility system and one is for the PC–1 and PC–2 systems. The power control systems indicator has two pointers, one labeled 1 for PC–1 and the other 2 for PC–2.

HYDRAULIC SYSTEMS INDICATOR LIGHTS

An amber CHK HYD GAGES indicator light is on the telelight panel. This single light is utilized by both the power control systems and the utility system to indicate loss of hydraulic system pressure and direct the pilot's attention to the hydraulic pressure indicators. Illumination of the CHK HYD GAGES indicator light is controlled by the hydraulic systems pressure switches. The CHK HYD GAGES light illuminates when the pressure in any one system drops below 1500 ±100 psi and/or when one of the utility hydraulic pumps fail. In all cases a loss of system pressure will be noted on the applicable hydraulic pressure indicator, but, a failed utility pump may not register a significant pressure drop on the utility pressure indicator. An illuminated CHK HYD GAGES light with no noted pressure drop on any of the hydraulic pressure indicators usually signifies that the right utility hydraulic pump has failed. An illuminated CHK 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 illuminates in conjunction with the CHK HYD GAGES indicator light. The MASTER CAUTION light may be extinguished by depressing the reset button. The CHK HYD GAGES light remains illuminated until the pressure in the faulty system increases beyond 1750 psi. If a failure occurs in one of the remaining hydraulic systems while the CHK HYD GAGES light is already illuminated, the MASTER CAUTION light will not illuminate again and the pilot will not be alerted to the second failure.

NOTE

The MASTER CAUTION and CHK HYD GAGES lights may illuminate momentarily due to high system demand when the landing gear is lowered or with rapid control movement. If pressure recovers without delay, disregard this indication.

PNEUMATIC SYSTEM

The pneumatic system provides high pressure air for the normal and emergency operation of the canopies, and the emergency operation of the landing gear and slats flaps. Refer to foldout illustrations for Pneumatic System illustration.

In flight, the pneumatic system pressure may indicate below the minimum 2650 psi due to a compressor malfunction or the moisture separator freezing up. Normally, water collected in the moisture separator is discharged automatically at the same time the compressor reaches its cutoff limit of 3050 to 3200 psi. When system pressure gets below 2650 psi, the dump valve closes and allows the compressor to cut–in again. If the heat blanket fails, ice can form and clog the dump valve in the open position. This allows system pressure to bleed off slowly. Cycling the pneumatic system control circuit breaker may provide a power surge sufficient enough to close the dump valve solenoid allowing pneumatic system pressure to return to normal. However, the problem may repeat itself when the dump valve opens at compressor cutoff. If cycling the circuit breaker does not work, a descent to a lower altitude will be necessary to thaw ice in the moisture separator and allow the system to reset itself. If the circuit breaker is out and will not reset, the compressor will not run and pneumatic system pressure will continue to bleed off.

NOTE

Consideration should be given to lowering gear while utility hydraulics are available. If pneumatic pressure is below the green zone and utility hydraulics are lost, there may not be sufficient pressure in the emergency air bottles (due to the possibility of leaking check valves) to lower the gear.

PNEUMATIC PRESSURE INDICATOR

A pneumatic pressure indicator, located on the pedestal panel in the front cockpit, shows only manifold pressure.

FLIGHT CONTROLS

The aircraft primary flight controls are the stabilator, rudder, ailerons, and spoilers. Refer to foldout illustrations for Flight Controls schematic. Artificial feel systems provide simulated aerodynamic forces to the control stick and rudder pedals. Secondary controls are slats flaps and speed brakes.

AILERON-SPOILER CONTROL SYSTEM

The aileron-spoiler control system uses PC-1 and utility hydraulic systems for the left aileron-spoilers, and PC-2 and utility hydraulic systems for the right aileron-spoiler. If one hydraulic system fails, the remaining system for that aileron-spoiler provides adequate control.

Lateral Control Feel and Trim System

When the trim' switch is activated, screwjack actuators extend or retract. The lateral controls are repositioned and the control stick follows the trim movements. Lateral control artificial feel is provided.

STABILATOR CONTROL SYSTEM

Longitudinal control is provided by a single-unit horizontal tail surface (stabilator). The leading edge of the stabilator is slotted for increased longitudinal control. Hydraulic pressure to the stabilator is supplied by both power control PC-1 and PC-2 systems. If one PC system fails, the remaining system provides adequate control. A hydraulic AFCS servo is integrated into the stabilator system. It positions the stabilator in the same manner as control stick inputs. As a result, when the autopilot signals a pitch attitude change, the control stick will follow the movement. An APU supplies hydraulic pressure to the PC-1 side of the stabilator actuator if the PC-1 system fails.

Stabilator Control Feel and Trim System

Artificial feel is provided by a ram air bellows. When the aircraft is in trim, ram air force on the bellows is balanced by a bob weight. As airspeed increases or decreases, the pressure on the bellows changes causing the bellows bob weight assembly to become off balance. The off balance condition is transmitted to the control sticks. Actuating the trim switch causes the stabilator trim actuator to move, balancing the force between the bellows and bob weight, eliminating force on the control sticks.

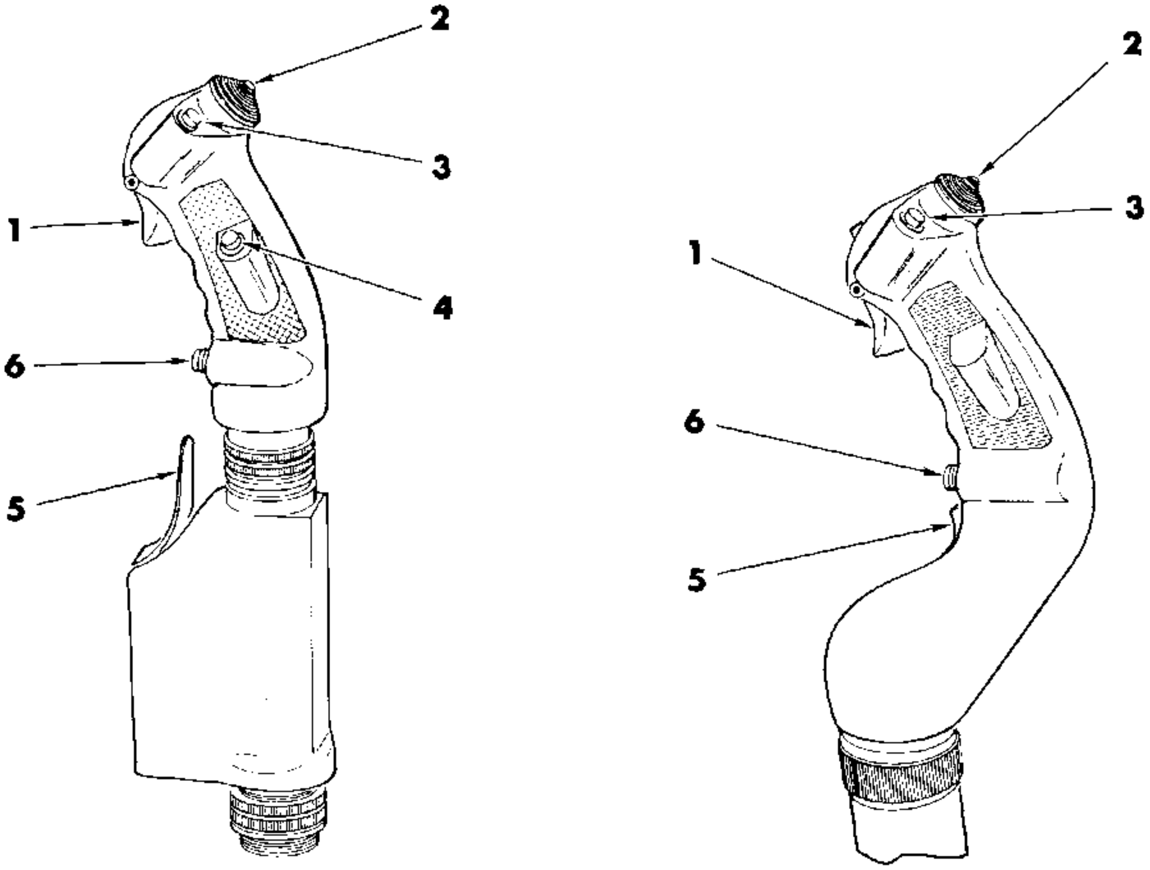
Stabilator Trim Position Indicator

The stabilator trim indicator is on the left vertical panel in the front cockpit. The indicator, marked in units of trim, represents trim actuator position.

CONTROL STICKS

The front cockpit control stick (figure 1-7) consists of a stick grip and force transducer, and contains six controls: an emergency quick release lever, a trigger switch for missiles, a bomb release button, a nose gear steering/auto aquisition button, a four-way trim switch, and an air refueling release button. The rear cockpit control stick does not incorporate the force transducer. The grip contains five control switches: an emergency quick release lever, a trigger switch, a bomb release button, a nose gear steering button and a four-way trim switch. The emergency quick release levers interrupt electrical power to the anti-skid system, the automatic flight control system, stab aug and the aileron-rudder interconnect. The nose gear steering button serves as an auto acquisition button for the radar. The nose gear steering button and the air refueling release button, aside from its air refueling function, have other ordnance functions. (refer to TO 1F-4G-34-1-1-1). The force transducer works with the automatic flight control system for control stick steering in the AFCS mode. It also disengages the automatic flight control system if the pilot exerts a force on the stick which exceeds the AFCS limit.

CONTROL STICKS



FRONT COCKPIT

REAR COCKPIT

1. TRIGGER
2. TRIM SWITCH
3. BOMB RELEASE BUTTON
4. AIR REFUELING RELEASE/ AIM-9/AGM-45/AGM-65
5. EMERGENCY QUICK RELEASE LEVER
6. NOSE GEAR STEERING/ AUTO-ACQUISITION/ AGM-45

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Figure 1-7

RUDDER CONTROL SYSTEM

Utility system hydraulic fluid positions the rudder. Limited mechanical authority over the rudder is available if the utility hydraulic system fails. Available rudder is then a function of air loads on 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, does not move the rudder pedals.

Rudder Feel Trim System

Artificial feel is supplied to the rudder pedals by an artificial feel trim system. An airspeed pressure switch converts from low to high gradient pedal pressure at 240 ±10 knots accelerating. Decelerating, the switch converts from high to low gradient at 225 ±5 knots. A rudder trim switch is on the left console.

Rudder Trim Switch

The rudder trim switch is in the front cockpit on the inboard engine control panel. This switch controls the trim actuator in the rudder feel and trim system.

Rudder Pedals

The rudder pedals are adjusted by turning the rudder pedal adjusting crank. The pedals are coupled to power brake valves so that the pressure on the pedal applies 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.

Stall Warning Vibrator

A stall warning vibrator, on the front cockpit left rudder pedal, warns of an approaching stall. A sufficient margin exists to return to the proper flight attitude by normal reaction to the warning. The vibrator is electrically connected to a switch in the angle of attack indicator. The switch is set to 22.3 units angle of attack and operates with the gear down. If a malfunction occurs where the vibrator runs continuously, it can be shut off by pulling the angle of attack probe heater control circuit breaker (C7, No. 3 panel).

NOTE

If the AOA probe heater control circuit breaker (C7, No. 3 panel) is pulled, the AOA probe heater, total temperature probe heater, bellmouth pitot probe heater, aural tone generator, stall warning vibrator, and automatic slat extension are disabled.

STABILITY AUGMENTATION

Stability augmentation can be obtained individually or in any combination for pitch, roll or yaw axis by placing the PITCH, ROLL and/or YAW stab aug switches to ENGAGE. Stab aug decreases any tendency of the aircraft to oscillate in roll, yaw, or pitch, or to develop lateral forces which cause aircraft slip or skid. With the roll stab aug switch engaged, the roll rate for a given stick deflection will be lower for the rear cockpit due to the roll stab aug remaining active during rear cockpit stick commands. Transferring control from the front to the rear cockpit can reduce roll rate. Transferring control from the rear to the front cockpit can cause an abrupt increase in roll rate.

AILERON RUDDER INTERCONNECT (ARI)

The aileron-rudder interconnect system causes rudder displacement proportional to aileron displacement to provide coordinated turns at low airspeeds. The limits of the system are 15° of rudder displacement when the automatic flight control system is in the stability augmentation or autopilot mode, and 10° rudder displacement when the yaw stab aug switch is disengaged. When the flap switch is down, and airspeed is below flap blowup speed, the ARI system is engaged. When the flaps are raised, or are blown up, the ARI is disengaged through the flap blowup switch. If the flaps are lowered during a turn, a rudder kick will occur as a result of ARI engagement with lateral controls deflected. The system can be disengaged by pressing the emergency disengage switch on the control stick. This will disengage the ARI system and the yaw stab aug as long as the emergency disengage switch is held pressed; when the switch is released, the ARI (10°) and the yaw stab aug (5°) rudder authority is regained. Regardless of the amount of ARI rudder authority, the pilot can easily override the ARI system with the rudder pedals.

NOTE

- To permanently disengage the ARI, the circuit breaker on the left utility panel must be pulled and the yaw stab aug switch must be disengaged. Pulling the circuit breaker with the yaw stab aug engaged will still provide 5° of ARI rudder authority. When the ARI circuit breaker is pulled, the anti-skid system is disabled.

- Rudder jump will occur when the ARI cuts in or out with a lateral control stick input. This normally occurs when the flaps are raised or lowered during a turn.

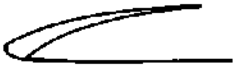
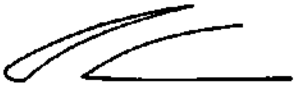
SLATS FLAPS SYSTEM

The slats and flaps system is an integrated system that provides an automatic slat configuration for inflight maneuvering and a selective flap/slat configuration for takeoff and landing. Each wing has two leading edge slats (one on the outboard wing panel and one on the inboard wing panel); and one flap mounted on the trailing edge, adjacent to the fuselage. The flaps and slats are electrically selected 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. Flap and/or slat chatter may occur and can be identified as a rapid-rate machine-gun like chatter similar to an air-hammer. There will be an interrupted electrical noise in the head phones and the slats flaps and utility hydraulic pressure indicators will fluctuate in unison. Generally, flap and slat chatter will not occur at the same time. Flap chatter is more common on retraction, whereas slat chatter may occur during any period of operation including maneuvering at altitude. This chatter can be of short duration or continuous. Either can be noted by sound and feel. When chatter occurs, determine whether flaps or slats are chattering by observing the indicators. If the normal system fails, the flaps and slats can be extended by an emergency pneumatic system. Two airspeed switches protect the flaps and slats from structural damage if they are inadvertently left extended above their structural airspeed limit. Refer to figure 1-8 for slats flaps operation.

SELECTIVE SLATS FLAPS

For takeoff and landing, the flaps and slats operate together and are controlled by a slats flaps switch in the front cockpit. To guard against overrotation on takeoff, the control circuit is wired through the nose gear to prevent a slat-out no-flap takeoff. Anytime the nose gear is down and locked, both the flaps and slats will extend if the slats flaps switch is moved to any position except NORM (provided electrical power and hydraulic pressure is applied). The normal takeoff position of the slats flaps switch is OUT and DOWN.

SLATS FLAPS OPERATION

	SLATS IN	SLATS OUT
OUTBOARD SLATS		
INBOARD SLATS		

SLATS FLAPS SWITCH POSITION	NOSE GEAR POSITION	SLATS FLAPS OPERATION
NORM	UP	FLAPS UP, SLATS OPERATE AS FUNCTION OF AOA
OUT	UP	SLATS EXTEND
OUT AND DOWN	UP	SLATS AND FLAPS EXTEND (WHEELS LIGHT FLASHING UNTIL LANDING GEAR IS DOWN)
NORM	DOWN	FLAPS UP, SLATS OPERATE AS FUNCTION OF AOA
OUT	DOWN	SLATS AND FLAPS EXTEND
OUT AND DOWN	DOWN	SLATS AND FLAPS EXTEND

NOTES

SLATS AIRSPEED SWITCH IS SET AT 568 TO 602 KNOTS (ACCELERATING) AND 10 TO 30 KNOTS BELOW ACCELERATING SPEED (DECELERATING)

FLAPS AIRSPEED SWITCH IS SET AT 235 ±5 KNOTS ACCELERATING AND 220 ±10 KNOTS DECELERATING.

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Figure 1–8

MANEUVERING SLATS

With the slats flaps switch in NORM, the maneuvering slats operate automatically as a function of AOA. As the AOA is increased to approximately 11.5 units, the slats will extend and remain extended until the AOA is reduced to approximately 10.5 units. Automatic slat extension is powered through the AOA probe heater control circuit breaker (C7, No. 3 panel). This circuit breaker also powers the AOA aural tone system and stall warning vibrator. If this circuit breaker is out or power to the circuit is lost, automatic slat extension, AOA aural tone, and the stall warning vibrator fail simultaneously. If this occurs, the aircraft will remain in the slats-in configuration regardless of AOA, and stall and departure will occur at a lower AOA then normal. Refer to Stalls, section VI. If desired, the slats may be extended (regardless of AOA) by selecting OUT on the slats flaps switch. If OUT is selected and the airspeed is increased above approximately 568 to 602 knots, the slats will automatically retract.

Slats Flaps Switch

The slats flaps switch is in the front cockpit above the left console outboard of the throttles. The switch is airfoil shaped and has positions of NORM, OUT, and OUT AND DOWN. This switch controls the operation of both the flaps and slats. Placing the switch to OUT extends the slats (regardless of landing gear position) and the flaps, providing the nose gear is down. Below flap blow up speed, the flaps will remain extended, even though the nose gear is subsequently retracted, until the slats flaps switch is placed to NORM. The OUT AND DOWN position extends the slats to the out position and the flaps to the down position. In NORM, the flaps are up and locked and the slats then operate automatically as a function of AOA.

Slats Override Switch

The slats override switch is located on the front cockpit left console, aft of the fuel control panel. The two-position cover-guarded switch has positions of IN and NORM. With the switch in NORM, the slats operate as previously described using the slats flaps switch or as a function of AOA. When IN is selected, the slats will retract, if extended, and remain retracted regardless of AOA or slats flaps switch position.

Slats In Light

The SLATS IN light on the telelight panel and the MASTER CAUTION light illuminate anytime the slats override switch is positioned to IN.

Emergency Slats Flaps Extension

Emergency extension of the slats flaps is accomplished pneumatically by high pressure air from an emergency air storage bottle. The emergency flaps/slats extension handles are on the slats flaps control panel in the front cockpit, and adjacent to the throttles in the rear cockpit. They are marked EMERG. Lowering the slats flaps pneumatically is accomplished by pulling either emergency flap extension handle aft. Since the handles are mechanically connected to the pneumatic actuation valve, emergency extension does not require electrical power. The emergency extension system bypasses the flap blow-up provision. The slats and flaps extend regardless of airspeed; however, above about 230 knots, the flaps will not be fully extended due to airloads acting against the pneumatic pressure. The handles are airfoil shaped and painted in black and yellow stripes for ease of identification. The air bottle contains sufficient air for only one extension.

Slats Flaps Indicators

The leading edge slat and trailing edge flap indicators are on the left subpanel in the front cockpit and on the landing gear-slat flap indicator panel in the rear cockpit. Slats in the retracted position are indicated by the word IN; slats in the extended position are indicated by the word OUT. The flap indicator is wired through the flap up limit switch; therefore, normal indications are as follows: When the slats flaps switch is moved to OUT AND DOWN, the indicator may show a momentary barberpole if one flap actuator unlocks before the other. When both actuators unlock, the indicator will immediately show DN regardless of any intermediate flap position. On the flaps up cycle, the indicator does not show UP until the flaps are fully retracted. It may show a momentary barberpole if one actuator locks before the other.

SPEED BRAKES

Hydraulically operated speed brake panels are mounted on the underside of the inboard wing surfaces. They are hinged on the forward side, permitting them to open down and forward. The speed brakes are electrically controlled by throttle mounted switches and a lockout relay. If the throttle mounted switches fail, the speed brakes may be retracted by pulling the speed brake circuit breaker. If an electrical failure occurs, the speed brakes automatically retract. If a utility system hydraulic failure occurs, the speed brakes retract (by air loads) to a low drag trail position.

Speed Brake Switches

The throttle mounted speed brake switches have three positions - front cockpit: maintaining IN, maintaining STOP, and momentary OUT; rear cockpit: momentary IN, maintaining STOP, and momentary OUT. The speed brakes are extended by holding either control switch to OUT. If desired, the speed brakes may be stopped at any intermediate position by releasing the control switch. When released, the control switch returns to the STOP position. If the front cockpit control switch is left in the IN position, it may be bypassed, to extend the speed brakes, by placing the rear cockpit control switch to OUT. A speed brake lockout relay is energized and removes the front cockpit control switch from the circuit. The lockout relay remains energized until the front cockpit switch is moved to the STOP position. The speed brakes may then be controlled by either switch. The speed brakes are retracted by placing either control switch to IN. With both speed brake switches in the STOP position, the speed brakes may creep enough to illuminate the SPEED BRAKE OUT indicator light. In this event, placing either speed brake switch to IN retracts the speed brakes and extinguishes the indicator light.

Emergency Speed Brake Retraction

Emergency speed brake retraction is accomplished by pulling the speed brake circuit breaker on the right console in the front cockpit.

Speed Brake Out Indicator Light

A SPEED BRAKE OUT indicator light on the telelight panel illuminates when either or both of the speed brakes are not fully closed. The SPEED BRAKE OUT indicator light does not illuminate the MASTER CAUTION light.

WING FOLD

The outer wing panel of both wings may be folded to a vertical position. The wing panels are hinged to the inner wings along the upper surface of the wing. The wing fold system is mechanically and manually actuated. Each wing fold incorporates a warning pin that protrudes above the wing surface on each wing when the safety lock is not in the lock position. The red pin is on the top of the wing, 2 inches inboard of the wing fold. The outer wing panel must be raised manually to fold position, and held in this position by a jury strut. Slats should not be operated with the wings folded.

LANDING GEAR SYSTEM

The aircraft is equipped with fully retractable, tricycle landing gear. The gear is electrically controlled and hydraulically actuated by the utility hydraulic system. Accidental retraction of the landing gear when the aircraft is on the ground is prevented by safety switches on the main gear.The gear is locked down by internal finger latches which require hydraulic pressure for release. The following systems have circuits that are wired through the landing gear control handle or landing gear scissors switches: landing gear control, landing gear position indicator, auxiliary air door, anti-skid, landing gear warning light, landing lights, angle of attack system, fuel pressurization and vent system, nose gear steering system, conventional weapons release system, external stores emergency release, and all normal jettison circuits.

CAUTION

> A malfunction of the landing gear scissors switch may disable the nose gear steering and also cause the anti-skid system to cut out without warning. This will result in loss of brakes and, ultimately, directional control. The primary method of regaining brakes and, therefore, directional control is by disengaging the anti-skid system. See Wheel Brake failure, Section III.

LANDING GEAR CONTROL HANDLE

The landing gear is controlled by a handle at the left side of the front cockpit 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 utility system hydraulic pressure to properly position the landing gear.

Landing Gear Emergency Extension Handles

Two air bottles provide compressed air to extend the landing gear if the utility hydraulic system fails. The front cockpit control is in the landing gear handle. Pulling the landing gear handle full aft (with the handle in any position) directs compressed air to open all gear doors, release the gear up-locks, and extend all three gear. The rear cockpit handle is on the left subpanel and is labeled EMERG LDG GEAR. A spring loaded locking plunger locks the rear handle in the emergency position when it is pulled full aft. The front and rear emergency landing gear extension handles are connected to the same air source.

Landing Gear Warning Lights

The landing gear warning light, marked WHEELS, is on the upper left corner of the front cockpit instrument panel. The WHEELS light will flash when the airspeed drops below flap blow-up (approximately 230 knots), and the landing gear has not been lowered regardless of flap position. A red warning light, in the landing gear handle, comes on when the handle is placed UP or DOWN and stays on until the gear is locked in place.

Landing Gear Position Indicators

The landing gear position indicators are on the left subpanel front cockpit and the left subpanel rear cockpit. The position of the landing gear wheels is indicated by drum dials viewed through cutouts in the panel. With gear up, the word UP will appear on the three indicators; gear in transient will be indicated by a barber pole; and with gear down, a picture of a wheel will be seen in each indicator.

NOSE GEAR STEERING

Nose gear steering is electrically activated, mechanically controlled, and hydraulically operated. The nose gear steering button uses power from one 28vdc circuit breaker, labeled nose wheel steering (A-13, No. 3 panel), to activate the nose gear steering system. The other (ac) circuit breaker, labeled nose wheel steering (A-12, No. 3 panel), no longer controls or operates the nose gear steering system. When the control stick grip nose gear steering button is held down with the main gear struts compressed, steering is commanded by rudder pedal movement and is affected by rudder trim. The nose gear steering limit is 70° on either side of center; however, with the steering deenergized, the nose gear may be rotated 360° for towing or positioning the aircraft. When the button is pressed and held, with the nose gear in any position, the nose gear will rapidly return to the position commanded by the rudder pedals.

CAUTION

If no response is noted or unscheduled steering commands occur with nose gear steering engaged, release the nose gear button and do not reengage. The aircraft should not be taxiied or flown with inoperative nose gear steering except in an emergency.

WHEEL BRAKE SYSTEM

The main landing gear wheels are equipped with full powered brakes operated by toe action on the rudder pedals which meters utility hydraulic pressure to the brakes. The amount of brake pedal force and the amount of utility pressure directed to the wheel brakes are proportional to pedal displacement. An anti-skid system is incorporated in the normal brake system to prevent wheel skid. An emergency brake system, when actuated, discharges accumulator hydraulic pressure to the brakes in the event of utility system failure. Operation of the brakes on the emergency system is identical to the normal system for the duration of the hydraulic accumulator supply. Anti-skid protection is not available on the emergency brake system. Each main landing wheel contains 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.

ANTI-SKID SYSTEM

The electrically controlled anti-skid system provides anti-skid protection at wheel speeds over 30 knots. The system detects the start of a skid and releases the brake pressure in proportion to skid severity. The anti-skid system provides consistently shorter landing rolls than manual braking. Below 30 knots, anti-skid protection is not available and braking is in direct proportion to brake pedal deflection. A touchdown protection feature prevents braking until three seconds after weight is sensed on the right main gear or the wheels spin up to about 50 knots. A low coefficient of friction between the runway and tires, as occurs during hydroplaning or with an icy runway, may cause the wheels to not spin up or cause them to slow below 30 knots wheel speed after spin-up. When this occurs, the system falsely senses that the aircraft speed is below 30 knots and reverts to manual braking. The anti-skid system does not include an electrical fail-safe provision. The system will not automatically revert to manual braking if an internal anti-skid electrical failure occurs. However, it will revert to manual braking if electrical power is lost to the anti-skid system. With anti-skid ON and the ANTI-SKID INOPERATIVE light on, disengage the system by pressing the emergency quick release lever and/or turning the anti-skid switch OFF. The system is activated by placing the anti-skid control switch ON and lowering the landing gear. It may be disengaged by placing the anti-skid switch to OFF, pulling the ARI circuit breaker on the front cockpit left subpanel or holding either emergency quick release lever pressed. An ANTI-SKID INOPERATIVE light illuminates when the system is not activated.

NOTE

During maximum braking on a dry runway with speed below 50 knots, a severe "BANG BANG" may be heard. This is normal for low speed operation during maximum braking and should not be interpreted as an anti-skid malfunction.

Anti-Skid Control Switch

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

Anti-Skid Inoperative Light

An ANTI-SKID INOPERATIVE light is on the left console in the front cockpit. The light illuminates any time the landing gear handle is down and the anti-skid switch is OFF, circuit continuity is not complete, or when the emergency quick release lever is held depressed. Anytime the light illuminates steady, the anti-skid system is inoperative and the control switch should be placed to OFF. If the light does not illuminate it can only be assumed that the anti-skid circuitry is good. Anti-skid protection still may not be available due to system component failure. The master caution light does not illuminate in conjunction with the ANTI-SKID INOPERATIVE light.

Emergency Quick Release Lever (Anti-Skid)

An emergency quick release lever is on each control stick below the stick grip. This lever is provided to disengage the anti-skid system as desired, or in the event of a system malfunction. The lever must be held depressed to disengage the system. Normal wheel braking is immediately available when the lever is depressed and the ANTI-SKID INOPERATIVE light illuminates. The anti-skid emergency quick release lever interrupts electrical power to the system. The two control stick mounted emergency quick release levers, and the console mounted control switch are connected in series, and actuation of any one will deactivate the system. When the landing gear handle is up, all power to the anti-skid system including the light, is shut off.

EMERGENCY HYDRAULIC BRAKE SYSTEM

An emergency hydraulic brake system is incorporated in the event of utility system hydraulic failure. Differential braking pressure can be utilized when operating with the emergency system; however, braking action is limited due to depletion of hydraulic pressure from the accumulator.

Emergency Brake Handle

An emergency brake handle is on the lower left side of each cockpit instrument panel. Pulling the emergency brake handle in either cockpit, approximately 5 inches, discharges the brake system hydraulic accumulator and provides emergency braking with normal feel but with a limited number of applications.

CAUTION

> Because of the limited number of brake applications, taxiing should not be attempted when using the emergency brakes.

ARRESTING HOOK SYSTEM

A retractable arresting hook provides reliable high energy stopping for takeoff and landing emergencies. Hook extension time is approximately 5 seconds. The hook is prevented from bouncing by the snubbing action of a dash pot.

ARRESTING HOOK HANDLE

An arresting hook shaped handle is on the right side of the front cockpit instrument panel. When the handle is placed in the down position, the tension on the control cable is relieved and the uplatch releases the arresting hook. When the handle is placed in the up position, the solenoid selector valve is energized and the control cable applies tension to the uplatch. If the arresting hook cable breaks with the handle UP, the uplatch will release and the hook will continuously cycle from partially down to up. When the handle is placed to DOWN, the hook will extend normally.

ARRESTING HOOK WARNING LIGHTS

A red warning light installed in the arresting hook control handle and a HOOK DOWN warning light on the telelight panel illuminates any time the arresting hook is not up and locked.

DRAG CHUTE SYSTEM

A drag chute, contained in the empennage, significantly reduces landing roll distances. The drag chute may also be used for out of control/spin recovery. It is pulled into the airstream by a pilot chute when the spring-loaded compartment door opens. If the compartment door opens inadvertently without cockpit handle operation, or if the cockpit handle is not locked in the up position when the drag chute is deployed, the jaws of the attaching mechanism allows the chute to be released and fall free of the aircraft.

DRAG CHUTE HANDLE

The drag chute is deployed by a control handle alongside of the left console front cockpit. Rotating the handle back to the detent, 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, and pulls out the drag chute. The drag chute is jettisoned by depressing the button and pulling back on the handle to clear the detent, and then by lowering the handle. The release and jettison mechanism then returns to its normal position, permitting the drag chute to pull free.

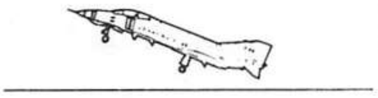
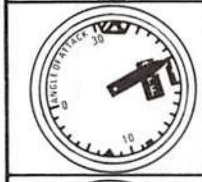
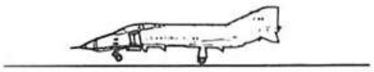
ANGLE OF ATTACK (AOA) SYSTEM

An AOA system presents a visual indication of optimum airplane flight conditions. Optimum angle of attack is not affected by gross weight, bank angle, load factor, airspeed, density altitude, or airplane configuration. Airspeeds automatically vary to compensate for the change in weight. Two electrical heaters, one in the AOA probe and one in the case (adjacent to the fuselage skin) prevent the formation of ice while flying through precipitation. The AOA probe heater and the AOA case heater are energized when the AOA circuit breakers and the CADC circuit breakers are pushed in and the weight is off the landing gear. The AOA circuit breakers are on the No. 3 circuit breaker panel at zones C6 and C7 in the rear cockpit. The CADC circuit breakers are at zones K1, K2, L3, L4, and L5, No. 4 panel. It is possible, under some conditions, for the probe to become iced even if the heaters are working properly. If the slotted probe becomes iced, the entire AOA system will be in error, causing erroneous readings/signals from all systems receiving AOA information. Probe icing most often results in the AOA indicator rotating to 30 units AOA causing the indexer lights to erroneously indicate very slow and the stall warning vibrator and aural tone generator, if operative, to erroneously indicate stall. The cockpit AOA indicator may lag true aircraft AOA by as much as eight units during a high rate maneuver. Caution should be exercised during rapid maneuvering at high angles of attack to avoid inadvertently exceeding aircraft angle of attack limitations.

ANGLE OF ATTACK INDICATORS

An AOA indicator is on each cockpit instrument panel. The indicator is calibrated from 0 to 30 in units. Indexer reference marks are provided, and are set at approximate cruise (7.9 units), and approach (19.2 units), and stall (30.0 units) angles of attack. The indicator reference mark set at an approximate cruise (7.9 units), pertains to maximum range cruise at optimum cruise altitude for the existing gross weight. Airflow around the AOA probe is altered by extension or retraction of the nosewheel door. As a result of this effect, with the nose gear up, the actual AOA is approximately 1 unit higher than indicated AOA and ON SPEED AOA is about 5 knots slow. When electrical power to the indicator is interrupted, the word OFF appears in a window in the face of the indicator. The AOA indicator contains switches that light the indexer lights and actuate

ANGLE OF ATTACK DISPLAYS

INDICATOR	INDEXER	ANGLE OF ATTACK UNIT	AIRSPEED	ATTITUDE
		20.3-30	VERY SLOW	
		19.7-20.3	SLIGHTLY SLOW	
		18.7-19.6	ON SPEED	
		18.1-18.6	SLIGHTLY FAST	
		0-18.0	VERY FAST	

4G–1–(1)A
R

Figure 1-9

the stall warning vibrator.

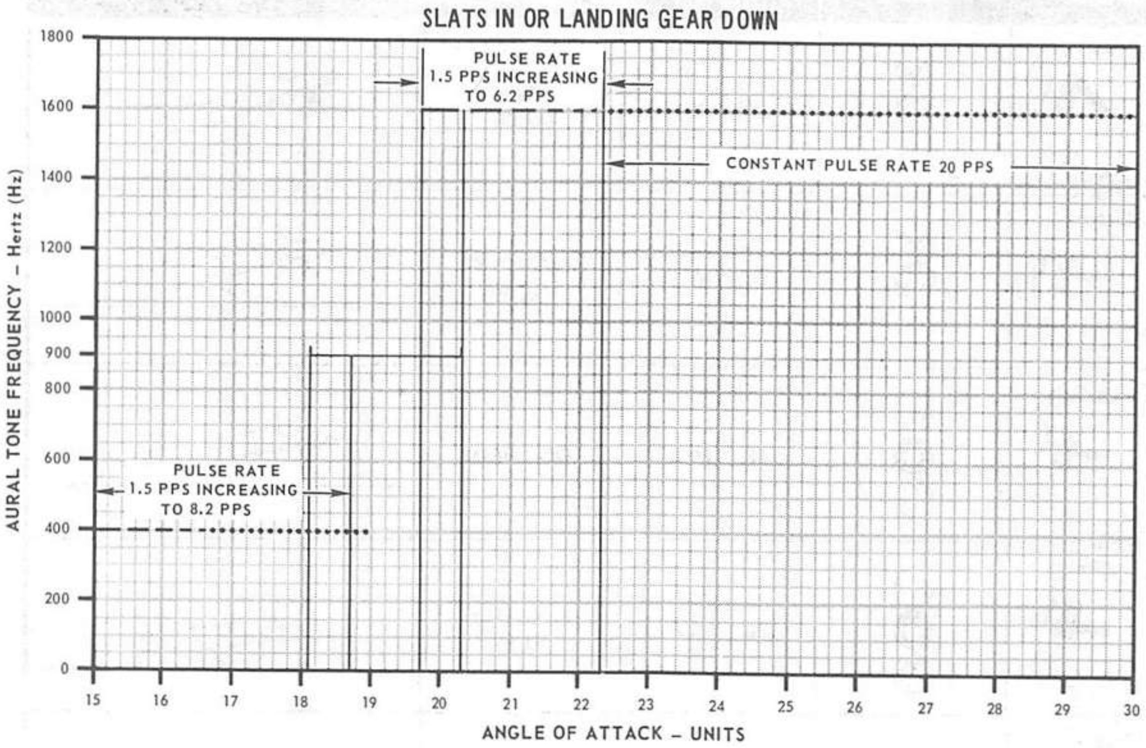
ANGLE OF ATTACK INDEXERS

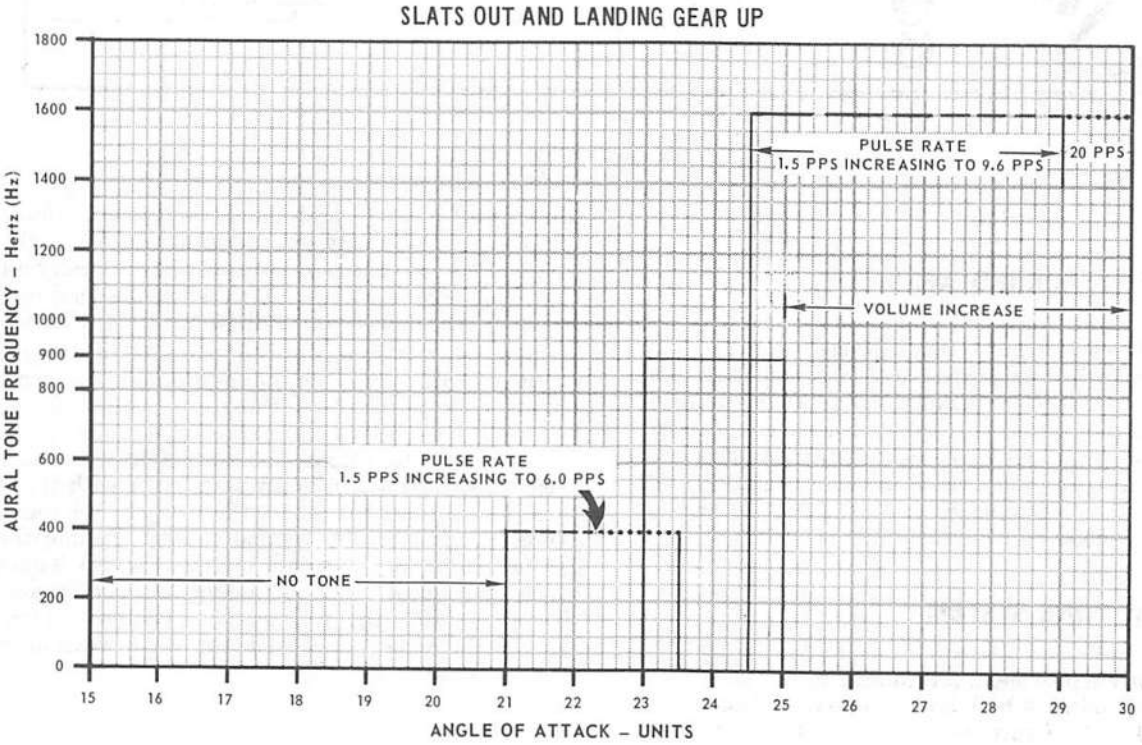
Before TO 1F-4-1500, the AOA indexers (figure 1-9) are located on each side of the windshield (front cockpit) and above the instrument panel (rear cockpit). After TO 1F-4-1500, the front cockpit indexers (LH only) are mounted to the left side and above the center glare shield. With the landing gear down, the indexers provide a visual indication of aircraft AOA in relation to the predetermined on-speed AOA by lighting appropriate symbols.

AOA AURAL TONE SYSTEM

The AOA system provides a continuous aural indication of AOA in the headset of both crewmembers to describe the aircraft AOA (see figure 1-10).The aural tone operates directly off the AOA probe; however, there is a built in lag of about 1 second between the actual AOA and the aural tone indication. The aural tone is present under all flight conditions above 15 units AOA when the landing gear is down or the slats are in, or above 21 units AOA when the landing gear is up and the slats are OUT. However, the volume control knob, on the instrument emergency flood lights control panel in the front cockpit (aural stall warning control panel, rear cockpit), may be used to eliminate the tone up to 20.3 units AOA with the landing gear down or slats in or 25 units AOA with the landing gear up and slats out. Above these values, the tone cannot be eliminated by the volume control. Pulling the AOA probe heater control circuit breaker (C7, No. 3 panel) will turn the aural tone off under all conditions. After TO 1F-4-1262, the rear cockpit volume control knob shares the same panel with the voice warning volume control knob.

ANGLE OF ATTACK AURAL TONE INDICATIONS





4G-1-(2)

Figure 1-10

NOTE

If the AOA probe heater control circuit breaker is pulled, the AOA probe heater, total temperature probe heater, bellmouth pitot probe heater, aural tone generator, stall warning vibrator, and automatic slat extension are disabled.

STALL WARNING VIBRATOR

Refer to Stall Warning Vibrator, Flight Control System, this section.

PITOT–STATIC SYSTEM

The pitot–static system supplies impact (pitot) and atmospheric (static) pressures to various flight instruments and airspeed switches. A conventional pitot–static system is used in the aircraft with a single pitot tube and two static ports. Two systems receive inputs from a single pitot–static boom on the nose of the aircraft. Both pressures may be utilized by the same instruments, but at no time do the pressures intermingle. The pitot and static pressures are applied to airspeed pressure switches that retract the flaps; actuate the rudder feel trim system; and engage the ARI (providing the flaps are DN).

PITOT HEAT SWITCH

The pitot heat switch is on the right console in the front cockpit. The switch controls operation of the heating element in the pitot head, the bellows ram air inlet probe, and the stabilator bellows venturi. The heater elements are energized any time electrical power is applied and the pitot heat switch is in the ON position.

AIR DATA COMPUTER SYSTEM

The air data computer (ADC) receives inputs of static pressure, pitot pressure, engine bleed air, angle of attack and total temperature. These inputs are utilized by the ADC to provide pneumatic and functionalized electrical analog outputs to the various aircraft systems. The electrical signals (figure 1–12) are used by the following: altitude encoder unit, automatic flight control system, DUCT TEMP HI light, fire control system, air induction system, STATIC CORR OFF light, true airspeed indicator, variable bypass bellmouths, and DMAS. The ADC provides DMAS with barometric altitude, angle of attack, and true airspeed. The ADC may malfunction during flight through ice and/or rain, due to impact forces imposed by ice and water on the total temperature sensor.

STATIC PRESSURE COMPENSATOR (SPC)

The SPC is a regulating module within the air data computer used to eliminate major altimeter lag during rapid changes in altitude. The CADC switch, located near the throttles, controls only the functioning of the SPC. The CADC switch has positions of RESET CORR, NORM, and CORR OFF. With the switch in NORM and the SPC operating normally, major altimeter lag during rapid changes in altitude is eliminated. If the SPC fails or the CADC switch is placed to CORR OFF, the SPC regulation is no longer applied to the indicated static pressure. If the STATIC CORR OFF light remains illuminated, the SPC has failed to reset, this may be due to a failure of the air data computer (ADC) and substantial altimeter lag will occur during during rapid changes of altitude. The ADC uses the STATUS CORR OFF light as an indication of any ADC failure.Refer to the Altimeter Lag chart in part 1 of the applicable appendix. In this event, extreme caution must be exercised if diving maneuvers are executed. A failure or interruption of the right main ac power supply, essential dc power supply, or equipment auxiliary air system will cause a failure of SPC regulation. If the failure was due to a transient condition, the SPC may be reset by placing the CADC switch to RESET CORR. If the STATIC CORR OFF light remains illuminated, the SPC has failed to reset and substantial altimeter lag will occur during rapid changes of altitude. The SPC must be reset (CADC switch to RESET CORR) after the engines have been started prior to each flight.

ALTITUDE ENCODER UNIT

The altitude encoder is a dual purpose electronic unit. It receives static pressure signals from the air data computer. With the SPC engaged, the encoder provides a digital input of altitude in 100–foot increments to the IFF. This input provides automatic altitude reporting to the air traffic control system when mode C is selected on the IFF control panel. In addition, the synchro input nulls out pneumatic errors in the altimeter with the SPC engaged and RESET selected on the altimeter.

ALT ENCODER OUT LIGHT

An ALT ENCODER OUT light is on the telelight panel in the front cockpit. The light will illuminate if there is an unreliable signal or no signal from the altitude encoder unit. Also the light may illuminate momentarily during a high–rate climb or dive maneuver, or during transonic flight.

EMERGENCY EQUIPMENT

WARNING AND INDICATOR LIGHTS

To keep instrument cross–check to a minimum, warning and indicator lights are incorporated throughout the two cockpits. The majority of the lights are in the front cockpit, and most of them are grouped on the right subpanel (telelight panel). All of the warning and indicator lights, with the exception of the FIRE and OVERHT warning

Figure 1-11. Deleted

lights and the EJECT light utilize power from the ac warning lights bus. With no ac power available, as with double generator failure, the dc bus telelight will operate on power from the essential dc bus. Additionally, the pull-up light and all radar indicator lights except the radar range lights and skin track light receive power from the warning lights bus, as do the station and weapons select lights. The missile status lights, the centerline tank aboard (CL TK) light, and the heads up display lights are powered from the main 28 volt dc bus. The 28/14 volt ac warning light bus provides power for the following rear cockpit lights: the MASTER CAUTION, RADAR CNI COOL OFF, INERTIAL NAV SYS OUT, CANOPY UNLOCKED, the AVTR EOT, and RECORD lights. The bus itself receives 28 volt ac power from the instrument 28 volt ac bus and 14 volt ac from the instrument 14 volt ac bus. Selection of 28 or 14 volt ac for warning lights operation is made automatically with the flight instrument lights control knob. When the flight instrument lights control knob is off, the warning lights operate from 28 volt ac power. When the flight instrument lights control knob is on, the warning lights operate from 14 volts ac. In the case of a left generator failure, bus tie open or a right generator failure, bus tie open, 28 volt ac power is always available to the warning lights bus and 14 volt ac power is available to the warning lights bus with a right generator out and the bus tie open. Depending on the position of flight instrument light control knob, 28 volt or 14 volt ac power is available to the warning lights bus in case of loss of either generator with the bus tie open. Loss of the main 28 volts dc bus (warning lights control voltage) prevents the warning lights bus from being dimmed, but the warning lights, if illuminated, illuminate bright regardless of the position of the instrument lights knob. The five shoot lights and the IN RANGE light are powered through a flasher unit from the main 28 volt dc bus. When the flight instrument lights control knob is moved from the OFF position, the shoot lights are deactivated and only the IN RANGE light flashes (at reduced intensity) to indicate an in envelope condition for missile firing. Refer to T.O. 1F-4G-34-1-1.

AIR DATA COMPUTER

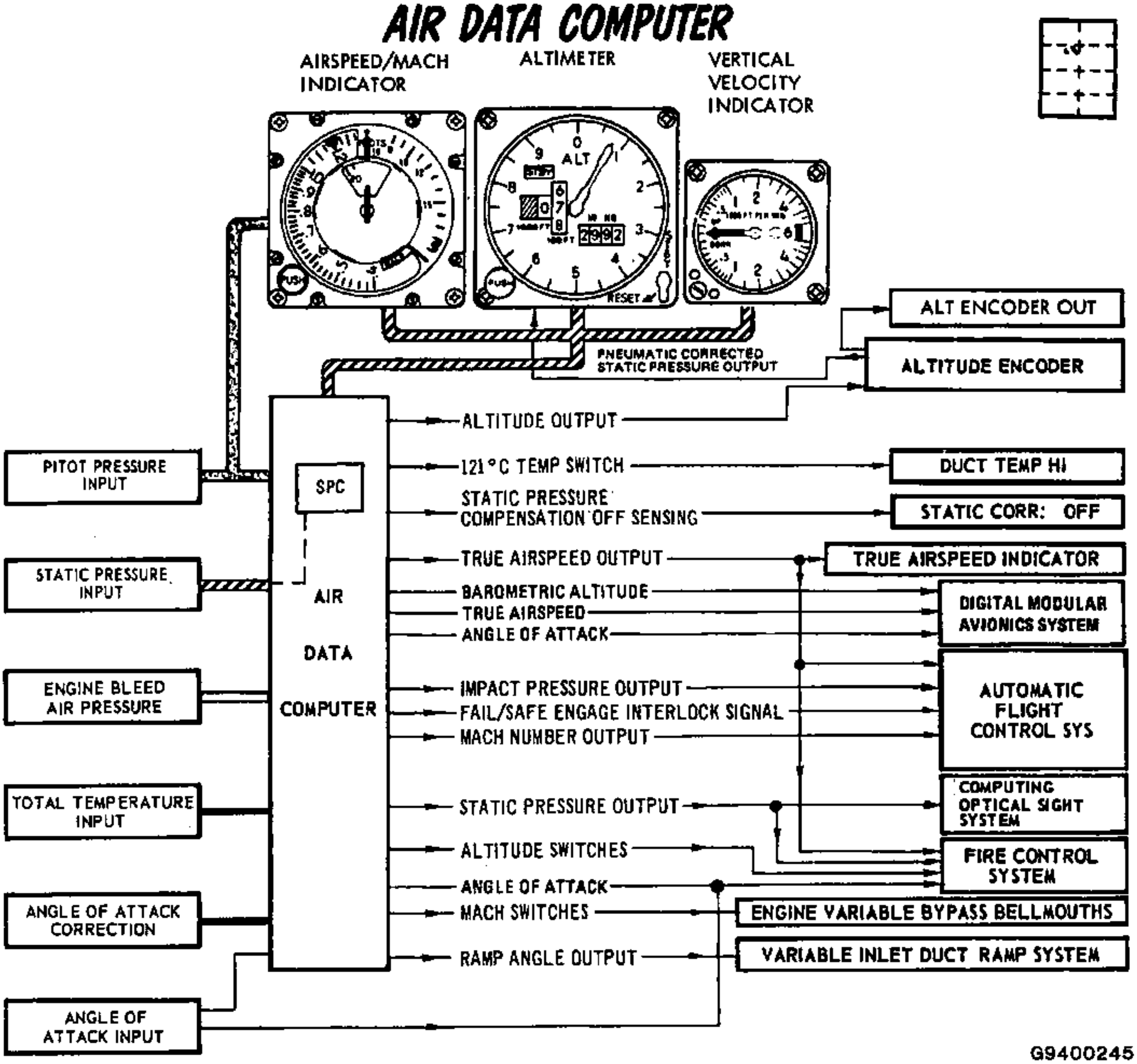


Figure 1-12.

Master Caution Light

The MASTER CAUTION light in the front cockpit operates in conjunction with the generator indicator lights and most of the warning and indicator lights on the telelight panel. The MASTER CAUTION light does not illuminate in conjunction with the following lights: FIRE/OVERHEAT (prior to TCTO 1F-4-1503), SPEED BRAKE OUT, R EXT FUEL, CTR EXT FUEL, L EXT FUEL, APU, and ALT ENCODER. A MASTER CAUTION light is installed in the rear cockpit and operates with the front cockpit MASTER CAUTION light. It is only necessary to monitor the MASTER CAUTION light for an indication of a condition requiring attention, and then refer to the telelight panel for the specific condition. The MASTER CAUTION light may be extinguished by depressing the master caution reset button on the generator control panel. The reset button is not on the generator control panel, but the button remains on the forward part of the right console. There is no reset button in the rear cockpit. Illuminated lights on the telelight panel will not be extinguished by the master caution reset button, with the exception of the A/P DISENGAGED light, until their respective faults have been corrected. After the MASTER CAUTION light is extinguished, and an additional condition exists that requires attention, the MASTER CAUTION light will again illuminate. When operating both generators in parallel and the left generator is cycled OFF and then ON, the MASTER CAUTION light may not extinguish when the left generator comes on and parallels with the right generator.

Warning Light Test Circuit

A warning light test circuit is used for testing the operation of the bulbs in the warning and indicator lights. The circuit does not check the operation of any of the systems utilizing a light, it merely checks the operation of the bulbs. The warning and indicator lights may be illuminated by actuating the warning lights test switch on each interior lights control panel. After TO 1F–4–1167, shoot lights are tested by activating the warning lights test switch on the front cockpit interior lights control panel. The flight instrument lights control knob must be in the OFF position to test the shoot lights. If this switch is not in the OFF position, only the IN RANGE light is powered by the 28/14 volt ac warning lights bus upon activation of the warning lights test switch.

ENGINE FIRE AND OVERHEAT DETECTOR SYSTEM (BEFORE TO 1F-4-1503 AND TO 1F-4-1484)

The engine fire and overheat detector system provides fire warning for the engine compartment and overheat warning for the aft fuselage. The system consists of four warning lights, a control unit with four independent channels (one for each light), and a series of pneumatic detectors. The system operates on a gas expansion principal. When heat causes the gas to expand, the resulting increase in gas pressure causes the appropriate warning to come on. If any sensor loop is punctured, severed, or burned through, no subsequent FIRE/OVERHT warning will be provided unless another sensor loop is also affected by the fire/overheat. Illumination of a fire or overheat warning light does not cause the MASTER CAUTION to come on. The system operates from the essential 28 volt dc bus, but to test the system requires both essential 28 volt dc and right 28 volt dc power.

Fire Warning

Illumination of a left or right FIRE warning light on the upper right front cockpit instrument panel warns the pilot of a fire or over—temperature condition in the designated engine compartment.

Aft Fuselage Overheat Warning

Illumination of a left or right OVERHT warning light below the FIRE lights on the upper right front cockpit instrument panel warns the pilot of an overheat condition in the designated side of the aft fuselage. Overheat detectors are externally visible inboard of each engine nozzle, mounted in a recess in the aft fuselage skin adjacent to the engine nozzle flaps.

Fire Test Button

The fire test button is between the four fire and overheat warning lights on the upper right front cockpit instrument panel. Pressing the fire test button tests for faulty detectors (low gas pressure) and wiring continuity. Failure of a FIRE or OVERHT light to come on indicates a fault. Holding the front cockpit warning lights test switch to WARN TEST while pressing and releasing the fire detector test button tests the control units ability to detect and signal a faulted detector. Proper operation of the four control unit channels is indicated by all four warning lights being out with both switches actuated and then all four lights coming on when the fire test button is released. Holding the warning lights test switch to WARN TEST without pressing the fire test button tests only the fire and overheat warning bulbs.

AIRCRAFT FIRE AND OVERHEAT DETECTOR SYSTEM (AFTER TO 1F-4-1503 AND TO 1F-4-1484)

The aircraft fire and overheat detection system provides fire, overheat, and burn-through detection for each engine compartment and aft fuselage. The system consists of four warning lights, a control module with four independent channels (one for each light), a series of pneumatic detectors, and a system fault light. The control module (installed by TO 1F-4-1503) provides automatic system fault monitoring; it interconnects with the MASTER CAUTION light and the telelight panel in the forward cockpit to provide the system fault warning. After compliance with TO's 1F-4-1484 and 1F-4-1503, the system also interconnects with the cockpit Voice Warning System to provide an aural FIRE-FIRE alarm. The detection system operates on a gas expansion principle. When heat causes the gas within the detectors to expand, the resulting increase in gas pressure causes the appropriate warning light to come on. The system operates from the essential 28 volt dc bus, but to test the system main 28 volt dc power is also required. The system is tested by pushing the FIRE TEST button on the forward cockpit instrument panel.

Fire Warning

The left and right FIRE warning lights are located on the upper right front cockpit instrument panel. The left or right FIRE warning light and the voice warning system warn the pilot of a fire or over-temperature condition in the designated engine compartment. During a situation when a heat source exceeds the threshold temperature of any of the system's detectors, the FIRE light will come on and the aural warning will be initiated. (The aural warning can not be activated again until after the cause of the initial warning no longer exists.)

Prior to system activation if the detector loop is severed, burned through, or other system fault occurs, the following indication will result: MASTER CAUTION, FIRE SYS, and FIRE lights illuminate and the aural warning sounds. After 4 seconds, the FIRE light will go out. Pressing the test button illuminates all the fire/overheat lights, except the FIRE light corresponding to the problem engine bay. Aural warning can not be sounded again until the original activation cause has been removed.

After system activation, (FIRE light already on and aural warning initiated) if a detector loop is severed, burned through, or other system fault occurs, the following indications will result: MASTER CAUTION and FIRE SYS lights illuminate. The FIRE light goes out after 4 seconds. Pressing the fire test button illuminates all the fire/overheat lights, except the FIRE light corresponding to the problem engine bay.

Overheat Warning

The left and right OVERHT warning lights are located below the FIRE lights on the front cockpit instrument panel. The left or right OVERHT warning light and the voice warning system warn the pilot of a fire or overtemperature condition in the aft portion of the designated engine compartment. During a situation when a heat source exceeds the threshold temperature of any of the system's detectors, the OVERHT light will come on and the aural warning will be initiated. (The aural warning can not be activated again until after the cause of the initial warning no longer exists.)

Prior to system activation if the detector loop is severed, burned through, or other system fault occurs, the following indication will result: MASTER CAUTION, FIRE SYS, and OVERHT lights illuminate and the aural warning sounds. After 4 seconds, the OVERHT light will go out. Pressing the test button illuminates all the fire/overheat lights, except the OVERHT light corresponding to the problem engine bay. Aural warning can not be sounded again until the original activation cause has been removed.

After system activation, (OVERHT light already on and aural warning initiated) if a detector loop is severed, burned through, or other system fault occurs, the following indications will result: MASTER CAUTION and FIRE SYS lights illuminate. The OVERHT light goes out after 4 seconds. Pressing the fire test button illuminates all the fire/overheat lights, except the OVERHT light corresponding to the problem engine bay.

System Fault

When a system fault exists, the MASTER CAUTION light and the telelight panel fault light (FIRE SYS) will come on. The appropriate FIRE or OVERHT warning light will also come on for approximately 4 seconds and then go off. After compliance with TOs 1F–4–1484 and 1F–4–1503, the voice warning system will provide an aural (FIRE–FIRE) warning during system fault, as well as during system alarm. A system fault warning will be signaled when:

a. any detector wire chafes to ground, or
b. any detector wire breaks, or
c. any detector's sensor tube is severed or chafed through, or
d. any detector's mating connector sockets are loose or contaminated, or
e. the control module fails

NOTE

- The difference between a fault caused by a problem in the system operation and a fault as a result of a burn through cannot be determined in flight.

- A fault (including burn through) can be isolated to its corresponding engine and corresponding overheat or fire system by pushing the FIRE TEST button. The corresponding FIRE/OVERHT light will not come on if there is a fault (including burn through) of the corresponding system.

Fire Test Button

The FIRE TEST button is above the four FIRE and OVERHT lights on the upper front cockpit instrument panel. Pressing the FIRE TEST button simultaneously checks the system alarm and fault circuitry. When the button is pushed, the four FIRE/OVERHT lights, the MASTER CAUTION light, and the FIRE SYS fault light on the telelight panel should come on. After compliance with TOs 1F-4-1484, 1F-4-1503 and with both canopies closed, the voice warning FIRE-FIRE should also be heard.

EJECT LIGHT

An EJECT light provides a positive visual command from the pilot to the EWO to prepare for ejection. The light is controlled only from the front cockpit. The pilot's switch and monitor light are incorporated into a single unit under the left canopy sill just forward of the flap switch. The switch is a push ON, push OFF type, with the push button being the lens of the light. The lens is recessed sufficiently to preclude an accidental actuation. The light in the rear cockpit is a rectangular press to test unit near the bottom center of the instrument panel. Pressing the lens of the rear light will test the rear light bulb and circuitry only. When the switch in the front cockpit is pressed, both EJECT lights illuminate. Pressing the switch again will extinguish both lights. The EJECT lights are powered by the battery bus and are operational at any time.

JETTISON SYSTEMS

Most stores carried on the aircraft may be jettisoned. Safety switches prevent jettison of most stores with the forward gear handle down, or the rear emergency gear handle pulled out. Stores are force-jettisoned by firing impulse cartridges in the armament pylon MAU-12 racks, the centerline rack, the fuselage station missile launchers, and the AGM-78 missile launchers. Therefore, cartridges are not installed for stores which command authority considers nonexpendable for any reason. AGM-65 missiles are fired from their launchers during jettisoning; the AGM-45 missile slides rearward off the launcher. Equipment that is physically nonjettisonable are the armament pylons, the AGM-45 launchers, the AIM-9 missiles and AIM-9 missile launchers. Refer to the jettison chart, section III, for the correct method of jettisoning stores. Refer to external stores limitations, section V, for stores jettison limitations.

External Stores Emergency Release Button

The external stores emergency release button (panic button) is on the front cockpit left subpanel (figure 1-13). This button, when depressed, will jettison all jettisonable external stores except air-to-air missiles. The button is operative under the following conditions: the aft emergency extension gear handle in the normal (IN) position and the forward gear handle in the up position. When the button is pressed, yellow paint can be seen inside the guard. If the external fuel transfer switch is in the OUTBD or CENTER position at the time of jettison, all external tanks fuel shutoff valves will close and the external transfer switch will be ineffective, allowing internal wing fuel to transfer normally. The external stores emergency release circuit receives power from the essential 28 volt dc bus.

Armament Safety Override Button

The armament safety override button (figure 1-13), under the left canopy sill, allows the safety switches to be bypassed for armament circuit checkout. When the override button is pressed, 28 volts dc power is directed to the holding coil which retains the button pressed until electrical power is removed from the aircraft, the armament bus control circuit breaker is pulled, or the gear handle is up. In an airborne emergency in which all other jettison methods have failed, the pilot can attempt stores jettison by pressing and holding the override button and actuating the applicable jettison switch. Pressing the armament safety override button bypasses the front cockpit gear handle safety switch and the REAR cockpit EMERGENCY gear handle safety switch This causes all jettison switches to become hot. The armament safety override button must be pressed and held with the forward gear handle up, since the button is not solenoid held with the handle in the up position.

WARNING

All jettison controls are disabled once the emergency gear extension handle in the rear cockpit is pulled. In this case, the controls may be re-established by use of the armament safety override button.

SELECTIVE JETTISON

The selective jettison control (figure 1-13) provides selective jettisoning of missiles, and of wing and centerline mounted stores. Any store that can be carried on the aircraft may be jettisoned through this control, except AIM-9 missiles.The circuit is hot anytime the rear gear handle is in and the forward gear handle is up.

JETTISON CONTROLS

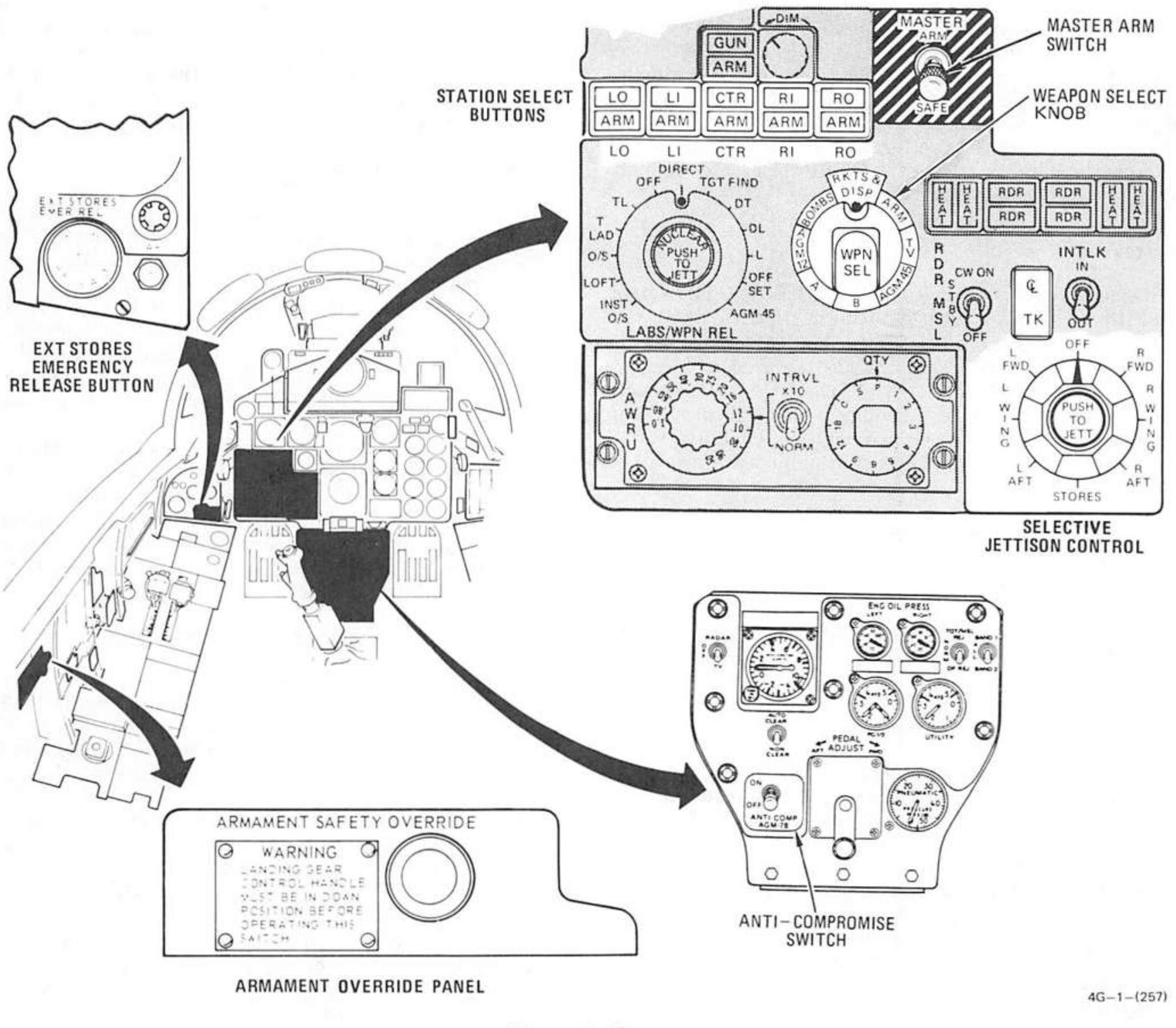


Figure 1-13

Wing and CL Station Jettison

Wing and centerline mounted store jettison circuits are activated by selecting STORES on the selective jettison control knob. The STORES position applies power from the PUSH TO JETT button through the station select buttons to the cartridge fire circuits of the wing and CL stations. Therefore with STORES selected, the pilot presses the required station select button(s) and presses the PUSH TO JETT button. Any selected single–carried store, MER/TER equipment with multiple stores, LAU−88/A or LAU−118 launcher with missiles are jettisoned. The AGM−45 missile is jettisoned from the LAU−34/A launcher.

AIM-7 Missiles

The AIM-7 missiles are individually jettisoned by selecting either L FWD, R FWD, L AFT, or R AFT fuselage stations on the selective jettison control and actuating the PUSH TO JETT button. Each fuselage missile jettisons without motor ignition. If a fuel tank or a MER is aboard the CL station, the two forward missiles are locked out of the jettison circuit and the CL TK aboard light is ON. With a single bomb on the centerline station, the CL TK aboard light is ON, but jettison of the two forward missiles is not inhibited. The light remains ON after release/ jettison of the single bomb.

AIM-9 Missiles

AIM-9 missile jettison circuit is disabled.

AGM-45 Missiles

The AGM−45, using the wing station jettison procedures, is jettisoned by selecting STORES on the selective jettison control knob, pressing the required station select button(s) and then pressing the PUSH TO JETT button. The missile(s) slides rearward off the LAU−34/A launcher unarmed without rocket motor ignition. The LAU−118 is jettisoned with the missile still attached.

AGM-65 Missiles

The AGM−65 missiles are individually jettisoned by selecting TV or AGM−45 on the weapon select knob (figure 1−13), pressing the desired station select button (LI or RI with no other stations selected), L WING or R WING on the selective jettison knob, and pressing PUSH TO JETT. With LAU−88/A launchers, a single missile is jettison−launched each time the JETT button is pressed until all missiles on the selected stations are expended. The entire load (missiles and LAU−88/A or LAU−117/A launcher) is jettisoned by following the procedures for wing stores.

AGM-88 Missiles

The AGM−88 is jettisoned by selecting ARM on the weapons selector knob, selecting ARM on the master arm switch, positioning the anti−compromise switch (figure 1−13) to ON, pressing the required station(s) on the station select button(s), selecting STORES on the selective jettison control knob and then pressing PUSH TO JETT. During jettison the rocket motor is ignited and the warhead is armed so that on missile impact the warhead explodes. The LAU−118 launcher, including any missile aboard, is jettisoned by using the procedures for wing station stores.

DCU-94/A JETTISON AND RELEASE CIRCUITS

The DCU-94/A panel may be used to jettison suspension equipment or weapons carried on the armament pylons (except the RO station). When the inflight lockout pin is installed in the wing armament pylons the LO, LI and RI UNLOCKED lights on the DCU-94/A illuminate when power is applied to the aircraft. The RO light will not illuminate even though the pin may be installed. If the nuclear jettison control is used to jettison conventional stores, then the contents of all nuclear stations (LO, LI, CL, RI) can be jettisoned simultaneously or individually by selecting one or more stations. If the nuclear release controls are used, stations can only be jettisoned individually.

VOICE WARNING SYSTEM (AFTER TO 1F-4-1262)

After TO 1F−4−1262, a voice warning system is installed to inform crewmembers that the front or rear canopy is unlocked, or when the aircraft is below the altitude set on the radar altimeter. With electrical power on the aircraft and both canopy selector levers in the CLOSE position for at least 12 seconds, a CANOPY−CANOPY voice warning is heard in both headsets provided canopy conditions exist which cause the forward or rear CANOPY UNLOCKED light to come on. The 12 second delay is to allow sufficient time for the last canopy to close and lock. An ALTITUDE−ALTITUDE voice warning is heard if conditions exist that cause the radar altimeter low altitude warning light to come on. Once inititated, the voice warning will not repeat unless the cause for inititation is corrected by action which causes the CANOPY UNLOCKED light to go out or the low altitude warning light to go out. If both warnings are initiated, but only one is reset (light out), the reset warning will repeat if conditions again turn on its light. The voice altitude warning has the same limitations as the radar altimeter and is nonpredictive of forward terrain clearance. The ALTITUDE−ALTITUDE voice warning may reset with the aircraft below the set warning altitude if bank exceeds 15° or pitch exceeds 15°. In this case, the ALTITUDE−ALTITUDE warning will repeat as the aircraft is leveled. See Radar Altimeter, this section. Activation of the front cockpit warning lights test switch causes CANOPY−CANOPY, ALTITUDE−ALTITUDE to be heard in both headsets providing power is on the aircraft and both canopy selector levers are in the CLOSE position for 12 seconds. If one or both of the voice warnings have been initiated prior to the test and not reset, the warnings will not be used during the test.

VOICE WARNING SYSTEM (AFTER TO 1F-4-1484 AND TO 1F-4-1503)

Fire Voice Warning

After TOs 1F−4−1484 and 1F−4−1503, the voice warning system provides an audible (FIRE−FIRE) warning to both headsets whenever the fire/overheat detection system signals an alarm or fault condition. With electrical power on the aircraft and both canopy selector levers in the CLOSE position for at least 12 seconds, the FIRE−FIRE voice warning is heard under any of the following conditions:

a. FIRE/OVERHT warning light illuminated on front cockpit instrument panel, or

b. MASTER CAUTION and FIRE SYS fault lights illuminated, or

c. Fire test button pressed.

Once initiated, the voice warning will not repeat unless the cause for initiation is corrected by action which causes the fire detection system warning or fault light to go out. When the warning lights test switch is activated with both canopies closed, the voice warning FIRE−FIRE, CANOPY−CANOPY, ALTITUDE−ALTITUDE is heard in both headsets.

Volume Control Knobs

A volume control knob for the voice warning system labeled CANOPY-LOW ALT, is installed in each cockpit. The knob in the front cockpit is on the utility panel on the left console. The volume control knob in the rear cockpit is on the stall warning tone and voice warning control panel on the right console. The panel contains two volume control knobs with the square-shaped voice warning knob on top and a circular-shaped stall warning volume control knob on the bottom. Voice warning volume should be adjusted during the voice warning system test prior to takeoff.

INSTRUMENTS

Most of the instruments are electrically operated by power from the electrical system. Some instruments, such as the accelerometer, are self-contained and do not require any external source of electrical power. Refer to foldout section for front and rear cockpit instrument panel illustrations. For information regarding instruments that are an integral part of a particular system, refer to applicable paragraphs in this section and section IV.

TRUE AIRSPEED INDICATORS

A true airspeed indicator is on front cockpit instrument panel. The indicator reads directly in knots TAS, and has a range of 0 to 1500 knots. The system calibrated range is 150 to 1500 knots. Therefore, true airspeed readings below 150 knots are not reliable.

ACCELEROMETERS

An accelerometer, to measure and record positive and negative acceleration G loads, is on the front cockpit instrument panel. The indicator has three movable pointers. One pointer moves to indicate 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 pointers remain at their maximum travel positions of applied G load. Depressing a PUSH TO SET button, in the lower left corner of the instrument will allow the recording pointers to return to the one G position.

CAUTION

The accelerometers may read ½ G low or lower when G onset rates are high.

AIRSPEED/MACH INDICATORS

A combination airspeed and Mach number indicator is on the front cockpit instrument panel and the rear cockpit instrument panel. They show airspeed readings below 200 knots and include 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 movable Mach number scale graduated from Mach 0.4 to Mach 2.5. A movable airspeed marker is included as an approach speed reference and can be positioned by the knob on the face of the instrument. The same knob, when depressed and rotated, will position another pointer on the Mach number scale for indicated Mach 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. There are two types of airspeed/mach indicators which can be installed in the aircraft. In the one type the mach number marker will not follow the movement of the mach number scale but will remain stationary once it is set.

CAUTION

Do not rotate airspeed index pointer below 80 knots or above 195 knots. Do not rotate mach index pointer below 225 knots or above 850 knots. Internal damage to the indicator may result if these limits are exceeded.

ALTIMETER

The altimeters are of the counter-pointer type which display the whole thousands number in a counter window and 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 feet 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 at sea level pressure. In the transonic range, an altimeter jump may be noticed. A servoed altimeter in each cockpit receives both pneumatic pressure and electronic signals from the altitude encoder unit for operation. A three position switch on the altimeter, labeled RESET and STBY, is springloaded to the center unmarked position. In STBY, only pneumatic pressure is applied to the altimeter and a red flag marked STBY appears on the face of the instrument. In RESET, the electronic signal is also applied to the indicator and the red STBY flag disappears; this condition is considered the normal mode of operation. If a failure occurs in the altimeter, altitude encoder unit, or the air data computer, the altimeter reverts back to STBY and cannot be reset. This is indicated by the appearance of the standby warning flag on the face of the altimeter, and by the possible illumination of associated warning lights (see figure 1-14). Refer to part 1 of the appendix for altimeter lag and altimeter position error correction.

WARNING

If the altimeter system is suspected to be in error, select STBY and check the altimeter jump. If altimeter jump is out of limits, select STATIC CORR–OFF (SPC) and apply the proper altimeter lag correction. If the altimeter is still suspected to be in error, depressurize the cockpit and cross check against the cockpit pressure altimeter.

CAUTION

To prevent damage to the selector switch, do not use excessive pressure when switching reset/standby switch.

MAGNETIC COMPASS

A conventional magnetic compass, one in each cockpit, is provided for navigation if an instrument or electrical malfunction occurs. Compass deviation cards are above the canopy sill on the right side of both cockpits.

VERTICAL VELOCITY INDICATORS

The vertical velocity indicators indicate the rate of climb or descent of the aircraft. The vertical velocity indicator is connected to the static pressure system of the airplane and measures the change in atmospheric pressure as the airplane climbs or descends.

RADAR ALTIMETER

The radar altimeter provides the pilot with accurate height information, with respect to the terrain, from 0 to 5000 feet. Accuracy of the system is ±5 percent of the indicated altitude or ±2 feet, whichever is greater. Operational limits allow the system to function normally from 0° to 30° bank angle and/or from 0° to 35° pitch angle. The dial scale is linear from 0 to 100 feet and logarithmic from 100 to 5000 feet. A function control switch, on the lower left side of the indicator provides complete control of the system. A red, low altitude warning light is on the lower right side of the indicator.

Function Control Switch

Clockwise rotation of the function control switch applies power to the system components. By rotating the control switch further clockwise, the reference marker may be positioned. This also sets the low altitude warning light limit. Any time the aircraft descends below the preselected altitude, the low altitude warning light illuminates. A self-test function may be initiated by pressing in on the function control switch and checking that the altitude pointer indicates 35 ±15 feet. Above 5000 feet, or when unreliable signals are being received, the altitude pointer is driven counterclockwise behind a mask which is located between the 0 and 5000 feet mark, and the OFF flag will appear. The OFF flag also appears when power is lost or turned off; however, the altitude pointer remains at the altitude it was indicating when the power interruption occurred. With external stores aboard and the aircraft in a maneuvering attitude, the radar altimeter will experience performance degradation. However, no degradation occurs in straight and level flight.

ALTITUDE REPORTING FAILURE INDICATIONS

TYPE OF FAILURE	ALTIMETER (AAU-19/A)	ALT ENCODER OUT LIGHT	STATIC CORR OFF LIGHT	MASTER CAUTION LIGHT	RESULTING SYSTEM OPERATION
ALTIMETER SERVO FAILURE OR MANUAL STBY SELECTION	STBY	OFF	OFF	OFF	ALTIMETER REVERTS TO PNEUMATIC OPERATION ON CORRECTED STATIC PRESSURE. ALTITUDE INFORMATION IS SUPPLIED TO THE ALTITUDE REPORTING TRANSPONDER.
ALTITUDE ENCODER UNIT FAILURE OR AIR DATA COMPUTER FAILURE	STBY	ON	OFF	OFF	ALTIMETER REVERTS TO PNEUMATIC OPERATION ON CORRECTED STATIC PRESSURE, AND NO ALTITUDE INFORMATION SUPPLIED TO ALTITUDE REPORTING TRANSPONDER.
AIR DATA COMPUTER SPC FAILURE OR MANUAL OFF SELECTION	STBY	ON	ON	ON	ALTIMETER REVERTS TO PNEUMATIC OPERATION ON UNCORRECTED STATIC PRESSURE, AND NO ALTITUDE INFO SUPPLIED TO ALTITUDE REPORTING TRANSPONDER.

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Figure 1-14

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.

Voice Warning System (After TO 1F-4-1262)

After TO 1F-4-1262, a voice warning system is installed which operates in conjunction with the low altitude warning light. See Voice Warning System, this section. Except for test, the altitude function will not operate whenever the OFF flag on the radar altimeter is showing.

TURN AND SLIP INDICATOR

A turn and slip indicator is incorporated in the attitude director indicator on the front cockpit instrument panel. The turn needle in the ADI, operated by a vertically mounted gyro, indicates direction of turn but does not provide accurate turn rate. Complete electrical failure renders the turn needle inoperative.

SLIP INDICATOR

A slip indicator is located below the HSI in the front cockpit.

ATTITUDE INDICATOR (REAR COCKPIT)

The attitude indicator on the rear cockpit instrument panel receives attitude information from the Attitude Heading and Reference System when the reference system selector switch is in either the PRIM or STBY position. The pitch trim knob is used to electrically rotate the attitude sphere to the desired position in relation to the fixed miniature airplane. An attitude OFF warning flag is visible on the face of the instrument when power is not applied or when any one phase of ac power to the instrument is lost.

WARNING

The attitude warning flag does not appear with a slight electrical power reduction or failure of other components within the system. Failure of certain components can result in erroneous or complete loss of pitch and bank presentations without a visible flag.

EMERGENCY ATTITUDE REFERENCE SYSTEM

The emergency attitude reference system operates independently of other systems. The system provides indications of aircraft pitch and roll attitude during normal operation and continues to provide reasonably accurate information (±6°) for 9 minutes if power to the system is lost and the OFF flag is in view. The system contains a standby (emergency) attitude indicator (SAI) inverter and circuit breaker. If normal power fails, the system will be powered by the aircraft battery.

EMERGENCY ATTITUDE INDICATOR

The emergency attitude indicator is a 2-inch self-contained instrument on the main instrument panel in the front cockpit. Except for the gyro spin motor and the indicator lights, the unit is entirely mechanical. The indicator includes an attitude sphere similar to the ADI, an OFF flag, and a pull to cage knob. The upper portion of the attitude sphere consists of a gray area which is always in view to indicate the direction of up or skyward. Power to the system should be applied at least 1 minute before pulling the cage knob. The pitch attitude markings on the sphere are in graduations of 5°, and the roll markings are in graduations of 10° with the larger markings indicating each 30°. The presentation on the indicator consists of a miniature airplane viewed against a rotating sphere. The indicator displays aircraft roll through 360°. Pitch is limited by mechanical stops set at 92° in climb and 78° in dive to prevent gimbal lock. As the aircraft climbs or dives to the mechanical stops, the pitch attitude changes smoothly until the stop is reached. The indicator sphere then tumbles 180° in roll to display the inverted position as the aircraft pitch attitude increases toward the inverted flight position. The indicator OFF flag appears if there is a power failure, or if the pull to cage knob is pulled. When the knob is pulled during initial erection, the emergency attitude indicator erects to 0° in pitch and roll regardless of the aircraft attitude. The knob also provides pitch trim in climb or dive. Rotating the knob clockwise or counterclockwise moves the miniature airplane up or down 5°. It is possible to lock the emergency attitude indicator gyro in the caged position by pulling the knob out and then turning it clockwise to engage the detent.

CAUTION

Do not lock the gyro in the caged position with the pull to cage knob if the gyro is spinning. Damage to the gyro might occur if it is moved while in the caged position. If the knob is in the locked position, it must be pulled out to clear the detent before it can be turned counterclockwise. The pull to cage knob should always be pulled back gently and released without being allowed to snap back.

EMERGENCY ATTITUDE INDICATOR (SAI) INVERTER

The SAI inverter is above the right console in the front cockpit. This unit contains one circuit breaker labeled AI PWR and an intensity control knob labeled LTG. The circuit breaker must be engaged for power to be supplied to the gyro motor. The intensity control knob varies the intensity of the lights on the face of the emergency attitude indicator.

EMERGENCY ATTITUDE INDICATOR OPERATION

To initially erect the emergency attitude gyro, pull the cage knob out and hold until the indicator displays 0° in pitch and roll. Release the knob and within 3 minutes the gyro will be fully erected. The mechanical erecting mechanism will drive the indicator to the desired position at the rate of 3° per minute. Do not recage the gyro.

NOTE

> Recage the gyro only when large errors are present. Large errors can be induced by more than 10° banks for such a period of time that an error of more than 10° is present which locks out the erecting mechanism. If recaging is necessary, attain a wings level attitude, recage the gyro and maintain the level attitude for 2 minutes after caging. Adjust the miniature airplane level with horizon bar. After the aircraft is in flight and in a wings level attitude, rotate the cage knob to adjust the miniature airplane on the indicator to the desired pitch position.

FLIGHT DIRECTOR GROUP

The flight director group provides an integrated display of the navigation situation of the airplane (figure 1–15). The flight director group consists of a flight director computer, the horizontal situation indicator (HSI), and a navigation function selector panel. The pilot selects various navigation information on the HSI and steering information on the ADI by positioning the bearing/distance selector knob and mode selector knob on the navigation function selector panel. Information displayed by the flight director group is integrated with DMAS. Although DMAS is not a component of the flight director group, it supplies signals to the flight director computer and flight director instruments. DMAS operation is discussed in this section only as it applies to flight director group operation. The flight director computer receives drift angle, relative bearing, and roll signals from DMAS to compute steering information displayed on the ADI. DMAS supplies range, relative bearing, course deviation, and course information to the HSI.

NAVIGATION FUNCTION SELECTOR PANEL

The navigation function selector panel (figure 1-16) is on the front cockpit instrument panel. The panel contains a bearing/distance knob and a mode selector knob.

The bearing/distance selector knob controls the bearing pointer and range indicator displays on the HSI (figure 1–17). Knob positions are VOR/TAC, TAC, ADF/TAC, and CMPTR NAV. With VOR/TAC selected, magnetic and relative bearing to the VOR station and range to the tacan station are displayed on the HSI's bearing pointer and range indicator. With TAC selected, magnetic and relative bearing and range to the selected tacan station are displayed. With ADF/TAC selected, magnetic and relative bearing to the selected ADF station and range to the tacan station are displayed. With CMPTR NAV selected, magnetic and relative bearing and range are provided to the destination in the navigation computer. The mode selector knob controls all the other navigation displays on the HSI (i.e. CDI, TO/FROM indicator, heading set marker, etc.) as well as pitch and bank steering bars on the ADI (figure 1–19). The mode selector knob operates independently and does not affect information displayed by the bearing pointer or range indicator. Any of the navigation modes selected by the pilot illuminates a mode of operation word message light on the HSI when the instrument panel lights control knob is ON. Intensity of the mode lights is also controlled by this knob. The mode words are: TAC (tacan), NAV (DMAS), UHF (ADF), MAN (HDG), ILS (instrument landing system), and TGT (target). During radar offset bombing operations illumination of the TGT mode word indicates that the EWO has pressed the TGT insert button on the cursor control panel. The data link (DL) light does not come on since this mode is not available. The mode selector knob positions are: VOR/ILS, TAC, CMPTR NAV, CMPTR APR, and HDG.

The flight director (FD) switch on the mode selector knob controls whether the pitch and bank steering bars on the ADI will function as directed by the mode selector knob or be driven out of view. For example, with the FD switch in the OFF (vertical) position, the bank steering bar normally used to direct a course interception in the TAC mode is out of view.

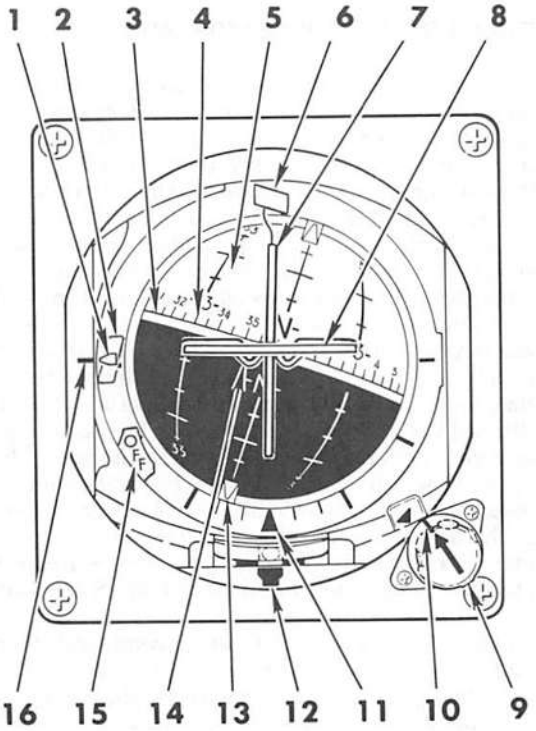
HORIZONTAL SITUATION INDICATOR

The HSI (figure 1-15) provides a horizontal or plan view of the aircraft with respect to the navigation situation. Four navigation situations are available for display on the HSI as chosen by the navigation mode selector knob position.

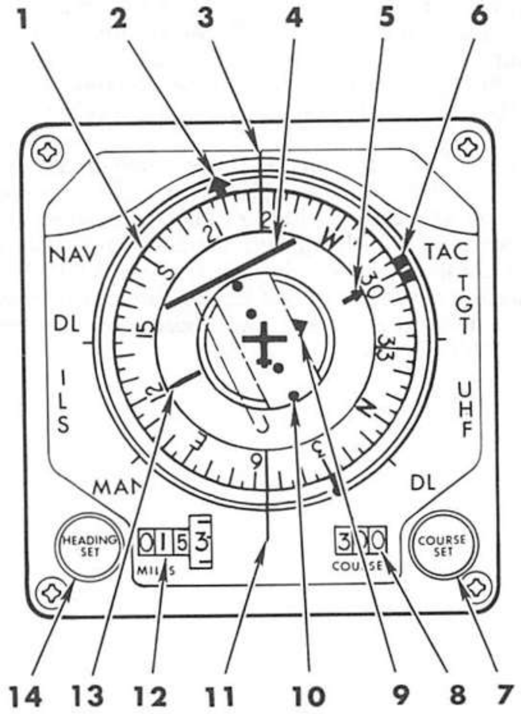
a. When the VOR/ILS mode is selected the heading marker is positioned by the heading set knob to the desired magnetic heading. The course arrow is positioned by the course set knob to the VOR radial or inbound front course localizer. The course deviation indicator displays the aircraft deviation from the selected VOR radial or inbound front course localizer.

b. The TACAN mode provides a display of a navigation situation with respect to the selected tacan. To provide a complete tacan display, the bearing/distance switch should be in the TACAN postion. The course arrow and the course selector window are set manually, using the course set knob, to the desired tacan course. The course deviation indicator and aircraft symbol display a plan view of the aircraft in relation to selected course. Maximum deflection of course deviation indicator is 10° (5° per dot). The heading set knob is used to manually set the heading marker to a desired tacan course, thus providing bank steering information on the ADI to command an asymptotic approach to desired tacan course. The bank steering bar does not correct for drift. If the heading marker is not set to the desired course, bank steering information is not correct for course interception. The to-from indicator operates when the mode selector is in the tacan mode or the VOR/ILS mode when a VOR or tacan station is tuned and received. It indicates whether the course selected, if intercepted and flown, takes the aircraft to or from the selected station.

ADI/HSI (ATTITUDE DIRECTOR INDICATOR/HORIZONTAL SITUATION INDICATOR)



1. GLIDE SLOPE INDICATOR
2. GLIDE SLOPE WARNING FLAG
3. HORIZON BAR
4. HEADING REFERENCE SCALE
5. ATTITUDE SPHERE
6. COURSE WARNING FLAG
7. BANK STEERING BAR
8. PITCH STEERING BAR
9. PITCH TRIM KNOB
10. PITCH TRIM INDEX
11. BANK SCALE
12. TURN AND SLIP INDICATOR
13. BANK POINTER
14. MINIATURE AIRCRAFT
15. ATTITUDE WARNING FLAG
16. GLIDE SLOPE DEVIATION SCALE



1. COMPASS CARD
2. BEARING POINTER
3. UPPER LUBBER LINE
4. COURSE DEVIATION INDICATOR
5. COURSE ARROW (HEAD)
6. HEADING MARKER
7. COURSE SET KNOB
8. COURSE SELECTOR WINDOW
9. TO-FROM INDICATOR
10. COURSE DEVIATION SCALE
11. LOWER LUBBER LINE
12. RANGE INDICATOR AND WARNING FLAG
13. COURSE ARROW (TAIL)
14. HEADING SET KNOB

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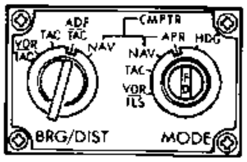
Figure 1-15

NAVIGATION FUNCTION SELECTOR PANEL



4G-1-(259)44

Figure 1-16

c. In the COMPTR NAV mode, three HSI displays, direct track (DIR TRK), HSI course (HSI), or keyboard course (KYBD), are available to the pilot as determined by the course select switch position. With the course select switch in the DIR TRK position, the HSI course deviation indicator displays course deviation error rate. Maximum deflection of the course deviation indicator is 100 feet per second (50 feet per dot). Bearing to the destination computed in the DMAS is displayed on the HSI course arrow and HSI course selector window. The heading marker displays the required magnetic heading to the DMAS destination, and the compass card displays aircraft magnetic heading. With the course select switch in the HSI position, the course deviation indicator displays cross−track error. In the CMPTR NAV mode, and with the course select switch in the HSI position, the full scale deflection of the course deviation indicator is 10,000 feet (5000 feet per dot). The course arrow and course selector window display the course selected by the course set knob. The heading marker displays the required heading to the DMAS destination, and compass card indicates aircraft magnetic heading. With the course select switch in the KYBD position, HSI displays are the same as those for the HSI position of the course select switch, with the exception of the course arrow and course select window, which display the course set with the DMAS KC.

d. In the CMPTR APR mode, lateral and vertical steering signals are provided to the AFCS from the DMAS. This mode enables the pilot to select a computer approach to a predetermined runway location set in the DMAS. CMPTR APR mode operation is displayed on the HSI and ADI. In CMPTR APR the HSI course deviation indicator displays angular error in degrees. Maximum deflection of the course deviation indicator is 2.5° (1.25° per dot). The course arrow and course selector window display the course set via the DMAS keyer control. The heading to the runway is indicated by the heading marker, and the compass card indicates aircraft magnetic heading. In the approach mode, the DMAS uses the course set with the keyer control (KYBD course) whenever the course select switch is in the direct track (DIR TRK) position. If no course is set and the pilot is not in HSI, disengaged indications will result.

e. When HDG is selected, the course arrow and course deviation indicator are slaved to the lubber line and display aircraft magnetic heading. The course selector window also displays magnetic heading. The heading marker may be manually set to the desired heading. This provides bank steering bar information to command an asymptotic approach to the selected heading.

ATTITUDE DIRECTOR INDICATOR (ADI)

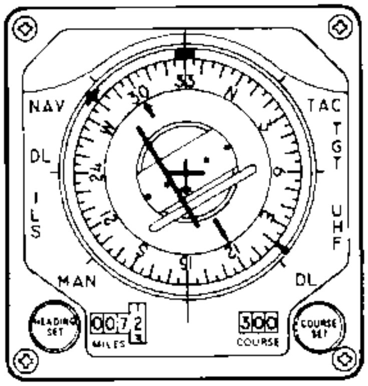
Signals to the ADI (figure 1−15) are received from the primary or standby attitude reference system. Either system can be selected by placing the reference system selector switch, located on the pilot's main instrument panel, to the desired position. When the reference system is changed from PRIM to STBY or vice versa, the ADI may temporarily swing to some random point in azimuth before synchronizing back to the correct heading, and may be accompanied by some unusual gyrations of the attitude director indicator sphere. The phenomenon is a simultaneous large gyration about all three axes after which normal attitude reference is displayed. The pitch reference relationship of the attitude sphere to the miniature aircraft may be adjusted with the pitch trim knob. The turn indicator in the lower portion of the ADI receives its signal from a gyro housed within the AN/AJB−7 system component. However, the operation or malfunction of one system will affect the other system. The bank steering bar provides command steering information to intercept selected headings, tracks, tacan or VOR radials, or DMAS destinations.

In non−DMAS modes bank steering commands from the heading marker and/or course arrow are transmitted through the flight director computer to the bank steering bar. The maximum bank angle commanded by the bank steering bar is 35°. If bank angles of more than 35° are desired during heading/course interception, the steering bar must be disregarded. During course interceptions, bank steering information is reliable when aircraft position is within a 60° arc either side of the slelected tacan course, or within a 90° arc either side of the selected VOR course, and the heading set marker is set to the selected course.

An OFF warning flag on the ADI is visible during the start cycle time delay; when the AN/AJB−7 gyro ac power fails; when the AN/AJB−7 pitch or roll signals fail; or while the fast erect switch is being activated. The attitude warning flag indicates only a failure in the AN/AJB−7 system regardless of the position of the reference system selector switch, and will not be in view if there is a failure or power loss within the INS.

HORIZONTAL SITUATION INDICATOR BEARING AND DISTANCE DISPLAYS

THE BRG/DIST SWITCH CONTROLS ONLY THE INDICATIONS DISPLAYED BY THE BEARING POINTER AND RANGE INDICATOR OF THE HSI.



BEARING DISTANCE SWITCH

VOR/TAC (VOR/TACAN)

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE VOR STATION SELECTED. THE RANGE INDICATOR INDICATES THE NAUTICAL MILES TO THE TACAN STATION SELECTED (TACAN IN T/R MODE).

BEARING DISTANCE SWITCH

ADF/TAC (AUTOMATIC DIRECTION FINDER/TACAN)

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 DISPLAY SLANT RANGE TO THE TACAN STATION (TACAN IN THE T/R MODE). THE UHF LIGHT WILL BE ILLUMINATED.

BEARING DISTANCE SWITCH

TAC (TACAN)

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE SELECTED TACAN STATION. THE RANGE INDICATOR INDICATES THE SLANT RANGE NAUTICAL MILES TO THE TACAN STATION (FOR DISTANCE INDICATIONS, THE TACAN SELECTOR SWITCH MUST BE IN THE T/R POSITION). THE TAC LIGHT WILL BE ILLUMINATED.

BEARING DISTANCE SWITCH

CMPTR NAV

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE STEER POINT. THE RANGE INDICATOR INDICATES THE NAUTICAL MILES TO THE STEER POINT. THE NAV LIGHT WILL BE ILLUMINATED.

4G-1-(10)44

Figure 1-17

WARNING

- Failure of certain components can result in erroneous or complete loss of pitch and bank presentations without a visible warning indication.
- If there is a confirmed or suspected ADI failure, switch to the standby attitude reference system and cross check ADI indications with the radar horizon line and emergency attitude indicator.
- The radar horizon line receives its input from the IMU when the reference system selector switch is in the PRIM position and from the AN/AJB–7 when in the STBY position. If the IMU fails, the ADI will indicate incorrect aircraft attitude, and the reference system selector switch should be placed to STBY immediately.

With the mode selector knob in CMPTR NAV, the pilot may obtain a different lateral command steering display on the bank steering bar for each position of the course

ADI AND HSI DISPLAYS

INDICATOR		NAVIGATION MODE SELECTOR POSITION								
		VOR OPERATION	ILS OPERATION	HDG	TAC	CMPTR NAV			[2] CMPTR APR	
						HSI CSE	DIR TRK	KYBD CSE	KYBD CSE	HSI CSE
ADI	[1] BANK STEERING BAR	Steer to VOR radial	Steer to ILS localizer	Steer to heading (HSI heading set knob)	Steer to Selected TAC Radial (HSI Heading Set Knob)	Steer to course (HSI course set knob)	Steer to DMAS destination (keyer control)	Steer to course (keyer control)	Steer to course (keyer control)	Steer to HSI course
	COURSE WARNING FLAG	In view when VOR info unreliable	In view when ILS localizer info unreliable	Out of view	In view when TAC signal unreliable	In view for SDC or NC malfunction				
	GLIDESLOPE INDICATOR	Out of view	Indicates aircraft deviation from ILS glidescope	Out of view	Out of view	Displays time to release in weapon mode when less than 12 seconds			Angular altitude deviation from glideslope	
	GLIDESLOPE WARNING FLAG	Out of view	In view when ILS glideslope info unreliable	Out of view	Out of view	In view for NC or SDC failure			In view for NC or SDC failure or no valid course	
	[1] PITCH STEERING BAR	Out of view	Steer to glideslope center after glideslope capture	Out of view	Out of view	Out of view blind bombing: advisory steering for a loft release.			Steering to runway glideslopı (keyer control)	
	SPHERE (AZIMUTH)	Aircraft mag heading								
HSI	HEADING MARKER	Set with heading set knob				Required magnetic heading to destination				
	COURSE ARROW AND COURSE SELECTOR WINDOW	Set to VOR radial with course set knob	Set to localizer course with course set knob	Aircraft mag heading	Set to TAC radial with course set knob	Course selected by course course set knob	Bearing to DMAS destination	Course selected by keyer control		Course selected on HSI
	COURSE DEVIATION INDICATOR	Aircraft deviation from VOR radial	Aircraft deviation from localizer course	Centered	Aircraft deviation from TAC radial	Aircraft position relative to HSI course	Aircraft cross track velocity	Aircraft position relative to keyer control course		Aircraft deviation from HSI course
	TO-FROM INDICATOR	Ind if VOR radial leads A/C to or from VOR	Out of view	Out of view	Ind if course will take A/C to or from TAC sta	Indicates if course selected will take aircraft to or from DMAS destination				
	MODE LIGHT	VOR (on front cockpit inst panel)	ILS	MAN	TAC	NAV				
	COMPASS CARD	Aircraft mag heading								

NOTES

[1] WITH THE FD SWITCH IN THE OFF POSITION, THE PITCH AND BANK STEERING BARS ARE DRIVEN OUT OF VIEW.

[2] THE DMAS USES THE COURSE SET VIA THE KEYER CONTROL (KYBD COURSE) WHENEVER THE COURSE SELECT SWITCH IS IN THE DIRECT TRACK (DIR TRK) POSITION

INDICATOR		BEARING DISTANCE SWITCH POSITION			
		VOR/TAC	TAC	ADF/TAC	CMPTR NAV
HSI	BEARING POINTER	Magnetic bearing to VOR station	Magnetic bearing to TACAN station	Relative bearing to selected ADF station	Relative bearing to a DMAS destination
	RANGE INDICATOR	Range to TACAN station (TACAN in T/R mode)	Range to TACAN station (TACAN in T/R mode)	Range to TACAN station (TACAN in T/R mode)	Range to DMAS destination
	MODE LIGHT	VOR (if VOR frequency is selected)	TAC	UHF	NAV

4G-1-(260)44

Figure 1-19

All data on 1-39 thru 1-40, including figures 1-18 and 1-20 deleted.

select switch. The commanded bank steering indication is to the course selected by the HSI course set knob when the course select switch is in HSI, or to the course selected by the DMAS keyer control when the course selector switch is in KYBD. With the course select switch in DIR TRK, the bank steering indication commands a course directly to the point set in the DMAS. When the mode selector knob is in the CMPTR NAV position, the pitch steering bar is out of view for all course select switch positions, except when the BLIND weapon delivery mode is selected. In BLIND, pitch steering for a loft weapon release is displayed on the ADI. If no climb indication is detected, the pitch steering bar will return to a level delivery.

In the automatic navigation mode of DMAS operation, navigation systems provide the ability to fly to sequential destinations (D and T) with command steering information in roll supplied to the ADI and AFCS. Command roll steering displayed with the bank steering bar is to the destination or weapon release point (during weapon delivery) set in the DMAS. Transition rates and roll attitudes from one leg of route to another are computed by the DMAS and displayed as roll commands on the bank steering bar, based on the sequential steer destination set in the DMAS. Under DMAS control, bank steering command corrections for cross–track error are limited to a rate of change of 10° per second. The value of cross–track error used by the DMAS in the computation of roll steering commands is limited to provide a constant 57° angle of approach to the selected course. This cross–track error limit is continuously computed by the DMAS based on current aircraft ground speed. DMAS roll commands are limited to 45° (30° when above 20,000 ft MSL or after approach mode course capture). With the delivery mode knob in BLIND, the glide slope indicator displays time to weapon release. At approximately 12 seconds before release the glide slope indicator drops into view. Each dot thereafter represents 5 seconds. At 10 seconds the indicator is at the lower limit (second dot down from level). At 5 seconds the indicator is at the first dot down from level. At release the indicator indicates level flight. At time—to—release values of greater than 12 seconds, the glide slope indicator is out of view.

In the CMPTR APR mode, bank steering information is to a course identical to the predetermined runway heading. If the course select switch is in KYBD or DIR TRK, keyboard steering is provided to the course entered in the destination list. If HSI is selected the pilot dials in the desired course using the HSI course knob. Direct track steering is not provided in the CMPTR APR mode. When the aircraft is less than 20 nautical miles from the runway, the glide slope indicator displays the aircraft's position releative to the glide slope angle inserted with the DMAS keyer control. At a distance of 20 nautical miles or less from the runway, the pitch steering bar comes into view and displays glide path command steering information. The pitch steering bar remains in view until the aircraft reaches the go—around altitude above AGL inserted in the DMAS. Glide path must be approached from below.

In the CMPTR NAV and CMPTR APR modes, a fault detected in the DMAS navigation computer or signal data converter causes the course warning and glide slope warning flags to come into view. If data received from the ADC is invalid, the glide slope warning flag is in view. In the CMPTR APR mode, a fault in the DMAS navigation computer or signal data converter causes the course and glide slope warning flags to come into view and the pitch steering bar to drive full up.

BEARING–DISTANCE–HEADING INDICATOR (BDHI)

The BDHI (figure 1–21) displays are controlled by positioning of the bearing/distance selector switch in the rear cockpit. In the TACAN/ADF/UHF (upper) position, the no. 1 pointer indicates UHF magnetic and relative bearing and no. 2 pointer indicates tacan magnetic and relative bearing. If the tacan is not operating, both the no. 1 and no. 2 pointers indicate ADF bearing. In the VOR/TAC (middle) position, the no. 1 pointer indicates VOR magnetic and relative bearing and the no. 2 pointer indicates tacan magnetic and relative bearing. If the tacan is not operating, the no. 1 and no. 2 pointers both indicate bearing to the VOR station. The range indicator displays range to the selected tacan station. In the NAV COMP (lower) position, the BDHI range indicator and no. 1 and no. 2 pointers are driven by the DMAS. The range indicator displays the range to the selected DMAS destination. The no. 1 pointer displays magnetic and relative bearing to the DMAS destination, and the no. 2 pointer displays the DMAS computer magnetic ground track.

PEDESTAL PANEL

The pedestal panel (figure 1—22) contains the following switches used for navigation purposes.

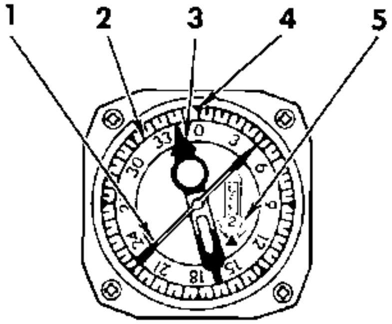
COURSE SELECT SWITCH

The course select switch is a three–position, pull–to–release toggle switch with the positions of DIR TRK, HSI, and KYBD. The switch selects the course to be displayed on the HSI, and used by the DMAS. With the course select switch in DIR TRK, a direct track course to the DMAS destination is displayed. In the HSI position, the course set with the HSI course set knob is displayed. In the KYBD position, the course set with the DMAS keyer control for the selected destination is displayed on the HSI.

NAVIGATION DESTINATION SELECT SWITCH

The navigation destination select switch is a three–position, pull–to–release toggle switch with positions of DEST A, DEST B, and KYBD. The KYBD position selects course data to the DMAS inserted destination and is the normal operating position of the switch. DEST A and DEST B switch positions are intended as emergency destinations if the keyer control fails.

BDHI (BEARING-DISTANCE-HEADING INDICATOR)



1. NO. 1 POINTER
2. COMPASS CARD
3. NO. 2 POINTER
4. LUBBER INDEX
5. RANGE INDICATOR

4G-1-(61)

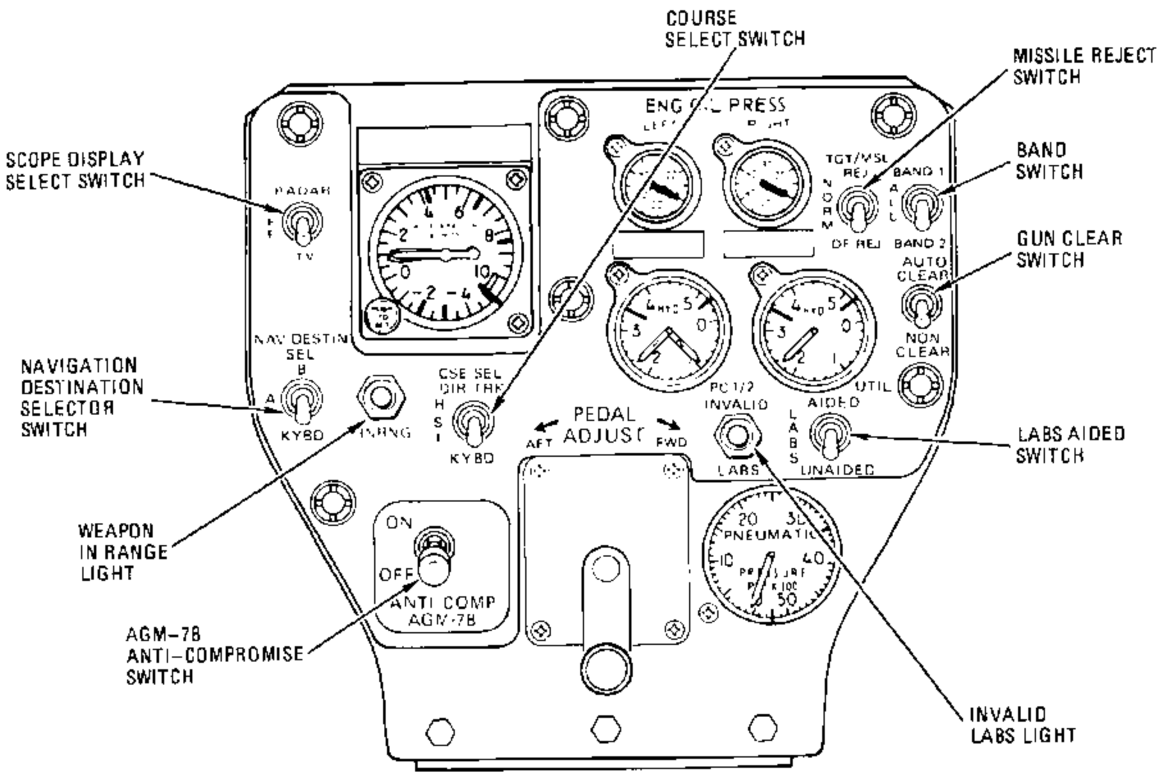
Figure 1-21

Regardless of the destination set in the DMAS, selecting DEST A or DEST B provides a direct track, HSI, or DMAS keyboard selected course to the selected emergency destination, depending on the position of the course select switch.

NOTE

KC cannot override displayed information when destination A or B is selected by the pilot.

PEDESTAL PANEL



4G-1 (263)44

Figure 1-22

COMMUNICATION, NAVIGATION, IDENTIFICATION (CNI) SYSTEM

The CNI system includes an intercom, a UHF receiver-transmitter, an auxiliary UHF receiver, tacan, VOR/ILS, and IFF (see figure 1-23).

EXTERNAL GROUND POWER OPERATION

With both generators off line and external ground power connected, placing the CNI ground power switch in the left wheelwell ON applies ground power to the Tacan, IFF, ADF, and aux receiver. The switch is electrically held ON and must be reset if external ground power is interrupted. Operation of CNI equipment on external ground power without ground cooling is limited to 10 minutes each hour.

INTERCOM SYSTEM

The intercom system provides communication between the pilot, EWO, and ground crew. The intercom system uses essential 28 volt dc power and will operate off the battery alone if either engine master switch is ON or the refuel-defuel switch is energized. Each cockpit has a primary and back-up amplifier. Normally, the primary amplifiers are used.

Intercom Control Panel

The intercom system is controlled through an intercom control panel on the left console in each cockpit. Each panel contains a volume control knob, an amplifier selector knob and a function selector switch.

COMMUNICATION-NAVIGATION-IDENTIFICATION EQUIPMENT

TYPE DESIGNATION	FUNCTION	RANGE
INTERCOM	Intercockpit and cockpit-to-ground communications.	
UHF RADIO	UHF radio communication between airplane and ground, or between airplanes.	Up to line of sight, depending upon frequency and antenna coverage.
AUTOMATIC DIRECTION FINDER	Indicates relative bearing of and homes on radio signal sources.	Up to line of sight, depending upon frequency and antenna coverage.
TACAN	Indicates bearing and distance to ground stations. Determines identity and dependability of beacon.	Line-of-sight distance up to 390 miles from ground station depending upon altitude and attitude, or within 200 miles of a cooperating aircraft.
IFF	Provides the functions of security, personal and traffic control identification.	0-200 miles or line-of-sight.
VOR/ILS	Provides steering to a VOR radial and station. Also provides capability to make precision land approach and descent.	VOR-Line-of-sight distance up to 196 miles depending upon altitude. ILS-Equivalent to maximum range of the transmitting station.

4G-1-(12)D

Figure 1-23

Volume Control Knob

Intercom volume in each cockpit is increased by clockwise rotation of the volume control knob in that cockpit. Ground crew volume is controlled by the EWO volume control knob. No other audio signals are affected by the intercom volume controls.

Function Selector Switch

The function selector toggle switch has positions of COLD MIC, HOT MIC, and RADIO OVERRIDE. The switch must be held in RADIO OVERRIDE to enable this function. Each crewmember's intercom transmits in the mode selected in that cockpit. The EWO's switch must be in HOT MIC to enable ground crew transmissions.

COLD MIC	The microphone switch on the inboard throttle grip must be held in ICS (aft) to enable intercom transmission.
HOT MIC	Voice automatically transmitted on intercom.
RADIO OVERRIDE	Voice automatically transmitted on intercom and all other audio volumes except pullup tone, stall warning, voice warning, and ECM warning are reduced.

Amplifier Select Knob

The rotary amplifier select knob has positions of B/U (backup), NORM, and EMER. The switch selects the intercom receiving mode for that cockpit.

B/U	Backup headset-amplifier provides intercom audio.
NORM	Primary headset-amplifier provides intercom audio.
EMER	Parallels backup headset-amplifier with the headset-amplifier selected in the other cockpit. Only the audio received in the other cockpit is heard. Volume is controlled by the volume control in the other cockpit.

NOTE

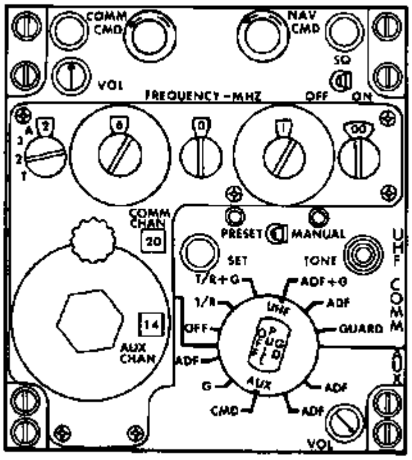
If both amplifier selector knobs are in B/U or EMER and both intercom volume control knobs are above 75% of their range, a loud squeal will occur in both headsets.

Microphone Switch

The ICS (aft) position of the microphone switch on the inboard throttle grip in each cockpit enables intercom transmission when COLD MIC is selected in that cockpit. All audio inputs except pullup tone, stall warning, voice warning, and ECM warnings are reduced.

UHF RADIO

BEFORE TO 1F-4-1552



COMM CONTROL PANEL

Manual frequencies – 7000

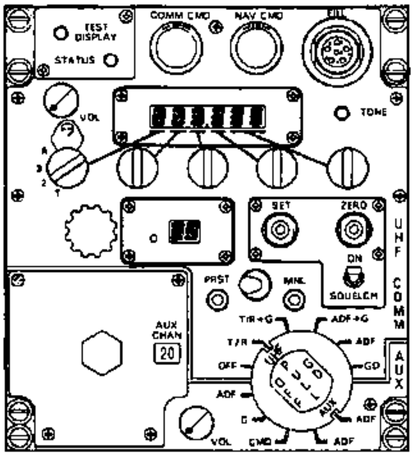
Preset channels – 20

Anti–jam (AJ) operation selectable (HAVE QUICK).

- Voice reception on aux receiver if antenna select switch in UPR.
- Automatic direction finding on aux receiver in all ADF positions if antenna select switch in LWR.

- Full comm receiver – transmitter operation on battery.
  No aux receiver on battery.

AFTER TO 1F-4-1552



COMM CONTROL PANEL

Manual frequencies - 7000

Preset channels - 20

Anti-jam (AJ) operation selectable (HAVE QUICK).

- Voice reception on aux receiver if antenna select switch in UPR.
- Automatic direction finding on aux receiver in all ADF positions if antenna select switch in LWR.
- Full comm receiver-transmitter operation on battery.
  No aux receiver on battery.
- Automatic MWOD loading available.

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Figure 1–24

The UHF (forward) position of the microphone switch, on the inboard throttle grip in each cockpit, keys the comm transmitter. All audio inputs except pullup tone, stall warning, voice warning, and ECM warning are reduced.

UHF RADIO

Voice communication and Automatic Direction Finding (ADF) are provided by the UHF radio (see figure 1-24). The UHF radio includes a comm receiver-transmitter, a guard receiver, and an aux receiver. The comm receiver-transmitter transmits and receives on 7000 manually selected frequencies, or on 20 preset channels, or on guard (243.0 MHz). The aux receiver receives on 20 preset channels or guard. The UHF radio uses an upper and lower blade antenna and an ADF antenna. Either blade antenna may be selected for comm receiver-transmitter voice communications. The upper blade antenna is not used for the aux receiver. When an ADF mode is selected for either receiver, a buzz may be heard while the antenna is homing. A tone transmission is required for ADF operation. System accuracy is dependent on signal strength and relative position to the lower antenna. Aircrew should only except general direction from the ADF system. When receiving from the auxiliary receiver, there will be about a two to five-second delay before squelch engages at the end of each transmission received.

NOTE

- Sizable bearing error can be expected at frequencies above 310 MHz.
- With the antenna switch in UPR, aux receiver ADF indications are invalid and should be disregarded.

A speech security system (KY-28/58) may be installed. These systems affect transmission and reception. Refer to section IV for description of these systems. The comm receiver-transmitter and guard receiver operate normally on battery power. The comm command lights and aux receiver are inoperative on battery power. The comm receiver-transmitter has an Anti-Jam (AJ) mode of operation. When in the AJ mode, the frequency is changed many times per second. The frequency at a particular instant depends on the precise Time-Of-Day (TOD), the preset channelization or Word-Of-Day (WOD) and the selected net number.

Either crew member may take or relinquish command of the UHF radios. The radios then operate in the manner selected on the comm control panel in the cockpit with command. The radio is operated by controls on the comm control panels, the antenna select switch, and the microphone switches.

Comm Control Panel

The comm control panel, on the right console in the front cockpit and the left console in the rear cockpit, provides the following controls:

COMM COMMAND BUTTON AND LIGHT

NOTE

Failure of the COMM CMD light could be indicative of a failure of the caution and warning light system. Check Warning Light Power circuit breaker (Panel 3, C-3).

When either COMM CMD button is pressed, control of the UHF radio is shifted from one cockpit to the other. The green light adjacent to the button comes on in the cockpit which has control.

UHF VOLUME CONTROL KNOB

Clockwise rotation of the UHF volume control knob increases the comm receiver volume.

SQUELCH SWITCH

The squelch switch enables and disables comm receiver squelch.

A-3-2-T SELECTOR KNOB

The rotary A-3-2-T selector knob controls the HAVE QUICK operation of the UHF radio and sets the first digit of the manually selected frequency. The T position is momentary hold.

A	UHF radio operates in the AJ mode.
3	Manual frequency in the 300.000 to 399.975 MHz range.
2	Manual frequency in the 225.000 to 299.975 MHz range.
T	Enables radio to accept a new TOD for one minute after actuation. When tone button pressed simultaneously, provides emergency start-up of TOD clock when TOD not available from external source.

COMM FREQUENCY SELECTION KNOBS AND INDICATORS

With the preset/manual switch in MANUAL, the comm frequency selector knobs set the frequency into the comm receiver-transmitter. With the preset/manual switch in PRESET, the comm frequency selection knobs preset the frequency into the selected channel when the set channel push button is pressed. The A-3-2-T switch is used to set the first digit of the frequency and the knobs set the remaining digits. Frequencies from 225.000 to 399.97 MHz in increments of 0.025 MHz can be set. The selected frequency is displayed in the windows above the knobs.

COMM CHANNEL CONTROL KNOB AND INDICATOR

In the normal mode with the preset/manual switch in PRESET, the comm channel control knob selects preset comm channels 1 through 19. In the AJ mode (A-3-2-T switch in A), channels 15 through 20 can be used for WOD entry. In the normal mode, channels used for WOD entry cannot be used as operating frequencies. Channels 15 through 19, when not used for WOD, can be used in the normal mode. The selected channel is displayed on the adjacent indicator.

AUX CHANNEL CONTROL KNOB AND INDICATOR

The aux channel control knob selects the aux receiver channel (1 through 20). The selected channel is displayed on the adjacent indicator. Channel frequencies cannot be reset in the cockpit.

PRESET/MANUAL SWITCH

This switch controls the comm receiver–transmitter frequency selection method.

MANUAL	Frequency selected with frequency selector knobs.
PRESET	Frequency selected with channel selector knob.

SET PUSHBUTTON

Pressing the set pushbutton with the preset/manual switch in PRESET, sets the frequency displayed on the comm frequency indicators into the channel displayed on the comm channel indicator. Comm command is required to preset a channel.

TONE PUSHBUTTON

When pressed with the A-3-2-T knob in A, 3 or 2, transmits a TOD signal followed by a tone. The tone stops when the pushbutton is released. When pressed with the A-3-2-T knob in T, starts the emergency TOD clock.

COMM FUNCTION SELECTOR KNOB

The comm receiver, comm transmitter, comm guard receiver, and aux receiver are controlled by this knob as follows:

OFF	All UHF radios off.

NOTE

Both UHF controls must be turned to the OFF position to turn off the radio.

T/R ADF	Comm receiver – comm reception. Comm transmitter – comm transmission. Comm guard receiver – standby Aux receiver – Before TO 1F-4-1241, ADF reception. After TO 1F-4-1241, with antenna select switch in UPR, comm reception; with antenna select switch in LWR, ADF reception.
T/R + G ADF	Comm receiver – comm reception Comm transmitter – comm transmission. Comm guard receiver – guard reception. Aux receiver – Before TO 1F-4-1241, ADF reception. After TO 1F-4-1241, with antenna select switch in UPR, comm reception; with antenna select switch in LWR, ADF reception.
ADF + G CMD	Comm receiver – ADF reception. Comm transmitter – comm transmission. ADF reception interrupted during transmission. Comm guard receiver – guard reception. Aux receiver – comm reception.
ADF G	Comm receiver – ADF reception Comm transmitter – comm transmission. ADF reception interrupted during transmission. Comm guard receiver – standby. Aux receiver– guard reception.
GUARD ADF	Comm receiver – guard reception. Comm transmitter – guard transmission. Comm guard receiver – standby Aux receiver – Before TO 1F-4-1241, ADF reception. After TO 1F-4-1241, with antenna select switch in UPR, comm reception, with antenna select switch in LWR, ADF reception.

AUX VOLUME CONTROL KNOB

Clockwise rotation of the aux volume control knob increases the aux receiver volume.

Comm Antenna Select Switch

The comm antenna select switch, on the outboard engine control panel in the front cockpit, has positions of UPR and LWR. The switch selects either the upper or lower blade antenna for comm receiver-transmitter operation. After TO 1F-4-1241, with the switch in UPR, the comm aux receiver is connected to the lower blade antenna regardless of the comm function selector knob selection. In this case, aux receiver ADF indications are invalid and should be disregarded.

UHF Remote Channel Indicator

The UHF remote channel indicator, on each cockpit instrument panel, indicates the channel to which the comm receiver-transmitter is tuned in the cockpit with command control when that preset/manual switch is in PRESET. The indicator shows M when the switch is in MANUAL, G when the COMM function selector knob is in GUARD/ADF, or A when the A-3-2-T switch is in A.

Microphone Switch

The UHF (forward) position of the microphone switch, on the inboard throttle grip in each cockpit, keys the comm transmitter. All audio inputs except pullup tone, stall warning, voice warning, and ECM warning are reduced.

HAVE QUICK SYSTEM (BEFORE TO 1F-4-1448)

The HAVE QUICK radio system provides a jam resistant capability through a frequency hopping technique. Frequency hopping is a technique in which the frequency being used for a given channel is automatically changed at some rate common to the transmitter and receiver. The jam resistance of the system is due to the automatic frequency changing and the pseudorandom pattern of frequencies used. In order to defeat this communications system, the jammer must find the frequency being used, jam it, and then predict or find the next frequency. The HAVE QUICK modification adds the frequency hopping cabability, yet it does not remove any of the previous capabilities of the radio. The HAVE QUICK modified radio retains the standard, single frequency UHF voice mode of operation. This is referred to as the normal mode while frequency hopping operation is called the anti-jam (AJ) mode. Several ingredients are necessary for successful system operation. These are:

1. Common frequencies
2. Time synchronization
3. Common hopping pattern and rate
4. Common net number

The common frequencies have been programmed into all HAVE QUICK radios. Time synchronization is provided via UHF and/or hardware by an external time distribution system. A time-of-day (TOD) signal must be received from the time distribution system for each time the radio is turned on. The hopping pattern and hopping rate are determined by the operator inserted word-of-day (WOD). The WOD is a multi-digit code, common worldwide to all HAVE QUICK users. In the AJ mode, a communications channel is defined by a net number instead of a single frequency as in the normal mode. Before operating in the AJ mode, the radio must be primed. This consists of setting the WOD, TOD, and net numbers. The AJ mode is then selected by placing the A-3-2-T knob to A. If the comm function selector knob is placed to T/R + G, guard transmissions take precedence. If guard is jammed, select T/R.

WORD-OF-DAY (WOD) ENTRY

WOD is entered in channels 15 through 20. The preset/manual switch is set to PRESET. The channel selector is set to 15. The WOD elements (numbers) are set with the manual frequency selector knobs. The set pushbutton is pressed to enter the data. Repeat the procedure for each additional WOD element storing successive elements in preset channels 16 through 20. A short tone is received when the preset button is pressed for channel 20. Once WOD programming is completed, deselect preset channel 20, return to preset 19, and select each preset channel in descending order down to channel 15. As each preset channel is selected, a single tone indicates transfer of the WOD element to the radio memory. A double tone is received after selecting channel 15 indicating transfer of the last WOD element. This completes WOD entry. Once the double tone is received, channel 20 cannot be selected without disabling the WOD entry. If channel 20 is inadvertently selected, the channels must again be cycled from preset 20 to 15 and receive the double tone. This restores the WOD into the radio memory.

TIME-OF-DAY (TOD) ENTRY

Initial TOD

The radio will accept the first valid TOD signal it receives following power application. To reduce the chance of false TOD, rotate the A3-2-T switch to T and return to the established broadcast frequency before receiving a TOD signal. The TOD reception is verified by a single tone in the headset. A user may confirm the radio has received a TOD by pressing the tone button. If a standard tone results, the radio has not received a timing signal. If the 0.25 - second TOD signal followed by the standard tone results, the radio has received the timing signal.

TOD Update

If after receiving initial TOD, a TOD update is required, momentarily rotate the A-3-2-T knob to the T position and return to the established TOD broadcast frequency. The radio then accepts the next TOD received if it arrives within one minute. TOD reception is possible in either the normal or AJ modes. Once synchronized, any HAVE QUICK user can transmit TOD by pressing the tone button. Power interruption anytime following WOD or TOD entry will require selecting preset 20 through 15 until the double tone is heard and obtain a new TOD.

NET ENTRY

Active nets are selected using either the manual frequency selector knobs or a preset channel designated for AJ mode use. Rotate the A-3-2-T knob to the A position and enter the appropriate net number into the 10MHZ, 1MHZ, and 0.1MHZ frequency control, for example, A327. All AJ mode net numbers are designated with the prefix A. If an alarm tone sounds when AJ mode (A) is selected, WOD and/or TOD must be re-entered into the radio.

Anti-Jam Mode Operation

1. Comm function selector knob - TR + G
2. Preset manual switch - Preset
3. Comm channel selector knob - 15
4. Manual frequency selector knob - Set first element of the word-of-day (WOD).
5. Set pushbutton - Press to store
6. Repeat steps 3 through 5 for channels 16 through 20.
7. Tone will be heard when first selecting 20. Another tone will be heard when set pushbutton is pressed for channel 20.
8. Select preset channels 19 through 15. A single tone will be heard for channels 19 through 16 and a double tone for channel 15.
9. Momentarily select T with the A-3-2-T knob (time-of-day must be received within 60 seconds).
10. Select preset manual frequency as appropriate and

obtain TOD.

11. Select AJ net by rotating A−3−2−T knob to A and setting net numbers.
12. If alarm tone activates in AJ mode, check WOD and/or TOD.

HAVE QUICK II SYSTEM(AFTER TO 1F-4-1448)

HAVE QUICK II enhances the operational use of HAVE QUICK and increases the jam resistance of HAVE QUICK. These improvements are implemented through the use of an expanded memory board (EMB).

Comm Control Panel

All the controls of the modified AN/ARC-164 retain the same functions except as follows:

COMM CHANNEL CONTROL KNOB

Selects preset channels in either the active or normal mode. The number of presets available for use depends on the type of word-of-day (WOD) loaded into the radio. If a headquarters word-of-day (HQ WOD) is loaded into the radio, presets available depend on the WOD length. If a multiple word−of−day (MWOD) is loaded into the radio, preset 20 cannot be used but presets 0−19 are available for use.

A−3−2−T SELECTOR KNOB

The A position selects the active mode. Selecting either 2 or 3 selects 100s digit frequency in normal mode. Selecting T position allows reception input of a new time-of-day (TOD) for up to 1 minute after being selected. The T position is a momentary position. The T position, in conjunction with simultaneously pressing the tone pushbutton, is used for autonomous start-up of TOD clock when TOD is not available from external sources. This TOD will not be synchronized to Universal Coordinated Time (UTC).

TONE PUSHBUTTON

Prior to TOD reception there is no change, it operates as a 1020 Hz tone transmission switch. After TOD has been received, it will transmit TOD followed by the 1020 Hz tone on the selected frequency. Simultaneously selecting the T position with the A−3−2−T selector knob and pressing the tone button starts the TOD clock within the radio.

Comm Control Panel (After TO 1F-4-1552)

All the controls on the panel retain the same functions except as follows:

TEST DISPLAY PUSHBUTTON

Pressing the test display pushbutton lights all segments of the frequency/status and comm channel indicators.

STATUS PUSHBUTTON

When pressed it displays the radio status for 5 seconds on the frequency/status indicators. Status words displayed are as follows:

REMOTE − Indicates radio set is under remote control.

VER/OP − Indicates radio set is in normal operating mode.

M−LOAD − Indicates radio set is in MWOD load mode.

ERASE − Indicates radio set is in MWOD erase mode.

FMT.CHG − Indicates radio set is in Frequency Management Training Change mode.

A−3−2−T SELECTOR KNOB

Functions are the same except when in T and SET pushbutton is pressed, MWOD erases.

ZERO PUSHBUTTON

When pressed it erases all MWODs stored in memory.

PRST MNL LIGHTS

These lights illuminate when in respective mode.

TIME-OF-DAY (TOD)

Correct TOD may be transmitted to a modified AN/ARC-164 by feeding the receiver with a radio signal carrying the proper time modulation. The signal may be provided by another modified radio which has the correct time, or it may be provided by the ground-based clock SG-1192/TRC. TOD entry must be done after the radio is switched on. The clock inside the radio would lose time when the radio is switched off. TOD entry would normally be done on the ground prior to take-off, although it can be easily done while inflight. This feature also permits time corrections in flight, when necessary. It is possible to transmit and receive timing information in both normal and active modes, by momentarily pressing the TONE button. In normal mode a complete TOD message is transmitted, while in the active mode only an updated time-tick is used. The purpose of the active mode time transmission is to allow a time update to take place in the event that a radio is drifting out of synchronization. An operator will know that his radio requires an update when incoming messages from several different radios have poor sound quality. If incoming messages from only one radio sound poor, then it is that radio which requires an update.

TOD and TOD Update

Normal mode: The radio will automatically accept only the first TOD message received after power-up. Subsequent messages will be ignored,unless the operator first selects the T position with the A-3-2-T knob. To receive time in normal mode, rotate the A-3-2-T knob to the T position and return to a normal channel (either manual or preset) on which TOD is being transmitted.

Active mode: To receive a time update in active mode, rotate the A-3-2-T knob to the T position and then back to the A position.

NOTE

- Pressing the tone button will send out a TOD update if in the active mode or a complete TOD message if in normal mode.
- When the T position is selected, the radio will accept the next TOD receiver in either normal or active mode provided that it arrives within one minute of the time T position has been selected.

WORD-OF-DAY (WOD)

There are two types of WODs available; HQ WOD and MWOD. The HQ WOD is the present signal WOD. MWOD is similar to the HQ WOD except a date tag is added. In addition, up to six MWODs can be loaded into the radio. The entry of WOD is done by making use of one or more of the channel presets 20 thru 15, available to the AN/ARC−164 UHF radio. For new WOD entry, the same method is used as in entering preset frequencies in the normal mode, i.e., the radio is set to the preset mode starting at preset channel 20. The WOD is set on the manual frequency indicators, before TO 1F−4−1552 the preset entry button is pressed to enter the data into the preset memory. After TO 1F−4−1552, the set entry button is pressed to enter the data into the preset memory. The operator then selects preset chanels 19, 18, etc, and continues entering WOD into preset memory. After doing this for each appropriate channel, select channel 20 to initiate transfer of the WOD from the non−volatile preset channel memory to the volatile WOD memory. A single or double beep will be heard when channel 20 is selected. A single beep indicates that the WOD element in that channel was accepted and that an additional WOD element is in the next lower channel. Progressively select the next lower channel until a double beep is heard indicating that all WOD elements have been transferred to the volatile memory.

When the radio is switched off, the MWOD data is not lost but stored in a non-volatile memory in the switching unit. When the radio is switched on, the MWOD must be transferred from the non-volatile memory in the switching unit to the receiver-transmitter. This is done by selecting the preset mode and starting with preset channel 20, rotating the comm channel knob backwards. The operator will hear a single or double beep, a single beep indicates that entry of WOD is not complete but has been transferred and accepted. After the single beep is heard, the operator selects preset 19, 18, etc, and continues transferring WOD until a double beep is heard. This double beep indicates WOD transfer is complete.

NOTE

During the transition from single to multiple WOD operation, the single WOD method is still available.

MWOD capability allows for up to six WODs to be loaded at one time, and each WOD will be tagged with a unique date code. When the current operational date is updated in the radio, the code generator will automatically be reinitialized with a new WOD having the same date. WOD elements are entered into memory locations accessed by the comm channel control knob front panel preset memory, they are stored in the non−volatile memory located in the SYNTH/ECCM slice. Channel 14 is used to enter the code necessary for implementation of the WOD. Channel 1 is used for entering the current operational date. WOD data is not stored in the front panel memory. Since the WO elements are stored in the non-volatile memory locations accessed by the comm channel control knob, they are entered with the TONE button while in manual mode. If the radio is switched off or power is lost after entry of WOD and date codes, the data will not be lost. Therefore, all of the information entered will remain intact until manually changed.

Because multiple WODs may be entered in the MWOD system, a date code is associated with each new WOD which specifies the day of the month it is to be utilized. The date is required to uniquely identify the appropriate WOD when reinitializing the code generator at midnight transitions. After the first complete WOD is entered, the corresponding date codes are entered by using the comm channel control knob to select channel 14, the date code is then entered as follows. Day of month date code entry for the WOD is represented by the format 3AB.000, where A =tens (0,1,2,or 3), and B = units (0 through 9). Examples: 301.000 =first day of month, 331.000 =thirty-first day of month. The date tag appears on the WOD tape.

The comm frequency selection knobs are used to enter the applicable date codes. When the TONE button is pressed, a double beep tone will sound indicating that the date code is now entered.One complete WOD has now been entered. To enter additional WODs, reselect channel 20, and perform the previous steps. The radio will retain the six most recently entered WODs. Previously entered WODs which are no longer among the six most recent are erased. If a WOD is entered having a duplicate date as one which was previously entered, the new entry will take precedence and will be identified as being the most recent entry. The operational date must be entered. The operational date is the current (GMT) date, and must be entered into the system so the radio can select one of the WODs for code generator initialization. If the aircraft is powered down after the MWOD are loaded, the MWODs will not be lost, but the operational date will. If TOD is being received from a HAVE QUICK II source, there is no need to enter the current date in channel 01 because the radio will receive the operational date (day−of−year, year) as part of the TOD message.

After TO 1F−4−1552, preset channels previously reserved for WOD storage (19 − 15) can now be used for normal preset operation, since the WOD does not take up preset memory. The WOD memory is still accessed through preset channel locations 20 through 14. At midnight (GMT), the radio set automatically generates a new frequency−hop pattern based on the new day's WOD. The radio set also has the capability to erase all stored MWODs. Also when in the AJ mode, the radio can receive and process two simultaneous transmissions on the same operating net without interference. This is done in the radio by automatically offsetting the second transmitter frequency to the next lower channel when it monitors a transmission on the primary frequency. Reception is possible due to the wideband characteristics of the radio. In the HAVE QUICK II radio this feature is enabled or disabled by the last two digits of the WOD in memory location 19. If the WOD element ends with 00 or 50, conferencing is enabled. If it ends in 25 or 75 conferencing is disabled.

NOTE

When operating in secure voice mode, conferencing is automatically disabled. If operating in AJ mode on a single element WOD (memory location 20 only), conferencing is enabled by default.

Multiple Word-Of-Day Loading Operation

1. Preset/manual switch − PRESET
2. Comm channel control knob − 20
3. Comm frequency selector knobs − 220.025 (MWOD load)
4. SET button − PRESS AND RELEASE (listen for single beep)
5. Preset/manual switch − MANUAL
6. Comm frequency selector knobs − TO ELEMENT 20 OF THE WOD
7. TONE button − PRESS AND RELEASE (listen for single beep)
8. Comm channel control knob − 19
9. Comm frequency selector knobs − TO ELEMENT 19 OF THE WOD
10. TONE button − PRESS AND RELEASE (listen for single beep)
11. Repeat steps 8 through 10 decreasing the channel and WOD element numbers by one for each WOD element through 15.
12. Comm channel control knob − 14
13. Comm frequency selector knob − TO ELEMENT 14 (day−of−month tag) OF THE WOD
14. TONE button − PRESS AND RELEASE (listen for double beep)
15. To load additional MWODS, set comm channel control knob to 20 and repeat steps 6 through 14 above. The six most recently entered WODS will be stored in the radio.
16. Comm channel control knob − 01
17. Set comm frequency selector knobs to current day−of−month. The format is 3AB.000, where A is the 10s digit and B is the 1s digit of the current day−of−month. For example, if today was the 26th, then select 326.000
18. TONE button − PRESS AND RELEASE (listen for single beep)
19. Preset/manual switch − PRESET
20. Comm channel control knob − 20
21. Comm frequency selector knobs − 220.000 (verify/operate)
22. SET button − PRESS AND RELEASE (listen for single beep). The radio is now ready to receive time−of−day and then operate in the active mode.
23. After TO 1F−4−1552, press STATUS button − VER/OP ON FREQUENCY/STATUS INDICATORS

Check Day

1. Preset/manual switch − MANUAL
2. Comm frequency selector knobs − 3XX.000 (where XX = day you want to check, i.e., 305.00 = day 05)
3. Comm channel control knob − MOMENTARILY TO 19 THEN TO 20 (a beep upon returning to 20 indicates an MWOD is loaded for the day tested)

Radio Set-up (MWODS Already in Memory)

When date is not part of TOD activate MWOD load mode.

1. Preset/manual switch − PRESET
2. Comm channel control knob − 20
3. Comm frequency selector knobs − 220.025
4. SET button − PRESS AND RELEASE (hear single beep)

Set Today's Date

1. Preset/manual switch − MANUAL
2. Comm channel control knob − 01
3. Comm frequency selector knobs − 3XX.000 (where XX = current date, i.e., 20th = 320.00)
4. TONE button − PRESS AND RELEASE (hear single beep)

Verify/operate (Puts Radio In Combat Mode)

1. Preset/manual switch − PRESET
2. Comm channel control knob − 20
3. Comm frequency selector knobs − 220.000
4. SET button − PRESS AND RELEASE (hear single beep)

Self-Start Radio's Clock

1. Preset/manual switch − MANUAL
2. A−3−2−T selector knob − HOLD IN T
3. TONE button − PRESS AND RELEASE

Get Time-of-Day

1. Same switch actions as basic HAVE QUICK

Net Selection

Select net − ABB.BCC where:

1. A = A (active)
2. BB.B = desired net
3. CC = 00 for basic HAVE QUICK, 25 for HAVE QUICK II NATO, 50 for HAVE QUICK II NON-NATO, (75 is invlaid, have interrupted tone)

NOTE

High pitched continuous tone means TOD or WOD not loaded. Interrupted tone means invalid net selected.

MWOD Operating Modes Selection (After TO 1F-4-1552)

Four operating modes are used within the radio set to initiate various MWOD programming functions. Listed below are the four modes and the displays applicable to each. After radio set has been turned on, proceed as follows to enter any of these modes.

CODE NUMBER	DISPLAY	FUNCTION
220.000	VER/OP	Verify and or operate
220.025	M–LOAD	MWOD load
220.050	ERASE	MWOD erase
220.075	FMT.CHG	Frequency Management Training change

1. Preset/manual switch – PRST
2. Comm channel control knob – 20
3. Comm frequency selector knobs to applicable code number (220.0XX) for desired operating mode
4. SET button – PRESS AND RELEASE
5. The radio set is now in selected mode. For MWOD load, MWOD erase or FMT change modes, the operating mode is displayed on the frequency/status indicator. For verify/operate mode, press STATUS pushbutton and VER/OP is displayed on indicator for 5 seconds.
6. Preset/manual switch – MNL

MWOD Erasing (After TO 1F-4-1552)

1. Enter erase mode in radio as described above
2. TONE button – PRESS AND RELEASE (all MWODs are erased)
3. Enter verify/operate mode
4. Alternate method is lift acess cover, ZERO button – PRESS AND RELEASE

TACAN (TACTICAL AIR NAVIGATION) SYSTEM

The AN/ARN-118 tacan system provides magnetic bearing and slant range at ranges up to 390 miles from the selected ground station, or within 200 miles of a suitably equipped cooperating aircraft (air-to-air). A suitably equipped cooperating aircraft is defined as one with bearing transmitting equipment. The tacan system can transmit only distance information when interrogated in the A/A TR mode. It determines the identity of the transmitting station and indicates the dependability of the transmitted signal. It also provides deviation indication from a selected course. The tacan system utilizes radio navigation frequencies, the propagation of which is virtually limited to line of sight distances. In case of co-channel interference in T/R mode, the interferring channel identifier is garbled. A warning flag appears when the desired station signal is invalid. When a temporary loss of signal occurs, a memory keeps range tracking for 15 seconds and bearing tracking for 3 seconds. The tacan automatically self-tests after a temporary signal loss and displays its status on the control panel.

TACAN CONTROLS

Controls for tacan operation are on the navigation control panels in each cockpit (figure 1-25).

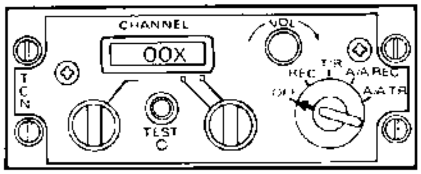
Navigation Command Button and Indicator

The navigation command (nav cmd) button and indicator transfers control of tacan functions from one cockpit to the other. The navigation command button and indicator are on the upper right corner of the communication control panel. A green light to the left of the button illuminates in the cockpit which has navigation command.

Mode Selector Knob

The mode selector knob is a four-position rotary switch used to select the source of information for display on the HSI and ADI. In TACAN, the tacan system supplies the HSI with information to display the source of the selected tacan radial, deviation from the selected radial, and whether the course is to or from the tacan station. With both course arrow/window and heading marker set to the desired course, a steering signal which assists the pilot in making an asymptotic approach to the selected tacan radial is displayed on the ADI bank steering bar. The course warning flag on the ADI is in view when the displayed tacan information is unreliable.

TACAN CONTROL PANEL



4G-1-(252)A

Figure 1-25

BRG/DIST Selector Switch

The brg/dist selector switch is a three-position switch that controls the source of information to the HSI bearing pointer, range indicator and mode word which indicates mode selected. With the switch in TACAN, the tacan system supplies information to the HSI bearing pointer and range indicator to indicate distance and magnetic bearing to the tacan station.

Navigation Function Selector Switch

When the navigation function select switch is placed to the UHF/ADF-TACAN position, the No. 2 pointer of the BDHI uses tacan system information to display magnetic bearing to the tacan station.

Navigation Channel Control Knobs

Two nav chan control knobs, one to the right and one to the left of the nav chan window permit channel selection. The left knob selects the tens and hundreds digits of the operating channel. The right knob selects the units digits of the operating channel and contains an outer knob which selects the X or Y channel. Placing the knob to X provides capability for 126 channel operation. Placing the knob to Y adds an additional 126 channel capability to the tacan system. The dial system is numbered 0 to 129, each number from 1 to 126 represents a specific pair (transmitting and receiving) of frequencies. Number 0, 127, 128 and 129 on the channel dial are not usable.

Tacan Function Selector Knob

OFF	The tacan system is deenergized.

REC	Only the receiver portion of the system is energized, and the system receives and decodes bearing signals from the tacan station and provides bearing information for HSI and BDHI bearing display and ADI steering display.
T/R	The tacan generates distance information which can be displayed on the HSI and BDHI as tacan station distance in nautical miles.
A/A REC	The system receives and decodes bearing information from a suitably equipped, cooperating aircraft and provides bearing information for HSI and BDHI displays and ADI steering display. The channel of the receiving aircraft must be either 63 channels above or 63 channels below the suitably equipped, cooperating aircraft channel but must be within the 1 thru 126 X or Y channel range.
A/A TR	The tacan system interrogates a reference aircraft and the slant range to the cooperating aircraft is displyed on the BDHI and/or HSI. In this mode, the tacan system provides distance replies to other aircraft when interrogated. Bearing to a suitably equipped, cooperating aircraft is also displayed on the BDHI and/or HSI. See A/A REC above for channel selection. The tacan system can transmit only distance information when interrogated in the A/A TR mode.

NOTE

- In the air-to-air modes, to prevent possible interference from IFF or transponder signals, channels 1 thru 11, 58 thru 74, and 121 thru 126 should not be used.
- To reduce the possibility of DME interference, the use of Y channels is recommended if the suitably equipped, cooperating aircraft is equipped with Y channel capabilities.

Navigation Volume Control Knob

The nav vol control knob controls the volume of the audio identification signal received from the transmitting station.

Tacan Test Button

The tacan test button may be used to test the tacan as follows:

1. Function selector knob – T/R
   Allow 90 seconds for warmup
2. Course – SET TO 180°
3. Tacan test button – PRESS AND RELEASE
4. Observe the following:
   a. Test indicator flashes momentarily.
   b. Course and range flags in view.
   c. Bearing pointer slews to 270° for about 7 seconds.
   d. Course and range flags out of view.
   e. Distance indicates 0.0 ±0.5 miles (−0.5 miles indicated as 399.5 miles).
   f. Bearing pointer slews to 180° ±3°.
   g. Course deviation indicator within ½ dot from center.
   h. TO-FROM indicator indicates TO.
   i. After about 15 seconds, course and range flags in view until test complete.

This test does not check the antenna interface. Tacan accuracy should be checked against a ground check point.

Automatic Self Test

If the tacan bearing signal becomes lost or is unreliable, the ADI course warning flag is in view and the tacan system switches to automatic self test. If there is a detected malfunction in the system, the test indicator comes on steady and all displayed bearing, course deviation, and to-from information is invalid. If there is no malfunction indicated and there is no reacquisition of the tacan signal, the BDHI and HSI bearing pointers will slew in a clockwise direction and the ADI course warning flag remains in view. If the indicator lights steady during the test cycle in both the T/R and REC modes, the bearing, course deviation, to – from, and distance information on the HSI is invalid.

Inflight Confidence Test

If tacan indicator readouts become suspect during flight, perform an inflight confidence self test of the tacan system by setting the tacan function selector knob to T/R and then pressing the tacan test button; the test indicator flashes momentarily. If the test indicator lights steady during the test cycle, place the function selector knob to REC and again press the test button. If the indicator lights steady during the test cycle in both the T/R and REC modes, the bearing, course deviation, to-from, and distance information on the HSI is invalid. If the test indicator came on in the T/R mode but not in the REC mode, the distance information is invalid and the bearing, course deviation, and to-from information displayed on the HSI is valid.

VOR/ILS SYSTEM

The VOR/ILS (VHF omnidirectional range, instrument landing system and marker beacon receiver) provides precise bearing to a ground station and displays deviation of the aircraft from a selected course (VOR). The system also provides the capability for the aircraft to make a precision landing approach and descent (ILS). The VOR function provides steering to the VOR radial and VOR station. The VOR frequency range is 108.00 to 117.95 MHz. The localizer function provides lateral guidance information to position the aircraft on the runway centerline during approach. The localizer frequency range is 108.10 to 111.95 MHz. The glideslope function provides vertical guidance information to position the aircraft on the glideslope angle during the final approach. The ILS glideslope frequency is automatically determined by the localizer frequency selection and operates within the frequency range of 329.15 to 335.00 MHz. The marker beacon is a 75 MHz receiver used as a positioning aid.

VOR/ILS CONTROLS AND INDICATORS

The VOR/ILS system consists of a VOR/ILS control panel, a course indicator, a VOR light, two marker beacon lights, a VOR/ILS volume control, and a marker beacon volume control. The VOR light, on the front cockpit main instrument panel, illuminates when the VOR system is initiated and ready for display. The marker beacon lights, on the main instrument panel of both cockpits, illuminate when the aircraft passes over a marker beacon transmitter during final approach. The VOR/ILS marker beacon volume control is a combination of two knobs. In the rear cockpit, the square knob adjusts the volume of the VOR and localizer audio and the round knob adjusts the volume of the marker beacon audio. In the front cockpit, separate volume control knobs are provided on the VOR/ILS control panel. Components used by the VOR/ILS that are not part of the system are the BDHI, intercom, ADI, HSI, bearing/distance selector switch, navigation mode selector switch, and the flight director switch. The flight director (FD) switch is a two position rotary switch stacked on the navigation mode selector switch. With the FD switch in the off position, the bank and pitch steering bars are driven out of view in all modes.

VOR/ILS CONTROL PANEL

The VOR/ILS control panel, in the front cockpit left console, contains a frequency indicator, two frequency selector knobs, a VOR/ILS volume control knob (NAV VOL), a marker beacon volume control knob (MB VOL), and a VOR/MKR test pushbutton. The frequency indicator displays the VOR or ILS localizer frequency selected by the concentric frequency selector knob. The outer knob selects the number to the left of the decimal point, and the inner knob selects the numbers to the right. Positioning the NAV VOL volume control knob clockwise from the OFF position enables the VOR/ILS control panel and the VOR/ILS receiver. This knob also adjusts the gain of the VOR and localizer audio in the front cockpit. The MB VOL control knob adjusts the gain of the marker beacon audio in the front cockpit.

VOR/Marker Test Pushbutton

Pressing the VOR/MKR test pushbutton, after an ILS frequency has been selected on the frequency indicator, causes the marker beacon lights to illuminate. If a VOR frequency is selected, a valid VOR signal must be present, a course of 315° selected on the HSI course selector window and the HSI mode selector must be in VOR/ILS before initiating test. Pressing the test pushbutton causes the course deviation indicator on the HSI to move to center (a maximum change of ±4° in the course selector window is allowable to center the course deviation indicator), the to – from indicator on the HSI to indicate TO, the marker beacon lights to come on and the bearing pointers on both the HSI and BDHI to swing to 315°.

COURSE INDICATOR

The course indicator, on the main instrument panel in the rear cockpit, displays heading relative to the course set in the course selector window and lateral and vertical position relative to the ILS localizer and glide slope, as selected in the front cockpit. The course is not usable with TACAN or VOR. System components are: TO-FROM indicator (not used with ILS), course deviation scale, glide slope deviation scale, course selector window (marked COURSE), course set knob (marked SET), heading pointer, heading scale (0 to 45°), marker beacon light, glide slope (marked GLIDE SLOPE), course deviation indicator (marked LOC OR RANGE), and course and glide slope OFF warning flags. Refer to Rear Cockpit, foldout section. After an ILS frequency is selected in the front cockpit, the course set knob must be rotated to the inbound heading in the course selector window for the heading pointer to function correctly. The heading pointer displays heading relative to the selected course in 5° increments up to 45° left or right of the nose or tail. Relative headings greater than 45° must be estimated. With the course OFF warning flag out of view, the course deviation indicator displays degrees left or right of localizer ON COURSE in relation to the course deviation scale (4 white dots). Each dot normally represents 1¼°. With the glide slope OFF warning flag out of view, the glide slope deviation indicator displays degrees above or below ON GLIDE SLOPE in relation to the glide slope deviation scale (4 white dots). Each dot normally represents ¼°. The localizer identification audio may be adjusted by using the VOR/ILS volume control knob on the left console. The course and glide slope OFF warning flags appear when an unreliable signal or receiver malfunction occurs. The marker beacon light and aural tone come on when the aircraft passes over the marker beacon transmitter. The marker beacon audio may be adjusted by using the MARKER BEACON volume control knob on the left console. The marker beacon light and aural tone function independently of the ILS signals.

NORMAL OPERATION OF VOR/ILS SYSTEM

To initiate the VOR system, rotate the NAV VOL control knob clockwise from the OFF position. Select a VOR frequency on the VOR/ILS control panel. Set the HSI heading marker, and the course window to the desired VOR course. Place the navigation mode selector knob to VOR/ILS and the bearing/distance (BRG/DIST) switch to VOR/TAC. The VOR light illuminates indicating the system is ready for display. When the aircraft receives valid VOR bearing signals, the following occurs: the course warning flag on the ADI goes out of view, the bank steering bar deflects to indicate in which direction to bank the aircraft and steer to intercept the VOR radial, the bearing pointer will unlock from its stationary 4 o'clock position and swing to the valid VOR bearing, and VOR audio is heard in the headsets. The ADI steering function enables the aircraft to approach the VOR radial asymptotically and eventually fly directly over the selected VOR station. The bank steering bar will not provide proper steering unless the heading set marker is set to the desired VOR course. At the same time that the

ADI is steering to intercept the radial, the HSI bearing pointer indicates magnetic heading to the VOR station, the course deviation indicator indicates the aircraft position with respect to the selected VOR radial, the to-from indicator is activated, and if tacan is operating, the range indicator displays slant range to the tacan station. In the rear cockpit, if the navigation mode selector switch is in VOR/TAC and both VOR and tacan are operating, the BDHI displays VOR bearing on the No. 1 pointer, tacan bearing on the No. 2 pointer, and tacan slant range on the range indicator. If tacan is not operating, the VOR bearing is displayed on both BDHI pointers and a flag covers the range indicator.

NOTE

> VOR information is unreliable if the HSI bearing pointer and the BDHI No. 1 pointer move to a stationary 4 o'clock position, and/or if the ADI course warning flag comes into view. Unreliable VOR information is displayed under marginal VOR signal conditions, such as maximum VOR radio range.

To initiate the ILS System, rotate the NAV volume control knob clockwise from OFF. Select the runway localizer frequency on the VOL/ILS control panel. Set the HSI course arrow and the course selector window to the ILS final approach course. Place the navigation mode selector knob to VOR/ILS and the ILS mode light on the HSI will illuminate. When the aircraft receives a valid localizer signal, the course warning flag on the ADI and the localizer warning flag on the course indicator are driven from view, the localizer identification tone is heard in the headsets and the ADI bank steering bar deflects to indicate in which direction to bank the aircraft and steer to intercept the localizer beam. The bank steering bar commands an asymptotic approach to the localizer centerline. Operational requirements may require a faster intercept in which case the bank steering bar should be disregarded and the intercept completed with reference to the CDI. The HSI course deviation indicator and the CI localizer pointer deflects to indicate aircraft position with respect to the localizer beam. A strong crosswind may cause the aircraft to track slightly off-center and parallel to the course with the bank steering bar centered. Once established on course, the pilot must provide his own drift correction by reference to the CDI to stay on the course centerline. As the aircraft continues inbound on the localizer approaching the glideslope from below, the ADI glideslope indicator and CI glideslope pointer deflect to indicate the aircraft position with respect to the glideslope and the ADI pitch steering bar pops into view indicating in which direction to steer the aircraft to reach glideslope center. Marker beacons associated with the approach will cause the marker beacon lights to illuminate and an identification tone to be heard as the aircraft passes overhead.

IDENTIFICATION SYSTEM (IFF)

The identification system provides automatic identification when challenged by surface or airborne radar sets. Supplementary purposes are to provide momentary identification of position upon request, and to transmit a specially coded response to indicate an emergency. In operation, the identification system receives coded interrogation signals and transmits coded response signals to the source of the challenge. Proper reply indicates the target is friendly. Three modes of operation are provided for interrogation or response to interrogation signals. These are known as Mode 1, Mode 2, and Mode 3/A, which are used for security identification, personal identification and traffic identification, respectively. Controls are provided for on the IFF control panel for a fourth mode, Mode 4. The codes for Modes 1 and 3/A can be set in the cockpit, but the code for Mode 2 must be set on the ground. Mode 2 can be set from code 0000 to code 7777.

IFF CONTROLS AND INDICATORS

The controls on the IFF control panel are shown in (figure 1-26). There is also an IFF and an ALT ENCODER OUT light on the telelight panel. Steady illumination of the IFF light indicates that the Mode 4 code is zeroed (no code inserted). The ALT ENCODER OUT light illuminates if the altitude reporting signal from the altitude encoder unit is unreliable.

Master Switch

The master switch is a five position rotary switch which controls the operation of the entire system as indicated below:

OFF	Identification system deenergized.
STBY	Full power supplied to the system, but with interrogations blocked.
LOW	System operates with reduced sensitivity.
NORM	System operates at full sensitivity.

IDENTIFICATION SYSTEM CONTROL PANEL

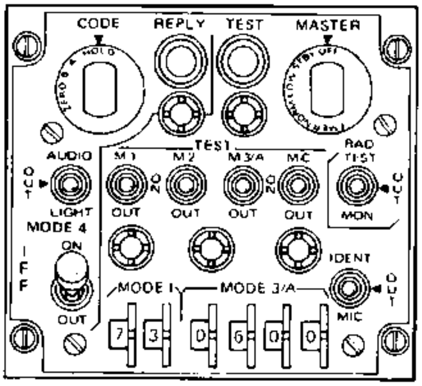


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Figure 1-26

EMER	Allows the system to respond to interrogations in MODES 1, 2 and 3/A. The reply for Modes 1 and 2 is a special emergency signal of the codes selected on the applicable dials, while Mode 3/A replies are special emergency signals of code 7700.

Mode 1 Selector Switch

The three position Mode 1 selector switch controls the operation of Mode 1 as follows:

M-1	Self test position. (Inoperative)
ON	Enables Mode 1 for operation.
OUT	Disables Mode 1.

Mode 2 Selector Switch

The three position Mode 2 selector switch controls operation of Mode 2 as follows:

M-2	Self test position. TEST light illuminates if Mode 2 is operating properly.
ON	Enables Mode 2 for operation.
OUT	Disables Mode 2.

Mode 3/A Selector Switch

The three position Mode 3/A selector switch controls operation of Mode 3/A as follows:

M-3/A	Self test position. TEST light illuminates if Mode 3/A is operating properly.
ON	Enables Mode 3/A for operation.
OUT	Disables Mode 3/A.

Mode C Selector Switch

The three position Mode C selector switch controls operation of Mode C as follows:

M-C	Self test position. (Inoperative)
ON	Enables Mode C operation.
OUT	Disables Mode C

Mode 1 and Mode 3/A Code Selectors

The Mode 1 code selector is used to select Mode 1 codes for 00 to 73. The Mode 3/A code selector is used to select Mode 3/A codes from 0000 to 7777.

Mode 4 Selector Switch

The two position selector switch controls the operation of Mode 4 as follows:

ON	Enables Mode 4 for operation.
OFF	Inhibits Mode 4 reply.

Mode 4 Indication Switch

This switch has positions of AUDIO, OUT, and LIGHT. In AUDIO, an audio signal indicates Mode 4 interrogations are being received, and the Mode 4 REPLY light illuminates when replies are transmitted. In LIGHT , the Mode 4 REPLY light illuminates when Mode 4 replies are transmitted and the audio is not present. In OUT, both light and audio indications are inoperative. The indication switch must be in the AUDIO or LIGHT position to test the press—to—test Mode 4 reply indicator light.

NOTE

> After TO 1F—4—1495, when the AUDIO—OUT—LIGHT switch is selected to AUDIO and a valid Mode 4 interrogation is recieved, a REPLY light will illuminate and no audio tone will be heard in the headset.

Mode 4 Function Switch

This switch has positions of ZERO, B, A, and HOLD. When the switch is placed to A, the systems transponder responds to Mode 4 interrogations from an interrogator using the same setting as set into the A position. In B, interrogations from an interrogator using the same code setting as that set into the B positions are answered. If the switch is in the wrong position for the code being interrogated (e.g., in A with B interrogation), the IFF warning light and MASTER CAUTION light will not come on. The code settings for the A and B positions are inserted before flight. Both code settings can be zeroed by placing the Mode 4 function switch to ZERO. The HOLD position is not used in flight but it is used to retain the code setting if another flight is anticipated during the code period. Positioning the switch momentarily to HOLD after landing before placing the IFF master switch and radar power knob to OFF will retain the code with the power off. Illumination of the IFF warning light and the MASTER CAUTION light can be caused by an internal component failure, a failure to respond to a valid interrogation or a zeroized code. See figure 1—26A.

MODE 4 INDICATIONS

SWITCH SETTINGS	INDICATIONS WHEN INTERROGATED (AUDIO SELECTED)
ALL-NORMAL	Audio [1] None [2]
MASTER-STBY	Audio and momentary IFF / MASTER CAUTION lights
MODE 4-OUT	
CODE WRONG MODE (A vs B)	Audio
MODE 4 CODE-ZEROED	Audio on Steady IFF / MASTER CAUTION lights

Notes

[1] Before TO 1F-4-1495
[2] After TO 1F-4-1495

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Figure 1-26A

Monitor-Radiation Test Switch

This switch has positions of RAD TEST, MON, and OUT. The switch is placed to the OUT position and is not used during flight.

Identification of Position Switch

The identification switch is a three position toggle switch used to provide momentary identification of position. The three positions are as follows:

IDENT	Allows the system to respond with identification of position replies in all modes that are being used. The response is continued for a 15 to 30 second duration after the switch is released.
OUT	Disables identification of position capability.
MIC	Same as positioning the switch to IDENT, except that the UHF microphone button must be keyed.

SELF TEST OPERATION

To self test Modes 2 and 3/A, place the master switch to NORM and hold the switch for the mode being tested to the upper (test) position. If the test light on the IFF control panel illuminates, this indicates the mode is operating properly. Mode 1 and Mode C do not have the self test feature.

NORMAL OPERATION OF IDENTIFICATION SYSTEM - IFF

To operate the system rotate the master switch to STBY. After an approximate 80 second time delay the system is supplied with full power but interrogations are blocked. Set the Mode 1, Mode 2, Mode 3/A, Mode 4 and Mode C switches as directed. Set the Mode 1 and Mode 3/A code selector switches and Mode 4 function switch as directed. Set the master switch to NORM. The system is now ready for operation on the selected modes. If the master switch is rotated from OFF directly to an operating mode, there is an approximate 80 second time delay before the system is fully operational. For I/P switch operation, place the I/P switch in the IDENT position, or place it in the MIC position and key the UHF microphone. The IFF system responds with special I/P signals. If the IFF warning light and MASTER CAUTION light come on momentarily, check the Mode 4 selector switch ON and the master switch NORMAL. Repeated illumination of the MASTER CAUTION light may be stopped only by placing the master switch OFF, thus losing all IFF capability, or placing the Mode 4 function switch to ZERO. Before or during flight, if the master switch is placed OFF, the IFF and MASTER CAUTION lights will not illuminate upon interrogation. Normal IFF operation will be available, after an 80 second warmup, when the master switch is again placed to NORMAL. If the Mode 4 function switch is placed to ZERO, the IFF light will come on steady and the MASTER CAUTION may then be reset. Mode 4 will not be available during the remainder of the flight.

IFF EMERGENCY OPERATION

Upon ejection from either cockpit, IFF emergency operation automatically becomes active. If the master switch is in the OFF position prior to ejection, the system will begin operation after an approximate 80 second delay. In an emergency rotate the master switch to EMER. The reply for Modes 1 and 2 are special emergency signals of the codes selected on the applicable dials; while Mode 3/A replies are special emergency signals of code 7700.

CANOPIES

Each cockpit area is enclosed by a separate transparent, acrylic plastic, clam shell type canopy. The canopies are hinged aft of each cockpit enclosure. Canopy operation, both normal and emergency, is accomplished pneumatically. Individual manual internal and external controls are provided for each cockpit. Normal canopy closing time, from full open to lock light out is 4 to 9 seconds. Each cockpit employs an inflatable canopy seal to seal the canopies for cockpit pressurization. The canopy seals are automatically inflated and deflated upon opening and closing of the canopies. The respective cockpit canopy internal control handle is on the left side of the cockpit above the flap control panel and below the canopy sill. Each canopy control operates independently of the other. Pull the control handle aft to OPEN the canopy; push forward to CLOSE the canopy. A guard is installed around both canopy controls to prevent inadvertent actuation of the canopy control. One rod of the mechanical canopy locking linkage on the left side of the cockpit is provided with a painted-on indicator stripe. This stripe, when aligned with a similar stripe on a fixed tab, gives a positive canopy locked indication. The cockpit external canopy control push buttons are on the left side of the aircraft below the respective canopy frame. Push the OPEN button to open the canopy; push the CLOSE button to close the canopy. The push buttons operate the same valves as the internal canopy controls.

EXTERNAL CANOPY MANUAL LOCK/UNLOCK HANDLES

The canopy external manual unlock handle is on the left side of the fuselage below the rear end of the respective canopy. Operating a push–type latch causes the handle to pop out. Rotation of the handle unlocks the canopy lock mechanism and permits the canopy to be lifted open manually. Operating the handles in the opposite direction, when the canopy is closed, locks the canopy. Before manual locking or unlocking of the canopy, the normal canopy pushbutton must be pressed to close position before locking, to open position before unlocking. The manual lock/unlock handle is used in the event the aircraft pneumatic systems are depleted.

INTERNAL CANOPY MANUAL UNLOCK HANDLES

The respective cockpit manual canopy unlock handle is on the right side of each cockpit. The handle, when pulled aft, unlocks the canopy so that it may be pushed open. Before manual unlocking of the canopy, the normal control lever must be placed in the OPEN position. The manual unlock handle is used in the event the aircraft pneumatic systems are depleted.

CANOPY UNLOCKED WARNING LIGHT

A red CANOPY UNLOCKED warning light, on the telelight panel in the front cockpit and on the instrument panel in the rear cockpit, is used to notify the crew that a canopy is unlocked. The front cockpit CANOPY UNLOCKED light illuminates when either canopy is unlocked. The rear cockpit warning light illuminates only when the rear canopy is unlocked. After TO 1F–4–1262, a voice warning system is installed and operates in conjunction with the CANOPY UNLOCKED warning lights. See Voice Warning System, this section.

CAUTION

The canopy should not be stopped in an intermediate position.

CANOPY EMERGENCY SYSTEMS

The canopies are jettisoned by compressed air. When the canopy external emergency jettison handle is actuated, both canopy jettison systems are operated and both canopies are jettisoned for ground rescue purposes. When the ejection handles or the canopy emergency jettison handles are pulled, the canopy opens quickly and its momentum shears the canopy attaching points. Electrically initiated cartridge thrusters are incorporated in the canopy sills under the forward cockpit canopy. The thrusters are fired electrically by a thermal battery which is activated by gases from either the seat mounted or cockpit mounted initiators. Once having been activated, the battery fires the thrusters through the canopy unlock switch as soon as the canopy unlocks and the switch closes. The thermal battery has a useful life of 15 seconds after activation and the canopy must be unlocked within this time to complete the circuit to the thrusters. The canopy will not jettison when open because the canopy actuator is at the top of the stroke; therefore, the canopy cannot develop momentum. Before TO 1F−4−1518, there is an air bottle for each canopy. After TO 1F−4−1518, there is one air bottle for the FWD canopy and two air bottles for the AFT canopy. Each air bottle has a gage which will read at least as high as the pneumatic system pressure. These gages are used by maintenance to detect leaking check valves with the system pressure at 0. The forward canopy jettison system air bottle and pressure gage are installed behind the forward seat. The AFT canopy jettison system air bottle and gage are located in door 16. After TO 1F−4−1518, the added AFT canopy jettison system air bottle and gage is installed in the AFT cockpit on the left seat rail.

WARNING

Do not jettison front canopy if rear canopy is open and rear seat is occupied because the front canopy will collide with the rear canopy and fall into the rear cockpit.

CANOPY KNIFE

A canopy knife (figure 3-1) is on the left canopy rail on both cockpits. They are used to break away the canopies for emergency egress should all other methods of opening the canopies fail.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

The exterior lights consist of the position lights (wing and tail) join-up lights (wing only), fuselage lights, anti-collision light, landing light, taxi light, inflight refueling receptacle light and electroluminescent formation lights. The exterior lights control panel (on the front cockpit right console) contains all the controls for exterior lighting except for the landing/taxi light switch and the formation lights controls.

Position and Join-Up Lights

The wing and join-up lights are controlled by one switch, labeled WING, with positions marked OFF, DIM, and BRT. The wing and join-up lights do not have flash capabilities. The tail light is controlled by a similar switch labeled TAIL. The tail light will not illuminate unless the flasher switch is in the STEADY or FLASH positions.

Anti-Collision and Fuselage Lights

Three semi-flush white lights are on the fuselage, one immediately aft of the rear cockpit canopy, and one light below each of the engine intake ducts. One red anti-collision light is on the leading edge of the vertical stabilizer. The anti-collision and fuselage lights are controlled by one switch labeled FUS, with positions marked OFF, DIM and BRT. The anti-collision light illuminates only when the fuselage switch is in the BRT and flasher switch is in the FLASH position. The fuselage lights will not illuminate unless the flasher switch is in the STEADY or FLASH positions. The fuselage lights flash when the flasher switch is in the FLASH position.

Exterior Light Flasher Switch

The exterior light flasher switch operates the fuselage lights, anti−collision light and tail light. The three positions of the exterior lights flasher switch are FLASH, OFF and STEADY. If STEADY is selected, the tail light and fuselage lights produce a steady illumination, provided the FUS light switch and tail light are in the DIM or BRT positions. Placing the flasher switch to FLASH causes the fuselage lights, tail light, and anti-collision lights to flash.

Landing and Taxi Lights

The landing and taxi lights are on the forward nose gear door. The landing and taxi lights switch is on the left sub-panel of the front cockpit. The left main landing gear must be down for operation of either light.

IFR Receptacle Lights

The lights for the air refueling receptacle illuminate automatically when the air refueling receptacle is raised.

Formation Lights

The electroluminescent formation lights are on the outer wing tips and on both sides of the vertical stabilizer, mid-fuselage and forward fuselage. These lights are controlled by the FORMATION lights switch and a variable brightness control knob on a panel above the right console. The switch has positions ON, OFF, and MOM (momentary). The formation lights fuse holder is to the rear of the exterior lights control panel and outboard of the spare lamp. The formation light fuse holder glows if the fuse is blown.

INTERIOR LIGHTING (FRONT COCKPIT)

Most of the lighting controls for the front cockpit, are on the cockpit lights control panel right console. A utility light, under the right canopy sill, has its own on–off switch and intensity control. An emergency red floodlight switch is above the cockpit lights control panel. The interior lights utilize ac power, from the engine driven generators.

Instrument Panel Lights

Instrument panel lighting is turned on as the control knob is rotated out of OFF. As the control knob is rotated toward BRT, the instrument panel lights increase in intensity until they illuminate bright. Secondary instrument panel lighting is provided by emergency (red) floodlights under the instrument panel glare shield. The control for the emergency floodlights is on the emergency floodlights panel above the cockpit lights control panel, and is labeled instrument floods. The emergency floodlights switch is marked OFF, DIM and BRT.

Flight Instrument Lights Control Panel

A flight instrument lights control panel is installed on the left corner of the main instrument panel. The control panel contains a knob which is used to simultaneously control the intensity of the lights of the following instruments: airspeed/Mach indicator, attitude director indicator, angle of attack indicator, vertical velocity indicator, altimeter, and the horizontal situation indicator. The above lights are turned on as the control is rotated clockwise from OFF, while the HSI mode lights and any energized warning and caution lights, except FIRE and OVERHEAT lights, are reduced in intensity. The control knob also controls the intensity of the rear cockpit CANOPY UNLOCKED, RADAR CNI COOL OFF, INERTIAL NAV SYS OUT and MASTER CAUTION lights. All shoot lights are disabled if the flight instrument lights control knob is moved from the OFF position. Moving the flight instrument lights control knob out of the OFF position permits only the IN RANGE light to flash (at reduced intensity) to indicate a missile firing in envelope condition. With the knob out of the OFF position, the intensity of the flight instrument lights can be individually controlled by the knobs on the instrument lights intensity control panel.

Flight Instrument Lights Intensity Control Panel

A flight instrument lights intensity control panel is installed above the right console. The control panel contains six knobs which are used to independently vary the intensity of the lights on the following instruments: airspeed/Mach indicator, attitude director indicator, angle of attack indicator, vertical velocity indicator, altimeter, and the horizontal situation indicator. The intensity of each light increases as its control knob is rotated clockwise.

Instrument Lights Intensity Circuit Breaker Panel

An instrument lights intensity circuit breaker panel is installed in the front cockpit outboard of the right subpanel. It contains the two circuit breakers necessary for the operation of the flight instrument lights control knob and for dimming the flight instruments lights and HSI mode lights.

Console Lights

Console lighting is comprised of a combination of edge lights and floodlights. Variation in edge light intensity is controlled by the console lights control knob on the cockpit lights control panel. The control knob has positions marked OFF and BRT, and controls all edge lighting on the left console, the right console, the pedestal panel, and the armament control panels on the instrument panel. When the control knob is rotated out of the OFF detent, the console lights illuminate dim, and the console floodlights illuminate dim if the console floodlights switch is in the DIM position. The console floodlights switch, on the cockpit lights control panel, selects DIM, MED or BRT brilliance of the console floodlights. The console floodlights are off only when the console floodlights switch is in the DIM position and the console lights control knob is in the OFF detent.

White Floodlights

One white floodlight (thunderstorm light) is mounted above each console, under the canopy sill. The white floodlight control switch has positions marked OFF and ON and is on the cockpit lights control panel. The switch is a lever–lock type switch which prevents inadvertent actuation. Power for the white floodlights is provided by the battery through the battery bus, which is energized at all times.

Magnetic (Standby) Compass Light

The standby magnetic compass light is controlled by a combination warning lights test/standby compass light switch and the console lights control knob on the interior lights control panel. The light is turned on by placing the switch to STBY COMP and turning the knob out of OFF.

Indexer Lights

Angle of attack indexer lights are provided for both cockpits. The indexer lights control knob on a panel above the right console has positions marked DIM and BRT. Rotating the control knob clockwise from DIM to BRT increases the intensity of the indexer lights.

Utility Light

A detachable utility light is under the right canopy sill. The light has its own on-off and intensity control. The light may be changed from red to white to red by depressing the lens latch button and rotating the lens housing.

Warning Lights Test Switch

The combination warning lights test/standby compass light switch is on the interior lights control panel. When the switch is held in WARN TEST, all warning lights illuminate except the AIR DATA MODE and EJECT lights. After TO 1F-4-1262, the WARN TEST position also tests the voice warning system. See Voice Warning System, this section.

Station Select Lights Control

A station select lights control is installed on the lower left instrument panel in the front cockpit. The control knob controls the intensity of the station and weapon select lights, HUD and radar range lights when the front cockpit flight instruments control knob is not in OFF. With the front cockpit flight instruments control knob in OFF, the station and weapons select lights, if selected, illuminate bright, regardless of the position of the station select lights control. With the front cockpit flight instruments control knob not in OFF, the intensity of these lights vary with the position of the station select lights control knob, with the extreme clockwise position being the brightest.

APR-47 Lights Panel

An APR−47 lights panel on the right edge of the main instrument panel contains two knobs for controlling the intensity of APR−47 system lights. The ADVSY knob controls the intensity of the forward warning and advisory lights. The PANEL knob controls the intensity of the forward cockpit edge light.

INTERIOR LIGHTING (REAR COCKPIT)

Cockpit lighting control knobs and switches in the rear cockpit, with few exceptions, are identical to those in the front cockpit. The cockpit lights control panel is on the right console and has a two−position white floodlights switch, a two−position magnetic compass light switch, a three−position console floodlights (red) switch, a two−position warning lights test switch, and instrument panel lights control knob an a console edge lights control knob. An APR−47 panel on the pedestal panel contains two knobs which control intensity of APR−47 system lighting. All control knobs and switches work identically to those in the front cockpit. However, with the exception of the APR−47 warning lights, the intensity of the rear cockpit warning lights is dependent on the position of the front cockpit flight instrument lights control knob.

OXYGEN SYSTEM

Breathing oxygen is supplied by a 10-liter liquid oxygen system. The oxygen system should indicate between 65 and 120 psi until the converter is depleted. Refer to figure 1-27 for the oxygen duration chart.

OXYGEN REGULATORS

The console mounted oxygen regulator is on the left console in the front cockpit, and the left subpanel in the rear cockpit. The regulator automatically controls the pressure and rate of flow of oxygen based on demand and altitude. It provides a proper mixture of air and oxygen at low altitudes and pressure oxygen at high altitudes. The console mounted oxygen regulator also provides a relief for any excess oxygen mask pressures.

Supply Lever

A two-position lever, on the lower right corner of the regulator panel, controls the flow (on or off) of oxygen from the regulator.

Diluter Lever

A two-position diluter lever, in the center of the regulator panel, controls the mixture of air and oxygen. For a proportional amount of air to oxygen, the NORMAL OXYGEN position should be selected. For only oxygen, the 100% OXYGEN position should be selected.

Emergency Lever

A three-position emergency lever, on the lower left corner of the regulator panel, permits selection of emergency positive pressure, normal oxygen supply, or testing pressure for a face mask check. The lever should remain in the center (NORMAL) position at all times, unless an unscheduled pressure increase is required. Moving the lever to EMERGENCY provides 100% oxygen with continuous positive pressure to the face mask for emergency use. Moving the lever to TEST MASK provides positive pressure to test the face mask for leaks.

Oxygen Flow Indicators

An oxygen flow indicator in each cockpit alternately shows black and white with each breath indicating oxygen flow.

OXYGEN DURATION CHART

OXYGEN DURATION-HOURS

COCKPIT ALTITUDE FEET	GAGE QUANTITY-LITERS										
	10	9	8	7	6	5	4	3	2	1	BELOW 1
35,000 and UP	24.3 24.3	21.8 21.8	19.4 19.4	17.0 17.0	14.6 14.6	12.1 12.1	9.7 9.7	7.2 7.2	4.8 4.8	2.4 2.4	-EMERGENCY- DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
30,000	17.8 18.0	16.0 16.2	14.2 14.4	12.5 12.6	10.7 10.8	8.9 9.0	7.1 7.2	5.3 5.4	3.5 3.6	1.7 1.8	
25,000	13.7 17.0	12.3 15.3	10.9 13.6	9.6 11.9	8.2 10.2	6.8 8.5	5.4 6.8	4.1 5.1	2.7 3.4	1.3 1.7	
20,000	10.3 19.2	9.3 17.2	8.3 15.3	7.2 13.4	6.2 11.4	5.1 9.6	4.1 7.6	3.1 5.7	2.0 3.8	1.0 1.9	
15,000	8.3 23.4	7.4 21.0	6.7 18.7	5.8 16.4	5.0 13.9	4.1 11.7	3.3 9.3	2.5 7.0	1.6 4.6	.8 2.3	
10,000	6.7 23.4	6.0 21.0	5.3 18.7	4.7 16.4	4.1 13.9	3.3 11.7	2.6 9.3	2.0 7.0	1.3 4.6	.6 2.3	

- UPPER FIGURES INDICATE DILUTER LEVER-100% OXYGEN
- LOWER FIGURES INDICATE DILUTER LEVER-NORMAL OXYGEN

Note

- THE DURATION TIME IS DOUBLED WHEN ONLY ONE CREWMEMBER IS USING OXYGEN
- DURATION FIGURES BASED ON OXYGEN REQUIREMENT RATES GIVEN IN MIL-D-19326E.
- OXYGEN DURATION INCREASES AS COCKPIT ALTITUDE INCREASES BECAUSE THERE IS LESS AMBIENT PRESSURE ACTING UPON THE LUNGS AT ALTITUDE THAN AT SEA LEVEL. THEREFORE, A SMALLER QUANTITY OF OXYGEN AT ALTITUDE WILL EXPAND THE LUNGS TO THE SAME SIZE THAT THEY WERE AT SEA LEVEL.

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Figure 1-27

Oxygen Pressure Gages

An oxygen pressure gage indicates oxygen supply pressure in pounds per square inch. The gage is calibrated from 0 to 500 psi.

OXYGEN QUANTITY GAGE

An oxygen quantity gage in each cockpit has a range from 0 to 10 liters. Loss of electrical power to either indicator is indicated by appearance of a power off flag on the instrument face.

Oxygen Quantity Gage Test Button

The oxygen quantity gage test button is on the left vertical panel adjacent to the oxygen quantity gage in the front cockpit. The button is used to test operation of the front and rear cockpit gages along with operation of the oxygen low warning system. With the button depressed, both gage needles should rotate from the current oxygen quantity indication to an indication of zero. As the pointer in the front cockpit passes through the 1 liter indication, the OXYGEN LOW warning light on the front telelight panel should illuminate, and remain illuminated until the pointer again rotates above 1 liter. After releasing the button, both gage pointers return to an indication of current oxygen quantity and the OXYGEN LOW warning light goes out when the front indicator indicates above 1 liter.

OXYGEN SUPPLY

Breathing oxygen can be supplied to the face mask by the pressure demand regulator or the emergency oxygen storage bottle on the ejection seat. Under normal operation, oxygen is converted from a liquid state to a gaseous state. The gaseous oxygen is then routed to the console mounted pressure demand regulator. The regulator will then supply oxygen upon demand at low altitudes, or under pressure at high altitudes. In the event of a failure of the main oxygen supply system, a limited amount of oxygen can be obtained from the emergency oxygen storage bottle. When the emergency oxygen manual release knob is pulled, either manually or automatically upon ejection, oxygen is released. The oxygen supply system has a normal and an emergency flow. See figure 1-28 for comparison of normal and emergency flow. Resistance to exhalation is noted when using oxygen in the emergency flow mode. This is caused by a back pressure buildup of the oxygen being delivered to the face mask once inhalation has ceased. This condition can be alleviated by spilling oxygen out of the side of the mask.

EJECTION SEAT

The ejection seat provides three ejection sequences from the aircraft in an emergency: (1) Dual ejection initiated from the front cockpit, (2) dual ejection initiated from the rear cockpit, and (3) single ejection of the rear crewmember initiated from the rear seat. Refer to Section III for ejection limitations.

EJECTION SEAT COMPONENTS

Refer to Ejection Seat foldout illustration.

Face Curtain Ejection Handle

The face curtain ejection handle is at the top of the seat projecting forward. A forward or downward pull of about 60 pounds releases the handle and about 10 inches of travel is required to initiate ejection. After canopy jettison, an additional pull of about 3 inches will fire the ejection gun. Sitting height should be adjusted to allow the face curtain to be pulled over the helmet without interference.

Lower Ejection Handle

The lower ejection handle is on the front of the seat between the crewmember's legs. An upward pull (45 pounds maximum) and about 1 inch travel initiates ejection. After canopy jettison, an additional pull of about 5 inches will fire the ejection gun.

Lower Ejection Handle Guard

With the guard up, the lower ejection handle cannot be pulled. With the guard down, the handle is unlocked.

Canopy Interlock Block

The canopy interlock block and associated canopy interlock cable and interdictor link safety pin assembly prevent the face curtain or lower ejection handle from firing the seat until after canopy jettison. On the ground, with the canopy near fully open, the canopy cannot be jettisoned.

Command Selector Valve Handle

The command selector valve handle is recessed below Panoramic, Analysis and Homing Indicator Control and to the right of the radar scope (see Rear Cockpit Foldout Illustration). See figure 1-29. It selects single or dual ejection initiated by the rear crewmember. With the handle vertical (closed), single ejection is selected and the rear crewmember ejects himself. With the handle horizontal (open), both the pilot and rear crewmember will be ejected when either initiates ejection. Two types of valves are installed. For the valve labeled PLT EJECT PULL TURN, to select dual ejection, pull the handle out without applying torque. The handle will rotate clockwise to horizontal. If released at an intermediate position, this handle will return to the vertical (single ejection) position. For the valve labeled PLT EJECT TURN, to select dual ejection, rotate the handle clockwise to horizontal. If released at an intermediate position, this handle may go to either the vertical or horizontal position.

Shoulder Harness Inertia Reel

The shoulder harness reel has an inertia lock which operates as a function of shoulder strap payout velocity. If this velocity is excessive, the reel locks and restrains the crewmembers. The inertial reel can be manually locked. A gas powered system retracts and locks the shoulder harness during ejection.

NOTE

Some aircrew members may have difficulty in reaching/actuating some normal and/or emergency controls with the inertia reel in the locked position.

Shoulder Harness Release Handle

The shoulder harness release handle is on the left side of the ejection seat. The forward postion locks the inertia reel and the rear position unlocks it. The unlocked position will not prevent automatic lock if strap payout velocity is excessive. Once automatically locked, the handle must be cycled forward and aft to unlock the reel.

Leg Restraints

The leg restraints hold the crewmember's legs against the front of the seat during ejection to prevent flailing. The leg restraints use two garters on each leg (figure 1-30). The garter with the double ring (calf garter) is worn above the flight boot. The garter with the single ring (thigh garter) is worn above the knee. Each garter should be buckled with the quick release on the inside of the leg. After the garter is adjusted, press and secure the loose end. Each leg restrant line is attached to the cockpit floor and passes through a snubber on the front of the seat, routed (without twists) through the calf garter outboard ring, through the inboard ring and then through the thigh garter ring. The lockpin on the end of the line is then inserted in the snubber box. A ring on the snubber box permits adjustment of slack in the restraint line by pulling on the ring and pulling the line forward through the snubber.

Leg Restraint Release Handle

The leg restrant release handle is on the forward left side of the seat bucket. The rear position releases the lockpins from the snubbers. The leg lines can then slide out of the garters.

Seat Positioning Switch

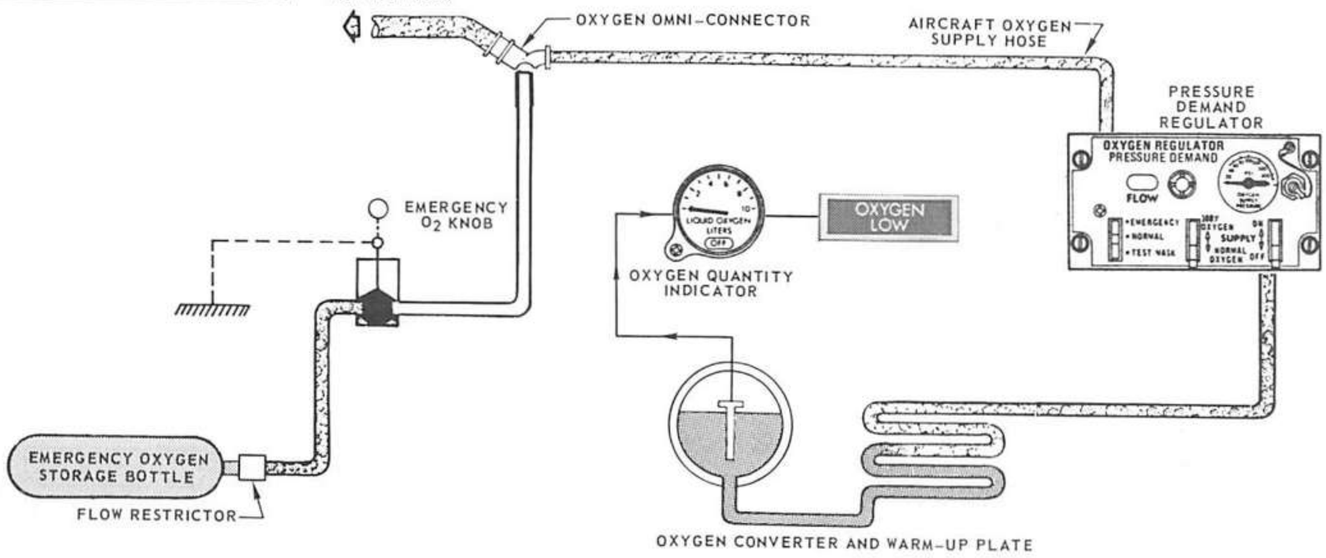
A contact switch on the right forward side of the seat bucket permits vertical adjustment of the seat.

Emergency Harness Release Handle

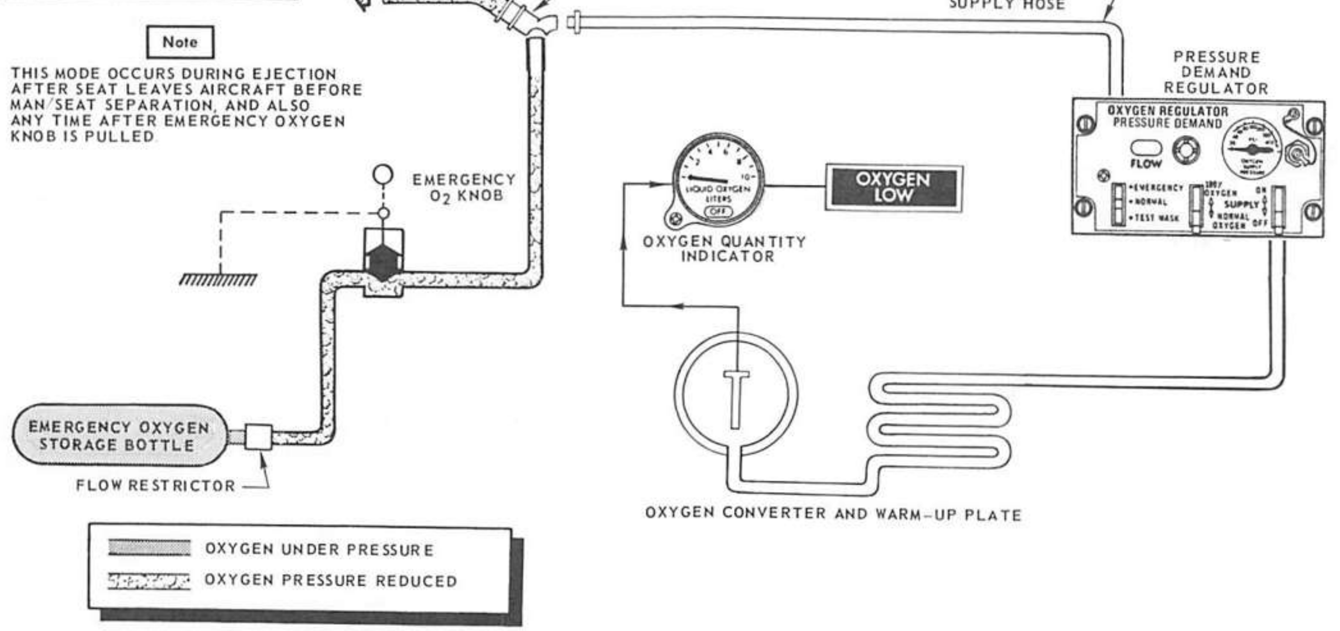
The emergency harness release handle is on the right edge of the seat bucket. It provides a single action release of the crewmember with parachute from the ejection seat. When the handle is pulled, the guillotine fires to cut the parachute withdrawal line, and the leg restraints, lap belt, shoulder harness restraints and parachute restraint straps are released. With only partial rotation, the crewmember may fire the guillotine and still have all other straps secure.

OXYGEN SUPPLY

NORMAL FLOW



EMERGENCY FLOW



Note

THIS MODE OCCURS DURING EJECTION AFTER SEAT LEAVES AIRCRAFT BEFORE MAN/SEAT SEPARATION, AND ALSO ANY TIME AFTER EMERGENCY OXYGEN KNOB IS PULLED.

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Figure 1-28

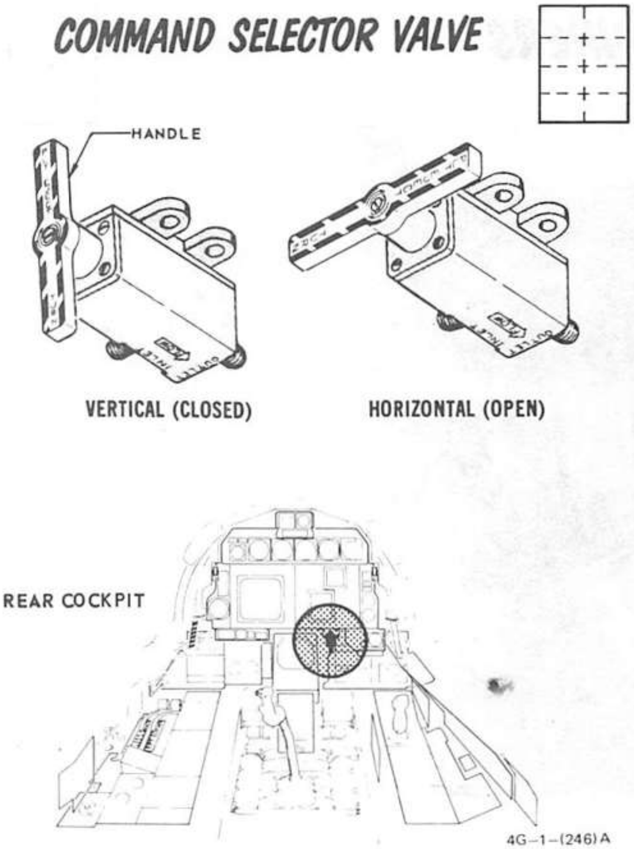

Figure 1-29

Emergency Oxygen Knob

The green emergency oxygen knob is on the forward left side of the seat bucket. Emergency oxygen is actuated automatically upon ejection. It may be actuated at any time with the emergency oxygen knob. The emergency oxygen bottle provides oxygen for about 10 minutes or until the crewmember separates from the seat.

Personal Parachute

The personal parachute is in a hardshell container on the back of the seat. Springs are compressed between the container and the seat to push the container from the seat when the restraint straps are released. The container separates from the crewmember when the chute deploys. Straps are attached across the parachute risers to prevent canopy collapse if a shoulder harness fitting is disengaged. The canopy incorporates two pull down vent lines (PDVL) for faster canopy inflation and to reduce opening shock. They are designed to be broken by the parachute opening. Do not be concerned by these dangling lines. The PDVL may not break if ejecting below about 300 knots. This is not a malfunction. If the PDVL do not break, the canopy will be slightly flattened, oscillation increased and descent rate slightly decreased. Four line jettison release will reduce oscillation and decrease descent rate. The four line jettison lanyards are identified by a red loop halfway up each rear chute riser. When pulled, the lanyards release four lines from the chute to produce a large lobe, or scallop, at the rear of the canopy. The chute can then be steered by pulling on the lanyards.

Survival Kit

The survival kit is a two-piece plastic container for an inflatable raft, a personnel locator beacon and a rucksack of provisions (figure 1-31). The seat cushion is attached to the kit lid and the kit is attached to the crewmember's harness by straps. With the survival kit selector switch (on the right front of the kit) up, the kit will automatically deploy shortly after seat separation following ejection. With the switch down, the crewmember must pull the survival kit release handle after seat separation to deploy the kit. When the kit is deployed, the kit lid falls away and the lower container with the raft, beacon and rucksuck drops below the crewmember and is attached to the crewmember's harness by the left kit restraining strap. The life raft CO_2 bottle is actuated when the drop line is fully extended. If the survival kit release handle is pulled before seat separation, the drop line will not be attached and the kit will be lost. During ground emergency egress, if the survival kit release handle is pulled before rising from the seat, the survival kit will separate but the drop line will not be connected to the crewmember and he can egress without the kit. If the survival kit is not resting on the seat bucket when the handle is pulled, the crewmember will be attached to the survival kit by the drop line.

Personnel Locator Beacon (PLB)

The AN/URT-33(B) PLB, in the survival kit left thigh support, is a radio beacon. The PLB mode rocker switch (figure 1-31) permits selection of automatic or manual activation. With rear arm of the PLB inflight mode rocker switch pressed in (red dot (A) position), the beacon will come on at man/seat separation. With forward arm of the rocker switch pressed in (green dot (M) position), the beacon is turned off. The proper switch position should be selected before ejection but may be changed after ejection if the kit has not been deployed. The battery switch on the PLB permits selection of TIMED or NORMAL operation and is preset when the survival kit is packed. After deployment a red light indicates that the beacon has timed out. A green light indicates the beacon is transmitting. The mode switch must be placed to NORMAL for continuous operation, or TIMED for timed operation. To recycle the timer the rocker switch must be placed momentarily to the manual (green dot) position then in the automatic (red dot) position. The timer is then reset for 10 minutes. The mode selector rocker switch selects automatic or manual as follows:

MODE ROCKER SWITCH	BATTERY SWITCH (PRESET) NORMAL	BATTERY SWITCH (PRESET) TIMED
Rear rocker switch arm pressed in (red dot)	Beacon tranmsits for approximately 15 hours.	Beacon transmits for approximately 10 minutes.
Fwd rocker switch arm pressed in (green dot)	Beacon is off.	Beacon is off.

LEG RESTRAINERS

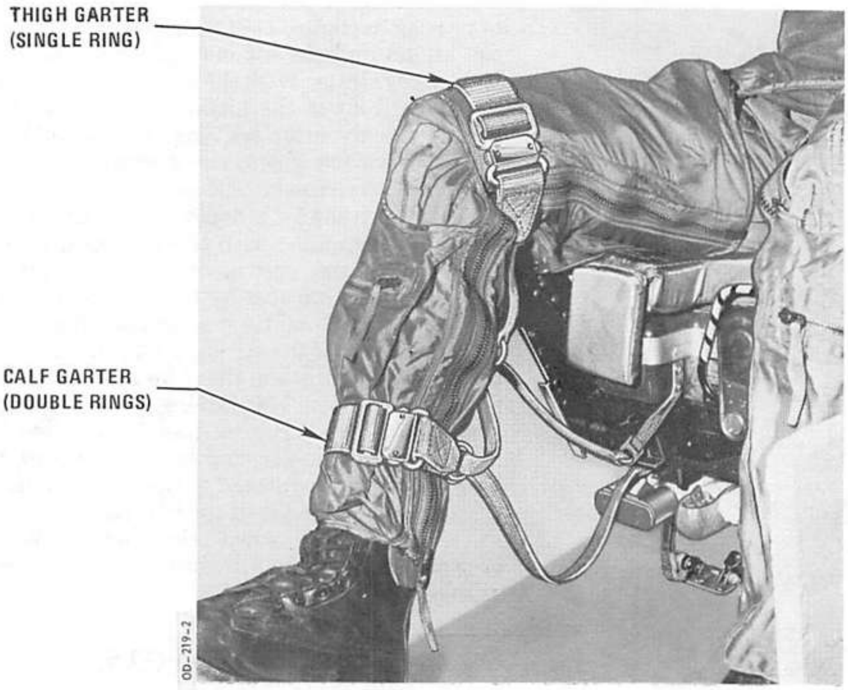

Figure 1-30

EJECTION SEAT SEQUENCING

Ejection is initiated by pulling either the face curtain or lower ejection handle to the stop. The seat mounted initiator fires, the shoulder harness power retracts and the rear canopy jettisons. When the canopy jettisons, it pulls the canopy interlock block arming the firing mechanism. After a short delay for canopy clearance, the ejection gun primary cartridge fires. Primary cartridge gas pressure extends the intermediate and inner gun tubes which unlocks the top latch to release the seat from the aircraft. As the gun extends, two auxiliary cartridges are fired by the hot gas. As the seat rises, emergency oxygen, emergency IFF, the drogue gun and time release mechanism are tripped. The leg restraint lines are pulled through the snubbers and draw the crewmembers legs back. When all slack is out, the floor attachment shears and the legs are held against the front of the seat bucket by the snubbers. A rocket motor initiator is mounted on the left side of the seat. 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. In a dual ejection, after a short delay, the front canopy is jettisoned and the front seat ejection sequence starts. After ejection, the drogue gun fires a projectile to deploy a small controller drogue which then deploys a larger stabilizer drogue. The drogues stabilize and decelerate the seat with the crewmember restrained in it. The time release operates upon reaching the preset barostat altitude (11,500 +3,000 −0 feet) or, in ejections below this altitude, shortly after ejection. When the time release operates, the seat belt, shoulder harness and leg restraints are released and the scissors open to release the drogues from the seat. This transfers the pull of the drogues to the parachute withdrawal line and deploys the parachute. The crewmember is held in the seat by sticker clips until the parachute opening shock snaps him out of the seat. Below the barostat altitude, the EWO's parachute is fully deployed about 5 seconds after ejection is initiated and the pilot's seat parachute is fully deployed about 1 second later.

SERVICING

See figure 1-32 for servicing requirements.

SURVIVAL KIT

TYPICAL

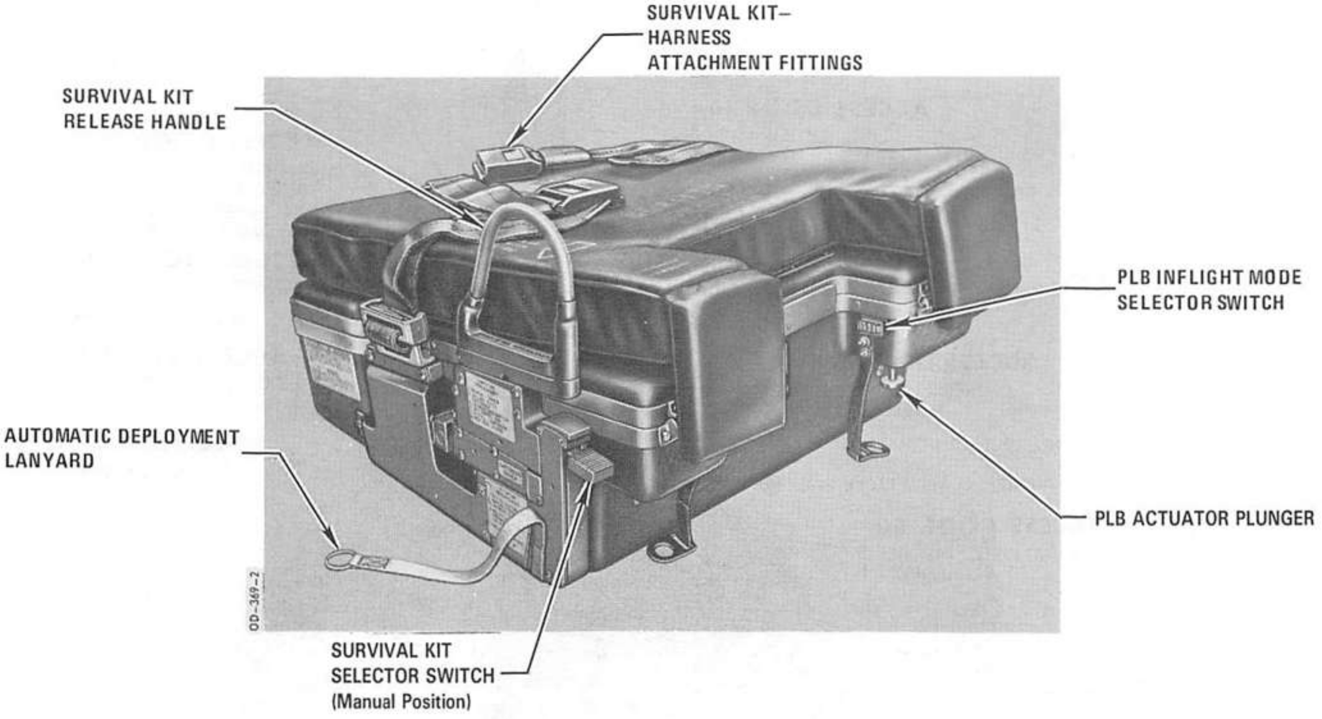

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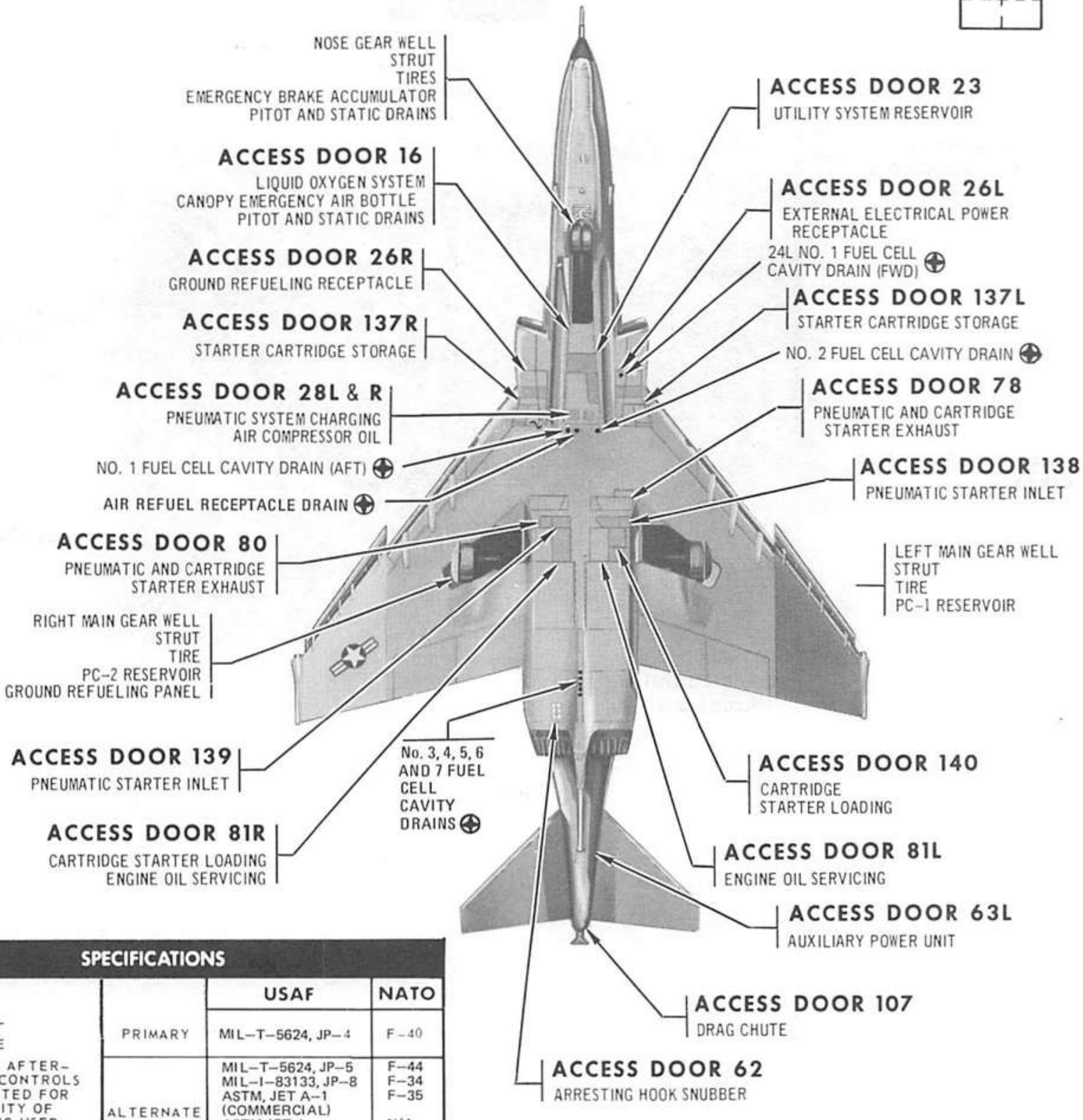
Figure 1-31

SERVICING DIAGRAM



SPECIFICATIONS

		USAF	NATO
FUEL NOTE • THE BASIC AND AFTERBURNER FUEL CONTROLS MUST BE ADJUSTED FOR SPECIFIC GRAVITY OF THE FUEL BEING USED. • REFER TO SECTION V, OPERATING LIMITATIONS, FOR ADDITIONAL INFORMATION WHEN EMERGENCY OR ALTERNATE FUEL IS UTILIZED.	PRIMARY	MIL–T–5624, JP–4	F–40
	ALTERNATE	MIL–T–5624, JP–5 MIL–I–83133, JP–8 ASTM, JET A–1 (COMMERCIAL) ASTM JET A (COMMERCIAL) ASTM B (COMMERCIAL)	F–44 F–34 F–35 N/A N/A
	EMERGENCY	MIL–G–5572, AVGAS GRADE 115/145	F–22
OIL	TURBINE ENGINE	MIL–L–7808 (NO ALTERNATE)	O–148
HYDRAULIC FLUID	PRIMARY	MIL–H–83282	H–515
	ALTERNATE	MIL–H–5606	H–515
OXYGEN	LIQUID	MIL–O–27210 TYPE II	
NITROGEN	GASEOUS	BB–N–411 TYPE I CLASS I GRADE B	

- UTILIZE MA–1A ENGINE STARTING UNIT OR EQUIVALENT FOR A PNEUMATIC START. (ELECTRICAL –115/200 VOLT AC, 400 Hz 3 PHASE; PNEUMATIC – 120 PPM, 49 PSI)
- UTILIZE A MXU–4A/A SOLID PROPELLANT CARTRIDGE FOR A CARTRIDGE START.

