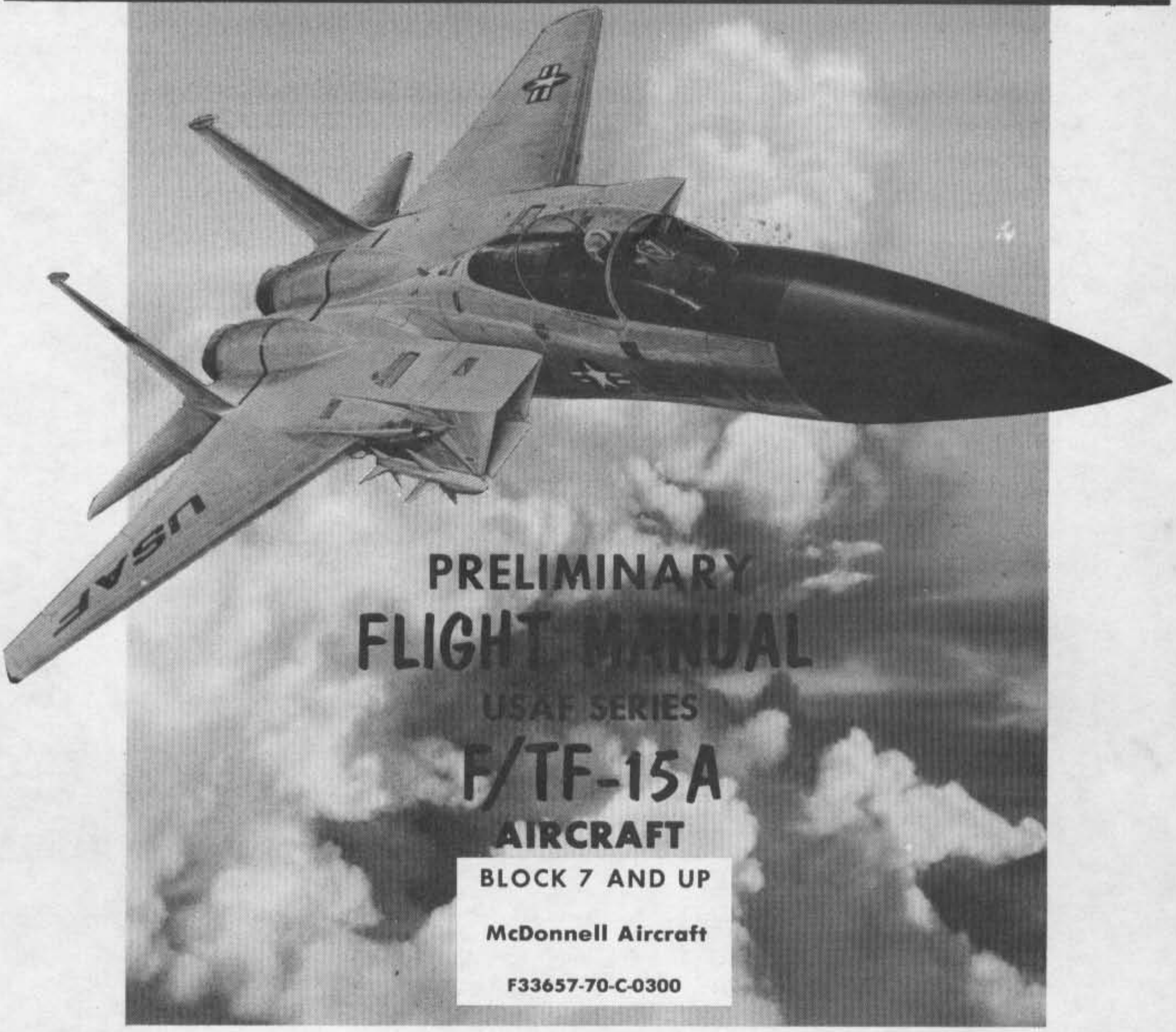

PRELIMINARY FLIGHT MANUAL

USAF SERIES F/TF-15A AIRCRAFT

BLOCK 7 AND UP

McDonnell Aircraft

F33657-70-C-0300

This manual supersedes T.O.1F–15A–1S–6 and –1S–7.

Commanders are responsible for bringing this publication to the attention of all affected personnel.

This document may be further distributed by any holder only with specific approval of ASD/YFK.

This manual is incomplete without T.O.1F–15A–1–1.

Published under authority of the Secretary of the Air Force.

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LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page.

Dates of issue for original and changed pages:

Original . . . 0 . . 15 Nov 74
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Total number of pages in this manual is 162, consisting of the following:

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CURRENT FLIGHT CREW CHECKLIST

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CURRENT SUPPLEMENTAL MANUAL

TO 1F—15A—1—1 Change 1 — 15 January 1975

Zero in this column indicates an original page.

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*Refer to Supplemental Manual, T.O.1F-15A-1-1

INTRODUCING THE F-15

SCOPE. This manual contains the necessary information for safe and efficient operation of your aircraft. These instructions provide you with a general knowledge of the aircraft and its characteristics and specific normal and emergency operating procedures. Your experience is recognized; therefore, basic flight principles are avoided. This manual provides the best possible operating instructions under most circumstances. 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. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA. Refer to T.O.0-1-1-4 for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also, check the flight manual cover page, the title block of each safety and operational supplement, and all status pages contained in the flight manual or attached to formal safety and operational supplements. Clear up all discrepancies before flight.

ARRANGEMENT. The manual is divided into seven fairly independent sections to simplify reading it straight through or using it as a reference manual.

SAFETY SUPPLEMENTS. Information involving safety will be promptly forwarded to you in a safety supplement. Supplements covering loss of life will get to you within 48 hours by teletype, and supplements covering serious damage to equipment within 10 days by mail. The cover page of the flight manual and the title block of each safety supplement should be checked to determine the effect they may have on existing supplements.

OPERATIONAL SUPPLEMENTS. Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

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

WARNING

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

CAUTION

Operating procedures, techniques, ETC., which will 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. Air Force personnel shall use ASD Form 0–271 (Recommendation for Change of Publication) to request changes to this publication. A copy of Form 0–271 is included at the back of this manual. These copies should be used to reproduce the form locally by any convenient method. Checklists do not contain samples of the form; however, when copies are required for these publications, the sample from any associated manual can be used to reproduce the form. Forward completed ASD Form 0–271 to AFFTC/DOVJV (Central Tech Order Unit), Edwards AFB, CA 93523.

CHECKLISTS. The flight manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures without the amplification. Primary line items in the flight manual and checklist are identical. If a formal safety or operational supplement affects your checklist, the affected checklist page will be attached to the supplement. Cut it out and insert it over the affected page but never discard the checklist page in case the supplement is rescinded and the page is needed.

HOW TO GET PERSONAL COPIES. Each flight crewmember is entitled to personal copies of the flight manual, safety supplements, operational supplements, and checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer – it is his job to fulfill your T.O. requests. Basically, you must order the required quantities on the appropriate Numerical Index and Requirement Table (NIRT). T.O.00–5–1 and T.O.00–5–2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL BINDERS. Looseleaf binders and sectionalized tabs are available for use with your manual. They are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Check with your supply personnel for assistance in procuring these items.

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 plotted illustrations) 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.

NOTE

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 effectivites.

SAFETY/OPERATIONAL SUPPLEMENT SUMMARY

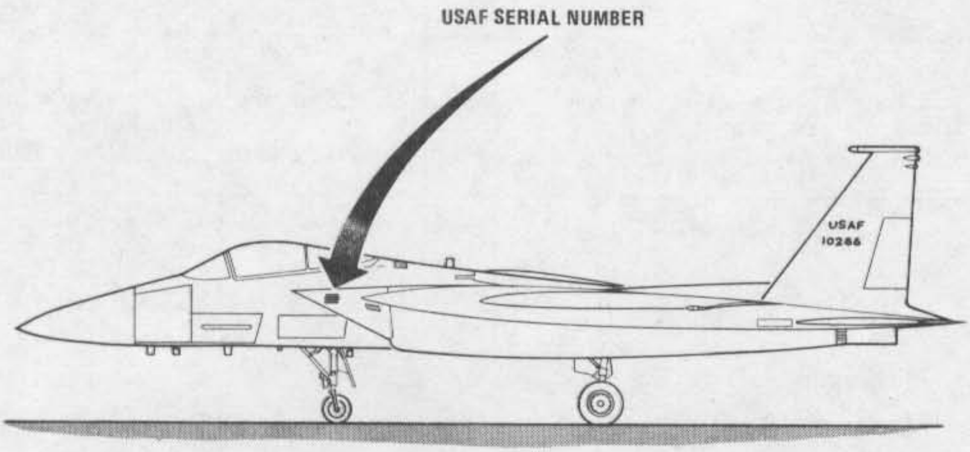
The following list contains: the previously cancelled or incorporated Safety/Operational Supplements; the outstanding Safety/Operational Supplements, if any; and the Safety/Operational Supplements incorporated in this issue. In addition, space is provided to list those Safety/Operational Supplements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

NUMBER	SUBJECT OR DISPOSITION
TO 1F–15A–1SS–1, –1S–2, and –1SS–3 thru –1SS–5	Previously cancelled or incorporated.
TO 1F–15A–1S–6	Modification of prohibited maneuvers with external tanks. Section V.
TO 1F–15A–1S–7	Modification of air refueling limitations.
TO 1F–15A–1S–8	Outstanding. Illumination of JFS Low Light.

TECHNICAL ORDER SUMMARY

Technical Order	ECP	Title	Production Effectivity	Retrofit Effectivity
1F-15A-522	318	Aft cockpit intercom	73-112 and up	73-108 thru 73-111
1F-15A-503	225	HUD Symbology modification	Block 10 and up	Block 7 thru 9

BLOCK NUMBERS



F-15A	TF-15A
BLOCK 7	BLOCK 7
73-085 thru 73-089	73-108 thru 73-110
BLOCK 8	BLOCK 8
73-090 thru 73-097	73-111 thru 73-112

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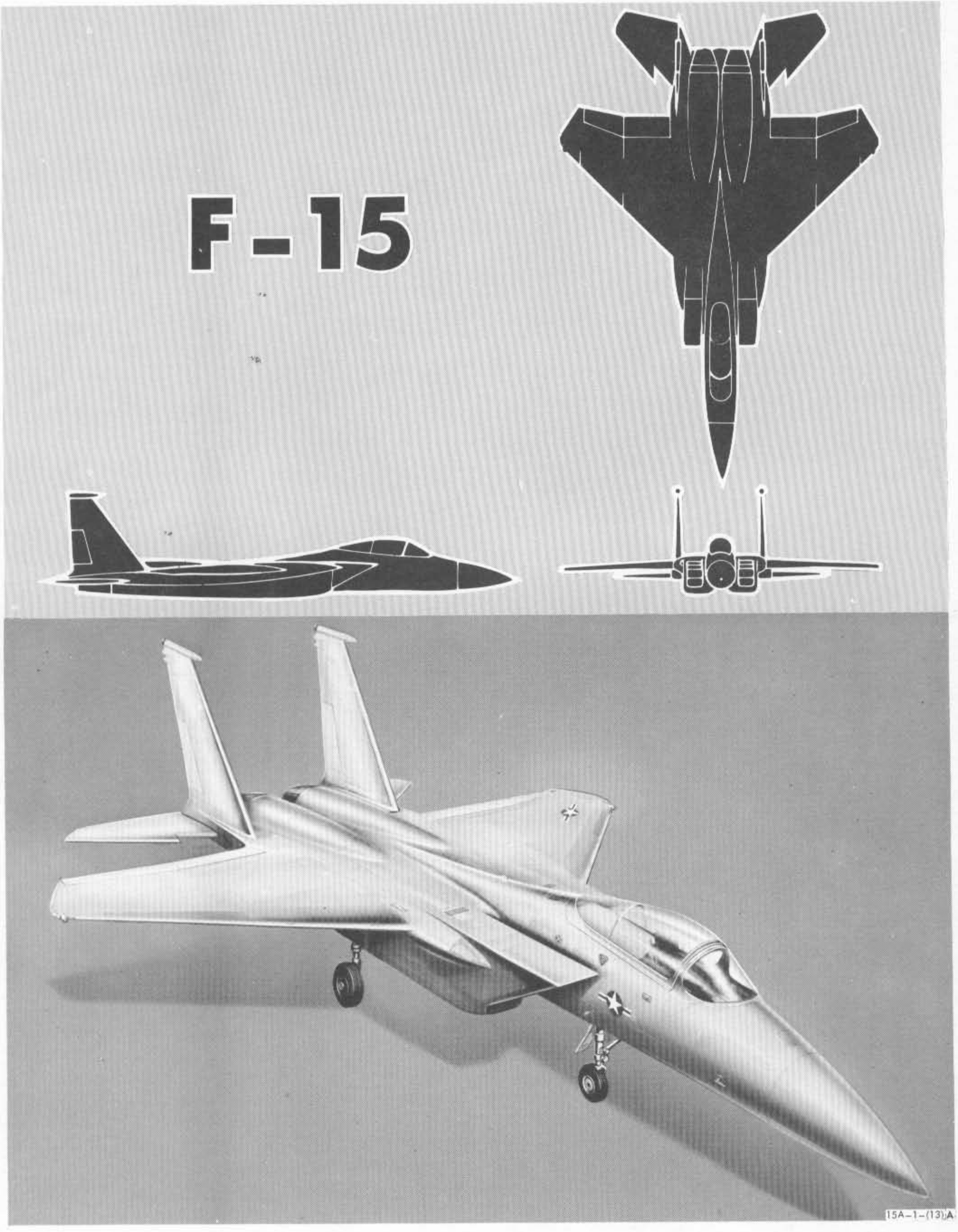
F-15
15A-1-(13)A

SECTION I
DESCRIPTION

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AIRCRAFT

The F-15 is a high-performance, supersonic, all-weather air-superiority fighter built by McDonnell Aircraft Company. Its primary mission is aerial combat, but it can also perform ground attack missions. Radar and heat seeking air-to-air missiles and a 20 MM gun are the primary armament. The aircraft is powered by two Pratt and Whitney F-100 turbofan engines which provide a high thrust to weight ratio. Aircraft appearance is characterized by a high-mounted swept-back wing, twin vertical stabilizers, and a light, high strength structure containing rugged subsystems. The cockpit is elevated to enhance visibility. The major aircraft systems are designed and located for high maintainability and reliability. An airframe mounted accessory drive (AMAD) contains many accessories previously mounted on the engine. A jet fuel starter provides self-starting of the engines. System design precludes the requirement for batteries. Refer to foldout section for general arrangement illustration.

DIMENSIONS

The approximate overall dimensions of the aircraft are:

Span - 42 feet, 8 inches

Length - 64 feet, 11 inches

Height - top of vertical tail - 18 feet, 6 inches
top of closed canopy - 10 feet, 10 inches

Distance between main landing gear - 9 feet, 1 inch

Minimum recommended turning radius during taxi - 45 feet, 1 inch

GROSS WEIGHT

The approximate gross weights are:

Empty weight	27,500 pounds
Operating weight (empty weight plus pilot, oil, and unusable fuel)	28,000 pounds
Takeoff gross weight (operating weight plus full internal fuel, ammunition and missiles)	42,000 pounds
Takeoff gross weight plus 3 external fuel tanks	53,000 pounds

ENGINES

The aircraft is powered by two F-100-PW-100 turbofan engines with afterburners. A self contained jet fuel starter is used to crank the engines for starting. External power is not required during engine starting.

ENGINE AIR INDUCTION SYSTEM

The two independent air induction systems consist of three variable ramps, a variable diffuser ramp, and a variable bypass door. Refer to figure 1-1.

Variable Ramps

The variable ramps provide air, at optimum subsonic flow, to the face of the engine fan inlet throughout a wide range of aircraft speeds. Ramp position is controlled by the air inlet controller.

ENGINE AIR INDUCTION SYSTEM

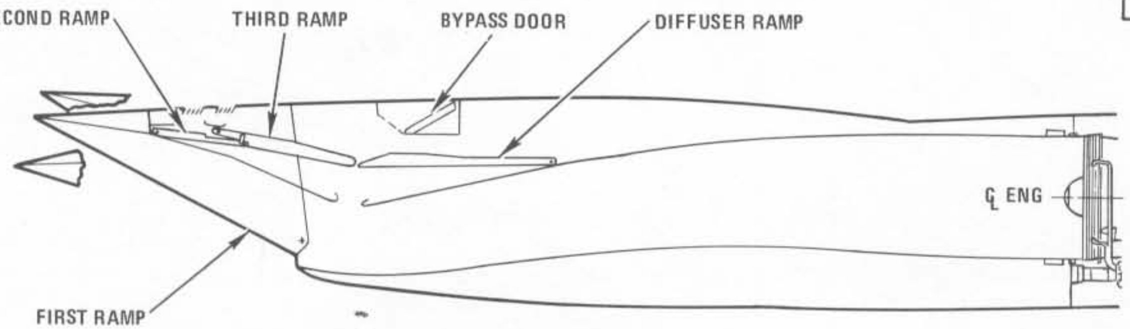


Figure 1-1

Bypass Door

The bypass door automatically controls the Mach number in the inlet duct. The air inlet controller positions the bypass door.

Air Inlet Controller

An air inlet controller (AIC), one for each inlet, uses angle of attack, aircraft Mach number and other air data system outputs to automatically schedule the ramps and bypass door throughout the aircraft envelope. The first ramp is locked in the up position until the engine is started. The diffuser ramp remains locked in the up position until the aircraft accelerates above 0.5 Mach. The L or R INLET light will illuminate to indicate an AIC failure.

Inlet Ramp Switch

An inlet ramp switch for each inlet is on the miscellaneous control panel. The switch is lever locked, and has positions of AUTO and EMERG. The L and R INLET lights warn of either an AIC failure or a diffuser ramp failure to lock or unlock at the appropriate times.

AUTO	The AIC automatically controls the air inlet system. This is the normal position.
EMERG	Removes electrical power from the ramp and bypass door actuators, causing them to move hydraulically to the emergency (ramps locked up and bypass door closed) positions. If hydraulic pressure fails, airloads will force the ramps and bypass door to the emergency position.

ENGINE OIL SYSTEM

Each engine is equipped with a completely self-contained oil system. Oil is supplied to the main pump element by gravity feed.

ENGINE FUEL SYSTEM

The fuel feed systems are independent and are identical (except for the jet fuel starter supply from the right engine feed line). Refer to foldout section for airplane and engine fuel system illustration.

Unified Control

The unified control (UC) performs the following functions: provides engine speed control, schedules rear compressor variable vanes, initiates engine and afterburner fuel flow, controls the convergent exhaust nozzles, provides cooling fuel for the engine electronic control and provides a positive fuel cutoff at engine shutdown. The unified control is scheduled mechanically from IDLE to MIL but is scheduled by the engine electronic control at MIL and above.

Engine Electronic Control

The engine electronic control (EEC) contains operating schedules for the variable fan inlet vanes and divergent exhaust nozzles. During operation at and above MIL power the EEC regulates engine fuel to control FTIT and provides supervisory trimming of the UC to maintain engine operation at maximum safe power. The EEC senses compressor speed, fan turbine inlet temperature and fan speed. It compares these values to its operating schedule and, if required, trims the UC to maintain optimum engine operation.

NOTE

In order to maintain efficient inlet airflow at speeds above Mach 1.4, a lock-up signal prevents the UC from reducing engine thrust below military. To reduce thrust below military, the pilot must slow the airplane below Mach 1.4.

IGNITION SYSTEM

Each ignition system contains an independent engine mounted generator and three igniter plugs (two for the engine and one for the afterburner). During engine start, moving the throttle from OFF to IDLE causes the engine igniter plugs to discharge. Igniter discharge then remains continuous during engine operation. When the throttle is moved into afterburner, afterburner ignition is activated for approximately ½ second.

AFTERBURNER FUEL SYSTEM

The afterburner fuel system provides fuel as a function of throttle position, burner pressure and fan exit temperature.

VARIABLE AREA EXHAUST NOZZLES

The engine has a convergent-divergent nozzle system which is continuously variable between minimum and maximum opening. The convergent nozzles are positioned pneumatically by engine bleed air.

Exhaust Nozzle Control

The convergent nozzle schedule is primarily controlled by the throttle position input to the Unified Control (UC). With the gear down and the throttle in IDLE, the nozzle will be approximately full open (100%). As the throttle is advanced approximately half way to MIL, the nozzle closes to near minimum area (0%). With the landing gear up, the nozzle is near minimum area at all times except at MIL or above. At MIL the EEC is automatically turned on and will trim the nozzle to regulate engine back pressure to control fan speed; the nozzle indicators will show slightly open (5-10% approximately). As the throttle is advanced in the afterburner range, the UC/EEC will schedule increasing nozzle area to compensate for increasing afterburner fuel flow. The convergent nozzle controls the exhaust gases while they remain subsonic. The divergent nozzle automatically controls the exhaust gases after they become supersonic.

ENGINE CONTROLS AND INDICATORS

Engine Master Switches

Two guarded engine master switches are on the engine control panel. Placing either switch to ON (with electrical power available), directs power to the fuel transfer pumps and opens the corresponding engine fuel shutoff valve. The engine master switch must be ON before the corresponding engine can be coupled to the JFS. Placing the switch OFF decouples the engine from the JFS.

Engine Start Fuel Switches

The engine start fuel switches, on the right console, provide improved starting performance under certain ambient temperatures and elevation. The switches have positions of SEA LEVEL, OFF and ALTITUDE and are spring loaded to the lever-locked OFF position.

OFF	Provides a lean fuel flow during normal start. Fuel flow is 350 pph until 30 seconds after engine rpm increases to 50% then automatically changes to 450 pph.
SEA LEVEL	Provides a rich fuel flow for starts when ambient temperature is below 40°F. Fuel flow is 450 pph regardless of rpm.
ALTITUDE	Provides a check of the system after engine is stabilized at IDLE. Fuel flow will drop approximately 100 pph when this position is selected.

Throttles

Movement of the throttle is transmitted by mechanical linkage to the engine unified control (UC). A friction adjusting lever is mounted adjacent to the right throttle. Finger lifts on the throttle couple the JFS to the engine during starting; they must also be lifted before the throttles can be moved from IDLE to OFF. Advancing the throttle from OFF to IDLE (during engine start) opens the main fuel shutoff valve in the UC and turns on engine ignition. Movement of the throttle from IDLE to OFF closes the main fuel shutoff valve in the UC, stopping fuel flow to the engine. Afterburner light-off is initiated by advancing the throttle forward of the afterburner detent.

Throttle Quadrant

The throttle quadrant contains the throttle levers and grips, friction adjusting lever, rudder trim switch and flap switch. Additionally, the throttle grips contain switches engineered to provide various system controls without moving the left hand from the grips. Refer to figure 1-2.

Vmax Switch

The Vmax switch is installed below the left canopy sill. The Vmax position allows the engines to operate above the normal FTIT limits. Use of the Vmax switch is prohibited.

Tachometers

Tachometers are mounted on the right side of the main instrument panel. Each indicator has a pointer and digital readout that indicates the core engine speed in percent rpm.

Fan Turbine Inlet Temperature (FTIT) Indicators

FTIT indicators are mounted on the right side of the main instrument panel. Each indicator has a pointer and a digital readout that indicates temperature in increments of 10 degrees Centigrade.

Fuel Flow Indicators

The indicators, on the main instrument panel, display fuel consumption per engine (with both a pointer and a counter) in pounds per hour. Total engine fuel flow (including afterburner) is displayed on the indicator.

Inlet Light

The L and R INLET lights, on the caution light panel, come on under the following conditions, depending on the inlet ramp switch position:

AUTO	AIC has failed or the diffuser ramp did not lock or unlock at the appropriate Mach number.
EMERG	The diffuser ramp did not lock up.

Oil Pressure Indicators

The oil pressure indicators are on the main instrument panel. The scale range is from 0 to 100 psi.

Oil Pressure Light

An OIL PRESS light, on the caution light panel, comes on if oil pressure is low. The signal comes from either oil pressure indicator.

Exhaust Nozzle Position Indicators

Exhaust nozzle position indicators, which show the exit area of the convergent nozzle in % of open, are on the main instrument panel. The indicators operate from movement of the exhaust nozzle control motor drive. Therefore, if the drive cable fails, the position indicator will show normal operation but the convergent exhaust nozzle will not move.

ENGINE STARTING SYSTEM

The engine is started by a small jet engine mounted on the central gearbox. This jet fuel starter (JFS) in conjunction with the AMAD provides cranking and initial electrical power for engine start. The engine starting system is complete in itself and no external power is required for starting. The JFS provides the only means of cranking the engines.

FIRE WARNING/EXTINGUISHING SYSTEM

The fire warning and extinguisher system consists of three illuminating pushbutton switches, one fire extinguisher bottle, a discharge/test switch, and dual-loop temperature sensors. The system provides fire and overheat warning, emergency engine and JFS shutdown, and selective fire extinguishing. The extinguisher bottle is located in the aft fuselage area between the engines. It is a gaseous system which provides one-shot, one-compartment extinguishing capability. The gas is non-toxic, non-corrosive and will not damage aircraft components. Electrical power is required to operate the fire warning and extinguisher system. During JFS operation, before the emergency generator comes on the line, only the AMAD system is operative.

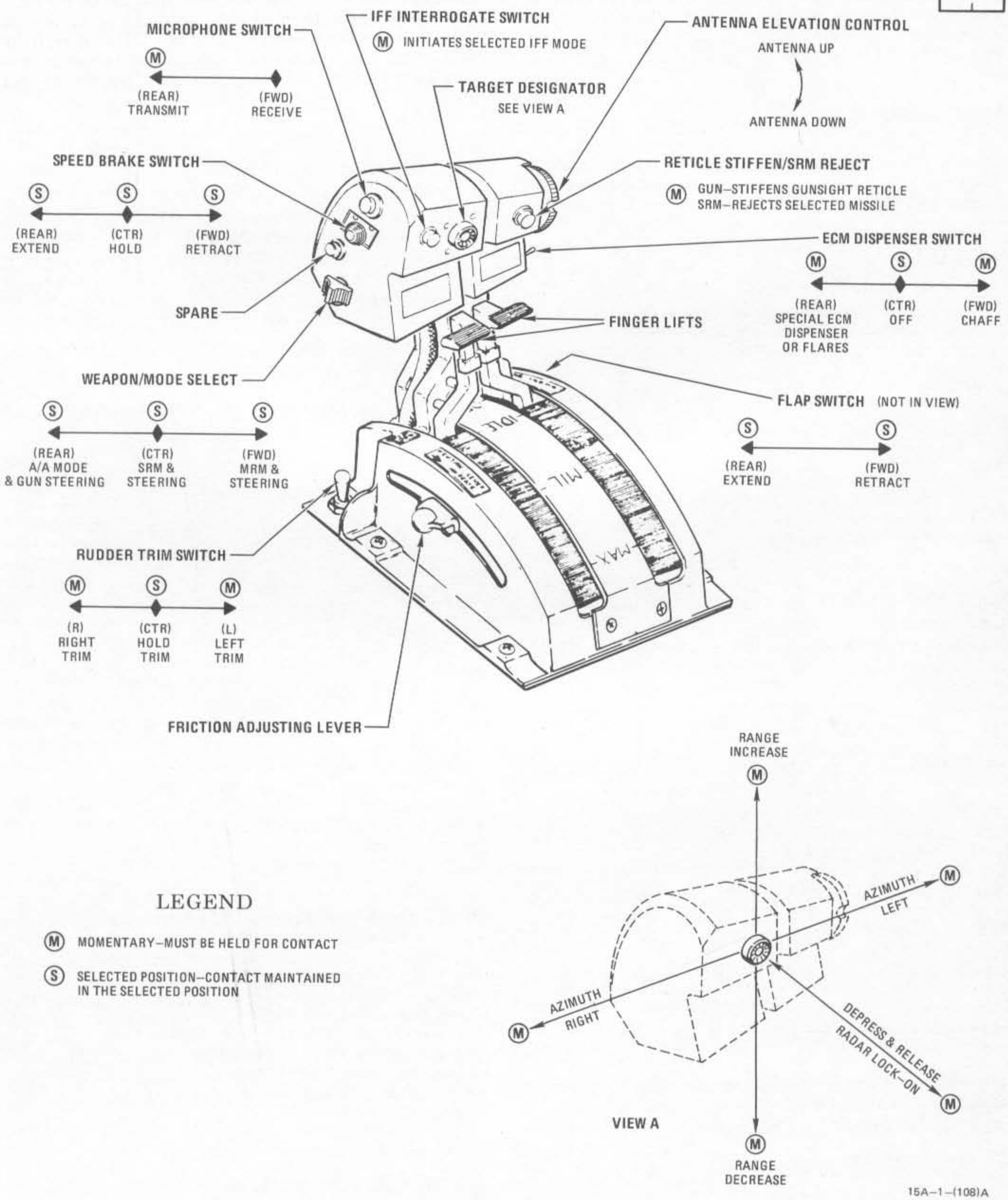
FIRE/OVERHEAT LIGHTS

The fire/overheat lights come on if a fire or overheat condition exists. Two of the lights are marked ENG FIRE PUSH with arrows pointing left or right. The third light is marked AMAD FIRE PUSH. A flashing light indicates an overheat condition and a steady light indicates a fire. Depressing the ENG FIRE PUSH light shuts off bleed air from, and fuel flow to, the corresponding engine, and arms the extinguisher bottle for release into the selected engine. Depressing the AMAD FIRE PUSH light arms the extinguisher bottle for release into the JFS. When arm is selected, approximately ⅛ inch of yellow and black stripes will be visible around the outer edges of the light(s). The fire/overheat lights must be depressed again to dearm the extinguisher and restore the selected system to normal operation.

DISCHARGE/TEST SWITCH

A discharge/test switch is located on the fire warning/extinguishing panel.

THROTTLE QUADRANT



LEGEND

(M) MOMENTARY–MUST BE HELD FOR CONTACT

(S) SELECTED POSITION–CONTACT MAINTAINED IN THE SELECTED POSITION

Figure 1-2

OFF	System provides normal fire and overheat warning.
TEST	Turns on the three fire/overheat lights (only the AMAD light if the JFS is providing electrical power) indicating the temperature sensors are operational. Switch is spring loaded to OFF.
DISCHARGE	Discharges the extinguisher bottle into the selected compartment. If the AMAD circuit was selected, the discharge switch also shuts off fuel flow to the JFS. The switch is lever-locked from OFF to DISCHARGE.

SECONDARY POWER SYSTEM

The secondary power system provides power for starting the aircraft engines and transmits power from the engine to the aircraft accessories. It consists of a central gearbox (CGB), JFS, and left and right AMAD gearboxes.

CENTRAL GEARBOX

The central gearbox provides the gearing and clutching functions necessary to transmit power developed by the jet fuel starter (JFS) for aircraft engine starting or limited duty operation for ammunition loading. After both engines have been started, the left and right AMAD gearboxes are completely isolated from the CGB and remain so throughout all phase of flight.

JET FUEL STARTER (JFS)

A JFS, mounted on the central gearbox, is used for engine starting. It can start both engines, but not simultaneously. JFS operation is controlled by the JFS starter switch and the JFS control handle; fuel is provided by the main aircraft fuel system. JFS ignition and initial electrical power are provided by the JFS generator (permanent magnet). Starting power to the JFS is provided by a hydraulic motor that is driven by hydraulic pressure accumulators. The accumulators are charged automatically by circuit B of the utility hydraulic system, or manually by hand pump. The JFS automatically shuts down when the second engine reaches approximately 50% rpm. The JFS cannot be operated during flight.

JFS Starter Switch

The jet fuel starter switch is on the engine control panel located on the right console. It has positions of ON and OFF. During engine start, the JFS is automatically shut down after both engines are started; however, it can be shut down at any time by placing the switch to OFF.

JFS Ready Light

The JFS ready light is on the engine control panel located on the right console. The light comes on as the JFS reaches approximately 50% speed, signifying the JFS is ready to be engaged. The light goes out when the JFS shuts down.

JFS Control Handle

The JFS control handle is located on the lower right corner of the main instrument panel. Pulling the handle straight out discharges one JFS accumulator. Rotating the handle 45° CCW and pulling discharges both accumulators, or the remaining accumulator if one has already been discharged. The handle is spring loaded to return to its normal position.

JFS Low Light

A JFS LOW light, on the caution light panel, comes on if either JFSaccumulator pressure is low.

AMAD GEARBOXES

The left and right gearboxes provide the gearing necessary to drive the accessories which supply the aircraft with electrical and hydraulic power, and to transmit mechanical power for engine starting. Each gearbox has one utility hydraulic pump, one power control (PC) hydraulic pump, and one integrated drive generator (IDG). During aircraft engine starting, power is transmitted from the JFS through the central gearbox and through the applicable gearbox to the engine. Once the engine is started, it drives its own gearbox and the associated accessories. The accessories mounted on either gearbox are sufficient to support the aircraft systems if one engine or its associated gearbox should fail. Two drive shafts (one for each engine) provide mechanical connection between the gearboxes and the engines. During engine starting, they transmit torque from the gearbox to the engine; after engine start, they transmit power from the engine to drive the accessories. On airplanes block 8 and up, a manual decoupler is provided in the left gearbox which permits the JFS to be used for driving the accessories without rotating the left engine (limited duty cycle).

AIRCRAFT FUEL SYSTEM

Refer to foldout section for airplane and engine fuel system illustration. Fuel is carried internally in four interconnected fuselage tanks, and two internal (wet) wing tanks. External fuel is carried in three 600 gallon drop tanks. The drop tanks, with pylons, are mounted on the centerline and inboard wing stations, and are completely interchangeable. All tanks may be refueled on the ground through a single pressure refueling point, airborne they can be refueled through the aerial refueling receptacle. External tanks may be individually fueled through external filler points. The internal wing tanks and tank 1 are transfer tanks. The tanks are so arranged that all internal fuel will transfer even if the transfer and boost pumps fail. Regulated engine bleed air pressure transfers fuel from the external tanks to any internal tank that will accept it and also provides a positive pressure on all internal fuel tanks. The fuel tanks are not pressurized until the weight is off the gear. Float type fuel level control valves control fuel level during refueling or fuel transfer operations. All internal and external fuel (except engine feed tanks) may be dumped overboard from an outlet at the trailing edge of each wing tip. All internal fuel tanks are vented through the vent/dump outlets at each wing trailing edge. The external tanks are vented through the vent outlets in their individual pylons. The fuel gaging system provides fuel quantity, in pounds, of all internal and external fuel. Refer to Servicing Diagram, this section, for fuel grade and specifications.

SURVIVABILITY

The fuel tanks, all of which are located forward of the engines, contain foam for fire/explosion protection. The feed tanks are self sealing for up to 50-caliber ammunition. Fuel lines are routed inside tanks where possible, and most have self-sealing protection when outside the tanks.

TRANSFER

The fuel transfer system is completely automatic and provides: automatic backup gravity transfer if normal transfer fails, full feed tanks for all engine power settings, and automatic external fuel transfer sequencing. Normal fuel transfer is accomplished by three electric transfer pumps and engine bleed air pressure. The pumps automatically transfer fuel to the engine feed tanks when the transfer level control valves in these two tanks drop to a specified level. The transfer pumps run continuously when electrical power is applied to the aircraft and an engine master switch is ON. If the electrical transfer pumps fail, all internal fuel will transfer (through gravity feed lines) to the engine feed tanks. External fuel is transferred by engine bleed air pressure. If a complete electrical failure occurs, the drop tanks will still transfer.

External Tank Fuel Control Switches

Two external tank fuel control switches, labeled WING (for external wing tanks) and CTR (for centerline tank), are located on the fuel control panel. These switches are inoperative when tanks are not aboard.

NORM	Provides automatic fuel transfer of the external wing tanks followed by the centerline tank.
STOP TRANS	Stops transfer from external tanks, unless FUEL LOW light is on, in which case fuel will transfer regardless of switch position.
STOP REFUEL	If selected prior to aerial refueling, will prevent filling of the tank(s) selected.

FUEL FEED SYSTEM

There are two separate fuel feed systems, one for each engine. During normal operation, the right boost pump supplies fuel to the right engine only and the left boost pump supplies fuel to the left engine only. The boost pumps are capable of supplying the engine with fuel during all flight attitudes. If one boost pump fails, the emergency boost pump is activated, the interconnect valve associated with the failed boost pump opens, and the crossfeed valve opens. With the interconnect valve open, fuel will gravity feed into the feed tank with the operating boost pump. The operating boost pump and the emergency boost pump then supply fuel to both engines through the crossfeed valve. If both boost pumps fail, the emergency pump is activated, both interconnect valves open and fuel will gravity feed between feed tanks. The emergency boost pump then supplies fuel to both engines through the crossfeed valve. If both boost pumps and the emergency boost pumps fail, fuel is supplied to the engines through the separate fuel feed lines by gravity and suction flow. Baffles in the feed tanks provide a limited fuel supply for the left and right boost pumps during negative G or inverted flight. The heat exchangers in each feed system provides cooling for the AMAD, IDG, PC1, PC2 and utility hydraulic systems. If the fuel is too hot, a thermally operated bypass valve on the heat exchanger opens and bypasses fuel back to the wing tanks after going through the heat exchanger. The wing tanks act as a heat exchanger to lower the fuel temperature.

Boost Pump Caution Lights

Two boost pump lights are located on the caution light panel. These lights are marked L BST PMP (for left boost pump) and R BST PMP (for right boost pump) and come on if the associated boost output pressure is low and the pressure operated interconnect is open.

Fuel Hot Light

The FUEL HOT light, on the caution light panel, illuminates when the engine feed fuel temperature is too high.

FUEL TANK PRESSURIZATION AND VENT

The pressurization and vent system provides regulated engine bleed air pressure to all internal and external tanks for pressurization, and to the external tanks for fuel transfer. The system also provides pressure relief of the fuel tanks during climbs, and vacuum relief of the fuel tanks, as required, during descents. The tanks do not pressurize until the weight is off the landing gear and terminates as soon as the left main gear is compressed at touchdown.

FUEL QUANTITY INDICATING SYSTEM

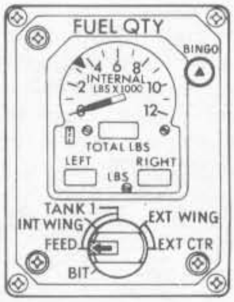
The fuel quantity indication system provides readings, in pounds, of usable internal and external fuel. Refer to figure 1-3. The system components include the fuel

FUEL QUANTITY DATA TABLE

JP-4

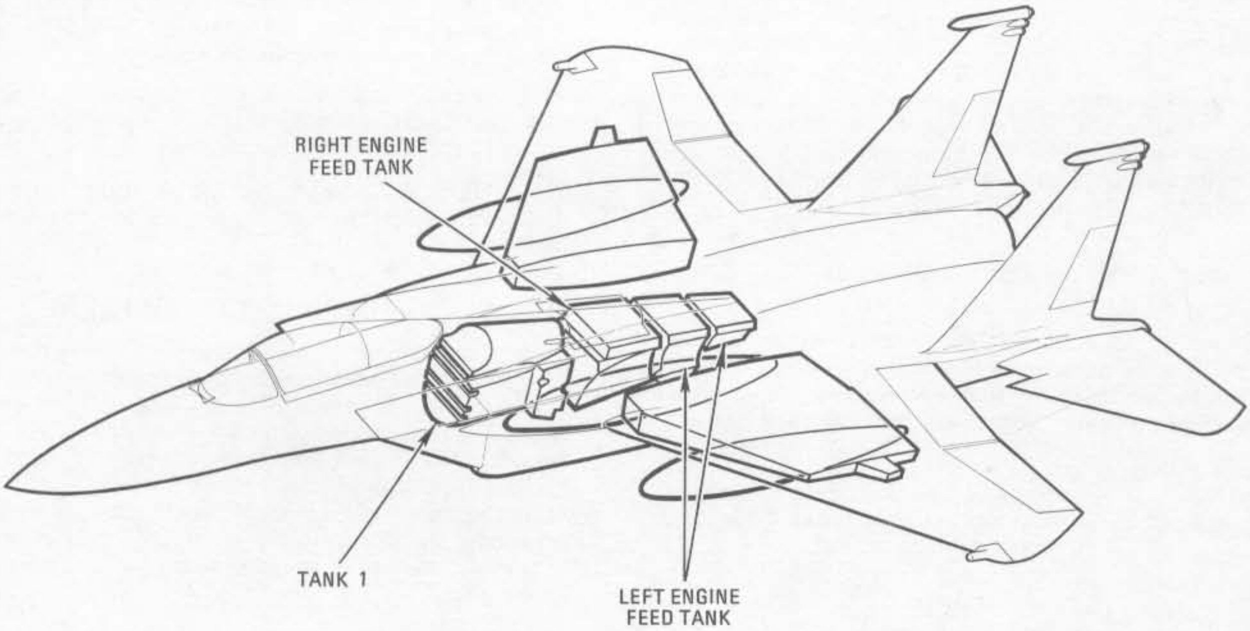
TANK		USABLE FUEL [1]	
		GALLONS	POUNDS
TANK 1		485	3150 ± 120
RIGHT ENG FEED TANK		242	1550 ± 90
LEFT ENG FEED TANK		186	1200 ± 80
INTERNAL WING TANKS	L	423	2750 ± 215
	R	423	2750 ± 215
TOTAL INTERNAL FUEL		1759	11,400 ± 430
EXTERNAL WING TANKS	L	610	3950 ± 265
	R	610	3950 ± 265
INTERNAL FUEL PLUS EXTERNAL WING TANKS		2979	19,300 ± 590
EXTERNAL ℄ TANK		610	3950 ± 265
INTERNAL FUEL PLUS EXTERNAL ℄ TANK		2369	15,350 ± 515
MAXIMUM FUEL LOAD TOTAL INTERNAL PLUS ALL EXTERNAL TANKS		3589	23,250 ± 670

[1] CALCULATED VALUES



NOTES

- THE FUEL QUANTITIES, IN POUNDS, ARE ROUNDED OFF TO READABLE VALUES OF COUNTER PORTION OF THE FUEL QUANTITY INDICATOR; THEREFORE, THE ACTUAL GALLONS TIMES 6.5 WILL NOT NECESSARILY AGREE WITH THE POUNDS COLUMN.
- FUEL WEIGHTS ARE BASED ON JP-4 AT 6.5 POUNDS PER GALLON AND 60 DEGREES FAHRENHEIT.



15A-1-(2 C

Figure 1-3

quantity indicator, a built-in-test (BIT), a BINGO light, and an independent FUEL LOW light.

Fuel Quantity Indicator

A combination pointer-counter fuel quantity indicator is on the lower right side of the main instrument panel. Refer to figure 1-3. The pointer indicates usable internal fuel (with readings multiplied by 1000). The counter indicates usable internal and external fuel. Two other counter positions, marked LEFT and RIGHT, and a selector switch provides individual tank monitoring and a check of the indicator. An OFF indicator will be displayed if no electrical power is available.

BIT	A spring loaded position that will drive the internal (pointer) and total (counter) indicators to 6000 pounds, and the LEFT and RIGHT (counters) to 600 pounds indicating the fuel system is operating normally.
FEED	The fuel remaining in the respective engine feed tanks will be displayed.
INT WING	The fuel remaining in the respective internal wing tanks will be displayed.
TANK 1	The fuel remaining in the transfer tank will be displayed in the LEFT counter (RIGHT will indicate zero).
EXT WING	The fuel remaining in the respective external wing tanks will be displayed.
EXT CTR	The fuel remaining in the centerline tank will be displayed in the LEFT counter (RIGHT will indicate zero).

Fuel Low Light

A FUEL LOW light, on the caution light panel, warns the pilot of a low fuel level in one or both engine feed tanks. The FUEL LOW light is completely independent of the fuel quantity indicating system and is controlled by a thermistor in each feed tank. The thermistor in the right feed tank is located at the 950 pound level and the thermistor in the left feed tank is located at the 540 pound level. If either thermistor is exposed (regardless of the combined indicated fuel quantity) the FUEL LOW light will come on. The light normally comes on at 1500 $\pm$200 pounds. However, if the light comes on with the fuel quantity gage indicating appreciably more than 1700 pounds, the rotary switch should be positioned to FEED and the LEFT and RIGHT counters checked to determine which feed tank has a low fuel state. The MASTER CAUTION light comes on in conjunction with the FUEL LOW light.

Bingo Light

A BINGO light is located on the caution light panel and comes on at a preset value, controlled by the pilot. An adjustable index (bug) on the face of the indicator may be set to any internal fuel quantity by turning the bingo knob. If the bingo index is set above 6000 pounds, the BINGO light will come on when the BIT check is made. The MASTER CAUTION light comes on in conjunction with the BINGO light. The bingo light circuit may be used to automatically terminate fuel dumping.

FUEL DUMP SYSTEM

All fuel except engine feed tank fuel may be dumped by placing the dump switch, on the fuel control panel, to DUMP. The fuel dump switch is spring loaded to the lever-locked NORM position and is electrically held in the DUMP position (with BINGO light off). When DUMP is selected, a motor-operated dump valve in each internal wing tank opens. With the dump valves open, the transfer pumps in the transfer tank and each internal wing tank forces fuel out the wing dump masts. The external fuel (if STOP TRANS is not selected) transfers into the wing tanks and transfer tank, and is then dumped. Dumping will continue until:

a. NORM is selected on the dump switch.
b. The BINGO light comes on, at which time the dump switch automatically returns to NORM terminating fuel dumping.
c. Only feed tank fuel remains. This can occur if the BINGO bug is below approximately 2700 lbs.

CAUTION

- When the aircraft is on the ground, internal fuel will dump anytime DUMP is selected, electrical power is available, and an engine master switch is on.
- The dump switch must be in the NORM position when electrical power is removed from the valve. If the valve is in the DUMP position it will not close without electrical power regardless of switch position. With the valve open, fuel will be dumped while refueling the aircraft.

EXTERNAL TANK JETTISON SYSTEM

The external fuel tanks may be jettisoned individually or simultaneously. The EMERG JETT button, A/G SELECT switch, and SELECT JETT switch control tank jettison. (For other stores, including missiles, refer to T.O.1F-15A-34-1.)

EMERG JETT	All stores from all stations including AIM-7, are jettisoned simultaneously, ground or air, when button is depressed.

A/G SELECT switch - STA/JETT side.

R	Selects right wing station (2).
C	Selects centerline station (5).
L	Selects left wing station (8).
ALL	Selects three stations (2, 5, and 8).

SELECT JETT Switch

COMBAT	Selects right and left wing tanks (or stores) plus centerline tank and pylon.
PYLON	Selects pylon and tank (or stores) on station(s) selected on A/G SELECT switch.
STORES	Selects tank (or stores) on stations selected on A/G SELECT switch.
JETT	If the aircraft is airborne (weight off wheels) or armament safety override switch engaged, depressing this button initiates the jettison sequence for the station(s) or tank(s) selected.

AIR REFUELING SYSTEM

The air refueling system has a fixed receptacle, a control switch, a hydraulically operated slipway door, two slipway lights, a receptacle flood-light, a signal amplifier, a READY light, an air refueling release button, an air refuel pressure switch, and an emergency slipway door actuating system. Normal operation is accomplished by placing the slipway control switch to OPEN; the slipway door opens and the signal amplifier conditions the fuel system circuitry to receive fuel. Once the slipway door is fully open; the slipway lights, the receptacle floodlight, and READY light (aircraft is ready for refueling) comes on. When the boom is locked in the receptacle; the READY light goes out, the tanker director lights come on, and fuel is transferred at a rate up to approximately 3900 pounds per minute without external tanks or approximately 1000 pounds per minute with external tanks. Boom locking also energizes the automatic (flight outside the boom envelope) and manual (tanker initiated) disengage capabilities. The air refuel pressure switch, in the receptacle outlet, automatically disengages the boom if refueling pressure becomes too great. If the boom becomes disengaged, the READY light comes on (after a 5 second delay) indicating fuel transfer is interrupted and the system has been automatically recycled for a new hook-up. At the completion of the air refueling sequence, the boom is disconnected by pressing the air refueling release button (auto acquisition button). For normal and emergency air refueling procedures refer to F/TF-15 Flight Crew Air Refueling Procedures (T.O.1-1C-1-25).

Slipway Switch

The three position slipway switch is located on the fuel control panel.

OPEN	Opens the slipway door, interrupts the fuel control panel, and turns on the READY light indicating the system is ready for boom engagement.
ORIDE	Allows boom locking, but all automatic disengage features will be lost; tanker manual disengage feature will be lost, and the tanker director lights will be inoperative.
CLOSE	Closes the slipway door and re-establishes fuel sequencing.

External Tank Switches

The two external tank switches, on the fuel control panel, provide an option of refueling the external tanks. If the switches are in NORM, the external tanks will fill during refueling. If either or both switches are in STOP REFUEL, the corresponding external tank(s) will not fill during refueling. When the external tanks are not installed or have been jettisoned the switches are inoperative.

Air Refueling Release Button

The air refueling release button is a push-button type switch on the stick grip. When release from the boom is desired, depress and hold the release button until the air refuel READY light comes on. Throttle or attitude changes should not be made until the boom is clear of the receptacle.

Emergency Air Refueling Handle

If UTL A fails, the slipway door can be opened by pulling the emergency air refueling handle on the left console. Pyrotechnic devices open the door, which cannot then be closed in-flight. Normal slipway lighting will be available, but the READY light will not extinguish during refueling, nor will the boom lock in the receptacle. Normal feed tank pressurization will be restored if the slipway door switch is placed to CLOSE.

GROUND REFUELING

All fuel tanks (including external tanks) are pressure fueled through a single point receptacle. The external tanks can also be fueled through filler caps. No external power is required for single point refueling.

CAUTION

If the fuel dump valve was open when electrical power was removed from the aircraft, it will remain open until power is reapplied. Fuel will be dumped during refueling if the dump valve is open.

ELECTRICAL POWER SUPPLY SYSTEM

The electrical power supply system consists of two main AC generators, two transformer-rectifiers, an emergency AC/DC generator, and a power distribution (bus) system. External electrical power can be applied to the bus system on the ground, and the JFS generator provides electrical power to part of the bus system during an engine start without external power. Refer to foldout section for electrical system simplified schematic.

AC ELECTRICAL POWER

Two AC generators are the primary source of electrical power. The two generators are connected for split bus nonsynchronized operation. This means that with both generators operating each generator supplies power independently to certain aircraft buses. If one generator fails, it drops off the line; and at the same time, power from the remaining generator is provided to the buses of the failed (or turned off) generator. Current limiters are provided to prevent a fault in one generator system from shutting down both generators. Either generator is capable of supplying power to the entire system; except that the TEWS pods and the internal TEWS will not operate simultaneously during single generator operation. Each generator is activated automatically when its control switch is in the ON position, and the generator is connected to its buses when voltage and frequency are within prescribed limits (approximately 50% engine RPM). A protection system within the generator control unit protects against damage due to undervoltage, overvoltage, over and under frequency, feeder faults, and generator locked rotor. If a fault or malfunction occurs, the generator control unit removes the affected generator from its buses. Except for an under frequency condition, the control switch of the affected generator must be cycled to bring the generator back on the line after the fault or out-of-tolerance condition clears. If the generator drops off the line due to under frequency and the prescribed frequency is restored, the generator will come back on the line automatically. A generator may be removed from its buses at any time by placing the generator control switch to OFF.

DC ELECTRICAL POWER

Two transformer-rectifiers are provided. The output of both transformer-rectifiers are connected in parallel; however, protection is provided so that a short on a bus of one transformer-rectifier will not affect the other transformer-rectifier. Also, if one transformer-rectifier fails, the other transformer-rectifier will power the entire DC system. No cockpit warning of single transformer-rectifier failure is provided.

EMERGENCY GENERATOR

A hydraulic motor-driven emergency AC/DC generator capable of supplying AC power simultaneously with DC power is provided. The emergency electrical power system is separate from the primary electrical system. When operating, the emergency generator is driven by a hydraulic motor which operates from utility hydraulic system pressure. If both main generators fail, or both transformer-rectifiers fail, or some combination of faults occur, a hydraulic motor selector valve automatically deenergizes open to start the emergency generator hydraulic motor. When the emergency generator comes up to speed with the emergency generator control switch in NORM, emergency AC and DC power is supplied and the EMER GEN ON light comes on. With the emergency generator on the line and the emergency generator control switch switched (after generator is on the line) from NORM to EMERG ON, emergency AC power is supplied only to the emergency boost pump and emergency DC power is supplied only to the arresting hook control and indicating circuits. The EMER GEN ON light does not come on with the emergency generator control switch in EMERG ON.

JFS GENERATOR

The jet fuel starter (JFS) generator system consists of a permanent magnet generator on the central gear box (CGB) and a regulator/rectifier on the jet fuel starter. The system provides electrical power for jet fuel starter ignition and control. When the jet fuel STARTER switch on the engine control panel is ON and the jet fuel starter handle is pulled, the JFS generator provides ignition to the JFS, arms the AMAD fire extinguisher system, opens the JFS fuel valves, and energizes the JFS control relay. At approximately 50% RPM the JFS/essential DC and fire extinguisher buses are energized and the STARTER READY light comes on indicating that the AMAD fire detection system is armed, the utility light is available, the intercom system is available, and then either engine can be started. The JFS/essential DC bus and the fire extinguisher bus remain energized by the JFS until both main generators come on the line to automatically shut down the JFS. The JFS can be shut down at any time by placing the starter switch to OFF. When shutting the JFS down using the starter switch, the JFS generator keeps the fire extinguisher bus energized for a short period of time during JFS run down.

EXTERNAL ELECTRICAL POWER

External electrical power may be connected to the aircraft bus system through an external electrical power receptacle on the bottom of the forward fuselage near the nose gear wheelwell. The aircraft busses are energized by external power in the same manner as if a main generator were operating. The exceptions to this are those busses which furnish power to systems which do not have on-off control switches and/or require cooling air. Power can be applied to these busses by the use of ground power switches. With external power on the airplane, if the left engine is started first, the complete electrical system automatically switches to internal power when the left generator comes on the line. If the right engine is started first, the right generator, when it comes on the line, energizes only the busses it normally feeds. The busses normally energized by the left generator remain on external power (except those busses energized by the JFS generator) until the left engine is started and the left generator comes on the line.

ELECTRICAL SYSTEM CONTROLS AND INDICATORS

Generator Control Switches

Two generator control switches, one for each generator, are on the engine control panel. They are two-position toggle switches with positions of OFF and ON. The switches are lever-lock type and must be raised up before they are moved to a new position.

Emergency Generator Control Switch

The emergency generator control switch, on the engine control panel, is a two-position toggle switch with position of NORM and EMERG ON. The switch is lever-locked in the NORM position, and must be unlocked by raising it before it can be placed to the EMERG ON position.

NORM	With emergency generator on the line, full emergency AC and DC power is supplied to the system.
EMERG ON	With emergency generator on the line, and with switch first in NORM and then in EMERG ON, emergency power is supplied only to the emergency boost pump and the arresting hook control and indicating circuits.

External Ground Power Switch

The external power control switch, on the engine control panel, controls application of external power to the aircraft electrical buses. If the external power is not of the proper quality (within voltage, phase, frequency limits) the external power monitor senses this and disconnects or prevents the external power from being connected to aircraft.

NORM	Allows the aircraft electrical busses to be energized by external power if no aircraft generators are operating.

GROUND POWER CONTROL PANEL & PLACARD

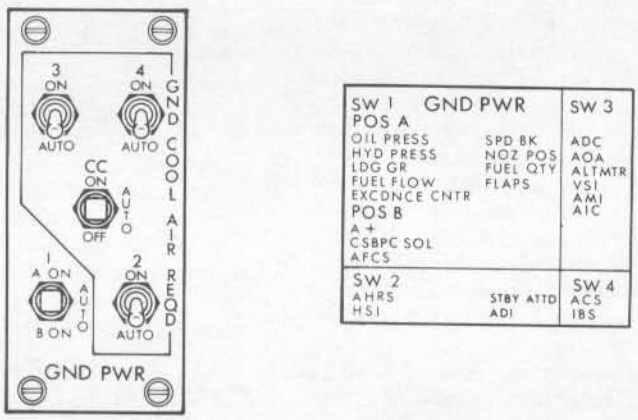


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Figure 1-4

OFF	Disconnects external power from the aircraft.
RESET	Will re-establish external power if it has dropped off line. The RESET position is spring loaded to NORM.

Ground Power Switches

Five ground power switches are provided on the ground power panel (figure 1-4) on the left console. Each controls a group of systems and/or instruments (listing is on a placard above the panel) and will prevent unnecessary operation of the systems/instruments on ground power. Switches 2, 3 and 4 have two positions, the CC switch and switch 1 have three. If external power is to be used for an extended period (more than 5 minutes) prior to starting engines, insure all switches are in AUTO, except CC in OFF.

AUTO	System/instrument can only be energized by aircraft generator power.
ON	System/instrument can be energized by external or generator power.
OFF	CC only is de-energized regardless of power source.

Circuit Breakers

There are eight circuit breakers on the lower center of the instrument panel.

HYDRAULIC POWER SUPPLY SYSTEM

Hydraulic power is supplied by three separate systems with each system divided into two or more circuits. Reservoir level sensing (RLS) is employed in all three systems for the purpose of isolating a leak. When a leak develops in a circuit a valve senses the reservoir level and shuts off the affected circuit. Through this method the maximum number of circuits remain operable. The hydraulic system also employs return pressure sensing (RPS). RPS prevents flow through a selector valve if a leak should develop in a subsystem downstream of the selector valve. Refer to Hydraulic Flow Diagram, section III and the hydraulic systems foldout for a description of what each system powers.

PC SYSTEMS

PC1 pump and PC2 pump operate at a pressure of 3000 psi. Each PC system is divided into a circuit A and a circuit B.

UTILITY SYSTEM

The utility system has a left pump which operates at a pressure of 3000 psi and a right pump which operates at a pressure of 2775 psi. The utility system is divided into a circuit A, circuit B, and a non-RLS circuit.

HYDRAULIC PRESSURE INDICATORS

Three hydraulic pressure gages on the upper right corner of the instrument panel display PC1, PC2 and utility hydraulic system pressures.

HYDRAULIC SYSTEMS CAUTION LIGHTS

An amber HYDRAULIC light on the caution light panel and the MASTER CAUTION light come on when any hydraulic systems caution light on the BIT panel comes on. PC1 A, PC1 B, PC2 A, PC2 B, UTL A and UTL B lights on the BIT panel come on when their respective RLS valve actuates to shut off that circuit. The LPMP or RPMP light comes on when the respective utility hydraulic pump output pressure is low. An indication of a PC pump failure or low pressure is illumination of both the A and B bit lights for that system. When the HYDRAULIC light is illuminated resetting the MASTER CAUTION light also resets the HYDRAULIC light.

BLEED AIR SYSTEM

The bleed air system supplies air to the ECS and fuel pressurization system. The flow, temperature and pressurization of the bleed air is initiated and regulated by the requirements of each system. A rotary switch provides selection of bleed air from one or both engines or shuts all bleed air off.

LANDING GEAR SYSTEM

The gear is electrically controlled and hydraulically operated. While weight is on the gear, the gear cannot be retracted. When the main and nose gears are extended, the forward door(s) will be closed.

LANDING GEAR CONTROL HANDLE

The landing gear is controlled by a wheel shaped handle located on the lower left side of the main instrument panel, and has two positions.

DOWN	Extends landing gear.
UP	Retracts landing gear.

Landing Gear Warning Light/Warning Tone

A red warning light in the landing gear control handle will illuminate when the landing gear or landing gear doors are not locked in the selected position. The light will illuminate and a warning tone will sound whenever the following conditions exist simultaneously: aircraft altitude is below 10,000 feet, airspeed is below 200 knots, and a rate of descent greater than 250 fpm. The warning tone may be silenced by depressing the warning tone silence button adjacent to the landing gear control handle.

Landing Gear Position Lights

There are three green landing gear position lights located above the landing gear control handle marked NOSE, LEFT, and RIGHT. Each light will illuminate when its respective gear is down and locked.

NOSE GEAR STEERING SYSTEM

The nose gear steering system is a continuous operation, dual mode system. It is electrically controlled by two switches located on the control stick and hydromechanically operated through inputs from the rudder pedals. The system is automatically engaged when the nose gear strut is compressed. The dual mode feature consists of a normal mode and a maneuvering mode. In the normal mode, the nosewheel can be turned left or right 15°. In the maneuvering mode, the nosewheel can be turned left or right 45°. The maneuvering mode is selected by depressing and holding the nose gear steering button located on the control stick. The normal mode can be disengaged by depressing the paddle switch located on the control stick. With the system disengaged the nose gear becomes free swivelling and may be rotated 360°. When the system is engaged with the nose gear positioned within a range of approximately 45° left or right, the nose gear will return to the position commanded by the rudder pedals. If the nose wheel is outside this range when the system is engaged, rudder pedal inputs will not have any effect. When taxiing is commenced the nose gear will be brought into range through centering action and the pedals will command nose wheel position.

EMERGENCY BRAKE/STEERING HANDLE

The emergency brake/steering handle is located on the lower center of the main instrument panel. Pulling the handle selects JFS hydraulic accumulator pressure to power the wheel brakes and the nose gear steering system. If utility circuit B is operating, the JFS accumulators will be continuously replenished. If not, 3–6 brake applications should be available without anti–skid protection, and sufficient nose gear steering to clear the runway, but nose gear steering cannot be disengaged by the paddle switch. Pushing the handle forward will restore the normal hydraulic power source.

BRAKE SYSTEM

The main landing gear wheels are equipped with full powered brakes operated by toe action on the rudder pedals. An anti–skid system is incorporated in the normal system to prevent wheel skid. A touchdown protection circuit (with anti–skid ON) prevent brake application until the main wheels reach a speed of approximately 45 knots.

ANTI–SKID SYSTEM

The anti–skid system is electrically controlled by a two position switch on the miscellaneous control panel located on the forward portion of the left console. An ANTI–SKID light on the caution light panel and the MASTER CAUTION light will illuminate anytime the main gear is down and the system is inoperative. With the landing gear handle down and the anti–skid switch OFF, the ARI system will be disengaged.

NORM	Activates the system.
OFF	De–energizes the system.

ARRESTING HOOK SYSTEM

A retractable arresting hook is enclosed in the underside of the aft fuselage. It is electrically controlled, extended by gravity and a hydraulic dashpot, and retracted by utility hydraulic pressure. The doors will not close when the hook is retracted.

Arresting Hook Switch

An arresting hook control switch is a two position switch located on the left sub panel.

DOWN	Hook is extended.
UP	Hook is retracted.

Arresting Hook Light

The HOOK light is on the caution light panel. Anytime the arresting hook is not up and locked the MASTER CAUTION and HOOK light come on.

FLAP SYSTEM

Each wing has a two position trailing edge flap. The flaps are electrically controlled and operated. When the flaps are down, they are protected from structural damage by a blow up airspeed switch. The switch is set to automatically retract the flaps at approximately 250 knots. At approximately 240 knots, the flaps will automatically return to the down position, providing the flap control switch is in the down position.

Flap Control Switch

The flap control switch is a two position switch located on the throttle quadrant.

UP	Retracts the flaps.
DOWN	Extends the flaps.

Flap Position Indicator

The flap position indicator is located on the left sub panel. A pointer on the indicator face is used to indicate position whether the flaps are UP, DN, or in transit.

SPEED BRAKE SYSTEM

A speed brake is located on the upper surface of the center fuselage just aft of the canopy. It is electrically controlled and hydraulically operated. The speed brake can be positioned to any intermediate position between fully retracted and fully extended.

Speed Brake Switch

The speed brake switch has three positions and is located on the inboard throttle. The switch will remain in any selected position.

AFT DETENT	Extends the speed brake.
FORWARD DETENT	Retracts the speed brake.
CENTER DETENT	Stops the speed brake in any intermediate position.

Speed Brake Out Light

The SPD BK OUT light located on the caution light panel illuminates when the speed brake is in the extended or partially extended position. The MASTER CAUTION light will not illuminate when the speed brake light illuminates.

FLIGHT CONTROL SYSTEM

The aircraft primary flight control surfaces consist of conventional ailerons, twin rudders, and stabilators which are capable of symmetrical or differential movement. The control surfaces are positioned by mechanical and/or control augmentation system (CAS) inputs. Artificial feel systems provide simulated aerodynamic forces to the control stick and rudder pedals. The feel systems have trim actuators which, through the power cylinders, move the entire control surfaces. Secondary flight control surfaces are flaps and speed brake. Refer to foldout section for the flight control schematic.

AILERON–STABILATOR CONTROL SYSTEM

Aileron–stabilator control is provided by mechanical and roll CAS inputs. The aileron–stabilator input is modified, according to airspeed, and correctly positions the ailerons and stabilators. Safety spring cartridges allow operation of a single aileron–stabilator combination if the other side becomes jammed. If both sides become jammed, the differential stabilators (through roll CAS) will provide lateral control for moderate flight maneuvers, including landing.