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Figure 1–32

SECTION II
NORMAL PROCEDURES

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

NOTE

The aircrew procedures through the Before Taxiing paragraph are separated into individual procedures for the pilot and electronic warfare officer. These separate procedures allow the individual crew member to perform the checks without requiring him to read the checks performed by the other crew member. The remaining procedures are combined and are coded for applicable crew member action. Items coded (P-EWO) are applicable to both the pilot and electronic warfare officer. Items coded (EWO) are applicable to the electronic warfare officer only, and items not coded are applicable to the pilot only.

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

Refer to section V, Operating Limitations, for detailed aircraft and engine operating limitations.

FLIGHT PLANNING

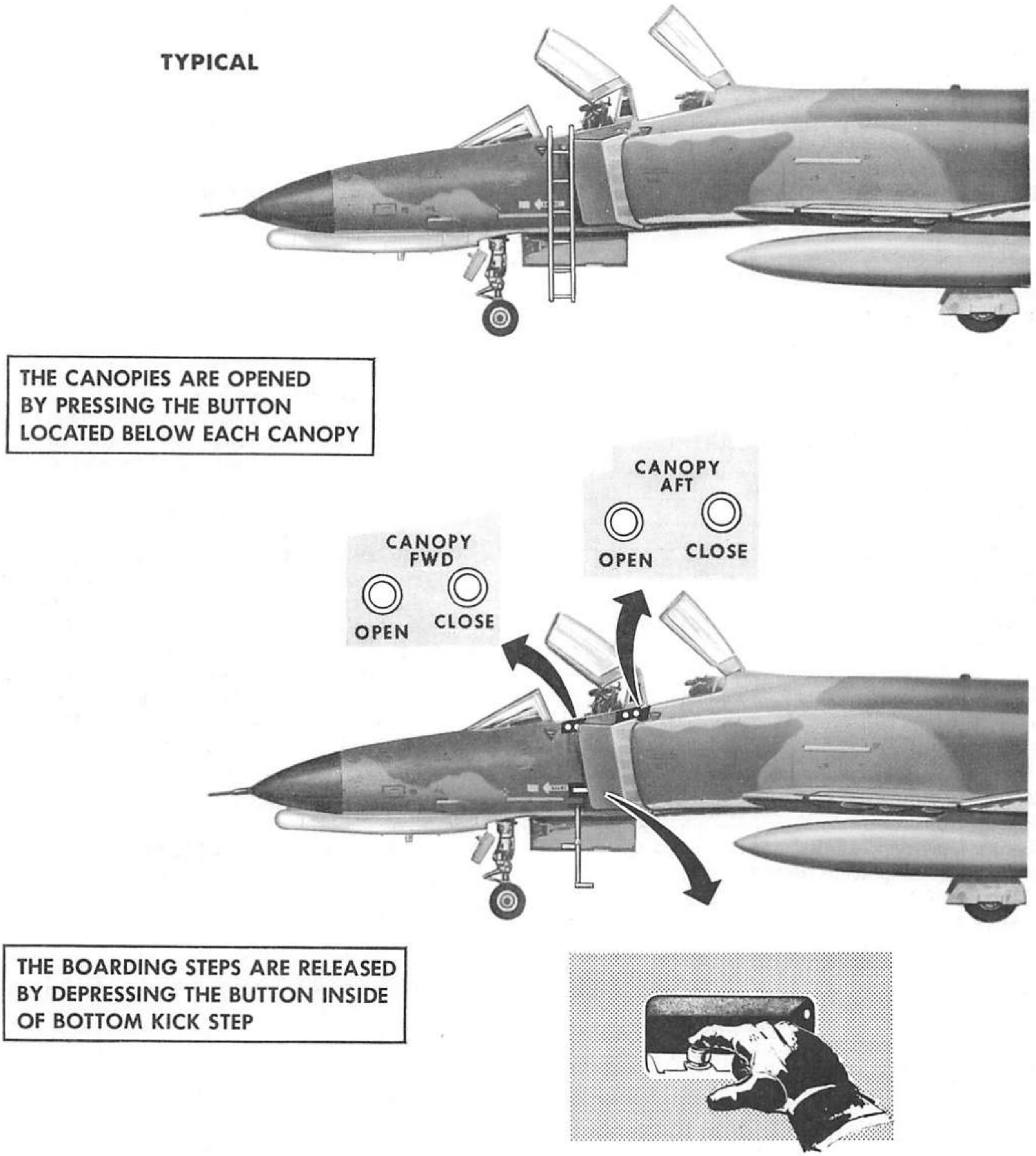
Refer to Performance Data, appendix A.

TAKEOFF AND LANDING DATA CARD

If the takeoff distance exceeds one-half of the available runway length, the takeoff and landing data card in the Aircrew's Checklist should be completed.

COCKPIT ENTRY

TYPICAL



THE CANOPIES ARE OPENED BY PRESSING THE BUTTON LOCATED BELOW EACH CANOPY

THE BOARDING STEPS ARE RELEASED BY DEPRESSING THE BUTTON INSIDE OF BOTTOM KICK STEP

Figure 2-1

WEIGHT AND BALANCE

For maximum gross weight limitations, refer to section V, Operating Limitations. For aircraft loading information, refer to Performance Data, appendix A, and to the manual of Weight and Balance Data, T.O. 1-1B-40.

PREFLIGHT CHECK

1. Check Form 781 for aircraft status and release.

2. Confirm ejector cartridges installed as required.

BEFORE EXTERIOR INSPECTION (FRONT COCKPIT)

WARNING

No object of any kind should ever be placed on top of the ejection seat.

1. Face curtain and seat mounted initiator safety pins - INSTALLED
2. Canopy interlock cable and interdictor link safety pin assembly - INSTALLED CORRECTLY AND ATTACHED TO CANOPY
3. Lower ejection handle guard - UP
4. Generator switches - OFF
5. AN/ALE-40 flare select switch - NORMAL

6. Internal wing dump switch - NORM

CAUTION

With electrical power applied to the aircraft, wing fuel will be spilled any time the internal wing dump switch is in the DUMP position.

7. Throttles - OFF
8. External stores emergency release - CHECK NO YELLOW SHOWING INSIDE CIRCULAR GUARD
9. Landing gear handle - IN AND DOWN
10. Armament switches - OFF/SAFE
11. Pitot heat - OFF
12. Battery - CHECK
    To determine battery relay closure, turn on engine master switch and check for proper positioning of gear and flaps position indicators.
13. Engine master switches - OFF
14. Formation lights switch - OFF

CAUTION

Do not use formation lights during daylight hours.

15. Emergency attitude reference system circuit breaker - IN
16. UHF radio - OFF
17. Reference system selector - STBY
18. Publications and flight data - CHECK
19. Gun camera magazine - INSTALL
20. Gun camera dust cover - STOW (with 780 equipment)

CAUTION

Either a camera magazine or dust cover must be installed at all times to prevent reticle boresight change. With electrical power on the aircraft, the camera heater will be damaged if a magazine or dust cover is not installed. The dust cover has serious FOD potential when it is removed to install the magazine.

21. External power - CHECK ON
22. Generator switches - EXT ON

CAUTION

Do not place the generator control switches to EXT ON until external power has been connected and has reached rated voltage and frequency.

NOTE

If a battery start is to be made, those checks requiring electrical power will have to be performed after the engines have been started.

23. Transformer rectifier - CHECK (Cannot be performed when battery start is made)
    Both transformer-rectifiers are operating if the landing gear indicators indicate gear down with the engine master switches OFF and the generator switches in EXT.

EXTERIOR INSPECTION

Check the aircraft exterior for indications of abnormalities which could affect flight (i.e., cracks, leaks, and dents). All antennas and sensors (AOA, pitot-static inlet ice, total temperature) should be checked. Check required doors and panels closed and fastened. The engine intake area should be clear of foreign objects. The nose area and then only the right side of the aircraft is discussed. The left side is identical to the right.

1. Nose area
   a. Safety pins
      Gear down lock - REMOVED
      Slat - REMOVED
   b. Pressure gages
      Emergency flap - 2650 to 3300 psi
      Emergency gear - 2650 to 3300 psi
      Emergency brake accumulator - 2750 to 3250 psi (950 to 1050 psi allowable for first flight of day)
   c. Emergency brake valve - BOTH LEVERS AFT
   d. Tire and strut
      Tire condition and inflation
      Strut leaks and inflation
   e. Refrigeration unit intakes
   f. Radome - LOCKED
   g. Beam receiver antennas
      Protective covers removed
   h. Pitot boom, static ports, AOA probe
      Protective covers removed
      AOA probe secure and free to rotate
2. Forward fuselage
   a. Intake
      Ramps secure
      Clear of FOD
      Engine compressor and dome condition
3. Center fuselage and wing
   a. Centerline tank
      Cap - LOCKED, ARROW FORWARD, NO LEAKS
      Standpipe - NO LEAKS, RED STRIPE VISIBLE
      Cartridges - INSTALLED
   b. Fuselage fuel cell cavity drains 1 and 2
   c. Aux air door area
      Throttle linkage
      Fire sensing circuitry
      Oil servicing caps in place
      Safety lock removed
      Centerline rack access panels in place and secure
      Starter breech caps secure
   d. Main gear wheel well area
      Gear down lock - REMOVED
   e. Tire and strut
      Tire condition and inflation
      Strut leaks and inflation

CAUTION

If upper cylinder pressure gage (if installed) reads in the red (above normal range markings), the chamber is overpressurized and may prevent strut from retracting or cause gear failure.

Brake assemblies
Anti-skid harness

f. Pylons and stores
Ensure that no store extends aft of the inboard pylon. Ensure wing tank fuel caps secure.

g. External wing tank jettison shear pins - INSTALLED

h. Wing and wing fold warning pin
Wing spread and warning pin flush with top of wing. Visually check center wing fold lower locking lugs and outer wing torque box skin for cracks.

WARNING

An unlocked wing will fold during takeoff resulting in an uncontrollable roll into the folded wing.

i. Dump mast

j. Speed brake area
Leaks and loose fasteners

4. Aft fuselage area
   a. Engine exhaust areaAB flame holder, spray bars, and ignitor, AB liner for bulges, cracks and sags.Puddled fuel or oil in tailpipe and under AB eyelids
   b. Hook
   Accumulator — 800 to 1000 psi

NOTE

Accumulator may read as low as 700 psi in extremely cold conditions (−30°C/−23°F).

Arresting hook uplock removed

c. Fuselage fuel cell cavity drains 3 thru 7

d. Bellows probe
Visually check cover removed

e. Stabilator and rudder
Surface area
Skid bars

f. Drag chute

NOTE

Dripping or puddled fuel or evidence of recent leakage in the area of any fuel cell cavity drain may indicate a fuel cell leak and is sufficient cause for abort.

BEFORE ENTERING FRONT COCKPIT

1. Canopy condition - CHECK
Check for cracks in the canopy and windshield plexiglass. Check condition of the canopy pressure seals. Ensure canopy knife present and secured.

CAUTION

The center mirror on the forward canopy can be tilted sufficiently to prevent canopy closing; therefore, assure that the mirror will clear the windshield bow before closing canopy.

2. Canopy safety strut - REMOVED
Ensure normal canopy control handle is in open position if safety strut requires removal.
3. Canopy actuator - SHEAR PIN INTACT

4. Ejection seat - CHECK
   a. Face curtain and seat mounted initiator safety pins - INSTALLED, ALL OTHER SAFETY PINS REMOVED

CAUTION

Exercise caution regarding hand movements in the vicinity of the bulkhead 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.

b. Canopy interlock cable and interdictor link safety pin assembly - INSTALLED CORRECTLY AND ATTACHED TO CANOPY

WARNING

If the canopy interlock cable and interdictor link safety pin assembly is pulled or bypassed and the sear pulled, the seat will fire immediately.

c. Banana links - ENGAGED IN MAIN SEAR

d. Drogue chute retaining flaps - FORWARD FLAP FOLDED OVER OTHER FLAPS

e. Seat mounted initiator - LINKAGE CONNECTED

f. Scissors - LOCKED TO SHACKLE AND TIED DOWN, SCISSORS GUARD NOT BROKEN

WARNING

If the scissors shackle safe-tie thread passes through the wire loop, the drogue chute may not deploy.

g. Drogue chute withdrawal line - ROUTED OVER ALL OTHER LINES

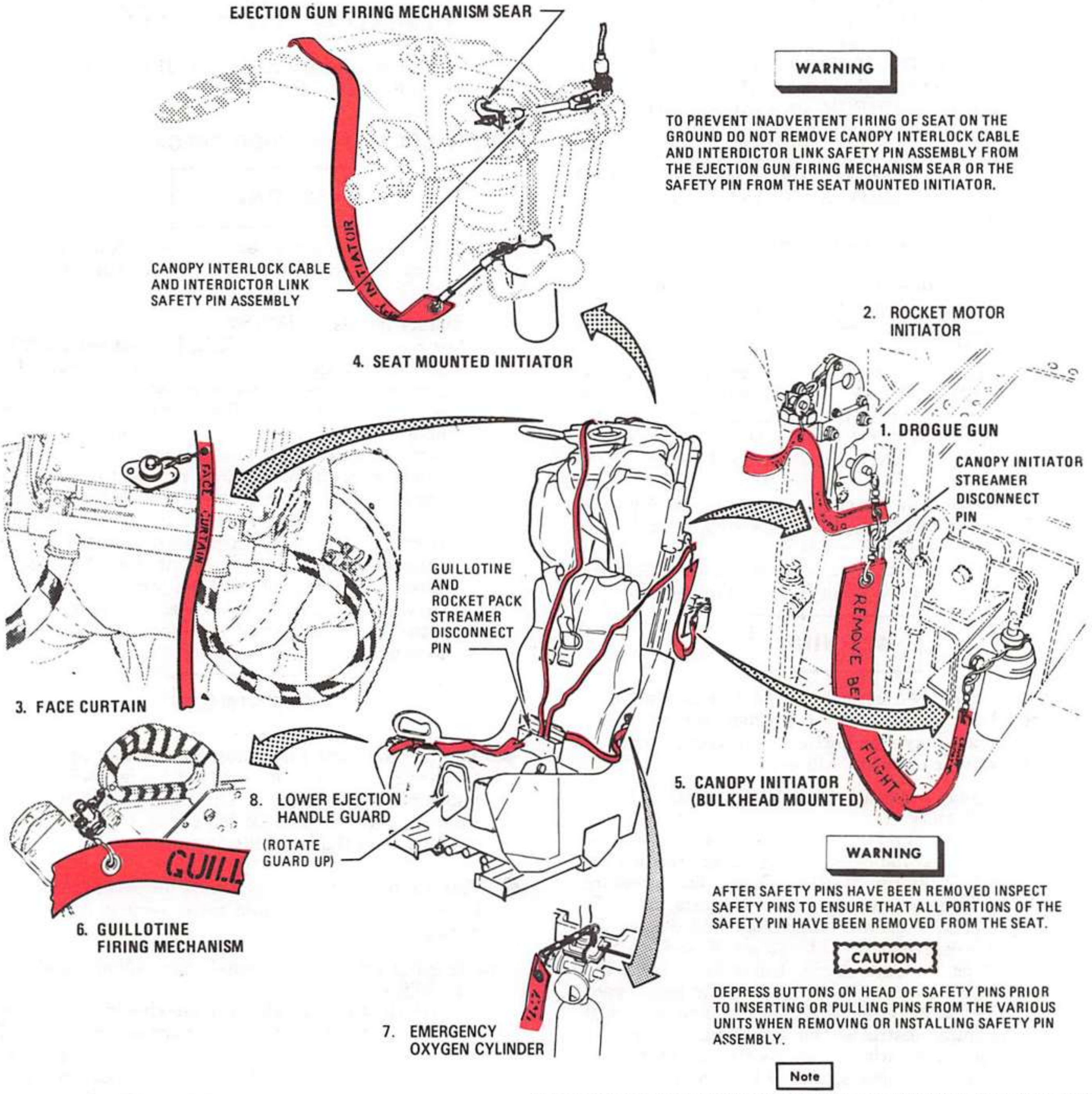
h. Top latch mechanism plunger and locking indicator - FLUSH WITH HOUSING

WARNING

If the plunger and locking indicator are not flush with the housing, the seat is not locked in position and an inadvertent ejection can occur.

i. Personnel parachute withdrawal line — QUICK DISCONNECT IS CONNECTED AND RUNS THROUGH GUILOTINE

EJECTION SEAT AND CANOPY INITIATOR SAFETY PINS



WARNING

TO PREVENT INADVERTENT FIRING OF SEAT ON THE GROUND DO NOT REMOVE CANOPY INTERLOCK CABLE AND INTERDICTOR LINK SAFETY PIN ASSEMBLY FROM THE EJECTION GUN FIRING MECHANISM SEAR OR THE SAFETY PIN FROM THE SEAT MOUNTED INITIATOR.

WARNING

AFTER SAFETY PINS HAVE BEEN REMOVED INSPECT SAFETY PINS TO ENSURE THAT ALL PORTIONS OF THE SAFETY PIN HAVE BEEN REMOVED FROM THE SEAT.

CAUTION

DEPRESS BUTTONS ON HEAD OF SAFETY PINS PRIOR TO INSERTING OR PULLING PINS FROM THE VARIOUS UNITS WHEN REMOVING OR INSTALLING SAFETY PIN ASSEMBLY.

Note

WHEN APPLICABLE (CROSS COUNTRY) ENSURE THAT CANOPY INTERLOCK CABLE AND INTERDICTOR LINK PIN ASSEMBLY IS INSTALLED CORRECTLY. ENSURE LOWER EJECTION HANDLE GUARD (8) IS UP. INSTALL SAFETY PINS CAREFULLY. ENSURE THE SAFETY PINS ARE COMPLETELY SEATED.

(1) DROGUE GUN
(2) ROCKET MOTOR INITIATOR
(3) FACE CURTAIN
(4) SEAT MOUNTED INITIATOR
(5) BULKHEAD MOUNTED CANOPY INITIATOR
(6) GUILLOTINE
(7) EMERGENCY OXYGEN

Figure 2-2

j. Personnel parachute safety pin line – NOT THROUGH GUILLOTINE
k. Parachute alignment ring – SAFETY PIN LINE AND RIPCORD PIN LINE (ATTACHED TO PARACHUTE WITHDRAWAL LINE) ROUTED THROUGH. PARACHUTE WITHDRAWAL LINE ROUTED AROUND
l. Check security of parachute container – PARACHUTE CONTAINER SHOULD NOT MOVE MORE THAN 1 INCH
m. Guillotine – CHECK PASSAGE AND HOSE SECURITY
n. Drogue gun assembly – SHEAR PIN INTACT, SAFETY PIN OUT, TRIP ROD CONNECTED WITH NO RED SHOWING ON INNER BARREL
o. Drogue gun cocking indicator – COCKED (some aircraft)

If the indicator is approximately 1/2 inch below the gun housing, it is cocked. If flush with the housing, it is uncocked and will not fire on ejection.

p. Rocket motor initiator – CHECK SEAR ENGAGED, SAFETY PIN REMOVED, ACTUATION LANYARD CONNECTED, HOSE ASSEMBLY CONNECTED AND PIN INSTALLED, AND TRIP ROD CABLE CONNECTED
q. Bulkhead mounted canopy initiator – LINKAGE CONNECTED, SAFETY PIN REMOVED
r. Harness assembly – CHECK

Ensure that parachute container holddown straps are routed in front of the backpad

WARNING

If the holddown straps are hooked or routed behind the back pad, or hooked behind the emergency oxygen bottle, interference with parachute deployment will occur.

s. Emergency oxygen – PRESSURE AND SAFETY PIN REMOVED

Proper servicing of the emergency oxygen bottle is indicated by a gage reading of 1800–2200 psi at 21°C (70°F). The pressure indication varies with temperature. To determine correct indication, add 6.5 psi for each degree above 21°C (3.5 psi/°F) and subtract 6.5 psi for each degree below 21°C. Thus, the bottle is correctly serviced if the gage reads 1890–2290 psi at 35°C (95°F). See ejection seat foldout illustration for approximate pressure values for various gage needle locations.

t. Emergency oxygen actuation knob and linkage – CHECK

Check knob not actuated. If actuated, knob is tilted approximately 45° from vertical. Check security of shear pin in cable to linkage connection by applying light tension on cable.

u. Leg guards – IN PLACE
v. Leg garters – LOCKED IN, AND LANYARDS NOT TWISTED
w. Survival kit – RELEASE HANDLE DOWN, SELECTOR SWITCH AS DESIRED
x. Emergency harness release handle – DOWN WITH SEAR ENGAGED, SAFETY PIN OUT, AND ACTUATION LANYARD CONNECTED
y. Time release trip rod – CONNECTED
z. Personnel locator beacon (PLB) infligth mode selector switch – AUTOMATIC POSITION (RED DOT SHOWING) FOR NORMAL PEACETIME OPERATION. SAFETY STREAMER REMOVED
aa. Time release mechanism – CHECK BAROSTAT HOLES UNBLOCKED

FRONT COCKPIT INTERIOR CHECK

WARNING

All harnessing, personal equipment leads and leg restraint lines must be secured before closing the canopy.

1. Rudder pedals – ADJUST
2. Leg restraint lines – BUCKLED AND SECURED

Garters buckled and properly adjusted, with the garter releases on the inside of the legs. Lines secured to seat and floor and not twisted or entangled in rocket motor or rocket motor sear cable. Leg restraint lines threaded through the calf garters (double D–ring), routing first through the outboard ring and then through the inboard ring, then through the thigh garters (single D–ring) before the lock pins are inserted in the snubber boxes. Leg restraint line lock pins threaded through hold–down strap lugs on the survival kit. Survival kit–to–seat retention straps attached to the leg restraint line lock pins at the lock pin attachment points.

WARNING

- The leg restraint lines must be buckled at all times during flight to ensure that the legs will be pulled back upon ejection. This will enhance seat stability and will prevent leg injury by keeping the legs from flailing following ejection.
- Failure to route the restraint lines properly through the garters could cause serious injury during ejection.

3. Harnessing and personal equipment leads – FASTEN

Attach the parachute riser–shoulder harness fittings to the integrated harness. Attach and firmly adjust the survival kit straps. Secure and firmly adjust the lap belt. Connect oxygen, communication and anti–G leads. Route the anti–G hose line behind personal harness sling if hose interferes with controls on left console. Check the operation of the shoulder harness locking mechanism.

WARNING

Failure to adjust survival kit straps to achieve a snug fit between the crewmember and kit may result in fatal injury during ejection.

4. Ejection seat height – ADJUST (cannot be performed when battery start is made)
5. Face curtain and seat mounted initiator safety pins – REMOVED

   After all personal leads have been fastened, have ground crewmember remove face curtain and seat mounted initiator safety pins, show them to aircrew member before stowing in bag, and hand bag to aircrew member.

WARNING

If the seat mounted initiator safety pin is left installed during flight, seat ejection is not possible. The ejection gun firing linkage will be restrained from moving, thus preventing firing of the ejection gun.

6. Stick grip and boot – CHECK

   Check stick grip firmly attached to stick and stick boot in place with no tears.
7. Gyro switch – NORM
8. Aural tone control knob – LOW
9. Slats override switch – NORM
10. Intercom control panel – SET
    - a. Volume control – AS DESIRED
    - b. Amplifier selector knob – NORM
    - c. Function selector switch – HOT MIC
11. ALE 40 flares/normal switch – NORMAL
12. Boarding steps position indicator – PROTRUDING
13. Fuel control panel – SET
    - a. Internal wing transfer switch – NORMAL
    - b. Internal wing dump switch – NORM
    - c. Refuel selection switch – ALL TANKS
    - d. External transfer switch – AS REQUIRED
    - e. Air refuel switch – RETRACT
    - f. Tank depressurization switch – NORM
14. Stab aug switches – OFF
15. VOR/ILS control panel – SET
    - a. Volume control knob – AS DESIRED
    - b. Marker volume knob – AS DESIRED
    - c. Frequency – AS DESIRED
    - d. VOR/MKR test switch – TEST (cannot be performed when battery start is made)
16. Slats flaps switch – AS REQUIRED

    Slats flaps switch should correspond with actual slats flaps position to prevent slats flaps movement during engine start.
17. Emergency slats flaps handle – FORWARD
18. Drag chute control handle – DOWN AND SECURE
19. Speed brake switch – IN
20. Throttle friction lever – SET AS DESIRED
21. APU reject switch – NORMAL
22. Comm antenna select switch – UPR

    Anti–skid may malfunction while transmitting on the lower antenna due to electromagnetic interference.
23. Engine anti–icing switch – NORMAL
24. Anti–skid – CHECK (cannot be performed when battery start is made)
    - a. Anti–skid switch on – LIGHT OFF
    - b. Emergency quick release lever – DEPRESS/LIGHT ON AND RELEASE/LIGHT OFF
    - c. Anti–skid switch off – LIGHT ON
25. Aileron rudder interconnect circuit breaker – IN
26. Landing and taxi lights switch – OFF
27. Slats flaps position indicators – SELECTED POSITION
28. Landing gear position indicators – GEAR DOWN INDICATION
29. Emergency brake control handle – IN AND SECURE
30. Canopy emergency jettison handle – FORWARD
31. Multiple weapons control panel – SET
    - a. Master arm switch – SAFE
    - b. Delivery mode knob – OFF
    - c. Weapon select knob – AGM–12
    - d. Radar missile power switch – OFF
    - e. Selective jettison knob – OFF
    - f. Interlock switch – IN

WARNING

If the missile power switch is in the PWR ON or CW ON position, and the radar power switch in the rear cockpit is in any position other than OFF or TEST, radiation will be emitted which can be harmful to ground personnel.

    - g. CL TK light – ON IF CENTERLINE TANK INSTALLED (cannot be checked when a battery start is made)

      If light is not on, centerline tank is not jettisonable.
32. Sensor select switch – AS DESIRED
33. Accelerometer – SET
34. AGM–78 anti–compromise jettison switch – OFF
35. Clock – WIND AND SET
36. Flight instrument light control – AS REQUIRED
37. Optical sight reticle – CHECK
38. Film magazine/dust cover – SECURE
39. Reference system selector switch – STBY
40. ADI – CHECK & SET (cannot be performed when battery start is made)
    - a. Rotate pitch trim knob to check travel (−10° +5° minimum)
    - b. Set horizon bar level with miniature aircraft.

WARNING

If the horizon bar will not move with the pitch trim knob, the ADI is unsafe for flight.

41. Emergency attitude indicator – CHECK
    - a. Cage and do not lock
    - b. Set miniature aircraft level with horizon bar
42. Navigation function selector panel – SET
    - a. Bearing distance selector switch – AS DESIRED
    - b. Mode selector knob – AS DESIRED
    - c. FD switch – AS REQUIRED
43. Auxiliary digital display indicator – SET
    - a. Selector knob – AS DESIRED
    - b. Dim control knob – AS REQUIRED
44. Pedestal panel – SET

a. Navigation destination select switch - AS DESIRED
b. Course select switch - AS DESIRED
c. LABS aided switch - AS REQUIRED

45. Fire warning lights — TEST (cannot be performed when battery start is made).
    Check that the four FIRE/OVERHT warning lights, the MASTER CAUTION light and telelight panel FIRE SYS light come on. AFTER TO 1F−4−1484, the voice warning FIRE−FIRE should also be heard if both canopies are closed.
46. Fuel quantity gage - CHECK (before TO 1F-4-1414 cannot be performed when battery start is made)
    Actuate and hold feed tank check switch to check fuel quantity (counter and tape or sector) in feed tank.
47. Canopy manual unlock handle - FORWARD
48. Arresting hook control handle - UP
    Failure to check the arresting hook control handle fully up may inadvertantly cause the hook to lower during taxi, takeoff or landing
49. Communication−navigation control panel — SET
    a. Communication frequency control knobs — AS REQUIRED (before TO 1F−4−1552)
    b. Communication channel control knob — AS REQUIRED (before TO 1F−4−1552)
    c. Mode select switch — AS REQUIRED
    d. Communication volume control knob — AS DESIRED
    e. Auxiliary channel control knob — AS REQUIRED
    f. Auxiliary volume control knob — AS DESIRED
    g. COMM−AUX pushbutton — TR + G — ADF
    h. Navigation channel control knobs — AS REQUIRED
    i. Navigation volume control knobs — AS DESIRED
    j. Tacan function selector knob — OFF
    k. Communication command button — AS DESIRED (before TO 1F−4−1552)
    l. Navigation command button — AS DESIRED
50. Emergency vent knob — IN
51. Rain removal switch — OFF (before TO 1F−4−1500)
52. Pitot heat — CHECK (cannot be performed when battery start is made)
53. Defog−foot heat control handle — AS DESIRED
54. IFF Mode 4 function switch — AS DESIRED (cannot be perfomed when battery start is made)
55. IFF master control knob - OFF
56. Circuit breakers - CHECK
57. Temperature control panel - SET
    a. Temperature control knob - AS DESIRED
    b. Mode selector switch - AUTO
58. DCU-94/A bomb control monitor panel - SET
    a. Station selector switches - AFT
    b. Master release lock switch - AFT
    c. Option selector knob - OFF
59. Cockpit lights control panel - AS REQUIRED
    a. White floodlight switch - OFF
    b. Instrument panel lights control knob - AS REQUIRED
       Warning and caution light dimming is controlled by the flight instruments control knob.
    c. Console lights control knob - AS REQUIRED
    d. Standby compass light switch - AS REQUIRED
    e. Console floodlight switch - AS REQUIRED
    f. Indexer lights control knob - AS REQUIRED
60. Warning and indicator lights — TEST (cannot be performed when battery start is made)
    Ensure cover assembly on wheels warning light is properly latched. Check that the four FIRE/OVERHT warning lights, the MASTER CAUTION light, and the telelight panel FIRE SYS fault light all come on when the warning lights switch is placed in the TEST position. After TO 1F−4−1484 with both canopies closed, the voice warning FIRE−FIRE, CANOPY−CANOPY, ALTITUDE−ALTITUDE should also be heard.
61. Instrument flood lights — OFF
62. Aural stall warning volume — AS DESIRED
63. Compass control panel — SET
    a. Latitude compensator — SET
    b. Mode control knob — SLAVED
    c. Synchronization indicator — CHECK
64. KY−28 power selector knob — OFF (some aircraft)
65. KY−28 mode select — P (some aircraft)
66. KY−58 power switch — OFF (some aircraft)
67. KY−58 mode select knob — P (some aircraft)
68. Exterior lights control panel — SET
    a. Fuselage lights switch - AS REQUIRED
    b. Wing lights switch - AS REQUIRED
    c. Tail lights switch - AS REQUIRED
    d. Exterior lights flasher switch - AS REQUIRED
    e. Formation lights control knob - AS REQUIRED

CAUTION

Use of formation lights during daylight hours is prohibited.

69. Instrument lights intensity control panel - SET
70. Intercom system - CHECK
71. APU system - CHECK (cannot be performed when a battery start is made)
    a. APU reject switch - TEST (APU light on)
    b. Move control stick very slightly fore and aft and check corresponding stabilator movement

CAUTION

Excessive movement of the control stick will cause failure of the PC-2 reservoir.

    c. APU reject switch - NORMAL (APU light out after 1 minute)

72. Oxygen quantity gage - CHECK (cannot be performed when battery start is made)
    Check that the oxygen quantity is sufficient for the intended mission, the OFF flag on the gage face is not visible, and the OXYGEN LOW light is extinguished. Press oxygen test button and check OXYGEN LOW light and MASTER CAUTION light illuminate at 1 liter. Notify rear crewmember, if applicable, that test is in progress.
73. Oxygen supply system - CHECK AND SET
 Pressure - 65–120 psi
 Regulator - CHECK
   a. Oxygen supply lever - FULLY ON
      On the CRU-73A regulator, it is possible for the oxygen supply lever to stop in an intermediate position between OFF and ON. Assure the lever is all the way on.
   b. Emergency lever - NORMAL
   c. Put mask on
 Indicator - CHECK
   a. Diluter lever - 100%
   b. Emergency lever - EMERGENCY
   c. Oxygen flow - CHECK
      Breath normally for three cycles and check flow indicator operation. Hold breath; all flow should stop and the indicator should show no-flow (black). A white indicator indicates a leak that must be corrected before flight.
 Connections - CHECK
 Emergency oxygen - CHECKED
   a. Pressure - CHECKED
   b. Actuation knob and linkage - CHECKED

WARNING

For regulators other than the CRU-73/A, if the oxygen supply lever is OFF and the diluter lever is in NORMAL, there will be no restriction to breathing but the crewmember will be breathing cockpit air only and hypoxia will occur as cockpit altitudes that require oxygen are reached. It is therefore imperative to check for oxygen flow prior to takeoff. With the diluter lever in 100%, if the oxygen supply lever is OFF, neither cockpit air nor oxygen is available at the mask. For the CRU-73A regulator, with the oxygen supply lever OFF, neither cockpit air nor oxygen is available at the mask regardless of diluter lever position.

74. Eject light — CHECK
    Press the light and check that both front and rear EJECT lights illuminate. Press the light again and check that both lights extinguish.

BEFORE STARTING ENGINES

1. (P-EWO) Seat pins - CHECK REMOVED AND STOWED
2. CNI switch - ON
   Have ground personnel place the CNI switch in the left wheel well to the ON position.

CAUTION

When the CNI equipment is operating on external power without cooling air applied, it is limited to 10 minutes of accumulated operation in a 1 hour period in order to prevent heat damage to the equipment.

3. Fore and aft area - CLEAR
   Ensure the wheels are chocked and the engine intake, and exhaust areas, starter exhaust areas, and cockpit and canopy rail areas are clear of personnel and equipment. Refer to Danger Areas Illustration, this section.
4. Fire guard - POSTED
5. Throttles - OFF

CAUTION

Attempting a pneumatic start with throttles out of OFF will result in fuel puddling and the possibility of a hot start or fire.

STARTING ENGINES

The engines can be started by utilizing electrical power from an external power source or the aircraft battery, and by utilizing air pressure from a ground cart or a pyrotechnic cartridge. As a result, several starting combinations can be realized; i.e., external power source and ground cart, external power source and cartridge, battery and cartridge, and battery and ground cart. Refer to section VII, System Operation, for a description of engine starter operation. This procedure establishes the right engine as being started first. This procedure was adopted in order to ascertain that both utility hydraulic system pumps are operating properly. The right engine pump delivers 2775 ±225 psi at idle, while the left engine pump delivers 3000 ±250 psi at idle. Because of this, the single needle utility hydraulic pressure indicator cannot be used to determine pump operation unless the right engine is started first. As the left engine is started, the utility hydraulic pressure will increase slightly indicating the left engine pump is operating. This procedure is based upon external power being available. During a start in which battery power is used, the oil pressure indicator, fuel flow indicator, and hydraulic pressure indicator will not be operative until airplane generated power is available. Cold Weather Procedures, section IX, are to be used any time the initial oil pressure exceeds 50 psi. This can occur even when the outside temperatures are not extremely cold.

WARNING

Under no circumstances will the aircraft be flown with unfired cartridges in the starter.

CAUTION

During engine start, if rpm increases rapidly from 0 to 30%, immediately abort the start. Such an rpm increase is an indication of failure within the starter-to-engine drive train. Further rotation of the engine is impossible with such a failure. Continued fuel flow to the engine under this condition may result in engine fire.

NOTE

If irritating noxious exhaust fumes are present, increasing engine(s) to 70% rpm, may reduce fume levels.

PNEUMATIC START

CAUTION

Do not make a pneumatic start with an unfired cartridge installed in the starter. The cartridge may ignite and the resulting added torque may shear the starter output shaft.

1. External air source - CONNECT TO RIGHT STARTER (MA-1A starting unit or equivalent).
2. Engine master switches - ON
3. Engine - CRANK
   Signal ground crew to start external airflow and monitor the tachometer for the first indication of engine rotation.

CAUTION

If there is no indication of engine rpm within 15 seconds or no indication of oil or hydraulic pressure within 30 seconds after external air is applied discontinue the start and investigate.

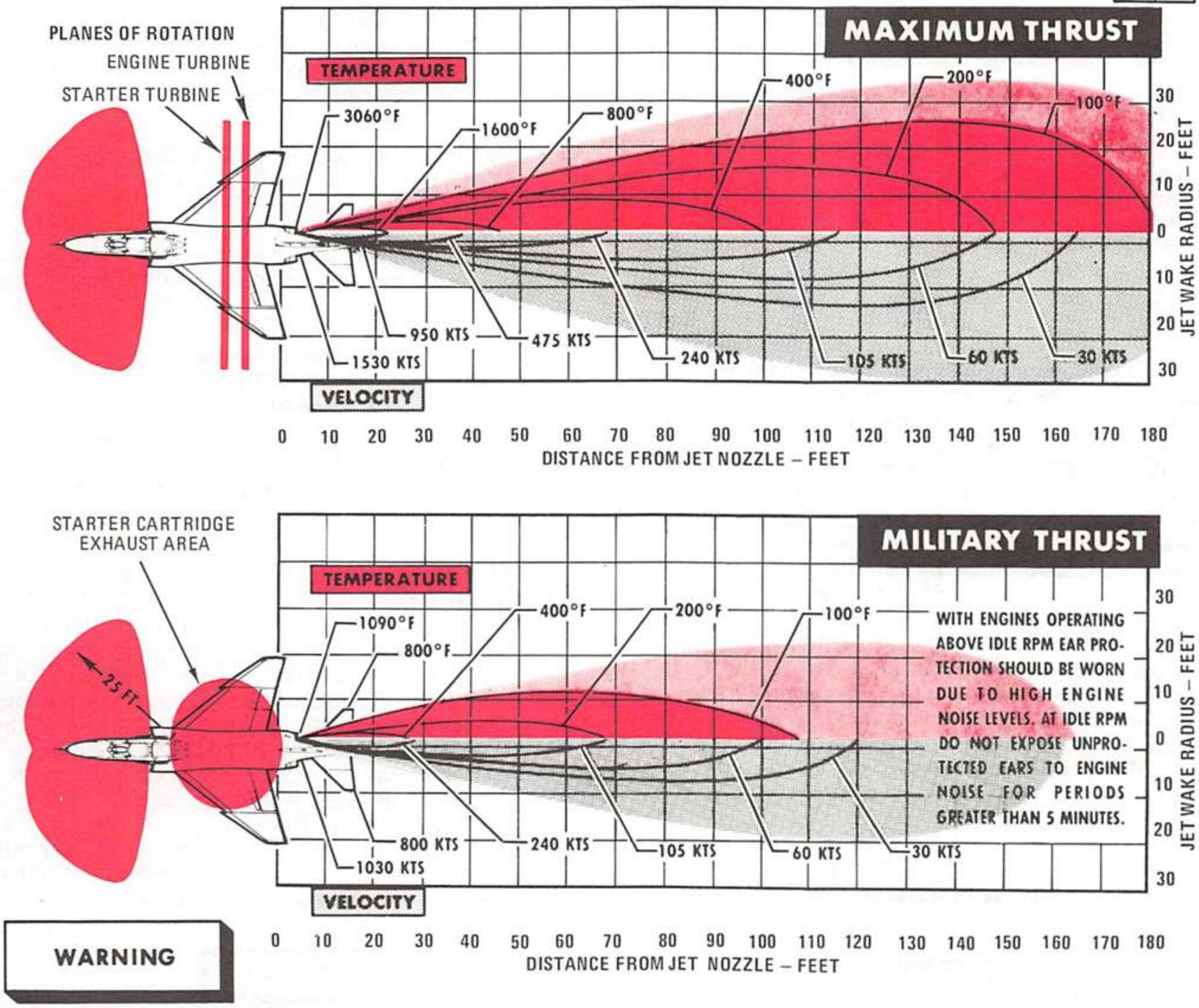
4. At 10% rpm, ignition button - DEPRESS AND HOLD WHILE ADVANCING THROTTLE
   Press the ignition button and simultaneously advance the throttle to a position halfway up the throttle quadrant, then snap the throttle to IDLE while monitoring fuel flow. If the fuel flow drops below 225 pph (400 pph, low smoke engines), the throttle rigging is out of limits and an entry shall be made in the Form 781. Do not accept the aircraft for flight where a snap deceleration is anticipated as flameout may occur. Rear crewmember will check for appropriate throttle movement during start. If throttles are not engaged, reconnect after engine start.

CAUTION

Do not attempt to start the engine before reaching 10% rpm. If the starting procedure is initiated at a lower rpm additional heat distress of the engine hot section is anticipated. Overtemperature of the turbine will generally occur during a low rpm start if starter air is inadvertently interrupted during the start cycle.

5. Ignition button - RELEASE WHEN LIGHTOFF

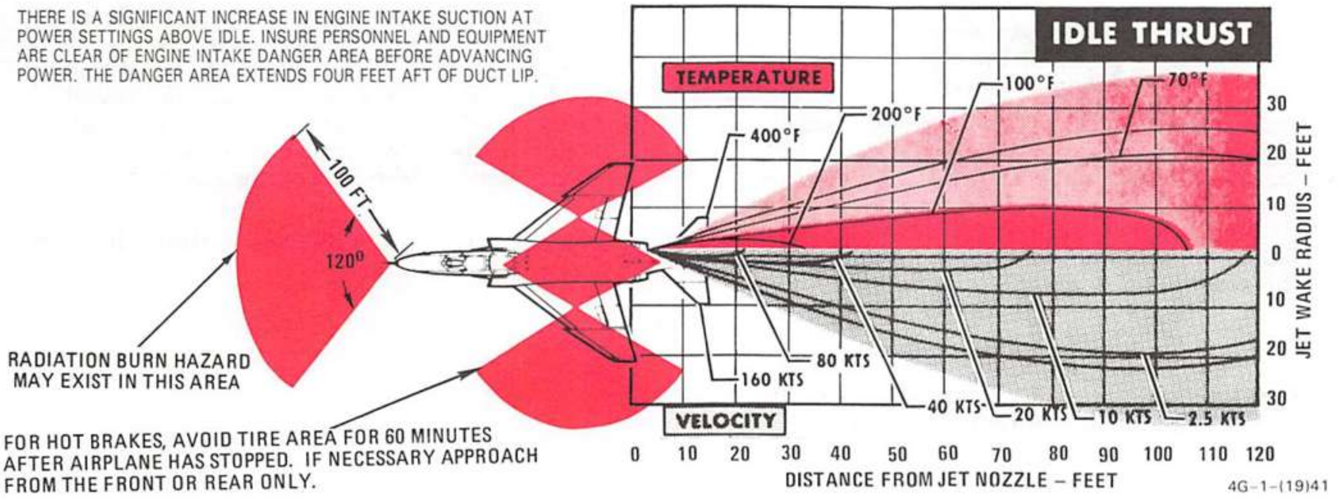
DANGER AREAS



WITH ENGINES OPERATING ABOVE IDLE RPM EAR PROTECTION SHOULD BE WORN DUE TO HIGH ENGINE NOISE LEVELS. AT IDLE RPM DO NOT EXPOSE UNPROTECTED EARS TO ENGINE NOISE FOR PERIODS GREATER THAN 5 MINUTES.

WARNING

THERE IS A SIGNIFICANT INCREASE IN ENGINE INTAKE SUCTION AT POWER SETTINGS ABOVE IDLE. INSURE PERSONNEL AND EQUIPMENT ARE CLEAR OF ENGINE INTAKE DANGER AREA BEFORE ADVANCING POWER. THE DANGER AREA EXTENDS FOUR FEET AFT OF DUCT LIP.



RADIATION BURN HAZARD MAY EXIST IN THIS AREA

FOR HOT BRAKES, AVOID TIRE AREA FOR 60 MINUTES AFTER AIRPLANE HAS STOPPED. IF NECESSARY APPROACH FROM THE FRONT OR REAR ONLY.

Figure 2-3

INDICATED

Lightoff is indicated by a rise in exhaust gas temperature followed by an increase in engine rpm. Engine lightoff is usually noted at approximately 13 to 16% rpm with a fuel flow of 225 to 750 pph (400 to 1200 pph, low smoke engines). Higher fuel flow values are likely to result in hot starts. To prevent an overtemperature condition from occurring, the engines should be shut down prior to reaching the actual EGT limit. In the event of a hot or false start, and the throttle cannot be returned to OFF, the engine may be shutdown from any throttle setting by placing its engine master switch OFF (provided the other master switch is ON, if a battery start is made). This closes the fuel shutoff valve and deprives the engine of fuel. The engine will flameout in approximately 30 seconds from idle and approximately 2 seconds from military. After a wet or false start, allow 1 minute or longer for the combustion system to drain while continuing to turn the engine with pneumatic air. Direct the crew chief to inspect the engine nozzle for residual fuel before restarting the engine. If the engine does not light off within 15 seconds after fuel flow is indicated, discontinue the start and investigate. If the engine does not continue to accelerate normally after lightoff, discontinue the start. If this occurs, motor the engine for 2 minutes with the throttle OFF and allow to coast down to 0% rpm before attempting another start.

6. At 45% rpm, signal ground crew to stop external airflow
7. Exhaust gas temperature indicator – 220° to 420°C (250°C to 540°C, low smoke engines)
8. Fuel flow indicator – WITHIN LIMITS

   Fuel flow should not exceed 750 pph at lightoff, and 800 to 1400 pph at idle. For low smoke engines, fuel flow should not exceed 1200 pph at lightoff and 800 to 1500 pph at idle. Fuel consumed during starting is approximately 65 pounds per engine.
9. Idle rpm – 65 ±1%
10. Right boost pump indicator – 30 ±5 PSI
11. Oil pressure indication – 12 PSI MIN
12. Hydraulic pressure indicators – WITHIN LIMITS

    With the right engine started, the PC-2 hydraulic pressure indicator should read 3000 ±250 psi and the utility hydraulic pressure indicator should read 2775 ±225 psi. The check hydraulic gage indicator light remains illuminated until the left engine is started and all four hydraulic pumps are operating above 1750 psi. When the left engine is started, the utility hydraulic pressure indicator should read 3000 ±250 psi.

CAUTION

With only one engine operating, excessive rapid movement of the control stick may rupture the inoperative power control system reservoir.

13. Right generator switch – GEN ON

    Ensure RH GEN OUT and BUS TIE OPEN lights go out. Generator switches may be cycled with the INS knob in ALIGN.

WARNING

Check that auxiliary air doors and speed brakes (if out) are clear prior to cycling generator switches. Any interruption in electrical power will cause them to close violently, with possible injury to ground crew personnel.

14. APU light – CHECK ON

    The APU light will remain illuminated for approximately 1 minute after the left engine is started.
15. Spoiler actuator – CHECK

    With the right engine operating, slowly deflect control stick approximately 1 inch to the left. Have ground crew or rear seat occupant verify that the spoiler does not fully deflect and that it returns to a flush position when the stick is returned to neutral. Abort if the spoiler check is not good.
16. Air refueling door and exterior air refueling lights – CHECK (if required)
17. Start the left engine per steps 1 through 12, substituting LEFT in all cases.
18. Left generator switch – GEN ON

    Ensure that the LH GEN OUT light goes out. If the BUS TIE OPEN light does not go out within approximately 18 seconds, accelerate either engine to approximately 70% rpm and cyle right generator. In low ambient temperatures, the BUS TIE OPEN light may not immediately go out after the left engine is started and the left generator light goes out. This may be due to failure of the generators to synchronize quickly because of cold oil in the left generator CSD.
19. Right generator switch – CYCLE

    Cycle the right generator switch (OFF, then GEN ON), and check that the RH GEN OUT light illuminates.

WARNING

Do not cycle both generator switches at once. Any interruption in electrical power will cause the auxiliary air doors and the speed brakes (if out) to close violently, with possible injury to ground crew personnel.

20. BUS TIE OPEN light – OUT

    Ensure that the BUS TIE OPEN light remains out when placing the right generator switch to OFF, and that it flashes on momentarily when the switch is returned to the GEN ON position.
21. External air – DISCONNECT
22. External electrical power – DISCONNECT
23. Interior check – COMPLETE (if applicable)

ENGINE GROUND OPERATION

No engine warm-up is necessary; however, allow the engines to operate at idle until instrument readings stabilize. As soon as instrument readings stabilize, the throttle may be advanced to maximum thrust.

BEFORE TAXIING (FRONT COCKPIT)

NOTE

Since pressure vibrations in some types of shelters may cause instrument fluctuations and/or inaccurate readings, the Before Taxiing checks should be performed outside the shelter when practical.

1. Anti–G suit system – CHECK
   Press and release manual inflation button on anti–G suit control valve. Check for proper suit inflation and deflation.
2. Communication and navigation equipment – ON AND CHECK
   After TO 1F–4–1552 following power–up, if frequency/status indicator displays M–LOAD, FMT.CHG or ERASE do the following:
   - a. Comm channel control knob – 20
   - b. Comm frequency selector knobs – 220.000
   - c. Preset/manual switch – PRST
   - d. SET button – PRESS AND RELEASE (now in VER/OP mode)
   - e. Preset/manual switch – MNL
   - f. Comm command button – AS DESIRED
3. APR–47 lights – AS DESIRED
4. IFF – STANDBY
   Prior to this point the IFF should remain OFF as any interruption of power would cause loss of the Mode 4 code.
5. Radar altimeter - ON
   Check that OFF flag moves out of view
6. Altimeter and SPC - SET AND CHECK
   - a. Set current altimeter setting on the barometric scale.
   - b. Altimeter pointer should indicate the field elevation within ±75 feet.
   - c. Place the SPC switch to RESET CORR. The STATIC CORR OFF light should go out and remain out. Disregard initial momentary engagement oscillations. Altimeter reading after oscillations stop should not exceed ±25 feet from original reading. Continued altimeter oscillations of any magnitude are unacceptable.

NOTE

Failure of the STATIC CORR OFF light to extinguish after SPC engagement could be an indication of CADC failure and the mission should be aborted.

   - d. With the static correction on (SPC engaged), the altimeter should indicate the field elevation within ±90 feet.
   - e. The difference between the front and rear cockpit altimeters should not exceed 100 feet.
   - f. Place the altimeter switch to RESET. Altimeter should not vary more than ±75 feet and the red STBY flag should not be in view.
   - g. The altimeter should indicate the field elevation within ±75 feet.
   - h. With both altimeters in RESET, the difference between the front and rear cockpit should not exceed 75 feet.

NOTE

If the altimeter is not within tolerance in RESET, the aircraft may be flown in the STBY mode provided that, in the STBY mode, the altimeter checks within ±75 feet of field elevation. The ±75 feet of field elevation is an operational restriction and does not necessarily reflect instrument tolerances.

7. Speed brakes - CYCLE
   Open and close the speed brakes to check proper operation. Have ground crew check that speed brakes extend simultaneously. Obtain a signal from the ground crew that the speed brakes are fully closed and observe that the SPEED BRAKE OUT indicator light is extinguished.
8. Slats flaps - CHECK
   Place slats flaps switch to OUT; observe that slats indicate OUT and flaps indicate DN. The flaps may not extend or retract together without airloads on them. This condition is normal and the flaps should extend and retract together when airborne. Place slats override switch to IN; observe slats retract. Place slats override switch to NORM; observe slats extend. If slats indicate barberpole or indication does not match switch position, leave switch as set and abort mission. If an audible (noticeable in headphones) chatter associated with slat flap and utility hydraulic indicators fluctuating in unison occurs, cycle the slats flaps. If chatter persists, abort the mission. If cycling eliminates chatter, continue mission and make an appropriate entry in AF Form 781.

CAUTION

Continued or prolonged operation with flap or slat chatter will damage actuator(s) and mechanisms.

9. Flight controls - CHECK (slats flaps OUT AND DOWN)
   Ground crew should confirm all flight control positions. The MASTER CAUTION and CHK HYD GAGES lights may illuminate momentarily during this check. If pressure recovers without delay, disregard this indication.

a. Pitch trim - 1 TO 3 UNITS NOSE DOWN

b. Control stick - PULL FULL AFT AND RELEASE

Movement forward should be smooth and free of any restriction. The stick may not return to the full forward position. The stick should move forward at least to the 1/2 travel position and further movement toward the stop should require no more than one pound push force. If trim is set full nose down, several slight bumps may be felt during this check. If these bumps do nor recur when stabilator is properly trimmed, disregard this indication.

c. Rudder - CHECK FULL TRAVEL LEFT AND RIGHT

d. Ailerons/ARI - CHECK

Move control stick full left. Observe left spoiler up, right aileron down, and rudder slightly left. Engage yaw stab aug. Observe rudder move further left. Depress emergency quick-release lever. Observe rudder move toward neutral. Release emergency quick-release lever, neutralize stick, and disengage yaw stab aug. Repeat check substituting right for left.

10. Slats flaps - NORM

11. ARI disengage - CHECK

Move stick full right and left. Observe no rudder movement.

12. Stab aug switches - ENGAGE AND CHECK

a. Each axis of stab aug - ENGAGE INDIVIDUALLY

Observe no movement of any control surface (1/4 inch allowable). If an aileron/spoiler deflects during roll stab aug engagement, it may take up to four seconds to resettle after roll stab aug is disengaged. Allow enough time for the aileron/spoiler to resettle before re-engaging roll stab aug to check the other aileron/spoiler.

If the AFCS is not to be checked or used during the flight -

b. (P) Emergency quick-release lever - PRESS AND HOLD

Observe PITCH AUG OFF and MASTER CAUTION lights illuminate. Release lever and observe PITCH AUG OFF light goes out.

c. (EWO) Emergency quick-release lever - PRESS AND HOLD

Observe PITCH AUG OFF and MASTER CAUTION lights illuminate. Release lever and observe PITCH AUG OFF light goes out.

13. Reference system selector - PRIM (ensure INS is in NAV)

14. Compass mode control knob - SYNC (if necessary)

Allow 10 seconds for automatic synchronization before manually synchronizing system.

15. Automatic flight control system - CHECK (if required)

a. AFCS - ENGAGE

Grasp stick below stick grip. Position stick near neutral. Hold switch to ENGAGE until AFCS engages. Check that the stick does not immediately drive forward or aft nor any control surface jump more than 1/2 inch. If the wings are not level, the ailerons will drive due to normal action of the heading hold function. Abruptly move the stick forward or aft and check that AFCS disengages. Re-engage AFCS switch.

b. Altitude hold - ENGAGE

Observe no control surface jump or rapid stick motion.

c. AFCS - DISENGAGE

Depress and hold the front cockpit emergency quick-release lever. Observe PITCH AUG OFF, AUTOPILOT DISENGAGE, and MASTER CAUTION lights illuminate. Release lever. Observe PITCH AUG OFF light goes out.

d. AFCS - ENGAGE

e. (EWO) AFCS - DISENGAGE

Depress and hold the rear cockpit emergency quick-release lever. Observe PITCH AUG OFF, AUTOPILOT DISENGAGE, and MASTER CAUTION lights illuminate. Release lever. Observe PITCH AUG OFF light goes out.

NOTE

Ground checks cannot ensure an operational AFCS inflight. If the AFCS does not engage during ground checks or fails ground checks, do not use during flight.

16. Stab aug switches - DISENGAGE
17. Trim - CHECK AND SET 1 TO 3 UNITS NOSE DOWN

    With three units nose down trim, expect a nose heavy tendency on the takeoff roll which quickly approaches a trimmed condition as the aircraft lifts off and the gear and flaps are retracted. With one unit nose down trim, a very marked nose up trim occurs after approximately 230 knots requiring a large nose down trim change at a very low altitude. Check operation of the trim indicator. Receive a signal from the ground crew/rear cockpit occupant that the ailerons and rudder are set at neutral.

18. Slats flaps - OUT AND DOWN (ground crew visually check)

NOTE

Do not move aircraft with INS/NCSC in ALIGN mode.

19. Optical sight - STBY OR CAGED
20. Pneumatic pressure - CHECK
21. IFF - CHECK
22. Radar altimeter - CHECK

    Allow five minutes warm-up after radar altimeter turned on.

    a. Function control switch - PRESS

       Check that pointer moves to 35 (±15) feet and stabilizes.

    b. Low altitude warning light - CHECK

       With function control switch pressed, move reference marker above and below pointer. Warning light must come on within ±15 feet of indicated altitude.

    c. Function Control switch - RELEASE

       Move reference marker to below five feet. Check that warning light is off and altitude pointer fluctuates.

    d. Reference marker - SET

       Set to desired low altitude limit.

23. Wheel chocks and ground interphone cord - REMOVED

BEFORE ENTERING REAR COCKPIT

1. Canopy condition - CHECK

   Check for cracks in the canopy and windshield plexiglass. Check condition of the canopy pressure seals. Ensure canopy knife present and secured.

2. Canopy safety strut - REMOVED

   Ensure normal canopy control handle is in open position if safety strut requires removal.

3. Canopy actuator - SHEAR PIN INTACT
4. Lower ejection handle guard - UP

WARNING

No object of any kind should ever be placed on the top of the ejection seat.

5. Command selector valve - VERTICAL
6. Ejection seat - CHECK

   a. Face curtain and seat-mounted initiator safety pins - INSTALLED; ALL OTHER SAFETY PINS REMOVED

WARNING

Exercise caution regarding hand movements in the vicinity of the bulkhead 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.

b. Canopy interlock cable and interdictor link safety pin assembly – INSTALLED CORRECTLY AND ATTACHED TO CANOPY

WARNING

If the canopy interlock cable and interdictor link safety pin assembly is pulled or bypassed and the sear pulled, the seat will fire immediately.

c. Banana links – ENGAGED IN MAIN SEAR
d. Drogue chute retaining flaps – FORWARD FLAP FOLDED OVER OTHER FLAPS
e. Seat mounted initiator – LINKAGE CONNECTED
f. Scissors – LOCKED TO SHACKLE AND TIED DOWN, SCISSORS GUARD NOT BROKEN

WARNING

If the scissors shackle safe–tie thread passes through the wire loop, the drogue chute may not deploy.

g. Drogue chute withdrawal line – ROUTED OVER ALL OTHER LINES
h. Top latch mechanism plunger and locking indicator – FLUSH WITH HOUSING

WARNING

If the plunger and locking indicator are not flush with the housing, the seat is not locked in position and an inadvertent ejection can occur.

i. Personnel parachute withdrawal line – QUICK DISCONNECT IS CONNECTED AND RUNS THROUGH GUILLOTINE
j. Personnel parachute safety pin line – NOT THROUGH GUILLOTINE
k. Parachute alignment ring – SAFETY PIN LINE AND RIPCORD PIN LINE (ATTACHED TO PARACHUTE WITHDRAWAL LINE) ROUTED THROUGH, PARACHUTE WITHDRAWAL LINE ROUTED AROUND
l. Check security of parachute container – PARACHUTE CONTAINER SHOULD NOT MOVE MORE THAN 1 INCH
m. Guillotine – CHECK PASSAGE AND HOSE SECURITY
n. Drogue gun assembly – SHEAR PIN INTACT, SAFETY PIN OUT, TRIP ROD CONNECTED WITH NO RED SHOWING ON INNER BARREL
o. Drogue gun cocking indicator – COCKED (some aircraft)

If the indicator is approximately 1/2 inch below the gun housing, it is cocked. If flush with the housing, it is uncocked and will not fire on ejection.

p. Rocket motor initiator – CHECK SEAR ENGAGED, SAFETY PIN REMOVED, ACTUATION LANYARD CONNECTED, HOSE ASSEMBLY CONNECTED AND PIN INSTALLED, AND TRIP ROD CABLE CONNECTED
q. Bulkhead mounted canopy initiator – LINKAGE CONNECTED, SAFETY PIN REMOVED
r. Harness assembly – CHECK

Ensure that parachute container holddown straps are routed in front of the backpad

WARNING

If the holddown straps are hooked or routed behind the back pad, or hooked behind the emergency oxygen bottle, interference with parachute deployment will occur.

s. Emergency oxygen – PRESSURE AND SAFETY PIN REMOVED

Proper servicing of the emergency oxygen bottle is indicated by a gage reading of 1800–2200 psi at 21°C (70°F). The pressure indication varies with temperature. To determine correct indication, add 6.5 psi for each degree above 21°C (3.5 psi/°F) and subtract 6.5 psi for each degree below 21°C. Thus, the bottle is correctly serviced if the gage reads 1890–2290 psi at 35°C (95°F). See ejection seat foldout illustration for approximate pressure values for various gage needle locations.

t. Emergency oxygen actuation knob and linkage – CHECK

Check knob not actuated. If actuated, knob is tilted approximately 45° from vertical. Check security of shear pin in cable to linkage connection by applying light tension on cable.

u. Leg guards – IN PLACE
v. Leg garters – LOCKED IN, AND LANYARDS NOT TWISTED
w. Survival kit – RELEASE HANDLE DOWN, SELECTOR SWITCH AS DESIRED
x. Emergency harness release handle – DOWN WITH SEAR ENGAGED, SAFETY PIN OUT, AND ACTUATION LANYARD CONNECTED
y. Time release trip rod – CONNECTED
z. Personnel locator beacon (PLB) inflight mode selector switch – AUTOMATIC POSITION (RED DOT SHOWING) FOR NORMAL PEACETIME OPERATION. SAFETY STREAMER REMOVED.
aa. Time release mechanism – CHECK BAROSTAT HOLES UNBLOCKED

BEFORE ELECTRICAL POWER (REAR COCKPIT)

1. AN/ALE-40 dispenser - OFF

   If either the chaff or flare CCU control knob is out of the OFF position and a programmer malfunction occurs, flares or chaff could be dispensed if the pins are pulled. Therefore, if chaff and/or flares are loaded, it is important that the CCU control knobs remain in the OFF position until airborne for peacetime or remain OFF until immediately prior to takeoff for wartime operations.

   a. Chaff mode switch - OFF

   b. Flare mode switch - OFF

   c. Ripple switch - OFF

2. Throttles - AFT

3. UHF radio - OFF

4. APX-80 mode switch - PASSIVE/OFF

5. Radar power - OFF

CAUTION

The radar power selector knob should remain OFF until the aircraft is operating on internal power.

6. Airborne video tape recorder switch - OFF

7. DSCG - OFF

8. APR-47 - OFF

9. ECM equipment - OFF

   a. Chaff/flare dispensers - OFF (some aircraft)

   b. EMC panel - OFF

10. Nuclear store consent switch - SAFE

11. Navigation computer set control - SET (with DMAS)

    a. Mode selector knob - AS DESIRED

    b. INS knob - SYS OFF

12. Circuit breaker panels - CHECK

13. Battery bypass switch - OFF

14. SST- 181X pulse selector switch - OFF

15. Electrical test receptacle plug 3P325 - ENSURE PLUG SEATED FLUSH, KNURLED LOCK RING SECURE, CAP TIGHT

    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 plug uses a knurled (twist clockwise to lock) lock ring which should not be confused with the chain equipped threaded cap.

16. KY-28/58 power - OFF

17. Publications and flight data - CHECK

AFTER ELECTRICAL POWER (REAR COCKPIT)

1. Instrument ground power switch - ACTUATE (cannot be performed when battery start is made)

2. DMAS alignment - AS DESIRED

   Navigation accuracy is adversely affected if the aircraft is disturbed during INS alignment.

NOTE

If electrical power is transferred while DMAS is ON, the DMAS computer fuzes may blow due to power transients.

REAR COCKPIT INTERIOR CHECK

WARNING

All harnessing, personal equipment leads, and leg restraint lines must be secured before closing the canopy.

1. Rudder pedals - ADJUST

2. Leg restraint lines - BUCKLED AND SECURE

   Check leg garters buckled and properly adjusted, with garter releases on the inside of the legs. Check that lines are secure to seat and floor, and not twisted or entangled in rocket motor or rocket motor sear cable. Leg restraint lines threaded through the calf garters (double D-ring), routing first through the outboard ring and then through the inboard ring, then through the thigh garters (single D-ring) before the lock pins are inserted in the snubber boxes. Leg restraint line lock pins threaded through hold-down strap lugs on the survival kit. Survival kit-to-seat retention straps (if incorporated) attached to the leg restraint line lock pins at the lock pin attachment points.

WARNING

- The leg restraint lines must be buckled at all times during flight to ensure legs will be pulled back upon ejection. This will enhance seat stability and will prevent leg injury by keeping legs from flailing following ejection.
- Failure to route the restraint lines properly through the garters could cause serious injury during ejection.

3. Harnessing and personal equipment leads - FASTEN

   Attach the parachute riser-shoulder harness fittings to the integrated harness. Attach and firmly adjust the survival kit straps. Secure and firmly adjust the lap belt. Connect oxygen communication and anti-G leads. Route the anti-G hose line behind personal harness sling if hose interferes with controls on left console. Check the operation of the shoulder harness locking mechanism.

WARNING

Failure to adjust survival kit straps to achieve a snug fit between the crew member and kit may result in fatal injury during ejection.

4. Ejection seat height - ADJUST (cannot be performed when battery start is made)
5. Face curtain and seat-mounted initiator safety pins - REMOVED

   After all personal leads have been fastened, have ground crew member remove face curtain and seat-mounted initiator safety pins, show them to aircrew member before stowing in bag, and hand bag to aircrew member.

WARNING

If the seat-mounted initiator safety pin is left installed during flight, seat ejection is not possible. The ejection gun firing linkage will be restrained from moving, thus preventing firing of the ejection gun.

6. Stick grip and boot - CHECK

   Check stick grip firmly attached to stick and stick boot in place with no tears.

7. Communication navigation control panel - SET
   a. Communication frequency control knobs - AS REQUIRED (before T.O. 1F-4-1552)
   b. Communication channel control knobs - AS REQUIRED (before T.O. 1F-4-1552)
   c. Mode select switch - AS REQUIRED
   d. Communication volume control knob - AS DESIRED
   e. Auxiliary channel control knob - AS REQUIRED
   f. Auxiliary volume control knob - AS DESIRED
   g. COMM-AUX push button - TR + G - ADF

h. Navigation channel control knob – AS REQUIRED
i. Navigation volume control knob – AS REQUIRED
j. Tacan function selector knob – OFF
k. Communications command button – AS DESIRED (before TO 1F–4–1552)
l. Navigation command button – AS DESIRED
8. VOR/ILS/marker beacon volume - AS DESIRED
9. Pull up tone switch - AS DESIRED
10. Emergency slats flaps handle - FORWARD
11. Intercom control panel - SET
a. Volume control knob - AS DESIRED
b. Amplifier selector knob - NORM
c. Function selector knob - HOT MIC
12. Emergency gear handle - IN AND SECURE
13. Emergency brake handle - IN AND SECURE
14. Slats flaps position indicators - IN AND UP
15. Landing gear position indicators - GEAR DOWN INDICATION
16. Canopy emergency jettison handle - FORWARD
17. Radar scope - SECURE
Check that radar scope retaining pins are properly installed.
18. Clock - WIND AND SET
19. Attitude indicator - CHECK AND SET (cannot be performed when battery start is made)
a. Rotate pitch trim knob to check travel (–10° to +5°)
b. Set horizon bar level with miniature aircraft.

WARNING

If the horizon bar will not move with the pitch trim knob, the attitude indicator is unsafe for flight.

20. Protective cover - STOWED
21. Navigation function selector switch - AS DESIRED
22. Navigation computer set control lamp button – PRESS
23. Digital display indicator lamp button – PRESS
24. Canopy manual unlock handle – FORWARD
25. Aural tone – AS REQUIRED
26. Cockpit lights control panel – SET
a. White floodlight switch – OFF
b. Instrument panel lights control knob - AS REQUIRED
c. Console lights control knob - AS REQUIRED
With the console lights control knob in the OFF position, the radar scope camera green operate light will be inoperative.
d. Standby compass light switch - AS REQUIRED
e. Console floodlights switch - AS DESIRED
f. Indexer lights control knob - AS DESIRED
27. Warning and indicator lights - TEST (cannot be performed when battery start is made)
28. Intercom system - CHECK
29. Oxygen quantity gage - CHECK (cannot be performed when battery start is made)
Check that the oxygen quantity is sufficient for the intended mission, and the OFF flag on the gage face is not visible.
30. Oxygen supply system - CHECK AND SET
Pressure - 65-120 psi
Regulator - CHECK
a. Oxygen supply lever - FULLY ON
On the CRU-73A regulator, it is possible for the oxygen supply lever to stop in an intermediate position between OFF and ON. Assure the lever is all the way on.
b. Emergency lever - NORMAL
c. Put mask on
Indicator - CHECK
a. Diluter lever - 100%
b. Emergency lever - EMERGENCY
c. Oxygen flow - CHECK
Breath normally for three cycles and check flow indicator operation. Hold breath; all flow should stop and the indicator should show no-flow (black). A white indicator indicates a leak that must be corrected before flight.
Connections - CHECK
Emergency oxygen - CHECKED
a. Pressure - CHECKED
b. Actuation knob and linkage - CHECKED

WARNING

For regulators other than the CRU-73/A, if the oxygen supply lever is OFF and the diluter lever is in NORMAL, there will be no restriction to breathing but the crewmember will be breathing cockpit air only and hypoxia will occur as cockpit altitudes that require oxygen are reached. It is therefore imperative to check for oxygen flow prior to takeoff. With the diluter lever in 100%, if the oxygen supply lever is OFF, neither cockpit air not oxygen is available at the mask. For the CRU-73A regulator, with the oxygen supply lever OFF, neither cockpit air nor oxygen is available at the mask regardless of diluter lever position.

BEFORE TAXIING (REAR COCKPIT)

NOTE

Since pressure vibrations in some types of shelters may cause instrument fluctuations and/or inaccurate readings, the Before Taxiing checks should be performed outside the shelter when practical.

1. Interior check - COMPLETE (battery start)
2. Anti-G suit system - CHECK
Press and release inflation button on anti-G suit control valve. Check for proper suit inflation and deflation.
3. Communication and navigation equipment – ON AND CHECK
After TO 1F–4–1552 following power–up, if frequency/status indicator displays M–LOAD, FMT.CHG or ERASE do the following:
a. Comm channel control knob – 20
b. Comm frequency selector knobs – 220.000
c. Preset/manual switch – PRST
d. SET button – PRESS AND RELEASE (now in VER/OP mode)
e. Preset/manual switch – MNL
f. Comm command button – AS DESIRED
4. APR–47 BIT checks – INITIATE
5. Radar BIT checks – INITIATE

6. ECM pod – AS REQUIRED
7. Keyer control – SET
   a. Steer knob – AS DESIRED
   b. Coord knob – AS DESIRED
8. Altimeter – SET AND CHECK
   a. Set current altimeter setting on the barometric scale.
   b. Altimeter pointer should indicate the field elevation within ±75 feet.
   c. With the SPC switch at RESET CORR, the STATIC CORR OFF light should go out and remain out. Disregard initial momentary engagement oscillations. Altimeter reading after oscillations stop should not exceed ±25feet from original reading. Continued altimeter oscillations of any magnitude are unacceptable.

NOTE

Failure of the STATIC CORR OFF light to extinguish after SPC engagement could be an indication of CADC failure and the mission should be aborted.

   d. With the static correction on (SPC engaged), the altimeter should indicate the field elevation within ±90 feet.
   e. The difference between the front and rear cockpit altimeters should not exceed 100 feet.
   f. Place the altimeter switch to RESET. Altimeter should not vary more than ±75 feet and the red STBY flag should not be in view.
   g. The altimeter should indicate the field elevation within ±75 feet.
   h. With both altimeters in RESET, the difference between the front and rear cockpit should not exceed 75 feet.

NOTE

If the altimeter is not within tolerance in RESET, the aircraft may be flown in the STBY mode provided that, in the STBY mode, the altimeter checks within ±75 feet of field elevation. The ±75 feet of field elevation is an operational restriction and does not necessarily reflect instrument tolerances.

TAXIING

1. Wheel brakes – TEST
   After initial roll, apply the wheel brakes to check their operation.
2. Nose gear steering – ENGAGE AND CHECK
   Engage nose gear steering and actuate in both directions to ensure proper operation.

CAUTION

- Taxi with canopies full open or full closed; with the canopies open, maintain taxi speeds below 60 knots to prevent damage to the canopy operating mechanism.
- Adequate distance between aircraft must be maintained during formation taxi. An open canopy may be damaged by engine exhaust blast.
- While taxiing during high gross weight conditions, the turning radius should be increased and speed reduced to the minimum practical to relieve excessive side loads on the main landing gear struts, wheels, and tires.
- A bottoming–out sensation during taxi is an indication of improper nose strut servicing.

3. (P–EWO) Flight instruments – CHECK OPERATION
4. (P–EWO) Oxygen diluter lever – AS REQUIRED

BEFORE TAKEOFF

CAUTION

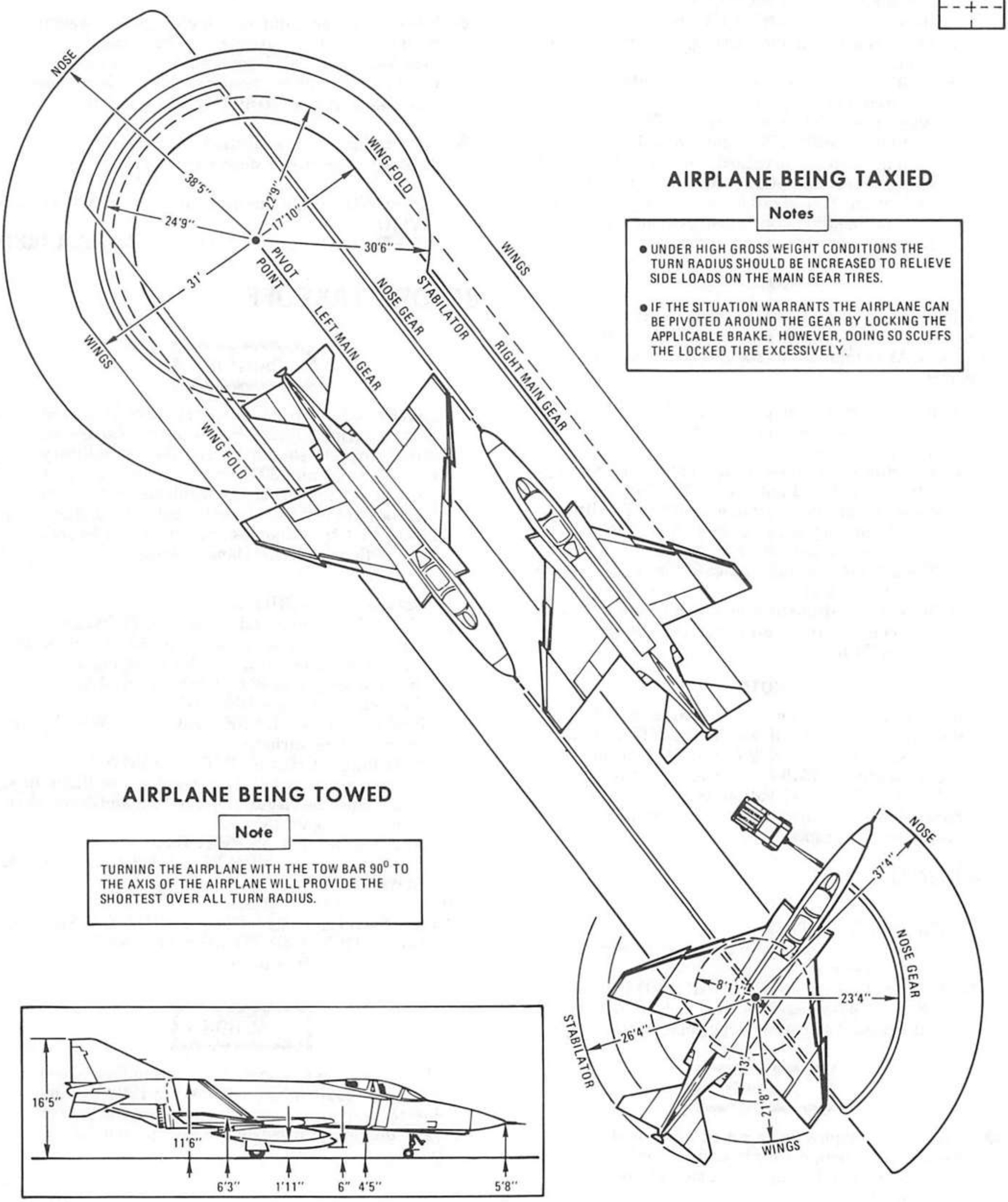
Exercise care in positioning the aircraft on the runway during formation operations. Clearance behind aircraft should be 150 feet at military thrust settings and 300 feet at maximum thrust settings. Try to stagger the airplane positions so that no aircraft is directly behind another. Ensure that the canopies are closed and locked. Refer to figure 2–3 for Danger Areas.

1. Optical sight – CHECK
2. (P–EWO) Harness and leads – FASTENED
   Parachute risers, lap belt, leg restraint lines and all other harnessing and leads fastened.
3. Internal wing transfer switch – NORMAL
4. Stab aug switches – ENGAGE
5. Flight controls – UNRESTRICTED (EWO visually check control surfaces)
6. Slats flaps – CHECK OUT AND DOWN
   If flaps are raised after leaving the flight line, they must be visually checked out and down when they are again lowered.
7. Anti–ice switch – AS REQUIRED
8. Stabilator trim – CHECK 1 TO 3 UNITS NOSE DOWN
9. Fuel quantity – CHECK
10. (P–EWO) Canopies – CLOSE, CHECK WARNING LIGHT OUT AND STRIPES ALIGNED
   a. Operate engines at idle rpm.

CAUTION

Closing of either canopy with engine rpm above idle may result in the canopy not fully locking due to premature canopy seal inflation and/or back pressure caused by cockpit pressurization system.

TURNING RADIUS AND GROUND CLEARANCE



AIRPLANE BEING TAXIED

Notes

- UNDER HIGH GROSS WEIGHT CONDITIONS THE TURN RADIUS SHOULD BE INCREASED TO RELIEVE SIDE LOADS ON THE MAIN GEAR TIRES.
- IF THE SITUATION WARRANTS THE AIRPLANE CAN BE PIVOTED AROUND THE GEAR BY LOCKING THE APPLICABLE BRAKE. HOWEVER, DOING SO SCUFFS THE LOCKED TIRE EXCESSIVELY.

AIRPLANE BEING TOWED

Note

TURNING THE AIRPLANE WITH THE TOW BAR 90° TO THE AXIS OF THE AIRPLANE WILL PROVIDE THE SHORTEST OVER ALL TURN RADIUS.

4G–1–(20)

Figure 2–4

b. Set air temperature control knob no higher than 2 o'clock and the defog-footheat lever in foot heat. An air temperature control knob setting higher than 2 o'clock may prevent the canopy from fully locking due to excessive cabin pressure.

c. Close aft canopy. Ensure closing time does not exceed 9 seconds from lever actuation to completion of locking cycle. Check aft CANOPY UNLOCKED light out, forward CANOPY UNLOCKED light ON.

d. Close forward canopy. Ensure closing time does not exceed 9 seconds from lever actuation to completion of locking cycle. Check forward CANOPY UNLOCKED light out.

CAUTION

The center mirror on the forward canopy can be tilted sufficiently to prevent canopy closing; therefore, assure that the mirror will clear the windshield bow before closing canopy.

e. Check that alignment stripe on canopy lock push rod aligns with the alignment stripe on the bracket hanging from the left canopy sill. The canopy over-center locking mechanism does not actually lock the canopy until approximately the last ¼ inch of pushpull rod movement.

WARNING

If a canopy malfunction occurs during the closing cycle or in the event that either the front or aft CANOPY UNLOCKED light remains on after attempted closure, refer to Canopy Malfunction, section III.

CAUTION

To ensure canopy retention during flight, the canopy control handle must be retained in the closed (full forward detent) position.

11. Defog–footheat and temperature controls – AS REQUIRED

When operating in high humidity conditions, a higher than normal temperature setting (3 o'clock or above) may be required to prevent cockpit fogging.

WARNING

A cockpit temperature malfunction (cold) in high humidity conditions may cause sufficient fog to obscure forward visibility during takeoff roll. A defog-footheat setting forward of footheat may compound the forward visibility problem and require immediate action to dump the cabin pressure in order to maintain visual contact with the runway or leader.

12. (EWO) Command selector valve – AS BRIEFED
13. (P–EWO) Lower ejection handle safety guard – CLEAR

Rotate the lower ejection handle safety guard to the down (horizontal) position.

WARNING

The lower ejection handle safety guard, when lowered, can rebound to the safe position if it is lowered too rapidly.

14. Warning lights/voice warning system – TEST.

After TO 1F–4–1262, CANOPY–CANOPY, ALTITUDE–ALTITUDE is heard in both headsets when the front cockpit warning lights test switch is placed to TEST (WARN TEST). After TO 1F–4–1262, TO 1F–4–1484, and TO 1F–4–1503, FIRE–FIRE, CANOPY–CANOPY, ALTITUDE–ALTITUDE is heard. Adjust voice warning volume as desired.

After runway line–up –

15. External transfer switch - AS DESIRED

WARNING

- If external tanks are installed, and the external transfer switch is positioned to OUTBD or CENTER, internal wing fuel will not transfer even though the internal wing transfer switch is positioned to NORMAL.
- Have any leak which cannot be positively identified as the dump mast investigated prior to takeoff.

16. Anti–skid - ON, LIGHT OUT
17. Compass heading - CHECK

If a significant error exists on the HSI compass card, resynch the compass by placing the compass controller mode switch to the SYNC position momentarily. If this doesn't resolve the problem or the heading returns to an incorrect heading when the switch is released, wait 20 seconds and repeat the procedure. If the heading remains incorrect, check the AN/AJB–7 heading by placing the reference system selector to STBY and note difference between PRIM and STBY headings.

18. Pitot heat - ON

Pitot heat should not be used for more than 1 minute on the ground.

19. IFF - AS REQUIRED

If the KIT-1A transponder is installed and keyed, the Mode 4 ON/OUT switch must be ON and the master switch in LOW or NORMAL to prevent illumination of the IFF and MASTER CAUTION lights during Mode 4 interrogations.

20. (P–EWO) Circuit breakers – CHECK
21. Warning lights
22. Radar altimeter – OFF (after TO 1F–4–1262)

    After TO 1F–4–1262, turn radar altimeter OFF until above low altitude warning setting to prevent ALTITUDE–ALTITUDE voice warning during taxi, takeoff, or after takeoff–climb.

TAKEOFF

NORMAL TAKEOFF

The slats out–flaps down position is recommended for all takeoffs. After taking the runway and completing necessary pre–takeoff checks, engines can be run to 85% with brakes held and nose gear steering engaged to ensure nose gear alignment (figure 2–5). With both engines operating in excess of 85% and the brakes locked, there is a possibility of rotating the tires on the wheel rims or skidding the tires. Check for normal rpm response, fuel flow gages approximately equal, and approximate readings of 450°C EGT, ¼ nozzles, and 30–40 psi oil pressure. If readings are significantly different, run the affected engine(s) individually to MIL and compare with section V limits. After releasing brakes, advance both throttles rapidly to full military power and check rpm, exhaust temperatures and nozzle position. EWO check the ramps fully retracted. If an afterburner takeoff is desired, shift the throttles into the afterburner detent and advance full forward for max thrust. Maintain directional control with nose gear steering or rudder as required. The rudder becomes effective for steering at approximately 70 knots. Do not use wheel braking for directional control during takeoff roll except in an emergency. Nose gear steering should be disengaged when rudder steering becomes effective. If it becomes necessary to re–engage nose gear steering at the higher speeds, rudder pedals should be returned to neutral prior to engagement since rudder displacement necessary for rudder steering will generally be excessive for nose gear steering. Sufficient aft stick should be applied prior to nose wheel liftoff speed to attain the desired pitch attitude. As the nose rises, pitch attitude must be controlled to maintain a 10° to 12° (first pitch mark) nose high attitude for aircraft fly–off. Caution must be exercised to preclude over–rotation due to excessive aft stick rate or an extended takeoff roll due to late lift–off. The basic takeoff attitude should be held during acceleration and transition to a clean configuration. Trim change and control action during this period are normal. The AUX AIR DOORS, WHEELS, and MASTER CAUTION lights may illuminate momentarily as the landing gear and flaps are retracted.

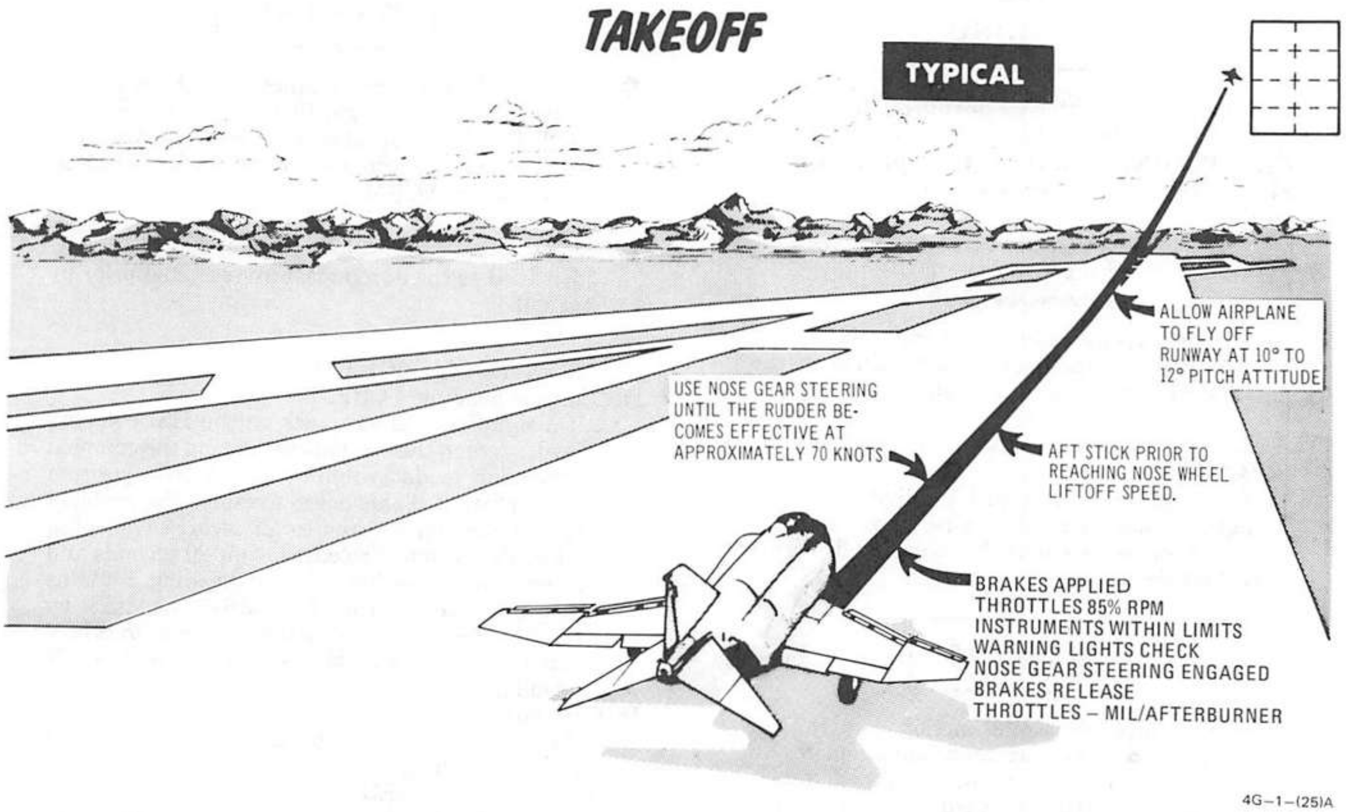


Figure 2–5

WARNING

Nose gear steering malfunctions can cause loss of directional control. If unscheduled steering responses are detected when using NGS before rudder control becomes effective, disengage NGS immediately and use brakes as required for directional control. Do not re-engage NGS.

CAUTION

Rapid full aft movement of the stick between takeoff airspeed and 30 knots below takeoff airspeed may result in the stabilator hitting the runway with the possibility of stabilator actuator damage.

NO-FLAP TAKEOFF

No-flap takeoffs are not recommended. However, if it is determined that no-flap takeoffs must be performed to satisfy mission requirements, aircrews should be aware that takeoff roll and airspeed will be increased and the takeoff attitude will be slightly steeper. Stabilator effectiveness is considerably increased and extreme caution must be exercised to prevent over rotation which could result in the stabilator striking the runway.

WARNING

Due to increased stabilator authority with the flaps up, aircraft rotation can be initiated at lower than normal airspeeds and over rotation is a definite possibility. If it appears that over rotation is occurring, positive control movement (stick forward) must be taken to prevent the stabilator from contacting the runway and/or loss of aircraft control.

MINIMUM RUN/HEAVY GROSS WEIGHT TAKEOFF

A minimum run/heavy gross weight takeoff (aircraft over 55,500 pounds) is accomplished in the same manner as a normal takeoff with the following exceptions: it is recommended that all minimum run/heavy gross weight takeoffs be made with afterburner. During the takeoff run, full aft stick must be applied prior to reaching 80 knots. As the aircraft starts to rotate, the stick should be adjusted to maintain 10 to 12 degrees pitch attitude for aircraft fly-off. The possibility of a main landing gear tire failure increases with an extended takeoff ground run under heavy gross weight conditions. Nose wheel lift-off speed and takeoff speed is increased during heavy gross weight conditions. In the event of an aborted takeoff, it must be remembered that stopping distance is greatly increased as abort speed increases.

CAUTION

With a combination of light gross weight and aft CG, the minimum run takeoff technique (i.e., full aft stick prior to reaching 80 knots) produces rapid pitch rates during nose rotation. This combination can exist when the radar package and APR-47 (or equivalent ballast) are not installed.

CROSSWIND TAKEOFF

Under crosswind conditions, the aircraft tends to weather vane into the wind. The weather vaning tendency can be easily controlled with nose gear steering. As forward speed increases, weather vaning tendency decreases. At speeds above 70 knots, rudder effectiveness will normally be sufficient to maintain directional control. After the nose is lifted to takeoff attitude, the aircraft will have a tendency to drift toward the downwind side of the runway. Therefore, when a long time period is expected between nose lift-off and aircraft fly-off or when the crosswind effect is particularly severe, nose lift-off can be delayed accordingly. Under normal operational conditions this action should not be required. As the aircraft leaves the ground, it should be crabbed into the wind, wings level, to maintain runway alignment. Takeoff in gusty crosswind or severe wake turbulence conditions can result in an abrupt wing low attitude at or near lift-off When these conditions are anticipated; use higher than computed takeoff speed to provide additional lateral control after lift-off

AFTER TAKEOFF - CLIMB

When the aircraft is definitely airborne -

1. Gear - UP

   Check that the landing gear position indicators display the word UP, and that the landing gear handle warning light is out.

   CAUTION

   - The landing gear and gear doors should be completely up and locked before the gear limit airspeed of 250 knots is reached; otherwise, excessive air loads may damage the landing gear mechanism and prevent subsequent operation.
   - When actuating the landing gear, keep a forward pressure on the landing gear control handle to prevent inadvertent actuation of the emergency system.

2. Slats flaps - NORM (180 knots minimum)

   Check that slats flaps indicators display IN and UP. Rudder jumps may occur during flap retraction with a lateral stick input. If an audible (noticeable in headphones) chattering associated with slats flaps and utility hydraulic pressure indicator fluctuating in unison occurs during slats flaps retraction, maintain airspeed below 250 knots and cycle slats flaps. If slat chatter occurs during maneuvering at altitude, it may require opposite slats positioning from where chatter occurs. If chatter persists, extend slats flaps and land as soon as practical. If cycling (slats repositioning) eliminates chatter, continue mission and make an appropriate entry in AF Form 781.

CAUTION

Continued or prolonged operation with flap or slat chatter will damage actuator(s) and mechanisms.

NOTE

- During the climb, it may be necessary to place the antenna selector switch to the LWR position to maintain ground communication.
- When transmitting on UHF using the lower antenna, a change in engine operation could occur. This can be seen as a shift or fluctuation of EGT, RPM, FUEL FLOW, and NOZZLE position.

CLIMB

A simplified climb can be made by maintaining a 10° to 12° (first pitch mark) nose high attitude until reaching 350 knots and then vary pitch as necessary to maintain 350 knots until reaching cruise Mach/TAS. Vary pitch as necessary to maintain cruise Mach/TAS until reaching cruise altitude. A simplified Maximum thrust climb, at normal gross weights, can be made by maintaining a 10° to 12° nose high attitude until reaching 350 knots and then vary pitch as necessary to maintain 350 knots until reaching Mach 0.9. Vary the pitch attitude as necessary to maintain Mach 0.9 until reaching cruise altitude.

CRUISE

1. (P-EWO) Altimeter - SET, CHECK STBY, RESET, COMPARE

   The following maximum tolerances should be met at subsonic speeds:

ALT FT	DIFF FRONT & REAR		ALTM JUMP (STBY TO RESET)
	BOTH STBY	BOTH RESET	
10,000	150 FT	75 FT	100 FT
20,000	250 FT	75 FT	150 FT
30,000	350 FT	75 FT	200 FT

NOTE

- If the altimeter is not within tolerance in RESET, the mission may be continued in STBY. Altimeter accuracy will be degraded.
- The allowable difference between the front and rear altimeters in different modes is 200, 300 and 400 feet for altitudes of 10,000, 20,000 and 30,000 feet respectively.

2. Radar altimeter - AS REQUIRED
3. (P-EWO) Survival kit selector switch - AS DESIRED
4. (P-EWO) Ops check
   a. Oxygen quantity/pressure/blinker
   b. Cockpit pressure indicator
   c. Fuel quantity/transfer switches
      If carrying external tanks, turn external fuel transfer switch to OFF after external tanks are empty, and keep internal wing transfer switch in NORMAL.
   d. Standby compass
   e. Circuit breakers
5. Anti-ice switch - AS REQUIRED

WARNING

- When transfer of external fuel is selected, transfer of internal wing fuel is stopped automatically and cannot be regained until the external wing fuel transfer switch is turned OFF, even though the internal wing transfer switch is positioned to NORMAL. However internal wing fuel and external fuel will simultaneously transfer when the automatic fuel transfer circuit is energized. When the external fuel tanks are not carried, the external wing tank transfer switch is inoperative.
- The possibility exists that engine flameout may occur while flying 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.
- The plume of an active volcano may contain ash which can seriously damage aircraft and/or cause engine flameout. Avoid flying in the plume or under IMC in the vicinity of an active volcano. Report any suspected flight in a volcanic plume in Form 781.
- During negative G flight, a foreign object may become lodged between the top of the ejection seat banana link area and the canopy actuator. Upon opening the canopy, the actuator may jam the foreign object down on the primary seat mounted initiator, or the ejection gun firing mechanism, causing the seat to fire. Therefore, be alert to the

position of foreign objects in the cockpit.

CAUTION

If radar has malfunctioned while at altitude, do not turn radar power off unless further damage is imminent. The radar components will cold soak and collect moisture upon descent causing additional costly repairs.

NOTE

- The windshield defogging system should be operated at the highest temperature possible (consistent with crew comfort) during all high altitude flights. This will provide sufficient preheating to prevent the formation of frost or fog during descent.
- When making throttle chops from the rear cockpit, avoid violently slamming against the idle stops and also avoid maintaining a high force to hold them against the stops. This practice can induce an engine flameout.
- The UHF upper antenna should be used for communication between aircraft, and the lower antenna should be used for aircraft to ground communication. However, antenna switching may be necessary to obtain best results.

RIG CHECK

A rig check shall be performed if an out-of-rig or unintentional asymmetric load condition is suspected and before maximum performance/high AOA maneuvering. With all axes of the stab aug engaged, center the front cockpit ball and check that aircraft does not roll more than 2°/second with ailerons and spoilers trimmed neutral. If a large amount of lateral trim (equivalent to more than one inch aileron down at 350 knots) is required to prevent roll, an out-of-rig, malfunctioning stab aug or asymmetrical load condition exists. Do not maneuver at high angles of attack if this condition exists.

STAB AUG/SLATS CHECK

A stab aug/slats check shall be performed before maximum-performance/high-AOA maneuvering. Do not perform maximum performance maneuvers if any of the following checks are unsatisfactory:

a. Pull nose up with 2G acceleration and release the stick. Aircraft should stabilize in one cycle.
b. Yaw aircraft to one ball width and release rudder. Aircraft should stabilize in one cycle.
c. Roll to 30 to 45 degrees bank and release stick. Aircraft should maintain bank angle. Roll to level flight and release stick. Aircraft should maintain wings level.
d. Gradually increase AOA through 11-1/2 units and ensure slats extend together. Decrease AOA below 10-1/2 units and ensure slats retract together.

Refer to section VI, Flight Characteristics.

DESCENT/BEFORE LANDING

The Descent/Before Landing check should be accomplished above 10,000 feet AGL and at a time when mission/flight demands are not critical. Prior to performing a rapid descent, the windshield and canopy surfaces should be preheated to prevent the formation of frost or fog. If it becomes necessary to dump fuel during a descent, thrust settings in excess of 85% rpm may be required to ensure rapid inflight dumping.

1. Defog-footheat/temperature controls - AS DESIRED
2. (P) ALE-40 flares/normal switch - NORMAL
3. (EWO) Chaff/flares switches - OFF/OFF
4. Stab augs - ENGAGED
5. Comm antenna select switch - UPR

   Anti-skid may malfunction while transmitting on the lower antenna due to electromagnetic interference.

6. Landing/taxi light - LANDING
7. Armament switches - OFF/SAFE
8. Sight - STBY/CAGED
9. Radar/pressure altimeters - SET
10. Fuel - Check

    If the automatic fuel transfer circuit is energized and external tanks are installed and empty, their corresponding external fuel flow lights will illuminate.

11. Circuit breakers - CHECK

WARNING

- Due to fuel quantity indicator tolerances at the low end of the fuel scale, the FUEL LEVEL LOW warning light may illuminate above 1850 pounds fuel remaining. Therefore, the FUEL LEVEL LOW light should be used as the primary indication of a low fuel state in the engine feed tank.
- Transient fuel readings are especially hazardous when decelerating in the emergency fuel range. When decelerating and descending, the fuel quantity indicator may read higher than the actual usable fuel on board. This erroneous quantity indication combined with allowable indicator tolerances may result in engine flameout, from fuel starvation with indicated fuel remaining.

DMAS APPROACH

When approach to landing mode (figure 2−5A) is selected, DMAS computes approach to landing steering information for display on the aircraft instruments and for the AFCS to the touchdown point via a course. If no course was entered and the pilot does not select HSI, disengage steering indications will result. The approach computations for the selected steer destination and course are based on data inserted via the keyer control for touchdown point position, altitude of touchdown point, desired glide slope angle (2° to 5°), and go−around−height (altitude at which DMAS ceases to compute pitch steering). Precision approach to sensor defined destinations is available by using the CCP when in approach mode.

Approach signals are not displayed on the ADI pitch steering bar until the aircraft is within 20 nautical miles of the touchdown point. Also, glide path steering is inhibited until aircraft cross−track error (CTE) and ground track angle are within capture bounds which decrease with decreasing touchdown range.

Vertical error bounds are consistent with the requirements of an instrument landing system (ILS) glide path. Error bounds to initiate DMAS approach for along−track distances (ATD) are as follows:

ATD	Track Error	CTE
20 nm	16°	2.072 nm
10 nm	10°	1.086 nm
5 nm	7°	0.596 nm
2.5 nm	5.5°	0.345 nm

Lateral (localizer) steering is displayed on the ADI and roll indices of COSS. The course deviation indicator is driven by the course angular error. This error is the difference between the desired course and the bearing to the touchdown point (identical to ILS course indication 1.25° per dot deflection). Glide path steering is displayed on the ADI horizontal steering pointer, and glide path error (GPE) from the inserted glide path angle is presented as angular error in degrees on the ADI vertical displacement pointer. GPE is also presented on the DDI in feet displacement from the desired glide slope.

NOTE

The ADI upper and lower full−scale marks serve as calibration points for GPE angular error. When the vertical pointer is at the upper mark, it indicates the glide slope is 0.3° or more above the aircraft. When it is at the lower mark, the glideslope is 0.5° or more below the aircraft.

MSL altitude is displayed during computer approach on the ADDI from 0−999.9 x 10 feet when the selector knob is set to CTR R/Ax10. Automatic approach steering is provided when the CMPTR STEER and ALT/GP switches on the AFCS control panel are engaged.

NOTE

When the inserted go−around height is reached during DMAS approach, DMAS ceases to compute glide path steering. The only indication that this has occured is removal of the ADI pitch steering bar from view; however, GPE remains displayed on the vertical displacement pointer. If the ALT/GP switch on the AFCS control panel is engaged, the AFCS will revert to an altitude hold mode. Completion of the approach after the go−around height has been reached requires pilot control and visual ground contact.

WARNING

The AN/ARN-101 is not a certified landing system. It is the responsibility of the aircrew to insert the go-around height. At go-around height, the ADI pitch steering bar is removed from view, the glide slope indicator remains in view indicating glide slope deviation, and the AFCS, if engaged reverts to altitude hold. At this point, positive aircrew action is required to accomplish a safe landing or go-around.

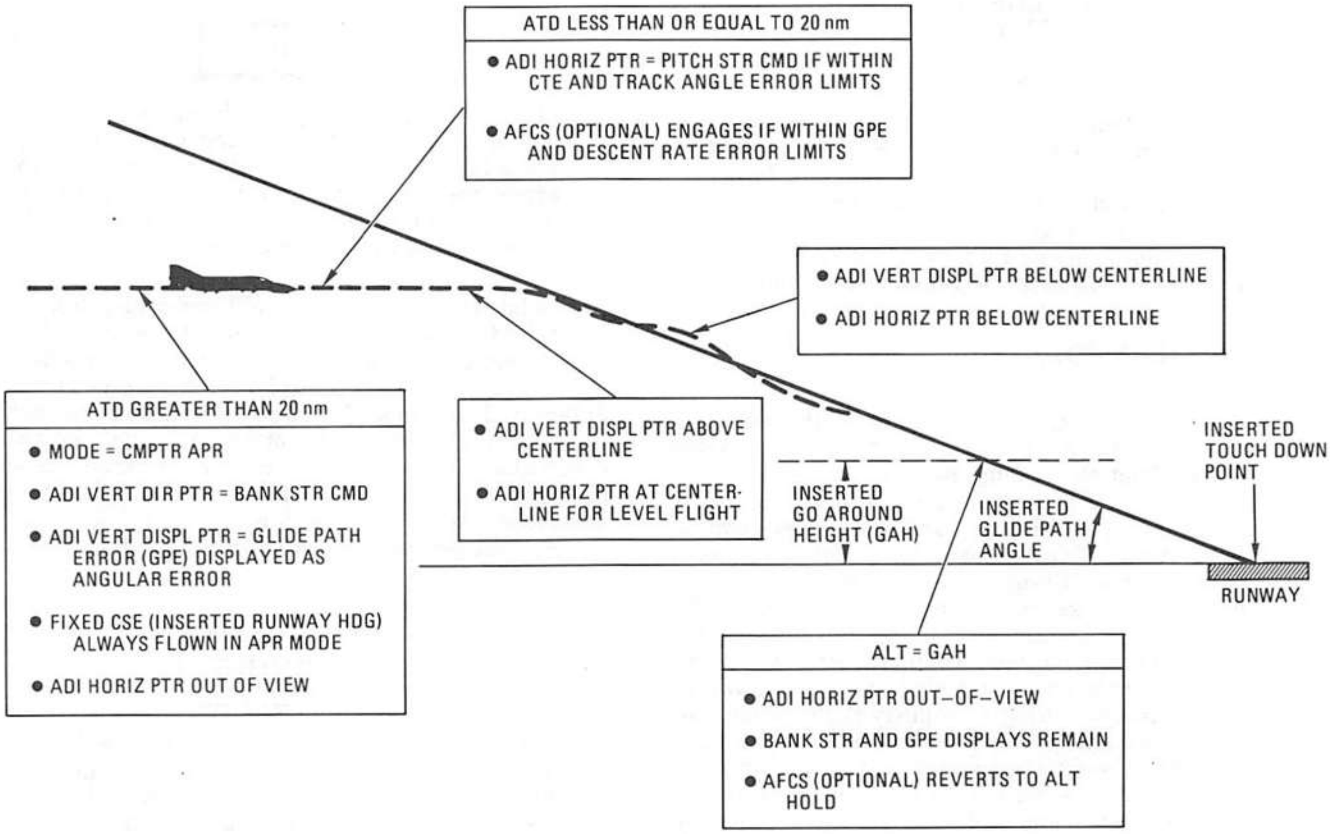
1. (EWO) KC data knob - FLT, INSERT FLY CUE DESTINATION, THEN VERIFY CSE GP PARAMETERS FOR DESTINATION RUNWAY
2. Stab aug switches - ENGAGE
3. Course select switch − KYBD OR HSI
4. Navigation destination select switch − AS DESIRED
5. (EWO) KC steer knob − NAV A or M
6. Nav mode selector knob − CMPTR APR

NOTE

With CMPTR APR selected, auto−sequencing is inhibited.

7. AFCS switch − ENGAGE (for coupled approach)
8. AFCS CMPTR STEER switch − ENGAGE (for coupled approach)
9. AFCS ALT/GP switch − ENGAGE (for coupled approach)

DMAS APPROACH TO LANDING MODE



NOTE

ATD = ALONG TRACK DISTANCE

MAJOR CHANGE

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Figure 2-5A

LANDING

In the pattern -

1. Gear - DOWN
2. Slats flaps - OUT AND DOWN

WARNING

Maintain wings level flight when extending or retracting the flaps.

3. Hydraulic pressure - CHECK
4. Warning lights - CHECK
5. Anti-skid - ON, LIGHT OUT

NOTE

To allow sufficient wheel brake assembly cooling, a minimum of 15 minutes should elapse between landings when the landing gear remains down and a minimum of 30 minutes between landings when the landing gear is retracted. Additional time should be allowed for cooling if brakes are used for steering, crosswind taxiing operation or a series of landings.

LANDING TECHNIQUE

For a normal landing, fly the pattern as illustrated in figure 2-6. Enter the pattern as local policy dictates. Avoid buffet throughout the landing pattern. Adjust power, as necessary, to attain allowable gear lowering airspeed. Extend landing gear and slats and flaps in level flight on downwind. Actual flap extension may not occur until slowing to 210 knots. Ensure slats out-flaps down prior to initiating turn to base leg. The optimum indicated AOA for approach is 19.2 units, and is adequate for all gross weight and normal flap/slat configurations. The AOA aural tone system provides an audible cue to maintain an on-speed approach. During very gusty flight conditions, full aileron may not be sufficient to correct a wing low condition. When landing in gusty or crosswind conditions, with wake turbulence, with high internal fuel load (aft (CG), or with an abnormal configuration (slats in, asymmetric slats or slats partially extended), a 17 unit AOA approach is recommended. A transition to ON SPEED and a flared landing will reduce the touchdown speed. The AOA indexer and aural tone indications remain unaffected. Establish and maintain On Speed angle-of-attack on the base leg or final approach, adjusting pitch attitude to maintain AOA and power to maintain desired glide slope/rate of descent. Cross-check computed airspeed and On Speed AOA to detect gross errors in AOA. When the aircraft reaches 20 to 30 feet altitude above the ground, ground effect will tend to rotate the aircraft in the nose-down direction. Maintaining pitch attitude will result in transition to a slightly slow indication at touch-down which is desired. Flying a 2 1/2° to 3° glide slope will produce an approach rate of descent of about 700 feet per minute. Sink rate at touchdown will be appreciably reduced by ground effect.

CAUTION

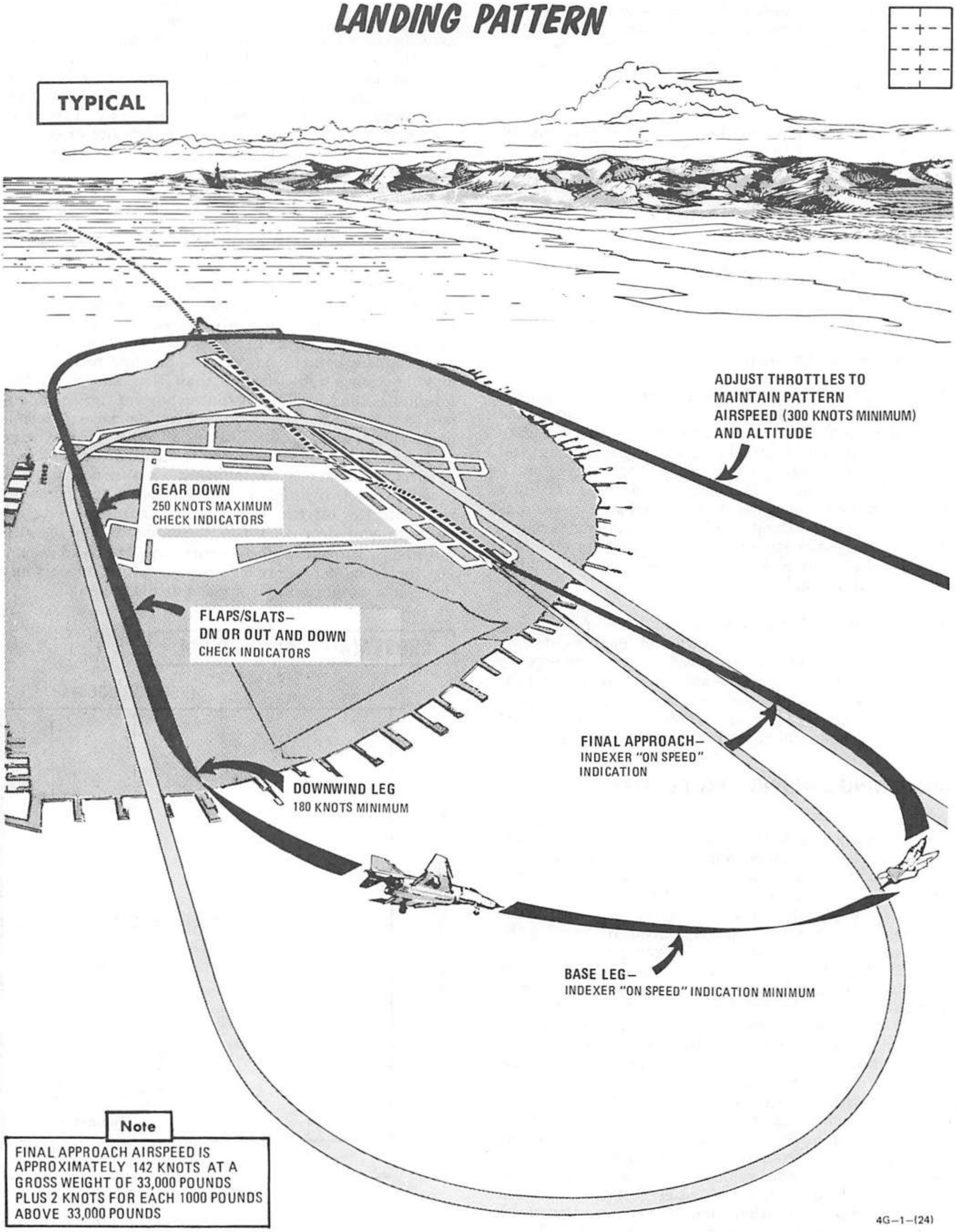
Flying a steeper than normal final approach or not maintaining pitch attitude when entering ground effect, can cause touchdown sink rates to exceed the design limit of the main landing gear struts. (Refer to section V for touchdown sink rates vs gross weight limitations.)

At touchdown, reduce power to idle and deploy drag chute. Use full aft stick to help decelerate. If nose gear shimmy is encountered, reduce aft stick pressure. Use rudder and ailerons for directional control down to 70 knots then use differential braking. Nose gear steering should not be required for directional control in light crosswind conditions. However, if rudder, aileron, and/or differential braking are not effective in maintaining directional control, use nose gear steering as required. Engage nose gear steering only with the rudder at or near neutral.

WARNING

Nose gear steering malfunctions can cause loss of directional control if engaged at high ground speeds; therefore, it should not be engaged above taxi speed unless required to maintain directional

LANDING PATTERN



Note

FINAL APPROACH AIRSPEED IS APPROXIMATELY 142 KNOTS AT A GROSS WEIGHT OF 33,000 POUNDS PLUS 2 KNOTS FOR EACH 1000 POUNDS ABOVE 33,000 POUNDS

Figure 2-6

control during crosswind landing conditions. If no response is noted or unscheduled steering responses are detected when engaging nose gear steering, disengage immediately and do not reengage.

During braking, cycling of the anti-skid system can be detected by a change in longitudinal deceleration. Cycling may not be apparent when braking at high speed immediately after landing, with drag chute failure, or with a wet or icy runway. Do not misinterpret this as anti-skid failure.

NO SLATS FLAPS LANDING

(Refer to section III).

SHORT FIELD LANDING

Short field landings require that normal final approach procedures be followed with precision and the aircraft be touched down as close to the end of the runway as safety permits. Full aft stick throughout the landing roll increases both aerodynamic drag and wheel brake effectiveness. Apply maximum braking by fully depressing the brake pedals to the pedal stops as soon as the nose gear is on the ground and nose gear steering is engaged. Nose gear steering should be used to maintain runway alignment and supplemented with differential braking only if required.

Operation on the AM-2 aluminum mat is similar to that conducted on a concrete runway of equivalent size. Arrestment should be regarded as an emergency procedure. However, since the aircraft is fully suitable for arrested landings, extremely adverse meteorological or operational conditions may warrant consideration of landing into a suitable approach-end arresting gear.

CROSSWIND LANDING (DRY RUNWAY)

Carefully 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. A 17 unit AOA approach is recommended. 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 the rudder pedals. If the crab method is employed, the aircraft heading should be aligned with the runway just prior to touchdown. After touchdown, use rudder, aileron and spoiler, and nose gear steering as required to maintain directional control. Crosswind effect on the aircraft is not severe; however, rudder, differential braking, and/or nose gear steering must be used as required to maintain alignment with the runway. Ensure directional control is established before deploying the drag chute. Use of the drag chute intensifies the weather vane effect for any given deployment condition. The weather vane effect increases as the forward velocity of the aircraft decreases, therefore, if the drag chute is to be used, it should be used at the initial portion rather than the latter portion of the landing roll. This also assures use of the drag chute in the speed region where it is most effective. If the drag chute is used and excessive weathervaning is encountered, jettison drag chute. Since the nose gear will rapidly assume a position relative to the rudder pedals, nose gear steering should be initiated with the rudder pedals at or near the neutral position. For this reason the use of nose gear steering is advocated early in the landing roll rather than at a time when large amounts of rudder are required to hold the aircraft aligned on the runway. The most important aspect of directional control under crosswind conditions is keeping the aircraft precisely aligned with the runway rather than trying to correct back to the runway centerline after it has deviated.

WET OR ICY RUNWAY LANDING

Wet or icy runway conditions pose severe problems in directional control and braking effectiveness. On wet runways, these problems are primarily the result of hydroplaning where the tire rides on a thin layer of water and produces little or no traction. Landing roll distance may be considerably longer than that shown on the Minimum Landing Roll Distance chart in the Appendix part 8 due to tire condition, runway surface material, paint, rubber deposits, etc. Braking effectiveness may vary along the runway due to most of the same reasons as well as variations in depth of standing water or ice patches. The probability of hydroplaning increases with increased water depth, increased ground speed, decreased tire pressure and decreased tire tread depth and is also affected by runway surface texture and tire tread design. Hydroplaning can occur on runways which appear only damp if severe braking is applied at high speeds.

CROSSWIND LANDING GUIDE

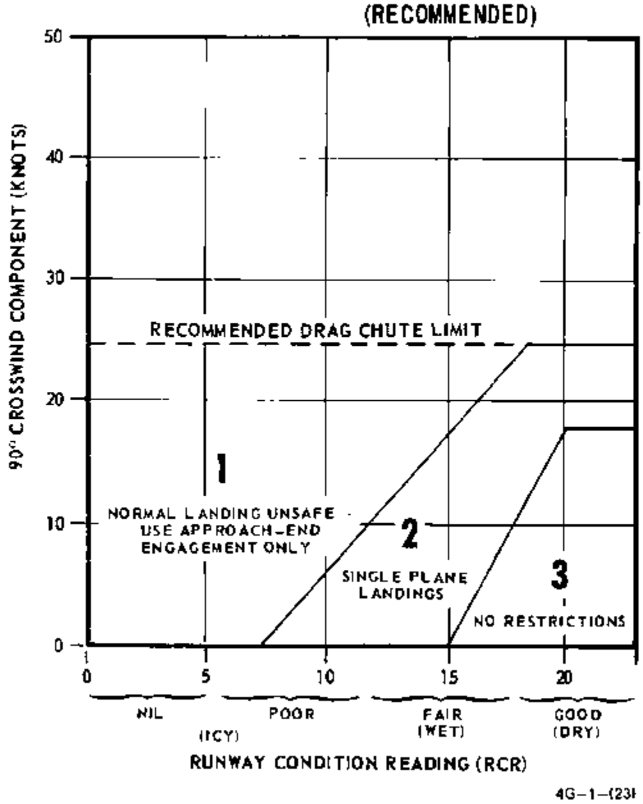


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Figure 2-7

NOTE

Hydroplaning can be expected above about 145 knots ground speed (main landing gear) based on normal tire inflation. Some hydroplaning may occur to varying degrees well below these speeds. The effects of hydroplaning can cause the anti-skid system to revert to manual braking because of system limitations as described in section I.

Hydroplaning and glare ice present essentially the same problems. Due to the reduced directional control, all landings on a wet or icy runway should be made utilizing a crosswind technique. Refer to the Crosswind Landing Guide (figure 2-7) to determine the advisability of making an approach-end engagement. The pilot should also consider the desirability of delaying the landing to permit the runway to dry or diverting to another field. Gross weight should be reduced to the minimum practicable. Plan the pattern to be well established on final with the aircraft tracking straight down the runway centerline with an ON SPEED indication. Use a wings - level crab, if required, to maintain the track. Establish the rate of descent at 800 fpm (slightly steeper than normal) and plan to touchdown on the centerline within the first 500 feet. Make a firm touchdown (500-600 fpm) while maintaining the wings-level crab. Immediately after touchdown retard the throttles to idle. 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. Maintain full forward stick to increase nosewheel traction. As wheel cornering capability overcomes aerodynamic effects the aircraft will align itself with the runway. Do not attempt to hasten this process. When the aircraft heading is aligned with the runway centerline, deploy the drag chute. Be prepared to jettison the drag chute if the weathervaning effect interferes with maintaining the track straight down the runway centerline. Nose gear steering is the primary method of directional control and should be utilized as early as possible. Nose gear steering should be engaged only with the rudder pedals at or near neutral. When directional control is firmly established, utilize maximum anti-skid braking. Brake pedals must be fully depressed to achieve maximum deceleration. At high speeds the braking potential will be very low and little deceleration will be felt. As braking potential increases with decreasing speed, the anti-skid system will increase deceleration accordingly. Unless the pilot is familiar with the variables in braking potential, the low deceleration at high speed may be mistakenly interpeted as a brake or anti-skid failure. Be prepared to make a mid-field or departure-end **arrestment or go-around if the drag chute fails or is jettisoned early, the anti-skid fails, or the landing roll is excessive for any other reasons. Lower the hook soon enough to ensure the hook is fully down prior to reaching the cable.**

CAUTION

Rubber deposits on the last 2000 feet of wet runway make directional control a difficult problem even at very low speeds. Braking should be started in sufficient time so as not to require excessive braking on the last portion of the runway.

HEAVY GROSS WEIGHT LANDING

The heavy gross weight landing pattern is the same as the basic pattern shown in figure 2-6 with the exception that it should be expanded slightly to compensate for the lower maneuvering capability of the heavy gross weight aircraft at low speeds. As in the normal pattern, an on-speed indication on the indexer will provide the optimum angle of attack and airspeed for the aircraft in the landing configuration for both level flight and maneuvering flight. Refer to Performance Data appendix for airspeed versus gross weight at approach AOA.

GO-AROUND

Any decision to go around should be made as early as possible. When the decision to go around is made, smoothly increase thrust to military (afterburner if required). Do not attempt to rotate the nose or stop rate-of-descent until adequate airspeed is built up. Continue to use the on speed indication as the optimum angle of attack until level flight is attained. As airspeed increases, establish normal takeoff attitude, retract gear when a positive rate of climb is established, retract slats and flaps at 180 knots minimum, and go around. Rudder jumps may occur during flap retraction with lateral stick input. For a closed pattern, accomplish a climbing 180° turn to roll out on downwind at 220 to 250 knots. Refer to Go-Around, figure 2-8. During go-around a rapid trim change is required to preclude high forward stick forces.

WARNING

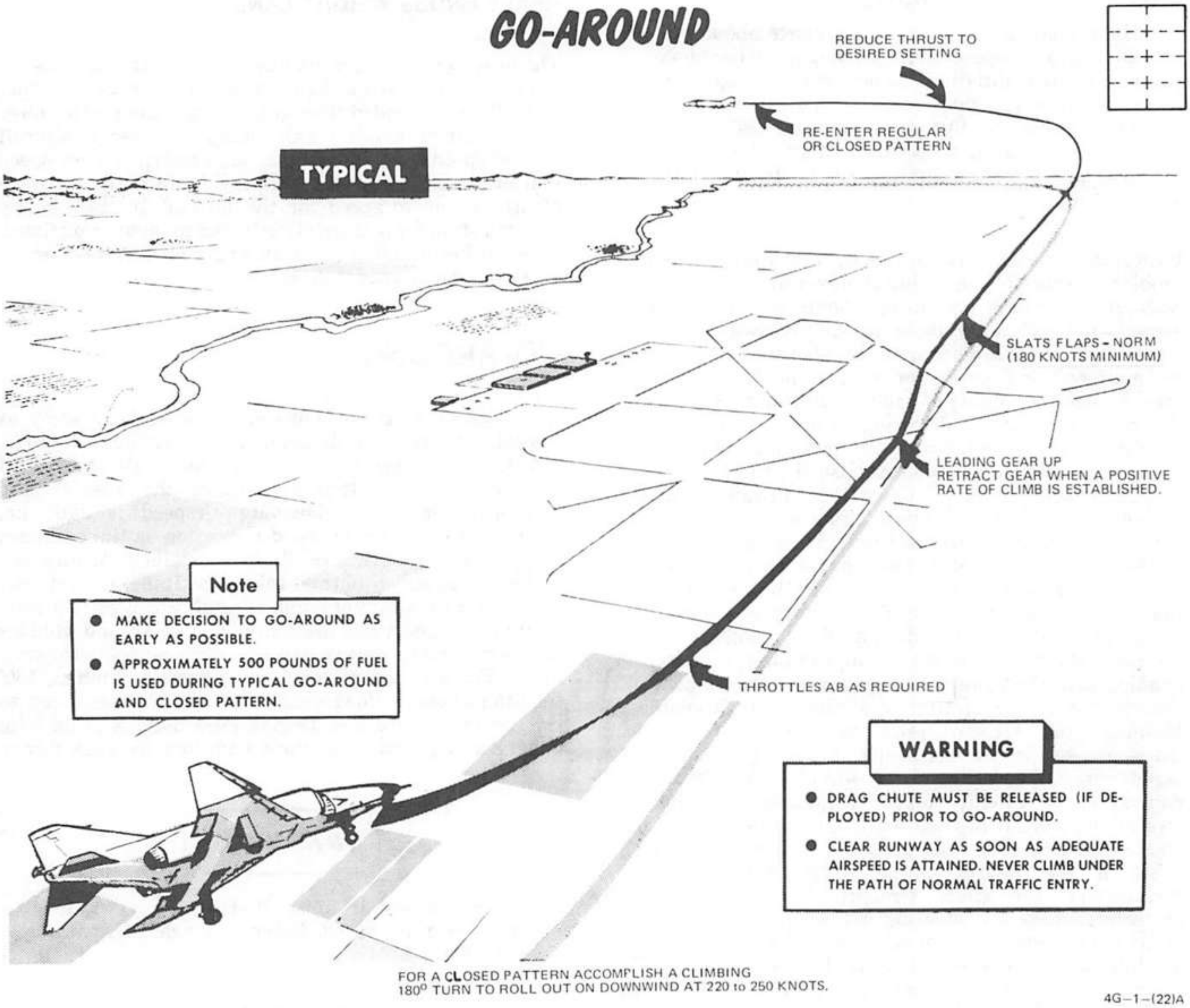
Do not exceed 18 units AOA during go-around with gear retracted. Refer to Angle of Attack, section VI.

CAUTION

- If a decision is made to go around after touchdown, do not exceed normal takeoff attitude for the aircraft can drag the stabilator and possibly leave the ground in a stalled condition.
- Because of the extremely high thrust/weight ratio and the excessive fuel consumption of afterburner use, it should be used only if required for safety of flight.

TOUCH-AND-GO

After making a normal approach and touchdown, smoothly advance throttles to full military power. Apply aft stick until the nose rotates 10° to 12° of pitch attitude maintaining this attitude until the aircraft is flying. When definitely airborne retract the gear, followed by the slats and flaps as the aircraft reaches a safe airspeed (180 knots minimum).



Note

- MAKE DECISION TO GO-AROUND AS EARLY AS POSSIBLE.
- APPROXIMATELY 500 POUNDS OF FUEL IS USED DURING TYPICAL GO-AROUND AND CLOSED PATTERN.

WARNING

- DRAG CHUTE MUST BE RELEASED (IF DEPLOYED) PRIOR TO GO-AROUND.
- CLEAR RUNWAY AS SOON AS ADEQUATE AIRSPEED IS ATTAINED. NEVER CLIMB UNDER THE PATH OF NORMAL TRAFFIC ENTRY.

Figure 2-8

AFTER LANDING

1. Anti-skid switch - OFF BELOW 30 KNOTS

NOTE

After clearing the active runway, a single engine may be shut down for taxiing. Refer to Single Engine Taxi procedures, this section.

2. (EWO) Command selector valve - CLOSED (vertical position)
3. Cockpit pressure indicator - CHECK

WARNING

- Prior to opening the canopies, check the cockpit pressure altimeter to assure that the cockpit is fully depressurized. Attempting to open a canopy while the cockpit is pressurized may cause damage or loss of the canopy. Refer to cockpit overpressurization, section III.
- Account for all loose items before opening canopy. Inadvertent seat ejection may occur if any foreign object in the cockpit becomes jammed between canopy actuator and the primary seat mounted initiator or the ejection gun firing mechanism sear. If all known loose objects cannot be accounted for, leave the canopy closed after flight until an inspection of the banana link area is made by a knowledgeable person.

WARNING

After flight, except in those instances where emergency ground egress is the primary consideration, remain completely strapped in until the canopy is fully open and will remain open.

4. (P-EWO) Lower ejection handle guard - UP
5. Landing/taxi light - AS REQUIRED
6. Slats flaps - NORM
7. Drag chute - JETTISON

CAUTION

- The drag chute should be jettisoned before taxiing downwind in winds exceeding 15 knots because of the possibility of the chute collapsing and burning upon contact on hot areas of the engine exhaust nozzles.
- If it is suspected that the brakes have been used excessively, and are in a heated condition, the airplane should not be taxied into a crowded parking area. Peak temperatures occur in the wheel brake assembly 30 minutes after maximum braking. To prevent brake fire and possible tire explosion, the specified procedures for cooling brakes should be followed.

8. Mode 4 selector - HOLD (if another flight is anticipated in code period)
9. ECM/ALE/RWR/APX - OFF
10. Radar/CW power - OFF
11. (EWO) AVTR - OFF (some aircraft)
12. Stab aug switches - OFF
13. Internal wing dump switch - NORMAL

CAUTION

The internal wing dump switch must be placed to NORMAL position prior to engine shutdown. If the switch is left in DUMP, fuel spillage will occur during refueling with battery power.

14. VOR/ILS control panel - OFF
15. Engine anti-ice switch - NORMAL
16. Radar altimeter function selector knob - OFF
17. Stabilator trim - SET 1 TO 3 UNITS NOSE DOWN
18. Reference system selector — STBY
19. Rain removal switch — OFF (before TO 1F—4—1500)
20. Pitot heat switch — OFF
21. IFF - OFF
22. Temperature control knob - FULL HOT
    Place the temperature control knob to full HOT to evaporate any water that may have collected in the air conditioning system during descent.
23. Defog-footheat control handle - DEFOG
24. (P-EWO) Tacan - OFF
25. Formation lights - OFF
26. Sight shutter - CLOSED

ENGINE SHUTDOWN

1. Wheels - CHOCKED
2. UHF radio - OFF
3. (P—EWO) Ejection seat — RAISE
   Elevate the seat to facilitate cockpit for cleaning, and to gain clearance for insertion of rocket motor safety pin. If Rigid Seat Back Pad is used with the Personnel Lowering Device (PLD), the crew member must lean forward while raising the seat. This will prevent damage to the parachute container.
4. Defog-footheat control handle - FULL AFT
5. Temperature control knob - 12 O'CLOCK POSITION
6. Air refuel switch - AS REQUIRED
   Extend air refueling receptacle if air refueling was accomplished during mission.
7. (EWO) DMAS — Store data in DTM
8. NCSC INS knob — SYS OFF (or ALIGN if required, then OFF)
9. (EWO) DTM — REMOVE
10. AVTR tape — REMOVE
11. Right throttle — OFF
    The BUS TIE OPEN light illuminates prior to the right generator out light and then goes out as the right generator out light illuminates.

CAUTION

Excessive rapid movement of the control stick with one engine operating may rupture the inoperative power control system reservoir.

12. Spoiler actuator — CHECK
    With the left engine operating and PC-2 pressure zero, slowly deflect the control stick approximately 1 inch to the right. Have ground crew or rear seat occupant verify that the spoiler does not fully deflect and that it returns to the flush position when the stick is returned to neutral. Any discrepancy should be entered in AF Form 781.
13. Left throttle — OFF

WARNING

When generator drops off the line the auxiliary air doors slam closed violently.

14. Engine master switches — OFF
15. APU reject switch — NORMAL

BEFORE LEAVING COCKPIT

1. (P-EWO) All switches and controls - OFF
2. (P-EWO) Face curtain safety pin - INSTALLED
3. (P-EWO) APR-47 scopes - COVERS ON/SECURE
4. (P-EWO) Oxygen diluter lever - 100%

WARNING

Ensure that all personal equipment leads and straps are free of cockpit controls and ejection seat handles.

SPECIAL PROCEDURES

SOLO FLIGHT INSPECTION (REAR COCKPIT)

1. Command selector valve handle - VERTICAL (closed)
2. Bulkhead mounted canopy initiator safety pin - REMOVED (all other pins installed)
   With the initiator safety pin installed, the front canopy cannot be jettisoned by means of the canopy jettison lanyard.

CAUTION

Exercise caution regarding hand movements in the vicinity of the bulkhead 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.

3. Lap belt, leg restraints, and harness assembly - SECURED
4. Communication-navigation control panel - SET
   a. COMM-AUX pushbutton - TR + G - ADF
   b. Communication channel control knob/mode selector switch - GUARD
   c. Navigation function selector knob - T/R
   d. Navigation channel control knob - AS REQUIRED
5. Emergency slats flaps handle - FORWARD
6. Function selector switch - HOT MIC
7. Amplifier selector knob - NORM
8. Oxygen supply lever - OFF
9. Emergency gear handle - IN AND SECURE
10. Emergency brake handle - IN AND SECURE
11. Radar scope retaining pins - INSTALLED
12. Radar power selector knob - OFF
13. APR-47 power — OFF
14. Circuit breakers — IN
15. Battery bypass switch - OFF
16. Electrical test receptacle plug 3P325 - ENSURE PLUG SEATED FLUSH, KNURLED LOCK RING SECURE, CAP TIGHT.
    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 plug uses a knurled (twist clockwise to lock) knurled lock ring which should not be confused with the chain equipped threaded cap.
17. Cockpit light switches - OFF
18. All loose items - SECURE
19. All other equipment - AS REQUIRED
20. Instrument ground power switch - ACTUATE (cannot be performed when battery start is made)
    Actuate the instrument ground power switch to energize the instrument 115/200 volt ac bus and the instrument 28 volt ac bus.
21. DMAS — ALIGNED
22. Canopy — CLOSED

CARTRIDGE START

This procedure is based upon external power not being available. During routine (other than scramble/exercise) cartridge starts, it is advisable to use external electrical power, if available, as this will allow use of the CNI and all engine instruments during the start. If external power is not used, normal generator switching should be used. To avoid possible irritation caused by cartridge exhast smoke/gases, it may be advisable to close canopies and select 100% oxygen during start cycle.

WARNING

Never attempt to load or unload a cartridge in either starter with the engine master switches on, ground refueling switch on, or external electrical power applied. If a malfunction in safety circuits occurs, serious injury could result.

1. Engine master switches - ON
2. Right generator switch - GEN ON
3. Ignition button - DEPRESS AND HOLD WHILE ADVANCING THROTTLE
   Depress the ignition button and simultaneously move the throttle halfway up the quadrant, and then return the throttle to IDLE. The rear crewmember will check for appropriate throttle movement during start. If throttles are not engaged, reconnect after engine start.
4. Engine start switch - R (right)
   The start switch should be returned to the center position once cartridge ignition is started. Releasing the spring-loaded switch may allow it to bounce across the neutral position and fire the left cartridge. Once cartridge ignition has been initiated, the engine will continue to accelerate until the cartridge propellant is consumed. The start may be discontinued by moving the throttle to OFF or, with the other engine master switch ON, moving the engine master switch to OFF.

WARNING

- If there is absolutely no indication of an engine rpm rise and no smoke is visible at the starter exhaust port, a misfire has occurred. It will not be possible to start the engine until the starter is reloaded. Refer to Cartridge Mode Starting Malfunctions, section III.
- If smoke is visible at the starter exhaust port but the engine does not reach idle rpm, a hangfire or hangstart has occurred, refer to Cartridge Mode Starting Malfunctions, section III.

5. Ignition button – RELEASE WHEN LIGHTOFF INDICATED
   Lightoff will be indicated by a rapid rise in exhaust gas temperature, followed by an increase in engine rpm. Engine lightoff is usually noted at approximately 13 to 16% rpm. To prevent an over temperature condition from occurring, the engines should be shutdown prior to reaching the actual EGT limit. If the engine does not continue to accelerate after lightoff, discontinue the start. In the event of a hot or false start and the throttle cannot be returned to OFF, the engine may be shut down from any throttle setting by placing its engine master switch OFF providing the other engine master switch is ON. This will close the fuel shutoff valve and deprive the engine of fuel. The engine will flameout in approximately 30 seconds from idle and approximately 2 seconds from military. After any wet or false start, allow 1 minute or longer for the combustion system to drain before restarting the engine.
6. Exhaust gas temperature indicator – 220° to 420°C (250° to 540°C, low smoke engines)
7. Idle rpm – 65 ±1%
   Ensure RH GEN OUT and BUS TIE OPEN lights go out.

CAUTION

If there is no indication of oil or hydraulic pressure within 30 seconds, shut down engine and investigate.

8. Right boost pump indicator – 30 ±5 PSI
9. Oil pressure indication – 12 PSI MIN
10. Fuel flow indicator – WITHIN LIMITS
    Fuel flow should not exceed 800 to 1400 pph at idle. For low smoke engines, fuel flow should not exceed 800 to 1500 pph at idle. Fuel consumed during starting is approximately 65 pounds per engine.
11. Hydraulic pressure indicators – WITHIN LIMITS
    With the right engine started, the PC–2 hydraulic pressure indicator should read 3000 ±250 psi and the utility hydraulic pressure indicator should read approximately 2775 ±225 psi. The check hydraulic gage indicator light remains illuminated until the left engine is started and all four hydraulic pumps are operating above 1750 psi. When the left engine is started, the utility hydraulic pressure indicator should read 3000 ±250 psi.

CAUTION

With only one engine operating, excessive rapid movement of the control stick may rupture the inoperative power control system reservoir.

12. APU light – CHECK ON
    The APU light will remain illuminated until approximately 1 minute after the left engine is started.
13. Spoiler actuator – CHECK
    With the right engine operating, slowly deflect control stick approximately 1 inch to the left. Have ground crew or rear seat occupant verify that the spoiler does not fully deflect and that it returns to the flush position when the stick is returned to neutral. Abort if the spoiler check is not good.
14. Air refueling door and exterior air refueling lights – CHECK (if required)
15. Start the left engine per steps 3 through 11 substituting LEFT in all cases.
16. Left generator switch – GEN ON
    Ensure that the LH GEN OUT light goes out. If the BUS TIE OPEN light does not go out within approximately 18 seconds, accelerate either engine to approximately 70% rpm and cycle right generator. In low ambient temperatures, the BUS TIE OPEN light may not immediately go out after the left engine is started and the left generator light goes out. This may be due to failure of the generators to synchronize quickly because of cold oil in the left generator CSD.
17. Right generator switch – CYCLE
    Cycle the right generator switch (OFF, then GEN ON), and check that the RH GEN OUT light illuminates.

WARNING

Do not cycle both generator switches at once. Any interruption in electrical power will cause the auxiliary air doors and the speed brakes (if out) to close violently, with possible injury to ground crew personnel.

18. BUS TIE OPEN light – OUT
    Ensure that the bus tie open light remains out when placing the right generator control switch to OFF, and that it flashes on momentarily when the switch is returned to the GEN ON position.
19. Interior check – COMPLETE

DMAS ALIGNMENT

Under normal operating conditions, it is not necessary to pause in STBY during initial DMAS power up. However, if the ambient temperature is below −35°C (−31°F) the INS knob should be left in STBY until the navigation computer memory warms up (two minutes for −54°C).

When DMAS is first turned on, the power on list is automatically selected, regardless of the position of the DATA knob.

NOTE

> A MALF light cannot be cleared until the power on list is completed.

Alignment begins and the IMU OUT light extinguishes approximately 40 seconds after the INS knob is moved past STBY. If the present position (UD LL) is changed any time during the alignment process, the internal alignment process is restarted.

CAUTION

> During all ground alignments, the aircraft must not be moved while the ALIGN light is on or the INS knob is in align.

If the system must be turned off, turn the INS knob to SYS OFF for 2 minutes before restarting.

The EWO must determine his alignment accuracy requirement and select a gyrocompass or rapid reaction alignment.

GYRO COMPASS ALIGNMENT

During alignment, the IMU is accurately leveled and the aircraft heading is accurately determined. If level is not accurately determined within a reasonable amount of time due to an inaccurate initial heading, wide angle heading search is automatically initiated using only IMU accelerometers. This process takes approximately 2 minutes.

1. INS knob – STBY, THEN ALIGN (ALIGN light on)
2. Power on list – PERFORM (Refer to TO 1F–4G–34–1–1)
3. NAV light – OBSERVE ON (4–7 minutes)
   If the INS knob is placed to NAV, the NAV light will remain ON indicating BATH alignment accuracy.
4. NAV light – OBSERVE FLASHING (9–14 minutes)
   If DMAS does not complete a gyrocompass alignment (flashing NAV light) within 16 minutes of accumulated ALIGN time, the MALF light will come on indicating an alignment failure (IMU F 1000). If the NAV light is not on, DMAS must be used in the TAS mode of shutdown for 2 minutes and a new alignment attempted. If the NAV light is on and mission requirements allow BATH accuracies, the MALF may be cleared by placing the INS knob to NAV and pressing the BIT button.
5. SPC – ON
6. INS knob – NAV (NAV, ALIGN, and NCSC TAS lights out)
   Do not position the INS knob to NAV until on internal power. Generator switches may be cycled with the INS knob in ALIGN.

To enhance alignment accuracy before takeoff, the INS knob should be moved from NAV to ALIGN anytime the aircraft is stationary even if it has taxied.

DMAS will change alignment axis each time a GC alignment is completed and the INS knob is turned OFF.

RAPID REACTION ALIGNMENT

If a full GC alignment has been performed prior to the last DMAS shutdown and the aircraft has not been moved since that time, a stored heading alignment will be performed. A BATH alignment is accomplished when the system has no accurate previous heading to use as a starting point.

1. INS knob – NAV (ALIGN light on)
2. Power on list – PERFORM (Refer to TO 1F–4G–34–1–1)
3. SPC – ON
4. NAV light – ON
5. ALIGN light – OFF (stored heading 4 minutes, BATH 6 minutes) Rapid reaction alignment complete.

To enhance alignment accuracy before takeoff, the INS knob should be moved from NAV to ALIGN anytime the aircraft is stationary even if it has taxied.

All data on pages 2-32A thru 2-32B deleted.

KY-28 OPERATION OR KY-58 OPERATION WITH KY-28 CONTROL PANEL

The KY−58 may be installed and used with the KY−28 control. This procedure applies for either KY−28 operation or KY−58/KY−28 combination.

1. Power knob − RLY
   The system alarm (a continuous beeping with a background noise rush) should be present on power up. Pressing and releasing the microphone switch will clear this alarm. If the alarm is not heard, turn power switch off and on again. Do not use the system if the alarm is not heard.
2. Mode switch − AS REQUIRED
   When in the cipher (C) mode, a short beep will be heard approximately 1 second after radio is keyed. Any speech prior to this beep will not be transmitted.
3. (P−EWO) All other UHF controls − AS REQUIRED

KY-58 OPERATION (AFTER TO 1F-4-1320)

1. Power switch − ON OR TD AS REQUIRED
2. Mode select knob − P, C OR CO AS REQUIRED
3. Fill select knob − AS REQUIRED
4. (P−EWO) All other UHF controls − AS REQUIRED

HAVE QUICK OPERATION

1. Function selector knob − TR + G
2. Preset/manual switch − PRESET
3. Channel selector knob − 15
4. Frequency selection knobs − SET FIRST ELEMENT OF WOD
5. Set pushbutton - PRESS
6. Repeat steps 3 thru 5 for channels 16 thru 20
7. Confirm tone when channel 20 selected and second tone when SET pressed for channel 20
8. Select channels 19 thru 15. Confirm single tone when channels 19 thru 16 selected and double tone when channel 15 selected.
9. A-3-2-T knob - T
10. Request TOD update on appropriate channel

To select AJ mode -

11. Channel/manual frequency - NET NUMBER
12. A-3-2-T knob - A

If alarm tone sounds -

13. Check WOD and/or request new TOD

HAVE QUICK II OPERATION

1. Preset/manual switch − PRESET
2. Channel selector knob − 20
3. Frequency selector knobs − 220.025 (MWOD load)
4. SET button − PRESS/RELEASE (single beep)
5. Preset/manual switch − MANUAL
6. Frequency selector knobs − ELEMENT 20 OF WOD
7. TONE button − PRESS/RELEASE (single beep)
8. Channel selector knob − 19
9. Frequency selector knobs − ELEMENT 19 OF WOD
10. TONE button − PRESS/RELEASE
11. Repeat steps 8 through 10 decreasing channel and WOD element numbers by one for each WOD element through 15
12. Channel selector knob − 14
13. Frequency selector knob − ELEMENT 14 OF WOD
14. TONE button − PRESS/RELEASE (double beep)
15. To load additional MWODs, set channel selector knob to 20 and repeat steps 6 through 14 above. Six most recently entered WODs will be stored in the radio.
16. Channel selector knob − 01
17. Set frequency selector knobs to current day−of−month
18. TONE button − PRESS/RELEASE (single beep)
19. Preset/manual switch − PRESET
20. Channel selector knob − 20
21. Frequency selector knobs − 220.000
22. SET buttons − PRESS/RELEASE (single beep)
    Radio ready to receive TOD and operate in active mode.
23. After TO 1F−4−1552, press STATUS button − VER/OP ON FREQUENCY/STATUS INDICATORS

SINGLE-ENGINE TAXI

When required the left engine may be shut down first.

1. Right generator switch - OFF
2. BUS TIE OPEN light - OUT
3. Utility hydraulic pressure indicators - WITHIN LIMITS
4. Right engine throttle - OFF (prior to entering hot pad refueling area if hot refueling)

HOT REFUELING

Before refueling -

1. Single-engine taxi procedure - COMPLETE
2. (P-EWO) Leg restraints, harness and personnel equipment leads (except oxygen and communications) - DISCONNECT IF CANOPY FULLY OPEN AND WILL REMAIN OPEN
3. Internal wing transfer switch - NORMAL
4. External transfer switch - OFF
5. Air refuel switch - EXTEND

6. Stop aircraft as directed by ground crew for tire/brake inspection and pinning of tanks and ordnance.

WARNING

- Do not turn generator switches off during this time as any interruption in electrical power will cause the auxiliary air doors to close violently with possible injury to ground crew.
- Do not enter hot pad area with hung ordnance aboard or if a known hot brake condition exists. If notified of hot brakes, taxi clear of the refueling area.

7. After entering hot pad area, establish three-way voice contact (intercom with pilot, refueling supervisor, and servicing crew member).

WARNING

Anytime three-way voice contact cannot be maintained, discontinue refueling immediately.

8. Refuel selection switch - AS DESIRED
   Fuel configuration should be determined by mission requirements/local directives.

During refueling -

1. Remain alert to all visual and voice signals from the refueling supervisor.
2. Monitor ground control frequency during refueling operation.

WARNING

- Radio transmissions are prohibited in the hot pad area except in an emergency.
- If fuel starts venting from the aircraft, place the refuel selection switch to INT ONLY and discontinue refueling immediately.
- In the event of fire or fuel leak on the aircraft or ramp area under the aircraft, shut down the left engine and evacuate aircraft.
- In the event of fire or fuel leak in the refueling hydrant control area (other than immediate vicinity of aircraft), discontinue refueling and taxi out of area if directed by ground crew.

After refueling -

1. Air refuel switch - RETRACT
2. Refuel selection switch - INT ONLY

DMAS PRE-SCRAMBLE ALIGNMENT

The following may be performed if the aircraft is to be placed on alert status and not moved following engine shutdown. DMAS stored heading alignment time is approximately 4 minutes if the following full gyrocompass alignment is accomplished.

1. NCSC mode knob - INS
2. NCSC INS knob - SYS OFF FOR 2 MINUTES
3. NCSC INS knob - STBY, THEN ALIGN
   a. Align light - ON

CAUTION

Do not move aircraft with the ALIGN light ON nor with the INS knob in ALIGN

4. DTM - INSERT
   Perform data transfer/store procedure if DTM available (Refer to TO 1F-4G-34-1-1).
5. Power on list - PERFORM
6. NAV light — OBSERVE FLASHING
7. NCSC INS knob — SYS OFF

SCRAMBLE

The following scramble procedures assume that the following actions have been completed prior to the aircraft being placed on an alert status (subject to scramble type activities):

a. Complete preflight inspection to include a power-on cockpit inspection, engine operational check, and operational check of speed brakes, flaps, flight controls and stab aug in accordance with normal BEFORE TAXIING (FRONT COCKPIT) checks.
b. DMAS pre-scramble alignment completed.
c. Aircraft is cocked for scramble per lcoal policy and instructions.

If the above actions are not completed prior to scramble, normal procedure should be used.

BEFORE TAXIING (FRONT COCKPIT)

1. Communication and navigation equipment — ON AND CHECK
   After TO 1F-4-1552 following power-up, if frequency/status indicator displays M-LOAD, FMT.CHG or ERASE do the following:

    - a. Comm channel control knob — 20
    - b. Comm frequency selector knobs — 220.000
    - c. Preset/manual switch — PRST
    - d. SET button — PRESS AND RELEASE (now in VER/OP mode)
    - e. Preset-manual switch — MNL
    - f. Comm command button — AS DESIRED
2. Emergency attitude indicator — SET
3. Altimeter and SPC — SET AND CHECK
4. Takeoff trim — CHECK
5. Slats flaps — OUT AND DOWN (groundcrew visually check)
6. Clearance to taxi from EWO.
7. Reference system selector - PRIM
8. Seat pins - CHECK REMOVED AND STOWED
9. Personal equipment - CHECK
10. Wheel chocks and ground interphone cord - REMOVED

BEFORE TAXIING (REAR COCKPIT)

1. Communication and navigation equipment — ON AND CHECK

   After TO 1F—4—1552 following power—up, if frequency/status indicator display M—LOAD, FMT.CHG or ERASE do the following:
    - a. Comm channel control knob — 20
    - b. Comm frequency selector knobs — 220.000
    - c. Preset/manual switch — PRST
    - d. SET button — PRESS AND RELEASE (now in VER/OP mode)
    - e. Preset-manual switch — MNL
    - f. Comm command button — AS DESIRED
2. APX—80 mode switch — PASSIVE/OFF
3. Pressure altimeter — SET AND CHECK
4. Radar power — STBY
5. Radar overtemp light — OFF, MONITOR
6. Stored heading/BATH alignment — COMPLETE

   A stored heading alignment is accomplished when the final value of the true heading from the previous turnon is used as the initial heading (aircraft has not been moved since system shutdown of previous flight). A BATH alignment is accomplished when the system has no accurate previous heading to use as a starting point.
    - a. NCSC mode knob — INS
    - b. NCSC INS knob — NAV, ALIGN LIGHT ON

CAUTION

Do not move the aircraft with the ALIGN light ON.

    - c. Data transfer module - INSERT

      Perform data transfer/store procedure if DTM available. Refer to TO 1F-4G-34-1-1.
    - d. Power on list - PERFORM

      (Refer to TO 1F-4G-34-1-1).
    - e. After approximately 2 minutes for stored heading or 5 minutes for BATH - ALIGN LIGHT OFF, NAV LIGHT ON.

      Aircraft may be taxied after ALIGN light OFF.
7. Seat pins — CHECK REMOVED AND STOWED
8. Personal equipment — CHECK
9. Notify pilot — CLEAR TO TAXI

BEFORE TAKEOFF

1. Flight instruments - CHECK AND SET
2. Stab aug switches - ENGAGE
3. Flight controls - UNRESTRICTED (WSO visually check control surfaces)
4. (P-EWO) Canopies - CLOSE AND CHECKED
5. (EWO) Command selector valve - AS BRIEFED
6. (P-EWO) Lower ejection handle guards - CLEAR
7. Fuel panel - SET AND CHECKED
    - a. Internal wing transfer switch - NORMAL
    - b. External transfer switch - AS REQUIRED
8. Slats flaps — CHECK OUT AND DOWN
9. Anti—skid — ON; LIGHT OFF
10. Warning lights — CHECKED
11. Anti—ice — AS REQUIRED
12. Pitot heat — ON
13. IFF — AS REQUIRED
14. (P—EWO) Circuit breakers — CHECK

OPERATIONS ON BOMB-DAMAGED RUNWAYS

TAXI

To prevent possible tire or structural damage, taxi speeds on bomb—damaged sufaces should be limited to approximately five knots. Use of braking while crossing unrepaired spalls is not recommended. Unrepaired spalls are shallow craters that are up to approximately two feet in diameter and approximately one and one—half inches deep.

TAKEOFFS

During operations on damaged runways containing unrepaired spalls, minimize the weight on the landing gear to prevent excessive loads and possible structural failure of the gear struts. A minimum run takeoff with afterburner and flaps down should be made. During the takeoff run, full aft stick must be applied prior to reaching 80 knots. As the aircraft starts to rotate, the stick should be adjusted to maintain 10 to 12° pitch attitude for aircraft fly—off.

LANDINGS

On landing, maintain maximum practical aft stick and do not retract flaps until below 30 knots. No—flap landings are not recommended.

NOTE

Because of the sharp impact loads on the landing gear, the exterior of the struts and tires should be visually inspected after each operation over damaged runways.

SECTION III
EMERGENCY PROCEDURES

TABLE OF CONTENTS

GROUND OPERATION EMERGENCIES

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INFLIGHT EMERGENCIES

LANDING EMERGENCIES

This section contains procedures to be followed to correct an emergency condition. These procedures will insure maximum safety for the crew and/or aircraft until a safe landing or other appropriate action is accomplished. The procedures are arranged in the most desirable sequence for the majority of cases; therefore, the steps should be performed in the listed sequence unless the pilot can determine a good cause for deviation. Multiple emergencies, adverse weather, and other peculiar conditions may require modification of these procedures.

The critical items **(BOLD FACE LETTERS)** contained in the various emergency procedures cover the most adverse conditions. Aircrew members will be able to accomplish bold face procedures without reference to the checklist. The nature and severity of the encountered emergency will dictate the necessity for complying with the critical items in their entirety. It is essential, therefore, that aircrews determine the correct course of action by use of common sense and sound judgement. As soon as possible, the pilot should notify the EWO, flight, or flight leader, and tower on any existing emergency and of the intended action.

The terms "Land as soon as possible" and "Land as soon as practical" are used in this section. These terms are defined as follows:

Land as soon as possible – An emergency will be declared. A landing should be accomplished at the nearest suitable airfield considering the severity of the emergency, weather conditions, field facilities, ambient lighting, aircraft gross weight, and command guidance.

Land as soon as practical – Emergency conditions are less urgent, and although the mission is to be terminated, the degree of the emergency is such that an immediate landing at the nearest adequate airfield may not be necessary.

The following basic rules apply to all aircraft emergencies and should be thoroughly understood by all aircrew:

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as practical.

NOTE

- For all landings, make a fully configured slats flaps OUT AND DOWN, gear down) on-speed approach unless otherwise directed.
- Should the bail out bottle be used as a backup oxygen supply, it may not provide adequate oxygen when used at low altitude.

WARNING

The canopies should be retained during all emergencies, except ditching, that could result in a crash or fire such as crash landings, aborted takeoffs, and arresting gear engagements. The protection the canopies afford the crew during these emergencies far outweigh the isolated risk of entrapment due to a canopy malfunction or overturn. During the aircraft abandonment phase, normal canopy opening procedures should be considered first to preclude the possibility of a static seat ejection.

GROUND OPERATION EMERGENCIES

CANOPY MALFUNCTION

In the event of unusual noise or other abnormal occurrence when the canopy is being closed or opened:

1. Notify egress personnel
2. (EWO) Command selector valve – VERTICAL
3. Do not actuate canopy lever
4. Remain strapped in until egress personnel check/safe the seat/canopy

WARNING

Do not taxi the aircraft with a known canopy malfunction with the canopy open. The canopy may separate from the aircraft causing damage to the aircraft and/or injury to the aircrew.

COCKPIT OVERPRESSURE

1. Emergency vent knob – PULL

WARNING

Do not attempt to open the canopy by the normal method if the cockpit is overpressurized since this may cause the canopy to lift and separate from the aircraft and fall on the banana links resulting in an inadvertent ejection.

If vent knob does not relieve pressure –

2. Cockpit heat and vent circuit breaker – PULL (C8, No. 3 panel)

CARTRIDGE MODE STARTING MALFUNCTIONS

Failure to start while in the cartridge mode may be caused by a malfunction in the cartridge, the starter, or the engine. Malfunctions are classified as misfires, hangfires, and hangstarts. In addition, the starter can fail catastrophically due to overpressurization. The pilot and ground crew can recognize a misfire; however, they may not be able to distinguish between a hangfire and hangstart.

MISFIRE

A misfire is defined as a failure of the cartridge ignitor squib to fire. This may be caused by a failure of the electrical ignition system, failure of the cartridge squib, or no contact between the cartridge ground clips and starter. A misfire may be detected by the absence of engine rotation and absence of smoke at starter exhaust door. When a misfire occurs, follow the Cartridge Start Malfunction procedure. After removal of the misfired cartridge, inspect cartridge ground clips to ensure they have been bent up sufficiently to make contact. Ensure that safety clip has been removed. If no obvious correctable fault can be found with misfired cartridge, another cartridge start with a new cartridge may be attempted.

HANGFIRE/HANGSTART

A hangfire/hangstart is a condition where the engine fails to accelerate in a normal manner after initiation of cartridge start. A hangfire is a cartridge malfunction where the main propellant grain does not burn or only partially ignites. In either case, the ignitor squib fires, as evidenced by a small amount of smoke at starter exhaust and engine rotation to a low rpm. If the main propellant grain partially ignites, it may smolder until enough pressure has built up in the starter breech for complete ignition to occur. The smoldering may last as long as 2 1/2 minutes. Hangfire is usually associated with extremely low cartridge soak temperature (−55°C). A hangstart is a start in cartridge mode in which engine rotation is produced but the engine does not accelerate to idle rpm.

Since the symptoms of a hangfire and a hangstart are similar and difficult to distinguish from each other, the following common procedure is established. If rpm hangs up below idle, complete the first two steps of Cartridge Start Malfunction procedure by retarding throttles to off and releasing ignition button. Be alert for possible engine rotational acceleration and re–initiate starting procedures as applicable, once sustained rotation is assured. If rotation ceases and there is no evidence of burning, complete Cartridge Start Malfunction procedure. To preclude a catastrophic failure due to a malfunctioning starter, do not attempt a second cartridge start until a successful pneumatic start has been accomplished. The malfunctioned start must be entered on Form 781 and both a successful pneumatic start and subsequent cartridge start are required to clear the 781 entry. If pneumatic start or second cartridge start is unsuccessful, the starter must be removed and inspected. The second cartridge start requirement is not cause for grounding the aircraft and may be accomplished at a later time.

CARTRIDGE START MALFUNCTION PROCEDURE

1. Throttles – OFF
2. Engine master switches – OFF
3. Wait 5 minutes

WARNING

- Do not attempt to remove a cartridge until 5 minutes after all evidence of burning has ceased.
- Do not attempt to perform any work in auxiliary air door area when utility hydraulic system is pressurized unless auxiliary air door lock is installed, since any interruption of electrical power will cause the auxiliary air doors to close forcefully and could cause injury.

ENGINE FIRE OR OVERHEAT DURING GROUND OPERATION

This procedure should be completed if a FIRE/OVERHEAT light comes on or if other indications of an engine or aft section fire exist. During start, if notified by a qualified ground crewman that a tailpipe fire exists, continue the start and carefully monitor EGT and FIRE/OVERHEAT lights. If the ground crewman does not specify a tailpipe fire, if there is any suspicion that the fire is not confined to the tailpipe, if the EGT approaches the limit, or if a FIRE/OVERHEAT light comes on, complete this procedure.

1. **THROTTLES – OFF**
2. Engine master switches – OFF

WHEEL BRAKE FAILURE

Wheel brake failure may be caused by mechanical malfunction, utility hydraulic system failure, or a malfunction of the anti–skid system. Wheel brake failure during normal anti–skid cycling is difficult to recognize and, at any time, the cause of wheel brake failure is difficult to diagnose rapidly. Therefore, the following procedure ensures that, regardless of cause, actions are taken sequentially to provide for the various contingencies.

1. Hook – DOWN
2. Brakes – RELEASE
3. Emergency quick release lever – HOLD PRESSED

4. Brakes - APPLY

   If normal braking is available without anti-skid, it is possible to lock the wheels and cause a blown tire. The brakes may be very sensitive and above normal braking speed, very light pedal pressure and small pedal deflection may lock a wheel. Runway condition and aircraft speed will dictate the amount of braking which can be applied. Plan on using all of the available runway.

If braking returns -

5. Anti-skid switch - OFF
6. Emergency quick release lever — RELEASE
7. Hook — UP (if not needed)

If still no brakes -

5. Brakes - RELEASE

NOTE

Brakes must be released to allow emergency hydraulic fluid to enter the brake system. If not fully released, a shuttle valve prevents emergency brake fluid from entering the brake system.

6. Emergency brake handle — PULL

   If the emergency brake handle in one cockpit is not effective, pull the emergency brake handle in the other cockpit.
7. Brakes - APPLY

   Pedal pressure is the same as the normal system. Without anti-skid it is possible to lock the wheels and cause a blown tire. The brakes may be very sensitive and above normal braking speed, very light pedal pressure and small pedal deflection may lock a wheel. When practical, delay braking until slowed to normal braking speed. Slowly apply the brakes to the desired amount and hold until stopped. Plan on using all of the available runway. Application and release of the brakes dumps some fluid; therefore, use steady brake pedal pressure. Do not taxi.

RUNWAY DEPARTURE

During taxi, takeoff, or landing, if departure from the load bearing surface is imminent, especially at high speed, rapid decisions must be made to minimize the risk to the crew and aircraft damage. Consideration of departure rate, angle, skid, terrain, ground condition, obstructions and ejection capability is necessary.

A go—around or continued takeoff may or may not be possible. The ability to go—around depends on surface conditions, obstructions, distance required to accelerate to flying speed, and aircraft condition. Once airborne, consideration must be given to possible engine foreign object damage and airframe damage.

If a go—around or takeoff is not attempted, consider shutting engines down to eliminate fire sources such as hot engine, pressurized hydraulics, and full power electronics. The decision to eject versus remaining with the aircraft must be tempered by the situation such as obstructions, speed, skid, crew boarding weight and landing gear integrity. In severe cases, the nose gear, or portion of it, may fail and enter the front cockpit floor resulting in possible inadvertent ejection and/or damage to the front cockpit ejection seat. A zero altitude ejection, even at high speed, may not be successful if conditions are severe. If the decision is made to eject, both crewmembers should pull their ejection handle.

EMERGENCY ENTRANCE AND EXIT

See figure 3-1.

EMERGENCY EVACUATION

WARNING

Crew members must coordinate the type escape to be used before initiating emergency evacuation or ejection.

1. **LOWER GUARD - UP**
2. **SHOULDER HARNESS - RELEASE**
3. **INSIDE HANDLE - ROTATE AFT**(completely disengage and discard)

   Survival kit release handle

   If the survival kit retaining straps fail to release or the drop line is attached to the left retaining strap, depress the quick disconnect(s) in the survival kit harness attachment fittings.
4. **OUTSIDE HANDLE - LOCK UP**

   Emergency harness release handle. Keep your feet forward and legs relaxed until outside handle is locked up to ensure proper release of leg restraint lines.
5. Canopy - OPEN
   a. Normal
   b. Manual unlock handle

      With the normal canopy select lever in CLOSED and an operational normal system, it is impossible to unlock the canopy with the manual unlock handle.
   c. Emergency canopy jettison handle

WARNING

- If there is any indication of fire inside or outside the cockpit, ensure both crewmembers are ready to egress before opening either canopy.
- To prevent injury to rear crewmember, front crewmember must jettison his canopy first.

   d. Break canopy with canopy knife

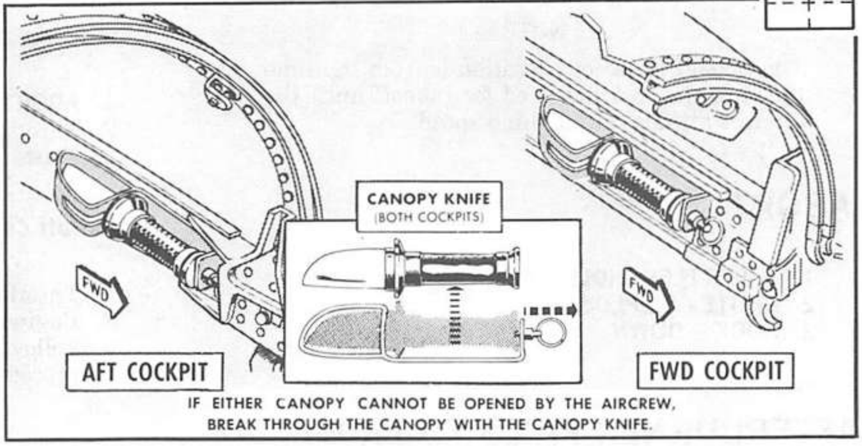
WARNING

Knife cutting edge must face crewmember to prevent possible injury.

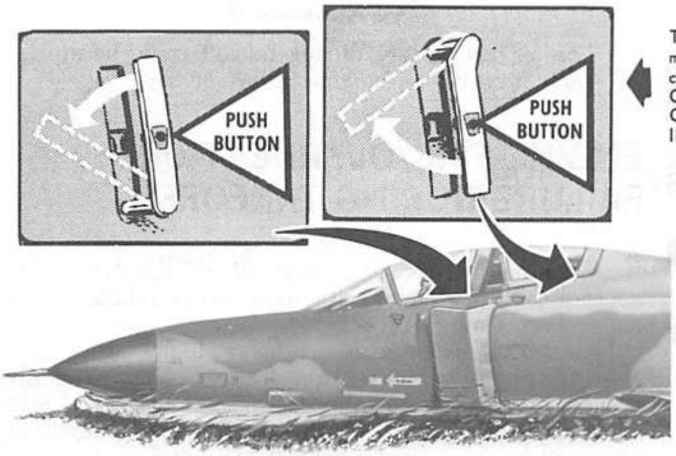
EMERGENCY ENTRANCE/EXIT

WARNING

WHEN CANOPY OR EJECTION SEAT DAMAGE IS SUSPECTED OR HAS OCCURRED DUE TO BATTLE DAMAGE, BIRD STRIKE, ETC, THE EJECTION SEAT FIRING MECHANISM AREA SHOULD BE VISUALLY INSPECTED FOR FOD PRIOR TO CANOPY OPENING. WHEN POSSIBLE, THE EJECTION SEAT SHOULD BE RENDERED SAFE PRIOR TO OPENING THE CANOPY FRAME.



IF EITHER CANOPY CANNOT BE OPENED BY THE AIRCREW, BREAK THROUGH THE CANOPY WITH THE CANOPY KNIFE.

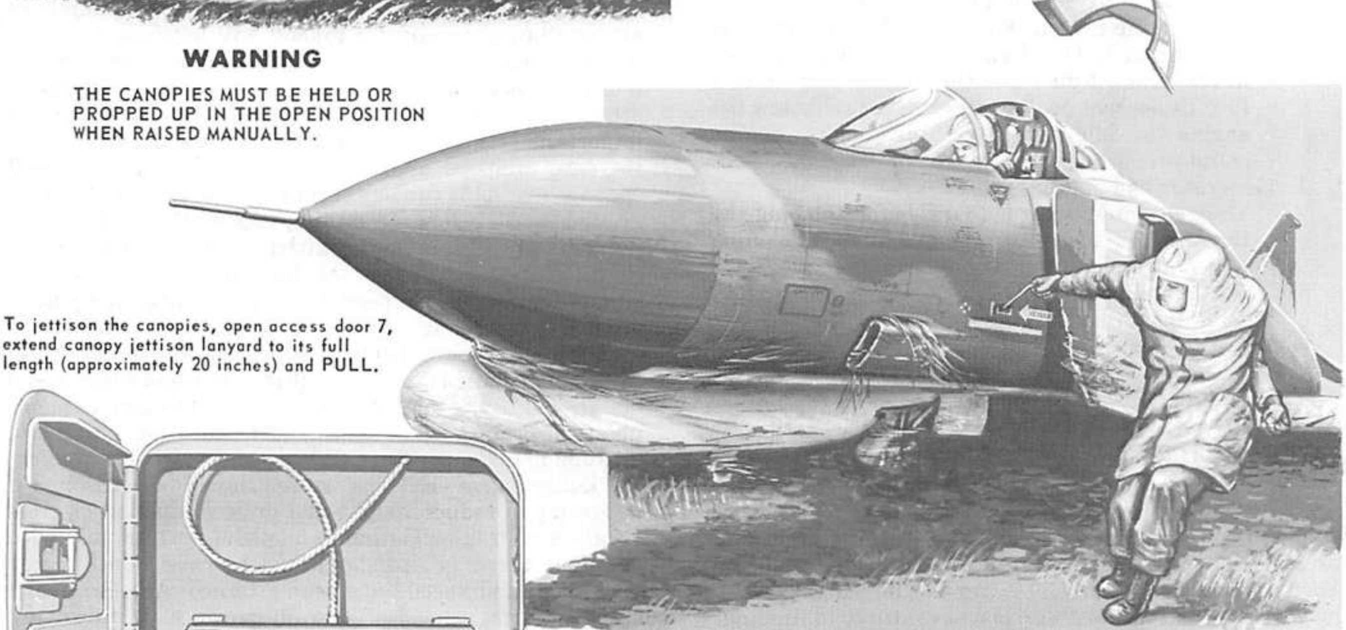


To manually open the canopies, depress the push buttons on the manual release handles. Depress the OPEN buttons on each normal canopy control. Rotate the FORWARD canopy manual release handle COUNTERCLOCKWISE. Rotate the AFT canopy manual release handle CLOCKWISE. After the canopies have been unlocked they can be lifted open manually.

Entrance to the cockpits while the engines are running is hazardous because of the possibility of being drawn into the intake duct. To reduce this hazard, it is suggested that a crash truck be driven up against the duct, thereby blocking the duct. The canopies can then be jettisoned or opened, and entry can be made from the top of the vehicle or from the wing.

WARNING

THE CANOPIES MUST BE HELD OR PROPPED UP IN THE OPEN POSITION WHEN RAISED MANUALLY.



To jettison the canopies, open access door 7, extend canopy jettison lanyard to its full length (approximately 20 inches) and PULL.

4G-1-(21)

Figure 3-1

TAKEOFF EMERGENCIES

NOTE

The takeoff phase of operation is from the time the throttles are advanced for takeoff until the aircraft attains initial climb speed.

ABORT

1. **THROTTLES - IDLE**
2. **CHUTE - DEPLOY**
3. **HOOK - DOWN**

AFTERBURNER FAILS TO LIGHT

If the afterburner fails to light, it may be cycled once during takeoff. If it still fails to light or again fails to light during the sortie, do not cycle. Afterburner failure to light may be an early indication of engine failure or fire. Report any failure to light on Form 781.

1. Throttle - CYCLE - AB–MIL–AB

If the afterburner still fails to light -

2. Discontinue takeoff
3. Throttle bad engine - IDLE FOR 1 MINUTE
   If an engine is shut down immediately after the afterburner fails to light, residual fuel may pool in the exhaust duct and then ignite and cause a fire. To prevent pooling of residual fuel, allow the engine to idle for 1 minute before engine shutdown.
4. Generator bad engine - OFF
   The generator is turned OFF before placing the throttle OFF to prevent the bus tie from opening when an underspeed occurs as rpm decreases.
5. Throttle bad engine - OFF
6. Master switch bad engine - OFF

AFTERBURNER MALFUNCTIONS AFTER LIGHT

If an afterburner fails or is shut down after light, the resulting loss of thrust is significant. Takeoff should be aborted if remaining runway is compatible. After failure, the variable area exhaust nozzle will continue to function as directed by exhaust gas temperature. In this circumstance, the nozzle moves as a function of temperature limiting only.

If decision to stop is made -

1. **ABORT**
2. Throttle bad engine - OFF
3. Master switch bad engine - OFF

If takeoff continued -

1. Throttle bad engine - MIL
2. Engine instruments - MONITOR
3. Follow Afterburner Malfunctions During Flight procedure

CAUTION

Loss of afterburner during takeoff could be an early indication of engine failure or fire.

ENGINE FIRE/OVERHEAT OR FAILURE DURING TAKEOFF

If an engine fails before aircraft lift–off, 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 is approximately 8 knots higher than two–engine takeoff speed. 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 low density ratios. Increase airspeed as much above single–engine takeoff speed as available runway permits (not to exceed 210 knots ground speed) 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. When safely airborne, retract the landing gear. 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.

If decision to stop is made –

1. **ABORT**
2. **THROTTLE BAD ENGINE – OFF**
3. Master switch bad engine – OFF

If takeoff is continued –

1. **THROTTLES – AFTERBURNER**
2. **LANDING GEAR HANDLE – UP**
3. **EXTERNAL LOAD – JETTISON** (if necessary)

WARNING

A leaking centerline fuel tank may be the cause of an engine fire/overheat. Jettison the tank as soon as possible. Delay in jettisoning a centerline tank can result is destruction of the jettisoning circuitry. With fire/overheat indications and jettison of the centerline tank not possible, the air refuel switch should be placed to EXTEND and the external transfer switch placed to OFF.

4. Throttle bad engine – AS REQUIRED
   After reaching safe ejection altitude, proceed with Engine Fire Or Overheat During Flight or Engine Failure During Flight procedures.
5. Flaps – DO NOT RETRACT BELOW 230 KNOTS
6. Air refuel switch - EXTEND (monitor fuel gage)
   Placing the air refueling switch to EXTEND depressurizes all tanks and possibly reduces the fuel source to the fire.

BLOWN TIRE DURING TAKEOFF

The decision to continue the takeoff or abort will depend on the speed at the time of the failure, stopping distance required, and arresting gear available. Generally it is better to continue the takeoff if the tire blows above 100 knots.

CAUTION

Directional control is extremely critical; therefore, immediate corrective action must be taken and all available means of maintaining directional control must be considered.

If decision to stop is made –

1. **ABORT**
2. **NOSE GEAR STEERING – ENGAGE**
   Even a momentary release of nose gear steering may result in loss of control. Full forward stick will increase nosewheel traction and improve steering capability. If required, use aerodynamic steering and braking on the good tire to maintain directional control.
3. **ANTI-SKID – OFF**
   Release brakes prior to disengaging the anti-skid to prevent blowing the good tire.
4. Use opposite braking to stop
5. Do not retract flaps.
   If flaps seals have been damaged by pieces of broken tire, retracting the flaps may increase the damage.

CAUTION

Avoid braking on the wheel with the blown tire. Heavy braking could cause a flat spot on the wheel which could prevent further rotation and make aircraft control more difficult.

If takeoff is continued –

1. Gear and flaps – DO NOT RETRACT
   Leave wing flaps extended and stay below flap-blowup speed if practical. If the wing flap seals were damaged as a result of a blown tire, retracting the flaps will increase the damage.
2. Tire – CHECK
   Check the condition of the blown tire, if possible, by verification from another aircraft/tower.
3. Refer to Landing With Blown Tire procedure, this section.

AUXILIARY AIR DOOR MALFUNCTION (GEAR UP)

If the L AUX AIR DOOR, and/or R AUX AIR DOOR indicator lights illuminate with landing gear handle UP:

1. Maintain 250 knots or less.
2. Landing gear – CYCLE

If light(s) remain on –

3. Auxiliary air door control circuit breaker(s) – PULL (A2, A3, No. 3 panel) RESET BEFORE LANDING

If light(s) still remain on –

4. Maintain no more than cruise power on the affected engine

CAUTION

Extended engine operation at high power settings will result in engine compartment and aft fuselage overheating.

NOTE

The auxiliary air doors can be closed by pulling the left and right AUX AIR DOOR circuit breakers. This will not affect normal operation of the aux air doors in flight. The circuit breakers must be reset before landing.

FUEL SIPHONING DURING TAKEOFF/CLIMB

Excessive fuel siphoning on takeoff could result in a torching effect if the afterburners are utilized. No damage will result from torching siphoned fuel; however, excessive fuel siphoning does unnecessarily deplete the fuel supply. If excessive fuel siphoning is noted:

1. External transfer switch - OFF
2. Internal wing transfer switch - STOP TRANSFER

If siphoning continues -

3. **Air refuel switch - EXTEND (monitor fuel gage)**

When siphoning ceases -

1. Air refuel switch - RETRACT
2. Internal wing transfer switch - NORMAL
3. External transfer switch - AS DESIRED

LANDING GEAR FAILS TO RETRACT

1. Climb to a safe altitude while maintaining airspeed below 250 knots.
   Do not reset the landing gear circuit breaker with the landing gear handle up.

WARNING

Airspeed is critical and should be maintained consistent with gross weight. Avoid abrupt throttle reductions.

2. Landing gear handle - DOWN
   If the landing gear is down and locked, make no further attempt to raise the landing gear.
3. Fuel quantity - MONITOR
   Failure of the gear to retract may be due to failure of a landing gear scissors switch and this failure may also prevent transfer of external and internal wing fuel.

INFLIGHT EMERGENCIES

OUT-OF-CONTROL RECOVERY

Recovery from most out—of—control conditions can be made rapidly with application of forward stick. Delay in applying forward stick can contribute to spin entry. If above 10,000 feet AGL, retard the throttles immediately to prevent engine flameout. Probability of flameout is reduced at lower altitudes. If both engines flame out, airstart at least one engine immediately to prevent loss of electrical and hydraulic power. Use the following procedure at the first indication of departure from controlled flight:

1. **STICK - FORWARD**
2. **AILERONS AND RUDDER - NEUTRAL**
3. **IF NOT RECOVERED - MAINTAIN FULL FORWARD STICK AND DEPLOY DRAG CHUTE**
   Maintain full forward stick until the aircraft unloads. If under sustained zero or negative G with the airspeed increasing above 200 knots, the aircraft is no longer out-of-control. If full forward stick is maintained after flying speed is attained, inadvertent control inputs can produce yawing and rolling which may be interpreted as still being out-of-control. When roll and yaw oscillations cease advance throttles and maintain 3 to 8 units AOA until speed is sufficient to perform a dive recovery. Refer to Flight Characteristics, Section VI.
4. Throttles — RETARD

WARNING

Abrupt application of forward stick may cause a negative angle of attack stall. When inverted, instinctive or rote application of forward stick may aggravate the stall and prevent recovery. To recover from an inverted stall, relax forward stick pressure and maintain 3 to 8 units AOA until recovered. Recognition of inverted stall during consecutive stall/post-stall gyrations may be difficult. If large yaw and roll motions are present, disregard AOA and follow Out-Of-Control Recovery procedure.

UPRIGHT SPINS

The Out-Of-Control Recovery procedure will recover the aircraft from nearly all spins regardless of CG position or external store loading. Do not apply aileron until you are certain that a spin exists. Use outside-the-cockpit visual cues, excessive yaw rate, and turn needle to verify spin and spin direction. The turn needle will always be pegged in the spin direction. AOA is not a primary indicator. Maintain full forward stick until the aircraft unloads. If under sustained zero or negative G with the airspeed increasing above 200 knots, the aircraft is no longer in a spin but may be in a rolling spiral preparatory to normal dive recovery. If full forward stick is maintained after flying speed is attained, inadvertent control inputs can produce yawing and rolling which may be interpreted as still being out-of-control. Use the following procedure only if the aircraft has not recovered using the out-of-control procedure.

WARNING

Under most conditions, about 15,000 feet is required for spin recovery. If there is insufficient altitude for recovery, eject.

1. **STICK – MAINTAIN FULL FORWARD**
2. **AILERONS – FULL WITH SPIN/TURN NEEDLE**
3. **AIRCRAFT UNLOADED – AILERONS NEUTRAL**
4. If out of control at or below 10,000 feet AGL – EJECT

INVERTED SPINS

The aircraft is highly resistant to an inverted spin. Recovery from inverted spins can be accomplished rapidly with netural flight controls. The Out–of–Control Recovery procedure will recover the aircraft from an inverted spin. However, if the pilot misidentifies inverted flight for an inverted spin and applies and holds full forward stick, a steady state inverted stall then becomes possible. A 3 to 8 units AOA recovery should be flown until sufficient speed for dive recovery is obtained.

ENGINE FAILURE/MALFUNCTION DURING FLIGHT

If a malfunction is not immediately evidenced by explosion, engine vibration, or engine seizure, press and hold the ignition button in an attempt to restart the engine before excessive rpm is lost. A normal relight and acceleration should not be expected outside the airstart envelope shown in figure 3-2. If engine failure occurs during air refueling, immediately disengage from the tanker and place the air refuel switch to RETRACT. The APU will provide back-up PC-1 hydraulic pressure for longitudinal control with the left engine inoperative.

CAUTION

To reduce the possibility of an engine seizure, do not delay an airstart attempt.

SINGLE ENGINE FAILURE

With one engine inoperative, slight to moderate rudder deflection is required to prevent yaw toward the failed engine if the recommended AOA of 17 units is not exceeded. Sideslip should be kept as small as possible. Banking 5° into the good engine reduces the rudder force required to maintain zero sideslip. No one system is entirely dependent on a specific engine, thus loss of one engine will not result in the loss of a complete system. Monitor the utility hydraulic system (especially during turns) as the handling qualities are severely degraded with its failure.

Aircraft service ceiling for single-engine operation (military thrust or afterburner) is a function of aircraft configuration and gross weight. Optimum altitude and airspeed for single-engine flight can be approximated by accelerating or decelerating to 300 knots or 0.6 Mach, whichever is less. Climb or descend at military thrust to the optimum single-engine cruise altitude. Refer to Cruise Summary, One Engine Operating, figure A4-3.

During single-engine operation, use care to avoid rapid airspeed bleed-off and/or excessive sink rates. Limited thrust available makes airspeed response to power much slower than normal two engine operation. Afterburner may be required for climbs and turns.

1. Airspeed – 300 KNOTS/0.6 MACH MINIMUM
   Below 0.6 Mach, accelerate to 0.6 Mach or 300 knots, whichever is less, using altitude and thrust (afterburner if necessary). If range is a consideration, climb at 300 knots minimum until reaching 0.6 Mach, then climb at 0.6 Mach until optimum single-engine cruise altitude. If 0.6 Mach is attained at higher altitude and cannot be maintained at military thrust in level flight, descend at 0.6 Mach until descent stops. If range is a consideration, then descend to optimum single-engine cruise altitude.
2. Land as soon as practical
   Refer to Single-Engine Landing procedure.

AIRSTART

1. Engine master switch – ON
2. Throttle – OFF
3. Ignition button – HOLD PRESSED
4. Throttle – IDLE
   If no fuel flow is observed, slowly advance throttle until fuel flow is noted.
5. If no fuel flow is observed after advancing the throttle, check the main fuel control circuit breakers (H3, J1, No. 2 panel) – RESET
6. Engine rpm, exhaust temperature, oil pressure and fuel flow – MONITOR
   An engine relight is indicated by an increase in exhaust temperature followed by an increase in engine rpm. If a relight does not occur within 30 seconds or the exhaust temperature exceeds its maximum limits; or the oil pressure does not reach its minimum limit; retard the throttle to OFF.

MECHANICAL MALFUNCTION

An engine mechanical malfunction is usually accompanied by engine vibrations, explosions, surges, or engine seizure. If one of the above symptoms occur, analyze and determine the malfunctioning engine through throttle manipulation and aircraft instruments.

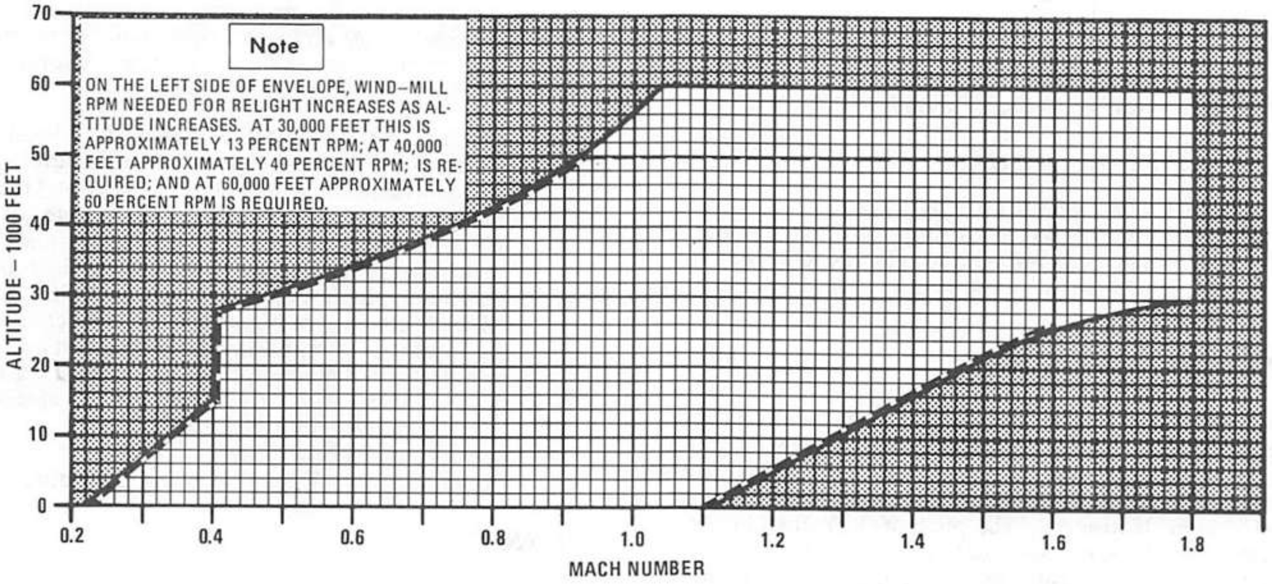
1. Throttle bad engine – IDLE
2. Fire test button – PRESS

AIRSTART ENVELOPES

ENGINE INFLIGHT STARTING LIMITS

REMARKS

J79–GE–17A/F ENGINE AND
—— JP–4 FUEL
– – ALTERNATE FUELS



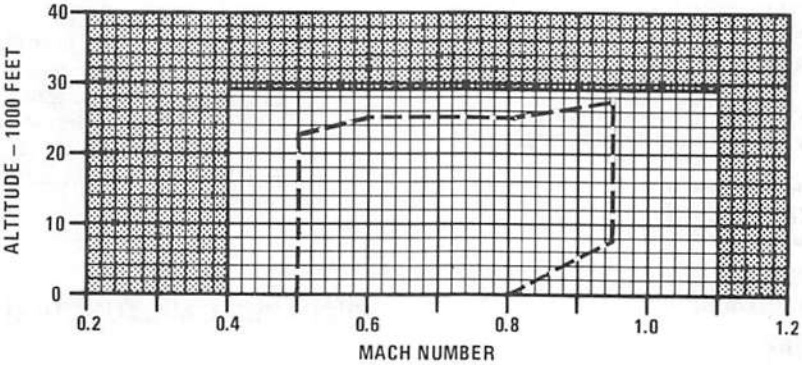
Note

ON THE LEFT SIDE OF ENVELOPE, WIND-MILL RPM NEEDED FOR RELIGHT INCREASES AS ALTITUDE INCREASES. AT 30,000 FEET THIS IS APPROXIMATELY 13 PERCENT RPM; AT 40,000 FEET APPROXIMATELY 40 PERCENT RPM; IS REQUIRED; AND AT 60,000 FEET APPROXIMATELY 60 PERCENT RPM IS REQUIRED.

LOW SMOKE ENGINES

REMARKS

J79–GE–17C/E/G ENGINES
—— JP–4, JP–8, JETA, JETA–1 FUELS
– – JP–5 FUEL



4G–1–(26)C

Figure 3–2

If any FIRE/OVERHT light does not come on –

3. Follow Engine Fire Or Overheat During Flight Procedure

If engine malfunction is still evident (vibrations, noises, surges, etc.) or if engine has failed (insufficient rpm or fuel flow for start) –

3. Generator – OFF
   The generator is turned OFF before placing the throttle OFF to prevent the bus tie from opening when an underspeed occurs as rpm decreases.
4. Throttle – OFF
5. Engine master switch – OFF
6. Airspeed – 300 KNOTS/0.6 MACH MINIMUM
   Below 0.6 Mach, accelerate to 0.6 Mach or 300 knots, whichever is less, using altitude and thrust (afterburner if necessary). If range is a consideration, climb at 300 knots minimum until reaching 0.6 Mach, then climb at 0.6 Mach until optimum single–engine cruise altitude. If 0.6 Mach is attained at higher altitude and cannot be maintained at military thrust in level flight, descend at 0.6 Mach until descent stops. If range is a consideration, then descend to optimum single–engine cruise altitude.
7. Land as soon as practical
   Refer to Single–Engine Landing procedure.

DOUBLE ENGINE FAILURE DURING FLIGHT

1. Either engine – AIRSTART
   a. **Refer to airstart procedure, this section.**

NOTE

It may take up to 30 seconds to obtain a relight and longer for thrust response. If engine rpm drops to 10–12%, approximately 40 seconds from lightoff is required to accelerate the engine to military thrust.

2. Reference system selector – STBY

If neither engine starts –

3. Fuel status – CHECK
   a. Tape or sector and fuel low level warning light – CHECK
   b. External transfer switch – OFF
   c. Internal wing transfer – NORMAL
4. Engine master switches – CHECK ON
5. Either throttle – OFF
   To provide maximum fuel flow to accomplish an airstart, retain throttle on one engine in the OFF position.
6. Other engine – AIRSTART
7. Remaining engine – AIRSTART

If neither engine can be started –

8. Eject

AFTERBURNER MALFUNCTIONS DURING FLIGHT

If the afterburner fails to light, it may be cycled one time per sortie. If it still fails to light or again fails to light later in the sortie, do not cycle. Afterburner failure to light or a malfunction after light may be an early indication of engine failure or fire. Report any failure to light or malfunction after light on Form 781.

Afterburner fails to light (first time) –

1. Throttle – CYCLE – AB–MIL–AB

Afterburner fails to light (second time) –

2. Do not cycle. Land as soon as practical

Afterburner malfunctions after light –

1. Throttle bad engine – IDLE (flight conditions permitting)
2. Land as soon as practical
3. If any FIRE/OVERHT warning light on, or if visible trailing fuel vapor or evidence of fire present, follow Engine Fire or Overheat During Flight procedure.

ENGINE FIRE OR OVERHEAT DURING FLIGHT

If any unusual indication of heat, smoke, trailing vapor, or abnormal engine operation is observed, press the FIRE TEST button.

BEFORE TO 1F–4–1503, if any FIRE or OVERHT light fails to come on, proceed as though that light is lit.

AFTER TO 1F–4–1503, if any FIRE or OVERHT light fails to come on, assume a burn–through condition in that engine. The MASTER CAUTION light and telelight panel fault light (FIRE SYS) will come on if a burn–through has occurred. After TOs 1F–4–1503 and 1F–4–1484, the voice warning FIRE–FIRE will be heard.

If no unusual indications are present but a FIRE or OVERHT light comes on –

1. Throttle bad engine – IDLE
2. If warning light goes out, fire test button – PRESS
3. If all FIRE/OVERHEAT lights come on when test button is pressed – LAND AS SOON AS PRACTICAL

After TO 1F–4–1503, if detector is severed during burn–through, the MASTER CAUTION and telelight panel fault light (FIRE SYS) will come on.

CAUTION

- Do not delay engine shutdown. Any delay may result in catastrophic damage that can lead to loss of the aircraft.
- Increasing thrust on the bad engine after the throttle has been retarded and the warning light goes out may cause fire or overheat damage and/or possible burn–through of the fire detector elements.

If warning light comes on, FIRE/OVERHT light fails test, trailing vapor is observed, or fire confirmed -

4. Maintain 300 knots minimum, anticipate utility hydraulic failure, and avoid turns into bad engine.
   Below 0.6 Mach, accelerate to 0.6 Mach or 300 knots, whichever is less, using altitude and thrust (afterburner if necessary). If range is a consideration, climb at 300 knots until reaching 0.6 Mach and then climb at 0.6 Mach until optimum single–engine cruise altitude. If 0.6 Mach is attained at a higher altitude and cannot be maintained at military thrust in level flight, descend at 0.6 Mach until descent stops. If range is a consideration, then descend to optimum single–engine cruise altitude.
5. Generator bad engine – OFF
   The generator is turned OFF before placing the throttle OFF to prevent the bus tie from opening when an underspeed occurs as rpm decreases.
6. Throttle bad engine – OFF
7. Master switch bad engine – OFF
8. **Air refuel switch - EXTEND (monitor fuel gage)**
9. If fire persists – EJECT
10. If fire ceases – LAND AS SOON AS POSSIBLE
    There is a high probability of losing utility hydraulic pressure. With one engine shut down and utility hydraulic pressure failure, flying qualities are significantly degraded and control difficulties are severe. To avoid loss of control while in the pattern prior to configuration, maintain a minimum maneuvering airspeed of 250 knots and avoid turns into the bad engine. Refer to Single–Engine Landing procedure.

CAUTION

Do not attempt to restart the bad engine. If the fire ceases, and a landing is to be accomplished, make a single–engine landing.

RAMP FAILURE

There are no provisions made for emergency operation of the variable area inlet ramps. Malfunction 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 or to continuously cycle between these positions.

RAMPS FULLY RETRACTED ABOVE 1.5 MACH

If the inlet ramps fail to extend while accelerating between 1.5 and 1.8 Mach, reduce airspeed to below 1.5 Mach and continue the mission.

CAUTION

Compressor stalls may occur at airspeeds above 1.7 Mach with the inlet ramps in the retracted position.

RAMPS FULLY EXTENDED BELOW 1.5 MACH

Extended inlet ramps may be detected by the EWO observing their position, significantly reduced fuel flow above 85% rpm, a high pitched howl above 300 knots, and significantly reduced thrust (about 35%) above 90% rpm. Below 18,000 feet MSL, jam accelerations, afterburner operation, and airstarts may be performed without overtemperature or compressor stall. Go–around performance is degraded. Power settings above 94% rpm will increase fuel flow without increasing thrust. To cruise with ramps extended, maintain the highest altitude at which the maximum range Mach for the existing gross weight and configuration can be maintained with 94% rpm. Range will be reduced at all altitudes (from 5% at 10,000 feet to 18% at 30,000 feet). Single engine range will be reduced 10% at all altitudes. It may be possible to retract a ramp which has failed in the extended position by pulling or cycling the applicable ramp control circuit breaker (G6, G7 No. 2 panel).

CAUTION

Above 18,000 feet, rapid throttle movement above 80% rpm with the inlet ramp extended may cause compressor stall and flameout.

NOTE

Above 30,000 feet, sustained power settings above 90% rpm at subsonic speed with an inlet ramp extended may cause the fire warning light to glow faintly. If this occurs, reduce altitude and power setting as necessary to extinguish the light.

RAMPS CYCLING

A cycling inlet ramp may be detected by a cycling noise or EWO observation. It may be possible to stop the ramp in the retracted position (desirable below 1.5 Mach).

1. Applicable ramp control circuit breaker – PULL (with ramp retracted) (G6, G7 No. 2 panel)

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, rocket/missile motor exhaust, misrigged or malfunctioning IGVs. In addition, the compressor may also be subject to abnormal operating conditions as a result of a malfunction of the ramp to bellmouth system. Compressor stalls may be self clearing, may cause the engine to flameout, 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 fuel flow, 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. In the event of a compressor stall, shut off and restart one engine at a time. A throttle chop to idle may clear the stall if a significant fuel flow reduction from the stall condition is achieved. If the 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.

1. Throttle - IDLE

If stall does not clear -

2. Generator - OFF
   The generator is turned OFF before placing the throttle OFF to prevent the bus tie from opening when an underspeed occurs as rpm decreases. Turn the generator switch ON after the engine is restarted.
3. Throttle - OFF
4. Inlet ramps - CHECK FULLY RETRACTED
5. Ignition button - HOLD PRESSED
6. Throttle - IDLE
   If throttle position beyond normal cruise setting is used, engine hang-up may occur due to back pressure caused by reduced nozzle area.
7. Engine rpm, exhaust temperature, and fuel flow - MONITOR
8. Generator - ON

BLEED AIR DUCT FAILURE/FUSELAGE FIRE

Severe damage to the aircraft may result from a bleed air duct failure due to the high temperature produced by the bleed air system. This air, leaking from a failed duct, may ignite flammable material in the vicinity of the leak and may cause failure of unrelated aircraft systems which have components in the vicinity of the leak. The following symptoms may be indicative of a bleed air system failure: a mild audible thump or bang on the airframe; complete or partial loss of cockpit pressurization; loss of pylons, missiles or other external stores; generator failure, popping of circuit breakers and illumination of several warning/indicator lights; erratic fuel quantity indications; mild stick transients; stiffness of throttles; hydraulic/pneumatic failure; nozzles open; 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). Make an arrested landing if possible, but do not delay landing waiting for arresting gear.

Complete loss of oxygen and heavy smoke in the cockpit may be due to a bleed air failure/fire in the door 16 or 22 area. Early ejection is recommended if a fire in the door 16/22 area is indicated. The EWO may have to use the Canopy Fails To Separate procedure during the ejection sequence due to fire damage to the rear canopy jettison air bottle.

CAUTION

Early analysis of a bleed air duct failure is required to prevent serious damage or loss of the aircraft and/or to prepare for ejection if the situation rapidly deteriorates.

If several symptoms occur -

1. Attain and maintain safe ejection altitude
2. Reduce power to minimum practical
3. Oxygen regulator - 100% AND EMERGENCY
   Placing the diluter lever to 100% and the emergency lever to EMERGENCY will provide pure oxygen under positive pressure. This will prevent smoke and fumes from entering the mask even if the mask leaks.

WARNING

The emergency oxygen supply (bailout bottle) does not supply sufficient flow for normal breathing unless the supply hose is disconnected from the CRU-60/P. This action will permit smoke and fumes to enter the mask.

4. Check for indications of fire

If fire confirmed -

5. Eject

If fire not confirmed –

5. Maintain minimum practical power
6. Landing gear – DOWN AS SOON AS PRACTICAL
7. Maintain safe ejection altitude as long as practical
8. Land as soon as possible.
9. **Make an arrested landing (if possible)**

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 a minor compressor stall and flame-out will occur at approximately 85% rpm. If a flame-out occurs, a restart can be made, but rpm will probably not go above 65%, EGT will rise to approximately 625°, and the nozzle will go full open. In either case normal engine performance can be regained as follows:

1. Throttle good engine – IDLE
   Idling the good engine will equalize the pressure in the air line.
2. Throttle bad engine – ADVANCE
3. Throttle good engine – ADVANCE
   The good engine should not be accelerated to, or operated at, a rpm greater than that of the affected engine for the remainder of the flight.
4. Land as soon as practical

DOUBLE EXHAUST NOZZLE FAILURE

In the event both exhaust nozzles fail to the open position, the total thrust available in MIL range will be approximately equal to the thrust available during single-engine operation in MIL range. Afterburner light-off above 15,000 feet is marginal: however, afterburner light-off probability increases with a decrease in altitude and normal afterburner thrust is available.

GLIDE DISTANCE

With both engines failed, the aircraft will glide approximately 6 nautical miles for each 5000 feet AGL. The recommended glide airspeed for maximum range with both engines out is 215 knots. This speed with allow the windmilling engines to maintain power control hydraulic pressures within safe limits but may not be optimum for airstart. Refer to Airstart Envelope, this section.

EJECTION

At ground level with wings level, canopy closed, and no sink rate, ejection may be initiated between 0 and 550 knots if neither crewmember's boarding weight is over 247 pounds. Boarding weight includes the crewmember and all personal equipment with which he boards the aircraft. If either crewmember's boarding weight is over 247 pounds, the minimum ejection airspeed is 50 knots. Initiate ejection below 450 knots if possible. Although the seat is qualified to 600 knots, ejection above 450 knots exposes the crewmember to forces which can cause serious injury. If airspeed is over 550 knots, minimum ejection altitude is 50 feet. In controlled level flight, eject above 2000 feet AGL if possible. If out-of-control at or below 10,000 feet AGL, eject. Refer to figures 3-4 and 3-5 for other factors affecting minimum ejection altitude.

WARNING

- Do not delay ejection below 2000 feet AGL for any reason.
- Do not pull the emergency harness release handle in flight.

If the harness release handle is pulled in flight and escape from the aircraft is necessary, perform a Manual Bailout as described in figure 3-3.

SEAT EJECTION PROCEDURES

Ejection procedures and separation sequences are shown in figure 3-3.

a. Time and circumstances permitting, the pilot will make the decision to eject.

b. Time and circumstances permitting, the pilot will alert the EWO to prepare for ejection and then direct individual ejections or initiate ejection for both crewmembers, as briefed. The following sequence will be used to alert the EWO for ejection:

Primary – Intercom
First Alternate – Eject light
Second Alternate – Rapid movement of stick from side to side to gain crewmembers attention.

c. EWO initiated ejection of the pilot shall be limited to emergency/combat situations when so directed by the pilot or when the pilot is incapacitated. The pilot shall consider the experience level of the EWO, the degree of training/proficiency, and meticulously brief on ejection signals (ICS and visual) and the exact circumstances under which the EWO will eject the crew.

d. The above procedures in no way precludes either occupant from initiating ejection at any time he determines that circumstances warrant such action.

WARNING

- If dual ejection is initiated without alerting the other crewmember, incapacitation on ejection may occur due to improper body position.
- If fire/smoke is the cause for ejection, a dual ejection should be made. Individual ejection by the EWO could incapacitate the pilot from intense heat and fire caused by windblast and draft effects of a jettisoned canopy.

EJECTION PROCEDURES

BEFORE EJECTION

A. IF TIME AND CONDITIONS PERMIT
- ALERT OTHER CREWMEMBER
- TIGHTEN LAP BELT
- TIGHTEN SEAT KIT STRAPS
- FULLY INSERT OXYGEN MASK BAYONETS
- LOWER HELMET VISORS
- TIGHTEN CHIN STRAP
- ADJUST SITTING HEIGHT IF NECESSARY
- STOW LOOSE EQUIPMENT
- LOCK SHOULDER HARNESS
- NOTIFY CONTROLLING AGENCY

B. SIT ERECT, BUTTOCKS BACK, SHOULDERS AGAINST PARACHUTE PACK, HEAD ERECT, SPINE STRAIGHT, LEGS EXTENDED AND THIGHS ON SEAT CUSHION.