Lateral Control Feel/Trim System

The lateral feel/trim system moves the lateral control linkage to reposition the control surfaces. Lateral control artificial feel is provided by double action spring cartridges. When the control stick is moved from the trimmed neutral position, the force required to compress the spring cartridge increasingly becomes greater. The spring cartridge returns the control stick to neutral when the force on the control stick is removed.

STABILATOR CONTROL SYSTEM

Mechanical and pitch CAS inputs control the movement of the two stabilators. Stabilator inputs are modified to provide the proper amount of stabilator movement. If the mechanical linkage becomes jammed, the stabilators (through pitch CAS) will provide longitudinal control for moderate flight maneuvers, including landing.

Longitudinal Control Feel Trim System (Manual)

The longitudinal feel/trim system consists of the trim switch and a pitch feel/trim actuator. The longitudinal feel/trim system is similar to the lateral feel/trim system.

CONTROL STICK

The control stick (figure 1—5) consists of a stick grip and motional pick—up (force) transducer, and contains six controls: an autopilot/nose gear steering disengage switch (paddle switch), nose gear steering button, a trigger, a weapon release button, a trim switch and auto acquisition button. These controls are described in their various sections.

RUDDER CONTROL SYSTEM

Rudder control is provided by inputs of mechanical, yaw CAS, and ARI. Inputs to the rudder system are modified to provide the proper amount of rudder control surface travel. Safety spring cartridges permit use of the yaw CAS and nose gear steering system if the rudder linkage jams. The nose gear steering system has a similar device to permit rudder operation if the nose gear steering jams.

Rudder Feel Trim System

The rudder feel trim system consists of a trim switch on the throttle quadrant, and a feel trim actuator. The rudder/trim system is similar to the lateral feel/trim system.

Rudder Trim Switch

The rudder trim switch is on the throttle quadrant. This switch controls the trim actuator in the rudder feel/trim system.

Rudder Pedals

The rudder pedals are conventional type units and are adjustable. The rudder pedals are also used for the brakes (toe action) and nose gear steering.

CONTROL STICK

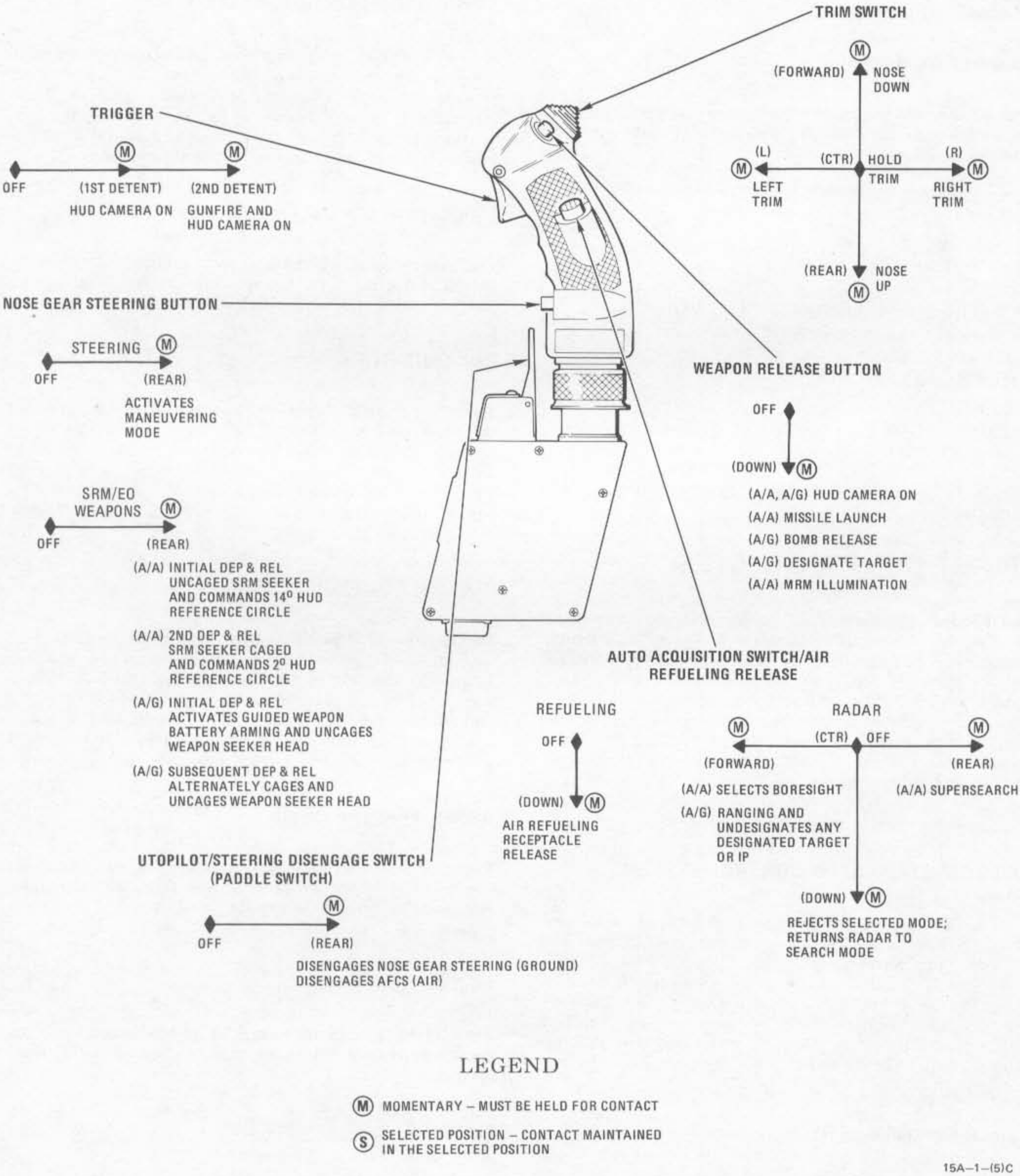


Figure 1–5

Rudder Pedal Adjust Knob

A rudder pedal adjust knob on the main instrument panel is used to adjust the synchronized rudder pedals. Pulling the knob out releases the pedals, which are spring loaded aft, allowing the pedals to be adjusted to the desired position.

Rudder Travel Limiter

The rudder travel limiter system is electrical/mechanical and completely automatic. When aircraft airspeed reaches approximately 1.5 Mach, a mechanical limiter limits rudder pedal movement. As aircraft airspeed decelerates through approximately 1.5 Mach, the limiter retracts and full rudder pedal movement is restored.

Rudder Travel Limiter Light

The RUDR LMTR light on the caution light panel comes on when the rudder pedal limiter is not engaged above 1.5 Mach or is engaged below 1.5 Mach.

AILERON RUDDER INTERCONNECT (ARI)

The aileron rudder interconnect system causes rudder displacement proportional to aileron displacement when accompanied by pitch. After the aircraft has accelerated above 1.0 Mach, the ARI system is automatically disengaged. The ARI displacement of the rudder will become greater when the flaps are lowered and automatically disengages during landing roll out. When the landing gear handle is down and the anti-skid switch is OFF, the ARI system will be disengaged.

CONTROL STICK BOOST AND PITCH COMPENSATOR (CSBPC)

Pilot stick movements for the pitch and roll axes are inputs into the control stick boost and pitch compensator. In conjunction with the control augmentation system, airspeed/mach number, and load factor inputs, the stick movements are modified and hydraulically boosted to control the primary flight controls.

Pitch Axis

The ratio of the number of degrees of collective stabilator deflection per degree of longitudinal stick deflection is determined by the pitch ratio changer of the CSBPC. A pitch ratio indicator displays the position of the pitch ratio changer. The pitch ratio changer is a variable linkage assembly which receives various signals to position the linkage to give the proper amount of control surface deflection for all flight regimes. A pitch trim compensator works simultaneously with the pitch ratio changer to automatically compensate for changes in trim such as caused by accelerating from subsonic to supersonic flight, operating flaps, speed brake, or store separation. The pitch axis control also drives an input to the roll axis and the ARI. If hydraulic power is lost, the pilot then controls the ailerons and differential stabilators at a fixed ratio without boost, thus the system reverts to a simple bellcrank system which provides adequate handling qualities for a safe return to base. When the pilot turns off the pitch axis the ARI is also turned off.

Pitch Ratio Switch

The pitch ratio switch is on the main instrument panel.

AUTO	Provides normal system functions.
EMERG	Disables the pitch and ARI functions of the CSBPC causing the pitch ratio changer, ARI, and the pitch trim compensator to all drive to their failed positions and lock.

Pitch Ratio Indicator

The pitch ratio indicator, on the main instrument panel, is driven by a transmitter signal that measures position of the pitch ratio changer actuator. The zero position indicates the minimum authority setting of the ratio changer (smallest travel of the stabilator in response to full pitch travel of the stick). The 1.0 position indicates the full authority setting (maximum travel of the stabilator in response to full pitch travel of the stick). If the pitch ratio switch is placed in EMERG, or hydraulic pressure to the CSBPC is lost, the indicator will drive to 0.4.

Pitch Ratio Light

The PITCH RATIO light, on the caution light panel, comes on if hydraulic pressure is lost to the CSBPC or the pitch ratio switch is in the EMERG position.

Roll Axis

The ratio of the number of degrees of aileron and differential stabilator per degree of lateral stick deflection is determined by the roll ratio changer. The roll ratio changer is a variable linkage assembly which receives various signals to position the linkage to give the proper amount of aileron and differential stabilator deflection for all flight regimes. Lateral stick deflections are also fed into the ARI ratio changer for roll axis control. When the landing gear control handle is in the down position, the roll ratio changer will move to give maximum roll axis control. If hydraulic power is lost, the pilot then controls the ailerons and differential stabilators at a fixed ratio without boost, thus the system reverts to a simple bellcrank system which provides adequate handling qualities for a safe return to base. When the pilot turns off the roll axis the ARI is also turned off.

Roll Ratio Switch

The roll ratio switch is on the miscellaneous panel.

AUTO	Provides normal system functions.
EMERG	Disables the roll and ARI functions of the CSBPC, and causes the roll and ARI ratio changers to drive to their failed positions and lock.

Roll Ratio Light

The ROLL RATIO light, on the caution light panel, comes on if hydraulic pressure is lost to the CSBPC, the roll ratio switch is in the EMERG position, or when the landing gear control handle is down and full roll authority is not available, or when the landing gear control handle is up and full roll authority is available.

AUTOMATIC FLIGHT CONTROL SYSTEMS (AFCS)

The AFCS provides the following functions: pitch, roll and yaw control augmentation (CAS); relief autopilot modes of pitch/roll attitude and altitude hold; pitch, roll and yaw trim, and takeoff trim.

CONTROL AUGMENTATION SYSTEM (CAS)

One function of the AFCS is the CAS. The CAS provides stability and is the primary means of controlling the flight control surfaces. The CAS measures the stick force exerted by the pilot and control surface deflection, compares these, and makes corrections to ensure that control surface deflection matches control stick forces. A dual channel fault monitor automatically turns a CAS axis off if an erroneous signal is supplied to the control surfaces. The mechanical flight control system and the CAS are independent and provide a redundant flight control system, therefore the aircraft may be flown by either system.

Roll CAS

Roll CAS provides stability and control about the lateral axis. Operation of roll CAS is controlled by the three position roll CAS engage switch on the CAS control panel. A failure in the pitch or yaw CAS causes roll CAS to disengage.

Pitch CAS

Pitch CAS provides stability and control about the longitudinal axis. Operation of pitch CAS is controlled by the three position pitch CAS engage switch on the CAS control panel.

Yaw CAS

Yaw CAS provides stability and control about the directional axis. Operation of the yaw CAS is controlled by the three position yaw CAS engage switch on the CAS control panel.

CAS Switches

The following three positions are applicable to the roll, pitch, and yaw CAS switches.

ON	Engages applicable axis.
RESET	Re-engages disconnected axis (provided fault no longer exists).
OFF	Disengages applicable axis.

PILOT RELIEF MODES

All three CAS axes must be engaged and operating satisfactorily to engage the two pilot relief modes, pitch/roll attitude and altitude hold.

Pitch/Roll Attitude Hold

Attitude hold is engaged by placing the attitude hold switch on the CAS control panel to ON. Attitude hold will automatically be disengaged and the attitude hold switch will remain in the ON position when the pitch attitude is greater than $\pm 45°$, or the roll attitude is greater than $\pm 62.5°$, or control stick steering (CSS) is in effect. Control stick steering will be engaged and roll attitude hold will be disengaged when 3 pounds force is applied, and pitch attitude hold will be disengaged when 3.5 pounds force is applied to the control stick. When stick forces are relaxed, CSS is disengaged, attitude hold is re-engaged, and the aircraft will hold the attitude that existed upon re-engagement. When one of the following conditions exist attitude hold will be disengaged and attitude hold switch will physically move to the OFF position: acceleration exceeds +3, −1G, INS attitude signals are not valid, a CAS axis is disengaged (manually or by a fault monitor), the emergency quick release lever is depressed, or the attitude hold switch is manually moved to OFF. To re-engage pitch/roll attitude hold the switch must be placed back to the ON position.

Altitude Hold

Altitude hold is engaged by placing the altitude hold switch, on the CAS control panel, to ON. The altitude at the time of engagement is the reference altitude. If the pitch (CSS) is in effect, or if roll attitude is greater than $\pm 62.5°$ altitude hold disengages and the altitude hold switch will remain in the ON position. When stick forces are relaxed, CSS is disengaged, and the aircraft will hold the altitude at re-engagement. When one of the following conditions exist altitude hold will be disengaged and altitude hold switch will physically move to the OFF position: an ADC or INS failure, ATT HOLD disengages, or the altitude hold switch is physically moved to OFF. To re-engage altitude hold the switch must be placed back to the ON position.

T/O TRIM BUTTON AND LIGHT

The T/O trim button, on the CAS control panel, when depressed drives the aileron, rudder and stabilator trim actuators to the takeoff positions. After all actuators are in the takeoff position the T/O light will come on. Releasing the T/O button will turn the T/O light off.

CAS Lights

Three CAS Lights (CAS YAW, CAS ROLL and CAS PITCH), on the caution light panel, come on anytime their respective CAS switch is OFF or are disengaged by a failure in the CAS system.

PITOT-STATIC SYSTEM

The pitot-static system (figure 1-6) employs multiple pitot and static sources for redundancy and to provide each inlet controller with conditions peculiar to its inlet during asymmetric conditions. There is an airstream pitot-static mast on each side of the forward fuselage and a pitot mast and flush static port in each inlet duct.

PITOT HEAT SWITCH

The pitot heat switch is on the ECS panel on the right console. Two circuit breakers are available to the pilot.

ON	Provides electrical power to the integral heating elements of all four pitot-static probes.

INSTRUMENTS

Refer to foldout section for cockpit instrument panel illustrations. For information regarding instruments that are an integral part of a particular system, refer to applicable paragraphs in this section.

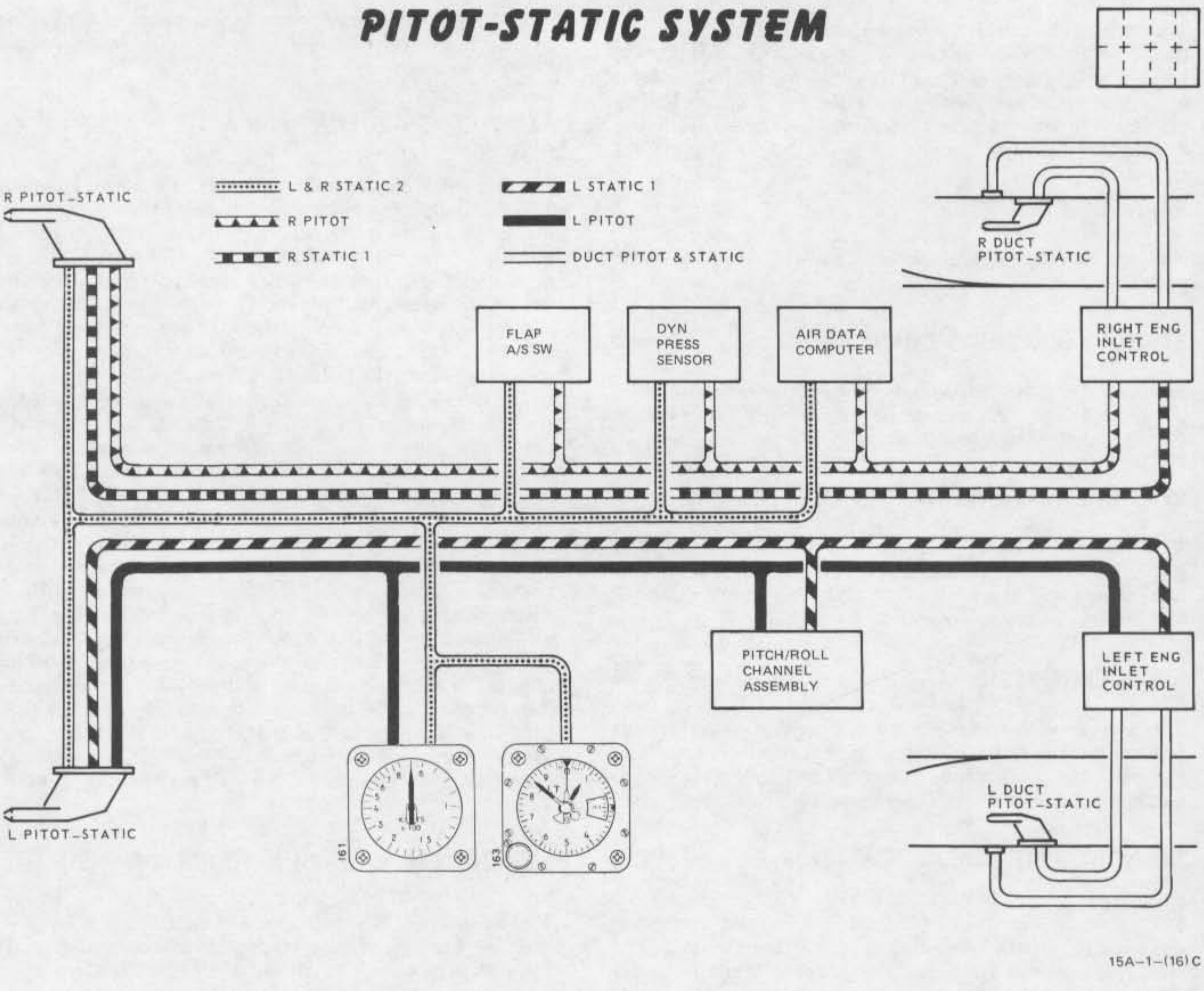


Figure 1-6

AIRSPEED/MACH INDICATOR

A combination calibrated airspeed and Mach number indicator is on the instrument panel. A fixed airspeed scale graduated from 50 to 1000 knots and a rotating Mach number scale, synchronized so that their proper relationship is displayed through all altitudes, enable a single pointer to indicate both readings. Only airspeed is shown below 200 knots. A movable index mark and an index set knob are provided. The indicator operates from electrical signals from the air data computer. Windows on the instrument will display an OFF flag if electrical power is lost or the display is not valid, or a MACH flag if the mach display is not valid.

STANDBY AIRSPEED INDICATOR

The standby airspeed indicator operates directly from pitot-static pressures. It has a fixed scale of 60 to 850 knots and a rotating pointer.

ALTIMETER

The altimeter is driven by electrical signals from the air data computer. The indicator is a counter-pointer type. A window on the face of the dial provides a digital readout of altitude in twenty foot increments. An OFF flag will be displayed in this window if electrical power is lost or the display is not valid.

STANDBY ALTIMETER

The standby altimeter operates directly from a static pressure source.

STANDBY MAGNETIC COMPASS

A conventional aircraft magnetic compass is mounted on the canopy arch. A compass deviation card is located on the right hand canopy sill.

VERTICAL VELOCITY INDICATOR

The vertical velocity indicator is driven by electrical signals from the air data computer. A window on the instrument will display an OFF flag if electrical power is lost or the display is not valid.

ACCELEROMETER

The accelerometer measures and displays instantaneous positive and negative normal acceleration G loads and records the maximum positive and negative loads sustained since the instrument was last reset.

STANDBY ATTITUDE INDICATOR

The standby attitude indicator is a self-contained electrically driven gyro-horizon type instrument. The OFF flag appears if there is a power loss to the indicator or the gyro is caged. The gyro is caged by pulling the knob. Do not turn the knob to lock the gyro in the caged position. The gyro cages to 0° pitch and roll regardless of airplane attitude. The caged position is approximately 4° nose up from the normal ground attitude and the gyro will precess 4° nose down after uncaging. Power should be applied to the instrument for at least 1 minute before caging. The indicator displays roll through 360°. Pitch display is limited by mechanical stops at 90° climb and 78° dive. As the aircraft climbs or dives, the pitch attitude changes smoothly until the stop is reached when the gyro tumbles 180° in roll.

ANGLE OF ATTACK (AOA) INDICATOR

The AOA indicator is driven by electrical signals from the probe and displays indicated AOA in units from 0 to 45. A T-shaped index mark is set at approximate optimum approach AOA. A window on the face of the instrument displays an OFF flag if electrical power is lost. A triangular index mark is positioned full scale and is inoperative.

STALL WARNING AURAL TONE

A beeping aural tone provides an indication of approach to a preset AOA. The tone may be eliminated only by decreasing AOA.

ATTITUDE DIRECTOR INDICATOR

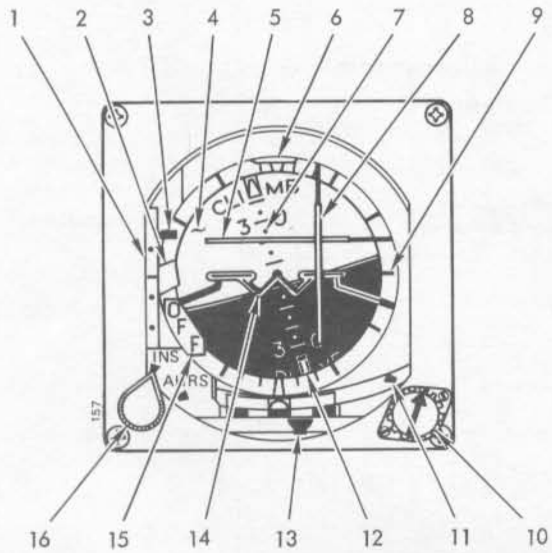
The indicator (figure 1-7) consists of the items indicated. The attitude sphere displays pitch and bank. The pitch markings on the sphere are in graduations of 5°, the bank markings are in graduations of 10° with the large markings indicating each 30°. Signals are received from the INS or AHRS attitude reference system. Either system can be selected by placing the attitude reference system selector knob to the desired position. If bus power to the indicator is lost, the indicator automatically selects AHRS as the source of attitude reference, bypassing the attitude reference selector knob. The pitch trim knob is used to adjust the sphere to indicate zero pitch when the aircraft is pitched to the desired attitude. The pitch and bank steering bars are driven by signals from the CC. The bank steering bar provides command steering information to intercept tacan radials and navigation computer destinations (see figure 1-13). The bank steering bar and glideslope indicator are used in conjunction with the instrument landing set (ILS). The course warning flag or glideslope warning flag appear in view if the bank steering bar or glideslope indicator displays are unreliable because of a lost or weak signal. The ADI provides continuous BIT monitoring. The OFF warning flag on the indicator comes into view if power to the unit is lost, if there is a loss of synchro signal to the pitch or roll servo, if there exists an excessive servo error, or if the ADI is receiving an invalid signal.

HORIZONTAL SITUATION INDICATOR (HSI)

The HSI (figure 1-7) provides a horizontal or plan view of the aircraft with respect to the navigation situation. The aircraft symbol in the center of the HSI is the airplane superimposed on a compass rose. The compass card rotates so that the aircraft heading is always under the top of the lubber line. Index marks are provided every 45° around the

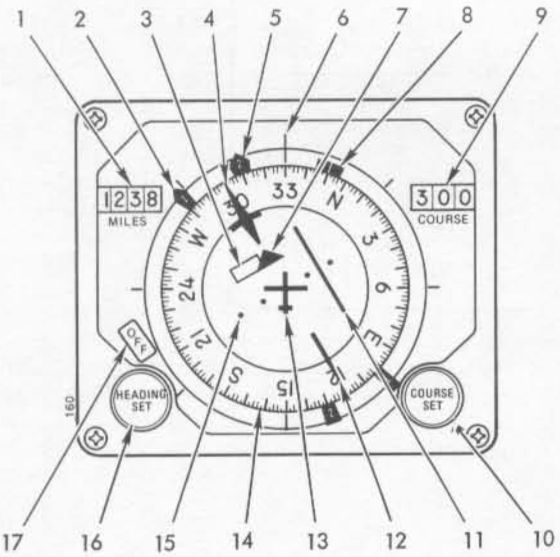
ADI/HSI

ADI



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

HSI



1. RANGE INDICATOR
2. BEARING POINTER NO. 1
3. COURSE DEVIATION WARNING FLAG
4. COURSE ARROW (HEAD)
5. BEARING POINTER NO. 2
6. LUBBER LINE
7. TO-FROM INDICATOR
8. HEADING MARKER
9. COURSE SELECTOR WINDOW
10. COURSE SET KNOB
11. COURSE DEVIATION INDICATOR
12. COURSE ARROW (TAIL)
13. STATIONARY AIRCRAFT SYMBOL
14. COMPASS CARD
15. COURSE DEVIATION SCALE
16. HEADING SET KNOB
17. POWER OFF FLAG

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Figure 1-7

HSI DISPLAYS

SYMBOL	NAV MODE	TCN MODE	ILS/NAV MODE	ILS/TCN MODE
BEARING PTR. NO. 1	TCN/ADF RELATIVE BEARING ADF Bearing is displayed if ADF is ON			
BEARING PTR NO. 2	DEST/TGT RELATIVE BEARING			
COMPASS CARD	MAGNETIC HEADING			
RANGE INDICATOR	DEST/TGT DISTANCE	TCN DISTANCE	DEST/TGT DISTANCE	TCN DISTANCE
COURSE SELECTOR WINDOW	MAGNETIC TRACK	COURSE SET (TCN RADIAL)	COURSE SET (RUNWAY/APPROACH HEADING)	
COURSE ARROW	MAGNETIC TRACK	COURSE SET (TCN RADIAL)	COURSE SET (RUNWAY/APPROACH HDG)	
HEADING MARKER	COMMAND HEADING	HEADING SET		
TO/FROM INDICATOR	OUT–OF–VIEW	TO/FROM TCN STATION	OUT–OF–VIEW	
COURSE DEVIATION INDICATOR	HEADING DEVIATION (10° MAX DEV)	TCN DEVIATION (10° MAX DEV)	LOCALIZER DEVIATION (2 1/2° MAX DEV)	
COURSE DEVIATION WARNING FLAG	OUT–OF–VIEW IF DEVIATION VALID		OUT–OF–VIEW IF LOCALIZER VALID	

15A–1–(25)A

Figure 1–8

perimeter of the compass card. Four modes of navigational operation are displayed on the HSI. These modes are selected by the steering mode knob (see figure 1-8).

Steering Mode Panel

The steering mode panel is on the main instrument panel, adjacent to the ADI. The panel contains a steering mode knob which selects the source of information or mode to be displayed on the HSI, ADI, and HUD as shown in figures 1-13 and 1-15.

NAV	Selects navigation computer mode.
TCN	Selects tacan mode.
ILS/NAV	Selects ILS with navigation information displayed.
ILS/TCN	Selects ILS with TACAN information displayed.

CANOPY SYSTEM

The cockpit area is enclosed by a clamshell type canopy. Refer to foldout section for ejection seat illustration. The main components of the canopy system are a hydraulic actuator which provides manual and powered operation of the canopy, a locking mechanism, and a pyrotechnic canopy remover for emergency jettison. Latches on the canopy frame and along the lower edge of the canopy engage fittings on the cockpit sill structure to lock the canopy to the fuselage. An inflatable seal, installed around the edge of the canopy frame, retains cockpit pressure when the canopy is locked. A rain seal is installed outboard of the pressure seal to divert rain water away from the cockpit.

NORMAL CANOPY SYSTEM

For normal canopy operation, the internal canopy control handle (figure 1-9) is provided on the right side of the cockpit under the canopy sill. For operation of the canopy from outside the aircraft, an external canopy control handle is located on the left side of the aircraft below the canopy. The external canopy control handle duplicates operation of the internal canopy control handle. An accumulator provides hydraulic power for powered operation of the canopy (2 ½ to 3 cycles) when utility hydraulic pressure is not on the aircraft. On TF aircraft the canopy can be operated without accumulator pressure by moving the external canopy control handle or one of the internal canopy handles to the UP position. This raises the canopy by a nitrogen charge in the canopy actuator. To lower the canopy with the accumulator pressure depleted, a hand pump is provided in the nosewheel well. When using the hand pump to lower the canopy one of the canopy control handles must be placed to the DN position. On all aircraft, a CANOPY UNLOCKED warning light is provided in each cockpit.

Internal Canopy Control Handle

The canopy control handle has four positions: LOCKED, DN, HOLD and UP. On TF aircraft, the handles are interconnected and follow each other in position when one handle is moved. The canopy control handles operate the same as in F aircraft except that the locking mechanism is mechanical rather than hydraulic.

UP	Raises canopy to maximum open position. If selected from the LOCK position, the canopy will first unlock, then move 1.5 inches aft before rising.
DN	Lowers canopy full down, then forward against the windscreen. In F aircraft, the canopy is then hydraulically locked.
HOLD	Will stop the canopy at any point in the open or close cycle.
LOCKED	Causes a hydraulic block, therefore it is necessary to have the canopy against the windscreen before placing the handle in LOCKED. In TF aircraft, placing the handle to the LOCKED position mechanically locks the canopy.

External Canopy Control Handle

The external canopy control handle (figure 1-9) is normally stowed flush with the fuselage mold line on the left side of the aircraft below the canopy. When the handle retaining push button is pushed, the handle springs outboard approximately 2 inches from the mold line. After rotating the handle full aft to the UP position, canopy will move slightly aft and start opening. To stop the canopy at any point in its opening travel rotate the handle slightly forward from the full aft position to the HOLD position. To close the canopy rotate the handle forward to the DOWN position. The DOWN position also locks the canopy in F aircraft. In TF aircraft the canopy can be locked once the canopy is completely closed by rotating the handle full forward to the LOCK position. In addition, the LOCK position produces a hydraulic block in the canopy system for F and TF aircraft. The handle is stowed flush with the mold line by manually pushing inboard until the retaining latch is engaged.

Internal Canopy Manual Unlock Handle (F Aircraft)

An internal canopy manual unlock handle, on the right canopy frame just aft of the canopy leading edge, is provided to unlock the canopy manually in case of loss of hydraulic pressure to the canopy system. Pulling the handle releases the canopy locking mechanism, thus permitting the canopy to be forced aft and up. Before pulling, a quick release pin in the handle must be removed and the internal canopy control handle must be positioned to UP.

NORMAL CANOPY CONTROL HANDLES

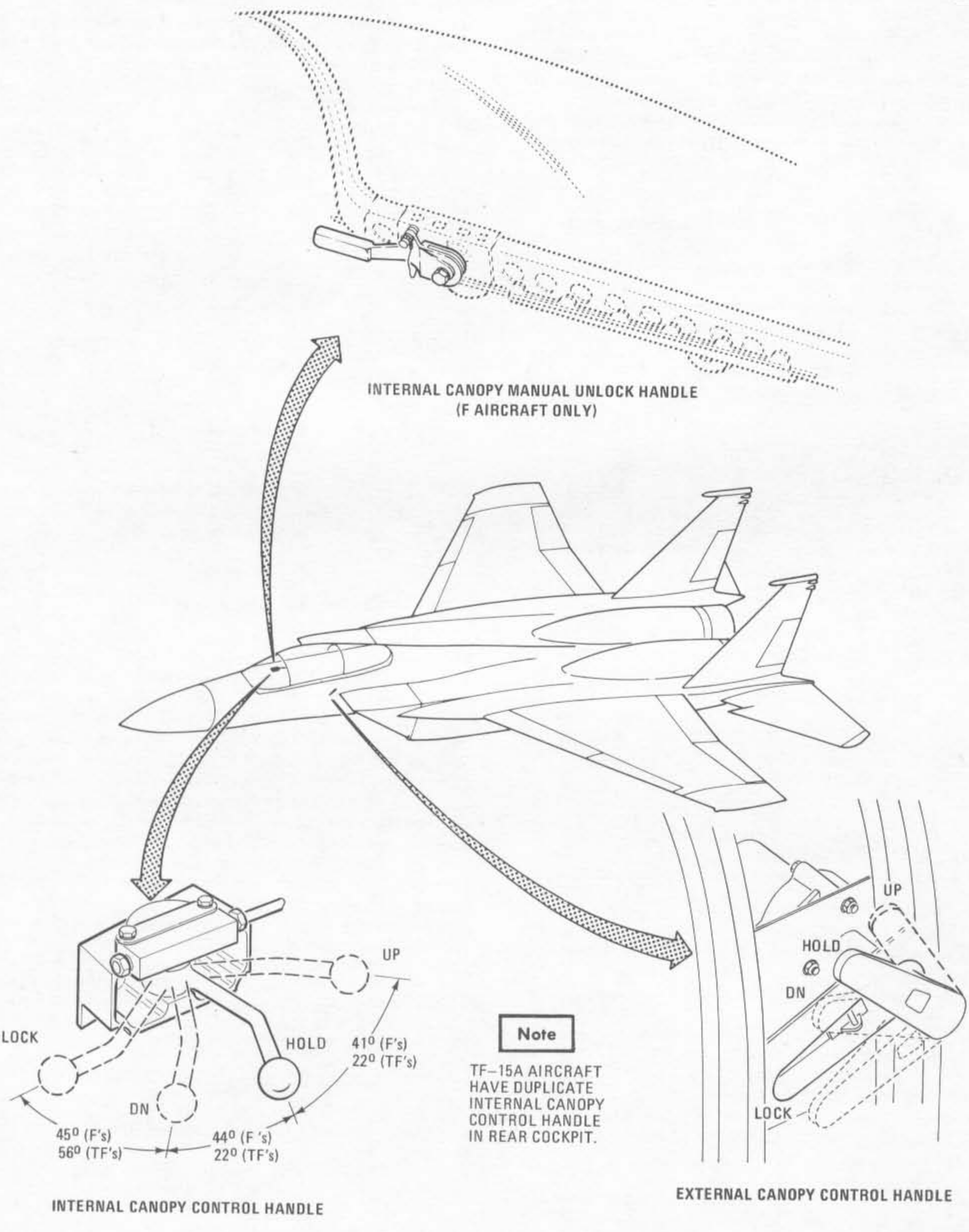


Figure 1-9

External Canopy Unlock Fitting (F Aircraft)

An external canopy unlock fitting, below the left canopy frame and forward of the external canopy control handle, is provided for manually unlocking the canopy from the outside of the aircraft. In case of loss of hydraulic pressure to the canopy system, the canopy can be unlocked by inserting a 0.5 inch square drive tool into the fitting and then rotating clockwise. Before utilizing the external canopy unlock fitting, either the internal canopy control handle or the external canopy control handle must be in the UP position. After the canopy is unlocked, the canopy must be forced aft and up in order to open.

Canopy Unlocked Warning Light

The CANOPY UNLOCKED warning light on the upper right of the instrument panel comes on whenever one or more of the following conditions exist: (a) canopy unlocked, (b) canopy opened or (c) canopy actuated initiator plug not connected.

Canopy Actuated Initiator Firing Indicator

The canopy actuated initiator firing indicator is located on the bulkhead in back of the seat. The indicator is a gray cylinder–like housing containing an orange spiral spring which extends when the canopy actuated initiator is fired.

EMERGENCY CANOPY SYSTEM

For canopy jettison, a pyrotechnic canopy remover operates independently of the normal canopy system. The canopy remover is designed to jettison the canopy only from the closed position. When the ejection control handle, or either internal or external canopy jettison handle is pulled, the remover mechanically unlocks and jettisons the canopy.

Canopy Jettison Handle

A black and yellow striped canopy jettison handle is located under the left canopy sill just aft of the instrument panel. Depressing an unlock button on the inboard side of the handle, and pulling the handle aft fires the internal canopy jettison system. The handle, once pulled to the fired position, is locked in the fired position where it remains locked until the handle and initiator are replaced. On TF aircraft, there is a canopy jettison handle in each cockpit.

External Canopy Jettison Handle

The external canopy jettison handle (figure 3–7) is a T–handle located within an access door just below and forward of the external canopy control handle, and is used to jettison the canopy from outside the aircraft. After pushing a release button to open the access door, the handle and its lanyard is played out 8 feet from the aircraft and then pulled. This fires the external canopy jettison system.

EJECTION SEAT SYSTEM

The IC–7 ejection seat is a fully automatic rocket system that provides the pilot with a quick, safe and positive means of escape from the aircraft under emergency conditions. Refer to foldout section for ejection seat illustration. The seat system includes an initiation system which, among other things, jettisons the canopy before firing the rocket catapult. In addition, the seat system includes a seat stabilization system called the Directional Automatic Realignment of Trajectory (DART) system to stabilize the seat during rocket burn. Operation of the seat is divided into two phases: primary and secondary operation. Primary operation of the seat includes all operating events that occur during the ejection sequence. This sequence begins with actuation of the ejection control handle which causes the canopy to jettison and the rocket catapult to fire. It continues until a normal parachute descent of the occupant is accomplished. After the ejection sequence, seat operation is completely automatic and requires no additional action by the occupant during the sequence. Secondary operation of the seat consists of seat height adjustment and controlling shoulder movement.

DUAL SEAT SYSTEM OPERATION (TF AIRCRAFT)

A command selector valve is provided in the rear cockpit to select the desired ejection sequence to be initiated from the rear cockpit, or provide for single ejection for solo flight. Positioning is accomplished by pulling out and turning to the desired detent position. Solo position requires use of a collar.

NORM	Single rear seat ejection when initiated from the rear cockpit. Dual ejection (rear seat first) when initiated from the front cockpit.
AFT INITIATE	Dual ejection (rear seat first) when initiated from either seat.
SOLO	Single ejection from front cockpit only. The 0.4 second delay between rear and front seat ejection is eliminated.

Seat Adjust Switch

The seat adjust switch is on the left side of the cockpit above the console. The switch has the three positions of UP and DN and is spring–loaded to the center off position. Maximum vertical seat travel is 5 inches.

CAUTION

The seat adjustment actuator does not have limit switches to cut off power to the electric motor once the seat has reached either vertical limit of travel. Care should be taken to release the seat adjust switch when the seat reaches an upper or lower limit. Failure to do so can result in damage to the actuator motor.

Ejection Control Handle

The ejection control handle on the lower front frame of the seat structure is the sole means by which ejection is initiated. The rubber handle, molded in the shape of a double loop, can be grasped by one or two hands. To initiate ejection requires from 20 to 40 pounds of upward force. The handle travels approximately 2 inches from its seated position before the seat-mounted initiator is fired. The handle separates from the seat after ejection. The ejection control handle can be saftied by the ejection seat ground safety handle.

Ejection Seat Ground Safety Handle (Head Knocker)

To prevent accidental seat ejection, an ejection seat ground safety handle (head knocker), when placed in the down-and-locked position, prevents inadvertent actuation of all component parts of the firing control mechanism. The handle is identified by a yellow and black decal which reads: PULL OUT TO SAFETY EJECTION CONTROLS. A safety lock, incorporated in the safety handle, automatically locks the handle in the full out position; the lock must be manually depressed before the ejection controls safety handle can be returned to the up (recessed) position. The upper surface of the handle is painted in a black and yellow checkerboard pattern for visual verification that the ejection controls are locked.

Shoulder Harness Inertia Reel

Pilot shoulder harness restraint is provided by a dual strap shoulder harness inertia reel mounted in the seat below the headrest pads. Automatic locking of the inertia reel occurs when the reel senses excessive G-forces. Manual locking and unlocking of the reel is controlled by the shoulder harness lock/unlock handle on the left armrest of the seat.

Shoulder Harness Lock/Unlock Handle

The inertia reel control handle on the left arm rest of the seat is spring-tensioned and has two positions.

LOCKED	The inertia reel prevents the reel straps from being extended and ratchets any slack in the straps back into the reel. This prevents the pilot from leaning forward; if he leans back, the slack in the reel straps is taken up, preventing forward movement again without first unlocking the reel.
UNLOCKED	The reel allows the pilot to lean forward, but the inertia portion of the reel continues to protect him by automatically locking the reel when it senses excessive G-forces. Once the reel has been locked by induced loads, the locked condition must be released by cycling the control lever to locked and back to unlocked.

Harness Release System

The harness release system restrains the pilot and his survival equipment in the seat, and provides automatic release of the shoulder harness and lap belt assemblies and the forced separation of the pilot from the seat after ejection.

Emergency Harness Release Handle (Outside Handle)

The emergency harness release handle (outside handle) on the right seat armrest is used for ground egress or during ejection if the automatic harness release assembly fails. The handle is actuated by depressing the trigger on the inside of the handle grip, and then pulling vertically. Actuation of the handle causes the harness release assembly to release the lap belt and shoulder harness. Initiation of the pilot-seat separation system is prevented by a mechanical stop. Handle actuation prevents automatic parachute deployment after a manual pilot-seat separation, and requires the J-ring to be used to open the parachute. Once released from the seat, the lap belt and shoulder harness cannot be reconnected during flight.

Pilot-Seat Separation System

The pilot-seat separation system provides rapid separation of the pilot from the seat after ejection so that the parachute can be deployed to provide quick, safe escape. The system is automatically actuated following ejection by the harness release system.

Survival Kit

Provisions for survival after ejection, bail-out, or ditching are stored in the survival kit. The kit is composed of a two-piece fiberglass container. The lower portion of the kit contains emergency provisions and an inflatable raft. The upper portion of the kit, containing a 10 minute emergency oxygen supply, serves as the kit cover and has a cushion attached to the top for the crewmember to sit on. The kit contains an emergency oxygen green ring and an emergency oxygen pressure indicator both on the left forward portion of the kit. The kit is attached to the crewmember's harness by attachment fittings on the kit retaining straps. An auto/manual deployment selector, located at the forward right thigh support of the kit, permits the pilot to select either manual or automatic deployment of the kit.

AUTO (Upper)	The kit automatically deploys.
MANUAL (Lower)	The pilot must pull the survival kit release handle on the right side of the kit during parachute descent.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system (ECS) provides conditioned air and pressurization, for the cockpit and avionics, windshield anti-fog and anti-ice, anti-G, canopy seal, and fuel pressurization. The ECS uses engine bleed air from both engines for normal operation. Cooling for the avionics, with the air source knob OFF, automatically switches to ram air. Also ram air cooling is automatically supplied to the avionics whenever compressor inlet duct pressure drops. See foldout section for the ECS schematic.

AIR SOURCE KNOB

The air source knob, on the temperature control panel located on the right console, selects the engine bleed air source for the ECS system.

OFF	Shuts off bleed air from both engines.
L ENG	Shuts off bleed air from the right engine.
BOTH	Supplies bleed air from both engines.
R ENG	Shuts off bleed air from the left engine.

CAUTION

Selection of OFF on the air source knob or cockpit temperature switch will shut off normal cooling and pressurization to the avionics, and damage to the avionics will occur.

BLEED AIR CAUTION LIGHTS

The L and/or R BLEED AIR light on the caution light panel comes on when a leak is detected in the primary bleed air system. The MASTER CAUTION light will illuminate with the bleed air lights.

COCKPIT PRESSURIZATION

Control of the pressure schedule by the cockpit pressure regulator is automatic. Refer to figure 1-10 for the cockpit pressure schedule.

COCKPIT PRESSURE ALTIMETER

The pressure altitude of the cockpit is indicated on a 0-50,000 foot pressure altimeter located on the right main instrument panel.

COCKPIT TEMPERATURE CONTROL

Cockpit temperature is controlled by the cabin temp control knob and switch on the temperature control panel.

AUTO	Cockpit temperature is maintained at the position selected.
MANUAL	Controls the cockpit air heat valve from open to closed.
OFF	Shuts off the ECS.

AVIONICS PRESSURIZATION AND TEMPERATURE

The pressurization and temperature control of the avionics system is automatic.

AVIONICS COOLING AIR CAUTION LIGHT

The ECS light located on the caution light panel warns of an overtemperature or low air flow condition in the avionics cooling air. The ECS caution light may illuminate during low speed flight, particularly at high power settings, with the ECS system operating normally.

EMERGENCY VENT CONTROL

The emergency vent handle on the right main instrument sub panel, when turned 45° CCW electrically opens the pressure dump portion of the cabin pressure regulator valve dumping cabin pressure. Initial extension of the handle closes a shutoff valve in the cabin air conditioning and pressurization line and starts to open the ram air shutoff valve. Ram air flow may be increased by further extension of the handle. At full travel the handle is locked and held. Ram air flow may be decreased by retraction of the handle. When fully retracted and rotated clockwise the ram air and cabin safety valve pressure dump valves will close, the cabin air conditioning and pressurization shutoff valve will open, and the system will revert to normal operation.

WINDSHIELD ANTI-FOG

Windshield anti-fog air is supplied and temperature regulated automatically when cockpit air conditioning is operating. If the emergency vent handle is actuated, shutting off cabin air conditioning, windshield anti-fog is still available provided the engine bleed air source is on either or both engines.

ANTI-G SYSTEM

The anti-G system is automatic and delivers cooled bleed air to the anti-G suit. The airflow into the suit is proportional to the G force experienced. A manual inflation button in the valve allows the pilot to inflate his suit for checking the system. The system incorporates an automatic pressure relief valve.

COCKPIT PRESSURE SCHEDULE

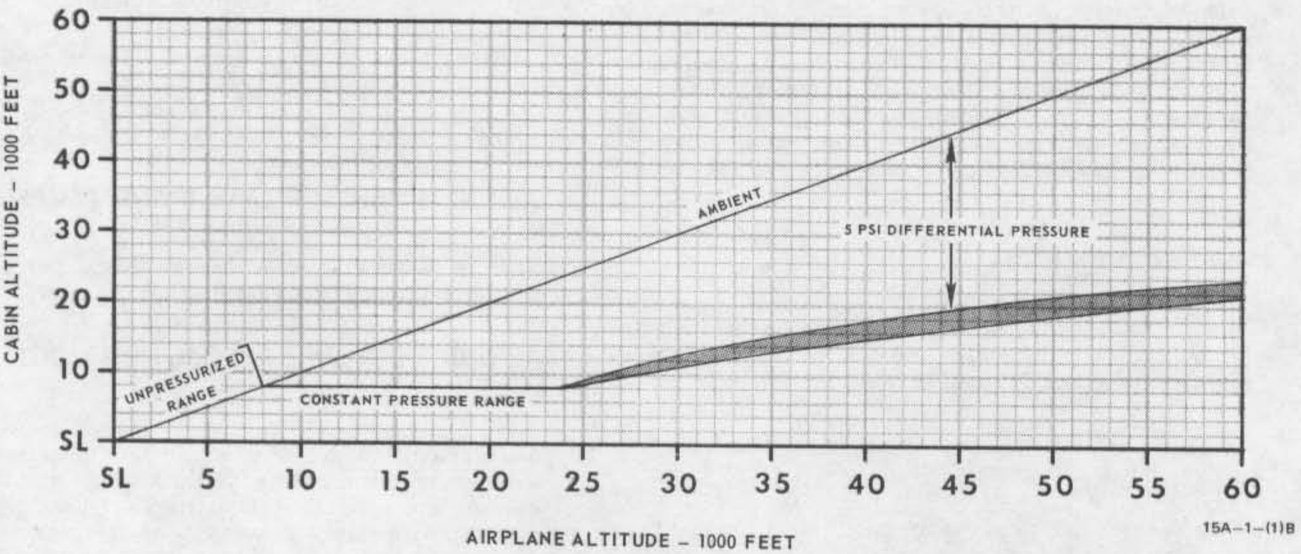


Figure 1-10

ANTI-ICING SYSTEMS

ENGINE ANTI-ICE

Illumination of the INLET ICE light on the caution light panel indicates an icing condition in the engine inlet duct. The anti-ice system must be activated by the ANTI-ICE ENG HEAT switch on the ECS panel.

ON	Activates the engine anti-ice system.
OFF	Deactivates the engine anti-ice system.
TEST	Checks detector operation, and illuminates the INLET ICE light on the caution panel.

WINDSHIELD ANTI-ICE

Placing the windshield anti-ice switch on the ECS panel to ON will permit warm air from the primary heat exchanger to flow to the windshield exterior anti-ice nozzle.

WINDSHIELD HOT CAUTION LIGHT

The WNDSHLD HOT caution light comes on whenever windshield anti-ice air temperature is excessive.

UHF COMMUNICATIONS SYSTEM

The UHF communications system provides air-to-air and air-to-ground communications, automatic direction finding (ADF), and monitoring of the guard (emergency) frequency. The system consists of a main communications transmitter-receiver, communication receiver (AUX receiver), electronic control amplifier for ADF, and a speech security unit (KY-28) for secure communications. The main transmitter-receiver transmits on manually selected frequencies or on 20 preset frequency channels, within the 225.0 to 399.9 MHZ frequency range. It also transmits and receives guard (243.0 MHZ). The receiver of this unit may be utilized to receive ADF signals within its frequency range and display them on the horizontal situation indicator. The AUX receiver is used as a backup receiver for the main transmitter-receiver. It uses the same manually selected, preset, guard, and ADF frequencies as the main transmitter-receiver. The AUX receiver also displays the ADF signals on the HSI.

MAIN COMMUNICATIONS CONTROL PANEL

The main communications control panel is on the main instrument panel, just below the head up display (HUD). The controls on the panel include the main UHF volume control knob, main mode selector switch, main manual frequency selector knobs, and the main channel selector knob.

Communication UHF Volume Control Knob

The communication UHF volume control knob adjusts the volume level for the main transmitter-receiver. Turning the knob fully counterclockwise turns off the main transmitter-receiver.

Communication Mode Selector Switch

The communication mode selector switch is a three-position toggle switch which controls the mode of channel selection.

G	Selects the guard frequency (243.0 MHZ) for main transmitter-receiver operation.
CHAN	Permits the main transmitter-receiver to operate on pre-set channels 00-19.
MAN	The main transmitter-receiver will operate on the manually selected frequencies.

Communication Manual Frequency Selector Knobs

The three communication manual frequency selector knobs are used to insert UHF frequencies into the main UHF comm set.

Communication Channel Selector Knob

The communication channel selector knob selects any one of 20 preset channels. The selected channel is shown in the main channel select window.

INTEGRATED COMMUNICATIONS CONTROL PANEL

The integrated communications control panel is on the left console. The controls on the panel include the AUX mode selector switch, AUX channel selector knob, AUX manual frequency selector knobs, channel set pushbutton, AUX volume control knob, comm (main) antenna selector switch, comm (main) guard receiver selector switch, ADF selector switch, cipher zero selector switch, cipher comm (main)/AUX selector switch, and the ICS volume control knob.

Auxiliary Mode Selector Switch

The auxiliary mode selector switch is a three-position toggle switch which controls the mode of channel selection.

G	Selects guard frequency (243.0 MHZ) for AUX receiver operation.
CHAN	Permits the AUX receiver to operate on preset channel 00-19.
MAN	AUX receiver will operate on manually selected frequencies.

Auxiliary Channel Selector Knob

The auxiliary channel selector knob selects any one of 20 preset channels. The selected channel is shown in the channel select window.

Auxiliary Manual Frequency Selector Knobs

The three auxiliary manual frequency selector knobs are used to manually insert UHF frequencies into the AUX receiver.

Channel Set Pushbutton

To rechannelize one of the 20 preset channels:

1. Select the new frequency with the AUX manual frequency selector knobs.
2. Select the channel to be rechannelized in the AUX channel select window.
3. Push the channel select pushbutton. The selected channel will now have the new frequency for both AUX and MAIN operation.

Auxiliary Volume Control Knob

The auxiliary volume control knob adjusts the audio volume for the AUX receiver. Turning the knob fully counterclockwise turns off the AUX receiver.

Communication Antenna Selector Switch

The communication antenna selector switch is a three position toggle switch.

UPPER	Selects the upper UHF antenna.
LOWER	Selects the lower UHF antenna.
AUTO	The main transmitter-receiver will automatically select the antenna receiving the strongest signal.

Communication Guard Receiver Selector Switch

The communication guard receiver selector switch is a two-position toggle switch.

ON	Enables the guard receiver for main transmitter-receiver.
OFF	Disables guard receiver.

ADF Selector Switch

The ADF selector switch is a three-position toggle switch that allows the relative bearing to the UHF transmitting station to be displayed on the number 1 bearing pointer of the HSI.

COMM	Enables ADF operation utilizing the main transmitter/receiver.
AUX	Enables ADF operation utilizing the AUX receiver.
OFF	Disables ADF operation.

Cipher Zero Selector Switch

The cipher zero selector switch is a lever-lock type switch. When the switch is placed to zero the codes stored in the speech security system are set to zero.

Cipher Communication/Aux Selector Switch

The cipher communication/auxiliary selector switch is a three-position lever-lock type switch.

COMM	Permits secure voice operations on the main transmitter-receiver.
AUX	Permits secure voice reception on the AUX receiver.
OFF	Disables secure voice operations.

ICS Volume Control Knob

The ICS volume control knob adjusts the intercom audio volume level for the pilot's headset.

Microphone Switch

A pushbutton-type microphone switch is on the inboard throttle control handle for UHF transmissions.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

Exterior lights are controlled from either the exterior lights control panel or the miscellaneous control panel, both on the left console.

Position Lights

The position lights include a green light on the forward edge of the right wing tip, a red light on the forward edge of the left wing tip, and a white light just below the tip of the left vertical tail fin. The position lights are controlled by a knob on the exterior lights control panel labeled POSITION. With the anti-collision lights on, the position lights automatically go to steady full brilliance, regardless of the position of the position lights knob.

OFF	Lights are off.
1 -5	Guide numbers for varying brightness from off to full bright.
BRT	Lights are at full brightness.
FLASH	The lights will flash at full brightness.

Anti-Collision Lights

There are three red anti-collision lights; one on the leading edge of each wing just outboard of the air intake and another just below the tip of the right vertical tail fin. The anti-collision lights are controlled by a single toggle switch on the exterior lights control panel labeled ANTI-COLLISION. The switch positions are OFF and ON.

Formation Lights

Six green electroluminescent formation lights are provided. Two lights are on the wingtips behind the position lights, two lights are on the side of the forward fuselage just forward of the cockpit, and two lights are on the aft fuselage just aft of wing trailing edge. The formation lights are controlled by a single knob on the exterior lights control panel labeled FORMATION.

OFF	Lights are off.
1 -5	Guide numbers for varying brightness from off to full bright.
BRT	The lights are at full brightness.

Landing and Taxi Lights

The landing and taxi lights are on the nose gear strut. They are controlled by a toggle switch on the miscellaneous control panel. The lights are off when the nose wheel is not down and locked, regardless of switch position.

OFF	Lights are off.
LDG LIGHT	If the nose gear is down and locked, the landing light is turned on.
TAXI	If the nose gear is down and locked, the taxi light is turned on.

INTERIOR LIGHTING

Except for the utility floodlight, all the controls for interior lights are on the interior lights control panel on the right console.

Flight Instrument Lighting

Integral lighting is provided for the following flight instruments: ADI, HSI, airspeed mach indicator, altimeter, vertical speed indicator, angle-of-attack indicator, clock, and accelerometer. The lights are controlled by the flight instrument lights knob, labeled FLT INST, which provides variable lighting between position OFF and BRT.

Engine Instrument Lighting

Integral lighting is provided for the following engine instruments: L & R tachometers, L & R FTIT, L & R fuel flow indicators, PC1, PC2 and utility hydraulic pressure indicators, oil/hydraulic lightplate, L & R nozzle position indicators, L & R oil pressure indicator, and the fuel quantity indicator. The lights are controlled by the engine instrument lights knob, labeled ENG INST, which provides variable lighting between positions OFF and BRT.

Auxiliary Instruments Lighting

The lights and lightplates on the instrument panel that are not controlled by the flight instruments or engine instruments lights knobs are controlled by the auxiliary instruments lights knob labeled AUX INST, which provides variable lighting between positions OFF and BRT.

Console Lighting

The console lights are controlled by the L CONSOLE and R CONSOLE knobs which provide variable lighting between positions OFF and BRT.

ACS Control Panel Lighting

The ACS control panel lights are controlled by the LT knob on the panel, which provides variable lighting between positions OFF and BRT.

Storm/Flood Lighting

Four storm/flood lights are provided as secondary cockpit lighting. The four lights are under the canopy sills, two above each console. The lights are controlled by the storm/flood lights knob labeled STORM FLOOD, which provides variable lighting between OFF and BRT. If the warning/caution/BIT/advisory lights are in the dimmed condition, moving the storm/flood lights knob to full BRT causes the warning/caution/BIT/advisory lights to revert to full intensity, regardless of the position of the WARNING CAUTION control.

Utility Flood Light

A portable utility floodlight is provided and is normally stowed on a bracket above the right console. An alligator clip attached to the light may be used to fasten the light at various locations in the cockpit at the pilot's discretion. The utility light is the only cockpit light designed to illuminate the cockpit which operates from JFS generator power.

Standby Instrument Lights

Lighting for the standby compass, the standby altimeter, the standby airspeed indicator and the standby attitude indicator are controlled by an individual toggle switch labeled STBY INST. Dimming control is provided by the AUX INST lights knob, which has positions OFF and ON.

Warning/Caution Lights Control Knob

A control is provided on the interior lights control panel to switch the warning/caution/BIT/advisory lights from bright intensity to the low intensity range, and then to vary the brightness within the low intensity range. The control is labeled WARNING CAUTION. The control only works provided the flight instrument lights knob is not in OFF, the storm/flood lights knob is not in full BRT, and the warning caution lights control knob has been momentarily placed to the RESET position. Once in the low intensity range, the warning/caution/BIT/advisory lights can be brought back to bright intensity by turning the flight instrument lights knob to OFF or turning the storm/flood lights knob to full BRT. The master caution light is also dimmed when the warning caution lights knob is placed to RESET, but intensity cannot be varied.

Lights Test Switch

A lights test switch, labeled LT TEST, is provided to test the warning/caution/BIT/advisory lights.

ON	Serviceable warning/caution/BIT/advisory lights will illuminate (except T.O. TRIM).
OFF	The switch is spring loaded off.

OXYGEN SYSTEM

NORMAL OXYGEN SUPPLY

Normal oxygen is supplied by a 5 liter liquid oxygen system. The oxygen system functions at approximately 75 PSI until the converter is depleted.

Oxygen Low Caution Light

The OXY LOW light located on the caution light panel will come on when oxygen quantity is below 2 liters. The light will also come on when the oxygen quantity test button is depressed and the oxygen quantity gage pointer drops below 2 liters.

EMERGENCY OXYGEN SUPPLY

A 10 minute supply of oxygen is furnished by a gaseous oxygen storage bottle in the survival kit. This supply is activated by pulling up on the emergency oxygen knob or automatically on ejection.

WARNING

The aircraft oxygen supply hose must be disconnected from the omni-connector upon activation of emergency oxygen.

OXYGEN REGULATOR

The oxygen regulator, on the right console, automatically controls the pressure and flow rate of normal oxygen based on demand and cockpit altitude.

Supply Lever

A two-position lever on the right corner of the regulator panel, controls the flow of oxygen from the regulator.

ON	The proper mix of cockpit air and oxygen are supplied to the mask.
OFF	Breathing is not possible with the mask on.

Diluter Lever

A two-position diluter lever, in the center of the regulator, controls the mixture of air and oxygen.

NORMAL	The scheduled mixture of air and oxygen is delivered.
100%	Pure oxygen is delivered.

Emergency Lever

A three-position emergency lever is on the lower left corner of the regulator panel.

NORMAL	Normal operation is provided.
EMERGENCY	Continuous positive pressure of oxygen is delivered to the mask.
TEST MASK	Positive oxygen pressure is supplied.

Oxygen Flow Indicator

The oxygen flow indicator on the regulator alternately shows white for flow and black for no-flow with each breath under normal conditions. Continuous black indicates no air/oxygen is being furnished and continous white indicates a leak in the system.

Oxygen Pressure Gage

The oxygen pressure gage on the regulator indicates oxygen delivery pressure to the regulator. The normal indication is approximately 75 PSI.

Oxygen Quantity Gage

The oxygen quantity gage, is located on the ECS panel adjacent to the regulator. See figure 1-17 for oxygen duration chart.

Oxygen Quantity Gage Test Button

The oxygen quantity gage test button, on the ECS panel adjacent to the gage, is used to test the operation of the gage and the OXY LOW caution light. Depressing the test button causes the gage needle to rotate from the present quantity indication to 0. As the needle passes below 2 liters the OXY LOW caution light should come on. Upon release of the test button, the gage needle should rotate from 0 to an indication of the present quantity and the OXY LOW caution light should go out as the needle passes above 2 liters.

Oxygen Hose Stowage Fitting

An oxygen hose stowage fitting is provided above and outboard of the right console. The oxygen hose should be stowed in this fitting at all times when not in use to prevent hose contamination and damage to the console by a flailing hose.

AIR DATA COMPUTER

The air data computer (ADC) is a digital computer which receives inputs from the pitot-static system, the AOA probes, the left total temperature probe, the altimeter setting knob, the nose landing gear door switch, and the flap switch. The ADC corrects these inputs for sensor error as required, computes various parameters from this data and furnishes required parameters to aircraft equipment and cockpit displays (refer to figure 1-11). In addition, the ADC performs validity checks on critical data as received by the using equipment or display and will actuate appropriate caution lights or warning flags if the data is determined to be invalid. Operation of the ADC is entirely automatic and no controls are available to the pilot.

ANGLE-OF-ATTACK (AOA) PROBES

The AOA probes, on each side of the forward fuselage, measure local AOA and furnish this data to the ADC and to the respective engine inlet controller, and directly to the cockpit AOA gage. Heaters to prevent ice formation are automatically energized when airborne. No controls are available to the pilot. The probes remain hot for some time after flight and contact should be avoided.

AIR DATA COMPUTER

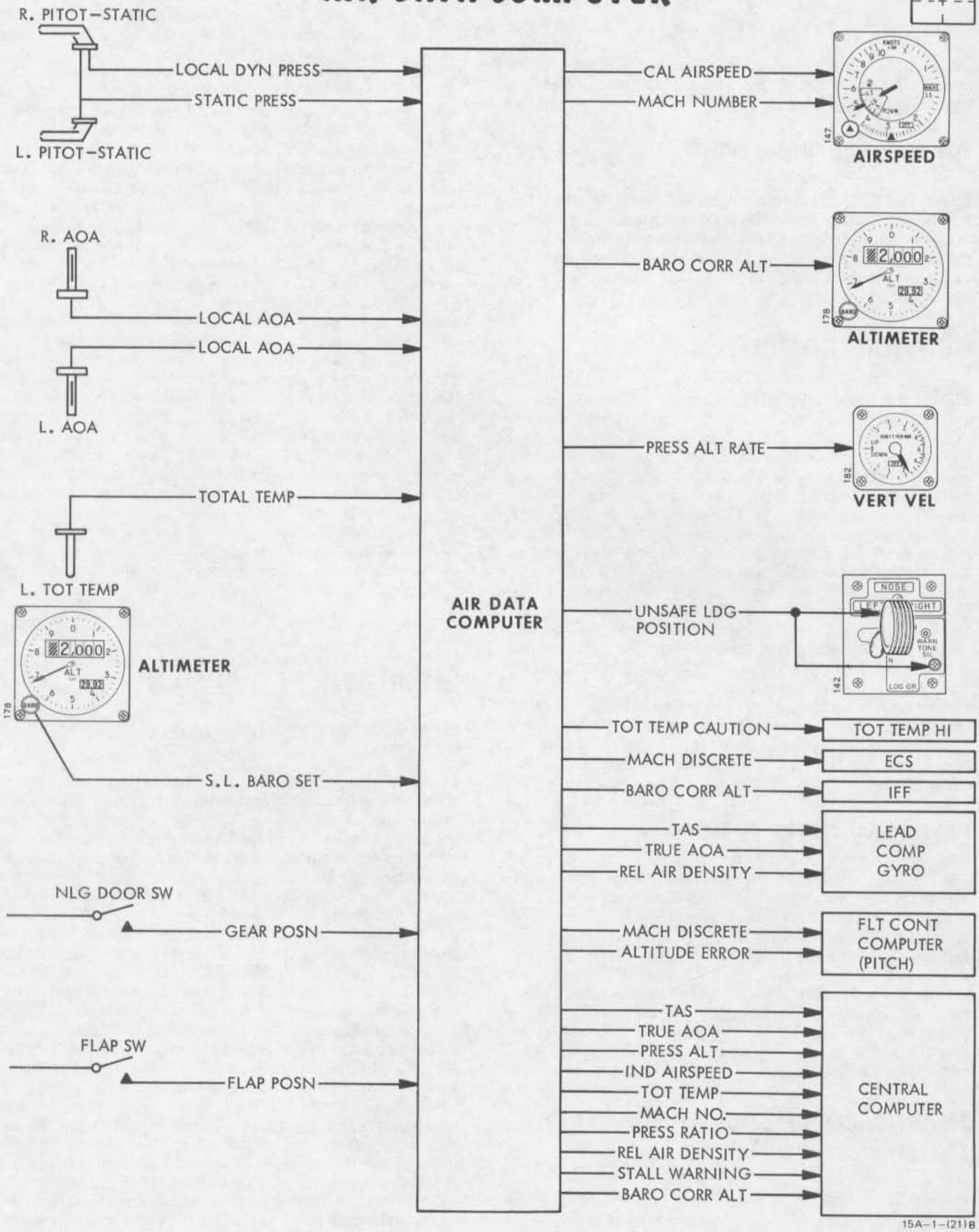


Figure 1–11

TOTAL TEMPERATURE PROBE

Total temperature probes are located on the left and right forward fuselage, the probes furnish temperature information to their respective engine air inlet controllers and the left probe also furnishes temperature information to the air data computer.