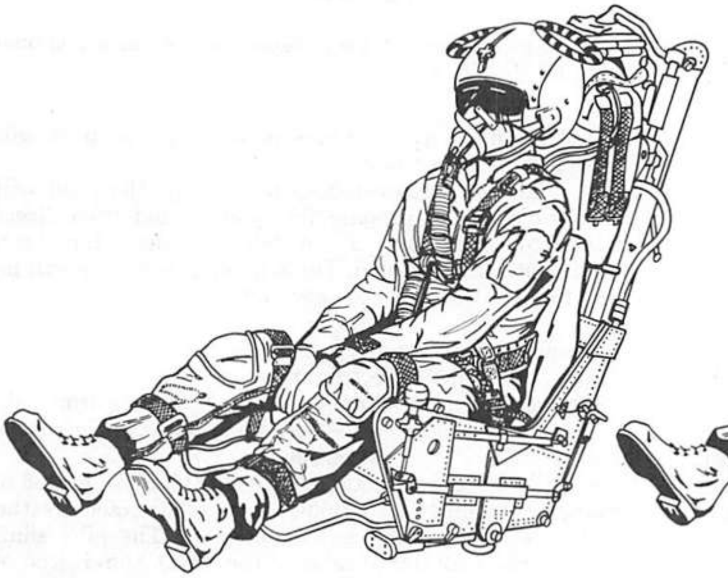
C. THE FORWARD CREWMEMBER WILL NORMALLY INITIATE EJECTION SEQUENCING, HOWEVER, THE AFT CREWMEMBER MAY INITIATE SINGLE OR DUAL SEQUENCING WHEN REQUIRED. THE CREWMEMBER NOT INITIATING THE EJECTION SHOULD BE ALERTED AND ASSUME THE PROPER BODY POSITION WITH HANDS ON THE HANDLE TO AVOID POSSIBLE INJURY.

1. Ejection Handle - PULL ....

Note

- IF THE CONTROL STICK IN THE REAR COCKPIT IS IN THE FULL AFT POSITION FOR ANY REASON, USE OF THE LOWER EJECTION HANDLE MAY BE RESTRICTED DUE TO INTERFERENCE FROM THE CONTROL STICK. FULL OR NEAR FULL UP SEAT HEIGHT ADJUSTMENT MAY IMPEDE USE OF THE FACE CURTAIN. A COMBINATION OF BOTH THESE CONDITIONS MAY CAUSE DIFFICULTY IN INITIATION OF EJECTION FROM THE REAR COCKPIT.
- ADJUST SEAT SO THAT HELMET IS BELOW THE FACE CURTAIN HANDLES TO ALLOW OPTIMUM BODY POSITION THEREBY MINIMIZING THE POTENTIAL FOR SPINAL INJURY DURING EJECTION.

LOWER HANDLE METHOD

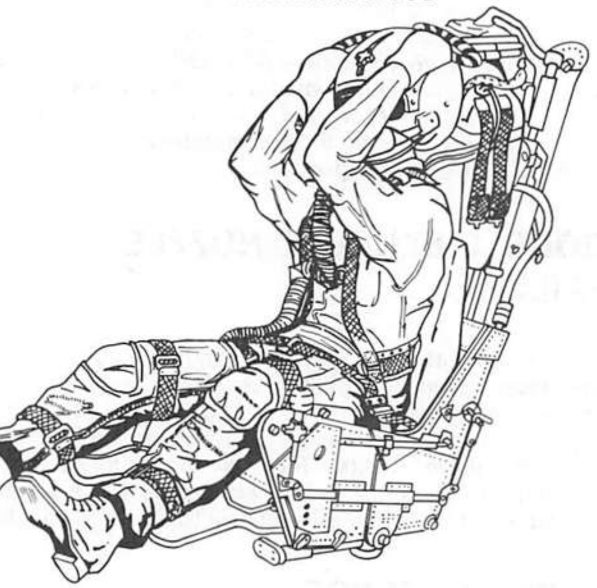


GRASP THE LOWER EJECTION HANDLE USING A TWO HANDED GRIP WITH THE THUMB AND AT LEAST TWO FINGERS OF EACH HAND. PULL STRAIGHT UP ON LOWER HANDLE AND MAINTAIN A CONTINUED PULL. WHEN CANOPY JETTISONS, CONTINUE PULLING UP ON LOWER EJECTION HANDLE UNTIL FULL TRAVEL IS REACHED.

WARNING

FAILING TO PULL THE LOWER EJECTION HANDLE STRAIGHT UP CAUSES BINDING WHICH CAN PREVENT THE LOWER EJECTION HANDLE FROM WITHDRAWING FROM ITS LOCKING DETENT.

FACE CURTAIN METHOD



REACH OVERHEAD WITH PALMS AFT KEEPING ELBOWS SHOULDER WIDTH APART. GRASP FACE CURTAIN HANDLE. PULL FORWARD AND DOWN AND MAINTAIN A CONTINUED PULL. WHEN CANOPY JETTISONS, CONTINUE PULLING FACE CURTAIN UNTIL FULL TRAVEL IS REACHED.

WARNING

ONCE FACE CURTAIN HAS BEEN UTILIZED, DO NOT RELEASE HANDLE. IF THE HANDLE IS RELEASED IT MAY BECOME ENTANGLED IN THE SEAT DROGUE CHUTE DURING THE EJECTION SEQUENCE.

WARNING

IF OUT–OF–CONTROL AT OR BELOW 10,000 FEET AGL, EJECT.
IN CONTROLLED FLIGHT MINIMUM EJECTION ALTITUDE IS DEPENDENT ON DIVE ANGLE, AIRSPEED AND BANK ANGLE. RECOMMENDED MINIMUM IN CONTROLLED FLIGHT IS 2000 FEET AGL.

4G-1-(28-1)44

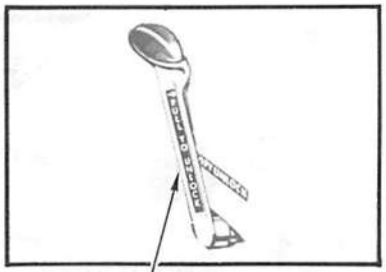
Figure 3-3 (Sheet 1 of 4)

CANOPY AND EJECTION SEAT FAILURES

CANOPY FAILS TO SEPARATE

1. Continue holding ejection handle without applying tension and keep elbows in toward aircraft centerline.
2. Normal canopy control handle – OPEN

3. Manual canopy unlock handle – PULL



WARNING

With the normal canopy control handle in CLOSED and an operational normal system, it is impossible to unlock the canopy with the manual unlock handle.

If canopy still fails to separate–

4. Canopy emergency jettison handle – PULL

If canopy still fails to separate–

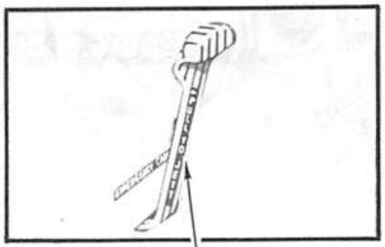
5. Put negative G's on aircraft and firmly bump forward edge of canopy with heel of hand.

Note

As last resort use canopy breaker knife and follow procedures for ejection seat failure

When canopy separates –

6. Pull ejection seat handle



EJECTION SEAT FAILURE

After canopy separation, if seat fails to fire –

1. Ejection handles – PULL

If seat still fails to fire –

2. Perform manual bailout

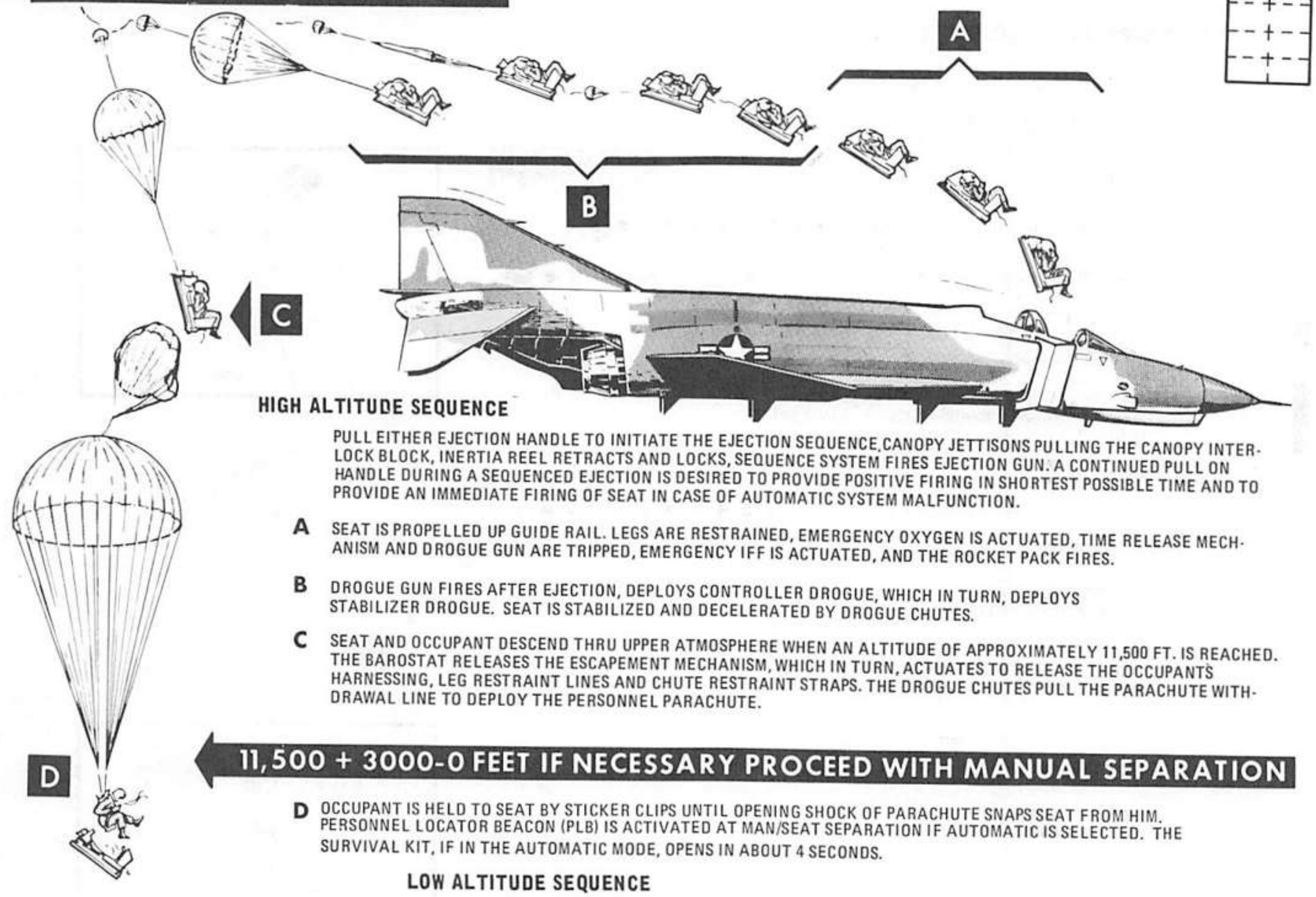
MANUAL BAILOUT

1. Canopy – JETTISON
2. Maintain 200–250 knots (if possible)
3. Outside handle (emergency harness release) – LOCK UP
4. Full nose down trim, full rudder trim and opposite aileron trim as required to hold wings level
5. Stick – RELEASE
6. Parachute – DEPLOY (below 10,000 feet)
7. Inside handle (survival kit) – PULL (as applicable)

4G-1-(28-2)F

Figure 3-3 (Sheet 2 of 4)

AFTER EJECTION SEQUENCE



HIGH ALTITUDE SEQUENCE

PULL EITHER EJECTION HANDLE TO INITIATE THE EJECTION SEQUENCE, CANOPY JETTISONS PULLING THE CANOPY INTERLOCK BLOCK, INERTIA REEL RETRACTS AND LOCKS, SEQUENCE SYSTEM FIRES EJECTION GUN. A CONTINUED PULL ON HANDLE DURING A SEQUENCED EJECTION IS DESIRED TO PROVIDE POSITIVE FIRING IN SHORTEST POSSIBLE TIME AND TO PROVIDE AN IMMEDIATE FIRING OF SEAT IN CASE OF AUTOMATIC SYSTEM MALFUNCTION.

A SEAT IS PROPELLED UP GUIDE RAIL. LEGS ARE RESTRAINED, EMERGENCY OXYGEN IS ACTUATED, TIME RELEASE MECHANISM AND DROGUE GUN ARE TRIPPED, EMERGENCY IFF IS ACTUATED, AND THE ROCKET PACK FIRES.

B DROGUE GUN FIRES AFTER EJECTION, DEPLOYS CONTROLLER DROGUE, WHICH IN TURN, DEPLOYS STABILIZER DROGUE. SEAT IS STABILIZED AND DECELERATED BY DROGUE CHUTES.

C SEAT AND OCCUPANT DESCEND THRU UPPER ATMOSPHERE WHEN AN ALTITUDE OF APPROXIMATELY 11,500 FT. IS REACHED. THE BAROSTAT RELEASES THE ESCAPEMENT MECHANISM, WHICH IN TURN, ACTUATES TO RELEASE THE OCCUPANTS HARNESSING, LEG RESTRAINT LINES AND CHUTE RESTRAINT STRAPS. THE DROGUE CHUTES PULL THE PARACHUTE WITHDRAWAL LINE TO DEPLOY THE PERSONNEL PARACHUTE.

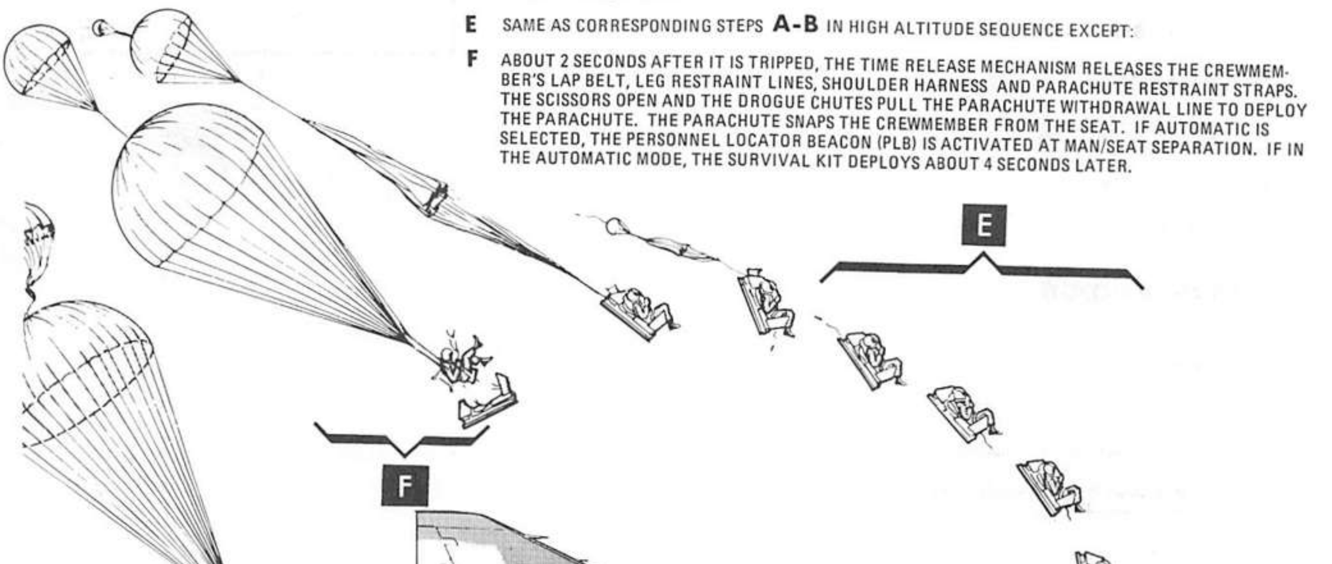
11,500 + 3000-0 FEET IF NECESSARY PROCEED WITH MANUAL SEPARATION

D OCCUPANT IS HELD TO SEAT BY STICKER CLIPS UNTIL OPENING SHOCK OF PARACHUTE SNAPS SEAT FROM HIM. PERSONNEL LOCATOR BEACON (PLB) IS ACTIVATED AT MAN/SEAT SEPARATION IF AUTOMATIC IS SELECTED. THE SURVIVAL KIT, IF IN THE AUTOMATIC MODE, OPENS IN ABOUT 4 SECONDS.

LOW ALTITUDE SEQUENCE

E SAME AS CORRESPONDING STEPS **A-B** IN HIGH ALTITUDE SEQUENCE EXCEPT:

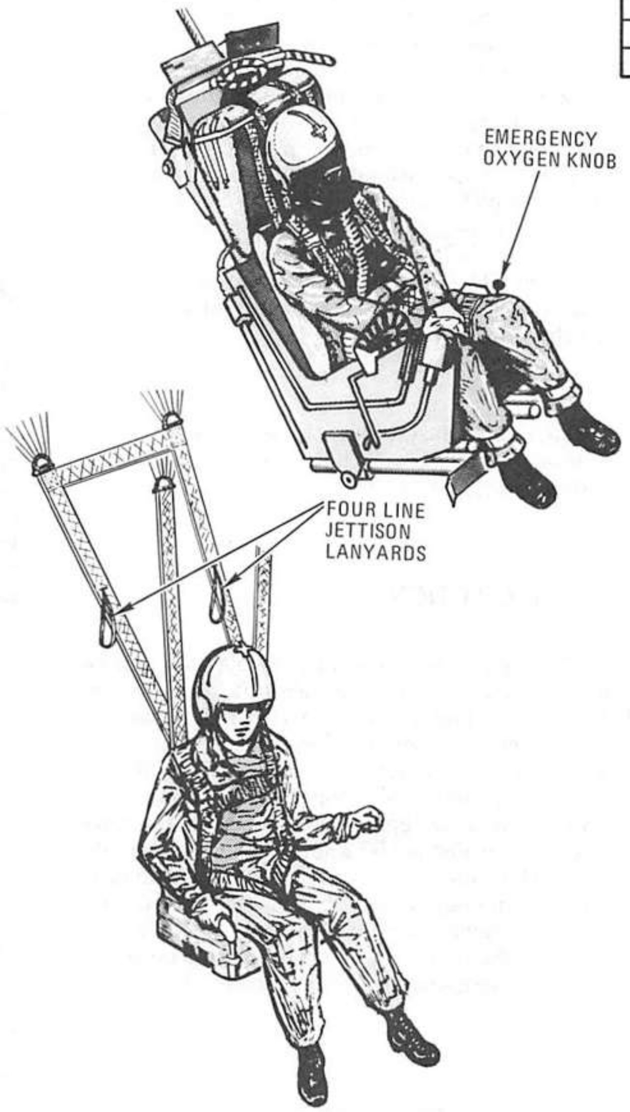
F ABOUT 2 SECONDS AFTER IT IS TRIPPED, THE TIME RELEASE MECHANISM RELEASES THE CREWMEMBER'S LAP BELT, LEG RESTRAINT LINES, SHOULDER HARNESS AND PARACHUTE RESTRAINT STRAPS. THE SCISSORS OPEN AND THE DROGUE CHUTES PULL THE PARACHUTE WITHDRAWAL LINE TO DEPLOY THE PARACHUTE. THE PARACHUTE SNAPS THE CREWMEMBER FROM THE SEAT. IF AUTOMATIC IS SELECTED, THE PERSONNEL LOCATOR BEACON (PLB) IS ACTIVATED AT MAN/SEAT SEPARATION. IF IN THE AUTOMATIC MODE, THE SURVIVAL KIT DEPLOYS ABOUT 4 SECONDS LATER.



4G-1-(28-3) B

Figure 3-3 (Sheet 3 of 4)

PARACHUTE DESCENT AND SURVIVAL EQUIPMENT DEPLOYMENT



PRIOR TO MAN/SEAT SEPARATION

1. Emergency oxygen knob (green apple) – PULL (if necessary)

   If for some reason the oxygen fails to trip automatically, pull the emergency oxygen knob on left side of seat.

WARNING

Do not pull inside handle before man/seat separation since this causes the kit to be lost.

AUTOMATIC MAN/SEAT SEPARATION FAILURE

If time release mechanism fails to operate automatically, manually separate from the seat as follows –

1. Grasp ripcord handle housing with left hand.
   Firmly grasp left parachute riser with left hand around the ripcord handle housing before actuating the emergency harness release handle.

2. Outside handle (emergency harness release handle) – LOCK UP
   Actuate outside handle on right side of seat to full aft position. This will release the lap belt, shoulder harness restraints, leg restraints and parachute restraint straps and fire the guillotine to cut the parachute withdrawal line. The occupant is now held in seat only by sticker clips.

CAUTION

Activation of outside handle results in loss of both parachute and survival kit automatic features. PLB activation is not affected.

3. Push free of sticker clips and clear seat.

Note

If all other means of separation are exhausted and crewman is still unable to push free from sticker clips due to injury, etc, lean forward with upper torso nearly resting on top both knees, and pull ripcord assembly.

4. Ripcord handle – PULL
   Having located the parachute ripcord assembly with left hand (located on left shoulder), pull ripcord handle sharply with the right hand. When possible, re–stow ripcord handle.

AFTER MAN/SEAT SEPARATION DURING PARACHUTE DESCENT

1. Check parachute canopy and suspension lines.

Note

The four line jettison system will not be used if any parachute suspension line is cut. The pulldown vent lines (PDVL) should not be confused with cut suspension lines.

2. Raise helmet visor and unmask.
   After parachute opens (about 11,500 ft) remove mask and discard.

3. Personnel locator beacon (PLB) – ACTIVATE (if required)
   PLB must be activated before survival kit is opened.
4. Inside handle (survival kit release handle) – ACTUATE (if required)
   If survival kit has not automatically deployed, actuate inside handle, if required. Continue pull on handle until it completely releases from the kit. Pulling the kit handle opens the survival kit. Life raft inflation is initiated by gravity when the drop line is fully extended after kit opening. If landing terrain so dictates, do not deploy the survival kit.

5. Actuate underarm life preserver, if applicable.

6. Four line jettison system – DEPLOY (if permissable)
   If canopy is visible, accomplish fourline jettison by pulling on both fourline jettison lanyards, after assuring canopy and suspension lines are intact. To steer parachute, pull down on the right fourline jettison lanyard for a right turn and pull the left fourline jettison lanyard for a left turn. Refer to personnel parachute under ejection seat, Section I.
7. Turn into wind and assume appropriate parachute landing fall (PLF) position.
   If fourline jettison system cannot be used, steer with the parachute risers, pulling down on the right rear riser for a right turn and pulling down on the left rear riser for a left turn.

WARNING

- Do not attempt parachute corrections below 200 feet.
- After landing, to insure the collapsing of the parachute canopy, it is necessary to release both parachute riser-shoulder harness release fittings.

4G–1–(28–4)C

Figure 3–4 (Sheet 4 of 4)

- If ejection is required after the front canopy or both canopies are lost or the front cockpit interlock cable and interdictor link safety pin assembly is jarred loose from the seat assembly, the EWO should rotate the command selector valve to the horizontal position and initiate dual ejection of both crewmembers. If the front canopy is lost and then the pilot initiates the ejection, the front seat will eject without the normal delay, exposing the EWO to the front seat rocket blast and a collision between seats could occur. If only the rear canopy is lost, normal ejection can be initiated from either cockpit. If the rear ejection system fails, the front seat ejection sequence will occur in the normal time.

- A bird strike may cause loss of the intercom and illumination of the EJECT light as a result of impact damage.

LOW ALTITUDE EJECTION

The chances for a successful low altitude ejection can be greatly improved by zooming the aircraft to exchange airspeed for altitude and to gain an upward vector for ejection. Do not exceed 20° nose up. Eject while the aircraft is still climbing. This will result in a more vertical seat trajectory providing more altitude and time for seat separation and parachute deployment. Fastest parachute deployment occurs at about 250 knots. After ejection, do not try to beat the automatic system as automatic seat separation/parachute deployment may be lost. If manual separation is made, deployment will be slow due to lack of drogue chutes. Manual seat separation should be made only if automatic separation fails (about 2 seconds required).

WARNING

The minimum ejection altitudes shown in figures 3–4 and 3–5 shall not be used as a reason for delaying ejection below 2000 feet AGL. These charts do not provide any safety factor for equipment malfunction, delay in separating from the seat, etc.

HIGH ALTITUDE EJECTION

Refer to figure 3–3 for ejection procedures. A zoom is useful to slow to a safer ejection speed and to provide more time or glide distance when immediate ejection is not necessary. Considerable time will elapse during drogue chute descent and before seat separation and parachute deployment. Do not manually separate from the seat unless the terrain is higher than the barostat altitude setting or there is a definite automatic sequence failure. Manual separation requires considerably more altitude.

EJECTION SEAT FAILURE

Refer to figure 3–3 for ejection seat failure procedures. If the canopy jettisons but the seat does not fire, pull the same ejection handle again. If the seat still does not fire, pull the other ejection handle. Do not release the face curtain once it is pulled. If the ejection seat still does not fire, perform Manual Bailout.

TIME RELEASE MECHANISM FAILURE (ACTIVATION) INFLIGHT

If the time release mechanism actuates inflight, the crewmember is not restrained in the seat as the lap belt, leg restraints and parachute restraints are released and cannot be reset. If ejection is initiated, the parachute will deploy immediately. If escape from the aircraft is necessary, pull the emergency harness release handle to cut the parachute withdrawal line and free the parachute from the seat, open the canopy using either normal or emergency jettison procedure and then use the Manual Bailout procedure shown in figure 3–3:

WARNING

Escape from the aircraft is impossible until the emergency harness handle is pulled because the parachute is still linked to the seat by the parachute withdrawal line.

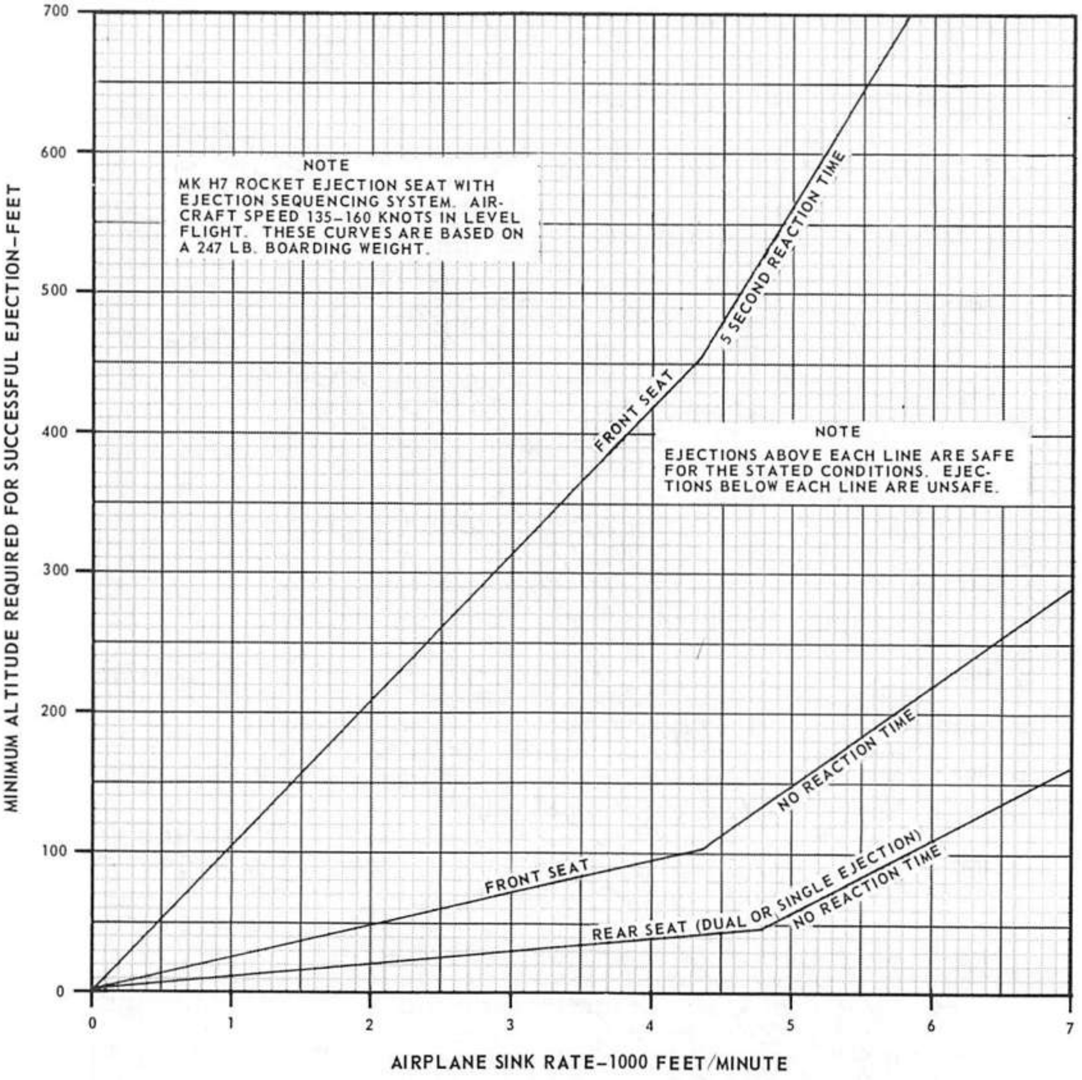
EMERGENCY OXYGEN

During ejection, the emergency oxygen is automatically tripped as the seat leaves the aircraft. A 10 minute supply is available if the crewmember stays in the seat. If emergency oxygen was not tripped automatically during ejection, pull the emergency oxygen knob on the left forward side of the seat to provide oxygen during descent in the seat. At man/seat separation, the emergency oxygen bottle stays with the seat and no oxygen is available to the crewmember.

SURVIVAL KIT DEPLOYMENT

If the survival kit selector switch is in automatic (up), the kit deploys about 4 seconds after man/seat separation. If the switch is in manual (down) or the kit fails to deploy automatically, pull the survival kit release handle with one continuous motion. The handle separates from the kit when the kit lid unlatches. If the emergency harness release handle is pulled, the kit must be manually deployed. When the kit is deployed, the kit cover falls free, the life raft inflates automatically when the drop line attached to the life raft CO_2 actuator is fully extended, and the lower kit container with the emergency provisions and personnel locator beacon drops below the raft. The drop line to the raft and kit is attached to the crewmember's harness by the left retaining strap.

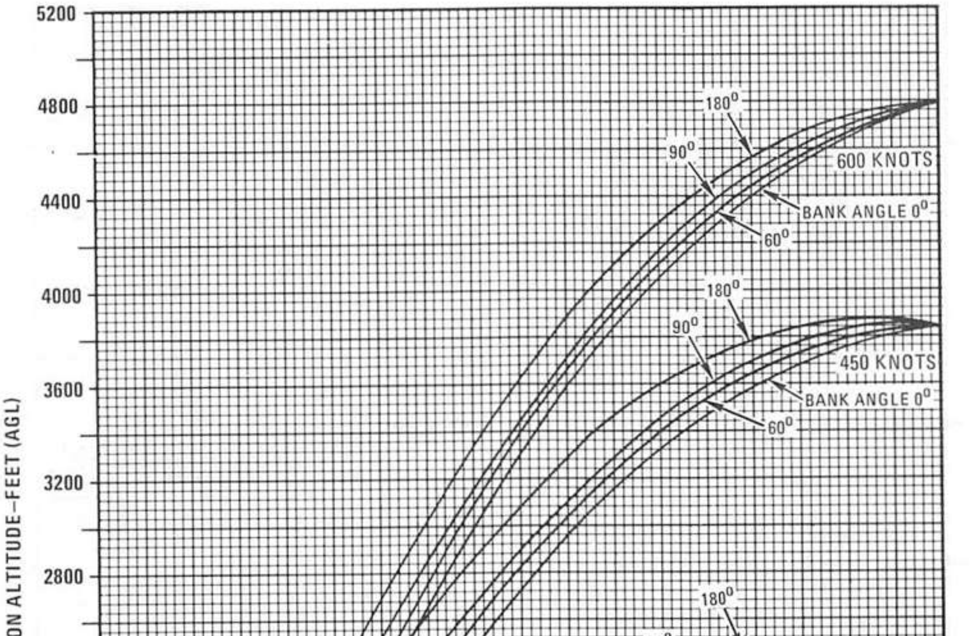
EJECTION ALTITUDE VS SINK RATE



4G–1–(29)

Figure 3-4

MINIMUM EJECTION ALTITUDE VS AIRSPEED, DIVE ANGLE AND BANK ANGLE



Notes

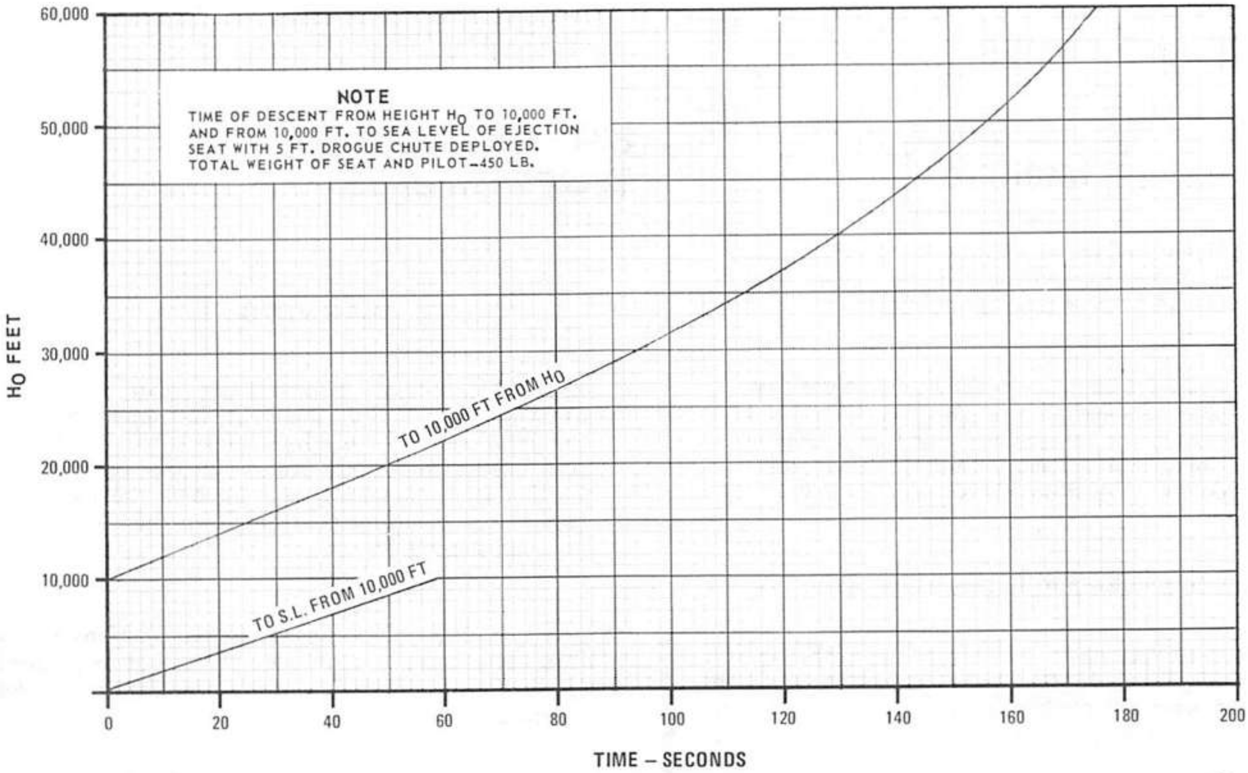
- Sequencing system times for a normal ejection, plus two seconds pilot reaction time are included.
- If the ejection is initiated by the rear crewman, an additional 240 feet of altitude is required at 600 knots in a vertical dive, with proportionately less required as speed and dive angle decreases.
- Correction for barometric altimeter lag is not included.
- The curves are based on a boarding weight of 247 pounds.

4G–1–(36)B

Figure 3–5

EJECTION SEAT DESCENT TIME

STABILIZER DROGUE DEPLOYED



4G–1–(35)

Figure 3–6

WARNING

- Do not pull the survival kit release handle before ejection or before man/seat separation. If this is done, the drop line will not be attached and the kit will be lost.
- If the survival kit handle is not pulled before landing in water, the kit cover must be pulled from the lower container and a snatch pull on the dropline is required to inflate the raft.

ELECTRICAL FIRE

Circuit breakers and fuses protect most circuits and tend to automatically isolate an electrical fire. If an electrical fire occurs:

1. Oxygen regulator – 100% AND EMERGENCY
   Placing the diluter lever to 100% and the emergency lever to EMERGENCY will provide pure oxygen under positive pressure. This will prevent smoke and fumes from entering the mask even if the mask leaks.

WARNING

The emergency oxygen supply (bailout bottle) does not supply sufficient flow for normal breathing unless the supply hose is disconnected from the CRU-60/P. This action will permit smoke and fumes to enter the mask.

2. Generators – OFF
   When both generator switches are turned off, boost pump pressure and primary attitude reference systems will be lost. Front cockpit emergency attitude indicator power is supplied from the battery.
3. Stab aug switches – OFF
4. All electrical switches – OFF
5. Generators – ON
6. Essential electrical equipment – ON
7. Stab aug switches – ENGAGE

If fire persists –

8. Generators – OFF
9. Land as soon as possible.
10. Make a fully configured 17 unit AOA approach

The slats flaps operate normally. If slats flaps are OUT AND DOWN and the battery fails, the slats will remain out and the flaps will retract to a low-drag trail position.

11. Make approach-end arrestment if possible.
12. Anticipate auto-acceleration

SMOKE AND FUMES

WARNING

- All unidentified odors shall be considered toxic. Go on 100% oxygen immediately, vent the aircraft and land as soon as practical.
- Smoke and fumes in the cockpit may be the first indication of a serious fire. Be alert for a rapid deterioration in the situation and catastrophic failure of aircraft systems. Maintain safe ejection altitude until the situation is under control.

To eliminate smoke and fumes from cockpit -

1. Oxygen regulator - 100% AND EMERGENCY
   Placing the diluter lever to 100% and the emergency lever to EMERGENCY will provide pure oxygen under positive pressure. This will prevent smoke and fumes from entering the mask even if the mask leaks.

WARNING

The emergency oxygen supply (bailout bottle) does not supply sufficient flow for normal breathing unless the supply hose is disconnected from the CRU-60/P. This action will permit smoke and fumes to enter the mask.

2. (EWO) Battery bypass switch - ON
   This disconnects the battery from the essential 28 volt dc bus and its' source of charging current to stop thermal runaway. If both generators fail, the battery will power only engine ignition, white flood light, and ejection light.
3. Emergency vent knob - PULL
4. Descend to below 25,000 feet as soon as practical

If smoke or fumes persists -

5. Command selector valve - HORIZONTAL
6. Aft canopy - JETTISON
   The aft canopy is jettisoned so that, if ejection becomes necessary, proper ejection sequencing will occur.

WARNING

Be prepared for immediate ejection when the canopy is jettisoned. The wind blast and draft after the canopy is jettisoned may cause fumes or smouldering material to ignite with catastrophic and incapacitating effect.

EXTREME COCKPIT TEMPERATURES

WARNING

Excessive cockpit temperatures can cause aircrew injury and disablement. Extremely hot temperatures can cause heat damage to aircraft components and toxic smoke in the cockpit. Pulling the emergency vent knob is the most expeditious means of shutting down the cockpit air conditioning system.

If the cockpit air conditioning system malfunctions with a resulting extreme hot or cold cockpit temperature proceed as follows: (Perform only those steps necessary to control temperature for safe recovery).

1. Temperature control switch - MANUAL
   Temperature adjustment may be obtained by bumping the temperature control switch to the hot or cold position.To avoid overshooting the desired temperature range, hold the switch in the desired position only 1 or 2 seconds at a time and wait for a few seconds to determine the effect. Avoid the extreme hot position because of the possibility of high temperature and damage to equipment.
2. Temperature control switch - AUTO
   When the cockpit temperature becomes extreme and cannot be controlled with manual temperature controls, placing the temperature control switch to auto will allow temperature range schedule to be selected by positioning the defog foot heat control lever forward for high and aft for low.
3. Defog foot heat control lever - FORWARD OR AFT
4. Cockpit air conditioning inlets - OPEN
   Placing the defog foot heat lever forward and checking the eyeball type nozzles in the rear seat open will give maximum dispersion of the extreme temperatures and prevent a concentration being deflected toward confined body areas.
5. Cockpit heat and vent circuit breaker - PULL (C8, No. 3 panel)
6. Emergency vent knob - PULL
   Pulling the emergency vent knob will warm an extremely cold cockpit or cool an extremely hot cockpit.

NOTE

- When necessary to depressurize the cockpit, descend to below 25,000 feet if possible.
- The emergency vent knob and the cockpit heat and vent circuit breaker (C8, No. 3 panel) are the only means of shutting down the cockpit air conditioning system when the engines are operating except for turning off both generators which should only be done in VMC conditions or as a last resort.

7. Command selector valve - HORIZONTAL
8. Aft Canopy - JETTISON

RADAR CNI COOL OFF LIGHT

RADAR CNI COOL OFF light indicates an overtemperature condition in the equipment cooling system. This can be caused by a bleed air duct failure.

1. Reduce airspeed and wait 15 seconds
2. CNI cooling reset button - PRESS (maximum 2 times)

If light goes out -

3. Continue mission

If light stays on -

3. Remain at reduced power and speed
4. Land as soon as practical
5. If smoke or fumes present, refer to Bleed Air Duct Failure.

EQUIPMENT COOLING TURBINE FAILURE

A malfunction of the equipment cooling turbine is evidenced by a high pitched whine and/or vibration forward and outboard of the pilot's left foot. Vibration may be felt through one or both throttles, or in the airframe itself. The noise generated by the turbine during failure may be loud enough to make intercockpit communication difficult. Delay in shutting down this turbine could lead to disintegration and probable injury to the pilot. The turbine may be shut down by the steps listed below. This procedure shuts off equipment air conditioning and turns on emergency ram air cooling but does not affect the fuel tank pressurization and transfer, anti–G suits, etc.

1. Equipment cooling circuit breakers - PULL (A6, B6, No. 3 panel)

If undue delay is involved in locating the proper circuit breaker -

2. Generators - OFF
   Turn off both generators to shut down the cooling turbine.

After circuit breakers are located and pulled -

3. Stab aug switches - OFF
4. Generators - ON
5. Stab aug switches - ON

OIL SYSTEM FAILURE

An oil system failure is recognized by a drop in oil pressure, a complete loss of pressure, or excessive oil pressure. If oil pressure cannot be maintained below 60 psi at IDLE, shut down the engine if conditions permit. In general, it is advisable to shut the engine down as early as possible after a loss of oil pressure is indicated, to prevent damage to the engine. The engine operates satisfactorily at military thrust for a period of 1 minute with an interrupted oil supply. The engine may operate for 4 to 5 minutes at 80 to 90% before a complete failure occurs. 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. Malfunctions of the oil system are indicated by a change from normal operating pressure, sometimes followed by vibrations. Vibrations may increase progressively until complete bearing failure occurs (engine seizure).

NOTE

Variable area exhaust nozzle failure or generator failure are possible indications of an impending oil system failure.

If 30 psi not maintained at MIL-

1. Throttle - IDLE
2. Land as soon as practical

If 12 psi not maintained at IDLE or oil pressure change with vibrations and shutdown feasible -

1. Generator - OFF
   The generator is turned OFF before placing the throttle OFF to prevent the bus tie from opening when an underspeed occurs as rpm decreases.
2. Throttle - OFF
3. Engine master switch - OFF

4. Airspeed - 300 KNOTS/0.6 MACH MINIMUM
   Below 0.6 Mach, accelerate to 0.6 Mach or 300 knots, whichever is less, using altitude and thrust (afterburner if necessary). If range is a consideration, climb at 300 knots minimum until reaching 0.6 Mach, then climb at 0.6 Mach until optimum single-engine cruise altitude. If 0.6 Mach is attained at higher altitude and cannot be maintained at military thrust in level flight, descend at 0.6 Mach until descent stops. If range is a consideration, then descend to optimum single-engine cruise altitude.
5. Land as soon as practical
   Refer to Single-Engine Landing procedure

If engine shutdown is not feasible -

1. Throttle - 80% - 90% rpm
2. Avoid abrupt maneuvers causing high G forces.
3. Avoid unnecessary throttle changes.
4. Land as soon as practical.

FUEL BOOST PUMPS INOPERATIVE

Provision is made to supply fuel to the affected engine by gravity flow if a boost pump failure occurs. This provision will allow engine operation at all power settings up to military power below approximately 20,000 feet. Afterburner operation is not recommended. Above 20,000 feet and/or high power settings, flameout or an unstable rpm indication on the affected engine may occur. The possibility of simultaneous mechanical failure of both boost pumps is highly remote. However, a failure may occur as a result of electrical malfunction.

If one boost pump fails -

1. Afterburner modulated or shutoff to maintain a 5 psi minimum boost pump pressure.

   A 5 psi boost pump pressure will generally permit unrestricted use of the engine without afterburner at any altitude. Afterburner and normal engine operation is degraded for the engine with the failed boost pump only.

If both boost pumps fail -

1. Adjust throttles and/or descend until a stable rpm can be maintained.
   Afterburner operation is not recommended. Unrestricted military thrust operation is available from sea level to 20,000 feet.

FUEL TRANSFER FAILURES

INTERNAL WING FUEL FAILS TO TRANSFER

Failure of internal wing fuel to transfer can be caused by the tanks failing to pressurize or the transfer valves failing to open.

1. External transfer switch - OFF
2. Internal wing transfer switch - NORMAL
3. Tank depressurization switch - NORM
4. Air refuel switch - RETRACT (If retracted, cycle)
   To cycle the fuel pressurization system without opening the receptacle door; first pull the air refuel receptacle circuit breaker (D1, No. 2 panel), then cycle the air refuel switch.
5. Internal wing fuel transfer control circuit breaker - IN (H2, No. 2 panel)

If fuel still fails to transfer –

6. Reduce airspeed below 250 knots, lower landing gear and check for fuel transfer.
   Failure of fuel to transfer may be the result of malfunctioning landing gear scissors switch which may disable the nose gear steering and/or cause anti–skid system to cut out without warning.

EXTERNAL FUEL FAILS TO TRANSFER

Failure of external fuel to transfer can be caused by the tank shutoff valve failing to the closed position or the tank failing to pressurize.

1. External transfer switch - CENTER/OUTBD
2. Air refuel switch - RETRACT (If retracted, cycle)
   To cycle the fuel pressurization system without opening the receptacle door; first pull the air refuel receptacle circuit breaker (D1, No. 2 panel), then cycle the air refuel switch.
3. External wing fuel transfer control circuit breaker - IN (J2, No. 2 panel)
4. Fuel valve power circuit breaker - IN (H1, No. 2 panel)

If fuel still fails to transfer –

5. Reduce airspeed below 250 knots, lower landing gear and check for fuel transfer.
   Failure of fuel to transfer may be the result of malfunctioning landing gear scissors switch which may disable the nose gear steering and/or cause anti–skid system to cut out without warning.

If fuel still fails to transfer -

6. External transfer switch – OFF

If single outboard tank fails to transfer -

7. **Do not exceed 16 units AOA**
8. **Refer to Controllability Check, this section**

FUSELAGE FUEL FAILS TO TRANSFER

A malfunction of the electrical fuel transfer pumps or the fuel level control valves may be indicated by a FUEL LEVEL LOW warning light while fuel on board is sufficient to keep the feed tanks full. A malfunction of the electrical fuel transfer pumps is indicated if one or more of the transfer pump or transfer pump control circuit breakers (D3, E3, F3, G3, D4, E4, F4, G4, No. 2 panel) is popped. A malfunctioning fuel level control valve may prevent pressure fuel transfer even though the hydraulic transfer pumps are operating. Pulling the fuel valve power circuit breaker (H1, No. 2 panel) will ensure that the fuel level control valves in cells 1 and 2 are open.

If complete transfer pump failure or fuel level control valve malfunction occures, avoid nose high attitudes, high power settings, and minimize longitudinal accelerations. This will allow fuel to gravity feed in sufficient quantities to sustain engine operation. Closely monitor feed tank level to ensure sufficient fuel exists for engine operation. Minimal time should be spent in a climb and a stair–step maneuver is recommended. Shold fuel in the feed tank become low, execute a nose low, low power descent. This will allow fuel in cells 4 through 7 to feed through cell 3 to cells 1 and 2. Although the fuel will gravity feed at 15,000 pounds/hour under optimum conditions, recommended reduced power setting if practical. This ensures that the fuel level contol valves in cells 1 and 2 are open and prevents any external fuel from transferring to the fuselage cells. Gravity feed capability is directly dependent on aircraft attitude. For instance during a 17 unit AOA final approach, half of the fuel in cell 3 and all of the fuel in cells 4 through 7 (approximately 5000 pounds) will not gravity feed. In normal cruise approximately 1/2 of the fuel in cells 3 through 7 will not gravity feed. Continually check feed tanks, avoid nose high situations and long final approaches.

1. Feed tank fuel – CHECK
2. If any transfer pump or transfer pump control circuit breaker (D3, E3, F3, G3, D4, E4, F4, G4, No. 2 panel) popped – DO NOT RESET
   Resetting the circuit breakers may result in arcing and cause a fire hazard.
3. Fuel valve power circuit breaker (H1, No. 2 panel) – PULL
   This ensures that the fuel level control valves in cells 1 and 2 are open and prevents any external fuel from transferring to the fuselage cells.
4. Air refuel switch – EXTEND (320 knots maximum) (monitor fuel gage)
   This ensures hydraulic fuel transfer pump operation. External and internal wing fuel will not transfer with the air refuel switch in EXTEND.
5. Feed tank fuel – MONITOR
   If gravity feeding, perform a nose low reduced power (low AOA) descent, if practical. This will allow cells 4 through 7 to gravity feed through cell 3 to cells 1 and 2.

When feed tank full -

6. Air refuel switch – CLOSE
   When feed tanks are refilled by the hydraulic transfer pumps, closing the air refuel door will allow external and internal wing fuel to feed.
7. Fuel valve power circuit breaker – IN (H1, No. 2 panel) (If fuselage fuel is still not transferring repeat steps 3 thru 7)
8. Engines – OPERATE AT MINIMUM POWER FOR SAFE FLIGHT
9. Land as soon as practical
10. Avoid nose high flight conditions
11. Delay slowing to landing configuration to avoid long, high AOA final approach
12. Fly 17 unit AOA approach

REVERSE FUEL TRANSFER

Reverse fuel transfer from the fuselage tanks to the external tanks can occur if there is a path for the fuel to flow between the fuselage and external tanks. A failed open defuel valve provides such a path. Generally, reverse fuel transfer is not noticeable until the external tanks are depressurized. Reverse fuel transfer occurs most often when the air refuel switch is placed to EXTEND but can also occur when the tanks are depressurized at touchdown or during auto transfer. Reverse fuel transfer is indicated by a rapid decrease in the tape and counter. If reverse fuel transfer occurs on the ground, shut down both engines as soon as practical to prevent flameout while taxiing.

1. Air refuel switch - RETRACT
2. External transfer switch - OFF
3. Refuel selection - INT ONLY
4. LH fuel boost pump control circuit breaker - PULL (J4, No. 2 panel)

If reverse transfer continues and internal fuel critical -

5. External tanks - JETTISON

FUSELAGE FUEL LEAK

If fuel fumes are detected, an abnormal decrease in fuel quantity is noted, or fuel is observed emitting from the fuselage, a fuselage fuel cell or fuel line rupture may exist. A fuel line rupture may be indicated by abnormal engine operation. In this case shutting down the engine and turning its master switch OFF may stop the leak. If the engines operate normally or shutting down the suspect engine does not stop the leak, it should be treated as a fuel cell rupture. The greatest danger is a catastrophic fire resulting from ignition of the leaking fuel. If a fire did not occur immediately, it probably will not erupt unless conditions are changed so as to provide an ignition source. The pilot must avoid the normal reaction to land immediately. Instead, he must do as little as possible to change conditions while attempting to stop the leak. All actions should be deliberate and unhurried. Any descent should be gradual to avoid excessive pitch angles, to maintain the recommended airspeed, and to avoid collapsing unpressurized external tanks. Landing should not be attempted until fuselage fuel is reduced below 1800 pounds (fuselage fuel in cells 1 and 2) since lowering the gear will open the auxiliary air doors and cause reverse air flow through the engine bay which may provide an ignition source.

1. **Air refuel switch - EXTEND (monitor fuel gage)**
   Placing the air refuel switch to EXTEND deactivates the automatic fuel transfer feature, depressurizes all tanks and prevents transfer of internal wing and external tank fuel to the fuselage cells. Fuel transfer is not recommended unless required to prevent flameout due to cell 1 fuel exhaustion. Wing fuel can be dumped normally with the air refuel switch in EXTEND. Placing the internal wing dump switch in DUMP repressurizes the internal wing tanks.
2. Maintain 350 knots
   This airspeed is optimum for ventilation of fuel tank and engine bay areas.

If an engine operates abnormally -

3. Generator bad engine - OFF
   Turn the generator OFF before placing the throttle OFF to prevent the bus tie from opening when an underspeed occurs as rpm decreases.
4. Throttle bad engine - OFF
5. Master switch bad engine - OFF

If engines operate normally or fuel leak continues -

3. Follow Smoke and Fumes procedure, this section (if required).
4. Use minimum bank and pitch angles for maneuvering.
   Maintaining near straight and level flight may reduce fuel spillage.
5. Do not use afterburner
6. Reduce fuselage fuel below 1800 pounds (if practical)
   The danger of fire or explosion is reduced if all fuselage fuel is in cells 1 and 2.
7. External stores - JETTISON (if required)
8. Make straight-in approach

SINGLE GENERATOR FAILURE

Single generator failure is indicated by illumination of the appropriate GEN OUT light. One generator (with bus tie relay closed) is sufficient to support the entire electrical load.

1. Affected engine instruments – CHECK
   A GEN OUT light may be the first indication of engine failure or CSD failure due to oil starvation. Refer to Oil System Failure, this section.

If night or IMC -

2. Generator switch – OFF
3. Oil pressure gage – MONITOR
4. Land as soon as practical

Day VMC only -

2. Stab aug switches – OFF IF RIGHT GENERATOR FAILED
   If failure of the right generator occurs, disengage the stab aug switches before cycling the generator switch. This prevents possible control surface transients. Without stab aug, do not exceed 300 knots below 10,000 feet and avoid abrupt control movements.
3. Generator switch – CYCLE
   Cycle generator switch from ON to OFF to ON. With DMAS, cycling the left generator may cause loss of DMAS alignment. If the generator fault

has been corrected, the generator will be reconnected to the system and the LH/RH GEN OUT light will go out.

4. Stab aug switches — ON

If generator light still on -

5. Generator switch — OFF
6. Oil pressure — MONITOR
   CSD failure due to oil starvation may be the source of trouble and subsequent engine failure could result.
7. Land as soon as practical

DOUBLE GENERATOR FAILURE

In most cases the generators will not fail simultaneously; it is more likely that one generator will fail, followed by the failure of the other generator. The GEN OUT lights do not illuminate for a double generator failure. However, double generator failure is accompanied by illumination of the DC BUS light. With a double generator failure, boost pump pressure and primary attitude reference systems will be lost. Front cockpit emergency attitude indicator power is supplied from the battery. When power is interrupted, the SPC will disengage. The STATIC CORR OFF light may not illuminate. The CADC switch should be turned off, the telelight panel checked and, after power is restored, the CADC should be reset. If, while performing this procedure, a single generator comes on line, proceed to the Single Generator Failure procedure or the appropriate Bus Tie Open procedure.

CAUTION

> With a double generator failure, rudder feel force will automatically revert from 11.5 to 2.6 pounds per degree of rudder deflection. As a result, rudder pedal force at high airspeeds becomes extremely sensitive, and excessive structural loads can be imposed on the aircraft if full rudder deflection is commanded.

1. Reference system selector - STBY
2. Unessential electrical switches - OFF
3. Stab aug switches - OFF
   Without stab aug, do not exceed 300 knots below 10,000 feet and avoid abrupt control movements.
4. Generator switches - CYCLE

If generators come on line -

5. Stab aug switches - ON

If generators do not come on the line -

5. (EWO) Electrical test receptacle plug 3P325 - ENSURE PLUG SEATED FLUSH, KNURLED LOCK RING SECURE, CAP TIGHT.
   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 plug uses a knurled (twist clockwise to lock) knurled lock ring which should not be confused with the chain equipped threaded cap.
6. Generator switches - CYCLE

If generators come on line -

7. Stab aug switches - ON

If generators still inoperative -

7. Generators - OFF
8. Land as soon as possible
   Battery life cannot be accurately predicted. Considering the difficulty in recovering the aircraft with complete electrical failure, you should land as soon as possible. With battery power, landing gear and slats flaps operation are normal. If the slats flaps are OUT AND DOWN and the battery fails, the slats will remain out and the flaps will retract to a low-drag trail position.
9. Make a fully configured 17 unit AOA approach
10. Make approach-end arrestment if possible.
11. Anticipate auto-acceleration
    The bellmouths and auxiliary air doors are inoperative. Refer to Auxiliary Air Door Malfunction (Gear Down) this section.

BUS TIE OPEN

An illuminated BUS TIE OPEN light is an indication that the right and left generator bus systems are no longer interconnected. If the left generator is disconnected and the bus tie relay is open, the left main ac buses will be lost. If the right generator is disconnected and the bus tie relay is open, the right main ac buses are lost. Refer to Emergency Power Distribution charts to determine affected systems. During night or IMC, consideration should be given to the possible loss of additional electrical power due to cycling a generator.

BUS TIE OPEN
(BOTH GENERATORS OPERATING - NIGHT OR IMC)

1. Land as soon as practical

BUS TIE OPEN
(BOTH GENERATORS OPERATING - DAY VMC)

In day VMC conditions, a BUS TIE OPEN light with both generators operating should not necessitate aborting the mission if the bus tie can be closed by cycling a generator switch. The bus tie cannot be closed if the DC BUS light is on and the main 28 VDC bus is inoperative. In most cases the bus tie can be closed by cycling a generator. If the bus tie remains open after generator cycling, an out of phase/frequency condition exists. Therefore , it is possible to create and undesirable difference frequency oscillation which may impair performance of systems utilizing inputs derived from both generators. In day VMC condition, the irregularities may be eliminated by turning a generator off and thus supplying the same phase/frequency to all systems. The utility power dc circuit breaker must be IN before the bus tie relay can be closed. If the circuit breaker is out and will not reset, cycling and/or turning off a generator will not close the relay and in fact will cause interruption of power to the applicable buses as long as the generator switch is off. In view of the above, proceed as follows:

1. Utility power dc circuit breaker - IN/CYCLE IF IN (D5, No. 2 panel)

If circuit breaker will not reset -

2. Land as soon as practical

If circuit breaker in or resets and BUS TIE OPEN light still on -

2. Stab aug switches - OFF
   The stab aug switches should be disengaged before cycling the generator switch to prevent possible control surface transients. Without stab aug, do not exceed 300 knots below 10,000 feet and avoid abrupt control movements.
3. Right generator switch - CYCLE

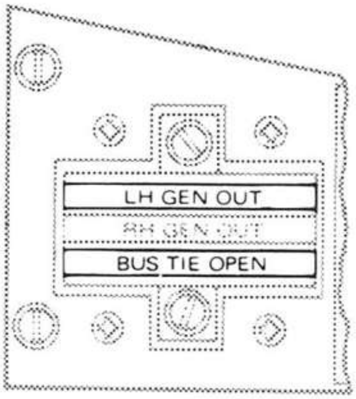
If BUS TIE OPEN light goes out -

4. Stab aug switches - ON

EMERGENCY POWER DISTRIBUTION

INOPERATIVE EQUIPMENT

LH Gen Out-Bus Tie Open



CRITICAL ITEMS

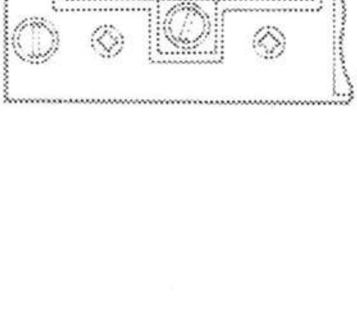
- ANTI-ICE
- ANTI-SKID
- AFTERBURNER IGNITION (RIGHT & LEFT)
- DMAS
- LANDING LT

NON-CRITICAL ITEMS

- ANTI-COLLISION LT (ONE FILAMENT)
- COSS
- DSCG
- ECM PODS (STA 2, 4 & 5)
- EQPT COOLING
- FRONT CKPT CONSOLE LTS
- FRONT CKPT RED INSTR FLOODS (DIM)
- FUSLG LTS
- LH 28V TRANSFORMER
- LH FUEL BOOST PUMP
- LH MISSILE FIRING
- LH MISSILE POWER
- LH TRANSFORMER RECTIFIER
- NO. 4 ELEC FUEL XFR PUMP
- RED CONSOLE FLOODS MED
- RADAR PWR
- RH MISSILE PWR
- SEAT ADJUST
- SHRIKE GUIDANCE
- UTILITY LT
- UTILITY PWR AC
- WING AND TAIL LT DIM

INOPERATIVE EQUIPMENT

RH Gen Out-Bus Tie Open



CRITICAL ITEMS

- AIRSPEED PITOT HEATER
- AOA PROBE HEATER
- BELLMOUTH PITOT HTR
- CKPT HEAT & VENT
- 2 FUEL QUANTITY INDICATORS
- IFF
- REAR COCKPIT CI HEADING POINTER
- TACAN
- VOR: BEARING POINTERS

NON-CRITICAL ITEMS

- ADF
- AILERON FEEL TRIM
- AILERON RUDDER INTERCONNECT
- ALTITUDE ENCODER
- ANTI COLLISION LT (ONE FILAMENT)
- APR-47
- APU
- ARMAMENT POWER
- AUTOPILOT
- AUX RECEIVER
- CADC
- ECM PODS (STA 6 & 8)
- FRONT CKPT LIGHTS
- FORM LTS
- GUNSIGHT CAMERA
- IFF (APX 80 A/A)
- IFR RCPT FLOOD LTS
- L ENGINE RAMP CONT
- NO. 6 ELEC FUEL XFR PUMP
- OXYGEN GAGE
- RADAR ALTIMETER
- RH 28V TRANSFORMER
- RH FUEL BOOST PUMP
- RH TRANSFORMER RECTIFIER
- RIGHT ENGINE RAMP CONT
- STAB AUG
- TAXI LT
- 6 WINDSHIELD TEMP SENSING
- WING & TAIL LT BRT

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Figure 3-7 (Sheet 1 of 2)

EMERGENCY POWER DISTRIBUTION

INOPERATIVE EQUIPMENT

Main 28 Volt DC Bus Out

CRITICAL ITEMS

- ANTI-SKID
- BUS TIE RELAY (BUS TIE OPEN LIGHT ON)
- CKPT HEAT & VENT
- DMAS
- FUEL DUMP ■
- LANDING & TAXI LTS
- NOSE WHEEL STEERING
- TACAN

NON-CRITICAL ITEMS

- ADF
- AGM-78 ANTI-COMPROMISE JETT
- AILERON RUDDER INTERCONNECT
- AIRBORNE VIDEO TAPE RECORDER (AVTR)
- ALE-40
- ALTIMETER VIBRATOR
- APR-47
- APU
- ARRESTING HOOK (UP OPERATION)
- AUX AIR DOORS
- AUX RECEIVER
- CONVENTIONAL WEAPONS RELEASE & FIRE
- COMBAT DOCUMENTATION CAMERAS
- COSS
- DSCG
- ECM CONTROL
- ECM PODS & DESTRUCT (STA 2,4,5,6,&8)
- ENG VARIABLE BELLMOUTH
- EQPT COOLING CONTROL
- FUSLG, ANTI COLLISION & TAIL LTS
- GUNSIGHT CAMERA
- IFF (APX-80 A/A)
- LH FUEL BOOST PUMP
- MISSILE FIRING
- NO. 4 ELEC FUEL XFR PUMP
- NO. 6 ELEC FUEL XFR PUMP
- PNEUMATIC COMPRESSOR
- RADAR
- RADAR ALTIMETER
- RADAR SCOPE CAMERA
- RH FUEL BOOST PUMP
- 6▶ RAIN REMOVAL
- RUDDER TRIM/BELLMOUTH CONT
- SHOOT LIGHTS
- SPEED BRAKE
- STABILATOR POSITION INDICATOR
- STATION & SELECT LTS
- UTILITY POWER D-C
- VGH RECORDER POWER D-C
- 1▶ * VOICE WARNING (ALTITUDE FUNCTION ONLY)
- WARNING LIGHTS DIM

OPERATIVE EQUIPMENT

Battery Power Only

CRITICAL ITEMS

- AOA INDICATOR
- EGT INDICATORS
- EJECTION LIGHT
- EMER ATTITUDE INDICATOR
- * ENGINE FIRE & OVHT DETECTOR
- EXTERNAL FUEL XFR (CONT)
- 3▶ FUEL QUANTITY INDICATORS
- INFLIGHT REFUELING
- ILS: CDIs, GLIDE SLOPE INDICATORS, AUDIO, AND MARKER BEACON
- INTERCOM
- INTERNAL WING FUEL XFR (CONT)
- LANDING GEAR POSITION INDICATOR
- LANDING GEAR CONTROL
- LEFT & RIGHT MAIN IGNITION
- SLATS FLAPS CONTROL
- STABILATOR FEEL TRIM
- UHF COMM RECEIVER-TRANSMITTER
- VOR: CDI, TO-FROM, AND AUDIO
- WHITE FLOOD LIGHT

NON-CRITICAL ITEMS

- ALL STORES EMER JETT
- AOA AURAL TONE GENERATOR
- EXHAUST NOZZLE POSITION INDICATORS
- GUARD RECEIVER
- FUEL CONTROL
- FUEL VALVE POWER
- 4▶ KY-28
- 5▶ KY-58
- FRONT CKPT INSTR FLOODS BRT
- MISSILE JETT
- OUTBOARD STATION JETT
- SLATS FLAPS POSITION INDICATOR
- TRIM CONTROL

* TEST FUNCTION INOPERATIVE
1▶ AFTER T.O. 1F-4-1262
2▶ BEFORE T.O. 1F-4-1414
3▶ AFTER T.O. 1F-4-1414
4▶ BEFORE T.O. 1F-4-1320
5▶ AFTER T.O. 1F-4-1320
6▶ BEFORE T.O. 1F-4-1500

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Figure 3-7. (Sheet 2 of 2)

If BUS TIE OPEN light stays on -

4. Right generator - OFF

If BUS TIE OPEN light goes out -

5. Stab aug switches - ON
6. Land as soon as practical

If BUS TIE OPEN light still on -

5. Right generator - ON
6. Stab aug switches - ON
7. Land as soon as practical

LEFT GENERATOR OUT - BUS TIE OPEN

1. Left engine instruments - CHECK
   A GEN OUT light may be the first indication of engine failure or CSD failure due to oil starvation. Refer to Oil System Failure, this section.
2. Left generator switch — CYCLE
   If the LH GEN OUT and BUS TIE OPEN lights stay on, the left main ac buses will be lost. Cycling the left generator may cause loss of DMAS alignment.

If LH GEN OUT and BUS TIE OPEN lights stay on -

3. Left generator — OFF
4. NCSC INS knob — ATTD
5. Unessential electrical equipment - OFF
   Turn off all electrical equipment not essential to flight. Refer to emergency power distribution chart.
6. Left engine oil pressure - MONITOR
   CSD failure due to oil starvation may be the source of trouble and subsequent engine failure may result.
7. Land as soon as practical
8. Make a fully configured 17 unit AOA approach
9. Consider an approach–end arrestment
   Anti–skid is inoperative.
10. Avoid heavy braking

RIGHT GENERATOR OUT - BUS TIE OPEN

A right generator out and bus tie open will cause random flight control inputs which can be as much as 15° rudder, 11° spoiler, and ½° stabilator deflection. Actuation of the emergency quick release lever or disengagement of stab aug switches and ARI will correct this but it may take as long as 8 seconds before all surfaces return to neutral. This delay may be interpreted as additional uncommanded input. Any momentary re–engagement will again cause another random input. The amount, rate of deflection, and rate of correction is neither predictable nor repeatable.

1. Emergency quick release lever - HOLD PRESSED
2. Right engine instruments - CHECK
   A GEN OUT light may be the first indication of engine failure or CSD faulure due to oil starvation. Refer to Oil System Failure, this section.
3. Stab aug switches - OFF
   The stab aug switches should be disengaged before cycling the generator switch to prevent possible control surface transients. Without stab aug, do not exceed 300 knots below 10,000 feet and avoid abrupt control movements.
4. ARI circuit breaker - PULL
   With the ARI circuit breaker pulled, the anti–skid system is inoperative.
5. Emergency quick release lever - RELEASE
6. Right generator switch - CYCLE
   If the RH GEN OUT and BUS TIE OPEN lights stay on, the right main ac bus will be lost.

If RH GEN OUT light or BUS TIE OPEN light out –

7. Stab aug switches - ON
8. ARI circuit breaker - RESET

If RH GEN OUT light and BUS TIE OPEN lights stay on –

7. Right generator - OFF
8. Right engine oil pressure - MONITOR
   CSD failure due to oil starvation may be the source of trouble and subsequent engine failure may result.
9. Land as soon as practical
10. Make a fully configured 17 unit AOA approach
11. Consider approach–end arrestment
    With the ARI circuit breaker pulled, anti–skid is inoperative.
12. Avoid heavy braking

DC BUS LIGHT ON

The DC BUS light comes on when the main dc bus and essential dc bus are disconnected. If the light should come on, check operation of equipment powered by each bus to determine its condition. Operate the speed brakes to check the main dc bus. Failure of the essential dc bus will cause the gear indicators to barberpole when the battery bypass switch is placed ON.

1. Speedbrake — CYCLE (to check the main 28 vdc bus)
2. Battery bypass — ON (to check the essential 28 vdc bus)
   Failure of the essential dc bus will cause the gear and flap indicators to barberpole when the battery bypass switch is placed to on.
3. Battery bypass - OFF

IN DAY VMC CONDITIONS –

1. Stab aug switches — OFF
2. Reference system selector — STBY
3. Generator switches – CYCLE SIMULTANEOUSLY
   Cycling the left generator may cause loss of DMAS alignment.
4. Stab aug switches – ON
5. Equipment operated by both dc buses – RECHECK

IF DAY VMC AND DC BUS LIGHT REMAINS ON OR NIGHT IMC –

Both buses operating - DC BUS light on –

1. Land as soon as practical

Main DC bus failed - DC BUS light on (speed brake - inop) —

1. Land as soon as practical
2. Make a fully configured 17 unit AOA approach
3. Make an approach end arrestment, if possible
   Anti-skid and nose wheel steering are inoperative. Refer to approach end arrestment this section.
4. Avoid heavy braking

ESSENTIAL BUS FAILED (WITH OPERATIVE BATTERY) - DC BUS LIGHT ON –

1. Land as soon as possible
2. Anticipate battery failure
   If unable to land immediately, battery life may be extended by placing the battery bypass switch to on until in a position to make a safe approach and landing. Those items listed in the emergency power distribution chart under Operative Equipment Battery Power Only are powered by the essential dc bus and battery bus and will be lost while the battery bypass is on or when the battery fails.
3. Configure as soon as practical
   Battery life cannot be accurately predicted. Without battery power, normal landing gear and slats/flaps controls are inoperative. If the slats/flaps are out and down and the battery fails, the slats will remain out and flaps will retract to a low drag trail position. Other critical items which will be lost include: intercom, AOA system, gear and slats/flaps indicators, EGT indicators, UHF radio and the internal and external wing transfer.
4. Fly computed fully configured on speed +10 knots approach

ESSENTIAL BUS FAILED (BATTERY FAILED) - DC BUS LIGHT ON –

1. Land as soon as possible
2. Make a straight in, no slat/flap approach
   Refer to no slats/flaps landing this section.

CAUTION

Without battery power, normal slats/flaps extension is not available. The emergency slats/flaps extension system should be activated only if the utility system fails. If the emergency system is activated with normal utility hydraulic pressure available, there is a high probability of losing utility hydraulic system pressure.

3. If gear not down and locked — BLOW DOWN
   Refer to landing gear emergency lowering (utility hydraulic or electric system failed) this section.
4. Fly approach at the airspeed shown below:

GROSS WEIGHT	APPRCH SPEED GEAR DOWN
34,000	166
35,000	168
36,000	170
37,000	172
38,000	174
39,000	176
40,000	178
41,000	180
42,000	182
43,000	184
44,000	186
45,000	188
46,000	190

FLIGHT CONTROL MALFUNCTION

Upon initial detection of any abnormal flight control movement, immediately depress the emergency quick-release lever and hold in order to determine if the stab aug or AFCS was causing the abnormality.

1. Emergency quick-release lever - HOLD PRESSED

   It may take up to eight seconds for an aileron or rudder input to cease after depressing the emergency quick-release lever or turning the appropriate roll or yaw stab aug off.

2. AFCS - DO NOT ENGAGE
3. Stab aug switches - AS REQUIRED
4. Emergency quick-release lever - RELEASE

NOTE

With pitch aug disengaged or inoperative, do not exceed 300 knots below 10,000 feet, and avoid abrupt control movements.

5. Malfunction other than AFCS - LAND AS SOON AS PRACTICAL

If severe flight control malfunctions continue -

6. Stab aug switches - OFF
7. Generators - OFF (conditions permitting)

   Consider flight conditions, weather, distance to suitable airfield, etc., prior to turning the generators OFF. Refer to Emergency Power Distribution Chart, this section, for inoperative/operative equipment.

If flight control malfunction corrected with generators OFF -

8. Land as soon as possible

   Battery life cannot be accurately predicted. Considering the difficulty in recovering the aircraft with complete electrical failure, land as soon as possible. With battery power, landing gear and slats flaps operation are normal. If the slats flaps are OUT AND DOWN and the battery fails, the slats will remain out and the flaps will retract to a low drag position.

9. Make a fully configured 17 unit AOA approach
10. Make an approach-end arrestment if possible
11. Anticipate auto acceleration

    The bellmouths and auxiliary air doors are inoperative. Refer to Auxiliary Air Door Malfunction (Gear Down), this section.

If severe flight control malfunction continues -

8. Generators - ON
9. Stab aug switches - AS REQUIRED
10. Land as soon as practical

HARD-OVER RUDDER IN FLIGHT

1. Emergency quick-release lever - HOLD PRESSED

   It may take up to eight seconds for the rudder (10 degrees ARI) malfunction to cease after pressing the emergency quick-release lever or turning the yaw stab aug off.

2. Maintain approximately 250 knots, not to exceed 13 units AOA.
3. Avoid abrupt pull-up maneuvering at high AOA.
4. AFCS - DO NOT ENGAGE
5. ARI circuit breaker - PULL

   With the ARI circuit breaker pulled, the anti-skid system is inoperative.

6. Yaw stab aug - OFF
7. Emergency quick-release lever - RELEASE

If rudder is no longer hard-over -

8. Land as soon as practical
9. Consider an approach-end arrestment (E-9)

If rudder still hard-over -

8. Stab aug switches - OFF
9. Generators - OFF (conditions permitting)

   Consider flight conditions, weather, distance to suitable airfield, etc., prior to turning the generators OFF. Refer to Emergency Power Distribution Chart, this section, for inoperative/operative equipment.

If rudder is no longer hard-over with generators OFF -

10. Land as soon as possible

    Battery life cannot be accurately predicted. Considering the difficulty in recovering the aircraft with complete electrical failure, land as soon as possible. With battery power, landing gear and slats flaps operation are normal. If the slats flaps are OUT AND DOWN and the battery fails, the slats will remain out and the flaps will retract to a low drag position.

11. Make a fully configured 17 unit AOA approach
12. Make an approach-end arrestment if possible
13. Anticipate auto acceleration

    The bellmouths and auxiliary air doors are inoperative. Refer to Auxiliary Air Door Malfunction (Gear Down), this section.

If rudder is still hard-over -

10. Generators - ON
11. ARI circuit breaker - IN
12. Pitch/roll aug switches - AS REQUIRED
13. Land as soon as practical

    Refer to Landing With Hard-Over Rudder, this section.

BELLOWS FAILURE

The following malfunctions to the ram air bellows system will normally give corresponding indications to the pilot:

a. Over-pressurized bellows: This condition results when the bellows bleed hole is plugged. Sudden blockage of the bellows bleed air orifice will induce an immediate control stick drive in the aft direction (aircraft pitch-up). Severity of the pitch-up will depend on airspeed and pilot reaction. A plugged bellows bleed air orifice, after initial drive, will produce stick forces slightly higher than normal and trim position will be slightly more nose down for any given flight condition.

b. No bellows pressure: This is caused by complete bellows failure or blockage of the ram air line. When this occurs, the aircraft will be sensitive in pitch control. There will be a nose down force on the control stick not to exceed three pounds per G. This force cannot be trimmed out; therefore, it is likely the pilot will apply full nose up trim attempting to trim out the stick force before detecting the malfunction.

c. Low-bellows pressure: This is caused by a leak in the bellows system. This will produce stick forces lighter than normal and trim position will be more nose up than normal for any given flight condition.

Any of these malfunctions may be intermittent depending on the source of the blockage or leak. Sudden restoration of normal bellows pressure will result in pitch transients. The magnitude of these transients will depend on flight conditions and trim setting. The severity increases in proportion to increasing airspeed and the degree of mistrim. Should a bellows malfunction occur or be suspected

1. Reduce airspeed to minimum practical.
2. Discontinue high G maneuvering.
3. Stab trim - 0 UNITS (if required)
4. Pitot heat switch - ON
5. Airspeed pitot heat circuit breaker - IN/ CYCLE (D9, No. 3 panel)
6. Avoid abrupt fore and aft stick movements.

WARNING

No/Low bellows pressure will result in an ultrasensitive control stick. If full/ near full nose up trim is applied to counter no/low bellows pressure, rapid aft stick inputs could result in restricted aft movement. Full travel may be regained by moving the stick forward and reapplying aft stick at a normal rate.

7. AFCS - DO NOT ENGAGE
8. Land as soon as practical

RUNAWAY STABILATOR TRIM

If the stabilator trim appears to be running away, it is possible, under certain conditions, to alleviate it by engaging the autopilot, providing: the stabilator feel trim circuit breaker has been pulled immediately upon detection of runaway trim; runaway trim is in the nose up direction; or runaway trim has not exceeded 2-1/2 units out-of-trim nose down and airspeed is reduced to 300 knots or less.

If the above conditions are met -

1. Stabilator feel trim circuit breaker - PULL
2. Reduce airspeed to 300 knots or less.

3. Autopilot - ENGAGE (if desired)

CAUTION

If the autopilot is used to alleviate excessive out-of-trim forces (for example full nose down runaway trim), the autopilot pitch parallel servo may be overpowered, thus preventing normal operation. If the pilot supplies stick force in an attempt to help the autopilot hold against the overpowering trim forces, the autopilot may alternately disengage and re-engage accompanied by large transients in pitch force. If the autopilot cannot maintain flight attitude without assistance from the pilot, disengage the autopilot. Be prepared to accept large transients when disengaging the autopilot after it has been used to hold against runaway trim.

4. Land as soon as practical.

SPEED BRAKE EMERGENCY OPERATION

Three basic failures, and their combinations, can affect the speed brakes. They are: switch failure, electrical failure, and utility hydraulic system failure. If utility hydraulic system fails with the speed brakes extended the speed brakes will be forced by air loads to a low drag trail position, regardless of switch positions. If an electrical failure occurs, the speed brakes automatically retract to a fully closed position. If both throttle–mounted switches fail, the speed brakes may be fully retracted by pulling the speed brake circuit breaker.

UTILITY HYDRAULIC SYSTEM FAILURE

1. Land as soon as practical.
   Refer to Landing With Utility Hydraulic System Failure, this section.

NOTE

- Due to the possibility of leaking check valves in the emergency air bottles, lower the gear as soon as practical. If necessary, gear lowering may be delayed as long as the pneumatic pressure gage needle remains in the green zone.
- If the CHECK HYD GAGES indicator light comes on and remains on, monitor the hydraulic system gages for the remainder of the flight, since warning of a second hydraulic system failure will not be given.
- If air refueling may be required, place the air refueling switch to EXTEND as soon as the possibility of a utility hydraulic system failure is noted. Fuel pressurization can be restored with the air refuel receptacle door open by pulling the air refuel receptacle circuit breaker (D1, No. 2 panel), then placing the air refuel switch to RETRACT.

The following equipment is inoperative with utility hydraulic failure –

a. Air refueling receptacle
b. AFCS
c. Anti–skid protection
d. ARI
e. Arresting hook retraction
f. Auxiliary air doors
g. Fuel transfer pumps (hydraulic)
h. Nose gear steering
i. Pneumatic system air compressor
j. Radar antenna drive
k. Roll stab aug
l. Rudder feel trim
m. Variable engine bellmouth
n. Variable engine intake duct ramps
o. Yaw stab aug

The following equipment is affected by utility hydraulic failure –

a. Aileron power control cylinders
   PC–1 will assume full demand of left aileron.
   PC–2 will assume full demand of right aileron.
b. Slats flaps
   Slats and flaps are available with pneumatic operation.
   If flaps are down when utility failure occurs, flaps will move to the trail position.
c. Landing gear
   Gear extension by pneumatic system.
d. Rudder
   Limited manual rudder available.
e. Speed brakes
   If extended, will move to trail position.
f. Spoiler power control cylinder
   PC–1 will assume full demand of the left spoiler.
   PC–2 will assume full demand of the right spoiler.
g. Wheel brakes
   Emergency braking available.

SINGLE POWER CONTROL SYSTEM FAILURE

A hydraulic pump failure of either PC–1 or PC–2 presents no immediate problem, since the utility system provides satisfactory power to the rudder and to the failed aileron/spoiler, and the remaining PC system provides stabilator power. If PC–1 hydraulic pressure drops below 500 psi, pitch stab aug and AFCS are inoperative but the AUTO PILOT DISENGAGE and PITCH AUG OFF lights will not come on. When pitch stab aug is lost or loss is anticipated, do not exceed 300 knots below 10,000 feet and avoid abrupt control movement. If PC–1 pressure drops below 1000 psi, the stabilator auxiliary power unit (APU), if reject switch in normal, supplies power to the AFCS, pitch stab aug, and stabilator actuator. The CHK HYD GAGES light will stay on; therefore, monitor the hydraulic system gages for the rest of the flight since there will be no warning of another system failure.

If PC-1 failed -

1. If below 10,000 feet, establish airspeed below 300 knots and avoid abrupt control movements
2. APU reject switch - REJECT
   The APU light will remain illuminated for approximately one minute after REJECT is selected. The APU reject switch is placed to REJECT to save the APU in case PC-2 fails. If PC-2 subsequently fails with the switch in REJECT, the APU will automatically power the stabilator, pitch stab aug, and the AFCS.

If either PC-1 or PC-2 failed -

1. Anticipate utility system failure
2. Land as soon as practical.
3. Plan for straight-in approach.
4. Extend gear at 230 knots on final
   Maintain a minimum maneuvering airspeed of 230 knots to insure adequate control if the utility system fails during gear extension.
5. Make a fully configured 17 unit AOA approach.

UTILITY HYDRAULIC AND SINGLE PC 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 landing; however, handling qualities are significantly degraded. 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. Asymmetric thrust may be used judiciously to aid lateral control. Excessive asymmetric thrust may compound the emergency. 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. Maintain a minimum maneuvering speed of 230 knots.
2. Jettison any asymmetric load.
3. Reduce gross weight to minimum practical (Below 37,000 lbs, if possible).
   Reduce gross weight to provide a final approach airspeed that is below the maximum engagement speed for the type approach arrestment gear available.
4. Plan straight-in, no slat flap approach and approach-end arrestment, if possible.
   The emergency pattern should be flown so that minimum maneuvering is accomplished prior to final approach.
5. If gear not down and locked - BLOW DOWN
   Refer to Landing Gear Emergency Lowering, this section. If a controllability check is impractical, lower the gear a minimum of 4-5 miles from the runway. If the gear was down and locked before loss of the utility hydraulic system, do not blow down.
6. Make a controllability check, if possible.
   If a controllability check can be accomplished or landing gear is lowered due to earlier utility hydraulic system failure, maintain a minimum of 230 knots after the controllability check/gear lowering until on final.
7. Anti-skid - OFF
8. Fly final no slower than 17 units AOA.
9. Use emergency brakes
   Anti-skid and nosewheel steering are inoperative.
10. Anticipate auto acceleration

UTILITY HYDRAULIC AND ENGINE FAILURE (WITH OR WITHOUT SINGLE PC FAILURE)

The problems associated with landing with a combination single engine and utility hydraulic failure are severe. The effects of losing powered rudder, rudder trim, yaw and roll augmentation, and possibly roll control surfaces on one wing when flying with only one engine seriously degrade flying qualities and control of the aircraft. If the combination of weather, landing facilities, and aircrew experience is less than ideal, consideration should be given to a controlled ejection. If the decision is made to land, plan straight-in, no slat flap approach. The emergency pattern should be flown so that minimum maneuvering is accomplished prior to final approach and required turns are always away from the dead engine. If time permits, request removal of the approach-end arresting gear so that the hook may be lowered before commencing approach. A steep, low power final should be planned. When assured of making the runway, power should be reduced slowly to minimize yaw/roll transients. The transition from approach to touchdown is critical. Touchdown should be planned to be in the first third of the runway. Use manual rudder and then emergency brakes for steering after touchdown. Plan to lower hook after landing to make a midfield or departure end engagement.

1. Do not make a controllability check
2. Maintain a minimum of 300 knots/0.6 Mach until established in the traffic pattern
3. External load - JETTISON
4. Reduce gross weight to minimum practical (below 37,000 pounds, if possible).
5. Plan straight-in, no slat flap, steep, low-power approach.
6. If gear not down and locked, landing gear handle DOWN AND PULL above 5,000 feet AGL and after established on final, if practical. Maintain 230 knots minimum.
7. If the pilot runs out of lateral control authority - Reduce power, lower the nose, and recover or eject rather than add power.

WARNING

- If afterburner is required at any time during the approach there may not be sufficient roll authority to compensate for the asymmetric thrust.
- Go-around capability in afterburner may not exist if airspeed is below 230 knots because of inadequate lateral directional control. Airspeeds should not be slowed below 230 knots until the pilot is firmly committed to land. In any case, power must be added slowly and airspeed increased to insure adequate control during any attempted go around. Afterburner should not be selected below 230 knots unless absolutely essential to prevent catastrophe and the aircrew must be aware that this use could cause loss of control.
- Any throttle movements should be made slowly to minimize rapid yaw/roll transients. Minimum practical power should be used at all times to minimize yaw and roll due to yaw. Minimum control speed in this situation is a direct function of throttle setting.

8. Anti-skid - OFF
9. When landing is assured, gradually reduce power to touchdown no slower than the airspeed given in figure 3-8.

GRWT	TOUCHDOWN FLAPS UP, GEAR DN
	KNOTS
34,000	184
35,000	187
36,000	190
37,000	192
38,000	195
39,000	198
40,000	200

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Figure 3-8

10. Land or Eject

NOTE

Drag chute use in a cross wind may increase directional control difficulties.

After landing -

11. Hook - DOWN (make mid-field or departure-end arrestment)
12. Emergency brake handle - PULL
    Only emergency brakes are available. Nose gear steering and anti-skid are inoperative. Differential emergency brakes should be used for control. Braking at high speed must be performed carefully.

DOUBLE POWER CONTROL SYSTEM FAILURE

After a complete PC-1 and PC-2 failure, degraded longitudinal control is available from the APU. If both power control systems fail rapid control inputs should be avoided to prevent system saturation and control stiffening.

1. Reduce speed below 600 knots or .95 Mach.
2. Descend to 20,000 feet or below
3. Use moderate control inputs.
4. Follow procedures for Single Power Control System failure, this section.
5. If the APU or utility system fails - EJECT

JETTISONING

The procedures for jettisoning are shown in Jettison Chart, figure 3-9.

ADI/INS FAILURE

1. Emergency attitude indicator - CHECK
2. Radar horizon - CHECK
3. Reference system selector - STBY
   If STBY is selected while turning faster than 15°/minute, heading may be in error. After wings level, select SYNCH on the compass controller to ensure error is removed.

DMAS NAVIGATION COMPUTER FAILURE

DMAS navigation computer failure is indicated by illumination of the CMPTR and MALF lights, or illumination of the MALF light and NCU F displayed on the DDI.

1. NCSC INS knob - ATTD

JETTISON CHART

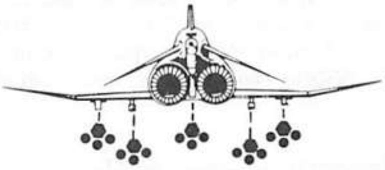
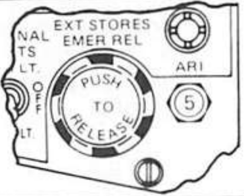
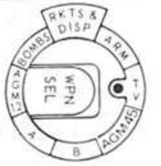
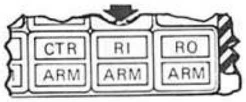
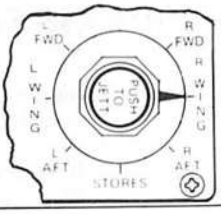
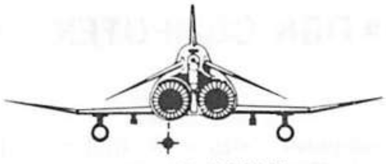
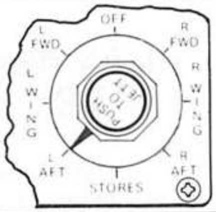
STATION JETTISON	JETTISON CONTROL		JETT PROCEDURE	LOCATION
 MULTI–STATION		EXTERNAL STORES EMERGENCY RELEASE (PANIC BUTTON) 2 4 6 7 9	PUSH	LEFT SUB PANEL
AGM–65 MISSILE JETTISON		WEAPON SELECT KNOB	1. SELECT AGM 45 OR TV	MAIN INSTRUMENT PANEL
		STATION SELECT BUTTON (RI STATION CONSIDERED)	2. SELECT LI OR RI 3. DESELECT ALL OTHER STATIONS	
		SELECTIVE JETTISON (R WING STATION CONSIDERED) 2 3 5 8	4. SELECT L OR R WING 5. PUSH TO JETT	
 FUSELAGE MISSILES		SELECTIVE JETTISON (ONE STATION CONSIDERED) 1 2	SELECT L FWD, R FWD, L AFT, OR R AFT AND PUSH TO JETT	MAIN INSTRUMENT PANEL
 AGM–88 MISSILES	ANTI–COMPROMISE JETT SWITCH WEAPONS SELECTOR MASTER ARM SWITCH STATION SELECT BUTTON(S) SELECTIVE JETTISON 2		1. SELECT ON 2. SELECT ARM 3. SELECT ARM 4. DEPRESS DESIRED STATION(S) 5. SELECT STORES 6. PUSH TO JETT (MISSILE WILL FIRE BALLISTIC)	PEDESTAL PANEL MAIN INSTRUMENT PANEL

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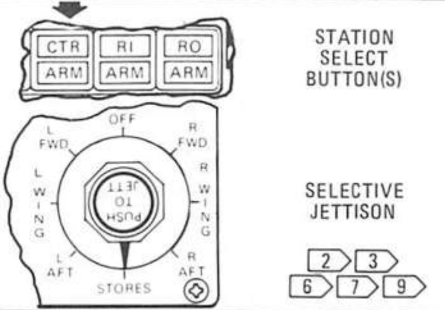
Figure 3-9 (Sheet 1 of 3)

JETTISON CHART

STATION JETTISON	JETTISON CONTROL	JETT PROCEDURE	LOCATION
 WING & CL STORES	 	1. DEPRESS DESIRED STATION(S) (CL STATION CONSIDERED). 2. SELECT STORES 3. PUSH TO JETT	MAIN INSTRUMENT PANEL

JETTISON WITH DCU-94/A RELEASE CIRCUIT

The DIRECT bombing mode and DCU–94/A release controls may be used as an alternate method of jettisoning the suspension equipment. However, the RO MER cannot be released with the nuclear release circuit and the LO MER cannot be released when the MER is shifted aft. The following procedures also apply to stores suspended directly from the armament pylons or the centerline bomb rack. With wing pylon lockout pins installed, the wing station UNLOCK lights are ON.

1. Delivery mode knob – DIRECT
   The DIRECT mode provides an immediate release when the bomb button is pressed.
2. DCU–94/A station select switch – FORWARD (Desired Station)
3. Master release lock switch – FORWARD
4. (WSO) Consent switch – REL or REL/ARM
   a. CL UNLOCKED light (if the CL station is selected) – ON
5. Bomb–button – PRESS
   The suspension equipment or the single suspended bomb on the selected station is released when the bomb button is pressed.
6. For remaining station(s), place the station selector AFT and repeat steps 2 and 5

JETTISON WITH DCU-94/A JETTISON CIRCUIT

The following procedures apply for bombs and MER/TER's that are suspended directly from the armament pylon or the centerline bomb rack.

1. DCU–94/A station select switches (loaded stations) – FORWARD
2. DCU–94/A master release lock switch – FORWARD
3. (WSO) Consent switch – REL or REL/ARM
   a. DCU–94/A CL UNLOCKED light (if CL station is selected) – ON
4. Nuclear store jettison button – JETT
   The selected stations jettison simultaneously.

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Figure 3-9 (Sheet 2 of 3)

NOTES

- Refer to Section V for jettison limitations.
- Inflight lockout pins must be installed on all MAU–12 armament pylons
- Fuselage ECM pods are non–jettisonable; carts are not installed in wing/CL station with ECM pods aboard.
- For bombs suspended directly from the armament pylons, the master arm switch or the nose/tail arm switch must be in SAFE if the bombs are to be jettisoned in the safe condition.

1 ▷ With CL tank or MER aboard (CL TK light on), L FWD and R FWD missiles will not jettison. With CL bomb aboard (CL TK light ON), missiles will jettison.

2 ▷ For all jettison, rear emergency gear handle must be IN with the landing gear handle UP; or the Arm Override button pushed IN.

3 ▷ AIM–9 missiles will not jettison.

4 ▷ AIM–7 and AIM–9 missiles will not jettison.

5 ▷ Wing flaps must be up to jettison AGM–65 missiles. This procedure is used to jettison a single AGM–65 missiles.

6 ▷ With High Performance centerline tank aboard do not jettison unless aircraft is at least 12 feet AGL.

7 ▷ The LAU–34/A launcher is retained.

8 ▷ AGM-65 missiles cannot be jettisoned from the LAU-117/A Launcher. To jettison AGM-65 missiles on a LAU-117/A Launcher, the Launcher must be jettisoned.

9 ▷ If CL-TK light out, CL tank, MER, or single bomb will not jettison.

WARNING

- All normal jettison circuits in the aircraft are disabled once the emergency extension gear handle in the rear cockpit is pulled. In this case jettison may be accomplished by use of the armament safety override button.
- To avoid stores collision with the landing gear/flaps, stores should be jettisoned before lowering the gear/flaps, if possible.

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Figure 3-9 (Sheet 3 of 3)

DMAS FAILURE (PC PSW ON DDI)

Some computer hardware/software failures disrupt the orderly execution of the operational flight program. These failures are detected by a combination of DMAS BITs and software checks. These failures will also occur with left generator failure and bus tie open. The CMPTR light will come on and PC PSW will be displayed on the DDI along with the failure numerics. The EWO should record the PC PSW numerics. With the left generator out and bus tie open a DMAS inflight alignment is not possible, however DG and attitude information from the IMU platform will go to the primary reference system if the EWO selects ATTD on the nav computer set control.

1. Emergency attitude indicator - CHECK
2. Radar horizon - CHECK
3. Reference system selector switch - STBY
4. AFCS switch - DISENGAGE
5. NCSC INS knob - SYS OFF
6. Refer to DMAS inflight start-up

DMAS INFLIGHT START-UP

1. Reference system selector switch - STBY
2. NCSC INS knob - SYS OFF FOR 2 MINUTES

CAUTION

After rotating the INS knob to SYS OFF, allow the system to remain off for at least two minutes to provide sufficient time for the IMU gyros to spin down. Failure to allow adequate spindown time will result in damage to the IMU.

3. NCSC INS knob - NAV (Check ALIGN light on).
4. KC keyboard power-on list - PERFORM
5. Resume aircraft maneuvers
   Navigation is degraded to the DR mode. The MALF light will come on after about 9 minutes indicating alignment failure but the DMAS may be used for DR navigation after a position update. The ALIGN light will stay on for the remainder of the flight.

CANOPY DAMAGE/LOSS

If a canopy is damaged or lost, especially as the result of a bird strike or other external factor, consider the following in determining the proper course of action: aircraft control, terrain avoidance, ejection seat damage, possibility of an uncommanded eject light, and impaired intercom/radio communications. If feasible, slow to 250 knots and lower the ejection seats to reduce windblast and improve communications. If applicable, refer to Landing From The Rear Cockpit With Pilot Disabled. It is imperative that EWO experience/abilities be considered before a back seat landing is attempted. After landing, do not open canopy until the ejection seats have been verified safe by egress personnel.

CONTROLLABILITY CHECK

During any inflight emergency, except utility hydraulic and engine failure, 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 5000 feet AGL).
2. Reduce gross weight to minimum practical.
3. Landing gear — DOWN
4. Slats flaps — OUT AND DOWN
   (without structural damage)
   — NORMAL AND SLATS OVERRIDE SWITCH IN
   (with structural damage)
5. Slow aircraft to determine the airspeed that produces acceptable approach and landing handling characteristics, no slower than 17 units AOA.

NOTE

- For aircraft with asymmetrical load, airspeed should be no slower than that at which full aileron trim will maintain wings level.
- **With an asymmetric load near 17,000 foot-pounds (1,500 pounds on station 1 or 9 or 2,500 pounds on 2 or 8), landing with a crosswind component over 10 knots from opposite the heavy wing is not recommended.**
- Arresting gear limitations and field conditions must be considered.

If adequate control is not available due to asymmetric load –

6. Asymmetric load — JETTISON (refer to Jettison Chart)

If adequate control is available –

6. Maintain landing configuration and make straight-in approach.
7. Enroute to final approach, fly no slower than 230 knots with gear down and flaps up; or 200 knots with gear down and slats out/flaps down.
8. Fly final approach no slower than minimum control airspeed determined during controllability check.
9. Do not flare during landing.

LANDING EMERGENCIES

EMERGENCY LANDING PATTERN

The emergency landing pattern is a pattern to be flown when engine thrust is available and an emergency exists or there is a malfunction which could result in an emergency. The primary objective of the pattern is to land the aircraft safely in the first attempt with least amount of risk. Because of the many variables involved, such as type of emergency, position and altitude in relation to the field, gross weight, fuel remaining, weather, populated areas, runway length, availability of arresting gear, etc., a standard pattern cannot be prescribed. Depending on the circumstances it might be desirable to utilize GCA, make a straight–in approach, enter the pattern from downwind or base leg, or make a 360° overhead pattern. Because of the various circumstances, the pilot's evaluation of all factors and his judgment will determine the type of landing pattern to be flown. However, there are some general guidelines which are applicable regardless of approach selected: Reduce gross weight to minimum practical. In the pattern and before establishing the landing configuration, maintain a minimum maneuvering airspeed of 230 knots (250 knots, single engine). The pattern should be planned to avoid abrupt, steep or hard turns and large or abrupt power changes especially with a flight control malfunction or a hydraulic system failure. Circumstances permitting, a long straight–in final should be planned and the landing configuration established when on final. The air refuel switch should be placed to EXTEND prior to landing to depressurize the fuel tanks. Should the nature of the emergency or other factors dictate establishing the landing configuration prior to final, 230 knots–flaps up, or 200 knots – slats flaps OUT AND DOWN should be maintained until established on final. These airspeeds will provide a margin of safety for maneuvering flight. If the pattern must be entered on downwind, base or from an overhead pattern, the pattern should be expanded, the landing configuration established prior to final, and roll–out on final should be at least 2 – 3 miles out. A normal 2 – 3° glide slope should be flown. For most emergencies, final approach airspeeds are increased and AOA decreased to provide adequate aircraft handling characteristics.

ENGINE FAILURE ON FINAL

At the first indication of engine failure, advance both throttles to maximum thrust rather than trying to determine which engine has failed. Any delay in applying power will result in an excessive sink rate and/or airspeed bleed–off. Accept a continued descent until level–off can be smoothly effected. External store drag is negligible at low airspeed and has little effect on performance. Gross weight dictates the thrust required to continue the approach or go–around. Very little yaw is induced by military thrust on one engine. Afterburner thrust creates a slight yaw which can be controlled with rudder. Normally the approach can be continued to a single–engine landing.

1. **THROTTLES - AFTERBURNER**
2. Go around or follow Single–Engine Landing procedure, this section.

NOTE

If the left engine fails and the bus tie remains open, afterburner ignition will not be available. If afterburner thrust is required, afterburner light–offs are generally obtainable through turbine torching by jam accelerating the right engine at 90% rpm or above.

ENGINE FIRE/OVERHEAT ON FINAL

1. Land as soon as possible

If time permits -

2. Throttle good engine – AS REQUIRED
3. Throttle bad engine – IDLE
4. If warning light goes out, fire test button – PRESS All FIRE and OVERHT lights should come on. After compliance with TOs 1F–4–1484 and 1F–4–1503, the voice warning FIRE–FIRE should also be heard. If any FIRE/OVERHT light does not come on, assume a burn–through condition in the corresponding engine/aft fuselage. After TO 1F–4–1503, if a burn–through has occured, the MASTER CAUTION light and telelight panel fault light (FIRE SYS) will come on.

If warning light on, detection system inoperative, or fire confirmed -

5. Generator bad engine - OFF
6. Throttle bad engine - OFF
7. Master switch bad engine - OFF
8. Follow Single–Engine Landing procedure, this section.

SINGLE–ENGINE LANDING

1. Reduce the airplane gross weight to minimum practical.
2. Inlet ramp on good engine - CHECK FULLY RETRACTED.
   If inlet ramp is in the extended position, the AB must be utilized to make a safe approach.
3. All nonessential electrical equipment - OFF
4. Make a fully configured 17 unit AOA approach.

WARNING

- If the utility system on the operating engine fails, the flaps will retract to a low drag trail position. Refer to Utility Hydraulic and Engine Failure (With or Without Single PC Failure).
- If power control system fails on the operating engine, refer to Double Power Control System Failure.

NOTE

- If the left engine is shut down, and the bus tie is open, afterburner ignition on the right engine is not available. However, if afterburner thrust on the right engine is required, afterburner lights—off are generally obtainable through turbine torching by jam accelerating the right engine at 90% rpm or above.
- Utility hydraulic pressure may go to zero for 10—15 seconds during landing gear extension with an engine shutdown. Aircraft handling difficulties may be encountered if in other than wings level flight. Delay selection of slats flaps OUT and DN until pressure recovers.
- As the rpm on a windmilling engine decreases, hydraulic pressure may drop below 1500 psi. Anticipate a master caution and CHK HYD telelight if not previously illuminated. As the rpm continues to decrease, loss of associated power control unit and utility pump for the affected engine is imminent.

SINGLE ENGINE GO–AROUND

At the first indication that a go–around may be necessary, advance the throttle of operating engine to maximum thrust. Continue the approach until sufficient airspeed to level off is attained. Begin a shallow angle climb and retract the landing gear. Do not retract the slats flaps below 230 knots.

SPLIT–FLAP/DEFLECTED RUDDER

An unusual roll occurring when the flaps are extended may be due to a split–flap condition. A similar yaw/roll will occur when the flaps are extended if the ARI signal excitation circuit breaker (E9, No. 2 panel) is popped or a fuse in the ARI amplifier is blown. In this case, when the flaps reach the down position the rudder will deflect 10°. The rudder deflection can be overcome by rudder pedal pressure or alleviated by depressing the emergency quick release lever, retracting the flaps or resetting the ARI signal excitation circuit breaker, if popped. When a split–flap condition or rudder deflection occurs or is suspected:

1. Emergency quick release lever – HOLD PRESSED
2. Immediately accelerate above 200 knots.
3. Slats flaps – NORM

   Retract slats flaps while maintaining positive aircraft control.
4. Emergency quick release lever – RELEASE (After flaps up)
5. ARI signal excitation circuit breaker – RESET (E9, No. 2 panel)
6. Follow No–Slats flaps Landing procedure.
7. AFCS – DO NOT ENGAGE

FLAP FAILURE

Inadvertent flap retraction caused by an electrical or hydraulic malfunction, when at normal approach AOA and with slats flaps OUT AND DOWN selected, can be expected to result in the following:

a. Immediate wing rocking due to asymmeteric flap retraction.

b. An immediate increase of 2 units AOA and lighter stick forces with a nose pitch up movement.

c. Mild buffet within 2 seconds, increasing with time.

d. Poor directional stability.

e. Increase of sink rate to about 2,000 fpm.

For the above condition, afterburner should be selected in order to ensure aircraft control. Flap failures at lesser AOA do not result in as sudden or significant a change in flight characteristics and should be easily controlled.

FLAPS SLATS EMERGENCY LOWERING

CAUTION

The emergency slats flaps extension system should be activated only if the utility system fails. If the emergency system is activated with normal utility hydraulic pressure available, there is a high probability of losing utility hydraulic system pressure. With utility system pressure available and a known or suspected slats flaps malfunction, a no–flap landing is recommended.

If normal slats flaps operation fails, slats flaps can be lowered pneumatically by executing the following steps:

1. Airspeed – BELOW 250 KNOTS
2. Slats flaps circuit breaker – PULL
3. Slats flaps emergency extension handle – PULL AFT

   If front cockpit emergency slats flaps lowering fails, retain front cockpit handle in the aft position and utilize rear cockpit emergency slats flaps handle. Asymmetric flap extension may occur when flaps are extended by the emergency method. This will result in a momentary roll which can be countered by normal application of aircraft controls. Leave emergency slats flaps extension handle in the full aft position. Returning handle to its normal position allows compressed air from the slats flaps down side of the actuating cylinders to be vented overboard.
4. Slats flaps position indicators – CHECK

   Slats flaps extension with the emergency extension handle will place the slats out and the flaps down. The flaps will indicate DN as soon as extension starts; however, actual flap extension is a function of airloads and they will not be fully extended above about 230 knots. The slats will not operate automatically and will remain out regardless of airspeed. If the pneumatic system fails, the flaps may retract asymmetrically. This will result in a momentary roll which can be countered by normal application of aircraft controls.

LANDING WITH NO FLAPS/SLATS IN OR OUT

A straight–in approach is recommended. For all abnormal slats flaps configurations, on–speed AOA on final will provide satisfactory control, but noticable buffet will be present. If a no slats flaps landing is a result of flap switch failure or split flaps on the downwind of an overhead pattern, expand the pattern and fly a minimum of 230 knots on the downwind. The slats will extend automatically in accordance with their AOA schedule if electrical and hydraulic power are available unless the slats override switch is placed to IN. The slats override switch should remain at NORM unless an asymmetric slat condition occurs. Refer to Final Approach Speeds chart, appendix A, for corresponding airspeeds for no–slats flaps approaches.

1. Slats flaps – NORM

   Failure of the flaps to extend may indicate a massive leak in the flaps down line. In this case, continued flight with the slats flaps switch OUT AND DOWN can cause utility hydraulic system failure.
2. Slats override switch – NORM (IN FOR ASYMMETRIC SLATS)
3. Fly on–speed AOA on final (17 units for abnormal slat configuration)

CAUTION

After touchdown, use of excessive back stick to provide aerodynamic braking can result in dragging the stabilator due to increased stabilator effectiveness at the higher touchdown speed.

LANDING WITH RAMP FAILURE

If both engines are operating, slats flaps OUT AND DOWN landings can be safely made with one inlet ramp fully extended. Reduce gross weight prior to landing. Normal thrust settings must be increased 1 to 2% rpm to maintain an on-speed approach. Afterburner may be required for a late go-around.

Both ramps extended –

1. Make a fully configured 17 unit AOA approach.

LANDING WITH EXHAUST NOZZLE FAILURE

If one or both nozzles fail fully closed, consideration should be given to reducing gross weight to the minimum practical. If one nozzle fails fully closed, consider shutting down the affected engine upon landing due to increased thrust at idle power. If both nozzles fail fully closed, the right engine should be shut down on landing to keep critical items on line in case of BUS TIE OPEN. If only one nozzle fails to the open position, make a normal approach and landing. In the event both nozzles fail to the open position, the thrust available in MIL range will be approximately equal to the thrust available during single engine operation in MIL range and a fully configured 17 unit AOA approach should be made.

1. Reduce the airplane gross weight to minimum practical.
2. Shut down affected engine upon landing.

If both nozzles failed open –

3. Make a 17 unit AOA approach.

If both nozzles failed closed -

3. Shut down right engine upon landing.

LANDING WITH BOTH ENGINES INOPERATIVE

Landing with both engines inoperative will not be attempted unless escape from the aircraft is impossible

LANDING WITH A 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 or during a touch and go landing. If a rupture occurs during a touch and go, the procedures for Blown Tire During Takeoff will apply. A blown tire and high speed require immediate corrective action to keep the aircraft aligned with the runway, therefore:

LANDING WITH A KNOWN BLOWN TIRE

1. Anti-skid switch - OFF
   Turn the anti-skid switch OFF to prevent loss of braking on the good tire resulting from skid indications from the blown tire.
2. Plan to make an approach-end arrestment.
   Refer to Approach-End Arrestment Procedure, this section.

If an approach-end arrestment is not feasible –

3. Land on side of runway opposite blown tire.
4. Touchdown with weight on good tire.
5. Nose gear steering - ENGAGE
   Even a momentary release of nose gear steering may result in loss of control. Full forward stick will increase nosewheel traction and improve steering capability. If required, use aerodynamic steering and braking on the good tire to maintain directional control.
6. Drag chute - DEPLOY
7. Use opposite braking to stop.

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.

8. Do not retract flaps.
   The wing flap seal may have been damaged by piece of broken tire and retracting the wing flaps will increase the damage.

BLOWN TIRE DURING LANDING ROLLOUT

1. **NOSE GEAR STEERING - ENGAGE**
   Even a momentary release of nose gear steering may result in loss of control. Full forward stick will increase nosewheel traction and improve steering capability. If required, use aerodynamic steering and braking on the good tire to maintain directional control.
2. **ANTI-SKID - OFF**
3. **HOOK - DOWN**
4. Use opposite braking to stop.

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.
- If both main tires fail, directional control difficulties may not be apparent until the latter part of the landing roll.

5. Do not retract flaps.
   The wing flap seals may have been damaged by pieces of broken tire and retracting the wing flaps will increase damage.

LANDING WITH ANTI-SKID FAILURE

Landing with a known anti-skid failure requires no special technique except that braking during landing roll must be done with extreme caution to avoid skidding a tire. At high speed and particularly with wet or icy conditions, a wheel can be locked with light pedal pressure and very small pedal deflections. Apply very light pedal pressure initially and slowly increase pedal pressure as speed decreases. If a skid occurs or is suspected, fully relieve brake pressure momentarily to allow the locked wheel(s) to come back up to speed. Plan on using all the runway.

Differential braking cannot correct for swerving or fishtailing due to wheel skid. The aircraft tends to swerve away from the locked wheel requiring release of the brake you would instinctively apply.

An approach-end arrestment should be considered in light of existing environmental factors such as runway condition, crosswind, and arrestment cable location. If the ANTI-SKID INOPERATIVE light illuminates:

1. ARI circuit breaker (Left Subpanel) and anti−skid circuit breakers (A11, B10, B11, No. 3 panel) − CHECK IN
2. Anti−skid switch − CYCLE

If anti-skid is still inoperative -

3. Anti-skid switch - OFF
4. Consider approach-end arrestment. Refer to Approach-End Arrestment, this section
5. Avoid heavy braking

LANDING FROM THE REAR COCKPIT WITH PILOT DISABLED

If the combination of weather, landing facilities, aircrew experience and aircraft condition is less than ideal, consideration should be given to a controlled ejection. A landing made from the rear seat when the pilot is incapacitated presents a number of problems. The problem areas are: slats flaps and gear lowering, directional control, braking, and engine shutdown. The landing gear and slats flaps can be lowered by the emergency method (blown down) from the aft cockpit. Assuming normal utility pressure, there is a possibility of rupturing the utility hydraulic reservoir when the gear and slats flaps are blown down. However, tests have shown that the probability of the reservoir rupturing when the gear is lowered is fairly remote. These same tests have shown the probability of the reservoir rupturing when the slats flaps are lowered is almost certain. Therefore, it would be advisable to land with flaps up, if practical. If the slats flaps are blown down, the resultant rupture of the utility hydraulic reservoir will make a landing without nosewheel steering or normal brakes necessary. Anti-skid will be inoperative with the front cockpit gear handle in the UP position. With the front cockpit gear handle up, the auxiliary air doors will remain closed and auto-acceleration (with no means to shut down an engine from the rear seat) must be anticipated. If the situation permits and utility hydraulic pressure is normal, pull the RH AUX AIR DOOR CONTROL circuit breaker (A3, No. 3 panel). This will open the left auxiliary air door and prevent auto-acceleration of the left engine. Additional items not available: utility hydraulic pressure indicator (loss of radar antenna drive, speed brakes and power rudder indicates utility failure), arresting hook, and drag chute.

CAUTION

Because of the limited number of brake applications, taxiing should not be attempted when using the emergency brakes.

LANDING WITH ONE UTILITY HYDRAULIC PUMP FAILED

1. Make straight-in approach
2. Make a fully configured 17 unit AOA approach.
3. Consider an approach-end arrestment

LANDING WITH UTILITY HYDRAULIC SYSTEM FAILURE

CAUTION

- When landing with a utility hydraulic system failure, nose gear steering and anti−skid protection will not be available, auto acceleration will probably occur, and expect approximately 10 percent of normal rudder authority for maintaining directional control after touchdown.
- If the utility hydraulic system fails after normal flap extension, expect flap failure symptoms.

NOTE

If CHK HYD GAGES indicator light comes on and remains on, monitor the hydraulic system indicators for the remainder of the flight, since warning of a PC hydraulic system failure will not be given.

1. Fly emergency landing pattern.
2. If gear not down and locked - BLOW DOWN
   Refer to Landing Gear Emergency Lowering, this section. If gear was down and locked before loss of utility hydraulic system, do not blow down.
3. Slats flaps - BLOW DOWN
   Refer to Slats Flaps Emergency Lowering this section.
4. Anti-skid - OFF.
5. Fly 17 units AOA on final.
   The increase in speed at 17 units AOA will help preclude directional control difficulties in the event that subsequent failures degrade available lateral control.
6. Make an approach end arrestment, if possible.
   Refer to Approach End Arrestment, this section.
7. Utilize emergency braking.
   Do not pull the emergency brake handle until just before braking is required. Refer to Directional Control After Landing With Utility Hydraulic System Failure, this section.
8. Anticipate auto acceleration.
   Refer to Aux Air Door Malfunction, this section.

DIRECTIONAL CONTROL AFTER LANDING WITH UTILITY HYDRAULIC SYSTEM FAILURE

Without utility hydraulic system pressure available, directional control is a major concern due to loss of normal rudder, normal braking and nose gear steering. Alternative means of managing the potential problem include: differential emergency braking, manual rudder, and ailerons/spoilers. Small deflections (approximately 10 percent of normal) of manual rudder are available at landing speeds, and require extreme pedal pressure. Aileron/spoiler steering is considerably less effective than normal due to loss of ARI. Asymmetric power may provide minimal directional assistance and should only be used as a last resort because it adversely effects deceleration, landing roll, and braking.

WARNING

- Without utility hydraulic system pressure available, differential emergency braking provides the only immediate and positive means of regaining/maintaining directional control. It should be used without hesitation if directional control becomes at all questionable. In cross winds and at low roll−out speeds, differential emergency braking may be the only way to maintain directional control.
- Use of the drag chute in a strong crosswind will require additional differential braking. It may become necessary to jettison the drag chute to regain directional control in a crosswind. On wet runways, this could be a very significant factor in maintaining heading through use of differential emergency brakes.
- The emergency brakes should be cycled as little as possible to conserve emergency accumulator pressure. Should accumulator pressure become depleted through repeated applications of the emergency brakes, very limited directional control remains through the use of manual rudder and aileron/spoilers.

LANDING WITH HARD–OVER RUDDER

The aircraft can be flown and landed with a hard–over rudder if the proper procedures are followed. Satisfactory aileron control is available up to 16 units angle of attack. Above 16 units full lateral stick is required to maintain level flight. If an inadvertent roll into the hard–over rudder occurs and full lateral stick will not reduce the roll rate, the angle of attack must be reduced to regain lateral control. When a hard–over rudder occurs, angle of attack indications are in error due to aircraft sideslip. If the hard–over rudder is to the right, the indicated angle of attack is 2 units lower than actual. If the hard–over rudder is to the left, the indicated angle of attack is 2 units higher than actual. Therefore, when flying an approach, it is imperative that an approach airspeed be used and that the angle of attack be disregarded. Inflight deployment of the drag chute considerably reduces sideslip and bank angles resulting in an easier approach and landing. However, due to the low reliability of the drag chute during inflight deployments, it is recommended that this procedure be used only if approach–end arresting gear is not available. Use of asymmetric thrust also reduces sideslip and bank angles and should be used if a hard–over rudder landing is made without the drag chute. If sufficient single engine thrust is available, additional asymmetric thrust effect can by obtained by extending the speed brakes. The drift must be arrested early and runway alignment maintained to engage the arresting gear as close to center as possible. Controlling the drift prior to cable engagement will increase engagement success and ensure directional control is maintained in the event of a missed engagement. After touchdown, immediate drift in the direction of hard−over rudder should be anticipated and controlled with nose gear steering and full forward stick for increased nose wheel traction. Even a momentary loss of NGS may cause loss of directional control. If arresting gear is not available or a cable engagement is not successful, a combination of NGS and light differential braking should be used to prevent runway departure.

If approach–end arresting gear is available -

1. Make a fully configured approach at the airspeed shown in figure 3−10.

GRWT	APRCH SP GEAR DN
	KNOTS
34,000	161
35,000	163
36,000	165
37,000	168
38,000	170
39,000	172
40,000	174

4G−1−(31)A

Figure 3–10

2. Engine opposite hard−over rudder − IDLE
3. If sufficient single engine thrust is available − EXTEND SPEED BRAKES
4. Make an approach−end arrestment.
   Refer to Approach−End Arrestment procedure, this section.
5. Anticipate immediate drift in the direction of hard−over rudder.
6. Drag chute − DEPLOY AT TOUCHDOWN
   Deploy drag chute immediately upon touchdown to assist in directional control while approaching the arresting gear.
7. Use full forward stick and nose gear steering to maintain runway alignment. Engage nose gear steering only when rudder pedals are neutral.

If approach-end arresting gear is not available -

1. Make a fully configured approach 15 knots faster than the airspeed shown in figure 3−10.
2. Deploy drag chute on final approach 1 1/2 miles from touchdown.
3. Fly final approach airspeed as shown in figure 3−10. Approximately 90% rpm will be required.
4. Land on side of runway opposite the hard−over rudder.

5. Anticipate immediate drift in the direction of hard—over rudder.
6. Use full forward stick, nose gear steering and light braking on the wheel opposite the hard—over rudder to maintain directional control. Engage nose gear steering only when rudder pedals are neutral.

LANDING GEAR MALFUNCTIONS

A landing gear malfunction may be caused by mechanical malfunction, loss of utility hydraulic system pressure or electrical malfunction. An apparent landing gear malfunction may be caused by an indication system failure rather than failure of the gear to extend and lock. After extending the gear, if a landing gear position indicator shows barberpole with the gear handle light out or all three position indicators show a wheel with the gear handle light on, the malfunction is probably in the indicating system. Use the Landing Gear Fails to Extend procedure when the utility and electrical systems are normal and a mechanical malfunction exists or an indication system failure is suspected. Use the Landing Gear Emergency Lowering procedure when the utility hydraulic or electrical system is failed. A visual check of the actual gear position should be made. If a gear appears fully extended, it is difficult to visually determine that it is locked down. When conflicting evidence (e.g., unsafe indications with gear visually confirmed down) is present, the pilot must make the decision to treat it as unsafe or down and locked based on all available evidence, landing conditions, and facilities. The procedures provided for this emergency, including those in the Landing Gear Malfunctions - Emergency Landing chart (figure 3-11), will usually be the safest and result in the least aircraft damage; however, results are difficult to predict in any particular case. When using the Landing Gear Malfunctions - Emergency Landings chart, treat an unsafe gear as though that gear is retracted.

LANDING GEAR FAILS TO EXTEND (NORMAL UTILITY HYDRAULIC AND ELECTRICAL SYSTEMS)

Usually, with a mechanical malfunction, only one gear will be affected. The malfunctioning landing gear may be locked up, partially extended, or down but not locked. Indications of this malfunction are a red light in the gear handle and the gear indicator indicating UP or barber pole. Check utility hydraulic system pressure and obtain a visual gear check if possible. Pulling and resetting the landing gear circuit breaker with the gear handle down provides a hydraulic pressure surge which may extend the nose gear. Negative G while placing the gear handle down reduces the breakout force required to get the gear out of the wheelwell. Positive G will put a vertical load and yaw will put a side load on a partially extended gear to assist in full extension and locking. Right yaw should be used for an unsafe right main gear and left yaw for a left main gear. With normal utility hydraulic system pressure, the Landing Gear Emergency Lowering procedure will probably not lock a gear down that is out of the well when the remaining gear are down and locked. If the gear is visually confirmed down, the Landing Gear Emergency Lowering procedure should not be used.

Certain electrical failures may cause all or some gear to remain in the well or partially extend. The probability of simultaneous mechanical failure of two or more gear is remote. Therefore, if two or more gear are in the wheelwell or partially extended, an electrical failure is most likely the cause. Gear lowering requires normal utility hydraulics and 28vdc power from either the right transformer rectifier or battery. In this case, the Landing Gear Emergency Lowering procedure may bypass the electrical failure.

1. Airspeed below 250 knots (gear handle down)
2. Landing gear circuit breaker - PULL (wait a few seconds) then RESET
3. Landing gear and flap position indicator circuit breaker (B13, No. 3 panel) - CHECK IN
4. Landing gear - CYCLE

GEAR INDICATOR FAILURE SUSPECTED–

Nose gear indicates unsafe–

5. Land beyond approach–end arresting gear
6. Do not shut down engines
7. Do not taxi until downlocks are installed

Nose gear indicates safe–

5. Make approach–end arrestment
6. Do not shut down engines
7. Do not taxi until downlocks are installed

GEAR INDICATOR OK –

If two or more gear up or partially extended –

5. Use Landing Gear Emergency Lowering procedure

If one gear still in wheelwell –

5. Landing gear handle - UP
6. Apply negative G
7. While under negative G, landing gear handle - DOWN
8. If gear still in wheelwell, refer to Landing Gear Malfunctions - Emergency Landings chart.

If one gear still partially extended –

5. Yaw aircraft and apply positive G.
6. If gear still partially extended, refer to Landing Gear Malfunctions - Emergency Landings chart.

LANDING GEAR EMERGENCY LOWERING (UTILITY HYDRAULIC OR ELECTRICAL SYSTEM FAILED)

CAUTION

- Do not use this procedure if the landing gear is already down and locked and subsequent electrical or hydraulic failure occurs. In this circumstance, emergency gear lowering does not make the gear safer and, rarely, has caused a previously down and locked gear to become unsafe.
- If the landing gear is inadvertently extended in flight by emergency pneumatic pressure, they must be left in the extended position until post-flight servicing. If retraction in flight is attempted, rupture of the utility reservoir will probably occur with subsequent loss of the utility hydraulic system.

If normal landing gear operation fails, the landing gear can be lowered by the following procedures:

1. Landing gear circuit breaker - PULL
2. Landing gear handle - DOWN
3. Landing gear handle - HOLD FULL AFT
   Hold handle in full aft position until gear indicates down and locked, and then leave the landing gear handle in the full aft position. 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.

WARNING

All normal jettison circuits in the aircraft are disabled once the emergency landing gear control handle in the rear cockpit is pulled. Jettison may still be accomplished by holding the armament safety override button in while actuating the appropriate jettison switch.

If landing gear is still unsafe –

4. Retain front cockpit handle in extend position and pull rear cockpit emergency gear lowering handle.
5. Yaw airplane to assist in locking main gear.
6. Bounce airplane on main gear (during touch–and–go) to assist lowering/locking the nose gear.
   Due to increased stabilator effectiveness, a no–flap touch and go is recommended.

WARNING

AOA is approximately 1 unit higher than indicated during nose gear up approaches.

7. If gear is still unsafe, refer to Landing Gear Malfunctions–Emergency Landings chart.

LANDING GEAR EMERGENCY RETRACTION

If the gear must be retracted after Landing Gear Emergency Lowering, use this procedure. If utility hydraulic system pressure is low, the gear may not retract or may only partially retract.

1. Emergency gear handle(s) – PUSH IN.

NOTE

The rear cockpit spring–loaded locking plunger must be pushed UP before the rear handle can be reset.

2. Wait as long as practical (minimum 1 minute)
3. Landing gear handle – UP
4. Landing gear circuit breaker – RESET

CAUTION

The landing gear circuit breaker must not be reset until the emergency handle(s) is/are returned to normal, maintained in that position for a minimum of 1 minute, and then landing gear handle placed UP. Only then may the circuit breaker be safely reset.

5. Refer to Landing Gear Malfunctions–Emergency Landings chart.

AUXILIARY AIR DOOR MALFUNCTION (GEAR DOWN)

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% 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 airflow and thrust under high temperature conditions, and can cause the idle speed to increase to 100% rpm. The auto–accelerated engine can be shut down 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).

1. Auxiliary air door control circuit breakers – RESET (A2, A3, No. 3 panel)

If light(s) remain on –

AUTO–ACCELERATION OF ONE ENGINE

1. Throttle bad engine – IDLE
   Modulate throttle of good engine for desired thrust. The combined thrust of the auto–accelerated engine in idle, and the good engine in idle, will not be in excess of that required to make an optimum on speed approach.
2. At touchdown, bad engine – SHUTDOWN

AUTO–ACCELERATION OF BOTH ENGINES

1. Throttle of either engine – IDLE
2. Modulate the throttle of the remaining engine for desired thrust.
3. Make a fully configured 17 unit AOA approach.
4. Make an approach–end arrestment.
   Refer to approach–end arrestment procedure, this section.
5. At touchdown, right engine – SHUTDOWN

LANDING GEAR MALFUNCTIONS - EMERGENCY LANDINGS

BEFORE ATTEMPTING LANDING, CONSIDER:
ARRESTING GEAR LIMITATIONS
CROSSWIND
RUNWAY AND OVERRUN CONDITION
AIRCRAFT CONFIGURATION
AIRCREW EXPERIENCE

IF CONDITIONS NOT IDEAL – **EJECT**
TREAT UNSAFE GEAR AS RETRACTED

BEFORE LANDING-

■ 1. JETTISON ARMAMENT (CONSIDER RETAINING RACKS) - REFER TO JETTISON CHART
2. DUMP OR BURN EXCESS FUEL
3. RETAIN EMPTY EXTERNAL WING TANKS (DEPRESSURIZE)
■ 4. JETTISON ℄ TANK - REFER TO JETTISON CHART
5. SHOULDER HARNESS - LOCK
6. SLATS FLAPS - OUT AND DOWN
7. FLY COMPUTED ON SPEED +10 KNOTS WITH FLAT APPROACH

LANDING NOT RECOMMENDED

ONE MAIN–NO NOSE

- ATTEMPT TO RETRACT GEAR (NORMAL OR EMERGENCY) AND REFER TO ALL GEAR UP.

IF GEAR WILL NOT RETRACT–
- GEAR–BLOW DOWN

IF STILL ONE MAIN–NO NOSE–
- RECOMMEND EJECT

ARRESTMENT NOT RECOMMENDED

BOTH MAIN–NO NOSE

- REQUEST REMOVAL OF APPROACH–END/ MIDFIELD ARRESTING GEAR CABLES
- LAND BEYOND APPROACH–END ARRESTING GEAR (IF INSTALLED)
- DO NOT SHUTDOWN ENGINES UNTIL STOPPED
- DEPLOY CHUTE AFTER NOSE LOWERED

BOTH MAIN–STUB NOSE

IF UTILITY HYDRAULIC PRESSURE NORMAL –
- RETRACT GEAR AND REFER TO ALL GEAR UP

IF GEAR IS NOT RETRACTED –
- REQUEST REMOVAL OF APPROACH–END/ MIDFIELD ARRESTING GEAR CABLES
- LAND BEYOND APPROACH–END ARRESTING GEAR (IF INSTALLED)
- DO NOT SHUTDOWN ENGINES UNTIL STOPPED
- DEPLOY CHUTE AFTER NOSE LOWERED

ALL GEAR UP

WITH OR WITHOUT WING PYLONS

WITHOUT EXTERNAL WING TANKS

- DEPLOY CHUTE AT TOUCHDOWN

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Figure 3-11 (Sheet 1 of 2)

LANDING GEAR MALFUNCTIONS - EMERGENCY LANDINGS (*Continued*)

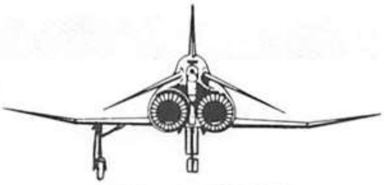
APPROACH END ARRESTMENT RECOMMENDED


ALL GEAR UP

WITH EXTERNAL WING TANKS

- DEPLOY CHUTE AT TOUCHDOWN

IF ARRESTMENT NOT PRACTICAL –
- DEPLOY CHUTE AT TOUCHDOWN


ONE MAIN NOSE DOWN

IF UTILITY HYDRAULIC PRESSURE NORMAL–
- RETRACT GEAR AND REFER TO ALL GEAR UP

IF GEAR IS NOT RETRACTED–
- DO NOT DEPLOY CHUTE (EXCEPT MISSED ENGAGEMENT)

IF ARRESTMENT NOT PRACTICAL–
- LAND OFF RUNWAY ℄ OPPOSITE FAILED GEAR
- DEPLOY CHUTE AT TOUCHDOWN
- DO NOT SHUT DOWN ENGINES UNTIL STOPPED


STUB MAIN OR BOTH STUB MAIN–NOSE DOWN

IF UTILITY HYDRAULIC PRESSURE NORMAL –
- RETRACT GEAR AND REFER TO ALL GEAR UP

IF GEAR IS NOT RETRACTED –
- LAND OFF RUNWAY ℄ OPPOSITE FAILED GEAR
- DO NOT DEPLOY CHUTE (EXCEPT MISSED ENGAGEMENT)

IF ARRESTMENT NOT PRACTICAL–
- LAND OFF RUNWAY ℄ OPPOSITE FAILED GEAR
- DEPLOY CHUTE AT TOUCHDOWN
- DO NOT SHUT DOWN ENGINES UNTIL STOPPED


NO MAIN – NOSE DOWN

- DEPLOY CHUTE AT TOUCHDOWN

IF ARRESTMENT NOT PRACTICAL –
- DEPLOY CHUTE AT TOUCHDOWN
- DO NOT SHUT DOWN ENGINES UNTIL STOPPED

4G-1-(30-2)44

Figure 3-11 (Sheet 2 of 2)

ARRESTING HOOK EMERGENCY OPERATION

If the arresting hook fails to extend when the control handle is placed in the down position, deenergize the solenoid selector valve by pulling the hook control circuit breaker in the rear cockpit. Pressure is then removed from the up side of the arresting hook actuator cylinder and the hook will extend. There are no provisions for arresting hook retraction in the event of a utility hydraulic failure or double generator failure.

1. Hook handle - DOWN
2. Arresting hook circuit breaker - PULL (A4, No. 3 panel)

APPROACH-END ARRESTMENT

Approach-end arrestments are considered practical whenever a malfunction or adverse weather conditions present a threat to directional control and there is suitable landing surface in front of the arrestment cable on which to land and lower the nose prior to cable contact. A touchdown point should be selected based on existing environmental factors such as arrestment cable location, runway condition, crosswind, nature of emergency and anticipated difficulty in high speed directional control. Consideration should also be given to the engaging speed limits to prevent structural failure to the arresting gear or the aircraft. See Field Arresting Gear Data (figure 3-12)

1. Notify tower.
2. Reduce gross weight to lowest practical.
3. Fly pattern as dictated by emergency.
4. Gear - DOWN
5. Hook - DOWN
6. **Air refuel switch - EXTEND (monitor fuel gage)**
7. Inertia reel - LOCKED
8. Plan for missed engagement
   Consider type of emergency, availability of back-up barriers, runway length, runway condition reading (RCR), fuel state, weather, and other pertinent factors.
9. Fly final approach to touchdown a minimum 300 feet short of cable.

WARNING

When directional control difficulties are anticipated, a landing should be planned as close to the cable as practical; however, no closer than 300 feet.

10. Throttles - IDLE
11. Stick - FORWARD

CAUTION

To preclude nose gear slap and damage, engage arresting gear with the nose gear on the runway.

12. Drag chute - AS DESIRED
    Use of the drag chute during approach-end arrestments should be considered in light of existing environmental factors such as arrestment cable location, runway condition, crosswind, nature of emergency, and probability of go-around. When drag chute is utilized the pilot must be prepared to jettison the drag chute should a go-around be required.
13. Engage cable in center at 90° with brakes off.
    The throttles may be inadvertently advanced should deceleration forces cause the pilot's hand to be thrown forward on the throttles.

NOTE

If runway centerline lights are installed, a 90° slightly off-centerline engagement is recommended due to possible hook bounce and missed engagement.

14. Control rate and direction of roll back with throttles. and brakes.
    The arrestment cable will pull the aircraft rearward after engagement. Be prepared to counteract rearward acceleration with throttles and/or brakes. When the aircraft has come to a complete stop, normal or emergency brakes may be used to maintain position. Normal brakes may not operate until the anti-skid is disengaged.

CAUTION

The arrestment cable may be damaged by the wheel rims of aircraft with blown tires. In instances where wheels are locked, the damage to the cable is more severe and cable failure is probable.

15. Flaps - DO NOT CHANGE POSITION
    Do not retract flaps until cleared to taxi by ground personnel.
16. **(P-EWO) Radar and radar altimeter - OFF**

MIDFIELD/DEPARTURE-END ARRESTMENT

1. Hook - DOWN
2. Throttles - IDLE
3. Stick - FORWARD
4. Drag chute - AS DESIRED
5. Engage cable in center at 90° with brakes off.
   If rudder control, nose gear steering, and brakes are lost, steering can be accomplished only by differential thrust and/or ailerons and spoilers if sufficient airspeed is available.

CAUTION

Cables may be damaged by the wheel rims of aircraft with blown tires. In instances where wheels are locked, damage to the cable is more severe and cable failure is probable.

NOTE

If runway centerline lights are installed, a 90° slightly off—centerline engagement is recommended due to possible hook bounce and missed engagement.

6. (P–EWO) Radar and radar altimeter - OFF
7. Control rate and direction of roll back with throttles and brakes.

   The arrestment cable will pull the aircraft rearward after engagement. Be prepared to counter any excessive rearward acceleration with normal or emergency brakes. Normal brakes may not operate until the anti–skid is disengaged.
8. Flaps - DO NOT CHANGE POSITION

   Do not retract slats flaps until cleared to taxi by ground personnel.

FIELD ARRESTMENT GEAR DATA

AIRCRAFT WEIGHT – POUNDS	BAK – 6	BAK – 9	BAK – 12/14 STD	BAK – 12/14 1200' R.O.	DUAL BAK – 12 / BAK – 13	M – 21	MA – 1/1A (MA – 1A Mod)	E – 28	MAAS *
	MAXIMUM ENGAGEMENT SPEED – KNOTS GROUND SPEED								
30,000	160	172	180	180	180	140	92	180	170
32,000	160	170	180	180	180	140	90	180	170
34,000	160	168	180	180	180	140	88	180	170
36,000	158	166	180	180	180	140	86	180	170
38,000	156	164	180	180	180	140	84	180	170
40,000	154	162	180	180	180	140	82	180	170
42,000	153	158	180	180	180	140	81	180	▨
44,000	152	155	178	180	180	135	▨	177	▨
46,000	150	150	176	180	180	135	▨	177	▨
48,000	148	146	174	180	180	135	▨	177	▨
50,000	146	142	170	180	180	135	▨	177	▨
52,000	145	140	168	179	180	135	▨	177	▨
54,000	▨	135	166	178	180	135	▨	177	▨
56,000	▨	134	163	177	180	125	▨	176	▨
58,000	▨	132	161	176	180	125	▨	176	▨
60,000	▨	130	159	175	180	125	▨	▨	▨

Mobile Aircraft Arresting System

NOTE

DO NOT DELAY A REQUEST FOR ARRESTING GEAR, RAISING A BAK–12 DEVICE CAN REQUIRE 7 1/2 SECONDS BEFORE IT IS FULLY UP AND LOCKED. WITH A 3 SECOND OPERATOR REACTION TIME, THE AIRCRAFT WILL TRAVEL 2200 FEET AT 125 KNOTS BEFORE THE GEAR IS FULLY UP AND LOCKED.

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Figure 3–12

DITCHING CHART

WARNING

THE AIRCRAFT SHOULD BE DITCHED ONLY WHEN ALL OTHER ATTEMPTS OF EGRESS HAVE FAILED.

BEFORE IMPACT

1. Canopy – JETTISON (fwd first) (PILOT – EWO)
2. Arresting hook – DOWN
3. Leg restraint release handle – PULL AFT (PILOT – EWO)

   Pull leg restraint lines and lock pins thru garter rings before ditching to expedite egress from cockpit.
4. Oxygen mask – TIGHTEN (PILOT – EWO)
5. Oxygen diluter selector – 100% (PILOT – EWO)
6. Shoulder harness – LOCK (PILOT – EWO)
7. Survival Kit selector switch – MANUAL (PILOT – EWO)
8. Fly parallel to swell pattern.
9. Attempt touchdown along wave crest.

AFTER IMPACT

1. Shoulder harness – RELEASE (Pilot – EWO)

WARNING

Do not pull the survival kit release handle until clear of the aircraft. Pulling the handle with the kit resting on the seat will cause the kit to be left in the aircraft. Pulling the handle while standing up in the cockpit will cause the kit to open and remain in the cockpit, and the crewmember will remain attached to the kit by the dropline.

WARNING

- If the lower ejection handle guard is down, rotate the guard up prior to evacuating the cockpit.

2. Pull up on the emergency harness release handle and using a hand–hold for additional leverage stand straight up without twisting to release sticker clips from the seat. (PILOT – EWO)

3. Abandon aircraft (PILOT – EWO)
4. Inflate life vest (PILOT – EWO)

WARNING

To prevent the lungs from bursting due to differential pressure, the crewmember must exhale while ascending to the surface from substantial depths.

5. Inflate life raft (PILOT – EWO)

Note

To inflate the raft the survival kit release handle must be pulled, then the CO_2 bottle cable in the kit must be pulled.

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Figure 3–13

AIRSPEED INDICATOR FAILURE

1. Pitot heat - ON
2. Pitot heat circuit breaker - CHECK IN (D9, No. 3 panel)

FLIGHT CONDITION		ANGLE-OF-ATTACK UNITS
MILITARY POWER CLIMB		
Drag Index = 0	Sea level	5.0
	combat ceiling	9.5
Drag Index = 120	Sea level	8.5
	combat ceiling	10.0
MAXIMUM POWER CLIMB		
All Drag Indexes	Sea level	4.5
	combat ceiling	11.5
CRUISE AT ALTITUDES BELOW 20,000 FT. (all gross weights)		
Drag Index = 0		7.0
Drag Index = 130		8.5
CRUISE AT OPTIMUM ALTITUDE		
Drag Index = 0		8.5
Drag Index = 130		9.0
ENDURANCE AT OPTIMUM ALTITUDE		
Drag Index = 0		9.5
Drag Index = 130		14.0
DESCENTS (low to medium gross weight)		
250 KNOTS, idle power		9.0
300 KNOTS, 80% rpm.		7.0
APPROACH		
GCA Pattern (250 KNOTS, gear up, slats flaps norm)		9.0
Safe gear extension		9.0
Slats flaps extension (gear down, 200 knots)		11.5
Final "On Speed" approach (slats flaps any position, gear down)		19.2
STALL		
Stall Warning (pedal shaker)		22.3

Notes

- DUE TO THE BASIC DIFFICULTY 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 LINERALLY FOR PRACTICAL PURPOSES.
- THE FLAP EXTENSION AND RETRACTION AIRSPEEDS ARE SENSED FROM THE PITOT STATIC SYSTEM.
- DURING LANDING APPROACH, WITH UNRELIABLE AIRSPEED INDICATIONS ABOVE THE 210-250 RANGE, THE FLAPS MAY NOT EXTEND AND THE RUDDERS MAY REMAIN IN THE HIGH GRADIENT LEVEL.

WARNING

DURING LANDING APPROCH WITH FLAPS SELECTED AND INDICATED AIRSPEED FLUCTUATIONS ABOVE AND BELOW THE 210-244 RANGE, THE FLAPS MAY EXTEND OR RETRACT WITHOUT WARNING.

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Figure 3-14

WARNING INDICATOR LIGHTS

LIGHT	CAUSE	CORRECTIVE ACTION/REMARKS
AFCS ALT/GP DISENGAGED	ALTITUDE HOLD OR AUTOMATIC GLIDEPATH STEERING DISENGAGED	INFO ONLY
ALT ENCODER OUT	UNRELIABLE OR NO SIGNAL FROM ALT ENCODER	IF LIGHT STAYS ON: USE VOICE COMMUNICATIONS IF LIGHT FLASHES CONTINUOUSLY: PULL AEU CB (H8, H9, NO. 2 Panel)
R OR L ANTI-ICE ON	NORMAL IS SWITCH ON	IF SWITCH OFF-REDUCE AIRSPEED. IF LIGHT GOES OUT-ACCELERATE AND DISREGARD LIGHT. IF LIGHT STAYS ON-REMAIN AT REDUCED SPEED
ANTI-SKID INOPERATIVE	ANTI-SKID HAS MALFUNCTIONED	• CARRY OUT EMERGENCY PROCEDURE • DISREGARD MOMENTARY LIGHT
APU	PC-1 PRESS BELOW 1000 PSI	• CARRY OUT PC FAILURE PROCEDURE IF NEITHER PC HAS FAILED– • APU CONTROL CB (F5, No. 1 PANEL) –PULL • LAND AS SOON AS PRACTICAL
AUTOPILOT DISENGAGE	AUTOPILOT IS NOT ENGAGED	INFO ONLY
AUTOPILOT PITCH TRIM	AUTOPILOT ENGAGED AND AUTOPILOT PITCH TRIM IS MALFUNCTIONING	• STICK-GRASP FIRMLY • AUTOPILOT-DISENGAGE
R OR L AUX AIR DOOR	DOOR(S) OUT OF PHASE WITH GEAR HANDLE	CARRY OUT EMERGENCY PROCEDURE
BUS TIE OPEN	GEN. ARE OUT OF FREQUENCY PHASE, OR FAULTED CSD UNDERSPEED SWITCH	CARRY OUT EMERGENCY PROCEDURE
CABIN TURB OVERSPEED	TURBINE PRESSURE/TEMP TOO HIGH	• REDUCE THRUST AND SPEED • IF LIGHT STAYS ON: EMER VENT KNOB-PULL
CANOPY UNLOCKED	CANOPY UNLOCKED	GROUND: • REFER TO CANOPY MALFUNCTION PROCEDURE INFLIGHT: • COCKPIT PRESS-DUMP • REDUCE POWER AND AIRSPEED • COMMAND SELECTOR VALVE-VERTICAL IF REAR CANOPY UNSAFE • CANOPY HANDLE-DO NOT MOVE
CHECK FUEL FILTERS	FUEL FILTER(S) ARE CLOGGED	NOTE IN FORM 781
CHK HYD GAGES	PRESSURE BELOW 1500 ± 100 PSI IN PC-1, PC-2 OR UTILITY SYS	CARRY OUT EMERGENCY PROCEDURE
DC BUS	MAIN 28VDC BUS DISCONNECTED FROM ESS 28VDC BUS BECAUSE OF LOW VOLTAGE ON 28VDC	CARRY OUT EMERGENCY PROCEDURE

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Figure 3-15 (Sheet 1 of 2)

WARNING INDICATOR LIGHTS *(Continued)*

LIGHT	CAUSE	CORRECTIVE ACTION/REMARKS
DUCT TEMP HI	INLET TEMP ABOVE 121°C	• REDUCE SPEED • MAINTAIN SUBSONIC CRUISE
L EXT FUEL CTR EXT FUEL R EXT FUEL	• TANK EMPTY • FLOW STOPPED • AIR REFUEL-EXTEND AND REFUEL SELECTION-ALL TANKS	INTERMITTENT ILLUMINATION DURING TRANSFER IS NORMAL.
FIRE OVERHT	EXCESSIVE TEMPERATURES IN ENGINE OR AFT COMPARTMENT	CARRY OUT EMERGENCY PROCEDURE
FIRE SYS	BURN - THROUGH OR DETECTION SYSTEM FAULT	CARRY OUT EMERGENCY PROCEDURES
FUEL LEVEL LOW	FUEL REMAINING: 1650 ±200 POUNDS	CHECK ALL FUEL TRANSFERRED, FEED TK CHK AND FUEL LOW WARN CB (H4, NO. 2 PANEL) IN, ESSENTIAL DC PWR AVAILABLE. IF ANY TANK TRANSFER CB POPPED, REFER TO FUSELAGE FUEL FAILS TO TRANSFER
FUEL INDICATOR ERR LEGEND FLASHING	FUEL QUANTITY SYSTEM MALFUNCTION	ID CODE C, NO CORRECTIVE ACTION. ID CODES 1, 26 AND 00, COMPARE SECTOR AND COUNTER FOR FUEL LOCATION. IF ANY ERR CODE DOES NOT CLEAR, MONITOR FUEL LEVEL LOW LIGHT AND LAND AS SOON AS PRACTICAL.
LH GEN OUT RH GEN OUT	GEN OFF THE LINE	CARRY OUT EMERGENCY PROCEDURE
HOOK DOWN	HOOK IS UNLOCKED	INFO ONLY
IFF	STEADY-MODE 4 ZEROIZED BLINKING-MODE 4 NOT RESPONDING TO INTERROGATION	STEADY-INFORMATION BLINKING-CHECK MODE 4 SELECTOR ON
INERTIAL NAV SYS OUT	IMU FAILURE OR MALFUNCTION	REFERENCE SYSTEM SELECTOR – STBY
MASTER CAUTION	CAUTION CONDITION EXISTS	CHECK TELELIGHTS
OXYGEN LOW	QUANTITY IS 1 LITER OR LESS	DESCEND TO SAFE ALTITUDE
PITCH AUG OFF	PITCH STAB AUG NOT ENGAGED	DO NOT EXCEED 300 KNOTS BELOW 10,000 FEET
RADAR CNI COOL OFF	EQUIPMENT COOLING TURBINE OFF	CARRY OUT EMERGENCY PROCEDURE
SLATS IN	SLAT OVERRIDE SWITCH AT IN POSITION	INFO ONLY
SPEEDBRAKE OUT	SPEEDBRAKES NOT CLOSED	INFO ONLY
STATIC CORR OFF	SPC INOPERATIVE	• CADC SWITCH – RESET CORR. IF LIGHT STAYS ON: • CADC SWITCH – CORR OFF • USE ALT LAG CHART
TANK 7 FUEL	LIGHT INOPERATIVE	LIGHTS ON TEST ONLY
WHEELS	BELOW APPROX 230K-GEAR UP	LOWER GEAR OR ACCELERATE ABOVE FLAP BLOW-UP SPEED
WINDSHIELD TEMP HIGH (BEFORE TO 1F-4-1500)	WINDSHIELD OVERHEATED ILLUMINATION NORMAL AND NO CORRECTIVE ACTION REQUIRED WITH: (1) BUS TIE OPEN -RIGHT GEN OUT (2) INTERMITTENT AT HIGH MACH WITH RAIN REMOVAL OFF	• RAIN REMOVAL SWITCH-OFF IF LIGHT STAYS ON: • EMERGENCY VENT KNOB-PULL • DESCEND BELOW 25,000 FEET

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Figure 3-15 (Sheet 2 of 2)

SECTION IV

AUXILIARY EQUIPMENT

TABLE OF CONTENTS

AIR CONDITIONING AND PRESSURIZATION SYSTEM

Air conditioning in the aircraft is divided into two major systems, one for cockpit areas and one for electronic equipment cooling. The cockpits for both crewmembers are pressurized and supplied with conditioned air from the cockpit air conditioning system. The same air that pressurizes and heats the cockpit is used to keep the windshield free of fog, frost, and rain. After TO 1F–4–1500, the rain removal system is deactivated. The equipment air conditioning system provides cooling air for the main radar package and communication–navigation–identification equipment. Both systems utilize high temperature, high pressure, 17th stage engine compressor bleed air from either or both engines.

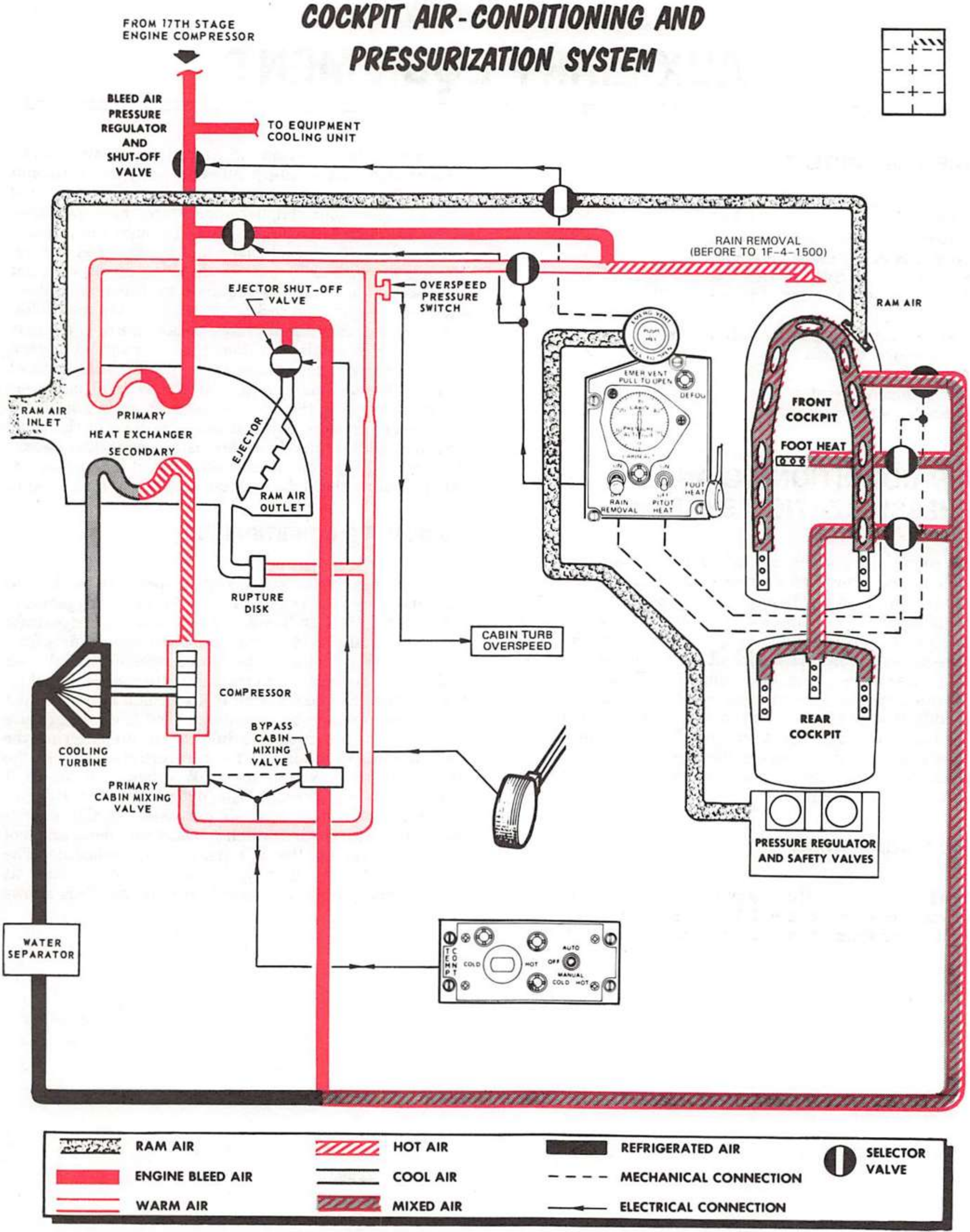
AIR CONDITIONING

The cockpit air conditioning system on the right side of the forward fuselage (figure 4-1) consists of two air-to-air heat exchangers, ground ejector, an expansion turbine, pressure regulator and shutoff valve, mixing valves, and a temperature control which allows a selection of cockpit conditioning 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 (cooled) through the cooling turbine. After being mixed with hot compressor bleed air (as required by the temperature selection) it enters the cockpit through several manifolds, one near the front cockpit rudder pedals, one near the rear cockpit rudder pedals, one along the lower surface of each windshield side panel and one at the base of the flat optical panel of the windshield. After TO 1F–4–1500, air enters the cockpit along the lower surface at each side of the one–piece windscreen and at the front base of the windscreen in addition to the locations by the rudder pedals. Two eyeball type air nozzles are located just below the canopy sill on the right and left side of the rear cockpit.

COCKPIT AIR CONDITIONING

The cockpit air conditioning system operation can best be explained by referring to the cockpit temperature schedule (figure 4-2). The lower temperature range (refer to the curve labeled foot heat) produces temperatures from –29°C to 38°C. These temperatures refer to the inlet air and not cockpit temperature; therefore, 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 lever is moved forward. Until a switch is made, both defog and foot heat air enter on the low temperature schedule. The switchover to the high temperature curve occurs at approximately 50% of forward lever travel. This allows

COCKPIT AIR-CONDITIONING AND PRESSURIZATION SYSTEM



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4G-1-(39)46

Figure 4-1

the pilot to use a greater portion of air for windshield defog while on the low temperature schedule, and affords the flight crew a greater degree of comfort. Thus full range on the auto rheostat (from 7 o'clock to 5 o'clock positions) will only produce −29°C to 38°C air unless the defog-foot heat lever is moved into the HI range. When the switch is made, the temperature schedule of all entering air switches to the high temperature curve. Thus, if 3:00 o'clock were the knob position, 31°C would be the temperature of incoming air in the low temperature range, but when the switch is made, the temperature would change to 58°C. As the defog-foot heat lever is moved forward through full travel, the foot heat butterfly valves for both front and rear cockpits close 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.

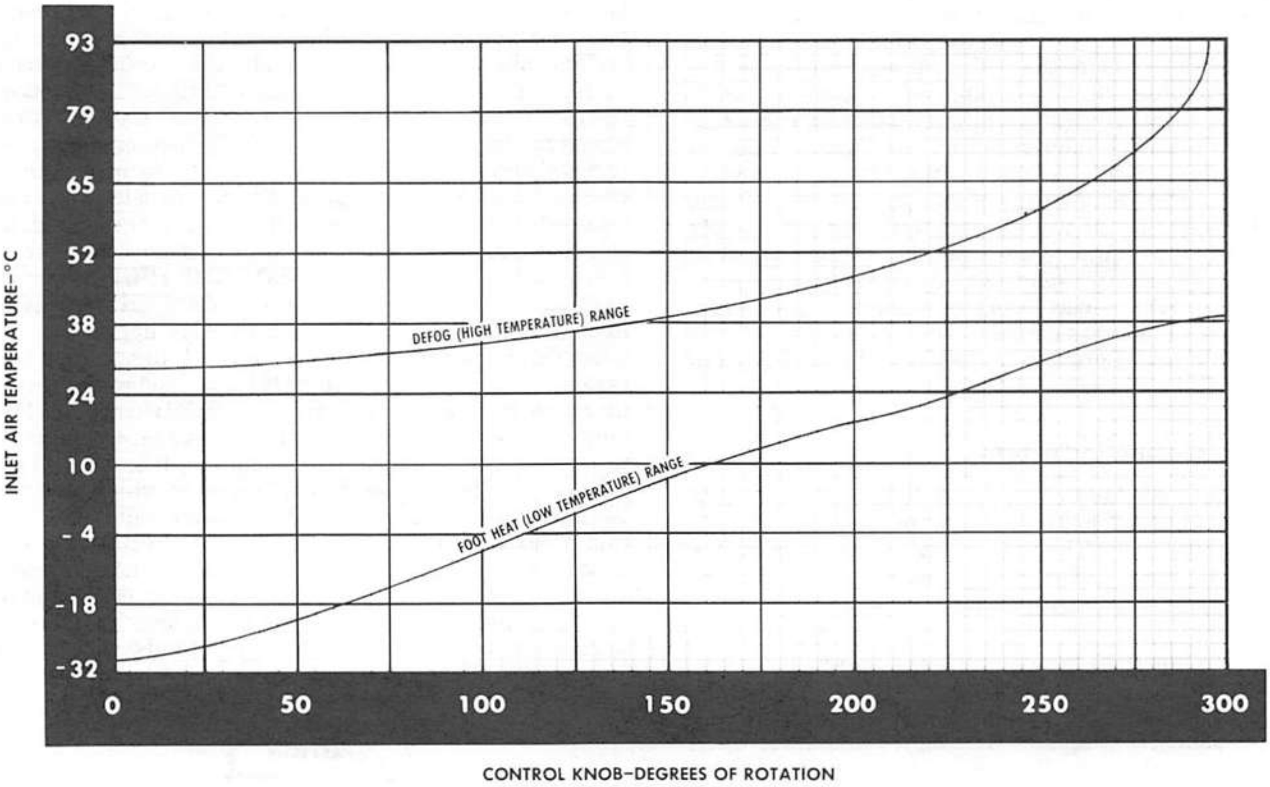
Manual Override-Cockpit Temperature Mixing Valve

If the automatic temperature control system malfunctions, the manual position of the temperature control auto-manual switch can be used to select a full range of temperatures up to 110°C. 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. Should a failure in the automatic system warrant a manual override selection, ensure the switch is moved only in the direction of the desired temperature change. The valve controlled by the switch takes about 8 seconds from one extreme to the other and automatically shuts off when the limit is reached. Pause three seconds between actuations. Extremely hot conditions can be alleviated by pulling the emergency vent knob (below 25,000 feet), pulling the cockpit heat and vent circuit breaker or as a last resort, jettisoning the rear cockpit canopy.

CAUTION

Holding the switch in HOT or COLD can cause excessive temperatures. Excessive temperatures can cause aircrew injury and disablement.

COCKPIT TEMPERATURE SCHEDULE



4G-1-(41)

Figure 4-2

CAUTION

Extremely hot temperatures can cause heat damage to aircraft components and toxic smoke in the cockpit.

Cockpit Fogging

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 dissipated by selecting a slightly warmer temperature. When operating in high humidity conditions, it is recommended that a warmer than normal temperature be selected, prior to starting the takeoff run, to preclude the possibility of cockpit fogging as thrust is increased. Should cockpit fogging occur, the quickest means of eliminating this condition is by activating the emergency vent knob.

COCKPIT PRESSURIZATION

With the canopy closed and the engine and cockpit refrigeration system in operation, the cockpit automatically becomes pressurized at an altitude of 8000 feet and above (figure 4-3). The pressure in the cockpit is maintained by a cockpit pressure regulator (located on the floor of the rear cockpit), which controls the outflow of air from the cockpit. Below 8000 feet, the regulator relieves cockpit air at a rate to keep the cockpit unpressurized. From 8000 feet up to approximately 23,100 feet, the regulator maintains a cockpit altitude of 8000 feet. From 23,100 feet and up, the regulator maintains a pressure differential of 5 psi between the cockpit altitude and airplane altitude. Operation of the pressure regulator is completely automatic. The cockpit safety valve is used to prevent the cockpit pressure differential from exceeding positive or negative differential pressure limits in case of a malfunction of the cockpit pressure regulator, and to provide 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. The cockpit safety valve and cockpit pressure regulator, which are both 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.

Cockpit Pressure Indicators

The pressure altitude of the cockpit is indicated on a pressure indicator. The front cockpit pressure indicator is on the right console. The rear cockpit pressure indicator is on the left console. The cockpit pressure indicators are vented directly to cockpit pressure.

Cabin Turbine Overspeed Indicator Light

The cabin turbine overspeed indicator light is on the telelight panel front cockpit. The light illuminates when the cooling turbine in the refrigeration unit is being subjected to pressures and temperatures in excess of normal operation. If possible, the aircraft speed and engine thrust should be reduced until the light goes out. If the light fails to go out, select ram air by pulling UP on the emergency vent knob. This diverts ram air into the cockpit and at the same time, shuts off bleed air to the air conditioning system, thereby stopping the cooling turbine.

WINDSHIELD DEFOGGING

Fogging of the windshield is prevented by heating the inside surface of the glass with incoming cockpit air that is diverted into the defogging manifolds, located along the lower surfaces of the side and center windshield panels (before TO 1F−4−1500). After TO 1F−4−1500, a one−piece windscreen is installed. The defog−foot heat lever provides selection of windshield defogging. The lever proportions the cockpit airflow between the footheat diffusers and windshield defogging tubes, such that, in the FOOT−HEAT position approximately 90% of the total cockpit airflow is delivered to the cockpit air distribution manifolds, and 10% through the windshield defog manifold. At the DEFOG position approximately 20% of the total airflow is delivered through the footheat manifolds, and 80% through the windshield defog manifold. Actuation of the high range temperature schedule is achieved only after the lever travel has moved approximately 50% of forward lever travel. The pilot should attempt to anticipate fogging conditions, so that, through proper management of temperature and airflow, it will not become necessary to subject the windshield and the crew to high temperatures and defog airflows which are required to clear an already fogged windshield.

Windshield Rain Removal (Before TO 1F-4-1500)

The rain removal system utilizes partially cooled air, taken from the cockpit air conditioning system, as its air/heat source. This air is 17th stage engine compressor bleed air which is bled off the cockpit air conditioning system after it passes through the air-to-air heat exchanger. Placing the rain removal switch to ON causes the rain removal valve to open, and allows the air to flow across the windshield center panel. The action of the rain removal air on the rain droplets breaks them up into small particles and pushes them off the windshield. The rain removal system is adequate when flying through light rain, but is marginal when operating in moderate to heavy precipitation. The WINDSHIELD TEMP HIGH indicator light on the telelight panel and the MASTER CAUTION light illuminates if the windshield approaches a temperature which will cause optical distortion. The system must be turned OFF immediately upon illumination of the WINDSHIELD TEMP HIGH light. The temperature sensing control unit utilizes a bridge network to sense the high temperature condition. It is possible for the bridge to be improperly calibrated, in which case the light may illuminate during high Mach flight with the rain removal switch in the OFF position. In this case, the light may be disregarded. Use of the rain removal system during takeoff should be limited to those cases where visibility, due to precipitation, is a problem. The system should not be operated with a dry windshield except during ground checks.

CAUTION

- To prevent heat damage to the windshield, operate the rain removal system only when essential to safety of flight.

COCKPIT PRESSURE SCHEDULE

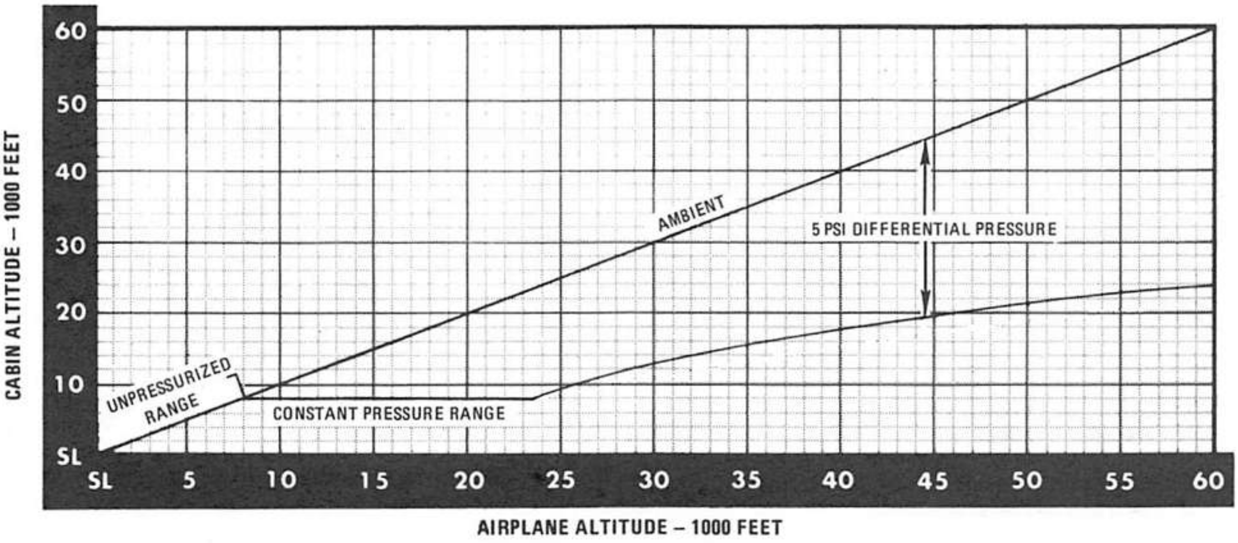


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Figure 4-3

CAUTION

- For a static ground check the system must be operated with the engines running at or below 80% rpm.
- Do not operate the rain removal system after takeoff at or above MIL power or above Mach 1.0.

NOTE

If the windshield rain removal system cannot be shut down, pull up on the cockpit emergency vent knob. Engine bleed air is shut off prior to entering the rain removal ducts.

EMERGENCY VENT KNOB

The cockpit may be cleared of smoke or fumes, and/or the cockpit air conditioning system may be shut down by pulling up on the emergency vent knob. When the emergency vent knob is pulled, all conditioned air to the cockpit and rain removal is shut off; the cockpit pressure regulator dump valve is opened; and the ram air shutoff valve is opened. After TO 1F–4–1500, the rain removal system is deactivated. The emergency vent knob is the quickest means to eliminate condensation (fogging) from the cockpit.

COCKPIT HEATING PROCEDURE

1. Temperature control switch - AUTO
2. Temperature control knob - AS DESIRED
   Adjust the temperature control knob for any desired cockpit temperature.
3. Defog-foot heat control lever - AS DESIRED
   Adjust the defog-foot heat control lever for personal comfort and effective windshield defogging. A transient flow disturbance may occur if the defog–foot heat control lever is moved from one extreme to the other.

NOTE

If the automatic temperature control system fails, a temporary adjustment may be obtained by bumping the temperature control switch to the HOT or COLD position.

WINDSHIELD DEFOGGING PROCEDURE

1. Temperature control switch - AUTO
2. Defog-foot heat control lever - DEFOG
   During cruise operations prior to letdown, place the defog-foot heat lever into the DEFOG position to preheat windshield and canopy surfaces.
3. Temperature control knob - AS DESIRED
   During cruise operations, prior to letdown, place the temperature control knob in the 2 o'clock position (200° of clockwise rotation) to increase the defog temperature for windshield and canopy preheating.

EQUIPMENT AIR CONDITIONING SYSTEM

The equipment air conditioning system, on the left side of the forward fuselage, supplies cooled air for electronic equipment cooling. The electronic equipment cooled by this system is; in the radar compartment in the nose, in the electronic equipment compartment aft of the nosewheel well, and in the electronic equipment shelf behind the rear cockpit bulkhead. The air conditioning system also supplies partially cooled air to the equipment auxiliary air system. The equipment air conditioning system utilizes a cooling (expansion) turbine and a compressor, mounted at opposite ends of a common shaft. High pressure, high temperature 17th stage engine compressor bleed air is directed to the periphery of the cooling turbine after passing through an air-to-air heat exchanger. As the air passes through the turbine, it causes the turbine to rotate (and thus the compressor) while at the same time undergoing rapid expansion, with a resulting temperature and pressure drop. This air is then directed through the various equipment cooling circuits. Ram air enters the aircraft at the forward left fuselage air scoop and splits into two parts. One part is directed through the compressor and the other through the air-to-air heat exchanger where it acts as a cooling media and thence to the ram air exit duct. The compressor performs two functions. It serves as the balance load for the turbine, while its exhaust is discharged through an ejector assembly located in the ram air exit duct. The purpose of the ejector is to ensure airflow through the ram air duct (and thus the air-to-air heat exchanger) during periods of low ram air pressure.

Controls and Indicators

Control of the system is entirely automatic. The temperature is controlled at approximately 29°C from sea level to 25,000 feet and 4°C from 25,000 feet and up. Over-temperature conditions are sensed in the cooling duct and, should they occur, the air conditioning system will be shut down and the RADAR-CNI COOL OFF indicator lights in the front and rear cockpits, will be illuminated and emergency ram air cooling will be provided. Reset buttons, one for each cockpit, serve to reset the temperature limiter and to restart the air conditioning system. Avoid operation for prolonged periods with RADAR-CNI COOL OFF light illuminated unless operational necessity dictates otherwise. If maximum allowable cooling temperatures are exceeded, equipment life and/or reliability may be adversely affected.

EQUIPMENT AUXILIARY AIR SYSTEM

The equipment auxiliary air system utilizes partially cooled air from the equipment air conditioning system. The air is 17th stage engine compressor bleed air which is bled off the equipment air conditioning system after it has passed through the air-to-air heat exchanger. The partially cooled air is distributed to the anti-G suits, front and rear canopy seals, air data computer, radar wave guide, EWO's radar scope, radio receiver(s)-transmitter, fuel system pressurization, and the pneumatic system air compressor.

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 flows 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 back-up in the event of a malfunction. The system is automatic and operates any time an engine is running.

WARNING

Ensure that the anti-G suit hose is free and clear of all other cockpit equipment so that in an emergency quick detachment is possible.

SPEECH SECURITY UNIT (KY-28)

The UHF communication system is modified to enable either crypto or conventional voice transmission and reception. The aircraft intercom system and UHF transceiver are modified to provide operational compatibility with the KY-28 speech security unit. The KY-28 speech security unit functions with the UHF transceiver to provide secure voice communications for all classified traffic in tactical environments. The KY-28 possesses enciphering and deciphering capabilities for transmitting and receiving respectively, but cannot perform these functions simultaneously. The crew member may select either a cipher or plain mode of operation. During the cipher mode, the KY-28 converts microphone (voice) inputs to crypto transmissions and conversely deciphers crypto replies for voice inputs to the aircrew headsets. When the plain mode is selected, the UHF radio equipment functions as a conventional voice transceiver. The speech security installation is cryptographically intercommunicable with other KY-28 units, the KY-8 units, and the KY-38 units (manpack version of KY-28). The KY-28 unit also has provisions for transmitting messages via a relay facility. The KY-28 contains a code assembly in which the cryptograph codes are set. Provisions are made for zeroing the codes either mechanically or electrically.

CONTROLS AND INDICATORS

The KY-28 controls consists of the KY-28 control panel and conventional communication controls. Mode selections are indicated by illumination of the mode lights on the instrument panels in both cockpits. Mode light P indicates selection of the plain mode and mode light C indicates selection of the cipher mode.

KY-28 Control Panel

The KY−28 control panel, in the rear cockpit, contains a power knob, a code zeroize button, and a mode switch. The power knob with positions of OFF, ON, and RLY (relay) provides control power to the KY-28 unit. In OFF, power is removed from the KY-28 unit. Power is applied to the unit when ON or RLY is selected. ON is selected when direct communications between stations is desired. RLY is selected when a retransmission (relay) facility is to be utilized. The mode switch enables selection of either the cipher (C) or plain (P) operating modes. This switch must be pulled outward to change modes. When power is applied to the KY-28 unit and the cipher mode is selected, the UHF transmitter is automatically selected for front cockpit transmissions. The code zeroize button, when pressed, electrically neutralizes the preset coding mechanism in the KY-28. The zeroize button is a guarded control and should not be pressed except in emergencies.

NOTE

> The P (plain) mode must be selected to permit UHF communication even when the KY-28 power knob is in OFF. If C (cipher) mode is selected with the KY-28 power knob in OFF, normal UHF communication is inhibited in both cockpits. However, the C position does not interfere with guard transmission/reception, or the aux receivers.

KY-28 MODES OF OPERATION

The speech security unit functions in either of two mode when the KY-28 power knob is in ON or RLY. Thes modes are cipher or plain (C or P) as selected by th crewmember. When P (plain) is selected, the UH transceiver operates in the conventional voice manner. Al transmit and receive signals are routed directly throug the KY-28 unit.

Cipher Operation

When C (cipher) is selected the KY-28 unit functions in one of three conditions: standby, receive, or transmit.

a. STANDBY. All KY-28 units remain in the standby condition until either the microphone button is actuated or a sync preamble is received. Upon completion of the transmitted or received crypto message, the unit automatically reverts to the standby condition. During the standby condition, the radio equipment may function as a conventional receiver; i.e., all incoming non-crypto transmissions are passed directly to the headsets.

b. RECEIVE. The unit automatically switches to the cipher receive condition when a sync preamble signal is received. The sync preamble signal is generated by external stations utilizing KY-8, -28, or -38 equipment when the operator of that station actuates the microphone button. The sync preamble signal assures that all recipient units in a security network are in the cipher receive condition. The enciphered (crypto) message is received immediately after the sync preamble signal. The crypto intelligence is decoded by the KY-28 unit and passed to the aircrew headsets in the form of plain language. During cipher receive operation, the UHF microphone button should not be actuated until the incoming message is completed.

NOTE

> Reception of emergency traffic by the UHF guard receiver is not inhibited when the KY-28 is in the cipher receive condition. These signals are passed through the KY-28 and mixed in the audio output circuits to the aircrew headsets. However, the aircrew may eliminate guard channel interference by selecting T/R on the UHF communications control panel.

c. TRANSMIT. The unit is in the cipher transmit condition when the UHF microphone button is positioned to UHF. The sync preamble signal is transmitted to all external KY stations causing them to switch to the cipher receive condition. Shortly after actuating the microphone button, a momentary tone is heard in the aircrew headsets. The momentary tone signal indicates completion of the sync preamble, after which the KY-28 unit is ready to process and transmit classified information. During the transmit cycle, the KY-28 decodes the crypto message and supplies a side-tone input (plain language) to the aircrew headsets. After the microphone button is released, the unit reverts to the cipher standby condition. With C selected, the transmit condition overrides the cipher receive condition.

KY-28 NORMAL OPERATION

The KY−28 power knob should be OFF and the cipher switch should be in P before applying aircraft power. For KY−28 operational checklist, see Section II.

NOTE

> The EWO must select UHF communications with radio selector switch to transmit crypto coded messages (cipher operation). UHF is automatically selected in front cockpit for cipher operation.

The KY-28 performs an automatic alarm check when the mode switch is in C and the power knob is placed to ON or RLY. The check continues for approximately 2 seconds after power is applied. During this time a constant 1200 Hz tone is heard in the headsets. Upon successful completion of the check, the 1200 Hz tone is interrupted at a 2.3 Hz rate. Momentarily position the microphone button to UHF to clear the interrupted tone. When the microphone button is released, the KY-28 reverts to standby condition and is ready for either transmission or reception. If the unit fails to pass the alarm check, the steady 1200 Hz tone continues and further cipher operation is inhibited.

NOTE

> If the KY-28 unit fails to pass this check and the power knob is positioned to OFF, the mode switch must be positioned to P (plain mode) to enable normal UHF communications.

To transmit crypto coded messages, position the microphone button to UHF and wait until a momentary tone is heard before speaking. With the power knob in ON, the momentary tone is delayed 0.5 second after actuating the microphone button. During this time an automatic encryption check is made and the synchronizing preamble is transmitted to the receiving stations. If the encryption check fails, a 1200 Hz tone interrupted at a 2.3 Hz rate is presented in the headsets and cipher transmission is inhibited. With a satisfactory encryption check, a momentary tone is presented in the headsets and transmissions may begin. When RLY is selected, the tone is delayed approximately 2 seconds. This longer delay ensures that the transmitter at the relay facility is at full power before any information is transmitted. Only one KY-28 can transmit at a given time. Simultaneous transmissions by two or more units on the same frequency may result in garbling of the messages or loss of synchronization. When the transmission is completed and the microphone button is released, the unit reverts to the cipher standby condition. Reception of crypto coded messages is completely automatic as long as the unit is energized and the cipher mode is selected. Normal non-crypto communications may be resumed at any time by placing the KY−28 mode switch to P (plain).

SECURE SPEECH SYSTEM (KY-58) (AIRCRAFT AFTER TO 1F-4-1320)

The secure speech system (KY-58) is used for ciphering (coding) or deciphering (decoding) audio routed through the UHF radio receiver-transmitter. The controls for the system are on the control panel on the main Instrument Panel in the rear cockpit. The system also contains a KY-58 processor/adapter.

KY-58 MODE LIGHTS

The mode lights are on the KY−58 light panel in the main instrument panel in both cockpits. The mode lights are labeled C (cipher) and CT (cipher text). When the plain mode of operation is selected both mode lights are off. Selecting C (cipher) or CO (cipher only) causes the green C light to come on. The CT (cipher text) amber light comes on when any cipher text message is transmitted or received in either C or CO mode.

KY-58 CONTROL PANEL

The control panel functions as a control for the remote ciphering or deciphering device for secure speech operation and for relaying ciphered information. The controls on the control panel are the mode select knob, the fill select knob, dim, and the power knob.

Mode Select Knob

The mode select knob has positions of P, C, CO, LD, and RV. Placing the knob to P enables plain mode of operation. Placing the knob to C enables the cipher mode of operation. Placing the knob to CO will prevent plain or guard audio from interfering with head set secure speech audio. With the knob set to LD the load mode of operation is enabled. This mode is used for loading data into the remote KY-58 unit. The RV knob position (receiver variable) is nonfunctional.

Fill Select Knob

The fill select knob has positions of 1 thru 6. Setting the knob to one of the six positions selects the position to be loaded with data.

Dim Control Knob

Turning this knob clockwise increases the intensity of the control panel lights and turning the knob counterclockwise decreases the intensity of the lights.

Power Knob

This knob has positions of ON, OFF, and TD. Placing the knob to ON turns on power to the KY−58 system. Placing the knob to OFF removes power to the system. With the knob in TD, power is turned on for the system and a time delay is selected for data processing.

KY-58 MODES OF OPERATION

The speech security unit functions in one of five modes of operation: plain, cipher, cipher only, load and receiver variable. When plain mode is selected, the UHF operates in a conventional manner. All transmitted and received signals are routed through the KY−58 unit.

Cipher Operation

When cipher (C) is selected, the KY−58 functions in either standby, transmit CT receive.

a. STANDBY. All KY−58 units remain in the standby condition until either the microphone button is actuated or a sync preamble is received. Upon completion of the transmitted or received crypto message, the unit automatically goes back to the standby condition. During the standby condition, the radio equipment may function as a conventional receiver, i.e., all incoming non−crypto transmissions are passed directly to the headsets.

b. RECEIVE. During reception of ciphered information, the ciphered audio is routed from the receiver−transmitter to the KY−58 for deciphering. The deciphered audio is routed back to the pilot's headset.

c. TRANSMIT. During ciphered transmissions, audio from the pilot's microphone is routed to the KY−58 where it is enciphered. The enciphered audio is then routed back to the receiver−transmitter for transmission.

KY-58 NORMAL OPERATION

The KY−58 control panel power switch should be off before aircraft power is supplied. To operate the speech security unit, place the KY−58 controls to the following positions:

1. Power switch – ON OR TD AS REQUIRED
2. Mode select knob – P, C, OR CO AS REQUIRED
3. Fill select knob – AS REQUIRED
4. (P–EWO) All other UHF controls – AS REQUIRED

AUTOMATIC FLIGHT CONTROL SYSTEM (AN/ASA–32)

The automatic flight control system (AFCS) is an electro-hydraulic system designed to provide stable, accurate, and coordinated flight maneuvers without interferring with manual control. The automatic flight control system is capable of performing two modes of operation, stability augmentation and AFCS. Stability augmentation improves airplane stability in pitch, roll, and yaw; it opposes any change of attitude but does not return the airplane to a given attitude or ground track. 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. The AFCS switch can be engaged with only the pitch stab aug switch engaged; however, to provide full AFCS operation, all three stab aug switches must 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.

STABILITY AUGMENTATION

In the stability augmentation mode of operation, the system senses motion about the longitudinal, lateral, and directional axes and acceleration along the lateral axis, by means of rate gyro and accelerometer sensors, respectively. All attitude changes cause these sensing devices to transmit signals representing the rate of change of motion about or along their respective axes. These signals are sent to servo valves in the control surface actuators. Therefore, any output signals from the rate gyro sensors, indicating yawing, pitching, or rolling motion, or from the lateral accelerometer indicating side slip, cause the automatic flight control system to position the appropriate control surface to oppose that motion. This action decreases any tendency of the airplane to oscillate in roll, yaw, or pitch, or to develop lateral forces which cause airplane slip or skid. In the stability augmentation mode, the rate gyros or lateral accelerometer send signals to the surface controls to oppose any deviation from selected flight attitudes but do not return the airplane to its original ground track 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.

AFCS MODE

In the AFCS mode, the displacement gyro (pitch and roll) heading reference signals are used, in addition to the rate gyro sensor signals, to maintain the airplane in a desired attitude with maximum pitch, roll, and yaw stability. The AFCS system can be engaged and hold maneuvers and attitudes within a range of ±70° pitch, 70° in bank and 360° in azimuth, providing the G limits are not being exceeded. Rapid stabilator movements, whether pilot induced or uncommanded, will cause the AFCS switch to disengage. The AFCS components are the AFCS panel, the control amplifier, force transducer, accelerometers, and rate gyro sensors. Equipment used in connection with AFCS operation are the attitude reference and bombing computer, air data computer, lateral series servos, directional series servo, and longitudinal servo.

COMPUTER STEER MODE

When CMPTR NAV is selected, the DMAS computer provides automatic sequencing of steering commands to a programmed set of destinations when the automatic destination sequencing of the DMAS (NAV A) is selected on the keyer control STEER knob. A smooth transition is made between each leg of the course. Steering commands provide for the overflight of all destinations. The DMAS utlizes cross-track error, selected course angle or bearing to destination, ground track angle, roll attitude, and ground velocity to compute the required bank angle. This bank angle is converted to a lateral steering signal and is provided to the ADI bank steering bar and AFCS roll axis.

In the computer steer mode, lateral steering signals to the AFCS are available within the range of ±45° of bank (except above 20,000 ft MSL or after approach mode course capture, where commands are limited to 30°) and are proportional to roll attitude error, with the director signal being zero whenever the aircraft roll angle is the same as that computed by the DMAS as being the optimum roll angle required to perform that maneuver. While in the computer steer mode, the pilot may override the AFCS in the normal manner by applying stick force. After release of this force, lateral steering again takes over. If the pilot wants to disengage from the computer steer mode entirely, he can either disengage the CMPTR STEER switch on the AFCS panel or disengage and reengage the AFCS switch.

NOTE

Maximum intercept to courses will be 57°.

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 automatic flight control components.

ATTITUDE REFERENCE AND BOMBING COMPUTER (AN/AJB-7)

The attitude reference and bombing computer provides the vertical and directional references for the AFCS. The directional reference is controlled by the compass controller on the front cockpit right console. With the compass controller in the SLAVED mode, the AFCS receives magnetic heading as a directional reference. The DG mode on the compass controller provides deviations from a manually-set heading as a directional reference to the AFCS. The COMP mode is an emergency mode of the AN/AJB-7 and an interlock is opened to prevent AFCS engagement. This prevents erratic magnetic heading signals from being applied to the AFCS. The AFCS is also disengaged when the mode selector on the compass controller is switched from DG to SLAVED, or when the reference system selector switch is switched between PRIM and STBY. The AFCS does not disengage when the mode selector is switched from SLAVED to DG.

AIR DATA COMPUTER

The air data computer performs two functions for the AFCS. First, it provides all required gain changes. This is necessary to maintain constant maneuvering rates, regardless of changes in airspeed and altitude. Second, it contains a clutched synchro which supplies the AFCS with a signal proportional to the deviation from the barometric altitude which existed when the altitude switch was placed in the engaged position. This signal is used by the AFCS to move the stabilator as necessary to maintain constant barometric altitude.

FORCE TRANSDUCER

The force transducer senses the physical force applied 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 sensitive switches which react to longitudinal and lateral stick forces. A lateral stick force of approximately 1.5 pounds 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 opposed while in the AFCS mode. The pilot maneuvers the aircraft by mechanical linkages until the lateral stick force is reduced to less than approximately 1.5 pounds. At this time the roll channel is returned to normal AFCS operation. A forward stick force of 3.75 ±0.25 pounds or an aft stick force of 2.55 ±0.25 pounds closes switches to operate certain AFCS components, and cause a force sensing device to send a signal, proportional to the applied stick force, to the servo amplifier and stabilator position is controlled through the AFCS. If the pitch or roll limits of the AFCS (±70°) are exceeded the AFCS will disengage. The AFCS switch may or may not disengage. If the switch does not disengage, the AFCS will immediately reengage when the aircraft returns to within the AFCS limits.

There is no stick force transducer in the rear cockpit. The AFCS and roll stab aug will oppose rear cockpit stick inputs. Do not fly the aircraft from the rear cockpit with AFCS engaged. Exercise care in transferring control between cockpits while rolling with roll stab aug engaged.

ACCELEROMETERS

During AFCS mode, two accelerometers are utilized to insure proper functioning of the AFCS system. One of the accelerometers, a G limiting type prevents excess G loads from occurring as a result of AFCS operation. The other accelerometer is a lateral accelerometer which is used to perform coordinated maneuvers while in AFCS or stab aug operation.

G-Limit Accelerometer

The normal load factor interlock (G - disengage) feature of the AFCS is designed to inhibit the system from commanding excessive load factors on the airplane. The system reverts automatically from whatever mode is engaged to stability augmentation in the event that plus 4 or minus 1 G is sensed by the G - disengage accelerometer switch. This switch is mounted forward on the radar bulkhead so that if the airplane is rotated rapidly into a maneuver, disengagement occurs at lower values of normal load factor due to the anticipation resulting from the forward location sensing a component of pitching acceleration. The G - disengage feature is inoperative outside the ±70° limits of the autopilot.

WARNING

The G switch does not disengage the autopilot under conditions of low airspeed or heavy gross weight before the aircraft stalls. If the autopilot remains engaged during a stall, the autopilot provides pro-spin controls.

Lateral Accelerometer

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

SERVOS

The automatic flight control system contains four control servos which operate the aircraft flight controls during stability augmentation and AFCS operation. Two lateral series servos (one in each wing) operate the spoilers and ailerons. A directional series servo, on the rudder power control cylinder, operates the rudder. A longitudinal servo, integral with the stabilator power cylinder, functions in series to operate the stabilator during stab aug operation. This same servo functions in parallel to operate the stabilator during AFCS operation. If the AFCS fails, it can be disengaged by pressing the emergency quick release lever. If the AFCS is not disengaged, the stabilator servo parallel mode can be overpowered by exerting sufficient force on the control stick.

RATE GYRO SENSORS

Refer to Stability Augmentation Mode, previously discussed in this section.

AFCS CONTROLS

The automatic flight control system panel is on the front cockpit left console. This panel contains all the controls for the normal operation of the flight control system.

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. The switches are lever lock type switches and the toggle must be lifted slightly before the switch position can be changed.

AFCS Switch

The AFCS switch is a two-position toggle switch on the AFCS panel. The switch can be engaged with only the pitch stab aug switch engaged. However, for the AFCS mode to be fully effective, holding attitude and heading selected, all three stab aug switches must be engaged.

Computer Steer Switch

The AFCS is modified to include a computer steering mode which is controlled by a two-position toggle switch on the AFCS panel. The switch positions are CMPTR STEER and ENGAGE. The computer steering feature is available only when the DMAS is operational, and AFCS and all three stab aug switches are engaged. Placing the computer steering switch to the ENGAGE position transfers the source of roll error signals from the AFCS roll rate gyro to the DMAS computer through the signal data converter. The navigation computer, computes the required roll angle based on the desired course set in the DMAS and the roll signal generated in the inertial measurement unit.

Altitude/Glide Path Switch

The altitude hold function is modified to include automatic glide slope steering. This function is controlled from the AFCS panel by a two-position toggle switch. The switch positions are ALT/GP and ENGAGE. Placing the switch to the ENGAGE position provides normal AFCS altitude hold operation. However, when the DMAS is placed in the computer approach mode, two conditions occur simultaneously which provide automatic glide slope steering. These conditions are (1) the source of pitch error signals to the AFCS control amplifier is transferred from the air data computer and pitch rate gyro to the DMAS computer and (2) the navigation computer is flagged to begin computation of glide slope steering command utilizing pitch signals from the inertial measurement unit and data inserted in the DMAS for glide slope angle, runway coordinates, heading, elevation, and go-around height. Automatic glide slope steering ceases at the DMAS-inserted go-around height and the AFCS then reverts to the altitude hold mode. The pilot must make visual contact with the runway and take manual control of the aircraft in order to land. The altitude hold function of the ALT/GP switch is available when the pitch STAB AUG and AFCS switches are engaged. The glide path function of the ALT/GP switch is available when the AFCS, STAB AUG, and computer steer switches are engaged with the COMPTR APR mode selected. Glide path steering is inhibited until the aircraft is within the computer approach capture bounds.

WARNING

The ARN-101 is not a certified landing system. It is the responsibility of the aircrew to insert the go-around height. At go-around height the ADI pitch steering bar is removed from view, the glide slope indicator remains in view indicating glide slope deviation, and the AFCS, if engaged, reverts to altitude hold. At this point, positive aircrew action is required to accomplish a safe landing.

Emergency Quick Release Lever (AFCS)

A spring-loaded emergency quick release lever is on each control stick. This lever operates in the same manner from both the front and the rear cockpits. Depressing the lever causes the AFCS and altitude hold switch to return to OFF. The stability augmentation mode, ARI and anti-skid, are disengaged as long as the lever is held depressed. When the lever is released, the stability augmentation, anti-skid, 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 and anti-skid, the yaw stab aug switch must be off and the ARI circuit breaker, on the front cockpit left subpanel, must be pulled.

Autopilot Disengage Indicator Light

An AUTOPILOT DISENGAGE indicator light is on the telelight panel. After initial engagement of the AFCS mode, the AUTOPILOT DISENGAGE indicator light and the MASTER CAUTION light illuminates when the AFCS is disengaged. Both lights are extinguished by pressing the master caution reset switch. The lights remain extinguished until the AFCS is again engaged and disengaged.

NOTE

If utility hydraulic pressure is lost or drops below 500 psi, the roll axis and the yaw axis in stab aug and AFCS are inoperative. The stabilator auxiliary power unit supplies pressure to the stabilator actuator if PC-1 fails. Therefore, the pitch axis in stab aug and AFCS is inoperative only if the APU reject switch is placed to REJECT. In either case, the AUTOPILOT DISENGAGE light and the PITCH AUG OFF light do not illuminate. The CHECK HYD GAGES light and the MASTER CAUTION light illuminate at approximately 1500 psi.

Pitch Aug Off Indicator Light

The PITCH AUG OFF indicator light is on the telelight panel. The PITCH AUG OFF and MASTER CAUTION lights illuminate when power is on the airplane and the pitch stab aug switch is not engaged. Depressing the master caution reset button extinguishes the MASTER CAUTION light; however, the PITCH AUG OFF light remains illuminated until the pitch stab aug is engaged.

AFCS ALT/GP Disengaged Indicator Light

The AFCS ALT/GP disengaged indicator light is on the telelight panel. The AFCS ALT/GP DISENGAGED and MASTER CAUTION LIGHTS come on when the altitude or glide path steering modes are disengaged. Pressing the master caution reset button turns off the MASTER CAUTION and AFCS ALT/GP DISENGAGED lights.

AUTOPILOT PITCH TRIM

An automatic pitch trim feature is included in the AFCS which attempts to keep the airplane 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 automatic pitch trim operates at approximately 40% the speed of the normal trim system, resulting in a slight delay after changing flight conditions before the basic airplane is properly trimmed. During control stick steering maneuvering, the auto-trim is inoperative. Auto-trim operation can be observed on the pitch trim indicator after changing flight conditions in the AFCS mode.

Autopilot Pitch Trim Light

An AUTOPILOT PITCH TRIM indicator light is on the telelight panel. This light illuminates during AFCS operation if the automatic pitch trim follow up is inoperative or lagging sufficiently behind airplane maneuvering to cause an out-of-trim condition in the basic airplane. Illumination of this light indicates the autopilot is engaged regardless of any switch position. Since (1) auto pitch trim rate is only 40% of normal trim rate, and (2) auto trim is inoperative anytime the stick grip transducer switch contacts are made, it is possible to develop an out-of-trim condition in the basic airplane while maneuvering in the AFCS mode. However, this out-of-trim condition must exist for approximately 10 seconds before the AUTOPILOT PITCH TRIM indicator light illuminates, thus eliminating constant on-off 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 condition. If an out-of-trim condition is realized by the steady illumination of the AUTOPILOT PITCH TRIM indicator light, the pilot should 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 AUTOPILOT PITCH TRIM indicator light is extinguished. Illumination of the AUTOPILOT PITCH TRIM indicator light also illuminates the MASTER CAUTION light. Depressing the master caution reset button only extinguishes the MASTER CAUTION light, leaving the AUTOPILOT PITCH TRIM indicator light illuminated.

NORMAL OPERATION

1. To engage the stability augmentation mode, place the pitch, roll, and yaw stab aug switches to ENGAGE.

NOTE

The stability augmentation mode can be selected individually or in any combination for pitch, roll, and yaw axis. The pitch stab aug switch must be engaged for the AFCS switch to energize. However, automatic steering and glide path functions are not available unless all three stab aug switches are engaged.

2. Trim aircraft in the stability augmentation mode before engaging AFCS mode.
3. To engage AFCS mode, establish an aircraft attitude within AFCS limits. Place the AFCS switch to ENGAGE.

WARNING

- Do not attempt to change pitch attitude of the aircraft from the rear cockpit in the AFCS mode. Since no force transducer is in the rear cockpit control stick, applying force will cause pitch trim to run up and down depending on pressure applied. If the pilot attempts to take control at that point, violent transients may be encountered.
- When selecting the AFCS mode, have hand on control stick to counteract any abrupt control movements in the event of an AFCS malfunction.
- Do not have the AFCS engaged when the AN/AJB-7 bombing mode is being used. Transients introduced into the attitude input of the AFCS at pull-up can cause pitch and/or roll oscillations.

NOTE

- Do not operate manual trim button while in the AFCS mode unless the AUTOPILOT PITCH TRIM light is illuminated. Use a small amount of manual trim to extinguish the AUTOPILOT PITCH TRIM light.
- The pitch rate gyro, as utilized by the AFCS modes, inadvertently senses structural vibrations of the airframe and tends to amplify these vibrations by generating commands through the autopilot to the stabilator. These vibrations can become quite pronounced while flying at very low indicated airspeeds. There should be no cause for alarm if this phenomenon occurs and the vibration, or chatter, can be eliminated by reverting to stability augmentation mode or by increasing airspeed above approximately 190 to 200 knots.

4. When altitude hold mode is desired, place altitude hold switch to ENGAGE.

NOTE

- To change altitude when operating in altitude hold, use the control stick. This disengages the altitude hold circuits and the altitude hold switch moves to OFF. Re-engage altitude hold at the new altitude if altitude hold is desired.
- The AFCS is disengaged when the emergency quick release lever on the control stick is depressed. The stability augmentation and ARI are disengaged as long as the lever is held depressed but returns to operation when the lever is released.

5. To engage the DMAS controlled computer autopilot steering mode, ensure that the following conditions are met:
   a. Destination data has been inserted in the DMAS.
   b. Keyer control steer knob – NAV M or NAV A
   c. Navigation function selector panel mode selector knob – CMPTR NAV
   d. Course select switch – AS DESIRED
   e. AFCS switch – ENGAGE
   f. CMPTR STEER switch – ENGAGE
6. To engage the DMAS computer coupled approach mode, ensure that the following conditions are met:
   a. The desired runway touchdown point coordinates and desired approach course have been inserted in the DMAS for the selected destination.
   b. Keyer control steer display window shows the destination number for the destination selected as the FLY TO point.
   c. Keyer control steer knob – NAV M or NAV A

NOTE

In the CMPTR APR mode, destination auto sequencing is inhibited.

   d. Course select switch – AS DESIRED
   e. Establish aircraft within the computer coupled approach capture bounds.
   f. Navigation function selector panel mode selector knob – CMPTR APR
   g. AFCS switch – ENGAGE (if desired)
   h. AFCS CMPTR STEER switch – ENGAGE (if desired)
   i. AFCS ALT/GP switch – ENGAGE (if desired)

GENERATOR SWITCHING

Power to the autopilot, air data computer, and the AJB-7 may be momentarily interrupted during the starting and stopping of the airplane engines or generators. When the right engine or generator is started with the left generator already on the line, the connection between the right and left main buses is momentarily opened to allow the right generator to come on the line. This momentary interruption of power will cause the autopilot to disengage. The stab aug switches are not solenoid held, and remain on without electrical power. The AFCS, AJB-7 and air data computer are not affected by starting or stopping the left engine or generator with the right generator on the line.

NOTE

> If failure of the right generator occurs, disengage the stab aug switches prior to cycling the generator. This prevents the possible occurrence of control surface transients. Stab aug may be re-engaged with the right generator control switch retained OFF or after the generator control switch has been returned to the ON position.

OPERATIONAL PRECAUTIONS

Roll Reversal

There is a possibility of a condition called roll reversal occurring when operating the automatic flight control system in the AFCS 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 channel, and is apparent as a slow rolling of the airplane in the opposite direction of the stick force. If, for instance, the airplane is out of trim laterally to the left when the AFCS mode is engaged, roll reversal may occur when right stick forces are applied. A roll reversal situation may be caused by operating the manual lateral trim button while in the AFCS mode, followed by small stick forces being applied opposite to the direction of the trim. There is a possibility of roll reversal occurring even if the airplane has been trimmed prior to engaging the AFCS mode, and the manual trim button has not been touched. This condition is caused by changes in airplane trim accompanying changed flight conditions. In view of the above, the following instructions should be observed:

1. Trim airplane in stability augmentation mode before engaging AFCS mode.
2. Do not operate manual lateral trim while the AFCS mode is engaged. If roll reversal is encountered due to change in flight condition; disengage roll, retrim, then reengage.

Pitch Oscillations

When using the altitude hold mode, the aircraft may experience pitch oscillations in the transonic regions due to fluctuations in the air data computer airspeed system. The nature of these oscillations vary from stick pumping to divergent pitch oscillations. It is recommended that if pitch oscillations occur at transonic speeds, the following corrective steps be attempted:

1. AFCS switch - DISENGAGE
2. Static pressure compensator switch - OFF
3. AFCS switch - ENGAGE
4. Engage altitude hold mode

If the oscillations persist after the above action, or if they are encountered at supersonic speeds:

1. Disengage altitude hold mode.

WARNING

> Divergent pitch oscillations should not be allowed to develop. If any divergent pitch activity is noted, corrective action should be taken immediately.

INERTIAL NAVIGATION AND ATTITUDE-HEADING REFERENCE SYSTEM

The system consists of two separate gyro reference components. The IMU supplies the primary azimuth and attitude reference, and in addition supplies direction, velocity, and distance inputs to the navigation computer. The IMU also supplies aircraft attitude, true heading, and velocities to the APR-47. The AN/AJB-7 is the standby attitude reference and in addition supplies information for LABS bombing maneuvers.

AN/AJB-7

The AN/AJB-7 is a two gyro all attitude reference platform which supplies standby azimuth information to the attitude director indicator, the horizontal situation indicator, and the bearing distance heading indicator. Additionally, the AN/AJB-7 supplies standby attitude information to the attitude director indicator. It also provides a standby attitude horizon for the front and rear cockpit radar indicators. The rear cockpit attitude indicator, the autopilot, and the bombing computer receive attitude information from the AN/AJB-7 at all times.

Compass Controller

The compass controller provides the controls and indicator necessary for proper operation of the azimuth system. 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 flux valve 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, manually adjusts the azimuth setting of the ADI, HSI and BDHI. When operating the compass system using the AJB-7 directional gyro (STBY selected on the reference system selector switch and DG on the mode switch), corrections for gyro precession are required to maintain system accuracy. Compensation is provided by the hemisphere switch (N-S) and the latitude control when they are set to the local hemisphere and latitude respectively.

REFERENCE SYSTEM SELECTOR SWITCH

The reference system selector switch on the ADI provides selection between the IMU and the AN/AJB−7 displacement gyroscope as the source of attitude information. The following inputs are provided by the inertial navigation set when the reference system selector switch is in PRIM, or by the AN/AJB−7 when the switch is in STBY.

a. Azimuth and attitude information to the attitude director indicator.

b. Azimuth information to the horizontal situation indicator.

c. Azimuth information to the bearing distance heading indicator (rear cockpit).

d. Attitude information to the fire control system.

NOTE

> Primary (inertial) information is not available unless the selector switch on the inertial navigator control panel is in the NAV position.

When switching from STBY to PRIM or vice versa, attitude information appears almost immediately but may be accompanied by some unusual gyrations of the attitude director indicator. This phenomenon is a simultaneous large gyration 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 is uppermost during the initial erection. Accurate heading information may not be immediately available when switching between PRIM and STBY, if the aircraft is in a turn having a turn rate of more than 15° per minute. In this condition, the fast synchronization feature of the compass is cut out. This is done to prevent erroneous heading errors resulting from turning errors which are generated in the flux gate compass. Switching between PRIM and STBY under the preceding conditions will result in random erroneous heading information. 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 compass controller mode switch to the SYNC position.

NOTE

> The pilot may fast erect the AN/AJB-7 gyro platform by selecting the FAST ERECT position on the gyro switch. This applies an electrical cage signal to the gyro caging mechanisms. As the caging signal is applied, the aircraft should be in level, non-accelerating flight. The switch must not be held in FAST ERECT for more than 60 seconds or damage to the gyro may result. FAST ERECT should not be used to correct a heading error unless the preceding procedures have failed to correct the error.

OPERATING MODES

Compass Mode

The compass mode is considered an emergency mode. When the reference systems are not usable because of malfunctions, the compass mode provides a source of magnetic heading information to other aircraft systems. 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, the attitude director indicator azimuth indications should not be used since it is still connected to the malfunctioning reference system. To place the attitude reference system in the compass mode proceed as follows:

1. Mode switch on the compass controller - COMP

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 indications. Apparent drift compensating voltages are inserted by use of the hemisphere switch (N-S) and latitude control on the compass system controller when operating with the reference system selector switch in the STBY (AN/AJB-7) position. However, when operating with the reference system selector switch in the PRIM (inertial) position, the latitude control knob must be set at zero, as a heading error is induced in the system if the control knob is set at any other value. To place the reference system in the DG mode proceed as follows:

1. Mode switch on compass controller - DG
2. Hemisphere switch - LOCAL HEMISPHERE
3. Latitude control knob - ZERO (with reference system selector switch in PRIM) - LOCAL LATITUDE (with reference system selector switch in STBY)
4. Aircraft magnetic heading - SET
   Set aircraft magnetic heading on the HSI, using the set heading knob.
5. Readjust the latitude control knob for each 2° change in latitude, if operating the reference system selector in STBY.

Slaved Mode

The slaved mode is the mode ordinarily used under normal conditions. In the slaved mode, the azimuth system is primarily controlled by signals from the compass transmitter (flux valve). Because 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 proceed as follows:

1. Mode switch on compass controller - SLAVED
2. Sync indicator meter - CHECK
   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.
3. Pitch trim control on ADI - ADJUST
   Adjust the pitch trim control on the ADI for zero pitch attitude.

AIR REFUELING SYSTEM

NOTE

Refer to foldout section for cockpit illustration.

The air refueling system utilizes a receptacle, aft of the rear cockpit, above the number 2 fuselage fuel cell. Actuation of the receptacle is controlled by the air refuel

All data on pages 4-17 thru 4-19 deleted.

switch on the fuel control panel. Placing the air refuel switch to EXTEND, extends the receptacle, interrupts the fuel control panel continuity, and illuminates the air refuel READY light. When the receptacle is extended, the air refueling lights (exterior) illuminate. With the receptacle extended, the pilot must fly a formation position with the tanker. The boom operator in the tanker then extends the boom into the receptacle. When the boom nozzle is seated in the receptacle, a solenoid actuated shuttle valve opens and directs utility hydraulic pressure to the two locking toggles in the refueling receptacle. These toggles grip the nozzle and lock the boom to the refueling receptacle. These toggles may be unlocked by the tanker when the tanker is in automatic mode. The tanker cannot release the toggles if refueling in TANKER MANUAL mode. The air refueling release button or the air refuel receptacle circuit breaker (No. 2 circuit breaker panel) will release the toggles regardless of the tanker refueling mode.

NOTE

- If the tanker informs the receiver that they are refueling in TANKER MANUAL mode, the receiver must initiate the disconnect by using the air refueling release button or pulling the air refuel receptacle circuit breaker.
- During any abnormal engagement, the automatic and tanker disengage features are lost and the receiver must initiate the disconnect.

Once the boom is locked in the receptacle; the READY light goes out and fuel is transferred (at a rate up to 3900 pounds per minute) to any fuel cell or tank that will accept it. An induction coil in the receptacle connects the receiver refueling amplifier and tanker electrical circuits. This illuminates the director lights, and establishes the automatic (tanker initiated) disengage capabilities. If the boom becomes disengaged, an air refuel DISENGAGED light illuminates indicating fuel transfer is interrupted. Once disengaged, the system must be reset to resume taking fuel. When the fuel system is reset, the READY light illuminates indicating a new hook-up can be made. At the completion of the air refueling sequence, the boom receptacle may be retracted and continuity restored to the fuel control panel, by placing the air refuel switch to RETRACT. An amplifier override relay in the air refueling circuit permits normal boom-receptacle engagement with a failed amplifier. For normal and emergency air refueling procedures refer to F/RF-4 Flight Crew Air Refueling Procedures (TO 1-1C-1-8).

Air Refuel Switch

The air refuel switch is a two-position toggle switch on the fuel control panel. Placing the air refuel switch to EXTEND, extends the boom receptacle, interrupts the normal continuity to the fuel control panel, depressurizes the tanks, turns on the hydraulic transfer pumps, and illuminates the air refuel READY light. The ready light will not illuminate until the receptacle is fully extended. After the boom is locked into the receptacle, fuel is transferred to any fuel cell or tank that will accept it. Fuel to each cell or tank is automatically shut off by its fuel level control valve. Three external tanks FULL indicator lights illuminate when the their respective tanks become full. Placing the air refuel switch to RETRACT, retracts the receptacle and restores normal continuity to the fuel control panel. The air refuel switch is used to reset the fuel system during air refueling by cycling from EXTEND to RETRACT and back to EXTEND. With the air refuel switch in EXTEND, pressurization to all internal and external fuel tanks is shut off and will not transfer from internal wing or external fuel tanks. However, placing the internal wing dump switch to DUMP repressurizes the internal wing tanks and provides normal wing fuel dump. If receptacle door is damaged during refueling operations, pull the air refuel receptacle circuit breaker (D1, No. 2 panel) and place the air refuel switch to RETRACT to pressurize fuel tanks and transfer fuel.

Refuel Selection Switch

A two-position refuel selection switch, marked INT ONLY and ALL TANKS, is on the fuel control panel. The INT ONLY position closes the external tank(s) fuel shutoff valves allowing only the fuselage and wing tanks to be refueled. The ALL TANKS position opens the external tank(s) fuel shutoff valves, allowing all fuel tanks to be refueled.

Air Refueling Release Button

The refueling release button is a push-button type switch on the front cockpit stick grip. When release from the boom is desired, depress and hold the release button down until the air refuel DISENGAGED light illuminates. Throttle or attitude changes should not be made until the boom is clear of the receptacle. If the above methods of disengagement fail, pull the AIR REFUEL RECEPT circuit breaker (No. 2 circuit breaker panel). Once disengagement is effected, reset the circuit breaker.

Ready Light

The air refuel READY light indicates that the fuel system is being conditioned to receive fuel. The READY light illuminates when the air refuel receptacle is fully extended. The air refuel READY light remains illuminated until the boom is locked into the receptacle or the air refuel switch is placed to RETRACT.

Disengaged Light

The air refuel DISENGAGED light indicates boom disengagement during the refueling cycle. The air refuel DISENGAGED light remains illuminated until the fuel system is reset to continue refueling, or the receptacle is retracted.

NOTE

- Illumination of the DISENGAGED light is not a positive indication of disconnect.
- A marginal or improperly rigged contact limit switch can cause the DISENGAGED light to illuminate after the boom is locked in the receptacle. If this occurs, refueling can be continued using the procedures for a failed refueling amplifier.

External Tanks Full Lights

Three external tanks full lights, marked L.H. FULL, CTR. FULL and R.H. FULL, illuminate during air refueling when their respective tanks become full. The external tanks full light(s) remain illuminated until the air refueling receptacle is retracted.

MISCELLANEOUS EQUIPMENT

REAR VIEW MIRRORS

There are three rear view mirrors installed on the front cockpit canopy arch, and two mirrors installed on the rear cockpit arch. The rear canopy arch also has two externally mounted rear view mirrors.

SPARE LAMPS

Spare lamps for the console panels are provided. The lamps are adjacent to the utility electrical receptacle on the right console front cockpit and on the oxygen/cabin altimeter panel on the left console in the rear cockpit.

SECTION V
OPERATING LIMITATIONS

TABLE OF CONTENTS

NOTE

> Refer to other sections of the flight manual for operating limitations that are characteristic of a particular phase of operation; i.e., emergency procedures, starting procedures, auxiliary equipment operation, etc.

CREW REQUIREMENTS

The minimum crew for safe flight is one. An additional crew member, as required, will be added at the discretion of the Commander.

INSTRUMENT MARKINGS

Instrument range markings are shown in figure 5-1.

INSTRUMENT FLUCTUATION

FUEL FLOW

100 PPH maximum for indicator readings of 0 to 3000 PPH.
750 PPH maximum for indicator readings of 3001 to 12,000 PPH.

RPM

±0.2% from steady-state condition.

EGT

±5°C maximum for steady-state operation from IDLE through MIL power settings. ±10°C for steady-state afterburner operation.

EXHAUST NOZZLE

Limited by EGT fluctuation.

OIL PRESSURE

±2.5 PSI from steady-state pressure.

NOTE

> Changes in engine compartment pressure affects oil pressure readings. Therefore, during afterburner lightoff and high Mach flight oil pressure changes down to 30 psi are acceptable.

ENGINE LIMITATIONS

STARTER LIMITATIONS

No more than two cartridge starts within a 60-minute period are permitted. Five minutes must elapse between cartridge starts. No more than three starts (any combination of pneumatic and cartridge starts) within a 60-minute period are permitted. Fifteen minutes must elapse between the first and third start. Applying external air on the engine (starter rotation) is considered a start attempt.

ENGINE SPEED

Engine rpm (not time-limited) is: 103% rpm for ground operation and 102% rpm for inflight operation.

AFTERBURNER LIGHT-OFF TIME

During takeoff, afterburner light-off time shall not exceed four seconds from MIL power.

RPM DROP

Drop-off to 87% rpm with a 12-second recovery time is allowable when initiating afterburner.

ENGINE EXHAUST TEMPERATURE LIMITATIONS

Starting

a. If EGT exceeds 750°C during start, shut down engine and abort the flight. Do not attempt to restart.

b. Temperatures from 733 to 750°C are allowable, providing they do not exceed 1 minute and 30 seconds duration. If EGT exceeds 733°C for longer than 1 minute and 30 seconds, the flight must be aborted.

c. Any temperature above 705°C that does not exceed the

INSTRUMENT MARKINGS

BASED ON JP-4 FUEL

EXHAUST TEMPERATURE

🟥 678° MAXIMUM STEADY STATE (–17A/F ENG)
🟥 704° MAXIMUM STEADY STATE (–17C/E/G ENG)

TACHOMETER

🟥 102% RPM – MAXIMUM STEADY STATE OVERSPEED (IN FLIGHT)

ACCELEROMETER

POSITIVE LOAD FACTOR (G) LIMITS

8.5G	🟥	MAXIMUM CLEAN SUBSONIC (M= 0.72 OR LESS) AT COMBAT DESIGN GROSS WEIGHT – 37,500 POUNDS
6.5G	🟥	MAXIMUM CLEAN SUPERSONIC (M = 1.05 OR GREATER) AT COMBAT DESIGN GROSS WEIGHT – 37,500 POUNDS
3.9G	🟥	MAXIMUM AT MAXIMUM GROSS WEIGHT – 62,000 POUNDS (M = 1.05 OR GREATER OR WITH CENTERLINE STORE)

NEGATIVE LOAD FACTOR (G) LIMITS

–1.8G	🟥	MAXIMUM AT MAXIMUM GROSS WEIGHT – 62,000 POUNDS
–3.0G	🟥	MAXIMUM CLEAN AT COMBAT DESIGN GROSS WEIGHT – 37,500 POUNDS

4G–1–(221–1)G
R

Figure 5–1 (Sheet 1 of 2)

🟥 12 PSI – MINIMUM AT IDLE RPM
🟥 60 PSI – MAXIMUM
35 PSI – STATIC MINIMUM AT MILITARY THRUST
🟩 30–60 PSI – INFLIGHT MILITARY

NOTES

- FROM FLIGHT TO FLIGHT, INDICATED PRESSURE AT MILITARY THRUST MUST REPEAT WITHIN $^{+5}_{-10}$ PSI OF THE KNOWN NORMAL INDICATED PRESSURE OF A PARTICULAR AIRPLANE ENGINE COMBINATION.
- 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% REDUCTION IN RPM BELOW 100% RPM.
- ANY STEADY–STATE OPERATION ERRATIC PRESSURE CHANGE WHICH EXCEEDS 5 PSI FOR MORE THAN 1 SECOND MUST BE INVESTIGATED.

MIL THRUST OIL PRESSURE CHECK

AT MILITARY THROTTLE SETTING ADD 1 PSI TO THE INDICATED OIL PRESSURE FOR EACH % RPM BELOW 100%. THIS VALUE MUST BE WITHIN $^{+5}_{-10}$ OF THE PLACARD OIL PRESSURE.

OIL PRESSURE

* 🟩 2750-3250 PSI – NORMAL **PC-1**
* 🟩 2750-3250 PSI – NORMAL **PC-2**
* 🟩 2750-3250 PSI – NORMAL **UTILITY**
🟧 2000-2750 NORMAL WITH RAPID CONTROL MOVEMENT.

NOTE

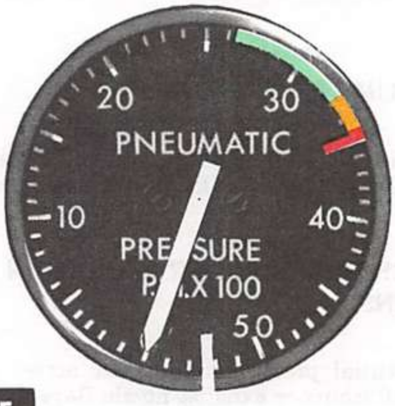
A MOMENTARY DROP BELOW 1500 PSI MAY OCCUR WITH VERY RAPID CONTROL MOVEMENT. IF PRESSURE RECOVERS WITHOUT DELAY, DISREGARD THIS INDICATION.

🟧 3250-3400 IF PRESSURE EXCEEDS 3250 STEADY STATE, AN ENTRY MUST BE LOGGED ON FORM 781.
🟥 3400 MAXIMUM

HYDRAULIC PRESSURE

*PRESSURE WITH NO DEMAND ON SYSTEM.

🟩 2650-3300 PSI NORMAL
🟧 3300-3500 PSI CAUTION AREA
🟥 3500 PSI MAXIMUM



PNEUMATIC PRESSURE

4G-1-(221-2)D
RGY

Figure 5-1 (Sheet 2 of 2)

above limitation must be written up on form 781, but the flight need not be aborted.

All Except Start (without low smoke)

a. Above 750°C – 3 seconds maximum duration.
b. 716°C to 750°C – 1 minute maximum duration.
c. 679°C to 715°C – 5 minutes maximum duration.
d. 678°C no limit – Any steady state (3 seconds or longer) temperature above 678°C must be written up on form 781.

All Except Start (with low smoke)

a. Above 774°C – 3 seconds maximum duration.
b. 741°C to 774°C – 1 minute maximum duration.
c. 705°C to 740°C – 5 minutes maximum duration.
d. 704°C no limit – Any steady state (3 seconds or longer) temperature above 704°C must be written up on form 781.

WINDMILLING LIMITATIONS

Prior to shutdown under non–emergency conditions, reduce thrust to idle and allow EGT to stabilize. For non–emergency shutdowns, do not allow engine windmill rpm to remain below 7% for longer than 10 minutes. The number of intervals operating below 7% rpm is not limited, provided each 10–minute period below 7% rpm is followed by at least a 10–minute period operating above 7% rpm. Operation at 7% rpm or above is required to provide adequate circulation of lubricating oil to various engine components.

THRUST LIMITATIONS

Figure 5–2 is used to determine engine temperature/rpm operating limits in relation to steady state military thrust for takeoff. Under these conditions ambient air temperature may be considered as compressor inlet temperature. The chart depicts minimum and maximum limits.

IGNITION LIMITATIONS

The engine ignition time–cycle is limited to 2 minutes ON, 3 minutes OFF, 2 minutes ON, and 23 minutes OFF.

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 (throttle angle of 35–65) with airspeed above 650 knots. When this condition occurs it will cause distortion of the secondary flaps. Refer to Airplane Speed Restrictions (figure 5–3) for gradual power reduction limitations.

ENGINE G LIMITATIONS

Due to limited oil distribution to the variable nozzle system during negative G or zero G flight, the airplane is limited to:

a. 30 seconds of negative G flight.
b. 10 seconds of zero G flight.

PRIMARY FUEL

JP–4/NATO F–40 is the primary fuel. NATO F–40 may not contain corrosion inhibitor. Restrict operation without corrosion inhibitor to 10 consective hours.

ALTERNATE FUEL

JP–5, JP–8; NATO F–34, F–35, F–43, F–44; and commerical JET A and JET A–1 are kerosene based alternate fuels. Jet B is a wide cut gasoline base alternate fuel equivalent to JP–4 except for freeze point and possible icing and corrosion inhibitor differences. The kerosene based fuels have greater density (6.8 pounds/gallon versus 6.5 pounds/gallon) and higher flash points then gasoline base fuels. This results in notably longer light off and

MILITARY POWER OPERATING LIMITS

(Static Condition Only)

OAT °C	RPM (±1%)	EGT °C	
		-17A/F ENG	-17E/G ENG
–50	90.5	527-585	553-611
–45	91.0	527-595	553-621
–40	91.5	527-609	553-633
–35	92.0	534-617	560-643
–30	92.5	547-628	573-654
–25	93.0	559-639	585-625
–20	93.5	572-650	598-626
–15	94.0	584-661	610-647
–10	94.5	596-672	622-698
–5	95.0	608-678	634-704
0	95.5	620-678	646-704
+5	96.0	632-678	658-704
+10	96.5	644-678	670-704
+15	97.0	656-678	682-704
+20	97.5	647-678	672-704
+25	98.0	640-678	666-704
+30	98.5	633-678	659-704
+35	99.0	632-678	658-704
+40	99.5	632-668	658-694
+45	100.0	632-661	658-687
+50	100.0	632-661	658-687

NOTES

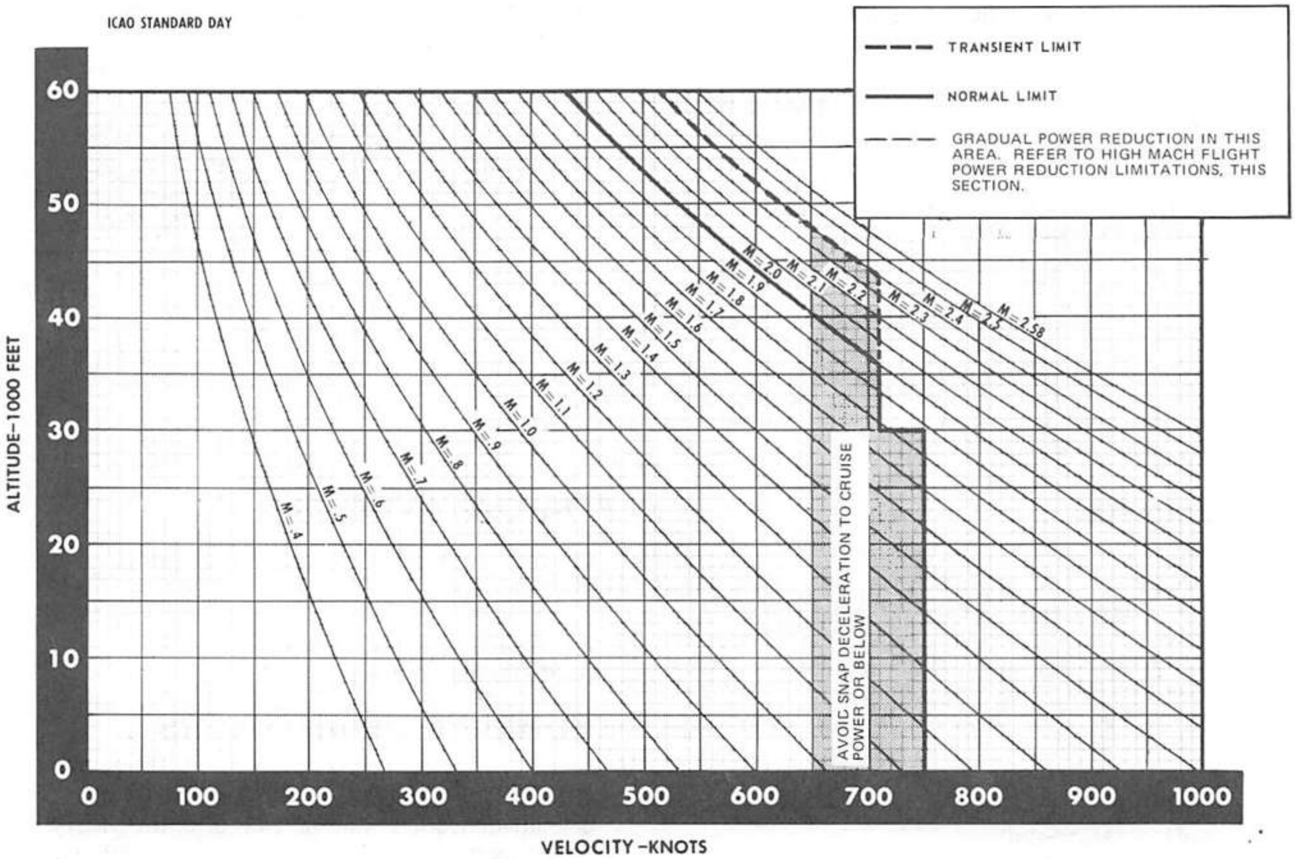
- INDICATED RPM MUST BE WITHIN ± 1% FOR A GIVEN OUTSIDE AIR TEMPERATURE.
- EGT MUST BE IN THE RANGE AS SHOWN USING ACTUAL INDICATED RPM.

4G-1-(220)C

Figure 5–2

AIRPLANE SPEED RESTRICTIONS

CLEAN OR (4) AIM-7 MISSILES



NOTE

UNDER SOME CONDITIONS, MAXIMUM AIRSPEEDS ARE DETERMINED BY INLET TEMPERATURE LIMITATIONS AND TRANSIENT OPERATIONS LIMITATIONS. REFER TO ENGINE AIRSPEED LIMITATIONS CHART, THIS SECTION.

4G-1-(239)A

Figure 5-3

acceleration times with kerosene base fuels for light-off for ground starts below 5°C (40°F).

Thrust is not degraded using alternate fuels. Airstart capability with an alternate fuel is not significantly different than with JP-4 provided the engine has not been inoperative for an extended time since the fuel entering the main fuel control will be warm.

A one time flight using an alternate fuel with the fuel controls specific gravity adjustment set for JP-4 is permissible; however, for optimum performance, the fuel controls should be set for the fuel in use. The following information is provided for comparison to operating on JP-4 with the fuel controls set for JP-4.

a. Fuel control set for JP-4, operating on JP-5 or JP-8.

(1) Rapid throttle transients to MAX afterburner during maneuvering flight, at angle of attack greater than 24 units, increases the possibility of engine flameouts/compressor stalls.

(2) Airstart capability does not change significantly when the engines have been shutdown for less than 1 minute. For shutdown times of 1-4 minutes, a general reduction in relight altitude of 6000 feet is realized.

(3) The following restrictions apply. Ambient temperature must be above -20° for engine start. Maximum rates of throttle movement allowed are 6 seconds IDLE to MIL, 3 seconds 85% to MIL and 3 seconds minimum AB to maximum AB. Stabilize engines at MIL prior to selecting AB.

b. Fuel control set for JP−8, operating on JP−8.
  (1) For airstarts, the time required from ignition/throttle ON to idle rpm increased by 10 to 25 seconds.
  (2) There is no loss in afterburner light−off, nor any increase in susceptibility to engine compressor stall, or flameout during throttle transients.

A one time flight only, fuels may be intermixed during ground or air refueling operations. No change in engine operating limitations or retrim is required.

NATO F-34 and F-44 may not contain corrosion inhibitor. NATO F-35, NATO F-43, JET A, and JET A-1 may not contain icing or corrosion inhibitors. Restrict operation without corrosion inhibitor to 10 consecutive hours. Restrict operation without icing inhibitor to one flight.

Alternate fuels except JET B are heavier than JP-4; refer to Fuel Quantity Data table, section I. The increased fuel weight will cause a CG shift of about 0.1% aft and an increase in range of about 5%.

EMERGENCY FUEL

In an emergency, the engines may be operated on MIL-G-5572B 115/145 AVGAS (NATO F-22) if JP-4 or an alternate fuel is not available. When AVGAS is used, the aircraft is restricted to one flight at subsonic speeds. AVGAS has a specific gravity range between 0.730-0.685. The pilot should be aware that the following degradations in engine performance will occur:

a. Longer time to start and accelerate, with possible missed-starts or start-stalls.
b. Maximum engine RPM and EGT may not be attained.
c. Slow acceleration throughout the operating range.
d. Lower than normal afterburner thrust.
e. Reduced aircraft range.

AIRSPEED LIMITATIONS

The maximum permissible airspeeds for flight in smooth or moderately turbulent air are shown in figure 5-3. Under some conditions, maximum airspeeds are determined by inlet temperature limitations and transient operations limitations; refer to Engine Airspeed Limits (figure 5-4). Limiting airspeeds for operation of various airplane systems are presented in figure 5-5.

NOTE

When flying below 10,000 feet, caution should be used when operating the aircraft above 0.87 Mach to preclude oscillations in case of stability augmentation failure.

ENGINE AIRSPEED LIMITS

ALTITUDE RANGE	STEADY STATE LIMIT	TRANSIENT LIMIT
SEA LEVEL TO 30,000 FEET	POINT AT WHICH DUCT TEMP HI LIGHT ILLUMINATES (121°C), OR 750 KNOTS WHICHEVER OCCURS FIRST	NONE
30,000 FEET AND UP	POINT AT WHICH DUCT TEMP HI LIGHT ILLUMINATES OR 710 KNOTS WHICHEVER OCCURS FIRST	5 MINUTES PER FLIGHT ABOVE THE STEADY STATE LIMIT NOT TO EXCEED 710 KNOTS OR .4 MACH ABOVE THE SPEED AT WHICH THE STEADY STATE LIMIT IS REACHED

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Figure 5-4

AOA LIMITATIONS

The maximum allowable angle of attack is:

a. Above 35,000 feet - 25 units.
b. 35,000 feet and below - 30 units.

PROHIBITED MANEUVERS

a. Full-deflection aileron roll in excess of 360°
b. Full-deflection aileron roll into the heavy wing during supersonic asymmetric flight is prohibited.
c. Intentional spins.

GROSS WEIGHT LIMITATIONS

The maximum allowable gross weights are:

a. Without 26 ply tires, 58,000 pounds for any ground operation.
b. With 26 ply tires, 62,000 pounds for any ground operation.
c. 46,000 pounds for landing.

To estimate aircraft takeoff gross weight, refer to Airplane Loading chart in part 1 of Performance Data Manual.

TOUCHDOWN LIMITATIONS

Refer to figure 5-6. The normal landing technique (outlined in section II) will result in descent rates of approximately 700 fpm during approach and 500 fpm touchdown at typical landing gross weights.

CENTER OF GRAVITY LIMITATIONS

Center of gravity (CG) position has a direct effect on aircraft flight characteristics. Refer to section VI for discussion of aircraft flight characteristics in relation to CG location.

The maximum allowable forward CG limits are:

a. Slats flaps - NORM: 22% MAC
b. Slats flaps - OUT AND DOWN: 22.5% MAC

The maximum allowable aft CG is 36% MAC. However, to determine the maximum allowable aft CG when wing-mounted stores or suspension equipment are on the aircraft, you must consider aircraft stability index. Refer to part 1 of the Performance Data appendix for a description of the method used to compute the stability index number.

After computing the aircraft stability number, refer to the AFT CG Limits Chart, figure 5-7, to determine the maximum allowable aft CG and the neutral stability point for that configuration. Although the aft CG limit and neutral stability point apply to all phases of flight so long as the wing-mounted stores configuration is unchanged, for planning purposes, the CG at engine start is used to determine if flight is authorized. Refer to the Handbook of Weight and Balance Data (TO 1-1B-40) and the DD Form 365F for the particular aircraft and configuration to determine CG at engine start. If the CG at engine start is aft of the aft CG limit for the computed stability index, flight is prohibited.

SYSTEMS OPERATION LIMITATIONS

CONDITION		AIRSPEED or MACH Whichever is Less	LOAD FACTOR
LANDING GEAR EXTENDED		250 KNOTS IAS	0 TO +2.0 G
WING FLAPS EXTENDED		250 KNOTS IAS	0 TO +2.0 G
SLATS EXTENDED		600 KNOTS IAS OR 2.0 MACH	SAME AS BASIC AIRPLANE
AIR REFUELING RECEPTACLE	EXTENSION	320 KNOTS IAS OR 0.85 MACH	-1.5 TO +3.0 G
	AFTER EXTENSION	400 KNOTS IAS OR 0.85 MACH	
CANOPY OPERATION		50 KNOTS	NOT APPLICABLE
CANOPY OPEN		60 KNOTS	NOT APPLICABLE
CANOPY JETTISON, INFLIGHT		SAME AS BASIC AIRPLANE	SAME AS BASIC AIRPLANE
DRAG CHUTE DEPLOYMENT		200 KNOT IAS	NOT APPLICABLE
COCKPIT ACCESS STEPS EXTENDED		400 KNOT IAS	NOT APPLICABLE
APU		600 KNOTS IAS OR .95 MACH	0 TO +4.0 G

Figure 5-5

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WARNING

If CG position is less than 1% MAC forward of the computed neutral stability point (refer to figure 5-7) at engine start, thoroughly review the flight characteristics discussion in section VI before flight.

ACCELERATION LIMITATIONS

The maximum acceleration (G) permitted for a specific flight condition depends on the basic structural design limits, aircraft gross weight, whether the aircraft is rolling (unsymmetrical) or not (symmetrical), aircraft/stores compatibility, specific systems limitations, and limitations due to external stores loaded on the aircraft. The pilot must know the governing criteria which determine the maximum G allowable for his particular flight conditions.

The Acceleration Limitations chart, figure 5-8, defines the aircraft G limits based on the aircraft structural strength and as a function of gross weight, Mach number, and configuration (with or without centerline or wing stores). Separate plots show the limits for symmetrical (neutral aileron and rudder) and unsymmetrical (any aileron and/or rudder input) maneuvers. The subsonic and supersonic limit lines define the G limits for a clean aircraft with or without fuselage missiles and/or fuselage mounted ECM pods. The centerline stores limit line (stores compatibility limit) is coincident with but separate from the supersonic limit line and defines the G limit with centerline stores (except 20mm gun pod, empty MER or empty high performance centerline tank) loaded on station 5. The wing stores limit line (stores compatibility limit) defines the G limit with a store or stores loaded on any wing station (except AIM-9 and/or empty MER/TER). The limits consider the effect of moderate turbulence. Load factor encounters (G overshoot) due to wing tip vortices/wake turbulence should be considered as an unsymmetrical load factor. Any G over that shown by the applicable line shall be reported so that the aircraft may be inspected for structural damage. Since aircraft fatigue life depends on the number and magnitude of G applications, accelerations should be used only as required by the mission.

CAUTION

- Acceleration of 8.5 G is permissable only for symmetrical maneuvers with gross weight below 37,500 pounds and airspeed less than Mach 0.72. All external stores except fuselage missiles/ECM pods, centerline gun pod, empty high performance centerline tank, AIM-9, and empty MER/TER, further limit the G allowable.
- Unsymmetrical (rolling) G-allowable is significantly less than that for symmetrical maneuvers. Any aileron or rudder input will cause an immediate 20% reduction in G-allowable. The lower limit for unsymmetrical flight is 0 G at all gross weights, airspeeds, and external stores loadings.

The Systems Operation Limitations chart, figure 5-5, presents the G limits for certain systems/components. Any G in excess of these limits shall be reported so that the system/component may be inspected for structural

TOUCHDOWN SINK RATE LIMITS

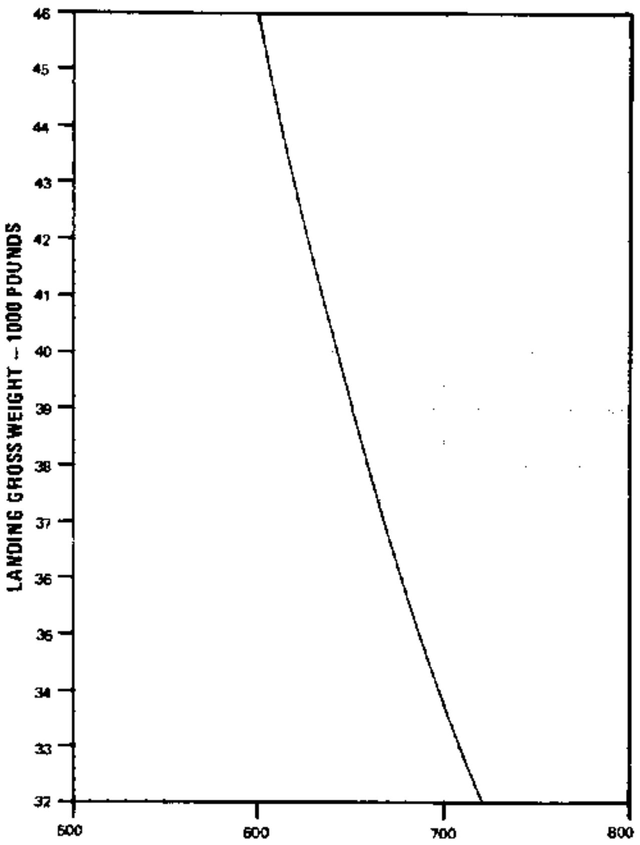

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Figure 5-6

damage.

The External Stores Limitations chart, figure 5–10 contain the G limits for the aircraft with the applicable external store loaded. Generally the carriage limit is based on either store limits or aircraft rack, pylon or supporting structure limits. Any G in excess of these limits shall be reported so that the store, if retained, and supporting structure may be inspected. Employment and release acceleration limits are generally based on separation criteria. If these are exceeded, surrounding structure must be inspected for damage.

FLIGHT STRENGTH DIAGRAM

The flight strength diagram (figure 5-9) is a composite presentation of basic aircraft's operating envelope (with or without fuselage missiles) at different gross weights. The parameters of each envelope include maximum allowable Mach number, wings level stall speed at sea level, and positive and negative load factor limits. This diagram further restricts allowable negative load factors at speeds above 1.5 Mach and decreases positive load factors between 0.72 and 1.0 Mach. Further restrictions to positive load factors occur above 1.8 Mach.

EXTERNAL STORES LIMITATIONS

Only the external stores listed in the External Stores Limitations chart (figure 5–10) may be carried and released, singly or in combination, by the aircraft. A mixed load of live and training missiles is not authorized. Different stores authorized for carriage on a specific station will not be combined unless depicted in combination. Any station loading depicted in figure 5–10 may be used in combination with any other depicted station loading on adjacent or opposite stations, unless otherwise annotated. This chart indicates store–to–airframe structural and flight handling characteristic compatability only; electromagnetic radiation compatability is indicated in the applicable equipment technical order when not stated in the Remarks column.

WARNING

Jettison and release limits are based on test data with the landing gear and flaps up. If centerline or inboard release or jettisoning is required with the landing gear down, or with the landing gear and flaps down, damage may occur to the aircraft which may result in loss of control.

NOTE

- Where applicable, alternate limitations are also included within a boxed area. These alternate limitations permit higher speeds if the indicated lower acceleration limits are observed.
- Avoid jettisoning or releasing any store(s) at the extremities of the published envelopes whenever possible.
- Release of weapons with a load factor in excess of 3 G may result in a small percentage of hung bombs: i.e., the failure of the bomb to release from the MER or TER ejector unit.
- When stores are released in either ripple or salvo mode, G jump (nose rise) up to 3.5 G can occur. Aircrews must ensure that maximum G limit for the configuration is not exceeded.
- Unless otherwise annotated, aircraft roll rates with external stores must be limited to 120 degrees per second below 550 KIAS and 90 degrees per second above 550 KIAS. Amount of stick throw is only limited by maximum roll rate.

PARTIAL CONFIGURATIONS.

a. Partial configurations are obtained from the configurations presented in figure 5–10 by deleting stores from the existing approved configurations.

b. Flight restrictions and limitations for all partial configurations are the same as the restrictions or limitations applying to the original configuration.

c. Partial configuration must be obtained by deleting stores in the normal release sequence. This rule is necessary to assure that only configurations that have

AFT CG LIMITS

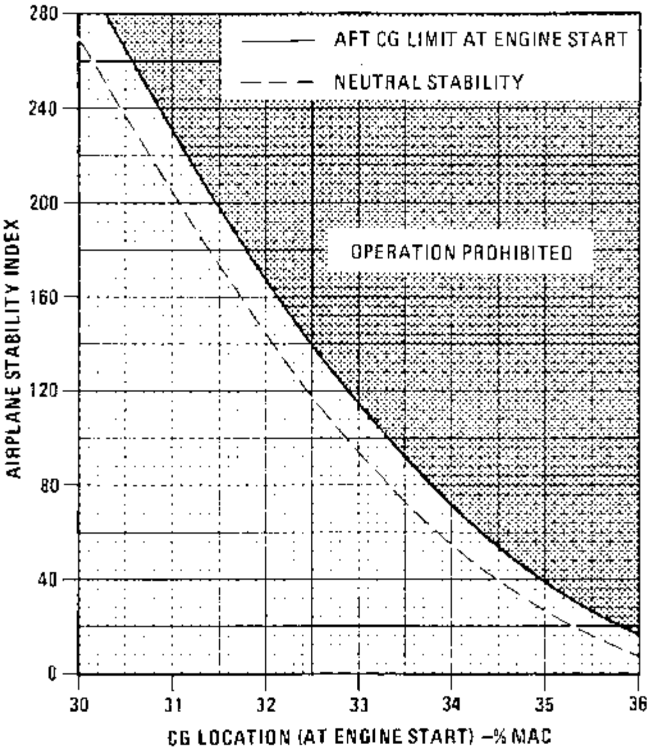

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Figure 5–7

been analyzed and flight tested are flown. Any configuration shown in figure 5–10 can be down loaded in accordance with these rules.

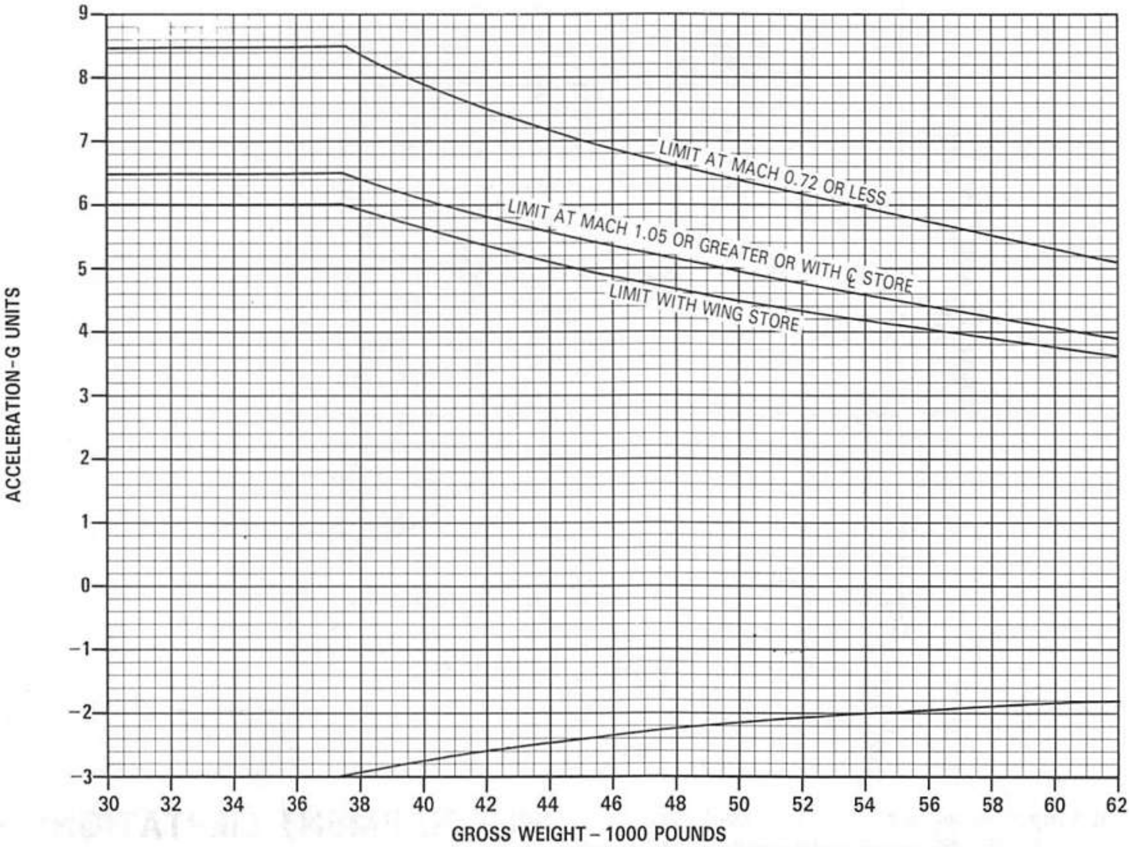
d. After the applicable release, employment or jettison of stores carried beneath AIM–9 missiles, AIM–9 limitations are authorized.

CNI EQUIPMENT LIMITATIONS

The maximum permissible altitude with CNI equipment on is 60,000 feet. Flight above 60,000 feet with CNI equipment on may result in damage to the equipment.

ACCELERATION LIMITATIONS

SYMMETRICAL MANEUVERS



NOTE: LINES INDICATE AIRCRAFT STRUCTURAL LIMITS DUE TO AIRCRAFT/STORES COMPATABILITY. REFER TO EXTERNAL STORES LIMITATIONS, FIGURE 5-10, FOR REDUCED ACCELERATION G LIMITS FOR SPECIFIC STORE CONFIGURATIONS. ACCELERATION LIMITATIONS VARY LINEARLY BETWEEN 0.72 AND 1.05 MACH.

UNSYMMETRICAL MANEUVERS

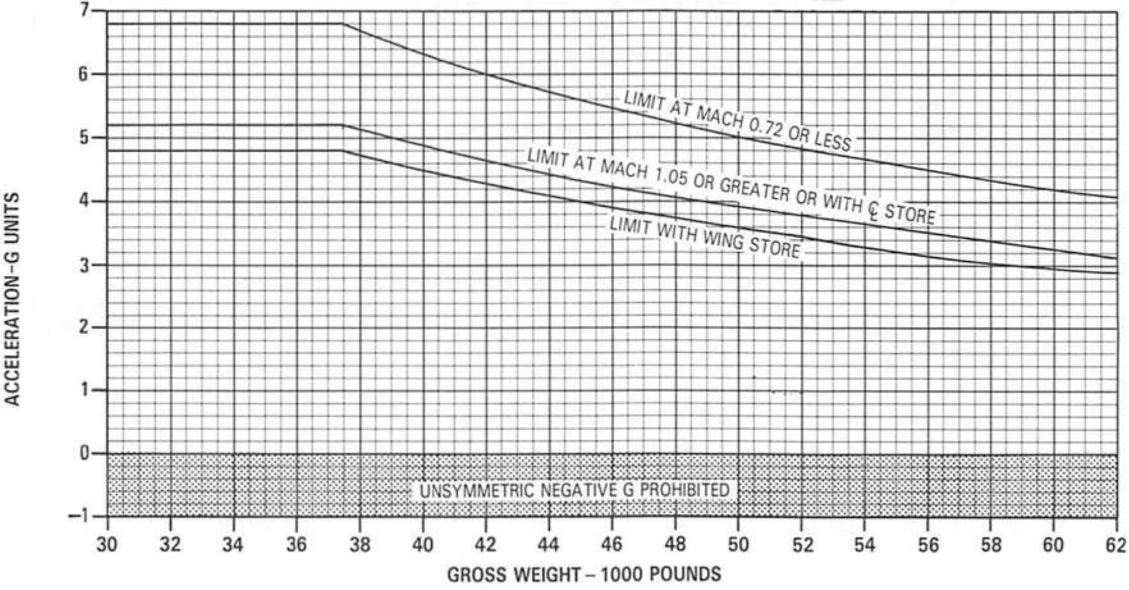


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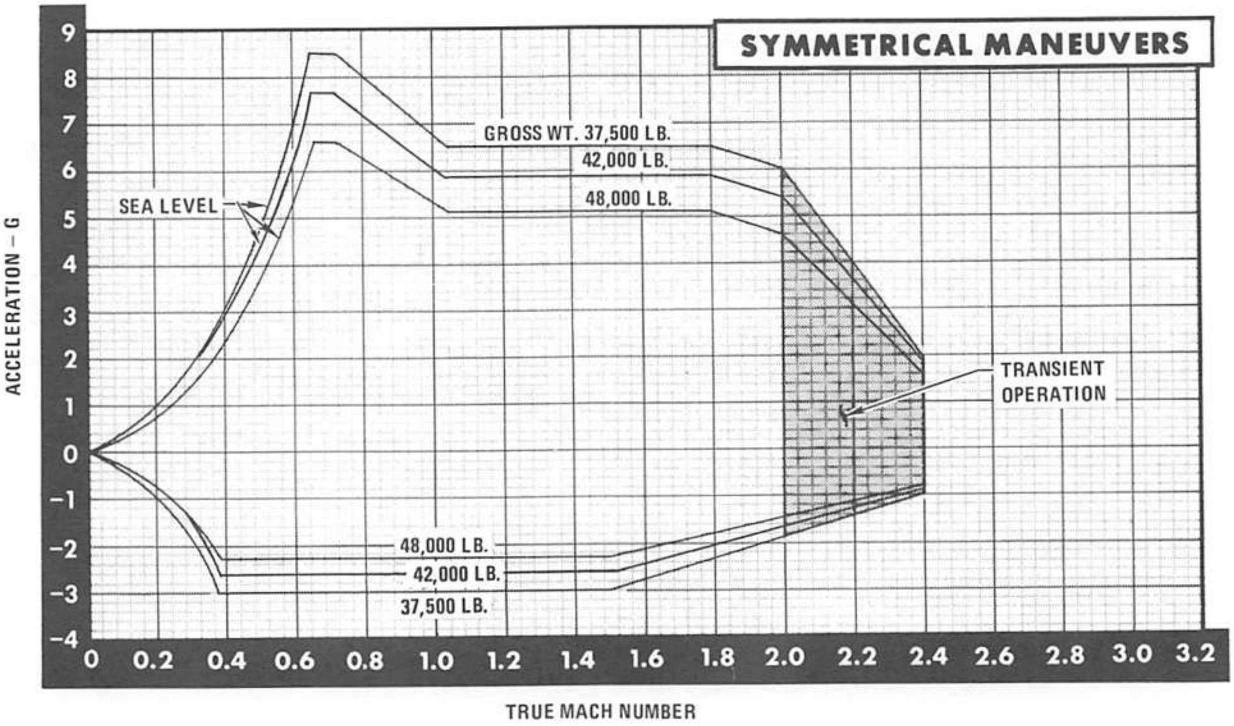
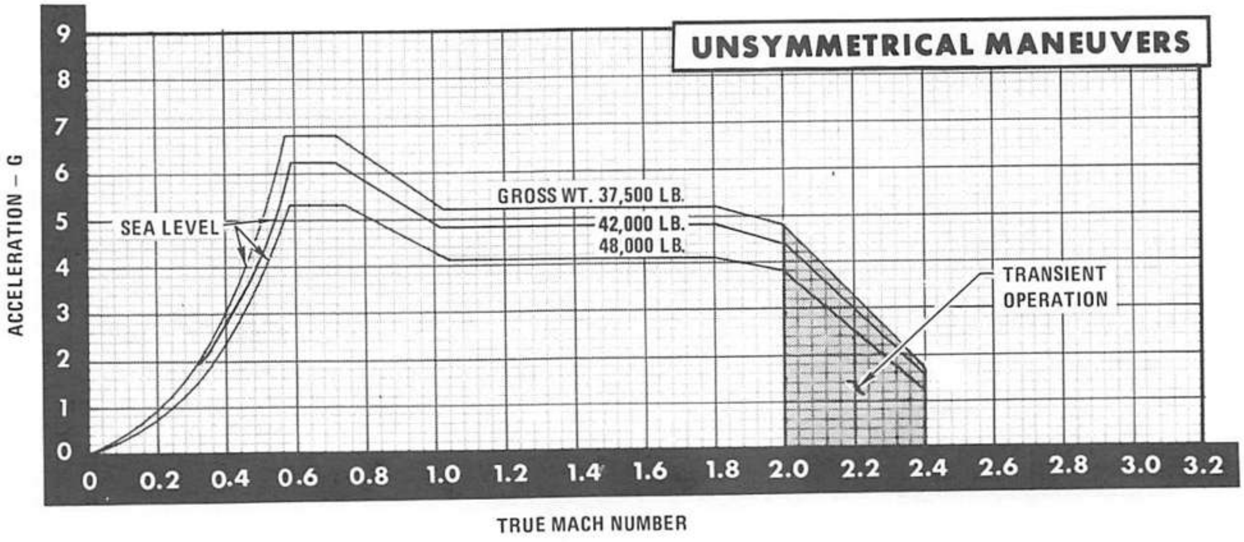
Figure 5-8

FLIGHT STRENGTH DIAGRAM





4G–1–(236)B

Figure 5-9

EXTERNAL STORES LIMITATIONS

TABLE OF CONTENTS

GENERAL

A. The minimum acceleration for release or employment in level flight is 1G. The minimum acceleration for employment or release in a dive delivery is the normal G loading for a given dive angle which can be obtained only when a wings level straight line flight path is maintained prior to release or employment.

B. Speeds or G quoted in the "employment" column are applicable to the dispensing limitations of the CBU's, and the launching limitations of the missiles, etc.

C. Speeds or G quoted in the "Release" column are applicable only to releasing the store from its suspension equipment.

D. Speeds quoted in the "Jettison" column are applicable to jettisoning the combined suspension equipment and store from the airplane.

E. The term "ripple" in the "External Stores Notes" applies to the single–ripple and single–continuous release modes.

F. Unless otherwise indicated in the "External Stores Notes" the minimum INTVL setting for the single–ripple and single–continuous release modes is .06 SEC.

G. Unless otherwise indicated in the "External Stores Notes" the minimum INTVL setting for the salvo release mode is .20 SEC when adjacent weapon stations are selected and .06 SEC when a single weapon station or non–adjacent weapon stations are selected.

H. With partially loaded MER/TER's, use a minimum interval of .09 SEC to step over one empty MER/TER position in the ripple or salvo mode. To step over two empty MER/TER positions, use a minimum interval of .14 SEC.

I. If the situation warrants, store(s) may be jettisoned with flaps and slats extended. However, release, jettison and employment of stores should be accomplished with slats in automatic operation only.

J. Refer to figure 5–8 for reduced acceleration G limits as a result of gross weight and Mach number.

K. For asymmetric carriage, refer to Section VI, Flight With Asymmetric Loading.

L. Recommended release sequence is outboard to inboard. Releasing inboard stores prior to outboard may result in an aft CG shift. Under some circumstances the shift may exceed the aft CG limit.

M. Captive AIM-9 missiles may be flown with wings, rollerons and/or fins/canards removed.

N. The most restrictive external store limit applies (refer to figures(s) 5-3, 5-7 thru 5-11).

NA, Not Applicable/Authorized

NE, Not Established

✈ Aircraft Limits.

▭ Alternate Limitations – Either primary or alternate limitations apply to all configurations for station loading.

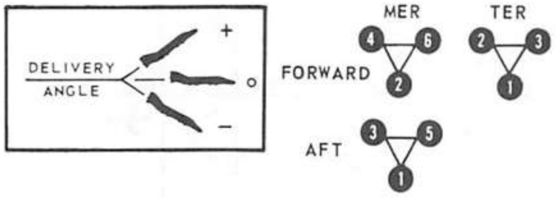


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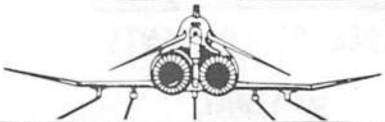
Figure 5-10 (Sheet 1 of 13)

EXTERNAL STORES LIMITATIONS



FUEL TANKS, ECM PODS AND SUSPENSION EQUIPMENT

STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT		
							AIRSPEED		ACCEL G		JETTISON		
											MIN	MAX	
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS	
600 Gallon High Performance Centerline Tank	BRU-5/A	Empty, Subsonic		●			660	2.0	✈ * * *	✈ * * *	—	660 2.0 *	
		Empty, Supersonic		●					+6.5 −2.0	+5.2 0.0			
		Empty to Full		●					+5.0 −2.0	+4.0 0.0		560 2.0 * *	A
Royal Jet 600 Gallon Centerline Tank	BRU–5/A	Empty to 10% Full		●			600	1.8	+5.0 0.0	+4.0 0.0	175	390	
		10% Full to 75% Full		●							Not Authorized		
		75% Full to Full		●					+3.0 0.0	+2.0 0.0	175	390	B
Sargent–Fletcher 370 Gallon Wing Tank	Pylon Installed as part of Wing Tank	●	Empty to 10% Full			●	750	1.6	+6.0 −2.0	+4.8 0.0	(1G Level Flight) 175 to 375 (2G Sym Flight) 400 to 445 (3G Sym Flight) 425 to 510		
		●	10% Full to 75% Full			●	550		+5.0 −2.0	+4.0 0.0			
		●	75% Full to Full			●			+4.0 −1.0	+2.0 0.0			C
Empty Aero-3/B or LAU-105 Launchers	MAU-12 with single or double 3-inch spacers		✚		✚		✈	✈	✈	✈	NA	NA	D
Empty MER Maximum Load–3	MAU–12	▽▽				▽▽	✈	✈	✈ *	✈ *	350	550/0.9	
	℄ Adapter			▽▽							275	350/0.7	E
Empty TER Maximum Load–2	MAU–12		▽		▽		✈	✈	✈	✈	175	550/0.9	F
ALQ–119(V)–15, –17 ALQ–131(V)–4, –5, –6, –9, –10 ALQ–176 ALQ–184(V)–1, –2, –3, –4, –5, –6 QRC 80–01(V)–3, –4 ECM Pod	MAU–12		●		●		✈	✈	✈	✈	NA	NA	
		MISSILE STATIONS	3	4	6	7							
	Missile Well Adapter			●									

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Figure 5-10 (Sheet 2 of 13)

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX	MIN	MAX	MAX	MIN	MAX		
	ACCEL G	KNOTS	KNOTS	ACCEL G	KNOTS	KNOTS		
	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll Rate: Empty –200 deg/sec. Empty –to Full –150 deg/sec. ● Roll Acceleration: Empty –Full stick throw. Empty to Full –1/2 stick throw. ● Do not exceed on speed AOA unless the tank is completely full or empty. This AOA restriction does not apply to the modified High Performance Centerline tank with filler cap locted on the rear of the tank. * Jettison 0.5G to 2.0G above 13 feet. * * Jettison 0.5G to 1.0G above 13 feet. * * * Stores compatibility limit does not apply.
A	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● (Full or Empty): Jettison between 350 and 390 knots below 15,000 may cause airplane contact and minor damage. ● Roll rate limited to 60 deg/sec. ● Catastrophic failure of the Royal Jet 600 gallon centerline tank may cause a severe pitch–up.
B	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● (Empty to 10% Full): Roll rate is aircraft limits.
C	NA	NA	NA	NA	NA	NA	NA	● (STA 2 and 8): One or two empty Aero-3/B launchers and spacers may be carried in combination with any other certified stores subject to the following restrictions: • Only one type of store in addition to the launchers permitted on each aircraft station and the flight limitations of the more restrictive of the two will be observed. • Fit clearance of at least one inch must exist between the launchers and the other stores mounted on the station. ● Maximum roll rate is aircraft limits. * Stores compatibility limit does not apply.
D	NA	NA	NA	NA	NA	NA	NA	● Maximum roll rate is aircraft limits. * Stores compatibility limit does not apply.
E	NA	NA	NA	NA	NA	NA	NA	● Maximum roll rate is aircraft limits. ● Stores compatibility limit does not apply.
F	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll rate is aircraft limits. ● Cartridges are not to be installed in MAU–12 pylon. ● (STA 4) with ALQ-131, Nose Gear may be slow to retract.

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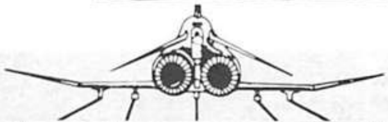
Figure 5-10 (Sheet 3 of 13)

EXTERNAL STORES LIMITATIONS

ECM PODS



STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT	
							AIRSPEED		ACCEL G		JETTISON	
											MIN	MAX
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS
ALQ-131(V)-12, -13, -14, -15 ECM Pod	MAU-12		●		●		750	1.8	✈	✈	NA	NA
		MISSILE STATIONS										
			3	4	6	7						
	Missile Well Adapter			●								
ALQ-188 ECM Pod	MAU-12		●		●		✈	✈	✈	✈	NA	NA

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Figure 5-10 (Sheet 3A of 13)

ECM PODS

EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
MAX ACCEL G	MIN KNOTS	MAX KNOTS	MAX ACCEL G	MIN KNOTS	MAX KNOTS		
NA	NA	NA	NA	NA	NA	NA	• If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. • Roll rate is aircraft limits. • Cartridges are not to be installed in MAU-12 pylon. • (STA4) with ALQ-131, Nose Gear may be slow to retract.
A NA	NA	NA	NA	NA	NA	NA	• If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. • Roll rate is aircraft limits. • Cartridges are not to be installed in MAU-12 pylon.

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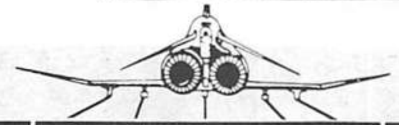
Figure 5-10 (Sheet 3B of 13)

EXTERNAL STORES LIMITATIONS



GP BOMBS

STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT		
							AIRSPEED		ACCEL G		JETTISON		
											MIN	MAX	
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS	
MK-82 LDGP, BDU-50/B, A/B MK-36 Destructor with MK-82 Fin, MAU-93B or MK-15 (banded closed) Fin	MER (Fwd)	●		●		●	550	1.1	+5.0 −1.0	+4.0 0.0	175	450/0.8	
							650	1.3	+3.0 0.0	+2.4 0.0			
Maximum Load–24	TER		●		●							550/0.9	A
MK-82 Snakeye 1 or MK-36 Destructor with MK-15 Mod 3A or Mod 4 Fins (high or low drag)	MER (Fwd) Single Release Mode or Ripple	●		● **		●	550	1.1	+5.0 −1.0	+4.0 0.0	175	450/0.8	
Maximum Load: Single–24 Ripple–21	TER		●		●							550/0.9	B
MK–82/ BSU–49/B (AIR)	MER (Fwd) Single Release Mode or Ripple	●		● **		●	600	1.2	+5.0 −1.0	+4.0 0.0	175	450/0.8	
Maximum Load: Single-24 Ripple-21	TER		●		●		650	1.4	+4.0 0.0	+3.2 0.0		550/0.9	C
MK-84 LDGP BOMB	MAU–12	●				●	600	1.3	+5.5 −3.0	+4.4 0.0	175	600/1.2	
Maximum Load –3	BRU–5/A			●			600	1.4	+3.0 0.0	+2.4 0.0			D
MK–84/ BSU–50/B (AIR)	MAU–12	●	●		●	●	600	1.3	5.5 −3.0	4.4 0.0	175	550/0.9	
Maximum Load–4							700	1.4	3.0 0.0	2.4 0.0			E
M129E1, M129E2 Leaflet Bomb and MJU-1 Chaff Bomb	MAU–12	●	●		●	●	550	1.1	+5.0 −1.0	+4.0 0.0	175	550	
	MER (Fwd)	●				●					275		
				●								450	
Maximum Load–18	TER		●		●						175	550	F
MC–1 Gas Bomb	MAU–12	●	●		●	●	550	1.1	+5.0 −1.0	+4.0 0.0	175	550	
	MER (Fwd)	●				●					275		
				●								450	
Maximum Load–17	TER		●		●						175	550	

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Figure 5-10 (Sheet 4 of 13)

GP BOMBS

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX ACCEL G	MIN KNOTS	MAX KNOTS	MAX ACCEL G	MIN KNOTS	MAX KNOTS		
	NA	NA	NA	+5.0	175	550/1.1	+60° to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart.
A	NA	NA	NA	+5.0	175	500/0.8 ∗550/1.1	Level to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Simultaneous release from TER and centerline MER is prohibited. ● To prevent bomb−to−bomb collision when released from stations 1, 5 and 9; select an interval setting which will provide 0.20 seconds or greater between tandem bomb releases on each station. ∗ MK-82 Snakeye 1 (LD) Low Drag ∗∗ Loading on station 5 is restricted to MER stations 1, 4 and 6 whenever ripple or continuous release mode is selected.
B	NA	NA	NA	+4.0 +0.8	175	550/1.2	+35° to −35°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Simultaneous release from TER and centerline MER is prohibited. ● To prevent bomb-to-bomb collision when released from stations 1, 5, and 9; select an interval setting which will provide 0.20 seconds or greater between tandem bomb releases on each station. ∗∗ Loading on station 5 is restricted to MER stations 1, 4, and 6 whenever ripple release mode is selected.
C	NA	NA	NA	+4.0	175	600/1.2	+60° to -60°	● If gross weight is over 41,000 lbs, refer to Acceleration Limitations Chart.
				+3.0	175	650/1.2	+30° to -30°	**No. M900 Series Fuse** **No. ATU−35 Drive**
D	NA	NA	NA	+4.0	175	600/1.2	+35° to −35°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Maximum carriage airspeed is 635 KCAS/1.2 Mach with MK-84 on stations 1 and/or 9.
				3.0	175	650/1.2		
E	NA	NA	NA	1	175	550	Level to −45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● The weight of the MJU−1 may vary by as much as 100 pounds depending upon type of chaff load.
F	NA	NA	NA	1	175	550	+45° to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart.

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Figure 5-10 (Sheet 5 of 13)

EXTERNAL STORES LIMITATIONS

GP BOMBS

STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT	
							AIRSPEED		ACCEL G		JETTISON	
											MIN	MAX
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS
BLU-109 with MK-84 Conical Fin	MAU-12	●				●	600	1.3	+5.0 -1.0	+4.0 0.0	175	550
							650	1.4	+3.0 0.0	+2.0 0.0		

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Figure 5-10 (Sheet 5A of 13)

GP BOMBS

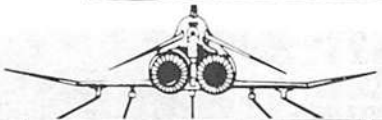
EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
MAX	MIN	MAX	MAX	MIN	MAX		
ACCEL G	KNOTS	KNOTS	ACCEL G	KNOTS	KNOTS		
NA	NA	NA	+4.0 +0.7	175	550	+45° to -45°	● If gross weight is over 45,000 lbs. refer to Acceleration Limitations Chart. ● Maximum jettison and release is 0.95 Mach.

4G-1-(242)-5-2(44)

Figure 5-10 (Sheet 5B of 13)

EXTERNAL STORES LIMITATIONS

ROCKET LAUNCHERS (FFAR) DISPENSERS CLUSTER AND PRACTICE BOMBS



STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT JETTISON		
							AIRSPEED		ACCEL G		MIN	MAX	
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS	
MK-20 Mod 2, 3, 4 Cluster Bomb (Rockeye II) Maximum Load-12	MER (Fwd)			●●● ●●●			550	1.1	+5.0 -1.0	+4.0 0.0	175	450/0.8	
	TER		●●●		●●●							550/0.9	A
SUU-20/A SUU-20A/A SUU-20 A/M SUU-20B/A Bomb and Rocket Dispenser with MK-106, BDU-33 B/B, D/B Maximum Load-2	MAU-12		●		●		550	1.2	+5.0 -2.0	+4.0 0.0	375 Single Speed 375		
							650	1.3	+3.0 0.0	+2.4 0.0			B
SUU-21/A Bomb Dispenser with MK-106, BDU-33B/B, D/B Maximum Load-5	Aero 27/A or BRU-5/A			●			550	1.3	+6.5 -3.0	+5.2 0.0	NA	NA	
	MAU-12	●	●		●	●		1.1	+5.5 -1.0	+4.4 0.0			C
BDU-33 B/B, D/B Practice Bomb Maximum Load-24	MER (Fwd)	●●● ●●●				●●● ●●●	550	0.95	+5.0 -1.0	+4.0 0.0	350	450/0.8	
				●●● ●●●							275 Single Speed 275		
	TER		●●●		●●●						175	550/0.9	D
LAU-131 with MK-66 Rockets	MAU-12		●		●		550	1.1	+5.0 -1.0	+4.0 0.0	200	450/0.8	
	MER (Fwd)	●●● ○○○				●●● ○○○					NA *	NA *	
	TER		○●●		●●○								E
CBU- SUU- 52 B/B 30H/B 58/B, A/B 30H/B 71/B, A/B 30H/B Dispenser and Bomb Maximum Load -15	MER (Fwd)			●○● ●●●			550	1.1	+5.0 -1.0	+4.0 0.0	300	500/0.8	
	TER		●●○		○●●		600	1.3	+3.0 0.0	+2.4 0.0	175		
			●○●		●○●								
	MER (Fwd)	○●● ●○○				●●○ ○○●					375		
	MAU-12	●	●		●	●					175	550/0.9	

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Figure 5-10 (Sheet 6 of 13)

ROCKET LAUNCHERS (FFAR), DISPENSERS, CLUSTER AND PRACTICE BOMBS

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX ACCEL G	MIN KNOTS	MAX KNOTS	MAX ACCEL G	MIN KNOTS	MAX KNOTS		
A	NA	NA	NA	+4.0	175	550/ 0.95	+45° to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart.
B	+4.0	ROCKETS 300 BOMBS 300	ROCKETS 450 BOMBS 550	NA	NA	NA	EMPLOY +60° to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Either 14 or 30–inch suspension hooks may be used. ● Maximum employment is .9 Mach.
C	+6.5	175	550	NA	NA	NA	EMPLOY +60° to −60°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● DCU–94/A release system only.
	+5.5							● If gross weight is over 41,000 lbs, refer to Acceleration Limitations Chart. ● (STA 2 and 8). Requires pylon and dispenser modifications.
D	NA	NA	NA	5.0	175	550/ 0.95	+60° to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart.
E	+5.0 +0.5	175	550/ 0.95	1.0	200	450/ 0.8	0° to −45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Roll rate is limited to 120 deg/sec. ● Maximum employment is .95 Mach. Reduce employment limit to 525 KCAS for dive angles above 15 degrees. ● LAU-131 tail fairing must not be installed. ● Release limits apply to the release of the LAU-131 launchers only. * LAU-131 launchers (full, partially full or empty) must be released prior to jettison of MER or TER.
	NA	NA	NA	+4.0	175	550/ 0.9	+60° to −60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart.

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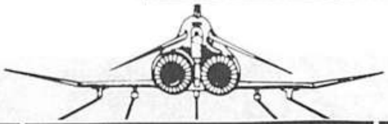
Figure 5-10 (Sheet 7 of 13)

EXTERNAL STORES LIMITATIONS

CLUSTER BOMB UNITS



STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT	
							AIRSPEED		ACCEL G		JETTISON	
											MIN	MAX
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS
CBU-87/B, A/B, B/B Maximum Load - 14	MER (Fwd)			●▽● ●▽●			550	0.95	+5.0 -1.0	+4.0 0.0	300	500/0.8
		●▽ ●▽●				▽● ●▽●					375	
	MAU-12	●				●	600	1.1			175	600/0.9
			●		●							
	TER		●▽●		●▽●		550	0.95				500/0.8
CBU-89/B Gator Mine Maximum Load - 18	MER (Fwd)			●▽● ●▽●			550	0.95	+5.0 -1.0	+4.0 0.0	300	500/0.8
		●▽ ●▽●				▽● ●▽●					375	
	TER		●▽●		●▽●						175	
	MAU-12	●				●	600	1.1				600/0.9
			●		●							

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Figure 5-10 (Sheet 7A of 13)

CLUSTER BOMB UNITS

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX	MIN	MAX	MAX	MIN	MAX		
	ACCEL G	KNOTS	KNOTS	ACCEL G	KNOTS	KNOTS		
	NA	NA	NA	+4.0 +0.7	175	550/ 0.95 600/ 1.1 550/ 0.95	+45° to −45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Maximum roll rate is limited to 120 degrees/second. ● Jettison limits are for emergency jettison only.
A	NA	NA	NA	+4.0	175	550/ 0.95 600/ 1.1	+45° to -45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● (STA 1, 5, 9): To prevent bomb-to-bomb collisions from MER stations, release interval must be 0.20 second or greater between tandom bomb releases on each station. ● To ensure fins open, fin release wire is hardwired to swaybraces. ● (STA 5): BRU-5A Screwjack jam nuts must be safety wired.

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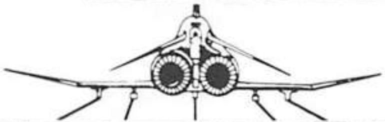
Figure 5-10 (Sheet 7B of 13)

EXTERNAL STORES LIMITATIONS

MISSILES AND MIXED LOADS



STORE	SUSPENSION	STATION LOADING 1	2 MISSILE STATIONS 3	5 4	8 6	9 7	CARRIAGE AIRSPEED KNOTS	MACH	ACCEL G SYM.	UNSYM.	JETTISON 1G LEVEL FLIGHT JETTISON MIN KNOTS	MAX KNOTS	
AIM-7E-3 AIM-7E-3 with AN/AWM-19 AIM-7F/M Missiles Maximum Load - 4	Aero-7A	FWD		●	●		✈	✈	✈	✈	175	✈	
		AFT	●			●							A
AIM-9B/E/J/N/P P-4 (basic, -1, -2 & -3 Configuration and Captive Training Missile) Maximum Load-4	Aero-3/B or LAU-105 with single or double 3-inch spacers		●●		●●		*	*	✈ **	✈ **	NA	NA	B
AIM-9B/E/J/N/P/ P-4 (basic, -1, -2 & -3 Configuration and Captive Training Missile) with MK-82 LDGP or Snakeye, CBU-52B/B, CBU-58/B, A/B, CBU-71B, A/B, MK-20, GBU-12 B/B, C/B, D/B	Aero-3/B or LAU-105 with double 3-inch spacer with Special Weapons Adapter on MAU-12 Pylon with 2 1/2-inch sway brace bolts and TER		●● ●▽●		●● ●▽●		550	1.1	+5.0 -1.0	+4.0 0.0	175	550/0.9	C
AIM-9B/E/J/N/P/ P-4 (basic -1, -2 & -3 Configuration and Captive Training Missile) with AGM-45 and ATM-45	Aero-3/B or LAU-105 with double 3-inch spacer with Special Weapons Adapter with LAU-34 launcher on MAU-12 Pylon with 2 1/2-inch sway brace bolts		●● ●		●● ●		✈	✈	+6.0 -3.0	+4.8 0.0	175	550/0.9	D
AIM-9B/E/J/N/P/ P-4 (basic -1, -2 & -3 Configuration and Captive Training Missile) with AGM-65A/B/D and TGM-65	Aero-3/B or LAU-105 with double 3-inch spacer with Special Weapons Adapter with LAU-117 launcher on MAU- 12 Pylon with 2 1/2-inch sway brace bolts.		●● ●		●● ●		✈	✈	+6.0 -3.0	+4.8 0.0	175	550/0.9	E
AIM-9 (Captive Training Missile) with BDU-33B/B, D/B	Aero-3/B or LAU-105 with double 3-inch spacer on MAU-12 Pylon and TER		●● ●▽●		●● ●▽●		550	0.95	+5.0 -1.0	+4.0 0.0	175	550/0.95	F
AIM-9 (Captive Training Missile) with MXU-648A/A, C/A Cargo Pod	Aero-3/B or LAU-105 with double 3-inch spacer on MAU-12 Pylon		●● ●		●● ●		550	0.95	+5.0 -1.0	*	NA	NA	G
AIM-9B/E/J/N/P/ P-4 (basic, -1, -2 & -3 Configuration and Captive Training Missile) with CBU-87/B, A/B, B/B	Aero-3/B or LAU-105 with double 3-inch spacer with Special Weapons Adapter on MAU-12 Pylon with 2 1/2-inch sway brace bolts and TER		●● ●▽●		●● ●▽●		550	0.95	+5.0 -1.0	+4.0 0.0	175	500/0.8	

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Figure 5-10 (Sheet 8 of 13)

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX	MIN	MAX	MAX	MIN	MAX		
	ACCEL G	KNOTS	KNOTS	ACCEL G	KNOTS	KNOTS		
	Sym +5.0 + 0.5 Unsym + 4.0 + 0.5 *	220	✈	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● If the tank aboard relay is energized (TK light illuminated), the missiles mounted on fuselage stations 4 and 6 cannot be launched or jettisoned. ● Roll rate is aircraft limits. ● AIM-7F/M after TO 1F-4-1167. ● Mixed load of AIM-7E, AIM-7F or AIM-7M is not authorized. * For AIM-7F/M Refer to TO 1 –1M–34 –1.
A	* * *	175	*	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll rate limit is 200 deg/sec. * Aircraft limits except with MK-8 warhead; see figure 5-11. * * Stores compatibility limit does not apply. * * * Refer to TO 1-1M-34-3.
B	+5.0	175	550/ 1.1	+4.0 *	175	550/ 1.1 **	+60° to -60° ***	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll rate limit is 120 deg/sec. ● CBU-52/58/71 release and jettison limits are 0.9 Mach. * 5G for MK-82 LDGP, Snakeye 1 and GBU-12B/B, C/B, D/B. ** 500/0.9 Mach for MK-82 Snakeye 1 High Drag, 550/0.9 Mach for GBU-52/58/71 and MK-20. *** -45° to +45° for GBU-12B/B, C/B, D/B; -60° to +45° for MK-20; Level to -60° for MK-82 Snakeye 1.
C	+1.0 (AIM-9) *AGM-45 **AIM-9P-4	175	750/ 1.2	NA	NA	NA	+50° to -50°	● If gross weight is over 37,500 lbs. refer to Acceleration Limitations Chart. * Refer to T O IF-4C-34-1-2-1. * * Refer to TO 1-1M-34-3.
D	+3.0 +0.5	250	750/ 1.2	NA	NA	NA	Level to -60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● To ensure the fins open, fin release wire is hardwired to swaybraces. ● Roll rate limit is 120 deg/sec.
E	NA	NA	NA	+5.0	175	550/ 0.95	+60° to -60°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll rate limit is 200 deg/sec. ● After release of all BDU-33 bombs, AIM-9 limitations are authorized.
F	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Cartridges are not to be installed in MAU-12 pylon. * A/A +3.0 to 0.0; C/A +4.0 to 0.0.
G	+5.0	175	550/ 0.95	+4.0 +0.7	175	550/ 0.95	+45° to -45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● To ensure fins open, fin release wire is hardwired to swaybraces.

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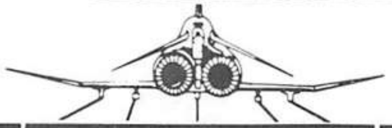
Figure 5-10 (Sheet 9 of 13)

EXTERNAL STORES LIMITATIONS

MISSILES AND MIXED LOADS



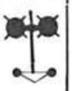
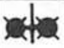
STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT		
							AIRSPEED		ACCEL G		JETTISON		
											MIN	MAX	
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS	
AIM-9B/E/J/N/P/P-4 (basic, -1, -2 & -3 Configuration and Captive Training Missile) with CBU-89/B Gator Mine	Aero-3/B or LAU-105 with double 3-inch spacer with Special Weapons Adapter on MAU-12 Pylon with 2 1/2-inch swaybrace bolts and TER-9A						550	0.95	+5.0 -1.0	+4.0 0.0	175	500/0.8	
AIM-9B/E/J/N/P/P-4 (basic, -1, -2 & -3 Configuration and Captive Training Missile) with BDU-33B/B, D/B	Aero-3/B or LAU-105 with double 3-inch spacers with Special Weapons Adapter on MAU-12 Pylon with 2 1/2-inch sway brace bolts and TER-9A						550	0.95	+5.0 -1.0	+4.0 0.0	175	550/0.9	A
AIM-9L/M and CATM-9L/M with BDU-33B/B, D/B	Aero-3/B or LAU-105 with double 3-inch spacers with Special Weapons Adapter on MAU-12 Pylon with 2 1/2- inch swaybrace bolts and TER-9A						550	0.95	+5.0 -1.0	+4.0 0.0	175	550/0.9	B
AIM-9B/E/J/N/P/P-4 (basic, -1, -2 & -3 Configuration and Captive Training Missile) with MXU-648A/A, C/A Cargo Pod	Aero-3/B or LAU-105 with double 3-inch spacers with Special Weapons Adapter on MAU-12 Pylon with 2 1/2-inch swaybrace bolts						550	0.95	+5.0 -1.0	*	NA	NA	C
AIM-9L/M and CATM-9L/M with MXU-648A/A, C/A Cargo Pod	Aero-3/B or LAU-105 with double 3-inch spacers with Special Weapons Adapter on MAU-12 Pylon with 2 1/2- inch swaybrace bolts						550	0.95	+5.0 -1.0	*	NA	NA	D
AIM-9L/M with MK-82 LDGP or Snakeye, CBU-52B/B, CBU-58/B, A/B CBU-71/B, A/B, GBU-12B/B, C/B, D/B, MK-20	Aero-3/B or LAU-105 with double 3-inch spacers with Special Weapons Adapter on MAU-12 Pylon with TER-9A						550	1.1	+5.0 -1.0	+4.0 0.0	175	550/0.9	E
AIM-9L/M with AGM-65A/B/D	LAU-105 with double 3-inch spacers with Special Weapons Adapter on MAU-12 Pylon with LAU-117 Launcher						✈	✈	+6.0 -3.0	+4.8 0.0	175	550/0.9	F
AIM-9L/M	LAU-105 with single or double 3-inch spacers						✈	✈	✈ **	✈ **	NA	NA	G
CATM-9L/M	LAU-105 with single or double 3-inch spacers						✈	✈	✈ *	✈ *	NA	NA	H

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Figure 5-10 (Sheet 9A of 13)

MISSILES AND MIXED LOADS

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX ACCEL G	MIN KNOTS	MAX KNOTS	MAX ACCEL G	MIN KNOTS	MAX KNOTS		
A	+5.0	175	550/ 0.95	+4.0	175	550/ 0.95	+45° to -45°	● If gross weight is over 45,000 lbs, refer to Acceleraton Limitations Chart. ● Maximum roll rate limit is 120 deg/sec. ● To ensure fins open, fin release wire is hardwired to swaybrace.
B	NA	NA	NA	+5.0	175	550/ 0.95	+60° to -60°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll rate limit is 200 deg/sec. ● After release of all BDU-33 bombs, AIM-9 limitations are authorized.
C	NA	NA	NA	+5.0	175	550/ 0.95	+60° to -60°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Roll rate limit is 200 deg/sec. ● After release of all BDU-33 bombs, AIM-9 limitations are authorized.
D	+5.0	175	550/ 0.95	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Cartridges are not to be installed in MAU-12 pylon. * A/A +3.0 to 0.0; C/A +4.0 to 0.0.
E	+5.0	175	550/ 0.95	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Charts. ● Cartridges are not to be installed in MAU-12 pylon. * A/A +3.0 to 0.0; C/A +4.0 to 0.0.
F	+5.0	175	550/ 1.1	+4.0 *	175	550/1.1 **	+60° to -60° ***	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Maximum roll rate limit is 120 deg/sec. ● CBU-52/58/71 release and jettison limits are 0.9 Mach. * 5G for MK-82 LDGP, Snakeye 1 and GBU-12B/B, C/B, D/B. ** 500/0.9 Mach for MK-82 Snakeye 1 High Drag. *** -60° to +45° MK-20; -45° to +45° GBU-12B/B, C/B, D/B, level to -60° MK-82 Snakeye 1.
G	+3.0 +0.5	250	750/ 1.2	NA	NA	550/ 0.9	Level to -60°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Maximum roll rate limit is 120 deg/ec. ● To ensure fins open, fin release wire is hardwired to swaybrace.
H	*	175	✈	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. * Refer to TO 1F-4C-34-1-2-1. ** Stores compatibility limit does not apply.
	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Maximum roll rate limit is 200 deg/sec. * Stores compatibility limit does not apply.

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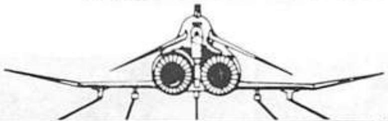
Figure 5-10 (Sheet 9B of 13)

EXTERNAL STORES LIMITATIONS

GUN PODS, GUIDED BOMBS, AIS,CARGO PODS



STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT JETTISON		
							AIRSPEED		ACCEL G		MIN	MAX	
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	KNOTS	KNOTS	
■ GPU-5/A 30-MM Gun Pod Maximum Load-1	[illegible]-27/A BRU-5/A			●			600	1.2	+5.0 −1.0	+4.0 0.0	175	300/0.7	
							750	1.2	+3.0 −1.0	NA			A
SUU-23/A Gun Pod Maximum Load −3	MAU−12	●				●	✈	✈	+6.0 −3.0	+4.8 0.0	250	325	
	℄ Adapter			●					✈ *	✈ *			B
■ GBU−12/B, A/B, B/B C/B, D/B (MK, −82 LGB) High and Low Speed Versions BDU−50A/B Maximum Load −4	MAU−12	●	●		●	●	550	1.1	+5.0 −1.0	+4.0 0.0	175	550/1.1	
■ GBU−12B/B, C/B, D/B BDU−50A/B Maximum Load −6	TER		●-●		●-●							550/0.95	C
■ GBU-24/B (MK-84), A/B (BLU-109) Maximum Load -4	MAU-12		●		●		600	1.1	+5.0 -1.0	+4.0 0.0	175	600/1.1	
		●				●	550						
							600	1.1	+4.0 0.0	+3.0 0.0			D
AN-ASQ T-11, T-13 T-17, T-20, T-21 T-25, AIS Pod (ACMI System), GRDCUS Shooter Pod Maximum Load-4	Aero-3/B, LAU−105 Launcher with or without 3-inch spacer		●		●		✈	✈	✈ *	✈ *	NA	NA	E
MXU-648A/A, C/A Cargo Pod	MAU−12		●		●		550	0.95	+5.0 -1.0	*	NA	NA	F
AN/AKQ-T1 Telementry Pod Maximum Load -1	AIS Pod on R2393 rail of inboard station of station 2		●				750	1.6	✈ *	✈ *	NA	NA	
		MISSILE STATIONS											
			3	4	6	7							
	Aero-7A		●										

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Figure 5-10 (Sheet 10 of 13)

GUN PODS, GUIDED BOMBS, AIS AND CARGO PODS

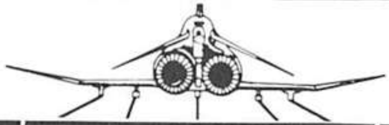
	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX ACCEL G	MIN KNOTS	MAX KNOTS	MAX ACCEL G	MIN KNOTS	MAX KNOTS		
	+5.0 0.0	175	600/ 1.2	NA	NA	NA	Level to −60°	● If gross weight is over 37,500 lbs. refer to Acceleration Limitation Chart. ● No stores are to be loaded in forward missile wells. ● Symmetrical flight only above 600 knots.
A	✈	✈	✈	NA	NA	NA	Employ Level to −60°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitation Chart. ● Roll rate limit is 200 deg/sec. ✻ Stores compatibility limit does not apply.
B	NA	NA	NA	+5.0	175	550/ 1.1	+45° to −45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart.
C	NA	NA	NA	+4.0 +3.0	175 175	600/ 1.1 550/ 1.1 600/ 1.1	+30° to −45°	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● For asymmetric carriage, refer to Section VI, Flight with Asymmetric Loading Subsonic and Supersonic Maneuvering. ● Roll rate must be limited to 120 deg/sec. ● Weight and balance of each aircraft loaded with one or two Guided Bombs must be examined for CG location during all possible takeoff and landing conditions.
D	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Maximum roll rate is 200 deg/sec. ● AIM-7 or AIM-9 not authorized when configured with AIS pod. However, captive AIM-9 with inert rocket motor and AIM-7 simulator plug are authorized. ✻ Stores compatibility limit does not apply.
E	NA	NA	NA	NA	NA	NA	NA	● If gross weight is over 45,000 lbs, refer to Acceleration Limitations Chart. ● Maximum roll rate is 120 deg/sec. ● Cartridges are not to be installed in MAU-12 pylon. ✻ A/A +3.0 to 0.0; C/A +4.0 to 0.0.
F	NA	NA	NA	NA	NA	NA	NA	● Mirror image is not authorized. ● (STA 3): Pod with simulator module (SM-862) and missile Gone switch. ● Caps on stations 4, 6 and 7. ● Maximum roll rate is 200 deg/sec. ● Only AIS pods with aft handle shortened are authorized for carriage on R2393 rail. ● AIM-9 or AIM-7 are not authorized when confined with pod. However, captive AIM-9 with inert rocket motor and AIM-7 simulator plug are authorized. ✻ Stores compatibility limit does not apply.

4G-1-(242-11)47

Figure 5-10 (Sheet 11 of 13)

EXTERNAL STORES LIMITATIONS

GUIDED MISSILES, CHAFF DISP, AND BL-755



STORE	SUSPENSION	STATION LOADING					CARRIAGE				JETTISON 1G LEVEL FLIGHT		
							AIRSPEED		ACCEL G		JETTISON		
		1	2	5	8	9	KNOTS	MACH	SYM.	UNSYM.	MIN KNOTS	MAX KNOTS	
AGM-45A, B or ATM-45 Missile Maximum Load-4	LAU-34/A Launcher or LAU-118 Launcher	●	●		●	●	✈	✈	+6.0 −3.0	+4.8 0.0	175	550/0.9	
AGM-65A/B/D/G Maverick Missile Maximum Load: LAU-88-6 LAU-117-2	LAU-88A, A/A Launcher *		●●●		●●●		✈	✈	+6.0 −3.0	+4.8 0.0	175	550/0.9	A
TGM-65 Maverick Trainer Maximum Load: LAU-88-6 LAU-117-2	LAU-117/A, (V) 1/A Launcher		●		●								
Empty LAU-117 Launcher			I		I				✈	✈			
AGM-88, ATM-88 or CATM-88 (with or without wings or fins) Missile Maximum Load-4	LAU-118 Launcher	●	●		●	●	✈	✈	+6.0 −3.0	+4.8 0.0	175	550/0.9	B
Empty LAU-118 Launcher		I	I		I	I			✈	✈			
ALE-38 Chaff Dispenser Maximum Load-2	MAU-12		●		●		550	1.2	+4.0 0.0	+3.2 0.0	275	375/0.9	C
ALE-40 Chaff/Flare Dispenser Maximum Load-4 (2 DISP. per pylon)	MAU-12		●		●		✈	✈	✈ *	✈ *	N/A	N/A	D
BL-755 Cluster Bomb (MK1, MK2 No. 1. and MK2 No. 1A)	TER		▽		▽		550	1.1	+5.0 −1.0	+4.0 0.0	175	550	E
Maximum Load -6	MER (Fwd)			▽			600	1.3	+3.0 0.0	+2.4 0.0	300	500	

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Figure 5-10 (Sheet 12 of 13)

GUIDED MISSILES,
CHAFF DISP, AND
BL-755

	EMPLOYMENT			RELEASE			DELIVERY ANGLE	REMARKS
	MAX	MIN	MAX	MAX	MIN	MAX		
	ACCEL G	KNOTS	KNOTS	ACCEL G	KNOTS	KNOTS		
	*	175	750/ 1.2	NA	NA	NA	+50° to −50°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● The ATM–45 can be flown as a training missile without wings or fins. Jettison or installation of jettison cartridges is not authorized. ● Roll rate limit is 200 deg/sec. * Refer to TO 1F–4C–34–1–2–1.
A	+3.0 +0.5	250	750/ 1.2	NA	NA	NA	Level to −60°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Speed brakes must be retracted when launching from stations 2 and 8. ● CG position could become critical. ● No other TGM-65 will be installed on the same launcher when one is equipped with recorder. ● All partial load configurations are authorized without sequencing restrictions for AGM-65 and TGM-65. * AGM-65G is not authorized on LAU-88.
	NA	NA	NA				NA	● Stores compatibility limit does not apply. ● Roll rate is aircraft limits.
B	+4.0 +0.5	175	650/ 1.2	NA	NA	NA	+50° to −50°	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart. ● Jettison or instalaltion of cartridges is not authorized when CATM–88/ATM–88 are flown without wings or fins.
	NA	NA	NA				NA	● Stores compatibility limit does not apply. ● Roll rate is aircraft limits.
C	+4.0	175	550/ 1.2	NA	NA	NA	NA	● If gross weight is over 37,500 lbs, refer to Acceleration Limitations Chart.
D	✈	✈	✈	NA	NA	NA	NA	● Can be combined with any store authorized for carriage on stations 2 and 8, or with any stores depicted in combination for carriage on stations 2 and 8. * Stores compatibility limit does not apply.
E	NA	NA	NA	+5.0 +0.9	175	550 500	Level to −20°	● If gross weight exceeds 45,000 lbs, refer to Acceleration Limitations Chart. ● Minimum release air speed for station 5 does not attest to weapons ability to function at this speed. ● Configure MAU–12 rack with two ARD–863–1 cartridges and two 0.081–inch diameter dash three orifices. ● Configure AERO 27 or BRU–5 rack with two MK2 cartridges and a forced jettison prevention sleeve. ● Minimum ripple release interval is 0.14 seconds. ● The BL–755 series cluster bombs have not received safety certification by USAF Non–nuclear Munitions Safety Board (NNMSB). ● This munition is certified only for the contingency rearming of USAF aircraft at allied bases with this munition from allied inventories.

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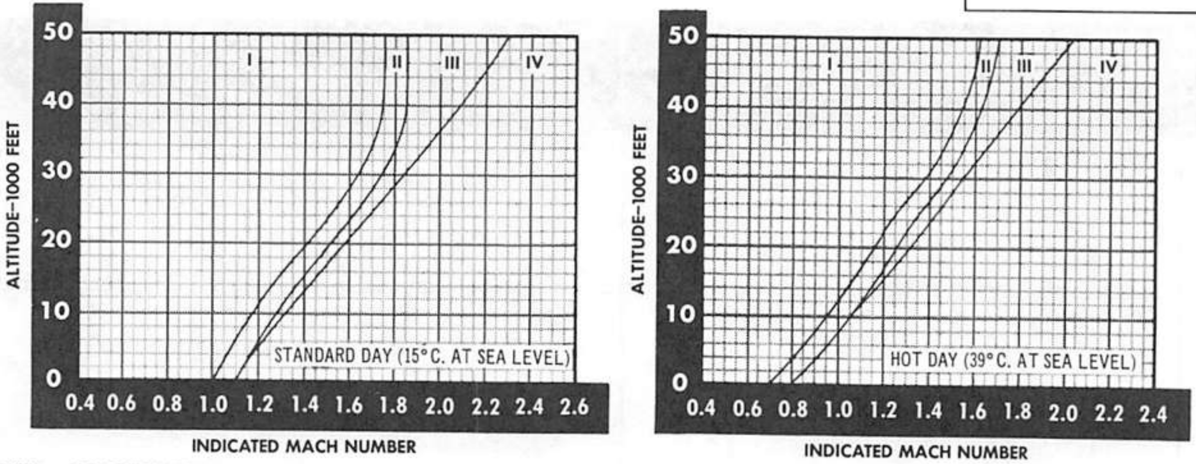
Figure 5-10 (Sheet 13 of 13)

AIM-9 AIRSPEED LIMITATIONS

MK 8 MOD 0/1/2 WARHEAD ONLY

Note

THE MK 8 MOD 3 WARHEAD IS UNRESTRICTED.



ZONE I – NO RESTRICTIONS.

ZONE II – REPEATED EXCURSIONS OF NO MORE THAN 10 MINUTES EACH ARE PERMITTED.

ZONE III – REPEATED EXCURSIONS OF NO MORE THAN 5 MINUTES EACH ARE PERMITTED. INSPECTION OF WARHEADS IS RECOMMENDED AFTER EACH FLIGHT INVOLVING EXCURSIONS INTO ZONES II AND III.

ZONE IV AVOID.

IF LIMITATIONS OF ZONES II, III, AND IV ARE VIOLATED THE WARHEAD SHOULD BE DESTROYED BY JETTISONING THE MISSILE IF POSSIBLE. LANDINGS CAN BE MADE WITH LOW ORDER RISK IF JETTISONING IS NOT POSSIBLE.

THESE LIMITATIONS DO NOT APPLY TO AIRCRAFT CLIMB SCHEDULES, INCLUDING MAXIMUM PERFORMANCE.

4G–1–(240)B

Figure 5-11

Section VI

FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

STABILITY AND CONTROL

CHARACTERISTICS

STABILITY AND CONTROL

GENERAL

Aircraft flight characteristics represent a compromise between the control response required to achieve desired performance and the stability necessary to keep pilot work load acceptable. As stability increases, responsiveness to control inputs or other disturbances (such as turbulence) decreases. As stability decreases, responsiveness to control inputs or other disturbances increases. Control effectiveness is a function of Mach number, but is even more dependent on dynamic pressure (q). Stability varies with Mach number and CG location. Longitudinal stability has the most critical effect on aircraft control. These factors must be considered and understood in order to safely and effectively operate the aircraft throughout the flight envelope.

LONGITUDINAL STABILITY

Longitudinal stability is stability in pitch. A measure of longitudinal stability is static margin, which is the distance, expressed as a precent of the mean aerodynamic chord (% MAC), between the aircraft center of gravity (CG) and the aerodynamic center (AC) or nominal point of lift (A, Figure 6–1). The neutral stability line on the AFT CG LIMITS chart (figure 5–7) plots the subsonic AC location as a function of the aircraft stability index. If the CG and AC are coincident, the static margin is zero and the aircraft has neutral longitudinal stability (B, Figure 6–1). A neutrally stable aircraft will remain at any angle of attack to which it is displaced by control movement or other disturbance. If the CG is forward of the AC, the static margin is positive and the aircraft is longitudinally stable. It will tend to return to the trim angle of attack following a control movement or other disturbance. Conversely, if the CG is aft of the AC, the static margin is negative and the aircraft is longitudinally unstable. In this condition, the aircraft will continue to pitch in the direction toward which it is disturbed by control movement or other disturbance.Static margin will continually change during flight due to fuel consumption or a change in the stability number due to release of external stores.

NOTE

> Maneuvering with a partially full unmodified high performance tank installed can cause the aircraft CG to shift aft due to fuel movement within the tank, resulting in increased pitch sensitivity. This does not apply to the modified high performance centerline tank which has an internal bulkhead and two fuel compartments, eliminating aft CG shift.

There are no sharp demarcation lines below which the aircraft becomes suddenly uncontrollable or above which the pilot can completely disregard longitudinal stability considerations. Beyond the aft CG limit, pilot reaction time may be too slow and, ultimately, stabilator authority may be insufficient to counter a pitch change. The aft CG limit (0.4% MAC negative static margin) is established to minimize the probability of loss of control while providing sufficient loading flexibility to meet tactical requirements. In establishing this limit, it is assumed that the Pilot is familiar with aircraft flight characteristics. At low static margins (less that 1% MAC positive static margin), the tendency to overcontrol must be anticipated and carefully avoided. In this regime, the stick force required to induce a pitch change is noticeably less than that required with higher static margin, and there will be a tendency to overshot desired pitch changes. Maneuvers requiring precise control, such as weapons delivery, inflight refueling, and close formation, are more difficult at low static margin. During high gross weight, maximum performance maneuvering or low speed flight, smooth longitudinal and lateral control inputs are required to prevent reaching stall angle of attack. The pitch stab aug is very effective in this regime, but smooth longitudinal control inputs are still required. No allowance are made for abrupt over–control inputs, regardless of static margin. If longitudinal stability becomes critical, the Pilot should consider jettisoning external wing tanks/stores to decrease the stability index number and increase static margin. At the first indication of departure from controlled flight, the Out–of–Control Recovery procedure must be initiated.

STABILITY EFFECTS

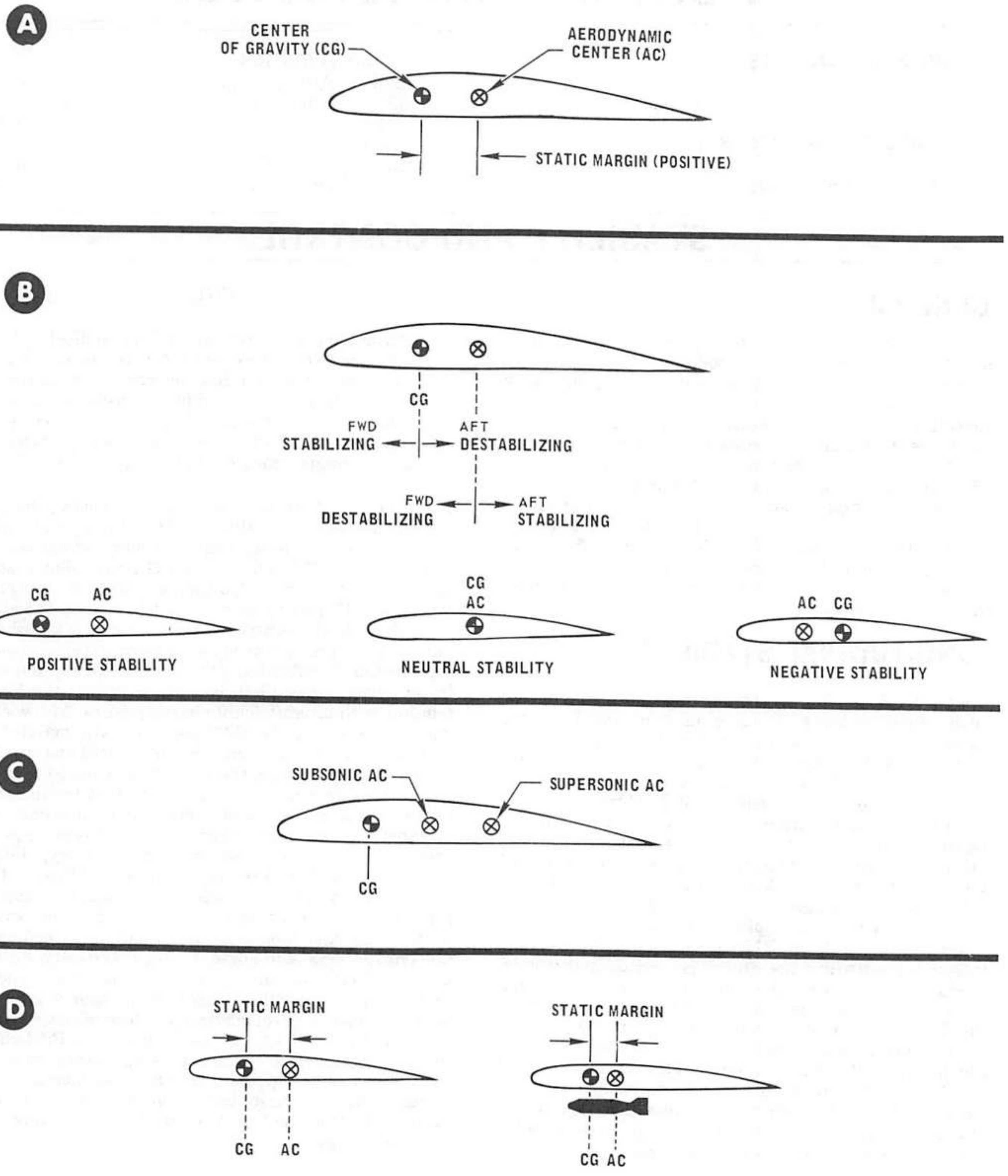
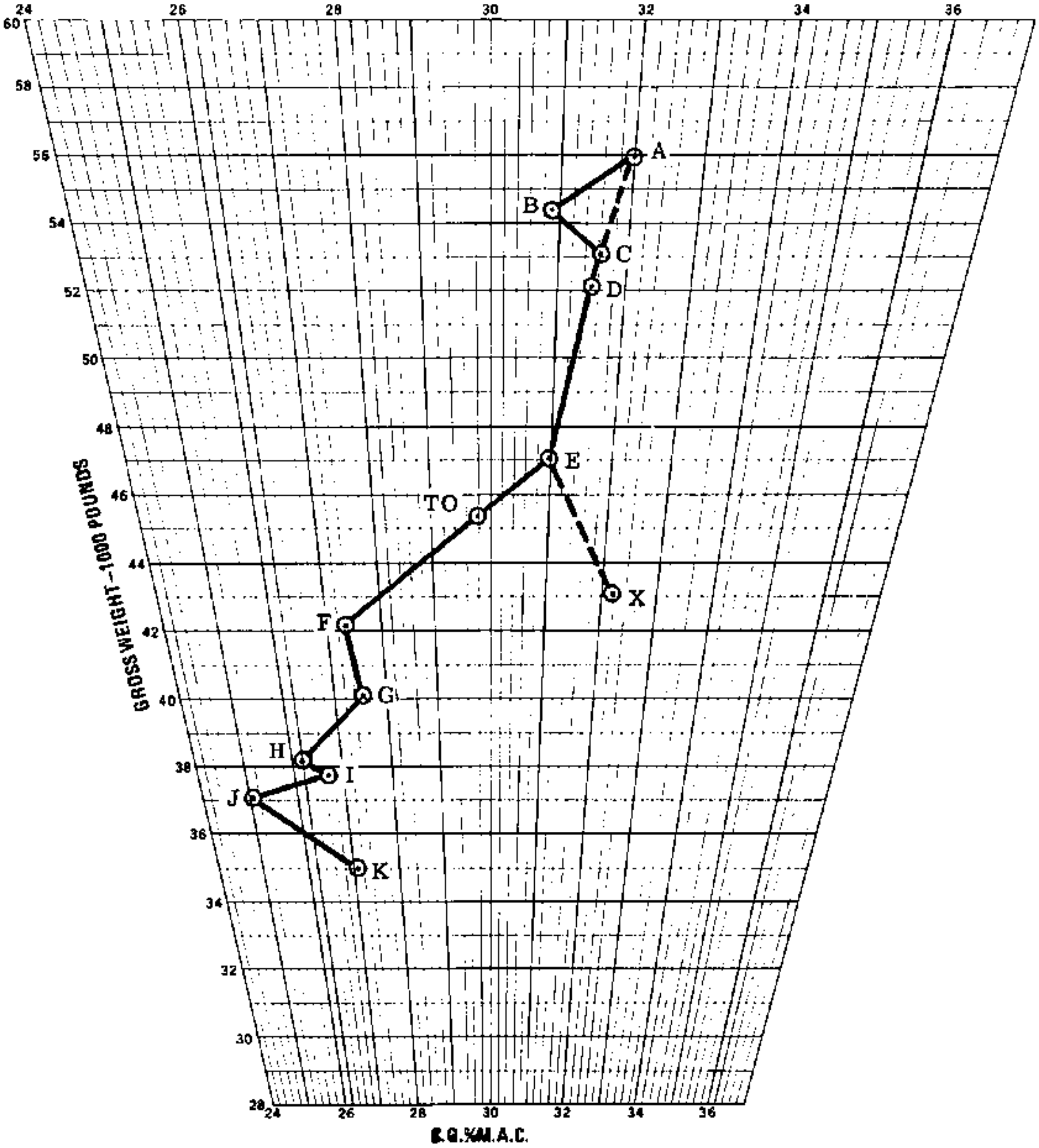


Figure 6-1

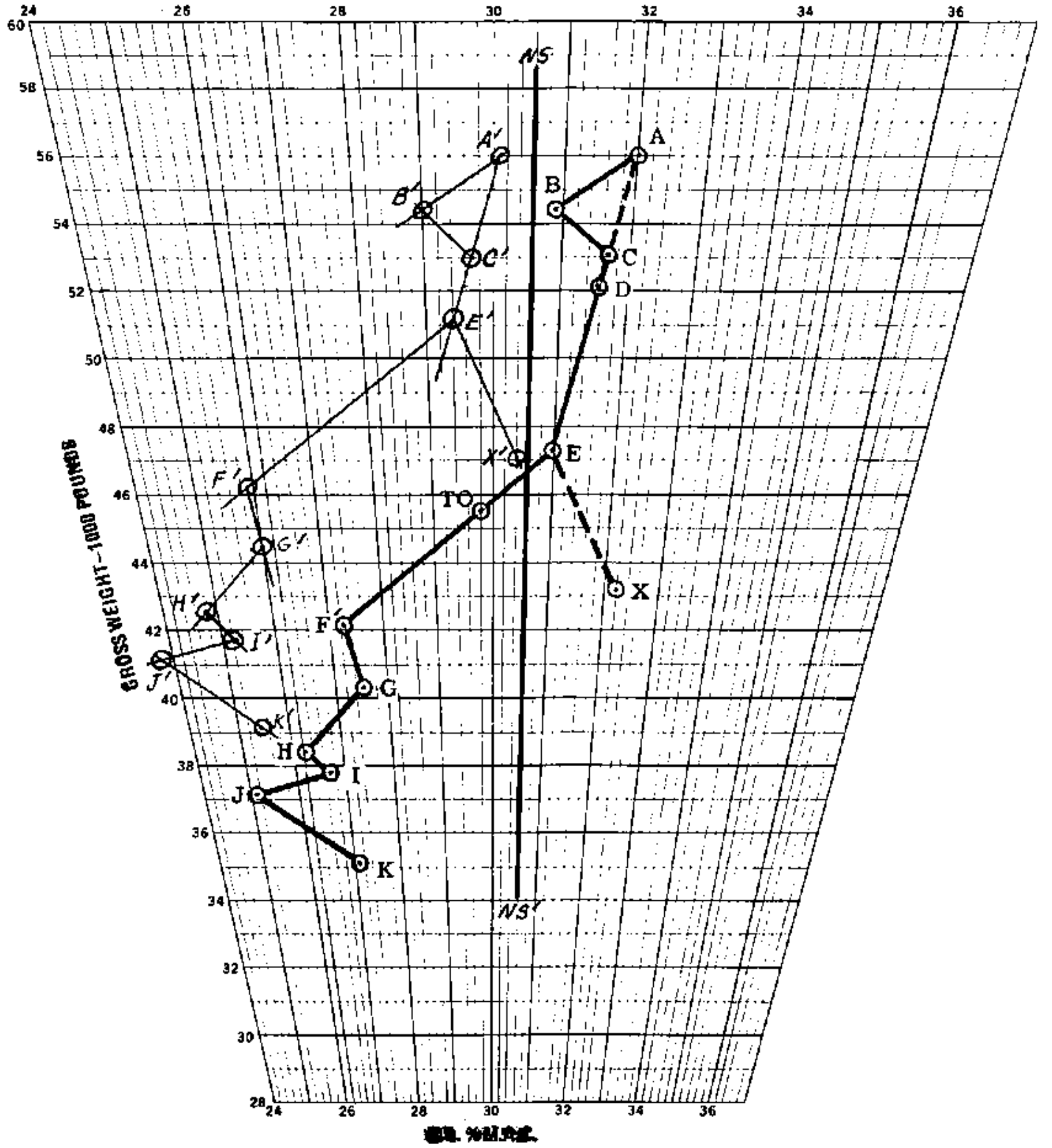
CG TRAVEL DUE TO FUEL CONSUMPTION



4G–1–(44)A

Figure 6–2

CG TRAVEL DUE TO FUEL CONSUMPTION



4G-1-(255)A

Figure 6-3

WARNING

- Removal of equipment from a position forward of the aircraft CG (e.g., cameras, radar black boxes, etc.) will move the CG aft and decrease static margin.
- Dumping internal wing fuel with full or nearly full fuselage fuel moves the CG aft approximately 1.2% MAC and may place the aircraft in a regime where operation is prohibited and aircraft control is marginal.

The forward CG limit is based on longitudinal control effectiveness (nose-up stabilator capability). Refer to CG limitations, Section V. Normally, the forward CG limit will not be exceeded when landing at high gross weights with heavy external stores retained. Jettisioning these stores will move the CG within limits. If jettisoning is impossible, make a no-flap landing.

CG TRAVEL DUE TO FUEL CONSUMPTION

If other factors such as external loading remain constant, fuel distribution determines CG position. Figure 6-2 illustrates approximate CG travel for an aircraft configured with three external tanks, at an engine start gross weight of 56,000 pounds and the CG at 32% MAC. The points designated by letters on Figure 6-2 correspond to fuel states which can be observed in the cockpit. The lines on the chart may be shifted to fit any initial condition, as discussed later in this section.

A. Gage 7400/12,000 ENGINE START/COMPLETION OF AIR REFUELING
B. Gage 5900/10,500. LIFTOFF. It is assumed that 1500 pounds of fuel are consumed during start, taxi, engine checks, and takeoff roll. This fuel is all from the fuselage tanks, CG will move forward rapidly. If less fuel is used before liftoff, longitudinal stability will be less. If more fuel is used before liftoff, the vector A-B will be longer and CG will be further forward at liftoff, with an increased nosewheel liftoff speed.
C. Gage 7400/12,000. After liftoff, with the centerline tank selected, fuel will transfer from the centerline tank to fill all fuselage tanks. The CG will move rapidly aft along the vector B-C until fuselage tanks are full (point C). Note that point C is on the dashed line vector A-D which represents the vector for the centerline tank if no fuel were used before liftoff. Point C is the most aft CG during flight (point A immediately after air refueling) and represents the point at which aircraft stability is lowest with normal fuel sequencing. This occurs shortly after takeoff, and may result in a formation joint-up during a period of decreasing or minimum stability.
D. Gage 7400/12,000. CTR EXT FUEL light on. Centerline tank empty. Outboard tanks selected.
E. Gage 7400/12,000. L&R EXT FUEL lights on. External wing tanks empty. This is also the engine start point if no external tanks are installed. When external tanks go dry, aircraft limits are less restrictive (see figure 5-8); however, this is in a flight regime where smooth control is critical due to the near neutral stability.
X. Gage 6800/7350. The vector E-X depicts the effect of dumping internal wing fuel at point E. As can be seen, this moves the CG rapidly aft.
TO. Gage 5900/10,500. LIFTOFF when no external tanks are installed. The vector E-TO represents CG travel prior to liftoff if no external tanks are installed.
F. Gage 6050/8200.
G. Gage 4900/5400.
H. Gage 2600/3100.
I. Gage 1800/2300.
J. Gage 1800/1800. The CG is at the most forward point for the flight. This occurs near normal landing fuel weight and may place the aircraft near the forward CG limit for landing. Longitudinal stability is high. The aircraft will be less responsive to stabilator inputs and large aft stick displacement may be required to maintain pitch attitude just prior to touchdown.
K. Gage 0/0.

SHIFTING THE CURVE

The general curve for CG Travel due to Fuel Consumption, Figure 6-2, may be shifted to adapt to any initial gross weight, CG position, and external stores configuration. CG travel in % MAC due to fuel consumption will vary depending on initial gross weight and CG location. Figure 6-2 is constructed so that any portion of the CG travel lines can be shifed to any position on the chart, as long as the slope and length of the applicable vectors are identical. Figure 6-3 illustrates this process for the following conditions.

Example:

2 external wing tanks
3 AIM-7F
1 ALQ-119
4 AGM-65

1. Determine initial gross weight from DD form 365F – 56,017 pounds
2. Determine initial CG from DD form 365F – 30.1% MAC
3. Plot point A' (engine start)
4. Plot A'-B' parallel and equal to A-B.
5. Plot B'-C' parallel and equal to B-C.
6. Plot A'-E'. This line is parallel and equal to D-E. This line eliminates the centerline tank as shown on the general chart and converts the plot to one in which only two wing tanks are installed. Point C' should fall on this line.
7. Plot E'-F' parallel and equal to E-F. Point TO is not plotted since it is of interest only when no external tanks are installed.

8. Plot remainder of line segments paralleled and equal to corresponding line segments.
9. Determine stability index from part 1 of the Performance Data appendix – 229.2.
10. Determine neutral stability point from figure 5–7 – 30.6% MAC.
11. Plot line NS–NS' which represents neutral stability point.

Transparent templates for various external tank configurations may be prepared locally so that an individual plot need not be made for each mission. The template may be shifted horizontally which different initial CG positions and/or vertically for different initial gross weights so long as the orientation is not changed and each line maintains the same slope. A few randomly spaced horizontal lines on the template which can be matched parallel to gross weight lines on the chart will aid in ensuring the slope is not changed.

CHARACTERISTICS

ANGLE OF ATTACK

Angle of attack (AOA) is of major importance in this aircraft, particularly during maneuvering and in low speed flight. AOA is defined as the angle formed by the chord line of the wing and the aircraft flight path (relative wind). At constant flight conditions, the indicated AOA will increase approximately one unit when the nose gear is extended; retracting the gear produces a corresponding decrease in indication. A change in airflow pattern over the AOA probe caused by the nose gear door is responsible for this AOA change. All references to indicated AOA take this factor into consideration. An error in AOA indication can also be induced as a result of sideslipping the aircraft. This proportional error is approximately 2 units for a low speed, full rudder sideslip. Right rudder sideslips produce AOA indications that are lower than actual. The reverse is true for left rudder sideslips.

WARNING

The cockpit AOA indicator and associated AOA aural tone are unreliable during high pitch rate maneuvers. The cockpit indicator may lag true aircraft AOA by as much as 8 units during a high rate maneuver. Lag may persist for as long as 7 seconds. The cockpit AOA indicator can momentarily hesitate at a lower–than–actual value during high rate maneuvers. Caution should be exercised during rapid maneuvering to avoid inadvertently exceeding AOA limitations and departing the aircraft.

LOW ANGLE OF ATTACK MANEUVERING

Drag is at a minimum at approximately five units angle of attack (nearly zero G). To achieve maximum performance acceleration, a five-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.

MEDIUM ANGLE OF ATTACK MANEUVERING

Maneuvering at an AOA from 5 to 20 units will produce normal response to control movement. Normally, buffet onset will not occur below 17 units AOA.

HIGH ANGLE OF ATTACK MANEUVERING

Above 20 units AOA, the response and flight characteristics begin to exhibit the changes expected in swept-wing high performance aircraft. The primary roll-yaw flight characteristics at high AOA are dihedral effect (roll due to yaw) and adverse yaw (yaw due to aileron deflection). Buffet intensity increases with angle of attack. Mild buffet increases to moderate at approximately 28–30 units AOA.

Dihedral Effect

Dihedral effect is the roll caused by sideslip. Attempts to yaw the airplane with rudder will produce roll in the same direction as the rudder input as well as an increase in AOA. Dihedral effect is strong at high AOA, and rudder inputs produce adequate and comfortable roll rates. Above 25 units AOA, more roll rate can be generated with rudder than with aileron. The best technique is a combination of rudder and aileron in the direction of the turn.

NOTE

When maneuvering at high AOA (25–30 units), large rudder inputs to effect rolls will cause excursions in AOA of up to 10 units if the control stick is not moved forward as rudder is applied. This sudden increase in AOA could cause the pilot to fly the aircraft well in excess of 30 units AOA during high AOA maneuvering.

Adverse Yaw

At high AOA, attempts to roll the airplane with aileron result in yaw opposite to the direction of the intended turn or roll. This yaw is partially produced by the drag of the down going aileron; and the dihedral effect, in turn, inhibits the roll. Adverse yaw is negligible. Aileron deflection at high AOA produces little opposite yaw, and ailerons are effective for roll control to 25 units AOA. The most effective roll technique is a combination of rudder and aileron in the direction of the turn.

WARNING

Operation above 30 units AOA at altitudes above 28,000 feet may result in engine flameout(s). Above 30,000 feet this critical AOA is reduced approximately 1 unit per 3000 feet (e.g. 29 units AOA at 33,000 feet). In some aircraft, stalls or flameouts can occur at angles of attack as low as 22 units AOA, especially at high yaw rate, with dynamic throttle. These stalls/flameouts can be avoided by not advancing the throttle while above 22 units AOA.

PITCH CONTROL AT LOW SPEEDS

The control of AOA at slow speeds is difficult because stick forces are lighter and aircraft stability is reduced. The AOA indicator is the primary recovery instrument when confronted with a condition of low airspeed and high pitch attitude. A smooth pushover to three to eight units AOA will unload the aircraft and prevent a stall. Recovery can be accomplished safely at any speed which will provide stabilator effectiveness (ability to control pitch attitude). Smooth control of AOA is required, and no attempt to control tank angle or yaw should be made until three to eight units is established.

MAXIMUM PERFORMANCE MANEUVERING

The factors that determine maximum performance maneuvering capability are structural limitations, stabilator effectiveness, and aerodynamic limitations. Structural limitations are outlined in section V. The limit of stabilator effectiveness occurs at supersonic Mach numbers at high altitude, where full aft stick can be attained without reaching either aerodynamic or structural limits. Aerodynamic limitations are primarily a function of angle-of-attack. Subsonic maximum performance turns are achieved by maintaining approximately 25 units AOA while utilizing afterburner as required. Good flying qualities and only moderate buffet exists to 30 units AOA depending on aircraft stores, aircraft symmetry, and flight control inputs. However, the drag increase must be considered as a significant reduction in energy occurs at AOA above 25 units. Rolling performance is adequate at all usable angles-of-attack, and can be best achieved at high AOA by a combination of aileron and rudder in the direction of the turn. During maximum performance maneuvering, higher roll rates may be achieved by momentarily unloading the aircraft (reducing AOA to between 3 and 8 units); utilizing aileron to roll to the desired bank angle; then neutralizing aileron and reestablishing the required angle-of-attack. Ailerons should be neutralized prior to re-establishing a high angle-of-attack. The AOA aural tone system provides audible cues to help achieve optimum turning performance. Tactical maneuvering can quickly place the aircraft at the unsymmetrical G limit. This is especially true for the zero G limit.

WARNING

- Nose rise can occur during high AOA maneuvering. This is characterized by a reduction or reversal of stick forces and can result in inadvertent increase in AOA and possible overstressing of the aircraft or loss of control.
- Nose rise can occur while pulling G at AOA near where the slats extend. This effect increases with increased G and may result in an over-G.
- If slats are not programming properly, 25 units AOA will result in an immediate departure. If slats do not extend or buffet occurs below 19 units AOA, do not exceed 19.2 units AOA.

EMERGENCY DIVE RECOVERY

Dive recovery with the least loss of altitude is accomplished by establishing wings level and ON SPEED AOA (25 units) at 390 knots. Above 390 knots, retard throttles to IDLE and extend speed brakes as necessary to reduce turn radius. Below 390 knots, add power as required to prevent energy bleed off. Establish a positive wings level recovery then increase back stick to maintain ON SPEED AOA, onset of buffet, wing rock or maximum G, whichever occurs first. Airspeed decay or failure to maintain maximum G or ON SPEED AOA will increase the altitude required for recovery.

LANDING

Refer to Landing Procedure, section II.

HANDLING QUALITIES

A large variation in handling qualities exist throughout the flight envelope. Consideration must be given in Mach number, CG position, indicated airspeed, AOA, and external store loading.

SUBSONIC REGION

Takeoff Configuration

The full aft stick takeoff technique provides the lowest nosewheel lift-off speed. Nosewheel lift-off speeds will normally be lower than computed takeoff speeds (refer to Performance Data appendix); however, with a forward CG position, it is possible to have nosewheel lift-off speeds which exceed computed takeoff speeds. With aft CG locations high rotation rates can be achieved, and caution should be exercised to avoid over-rotation. Roll response is low and may not be sufficient to correct a wing low condition at low speed after over-rotation. In computing CG for takeoff, allowance must be made for a forward CG shift during ground operation. This forward movement is approximately 1 percent MAC for every 1000 pounds of internal fuel used. In the forward CG range, nosewheel lift-off speed is increased approximately 3 to 4 knots for each 1 percent of forward CG movement.

Landing Configuration

In the landing configuration, pitch or airspeed changes require few, if any, trim changes to relieve stick pressures. This is due to control system friction and weak stick centering. Landings at aft CG positions require more attention to AOA control than landing with a forward CG. This is due to increased stick sensitivity and a mild nose rise tendency at about 18 units AOA. Aileron and rudder response in the landing configuration is good; however, adverse yaw produces a decrease in roll response due to strong dihedral effect. Rudder can be used to provide roll due to dihedral effect. The aileron-rudder interconnect feeds in rudder automatically to improve roll performance and turn coordination.

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Cruise Configuration

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 low speed tactical maneuvers, maximum range descents, holding, insturment approaches, and landing. This minimum airspeed provides reasonable handling qualities and adequate maneuver margins for terrain and collision avoidance. At and above this speed, control effectiveness is good. Roll rate capability is quite high and coordinated turns can be made without the use of rudder at 12 units AOA or less. When adverse yaw is experienced, the yaw stability augmentation is relatively effective in returning the ball to center.

TRANSONIC REGION

High Altitude

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 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 airplane in buffet at high altitude or cause a significant load factor increase at low altitude and high G levels with a possible resultant overstress. Speed brakes 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.

Low Altitude (Below 15,000 feet MSL)

Flight in the low altitude, high speed region is most critical at high subsonic indicated airspeeds (475 knots to 0.95 Mach) where airplane response is high and stick forces are low, resulting in an area of increased sensitivity and possible over-control. Even though the inherent dynamic stability of the airplane is positive, it may be possible to create a short period longitudinal oscillation if the pilot's response becomes out of phase with the airplane 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. Afterburner shutdown at high indicated airspeeds can produce pitch transients. Abrupt pitch inputs can cause a pitch oscillation to start; therefore, all corrections should be performed smoothly. An out-of-trim condition is conducive to PIO; therefore, it is advisable to remain trimmed for approximately 1G flight while in the low altitude, high speed region. The standard and most effective recovery technique from a pilot induced oscillation is to release the controls. If the altitude 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.

SUPERSONIC REGION

As Mach number is increased in the supersonic region, stabilator effectiveness decreases somewhat. Maneuvering stick forces are high. Maneuvering capability is limited by stabilator effectiveness at the higher Mach numbers and altitudes; for example, full aft stick at Mach 2 at 50,000 feet will produce about 3.5 G, while full aft stick at Mach 1.5 at 36,000 feet will produce about 5G. More maneuvering capability is available at aft CG conditions than at forward CG conditions. No abnormal control problems exist during supersonic flight. Roll rate, although decreasing with Mach number, remains adequate out to limit Mach numbers.

EFFECT OF EXTERNAL STORES

The addition of external stores generally increases pitch sensitivity and nose-rise tendencies (refer to CG Limitations, section V). In addition, inertial effects are evidenced during abrupt maneuvers especially at high AOA. The most noticeable inertial effect takes place during rolling maneuvers. It takes longer to build up a given roll rate, but once the rate is established, it takes longer to stop. This inertial effect results in less wing rock when approaching the stall. Most high speed flight restrictions with external stores are based on structural considerations. Takeoff with external stores will normally increase rotation rate. A minimum-speed lift-off results in reduced lateral directional stability, and roll control activity is higher during gusty flight conditions.

SINGLE ENGINE FLIGHT CHARACTERISTICS

See Engine Failure During Flight, Section III.

FLIGHT WITH ASYMMETRIC LOADING

Asymmetric loading is present when there are unequal moments on either side of the aircraft centerline. The moment for a given store loaded on the aircraft is determined by multiplying the weight of the store (and its suspension equipment if not duplicated on the other side) by the distance from the aircraft centerline. Refer to Stores Moment chart in the appendix. The difference between the sum of the moments on one side and the sum of the moments on the other side is the lateral asymmetry.

NOTE

With an asymmetric load near 17,000 foot-pounds (1500 pounds on station 1 or 9 or 2500 pounds on station 2 or 8), takeoff or landing with a crosswind component over 10 knots from opposite the heavy wing is not recommended.

All data on pages 6-8A thru 6-8B deleted.

Takeoff

Takeoff with an asymmetric loads up to 30,000 foot-pounds can be made. Recommended techniques are essentially the same as for crosswind operation. A strong turning moment into the heavy wing will exist during takeoff roll and will increase during rapid accelerations. Nose gear steering and rudder (when rudder becomes effective) should be used for directional control. As the aircraft breaks ground, it will tend to roll into the heavy wing if not previously trimmed to counteract the asymmetric condition. Approximately 5° aileron (3 seconds trimming from neutral) away from the heavy wing is normally sufficient for an asymmetric load of 30,000 foot-pounds. Abrupt lift-offs should be avoided. Establish an attitude and allow the aircraft to fly itself off using rudder and aileron as required.

Landing

Landing with asymmetric loads equivalent to one full external wing tank can be made. Recommended techniques are essentially the same as for crosswind operation. A straight-in pattern avoiding abrupt or accelerated maneuvers is recommended. To determine approach speed and AOA, establish the landing configuration and slow to a speed at which full aileron trim will hold wings level. This should result in 16 to 17 units AOA for an asymmetric load equivalent to one full external wing tank. A check for roll capability by applying additional aileron to pick up the heavy wing should be made. This AOA should be maintained during the approach and touchdown. An abrupt flare will cause a strong roll into the heavy wing. During landing roll, the aircraft may turn away from the heavy wing as brakes are applied. This can be controlled by rudder and nose gear steering.

Go-Around

If a go-around is necessary from an established final, abrupt stick movement should be avoided. Power should be advanced to military and the nose smoothly raised to the desired attitude. When no longer in a descent, the gear may be retracted; however, flap retraction should be delayed until at least 200 knots has been attained. Rudder and afterburner may be required to maintain wings level flight.

Maneuvering

During any maneuvering with asymmetric stores, expect a degradation of normal control response. This is most apparent at low subsonic or high supersonic speeds. Roll tendency increases significantly with increased G loading, especially for large load asymmetries. At some airspeeds/Mach numbers, roll authority with both aileron and rudder may be insufficient to counter the rolling moment developed by increased G load and an asymmetric store.

Use smooth control inputs when flying with an asymmetric load. With asymmetry equivalent to one full wing tank (maximum allowable) do not exceed 16 units AOA. Normal stall warning cues may be absent when maneuvering with an asymmetric load. At the first indication of a departure, immediately reduce AOA. If a departure occurs, spin entry is highly probable.

SUBSONIC MANEUVERING

Aircraft response with asymmetric stores at low subsonic speed and high G loading is characterized by a failure to respond in roll. This is caused by coupling of excessive aileron drag (adverse yaw) and an inability of the ailerons and spoilers to overcome the additional weight and momentum of an asymmetric load. In some flight conditions (low speed with large asymmetric load) it is possible to exceed the aerodynamic roll authority of the aircraft and a rapid departure will result. Departure may occur at an airspeed well above and an AOA well below the onset of normal buffet and stall cues. At the first indication of a deterioration of roll authority, reduce AOA and increase airspeed.

At high subsonic airspeed, high G loading and large asymmetry, the only way to regain control of the aircraft once the roll has developed is to reduce the G loading thereby regaining aircraft roll authority over the asymmetric load. The maximum aircraft roll authority is attained at zero G.

SUPERSONIC MANEUVERING

At supersonic speed, roll control decreases with increasing Mach number. Roll authority is a function of Mach, dynamic pressure, aileron authority, asymmetric moment and store drag. Supersonic flight may result in inadequate roll authority to maintain wings level with an asymmetric load. As G is increased, aileron authority will decrease until the aircraft rolls off toward the store. The roll off will occur abruptly if G onset is rapid. If total loss of roll authority occurs with an asymmetric load at supersonic speed, reduce power, extend speed brakes, and unload as necessary to regain roll authority. Maximum roll authority is achieved at zero G. Since the rudder is ineffective in producing roll above 1.1 Mach, ailerons should be used to roll the aircraft above this speed. Extreme caution must be used in the transonic region. The abrupt increase in G loading experienced in the transition from supersonic to subsonic speed can lead to further degradation in roll authority and possible departure.

WARNING

For recovery from loss of roll authority at supersonic speed, reduce power, extend speed brakes, and perform an unloaded roll to the nearest horizon. When wings level, smoothly apply back stick to help decrease airspeed and minimize altitude loss. As speed decreases, additional roll authority will be available and G can be increased. Aileron into the heavy wing can result in an extremely high rate self-sustaining roll from which recovery may be impossible.

FLIGHT WITH ASYMMETRIC SLATS

Asymmetric slats produce roll, and therefore limit maneuvering capability. Roll–off is first experienced at 14 units AOA, and full cross–controls will be required to maintain straight and level flight when reaching 19 units AOA. A symmetrical slat configuration (extended or retracted) is necessary for combat maneuvering.

STALLS

A stall, as discussed in the Flight Manual, is defined as a breakdown in directional stability (i.e., nose slicing). Characteristics normally experienced while approaching a stall include buffet onset, nose rise, and wing rock. These characteristics and the violence of the stall itself are dependent upon the external loading, CG location, and control technique. They are not entirely predictable or repeatable.

WARNING

> The pilot should not depend upon wing rock, buffet, directional instability (nose slice), or any classic characteristics for a stall warning. In any configuration or loading, and especially with moderately high pitch change rates, it is possible to increase AOA above 30 units without wing rock or directional instability, at which time loss of control may result.

NOTE

> Refer to section I for rudder pedal shaker and AOA aural tone operation.

CRUISE/COMBAT CONFIGURATION

1 G Stalls

Conventional stalls do not normally occur until well above 30 units AOA. Departures and/or engine stall/flameout can occur above 30 units AOA. Buffet is mild, and wing-rock will not normally occur below 30 units AOA. Pitch control is positive, and the AOA can be easily reduced by forward stick movement. Recovery, if initiated rapidly, is effected by positioning the stick forward (3-8 units angle of attack) and advancing the throttles to military power while maintaining ailerons and rudder neutral. Altitude loss can be minimized by applying maximum power, easing the stick forward momentarily to attain 21 to 25 units AOA, then stabilize AOA at 25 units. Also refer to Stall characteristics chart (figure 6-4).

Accelerated Stalls

Accelerated stalls produce only mild to moderate buffet. Wing–rock normally does not occur below 25 units AOA, and often does not occur until reaching 28–30 units AOA. Departures which occur above 30 units tend to be gentle, and are predominantly roll rather than yaw. Normal recoveries are positive. Prompt neutralization of controls will generally effect recovery from accelerated stall approaches. Control of angle of attack with stick position is of paramount importance to effect recovery from the 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 aileron or rudder.

WARNING

- The use of aileron or excessive rudder when approaching either a 1 G or accelerated stall condition will produce yaw and increase AOA. This increases the probability of loss of control. Left stick produces a right yaw, and right stick produces left yaw.
- If slats are not programming properly, 25 units AOA will result in an immediate departure. If slats do not extend or buffet occurs below 19 units AOA, do not exceed 19.2 units AOA.

Negative G Stall

A negative (inverted) G stall can be entered with abrupt application of forward stick and is indicated by 0 AOA. Light to moderate buffet will occur at the stall and there is no distinct yaw or roll tendencies. Recovery from the negative G stall is effected by relaxing the forward stick pressure and maintaining AOA between 3-8 units until recovered.

Landing Configuration Stalls

Stall approaches in the landing configuration are safe, with satisfactory control about all axes up to 26 to 28 units angle of attack. In the landing configuration, the aircraft will generally stall at higher AOA than in the cruise configuration. Above 26 units AOA, the increase in stick forces serves to reduce the potential for inadvertent stalls. Approaching the stall, the airplane exhibits a slight nose rise (a reduction in the stick force required to hold pitch attitude). The magnitude of this stick force lightening is a function of the center of gravity position (aft CG gives lighter forces). Stick force lightening occurs between 23 and 25 units AOA. Wing rock usually increases in intensity as angle of attack is increased, but seldom exceeds ±40° bank angle at the stall. If bank angles in excess of 30° or nose slicing are experienced, the stall approach should be discontinued. Moderate buffet and wing rock will occur above 26 to 28 units AOA. Recovery is effected by advancing the throttles to MAX AB and placing the stick forward to attain and maintain ON SPEED AOA. If altitude is critical, 21 to 25 units AOA will result in minimum altitude loss.

WARNING

> Do not depend on the wing rock or buffet for natural stall warning. In any configuration or loading, it is possible to exceed 30 units AOA without any wing rock or buffet, at which time loss of control may result. Loss of at least 3000 feet altitude should be anticipated.

STALL CHARACTERISTICS

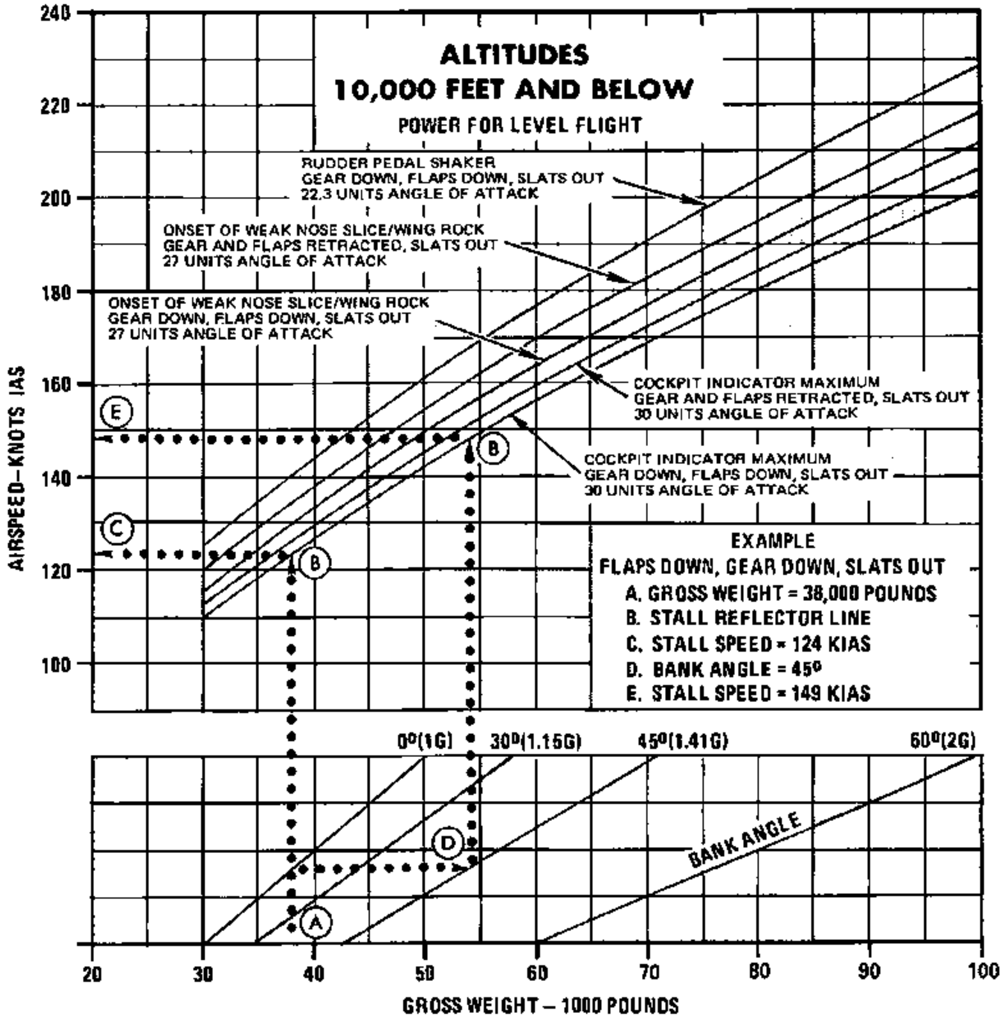

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Figure 6–4

Roll Coupling

The F-4G, like all aircraft with a high fuselage loading design, is susceptible to roll coupling. This is a flight phenomenon where inertia and adverse aerodynamic effects of roll, pitch, or yaw can combine to exceed the stabilizing forces on the aircraft and cause divergence about one or all of these axes. A common method of encountering roll coupling is performing continuous full stick deflection aileron rolls. While rolling rapidly, the aircraft diverges slightly from roll about the longitudinal axis. If the roll is continued, forces can build which may cause the aircraft to rapidly transition to movement around the vertical axis. Because there is a high probability that roll coupling will occur under the above conditions; full deflection aileron rolls exceeding 360° are prohibited. The higher the AOA during the roll, the quicker the aircraft can be adversely affected by roll coupling. It is possible to aggravate the effects of roll coupling by adding pitch and yaw inputs to the aircraft while rolling rapidly. Aircraft susceptibility to roll coupling is increased with aft center of gravity, with centerline stores loaded, and with absence of wing mounted stores. Under certain conditions this can cause the aircraft to depart without stall warning. Out—of—Control Recovery procedures in Section 3 should be used if the aircraft departs under these conditions.

DEPARTURES

Post-stall gyrations are uncontrolled aircraft motions following aggravated stall penetrations. They are best described as uncontrolled motions about any or all axes following a departure from controlled flight. Post-stall gyrations are caused by excessive AOA and can be prevented only by proper control of angle of attack. Directional stability deteriorates and goes negative at high AOA. Without directional stability, the aircraft will depart regardless of aileron or rudder position. Misapplication of lateral/directional controls may tend to aggravate the departure; however, the aircraft can depart and enter a spin with neutral ailerons and rudder. Departure and spin susceptibility is greater in the high subsonic and transonic (0.8 to 1.0) Mach regime. The severity of the departure is dependent upon the aircraft loading, airspeed, Mach number, and type of entry and is not predictable. Normally, the pilot will sense a buildup of side forces in the cockpit just prior to a departure. The AOA at departure is dependent upon the configuration; the more external stores, the lower the AOA at departure. The departure is characterized by a nose rise followed by an immediate yaw with a roll in the direction of yaw. Landing configuration departures evidence the same characteristics as the clean configuration.

RECOVERY CHARACTERISTICS AND TECHNIQUES

At the first indication of departure, the ailerons and rudder should be neutralized while moving the stick smoothly forward (full forward if necessary). Recovery from most out—of—control situations will be effected rapidly with forward stick, in some cases before reaching the full forward position. The drag chute will effect recovery from most departures and should be deployed without hesitation if the aircraft does not recover rapidly with full forward stick. Large oscillations in pitch, roll and yaw may be present as the aircraft unloads (zero or negative G) during the recovery. This unloading, using forward stick, is the best means of reducing these oscillations and is a positive indication that recovery is imminent. No attempt should be made to fly AOA while large roll and yaw motions are present because the AOA probe gives erroneous information under these conditions. The aircraft may enter a series of uncommanded rapid rolls as it recovers and accelerates. While AOA will indicate less than 30 units, the rudder and ailerons are ineffective in stopping these recovery rolls. These rolls should not be mistaken for a spin and will cease within two or three rolls. Maintain full forward stick until the aircraft unloads. If under sustained zero or negative G with the airspeed increasing above 200 knots, the aircraft is no longer out-of-control. If full forward stick is maintained after flying speed is attained, inadvertent control inputs can produce yawing and rolling which may be interpreted as still being out-of-control. Once all oscillations have stopped, normal throttle and control use will be effective for regaining the desired flight attitude. Do not exceed buffet onset during the recovery. Use the Emergency Dive Recovery procedure if at low altitude. Normally the drag chute need not be jettisoned since it will fail and streamline behind the aircraft as speed builds up above 250 knots; however, airspeed will not increase above 240 knots with the drag chute out and throttles at IDLE. Refer to figure 6-5 for a summary of out-of-control recovery techniques. Recovery characteristics and techniques are the same for the landing configuration.

SPINS

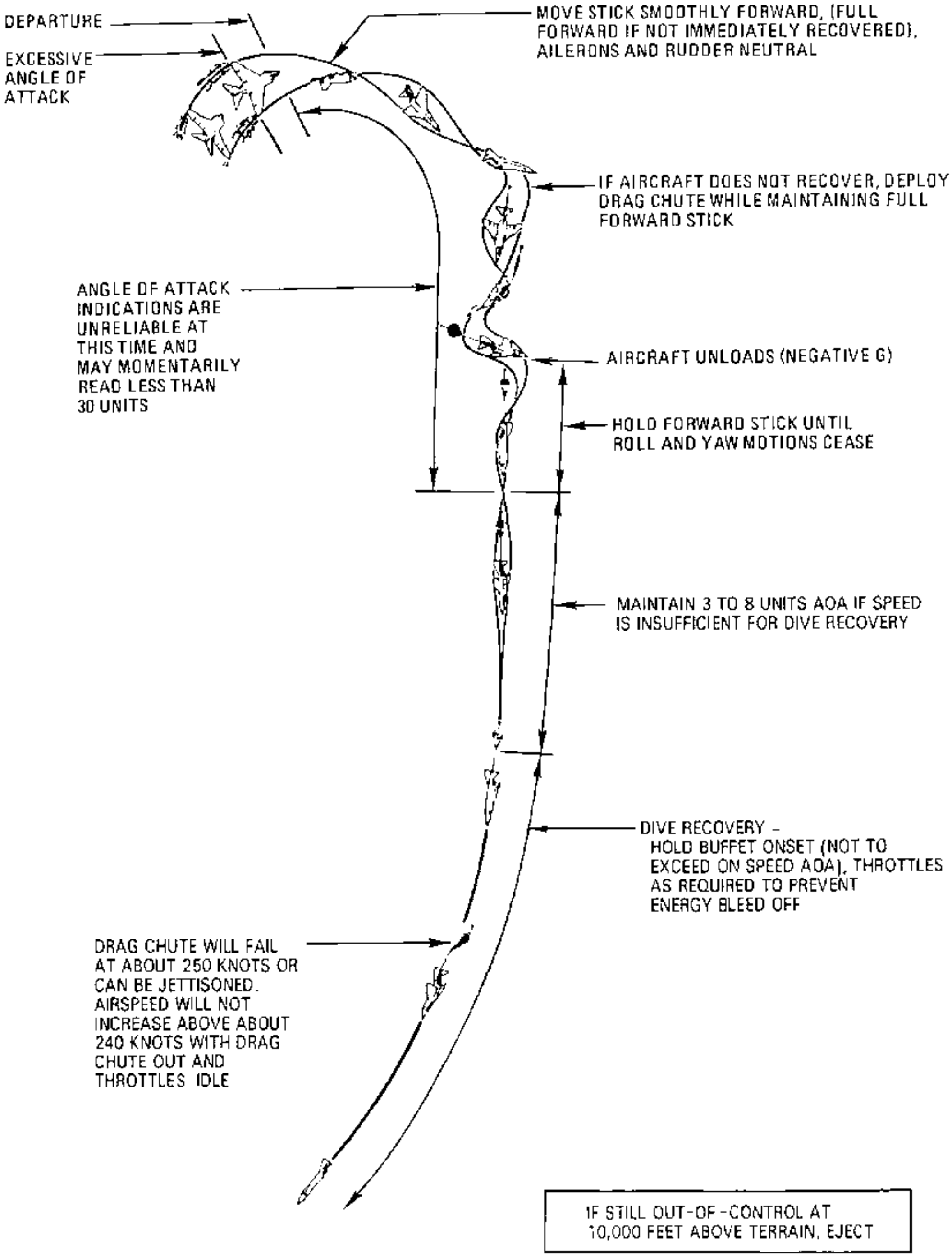
Spins have been entered from level flight stalls and tactical maneuvers including accelerated turns, reversals, and vertical and inverted climbs and dives. Departure and spin characteristics have been investigated over operational CG positions at Stability Indexes ranging from zero to 180. Asymmetric configurations up to the maximum allowable (one full 370-gallon external wing tank) have also been tested. Spin progression can be defined in two phases: incipient and developed. The incipient phase is the initial phase characterized by irregular oscillations about all three axes. The developed spin is attained when equilibrium conditions are approached and the oscillations are more or less consistent about all three axes from one turn to the next.

NOTE

- The out-of-control procedure will recover the aircraft from nearly all spins regardless of CG position or external store loading. While the rudder is relatively ineffective in a spin, applying full aileron in the direction of the spin will effect a more rapid recovery. Aileron should not be applied, however, until the pilot has ascertained that a spin condition exists.

- Visual cues outside the cockpit, an excessive yaw rate, and the turn needle (not the ball) should all be used to verify a spin condition and the spin direction. The turn needle will always be pegged in the spin direction.

OUT-OF-CONTROL RECOVERY



DEPARTURE

EXCESSIVE ANGLE OF ATTACK

MOVE STICK SMOOTHLY FORWARD, (FULL FORWARD IF NOT IMMEDIATELY RECOVERED), AILERONS AND RUDDER NEUTRAL

IF AIRCRAFT DOES NOT RECOVER, DEPLOY DRAG CHUTE WHILE MAINTAINING FULL FORWARD STICK

ANGLE OF ATTACK INDICATIONS ARE UNRELIABLE AT THIS TIME AND MAY MOMENTARILY READ LESS THAN 30 UNITS

AIRCRAFT UNLOADS (NEGATIVE G)

HOLD FORWARD STICK UNTIL ROLL AND YAW MOTIONS CEASE

MAINTAIN 3 TO 8 UNITS AOA IF SPEED IS INSUFFICIENT FOR DIVE RECOVERY

DIVE RECOVERY -
HOLD BUFFET ONSET (NOT TO EXCEED ON SPEED AOA), THROTTLES AS REQUIRED TO PREVENT ENERGY BLEED OFF

DRAG CHUTE WILL FAIL AT ABOUT 250 KNOTS OR CAN BE JETTISONED. AIRSPEED WILL NOT INCREASE ABOVE ABOUT 240 KNOTS WITH DRAG CHUTE OUT AND THROTTLES IDLE

IF STILL OUT-OF-CONTROL AT 10,000 FEET ABOVE TERRAIN, EJECT

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Figure 6-5

NOTE

- AOA is not a primary indication to determine a spin condition as the AOA probe gives erroneous information when large roll and yaw motions are present. The AOA indicator may show less than 30 units and even below 15 units momentarly during a spin; however, the AOA indicator will be 30 units during most of an upright spin. Even if the indicated AOA comes down during an out-of-control condition, the stick should remain forward until the aircraft unloads and yaw and roll motions cease.

CAUTION

External stores should be retained if a spin is entered. Jettisoning stores is not required for spin recovery and will only increase the risk of aircraft damage due to probable aircraft-store collision.

UPRIGHT SPINS

Recoverable Mode (Oscillatory)

The oscillatory mode is by far the most prevalent spin mode of the aircraft, and an aerodynamic recovery can always be accomplished if altitude conditions permit. This spin may oscillate rather violently in pitch, roll, and yaw, especially during the first few turns. The severity and magnitude of the oscillations are dependent upon the entry conditions and aircraft loading. External stores, particularly asymmetric loadings, will cause the spin to be more oscillatory. The pitch attitude may initially vary from greater than 90° nose low to 60° above the horizon until steady state conditions are approached. The oscillations in yaw rate can vary between 20° and 100° per second and roll oscillations can be as much as ±60° of bank angle. Bank angle changes opposite to the spin direction (e.g., rolling left in a right spin) can be confusing when trying to determine the spin direction. The spin direction can be determined by observing the arc made by the nose of the airplane across the ground or horizon, but the spin direction should be verified by checking the turn needle. In the clean or centerline tank only configuration, the aircraft spins more steeply (at a lower AOA) with relatively mild oscillations about all axes. These oscillations may be so mild that the spin can be misinterpreted as a steep descending spiral. The drag chute is an effective recovery device. In the clean configuration, spin susceptibility is reduced and recovery characteristics are enhanced with the inboard pylons installed. As external stores are added, the spin becomes more oscillatory, the aircraft spins at a higher nominal angle of attack, and the drag chute becomes less effective for recovery. Cockpit accelerations vary with the magnitude of the oscillations and may become somewhat uncomfortable in asymmetric configurations. The yaw rate will decrease and then increase at least once a turn (airplane tends to hesitate briefly and then wrap back up in yaw). Bank angle is also quite oscillatory. These oscillations are quite noticeable and indicate that the aircraft is not in a flat spin. The altitude loss in an oscillatory spin will average 1500 to 2000 feet per turn.

While the drag chute may be completely ineffective in a highly oscillatory spin, aerodynamic recovery can be accomplished within several turns. As forward stick and/or forward stick and aileron start to recover the aircraft, the magnitude of the oscillations will increase. The most violent oscillations and the most uncomfortable portion of the spin will generally occur as the aircraft unloads (zero to negative G) during recovery. This unloading using forward stick is the best means of reducing these oscillations and is a positive indication that recovery is imminent. Maintain full forward stick until the aircraft unloads. If under sustained zero or negative G with the airspeed increasing above 200 knots, the aircraft is no longer in a spin but may be in a rolling spiral preparatory to normal dive recovery. If full forward stick is maintained after flying speed is attained, inadvertent control inputs can produce yawing and rolling which may be interpreted as still being out-of-control.

Reversals (changing spin direction) are rare using forward stick for spin recovery. If a reversal should occur, maintain forward stick and re-apply aileron with the spin. When the aircraft unloads and yaw rate decreases, the ailerons should be neutralized; however, forward stick should be maintained until all oscillations cease to preclude pitching back into another out-of-control condition. The timing involved in detecting recovery using forward stick and aileron is not critical. The unloading at recovery will, in most cases, be rather abrupt. As the aircraft recovers and accelerates, it may enter a series of rapid rolls. While AOA will indicate less than 30 units, the rudder and aileron are relatively ineffective in stopping these recovery rolls. These rolls should not be mistaken for a spin or spin reversal, and will cease within 2 or 3 rolls.

The drag chute becomes more effective as the aircraft unloads and will quickly reduce the recovery oscillations. After recovery (aircraft unloaded and oscillations stopped), the throttles should be advanced and the dive recovery accomplished by holding buffet onset, or using the Emergency Dive Recovery procedure if at low altitude. Refer to figure 6-6 for a summary of spin recovery techniques.

Non–Recoverable Mode

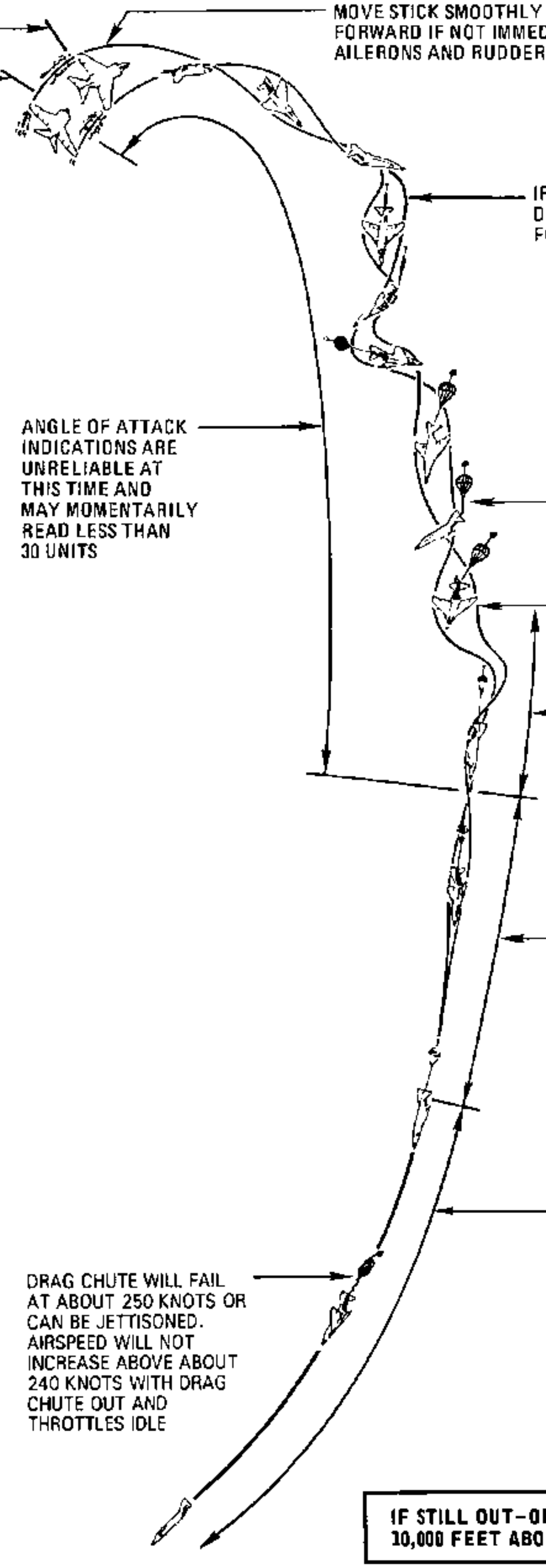
There have been isolated cases of upright spins progressing rapidly into a flat mode. The flat spin can develop within one or two turns after a departure from controlled flight; however, it is doubtful that an oscillatory spin will go flat if forward stick is maintained. The characteristics of the flat spin mode are quite different from those of the oscillatory mode. Once the flat spin is developed, oscillations in pitch and roll will not be noticeable. Yaw rate will increase rapidly to 80° per second or higher and there will be no hesitations in yaw during each turn. The flat spin is very smooth and the only accelerations on the crew will be a push forward (1 to 1.5 G). The altitude loss in a flat spin will average between 1000 and 1800 feet per turn. Recovery from a flat spin cannot be accomplished by either aerodynamic controls or the drag chute.

INVERTED SPINS

A true inverted spin is extremely unlikely even though the aircraft may be inverted at some point during a departure. An inverted spin would be characterized by negative G, an angle of attack of zero units, and is less oscillatory then the upright oscillatory spin. Spin direction can be determined by the yawing motion of the aircraft and the deflection of the turn needle. Recovery from inverted spins can be accomplished rapidly with neutral flight controls.

The Out–of–Control procedure will recover the aircraft from an inverted spin. However, if the pilot misidentifies inverted flight for an inverted spin and applies and holds full forward stick, a steady state inverted stall then becomes possible. A 3 to 8 units AOA recovery should be flown until sufficient speed for dive recovery is obtained.

SPIN RECOVERY



DEPARTURE

EXCESSIVE ANGLE OF ATTACK

MOVE STICK SMOOTHLY FORWARD, (FULL FORWARD IF NOT IMMEDIATELY RECOVERED), AILERONS AND RUDDER NEUTRAL

IF AIRCRAFT DOES NOT RECOVER, DEPLOY DRAG CHUTE WHILE MAINTAINING FULL FORWARD STICK

ANGLE OF ATTACK INDICATIONS ARE UNRELIABLE AT THIS TIME AND MAY MOMENTARILY READ LESS THAN 30 UNITS

DEFINITELY ASCERTAIN THAT A SPIN CONDITION EXISTS AND APPLY AILERON IN DIRECTION OF SPIN WHILE MAINTAINING FULL FORWARD STICK

AIRCRAFT UNLOADS (NEGATIVE G) NEUTRALIZE AILERONS

HOLD FORWARD STICK UNTIL ROLL AND YAW MOTIONS CEASE

SPIN STOPPED
MAINTAIN 3 TO 8 UNITS AOA IF SPEED IS INSUFFICIENT FOR DIVE RECOVERY

DIVE RECOVERY -
HOLD BUFFET ONSET (NOT TO EXCEED ON SPEED AOA). THROTTLES AS REQUIRED TO PREVENT ENERGY BLEED OFF

DRAG CHUTE WILL FAIL AT ABOUT 250 KNOTS OR CAN BE JETTISONED. AIRSPEED WILL NOT INCREASE ABOVE ABOUT 240 KNOTS WITH DRAG CHUTE OUT AND THROTTLES IDLE

IF STILL OUT-OF-CONTROL AT 10,000 FEET ABOVE TERRAIN, EJECT

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Figure 6-6

ENGINE EFFECTS

If the engines are at high power settings, a flameout of one or both engines will probably occur at or just after departure. Should a flameout occur, an airstart can be obtained with the throttles at idle even during a spin. If both engines flamout and an airstart is not obtained, electrical power will be lost within 3 to 4 turns and normal operation of flight controls will deteriorate after approximately 4 turns and will be lost shortly thereafter.

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 light–offs during descent. Above 70,000 feet, the engines will have to be shut down if they tend to over–speed or over–temp. Engine windmill speed at altitudes above 70,000 feet is 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 demands smooth coordinated control action. The angle of attack indication is the primary recovery aid regardless of recovery method. A zoom climb recovery initiated from an indicated airspeed 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. Attemps to hasten the recovery by pushing over to a value below 5 units AOA produce negative G on the aircraft and possible stall. 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 8 units to produce maximum safe G loading on the aircraft. When the aircraft is in inverted recovery dive, the roll to wings–level must again be accomplished with smooth slow control action while holding angle of attack between 3–8 units. As before, angle of attack should be maintained in the recovery dive until airspeed builds up to 250 knots. A zoom climb recovery initiated at an indicated airspeed less than 250 knots should be accomplished with the pilot's sole attention devoted to proper control of angle of attack between 3–8 units. Roll attitude should be completely ignored with aileron and rudder held generally neutral to maintain coordinated flight.

SECTION VII

SYSTEMS OPERATION

TABLE OF CONTENTS

ENGINE OPERATING CHARACTERISTICS

The engine has several characteristics that are utilized to achieve optimum engine performance in all flight conditions without exceeding the operating limits of the engine. These characteristics are discussed in the following paragraphs.

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. As compressor inlet temperature increases from 56°C ±5 to 108°C ±5, engine idle speed is raised from normal idle (65 percent) to 100 percent regardless of the throttle position. To reduce engine idle speed once it has been reset, compressor inlet temperature must be reduced. This is effected by retarding the throttles. As thrust decreases, compressor inlet temperature decreases as a result of lower airspeed, and engine speed control is returned to the throttle. T2 reset may also occur during ground operation when hot exhaust gases from other aircraft are directed at the intake of the affected engine.

T2 CUTBACK

When the compressor inlet temperature (T2) falls below +45°C, the maximum engine rpm is limited to prevent excessive mass airflow through the engine. The rpm maximum speed reduction starts at +45°C and is reduced until, at −54°C, the maximum rpm is approximately 90 percent.

T5 RESET

The engine incorporates an exhaust gas temperature (T5) reset during military and full afterburner 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 EGT's, 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.

AUTO–ACCELERATION

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% rpm. A utility hydraulic system or double generator 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 will allow 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) will auto–accelerate. The auto–accelerated engine(s) can be shut down, if on the ground, by placing the throttle to OFF. If engine operation is required, the thrust output can be regulated by modulation of the engine throttle. Modulation of the engine throttles will re–position the exhaust nozzles. However, the engine rpm will not be affected.

ENGINE OPERATING ENVELOPE

The engine operating envelopes (figure 7–1) show pertinent engine operating data for an ICAO Standard Day. The various envelopes are plotted to show an approximate area of operation; therefore, air–starts, 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 the Airplane Speed Restriction Chart and Engine Airspeed Limit Chart in section V of this manual shall take precedence over any or all operations shown herein.

NOTE

- Engine compressor stalls which were self clearing and occur at AOA greater than 22 units are not indicative of an engine malfunction. These stalls will not cause damage to the engine or airframe; however, an entry into the AFTO Form 781 should be made at the completion of the mission.
- Flight through dense smoke may cause compressor stall or flameout.

ENGINE STARTER OPERATION

The engine starting system utilizes a turbine type cartridge/pneumatic starter unit, mounted on the accessory gear box of each engine. These units provide starting capabilities with either the pneumatic starting

ENGINE OPERATING ENVELOPES

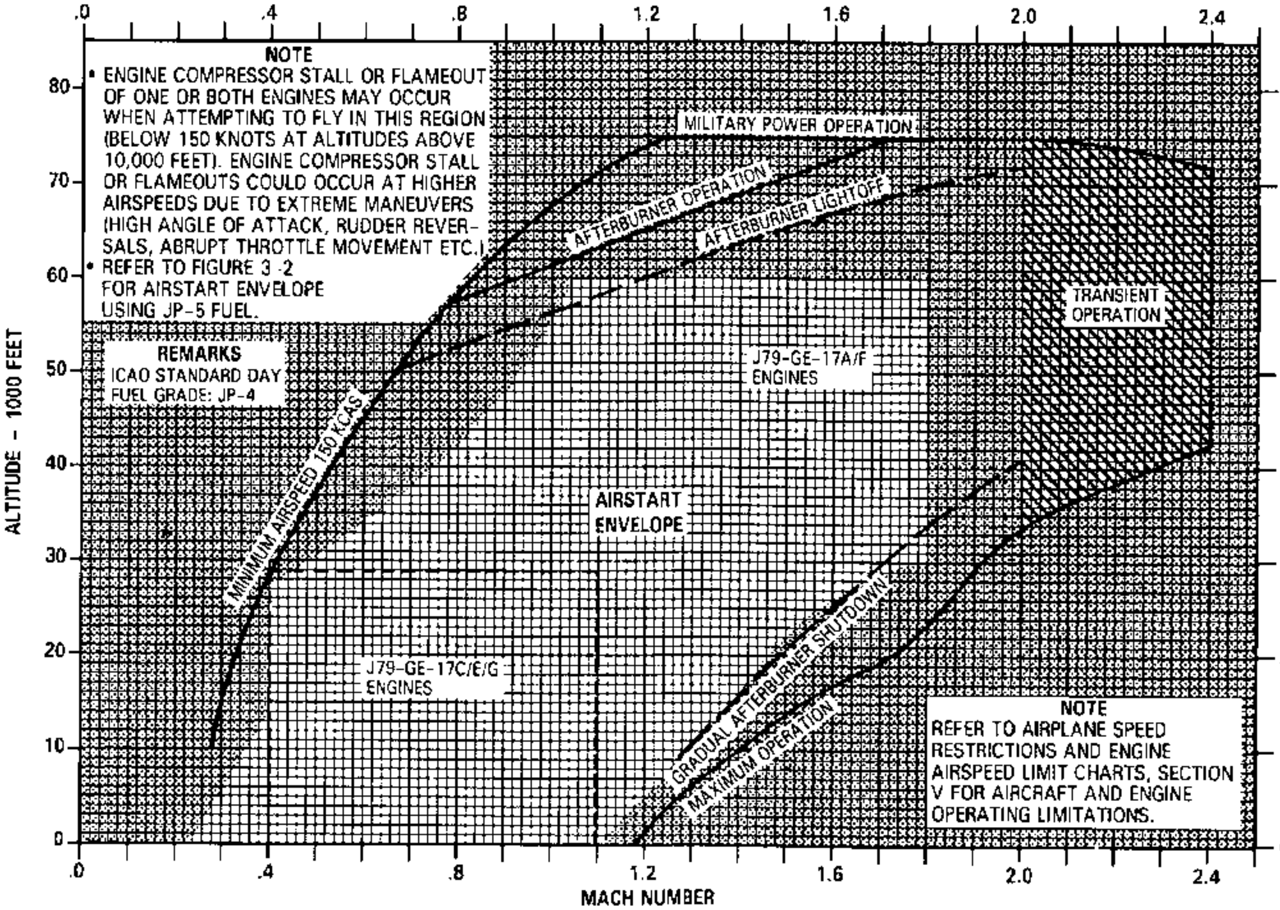


Figure 7-1

unit, (type MA-1A or equivalent), or with a MXU-4/A or MXU-4A/A solid propellant cartridge. Electrical power for starting may be supplied by an external electrical power unit or the aircraft battery.

STARTER CARTRIDGES

The MXU-4/A or MXU-4A/A engine starter cartridges are used for starting the engines. Spare cartridges, two per aircraft, may be stored behind access doors 137, left and right on aircraft without combat documentation cameras.

NOTE

Stored cartridges are limited to a maximum of 20 captive flights. Cartridges which exceed this limitation must be removed for Explosive Ordnance Disposal.

WARNING

Under no circumstances should electrical contacts of the starter cartridge be brought in contact with the surface of an aircraft.

FUEL WEIGHT VARIATIONS

Fuel quantity indications vary from day-to-day, even though the aircraft is serviced with the same total number of gallons of fuel. These variations between fuel quantity and weight are a source of considerable difficulty in the accurate determination of aircraft performance. The factors that cause the fuel weight to change, in respect to a constant quantity, are temperature effects and specific density tolerances. Fuel production specifications for JP-4, permit the specific density to range from 6.2 to 6.7 pounds per gallon at standard day conditions, or a maximum of one-half pound per gallon. The usable fuselage fuel, as indicated on the tape portion (before TO 1F-4-1414) or sector portion (after TO 1F-4-1414) of the quantity indicator, can vary about 650 pounds, and the total usable fuel (all internal tanks) as indicated on the counter portion of the quantity indicator, can vary about 950 pounds, depending on specific density tolerances alone. Added to the specific density variations, is the effect of temperature. For each change in the fuel temperature of 1°C, the fuel density varies inversely by 0.01 percent. Therefore, with the additional weight variations caused by temperature changes, a wide range of fuel weights for the same quantity can be realized. For example, if the fuselage cells were filled with JP-4 manufactured at the low end of the specific density scale (6.2 pounds per gallon), and the fuel temperature was 40°C, the tape or sector portion of the quantity indicator would show approximately 7600 pounds of usable fuel. However, if the fuselage cells were filled with JP-4 manufactured at the high end of the specific density scale (6.7 pounds per gallon), and the fuel temperature was -10°C, the tape or sector portion of the fuel quantity indicator would show approximately 8600 pounds of usable fuselage fuel. While it is not expected that a clinical study of the fuel density be made prior to each flight, it should be remembered that the engine fuel control schedules fuel in pounds, not gallons.

SECTION VIII

CREW DUTIES

GENERAL AIRCREW RESPONSIBILITIES

The safe operation of the aircraft is the responsibility of both aircrew members. The flight manual and checklist is based on a definite division of responsibilities between cockpits. Each aircrew member should have a thorough working knowledge of Aircraft Systems, Normal/Emergency Procedures, Operating Limitations, and Aircraft Flight Characteristics.

CREWMEMBER IN COMMAND OF AIRCRAFT

The primary responsibility of the crewmember in command of the aircraft is to ensure mission accomplishment within acceptable safety limits. Specific responsibilities are:

a. Conduct adequate integral aircrew briefings to ensure definite division of responsibility during flight.
b. Accomplish Normal/Emergency Procedures as outlined in this manual.
c. Operation of the aircraft within published operating and structural design limitations.
d. Ensure use of abbreviated checklist on all flights.

CREWMEMBER IN CONTROL OF AIRCRAFT

The crewmember actually in control of the aircraft is responsible for flying the aircraft and operating auxiliary equipment under his control in accordance with this manual. Those procedures requiring immediate response will be accomplished as required; however, aircrew member not in control of the aircraft will be required to read the procedure from the checklist when time and circumstances permit. The crewmember in control of the aircraft will call for checklist items when required during flight profile.

CREWMEMBER NOT IN CONTROL OF AIRCRAFT

The crewmember not in control of the aircraft shares overall responsibility for the safe accomplishment of the mission. In addition, he is responsible for operating auxiliary equipment under his control in accordance with this manual. Specifically, his responsibilities are:

a. Perform navigational duties as required.
b. Assist other aircrew member in monitoring flight progress.
c. Assist other aircrew member in monitoring aircraft systems and detecting system malfunctions.
d. Initiate required inflight checklist items when not called for by crewmember in control of aircraft.
e. Monitor instruments during all climbs and descents and advise the other crewmember of any deviations from established flight parameters.
f. Clear the flight area whenever possible.

SECTION IX

ALL WEATHER OPERATION

TABLE OF CONTENTS

This section provides information for operation during conditions of instrument flight, flight in turbulent air, various penetration/approach procedures, and extreme temperature conditions. These are procedures that differ from, or are in addition to, those contained in the normal operating procedures covered in section II.

INSTRUMENT FLIGHT PROCEDURES

This all weather aircraft is designed to perform operational missions in all extremes of weather. Rapid acceleration rates and high pitch angles during climb, dictate some modification of standard instrument procedures. When flight through clouds, precipitation, or visible moisture is anticipated:

1. Pitot heat switch - CHECK ON
2. Engine anti-icing switch - DE-ICE

Upon reaching clear air –

3. Engine anti-icing switch - NORMAL

INSTRUMENT TAKEOFF

An instrument takeoff is the same as a normal takeoff.

INSTRUMENT CLIMB (MIL THRUST)

An instrument mil thrust climb is the same as a normal mil thrust climb.

INSTRUMENT CLIMB (MAX THRUST)

An instrument A/B climb is the same as a normal A/B climb.

HOLDING/LOITER

Holding patterns or loitering flight may be flown at most altitudes at 280 knots, using approximately 30° of bank.

INSTRUMENT DESCENT

Refer to figure 9–1 for typical penetration pattern.

NOTE

- Do not reduce thrust below 80% rpm (85% single engine) to ensure adequate windshield defogging/rain removal/engine anti-ice effectiveness. If the throttle is retarded to idle in heavy precipitation a lower than normal idle rpm indication may be noted.
- The pressure altimeter should be crossed checked with the radar altimeter to confirm terrain clearance at low altitude.

INSTRUMENT APPROACH

The aircraft approach category is E. See figure 9–2 for closed instrument approach.

1. Descend to glide slope intercept or GCA pick–up altitude and transition to landing configuration approximately 10 miles out on final or base leg (as appropriate).
2. Establish on–speed AOA before touchdown.

When commencing descent –

3. Retard power to approximately 82–84% rpm.
4. Adjust pitch and power as necessary to maintain desired rate of descent.

A straight-in TACAN penetration followed by a GCA or ILS final requires approximately 500-800 pounds of fuel. A missed approach followed by a second GCA or ILS approach requires an additional 1000 pounds of fuel.

CIRCLING APPROACH

For a circling approach, maintain 180 knots with gear and flaps extended (230 knots minimum for no-flap). Reduce to computed final approach speed when in position to execute a normal landing.

MISSED APPROACH PROCEDURES

1. Throttles - MILITARY (afterburner, if required)
2. Gear - UP (when a postive rate of climb is established)
3. Slats flaps - NORM (minimum of 180 knots)
4. Power as required to maintain 240-250 knots and maintain a 1500 to 2500 feet per minute climb.
5. Follow published missed approach procedures.

NIGHT FLYING

ON ENTERING AIRCRAFT

1. Interior lighting - CHECK
2. Emergency floodlights - CHECK
3. Navigation lights and exterior lights - CHECK
4. Landing and taxi lights - CHECK

DURING FLIGHT

NOTE

During instrument conditions, exterior lights should be on STEADY due to vertigo inducing effect of flashing light reflections from surrounding clouds.

COLD WEATHER PROCEDURES

BEFORE ENTERING COCKPIT

The entire aircraft should be free of snow, ice, and frost collections. These conditions are a major flight hazard and result in a loss of lift and increased stall speeds. They must be removed before flight, but do not chip or scrape away ice as damage to aircraft may result. Special emphasis must be placed on the following:

1. Shock struts, pitot tube, fuel vents, and actuating cylinders are free of ice or dirt.
2. Fuel drain cocks free of ice and insure that all pneumatic bottles have been adequately serviced.
3. All exterior covers removed.
4. Closely inspect the 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.

INTERIOR CHECK

In temperatures below 0°C, difficulty may be experienced when connecting the oxygen mask hose to the CRU−60/P oxygen connector, due to a stiff O−ring in the CRU−60/P. Application of a small amount of heat to the CRU−60/P will alleviate this problem. Also, if the oxygen mask is not fastened, keep it well clear of the face to prevent freezing of the valves.

ENGINE START

During pneumatic engine start operation, depress ignition buttons at approximately 6% rpm; however, do not advance the throttles until approximately 10% rpm is reached. During cartridge start operation, press ignition buttons approximately 5 seconds before advancing throttles. Depressing 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 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 shut down 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

JET PENETRATION

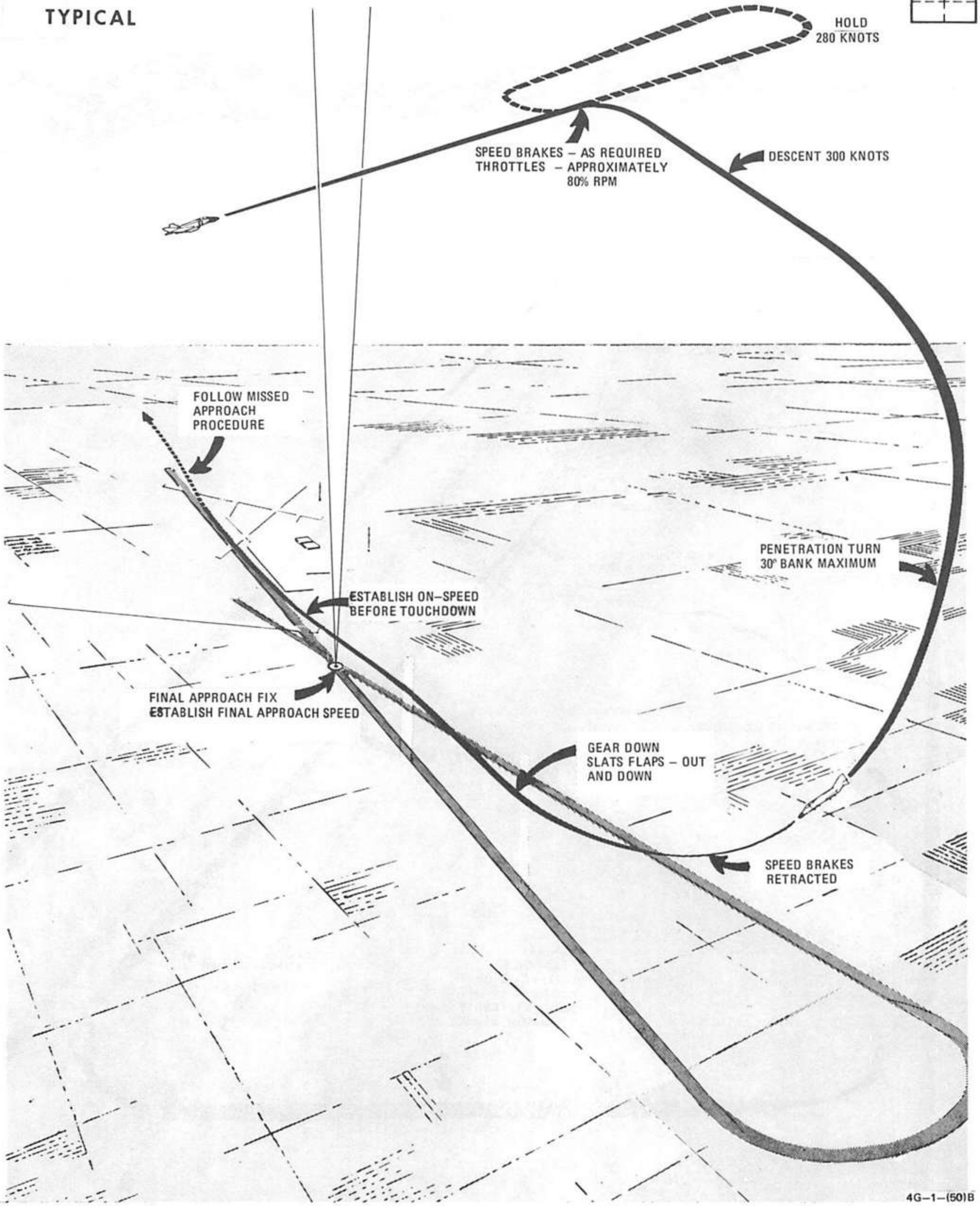
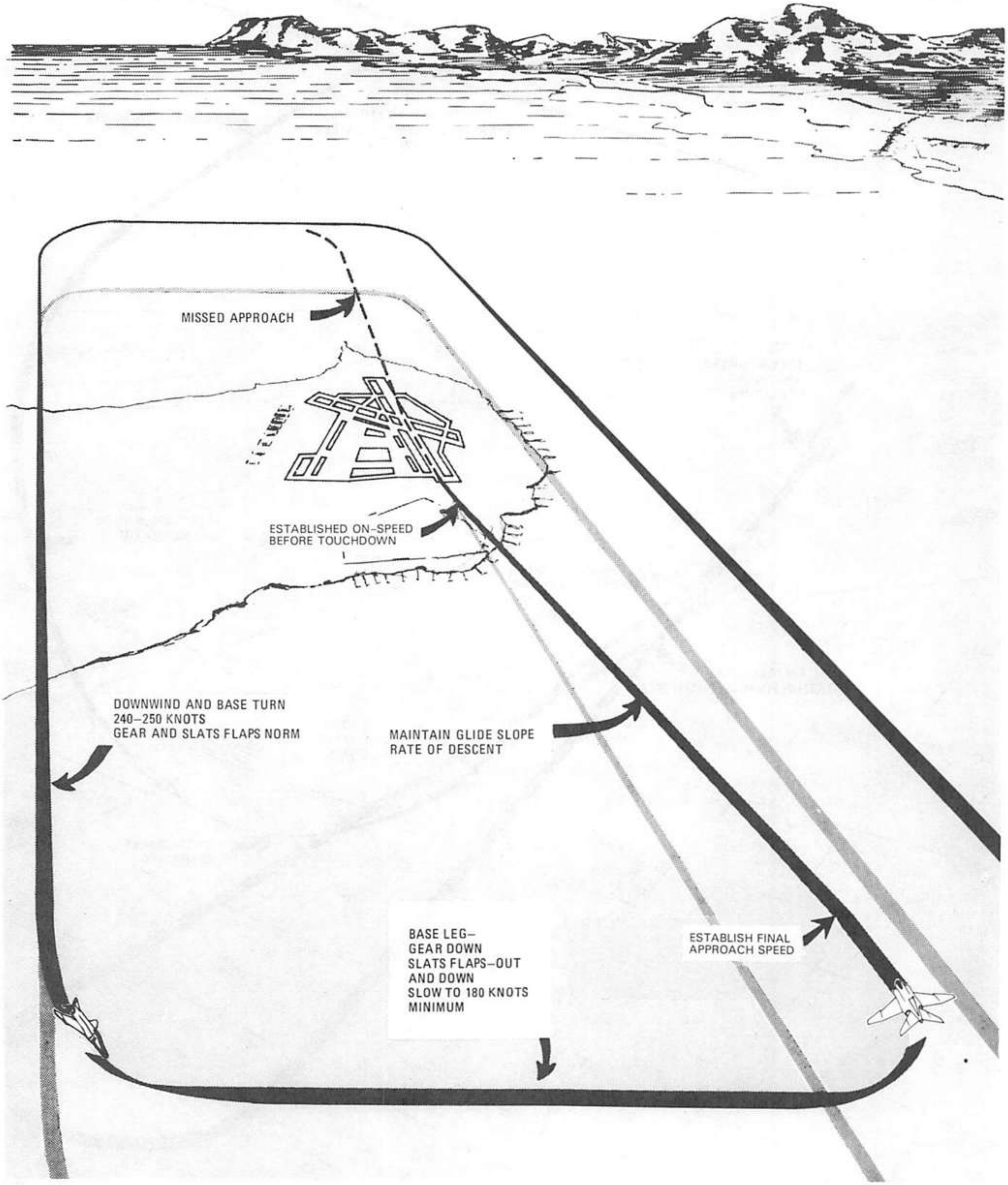


Figure 9–1

INSTRUMENT APPROACH

TYPICAL



4G–1–(51)39

Figure 9–2

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 warm-up nor should an abort be declared if an engine shut-down and restart will bring and keep a generator on the line. Starts using alternate fuels (JP-5, JP-8, JET A or JET A-1) will require longer to accelerate to idle rpm. The degradation in acceleration time becomes progressively more pronounced as temperature decreases. Starts at sub-zero temperatures using kerosene base fuels may require up to 75 seconds longer than with JP-4. Rpm increase after light-off may be particularly slow when making cartridge mode starts. Starts should not be discontinued prematurely due to slow acceleration or temporary rpm stagnation. Temporary stagnation at settings below idle rpm is acceptable for periods up to 30 seconds provided permissible EGT limits are not exceeded.

CAUTION

Ensure that GEN OUT and BUS TIE OPEN lights go out. The maximum amount of time that the engine can run at 100 psi oil pressure before discontinuing the start is 2 minutes when the temperature is below −18°C (0°F) and 4 minutes when the temperature is below −35°C.

NOTE

In extremely cold weather, the throttle linkage is very stiff and both hands may be required to move the throttles out of the OFF position.

WARM-UP AND GROUND CHECK

When checking the flight controls, lateral stick movement will be extremely stiff. Slowly cycle the control stick until full lateral stick throw is available. Repeated control cycling will alleviate the stiffness somewhat, but normal system feel may not return until after approximately 1 hour of system operation. Before takeoff, assure all instruments are allowed an adequate warm-up period and are operating normally.

CAUTION

- During engine ground operation when icing conditions are present, rapid throttle movement with possible ice accumulation in the compressor could result in a stall. Do not operate below 82% rpm for more than 5 minutes. Operate at MIL for at least 30 seconds for each period below 82% rpm.
- Cold weather operation (below 40°F) contributes to AVTR head clogging. Before engine start, load cassette leaving cassette door open allowing cockpit heaters to heat AVTR. Turn AVTR to STBY. Close AVTR door prior to takeoff.

TAXIING

Avoid taxiing in deep or rutted snow since frozen brakes will likely result. Also, increase space between aircraft while taxiing at sub-freezing temperatures, to insure safe stopping distance and to prevent icing of aircraft surfaces by melted snow and ice blown by the jet blast of a preceding aircraft.

BEFORE TAKEOFF

The thrust developed by the engine in low temperature is noticeably greater and brake demands will be greater to hold position; however, 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 hang-up. If engine icing conditions are anticipated, place the engine anti-ice switch in the DE-ICE position and place the pitot heat switch ON.

NOTE

When operating under extremely low temperatures (approximately −40°C or below), RPM hang-up, cyclic afterburner operation, or engine flameout may be experienced.

TAKEOFF

NOTE

- When operating from runways which are covered with excessive water, snow or slush, high-speed aborts may result in engine flame-out due to precipitation ingestion. The probability of flame-out is highest when throttles are chopped from afterburner to IDLE at speeds above 100 knots. With a double flame-out, normal braking, anti-skid protection, 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.
- If inflight freezing within the longitudinal control system is experienced, excessive stick forces may be required to move the control stick. Normal airplane control is available but requires higher initial force inputs. Normal control forces should return at lower (warmer) altitudes.

AFTER LANDING

When wearing bulky arctic survival clothing and winter flying gloves, rapid egress from the cockpit by disconnecting the torso harness will be impeded due to the inability to see the connectors and by a degraded sense of touch. During operations where the temperature is below freezing with heavy rain, or expected to drop below freezing with heavy rain, the aircraft should be parked with wings spread.

BEFORE LEAVING AIRCRAFT

Leave canopy open, unless weather prevents, to permit circulation. This helps prevent canopy cracking from differential cooling and decreases windshield and canopy frosting. Also check that all protective covers are installed.

HOT WEATHER PROCEDURES

CAUTION

Do not attempt takeoff or engine operation in a sand storm or dust storm, if avoidable. Park aircraft crosswind and shut down engine to prevent sand or dirt from damaging engine.

TURBULENCE AND THUNDERSTORMS

WARNING

The following factors, singly or in combination, could cause engine flame-outs:

- Penetration of cumulus build-ups with associated high moisture content.
- Engine icing of either nose cowl or inlet guide vanes.
- Turbulence associated with penetration can result in extreme angles of attack which may cause marginal engine performance.
- Above 40,000 feet, the surge margin of the engine is reduced and there is poor air distribution across the face of the compressor.
- In view of the above, the pilot should avoid areas of turbulent air, hail storms, or thunderstorms, whenever possible, because of the increased danger of engine flame-out. If these areas cannot be avoided, the engine anti-icing system should be turned on prior to weather penetration. EGT gages should be monitored continuously during weather penetration. A rise of EGT is an indication of engine icing. The engine anti-icing systems prevent the formation of ice and is not a de-icer. Whenever possible, icing conditions should be anticipated in advance and the anti-icing system should be turned on to warm up the engine air inlet.

PENETRATION

The aircraft is exceptionally stable and comparatively easy to control in the severe turbulence; however, the effects of turbulence becomes noticeably more abrupt and uncomfortable at airspeeds above optimum cruise and below 35,000 feet. The aircraft is not displaced significantly from the intended flight path and desired heading. Attitude can be maintained with reasonable accuracy.

PENETRATION AIRSPEED

The optimum thunderstorm penetration speed is 300 knots. Afterburner may be necessary to maintain this airspeed above 35,000 feet.

NOTE

Optimum thunderstorm penetration airspeed is a compromise between pilot comfort, controllability, structural stress (due to gust loads and impact precipitation), and engine inlet air distortion. At high airspeeds, aircrew discomfort and structural stress are greater. At slow speeds, controllability is somewhat sacrificed and inlet airflow distortion (due to turbulence) may induce compressor stalls and/or engine flameout.

APPROACHING THE STORM

If storm cannot be seen, it may be located by use of radar. Establish the recommended penetration airspeed and perform or check the following:

1. Adjust throttle to maintain desired penetration speed.
2. Pitot heat switch - CHECK ON
3. Engine anti-icing switch - DE-ICE
4. Autopilot - OFF
5. Lower seat
6. Inertia reel - MANUALLY LOCK

If night penetration -

7. White floodlights - ON
8. Instrument lights - FULL BRIGHT
9. Console lights - FULL BRIGHT

CAUTION

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 airspeeds is much more advantageous than floundering into the storm at a dangerously slow airspeed while attempting to reach the top.

IN THE STORM

Maintain a normal instrument scan with added emphasis on the attitude indicator (ADI). Attempt to maintain attitude, and accept altitude and airspeed fluctuations. If compressor stall or engine stagnation occurs, retard throttle to idle momentarily, then advance the throttle slowly. If the stall persists, shut down the engine and airstart. If stagnation persists, and EGT is within limits, maintain reduced power until clear of the thunderstorm. The AOA probe may become distorted by impact ice/hail, which may cause erroneous actuation of the aural tone generator and rudder pedal shaker. Pulling the AOA heater circuit breaker (C7, No. 3 panel) will disable the aural tone generator and rudder pedal shaker but will also disable the AOA probe heater, total temperature probe heater, bellmouth probe heater, and automatic slat extension.

CAUTION

With the AOA probe heater control circuit breaker pulled, operation of the nose gear steering with the landing gear extended may cause a severe swerve at nosewheel touchdown.

ICE AND RAIN

BEFORE TAXIING

Before taxiing prior to severe weather flight, the engine anti-ice system should be checked as follows:

1. Engine rpm - IDLE
2. Anti-ice switch - DE-ICE

NOTE

If an anti-ice light cannot be illuminated at idle, advance engine to 80% rpm or higher.

3. EGT - CHECK
   Check for rise in EGT of approximately 10°C.
4. Fuel flow - CHECK
   Check for slight increase in fuel flow.
5. Anti-ice switch - OFF

INFLIGHT

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's 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. Flight through ice and/or rain requires no special technique; however, certain aircraft systems do require particular attention. These systems are engine anti—ice, windshield rain removal, longitudinal feel, and ADC. After TO 1F—4—1500, the rain removal system is deactivated.

NOTE

Selection of lower antenna may reduce static caused by heavy precipitation.

ENGINE ANTI-ICE SYSTEM

There is no immediate indication during flight of engine icing, such as decreased power or reduction in fuel flow; however, as ice build-up becomes critical, fuel flow will decrease, EGT will increase, and there will be a noticeable power loss. Therefore, the engine anti-ice system should be used whenever icing conditions are anticipated. Anti-ice system operation can be noted by an increase in EGT and fuel flow when the system is actuated. After clearing all precipitation and clouds, place the anti-ice switch to NORMAL. Unnecessary use of engine anti-ice air produces the following adverse effects:

a. Probable compressor front end damage at high supersonic speeds.
b. Probable decrease in compressor stall margin.
c. Slightly increased fuel consumption.

WINDSHIELD RAIN REMOVAL (BEFORE TO 1F-4-1500)

The following precautions should be observed when contemplating the use of the windshield rain removal system:

a. Do not operate on a dry windshield or when not essential to safety of flight.
b. Turn the system OFF immediately if WINDSHIELD TEMP HIGH indicator light illuminates.
c. Do not operate after takeoff at MIL power or above, or above Mach 1.0.
d. The system should be turned on at 3 to 5 miles on final and turned off as soon as practical during missed approach.

STABILATOR FEEL AND TRIM

When flying through areas of precipitation, partial or complete failure of the longitudinal control artificial feel system may result due to 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. A heater has been incorporated in the longitudinal feel system bellows inlet. The heater is turned on when the pitot heat switch is moved to the ON position.

CAUTION

> If ice and/or water blockage of the artificial feel bellows ram air line is suspected, longitudinal trim should not be applied to relieve control stick force, due to intermittent nature of the failure and suddenness of return to normal. Instead, use extra effort on stick to maintain desired airplane attitude. If nose up trim has been applied before the bellows failure was recognized, trim should be returned to near neutral (0 units if in doubt) before attempting any corrective action.

AIR DATA COMPUTER

The air data computer may malfunction during flight through ice and/or rain due to impact forces imposed by water and ice on the ADC total temperature sensor. A momentarily flashing DUCT TEMP HI warning light usually indicates that the sensor probe has been blocked or shorted by ice accumulation. A sensor probe that has completely failed will be evidenced by a continuously flashing DUCT TEMP HI warning light. These total temperature malfunctions result in erroneous true airspeed signals to the navigation computer, and cyclic operation of the intake duct ramps at all airspeeds. A malfunction in the ADC may also be caused by rain and/or ice impact damage to the angle of attack probe. The probe may become fixed at its extreme limits, thereby actuating the rudder pedal shaker with landing gear down.

APPENDIX A PERFORMANCE DATA

The appendix is divided into parts, as outlined below, to present the performance data in proper sequence for preflight planning. Each part contains descriptive text and sample problems for the applicable charts.

4G-1-(53)

PART 1

INTRODUCTION

TABLE OF CONTENTS

Charts

NOTE

> The performance charts in this manual were computed for the F-4E aircraft with -17A engines. The F-4G configuration increases drag and, consequently, decreases range approximately 2%. The -17C/E/G low smoke engine causes a degradation of approximately 1.5% for a total degradation of approximately 3.5% for F-4G aircraft with lower smoke engines.

DRAG INDEX SYSTEM

Most of the charts utilize the drag index system to effectively present the many combinations of weight/drag effects on performance. The Airplane Loading chart (figure A1-1) contains the drag number and weight of each externally carried store and its associated suspension equipment. 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. 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.

Sample Problem

Configuration: 6 – MK82 general purpose bombs on stations 1 & 9 (3 each station)

6 – MK82 general purpose bombs on station 5

6 – MK82 general purpose bombs on stations 2 & 8 (3 each station)

A. MK82 drag number	1.1 x 18 = 19.8
B. MK82 suspension equipment stations 1 & 9	10.1 x 2 = 20.2
C. MK82 suspension equipment stations 2 & 8	6.8 x 2 = 13.6
D. MK82 suspension equipment station 5	10.0×1=10.0
E. Total drag index	63.6

STABILITY INDEX SYSTEM

The stability index system is established to account for the destabilizing effect of wing-mounted stores. Wing-mounted stores shift the aerodynamic center (AC) forward and thereby reduce the static longitudinal stability. Fuselage mounted stores are not used in determining the airplane stability index. When the loading configuration is determined, enter the Airplane Loading chart, figure A1-1, to obtain the stability index number for each wing-mounted store loaded. Unit stability numbers are asigned for single mounted and cluster mounter weapons. Tandem mounted weapons count as a single weapon. The cluster mounted unit stability number is used when two or more weapons are not mounted in tandem. Each weapon in the cluster is assigned this number. For stability index computation of cluster mounted weapons, the maximum number of stores per station is three. The total of the stability index numbers for all stores loaded is the aircraft stability index. The aircraft stability index is used to determine the aft CG limit and the neutral stability point. Refer to Center of Gravity Limitations, section V.

Sample Problem

NOTE

> The following example is based on the aircraft operating weight plus a full internal fuel load (45,599 pounds). The external loading is the same as used in determining the drag index.

A. MK82 (cluster mounted stations 1, 2, 8 & 9)	3.7 x 12 = 44.4
B. MK82 (suspension equipment stations 1 & 9)	11.4 x 2 = 22.8
C. MK82 (suspension equipment stations 2 & 8)	13.5 x 2 = 27.0
D. Stability Index	94.2
E. Aft CG limit (at engine start) based on stability index	33.4% MAC
F. Takeoff gross weight	55,363 Lb

G. Aircraft CG location	30.9% MAC

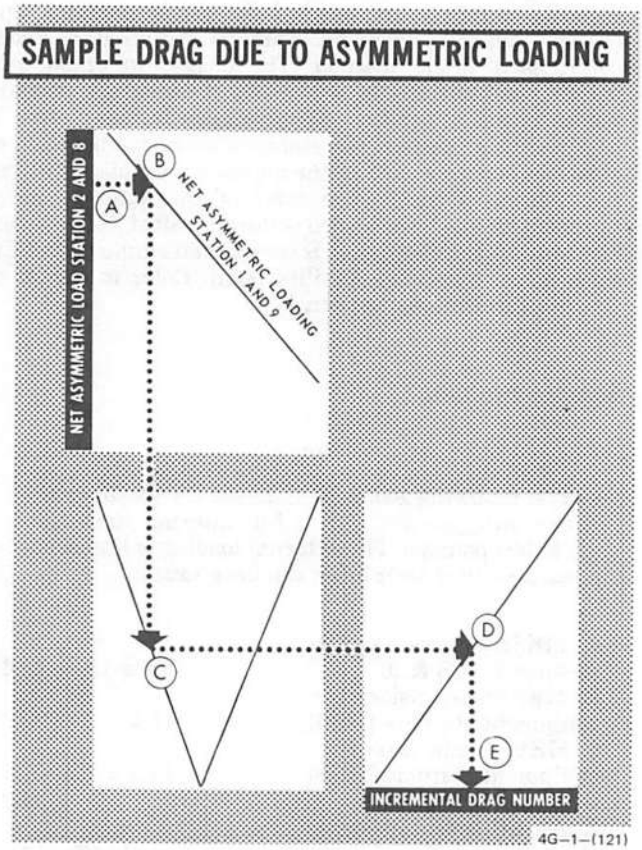
Result - airplane CG within limits.

DRAG DUE TO ASYMMETRIC LOADING

This chart (figure A1–3) provides the drag number due to trimming asymmetric store loading. The drag number is added to the computed drag of the airplane to obtain the drag index. This chart is unlike the Airplane Loading chart in that the drag varies with Mach number and altitude.

USE

Find the net asymmetric load on stations 2 and 8 (left vertical axis) 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 applicable. In the same manner, find the net asymmetric load on stations 1 and 9 (diagonal parallel lines). Enter the chart with the net asymmetric load for stations 2 and 8 (RWH or LWH). Proceed horizontally to the right to the net asymmetric load on stations 1 and 9 (RWH or LWH). Proceed vertically downward to the applicable altitude, horizontally to the right to the applicable Mach number, and then vertically downward to obtain the incremental drag number.



SAMPLE DRAG DUE TO ASYMMETRIC LOADING

Sample Problem

A. Load on station 2 = 1000 Lb
Load on station 8 = 3000 Lb
Net asymmetric load on stations 2 & 8 = 2000 Lb RWH

B. Load on station 1 = 2500 Lb
Load on station 9 = 2000 Lb
Net asymmetric load on stations 1 & 9 = 500 Lb LWH

C. Altitude	25,000 Ft
D. Mach number	0.7
E. Incremental drag number	5.25

AIRSPEED CONVERSION

The Airspeed Conversion chart, (figure A1–6) provides a means of converting calibrated airspeed to true Mach number and true airspeed.

INDICATED AIRSPEED

Indicated airspeed (IAS) is the uncorrected airspeed read directly from the indicator.

CALIBRATED AIRSPEED

Calibrated airspeed (CAS) is indicated airspeed corrected for static source error.

EQUIVALENT AIRSPEED

Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility. There is no provision made for reading equivalent airspeed.

TRUE AIRSPEED

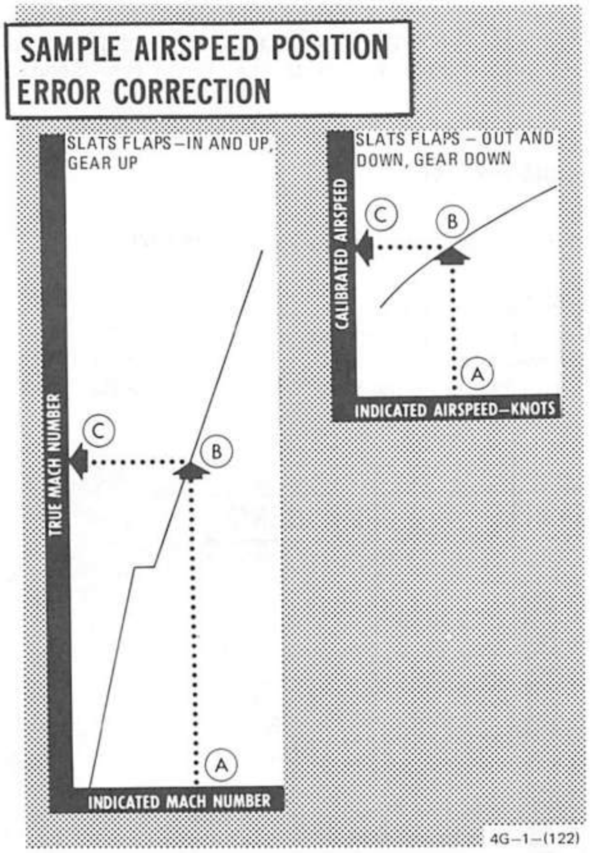
True airspeed (TAS) is equivalent airspeed corrected for density altitude. Refer to the Airpseed Conversion charts (figure A1–6).

AIRSPEED POSITION ERROR CORRECTION

These charts (figures A1–7 and A1–8) provide the means to correct indicated airspeed and Mach number to calibrated and true values respectively.

Sample Problem

Configuration: Slats Out, Flaps Down, Gear Down


SAMPLE AIRSPEED POSITION ERROR CORRECTION

4G–1–(122)

A. Indicated airspeed	180 Kt
B. Reflector curve	
C. Calibrated airspeed	178 Kt

Configuration: Slats In, Flaps Up, Gear Up

A. Indicated Mach number	1.1
B. Reflector curve	
C. True Mach number	1.08

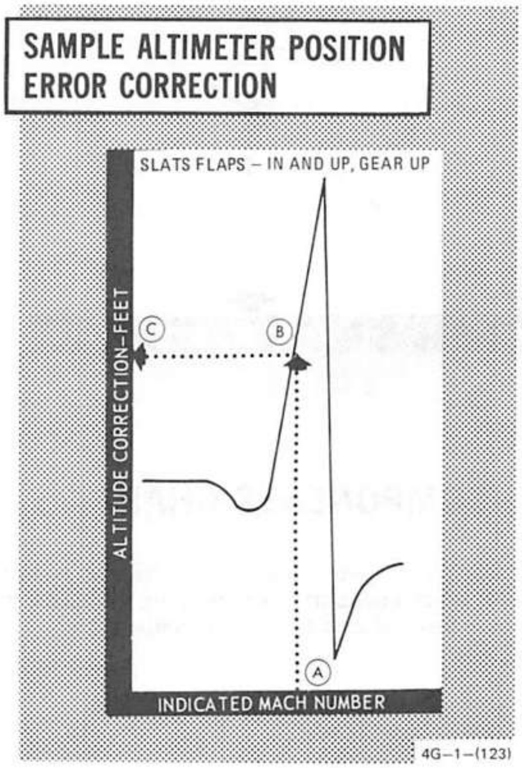
ALTIMETER POSITION ERROR CORRECTION

This chart (figure A1–9) provides altimeter error corrections for given Mach numbers at various altitudes. An altitude correction factor is included for landing configurations.

Sample Problem

Configuration: Slats In, Flaps Up, Gear Up

A. Indicated Mach number	1.4
B. Assigned altitude	40,000 Ft
C. Δ H correction	+75 Ft
D. Indicated altitude necessary to maintain assigned altitude (B+C)	40,075 Ft


SAMPLE ALTIMETER POSITION ERROR CORRECTION

4G–1–(123)

ALTIMETER LAG CHART

These charts (figures A1–10 and A1–11) 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 knots TAS.

USE

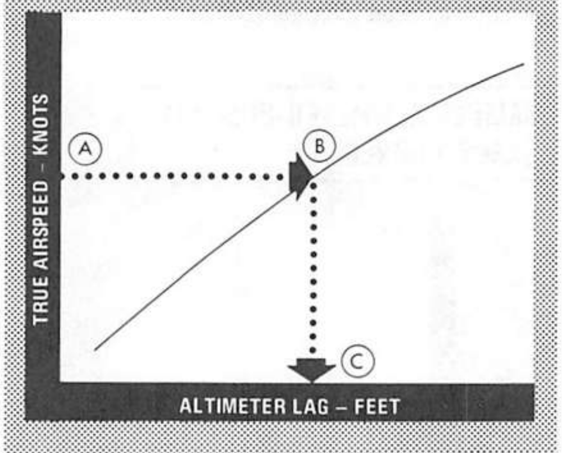
Enter the chart with dive airspeed, and project horizontally to the right to intersect the dive angle curve. From this point, project vertically downward to read the resulting altimeter lag. Add the altimeter lag data to desired/required pullout altitude to obtain indicated altitude for pullout.

Sample Problem

Aircraft with SPC Inoperative

A. Dive airspeed (TAS)	400 Kt
B. Dive angle	45°
C. Altimeter lag	1,120 Ft

SAMPLE ALTIMETER LAG



4G-1-(124)

WIND COMPONENTS CHART

A standard Wind Components chart (figure A1-12) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind components.

USE

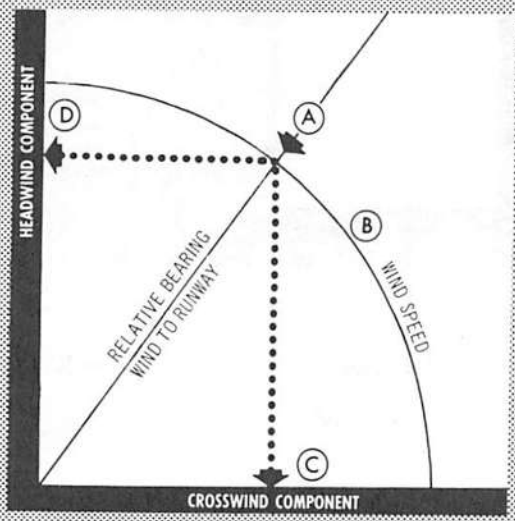
Determine the effect wind velocity by adding one-half the gust velocity (incremental wind factor) to the steady state velocity; e.g., reported wind 050/20 G30, effective wind is 050/25. Reduce the reported wind direction to a relative bearing by determining the difference between the wind direction and runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the effective wind speed arc. From this point, descend vertically downward to read the crosswind component. From the intersection of bearing and wind speed, project horizontally to the left to read headwind component.

Sample Problem

Reported wind 050/35, runway heading 030

A. Relative bearing	20°
B. Intersect windspeed arc	35 Kt
C. Crosswind component	12 Kt
D. Headwind component	33 Kt

SAMPLE WIND COMPONENTS



4G-1-(54)

AIRPLANE LOADING

WARNING

FOR PRECISE AIRPLANE BASIC WEIGHT, EXTERNAL STORE AND ATTACHMENT INFORMATION, REFER TO CHARTS C AND E OF THE WEIGHT AND BALANCE DATA HANDBOOK (T O 1 1B--40) FOR THE PARTICULAR AIRPLANE.

SUSPENSION EQUIPMENT	WEIGHT PER STATION	DRAG PER STATION	STABILITY INDEX NUMBER
CENTERLINE MER ADAPTER AND SWAYBRACE ADAPTERS	71	3.9	N A
CENTERLINE MER WITH ADAPTER	270	10.0	N A
INBOARD ARMAMENT PYLON	264	2.6	6.9
INBOARD ARMAMENT PYLON AND TER	359	6.8	13.5
INBOARD ARMAMENT PYLON AND TWO AERO-3B MISSILE LAUNCHERS	374	3.4	9.1
INBOARD ARMAMENT PYLON AND LAU-34/A MISSILE LAUNCHER	350	4.0	9.3
INBOARD ARMAMENT PYLON AND LAU-88/A, A/A LAUNCHER	740	13.7	21.5
INBOARD ARMAMENT PYLON AND LAU-117 LAUNCHER	399	9.6	13.9
INBOARD ARMAMENT PYLON AND LAU-118 LAUNCHER	367	5	10
SPECIAL WEAPONS ADAPTER	66	1.6	1.6
OUTBOARD ARMAMENT PYLON	190	2.1	4.3
OUTBOARD ARMAMENT PYLON AND OUTBOARD MER	410	10.1	11.4
OUTBOARD ARMAMENT PYLON AND LAU-34/A MISSILE LAUNCHER	276	3.4	6.8
OUTBOARD ARMAMENT PYLON AND LAU-118 LAUNCHER	293	5	10

Notes • ARMAMENT PYLON WEIGHTS ARE BASED ON MAU-12B/A. FOR MAU-12C/A, ADD 9 POUNDS.