TOT TEMP HI CAUTION LIGHT

The TOT TEMP HI caution light will come on when the sensed duct temperature becomes high enough to cause critical engine inlet heating. Such temperatures will be the result of ram rise at high Mach numbers and the airplane should be slowed until the light goes out (3 minute limit).

CENTRAL COMPUTER

The central computer (CC) is a high speed, stored program, general purpose digital computer that performs mission oriented computation from data received from control panel and subsystems aboard the aircraft. The computations include A/A and A/G steering and weapon delivery, navigation, flight director, and control and display management. The CC provides the pilot with steering and weapon delivery cues, target data, avionic system status, weapons configuration and flight data in the air-to-air attack, air-to-ground attack, visual identification (VI), and attitude director indicator (ADI) modes of operation. The CC computations are controlled by the operational flight program stored in the CC memory. Upon application of aircraft power, the computer is operational. Failure detection of the peripheral systems and CC internal operation is done by continual monitoring. Back up system substitution is also accomplished in the central computer. If the computer detects a power loss or failure, the CC light on the BIT panel, and AV BIT light on the caution light panel will come on steady.

CENTRAL COMPUTER INTERFACE

The central computer is interfaced with the radar, armament control system (ACS), air data computer (ADC), attitude heading reference system (AHRS), horizontal situation indicator (HSI), head up display (HUD), lead computing gyroscope (LCG), signal data recorder (SDR), radar warning receiver (RWR), inertial navigation measuring unit (IMU), vertical situation display (VSD), navigation control indicator (NCI), the BIT panel and the avionics status panel. A CC reset is performed by depressing the CC reset button on the BIT panel. The CC reset should be initiated only if a CC problem is suspected.

NAVIGATION HEAD-UP DISPLAYS (HUD)

The HUD, on the main instrument panel, displays the following aircraft parameters in all modes of the avionics system: magnetic heading, indicated airspeed, barometric altitude, velocity vector, flight path, and pitch and roll. In all modes the heading, airspeed and altitude symbology can be removed by placing the HUD symbol switch, on the HUD control panel, to the reject position. In addition to the flight parameters, the HUD displays navigational data if the avionics system is in the ADI mode. The ADI mode is selected by positioning the weapon select switch on the throttles to any position other than gun, and depressing ADI switch on the master mode panel. In NAV (navigation) mode, in addition to the flight parameters, the HUD displays bank steering to the destination selected, distance to destination, steering mode selected, and nav destination selected. In TCN (tacan) mode, the HUD displays are the same as in NAV mode except that the bank steering displayed is to the selected tacan radial, the distance displayed is to the tacan station, and destination is not displayed. In ILS/NAV and ILS/TCN (instrument landing set) modes, in addition to the flight parameters, the HUD displays the following: bank and pitch steering bars for approach and landing on runway destination, distance to destination (in ILS/NAV) or tacan station (in ILS/TCN), and the discrete of the steering mode selected. Also when the steering mode knob is in either the ILS/NAV or ILS/TCN mode and the aircraft passes over the outer marker or middle marker beacon, the beacon light will flash and an MKR will flash on the HUD. On all airplanes after T.O.1F-15A-503, instead of the HUD displaying distance to destination or tacan station, the HUD displays the time-to-go to the selected destination in navigation steering mode, or to the tacan station in tacan steering mode. Time-to-go is displayed to the nearest minute with a maximum reading of 999 minutes. When the gear is down, in ADI mode, angle-of-attack data in cockpit units is displayed on the HUD.

EMERGENCY EQUIPMENT

WARNING/CAUTION/BIT/ADVISORY LIGHTS

The warning lights provide indications of system malfunctions requiring immediate corrective action. They illuminate red and are prominently located at or near the top of the instrument panel. Corrective action deenergizes all warning indications. The caution/advisory lights give indications of lesser urgency requiring no immediate action. The yellow caution lights provide malfunction indication of the major systems requiring attention but not necessarily immediate action. The caution lights are on the caution lights panel on the lower right sub-instrument panel. The MASTER CAUTION light on the upper instrument panel illuminates simultaneously when any caution light, except AV BIT, JFS LOW, or SPD BK OUT illuminates. The MASTER CAUTION light extinquishes when it is depressed but, except for the HYDRAULIC light, the caution light on the caution lights panel remains on until the malfunction is corrected. The advisory lights, which are either green or white, indicate safe and normal conditions and impart information for routine purposes. Individual advisory lights are located throughout the cockpit and are described with their applicable equipment. The BIT lights are described in built-in-test (BIT), this section. A list of warning/caution lights with causes of their illumination and corrective action-taken is described in Section III. Intensity control of the lights is described in lighting, this section.

EMERGENCY JETTISON BUTTON

The emergency jettison button is located on the center of the instrument panel to the left of the ADI. This button, when depressed, will simultaneously jettison all external stores on all stations except the TEWS pods from stations 1 and 9. Although the button is spring–loaded to the normal position, a means is provided to determine that the button is not stuck in the jettison position. In the normal position only the color black on the inside lip of the button guard can be seen above the button. If the button is stuck in the jettison position, yellow color can be seen in the switch guard below the black color.

CAUTION

Emergency jettison button is hot when electrical power is on the aircraft.

ARMAMENT SAFETY OVERRIDE SWITCH

The armament safety override switch; on the left console outboard of the anti–G valve, allows the ground safety interlocks to be bypassed for armament circuit checkout.

SAFE	Normal circuitry is used.
OVERRIDE	The switch will be solenoid held until electrical power is removed, the landing gear handle is placed UP, or the switch is manually placed to SAFE.

BUILT–IN–TEST (BIT) SYSTEM

The BIT panel on the left console (figure 1–12) provides the controls and most of the cockpit indicators for the avionics built–in–test. Indicator lights for hydraulic subsystems are also located on the panel (see hydraulic system, this section). Some cockpit units have a BIT failure indicator on the face of the unit.

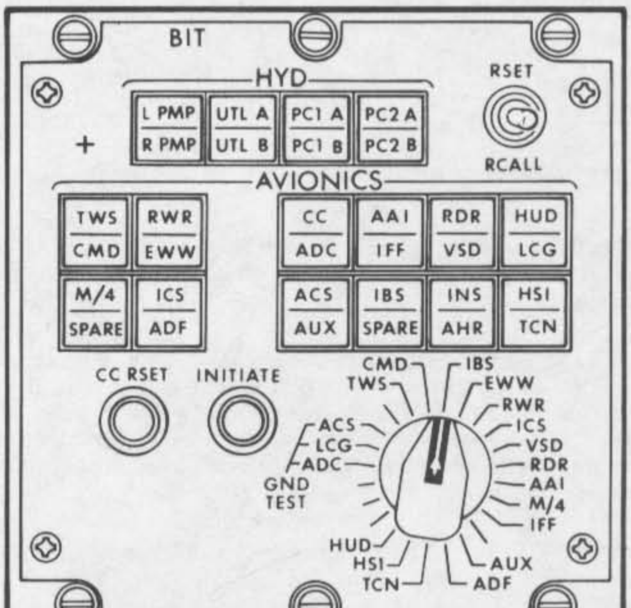
Three test methods are used; continuous, interleaved and interrupted. The continuous method constantly monitors particular signals for presence, value or logic. The interleaved method automatically intersperses test signals and replies amongst operating signals in such a manner that they do not interfere with normal equipment operation. The interrupted method must be initiated by the pilot and causes an interruption of normal operation of the designated system for the duration of the test.

Failure to pass any BIT test causes the appropriate indicator light to illuminate steady, the appropriate equipment location indicator(s) on the avionics status panel in the nosewheel well to latch, and the AV BIT light on the caution light panel, but not the master caution light, to illuminate. Illuminated BIT lights and the AV BIT light will go off when the reset/recall switch is actuated to RSET. Previously illuminated lights will come on again when the switch is actuated to RCALL or if any other BIT light illuminates. The associated BIT light will be on if there is no power on the system but nosewheel well indicators will not latch. Failure of BIT circuitry within a system will latch indicators in the nosewheel well but the BIT panel light will not illuminate.

BIT indicator lights are provided as follows:

HSI – horizontal situation indicator
HUD – head–up display
VSD – vertical situation display
RDR – radar
ACS – armament control set
AUX – UHF receiver and integrated communications control
TCN – tacan
ADF – automatic direction finder
LCG – lead computing gyro
IFF – IFF transponder and control panel

BIT CONTROL PANEL



15A–1–(104)C

Figure 1–12

AAI – IFF reply evaluator, interrogator
M/4 – IFF reply evaluator, interrogator, control panel, transponder, KIT and KIR
RWR – radar warning receiver
ADC – air data computer
IBS – interference blanker set
ICS – internal countermeasure set
EWW – electronic warfare warning set
AHR – attitude and heading reference system
INS – inertial navigation system
CC – central computer
TWS – tactical electronic warfare system (TEWS)
CMD – countermeasures dispenser

BIT failure indication for the air inlet controllers is provided by the R INLET and L INLET lights on the caution light panel. There is no interrupted BIT for the air inlet controllers.

The IBS light may be illuminated by IBS failure or by too long a pulse to the IBS from the IFF, tacan, radar, EWWS or either TEWS pod which will disable the IBS. If the long pulse was a one time failure, the IBS may be restored to operation by initiating an interrupted BIT. If the IBS light illuminates steady during this test either the IBS is malfunctioning or one of the equipment is continuing to deliver too long a pulse. To locate the problem, turn off the IFF, tacan, radar, EWWS and both TEWS pods and initiate an interrupted BIT. If the IBS light illuminates steady, the IBS has failed. If the light goes out, the equipment may be turned on individually to determine which is delivering the too long pulse. When the IBS light is illuminated, no blanking pulses are supplied and operation of the IFF transponder, IFF interrogator, tacan, radar, EWWS, RWR, and TEWS may be affected.

INTERRUPTED BIT

The AHR, AFCS and CC do not have interrupted BIT. Depressing the CC reset pushbutton resets the central computer.

The INS interrupted BIT is a maintenance function requiring ground power and 55 minutes to perform. It is initiated by placing the INS mode selector knob to GB/TEST. Another gyro bias test is completed automatically when the INS mode select knob is at GC for 20 minutes.

The ACS, LCG and ADC lights are in an area of the BIT panel marked GND TEST and interrupted BIT for this equipment is inhibited unless the weight-on-wheels switch is closed.

The ACS interrupted BIT is a pre-loading maintenance function and should not be initiated by the pilot.

Interrupted BIT is initiated by selecting the function on the BIT select knob and depressing the initiate button. The selector should not be moved until the test is completed. All previously reset lights and the AV BIT light will illuminate when the initiate pushbutton is depressed. The associated light will blink during the test. The associated light will extinquish at satisfactory completion of the test or illuminate steady for test failure.

HSI interrupted BIT initiation drives the HSI display as follows:

Compass card – 020
Course arrow – 040
Bearing pointer 1 – 040
Bearing pointer 2 – 060
Range indicator – 1234
Course selector window – 040
Course deviation bar – ½ scale to right
To-from indicator – TO
OFF flage – out of view
Course deviation warning flag – in view

and the ADI display as follows:

Pitch steering bar – ½ scale up
Roll steering bar – ½ scale to right
Glide slope indicator – out of view
Glide slope warning flag – out of view

TCN interrupted BIT initiation, providing steermode knob is at TCN and the tacan mode knob is not OFF, drives the HSI display as follows:

Bearing pointer 1 – 000
Range indicator – 0000

Tacan R/T failure will not turn on the TCN light until an interrupted BIT is initiated.

ADC interrupted BIT initiation drives the flight instrument display as follows:

Airspeed – 250 knots
Mach – .465
Vertical velocity – 500 feet/minute climb
Altimeter – 11,500 feet (29.92)

AAI interrupted BIT results in a VSD display of four targets at 22.8° left and right and 6.8 and 27.4 miles range providing sufficient range is selected on the radar range knob and the mode select knob is at LRS.

NOTE

Interrupted BIT initiations which drive displays to preset values may also drive displays other than those listed. Disregard these indications.

IFF continuous or initiated BIT failure does not turn on the IFF light until the failed mode is selected ON. Therefore, the IFF interrupted BIT should be initiated with all but one of the M1, M2, M3/A, and MIC switches OUT. After the IFF light stops flashing these switches should be placed ON one at a time while observing the IFF light so that any failed mode can be isolated. Most initiated tests require 2 seconds or less to complete and some are in the 100 millisecond range. When instrument readings must be noted, it may be necessary to hold the initiate pushbutton depressed until the reading is completed.

Inflight AFCS BIT failure indication is provided by the CAS YAW, CAS ROLL, and CAS PITCH caution lights on the caution light panel.

RDR interrupted BIT must be initiated with the radar power knob at OPR after 3 minute warm-up. It may be initiated either airborne or on the ground. When airborne, BIT initiation results in the word TEST appearing in the lower left corner of the VSD. The transmitter is checked for RF power on all RF channels in LO PRF, MED PRF, HI PRF and BCN modes. A failure in any channel or mode will cause the VSD to display RF NG in lieu of TEST. The radar computer, power supply, antenna and signal processor undergo self test. Failure to pass any of these tests will illuminate the RDR light steady. The following displays are presented in order on the VSD for 5 seconds each:

SRS (10 mile scale)
At 50° right, a strobe each mile and targets at 7.0 and 9.1 miles; the acquisition symbol at 30° right and 2.5 miles; the elevation symbol at 50° up and the azimuth symbol at 50° right.

MAP (80 mile scale)
PPT display of targets at each 5.24 miles at 0° azimuth except that targets are blanked at short range (below approximately 20 miles).

PULSE (40 mile scale)
Targets each 5.24 miles at 30° right; acquisition symbol at 0° and 20 miles; elevation symbol 30° up; azimuth symbol 30° right.

The airborne test requires approximately 1 minute 20 seconds to complete.

RDR BIT on the ground causes the same tests and presentations as when airborne plus further tests and fault isolation requiring an additional 15-20 seconds to perform. Acquisition tests in all channels and air-to-air modes and end-to-end track test in the SRS and VS modes is performed. This tests overall system performance. During the test, the words SW TST will appear on the VSD. At this time, the special mode, frame store, range, elevation scan, azimuth scan and mode select knobs should be rotated full CCW then full CW. Switch operation must be commenced within 5 seconds after SW TST appears or the test will be bypassed. Once commenced, switch operation must be completed or a spurious fault may be generated. A BIT NG message may appear for 10 seconds indicating a fault in the BIT logic and as an indication to maintenance personnel to read out the BIT matrix on the VSD by initiating BIT with the radar power knob at STBY.

TACAN (TACTICAL AIR NAVIGATION) SYSTEM

The tacan system functions to give precise air-to-ground bearing and distance information at ranges up to approximately 300 miles (depending on aircraft altitude) from an associated ground or shipboard transmitting station. It determines the identity of the transmitting station and indicates the dependability of the transmitted signal. When operating in conjunction with aircraft having air-to-air capability, the A/A mode provides line of sight distance between two aircraft operating their tacan sets 63 channels apart. Up to five aircraft can determine line of sight distance from a sixth lead aircraft in the A/A mode, provided their tacan sets are set 63 channels apart from the lead aircraft. The lead aircraft will indicate distance from one of the other five, but it cannot readily determine which one. Before operating in the A/A mode, the frequencies used by each aircraft must be coordinated. Tacan information except in A/A mode is presented on the horizontal situation indicator (HSI), the attitude director indicator (ADI), and the head-up display (HUD). In A/A mode, the only tacan information displayed is line of sight distance on the HSI.

TACAN CONTROLS

The controls for tacan operation are on the ILS/tacan control panel on the left console, on the steering mode panel on the main instrument panel, and on the HSI. The controls on the ILS/tacan control panel are the function selector knob, the volume control knob, the channel selector knob, and the XY switch. The controls on the steering mode panel consist of the steering mode knob. The controls in the HSI are the course set knob and the heading set knob.

Function Selector Knob

The function selector knob is a four-position rotary knob used for selecting tacan modes of operation. The mode positions are marked OFF, A/A, T/R, and REC.

A/A	Tacan interrogates other aircraft which contain a tacan in the A/A mode and tuned 63 channels apart from the channel setting of the interrogating aircraft. Tacan bearing is held to 0°.
T/R	Tacan receives bearing signals from the tacan ground station, and in addition, the tacan interrogates the tacan ground station to establish distance from the aircraft to the ground station. The bearing and distance information is displayed on the HSI.
REC	Tacan receives bearing signals from the tacan ground station for bearing display on the HSI, and also for steering display on the ADI and HUD. Tacan distance readout is shuttered on the HSI.

Volume Control Knob

The volume control knob is used for volume adjustment of the station identity tone signal.

Channel Selector Knob

The channel selector knob provides for selection of 126 tacan channels. The control consists of an outer knob used to select the units digit of the channel counter (0 to 9), and an inner knob used to select the tens and hundreds digits (00 to 12).

XY Switch

The XY switch is a toggle-type switch with positions of X and Y. Placing the switch to the X position provides capability for 126 channel operation. Placing the switch to the Y position adds an additional 126 channel capability to the tacan system.

Steering Mode Knob

With the steering mode knob on the steering mode panel set to the TCN (tacan) position, the tacan supplies information to the HSI, ADI and HUD (figure 1-13). The HSI displays the source of the selected tacan radial, deviation from the selected radial, and also indicates whether the course being flown is to or from the tacan station. In addition, the tacan supplies information to the HSI number 1 bearing pointer and to the range indicator to indicate distance and magnetic bearing to the tacan station. A steering signal which aids the pilot in making an asymptotic approach to the selected tacan radial is displayed on the bank steering bar of the ADI and the HUD.

Course Set Knob

The course set knob is used for manually selecting the desired tacan magnetic course.

Heading Set Control

The heading set control is used for adjusting the magnetic command heading bug.

INSTRUMENT LANDING SYSTEM (ILS)

The instrument landing system provides the capability for the aircraft to make a precision landing approach and descent. The localizer function provides lateral guidance information to position the aircraft on the runway center line during approach. The localizer frequency is 108.10 to 111.95MHZ. The localizer identification tone can be heard in the headset during ILS operation. A course deviation warning flag appears if the localizer signal is unreliable. The glide slope function provides vertical guidance information to position the aircraft on the glide slope angle during the final approach. A glide slope warning flag appears if the glide slope signal is unreliable. A beacon light adjacent to the HSI begins flashing when the aircraft passes over a marker beacon. A MKR also flashes on the head-up display indicator. ILS guidance information is displayed on the HSI, ADI, and head-up display indicator (see figure 1-14).

ILS CONTROLS

The controls for the ILS are on the ILS/tacan control panel on the left console. The controls consist of frequency selector knobs to select the frequency for the ILS operation. The inner knob selects the units and tens counters (08 to 11 in increments of 1), and the outer knob selects the decimal counter. The hundreds digit is fixed. The volume control knob controls the audio of the localizer signal, and when the knob is turned fully counterclockwise it turns off the ILS system.

INERTIAL NAVIGATION SYSTEM

The inertial navigation system (INS) is a self-contained, fully automatic navigation system which provides continuous present position monitoring and the capability for visual, tacan or radar updating. Data for twelve destinations, with offsets, and twelve tacan stations may be inserted for mission requirements. The target mark feature provides an airborne capability to designate and store three target positions.

INS INTERFACE

The INS supplies the primary attitude reference for the aircraft. In addition, aircraft attitude, heading, velocity and acceleration information are utilized by the fire control system, ADI, AHRS, and automatic flight control set.

INERTIAL MEASURING UNIT

The IMU contains the inertial platform, a digital computer, power supply and a battery which can sustain IMU operation for 7 seconds if main power is interrupted while airborne.

Inertial Platform

The platform maintains continuous pitch, roll and relative azimuth at all platform attitudes. The gimbals provide 360° freedom of rotation, allowing the platform to remain level with respect to local gravity.

Digital Computer

The computer controls the INS alignment sequence, computes aircraft present position, horizontal and vertical velocities, inertial altitude, and true heading, and processes accelerometer signals. It also provides BIT control and performs BIT functions.

NAVIGATION CONTROL INDICATOR

The NCI, located on the right console, (figure 1-15) contains its own power supply and can operate independent of the IMU. It contains all of the controls necessary to operate the INS. The controls and indicators are described in the following paragraphs.

TACAN/NAV MODE DISPLAYS

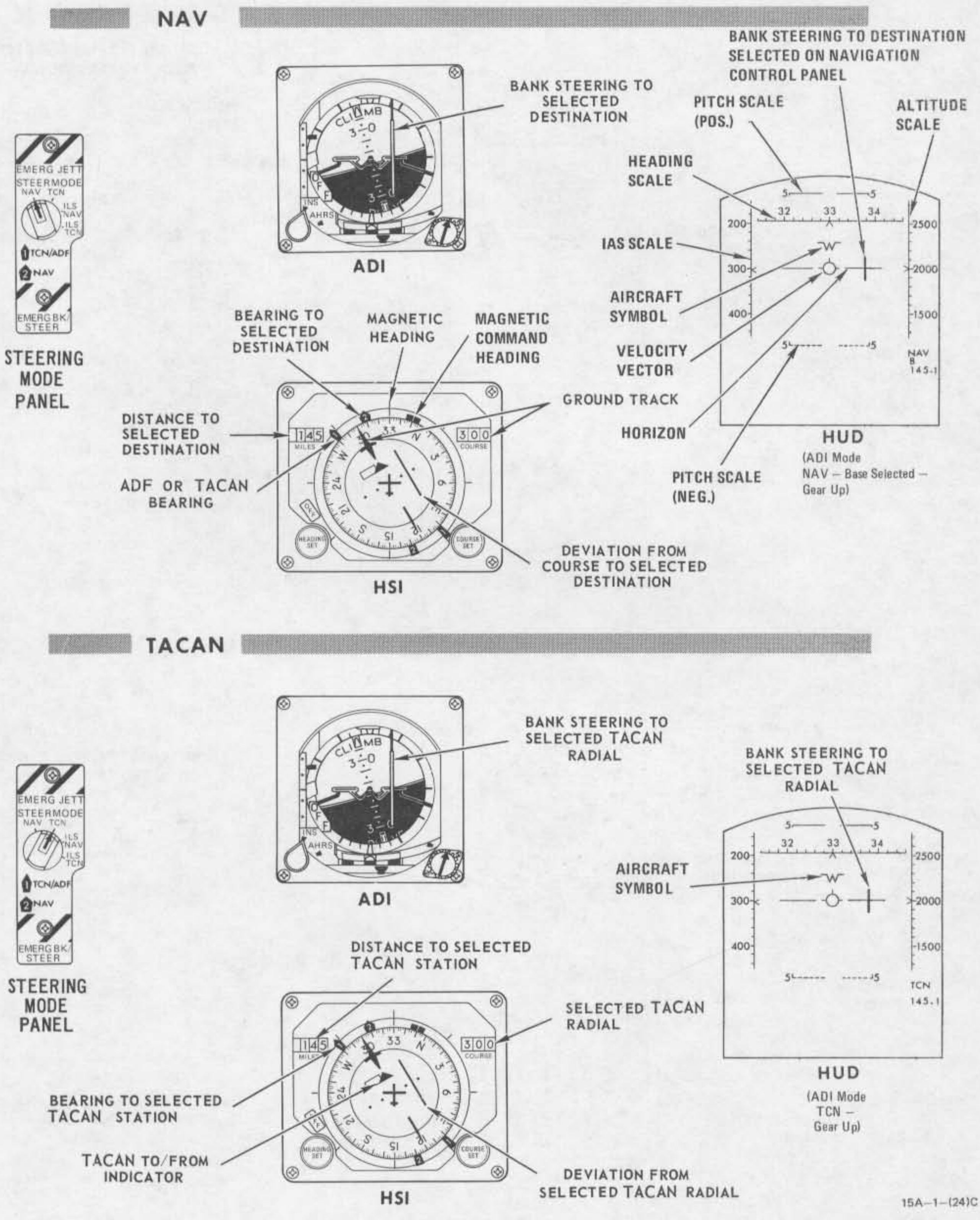


Figure 1-13

ILS/NAV AND ILS/TACAN MODE DISPLAYS

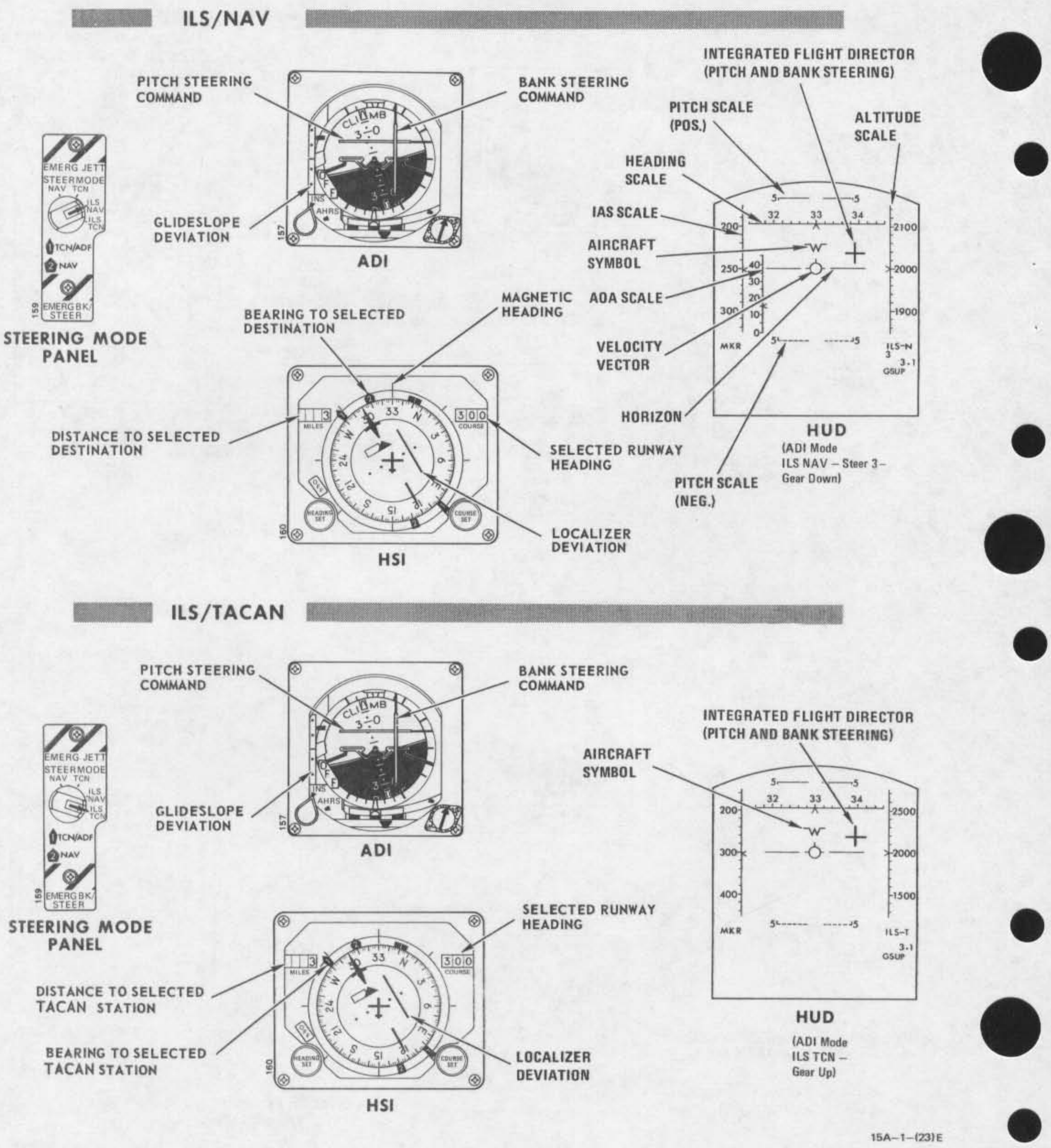


Figure 1–14

NAVIGATION CONTROL INDICATOR

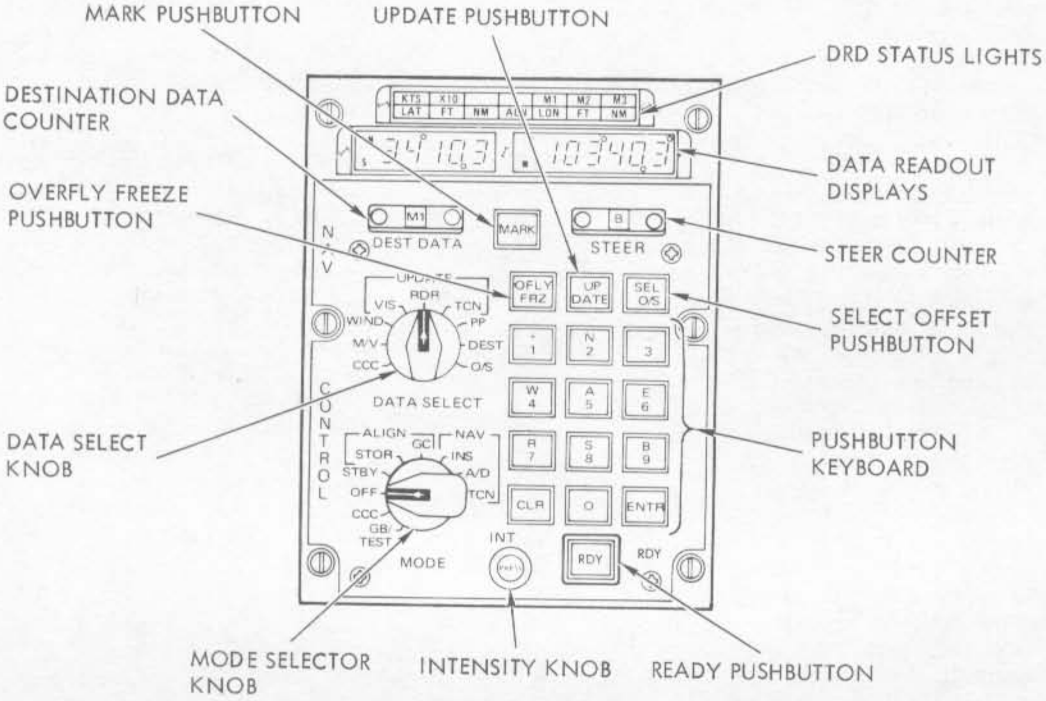


Figure 1-15

Mode Selector Knob

The mode selector knob is used to align the INS and select navigation mode.

GB/TEST	Initiates a gyro bias test. This is a ground test function.
CCC	Applies power to the NCI for the programming and readout of CC data. No power is applied to the IMU.
OFF	Power is removed from the INS.
STBY	Applies power to heat the IMU to its normal operating temperature. This mode is used only for extremely cold environments, or to allow for a shorter than normal (10 minutes) gyrocompass alignment when standing by for emergency conditions. Normally this mode is bypassed and the mode selector knob is placed directly from OFF to one of the alignment modes. The mode is also used for NCI and CC operation.
STOR	The stored heading position allows the use of INS heading that has been previously stored at time of power shut-off so that rapid alignment of the INS can occur. This mode is used only when aircraft has not been moved after power has been turned off. Time of alignment in this mode is 3 minutes plus heating time. When alignment is completed, the ALN (align) light on the NCI display window will flash.
GC	Gyrocompass alignment enables the INS to achieve a high alignment accuracy. Approximately 3 minutes after placing the mode selector knob to GC the INS is coarse aligned to best available true heading (BATH). At this time, the ALN (align) light comes on steady. After approximately 9 minutes, the INS will be fully aligned and the ALN light begins flashing.

INS	This is the primary navigation mode. In this mode, the INS solves the navigation problem by sensing aircraft accelerations, applying appropriate corrections and determining aircraft velocity and position. Steering to destination is computed in the CC based on inertially derived present position.
A/D	The air data mode is a backup to the primary INS mode. If the INS fails, the CC automatically switches to the air data navigation mode. The central computer utilizes true airspeed, wind velocities, and magnetic heading to derive aircraft position and compute steering to destinations. INS computation of inertially derived aircraft velocity and position is not disturbed by selection of A/D mode.
TCN	The CC utilizes pre-stored tacan station latitude and longitude, magnetic variation, and tacan measured range and bearing to derive aircraft present position, and compute steering to destination. INS computation of inertially derived aircraft velocity and position is not disturbed by selection of this mode.

Data Select Knob

The rotary data select knob selects the type of program data which is to be programmed and displayed on the data readout displays.

CCC	Allows the programming and readout of CC data. Entry of tacan channel, latitude, longitude, magnetic variation and altitude is performed in this position.
M/V	Selects magnetic variation for entry and display.
WIND	Selects wind data for entry and display from the CC.
VIS	Allows a visual overfly present position update when a valid CC signal is present. If the CC signal is invalid, then allows an INS visual overfly update if the INS position is selected with the mode selector knob.
RDR	Allows a radar present position update through the CC when the tacan is in either receive or transmit/receive mode.
TCN	Allows a present position update through the CC when the tacan is in either receive or transmit/receive mode.
PP	Selects present position latitude and longitude for entry and display.
DEST	Allows the entry and display from the CC of latitude, longitude, and altitude for any of the 12 destinations or three mark positions selected on the destination data counter.
O/S	Allows the entry and display from the CC of offset distances in feet north-south and east-west, or offset range in miles and tenths and bearing with respect to the destination selected on the destination data counter, or the corresponding altitude of the offset point.

Destination Data Counter

Selects any of 12 destination (B, 1-11) or 3 marks (M1, M2, M3) for data entry and display when the DEST position on the data select knob is selected. Depressing the pushbutton on the right side advances the counter one digit on the destination data counter. The counter has 16 positions, the sixteenth occurring after M3 in the sequence. However, the sixteenth position is unlabeled and is normally nonfunctional. Depressing the left pushbutton decreases the counter one digit.

Steer Counter

Selects any one of 12 destinations or 3 mark position (M1, M2, M3) to which steering information is presented on the cockpit indicators. The steer pushbuttons on each side of the steer counter operate the same as the destination pushbuttons.

Pushbutton Keyboard

The pushbutton keyboard consists of 10 pushbutton keys numbered from 0 to 9, and CLR (clear) and ENTR (enter) pushbuttons. In addition to inserting numbers, the keys are also used to enter east, west, north, south, plus, minus, bearing, range, and altitude. A minus sign can be entered and seen on the right data readout display, but a plus sign is not displayed. The keyboard works in conjunction with the CC and the IMU. The pushbutton keys insert data selected by the data select knob. Data is inserted by first depressing the appropriate alpha key and then the numeric keys. Depressing the enter (ENTR) pushbutton key enters the programmed data. Depressing the clear (CLR) pushbutton key removes incorrectly programmed data.

Overfly Freeze Pushbutton

Depressing the overfly freeze (OFLY FRZ) pushbutton freezes the latitude and longitude error display on the data readout displays when performing a visual position update. The VIS position on the data select knob enables the OFLY FRZ button.

Update Pushbutton

Depressing the UPDATE pushbutton manually accepts a navigation position update, when the data select knob is in the VIS, RDR or TCN position. The update pushbutton is also used to sequence the insertion of tacan station information.

Select Offset Pushbutton

Depressing the select offset (SEL O/S) pushbutton inserts stored offset data for the destination selected on the steer counter into the navigation problems.

Mark Pushbutton

Depressing the MARK pushbutton stores either the computed latitude and longitude of a designated air-to-ground target or aircraft present position latitude and longitude (overfly) if no target is designated. The appropriate M1, M2, and M3 light above the right data readout display illuminates to indicate the mark position into which latitude and longitude was stored when the mark pushbutton was last depressed. Each time the MARK pushbutton is depressed, the current MARK light will go out. If the pushbutton is depressed again after M3 is inserted, the M3 light goes out, the M1 light comes on, the data stored for the first mark depression (M1) is erased, and new position data is stored in the M1 position.

Data Readout Displays

The data readout displays (DRD), or monitor windows, display the data being entered, or the data selected for display. The DRD status lights, above the DRD, illuminate to indicate the units of the data being displayed, such as knots (KTS) when wind is displayed, or nautical miles (NM) when offset range is displayed.

Ready Pushbutton

Depressing the ready (RDY) pushbutton illuminates the pushbutton and also illuminates and enables the pushbutton keyboard. At the same time the CLR (clear) and ENTR (enter) pushbuttons are enabled. Alternate depression of the RDY pushbutton causes the pushbutton to illuminate or extinguish.

Intensity Knob

The intensity knob adjusts the brightness of the DRD, and DRD status lights, and the ready pushbutton. Depressing the intensity knob (press to test) illuminates all the NCI lights. The leftmost digit of the right DRD illuminates as a minus (–) and a 1, all other DRD digits illuminate as eights (8).

ATTITUDE HEADING REFERENCE SET (AHRS)

The attitude heading reference set supplies aircraft magnetic heading to various avionic systems. The AHRS is also the standby system which provides attitude (roll and pitch) information if the primary (INS) system fails. The AHRS mode of operation is selected on the attitude reference selector knob on the ADI.

AHRS INTERFACE

The INS provides roll and pitch data to the radar set and to the HUD. The AHRS provides INS with magnetic heading. The AHRS is informed by the INS of INS attitude validity. If INS attitude is invalid, the AHRS sends attitude information to the radar set and HUD. The INS provides compass mode command to AHRS, forcing AHRS into compass mode during INS alignment. The AHRS provides the central computer with magnetic heading at all times and informs the computer when the AHRS is in the slaved mode of operation. The AHRS sends roll and pitch information to the central computer. The AHRS supplies magnetic heading to the HSI to position the compass card, and provides roll and pitch information to the ADI when AHRS is selected.

COMPASS CONTROL PANEL

The compass control panel, on the right console, provides the necessary controls to operate the gyromagnetic compass system. These controls are the sync indicator meter, push to sync knob, fast erect pushbutton, hemisphere switch, latitude control knob, and the mode selector knob.

Sync Indicator Meter

The sync indicator meter indicates the direction (plus or minus) between the AHRS directional gyro and the magnetic azimuth detector, in the slaved mode.

Push To Sync Knob

The push to sync knob is a combination push to sync and push to turn (set heading) knob. When the knob is depressed and the mode selector knob is in SLAVED position, the AHRS provides fast synchronization of the gyro stabilized magnetic heading output to the magnetic azimuth detector. When the mode selector knob is in DG position, depressing and rotating the push to sync knob will slew the AHRS heading output through 360° of rotation (on the compass card). Rotating the push to sync knob causes the HSI compass card to rotate while the heading on the HUD remains steady.

Fast Erect Pushbutton

Depressing the fast erect pushbutton causes the AHRS pitch and roll erection loops to revert to the fast erection rate.

Hemisphere Switch

The hemisphere switch selects the northern (N) or southern (S) hemisphere for operation of AHRS.

Latitude Control Knob

The latitude control knob manually inserts present position latitude, in DG and slaved mode, so that the AHRS can determine the correction needed for gyro drift due to the earths rotation.

Mode Selector Knob

The mode selector knob is a three-position rotary knob with positions of COMP, SLAVED, and DG.

a. COMP - The compass mode is usually selected only when there is a gyro malfunction which the slaving system cannot overcome. The compass mode, through the magnetic azimuth detector, provides a source of magnetic heading information to other aircraft systems.
b. DG - 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. In this mode, azimuth information is received only from the directional gyro. When the DG mode is initially selected, the magnetic heading of the aircraft must be set into the system with the push to sync/push to turn knob on the compass control panel. 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 the latitude control knob on the compass control panel.
c. SLAVED - The slaved mode is the mode used under normal conditions. In this mode, gyro sensed heading is transmitted by the AHRS, but the gyro heading is continuously corrected to agree with the heading sensed by the magnetic azimuth detector.

NOTE

When in the SLAVED or DG mode, periodically check that the hemisphere and latitude control settings correspond to the correct latitude.

If the aircraft is in unaccelerated flight and there is an obvious disagreement between the attitude indicator and the visually verified attitude of the aircraft, go to straight-and-level unaccelerated flight and momentarily depress the fast erect pushbutton to re-erect the gyro for correct attitude sensing. During the fast erect condition the AHRS will indicate invalid BIT outputs, and level, unaccelerated flight must be maintained until a valid output is obtained.

IDENTIFICATION SYSTEM

IFF TRANSPONDER SET

The IFF (identification friend or foe) transponder set provides automatic identifications of the airplane in which it is installed when challenged by surface or airborne interrogator sets, and provides momentary identification of position (I/P) upon request. The modes provided for interrogation are mode 1, mode 2, mode 3/A, mode 4, and mode C. Modes 1, 2, and 3/A are selective identification feature (SIF) modes. Mode 4 is used for highest confidence identification (crypto), and mode C is used for altitude reporting. The codes for modes 1 and 3/A can be set in the cockpit.

Transponder Controls

The IFF transponder set is controlled by the IFF control panel on the left console, and the upper section of the main communication control panel on the main instrument panel (figure 1-16). The controls consist of the master switch, the mode C selector switches, the mode 1 and mode 3/A code selectors, the mode 4 function switch, the mode 4 indication switch, the mode 4 reply light, and the I/P pushbutton. There is also an IFF mode 4 light on the caution light panel.

MASTER SWITCH

LOW	System operates with reduced sensitivity.
NORM	System operates at full sensitivity.
EMERG	Selects normal sensitivity emergency IFF operation. Allows the system to respond to interrogations in modes 1, 2, and 3/A. The reply for modes 1 and 2 is the code selected on the applicable dials, while mode 3/A transmits code 7700.

MODE 1, 2, 3/A, AND C SELECTOR SWITCHES

Two-position selector switches control the operation of these modes as follows:

ON	Enables response to mode interrogation.
OUT	Disables mode response.

MODE 4 SELECTOR SWITCH

The three-position mode 4 selector switch controls operation of mode 4 as follows:

B	Enables mode 4/B reply.
A	Enables mode 4/A reply.
OUT	Disables all mode 4 reply.

IFF & AAI CONTROL PANELS

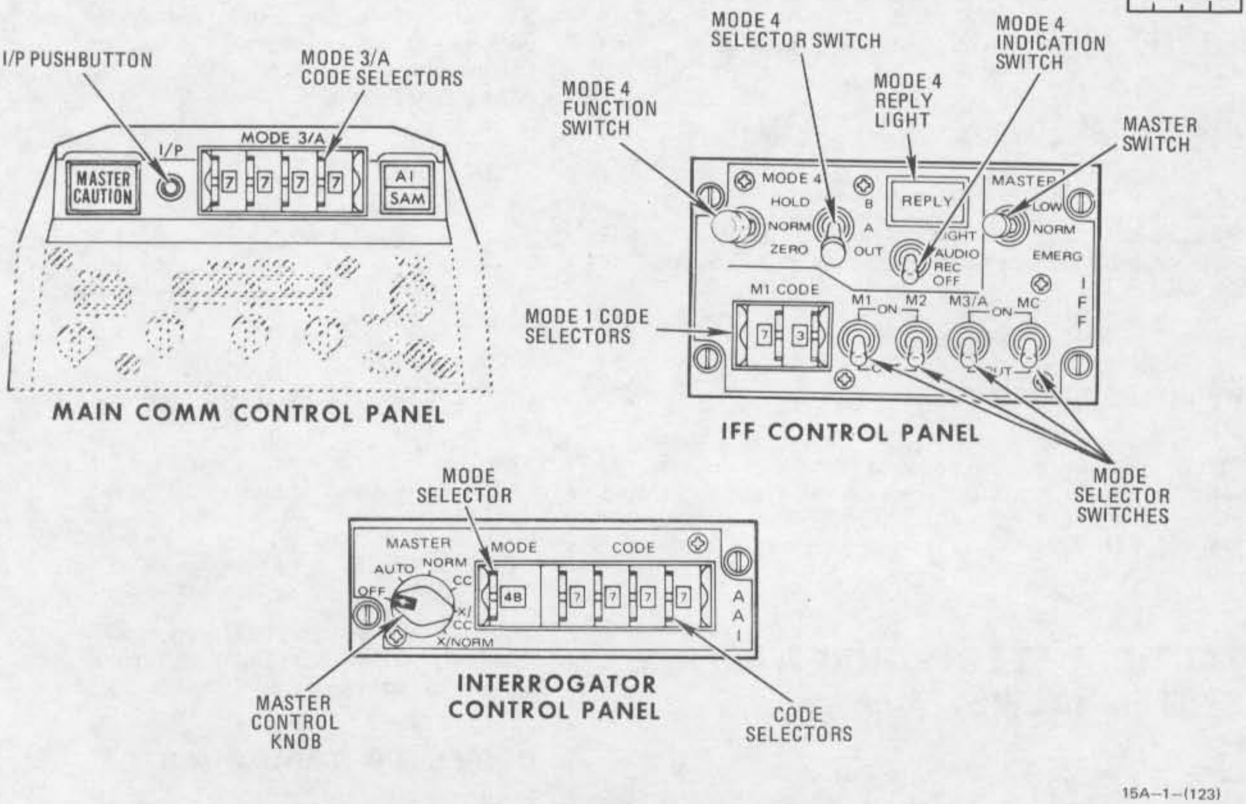


Figure 1-16

MODE 1 AND MODE 3/A CODE SELECTORS

The mode 1 code selector thumbwheels on the IFF control panel are used to select mode 1 codes. The mode 3/A thumbwheels on the main communication control panel are used to select mode 3/A codes.

MODE 4 FUNCTION SWITCH

This switch has positions of HOLD, NORM and ZERO. The HOLD position is not used during flight but it is used to retain the code setting if another flight is anticipated during the code period. Positioning the switch to HOLD after landing and waiting 15 seconds before turning off aircraft electrical power will retain the code after aircraft power is turned off. Placing the switch to NORM permits normal mode 4/A and mode 4/B replies. The mode 4 code settings are inserted before flight, and placing the function switch to ZERO will set the code settings back to zero.

MODE 4 INDICATION SWITCH

This switch has positions of LIGHT, AUDIO REC, and OFF. When modes 1, 2, 3/A, C, and 4 are not enabled and AUDIO REC is selected, mode 4 standby operation is enabled. In this mode 4 standby condition, the transponder is capable of detecting mode 4 interrogations without replying. If a valid interrogation is received, an audio signal is heard in the headset. The pitch of the tone increases as the rate of received interrogations increases. With mode 4 enabled and the AUDIO REC position selected, the audio tone is generated when valid interrogations are received. In addition, when mode 4 replies are transmitted above a minimum threshold rate, the REPLY light comes on. If no replies are being generated, the REPLY light will not come on; however, the IFF mode 4 light on the caution light panel will come on, which in turn activates the MASTER CAUTION light. With mode 4 enabled and the switch in the LIGHT position, the mode 4 light comes on indicating mode 4 response. With mode 4 enabled and the switch in the OFF position, both the audio and the REPLY light are disabled, and there is no indication of mode 4 interrogation and reply activity. The IFF MODE 4 caution light remains in operation.

IDENTIFICATION OF POSITION (I/P) SWITCH

Depressing the I/P pushbutton enables the IFF system to transmit momentary identification of position when interrogated. The response is continued for a period of 15 to 30 second duration after the pushbutton is released.

IFF ANTENNA SELECTOR SWITCH

The antenna selector switch is on the left console adjacent to the IFF control panel.

Upper	Selects upper antenna
LOWER	Selects lower antenna
BOTH	Provides automatic antenna selection

IFF EMERGENCY OPERATION

Upon ejection from the cockpit, the IFF emergency mode automatically becomes active if mode 1, 2, 3/A, or C is enabled.

IFF INTERROGATOR SET

The interrogator control panel (figure 1-16) contains the controls for providing air-to-air (AAI) target identification. Refer to Nonnuclear Weapons Delivery Manual, T.O.1F-15A-34-1-1 for description of the system.

TACTICAL ELECTRONIC WARFARE SYSTEM (TEWS)

Refer to supplement Nonnuclear Weapon Delivery Manual, T.O.1F-15A-34-1-1, for description of the Tactical Electronic Warfare System (TEWS).

RADAR SYSTEM

Refer to Nonnuclear Weapons Delivery Manual, T.O.1F-15A-34-1-1, for description and operation of the Radar System.

WEAPON SYSTEMS

Refer to the Nonnuclear Weapons Delivery Manual, T.O.1F-15A-34-1-1, for a detailed and operational description of the following systems.

Aircraft Weapons Capabilities
Armament Control Set
Head-Up Display System
Vertical Situation Display System
AAI System
Stores Jettison System
Weapon Employment
Suspension Equipment
Bomb Fuzes
Combat Weapons
Training Weapons
Camera Systems
KY-28 Speech Security Unit

TRAINER FIGHTER (TF) VERSION

The aircraft is a tandem configured aircraft which performs the secondary role of a trainer without compromising its primary role of an all-weather air superiority fighter.

FRONT COCKPIT

The front cockpit of the two-seater is identical to the single-seat cockpit except that an intercom system has been added, and the oxygen quantity gage registers 10 liters.

OXYGEN QUANTITY GAGE

The appearance of a power-off flag on the gage face is an indication of a loss of electrical power.

REAR COCKPIT

The rear cockpit contains the equipment described in the following paragraphs. Refer to foldout section for rear cockpit illustration.

OXYGEN LOW CAUTION LIGHT

The OXY LOW light will come on when oxygen quantity is below 4 liters. The light will also come on when the oxygen quantity test button is depressed and the oxygen quantity gage pointer drops below 4 liters.

FIRE WARNING LIGHTS

Left and right fire warning lights are provided to warn of a fire or overheat condition in the aft section of the aircraft.

VERTICAL SITUATION DISPLAY (VSD)

The rear cockpit VSD provides the same displays as the front cockpit VSD for all radar modes including the IFF confidence symbols, the video for TV weapons, and aircraft flight status symbology.

MASTER CAUTION LIGHT

A rear cockpit master caution light illuminates any time the front cockpit master caution light illuminates. The light can not be extinguished from the rear cockpit.

AI/SAM WARNING LIGHTS

When an airborne or surface-to-air missile threat is detected, the respective AI or SAM lights illuminate. Refer to T.O.1F-15A-34-1-1.

MAIN COMMUNICATION CONTROL PANEL

The rear cockpit main communication control panel operates and functions the same as the main communication control panel in the front cockpit, except the mode 3/A thumbwheels and the I/P pushbutton are inoperative.

CANOPY UNLOCK WARNING LIGHT

The rear cockpit light operates identically as the front cockpit canopy unlock light.

CAUTION LIGHTS PANEL

The caution lights panel contains a SPD BK OUT light, TOT TEMP HI light, FUEL LOW light, BINGO FUEL light, and an OXY LOW light. These lights illuminate any time the respective front cockpit caution light illuminates.

AIRSPEED/MACH INDICATOR

The airspeed/mach indicator receives the same signals sent to the front cockpit airspeed/mach indicator.

ANGLE OF ATTACK (AOA) INDICATOR

A measurement of local AOA sensed by a left and right probe supplies signals to both the front and the rear angle of attack indicators.

ACCELEROMETER

The accelerometer measures acceleration G loads. It operates the same but is independent of the front cockpit accelerometer.

LANDING GEAR INDICATOR

LEFT, RIGHT and NOSE gear indicators are provided to show landing gear position. Signals sent to the front cockpit indicators are also sent to the rear cockpit indicators. The UNSAFE light will come on anytime the landing gear handle warning light in the front cockpit comes on indicating the same conditions exist.

EMERGENCY BRAKE/STEERING CONTROL

The front and rear cockpit emergency brake/steering control performs the same function.

ATTITUDE DIRECTOR INDICATOR

The same input signals which are sent to front cockpit attitude director indicator are also sent to the rear cockpit.

HORIZONTAL SITUATION INDICATOR

The horizontal situation indicator receives the same signals sent to the front cockpit horizontal situation indicator.

MASTER MODE CONTROLS/MARKER BEACON PANEL

The A/G, ADI, and VI mode advisory lights in the rear cockpit indicate what mode the pilot in the front cockpit has selected. The beacon light receives the same signals sent to the front cockpit beacon light.

RUDDER PEDALS AND RUDDER PEDAL ADJUST KNOB

The same functions are performed by the front and the rear rudder pedals and rudder pedal adjustment knob.

ALTIMETER

The altimeter receives the same signals as the front cockpit altimeter.

VERTICAL VELOCITY INDICATOR

Inputs supplied to the rear cockpit vertical velocity indicator are the same as those sent to the front cockpit vertical velocity indicator.

TACHOMETERS

Left and right tachometers receive the same signals as the front cockpit tachometers.

FAN TURBINE INLET TEMPERATURE INDICATORS

Temperatures measured at the fan inlet are supplied to both the front and rear fan turbine inlet temperature indicators.

DUAL SEAT OPERATION

A command selector valve is provided in the rear cockpit to select the desired ejection sequence to be initiated from the rear cockpit, or provide for single ejection for solo flight. Positioning is accomplished by pulling out while tuning to the desired position. Solo position requires use of a collar.

NORM (vertical)	Single rear seat ejection when initiated from the rear cockpit. Dual ejection (rear seat first) when initiated from the front cockpit.
AFT INITIATE (horizontal)	Dual ejection (rear seat first) when initiated from either seat.
SOLO (45° CCW)	Single ejection from front cockpit only. The 0.4 second delay between rear and front seat ejection is eliminated.

INTERCOM SYSTEM

Intercommunications between the pilot and the rear crewmember, or between the pilot or rear crewmember and the ground crew, is provided by the intercom system. An external intercom receptacle and a volume control are installed on the aircraft exterior to provide communications between the ground and the aircrew. The volume control adjusts the intercom audio volume level for the ground crewmember's headset. During starts without external power, the rear cockpit intercom is inoperative until a main generator comes on the line. After TO 1F-15A-522, the rear cockpit intercom is operative during JFS operation.

Take Command/ICS Control Panel

The take command/ICS control panel (one in each cockpit), contains the command controls and ICS controls. The intercom system is controlled only by the ICS portion of the control panel. However, all the panel controls are described in the following paragraphs. The panels contain a UHF comm command switch/indicator, a tacan/ILS nav command switch/indicator, and a ICS function selector switch.

UHF COMM Command Switch/Indicator

Depressing the comm command switch/indicator in either cockpit takes or relinquishes command of the UHF communications system from one cockpit to the other. The switch/indicator is illuminated in the cockpit that has control.

Tacan/ILS NAV Command Switch/Indicator

Depressing the TCN/ILS switch/indicator in either cockpit takes or relinquishes command of the tacan and ILS systems from one cockpit to the other. The switch/indicator is illuminated in the cockpit that has control.

ICS Function Selector Switch

The ICS function selector switch on the take command/ICS control panel is a three-position toggle switch.

RADIO OVERRIDE	Reduces the audio level of all signals (except intercom, unsafe gear, and TEWS launch) to facilitate inter-cockpit communications.
HOT MIC	Allows the microphone circuit in that cockpit to be activated.
COLD MIC	Disables the microphone circuit in that cockpit except for UHF transmissions.

ICS Volume Control Knob

There is an ICS volume control knob on the integrated communications control panel in the rear cockpit. This knob adjusts the intercom audio volume level for the rear crewmember's headset.

OXYGEN DURATION CHART

OXYGEN DURATION - HOURS

NOTE ● THE DURATION TIME IS DOUBLED WHEN ONLY ONE CREWMEMBER IS USING OXYGEN

TF-15

COCKPIT ALTITUDE FEET	Diluter Lever	10	9	8	7	6	5	4	3	2	1	BELOW 1
35,000 and UP	100%	24.3	21.8	19.4	17.0	14.6	12.1	9.7	7.2	4.8	2.4	-EMERGENCY- DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	Normal	24.3	21.8	19.4	17.0	14.6	12.1	9.7	7.2	4.8	2.4	
30,000	100%	17.8	16.0	14.2	12.5	10.7	8.9	7.1	5.3	3.5	1.7	
	Normal	18.0	16.2	14.4	12.6	10.8	9.0	7.2	5.4	3.6	1.8	
25,000	100%	13.7	12.3	10.9	9.6	8.2	6.8	5.4	4.1	2.7	1.3	
	Normal	17.0	15.3	13.6	11.9	10.2	8.5	6.8	5.1	3.4	1.7	
20,000	100%	10.3	9.3	8.3	7.2	6.2	5.1	4.1	3.1	2.0	1.0	
	Normal	19.2	17.2	15.3	13.4	11.4	9.6	7.6	5.7	3.8	1.9	
15,000	100%	8.3	7.4	6.7	5.8	5.0	4.1	3.3	2.5	1.6	.8	
	Normal	23.4	21.0	18.7	16.4	13.9	11.7	9.3	7.0	4.6	2.3	
10,000	100%	6.7	6.0	5.3	4.7	4.1	3.3	2.6	2.0	1.3	.6	
	Normal	23.4	21.0	18.7	16.4	13.9	11.7	9.3	7.0	4.6	2.3	

F-15

COCKPIT ALTITUDE FEET	Diluter Lever	10	9	8	7	6	5	4	3	2	1	BELOW 1
35,000 and UP	100%						24.2	19.4	14.4	9.6	4.8	-EMERGENCY- DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	Normal						24.2	19.4	14.4	9.6	4.8	
30,000	100%						17.8	14.2	10.6	7.0	3.4	
	Normal						18.0	14.4	10.8	7.2	3.6	
25,000	100%						13.6	10.8	8.2	5.4	2.6	
	Normal						17.0	13.6	10.2	6.8	3.4	
20,000	100%						10.2	8.2	6.2	4.0	2.0	
	Normal						19.2	15.2	11.4	7.6	3.8	
15,000	100%						8.2	6.6	5.0	3.2	1.6	
	Normal						23.4	18.6	14.0	9.2	4.6	
10,000	100%						6.6	5.2	4.0	2.6	1.2	
	Normal						23.4	18.6	14.0	9.2	4.6	

(Column headings 10 through BELOW 1 = GAGE QUANTITY)

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

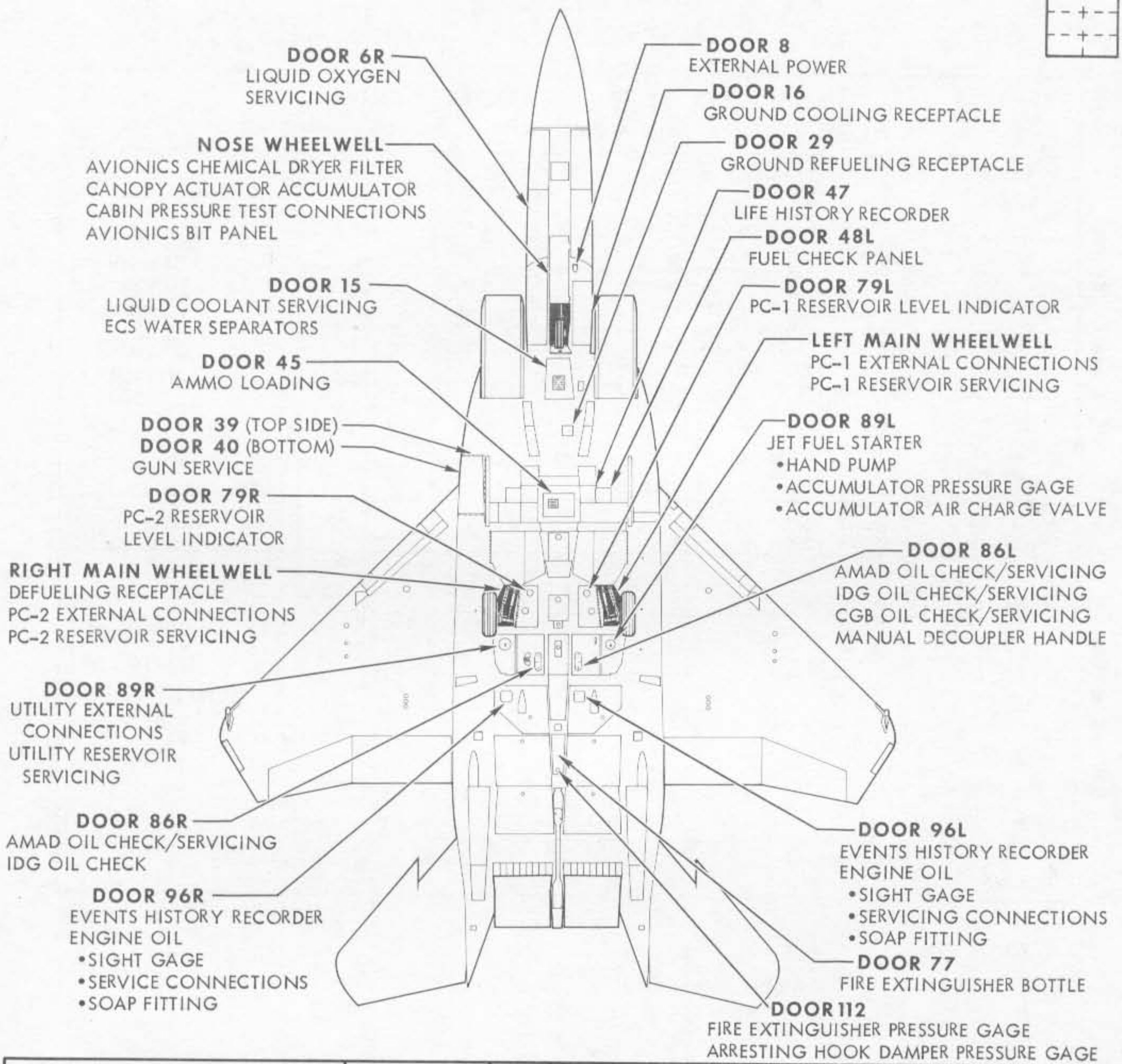
NOTE

- 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.

15A–1–(100)

Figure 1–17

SERVICING DIAGRAM



SPECIFICATIONS		USAF	NATO
FUEL	PRIMARY	MIL-T-5624, JP-4	F-40
	ALTERNATE (REFER TO SECTION V)	MIL-T-5624, JP-5 ASTM, JET, A-1 (COMMERCIAL) ASTM, JET, B (COMMERCIAL)	F-44 F-43 F-45
EXTERNAL ELECTRICAL POWER	115 ± 15 VAC, 400 ± 30 Hz	A/M 32A-60A ONLY	
HYDRAULIC FLUID		MIL-H-5606	H-515
OXYGEN	LIQUID	MIL-O-27210	
RAIN REPELLENT	TYPE II UNELKO REPCON 50159	STOCK NO. 6850-139-5297	

SPECIFICATIONS		USAF	NATO
OIL	TURBINE ENGINE CENTRAL GEAR BOX INTEGRATED DRIVE GENERATOR AMAD	MIL-L-7808 (NO ALTERNATE)	O-148
NITROGEN	GASEOUS	BB-N-411 GRADE A, TYPE I OR II	
OIL	M61A1 GUN	MIL-L-46000	
EXGINGUISHING AGENT	FIRE EXTINGUISHER BOTTLE	HALON-1301	

15A-1-(22)D

Figure 1-18

SECTION II
NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

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

FLIGHT PLANNING

Refer to T.O.1F-15A-1-1, Performance Data.

TAKEOFF AND LANDING DATA CARD

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

WEIGHT AND BALANCE

For maximum gross weight limitations, refer to section V, Operating Limitations. For weight and balance information refer to the individual aircraft's Form F, section V, Operating Limitations and the handbook of Weight and Balance Data, T.O.1-1B-40.