STORE	WEIGHT PER STORE (POUNDS)	DRAG PER STORE	UNIT STABILITY NUMBER	
			SINGLE MOUNTED	CLUSTER MOUNTED
WING TANK AND PYLON	F-2713 E-308	6.4	SEE BELOW	
WITHOUT INBOARD STORES OR PYLONS			20.0	NA
WITH INBOARD STORE AND/OR PYLON			30.0	NA
WITH INBOARD LAU-88 LAUNCHER			46.5	NA

F-FULL E-EMPTY N A-NOT APPLICABLE

4G 1 (244 1)41

Figure A1-1 (Sheet 1 of 3)

STORE	WEIGHT PER STORE (POUNDS)	DRAG PER STORE	UNIT STABILITY NUMBER	
			SINGLE MOUNTED	CLUSTER MOUNTED
600-GAL EXT HIGH PERFORMANCE CENTERLINE TANK	F-4244 E-338	9.6	NA	NA
ROYAL JET 600-GAL EXT TANK	F-4200 E-300	9.6	NA	NA
AGM-45 OR ATM-45 TRAINING MISSILE	395	2.3	2.7	NA
AGM-65 OR AGM-65 TRAINING MISSILE	464	2.8	17.6	23.5
AGM-88, ATM-88, CATM-88 TRAINING MISSILE WITH WING AND FINS	795	3.0	10.0	NA
CATM-88 TRAINING MISSILE WITHOUT WINGS AND FINS	718	3.0	10.0	NA
AIM-7E, AND AIM-7E WITH AN/ AWM-19; -7F/ M MISSILE	435; 510	1.3	NA	NA
AIM-9 (BASIC, -1 CONFIGURATION) MISSILE	166	1.3	1.0	1.4
AIM-9 (-2, -3 CONFIGURATION) MISSILE	178			
AN/ASQ-T-13	160	1.3	1.0	NA
ALE-38 CHAFF DISPENSER	F-470 E-212	4.0	21.0	NA
ALE-40 DISPENSER (MASTER AND SLAVE)	F-67 E-45	2.8	0	NA
ALQ-119(V)-15, (V)-17	580/406 **	WING - 2.5 FUS - 1.7	12.2	NA
ALQ-131(V)-4, -5, -6	675	WING -4.5 FUS-5.8	35.0	NA
ALQ-131(V)-9, -10	600			
ALQ-131(V)-13	540			
ALQ-131(V)-12, -14	640/ 680			
ALQ-131(V)-15	580			
ALQ-176	247	WING-2.0 FUS-1.3	4.4	NA
ALQ-184(V)-1	658	WING-2.5 FUS-1.7	12.2	NA
ALQ-184(V)-2	474			
ALQ-184(V)-3	621			
ALQ-184(V)-4	469			
ALQ-184(V)-5	631			
ALQ-184(V)-6	470			
ALQ-188	300	4.0	4.1	NA
AN/ASQ-T17, -20, -21, -25	122	1.3	1.0	NA
QRC 80-01 (V)-3, -4	595/435 **	WING-2.5 FUS-1.7	12.2	NA
BDU-33 PRACTICE BOMB	23	0.2	0.6	0.8
BL-755 BOMB	610	4.4	7.8	10.4
BLU-109 WITH MK-84 CONICAL FIN	2020	3.4	7.2	NA
CBU-52 DISPENSER	785	4.6	7.4	9.9
CBU-58, -71 DISPENSER	800	4.6	7.4	9.9
CBU-87	960	5.0	8.0	10.0

NA - NOT APPLICABLE
NE-NOT ESTABLISHED

F - FULL
E-EMPTY

* TOTAL CARGO WEIGHT SHALL AT NO TIME EXCEED 300 POUNDS
** FOR FUSELAGE MOUNTED PODS, ADD 57 POUNDS FOR ADAPTER

4G-1-(244-2)48

Figure A1-1 (Sheet 2 of 3)

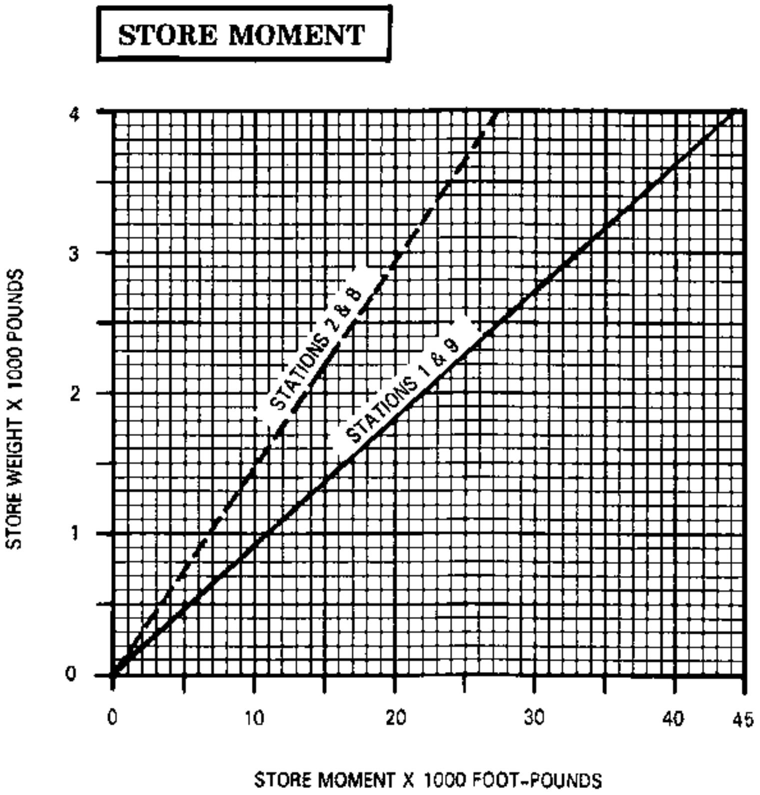
STORE		WEIGHT PER STORE (POUNDS)	DRAG PER STORE	UNIT STABILITY NUMBER	
				SINGLE MOUNTED	CLUSTER MOUNTED
CBU-89/B GATOR MINE		680	5.0	8.0	10.0
GBU-12/B, A/B (MK-82) LASER GUIDED BOMB) OR BDU-50A/B PRACTICE BOMB	HIGH SPEED FIN	620	2.3	9.4	NA
	LOW SPEED FIN		3.1		
GBU-12B/B, C/B, D/B (Mk-82 LGB) OR BDU-50A/B PRACTICE BOMB		620	2.0	4.5	6.0
GRDCUS (SHOOTER POD)		126	1.3	1.0	NA
GBU-24/B, A/B LOW LEVEL LGB		2315/2354	6.3	26.2	NA
LAU-131 ROCKET POD	WITH NOSE CONE	F-226	1.6	3.9	5.2
	WITHOUT NOSE CONE	F-68	2.5	3.9	5.2
M129 E1, M129 E2 LEAFLET BOMB/MJU-1 CHAFF BOMB		206/305	3.0	7.3	9.7
MC-1 GAS BOMB		740	3.0	7.3	9.7
MK-20 ROCKEYE II		490	2.9	7.2	9.6
MK-82 GENERAL PURPOSE BOMB OR BDU-50 PRACTICE BOMB		510	1.1	2.8	3.7
MK-82 SNAKEYE 1 BOMB OR MK-36 DESTRUCTOR		550	2.4	2.8	3.7
MK-82/BSU-49/B (AIR INFLATABLE RETARDER)		528	1.1	2.8	3.7
MK-84 GENERAL PURPOSE BOMB		1970	3.4	7.2	NA
MK-84/BSU-50/B (AIR INFLATABLE RETARDER)		2008	3.4	7.2	N/A
MXU-648 CARGO POD	REMOVABLE TAILCONE	E-130 *	3.4	14.0	NA
	FIXED TAILCONE	E-98 *			
SUU-20/A, A/A, A/M, B/A PRACTICE BOMB AND ROCKET DISPENSER W/SIX BDU-33		F-378, 468, 468, 414, E-240, 330, 330, 276	F-3.1 E-3.7	12.3	NA
SUU-21 PRACTICE BOMB DISPENSER WITH SIX BDU-33		F-598 E-460	3.3	11.8	NA
SUU-21 PRACTICE BOMB DISPENSER WITH SIX MK-106		F-490 E-460	3.3	11.8	NA
SUU-23/GUN POD (50 ROUNDS AMMO/FULLY LOADED).		1080/1739	8.1	26.4	NA
GPU-5/A GUN POD (FULL) (EMPTY) (FIRED OUT)		1865/1273/1393	9.7	NA	NA

NA - NOT APPLICABLE
NE-NOT ESTABLISHED

F FULL
E-EMPTY

4G-1-(244-2 1)47

Figure A1-1 (Sheet 3 of 3)



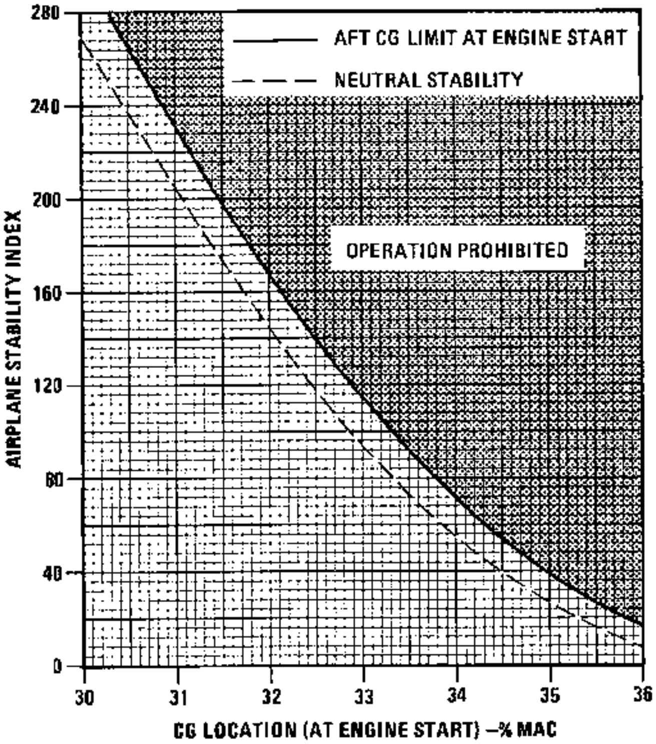
NOTE

TO DETERMINE THE ASYMMETRIC MOMENT, STORES MOMENTS SHOULD BE ADDED ALGEBRAICALLY WITH STATIONS 1 AND 2 HAVING (-) VALUES AND STATIONS 8 AND 9 HAVING (+) VALUES.

4G-1-(262)

Figure A1-1A

AFT CG LIMITS



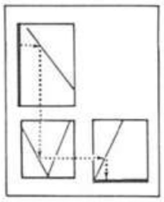
4G–1–(119)A

Figure A1–2

DRAG DUE TO ASYMMETRIC LOADING

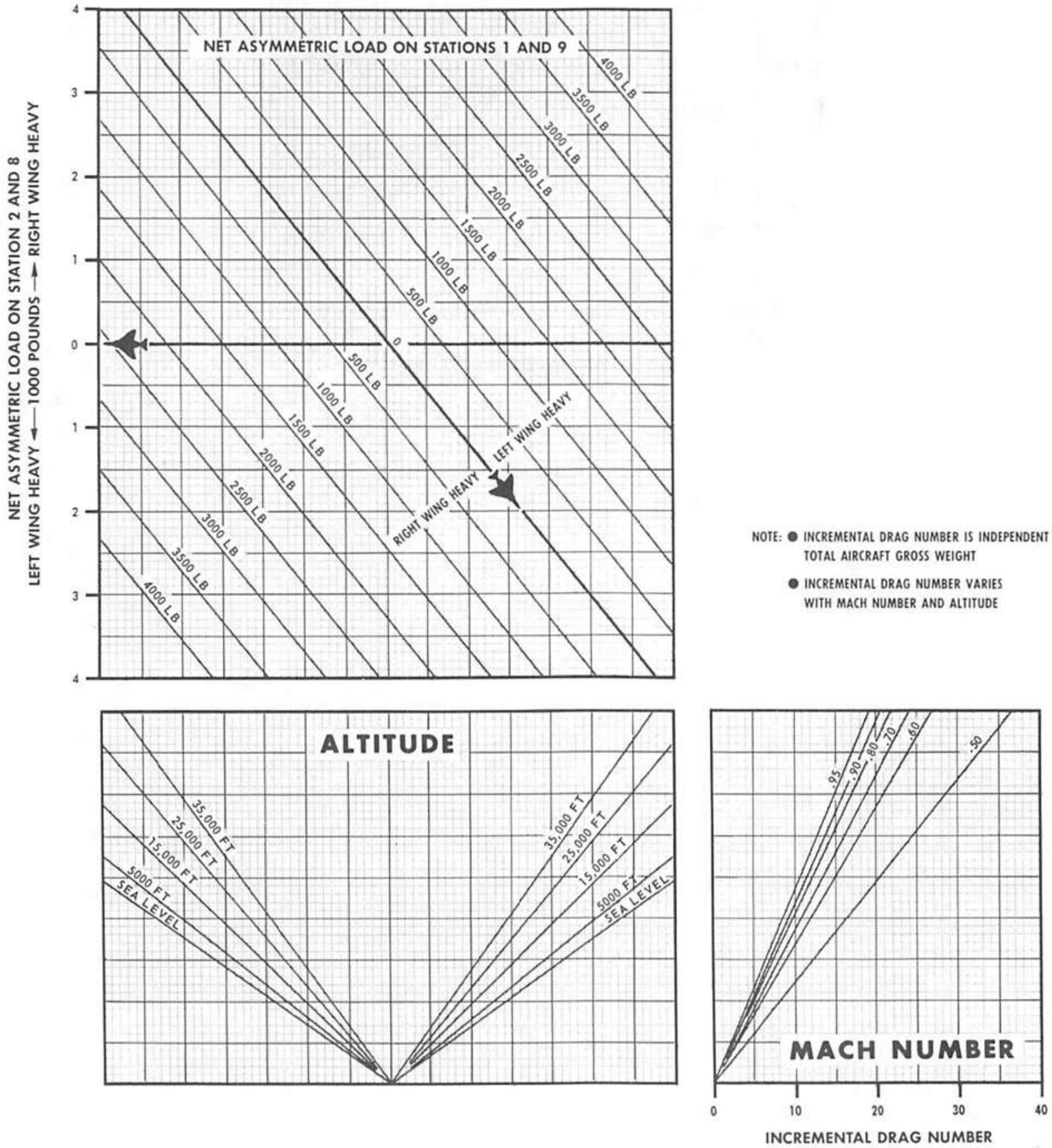
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

DATE: 15 JULY 1965
DATA BASIS: **FLIGHT TEST**



NOTE:
- INCREMENTAL DRAG NUMBER IS INDEPENDENT OF TOTAL AIRCRAFT GROSS WEIGHT
- INCREMENTAL DRAG NUMBER VARIES WITH MACH NUMBER AND ALTITUDE

4G-1-(118)

Figure A1-3

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:
T=15°C.
P=29.921 INCHES OF Hg.

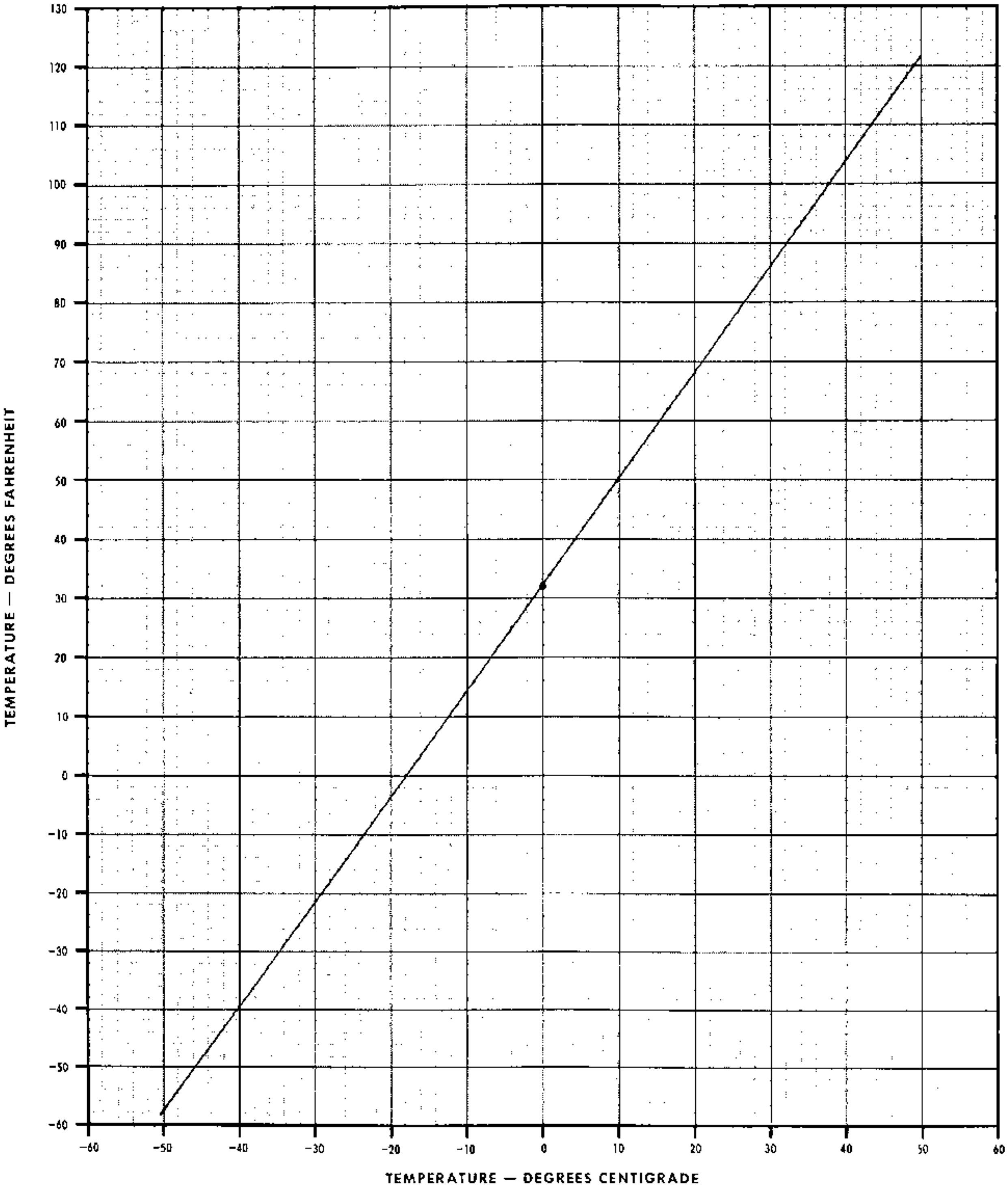
W=.07651 POUNDS/CUBIC FOOT ρ_o=.002378 SLUGS/CUBIC FOOT
1" OF Hg.=70.732 POUNDS/SQUARE FOOT=0.4912 POUND/SQUARE INCH
a_o=1116 FEET/SECOND

ALTITUDE FEET	DENSITY RATIO ρ/ρ_o	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND RATIO a/a_o	PRESSURE	
			DEG. C	DEG. F		IN. OF Hg	RATIO P/P_O
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	.2981	1.8315	56.323	−69.382	.868	6.712	.2243
36,089	.2971	1.8347	−56.500	−69.700	.867	6.683	.2234
37,000	.2843	1.8753	−56.500	−69.700	.867	6.397	.2138
38,000	.2710	1.9209	−56.500	−69.700	.867	6.097	.2038
39,000	.2583	1.9677	−56.500	−69.700	.867	5.811	.1942
40,000	.2462	2.0156	−56.500	69.700	.867	5.538	1851
41,000	.2346	2.0645	−56.500	69.700	.867	5.278	.1764
42,000	.2236	2.1148	−56.500	69.700	.867	5.030	.1681
43,000	.2131	2.1662	−56.500	69.700	.867	4.794	.1602
44,000	.2031	2.2169	−56.500	69.700	.867	4.569	.1527
45,000	.1936	2.2728	−56.500	69.700	.867	4.355	.1455
46,000	.1845	2.3281	56.500	69.700	.867	4.151	.1387
47,000	.1758	2.3846	56.500	−69.700	.867	3.956	.1322
48,000	.1676	2.4426	56.500	−69.700	.867	3.770	.1260
49,000	.1597	2.5027	−56.500	69.700	.867	3.593	.1201
50,000	.1522	2.5630	−56.500	69.700	.867	3.425	.1145

4G–1–(117)

Figure A1–4

TEMPERATURE CONVERSION

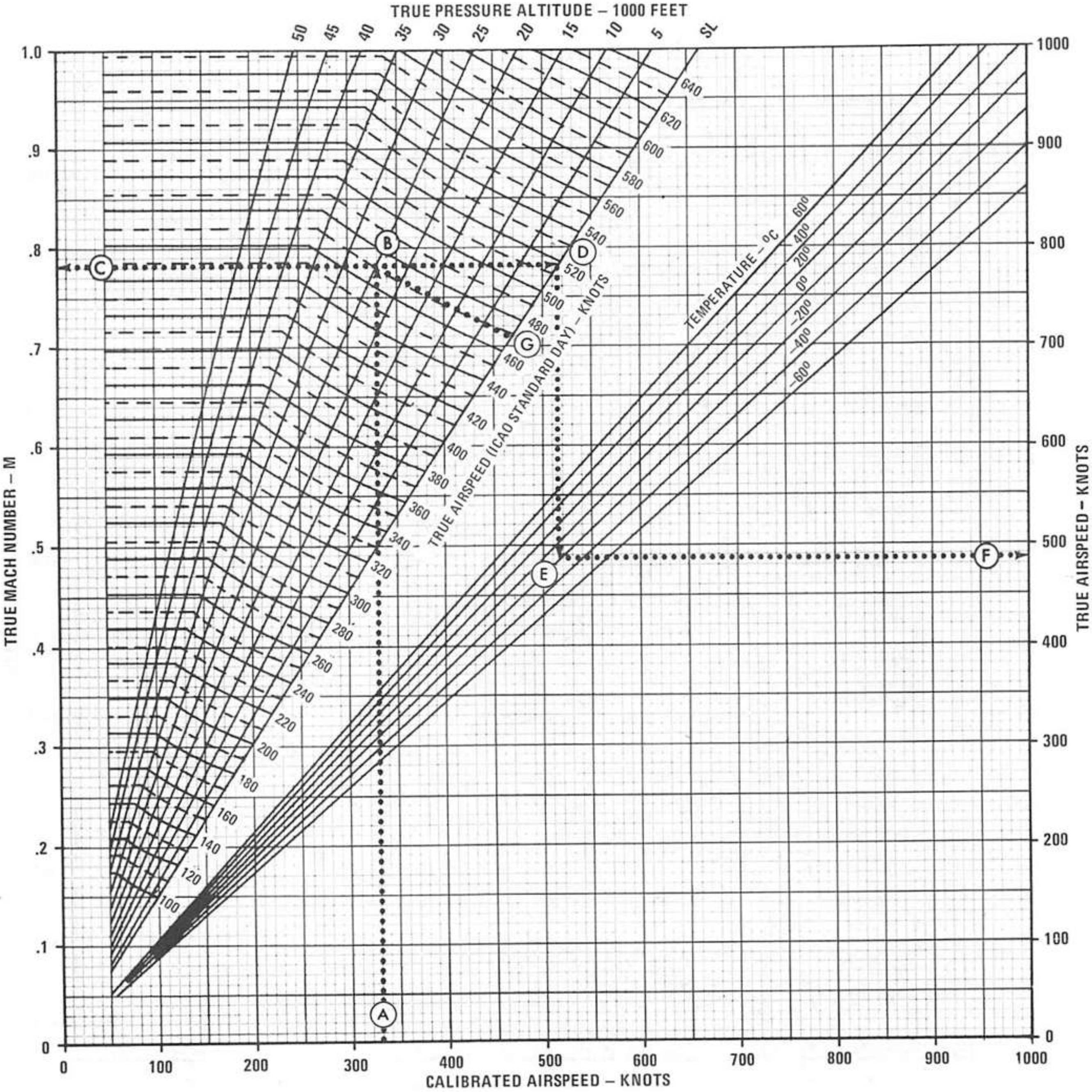


4G-1-(116)

Figure A1-5

AIRSPEED CONVERSION

LOW MACH



EXAMPLE

A = CAS = 330 KNOTS
B = ALTITUDE = 25,000 FEET
C = MACH = .782
D = SEA LEVEL LINE
E = TEMPERATURE = –20°C
F = TAS = 486 KNOTS
G = TAS (STANDARD DAY) = 472 KNOTS

4G–1–(115–1)

Figure A1–6 (Sheet 1 of 2)

AIRSPEED CONVERSION

HIGH MACH

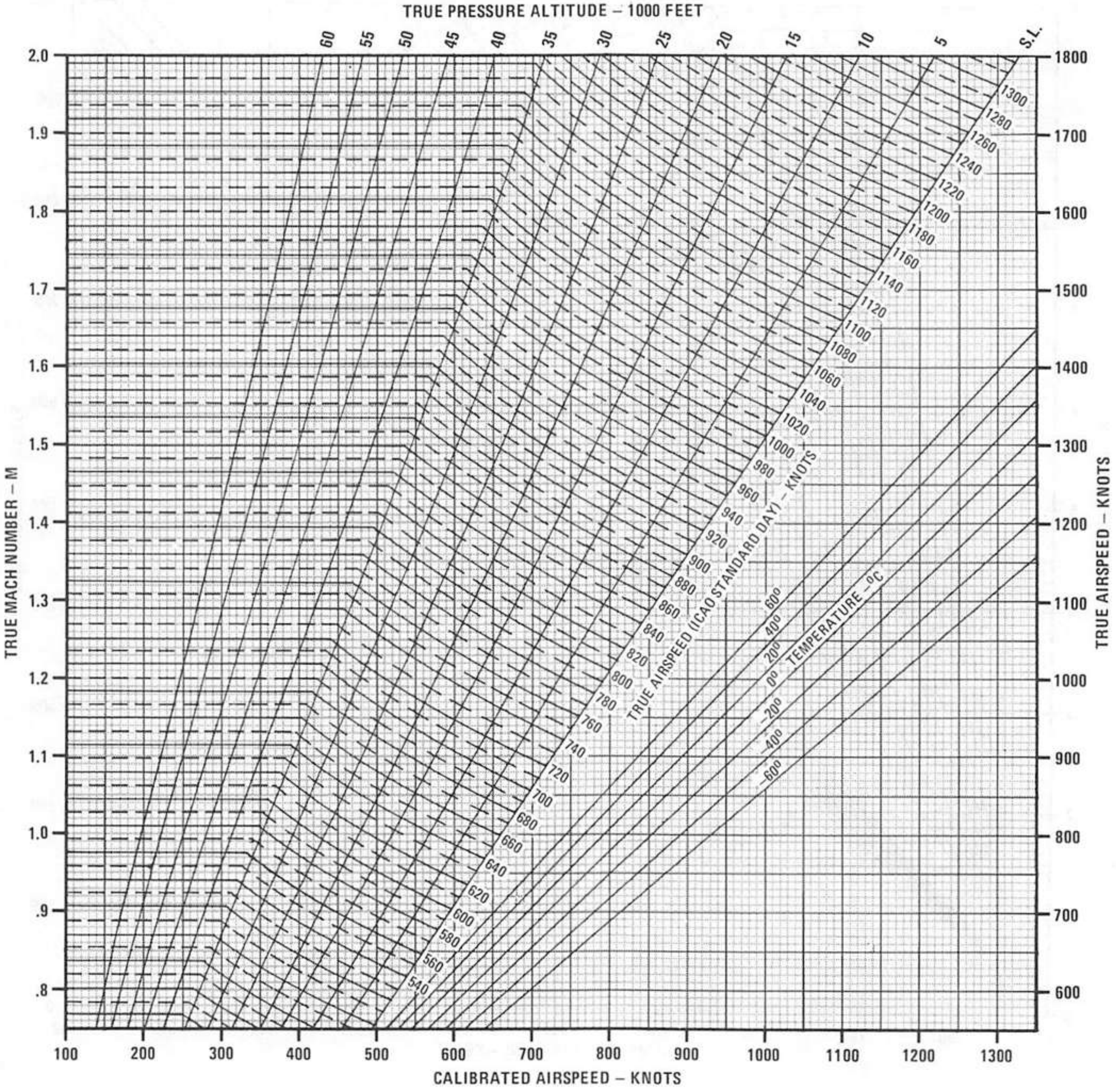


Figure A1-6 (Sheet 2 of 2)

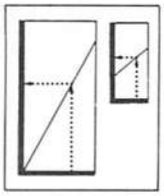
AIRSPEED POSITION ERROR CORRECTION

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS AND GEAR AS NOTED

REMARKS

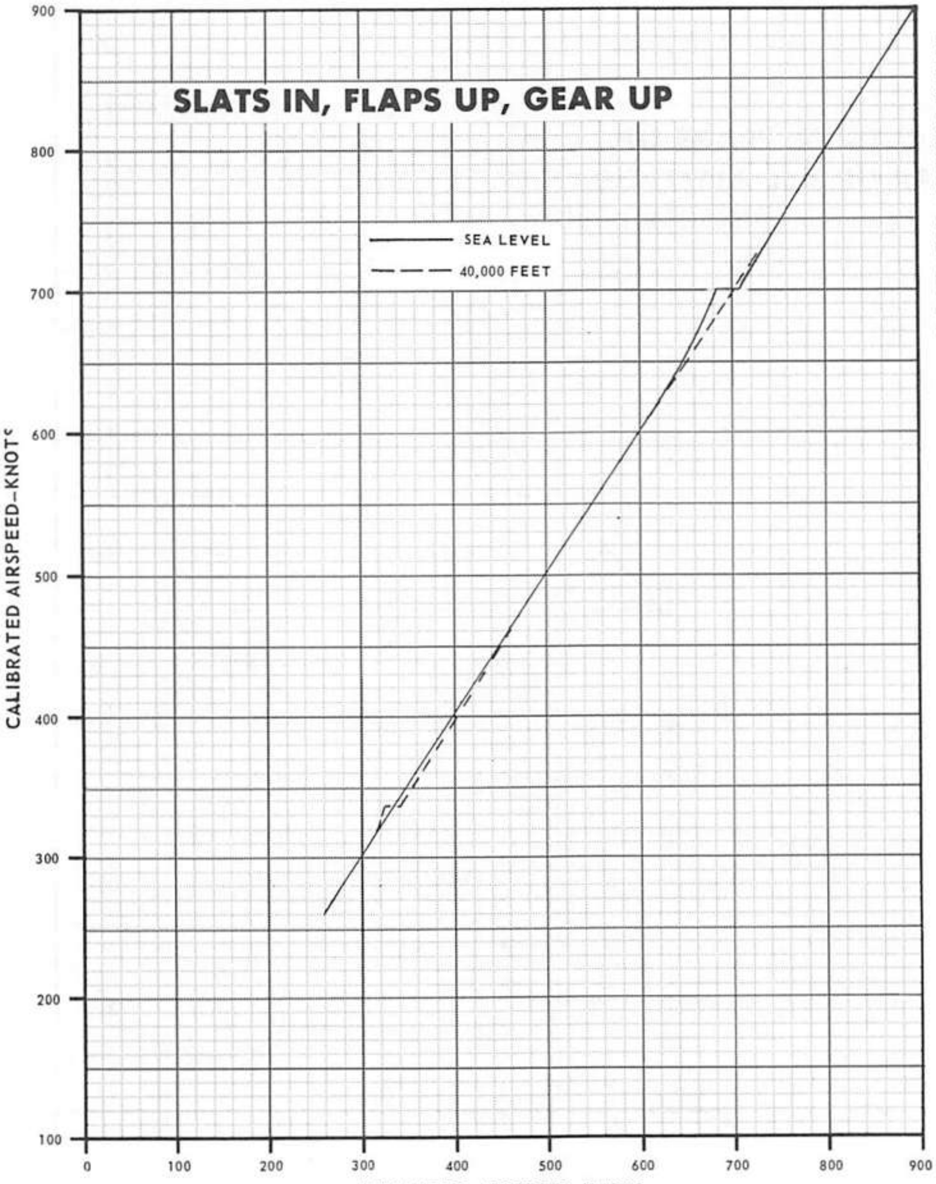
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

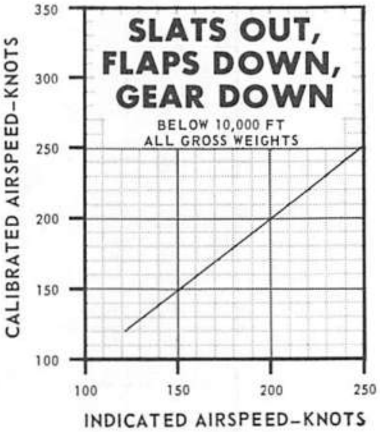
GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





4G-1-(114)

Figure A1-7

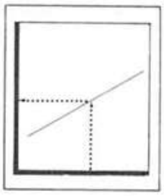
AIRSPEED POSITION ERROR CORRECTION

MACH NUMBER

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS IN, FLAPS UP
GEAR UP

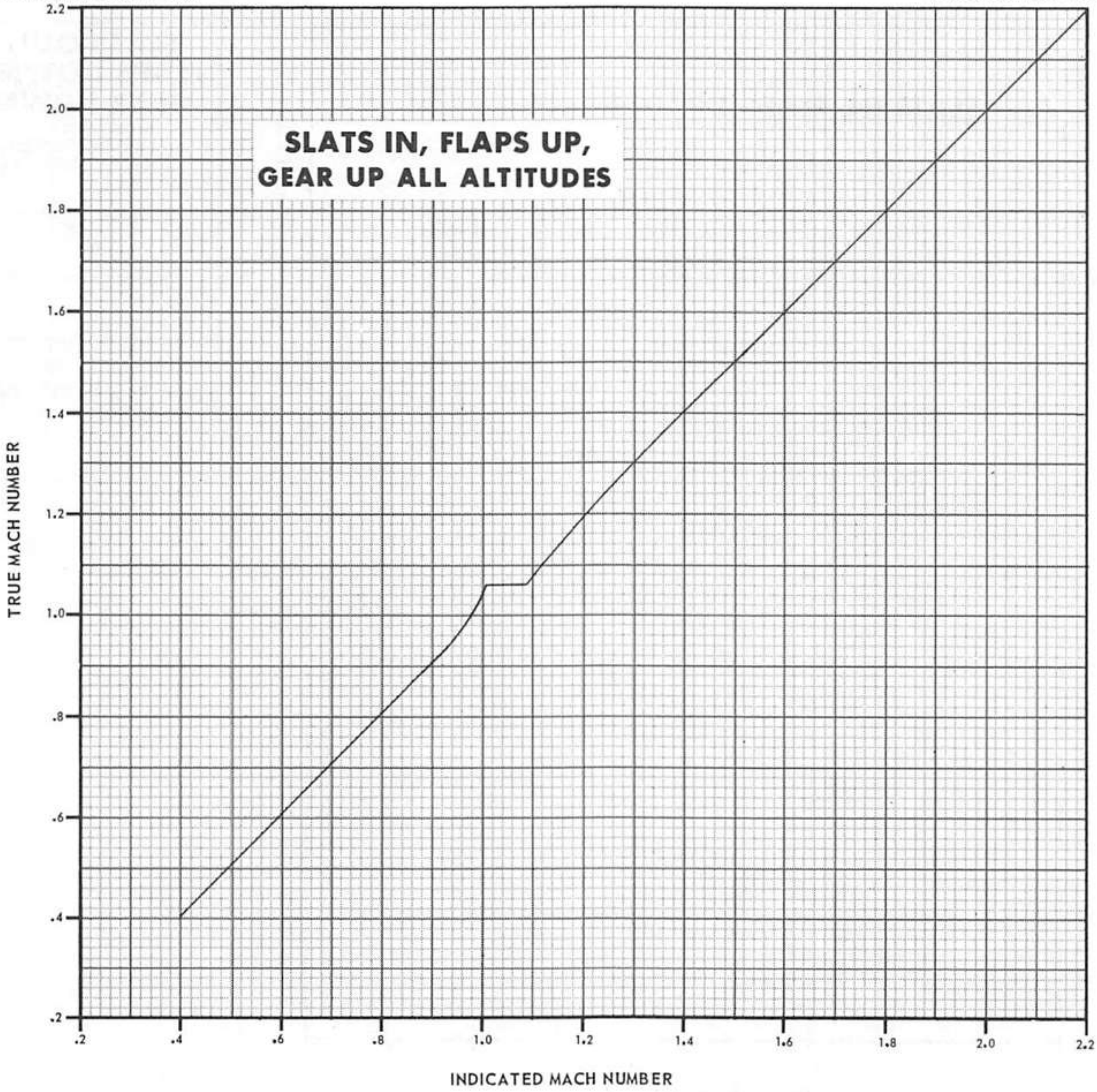
REMARKS
ENGINE(S): (2) J79-17
ICAO STANDARD DAY

GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(113)

Figure A1-8

ALTIMETER POSITION ERROR CORRECTION

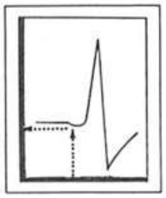
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS, FLAPS AND
GEAR AS NOTED

REMARKS

ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

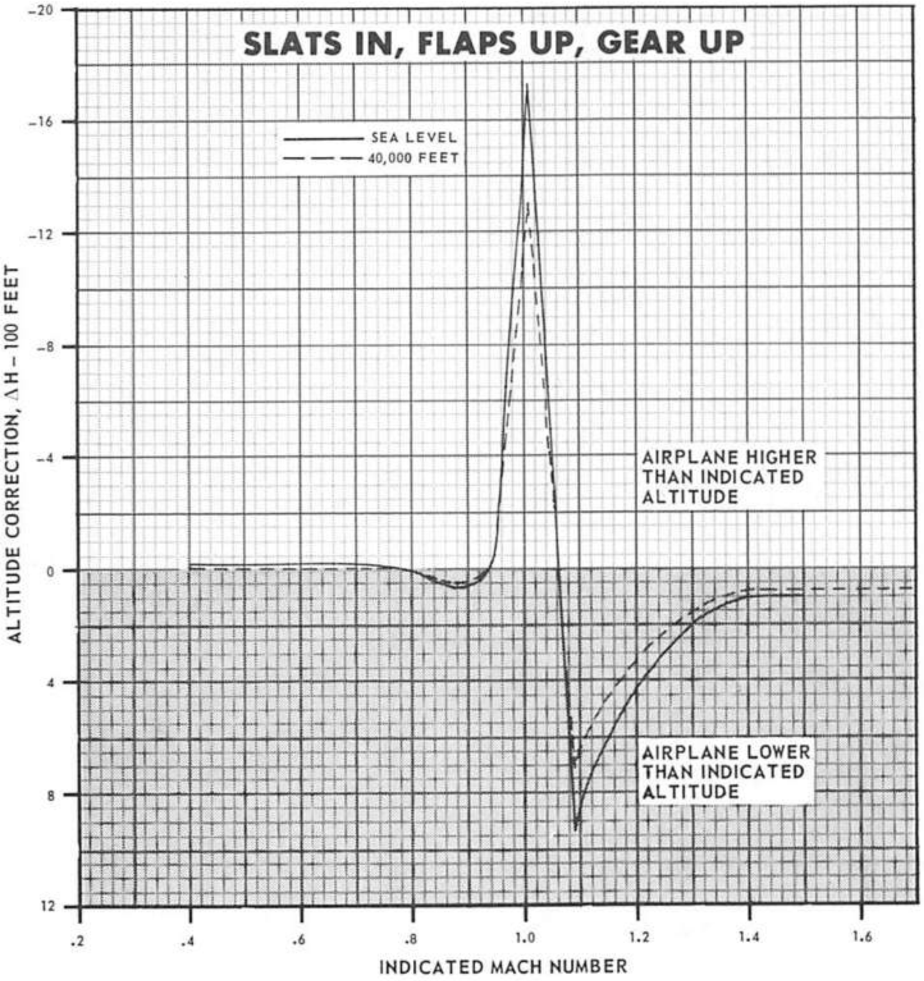
NOTE
FLY ASSIGNED ALTITUDE +ΔH

GUIDE



DATE: 1 AUGUST 1968
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



SLATS OUT, FLAPS DOWN, GEAR DOWN

BELOW 10,000 FEET
ALL GROSS WEIGHTS:

ADD 25 FEET TO ASSIGNED ALTITUDE TO OBTAIN INDICATED ALTITUDE.

4G-1-(112)A

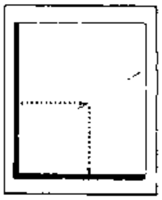
Figure A1-9

ALTIMETER LAG

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

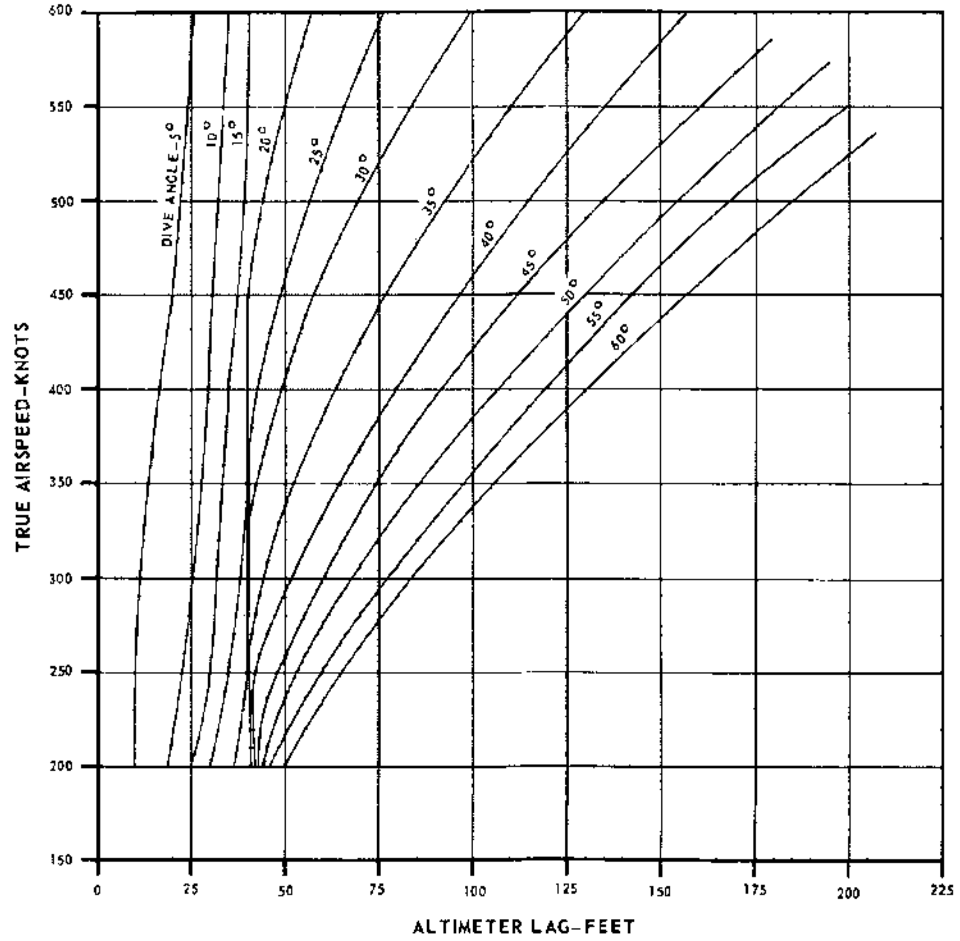
GUIDE



AIRCRAFT WITH SPC OPERATIVE

DATE: 15 DECEMBER 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB GAL



4G-1-(111)

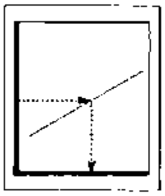
Figure A1-10

ALTIMETER LAG

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)J79-GE-17

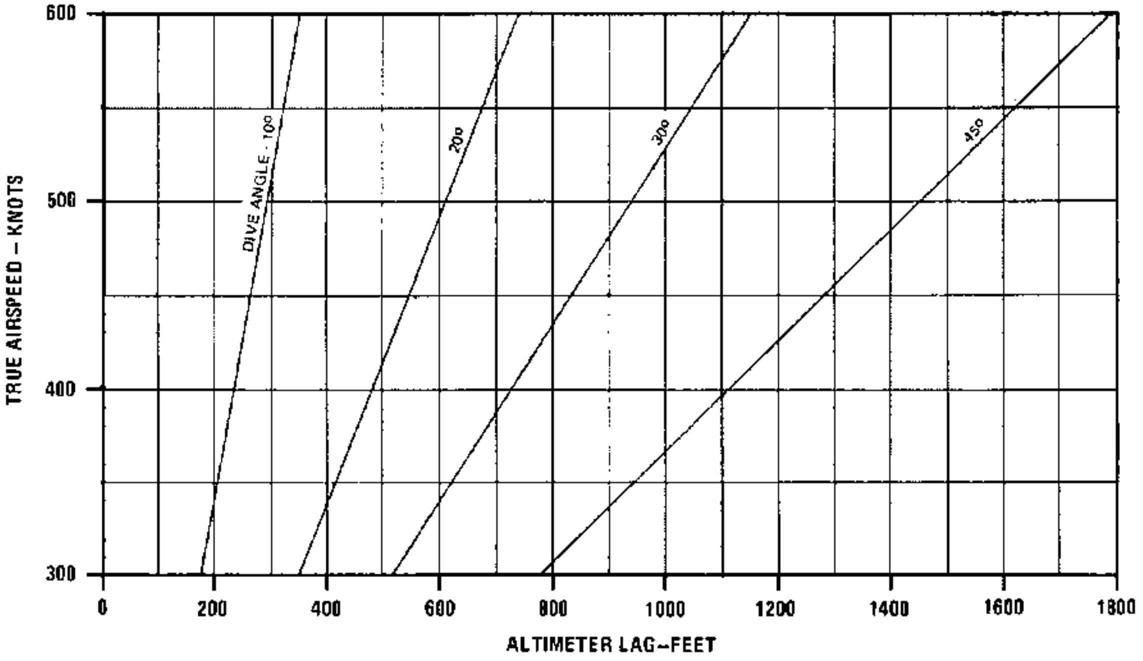
GUIDE



AIRCRAFT WITH SPC INOPERATIVE

DATE: 15 DECEMBER 1968
DATA BASIS: **USAF FLIGHT TEST**

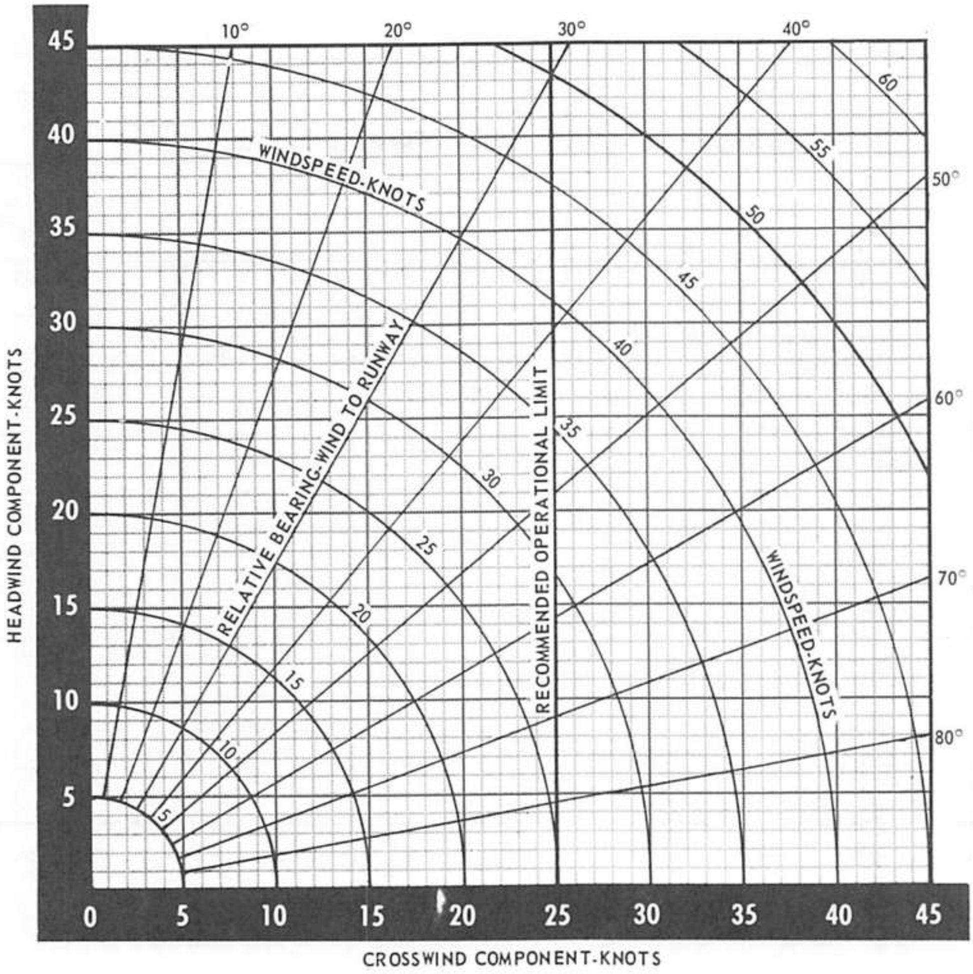
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(110)

Figure A1–11

WIND COMPONENTS



4G-1-(109)A

Figure A1-12

PART 2

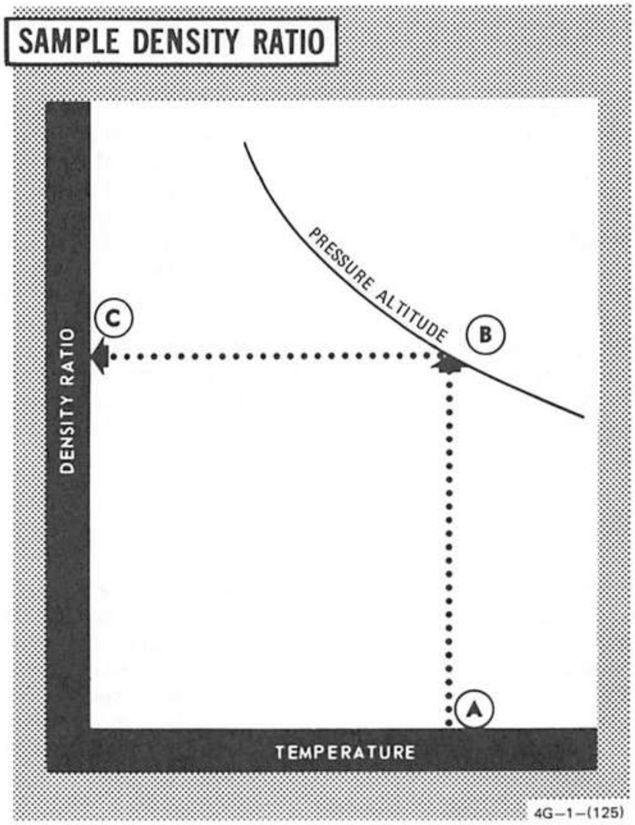
TAKEOFF

TABLE OF CONTENTS

Charts

DENSITY RATIO CHART

This chart (figure A2-1) 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.



USE

Enter the chart with existing temperature, and project vertically to intersect the applicable pressure altitude curve. From this point, project horizontally to the left scale to read density ratio.

Sample Problem

A. Temperature	60°F
B. Pressure Altitude	2000 Ft
C. Density ratio	0.93

MINIMUM GO SPEED CHART

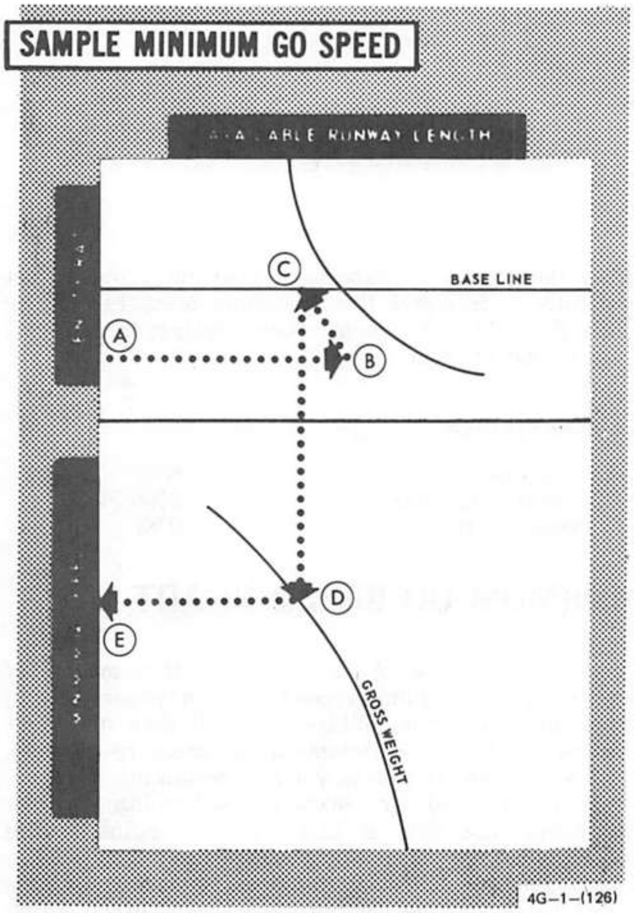
This chart (figure A2-2) provides the means of determining the minimum speed at which the aircraft can experience an engine failure and still take off under existing conditions of temperature, pressure altitude, gross weight, and the runway length remaining. Separate plots are provided for maximum and 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. Refer to Engine Failure During Takeoff, section III.

USE

Enter the applicable plot with the prevailing density ratio, and project horizontally to the available runway length grid line. Parallel the nearest guide line up or down to intersect the base line. 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.

Sample Problem

Military Thrust Takeoff

A. Density ratio	0.95
B. Available runway length	6800 Ft
C. Parallel guide line to base line	
D. Takeoff gross weight	52,000 Lb
E. Minimum go speed	128 KIAS

NOTE

This problem assumes maximum thrust on operating engine within 6 seconds after engine failure.

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 (figures A2–3 and A2–4) 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 a 3–second decision period (with both engines operating at the initial thrust setting) and a 5–second period to accomplish abort procedures.

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 runway condition guidelines, and parallel nearest guideline down to the appropriate runway condition. From this point, descend further to intersect the computed takeoff gross weight, then horizontally to read the corresponding maximum abort speed.

Sample Problem

Maximum Thrust Takeoff, Without Drag Chute

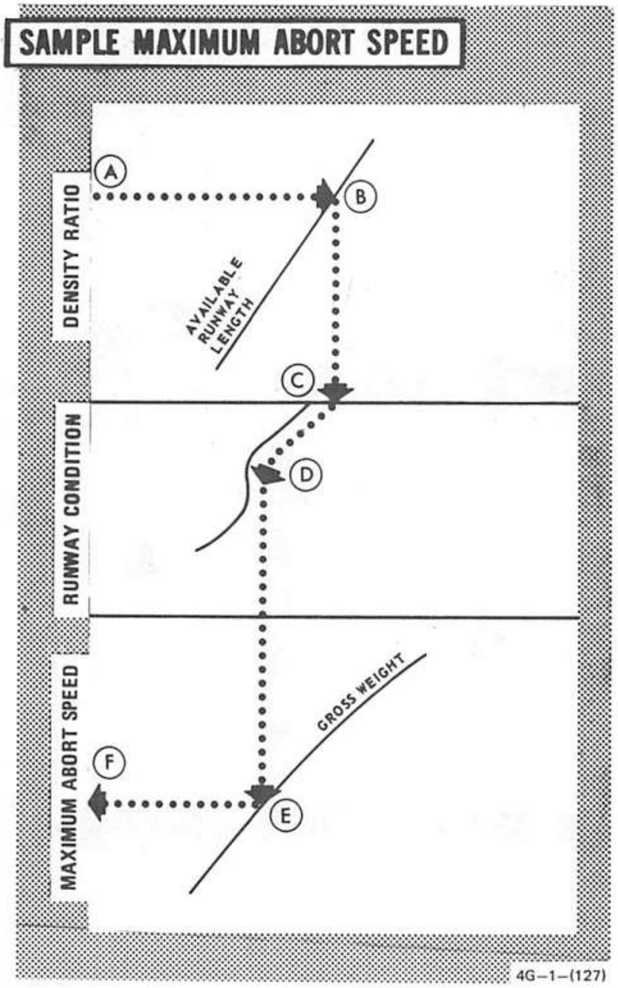
A. Density ratio	1.0
B. Available runway length	10,000 Ft
C. Runway condition guidelines	
D. Wet runway	
E. Gross weight	50,000 Lb
F. Maximum abort speed	65 Kt

TAKEOFF DISTANCE CHARTS

These charts (figures A2–5 and A2–6) are used to determine the no wind ground run distance, wind adjusted ground run and the total distance to a height of 50 feet. Separate charts are provided for maximum and military thrust. A table has been provided to show nosewheel ~~lift–off~~ speed with the corresponding aircraft takeoff speed for various gross weight and CG combinations. If these speeds fall in the shaded area of the table provided, it is necessary to correct the distances obtained from the Takeoff Distance charts by using the Velocity During Takeoff Ground Run and CG Correction charts. Wind and CG corrections (in that order) should be made to the ground run distance before determining the total distance to a height of 50 feet.

USE

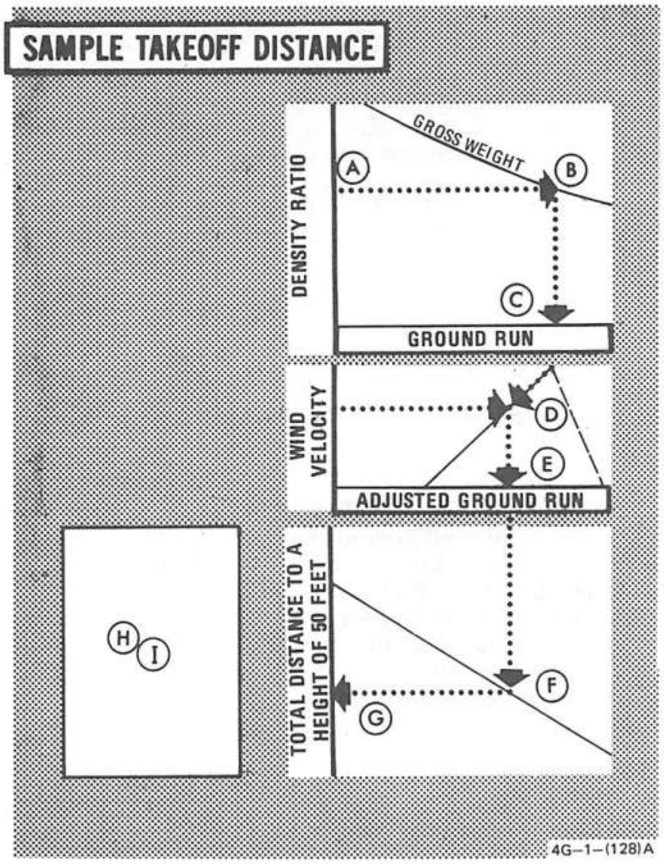
Enter the chart with the applicable density ratio, and proceed horizontally to the right and intersect the takeoff weight line. Then descend vertically to read no wind ground run distance. Parallel the appropriate wind guide line (headwind or tailwind) to intersect the takeoff wind velocity. From this point project vertically down to read the ground run adjusted for wind effects. If required, make CG corrections to this ground run distance (See descriptive paragraph above). To find the total distance to a height of 50 feet, continue downward to the reflector line and project horizontally to the left scale.



Sample Problem

Maximum Thrust, Takeoff CG 27% MAC

A. Density ratio	0.98
B. Gross weight	42,000 Lb
C. No wind Ground run distance	1750 Ft
D. Effective headwind	10 Kt
E. Ground run (wind corrected)	1500 Ft
F. Intersect relfector line	
G. Total distance to a height of 50 feet	2650 Ft
H. Nosewheel lift-off speed for CG of 27 MAC (from table)	131 Kt
I. Takeoff speed for a CG of 27% MAC	162 Kt
J. No wind ground run for a CG of 27% MAC	2200 Ft
K. Ground run corrected for wind and a CG of 27% MAC	2000 Ft
L. Total distance to a height of 50 feet for a CG of 27% MAC	3250 Ft

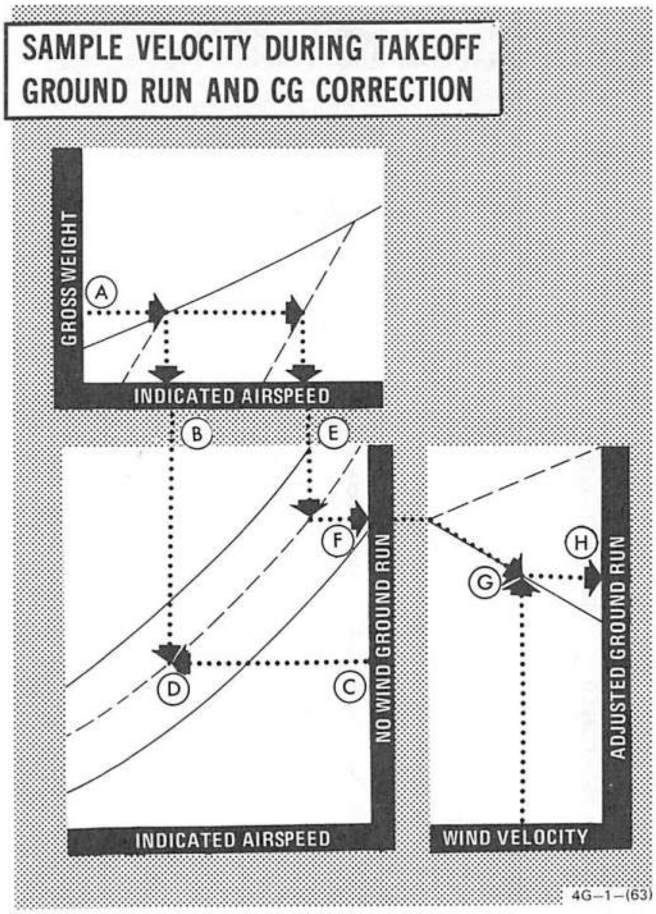


VELOCITY DURING TAKEOFF GROUND RUN AND CG CORRECTION CHARTS

These charts (figures A2-7 and A2-8) provide takeoff speeds for various gross weights and CG locations, and are used primarily to adjust takeoff distances resulting from adverse conditions of high gross weight and forward CG. The charts can also be used to obtain any line distance and speed relationship during takeoff ground run and to adjust the computed ground run distance for wind effects.

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 applicable 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 normal aircraft takeoff speed 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 guide line. Reenter with the tabulated takeoff speed, and descend vertically to intersect newly plotted acceleration guide line. From this intersection, project horizontally to the right and read CG adjusted no wind ground run. Continue to the right and parallel the appropriate wind guide line to the takeoff wind velocity. From this point project horizontally to the right to read the adjusted ground run with wind effect.


SAMPLE VELOCITY DURING TAKEOFF GROUND RUN AND CG CORRECTION

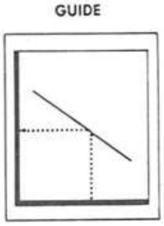
Sample Problem

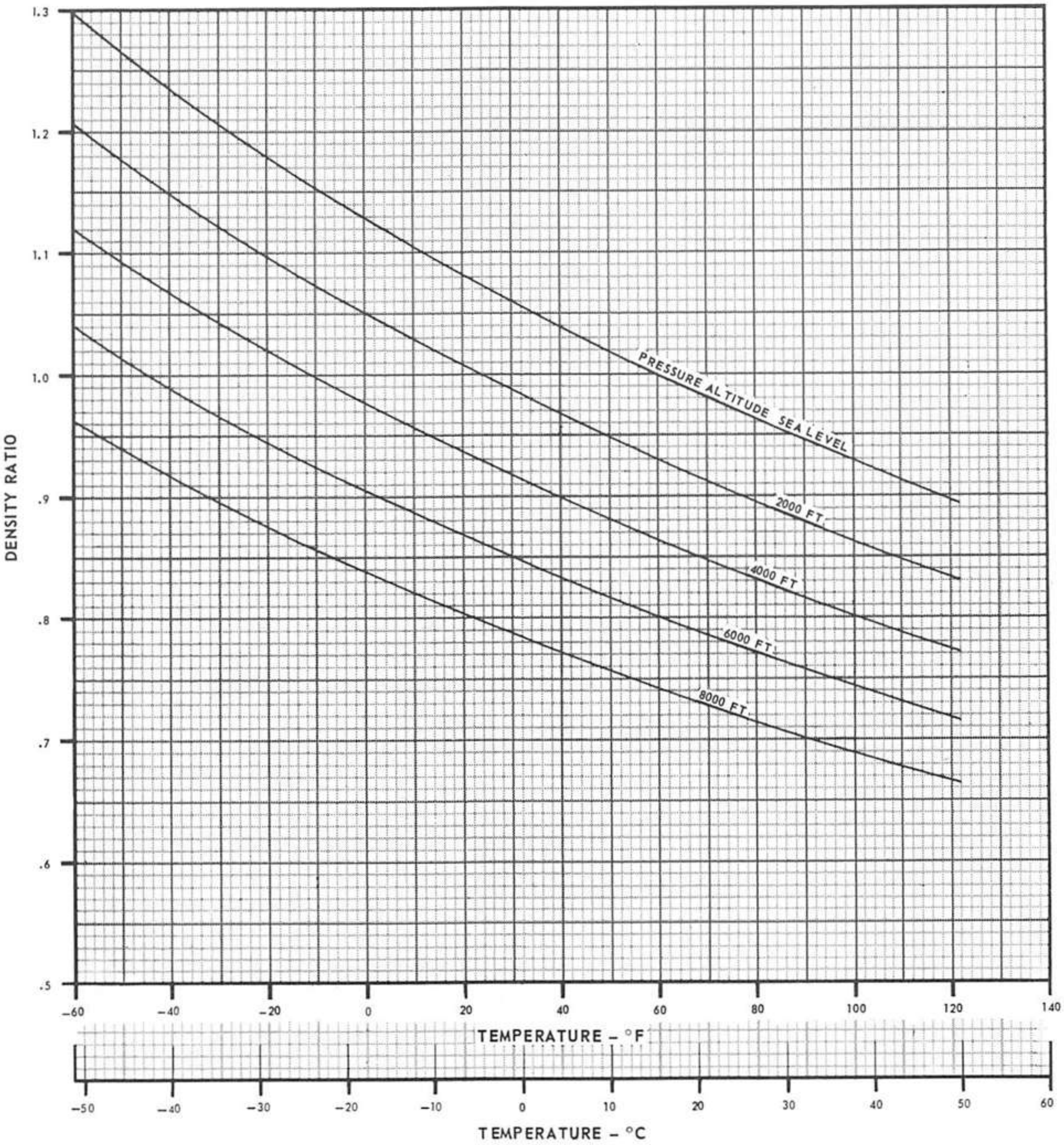
Maximum Thrust

A. Gross weight	42,000 Lb
B. Normal aircraft takeoff speed	148 Kt
C. Normal no wind ground run (from Takeoff Distance chart)	1750 Ft
D. Parallel acceleration guide line	
E. Tabulated takeoff speed	162 Kt
F. Adjusted no wind ground run	2100 Ft
G. Effective headwind	10 Kt
H. Adjusted ground run (wind corrected)	1850 Ft

DENSITY RATIO

AIRPLANE CONFIGURATION
ALL DRAG INDEXES





4G-1-(108)

Figure A2-1

MINIMUM GO SPEED
(WITH SINGLE-ENGINE FAILURE)

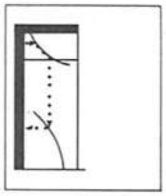
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN

REMARKS
ENGINE(S): (2) J79-GE-17

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.

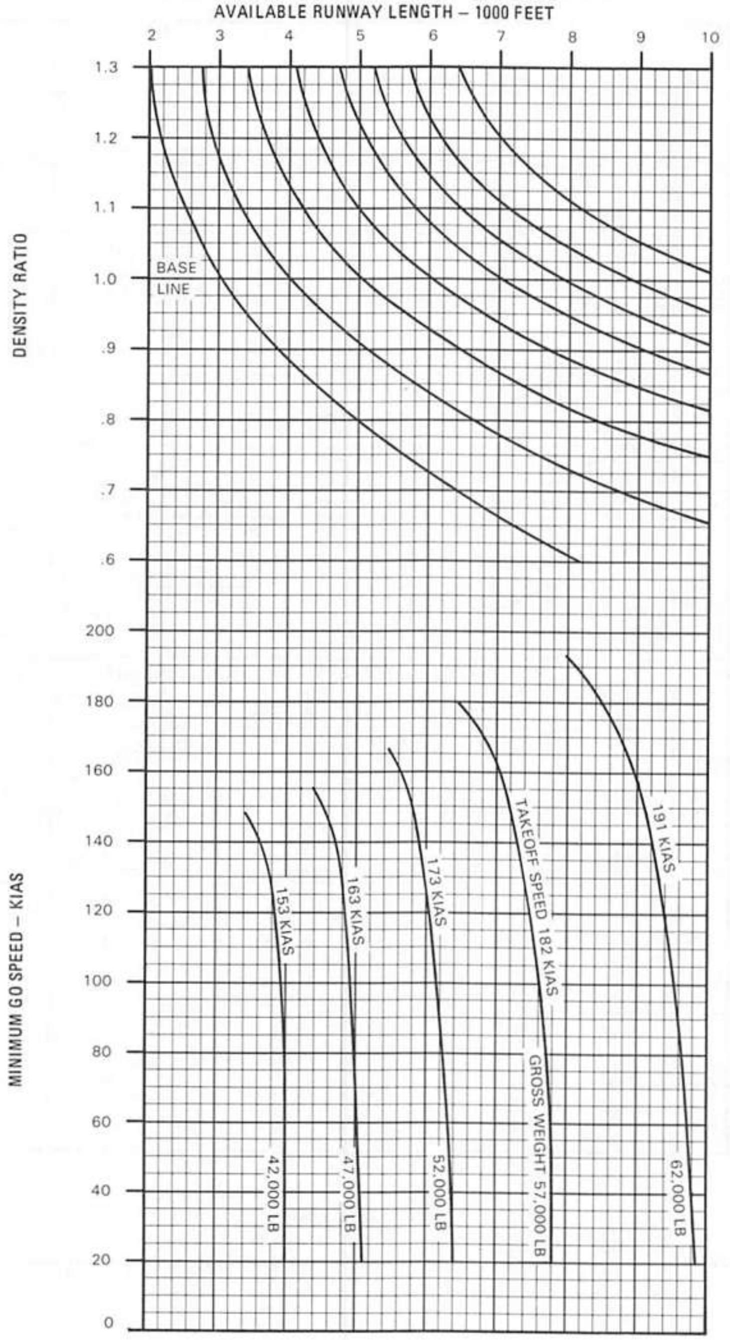
GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

DATE: 15 APRIL 1972
DATA BASIS: FLIGHT TEST

MILITARY THRUST TAKEOFF



4G-1-(107-1)A

Figure A2-2 (Sheet 1 of 2)

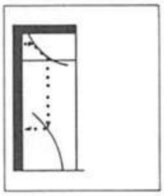
MINIMUM GO SPEED
(WITH SINGLE-ENGINE FAILURE)

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN

REMARKS
ENGINE(S): (2) J79–GE–17

NOTE
SINGLE–ENGINE TAKEOFF/CLIMB–OUT CAPABILITY IS CRITICAL WITH HIGH GROSS WEIGHT AT LOW DENSITY RATIOS.

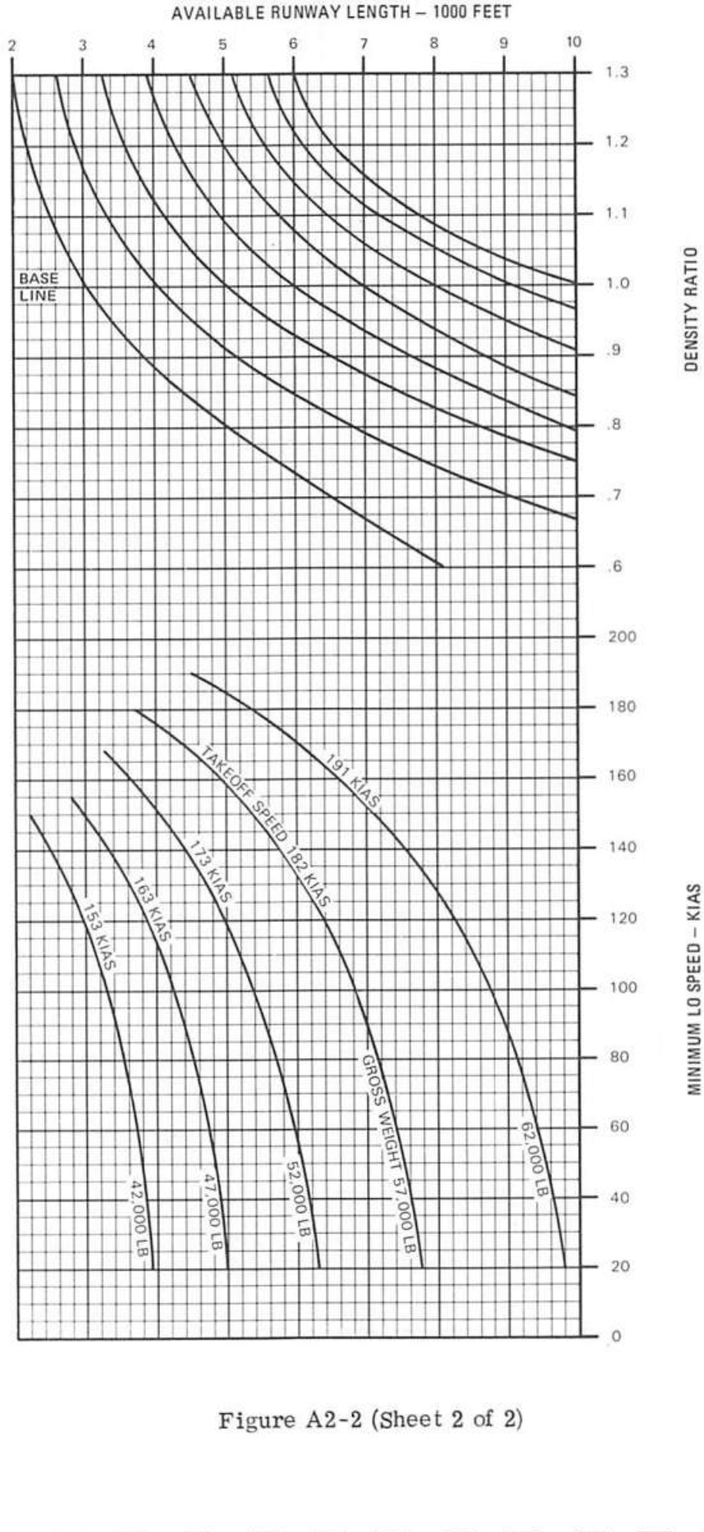
GUIDE



DATE: 15 APRIL 1972
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

MAXIMUM THRUST TAKEOFF



4G-1-(107-2)B

Figure A2-2 (Sheet 2 of 2)

MAXIMUM ABORT SPEED

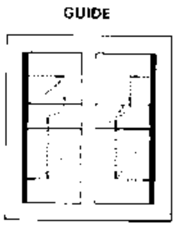
MAXIMUM THRUST

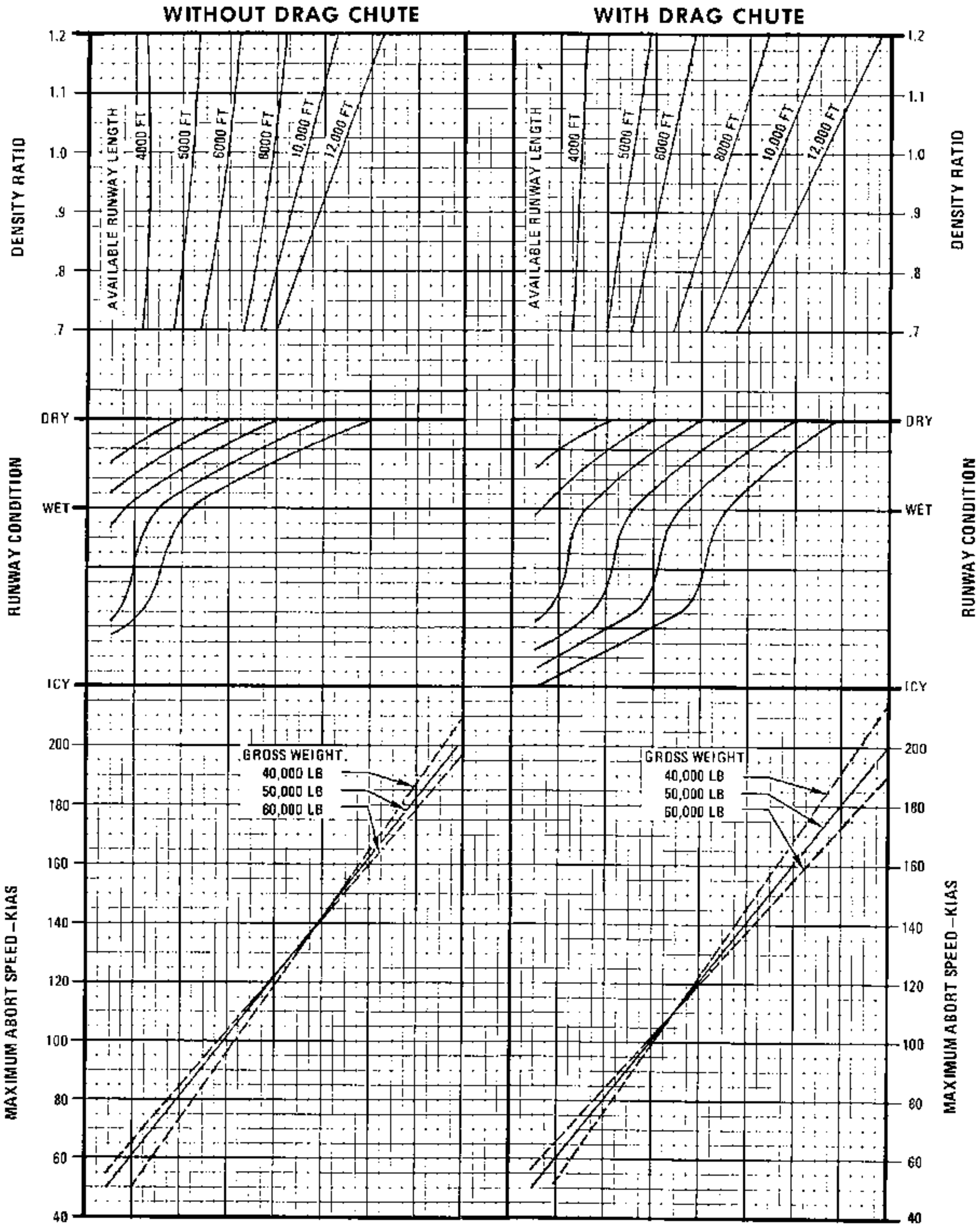
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN

DATE: 1 JUNE 1977
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79-GE-17

NOTE
SUBTRACT TAILWIND TO DETERMINE ADJUSTED ABORT SPEED.





4G-1-(105)B

Figure A2-3

MAXIMUM ABORT SPEED

MILITARY THRUST

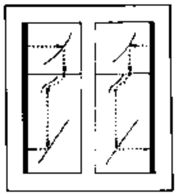
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN

DATE: 1 JUNE 1977
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79-GE-17

NOTE
SUBTRACT TAILWIND TO DETERMINE
ADJUSTED ABORT SPEED.

GUIDE



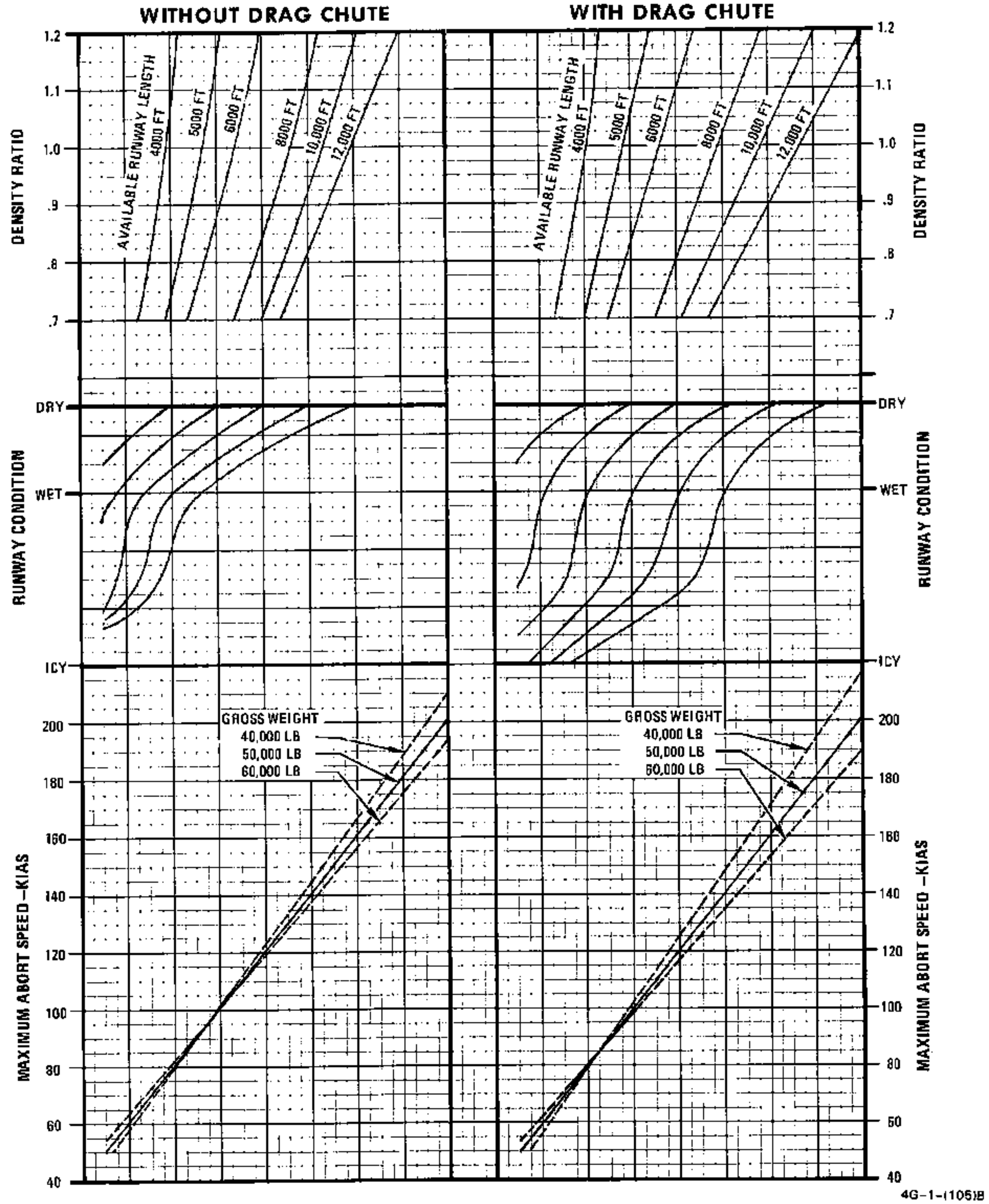


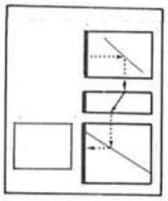
Figure A2–4

TAKEOFF DISTANCE
MAXIMUM THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN
GEAR DOWN

REMARKS
ENGINE(S): (2)J79-GE-17

GUIDE



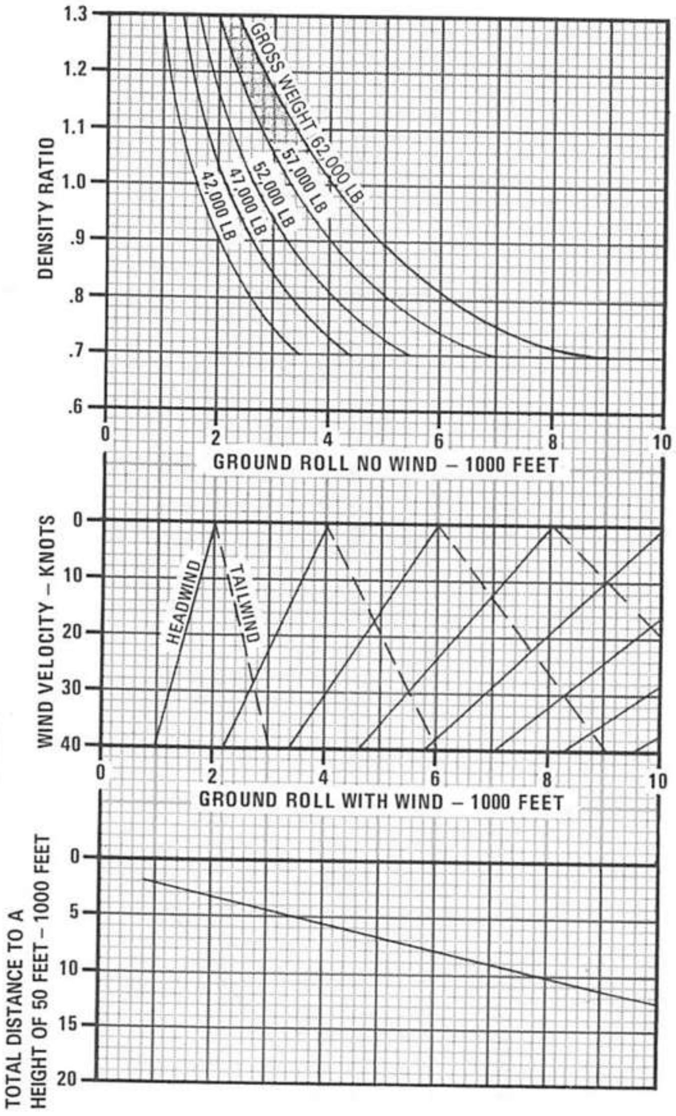
DATE: 1 AUGUST 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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, T O 1-1B-40.
- IF THE GROSS WEIGHT/CG COMBINATION YIELDS A NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED THAT FALLS IN THE SHADED AREA, USE THE APPROPRIATE VELOCITY DURING TAKEOFF GROUND RUN AND CG CORRECTION CHART TO OBTAIN THE CORRECTED GROUND RUN DISTANCE FOR CG LOCATION.

CG % MAC	GROSS WEIGHT – 1000 POUNDS									
	42		47		52		57		62	
	NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED									
27	131	162	139	168	146	170	154	179	159	187
29	125	157	133	161	140	170	147	179	152	187
31	119	150	126	159	133	170	140	179	144	187
33	112	148	120	159	126	170	133	179	136	187
35	105	148	112	159	119	170	125	179	128	187



4G-1-(62)C

Figure A2-5

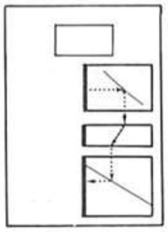
TAKEOFF DISTANCE

MILITARY THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN
GEAR DOWN

REMARKS:
ENGINE(S): (2) J79-GE-17

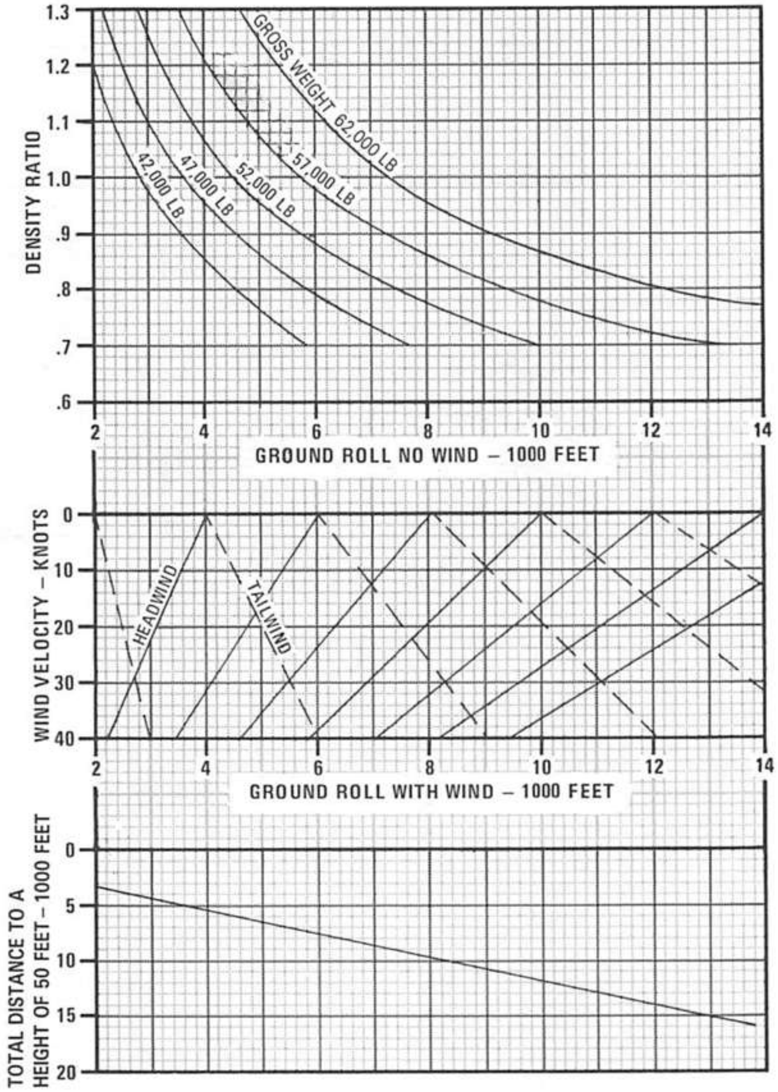
GUIDE



DATE: 1 AUGUST 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

CG %MAC	GROSS WEIGHT – 1000 POUNDS				
	42	47	52	57	62
	NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED				
27	132/156	140/166	147/176	155/186	160/194
29	126/156	134/166	141/176	147/186	153/194
31	120/156	127/166	134/176	141/186	145/194
33	113/156	121/166	127/176	134/186	137/194
35	106/156	113/166	120/176	126/186	129/194



4G-1-(61)C

NOTES

- DATA ARE FOR ALL CG LOCATIONS.
- 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, T O 1-1B-40.

Figure A2-6

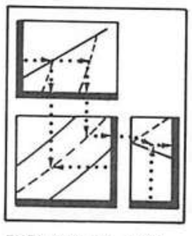
VELOCITY DURING TAKEOFF GROUND RUN AND CG CORRECTION

MAXIMUM THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN
GEAR DOWN

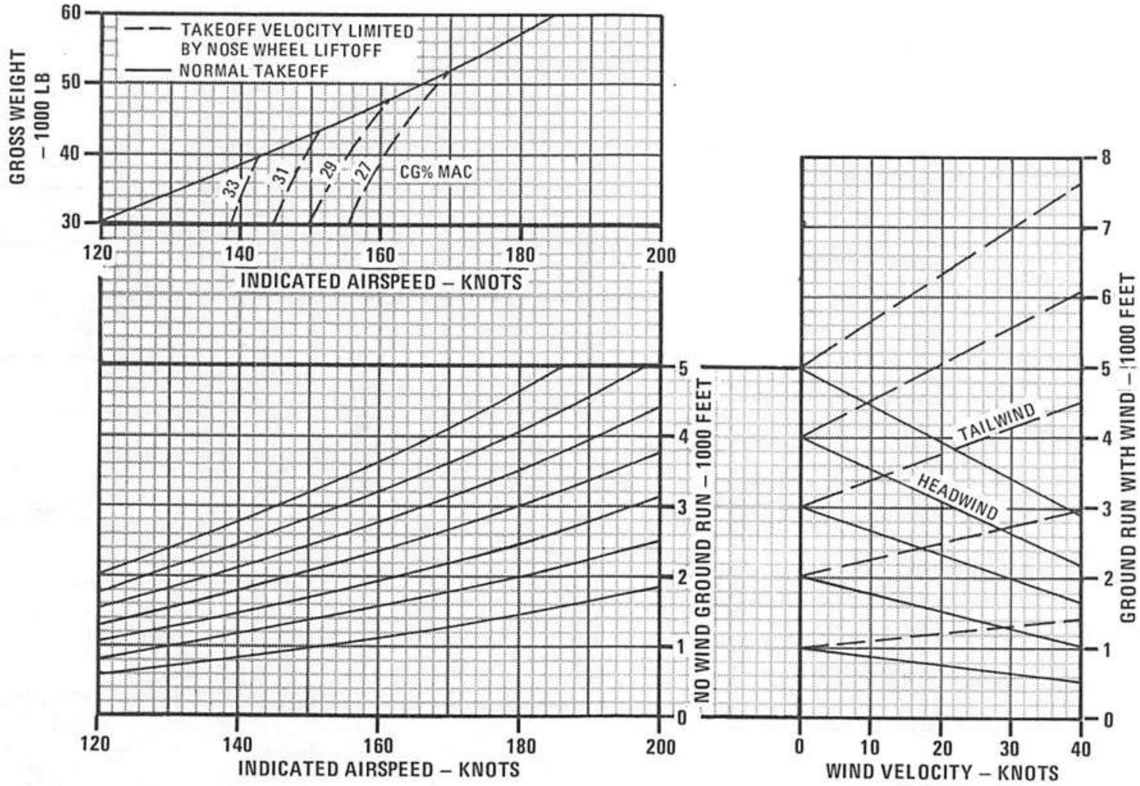
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 AUGUST 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(60)B

Figure A2-7

VELOCITY DURING TAKEOFF GROUND RUN AND CG CORRECTION

MILITARY THRUST

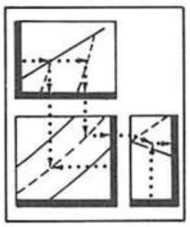
AIRPLANE CONFIGURATION

ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN
GEAR DOWN

REMARKS

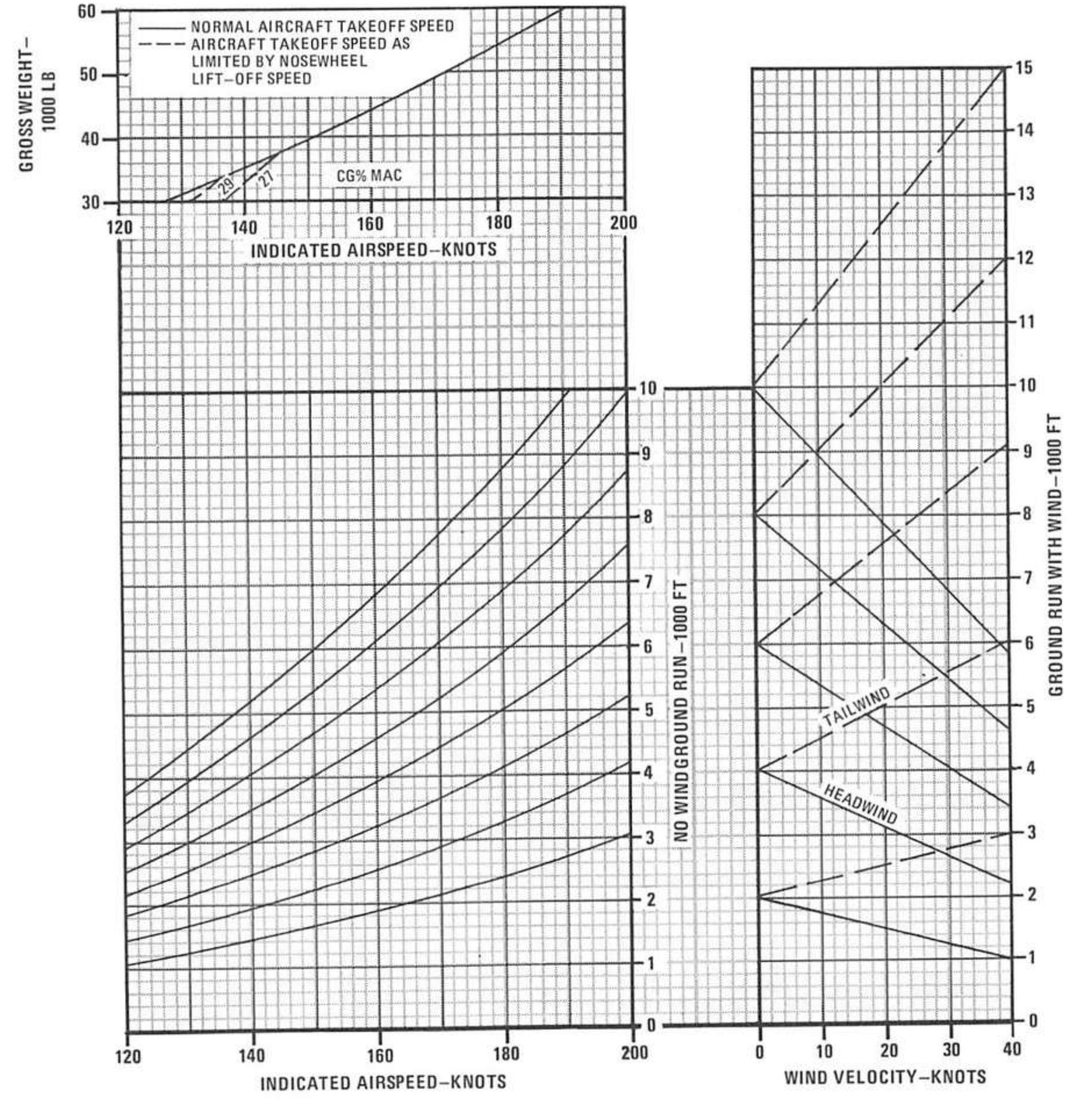
ENGINE(S): 2 J79-GE-17
ICOA STANDARD DAY

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

DATE: 1 AUGUST 1973
DATA BASIS: **FLIGHT TEST**



4G-1-(59)B

Figure A2-8

PART 3
CLIMB

TABLE OF CONTENTS

Charts

CLIMB CHARTS

Two series of charts are presented, one for military and one for maximum thrust climb schedules (figures A3–1 and A3–2). Each series includes charts for determining time, distance covered and fuel used while in the climb, and tables for determining climb calibrated airspeed and Mach number. Pre–climb 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 A3–3. This data is based on climbing at 350 knots until interception of optimum cruse Mach/TAS, then maintaining cruise Mach to cruise altitude.

USE

Tables

Enter the Climb Speed Schedule tables corresponding to the climb thrust and the computed drag index. Read the column of airpseeds and the Mach numbers to be used during climb. Determine the preclimb fuel, distance, and time to climb schedule which corresponds to the applicable takeoff and acceleration options.

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 deviation base line (corresponds to ICAO Standard day (°C)). Parallel the applicable guide line (hotter or colder) to intersect a vertical grid line 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.

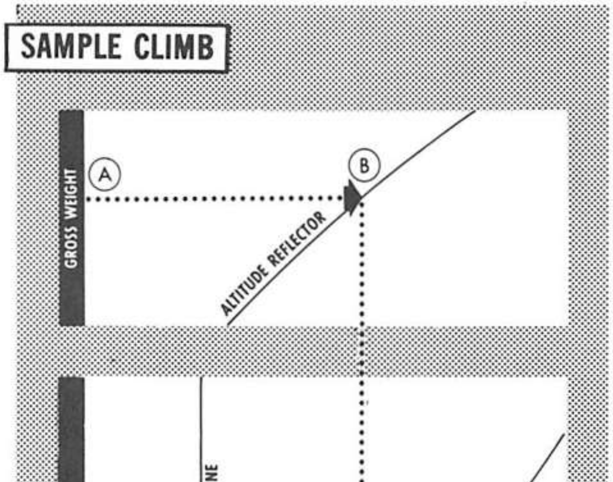
Sample Problem

Fuel Required – Military Thrust

A. Gross weight	50,000 Lb
B. Cruise altitude	30,000 Ft
C. Drag Index	60.0
D. Temperature base line	
E. Temperature deviation	+5°C
F. Fuel required	1980 Lb
G. Time to Climb	8.3 Min
H. Distance nautical miles	62

COMBAT CEILING CHARTS

These charts (figures A3–4 and A3–5) present the military and maximum thrust combat ceiling for normal two engine and emergency single engine operation. The variables of gross weight, pressure altitude and drag index are taken into consideration.



4G–1–(129)

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 base line (corresponds to ICAO Standard day (°C)). From this point, parallel the applicable guide line (hotter or colder) to intersect a vertical grid line corresponding to the degree of deviation between the altitude at the end of climb and standard day temperature. From this point continue horizontally to the left to read combat ceiling.

Sample Problem

Maximum Thrust – (2) Engines

A. Gross weight at end of climb	45,000 Lb
B. Drag index	40.0
C. Temperature base line	
D. Temperature deviation	+8°C
E. Combat ceiling	48,300 Ft

CLIMB SPEED SCHEDULE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

MAXIMUM THRUST

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	DRAG INDEX													
	0		10		20		30		40		50		60	
ALTITUDE	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH
S.L.	596	.90	589	.89	589	.89	582	.88	569	.86	563	.85	556	.84
5,000	551	.90	551	.90	545	.89	538	.88	533	.87	526	.86	519	.85
10,000	508	.90	508	.90	502	.89	495	.88	489	.87	484	.86	478	.85
15,000	464	.90	464	.90	464	.90	459	.89	454	.88	448	.87	442	.86
20,000	429	.91	429	.91	429	.91	418	.89	413	.88	408	.87	403	.86
25,000	394	.92	389	.91	389	.91	384	.90	379	.89	375	.88	370	.87
30,000	355	.92	355	.92	351	.91	347	.90	342	.89	342	.89	338	.88
35,000	322	.93	318	.92	314	.91	314	.91	310	.90	307	.89	307	.89
40,000	288	.93	284	.92	280	.91	280	.91	277	.90	277	.90	273	.89
45,000	256	.93	253	.92	250	.91	250	.91	247	.90	247	.90	244	.89

	DRAG INDEX															
	70		80		90		100		110		120		130		140	
ALTITUDE	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH
S.L.	543	.82	529	.80	516	.78	496	.75	477	.72	457	.69	443	.67	437	.66
5,000	507	.83	495	.81	482	.79	469	.77	451	.74	432	.71	420	.69	407	.67
10,000	472	.84	460	.82	448	.80	437	.78	425	.76	408	.73	397	.71	384	.69
15,000	432	.84	427	.83	416	.81	410	.80	399	.78	388	.76	378	.74	367	.72
20,000	398	.85	393	.84	388	.83	378	.81	373	.80	364	.78	353	.76	348	.75
25,000	366	.86	361	.85	356	.84	342	.83	347	.82	343	.81	333	.79	324	.77
30,000	333	.87	329	.86	329	.86	325	.85	321	.84	317	.83	312	.82	304	.80
35,000	303	.88	303	.88	299	.87	299	.87	299	.87	295	.86	287	.84	283	.83
40,000	270	.88	270	.88	270	.88	266	.87	266	.87	266	.87	259	.85	256	.84
45,000	240	.88	240	.88	240	.88	237	.87	237	.87	237	.87	231	.85	228	.84

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 – LB	1225
DIST – NM	5.0
TIME – MIN	1.0

4G–1–(104–1)

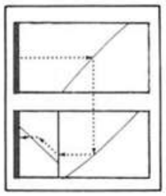
Figure A3–1 (Sheet 1 of 4)

TIME TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

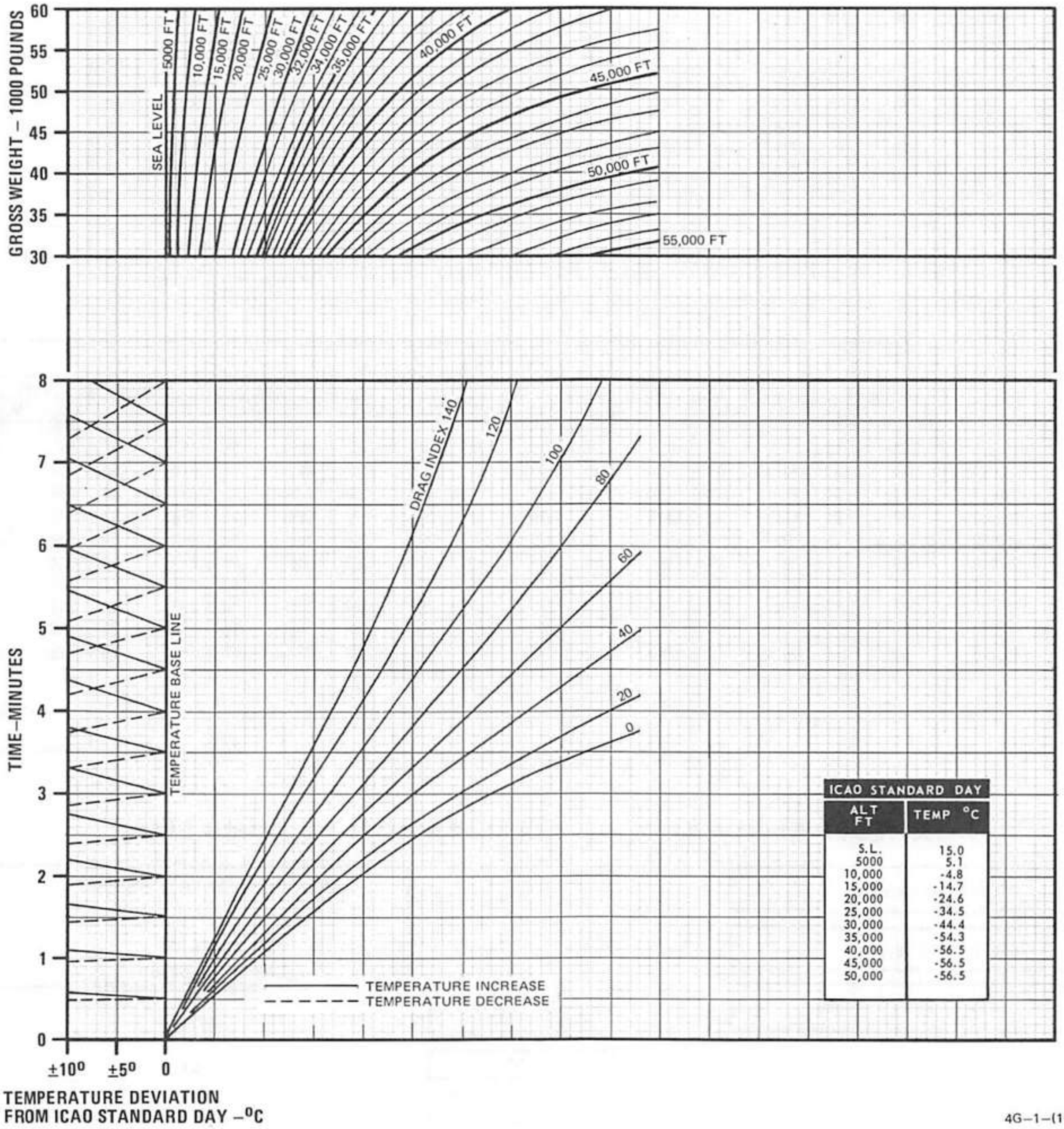


NOTE

CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE CONSTANT ALTITUDE CRUISE CHART.

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

4G–1–(104–2)

Figure A3–1 (Sheet 2 of 4)

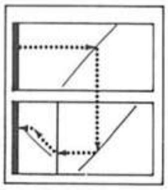
FUEL REQUIRED TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

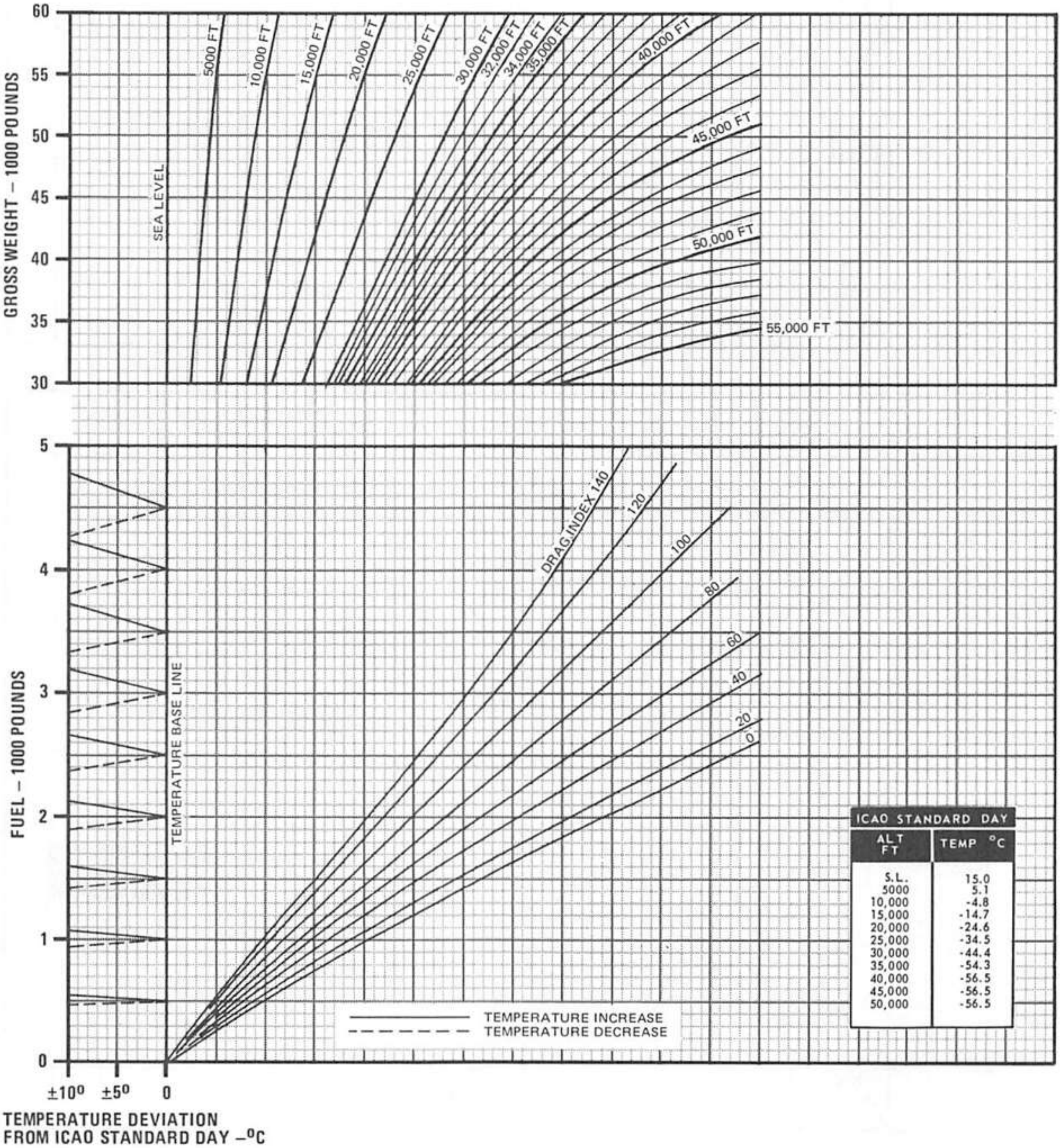
GUIDE



NOTE
CRUISE ALTITUDE AT END OF CLIMB MUST BE OBTAINED FROM THE CRUISE ALTITUDE CHART.

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

4G–1–(104–3)

Figure A3–1 (Sheet 3 of 4)

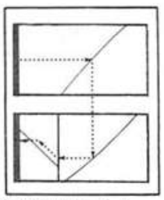
DISTANCE REQUIRED TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

GUIDE

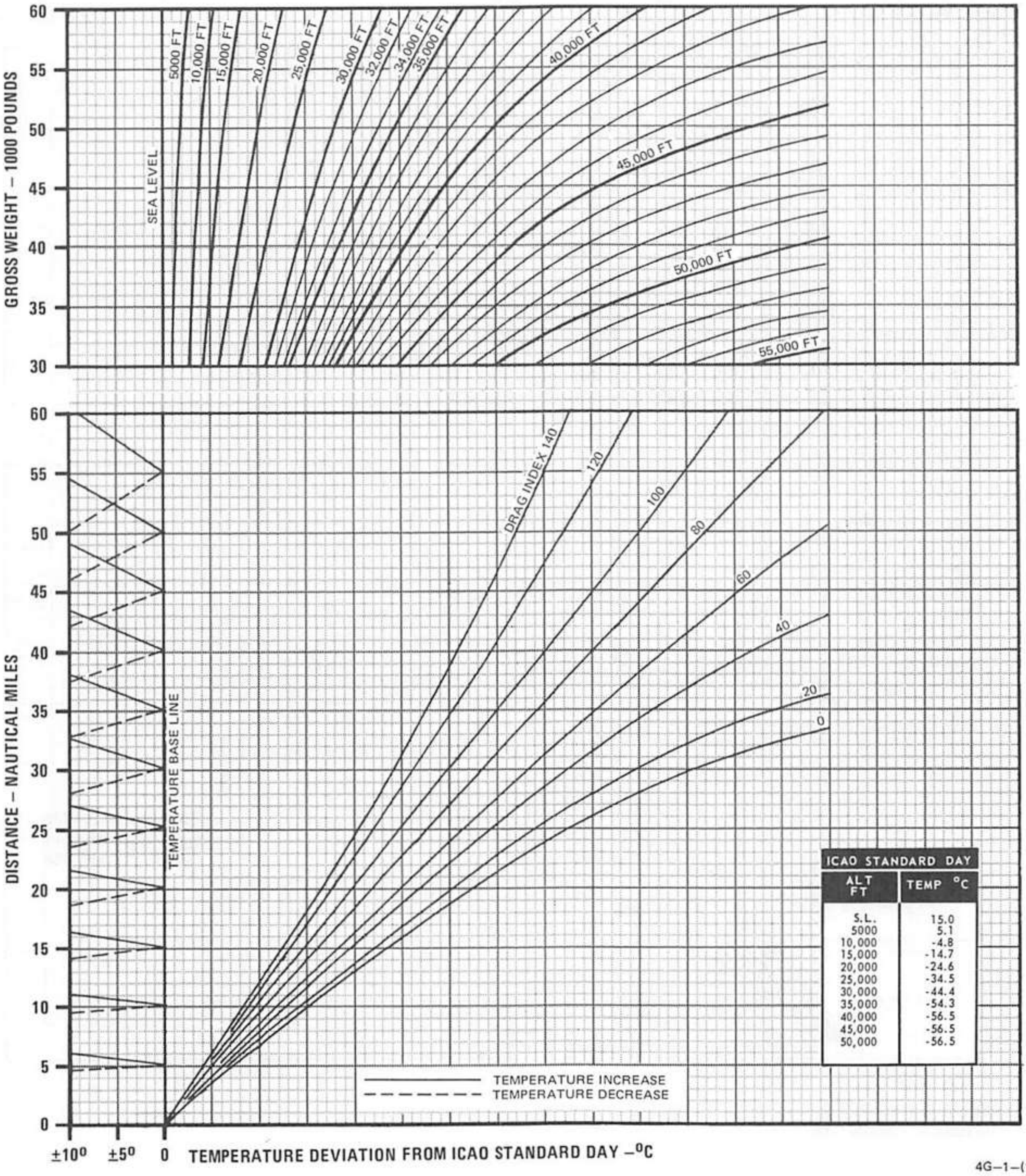


NOTE

CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE CONSTANT ALTITUDE CRUISE CHART.

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 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

4G–1–(104–4)

Figure A3–1 (Sheet 4 of 4)

CLIMB SPEED SCHEDULE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

MILITARY THRUST

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

ALTITUDE	DRAG INDEX													
	0		10		20		30		40		50		60	
	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH
S.L.	503	.76	483	.73	456	.69	436	.66	417	.63	407	.60	377	.57
5,000	470	.77	451	.74	433	.71	414	.68	395	.65	377	.62	364	.60
10,000	442	.79	426	.76	409	.73	397	.71	379	.68	368	.66	351	.63
15,000	411	.80	399	.78	389	.76	373	.73	362	.71	351	.69	341	.67
20,000	383	.82	373	.80	368	.79	358	.77	348	.75	338	.73	329	.71
25,000	356	.84	352	.83	347	.82	338	.80	333	.79	324	.77	315	.75
30,000	325	.85	325	.85	325	.85	321	.84	317	.83	308	.81	304	.80
35,000	299	.87	303	.88	303	.88	303	.88	299	.87	291	.85	287	.84
40,000	270	.88	273	.89	273	.89	–	–	–	–	–	–	–	–

ALTITUDE	DRAG INDEX															
	70		80		90		100		110		120		130		140	
	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH
S.L.	364	.55	344	.52	338	.51	324	.49	318	.48	311	.47	304	.46	298	.45
5,000	353	.58	340	.56	328	.54	316	.52	309	.51	303	.50	297	.49	291	.48
10,000	339	.61	328	.59	317	.57	305	.55	300	.54	294	.53	288	.52	283	.51
15,000	330	.65	320	.63	309	.61	299	.59	293	.58	283	.56	278	.55	273	.54
20,000	319	.69	309	.67	299	.65	289	.63	285	.62	275	.60	266	.58	261	.57
25,000	306	.73	297	.71	288	.69	279	.67	275	.66	266	.64	257	.62	253	.61
30,000	296	.78	284	.75	275	.73	267	.71	263	.70	254	.68	–	–	–	–
35,000	279	.82	272	.80	–	–	–	–	–	–	–	–	–	–	–	–
40,000	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

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 - LB	525	725	925
DIST.–NM	6.0	5.3	3.0
TIME – MIN	1.7	1.3	.8

4G-1-(103-1)

Figure A3-2 (Sheet 1 of 4)

TIME TO CLIMB

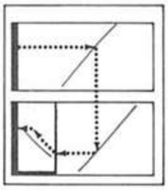
MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

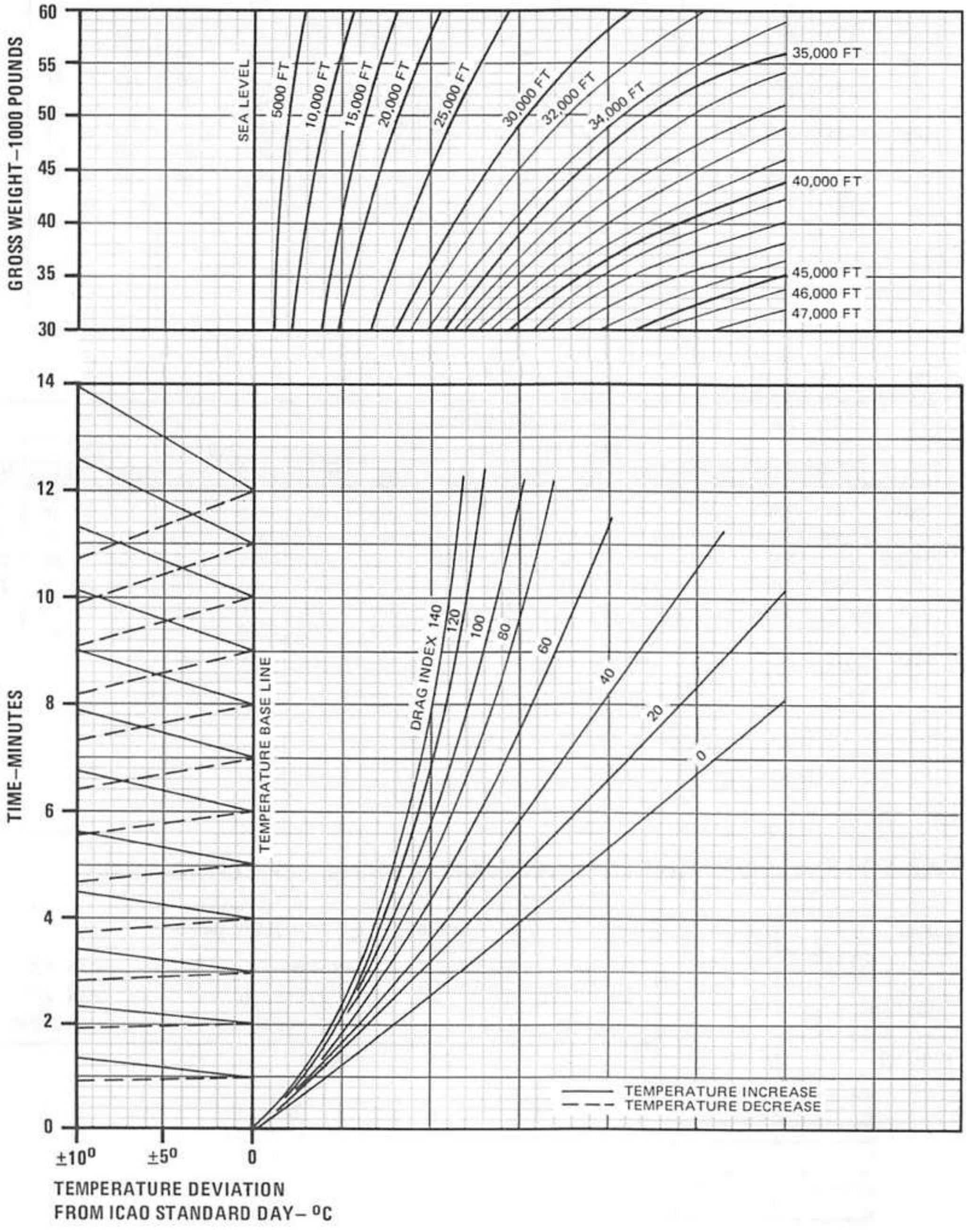
NOTE
CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE CONSTANT ALTITUDE CRUISE CHART

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(103–2)

Figure A3–2 (Sheet 2 of 4)

FUEL REQUIRED TO CLIMB

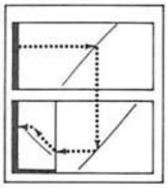
MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

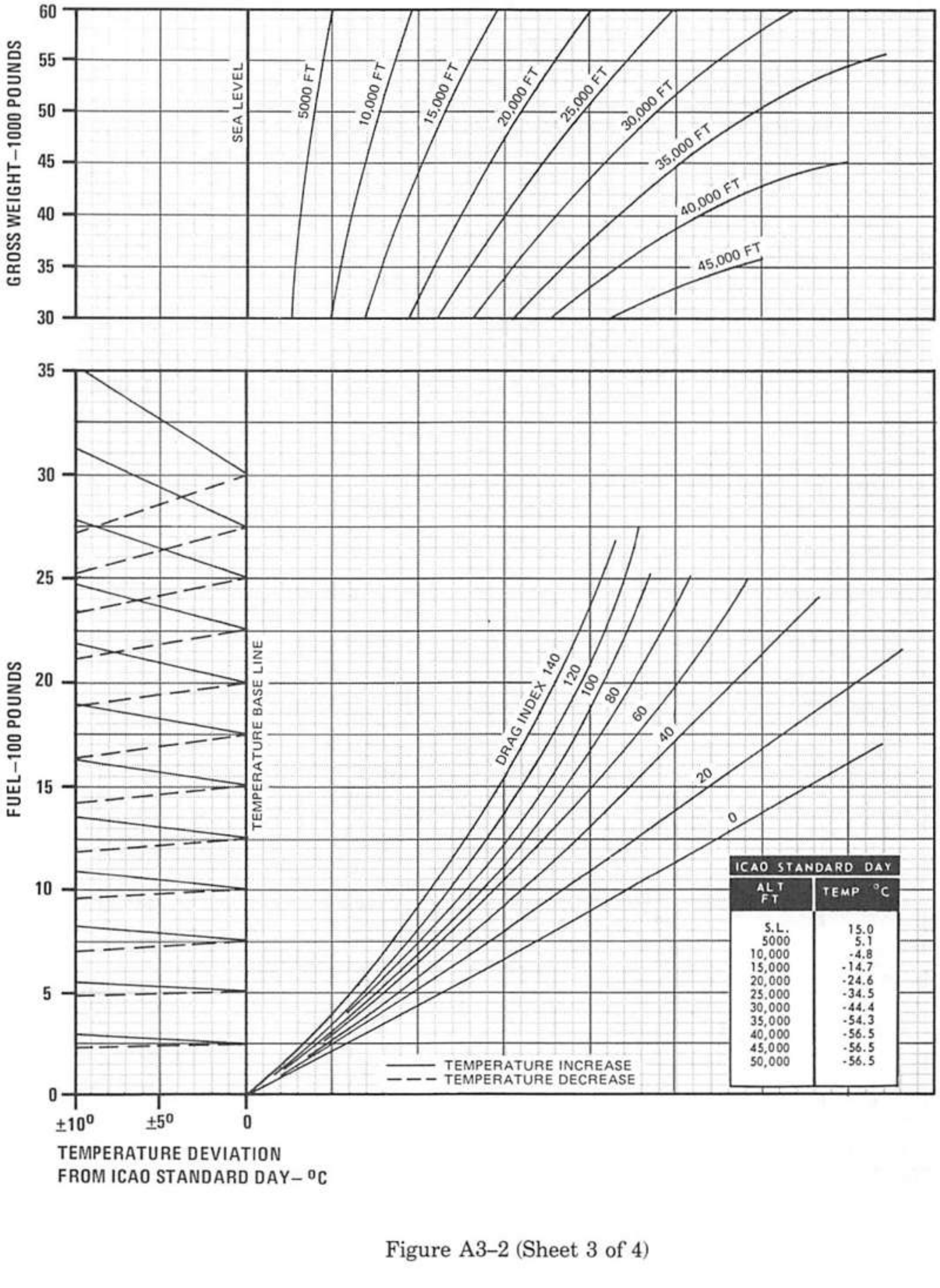
NOTE
CRUISE ALTITUDE AT END OF CLIMB MUST BE READ
ON THE CONSTANT ALTITUDE CRUISE CHART

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

4G–1–(103–3)

Figure A3-2 (Sheet 3 of 4)

DISTANCE REQUIRED TO CLIMB

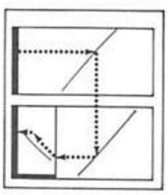
MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

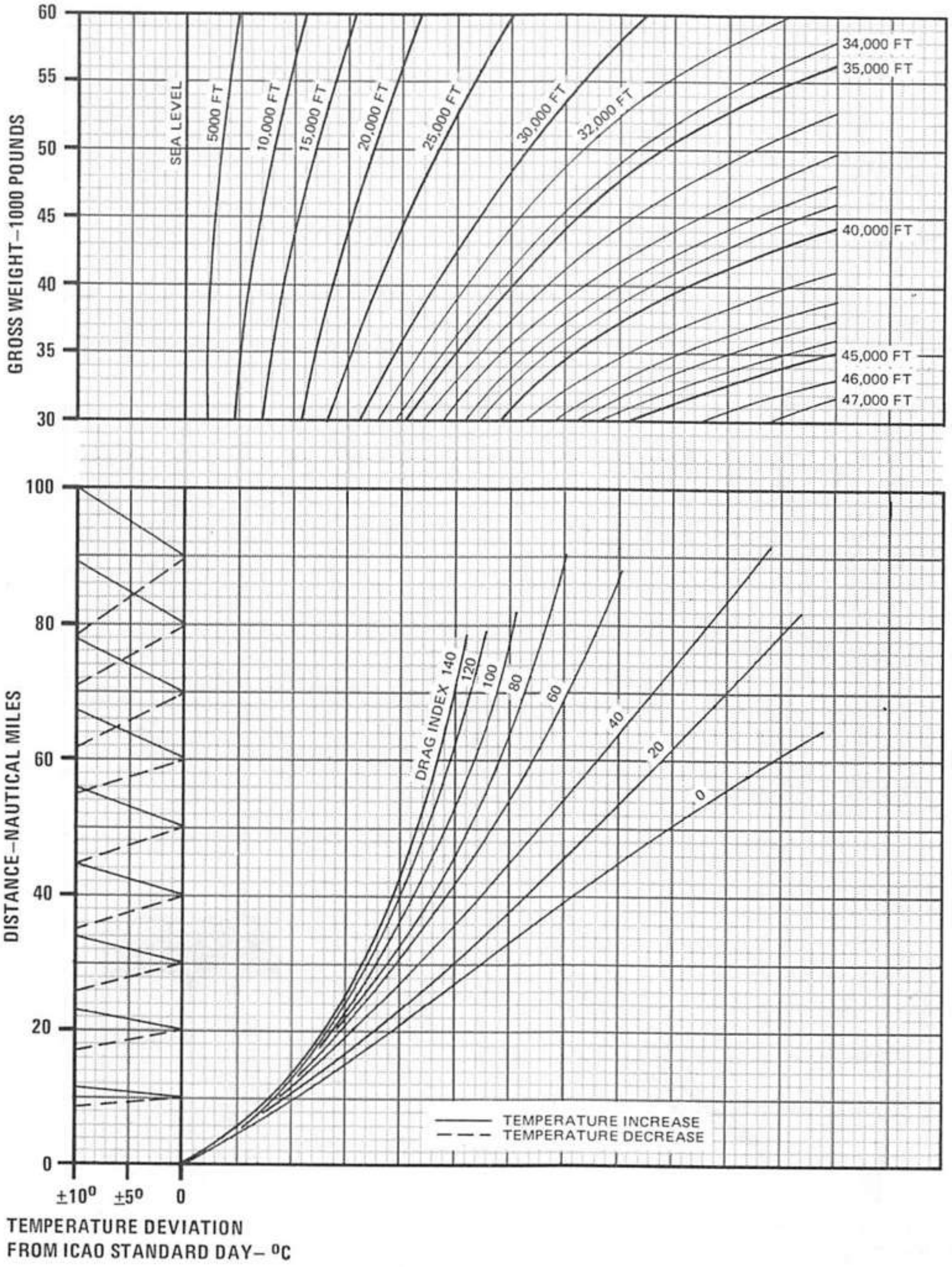
NOTE
CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE CONSTANT ALTITUDE CRUISE CHART

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(103-4)

Figure A3-2 (Sheet 4 of 4)

TIME TO CLIMB

350 KIAS-MILITARY THRUST

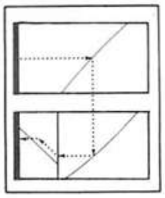
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)J79-GE-17

NOTE

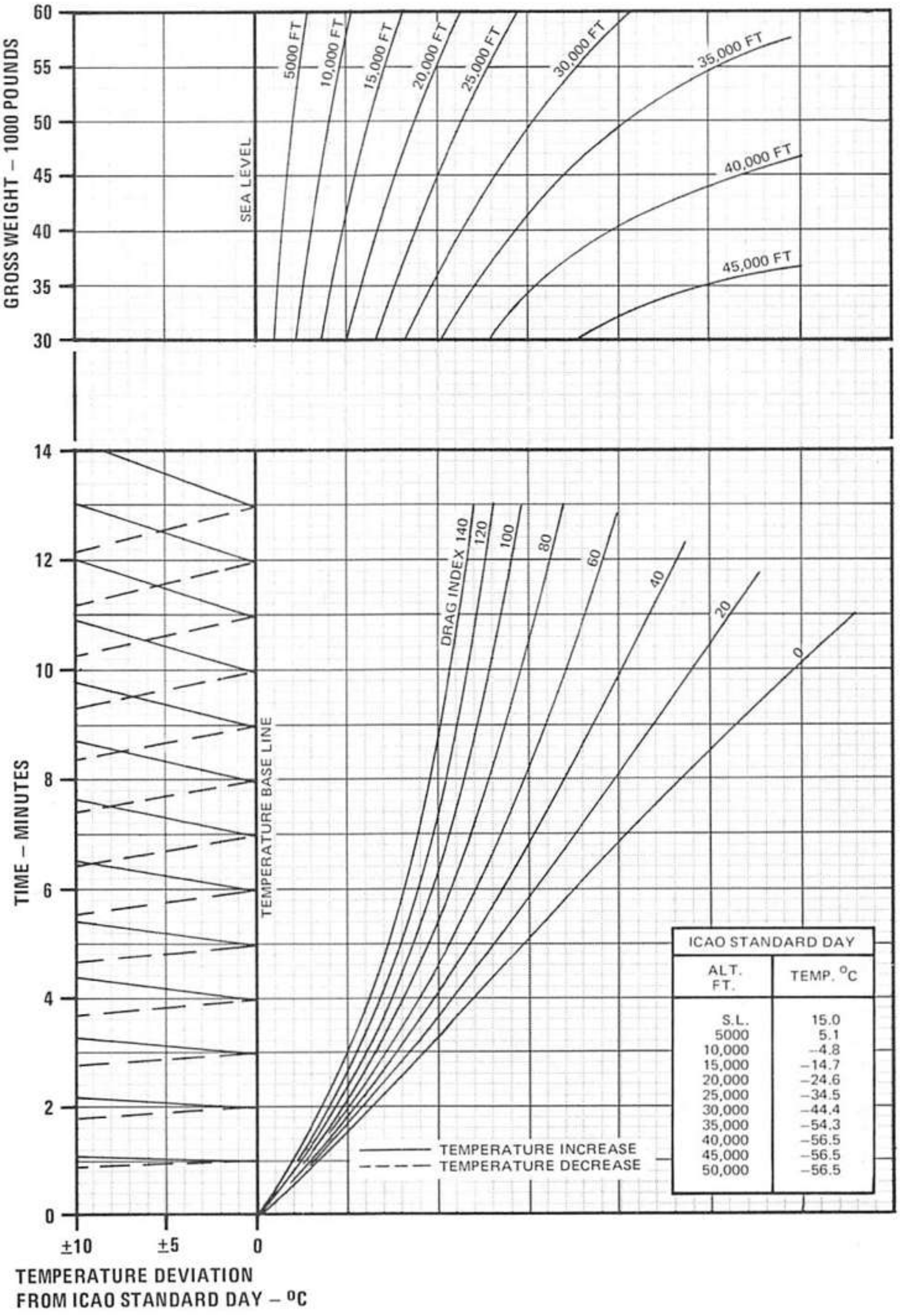
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/TAS, THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

4G-1-(102-1)

Figure A3-3 (Sheet 1 of 3)

FUEL REQUIRED TO CLIMB

350 KIAS-MILITARY THRUST

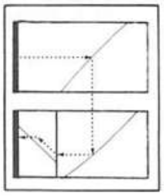
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)J79-GE-17

NOTE

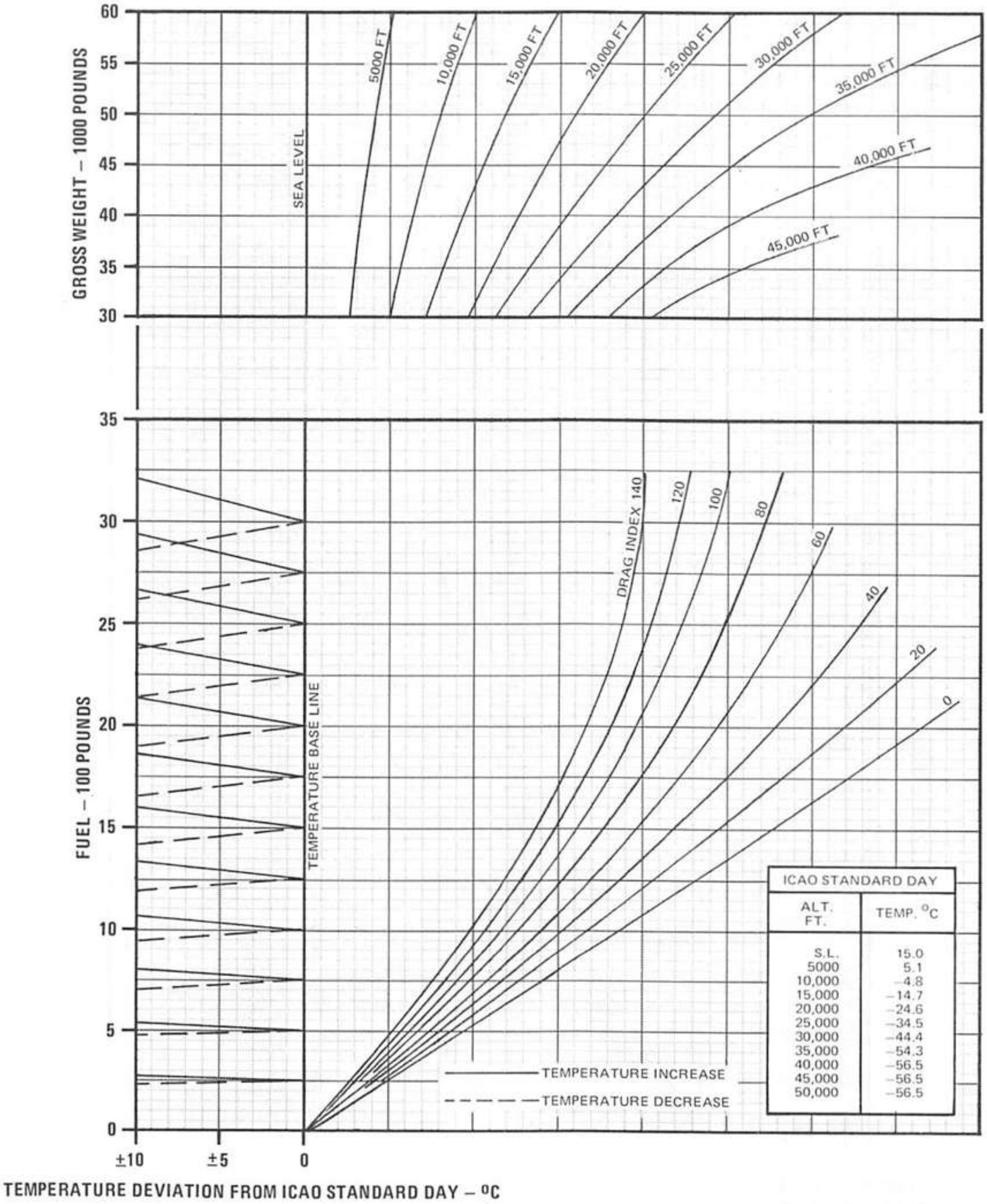
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/ TAS, THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

4G-1-(102-2)

Figure A3-3 (Sheet 2 of 3)

DISTANCE REQUIRED TO CLIMB

350 KIAS-MILITARY THRUST

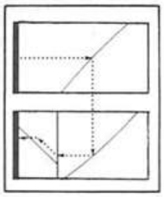
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)J79-GE-17

NOTE

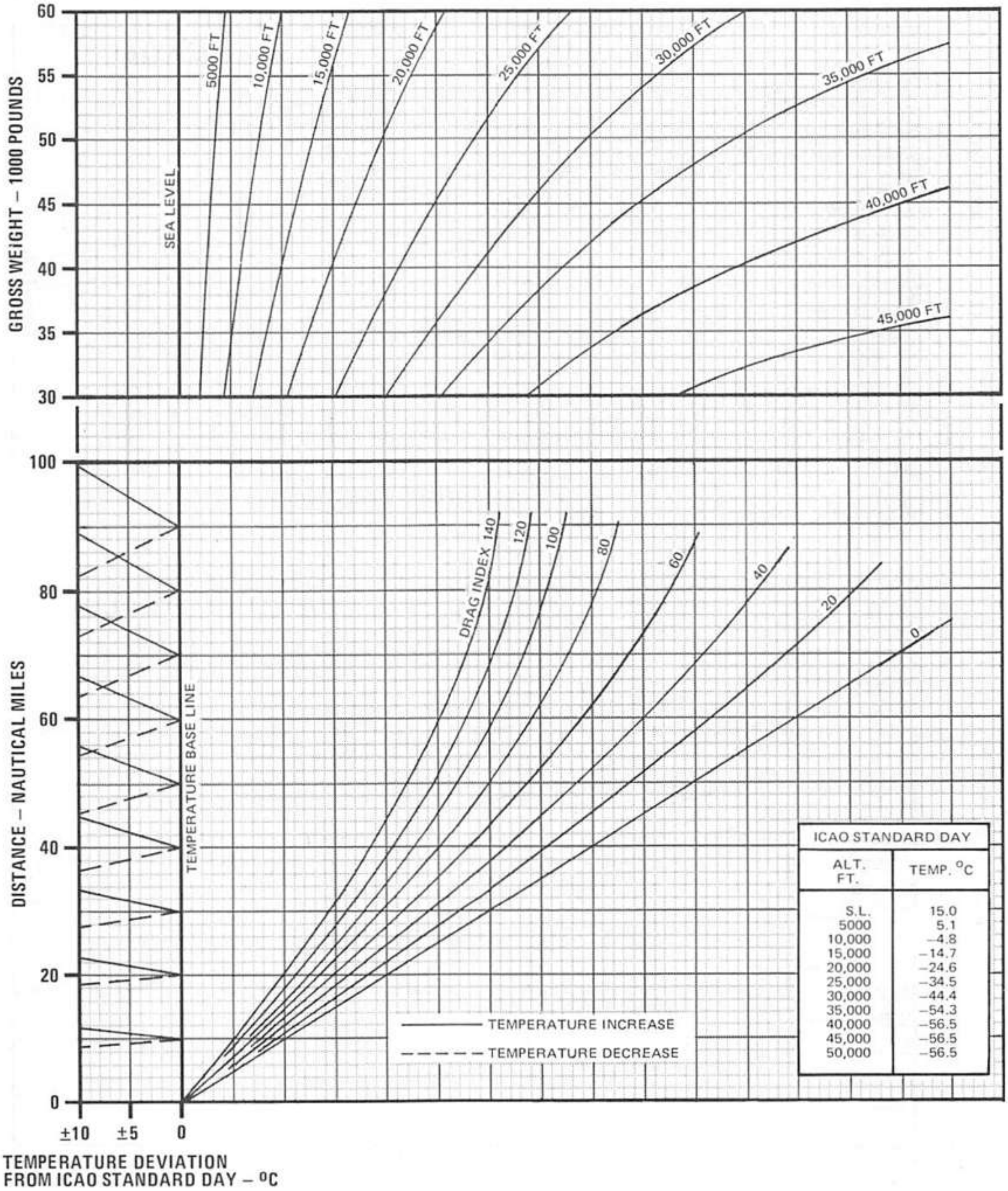
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF OPTIMUM CRUISE MACH/TAS, THEN MAINTAIN CRUISE MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN CRUISE ALTITUDES.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

4G–1–(102–3)

Figure A3–3 (Sheet 3 of 3)

COMBAT CEILING

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

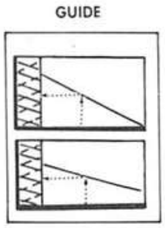
DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

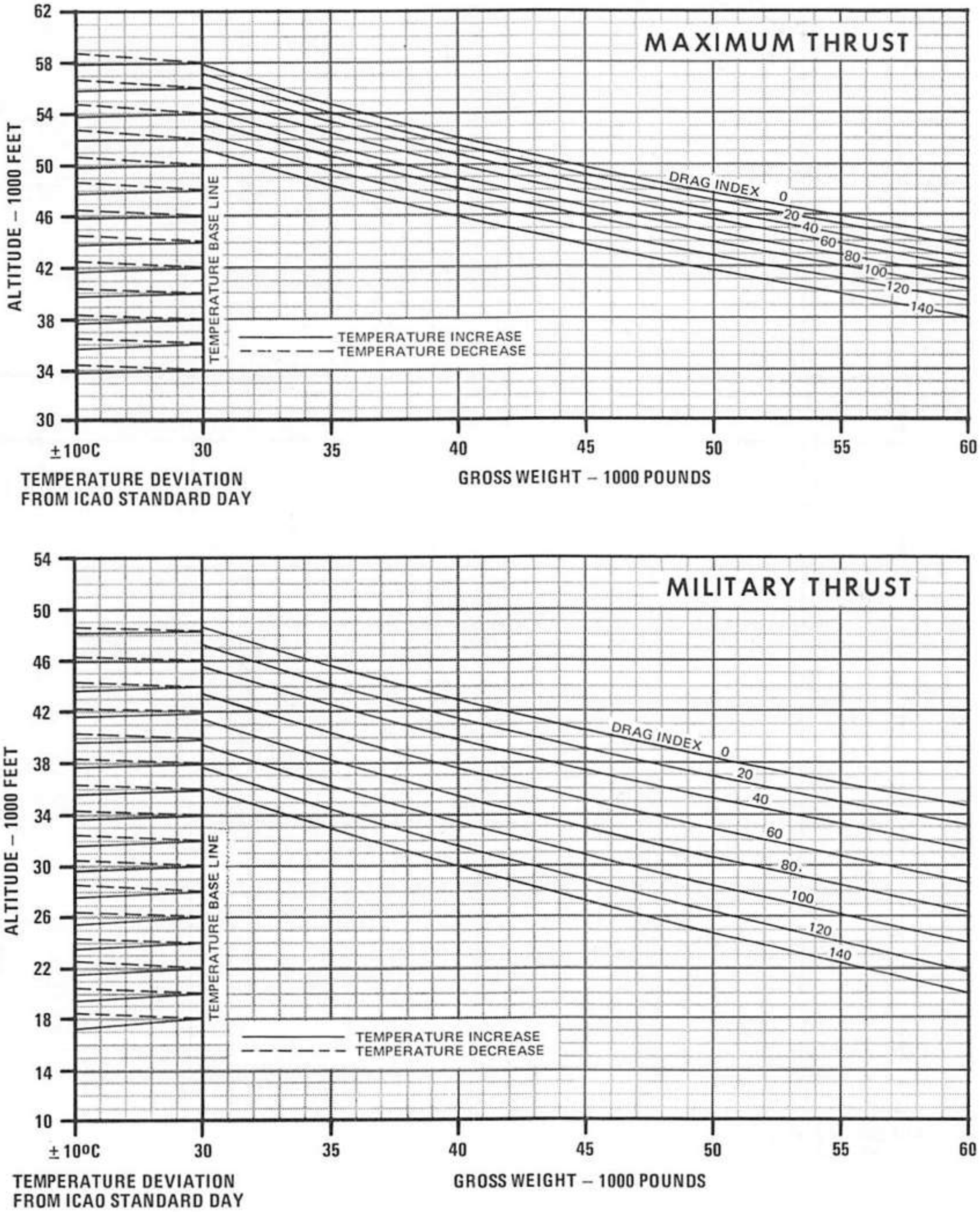
NOTE

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-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(101)

Figure A3-4

COMBAT CEILING

ONE ENGINE OPERATING

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 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

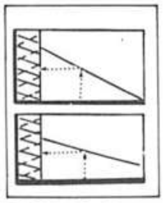
REMARKS

ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

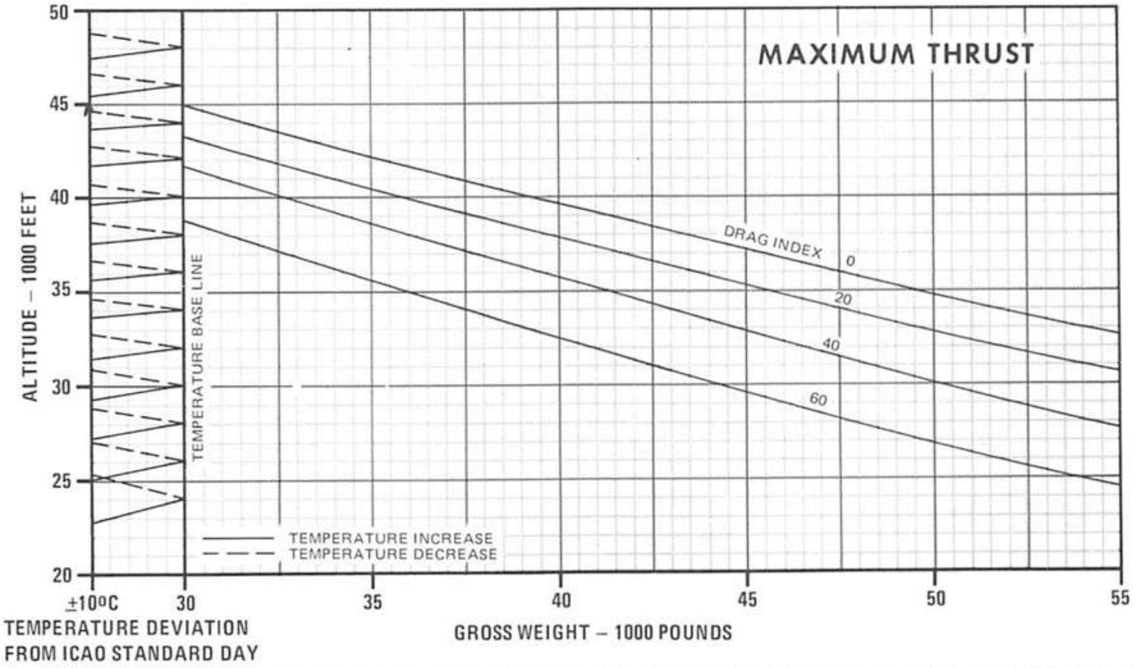
NOTE

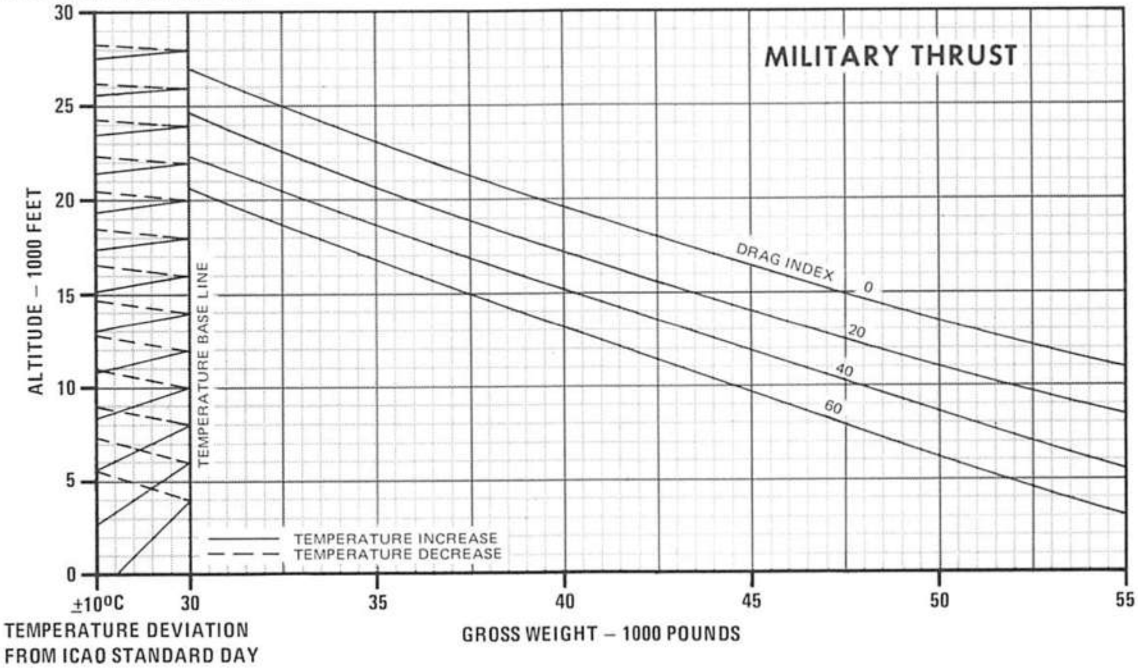
- COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE.
- IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS.

GUIDE



FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL





4G-1-(100)A

Figure A3–5

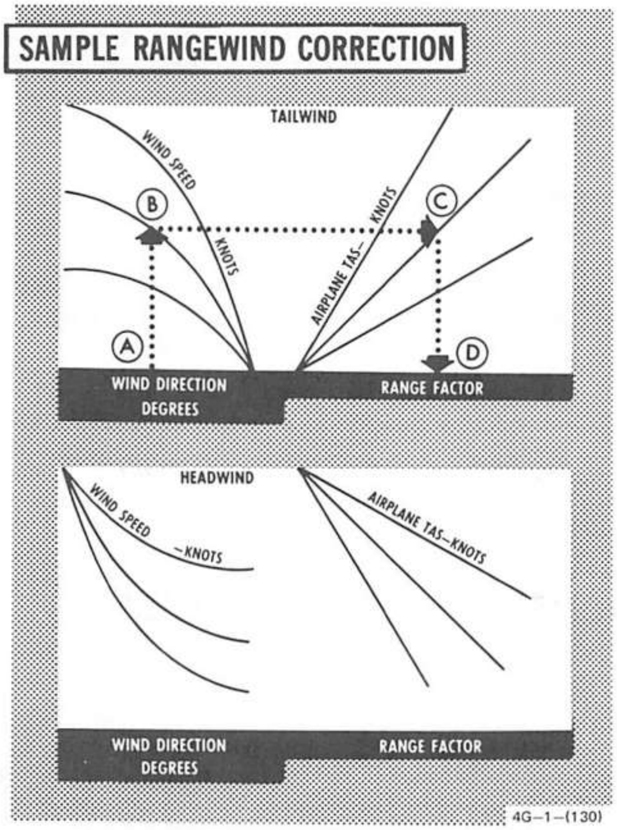
PART 4
RANGE

TABLE OF CONTENTS

Charts

RANGEWIND CORRECTION

This chart (figure A4–1) provides a means of correcting computed range (specific or total) for existing wind effect. The presented range factors consider wind speeds up to 150 knots from any relative wind direction for airplane speeds of 200 to 1300 knots (TAS).



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 wind direction and then perform the subtraction. Enter the chart with relative wind direction and proceed vertically to the interpolated wind speed. From this point, project horizontally to intersect the airplane 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.

Sample Problem

A. Relative wind direction	150°
B. Wind speed	125 Kt
C. Airplane speed (TAS)	400 Kt
D. Range factor	1.25

OPTIMUM CRUISE SUMMARY

These charts (figures A4–2 and A4–3) present cruise data for both two engine and single engine operation. The charts depict optimum cruise altitude, specific range (in nautical miles per pound) and cruise Mach number for all gross weights and drag indexes.

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.

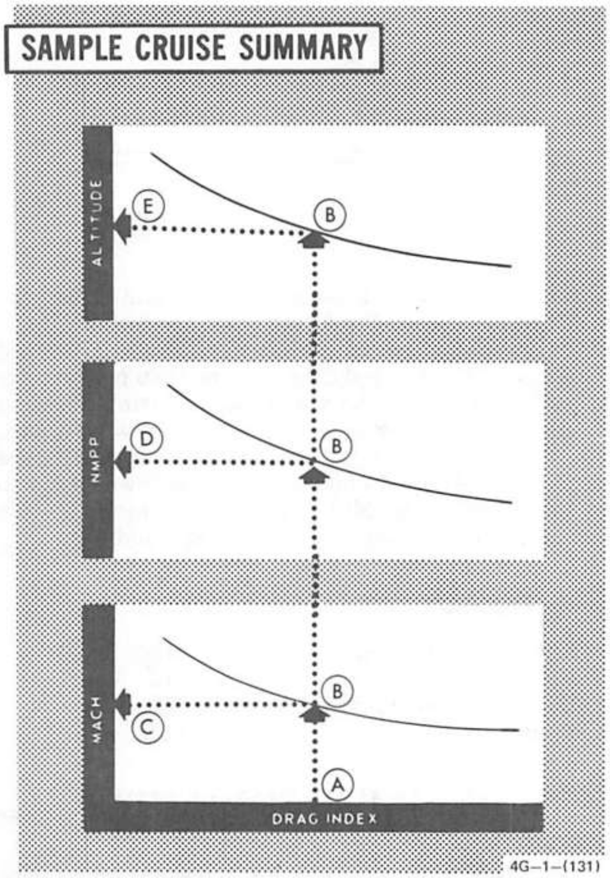
Sample Problem

(2) Engines

A. Drag index	20
B. Gross weight	40,000 Lb
C. Mach number	0.86
D. Specific range	0.092 NMPP
E. Cruise altitude	38,700 Ft

LOW ALTITUDE CRUISE TABLES

These tables (figures A4–4 thru A4–9) present total fuel flow values for various combinations of cruise airspeed and drag index at altitudes of Sea Level, 4000, 8000, 12,000 and 16,000 feet. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum



attainable TAS) for a MIL thrust setting. Separate tables are provided for several gross weights. Fuel flow values are tabulated for ICAO Standard Day; however, correction factors are given for non-standard temperatures.

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 non-standard 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 fuel flow for a standard day. To obtain the total fuel flow at the desired true airspeed, multiply the total fuel flow for a standard day by the nonstandard day temperature correction factor.

Sample Problem

Gross weight 50,000 Lb, Sea Level (15°C)

A. Desired airspeed	540 KTAS
B. Drag Index	0.20
C. Nonstandard day temperature	−20°C
D. Correction factor	.937
E. Equivalent standard day ture airspeed (A÷D)	576 KTAS
F. Standard day total fuel flow	21266 PPH
G. Total fuel flow at desired true airspeed (F×D)	19926 PPH

HIGH ALTITUDE CRUISE TABLES

These charts (figures A4–10 thru A4–15) present total fuel flow values for various combinations of cruise airspeed and drag index at altitudes of 20,000 feet thru 40,000 feet in 5000 foot increments. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum attainable TAS) for a MIL thrust setting. Separate charts are provided for several gross weights. Fuel flow values are tabulated for ICAO Standard Day; however, correction factors are given for non-standard temperatures.

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 fuel flow for a standard day. To obtain the total fuel flow at the desired true airspeed, multiply the total fuel flow for a standard day by the nonstandard day temperature correction factor.

Sample Problem

Gross weight 40,000 Lb, 35,000 ft. (−55°C)

A. Desired airspeed	440 KTAS
B. Drag Index	0.20
C. Nonstandard day temperature	−20°C
D. Correction factor	1.074
E. Equivalent standard day true airspeed (A÷D)	410 KTAS
F. Standard day total fuel flow	4983
G. Total fuel flow at desired true airspeed (F×D)	5352 PPH

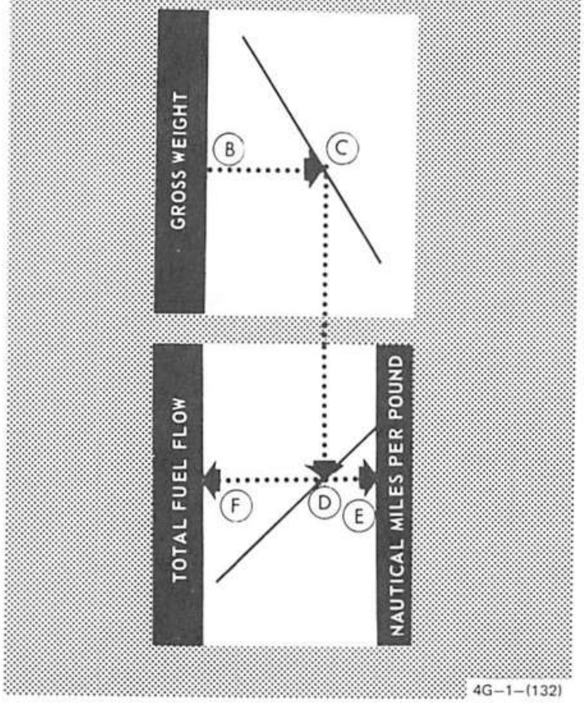
CONSTANT MACH/ALTITUDE CRUISE

These charts (figures A4–16 thru A4–22) present nautical miles per pound and total fuel flow 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. Fuel flow is presented for 0°C; however, correction factors are provided for temperature deviations.

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 fuel flow for 0°C temperature. If required, correct the total fuel flow for the actual temperature.

SAMPLE CONSTANT MACH/ALTITUDE CRUISE



4G-1-(132)

Sample Problem

A. Mach number	0.85
B. Gross weight	40,000 Lb
C. Altitude	30,000 Ft
D. Drag index	40
E. Specific range	0.075 NMPP
F. Total fuel flow	7300 PPH
G. Total fuel flow (corrected)	6643 PPH

CONSTANT ALTITUDE CRUISE

These charts (figures A4-23 and A4-24) 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.

USE

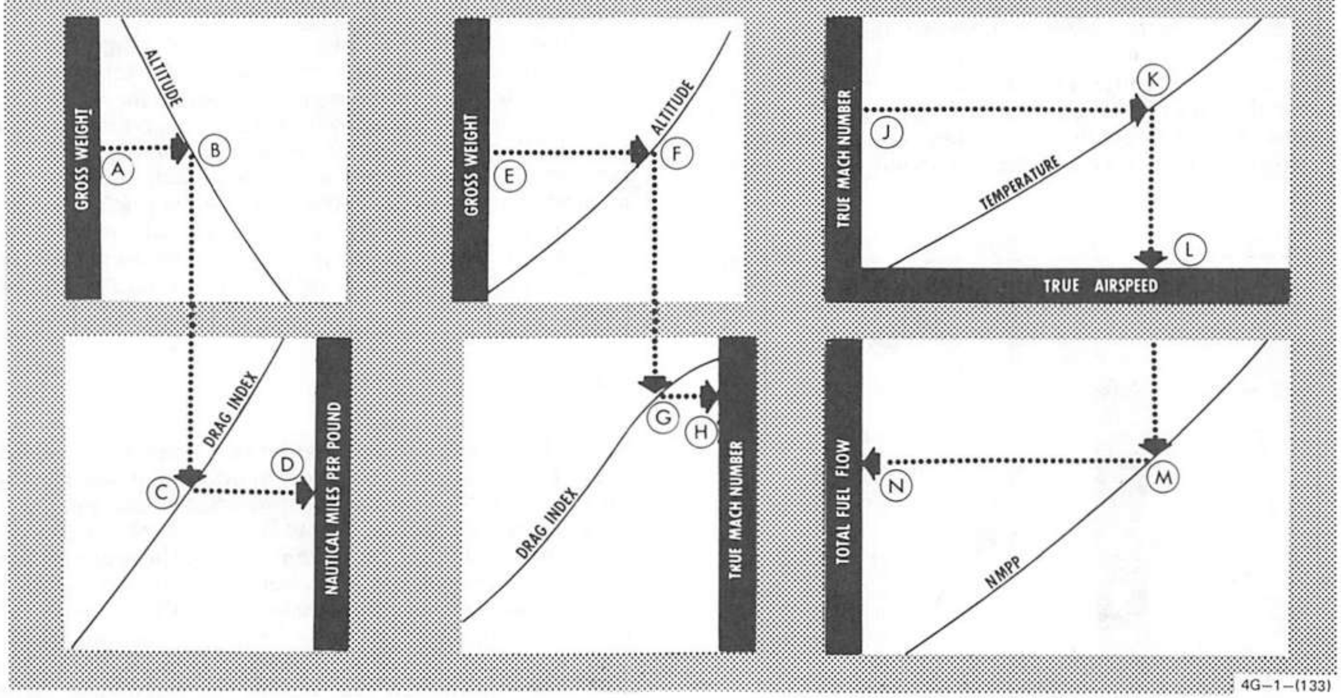
Enter the left side of sheet 1 with the average gross weight. Project horizontally to the right to intersect desired cruise altitude, and then vertically downward to the computed drag index, then horizontally to the right to obtain specific range (nautical miles per pound). Repeat these projections on 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 fuel flow required in pounds per hour.

Sample Problem

(2) Engines

A. Average gross weight for first leg	45,000 Lb
B. Cruise altitude	30,000 Ft
C. Computed drag index	40.0
D. Specific range	0.072 NMPP
E. Gross weight	45,000 Lb
F. Altitude	35,000 Ft
G. Drag index	40.0
H. True Mach number	0.83
J. True Mach number	0.83
K. Temperature at flight altitude	−40°C
L. True airspeed	495 Kt
M. Specific range	0.072 NMPP
N. Total fuel flow	6800 PPH

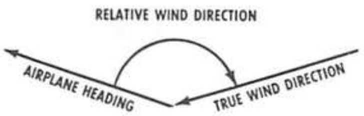
SAMPLE CONSTANT ALTITUDE CRUISE



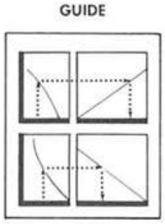
RANGEWIND CORRECTION

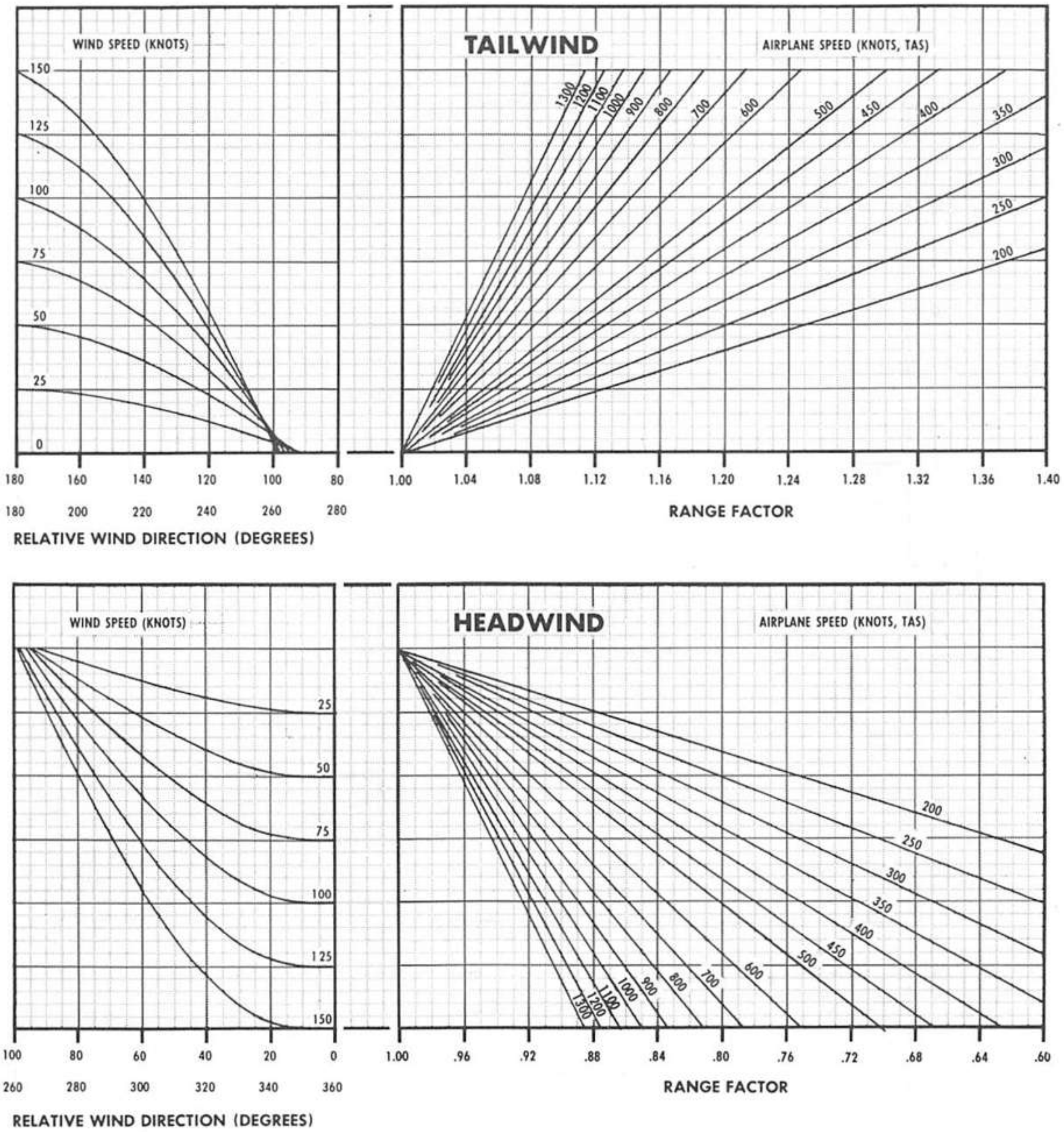
AIRPLANE CONFIGURATION

ALL CONFIGURATIONS



NOTE: RELATIVE WIND DIRECTION = ANGULAR DIFFERENCE MEASURED CLOCKWISE, BETWEEN AIRPLANE HEADING AND TRUE WIND DIRECTION





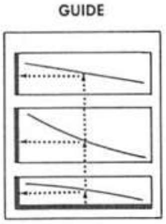
4G-1-(99)

Figure A4-1

OPTIMUM CRUISE SUMMARY

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

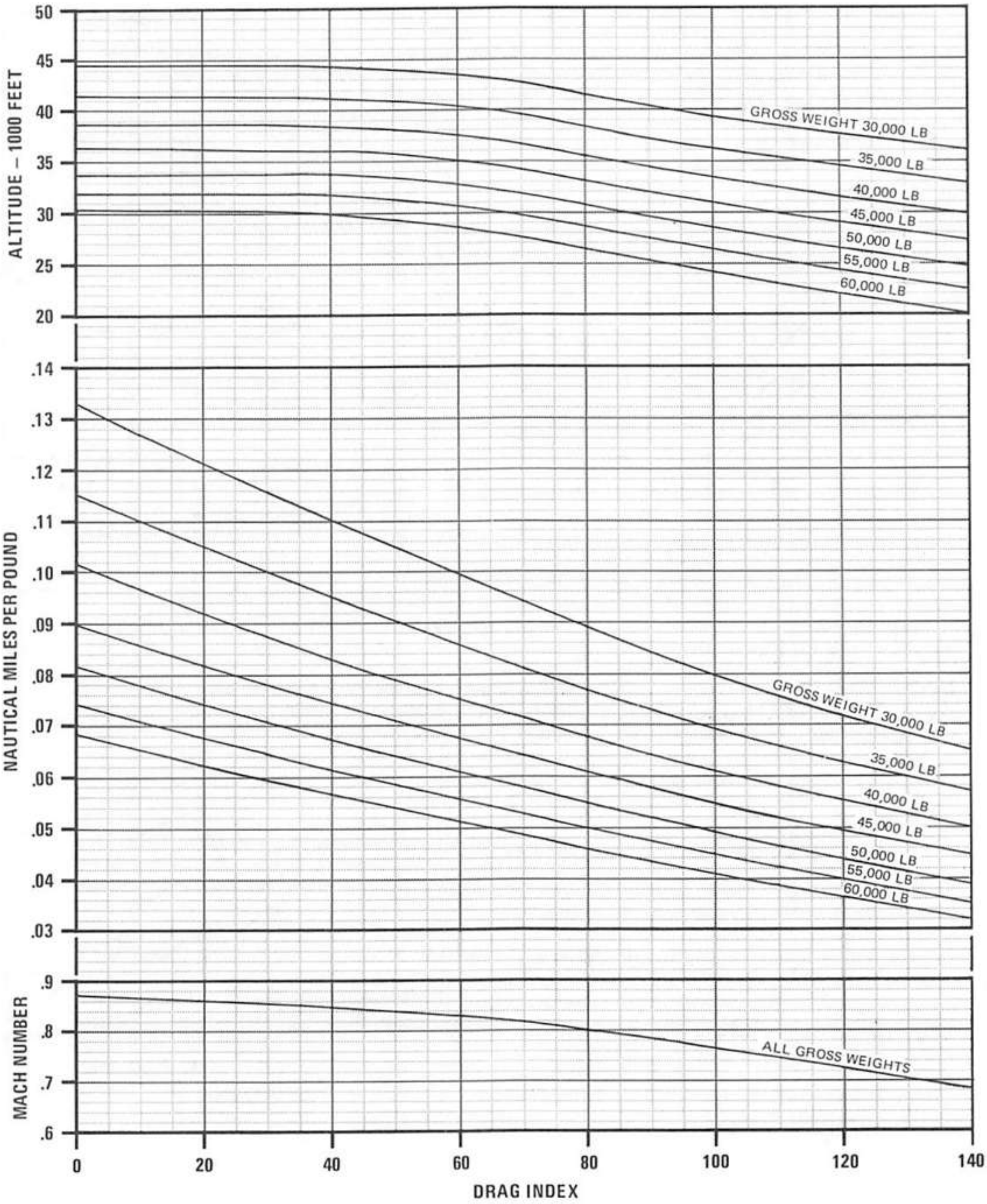


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Figure A4-2

OPTIMUM CRUISE SUMMARY

ONE ENGINE OPERATING

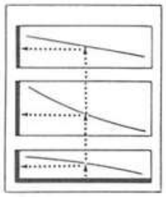
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

NOTE

IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

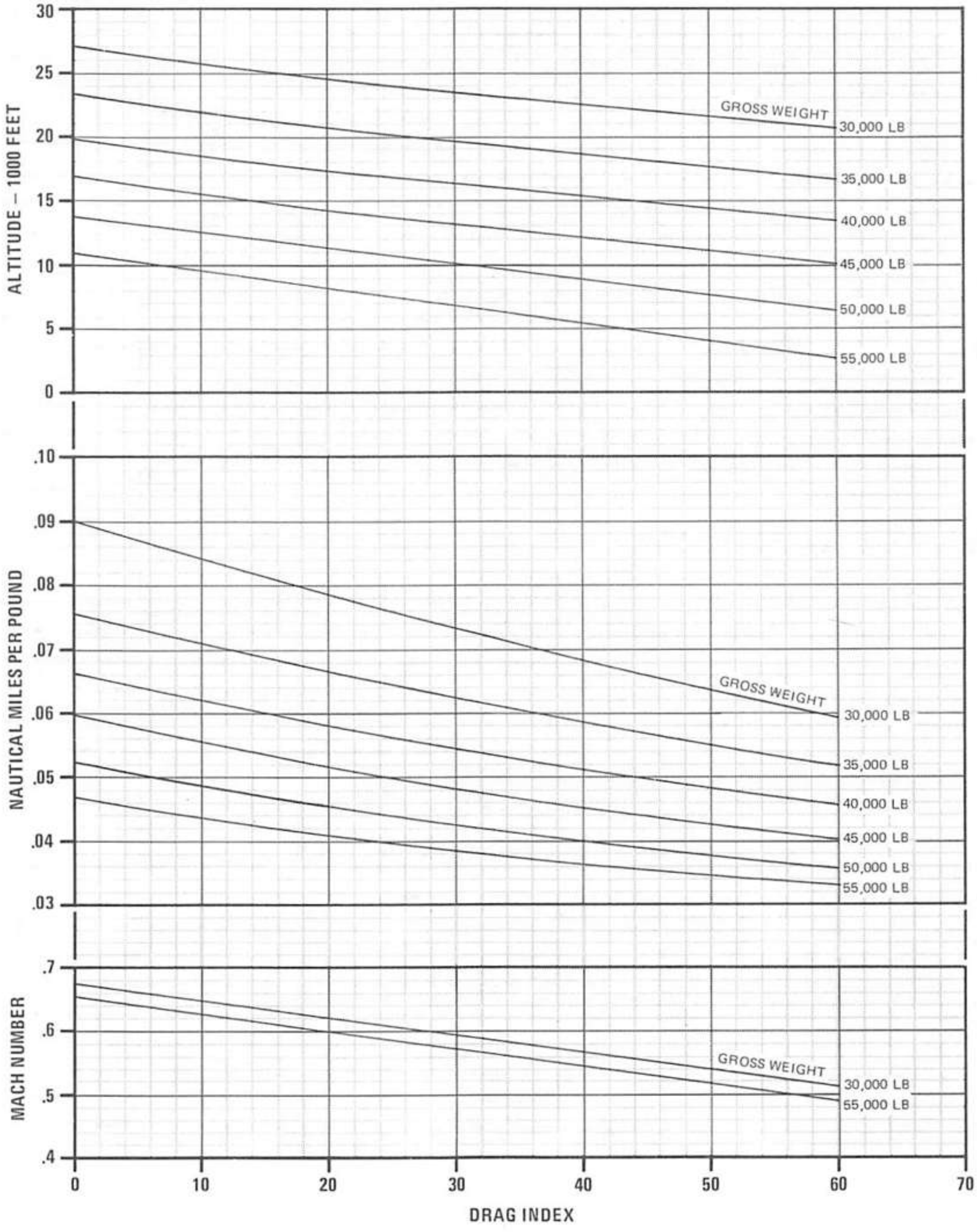


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Figure A4–3

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX 0	TOTAL FUEL FLOW – LBS/HR 20	40	60	80	100	120	TEMP EFFECTS 0°C	FACTOR
SEA LEVEL (15°C)	360	7364	8144	8947	9771	10619	11480	12322		
	420	9320	10473	11681	12841	14166	15467	16828	–40	.899
	480	11704	13279	14953	16733	18562	20456	22861	–20	.937
	540	14769	16860	18957	21609	25049			0	.973
	600	20345	23408	27150					20	1.008
	MIL	28219	27948	27630	27183	26648	26042	25412	40	1.042
	VMAX	631.5	617.6	601.8	580.6	556.2	529.7	503.9		
4,000 FEET (7°C)	360	6625	7339	8063	8784	9527	10291	11099		
	420	8315	9347	10390	11463	12530	13777	15130	–40	.913
	480	10342	11750	13129	14752	16665	18575	20442	–20	.949
	540	13059	14926	16872	19783	22632			0	.987
	600	19049	22630						20	1.022
	MIL	25726	25431	25054	24647	24130	23600	23076	40	1.057
	VMAX	628.0	614.9	599.3	581.7	558.8	534.1	509.3		
8,000 FEET (–1°C)	360	5958	6588	7210	7886	8524	9188	9898		
	420	7392	8310	9232	10150	11136	12087	13241	–40	.925
	480	9135	10360	11613	12892	14475	16394	18465	–20	.963
	540	11573	13109	14800	17256	20364			0	1.001
	600	17694	21416						20	1.037
	MIL	23181	22832	22522	22175	21780	21379	21022	40	1.072
	VMAX	624.2	610.8	596.6	580.5	560.6	538.8	515.0		
12,000 FEET (–9°C)	360	5391	5938	6493	7043	7651	8220	8839		
	420	6575	7349	8170	9002	9859	10731	11614	–40	.939
	480	8070	9149	10226	11388	12599	14087	15935	–20	.978
	540	10221	11609	13025	14965	17519	19108		0	1.016
	600	16377	19967						20	1.052
	MIL	20795	20492	20248	19996	19741	19404	19079	40	1.088
	VMAX	620.1	606.2	592.9	578.3	561.8	541.6	518.8		
16,000 FEET (–16°C)	360	4910	5384	5862	6355	6837	7391	7907		
	420	5881	6566	7242	7963	8760	9536	10409	–40	.953
	480	7126	8060	8997	10035	11162	12331	13762	–20	.993
	540	9135	10332	11701	13449	15301	17280		0	1.032
	600	15451	17462						20	1.069
	MIL	18681	18436	18243	18080	17882	17569	17207	40	1.105
	VMAX	615.2	600.8	588.3	575.6	561.5	542.2	520.3		

4G–1–(96)

Figure A4–4

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 40,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0^oC	FACTOR
SEA LEVEL (15^oC)	360	7605	8394	9195	10020	10871	11712	12590		
	420	9491	10655	11878	13028	14338	15672	17016	–40	.899
	480	11816	13392	15062	16837	18690	20582	23019	–20	.937
	540	14895	16984	19078	21739	25222			0	.973
	600	20480	23587	27322					20	1.008
	MIL	28202	27931	27612	27177	26610	26003	25383	40	1.042
	V_{MAX}	630.9	617.0	601.1	580.0	554.8	528.4	502.6		
4,000 FEET (7^oC)	360	6867	7566	8303	9046	9781	10543	11331		
	420	8501	9536	10578	11641	12719	13971	15364	–40	.913
	480	10495	11919	13295	14926	16832	18782	20622	–20	.949
	540	13161	15027	16995	19901	22786			0	.987
	600	19219	22855						20	1.022
	MIL	25710	25415	25037	24613	24094	23563	23048	40	1.057
	V_{MAX}	627.3	614.3	598.6	580.4	557.5	532.8	508.0		
8,000 FEET (-1^oC)	360	6237	6873	7497	8158	8842	9488	10190		
	420	7592	8511	9438	10368	11352	12318	13506	–40	.926
	480	9316	10550	11785	13088	14691	16613	18745	–20	.963
	540	11678	13216	14905	17406	20506			0	1.001
	600	17865	21662						20	1.037
	MIL	23165	22816	22506	22143	21755	21362	20974	40	1.072
	V_{MAX}	623.6	610.1	596.8	579.2	559.3	537.5	513.0		
12,000 FEET (-9^oC)	360	5685	6238	6792	7365	7948	8564	9156		
	420	6822	7602	8416	9240	10110	10995	11876	–40	.939
	480	8264	9343	10405	11549	12795	14306	16185	–20	.978
	540	10377	11757	13192	15137	17788			0	1.016
	600	16544	20214						20	1.052
	MIL	20787	20478	20218	19995	19724	19377	19058	40	1.088
	V_{MAX}	619.5	605.5	591.6	577.7	560.6	539.6	516.8		
16,000 FEET (-16^oC)	360	5267	5746	6232	6714	7242	7760	8330		
	420	6143	6828	7527	8235	9024	9830	10730	–40	.953
	480	7320	8255	9197	10241	11360	12574	14039	–20	.993
	540	9324	10501	11873	13630	15535	17532		0	1.032
	600	15628	17595						20	1.069
	MIL	18673	18428	18235	18064	17857	17542	17164	40	1.105
	V_{MAX}	614.5	600.2	587.7	574.6	559.6	540.3	517.8		

4G–1–(95)

Figure A4–5

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
SEA LEVEL (15°C)	360	7823	8626	9448	10282	11135	11954	12870		
	420	9669	10843	12040	13221	14514	15883	17208	−40	.899
	480	11984	13561	15224	16992	18862	20769	23253	−20	.937
	540	15024	17109	19201	21870	25399			0	.973
	600	20617	23769	27485					20	1.008
	MIL	28215	27944	27607	27172	26604	25976	25342	40	1.042
	VMAX	630.9	617.0	600.5	579.3	554.2	527.0	501.3		
4,000 FEET (7°C)	360	7154	7856	8585	9333	10098	10861	11623		
	420	8717	9745	10791	11846	12964	14222	15668	−40	.913
	480	10677	12107	13493	15133	17029	18992	20833	−20	.949
	540	13265	15130	17119	20020	22943			0	.987
	600	19393	23085						20	1.022
	MIL	25720	25398	25020	24578	24087	23537	23001	40	1.057
	VMAX	627.3	613.6	598.0	579.1	556.9	531.5	506.0		
8,000 FEET (−1°C)	360	6540	7164	7832	8472	9140	9828	10524		
	420	7841	8760	9685	10617	11590	12598	13822	−40	.925
	480	9505	10733	11949	13290	14913	16839	19033	−20	.963
	540	11842	13382	15067	17642	20726			0	1.001
	600	18040	21915						20	1.037
	MIL	23150	22801	22499	22135	21730	21328	20947	40	1.072
	VMAX	623.0	609.5	595.3	578.6	558.0	535.5	511.1		
12,000 FEET (−9°C)	360	6049	6613	7163	7762	8346	8935	9573		
	420	7083	7890	8695	9507	10372	11244	12167	−40	.939
	480	8469	9536	10604	11743	13034	14573	16490	−20	.978
	540	10557	11910	13384	15333	18098			0	1.016
	600	16718	19100						20	1.052
	MIL	20752	20463	20218	19972	19685	19351	19014	40	1.088
	VMAX	618.2	604.9	591.0	576.4	558.6	537.8	514.3		
16,000 FEET (−16°C)	360	5690	6173	6656	7174	7690	8239	8779		
	420	6455	7128	7854	8581	9356	10168	11045	−40	.953
	480	7568	8503	9445	10500	11609	12879	14388	−20	.993
	540	9487	10676	12049	13816	15782			0	1.032
	600	15911							20	1.069
	MIL	18647	18420	18219	18028	17831	17495	17106	40	1.105
	VMAX	613.3	599.6	586.5	572.7	557.8	537.8	514.7		

4G–1–(94)

Figure A4–6

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 50,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
SEA LEVEL (15°C)	360	8098	8901	9725	10573	11436	12255	13219	–40	.899
	420	9895	11055	12241	13464	14736	16127	17448	–20	.937
	480	12177	13755	15409	17169	19038	20982	23520	0	.973
	540	15151	17236	19326	22002	25578			20	1.008
	600	20755	23953	27610					40	1.042
	MIL	28198	27926	27620	27122	26566	25936	25293		
	V_{MAX}	630.2	616.3	600.5	578.0	552.8	525.7	499.3		
4,000 FEET (7°C)	360	7444	8184	8905	9644	10408	11188	11949	–40	.913
	420	8956	9991	11048	12091	13258	14523	16034	–20	.949
	480	10865	12271	13696	15345	17230	19171	21049	0	.987
	540	13421	15285	17305	20198	23177			20	1.022
	600	19569	23319						40	1.057
	MIL	25704	25382	25014	24571	24051	23502	22965		
	V_{MAX}	626.7	613.0	597.3	578.4	555.6	529.5	504.1		
8,000 FEET (–1°C)	360	6911	7535	8194	8876	9527	10205	10926	–40	.925
	420	8109	9026	9948	10881	11842	12896	14158	–20	.963
	480	9714	10924	12135	13521	15168	17097	19243	0	1.001
	540	12028	13569	15251	17909	20975			20	1.037
	600	18218	22173						40	1.072
	MIL	23135	22801	22459	22103	21706	21276	20919		
	V_{MAX}	622.3	609.5	594.0	577.3	556.8	533.0	509.2		
12,000 FEET (–9°C)	360	6461	7012	7622	8184	8784	9381	9997	–40	.939
	420	7384	8204	9035	9847	10704	11558	12536	–20	.978
	480	8713	9785	10860	11991	13340	14915	16879	0	1.016
	540	10733	12066	13582	15534	18419			20	1.052
	600	17013	19300						40	1.088
	MIL	20744	20456	20188	19949	19660	19331	18983		
	V_{MAX}	617.6	604.3	589.7	575.1	556.8	535.8	511.8		
16,000 FEET (–16°C)	360	6181	6664	7183	7698	8239	8768	9351	–40	.953
	420	6795	7486	8196	8933	9740	10563	11394	–20	.993
	480	7834	8767	9708	10773	11869	13194	14754	0	1.032
	540	9691	10894	12268	14046	16109			20	1.069
	600	16201							40	1.105
	MIL	18632	18398	18189	18022	17786	17454	17029		
	V_{MAX}	612.0	598.3	584.6	571.5	555.3	535.3	510.4		

4G–1–(93)

Figure A4–7

LOW ALTITUDE CRUISE

GROSS WEIGHT – 55,000 POUNDS

REMARKS

ENGINES: (2) J79–GE–17

AIRPLANE CONFIGURATION

INDIVIDUAL DRAG INDEXES

DATE: 1 JANUARY 1973

DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4

FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
SEA LEVEL (15°C)	360	8414	9216	10041	10891	11731	12594	13546		
	420	10132	11311	12488	13763	15006	16377	17741	–40	.899
	480	12377	13955	15598	17349	19217	21199	23794	–20	.937
	540	15285	17376	19471	22183	25823			0	.973
	600	20896	24141						20	1.008
	MIL	28181	27909	27602	27117	26560	25890	25256	40	1.042
	V_{MAX}	629.6	615.7	599.8	577.3	552.3	523.7	497.3		
4,000 FEET (7°C)	360	7793	8524	9273	10033	10792	11540	12352		
	420	9209	10250	11317	12347	13566	14836	16305	–40	.913
	480	11055	12439	13906	15564	17436	19354	21269	–20	.949
	540	13602	15464	17521	20404	23448			0	.987
	600	19745	23559						20	1.022
	MIL	25688	25365	24997	24547	24026	23428	22928	40	1.057
	V_{MAX}	626.0	612.3	596.7	577.1	554.3	526.9	502.1		
8,000 FEET (–1°C)	360	7274	7946	8595	9255	9941	10628	11313		
	420	8433	9359	10289	11231	12173	13289	14604	–40	.925
	480	9956	11183	12387	13824	15513	17445	19514	–20	.963
	540	12196	13762	15438	18184	21230			0	1.001
	600	18499	22583						20	1.037
	MIL	23120	22761	22452	22079	21664	21258	20891	40	1.072
	V_{MAX}	621.7	608.2	593.4	576.0	554.8	531.0	506.6		
12,000 FEET (–9°C)	360	6940	7539	8107	8713	9297	9897	10550		
	420	7714	8524	9344	10166	11036	11892	12929	–40	.939
	480	8972	10047	11128	12249	13628	15273	17288	–20	.978
	540	10904	12235	13777	15752	18770			0	1.016
	600	17318	19934						20	1.052
	MIL	20716	20420	20187	19933	19627	19295	18926	40	1.088
	V_{MAX}	616.3	603.0	589.1	573.9	554.8	533.3	508.0		
16,000 FEET (–16°C)	360	6807	7349	7848	8402	8915	9499	10152		
	420	7168	7892	8626	9340	10156	10985	11820	–40	.953
	480	8162	9103	10052	11115	12214	13585	15245	–20	.993
	540	9950	11172	12546	14337	16526			0	1.032
	600	16501							20	1.069
	MIL	18610	18377	18173	17992	17746	17403	16941	40	1.105
	V_{MAX}	610.8	597.1	583.3	569.6	552.8	532.2	505.4		

4G–1–(92)

Figure A4–8

LOW ALTITUDE CRUISE

GROSS WEIGHT – 60,000 POUNDS

REMARKS

ENGINES: (2) J79-GE-17

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0^0C	FACTOR
SEA LEVEL (15°C)	360	8731	9554	10399	11261	12070	12985	13888		
	420	10379	11579	12745	14044	15287	16635	18044	–40	.899
	480	12556	14161	15792	17533	19399	21421	24074	–20	.937
	540	15454	17545	19645	22410	26130			0	.973
	600	21038	24331						20	1.008
	MIL	28181	27892	27585	27080	26503	25823	25186	40	1.042
	V_{MAX}	629.6	615.0	599.1	576.0	550.2	521.1	494.6		
4,000 FEET (7°C)	360	8196	8919	9658	10421	11200	11942	12813		
	420	9532	10575	11638	12669	13907	15232	16616	–40	.913
	480	11306	12689	14206	15888	17742	19622	21594	–20	.949
	540	13788	15647	17742	20614	23726			0	.987
	600	19970	23881						20	1.022
	MIL	25672	25349	24963	24485	24001	23393	22882	40	1.057
	V_{MAX}	625.4	611.7	595.4	575.2	553.0	524.9	499.5		
8,000 FEET (–1°C)	360	7792	8435	9105	9792	10460	11137	11849		
	420	8744	9669	10601	11530	12523	13683	15078	–40	.925
	480	10211	11454	12650	14110	15874	17808	19792	–20	.963
	540	12352	13961	15631	18467	21491			0	1.001
	600	18809	21421						20	1.037
	MIL	23104	22754	22420	22055	21656	21215	20826	40	1.072
	V_{MAX}	621.0	607.5	592.1	574.8	553.5	528.5	502.7		
12,000 FEET (–9°C)	360	7577	8141	8744	9333	9929	10560	11153		
	420	8124	8956	9755	10566	11414	12332	13460	–40	.939
	480	9288	10357	11424	12559	13971	15705	17781	–20	.978
	540	11150	12478	14017	16097	19283			0	1.016
	600	17634	20147						20	1.052
	MIL	20687	20398	20164	19901	19586	19250	18860	40	1.088
	V_{MAX}	615.0	601.7	587.8	572.0	552.3	530.2	503.6		
16,000 FEET (–16°C)	360	7559	8079	8614	9155	9748	10422	10992		
	420	7640	8342	9072	9827	10669	11433	12341	–40	.953
	480	8476	9418	10375	11423	12586	14007	15779	–20	.993
	540	10224	11433	12837	14640	16965			0	1.032
	600	16839							20	1.068
	MIL	18570	18356	18162	17953	17676	17343	16843	40	1.105
	V_{MAX}	608.9	595.8	582.1	567.1	549.0	528.4	499.7		

4G-1-(91)

Figure A4-9

HIGH ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
20,000 FEET (−25°C)	360	4553	4969	5393	5821	6252	6684	7185	−40	.968
	400	5032	5562	6101	6625	7208	7802	8474	−20	1.008
	440	5615	6276	6912	7626	8393	9224	10190	0	1.048
	480	6331	7099	7907	8833	9868	11079	12286	20	1.085
	520	7319	8259	9257	10640	12062	13822		40	1.122
	560	9375	10626	12397	14550					
	MIL	16941	16645	16412	16214	15999	15690	15274		
	VMAX	611.7	596.4	584.1	571.2	557.1	539.9	518.4		
25,000 FEET (−35°C)	360	4239	4592	4951	5311	5669	6043	6407	−40	.988
	400	4523	4968	5422	5870	6329	6808	7341	−20	1.029
	440	4949	5495	6042	6591	7220	7869	8634	0	1.069
	480	5505	6156	6777	7551	8385	9323	10525	20	1.108
	520	6410	7150	8037	9149	10376	11823		40	1.145
	560	8515	9697	11267	13263					
	MIL	14493	14163	13901	13641	13365	13000	12546		
	VMAX	604.2	587.4	574.1	561.5	548.2	530.8	509.1		
30,000 FEET (−44°C)	360	4165	4455	4746	5041	5344	5677	6032	−40	1.009
	400	4207	4569	4923	5286	5693	6124	6613	−20	1.051
	440	4439	4875	5312	5787	6313	6912	7612	0	1.092
	480	4859	5381	5907	6565	7307	8237	9361	20	1.131
	520	5672	6288	7097	8098	9152			40	1.170
	560	7929	9143	10529						
	MIL	11871	11526	11268	11017	10732	10383	9887		
	VMAX	591.6	574.5	561.5	548.5	533.8	516.1	490.2		
35,000 FEET (−55°)	360	4170	4432	4715	5013	5338	5708		−40	1.032
	400	4092	4404	4720	5080	5490	5943		−20	1.074
	440	4111	4472	4850	5284	5811	6414		0	1.116
	480	4383	5215	5716	6432	7221	8224		20	1.157
	520	5159	5734	6574	7625				40	1.196
	560	7804								
	MIL	9359	9065	8814	8602	8321	7944			
	VMAX	572.8	557.8	544.6	531.3	514.0	491.6			
40,000 FEET (−57°C)	360	4597	4898						−40	1.037
	400	4121	4430	4766	5149				−20	1.080
	440	4055	4380	4756	5221				0	1.122
	480	4166	4550	5002	5655				20	1.162
	520	4798	5339	6189					40	1.202
	560									
	MIL	7190	7012	6812	6519					
	VMAX	559.1	544.7	528.7	505.2					

4G–1–(90)

Figure A4–10

HIGH ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 40,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX 0	TOTAL FUEL FLOW – LBS/HR 20	40	60	80	100	120	TEMP EFFECTS 0°C	FACTOR
20,000 FEET (−25°C)	360	4978	5403	5830	6260	6681	7176	7642	−40	.968
	400	5362	5894	6436	6957	7562	8173	8850	−20	1.008
	440	5903	6560	7196	7906	8708	9575	10566	0	1.048
	480	6577	7344	8149	9085	10154	11348	12618	20	1.085
	520	7499	8440	9447	10863	12290	14088		40	1.122
	560	9577	10849	12652	14834					
	MIL	16904	16607	16374	16197	15982	15654	15201		
	V_{MAX}	609.9	594.5	582.3	570.0	555.8	538.0	514.7		
25,000 FEET (−35°C)	360	4813	5173	5532	5890	6241	6632	7059	−40	.988
	400	4928	5380	5833	6269	6729	7249	7786	−20	1.029
	440	5273	5817	6362	6906	7542	8240	9035	0	1.069
	480	5792	6438	7059	7831	8678	9682	10904	20	1.108
	520	6636	7395	8283	9418	10681	12185		40	1.145
	560	8763	9951	11564						
	MIL	14434	14127	13879	13604	13302	12924	12422		
	V_{MAX}	601.2	585.6	572.9	559.7	545.2	527.2	503.1		
30,000 FEET (−44°C)	360	4837	5139	5441	5761	6104	6500	6951	−40	1.009
	400	4741	5099	5466	5857	6294	6773	7326	−20	1.051
	440	4825	5260	5705	6198	6749	7403	8181	0	1.092
	480	5186	5706	6240	6927	7724	8680		20	1.131
	520	5979	6600	7461	8496	9659			40	1.170
	560	8270	9515							
	MIL	11772	11467	11209	10960	10653	10219	9635		
	V_{MAX}	586.8	571.5	558.6	545.6	529.7	507.9	476.1		
35,000 FEET (−55°)	360	4925	5242	5580	5946	6338			−40	1.032
	400	4632	4975	5345	5748	6226			−20	1.074
	440	4620	5005	5421	5932	6509			0	1.116
	480	5202	5688	6248	7022	7919			20	1.157
	520	5570	6171	7096	8116				40	1.196
	560	8332								
	MIL	9246	8963	8731	8473	8098				
	V_{MAX}	567.1	552.7	539.4	523.3	500.8				
40,000 FEET (−57°C)	360								−40	1.037
	400	5078							−20	1.080
	440	4689	5105						0	1.122
	480	4775	5239						20	1.162
	520	5397	6044						40	1.202
	560									
	MIL	7055	6869							
	V_{MAX}	548.2	533.3							

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Figure A4–11

HIGH ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
20,000 FEET (–25°C)	360	5511	5934	6358	6792	7273	7741	8270	–40	.968
	400	5742	6275	6798	7381	7963	8609	9324	–20	1.008
	440	6214	6851	7536	8237	9051	9948	10974	0	1.048
	480	6838	7622	8421	9367	10475	11646	12988	20	1.085
	520	7752	8691	9710	11139	12605	14456		40	1.122
	560	9789	11080	12918	15129					
	MIL	16867	16587	16362	16181	15956	15583	15118		
	VMAX	608.0	593.3	581.0	568.7	554.0	534.4	510.4		
25,000 FEET (–35°C)	360	5509	5867	6219	6588	7003	7402	7848	–40	.988
	400	5424	5871	6306	6743	7254	7773	8375	–20	1.029
	440	5656	6195	6712	7312	7947	8677	9550	0	1.069
	480	6107	6730	7399	8173	9035	10119	11308	20	1.108
	520	6903	7667	8563	9733	11044	12409		40	1.145
	560	9055	10275	11943						
	MIL	14387	14079	13830	13552	13238	12810	12233		
	VMAX	598.8	583.1	570.5	557.3	542.2	521.8	494.1		
30,000 FEET (–44°C)	360	5479	5801	6145	6524	6956	7352		–40	1.009
	400	5328	5706	6108	6527	7048	7551		–20	1.051
	440	5297	5741	6203	6718	7344	8069		0	1.092
	480	5566	6092	6635	7385	8257	9192		20	1.131
	520	6308	6948	7840	8904	9967			40	1.170
	560	8658	9864							
	MIL	11692	11396	11131	10846	10490	9984			
	VMAX	582.7	568.0	554.4	539.7	521.4	495.5			
35,000 FEET (–55°)	360	6058	6438						–40	1.032
	400	5347	5743	6183	6616				–20	1.074
	440	5196	5636	6129	6671				0	1.116
	480	5759	6311	6926	7819				20	1.157
	520	6050	6706	7713					40	1.196
	560	8950								
	MIL	9133	8860	8621	8244					
	VMAX	561.3	547.5	532.5	509.4					
40,000 FEET (–57°C)	360								–40	1.037
	400								–20	1.080
	440	5635							0	1.122
	480	5407							20	1.162
	520	6166							40	1.202
	560									
	MIL	6862								
	VMAX	532.7								

4G–1–(88)

Figure A4–12

HIGH ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 50,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
20,000 FEET (−25°C)	360	6146	6566	7029	7491	7972	8490	9036		
	400	6211	6734	7306	7863	8507	9171	10049	−40	.968
	440	6580	7217	7899	8650	9491	10415	11396	−20	1.008
	480	7135	7943	8771	9737	10896	12035	13473	0	1.048
	520	8002	8947	9978	11397	12936	14843		20	1.085
	560	10102	11381	13321	15575				40	1.122
	MIL	16830	16562	16334	16143	15900	15517	15008		
	V_{MAX}	606.2	592.1	579.2	566.3	550.9	530.7	504.9		
25,000 FEET (−35°C)	360	6166	6528	6936	7321	7738	8213	8714		
	400	6052	6481	6944	7417	7951	8544	9234	−40	.988
	440	6104	6624	7183	7770	8468	9258	10209	−20	1.029
	480	6475	7095	7755	8564	9475	10672	11811	0	1.069
	520	7232	8004	8928	10147	11503			20	1.108
	560	9367	10620	12348					40	1.145
	MIL	14314	14034	13768	13492	13125	12672	11967		
	V_{MAX}	595.2	580.7	567.5	554.2	536.8	515.1	481.4		
30,000 FEET (−44°C)	360	6294	6692	7132	7476	7857				
	400	5929	6332	6781	7265	7792			−40	1.009
	440	5871	6334	6835	7428	8138			−20	1.051
	480	6028	6557	7162	7978	8850			0	1.092
	520	6720	7411	8333	9338				20	1.131
	560	9092	10270						40	1.170
	MIL	11609	11313	11039	10734	10266				
	VMAX	578.6	563.9	549.7	533.8	510.2				
35,000 FEET (−55°)	360									
	400	6290	6729						−40	1.032
	440	5849	6343	6873					−20	1.074
	480	6363	6965	7668					0	1.116
	520	6649	7413						20	1.157
	560								40	1.196
	MIL	8974	8722	8417						
	VMAX	553.2	538.8	519.8						
40,000 FEET (−57°C)	360									
	400									
	440									
	480									
	520									
	560									
	MIL									
	V_{MAX}									

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Figure A4–13

HIGH ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 55,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	TOTAL FUEL FLOW – LBS/HR							TEMP EFFECTS	
		DRAG INDEX 0	20	40	60	80	100	120	0°C	FACTOR
20,000 FEET (−25°C)	360	6888	7362	7827	8336	8840	9456	10442		
	400	6733	7305	7862	8476	9134	9955	11061	−40	.968
	440	6942	7631	8313	9074	9959	10933	11878	−20	1.008
	480	7459	8261	9095	10101	11243	12450	13997	0	1.048
	520	8288	9246	10308	11739	13378	15360		20	1.085
	560	10394	11693	13700	16047				40	1.122
	MIL	16797	16529	16292	16092	15830	15432	14850		
	V_{MAX}	604.4	590.2	576.7	563.2	547.2	526.4	496.9		
25,000 FEET (−35°C)	360	6863	7255	7664	8115	8583	9134			
	400	6645	7133	7596	8123	8714	9411		−40	.988
	440	6584	7136	7694	8342	9086	9962		−20	1.029
	480	6841	7510	8173	8997	10003	11166		0	1.069
	520	7584	8365	9312	10588	12000			20	1.108
	560	9763	11033	12882					40	1.145
	MIL	14270	13986	13704	13391	13000	12434			
	V_{MAX}	592.8	578.3	564.5	549.4	530.8	503.7			
30,000 FEET (−44°C)	360	7415	7787							
	400	6630	7121	7586	8117				−40	1.009
	440	6427	6943	7502	8178				−20	1.051
	480	6528	7123	7776	8650				0	1.092
	520	7187	7909	8867	9976				20	1.131
	560	9609							40	1.170
	MIL	11514	11233	10936	10513					
	V_{MAX}	573.9	559.7	544.4	522.6					
35,000 FEET (−55°)	360									
	400								−40	1.032
	440	6686							−20	1.074
	480	7068							0	1.116
	520	7363							20	1.157
	560								40	1.196
	MIL	8786								
	V_{MAX}	542.9								
40,000 FEET (−57°C)	360									
	400									
	440									
	480									
	520									
	560									
	MIL									
	V_{MAX}									

4G–1–(86)

Figure A4–14

HIGH ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 60,000 POUNDS
REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LBS/HR						TEMP EFFECTS	
		0	20	40	60	80	100	120	0°C	FACTOR
20,000 FEET (–25°C)	360	7584	8078	8577	9113	9873	10944	11830		
	400	7421	7977	8591	9232	10085	11167	11862	-40	.968
	440	7449	8124	8852	9668	10590	11498	12547	-20	1.008
	480	7870	8692	9529	10589	11692	13003	14364	0	1.048
	520	8629	9600	10700	12142	13846	15303		20	1.085
	560	10702	12022	14065	15975				40	1.122
	MIL	16773	16488	16242	16061	15663	15314	14628		
	VMAX	602.9	588.0	572.9	560.9	538.3	520.2	485.8		
25,000 FEET (–35°C)	360	7682	8134	8604	9131	10094	11625			
	400	7289	7773	8311	8890	9648	10725		-40	.988
	440	7209	7764	8383	9082	9931	10920		-20	1.029
	480	7339	7988	8686	9579	10719	11803		0	1.069
	520	7995	8799	9797	11108	12612			20	1.108
	560	10143	11451	13441					40	1.145
	MIL	14201	13889	13635	13175	12803	11969			
	VMAX	589.2	573.2	561.0	539.0	521.3	481.4			
30,000 FEET (–44°C)	360	8755	9236							
	400	7523	8044	8589	9140				-40	1.009
	440	7047	7610	8258	8911				-20	1.051
	480	7068	7713	8451	9292				0	1.092
	520	7750	8518	9496					20	1.131
	560	10094							40	1.170
	MIL	11376	11028	10642	9944					
	VMAX	566.8	549.0	529.0	493.2					
35,000 FEET (–55°)	360									
	400								-40	1.032
	440	7832							-20	1.074
	480	7393							0	1.116
	520	8091							20	1.157
	560								40	1.196
	MIL	8506								
	VMAX	525.2								
40,000 FEET (–57°C)	360									
	400									
	440									
	480									
	520									
	560									
	MIL									
	VMAX									

4G-1-(261)

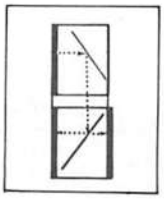
Figure A4–15

CONSTANT MACH/ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

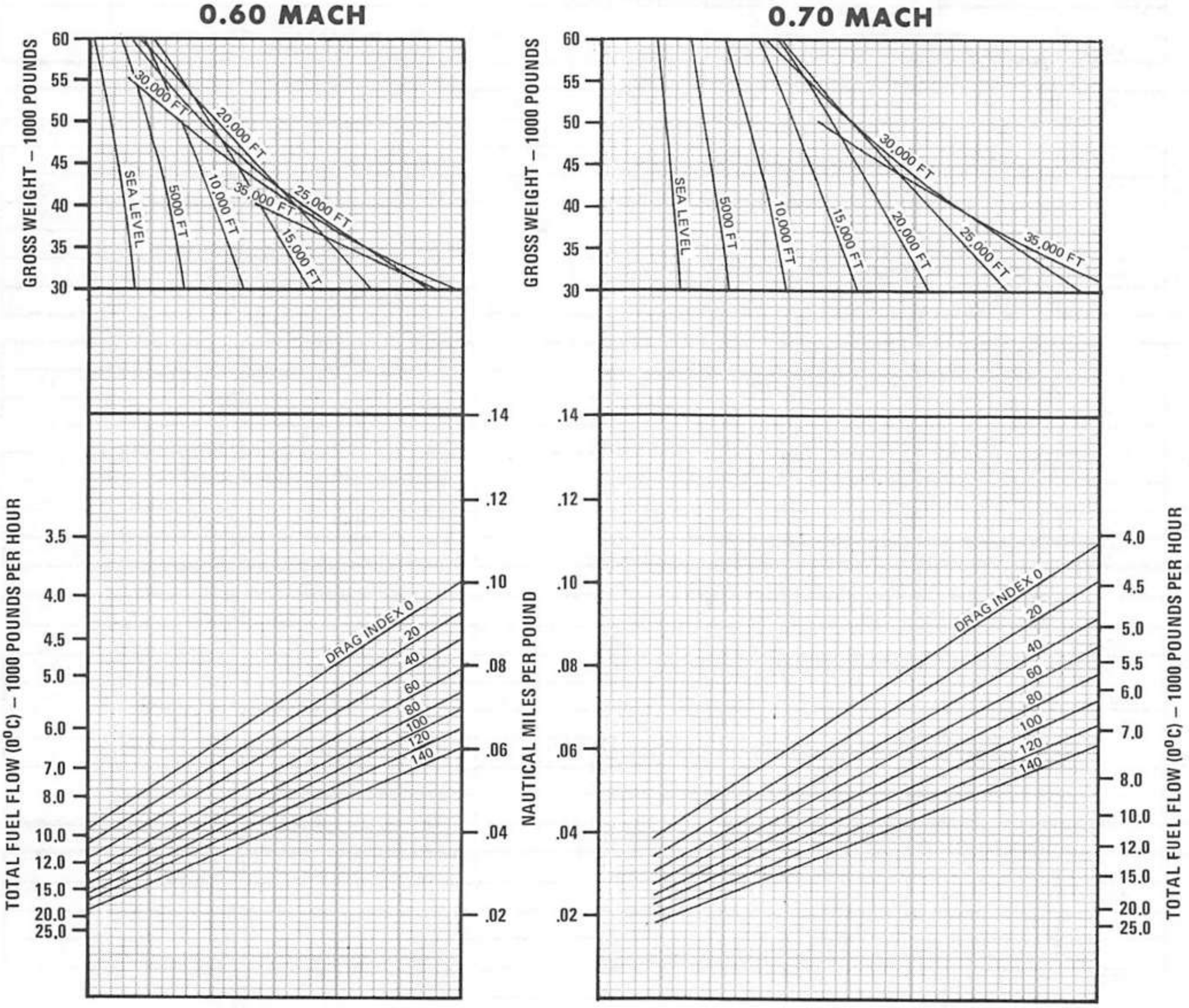
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY


GUIDE

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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



4G-1-(85)

Figure A4–16

CONSTANT MACH/ALTITUDE CRUISE

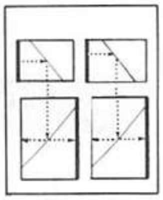
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

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 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

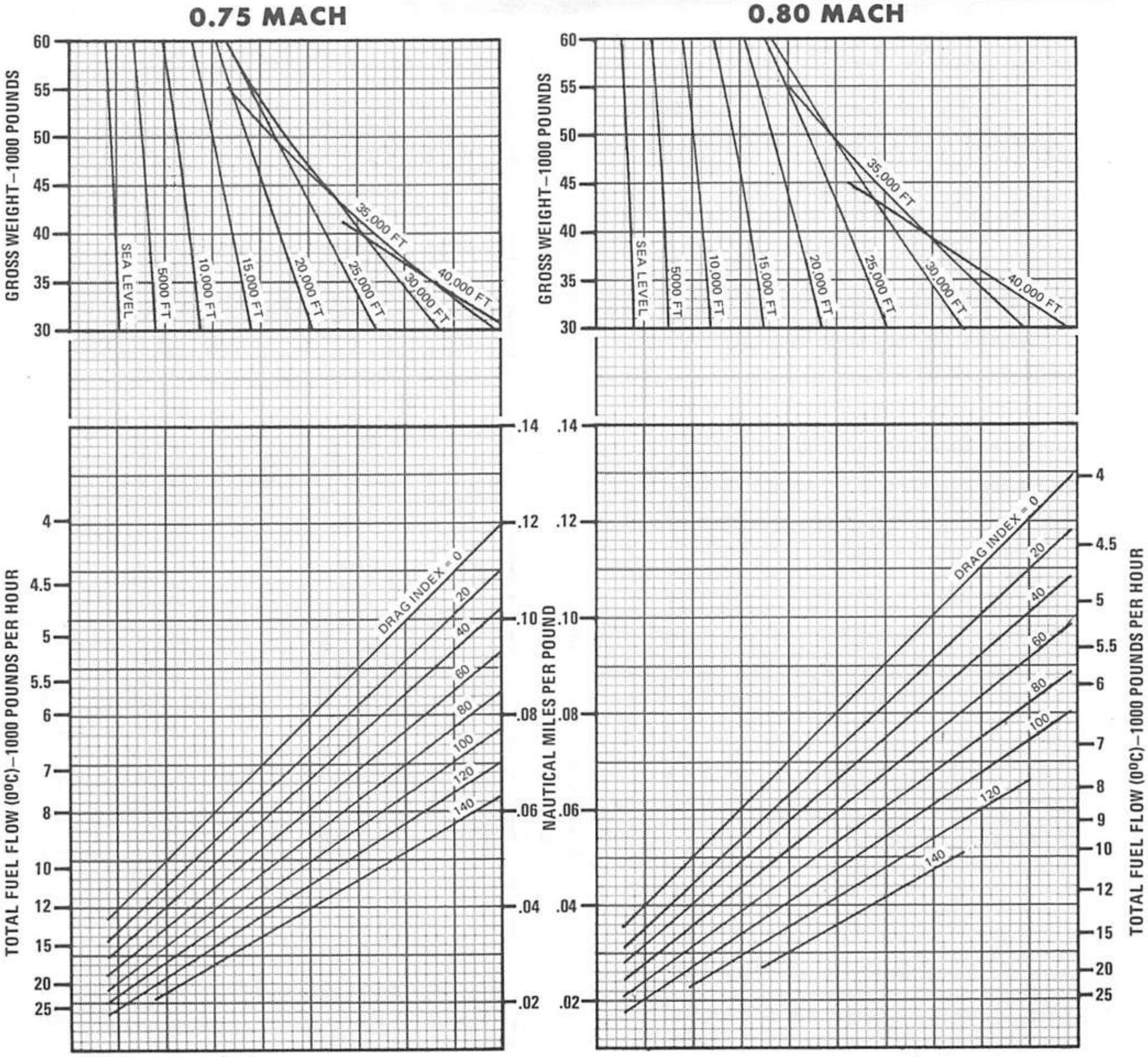
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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



4G–1–(84)

Figure A4–17

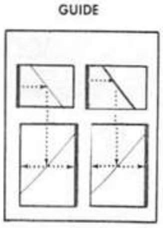
CONSTANT MACH/ALTITUDE CRUISE

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 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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

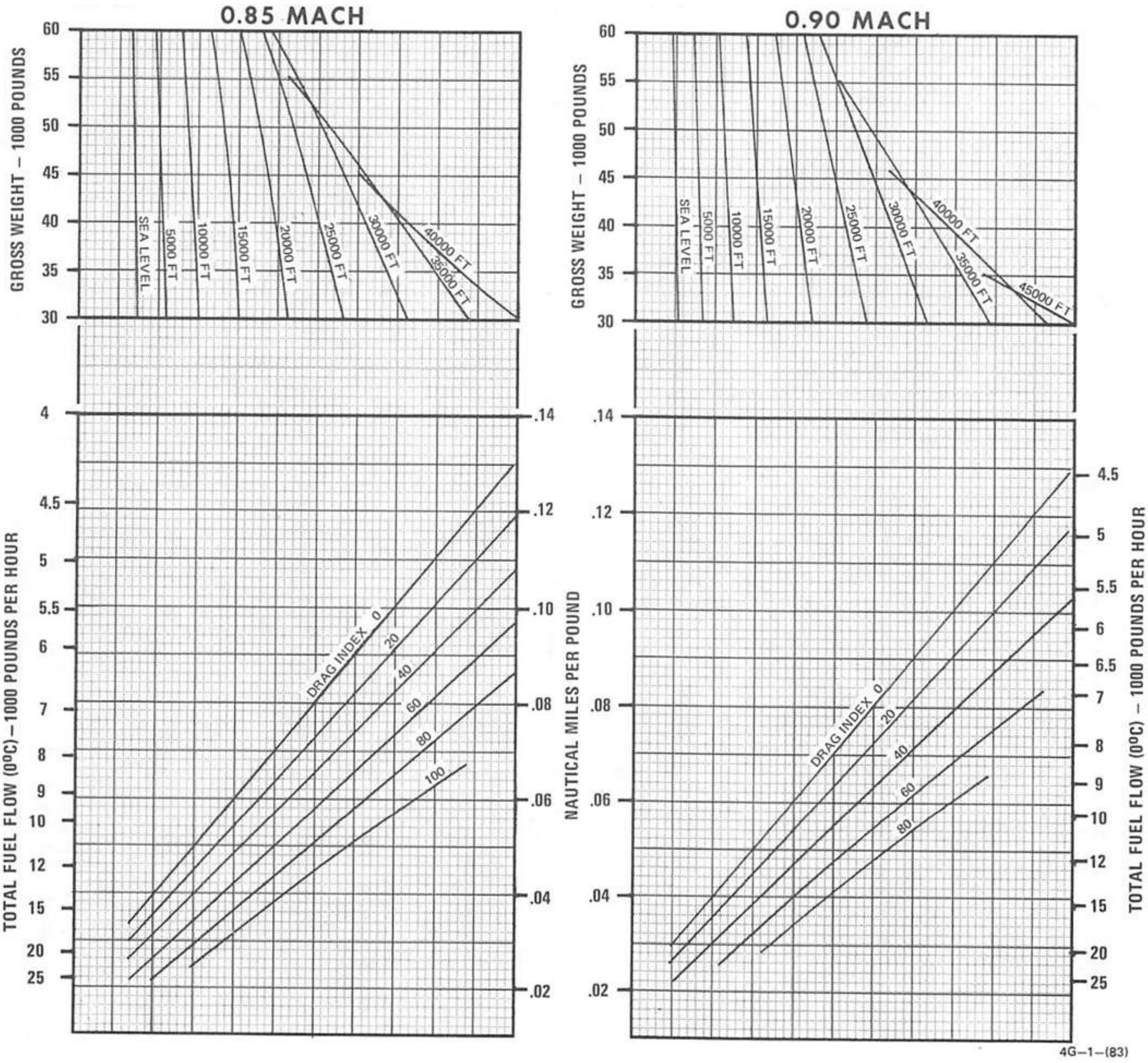


Figure A4-18

CONSTANT MACH / ALTITUDE CRUISE

ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

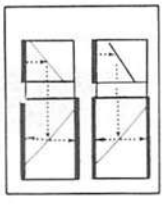
ICAO STANDARD DAY	
ALT FT	TEMP °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79–GE–17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS

GUIDE



FUEL GRADE: JP–4
FUEL DENSITY: 6.5 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

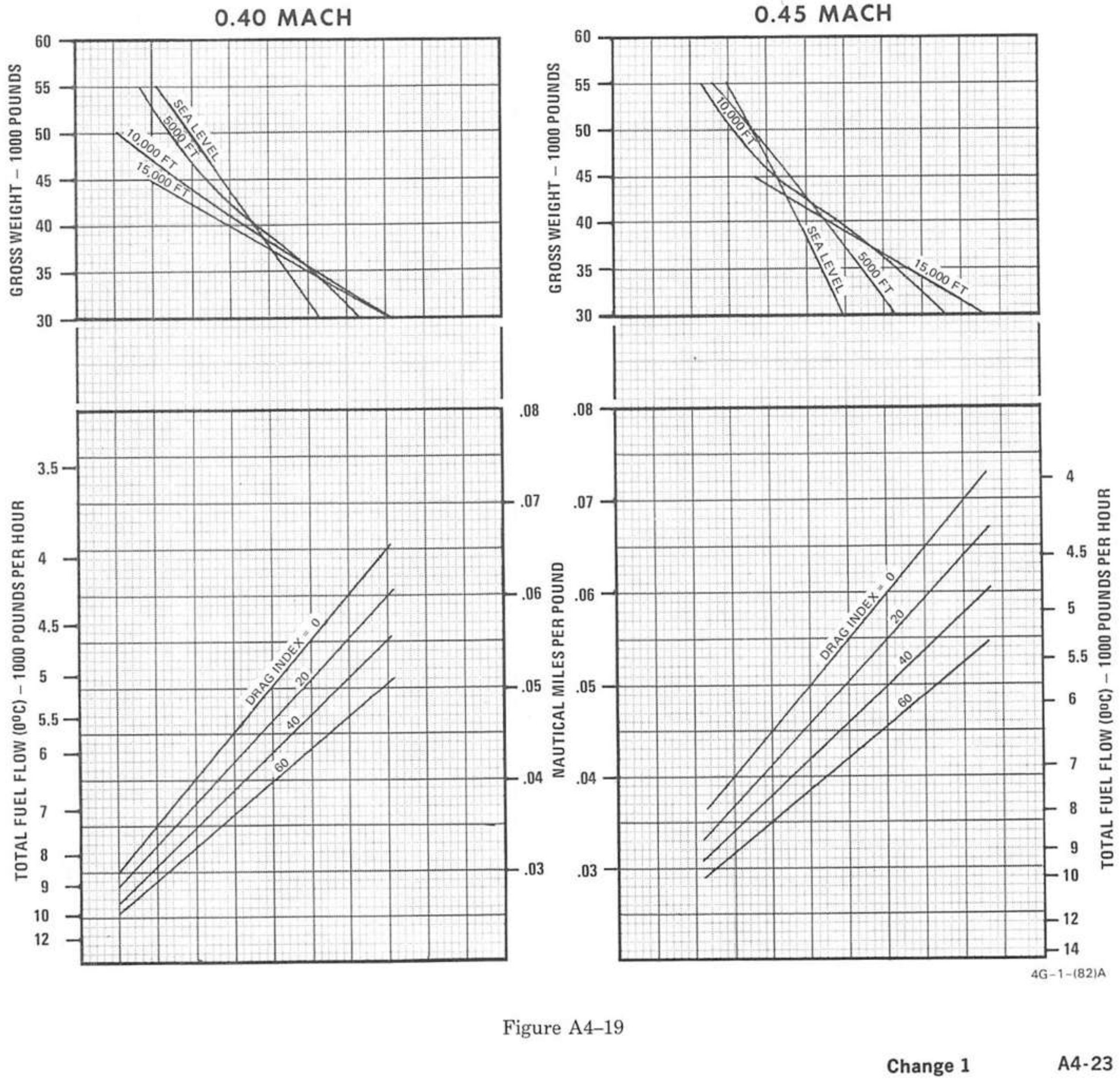


Figure A4–19

CONSTANT MACH/ALTITUDE CRUISE

ONE ENGINE OPERATING

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 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

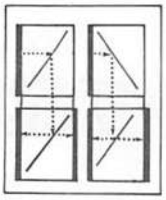
REMARKS

ENGINE(S): (2) J79–GE–17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

NOTE

IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS.