PREFLIGHT CHECK

1. Check Form 781 for aircraft status and release.

EXTERIOR INSPECTION

1. Check general condition.
   Check the aircraft exterior for indications of abnormalities which could affect flight (i.e., cracks or leaks). All sensors (AOA, pitot/static, inlet ice, total temperature) should be checked. The ground intercom compartment door will be open. Additionally, the hydraulic and JFS accumulator circular access panels (4) may be open for after start servicing. Check all other doors and panels closed and fastened. Intakes should be clear of foreign objects, and all external/internal inlet ramps should be in the up position. Tires should be checked for condition and inflation. The gear struts should be checked for extension. Check that the landing gear pins (3), the arresting hook pin, and the canopy strut are removed.

BEFORE ENTERING COCKPIT

1. External electrical power - OFF
2. Head knocker - DOWN
3. Canopy Initiator Indicator - NOT FIRED
   If indicator has been fired, the gray cap and orange spring will be exposed.
4. Safety pins - REMOVED
   a. Canopy jettison handle pin
   b. Seat mounted initiator pin
   c. Canopy actuated initiator pin
5. Auto/manual seat kit deployment selector - AS DESIRED
   Up is auto, down is manual.
6. Emergency harness release (outside) handle - CABLE BALL IN HANDLE HOLDER
7. Internal Canopy Manual Unlocking Handle - STOWED/PIN IN

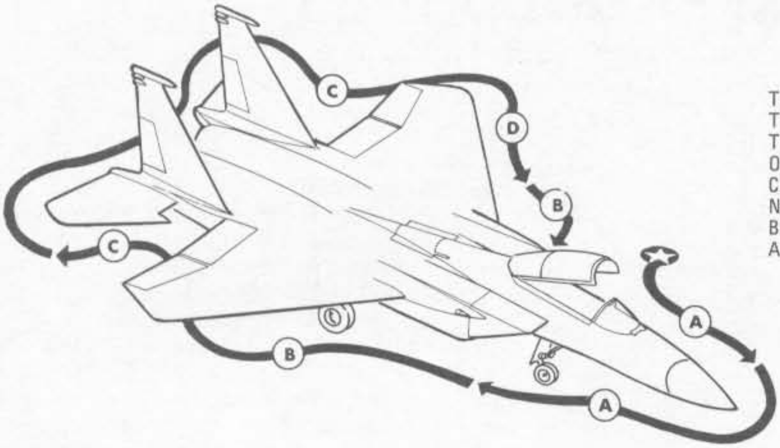
For Solo Flight in TF aircraft -

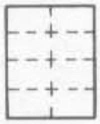
8. Command selector valve - SECURED IN SOLO POSITION
9. Rear cockpit circuit breakers - IN
10. Aft cockpit - SECURED

COCKPIT INTERIOR CHECK

A thorough cockpit interior preflight shall be accomplished prior to each flight. The design features of the aircraft greatly simplify this task, but do not alleviate the requirement. Switch positions designated AS DESIRED allow pilot preference in switch/control positioning. AS REQUIRED indicates those switches that will differ with mission requirements. If no specific requirement exists, pilot preference should be used.

EXTERIOR INSPECTION





THE EXTERIOR INSPECTION IS DIVIDED INTO FOUR AREAS. THE INSPECTION BEGINS AT THE COCKPIT STEPS INCLUDING THE LEFT FORWARD NOSE AND THEN ONLY THE RIGHT SIDE OF THE AIRPLANE IS DISCUSSED. THE LEFT SIDE IS IDENTICAL TO THE RIGHT EXCEPT FOR ITEMS SPECIFICALLY DESIGNATED AS RIGHT (R) OR LEFT (L). CHECK DOORS SECURE. BE ALERT FOR LOOSE FASTENERS, CRACKS, DENTS, LEAKS, AND OTHER GENERAL DISCREPANCIES.

(A) NOSE

1 UNDERSIDE

A. NLG TIRE, WHEEL AND STRUT CONDITION
B. NLG DOORS & LINKAGE SECURE, GROUND LOCK REMOVED
C. ANTENNAE CONDITION

2 FORWARD FUSELAGE

A. PITOT–STATIC PROBE CONDITION (2)
B. AOA PROBE SECURE CONDITION (2)
C. ENGINE INTAKE DUCT CLEAR (2)

(B) CENTER FUSELAGE AND WING

1 WING

A. EXTERNAL STORES & PYLONS SECURE
B. NAVIGATION & FORMATIONS LIGHTS CONDITION
C. AILERON & FLAP CONDITION
D. FUEL DUMP/VENT MAST CONDITION

(C) AFT FUSELAGE

1 GENERAL AREA

A. ARRESTING HOOK DOORS CLOSED
B. STABILATOR CONDITION
C. RUDDER CONDITION
D. ANTENNA COVER CONDITION (VERTICAL STABILIZER)
E. NAVIGATION & FORMATION LIGHTS CONDITION
F. ENGINE EXHAUST AREA CONDITION

(D) UNDERSIDE OF FUSELAGE

1 GENERAL AREA

A. ℄ STORE & PYLON SECURE

2 MAIN GEAR AND WHEELWELL

A. WHEEL, TIRE AND STRUT CONDITION
B. DOORS AND LINKAGE SECURE
C. GROUND LOCK REMOVED

15A–1–(17)C

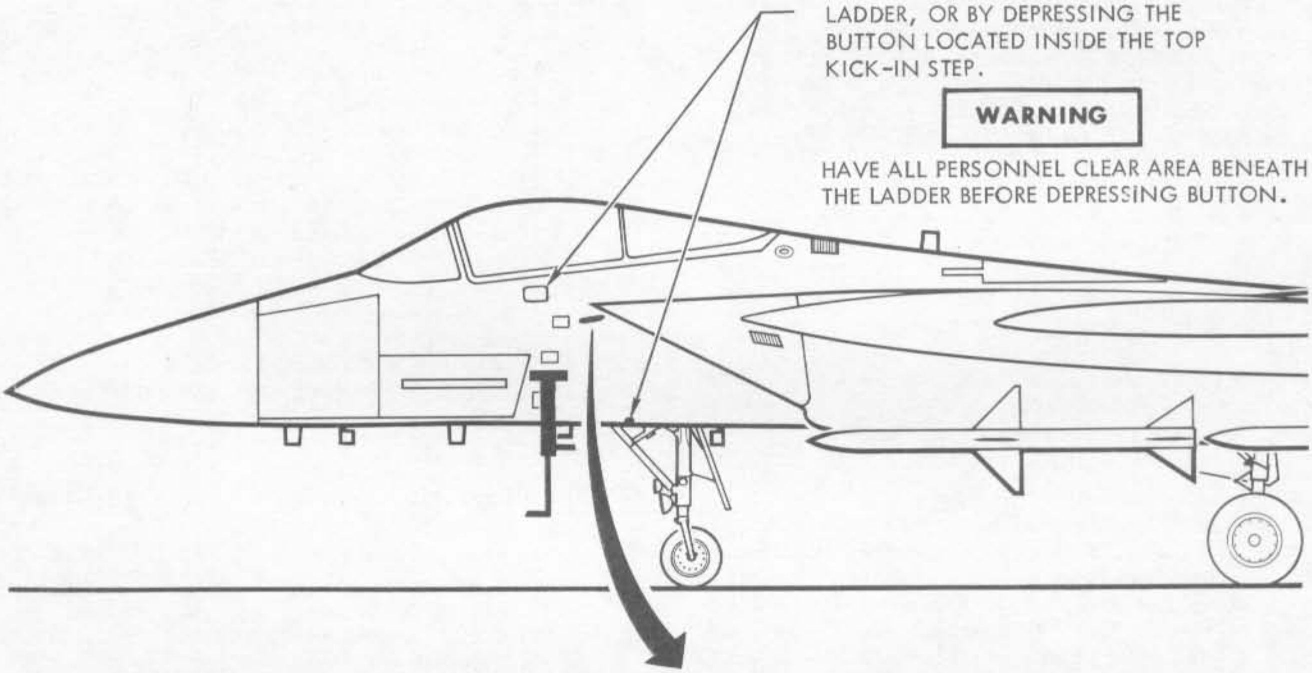
Figure 2-1

COCKPIT ENTRY

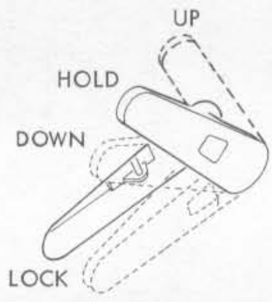
THE LADDER IS RELEASED BY DEPRESSING THE LADDER RELEASE BUTTON LOCATED AT THE BOTTOM OF THE FUSELAGE APPROXIMATELY 3 FEET AFT OF THE LADDER, OR BY DEPRESSING THE BUTTON LOCATED INSIDE THE TOP KICK-IN STEP.

WARNING

HAVE ALL PERSONNEL CLEAR AREA BENEATH THE LADDER BEFORE DEPRESSING BUTTON.



1. EXTEND CANOPY EXTERNAL CONTROL HANDLE BY PUSHING RELEASE BUTTON IN CENTER OF HANDLE.
2. TO RAISE CANOPY, ROTATE HANDLE AFT.
3. TO LOWER CANOPY, ROTATE HANDLE FWD.



EXTERNAL CANOPY CONTROL HANDLE

15A-1-(4)C

Figure 2-2

Normally, those avionics switches designated AS DESIRED or AS REQUIRED should be OFF for start. However, if no delays are expected during the starting sequence, no system damage will result if the avionics switches are placed ON prior to start.

CAUTION

- Single Engine operation does not provide adequate cooling for the avionics. During the start, with one engine running, the ECS light on the caution panel will be illuminated. If the light cannot be extinguished within 2 minutes, the avionics must be turned off to prevent overheating.
- If external electrical power is used, avionics will be OFF until after both engines are running.
- DO NOT place any item on the glare shield, as scratching the windshield is probable.

The VERIFY items are those important items which, if not correctly positioned, could cause a safety hazard and/or system damage.

1. Interior check - COMPLETE
   a. Harness and personal equipment leads - FASTEN
      Attach the parachute risers to the harness buckles. Attach and firmly adjust the survival kit and crotch straps. Secure and firmly adjust the lap belt. Connect oxygen, G suit and communication leads. Check the operation of the shoulder harness locking mechanism.

Left Console -

b. Air refueling emergency handle - DOWN
c. Integrated communications controls - AS REQUIRED
   (1) Antenna select - AUTO
   (2) Guard receiver - ON
   (3) ADF - OFF
   (4) ICS - ON
d. IFF antenna select switch - BOTH
e. IFF - ALL MODES OUT
   (1) Master mode - LOW/NORM
f. AAI - AS REQUIRED
g. EW panel - AS REQUIRED
h. External light controls - AS REQUIRED
   (1) Anti-collision - ON
   (2) Formation - OFF
i. Throttles - OFF
j. Friction lever - AS DESIRED
k. Radar controls - AS DESIRED
   (1) Master mode - OFF
l. Fuel control panel - SET
   (1) Fuel dump switch - NORM
   (2) Wing switch - NORM
   (3) Center switch - NORM
   (4) Slipway switch - CLOSE
m. V-MAX switch - COVER CLOSED AND SAFETY WIRED
n. CAS switches - ON
o. Miscellaneous control panel - SET
   (1) Anti-skid switch - ON
   (2) Inlet ramp switches - AUTO
   (3) Roll ratio switch - AUTO
   (4) Landing/taxi light switch - OFF
p. ILS/TACAN controls - AS REQUIRED
q. Canopy jettison handle - FORWARD
r. Emergency landing gear handle - IN
s. Hook - UP

Instrument panel -

a. Landing gear handle - DOWN
b. Pitch ratio switch - AUTO
c. VSD controls - AS REQUIRED
d. Armament master switch - SAFE
e. Fire/overheat lights - NOT DEPRESSED
f. Main communications controls - ON AND SET
g. HUD display controls - AS REQUIRED
h. Select ASA thumbwheel - SET FILM ASA
i. Gunsight camera controls - AS REQUIRED
   Insure camera switch is not in run.
j. Steermode knob - AS REQUIRED
k. Emergency brake/steer handle - IN
l. Standby attitude indicator - UNLOCKED
m. Circuit breakers - IN

Right Console -

a. Emergency vent handle - IN AND VERTICAL
b. Oxygen system - CHECK AND SET
   (1) Emergency lever - NORMAL
   (2) Diluter lever - NORMAL
   (3) Supply lever - ON
   (4) Pressure gage - 75 $\pm$25 PSI
c. Anti-ice switches - OFF
d. Engine control panel - SET
   (1) Generator switches - ON
   (2) Emergency generator switch - NORMAL
   (3) EEC switches - ON
   (4) JFS starter switch - ON
   (5) Engine master switches - ON
e. Temperature Panel - AUTO and BOTH
f. INS mode knob - OFF
g. Interior lights controls - AS REQUIRED
h. TEWS Panel - AS REQUIRED
i. Compass control panel - AS REQUIRED

After cockpit check is complete -

VERIFY:

1. Emergency air refueling handle - DOWN
2. Throttles - OFF
3. Formation lights - OFF
4. Radar master mode - OFF
5. Fuel dump switch - NORM
6. Emergency landing gear handle - IN
7. Hook - UP
8. Landing gear handle - DOWN
9. Master arm switch - SAFE
10. Emergency brake/steer handle - IN
11. Emergency vent handle - IN and VERTICAL
12. EEC switches - ON
13. Anti-ice switches - OFF

STARTING ENGINES

The normal engine start procedure does not use external power. With the JFS running, power is available to operate the AMAD fire warning system, the intercom system between the pilot and the ground, and the cockpit utility light. The engine rpm and FTIT gages are inoperative until the emergency generator comes on line during engine start. The rest of the engine instruments are inoperative until a main generator comes on at about 45% rpm during the first engine start.

Because a JFS accumulator was discharged to initially start the JFS, the JFS LOW light will come on when power is available to light the caution panel. It will go out when the accumulators are recharged by a running engine.

After the emergency generator is on, and rpm is observed, move the throttle to IDLE. A normal start is indicated by an increase in rpm occurring slightly before FTIT movement. However, if rpm occurs simultaneously with, or after initial FTIT movement, a hot start is probable. (Refer to Engine Starting Emergencies, section III.)

If engine light–off is not obtained within 20 seconds after placing the throttle in IDLE, place the engine start fuel switch to SEA LEVEL. This increases starting fuel flow, and enhances starting under some circumstances. When light–off occurs, release the switch back to OFF. Monitor the engine instruments and compare against the operating limitations listed in section V. After the first engine starts, the JFS automatically decouples from that engine and is ready for the second engine start. After the second engine starts, the JFS shuts down automatically. As each engine reaches approximately idle rpm during start, the inlet ramps drop to the down position.

The following procedure is applicable to either engine. The right engine is started first to permit checking the utility hydraulic pressure with only the right pump operating.

JFS START

1. Engine master switches – CHECK ON
2. JFS switch – CHECK ON
3. JFS handle – PULL AND RELEASE
4. Starter ready light – ON (within 10 sec)
5. Fire extinguisher switch – TEST
   Observe the AMAD fire warning light illuminated.

ENGINE START

1. Finger lift – RAISE AND RELEASE
   This engages the engine to the JFS.
2. Emergency generator – OBSERVE ON
   This indicated by the EMERG GEN ON light illuminating and tachometer operation.
3. Throttle – IDLE (when rpm observed)
4. Engine instruments – CHECK
   Engine limits are contained in section V.
5. JFS deceleration – CONFIRM
   If JFS fails to decelerate after either engine start, abort. This is an indication of AMAD lubrication pump failure.
6. Fire extinguisher switch – TEST
   Check all fire lights illuminated.
7. Warning and caution lights – TEST
8. Other engine – START
9. JFS switch – OFF AFTER JFS SHUTDOWN
10. ECS light – OFF

BEFORE TAXIING

1. INS – ALIGN (See INS Alignment Procedures)
2. Oxygen – CHECK
   a. Quantity – CHECK
   b. Oxygen test – Observe OXY LOW light at 2 liters (4 Liters for TF)
3. Fuel quantity gage – CHECK
   a. Quantity – CHECK
   b. BIT – CHECK
   c. Bingo bug – SET
4. Avionics – AS REQUIRED (AAI, IFF, RADAR, ILS/TACAN, VSD, HUD)
5. Speed Brake – CYCLE
6. Flaps – DOWN
7. Slipway door – CHECK
8. Trim – CHECK AND SET
   a. Trim pitch, roll, and yaw off neutral
   b. T/O trim button – PUSH
      Lateral stick and rudders should drive to center and longitudinal stick to takeoff position.
   c. T/O trim light – ON
9. Flight controls – CHECK
   a. Stick full aft and full left – Observe stabilator trailing edge up (left further up than the right) rudder left, left aileron up, right aileron down.
   b. Stick full forward and full left – Observe stabilator leading edge move to full up (right further up than left) and rudder move right.
   c. Stick full forward and full right – Observe left aileron move down and right aileron move up, rudder move left, left stabilator leading edge higher than right.
   d. Stick full aft and full right – Observe stabilator trailing edge move to full up (right higher than left) and rudder move right.
   e. Rudder – Check. Hold stick neutral and paddle switch depressed. Move rudder pedal left and right and observe rudder travel.
10. CAS – RESET
11. Step 9 – REPEAT
12. Armament control panel – CHECK AND PROGRAM
    Refer to T.O.1F-15A-34-1.
13. INS mode switch – INS (when aligned)
14. Altimeters – SET
15. Head knocker – UP
16. BIT lights – CHECK
    Investigate any unusual BIT lights before taxiing.

TAXIING

Release brakes and advance power slightly if necessary. As aircraft starts to roll, apply the brakes to check their operation. When clear, actuate the nose gear steering in both directions to ensure proper operation. During taxi, check all the flight instruments. Due to excess thrust at idle power, taxi speed requires continual attention.

1. Brakes - CHECK
2. Nose gear steering - CHECK
3. Flight instruments - CHECK

BEFORE TAKEOFF

1. Radar - OPERATE
2. Harness - CHECK
   Insure all buckles, straps, and fittings are secure and tight.
3. Head knocker - CHECK UP
4. Flight controls - CHECK
5. Flaps - CHECK DOWN
6. T/O trim - CHECK
7. Canopy - CLOSED & LOCKED
8. Pitot heat - ON
9. Warning, caution and BIT lights - CHECK
10. Engines - CHECK (Individually)
   a. Advance throttle rapidly to MIL

(1) Nozzle should close rapidly to near 0% and open somewhat as the EEC trims the engine.

(2) Rpm and FTIT should increase rapidly at first, then more slowly as the EEC trims the engine. (FTIT movement should correspond to rpm.)

TAKEOFF

Advance engines to 80% and check instruments. When ready for takeoff, release the brakes and advance throttles to MIL or MAX as desired. Monitor engine instruments for proper operation. Start aircraft rotation at approximately 120 knots and rotate to 10° pitch attitude. Retract the gear and flaps when airborne.

AFTERBURNER OPERATION

During normal afterburner operation, the convergent exhaust nozzles open progressively with each afterburner segment; thrust and fuel flow increase proportionately. As throttles are advanced from minimum to maximum afterburner, the increase in thrust is fairly smooth and continuous.

CLIMB TECHNIQUES

MIL Power - Climb at 350 knots to 0.90 Mach, then maintain 0.90 Mach.

MAX Power - Climb at 350 knots to 0.95 Mach, but do not exceed 40° pitch attitude. If Mach increases above 0.95 at 40° pitch attitude, hold 40° and allow the Mach to increase. (The Mach will rise only slightly before returning to 0.95.)

CRUISE

Throughout the flight, the operation of aircraft systems must be continually monitored. At frequent intervals check the engine instruments, cabin pressure, oxygen blinker and system operation, and fuel quantity and transfer.

INSTRUMENT FLIGHT PROCEDURES

RECOMMENDED AIRSPEEDS

The holding, penetration, and downwind airspeeds for instrument approaches may vary from those which are recommended. When the aircraft is at normal approach gross weights, the acceleration and high residual thrust characteristics of the turbofan engines at low power settings, combined with low aerodynamic drag, make precise airspeed control difficult. The recommended technique during instrument approaches is to select a power setting which will allow the aircraft to stabilize at the approximate recommended airspeed.

HOLDING

The recommended holding airspeed is 250 knots.

PENETRATION

Normally, after the power is set (approximately 72%) the nose is lowered to approximately 10°, and the airspeed is allowed to increase slowly to 300 knots. The speed brake can be used if a faster descent is required. Approaching the final approach fix slow to 200–250 knots and lower the gear and flaps.

INSTRUMENT APPROACHES

The HUD is the primary reference for instrument flight with ADI mode selected. On downwind, select a power setting that will maintain between 200 and 250 knots. Approaching final, lower gear and flaps, and slow to not greater than on-speed AOA. The speedbrake can be used to control descents and airspeed if desired. On GCA final, the velocity vector can be used to indicate glide slope. If a 2½° glide slope is used, holding 2½° flight path angle with the velocity vector will provide a good basis from which corrections, if required, can be made.

On an ILS approach, use of the ILS function is not recommended until approximately aligned with the final approach heading. ILS bank steering information on the HUD and ADI switches to the final approach mode when the glide slop is intercepted. This is indicated on the HUD when the GS UP or GS DN light extinguishes. In the final approach mode the maximum bank angle command is reduced from 30° to 15°. If the aircraft heading is considerably different from the final approach heading, the bank angle command may not be sufficient to align the aircraft on final approach.

MISSED APPROACH/GO AROUND

Advance power as required and retract the speed brake. Retract the gear and flaps when a climb is established.

DESCENT CHECK/BEFORE LANDING

a. Armament master switch - SAFE
b. Altimeter - SET

LANDING TECHNIQUE

The aircraft can accommodate several different landing techniques, however, the procedures described are recommended.

Normal Landing Pattern

Approaching the break, power should be set to maintain altitude and airspeed. In the break, extend the speed brake to assist in decelerating to gear down speed. On downwind, below 250 knots, lower gear and flaps. During base turn reduce speed so as to arrive on final at on-speed AOA. If faster than on-speed, the aircraft will float for considerable distances. If slower than on-speed, minor buffet may be noticed.

At the flare point, smoothly retard the throttles to IDLE, and reduce the rate of descent. Ground effect will cushion the aircraft, and touchdown will occasionally be difficult to recognize. Raising the nose too high in the flare will cause ballooning, and possibly a hard landing. After touchdown, raise the nose to 12° - 15° pitch attitude, maintaining direction with rudder.

CAUTION

Limit pitch attitude to 15° to prevent scraping the nozzles.

As aerodynamic braking effects decrease (60 knots minimum), fly the nose wheel to the runway and apply brakes as required. At high gross weights, or forward CG conditions, the nose may begin to fall at speeds above 60 knots (do not attempt to hold it off). Due to high residual thrust, the aircraft may accelerate after the nose wheel is on the ground unless braking is used.

CROSS WIND LANDING

Normal landing procedures can be followed. Insure the pattern is adjusted so that excessively steep or shallow base turns are avoided. On final, a wings level crab into the wind will counteract drift and maintain runway alignment. Hold the crab through touchdown, then maintain ground track with rudder. After landing, aileron into the wind may be useful to maintain a wings level attitude and counteract drift. In crosswinds exceeding 15 knots, touchdown on the upwind side of the runway is recommended. For gusty, or turbulent conditions, the normal on-speed AOA can still be used, but AOA deviations become more critical.

MINIMUM RUN LANDING

When stopping distance is critical, fly final at 23 units AOA, and use a flatter approach angle (1½° - 2°). Precise control of the touchdown point can be achieved utilizing the velocity vector.

AFTER LANDING

1. Head knocker - DOWN
2. Speedbrake - IN
3. Flaps - UP
4. IFF mode switches - OUT
5. RADAR power switch - OFF
6. Fuel dump switch - NORM
7. Trim - T/O
8. Landing/taxi light - AS REQUIRED
9. Formation lights - OFF
10. Anti-ice switches - OFF

SINGLE ENGINE TAXI

1. CC ground power switch - OFF
2. AAI - OFF
3. ILS/TACAN - OFF
4. VSD - OFF
5. HUD - OFF
6. TEWS - OFF
7. L or R Throttle - OFF

ENGINE SHUTDOWN

1. INS - OFF
2. Mode 4 selector - HOLD (If another flight is anticipated in code period.)
3. Avionics switches - OFF
   Turn avionics OFF prior to shutting down engines to prevent false BIT warnings on the status panel.
4. Throttle(s) - OFF AFTER 15 SECONDS
   Wait 15 seconds after INS is shut off or Mode 4 selector is placed to HOLD before placing throttle(s) off.

INS PROCEDURES

NOTE

- All procedures in this section are for normal INS operations with the CC operating.
- After entering data, the RDY pushbutton should be depressed again to disable the keyboard and prevent inadvertent entries.

INS ALIGNMENTS

Three types of INS alignments are available. Gyrocompass (GC) is the most accurate, and requires 9½ minutes. The stored heading (STOR) alignment is also accurate and requires only 3 minutes. However, a previous GC alignment must be accomplished with no subsequent movement of the aircraft. Best available true heading (BATH) is also a 3 minute alignment, but provides reduced accuracy. Factors such as wind and temperature can affect alignment times for all modes.

GC Alignment

1. Mode selector knob - GC
2. Data select knob - PP
3. RDY pushbutton - DEPRESS
4. Type present latitude, then depress ENTR pushbutton.
5. Type present longitude, then depress ENTR pushbutton.
   After depressing the N/S or E/W pushbutton, the appropriate display window will go blank. The latitude or longitude is then typed in. When ENTR is depressed, the latitude/longitude will be replaced by numbers counting up to those desired for entry. It is not necessary to wait until the counting is complete to continue. The counting only occurs in the alignment process.
6. Flashing ALN, GC complete. Steady ALN should appear after 3 minutes, and flash at 9½ minutes.
7. Mode selector knob - INS

NOTE

If ALN is still steady after 10 minutes - switch to INS.

STOR Alignment

1. Mode selector knob - STOR
2. Data select knob - PP
3. RDY pushbutton - DEPRESS
4. Type present latitude, then ENTR.
5. Type present longitude, then ENTR.
6. Flashing ALN, STOR complete.
   ALN should not appear steady, but should flash after 3 minutes.
7. Mode selector knob - INS

BATH Alignment

1. Mode selector knob - STBY
2. Data select knob - M/V
3. RDY pushbutton - DEPRESS
4. Type magnetic variation, then ENTR.
5. Follow GC procedure. Mode selector knob is placed in INS when ALN light comes on steady.

DATA ENTRY PROCEDURES

Data may be entered into the twelve destination positions during the alignment sequence, or during ground or flight operations. The mode selector knob must be in STBY, or an ALIGN, CCC, or NAV position.

Destination Data

1. Data select knob - DEST
2. Dest data counter - SET
3. RDY pushbutton - DEPRESS
4. Type destination latitude, then ENTR.
   When appropriate alpha letter is depressed, the display windows will go blank. When the ENTR pushbutton is depressed, and the data is accepted, the numbers will not change. If the latitude data is not entered correctly the window will display the numbers originally displayed when DEST was selected.
5. Type destination longitude, then ENTR.
   For air-to-ground target destinations, target altitude in feet MSL must also be entered.
6. Type A, + or −, then ENTR.

Offset Data

Offset data required for the mission must be entered with respect to a destination previously stored. The offset may be defined in terms of range and true bearing (nautical miles to tenths and degrees), or in terms of feet (north/south and east/west). The maximum distance available is 199,999 feet or 32.8 nautical miles.

1. Data select knob - O/S
2. Dest data counter - SET
3. RDY pushbutton - DEPRESS

Offset in range and bearing -

4. Type R, miles, then ENTR.
5. Type B, degrees, then ENTR.

Offset in feet -

4. Type N or S, feet, then ENTR.
5. Type E or W, feet, then ENTR.

Enter offset altitude -

6. Type A, + or −, altitude, then ENTR.

Tacan Data

Tacan stations and data are entered in the same twelve destination positions utilized for destination and offset data. The update pushbutton is used in this mode to sequence the data entry. The + and − keys during channel entry denote X or Y band respectively. Two stations of the same channel and band should not be entered.

1. Data select knob - CCC
2. Dest data counter - SET
3. RDY pushbutton - DEPRESS
4. Type + or −, channel, then ENTR.
5. Update pushbutton - DEPRESS
6. Type tacan latitude, then ENTR.
7. Type tacan longitude, then ENTR.

8. Update pushbutton - DEPRESS
9. Type + or −, altitude, then ENTR.
10. Update pushbutton - DEPRESS
11. Type station magnetic variation, then ENTR.

Subsequent depressions of update can be used to recheck the stored data.

INS UPDATING

INS updates are performed with respect to a destination or tacan previously entered. If it is desired only to note the update differences and not enter them into the INS, the CLR pushbutton must be depressed in place of UPDATE in the following procedures:

Visual Update (Aircraft is flown directly over selected destination.)

1. Data select knob - VIS
2. Steer counter - SET
3. Overfly freeze pushbutton - DEPRESS (when over destination)
4. Update pushbutton - DEPRESS

Radar Update (Selected destination is identified on radar.)

1. Data select knob - RDR
2. Steer counter - SET
3. TDC - DEPRESS, position cursor, then RELEASE.
4. Update pushbutton - DEPRESS

Tacan Update (Stored tacan station is tuned and received on tacan panel.)

1. Data select knob - TCN
2. Tacan panel - SELECT CHANNEL
3. Update pushbutton - DEPRESS

INS NAVIGATION

Navigation to stored destinations -

1. Steer counter - SET
2. Mode selector knob - INS
3. Steer mode panel - NAV

Navigation to offset point (aircraft over destination) -

4. SEL O/S pushbutton - DEPRESS

Navigation to offset point from present position -

4. SEL GND MAP on radar
5. SEL O/S pushbutton - DEPRESS

Alternate method.

4. Master mode - A/G
5. TDC - DEPRESS (less than 1 second).
6. SEL O/S pushbutton - DEPRESS

NOTE

The destination information can be refined to provide more accurate steering by utilizing radar or HUD designation methods. (Refer to T.O.1F-15A-34-1-1 for detailed procedures.)

POSITION MARKING

To mark aircraft position -

1. Mark pushbutton - DEPRESS (over desired position).
   The status lights will indicate M1, M2, or M3.

To read marked coordinates -

1. Dest data counter -.SET (M1, M2, or M3).
2. Data select knob - DEST

To steer to marked position -

1. Steer counter - SET (M1, M2, or M3).
2. Mode selector knob - INS
3. Steer mode panel - NAV

NOTE

The INS mark function also provides the capability to mark radar or HUD designated ground targets. (Refer to T.O.1F-15A-34-1-1 for detailed procedures.)

EXTERNAL POWER START (Following cockpit interior check)

If external power is to be used, and cooling air is not available, the following procedures should be accomplished after the normal cockpit preflight, but before electrical power is applied.

1. Avionics - OFF. (IFF, RADAR, ILS/TCN, HUD, VSD, INS).
   If cooling air is available, avionics may be ON as desired.
2. CC switch - AUTO
3. External power switch - RESET

NOTE

If finger lifts are raised with electrical power on the aircraft and engine master switches ON, an engine will engage without command as the JFS starts.

4. Ground power switch 1-B – ON
   This activates engine instruments.
5. Fire extinguisher switch – TEST
6. Warning and caution lights – TEST

JFS START

1. Engine master switches – CHECK ON
2. JFS switch – CHECK ON
3. JFS handle – PULL AND RELEASE
4. Starter ready light – ON (within 10 sec)

ENGINE START

1. Right throttle finger lift – RAISE AND RELEASE
2. Right throttle – IDLE (when rpm observed)
3. Engine instruments – CHECK
4. JFS deceleration – CONFIRM
   If JFS fails to decelerate after either engine start, abort. This is an indication of AMAD lubrication pump failure.
5. External power – DISCONNECT
6. Fire extinguisher switch – TEST
7. Warning and caution lights – TEST
8. Left engine – START (steps 1 thru 3)
9. JFS switch – OFF AFTER JFS SHUTDOWN
10. ECS light – OFF
11. Emergency generator – CHECK
    Turn off both generators and confirm emergency generator comes on line. Then turn generators back on.

BEFORE TAXI

Continue with normal procedures.

SCRAMBLE

BEFORE SCRAMBLE

1. Complete the Before Flight procedures through Before Taxiing.
   a. When the INS has aligned in GC (flashing light), go to OFF without going to INS.
2. Perform engine shutdown procedure
3. INS mode select knob – STOR
4. Avionics switches – ON
5. DO NOT move the aircraft

If these actions have not been accomplished, use normal prodecures.

JFS/ENGINE START

Use normal procedures.

Before Taxiing

1. Present position – ENTER
2. Communications and navigation equipment – CHECK
3. Altimeters – SET & CHECK
4. Personal equipment – CHECK
5. ALN light – FLASHING
6. NAV control mode knob – INS
7. Wheel chocks and intercom cord – REMOVE

BEFORE TAKEOFF

1. Use normal procedures.

TF REAR COCKPIT PROCEDURES

BEFORE ENTERING COCKPIT

1. Head knocker – DOWN
2. Safety pins – REMOVED
   a. Canopy jettison handle safety pin – REMOVED
   b. Seat mounted initiator safety pin – REMOVED
3. Auto/manual deployment selector – AS DESIRED
   Up is auto, down is manual
4. Emergency harness release (outside) handle – CABLE BALL IN HANDLE HOLDER

INTERIOR CHECK

1. Interior check – COMPLETE
   a. Harness and personal equipment leads – FASTEN. Attach the parachute risers to the harness buckles. Attach and firmly adjust the survival kit and crotch straps. Secure and firmly adjust the lap belt. Connect oxygen G suit and communication leads. Check the operation of the shoulder harness locking mechanism.
   b. Integrated communications control – AS REQUIRED
   c. Canopy jettison handle – FORWARD
   d. Emergency landing gear handle – IN
   e. VSD – AS REQUIRED
   f. Communications controls – ON AND SET
   g. Emergency brake/steer handle – IN
   h. Oxygen system – TEST AND SET
      (1) Emergency lever – NORMAL
      (2) Diluter lever – NORMAL
      (3) Supply lever – ON
      (4) Pressure gage – 75 $\pm$25 PSI
   i. Circuit breakers – IN
   j. Interior lights – AS REQUIRED
2. Hook – UP
3. Emergency landing gear handle – IN
4. Command selector valve – NORM (Vertical)

BEFORE TAXIING

1. Oxygen – CHECK QUANTITY
2. Avionics – AS REQUIRED (INS/TACAN, VSD)
3. Altimeter – SET
4. Head knocker – UP

BEFORE TAKEOFF

1. Harness - CHECK
   Insure all buckles, straps, and fittings are secure and tight.
2. Head knocker - CHECK UP
3. Command selector valve - AS BRIEFED
4. Warning and caution lights - CHECK OUT

AFTER LANDING

1. Head knocker - DOWN
2. Command selector valve - NORM (vertical)
3. Avionics - OFF

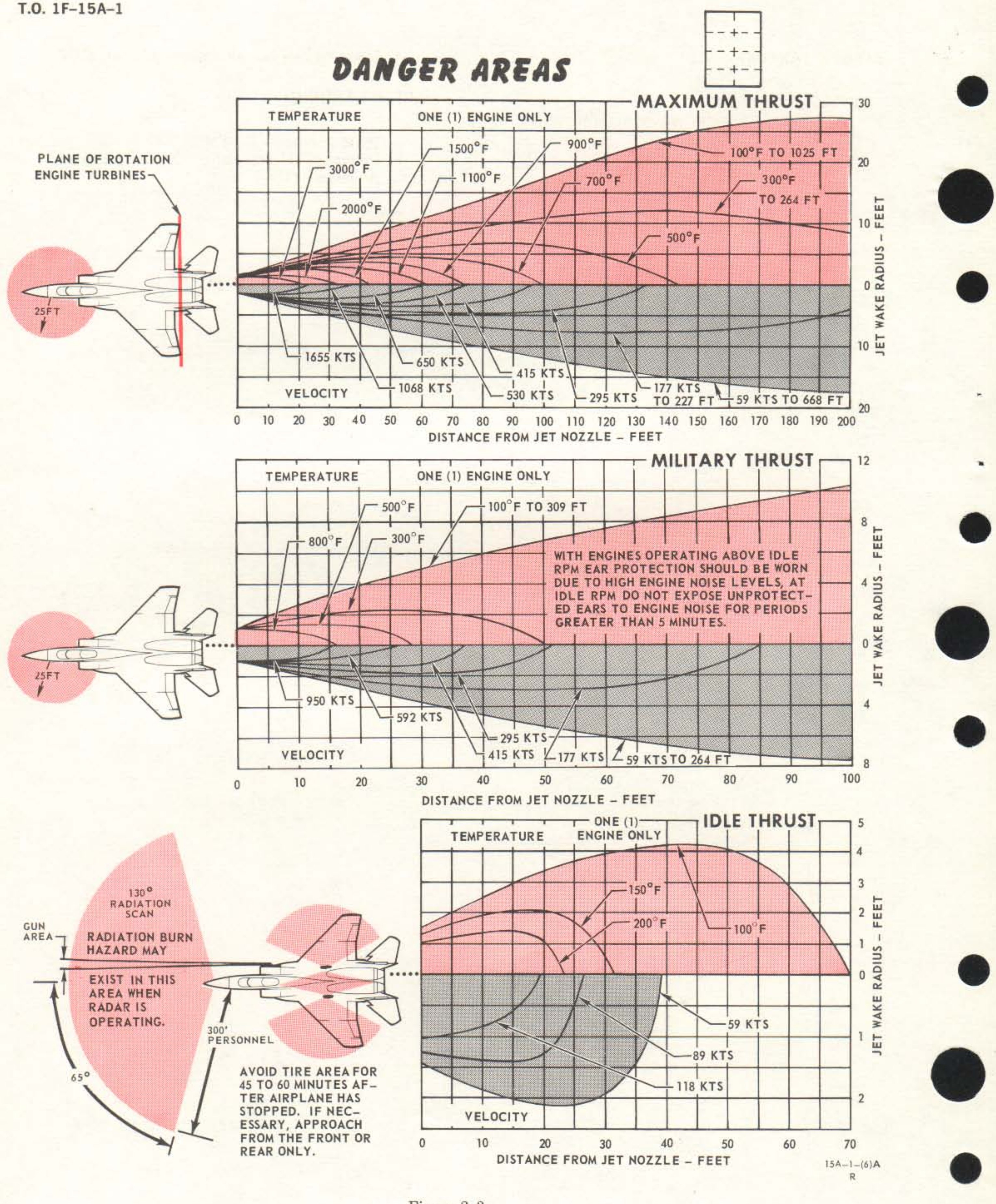
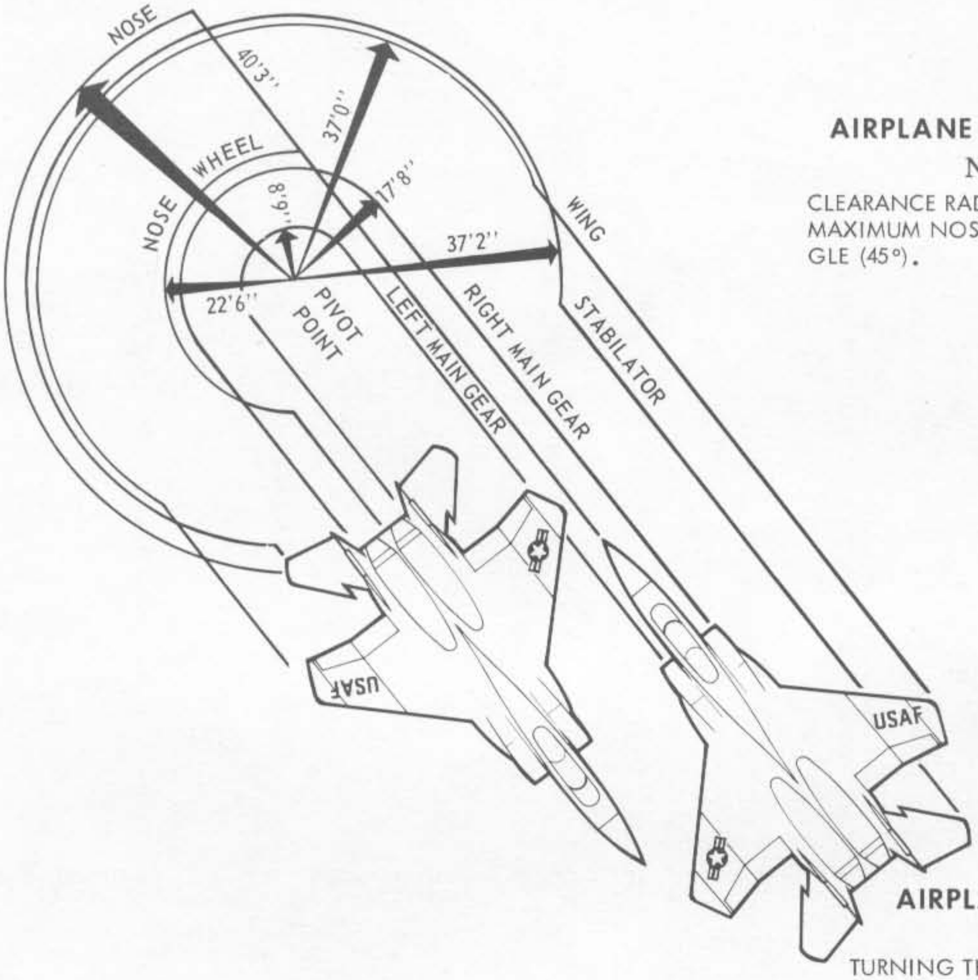

DANGER AREAS
MAXIMUM THRUST
TEMPERATURE
ONE (1) ENGINE ONLY
PLANE OF ROTATION
ENGINE TURBINES
3000° F
2000°F
1500°F
1100°F
900°F
700°F
100°F TO 1025 FT
300°F
TO 264 FT
500°F
25FT
1655 KTS
1068 KTS
650 KTS
530 KTS
415 KTS
295 KTS
177 KTS
TO 227 FT
59 KTS TO 668 FT
VELOCITY
DISTANCE FROM JET NOZZLE – FEET
JET WAKE RADIUS – FEET
MILITARY THRUST
TEMPERATURE
ONE (1) ENGINE ONLY
500°F
100°F TO 309 FT
800°F
300°F
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.
25FT
950 KTS
592 KTS
295 KTS
415 KTS
177 KTS
59 KTS TO 264 FT
VELOCITY
DISTANCE FROM JET NOZZLE – FEET
JET WAKE RADIUS – FEET
IDLE THRUST
ONE (1) ENGINE ONLY
TEMPERATURE
130° RADIATION SCAN
GUN AREA
RADIATION BURN HAZARD MAY
EXIST IN THIS AREA WHEN RADAR IS OPERATING.
300' PERSONNEL
65°
AVOID TIRE AREA FOR 45 TO 60 MINUTES AFTER AIRPLANE HAS STOPPED. IF NECESSARY, APPROACH FROM THE FRONT OR REAR ONLY.
150°F
200°F
100°F
59 KTS
89 KTS
118 KTS
VELOCITY
DISTANCE FROM JET NOZZLE – FEET
JET WAKE RADIUS – FEET
15A–1–(6)A
R

Figure 2–3

TURNING RADIUS AND GROUND CLEARANCE



AIRPLANE BEING TAXIED

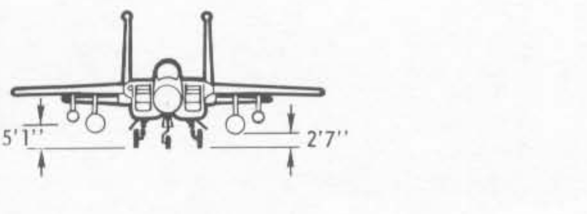
NOTE

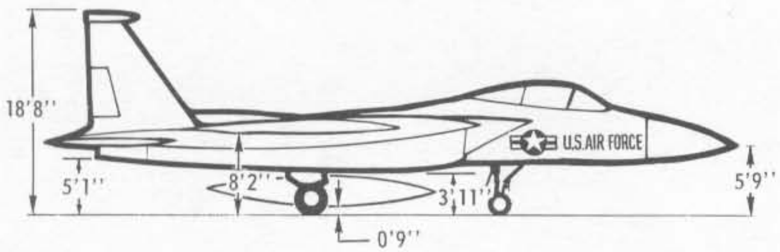
CLEARANCE RADII CALCULATED ON MAXIMUM NOSE GEAR STEERING ANGLE (45°).

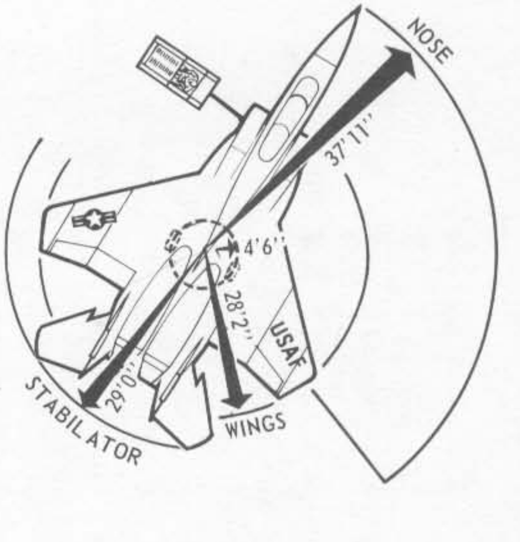
AIRPLANE BEING TOWED

NOTE

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







15A-1-(3)A

Figure 2-4

SECTION III

EMERGENCY PROCEDURES AND ABNORMAL OPERATION

TABLE OF CONTENTS

This section covers the operation of the aircraft during emergency/abnormal conditions. It includes a discussion of problem indications and corrective actions as well as procedural steps when applicable. Adherence to these guidelines will insure maximum safety for the pilot and/or aircraft. The situations covered are representative of the most probable malfunctions. However, multiple emergencies, weather or other factors, may require modification of the recommended procedures. Only those steps required to correct or manage the problem should be accomplished. When dealing with emergency/abnormal conditions, it is essential that the pilot determine the most correct course of action using sound judgment, common sense and a full understanding of the applicable system(s). When practicable, other concerned agencies (i.e., flight lead, tower, etc.) should be advised of the problem and intended course of action. The following rules are basic to all emergency/abnormal conditions and should be thoroughly understood and applied by the pilot.

1. MAINTAIN AIRCRAFT CONTROL.
2. ANALYZE THE SITUATION AND TAKE THE PROPER ACTION
3. LAND AS SOON AS PRACTICABLE

WARNING

- During any inflight emergency, when structural damage or any other failure is known or suspected that may adversely affect aircraft handling characteristics, a controllability check should be performed. (See Controllability Check, this section.)
- The canopy should be retained during all emergencies that could result in a crash or fire such as crash landings, aborted takeoffs, and arresting gear engagements. The protection the canopy affords the pilot during these emergencies far outweighs the isolated risk of entrapment due to a canopy malfunction or overturn. During ground egress normal canopy opening procedures should be considered first to preclude the possibility of a static seat ejection.

STARTING

AMAD FIRE/OVERHEAT DURING START

An AMAD fire/overheat may be recognized by either illumination of the AMAD fire/overheat light, or by ground crew notification. Extinguisher actuation will discharge the fire extinguisher into the AMAD compartment and automatically shut down the JFS. If this action does not suffice, ground fire extinguishers may be required. If fire light (steady light) or overheat light (flashing light) is on:

1. AMAD light - PUSH
2. Fire extinguisher - DISCHARGE

JFS READY LIGHT DOES NOT ILLUMINATE

If the JFS ready light does not illuminate within 10 seconds, and -

a. The JFS sounds normal.
b. The AMAD fire light tests normally.
c. The Intercom is operating.

then the JFS light is inoperative, and the start may be continued. If the above cues are not present, or the JFS did not start:

a. JFS Switch - OFF
b. Have ground crew check JFS system.

If no abnormalties are found, another JFS start may be attempted.

JFS FAILS TO ENGAGE/ACCELERATE

When throttle fingerlift is raised, the JFS should engage the engine and accelerate it. Indications of proper JFS engagement are an audible decrease followed by an increase in JFS speed within approximately 5 seconds. If electrical power is available, engine rpm increase will be apparent. Various failures may cause the JFS not to engage, accelerate, or to accelerate to less than windmill speed.

If, after fingerlift is raised, the JFS does not audibly accelerate within approximately 5 seconds or rpm hangs up -

1. Throttle — OFF
2. Engine master switch — CYCLE
3. JFS switch — OFF
4. Do not attempt another start.

EMERGENCY GENERATOR NOT ON LINE ON START

Normal Emergency Generator operation can be recognized by the EMER GEN ON and other Caution Panel lights illuminating, and the rpm indicator operating.

If the emergency generator does not come on the line within 30 seconds after raising the finger lift -

1. Emergency generator switch - CYCLE
   If the emergency generator still does not come on line, the start can be completed without the emergency generator. However, this should be attempted only in those extreme cases when the requirement for starting is greater than the need for fire warning and engine instruments during the initial starting sequence (until main generators cut in at approximately 50% rpm).

If the emergency generator still does not come on the line -

1. Engine master switches - CYCLE (to decouple engines)
2. Perform an External Power Start.
   If, during the emergency generator check, the emergency generator does not come on the line, abort.

ENGINE HOT START

During normal engine starts, rpm movement precedes FTIT rise. If the FTIT rise is noted first, or if the FTIT is above 450° while rpm is below 40%, be alert for a hot start.

If FTIT rises rapidly through 550°C -

1. Throttle - OFF
2. Engine - WINDMILL (Until FTIT is below 200°C)

If FTIT did not exceed the starting limit, a normal start may be re-attempted -

1. Throttle - IDLE

If FTIT exceeded the starting limit, abort the flight -

1. Engine master switches - OFF
2. JFS switch - OFF
3. Complete the engine shutdown procedure.

ENGINE FAILS TO START

If no indications of ignition are observed within 30 seconds after advancing throttle to IDLE, the start attempt should be discontinued -

1. Throttle - OFF

If another start attempt is desired -

1. Engine - WINDMILL (10 seconds)
2. Throttle - IDLE

If another start is not desired -

1. Engine master switch — CYCLE
2. JFS - IDLE (30 seconds)
   The JFS should be idled for 30 seconds prior to shutdown.

ENGINE FIRE/OVERHEAT DURING START

If the JFS is still operating, allowing the engine to windmill will assist cooling, and may be beneficial in extinguishing a fire. If fire/overheat indications are noted:

1. Throttle - OFF

If warning light remains ON -

1. Fire warning light - PUSH
   Although fuel was shut off in the preceeding step, this shuts off bleed air, and arms the extingusihing circuit.

If warning light is still ON -

1. Fire extinguisher - DISCHARGE
2. JFS switch - OFF

GROUND OPERATION

ANTI-SKID FAILURE

Malfunctions of the anti-skid system will normally be indicated by the anti-skid caution light, but may be manifested by cycling at low pedal force pressures or no braking action at all.

1. Brakes - RELEASE (if applied)
2. Anti-skid Switch - OFF

DIRECTIONAL CONTROL PROBLEM

Directional control problems may be caused by a blown tire, defective nose gear steering, defective anti-skid or a faulty brake. As it is difficult to identify the problem source, and the time spent in fault isolation may worsen the situation, a single procedure is recommended for all directional control problems on the runway. This procedure is to pull the emergency brake/steer handle. Selection of this mode on the ground will provide an alternate source for powered braking and steering, and disables the anti-skid system, thereby accommodating all of the various failure modes which may have caused the directional control problem. If UTL B has failed, 3-6 full brake applications should be available. The emergency brake/steer handle should not be pulled in flight as the nosewheel will follow rudder commands, and anti-skid protection against locked brakes is lost. To restore normal operation, push in the emergency brake/steer handle.

1. Brakes - RELEASE
2. Emergency brake/steer handle - PULL

GROUND EGRESS

If time is extremely critical, consideration should be given to ground ejection. Otherwise, the evacuation procedure is identical to normal egress.

1. Head knocker - DOWN
2. Shoulder harness - RELEASE
3. Lap belt - RELEASE
4. Survival kit straps - RELEASE
5. Canopy - OPEN

If manual canopy operation is required -

a. (F) Internal canopy manual unlock handle - Remove pin and actuate.
b. Canopy - PUSH
   The canopy may tend to drift close, and may require some hand pressure to keep open. Care should be exercised to avoid catching personal equipment on the canopy rail hooks. If canopy jettison is required, remain in the seat to minimize possibility of injury as the canopy departs the aircraft. The internal boarding ladder may be extended by foot pressure on a button inside the upper foot well. However, the most rapid egress is made by hanging from canopy rail and dropping to the ground.

TAKEOFF

ABORT

The decision to abort or continue takeoff depends on many factors, most of which relate to a specific takeoff situation. Considerations should include, but are not limited to, the following:

a. Runway factors: Runway remaining, surface condition (wet, dry, etc.), type and/or number of barriers available, obstructions alongside or at the departure end, wind direction and velocity, weather and visibility.

b. Aircraft factors: Weight, stores aboard, nature of the emergency, velocity at decision point, and importance of getting airborne.

c. Stopping factors: Maximum braking (see Minimum Run Landing, section II), speedbrake, jettisoning stores.

Consideration should also be given to aborting after airborne in those situations where sufficient runway is available. Normally, with the short takeoff distances of the aircraft, abort is not a problem, but an early decision will provide the most favorable circumstances.

1. Throttles - IDLE
2. Brakes - APPLY

WARNING

After an abort where unusual braking is required, do not shut down engines until adequate fire fighting equipment is available. Hot wheels and brakes can provide an ignition source for fuel drained overboard during engine shutdown.

EXTERNAL STORES JETTISON

Two means exist to jettison external stores: The emergency jettison button, on the center instrument panel, and the select jettison button, on the armament control panel.

WARNING

The emergency jettison button simultaneously jettisons all pylons and AIM-7 missiles. When airborne, the possibility exists of an AIM-7-pylon-store collision, with subsequent missile/store collision with the aircraft. With no AIM-7's aboard, store-to-store collision is still possible, but the probability of aircraft involvement is minimal. Ground jettisoning may result in the store/pylon striking the ground before the pylon aft pivots release. Under these conditions, the wing mounted pylon stores will probably rotate horizontally, and will strike the landing gear if the rotation is in that direction. The center line pylon will almost certainly strike the landing gear.

Emergency jettison should not be used on the ground, or with AIM-7 missiles aboard, except as a last resort or in extreme emergencies. Normally, the COMBAT jettison feature of the select jettison button is preferable, since AIM-7 missiles are retained and the gear handle interlock prevents ground jettison.

ENGINE FAILURE ON TAKEOFF

If takeoff is continued -

1. Throttle(s) - AS REQUIRED
   Depending on the type of failure, and aircraft conditions, MIL power may be sufficient to sustain flight. If afterburner is required, use only that necessary to maintain safe flight. MAX power may generate airspeeds, altitudes, and/or pitch attitudes that could complicate handling of the engine failure.
2. Climb to a safe altitude, and follow Engine Failure During Flight procedures.

AFTERBURNER FAILURE

The two most common malfunctions are afterburner induced fan stall and afterburner blowout/failure to light. Fan stall is an audible bang occurring when afterburner is selected and the nozzles do not open sufficiently to reduce back pressure on the fan. Fan stalls are normally self clearing. Afterburner blowout can occur at any afterburner setting, and is usually associated with high altitude and low speed operation. Blowouts are detected by thrust loss followed by nozzle closure. If either a fan stall or afterburner blowout occurs, reduce throttle to MIL or below to terminate afterburner fuel flow. This prevents auto-ignition, and resets the afterburner ignition timer. If engine indications return to normal, afterburner operation may be re-attempted.

NOTE

If the afterburner fails to light, the throttle must be retarded to MIL, or lower, and then moved back into afterburner to regain ignition.

ENGINE FIRE/OVERHEAT ON TAKEOFF

If you decide to abort -

1. Fire warning light - PUSH

If fire warning light remains on -

1. Fire extinguisher - DISCHARGE

If you decide to continue -

1. Climb to safe altitude and follow Engine Fire/Overheat Inflight procedures.

PITCH RATIO FAILURE

If takeoff is made with the CAS-ON, it is unlikely that a pitch ratio failure will cause any control difficulties, and a normal takeoff may be continued. In fact, the pitch ratio light on the caution panel may be the only noticeable indication of failure. However, if the failure occurs with CAS-OFF, longitudinal stick forces may be considerably higher than normal, and a late nosewheel liftoff will likely result. In this case, aborting the takeoff is preferred if conditions permit. If takeoff is continued, maneuver conservatively since the ARI is inoperative.

TIRE FAILURE DURING TAKEOFF

Tire failure is very difficult to recognize, and may not be noticed from inside the cockpit. If a failure is suspected, or confirmed, and:

If takeoff is continued -

1. Gear - DO NOT RETRACT
2. Follow Landing With Blown Tire Procedure.

LANDING GEAR FAILS TO RETRACT

If the warning light in the landing gear handle stays on after the handle is placed up, the gear or gear doors are not correctly sequenced. Reduce airspeed below 250 knots and lower the gear. If the gear comes down normally, attempt another retraction. If the light is still illuminated, lower the gear, reduce weight, and land. If the gear will not indicate a normal down and locked condition, see Emergency Gear Lowering Procedure.

INFLIGHT

OUT-OF-CONTROL RECOVERY

If aircraft maneuvers are not in harmony with flight control inputs at a high angle of attack, an incipient out-of-control situation exists. Allowing the stick to return to neutral will probably preclude departure. Throttles should not be moved as an engine stall/stagnation may be induced. If an out-of-control situation develops:

1. Controls - NEUTRAL
2. Speedbrake - IN

If not recovered by 10,000 feet AGL -

1. Eject

EJECTION

Ejection can be accomplished at ground level between zero and 600 knots airspeed with wings level and no sink rate. The canopy must have departed before you can eject, as the seat will not go through the canopy. Ground ejection cannot be accomplished unless the canopy is down and locked or has been jettisoned previously. Basic procedures are shown in figure 3-8. Minimum ejection altitudes for various flight conditions and attitudes are shown in figures 3-9 and 3-10.

1. Ejection handle - PULL

ENGINE STALL/STAGNATION

Two types of engine stall may be experienced. Both are more likely in the high altitude and low airspeed regime. The most common type produces an audible bang, or bangs, and is usually self-clearing. Throttle slams from IDLE, before the rpm has decreased to idle, and hard afterburner lights are the areas most sensitive to this type stall. Returning the throttle to IDLE, or MIL for an AB light stall, will probably clear the stall, and normal engine operation will be restored. A stagnated stall is characterized by slowly rising FTIT, and slowly decreasing rpm. No audible indications are present, and extreme FTIT can occur if the stagnation is allowed to progress. Stagnations usually develop from stalls that have not cleared, but may result from low rpm and low airspeed operation at high altitudes. To clear a stagnation, cycle the throttle to OFF, and perform an airstart. If the engine recovers to normal operation after an excessive FTIT (over 1060°) has occurred, leave the engine at IDLE unless a higher power setting is required to insure a safe recovery. In a stagnated stall, FTIT usually increases more slowly above 1000°, and stabilizes below 1100°. Engine operation in the 1000° - 1100° regime has been sustained for several minutes with no adverse effects. Leaving a stagnated engine running is preferable to flight with both engines inoperative. After a stall is cleared, engine parameters at MIL will initially be lower than normal until the EEC can effect a return.

SINGLE ENGINE STALL/STAGNATION

1. Throttle - CHOP TO IDLE (MIL if in AB)
   If engine stalls when in AB, retard throttle to MIL. If stall does not clear at MIL, chop throttle to idle.

If FTIT continues to rise (stagnation) -

1. Throttle - OFF
2. Perform restart.

DOUBLE ENGINE STALL/STAGNATION

1. Both throttles - CHOP TO IDLE (MIL if in AB)
   If engine stalls while in AB, retard throttle to MIL. If stall does not clear at MIL, chop throttle to idle.

If FTIT continues to rise (stagnation) -

1. Throttle - OFF (engine with highest FTIT)
   If there is no appreciable difference in FTIT, shut down the right hand engine since it has less hydraulic load.
2. Perform restart.

After one engine is operating normally, other engine -

1. FTIT - CHECK
2. Throttle - OFF
3. Perform restart.

If the FTIT exceeded 1060° -

1. Throttle - LEAVE AT IDLE (if practicable).

RESTART/STALL CLEARING

Ignition and fuel are continuously supplied when the throttles are at IDLE or above. If an engine does flameout, and auto start does not occur, it is unlikely that a start can be accomplished since cycling the throttles through OFF does not recycle either ignition circuits or fuel flow, and no cockpit scheduling for fuel or ignition, other than the throttle, exists.

To restart an engine that has been shut down for whatever reason, bringing the throttle to IDLE or above is all that is required.

When a throttle is cut off due to a stall/stagnation, attempt to attain at least 350 knots which will keep the rpm up. As the rpm decreases thru 50% return the throttle to IDLE if FTIT is below 500°C. If the FTIT is not below 500°C, allow rpm to decrease until 500°C is attained. The minimum rpm for any airstart is 12% as there is no fuel flow available below 12% rpm. A restart should be successful above 180 knots at lower altitude or above 250 knots at high altitude and may be successful below these speeds.

Airstart instrument indications are practically the same as those encountered in ground starting. Rpm rise should precede FTIT, and should increase rapidly to a value commensurate with throttle position. FTIT should not exceed that normally experienced in groundstarts, although the maximum allowed is higher. If an abnormal start occurs, abort the attempt, and try again. Increasing airspeed above 350 knots and/or decreasing altitude, if feasible, may provide better airstart conditions.

If a hot start is experienced, holding the engine start fuel switch to ALTITUDE (low fuel flow) will override the automatic low fuel flow in OFF if it is malfunctioning. If the engine will not accelerate, holding the engine start fuel switch to SEA LEVEL (high fuel flow) will provide additional starting fuel flow.

ENGINE ELECTRONIC CONTROL MALFUNCTION

The symptoms of an EEC malfunction are abnormal rpm, FTIT, and/or nozzle indications, including fluctuation or oscillations. Cycling the EEC may clear the malfunction, in which case normal engine operation is restored. If the malfunction does not clear, the EEC may be left off. In this case, power settings near MIL, or above, should be avoided, and engine instruments should be closely monitored. EEC switch actuations should not be made with the throttle near MIL or above.

1. Throttle - 80% (inflight) - IDLE (on ground)
2. EEC - CYCLE

If malfunction still exists -

1. EEC - OFF

If engine limits cannot be maintained -

1. Throttle - OFF

DOUBLE ENGINE FAILURE

Since ignition is continually available with the throttles at IDLE or above, and fuel transfer is automatic, double engine failures should be extremely rare. If a double failure does occur:

1. Maintain at least 12% rpm.
   It may require 45° dive angle for the 350 knots normally needed for 12% rpm.
2. Perform restart.

NOZZLE FAILURE

The cockpit nozzle indicator indicates nozzle control unit commands, not actual nozzle position. It is possible for the nozzle to fail (actuator cable broken) and still have normal indications. If the nozzles fail full open the FTIT will be abnormally low, thrust loss is significant and at high thrust settings fan overspeed is possible. If the nozzle fails full open, setting power at 80% and cycling the EEC switch may restore normal nozzle operation. If normal operation is not restored, restrict engine operation to below 80%. Operation above 80% (including AB attempts) is permitted as necessary for flight safety.

If the nozzle fails to the closed position engine stalls will occur upon AB selection. Do not attempt AB.

ENGINE FIRE/OVERHEAT INFLIGHT

Any of the prescribed corrective steps may extinguish the fire light. If this is done, and the warning light test good, thrust should be restricted. Other indications of fire such as smoke, control difficulties, and hydraulic or electric anomalies, should be closely monitored. If the fire extinguisher is used successfully, restarting the engine should not be considered unless absolutely necessary.

1. Throttle - IDLE

If warning light remains on -

1. Fire warning light - PUSH

If warning light still remains on -

2. Fire extinguisher - DISCHARGE

If fire persists -

1. Eject

If warning light goes off -

1. Fire warning system - TEST
2. Monitor other indications of fire closely.

AMAD FIRE/OVERHEAT INFLIGHT

The most likely cause of an AMAD fire light inflight is the generators. If indications of a fire or overheat exist, check electrical indications as well. Turning off a generator may remedy the situation. If an AMAD fire or overheat light illuminates:

1. Power - REDUCE

If overheat warning light remains on -

1. Discontinue mission

If fire warning light remains on -

1. AMAD light - PUSH
2. Fire extinguisher - DISCHARGE

If fire confirmed -

1. Left and right generators - OFF

If fire persists:

1. Eject

ELECTRICAL FIRE

Electrical Fire will normally be detected by the distinctive odor. In addition to steps alleviating the smoke/fumes, try to isolate the offending item:

1. Non–essential electrical equipment - OFF
2. Equipment - ON INDIVIDUALLY

If fire is isolated -

1. Affected equipment - OFF

If fire persists -

1. Both generators - OFF

If fire still persists -

1. Emergency generator switch - EMER ON

SMOKE OR FUMES IN COCKPIT

All unidentified odors should be considered toxic. Do not confuse condensation from the air conditioning system with smoke. If smoke or fumes are encountered:

1. Oxygen - 100%

If smoke or fumes become intolerable -

1. Emergency vent handle - TURN AND PULL

In extreme cases, the canopy may be jettisoned to clear smoke or fumes.