GUIDE



FUEL GRADE: JP–4
FUEL DENSITY: 6.5 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

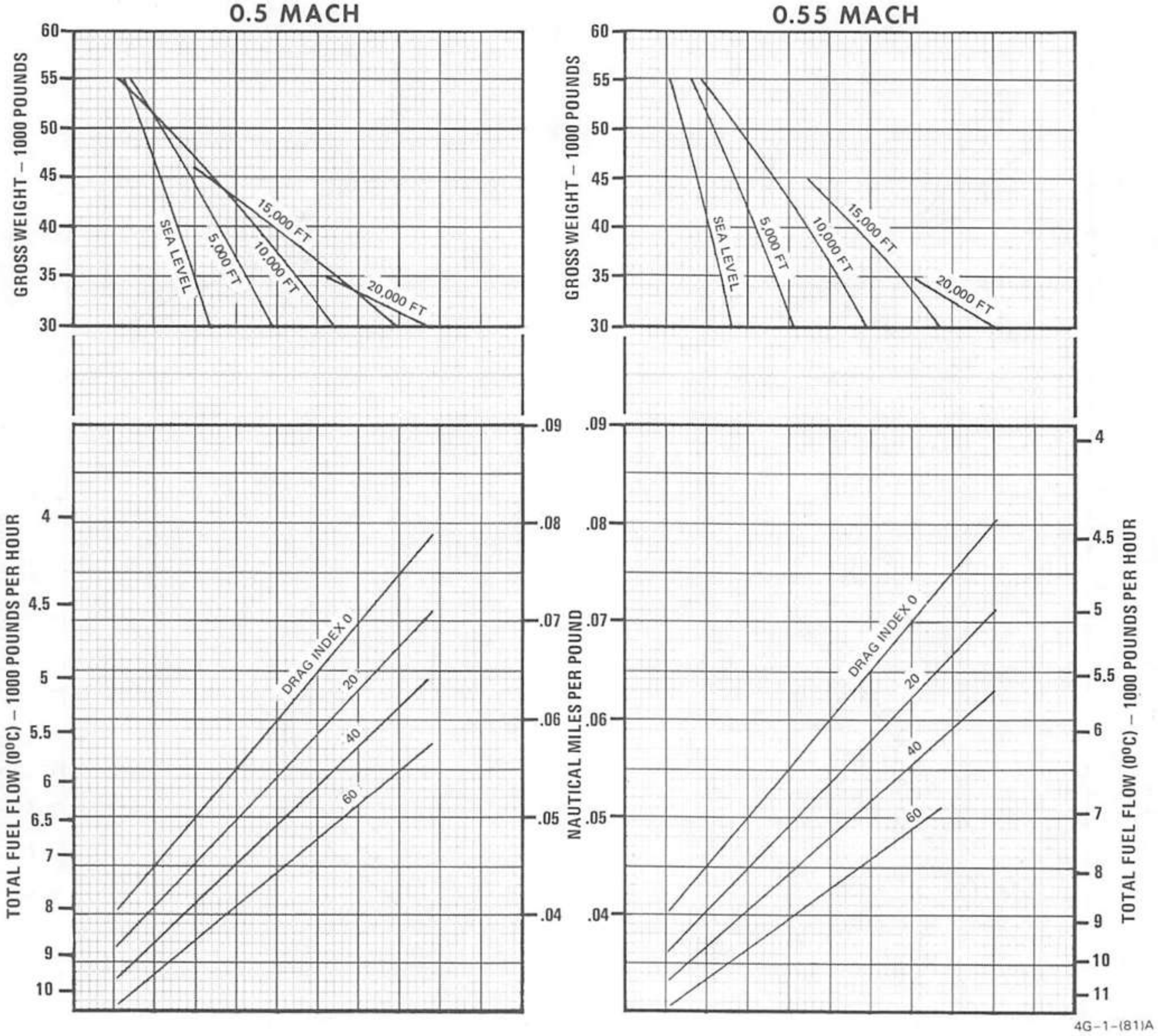


Figure A4–20

CONSTANT MACH/ALTITUDE CRUISE

ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

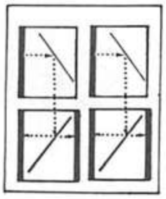
ICAO STANDARD DAY	
ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

REMARKS
ENGINE(S): (2) J79-GE-17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

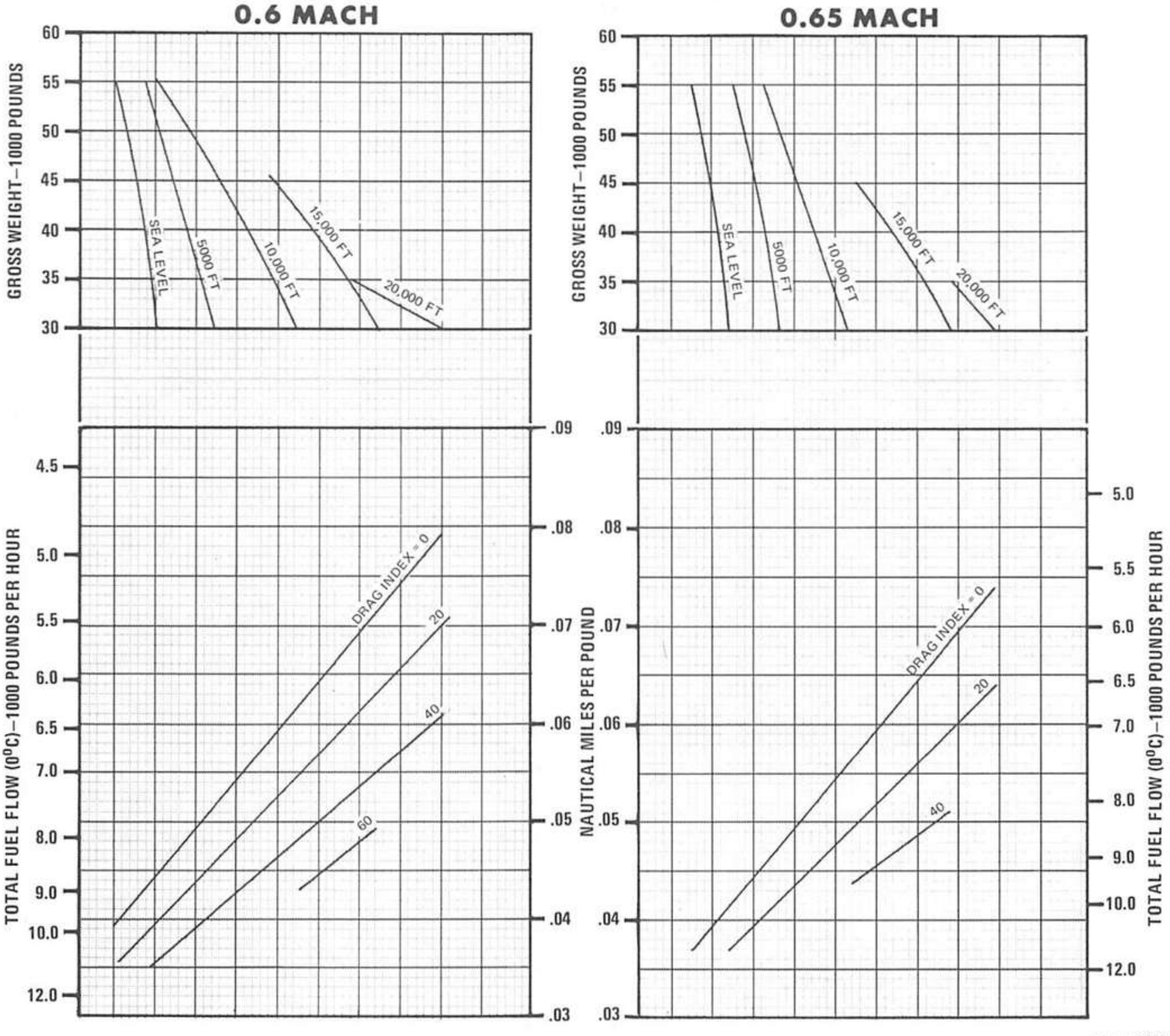
NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS.

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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



0.6 MACH

0.65 MACH

4G-1-(80)A

Figure A4-21

CONSTANT MACH/ALTITUDE CRUISE

ONE ENGINE OPERATING

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 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

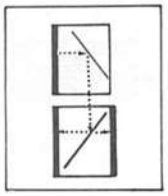
REMARKS

ENGINE(S), (2) J79–GE-17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

NOTE

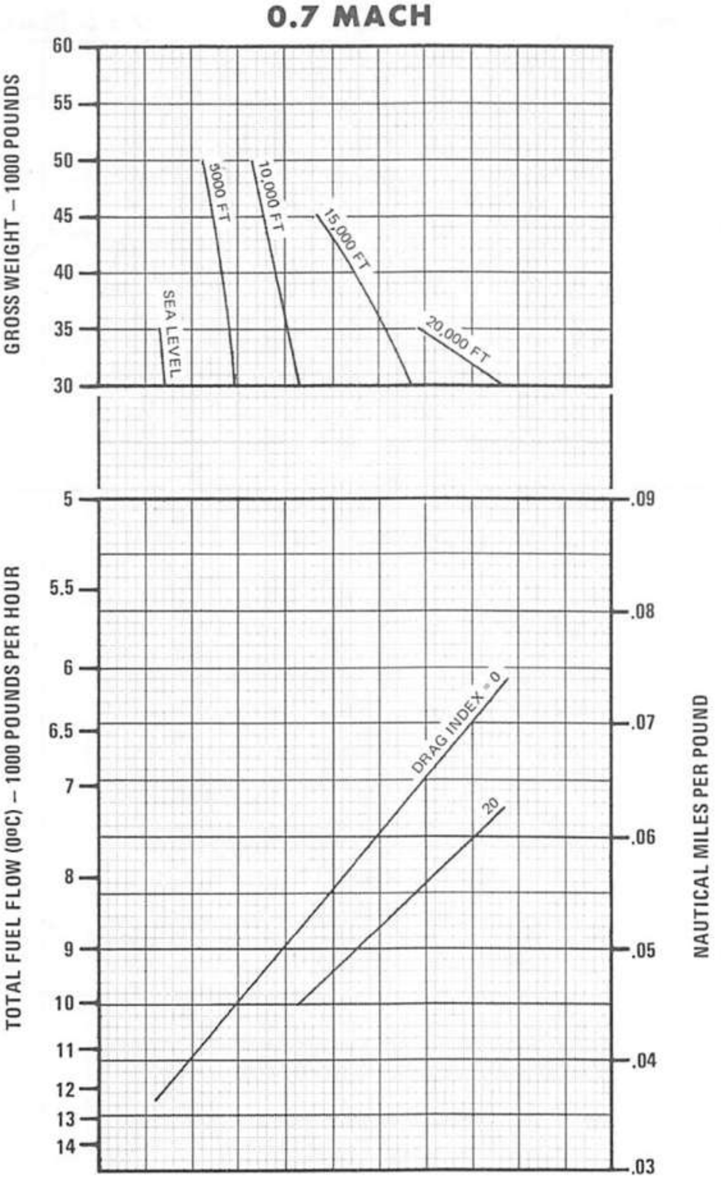
IF INOPERATIVE ENGINE IS NOT WINDMILLING INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS

GUIDE



FUEL GRADE: JP–4
FUEL DENSITY: 6.5 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



4G-1-(79)A

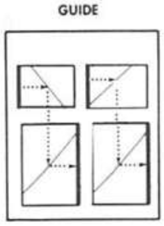
Figure A4–22

CONSTANT ALTITUDE CRUISE

LONG RANGE SPEED NAUTICAL MILES PER POUND AND MACH NUMBER

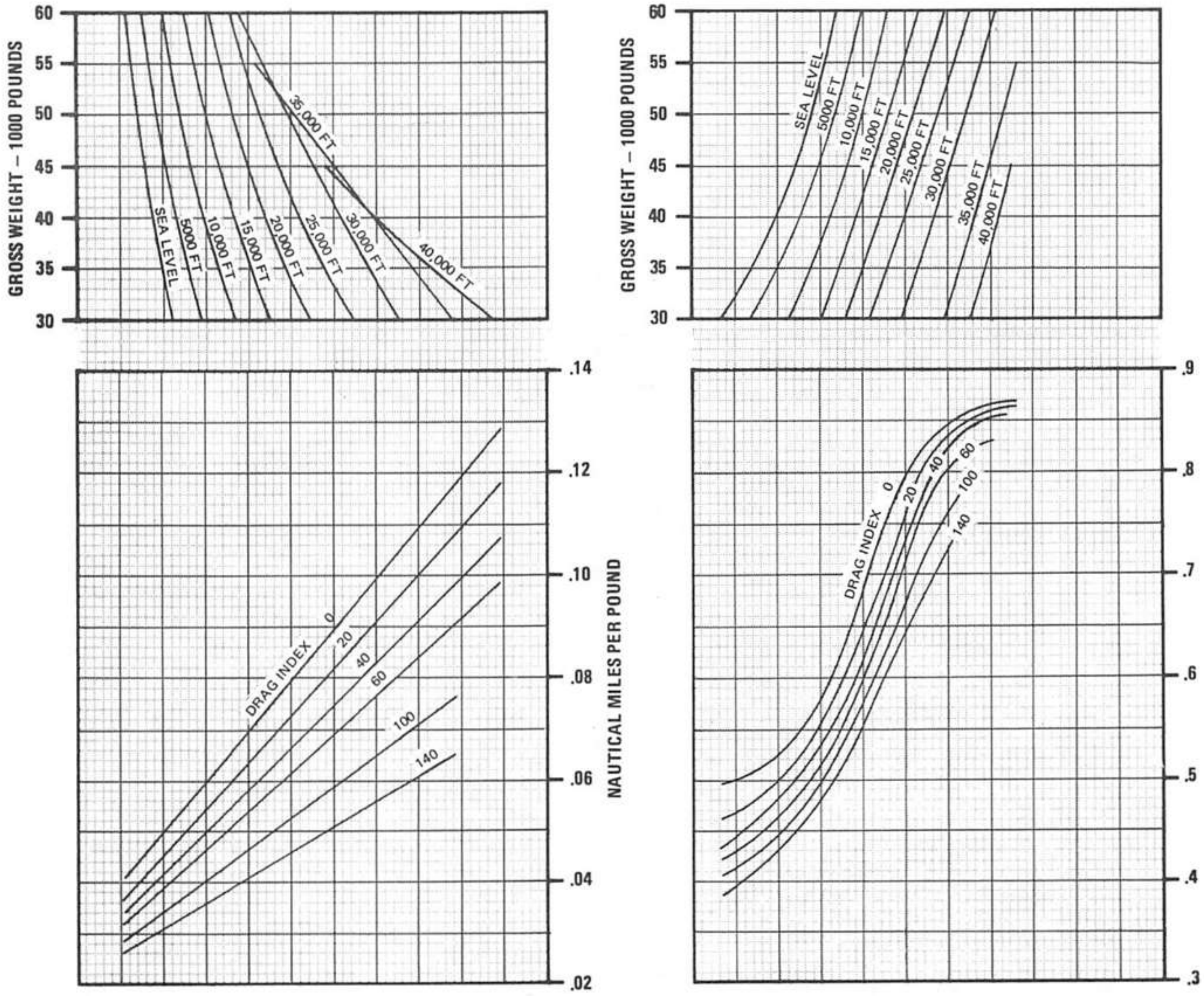
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(78-1)

Figure A4-23 (Sheet 1 of 2)

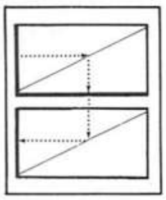
CONSTANT ALTITUDE CRUISE

LONG RANGE SPEED
TRUE AIRSPEED AND FUEL FLOW

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

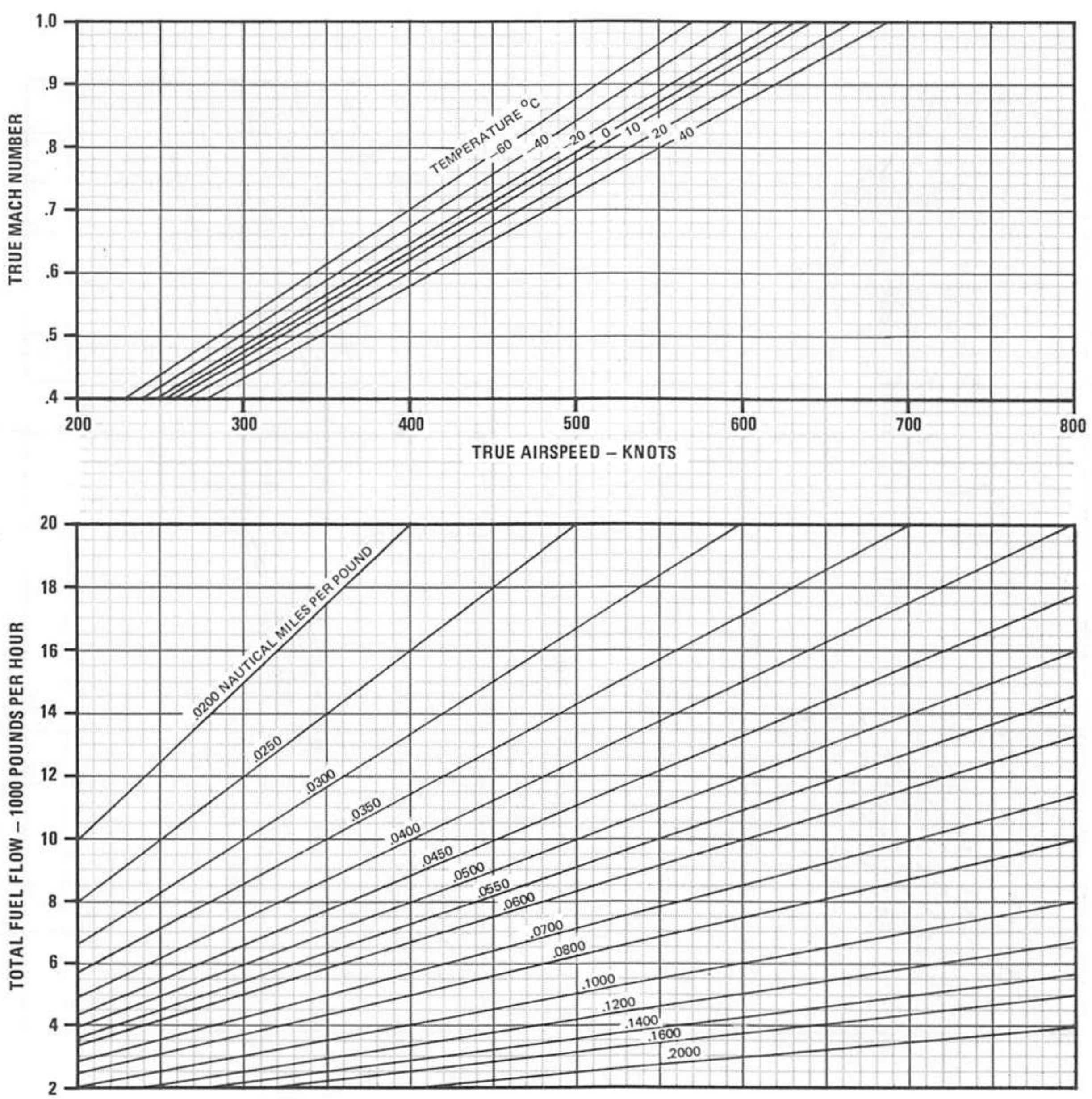
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(78–2)

Figure A4–23 (Sheet 2 of 2)

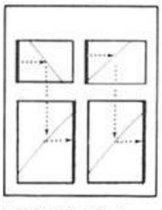
CONSTANT ALTITUDE CRUISE

LONG RANGE SPEED
NAUTICAL MILES PER POUND
AND MACH NUMBER
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79–GE–17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

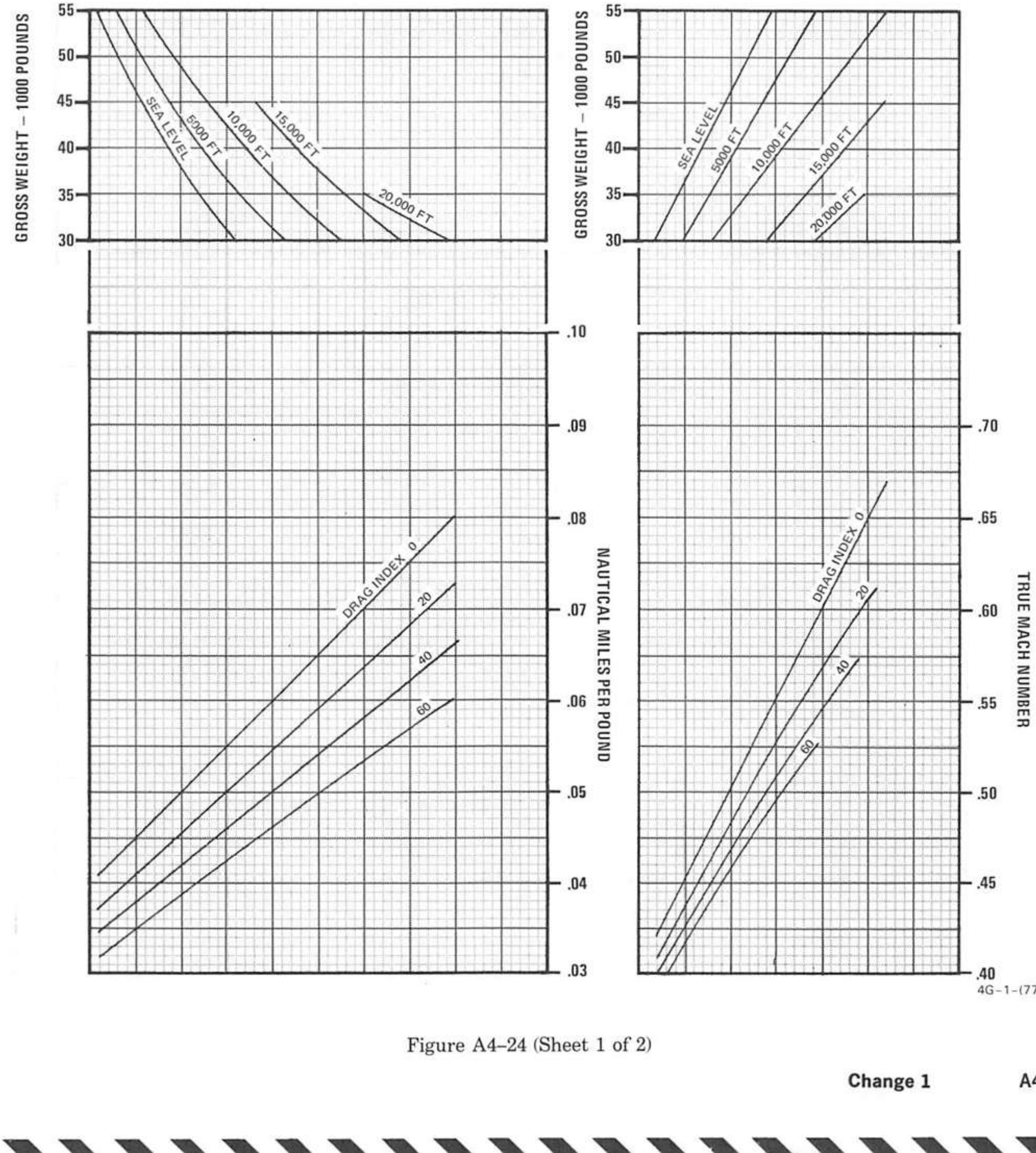
GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

NOTE
IF INOPERATIVE ENGINE IS NOT
WINDMILLING, INCREASE DRAG
INDEX BY 3 ADDITIONAL UNITS

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(77-1)A

Figure A4–24 (Sheet 1 of 2)

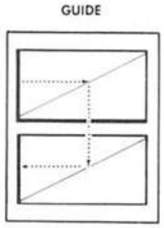
CONSTANT ALTITUDE CRUISE

LONG RANGE SPEED
TRUE AIRSPEED AND FUEL FLOW
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

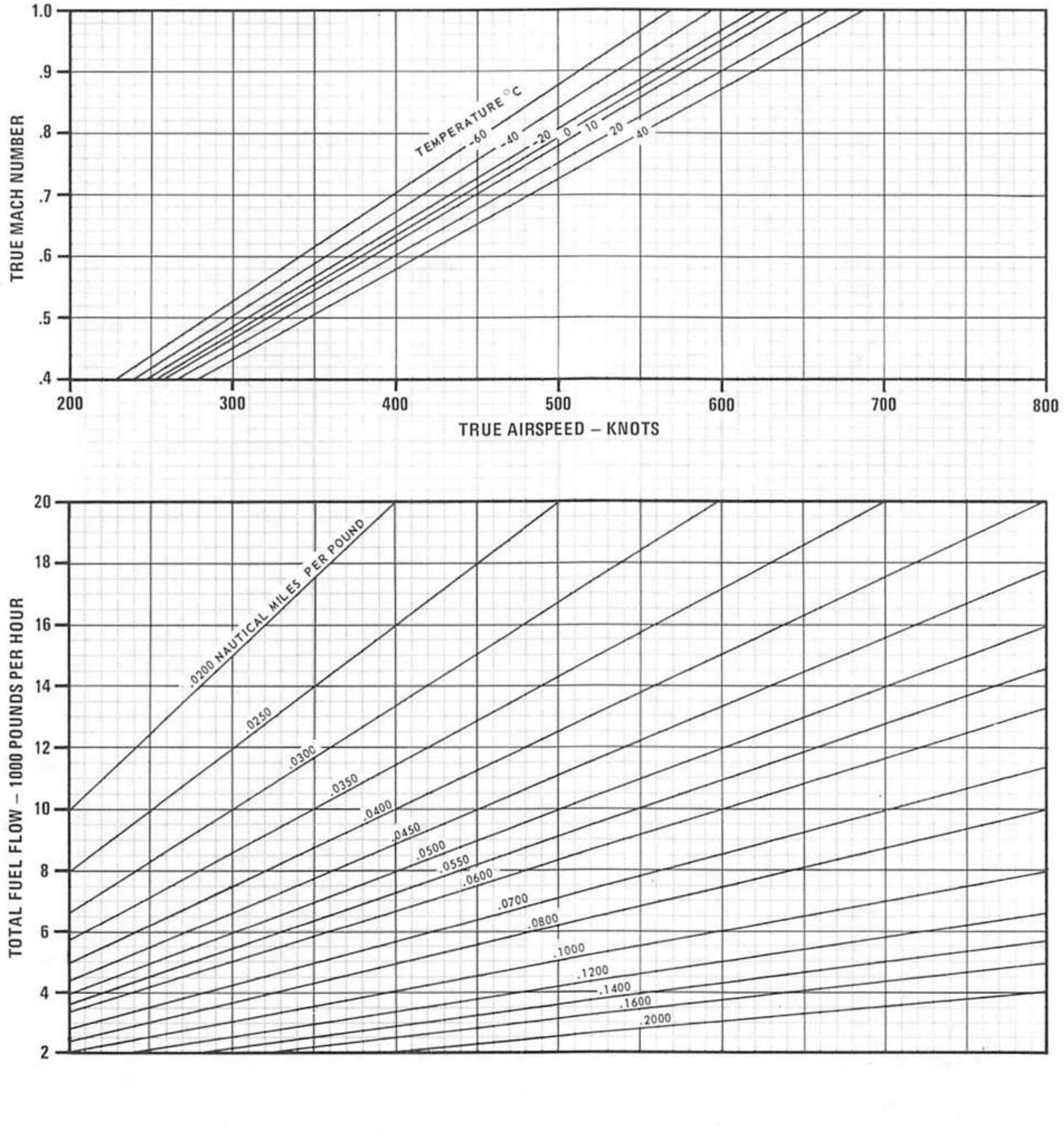
REMARKS
ENGINE(S): (2) J79-GE-17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(77-2)A

Figure A4–24 (Sheet 2 of 2)

PART 5

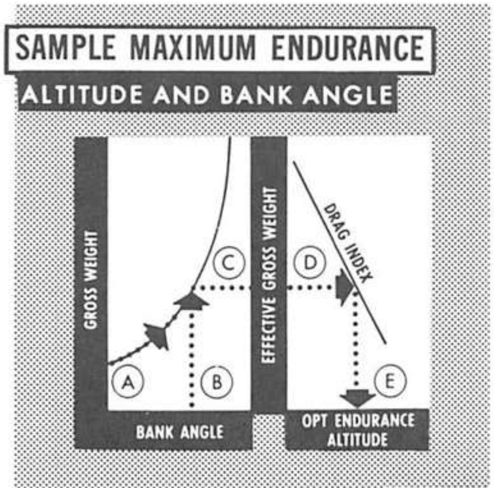
ENDURANCE

MAXIMUM ENDURANCE CHARTS

These charts (figures A5-1 thru A5-5) present optimum endurance altitude and maximum endurance specifics (fuel flow and Mach number) for all combinations of drag index, effective gross weight, and altitude. Separate charts are included for single engine operation.

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 vertically and intersect the computed drag index then horizontally to the left (drag index 0–60) or right (drag index 60 – 140) and read true Mach number. From the intersection of endurance altitude and computed drag index, proceed horizontally to the right (drag index 0 – 60) or left (drag index 60 – 140) and read optimum endurance altitude. Enter the Fuel Flow 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 fuel flow.



4G–1–(134)

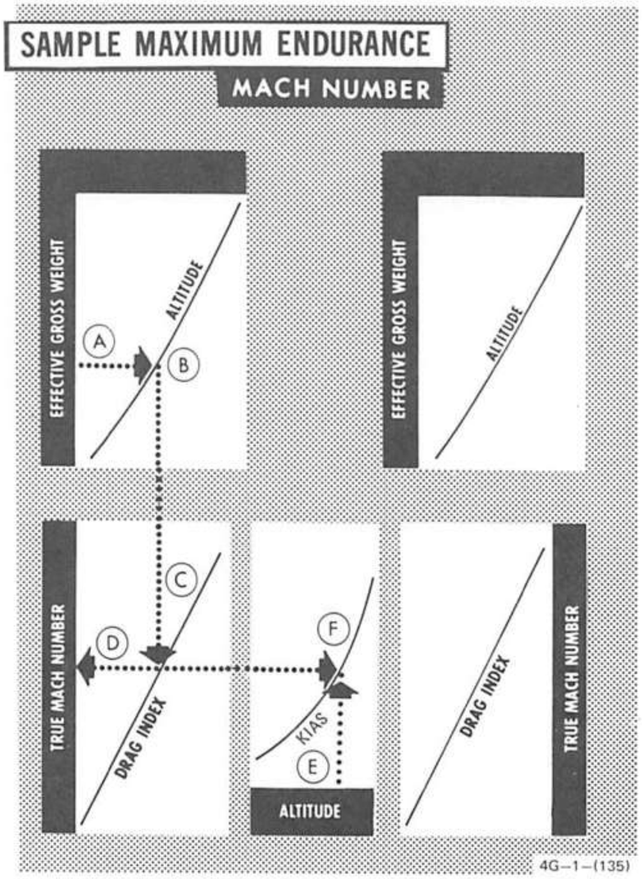
Sample Problem

Altitude and Bank Angle

A. Gross weight	45,000 Lb
B. Bank angle	20°
C. Effective gross weight	48,000 Lb
D. Drag index	40
E. Optimum endurance altitude	30,300 Ft

Mach Number

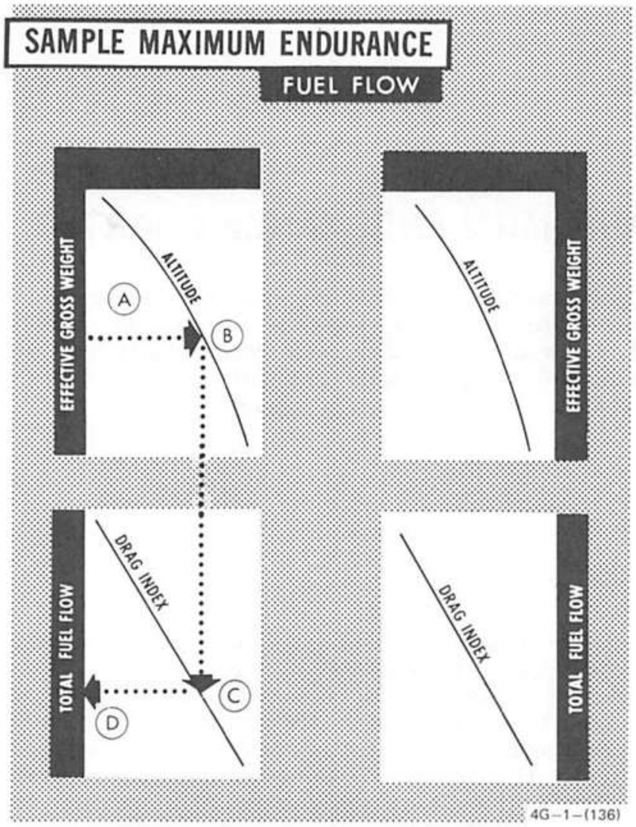
A. Effective gross weight	48,000 Lb
B. Endurance altitude	30,300 Ft
C. Drag index	40
D. Mach number	0.72
E. Endurance altitude	30,000 Ft
F. Airspeed IAS	265 Kt



4G–1–(135)

Fuel Flow

A. Effective gross weight	48,000 Lb
B. Endurance altitude	30,300 Ft
C. Drag index	40
D. Fuel flow	6500 PPH



4G-1-(136)

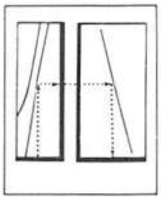
MAXIMUM ENDURANCE

ALTITUDE AND BANK ANGLE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

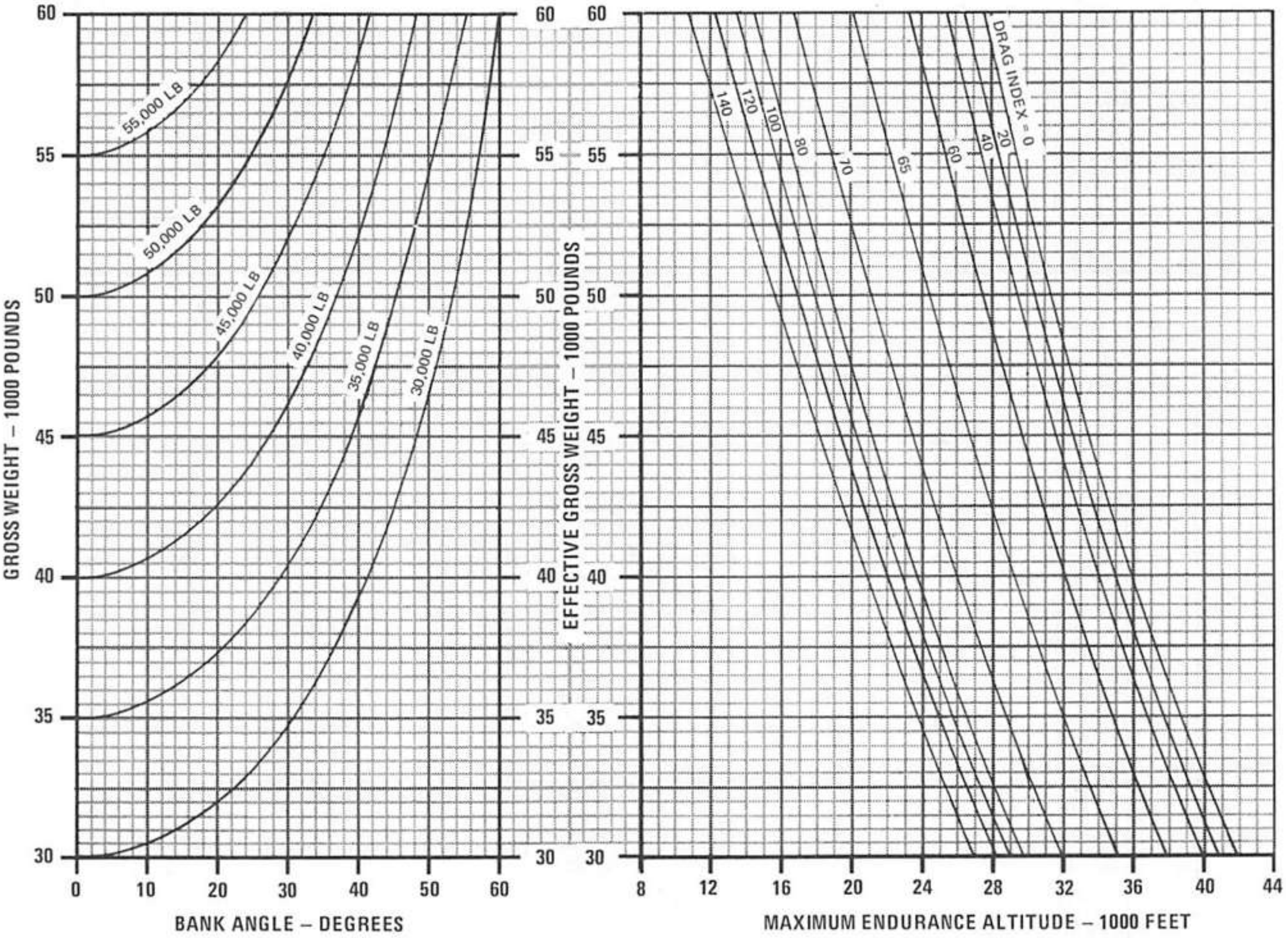
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(76)

Figure A5-1

MAXIMUM ENDURANCE

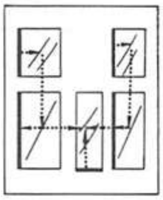
MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

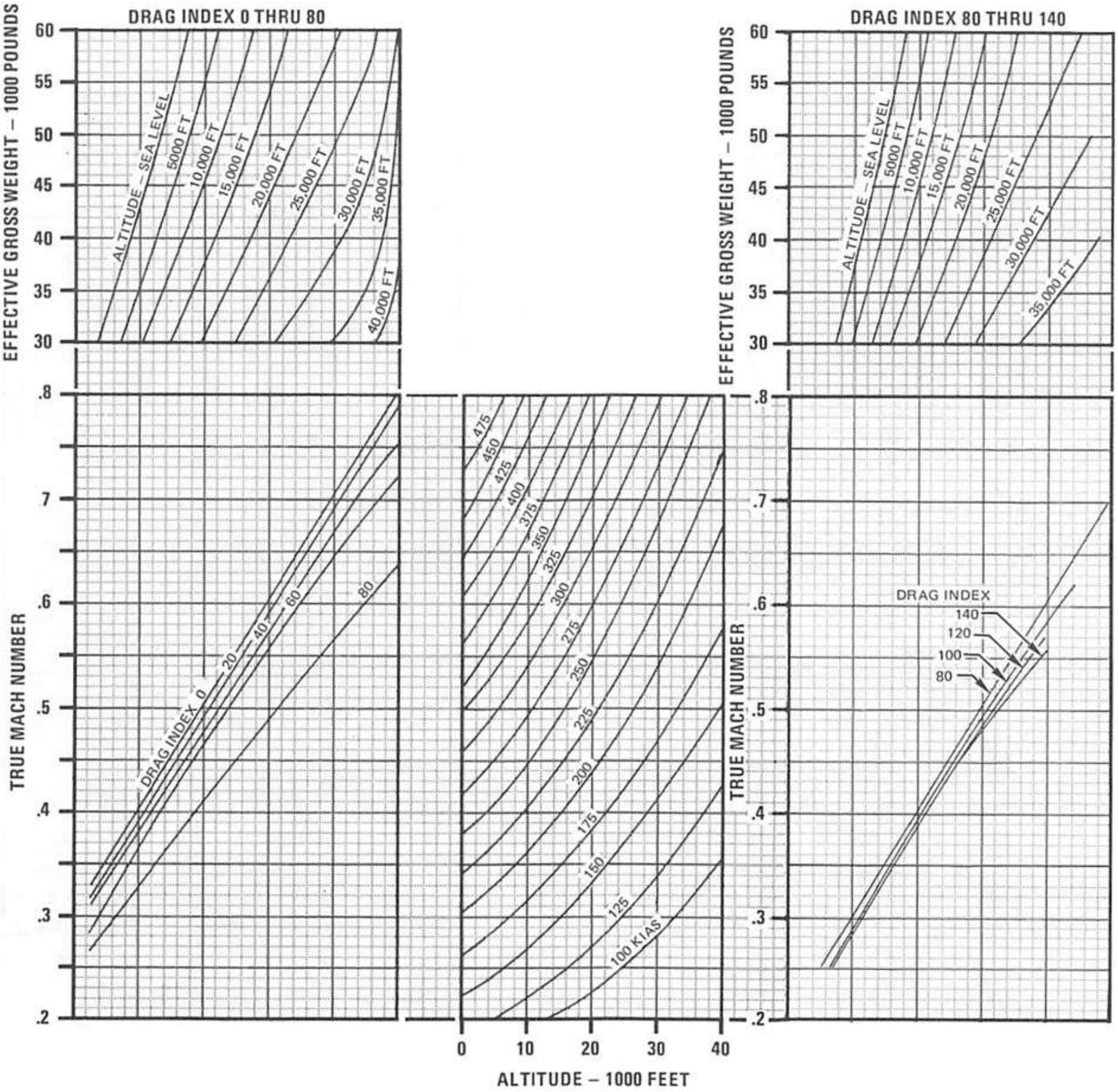
REMARKS
ENGINE(S): (2)J79-GE-17
ICAO STANDARD DAY

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(75)

Figure A5-2

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
(0-80)

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 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

MAXIMUM ENDURANCE

FUEL FLOW

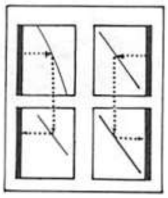
REMARKS

ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

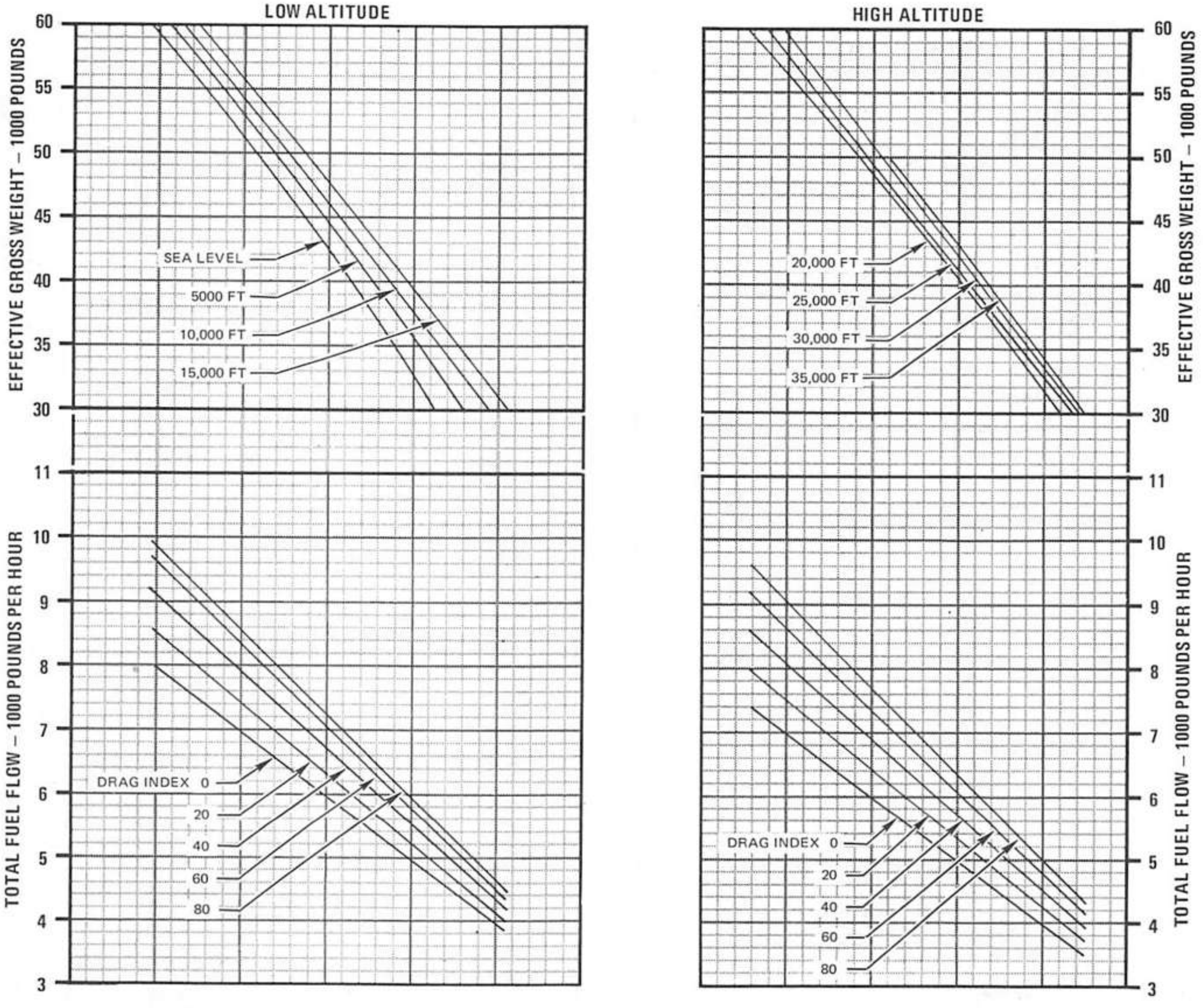
NOTE

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–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(74–1)

Figure A5–3 (Sheet 1 of 2)

MAXIMUM ENDURANCE *(Continued)*

FUEL FLOW

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
(30 – 140)

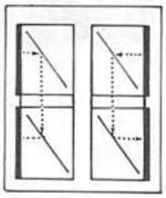
ICAO STANDARD DAY	
ALT. FT.	TEMP. °C
S.L.	15.0
5000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
40,000	-56.5
45,000	-56.5
50,000	-56.5

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

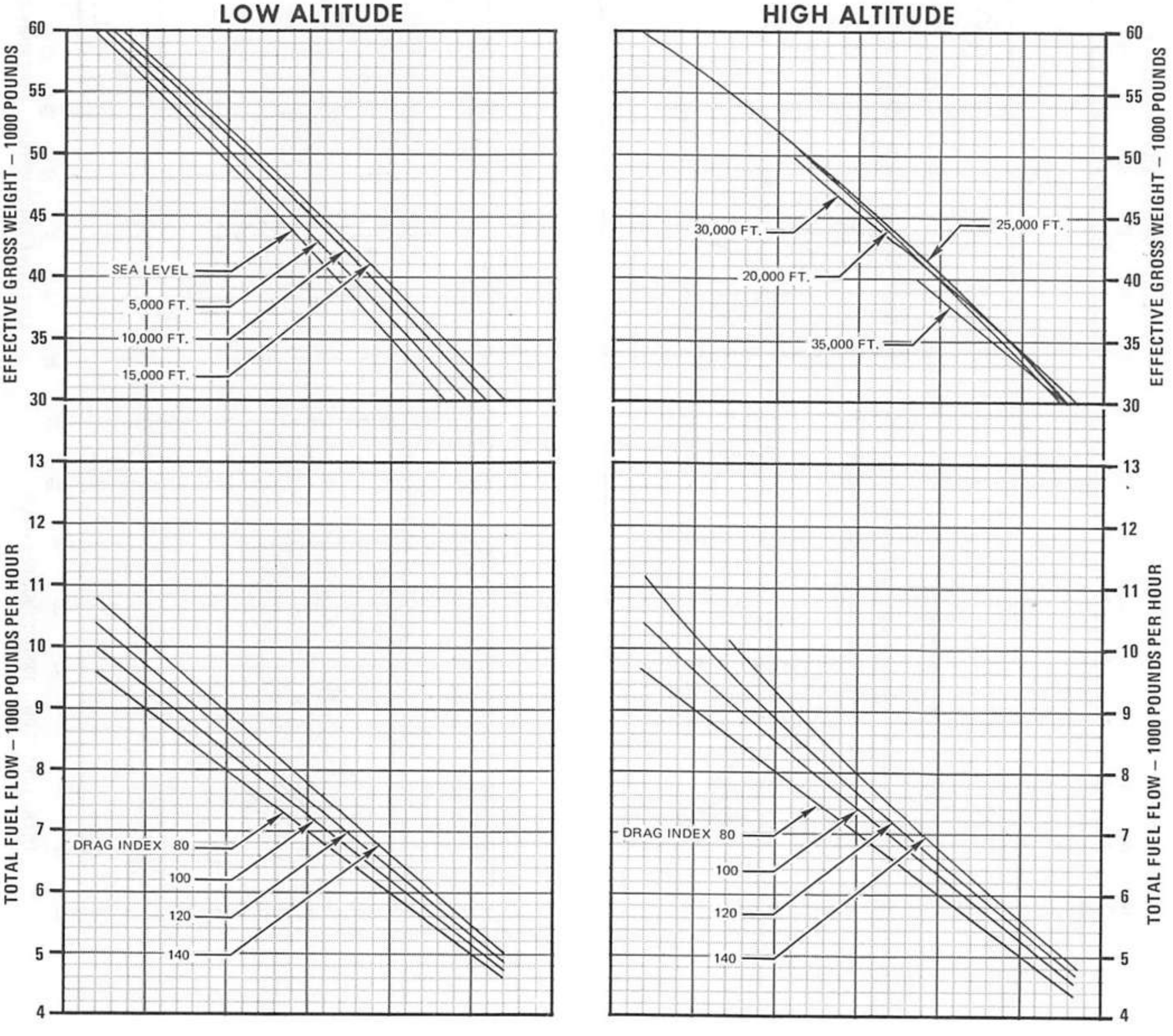
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

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–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(74–2)

Figure A5–3 (Sheet 2 of 2)

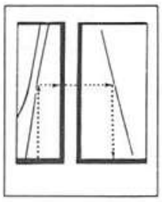
MAXIMUM ENDURANCE

ALTITUDE AND BANK ANGLE
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE (S): (2) J79-GE-17
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

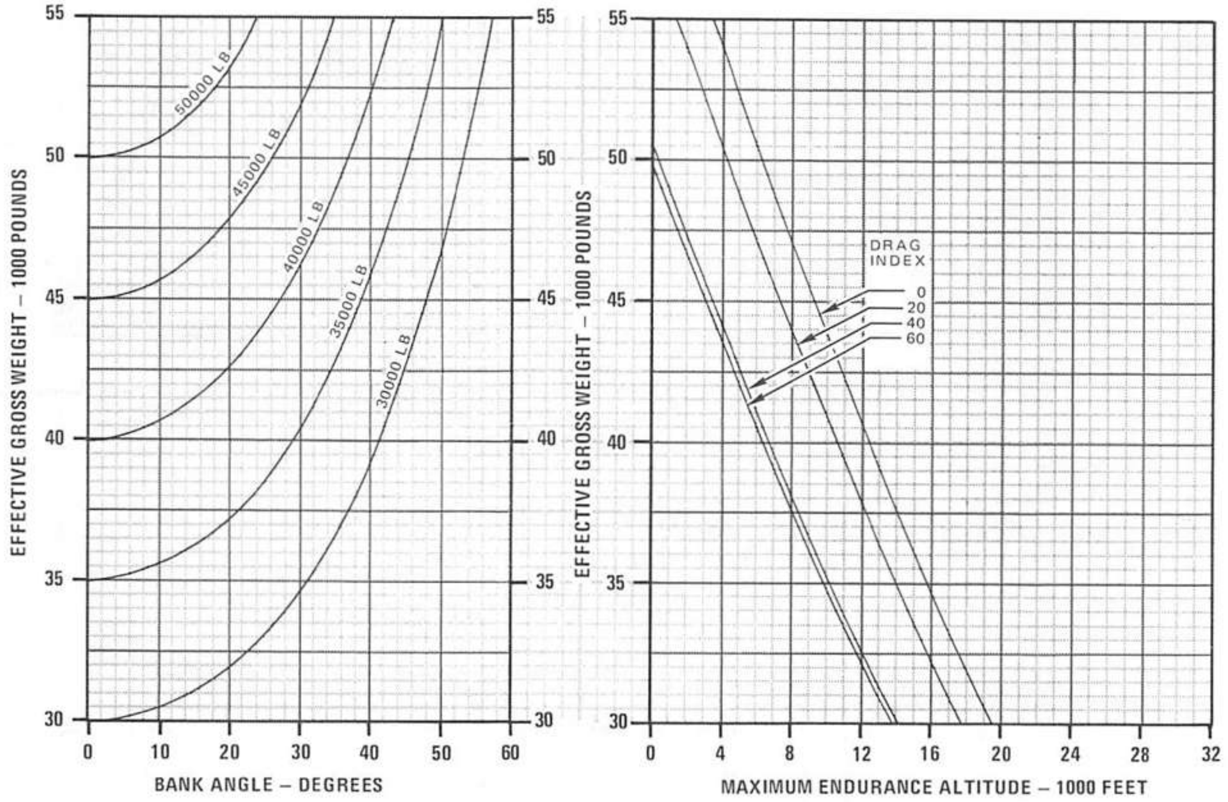
GUIDE



NOTE
IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS.

DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(73)A

Figure A5-4

MAXIMUM ENDURANCE
MACH NUMBER AND FUEL FLOW
ONE ENGINE OPERATING

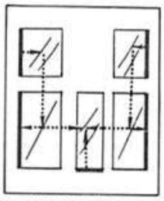
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) J79-GE-17

NOTE

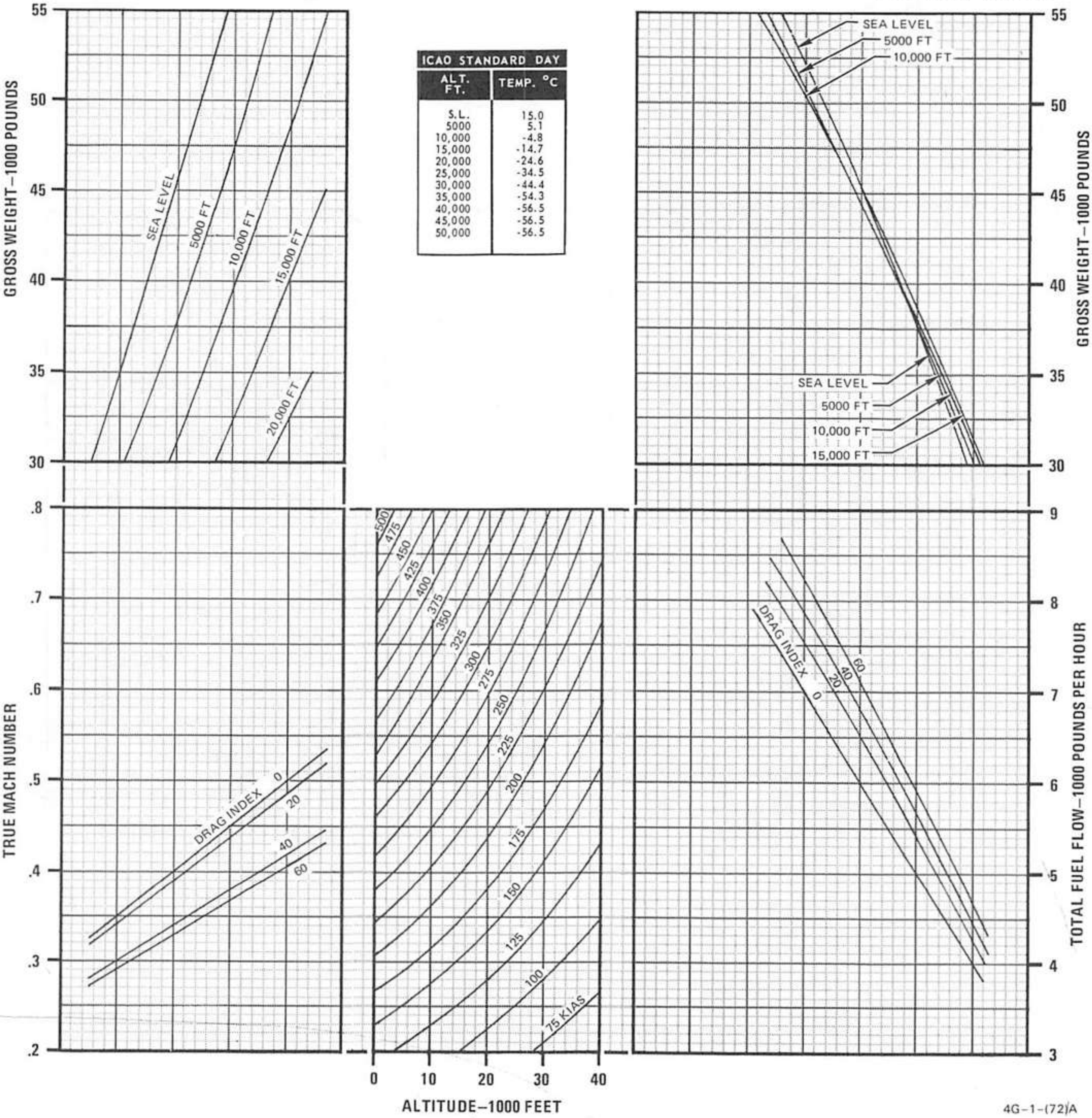
- IF INOPERATIVE ENGINE IS NOT WINDMILLING, INCREASE DRAG INDEX BY 3 ADDITIONAL UNITS.
- TOTAL FUEL FLOW IS DIRECTLY PROPORTIONAL TO TEMPERATURE CHANGE, INCREASING OR DECREASING 2% FOR EACH 10°C INCREMENT FROM STANDARD DAY.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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 A5-5

PART 6
AIR REFUELING

Refer to Air Refueling Manual, TO 1-1C-1-8.

PART 7

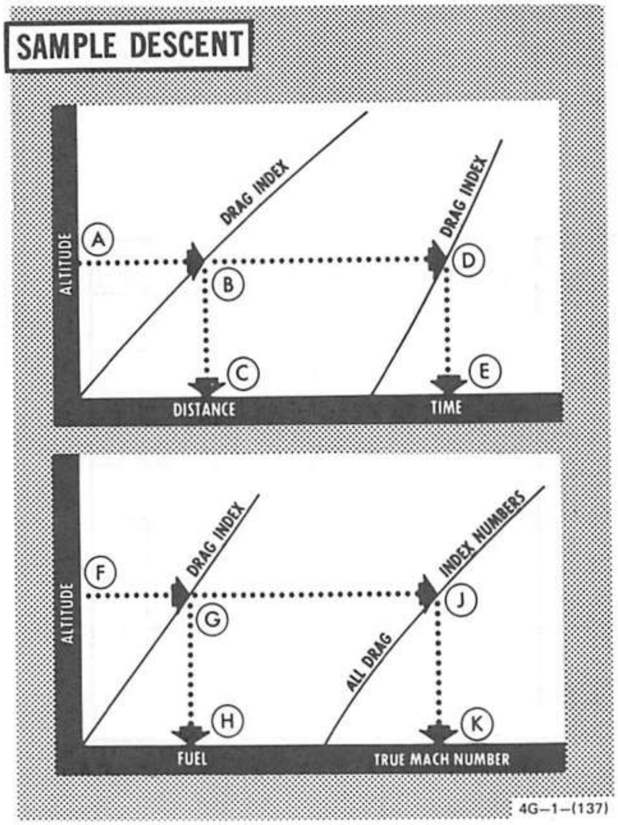
DESCENT

DESCENT

The descent charts (figures A7-1 thru A7-3) present distance, time, fuel used, and Mach number in the descent. Incremental data may be obtained for distance, time, and fuel by subtracting data corresponding to level off altitude from the data for the original crusing altitude.

USE

Enter the upper plot of the appropriate chart at the cruising flight level, project horizontally to the right to intersect both drag reflectors at the applicable computed drag index. From the first intersection, project vertically downward to intersect and read the distance. From the second intersection, project vertically downward to intersect and read time to descend. Enter the lower plot with the cruising altitude and proceed horizontally to the right to intersect the drag reflector at the applicable computed drag index on the fuel graph. Continue horizontally to the right to intersect the single drag reflector on the Mach number graph. From the intersection on the fuel graph, project vertically downward to intersect and read fuel required. From the intersection at the single drag reflector on the Mach number graph, project vertically downward to intersect and read Mach number.



Sample Problem

Descent (idle thrust), 250 KIAS

A. Altitude	30,000 Ft
B. Computed drag index	40.0
C. Distance	38 NM
D. Computed drag index	40.0
E. Time required	7.5 Min
F. Altitude	30,000 Ft
G. Computed drag index	40.0
H. Fuel required	180 Lb
J. Single drag reflector	
K. Mach number	0.67 Mach

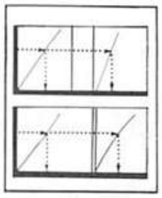
DESCENT

250 KIAS-IDLE THRUST
MAXIMUM RANGE
SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

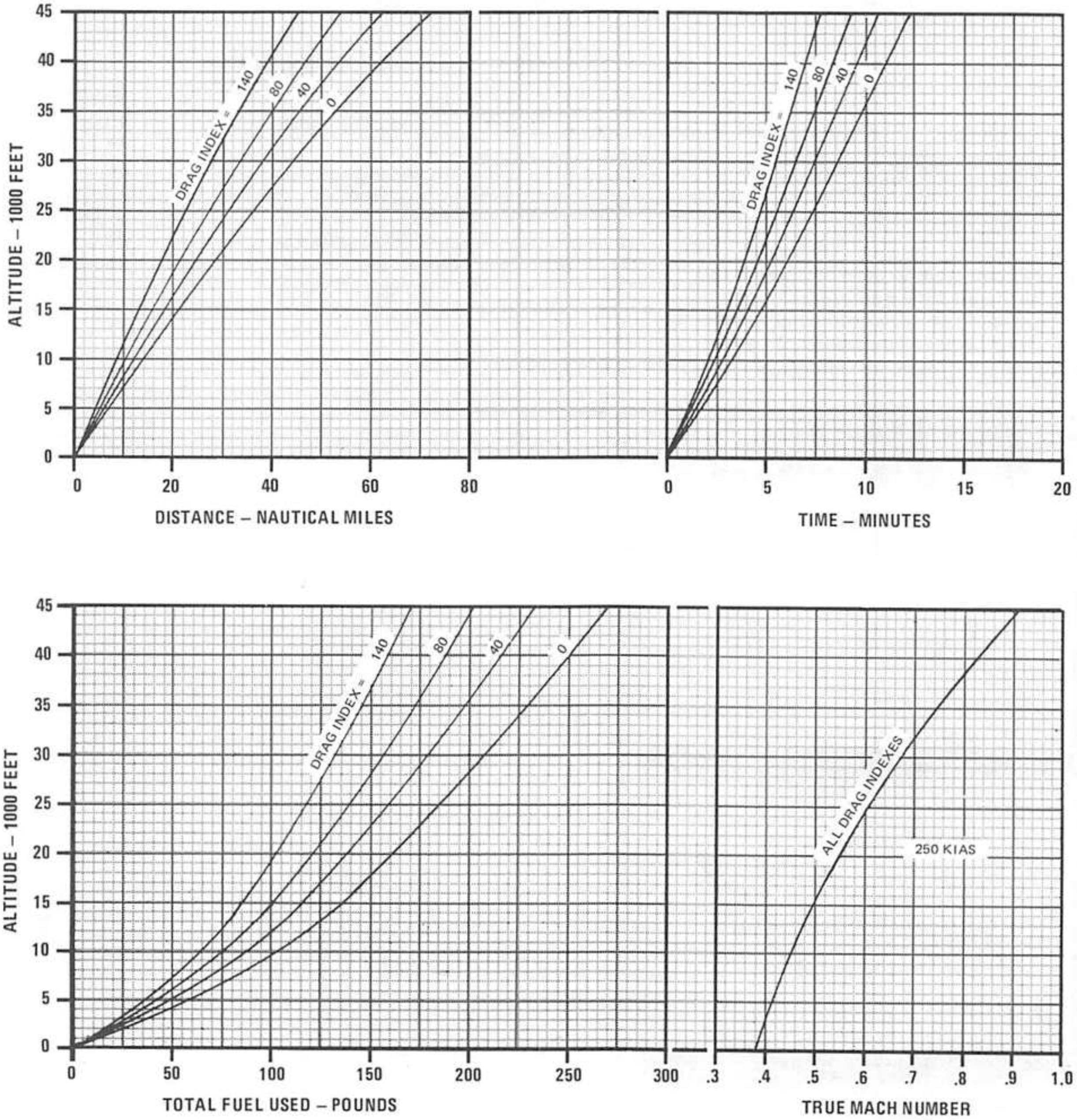
REMARKS
ENGINE(S): (2) J79-GE-17
ALL GROSS WEIGHTS
ICAO STANDARD DAY

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(71)

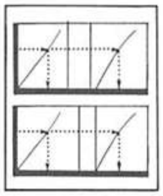
Figure A7–1

DESCENT
300 KIAS-80% RPM
SPEED BRAKES EXTENDED

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

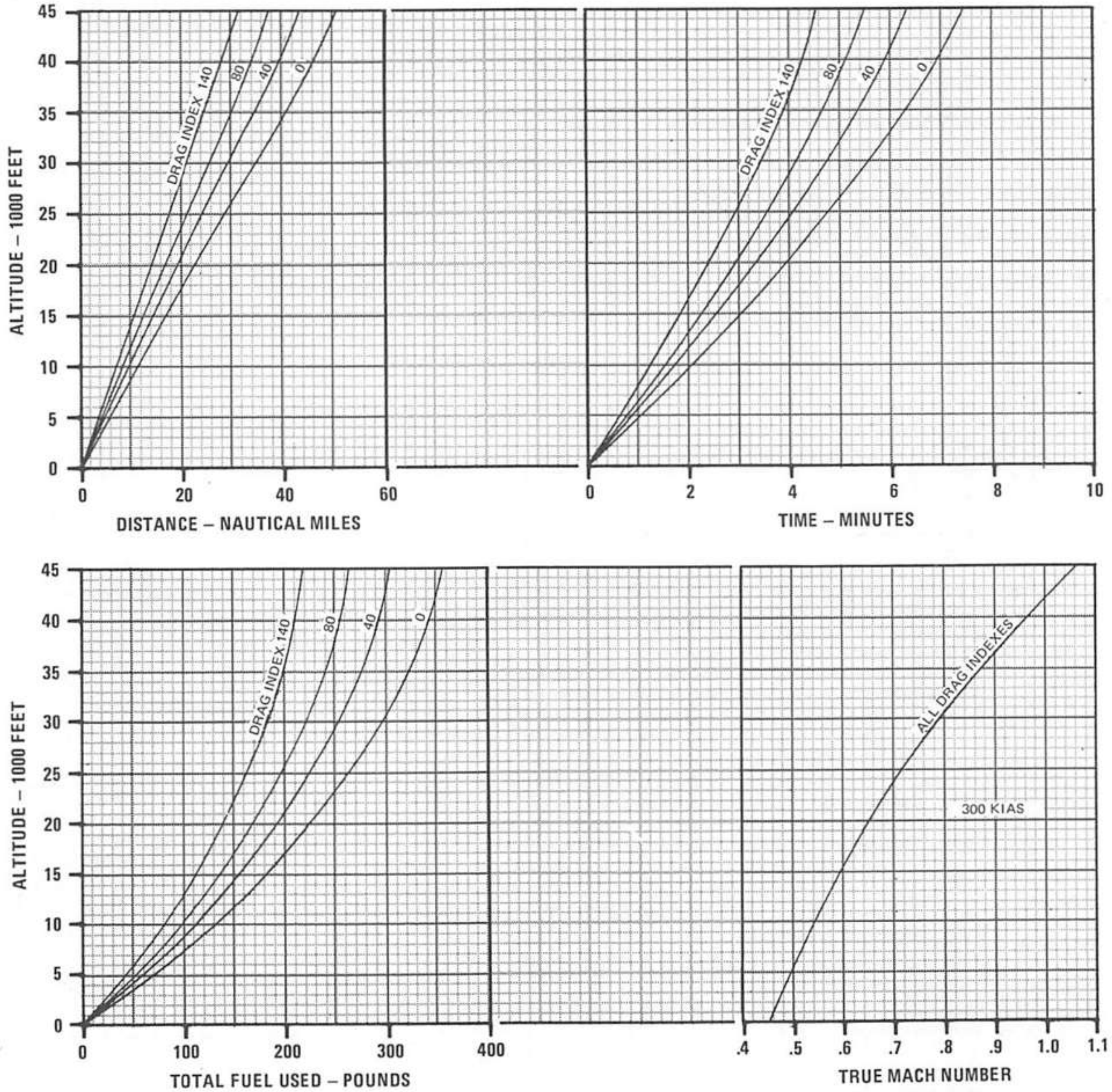
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY
ALL GROSS WEIGHTS

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(65)

Figure A7-2

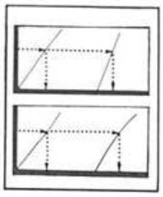
DESCENT

300 KIAS - 80% RPM
SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

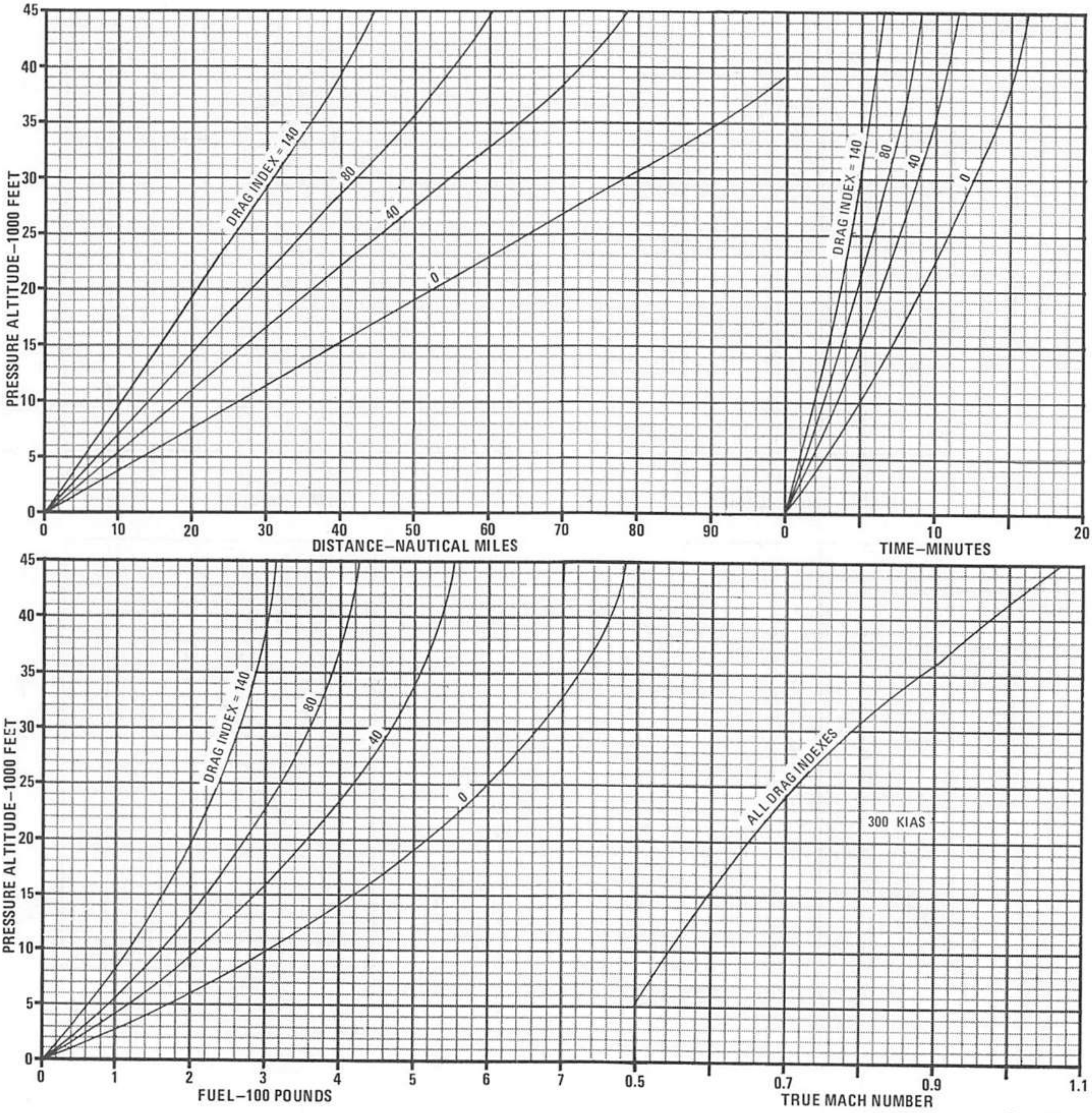
REMARKS
ENGINE(S): (2) J79-GE-17
ALL GROSS WEIGHTS
ICAO STANDARD DAY

GUIDE



DATE: 1 OCTOBER 1976
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(56)

Figure A7–3

PART 8
LANDING

FINAL APPROACH SPEEDS CHART

The Final Approach Speeds chart (figure A8-1) shows recommended approach speed curves for the various approach configurations, AOA and gross weights of the aircraft.

USE

Enter the chart at estimated landing gross weight. Proceed vertically to the applicable configuration and AOA reflector line and project horizontally to the left scale to read recommended approach speed.

Sample Problem

Configuration: Slats Out, Flaps Down, Gear Down

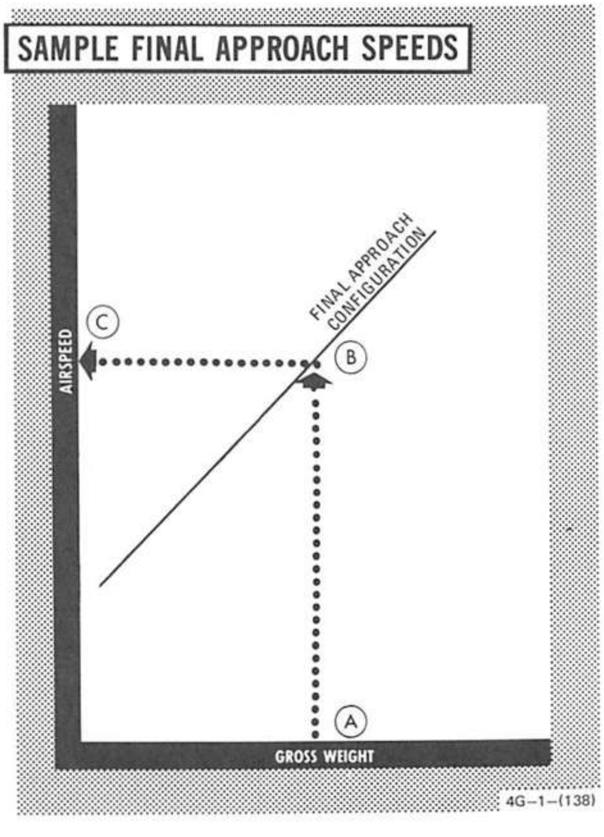
A. Estimated landing gross weight	36,000 Lb
B. Intersect applicable reflector line	
C. Recommended approach speed (IAS) at 19.2 units (AOA)	149 Kt

MINIMUM LANDING ROLL DISTANCE CHART

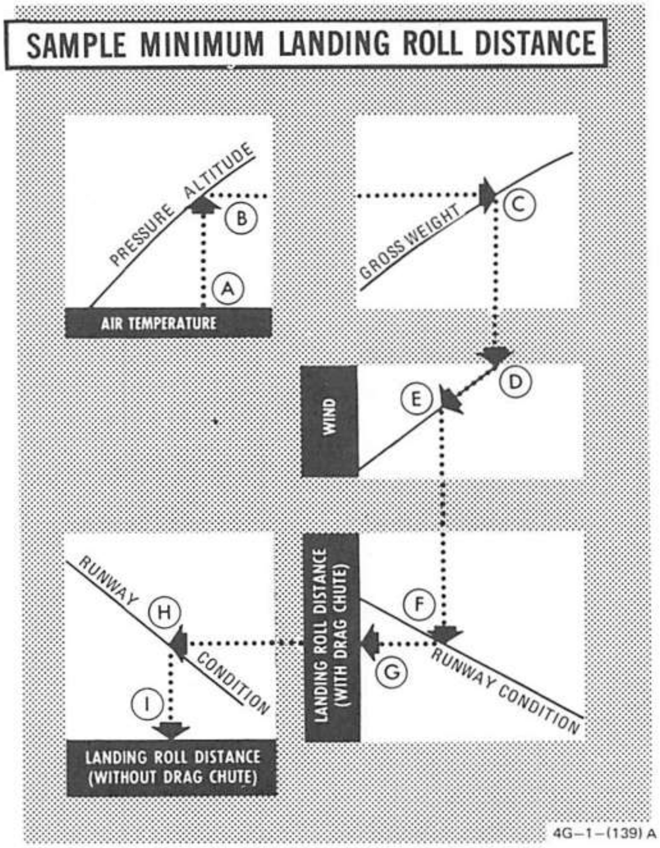
Landing roll distance information is provided in this chart (figure A8-2). Stopping distances are based on the anti-skid system operating and full brake pedal deflection applied. The variables of temperature, altitude, gross weight, effective wind, runway condition, and drag chute are taken into consideration. A 10 percent increase in touchdown speed will result in a 20 percent increase in landing roll distance.

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



4G-1-(138)



4G-1-(139) A

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 runway condition curve 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 runway condition curve and then proceed down to read the landing roll distance. If the landing is to be made over a 50-foot obstacle, allow 1900 feet for airborne distance required from the obstacle to the landing touchdown point.

Sample Problem

A. Temperature	15°C
B. Pressure altitude	Sea Level
C. Gross weight	35,000 Lb
D. Wind base line	
E. Effective headwind	10 Kt
F. Dry runway	
G. Landing roll distance	2500 Ft

If operating without drag chute:

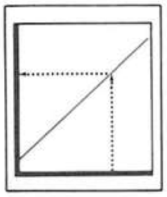
H. Dry runway	
I. Landing roll distance	3000 Ft

FINAL APPROACH SPEEDS

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS/SLATS AS NOTED
GEAR DOWN

REMARKS
ENGINE(S): (2)J79-GE-17
ICOA STANDARD DAY

GUIDE

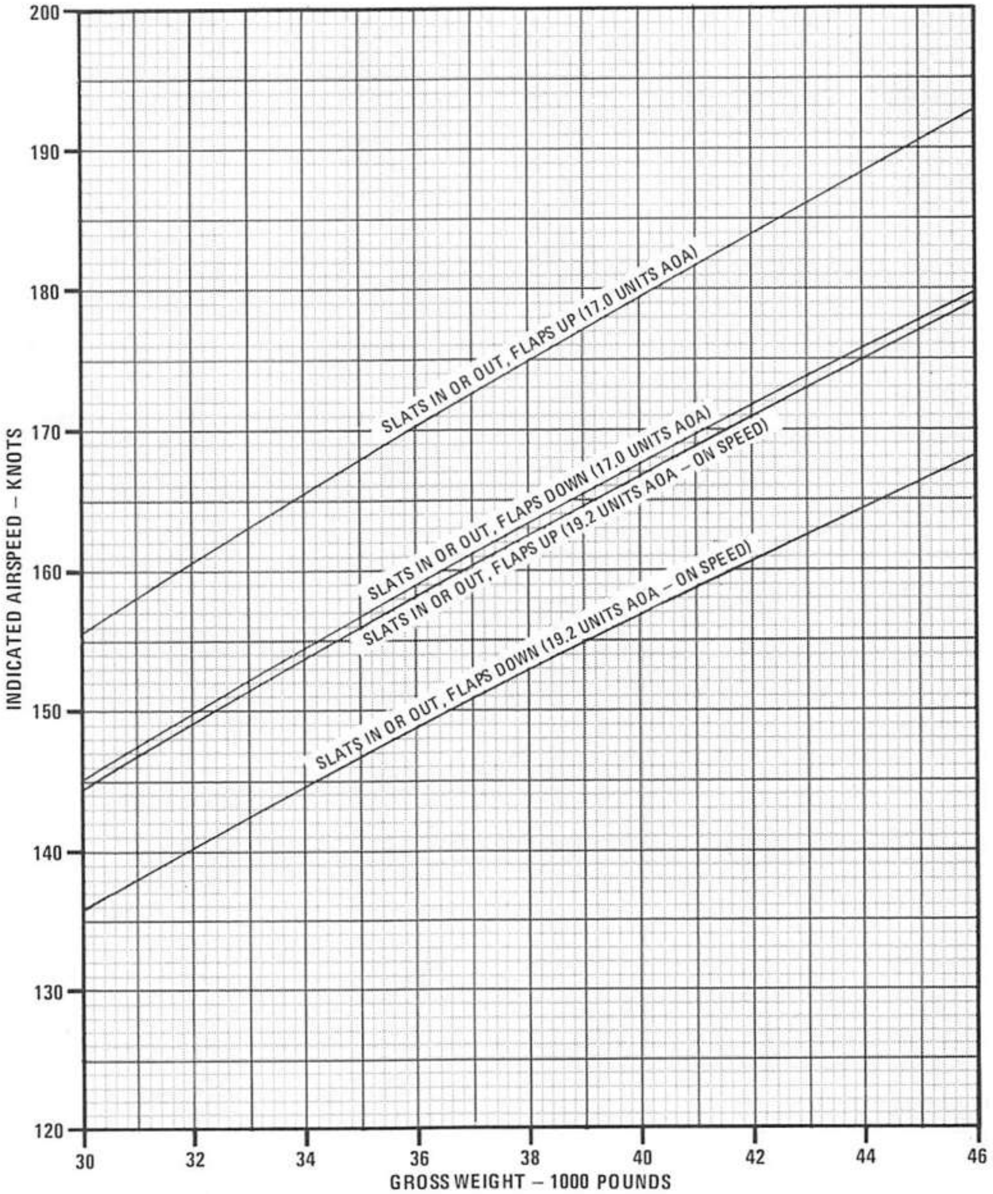


NOTES

- DATA IS FOR A CG LOCATION OF 31% MAC. ADD 0.5 KNOTS FOR EACH PERCENT OF CG FORWARD OF 31% MAC.
- AIRSPEED MAY VARY ±6 KNOTS FROM THAT SHOWN ON THIS CHART DUE TO INSTRUMENT TOLERANCES.

DATE: 1 AUGUST 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(64)B

Figure A8-1

MINIMUM LANDING ROLL DISTANCE

IDLE THRUST

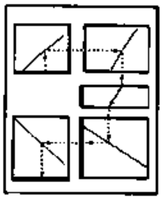
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
SLATS OUT
FLAPS DOWN
GEAR DOWN
DRAG CHUTE DEPLOYED
FULL BRAKE PEDAL DEFLECTION
19.2 UNIT AOA TOUCHDOWN.

REMARKS
ENGINE(S): (2) J79-GE-17

NOTE

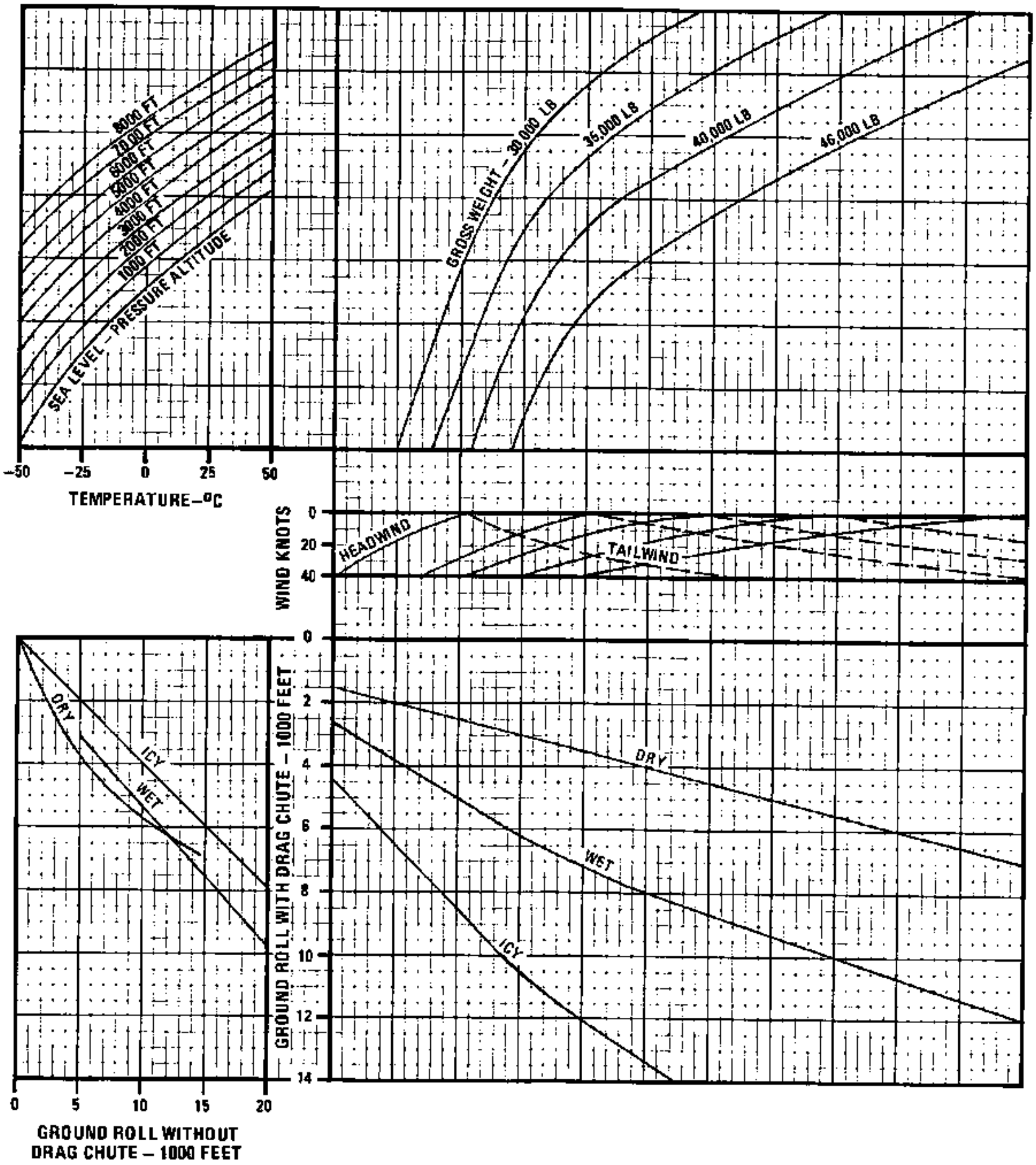
A 10 PERCENT INCREASE IN TOUCHDOWN SPEED WILL RESULT IN A 20 PERCENT INCREASE IN LANDING ROLL DISTANCE.

GUIDE



DATE: 1 JUNE 1977
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(55)A

Figure A8-2

PART 9

COMBAT PERFORMANCE

TABLE OF CONTENTS

Charts

COMBAT FUEL FLOW CHARTS

These charts (figures A9–1 thru A9–3) present the specific fuel flow 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 fuel flow values are based on a stabilized level flight condition and do not represent the fuel flow required to accelerate to a given Mach number.

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 to the left to read specific fuel flow.

Sample Problem

Configuration: (4) AIM–7 Missiles

A. Desired Mach number	1.5
B. Altitude	25,000 Ft
C. Power setting required	Modulated Afterburners
D. Specific fuel flow	1010 PPM

COMBAT SPECIFIC RANGE

These charts (figures A9–4 thru A9–6) 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 fuel flow required to accelerate to a given Mach number.

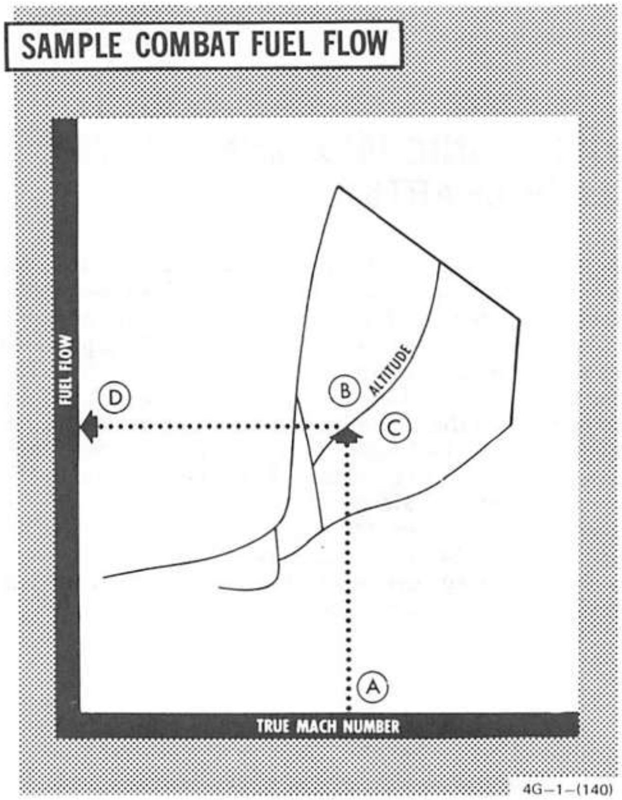
USE

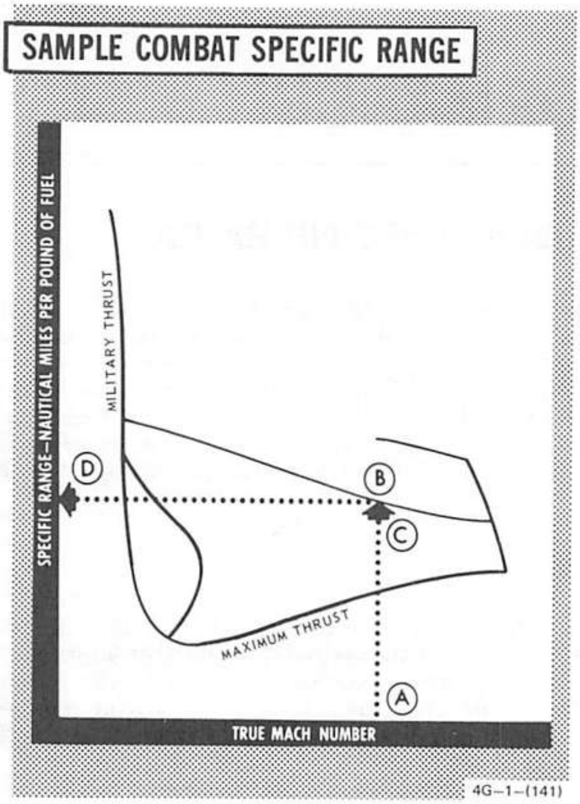
Enter the chart corresponding to the aircraft configuration with the desired Mach number for stabilized level flight. Proceed vertically upward to the selected flight altitude. Note the general thrust setting required, and then project horizontally left to obtain the specific range.

Sample Problem

Configuration: (4) AIM–7 Missiles and (2) Wing Tanks

SAMPLE COMBAT FUEL FLOW





A. Desired Mach number	1.3
B. Altitude	30,000 Ft
C. Thrust required	Modulated Afterburners
D. Specific range	0.018 NMPP

SUPERSONIC MAXIMUM THRUST CLIMB CHARTS

These charts (figures A9-7 thru A9-9) 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 guide lines 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.

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 guide lines to the desired supersonic climb Mach number (end of acceleration). Project both vertically downward and horizontally to the 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 guide lines 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.

Sample Problem

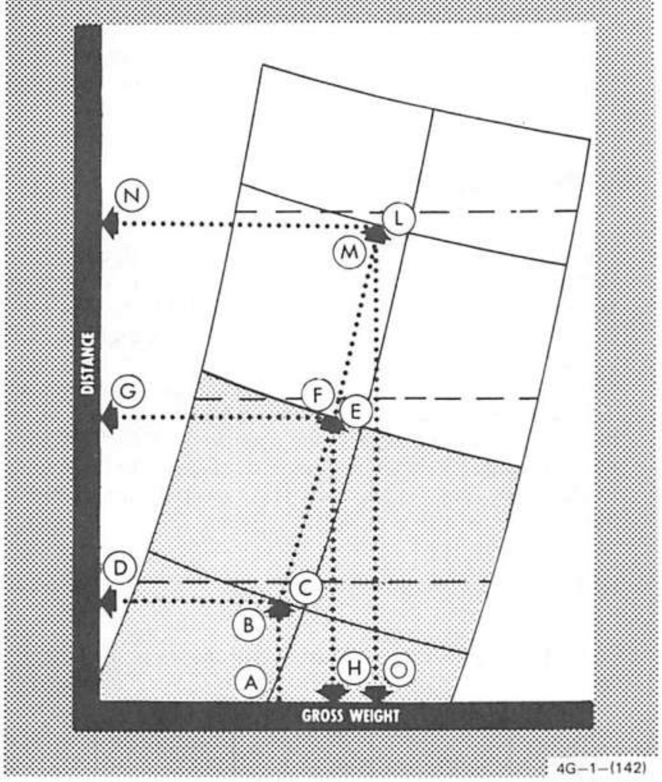
Configuration: (4) AIM-7 Missiles

A. Initial gross weight	40,000 Lb
B. Initial Mach number	1.2
C. Time corresponding to initial Mach number	0.7 Min
D. Distance corresponding to initial Mach number	7.5 NM
E. Climb Mach number	1.6
F. Time at end of acceleration	1.9 Min
G. Distance at end of acceleration	23.5 NM
H. Gross weight at end of acceleration	38,900 Lb
I. Time required for acceleration (F-C)	1.2 Min
J. Fuel required for acceleration (A-H)	1100 Lb
K. Distance required for acceleration (G-D)	16 NM
L. Altitude at end of climb	52,000 Ft
M. Time at end of climb	4.4 Min
N. Distance at end of climb	61.4 NM
O. Gross weight at end of climb	37,500 Lb
P. Time required for climb (M-F)	2.5 Min
Q. Distance required for climb (N -G)	37.9 NM
R. Fuel required for climb (H-O)	1400 Lb
S. Total time required to accelerate and climb (I+P)	3.7 Min
T. Total distance required to accelerate and climb (K+Q)	53.9 NM
U. Total fuel required to accelerate and climb (J+R)	2500 Lb

LOW ALTITUDE ACCELERATIONS

These charts (figures A9-10 thru A9-21) present time and fuel required to accelerate from 0.5 to 0.9 Mach at altitudes of Sea Level, 2000, 4000, and 6000 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,

SAMPLE SUPERSONIC MAXIMUM THRUST CLIMB



correction factors are given for nonstandard temperatures.

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.

ACCELERATION CHARTS

These charts (figures A9-22 thru A9-46) show the relationship of time, distance, and fuel required for level flight maximum or military thrust accelerations. This data is presented for various altitudes and configurations.

WARNING

Refer to section V for external stores operating limitations.

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 guide lines 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.

Sample Problem

Configuration: (4) AIM-7 Missiles and (2) WING TANKS, 45,000 feet; Maximum thrust.

A. Gross weight	45,000 Lb
B. Initial Mach number	1.0
C. Time	2 Min
D. Distance	17 NM
E. Parallel guide lines	
F. Desired Mach number	1.30
G. Time corresponding to new Mach number	8.8 Min
H. Distance corresponding to new Mach number	93 NM
I. Gross Weight corresponding to new Mach number	41,950 Lb
J. Time required for acceleration (G–C)	6.8 Min
K. Distance required for acceleration (H–D)	76 NM
L. Fuel required for acceleration (A–I)	3050 Lb

LEVEL FLIGHT ENVELOPE

This chart (figure A9–47) 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.

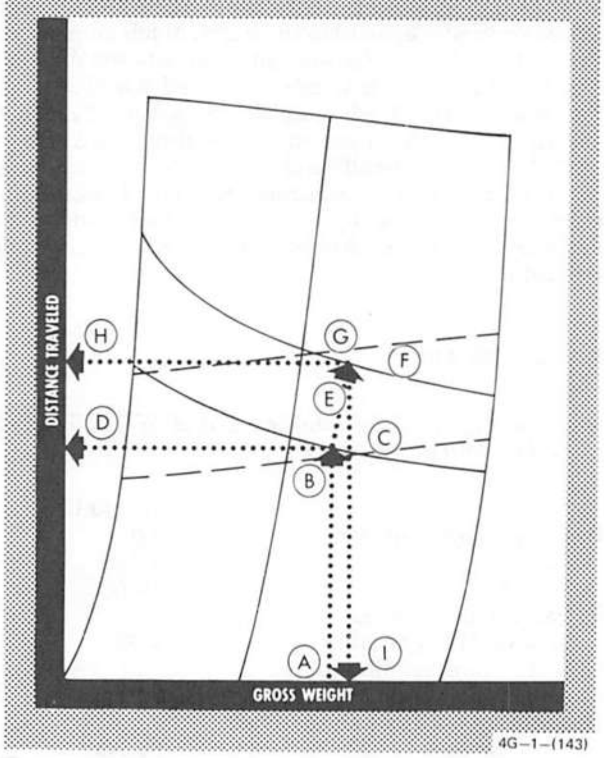
WARNING

Refer to section V for external stores operating limitations.

USE

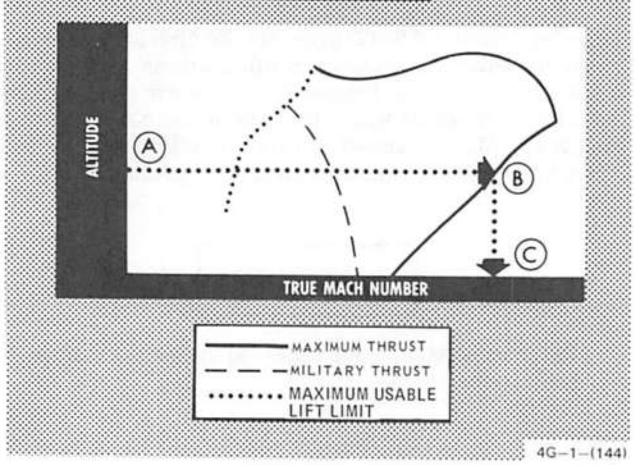
Enter the appropriate chart with the desired combat altitude. Proceed horizontally to intersect the applicable configuration power curve. From this point proceed vertically downward to read the maximum attainable Mach number in level flight.

SAMPLE ACCELERATION



4G-1-(143)

SAMPLE LEVEL FLIGHT ENVELOPE



4G-1-(144)

Sample Problem

Configuration: (4) AIM-7 Missiles

A. Combat altitude	36,000 Ft
B. Maximum attainable Mach number	2.04

V-N ENVELOPE

The Symmetrical Flight V-N Envelopes (figures A9-48 thru A9-51) are a graphical presentation of airspeed versus acceleration with lines of indicated angle of attack superimposed. Data is supplied for a gross weight of 37,500 pounds at four altitudes. The charts may be used to determine the allowable maximum symmetrical maneuvering capability of the airplane 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.

USE

To find the allowable maximum symmetrical performance capability, enter the chart with the indicated 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 AOA 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.

Sample Problem

Altitude 5000 Feet; Gross Weight-37,500 pounds

A. Speed (IAS)	500 Kt
B. Load factor	6 G
C. AOA	12 units

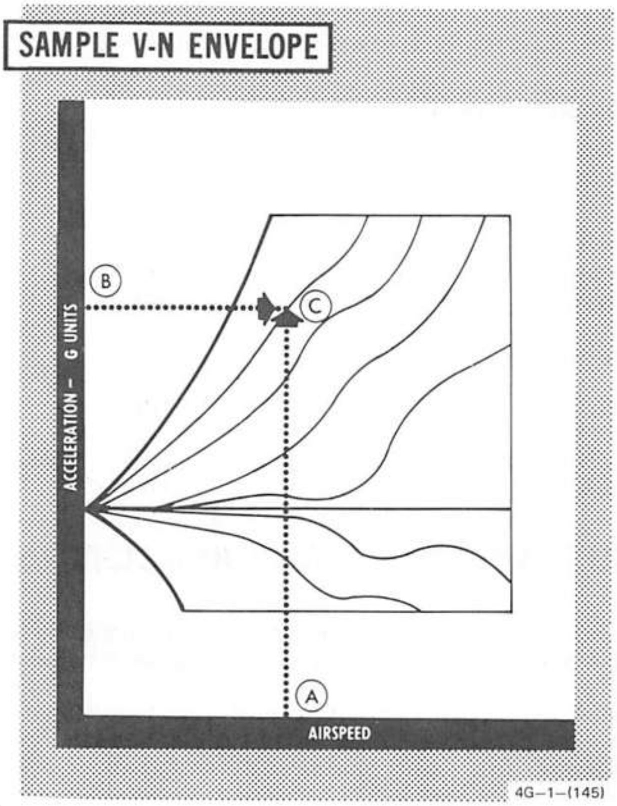
DIVE RECOVERY CHARTS

These charts (figures A9-52 thru A9-55) present the airplanes dive recovery capability for various speeds (subsonic and supersonic), altitudes and dive angles at 16 units and 25 units AOA.

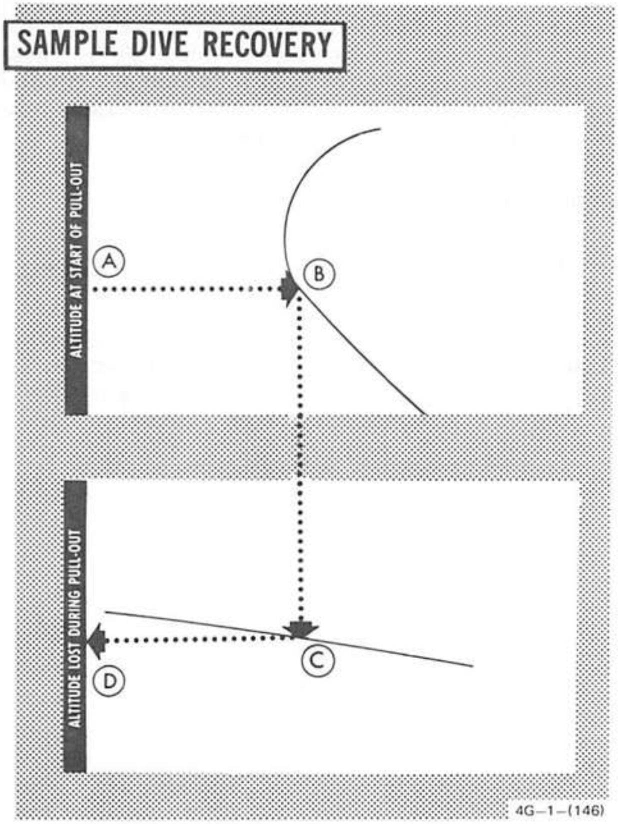
USE

Enter the applicable chart at the start of the pull-out, and project horizontally to intersect the Mach number at the start of the pull-out. From this point, descend vertically and intersect the dive angle at the start of pull-out, then proceed horizontally to the left to read altitude lost during pull out.

SAMPLE V-N ENVELOPE



SAMPLE DIVE RECOVERY



Sample Problem

Configuration: (4) AIM-7 Missiles; 16 Units AOA; Supersonic

A. Altitude at start of pull-out	40,000 Ft
B. Mach number at start of pull-out	1.5
C. Dive angle at start of pull-out	70°
D. Altitude loss during constant 16 unit AOA pull-out	13,500 Ft

TEMPERATURE EFFECT ON MAXIMUM SPEED

This chart (figure A9-56) shows the effect of nonstandard 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.

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 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.

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 Ft
D. Mach/10°C variation	0.17 Mach
E. Mach/2.4°C variation	0.04 Mach
F. Mach number (B+E)	1.84 Mach

TURN CAPABILITIES

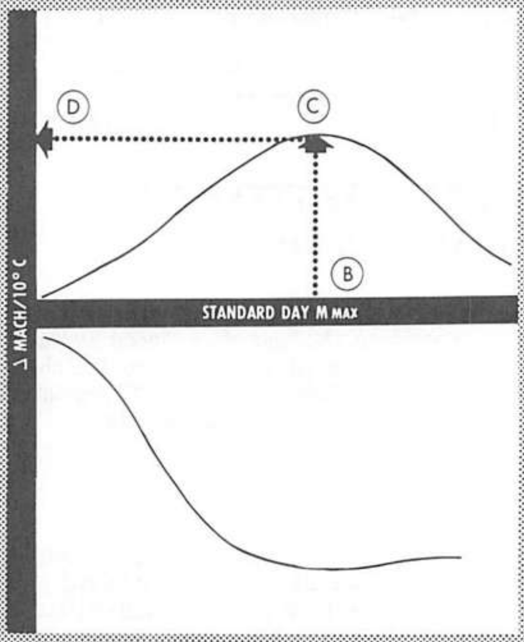
This chart (figure A9-57) presents the radius of turn and the rate of turn for a constant altitude, constant speed turn. Turn data is available for various speeds and bank angles. Load factor is also included for each bank angle.

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

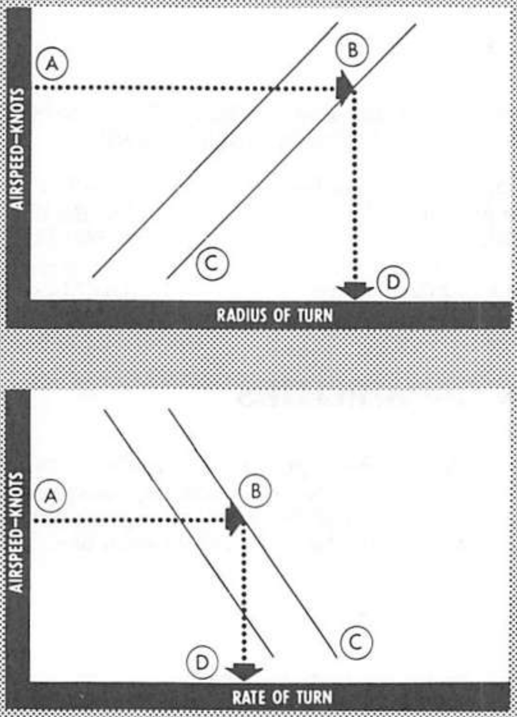
SAMPLE TEMPERATURE EFFECT ON MAXIMUM SPEED

MAXIMUM THRUST



4G–1–(147)

SAMPLE TURN CAPABILITIES



4G–1–(148)

the right to the bank angle, note the load factor and then proceed vertically downward to read the rate of turn.

Sample Problem

Radius of Turn

A. True airspeed	420 Kt
B. Bank angle	60°
C. Load factor	2.0 G
D. Radius of Turn	9000 Ft

Rate of Turn

A. True airspeed	420 Kt
B. Bank angle	60°
C. Load factor	2.0 G
D. Rate of turn	4.5°/sec

SUSTAINED G TURN CAPABILITIES

This chart (figure A9–58) presents the minimum radius of turn and corresponding maximum rate of turn and load factor for an airplane configured with (4) AIM–7 missiles and a gross weight of 42,596 pounds. The chart is plotted for various constant airspeeds and altitudes from sea level to 45,000 feet. Bank angles are also shown with the corresponding load factor.

USE

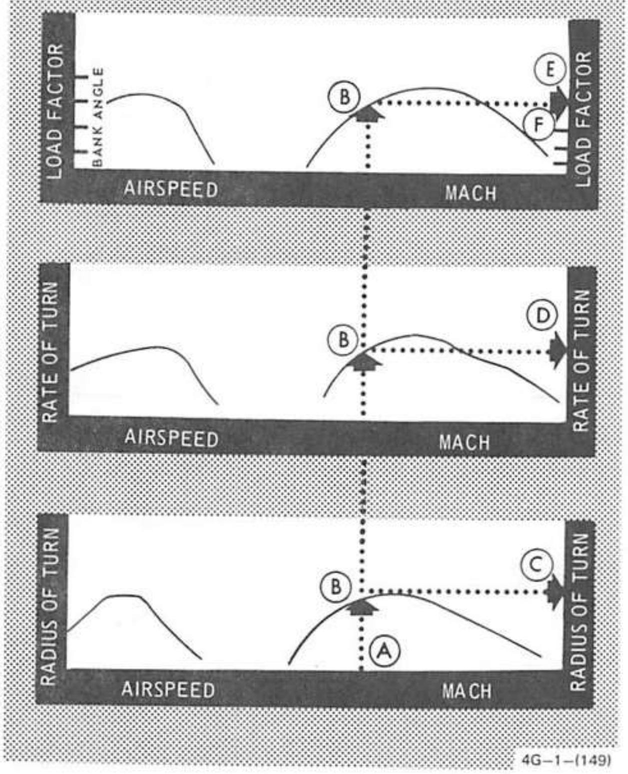
Enter the chart with the applicable airspeed or Mach number and proceed vertically to interesect the applicable altitude in each of the three plots. From these intersections, proceed horizontally to the left or right and read the minimum radius of turn, maximum rate of turn and maximum load factor attainable.

Sample Problem

Configuration: (4) AIM–7 Missiles, Gross Weight 42,596 Lb

A. Mach	0.80
B. Altitude	35,000 Ft
C. Minimum radius of turn	1.7 NM
D. Maximum rate of turn	4.2°/sec
E. Maximum sustained load factor	2.1 G
F. Bank angle	61°

SAMPLE SUSTAINED G TURN CAPABILITIES



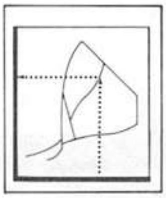
4G–1–(149)

COMBAT FUEL FLOW
STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM 7

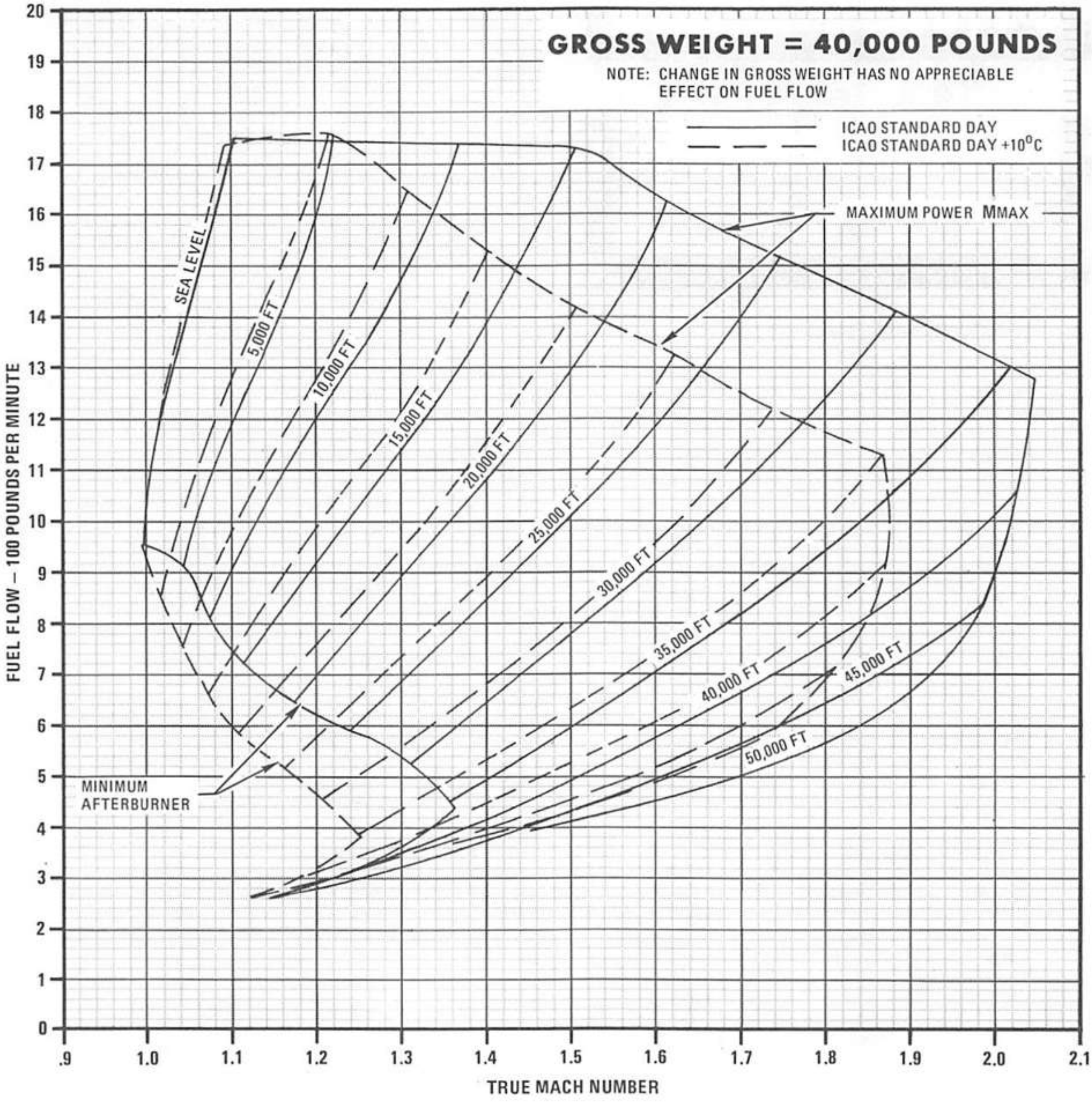
REMARKS
ENGINE(S): (2) J79-GE-17

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(150)

Figure A9-1

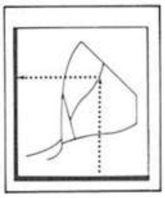
COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4)AIM-7 AND (1) ℄ TANK

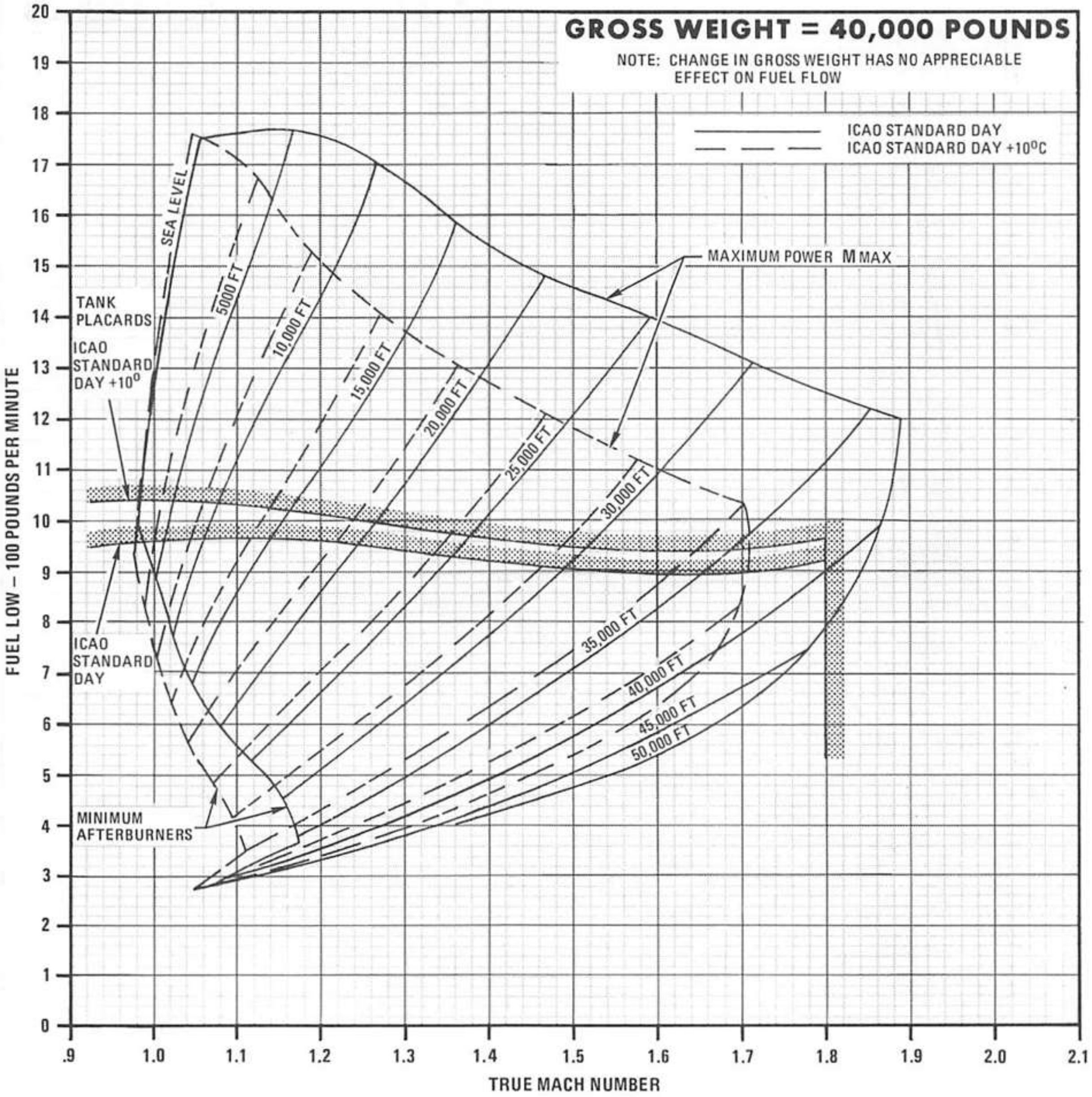
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(151)

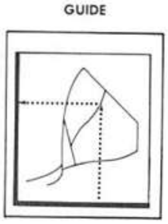
Figure A9-2

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

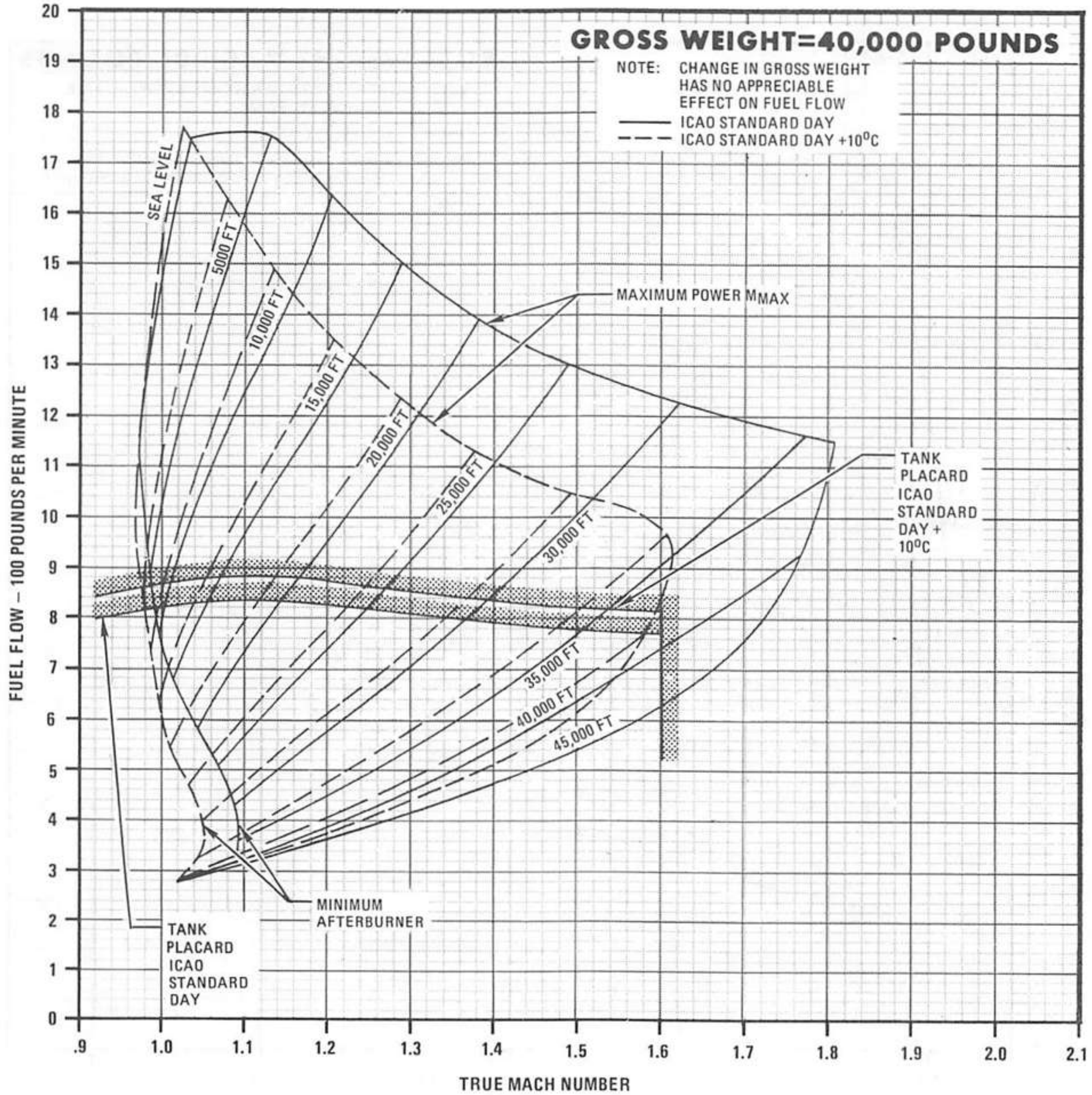
AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

REMARKS
ENGINE(S): (2) J79-GE-17



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(152)

Figure A9-3

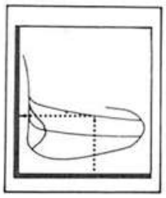
COMBAT SPECIFIC RANGE

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7

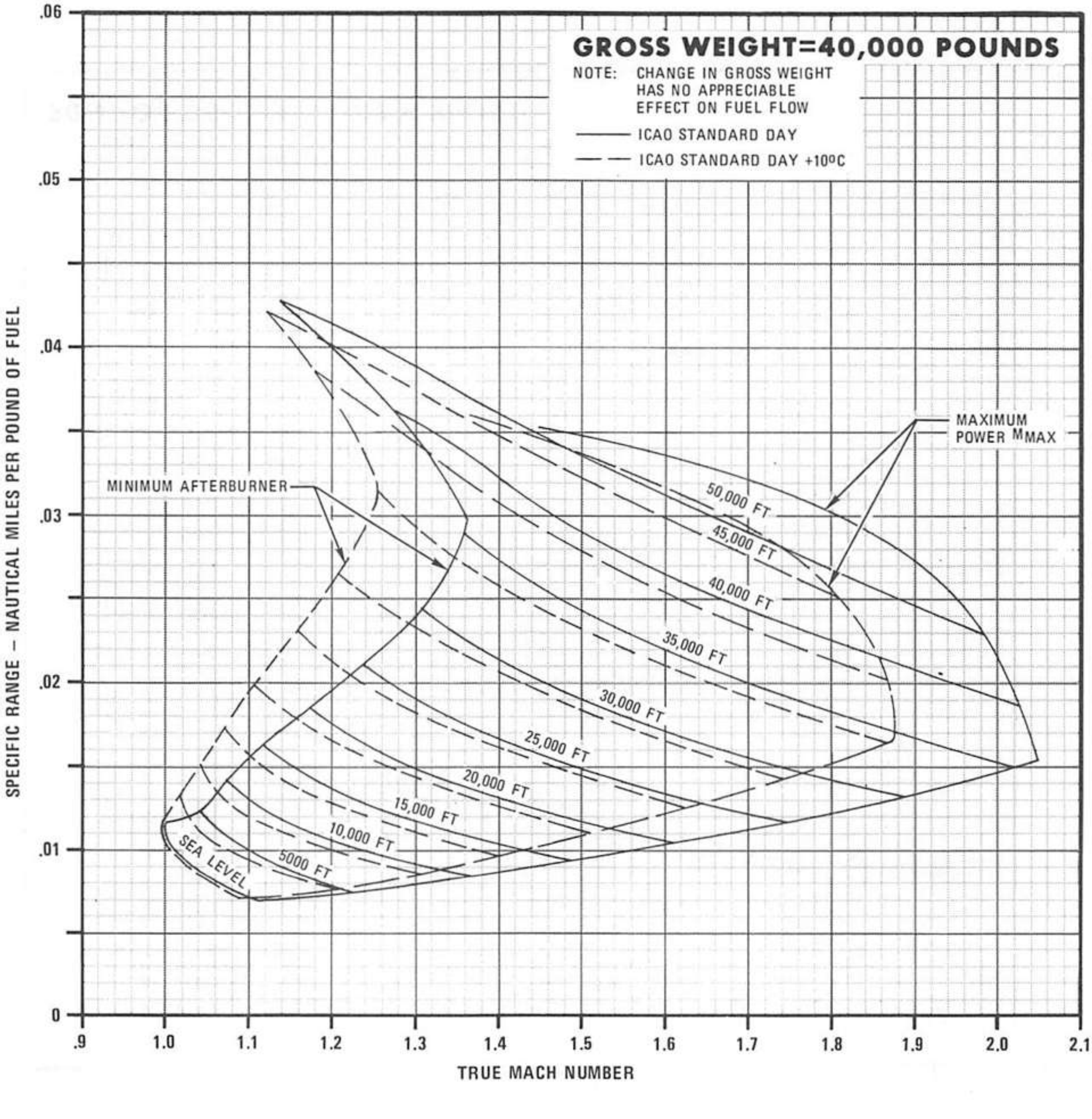
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(153)

Figure A9-4

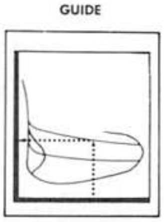
COMBAT SPECIFIC RANGE

STABILIZED LEVEL FLIGHT

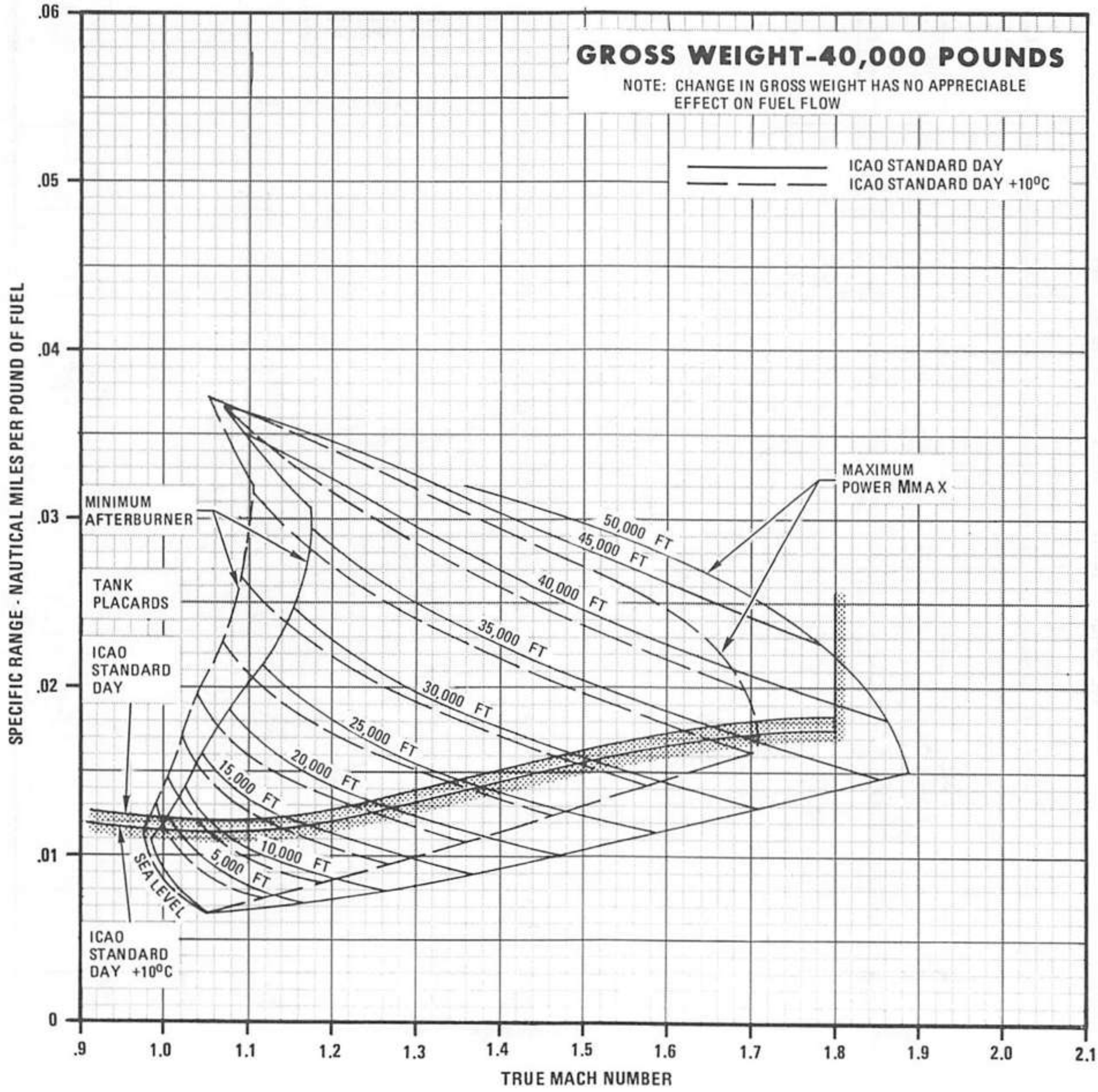
AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(154)

Figure A9–5

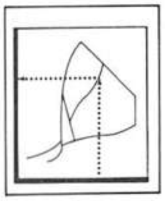
COMBAT SPECIFIC RANGE

STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

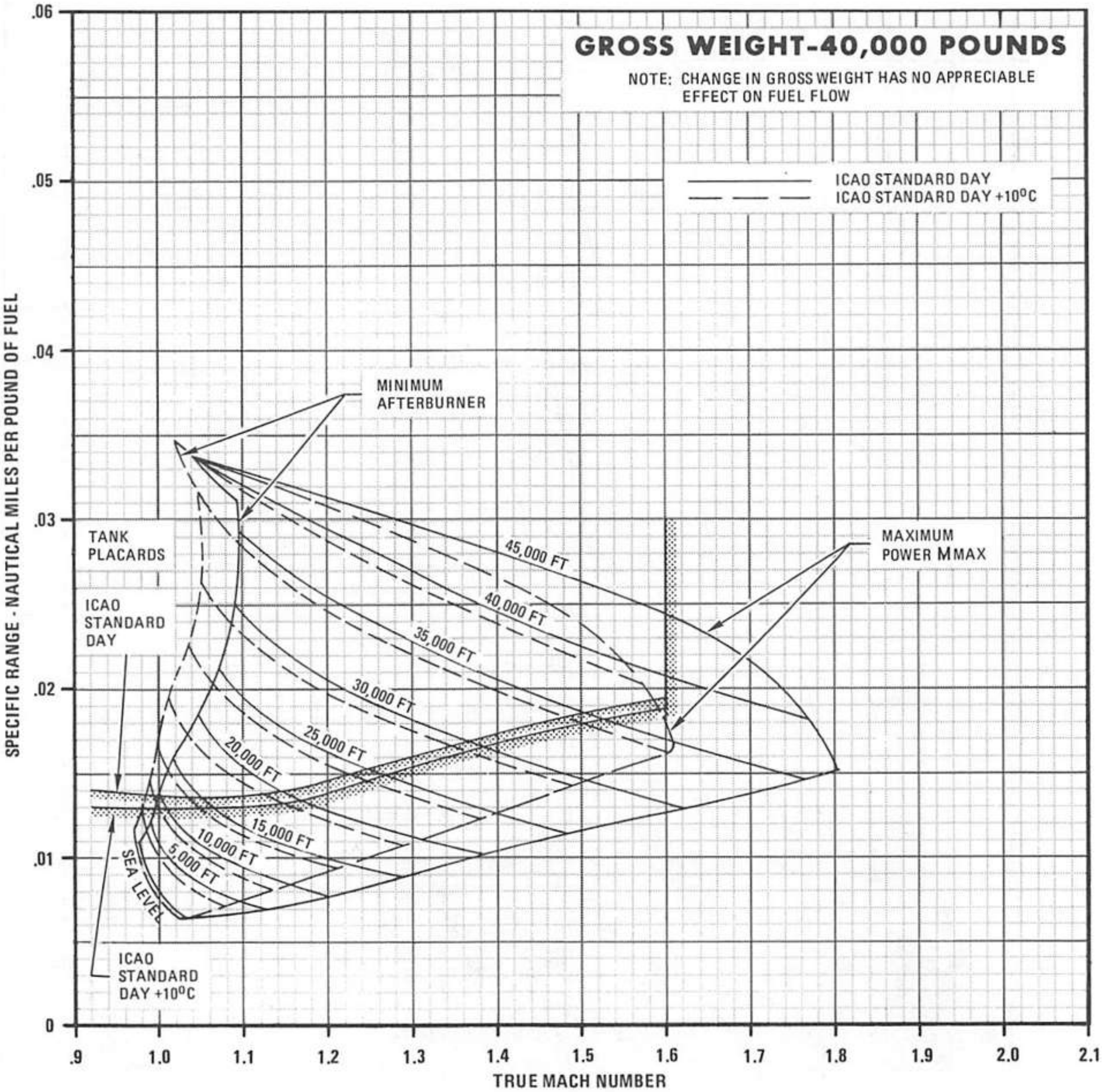
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**



GROSS WEIGHT-40,000 POUNDS

NOTE: CHANGE IN GROSS WEIGHT HAS NO APPRECIABLE EFFECT ON FUEL FLOW

4G-1-(155)

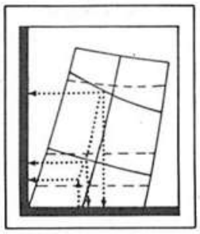
Figure A9-6

SUPERSONIC MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION
(4) AIM-7

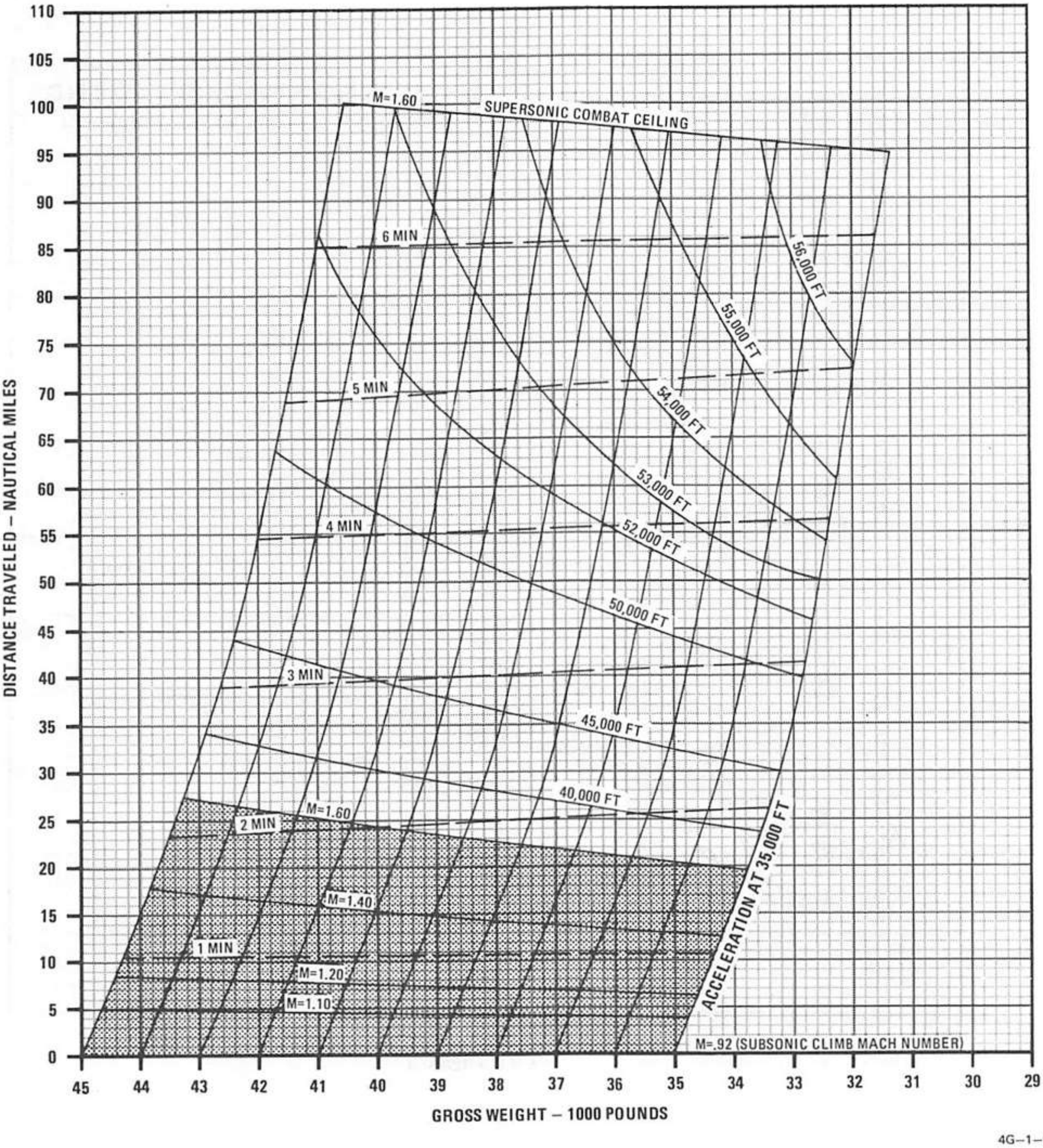
REMARKS
ENGINE(S): (2)J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATE BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(156)

Figure A9-7

SUPERSONIC MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION

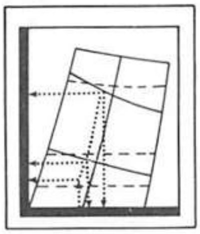
(4) AIM-7 AND
(1) ℄ TANK

REMARKS

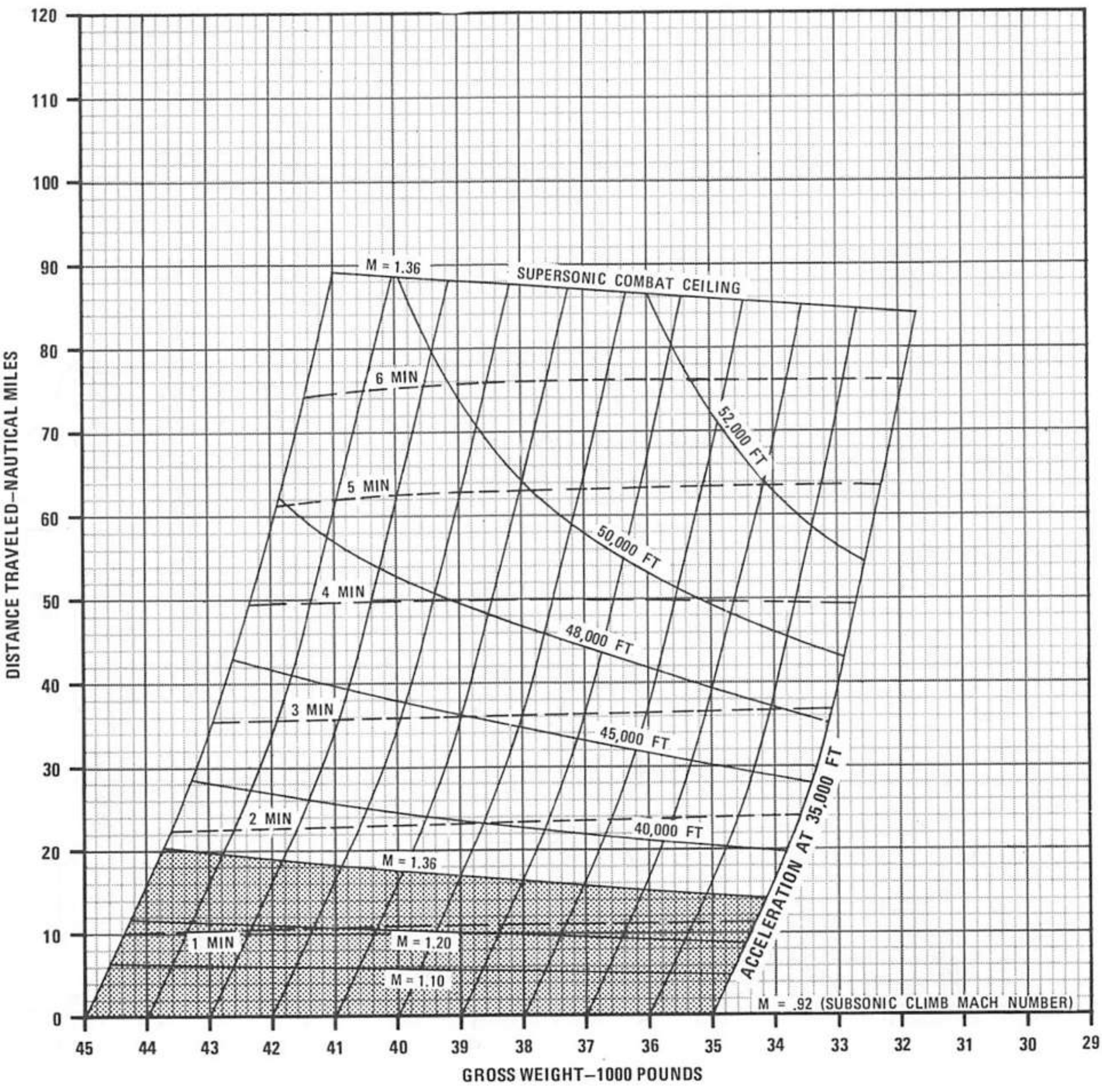
ENGINE(S): (2)J79-GE-17
ICAO STANDARD DAY

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(157)

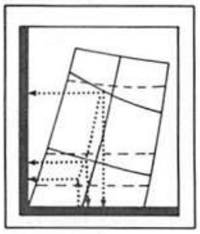
Figure A9-8

SUPERSONIC MAXIMUM THRUST CLIMB

AIRPLANE CONFIGURATION
(4) AIM–7 AND
(2) WING TANKS

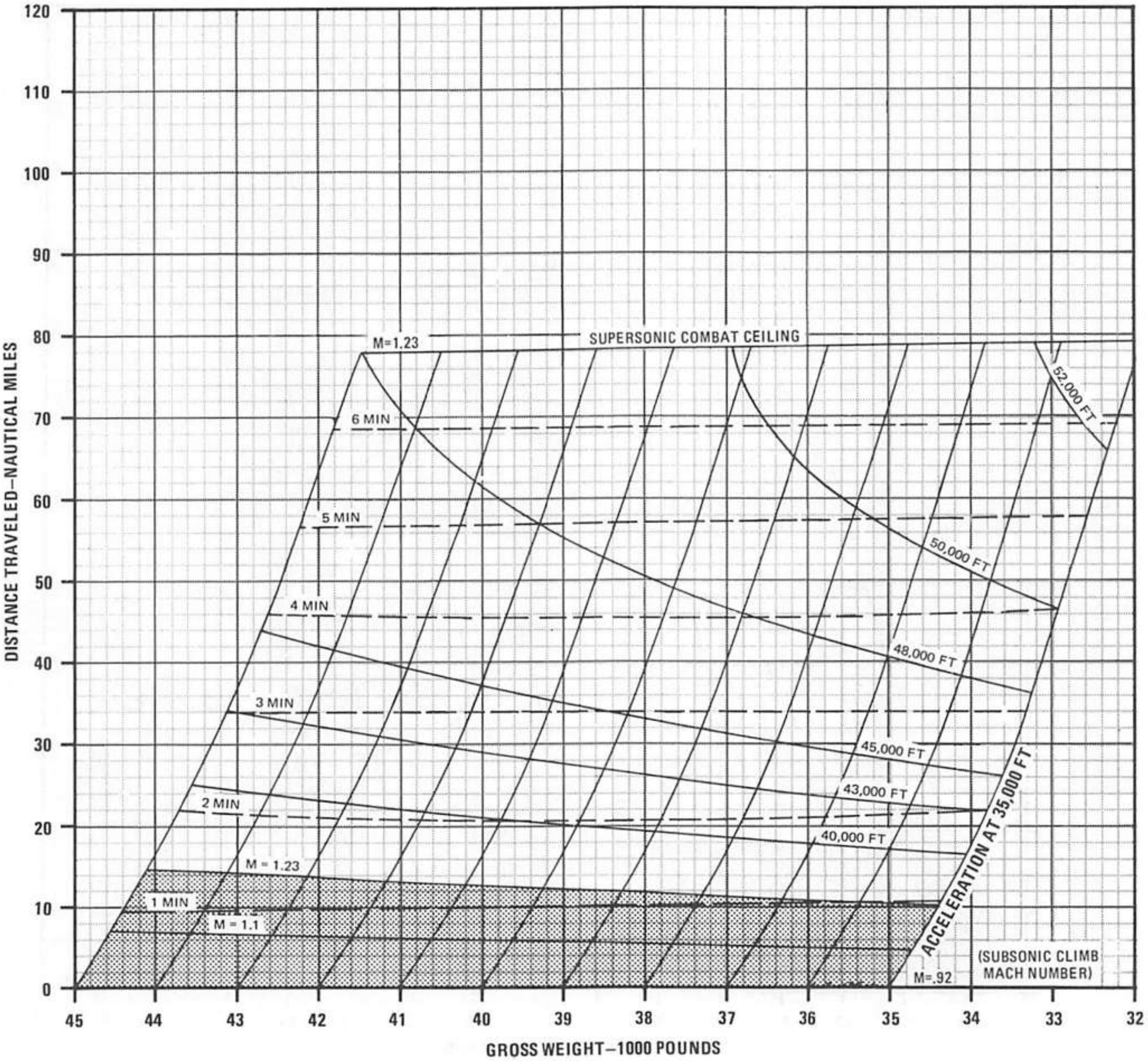
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(158)

Figure A9–9

LOW ALTITUDE ACCELERATION
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.08/108	.08/112	.08/116	.09/121	1.10/1.07	.90/.93
	.65	.11/149	.11/155	.11/161	.12/167	12/174	.13/182	.14/190	1.10/1.07	.89/.92
	.7	.14/202	.15/211	.15/219	.16/229	.17/239	.18/252	.19/266	1.11/1.08	.89/.92
	.75	.18/257	.19/269	.19/282	.20/295	.21/312	.23/330	.24/352	1.11/1.08	.89/.91
	.8	.21/313	.22/328	.23/346	.25/364	.26/389	.28/417	.30/451	1.11/1.08	.88/.91
	.85	.25/371	.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	.04/47	.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	.09/113	.09/118	1.10/1.07	.90/.93
	.65	.11/146	.11/152	.12/157	.12/163	.13/170	.13/177	.14/185	1.10/1.07	.89/.92
	.7	.15/198	.15/206	.16/214	.17/224	.17/234	.18/245	.19/257	1.10/1.08	.89/.92
	.75	.18/251	.19/263	.20/275	.21/288	.22/303	.28/320	.25/340	1.11/1.08	.89/.91
	.8	.22/306	.23/320	.24/337	.25/355	.27/377	.29/400	.31/434	1.11/1.08	.88/.91
	.85	.26/363	.27/382	.28/403	.30/428	.32/459	.35/497	.38/547	1.12/1.09	.88/.90
	.9	.29/421	.31/445	.33/473	.35/508	.38/552	.42/611	.42/696	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	.08/94	.08/97	.08/101	.08/104	.09/107	.09/111	.09/115	1.10/1.07	.90/.93
	.65	.11/143	.12/149	.12/154	.13/160	.13/166	.14/172	.14/180	1.10/1.07	.89/.92
	.7	.15/194	.16/202	.16/209	.17/218	.18/228	.19/238	.20/250	1.10/1.08	.89/.92
	.75	.19/246	.20/257	.21/268	.22/280	.23/294	.24/310	.25/328	1.11/1.08	.89/.91
	.8	.23/299	.24/312	.25/328	.26/344	.28/365	.29/389	.31/418	1.11/1.08	.88/.91
	.85	.26/354	.28/373	.29/392	.31/416	.33/444	.35/479	.39/524	1.12/1.09	.88/.90
	.9	.30/411	.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	.90/.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	.16/190	.16/198	.17/205	.18/213	.18/221	.19/232	.20/242	1.10/1.08	.89/.92
	.75	.20/241	.21/251	.21/261	.22/273	.23/286	.25/301	.26/318	1.11/1.08	.89/.91
	.8	.24/293	.25/305	.26/320	.27/336	.28/335	.30/375	.32/403	1.11/1.08	.88/.91
	.85	.27/346	.29/364	.30/382	.32/404	.34/430	.36/462	.40/503	1.12/1.09	.88/.90
	.9	.31/402	.33/423	.35/446	.37/478	.40/515	.43/564	.48/630	1.14/1.10	.87/.90

4G–1–(159)

Figure A9–10

LOW ALTITUDE ACCELERATION
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 40,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-17

DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)							TEMP. EFFECTS FACTOR	
		DRAG INDEX 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	.04/56	.04/57	.04/59	.04/61	.05/63	.05/65	.05/65	1.10/1.07	.90/.93
	.6	.08/113	.08/117	.09/121	.09/125	.09/130	.10/135	.10/140	1.10/1.07	.90/.93
	.65	.12/173	.13/179	.13/186	.14/193	.14/201	.15/210	.16/219	1.10/1.07	.89/.92
	.7	.16/234	.17/243	.18/253	.19/264	.19/277	.20/291	.21/307	1.10/1.08	.89/.92
	.75	.20/297	.21/310	.22/324	.23/340	.25/359	.26/380	.28/406	1.11/1.08	.89/.91
	.8	.25/362	.26/379	.27/398	.28/421	.30/448	.32/480	.35/520	1.11/1.08	.88/.91
	.85	.29/428	.30/451	.32/476	.34/508	.36/546	.39/595	.43/659	1.12/1.09	.88/.90
	.9	.33/497	.34/525	.37/559	.39/604	.43/660	.48/735	.54/845	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	.04/55	.04/56	.05/58	.05/60	.05/62	.05/64	.05/66	1.10/1.07	.90/.93
	.6	.08/111	.09/115	.09/119	.09/123	.10/127	.10/132	.10/137	1.10/1.07	.90/.93
	.65	.13/169	.13/175	.14/182	.14/188	.15/196	.15/204	.16/213	1.10/1.07	.89/.92
	.7	.17/229	.18/238	.18/247	.19/258	.20/270	.21/283	.22/298	1.10/1.08	.89/.92
	.75	.21/291	.22/303	.23/316	.24/331	.25/349	.27/369	.28/392	1.11/1.08	.89/;91
	.8	.25/354	.26/370	.28/388	.29/409	.31/434	.33/464	.33/464	1.11/1.08	.88/.91
	.85	.29/419	.31/440	.33/464	.35/493	.37/529	.40/573	.44/631	1.12/1.09	.88/.90
	.9	.34/485	.35/512	.38/544	.40/585	.44/637	.48/704	.55/801	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	.04/54	.05/55	.05/57	.05/59	.05/61	.05/62	.05/65	1.10/1.07	.90/.93
	.6	.09/109	.09/112	.09/116	.10/120	.10/124	.10/129	.11/133	1.10/1.07	.90/.93
	.65	.13/166	.14/172	.14/178	.15/184	.15/191	.16/199	.16/208	1.10/1.07	.89/.92
	.7	.18/224	.18/233	.19/242	.20/252	.21/263	.21/275	.23/289	1.10/1.08	.89/.92
	.75	.22/284	.23/296	.24/309	.25/323	.26/339	.27/358	.29/379	1.11/108	.89/.91
	.8	.26/346	.27/361	.29/378	.30/398	.32/421	.34/446	.36/482	1.11/1.08	.88/.91
	.85	.31/409	.32/429	.34/451	.36/479	.38/512	.41/553	.45/605	1.12/1.09	.88/.90
	.9	.35/474	.37/499	.39/529	.41/568	.45/615	.49/676	.55/763	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	.05/53	.05/55	.05/56	.05/58	.05/60	.05/62	.06/63	1.10/1.07	.90/.93
	.6	.09/108	.09/111	.10/114	.10/118	.10/122	.11/126	.11/131	1.10/1.07	.90/.93
	.65	.14/163	.14/169	.15/175	.15/181	.16/187	.16/195	.17/203	1.10/1.07	.89/.92
	.7	.18/220	.19/228	.20/237	.20/246	.21/257	.22/268	.23/281	1.10/1.08	.89/.92
	.75	.23/279	.24/290	.25/302	.26/315	.27/330	.28/348	.30/368	1.11/1.08	.89/.91
	.8	.27/339	.28/353	.30/369	.31/388	.33/410	.35/435	.37/466	1.11/1.08	.88/.91
	.85	.32/400	.33/419	.35/440	.37/466	.39/496	.42/534	.42/581	1.12/1.09	.88/.90
	.9	.36/463	.38/487	.40/515	.43/551	.46/595	.50/650	.56/727	1.14/1.10	.87/.90

4G–1–(160)

Figure A9–11

LOW ALTITUDE ACCELERATION

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.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	.38/549	.40/580	.43/616	.46/664	.50/721	.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

4G–1–(161)

Figure A9–12

LOW ALTITUDE ACCELERATION

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 50,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.05/71	.05/73	.06/76	.06/78	.06/81	.06/83	.06/86	1.10/1.07	.90/.93
	.6	.10/144	.11/149	.11/154	.12/160	.12/166	.12/172	.13/179	1.10/1.07	.90/.93
	.65	.16/220	.16/228	.17/236	.17/246	.18/256	.19/268	.20/281	1.10/1.07	.89/.92
	.7	.21/297	.22/309	.23/322	.24/337	.25/353	.26/371	.27/392	1.10/1.08	.89/.92
	.75	.26/377	.27/394	.28/412	.30/433	.31/457	.33/485	.36/518	1.11/1.08	.89/.91
	.8	.31/459	.33/481	.34/506	.36/535	.38/570	.41/611	.45/663	1.11/1.08	.88/.91
	.85	.36/543	.38/572	.40/604	.43/645	.46/695	.50/757	.55/840	1.12/1.09	.88/.90
	.9	.41/629	.44/665	.46/709	.50/766	.54/838	.61/935	.69/1078	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	.05/70	.06/72	.06/74	.06/77	.06/79	.06/82	.07/85	1.10/1.07	.90/.93
	.6	.11/142	.11/147	.12/152	.12/157	.12/163	.13/169	.13/175	1.10/1.07	.90/.93
	.65	.16/216	.17/224	.17/232	.18/241	.19/251	.20/261	.20/274	1.10/1.07	.89/.92
	.7	.21/292	.22/303	.23/316	.24/329	.25/344	.27/362	.28/381	1.10/1.08	.89/.92
	.75	.27/370	.28/386	.29/403	.31/422	.32/445	.34/471	.36/502	1.11/1.08	.89/.91
	.8	.32/450	.34/471	.35/494	.37/521	.40/554	.42/592	.46/640	1.11/1.08	.88/.91
	.85	.37/532	.39/569	.41/589	.44/627	.47/673	.51/731	.56/806	1.12/1.09	.88/.90
	.9	.43/616	.45/650	.48/691	.51/744	.56/810	.61/893	.70/1024	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	.06/69	.06/71	.06/73	.06/75	.06/78	.07/80	.07/83	1.10/1.07	.90/.93
	.6	.11/140	.12/144	.12/149	.12/154	.13/159	.13/165	.14/172	1.10/1.07	.90/.93
	.65	.17/212	.17/219	.18/227	.19/236	.19/245	.20/255	.21/267	1.10/1.07	.89/.92
	.7	.22/286	.23/297	.24/309	.25/322	.26/336	.28/352	.29/371	1.10/1.08	.89/.92
	.75	.28/362	.29/377	.30/394	.32/412	.33/433	.35/458	.37/486	1.11/1.08	.89/.91
	.8	.33/440	.35/460	.37/482	.38/508	.41/538	.43/574	.47/618	1.11/1.08	.88/.91
	.85	.39/520	.41/546	.43/575	.45/610	.49/653	.52/706	.57/774	1.12/1.09	.88/.90
	.9	.44/602	.47/634	.49/673	.53/722	.57/784	.63/863	.70/975	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	.06/69	.06/70	.06/73	.06/75	.07/77	.07/79	.07/82	1.10/1.07	.90/.93
	.6	.12/138	.12/143	.13/147	.13/152	.13/157	.14/163	.14/169	1.10/1.07	.90/.93
	.65	.18/209	.18/216	.19/224	.20/232	.20/241	.21/251	.22/262	1.10/1.07	.89/.92
	.7	.23/282	.24/292	.25/304	.26/316	.27/329	.29/345	.30/362	1.10/1.08	.89/.92
	.75	.29/356	.30/370	.32/386	.33/404	.35/424	.36/446	.39/473	1.11/1.08	.89/.91
	.8	.35/432	.36/451	.38/472	.40/496	.42/525	.45/558	.48/598	1.11/1.08	.88/.91
	.85	.40/510	.42/534	.44/562	.47/595	.50/635	.54/684	.59/746	1.12/1.09	.88/.90
	.9	.46/590	.48/620	.51/656	.54/703	.59/760	.64/832	.71/933	1.14/1.10	.87/.90

4G–1–(162)

Figure A9–13

LOW ALTITUDE ACCELERATION
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 55,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.06/78	.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	.30/435	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	.36/524	.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	.61/930	.67/1039	.77/1201	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	.07/86	.07/86	.07/88	.07/91	.07/95	1.10/1.07	.90/.93
	.6	.12/158	.12/163	.13/175	.13/175	.14/181	.14/188	.15/196	1.10/1.07	.90/.93
	.65	.18/240	.19/249	.20/268	.20/268	.21/279	.22/292	.23/305	1.10/1.07	.89/.92
	.7	.24/324	.25/337	.26/351	.27/366	.28/382	.30/403	.31/423	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	.29/374	.31/393	.32/413	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	.55/747	.59/803	.63/872	.70/962	.79/1089	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	.16/183	.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	.33/405	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	.40/501	.42/526	.44/553	.47/585	.50/623	.53/669	1.11/1.08	.88/.91
	.85	.45/567	.47/595	.49/625	.54/663	.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	.80/1042	1.14/1.10	.87/.90

4G–1–(163)

Figure A9–14

LOW ALTITUDE ACCELERATION

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 60,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.06/87	.07/90	.07/93	.07/96	.07/99	.08/103	.08/107	1.10/1.07	.90/.93
	.6	.13/177	.13/183	.14/190	.14/197	.15/204	.15/212	.16/221	1.10/1.07	.90/.93
	.65	.19/269	.20/279	.21/290	.21/302	.23/315	.23/330	.25/346	1.10/1.07	.89/.92
	.7	.25/364	.27/379	.28/395	.29/413	.30/434	.33/457	.34/483	1.10/1.08	.89/.92
	.75	.32/461	.33/482	.35/505	.37/531	.39/561	.41/596	.44/638	1.11/1.08	.89/.91
	.8	.38/560	.40/588	.42/619	.44/655	.47/699	.51/751	.55/816	1.11/1.08	.88/.91
	.85	.44/663	.47/698	.49/739	.52/789	.56/851	.61/929	.68/1033	1.12/1.09	.88/.90
	.9	.50/767	.53/812	.56/866	.61/936	.67/1026	.74/1146	.85/1326	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	.07/87	.07/89	.07/92	.07/95	.08/98	.08/101	.08/105	1.10/1.07	.90/.93
	.6	.13/175	.14/181	.14/187	.15/194	.15/201	.16/209	.17/217	1.10/1.07	.90/.93
	.65	.20/265	.21/275	.21/285	.22/297	.23/309	.24/323	.25/338	1.10/1.07	.89/.92
	.7	.26/358	.27/372	.29/388	.30/405	.31/424	.33/446	.35/471	1.10/1.08	.89/.92
	.75	.33/453	.34/473	.36/495	.38/519	.40/547	.42/580	.45/619	1.11/1.08	.89/.91
	.8	.29/550	.41/576	.43/606	.46/640	.49/680	.52/729	.56/789	1.11/1.08	.88/.91
	.85	.46/650	.48/684	.51/722	.54/769	.58/827	.63/898	.69/993	1.12/1.09	.88/.90
	.9	.52/752	.55/794	.58/845	.63/911	.68/993	.75/1103	.86/1261	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	.07/86	.07/88	.07/91	.08/94	.08/97	.08/100	.08/104	1.10/1.07	.90/.93
	.6	.14/173	.14/178	.15/184	.15/191	.16/198	.16/205	.17/213	1.10/1.07	.90/.93
	.65	.21/261	.21/271	.22/281	.23/292	.24/303	.25/316	.26/331	1.10/1.07	.89/.92
	.7	.28/352	.29/366	.30/381	.31/397	.32/415	.34/436	.36/459	1.10/1.08	.89/.92
	.75	.34/445	.36/464	.37/485	.39/508	.41/535	.43/565	.46/602	1.11/1.08	.89/.91
	.8	.41/540	.43/565	.45/593	.47/625	.50/663	.53/708	.58/764	1.11/1.08	.88/.91
	.85	.47/637	.50/670	.53/705	.56/750	.60/804	.64/870	.71/959	1.12/1.09	.88/.90
	.9	.54/737	.57/777	.60/825	.65/887	.70/963	.77/1063	.87/1205	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	.07/85	.08/88	.08/91	.08/93	.08/96	.09/100	.09/103	1.10/1.07	.90/.93
	.6	.15/177	.15/177	.16/183	.16/190	.17/196	.17/203	.18/211	1.10/1.07	.90/.93
	.65	.22/259	.23/268	.25/278	.24/288	.25/300	.26/312	.27/326	1.10/1.07	.89/.92
	.7	.29/348	.30/361	.31/376	.32/391	.34/409	.35/428	.37/450	1.10/1.08	.89/.92
	.75	.36/439	.37/457	.39/477	.41/499	.43/524	.45/553	.48/587	1.11/1.08	.89/.91
	.8	.43/532	.45/556	.47/582	.49/612	.52/648	.55/691	.59/742	1.11/1.08	.88/.91
	.85	.50/627	.52/657	.55/691	.58/733	.62/784	.66/845	.73/925	1.12/1.09	.88/.90
	.9	.56/723	.59/762	.63/807	.67/865	.72/936	.79/1028	.89/1156	1.14/1.10	.87/.90

4G–1–(164)

Figure A9–15

LOW ALTITUDE ACCELERATION

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 35,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.07/25	.07/27	.07/28	.08/30	.08/32	.09/34	.10/37	1.17/1.11	.87/.93
	.6	.14/52	.15/55	.16/59	.17/64	.18/69	.20/75	.22/83	1.18/1.11	.86/.91
	.65	.21/81	.23/87	.24/94	.27/103	.29/113	.32/126	.37/143	1.19/1.13	.84/.90
	.7	.29/113	.31/122	.34/134	.38/149	.43/168	.49/194	.60/237	1.23/1.16	.83/.88
	.75	.37/147	.41/162	.45/180	.51/205	.61/242	.76/306	1.20/486	1.24/1.18	.79/.83
	.8	.46/185	.51/207	.58/236	.69/280	.89/364	2.13/893		1.26/1.20	.80/.85
	.85	.56/229	.64/261	.75/308	.99/410				1.30/1.24	.83/.87
	.9	.68/283	.80/336	1.07/455					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	.08/28	.08/29	.09/31	.09/34	.10/36	1.17/1.11	.87/.93
	.6	.14/51	.15/54	.16/58	.17/62	.18/67	.20/73	.22/80	1.18/1.11	.86/.91
	.65	.22/80	.23/85	.25/92	.27/100	.29/109	.33/121	.37/136	1.19/1.13	.84/.90
	.7	.30/110	.32/119	.35/130	.38/143	.43/160	.49/183	.58/218	1.23/1.16	.83/.88
	.75	.38/143	.41/157	.46/174	.52/196	.60/228	.73/280	1.02/391	1.24/1.18	.79/.83
	.8	.47/180	.52/200	.59/226	.68/264	.86/333	1.35/533		1.26/1.20	.80/.85
	.85	.57/222	.64/251	.75/293	.95/374	2.26/925			1.30/1.24	.83/.87
	.9	.69/273	.80/320	1.03/415					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	.07/25	.08/26	.08/27	.08/29	.09/31	.10/33	.10/35	1.17/1.11	.87/.93
	.6	.15/51	.15/54	.16/57	.18/61	.19/65	.20/71	.22/77	1.18/1.11	.86/.91
	.65	.22/78	.24/84	.26/90	.28/97	.30/106	.33/116	.37/130	1.19/1.13	.84/.90
	.7	.30/108	.33/116	.35/126	.39/138	.43/154	.49/174	.57/204	1.23/1.16	.83/.88
	.75	.39/140	.42/153	.47/168	.52/188	.60/216	.71/258	.93/340	1.24/1.18	.79/.83
	.8	.48/175	.53/194	.59/217	.68/251	.83/307	1.18/437		1.26/1.20	.80/.85
	.85	.58/215	.65/242	.75/279	.93/347	1.45/553			1.30/1.24	.83/.87
	.9	.70/264	.81/306	1.01/385					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	.08/24	.08/26	.08/27	.09/29	.09/30	.10/32	.11/35	1.17/1.11	.87/.93
	.6	.15/50	.16/53	.17/56	.18/60	.19/64	.21/69	.23/75	1.18/1.11	.86/.91
	.65	.23/77	.25/82	.26/88	.28/95	.31/103	.34/113	.37/125	1.19/1.13	.84/.90
	.7	.31/106	.34/114	.37/123	.40/135	.44/149	.49/167	.57/193	1.23/1.16	.83/.88
	.75	.40/137	.44/149	.48/163	.53/182	.60/207	.71/243	.89/307	1.24/1.18	.79/.83
	.8	.49/171	.54/188	.60/210	.69/240	.82/287	1.09/382		1.26/1.20	.80/.85
	.85	.60/209	.67/234	.76/267	.92/324	1.29/402			1.30/1.24	.83/.87
	.9	.72/255	.82/293	1.00/360					1.22/1.17	.81/.85

4G–1–(165)

Figure A9–16

LOW ALTITUDE ACCELERATION

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 40,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-17

DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 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 (LB.)								
SEA LEVEL (15°C)	.5	.0 /0	.0 /0	.0 /0	.0 /0	.0 /0	.0 /0	.0 /0	.0 / .0	.0 /.0
	.55	.08/29	.08/31	.09/33	.09/35	.10/37	.11/40	.11/43	1.17/1.11	.87/.93
	.6	.16/60	.17/64	.18/69	.19/74	.21/80	.23/88	.25/97	1.18/1.11	.86/.91
	.65	.24/94	.26/101	.28/110	.31/119	.34/132	.38/147	.43/168	1.19/1.13	.84/.90
	.7	.33/131	.36/142	.40/156	.44/173	.50/196	.58/227	.75/298	1.23/1.16	.83/.88
	.75	.43/170	.47/188	.53/209	.60/238	.71/282	.90/359	1.44/582	1.24/1.18	.79/.83
	.8	.53/214	.59/240	.68/274	.80/325	1.04/424			1.26/1.20	.80/.85
	.85	.65/264	.74/302	.87/358	1.15/477				1.30/1.24	.83/.87
	.9	.78/327	.93/389	1.26/534					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	.08/29	.08/31	.09/32	.10/34	.10/37	.11/39	.12/42	1.17/1.11	.87/.93
	.6	.16/60	.17/63	.19/68	.20/73	.21/78	.23/85	.26/94	1.18/1.11	.86/.91
	.65	.25/92	.27/99	.29/107	.31/116	.34/127	.38/141	.43/160	1.19/1.13	.84/.90
	.7	.34/128	.37/139	.40/151	.45/167	.50/188	.57/215	.69/258	1.23/1.16	.83/.88
	.75	.44/166	.48/182	.53/202	.60/228	.70/266	.86/329	1.22/468	1.24/1.18	.79/.83
	.8	.54/208	.60/232	.68/262	.80/308	1.00/390	1.62/638		1.26/1.20	.80/.85
	.85	.66/256	.75/291	.87/340	1.10/436				1.30/1.24	.83/.87
	.9	.80/316	.93/371	1.21/486					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	.08/29	.09/30	.09/32	.10/34	.11/36	.11/39	.12/42	1.17/1.11	.87/.93
	.6	.17/59	.18/63	.19/67	.20/71	.22/77	.24/83	.26/91	1.18/1.11	.86/.91
	.65	.26/91	.28/97	.30/105	.32/113	.35/124	.39/137	.43/153	1.19/1.13	.84/.90
	.7	.35/125	.38/135	.41/147	.45/162	.51/180	.57/205	.67/240	1.23/1.16	.83/.88
	.75	.45/163	.49/178	.54/196	.61/219	.70/253	.85/307	1.11/406	1.24/1.18	.79/.83
	.8	.56/203	.62/225	.69/253	.80/293	.98/362	1.40/520		1.26/1.20	.80/.85
	.85	.67/249	.76/281	.87/325	1.09/408	1.74/663			1.30/1.24	.83/.87
	.9	.81/306	.94/355	1.18/450					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	.09/29	.09/30	.10/32	.10/34	.11/36	.12/38	.13/41	1.17/1.11	.87/.93
	.6	.18/59	.19/62	.20/66	.21/70	.23/76	.25/82	.27/89	1.18/1.11	.86/.91
	.65	.27/90	.29/96	.31/103	.33/111	.36/121	.40/133	.44/138	1.19/1.13	.84/.90
	.7	.37/124	.39/133	.43/144	.47/158	.52/175	.58/197	.67/228	1.23/1.16	.83/.88
	.75	.47/160	.51/174	.56/191	.62/213	.71/243	.83/287	1.06/367	1.24/1.18	.79/.83
	.8	.58/199	.63/219	.71/245	.81/281	.98/341	1.29/455		1.26/1.20	.80/.85
	.85	.69/243	.77/272	.88/312	1.08/383	1.52/547			1.30/1.24	.83/.87
	.9	.83/297	.95/341	1.17/421					1.22/1.17	.81/.85

4G–1–(166)

Figure A9–17

LOW ALTITUDE ACCELERATION
MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 45,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.09/34	.09/36	.10/38	.11/40	.11/43	.12/46	.13/50	1.17/1.11	.87/.93
	.6	.18/69	.19/74	.21/79	.22/85	.24/93	.26/101	.29/112	1.18/1.11	.86/.91
	.65	.28/108	.30/116	.32/126	.35/137	.39/152	.44/170	.50/194	1.19/1.13	.84/.90
	.7	.38/149	.42/163	.46/179	.51/199	.57/226	.67/263	.82/325	1.23/1.16	.83/.88
	.75	.49/195	.54/215	.60/240	.69/274	.81/325	1.04/417	1.74/707	1.24/1.18	.79/.83
	.8	.61/244	.68/274	.78/313	.92/374	1.20/490			1.26/1.20	.80/.85
	.85	.74/301	.84/345	.99/410	1.32/550				1.30/1.24	.83/.87
	.9	.90/373	1.06/445	1.45/618					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	.11/40	.12/42	.13/46	.14/49	1.17/1.11	.87/.93
	.6	.19/68	.20/73	.21/78	.23/84	.25/91	.27/99	.30/109	1.18/1.11	.86/.91
	.65	.29/106	.31/114	.33/123	.36/134	.40/147	.44/164	.50/186	1.19/1.13	.84/.90
	.7	.39/146	.43/159	.46/174	.51/192	.58/216	.66/249	.85/320	1.23/1.16	.83/.88
	.75	.50/190	.55/209	.61/232	.69/263	.81/308	1.00/381	1.45/560	1.24/1.18	.79/.83
	.8	.62/238	.69/266	.78/301	.92/354	1.20/475	1.96/775		1.26/1.20	.80/.85
	.85	.75/293	.85/333	1.00/390	1.28/506				1.30/1.24	.83/.87
	.9	.91/361	1.07/425	1.39/560					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	.10/33	.10/35	.11/37	.11/39	.12/42	.13/45	.14/49	1.17/1.11	.87/.93
	.6	.20/68	.21/72	.22/77	.24/83	.26/89	.28/97	.30/106	1.18/1.11	.86/.91
	.65	.30/105	.32/112	.34/121	.37/131	.41/143	.45/159	.51/178	1.19/1.13	.84/.90
	.7	.40/144	.44/156	.48/170	.52/187	.59/209	.67/238	.79/284	1.23/1.16	.83/.88
	.75	.52/186	.57/204	.63/225	.70/253	.81/293	.98/355	1.34/488	1.24/1.18	.79/.83
	.8	.64/233	.71/258	.79/291	.92/338	1.13/418	1.67/620		1.26/1.20	.80/.85
	.85	.77/285	.87/322	1.00/373	1.25/468	2.09/796			1.30/1.24	.83/.87
	.9	.93/349	1.08/407	1.36/519					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	.11/35	.11/37	.12/39	.13/42	.14/45	.13/41	1.17/1.11	.87/93
	.6	.20/68	.22/72	.23/76	.25/82	.27/88	.29/95	.27/89	1.18/1.11	.86/.91
	.65	.31/104	.33/111	.36/119	.39/129	.42/141	.46/155	.44/148	1.19/1.13	.84/.90
	.7	.42/142	.45/154	.49/167	.54/183	.60/203	.68/230	.67/228	1.23/1.16	.83/.88
	.75	.54/184	.59/200	.64/220	.72/246	.82/282	.98/336	1.06/367	1.24/1.18	.79/.83
	.8	.66/229	.73/252	.81/282	.93/325	1.13/395	1.53/540		1.26/1.20	.80/.85
	.85	.79/279	.89/313	1.02/359	1.25/442	1.81/650			1.30/1.24	.83/.87
	.9	.95/340	1.09/392	1.35/486					1.22/1.17	.81/.85

4G–1–(167)

Figure A9–18

LOW ALTITUDE ACCELERATION

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 50,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
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 (LB.)						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	.10/38	.11/40	.11/43	.12/46	.13/49	.14/53	.15/58	1.17/1.11	.87/.93
	.6	.21/79	.22/84	.24/90	.25/97	.28/106	.30/116	.34/129	1.18/1.11	.86/.91
	.65	.32/122	.34/132	.37/143	.40/156	.45/173	.50/195	.58/224	1.19/1.13	.84/.90
	.7	.43/169	.47/184	.52/203	.58/226	.66/257	.77/302	.96/378	1.23/1.16	.83/.88
	.75	.55/220	.61/243	.68/272	.78/312	.93/372	1.20/482	2.18/888	1.24/1.18	.79/.83
	.8	.69/276	.77/310	.88/355	1.05/426	1.39/566			1.26/1.20	.80/.85
	.85	.83/340	.95/391	1.13/465	1.51/628				1.30/1.24	.83/.87
	.9	1.01/421	1.20/504	1.66/708					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	.11/38	.11/40	.12/43	.13/46	.13/49	.15/53	.16/57	1.17/1.11	.87/.93
	.6	.21/78	.23/83	.24/89	.26/96	.28/104	.31/114	.34/126	1.18/1.11	.86/.91
	.65	.33/120	.35/130	.38/140	.41/153	.46/169	.51/188	.58/214	1.19/1.13	.84/.90
	.7	.44/166	.48/181	.53/198	.59/219	.66/248	.76/287	.93/348	1.23/1.16	.83/.88
	.75	.57/216	.63/237	.70/264	.79/300	.93/353	1.16/443	1.74/670	1.24/1.18	.79/.83
	.8	.70/270	.78/301	.89/342	1.05/405	1.34/521	2.43/959		1.26/1.20	.80/.85
	.85	.85/331	.97/377	1.13/443	1.47/581				1.30/1.24	.83/.87
	.9	1.03/408	1.21/481	1.59/641					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	.11/38	.12/40	.12/42	.13/45	.14/48	.15/52	.16/56	1.17/1.11	.87/.93
	.6	.22/77	.24/82	.25/88	.27/95	.29/102	.32/111	.35/123	1.18/1.11	.86/.91
	.65	.34/119	.36/128	.39/138	.43/150	.47/165	.52/183	.59/207	1.19/1.13	.84/.90
	.7	.46/164	.50/177	.54/194	.60/214	.67/240	.77/274	.91/327	1.23/1.16	.83/.88
	.75	.59/212	.64/232	.71/257	.80/289	.93/336	1.14/412	1.56/571	1.24/1.18	.79/.83
	.8	.72/264	.80/293	.91/331	1.05/387	1.31/484	1 99/741		1.26/1.20	.80/.85
	.85	.87/323	.99/366	1.14/425	1.43/537	2.52/966			1.30/1.24	.83/.87
	.9	1.05/396	1.22/462	1.55/593					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	.12/38	.12/40	.13/43	.14/45	.15/48	.16/52	.17/56	1.17/1.11	.87/.93
	.6	.23/77	.25/82	.27/88	.29/94	.31/102	.33/111	.37/122	1.18/1.11	.86/.91
	.65	.36/119	.38/127	.41/137	.44/149	.49/163	.54/180	.60/202	1.19/1.13	.84/.90
	.7	.48/162	.52/176	.57/191	.62/210	.69/235	.79/267	.92/314	1.23/1.16	.83/.88
	.75	.61/209	.67/228	.74/252	.82/282	.95/325	1.13/389	1.48/513	1.24/1.18	.79/.83
	.8	.75/260	.83/288	.93/323	1.07/373	1.30/455	1.81/639		1.26/1.20	.80/.85
	.85	.90/317	1.01/356	1.16/410	1.43/509	2.13/766			1.30/1.24	.83/.87
	.9	1.08/386	1.25/446	1.54/557					1.22/1.17	.81/.85

4G–1–(168)

Figure A9–19

LOW ALTITUDE ACCELERATION

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 55,000 POUNDS

REMARKS
ENGINES: (2) J79–GE–17

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.11/43	.12/46	.13/49	.14/52	.15/56	.16/61	.17/66	1.17/1.11	.87/.93
	.6	.23/88	.25/95	.27/102	.29/110	.31/120	.35/132	.38/147	1.18/1.11	.86/.91
	.65	.35/137	.38/148	.42/161	.46/177	.51/196	.57/222	.66/257	1.19/1.13	.84/.90
	.7	.48/190	.53/207	.58/229	.65/256	.74/292	.87/346	1.10/435	1.23/1.16	.83/.88
	.75	.62/247	.69/273	.77/307	.88/352	1.06/423	1.37/551	2.91/1191	1.24/1.18	.79/.83
	.8	.77/309	.86/348	.99/400	1.19/484	1.58/646			1.26/1.20	.80/.85
	.85	.93/381	1.07/438	1.28/526	1.71/713				1.30/1.24	.83/.87
	.9	1.13/471	1.35/566	1.90/807					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	.12/43	.13/46	.13/48	.14/52	.15/56	.17/60	.18/65	1.17/1.11	.87/.93
	.6	.24/88	.26/94	.28/101	.30/109	.32/118	.35/130	.39/144	1.18/1.11	.86/.91
	.65	.37/136	.40/146	.43/159	.47/173	.52/192	.58/215	.67/246	1.19/1.13	.84/.90
	.7	.50/187	.54/204	.60/224	.66/249	.75/282	.88/328	1.08/405	1.23/1.16	.83/.88
	.75	.64/242	.71/267	.79/298	.89/340	1.06/402	1.33/508	2.08/804	1.24/1.18	.79/.83
	.8	.79/303	.88/339	1.00/386	1.19/459	1.53/595	3.30/1312		1.26/1.20	.80/.85
	.85	.95/372	1.09/424	1.28/501	1.67/659				1.30/1.24	.83/.87
	.9	1.15/457	1.36/541	1.80/727					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	.13/43	.13/46	.14/49	.15/52	.16/56	.17/60	.19/65	1.17/1.11	.87/.93
	.6	.25/88	.27/94	.29/101	.31/108	.34/117	.37/128	.41/142	1.18/1.11	.86/.91
	.65	.38/135	.41/145	.45/157	.49/171	.53/188	.60/210	.68/239	1.19/1.13	.84/.90
	.7	.52/185	.56/201	.62/220	.68/243	.77/274	.89/316	1.07/382	1.23/1.16	.83/.88
	.75	.66/239	.73/262	.81/291	.91/329	1.06/385	1.31/476	1.85/677	1.24/1.18	.79/.83
	.8	.82/297	.91/331	1.03/375	1.20/440	1.50/555	2.39/893		1.26/1.20	.80/.85
	.85	.98/364	1.11/412	1.29/481	1.64/616	3.34/1285			1.30/1.24	.83/.87
	.9	1.18/445	1.38/521	1.77/674					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	.13/44	.14/46	.15/49	.16/52	.17/56	.18/60	.20/66	1.17/1.11	.87/.93
	.6	.27/88	.28/94	.30/101	.33/108	.35/117	.39/128	.43/141	1.18/1.11	.86/.91
	.65	.40/135	.43/145	.47/156	.51/170	.56/187	.62/208	.70/235	1.19/1.13	.84/.90
	.7	.55/184	.59/199	.64/218	.71/240	.79/269	.91/308	1.08/367	1.23/1.16	.83/.88
	.75	.69/237	.76/259	.84/287	.94/322	1.09/373	1.32/453	1.76/609	1.24/1.18	.79/.83
	.8	.85/294	.94/326	1.06/366	1.22/425	1.50/526	2.14/755		1.26/1.20	.80/.85
	.85	1.02/357	1.15/403	1.32/466	1.66/588	2.54/914			1.30/1.24	.83/.87
	.9	1.22/435	1.41/505	1.76/636					1.22/1.17	.81/.85

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Figure A9–20

LOW ALTITUDE ACCELERATION

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 60,000 POUNDS

REMARKS
ENGINES: (2) J79-GE-17

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

	MACH	DRAG INDEX	TIME TO ACCELERATE (MIN.)/FUEL TO ACCELERATE (LB.)						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	.13/48	.14/51	.14/55	.16/59	.17/63	.18/69	.20/75	1.17/1.11	.87/.93
	.6	.26/99	.28/106	.30/115	.32/124	.35/136	.39/150	.44/168	1.18/1.11	.86/.91
	.65	.40/153	.43/166	.47/181	.51/199	.57/222	.65/252	.76/293	1.19/1.13	.84/.90
	.7	.54/212	.59/232	.65/256	.73/288	.84/330	1.00/392	1.27/500	1.23/1.16	.83/.88
	.75	.69/275	.77/305	.86/344	1.00/396	1.20/479	1.57/632		1.24/1.18	.79/.83
	.8	.86/345	.96/389	1.11/448	1.34/543	1.80/737			1.26/1.20	.80/.85
	.85	1.04/424	1.19/489	1.43/588	1.94/810				1.30/1.24	.83/.87
	.9	1.26/524	1.51/631	2.15/915					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	.13/49	.14/52	.15/55	.16/59	.18/64	.19/69	.21/75	1.17/1.11	.87/.93
	.6	.27/99	.29/106	.31/114	.34/124	.37/135	.41/148	.45/165	1.18/1.11	.86/.91
	.65	.41/153	.45/165	.48/179	.53/196	.59/218	.66/246	.76/283	1.19/1.13	.84/.90
	.7	.56/210	.61/229	.67/252	.75/281	.85/320	1.00/375	1.25/470	1.23/1.16	.83/.88
	.75	.72/271	.79/300	.88/335	1.01/384	1.20/456	1.52/582	2.54/983	1.24/1.18	.79/.83
	.8	.88/338	.99/380	1.13/434	1.34/518	1.74/677			1.26/1.20	.80/.85
	.85	1.07/415	1.22/475	1.44/563	1.88/745				1.30/1.24	.83/.87
	.9	1.29/510	1.52/606	2.04/825					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	.14/49	.15/52	.16/55	.17/59	.19/64	.20/69	.22/75	1.17/1.11	.87/.93
	.6	.28/99	.30/106	.33/114	.35/123	.38/134	.42/147	.47/164	1.18/1.11	.86/.91
	.65	.43/152	.47/164	.50/178	.55/194	.61/215	.68/241	.78/276	1.19/1.13	.84/.90
	.7	.58/208	.64/226	.70/248	.77/276	.88/312	1.01/362	1.24/443	1.23/1.16	.83/.88
	.75	.74/268	.82/295	.91/329	1.03/373	1.21/439	1.51/549	2.23/814	1.24/1.18	.79/.83
	.8	.91/333	1.02/372	1.16/422	1.36/498	1.72/632	2.92/1093		1.26/1.20	.80/.85
	.85	1.10/407	1.25/463	1.46/544	1.86/697				1.30/1.24	.83/.87
	.9	1.32/497	1.55/585	2.01/768					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	.15/50	.16/53	.17/57	.19/61	.20/65	.22/71	.24/77	1.17/1.11	.87/.93
	.6	.30/101	.33/108	.35/116	.38/125	.41/136	.45/149	.50/165	1.18/1.11	.86/.91
	.65	.46/153	.49/165	.53/179	.58/195	.64/215	.72/241	.82/274	1.19/1.13	.84/.90
	.7	.62/208	.67/226	.73/248	.81/274	.91/309	1.05/356	1.26/429	1.23/1.16	.83/.88
	.75	.78/267	.86/293	.95/325	1.07/368	1.25/428	1.53/526	2.10/729	1.24/1.18	.79/.83
	.8	.96/331	1.06/368	1.20/415	1.39/485	1.73/605	2.55/900		1.26/1.20	.80/.85
	.85	1.14/402	1.29/454	1.50/529	1.86/661	3.05/1103			1.30/1.24	.83/.87
	.9	1.37/488	1.59/569	2.00/724					1.22/1.17	.81/.85

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Figure A9-21

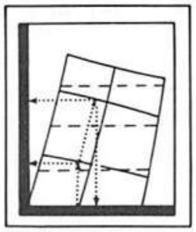
MAXIMUM THRUST ACCELERATION

10,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7

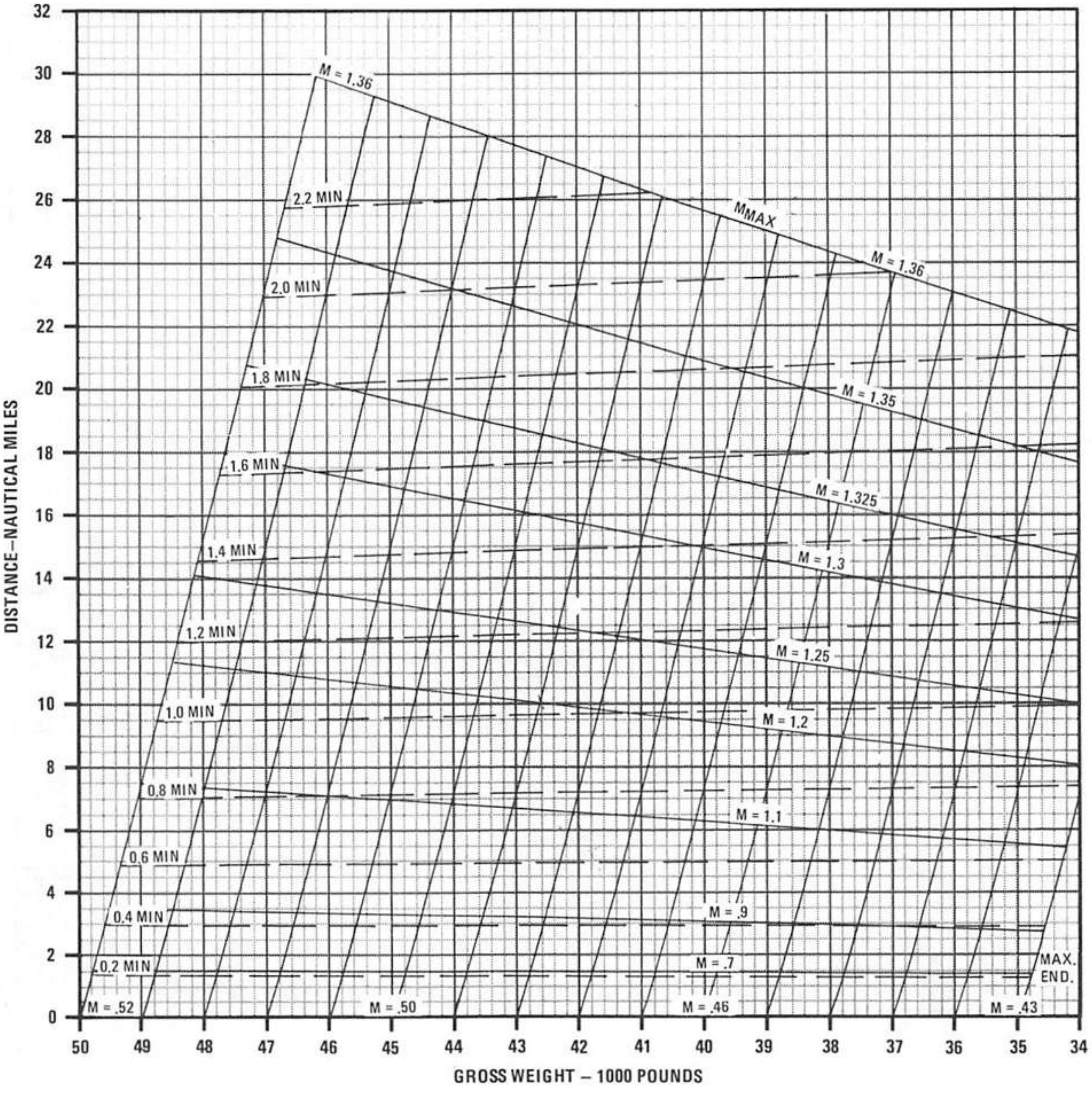
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(171)

Figure A9-22

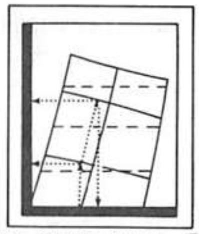
MAXIMUM THRUST ACCELERATION

30,000 FEET

AIRPLANE CONFIGURATION
(4) AIM–7

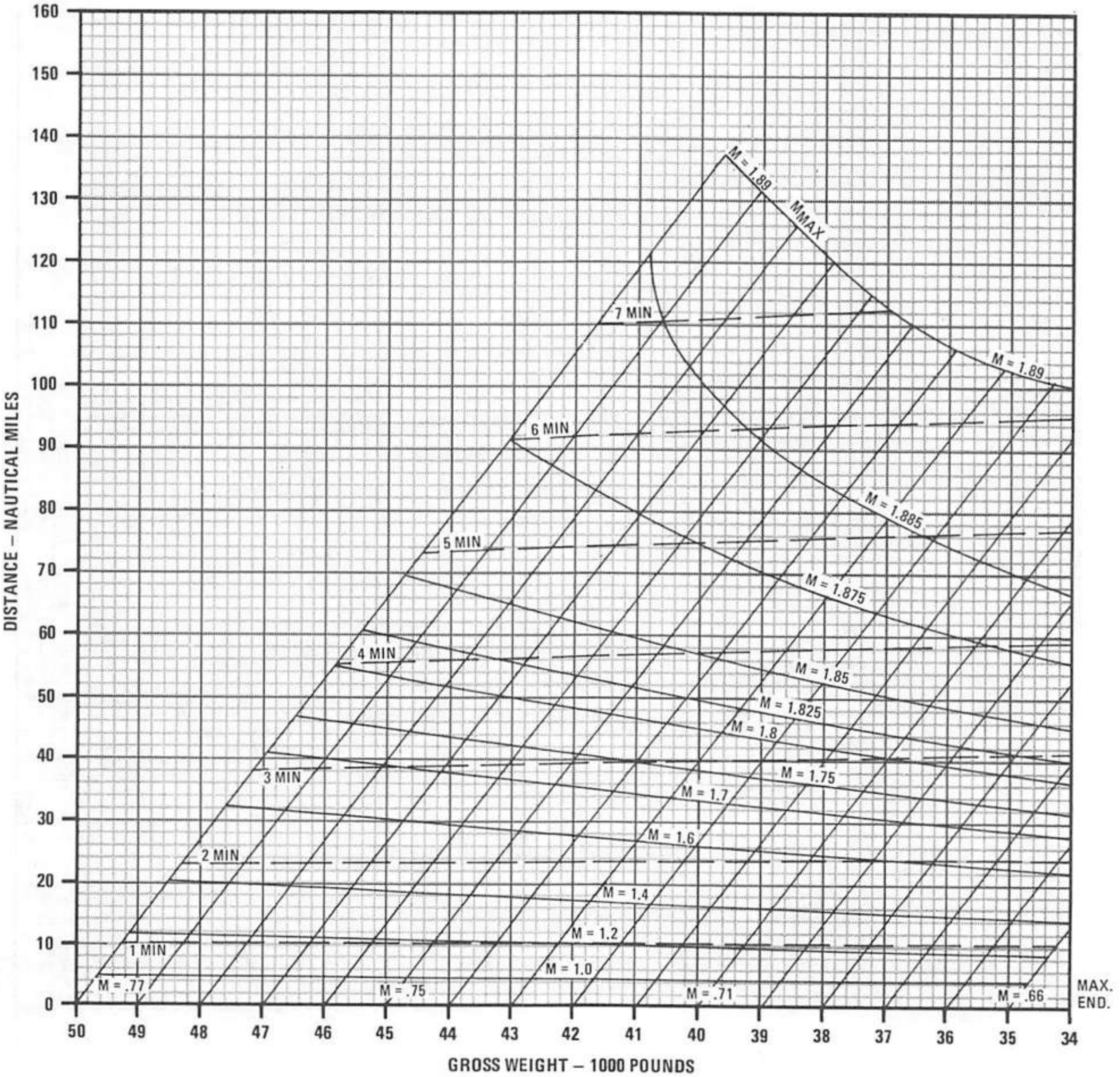
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(172)