WARNING

If the cockpit is the source of the smoke or fumes, canopy jettison may cause an eruption of flames around the pilot.

EXTREME COCKPIT TEMPERATURE

If temperature control cannot be maintained in the AUTO position, switch to MANUAL, and adjust temperature control. If attempts in manual fail and temperatures become excessive, pull the emergency vent handle. Caution should be observed when operating at altitude, and descent should be considered. If the temperature is hot, and altitude is low, a climb to cooler air and/or a deceleration to a slower airspeed, should be considered.

ECS LIGHT ON

Level flight –

1. Maintain 400 knots

Descent –

1. Increase rpm or maintain minimum 68% rpm

If light remain on –

2. Radar – OFF

If light still remains on –

3. Non–essential avionics – OFF
4. Descend to below 25,000 feet
5. Emergency vent handle – TURN AND PULL
   Dumping cabin pressure will divert all ECS cooling to the avionics.

If light still remains on –

6. Cabin temperature control switch – OFF
   Turning the cabin temperature control switch OFF will switch avionics cooling to ram air. The light will continue to monitor adequate avionics cooling air flow and temperature. Optimum cooling is obtained at 400 $\pm$50 knots and 10,000 to 25,000 feet altitude.
7. Land as soon as practicable.

When clear of the active runway and stopped –

8. Throttles – OFF

OIL SYSTEM MALFUNCTION

Engine oil system malfunctions include over or under pressure, and excessive fluctuations. If an oil system malfunction occurs, monitor engine parameters and levels of vibration for possible engine seizure. The engine can run for extended periods on very little oil, but shutting down an engine with little or no oil pressure is preferred whenever possible. Restarting the engine for critical flight phases can then be considered.

If engine instruments are not within limits –

1. Throttle – OFF

FUEL SYSTEM MALFUNCTION

The primary indication of a fuel system malfunction is the fuel gauge. Other indications, such as wing low tendencies or fuel flow anomalies, can be used to cross check the fuel gauge. Normally, internal fuel will not transfer until all external fuel has been transferred.

CAUTION

The STOP TRANS function is restricted to emergency use. (e.g., to prevent fuel loss). Cycling the external tank switch and slipway door may restore transfer. If not, it may be necessary to jettison the tanks for controllability or range considerations. Landing with up to a full tank on one side will normally present no problem, but a controllability check should be performed when practicable.

EXTERNAL TANK FAILS TO TRANSFER

With wing tanks installed, if the external fuel tanks fail to transfer completely or if STOP TRANS is selected due to an emergency and any external tank, including the centerline, is partially full, the aircraft may exceed the aft CG limit at light internal fuel weights due to fuel moving aft in the external tanks. External tank jettison may be required to improve handling qualities or to reduce weight to maximum landing gross weight.

1. External tank switch – CYCLE
2. Slipway switch – CYCLE

If external tank still fails to transfer or STOP TRANS is selected –

3. Maintain minimum 250 knots.
4. Use minimum pitch angles for maneuvering.
5. Land as soon as practicable.
6. Jettison external tanks if required.

If external tanks are retained –

7. Maintain 18 units AOA on final.

GENERATOR FAILURE

A generator failure will be indicated by illumination of the appropriate light on the caution panel. Normal flight electrical loads (except TEWS and pods) can be handled by one generator. A check of the hydraulic warning lights and gauges should be accomplished for a possible AMAD failure.

1. Generator switch – CYCLE
2. Hydraulics – CHECK

If generator still failed –

1. Generator switch – OFF

DOUBLE GENERATOR FAILURE

If both generators fail, the emergency generator will automatically come on line and power the emergency busses. Refer to Emergency Power Distribution Chart (figure 3-1) for equipment that will be operative/ inoperative when the emergency generator is on line. If either generator can be reset, the system will revert to normal operation.

The primary airspeed/Mach indicator, primary altimeter, vertical velocity indicator, and AOA indicator will fail immediately, and will tend to remain at the last valid reading. The HUD will also fail. Standby instruments are operative.

1. Emergency generator light – CHECK ON
   If not on, check emergency generator switch in the NORM position.
2. Generator switches – CYCLE

If generators still failed –

1. Generator switches – OFF

When the emergency generator is on line and a fault in the emergency generator circuit appears, the generator will be dropped off line, and the EMER GEN ON light will extinquish. The emergency generator switch must be cycled to restore operation. If the emergency generator fails to restore, you have a complete electrical failure.

AMAD FAILURE

AMAD failure is indicated by the simultaneous loss of the PC system, the utility system, and the generator on the same side. If this occurs:

1. Throttle – IDLE
2. Reduce electrical requirements as practicable.
3. Refer to Electrical and Hydraulic Failures.

If double AMAD failure occurs, total hydraulic and electric power are lost, and aircraft control is impossible.

RUNAWAY TRIM

Sufficient control is available to land the aircraft from a runaway trim in any direction. Control forces in normal flight can be excessively tiring, and may be relieved by use of the pilot relief modes.

1. Attitude hold switch – ON (if desired)

FLIGHT CONTROL SYSTEM MALFUNCTION

The CAS is a highly reliable, two channel, fail–safe system which continuously self–checks its operation. If the CAS senses a malfunction, it will drop itself off line. If any flight control system anomaly is apparent to the pilot, and the CAS is still operating, the fault is almost certainly in the mechanical system. In this case, CAS should not be disengaged, as it may be responsible for maintaining controlled flight. If it were to be disengaged, not only would aircraft control be jeopardized, but it may not be possible to re–engage CAS. A controllability check should be performed, if practicable, prior to landing.

If the malfunction appears in pitch –

1. Pitch ratio switch – EMERG
2. Pitch ratio indicator – OBSERVE 0.4

If malfunction appears in roll –

1. Roll ratio switch – EMERG

Placing either ratio switch to EMERG will fail the aileron–rudder interconnect (ARI), and will remove pitch and/or roll compensations provided by the ratio changer. Selection of the emergency pitch system will also disable pitch trim compensation. Adequate flying qualities for recovery are provided. If CSBPC hydraulic pressure is lost, the pitch ratio will indicate 0.4 regardless of gear position when EMERG is selected. Handling qualities are adequate for recovery. Make a low angle straight–in approach not to exceed 18 units AOA.

SPEEDBRAKE FAILURE

If either a hydraulic or electric failure occurs, the speedbrake will be closed by air pressures. If the speedbrake will not retract, pulling the SPD BK circuit breaker will remove electric and hydraulic power, and allow air load closure.

1. Speedbrake circuit breaker – PULL

EMERGENCY POWER DISTRIBUTION

EMERG GEN
NORM

EMERG ON

EMERGENCY GENERATOR OPERATING WITH SWITCH IN NORM

| L GEN OUT | R GEN OUT | EMERG GEN ON |

INOPERATIVE EQUIPMENT

ENGINE-
- ENGINE ANTI-ICE
- ENGINE OIL PRESS INDICATORS
- FUEL FLOW INDICATORS
- FUEL TRANSFER PUMPS
- ICE DETECTOR
- L & R BOOST PUMPS
- L & R DUCT TEMP PROBE HEATERS
- L & R ENG INLET CONTROLLERS
- L & R TOTAL TEMP PROBE HTRS
- NOZZLE POSITION INDICATORS

FLIGHT INSTRUMENTS -
- ANGLE-OF-ATTACK IND
- PRI AIRSPEED/MACH IND
- PRI ALTIMETER
- VERTICAL VELOCITY IND

NAVIGATION EQUIPMENT-
- AUX RCVR
- IFF INTERROGATOR (NO IFF DISPLAY ON ANMI)
- ILS
- INS
- KY-28
- TACAN

[1] TAKE COMMAND (REAR CKPT)

OTHER -
- AIR DATA COMPUTER
- ANTI-COLLISON LTS
- CENTRAL COMPUTER
- CONSOLE LT
- FORMATION LTS
- HUD
- INSTRUMENT LTS (FLT, ENG & AUX)
- IRE
- JETTISON USING A/G SELECT AND SELECT JETTISON CONTROLS
- KIR
- KIT
- LDG & TAXI LTS
- LEAD COMP GYRO
- OXYGEN GAGE
- PC-1 HYD PRESS IND
- PC-2 HYD PRESS IND
- PITCH RATIO INDICATOR
- POSITION LTS
- RADAR
- SEAT ADJUST
- TEWS (RWR, EWWS, ICS)
- UTILITY HYD PRESS IND
- [1] UTILITY FLOOD LIGHT (REAR CKPT)
- VSD
- WPN NORM RELEAVE/LAUNCH
- WSHLD ANTI-ICE SYS

[1] TF AIRCRAFT ONLY

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Figure 3-1 (Sheet 1 of 2)

EMERGENCY POWER DISTRIBUTION

EMERGENCY GENERATOR OPERATING WITH SWITCH IN NORM

L GEN OUT | R GEN OUT | EMERG GEN ON

OPERATIVE EQUIPMENT

ENGINE –
- AMAD FIRE DETECTION SYS
- AMAD FIRE EXTINGUISHER SYS
- BLEED AIR LEAK DETECTOR
- EMER FUEL BOOST PUMP
- ENG AND A/B IGNITION
- ENG FIRE EXTINGUISHER SYS
- ENG FIRE/OVERHEAT DETECTION SYS
- ENG RPM INDICATORS
- FTIT INDICATORS
- FUEL DUMP (WG & EXT TANKS W/O XFR PUMPS)
- FUEL LOW & BINGO LT
- FUEL PRESS AND VENT
- FUEL QUANTITY INDICATORS
- L & R ENG FUEL SHUTOFF VALVES

FLIGHT INSTRUMENTS –
- PITOT HEAD HEAT
- STBY AIRSPEED/MACH INDICATOR
- STBY ALTIMETER
- STBY ATTITUDE INDICATOR

NAVIGATION EQUIPMENT –
- ADF
- ADI
- ATTITUDE HEADING REF SYS
- [1] COMM AFT (INTERCOM AND TACAN AUDIO SIGNALS)
- HSI
- IFF TRANSPONDER
- STBY COMPASS LT
- UHF R/T

OTHER –
- AERIAL REFUELING
- AERIAL REFUELING FLOOD LTS
- AFCS/CAS
- ANTENNA SELECT
- ANTI-SKID
- ARRESTING HOOK
- EMER JETTISON PWR (EMER JETTISON BUTTON)
- ENVIRONMENTAL CONTROL SYS
- FLAPS
- LANDING GEAR
- LANDING GEAR POSITION INDICATORS
- MASTER CAUTION RESET
- NOSE WHEEL STEERING
- PITCH RATIO
- SPEED BRAKE
- STORM/FLOOD LTS
- TRIM (AIL/RUD/STAB)
- UTILITY FLOOD LT (FRONT CKPT)
- WARNING/CAUTION/BIT/ADVISORY LTS
- WARNING/CAUTION/BIT/ADVISORY LTS TEST

EMERGENCY GENERATOR OPERATING WITH SWITCH IN EMERG ON

OPERATIVE EQUIPMENT

- ARRESTING HOOK
- EMER FUEL BOOST PUMP
- ENG AND A/B IGNITION
- STBY AIRSPEED
- STBY ALTIMETER

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Figure 3–1 (Sheet 2 of 2)

INLET LIGHT ON

NOTE

Procedures for this malfunction appear in figure 3-12, Warning, Caution, and Indicator Lights.

With the inlet ramp switch in AUTO, the light indicates either an AIC failure, or a diffuser ramp that did not lock or unlock at the appropriate Mach number.

If the inlet ramp switch is in EMERG, the light indicates the diffuser ramp did not lock. In any case, maintain speed below Mach 1.0. G loads are limited to 3.0 G above Mach 0.9. The throttle should not be reduced below MIL above Mach 1.0.

BLEED AIR LIGHT ON

When either light comes on, the opposite engine air source must be selected. If both lights come on, the air source knob must be placed to OFF, and the emergency vent control should be placed to the ram air position. In this case, airflow and pressurization to the cockpit, avionics, G suit, windscreen anti-ice, and fuel system will be shut off. Ram air cooling for the avionics, and pressure for the fuel system, will be automatically supplied.

ATTITUDE/INS FAILURE

If the ATTITUDE warning light illuminates, but no warning flags are displayed on the ADI, the system not being used for attitude reference is probably at fault. Check the standby attitude indicator to insure the ADI has not failed without indication, then switch to the other attitude source to confirm the failure. If the INS system fails, the INS light on the BIT panel and the AV BIT light on the caution panel will also illuminate.

UHF FAILURE

If failure of the primary UHF radio occurs, operation may be restored by cycling either pre-set or manual frequencies, cycling mode selector switch or turning the radio off, then back on. If failure cannot be corrected, monitor AUX UHF and guard receivers.

IFF FAILURE

A failure of the IFF will be indicated by an AV BIT light on the caution light panel and an IFF light on the BIT panel. Cycling the transponder master switch and the mode selector switches may be accomplished in an attempt to restore operation.

LANDING

CONTROLLABILITY CHECK

If handling characteristics for recovery are suspect, for whatever reason, a controllability check should be performed to determine if recovery is possible, and if so, at what conditions. Do not exceed the limits discussed below, as they will provide a safe recovery.

1. Attain a safe altitude (at least 5000 feet AGL preferred).
2. Reduce gross weight to minimum practicable.
3. Establish landing configuration.
   Use of flaps is not recommended if structural damage in the wing is suspected.
4. Slow aircraft to 19 units AOA maximum.
   Slow only to that AOA/speed which allows acceptable handling characteristics.

If recovery is possible –

5. Maintain landing configuration and fly straight-in approach no slower than minimum control AOA found in step 4.

SINGLE ENGINE OPERATION

A single engine provides adequate power for normal flight operations for most configurations. Since loss of electric and hydraulic redundancy is the major concern, every attempt should be made, consistent with safety and prudence, to have the ailing engine running, even at idle. Otherwise, normal procedures should be followed, making appropriate allowances for reduced thrust. Reduce gross weight as practicable; avoid situations requiring high thrust levels, such as steep turns, flat approaches, speedbrake on final, and late decisions to go-around; and in general plan ahead.

FLAP MALFUNCTIONS

If a no-flap situation occurs, fly normal AOA and airspeeds, making allowance for the higher nose position and the lower deceleration on final.

If a split-flap situation occurs, fly a wider than normal pattern using normal AOA and airspeeds. Sufficient control will be available either CAS-ON or CAS-OFF under most configurations, but a controllability check should be performed if doubt exists. With CAS–ON, only a slight rolling tendency will be noticed. CAS–OFF, the tendency is more pronounced, but not severe.

OVERHEAD PRECAUTIONARY APPROACH

The nature of an emergency and pilot judgement will determine whether a straight in or overhead precautionary approach is flown. The overhead approach is recommended for most emergencies (especially engine problems) because of the judgement it affords and the airspeed it provides to zoom and eject if conditions warrant. This is not a dual flameout approach. If dual engine flameout occurs – eject.

LANDING WITH A BLOWN TIRE

The anti–skid system should be OFF to prevent continuous anti–skid cycling due to skid sensing on the blown tire, and to allow braking on the good tire. Land on the side of the runway opposite the blown tire, and use light braking on only the good tire. Braking the blown tire will not significantly affect stopping distance. Aileron can be used to maintain a wings–level attitude, and relieve most pressure on the blown tire while at speed. If directional control or braking problems occur, use the emergency brake/steer handle. If the nose tire is blown, the possibility of engine FOD due to rubber being thrown from the nose wheel exists. Hold the nosewheel off as long as practicable (below 70 kts), and insure engines are at IDLE when touchdown of the nosewheel occurs.

In either case, stop straight ahead and shutdown as soon as fire equipment is available. Do not attempt to taxi unless an emergency situation exists.

If the blown tire occurs on roll–out, the same precautions apply, except the possibility of an overrun–end arrestment is increased.

1. Anti–skid – OFF
2. Use light braking on good tire.

HYDRAULIC FAILURE

Refer to hydraulic flow diagram (figure 3–3) and bit panel for systems affected.

A failure of a single hydraulic system is not considered a critical item because of dual systems, return pressure sensing (RPS) and reservoir level sensing (RLS) incorporated in the hydraulic system design. Although not considered critical, proper treatment of the situation is warranted, as with any emergency, due to the possibility of subsequent failures which may compound the problem.

UTL A FAILURE

An UTL A failure is the only single hydraulic failure which requires pilot action.

1. Refer to Emergency Landing Gear Extension procedure.
2. Emergency brake/steer handle – PULL WHEN NEEDED AFTER LANDING.

UTL A AND PC2 A FAILURE

An UTL A and PC2 A failure is the only double hydraulic failure which reduces aircraft control appreciably.

1. Slow to subsonic.
2. Conduct Controllability Check as required.
3. Refer to Emergency Landing Gear Extension procedure.
4. Emergency brake/steer handle – PULL WHEN NEEDED AFTER LANDING.

LANDING GEAR EMERGENCY LOWERING

Emergency extension of the landing gear is controlled by a handle on the left sub–panel, and is accomplished by pulling the handle out. This allows JFS accumulator pressure to open the gear doors. The landing gear, aided by air loads, then free falls to the down and locked position. The doors will remain open. The landing gear may be retracted after they have been lowered with the emergency system provided the emergency landing gear handle is pushed in and normal hydraulic and electric power are available. Refer to figure 3–5 for landing with various abnormal landing gear configurations.

1. Airspeed – BELOW 250 KNOTS
2. Landing gear handle – DOWN
3. LG circuit breaker – PULL
4. Emergency landing gear handle – PULL

APPROACH–END ARRESTMENT

Approach–end arrestments are considered practicable when a malfunction affects directional control. Touchdown should occur at least 300 feet short of the cable, and the nose must be lowered immediately. To precisely control touchdown point, and to avoid bouncing on touchdown, precise AOA and flightpath control is required. Consideration should be given to minimum run landing techniques. Structural limitations of the arresting gear must also be considered. Refer to figure 3–4.

1. Hook – DOWN
2. Inertia reel – LOCKED
3. Throttles – IDLE
4. Nose – LOWER
5. Engage barrier in the center with brakes off.

OVERHEAD PRECAUTIONARY APPROACH

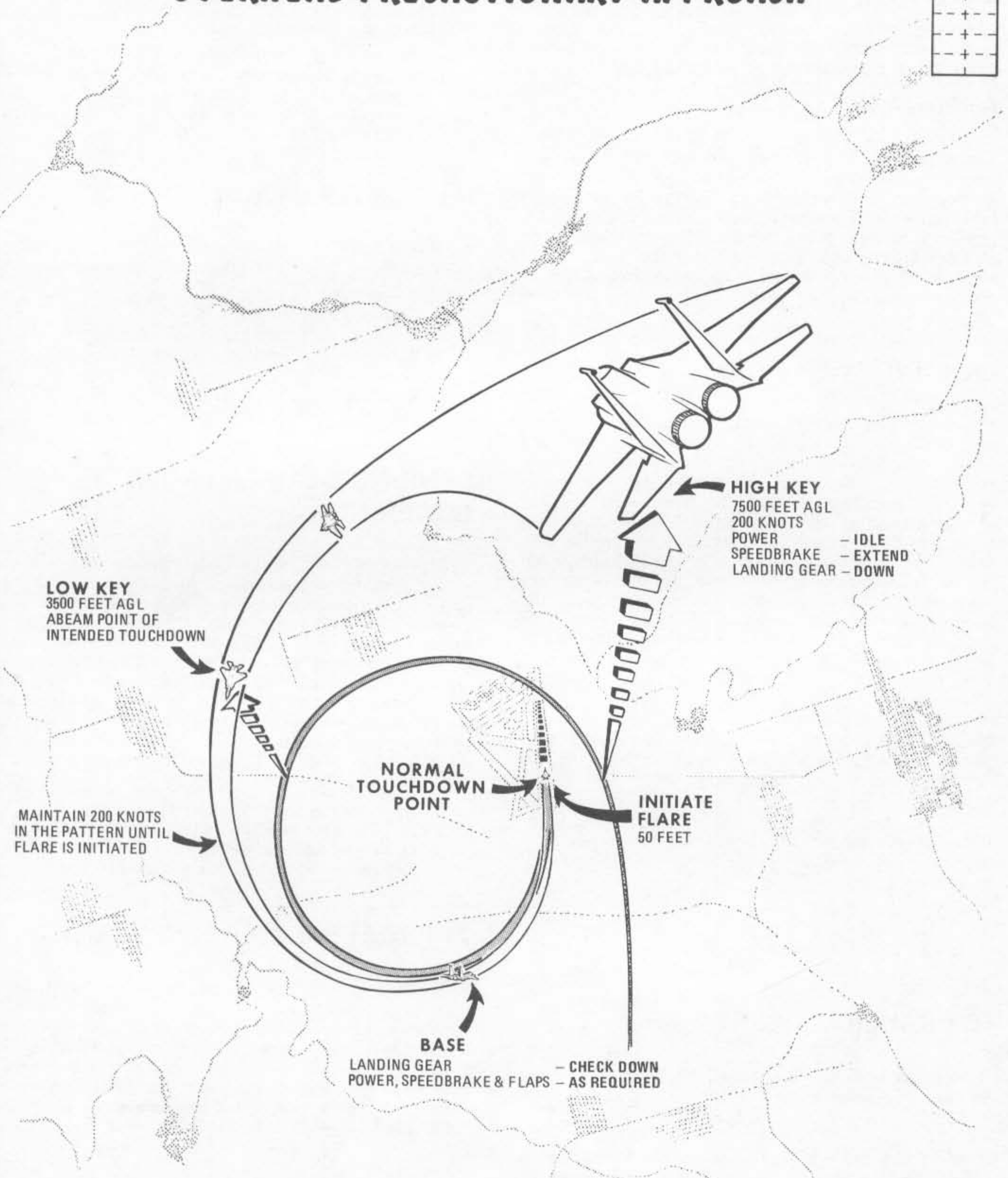


Figure 3-2

HYDRAULIC FLOW DIAGRAM

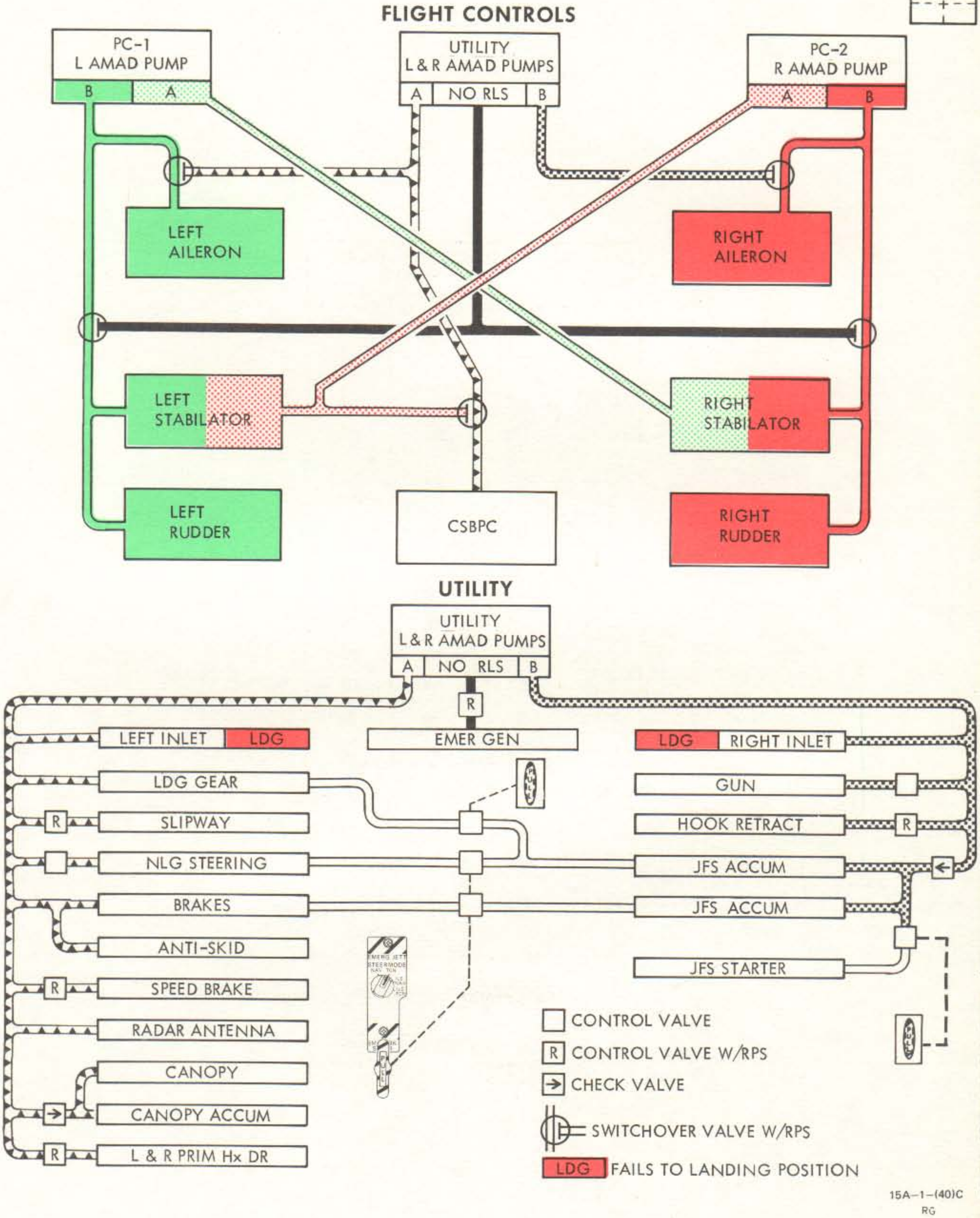


Figure 3-3

FIELD ARRESTMENT GEAR DATA

AIRCRAFT WEIGHT – POUNDS	MAX ENGAGEMENT GROUND SPEED – KNOTS		
	BAK – 9	BAK – 12	BAK – 13
28,000	185	**186**	160
30,000	183	**185**	160
32,000	181	**184**	160
34,000	179	**183**	160
36,000	177	**181**	160
38,000	175	**179**	**158**
40,000	173	**177**	**156**
42,000	169	**173**	**154**
44,000	165	**169**	**153**
46,000	161	**165**	**152**
48,000	157	**161**	**151**
50,000	154	**157**	**150**
52,000	151	**154**	**149**
54,000	148	**151**	**148**

BOLDFACE NUMBERS ARE HOOK LIMITATIONS

15A–1–(27)A

Figure 3–4

OVERRUN-END ARRESTMENT

If there is any doubt about the ability to stop the aircraft on the remaining runway, lower the tail hook. Stopping short of the barrier will only require raising the hook, but rolling over the barrier when it is needed may cause serious damage and/or injury. Engagement should be made as close to center as possible, without brakes, and aligned with the runway. The hook should be placed down at least 2000 feet before the barrier, and speed reduced as much as possible. AFter engagement, apply the brakes to avoid barrier towing the aircraft backward, and await the barrier chief's instruction.

1. Hook - DOWN
2. Engage Barrier in center with brakes off.

LANDING GEAR EMERGENCY LANDING

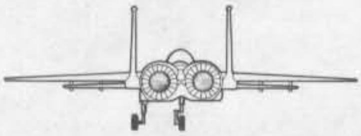
BEFORE ATTEMPTING LANDING, CONSIDER: ARRESTING GEAR LIMITATIONS
CROSSWIND
RUNWAY AND OVERRUN CONDITION

IF CONSIDERATIONS NOT FAVORABLE – **EJECT**

BEFORE LANDING-

1. JETTISON ARMAMENT (CONSIDER RETAINING RACKS)
2. DUMP OR BURN EXCESS FUEL
3. RETAIN EMPTY DROP TANKS (DEPRESSURIZE)
4. REQUEST RUNWAY FOAM
5. FLAPS – DOWN
6. FLY 19 UNITS AOA WITH FLAT APPROACH

LANDING NOT RECOMMENDED

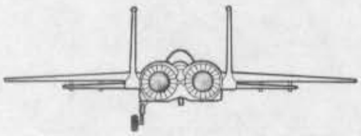


ONE MAIN – NOSE DOWN

- RETRACT GEAR AND REFER TO ALL GEAR UP

IF GEAR WILL NOT RETRACT –

- RECOMMEND EJECT



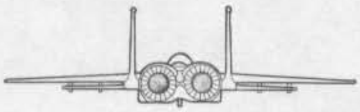
ONE MAIN–NO NOSE

- RETRACT GEAR AND REFER TO ALL GEAR UP

IF GEAR WILL NOT RETRACT –

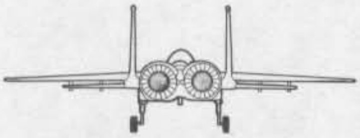
- RECOMMEND EJECT

ARRESTMENT NOT RECOMMENDED



ALL GEAR UP

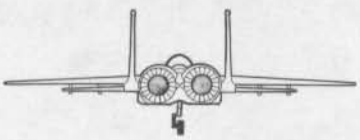
- 170 KNOTS TOUCHDOWN SPEED
- RETAIN ℄ TANK IF EMPTY AND UNPRESSURIZED



BOTH MAIN–NO NOSE

- JETTISON ℄ TANK
- DO NOT SHUT DOWN ENGINES UNTIL STOPPED

APPROACH END ARRESTMENT RECOMMENDED



NO MAIN –NOSE DOWN

- JETTISON ℄ TANK

IF ARRESTMENT NOT PRACTICABLE –

- JETTISON ℄ TANK
- DO NOT SHUT DOWN ENGINES UNTIL STOPPED

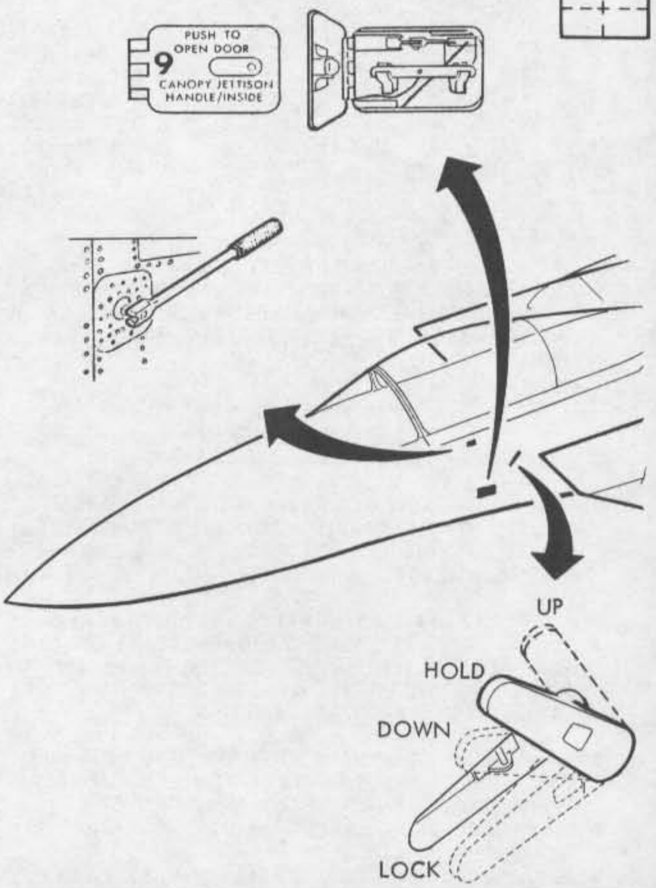
15A–1–(102) B

Figure 3–5

AIRPLANE ENTRY / AIRCREW EXTRACTION

WARNING

IF LEFT ENGINE IS RUNNING, APPROACH AIRPLANE ONLY IF SECURED BY AN ADEQUATE RESTRAINING LINE.



NORMAL ENTRY

1. PUSH HANDLE RELEASE BUTTON ON NORMAL CONTROL HANDLE, ALLOWING THE HANDLE TO SPRING OUT
2. ROTATE THE HANDLE FULLY AFT. THE CANOPY WILL UNLOCK AND OPEN.

MANUAL ENTRY

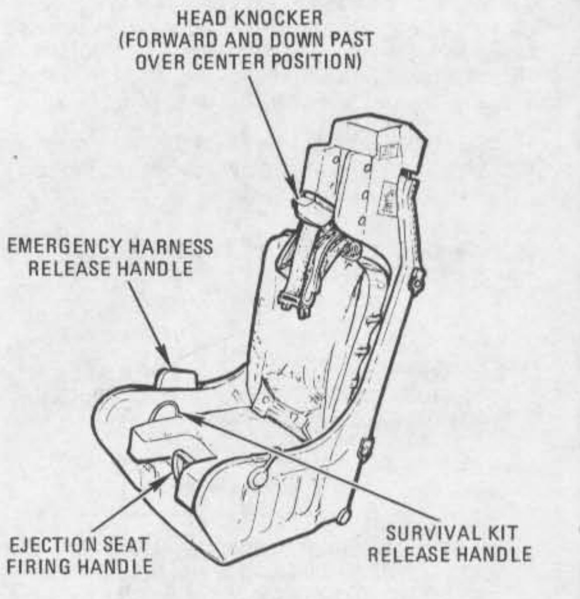
1. ENSURE NORMAL CONTROL HANDLE IS OUT AND ROTATED FULL AFT.
2. (F) INSERT 1/2–INCH DRIVE SOCKET WRENCH OR BREAKER BAR INTO MANUAL UNLOCK SOCKET AND ROTATE CLOCKWISE.
3. LIFT CANOPY AND INSTALL SAFETY STRUT.

EMERGENCY ENTRY

1. PRESS BUTTON TO OPEN DOOR 9, AND REMOVE T–HANDLE.
2. TO JETTISON CANOPY, PULL T–HANDLE TO FULL LENGTH (APPROXIMATELY 8 FEET) AND YANK HARD.

WARNING

- DO NOT ACTUATE EJECTION SEAT FIRING HANDLE. PULL THE EJECTION CONTROL SAFETY HANDLE DOWN TO SAFETY THE SEAT.
- IF THE SURVIVAL KIT IS RAISED 3/4 OF AN INCH PRIOR TO PULLING THE KIT RELEASE HANDLE, THE KIT LANYARD WILL RESTRICT PILOT TO WITHIN 25 FEET OF THE COCKPIT, UNLESS UNHOOKED OR CUT FROM PILOT'S INTEGRATED HARNESS.



NORMAL AIRCREW EXTRACTION

1. RELEASE LEFT AND RIGHT SURVIVAL KIT BUCKLES.
2. RELEASE LEFT AND RIGHT SHOULDER HARNESS STRAPS AND LAP BELTS.

EMERGENCY AIRCREW EXTRACTION

1. RELEASE LEFT AND RIGHT SHOULDER HARNESS STRAPS.
2. PULL YELLOW SURVIVAL KIT RELEASE HANDLE, NEXT TO CREW MEMBERS RIGHT LEG, UP AND AFT UNTIL IT SEPARATES FROM THE KIT.
3. PULL EMERGENCY HARNESS RELEASE HANDLE, ON RIGHT ARM–REST, UP TO FULL EXTENSION.

15A–1–(28) D

Figure 3-6

EJECTION PROCEDURES

IF TIME AND CONDITIONS PERMIT

- ALERT REAR CREW MEMBER (IF APPLICABLE)
- TIGHTEN LAP BELT
- LOWER HELMET VISOR
- STOW LOOSE EQUIPMENT
- ASSUME PROPER EJECTION POSITION
- IF AT LOW ALTITUDE ZOOM AIRCRAFT
- EJECT AT LEAST 2000 FEET (AGL)

1. EJECTION CONTROL HANDLE – **PULL**
   GRASP THE EJECTION HANDLE, USING A TWO-HANDED GRIP WITH THUMB AND AT LEAST TWO FINGERS OF EACH HAND. PULL UP ON HANDLE AND CONTINUE HOLDING HANDLE UNTIL AFTER PILOT-SEAT SEPARATION.

WARNING

- MINIMUM ALTITUDES ARE DEPENDENT UPON DIVE ANGLE, AIRSPEED, AND BANK ANGLE. RECOMMENDED MINIMUMS ARE 10,000 FEET (AGL) IF OUT OF CONTROL, AND 2000 FEET (AGL) IN CONTROLLED FLIGHT.
- IF THE COMMAND SELECTOR VALVE IS IN SOLO, THE REAR SEAT WILL NOT EJECT, NOR CAN THE REAR SEAT EJECT ONCE THE FRONT SEAT HAS BEEN EJECTED. FAILURE TO INSTALL THE SOLO FLIGHT COLLAR WILL CAUSE A 0.4 SECOND DELAY IN FRONT SEAT EJECTION.
- IF THE EMERGENCY OXYGEN GREEN RING IS PULLED WHILE STILL IN THE COCKPIT, THE AIRCRAFT OXYGEN HOSE MUST BE DISCONNECTED FROM THE CRU-60P CONNECTOR, OR THE PILOT WILL NOT BE ABLE TO EXHALE.
- DO NOT PULL THE SURVIVAL KIT RELEASE HANDLE WHILE SITTING IN THE SEAT. THE DROP LINE WILL BE DETACHED, AND THE KIT WILL BE LOST WHEN PARACHUTE OPENS.

CANOPY SEPARATION FAILURE

IF CANOPY DOES NOT JETTISON AFTER PULLING THE EJECTION CONTROL HANDLE, REMAIN IN POSITION FOR EJECTION AND PERFORM THE FOLLOWING WHILE KEEPING ARMS INBOARD IN READINESS TO REGRASP THE EJECTION CONTROL HANDLE.

IF CANOPY FAILS TO SEPARATE

1. CANOPY JETTISON HANDLE – **PRESS UNLOCK BUTTON AND PULL**

IF CANOPY STILL FAILS TO SEPARATE

2. CANOPY CONTROL HANDLE – **UP POSITION**

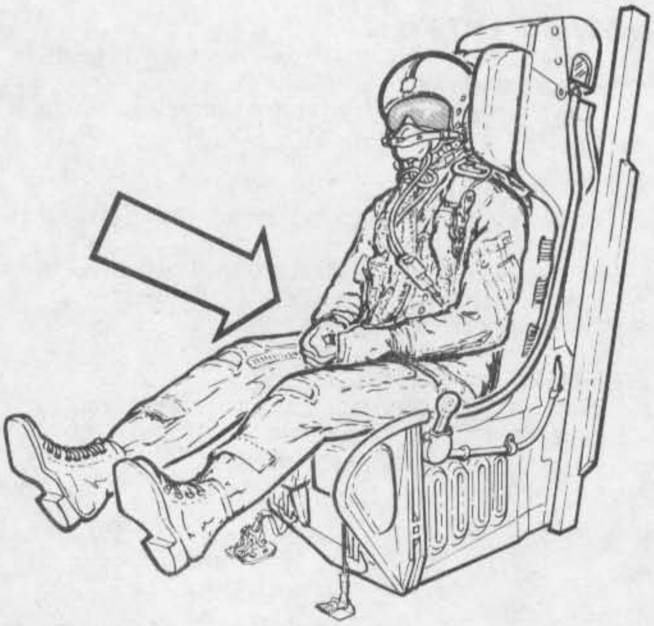
IF CANOPY STILL FAILS TO SEPARATE

3. (F) INTERNAL CANOPY MANUAL UNLOCK HANDLE– **REMOVE QUICK RELEASE PIN AND PULL**

WARNING

USE OF THE INTERNAL CANOPY UNLOCK HANDLE MAY RESULT IN SERIOUS INJURY. TO MINIMIZE CHANCES OF INJURY, IMMEDIATELY RELEASE THE HANDLE AS THE CANOPY BEGINS TO SEPARATE.

4. PULL CANOPY AFT AND THEN PUSH TO OPEN.



EJECTION SEAT FAILURE

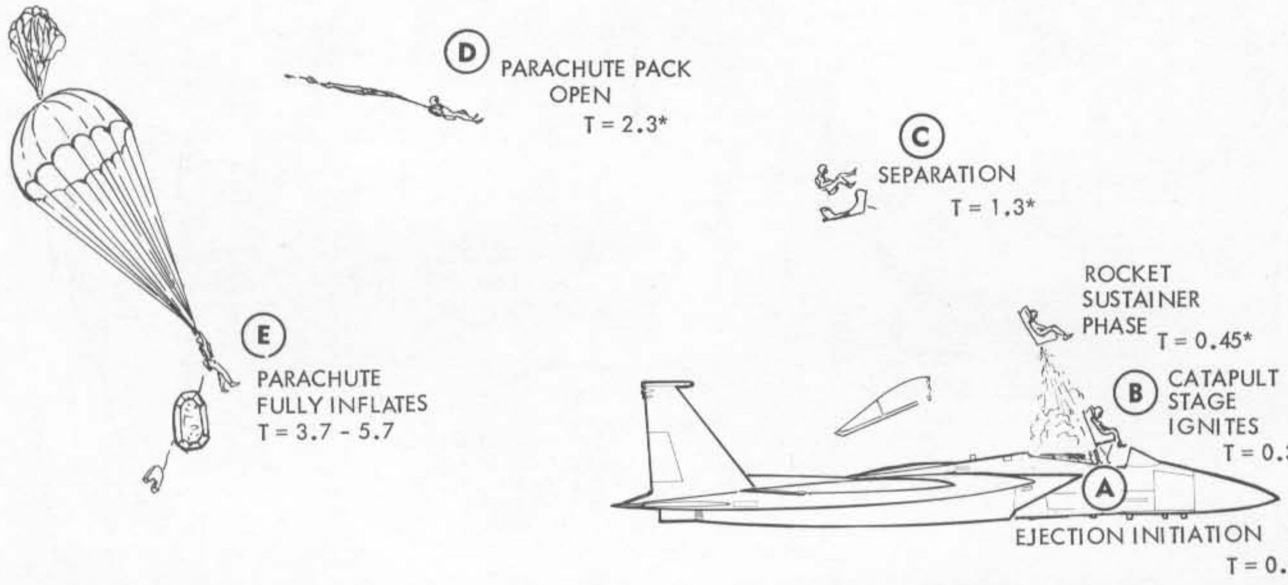
IF EJECTION SEAT FAILS AFTER CANOPY SEPARATES PULL EJECTION HANDLE AGAIN AND IF SEAT DOES NOT FIRE:

1. MAINTAIN 200–250 KNOTS, IF POSSIBLE
2. EMERGENCY HARNESS RELEASE HANDLE – **PULL**
3. APPLY FULL NOSE DOWN TRIM WHILE HOLDING AIRPLANE LEVEL
4. PUSH STICK FORWARD AND PUSH SHARPLY AGAINST SEAT TO FALL CLEAR OF AIRPLANE
5. WHEN BELOW 14,000 FEET, GRASP THE RIPCORD HANDLE HOUSING WITH LEFT HAND AND PULL PARACHUTE HANDLE SHARPLY WITH THE RIGHT HAND.

15A-1-(47-1)F

Figure 3-7 (Sheet 1 of 3)

EJECTION SEQUENCE



*TIMES IN SECONDS ARE FOR ZERO SPEED AND BELOW 14,000 FT. THEY WILL BE SLIGHTLY LESS AT HIGHER SPEEDS WHERE QUICKER CANOPY REMOVAL DUE TO AIRSTREAM EFFECTS WILL REDUCE THESE TIMES. ABOVE 14,000 FT. PARACHUTE OPERATION IS DELAYED BY THE BAROSTAT UNTIL THAT ALTITUDE IS REACHED.

(A) EJECTION CONTROL HANDLE PULLED TO ACTUATE SEAT-MOUNTED GAS INITIATOR AND:
- POWERED INERTIA REEL RETRACTS SHOULDER STRAPS
- CANOPY REMOVER FIRES.
- CANOPY JETTISONS AND PULLS LANYARD TO FIRE CANOPY ACTUATED INITIATOR
- IFF SWITCH ACTUATED.

(B) ROCKET CATAPULT FIRES, SEAT MOVES UP RAILS AND:
- HARNESS RELEASE ACTUATOR SEAR IS TRIPPED INITIATING 1.0 SECOND DELAY.
- PARACHUTE ARMING CABLE IS PULLED BY ZERO-DELAY LANYARD.
- COMMUNICATIONS AND SHIPS OXYGEN LINES DISCONNECT.
- EMERGENCY OXYGEN IS TRIPPED.
- DART SYSTEM STABILIZES SEAT.

(C) HARNESS RELEASE ACTUATOR CARTRIDGE FIRES AND:
A. LAP BELT AND SHOULDER HARNESS STRAPS RELEASE FROM SEAT STRUCTURE
B. SEPARATION BLADDERS INFLATE.
C. EJECTION CONTROL HANDLE DISCONNECTS FROM SEAT
D. PILOT IS SEPARATED FROM SEAT.

(D) PARACHUTE PACK OPENS APPROXIMATELY 2.0 SECONDS AFTER PASSING THROUGH 14,000 ± 500 FEET. IF EJECTION OCCURS BELOW 14,000 ± FEET, PARACHUTE OPENS APPROXIMATELY 2.0 SECONDS AFTER PARACHUTE ARMING CABLE IS PULLED DURING ARMING PHASE (B).

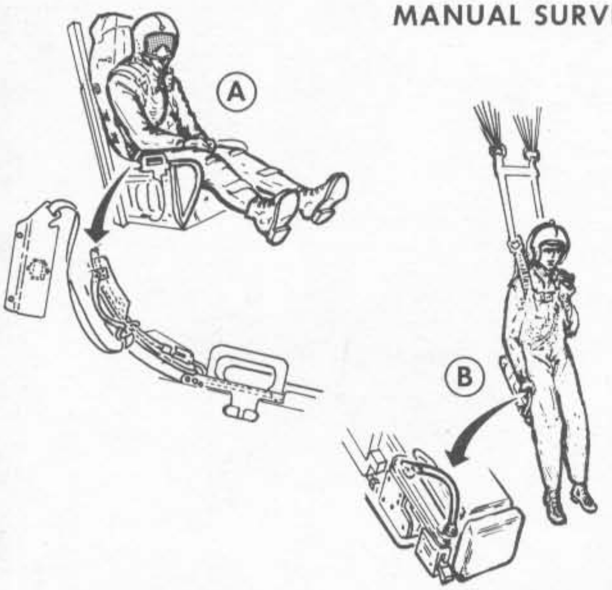
(E) PARACHUTE FULLY INFLATED; SURVIVAL KIT DEPLOYED (PROVIDED AUTO SELECTED ON DEPLOYMENT SELECTOR)

IF HARNESS RELEASE ACTUATOR FAILS TO OPERATE PROCEED WITH MANUAL SEPARATION

15A-1-(47-2) D

Figure 3-7 (Sheet 2 of 3)

MANUAL SURVIVAL KIT DEPLOYMENT



A IF SURVIVAL KIT OXYGEN FAILS TO RELEASE AUTOMATICALLY UPON EJECTION PULL THE OXYGEN RELEASE RING ON FRONT OF SURVIVAL KIT.

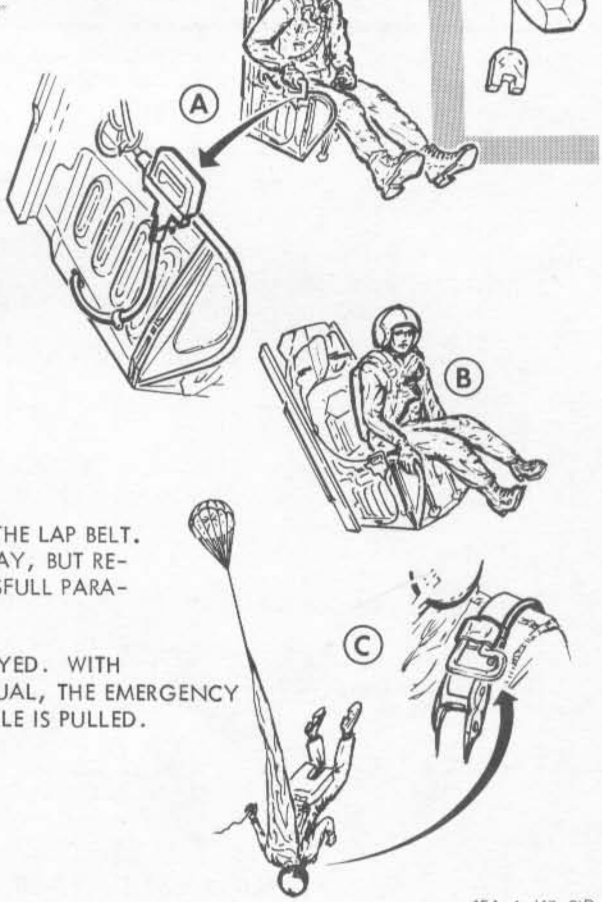
B AFTER PARACHUTE DEPLOYMENT OPEN THE FACE MASK. IF SURVIVAL KIT DOES NOT DEPLOY AUTOMATICALLY, GRASP KIT HANDLE BY THE FORWARD PART AND PULL RAPIDLY OUT OF HOUSING UNTIL THE HANDLE COMPLETELY RELEASES FROM THE KIT.

C LIFE RAFT INFLATION IS INITIATED BY GRAVITY WHEN THE DROP LINE IS FULLY EXTENDED AFTER KIT OPENING.

WARNING

IF THE SURVIVAL KIT IS DEPLOYED AFTER LANDING IN WATER, THE KIT COVER MUST BE PULLED FROM THE LOWER PORTION OF THE KIT AND A SNATCH PULL ON THE DROP LINE (NEAR CO_2 BOTTLE) IS REQUIRED TO INFLATE THE LIFE RAFT.

MANUAL SEPARATION



A ACTUATE EMERGENCY RELEASE HANDLE.

B PUSH FREE OF SEAT.

C WHEN BELOW 14,000 FEET, GRASP THE RIPCORD HANDLE HOUSING WITH LEFT HAND AND PULL PARACHUTE RIPCORD HANDLE SHARPLY WITH RIGHT HAND.

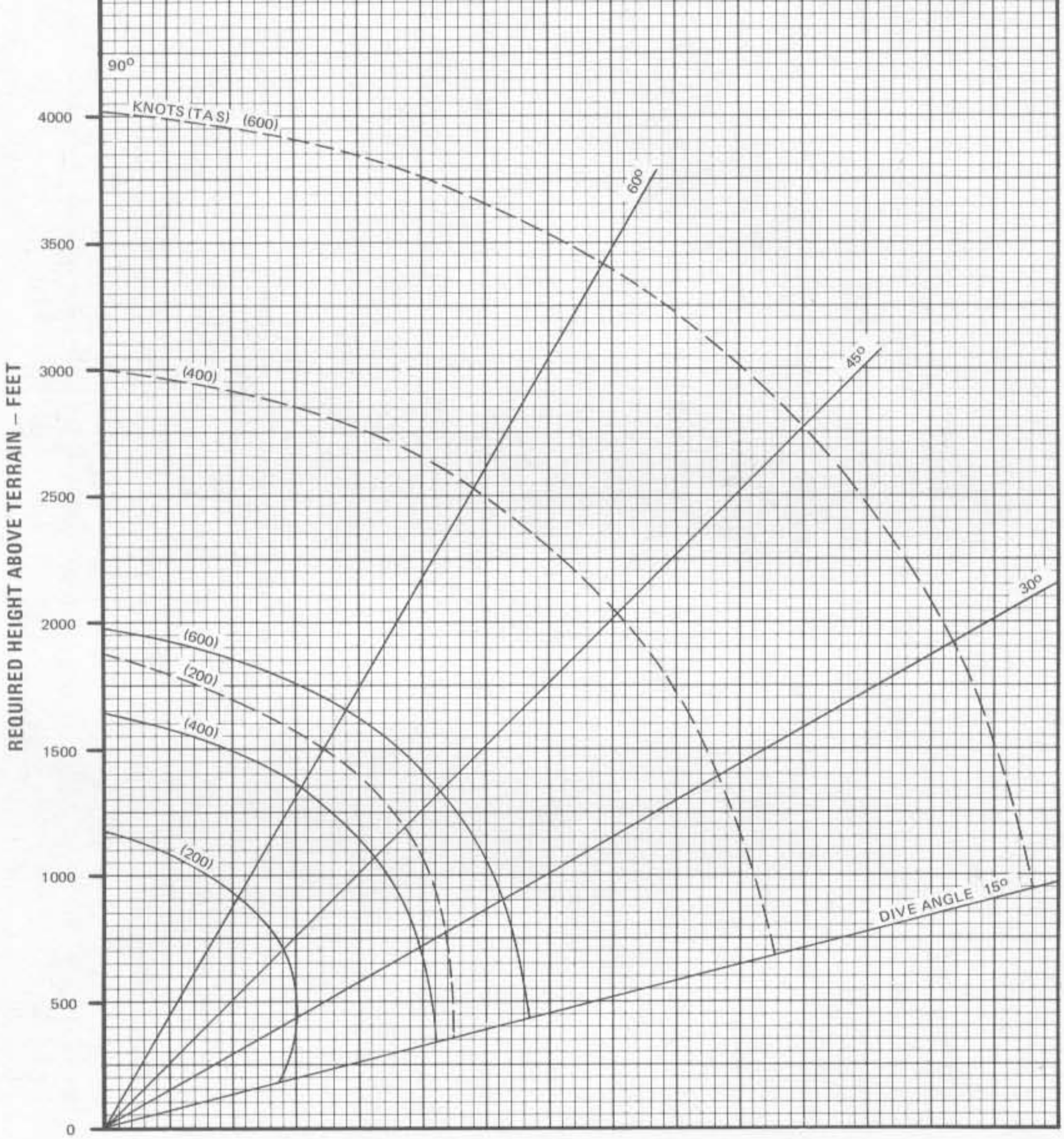
WARNING

- DO NOT ATTEMPT TO HASTEN SEAT SEPARATION BY OPENING THE LAP BELT. IF THE LAP BELT IS OPENED, THE SEAT WILL PARTIALLY FALL AWAY, BUT REMAIN ATTACHED BY THE SHOULDER HARNESS MAKING SUCCESSFULL PARACHUTE DEPLOYMENT VERY UNLIKELY.
- DO NOT DEPLOY THE SURVIVAL KIT UNTIL PARACHUTE IS DEPLOYED. WITH SURVIVAL KIT AUTO/MANUAL DEPLOYMENT SELECTOR IN MANUAL, THE EMERGENCY OXYGEN SUPPLY DISCONNECTS WHEN THE SURVIVAL KIT HANDLE IS PULLED.

15A-1-(47-3)D

Figure 3-7 (Sheet 3 of 3)

MINIMUM EJECTION ALTITUDE VS. AIRSPEED AND DIVE ANGLE



WARNING

THE FIGURE DOES NOT PROVIDE ANY SAFETY FACTOR SUCH AS EQUIPMENT MALFUNCTION, DELAYS IN SEPARATING FROM THE SEAT; ETC. THE ABOVE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET.

NOTE

THE SOLID CURVES INDICATE MINIMUM TERRAIN CLEARANCE WITH NO PILOT REACTION TIME. THE DASHED CURVES INDICATE MINIMUM TERRAIN CLEARANCE WITH A 2 SECOND PILOT REACTION TIME.

15A–1–(98)B

Figure 3-8

LOW LEVEL IC-7 EJECTION SEAT PERFORMANCE

FLIGHT CONDITIONS	MINIMUM EJECTION ALTITUDE (FT)
ZERO SPEED, ZERO ALTITUDE - (CANOPY MUST BE CLOSED AND LOCKED OR COMPLETELY SEPARATED)	0
600 KNOTS - (BELOW 450 KNOTS RECOMMENDED TO REDUCE WINDBLAST)	0
120 KNOTS, 0° PITCH, 60° ROLL	0
150 KNOTS, 0° PITCH, 180° ROLL	460
150 KNOTS, 0° PITCH, 0° ROLL, 10,000 FPM SINK RATE	390

WARNING

THIS FIGURE DOES NOT PROVIDE ANY SAFETY FACTOR SUCH AS EQUIPMENT MALFUNCTION, DELAYS IN SEPARATING FROM THE SEAT ETC. THE ABOVE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET.

15A-1-(45)C

Figure 3-9

MINIMUM EJECTION ALTITUDE VS. SINK RATE

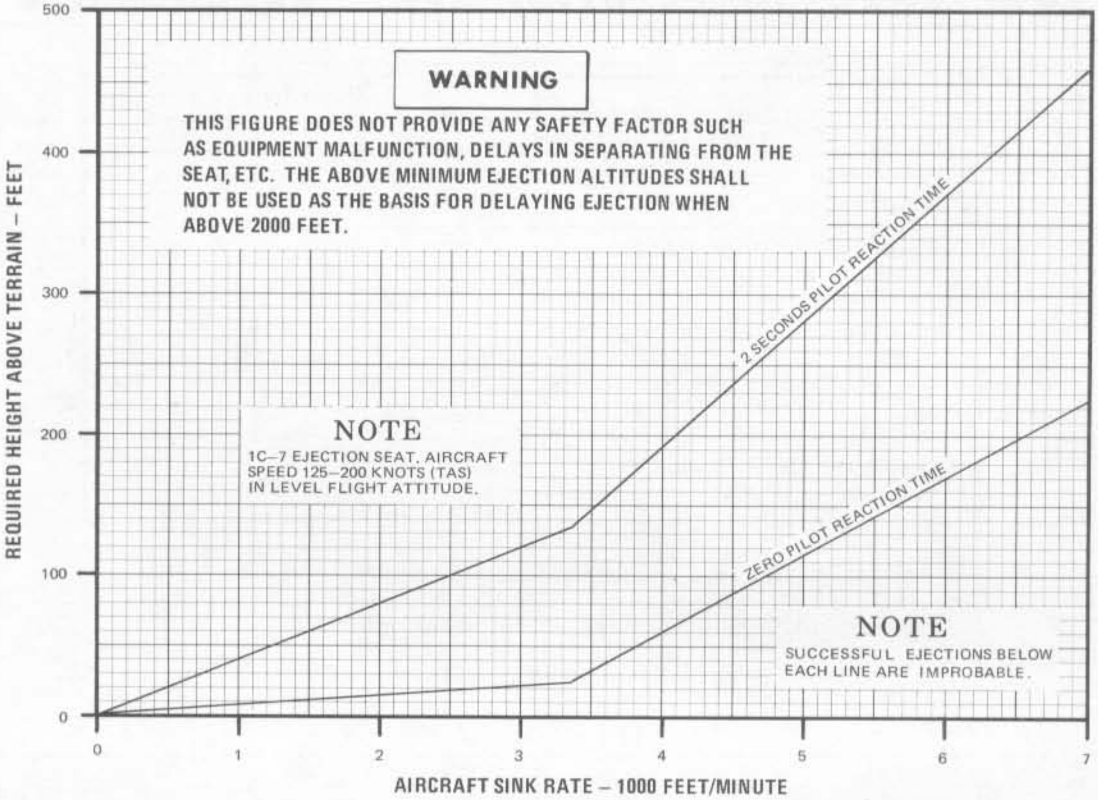


Figure 3–10

WARNING/CAUTION/INDICATOR LIGHTS

LIGHT	CAUSE	CORRECTIVE ACTION/REMARKS
FIRE OVERHEAT	EXCESSIVE TEMPERATURE IN INDICATED AREA	CARRY OUT EMERGENCY PROCEDURES
LANDING GEAR WARNING LIGHT	GEAR UP & AIRCRAFT IN LDNG REGIME OR GEAR NOT IN POSITION SELECTED	INFORMATION
WHEELS DN	GEAR DOWN AND LOCKED	INFORMATION
CANOPY UNLOCKED	CANOPY UNLOCKED OR CANOPY ACTUATED INITIATOR LANYARD DISCONNECTED	GROUND: RELOCK CANOPY OR CONNECT LANYARD AIR: COCKPIT PRESSURE - DUMP AIRSPEED - REDUCE TO 250 KNOTS CANOPY - LOCK
MASTER CAUTION	CAUTION CONDITION EXISTS	CHECK CAUTION LIGHT PANEL
REFUEL READY	AIRCRAFT READY FOR AERIAL REFUELING	INFORMATION
STARTER READY	JFS READY TO ENGAGE FOR START	INFORMATION
TAKEOFF TRIM	TAKEOFF TRIM SET	INFORMATION
AI	AIR INTERCEPT THREAT	INFORMATION
SAM	MISSILE THREAT	INFORMATION
BEACON	AIRCRAFT OVER MARKER BEACON	INFORMATION
CAUTION LIGHT PANEL		
SPD BK OUT	SPEED BRAKE OUT	INFORMATION*
RUDR LMTR	RUDDER LIMITER NOT SCHEDULING PROPERLY	AVOID USING LARGE RUDDER INPUTS
FUEL HOT	ENGINE FUEL INLET TEMP HIGH FUEL RECIRCULATING TO WINGS	DECREASE SPEED AND INCREASE FUEL FLOW AS FEASIBLE
TOT TEMP HI	CRITICAL INLET TEMP (3 MINUTE LIMIT)	REDUCE AIRSPEED
ATTITUDE	ADI UNRELIABLE	CHECK STBY ATTITUDE INDICATOR SELECT OPERABLE MODE *
L BST PUMP R BST PUMP	LEFT OR RIGHT BOOST PUMP FAILURE	EITHER LIGHT-AVOID AB OPERATION BELOW 30,000 FT BOTH LIGHTS - LIMIT POWER TO MIL
L INLET R INLET	LEFT OR RIGHT ENGINE INLET CONTROLLER FAILURE	THROTTLE-MIL IF ABOVE MACH 1.0 L OR R INLET RAMP SWITCH-EMERG REDUCE AIRSPEED BELOW MACH 1.0*
IFF MODE 4	IFF OFF OR MODE 4 ZEROIZED/INVALID RESPONSE	INFORMATION
AV BIT	AVIONICS BIT FAILURE	CHECK BIT PANEL
JFS LOW	JFS ACCUM PRESSURE LOW	EMER GEAR/BRAKE/STEER MAY BE INOP
L GEN OUT R GEN OUT	LEFT OR RIGHT GENERATOR FAILURE	REFER TO EMERGENCY PROCEDURES*
EMER GEN ON	EMERGENCY GENERATOR SUPPLYING POWER	INFORMATION *
HYDRAULIC	HYDRAULIC FAILURE	CHECK HYD GAGES AND BIT PANEL
OIL PRESS	OIL PRESS LOW	CHECK OIL PRESSURE GAGES*
INLET ICE	ICE BUILD UP IN LEFT INLET	ANTI-ICE ENG HEAT SWITCH - ON
PITCH RATIO	PITCH RATIO INCORRECT	PITCH RATIO SWITCH - EMERG *
ROLL RATIO	ROLL RATIO INCORRECT	ROLL RATIO SWITCH - EMERG *
ANTI-SKID	ANTI-SKID INOPERATIVE	SWITCH OFF IF FAILED

* ADDITIONAL INFORMATION AVAILABLE IN THIS SECTION

15A-1-(29-1)E

Figure 3-11 (Sheet 1 of 2)

WARNING/CAUTION/INDICATOR LIGHTS CONTINUED

LIGHT	CAUSE	CORRECTIVE ACTION/REMARKS
CAS YAW	CONTROL AUGMENTATION SYSTEM INOPERATIVE OR DISENGAGED IN MODE SHOWN	CAS YAW - RESET CAS ROLL-RESET
CAS ROLL		CAS ROLL - RESET
CAS PITCH		CAS PITCH - RESET
L BLEED AIR	LEFT OR RIGHT BLEED AIR LEAK OR OVERTEMP	SELECT OPPOSITE SOURCE *
R BLEED AIR		
WNDSHLD HOT	ANTI-ICE AIR HOT	WINDSHIELD ANTI-ICE SWITCH - OFF
FUEL LOW	FEED TANK FUEL LOW	USE MINIMUM POWER CHECK ALL TANKS
BINGO FUEL	FUEL AT PRESET AMOUNT	INFORMATION
OXY LOW	2 LITERS OXYGEN REMAINING (F) 4 LITERS OXYGEN REMAINING (TF)	INFORMATION
ECS	ECS LOW FLOW OR HIGH TEMP	CARRY OUT PROCEDURES *
HOOK	HOOK UNLOCKED	SLOW & CYCLE HOOK
BIT PANEL		
L PMP	RIGHT OR LEFT UTILITY PUMP PRESSURE LOW	REFER TO HYDRAULIC FLOW DIAGRAM FOR SYSTEMS AFFECTED IF UTL A FAILURE- 1. FOLLOW EMERG LDG GEAR EXTENSION PROCEDURE 2. EMERG BK/STEER HANGLE - PULL WHEN NEEDED AFTER LANDING (ANTI-SKID NOT AVAILABLE) IF UTL A & PC2A FAILURE- 1. SLOW TO SUBSONIC 2. CONDUCT CONTROLABILITY CHECK AS REQUIRED 3. FOLLOW EMERG LDG GEAR EXTENSION PROCEDURE 4. EMERG BK/STEER HANDLE-PULL WHEN NEEDED AFTER LANDING (ANTI-SKID NOT AVAILABLE)
R PMP		
UTL A	DESIGNATED RLS VALVE HAS ACTUATED TO SHUT OFF SUBSYSTEM	
UTL B		
PCI A		
PCI B		
PC2 A		
PC2 B		
ANY BIT LIGHT	DESIGNATED SYSTEM HAS FAILED BIT	RESET OR PERFORM ACTIVE BIT (REFER TO SECTION I FOR SYSTEM OPERATION)

15A-1-(29-2)E

Figure 3-11 (Sheet 2 of 2)

SECTION IV
CREW DUTIES

NOT APPLICABLE

SECTION V
OPERATING LIMITATIONS

TABLE OF CONTENTS

GENERAL

All aircraft/system limitations that must be observed during normal operation are covered herein. Some limitations that are characteristic only of a special phase of operation (emergency procedures, flight through turbulent air, etc.) are not covered here; however, they are contained along with the discussion of the operation in question.