Figure A9–23

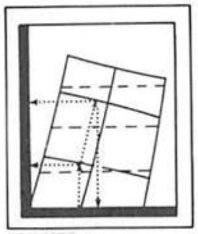
MAXIMUM THRUST ACCELERATION

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7

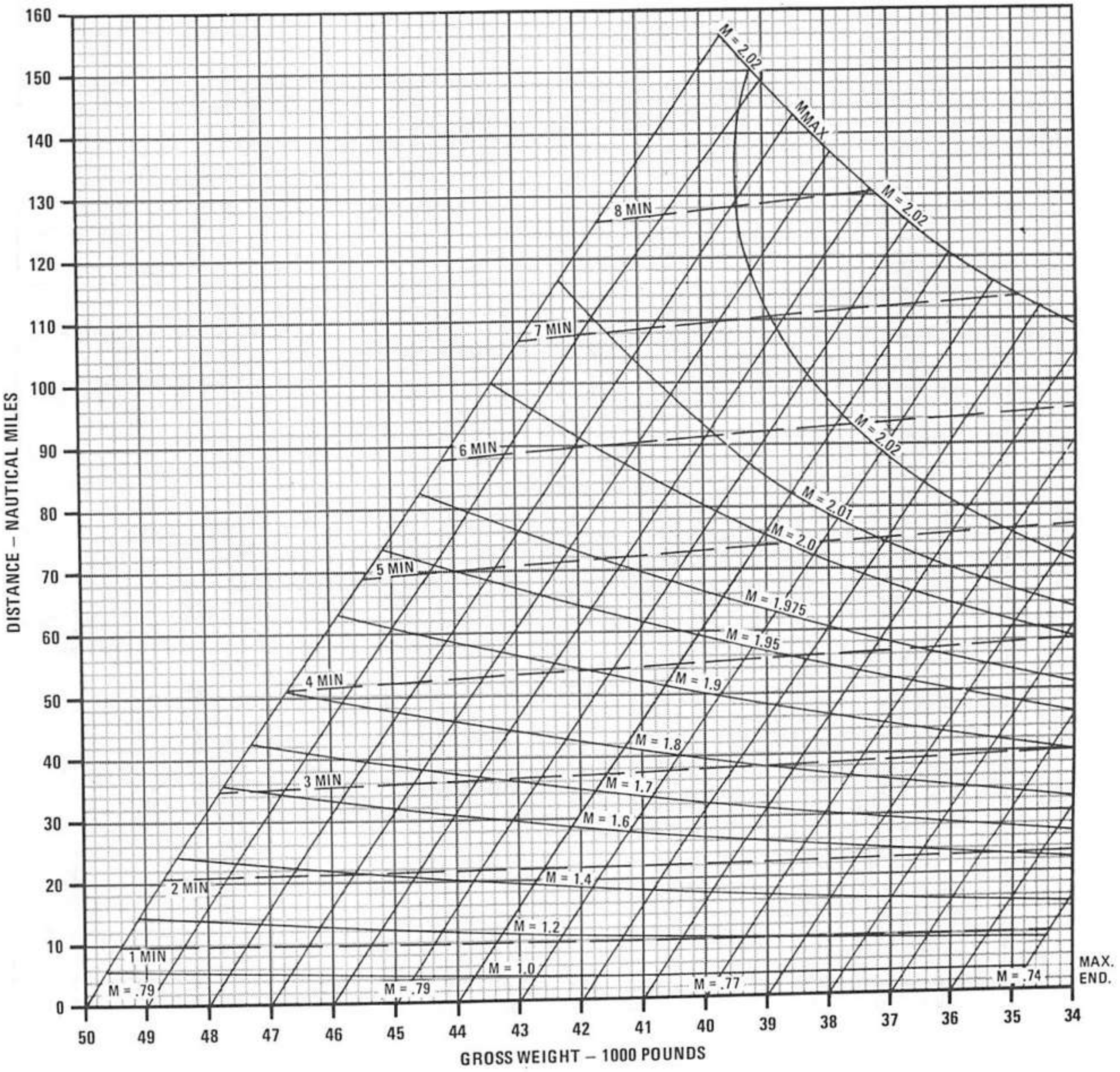
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(173)

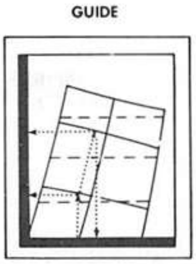
Figure A9-24

MAXIMUM THRUST ACCELERATION

40,000 FEET

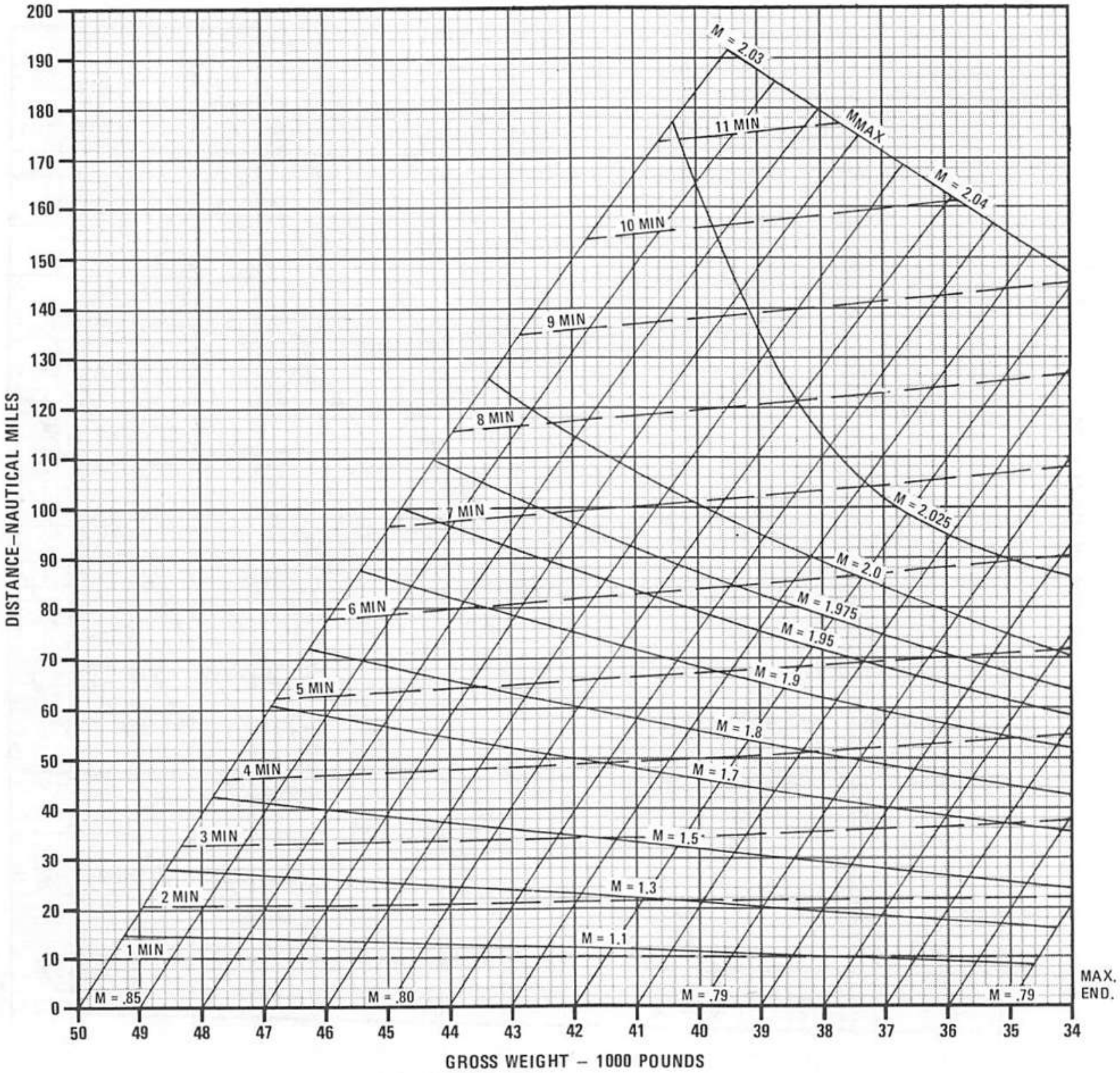
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(174)

Figure A9-25

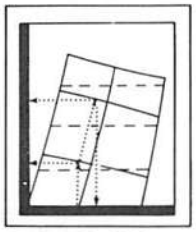
MAXIMUM THRUST ACCELERATION

45,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7

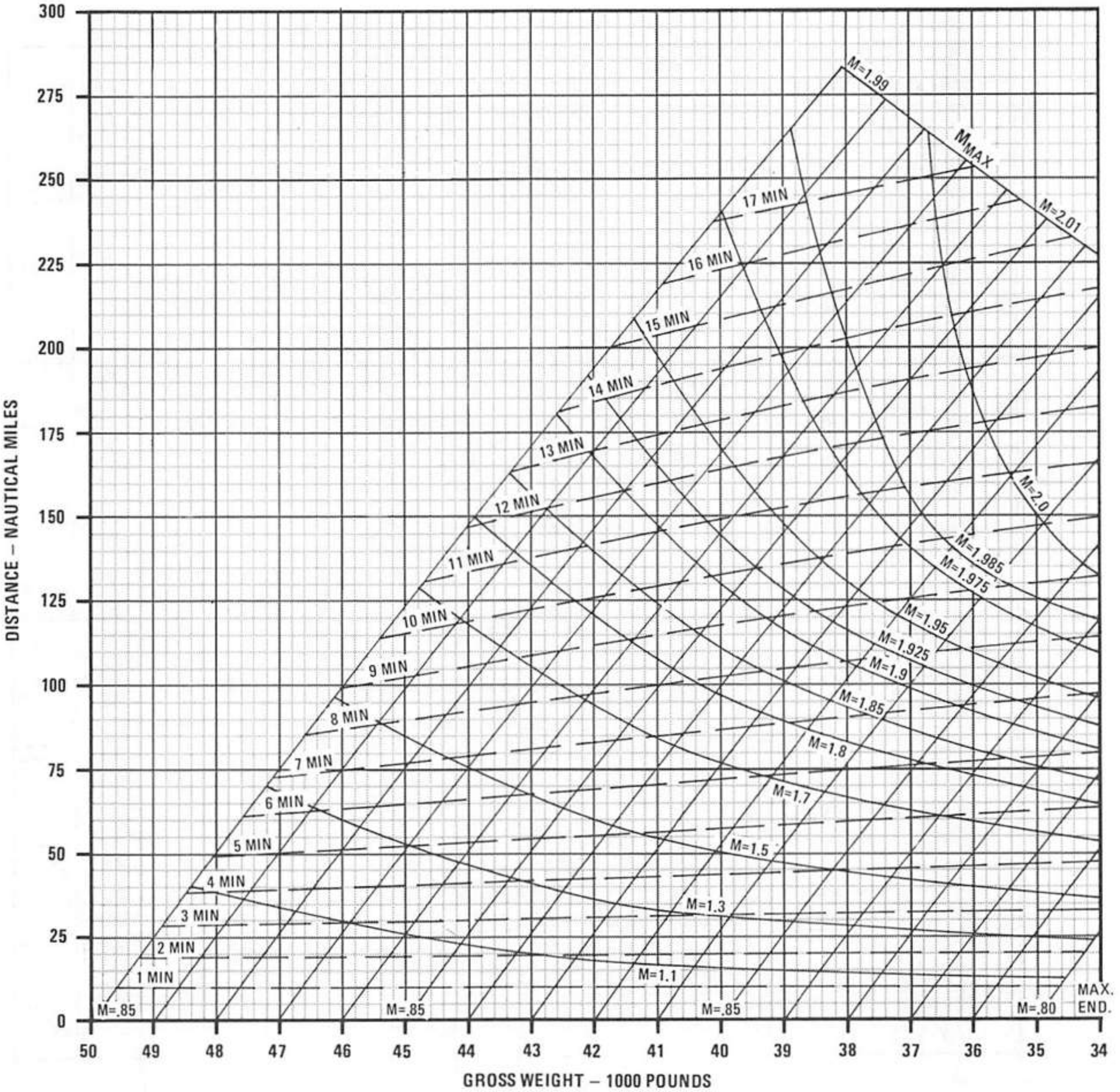
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.5 LB/GAL



4G-1-(175)

Figure A9-26

MAXIMUM THRUST ACCELERATION

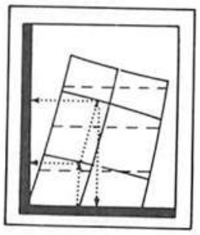
30,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

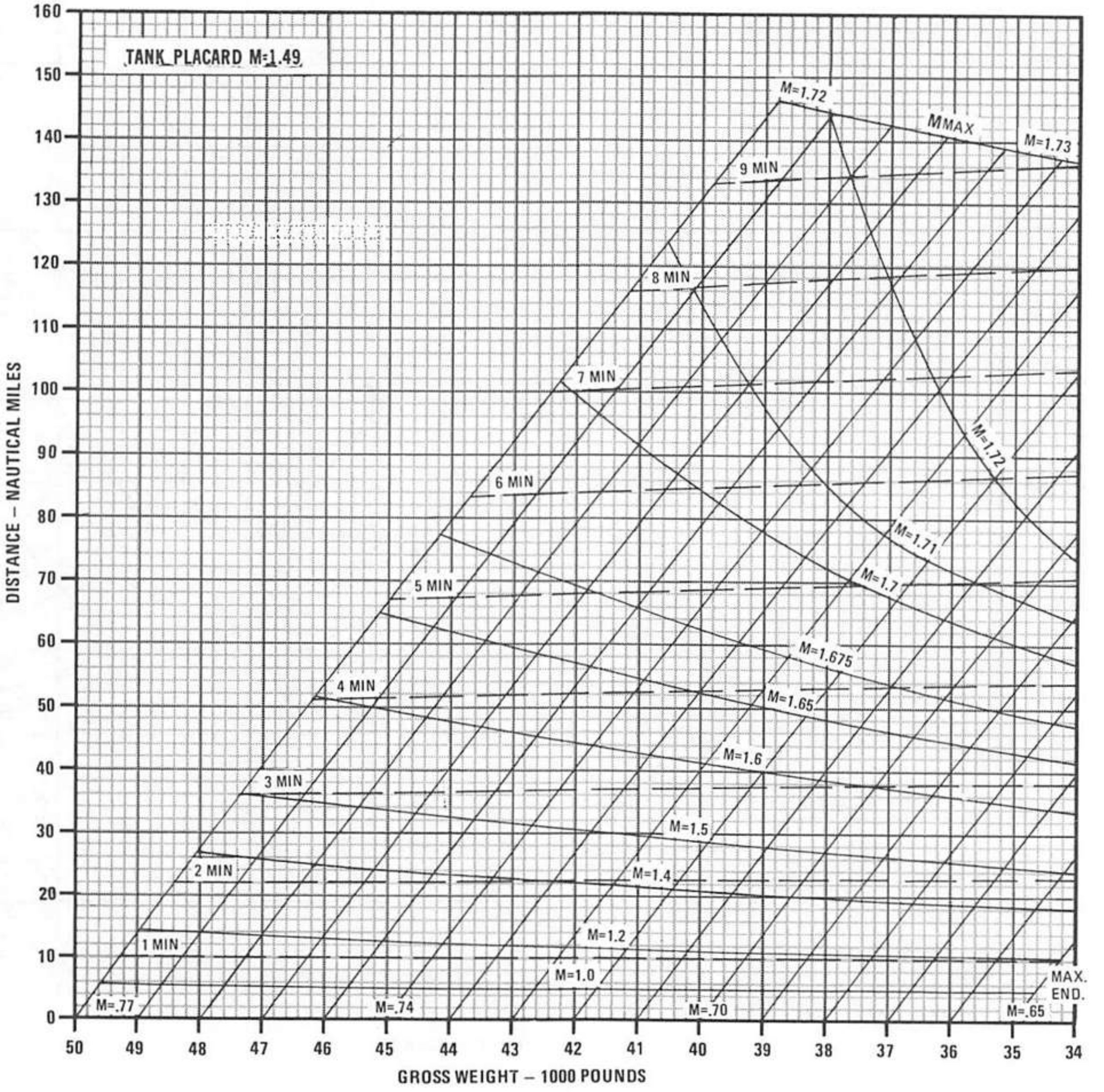
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

GUIDE



FUEL GRADE: JP-4
DATA BASIS: 6.5 LB/GAL



4G-1-(176)

Figure A9-27

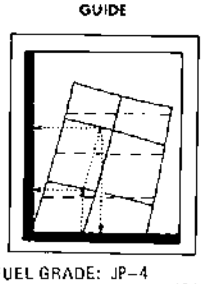
MAXIMUM THRUST ACCELERATION

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

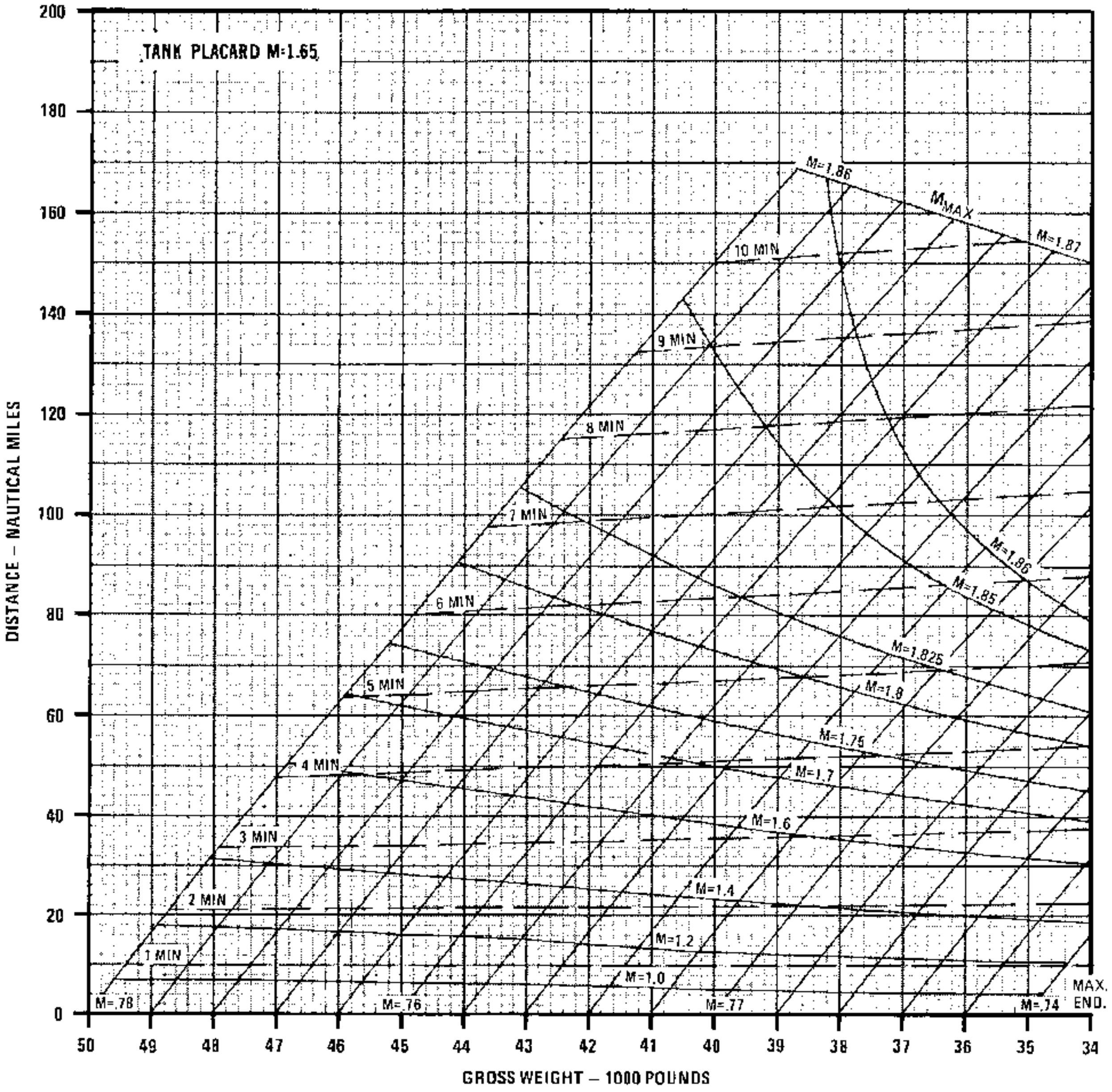
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(177)

Figure A9-28

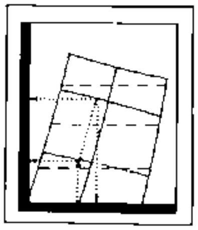
MAXIMUM THRUST ACCELERATION

40,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

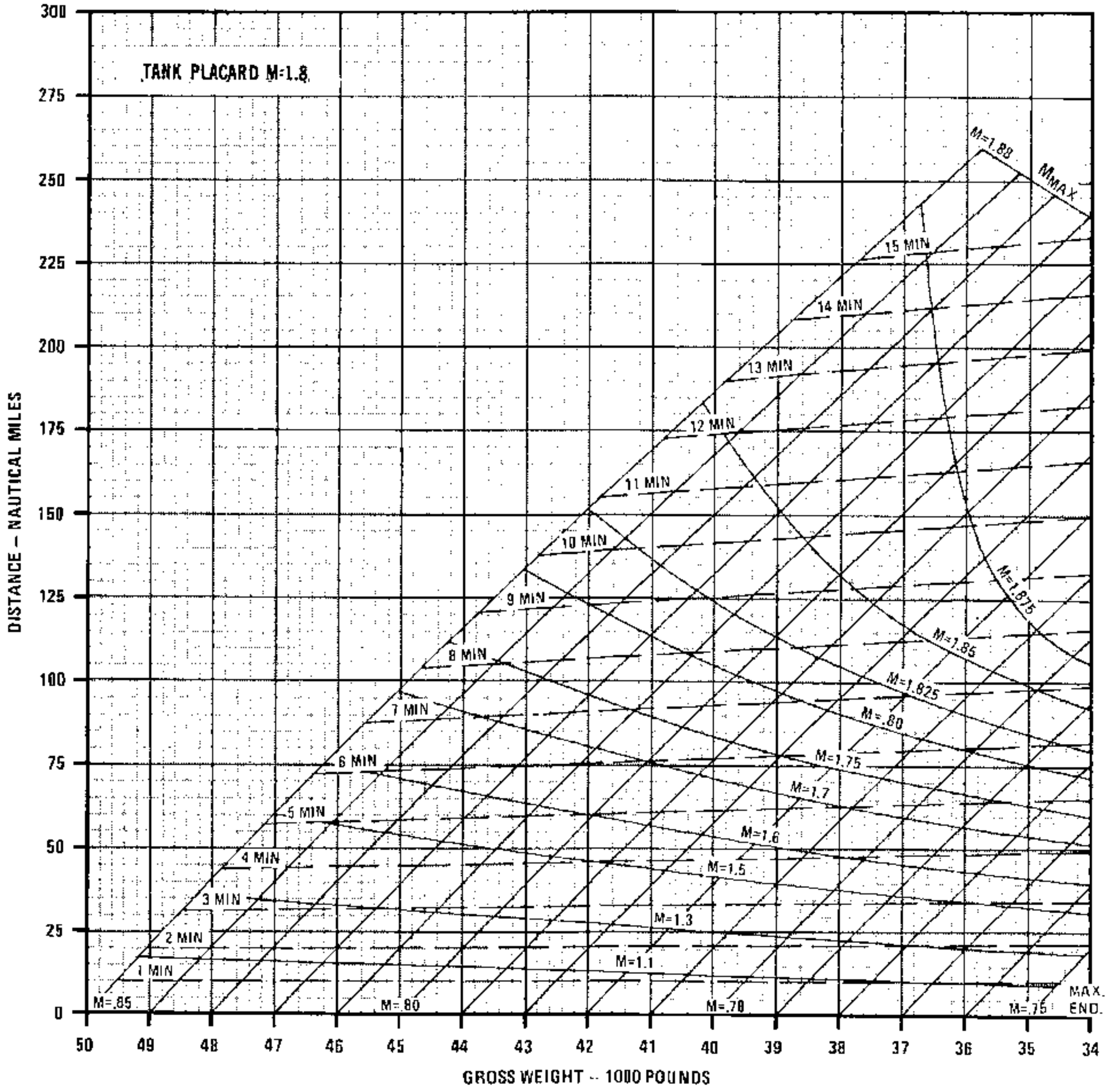
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 5.8 LB/GAL



4G-1-(178)

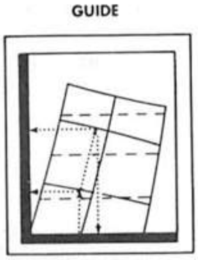
Figure A9-29

MAXIMUM THRUST ACCELERATION

45,000 FEET

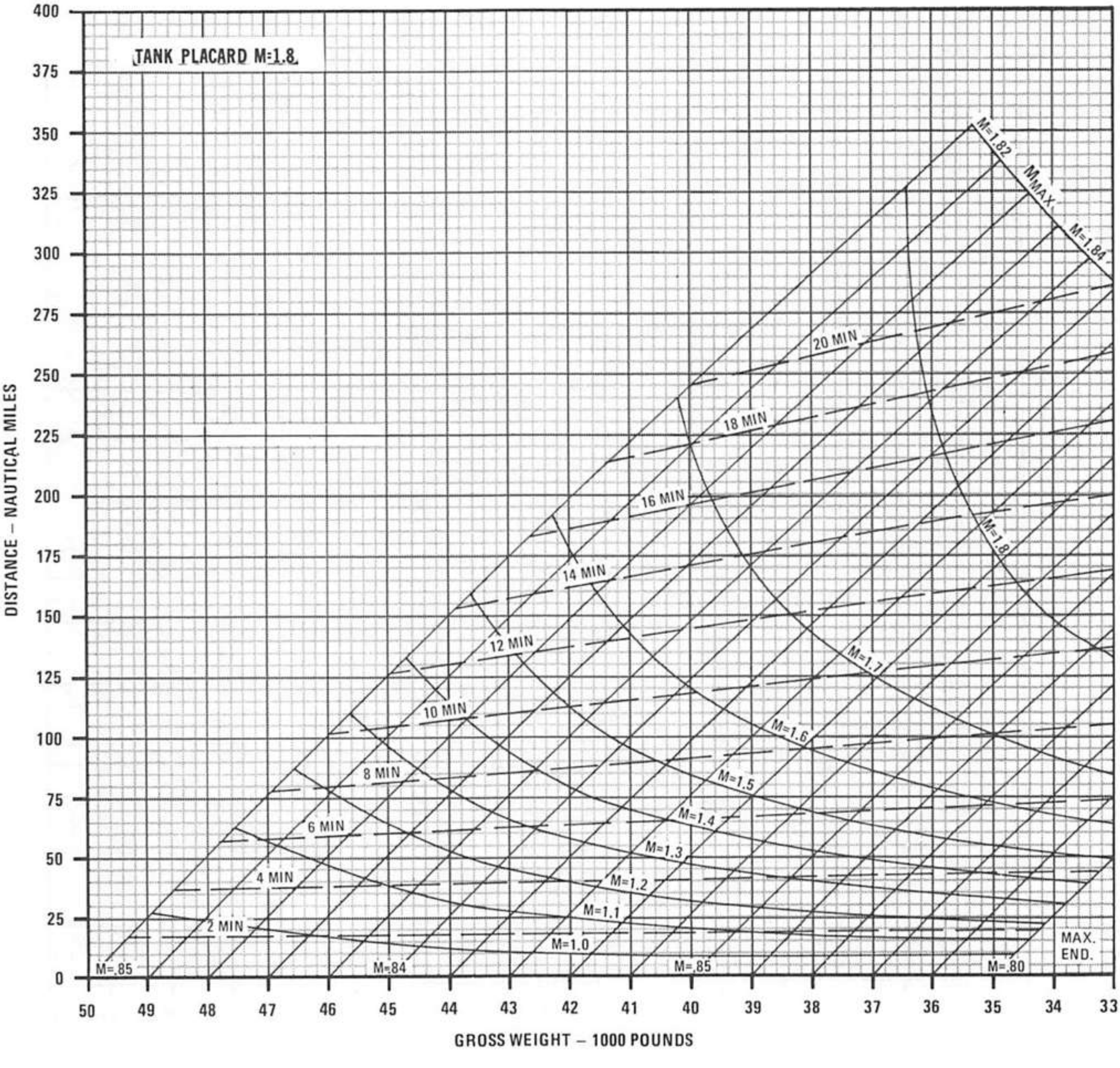
AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 5.8 LB/GAL



4G-1-(179)

Figure A9-30

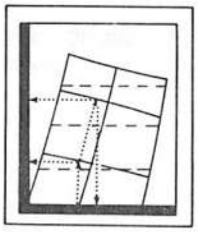
MAXIMUM THRUST ACCELERATION

30,000 FEET

AIRPLANE CONFIGURATION
(4)AIM-7 AND
(2)WING TANKS

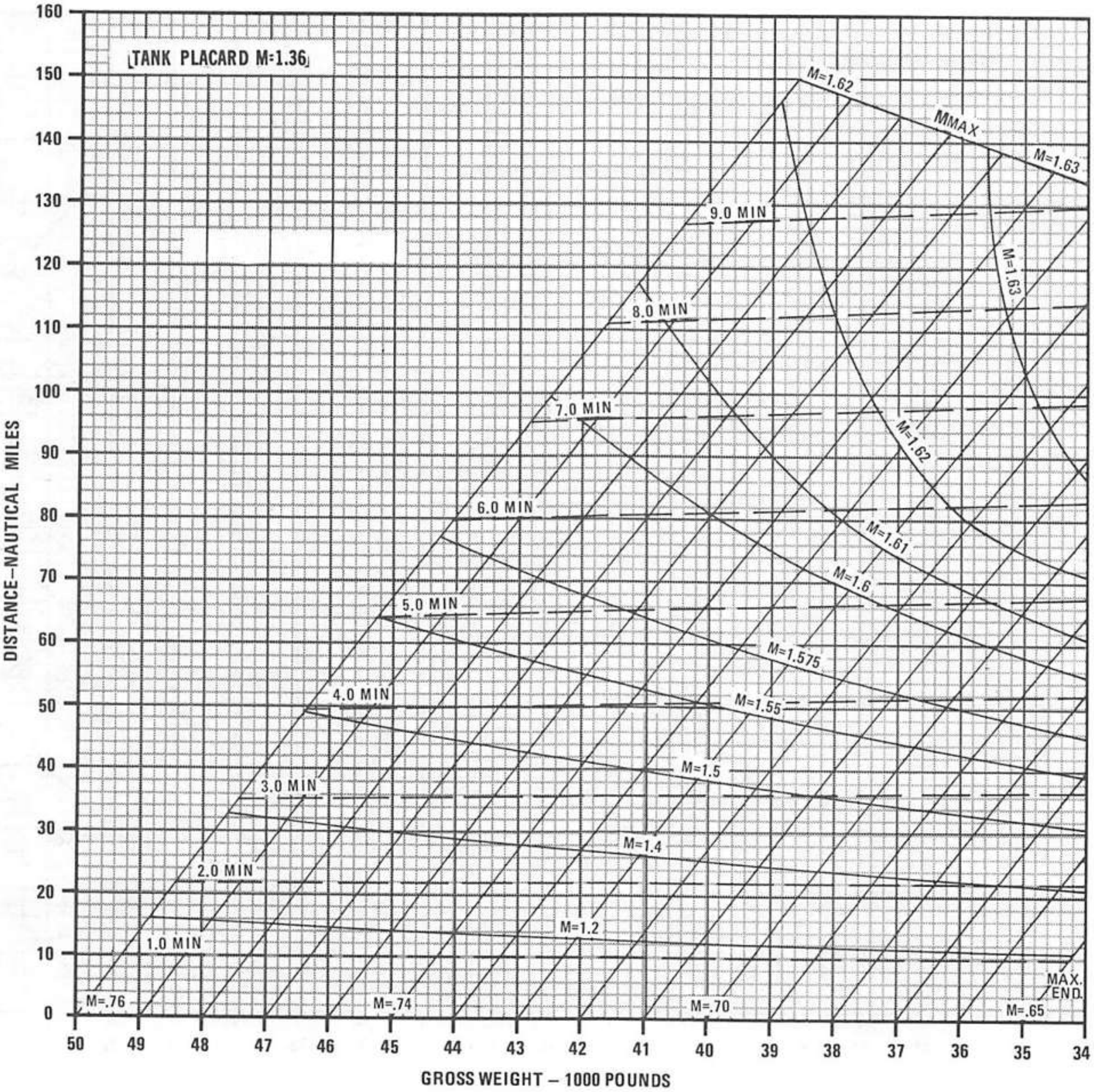
REMARKS
ENGINE(S): (2)J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(180)

Figure A9-31

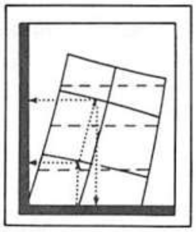
MAXIMUM THRUST ACCELERATION

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND
(2) WING TANKS

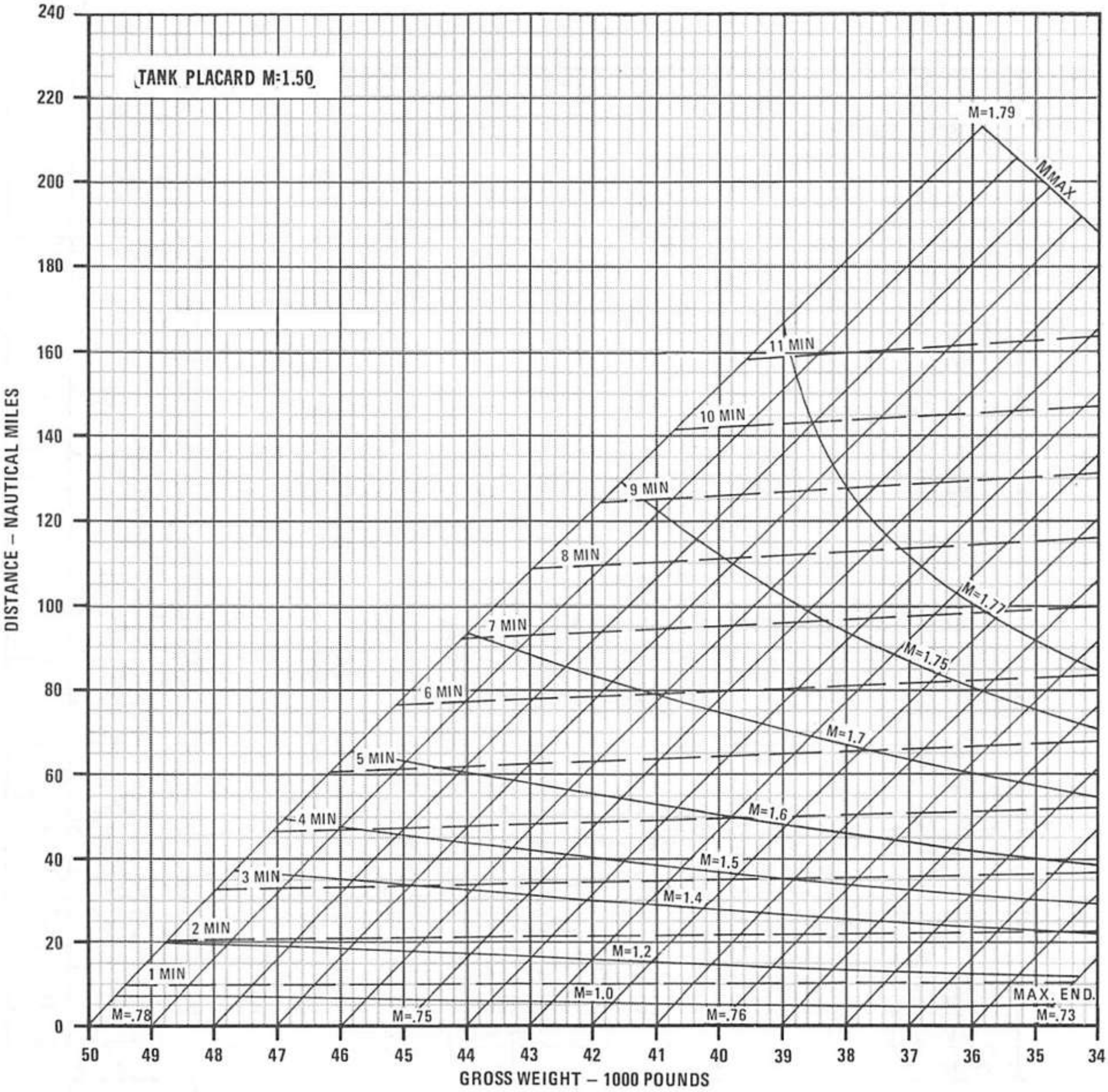
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(181)

Figure A9-32

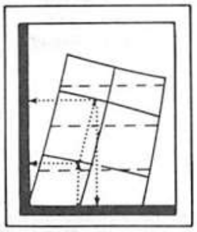
MAXIMUM THRUST ACCELERATION

40,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

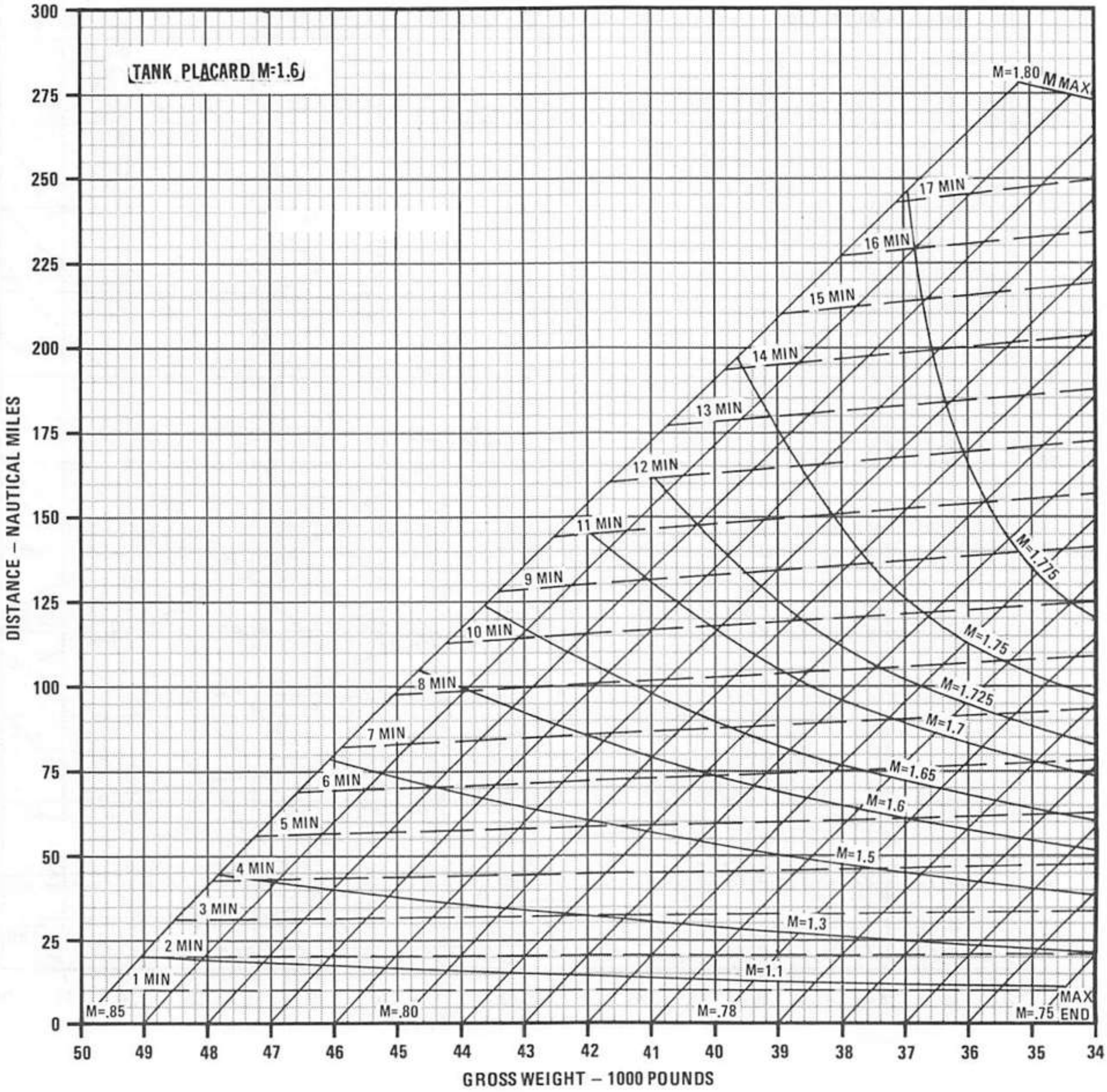
REMARKS
ENGINE(S): (2)J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 5.8 LB/GAL



4G-1-(182)

Figure A9-33

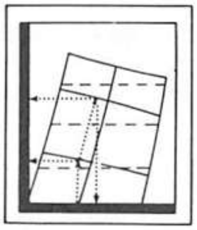
MAXIMUM THRUST ACCELERATION

45,000 FEET

AIRPLANE CONFIGURATION
(4)AIM-7 AND
(2)WING TANKS

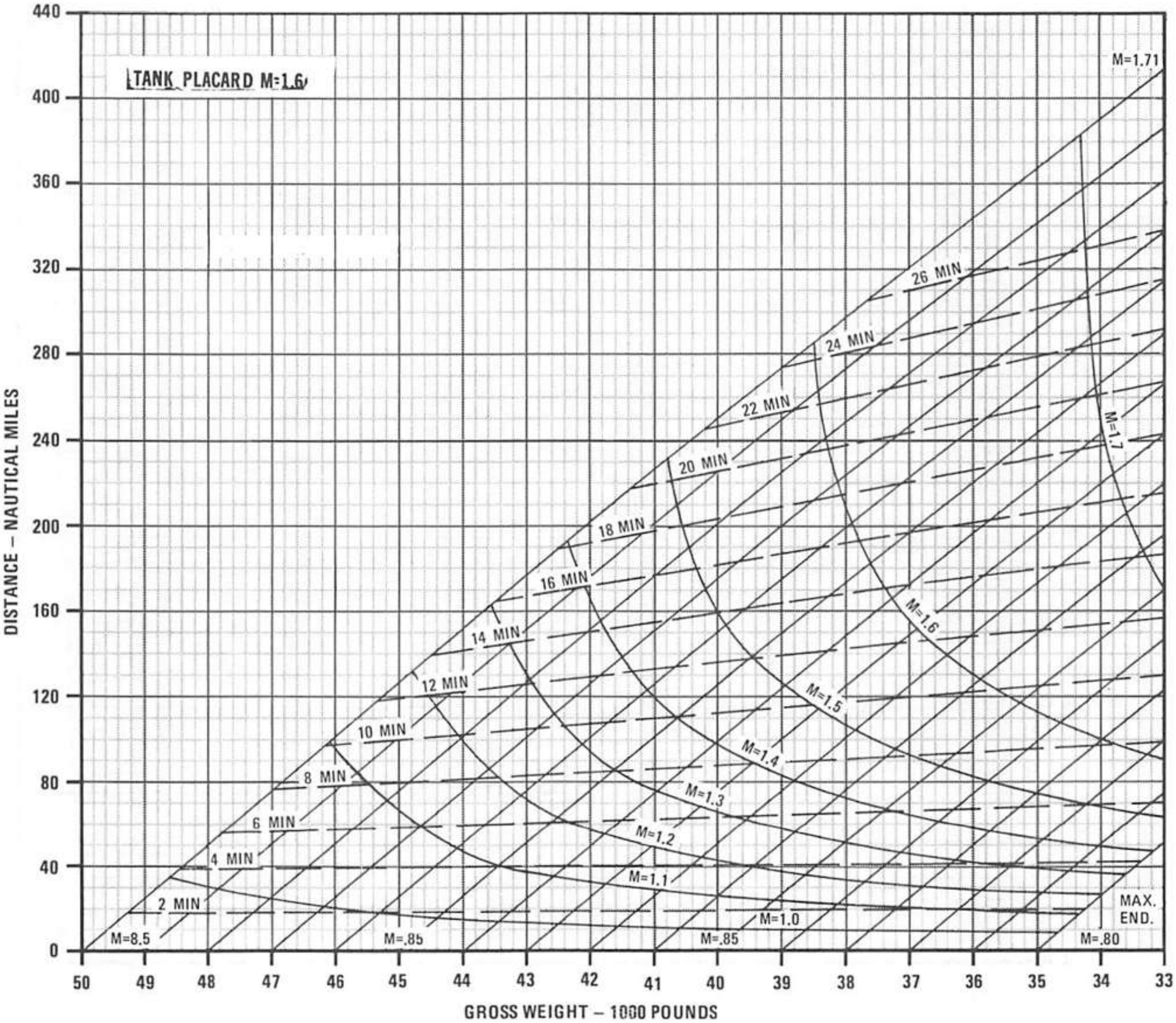
REMARKS
ENGINE(S): (2)J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(183)

Figure A9-34

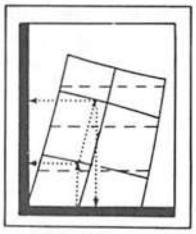
MILITARY THRUST ACCELERATION

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM–7

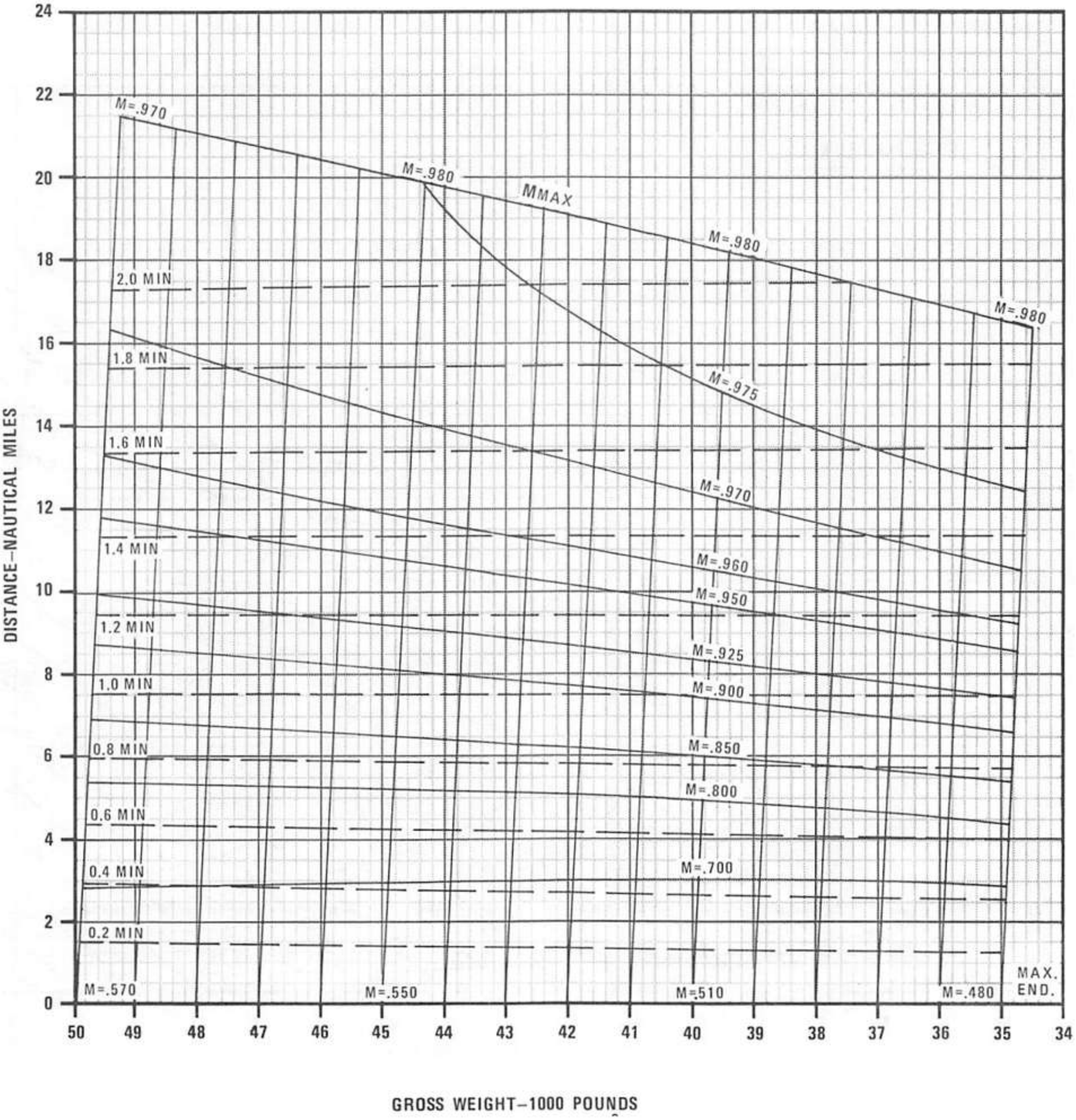
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(184)

Figure A9–35

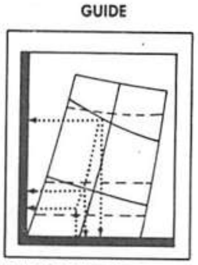
MILITARY THRUST ACCELERATION

25,000 FEET

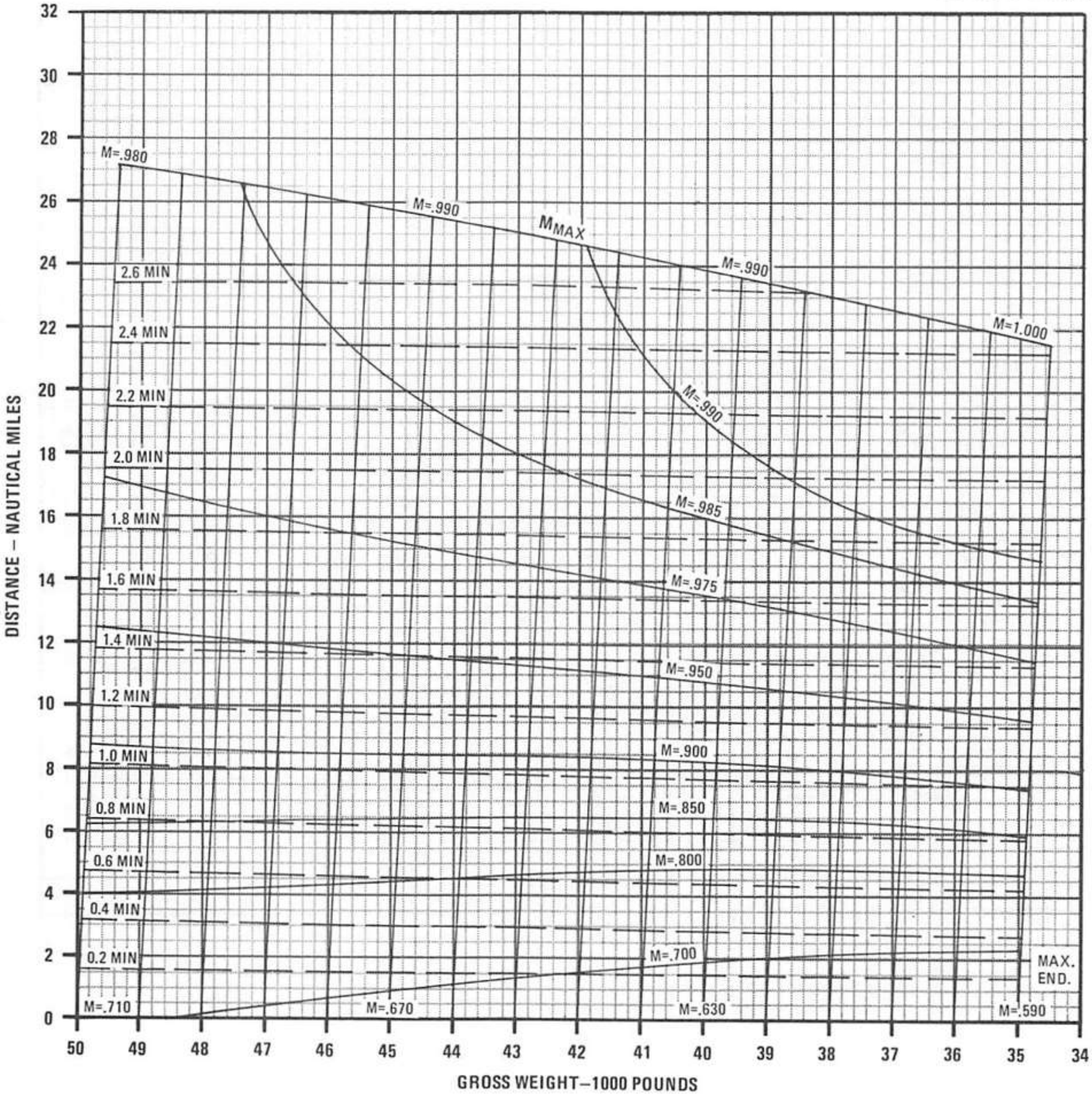
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINES(S): (2) J79-GE-17
ICAO STANDARD DAY

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL.



4G-1-(185)

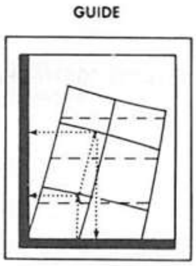
Figure A9-36

MILITARY THRUST ACCELERATION

35,000 FEET

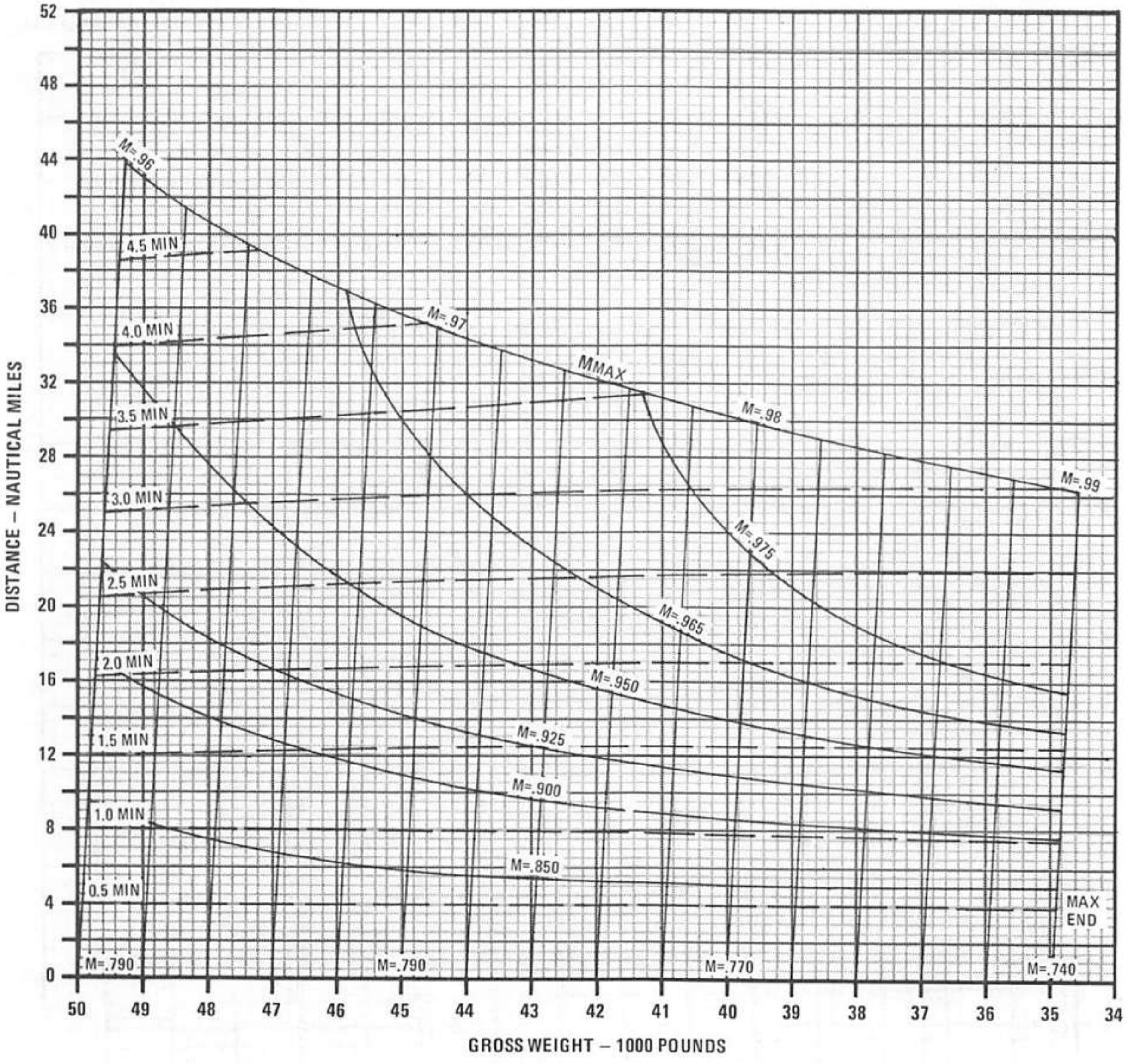
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY : 6.5 LB/GAL



4G-1-(186)

Figure A9-37

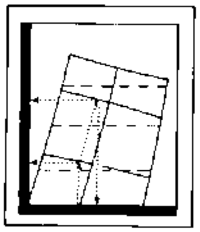
MILITARY THRUST ACCELERATION

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

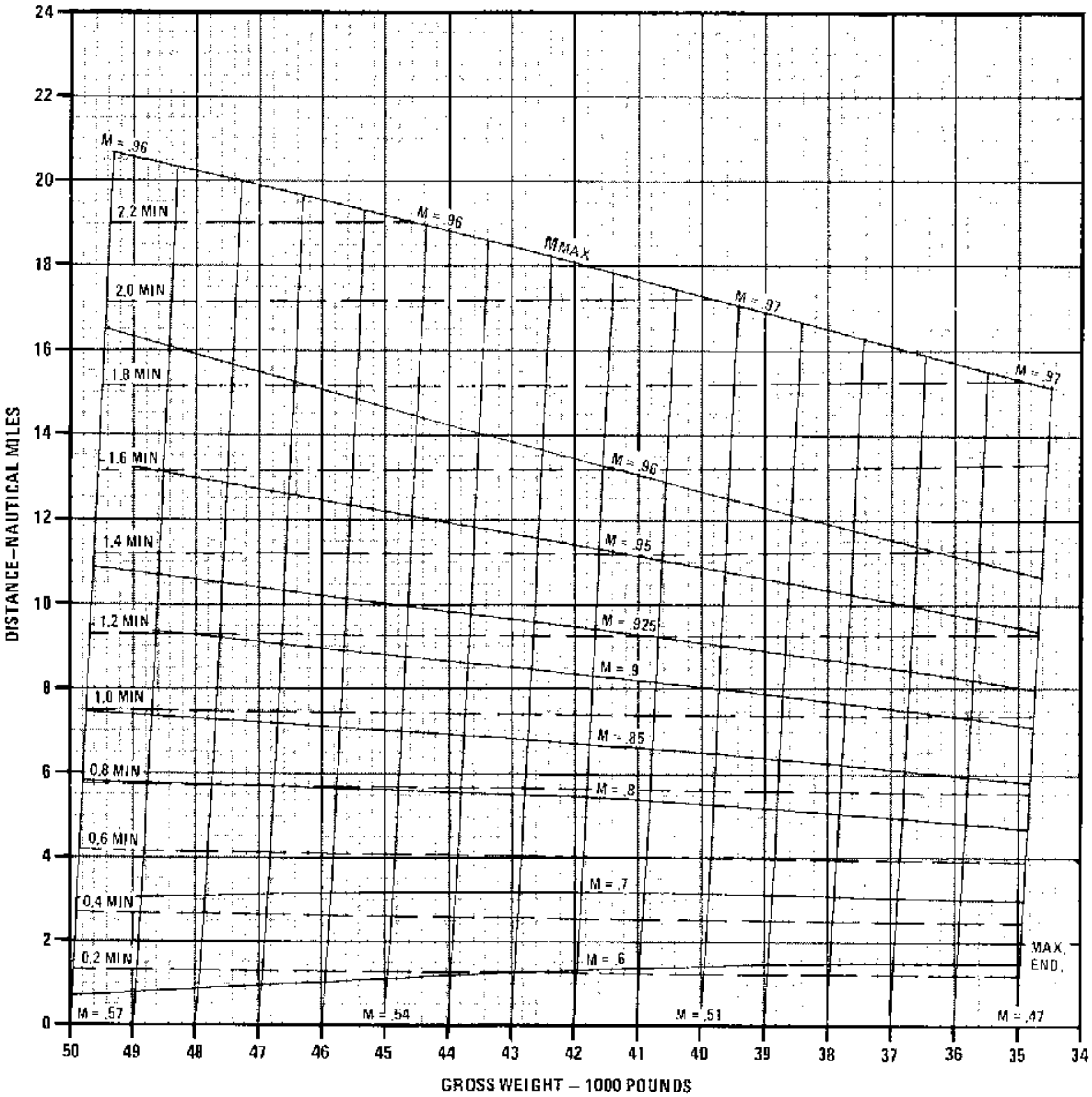
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(187)

Figure A9-38

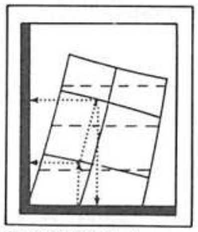
MILITARY THRUST ACCELERATION

25,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

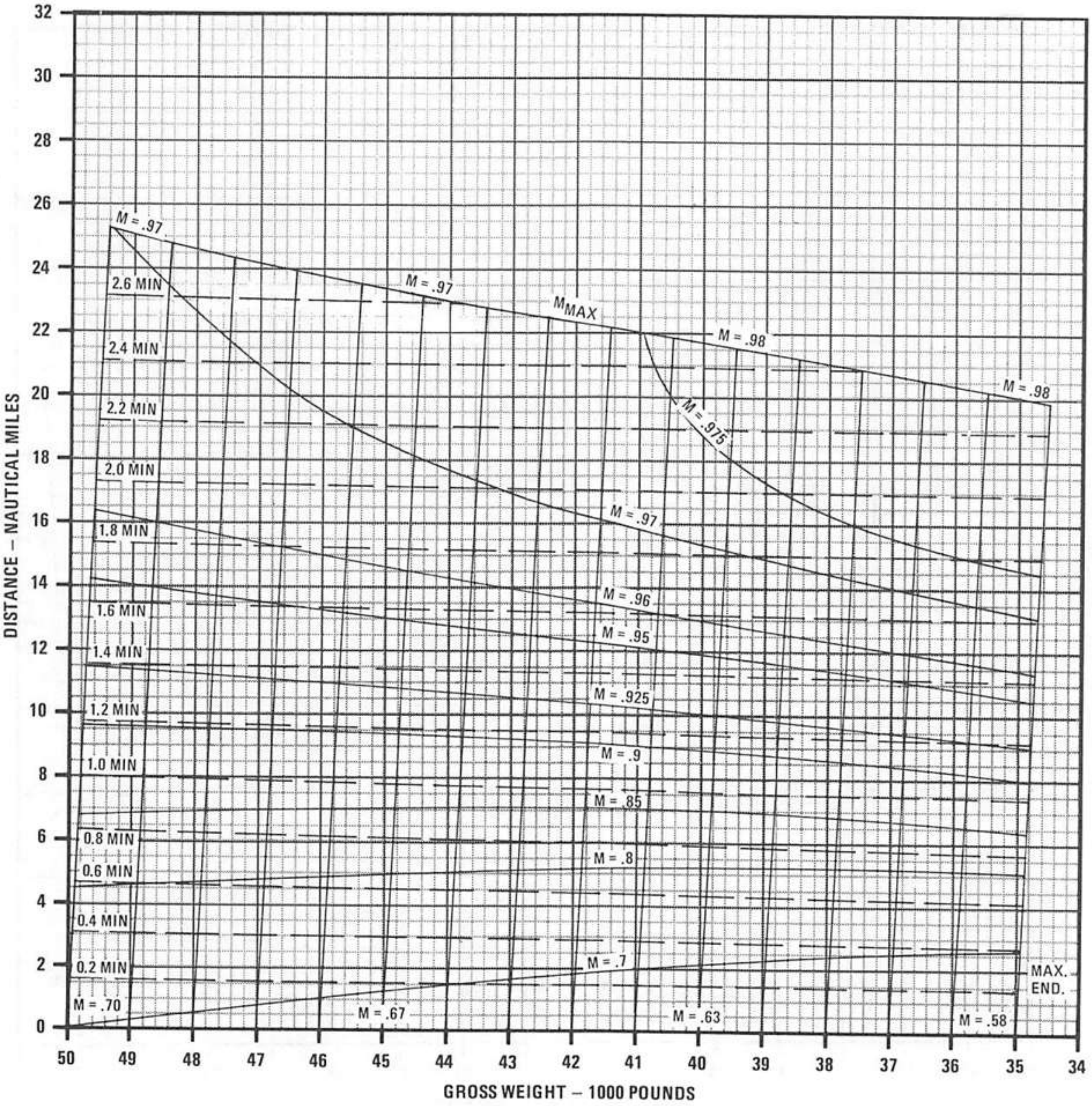
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(188)

Figure A9-39

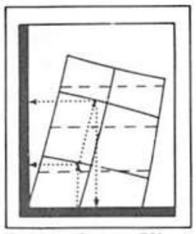
MILITARY THRUST ACCELERATION

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (1) ℄ TANK

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

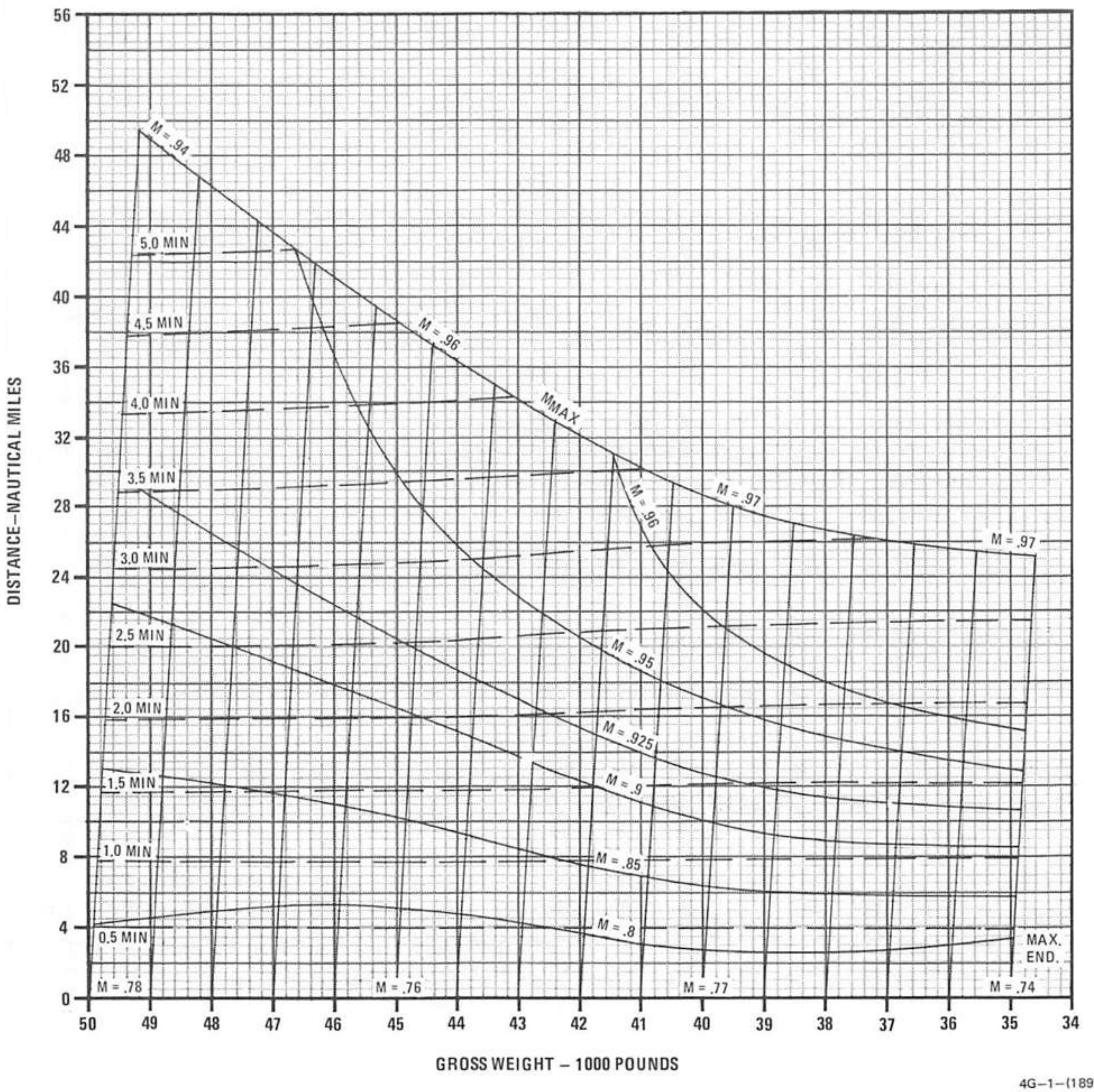
GUIDE



FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB/GAL

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**



4G-1-(189)

Figure A9-40

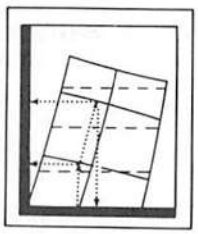
MILITARY THRUST ACCELERATION

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM–7 AND (2) WING TANKS

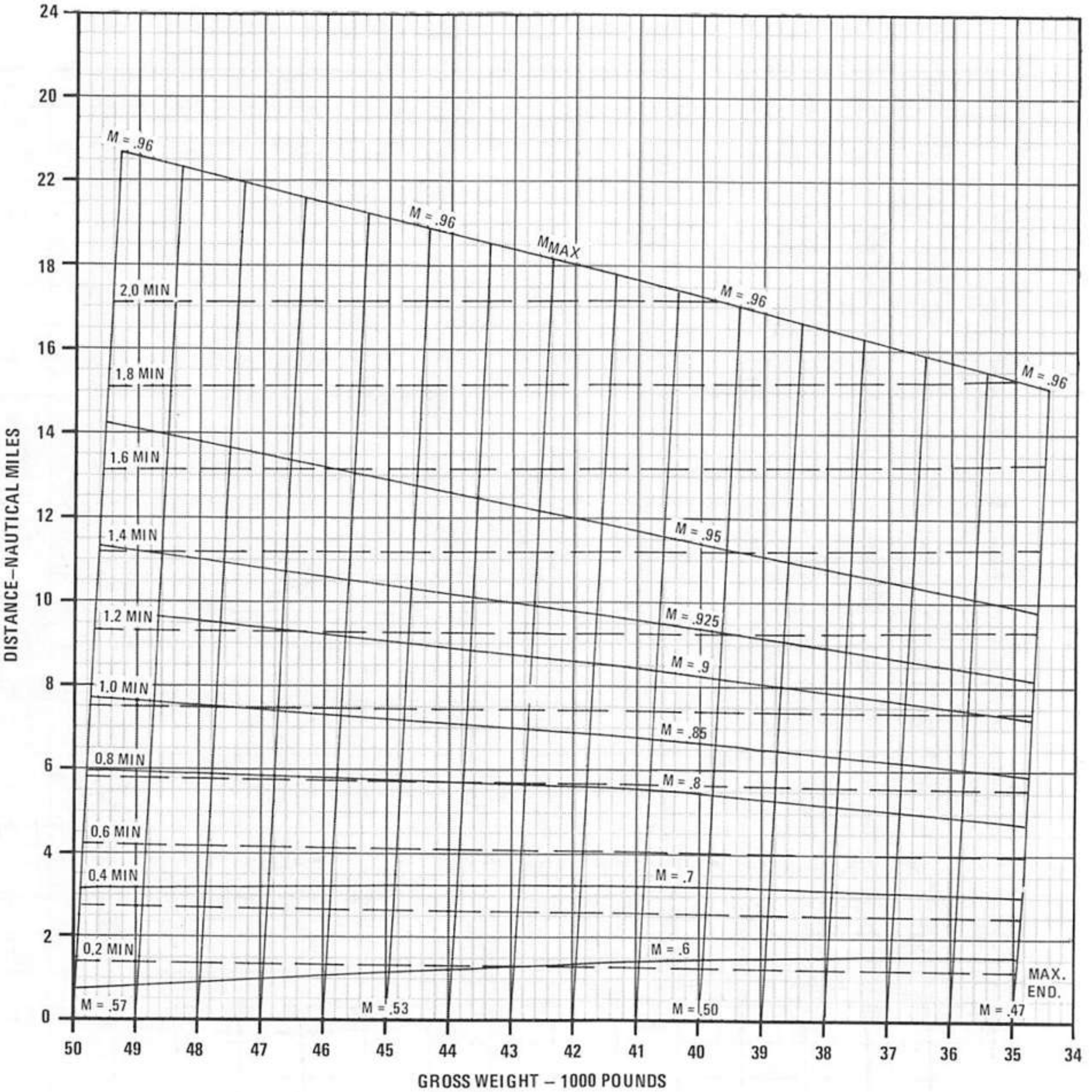
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(190)

Figure A9–41

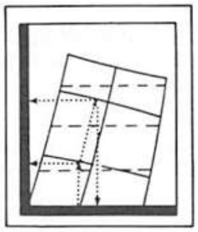
MILITARY THRUST ACCELERATION

25,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

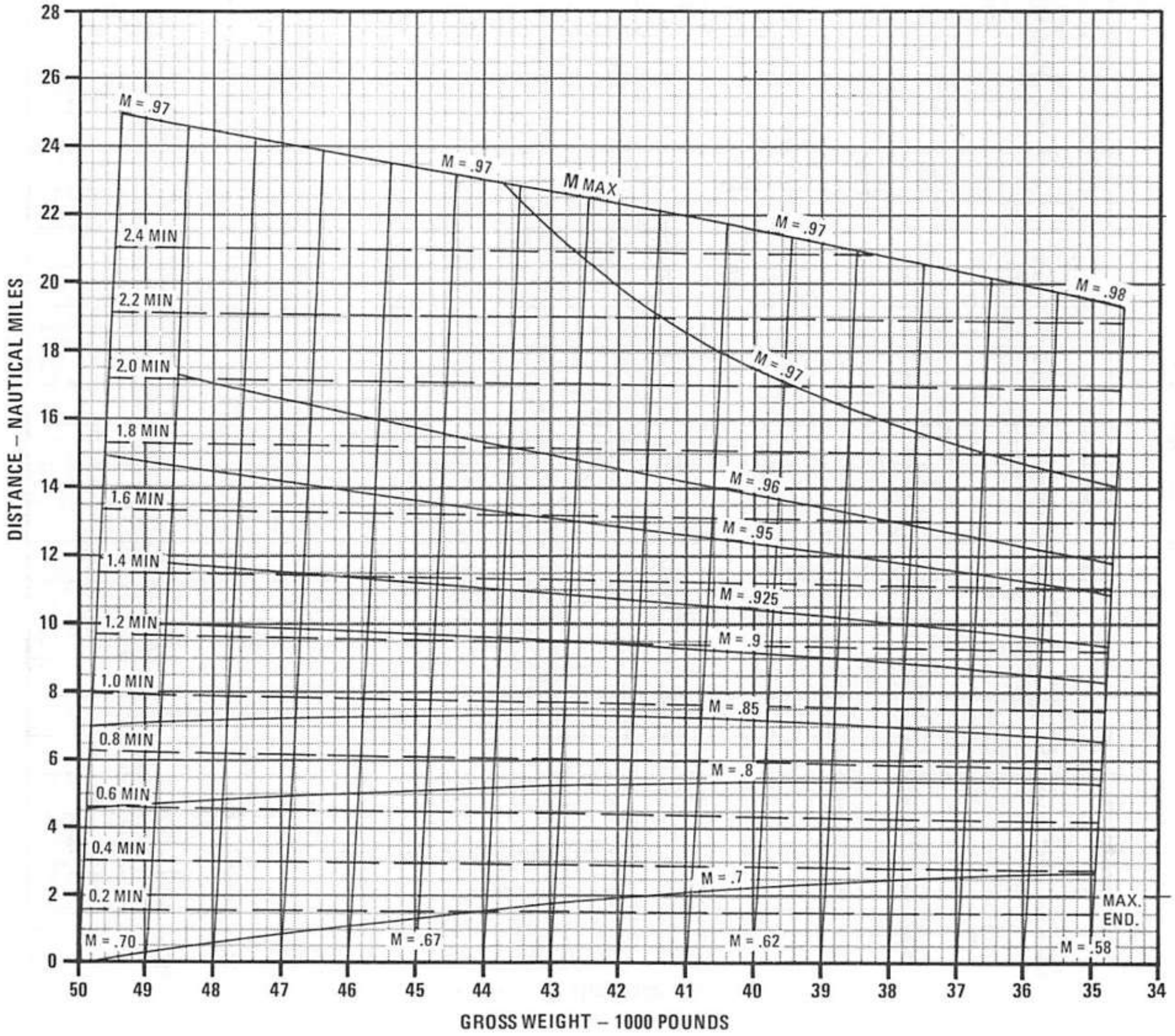
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(191)

Figure A9-42

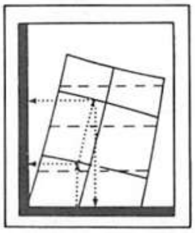
MILITARY THRUST ACCELERATION

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7 AND (2) WING TANKS

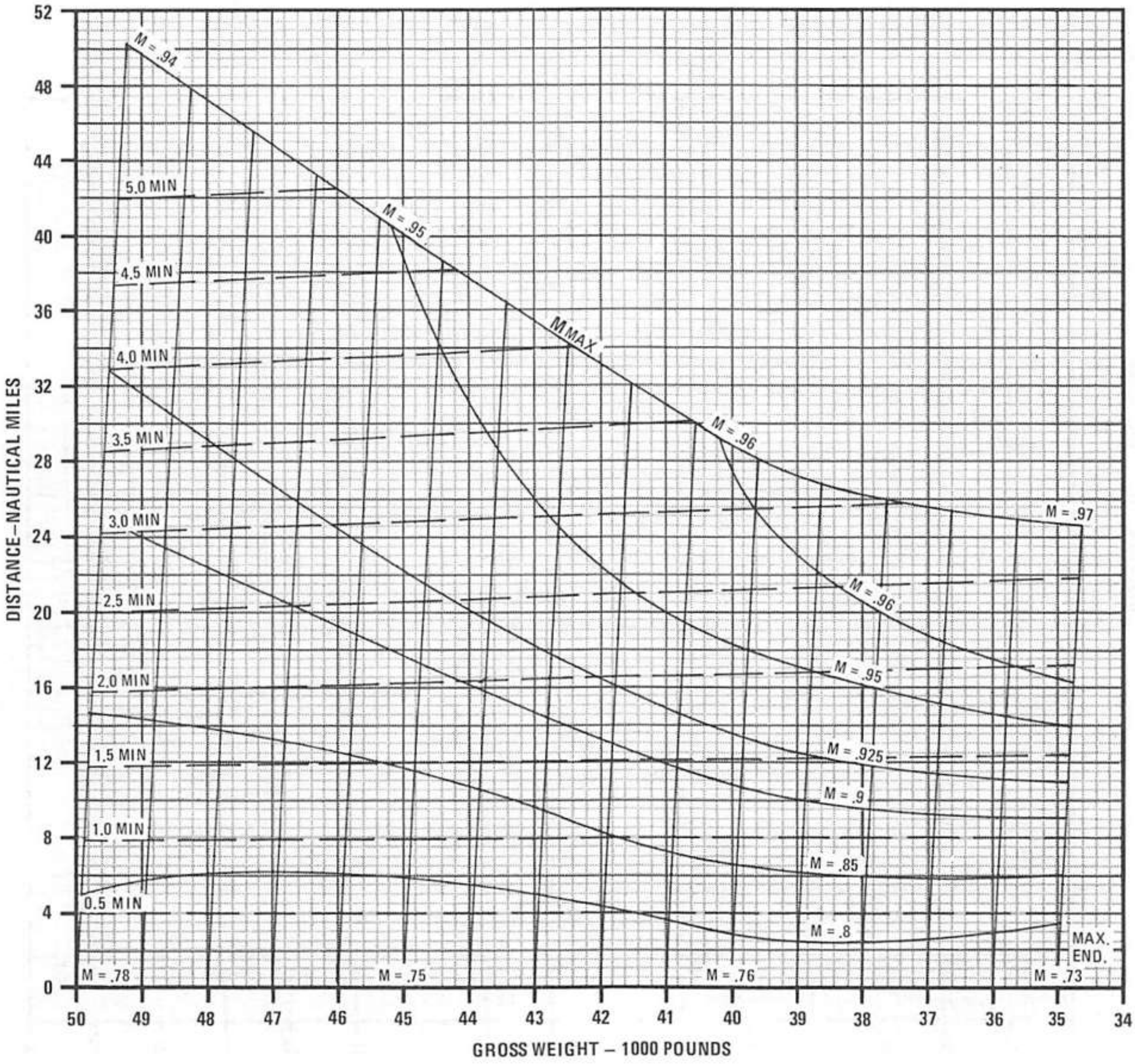
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(192)

Figure A9-43

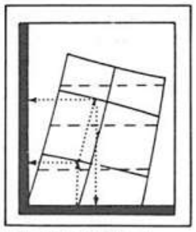
MILITARY THRUST ACCELERATION

15,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK AND
(2) WING TANKS

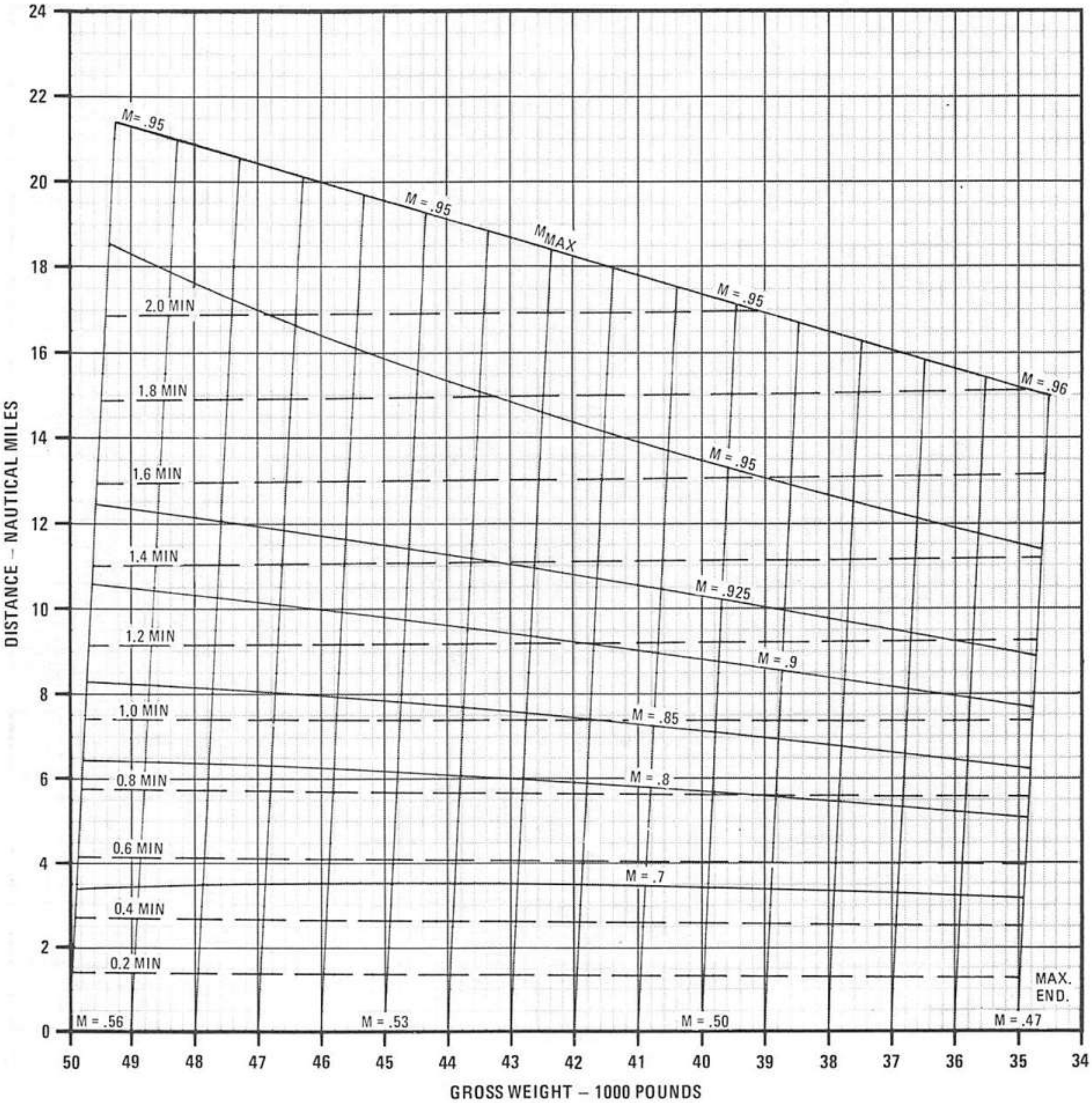
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(193)

Figure A9-44

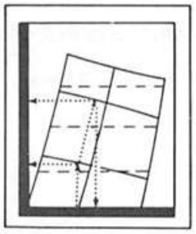
MILITARY THRUST ACCELERATION

25,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK
AND (2) WING TANKS

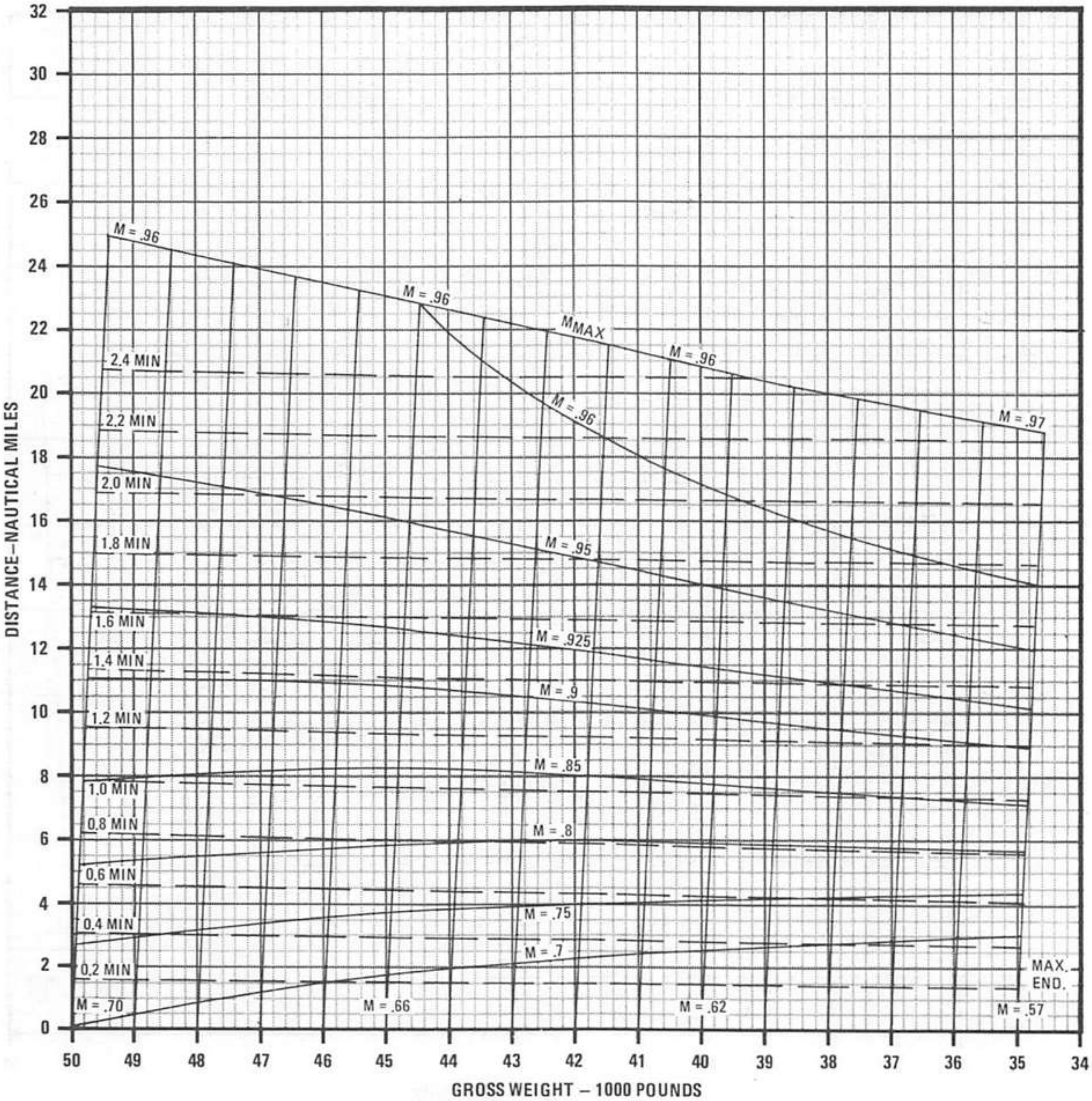
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(194)

Figure A9-45

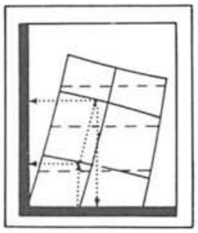
MILITARY THRUST ACCELERATION

35,000 FEET

AIRPLANE CONFIGURATION
(4) AIM-7, (1) ℄ TANK
AND (2) WING TANKS

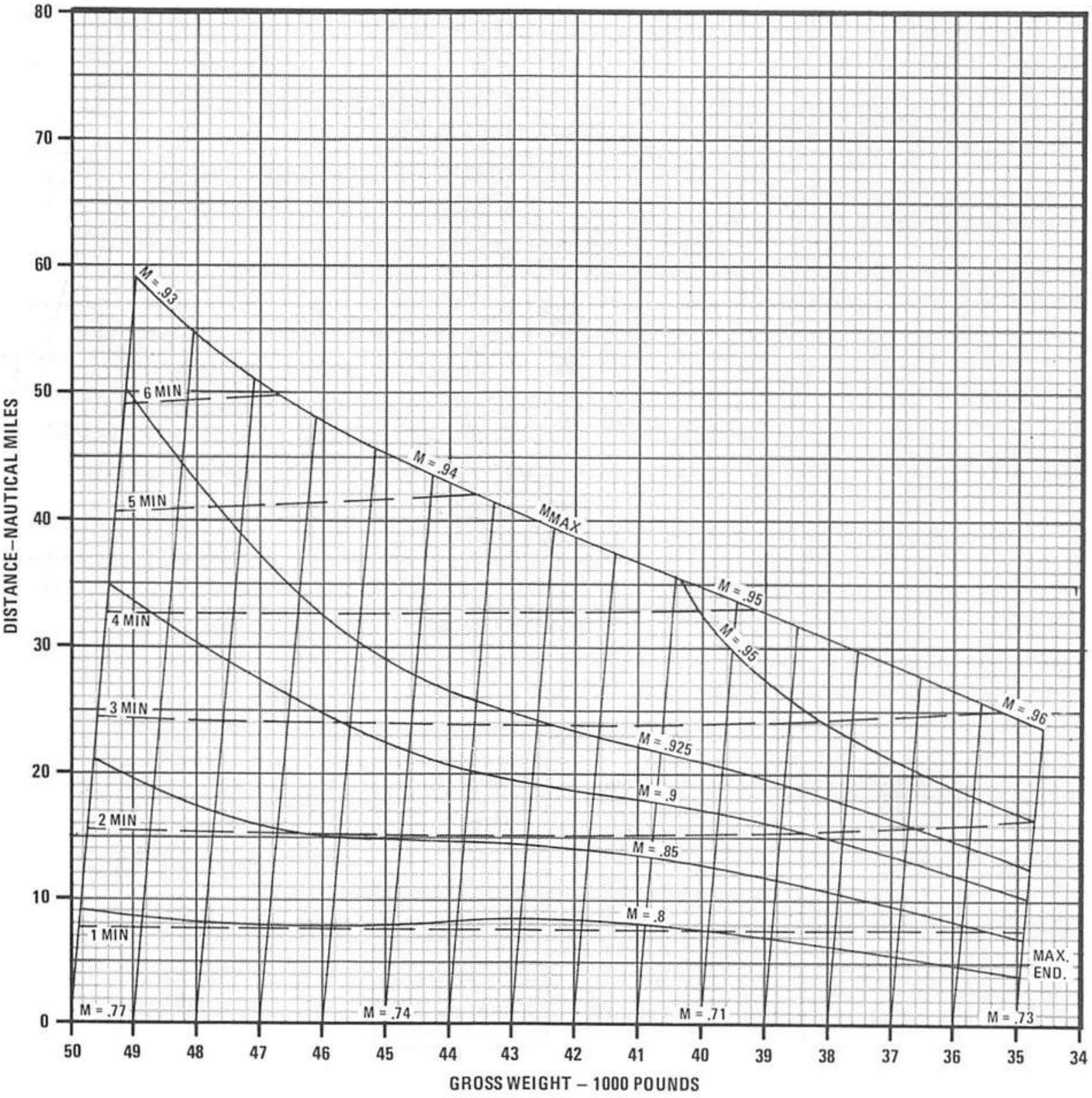
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(195)

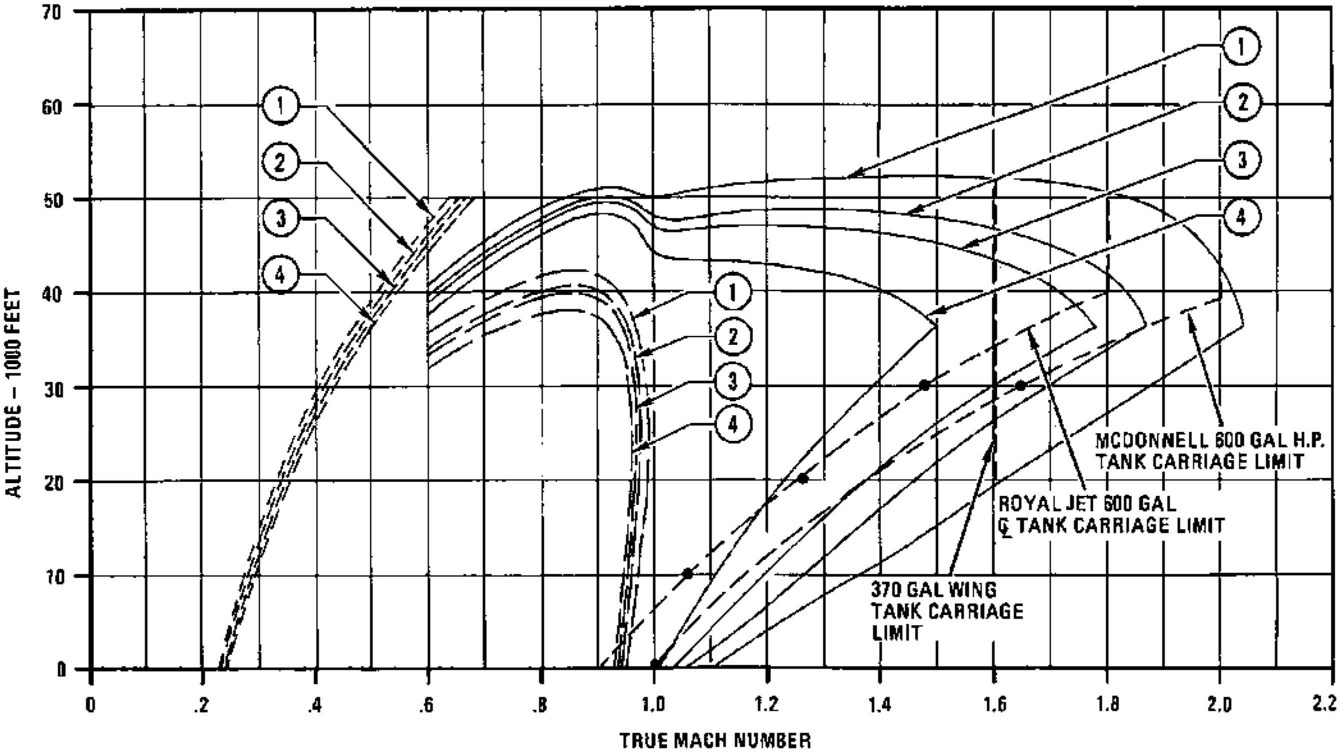
Figure A9–46

LEVEL FLIGHT ENVELOPE

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY
COMBAT GROSS WEIGHTS

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



CURVE NO.	CONFIGURATION	GROSS WEIGHT
①	(4) AIM-7	42,596 LB
②	(4) AIM-7 AND (1) ℄ TANK	45,291 LB
③	(4) AIM-7 AND (2) WING TANKS	46,098 LB
④	(4) AIM-7, (1) ℄ TANK AND (2) WING TANKS	48,793 LB

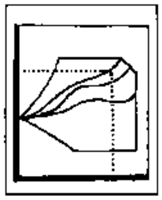
LEGEND	
———	MAXIMUM THRUST
— - —	MILITARY THRUST
- - - -	MAXIMUM USABLE LIFT LIMIT

4G-1-(196)A

Figure A9-47

V-N ENVELOPE
SYMMETRICAL FLIGHT

GUIDE



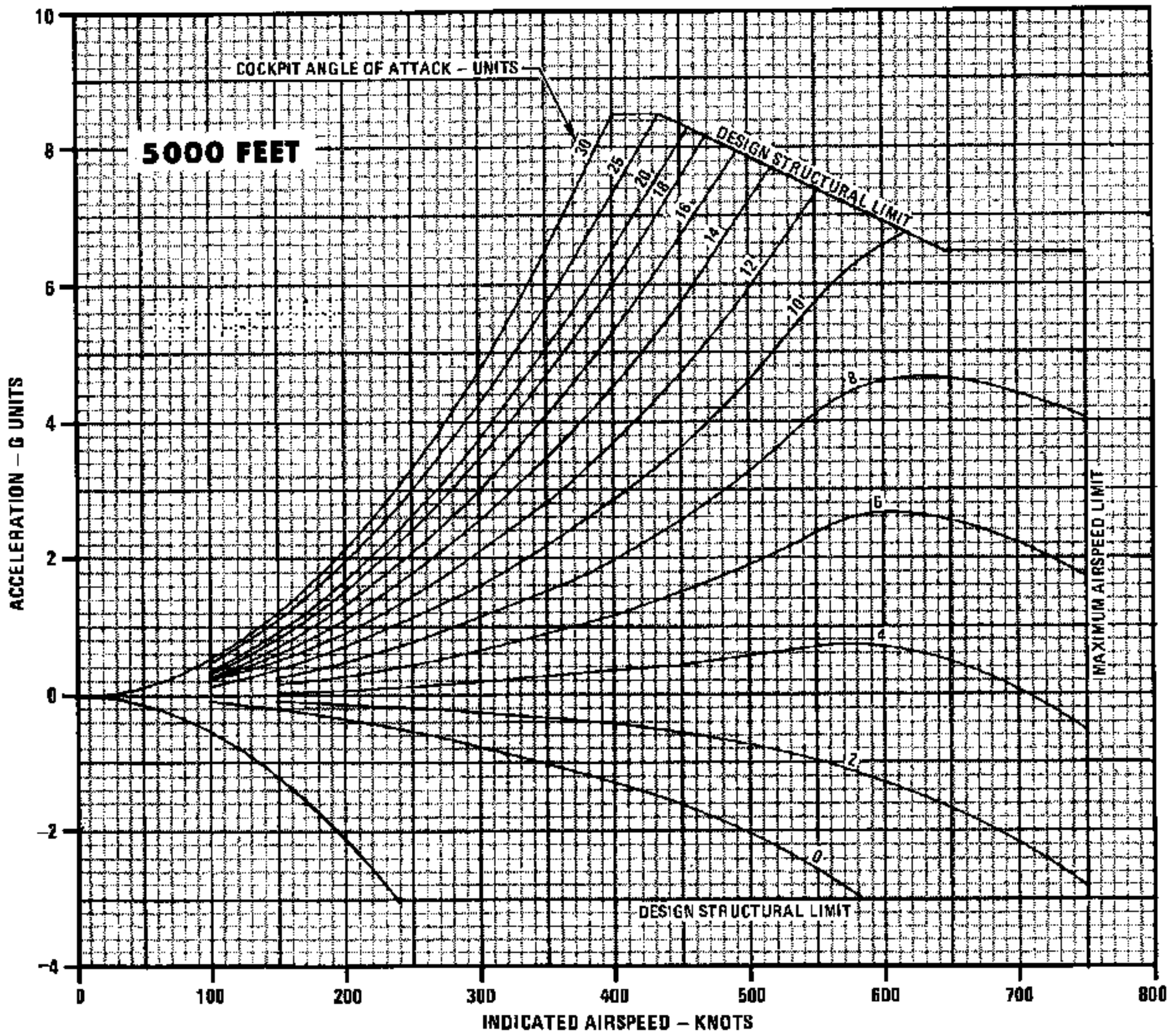
AIRPLANE CONFIGURATION
CLEAN OR (4) AIM-7

GROSS WEIGHT – 37,500 POUNDS

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

DATE: 1 NOVEMBER 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(197)

Figure A9-48

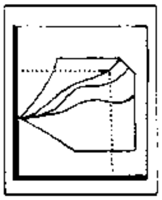
V-N ENVELOPE

SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM-7

GROSS WEIGHT – 37,500 POUNDS

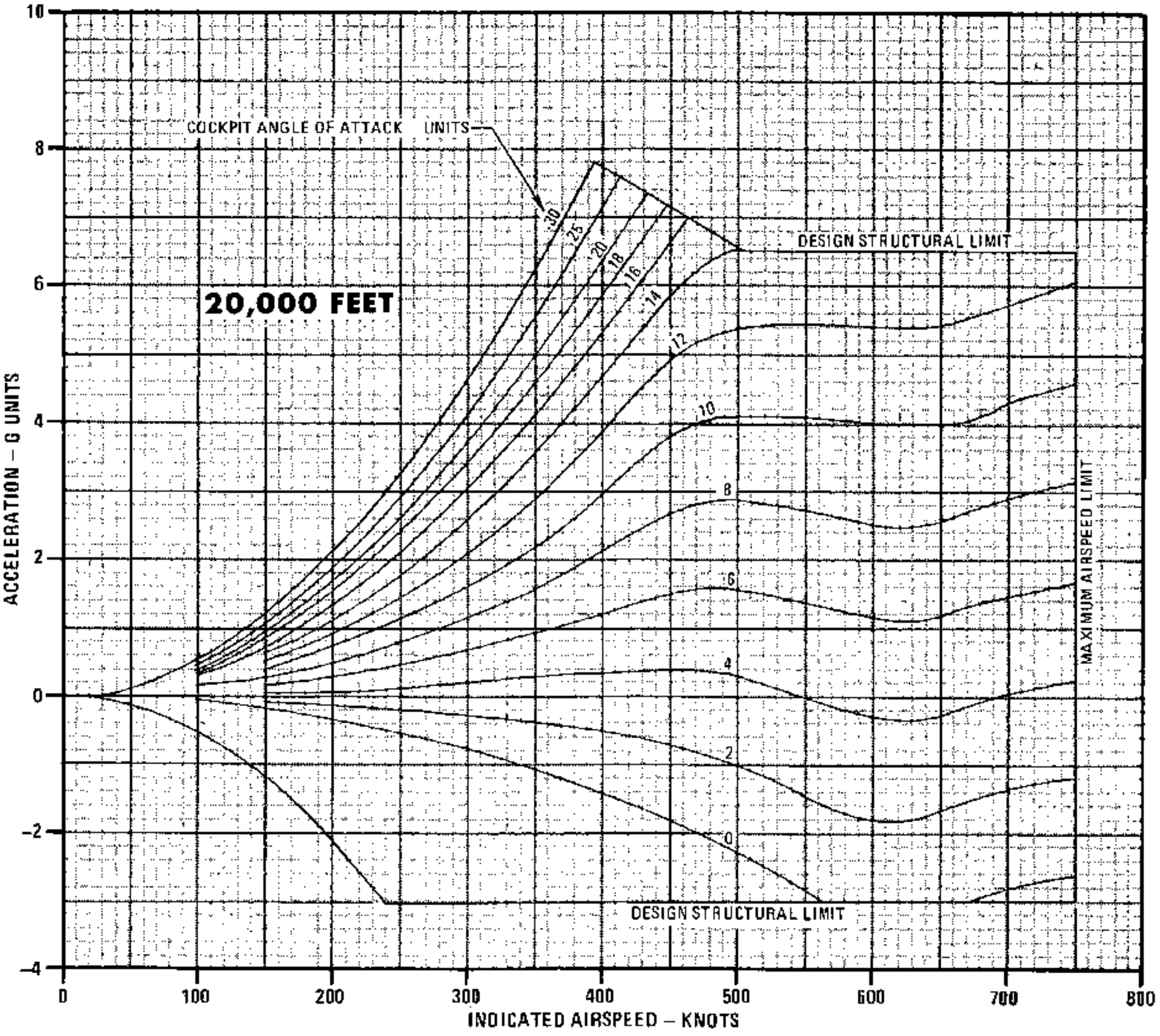
GUIDE



REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

DATE: 1 NOVEMBER 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(198)

Figure A9-49

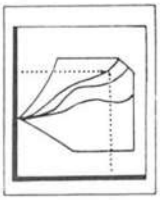
V-N ENVELOPE
SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM–7

GROSS WEIGHT - 37,500 POUNDS

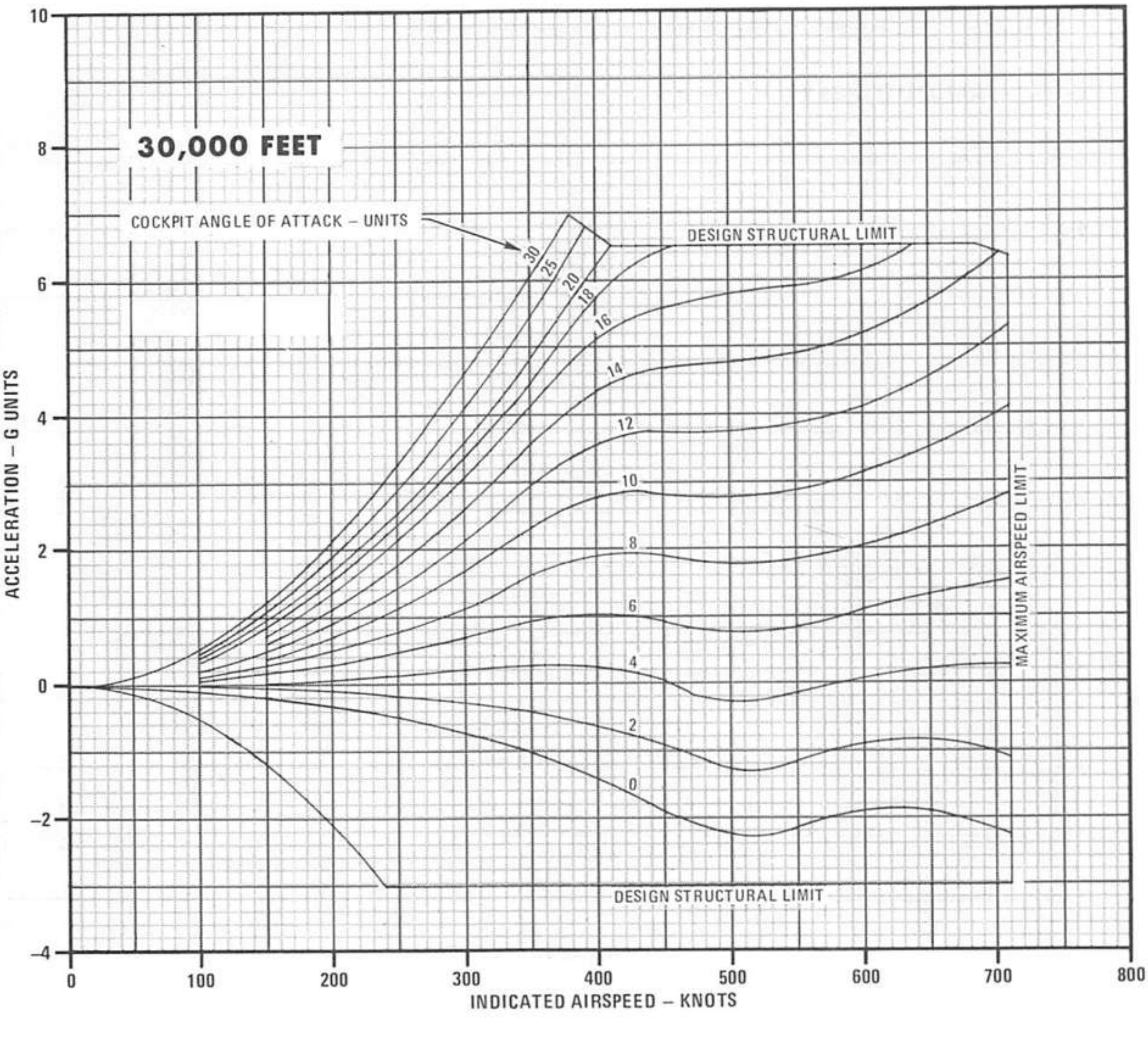
REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

GUIDE



DATE: 1 NOVEMBER 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL



4G–1–(199)

Figure A9–50

V-N ENVELOPE

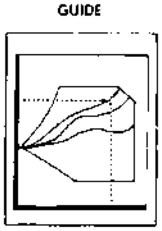
SYMMETRICAL FLIGHT

AIRPLANE CONFIGURATION
CLEAN OR (4) AIM-7

GROSS WEIGHT – 37,500 POUNDS

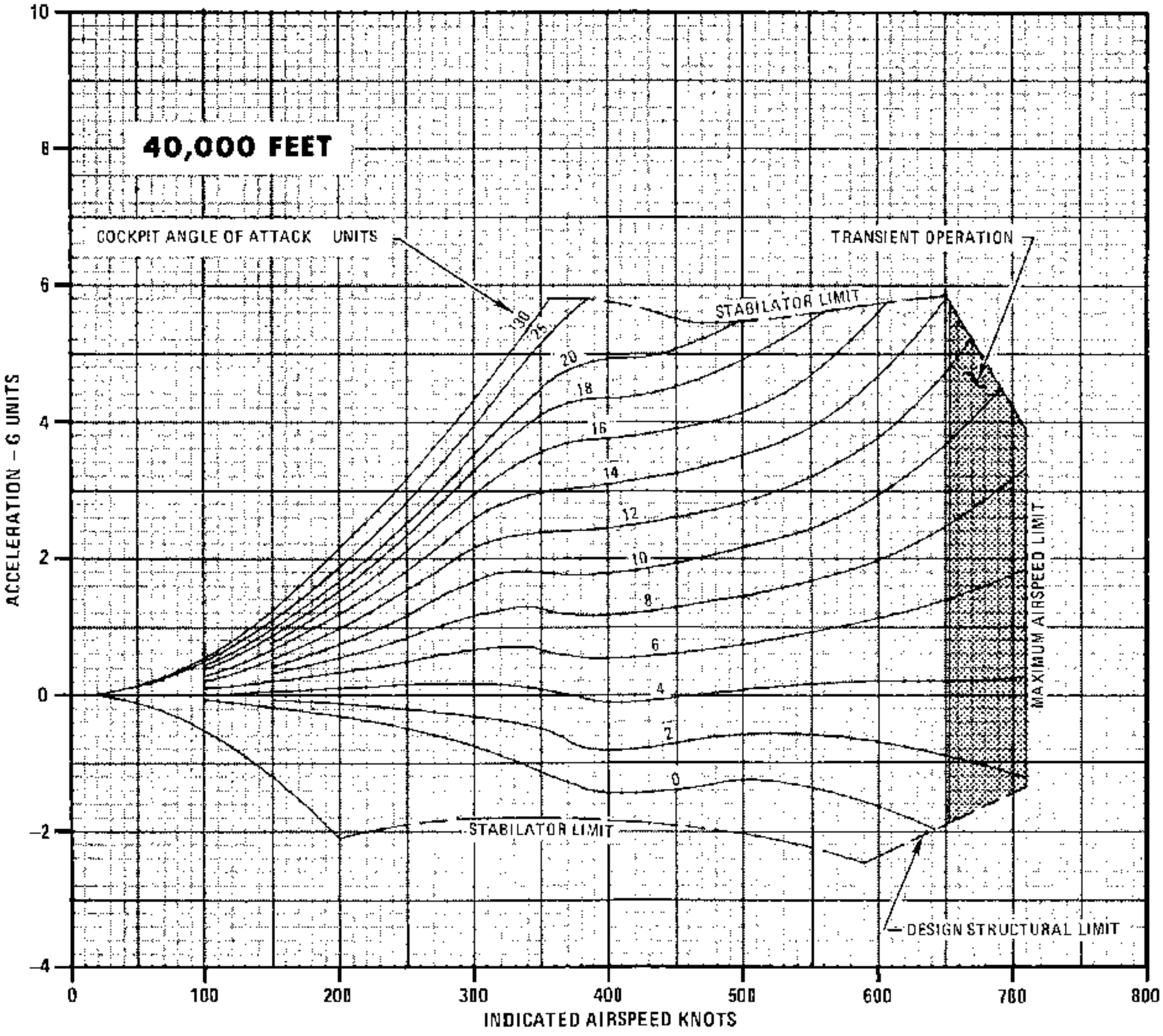
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

GUIDE



DATE: 1 NOVEMBER 1973
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(200)

Figure A9-51

DIVE RECOVERY -16 UNITS AOA

SUBSONIC-SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4)AIM-7

GROSS WEIGHT 40,000 POUNDS

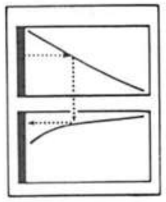
REMARKS

ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

NOTES

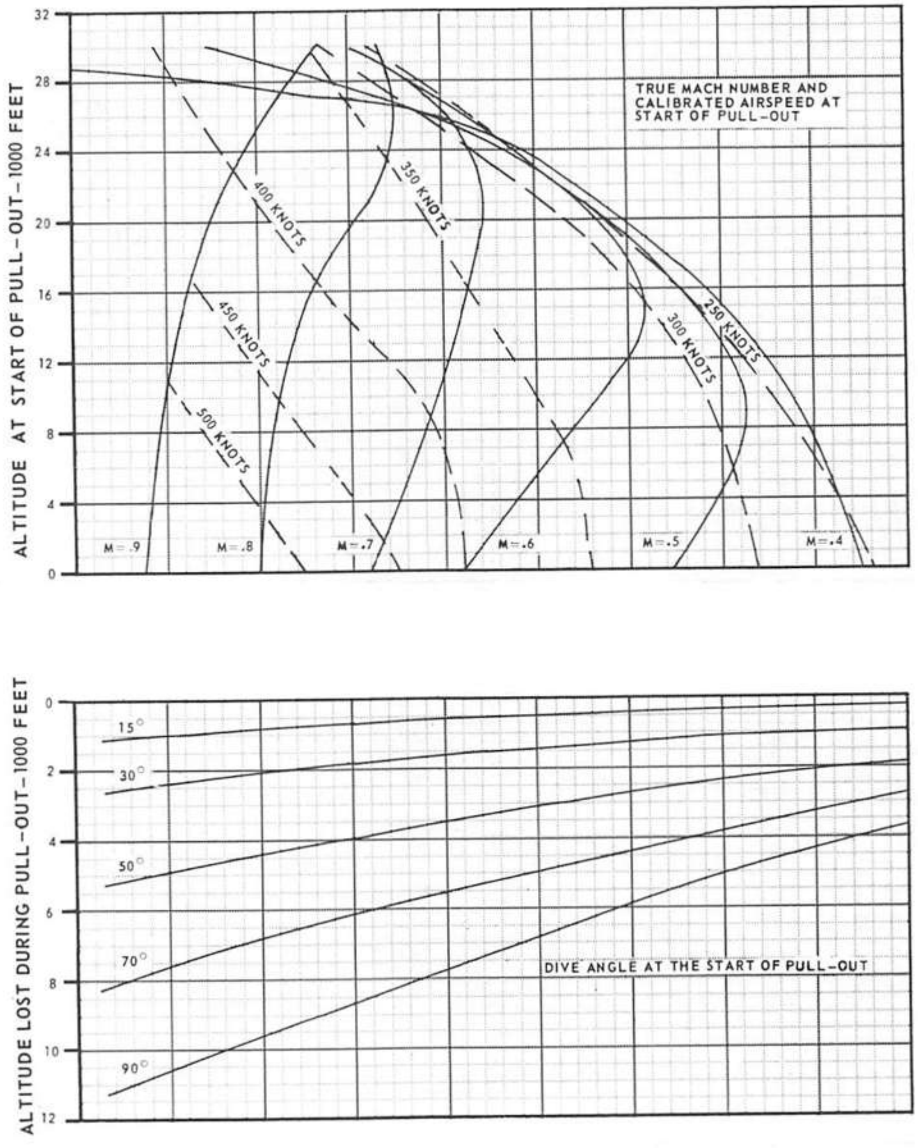
1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULL-OUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 16 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

GUIDE



DATE: 1 NOVEMBER 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(201)

Figure A9-52

DIVE RECOVERY -25 UNITS AOA

SUBSONIC-SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
(4) AIM-7

GROSS WEIGHT 40,000 POUNDS

REMARKS

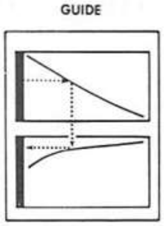
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

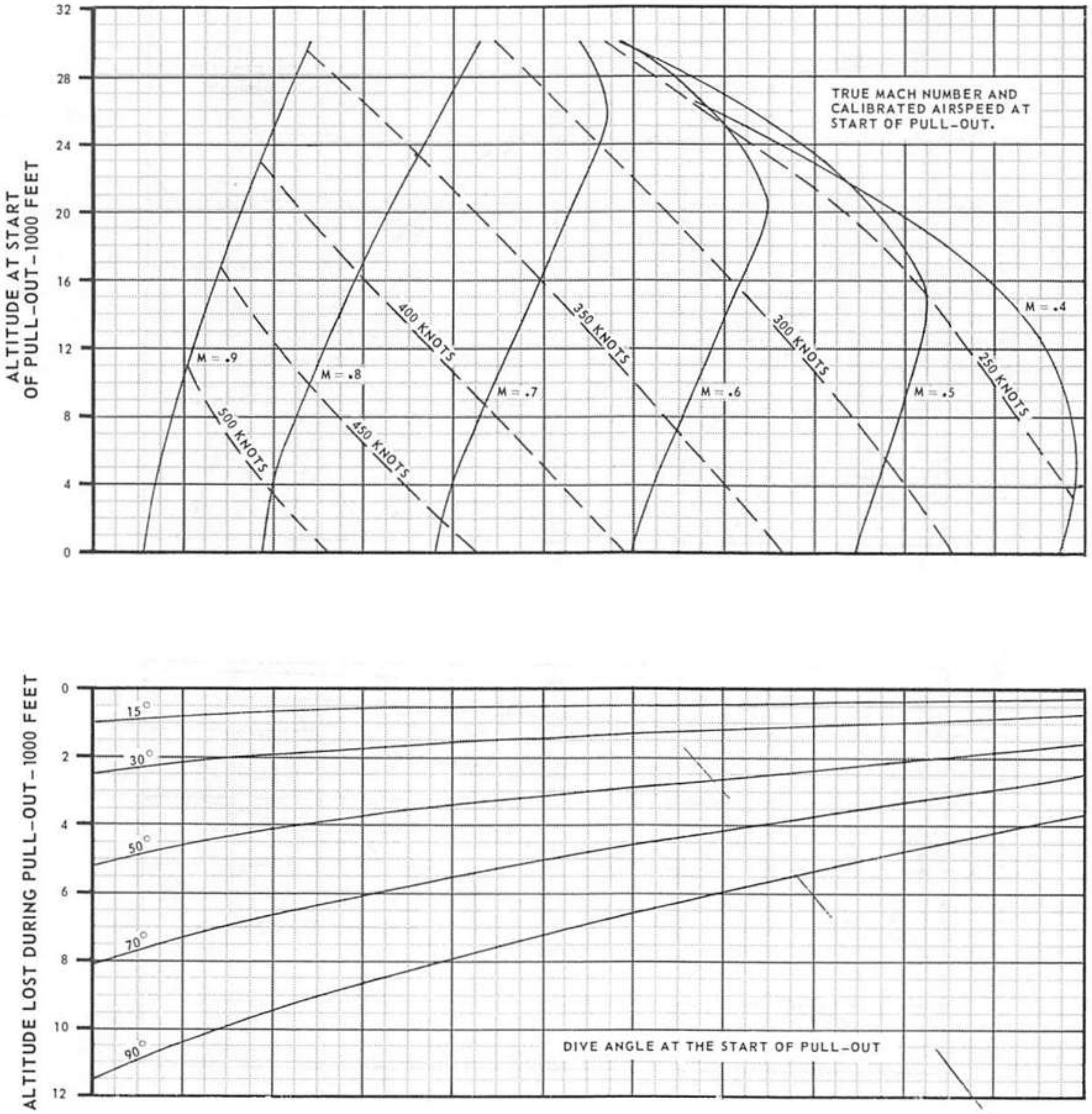
NOTES

1. ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST.
2. PULLOUT BASED ON 1.0G PER SECOND ACCELERATION BUILDUP TO 25 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

DATE: 1 NOVEMBER 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL





4G-1-(202)

Figure A9-53

DIVE RECOVERY-16 UNITS AOA

SUPERSONIC-SPEED BRAKES RETRACTED

GROSS WEIGHT – 40,000 POUNDS

AIRPLANE CONFIGURATION
(4) AIM-7

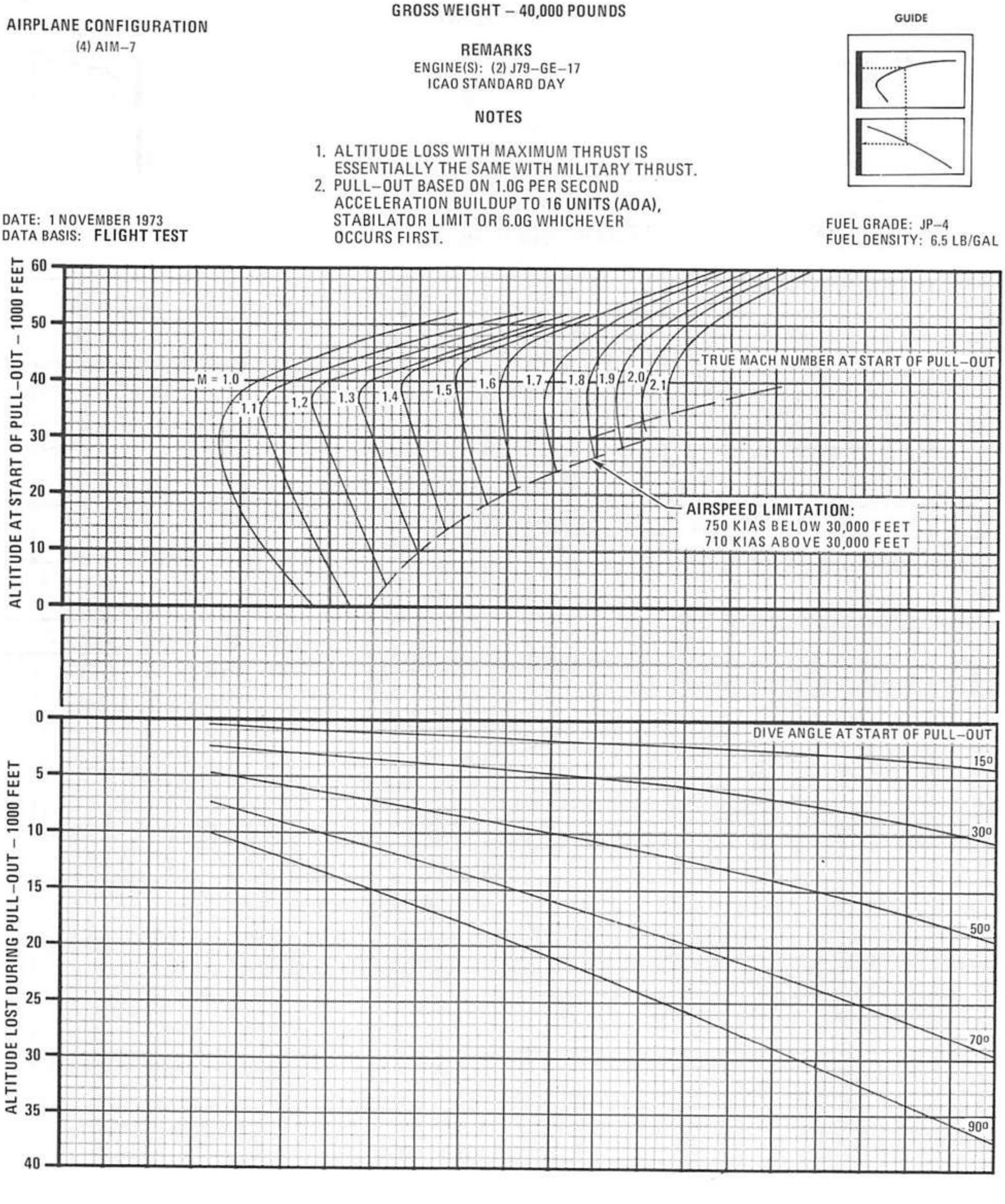
REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

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 16 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

DATE: 1 NOVEMBER 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



4G-1-(203)

Figure A9-54

DIVE RECOVERY-25 UNITS AOA

SUPERSONIC-SPEED BRAKES RETRACTED

GROSS WEIGHT – 40,000 POUNDS

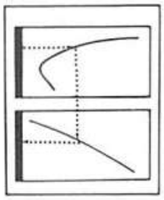
AIRPLANE CONFIGURATION
(4) AIM–7

REMARKS
ENGINE(S): (2) J79–GE–17
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 25 UNITS (AOA), STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST.

GUIDE



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DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

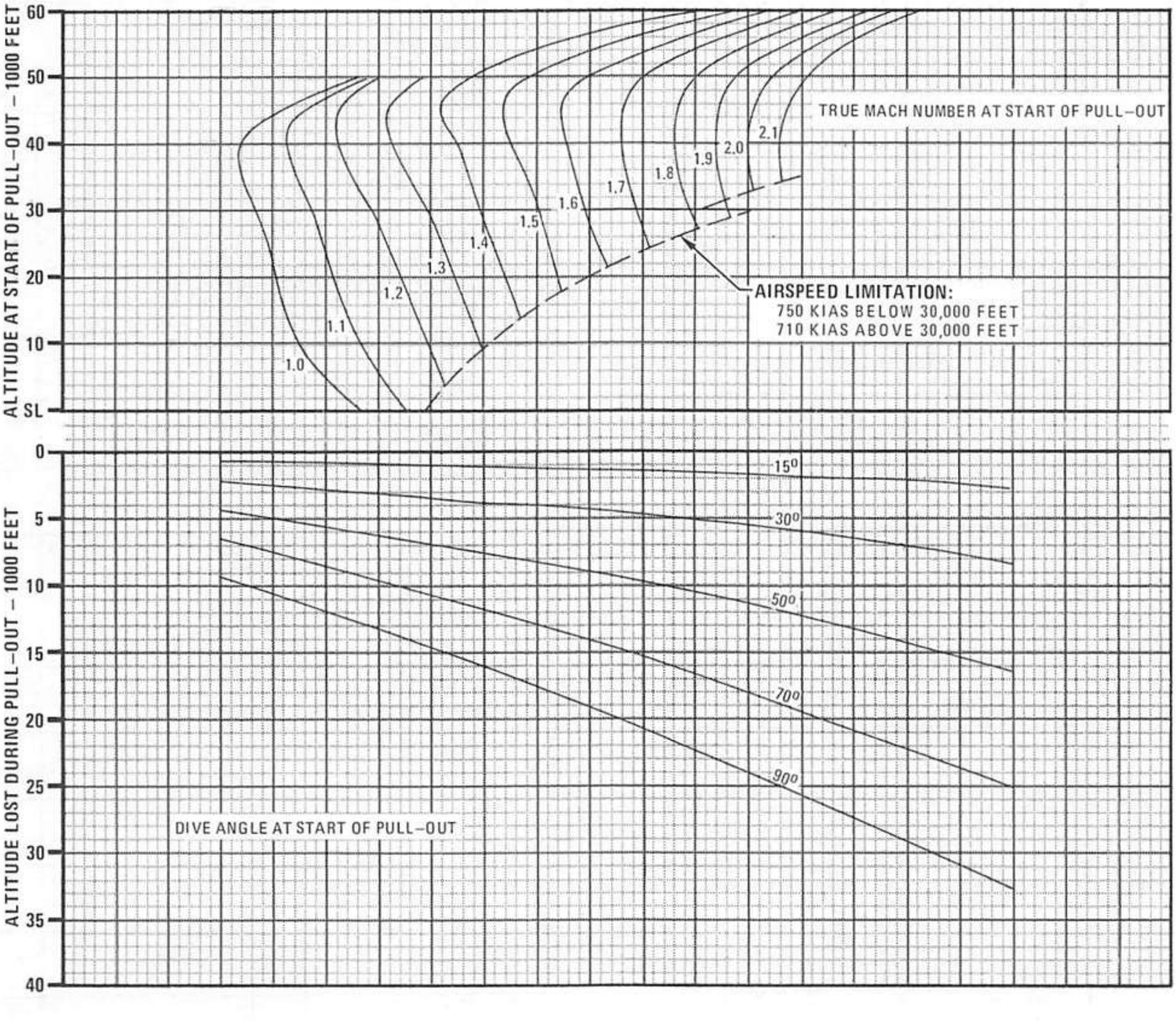


Figure A9–55

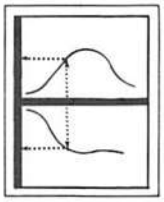
TEMPERATURE EFFECT ON MAXIMUM SPEED

MAXIMUM THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

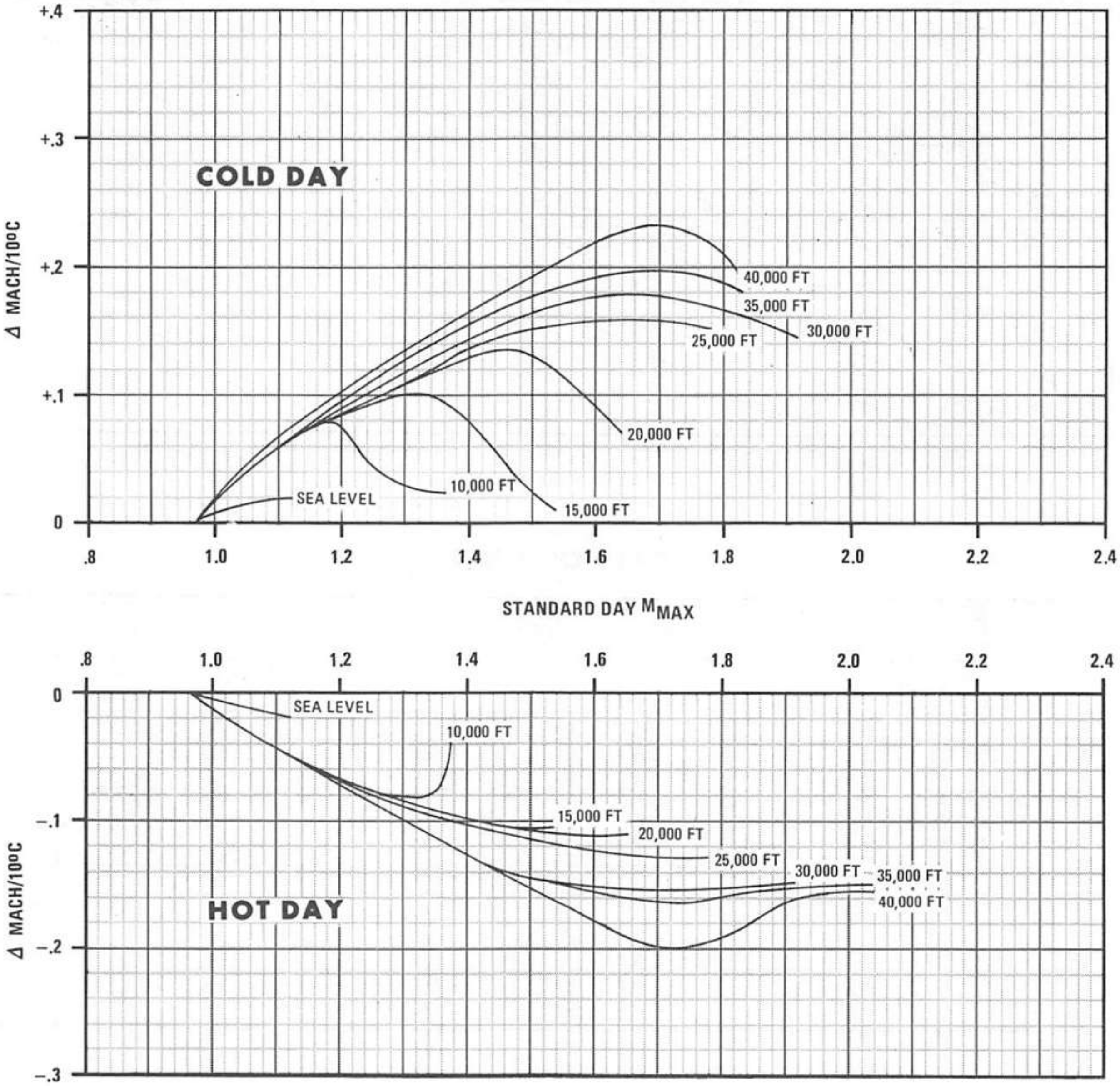
REMARKS
ENGINE(S): (2) J79-GE-17

GUIDE



FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**



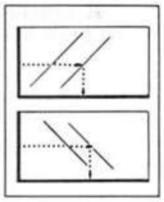
4G-1-(205)

Figure A9-56

TURN CAPABILITIES
CONSTANT SPEED AND ALTITUDE

REMARKS
ENGINE(S): (2) J79-GE-17
ICAO STANDARD DAY

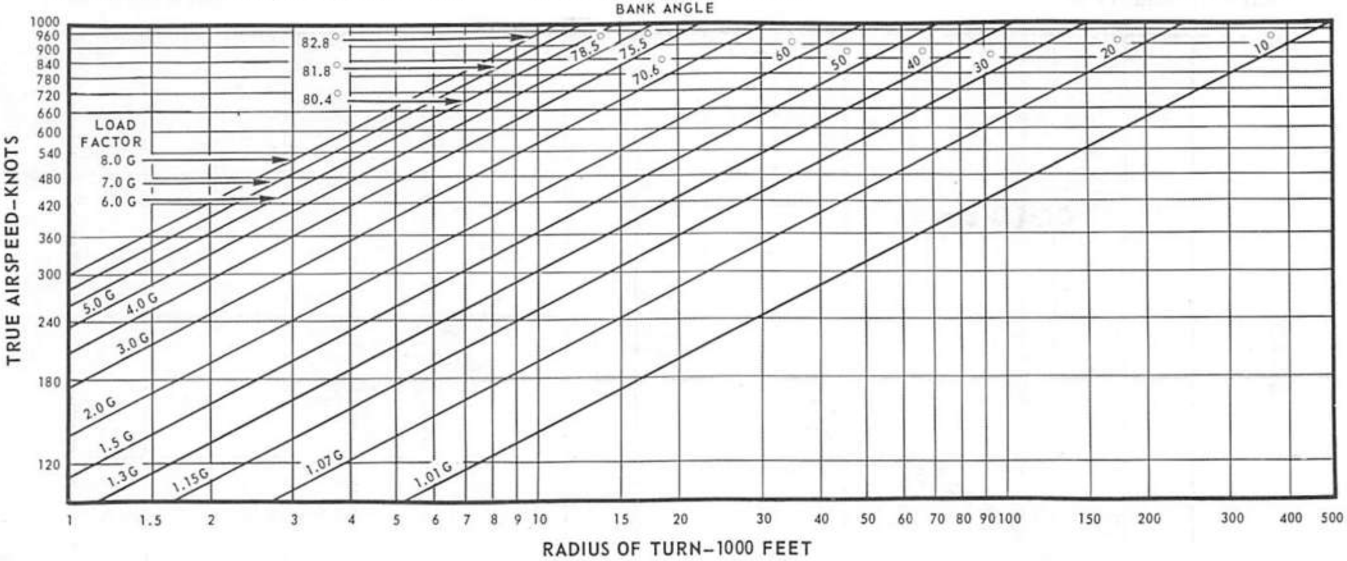
GUIDE



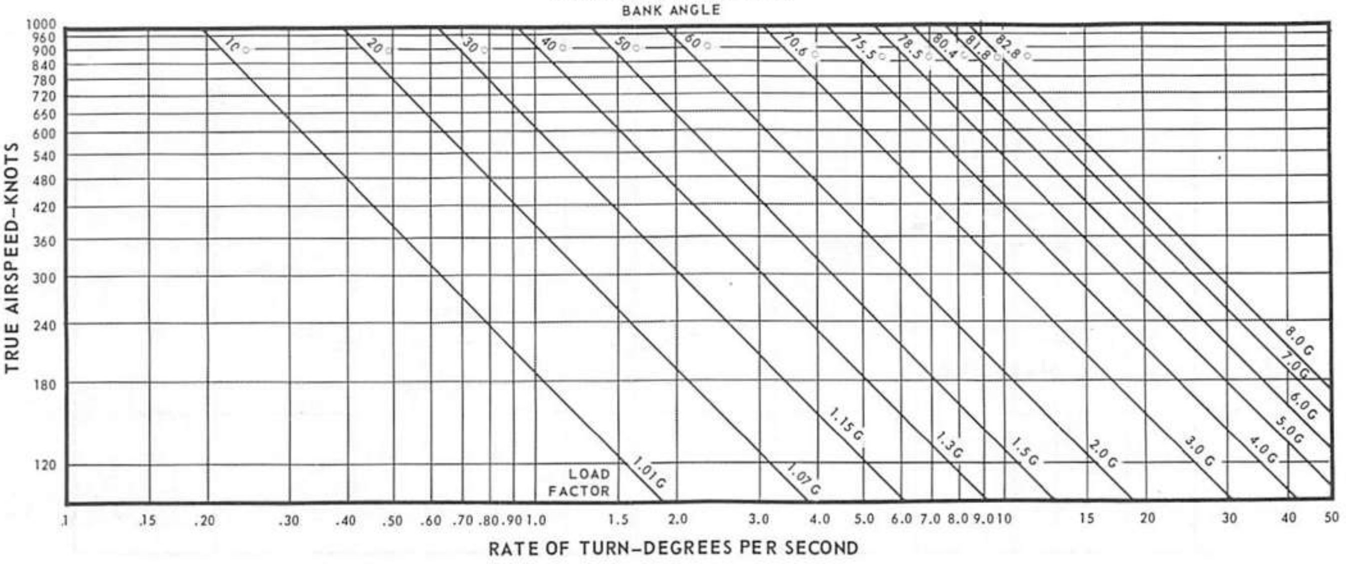
DATE: 1 FEBRUARY 1973
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-4
FUEL DENSITY: 6.5LB/GAL

RADIUS OF TURN



RATE OF TURN



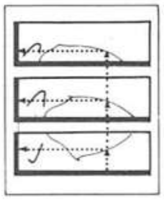
4G-1-(206)

Figure A9-57

SUSTAINED G TURN CAPABILITIES

GROSS WEIGHT-42,596 POUNDS
MAXIMUM THRUST
CONSTANT SPEED AND ALTITUDE

GUIDE



AIRPLANE CONFIGURATION
(4) AIM–7

REMARKS
ENGINE(S): (2) J79–GE–17
ICAO STANDARD DAY

NOTE
MAXIMUM SPEED LIMITED
BY ENGINE LIMIT

DATE: 1 FEBRUARY 1973
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP–4
FUEL DENSITY: 6.5 LB/GAL

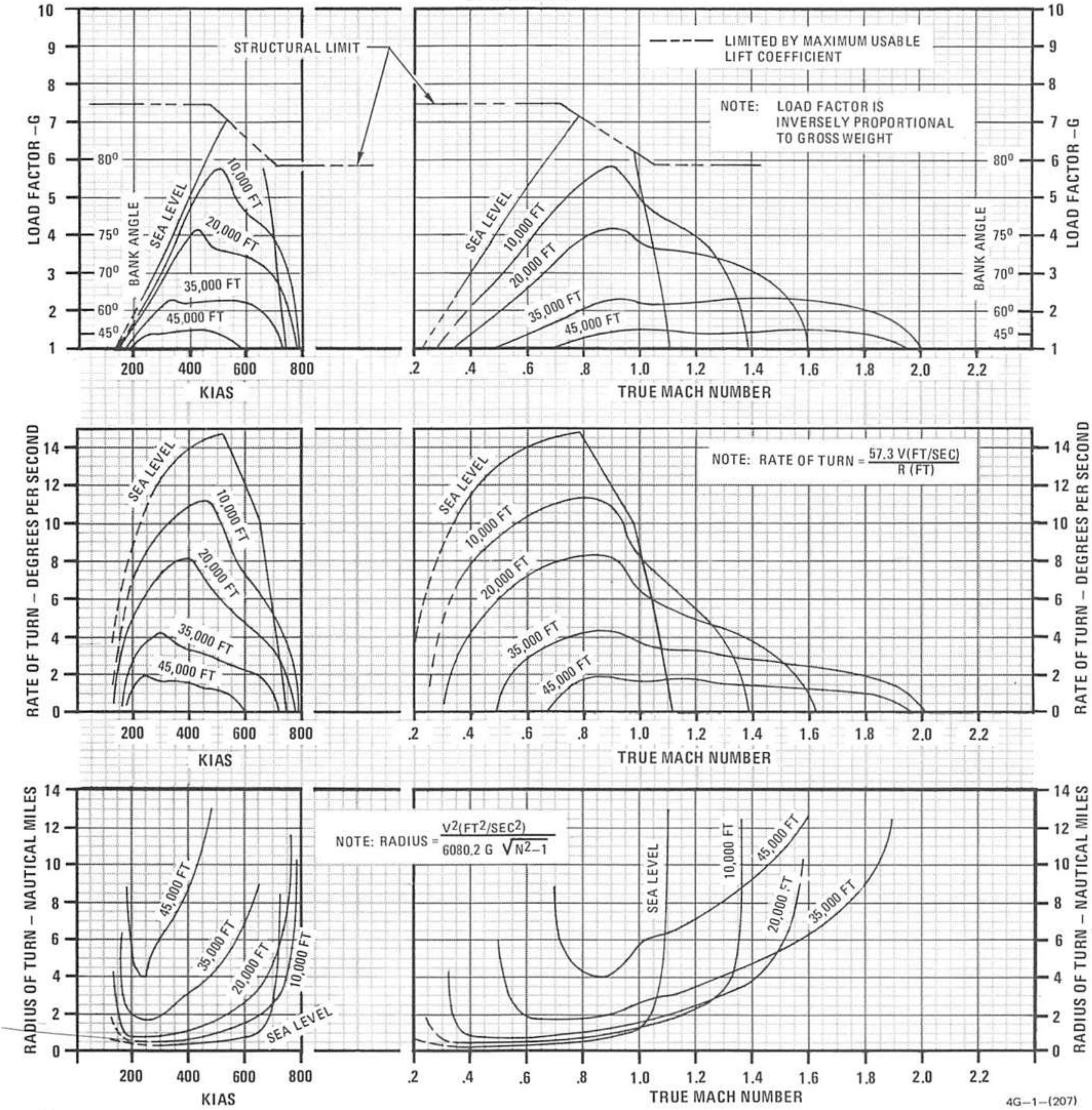


Figure A9–58

PART 10

MISSION PLANNING

MISSION PLANNING

Optimum use of the aircraft to obtain maximum performance with minimum fuel consumption requires careful preflight planning for the mission. The planning of a mission involves many things which are beyond the scope of this publication. As used here, mission planning will cover certain key phases of a mission and explain the use of performance charts.

The following sample Wild Weasel mission demonstrates features of performance data in Parts 1 thru 9. Although the sample problem does not cover the many mission capabilities of the aircraft, it familiarizes the aircrew with the use of performance data so that any mission may be preflight planned in a short time.

The sample problem illustrates, through a graphical solution, how performance charts can be integrated to form a complete mission flight plan. The steps used to develop such a plot are shown with the problem.

WILD WEASEL MISSION PROFILE

Perform maximum thrust takeoff and climb at military thrust. Cruise at optimum altitude and maximum range speed to a target zone 150 miles from the air base. Perform AGM-65 missile deployment at military/maximum thrust for the full duration allowed by return and landing fuel requirements. Air-to-Ground munitions are assumed to be expended at the end of the combat period. Return to the airfield at optimum altitude and airspeed. Descend at maximum range descent, arriving at the destination with 2000 pounds landing fuel reserve. The Wild Weasel Mission Overview (figure A10-1) and the Sample Mission Plan (figure A10-2) depict the overall mission plan.

MISSION DATA

Configuration

(4) AGM-65 Missiles, Pylons and Launchers

(3) AIM-7D Missiles

(1) ALQ-119(V)-12 ECM Pod

(2) 370 Gallon External Wing Tanks

Useable Fuel (includes external tanks) 16,868 pounds

MISSION FACTORS

Takeoff

Wind	Calm
Pressure altitude	1100 Ft
Temperature	+12°C
Runway	040°
Runway length	9500 Ft
Climb out wind (headwind)	20 Kt
Cruise out wind (headwind)	50 Kt
Cruise return wind (tailwind)	50 Kt
Descent wind (tailwind)	20 Kt

Landing

Wind	020°/10
Pressure altitude	1100 Ft
Temperature	+12°C
Runway	040°
Runway length	9500 Ft

Sample Problem

The graphic solution of the problem is introduced in the Sample Mission Plan (figure A10-2) so that the aircrew can see the complete picture before the actual solution is broken into parts. The problem is solved by plotting fuel remaining versus distance. Gross weight is also superimposed on the vertical scale.

TAKEOFF AND LANDING DATA

The first step involves calculation of the aircraft gross weight, drag and stability indexes (refer to charts in Part 1) and completion of the checklist Takeoff and Landing Data card. The mission problem is then solved in incremental steps working backward from landing to the combat zone. Finally performance calculations are computed from takeoff to the target zone. The weight difference between entering and leaving the target zone dictates the target zone fuel availability.

Begin preflight planning by determining the aircraft gross weight, drag and stability indexes by using the Airplane Loading chart (Part 1).

Item	Wt (Lb)	Drag Index	Stab Index
Basic Takeoff Weight (includes internal fuel)	45,762	0.0	0.0

WILD WEASEL MISSION OVERVIEW

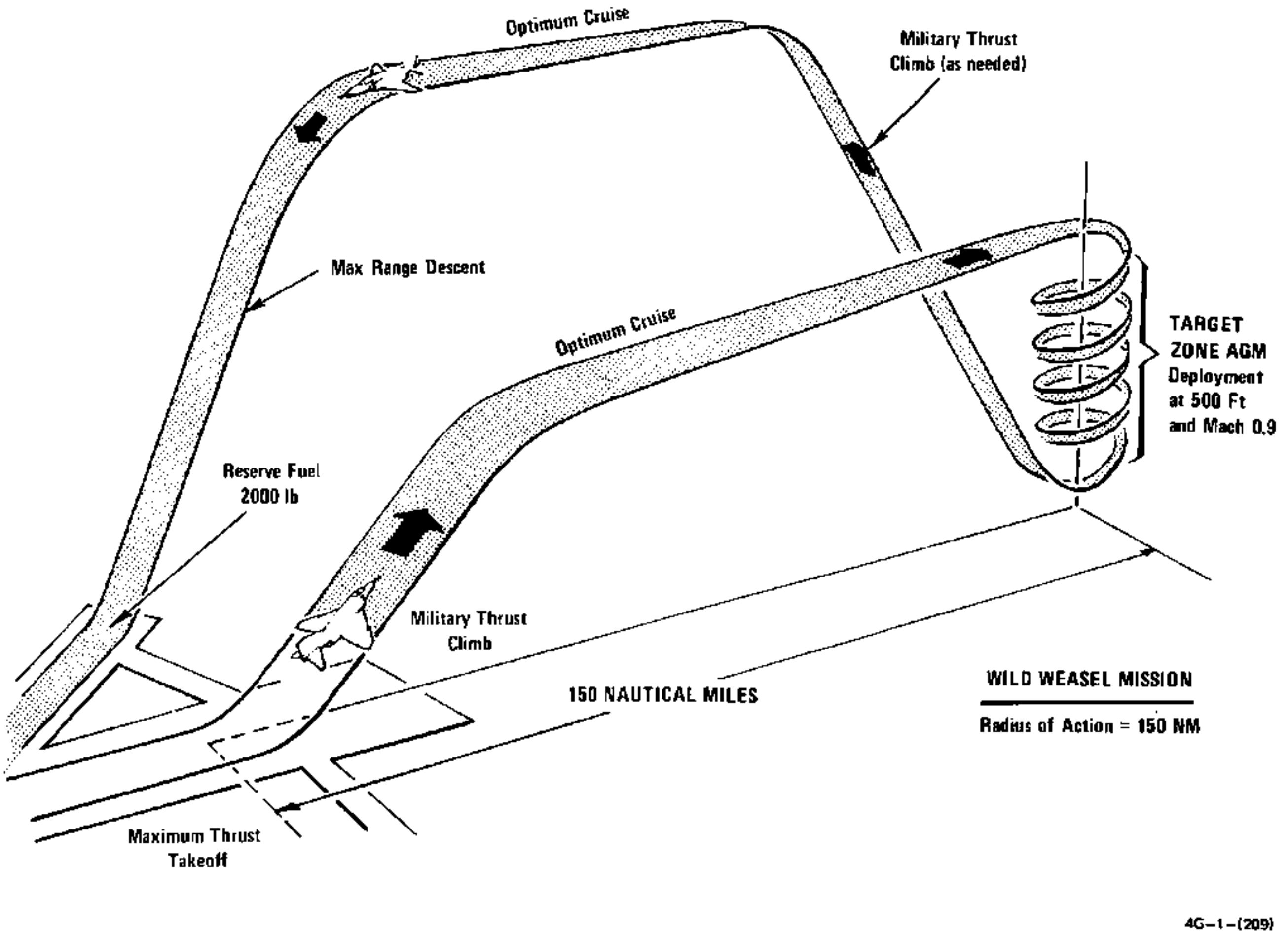


Figure A10-1

Item	Wt (Lb)	Drag Index	Stab Index
(2) Wing tanks (Sargent–Fletcher) (full)	5,426	12.8	93.0
(4) AGM–65 missiles	1852	11.2	94.0
(2) Inboard armament pylons and LAU–88 launchers	1480	27.4	43.0
(3) AIM–7D missiles	1305	3.9	0.0
(1) ALQ–119(V)–12 ECM Pod			
Start engine totals	56,405	57.0	230

The allowable Aft CG Limit chart (Part 1) with the computed stability index of 230 is 31.0% MAC. Given a CG of 30.1% for this aircraft and configuration, the Aft CG Limit chart depicts operation in an area which is less than 1% MAC forward of the computed neutral stability point at engine start; therefore, the pilot should thoroughly review the flight characteristics discussion in section VI before flight.

APPROACH AND LANDING RESERVE

Plan the mission by working backwards from the landing reserve. The planned landing fuel reserve for this mission is 2000 pounds which will permit landing pattern operation for 15 to 20 minutes.

DESCENT FROM CRUISE ALTITUDE

The time, fuel, and descent distance can be determined from the descent charts (Part 7). The drag index for the cruise return leg configuration is 45.8. The airplane gross weight at the end of letdown is 39,685 pounds which includes 2000 lb reseve landing fuel armament pylons and LAU–88 launcher +2000 lb reserve fuel. The optimum cruise altitude for this weight and drag index is found on the Optimum Cruise Summary chart (Part 4) as 40,000 feet. Next enter the Maximum Range Descent chart (Part

SAMPLE MISSION PLAN

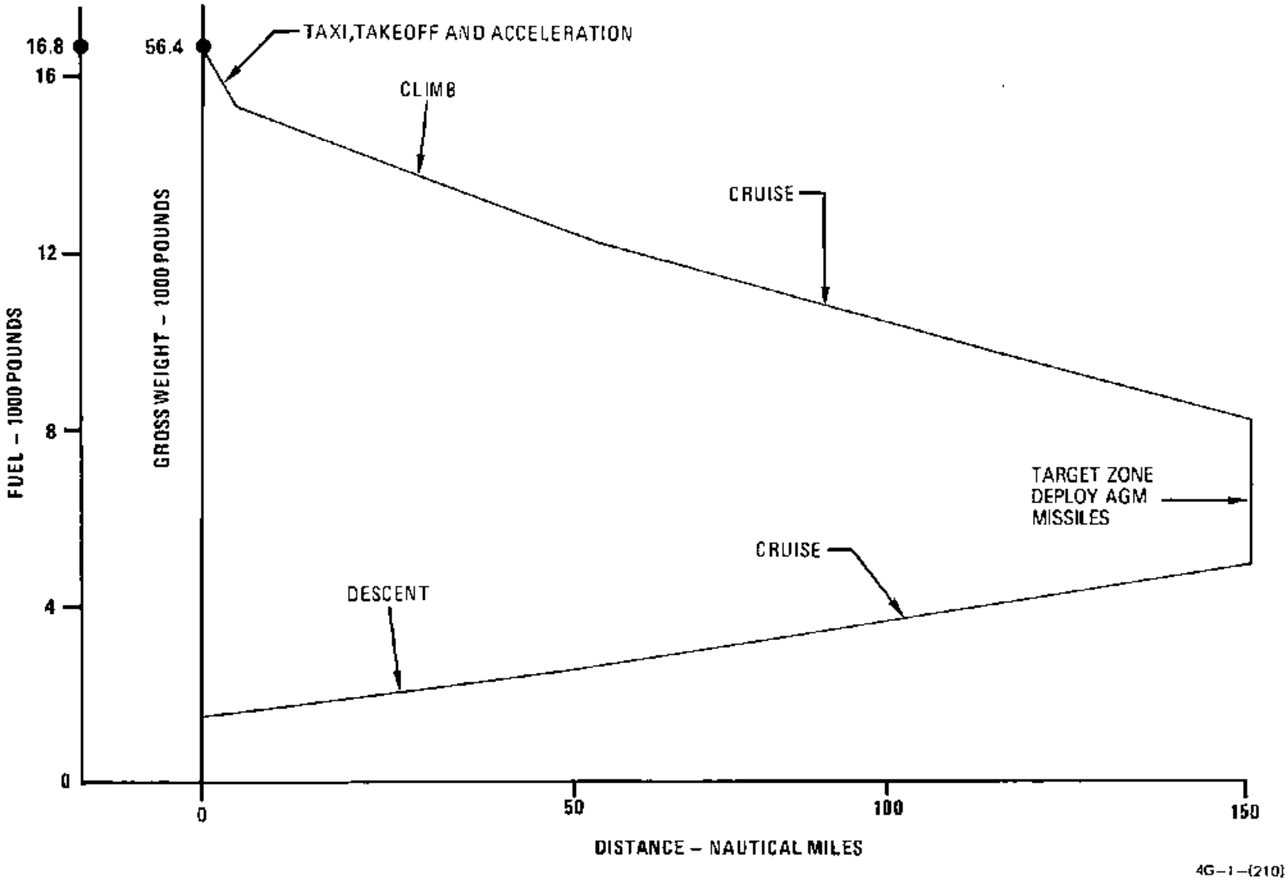


Figure A10-2

7) and determine the descent data (assume descent to sea level).

Distance (no wind)	51 NM
Time	9.4 Min
Fuel	210 Lb
Speed (Mach number)	.83

Correct the descent distance for the 20 knot tailwind using the Rangewind Correction chart (Part 4).

Range factor	1.04
Distance (corrected)	54 NM

RETURN AT OPTIMUM CRUISE ALTITUDE

The cruise data may be obtained from the Optimum Cruise Summary chart (Part 4). The drag index is 45.8 (57.0–11.2 AGM-65 missiles) and end of cruise gross weight is 39,895 pounds (39,685 lb +210 lb descent fuel). Since the target zone is 150 NM from base, a return cruise of 96 NM will be required (150–54 descent miles). Construct the return fuel–distance line as shown on the Sample Cruise Return and Descent chart (figure A10-3).

Drag index	45.8
Estimated average weight	39,800 Lb
Optimum cruise altitude	39,000 Ft
Specific range	.084 NMPP
Speed (Mach)	.84
Speed (TAS)	485 Kt
Ground speed	534 Kt
Distance (to go)	96 NM
Time	10.8 Min
Distance (no wind)	87 NM
Fuel used	1035 Lb

Total fuel needed when departing the target area at cruise altitude for return to base is 3245 pounds (2000 lb +210 lb +1035 lb). Gross weight when departing target area is 40,906 pounds (33,680 lb airplane operating weight +1480 lb inboard pylons and LAU-88 launchers +3245 lb fuel).

TAXI, TAKEOFF AND ACCELERATION

The first portion of the mission fuel graph was constructed by working backwards from the landing reserve. The remainder of the plot is developed from the engine start condition. Takeoff gross weight is 55,755 pounds with a corresponding drag index of 57.0. This data was obtained from the Climb Speed Schedule (Part 3) using a start engine weight of 56,405 lb –130 lb (start engines) –420 lb

SAMPLE CRUISE RETURN AND DESCENT

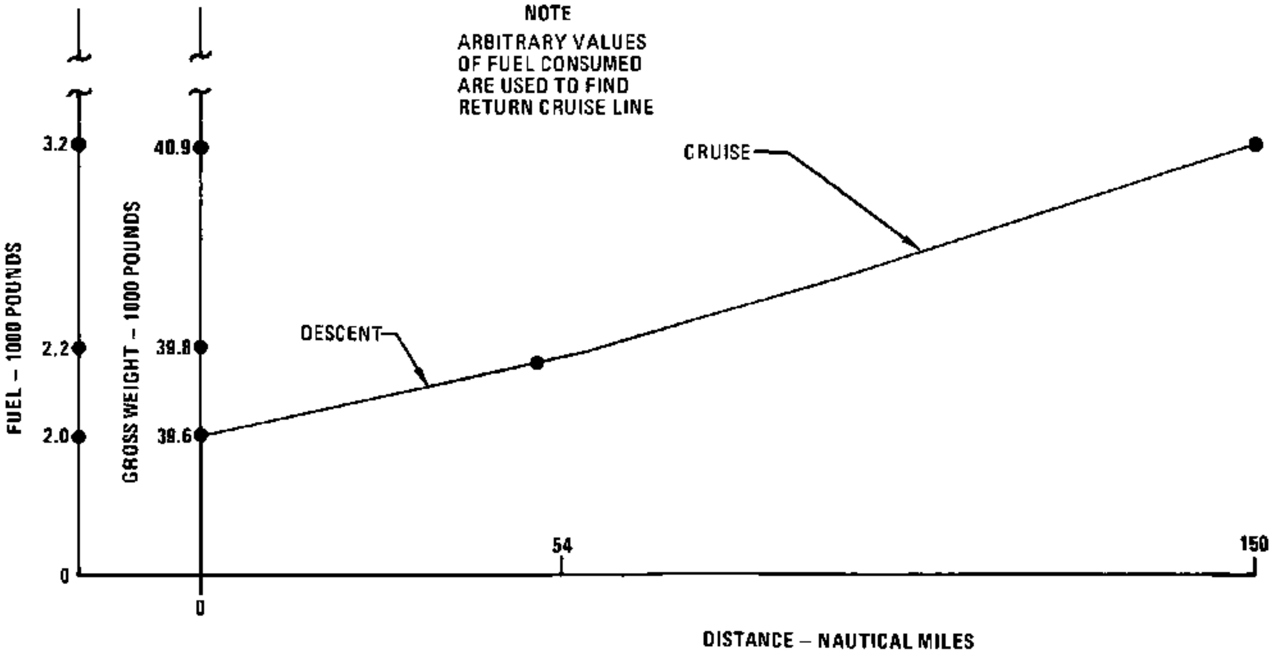


Figure A10–3

4G–1–(211)

(taxi at idle rpm for 10 min) –100 lb (engine run–up). The Maximum Thrust takeoff and acceleration data (found in the Climb Speed Schedule, Part 3) is 925 lb (fuel), 0.8 min (time) and 3.0 NM (distance). This reduces initial climb weight to 54,830 pounds (55,755 lb –925 lb).

The Takeoff and Landing Data Card, located in the normal procedures Checklist, TO 1F–4G–1CL–1, should be completed during the final mission planning phase. The format of the card (figure A10–4) provides a ready reference of: Known conditions (A thru F); Takeoff data (G thru L); and Landing data (M thru P). The Takeoff and Landing Data card should be filled out in the following sequence:

a. Steps A thru F are known conditions and must be completed before takeoff calculations can be made. The takeoff gross weight is obtained by subtracting the engine start, run–up and acceleration fuel obtained from the Military Thrust Climb chart (Part 3) from the engine start gross weight.

b Step H is obtained from the Maximum Thrust Takeoff Distance chart (Part 2).

c. Step G is obtained from the Velocity During Takeoff Ground Run chart (Part 2). Establishment of an acceleration check is based on the availability of runway distance markers or other fixed points necessary to accurately relate distance traveled to the acceleration check point.

d. Step I is obtained from the Minimum Go Speed chart (Part 2).

e. Step J is obtained from the Maximum Abort Speed charts (Part 2). Since the Minimum Go Speed exceeds the Maximum Abort Speed in this problem, the WARNING in Part 2 applies.

f. Steps K and L are obtained from the Takeoff Distance chart (Part 2).

g. Steps M and P are obtained from the Final Approach Speeds chart (Part 8), using the applicable configuration.

h. Steps N and O are obtained from the Minimum Landing Roll Distance chart (Part 8).

CLIMB TO CRUISE ALTITUDE

Determine the cruise altitude from the Optimum Cruise Summary chart (Part 4).

Drag index	57.0
Weight (estimated)	54,500 Lb
Cruise altitude	31,000 Ft

Determine the climb time, distance, and fuel data from the Military Thrust Climb charts (Part 3). Assume climb from sea level and standard temperature during climb.

Drag index	57.0
Initial Weight	54,830 Lb
Time	9.9 Min
Fuel	2350 Lb
Final Weight	52,480 Lb
Air distance	80 NM
Speed (average TAS)	485 Kt
Ground speed	468 Kt
Ground distance	77 NM

SAMPLE TAKEOFF AND LANDING DATA CARD

CONDITIONS

		TAKEOFF	LANDING
A	GROSS WEIGHT	55,755LB	36,690LB
B	RUNWAY LENGTH	9500 FT	9500 FT
C	WIND	CALM	020/10
D	RUNWAY TEMPERATURE	+12°C	+12°C
E	PRESSURE ALTITUDE	1100 FT	1100 FT
F	DENSITY RATIO	0.98	0.98

TAKEOFF (MAXIMUM THRUST)

G	ACCELERATION CHECK	122 KT	2000 FT
H	TAKEOFF DISTANCE (TO CLEAR 50 FOOT HEIGHT)		5000 FT
I	MINIMUM GO SPEED		NA
J	MAXIMUM ABORT SPEED (WITH DRAG CHUTE)		157 KT
K	NOSEWHEEL LIFT-OFF SPEED		143 KT
L	TAKEOFF SPEED		179 KT

LANDING

		IMMEDIATELY AFTER TAKEOFF	FINAL LANDING
M	APPROACH SPEED	168 KT	149 KT
N	LANDING ROLL	5000 FT	3600 FT
O	NO DRAG CHUTE	6200 FT	4500 FT
P	NO FLAP APPROACH SPEED (ON SPEED)	179 KT	159 KT

4G-1-(212)

Figure A10-4

CRUISE OUT AT OPTIMUM ALTITUDE

Cruise calculations are based on the Optimum Cruise Summary chart (Part 4). The useable fuel remaining is 12,943 pounds (16,868 lb −130 lb −420 lb −100 lb −925 lb −2350 lb). The estimated average weight for this return cruise leg is 51,700 pounds. Since the distance to the target zone is 150 miles, the distance remaining after climb out is 73 NM (150 − 77 climb out miles). Determine the cruise altitude, speed, and specific range from the Optimum Cruise Summary chart (Part 4).

Drag index	57.0
Estimated average weight	51,700 Lb
Cruise altitude	32,000 Ft
Specific range	.061 NMPP
Mach	0.84
Speed (TAS)	493 Kt
Ground speed	444 Kt
Time	9.8 Min
Distance (air miles)	81 NM

The fuel consumed is 1328 pounds (81 NM/.061 NMPP).

SAMPLE TAKEOFF CLIMB AND CRUISE

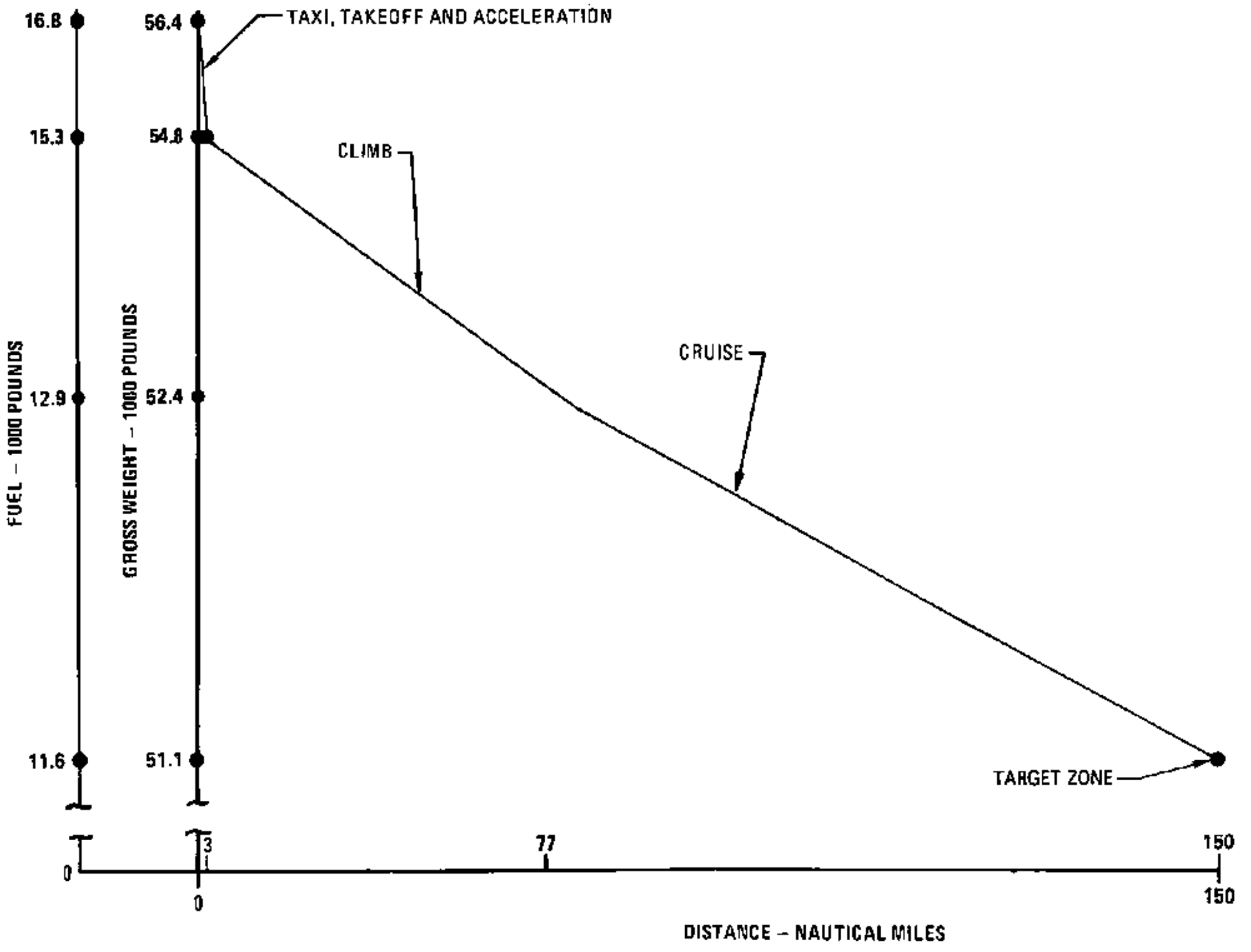


Figure A10-5

TARGET ZONE OPERATIONS

The gross weight upon arrival at the target zone is 51,152 pounds (52,480 lb – 1328 lb). Fuel available for target zone operation is 8394 pounds (16,868 lb full fuel load – 5253 lb start, taxi, run-up, accelerate, climb, and cruise fuel to target zone – 3221 lb cruise return, descent, and landing reserve fuel). Assuming the deployment of the AGM-65 missiles will be accomplished at an average altitude of 5000 ft MSL, a descent from cruise out altitude and a climb back to return cruise altitude will be required. Use the descent charts (Part 7) and the climb charts (Part 3) to determine the amount of fuel required.

Maximum Range Descent

Speed (Mach)	0.7
Time	5.1 min
Fuel	170 Lb

Military Thrust Climb

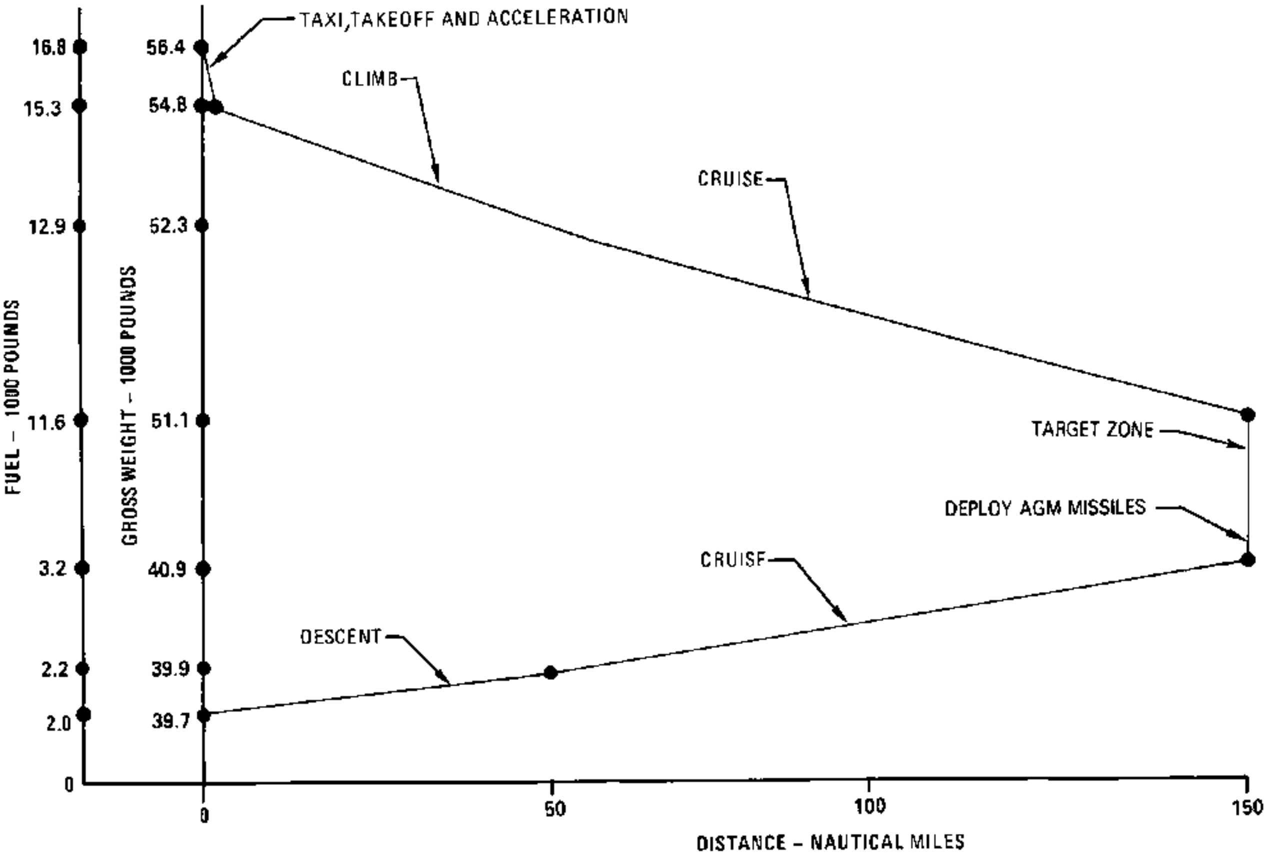
A. Estimated initial gross wt.	41,000 Lb
B. Cruise altitude	40,000 Lb
C. Start climb altitude	5000 Ft
D. Drag index	45.8
E. Fuel required to reach B	1900 Lb
F. Fuel required to reach C	350 Lb
G. Fuel required to climb (E–F)	1550

Fuel available for deployment of the AGM-65 missiles is 7674 lbs (8394 – 170 descent fuel – 1550 climb fuel).

MISSION PLANNING SUMMARY

A breakdown of the entire flight is shown in the Sample Mission Profile (figure A10-6), and Sample Mission Summary (figure A10-7). Any deviations from the planned

SAMPLE MISSION PROFILE



4G–1–(214)

Figure A10–6

mission factors (changes in headwind, excess combat time, and availability of air refueling) must be considered as the flight progresses to insure successful mission accomplishment.

SAMPLE MISSION SUMMARY

SEGMENT (CONFIGURATION)	WEIGHT (LB)	DRAG INDEX	FUEL (LB)	TIME (MIN)	DISTANCE		ALTITUDE (FT)	SPEED MACH/TAS
					AIR (NM)	GROUND (NM)		
MAX THRUST TAKEOFF	56,405	57.0	1575	0.8	3	3	1100	ACCELERATE
MIL THRUST CLIMB	54,830	57.0	2350	9.9	80	77	32,000	CLIMB SCHEDULE
OPTIMUM CRUISE OUT (2) WG TANKS, (3) AIM-7, (1) ECM POD & (4) AGM-65	52,480	57.0	1328	9.8	81	73	32,000	.84/493
TARGET ZONE – DESCENT, DEPLOY (4) AGM-65 & CLIMB	51,152	57.0	8394	–	–	–	5000	.90/583
RETURN OPTIMUM CRUISE (2) WG TANKS, (3) AIM-7 (1) ECM POD & (2) LAU-88 LAUNCHERS	40,906	45.8	1035	10.8	87	96	39,000	.84/485
DESCENT	39,871	45.8	210	9.4	51	54	39,000 TO SEA LEVEL	250 KIAS
APPROACH & LANDING RESERVE	39,661	45.8	2000	10.0	–	–	1100	–

4G-1-(215)

Figure A10-7

GLOSSARY

A

AC – Aerodynamic center

ac – Alternating current

ADCS – Air Data Computer Set

ADI – Attitude Director Indicator

AFC – Automatic Frequency Control

AFCS – Automatic Flight Control System

AGC – Automatic Gain Control

AHRS – Attitude Heading Reference System

AI – Airborne Intercept

AJB – Airborne, Electro–Mechanical, Bombing

AOA – Angle of Attack

APA – Airborne, Radar, Auxiliary Assembly

APN – Airborne, Radar, Navigational Aid

APQ – Airborne, Radar, Special Purpose

APU – Auxiliary Power Unit

AR – Air Refueling

ARI – Aileron Rudder Interconnect

ARC – Airborne, Radio, Control

ASA – Airborne, Special Type, Auxiliary Assembly

ASE – Allowable Steering Error

ASN – Airborne, Special Type, Navigational Aid

ASQ – Airborne, Special Type, Combination of Purposes

AVTR – Airborne Video Tape Recorder

AWW – Airborne, Armament, Control

B

BDHI – Bearing Distance Heading Indicator

BIT – Built–In–Test

BST – Boresight

C

CAT – Clear Air Turbulence

CADC – Central Air Data Computer

CAS – Calibrated Airspeed

CG – Center of Gravity

CIT – Compressor Inlet Temperature

CNI – Communication Navigation Identification

COSS – Computing Optical Sight System

CSD – Constant Speed Drive

D

dc – Direct current

DCU – Douglas Control Unit

DME – Distance Measuring Equipment

DMAS – Digital Modular Avionics System

DR – Dead Reckoning

DSCG – Digital Scan Converter Group

E

EAS – Equivalent Airspeed

ECM – Electronic Countermeasure(s)

EGT – Exhaust Gas Temperature

EWO – Electronic Warfare Officer

F

FL – Flight Level

G

G – Gravity

GCA – Ground Control Approach

GCI – Ground Control Intercept

gpm – Gallon per minute

H

Hangfire – A delay or failure of an article of ordinance after being triggered

Hang Start – A start that results in a stagnated rpm and temperature

Hot Start – A start that exceeds normal starting temperatures

HSI – Horizontal Situation Indicator

GLOSSARY (CONT)

Hz – Hertz

I

IP – Identification Point

IAS – Indicated Airspeed

IFF – Identification Friend or Foe

IFR – Instrument Flight Rules

ILS – Instrument Landing System

IMC – Instrument Meteorological Conditions

IR – Infrared

I/P – Identification of Position

J

JP – Jet Propulsion

K

KTS – Knots

L

LABS – Low Altitude Bombing System

LE – Leading Edge

LOX – Liquid Oxygen

Lpm – Liters per minute

M

MAC – Mean Aerodynamic Chord

MIL – Military

Misfire – A permanent failure of an article of ordinance being triggered

MSL – Mean Sea Level

N

N/A – Not applicable

N/E – Not established

NMPP – Nautical Miles Per Pound

O

OAT – Outside Air Temperature

P

P – Pilot

PC – Power Control

PDVL – Pull Down Vent Line

PLB – Personnel locator beacon

PRF – Pulse Repetition Frequency

PRI – Pulse Repetition Interval

psi – Pounds per square inch

Q

q – Dynamic Pressure, psf

R

RADAR – Radio Detection and Ranging

RCR – Runway Condition Reading

RF – Reconnaissance – Fighter

rpm – Revolutions Per Minute

S

SID – Standard Instrument Departure

SPC – Static Pressure Compensator

T

TACAN – Tactical Air Navigation

TAS – True Airspeed

TE – Trailing Edge

TMN – True Mach Number

U

UHF – Ultra High Frequency

V

VFR – Visual Flight Rules

VHF – Very High Frequency

VMC – Visual Meteorological Conditions

Vn – Velocity Acceleration Relationship

VORTAC – Very High Frequency – Omni Range and Tactical Air Navigation

ALPHABETICAL INDEX

NOTE

All text and illustrations numbers in this alphabetical index refer to page numbers, illustration page numbers are shown in parenthesis.

*U.S. GOVERNMENT PRINTING OFFICE: 1992-676-013

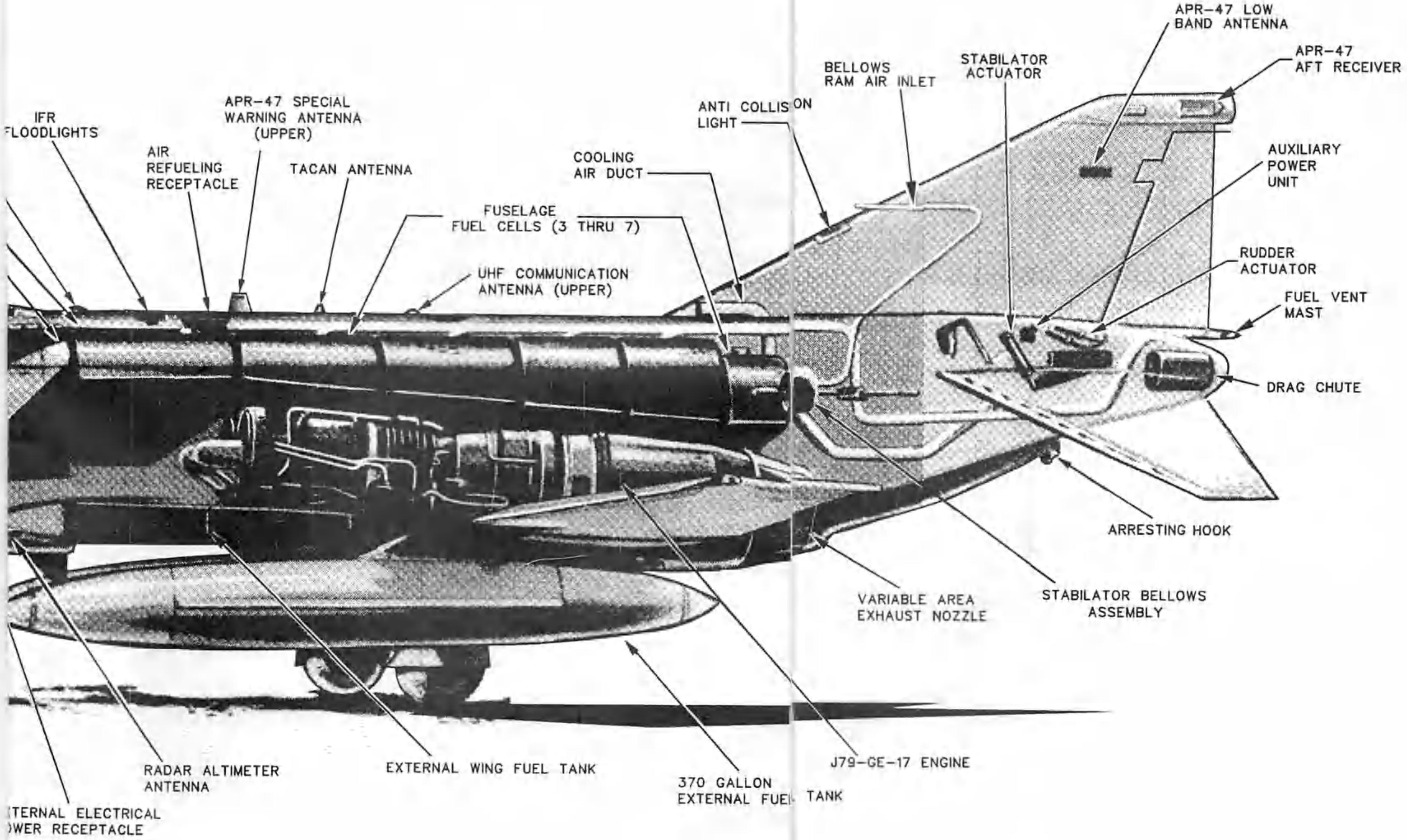
SECTION FO

FOLDOUT ILLUSTRATIONS

TABLE OF CONTENTS

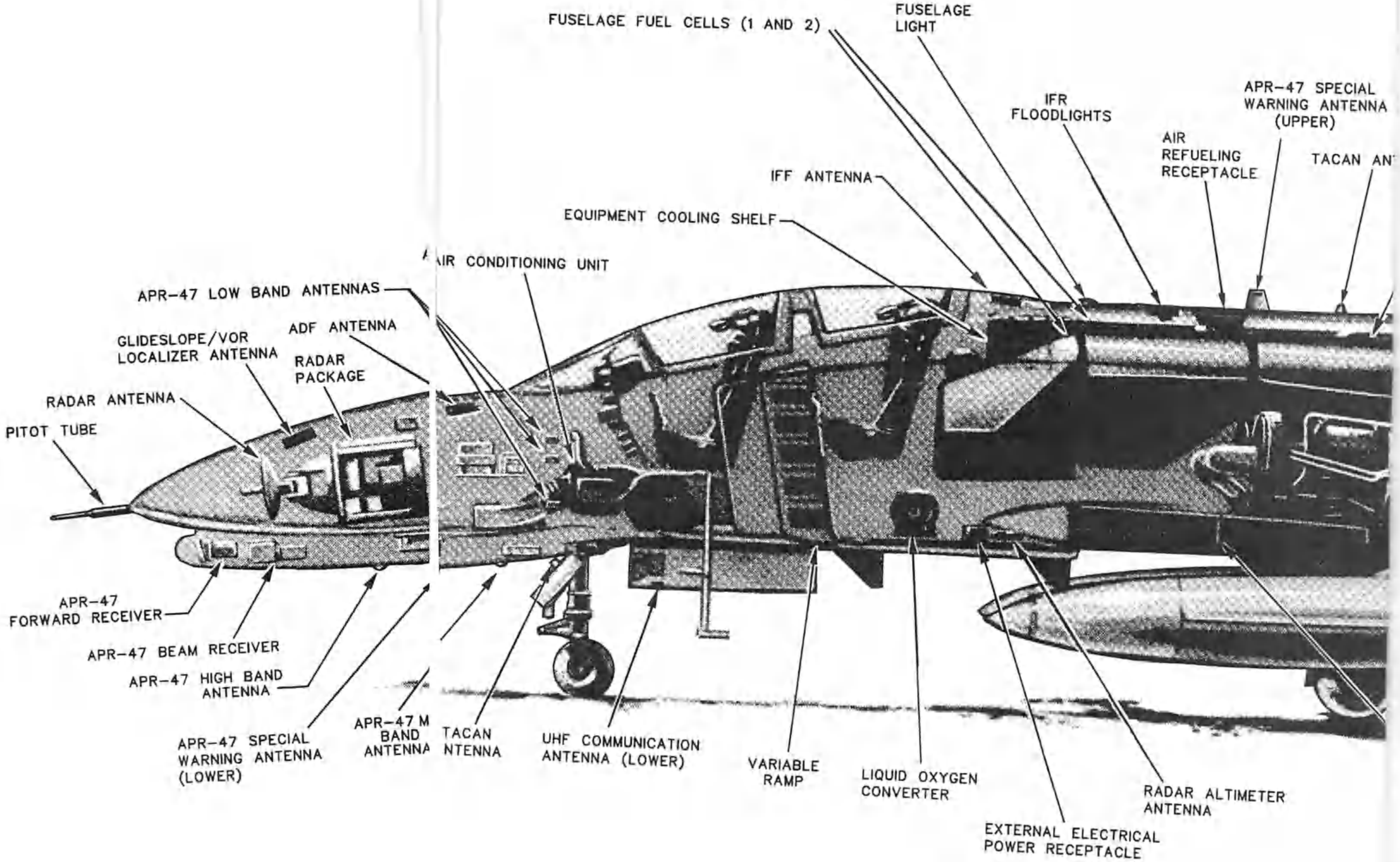
GENERAL ARRANGEMENT

TYPICAL

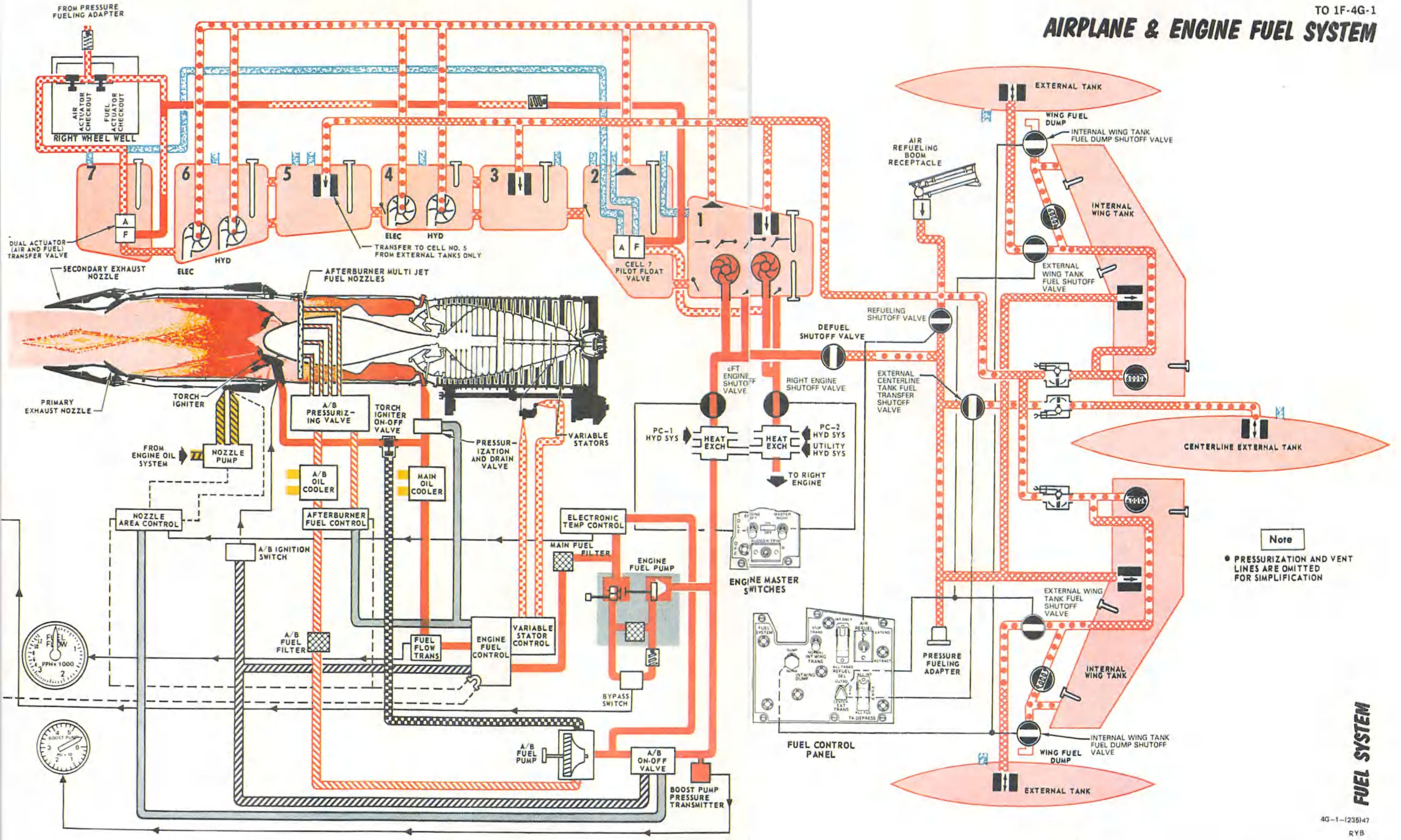


G9400247

FO-1.


FUSELAGE FUEL CELLS (1 AND 2)
FUSELAGE LIGHT
IFR FLOODLIGHTS
APR–47 SPECIAL WARNING ANTENNA (UPPER)
AIR REFUELING RECEPTACLE
TACAN AN
IFF ANTENNA
EQUIPMENT COOLING SHELF
AIR CONDITIONING UNIT
APR–47 LOW BAND ANTENNAS
ADF ANTENNA
GLIDESLOPE/VOR LOCALIZER ANTENNA
RADAR PACKAGE
RADAR ANTENNA
PITOT TUBE
APR–47 FORWARD RECEIVER
APR–47 BEAM RECEIVER
APR–47 HIGH BAND ANTENNA
APR–47 SPECIAL WARNING ANTENNA (LOWER)
APR–47 M BAND ANTENNA
TACAN NTENNA
UHF COMMUNICATION ANTENNA (LOWER)
VARIABLE RAMP
LIQUID OXYGEN CONVERTER
EXTERNAL ELECTRICAL POWER RECEPTACLE
RADAR ALTIMETER ANTENNA

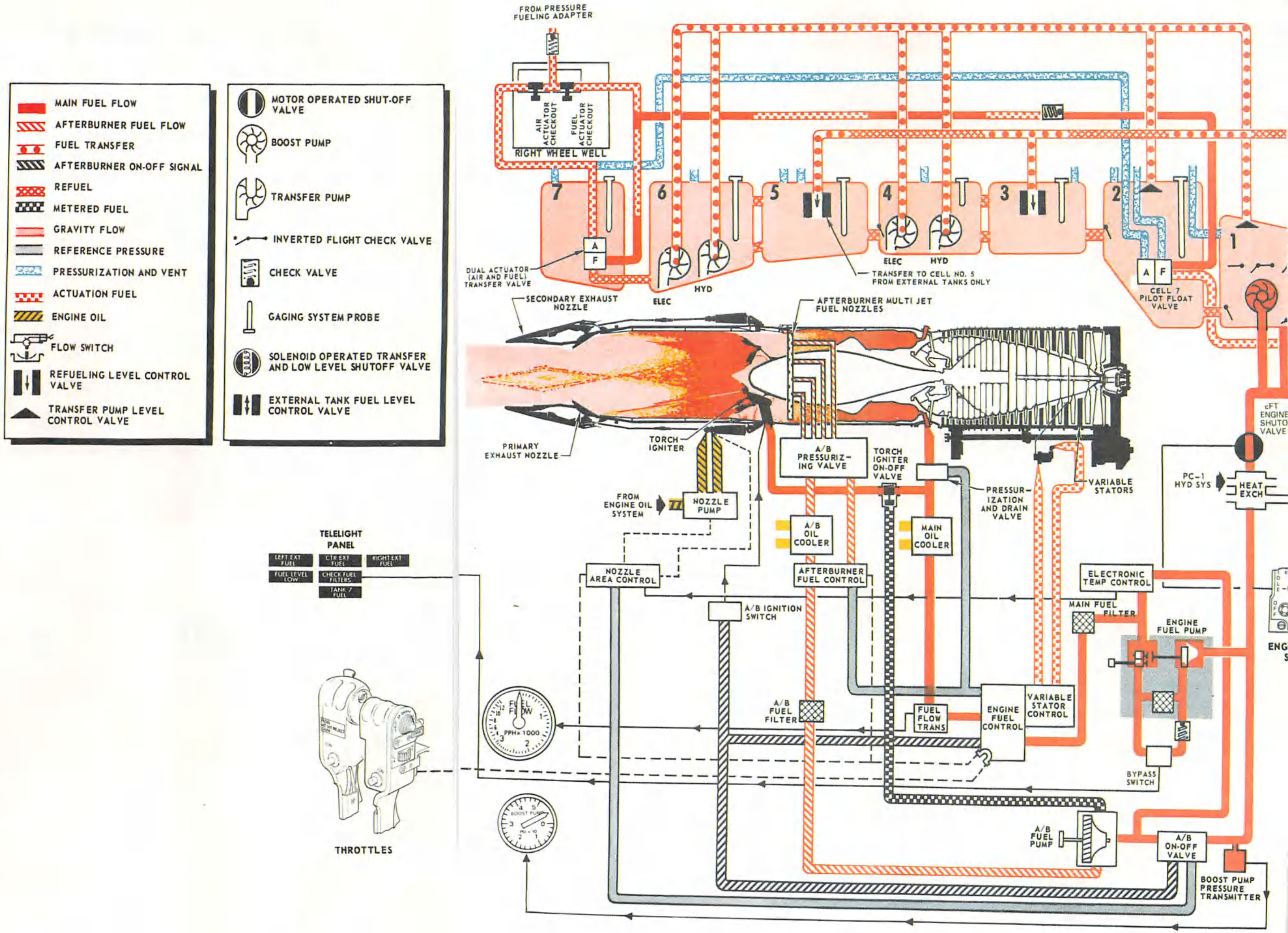
AIRPLANE & ENGINE FUEL SYSTEM



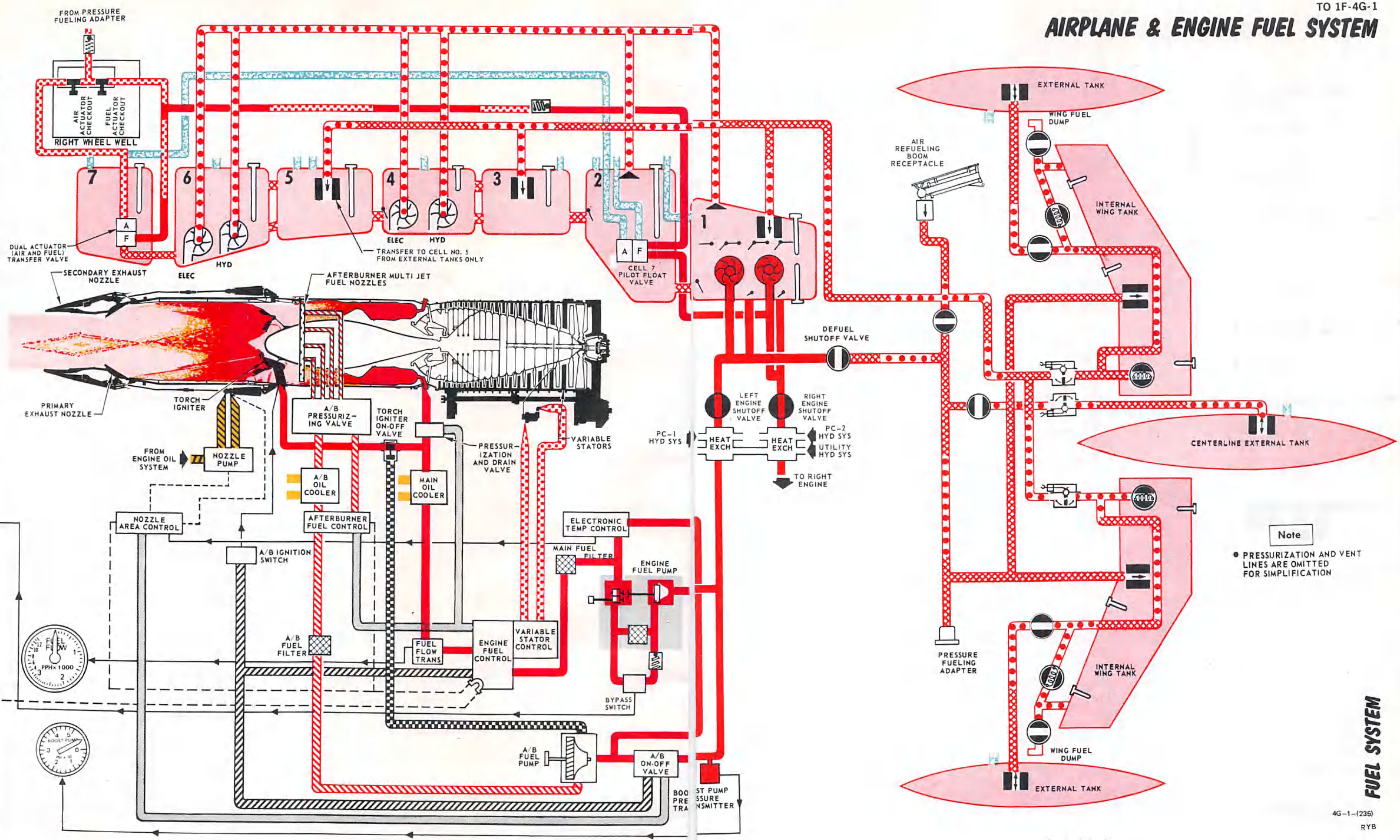
Note

- PRESSURIZATION AND VENT LINES ARE OMITTED FOR SIMPLIFICATION

Figure FO-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
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
TELELIGHT PANEL
LEFT EXT FUEL
CTR EXT FUEL
RIGHT EXT FUEL
FUEL LEVEL LOW
CHECK FUEL FILTERS
TANK 7 FUEL
THROTTLES
FROM PRESSURE FUELING ADAPTER
AIR ACTUATOR CHECKOUT
FUEL ACTUATOR CHECKOUT
RIGHT WHEEL WELL
7
6
5
4
3
2
1
A
F
DUAL ACTUATOR (AIR AND FUEL) TRANSFER VALVE
ELEC
HYD
ELEC
HYD
TRANSFER TO CELL NO. 5 FROM EXTERNAL TANKS ONLY
A
F
CELL 7 PILOT FLOAT VALVE
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
FT ENGINE SHUTO VALVE
PC-1 HYD SYS
HEAT EXCH
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
ENG
FUEL FLOW
PPH × 1000
A/B FUEL FILTER
FUEL FLOW TRANS
ENGINE FUEL CONTROL
VARIABLE STATOR CONTROL
BYPASS SWITCH
BOOST PUMP
PSI × 10
A/B FUEL PUMP
A/B ON-OFF VALVE
BOOST PUMP PRESSURE TRANSMITTER

AIRPLANE & ENGINE FUEL SYSTEM



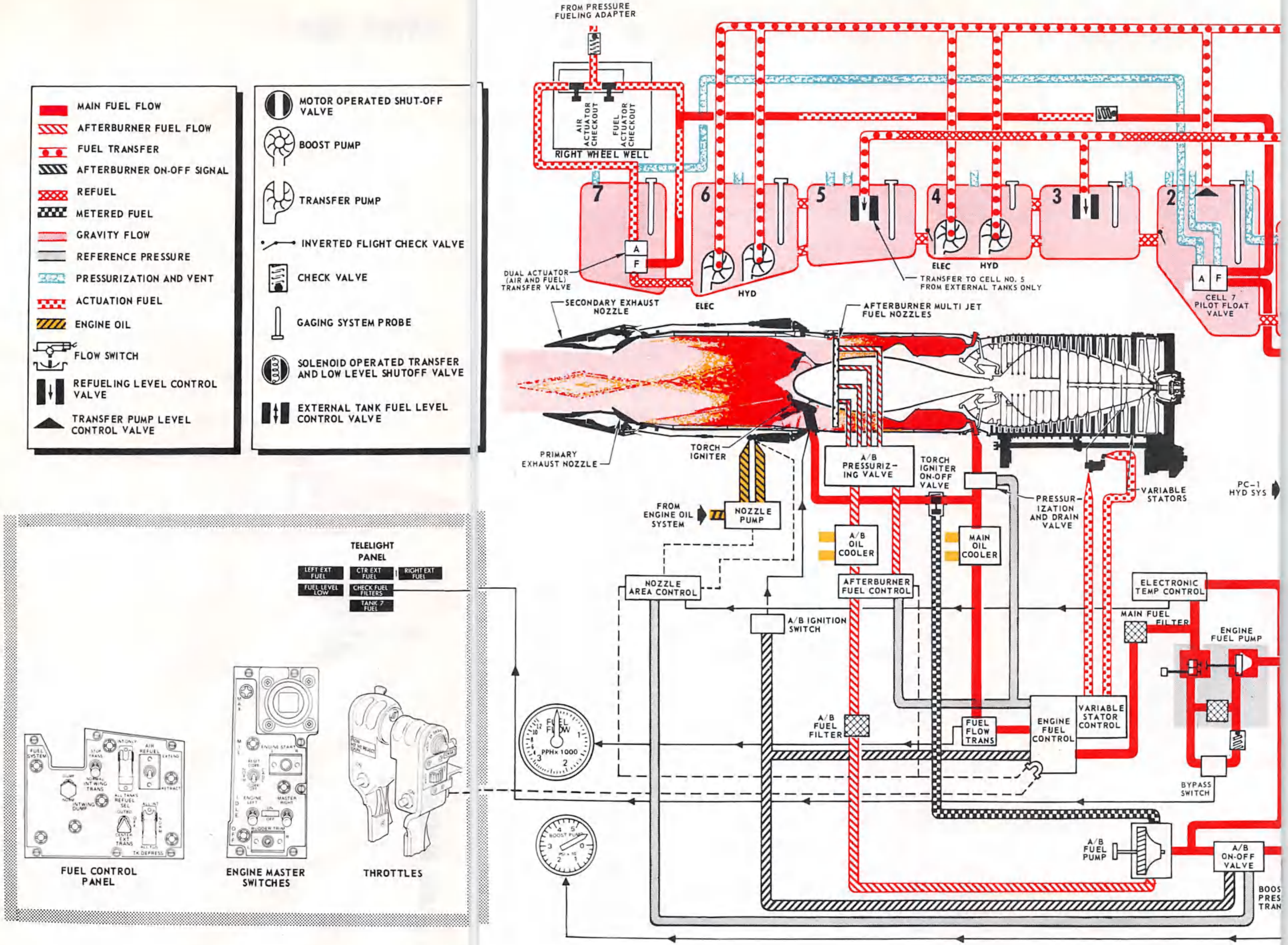
Note

- PRESSURIZATION AND VENT LINES ARE OMITTED FOR SIMPLIFICATION

FUEL SYSTEM

4G-1-(235)
RYB

Figure FO-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
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
TELELIGHT PANEL
LEFT EXT FUEL
CTR EXT FUEL
RIGHT EXT FUEL
FUEL LEVEL LOW
CHECK FUEL FILTERS
TANK 7 FUEL
FUEL SYSTEM
STOP TRANS
INT ONLY
AIR REFUEL
EXTEND
RETRACT
DUMP
NORM
NORMAL INT WING TRANS
INTWING DUMP
ALL TANKS REFUEL SEL
OUTBD
CENTER EXT TRANS
ALL INT
ALL FUS
TK DEPRESS
FUEL CONTROL PANEL
MAX
MIL
IDLE
OFF
ENGINE START
ENGINE LEFT
MASTER RIGHT
ON
OFF
RUDDER TRIM
ENGINE MASTER SWITCHES
THROTTLES
FROM PRESSURE FUELING ADAPTER
AIR ACTUATOR CHECKOUT
FUEL ACTUATOR CHECKOUT
RIGHT WHEEL WELL
7
6
5
4
3
2
A
F
DUAL ACTUATOR (AIR AND FUEL) TRANSFER VALVE
ELEC
HYD
ELEC
HYD
TRANSFER TO CELL NO. 5 FROM EXTERNAL TANKS ONLY
CELL 7 PILOT FLOAT VALVE
SECONDARY EXHAUST NOZZLE
AFTERBURNER MULTI JET FUEL NOZZLES
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A/B PRESSURIZING VALVE
TORCH IGNITER ON-OFF VALVE
PRESSURIZATION AND DRAIN VALVE
VARIABLE STATORS
PC-1 HYD SYS
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
A/B FUEL FILTER
FUEL FLOW TRANS
ENGINE FUEL CONTROL
VARIABLE STATOR CONTROL
BYPASS SWITCH
FUEL FLOW PPH× 1000
BOOST PUMP
A/B FUEL PUMP
A/B ON-OFF VALVE
BOOS
PRES
TRAN

ELECTRICAL SYSTEM

EXTERNAL POWER APPLIED

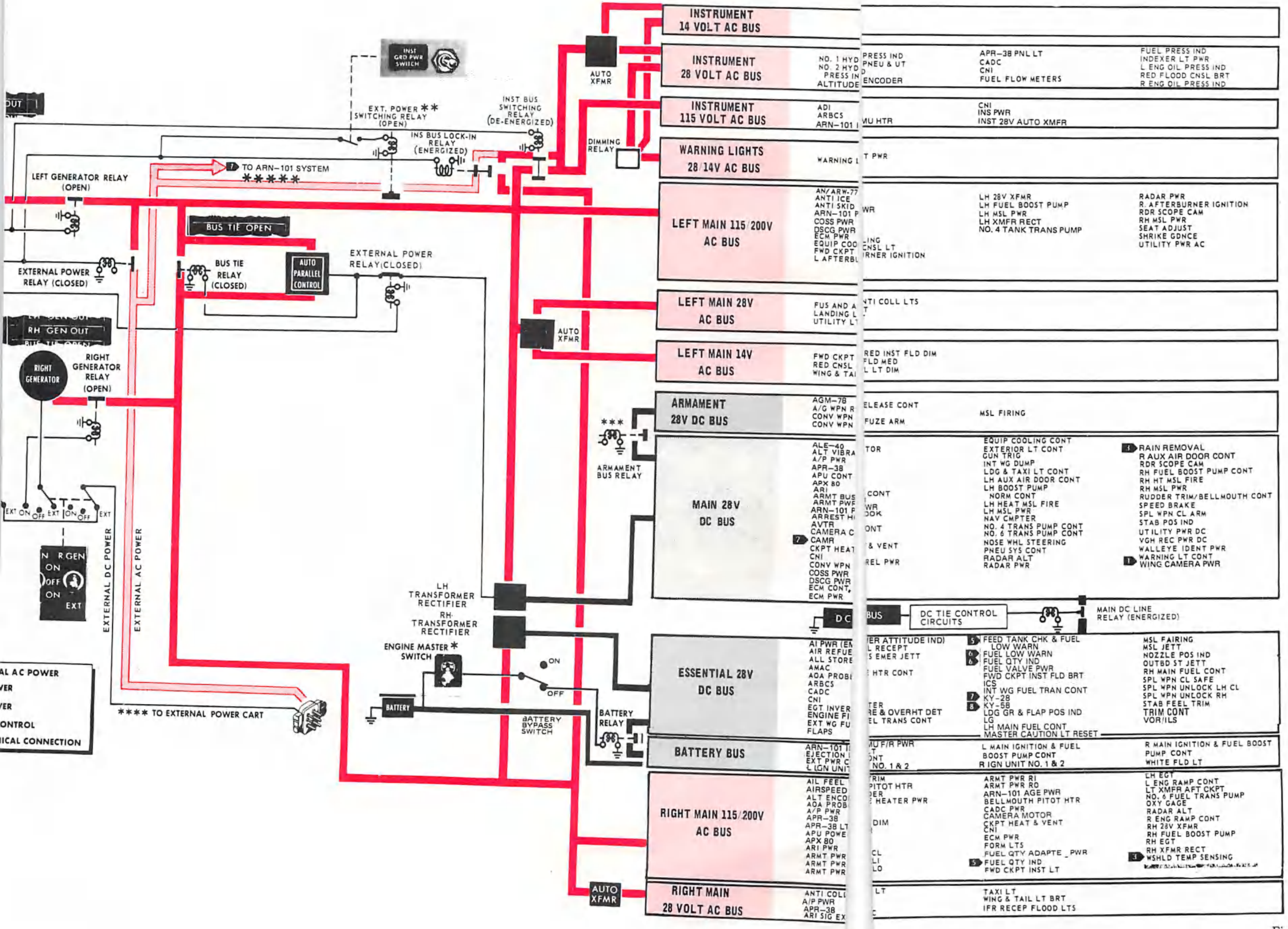


Figure FO-3

Notes

- REFER TO EMERGENCY POWER DISTRIBUTION CHART, SECTION III, FOR OPERATIVE AND INOPERATIVE EQUIPMENT IN THE EVENT OF ELECTRICAL FAILURE.
- NOMENCLATURE CALLOUTS ON THE INDIVIDUAL BUSES ARE CIRCUIT BREAKER NOMENCLATURES. THESE NOMENCLATURES DO NOT NECESSARILY IDENTIFY EACH SYSTEM POWERED BY THE CIRCUIT BREAKERS.