NOTE

All references to airspeed quoted in knots refer to calibrated airspeed.

CREW REQUIREMENTS

The minimum crew for safe flight in the TF aircraft is one.

INSTRUMENT MARKINGS

Instrument markings are shown in figure 5-1.

ENGINE LIMITATIONS

Refer to figure 5-2.

ENGINE G LIMITATIONS

Engine air inlet controller emergency operation is limited to +3.0 to −1.0G above 0.95 Mach.

ALTERNATE FUEL

The engines will be operated on JP-4 only until limitations are established for alternate fuels.

SYSTEM RESTRICTIONS

JFS LIMITATIONS

JFS limitations are shown on figure 5-6.

BRAKES

Maximum braking is prohibited without nosewheel on the runway.

NEGATIVE G FUEL FEED

During negative G flight, the fuel feed system will supply engine requirements for a limited time. This time is dependent on engine fuel flow, refer to figure 5-3.

NEGATIVE G TIME LIMIT

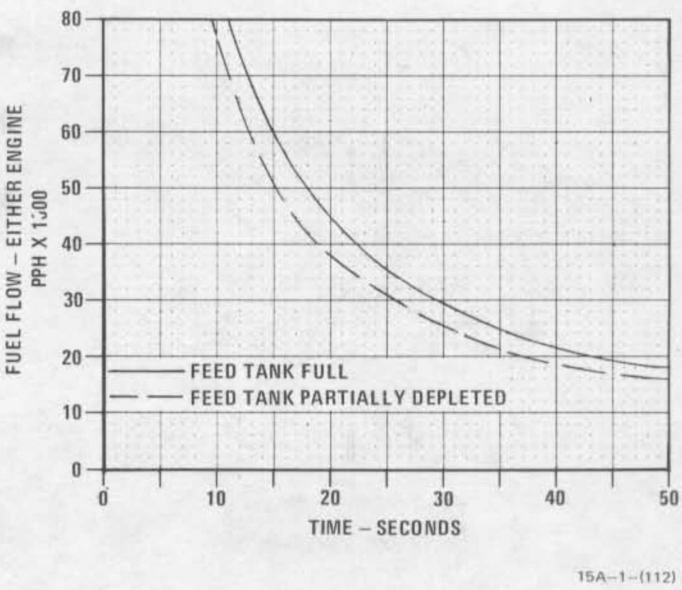
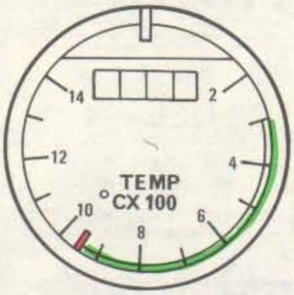


Figure 5-3

INSTRUMENT MARKINGS

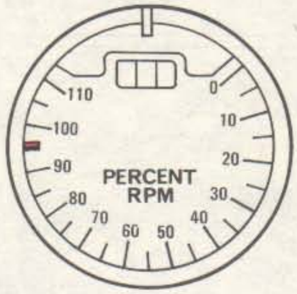
BASED ON JP-4 FUEL



960° MAXIMUM STEADY STATE

300° – 960° CONTINUOUS OPERATION

FTIT TEMPERATURE

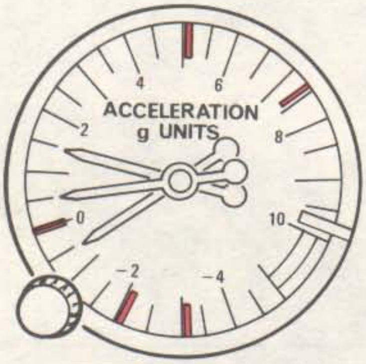


96% RPM MAXIMUM STEADY STATE

TACHOMETER

+7.3G		MAXIMUM POSITIVE LOAD FACTOR AT 37,400 POUNDS OR BELOW.
+5.1G		MAXIMUM POSITIVE LOAD FACTOR AT 53,300 POUNDS.
ZERO G		ZERO G EXCEPT TRANSENT PROHIBITED.
–2.0 G		MAXIMUM NEGATIVE LOAD WITH TANKS OR AIR–TO–GROUND STORES.
–3.0 G		MAXIMUM NEGATIVE LOAD FACTOR AT 37,400 POUNDS OR BELOW WITHOUT TANKS OR AIR–TO–GROUND STORES.

REFER TO ACCELERATION LIMITATIONS FOR ADDITIONAL RESTRICTIONS.



ACCELEROMETER

NOTE

THE ACCELEROMETER INDICATES UP TO 1G LOW WHEN PULL IN RATES ARE HIGH (1 G /SEC OR MORE). THE G INDICATIONS ON THE HUD ARE ACCURATE.

15A–1–(109–1)B

Figure 5–1 (Sheet 1 of 2)

20 PSI – MINIMUM

85 PSI – MAXIMUM

20 – 85 – NORMAL

NOTES

- ENGINE OIL PRESSURE VARIES IN PROPORTION TO ENGINE RPM AND ENGINE INLET OIL TEMPERATURE.
- OIL PRESSURE FLUCTUATIONS OF ± 10 PSI ARE ACCEPTABLE.
- ZERO OIL PRESSURE DURING START AND INITIAL OPERATION FOR 1 MINUTE IS ACCEPTABLE.
- MAXIMUM OIL PRESSURE DURING STARTS AND INITIAL OPERATION MAY EXCEED 100 PSI FOR A PERIOD NOT EXCEEDING 1 MINUTE AFTER REACHING IDLE.
- DO NOT EXCEED 1 MINUTE DURING NEGATIVE G OPERATION. DURING NEGATIVE G OPERATION, THE OIL PRESSURE MAY DROP AS LOW AS 0 PSI.

OIL PRESSURE

* 2750 – 3250 PSI – NORMAL

2000 – 2750 NORMAL WITH RAPID CONTROL MOVEMENT

3250 – 3400 IF PRESSURE EXCEEDS 3250 STEADY STATE, AN ENTRY MUST BE LOGGED ON FORM 781.

3400 MAXIMUM

* PRESSURE WITH NO DEMAND ON SYSTEM.

HYDRAULIC PRESSURE

15A–1–(109–2)B
RGY

Figure 5–1 (Sheet 2 of 2)

ENGINE LIMITATIONS

GROUND

CONDITION	FTIT °C	RPM %	OIL PSI	REMARKS
START	680	–	NOTE 1	
IDLE	–	–	20–85	
MILITARY/AB	960	96	20–85	NOTE 3
TRANSIENT	970	96	20–85	
FLUCTUATION	±10	±1	±10	NOTES 5, 6, & 7

FLIGHT

CONDITION	FTIT °C	RPM %	OIL PSI	REMARKS
AIRSTART	800	–	–	NOTE 8
IDLE	–	–	20–85	
MILITARY/AB	960	96	20–85	NOTES 2, 3, & 4
TRANSIENT	970	96	20–85	
FLUCTUATION	±10	±1	±10	NOTES 5, 6, & 7

NOTES

1. ZERO OIL PRESSURE AND/OR OIL PRESSURE OVER 100 PSI IS ACCEPTABLE FOR A PERIOD NOT EXCEEDING 1 MINUTE AFTER REACHING IDLE.
2. DURING NEGATIVE G OPERATION, THE OIL PRESSURE MAY DROP AS LOW AS 0 PSI.
3. THE ENGINE MAY BE OPERATED CONTINUOUSLY IN AFTERBURNER FOR A MAXIMUM OF 15 MINUTES OR IN MILITARY FOR A MAXIMUM OF 30 MINUTES.
4. USE OF THE Vmax SWITCH IS PROHIBITED.
5. INDICATIONS SHOULD NOT EXCEED LIMITS DUE TO FLUCTUATION.
6. IN PHASE FLUCTUATION OF MORE THAN ONE INSTRUMENT, OR SHORT TERM CYCLIC FLUCTUATIONS (1–2Hz) ACCOMPANIED BY THRUST SURGES, ARE NOT PERMITTED AND INDICATE ENGINE CONTROL PROBLEMS.
7. NOZZLE FLUCTUATIONS ARE LIMITED TO ±2% AT MILITARY POWER AND ABOVE. FLUCTUATIONS ARE NOT PERMITTED BELOW MILITARY POWER.
8. ONE ENGINE IS NOT TEMPERATURE LIMITED DURING DOUBLE ENGINE STAGNATION. REFER TO DOUBLE ENGINE STAGNATION PROCEDURE, SECTION III.

15A–1–(119)B

Figure 5–2

AIR REFUELING

a. Air refueling with external wing tanks installed is prohibited.
b. With centerline tank and any wing store installed, air refueling with CAS inoperative is prohibited.

EXTERNAL FUEL TRANSFER

Placing the external tank fuel control switch(es) to STOP TRANS is prohibited except in an emergency to prevent excessive loss of fuel. Refer to External Tank Fails To Transfer procedure, section III.

Placing the external tank fuel control switch(es) to STOP REFUEL is prohibited unless all external tanks are empty and STOP REFUEL is selected prior to start of refuel flow.

FUEL REMAINING

Flight with total feed tank fuel below 900 pounds is prohibited.

AIRSPEED LIMITATIONS

Maximum and minimum airspeeds are shown in figure 5-5. Additional limitations may be imposed by external stores, refer to figure 5-8. Limiting airspeed for operation of various aircraft systems are shown in figure 5-6.

PROHIBITED MANEUVERS

a. AOA in excess of 30 units.
b. Stalls
c. Spins
d. Zero G flight, except transient, is prohibited.
e. Flight above 25 units AOA with the speedbrake extended any amount.
f. Full lateral stick rolls in excess of 360°.
g. Full lateral stick rolls in excess of 180° at less than +1.0 G or greater than +3.0 G.

NOTE

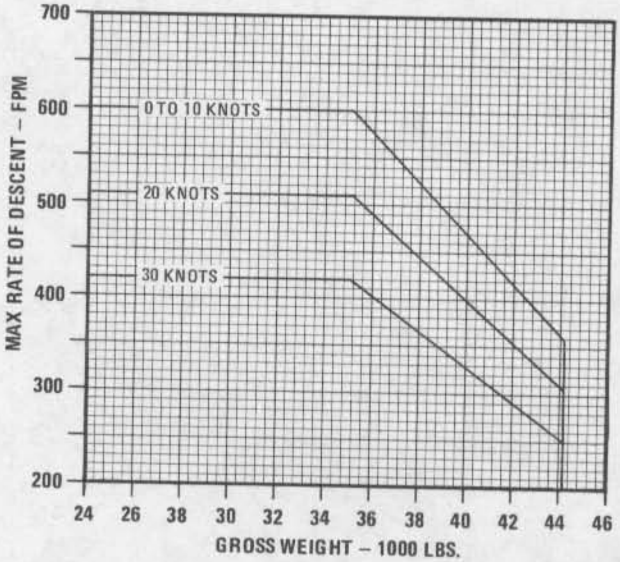
Mild to moderate rolls with CAS on at speeds below 550 knots or Mach 1.4, whichever is less, are not limited by bank angle change or initial load factor provided that unsymmetrical load factor limits are not exceeded. Longitudinal control coordination may be required to prevent load factor excursions outside the unsymmetrical load factor limits during the roll.

h. Rolls in excess of 360° under any of the following conditions:
   1. External wing tanks and/or air-to-ground stores installed.
   2. Airspeed above 550 knots or Mach 1.4, whichever is less.
   3. Any CAS axis disengaged.
i. Roll in excess of 180° at other than +1.0 G under any of the following conditions:
   1. External wing tanks and/or air-to-ground stores installed.
   2. Airspeed above 550 knots or Mach 1.4, whichever is less.
j. Roll rate greater than 120°/sec with full or partially full external tanks or air-to-ground stores.
k. Rolls in excess of 90° with gear down.
l. Rolls at more than 20 units AOA, below Mach 1.0 with PITCH RATIO or ROLL RATIO light ON.
m. Rolls with roll CAS on, above 475 knots below 12,000 feet, with abrupt lateral stick deflection. Such rolls shall be performed with smooth lateral stick deflections. Close formation flight in this speed/altitude region is not recommended.
n. More than 1/2 lateral stick deflection is prohibited with more than 25 units AOA with gear down.

TOUCHDOWN LIMITATIONS

Touchdown limitations are based on gross weight, sink rate, and crosswind. Refer to figure 5-4.

TOUCHDOWN LIMITS



VALUES SUPERIMPOSED ON THE CURVES ARE THE 90° CROSSWIND COMPONENT.

ABOVE 10 KNOTS INTERPOLATE LINEARLY BETWEEN VALUES.

LANDINGS ARE NOT RECOMMENDED ABOVE 30 KNOTS 90° CROSSWIND COMPONENT DUE TO SIDE LOADS IMPOSED ON THE LANDING GEAR.

15A-1-(115)A

Figure 5-4

GROSS WEIGHT LIMITATIONS

The maximum allowable gross weights are:

a. 53,300 pounds for takeoff.
b. 44,300 pounds for landing.

CENTER OF GRAVITY LIMITATIONS

The forward CG limit is 22.0% MAC without wing stores and 23.0% MAC with wing stores. The aft CG limit is 29.9% MAC without wing stores and 29.0% MAC with wing stores.

AIRPLANE SPEED RESTRICTIONS

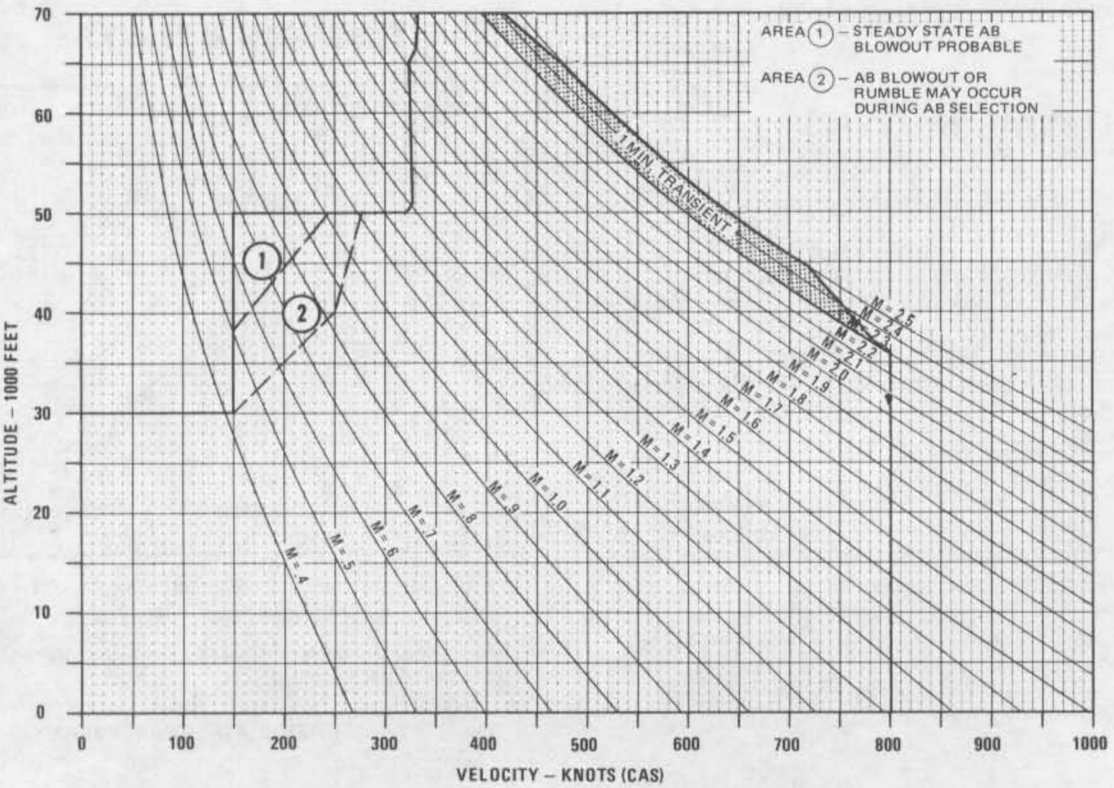


Figure 5-5

ACCELERATION LIMITATIONS

The maximum accelerations presently permitted for flight in smooth or moderately turbulent air are as shown in figure 5-7. Separate plots are provided for symmetrical maneuvers (maneuvers under G loading other than 1G without any roll rate) and unsymmetrical maneuvers (maneuvers under G loading other than 1G with an accompanying roll rate such as rolling pullouts, etc.).

EXTERNAL STORES LIMITATIONS

Only the external stores configurations shown in the External Stores Limitation chart (figure 5-8) and those configurations derived during the normal release sequence from a depicted configuration may be loaded and carried. Stores may be released singly or in combination unless otherwise noted on the chart. This chart indicates store-to-airframe structural and flight handling characteristic compatibility only; electro-magnetic radiation compatibility is indicated in the applicable equipment technical order when not stated in the Remarks column.

CAUTION

If centerline or inboard release is required with the landing gear down, damage may occur to the aircraft.

NOTE

When alternate limitations exist, these limitations are shown within a boxed area. Such alternate limitations usually provide for a different G versus airspeed limit. Limitations within the boxed area apply to all the configurations to which the primary limitations apply.

SYSTEMS LIMITATIONS

WEIGHTS

MAXIMUM TAKEOFF	53,300 lb.
MAXIMUM LANDING (REFER TO TOUCHDOWN LIMITS)	44,300 lb.

AIRSPEEDS

LANDING GEAR EXTENSION, RETRACTION OR FLIGHT WITH GEAR EXTENDED	Maximum: 300 Kts + 1.25 load factor (clean or missiles only) Normal: 250 Kts + 2.0 load factor (any configuration) Maintain Minimum Sideslip
FLAPS (EXTENSION)	250 Kts (+3.00 load factor)
CANOPY OPEN (INCLUDING WIND)	60 Kts

SYSTEMS

JET FUEL STARTER (JFS)

JFS start below -35°F ambient is prohibited.

Maximum 10 seconds between JFS start initiation and READY light.

Starter engagement time shall not exceed 90 seconds except, if a hot start occurs, the time may be extended to 150 seconds.

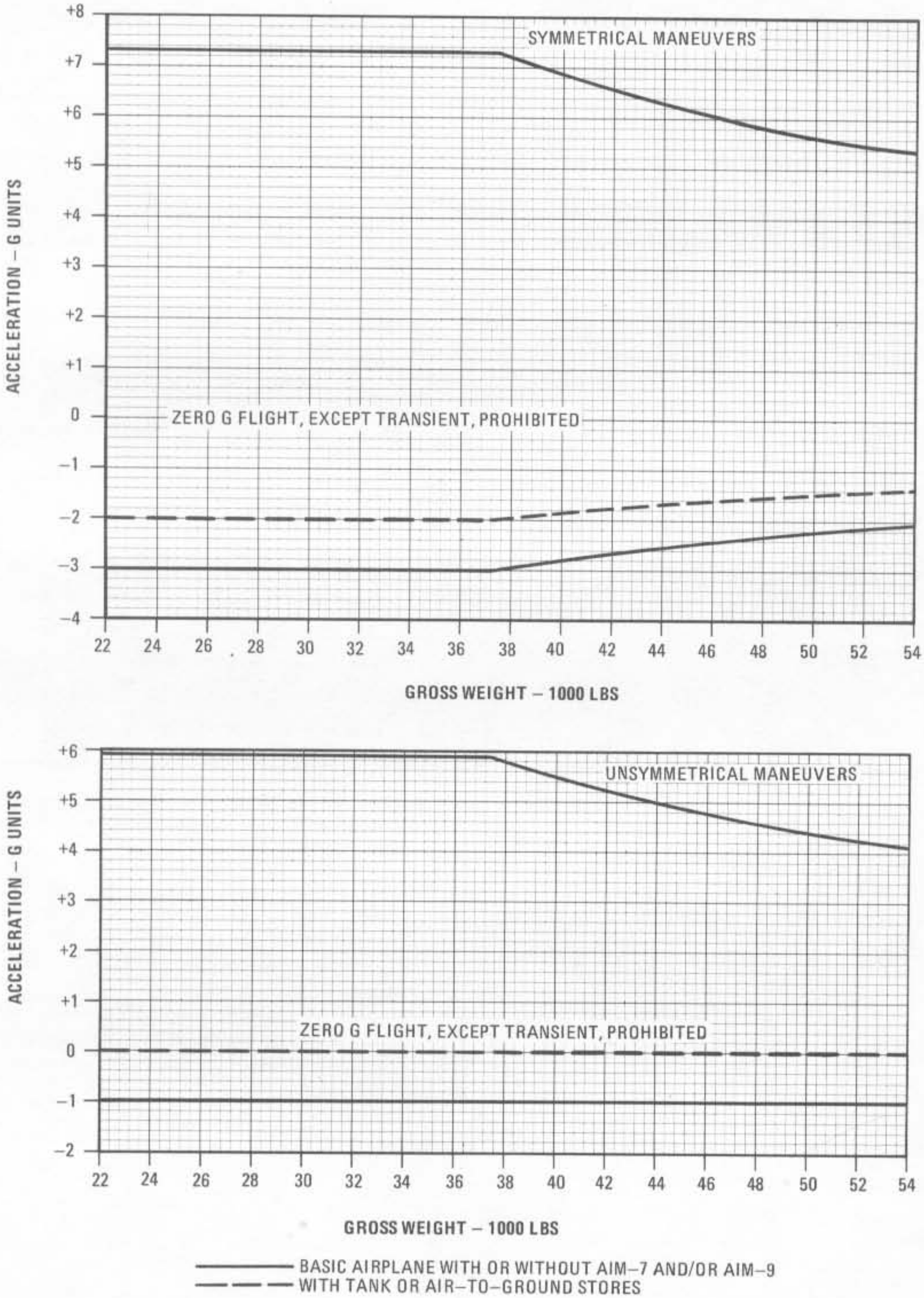
Minimum 10 seconds between first engine at idle speed and engagement for second engine start. If the engine engagement time exceeds 90 seconds, wait 20 seconds before again engaging the JFS.

The JFS is limited to no more than 3 engagements within 30 minutes followed by 30 minutes cool down.

15A-1-(110)A

Figure 5-6

ACCELERATION LIMITATIONS



NOTE

SEE AIRPLANE SPEED RESTRICTIONS AND EXTERNAL STORES LIMITATIONS FOR ADDITIONAL ACCELERATION LIMITATIONS

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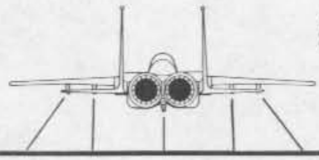
Figure 5–7



EXTERNAL STORES LIMITATIONS

WEIGHTS INCLUDE SUSPENSION EQUIPMENT

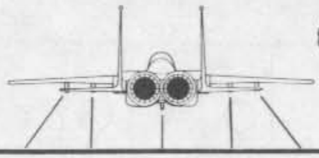
NA – NOT APPLICABLE
NE – NOT ESTABLISHED
BAL – BASIC AIRCRAFT LIMITS

STORE	LINE NUMBER	STATION LOADING AND SUSPENSION					MAXIMUM KCAS OR IMN WHICHEVER IS LESS			ACCELERATION–G				MAX DIVE FOR DEL	AFT CG LIMIT– % MAC	STORES CONFIGURATION WEIGHT LBS	TOTAL DRAG INDEX	REMARKS
										CARRIAGE								
		1	2	5	8	9	CARRIAGE	EMPLOY–MENT	JETTISON	SYM	UNSYM	EMPLOY–MENT	JETTISON					
600 Gallon Fuel Tank	1		○	○	○		1.0	NA	150 to 1.0	BAL	BAL	NA	+0.5 to +2.0	NA	29.0	EMPTY 1916 FULL 13,811	29.2	✱ Jettison of SUU–20B/A Dispenser permitted only with pylon attached. ✱✱ –2.0G above Mach 1.0
	2		○		○										29.0	EMPTY 1310 FULL 9240	20.8	
	3			○											29.9	EMPTY 606 FULL 4571	8.4	
℄ Pylon	4			I			BAL	NA	150 to 700 1.4	BAL	BAL	NA	+0.5 to +2.0	NA	29.9	286	1.8	
Inboard Pylon	5		I		I		BAL	NA	150 to 1.0	BAL	BAL	NA	+0.5 to +2.0	NA	29.0	670	5.0	
SUU–20B/A Dispenser	6		●	●	●		700 2.0	250 to 520 1.0	150 to 1.0 ✱	BAL ✱✱	BAL	0.0 to +5.86	+0.5 to +2.0 ✱	60°	29.0	E1789 F2210	E20.0 F17.9	
	7		●		●										29.0	E1222 F1506	E13.8 F12.4	
	8			●											29.9	E562 F704	E6.2 F5.5	
600 Gallon Fuel Tank and SUU–20B/A Dispenser	9		●	○	●		1.0	250 to 520 1.0	150 to 1.0 ✱	BAL ✱✱	BAL	0.0 to +5.86	+0.5 to +2.0 ✱	NA Tanks 60° SUU–20B/A	29.0	EMPTY 1828 FULL 6077	E22.2 F20.8	
	10		○	●	○											EMPTY 1872 FULL 9944	E27.0 F26.3	

15A-1-(117-1)B

Figure 5-8 (Sheet 1 of 2)

EXTERNAL STORES LIMITATIONS



WEIGHTS INCLUDE SUSPENSION EQUIPMENT

NA – NOT APPLICABLE
NE – NOT ESTABLISHED
BAL – BASIC AIRCRAFT LIMITS

STORE	LINE NUMBER	STATION LOADING AND SUSPENSION					MAXIMUM KCAS OR IMN WHICHEVER IS LESS			ACCELERATION–G				MAX DIVE FOR DEL	AFT CG LIMIT– % MAC	STORES CONFIGURATION WEIGHT LBS	TOTAL DRAG INDEX	REMARKS
										CARRIAGE								
		1	2	5	8	9	CARRIAGE	EMPLOY–MENT	JETTISON	SYM	UNSYM	EMPLOY–MENT	JETTISON					
AIM–9E Missile	1		● ●		● ●		450 * **	150 to 450 *	150 to 450 1.0	BAL	BAL	–0.5 to +7.33	+0.5 to +3.0	NA	29.0	1318	22.2	● Subtract 670 pounds from stores configuration and 5.0 from total drag index if AIM–9 missiles are loaded with other inboard pylon mounted stores. * Speeds may be further limited by warheads. See figure 5–9. ** BAL with wings removed.
AIM–7F Missile	2	MISSILE STATIONS					BAL	150 to 800 2.3	150 to 1.0	BAL	BAL	–0.5 to +7.33	+0.5 to +3.0	NA	29.9	2040	8.8	● Employment not permitted when tanks or AG weapons are carried on stations 2 & 8. ● Jettisoning of missiles permitted only between 250–350 knots, IG when tanks or AG weapons are carried on stations 2 & 8. ● Carriage of the AIM-7F LCDM is authorized to the same limits as identified above for live missiles providing the LCDM inspection has been accomplished in accordance with SPO directive dated 18 September 1974. ● Carriage of DUMMY TRAINING missiles is prohibited.
			3	4	6	7												
		FWD	●			●												
		AFT		●	●													

NOTES

- Speeds may be further limited by applicable aircraft/engine airspeed envelope.
- AIM–9E and AIM–7F missiles may be carried in conjunction with any combination of stores loading on stations 2, 5 and 8 currently identified in Section 5, T.O.1F–15A–1.

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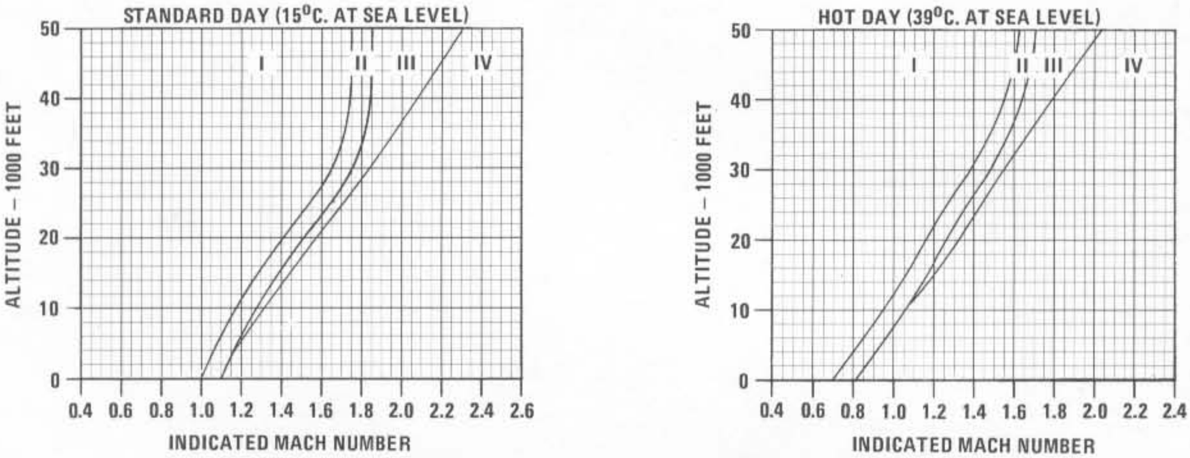
Figure 5-8 (Sheet 2 of 2)

AIM-9E 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.

15A–1–(116)

Figure 5-9

SECTION VI
FLIGHT CHARACTERISTICS

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GENERAL

Any discussion of flight characteristics must include a description of the flight control system since its operation modifies the inherent handling qualities of the aircraft. The pilot must understand the way that loss of various portions of the system will affect the handling qualities. The aircraft was designed for maximum performance and compromises were made to achieve this performance. The flight control system was designed to negate the undesirable effects of these compromises and provide superior handling qualities and maneuverability. While the aircraft is controllable in conservative flight and landing without the aid of various portions of the system, handling qualities will be degraded.

The aircraft has a hydro–mechanical control system with conventional ailerons and twin rudders. A differential stabilator provides both pitch control and, in addition to the ailerons, roll control. The relationship between stick force and/or position versus control surface movement is modified by the Control Stick Boost And Pitch Compensator (CSBPC). Superimposed on this hydro–mechanical system is an electrical, dual channel, high authority, three axis Control Augmentation System (CAS) utilized to shape aircraft response to pilot inputs while providing three axis stability augmentation and autopilot functions. Since CAS electrical inputs are applied directly at the actuator, the aircraft is fully controllable with the loss of any or all mechanical linkages with CAS on. In fact, the pilot will not necessarily be aware of loss of mechanical linkages since, with CAS on, control surfaces are positioned by the CAS electrical inputs rather than by the mechanical linkage inputs.

CONTROL STICK BOOST AND PITCH COMPENSATOR (CSBPC)

The CSBPC contains the Pitch Ratio Adjust Device (PRAD), the Pitch Trim Compensator (PTC), Roll Ratio Adjust Device (RRAD) and the Aileron–Rudder Interconnect (ARI).

PRAD

The PRAD adjusts the amount of collective (pitch) stabilator deflection available for a given longitudinal stick displacement. The ratio of stick displacement to stabilator travel is adjusted to produce an essentially constant ratio of stick displacement per G throughout the flight envelope. Since feel is provided by a spring cartridge, this system provides a relatively constant stick force per G (approximately 4¼ pounds/G) throughout the flight envelope, although the dual gradient spring tends to reduce this at high G levels. The PRAD is scheduled by Mach number and altitude.

PTC

An aircraft can be disturbed in pitch trim in a number of ways such as speed changes, flap extension or retraction, speed brake extension or retraction, etc. The PTC is designed to relieve the pilot of the necessity for retrimming to compensate for such changes. The PTC is an automatic series trim which senses the pilot is beginning to compensate for a change in trim and automatically trims to remove that compensating force. As previously discussed the PRAD operates to maintain a constant stick displacement per G. If the stick displacement changes and the aircraft is not responding with the correct G, the PTC will move the stabilator to maintain the G schedule. Since the PTC is a series trim which moves the stabilator, stick position will not change perceptibly and the pilot will sense the change as a removal of the excess force required to maintain G. Since the schedule is 0 pounds for 1G, the result is that there is little requirement for the pilot to retrim with changes in airspeeds or configuration. The trim button on the stick puts a bias on the system which is not trimmed out by the PTC. In other words it biases the stick force per G by a given amount of either aft or forward stick force.

RRAD

The RRAD adjusts the amount of differential (roll) stabilator and aileron deflection available for a given lateral stick displacement. The ratio of stick displacement to control surfaces deflection is adjusted to produce an essentially constant ratio of stick displacement versus initial roll rate (through 90°) throughout the flight envelope. Since feel is provided by a spring cartridge, this provides a relatively constant stick force versus initial roll rate throughout the flight envelope; however, maximum roll rates vary significantly with Mach and altitude. Roll trim operates the same as pitch trim and provides an out–of–balance force for zero roll rate which may be used to compensate for an asymmetric condition. Above Mach 1.0, the RRAD reduces the lateral authority by about 30% in order to reduce supersonic roll rates.

ARI

In the subsonic regime the aircraft has strong positive dihedral effect (roll in the direction of yaw) and considerable adverse yaw (yaw opposite to roll) at aft stick positions and proverse yaw (yaw in the same direction as roll) at forward stick positions. The ARI operates to cancel undesirable yaw. Since the effects occur primarily at subsonic speeds, the ARI is cut out above Mach 1. The combination of positive dihedral effect and adverse yaw would cause the aircraft, at higher angles of attack, to yaw right with left stick while the dihedral effect from this yaw could prevent the aircraft from developing roll in response to pilot input. At low angles of attack, the aircraft would yaw with the roll and the dihedral effect would then cause an increase in the roll rate. The ARI is scheduled to cancel these effects and provide normal response to control inputs; i.e., lateral stick produces roll in the direction of displacement and rudder deflection produces yaw in the direction of displacement. The ARI also utilizes the PRAD to decrease the roll control surface deflections at aft or forward stick positions (remember that stick position determines G and therefore affects AOA) and to produce rudder in the direction of roll at aft stick positions or rudder opposite to roll at forward stick positions. Since the normal ARI response would tend to reduce the roll rates available plus other undesirable effects in crosswind landings, the ARI is altered for the landing configuration. Upon gear extension, the reduction in roll control deflection with aft or forward stick is eliminated but the rudder deflection is maintained. On touchdown, the ARI is disengaged as a result of wheel spin-up, eliminating rudder deflection with lateral stick displacement. This prevents rudder into the wind from being applied as lateral stick is used to counteract a rising wing during crosswind landings. The ARI is reengaged below approximately 50 knots to allow for ground checks of the ARI.

CONTROL AUGMENTATION SYSTEM (CAS)

The CAS utilizes series authority in all three axes. This simply means that the control surface actuators contain an electrically controlled input which can move the control surface without pilot control stick motion. Although the CAS cannot move the actuators full stroke, the authority is sufficient to produce structural failure or an out-of-control situation if a hardover failure occurs. Since the pilots reaction time is too slow to prevent possible catastrophe with such a failure, the CAS operates through redundant dual channels which are constantly compared to each other. If the two channels are not identical, both channels for that axis are automatically disengaged.

Pitch Channel

The pitch CAS channel detects pilot longitudinal stick force and converts this into an electrical pitch command at approximately 3¾ pound per G. Thus the pilot will sense slightly lower pitch control forces with pitch CAS engaged. As the CAS attempts to maintain a specific G for a specific stick force, it functions as a stability augmentation device which damps out undemanded accelerations. The pitch CAS incorporates a wash out with AOA so that the servo will not operate to the limit of its authority at high AOA. By reducing pitch CAS authority at high AOA, the feel is the same with CAS on or off; i.e., the nose gets heavy at the same speed.

Roll Channel

The roll channel operates only through the differential stabilator. There is no CAS on the ailerons. The roll channel operates similarly to the pitch channel to control roll rate with lateral stick force. The maximum CAS roll rate command is reduced above Mach 1.5.

Yaw Channel

The yaw channel provides yaw damping, CAS ARI and turn coordination. The CAS ARI has the same function as the CSBPC ARI except that it is scheduled as a function of AOA and roll rate rather than stick longitudinal displacement. It operates both subsonically and supersonically to keep the lateral acceleration as near zero as possible thus providing turn coordination with roll as well as eliminating dihedral effect and adverse or proverse yaw.

ANGLE OF ATTACK

Angle of Attack (AOA) is defined as the angle formed by the chord line of the wing and the aircraft flight path (relative wind). AOA in arbitrary units is displayed on the AOA indicator and, with the gear down, on the HUD. The true AOA is displayed on the HUD at all times as the angle between the aircraft symbol and the velocity vector. The relationship between true AOA in degrees and units AOA displayed on the indicator and HUD varies non-linearly with Mach number. At Mach 0.2, 19 units is approximately 10°. At Mach 0.85, 8 units is approximately ½°.

HANDLING QUALITIES

NOTE

The discussion of handling qualities assumes that both the CSBPC and CAS are operating normally unless otherwise noted.

Handling qualities are essentially the same throughout the flight envelope with the CSBPC and CAS operating. With CAS disengaged only minor differences can be noted, primarily, in damping. With the CSBPC failed, handling qualities are severely degraded but the aircraft may be flown subsonically in conservative flight. If the CSBPC fails, a controllability check should be performed. Refer to section III.

TAKEOFF

CAS On

Normal takeoff characteristics with CAS on are contained in section II.

CAS Off

The aircraft is slightly more sensitive in pitch and has slightly less directional damping. No special techniques are required except that more attention should be given to smooth control inputs.

MANEUVERING

Control effectiveness is excellent and roll capability is quite high. Coordinated turns can be made without use of rudder at high AOA.

Symmetrical Maneuvers (CAS On)

Symmetrical maneuvering throughout the flight envelope results in positive stick forces at all angles of attack. G and angle of attack capture are easily accomplished, and stick forces remain relatively constant. Stick deflection to obtain high load factors increases slightly at high altitude, high supersonic speeds, but is not distracting.

Symmetrical Maneuvers (CAS Off)

CAS Off reduces pitch, roll, and yaw damping; and in most instances, this simply results in a higher pilot workload. However, above Mach 2.0 and above 40,000 feet, the aircraft pitch damping and frequency combination produce a rather sensitive pitch channel. In addition, stick force and stick deflection per G will be substantially higher in those areas where the pitch trim compensator reaches its limit; i.e., at high load factors and/or supersonic speeds.

Roll Maneuvers (CAS On)

Available roll rates vary across the Mach/altitude range of the aircraft with supersonic low altitude producing lower roll rates. In addition, roll rates during rolling pull–outs will decrease slightly. Subsonic roll performance is conventional even at high angles of attack, with lateral stick being used for roll control. During supersonic rolls, some noticeable amount of lateral acceleration is present. Lateral stick forces are light, and initial roll acceleration is quite high, particularly during subsonic low altitude–high speed flight. This somewhat abrupt lateral response may cause a small measure of over control upon initial exposure; however, the motion is well damped and pilot adaptation is rapid.

Roll Maneuvers (CAS Off)

Rolling maneuvers will generally produce an increase in undamped motion during maneuvers, particularly upon maneuver termination. Roll rates are still quite high, and follow the same general variation as CAS On. The mechanical ARI continues to produce the proper response for conventional roll inputs at elevated angles of attack.

LANDING

CAS On

Normal landing characteristics with CAS on are contained in section II.

CAS Off

Pilot workload is higher due to lack of damping but normal on–speed approaches do not produce adverse control problems.

EFFECT OF EXTERNAL STORES

Except for the centerline fuel tank, external stores reduce the static margin. With CAS on, this has little noticeable effect. With CAS off, there will be an increase in pitch sensitivity and excursions in pitch will occur with power changes and speedbrake operation. Inertial effects will affect the roll response requiring more time to attain or stop a given roll rate, particularly at high AOA.

FLIGHT WITH ASYMMETRIC LOADING

Takeoff

Takeoff with an asymmetric load equivalent to one full external wing tank can be made in crosswinds up to 15 knots. The aircraft should be trimmed laterally away from the heavy wing. A strong turning moment into the heavy wing will exist during the takeoff roll and will increase during rapid accelerations. Nose gear steering and rudder should be used for directional control. Avoid an abrupt lift–off. Establish the takeoff attitude slowly and allow the aircraft to fly off.

Maneuvering

There will be a rapid build–up of asymmetric forces during maneuvering. Roll tendency increases with load factor and control of roll decreases with decreased airspeed. Loss of control can occur at AOA well below buffet onset and stall. Control can be regained only by reducing AOA. Smooth control inputs must be used. Rapid inputs will cause abrupt rolloffs at high AOA.

Landing

Landing with an asymmetric load equivalent to one full external wing tank can be made in up to 15 knots crosswind. To determine approach AOA, establish the landing configuration and slow to the speed at which full aileron trim will hold the wings level. Check the roll capability by applying aileron to pick up the heavy wing. A straight in pattern avoiding abrupt or accelerated maneuvers should be flown. The approach AOA should be maintained to touchdown. An abrupt flare will cause a strong roll into the heavy wing.

Go – Around

Advance power to military and smoothly raise the nose to the desired attitude. Avoid abrupt stick movement. When a rate of climb is established, retract the gear. Delay flap retraction until a comfortable airspeed is attained. Rudder and afterburner may be required to maintain wings level flight.

FLIGHT WITH FAILED CONTROL STICK BOOST AND PITCH COMPENSATOR (CSBPC)

With a failed CSBPC, the PRAD and RRAD will go to the emergency (medium authority) position. While it is possible that the PRAD and RRAD can fail to the emergency position without affecting the CAS, the following discussion is based on the worst case with the PRAD, RRAD and PTC failed to the emergency condition and the CAS off. Since control boost and CAS are both off, control forces are considerably higher than normal.

High Altitude

Up to 0.9 Mach there is less than normal stabilator authority so that the stick position is further aft and the aircraft response is reduced, particularly in pitch. Control displacements produce some overcontrol and sluggish response although the aircraft does have positive damping. At speeds above 0.9 Mach the stick position is even further aft.

Low Altitude

Below 350 knots, the aircraft has less than normal stabilator authority and feels sluggish and undamped in pitch. Above 0.9 Mach the aircraft becomes more stable in pitch, less stable in yaw and roll rates decrease as airspeed is increased. Stick position is far forward and nose down capability is limited.

STALLS

A stall is defined as the maximum AOA that can be attained with full aft stick.

1 G STALLS

The 1 G stall is characterized by light buffet commencing at 20 units AOA. The buffet increases in intensity up to about 23 units then decreases in intensity as AOA is further increased. Only minor lateral or directional oscillations occur. With the stick on the aft stop, any lateral and/or directional control inputs may be made with no adverse effects. Lateral and directional control inputs forward of the aft stop have not been investigated. The stall stabilizes at 85–90 knots with well damped yaw oscillations not exceeding 5° and well damped roll oscillations not exceeding 15°. Longitudinal control is positive and stall recovery is positive when the stick starts forward.

WARNING

AOA above 25 units with the speedbrake extended should be avoided as this may cause departure. Inadvertent excursions above 25 units AOA are probable during maneuvering near 25 units with the speedbrake extended.

DEPARTURES

Departures are more probable with the speedbrake extended, in accelerated stalls, and with CAS on. Most departures are dominantly rolling. Recovery is positive with neutral lateral and longitudinal stick. Recovery rolls are usual. Neutral stick position provides maximum aileron deflection. Stagnation of both engines will probably occur (refer to section III).

SPINS

UPRIGHT SPINS

A non–oscillatory spin mode has been encountered after a speedbrake–out accelerated departure. Spin recovery appears probable from a steady state spin. Full aileron with the spin should be maintained until the AOA is reduced. Maximum aileron is available with neutral longitudinal stick. Stagnation of both engines will probably occur (refer to section III).

SECTION VII
ADVERSE WEATHER OPERATION

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This section provides information for operation in adverse weather. Procedures in section II of this manual provide normal instrument flight procedures. These are procedures that differ from, or are in addition to, those contained in section II.

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 inlet guide vanes.

Turbulence associated with penetration can result in extreme angles of attack which may cause marginal engine performance.

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. FTIT gages should be monitored continuously during weather penetration. A rise of FTIT is an indication of engine icing. The inlet ice caution light provides warning of icing conditions in the engine inlet. Whenever possible, icing conditions should be anticipated in advance and the anti-icing system should be turned on to warm up the engine inlet guide vanes.

PENETRATION

The basic structure of the aircraft is capable of withstanding the accelerations and gust loadings associated with the largest thunderstorms at subsonic airspeed. Supersonic thunderstorm penetrations have not been investigated to date. 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. Attitude can be maintained with reasonable accuracy.

PENETRATION AIRSPEED

The optimum thunderstorm penetration speed is 300 knots.

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. Throttle - ADJUST TO MAINTAIN DESIRED PENETRATION SPEED
2. Pitot heat switch - ON
3. Engine anti-ice switch - ON
4. Windshield anti-ice switch - ON
5. Lower seat.

If night penetration -

6. Storm flood switch - BRT
7. Instrument lights - BRT
8. Console lights - BRT
9. Anti-collision lights - OFF

CAUTION

Do not try to top thunderstorms at subsonic speeds above 40,000 feet. 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.

CAUTION

- If compressor stall or engine stagnation develops, retard throttle to idle momentarily, then attempt to regain normal engine operation by advancing the throttle. If the stall persists, shut down the engine and attempt a relight. If engine remains stagnated at reduced power, and FTIT is within limits, maintain reduced power until clear of the thunderstorm.
- The angle of attack probes may become distorted by impact ice and/or hail.

SNOW, ICE, RAIN AND SLUSH

TAXIING

Painted areas on runways, taxiways, and ramps are significantly more slippery than nonpainted areas. When painted areas are wet, the condition may deteriorate to the extent that the braking is negligible. In addition, painted areas may serve as condensation surfaces and it is possible to have wet, frosty, or icy conditions on these areas when the overall weather condition is dry. When conditions of snow or ice exist, the approach ends of the runway are usually more slippery than any other areas due to the melting and refreezing of the ice and snow at this location.

TAKEOFF

Takeoff shall not be attempted with ice or snow on the lifting surfaces or accumulations on other surfaces that may adversely affect performance.

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 and windshield anti-ice. The inlet caution light may illuminate during flight in icing conditions below 1.33 Mach due to ice blockage of the duct static port. This can result in a slight loss in engine performance.

COLD WEATHER OPERATION

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.
3. All exterior covers removed.

INTERIOR CHECK

In temperatures below 0°C, difficulty may be experienced when connecting the oxygen mask hose to the T–connector. Application of a small amount of heat to the T–connector will alleviate this problem. Also, if the oxygen mask is not fastened, keep it well clear of the face to prevent freezing of the valves.

STARTING ENGINES

During cold weather starting both JFS accumulators must be discharged simultaneously in order for the JFS to reach normal starting rpm. Allow the JFS to run for 1 minute prior to engaging an engine. The engine start should be made with the engine start fuel switches in the SEA LEVEL position.

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 blase 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.

LANDING

When stopping distance is critical, fly final approach at 23 units AOA and use a flat approach angle (1½ –2°). Precise control of the touchdown point can be achieved using the HUD velocity vector display.

AFTER LANDING

After landing, make maximum use of aerodynamic braking. Consideration should be given to single engine taxiing since engine residual thrust becomes significantly greater as am—bient temperature decreases. When wearing bulky arctic survival clothing and winter flying gloves, rapid egress from the cockpit by disconnecting the torso harness will be im—peded due to the inability to see the connectors and by a degraded sense of touch.

BEFORE LEAVING AIRCRAFT

Leave canopy open, unless weather prevents, to permit circulation. This decreases windshield and canopy frosting. Also check that all protective covers are installed.

HOT WEATHER/DESERT OPERATION

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.

APPENDIX A
PERFORMANCE DATA

Refer to T.O.1F-15A-1-1.

FOLDOUT ILLUSTRATIONS

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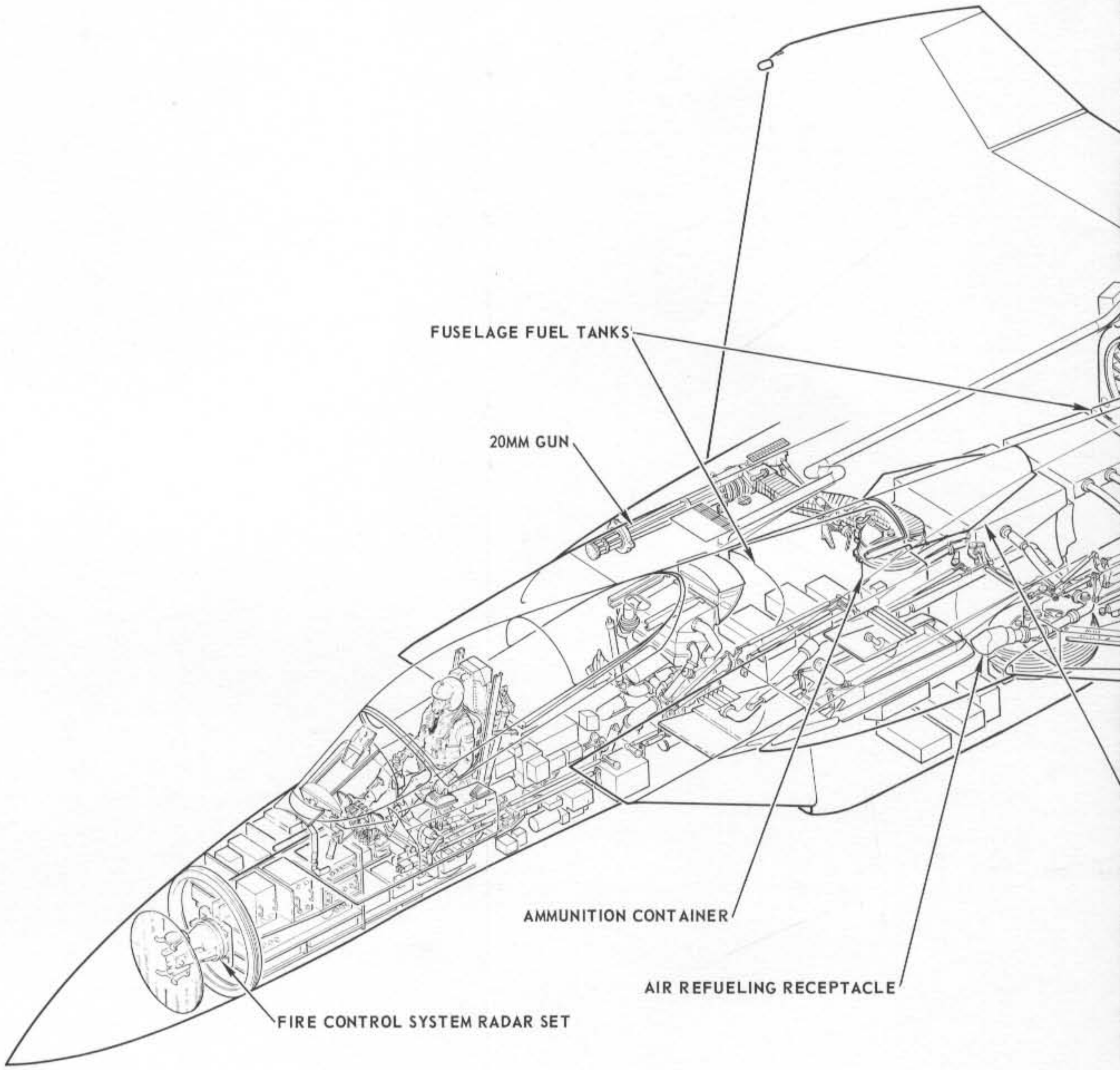

FUSELAGE FUEL TANKS
20MM GUN
AMMUNITION CONTAINER
AIR REFUELING RECEPTACLE
FIRE CONTROL SYSTEM RADAR SET

GENERAL ARRANGEMENT

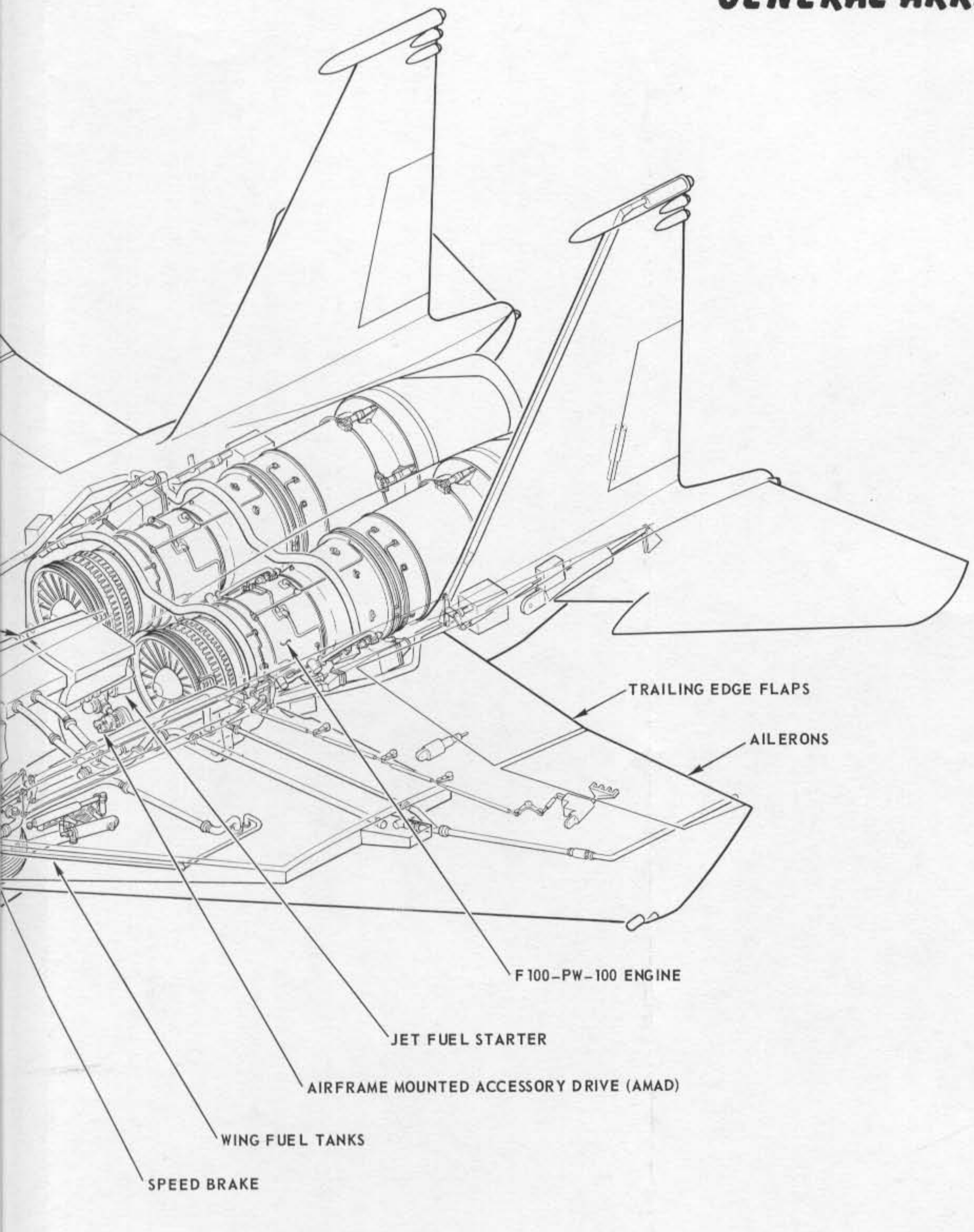
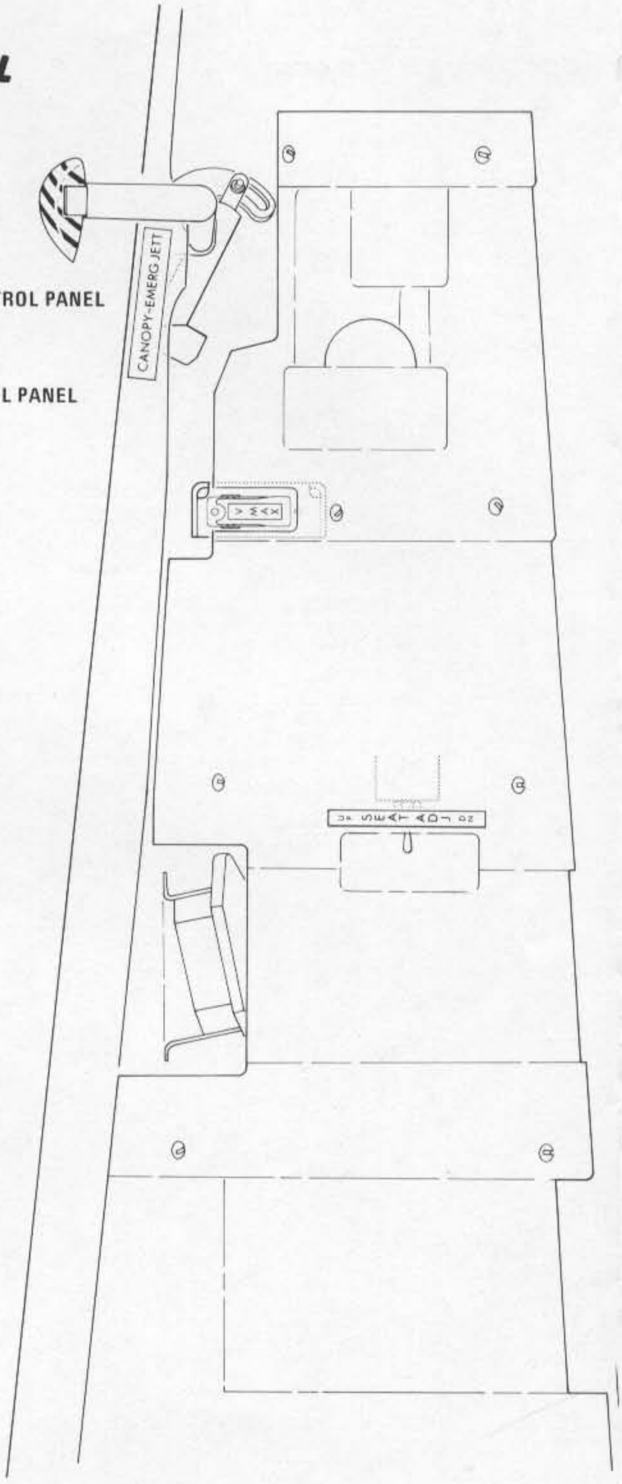
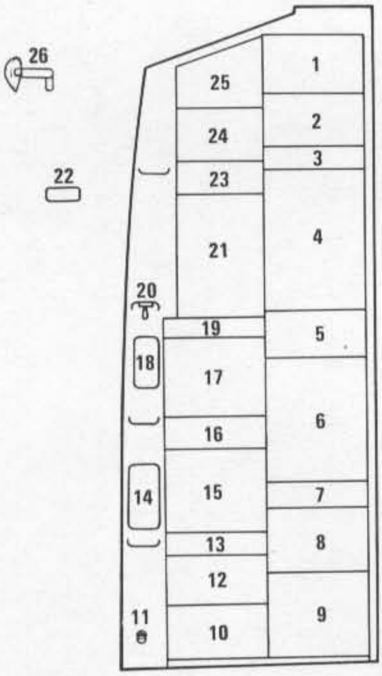


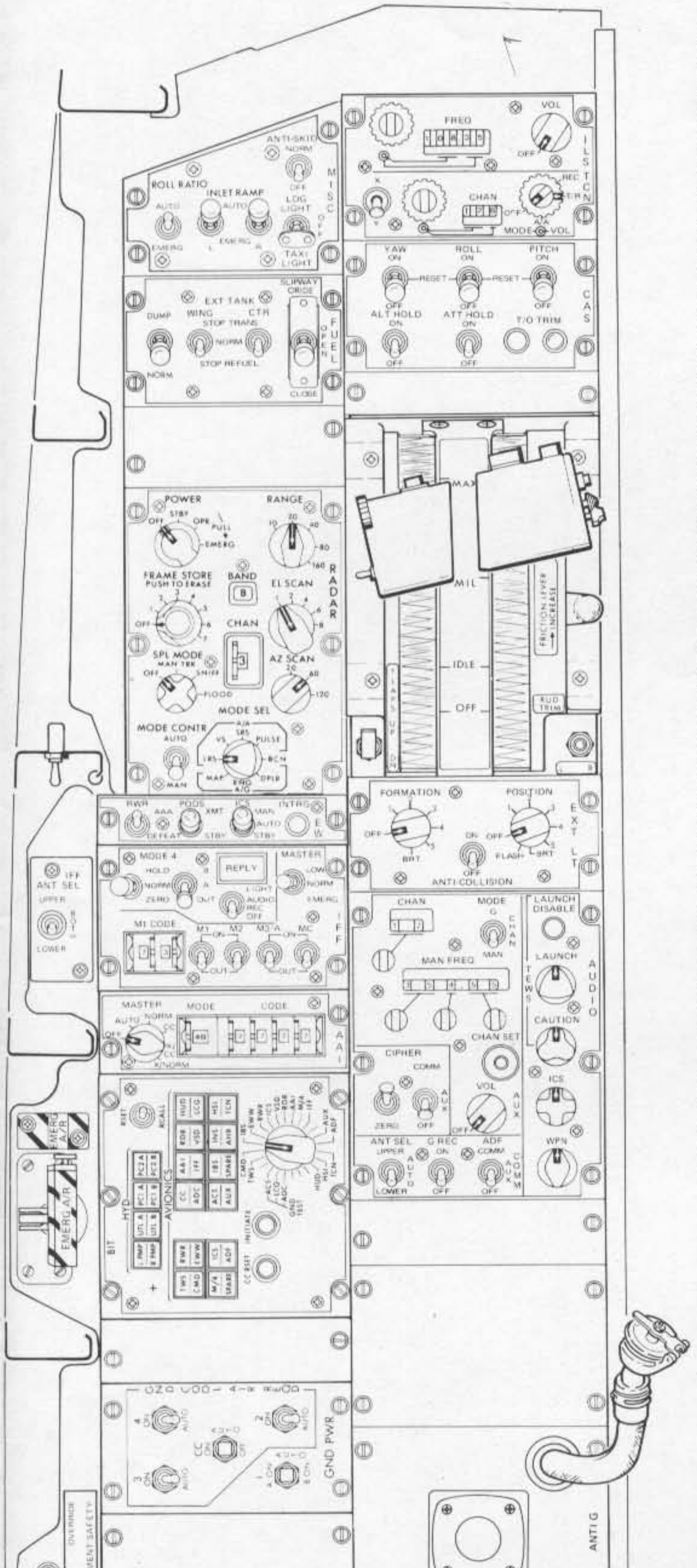
Figure FO-1

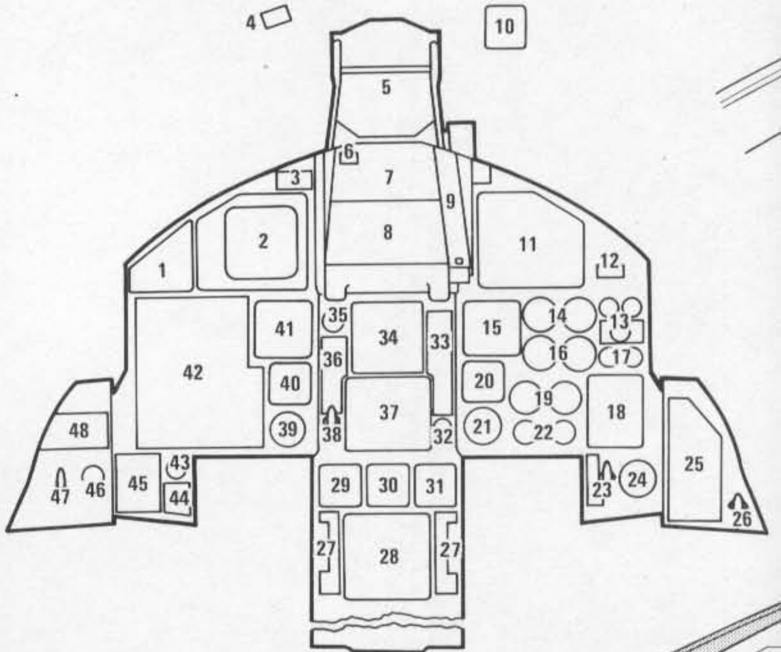
LEFT CONSOLE PANEL



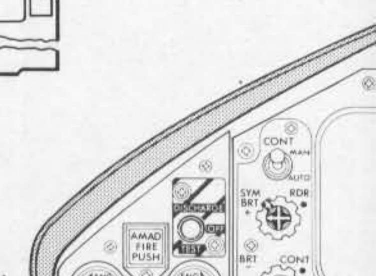
1. ILS/TACAN CONTROL PANEL
2. CONTROL AUGMENTATION SYSTEM CONTROL PANEL
3. BLANK
4. THROTTLE QUADRANT
5. EXTERIOR LIGHTS CONTROL PANEL
6. INTEGRATED COMMUNICATIONS CONTROL PANEL
7. BLANK
8. BLANK
9. ANTI–G PANEL
10. BLANK
11. ARMAMENT SAFETY OVERRIDE SWITCH
12. GROUND POWER PANEL
13. BLANK
14. EMERGENCY AIR REFUELING HANDLE
15. BIT PANEL
16. INTERROGATOR CONTROL PANEL
17. IFF CONTROL PANEL
18. IFF ANTENNA SELECT SWITCH
19. TEWS PANEL
20. SEAT ADJUST SWITCH
21. RADAR CONTROL PANEL
22. V_{MAX} SWITCH
23. BLANK
24. FUEL CONTROL PANEL
25. MISCELLANEOUS CONTROL PANEL
26. CANOPY JETTISON HANDLE

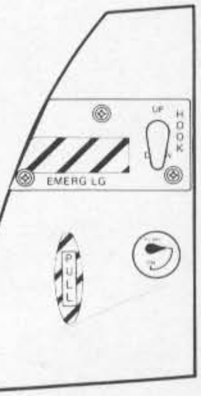






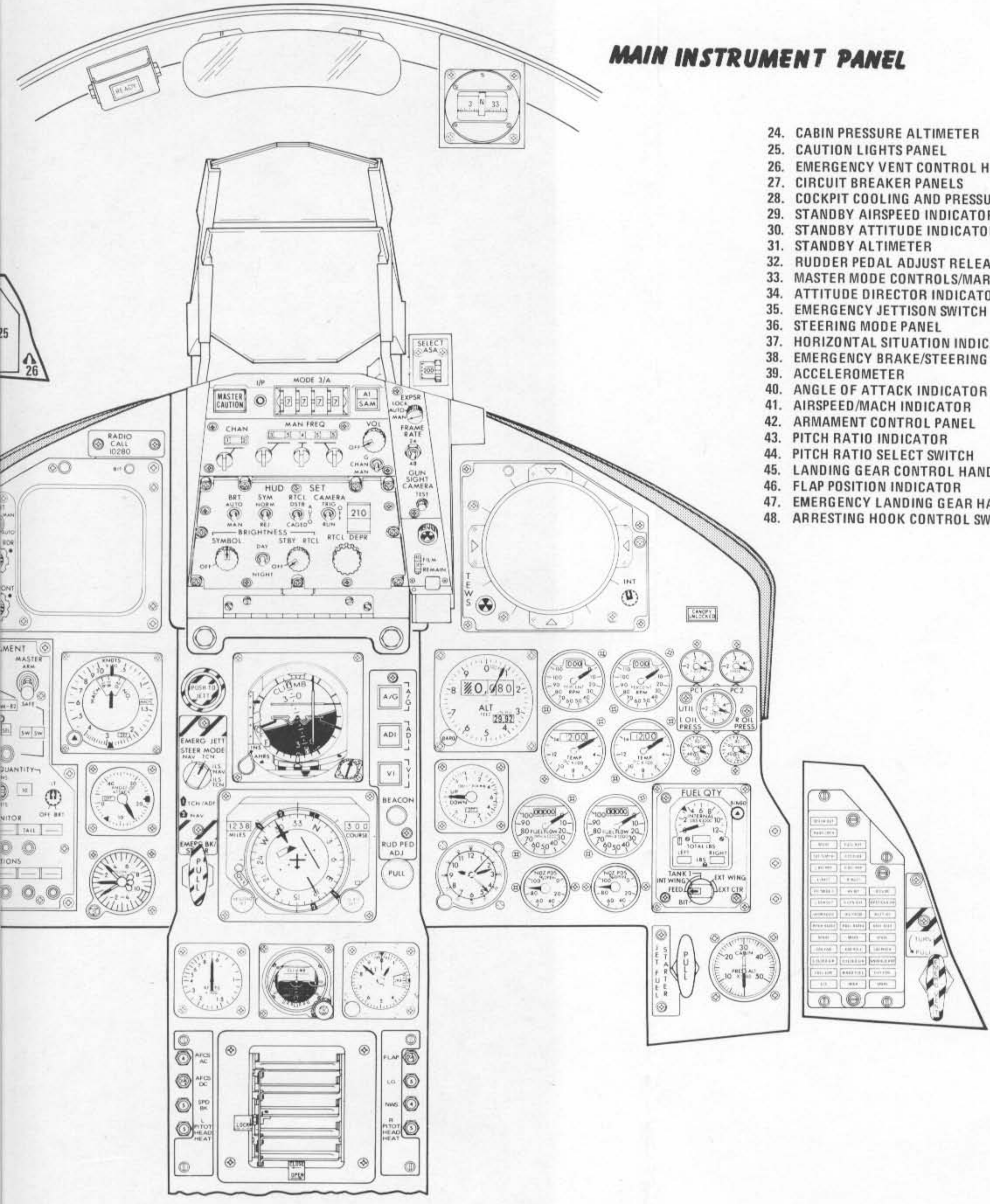
1. FIRE WARNING/EXTINGUISHING PANEL
2. VERTICAL SITUATION DISPLAY (VSD)
3. RADIO CALL PANEL
4. AIR REFUELING READY LIGHT
5. HEAD UP DISPLAY COMBINING GLASS
6. MASTER CAUTION LIGHT
7. MAIN COMMUNICATIONS CONTROL PANEL
8. HEAD UP DISPLAY CONTROL PANEL
9. GUN SIGHT CAMERA CONTROL PANEL
10. STANDBY MAGNETIC COMPASS
11. TEWS DISPLAY UNIT
12. CANOPY UNLOCKED WARNING LIGHT
13. HYDRAULIC PRESSURE INDICATORS
14. ENGINE TACHOMETERS
15. ALTIMETER





16. FAN TURBINE INLET TEMPERATURE INDICATORS
17. ENGINE OIL PRESSURE INDICATORS
18. FUEL QUANTITY INDICATOR
19. ENGINE FUEL FLOW INDICATORS
20. VERTICAL VELOCITY INDICATOR
21. EIGHT DAY CLOCK
22. ENGINE EXHAUST NOZZLE POSITION INDICATORS
23. JET FUEL STARTER CONTROL HANDLE

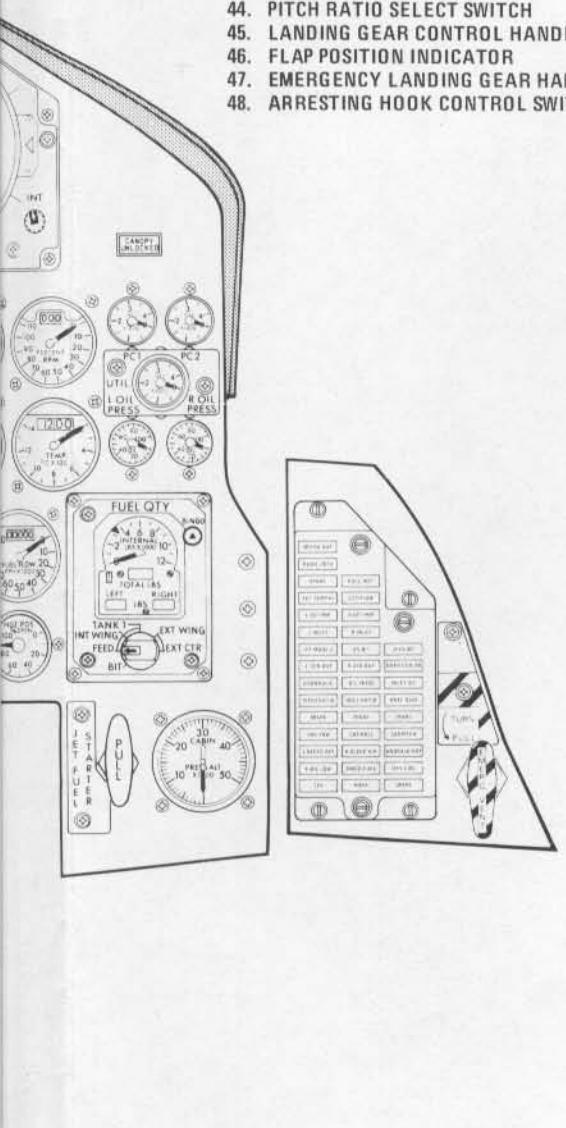
MAIN INSTRUMENT PANEL



24. CABIN PRESSURE ALTIMETER
25. CAUTION LIGHTS PANEL
26. EMERGENCY VENT CONTROL HANDLE
27. CIRCUIT BREAKER PANELS
28. COCKPIT COOLING AND PRESSURIZATION OUTLET
29. STANDBY AIRSPEED INDICATOR
30. STANDBY ATTITUDE INDICATOR
31. STANDBY ALTIMETER
32. RUDDER PEDAL ADJUST RELEASE KNOB
33. MASTER MODE CONTROLS/MARKER BEACON PANEL
34. ATTITUDE DIRECTOR INDICATOR
35. EMERGENCY JETTISON SWITCH
36. STEERING MODE PANEL
37. HORIZONTAL SITUATION INDICATOR
38. EMERGENCY BRAKE/STEERING CONTROL HANDLE
39. ACCELEROMETER
40. ANGLE OF ATTACK INDICATOR
41. AIRSPEED/MACH INDICATOR
42. ARMAMENT CONTROL PANEL
43. PITCH RATIO INDICATOR
44. PITCH RATIO SELECT SWITCH
45. LANDING GEAR CONTROL HANDLE
46. FLAP POSITION INDICATOR
47. EMERGENCY LANDING GEAR HANDLE
48. ARRESTING HOOK CONTROL SWITCH

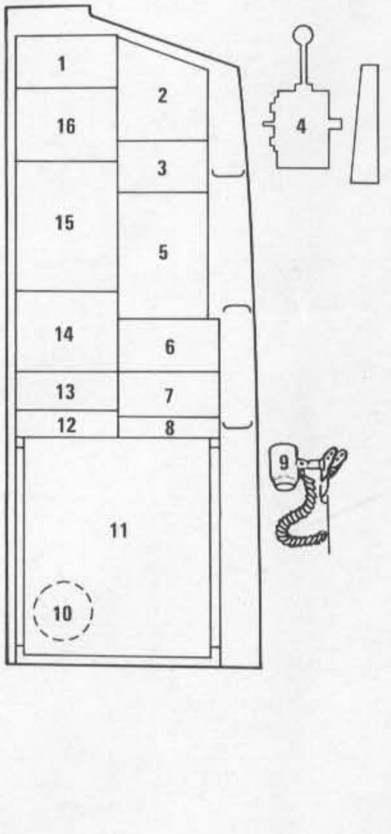
MAIN INSTRUMENT PANEL

24. CABIN PRESSURE ALTIMETER
25. CAUTION LIGHTS PANEL
26. EMERGENCY VENT CONTROL HANDLE
27. CIRCUIT BREAKER PANELS
28. COCKPIT COOLING AND PRESSURIZATION OUTLET
29. STANDBY AIRSPEED INDICATOR
30. STANDBY ATTITUDE INDICATOR
31. STANDBY ALTIMETER
32. RUDDER PEDAL ADJUST RELEASE KNOB
33. MASTER MODE CONTROLS/MARKER BEACON PANEL
34. ATTITUDE DIRECTOR INDICATOR
35. EMERGENCY JETTISON SWITCH
36. STEERING MODE PANEL
37. HORIZONTAL SITUATION INDICATOR
38. EMERGENCY BRAKE/STEERING CONTROL HANDLE
39. ACCELEROMETER
40. ANGLE OF ATTACK INDICATOR
41. AIRSPEED/MACH INDICATOR
42. ARMAMENT CONTROL PANEL
43. PITCH RATIO INDICATOR
44. PITCH RATIO SELECT SWITCH
45. LANDING GEAR CONTROL HANDLE
46. FLAP POSITION INDICATOR
47. EMERGENCY LANDING GEAR HANDLE
48. ARRESTING HOOK CONTROL SWITCH



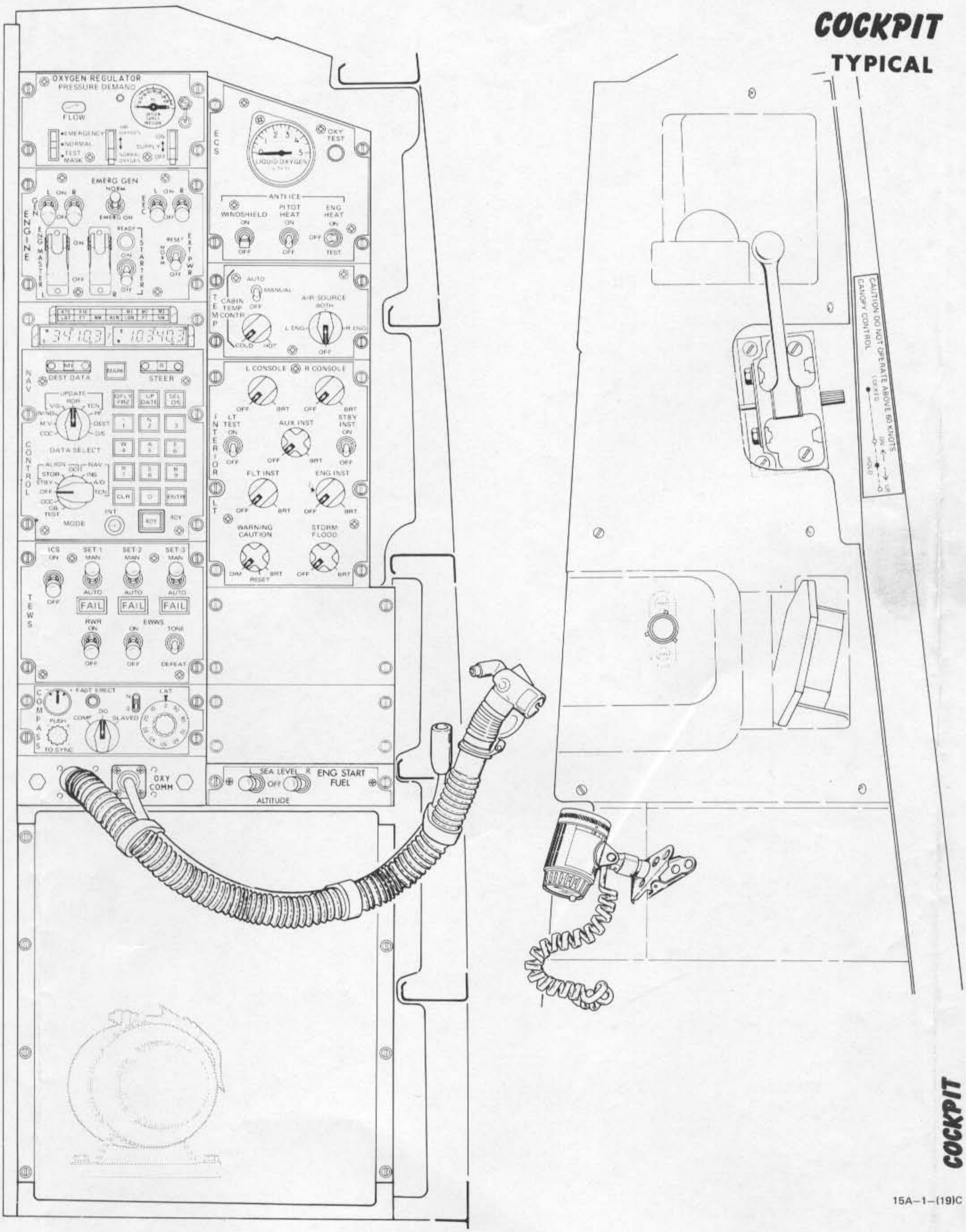
RIGHT CONSOLE PANEL

1. OXYGEN REGULATOR
2. ECS PANEL
3. TEMPERATURE PANEL
4. CANOPY CONTROL HANDLE
5. INTERIOR LIGHTS CONTROL PANEL
6. TEWS POD CONTROL PANEL
7. BLANK
8. ENGINE START FUEL SWITCHES
9. UTILITY LIGHT
10. VACUUM BOTTLE
11. STOWAGE COMPARTMENT
12. OXYGEN/COMMUNICATION OUTLET PANEL
13. COMPASS CONTROL PANEL
14. TEWS POWER CONTROL PANEL
15. NAVIGATION CONTROL PANEL
16. ENGINE CONTROL PANEL



COCKPIT

TYPICAL

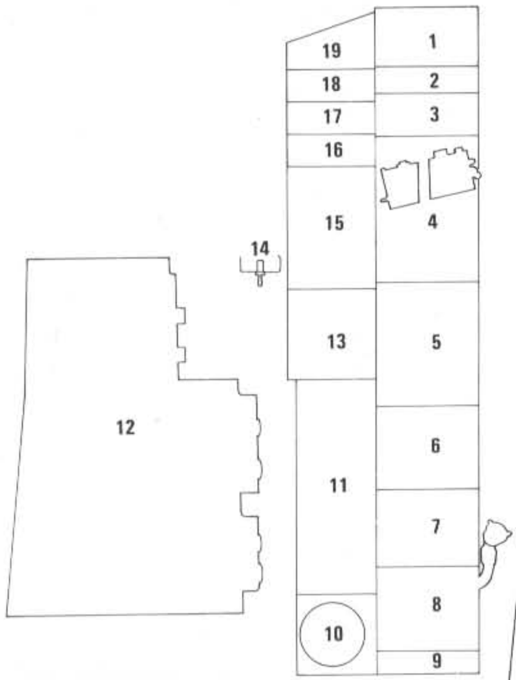


COCKPIT

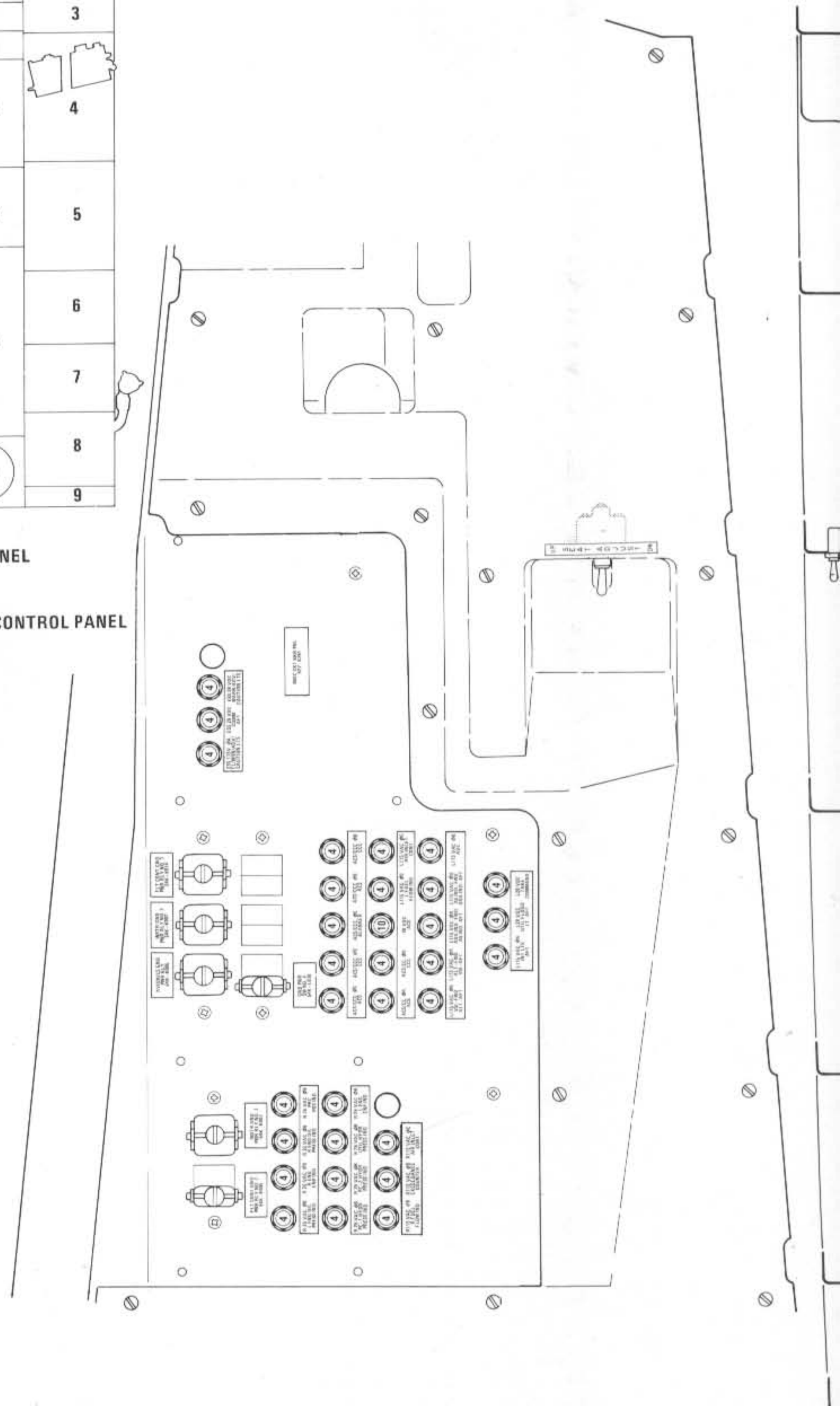
15A-1-(19)C

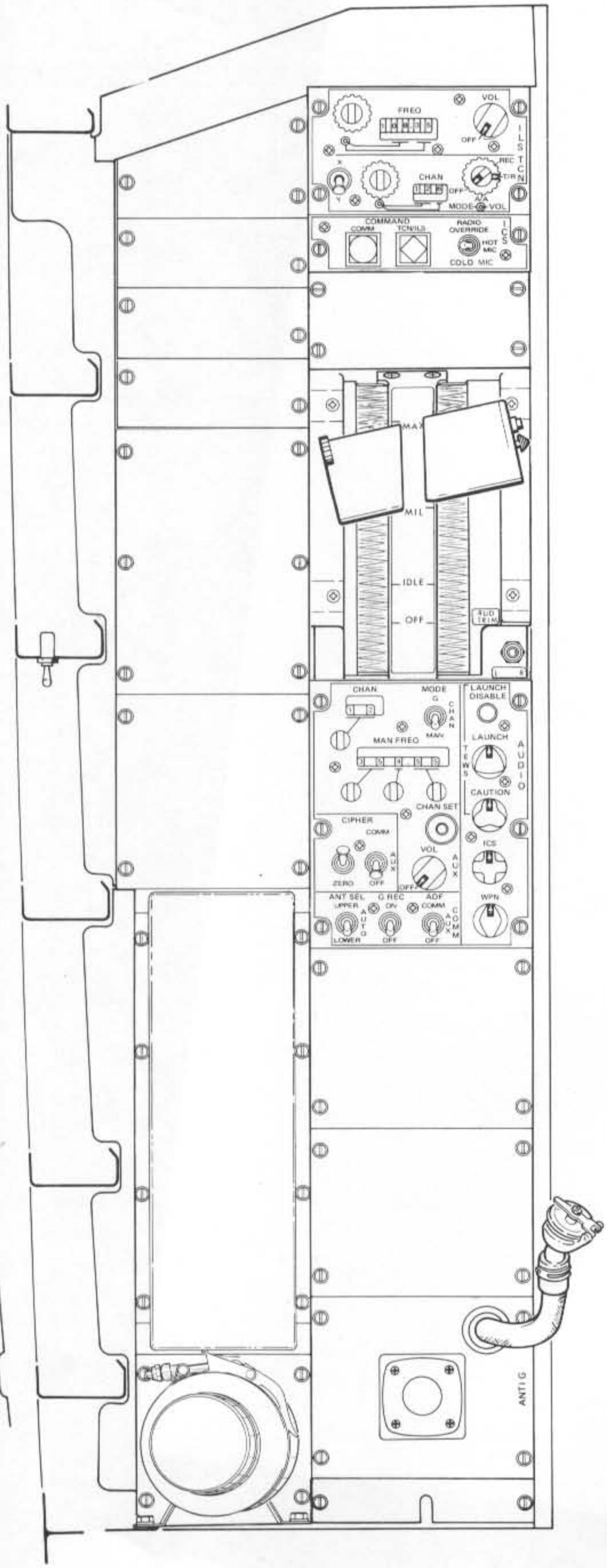
Figure FO-2

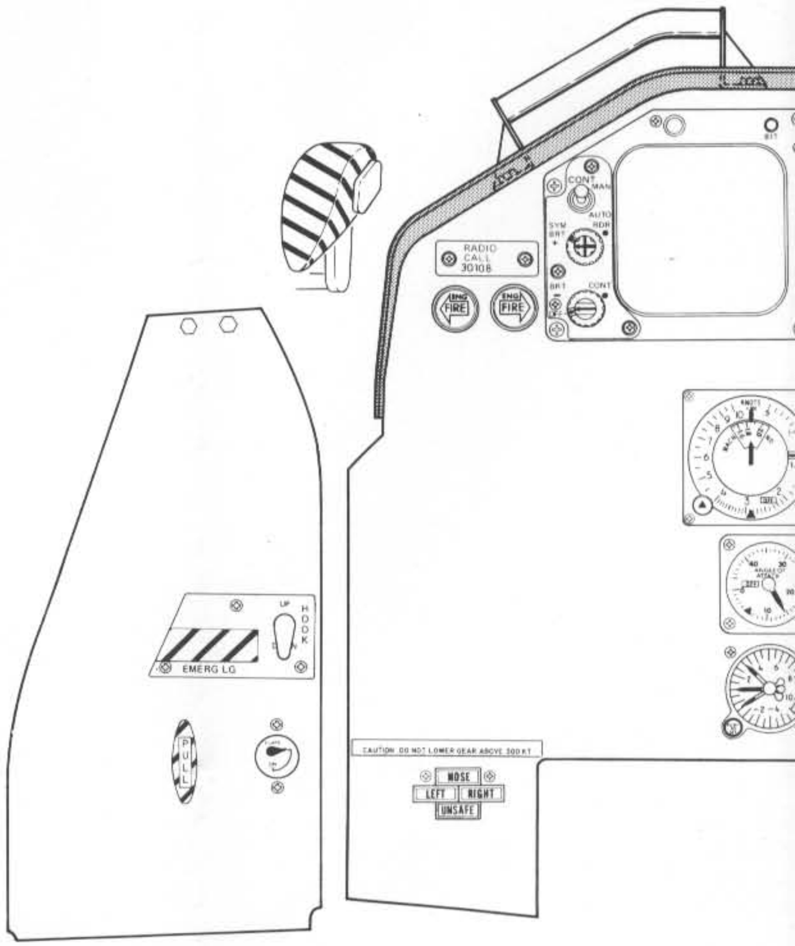
LEFT CONSOLE AREA

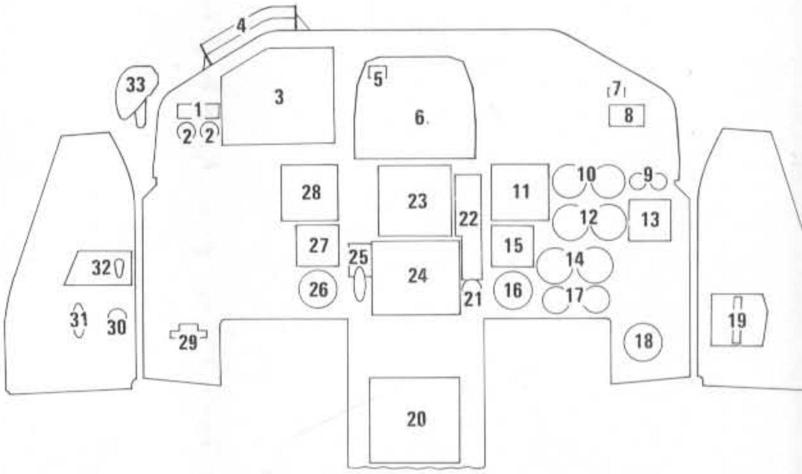


1. ILS/TACAN CONTROL PANEL
2. TAKE COMMAND/ICS CONTROL PANEL
3. BLANK PANEL
4. THROTTLE QUADRANT
5. INTEGRATED COMMUNICATIONS CONTROL PANEL
6. BLANK PANEL
7. BLANK PANEL
8. ANTI–G PANEL
9. BLANK PANEL
10. VACUUM BOTTLE
11. STOWAGE COMPARTMENT
12. CIRCUIT BREAKER PANEL
13. BLANK PANEL
14. SEAT ADJUST SWITCH
15. BLANK PANEL
16. BLANK PANEL
17. BLANK PANEL
18. BLANK PANEL
19. BLANK PANEL



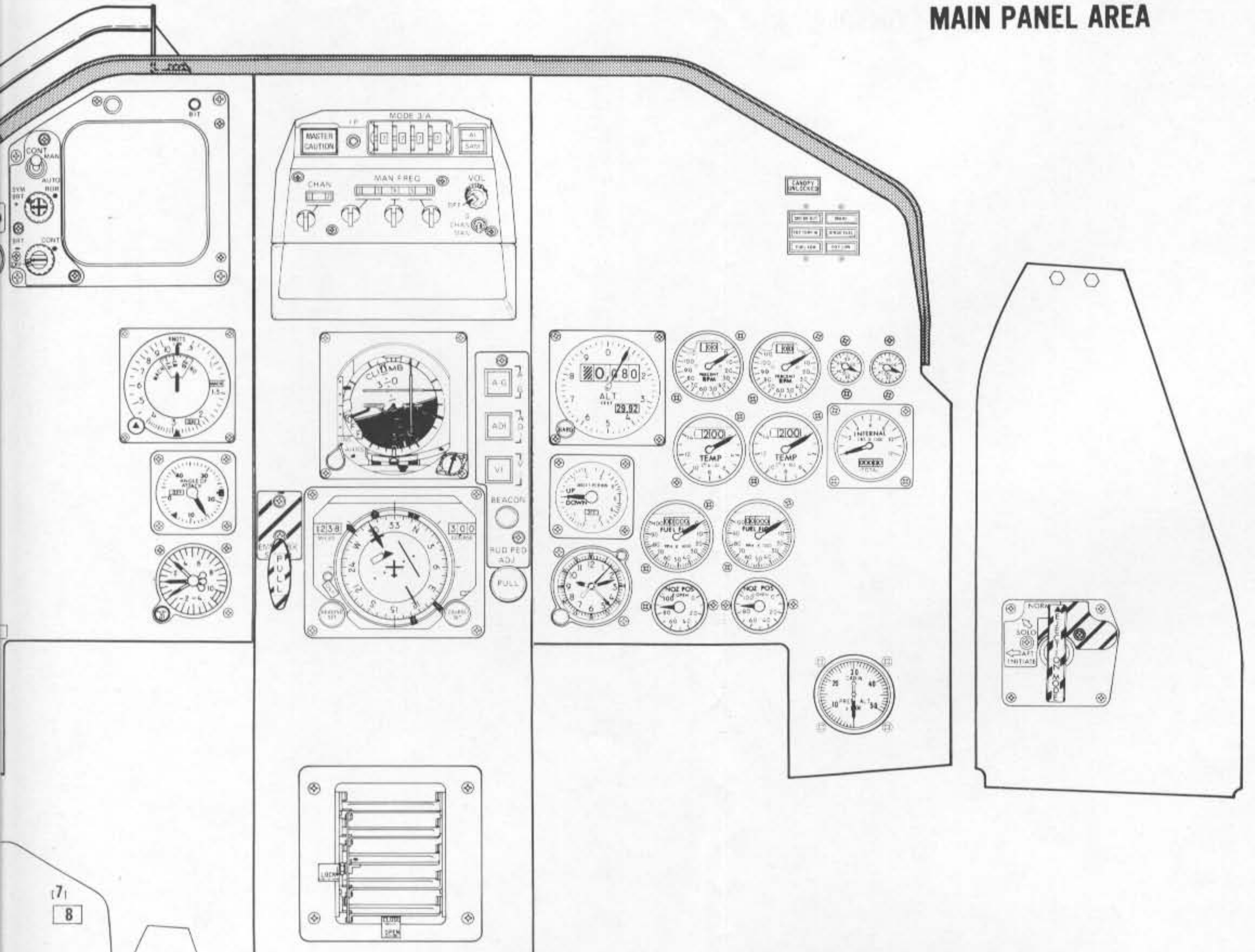


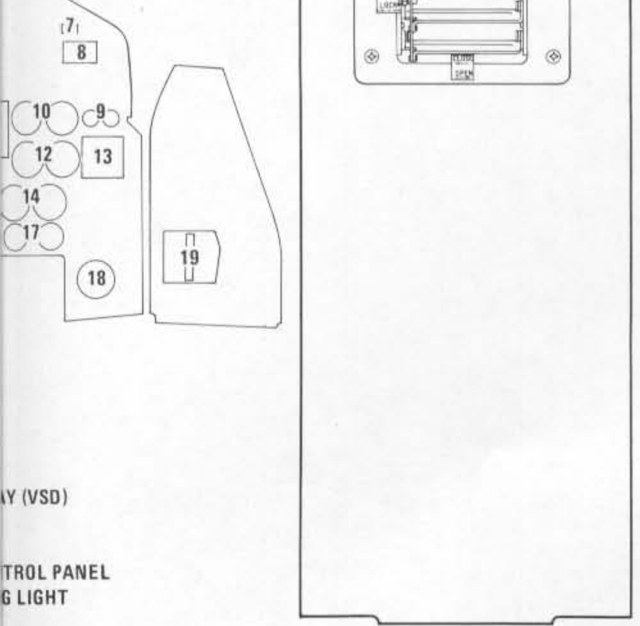




1. RADIO CALL PANEL
2. FIRE WARNING LIGHTS
3. VERTICAL SITUATION DISPLAY (VSD)
4. HAND HOLD
5. MASTER CAUTION LIGHT
6. MAIN COMMUNICATIONS CONTROL PANEL
7. CANOPY UNLOCKED WARNING LIGHT
8. CAUTION LIGHTS PANEL
9. ENGINE OIL PRESSURE INDICATORS
10. ENGINE TACHOMETERS

MAIN PANEL AREA





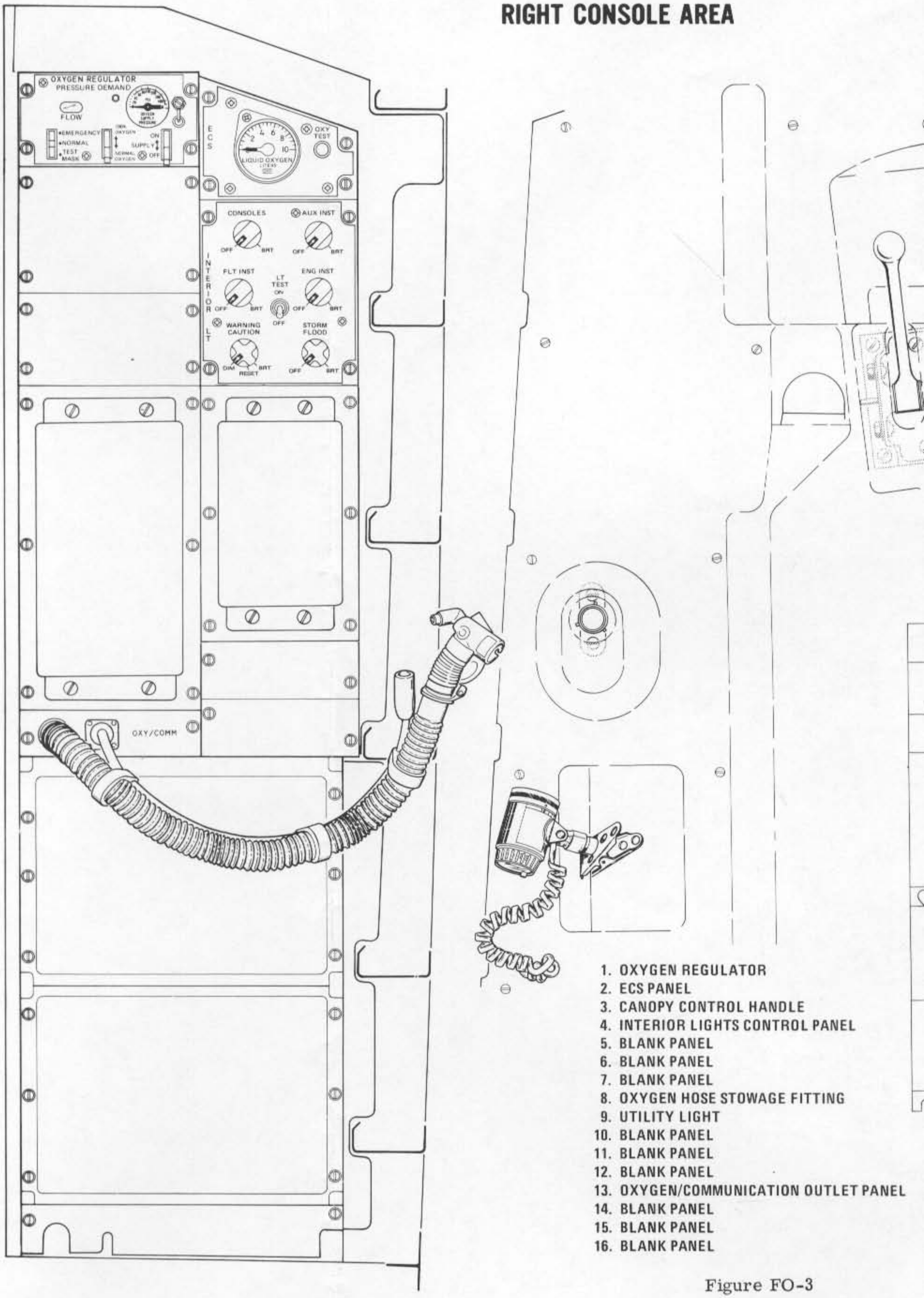
Y (VSD)

TROL PANEL
G LIGHT

ATORS

11. ALTIMETER
12. FAN TURBINE INLET TEMPERATURE INDICATORS
13. FUEL QUANTITY INDICATOR (REPEATER)
14. ENGINE FUEL FLOW INDICATORS
15. VERTICAL VELOCITY INDICATOR
16. EIGHT DAY CLOCK
17. ENGINE EXHAUST NOZZLE POSITION INDICATORS
18. CABIN PRESSURE ALTIMETER
19. COMMAND SELECTOR VALVE HANDLE
20. COCKPIT COOLING AND PRESSURIZATION OUTLET
21. RUDDER PEDAL ADJUST RELEASE KNOB
22. MASTER MODE CONTROLS/MARKER BEACON PANEL
23. ATTITUDE DIRECTOR INDICATOR
24. HORIZONTAL SITUATION INDICATOR
25. EMERGENCY BRAKE/STEERING CONTROL HANDLE
26. ACCELEROMETER
27. ANGLE OF ATTACK INDICATOR
28. AIRSPEED/MACH INDICATOR
29. LANDING GEAR POSITION INDICATORS
30. FLAP POSITION INDICATORS
31. EMERGENCY LANDING GEAR HANDLE
32. ARRESTING HOOK CONTROL SWITCH
33. CANOPY JETTISON HANDLE

RIGHT CONSOLE AREA



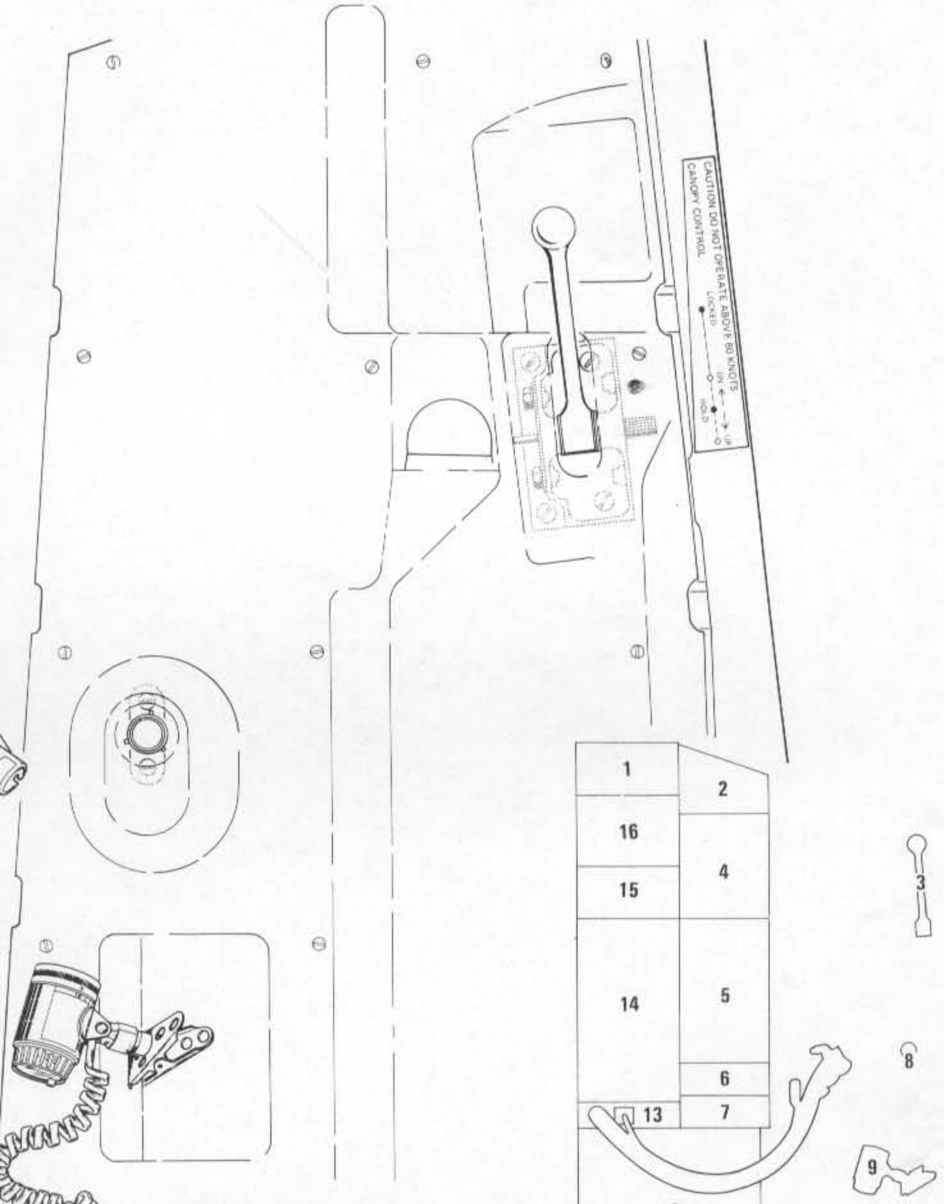
1. OXYGEN REGULATOR
2. ECS PANEL
3. CANOPY CONTROL HANDLE
4. INTERIOR LIGHTS CONTROL PANEL
5. BLANK PANEL
6. BLANK PANEL
7. BLANK PANEL
8. OXYGEN HOSE STOWAGE FITTING
9. UTILITY LIGHT
10. BLANK PANEL
11. BLANK PANEL
12. BLANK PANEL
13. OXYGEN/COMMUNICATION OUTLET PANEL
14. BLANK PANEL
15. BLANK PANEL
16. BLANK PANEL

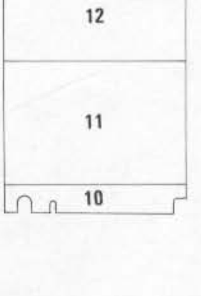
Figure FO-3

RIGHT CONSOLE AREA

REAR COCKPIT TF

TYPICAL



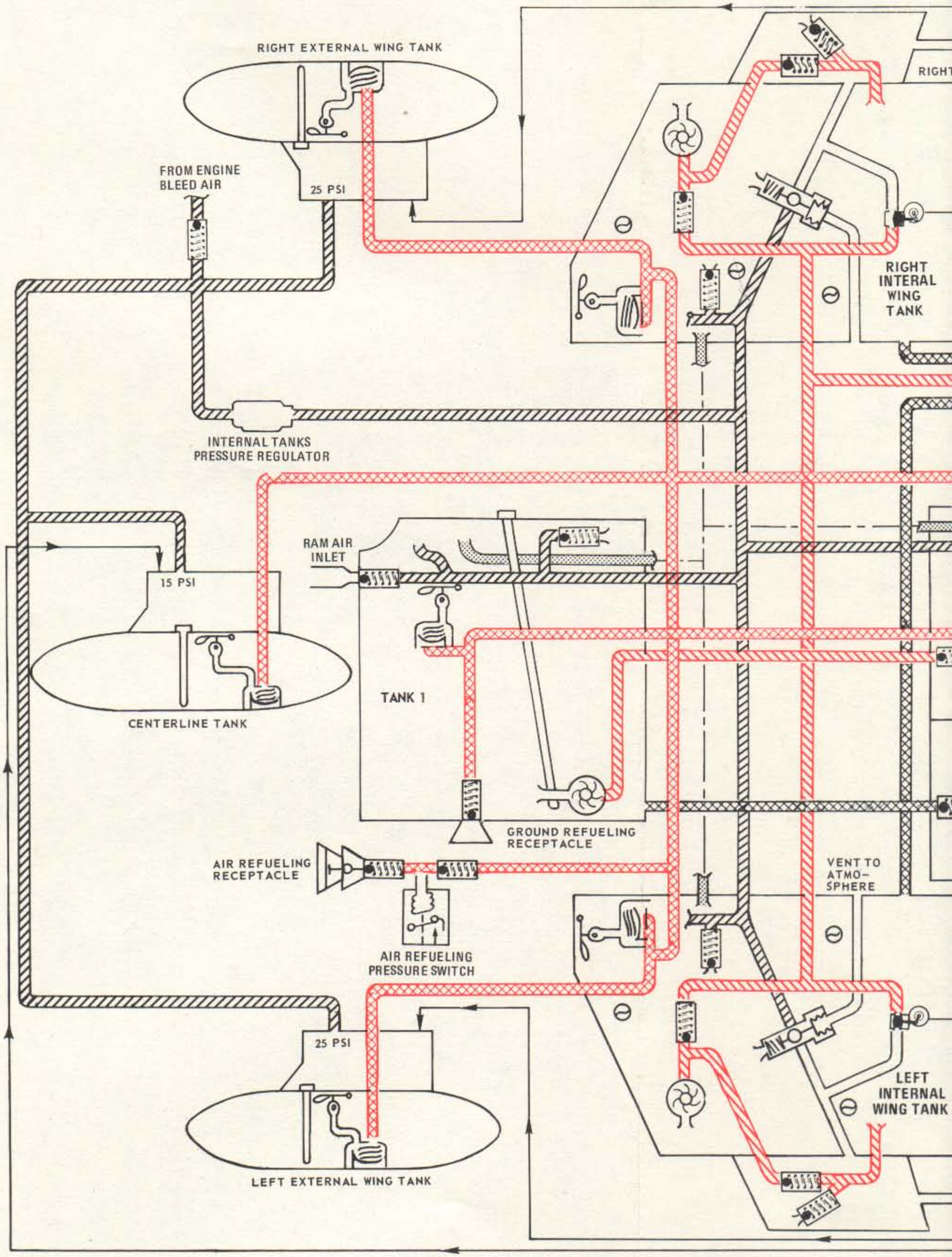


1. OXYGEN REGULATOR
2. ECS PANEL
3. CANOPY CONTROL HANDLE
4. INTERIOR LIGHTS CONTROL PANEL
5. BLANK PANEL
6. BLANK PANEL
7. BLANK PANEL
8. OXYGEN HOSE STOWAGE FITTING
9. UTILITY LIGHT
10. BLANK PANEL
11. BLANK PANEL
12. BLANK PANEL
13. OXYGEN/COMMUNICATION OUTLET PANEL
14. BLANK PANEL
15. BLANK PANEL
16. BLANK PANEL

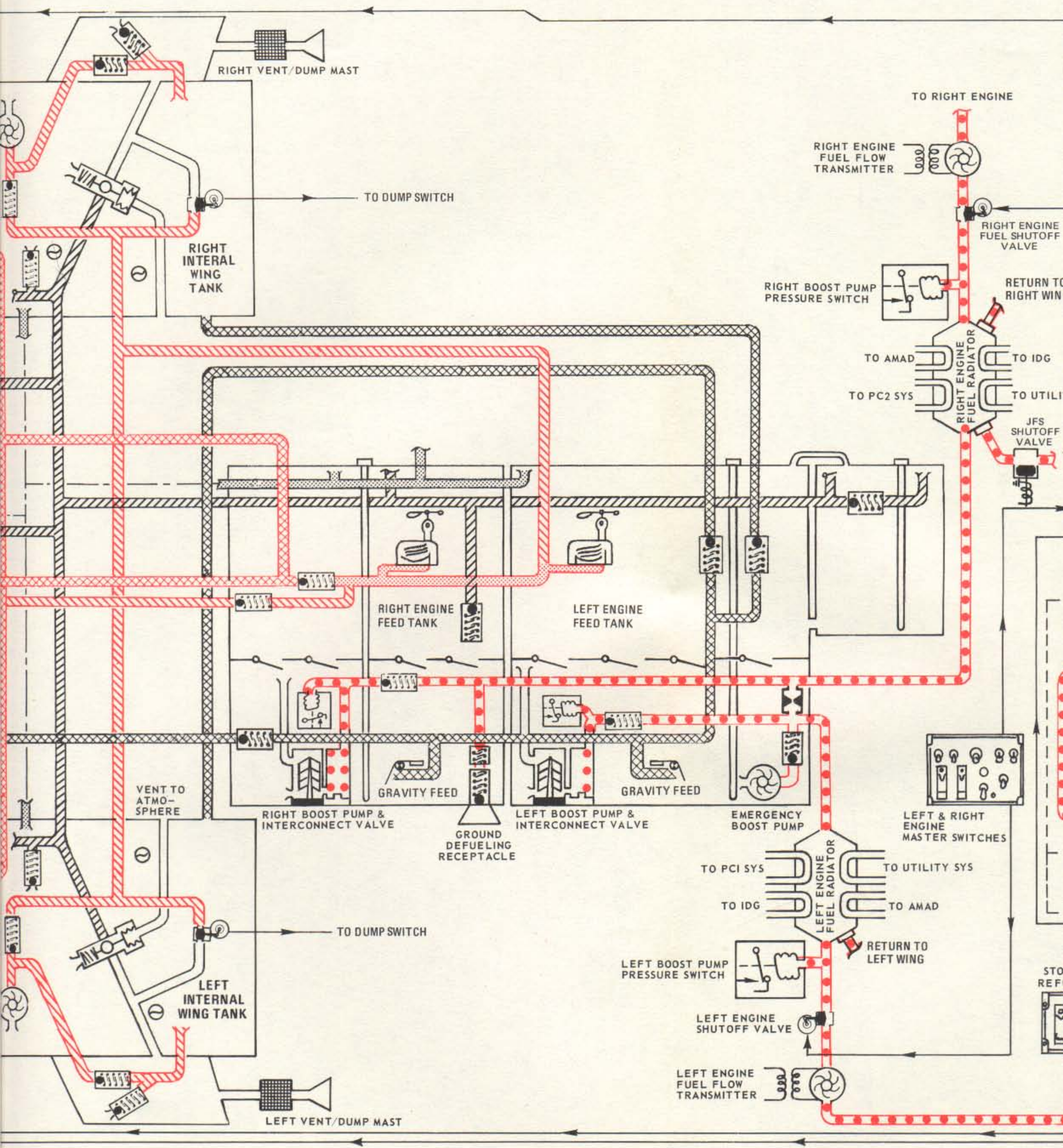
REAR COCKPIT

15A-1-(103)A

Figure FO-3



RIGHT EXTERNAL WING TANK
RIGHT
FROM ENGINE BLEED AIR
25 PSI
RIGHT INTERAL WING TANK
INTERNAL TANKS PRESSURE REGULATOR
RAM AIR INLET
15 PSI
TANK 1
CENTERLINE TANK
GROUND REFUELING RECEPTACLE
AIR REFUELING RECEPTACLE
VENT TO ATMO- SPHERE
AIR REFUELING PRESSURE SWITCH
25 PSI
LEFT INTERNAL WING TANK
LEFT EXTERNAL WING TANK



RIGHT VENT/DUMP MAST
TO RIGHT ENGINE
RIGHT ENGINE FUEL FLOW TRANSMITTER
TO DUMP SWITCH
RIGHT ENGINE FUEL SHUTOFF VALVE
RIGHT INTERAL WING TANK
RIGHT BOOST PUMP PRESSURE SWITCH
RETURN TO RIGHT WIN
TO AMAD
RIGHT ENGINE FUEL RADIATOR
TO IDG
TO PC2 SYS
TO UTILI
JFS SHUTOFF VALVE
RIGHT ENGINE FEED TANK
LEFT ENGINE FEED TANK
GRAVITY FEED
GRAVITY FEED
VENT TO ATMO- SPHERE
RIGHT BOOST PUMP & INTERCONNECT VALVE
GROUND DEFUELING RECEPTACLE
LEFT BOOST PUMP & INTERCONNECT VALVE
EMERGENCY BOOST PUMP
LEFT & RIGHT ENGINE MASTER SWITCHES
TO PCI SYS
LEFT ENGINE FUEL RADIATOR
TO UTILITY SYS
TO IDG
TO AMAD
TO DUMP SWITCH
RETURN TO LEFT WING
LEFT BOOST PUMP PRESSURE SWITCH
LEFT INTERNAL WING TANK
LEFT ENGINE SHUTOFF VALVE
STO REF
LEFT ENGINE FUEL FLOW TRANSMITTER
LEFT VENT/DUMP MAST

AIRPLANE & ENGINE FUEL SYSTEM

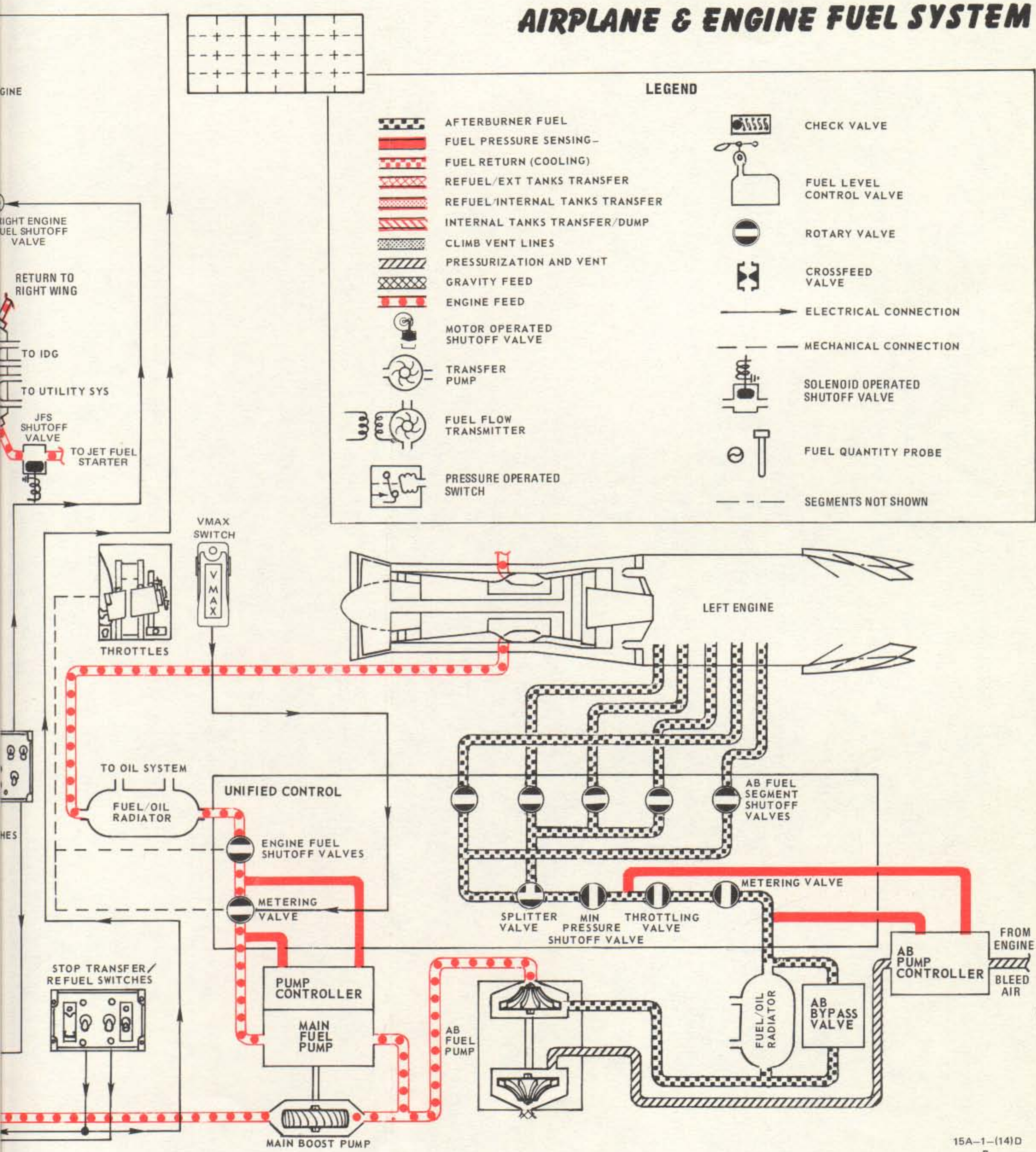
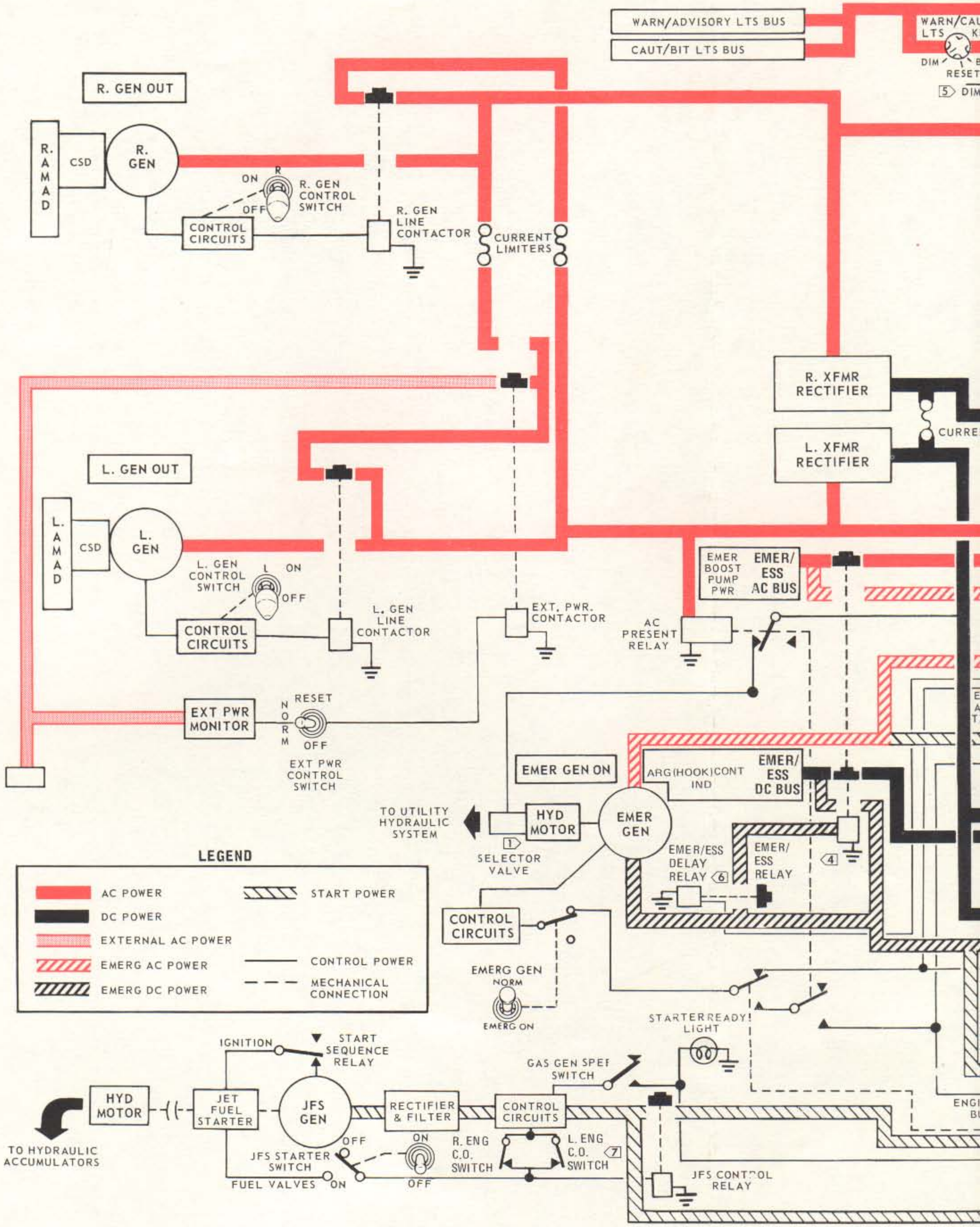
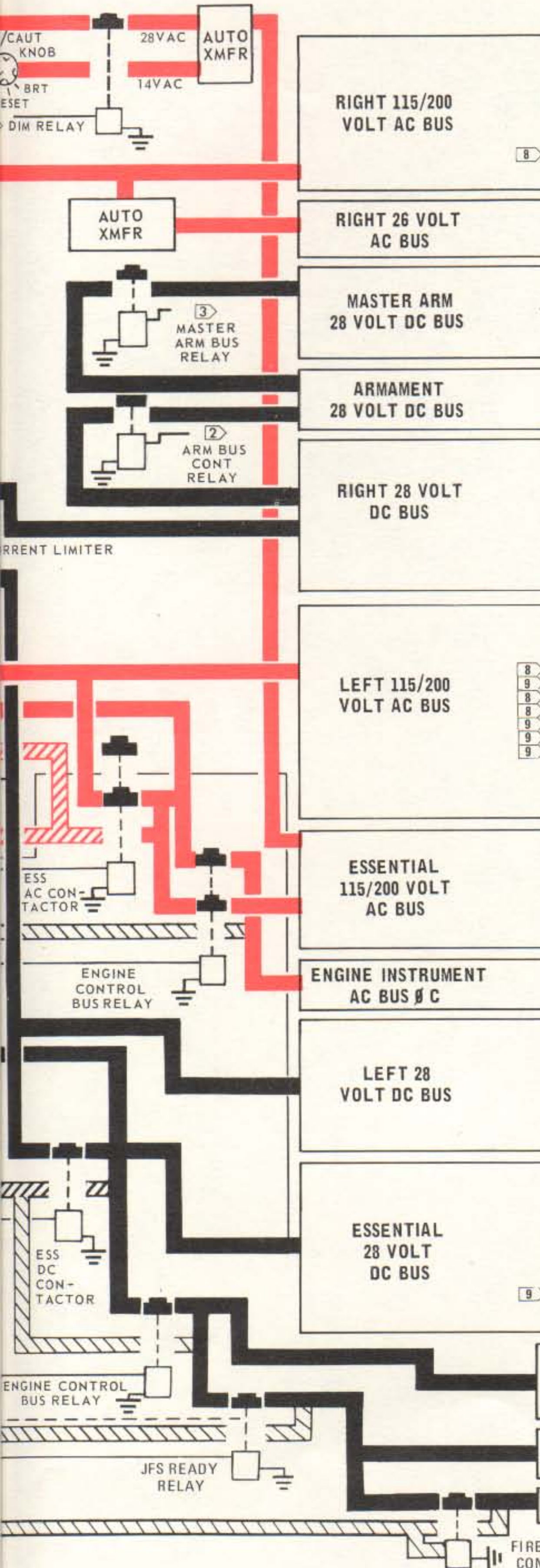