* PROVIDING BATTERY BYPASS SWITCH IS IN OFF, BATTERY RELAY IS ENERGIZED WHEN EITHER ENGINE MASTER SWITCH IS ON OR WHEN THE GROUND REFUELING CONTROL SWITCH IS IN THE REFUEL OR DEFUEL POSITION.

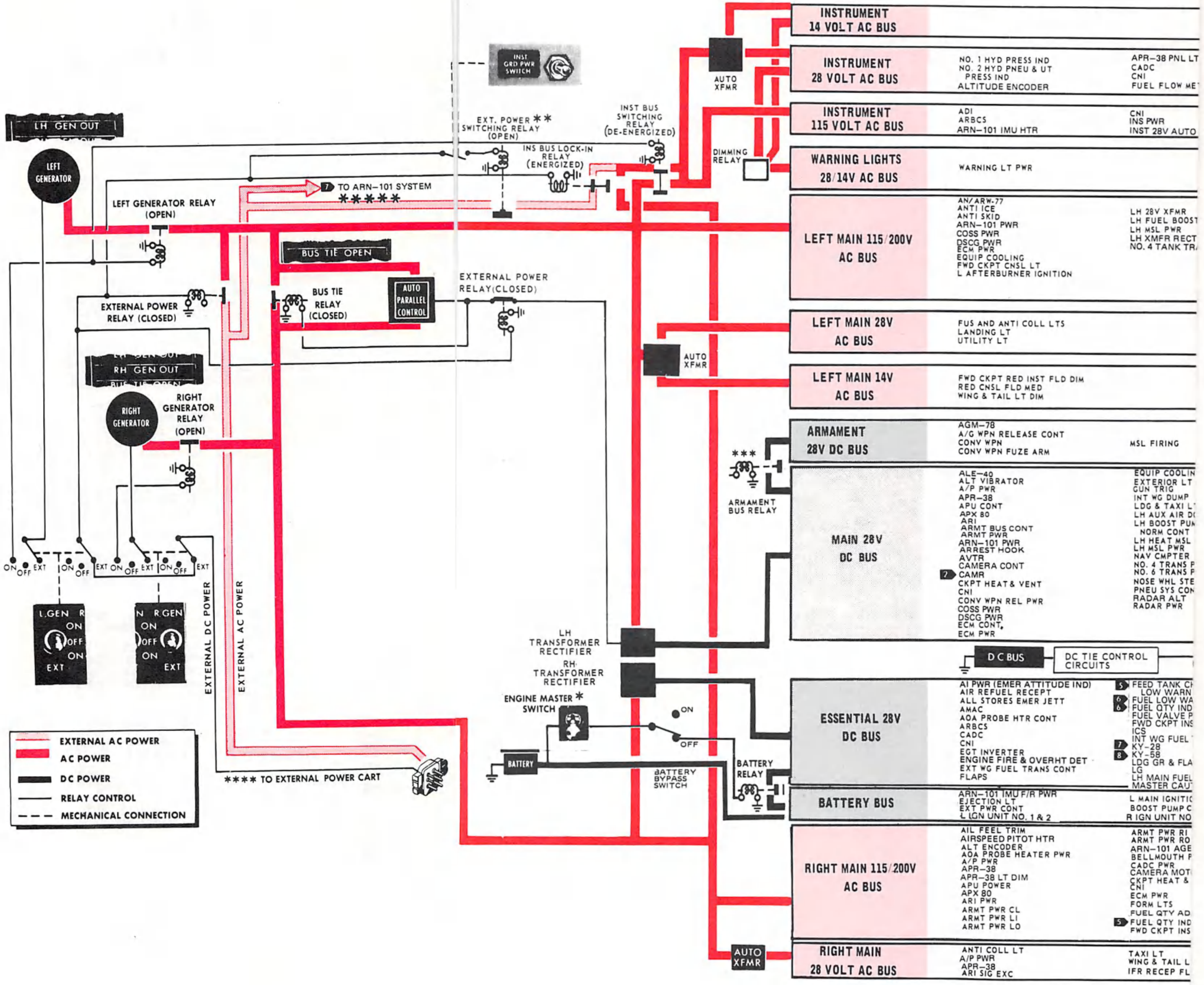
** WITH EXTERNAL POWER APPLIED (NO GENERATORS OPERATING), AND THE INSTRUMENT GROUND POWER SWITCH ACTUATED, THE INSTRUMENT BUSES WILL REMAIN ENERGIZED EVEN IF A GENERATOR CONTROL SWITCH(ES) IS PLACED OUT OF THE EXT POSITION (ALL MAJOR BUSES DE–ENERGIZED). THIS IS DUE TO HOLDING CIRCUITRY (NOT SHOWN) FOR THE EXTERNAL POWER SWITCHING RELAY AND THE INSTRUMENT BUS LOCK–IN RELAY. THE INSTRUMENT BUSES THEN CAN BE DE–ENERGIZED BY PLACING THE INSTRUMENT GROUND POWER SWITCH TO THE DE–ENERGIZED POSITION.

*** ARMAMENT RELAY IS ENERGIZED WHEN THE LANDING GEAR HANDLE IS IN THE UP POSITION OR WHEN THE ARMAMENT SAFETY OVERRIDE SWITCH IS PUSHED TO OVERRIDE.

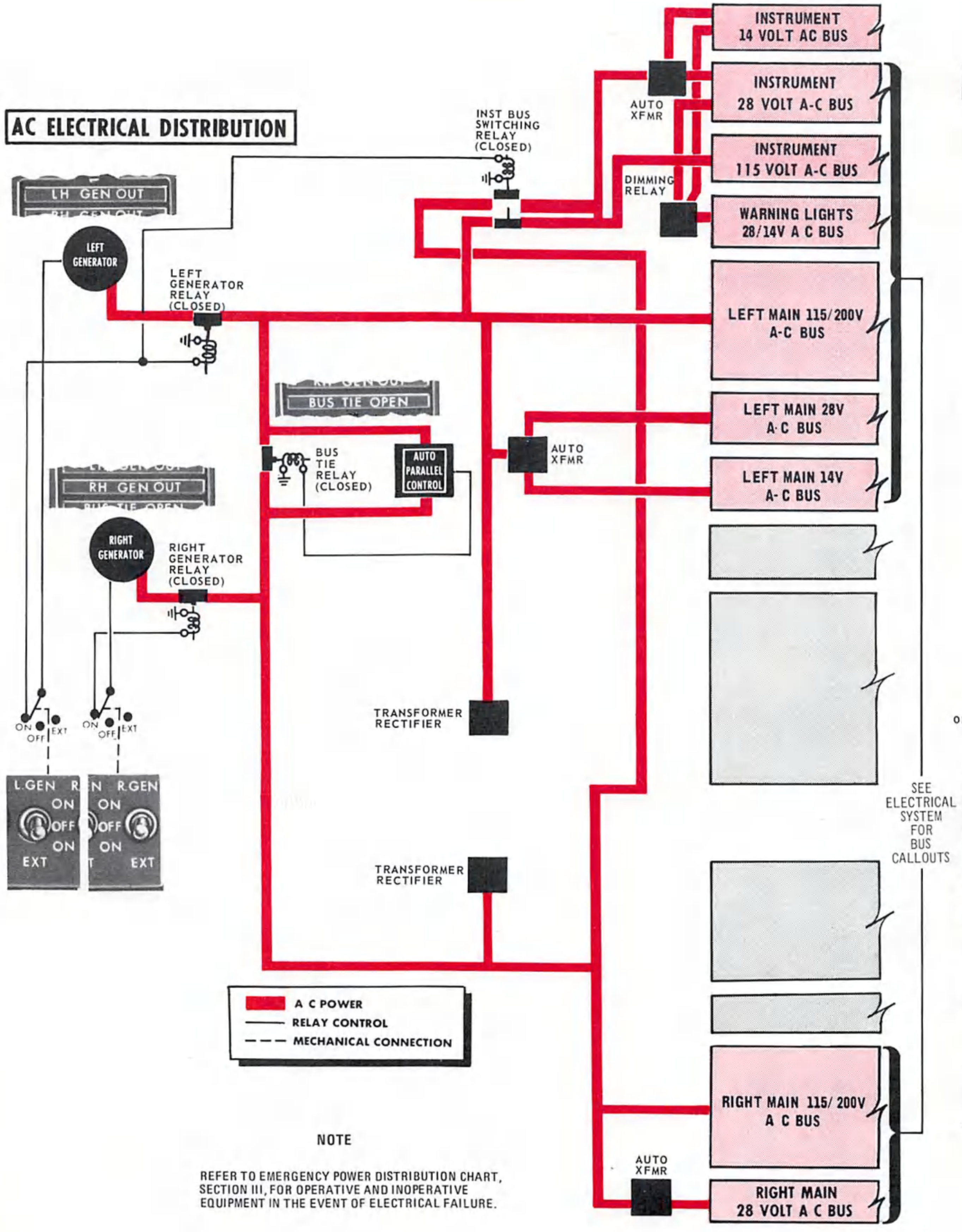
**** DC CONTROL POWER FOR EXTERNAL POWER PROVIDED BY BATTERY BUS.

***** THREE PHASE AC POWER TO ARN–101 SYSTEM PROVIDING EXTERNAL POWER IS APPLIED, GENERATOR SWITCHES IN EXT, AND INS SWITCH IN ANY POSITION EXCEPT OFF OR ATT – POWER WILL REMAIN FOR FOUR SECONDS AFTER GENERATOR SWITCH (ES) IS PLACED OUT OF EXT.

1 AIRCRAFT 69–7579 THRU 69–7588
2 AIRCRAFT 69–236 THRU 69–7578
3 DEACTIVATED AFTER TO 1F–4–1500
4 DELETED
5 BEFORE TO 1F–4–1414
6 AFTER TO 1F–4–1414
7 BEFORE TO 1F–4–1320
8 AFTER TO 1F–4–1320

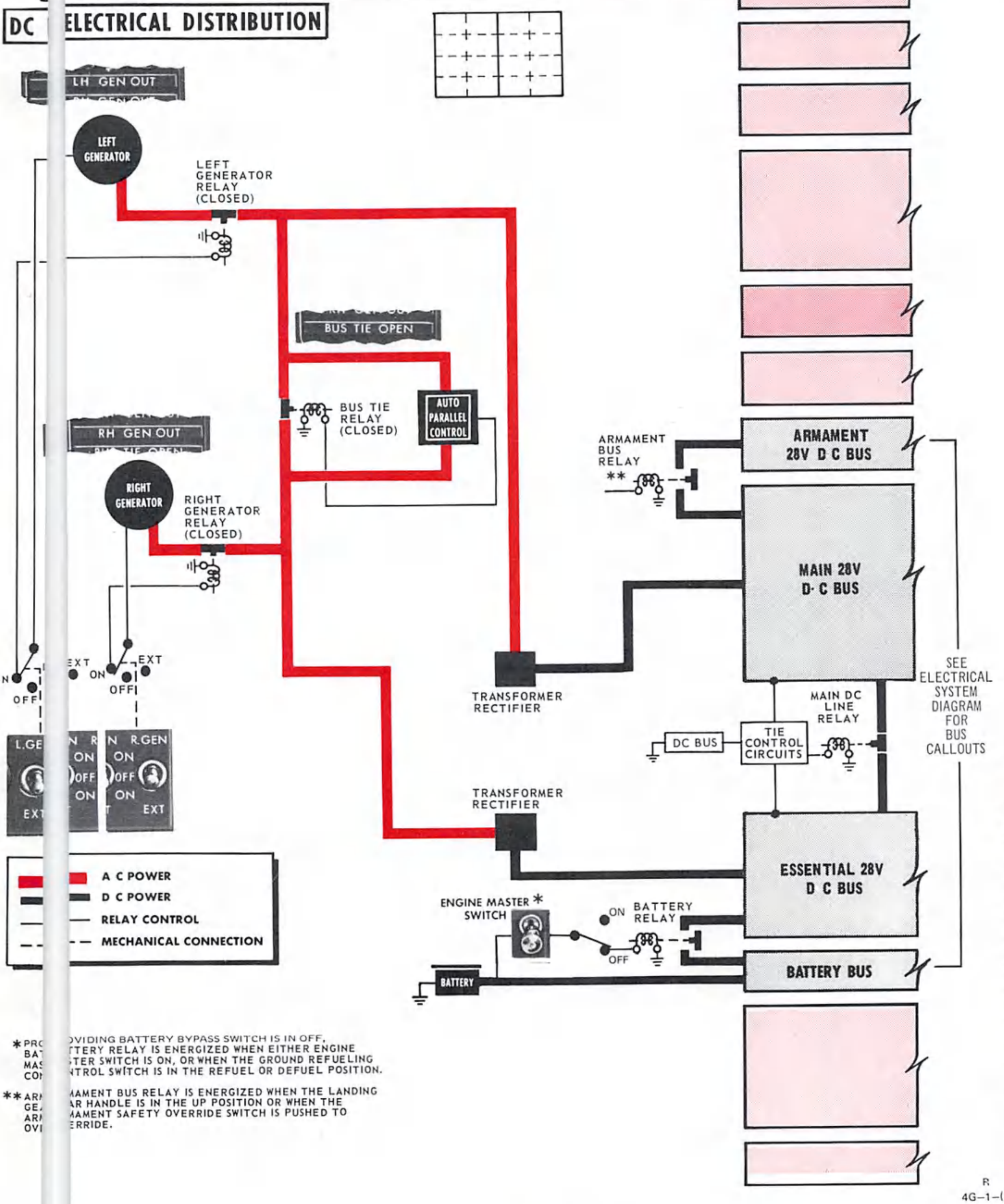

INST GRD PWR SWITCH
LH GEN OUT
LEFT GENERATOR
LEFT GENERATOR RELAY (OPEN)
EXT. POWER ** SWITCHING RELAY (OPEN)
INS BUS LOCK-IN RELAY (ENERGIZED)
INST BUS SWITCHING RELAY (DE-ENERGIZED)
AUTO XFMR
DIMMING RELAY
7 TO ARN-101 SYSTEM *****
BUS TIE OPEN
EXTERNAL POWER RELAY (CLOSED)
BUS TIE RELAY (CLOSED)
AUTO PARALLEL CONTROL
EXTERNAL POWER RELAY(CLOSED)
RH GEN OUT
RIGHT GENERATOR
RIGHT GENERATOR RELAY (OPEN)
ON OFF EXT
ON OFF
EXT ON OFF EXT
ON OFF EXT
L.GEN ON OFF ON EXT
R.GEN ON OFF ON EXT
EXTERNAL DC POWER
EXTERNAL AC POWER
AUTO XFMR
***
ARMAMENT BUS RELAY
LH TRANSFORMER RECTIFIER
RH TRANSFORMER RECTIFIER
ENGINE MASTER SWITCH *
ON
OFF
BATTERY
BATTERY BYPASS SWITCH
BATTERY RELAY
**** TO EXTERNAL POWER CART
AUTO XFMR
EXTERNAL AC POWER
AC POWER
DC POWER
RELAY CONTROL
MECHANICAL CONNECTION
INSTRUMENT 14 VOLT AC BUS
INSTRUMENT 28 VOLT AC BUS
NO. 1 HYD PRESS IND
NO. 2 HYD PNEU & UT PRESS IND
ALTITUDE ENCODER
APR-38 PNL LT
CADC
CNI
FUEL FLOW ME
INSTRUMENT 115 VOLT AC BUS
ADI
ARBCS
ARN-101 IMU HTR
CNI
INS PWR
INST 28V AUTO
WARNING LIGHTS 28/14V AC BUS
WARNING LT PWR
LEFT MAIN 115/200V AC BUS
AN/ARW-77
ANTI ICE
ANTI SKID
ARN-101 PWR
COSS PWR
DSCG PWR
ECM PWR
EQUIP COOLING
FWD CKPT CNSL LT
L AFTERBURNER IGNITION
LH 28V XFMR
LH FUEL BOOST
LH MSL PWR
LH XMFR RECT
NO. 4 TANK TR
LEFT MAIN 28V AC BUS
FUS AND ANTI COLL LTS
LANDING LT
UTILITY LT
LEFT MAIN 14V AC BUS
FWD CKPT RED INST FLD DIM
RED CNSL FLD MED
WING & TAIL LT DIM
ARMAMENT 28V DC BUS
AGM-78
A/G WPN RELEASE CONT
CONV WPN
CONV WPN FUZE ARM
MSL FIRING
MAIN 28V DC BUS
ALE-40
ALT VIBRATOR
A/P PWR
APR-38
APU CONT
APX 80
ARI
ARMT BUS CONT
ARMT PWR
ARN-101 PWR
ARREST HOOK
AVTR
CAMERA CONT
7 CAMR
CKPT HEAT & VENT
CNI
CONV WPN REL PWR
COSS PWR
DSCG PWR
ECM CONT.
ECM PWR
EQUIP COOLIN
EXTERIOR LT
GUN TRIG
INT WG DUMP
LDG & TAXI L
LH AUX AIR D
LH BOOST PU
NORM CONT
LH HEAT MSL
LH MSL PWR
NAV CMPTER
NO. 4 TRANS P
NO. 6 TRANS P
NOSE WHL STE
PNEU SYS CON
RADAR ALT
RADAR PWR
D C BUS
DC TIE CONTROL CIRCUITS
ESSENTIAL 28V DC BUS
AI PWR (EMER ATTITUDE IND)
AIR REFUEL RECEPT
ALL STORES EMER JETT
AMAC
AOA PROBE HTR CONT
ARBCS
CADC
CNI
EGT INVERTER
ENGINE FIRE & OVERHT DET
EXT WG FUEL TRANS CONT
FLAPS
5 FEED TANK C
LOW WARN
6 FUEL LOW WA
6 FUEL QTY IND
FUEL VALVE P
FWD CKPT INS
ICS
INT WG FUEL
7 KY-28
8 KY-58
LDG GR & FLA
LG
LH MAIN FUEL
MASTER CAU
BATTERY BUS
ARN-101 IMU F/R PWR
EJECTION LT
EXT PWR CONT
L IGN UNIT NO. 1 & 2
L MAIN IGNITI
BOOST PUMP C
R IGN UNIT NO
RIGHT MAIN 115/200V AC BUS
AIL FEEL TRIM
AIRSPEED PITOT HTR
ALT ENCODER
AOA PROBE HEATER PWR
A/P PWR
APR-38
APR-38 LT DIM
APU POWER
APX 80
ARI PWR
ARMT PWR CL
ARMT PWR LI
ARMT PWR LO
ARMT PWR RI
ARMT PWR RO
ARN-101 AGE
BELLMOUTH
CADC PWR
CAMERA MOT
CKPT HEAT &
CNI
ECM PWR
FORM LTS
FUEL QTY AD
5 FUEL QTY IND
FWD CKPT INS
RIGHT MAIN 28 VOLT AC BUS
ANTI COLL LT
A/P PWR
APR-38
ARI SIG EXC
TAXI LT
WING & TAIL L
IFR RECEP FL

AC & DC ELECTRICAL DISTRIBUTION



NOTE

REFER TO EMERGENCY POWER DISTRIBUTION CHART, SECTION III, FOR OPERATIVE AND INOPERATIVE EQUIPMENT IN THE EVENT OF ELECTRICAL FAILURE.



*PRO VIDING BATTERY BYPASS SWITCH IS IN OFF,
BAT TERY RELAY IS ENERGIZED WHEN EITHER ENGINE
MAS TER SWITCH IS ON, OR WHEN THE GROUND REFUELING
CON TROL SWITCH IS IN THE REFUEL OR DEFUEL POSITION.

**ARM AMENT BUS RELAY IS ENERGIZED WHEN THE LANDING
GEA AR HANDLE IS IN THE UP POSITION OR WHEN THE
ARM AMENT SAFETY OVERRIDE SWITCH IS PUSHED TO
OV ERRIDE.

AC/DC ELECTRICAL DISTRIBUTION

R
4G-1-(249)

Figure FO-4

HYDRAULIC SYSTEMS

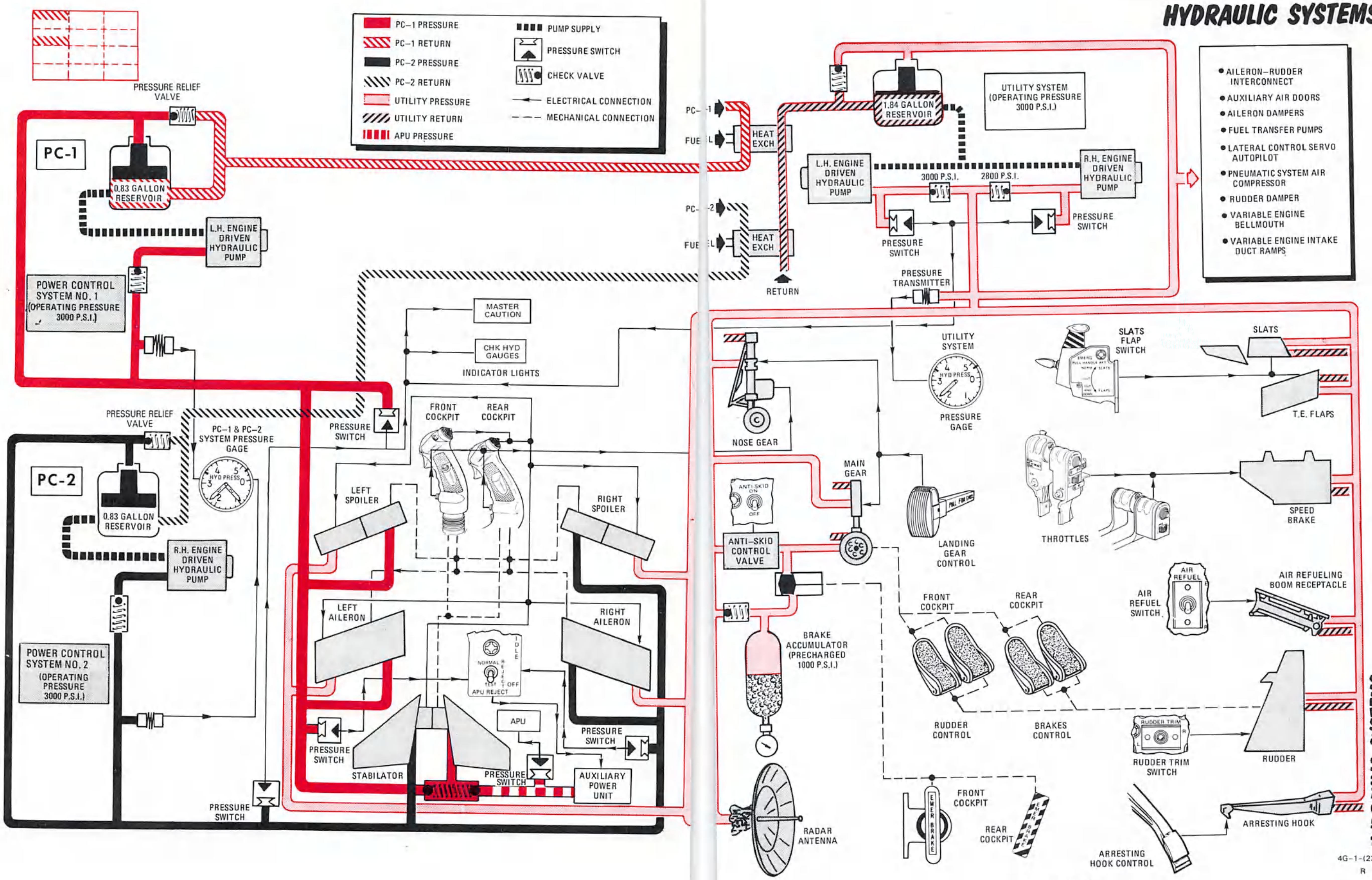
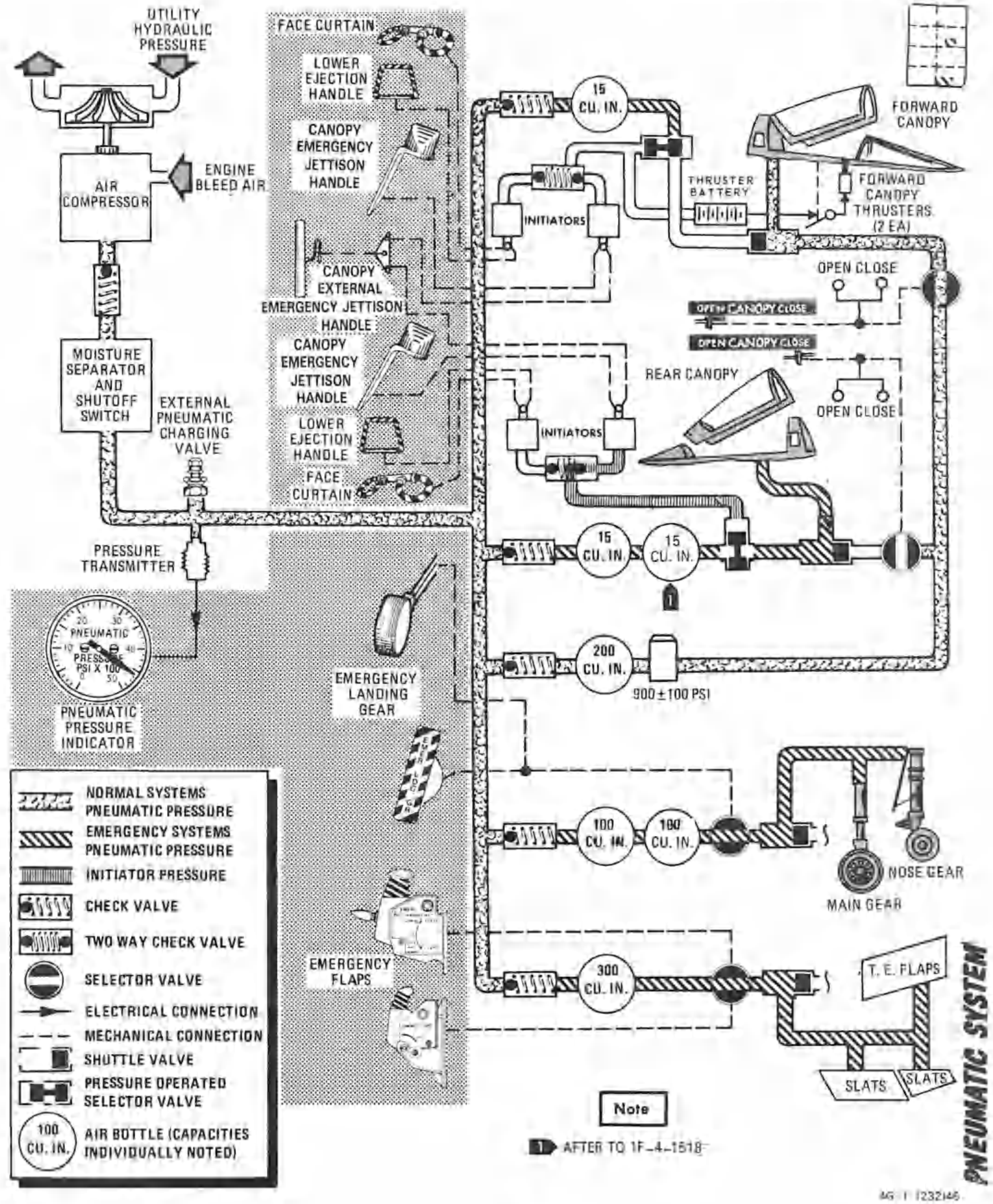


Figure FO–5

PNEUMATIC SYSTEM



Note

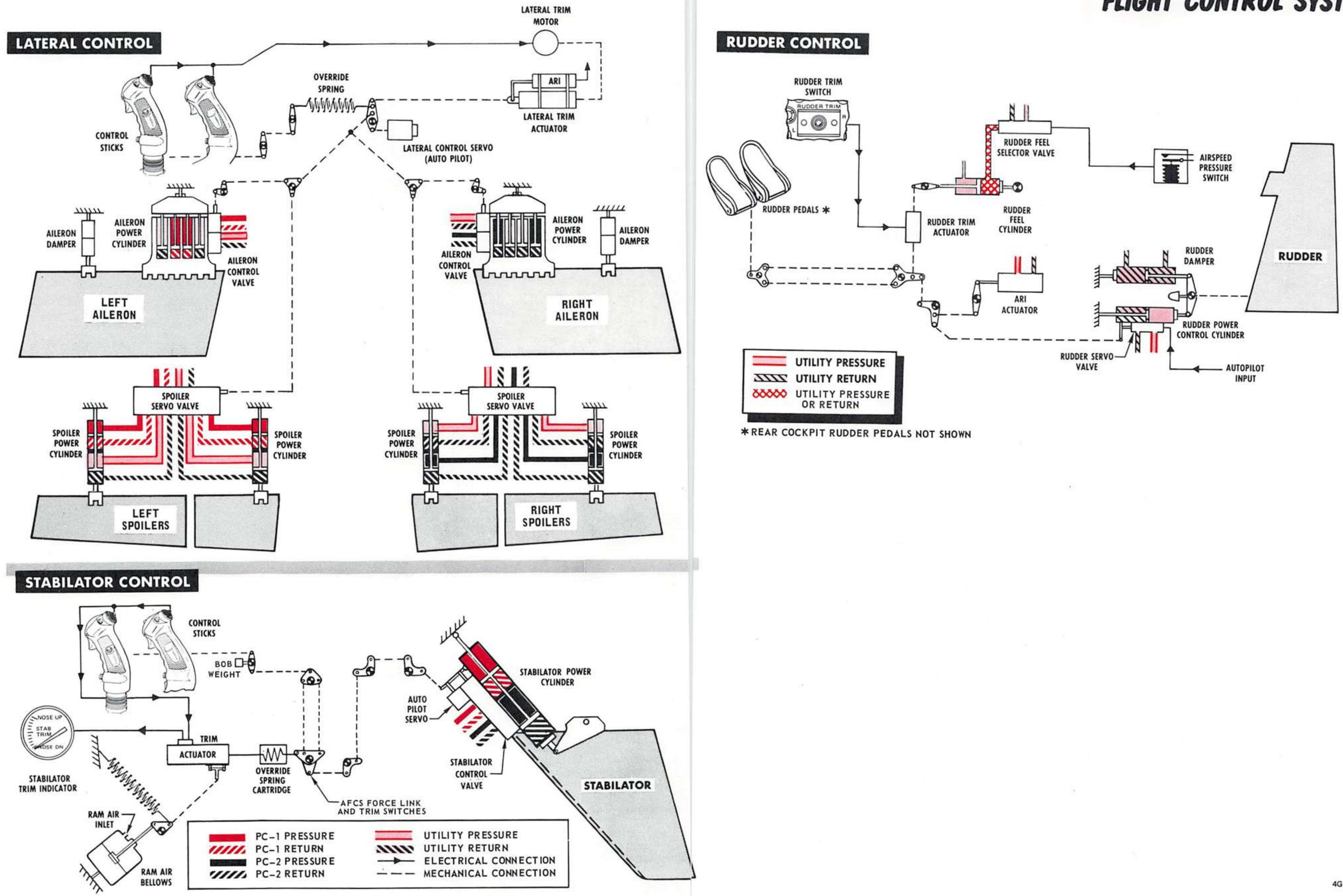
1 AFTER TO 1F-4-1518

4G-1-1232146

PNEUMATIC SYSTEM

Figure FO-6

FLIGHT CONTROL SYSTEMS



4G–1–(231)
R

Figure FO-7

EJECTION SEAT

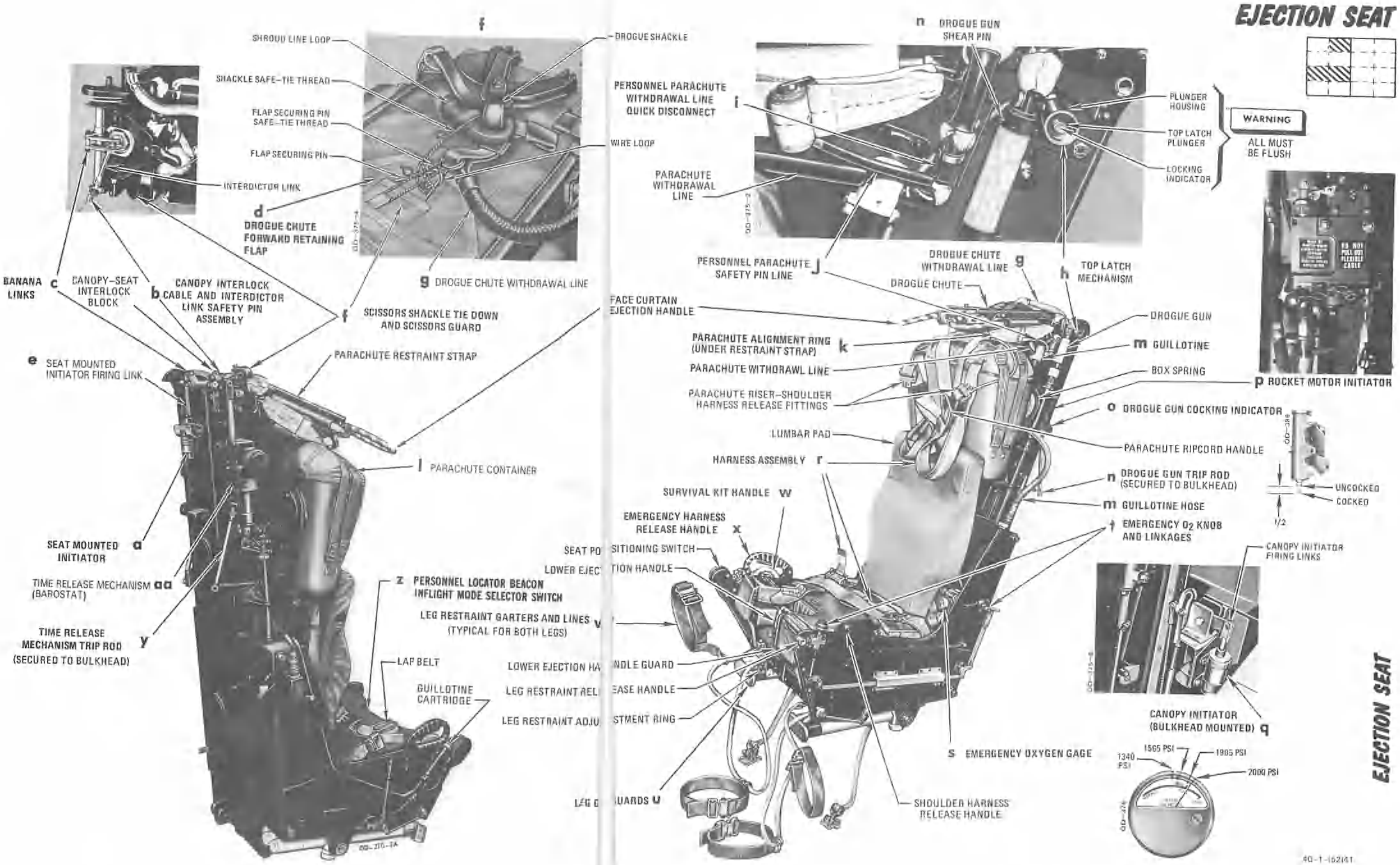


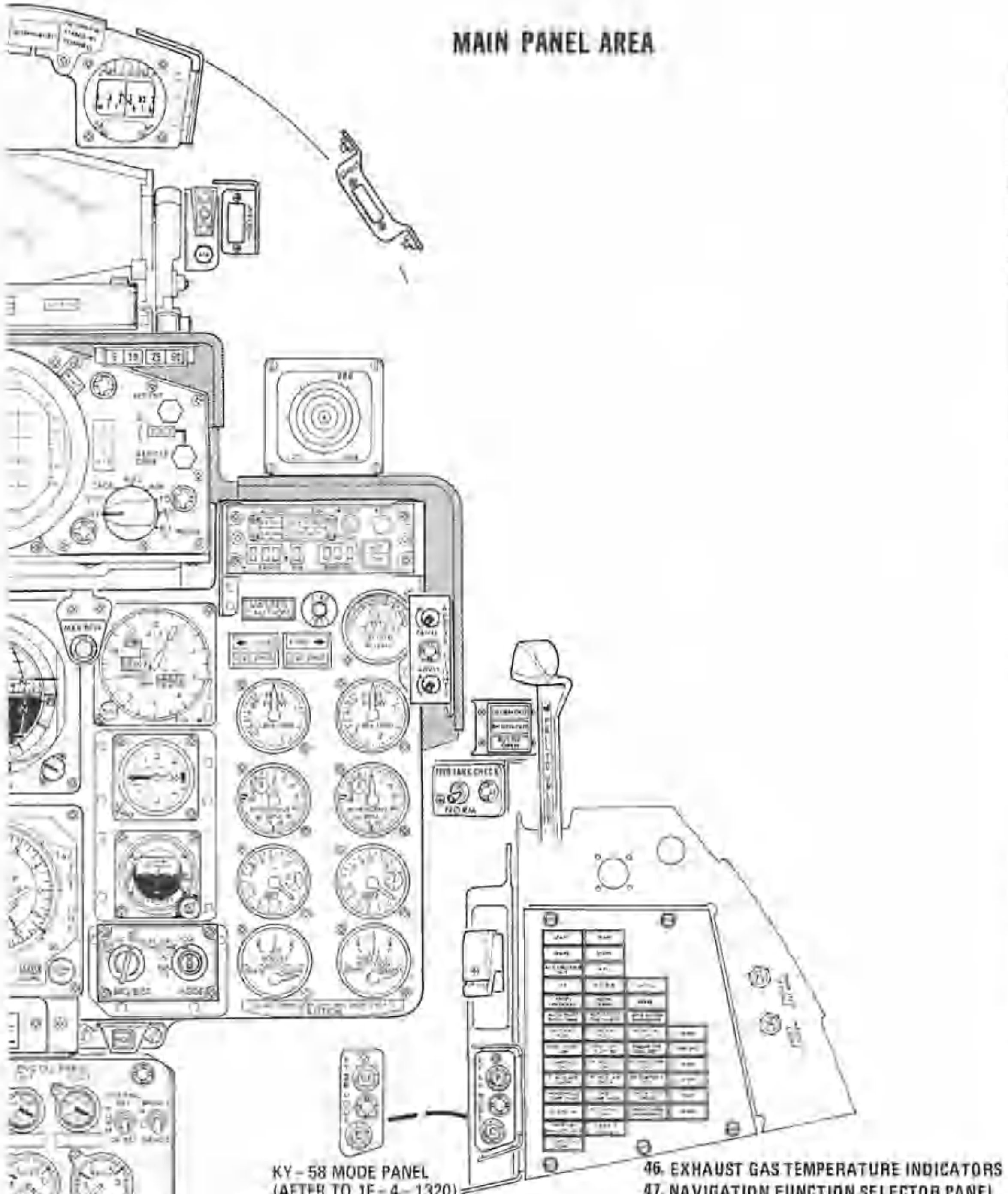
Figure FO-8

FRONT COCKPIT

TYPICAL

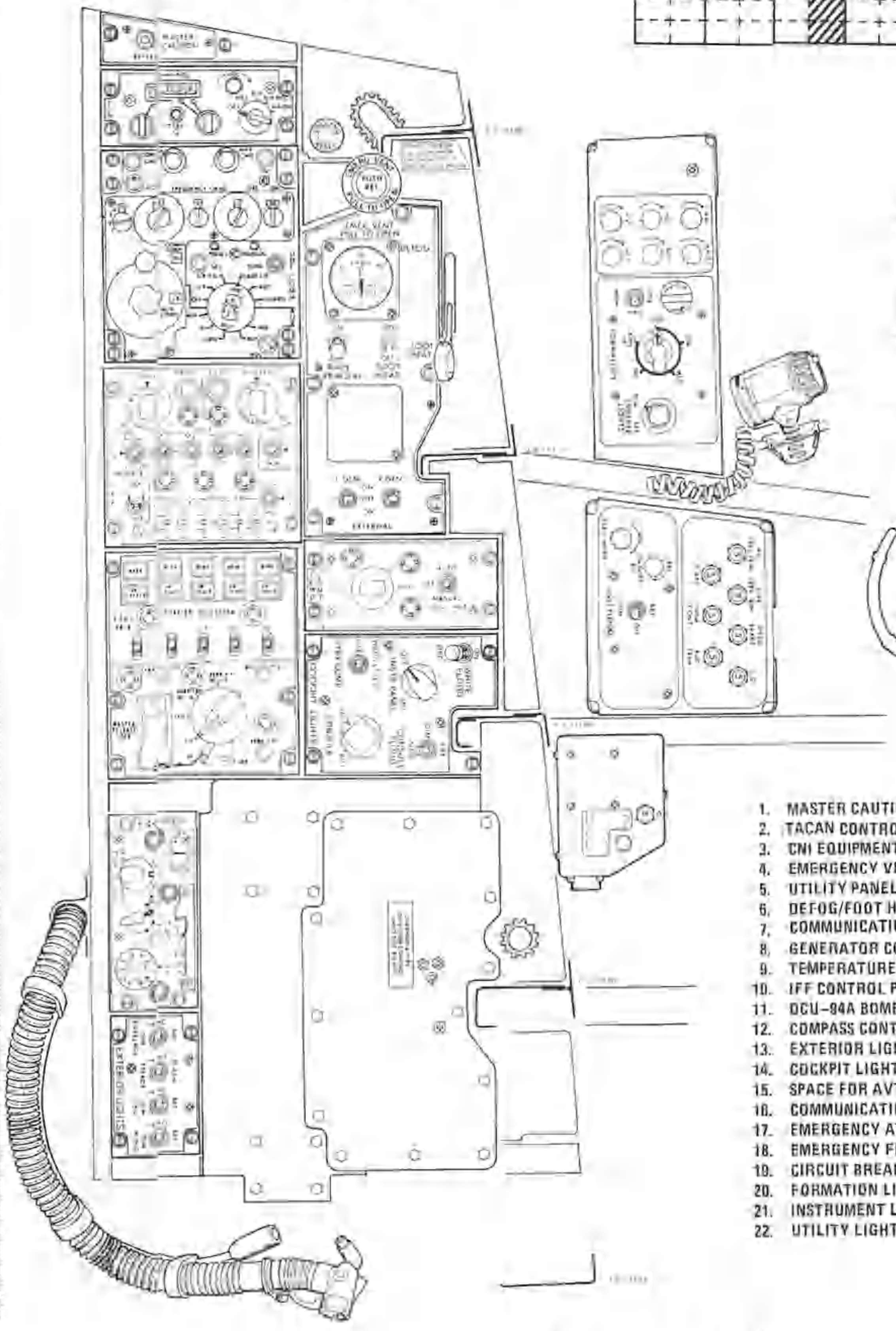
WITHOUT DMAS

MAIN PANEL AREA



32. LEFT SUB PANEL
33. EMERGENCY BRAKE CONTROL HANDLE
34. LANDING GEAR CONTROL HANDLE
35. RECORDER LIGHT
36. AUTOMATIC WEAPONS RELEASE UNIT
37. MULTIPLE WEAPONS SELECTOR PANEL
38. ANGLE OF ATTACK INDICATOR
39. HORIZONTAL SITUATION INDICATOR
40. VERTICAL VELOCITY INDICATOR
41. FUEL FLOW INDICATORS
42. GENERATOR INDICATOR LIGHTS
43. TACHOMETERS
44. FEED TANK CHECK SWITCH
45. EMERGENCY ATTITUDE INDICATOR
46. EXHAUST GAS TEMPERATURE INDICATORS
47. NAVIGATION FUNCTION SELECTOR PANEL
48. EXHAUST NOZZLE POSITION INDICATORS
49. ARRESTING HOOK CONTROL HANDLE
50. RIGHT SUB PANEL
51. PRIMARY INSTRUMENT & MODE LIGHTS CONTROL CIRCUIT BREAKERS
52. KY-28 MODE LIGHTS
53. SLIP INDICATOR
54. VOR MODE LIGHT
55. ACCELEROMETER
56. OIL PRESSURE INDICATORS
57. HYDRAULIC PRESSURE INDICATORS
58. PEDESTAL PANEL
59. RUDDER PEDAL ADJUSTMENT CRANK
60. PNEUMATIC PRESSURE INDICATOR

RIGHT CONSOLE AREA



1. MASTER CAUTION RE-SET
2. TACAN CONTROL PANEL
3. CNI EQUIPMENT COOLING RESET BUTTON
4. EMERGENCY VENT HANDLE
5. UTILITY PANEL (RIGHT)
6. DEFOG/FOOT HEAT CONTROL HANDLE
7. COMMUNICATION CONTROL PANEL
8. GENERATOR CONTROL SWITCHES
9. TEMPERATURE CONTROL PANEL
10. IFF CONTROL PANEL
11. DCU-94A BOMB CONTROL-MONITOR PANEL
12. COMPASS CONTROL PANEL
13. EXTERIOR LIGHTS CONTROL PANEL
14. COCKPIT LIGHTS CONTROL PANEL
15. SPACE FOR AVTR
16. COMMUNICATION/OXYGEN LEADS
17. EMERGENCY ATTITUDE LIGHT CONTROL PANEL
18. EMERGENCY FLOODLIGHTS PANEL
19. CIRCUIT BREAKER PANEL
20. FORMATION LIGHTS CONTROL PANEL
21. INSTRUMENT LIGHTS INTENSITY CONTROL PANEL
22. UTILITY LIGHT

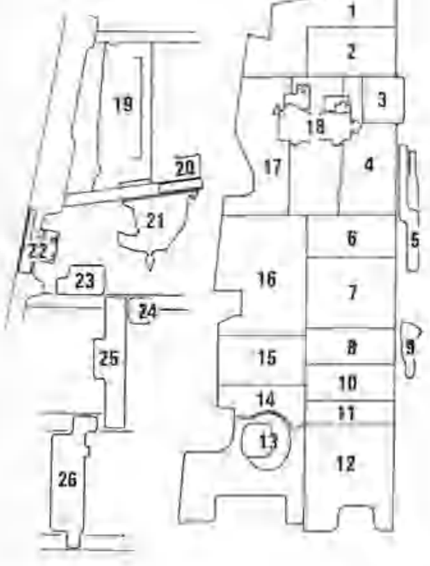
FRONT COCKPIT

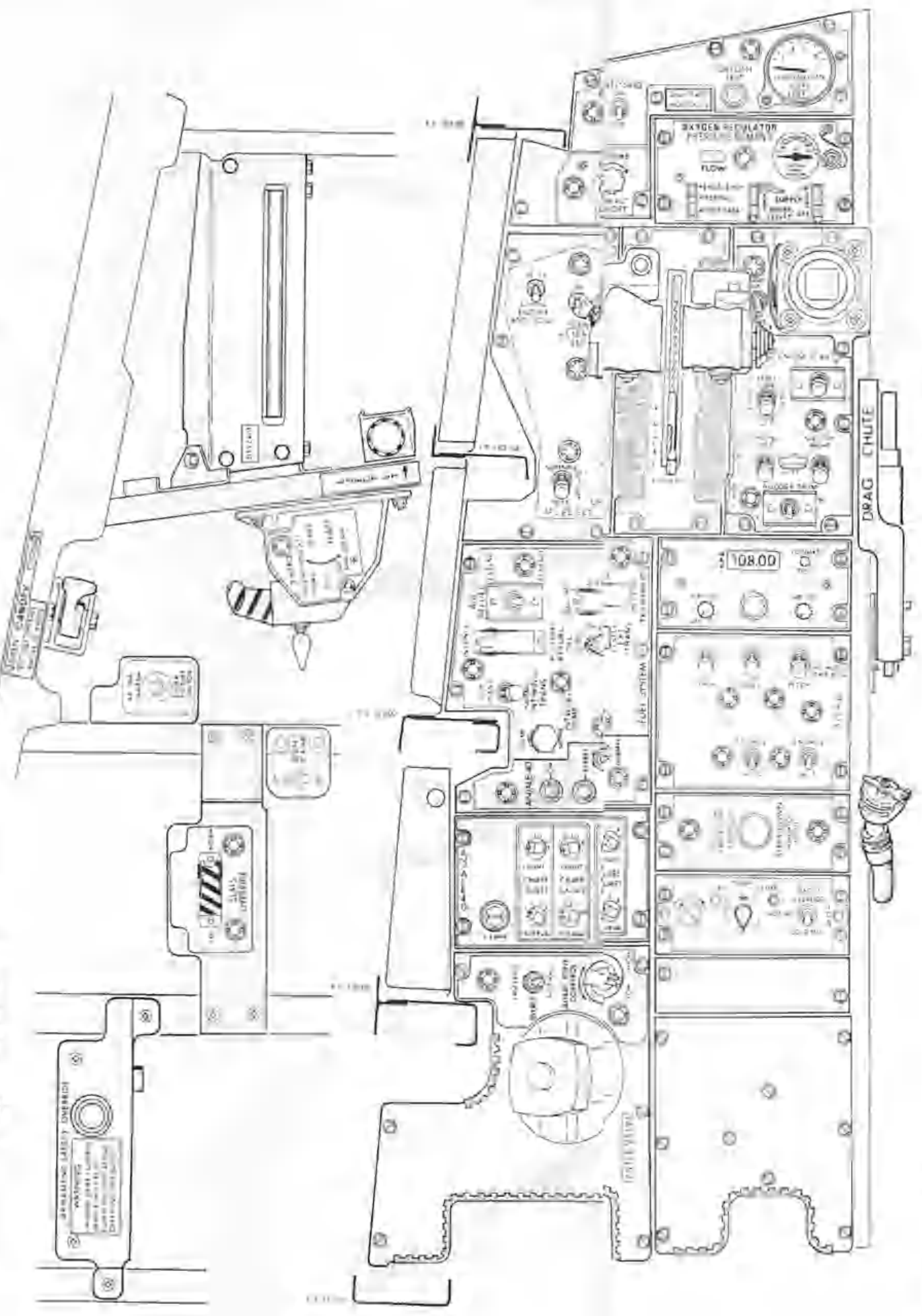
4G-1-3120-1H

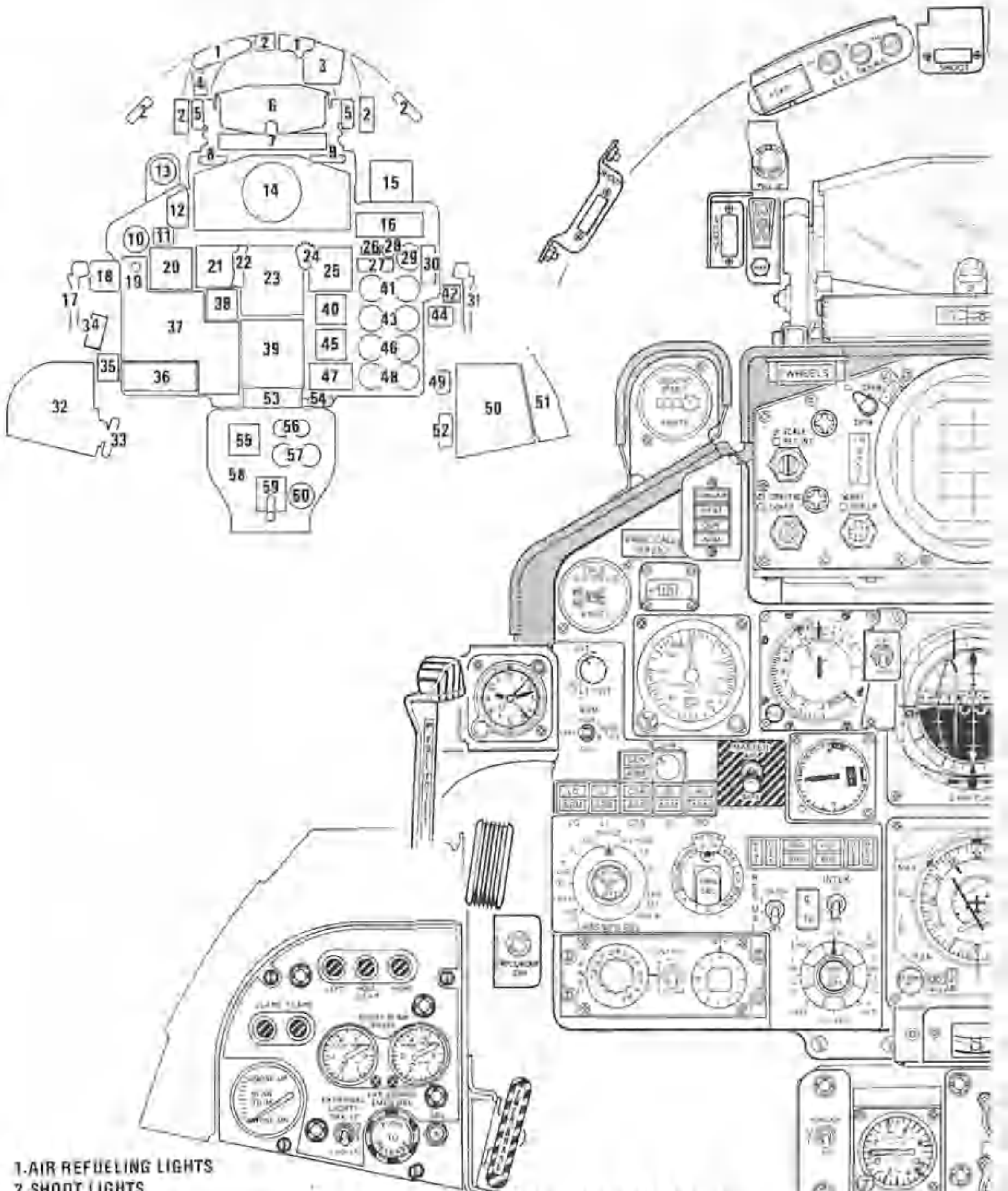
Figure FO-9 (Sheet 1 of 2)

LEFT CONSOLE AREA

1. UTILITY PANEL (LEFT)
2. OXYGEN CONTROL PANEL
3. AGM CONTROL HANDLE
4. ENGINE CONTROL PANEL (INBOARD)
5. DRAG CHUTE CONTROL HANDLE
6. VOR/ILS CONTROL PANEL
7. AUTOMATIC FLIGHT CONTROL SYSTEM CONTROL PANEL
8. BOARDING STEPS POSITION INDICATOR
9. ANTI-G SUIT HOSE
10. INTERCOM SYSTEM CONTROL PANEL
11. BLANK PANEL
12. BLANK PANEL
13. ANTI-G SUIT CONTROL VALVE
14. AURAL TONE & GYRO FAST ERECT PANEL
15. AN/ALE-40 PROGRAMMER
16. FUEL CONTROL PANEL
17. ENGINE CONTROL PANEL (OUTBOARD)
18. THROTTLES
19. ELEVATION CAGE TOUCH BAR
20. EJECT LIGHT/SWITCH
21. SLATS FLAPS CONTROL PANEL
22. CANOPY SELECTOR
23. EXTRA PICTURE SWITCH
24. GUN CAMERA SWITCH
25. SLATS OVERRIDE SWITCH
26. ARMAMENT SAFETY OVERRIDE SWITCH

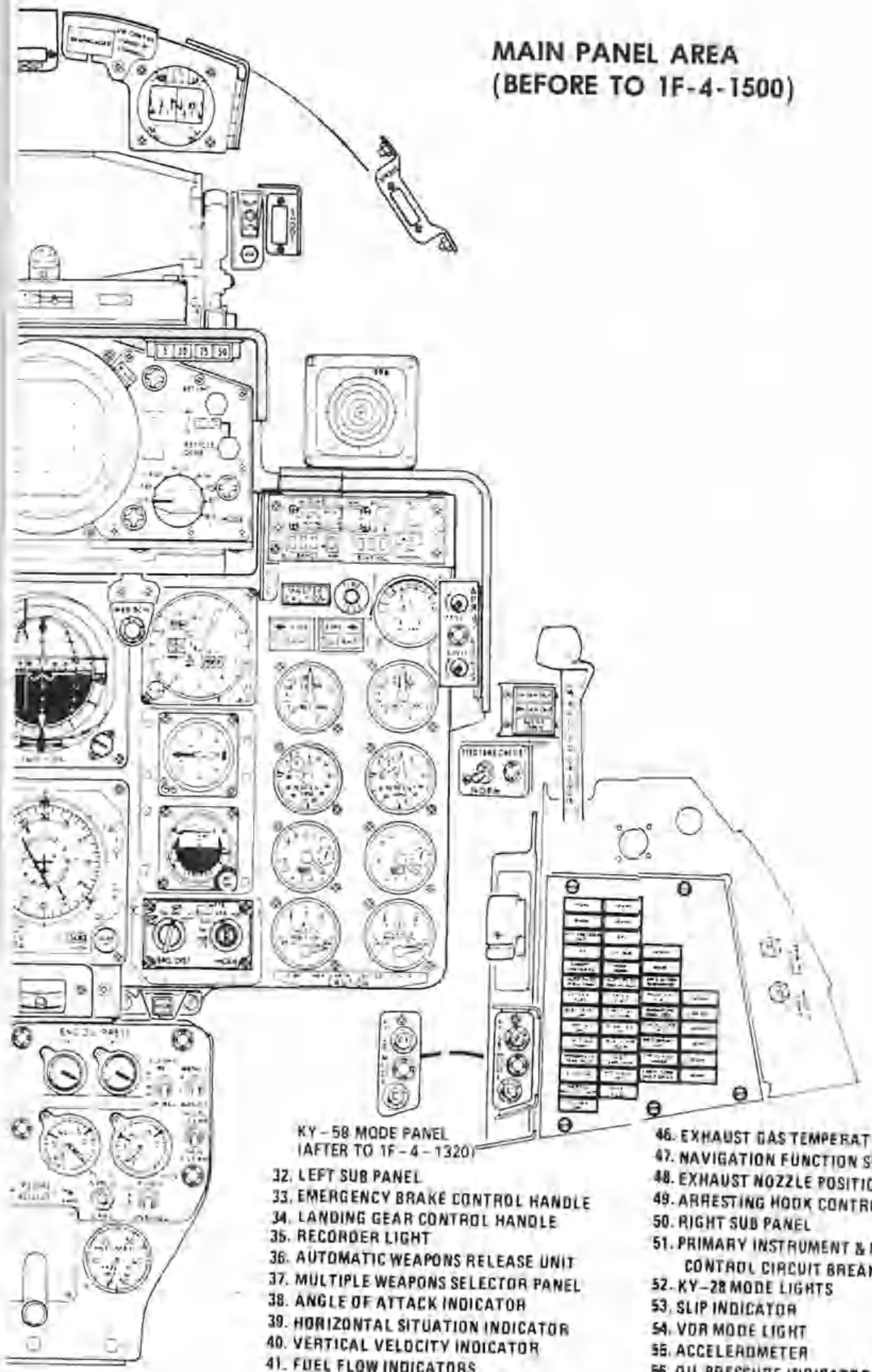






1. AIR REFUELING LIGHTS
2. SHOOT LIGHTS
3. STANDBY MAGNETIC COMPASS
4. LABS PULL-UP LIGHT
5. ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
6. OPTICAL SIGHT UNIT
7. OPTICAL SIGHT CAMERA
8. LANDING GEAR WARNING LIGHT
9. RANGE LIGHTS PANEL
10. TRUE AIRSPEED INDICATOR
11. UHF REMOTE CHANNEL INDICATOR
12. HEAD-UP DISPLAY (HUD)
13. GROUND SPEED INDICATOR
14. RADAR SCOPE
15. PLAN POSITION INDICATOR
16. WARNING PANEL
17. CANOPY EMERGENCY JETTISON HANDLE
18. EIGHT DAY CLOCK
19. FLIGHT INSTRUMENT LIGHTS CONTROL
20. RADAR ALTIMETER
21. AIRSPEED MACH INDICATOR
22. REFERENCE SELECTOR SWITCH
23. ATTITUDE DIRECTOR INDICATOR
24. MARKER BEACON LIGHT
25. ALTIMETER
26. MASTER CAUTION LIGHT
27. FIRE-OVERHEAT WARNING LIGHTS
28. FIRE DETECTOR CHECK BUTTON
29. INTERNAL FUEL QUANTITY INDICATOR
30. APR 38 LIGHTS CONTROL PANEL
31. CANOPY MANUAL UNLOCK HANDLE

MAIN PANEL AREA (BEFORE TO 1F-4-1500)

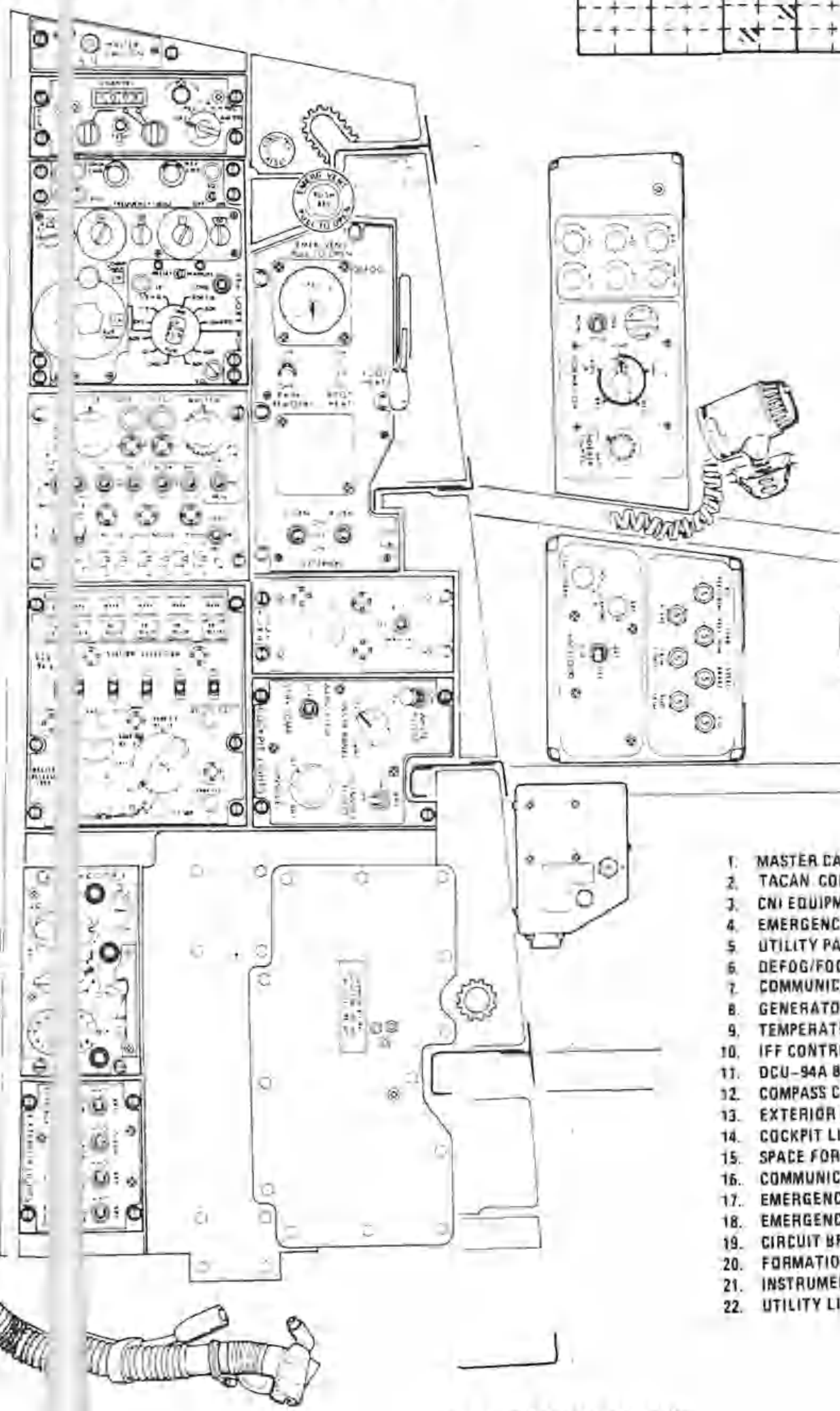


32. LEFT SUB PANEL
33. EMERGENCY BRAKE CONTROL HANDLE
34. LANDING GEAR CONTROL HANDLE
35. RECORDER LIGHT
36. AUTOMATIC WEAPONS RELEASE UNIT
37. MULTIPLE WEAPONS SELECTOR PANEL
38. ANGLE OF ATTACK INDICATOR
39. HORIZONTAL SITUATION INDICATOR
40. VERTICAL VELOCITY INDICATOR
41. FUEL FLOW INDICATORS
42. GENERATOR INDICATOR LIGHTS
43. TACHOMETERS
44. FEED TANK CHECK SWITCH
45. EMERGENCY ATTITUDE INDICATOR
46. EXHAUST GAS TEMPERATURE INDICATORS
47. NAVIGATION FUNCTION SELECTOR PANEL
48. EXHAUST NOZZLE POSITION INDICATORS
49. ARRESTING HOOK CONTROL HANDLE
50. RIGHT SUB PANEL
51. PRIMARY INSTRUMENT & MODE LIGHTS CONTROL CIRCUIT BREAKERS
52. KY–28 MODE LIGHTS
53. SLIP INDICATOR
54. VOR MODE LIGHT
55. ACCELEROMETER
56. OIL PRESSURE INDICATORS
57. HYDRAULIC PRESSURE INDICATORS
58. PEDESTAL PANEL
59. RUDDER PEDAL ADJUSTMENT CRANK
60. PNEUMATIC PRESSURE INDICATOR

RIGHT CONSOLE AREA

FRONT COCKPIT

TYPICAL



1. MASTER CAUTION RE–SET
2. TACAN CONTROL PANEL
3. CNI EQUIPMENT COOLING RESET BUTTON
4. EMERGENCY VENT HANDLE
5. UTILITY PANEL (RIGHT)
6. DEFOG/FOOT HEAT CONTROL HANDLE
7. COMMUNICATION CONTROL PANEL
8. GENERATOR CONTROL SWITCHES
9. TEMPERATURE CONTROL PANEL
10. IFF CONTROL PANEL
11. DCU–94A BOMB CONTROL–MONITOR PANEL
12. COMPASS CONTROL PANEL
13. EXTERIOR LIGHTS CONTROL PANEL
14. COCKPIT LIGHTS CONTROL PANEL
15. SPACE FOR AVTR
16. COMMUNICATION/OXYGEN LEADS
17. EMERGENCY ATTITUDE LIGHT CONTROL PANEL
18. EMERGENCY FLOODLIGHTS PANEL
19. CIRCUIT BREAKER PANEL
20. FORMATION LIGHTS CONTROL PANEL
21. INSTRUMENT LIGHTS INTENSITY CONTROL PANEL
22. UTILITY LIGHT

FRONT COCKPIT

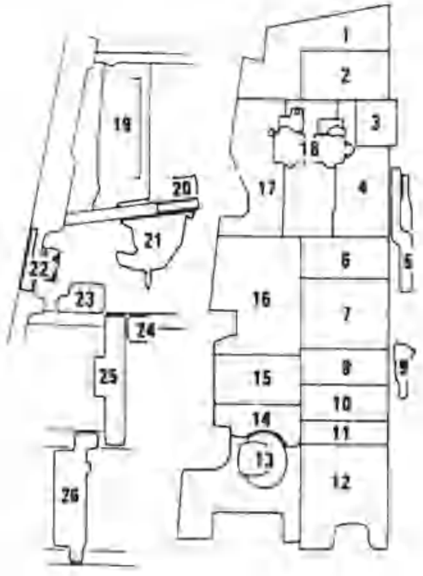
4G-1-1120-146

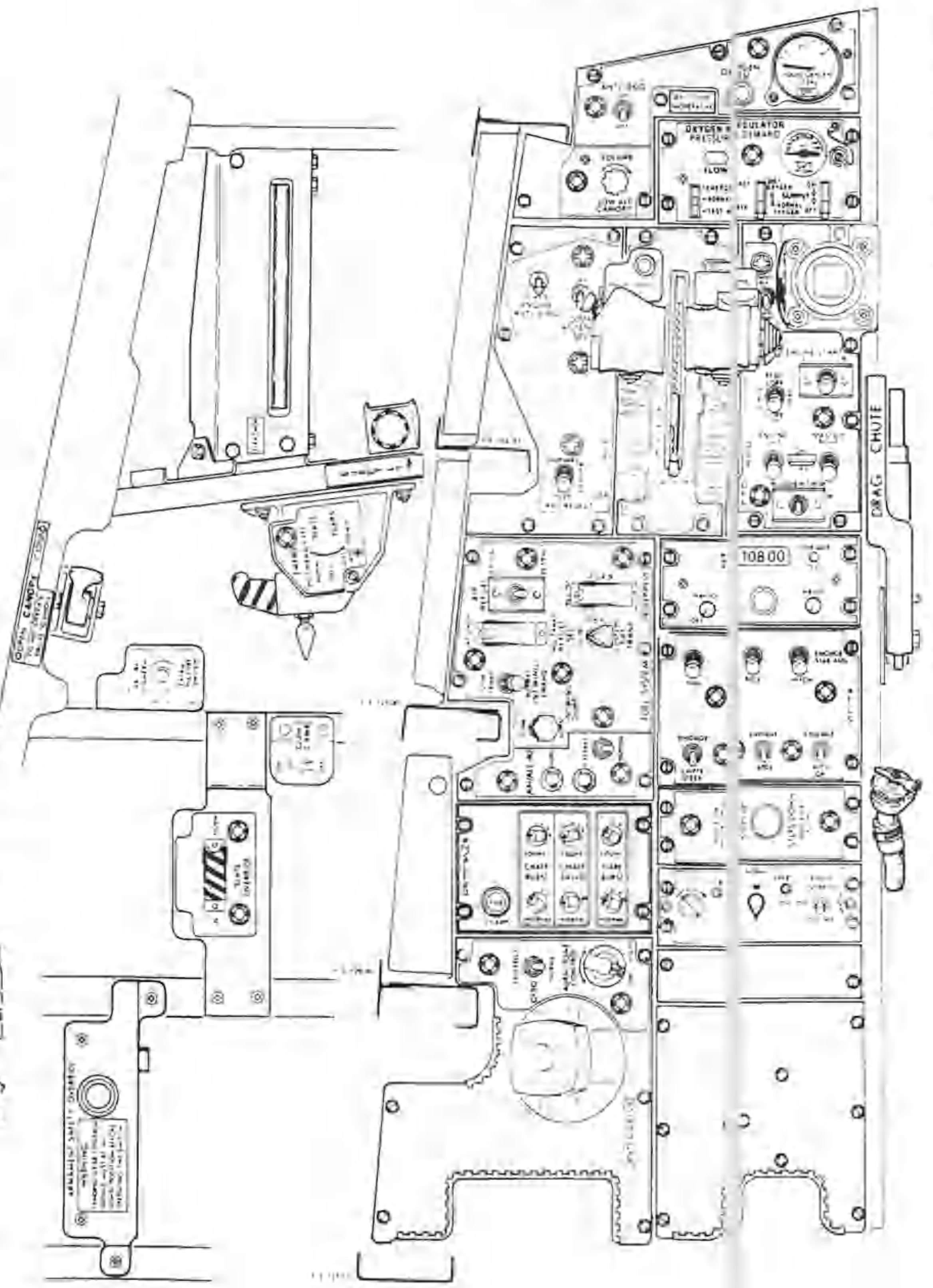
Figure FO-9 (Sheet 1 of 2)

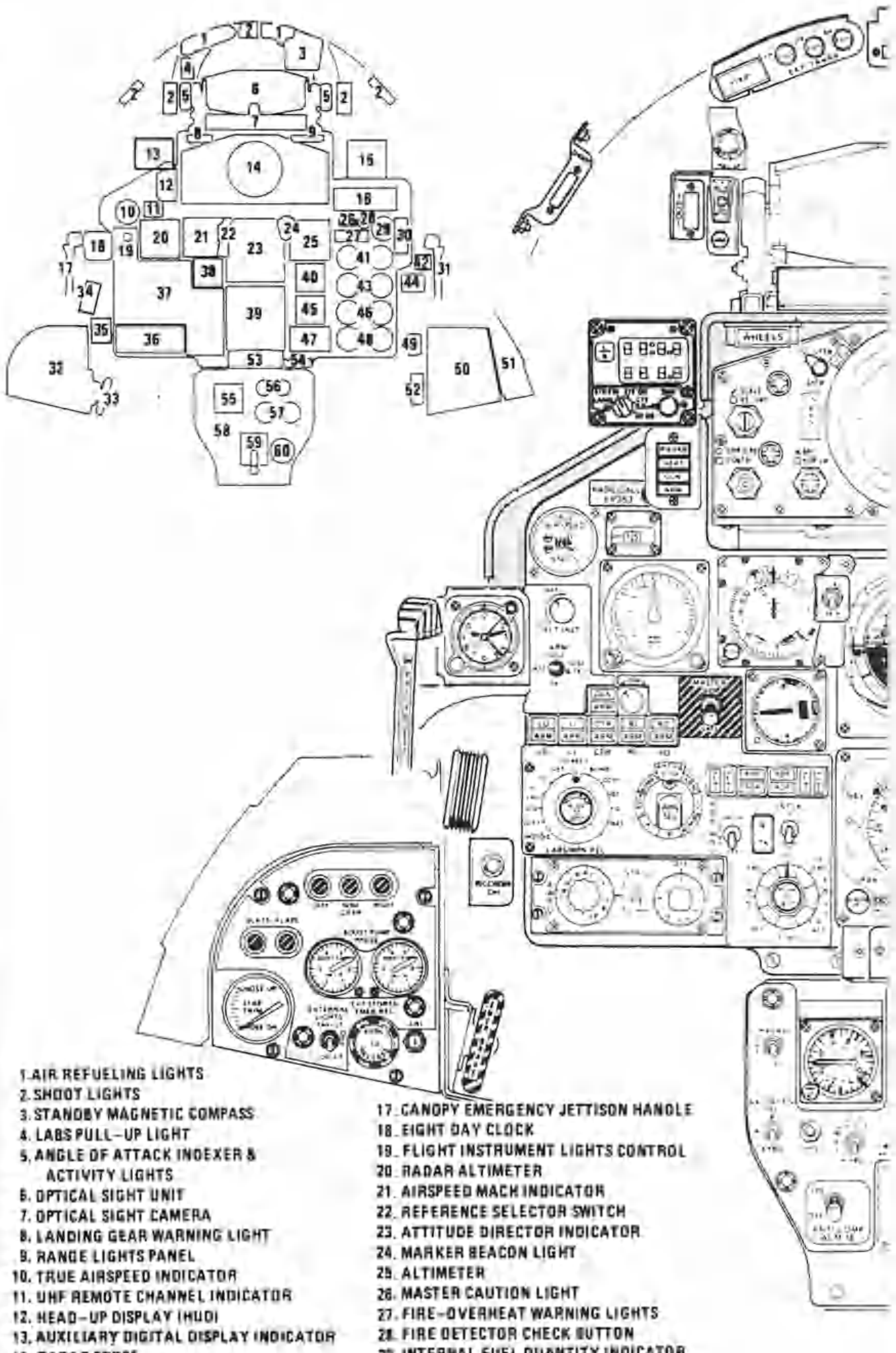
All data on pages FO-19 thru FO-20 deleted.

LEFT CONSOLE AREA

1. UTILITY PANEL (LEFT)
2. OXYGEN CONTROL PANEL
3. AGM CONTROL HANDLE
4. ENGINE CONTROL PANEL (INBOARD)
5. DRAG CHUTE CONTROL HANDLE
6. VOR/ILS CONTROL PANEL
7. AUTOMATIC FLIGHT CONTROL SYSTEM CONTROL PANEL
8. BOARDING STEPS POSITION INDICATOR
9. ANTI–G SUIT HOSE
10. INTERCOM SYSTEM CONTROL PANEL
11. BLANK PANEL
12. BLANK PANEL
13. ANTI–G SUIT CONTROL VALVE
14. AURAL TONE & GYRO FAST ERECT PANEL
15. AN/ALE–40 PROGRAMMER
16. FUEL CONTROL PANEL
17. ENGINE CONTROL PANEL (OUTBOARD)
18. THROTTLES
19. ELEVATION CAGE TOUCH BAR
20. EJECT LIGHT/SWITCH
21. SLATS FLAPS CONTROL PANEL
22. CANOPY SELECTOR
23. EXTRA PICTURE SWITCH
24. GUN CAMERA SWITCH
25. SLATS OVERRIDE SWITCH
26. ARMAMENT SAFETY OVERRIDE SWITCH







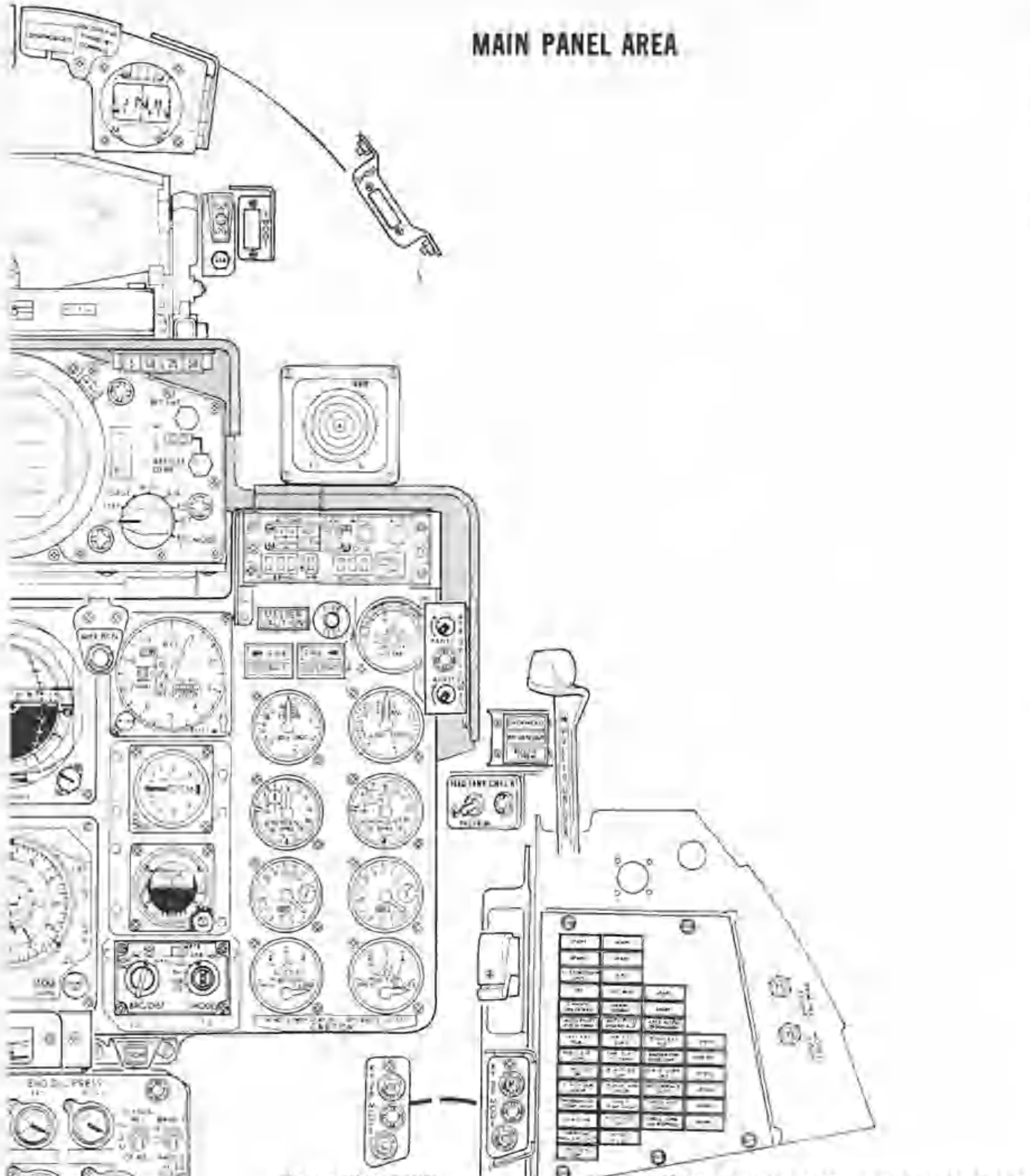
1. AIR REFUELING LIGHTS
2. SHOOT LIGHTS
3. STANDBY MAGNETIC COMPASS
4. LABS PULL–UP LIGHT
5. ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
6. OPTICAL SIGHT UNIT
7. OPTICAL SIGHT CAMERA
8. LANDING GEAR WARNING LIGHT
9. RANGE LIGHTS PANEL
10. TRUE AIRSPEED INDICATOR
11. UHF REMOTE CHANNEL INDICATOR
12. HEAD–UP DISPLAY (HUD)
13. AUXILIARY DIGITAL DISPLAY INDICATOR
14. RADAR SCOPE
15. PLAN POSITION INDICATOR
16. WARNING PANEL
17. CANOPY EMERGENCY JETTISON HANDLE
18. EIGHT DAY CLOCK
19. FLIGHT INSTRUMENT LIGHTS CONTROL
20. RADAR ALTIMETER
21. AIRSPEED MACH INDICATOR
22. REFERENCE SELECTOR SWITCH
23. ATTITUDE DIRECTOR INDICATOR
24. MARKER BEACON LIGHT
25. ALTIMETER
26. MASTER CAUTION LIGHT
27. FIRE–OVERHEAT WARNING LIGHTS
28. FIRE DETECTOR CHECK BUTTON
29. INTERNAL FUEL QUANTITY INDICATOR
30. APR 47 LIGHTS CONTROL PANEL
31. CANOPY MANUAL UNLOCK HANDLE

FRONT COCKPIT

TYPICAL

WITH DMAS

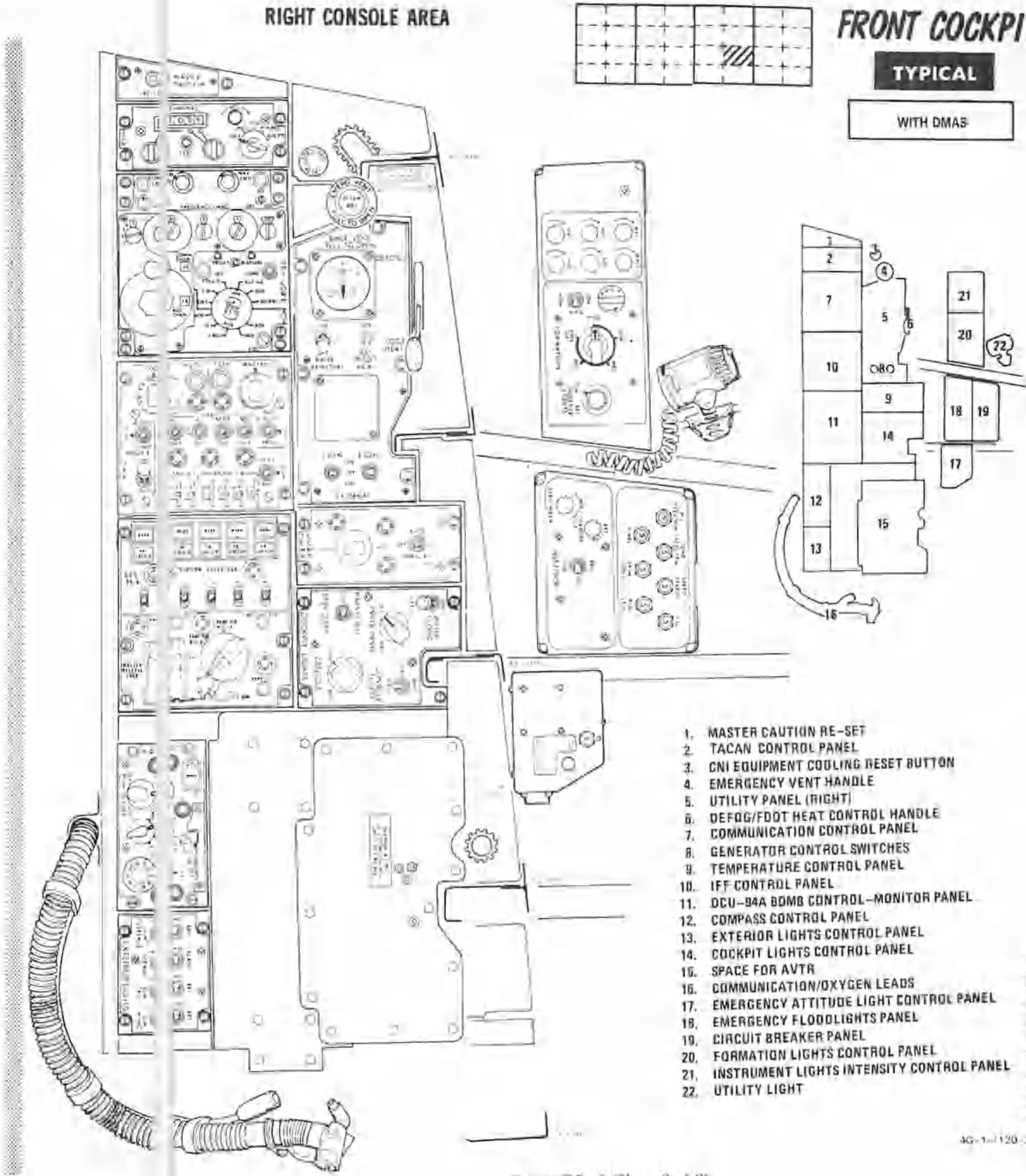
MAIN PANEL AREA



KY - 58 MODE PANEL (AFTER TO 1F-4-1320)

32. LEFT SUB PANEL
33. EMERGENCY BRAKE CONTROL HANDLE
34. LANDING GEAR CONTROL HANDLE
35. RECORDER LIGHT
36. AUTOMATIC WEAPONS RELEASE UNIT
37. MULTIPLE WEAPONS SELECTOR PANEL
38. ANGLE OF ATTACK INDICATOR
39. HORIZONTAL SITUATION INDICATOR
40. VERTICAL VELOCITY INDICATOR
41. FUEL FLOW INDICATORS
42. GENERATOR INDICATOR LIGHTS
43. TACHOMETERS
44. FEED TANK CHECK SWITCH
45. EMERGENCY ATTITUDE INDICATOR
46. EXHAUST GAS TEMPERATURE INDICATORS
47. NAVIGATION FUNCTION SELECTOR PANEL
48. EXHAUST NOZZLE POSITION INDICATORS
49. ARRESTING HOOK CONTROL HANDLE
50. RIGHT SUB PANEL
51. PRIMARY INSTRUMENT & MODE LIGHTS CONTROL CIRCUIT BREAKERS
52. KY–28 MODE LIGHTS
53. SLIP INDICATOR
54. VOR MODE LIGHT
55. ACCELEROMETER
56. OIL PRESSURE INDICATORS
57. HYDRAULIC PRESSURE INDICATORS
58. PEDESTAL PANEL
59. RUDDER PEDAL ADJUSTMENT CRANK
60. PNEUMATIC PRESSURE INDICATOR

RIGHT CONSOLE AREA



1. MASTER CAUTION RE–SET
2. TACAN CONTROL PANEL
3. CNI EQUIPMENT COOLING RESET BUTTON
4. EMERGENCY VENT HANDLE
5. UTILITY PANEL (RIGHT)
6. DEFOG/FOOT HEAT CONTROL HANDLE
7. COMMUNICATION CONTROL PANEL
8. GENERATOR CONTROL SWITCHES
9. TEMPERATURE CONTROL PANEL
10. IFF CONTROL PANEL
11. DCU–94A BOMB CONTROL–MONITOR PANEL
12. COMPASS CONTROL PANEL
13. EXTERIOR LIGHTS CONTROL PANEL
14. COCKPIT LIGHTS CONTROL PANEL
15. SPACE FOR AVTR
16. COMMUNICATION/OXYGEN LEADS
17. EMERGENCY ATTITUDE LIGHT CONTROL PANEL
18. EMERGENCY FLOODLIGHTS PANEL
19. CIRCUIT BREAKER PANEL
20. FORMATION LIGHTS CONTROL PANEL
21. INSTRUMENT LIGHTS INTENSITY CONTROL PANEL
22. UTILITY LIGHT

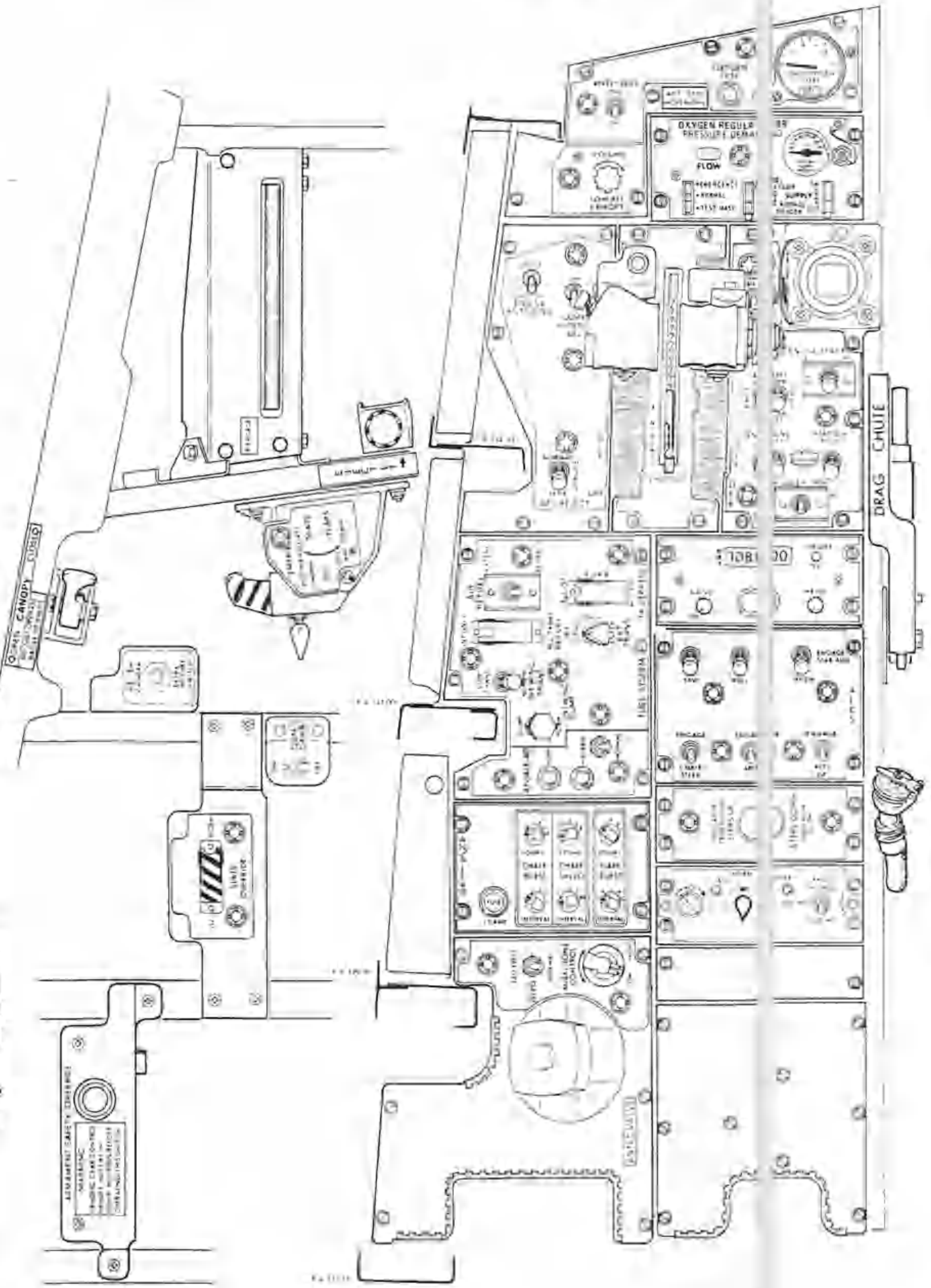
FRONT COCKPIT

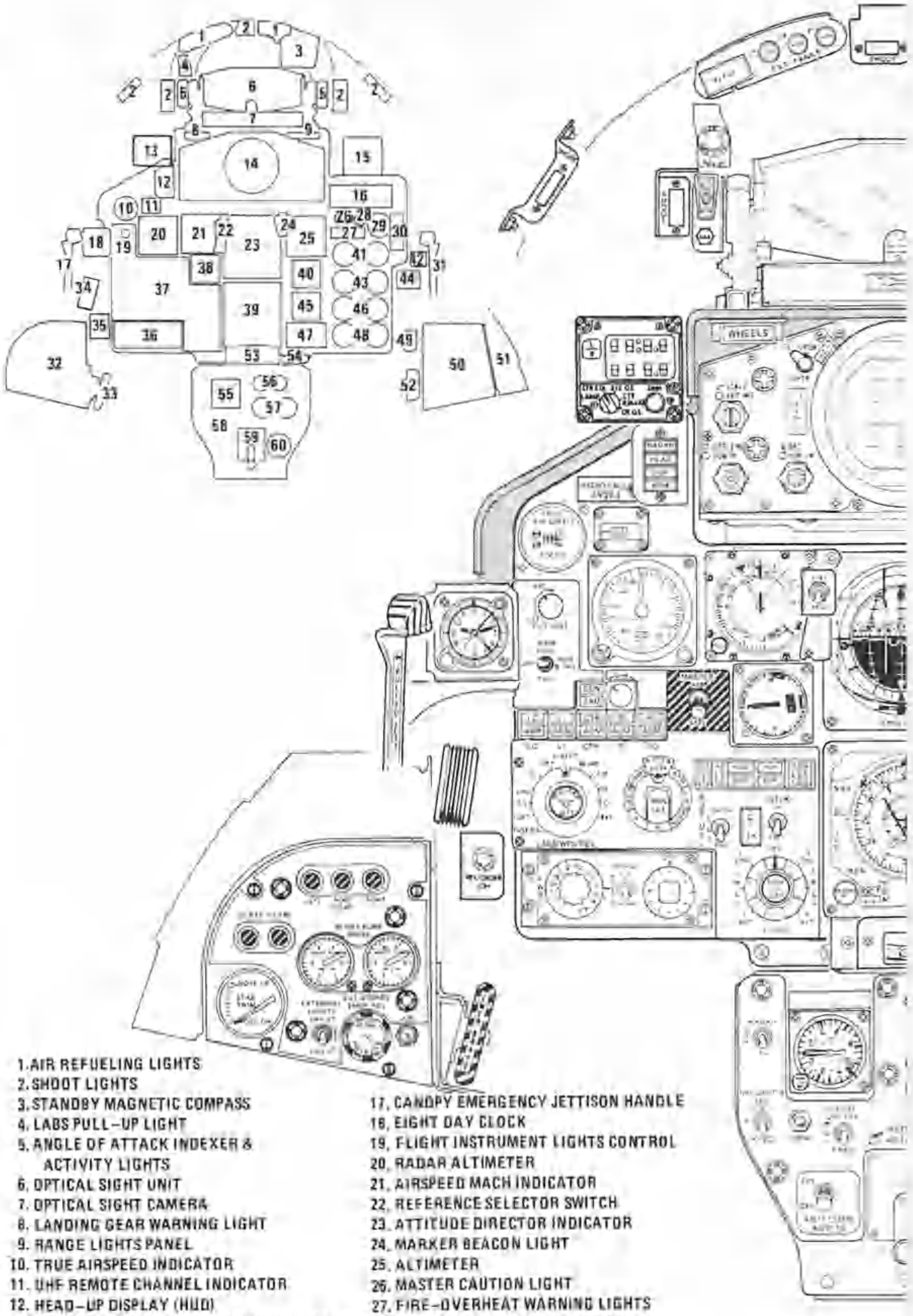
4G-1-/120-2H

Figure FO-9 (Sheet 2 of 2)

LEFT CONSOLE AREA

1. UTILITY PANEL (LEFT)
2. OXYGEN CONTROL PANEL
3. AGM CONTROL HANDLE
4. ENGINE CONTROL PANEL (INBOARD)
5. DRAG CHUTE CONTROL HANDLE
6. VOR/ILS CONTROL PANEL
7. AUTOMATIC FLIGHT CONTROL SYSTEM CONTROL PANEL
8. BOARDING STEPS POSITION INDICATOR
9. ANTI–G SUIT HOSE
10. INTERCOM SYSTEM CONTROL PANEL
11. BLANK PANEL
12. BLANK PANEL
13. ANTI–G SUIT CONTROL VALVE
14. AURAL TONE & GYRO FAST ERECT PANEL
15. AN/ALE–40 PROGRAMMER
16. FUEL CONTROL PANEL
17. ENGINE CONTROL PANEL (OUTBOARD)
18. THROTTLES
19. ELEVATION CAGE TOUCH BAR
20. EJECT LIGHT/SWITCH
21. SLATS FLAPS CONTROL PANEL
22. CANOPY SELECTOR
23. EXTRA PICTURE SWITCH
24. GUN CAMERA SWITCH
25. SLATS OVERRIDE SWITCH
26. ARMAMENT SAFETY OVERRIDE SWITCH

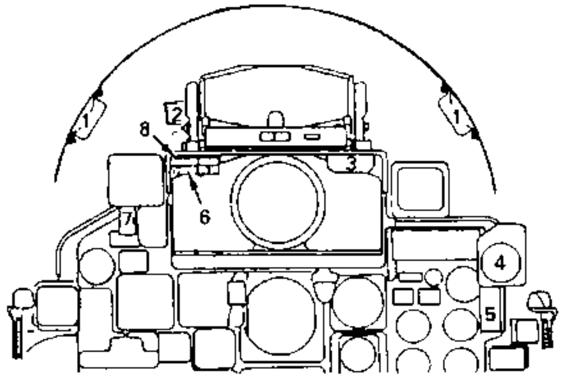




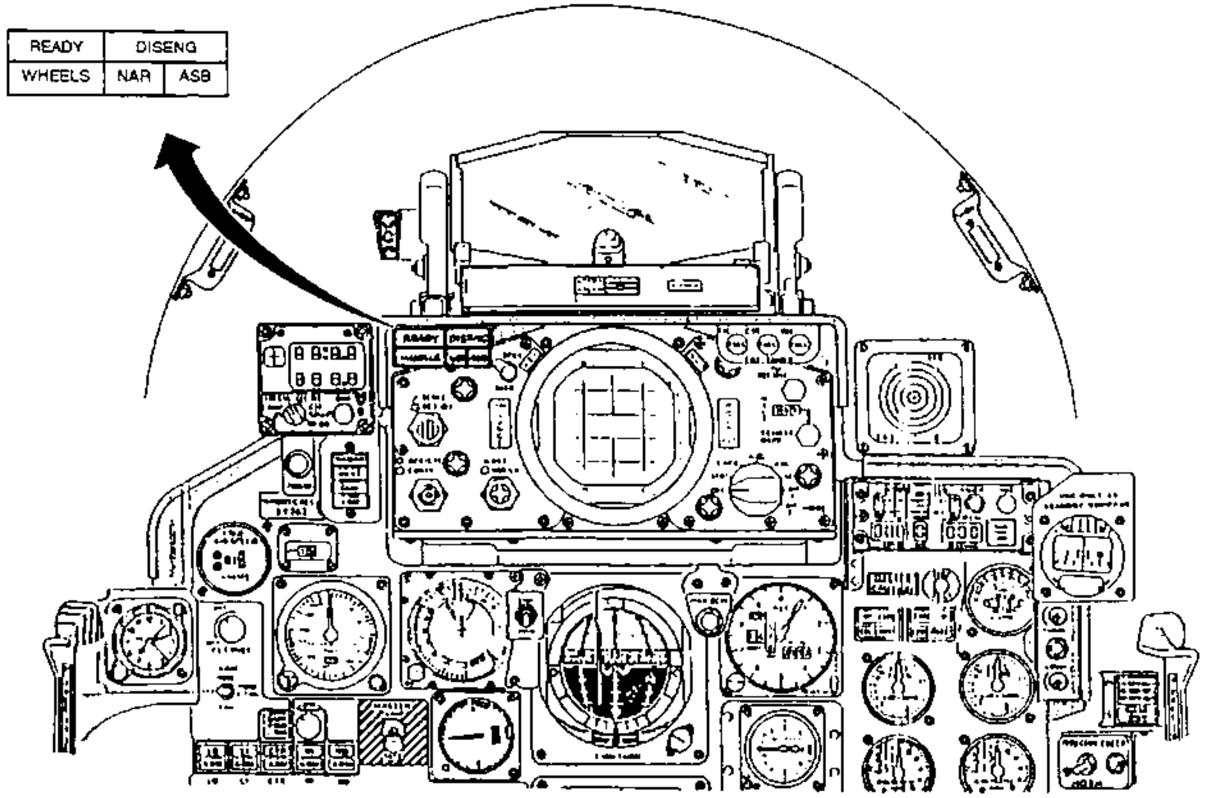
1. AIR REFUELING LIGHTS
2. SHOOT LIGHTS
3. STANDBY MAGNETIC COMPASS
4. LABS PULL–UP LIGHT
5. ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
6. OPTICAL SIGHT UNIT
7. OPTICAL SIGHT CAMERA
8. LANDING GEAR WARNING LIGHT
9. RANGE LIGHTS PANEL
10. TRUE AIRSPEED INDICATOR
11. UHF REMOTE CHANNEL INDICATOR
12. HEAD–UP DISPLAY (HUD)
13. AUXILIARY DIGITAL DISPLAY INDICATOR
14. RADAR SCOPE
15. PLAN POSITION INDICATOR
16. WARNING PANEL
17. CANOPY EMERGENCY JETTISON HANDLE
18. EIGHT DAY CLOCK
19. FLIGHT INSTRUMENT LIGHTS CONTROL
20. RADAR ALTIMETER
21. AIRSPEED MACH INDICATOR
22. REFERENCE SELECTOR SWITCH
23. ATTITUDE DIRECTOR INDICATOR
24. MARKER BEACON LIGHT
25. ALTIMETER
26. MASTER CAUTION LIGHT
27. FIRE–OVERHEAT WARNING LIGHTS
28. FIRE DETECTOR CHECK BUTTON
29. INTERNAL FUEL QUANTITY INDICATOR
30. APR 38 LIGHTS CONTROL PANEL
31. CANOPY MANUAL UNLOCK HANDLE

MAIN PANEL AREA (AFTER TO 1F-4-1500)

NEW FRONT COCKPIT



1. SHOOT LIGHTS
2. INDEXER LIGHTS
3. EXTERNAL TANKS FULL LIGHTS
4. STANDBY COMPASS
5. DIMMER SWITCH PANEL
6. WHEELS/ACTIVITY LIGHTS
7. PULL UP LIGHT
8. AIR REFUELING LIGHTS

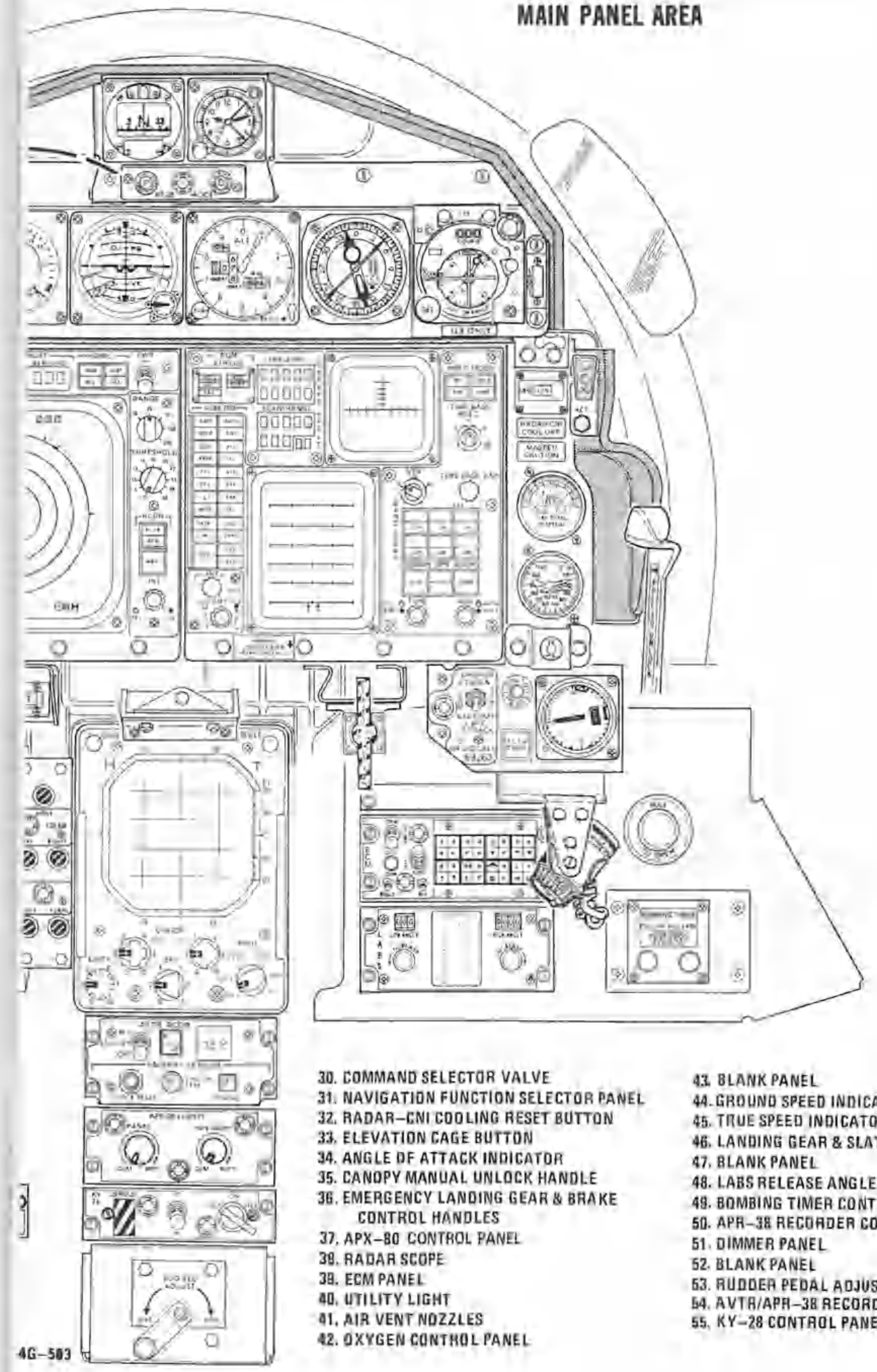


FRONT COCKPIT

4G-1-(120-2)46

Figure FO-9 (Sheet 2 of 2)

MAIN PANEL AREA



4G-583

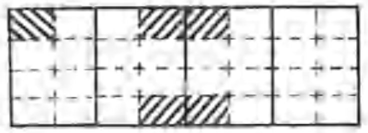
- 30. COMMAND SELECTOR VALVE
- 31. NAVIGATION FUNCTION SELECTOR PANEL
- 32. RADAR–CNI COOLING RESET BUTTON
- 33. ELEVATION CAGE BUTTON
- 34. ANGLE OF ATTACK INDICATOR
- 35. CANOPY MANUAL UNLOCK HANDLE
- 36. EMERGENCY LANDING GEAR & BRAKE CONTROL HANDLES
- 37. APX–80 CONTROL PANEL
- 38. RADAR SCOPE
- 39. ECM PANEL
- 40. UTILITY LIGHT
- 41. AIR VENT NOZZLES
- 42. OXYGEN CONTROL PANEL
- 43. BLANK PANEL
- 44. GROUND SPEED INDICATOR
- 45. TRUE SPEED INDICATOR
- 46. LANDING GEAR & SLATS FLAPS INDICATOR PANEL
- 47. BLANK PANEL
- 48. LABS RELEASE ANGLE CONTROL PANEL
- 49. BOMBING TIMER CONTROL PANEL
- 50. APR–38 RECORDER CONTROL PANEL
- 51. DIMMER PANEL
- 52. BLANK PANEL
- 53. RUDDER PEDAL ADJUSTMENT CRANK
- 54. AVTR/APR–38 RECORDER CONTROL PANEL
- 55. KY–28 CONTROL PANEL

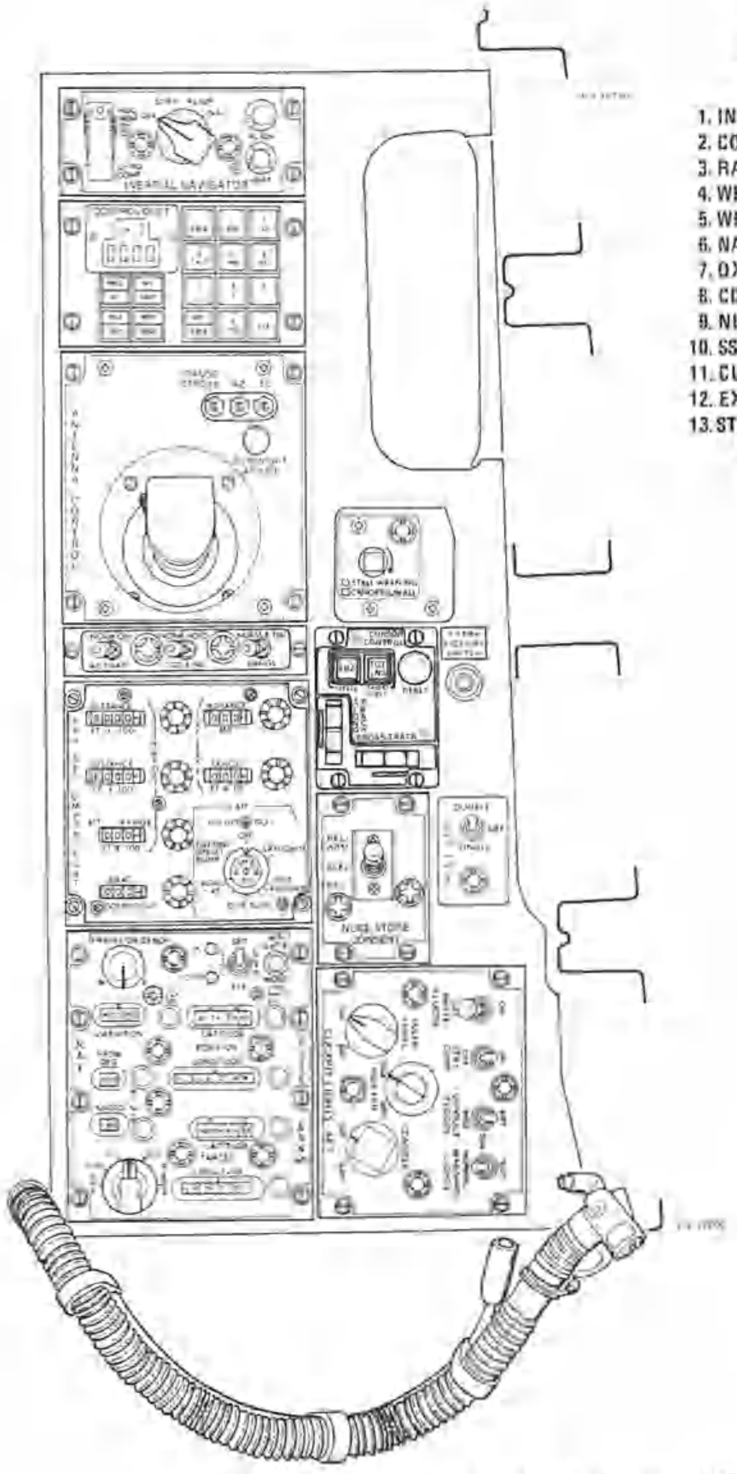
RIGHT CONSOLE AREA

REAR COCKPIT

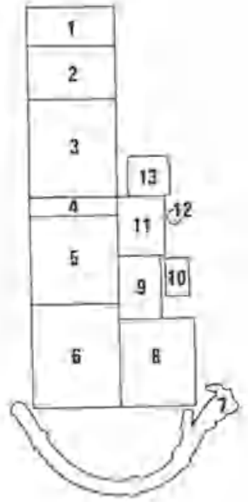
TYPICAL

WITHOUT DMAS





- 1. INERTIAL NAVIGATION CONTROL PANEL
- 2. COMPUTER & MISSILE PROGRAMMER
- 3. RADAR ANTENNA CONTROL PANEL
- 4. WEAPON DELIVERY PANEL
- 5. WEAPONS RELEASE COMPUTER CONTROL PANEL
- 6. NAVIGATION CONTROL PANEL
- 7. OXYGEN & COMMUNICATION LEADS
- 8. COCKPIT LIGHTS CONTROL PANEL
- 9. NUCLEAR STORE CONSENT SWITCH
- 10. SST–181X PULSE SELECTOR SWITCH
- 11. CURSOR CONTROL PANEL
- 12. EXTRA PICTURE SWITCH
- 13. STALL WARNING TONE AND VOICE WARNING CONTROL PANEL



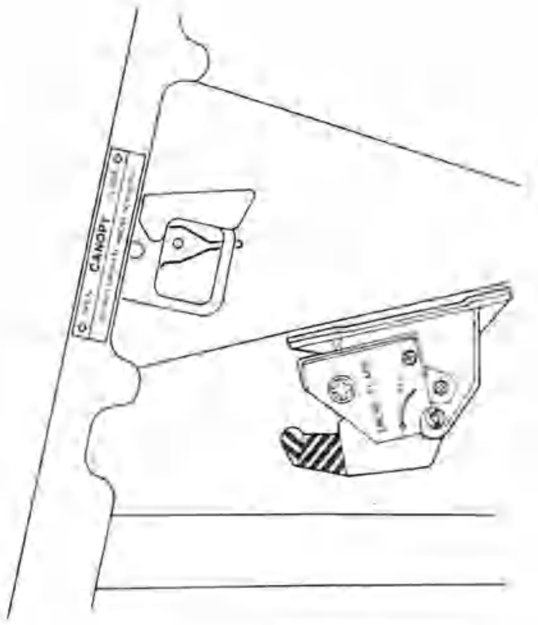
REAR COCKPIT

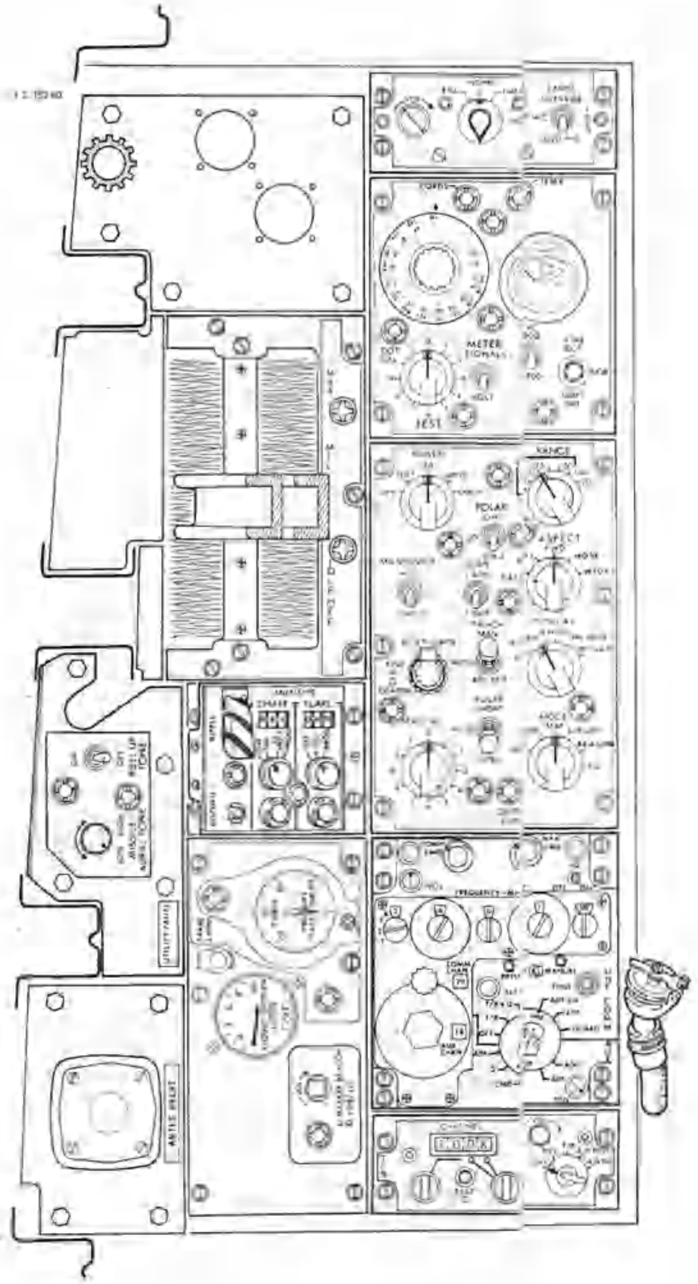
4G-1-1216-1H

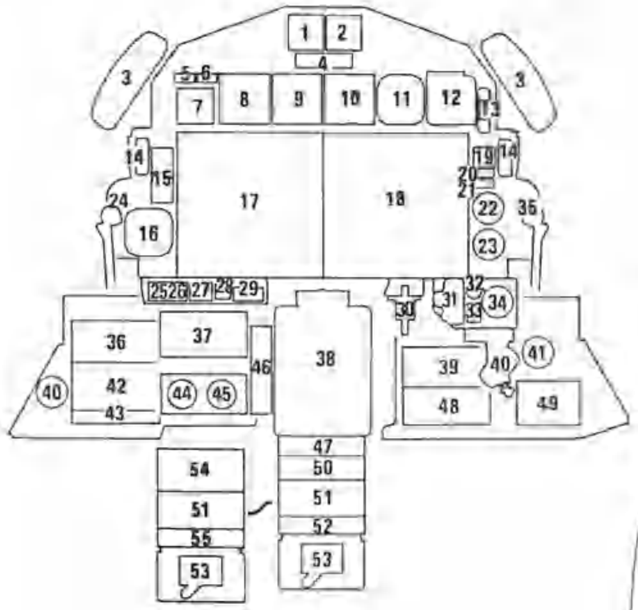
Figure FO–10 (Sheet 1 of 2)

LEFT CONSOLE AREA

1. INTERCOM CONTROL PANEL
2. CONTROL–MONITOR PANEL
3. RADAR CONTROL PANEL
4. COMMUNICATION CONTROL PANEL
5. ANTI–G SUIT HOSE
6. TACAN CONTROL PANEL
7. MARKER BEACON VOR/ILS AUDIO CONTROL
8. ANTI–G SUIT CONTROL VALVE
9. OXYGEN QUANTITY GAGE
10. CABIN ALTIMETER
11. UTILITY PANEL
12. AN/ALE–40 PROGRAMMER
13. THROTTLES
14. BLANK PANEL
15. EMERGENCY SLATS FLAPS
16. CANOPY CONTROL HANDLE







1. STANDBY MAGNETIC COMPASS
2. EIGHT DAY CLOCK
3. REAR VIEW MIRROWS
4. KY–28 MODE LIGHTS
5. CANOPY UNLOCKED WARNING LIGHT
6. INERTIAL NAV SYS OUT LIGHT
7. VERTICAL VELOCITY INDICATOR
8. AIRSPEED–MACH INDICATOR
9. ATTITUDE INDICATOR
10. ALTIMETER
11. BEARING–DISTANCE–HEADING INDICATOR
12. COURSE INDICATOR
13. SHOOT LIGHT
14. ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
15. THREAT LIGHTS PANEL

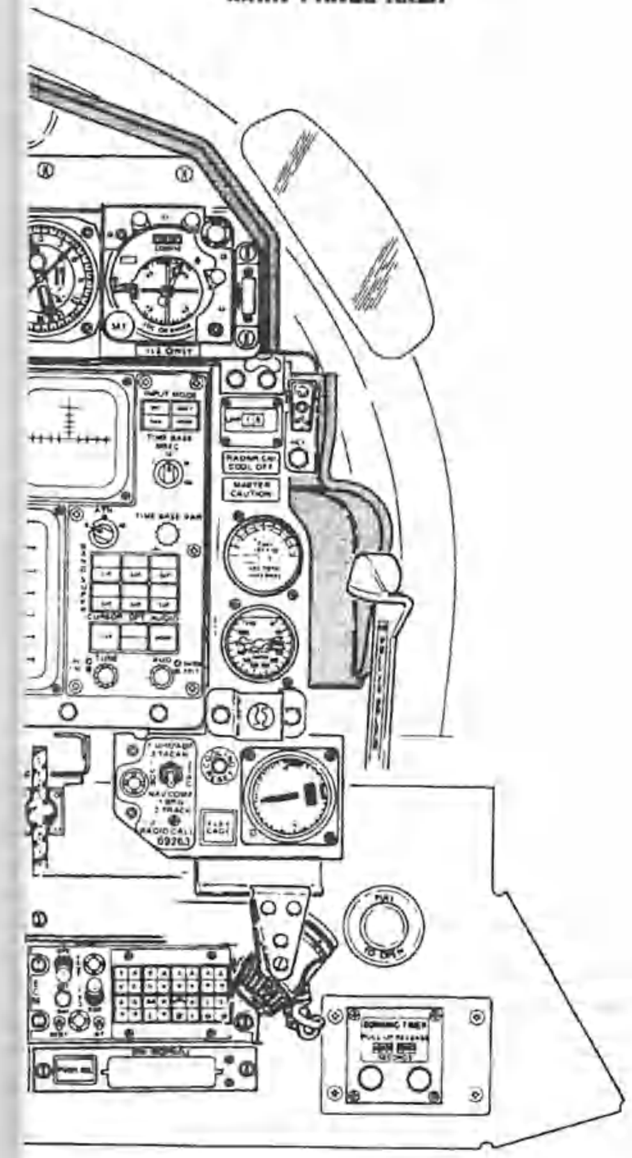
KY–58 MODE PANEL
(AFTER TO 1F–4–1320)

16. VIS IDENT METER
17. PLAN POSITION INDICATOR & CONTROL
18. PANORAMIC, ANALYSIS & HOMING INDICATOR CONTROL
19. UHF CHANNEL REMOTE INDICATOR
20. RADAR CNI COOL OFF LIGHT
21. MASTER CAUTION LIGHT
22. FUEL QUANTITY INDICATOR
23. TACHOMETER (DUAL POINTERS)
24. CANOPY EMERGENCY JETTISON HANDLE
25. SEEKER SLAVE SWITCH
26. EO WEAPON CONTRAST SWITCH
27. GUN CAMERA SWITCH
28. AIR–TO–AIR BUTTON
29. EJECT LIGHT

KY–58 CONTROL PANEL
(AFTER TO 1F–4–1320)

AFTER T01F–

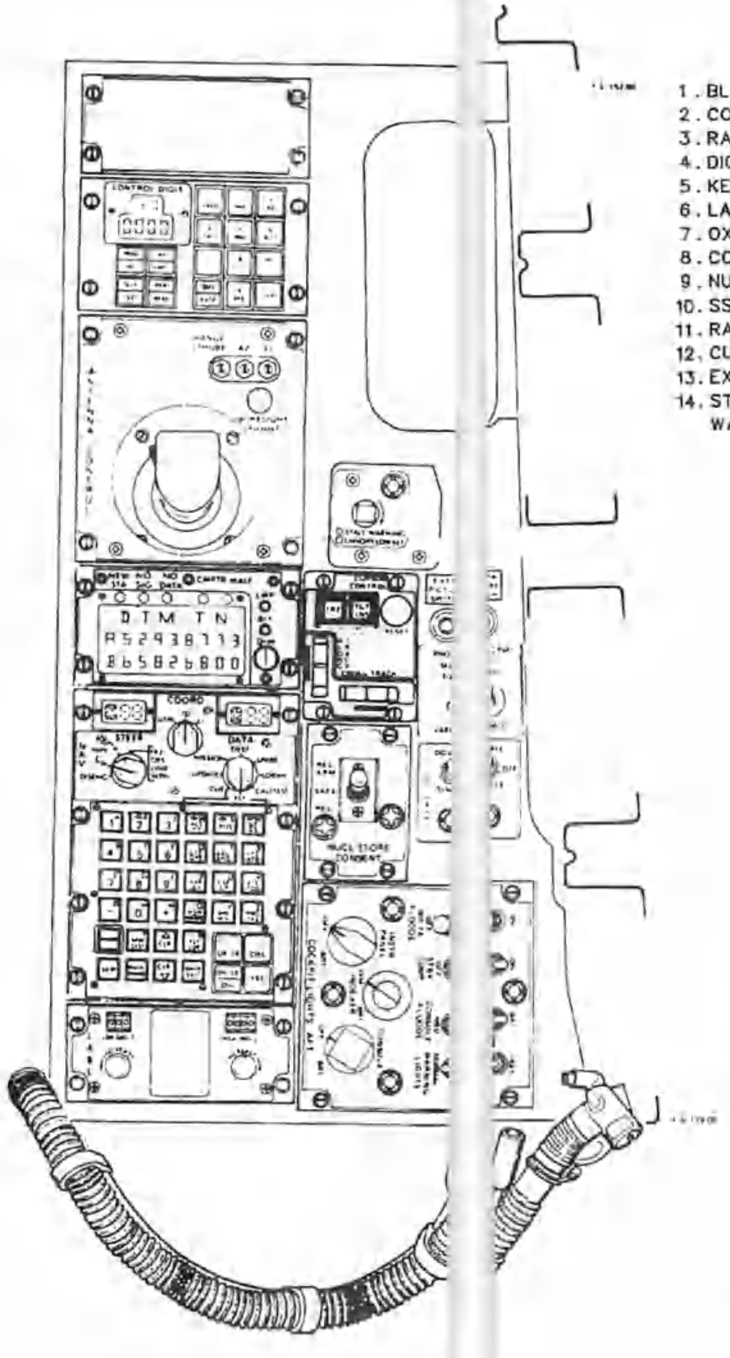
MAIN PANEL AREA



OMMAND SELECTOR VALVE
AVIGATION FUNCTION SELECTOR PANEL
ADAR-CNI COOLING RESET BUTTON
LEVATION CAGE BUTTON
NGLE OF ATTACK INDICATOR
ANOPY MANUAL UNLOCK HANDLE
MERGENCY LANDING GEAR & BRAKE
CONTROL HANDLES
AVIGATION COMPUTER SET CONTROL
ADAR SCOPE
LANK
TILITY LIGHT
IR VENT NOZZLES
XYGEN CONTROL PANEL

43. BLANK PANEL
44. APX-80 CONTROL PANEL
45. ECM PANEL
46. LANDING GEAR & SLATS FLAPS INDICATOR PANEL
47. BLANK PANEL
48. DATA TRANSFER MODULE RECEPTACLE
49. BOMBING TIMER CONTROL PANEL
50. APR-47RECORDER CONTROL PANEL
51. DIMMER PANEL
52. BLANK PANEL
53. RUDDER PEDAL ADJUSTMENT CRANK
54. AVTR/APR-47 RECORDER CONTROL PANEL
55. KY-28 CONTROL PANEL

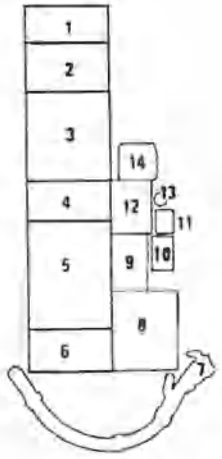
RIGHT CONSOLE AR EA



REAR COCKPIT

TYPICAL

1. BLANK
2. COMPUTER & MISSILE PROGRAMMER
3. RADAR ANTENNA CONTROL PANEL
4. DIGITAL DISO;AY INDICATOR
5. KEYER CONTROL
6. LAB RELEASE ANGLE CONTROL PANEL
7. OXYGEN &COMMUNICATION LEADS
8. COCKPIT LIGHTS CONTROLPANEL
9. NUCLEAR STORE CONSENT SWITCH
10. SST-181X PULSE SELECTOR SWITCH
11. RANGE CURSOR SELECT SWITCH
12. CURSOR CONTROL PANEL
13. EXTRA PICTURE SWITCH
14. STALL WARNING TONE AND VOICE WARNING CONTROL PANEL



REAR COCKPIT

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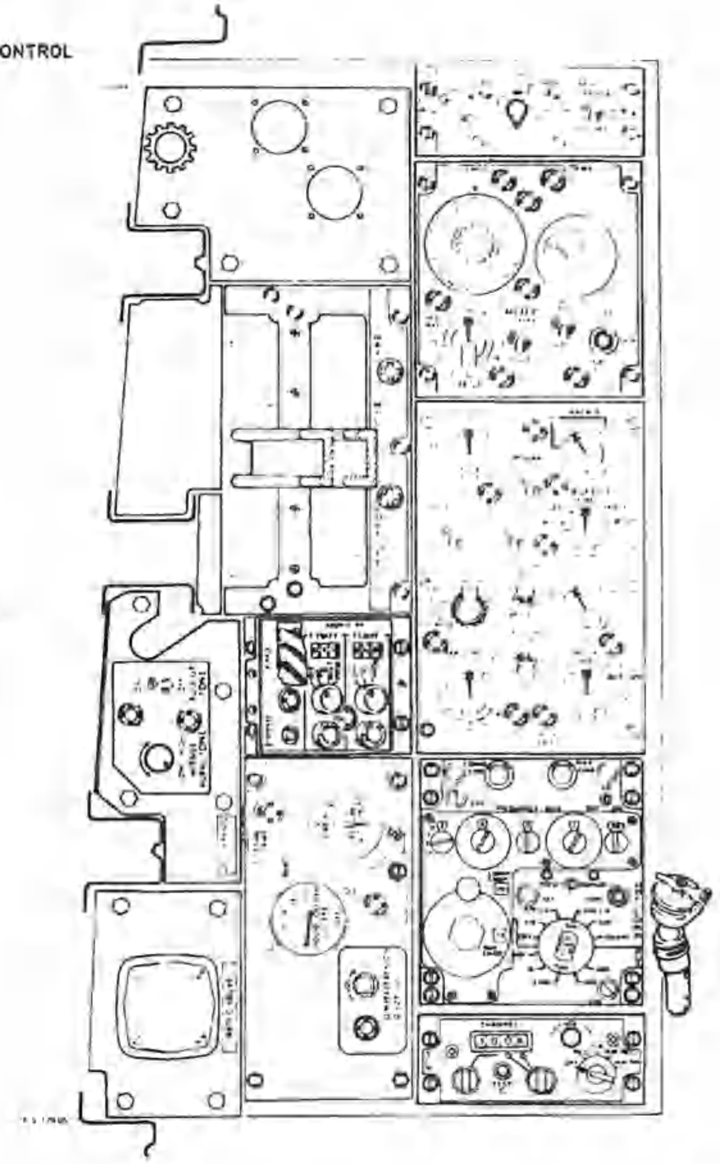
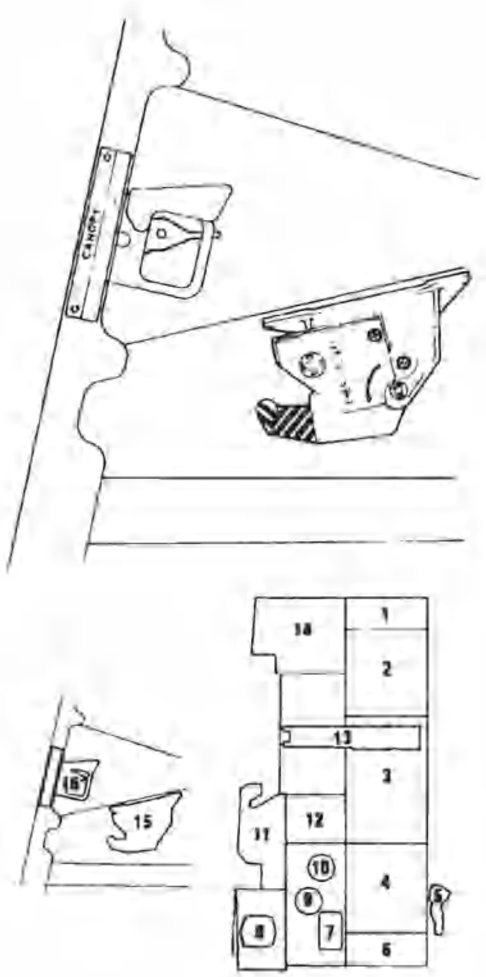
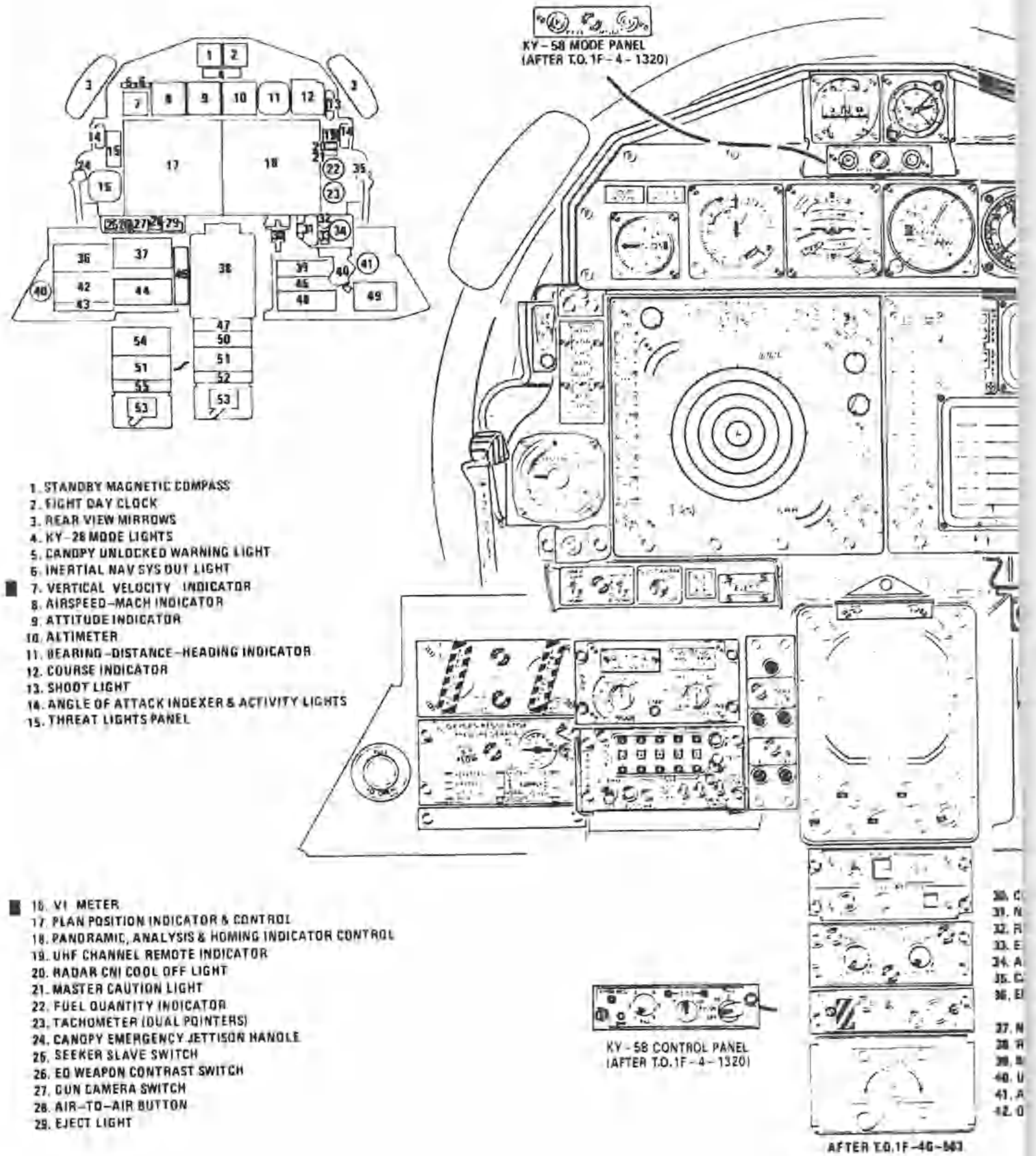
FO-10.

LEFT CONSOLE AREA

1. INTERCOM CONTROL PANEL
2. CONTROL-MONITOR PANEL
3. RADAR CONTROL PANEL
4. COMMUNICATION CONTROL PANEL
5. ANTI-G SUIT HOSE
6. TACAN CONTROL PANEL
7. MARKER BEACON VOR/ILS AUDIO CONTROL
8. ANTI-G SUIT CONTROL VALVE
9. OXYGEN QUANTITY GAGE
10. CABIN ALTIMETER
11. UTILITY PANEL
12. AN/ALE-40 PROGRAMMER
13. THROTTLES
14. BLANK PANEL
15. EMERGENCY SLATS FLAPS
16. CANOPY CONTROL HANDLE







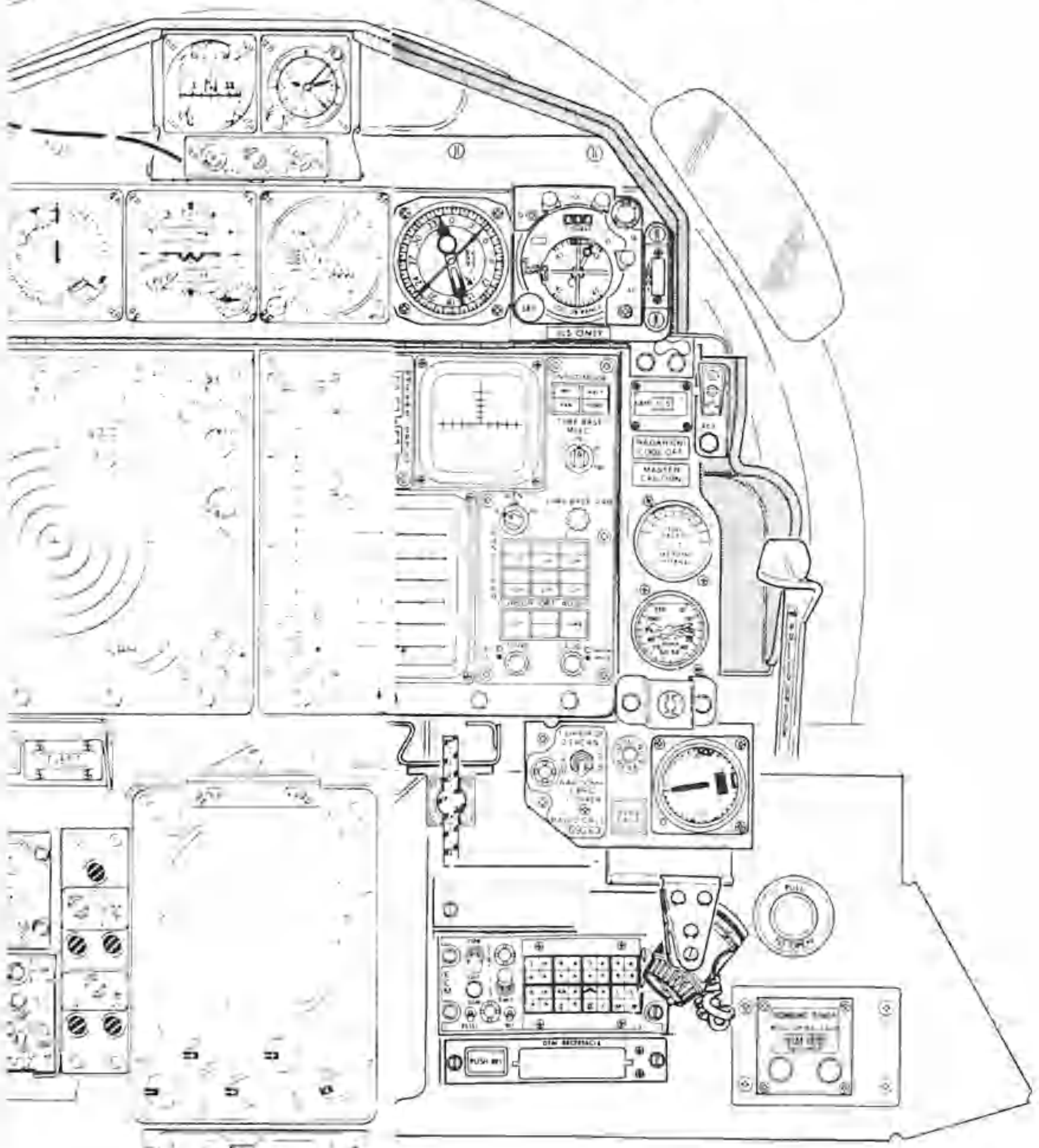
1. STANDBY MAGNETIC COMPASS
2. FIGHT DAY CLOCK
3. REAR VIEW MIRROWS
4. KY-28 MODE LIGHTS
5. CANOPY UNLOCKED WARNING LIGHT
6. INERTIAL NAV SYS OUT LIGHT
7. VERTICAL VELOCITY INDICATOR
8. AIRSPEED-MACH INDICATOR
9. ATTITUDE INDICATOR
10. ALTIMETER
11. BEARING-DISTANCE-HEADING INDICATOR
12. COURSE INDICATOR
13. SHOOT LIGHT
14. ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
15. THREAT LIGHTS PANEL

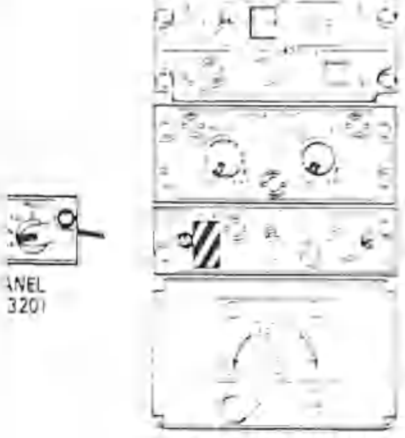
16. VI METER
17. PLAN POSITION INDICATOR & CONTROL
18. PANORAMIC, ANALYSIS & HOMING INDICATOR CONTROL
19. UHF CHANNEL REMOTE INDICATOR
20. RADAR CNI COOL OFF LIGHT
21. MASTER CAUTION LIGHT
22. FUEL QUANTITY INDICATOR
23. TACHOMETER (DUAL POINTERS)
24. CANOPY EMERGENCY JETTISON HANDLE
25. SEEKER SLAVE SWITCH
26. EO WEAPON CONTRAST SWITCH
27. GUN CAMERA SWITCH
28. AIR-TO-AIR BUTTON
29. EJECT LIGHT

30. C
31. N
32. R
33. E
34. A
35. C
36. E

37. N
38. R
39. S
40. U
41. A
42. O

MAIN PANEL AREA





AFTER TO 1F-4G-503

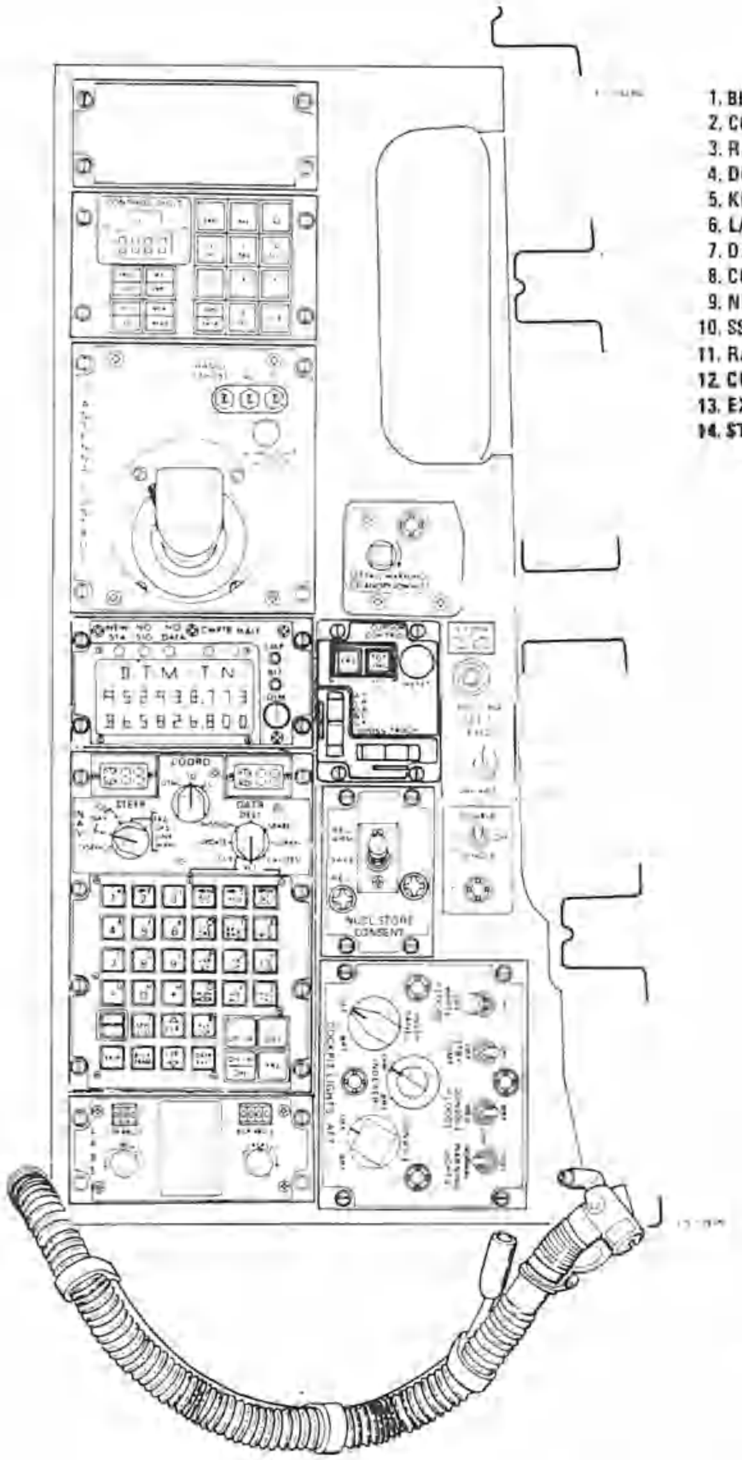
30. COMMAND SELECTOR VALVE
31. NAVIGATION FUNCTION SELECTOR PANEL
32. RADAR-CNI COOLING RESET BUTTON
33. ELEVATION CAGE BUTTON
34. ANGLE OF ATTACK INDICATOR
35. CANOPY MANUAL UNLOCK HANDLE
36. EMERGENCY LANDING GEAR & BRAKE CONTROL HANDLES
37. NAVIGATION COMPUTER SET CONTROL
38. RADAR SCOPE
39. BLANK
40. UTILITY LIGHT
41. AIR VENT NOZZLES
42. OXYGEN CONTROL PANEL
43. BLANK PANEL
44. APX-80 CONTROL PANEL
45. ECM PANEL
46. LANDING GEAR & SLATS FLAPS INDICATOR PANEL
47. BLANK PANEL
48. DATA TRANSFER MODULE RECEPTACLE
49. BOMBING TIMER CONTROL PANEL
50. APR-47RECORDER CONTROL PANEL
51. DIMMER PANEL
52. BLANK PANEL
53. RUDDER PEDAL ADJUSTMENT CRANK
54. AVTR/APR-47 RECORDER CONTROL PANEL
55. KY-28 CONTROL PANEL

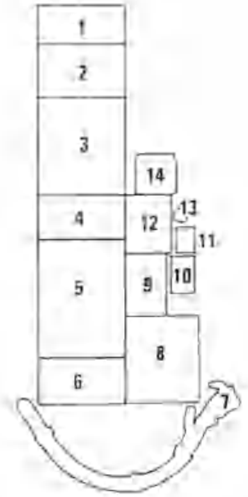
RIGHT CONSOLE AREA

REAR COCKPIT

TYPICAL

1. BLANK
2. COMPUTER & MISSILE PROGRAMMER
3. RADAR ANTENNA CONTROL PANEL
4. DIGITAL DISPLAY INDICATOR
5. KEYER CONTROL
6. LAB RELEASE ANGLE CONTROL PANEL
7. OXYGEN & COMMUNICATION LEADS
8. COCKPIT LIGHTS CONTROL PANEL
9. NUCLEAR STORE CONSENT SWITCH
10. SST-181X PULSE SELECTOR SWITCH
11. RANGE CURSOR SELECT SWITCH
12. CURSOR CONTROL PANEL
13. EXTRA PICTURE SWITCH
14. STALL WARNING TONE AND VOICE WARNING CONTROL PANEL





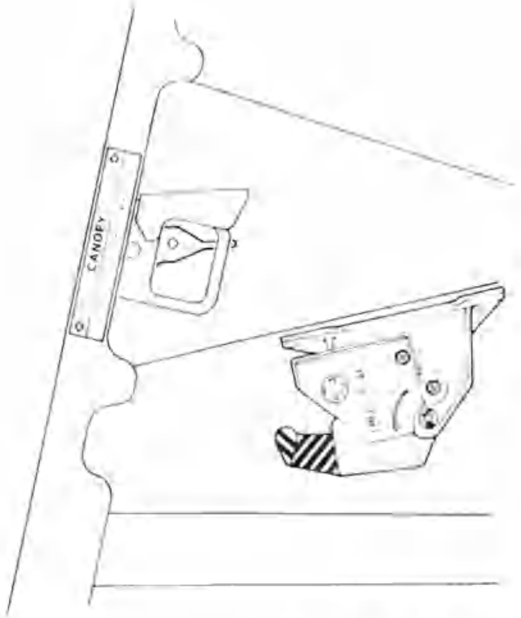
REAR COCKPIT

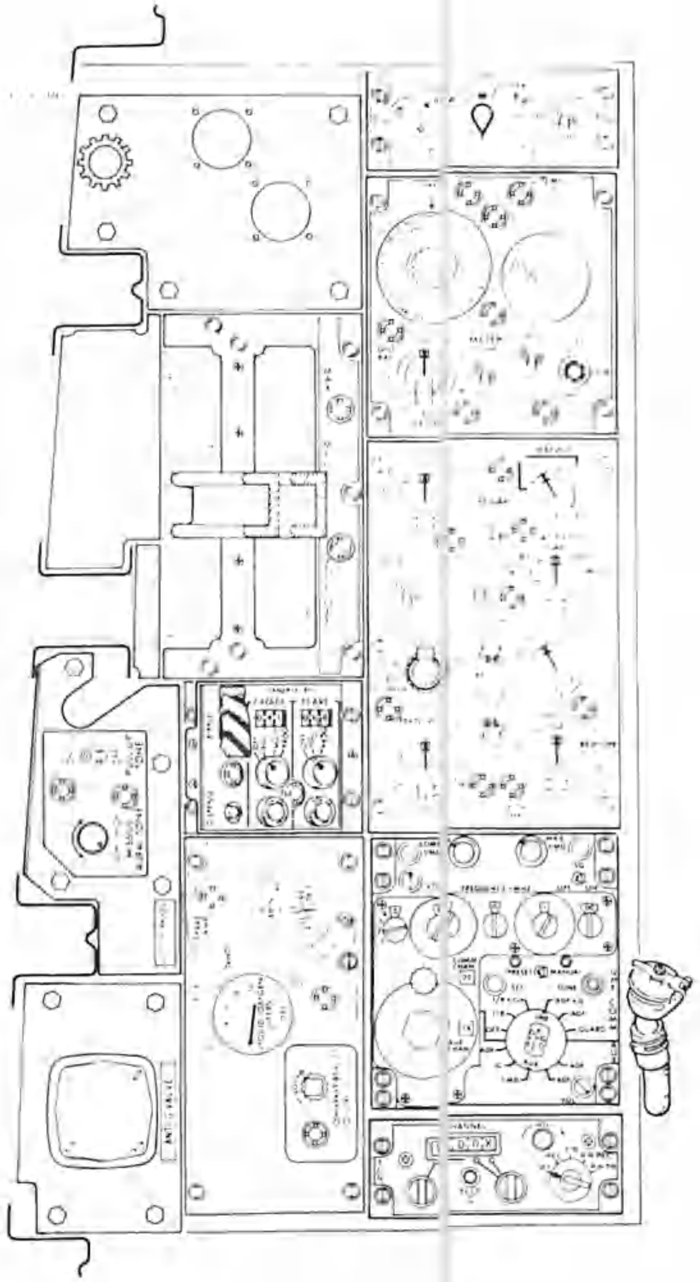
4G-1-(216)44

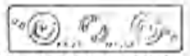
Figure FO-10

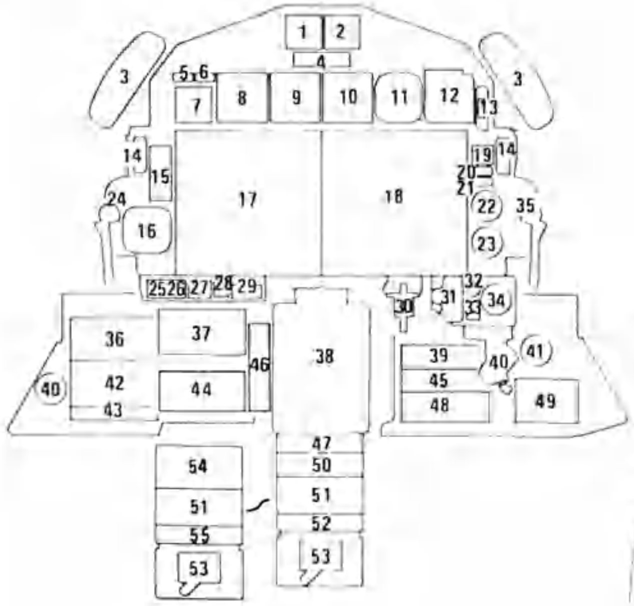
LEFT CONSOLE AREA

1. INTERCOM CONTROL PANEL
2. CONTROL–MONITOR PANEL
3. RADAR CONTROL PANEL
4. COMMUNICATION CONTROL PANEL
5. ANTI–G SUIT HOSE
6. TACAN CONTROL PANEL
7. MARKER BEACON VOR/ILS AUDIO CONTROL
8. ANTI–G SUIT CONTROL VALVE
9. OXYGEN QUANTITY GAGE
10. CABIN ALTIMETER
11. UTILITY PANEL
12. AN/ALE–40 PROGRAMMER
13. THROTTLES
14. BLANK PANEL
15. EMERGENCY SLATS FLAPS
16. CANOPY CONTROL HANDLE

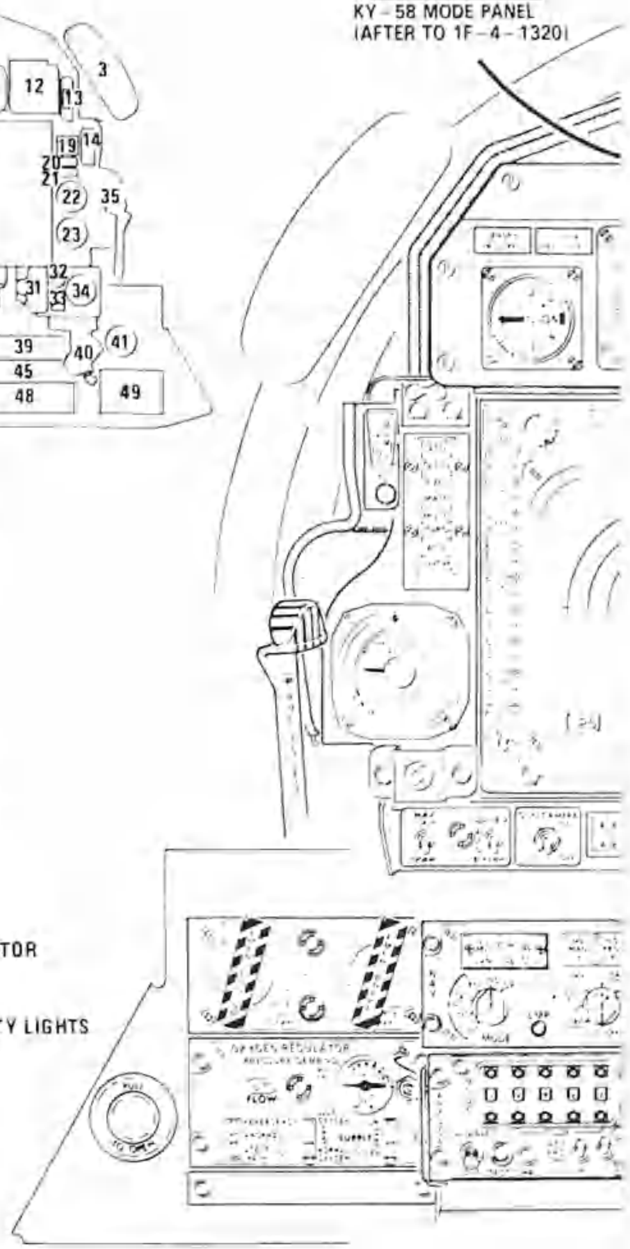





KY – 58 MODE PANEL
(AFTER TO 1F – 4 – 1320)



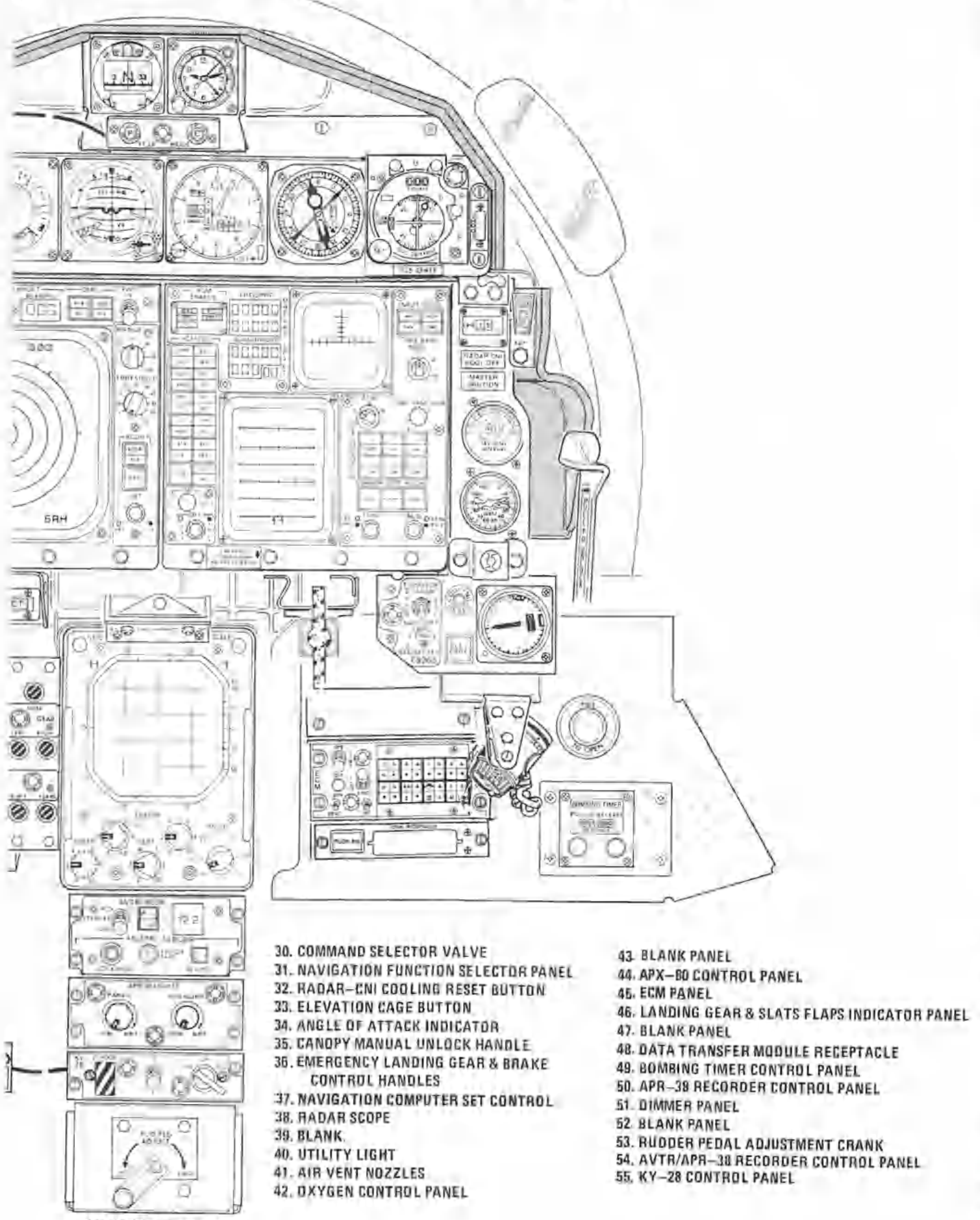
1. STANDBY MAGNETIC COMPASS
2. EIGHT DAY CLOCK
3. REAR VIEW MIRROWS
4. KY–28 MODE LIGHTS
5. CANOPY UNLOCKED WARNING LIGHT
6. INERTIAL NAV SYS OUT LIGHT
7. ACCELEROMETER
8. AIRSPEED–MACH INDICATOR
9. ATTITUDE INDICATOR
10. ALTIMETER
11. BEARING–DISTANCE–HEADING INDICATOR
12. COURSE INDICATOR
13. SHOOT LIGHT
14. ANGLE OF ATTACK INDEXER & ACTIVITY LIGHTS
15. THREAT LIGHTS PANEL



16. RADAR ALTIMETER
17. PLAN POSITION INDICATOR & CONTROL
18. PANORAMIC, ANALYSIS & HOMING INDICATOR CONTROL
19. UHF CHANNEL REMOTE INDICATOR
20. RADAR CNI COOL OFF LIGHT
21. MASTER CAUTION LIGHT
22. FUEL QUANTITY INDICATOR
23. TACHOMETER (DUAL POINTERS)
24. CANOPY EMERGENCY JETTISON HANDLE
25. SEEKER SLAVE SWITCH
26. EO WEAPON CONTRAST SWITCH
27. GUN CAMERA SWITCH
28. AIR–TO–AIR BUTTON
29. EJECT LIGHT


KY – 58 CONTROL PA
(AFTER TO 1F – 4 – 1

MAIN PANEL AREA

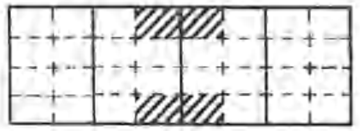


30. COMMAND SELECTOR VALVE
31. NAVIGATION FUNCTION SELECTOR PANEL
32. RADAR–CNI COOLING RESET BUTTON
33. ELEVATION CAGE BUTTON
34. ANGLE OF ATTACK INDICATOR
35. CANOPY MANUAL UNLOCK HANDLE
36. EMERGENCY LANDING GEAR & BRAKE CONTROL HANDLES
37. NAVIGATION COMPUTER SET CONTROL
38. RADAR SCOPE
39. BLANK
40. UTILITY LIGHT
41. AIR VENT NOZZLES
42. OXYGEN CONTROL PANEL
43. BLANK PANEL
44. APX–80 CONTROL PANEL
45. ECM PANEL
46. LANDING GEAR & SLATS FLAPS INDICATOR PANEL
47. BLANK PANEL
48. DATA TRANSFER MODULE RECEPTACLE
49. BOMBING TIMER CONTROL PANEL
50. APR–38 RECORDER CONTROL PANEL
51. DIMMER PANEL
52. BLANK PANEL
53. RUDDER PEDAL ADJUSTMENT CRANK
54. AVTR/APR–38 RECORDER CONTROL PANEL
55. KY–28 CONTROL PANEL

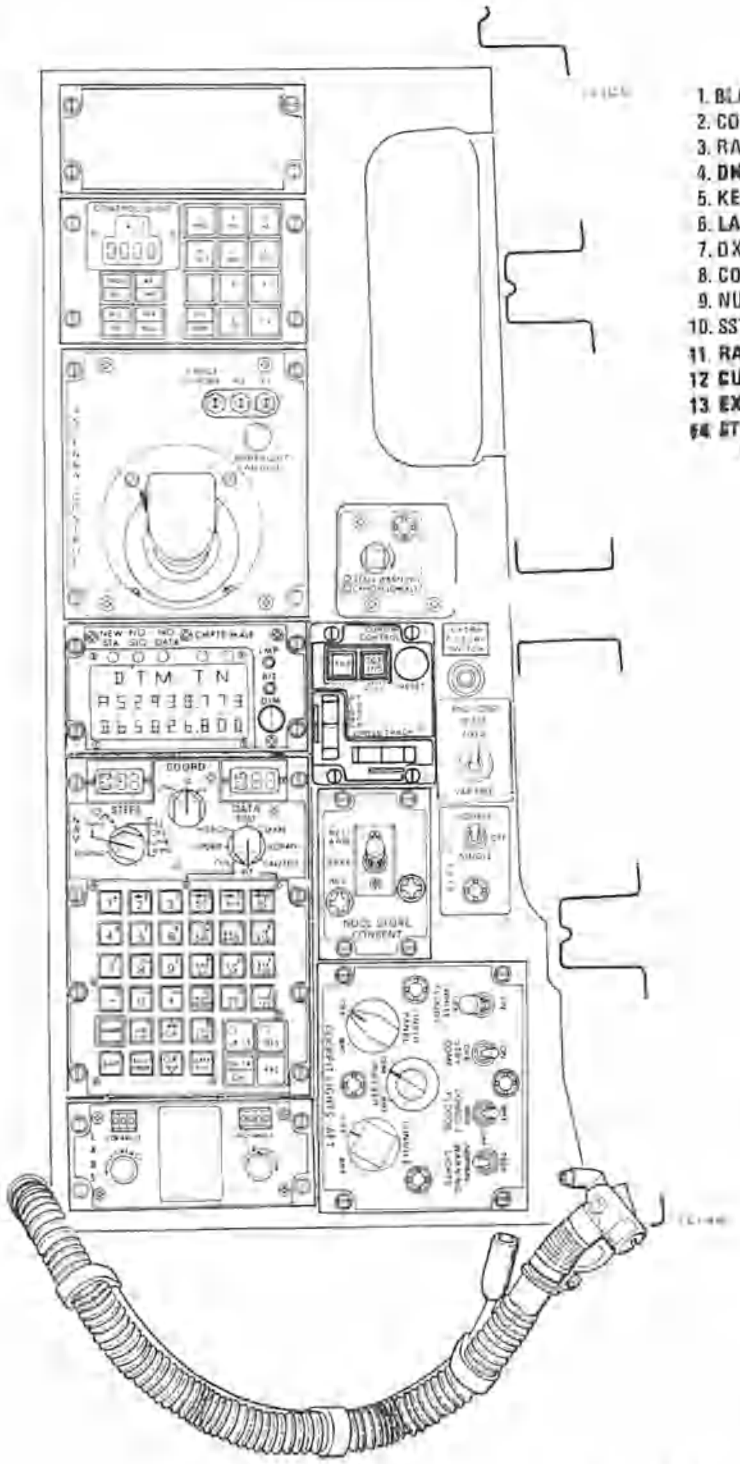
REAR COCKPIT

TYPICAL

WITH DMAS



RIGHT CONSOLE AREA



1. BLANK
2. COMPUTER & MISSILE PROGRAMMER
3. RADAR ANTENNA CONTROL PANEL
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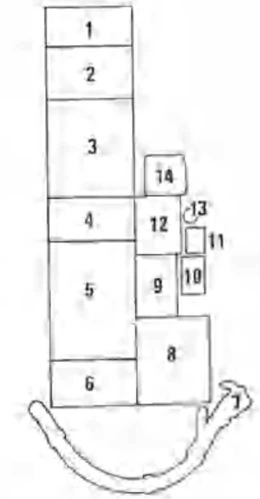

REAR COCKPIT

4G-1-1216-2(F)

Figure FO–10 (Sheet 2 of 2)

LEFT CONSOLE AREA

1. INTERCOM CONTROL PANEL
2. CONTROL–MONITOR PANEL
3. RADAR CONTROL PANEL
4. COMMUNICATION CONTROL PANEL
5. ANTI–G SUIT HOSE
6. TACAN CONTROL PANEL
7. MARKER BEACON VOR/ILS AUDIO CONTROL
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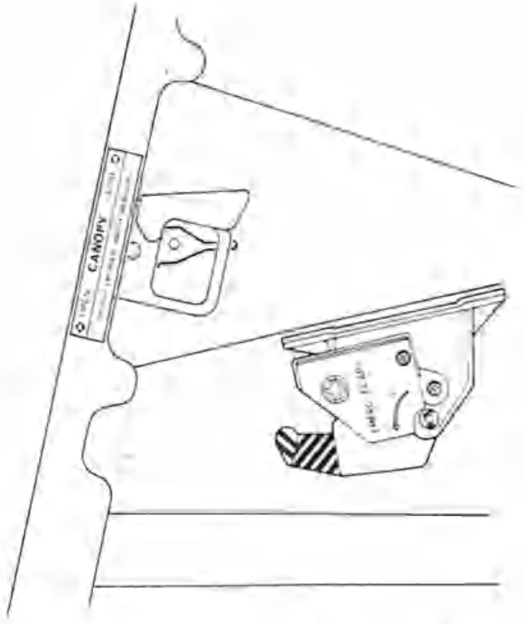
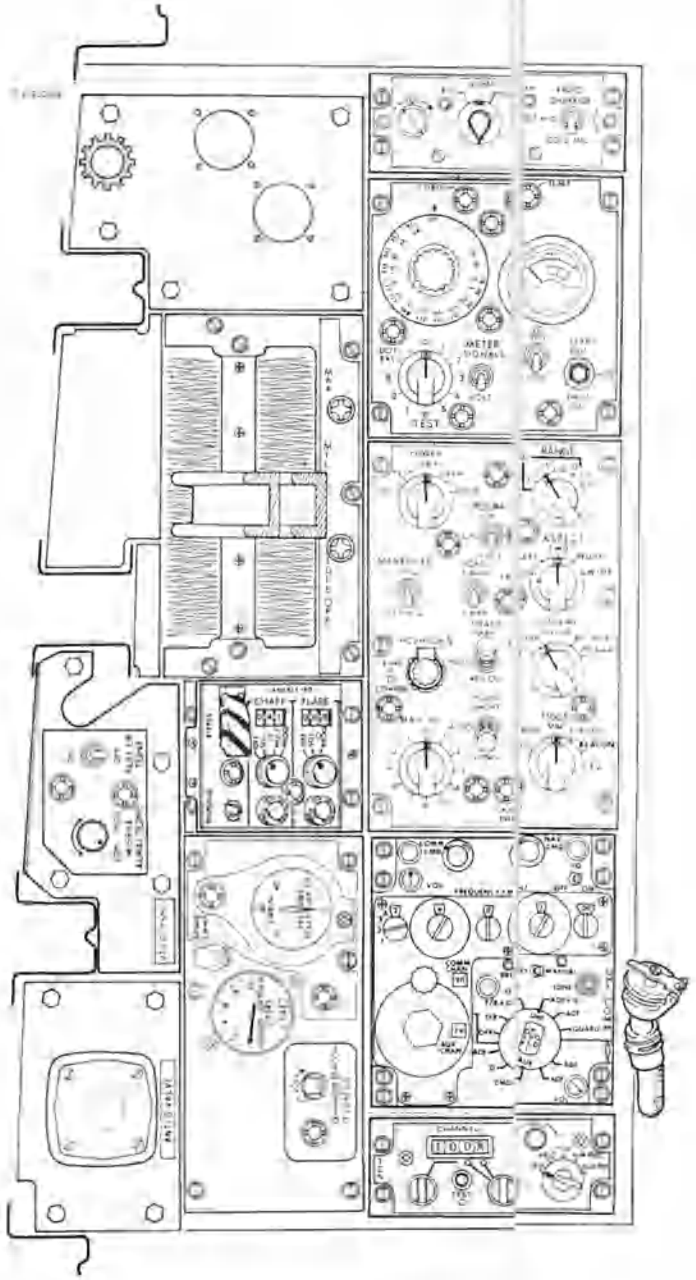
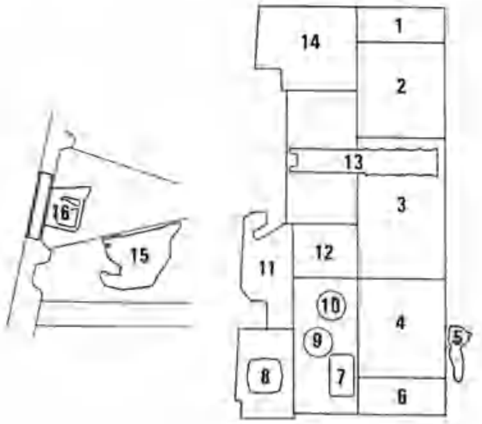
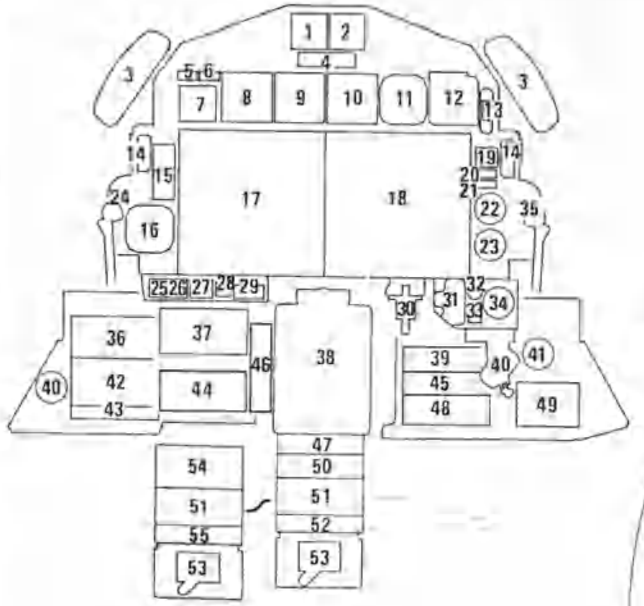
12. AN/ALE–40 PROGRAMMER
13. THROTTLES
14. BLANK PANEL
15. EMERGENCY SLATS FLAPS
16. CANOPY CONTROL HANDLE

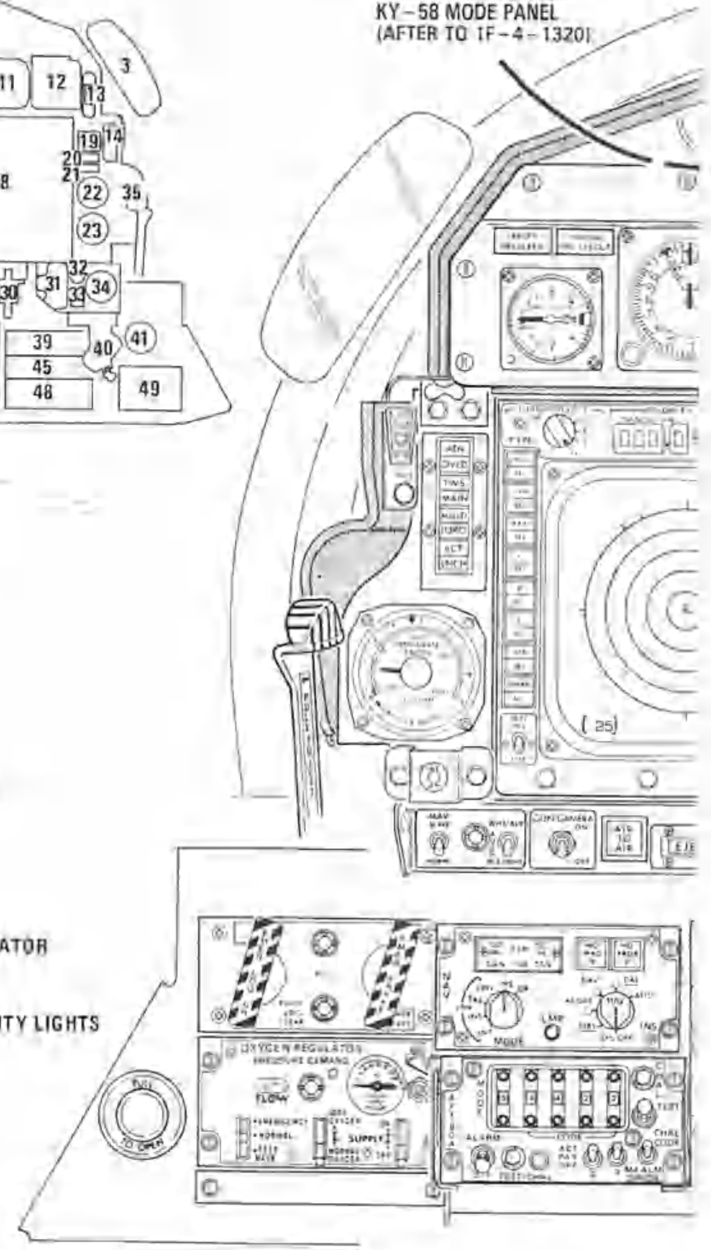








KY–58 MODE PANEL
(AFTER TO 1F–4–1320)



1. STANDBY MAGNETIC COMPASS
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16. RADAR ALTIMETER
17. PLAN POSITION INDICATOR & CONTROL
18. PANORAMIC, ANALYSIS & HOMING INDICATOR CONTROL
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25. SEEKER SLAVE SWITCH
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27. GUN CAMERA SWITCH
28. AIR–TO–AIR BUTTON
29. EJECT LIGHT

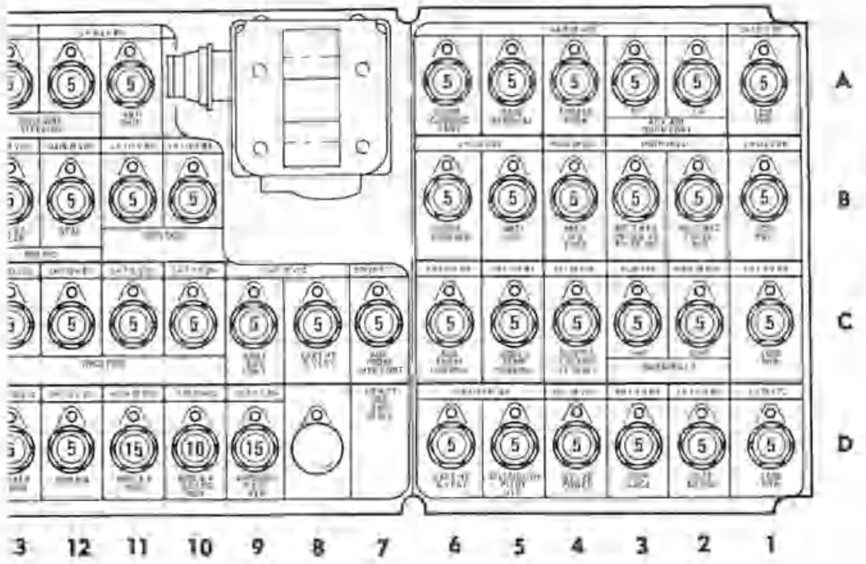
KY–58 CONTROL PANEL
(AFTER TO 1F–4–1320)

CIRCUIT BREAKERS

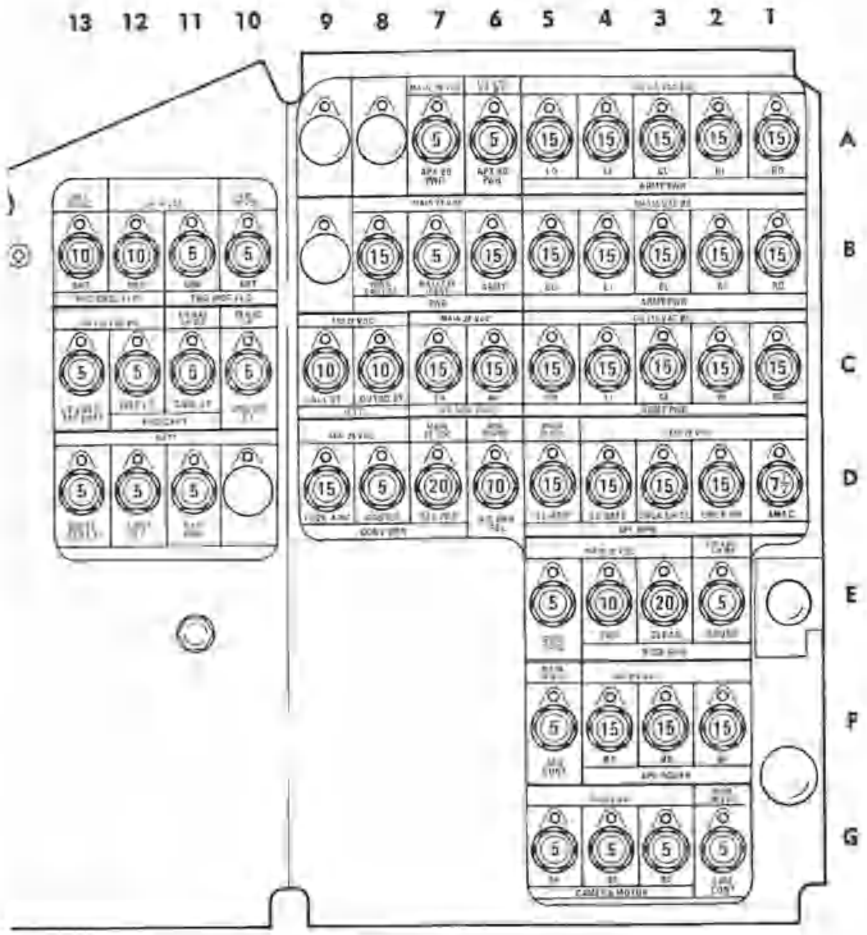
TYPICAL

Note

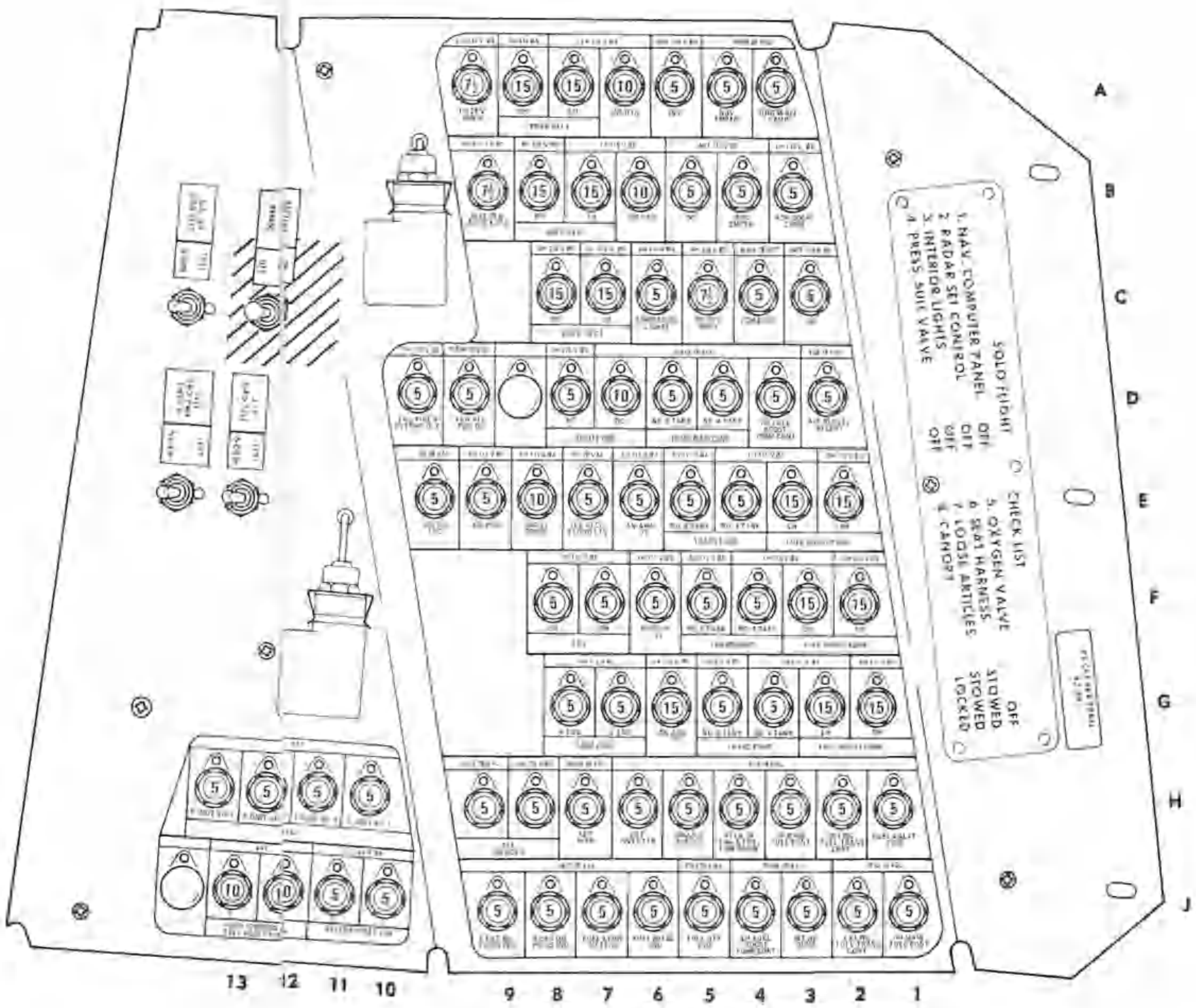
CIRCUIT BREAKER PANELS SHOWN ARE TO ILLUSTRATE THE ZONE REFERENCE SYSTEM AND ARE NOT INTENDED TO DEFINE THE CIRCUIT BREAKER PANEL CONFIGURATION IN A PARTICULAR AIRCRAFT.



CIRCUIT BREAKER PANEL NO. 3



CIRCUIT BREAKER PANEL NO. 1

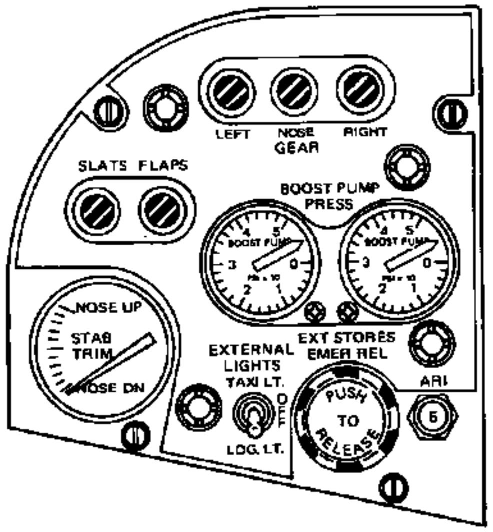


CIRCUIT BREAKER PANEL NO. 2

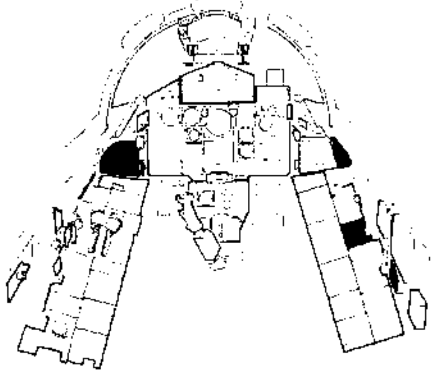
Figure FO-11

CIRCUIT BREAKERS

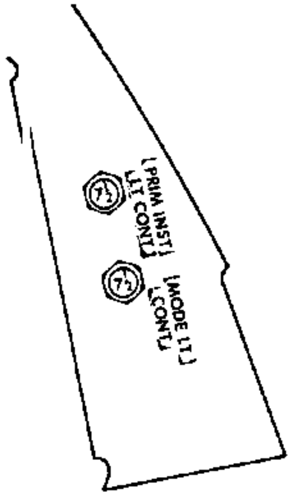
40_1-(94)B



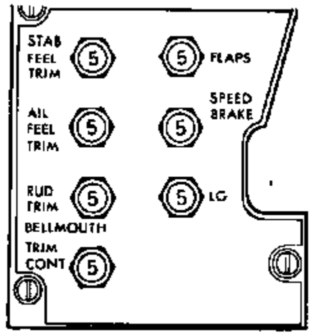
LEFT SUB PANEL



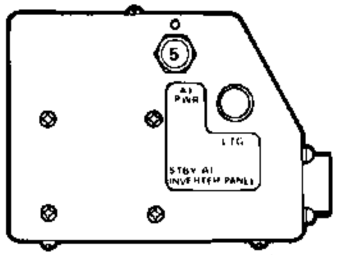
FRONT COCKPIT



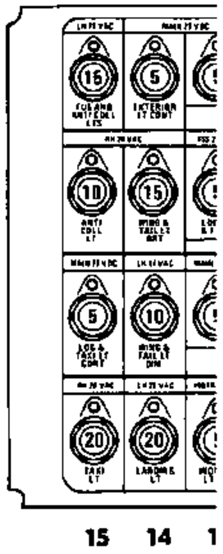
PRIMARY INSTRUMENT AND MODE LIGHTS CONTROL CIRCUIT BREAKERS

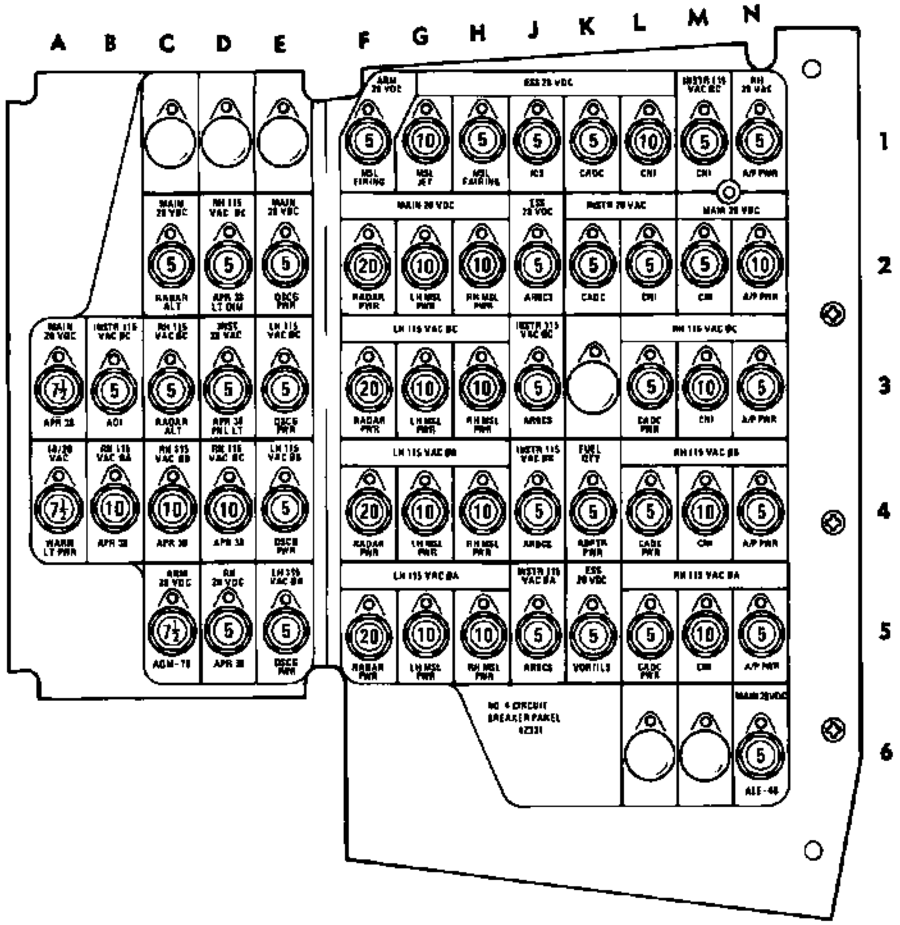


CIRCUIT BREAKER PANEL-RIGHT CONSOLE

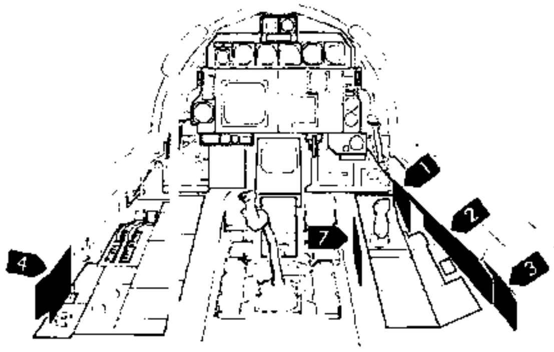


EMERGENCY ATTITUDE LIGHT CONTROL PANEL

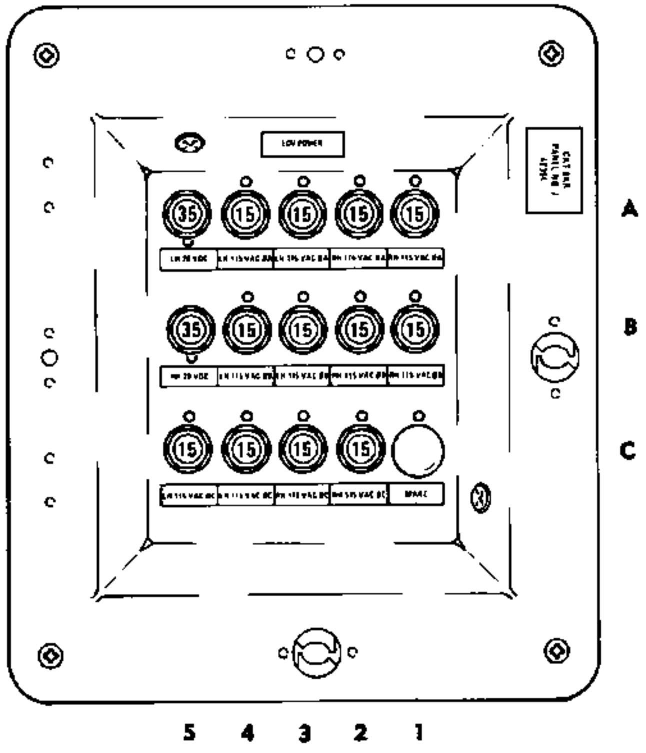




CIRCUIT BREAKER PANEL NO. 4



REAR COCKPIT



CIRCUIT BREAKER PANEL NO. 7

GLOSSARY

A

AC – Aerodynamic center

ac – Alternating current

ADCS – Air Data Computer Set

ADI – Attitude Director Indicator

AFC – Automatic Frequency Control

AFCS – Automatic Flight Control System

AGC – Automatic Gain Control

AHRS – Attitude Heading Reference System

AI – Airborne Intercept

AJB – Airborne, Electro-Mechanical, Bombing

AOA – Angle of Attack

APA – Airborne, Radar, Auxiliary Assembly

APN – Airborne, Radar, Navigational Aid

APQ – Airborne, Radar, Special Purpose

APU – Auxiliary Power Unit

AR – Air Refueling

ARI – Aileron Rudder Interconnect

ARC – Airborne, Radio, Control

ASA – Airborne, Special Type, Auxiliary Assembly

ASE – Allowable Steering Error

ASN – Airborne, Special Type, Navigational Aid

ASQ – Airborne, Special Type, Combination of Purposes

AVTR – Airborne Video Tape Recorder

AWW – Airborne, Armament, Control

B

BDHI – Bearing Distance Heading Indicator

BIT – Built-In-Test

BST – Boresight

C

CAT – Clear Air Turbulence

CADC – Central Air Data Computer

CAS – Calibrated Airspeed

CG – Center of Gravity

CIT – Compressor Inlet Temperature

CNI – Communication Navigation Identification

COSS – Computing Optical Sight System

CSD – Constant Speed Drive

D

dc – Direct current

DCU – Douglas Control Unit

DME – Distance Measuring Equipment

DMAS – Digital Modular Avionics System

DR – Dead Reckoning

DSCG – Digital Scan Converter Group

E

EAS – Equivalent Airspeed

ECM – Electronic Countermeasure(s)

EGT – Exhaust Gas Temperature

EWO – Electronic Warfare Officer

F

FL – Flight Level

G

G – Gravity

GCA – Ground Control Approach

GCI – Ground Control Intercept

gpm – Gallon per minute

H

Hangfire – A delay or failure of an article of ordinance after being triggered

Hang Start – A start that results in a stagnated rpm and temperature

Hot Start – A start that exceeds normal starting temperatures

HSI – Horizontal Situation Indicator

GLOSSARY (CONT)

Hz – Hertz

I

IP – Identification Point

IAS – Indicated Airspeed

IFF – Identification Friend or Foe

IFR – Instrument Flight Rules

ILS – Instrument Landing System

IMC – Instrument Meteorological Conditions

IR – Infrared

I/P – Identification of Position

J

JP – Jet Propulsion

K

KTS – Knots

L

LABS – Low Altitude Bombing System

LE – Leading Edge

LOX – Liquid Oxygen

Lpm – Liters per minute

M

MAC – Mean Aerodynamic Chord

MIL – Military

Misfire – A permanent failure of an article of ordinance being triggered

MSL – Mean Sea Level

N

N/A – Not applicable

N/E – Not established

NMPP – Nautical Miles Per Pound

O

OAT – Outside Air Temperature

P

P – Pilot

PC – Power Control

PDVL – Pull Down Vent Line

PLB – Personnel locator beacon

PRF – Pulse Repetition Frequency

PRI – Pulse Repetition Interval

psi – Pounds per square inch

Q

q – Dynamic Pressure, psf

R

RADAR – Radio Detection and Ranging

RCR – Runway Condition Reading

RF – Reconnaissance – Fighter

rpm – Revolutions Per Minute

S

SID – Standard Instrument Departure

SPC – Static Pressure Compensator

T

TACAN – Tactical Air Navigation

TAS – True Airspeed

TE – Trailing Edge

TMN – True Mach Number

U

UHF – Ultra High Frequency

V

VFR – Visual Flight Rules

VHF – Very High Frequency

VMC – Visual Meteorological Conditions

Vn – Velocity Acceleration Relationship

VORTAC – Very High Frequency – Omni Range and Tactical Air Navigation

ALPHABETICAL INDEX

NOTE

All text and illustrations numbers in this alphabetical index refer to page numbers, illustration page numbers are shown in parenthesis.

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