Figure FO-4



WARN/ADVISORY LTS BUS
CAUT/BIT LTS BUS
WARN/CAU
LTS
DIM
RESET
5 DIM
R. GEN OUT
R. RAMAD
CSD
R. GEN
ON
R
OFF
R. GEN CONTROL SWITCH
CONTROL CIRCUITS
R. GEN LINE CONTACTOR
CURRENT LIMITERS
R. XFMR RECTIFIER
L. XFMR RECTIFIER
CURRE
L. GEN OUT
L. RAMAD
CSD
L. GEN
L. GEN CONTROL SWITCH
L
ON
OFF
CONTROL CIRCUITS
L. GEN LINE CONTACTOR
EXT. PWR. CONTACTOR
EMER BOOST PUMP PWR
EMER/ ESS AC BUS
AC PRESENT RELAY
EXT PWR MONITOR
RESET
NORM
OFF
EXT PWR CONTROL SWITCH
EMER GEN ON
ARG (HOOK) CONT IND
EMER/ ESS DC BUS
TO UTILITY HYDRAULIC SYSTEM
HYD MOTOR
EMER GEN
1 SELECTOR VALVE
EMER/ESS DELAY RELAY 6
EMER/ ESS RELAY
4
LEGEND
AC POWER
DC POWER
EXTERNAL AC POWER
EMERG AC POWER
EMERG DC POWER
START POWER
CONTROL POWER
MECHANICAL CONNECTION
CONTROL CIRCUITS
EMERG GEN
NORM
EMERG ON
STARTER READY LIGHT
IGNITION
START SEQUENCE RELAY
GAS GEN SPEE SWITCH
HYD MOTOR
JET FUEL STARTER
JFS GEN
RECTIFIER & FILTER
CONTROL CIRCUITS
TO HYDRAULIC ACCUMULATORS
OFF
ON
JFS STARTER SWITCH
FUEL VALVES
ON
OFF
R. ENG C.O. SWITCH
L. ENG C.O. SWITCH
7
JFS CONTROL RELAY
ENGI



Bus			
RIGHT 115/200 VOLT AC BUS	AIM–7 STATION 3 & 4 AIM–7 STATION 6 & 7 AIM–9 STATION 2 AIM–9 STATION 8 AIR INLET CONT ENGINE ANTI–ICE EXCEEDANCE COUNTER GUN POWER [8] ICS PWR L WING XFR PUMP PWR MK–84 STATION 2	MK–84 STATION 2, 5 & 8 MK–84 STATION 5 & 8 OXY GAGING PWR R AOA PROBE HTR R BOOST PUMP PWR RH TEWS POD R DUCT PITOT HTR R ENG FUEL FLOW IND R TOTAL TEMP PROBE HTR R WING XFR PUMP R XMFR/RECT	RDR WARN RCVR POD RWR PWR SEAT ADJUST PWR UTILITY PWR RECEP 26 VAC AUTO XFMR
RIGHT 26 VOLT AC BUS	L ENG ENP IND L ENG OIL PRESS IND PC–1 HYDR PRESS IND PC–2 HYDR PRESS IND	[8] PRAD IND [9] PRC IND R ENG ENP IND	R ENG OIL PRESS IND UTIL HYDR PRESS IND
MASTER ARM 28 VOLT DC BUS	AIM–7 BATTERY ACTIVE PWR NO. 1 AIM–7 BATTERY ACTIVE PWR NO. 2 AIM–7 MOTOR FIRE NO. 1 AIM–7 MOTOR FIRE NO. 2	AIM–9 LAUNCHER PWR NO. 1 AIM–9 LAUNCHER PWR NO. 2 AIM–9 STATION 2 AIM–9 STATION 8 GUN CONT LOGIC PWR	STATION 2 ARMING PWR STATION 5 ARMING PWR STATION 8 ARMING PWR
ARMAMENT 28 VOLT DC BUS	A/G JETT PWR NO. 1 A/G JETT PWR NO. 2 AIM–7 JETT PWR NO. 1	AIM–7 JETT PWR NO. 2 AIM–9 JETT PWR NO. 1 AIM–9 JETT PWR NO. 2	MASTER ARM BUS PWR MASTER ARM CONT
RIGHT 28 VOLT DC BUS	AIM–9 STATION 2 AIM–9 STATION 8 ARM BUS CONT CSBPC HYD BYPASS ENG ANTI–ICE GRD FUEL CONT CK GUN CLEAR HYD PRESS LANDING LT LANDING & TAXI LT CONT L WING XFR PUMP RLY	MK–84 STATION 2 MK–84 STATION 5 & 8 MODE SEL POWER RH IDLE NOZZLE RESET RIGHT AIR INLET CONTROLLER R BOOST PUMP RELAY RH TEWS POD RUDDER TRAVEL LMTR R WG XFER PUMP RLY RDR WRN RCVR PWR	RWR PWR SEAT ADJUST CONT TAXI LT TEWS POD CONT UTILITY PWR RCPT WSHLD ANTI–ICE
LEFT 115/200 VOLT AC BUS	AC PRESENT RLY ACS POWER ADC AIR INLET CONTROL [8] AIRSPEED MACH NO. IND [9] ALT FWD–VSI AFT [8] ALTITUDE IND [8] ANGLE OF ATTACK IND [9] AOA IND–FWD AS IND–AFT [9] AS IND–FWD AOA IND–AFT [9] BLANKER CCC EWWSS FORM LTS & AVIONICS DIM CONT HUD	INERTIAL NAV SET MEAS UNIT INTRG RCVR/XMTR PWR INTRL NAV SET DSPL UNIT INTERIOR LTS [9] INT. LTS AFT [8] INTR BLANKER IRE KIR KIT L AOA PROBE HTR L BOOST PUMP POWER L & R PITOT MAST HTR LEAD COMP GYRO L ENG FUEL FLOW IND LH TEWS POD	L TOTAL TEMP SNSR HTR L XFMR/RECT POS/ANTI COLLISION LTS RADAR COOLANT PUMP RADAR XMTR RADAR XMTR & LVPS POWER SIGNAL DATA RCDR TACAN RCVR/XMTR TANK NO. 1 XFR PUMP PWR UHF AUX RCVR [8] VERTICAL VELOCITY IND VSD [9] VSI–FWD ALT–AFT
ESSENTIAL 115/200 VOLT AC BUS	AFCS AC ARR FLOODLIGHTS ATTD DIR IND ATTD HDG REF SET BLEED AIR LEAK DET CAUT/WRN/ADVY/LTS ENG INSTR ESS AC Ø	FLAPS [9] FL/WRN/ADV/CAUT LTS FUEL QTY IND PWR HORIZ SIT IND L & R PITOT HEAD HEAT L DUCT PITOT HTR POSN/ANTI COLLISION LTS CONT RADAR CONT & LVPS	STANDBY ATTITUDE IND STORM FLOODLIGHTS UHF RCVR/XMTR
ENGINE INSTRUMENT AC BUS Ø C	L ENG FTIT L ENG RPM TACH	R ENG FAN TIT	R ENG RPM TACH
LEFT 28 VOLT DC BUS	ASP & BIT CONT PNL ECS TEMP CONT EMER BOOST PUMP CONT EMER GEN HYD SOL GRD PWR/RUD TRVL CAUTION CONTROL HUD ILS IRE	KY–28 LEAD COMP GYRO LEFT AIR INLET CONTROLLER L BOOST PUMP LH IDLE NOZZLE RESET LH TEWS POD [10] MLG WHEEL ANTI–SPIN PSN ANTI–COLLISION LTS CONT	RADAR CONT & LVPS RADAR COOLANT PUMP RADAR LVPS POWER TACAN/ADI TCN/ILS PNLS [9] TAKE COMMAND TANK NO. 1 XFR PUMP [9] UTIL FLOOD LT–AFT
ESSENTIAL 28 VOLT DC BUS	AERIAL REFUELING AFCS DC AIM–7 EJECT NO. 1 AIM–7 EJECT NO. 2 ANTENNA SEL PWR ARI SHUTOFF/ANTI–SKID CONT AUTO DIR FINDER BLEED AIR LEAK DET PWR CABIN AIR DUMP SOL [9] COMM AFT ECS HEAT EXCHANGER EMER JETT NO. 1	EMER JETT NO. 2 ENG CONTROL ESS DC BUS ENVIRONMENTAL CONT SYS FLAP FUEL DUMP FUEL LEVEL SENSING UNIT FUEL PRESS REGULATORS HOT FUEL/GRD REFUEL IFF/TRANSPONDER INT COM M PANEL INT LTS TEST	LG LG POS IND L MAIN GEAR WOW PWR NOSE LDG GEAR WOW PWR NWS PRAD CONT R MAIN GEAR WOW PWR SPD BRK STORE RELEASE NO. 1 STORE RELEASE NO. 2 WRN/ADV/CAUT LTS
ENGINE CONT/ ESSENTIAL DC BUS		L ENG EHR/START BYP L ENG FUEL SOV EMER GEN/CAUT LT/RESET ENG FE SYS ENG FIRE/OVHT DET SYS	AFTER NC EHR/START BYP R ENG FUEL SOV
JFS/ESSENTIAL DC BUS		AMAD FIRE DET SYS INTERCOM L AMAD SEL	R AMAD SEL UTILITY FLOODLIGHT
FIRE EXT BUS		AMAD F EXT SYS	

ELECTRICAL SYSTEM
EXTERNAL POWER APPLIED

1 WITH AC PRESENT RELAY DEENERGIZED, SELECTOR VALVE OPENS TO OPERATE EMERGENCY GENERATOR.

2 ARMAMENT BUS CONTROL RELAY ENERGIZED WITH GEAR HANDLE UP. WITH GEAR HANDLE DOWN, RELAY IS ENERGIZED BY PLACING ARMAMENT SAFETY OVERRIDE SWITCH TO OVERRIDE POSITION.

3 MASTER ARM BUS RELAY IS ENERGIZED WITH THE MASTER ARM SWITCH IN THE ARM POSITION, PROVIDING ARMAMENT BUS IS ENERGIZED.

4 WITH EMERGENCY GENERATOR ON THE LINE AND EMERG GEN SWITCH IN EITHER NORM OR EMERG ON (BUT ONLY IF SWITCH IS FIRST PLACED TO NORM), THE EMERG/ESS RELAY ENERGIZES THE EMER/ESS BUSES WHICH PROVIDE POWER ONLY TO THE EMERG BOOST PUMP AND TAIL HOOK. THE EMER/ESS DELAY RELAY ENERGIZES FROM THE ESSENTIAL 28 VOLT DC BUS THRU A CONTACT OF THE ESS AC CONTACTOR. THUS, THE EMERG ON POSITION OF THE EMERG GEN SWITCH CAN BE USED TO ENERGIZE THE EMER/ESS AC AND DC BUSES ONLY AFTER THE SWITCH IS IN THE NORM POSITION WITH THE EMERGENCY GENERATOR ON THE LINE. THE EMER/ESS BUSES ARE ENERGIZED BY THE ESSENTIAL BUSES DURING NORMAL MAIN GENERATOR OPERATION.

5 DIMMING RELAY ENERGIZED WITH FLIGHT INSTRUMENT LIGHTS KNOB ON AND WARNING/CAUTION LIGHTS KNOB MOVED TEMPORARILY TO RESET. RELAY IS DEENERGIZED BY TURNING FLIGHT INSTRUMENTS LIGHT OFF OR TURNING STORM/FLOODS KNOB TO FULL BRIGHT. OPERATION TYPICAL FOR F AIRCRAFT AND BOTH COCKPITS OF TF AIRCRAFT.

6 THE EMERG/ESS DELAY RELAY ENERGIZES ONLY AFTER THE EMERG GEN IS ON THE LINE WITH BOTH THE ESS AC AND DC CONTACTORS ENERGIZED (EMERG GEN SWITCH MUST BE IN NORM).

7 ENGINE CUTOUT SWITCHES OPEN AFTER THEIR RESPECTIVE ENGINES START.

8 F AIRCRAFT ONLY.
9 TF AIRCRAFT ONLY.
10 F AIRCRAFT 73–085 THRU 73–097, TF AIRCRAFT 73–111 AND 73–112.

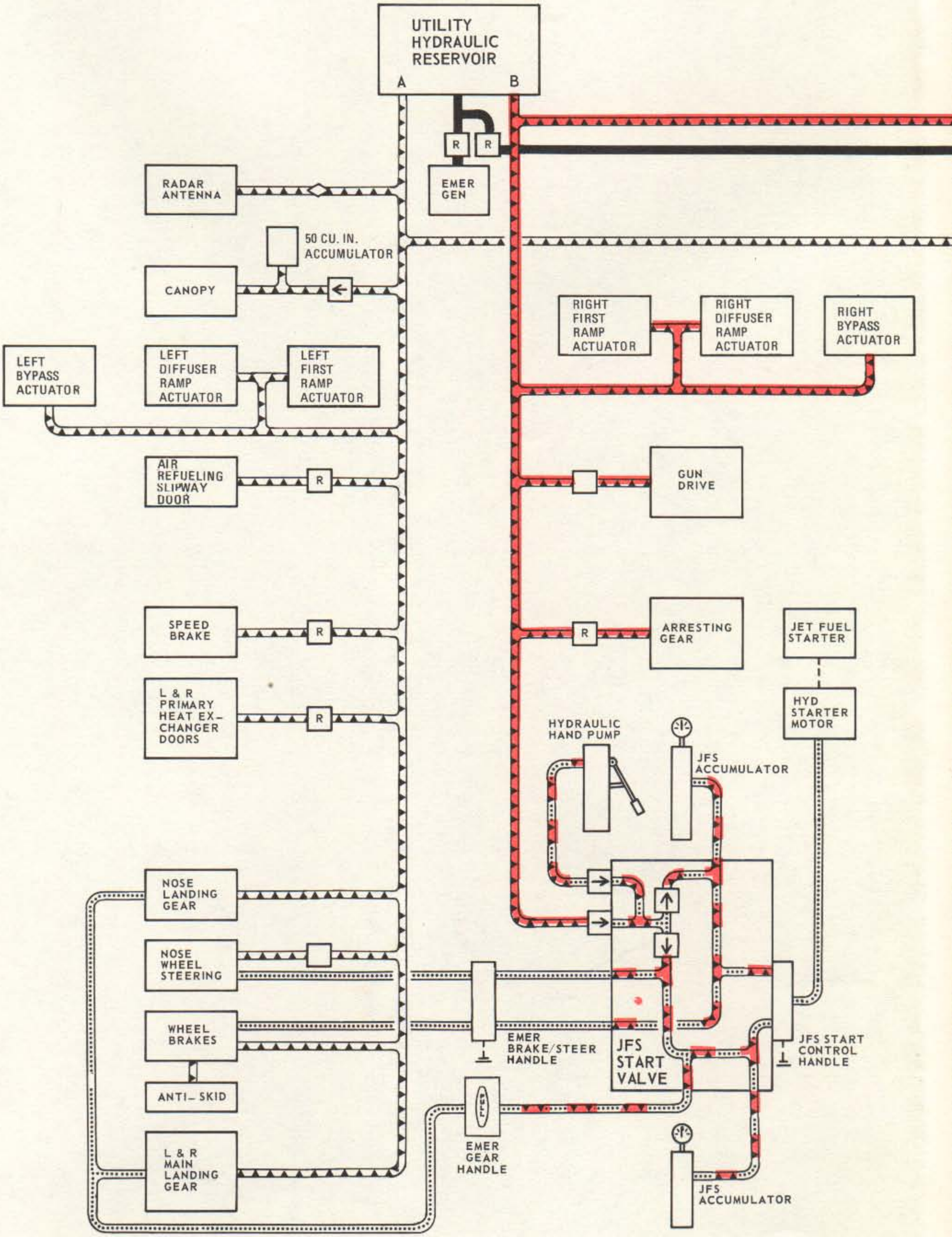
Note

NOMENCLATURE CALLOUTS ON THE INDIVIDUAL BUSES ARE CIRCUIT BREAKER NOMENCLATURES. THESE NOMENCLATURES DO NOT NECESSARILY IDENTIFY EACH SYSTEM POWERED BY THE CIRCUIT BREAKERS.

ELECTRICAL SYSTEM

15A–1–38F (R)

Figure FO-5


UTILITY HYDRAULIC RESERVOIR
A
B
R
R
EMER GEN
RADAR ANTENNA
50 CU. IN. ACCUMULATOR
CANOPY
RIGHT FIRST RAMP ACTUATOR
RIGHT DIFFUSER RAMP ACTUATOR
RIGHT BYPASS ACTUATOR
LEFT BYPASS ACTUATOR
LEFT DIFFUSER RAMP ACTUATOR
LEFT FIRST RAMP ACTUATOR
AIR REFUELING SLIPWAY DOOR
R
GUN DRIVE
SPEED BRAKE
R
R
ARRESTING GEAR
JET FUEL STARTER
L & R PRIMARY HEAT EX– CHANGER DOORS
R
HYD STARTER MOTOR
HYDRAULIC HAND PUMP
JFS ACCUMULATOR
NOSE LANDING GEAR
NOSE WHEEL STEERING
WHEEL BRAKES
EMER BRAKE/STEER HANDLE
JFS START VALVE
JFS START CONTROL HANDLE
ANTI– SKID
EMER GEAR HANDLE
L & R MAIN LANDING GEAR
JFS ACCUMULATOR

HYDRAULIC SYSTEMS

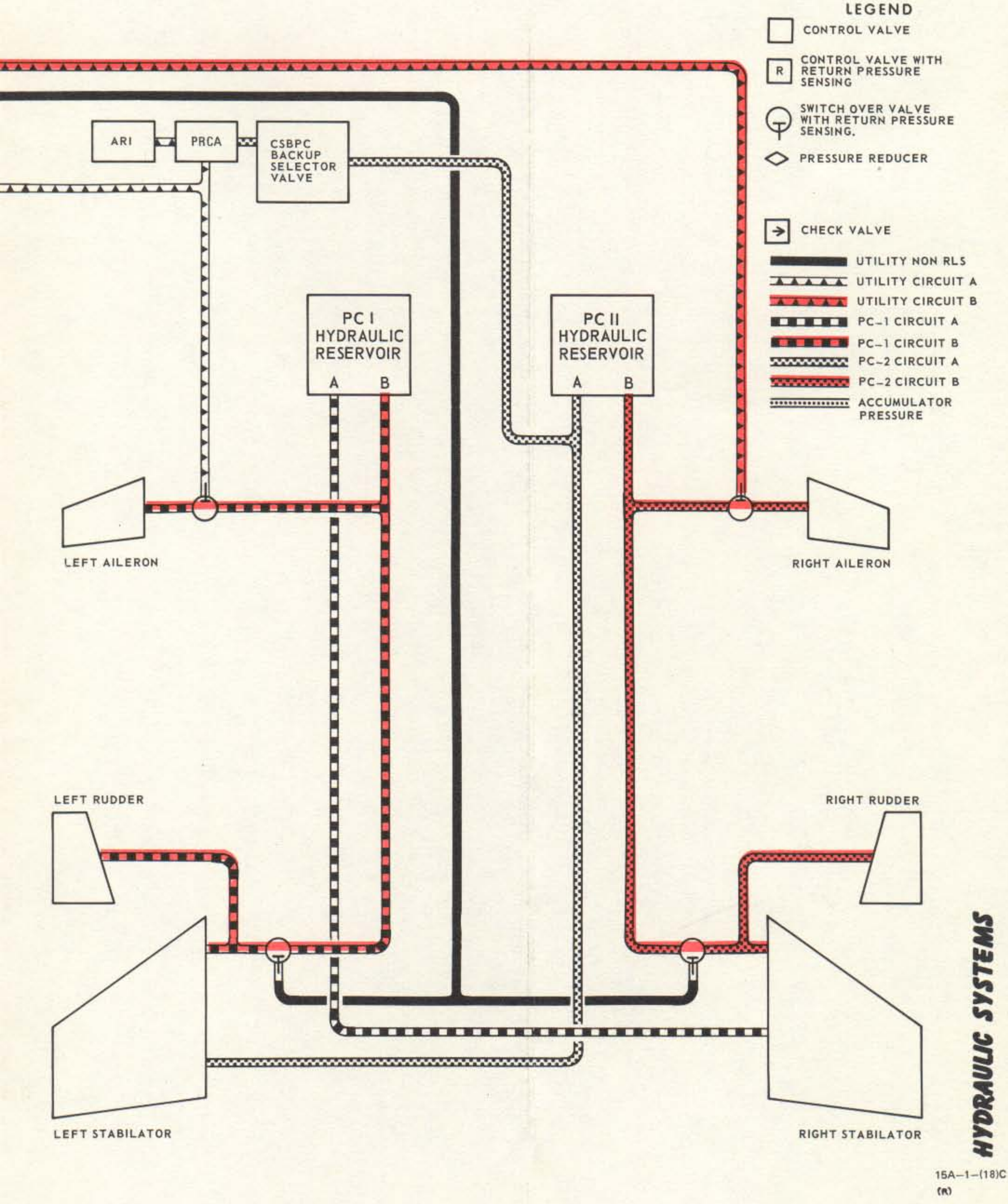
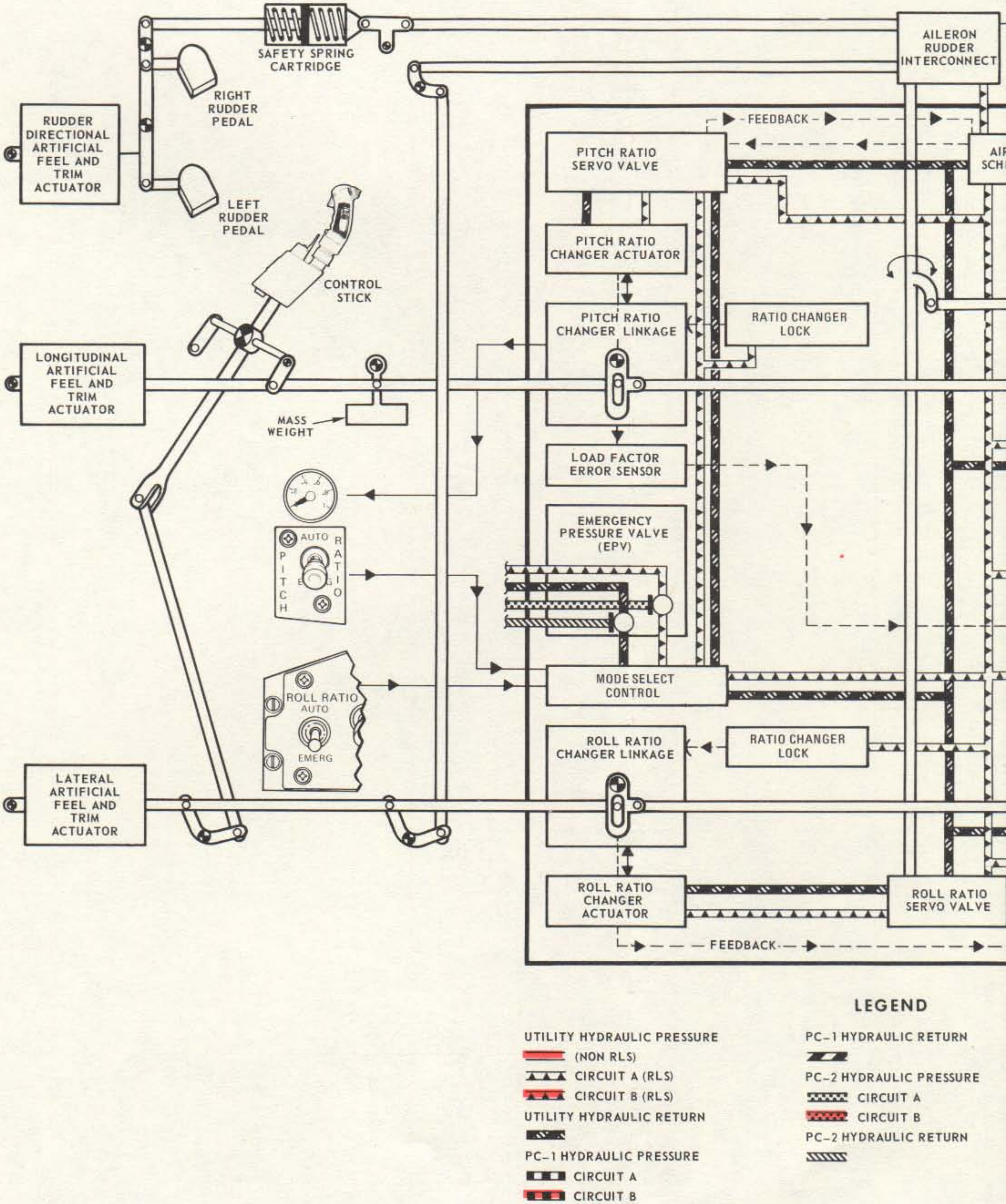
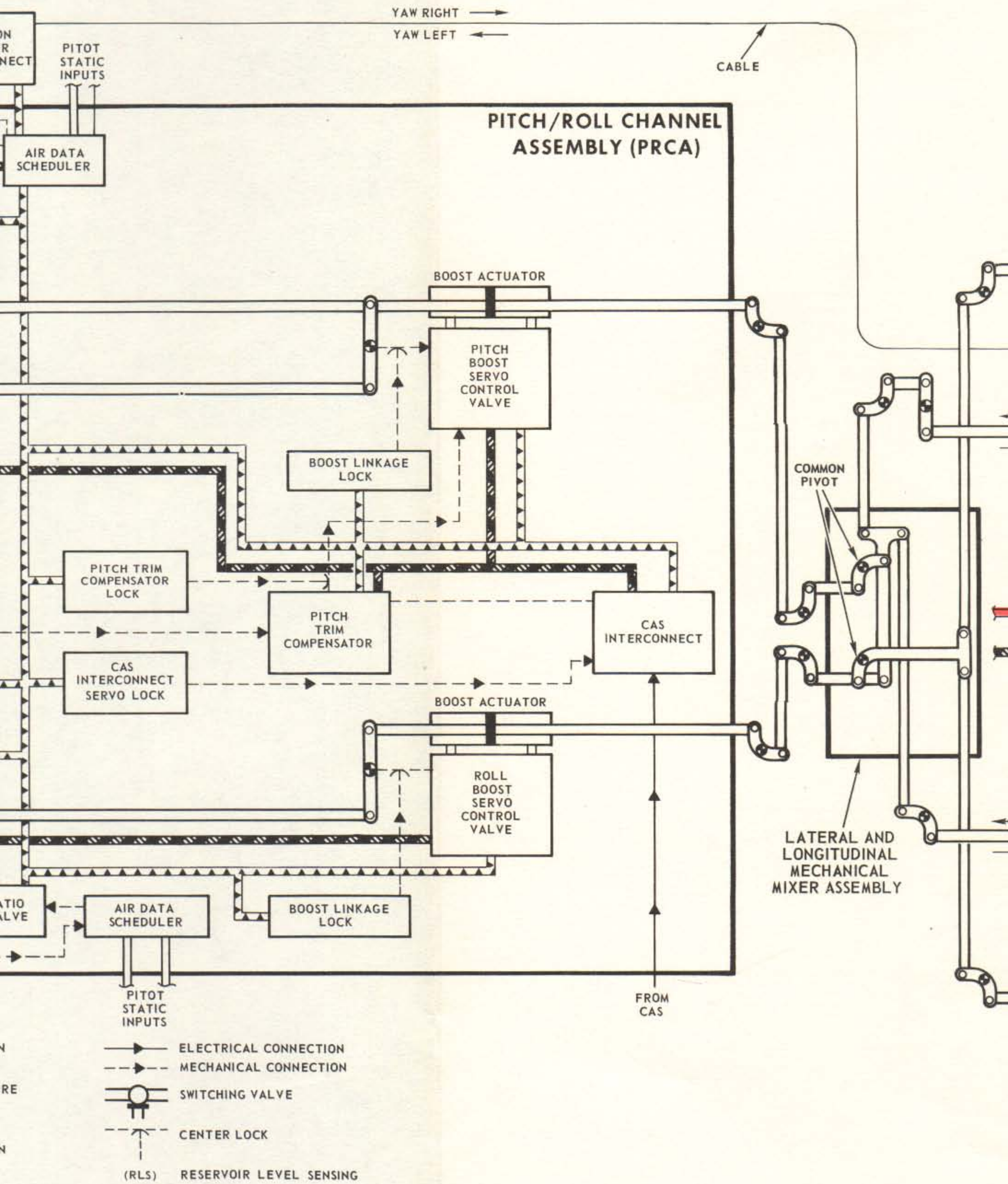


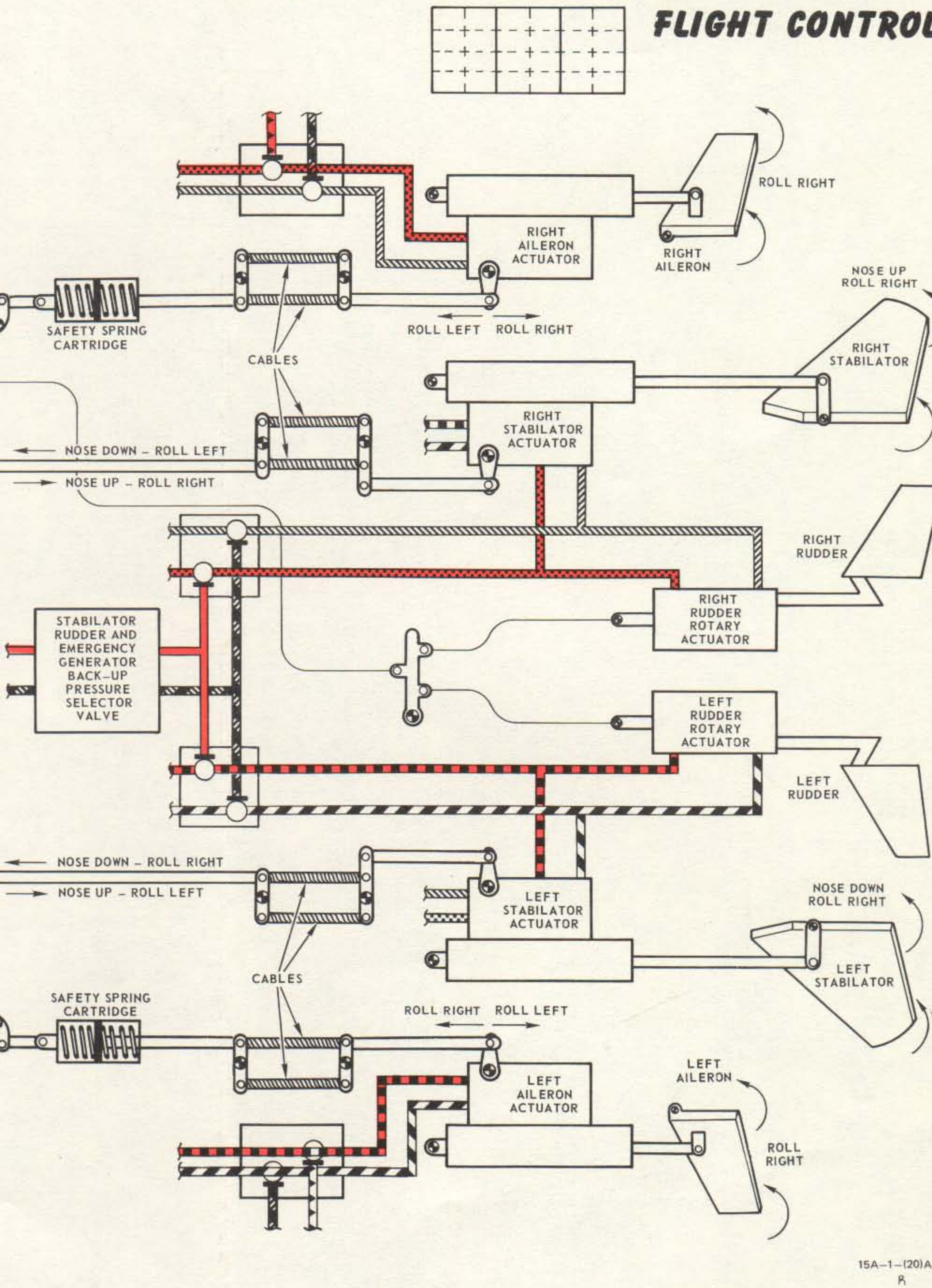
Figure FO-6


SAFETY SPRING CARTRIDGE
AILERON RUDDER INTERCONNECT
RIGHT RUDDER PEDAL
RUDDER DIRECTIONAL ARTIFICIAL FEEL AND TRIM ACTUATOR
LEFT RUDDER PEDAL
FEEDBACK
PITCH RATIO SERVO VALVE
PITCH RATIO CHANGER ACTUATOR
CONTROL STICK
PITCH RATIO CHANGER LINKAGE
RATIO CHANGER LOCK
LONGITUDINAL ARTIFICIAL FEEL AND TRIM ACTUATOR
MASS WEIGHT
LOAD FACTOR ERROR SENSOR
AUTO
PITCH
RATIO
EMERGENCY PRESSURE VALVE (EPV)
MODE SELECT CONTROL
ROLL RATIO
AUTO
EMERG
ROLL RATIO CHANGER LINKAGE
RATIO CHANGER LOCK
LATERAL ARTIFICIAL FEEL AND TRIM ACTUATOR
ROLL RATIO CHANGER ACTUATOR
ROLL RATIO SERVO VALVE
FEEDBACK
LEGEND
UTILITY HYDRAULIC PRESSURE
(NON RLS)
CIRCUIT A (RLS)
CIRCUIT B (RLS)
UTILITY HYDRAULIC RETURN
PC–1 HYDRAULIC PRESSURE
CIRCUIT A
CIRCUIT B
PC–1 HYDRAULIC RETURN
PC–2 HYDRAULIC PRESSURE
CIRCUIT A
CIRCUIT B
PC–2 HYDRAULIC RETURN



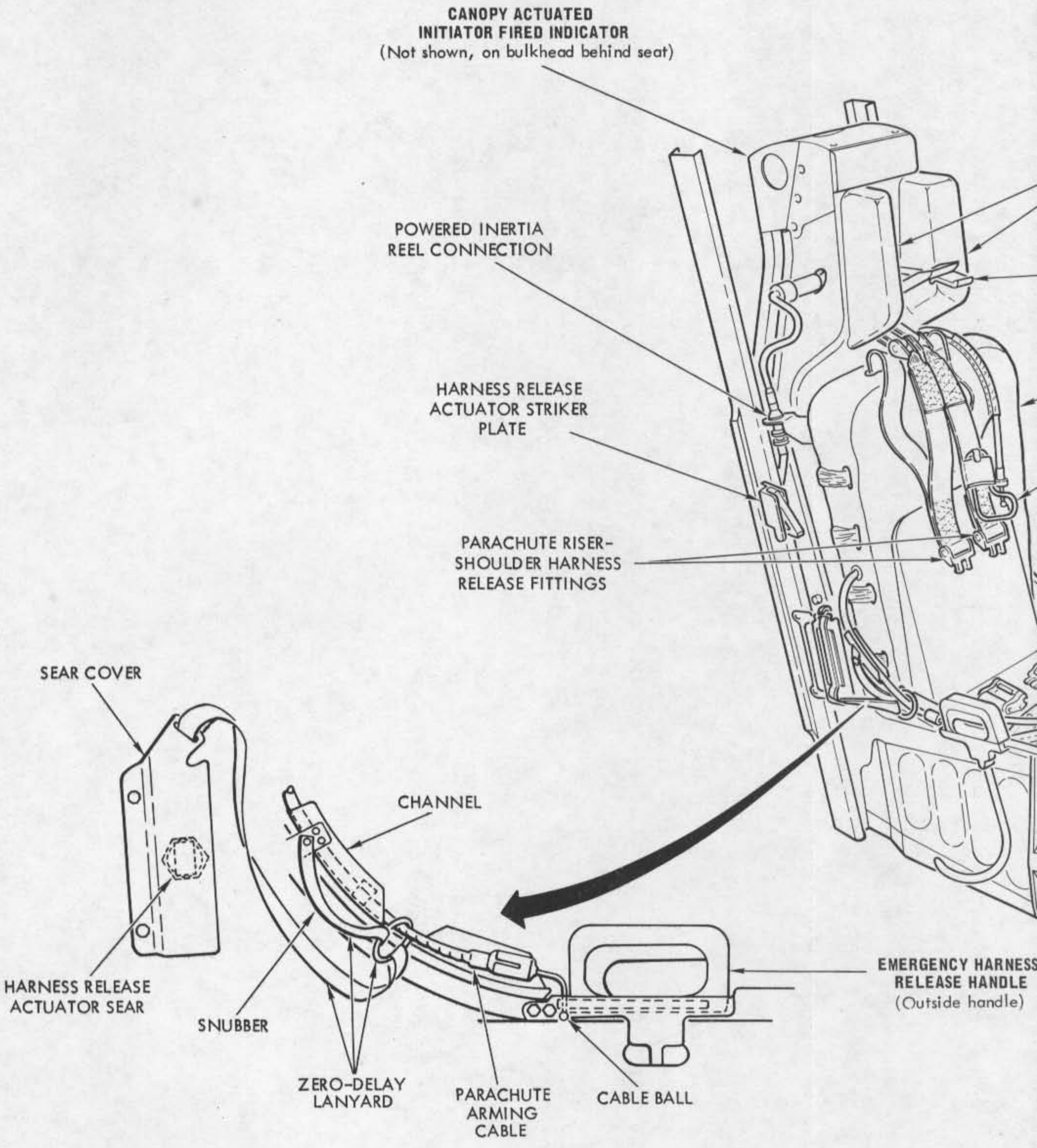
YAW RIGHT
YAW LEFT
CABLE
PITOT STATIC INPUTS
PITCH/ROLL CHANNEL ASSEMBLY (PRCA)
AIR DATA SCHEDULER
BOOST ACTUATOR
PITCH BOOST SERVO CONTROL VALVE
BOOST LINKAGE LOCK
COMMON PIVOT
PITCH TRIM COMPENSATOR LOCK
PITCH TRIM COMPENSATOR
CAS INTERCONNECT
CAS INTERCONNECT SERVO LOCK
BOOST ACTUATOR
ROLL BOOST SERVO CONTROL VALVE
LATERAL AND LONGITUDINAL MECHANICAL MIXER ASSEMBLY
AIR DATA SCHEDULER
BOOST LINKAGE LOCK
PITOT STATIC INPUTS
FROM CAS
ELECTRICAL CONNECTION
MECHANICAL CONNECTION
SWITCHING VALVE
CENTER LOCK
(RLS) RESERVOIR LEVEL SENSING

FLIGHT CONTROLS

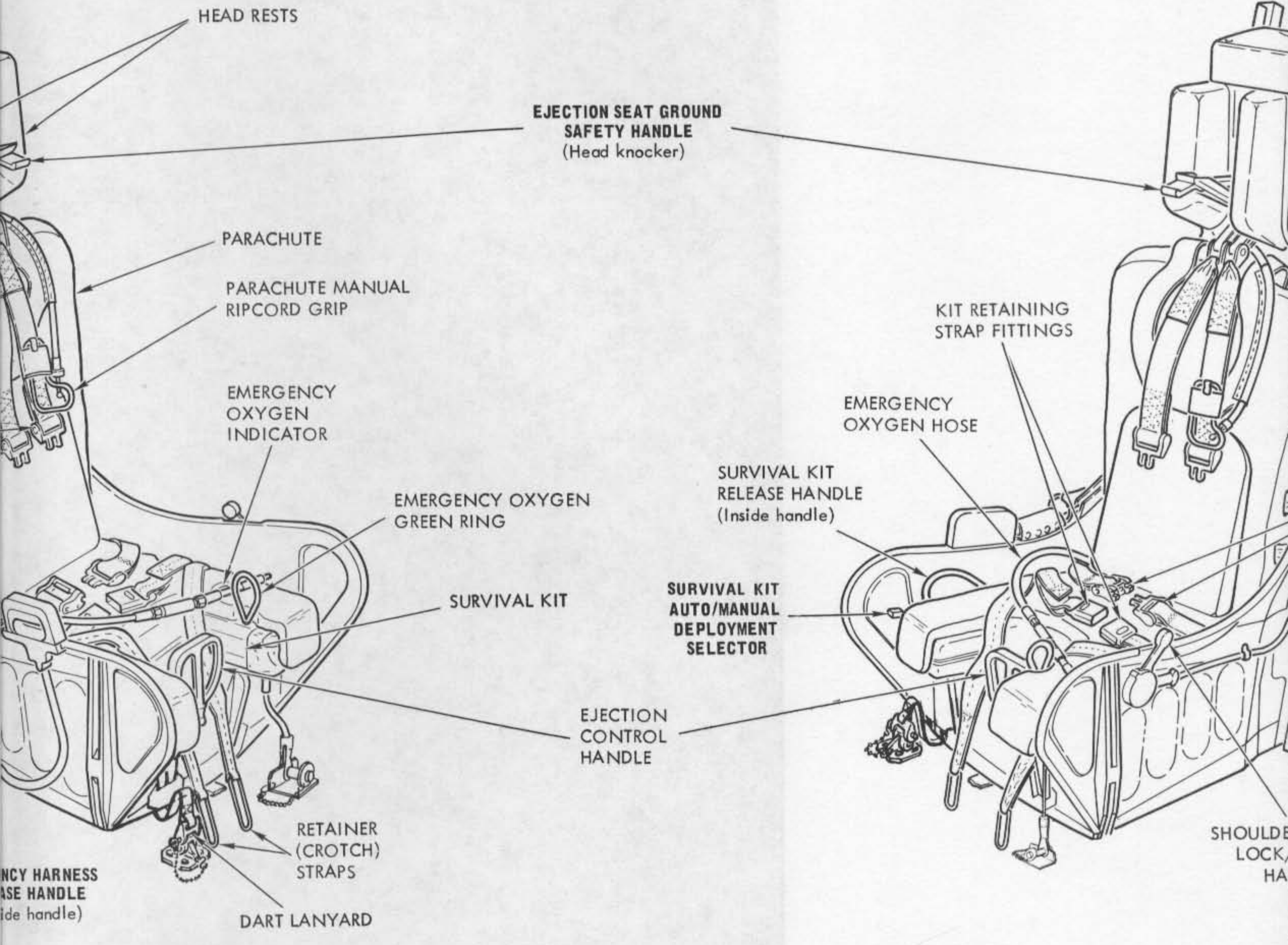


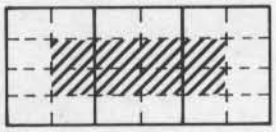
FLIGHT CONTROLS

Figure FO-7

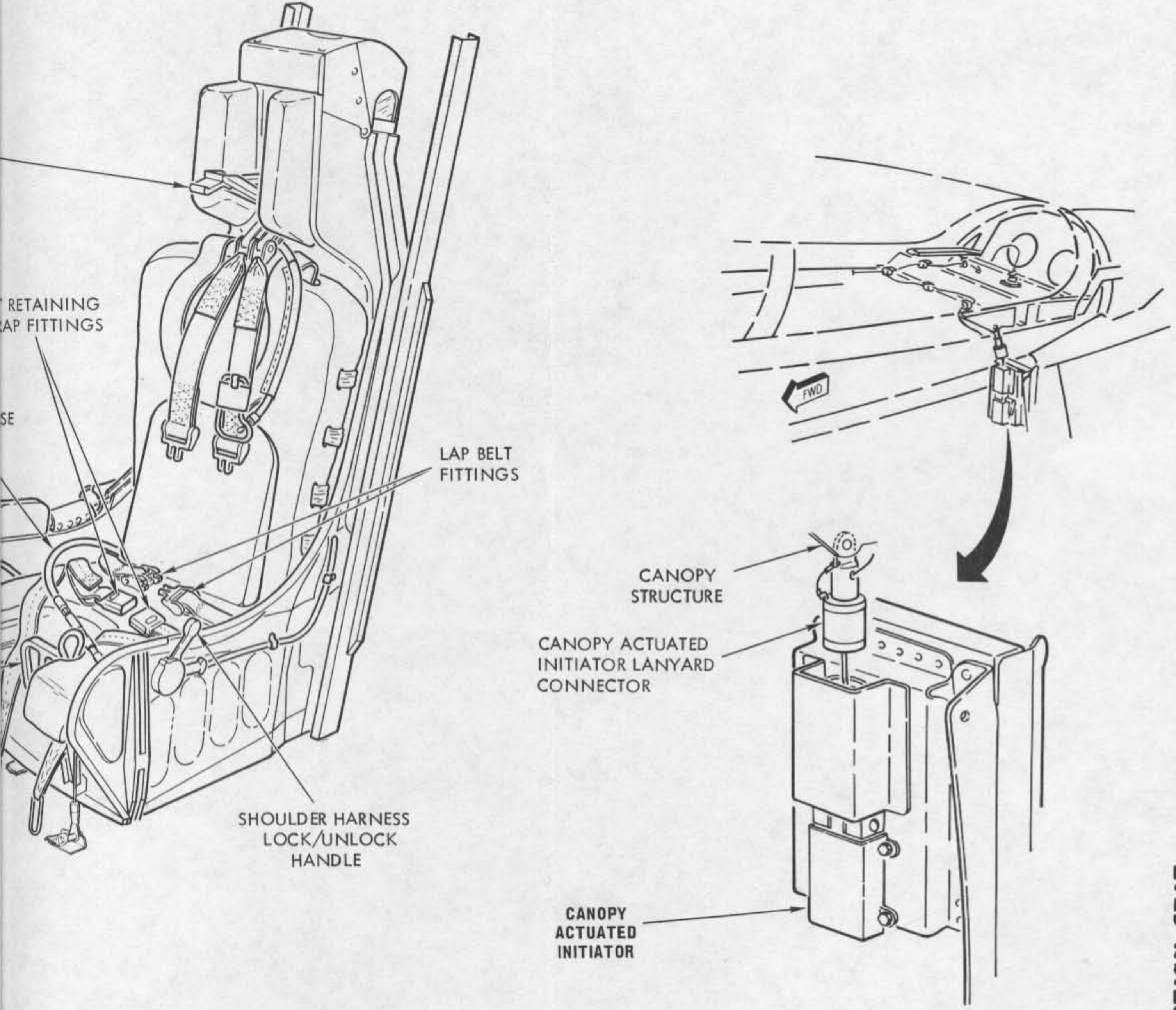


CANOPY ACTUATED
INITIATOR FIRED INDICATOR
(Not shown, on bulkhead behind seat)
POWERED INERTIA
REEL CONNECTION
HARNESS RELEASE
ACTUATOR STRIKER
PLATE
PARACHUTE RISER-
SHOULDER HARNESS
RELEASE FITTINGS
SEAR COVER
CHANNEL
HARNESS RELEASE
ACTUATOR SEAR
SNUBBER
ZERO-DELAY
LANYARD
PARACHUTE
ARMING
CABLE
CABLE BALL
EMERGENCY HARNESS
RELEASE HANDLE
(Outside handle)


HEAD RESTS
EJECTION SEAT GROUND SAFETY HANDLE (Head knocker)
PARACHUTE
PARACHUTE MANUAL RIPCORD GRIP
EMERGENCY OXYGEN INDICATOR
EMERGENCY OXYGEN GREEN RING
SURVIVAL KIT
EJECTION CONTROL HANDLE
RETAINER (CROTCH) STRAPS
DART LANYARD
NCY HARNESS
ASE HANDLE
ide handle)
KIT RETAINING STRAP FITTINGS
EMERGENCY OXYGEN HOSE
SURVIVAL KIT RELEASE HANDLE (Inside handle)
SURVIVAL KIT AUTO/MANUAL DEPLOYMENT SELECTOR
SHOULDE
LOCK/
HA

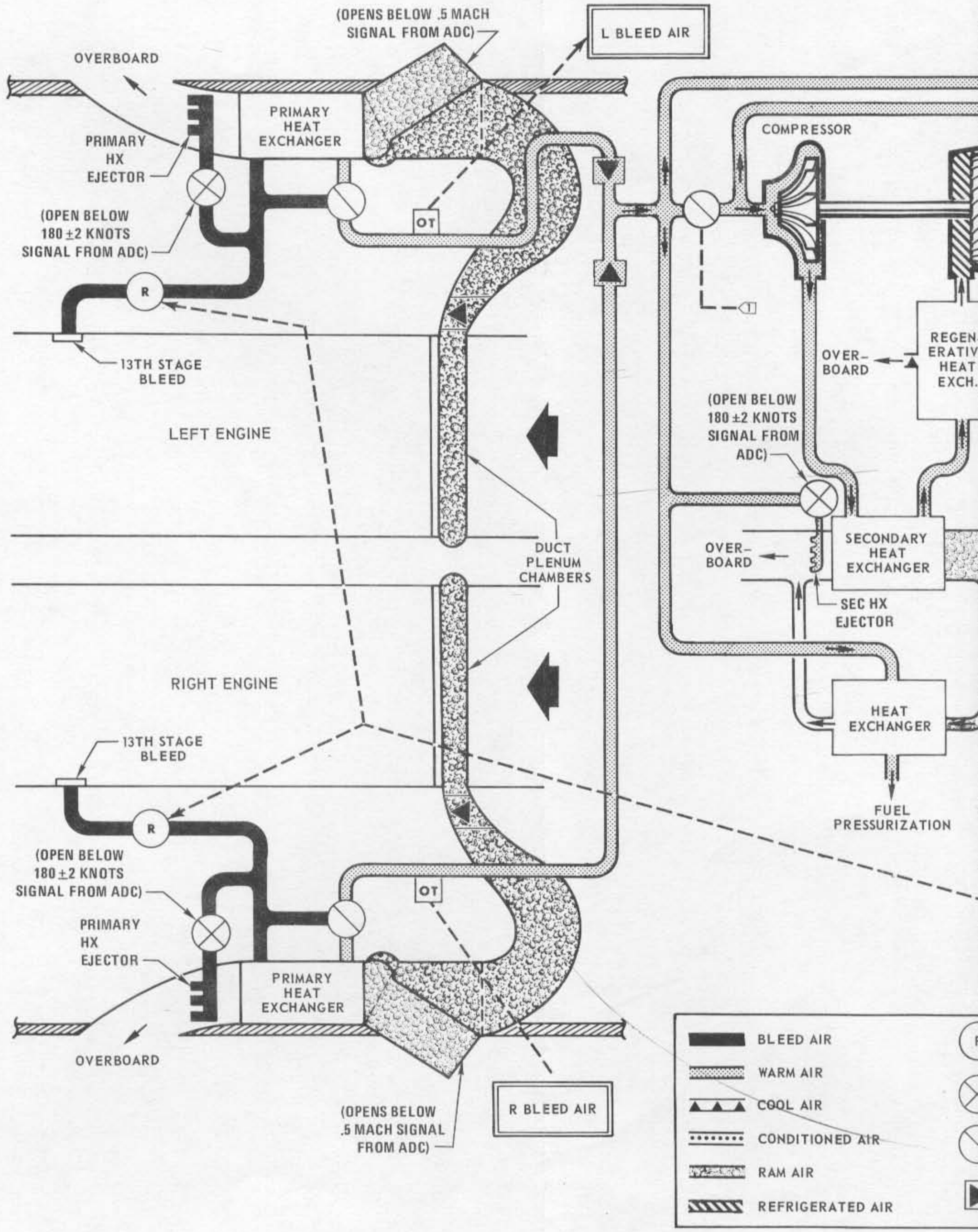


IC-7 EJECTION SEAT

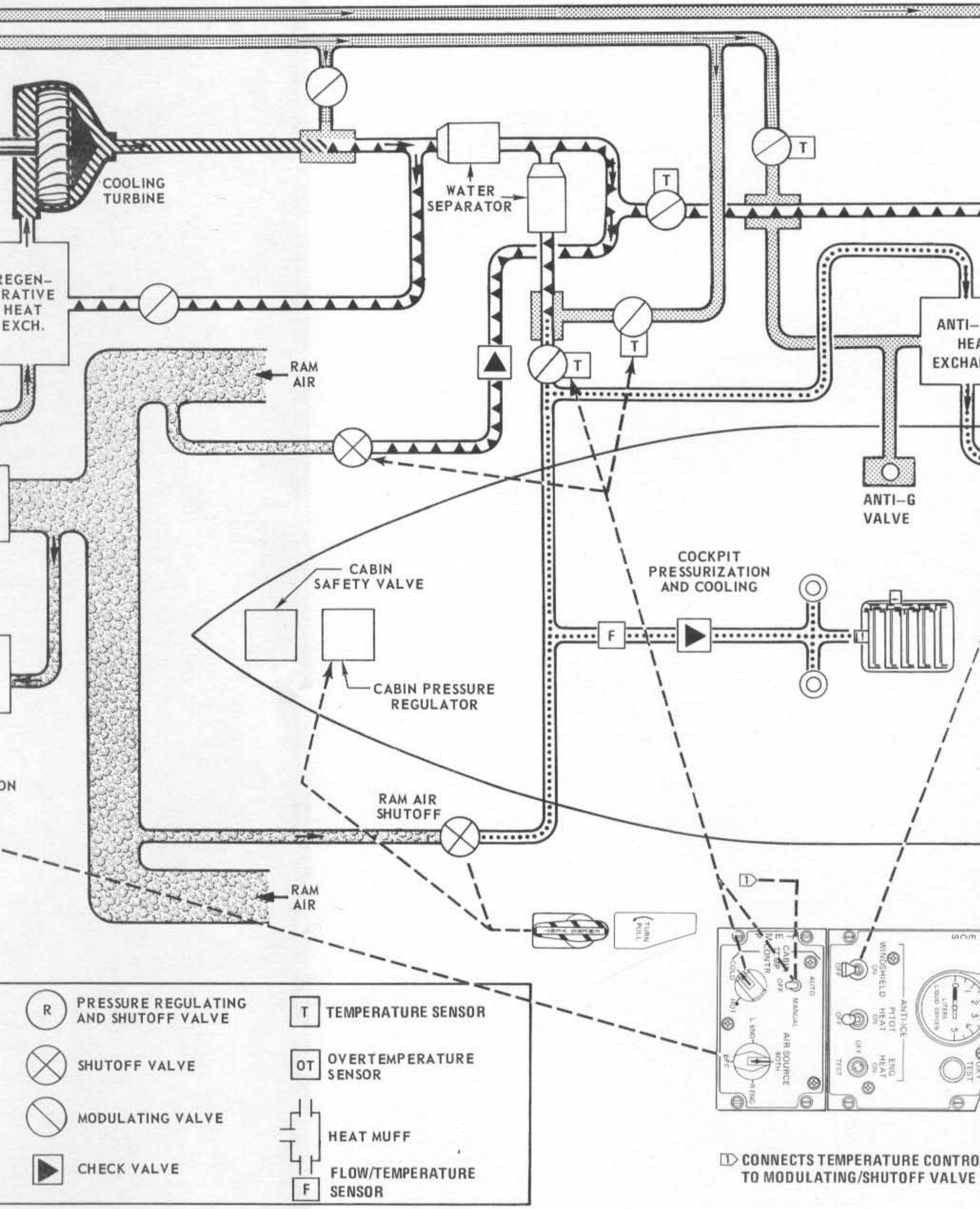


15A-1-(55)E

Figure FO-8

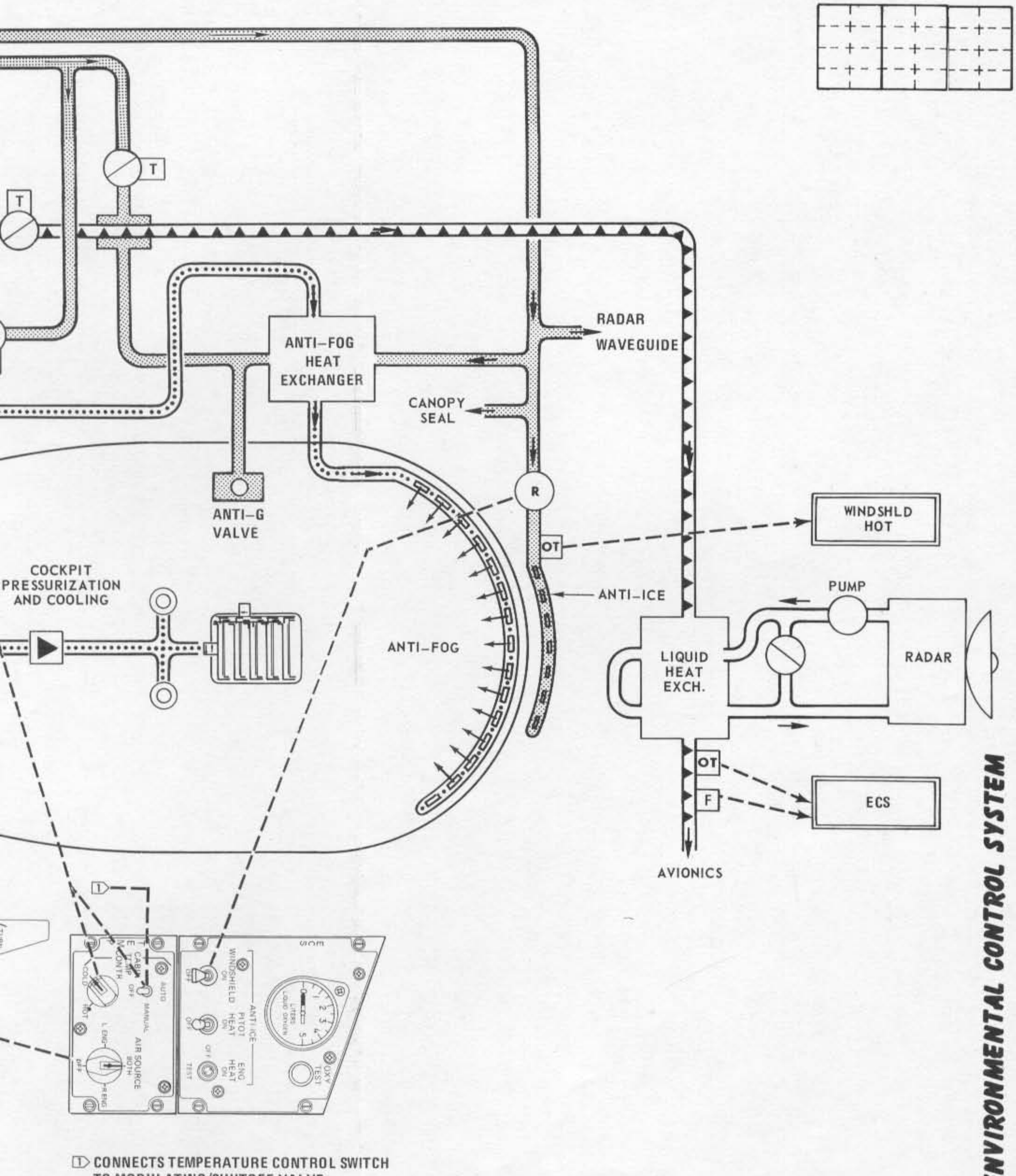


(OPENS BELOW .5 MACH
SIGNAL FROM ADC)
L BLEED AIR
OVERBOARD
PRIMARY
HEAT
EXCHANGER
PRIMARY
HX
EJECTOR
(OPEN BELOW
180 ±2 KNOTS
SIGNAL FROM ADC)
OT
R
13TH STAGE
BLEED
LEFT ENGINE
COMPRESSOR
OVER-
BOARD
REGEN-
ERATIV
HEAT
EXCH.
(OPEN BELOW
180 ±2 KNOTS
SIGNAL FROM
ADC)
SECONDARY
HEAT
EXCHANGER
OVER-
BOARD
SEC HX
EJECTOR
DUCT
PLENUM
CHAMBERS
RIGHT ENGINE
HEAT
EXCHANGER
FUEL
PRESSURIZATION
13TH STAGE
BLEED
R
(OPEN BELOW
180 ±2 KNOTS
SIGNAL FROM ADC)
OT
PRIMARY
HX
EJECTOR
PRIMARY
HEAT
EXCHANGER
OVERBOARD
R BLEED AIR
(OPENS BELOW
.5 MACH SIGNAL
FROM ADC)
BLEED AIR
WARM AIR
COOL AIR
CONDITIONED AIR
RAM AIR
REFRIGERATED AIR



1 CONNECTS TEMPERATURE CONTRO
TO MODULATING/SHUTOFF VALVE

ENVIRONMENTAL CONTROL SYSTEM



1 CONNECTS TEMPERATURE CONTROL SWITCH TO MODULATING/SHUTOFF VALVE

Figure FO-9

GLOSSARY

A

A/A – Air-to-air

AAI – Air-to-air interrogator

AB – Afterburner

AC – Alternating current

ACS – Armament control system

A/D – Air data

ADC – Air data computer

ADF – Automatic direction finding

ADI – Attitude director indicator

AFCS – Automatic flight control system

A/G – Air-to-ground

AHRS – Attitude heading reference system

AIC – Air inlet controller

AIM – Air intercept missile

AMAD – Airframe mounted accessory drive

AOA – Angle-of-attack

ARI – Aileron rudder interconnect

ASP – Avionics status panel

AUX – Auxiliary

B

BATH – Best available true heading

BCN – Beacon

BCP – Bit control panel

BINGO – Return to this channel (radio). Return fuel state

BIT – Built-in-test

BST PMP – Boost pump

C

CC – Central computer

CCC – Central computer complex

CCW – Counterclockwise

CAS – Control augmentation system. Calibrated airspeed

CG – Center of gravity

CGB – Central gearbox

COMM – Communication(s)

CSBPC – Control stick boost/pitch compensator

CSD – Constant speed drive

CSS – Control stick steering

CTR – Centerline tank. Center

CW – Clockwise

D

DART – Directional automatic realignment of trajectory

DC – Direct current

DG – Direct gyro

DRD – Data readout display

E

EAS – Equivalent airspeed

ECCM – Electronic counter-countermeasures

ECM – Electronic countermeasures

ECS – Environmental control system

EEC – Engine electronic control

EWW – Electronic warfare warning

EXT – External

F

FF – Fuel flow, Free fall

FPM – Feet per minute

FTIT – Fan turbine inlet temperature

G

G – Unit of acceleration of gravity

GCA – Ground control approach

GPM – Gallons per minute

H

HSI – Horizontal situation indicator

HUD – Head-up display

GLOSSARY (CONT)

HZ – Hertz

I

IAS – Indicated airspeed

IBS – Interference blanker set

ICS – Internal countermeasures set. Intercommunication system

IDG – Integrated drive generator

IFF – Identification friend or foe

ILS – Instrument landing system

IMU – Inertial measuring unit

INS – Inertial navigation system

I/P – Identification of position

J

JFS – Jet fuel starter

K

KT – Knot(s)

L

LCG – Lead computing gyroscope

LE – Leading edge

LOX – Liquid oxygen

LRS – Long range search

M

MAC – Mean aerodynamic center

MAX – Maximum

MIL – Military

MHZ – Megahertz

MRM – Medium range missile

M/V – Magnetic variation

N

NCI – Navigation control indicator

NM – Nautical mile(s)

N_1 – Fan speed

N_2 – High compressor speed

O

OAT – Outside air temperature

OMNI – Omnidirectional range (VOR)

ORIDE – Override

O/S – Offset

P

PC – Power control

PC1, PC2 – Power control hydraulic system

PMG – Permanent magnet generator

PP – Present position

PPH – Pounds per hour

PRAD – Pitch ratio adjust device

PRCA – Pitch/roll channel assembly

PRF – Pulse repetition frequency

PSI – Pounds per square inch

PTC – Pitch trim compensator

Q

Q – Dynamic or impact pressure

R

RADAR – Radio detection and ranging

RLS – Reservoir level sensing

RPM – Revolutions per minute

RPS – Return pressure sensing

RRAD – Roll ratio adjust device

R/T – Receiver transmitter

RWR – Radar warning receiver

S

SAI – Standby attitude indicator

SDR – Signal data recorder

SIF – Selective identification feature

SRM – Short range missile

GLOSSARY (CONT)

SRS – Short range search

STA/JETT – Station jettison

STBY – Standby

T

TAS – True airspeed

TCN – TACAN. Tactical air navigation

TDC – Target designator control

TE – Trailing edge

TEWS – Tactical electronic warfare system

TF – Trainer–fighter

T/O – Takeoff

TRANS – Transfer

U

UC – Unified control

UHF – Ultra high frequency

UTL – Utility hydraulic system

V

VAC – Volts alternating current

VDC – Volts direct current

VHF – Very high frequency

VI – Visual identification

V_{max} – Maximum speed

VS – Velocity search

VSD – Vertical situation display

VORTAC – Very high frequency – omni range and tactical air navigation

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ALPHABETICAL INDEX

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